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UK Climate Change Risk Assessment

Poster 1: Climate change risks to the UK natural environment

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Keywords: risks, impacts, vulnerability, policy, natural environment, agriculture, science-policy interface.

Climate change is already having an impact on natural systems in the UK. Evidence of long-term shifts in the distribution and abundance of some terrestrial, freshwater and marine species due to higher temperatures is now discernible, despite complex interactions. The natural environment in the UK is also already experiencing many pressures in addition to climate change, including adverse management practices, habitat loss and fragmentation, pollution and overexploitation of natural resources. The CCRA analysis identified the key risk to the UK natural environment, including those to biodiversity, water resources, agriculture and forestry. The analysis highlighted areas of interaction between climate change and socio-economic factors, including the relative contribution of climate change versus other drivers of risk, both now and in the future.

Poster 2: Climate change risks to the UK infrastructure

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Keywords: risks, impacts, vulnerability, policy, infrastructure, science-policy interface.

Infrastructure services such as heating, lighting, mobility and sanitation are essential for modern society. Current variability in weather already impacts the performance of the UK’s infrastructure. Climate change is expected to lead to an increase in the frequency and severity of severe weather including flooding, higher temperatures and possibly drought. The CCRA analysis identified current and future climate risks to UK infrastructure, looking at the different sectors, as well as interdependencies between and within infrastructure networks.
**Poster 3:Climate change risks to people and the built environment in the UK**

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**Keywords:** risks, impacts, vulnerability, heat, flooding, health, well-being, science-policy interface.

Increasing temperatures, rising sea-levels and modified rainfall patterns will change the climate-related risks to people and the built environment. The CCRA identified the main climate change risks to the built environment and urban layout and how these translate into risks to safety, health, and well-being to people both as individuals and as communities. The analysis covered all UK populations, both urban and rural, and addressed how climate change risks are likely to vary by type of settlement as well by geographic region within the UK. Flooding and extreme hot weather were found to pose the highest magnitude risks and the greatest need for action in the next five years.

**Poster 4:Climate change risks to the UK businesses and industries**

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**Keywords:** risks, impacts, vulnerability, policy, business, flooding, heat, science-policy interface.

Recent evidence highlights the growing impact that climate risks have on business and industry in the UK. Flooding and extreme weather events which damage assets and disrupt business operations pose the greatest risk now and in the future. The analysis carried out for the CCRA identified the key risks and opportunities for UK businesses and industries using a “business function approach”. This included analyse how climate change could impact on the main functions that every businesses need to operate: products and services; site locations; distribution; employees; supply chains and investments.

**Poster 5:Risks to the UK from international climate change impacts**

Andy Challinor1, Neil Adger2, **Manuela Di Mauro**3, Matthew Baylis4, Tim Benton5, Declan Conway6, Duncan Depledge7, Andrew Geddes8, Steve McCorriston9, Lindsay Stringer10, Laura Wellesley11

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Climate change will impact populations, economies and livelihoods around the world. An increase in extreme weather impacts can be expected to cause widespread loss of life and severe humanitarian crises. Increasing pressure will be placed on scarce natural resources, patterns of agricultural production will change and be disrupted, and when combined with other factors this could cause individual states to fail. The CCRA identified some of the key international climate change risks that have an impact to the UK, and whether current policies are sufficient to manage these risks. This analysis found that impacts will be imported to the UK through the price and safety of food and other commodities, changes in the patterns of trade, disruption to global supply chains, and risks to overseas investments.

**Poster 6: Cross-cutting issues affecting the UK capacity to assess climate change risks and adapt to climate changes**

Roger Street\(^1\), Manuela Di Mauro\(^2\), Kathryn Humphrey\(^2\), Daniel Johns\(^2\), Emily Boyd\(^3\), Douglas Crawford-Brown\(^4\), Jens Evans\(^5\), Jim Kitchen\(^6\), Alistair Hunt\(^7\), Katharine Knox\(^8\), Raghe Low\(^9\), Robert McCall\(^10\), Paul Watkiss\(^11\), Rob Wilby\(^12\)

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**Keywords:** risks, impacts, vulnerability, policy, collaboration, interactions, distributional impacts, science-policy interface.

Effective adaptation cannot be undertaken without careful consideration of the cross-cutting nature of risks and interactions between adaptation activities. The CCRA identified the main cross-cutting factors relating to climate change risks to be due to: interactions among risks; indirect and macroeconomic impacts; and distributional impacts. The analysis also identified cross-cutting issues in relation to adaptation planning and policy responses, including: institutional barriers; unintended consequences of adaptation; and issues related to adaptive capacity. Unless these cross-cutting issues are considered, actions could be ineffective, sub-optimal in terms of their costs and benefits, or lead to unintended consequences.

**Climate Services**

**Poster 7: Climateurope: the European network for climate services**

Dr. Natalie Garrett\(^1\), Mr Chris Hewitt\(^1\), Ms Paula Newton\(^1\)

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In recent years, climate services have emerged as a fast-growing and dynamic field to meet the growing recognition of the need for adaptation and mitigation strategies to climate change. In spite of the broad and diverse range of climate services currently underway in Europe as yet there has been no coordination of these activities, leading to duplication of efforts and fragmentation. To address this, a consortium of key actors in climate services in Europe have formed a coordination and support action funded by the European Union under Horizon 2020, called Climateurope.

The four main aims of Climateurope include:
1. Develop a European framework for Earth-system modelling and climate service activities. The framework will be built around a managed network of European, national and international activities and organisations. Such a network does not yet exist but is becoming increasingly necessary.

2. Coordinate and integrate European climate modelling, climate observations and climate service infrastructure initiatives (including JPI-Climate, Climate-KIC, Copernicus C3S) and facilitate dialogue among the relevant stakeholders, including climate science communities, funding bodies, providers and users. This will improve synergies, reduce fragmentation and promote alignment between activities. The user communities will include public sector, businesses, industry and society.

3. Establish multi-disciplinary expert groups to assess the state-of-the-art in Earth-system modelling and climate services in Europe; and identify existing gaps, new challenges and emerging needs.

4. Enhance communication and dissemination activities with stakeholders, in particular through events to bring the network together and showcase progress; stakeholder-oriented reports on the state-of-the-art in Earth-system modelling and climate services in Europe; operating a website; and undertaking additional stakeholder interactions to increase awareness and maximise project impacts.

This presentation will explain how the Climateurope CSA will deliver a range of highly beneficial impacts. Two key impacts are (i) to greatly enhance the transfer of information between suppliers and users to improve the resilience of European society to climate change and mitigation of the risk of dangerous climate change; and (ii) to improve coordination to increase efficiency, reduce fragmentation and create synergies with international R&I programmes. The outcomes of the first Climateurope climate services Festival held in Valencia in April 2017 will also be discussed.

**Significance of your presentation to adaptation practice, policy and/or business?** Climate services offer a unique opportunity for policy makers and the private sector to develop tailored mitigation and adaptation strategies to the impacts of climate change on. In spite of the great potential economic benefits, the market for climate services in Europe is not yet mature. Climateurope will help bridge the gap between the users of climate information and the providers, by coordinating climate service activities in Europe and forming a network of climate service providers, users, stakeholders, funding bodies and policy makers.

**Poster 8: Copernicus Climate Change Service Roadmap for European Climate Projections**

Dr. Bernd Eggen\(^1\), Dr Jane Strachan\(^1\), Dr Chris Hewitt\(^1\), Dr Sylvie Joussaume\(^2\), Dr Robert Vautard\(^2\)

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CRECP, The Copernicus Climate Change Service (C3S) Roadmap for European Climate Projections, guides requirements and resource allocations for the operational phase of the Copernicus Climate Change Service (C3S). C3S European Roadmap is drawing upon climate research and modelling activities, and expertise from across Europe and beyond, including best practices from several precursor FP7 and H2020 climate service projects. This C3S activity will design a scientific plan for climate projections appropriate for informing European policy and adaptation in key socio-economic sectors. The plan, to be delivered at the end of 2018, will include recommendations for a set of minimum standards for climate simulations, based on an assessment of key climate modelling issues, including resolution, ensemble design and initialisation, for their potential benefit in improving climate model predictions and projections. Case studies, examining the ability to simulate processes and phenomena relevant to sector application, will be developed to focus the assessment of the modelling issues, and will address the fact that information about regional impacts is crucial to support planning in many socio-economic sectors. We will present the approach we are taking to
develop a thorough and actionable roadmap, including the simulation analysis process and phenomena assessment. We will also present highlights of the initial literature review of existing studies assessing the topics of model resolution, ensemble design, and the impact of initialisation.

**Significance of your presentation to adaptation practice, policy and/or business?**
The Copernicus Climate Change Service (C3S) is Europe’s flagship programme on Earth observations and climate services. The C3S Roadmap for European Climate Projections will support strategic planning for the provision of European Climate Projections, which will in turn be crucial for adaptation planning for both public and private users of climate information.

**Poster 9: Extremes indices in high end climate change simulations**

**Dr. John Caesar, Dr Laila Gohar**

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Climate extremes can be represented through the use of indices based on daily observations of air temperature and precipitation. Examples include percentile based indices such as the number of days above the 90th percentile of a baseline period (TX90p), the annual maximum 5-day precipitation total (RX5day) or the simple daily intensity index (SDII). This approach has facilitated studies of climate change over regions of the world where surface observational data availability is limited, but where there is a willingness to exchange indices derived from daily observations. Indices can also be selected which are particularly relevant to specific impact sectors, such as health or agriculture. Indices based on historic and present day observations provide a valuable baseline against which to evaluate the performance of climate model simulations.

New high resolution global climate simulations from the Helix project use two atmospheric models which are driven by sea surface temperature and sea ice from a selection of CMIP5 simulations. The gridded daily temperature and precipitation data from these new simulations have been used to calculate projections of extremes indices on grid resolutions of around 40-60km to the end of the 21st century. The majority of these simulations use the high emissions RCP8.5 scenario, and are able to represent climate extremes at various levels of global mean warming, ranging from 1.5°C to 4°C (and in a few cases 6°C). These new high resolution projections of extremes indices can be compared with the projections provided by lower spatial resolution climate models used in the IPCC Fifth Assessment Report.

**Significance of your presentation to adaptation practice, policy and/or business?**
Projections of extremes indices which have been tailored to the requirements of specific impacts sectors can add value to standard climate change metrics. The approach used here is to frame changes relative to thresholds of global warming (1.5°C, 2°C, 4°C and 6°C), rather than for a particular point in time in the future. The simulations use a higher spatial resolution than typically used in the past for projections of the 21st century, and therefore have the potential to provide greater detail of changing climate extremes, particularly along coastlines or regions with varying topography.
The European Commission has recently stated (“Roadmap for Climate Services”, 2015) that climate services have the potential to become the intelligence behind the transition to a climate-resilient society. In this scope, the Copernicus Climate Change Service (C3S) aims to provide information that will help societal and business sectors improve decision-making and planning regarding climate mitigation and adaptation. The C3S Urban SIS project, running from Nov 2015 to Dec 2017, serves as a proof-of-concept for a Sectoral Information System (SIS) serving especially the infrastructure and health sectors in European cities.

The goal of Urban SIS is to develop, demonstrate and put into production a method to downscale climate and impact indicators to the urban scale, delivering the information in a format that it is directly useful for consultants, planners, engineers and scientists dealing with the consequences of intense rainfall, heat waves, and air pollution hazards.

The demonstration consists of three pilot cities: Bologna, Stockholm and Amsterdam-Rotterdam. Aiming to cover a lack of climate data that takes into account the specific conditions and intra-city gradients of individual cities, Urban SIS delivers selected Essential Climate Variables (ECV) on a spatial resolution of 1x1 km\(^2\) and a temporal resolution of 1 hour, spanning over two time windows of 5 years each, representing present and future climate. From these ECV a series of statistical impact indicators are calculated for these periods, so that the spatially distributed information can be used directly by decision makers and urban planners.

The urban downscaling modelling chain consists of three components: the meteorological/climate model HARMONIE-AROME, the air quality model MATCH and the hydrological model E-HYPE. To allow a validation against measured data, there is a historical 5-year data set, with meteorological boundary and initial conditions provided by the UERRA reanalysis. Detailed urban physiography description aggregates ECOCLIMAP-II, Copernicus land services and – if available - national databases. Air pollution emission data is provided by Copernicus on the regional scale and by national services on the finer resolution.

For the future climate, boundary conditions are driven by the global climate model EC-EARTH and the chosen climate scenario is RCP8.5. This scenario has been regionally downscaled over Europe for two 30-year windows (1980-2010 and 2055-2085) using the HARMONIE-ALARO model which for this domain runs on a 20x20 km\(^2\) spatial resolution. The 5-year windows representing present (around 2000) and future (around 2050) are made by selecting different output years so that they statistically match – for temperature and precipitation in the city to be downscaled – with the 30-years windows produced by the regional downsampling. Future emissions are provided to MATCH by ECLIPSE database and local data sources. The regional hydrological model is driven by bias-corrected data from the Pan-European model HARMONIE-ALARO and the urban hydrological model with bias-corrected data output from the high-resolution HARMONIE-AROME model.

The focus of Urban SIS is to provide climate variables and impact indicators on a spatial and temporal resolution that reflects the major characteristics of a city and its feedback on the climate. This allows the identification of critical areas and also the possibility to assess the areal extension of intense precipitation and extreme temperatures. Moreover, as a proof-of-concept, this methodology gives the added-value of
being replicable in other European cities, offering the possibility to compare indicators determined in a consistent way. Urban downscaled ECVs and impact indicators from Stockholm and Bologna will be presented.

**Significance of your presentation to adaptation practice, policy and/or business?**

UrbanSIS web-portal ([http://urbansis.climate.copernicus.eu/](http://urbansis.climate.copernicus.eu/)) enables the user to plot, download and post-process selected ECV and indicators, representing a source of high-resolution information for end-users and a business opportunity for purveyors seeking for climate services in the context of urban adaptation.

Two types of end-users can potentially benefit from this service:

- professionals (consultants, engineers) and researchers that need to perform technically advanced assessments, normally driven by ECV data (contributing to improved input data to local models and assessments)
- decision makers (planners, emergency managers, health professionals) in various economic and societal sectors related to urban infrastructure and health (contributing to sector specific impact indicator maps over the city)

**Poster 11: Predicting the future patterns of urban growth and population distribution in Hungary**

**Dr Sen Li**

Ms Linda Juhász-Horváth, Ms Simona Pedde, Dr Paula A. Harrison, Prof László Pintér, Prof Mark D.A. Rounsevell

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Understanding how urban land cover and population distribution are likely to evolve in the future is important to the assessment of our cities’ vulnerabilities to climate change and to the improvement of residents’ safety and wellbeing. To date, much attention has been drawn on the climate change adaptation policies at the global and national scales. The lack of focus on the local-level anticipation of urban development has obstructed the development of inter-sectoral, cross-level spatial planning towards an adaptive management of climate change risks.

This storyline-and-simulation study was conducted to fill this gap for Hungary. An integrated model for fine-level urban land cover change and age-structured population distribution was developed by combining a range of existing statistical and cartographical approaches. Localised scenarios describing the potential extremes of the future socio-economic and climate conditions were constructed by working closely with local stakeholders. For the simulation exercise, a group of economic, climatic, demographic and urban planning drivers of urban changes were selected as they were not only important model parameters but also of strong interests to local stakeholders. The evolution of these drivers up to 2100 under each localised scenario was quantified by integrating quantitative predictions from the existing higher-level models and qualitative estimations from the local stakeholders. Then, the joint influence of these drivers was tested with the integrated model to predict the future patterns of urban land cover and age-structured population. The results showed that, despite the speed varies and pattern contrasts between scenarios, peri-urbanisation of the Budapest region and out-migration from the capital centre were predicted to occur under all scenarios.
Our predictions and data products can be used in the vulnerability assessment of nation-specific climate hazards in Hungary. The integrated model can serve as a useful tool to guide priorities for existing policies, and to test the cost-effectiveness of potential inter-sectoral, cross-level policy responses. Future improvements may focus on embedding more localised and sectoral knowledge in the development of a broader range of scenarios.

Significance of your presentation to adaptation practice, policy and/or business?
Urban infrastructure and population are most commonly regarded as the elements exposed to climate hazards in various sectors such as water, energy, transportation and health. The distribution of urban infrastructure and population is a key to the assessment and adaptive management of climate change risks. Assessing urban and population vulnerabilities to climate change at lower governance levels can facilitate inter-sectoral research partnerships and cross-level spatial planning communications towards climate adaptive cities.

Poster 12: Geological and hydrogeological characterization of the subsurface to support climate adaption in urban development

Mr. Theis Raaschou Andersen
Via University College, Horsens, Denmark

The world population in 2050 is approximately 10 billion people of which 75% reside in cities. The continuous growth of cities in combination with future climate changes present authorities with great challenges. One of the most significant challenges is to ensure a stable disposal of wastewater and surface water.

In Denmark, the municipalities are implementing climate change adaptation (CCA) plans for existing urban areas. However, lack of geological and hydrological information about the subsurface introduce significant uncertainties in the CCA implementation. In Denmark some CCA plans have been impossible to implement due to insufficient characterization of geological and hydrological conditions. Based on examples from two research projects we demonstrate how detailed geological and hydrological information supports sustainable and more efficient implementation of the CCA plans in areas scheduled for urban development.

Research project no. 1 is a collaboration with Vejle City, Denmark. Vejle City is part of the worldwide research project “100 resilient cities” founded by the Rockefeller Foundation. Vejle City plans to undertake urban development of a wetland located west of the city. The area is prone to flooding which is expected to further increase in the future. The research project aims at characterizing the geology and hydrogeology of the wetland by means of geophysics, boreholes and groundwater level measurements on which basis a detailed 3D hydrogeological model is constructed. The aim of the research project is to locate suitable and cost efficient green-, blue- as well as paved and build-up areas, respectively.

Research project no. 2 is conducted in collaboration with the city of Horsens and is part of the research project Coast to Coast Climate Challenge founded by the EU Life IP programme. The Horsens CCA plans specify that areas scheduled for urban development must handle surface water locally using various types of sustainable drainage systems (SUDS). However, at present time the knowledge about the geological and hydrological potential for local SUDS in the development areas is limited. In the research project an area of 250 ha will be mapped with high-precision geophysics supplemented with drillings and infiltration tests.
Geophysics-based mapping in conjunction with boreholes and groundwater level measurements yield maps of the infiltration potential for the development areas.

Significance of your presentation to adaptation practice, policy and/or business?
The results from the two research projects will contribute to adaptation practice. In particular, the project will outline the benefits of geophysical mapping for improved fidelity of the geological and hydrogeological characterization at all depths of interest. The outcomes of the two research projects will be implemented directly in the CCA plans for the two municipalities over the next 2-6 years. Thus, the results from the research projects can likewise be implemented by other authorizes and entrepreneurs with similar challenges elsewhere in the world.

Poster 13: Climate services for natural and cultural resource managers from the U.S. Department of the Interior Climate Science Centers

Ms Emma Kuster², **Prof. Renee McPherson**¹², Ms. Aparna Bamzai³

¹University of Oklahoma, Department of Geography and Environmental Sustainability, Norman, United States, ²South Central Climate Science Center, Norman, United States, ³North Central Climate Science Center, U.S. Geological Survey

Between 2010 and 2012, the United States (U.S.) Department of the Interior established a network of eight regional Climate Science Centers, under the oversight from the U.S. Geological Survey’s (USGS) National Climate Change and Wildlife Science Center. The Climate Science Centers gather the information and build the tools needed to help natural and cultural resource managers make decisions to adapt their jurisdictional resources to the impacts of climate change. Each Climate Science Center delivers climate-change-impact science, data, climate services, & science communication to those within their respective regions.

Hosted by the University of Oklahoma and funded by the USGS, the South Central Climate Science Center is one of the eight centers, and its region extends from the coast of the Gulf of Mexico in Louisiana across the forests and plains of Texas and Oklahoma into the deserts and mountains of New Mexico. This region spans a gradient of annual average precipitation from 175 cm along the coast to 25 cm in the desert, and it encompasses almost 70 sovereign Tribal Nations (Indigenous Peoples) and several of the fastest-growing cities in the U.S. In addition, the south-central U.S. has suffered more Federally declared natural disasters due to extreme weather than any other region of the U.S. during the past decade. The breadth of climates, cultures, and landscapes across this area make provision of climate data, tools, and services a challenge.

In this presentation, I will discuss the roles of various climate agencies (Federal, state, university) in the provision of climate services across the south-central U.S. In particular, I will focus on the development, evaluation, and provision of an ensemble of statistically downscaled climate projections for the region as a partnership of the University of Oklahoma and the Geophysical Fluid Dynamics Laboratory of the U.S. National Oceanic and Atmospheric Administration. I will describe ongoing efforts to help guide decision makers to identify and apply appropriate climate projection datasets to their particular need.

Significance of your presentation to adaptation practice, policy and/or business?
This presentation highlights the extensive challenges and opportunities of adapting to climate change across a physically and culturally varied region. It recognizes the need to partner with individuals, institutions, and organizations that have existing relationships with local decision makers. The information conveyed also
focuses on the need to provide measures of uncertainty in the provision of climate projections as well as a continued effort to educate those who will apply the projections in their adaptation planning efforts.

**Poster 14: Improving Predictions and Management of Hydrological Extremes Through Weather & Climate Services**

*Len Shaffery*¹⁴, *Ms Janet Wijngaard*¹, Ms. Felicity Liggins², Mr. Bart van den Hurk¹, Mr. Laurens Bouwer³, Mr. Albrecht Weerts³, Mr. David Lavers⁴, Mr. Linus Magnusson⁴, Mr. Erik Kjellström⁵, Ms. Maria-Helena Ramos⁶, Ms. Maria Mañez⁷, Mr. Cédric Hananel⁸, Mr. Ertug Ercin⁹, Mr. Johannes Hunink¹⁰, Mr. Bastian Klein¹¹, Mr. Laurent Pouget¹², Mr. Hans de Moel¹³

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The EU Roadmap on Climate Services can be seen as a result of convergence between society’s call for “actionable research” and the climate research community’s provision of tailored data, information and knowledge.

Although weather and climate have distinct definitions, a strong link between weather and climate services does exist but, to date, this link has not been explored extensively. Stakeholders being interviewed in the context of the Roadmap consider changes in our climate as distant, long-term impacts that are difficult to consider in present-day decision making, a process usually dominated by their daily experience with handling adverse weather and extreme events. However, it could be argued that this experience is a rich source of inspiration to increase society’s resilience to an unknown future.

The European research project, IMPREX, is built on the notion that “experience in managing present day weather extremes can help us anticipate the consequences of future climate variability and change”. This paper illustrates how IMPREX is building the link between the providers and users of information and services addressing both the weather and climate timescales. For different stakeholders in key economic sectors the needs and vulnerabilities in their daily practice are discussed, followed by an analysis of how weather and climate (W&C) services could contribute to the demands that arise from this. Examples of case studies showing the relevance of the tailored W&C information in users’ operations will be included.

**Significance of your presentation to adaptation practice, policy and/or business?**

IMPREX optimizes the supply of hydro-meteorological information and risk assessment tools to six key water related sectors. IMPREX will provide guidance on the information and knowledge needed in the daily practice of these water sectors to allow adequate adaptation to these risks. It also will inform a broader community - including policy makers - to support their decisions on adaptation strategies focusing on climate-sensitive decisions in the water sector.

**Poster 15: Quality assurance of climate services**

*Prof. Adriaan Perrels*¹, Dr. Jörg Cortekar², Dr. Alistair Baglee³, Dr. Andrea Damm⁴

¹Finnish Meteorological Institute (fmi), Helsinki, Finland, ²HZG-GERICS, Hamburg, Germany, ³Acclimatise Group Ltd, Nottingham, United Kingdom, ⁴Joanneum Research, Graz, Austria
The European Research and Innovation *Roadmap for Climate Services* aims to unleash the benefit potential of the market for climate services (CS). In support of this aim, two studies were awarded in the H2020 programme that should (1) define the (European) CS market characteristics and give foresight into market growth, and (2) analyse CS market barriers and enabling conditions and suggest remedies. Assignment no. 2 is covered by the EU-MACS project to which this poster belongs.

The current emerging market for CS is subject to knowledge gaps of both users and suppliers, lack of visibility and transparency, overemphasis of supply side possibilities versus user needs, regulatory inhibitions, lack of alternative business models and of integration with users’ overall risk management. A factor in these current shortcomings of the CS market is the as yet poorly developed quality assurance practice.

Only for intra-annual seasonal climate products quantitative verification of accuracy of the information can be provided in a similar way as for weather forecast products. For other – longer term – climate information products verification in the traditional sense is impossible. Furthermore, a part of the climate information products is more impact oriented thereby adding new realms of uncertainty, of which a part is even hard to quantify. In addition for many end-users dealing with adaptation ‘quality’ may cover a much wider scope of characteristics than quantified accuracy of a few key variables. For example, given the length of policy cycles, end users may attach high value to assurance of long term continuation of a climate product. Also the extent of connectivity (in terms of temporal and spatial resolution) to other data of end-users can have large impacts on the *attainable* quality level for the user.

The poster will summarize the findings of a review of current practices and needs regarding quality assurance, as well as of an assessment of the applicability of (semi)quantitative quality indicators. Results also include indications of the degree to which shortcomings in quality assurance obstruct uptake of CS, and what seem critical thresholds for improvement in the light of better uptake of CS.

**Significance of your presentation to adaptation practice, policy and/or business?**

Climate services, being often an essential ingredient in both preparation and monitoring of adaptation, would greatly benefit from improved quality assurance practices and tools. Improved and widely accepted common quality assurance practices and indicators promote market transparency and thereby enhance a better fit of climate products to user needs. As a consequence the benefit potential of acquired climate services improves, and the threshold for new users will be reduced.

**Poster 16: Toward cost-efficient and robust weather and climate risk management in Finland**

*Mr. Atte Harjanne*¹, *Ms Karoliina Pilli-sihvola*¹, *Ms Riina Haavisto*¹, *Mr Väinö Nurmi*¹

¹Finnish Meteorological Institute, Helsinki, Finland

Weather and climate risks are increasingly receiving attention even in countries with relatively low risk and high adaptive capacity, such as Finland. Due to the multitude of changes taking place in society, the planning and implementation of cost-efficient and robust disaster risk management (DRM) and climate change adaptation (CCA) measures is important. The cost-effectiveness and robustness of measures should be evaluated *ex-ante* (early in the planning phase), but it is also important to understand if the policy and practice measures implemented have been cost-efficient. Several analysis methods have been proposed in the literature to assess the cost-efficiency and robustness of different risk management measures.
This study focuses on cost-efficient DRM and CCA in Finland. We have analysed how cost-efficiency or cost-effectiveness has been incorporated into mandatory flood risk management plans, climate change analyses in the water management sector, and urban planning. Cost-efficiency is generally emphasised in all public decision-making. However, we find that in weather and climate-related DRM and CCA, the role of cost-efficiency is understood as an important criteria among stakeholders but in practice, other goals dominate. Furthermore, economic analysis should be used to justify certain investments. Due to the lack of the analysis, some measures, particularly measures with indirect, un-monetised costs or benefits have been harder to justify in the past.

A cost-benefit analysis is presented from electricity distribution sector. In 2013, a revised Electricity Market Act stated a clear goal for service quality, i.e. maximum allowable time limits for power outages in the face of severe storms or snow loads. This resulted in major investments on underground cables among certain major electricity distribution companies, which are natural monopolies in their area. The cost-benefit analysis shows that, despite clear benefits through reduced vulnerability to storms and heavy snow loads, cost-effectiveness is not guaranteed and is sensitive to the assumptions for instance about the consumers’ willingness-to-pay for avoided power outages, and available data.

The study was undertaken in a national policy support project ELASTINEN (Proactive Management of Weather and Climate Related Risks), coordinated by the Prime Minister’s Office of Finland, and funded by the Ministry of Agriculture and Forestry of Finland.

**Significance of your presentation to adaptation practice, policy and/or business?**
The recommendations provided by the ELASTINEN-project will enhance the planning and implementation of robust and cost-efficient weather and climate risk management measures for current and future climate in a situation where cost-efficiency has not been an important criteria before.

**Poster 17. The EUSTACE project: constructing global, daily information on surface air temperature**

**J. Bessembinder**, 1 A. Squintu, 1 G. van der Schrier, 1 N. Rayner, 2 S. Brönnimann, 3 Y. Brugnara, 3 R. Auchmann, 3 E. Conway, 2 D. Ghent, 1 E. Good, 2 J. Höyer, 6 J. Kennedy, 2 F. Lindgren, 1 K. Madsen, 6 C. Merchant, 8 J. Mitchelson, 2 C. Morice, 2 P. Ortiz, 5 J. Remedios, 1 A. Stephens, 4 R. Tonboe, 6 A. Waterfall, 4 R.I. Woolway 8

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Day-to-day variations in surface air temperature affect society in many ways and are fundamental information for many climate services; however, daily surface air temperature measurements are not available everywhere. With the incorporation of satellite measurements information for the whole globe can be obtained. To achieve this, we must develop an understanding of the relationships between traditional surface air temperature measurements and surface skin temperature from satellite measurements. EUSTACE (EU Surface Temperature for All Corners of Earth) is a Horizon2020 project that will give publicly available daily estimates of surface air temperature since 1850 across the globe for the first time by combining surface and satellite data using novel statistical techniques.
The EUSTACE project will use new statistical techniques to provide information on higher spatial and temporal scales than currently available, making optimum use of the information in data-rich eras. EUSTACE undertakes this work between January 2015 and June 2018. The final and intermediate products (e.g. overview of current data sets on temperature, satellite skin temperature retrievals over all surface of earth with consistent uncertainty estimates; station time series with discontinuities identified; information on the relationship between skin and air temperature over different domains and in different seasons) of EUSTACE will be interesting for many applications. Some other differences from other surface temperature data are:

- globally complete daily dataset from 1850 on
- designed in collaboration with users
- validated information on the certainty of each daily value as an integral component

This presentation provides an overview of the EUSTACE project. Also some intermediary results will be presented. Before determining the relationships between in-situ air temperature and satellite skin temperature, the in-situ temperature data from the ECA&D set (> 7500 stations) for Europe were homogenized. This means that breaks due to e.g. location or instrument changes were identified and adjusted. All the stations in the homogenized dataset show warming trends over the 1950-2010 period. Furthermore the amplitudes related to these trends are more spatially homogeneous than in the non-homogeneous version. The effects on the estimate of the European averaged temperature and of estimates of the increase in extreme events, like heat waves or cold snaps, are better quantified.

Poster 18. Inventory of the current climate services market characteristics

Dr. Jörg Cortekar1, Dr. Jaroslav Mysiak2, Harlad Jenull3

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The European Research and Innovation Roadmap for Climate Services aims to unleash the benefit potential of the market for climate services (CS). In support of this aim, two studies were awarded in the H2020 programme that should (1) define the (European) CS market characteristics and give foresight into market growth, and (2) analyse CS market barriers and enabling conditions and suggest remedies. Assignment no. 2 is covered by the EU-MACS project to which this poster belongs.

The currently emerging market for CS is subject to knowledge gaps of both users and suppliers, lack of visibility and transparency, overemphasis of supply side possibilities versus user needs, regulatory inhibitions, lack of alternative business models and of integration with users’ overall risk management. This results in barriers that can be of different kinds and includes regulatory, technological, scientific and other issues. It is important to know and better understand these barriers in order to overcome them in the future.

To identify the key barriers to be removed and enablers to be enhanced in the current provision of climate services, and the corresponding European policy reform that would be required to maximize growth potential in Europe, a market analysis is among the first tasks in EU-MACS. This market analysis aims at painting the bigger picture of the current market in terms of a) mapping the involved actors along the climate services chain according to the Roadmap, which includes providers, intermediaries and users, b) reviewing market failures, c) analysing current ways of climate services provision and use in their technical, regulatory, economic etc. dimensions including historical evolution and main drivers of this development, and d) mapping the multi-layer climate service innovation dynamics in terms of regime, niche and landscape.
The overview of the climate services market will be compiled based on an online questionnaire collecting data on providers, e.g. business model (public, private etc.), the types of services provided, to whom, on which temporal and spatial scales and many more. In addition to information on the services itself, the results show the provision modes that allow conclusions on the provision chains. Literature analysis, stakeholder consultations in workshops and interviews and statistics will supplement the market analysis. The results of these tasks will be presented on the envisaged poster.

**Significance of your presentation to adaptation practice, policy and/or business?**
Climate services as part of the solution to one of the biggest challenges of our time will play a crucial role in climate change adaptation and mitigation in the future. To foster market development and market uptake of these services we need to better understand how climate services are used and provided to overcome the barriers that a currently hindering to exploit their full potential. Once the process of provision and use is better understood, climate services could better be implemented in users’ decision-making procedures.

**Poster 19. Blue-Action: translating advances in Arctic climate science to climate services across the Northern Hemisphere**

Dr. Raeanne Miller¹, Dr. Mark Payne², Dr. Kathrin Kiel³, Dr. Erik Kolstad⁴, Dr. Joan Ballester⁵, Dr. Pamela Lesser⁶, Peter Vangsbo⁷

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Weather and climate prediction in the Arctic and northern regions is inherently challenging and year-on-year and decadal variability makes it difficult to detect reliable signals of change. Changes in Arctic climate and weather patterns also influence Northern Hemisphere weather and climate, and potentially other climate systems worldwide. In an increasingly globalized world, decision-makers from all sectors need to access improved climate and weather information across regional boundaries to address forthcoming social and economic challenges posed by a changing climate.

In response, the H2020 funded Blue-Action project aims to deliver improved modelling, prediction, and forecasting of Arctic climate change and its impact on Northern Hemisphere climate, weather, and extreme weather events, in line with stakeholder needs. Activities across the academic, business, policy, and public communities are often largely disconnected, or followed a linear, ‘scientist-tells-end-user’ pathway, limiting opportunities for true co-creation of outcomes and real innovation. Enabling better co-creation of climate services is central to Blue-Action’s approach.

To illustrate pathways for transforming complex climate model output to relevant, user-specific climate services, we highlight five case studies where climate scientists are working collaboratively with user groups to develop targeted and relevant climate services based on newly improved climate data. They include:

1. Assessing the value of improved weather and climate predictions for short-term and mid-term planning of operations for ski centres in Northern Finland;
2. Developing, in collaboration with key stakeholders, a forecast scheme for temperature-related mortality for a very large ensemble of regions in Europe;
3. Forecasting wintertime cold air outbreaks from polar ice to open water, linked to dangerous weather features such as polar lows;
4. Developing and operationalizing annual and multi-annual fisheries-related prediction, and estimating their value to specific industry end-users, as well as the sector overall; and,
5. Developing and evaluating scenarios for resource extraction in the Russian Arctic to enable evidence-based decision-making at various levels of governance and across spatial scales.

Across these case studies and the Blue-Action Stakeholder Engagement Group, we are establishing a two-way dialogue around climate science, climate services, and end-user needs between Blue-Action’s project partners, European-level policymakers, businesses, NGOs, indigenous groups, and other relevant stakeholders. We must work to understand each other’s needs, as well as our limitations.

**Significance of your presentation to adaptation practice, policy and/or business?**

Although high-quality, operational weather and climate models have been available for decades, the development of climate services which translate model outputs to inform climate adaptation, mitigation, and decision making, particularly for high-latitude applications, have lagged substantially. Our presentation illustrates different approaches and applications climate service development to demonstrate the value of the development process and end products to a wide range of potential users, including policymakers and businesses.

**Poster 20: Training program for consultants and financing institutions: Integrating climate information into development projects and climate risk analyses**

**Dr. Diana Rechid**, Dr. Paul Bowyer, Dr. Andreas Hänsler, Prof. Daniela Jacob, Dr. Peer Seipold

*Climate Service Center Germany (GERICS) / Helmholtz-Zentrum Geesthacht (HZG), Hamburg, Germany*

Development projects with long-term investments, e.g. in infrastructure, need to incorporate climate risk assessments and adaptation strategies. State-of-the-art climate information need to be considered in the planning process. A solid base of understanding on how to interpret climate change information has to be established at the consultants’ side, who elaborate the feasibility study including the climate risk analysis, as well as on the side of experts and project managers of the development banks, who have to make decisions on the basis of the information provided.

The Climate Service Center Germany (GERICS) developed in cooperation with the "European Financing Institutions Working Group on Climate Change Adaptation" (EUFIWACC) and the German Development Bank KfW a two-stage training program for (I) consultants involved in climate risk analyses and (II) for experts of financing institutions. The overall aim is to strengthen the capabilities for integrating climate information into development projects and climate risk analyses, sustained in an international network of climate experts, consultants and financing institutions.

The training for consultants contains thematic modules of EUFIWACC members with the focus on how to incorporate climate risk analyses into feasibility studies and investment design. GERICS developed modules with focus on the availability and accessibility of state-of-the-art climate change information and on methods and tools how to analyse climate information and how to deal with its associated uncertainties. The aim of the training for experts of financing institutions is to enable project managers to better judge the quality and reliability of climate change information which has to be incorporated in the project design. A prototype training is developed in cooperation with the German Development Bank KfW. The thematic focus is on what is state-of-the-art climate information and its robustness and how to use climate information in
project planning and decision making. The training is structured along a checklist on what to keep in mind when using climate change projections for adaptation planning.

In this contribution, we will present the development of the prototype training program, provide an overview on its structure and contents, and we will report experiences from its first practical implementations.

**Significance of your presentation to adaptation practice, policy and/or business?**
Development projects with long-term investments, e.g. in infrastructure, need to incorporate climate risk assessments and adaptation strategies. We present a prototype for a two-stage training program (I) for consultants, with the aim to strengthen their capabilities to integrate state-of-the-art climate information into climate risk analyses, (II) for project manager of financing institutions, with the aim to strengthen their capabilities to judge on the quality of climate information and to develop more specific terms of references for climate risk analyses. The training concept makes significant contributions to adaptation practise and science-service-business interface.

**Monitoring and evaluation**

**Poster 21: Uncertainty assessment of climate impact indicators – presentation of a new methodology**

Dr. Elke Keup-Thiel and **Dr. Diana Rechid**  
*Climate Service Center Germany - Gerics*

Existing climate data portals mainly treat the uncertainties of climate indicators in two ways: either they provide generic information and/or they express the quantifiable fraction of uncertainty with statistical measures. However, none of the climate data portals provide users with direct guidance on how confident they can be in the displayed data.

A new integrated platform of climate data services has been developed in the FP7 project “Climate Information Portal for Copernicus”, CLIPC. The new data portal of CLIPC provides a single point of access for comprehensive scientific information on climate change and climate change impacts.

In this project, the Climate Service Center Germany (GERICS) developed a methodology on how to assess uncertainties related to climate impact indicators. This approach provides information on the importance of different sources of uncertainties associated with a specific climate impact indicator, and how these different aspects are combined into an overall ‘degree of confidence’, for a given indicator. A key part of our approach was gathering feedback from users to ensure that the portal was meeting user requirements in terms of uncertainties of climate indicators. In the presentation, we will highlight the new uncertainty assessment approach available at the portal of CLIPC.
Poster 22: About Quality of Transdisciplinary Research: From Dimension to Indicator and Measurement

Ms Susanne Schuck-Zöller, Dr. Elke Keup-Thiel and Dr. Diana Rechid, Climate Service Center Germany/HZG, Hamburg, Germany

Developing appropriate climate information products and adaptation options climate services are used to integrate users in research and development activities (co-creation of knowledge). How to evaluate those transdisciplinary processes and ascertain their quality?

In other fields of transdisciplinarity - such as health care - the evaluation of quality in terms of service, product, and management processes is already being discussed for some years. In climate services, however, monitoring and evaluation is still in an early stage. Why not bundle the experiences over all research fields and learn about already existing schemes to monitor and assess the process of research and development, on the one hand, and to evaluate the quality of results, on the other.

The talk will present results of a comprehensive and interdisciplinary literature analysis. It shows the evaluation cascade which make evaluation criteria tangible, stretching from quality dimensions over quality criteria and indicators to evaluate co-creation of knowledge. The talk will show evaluation indicators already being documented in the whole range of fields, where co-production and co-design is already taking place. A closer look is taken on some evaluation examples, being helpful to assess the quality of climate services.

Poster 23: The Holistic Integrity Test (HIT) - Quantified Resilience Analysis

Mr. Mike Dobson¹, Dr Paul Smith¹, Dr Helen Evans¹
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Rising sea levels and wider climate change mean we face an increasing risk from flooding and other natural hazards. Tough economic times make it difficult to economically justify or afford the desired level of engineered risk reduction. Add to this significant uncertainty from a range of future predictions, constantly updated with new science. We therefore need to understand not just how to reduce the risk, but what could happen if above design-standard events occur. In flood terms this includes not only the direct impacts (damage and loss of life), but the wider cascade impacts to infrastructure systems and the longer term impacts on the economy and society. However, understanding the “what if” is only the first part of the equation; a range of improvement measures to mitigate such effects need to be identified and implemented. These measures should consider reducing the risk, lessening the consequences, aiding the response, and speeding up the recovery. However, they need to be objectively assessed through quantitative analysis, which underpins them technically and economically. Without such analysis, it cannot be predicted how measures will perform if the extreme events occur. It is also vital to consider all possible hazards as measures for one hazard may hinder the response to another.

The Holistic Integrity Test (HIT), uses quantitative system analysis and “HITs” the site, its infrastructure, contained dangers and wider regional system to determine how it copes with a range of severe shock events, Before, During and After the event, whilst also accounting for uncertainty (as illustrated in figure 1). First explained at the TINCE 2014 Nuclear Conference in Paris, it was explained in terms of a Nuclear Facility needing to analyse the site in response to post Fukushima needs; the hit is however universally applicable. The HIT has three key risk reduction goals:
The ability to tolerate and withstand shocks, while continuing to sustain key safety functions;
- The ability to wisely direct and manage the crisis situation, accounting for the diverse scenarios that could occur;
- To be able to quickly recovery and stabilise to a safe and secure state that is stable and sustainable in the long term.

Figure 1

Significance of your presentation to adaptation practice, policy and/or business?
We need to understand what could happen when our flood defenses are exceeded, so we can plan for a future when this becomes more frequent as the climate changes.
The HIT, developed for this purpose, “HITs” the site, its infrastructure and wider regional system to determine how it copes. This allows a holistic assessment of measures that reduce risk, lessen the consequences, aid the response, and speed up the recovery.
Importantly, the assessment is objective, using quantitative system analysis to select a mix of measures, whilst providing technical and economic justification to investors.

Poster 24: Mandatory reporting – why bother?! Learnings from the Scottish Public Bodies Climate Change Duties Reports.

Mrs Sophie Turner
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Adaptation Scotland, Edinburgh, Scotland, United Kingdom

In 2009, the Climate Change (Scotland) Act (the Act) was established. The Act places a duty on Public Bodies to act “in the way best calculated to help deliver” the Scottish Climate Change Adaptation Programme (SCCAP). Part of this delivery requires 151 major Public Bodies in Scotland to submit a report on their adaptation work. This reporting requirement was introduced on a voluntary basis in 2015 and became mandatory to report on an annual basis in 2016.
In the first year of reporting, Adaptation Scotland undertook a high level analysis of the Public Bodies Climate Change reports submitted. The initial aim of the analysis was to establish whether progress was being made on adaptation and if so in which organisations. The analysis focused on a number of questions that included whether the organisation had assessed their current and future climate-related risks, what action was being taken to adapt to climate change and what progress the organisation was making in delivering the policies and proposals set out in the Scottish Climate Change Adaptation Programme.

Following the initial analysis, it became evident that the reporting data was rich with useful insights that could offer strategic direction for the type of support that Adaptation Scotland could deliver. The data was abundant with potential and while Adaptation Scotland only scratched the surface with the analysis undertaken, it has already shaped the work that we have delivered. The analysis identified whole sectors that were not performing well in adaptation, whole sectors that were making good progress and individual organisations that could provide exemplar answers of their adaptation work and progress.

Since the reporting was introduced (in its pilot year), Adaptation Scotland have delivered tailored training to help the sectors not performing well and been contacted by a number of organisations who have been disengaged in the past. The momentum for work on climate change adaptation has increased exponentially and we predict that adaptation work across the public sector will continue to thrive.

For the Scottish Government, the reporting process has offered a unique opportunity to gauge the sector’s contributions to the achievement of national targets and for many public sector organisations, it has either given them the permission to allocate time to adaptation planning or it has given traction, where there were once institutional barriers.

This presentation explores the findings from the first year of the statutory reporting and presents them in the context of providing evidence-based adaptation support to organisations across Scotland.

Significance of your presentation to adaptation practice, policy and/or business?
Mandatory reporting for adaptation can be seen as a tick the box exercise, additional form filling and/or an additional role or responsibility that organisations, who are already working at full capacity, have to adhere to. This presentation describes the other side of the case by explaining the multiple benefits that mandatory reporting provides. From a monitoring perspective at government level, to providing targeted support through the Adaptation Scotland programme and being able to make traction with adaptation at the organisational level, this presentation explores the learnings from the first year of reporting in Scotland.

Poster 25: Regional and Local Adaptation in the EU since the Adoption of the EU Adaptation Strategy in 2013

Evelyn Lukat1, Jenny Tröltzsch1, Giacomo Cazzola, Zoritza Kiresiewa1, Daniel Blobel1, Marius Hasenheit1, Ray Purdy2, Peter Hjerp2, Alberto Terenzi3, Julia Peleikis3, Vasileios Latinos3

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The process to adopt strategies and action plans for the adaptation to climate change received momentum when the EU Adaptation Strategy was adopted in 2013. Until that date, seventeen Member States had developed national adaptation strategies. After 2013, several countries published revisions to their national
strategies or published a first strategy. To date, ten Member States are still in the process of developing national strategies.

However, adaptation efforts also take place on regional and local level. Several regions were far advanced before adaptation strategies were adopted on national or EU level. In order to evaluate the impact on regional adaptation efforts that the EU Adaptation Strategy had, the understanding of regional adaptation in the EU Strategy was analysed. Actions on regional level differ from country to country. For example in Spain or Sweden, regions are well advanced in defining regional adaptation efforts. However, Finland or France do not have strong regional adaptation efforts. The initiative RegionsAdapt might support regions in the future. The initiative was just established by the regions Catalonia and Rio de Janeiro and aims to form the capacities of governments to target adaptation regionally. However, adaptation does not need to be institutionalized but can be implemented in form of regional projects or on macro-regional level. There are several EU financed support programmes that assist adaptation on these levels. Furthermore, adaptation action is streamlined through various directives such as the Common Agricultural Policy. In particular, The Common Agricultural Policy implemented a strategic climate mainstreaming with its current funding cycle. As surveys with local governments suggested, adaptation efforts taken on the local level increased vastly from 2012 to 2016. One of the reasons for the increase seems to be the focus that was given to the local level in the EU Adaptation Strategy. It provides solutions to many urgent requests formulated by local governments. Furthermore, a range of support tools, like Climate-ADAPT and the Urban Adaptation Support Tool, was created particularly supporting local governments to formulate adaptation needs and to design adaptation actions. The strategy strengthened furthermore the role of the Mayors Adapt initiative and the Covenant of Mayors for Energy and Climate that fosters climate change mitigation and adaptation. By means of a survey to Mayors Adapt signatories, the efforts and progress of local governments were highlighted. The report emphasises potential synergies between Mayors Adapt and RegionsAdapt and shows how international networks can support local adaptation.

**Significance of your presentation to adaptation practice, policy and/or business?**

A review was elaborated on the current state of national, regional and local adaptation efforts. It presents different funding and governance mechanisms. From the detailed analyses of the national, regional and local level with regards to adaptation efforts, conclusions were drawn how the regional and local levels could improve adaptation actions. The conclusions were directed to the Committee of the regions who represents and supports regional authorities in the EU Parliament. For the currently planned review of the EU Adaptation Strategies, recommendations were formulated on how to better support local and regional administrations with regards to their adaptation efforts.
Poster 27: Developing proactive management of weather and climate related risks in Finland

Dr. Heikki Tuomenvirta¹, Dr. Antti Mäkelä¹, Dr. Karoliina Pilli-Sihvola¹, Prof. Mikael Hildén², Mrs. Sanna Luhtala¹, Dr. Hilppa Gregow¹

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The project “Proactive Management of Weather and Climate Related Risks” (ELASTINEN) was initiated to support the implementation of the Finland’s Climate Change Adaptation Plan 2022. Specifically, the purpose was to improve actors’ access to methods and tools for managing risks related to weather and climate. The intense 14-month research project (2015-2016) was funded through the Government’s Analysis, Assessment and Research Activities. The project was carried out by five research organisations jointly providing wide expertise in the fields of weather, hydrology, climate change, adaptation, risk management, economics, natural resources, health and policy analysis (Finnish Meteorological Institute, Finnish Environment Institute, University of Helsinki, National Institute for Health and Welfare, Natural Resources Institute Finland) jointly with Gaia Group; a consultancy company extending project team’s expertise to business.

The objectives of the ELASTINEN-project were to provide information and seek solutions for strengthening the capabilities of different sectors to assess and manage their risks related to weather and climate, to examine economic impacts of weather and climate risks, and to explore the use of economic analysis methods in adaptation assessments. The overall aim of the project was to decrease the vulnerability of Finnish society and increase its adaptive capacity to a changing climate.

In creating a foundation for developing risk management the project examined questions such as: How do Finnish municipalities and organizations in general perceive and manage weather and climate risks? What are the main drivers for weather and climate risk management? What information, tools and services would end-users, i.e. those facing weather and climate risks, like to have? How can one improve weather and climate risk management of those end-users who consider risks relevant but whose risk assessment and management have flaws? How do climate impacts occurring outside Finnish borders contribute to risks in Finland? Do stakeholders see business opportunities in weather risk management and climate change adaptation?

The project produced detailed analyses of the current state of weather and climate risks assessment and management. Based on the analysis policy advice to improve weather and climate risk management were formulated and discussed with stakeholders. We will present the recommendations, their rationale, the stakeholders, and the likely benefits of the advice.

Significance of your presentation to adaptation practice, policy and/or business?

The paper presents a concrete example of how research based analyses and assessments can support decision-making and knowledge based management of weather and climate risks and climate change adaptation. The work is positioned in the science-policy interface and demonstrates how to develop fruitful interaction with policy makers and also the private sector. It shows how policy advice can be systematically developed for administrators and officials while at the same time recognising the need for public-private partnerships and the possibilities to create business opportunities.
Ecosystems and societies rely on water in a myriad of ways, but as future water availability alters with climate change, challenges and conflicts may arise. Plants and animals that have already been made vulnerable by other human activities, such as converting forests to fields for agriculture, must now face potentially rapid changes in climate. As well as increased temperatures, species must contend with changing rainfall and extreme weather events. Biodiversity hotspots are often under the greatest pressure from humans. This is particularly the case for developing countries in the tropics, such as Kenya, who must face the task of improving socio-economic conditions while responding to climate change and also protecting their biodiversity.

This research focuses on Kenya’s Tana River Basin and aims to project the impacts of climate change upon the hydrology and terrestrial biodiversity, in order to inform national climate change adaptation plans. The Tana basin has been identified as crucial for Kenya’s development, with increased irrigated agriculture planned. Here the Wallace Initiative database (wallaceinitiative.org/), which employs the MaxEnt species distribution model and the latest generation of climate change projections (CMIP5), is used to identify climate refugia and areas of concern for different taxa. Shifts in species’ ranges are predicted, with the mountains and Tana Delta identified as important ‘refugia’ for all taxa. Some refugia coincide with existing protected areas, whereas other National Reserves are likely to see a significant decline in the number of species present.

The WaterWorld model is used to determine annual and monthly changes in hydrology. Results show rises in precipitation under the 4 RCPs for the 2050s, with the annual basin-average rainfall increasing between 112% and 149% depending on the RCP. Seasonally, drying is projected in some months, whereas wetter conditions are projected in others. Average predicted precipitation changes do not vary greatly between the RCPs, but there are large discrepancies between individual GCMs for the area, showing that robust management decisions will need to be made in the face of considerable uncertainty. By combining spatial projections of land use change in the Basin with spatially explicit projected changes in water resources and the locations of climate refugia, it is possible to identify the extent of conflict between biodiversity conservation and human development in a climate-changed future. Overall, this research combines projected land use change with hydrological and species distribution modelling to help inform conservation and climate change adaptation strategies.

Significance of your presentation to adaptation practice, policy and/or business?
Through examining land use, species distribution and hydrological changes, it is possible to take a more holistic view and to see where conflicts may arise. For instance, if areas identified as refugia are also selected for agricultural development, trade-offs between conservation and development may be necessary. The range of projections, especially for future rainfall values, also indicate that policy and management decisions need to be made in the face of uncertainty.
Poster 29: The role of uncertainty in adaptation policy process: a case study of South Korea

Ms Yi Hyun Kang
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Climate change raises the question of the role of uncertainty in the policy process. This is because of the limitations in both our scientific knowledge about the climate system and our understanding of the impacts of climate change on society and the environment. Uncertainty in the decision-making process is not a brand-new topic in political science. However, climate change adds even more uncertainty to the decision making process. How do the actors involved in climate change adaptation policies deal with this uncertainty when constructing discourses which influence the policy process?

To answer this question, the study analyses the case of South Korea’s national adaptation policy which was first formulated under the Low Carbon Green Growth Act of 2008. Particularly, this study focuses on the ‘Four Rivers Project’, which was implemented by the Korean government as its main adaptation scheme. The project consisted of dredging and constructing 16 weirs in the four major rivers in South Korea, and there has been a discourse collision between policy makers, businesses, scientists and environmentalists. The government, major construction companies and the media produced a discourse in support of the project emphasizing that the project could prevent floods and alleviate droughts which were expected due to climate change. However, many scholars and environmental NGO workers opposed the project arguing that the future water shortage was exaggerated and that the project would only deteriorate ecosystems. The collision of the two different discourses became intensified by another uncertainty concerning the social-economic effects of the project. While the discourse promoting the Four Rivers Project claimed that top-down economic growth was necessary for adaptation, the contrasting discourse, taken by the opponents of the project, emphasized the limitations of growth and put more value on a bottom-up, social justice approach.

Document analysis and interviews with the key actors in the different discourses are conducted for this study. In this way, it is possible to examine the underlying assumptions, interests, frames and concepts which constructed the narratives, story lines and metaphors of the discourses.

How is your session significant to adaptation practice, policy and/or business?
This study tries to extend discourses on adaptation policy to the issue of uncertainty which underlies adaptation but has not been actively debated so far. Although uncertainty poses a great challenge to adaptation, the literature related to climate change and uncertainty has been often produced in the mitigation/carbon emission reduction area. The significance of uncertainty in adaptation policy process will possibly increase in the future as unpredictable extreme weather events become more frequent. This study will bring attention to the empirical case of South Korea so that the dynamics of the actors involved in adaptation policy are better understood.

Poster 30: Climate change adaptation in regions - a new funding approach

Mr. Gernot Wörther
1Klima Und Energiefonds, Vienna, Austria
The fifth IPCC assessment report has shown that climate change will continue in the next decades also with very optimistic RPC-Scenarios (e.g RCP 2.6) and also in the political arena adaption is growing in importance (e.g. the Paris agreement (COOP 21)).

By looking at the situation on a national level it becomes evident that Austria as a country is heavily affected by climate change. The first Austrian assessment report (see http://www.ccca.ac.at/en/apcc/) provides an in depth understanding about the situation in the country. Furthermore, a recent study, called COIN (cost of inaction, http://coin.ccca.at/) revealed that the potential damages due to not responding to challenges related to climate change might reach 8.8 Billion € per year in 2050 in Austria.

Politics has reacted and developed and implemented adaption strategies both, on national and federal state level. However, adaptation also has to take place on a regional level. Up to date there have only been very view examples on adaption at regional level in Austria, mostly within research projects. Against this background, the climate and energy fund, an Austrian national funding body, has developed a funding programme focusing on adaption on regional level. The Programme, called KLAR! – Klimawandelanpassungs-Modellregionen (in English: climate change adaptation model regions) focuses on municipalities and regions (from 3.000 to 60.000 inhabitants) and has 3 phases a) setting up a regional adaptation concept + awareness raising, b) implementing the concept and setting concrete adaptation action c) Dissemination and communicating results. Furthermore, the programme is based on two pillars a) a manager at regional level, who will organize the activities and ensure the implementation of concrete actions on site and b) a central advisory centre which collects R&D results, translates them in a usable form for regions, provides best practices examples for municipalities and consults on all aspects of adaption. A special focus of the advisory centre is on how to connect research results with real life planning and implementation of activities and on how to avoid male adaption. A graphical summary can be found below. This new funding programme started on 21st September 2016 and will close by the end of March 2017. By the time the conference takes place it will be possible to present first results of the call.

<table>
<thead>
<tr>
<th>Manager</th>
<th>Advisory Centre</th>
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| Phase 1 – Conception and awareness raising  
  • Result: draft Concept + awareness | Consultation and Workshops |
| Phase 2 – Implementation  
  Förderkataster  
  • Result: concrete actions | R&D Dissemination, collection of needs for R&D, |
| Phase 3 – Dissemination & Adaptation  
  Result: Monitoring, adaptation, measures, Best Practice | Monitoring |

Significance of your presentation to adaptation practice, policy and/or business?
The presentation shows an approach on how to start climate change adaptation activities on regional level by providing a minimum of public funding. To our knowledge it is the first funding programme with this set-up and focus in the DACH-Region (Germany, Austria, Switzerland) and addresses the 3 major problems regions/municipalities: a) it provides manpower, b) it provides in depth knowledge on the topic adaptation, c) it is embedded in national and regional climate adaption strategies.
The programme KLAR! is a best practice example on how to set up a funding programme on climate change adaptation in action.

**Poster 31: Costing the national adaptation strategy: What is the relevance for public budgets now and in the future?**

**MA Nina Knittel**¹, Prof. Birgit Bednar-Friedl¹

¹University of Graz, Wegener Center For Climate and Global Change, Austria

Many European and other countries implemented adaptation strategies and implementation plans, but little is known about the budgetary implications thereof. In this presentation, we illustrate how public budgets can be screened to identify current and future adaptation expenditures in the two categories (i) changed expenditures on existing measures (adaptation mark-up), and (ii) expenditures on additional measures (specific adaptation).

The main methodology consists of a review of Federal Budget Plans for adaptation relevant expenditure groups, and interviews with staff in the different governmental departments. We illustrate our methodology and results for the case of Austria.

While many adaptation measures are already covered in existing budget expenditure groups, it is not yet possible to identify the share of costs due to adaptation because adaptation is often doing the same project in a better way, rather than conducting a specific project of adaptation. In our analysis, we therefore estimate adaptation related expenditures which comprise both the adaptation and the non-adaptation share of a project, and only in some specific cases we are also able to define the share of adaptation.

By attributing the 132 adaptation measures of the Austrian national adaptation strategy to current budget positions, we find that some budget positions are dominated by adaptation related expenditures already, such as the field of water management and flood protection. Other fields’ expenditures support adaptation as a side effect, such as the Austrian programme for promoting sustainable agriculture.

When comparing costs across measures and fields, we find that they vary substantially. More case studies on specific measures, implementation costs, and effectiveness are therefore needed to better understand the implications of adaptation for public budgets.

For the expected development of future adaptation costs, results differ strongly across fields. To meet the adaptation goal, expenditures will either need to be expanded or a shift in the type of measures is required, for instance because the potential for technical measures has been explored and therefore green measures need to be implemented in the future. Finally, the interviews reveal that government officials expect priorities in expenditures to shift towards climate change adaptation with increased evidence of climate change impacts at the regional scale. Consequently, with total resources remaining constant, other expenditure groups, such as education and research, might incur a reduction.

**Significance of your presentation to adaptation practice, policy and/or business?**

While adaptation in early years was mostly the concern of Ministries of the Environment, now Ministries of Finance indicate increased interest to climate and adaptation to ensure the sustainability of their public budgets. This presentation contributes to a better understanding of how public budgets are already affected
and might be affected by climate change impacts and adaptation in the future. It also proposes a methodology which can be applied to different countries and governance scales.

**Poster 32: From national to local level: supporting the development of urban adaptation strategies in the Czech Republic**

**Dr. Eliška Krkoška Lorencová**¹, Adam Emmer³, Zuzana Harmáčková, David Vačkář¹

¹Czechglobe - Global Change Research Institute, Czech Republic

Future and ongoing climate change-related risks and need for adaptation represent major issue in science as well as practice at all spatial administrative levels. National adaptation strategy of the Czech Republic at national level was adopted by the government in fall 2015. In order to support mainstreaming of adaptation, our project aims to implement the strategy into the decision-making processes at local level (adaptation strategies of individual cities). We, therefore, aimed to initiate and further develop the process of preparation of urban adaptation strategies in several pilot cities (such as Prague, Brno, Pilsen). The adaptation cycle was promoted as a generic framework to adaptation.

Firstly, we assessed climate-related risks and impacts experienced in cities in the present and expected future impacts. To ensure effective participation of stakeholders, we organized a series of participatory workshops, where climate change-related risks were evaluated. Secondly, various adaptation measures have been prioritized by stakeholders using multiple criteria (including economic aspects, timeframe, etc.). Although “traditional” approaches in the Czech Republic usually supported use of technical (grey) measures, ecosystem-based approaches to adaptation (EBA) were shown to have a very high priority among stakeholders during the workshops. Thirdly, main barriers as well as opportunities for implementation have been identified using findings of an institutional analysis.

The above mentioned outcomes from particular city were used to develop city’s adaptation strategy. The adaptation strategies of Prague, Brno, Pilsen will be presented in this paper also in the context of mainstreaming the adaptation efforts into the local decision making. For instance, in Brno the adaptation strategy of the city is aimed to be used as one of the main building stones for overall city strategy “2050 Strategy for Brno”.

**Significance of your presentation to adaptation practice, policy and/or business?**

Presented work is designed as applied research – using participatory methods to involve local stakeholders in order to connect science with policy and practice. Outcomes of this study contribute with relevant findings to support decision-making in the area of climate change, adaptation strategies development as well as urban planning.

**Poster 33: Strategic narratives to induce preparedness and prevention in cities – new governance tool for public action**

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Recent research and policy initiatives have recognized that policy processes and scientific discourses between CCA and DRR are different and developed in separate ways. Furthermore, many local communities that have successfully accumulated knowledge and strategies to cope with disaster risks are likely to be insufficiently prepared for projected climate change impacts. A strategic and inclusive effort to integrate both areas is needed to avoid duplication of and conflicts between responses as well as to enhance possible synergies at all governance levels.

This paper suggests that differences between different actors in language and narratives that frame climate-related risks and solutions are hampering this integration. The prevailing focus on technological and economic barriers to the development and implementation of measures to increase resilience obscures a joint understanding of the problem and makes it difficult to find and to implement respective response measures.

We argue that development of a shared understanding and the necessity to act that draws on values, norms and beliefs of each stakeholder group are crucial components of a joint harmonised effort. Both of them can be facilitated by means of frames - meaning creating representations, often embedded in narratives, that influence perception of the problem and the solution. Consequently, strategic and deliberate framing shows the potential to steer human behaviour, in this case to induce an integrated and effective preparedness to and prevention of climate risks with the goal of increasing resilience.

The presented analysis is illustrated by examples from cities from Europe and other continents. Cities are accumulators of human capital, wealth and cultural heritage, and can be expected to be hit hardest in the absence of an integrated strategy to tackle climate-related extreme events. Our theoretical considerations on the construction of joint strategic action frames are enriched by the analysis of empirical questionnaire data collected in the context of the H2020 PLACARD project during Resilient Cities 2016 - Annual Global Forum on Urban Resilience. Results shed light on the perception of the local urban policy makers, practitioners and NGOs of the climate-related risks and specific policies and operational measures applied in their cities.

**Significance of your presentation to adaptation practice, policy and/or business?**

Although both CCA and DRR communities aim to increase resilience, they differ substantially in terms of spatial (global vs. local perspective), temporal (short vs. long term) and functional scales (different institutions). A joint perception framework encompassing different urban stakeholders groups including (local) policy makers, practitioners, businesses and households that is deeply embedded in their respective socio-cultural environments and attached to their values can largely influence their risk-related decisions. Thus, it has the potential act as a powerful (but underestimated) social leverage, a new governance tool, to ultimately bridge the gap between CCA and DRR and induce a bottom-up driven harmonisation.

**Poster 34: Actors and roles in transformative climate governance in Rotterdam and New York City**

*katharina hölscher1, dr. niki frantzeskaki1, dr. timon mcphearson2, dr. derk loorbach1*

1drift, rotterdam, netherlands, 2urban ecology lab, the new school, new york city, usa

The multi-actor nature of urban climate governance and the emergence of new actor configurations challenge existing social fabrics and local governance settings. It raises questions about who takes up what roles, with which agenda, how do actors interact and what are implications for (changing) roles and
relationships between actors. Particularly the re-organisation of what were considered governments’ tasks vis-à-vis civil society and businesses raises questions about the (re-)distribution of responsibilities between different actors that might have different decision-making authorities and resources bases. While governments increasingly call upon ‘the community’ to take over public services that they have become constrained or unable to provide, bottom-up initiatives that emerge to fill this gap often find themselves outside of standardised arrangements. Increasing community self-organisation and market self-regulation might also veil the need for alignment of action to foster synergies and deal with trade-offs and to more traditional governmental instruments such as regulation.

This paper zooms in on the questions of who are the actors and what roles do they take up in transformative climate governance in Rotterdam and New York City. Transformative climate governance is a holistic governance framework that encompasses different types of governance functions and corresponding capacities to safeguard infrastructures and populations from disturbances and shocks, minimise risks and vulnerabilities and promote radical innovation in synergy. The capacities for transformative climate governance manifest in a variety of processes through which actors generate knowledge, organise services and mediate resources. Rotterdam and New York City are both considered frontrunners in addressing climate change and sustainability; the local governments have formulated ambitious strategies, implemented innovative solutions and set up complex networks and partnerships to involve a large diversity of actors in climate governance.

We analyse who are the actors engaged in what kind of transformative climate governance processes by looking at different societal spheres (government, market, community, Third Sector), sectors and geographical scales. We particularly zoom in on how different types of actors collaborate, what resource synergies arise from collaboration, what actors are excluded and what conflicts arise between diverse interests. The analysis suggests changing roles of local governments towards facilitating and coordinating networks and innovation. Knowledge partnerships provide central platforms for nurturing collaboration by generating and sharing knowledge and creating trust. Key challenges include the involvement of civil society actors, the clarification of responsibilities for action and for bearing costs, and arising questions for the legitimacy of transformative climate governance processes.

Significance of your presentation to adaptation practice, policy and/or business?
The comprehensive perspective processes for transformative climate governance in cities enables a better understanding of different types of processes and strategies for urban climate governance. The selection of case studies (Rotterdam and NYC) enables to learn from frontrunners, i.e. what opportunities were created and used and what are (persisting) challenges in developing and implementing transformative climate governance. The critical perspective on actors serves to question underlying assumptions of roles and responsibilities, reveals implications of power and interests and facilitates the coordination and collaboration of actors in practice.

Poster 35: The lack of mainstreaming as a challenge for Mexico’s climate adaptation policy

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Centralization is one of the main characteristics of public policy implementation in Mexico, specially, when we focus on climate change policy. This impedes the achievement of goals and commitments that the
Mexican government has agreed in international forums in order to reduce greenhouse gas emissions and prevent the impacts of climate change.

Climate adaptation actions require coordinated efforts among several sectors and actors for obtaining integral results. However, in Mexico, adaptive measures are mostly designed and performed by federal agencies that concentrate the power of decision on this matter.

The lack of mainstreaming for the climate adaptation policy in Mexico can be explained by several factors, chiefly, governmental common practices and institutional capacities. The objective of this research is to analyse such issue in relation to the expected results on disaster prevention and building resilience in vulnerable communities against extreme weather events.

The research consists on the study of a concrete case and the analysis of the institutional framework of the Mexican climate adaptation policy. The case is the Hurricane Patricia contingency in the municipality of La Huerta, Jalisco, in 2015, which affected a considerable amount of population that had already been harmed 4 years earlier by Hurricane Jova. This event uncovered the way federal, state and local governments operated before, during and after the emergency and gives clues about the implementation of disaster prevention and resilience within the climate adaptation policy.

Significance of your presentation to adaptation practice, policy and/or business?
Based on a real case, this presentation offers evidence about the importance of mainstreaming in the implementation of climate adaptation policy. Besides, it shows the articulations of public policy at different government levels and how it works within a context of centralized decision making.

Poster 36: Good Governance for Climate Adaptation

Mr. Rohan Hamden¹, Dr Russell Wise¹
¹Rohan Hamden & Associates, Campbelltown, Australia

Effective governance for adaptation is more than just the committee or decision-making structure that sits over a climate change program or policy. The decisions or actions under these adaptation programs or policies must be implemented and lead to sustained, desirable outcomes if the governance is to be considered effective. Efforts to design and support effective governance therefore need to capture / be informed by the full gamut of relevant actors, processes, cultures and structures of the decision context that give effect to, or constrain, decisions.

For example, the decision of an authority must go through the relevant legal frameworks, organisational structures, budgetary processes and planning cycles before it can be implemented. And only having gone through these processes, will an action emerge that will lead to a change. Monitoring, evaluation, reporting and learning processes are then required to provide feedback to the decision-making body so that it is aware of how its decision was implemented, whether it had the desired effects, and to take corrective actions if required. To test these propositions of effective governance, we conducted a survey of the governance approaches in national and sub-national governments in Australia, Europe, USA and Canada. We interviewed about 30 bureaucrats with a detailed understanding of their internal governance. From the findings we identified a core set of principles consistent across these countries that might be considered as preconditions to effective governance that enables good adaptation actions and can deliver desirable
results. The findings from the survey also revealed the pitfalls that governments often fall into that compromise the delivery of adaptation objectives. These findings will be presented and discussed.

Participation and co-production

Poster 37: Participatory future climate risk mapping using SoftGIS tool for map co-production

Ms Alexandra Jurgilevich¹, Ms Sirkku Juhola¹
¹University Of Helsinki, Helsinki, Finland

While the literature on climate change risk and adaptation has expanded vastly in the recent decade, providing higher accuracy of climate projections and deeper understanding of biophysical processes, the socio-economic processes of climate risk formation are still not well understood (Oppenheimer et al. 2014). Understanding future patterns of risk development, as well as local socio-economic development allows for preventative adaptation planning locally, but also presents even larger methodological challenges (Hewitson et al. 2014). Particularly at the subnational level, (e.g. urban), decision-making context is such that it requires nuanced assessments with a focus on socio-economic drivers, conducted through participatory methods and tools (Hewitson et al. 2014; van Aalst et al. 2008).

Our current research is exploring future climate risks in the urban context at the case of Helsinki, paying particular focus to socio-economic risk drivers and their dynamics over time. More specifically, this study develops and tests the use of SoftGIS in participatory mapping (Kahila and Kyttä 2009). By using SoftGIS methodology, we are bridging common indexed mapping with the stakeholder qualitative data in order to explore nuanced local processes of risk formation. First, we have selected indicators through the literature review. Validation and weighing of the indicators will be done with the Delphi survey (Hsu and Sandford 2007) and in the stakeholder workshop. Afterwards, the quantitative data for hazards and for demographics will be mapped and exposure will be simulated through the land-use plans. The maps will be then complemented with qualitative local data using SoftGIS survey (Kahila and Kyttä 2009). The manuscript discusses the novel use of SoftGIS as a tool for participatory future risk mapping in the urban context. Particularly, we will focus on how to improve the inclusion of dynamics and future changes of socio-economic drivers through participatory mapping.

Significance of your presentation to adaptation practice, policy and/or business?
Participatory risk assessment has been recognized as a useful and necessary way to conduct assessments at the subnational level, and goes in line with the expanding research on benefits of bottom-up adaptation planning (Biesbroek et al. 2013; Poplin 2012; Jonsson et al. 2012). The project maps, produced together with the stakeholders with participatory approaches also enable the identification of risk drivers in the future, paying special attention to dynamic changes in socio-economic dimensions. The use of SoftGIS is a novel method to conduct participatory climate risk mapping and to co-produce climate risk data, in addition to traditional interviews and workshops.

Poster 38: Meeting Information Needs in Communities by Tailored Climate Parameters

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¹University Of Munich, Munich, Germany
²University Of Luzern, Luzern, Switzerland

While the literature on climate change risk and adaptation has expanded vastly in the recent decade, providing higher accuracy of climate projections and deeper understanding of biophysical processes, the socio-economic processes of climate risk formation are still not well understood (Oppenheimer et al. 2014). Understanding future patterns of risk development, as well as local socio-economic development allows for preventative adaptation planning locally, but also presents even larger methodological challenges (Hewitson et al. 2014). Particularly at the subnational level, (e.g. urban), decision-making context is such that it requires nuanced assessments with a focus on socio-economic drivers, conducted through participatory methods and tools (Hewitson et al. 2014; van Aalst et al. 2008).

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Regionally different climate change impacts call for regional adaptation and communities are an important actor in planning and implementing adaptation measures. Thus, they need reliable climate information and data on a regional scale both scientifically sound and tailored to their needs.

The development of climate models during the last decades allows simulating at higher horizontal resolutions over longer time periods and generating ensembles of regional climate model projections based on different global climate model driving data (e.g. Hackenbruch et al., 2016, Sedlmeier, 2015). Such an ensemble of regional climate model simulations at high horizontal resolution can project the range of the future regional climate and makes small-scale assessments of climate change possible.

However, so far mainly parameters defined from a climatological point of view are evaluated with climate model data, for example annual or seasonal precipitation sums or deduced parameters over a threshold as the number of frost days or the number of hot days. Yet, climate information inquiries at the South German Climate office at Karlsruhe Institute of Technology, a regional climate service, have shown that in practice also combinations of meteorological parameters are important for decision-making. These often take into account specific thresholds or durations of weather events.

In order to identify so-called tailored climate parameters that are relevant for decision-making in communities in different fields of action, a survey was launched among the communities in the state of Baden-Wuerttemberg in Southern Germany. By means of a questionnaire survey and additional expert interviews with stakeholders in communities, it was investigated what the status quo of climate change adaptation is, which information and data is used today, and which should be provided by climate science to support the process of planning and implementing climate change adaptation in communities. The presentation will show the main results of the survey.

**Literature:**


**Significance of your presentation to adaptation practice, policy and/or business?**
If the tailored climate parameters, which have been identified in the survey, are evaluated in climate models and the results are communicated to local experts, they can, even more if coupled to impact models, enlarge the data base on possible future climate change in a community and thereby support decisions on adaptation strategies and measures.
The approach presented allowed detecting so far unused potentials in the exchange between climate science and stakeholders. On the one hand, it made the practical knowledge and experience of the local decision-makers with weather and climate impacts accessible. On the other hand, it increased their knowledge about possible applications and use of climate model data.

Poster 39: The needs-knowledge gap and geotechnical risk in Swedish local and regional planning

Dr. Lisa Van Well¹, Dr. Miriam Zetterlund¹

¹Swedish Geotechnical Institute, Department of Land Use Planning and Climate Adaptation, Stockholm, Sweden

While geotechnical research on erosion, landslides and polluted land form essential inputs into regional and local planning and risk reduction strategies, their societal relevance as perceived by end-users is sometimes implicit and appears to be “buried” in the technical details. The Swedish Geotechnical Institute (SGI) has been examining ways to make geotechnical knowledge in the form of guidance papers and decision-support tools more sensitive to the needs of the users. This paper documents the results of current research projects and governmental missions to evaluate and address the gap between what local and regional users of geotechnical risk analysis need and how geotechnical risk is analyzed and communicated. The research question is: How can methods be developed and applied to better span the boundary gap between science, policy and practice?

Decision support tools are available to help Swedish planners in managing and reducing risks in the face of uncertainty associated with the challenges of climate adaptation, disaster risk reduction and remediation of contaminated lands. However many of these are not used and thus further work is needed to bridge the gap between science and policy. The problem is that users often want simple, one-size-fits all tools tailored to local risks and pre-conditions, while the problems are of a complex and multi-risk nature. The challenge for scientists and authorities is then is to produce simple but robust methods for facilitating decision-making that are both specific enough to be useful for end users, and general enough to be replicable and used in other contexts.

The study examines both the end-user needs from a social science perspective (governance and planning theory) and the knowledge providers’ perspective (decision-support analysis, geotechnical risk analysis). The needs analysis is based on interviews with municipal and regional end-users of SGI risk analysis and decision-support tools as well as compilations and surveys of end-user needs. The knowledge provision analysis is based on a critical self-examination of geotechnical analyses and tools and complemented by end-user evaluations and trials of decision-making tools and guidance papers. Results show that end-user involvement at an early stage in knowledge creation contributes positively to bridging the knowledge gap, as does the recognition that complex geotechnical risk issues can seldom be managed by simple checklists only.

Significance of your presentation to adaptation practice, policy and/or business?

The presentation is specifically focused on addressing the gap between climate adaptation research, policy and practice. It discusses ways to bridge this gap and to develop decision support tools as types of climate services which are better attuned to the municipal and regional governance procedures and therefore more likely to be utilized in practice.
Poster 40: Towards collaborative adaptation implementation: defining the attributes of successful climate change adaptation in the coastal zone.

Ms Jennifer Armstrong¹
¹Loughborough University, Leicester, United Kingdom

Climate variability and change threaten human and physical systems in coastal zones. With more than 10% of the global population now living and working in low elevation coastal zones, ‘successful’ adaptation to climate change is becoming a pressing issue, particularly for those domains featuring critical, long-lived infrastructure. This research aimed to define the fundamental attributes contributing to successful adaptation to climate change, then to use the insights gained to shape advice for practitioners. Here, success is measured in terms of the process rather than the outcomes of adaptation initiatives.

The research investigated the social factors enabling or inhibiting stakeholder adaptation efforts. The Grounded Theory Methodology (GTM) was used to design and iteratively adjust semi-structured interviews with 30 participants representing 16 stakeholder organisations in the nuclear neighbourhood of Sizewell, Suffolk, UK. Interviews were transcribed and coded using the qualitative analysis software NVivo 10. The findings were used to identify opportunities for the strengthening the adaptation processes, focusing on gaps and incentives.

The semi-structured interviews exposed six key themes that define the adaptation process. These are: decision timescales; perceived responsibility; units of governance; response to climate shocks; knowledge flows and; levels of partnership working. Each theme is interlinked and influenced by social factors. Stakeholder organisations reported 12 factors that affect their standpoints. These are: i) communication, ii) education, iii) empathy, iv) empowerment, v) finance, vi) intellectual capital, vii) legacy of extreme events, viii) perceived responsibility, ix) politics, x) positionality, xi) preparedness and xii) trust. Standpoints were broadly similar within stakeholder thematic networks (STNs) of corporations, community groups, national Government, local government, NGO’s and statutory agencies.

The STNs, key themes and influencing factors provide an evidence base for evaluating the complex social dynamics affecting ‘successes’ of the adaptation process, potentially offering a route to pragmatic guidance. In particular, gaps between theory and practice, unequal knowledge and differing resources, and variations in stakeholder positionality need to be addressed. This can be achieved by i) commonly aligning different sectors of society and ii) positively framing and incentivising adaptation.

This research differentiated elements of the adaptation decision-making process. By considering the attributes of adaptation, coastal stakeholders in neighbourhoods with long-lived static infrastructure could strengthen the adaptation process, thereby realising their shared vision(s) of integrated coastal management.

Poster 41: Adaptation in Metropolitan Area of Barcelona: empowering society through knowledge

Ms Ana Romero¹, Ms Elena Lacort²
¹Barcelona Metropolitan Area, Barcelona, Spain, ²Barcelona Metropolitan Area, Barcelona, Spain

The Barcelona Metropolitan Area hosts a dense population, in some neighbourhoods, density reaches more than 6.000 inhabitants/km2. Although it is one of the most important economical poles in Spain, part of the
population is in the border of poverty. Poverty will probably increase with climate change. For example, some of the greatest challenges faced will be how to avoid vulnerability due to high temperatures in summer nights (more than 30 ºC) and insufficient resources for indoor acclimatization. It is essential to address the energy transition also in terms of social justice and equity.

AMB launched the Metropolitan Observatory of Climate Change (METROBS), where politicians and practitioners meet together with members of the Expert Group on Climate Change in Catalonia (linked directly to the Intergovernmental Panel on Climate Change).

The aim of METROBS is the promotion of a deeper knowledge of vulnerability plus its immediate transference to the society, for awareness raising and political decision-making thorough:

- Up-to-date available information and knowledge in the website available for experts, universities, etc.
- Downscaled and specific information at a municipal and regional level allowing municipalities to tailor the design of more realistic actions as part of their Climate adaptation strategies and plans.
- Raising citizen awareness through the improvement of contents related to climate change and capacity building of schools, teachers and educators.

METROBS has undertaken 8 studies:

- Urban heat island
- Effects of climate change on the coastline
- Energy characterization of the residential sector
- Effects of climate change on the water resources
- Flood evolution from an holistic perspective: pass, present and future
- Economy and legislation related to climate change
- Evaluation of green infrastructure and agronomic patterns to raise efficiency in the use of water resources
- Downscaling of global climate models for the metropolitan area

**Significance of your presentation to adaptation practice, policy and/or business?**
The main strengths are the knowledge and governance through collaboration with experts on climate change where scientists, politicians and technicians meet. Moreover, the networking between municipalities and different administrative levels and bottom up experiences allows AMB to approach reality and face challenges from a closer perspective. At the end, the focus on significant subjects which were traditionally under evaluated such as urban heat island or vulnerability of energy infrastructures, have allowed empowering society and make politicians become more aware about climate change impacts at a local level to change their role into a one of real decision-making.

**Poster 42: Adaptation research – getting information into the right hands**

Dr. Sarah Boulter1, Ms Ana Cecilia Vidaurre Perez1, Prof. Jean Palutikof1, Dr Dave Rissik1, Ms Anne Leitch1

1Nccarf, Southport, Australia

Adaptation as a field of enquiry is a busy space right now. Research is rapidly developing information about not only about the risks and impacts of climate change, but how it can be tackled through strategic approaches, decision-making processes and balanced adaptation actions. The research, like the practice, is itself an adaptive learning process and evolving rapidly. The Australian government invested $30million in adaptation research via its National Climate Change Adaptation Research Facility (NCCARF). The investment
yielded a significant, coordinated research effort on adaptation. The magnitude of the work and the short delivery timeframe (within three years) did leave a legacy of quite technical information. NCCARF has developed a synthesis and communication program to condense and translate that information into digestable communication products for a diverse audience of end users. To shape the delivery of this program we held online workshops and one-on-one interviews with stakeholders. The consultation informed the mode of delivery and key challenges to address. From this a series of 17 synthesis products were developed. They include a set of actor specific briefs that target stakeholder groups with the pathways to the knowledge they need to undertake adaptation, a set of research summaries that condense a range of findings to an accessible format and a set of policy briefs highlighting the key challenges for some of Australia’s key assets and communities. In disseminating the products we have undertaken further testing of the success of our approach. This paper will look at the outcomes of a two-step stakeholder consultation process and the outcome of testing of the synthesis and communication products coming out of that process – have we successfully delivered research into the right hands.

**Poster 43: Testing the performance of a decision support framework in the real world**

**Dr. Jean Palutikof**, Dr Sarah Boulter, Dr David Rissik, Ms Ana Perez Vidaurre

1Griffith University, Australia

In 2014-2016, the National Climate Change Adaptation Research Facility (NCCARF) built an online information delivery and decision support framework for coastal managers, CoastAdapt. Following intensive Australia-wide stakeholder engagement and consultation, CoastAdapt has been well received, but tracking take-up and use has proved elusive. To explore whether the Framework provides useful support for coastal adaptation, NCCARF set up short (6 week) test cases. The process for identifying test cases, implementing these and monitoring the outcomes is described in this presentation.

NCCARF has a standing Panel of potential CoastAdapt end-users, drawn from coastal local councils together with one small business. Working with this Panel, we created a two-dimensional matrix of use sectors versus coastal adaptation components. The use sectors were council, community, industry, infrastructure, national security and Indigenous communities. The adaptation components were risk assessment, community engagement, awareness-raising within the organisation, options assessment, and monitoring and evaluation. Then, the cells of the matrix were populated with organisations (councils, small businesses, infrastructure operators, community groups etc.) the Panel considered would be open to addressing coastal management issues side-by-side with CoastAdapt to ensure effective adaptation decisions. Five groups were identified and approached to participate as a test case. A small grant was made to cover staff time; any travel costs etc. were covered by NCCARF.

The five groups were one infrastructure operator, two local councils undertaking community engagement, one small business (an aquaculture company), and an Aboriginal Shire Council seeking to build organisational capacity. All groups accepted the invitation.

At present, NCCARF has commissioned an independent facilitator to work with each group; their first task is to write a short specification of their project, including how CoastAdapt will be used, expected outcomes and how CoastAdapt is expected to make a difference. A start-up workshop will be held, and then each facilitator will hold a teleconference and/or meeting with their group each week. A final workshop will be held with all groups together to evaluate results and share experiences.
The five test cases are currently underway but final reporting has not yet been carried out. The presentation will look at the final results, in particular exploring the extent to which CoastAdapt has, or has not, added value. Overall, it is expected that the test cases will, if successful, present a compelling case for CoastAdapt to become key support for coastal adaptation in Australia.

**Significance of your presentation to adaptation practice, policy and/or business?**

Around 85% of Australia’s population lives close to the coast. Therefore the majority of the population and associated critical infrastructure are exposed to risks from climate change and sea-level rise. A tool has been developed to support coastal managers seeking to build climate change resilience and adaptive capacity. Determining whether this tool properly supports end-user needs is a critical evaluation step. Satisfactory performance of the tool in the test cases described in this presentation will brand it as authoritative, build credibility and provide end-users with the confidence to make use of it.

**Poster 44: Exploring Local Climate Change Adaptation to Inform Climate Change Adaptation Policies and Programs**

*Ms Camille Manning-Broome*

*Center For Planning Excellence, Baton Rouge, United States*

Tobler’s First Law of Geography states “Everything is related to everything else, but near things are more related than distant things.” As planners working to implement resiliency into our built environment we would do well to keep this deceptively simple Law in the front of our minds. As we learn from others’ efforts elsewhere we must never forget that we are working in a different environment where people have different needs and preferences. Resilient design in one location may be inadequate in another or culturally be a non-starter. For example, elevated housing is part of coastal Vietnam’s architectural vernacular. It protects from high tides and flood events. In coastal Louisiana, elevated housing is associated with camps (semi-permanent secondary residences primarily used for recreation). Promoting elevation for primary residences in Louisiana therefore encounters a cultural barrier before it ever gets to a logistical barrier. With this in mind, CPEX developed a survey to assess climate change adaptation needs, risk perceptions, and flood risk reduction efforts in coastal Louisiana. We used the Delphi method to elicit expert feedback on a comprehensive list of climate change adaptation measures relevant to Louisiana. Through a series of inquiries, we had experts rank the list of adaptation measures by their effectiveness at reducing risk in coastal Louisiana as well as the feasibility of implementing each adaptation measure at a meaningful scale given existing political and socioeconomic barriers in the state. From these results, we developed a survey, and administered it to local officials and community members throughout coastal Louisiana to gauge the current implementation of adaptation measures, perceptions of risk, preferences for adaptation measures, and support or opposition to state and local policies regarding their role in climate change adaptation. The results of this survey were used to inform policy makers of the challenges and opportunities for implementing adaptation measures at the local level in order to better develop adaptation policies and programs.

**Significance of your presentation to adaptation practice, policy and/or business?**

Creating effective policies and programs requires understanding the needs and motivations of local populations. This requires both expert and local knowledge. The methods for survey design and development used in this work are applicable worldwide and provide a framework for eliciting feedback and knowledge from experts and locals to better understand and address climate change adaptation needs.
Poster 45: Local adaptation in a climate-changed world: a case study in Tanna island, Vanuatu

Dr. Johanna Nalau\textsuperscript{1,2,4}, Professor Brendan Mackey\textsuperscript{1,3}, Associate Professor Christopher Fleming\textsuperscript{2}, Dr Jim Smart\textsuperscript{3}

\textsuperscript{1}Griffith Climate Change Response Program, Gold Coast, Australia, \textsuperscript{2}Griffith Business School, Gold Coast, Australia, \textsuperscript{3}Griffith School of Environment, Gold Coast, Australia, \textsuperscript{4}Griffith Institute for Tourism, Gold Coast, Australia

The Republic of Vanuatu has long been regarded as the most vulnerable country in the world due to its range of natural disasters and the underlying societal vulnerabilities. In March 2015, Tropical Cyclone Pam made landfall in Vanuatu, one of the strongest cyclones for the country. The eye of TC Pam went directly over the island of Tanna stripping off all the green vegetation and destroying most of the houses, livestock and crops. The damages were unprecedented in scale and intensity. Given that most of the population relies still on subsistence farming and that climate change impacts are expected to increase in scale, adaptation responses need to be developed that provide culturally relevant options especially in the more remote areas. This paper presents a case study of the first real-life climate adaptation project post-TC Pam on the island of Tanna, Vanuatu. The project is a partnership between development partners, the Provincial Government, and 3 remote tribes on building cyclone-proof community structures as long-term adaptation options. This presentation focuses on the lessons learned from dealing with compounded vulnerabilities and unprecedented disasters, identifying hybrid knowledge systems that seem to best support both climate adaptation and disaster risk reduction, and discusses the realities of implementing multi-stakeholder projects.

Significance of your presentation to adaptation practice, policy and/or business?
The presentation is of significance to adaptation practice and policy as it outlines important lessons regarding working with rural communities in multi-partnership projects. It also is of significance in terms of providing insights of the impacts of mega disasters, how in particular low socio-economic groups are impacted, and can be engaged in adaptation and disaster risk reduction projects.

Poster 46: The Green Circles initiative: a public – private partnership for sustainable and climate proof regional development

Dr. Karianne De Bruin\textsuperscript{1,2}, Dr. Hasse Goosen\textsuperscript{1,3}, MSc Bertram de Rooij

\textsuperscript{1}Wageningen Environmental Research (Alterra), Wageningen, the Netherlands, \textsuperscript{2}CICERO, Oslo, Norway, \textsuperscript{3}Climate Adaptation Services, Bussum, the Netherlands

One of the ambitions of the Green Circles Initiative is to have the most sustainable water system of the Netherlands by the year 2030. The key partners of this initiative, Heineken Brewery, the provincial authority, the drinking water company, the water board, and Wageningen Environmental Research, have formulated a joint ambition to secure sustainable water management in the area of South-Holland towards 2030. A linkage between the European climate services data platforms (FP7 project ClipC and Copernicus C3S SWICCA), the national Dutch climate effect atlas and expert judgement are established to map the story about climate change and relate this to the regional development ambitions.
A lot of research has been done in recent years on the impacts of climate change. At the European and national levels there are various reports, tools, and data platforms available which detail and visualise the impacts of climate change. At the same time, there is a need to further tailor and translate the flow of information to knowledge purveyors and ultimately to societal end-users. A complicating factor is the spatial scale level, where end-users work on much smaller scales than the original global modelling sources of climate information. We use ‘story mapping’ as a promising tool to communicate about the impacts of climate change. The focus is on supporting an opportunity-driven approach to adaptation planning.

In our presentation, we illustrate this process of providing tailored information on climate change and its impacts for the Green Circles Initiative case in the Netherlands and discuss the challenges of linking the European, national, regional and local scales.

**Significance of your presentation to adaptation practice, policy and/or business?**
Practice of the usability and linking of an EU climate information platform, national climate information and impact and data and the local context.

**Poster 47: The relevance of co-development for a high-resolution urban climate model´s practicability and user-friendliness**

Bettina Steuri¹, Dr. Joerg Cortekar¹, PD Dr. Steffen Bender¹

¹Climate Service Center Germany (GERICS), Hamburg, Germany

Urban agglomerations are particularly vulnerable to the expected impacts caused by climate change. In order to support cities to adapt to these changes, a new urban climate model should be established for Germany in the nationally funded research project “Urban Climate Under Change”. The main aim of the project is not to develop another urban climate model, but to develop a practice-oriented model that can be used by municipal administrations, consultancy companies and engineering offices. To do so, the project consists of three parts: i) model development (module A), ii) data monitoring to support model validation (module B) as well as iii) assessing user requirements to ensure the model’s practicability (module C). But how is a user-friendly model designed? What explicit specifications does it require in terms of computer infrastructure requirements and the level of expertise of potential users?

In order to provide this information to the model developers, we started an assessment of user requirements. This process consists of workshops, a literature analysis, and an online questionnaire. The first scoping aimed at identifying the most important contexts in which the model could be implemented. Even though municipal administrations will be the predominant scope, the model seems to be an interesting tool also for a variety of private businesses and scientific institutions.

After identifying the most important application areas, the different user groups and their respective requirements will be analysed. This will be done by an extensive literature analysis that will reveal how user needs could be assessed, which topics need to be covered and how the results should be structured and presented to the model developers. Based on the literature analysis, an online questionnaire will be elaborated to address the various user groups in urban administration, businesses and science. Topics will include individual capacities of the users (e.g. layman vs. experienced user), technical issues such as computing capacity, visualization and data output presentation, interpretation of results, interfaces to other models such as hydrological modelling and many more.
The results of the survey will then be synthesised and refined in a final workshop, to which all who replied to the questionnaire will be invited. Based on this workshop, a catalogue with necessary requirements as well as relevant application areas will be developed and further on delivered to the model developers.

**Significance of your presentation to adaptation practice, policy and/or business?**

In order to support *urban* climate change adaptation, users should be capacitated to run, interpret and update their own simulations. To do so, a user-friendly as well as highly practice-oriented urban climate model has to be developed that could be used by non-experts and with standard IT infrastructure (without the need for a super-computer). In order to assure the model’s practicability, the application areas and purposes are closely co-developed with the potential user groups.

**Poster 48: South Seeds: climate adaptation in an urban community**

**Ms Lucy Gillie**

*South Seeds, Glasgow, United Kingdom*

Climate change is a global crisis. Adapting effectively to its challenges requires action at all levels, from the supranational down to the individual. In the academic literature, there is much discussion of the political and economic barriers to change faced by governments and international organisations. The barriers faced by individuals and communities – lack of resources, lack of knowledge, lack of motivation – have received less focus. This paper will bring the local barriers to climate change adaptation into the spotlight, and offer a successful model for tackling them at community level using the Glasgow-based charity South Seeds as a case study.

The G42 postcode area on the southside of Glasgow is geographically small, densely populated and home to a diverse population in terms of nationality, religion and socio-economic background. The majority of the housing stock is tenement apartments, many of which are more than 100 years old; improving its energy efficiency can be complicated and expensive, moreso when the buildings have not been well maintained in the first place. Garden space is limited and often in a poor state. Money is in short supply for many members of the community and, particularly for the migrant population, the language barrier can be difficult to overcome.

South Seeds was created by members of the G42 community to support local people in taking action in relation to climate change. The focus is on seeding many small changes – developing community gardens, assisting residents in gradual improvements to the energy efficiency of their homes, supporting alternatives to landfill for local waste – which local people are able to build on for themselves, spreading the benefits out through the community. This approach is coupled with an activist element, working with local and national government to highlight the need for larger infrastructure development and related investment.

By offering an overview of what South Seeds has achieved in its first five years, the paper will offer practical lessons to others around the world who are trying to tackle climate change amidst the complexities present in heavily populated urban environments.

**Significance of your presentation to adaptation practice, policy and/or business?**

The experience of South Seeds provides a successful good practice model for bringing about sustainable change in urban communities, of relevance to practitioners and policymakers dealing with adaptation in urban environments throughout the world.
To understand and manage the complex and multi-faceted issue of adapting to climate change, we need to know and quantify the risks and realised impacts, and identify the outcomes of our actions.

ClimateXChange (CXC) has published over 100 indicators measuring and monitoring progress in building a Climate Ready Scotland. These indicators support Scottish Government policy by:

- Informing and analysing risks identified for Scotland in the UK’s Climate Change Risk Assessment (CCRA)
- Show progress towards the objectives set out in Scotland’s Climate Change Adaptation Programme (SCCAP)
- Inform the independent assessment of the SCCAP carried out by the Adaptation Sub-Committee of the UK Committee on Climate Change

105 indicators are presented within 13 narratives. 42% of the indicators provide baseline data only; 22% provided data over time but with no discernible trend and 36% indicate a trend.

The indicators were built around policy need. They directly address the risks identified in the CCRA and the objectives of the SCCAP. Indicators explore the RISKS and OPPORTUNITIES resulting from climate change and quantify the IMPACTS across sectors and the regions of Scotland. ACTION indicators look at what is being done. Are current policy and climate change adaptation actions having the desired effect?

The indicators are multidisciplinary and cross-sectoral. As such they are relevant to the work of a wide range of government policy teams, agencies, NGOs, local authorities, planners and others working towards a climate resilient Scotland. Individual indicators are presented within thematic narratives – a ‘one-stop-shop’ providing data, insight and analysis on adaptation.

Policy makers and practitioners are generally trying to meet multiple objectives. Climate change risk and adaptation action plays into many of these, sometimes magnifying existing challenges and other times offering ways of achieving multiple benefits. Our indicators recognise the complexity of decision making and provide a ‘way in’ to understanding climate change adaptation that explicitly links to other policy aims and challenges.

The poster will include examples showing:

1. Related indicators: the risk of tree pests and diseases, *Phytophthora ramorum* – risk, impact and action indicators
2. Individual indicator: Number of registrations for flood warnings/alerts
Significance of your presentation to adaptation practice, policy and/or business?
To manage adaptation to climate change, we need to quantify the risks and impacts, and identify the outcomes of our actions. CXC’s indicators measure and monitor progress in building a Climate Ready Scotland. Policy makers and practitioners are generally trying to meet multiple objectives. Our indicators recognise the complexity of decision making, providing data and contextual information helping link climate change adaptation to other policy objectives. Additionally, the project is important in identifying critical data gaps, and will play a significant role in informing future cycles of policy development.

Poster 54: The ClimateXChange knowledge exchange model for research, policy and practice

Anne Marte Bergseng

ClimateXChange was designed to build an effective, trusting relationship between policy teams and the research community, brokered by the core ClimateXChange team of Directors and Secretariat. Since inception in 2011 it has been trial and error. This poster will look at the lessons learnt and how this can be transferred to other settings where there is a need to make better use of publicly funded research in the policy development process.

The poster will look at how the organisational structure has developed to:

- deliver a research and analysis service that meets the needs of the end user – the policy teams and public agencies;
- demonstrate the value of embedding academic analysis in their work; and
- build a network of researchers willing and interested in engaging with policy.

We will use project examples to show the workings of our genuinely collaborative approach to project scoping and co-production of knowledge. Close working relationships with a range of Scottish Government policy teams allow us to pre-empt research needs as well as to proactively propose research and engagement work where we see an emerging need.

Significance of your presentation to adaptation practice, policy and/or business?
Better use of publicly funded research is an important aim for governments. As demand for evidence based policy increases, we believe the lessons from setting up ClimateXChange can be used by those who have similar aims to CXC, and inform funding decisions and design of knowledge exchange beyond Scotland and for any policy area.

The lessons look at both how research and policy need to work on structural and organizational models to achieve the aims of the policy, practice and research community in order to build long term relationships and understanding.
Poster 55: Gulf of Mexico Climate Outreach Community of Practice: A Model for Adaptation Dialogue

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Climate change and associated sea-level rise are affecting the Gulf States of Florida, Alabama, Mississippi, Louisiana, and Texas and it is predicted the impacts will increase in future years. The Gulf of Mexico Climate Outreach Community of Practice (Gulf Climate CoP) formed in 2010 to bring extension, outreach and education professionals together with government staff and elected officials to share best practices for climate change adaptation planning. The group’s three working objectives include (1) explore the state of climate science in the Gulf region, (2) learn how coastal communities can adapt to climate change impacts, and (3) share lessons-learned related to climate communication. These objectives are met through an annual 3-day workshop that rotates annually in location around the Gulf. Components of each workshop include expert scientific presentations, a hands-on tools café, a panel of government employees sharing on-the-ground adaptation practices, breakout group working sessions, and a field tour. Each year, members of the Gulf Climate CoP nominate from within the Community of Practice (1) an individual who demonstrates leadership in climate change communication and engagement and (2) one community that shows leadership in climate change adaptation planning to receive the Spirit of the Community Award. This best practice helps incentivize CoP members to continue their work. The Gulf CoP has attracted over 300 members from diverse organizations, and members utilize different mechanisms for engagement including webinars, work groups, social media, and an annual in-person meeting. The 2016 Gulf of Mexico Climate Outreach Community of Practice educated 80 extension professionals, floodplain managers, and government leaders. In post-conference evaluations participants reported knowledge gain as a result of the workshops on the following topics: 87% climate change science, 81% online adaptation planning tools and 94% local adaptation planning efforts. One hundred percent (100%) of participants reported the workshop provided an opportunity to foster long-term engagement with other professionals who work on climate issues. Throughout the year, participants are kept engaged through digital newsletters and webinar series. Gulf Climate CoP has fostered multi-state collaboration on projects including but not limited to Regional Floodplain Management Workshops, Coastal Resilience Indices, and a small grants program for coastal communities. Detailed examples of success and best practices from the CoP’s six years in operation will be shared in the poster.

Significance of your presentation to adaptation practice, policy and/or business?
Communities of Practice offer members a safe and comfortable space to learn from and with their peers. The Gulf of Mexico Climate Outreach Community of Practice is a model whereby Gulf Coast communities have increased climate literacy, and incorporated climate science into comprehensive planning and policy. This model is transferable to other regions around the globe.

Poster 56: A Communication Strategy for Climate Change in Tampa, FL

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A 2013 report published by the World Bank, examined maps and databases of population and world assets, flood-prone regions, storm frequency data, and cost of damage models for 136 large coastal cities. The study identified Tampa Bay as one of the ten coastal metropolitan at the highest risk. In response, UF/IFAS Extension, Florida Sea Grant and University of South Florida Department of Anthropology collaborated to develop “Climate: Change the Conversation” to engage and assess how key stakeholders and local residents view climate change risk and vulnerability. Between 2013 and 2015, a total of four (4) workshops were conducted in Pinellas County, FL with 130 participants. The workshops are informed by findings from a National Science Foundation-funded study at USF, an interdisciplinary project that integrated global and regional climate science, local population demographics, and input from policy makers, planners, and scientists to develop visual climate change scenarios about potential impacts on linked social and ecological systems in Tampa Bay. The workshops consisted of a climate science overview, a video proposing three possible climate futures for the Tampa Bay region, and five interactive listening stations: sea level rise, transportation and infrastructure, water resources, food systems, and natural resources. Eighty-nine percent of those surveyed after the program indicated they are very concerned about climate change in the Tampa Bay Region (n=93). Of those surveyed, 91% (43 of 47) pledged to modify actions based on knowledge gain. The “Climate: Change the Conversation” workshops have been well received by participants and results support the program’s objectives. The poster will focus on lessons learned from the workshops about translating climate science from global or regional scales to local scales, communicating with decision makers, and gathering data about perceptions of climate change.

**Significance of your presentation to adaptation practice, policy and/or business?**
Coastal communities around the world are faced with the task of integrating climate change adaptation planning into present government operations and long-term planning. However, it is important to consider the human element of our communities and first assess how key stakeholders and local residents view climate change risk and vulnerability. Research shows that stakeholders are more likely to buy-in to a planning process if they are involved in the conversation from the start. This program is a model to gather stakeholder input related to adaptation planning and policies.

**Poster 57: Serious gaming as a tool for personal and collective mind-set transformations related to climate adaptation**

**Prof Lotta Andersson**, Associate Professor Tina-Simone Næset

1. Swedish Meteorological and Hydrological Institute, Norrköping, Sweden, 2. Linköping University, Linköping, Sweden

The general understanding of the need for climate adaptation is increasing. A national Swedish survey showed that almost all municipalities recognise that they will be impacted by climate change. In spite of this, only 20% have an action plan. However, moving from understanding on an abstract level to concrete plans and actions requires a change in mind-sets. In addition to adjusting political and legal frameworks, as well as providing information and practical solutions, there is thus a need for tools that facilitate such personal transformations.

We are assessing if and how serious gaming can contribute to personal and collective transformation towards considering climate adaptation as a pre-requisite to meet visions of a sustainable society and environment. We hypothesise that this requires experiences of how climate change “affects you where you are”, which we visualize by means of serious gaming, aiming to create an “aha” experience of the short and long-term impact of climate change and of decisions (and absence of decisions). The aim of the game is to
facilitate a change of mind-sets from looking at climate adaptation as something abstract to something graspable that has to be initiated now and that cannot be achieved by sectorial planning alone.

The game will mainly be targeted towards an educational context for students, politicians and managers at the municipal level, and will include interactions between various actors. It applies a combination of moderated “in real life” role-plays and digital simulations of the consequences of climate change, based on participants’ strategies and decisions, as well as of changes that are outside their spheres of impact (e.g. climate variability and change during the time frame of the game, demographic changes, as well as direct and indirect impacts of climate change that have taken place outside the municipality).

Following a design process in collaboration with researchers, municipality officers, teachers and students, a game concept is developed. During 2017 a prototype will be tested and further developed in collaboration with a group of municipality officers from different sectors, as well as with a group of high-school teachers and students. The two testing groups will contribute both to making the concept relevant to their requirements and to the evaluation and ideas for further develop of the game.

Our presentation draws on our experiences from the design and development of the serious game, with emphasis on the overall framework, actor involvement and end-user evaluation.

**Significance of the presentation to adaptation practice, policy and/or business?**
The presentation demonstrates how serious gaming can make climate adaptation graspable. Focus is on municipal practitioners and politicians, as well as schools (the coming generation of decision-makers), but the concept can also contribute to individual and collective transformations among national policy and business actors. The game is aimed to be web-based and open access, and allows knowledge brokers to make the issue of climate adaptation tangible for actors that, despite a general awareness of the potential impacts of climate change, have a diffuse perception of how to transform this knowledge into their own sphere of reality and actions.

**Poster 58: Perspectives on contentions about climate change adaptation in the Canary Islands**

**Dr Michalis Vousdoukas**, Mr. Yeray Hernández-González, Mr. Paulo Barbosa, Mr. Serafín Corral-Quintana, Ms. Ângela Guimarães-Pereira, Mr. Giuseppe Munda

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Although higher resolution climate models are needed for the Canary Islands, it should be expected that both heatwaves and Saharan dust intrusion become more frequent and intense in the Canary Islands as a consequence of climate change. Currently, both meteorological events produce negative impacts on the society, such as morbidity and mortality among elderly and people with chronic diseases, as well as on the environment, such as heat-related forest fires. However, climate governance is not perceived as relevant in the Islands, in fact, the previous Canary Islands Agency for climate change policy was shut in 2012 for budget cut reasons. Although there are a certain number of policies regarding climate change adaptation, such as civil protection plans and an obsolete regional adaptation plan, an integrated policy for the Islands has not yet been conceived. As a consequence, a participatory integrated approach was implemented to facilitate the understanding of climate change adaptation governance issues in Tenerife (Canary Islands). Stakeholders, experts and decision-makers were initially engaged in the policy proposal through in-depth
interviews, questionnaires and a focus group; however, probably as a consequence of their political or administrative constraints, the identification of a range of alternative policy options was not possible, resulting only in a single consensus proposal to re-establish the previous Canary Islands Agency. In a second process stage, citizens and lay people were involved in the policy proposal by means of focus groups. During this second step, alternative adaptation policies could be identified and, therefore, assessed by means of multi-criteria analysis methods. The main outcomes of this analysis were: (a) the inclusion of citizens and lay people together with experts and decision-makers in adaptation policy is crucial to frame climate governance and to define and assess plausible policy alternatives; (b) a ranking of climate change adaptation options for Tenerife has been provided through the multi-criteria analysis that used the focus groups proposed alternatives.

Pathways and transformation

Poster 61: Pan-European Regional Urban Growth Modelling: A demographic and residential preferences approach

Dr. Elizabeth Clarke¹, Dr. Emma Terama², Prof. Mark D.A. Rounsevell¹, Mr Calin Cojocaru³, Ms Cristina Savin³

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RUG (v4) is a pan-European, land use model that explores trends in the driving forces of future urbanisation (artificial surfaces) through socio-economic scenarios. Urbanisation trends (across three residential and one non-residential type) are estimated as a function of changing population demographics and residential preferences; reflecting changes in spatial planning and societal attitudes. RUG (v4) spatially allocates artificial surface expansion to 10’ Latitude/Longitude cells as a function of (a) the spatial autocorrelation between artificial surface types, and (b) societal (residents) location preferences.

The modelling of residential types is achieved by establishing a link between RUG (v4) and an associated population model. Population modelling outcomes are downscaled, age-group specific population projections. Life-cycle stage (here: age) is a predominant factor in defining the residential location of an individual/household. RUG (v4) leverages this concept to determine how future population change, across six distinct life-cycle stages, might influence demand for each residential type. This combination of population and urbanisation models is, it will be argued, one of the key strengths of the RUG (v4) modelling framework as it (i) incorporates projected demographic change into the modelling of future artificial surface; an important construct given the predominantly aging population profiles of Europe, (ii) increases the thematic detail of modelling outcomes in terms of both future population (age-groups) and artificial surface structures (residential types), and (iii) enables key linkages between demographics, residential preferences and urbanisation outcomes to be established and explored.

Shared socio-economic pathway (SSP) scenarios will be used to illustrate the modelling strengths of RUG (v4). Modelled outcomes will demonstrate the improvements gained in establishing linkages between demographics, residential preferences and urbanisation outcomes. Important, and demonstrable, distinctions presented across the scenarios will include (i) the potential to mitigate artificial surface expansion via increasing population densities (as evident in SSP1), (ii) the potential of artificial surfaces to expand in the presence of decreasing populations where changing residential preferences favour expansive residential types (SSP3), and (iii) the regional variability in artificial surface expansion as a function of both demographic change and residential preferences. Such trends would not be evident in a total
population/economic focused urbanisation model. Results indicate that future artificial surface areas could increase to 9% of the European land area by 2100. The extent, structure and demographic profile of future European urban areas will be presented and the importance of this for urban policy and integrated, cross-sectoral land use modelling will be discussed.

Significance of your presentation to adaptation practice, policy and/or business?
RUG (v4) is able to estimate both the magnitude and compositional changes of future artificial surfaces. Further, the residential circumstances of the population can be explored within the context of the socio-economic scenarios; a broad-scale indicator of access to social services such as (but not exclusively) education and health-care. Modelling outcomes enable stakeholders to explore urbanisation trends, but also more broadly explore the implications of these trends for human well-being and land use more broadly.

**Poster 62: Extending the Shared Socioeconomic Pathways (SSP) narratives and population scenarios for the Mediterranean region**

**Ms Lena Reimann¹, Mr Jan-Ludolf Merkens¹, Prof. Athanasios T. Vafeidis¹**

¹Christian-albrechts University Kiel, Kiel, Germany

In the context of the RISES-AM project, we have extended the global Shared Socioeconomic Pathways to develop regional narratives and spatial population scenarios for the Mediterranean basin. As the existing global SSP narratives and quantifications do not explicitly account for regional characteristics, our work aims to reflect the regional differences in socioeconomic development, focusing on the observed uneven population-growth trends between Mediterranean nations, rural areas and urban centres as well as between the coastal zone and the inland. Our work builds on previous work by Merkens et al. (2016) who developed spatial projections of coastal population distribution on a global scale. Based on existing literature, we enhance those global coastal SSPs with region-specific elements, which influence population distribution and socioeconomic development, such as the use of water resources, rapid development of the coastal zone due to secondary housing and accelerated land subsidence. Using a set of general and Mediterranean-specific assumptions, we first develop coastal narratives that are consistent with the five global SSPs but also account for socioeconomic differences across countries as well as for coastal versus inland developments. In a next step, we quantitatively interpret our narratives to develop spatial population scenarios until the end of the 21st century, at a spatial resolution of 30 arc seconds and a temporal resolution of five years. These projections reflect, in line with the narratives, regional differences across countries as well as coastal versus inland population growth in rural and urban areas in each country. Results indicate that our extended SSPs account for a larger range of uncertainty compared to the global coastal SSPs, exhibiting differences in spatial patterns of population distribution as well as in the total numbers of coastal population of the Mediterranean, which are up to 15% lower (SSP1) and up to 14% higher (SSP5) than the global ones.

Significance of your presentation to adaptation practice, policy and/or business?
The global SSPs are currently the standard scenarios used in Impact, Adaptation and Vulnerability (IAV) assessments. By accounting for regional differences, these new extended Mediterranean SSP narratives can provide the basis for new quantifications that better reflect the entire range of uncertainty of socioeconomic development in the region. Moreover, our spatial population projections are essential for impact assessments and for the development of adaptation policies in the Mediterranean, particularly in the context of coastal adaptation where the distribution of population and assets is essential for undertaking adaptation measures.
Poster 63: Do we need to scale-up? Examining multiple win-win solutions to complex problems in India, Indonesia and South Africa.

Dr. David Tabara\(^1\), Dr. Takeshi Takama\(^2\), Pacia Díaz\(^1\), John Ziniades\(^3\)

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Growing concerns about the limitations of one-fits-all solutions to climate change is unveiling the need develop a more nuanced approach to socio-ecological complexity and to collect multiple practical lessons on what works in the ground to enhance adaptive and mitigative capacities at community level. As part of the EU funded project GREEN-WIN (http://green-win-project.eu/), we use an Action-Research approach to identify win-win solutions, examine new forms of green business models and support enabling conditions that help reduce energy poverty and improve resilient livelihoods in the face of accelerated climate change. Our work provides a first selection of exemplary cases and analyses from India, Indonesia and South Africa which meet climate, economic and sustainable development goals. Our first insights show that while cross-fertilisation and learning is possible and necessary, win-win solutions do not necessarily need to be or can be scaled-up; but only they may need to be fit-for-purpose in their own socio-ecological contexts of action.

Poster 64: Squeezed between two extremes: Adaptation-related decision-making processes in the context of ‘high-end’ scenarios (>2°C) and the 1.5°C target

Mr. Adis Dzebo\(^1\), Dr. Tiago Capela Lourenço\(^2\), Dr. Henrik Carlsen\(^1\)

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Whilst the ambition of the Paris Agreement is to limit the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C, in reality we are still on the course for reaching temperatures above 2°C. Thus, such high-end scenarios (HES) are becoming increasingly plausible. In this context, how should decision-makers handle the complex situation where they have a target on 1.5°C and the current emission development, which is potentially going towards high-end 3-5°C degrees?

The decision-making landscape has been transformed into something with two extreme outcomes and ‘nothing in between’. A few years ago most national adaptation strategies and plans aimed for something that was perceived as in the middle of the outcome space. Now, the situation has changed, where we have an ambition target on the one end, and real emission curves on the other.

HES may imply increasing climate variability and extremes as well as the possibility of triggering tipping points, lending further difficulties for assessments. From a societal point of view, HES can imply difficulties in processing and using information about highly extreme and uncertain futures. For example, HES may push ecosystems and societies beyond their limits of adaptation thus raising additional problems for decision-making, as there are potential psychological and social barriers to adapting to a future world much warmer than today. On the other hand, a pathway towards 1.5°C could imply drastic socio-economic challenges. The transition pathway towards brings a whole new set of challenges for decision-makers across the whole decision-space.

Various support frameworks have been developed to assist decision-makers in developing their policies and plans, while simultaneously addressing uncertainties. However, these are not necessarily designed to equip
decision-makers with knowledge require to consider HES or extreme socio-economic change. For example, most impact and adaptation assessments do not account for tipping points and still take a sectoral, short-term, and single-scale approach.

In turn, and because incorporating uncertain scientific evidence into real-world adaptation processes is bounded not only by the science but also by a significant suit of other challenges, novel decision-making frameworks are required to deal with these extremes, paying explicit attention to the importance of existing barriers, conflicts and trade-offs. This presentation will focus on current research in the context of FP7 IMPRESSIONS project. Its theoretical premises will be complemented with empirical insights from four European case studies (Iberia, Scotland, Hungary and EU).

**Significance of your presentation to adaptation practice, policy and/or business?**
The expected outcome of this presentation would be an improved understanding of high-end climate change scenarios and high-end socio-economic scenarios, their potential impacts, the ability of adaptation options to reduce vulnerabilities, and the potential synergies and trade-offs between adaptation and mitigation. The significance of these insights go beyond the adaptation research community.

**Poster 65: The current evidence regarding mal-adaptation**

**Diana Reckien**  
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Despite the universal agreement on the need to strengthen climate change adaptation and the increasing scholarship on adaptation our understanding of the magnitude of the adaptation challenge is miniscule. Still a very low number of studies to climate change address adaptation (fewer than 5% of all papers published in ‘Climatic Change’ from 1977 to 2010). Evidence of these studies points towards an increasing body of knowledge about the potential effectiveness of adaptation—but not about what actually works. Moreover, strikingly, a large body of recent analyses has identified adaptation practices that lead to forms of maladaptation, i.e. ‘adaptation’ that causes a subsequent increase in risk for the vulnerable social groups and/or a rise in GHG emissions. Studies have found evidence of such inequitable outcomes of adaptation in a large number of cases around the world, leading to the conclusion that our knowledge about whether and how we can adapt successfully to climate change is very small. Scholars argue that maladaptation results from the failure to consider intended and unintended (side-)effects of adaptation and their interactions, i.e. the consequences, trade-offs and feedback effects of adaptation, across scale and time. Considering effects of adaptation across time and scales is a complex task and an interdisciplinary, socio-ecological research problem. Analysing and assessing the effects of adaptation is one of the biggest research challenges for the climate change impact and adaptation community to date. In this session I invite contributions that help critically assessing the intended and un-intended effects of adaptation across various sectors, disciplines, spatial administrative levels, time and place to build an evidence base for critical adaptation evaluation and monitoring. In this presentation I will present on the current evidence base regarding maladaptation as documented in the scientific literature to date.
Poster 66: Multi-risk analysis in mountain regions: a review of models, methodologies and future perspectives for climate change adaptation

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Climate change has already led to a wide range of impacts on the environment, the economy and society. Adaptation actions are needed to cope with the impacts that have already occurred (e.g. storms, glaciers melting, floods, droughts) and to prepare for future scenarios of climate change. Mountain environment is particularly vulnerable to the climate changes due to its exposure to recent climate warming (e.g. water regime changes, thawing of permafrost) and due to the high degree of specialization of both natural and human systems (e.g. alpine species, valley population density, tourism-based economy).

As a consequence, the mountain local governments are encouraged to undertake territorial governance policies to climate change, considering multi-risks and opportunities for the mountain economy and identifying the best portfolio of adaptation strategies.

The main aim of this study is to provide a literature review of available qualitative and quantitative tools, methodological guidelines and best practices for conducting climate change multi-risk assessments in the mountain environment. Multi-risk approaches and techniques already applied in alpine regions (e.g. event trees, Bayesian Networks, Agent Based Models) are analysed in order to identify key concepts (exposure, resilience, vulnerability, risk, adaptive capacity), climatic drivers, cause-effect relationships and socio-ecological systems to be integrated in a comprehensive framework. The main outcomes of the review, including a comparison of existing techniques based on different criteria (e.g. scale of analysis, targeted questions, level of complexity) and a snapshot of the developed multi-risk framework for climate change adaptation will be here presented and discussed.

Significance of your presentation to adaptation practice, policy and/or business?
The investigation of methods to underpin the multi-risk knowledge is an important prerequisite to strengthen the link between disaster risk reduction measures and actions to adapt to climate change. The review allows to shift from defense against hazards to a more comprehensive and integrated multi-risk approach, for the development of a specific methodology applied to the Alpine environment. Finally, the review aims to mainstream climate change adaptation actions in mountainous risk governance.

Poster 67: How to Complement Climate Change Adaptation and Disaster Risk Reduction: A Case of Drought and Water Resource Policing

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Keywords: climate change adaptation, disaster risk reduction, drought, water resource, risk governance
Since climate change and disaster risks are key threats to humans’ sustainability, the leaders around the world have placed these two issues in international political agenda. The Paris agreement in 2015 aims to control risk and to limit loss and damage by encouraging members to take several disaster mitigation strategies to avoid dangerous and irreversible impacts. The Sendai Framework for Disaster Risk Reduction 2015-2030 states that disaster risk management needs to take climate change into consideration at global or local levels. These international political efforts point out that both climate change community and disaster community recognize the need and the importance of incorporating the other issue in its own agenda in the future.

While many researchers and policy makers recognize that there are indeed interconnections between climate change adaptation and disaster risk reduction, few studies has been conducted to explore how these policies integrate altogether to achieve the effectiveness of policy cohesion and synergy in practice. More specifically, it remains under-discovered that how to meaningfully mainstream climate change adaptation into existing policy process as UNDP’s Adaptation Policy Framework emphasized.

Therefore, this study uses drought/water resource as the study issue—which involves both drought disaster responses for short term and water resource planning and conservation for long term. It thoroughly reviews the current institutional setting in Taiwan (e.g., drought disaster prevention and response operation plans, procedures and strategies, the decision and governance framework). We then conduct in-depth interviews and focus groups to collect valuable perspectives of various stakeholders (e.g., Water Resource Agency, Irrigation Association, Taiwan Water Corporation) on their risk perception toward climate change drought, the role of scientific assessment, and the challenges of integrated risk governance.

The result shows that while this issue causes controversies among different water demands, such as agricultural irrigation, manufactory production, and domestic water, currently the Taiwanese government thinks drought as a short-term risk that can be dealt by imposing several management measures, such as water rationing and agricultural fallowing. The relation between drought and climate change is disconnected. The study concludes that to complement climate change adaptation and disaster risk reduction effectively, it requires extra efforts from each stakeholder (e.g., policy makers need to overcome the spatial and temporal gaps, scientists need to provide policy-relevant information) and the governance framework needs to conduct a holistic principle to integrate various areas (e.g., water resource, agriculture, local development).

**Significance of your presentation to adaptation practice, policy and/or business?**
This case reviews the current framework of drought risk management in Taiwan and attempts to explore the possibility of integrating climate change adaptation into current practice. It is significant for policy makers to mainstream adaptation into current disaster risk management practice.

**Poster 68: Benefit Analysis for Evacuation policy of extreme typhoon event under Globe Warming Scenario**

**Dr. Hsinchi Li**, **Dr. Shihyun Kuo**, **Dr. Yunru Chen**, **Dr. Yungming Chen**

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The nearly world-record breaking extreme rainfall of Typhoon Morakot in 2009 caused not only over 700 deaths in Taiwan, but also approximately 6.7 billion USD of direct economic loss. However, according to Climate Change in Taiwan: Scientific Report 2011, it is found that the average temperature in Taiwan in the
past 100 years (1911-2009) has risen by 1.4°C, which is almost twice of the global average temperature. Therefore, under the effect of continually warming, Taiwan, the island nation with limited natural resources, is expected to encounter more serious typhoon disaster risk.

Substantially reducing global disaster mortality and reducing the number of affected people are two of the seven global primary goals in the Sendai Framework for Disaster Risk Reduction 2015-2030. Hence, this study aims to conduct policy evaluation and benefit analysis of evacuation policy based on the Article 27 of Disaster Prevention and Protection Act (i.e., the government shall evacuate people in the alert area prior to the disaster). By using NCDR’s Taiwan Typhoon Loss Assessment System (TLAS), this study is able to assess the potential benefit of the implementation of evacuation policy for Typhoon Morakot under global warming scenario. The results can be used for emergence response decision making in the future.

**Poster 69: Visualizing a harmonized language for climate change adaptation and disaster risk reduction**

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Past and ongoing research has shown that shared language and terminologies are key to improving the effectiveness of climate communication and its uptake. At the same time, the huge amount of information available today (often fragmented and unstructured), leads to limited learning about adaptation successes and failures and why there remains a large gap between research and action. Increased understanding and harmonization between the terms and language used in the fields of climate adaptation and disaster risk reduction, for example, is key to effectively managing climate-related risk and ultimately delivering the goals of the Paris Agreement and the Sendai Framework for Disaster Risk Reduction.

This paper will discuss the value of developing improved terminological guidelines and standards for a systematized ontology for climate adaptation and disaster risk to address this loss of potential shared learning and reduction in impact. The development of such a terminology set has enabled the data analysis of a large number of country reports and visualization of the landscape of adaptation and disaster risk at the national level in Europe, revealing its commonalities and divergences. Whether systematized and standardized information transfer can increase the potential for learning between climate scientists, decision makers and communication practitioners has been explored. Through the Horizon 2020 PLACARD project, the ontology, visualizations and insights from them have been discussed with users and their feedback will be shared.

It is argued that the development of such standardized ontologies can lead to a greater understanding across different disciplines, knowledge systems and areas of expertise, facilitating a potentially transformed understanding of user needs. This could, in turn, lead to a better understanding of what climate information is needed from providers and how this information should be communicated.

**Significance of your presentation to adaptation practice, policy and/or business:**

The results from iteration and analysis of the ontology and visualization development with stakeholders will translate merely “useful” information into "usable" knowledge for both adaptation policy and practice. It will also guide climate information providers (including the private sector) on the content (scope, scale, context, etc.) of the information they supply, maximizing opportunities for “usability” and user-driven applicability in a wide range of sectors.
Climate justice

Poster 70: Examining vulnerability and adaptive capacity in a dynamic urban setting: A case study of Bangalore’s interstate migrant waste pickers

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The political economy of climate change in India depicts multiple and complex intersections with the current development paradigm and the emerging patterns of socioeconomic inequality in the country. The neoliberal reforms in India have been socially divisive leading to land dispossession, loss of livelihoods and decline of agricultural incomes in the villages exacerbating poverty and inequalities. This has created a mass exodus of rural workers (agricultural and non-agricultural) into the cities. This migration has been an outcome of climatic factors like erratic rainfall patterns, floods and cyclonic storms among others as well as non-climatic factors associated with agrarian distress and oppressive socio-economic divisions on the lines of class, caste and income. Lack of skills restrict their entry into the formal labour market in the city and they end up as waste workers residing in hazardous locations. These workers often end up in the informal settlements of the city where the effects of climate change are more subtle as it often intersect with their livelihoods and living conditions altering them on a daily basis. The paper examines complex intersections between a multitude of factors like climate change, agrarian distress, exclusionary patterns of urbanisation and the resultant mal recognition that shapes and reshapes the vulnerability and adaptive capacity of a certain group of people. We illustrate these intersections in the paper using a case study of interstate migrants from West Bengal residing in informal squatter settlements of Bangalore city working as waste pickers.

Our findings indicate that while the root causes of their vulnerability can be traced back to the socioeconomic and ecological conditions in their homeland, exclusionary urbanization patterns in Bangalore renders them access to a livelihood that has severe implications on their health and identities. In addition they reside in extremely hazardous zones amidst heaps of garbage with an erratic rainfall likely to have severe implications on their health and incomes. However they also provide an essential eco-system service to the city from a mitigation perspective by handling and processing a large amount of waste generated by the city. Using the interstate migrants as an example our study illustrates the importance of recognizing the need for bringing a climate justice lens to the city by recognizing the existing forms of marginalization’s and how climate change can exacerbate it.

Significance of your presentation to adaptation practice, policy and/or business?
There is a significant gap in literature in understanding the causality of vulnerability. While analysing vulnerability or adaptive capacity understanding causality the larger social, political-economic and structural variables that shape capacity and “enables or disables people’s abilities to maintain their security” is critical (Ribot 2014). Hence examining vulnerability from a structural perspective our presentation contributes significantly to understanding the barriers and enablers of adaptation and the need for vulnerability and adaptation research and practice to link back to justice.
The urban poor and marginalized are subject to a range of stressors due to prevailing development paradigm and discriminatory urbanization patterns. Climate change acts as a crisis catalyst and exacerbates existing vulnerabilities. This results in the poor taking short term and reactive measures to cope with a crisis. Often the lack of awareness and alternatives forces them to take immediate action. These symptomatic solutions often evade the root causes thereby increasing the vulnerabilities and degrading resources in the long run and thus undermine opportunities for long term and effective adaptation. Using the case of some of Bangalore’s informal economy who are predominantly migrants (inter and intra state) the aim of this research is to understand the barriers and enablers to effective long term local adaptation measures.

The project uses a mixed method approach (quantitative and qualitative tools) as the triangulation of these methods helped capture cross scalar and multidimensional issues. Migration is a common coping strategy against climatic and non-climatic risks, as it opens up income diversification opportunities and also results in shifts in traditional gender norms and practices. However, post migration, climatic and non climatic factors also have subtle effects on their livelihood in the cities denying the right to live in a clean and safe environment. The working conditions here are often exploitative and detrimental. Due to the unregulated and poor pay in the informal sector, the migrants settle in informal settlements with poor or no access to basic services. These people provide innumerable services for the city like labor for construction, domestic work and waste picking which are critical for the smooth functioning and development of the city. However adaptation measures employed at a city scale often favours a certain group of people at the expense of certain others. It is of critical importance to address the question, “Adaptation for whom?” Our study emphasises the need to recognise the pervasively marginalised in the whole process of urbanisation and ensure “the right to city” to all. There is a need to monitor the coping strategies employed by them and identify the barriers and enablers of long term adaptation. Policy interventions can help transform short term coping measures to transformative adaptation practices.

Significance of your presentation to adaptation practice, policy and/or business?
Studies on climate change at a city scale are often mitigation focused. In the Indian context very little has been done on city level climate change adaptation. We use the above case to clearly highlight urban coping strategies and how some of these in the long run can be barriers to effective adaptation. We plan to identify the possibility for upscaling successful local initiatives.

Poster 73: Do existing social protection programs address the emerging socio-ecological vulnerability of coastal fisheries-based households?

Mr. Iftekharul Haque

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Bangladesh is one of the most vulnerable countries to the potential impacts of climate change. However, Bangladesh’s coastal districts are already facing the effects of socio-ecological changes that took place over last few decades. The Government of Bangladesh runs several social protection programs to reduce vulnerability of affected population. Most of the existing social protection programs in Bangladesh were designed pre-1990. Since then new types of socio-ecological vulnerabilities have emerged in Bangladesh, particularly, in the coastal regions in the last two decades. No study has been done in recent years to understand if existing social protection programs are addressing vulnerabilities to emerging socio-ecological changes by increasing adaptive capacity of the beneficiaries. Drawing upon a survey of 600 households in three coastal districts of Bangladesh, this paper attempts to understand if existing social protection programs in Bangladesh address the emerging socio-ecological vulnerability faced coastal households, particularly those are dependent on small-scale fisheries. Using Econometric models this paper first examines if any selection bias exists in targeting of social protection programs. Then this paper assesses if existing social protection programs are contributing to reducing the vulnerability of coastal households through increasing their adaptive capacity.

**Significance of your presentation to adaptation practice, policy and/or business?**

Social protection programs are an integral part of Bangladesh’s poverty reduction strategies. Major policy documents including the recent seventh five-year plan, and previous poverty reduction strategy papers (PRSPs) recognize the importance of social protection programs in supporting livelihoods and food security of the poor. The Government of Bangladesh (GoB) finances 52 different types of social protection programs, allocating around USD 3 billion in support of these programs (MoF, 2014). More than one-third of the total allocated fund (1.12 billion in 2014-15) are used for financing livelihood supporting programs. This paper will contribute to shaping social protection policies appropriate for reducing climate change related vulnerability in Bangladesh.

**Health**

**Poster 79: Spatially-explicit assessment of future socio-climatic vulnerability to heat stress in Europe based on scenarios combinations**

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It is globally acknowledged that the frequency, duration, intensity, and spatial extent of heat waves, which lead to increases in mortality due to a wide range of causes, will significantly rise in Europe during the 21st century, under different climatic scenarios. While most – if not all – future heat stress vulnerability assessments are based on climatic projections superimposed on current socioeconomic conditions, there is a crucial need to investigate the potential influence of different socioeconomic development pathways on future heat stress vulnerability. The study presented here intends to investigate the impacts of different combinations of socioeconomic developments and climate forcing on future socio-climatic vulnerability to heat stress in Europe. Several climate forcing are used to represent potential future heat stress, and several European socioeconomic scenarios are used to project future sensitivity and adaptive capacity, based on a large number of socioeconomic projections. Then, using different combinations of climatic and
socioeconomic scenarios, we have determined several spatially-explicit scenarios of future socio-climatic vulnerability to heat stress and have linked them with measurable health outcomes at regional level. Furthermore, we also included several adaptation options in the socioeconomic scenarios and have used the scenarios combinations approach to estimate their efficiency on reducing future socio-climatic vulnerability to heat stress.

This innovative study (i) presents a set of integrated European socioeconomic scenarios that are based on a systematical matching of several existing sets of scenarios, (ii) provides methods and tools to integrate future socioeconomic conditions within future vulnerability assessments, (iii) demonstrates the important role that future socioeconomic changes play in the characterization of future vulnerability, (iv) shows how adaptation options can significantly decrease future socio-climatic vulnerability in multiple scenarios, and (v) discusses the pros and cons of the scenarios matrix approach, of which little used has been made so far in the IAV community (Impacts, Adaptation, and Vulnerability).

**Significance of your presentation to adaptation practice, policy and/or business:**

The study presented here emphasizes on the crucial importance of taking into account future socioeconomic development pathways when assessing future socio-climatic vulnerability to heat stress. This highlights the need for designing adaptation options in line with potential future socioeconomic developments. In addition of raising awareness about potential combined effects of climatic and socioeconomic changes, results of this study also provide an innovative and novel way to estimate efficiency of several adaptation options under multiple climatic and socioeconomic futures. We believe that this is of high significance and interest for decision-makers in charge of designing adaptation strategies for medium-term time horizons.

**Poster 80: Future projections of climatological health indices related to temperature over Bologna as a Resilient City**

**Ph.D. Rodica Tomozeiu**, Dr. Lucio Botarelli\(^1\), Ph.D. Jorge Amorim\(^2\), Ph.D. Lars Gidhagen\(^2\)

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Global climate is projected to change over this century and beyond. The magnitude of changes is different from area to area and detailed studies at small scale are requested in order to analyse the impact on various sectors of activities. Many studies suggest that the Mediterranean area could be a very vulnerable region to global change, with focus also on Italian peninsula. Urban SIS-Climate Information for European Cities, is a project funded by the European Earth observation programme Copernicus, where Bologna, city located in northern Italy, together with Stockholm and Amsterdam-Rotterdam are selected as case studies. The goal of the project is to provide a proof-of-concept of a climate service offering essential climate variables and impact indicators based on temperature and other climatic variables peculiar for the urban environment.

The present work aims to create a complete framework of present and future climatological indicators derived from minimum and maximum temperature with impact on health sector, over the city of Bologna. The accent is made on two “health” indices: heat wave duration and tropical nights. Daily minimum and maximum temperature over Bologna metropolitan area are used in order to define the indices and to study present trends at seasonal scale, over 1961-2015 period. Future climate scenarios of these indices are constructed at local level, over the period 2021-2050 and 2051-2080 with respect to 1971-2000 through a statistical downscaling model based on multivariate regression, applied to CMCC-CM global climate simulation, in the framework of RCP4.5 and RCP8.5 radiative concentration pathways. The observed climate profile reveals significant positive trends in seasonal minimum and maximum temperature accompanied by
an increase in heat waves and tropical nights, especially during summer. The same profile is projected also over the future, more intense over the second period of the century. The present and future climatological indicators constructed at local level are compared to the spatially 1x1 km² output resulting from the experiments done in the framework of URBAN SIS project.

Significance of your presentation to adaptation practice, policy and/or business?
The study is relevant for health sector and the results could be used to address efficient adaptation practices.

Poster 81: When do we pass dangerous levels of heat stress

Dr Laila Gohar¹, Dr Jason Lowe¹, Dr Dan Bernie¹
¹Met Office, United Kingdom

In a warming world, the occurrences of heat stress that will affect labour and exceed possibly dangerous levels is expected to increase. The Paris agreement has the aspiration of curtailing global warming to 1.5 degC above pre-industrial levels, but currently emissions continue to increase and there is little indication that country commitments to mitigate greenhouse gas emissions will be able to reduce warming to below 2 degC. Under these circumstances, exploring the local timings of when thresholds in heat stress are exceeded and the uncertainty of when these levels are exceeded is critical for society to be prepared and be resilient. Here we present the local timings of passing thresholds in heat stress that would reduce a person’s ability to work and pose a danger to their health using a range of heat stress metrics and the climate simulations from the fifth phase of the coupled model intercomparison project (CMIP5).

Significance of your presentation to adaptation practice, policy and/or business?
This work will offer guidance to where and when the exceedance of heat stress thresholds that will significantly affect people’s health will occur. The timings will provide a first order estimate of the time frame needed for policy and adaptation practice.

Poster 82: Estimating the benefit of housing adaptations on heat-related risks in the West Midlands region (UK)

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BACKGROUND Climate change will negatively affect the public health sector as there will be an increase in mortality and morbidity due to the rise of ambient temperatures and the increase of frequency, length and/or intensity of heat waves. Most epidemiological studies link heat-related mortality risks to outdoor ambient temperature. However, people in the UK spend the majority of their time (around 90%) indoors. The home indoor environment is likely to play an important role in determining an individual’s exposure to high temperatures during hot weather, especially for the elderly and other vulnerable individuals. We estimated the potential impact on health of a range of passive housing adaptations.

METHODS A metamodel derived from EnergyPlus 8.1 dynamic thermal building simulations was used to estimate indoor overheating metrics during periods of high temperatures (using standard weather files
RESULTS We quantified the effect of two adaptation measures: external shutters, and energy efficiency improvements. Initial results suggest that external shutters used throughout the day on days with maximum temperature above 23ºC could reduce the median indoor temperature from 26.1ºC to 24.3ºC, and heat-related mortality by 82.5% under the modelled warm, but not extreme, summer. The largest impact of use of shutters was on semi-detached dwellings (a mean decrease of 3.85ºC (95%CI 3.81-3.88ºC), while highrise flats saw the smallest decrease (1.31ºC, 1.28-1.45ºC). Residents in bungalows, who are disproportionately an elderly population in the UK, carried the greatest overall risk of heat death. Energy-efficiency (insulation) adaptations in contrast led to a small increase in median temperature with an associated 31.2% increase in heat related mortality. Applying shutters selectively to dwellings with elderly occupants (≥75 years old) or non-high-rises built after 1919 reduced the excess heat-related mortality by 59.5% and 76.6%, respectively.

CONCLUSIONS Our model for estimating the impact of passive housing adaptations on heat-related mortality suggests substantial benefit from use of external shutters under moderate high temperatures, but potentially negative impacts of energy efficiency adaptations.

How is your presentation significant to adaptation practice, policy and/or business?
This research will help policy makers to direct their priorities toward adaptive measures that do not require additional energy production (such as domestic air conditioning). The results are of directly relevance to UK policy makers and regulatory agencies, including the Department of Communities and Local Government (DCLG), Local Councils, construction industry, homeowners. Prioritizing specific population groups (e.g. elderly residents) should be encouraged, as this measure may significantly affect heat-related mortality, and is less expensive and more realistic than applying shutters to the entire dwelling stock.

Poster 83: Establishment and application of indices of community adaptability to floods and high temperatures

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To understand and evaluate the ability of Taiwanese communities to adapt to climatic events, especially floods and high temperatures, fuzzy Delphi and analytic hierarchy process (AHP) were used to establish indices of community adaptability to climate change. Fuzzy Delphi was used to ascertain the items of the indices; moreover, it was used to verify consensus among experts and to determine any inconsistency in the consensus. AHP was used to analyze and summarize the importance of the categories, as determined by the experts through questionnaires, and to calculate the weighting for individual indices in the entire evaluation framework. In this study, the relevant literature was first reviewed, and indices suitable for Taiwan were grouped into 15 items that were subsequently classified into five categories. Through the questionnaires, the experts selected “infrastructure stability” as the most vital category and “drainage and pumping system” as the most vital item, with weights of 0.314 and 0.149, respectively. The indices were applied to 21 communities in Tainan city, and the results showed that all major differences among the communities arose
from variations in the extent to which they were equipped to withstand flooding. Furthermore, all communities scored relatively low in the “interior environmental capacity” category. Hence, the construction sector may need to devise effective methods to build houses that are more adaptable to climate change. Finally, the results of the investigation and analysis conducted in this study suggest a direction for local governments to improve the facilities afforded to local communities.

How is your presentation significant to adaptation practice, policy and/or business?
This paper presents a diagnostic evaluation of the adaptability of Taiwan’s communities to climate change. The indices presented herein correspond to people, infrastructure and external environments, community organization, and the ability of buildings to withstand high temperatures. Quantitative data on conditions influencing the recovery of a community from climate-change-induced damage in the shortest possible time clearly reveal the strengths and weaknesses of that community.

The final evaluation results can be used as the basis for planning construction projects for communities. Furthermore, the evaluation results can provide a valuable reference for developing weather insurance plans in the future.

Poster 84: Potential risk map of dengue fever in Taiwan to climate change

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Climate change and urban heat island would cause higher temperature and extremely precipitation in hot-humid regions and environment; those also increase probability of breeding mosquito and have negative impact on public health.

Literatures emphasize that a positive correlation existed between mosquito breed and environment factor such as temperature, rainfall, sunshine duration, and containers in environment to dengue epidemic. Integrating climate data and constructing a high-resolution climate map could help local department, community and resident to take more efficiency prevention approach. The purpose is establishing a high-resolution climate map in local scale. Then, this research compares hot spot of dengue fever and discusses the correlation with climate situation and outbreak of dengue fever. The material is 2015 dengue fever in Tainan as case study because it has 22,776 confirming dengue cases and 214 deaths, which is the most serious dengue fever in Taiwan. Finally, we use overlay technique to show the spatial relationship with the timeliest of dengue cases and spatial-temporal climate map. From this process, it also demonstrates the feature risk map of dengue fever in Tainan City.

The main findings in our case study are (a) higher air temperature with higher stagnant water area, will have more dengue cases; (b) residential density and older apartment complex maybe affect spread of the dengue epidemic due to more water containers. If environment is under high temperature and high stagnant water area situation, it will accelerate the rate of diffusion of dengue risk. IPCC report exhibited that high air temperature will increase dengue fever on climate change according to down scaling model to simulate local climate condition such as Tainan, Taiwan. Therefore, having detailed and small scale of climate information to provide more efficient adaptive option and planning to decrease risk of dengue fever in public issue is important. Thought, ahead of planning the police healthy strategy, that can mitigate the urban heat island
and reduce the potential of stagnant water area. Above those, we can reduce potential risk and make positive opportunity to climate change.

In this study, the results show the potential risks of climate change dengue state to drive government-related adaptation strategies, including urban high temperature of mitigation strategies, water flooding and solve problems, and to provide warning and adjustment program resident dengue risk in order to avoid the disease broke out again, to reduce the loss of life and property of the people.

**Poster 85: The health burden of climate change in us: evidence from influenza-like-illness**

**Dr. Shouro Dasgupta**¹,², Professor Ian Sue Wing³
¹Fondazione Eni Enrico Mattei, Venezia, Italy, ²Euromediterranean Center for Climate Change, Venice, Italy, ³Boston University, Boston, USA

We use a non-parametric analysis on a city-by-week level dataset between 1970 and 2010 for 122 cities in the US to investigate the impact of temperature and specific humidity on influenza mortality. Furthermore, in order to determine the future impact of climate change on influenza mortality, we provide bias corrected projections under RCP 4.5 and RCP 8.5 scenarios for two time epochs of the 21st century (2026-2045 and 2081-2100). The climatic data comes from the GLDAS (Rodell et al., 2004), while weekly influenza mortality data was taken from the Morbidity and Mortality Weekly Report of the CDC. We utilize generalized additive and include location (city) and time (year and week) fixed effects to control for unobserved heterogeneity, thus we are measuring the excess mortality above the all-city long-run average rate for each week. For the projections, we use data from three GCMs; GISS-ER-2 3, CNRM-CM5, and NorESM1-M.

We find robust non-linear effects of both temperature and specific humidity on influenza mortality rates in the U.S. We find that the risk of influenza mortality is positive between −30°C and 5°C but the risk becomes negative between temperature range of 5°C and 25°C, and the effect of humidity is highest between specific humidity levels of 4 g/kg and 12 g/kg (equivalent to Relative Humidity of 20% and 35%). Our projection results suggest that the West, Midwest, and Southeastern US are at high risk of increase in per capita influenza mortality due to climate change - up to 3% by the end of the 21st century.

**Significance of your presentation to adaptation practice, policy and/or business?**

Our projections on the expected impact of climate change on influenza mortality suggests that the West, Midwest, and the Southeastern parts of the U.S. are at high risk of influenza mortality increase in the coming century (up to 3% in some areas). Furthermore, there seems to be a spatial shift of influenza mortality from the West and Southwestern parts of the U.S. to the South and Southeastern regions during the 21st century. Thus, the distribution of the future changes in influenza will be unequal across the U.S. These findings can be used to target locations at high risk of influenza mortality and the non-linear estimations means that vaccination drives can be focused at specific times and the projections can be used to target the particularly vulnerable regions.

**Poster 86: Climate Change: The Paris Agreement and Human Health in WHO European Region**

**Prof Vladimir Kendrovski**¹
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The health sector has critical evidence, and positive arguments, to bring to the climate talks. Existing strategies that work well to combat climate change also bring important health gains. For over a decade, the WHO has been leading efforts in the global health sector to win greater recognition for health in climate assessment and agreements. WHO is also a co-sponsor or collaborator of a range of other events sponsored by countries, other UN agencies or civil society on themes related to health adaptation to climate change, health benefits of mitigating climate change, and health, air pollution and climate linkages.

The Paris Agreement reached in December acknowledges in the preamble “that Parties should, when taking action to address climate change, respect, promote and consider...the right to health...”. The Agreement, also calls upon significantly strengthening national adaptation efforts, through regional cooperation, enhancing adaptive capacity, strengthening resilience, reducing vulnerabilities, and increasing the understanding and implementation of adaptation actions, with a view to contributing to sustainable development and ensuring an adequate adaptation response. National adaptation plans should be based on assessments of climate change-related impacts and vulnerabilities, taking into account vulnerable people and places, and include monitoring, evaluation, and learning systems. Fifty-two WHO European Member States submitted intended nationally determined contribution. Only about 19 % of countries in the WHO European region refer to health in the adaptation section. The Paris agreement provides a critical opportunity to advance public health as a central element not only of the response to climate change, but of the overall 2030 Agenda for Sustainable Development. It provides specific entry points to support action to protect and promote health, both through increasing health resilience to climate risks, and through prioritizing mitigation actions that also improve health. In the WHO European Region, most health adaptation interventions to date have focused on improving current public health functions to better manage adverse health outcomes from climate variability, such as enhancing surveillance and monitoring programs, improving disaster risk management, and facilitating coordination between health and other sectors to deal with shifts in the incidence and geographic range of diseases. Significant further support is needed to strengthen health in national adaptation plan development, the promotion of whole of government approval and the evaluation of the effectiveness of those strategies or action plans over time. Given the diversity of country contexts, SDGs implementations will naturally take a different shape both across countries, and also within countries (i.e. at national, subnational, local levels), and ultimately determine the national and local adaptive capacity. The latest WHO/Europe’s policy on climate change and health, recognized the importance of climate change as a threat to public health in Europe, establishing six priority objectives. All WHO European Member States declared their commitment to: protecting health and wellbeing, natural resources and ecosystems; and promoting health equity, health security and healthy environments in a changing climate. The Working Group on Health in Climate Change was established to help support and coordinate the implementation of these objectives in the Member States.

Poster 88: The similarities and differences between Health Behaviour Change and Sustainability Behaviour Change: A systematic literature review

Ms Elizabeth Oldcorn1
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Objective. To investigate the differences and similarities between changing health behaviours and the adaption of behaviours for sustainability (sustainability behaviour change).

Design. Systematic literature review.
Method. Two searches of the literature were conducted into a. health behaviour change and b. sustainability behaviour change. Papers published since a. 2010 and b. 2005 respectively, in English, worldwide were included. Databases searched were Applied Social Science Index and Abstracts (ASSIA), Cochrane and Science Direct, PsychINFO and Proquest Public Health. Google Advanced and Google Scholar were used to search the grey literature. Studies were included that assessed the impact of measures to bring about behaviour change.

Results. Twenty-five studies were selected for final review. Sixteen from the health behaviour change search and nine from the sustainability behaviour change search. Studies looking at HBC were more likely to have a randomised controlled trial design, particularly those concerning physical activity, weight control/loss. The Theory of Planned Behaviour (TPB) was the model most often applied to both health and pro-environmental behaviours, with some support demonstrated for the construct of perceived behavioural control being important for both areas of behaviour change. Constructs from other models identified as important included intrinsic motivation, values, habits and social factors. Tools and approaches shown to have some value included planning, personalised feedback, incentives and information provision.

Conclusions. Similarities between the underlying processes that bring about health behaviour change and the adaptation of behaviours for sustainability were demonstrated. In particular, perceived behavioural control, self-efficacy, social norms and supports. The review was not able to conclude that the same measures to affect these constructs for HBC can be replicated for SBC. Further studies comparing specific constructs and/or behaviours could be useful in determining the transferability of effective interventions. Further research across both areas would benefit from more randomised controlled trials, the use objective measures of behaviours and follow up. Consideration in the literature of the efficacy of different interventions in terms of inequalities would also be welcomed. One of the key findings is the need for more studies looking at actual change, rather than predicting behaviour or measuring associations between variables and behaviours for both SBC and HBC.

Poster 89: Climate Change Adaptation Actions: Benefits and Dis-benefits for Health – A Systematic Review.
Emily Stevenson1, Phil Mackie1, Ann Conacher1, Julie Arnot1
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Introduction: In 2015, the Conference of Parties (COP 21) finally recognised climate change as a health issue due to the many impacts now and in the future. It also acknowledged the co-benefits to human wellbeing and resilience in mitigation and adapting to climate change.1 The Climate Change Risk Assessment (CCRA) for Scotland identified climate threats will mainly result from rising temperatures; extreme weather (storms, flooding, heat-waves); rising sea level; and changes in winter/summer precipitation, as well as indirect global impacts e.g. food supply/price; population migration.2 Examples of adaptation actions in Scotland include relocation of individuals and communities at risk from flooding/coastal-flooding and urban greenspace development to reduce the urban island effect. These actions may well bring about health co-benefits e.g.

1 Adoption of the Paris Agreement (2015): Enhanced Action Before 2020, para 109
2 Climate Change Risk Assessment for Scotland, July 2012
mental/physical health benefits from increased availability of greenspace in cities. However, health co-benefits are not guaranteed and there is the potential for adverse consequences e.g. negative impacts on mental health from disbanded coastal communities.

**Methods:** The Scottish Managed Sustainable Health Network (SMaSH) has been undertaking a systematic review of the literature considering the health co-benefits and dis-benefits of climate change adaptation actions. The following databases have been searched: EMBASE, Web of Science and GEOBASE, as well as grey literature sources e.g. European Climate Adaptation Platform. Identified studies are being assessed, including an assessment of bias, through a PRISMA checklist. Inclusion criteria: Peer reviewed evaluations of interventions; published January 2006-July 2016; English language; climate change adaptation action relevant to Scotland; adaptation action which has benefits and/or dis-benefits to health as a primary or secondary outcome.

**Results:** Preliminary findings indicate an increasing focus on positive health consequences from climate change adaptation actions but little understanding and consideration of the negative consequences.

**Discussion:** Climate change adaptation actions should be carefully planned to maximise health benefits and minimise health dis-benefits. Where adverse consequences are identified, health mitigation is needed to reduce this risk. The initial results indicate that Public Health practitioners in Scotland should work closely with partners through existing networks (e.g. Community Planning Partnerships) to ensure climate change adaptation actions take full consideration of the impacts on health e.g. through a health impact assessment.

**Significance of your presentation to adaptation practice, policy and/or business?**
The systematic review highlights the need for close collaboration and cross sector working for climate change adaptation. Single sector working may have unintended negative impacts on a different sector. This presentation illustrates this using health as example.

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Biodiversity, ecosystem services and nature-based solutions

Poster 90: The Green Link project: Restore desertified areas with an innovative tree growing method across the Mediterranean border to increase resilience.

Dr. Katherine Franco¹, Mr Sven Kallen²
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The Green Link aims to demonstrate the environmental and economic benefits of an innovative tree growing method that has the potential to restore desertified areas across the Mediterranean border. Mediterranean societies are increasingly facing floods, water scarcity, heat waves, prolonged droughts, flows variability, temperature rises and decreased rainfall with related impacts on vegetation. The impact of these phenomena is expected to intensify the existing risks of desertification and forest fires, particularly in regions where water scarcity is already a concern. Developing adaptation measures aimed at reducing the vulnerability of these ecosystems and strengthening their resilience is therefore of crucial importance.

The Green Link project seeks to contribute to the development of effective adaptation strategies across the Mediterranean region by testing an innovative growing method to restore desertified areas. This consists of replacing traditional irrigation techniques with the Cocoon, a water-efficient, low-cost and 100% biodegradable device.

Through six trials in extremely vulnerable areas in Spain, Italy and Greece, the project will:

1. Demonstrate that Cocoon technology can help combat desertification and climate change in the Mediterranean while providing a competitive market alternative to traditional irrigation.
2. Demonstrate the economic feasibility of an improved and more sustainable technology to plant trees without the use of irrigation.
3. Design specific ecological interventions (study of assisted migration of species) for a more efficient adaptation to climate change and enhance ecosystem services, particularly in relation to soil quality improvement and biodiversity.
4. Integrate novel methodologies to measure biodiversity, soil carbon stock, soil loss and human well-being while allowing for the assessment of climate change impact and resilience in the future.
5. Map ecosystem services for adaptation strategies in order to gain a better understanding of the positive outputs of the project.

Expected results include:

1. 90% survival rate after planting for all the species selected and savings of up to 50% for planters (taking into account maintenance and repositioning costs) vs traditional methods in these areas.
2. Soil quality improvement by 20% due to improved water retention, and further green cover, microorganism and mycorrhiza.
3. Increase of biodiversity by at least 15% and positive growth of soil carbon stock over time.
4. Comprehensive modelling and mapping of local ecosystem services.
5. Replicate the project experience and increased awareness and dissemination of adaptation strategies on forest management among stakeholders (particularly on EU relevant legislation and objectives).

Significance of your presentation to adaptation practice, policy and/or business?

This project is presented as a case study that puts adaptation strategies into practice. The project will plant trees in eroded areas that will contribute to reverse degradation of European soils by improving soil quality and allowing natural restoration of other vegetation. The combination of specific species of trees and the
Cocoon technology will allow for erosion control by protecting nutrients, water supply and soil cover. Furthermore, assessment of ecosystem services and their complex interactions with socio-economic variables and human wellbeing will be implemented. The Green Link LIFE15/CCA/ES/125 is co-financed by the EU through the LIFE program (01/07/2016 - 31/03/2020).

**Poster 91: Increased resilience and climate change adaptation through catchment process restoration**

*Miss Cat Dixon¹, Dr. David Hetherington¹, Dr Alex Nicholson¹, Dr Paul Quinn²*

¹Ove Arup & Partners Ltd, Newcastle Upon Tyne, United Kingdom , ²Newcastle University, Newcastle Upon Tyne, United Kingdom

It is predicted that under likely future climate change scenarios, the magnitude and frequency of extreme events will increase, which will also lead to reduced overall societal resilience. This will compound the problems that are caused due to the fact that many of our catchments worldwide are already more prone to generating flood and drought conditions due to historic artificial interventions.

Large areas of our landscape have been greatly altered after centuries of human activity across the globe. Such changes include deforestation, increased land drainage, surface mining, the straightening and embanking of rivers, the dewatering of wetlands and, critically, the establishment of intensive agricultural practices. In natural catchment systems (before human intervention) densely vegetated areas with deep absorbent soils catch and hold rainwater where it can slowly seep through the land and recharge groundwater reserves. Artificial changes have stripped away many of the natural environmental and ecological systems that have evolved and now ‘drain’ and degrade our catchments, increasing pollution, erosion and sediment transport, and flood and drought risk. Without efforts to restore catchment processes our drought, flooding, food production, biodiversity and infrastructure resilience will reduce. An example of this is that incremental increases in flooding magnitude will essentially ‘erode’ the standard of protection of our flood alleviation schemes if left unmanaged. Iterative NFM interventions have the capability to absorb increasing climate change induced pressures, and at least maintain a resilience status quo.

This paper explains how the principals of Natural Flood Management (NFM) and ‘Catchment Process Restoration’ can be used to adapt to climate change scenarios, and to increase levels of infrastructure resilience. Additionally, such approaches result in a more sustainable situation that delivers a whole swathe of ecosystem services benefits such as increased food production, improved biodiversity, improved aesthetics and property values, infrastructure resilience and climate change mitigation. Together, these benefits ultimately lead to economic, societal and infrastructure resilience, which is increasingly important as the global population increases and becomes increasingly concentrated in urbanised locations. Examples will be given from numerous catchments in the UK and elsewhere in the world.

**Significance of your presentation to adaptation practice, policy and/or business?**

The restoration of environmental processes at the catchment scale can confront the negative impacts of climate change in a tangible way that delivers a whole swathe of other benefits. Such approaches, including Natural Flood Management, allow iterative adaptation in the face of uncertain climate change and are increasingly being placed into catchment management policy in UK and abroad. Scientifically-informed catchment process restoration increases economic resilience through reduced costs associated with floods, droughts and food scarcity. Restored catchment processes allow societal systems to be built on a stronger fundamental foundation, which will improve the conditions for successful business, and business growth.
**Poster 92: Putting a positive Value on nature through Natural Assurance Schemes**

**Dr. Elena Lopez Gunn**, Dr Monica Altamirano

1ICATALIST, LAS ROZAS, España, 2Deltares, Delft, Holland

The NAIAD H2020 Project starting on December 2016 will aim to demonstrate through the development of so called Natural Assurance Schemes in 8 pilot case studies located in 8 different countries across Europe the role that nature can play as an insurance system against the impacts from climate change. Focusing on nature based solutions in a source to sea frame we will look at cases that range from the southern west and east Mediterranean, central and Atlantic Europe through to Scandinavia. Focused on the catchment, we will aim to demonstrate the positive value that good functioning ecosystems can play to reduce water risks. Furthermore a key element will be to find innovative public procurement and financing schemes to put value on positive environmental externalities to restore, protect and enhance our natural water systems.

**Significance of your presentation to adaptation practice, policy and/or business?**

The main significance is to develop viable financing schemes for nature based solutions starting from real cases at different scales and at different levels of development and knowledge on nature based solutions from Copenhagen all the way to sections of the Danube in Romania.

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**Poster 93: Challenges and opportunities in the adaptation planning of the EU NATURA 2000 network**

**Ms Andreia Sousa**, Mr. Mário Pulquério, Dr. Maria João Cruz

1cE3c – Center for Ecology, Evolution and Environmental Changes, Faculdade de Ciências da Universidade de Lisboa, Lisbon, Portugal

Climate change is a major threat to species’ and ecosystems’ functioning and distribution. However, it is particularly challenging to integrate the outcomes of habitats vulnerability assessments in adaptation decision-making, mainly because of: i) the temporal and geographical scales at which the vulnerability assessments and the decision-making processes are conducted; ii) the mismatch between the objects of the vulnerability assessments and the objects of decision making. For example, while a vulnerability assessment usually focuses in species, groups of species or habitats, decision-making focuses on protected areas, regions, ecosystems, or ecosystems services.

To address these challenges we developed an approach that enables the use of a habitat vulnerability assessment to define an adaptation plan for protected areas and applied it to the Azores archipelago as a case study. Our approach included: 1) the assessment of the vulnerability of the Natura 2000 habitats to climate change; 2) the integration of the habitat results in the Natura 2000 protected areas; and 3) the identification of adequate adaptation measures at the level of protected areas.

Habitat vulnerability was assessed through the application of a climate change impact index (based on expert knowledge) and an adaptive capacity indicator (the conservation status of each habitat). The results were discussed and validated with local experts and stakeholders. After integrating the habitat vulnerability results for each Natura 2000 protected area, a vulnerability map was produced and presented in a stakeholder workshop. The maps served as the basis for selecting and prioritizing a list of adaptation measures at the protected area and archipelago levels.
Active measures for protection of Natura network and adjacent protected areas selected by stakeholders focused on both the reduction of the impacts of climate change and other anthropogenic pressures. Other measures, transversal to all network protected areas, focused on research and monitoring networks, education and dissemination measures and legal and administrative measures.

This method was useful to integrate and extend the identified measures into ongoing conservation planning. Spatial distribution of habitats vulnerability provided relevant support for decision-makers in the evaluation of adaptation measures. Limitations of this method were the lack of data on the distribution, conservation status and impact of climate change in habitats. Thus, measures that extend beyond current conservation responses and consider future climate conditions (e.g. expansion of protected areas, plan green corridors considering the effects of climate change) could not be evaluated in this study. Further research on this topic should be developed.

Significance of your presentation to adaptation practice, policy and/or business?
A stakeholder workshop was conducted where vulnerability spatially explicit results were presented at the levels that the decision-makers usually operate (i.e. protected areas, island, archipelago). Adaptation measures were discussed and drawn directly in the vulnerability maps. We believe this methodology is therefore very useful to communicate vulnerability results to decision-makers in a useful way and to identify and prioritize adaptation measures for protected areas.

Poster 94: Biodiversity conservation under a changing climate: a case study of Brazilian protected areas as future climate change refugia

Ms Cristina Pereira1, Dr Jeff Price1, Prof Rachel Warren1
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Protected areas (PAs) promote biodiversity conservation in situ by safeguarding habitat for one or multiple species. However, future climate change projections show that these areas might become climatically unsuitable for many species that they aim to protect. On the other hand, some PAs might continue to be climatically suitable for the majority of the species with them, acting as climate change refugia. Hence investigation of PAs’ role as future climate change refugia is important for long-term biodiversity conservation planning.

This is particularly important for Brazil, since it is the most megadiverse country in world, with two biomes considered biodiversity hotspots. In addition, Brazil has set National Biodiversity Targets for the period of 2011-2020, including the reduction of extinction risks. Moreover, one of the targets of its National Adaptation Plan for climate change is to model climate change impacts on biodiversity. Hence this study is extremely well placed to inform national adaptation policy making.

The main objective of this study is to inform Brazilian decision makers about the extent to which existing Brazilian protected areas will be sufficient to conserve biodiversity in the country as climate changes during the 21st century.

The analysis applies a standard climatic envelope modelling approach on a species by species basis, using information about the present distribution of species (www.gbif.org), and projections of climate change
consistent with the projections of the 21 climate models used in the model intercomparison study reported in the IPCC Fifth Assessment report, and further downscaled to 20x20 km.

The will present a spatial analysis of the relationship between the Brazilian PAs and climate change refugia in the 2020s, 2050s and 2080s, using a range of climate change scenarios (including those matching the outcomes of a successfully implemented Paris Agreement) and exploring the degree to which climate models agree about the location and persistence of refugia for five groups of terrestrial biota (plants, amphibians, birds, mammals, reptiles) will be explored.

The Brazilian Environment Ministry (MMA in Portuguese) is acting as a stakeholder in this analysis, providing informal guidance on the study design. This co-productive research is designed to enhance biodiversity conservation in Brazil.

**Significance of your presentation to adaptation practice, policy and/or business?**

The study presented here addresses directly targets of the Brazilian National Adaptation Plan and National Biodiversity Targets, aiming to provide scientific knowledge to decision makers. Moreover, it will also complement current efforts leaded by Brazilian Environmental Ministry (MMA) to evaluate climate change impacts on the Brazilian biodiversity and ecosystems.

**Poster 95: Physiological response of different tree species under conditions of drought and waterlogging. Knowing the mechanisms of adaptation.**

**Prof. Darwin Leonel Moreno Echeverry²**

²*Universidad Nacional De Colombia, Bogotá, Colombia, Jardín Botánico de Bogotá - José Celestino Mutis, Bogotá, Colombia*

The effects of climate change is more pronounced in urban ecosystems, make preponderant studying tree species to different stress conditions biotic and abiotic both, in order to ensure the sustainability of trees in cities in the near future. The emergence of urban trees has been predominant in cities, because of its ornamental role and multiple ecosystem services it provides to the community for their welfare. However, the complex environmental factors that occur in urban areas, which are very different from the conditions where are the natural plant species are considered as the main factors that determine the susceptibility of trees to other factors such as biotic.

Bogota, has areas with high rainfall an/or prone to flooding and in turn areas with high temperatures and increased solar radiation, known as heat island, therefore this study analyzes the physiological behavior of different tree species in order to characterize their tolerance to waterlogging and/or drought. For this, the water status of plants, photosynthetic behavior and electrolyte loss being an indirect indicator of the stability of cell membranes was determined.

These studies are of great importance for the inhabitants of large cities, which are exposed to extreme conditions of pollution, heat waves, changing climate scenarios, among others. Therefore, generating studies of plant physiology in the context of urban trees with different types of abiotic stress such as drought and flooding in cities like Bogota, its preponderant to generate timely management and make decisions from the political sector to implement a design city future.
Poster 96: Extreme temperature events may cause severe negative effects in the early stages of the coastal seagrass Posidonia oceanica

Ms Laura Guerrero-Meseguer¹, Carlos Sanz-Lázaro¹, Prof Arnaldo Marín¹
¹University Of Murcia, Murcia, Spain

The frequency of extreme temperature events, as heat waves, is expected to increase in this century due to climate change. Heat waves could have devastating consequences in marine ecosystems, especially in marine habitat forming species as seagrasses, such as Posidonia oceanica (L.) Delile. This marine plant is endemic from the Mediterranean, predominating in coastal seabeds where occupies an area around 12,200 km². This species sustains a high biodiversity and many ecosystems services, among others, the maintenance of the beaches structures or the CO₂ sequestration. Therefore, improving our understanding on the effects of extreme temperature events on the development of P. oceanica is necessary to manage strategies for the conservation of one of the most important habitats of the Mediterranean coasts. In the present study, by means of a mesocosm study, we evaluated long-term effects of a simulated heat wave in the development of P. oceanica seedlings. Additionally, we did a short-term experiment to evaluate the effects of high temperatures on photosynthesis. Critical temperature threshold for seedling photosynthesis is reached at 29ºC. Above this temperature threshold, the photosynthetic rate of the seedling is significantly affected, decreasing the production of oxygen and the performance of the photosystem II (PSII). The inactivation of the photosynthesis at these temperatures produces serious alterations on seedling development after one month, especially decreasing the growth rate and enhancing the mortality of the leaves. This temperature already occurs during certain days by heat waves in Mediterranean in summer months and therefore, recruitment and colonization of P. oceanica might already be affected.

Significance of your presentation to adaptation practice, policy and/or business?
This study is an example of how global warming could have severe effects in an important habitat forming species such as P. oceanica. This study uses P. oceanica as a model of habitat forming species to help us to forecast future consequences of climate change and to design preventive, adaptive and mitigation measures against extreme events in seagrasses to promote the conservation of marine habitats.

Agriculture, forestry and fisheries

Poster 101: Analysis of the water-food nexus under climate change: A case study of thousand-ponds-city in Taiwan

Mr. Chung-Yi Lin¹, Mrs. Yuan-Hua Li¹, Dr. Ming-Hsu Li², Dr. Ching-Pin Tung³
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The water-food-energy nexus is now extensively discussed in the worldwide. However, the nexus among three elements have not been well defined. In this study, the nexus between water and food is established for developing an assessment tool. The purpose of the assessment tool is to analyse adaption options for managing irrigation water. Irrigation water demands are the major water use in Taiwan. The major crop, rice, usually encounters great deficits during drought years and causes more fallow farm. Additionally, diet habit changes from rice product to wheat product, the import rate of wheat increases. Therefore, the food self-sufficiency of Taiwan decreases. Irrigation area in TaoYuan is selected to demonstrate possible options may be used to enhance food self-sufficiency rate of Taiwan and reactivate fallow farm. Irrigation ponds located
in TaoYuan is a unique feature which plays a role as buffer zone for water resource management. During flood period, ponds store excessive rainfall and delay flood. During drought period, ponds provide additional water for irrigation water demand. And partially dry farming is another adaptation method for increasing food self-sufficiency.

Through combining water-food nexus model, TaiWAP (Taiwan Water Resources Assessment Program) and AquaCrop (Crop model developed by FAO), adaptation options may be evaluated. TaiWAP is an assessment program that may generate future weather data based on GCMs and analyse future risk of water supply by specific system dynamic model. AquaCrop simulates crop yield response to the water. Water-food nexus serves as an integrated model, which presents the characteristic of irrigation ponds and links future field water demands extracting from AquaCrop to TaiWAP. The water-food nexus assessment tool calculates the risk of water supply for different dry farming adaptation options. The food self-sufficiency rate increases as the consequence of growing wheat as dry farming crops which also reactivate fallow lands. The water saved from dry farming can be used for domestic and industrial demands and decrease the risk of water supply under climate change. In future studies, water-food nexus model may be applied in different case studies for providing adaption options.

**Significance of your presentation to adaptation practice, policy and/or business?**
The water-food nexus assessment tool integrates future weather data and simulated crop yield under climate change. The assessment tool is able to evaluate suitable adaptation options and optimize irrigation water management for future agriculture and water supply under climate change.

**Poster 102: Sustainable Development Goal: Poverty Reduction and Zero Hunger by 2030 - Contribution of the Democratic Republic of the Congo to ECCA 2017**

**Jean Bernard Musamu Diakwaku**  
*Info-environement, Kinshasa, Congo*

**Introduction:** In order to contribute actively to the first two sustainable development objectives (SDGs), namely: (1) poverty reduction and (2) zero hunger by 2030, the Democratic Republic of the Congo (DRC), according to its plan Sustainable development under review has taken very important options to significantly reduce the poverty rate and the hunger of its citizens, in line with the recommendations adopted at the UN Summit on SDGs. What drove the DRC, to go through a policy implementation and strategies to achieve the objectives that the government has set itself in recent years. Thus, with significant natural forest and land resources, of which more than 150 million hectares of forest, 80 million arable land and a younger population estimated at more than 70%, face enormous challenges in providing food And a healthy environment, as the bulk of current agricultural production comes from peasant farming by abatis-burning, the main current cause of deforestation.

Indeed, climate change is a serious threat to us. We are not the only ones responsible and we are not the only victims. There are no individual solutions to these challenges, all countries in the South or the North must each have their own, to make efforts for our planet to absorb its greenhouse gases that cause already causing enormous damage to all aspects of human life. We must therefore meet these challenges together, in accordance with our historical responsibilities and our respective capacities.

**How then does the DRC go about it?** Of course the country’s development needs are immense, and part of the forest will certainly have to be converted to other uses. But the Congolese vision affirmed in the framework strategy to reduce emissions from deforestation (REDD +), advocates a reasoned use of the
territory, and the stabilization by 2030 of forest cover on 63.5% of the national territory. By 2035, this would reduce national emissions from deforestation in a context of sustained economic development and a victory against poverty by 56%.

**On the agricultural level** The DRC intends to create conditions favorable to the harmonious and complementary development of the three types of agriculture (peasant, intermediate, industrial) using sustainable practices, minimizing in particular the reduction of forest cover. This will be achieved by promoting (i) community-based structuring, (ii) optimizing land use in land-use planning and micro-zoning, and, in particular, orienting agriculture where possible towards Degraded ecosystems (savannas, recruits, old plantations, etc.), (iii) supporting the adoption of improved, ecologically intensive cultivation techniques and the development of sectors, supported by compliance with a prior zoning plan.

**On the forest level** The REDD + framework strategy of the DRC clearly sets out our vision for the future. A future where the Congolese forest is better managed better preserved and where its sustainable exploitation fuels the rapid development of the country. Where its multiple ecological services are valued socially and economically through the various sectors that feed on them: water resources, vital to agriculture and the production of renewable energy, soil protection, reduction of hazards The provision of firewood and construction, medical or recreational care, and food resources for forest and indigenous peoples.

**Poster 103: Oil Palm Expansion, Social-Economic and Landscape Change: Livelihood Structure, Resilience and Adaptation in Jambi, Indonesia**

Dr. Arya Hadi Dharmawan¹, Dr. Eka Intan Kumala Putri¹, Prof. Dr. Lilik Budi Prasetyo¹, Mr. Faris Rahadian², Ms. Fatimah Azzahra¹, Ms. Hilda Nurul Hidayah¹, Mr. Nana Kristiawan¹, Ms. Audina Amanda Prameswari¹, Ms. Rany Utami¹, Mrs. Rizka Amalia¹

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Oil palm investments in tropical region, e.g., Indonesia, have taken place very massively since last decades. Oil palm plantation has grown and expanded very rapidly for last ten years in almost all over Sumatera Island of Indonesia. Oil palm plantations occupy in some cases, illegal lands that are actually not used for plantation. Forest lands are systematically encroached by oil palm plantation leading to radical landscape change. Social-ecological system changes alongside landscape changes. The most important driving force explaining the expansion of oil palm is the lucrative economic benefit that is gained from palm oil export and trade. Oil palm economy is very beneficial for either large scale investors or small scale farmers, though its market is vulnerable to international price fluctuation. Nevertheless, economic reason has been major factor for people to change the rural landscape into oil palm without considering further negative socio-economic and socio-ecological consequences. This paper is dedicated to elaborate more the impact of oil palm expansion on social-economic, landscape, and rural livelihood changes. This paper is based on the micro-empirical study carried out in two villages of Merlung sub-District, Tanjung Jabung Barat District of Jambi Province of Indonesia where oil palm are grown and are expanding very widely. The empirical study used survey methods and statistical analysis. A number of oil palm grower households are drawn as either unit of analysis and samples for interviews. The study used either quantitative or qualitative approaches to obtain objective arguments.
At least three negative impacts are identified: (1) socio-culturally, most of traditional rural households actually do not yet ready for implementing industrialized oil palm agriculture system. Its social system disrupted due to oil palm expansion; (2) socio-economically the income of the households becomes vulnerable as the income structure is mostly dominated by oil palm. Once there is falling down of oil price, the entire economy of the households will be definitely collapse; (3) the monoculture system of oil palm occupying thousands of hectares land with single plants leads to a risky ecosystem. Water has become one that is felt critically available to suffice rural people’s needs. The study tries to formulate adaptive socio-ecological solution for the people living under the threat of oil palm monoculture system.

Significance of your presentation to adaptation practice, policy and/or business?
Rural landscape undergoes very rapid change due to the expansion of large scale agricultural investments (oil palm). Massive capitals are invested, accompanied by the introduction of new technology and institutions. In developing countries, agriculture expansion creates shock and stress to the rural people who are normally poor. The agricultural expansion also resulted in socio-economic and ecological changes. It singled out the source of income of rural households making them less resilient to crisis. Forest landscape becomes monoculture farming system causing risky livelihood. This study helps the government to formulate policy enabling rural people to escape from crisis and vulnerability.

Poster 104: Gender and Resilience: Livelihood Under Ecological Crisis in Jambi

Ms Fatimah Azzahra
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Water is a primary human need. Water is indispensable for living expenses that are usually done by a woman. The expansion of oil palm plantations in Jambi Indonesia have an impact on economic improvement, but there are social and ecological problems. Tanjung Jabung Barat District categorized as highly vulnerable caused by drought. Although it can provide jobs for women, the palm oil industry further segregates women as keeping the water for all household activities. This creates a vulnerability of social and ecological consequences for smallholder households. The purpose of this study is to look at the link between gender, resilience, and drought experienced by smallholder households in Jambi, Indonesia. This study combined quantitative approach using questioner method and qualitative approach using depth interview method. Factors that influence the vulnerability tested with linear regression analysis, using SPSS version 20. Jambi is one of the location with oil palm plantations that are changing ecosystem radically. One of the long-term impact is the threat of drought during the dry season. The economic benefits enjoyed by only a small part of society. Most smallholder households still live in poverty. Household economy experienced a tremendous crisis in the past year and cause all layers households with income shortfall owed to traders of fresh fruit bunches. The heavy reliance on oil palm economy caused tremendous shock to fall to the level of crisis when the price of oil and oil productivity in decline. There are two factors that led to this crisis happen first is climate variabilities, which led to crop failure, the second is fall of oil palm prices in the international market. Drought also caused smallholders household have to go to the river to meet water needs. Rivers in their area have been polluted by oil palm waste from oil pam factories. Livelihood assets that drastically declining are natural capital and social capital. That is attributable to the decline in the quality of natural resources in the region. In social capital, a shift in the role of women as guardians of the water for the household to be a labourer in the cultivation of oil palm. The conclusion of this analysis that the economic increasing gives environmental impacts such as drought and livelihood vulnerability of smallholders household in Indonesia.
The expansion of oil palm plantations in Indonesia have an impact on economic improvement, but there are social and ecological problems for the people in the oil palm plantations’s area, including in Jambi, Indonesia. The drought that struck Jambi last two months has caused drought in two cities and nine counties. Tanjung Jabung Barat District categorized as highly vulnerable to food security. All of three districts are food insecurity cause the area of food crops that decrease radically. In 1990 and 2013, the rate of deforestation in Tanjung Jabung Barat reached 2,884,884 hectares out of a total of thirteen districts. Land use change into oil palm plantations is causing the loss of biodiversity. That is one of the external shock or exposure of people living around oil palm plantations, besides causing changes to the ecosystem in the region. The purpose of this study is to look at the link between economic progress palm with climate change and drought experienced by households farmers in Jambi, Indonesia. This study combined quantitative approach using questioner method and qualitative approach using depth interview method. Factors that influence the vulnerability tested with linear regression analysis, using SPSS version 20. Jambi is one of the location with oil palm plantations that are changing ecosystem radically. One of the long-term impact is the threat of drought during the dry season. The economic benefits enjoyed by only a small part of society. Most farming households still live in poverty. Household economy experienced a tremendous crisis in the past year and cause all layers households with income shortfall owed to traders of fresh fruit bunches. The heavy reliance on oil palm economy caused tremendous shock to fall to the level of crisis when the price of oil and oil productivity in decline. There are two factors that led to this crisis happen first is climate variabilities, which led to crop failure, the second is fall of oil palm prices in the international market. Drought also caused smallholders household have to go to the river to meet water needs. Rivers in their area have been polluted by oil palm waste from oil pam factories. Livelihood assets that drastically declining is natural capital. That is attributable to the decline in the quality of natural resources in the region. The conclusion of this analysis that the economic increasing gives environmental impacts such as drought and livelihood vulnerability of smallholders household in Indonesia.

Significance of your presentation to adaptation practice, policy and/or business?

The significance of this research for adaptation by policy makers in Indonesia. Climate change caused by the expansion of oil palm plantations give seriously impact that the drought. Oil palm economy development in fact only has given more inequality and impoverishing local communities. Increased vulnerability due to the loss of the role of women in the household. Efforts to achieve resilience must also consider the role of women in the rural economy. The case of Indonesia revealed that the potential land conflicts not only hailed by NGOs and academics but also economic and political policy makers.
Poster 106: Climate Variability and Livelihood Vulnerability in Dry Region of Indonesia: Farming under Uncertainty

Ms Rizka Amalia¹, Dr Arya Hadi Dharmawan¹, Dr Eka Intan Kumala Putri², Dr Nurmala Katrina Pandjaitan¹, Ms Diyane Astriani Sudaryanti², Ms Audina Amanda Prameswari¹

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Climate variability is one of strong sign of climate change in the planet earth. It gives significant impact on livelihood vulnerability especially to the household farmer who depend on climate for planting their commodity in the tropic. The household farmer in dry region such as Kupang, East Nusa Tenggara undergo depressing impact in term of uncertainty of production due to climate variability. As the farming is highly dependent on precipitation, disrupted rainfalls will result in the ruin of production that may lead to household economic crisis.

This paper is based on a study conducted in two villages in East Nusa Tenggara where the socio-ecosystem differs one two another. The first village is located far away from local water resources reserve and the other is located near from water resources reserve, enabling the farmer to build up the different resilience actions. Using survey method, the study assesses health, food, institution, income and climate variability indicators to come up with calculating livelihood vulnerability index. The study found interesting findings: (1) the household farmers who live in areas without water resources reserve support has higher livelihood vulnerability index, making them always to compromise with uncertain rainfall (2) the household farmers who live with water resources reserve has stronger livelihood resilience. Both farmers develop different types of techno-institutional adaptive mechanisms to survive.

Significance of your presentation to adaptation practice, policy and/or business?

This research significant in policy making process especially in food security and understanding in pattern of people responding ecological and economics crisis. This research also important to mitigating vulnerability caused by climate variability.

Poster 107: Climate services supporting bioeconomy based climate change adaptation

Dr. Ari Venäläinen¹, Mr. Ilari Lehtonen¹, Mr. Mikko Laapas¹, Mr. Pentti Pirinen¹, Dr. Andrea Vajda¹, Dr. Hilppa Gregow¹

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In Finland bioeconomy has a major role in guaranteeing low-carbon and resource efficient society and sustainable economic development. More specifically, for the forested country the forest based bioeconomy has growing importance in this endeavor. In northern Europe climate warming increases forest growth and forest harvesting potential and contributes to increasing possibilities to promote the use of forests to gain the required climate change mitigation goals. Though higher temperatures and longer growing seasons are beneficial for the forest growth, there exists a number of risks forests are exposed to. For example excess snowfall, drought/fires and wind storms can cause large damage in the forests. These risks will change in the
course of climate change and in this respect climate research and climate services have an important role
while seeking possibilities to adapt to climate induced risks and while optimizing the forestry production. We
present here some of the key findings of our climate research activities that contribute to the
implementation of the national bioeconomic strategy in Finland. The studies involve wind storms, forest
fires, snow damage and soil frost.

Significance of your presentation to adaptation practice, policy and/or business?
Forest based bioeconomy has an important role while seeking ways to maintain sustainable development.
Forest are an important source of raw material and on the other hand they offer large recreational values
and it is important to find a balance between these two somewhat diverging development paths. This
presentation discusses about climate risk management and adaptation possibilities in the forestry section
and these results can be regarded very beneficial for the forest industry but also for the policy makers and
authorities.

Poster 108: Climate change impacts and adaptation in the context of Scotland’s
forestry supply chain

Dr. Kate Beauchamp

Scotland’s forest sector includes both forestry and timber production and the delivery of a range of non
timber goods and services including recreation and tourism. Overall it contributes almost £1 billion to the
economy each year and employs over 25,000 people. Climate change is expected to have wide ranging
impacts in Scotland. Understanding these impacts and identifying how the sector can adapt is of huge
economic, social and environmental importance.

A business supply chain is the sequence of stages involved in producing and distributing a product or service.
Scotland’s forest supply chain includes forest growers and nurseries, forest managers, timber harvesting,
timber transport, wood processing, and recreation and hospitality services. Climate change will impact each
stage of the forest supply chain.

Supply chain resilience refers to the ‘ability of a supply chain to cope with change’. The United Kingdom
Forestry Standard defines resilience as ‘the ability of a social or ecological system to absorb disturbances
while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the
capacity to adapt to stress and change’. These definitions are excellent targets for Scotland’s forest supply
chain when considering climate change adaptation.

It is important to examine the whole supply chain when considering the impacts of climate change, as
impacts at one stage (primary impacts) could affect stages up and down the chain (secondary impacts).
Furthermore, adaptation actions taken at each stage of the supply chain could have consequences
elsewhere, and any limitations to adaptation at one stage could also restrict adaptation actions at other
stages or across the whole chain.

We have applied these principles to the forestry and timber production aspect of the forestry supply chain in
Scotland and will provide a summary of our findings illustrated with key examples.
By documenting climate change impacts and adaptation in the context of the supply chain we aim to raise awareness and promote discussion across Scotland’s forest sector in order to support adaptation. Facilitating communication between the stages of the forestry supply chain will confer benefits for practitioners, businesses and the development of robust forest policy, and support efforts to increase the resilience of the forest sector.

Significance of your presentation to adaptation practice, policy and/or business?
Viewing climate change impacts and adaptation in the context of the wider supply chain allows businesses and practitioners at each stage to consider and prepare for a wider range of potential impacts and understand how their adaptation actions affect others. Considering the whole supply chain may identify universal themes and potential barriers to adaptation which require additional research and policy support. Facilitating communication across the supply chain promotes an integrated approach to adaptation, which when underpinned by science and policy enables the development and implementation of solutions for building resilience, and supports delivery of the Scottish Climate Change Adaptation Programme.

Poster 109: Future governance approaches for reducing nutrients at local farm scale – insights from the project Soils2Sea

Dr. Nico Stelljes¹, Katriona McGlade
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Eutrophication is a serious challenge for the Baltic Sea; effects of eutrophication include algal blooms, dead sea beds and reductions in fish stocks (Arheimer et al. 2012). Climate Change can increase these challenges. Agriculture can be identified as a main reason for eutrophication of the Baltic Sea (see Helcom 2007); this implies a field of possible actions to tackle the problem. The introduction of additional new and innovative measures will be required.

Here comes the project SOILS2SEA in place. The project proposes to exploit the fact that the retention (removal by biogeochemical processes or sedimentation) of nutrients in groundwater and surface water systems shows a significant spatial variation, depending on the local hydrogeological and riverine regime. If we can more accurately predict where N and P are retained in a catchment by estimating the retention in the different compartments along the flow path, then we can more cost-effectively design measures to reduce the nutrient loads to the Baltic Sea. Currently, the traditional uniform regulations do not account for local data and knowledge and are much less cost-effective than spatially differentiated. Therefore, it is necessary to utilise all local information and find locally designed and optimised solutions to reduce nutrient leaching. This calls for new innovative governance regimes with active involvement of key stakeholders.

Within the project, there are three in depth local case study sites where an intensive stakeholder involvement takes place. At each case study site, located in Denmark, Sweden and Poland, we use different participatory methods at workshops to find out about stakeholders reaction to the idea of spatial differentiated solutions towards eutrophication. At these workshops, different policy options will be proposed and discussed, including ones that empower local stakeholders collectively to commit to targets and decide on technical measures to implement.

The poster will present the project itself with a special focus on the procedure and the results of the first participatory interactions.
Significance of your presentation to adaptation practice, policy and/or business?
Eutrophication is a serious problem for the Baltic Sea with climate change increasing the challenge. With the project we are introducing and discussing new governance concepts for different case studies. These governance concepts could be of interest for policy makers and agricultural practitioners, showing new opportunities for combating eutrophication and therefore adapting to the need of reducing N and P.

Poster 110: Climate change-induced forest productivity changes amplified by changing disturbance regimes: implications for adaptation

Dr. Christopher Reyer¹, MOTIVE Partners & Modelling Teams
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Recent studies projecting future climate change impacts on forests usually consider either the effects of climate change on productivity or on disturbances. But productivity and disturbance are intrinsically linked because 1) disturbances directly affect forest productivity (e.g., via a reduction in leaf area and resource use efficiency), and 2) disturbance susceptibility is often coupled to a certain development phase of the forest with productivity determining the time a forest is in this specific phase of susceptibility. These trade-offs have important implications for planning adaptation of forest management to climate change e.g. when to rejuvenate a forest or how to conduct thinnings.

The objective of this presentation is to provide an overview of forest productivity changes in different forest ecosystems in Europe under climate change, and partition these changes into effects induced by climate change and disturbances. We present projections of climate change impacts on forest productivity from state-of-the art regional forest models that dynamically simulate forest productivity and the main European disturbance agents (fire, storm, insects), driven by the same climate scenario in seven forest regions along a large climatic gradient throughout Europe. We show that in most cases, including disturbances in the simulations clearly exaggerate ongoing productivity declines or cancel out productivity gains in response to climate change. In fewer cases, disturbances also increase productivity or buffer climate-change induced productivity losses, e.g. because low severity fires can alleviate resource competition and increase fertilization. Therefore, we argue that it is necessary to interpret climate change-induced productivity and disturbance changes jointly to capture the full range of climate change impacts on forests and to plan adaptation. We explore the implications of these findings for some commonly proposed forest adaptation measures.

Poster 111: What are the options for adaptation option for arable agriculture in the EU?

Dr. Kairsty Topp¹, Prof Christine Watson¹
¹
Climate change is impacting and will continue to impact on farmer decision making. The effect of the changes in weather across Europe on agricultural production will vary with the North likely to be affected by increases in winter rainfall and the south by increased risk of drought. Hence, the drivers for adaptation and the appropriate adaptation measures may vary across Europe. As part of an EU project, scientists and actors working with farmer groups from Spain, the Netherlands, Switzerland, Finland, Germany, Denmark, Sweden and France were asked to identify the adaptation options that farmers were likely to consider implementing for the following categories: calendar, substitute, modify, innovate and create. These categories represent the time-scale from immediate action to requiring time to plan and implement, and they also represent the scale of costs, with “calendar” being relatively cheap, and “create” requiring significant investment. Network analysis has been used to analyse the information gathered to identify practices that are common across several countries. With the exception of the Netherlands, for the “calendar” actions, farmers will modify the day-to-day management decisions in terms of sowing and harvest. In terms of the “substitute” category, modification of the tillage practices and machinery are seen as possible adaptation. However, there is a strong message that there is a need for adapted crop varieties. This may be simply using varieties that are currently grown in other climatic zones, but it may also require input from breeders. Technical fixes such as new pesticides and fertilisers will also be required, which will require input from the industry. In terms of modifying the system, the day-to-day management and changes in machinery are again highlighted. Nevertheless, there is a clear message that farmers will start to diversify their rotations and the types of crops that they grow. Interestingly, even though we currently have the technology to adopt precision farming techniques, this practice is identified as an innovation. Although this is probably a reflection of the people asked rather than the regional differences, a very diverse range of options have been identified as “create” measures. Agroforestry and land-use change, local produce, and being paid to provide ecosystem services are seen as possible options. There is clearly a need to understand how the options identified will impact not only on the long-term productive capacity but also on the financial sustainability of the farm.

Significance of your presentation to adaptation practice, policy and/or business?
There is clearly a need for the industry to identify both crops and input products that will be fit for purpose in a changing climate. Although these products may not be required in the short-term, the industry does need to act now to ensure that these crops and products are available in the medium to long-term. In terms of adaption practices, there is a need to understand the effectiveness of the possible adaptation measures. Sharing of knowledge between the key players will assist in the identification of the appropriate adaptation options for the specific systems.
Poster 112: Simulating farm-level risks and adaptation options for cereal cultivation in northern and southern Europe

Mrs. Nina Pirttioja\textsuperscript{1}, Dr. Margarita Ruiz-Ramos\textsuperscript{2}, Dr. Roberto Ferrise\textsuperscript{3}, Dr. Stefan Fronzek\textsuperscript{1}, Dr. Ignacio J. Lorite\textsuperscript{4}, Dr. Taru Palosuo\textsuperscript{5}, Dr. Jouni Räisänen\textsuperscript{6}, Dr. Alfredo Rodríguez\textsuperscript{2}, Dr. Marco Bindi\textsuperscript{3}, Dr. Reimund Rötter\textsuperscript{7}, Dr. Timothy R. Carter\textsuperscript{1}

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Process-based crop growth models have been used in many studies to estimate future cereal yield under changing conditions of atmospheric composition and climate. Model estimates of future crop development and yield are uncertain because key parameters, assumptions about crop management and projections of future climate can all vary across a range of values. This study presents an approach for undertaking a simultaneous analysis of parameter uncertainty, sensitivity to climate and probabilistic climate projections, which can be used to offer insights into future risks of cereal yield shortfall and potential adaptation options in contrasting parts of Europe.

A method of analysing the likelihood of specified impacts is presented where impacts of climate change on crop response are assessed by combining impact response surfaces (IRS) constructed from the results of a sensitivity analysis of an impact model with probabilistic projections of regional changes in key climatic variables. By defining and quantifying thresholds as functions of the most relevant climatic variables, such as precipitation and temperature, the likelihood of exceeding the threshold can be analysed. Analyses such as these are required when assessing the effects of climate change, due to the low confidence in individual predictions of impacts associated with large uncertainties in projections of greenhouse gas induced climate change.

IRSs were constructed from crop model simulations for altered temperature and precipitation and assuming different atmospheric CO\textsubscript{2} concentrations for spring barley in Finland and winter wheat in Spain under rain-fed conditions. Parameter uncertainties were explored by altering assumptions about sowing dates, crop cultivar characteristics and CO\textsubscript{2} responses. Projections of crop reliability during the 21st century, based on likelihoods of achieving a target yield level, were derived by combining IRSs with probabilistic climate.

The results indicate that yield benefits for spring barley are possible in Finland if new cultivars optimized for future conditions can be bred. For winter wheat in Spain, effective adaptation can best be reached using a combination of cultivar and sowing dates several adaptation options.

Significance of your presentation to adaptation practice, policy and/or business?

The research results can inform crop breeding (by identifying optimal cultivar properties) and agricultural management measures under both temperature- and water-limited cultivation conditions. The methods presented directly address uncertainties, both in climate change and impact projections, and hence support more robust decision-making when planning adaptation in the agricultural sector. Finally, the impact response surface approach is an effective device to communicate the uncertainty of complex model results.
Poster 113: Linking soil degradation control to climate change adaptation: a literature review-based inventory of costs and benefits of soil protection techniques in Europe

Alina Tepes, Basque Centre For Climate Change (bc3)

From experience we understand that financial profitability is only one of a set of other decision criteria in policy making. Despite a failed attempt to divert the debate on costs and benefits towards incentivising climate change adaptation by an adequate use of policy instruments, adaptation costing still looms large on policy agendas. This is because costs of adaptation are believed to better serve investment decisions by facilitating the prioritization of adaptation options. Unfortunately, costing adaptation is challenging for a variety of reasons, including climate change related uncertainties, valuation methods and the subjectivity of approaches to adaptation, which covers a variety of actors, visions and interests. Assuming cost assessments are of value to inform decision-making, this paper’s objective is to provide an economic inventory of soil management techniques at farm level. It considers measures according to the three soil conservation principles of minimum soil disturbance, permanent soil cover and crop diversification and extends those to more broader sustainable land management techniques. These are also called no regret adaptation options, as they serve independently of future climate scenario realisations. These are the recent focus of adaptation studies because they provide a good start for adaptation, which is in need of action. Quantitative data for 27 economic indicators, including average costs and benefits, benefit to cost ratios and subsidies is retrieved from 27 documents. Results from this study are not new. Neither can results be definitive from the limited economic data for no-regret adaptation measures considered. Instead, messages from previous studies are supported by quantitative insights. Firstly, no regret adaptation measures provide a potential for low cost adaptation measures, which does not mean, their implementation is guaranteed. This has been a result particularly for developing countries. Here we suggest, this might also be true for the European region. Secondly, location specificity and the knowledge of it are key ingredients to successful adaptation. Thirdly, an integrated approach is called for, to fusion communities that work on different policy and research streams with clear links such as the soil degradation and climate change. Finally, this study suggests successful adaptation is not a matter of economic costs, but of ambition, of consumer, farmer, institution and authorities.

Flooding and water scarcity

Poster 118: BINGO: Climate change and watercycle impacts. Triggering sustainable development and adaptation pathways in society

Dr. Ana Estela Barbosa¹, Dr. Rafaela Matos¹

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Climate changes are perceived differently by different sectors of society, including common citizens. Decision-makers often express frustration about the limited practical use of climate change scenarios provided by researchers. The need to plan ahead, the uncertainty associated to future climate scenarios, as well as the management of limited and valuable material and human resources, place politicians and key decision makers in a cautious approach. Also relevant is the fact that technical staff and common citizens are not always so well informed on the key issues regarding climate change.
**BINGO** (*Bringing INnovation to onGOing Water Management – a better future under climate change*) is an H2020 funded research project, aiming at providing adaptation strategies for climate change-related challenges, providing methodologies for water and land resources management that are based on an improved understanding of future climate impacts on the hydrological cycle. As a hands-on response, BINGO aims both at reducing the uncertainty of near-term climate predictions and developing response strategies that may help society to better manage the remaining uncertainty. BINGO is committed to develop and validate the adaptation strategies in a dynamic cooperation between researchers and end-users. By fostering these knowledge alliances between different actors and by creating a Community of Practice (CoP), BINGO will address both the real concerns and the near future scenarios.

BINGO started June 2015 and has already achieved downscaled climate data provided as decadal predictions (2015-2024). The 10-year scenarios were produced at a spatial resolution adapted to the specific problems of six research sites, from Portugal, Spain, Cyprus, the Netherlands, Germany and Norway. DECO, a web-based extraction and conversion tool was set up, and is publically available upon request on the BINGO website (http://www.projectbingo.eu/). Local workshops with stakeholders and the Bingo CoP are successfully going on.

The vast dissemination of BINGO made during 2015 and 2016 at numerous events in Europe, Asia and North America clearly showed that climate change is an ongoing reality affecting all corners of the world, placing technical but also social, ethical and governance concerns (e.g., gender, inequality, etc.). This presentation aims to share the ongoing experience of the BINGO Research Sites communities representing a diverse, rich and wide range of situations. The, raised knowledge can be shared and seems relevant to prepare society at a global level, to develop resilience, innovation and increased cooperation.

**Significance of your presentation to adaptation practice, policy and/or business?**
In recent past research has been developed by researchers and communicated to society. The approach nowadays is quite different. BINGO is focused in creating and enhancing collaboration between researchers and end users. Ensuring extensive end users engagement through meetings with local, regional and national decision-makers already implemented, as well as participation in international dissemination forums allowed understanding the huge value of BINGO in addressing and pointing out future direction for increased cooperation and education in society - in addition to the specific scientific field of climate and water cycle modelling data production and innovation, as well as co-production of a portfolio of adaptation strategies.

**Poster 119: Stormier, wetter, higher: Impacts of climate change on flood risk in Scotland**

*Ms Iris Krammer*, *Ms Leigh Fraser*

*1Scottish Environment Protection Agency, United Kingdom*

The Scottish Environment Protection Agency (SEPA) is a responsible authority under the Flood Risk Management (Scotland) Act 2009, which transposes the EC Floods Directive. SEPA’s duties include the production of national flood risk and hazard maps. Climate projections were incorporated into the flood hazard maps using the United Kingdom Climate Change Projections (UKCP09). Climate change impacts were modelled for 30 year (fluvial and pluvial flooding) and 200 year (coastal, fluvial and pluvial flooding) return periods.
For fluvial flooding the UKCP09, 2080s high emissions scenario, 67th percentile was mapped and for coastal flooding the UKCP09, 2080 high emissions scenario, 95th percentile was mapped. Climate projections for short duration rainfall, which causes pluvial flooding, are not available for Scotland so for pluvial flood modelling the sensitivity to a 20% increase in peak rainfall was mapped.

The climate change scenarios results show an increase in the number of receptors (residential properties, non-residential properties, roads, utilities, community services and sites of historic or natural significance) at risk of flooding. For example, for all sources of flooding the number of residential properties at 200yr flood risk could increase by 60% due to climate change. This varies from a 50% increase in surface water flooding to 105% increase for coastal flooding. For river flooding the 30 year plus climate change scenario is worse than the current 50 year and even the 100 year scenarios in terms of the number of residential properties at risk.

This has implications for flood risk management planning as the areas with greatest risk now may not have the greatest future risk. Heat mapping is used to assess areas of greatest concern for each flood source. Changes in flood depths due to climate change are also analysed through spatial mapping.

**Significance of your presentation to adaptation practice, policy and/or business?**

It is important to assess changes in flood risk due to climate change to create a holistic picture and to plan for the future. Various areas, including land use planning, policy, insurance and more may benefit by considering the effects of climate change. This information can support adaptation planning and should be increasingly used to influence decision makers, policy and industry to reduce the impacts of flooding and climate change.

**Poster 120: Flood Risk Management: Planning for the Future**

**Ms Ruth Ellis**

1Scottish Environment Protection Agency, United Kingdom

There are currently 108,000 properties in Scotland at risk of flooding. It is estimated that by 2080 an additional 60,000 properties will be at risk – an increase of over 50%. This increase is solely as a result of predicted increases to rainfall and sea level rise. It does not take into account the complex and interrelated impacts of population growth, demographic change, urban creep, development, land-use change and coastal erosion: these factors could compound the risk increase.

Scotland’s first Flood Risk Management Strategies have only begun to highlight the scale of the challenge. They have crystallized the need for pro-active, future-focused analysis and planning.

This begins with the next National Flood Risk Assessment which updates our underlying understanding of flood risk, and identifies Potentially Vulnerable Areas to target flood risk management activities. It follows through to the appropriate selection and agreement of flood risk management objectives with responsible authorities. It leads on to strategic appraisal, selection and prioritisation of sustainable actions to manage flood risk. It concludes with the publication of the second cycle of flood risk management strategies.

Embedding climate change and other change factors into the principles, methodological development and application throughout this process, and drawing on the best available scientific projections will enable a step change: from understanding the impacts of climate change to actively planning for it. Here we will
present a comparison of our first and second cycle approaches to climate change within the National Flood Risk Assessment and analyse the ways in which we can then use this information to increase the sustainability of flood risk management in Scotland. This will include discussion of future approaches to developing a national baseline of flood risk, strategic action appraisal and prioritisation: how can we use our extensive national datasets to evidence these activities and ensure robust, appropriate, forward looking and adaptive solutions are embedded into the suite of flood risk management actions?

Partnership working has been fundamental to the success of the first Flood Risk Management Strategies. Strong partnerships have been developed and will continue to be built upon going forwards. We will also enhance engagement with wider stakeholders, using our evidence to create a compelling case for changing approaches. However this is not without challenges: we will look at those faced to date, key lessons learned, and major future challenges.

Significance of your presentation to adaptation practice, policy and/or business?

The presentation will set out advances in the consideration of climate change in assessing and managing flood risk in Scotland, drawing on practical experiences from the development and implementation of the first cycle Flood Risk Management Plans. It may of particular relevance to policy makers and practitioners working in the field of flood risk management.

Poster 121: Preventing Consequences When Living in a Flood Zone: Development of an Index of Preventive Adaptive Behaviours at the Household Level

Ph.D. Pierre Valois¹, M.Sc. Maxime Caron¹, Dr. Pierre Gosselin², Ph.D. Denis Talbot¹, M.A. Marie-Pier Carrier¹, Ph.D. Jean-Sébastien Renaud¹

¹Université Laval, Quebec, Canada, ²Ouranos and Institut National de Sante publique du Quebec, Quebec, Canada

According to the intergovernmental panel on climate change, millions of people are expected to be flooded in the near future. Flooding can have numerous impacts on the victims’ health. On the one hand, there are physical health problems, such as injuries, drownings, infections and mould-related respiratory problems. On the other hand, there are mental health problems, such as post-traumatic stress disorder, anxiety and depression. The adoption of preventive coping behaviours should significantly reduce the negative consequences of flooding. To our knowledge, no index of adaptive preventive behaviour toward flooding risk exists. Thus, the aim of this study was to develop and validate such an index. The study concerns 18,170 households living in all the flood-prone areas in the province of Quebec (Canada). Among these households, 8,994 were contacted to participate in the study. Of those contacted, 1,450 residents in a flood-risk area and 501 residents living 150 metres from a flood-prone area responded to the survey, resulting in an overall response rate of 21.69%. The questionnaire was administered to these 1,951 households by telephone interview. The person with the best knowledge of environmental household practices was asked to respond on behalf of the household. The questionnaire included 125 questions. Among them, 26 measured preventive adaptive behaviours, and the rest measured socio-demographic characteristics, knowledge, perceived severity of flooding, and self-reported adverse health impacts. Item response theory and confirmatory factor analyses revealed that this newly developed adaptation index summarizes a range of fifteen preventive behaviours that can be used to differentiate respondents who adapt to flooding from those who do not. The adjustment tests indicate that the model has good factorial validity: CFI = .933; TLI = .921; RMSEA = .034; and $\chi^2/dl = 3.21$. Moreover, a multiple correspondence analysis was performed to determine the most relevant factorial axes that would serve to build the index. The results showed that 15 of
the 26 behavioural questions assessed adaptive preventive behaviours, the first dimension explaining 98% of
the inertia. The preventive coping behaviours index that was developed presents good metrological
qualities. It will be useful for monitoring the evolution over time of the Québec population’s adaptation to
flooding. Future studies will help establish the links between this index and a number of variables, such as
flood experience, socioeconomic level and age.

Significance of your presentation to adaptation practice, policy and/or business?
Individuals’ adoption of flood adaptation behaviours is an essential measure in a context where climate
change is conducive to the increased occurrence of such events. However, despite the multiple research
projects, initiatives and adaptation plans that have emerged around the world in recent years, the actual
implementation in the field of such recommended adaptation behaviours remain largely unknown of
decision-makers. Our study attempts to address this issue by presenting a valid and reproducible measure of
household flood adaptation. Health and public safety authorities could use this index to better evaluate the
effectiveness of their outreach programs and improve the actual implementation of self-protective
behaviours by residents in flood-prone areas.

Poster 122: Bottom-up interface in transformative adaptive flood risk management –
decision-making in Eastern Alps

Dr. Thomas Thaler1, Dr. Sven Fuchs1
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Facing the challenges of climate change, this paper aims to analyse and to evaluate the multiple use of flood
alleviation schemes with respect to social transformation in communities exposed to flood hazards in
Europe. The overall goals are: (1) the identification of indicators and parameters necessary for strategies to
increase societal resilience, (2) an analysis of the institutional settings needed for societal transformation,
and (3) perspectives of changing divisions of responsibilities between public and private actors necessary to
arrive at more resilient societies. As such, governance is done by people interacting and defining risk
mitigation measures as well as climate change adaptation are therefore simultaneously both outcomes of,
and productive to, public and private responsibilities. Building off current knowledge this paper focussed on
different dimensions of adaptation and mitigation strategies based on social, economic and institutional
incentives and settings, centring on the linkages between these different dimensions and complementing
existing flood risk governance arrangements. As such, the challenges of adaptation to flood risk will be
tackled by converting scientific frameworks into practical assessment and policy advice.

This paper used the Formative Scenario Analysis (FSA) as a method to construct well-defined sets of
assumptions to gain insight into a system and its potential future development, based on qualitatively
assessed impact factors and rated quantitative relations between these factors, such as impact and
consistency analysis. The purpose of this approach was to develop scenarios, where participations develop
their own strategies how to implement a transformative adaptation strategy in flood risk management. In
particular, the interaction between researcher, the public and policy makers was analysed. Challenges and
limitations were assessed, such as benefits on costs of adaptation measures, for the implementation of
visions to develop bottom-up community actions in flood risk adaptation. The workshops delivered a case-
and stakeholder-specific preference matrix which allowed us to elaborate on the relative differences in
preferences between stakeholder groups also to determine economically and socially feasible measures. The
workshops ended with developing a strategy and working plan how to start bottom-up initiatives in the
respective communities with focus on questions of responsibility for encouraging and supporting bottom-up actions and needed resources.

**Poster 123: Resilient Planning in a State of Spatial Flux: An Analysis of the Amsterdam Water System**

**Dr. Mendel Giezen**

1 *University Of Amsterdam, Netherlands*

As the issue of climate change becomes increasingly apparent in the extremities of weather events across the world, urban resilience has become a key policy goal for cities. As shown by Meerow (2016), the popularity of the concept has exploded since 2006. However, what is crucial to keep in mind is that resilience is unlikely to be an endstate, but a continuous battle to ensure cities bounce back or even bounce forward when faced with change (Davoudi, Brooks, & Mehmood, 2013). Governance and planning for urban resilience thus takes place in a state of continuous flux. Building forth on the interesting proposition by Dovey (Dovey, 2012) that we should view cities as complex adaptive assemblages, this article develops a model of spatial flux that can be used to analyse cities and urban spaces to determine the governance and planning strategy for resilience.

Taking the basic axis of assemblage theory that a place is territorialisated through both the expressive/social and the material/spatial (Kamalipour & Peimani, 2015; McFarlane, 2011), this paper argues a city is in a constant flux between collapse and reorganisation. There are expressive forces and spatial forces that pull and push an urban place or city into either direction and that there is thus a continuous process of territorialisation and deterritorialisation. For example, there can be positive and negative discourses that push the perception of a place in a positive or negative direction. And the physical state of a city or urban place can be either in decay or in reorganisation. Whether these directions are good or bad is a matter of subjective choice, but the fact is that urban planning and governance aimed at urban resilience should take into consideration these forces. Policies that aim at spatial development, but neglect the expressive dimension will find it very difficult to create actual change.

To illustrate the model, the article will analyse the development in water management in the Amsterdam Region. In the push towards resilient and sustainable water systems, new decentralised technologies are introduced within new and existing developments within the city. Currently, these innovations are considered as valuable contributions to the strategy towards resilience. However, from interviews done with key actors within the water sector, it is increasingly becoming clear that there are substantial spatial and social consequences that might eventually reduce the resilience of the system. The analysis using the model of spatial flux shows that issues such as social cohesion, equity, affordability, the quality of the infrastructure, and the water quality will increasingly be influenced by the introduction of decentralised technologies. To overcome this issue, the current system of water governance needs to be rethought in order to assure that the development of a resilient water system will not paradoxically be a move into the other direction. The analysis with the model of spatial flux shows a potential direction.


Poster 124: A platform for enhancing urban resilience towards the increase of extreme precipitations and floods caused by climate change

Mr. Lucio Botarelli¹, Mrs. Stefania Nanni², Mrs. Stefania Pasetti³, Mrs Rita Mangiaracina⁴, Mrs. Chiara Caranti⁵

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Extreme precipitations and floods are expected to increase due to climate change. Projections of their impacts on urban settlements show a growing cost for recovering damages on assets and avoid casualties. Adaptation strategies and measures are needed to reduce risk exposures and tackle the emergencies. A peculiar problem is related to flash floods in small catchments connected with urban drainage system. High temporal and spatial resolution are required to monitor scenario evolution and apply predictive models. Traditional monitoring system could be not adequate to measure properly extreme precipitations and to inform deciders and stakeholders on time. Uncertainty comes from the lack of data and direct observation through appropriate sensors. Warning protocols and forecasting models about heavy rainfalls initiating flash floods in small basins are different due to the detailed simulations of topography, soil conditions, and ground cover. Critical infrastructures (e.g. road/railways transport networks, electricity/gas distribution) and buildings for primary services (e.g. hospitals, schools) in the urban area shall be monitored as potential targets. A platform feeded by advanced measuring system and equipped with simulation models could be a good adaptive answer for planning, forecast and acting properly during emergencies. The Life RainBo (31/07/2016 - 31/07/2019) is project funded by the EU Life Program, aiming to improve knowledge, methods and tools to tackle with extreme precipitations and floods. The expected results of the project are the implementation of an advanced weather monitoring framework based on a fast communication system, the creation of a software platform to provide data from survey, forecasts and models for administrations and water authorities before and during extreme and localized precipitation in sensitive river basins, and a warning protocol for catalogue the potential impacts on risk prone areas. The RainBo project has also policy implications through contributing to achieve EU policy objectives by supporting the development and implementation of local adaptation strategies and action plans against flood risks, on the basis of an improved detection of the phenomena and through advanced technologies for weather monitoring. The RainBo project is a follow-up of BLUEAP (Bologna Local Urban Environment Adaptation Plan for a Resilient City) LIFE project, which found out extreme rainfalls as a critical point for the town drainage system, and T-Rain, a Climate-KIC project, in terms of implementing a reliable service based on Big data coming from cellular networks. The study areas of are therefore located in Parma and Bologna, Emilia-Romagna Region, Italy.
Significance of your presentation to adaptation practice, policy and/or business?
The presentation (poster) of the aims of RainBo project is relevant for showing how the enhancement of urban resilience to flash floods due to climate change can take advantage from organizing a response platform comprehensive of monitoring system, forecasting models and warning protocols for preventing adverse events, for planning adaptation measures and managing emergencies actions.

Poster 125: Impact of climate change on glacier evolution and runoff generation in ice and snow melt dominated catchments in Austria

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Mountainous river basins with snow- and glacier-melt dominated runoff regimes are commonly referred to as ‘water towers’. This term strikingly acknowledges the fact that the seasonal release of melt water is also relevant for downstream communities outside mountainous regions. Due to increasing temperatures in the last decades, the seasonal snow cover and glaciers underwent a decline in snow cover duration and glaciated area, respectively. It is expected that the observed trends regarding seasonal shifts of snow cover duration and shrinkage of glacier volumes will continue and might even intensified as a consequence of climate change. The strong interrelations between climate and the cryospheric components of the hydrologic cycle will have far-reaching impacts on water availability as seasonal runoff patterns are strongly dependent on snow and glacier processes. For instance, changes in water availability might affect the supply of drinking and agricultural water, and the efficiency of hydropower production. Hence, adequate adaptation strategies that address these changes in a quantitative way are required.

We present findings of an impact study conducted in the Ötztal Alps (Austria), the most glaciered mountain range of the Eastern European Alps, focusing on the ice and snow melt induced alteration of both timing and magnitude of runoff. The study area comprises the catchments of the Ötztal, Pitztal, and Kaunertal valleys which are highly relevant for hydropower production.

The model experiment of the impact study comprises a model chain including spatial and temporal downscaling of climate scenarios, glacier evolution, and hydrological modelling. Downscaled Regional Climate Model (RCM) ensembles of available EURO-CORDEX runs are used to force two different model setups: (i) a coupled modelling system including a glacier evolution model (GEM) and the semi-distributed conceptual hydrological model HQsim, and (ii) the fully-distributed physically-based hydroclimatological model AMUNDSEN which has been extended by an alternative approach to account for changing glacier characteristics. As the spatial and temporal resolution of the EURO-CORDEX simulation does not match the requirements of the detailed models, further downscaling steps have been performed prior to the simulations. Spatial downscaling was carried out utilizing the quantile mapping approach supplemented by an optimum scale analysis in order to minimize the bias of the RCMs at the observational sites in the study area. A subsequent temporal downscaling was applied using the MELODIST software package in order to provide sub-daily time series of meteorological forcing data. Results of this multi-model approach will be presented and compared.

Significance of your presentation to adaptation practice, policy and/or business?
The complex interactions among climate, the seasonal snow cover, glaciers, and water availability require a comprehensive and quantitative assessment of the water balance of mountainous catchments. This poster presents a set of methods and tools that are suitable to understand complex hydrological processes in mountainous regions. They are scenario-capable and help to design adaptation measures for various societal and economical needs. As the methods are transferrable, they might be relevant for the design and implementation of adaptation measures in other mountainous regions as well.

**Poster 126: A runoff forecasting system for the river Inn as decision support/early warning system for hydropower management and civil protection**

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Decision support and early warning systems are a main technological action to support disaster risk reduction and adaptation. Flood forecasts play a central component for early warning as timely flood forecasting is an efficient instrument to (i) enable effective emergency response and (ii) enable hydropower plant operations with respect to flood control. Moreover, runoff forecasts as decision support system can support hydropower operators in their manifold day-to-day business (e.g. inflow forecasts for individual power plants, river regulations like residual water flows and hydropeaking, planning of revision works, and others). The development, implementation, operational application, and continuous further development of such systems are an iterative process involving various scientific disciplines and user groups.

The development of such an operational forecasting system for the Swiss and Austrian Alpine catchment of the river Inn was realized in a joint public-private research initiative of the affiliated institutions of this conference contribution. The catchment covers an area of 9,700 km² in total whereas the elevation reaches from approx. 450 m (Austrian-German border) up to approx. 4,050 m (Piz Bernina). The challenge for the development and operation of this forecast systems lies in the complex geological, meteorological, and topographical situation. Runoff generation processes in the sub-catchments reach from ice and snow melt dominated high Alpine headwater catchments to sub-catchments with a more or less Pre-alpine characteristic.

Following the flood event in 2002, the development of the forecasting system started with the prototype of the modular-based, hybrid hydrological/hydraulic setup from 2003 to 2006 which was continuously further developed since then. The current setup of the forecasting system called ‘HoPI – Hochwasserprognose Inn’ has the following modular structure:

- data management and pre-processing
- hydrological simulation of tributary catchments
- hydraulic as well as hydrological (for ensemble runs) wave propagation
- post-processing and visualization

Hydropower infrastructures are considered with defined operation rules.
Observed data and analyses data of previous meteorological nowcasts as well as nowcasts for the next forecast period drive the forecasting system. Beside the ‘main runs’ of the Austrian weather model INCA, seventeen additional ensemble members are considered. The current forecast period is up to 120 hours, the system is running at hourly time steps. Runoff generation from glaciated sub-catchments is modelled with the fully distributed water-balance model SES. By contrast, runoff generation from non-glaciated sub-catchments is modelled with the semi-distributed water balance model HQsim. The modelled runoff provides the boundary conditions (i) for a 1D-hydraulic model for the ‘main runs’ and (ii) the hydrological routing for the ‘ensemble runs’, respectively, of the river Inn. Depending on the user needs of the individual operational applications (energy supplier TIWAG- Tiroler Wasserkraft AG; Hydrographic Office, Province of the Tyrol; research centre alpS) post-processing routines and visualizations vary.

The current research activities are focusing on:

i. better understanding and modelling of snow-hydrological processes,

ii. development of a model output statistic (MOS) application in order to correct the model results in sub-catchments where runoff characteristic is highly dependent on hydropower operations,

iii. development of a new model architecture for the hydrological module of the system, and

iv. adapted calibration strategy.

The results will be implemented in the operational system until 2018.

With this contribution, we will present the current forecasting system, findings of current research activities to further developed the system, and experiences of the transdisciplinary co-operation.

**Significance of your presentation to adaptation practice, policy and/or business?**

With our contribution we will present a state-of-the-art forecasting system, experiences of its operational application, and experiences of the transdisciplinary research activity as well as the operational application for various user groups. The system was developed especially for the complex challenges in mountainous regions. As mountainous regions will be disproportional affected by climate change and mountainous regions are commonly referred to as ‘water towers’, we want to share our knowledge and our experiences with practitioners from other regions. Moreover, our system can be seen as framework which could be adapted and transferred to other regions to support flood and water resources management.

**Poster 127: Comparative analysis of flood risk evolution considering changes in climate, hydrology, and socio-economy as well as adaptation on the meso-scale**

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Flood damages have increased significantly during past decades whereas the overall magnitude of peak discharge does not have increased in the same way. Increases in human population, wealth, and urbanization in flood-prone areas have contributed to increased flood damages. Thus, understanding the drivers that alter flood risk is crucial for future flood risk management. The drivers of change emerge from complex interactions among the (i) climate system, (ii) terrestrial/hydrological system, and (iii) socio-economic system and their system changes over time.
Up to now, these systems have been addressed separately or considered incompletely in most flood risk related studies. The consideration of interactions among these systems requires both new approaches in modelling and stakeholder involvement focusing on the co-evolution of coupled human-hydrological systems. With respect to future flood risk it is therefore important to account for the long-term feedback of all drivers of flood risk.

With this contribution we present the methodological framework and first findings of a transdisciplinary project which take into account the mentioned three drivers of flood risk. The methodological framework represents a synthesis of the needs towards an integrative (adaptive) flood risk management under changing conditions. The project is called ‘HiFlow-CMA – High Resolution Flood Risk Assessment for Climate Change Adaptation with a Coupled Modelling Approach’ and the Austrian Federal Province of Vorarlberg serves as pilot study area. The overall aim is to analyse future flood risk and its implication on flood risk management. Potential adaptation measures (protection measures) are considered to assess their effectiveness to reduce flood losses. This is achieved by using a coupled modelling approach incorporating future scenarios of climate and land-use with corresponding effects on runoff generation by means of expert modelling and stakeholder engagement. Thereby, land-use change will not only alter the hydrological responses of the catchment areas but also changes in damage potential over time through settlement dynamics. To compare the effectiveness of exemplary adaptation measures, two different types of potential protection measures are compared: measures by spatial planning and flood-proof structural measures. The results obtained serve as a basis for investigating potential adaptation measures in a participatory manner addressing public authorities, insurances, spatial planner but also the general public. An implemented science-policy interface act as a bridge between the interests and demands of the stakeholders on one hand side and the model-based research activities on the other hand side.

Significance of your presentation to adaptation practice, policy and/or business?
The developments presented are an innovative contribution towards integrative flood risk management under changing environmental and social conditions in a transdisciplinary manner as demanded by the EU Water Framework Directive.

The framework developed will be generally applicable, can therefore be transferred to other regions and serves as a tool for Disaster Risk Reduction and Climate Change Adaptation. The project itself and the content of the presentation addresses the needs of various stakeholders involved in flood risk management from a methodological and/or a practise-oriented point of view.

Poster 128: Climate change, glacier retreat and lake outburst floods: challenges for adaptation and mitigation in Peruvian Andes

Mr. Adam Emmer¹²
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Recent climate change-induced glacier retreat in Peruvian Andes has led to the formation and evolution of different sub-types of glacial lakes. These young lakes are generally susceptible to produce glacial lake outburst floods (GLOFs). Glacial lake outburst floods are characterised by extreme peak discharges and associated destructive potential, making mitigation and adaptation rather challenging issue.
In our projects, we focused on the highest Peruvian mountain range Cordillera Blanca, Ancash region. In a frame of GLOF risk management, we have firstly developed a methodological framework for the identification of hazardous lakes, based on analysis of previous GLOFs. Secondly, we did inventory of lakes of the Cordillera Blanca, identifying 882 lakes. In order to identify potentially hazardous ones, we thirdly applied our method to all large lakes \( n = 64 \). Fourthly, we have used recent GLOFs to set up the parameters of r.avaflow model in order to use it for modelling of potential GLOFs originating in the lakes, which were identified as hazardous. Parallely, we also researched effectiveness of different types of structural mitigation measures for different scenarios of causes and mechanisms of GLOFs. Challenges and implications for adaptations in a frame of risk management were identified as follow: (i) the magnitude of GLOF can be mitigated by implementation of specific type of structural mitigation measures; (ii) the use of ‘traditional’ flood protecting measures is limited due to the extreme magnitude of these events; (iii) modelled results may provide valuable inputs for enhanced spatial planning; (iv) soft adaptation measures (e.g., prevention, education) in combination with early warning systems may decreased vulnerability of the population at risk significantly.

**Significance of your presentation to adaptation practice, policy and/or business?**

This work has been conducted in close cooperation with local authorities (Autoridad Nacional del Agua). Presented results have potential to be used in the GLOF risk management on local level.

**Poster 129: Assessing Impact of Climate Change on Runoffs in the Gumara and Gilgel Abbay Watersheds, the upper Blue Nile basin, Ethiopia**

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Impact assessment is critical to the planning of adaption measures. The Gilgel Abbay and Gumara watersheds provide more than 65% of the inflow to the Lake Tana (having a lake area of 3041 km\(^2\)) and are also the home of nearly 2 million people that depend entirely on subsistence rain-fed agricultural activities. Lake Tana is the water tower of the Ethiopia’s Grand Renaissance Dam on the Blue Nile. Any potential impacts of climate change on runoffs in the Gumara and Gilgel Abbay Watersheds will have substantial consequences on regional water resources in east Africa. In this study, projections of seven global circulation models (GCMs) associated with high and medium–low Representative Concentration Pathways (RCP 8.5 and RCP 4.5) for the period 2021–2040 and 2081–2100 were adopted to assess impacts of climate change on runoffs in Gumara and Gilgel Abbay watersheds. The GCMs selected were first screened in harmony with baseline climate statistics of study areas. Based on climate projections and statistical characteristics of historical weather data, a weather generator was employed to generate daily temperature and precipitation as inputs for the GWLF hydrological model to simulate runoffs. Changes of projected temperature and precipitation were analyzed to explain variations of evapotranspiration and influences on future runoffs. We found that, despite the fact that the projected magnitude varies among different GCMs, increasing in the wet and a decreasing in dry seasons runoffs were observed in both time windows in Gilgel Abbay and Gumara watersheds. In both watersheds the change in runoffs is mainly attributes to the increase of precipitations projected by most of GCMs. In contrast to great increases in runoffs, the increase of evapotranspiration by elevating temperature is less significant. In view of seasonal variations, we found a slight decrease at the beginning and an increase at the end of the rainy season in comparison with the baseline which is critical to rain-fed agricultural activities lacking sufficient irrigation systems. Although the increasing runoffs will provide more water inflow to the Lake Tana, the increase of precipitation in wet season makes the wet season wetter and implies higher possibility of flash floods. This will have deleterious
consequences in the local community. Therefore, concerned water organizations in local, state, and federal levels shall be prepared to harness the opportunities with more water resources for utilization and management, as well as flood preventive measures.

**Significance to adaptation practice, policy and/or business?**
Decrease runoffs in dry-season further intensify existing shortage of irrigation water demand. These changes will have deleterious consequences on the economic wellbeing of the country and require successful implementation of adaption measures like alternative sources of water (groundwater) to reduce vulnerability. On other hand, increase of runoff in wet-season will expose the community to flooding and displacement. Policy makers and water resources managers should have to develop adaptation measures smartly with climate informed.

**Poster 130: Building a Resilient Great Lakes Coastal Community in Erie, Pennsylvania**

*Ms Sara Stahlman*

1. *Pennsylvania Sea Grant, Erie, United States*

Over the last several years, Great Lakes communities have faced an increase in the frequency and severity of climate-related impacts such as extreme temperatures, severe storm events, drought, and flooding. While these impacts are becoming more evident throughout the region, coastal communities residing on the Great Lakes continue to face unique barriers associated with responding to these challenges, including a lack of understanding about climate science, specific local impacts, which features of their community are at the most risk, and how to focus limited resources towards their climate adaptation goals.

The Community Resiliency Workgroup (CRW), made up of partner organizations in the Erie, Pennsylvania area (Pennsylvania Sea Grant, Environment Erie, the Northwest Pennsylvania Green Economy Taskforce, and Erie County Sustainability Office), have come together to assist Erie in moving forward with climate adaptation. This poster will highlight several of the projects the CRW has undertaken to increase resiliency in the community. Over the past three years, the CRW has hosted a series of climate symposiums targeted towards climate vulnerabilities in the region, including hazardous weather, impacts to tourism, and impacts to agriculture. These summits gather various sectors of the community such as local businesses, municipal leaders, planners, non-profit groups, state agencies, and members of the general public to learn and discuss climate change impacts through various methods including films, panel discussions, presentations, and focus groups. Colorful and informative infographics were developed for each summit that highlights regional challenges to consider with each topic, as well as potential adaptation and mitigation strategies for each. This poster will also highlight the results of a focus group that identified barriers to climate adaptation in Erie, and what the CRW and Erie region are doing to address those barriers.

The overall goal of this work is to take the information learned from the summits and develop a county-wide climate action plan which would build knowledge and resiliency in Erie by providing coordinated action strategies for each vulnerability. This work provides a regional strategy for building hazard resilient communities that can be used throughout the Great Lakes and other similar coastal communities around the world.
Significance of your presentation to adaptation practice, policy and/or business?
Erie, like many other Great Lakes communities, faces unique challenges to adaptation planning, including lack of understanding of future threats, lack of available information, political barriers, and lack of capacity to move forward on their own. This poster highlights methods the CRW is taking to overcome these barriers and move the community from the first steps of adaptation (assessment of impacts, vulnerabilities, and risks) all the way to the creating action strategies. Other regions that face similar barriers and restrictions could benefit from learning about these adaptation practices and utilize similar strategies in their own communities.

Poster 131: Model projections of glacial runoff in South Asia under high-end climate change scenarios.

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¹University Of Exeter, Exeter, United Kingdom , ²University of Bristol, Bristol, United Kingdom, ³Met Office Hadley Centre, Exeter, United Kingdom

The Indus, Ganges and Brahmaputra river systems supply fresh water to approximately 0.8 billion people in South Asia[1]. Runoff in these rivers is supplied by glacier melting in the Tibetan plateaux and surrounding mountain ranges during the dry season. This precious water supply could be under threat as warming temperatures cause glaciers to retreat. Future projections suggest that runoff may increase until 2050 due to enhanced glacier melting combined with an increase in monsoon precipitation [2-4], however, much of the uncertainty in these estimates are associated with how monsoon precipitation will change in the future.

To access the impact of glacial melt on water supply we have developed a glacier scheme for the Joint UK Land Environment Simulator (JULES). JULES is the land surface component of the UK Met Office Global Climate Model which has been developed to include a crop model, an irrigation scheme and river routing models.

In this presentation we show projections of runoff for the rest of this century under the high-end climate change scenarios of 2, 4 and 6 degree global average warming. To capture the uncertainty in future monsoon precipitation, we force the model with an ensemble of the regional climate model data from the ER-EARTH-HR model which have been generated for the HELIX High-End cLimate Impacts and eXtremes (HELIX) project.

Acknowledgments:
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References:

Coastal

Poster 132: Sea level rise, coastal flood hazard and adaptation assessment toolkit for cities

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Population migration and sea level rise mean that coastal cities face a range of increasingly severe challenges in the future, and many cities will not be able to rely solely on engineering structures for flood protection. They will need to develop a suite of policy responses to increase their resilience in the face of uncertain and rapidly developing flood risk.

A significant wealth of papers and techniques have been built up within the technical and academic flood risk management community, but often the application of each of these is specific to a particular scenario, remit, geographic application or data availability. This project was motivated by a desire for a more universally applicable toolkit that would give coastal city planners a methodology to assess the risks for the full range of plausible sea-level rise trajectories. The toolkit helps to identify the most suitable adaptation strategies for a given city, taking into account the characteristics, opportunities and constraints of its specific country or locality in relation to economic, political, social and environmental priorities.

For many cities, the tools to promote flood risk adaptation for sea level rise are already within their capacity, through modification of policy tools developed to address other land-use problems. In some cases, defending all areas may no longer be an option, and the drive to refocus development around lower risk areas may present significant opportunities. The paper outlines the tools available to help city managers choose the most appropriate protection, adaptation and mitigation measures.

Key strategies are illustrated in their application through case studies based on forward thinking cities engaged in effective adaptation, including Rotterdam (Netherlands), Ho Chi Minh City (Vietnam), Hull (UK), Bristol (UK), Norfolk, Virginia (USA) and New York (USA). The findings from these cities show that the main barriers to adaptation are governance, politics, and the costs of adaptation responses. The following key conclusions are drawn from the case studies.

- Incentives are often needed for improved risk management at community and property levels.
- More effective adaptation occurs when adaptation strategy and insurance are linked with land use planning and building codes.
- Collaborative regional planning is critical, although strong leadership is essential.
- It can help to start with low regret measures and easy wins.
- It is important to plan now to finance future adaptation measures.
- Extreme events can act as policy windows: it is important to have a plan ready to go.
Significance of your presentation to adaptation practice, policy and/or business?
The toolkit helps to identify the most suitable adaptation strategies for a given city, taking into account the characteristics, opportunities and constraints of its specific country or locality in relation to economic, political, social and environmental priorities. For many cities, the tools to promote flood risk adaptation for sea level rise are already within their capacity, through modification of policy tools developed to address other land-use problems. The paper outlines the tools available and lessons learned from case studies to help city managers choose the most appropriate protection, adaptation and mitigation measures.

Poster 133: Impacts of sea-level rise and storm surge as a result of climate change in the Clyde Marine Region

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The poster will present the key findings of a report by Arup and the University of Glasgow, published in 2016 by Scottish Natural Heritage; legal & policy overview, projected level of sea-level rise (and storm surges) in the Clyde Marine Region (based on UKCP09 projections, High scenario, 95% probability, 2080), mapping analysis of potential coastal areas at risk, likely impacts on natural features such as salt marsh and designated sites, and initial assessment of managed realignment potential at 3 sites in the Clyde estuary and 1 site at Holy Loch. It will also consider the challenges of ensuring that the findings are taken into account at the local level (see below).

How is your session significant to adaptation practice, policy and/or business?
The poster will consider the challenges of adaptation in practice - despite legal instruments and policy being in place, there are challenges both to working at a regional scale across multiple public authorities and agencies and also to working at a local scale, with key stakeholders, to ensure adaptation opportunities happen. In particular the session will consider the role of regional marine planning in realising coastal adaptation opportunities. The session will encourage delegates to consider ways to progress action by sharing experiences and ideas from other regions and countries.

Poster 134: A National Coastal Erosion Risk Assessment for Scotland

James Fitton¹, Jim Hansom¹ & Alistair Rennie²
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Coastal erosion has historically been an issue in many parts of Scotland and will continue to cause problems into the future. Scotland has many key assets located at the coast in addition to 3.5 million people who live within 10 km of the coast. In order to manage the coast in a sustainable manner and to ensure that all stakeholders benefit, coastal managers need to be aware of the areas that are physically susceptible to coastal erosion, as well as identify those groups of people who are the most vulnerable and are at risk from the impact of coastal erosion.

In response to this need, a Coastal Erosion Susceptibility Model (CESM) and a Coastal Erosion Vulnerability Model (CEVM) was developed for Scotland. The CESM is a national raster model (50 m cell size) which uses a number of datasets; ground elevation, rockhead elevation, proximity to the open coast, wave exposure,
presence of defences, and sediment supply to identify those areas most susceptible to erosion. The CESM can then be used with other asset data such as locations of properties, roads and railways etc. to identify the assets that are potentially exposed to coastal erosion. The CEVM uses data from the Experian Mosaic Scotland geodemographic database, which categorises each postcode in Scotland into one of 44 socioeconomic groups based on a range of socioeconomic indicators such as income, qualifications, property type, education etc. Key vulnerability indicators were identified and extracted to form a single vulnerability index variable.

Combining the two models allows identification of areas where both coastal erosion susceptibility and vulnerability is high i.e. coastal erosion risk. The model serves as a tool to help coastal managers target those areas requiring more detailed investigation, increasing the efficiency of resource allocation. The raster-based approach used here has not previously been applied at a national scale since the quality and resolution of data required is difficult to obtain. However the advantage of a raster based approach over a line output is its greater flexibility when combined with other data. The CESM and CEVM allow both coastal managers and the public to adopt proactive approaches to assess the risk to coastal assets, adapt to coastal change and build toward a sustainable coastal future.

Significance of your presentation to adaptation practice, policy and/or business?
The CESM has had a significant impact upon coastal and flood management in Scotland with a version of the CESM currently in use by the Scottish Environment Protection Agency (SEPA) to identify areas where removal of natural flood defence assets (beaches, sand dunes, salt marsh) by erosion may exacerbate the extent and impact of coastal flooding. The CESM is also utilised within the National Coastal Change Assessment (NCCA) which will inform existing strategic planning (Shoreline Management Plans, Flood Risk Management Planning, Strategic and Local Plans, National and Regional Marine Planning etc.)

Poster 135: Adapting to sea-level rise at 1.5 degree celsius: A case study of the Maldives

Dr. Sally Brown¹, Dr Matthew Wadey¹, Prof Robert Nicholls¹, Mr Ali Shareef², Mr Zammath Khaleel², Dr Jochen Hinkel³, Dr Daniel Lincke³, Dr Ivan Haigh¹, Dr Maurice McCabe⁴

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Small island developing states lobbied and were granted under the Paris Agreement, special consideration for climate change adaptation, even at 1.5°C. For the world’s lowest lying nation, the Maldives (with a mean elevation of 1m above mean sea-level), adaptation to sea-level rise is required on a national scale. Even with successful climate change mitigation leading to the stabilisation of surface temperatures, sea-levels will keep on rising due to the commitment to sea-level rise. Hence, impacts are delayed, but not totally avoided. This increases the uncertainty of the magnitude of rise, but also provides valuable planning time to cope with impacts. This includes tourist islands, where many Europeans visit.

The Maldives is undergoing rapid development, with large numbers of people migrating to the capital city. To relieve population pressure in the capital, a new artificial island, Hulhumalé, was built in the late 1990s with a mean elevation of 2m above mean sea-level. Using hindcast wave data with bathymetric and topographic measurements in an overtopping model, extreme water levels were analysed with incremental sea-level rise. Sensitivities (e.g. reef growth, bathymetry, roughness) were tested for and indicated a range of overtopping volumes and water depths. When considering the most severe extreme water levels
(including tides), ‘nuisance’ flooding (< 0.2m water depth) could result with 0.6m of sea-level rise. With 1m of sea-level rise, more severe flooding could result, and with 1.5m sea-level rise regular flooding could occur, and with 2m of sea-level rise, the island would be totally flooded. Nuisance flooding could occur by 2090s, and continue into the 21st century.

A 1.5°C rise in temperature by the end of the century and resulting sea-level rise, could mean periodic flooding in the Maldives. When a 1.5°C first occurs, the consequences of flooding could be reduced through local level adaptation. However, over longer timescales (e.g. > century) where temperatures may stabilise, but where sea-levels keep rising, larger-scale government led adaptation would be required. Given the large uncertainty in sea-level rise and significant assets, incremental adaptation planning for Hulhumalé is advised.

At a national scale, adaptation is complex due to cultural ties, legislation and wider development issues, and requires careful consideration and planning from the Maldivian government and international community. Adaptation, through hard protection is expensive and cannot be undertaken for every island, particularly those that have low population densities. Climate change mitigation helps provides time to consider other adaptation options.

**Significance of your presentation to adaptation practice, policy and/or business?**

Our research involves the Maldivian government, and has indicate a possible lifespan of one of their major development centres. This information could be useful to others researching vulnerable areas. The results have informed the government of long-term risks associated with climate change and sea-level rise, making them consider beyond their normal 20-25 year time frame. We have discussed with them different ways to adapt, from hard engineering practices to policies and regulations that occur simultaneous to development, including the concept of adaptation pathways. This has helped to broaden the number of adaptation options available to them.

**Urban, energy & infrastructure**

**Poster 136: How does Amsterdam use retrofitting of urban areas for climate proofing a neighborhood / a field laboratory study**

ir Linda Hooijer, **Prof Jeroen Kluck**

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Although there is elaborate technical knowledge on climate adaptation, the implementation and involvement of residents stays behind. In order to learn why and in order to identify obstacles and solutions, we started a field laboratory research. In this research we follow the process of major maintenance in the urban neighborhood Middenmeer, Amsterdam. In 2018 the city of Amsterdam will retrofit the urban space and renew the sewer in area. This is a once in 30 years opportunity to make it climate proof. This requires the collaboration of the municipality and the local water company and a change of working in the institutes and involvement of the residents.

In the research we observed if design choices of the municipality also are climate proof. We visualize the decision moments in a timeline. To properly assess the choices for climate resilience we used a reference design, prepared by technical researchers of the Amsterdam University of Applied sciences. Next to this, we interviewed the professionals of the community and Watercompany about their
responsibility and role in relation to climate resilience. We also asked them if and how they involve residents in order to find out how these can have a meaningful contribution to a climate-proof setup in the process of the retrofit operation.

In parallel, we investigated the opinion of the people in the neighborhood. What does climate-proofing mean for the residents? By means of an area analysis, and area scans we looked for opportunities related to climate resilience. What are the problems, desires, needs and motivation, energy of local actors and how can we reach them? Do people consider climateproofing as their responsibility and are they willing to take a role. What holds them back?

Together with the municipality we organize interventions and help to make a platform for residents and entrepreneurs to share information and ideas.

In the paper we will present results in two storylines:

- To what extent do the municipality and the water company succeed in implementing a climate-proof design in the process of retrofitting?
- Are the needs of the locals in terms of climate resilience in the neighborhood known and how are they prepared to make an own contribution to climate resilience.

What is the relationship between these storylines? Can they reinforce each other? Is this local force sufficiently recognized and what added value is possible?

**Poster 137: Really cooling water bodies in cities - REALCOOL**

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Many cities around the globe suffer from urban heat problems and climate change is likely to exacerbate it. Faced to the importance of adapting urban areas to this phenomenon, urban climate research has been stating the importance of urban water bodies, assuming that they necessarily reduce air temperature. Urban designers have then been basing their designs around water on these assumptions. Recent research shows, however, that water bodies may actually have a warming effect, particularly during the night. It follows that designers need to be given guidance on how to design urban water bodies with an effective cooling potential.

The goal of this research targeted at design professionals is to develop prototypes of water bodies for cities of temperate climates able of actually cooling its surroundings and being easily integrated into urban design. Which combinations of urban water bodies with shading, evaporation and ventilation strategies are most effective in improving outdoor human thermal sensation? In addition, what is the potential of these water bodies in retaining rainwater?

This research follows a Research Through Design method - an iterative multiple cycle process where each cycle is based on designing, assessing, refining and testing. Following the testing results, the designs will be adjusted, improved and tested again in a number of cycles necessary to the achievement of consistent final design prototypes. Testing will include micrometeorological simulations (Envi-Met® and Cool Water Tool) and external feedback by different entities (scientists, consultancies, urban design and landscape
architecture offices, municipalities and the general public) on common urban design criteria (perception, functional, cost-effectiveness and maintenance). The research aims at making optimal design prototypes for delivering better conditions for outdoor human thermal sensation that designers can feel impelled to take as a design conceptual framework.

**Significance of your presentation to adaptation practice, policy and/or business?**
This research sheds light on the use of urban water bodies for cooling their surrounding environment and simultaneously, for retaining larger amounts of rainwater. The final output are design prototypes, targeted at design practice, showing optimal spatial configurations as well as the urban climate processes according to which water bodies influence the urban climate at the micrometeorological scale. This can have a straightforward impact in the implementation of well-educated adaptation strategies into urban design and landscape architecture practice.

**Poster 138: The Use of Artificial Thermal Mountains for Large-Scale Carbon Draw-Down and Reclaiming Desert Land**

**Mr. George Knox**, Professor Colin McInnes

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Due to the long-term impact of increasing CO\textsubscript{2} concentration in the atmosphere, it is important to explore large-scale options for carbon draw-down. A potential method is using the thermal mountain effect, a phenomenon whereby air passing over surfaces of increased temperature is forced upwards, and so can induce precipitation much like wind blowing across a physical mountain. This could be achieved artificially by deploying a dark surface which will absorb more solar radiation than its surroundings and therefore have a higher surface temperature. The subsequently induced rainfall would promote vegetation growth, sequestering carbon from the air.

The impact of the system could be maximised by deployment in the desert, where the reflective sand would offer a greater temperature contrast. By harnessing positive feedback effects, afforestation and pushing back desert margins could be achieved by relatively modest levels of intervention. The presentation will cover the physics behind the concept, approximate costs for its deployment in various suitable locations and discuss the environmental and economic benefits of such a scheme.

**Significance of your presentation to adaptation practice, policy and/or business? (100 words):** Large scale carbon draw-down concepts such as utilisation of the thermal mountain effect highlight the necessity for international cooperation in combatting climate change, along with the importance of realistically considering large-scale options. Artificial thermal mountains also offer an interesting opportunity for businesses or governments to develop new carbon negative technology – after the initial investment into constructing the thermal mountain, desert land could then be transformed through forestry or farming.

**Poster 139: The impact of green water scarcity on land cover pattern under future climate scenario: a Portuguese case study**

Dr. Paula Quinteiro, **Sandra Rafael**, Dr. Carlos Borrego, Dr. Luís Arroja, Dr. Ana Cláudia Dias

1University Of Aveiro, Aveiro, Portugal
Observed human-induced climate changes have been changing precipitation and temperature patterns, affecting the quantity and quality of freshwater resources for agriculture and forestry. The impacts related with water use, and mainly the impact of green water flows, are particularly relevant for agricultural and agro-forestry based products, depending on local land-use and land cover changes. Green water flows refer to the portions of green water (from rain) used by vegetation that is evaporated or transpired. This is an on-going research issue in Life Cycle Assessment (LCA), since the environmental mechanisms of green water consumption are not yet well understood. These mechanisms are: (1) potential disturbances of regional long-term availability of surface blue water (called as green water and soil interface) due to changes in green water use, and; (2) potential perturbations in the evaporation and transpiration that is recycled into the atmosphere, and then, in the rainfall that returns to the regional terrestrial ecosystem (called as green water and atmosphere interface), due to land covers.

With current climate conditions, the developed green water scarcity indicators (ranging from 0.01 to 1) for both interfaces at 0.5 degrees global domain shows high variability, mostly in the northern hemisphere. This means that this hemisphere already experiences reduction of green water flows recycled to atmosphere, potentially affecting regional rainfall levels to maintain agriculture and forestry. In addition, some regions of the northern hemisphere already experience disturbances in the production of surface blue water.

This study is devoted to evaluate the changes in the green water scarcity indicators for a future climate projections downscaled to Portugal from the CMIP5 earth system model MPI-ESM, for the Representative Concentration Pathway RCP 8.5 scenario. Preliminary results based on the outcomes of the CLICURB project – Urban Atmospheric Quality, Climate Change and Resilience indicate that the precipitation levels will decrease around 1 to 5 mm/day in Portugal (mainly during Spring and Autumn) in a future climate. These changes in the green water scarcity indicators allow to the midpoint water focused-LCA methodology to assess the actual and future magnitude of potential impacts related to green water. This knowledge is crucial to evaluate how green water demand and availability can change blue water production, ensuring a sustainable consumption of water, demystifying the idea that crops and forest-based products present a huge consumption of green water, leading to severe depletion of water resources and droughts in the future.

Significance of your presentation to adaptation practice, policy and/or business?
The consideration of future climate in midpoint water-focused LCA studies, using water scarcity indicators, is useful for environmental decision-support in the production of rain feed agriculture and forestry, allowing for accounting the water scarcity in environmental and economic decision-makers. In addition, measures to overcome the inefficient of water use and its shortage can be developed and adopted with the support of these current and future green water scarcity indicators.

Poster 140: Influence of resilient measures on urban energy fluxes: a Portuguese study case
Ms Sandra Rafael¹, Dr Vera Rodrigues¹, Dr Carlos Borrego¹, Dr Myriam Lopes¹
¹University Of Aveiro, Aveiro, Portugal

Today more than half of the world’s population lives in urban areas. In Europe, nearly 75% of Europeans live in cities, and by 2050 this is expected to rise to 80%. Cities are no longer only economic, social and environmental stimulators, but are in the forefront to achieve the sustainable development. A recent key issue for urban investigations is related with the understanding of how energy in the form of radiation and...
heat (energy fluxes) influences the urban climate as well as the understanding of how urban geometry and urban materials influence the magnitude and the behaviour of these fluxes. This information is vital to address the challenges of urban planning and sustainability, for instance to resources management and to develop climate change mitigation and adaptation strategies. The goal of this work is to evaluate the influence of the application of resilience measures, such as adaptation strategies to deal with heat waves impacts in the urban energy fluxes for a future climate projections downscaled to Porto urban area. To accomplish this goal a modelling setup which includes the Weather Research and Forecasting Model (WRF) and the Surface Urban Energy and Water Balance Scheme (SUEWS) was developed and applied, and three resilience measures were studied and compared with a baseline scenario: i) introduction of white roofs in high density residential areas; ii) double the urban green areas; and iii) combination of the two previous measures. The most important results are the following: i) the duplication of urban green areas increases the magnitude of the latent heat flux (maximum increase of +200 W m\(^{-2}\)), which is result of the increase of the evaporation process; ii) more latent heat flux means that a higher proportion of solar radiation is used in the evaporative process thereby a reduction of sensible heat flux is obtained (reduction of up to -170 W m\(^{-2}\)), contributing to a reduction in the energy released into the atmosphere and for the cooling of the surface; iii) the introduction of white roofs implies that less solar radiation is absorbed by the surfaces, which promotes a reduction of the sensible and storage heat flux (maximum reductions of -63 and -35 W m\(^{-2}\)), contributing also to a reduction in the surface temperature. The results show that changes in the urban planning can influence the magnitude of the energy fluxes, which can directly affect the quality of citizen’s life (e.g. thermal comfort).

**Significance of your presentation to adaptation practice, policy and/or business?**

In the last years, the concept of resilience is gaining increasing prominence across the scientific community. This work shows that the adoption of adaption measures directly improves cities resilience and provides support for dealing with the effects of climate change and extreme events, namely heat waves. The adopted methodology may be replicated to different planning scenarios in order to assess different types of proactive adaptation strategies, contributing to the development of more resilient and sustainable cities.

**Poster 141: Climate services for wind energy**

Mr. Llorenç Lledó\(^1\), Dr. Dragana Bojovic\(^1\), Dr. Isadora Christel\(^1\), Dr. Albert Soret\(^1\), Dr. Francisco Javier Doblas-Reyes\(^1,2\)

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The energy sector is the largest greenhouse gases emitting sector, being responsible for 35% of global emissions (IPCC, 2014). Mitigation efforts are promoting the growth of low-carbon energies, while the EU targets at least 27% share of renewable energy consumption by 2030 (EC, 2014). This ever-growing share of renewables makes production, transmission and distribution of energy increasingly sensitive to weather and climate variability. Energy producers, traders and operators need to anticipate resources, their variability and trends at several temporal scales, from hours to decades. Synergies between climate adaptation and mitigation plans are thus crucial for the energy sector to achieve its climate related goals.

While the energy sector has long been using weather forecasts and historical climatologies, the Copernicus Climate Change Service programme (C3S) emphasises the use of climate services providing seasonal predictions and climate projections. To enhance the role of climate services in the energy sector decision-making, certain aspects related to climate science, such as uncertainty representation and tailoring of the
information, need to be tackled. Within C3S, the CLIM4ENERGY project addresses these challenges by designing, producing and evaluating specific climate services for the energy sector.

Barcelona Supercomputing Centre's (BSC) service will provide climatic information impacting wind power generation. The use of a co-design approach, involving end-users from the very beginning of the process, helps understanding user requirements and shaping the service's visualization output. In close collaboration with EDPR, capacity factor emerged as the most useful indicator for assessing wind power production. BSC uses seasonal wind speed predictions from ECMWF System4 to provide capacity factor predictions for the next season at least one month in advance. A participatory design approach has also helped defining the methodology for computing capacity factor. In addition, end-users will provide site specific data for the practical demonstration of this service and evaluate the usability of the service, giving feedback to shape the final product.

The climate service based on seasonal forecasts and climate projections of capacity factor will contribute to a more efficient energy planning, resulting in better informed mitigation measures. Besides mitigation, this service can support adaptation measures of the wind energy sector by providing more accurate information for: resource modelling, encouraging banks to increase amount of lending; increased turbine availability and minimized production losses from better operation and maintenance scheduling. All this will favour the adoption and testing of adaptation strategies well ahead of the local impact of anthropogenic global change.

**Significance of your presentation to adaptation practice, policy and/or business?**

A flexible energy sector, with an increasing share of renewables in the energy mix, needs to be able to adapt to changing trends in resources availability. This presentation illustrates how to use both seasonal climate predictions and long-term climate projections to provide climatic information susceptible of impacting wind power generation. Tailored to satisfy user needs and understandings, this knowledge can inform decision-making in this ever-growing sector that can significantly contribute to climate change mitigation and adaptation. Wind power business emerges as the primary beneficiary of this new service.

**References:**


**Poster 142: Co-designing the next generation of climate models for a better informed society**

Dr. Dragana Bojovic¹, Dr. Eveline C. van der Linden², Dr. Isadora Christel¹, Dr. Erika Palin³

¹Barcelona Supercomputing Center (BSC), Barcelona, Spain, ²Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands, ³Met Office Hadley Centre, Exeter, United Kingdom

A wide range of decision-makers, from governments, over businesses to the general public, need
information from climate projections to respond and adapt to climate change. Despite the improvements in climate change projections and information associated with climate change impacts at a global scale, large uncertainties still limit our understandings at the spatial scales relevant for the society. Finer scale projections are vital to assess how the risks of high-impact climate events, such as heat waves, floods, and droughts, will change over the next few decades. Physical processes behind high-impact events are better resolved in high-resolution (~25 km) global climate models than in commonly used, coarse-resolution (~100 km) global and regional climate models. Consequently, resolution has been identified as an essential element for understanding the detailed characteristics of climatic events, including their duration, intensity, frequency, spatial distribution, and interannual variability.

Processed-Based Climate Simulation: Advances in High-Resolution Modelling and European Climate Risk Assessment (PRIMAVERA) project develops new generation high-resolution global climate models, capable of simulating and predicting regional climate with high fidelity. Near-term (2020-2050) climate change information should however be in line with decision-makers’ needs and understandings. A common barrier to the use of climate information is a mutual lack of understanding between the capabilities of the producers of climate science and needs of the users. PRIMAVERA applies a co-design approach to tailor its scientific outputs to the user needs. As a first step, a user engagement plan was developed to define engagement activities best suited to each stage of the project development. Specific attention is given to visualisation and communication of information to improve end-user understanding and enhance information use. PRIMAVERA project goes above simple information dissemination, while enforcing ideas exchange between decision-makers and the project scientists. A user interface platform will be developed to facilitate this information exchange. This participatory design approach will help scientists understand decision-makers’ short-term (operational) and longer-term (planning) strategies that are affected by climate variability. The scientists will together with users explore potential risk of future climate variability to the identified strategies in a series of case studies. Finally, the project will identify unique features of high-resolution simulations that can improve representation of climate events of relevance to end-users.

Detailed information about near-term behaviour of climate events, tailored to meet users’ needs and understandings, will inform wide range of decisions related to adaptation to high-impact climate events that are with an increasing frequency affecting our society.

Poster 143: Effects of integrating climate feedback from CMIP5 earth system models in the energy system integrated assessment model TIAM-UCL.

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Projections of the future state of the environment are required to advise society and government on the nature and implications of climate change, and to provide a rigorous basis for the evaluation of policies to avoid or adapt to climate change. Integrated Assessment Models (IAMs) provide a way of combing a representation of climate with models of aspects of the socio-economic system, such as the energy sector (TIAM-UCL). The climate system in IAMs is a simple representation of the physical climate, which is usually restricted to greenhouse gases concentration, radiative forcing, global average temperature, sea level rise and climate change’s economic damages. However the stages of the atmospheric treatment within the climate module express large uncertainties that impacts on the carbon budget available to achieve strong climate target. To improve policy advice based upon the Integrated Assessment Models, better treatment of the output of the latest climate model experiments is included in the climate treatment of the TIAM-UCL.
model to provide information on the sensitivity of the socio-economic response to different climate factors and to help guide future mitigation/adaptation efforts.

We have decided to study the impacts and effects of the three following parameters:

1. The carbon cycle: we have tuned the carbon cycle to the responses of the CMIP5 models, and use a subset (high and low response) of these tunings so sample the carbon cycle uncertainty – additional emissions are now represented under temperature changes.

2. The transient climate response: has been extracted for different CMIP5 models from the 4 times abrupt CO2 experiment. The extremes are included in the TIAM-UCL to calculate the global temperature change.

3. The additional radiative forcing feedbacks: following IPCC AR5 the strength of these has been diagnosed as additional forcing per degree of warming. We have added these as an additional temperature dependant forcing.

From these improvement we have quantified the sensitivity in the climate uncertainty on the assessment modelling tool. The technologies and emissions pathways produced under the improved climate module are analysed. The systematic study of the implementation of the different versions of the earth system feedbacks in the TIAM-UCL model shows that under certain conditions negative emission technologies are becoming necessary to achieve the Paris targets.

The subsequent improved emission pathways for anthropogenic forcing factors will then benefit the stakeholders and the climate modelling community to help future decision takings on mitigation and/or adaptation.

**Poster 144: Economic Implications from Electricity Grid Outages: On the Relevance of Interregional Heterogeneity of Outages Costs for Adapting Electricity Distribution Networks**

*Mr. Marius Stankoweit*

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Besides its essential role towards a carbon-neutral electricity generation, the reliability of the electricity sector is of vital importance for the proper functioning of a society and its economy. Therefore, it is regarded as part of a country’s critical infrastructure, which is attributed to all assets of such essential importance. The fact that an electricity blackout could also lead to the collapse of other critical infrastructures emphasizes the special importance of the sector. Hence, the vulnerability of the energy sector due to climate change increasingly becomes a matter of research.

The German “Energiewende” triggers the need for substantially reconfiguring the electricity distribution grids. Due to the long life expectancy of energy infrastructure investments, the infrastructure planning should consider two streams of information:

(i) The economic sensitivity of the individual asset, which represents the economic implications resulting from an interruption of the proper functioning of an asset;

(ii) The actual climatic conditions and potential alterations of relevant climatic variables due to climate change. Historically, grid disruptions occurred mainly in the distribution networks, most frequently caused by wind conditions.
Based on data on the characteristics of the regional distribution networks extracted from the companies’ legal reporting obligations as well as macroeconomic data on county-level available via the German federal statistical office, a parameter that quantifies the economic sensitivity to a grid interruption is determined. For that purpose, in a first step, the monetary loss from a non-delivered kWh of electricity, the so-called Value of Lost Load, is determined from a macroeconomic model relying on the macroeconomic data on county resolution. In a second step, the Value of Lost Load is calculated with respect to each voltage level of each distribution grid operator. Finally, the paper proposes a new concept, the Value of Lost Grid, to determine the economic sensitivity of a specific voltage level of a specific distribution grid operator.

The developed concept provides a tool for regionally quantifying the economic costs resulting from an interruption of an electricity distribution grid, for example as a result to climate extremes. Hence, the analysis highlights electricity grid domains of significant economic importance. Further, the results enable to compare the economic sensitivities between different voltage levels as well as between different distribution grid operators and enables to put them in perspective to actual climatic risks.

Significance of your presentation to adaptation practice, policy and/or business?
The results of the study serve practitioners to consider the economic implications of an interruption of its electricity networks in its grid maintenance as well as future adaptation plans. Additionally, the analysis provides valuable insights for policy makers, with respect to designing regulative requirements in such a way that the actual economic importance of a grid as well as the actual climate risks to which a grid is exposed, are incorporated in the planning process of electricity infrastructure projects.

Poster 145: Energy use studied in remote Australian buildings to enhance resilience to climate change

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This project is conducting case studies in Central Australia and Far North Queensland to find out what interventions can reduce energy costs and improve liveability in remote buildings under a warming climate. By 2090, areas around Alice Springs may have 83 days over 40°C (currently 17 days), while areas near Cairns may have 48 days over 35°C (currently 3 days) (http://www.climatechangeinaustralia.gov.au). While people and businesses in remote areas are resilient and already adapt to a very variable climate, there is a lack of reliable, locally-specific information about how to invest in transformative change that’s positive, strategic and long-term. This project uses participatory research with local communities and businesses to inform what pathways are feasible and preferred – pathways that will lead to a more vibrant and economically enhanced future.

Two building types, concrete block and steel frame, were investigated in both hot arid and hot humid climate zones of northern Australia. Aboriginal community art centre buildings were studied due to their accessibility and their important cultural and economic role in many remote communities. These community buildings have unique requirements. Electricity and transport are expensive, incomes are relatively low and maintenance services are almost non-existent. Additionally, building construction is largely reliant on building energy efficiency codes developed in the major cities where the climates are temperate or cool.
The data acquired included architectural drawings and photographs, temperature and relative humidity measurements, infrared photography and switch board sub-circuit electricity consumption measurements. Brief interviews were also conducted with each art centre manager. In return for assisting the study the building managers will receive a report with recommendations on energy saving strategies focused specifically on their art centre buildings. Key findings are: **electricity consumption savings of up to 40 percent are achievable if out of hours’ consumption is reduced by switching off appliances not being used or operating in standby mode; electricity can be saved and comfort improved in buildings with air conditioning by upgrading building design by insulating the walls, roofs and ceilings and using controlled forced ventilation at night in buildings with high thermal mass; evaporative coolers although very efficient are too hazardous for use in remote locations due to lack of maintenance resources.** Recommendations were also made on how the house energy efficiency design and rating tool AccuRate could be made suitable for designing thermally efficient enterprise buildings in remote Australia. Findings are available at [http://crc-rep.com/research](http://crc-rep.com/research).

**Significance of your presentation to adaptation practice, policy and/or business?**

Much climate change adaptation research, including infrastructure research, is conducted in urban areas. Regional and remote areas have unique environmental, societal and infrastructural characteristics that will affect their ability to adapt to climate change. Through participatory research conducted in very remote locations, this study has developed data and findings that are useable by many stakeholders to increase resilience to climate change; from the Aboriginal managers of art centre buildings through to the engineers and architects that design and build infrastructure for extreme environments worldwide.

**Poster 146: The role of a knowledge broker in climate change adaptation planning in the Australian Rangelands**

**Dr. Kevin Williams¹, Ms Kate Forrest², Ms Mary-Anne Healy¹**

¹Ninti One, Adelaide, Australia, ²Rangeland NRM Alliance, Adelaide, Australia

A knowledge broker organisation was used in a three year project that aimed to deliver climate change information and adaptation research findings to regional natural resource management (NRM) planners in the Australian rangelands. Prior to the project, climate change information was not being successfully transferred to and adopted by the Australian NRM community. The Rangelands Cluster Project (RCP) covered a huge area (4,519,756 km² – about 50 times the size of Scotland) of Australia across its most remote environments and sparsest populations. A knowledge broker was used to achieve these challenging project objectives: 1) identify climate change information needs, 2) provide quality information for incorporation into NRM planning, and 3) establish enduring networks of researchers and NRM planners.

The Rangelands Cluster Project (RCP) was one of 8 cluster projects funded through the Australian Government’s Regional Natural Resource Management Planning for Climate Change Fund. The RCP aimed to improve the information available for regional NRM planning for climate change. NRM is complex and involves social, economic and environmental considerations. Rangelands NRM organisations are mostly headquartered in regional or remote towns. They conduct a broad range of community-directed planning and on-ground activities, often delivered by a small complement of staff. In contrast, most climate scientists work on researcher-directed projects in large organisations in major cities. The RCP implemented an engagement process that acknowledged and mitigated some of the potential reasons that climate change adaptation was not being transferred to the NRM community: that researchers and NRM staff (1) came from various disciplinary backgrounds that used different technical languages and operating styles; (2) came from
different work environments; and (3) had different aspirations, time frames and stakeholder responsibilities, even in the same general field of environmental science and natural resource management.

Project publications were co-designed to be appropriate to stakeholder needs. There were 14 reports published by the project team. They are available singly and have also been collated and published as *It’s Hot and Getting Hotter. Australian rangelands and climate change – Reports of the Rangelands Cluster Project* (Healy M-A [Ed.], 2015). The reports cover a range of topics, including the rangeland climate projections, fire, meteorological drought, aquatic refugia, pastoral production; there is also an adaptation user guide. The reports can be found at [https://terranova.org.au/repository/rangelands-cluster-nrm-collection/its-hot-and-getting-hotter-australian-rangelands-and-climate-change-reports-of-the-rangelands-cluster-project](https://terranova.org.au/repository/rangelands-cluster-nrm-collection/its-hot-and-getting-hotter-australian-rangelands-and-climate-change-reports-of-the-rangelands-cluster-project).

**Significance of your presentation to adaptation practice, policy and/or business?**

The use of a knowledge broker in this project broke down barriers, forged relationships, built trust and empowered all partners in the project. We showed that co-production of knowledge resources meant that knowledge was not just published; it was also adopted by the NRM planners. We believe that many other stakeholder groups also face cultural, geographic or technical barriers in accessing and using climate change science for adaptation. We propose that the knowledge brokering approach described above is a cost-effective strategy that can be employed to enhance engagement and learning between climate change adaptation scientists and practitioners.

**Poster 147: Assessing the potential impacts of climate change on hydropower in Scotland**

Ms Tiffany Lau¹, Mr Stephen McGuire¹, Dr Richard Gosling¹, Mr Stuart Ferns²

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Satisfying Scotland's electricity demand through the use of renewable energy is a key commitment under the Scottish Government's plan to combat climate change. SEPA has statutory duties to protect the environment and promote sustainable economic development and as such, it has an interest in understanding whether the hydropower industry can supply the environmental flows required to meet the requirements of the Water Framework Directive, whilst maintaining or increasing energy production under the projected future climate scenarios.

This paper provides a national assessment of future climate impacts on the generation potential of both storage and run of river hydropower in Scotland. A storage hydropower scheme case study is provided based on model simulations of the Galloway Hydropower scheme, comparing a series of 11 plausible Future Flows climate scenarios and current scenarios under the medium emissions scenario. The Galloway Hydropower Scheme was commissioned in the mid 1930s as the first large scaled storage hydropower scheme built in Britain for public electricity supply. The scheme covers an approximate area of 1000km² in Galloway and South Ayrshire which consists of six power stations with an installed capacity of 108 MW. Potential seasonal and annual impacts of climate change are assessed and possible adaptive solutions such as reservoir management are suggested, with the findings extended to the wider hydropower industry across Scotland. Further adaptive options to improve delivery of environmental flows in order to meet Water Framework Directive (WFD) objectives of Good Ecological Potential (GEP) and/or to balance generation loss elsewhere in the system are also evaluated. (Word Count: 252)
Significance of your presentation to adaptation practice, policy and/or business?
The impacts of climate change on hydropower sector factsheet is to be published by Scottish Environment Protection Agency prior to this conference. This presentation along with the published factsheet will continue to raise awareness of the impact of climate change and suggest some adaptive options for hydropower operators and developers to consider. For new run of river hydropower schemes, both historic and future flows will need to consider during site feasibility studies. For storage schemes, reservoir management such as timing of drawdown can be reviewed and adapted to maximise generation and/or improve delivery of environmental flows. (Word Count: 96)

Poster 148: Assessing the UK’s Renewable Heat Incentive and the reality of living with renewable heating technologies
Dr. Louise Reid¹, Dr. Katherine Ellsworth-Krebs¹
¹University Of St Andrews, United Kingdom

The UK is committed to an 80% emissions reduction by 2050, and a target to achieve 15% of energy consumption from renewable sources by 2020 (from 1.5% in 2005) (HM Govt 2010: 5). Given that heating is the main reason for energy consumption in almost every country, the shift towards renewables in this sector has a major impact and it cannot be overlooked in decarbonisation strategies. Yet heat is much less amenable to measurement and regulation since it is produced in millions of separate installations at widely varying sizes, from several different fuels, and at different temperatures. Heat metering is thus uncommon, making the development of renewable heating policies, as well as the assessment of their effectiveness, much more complex and difficult. A particularly new and exciting development to increase heating microgeneration is the UK’s Renewable Heat Incentive. This is the first scheme in the world that replaces grants, the typical funding mechanism for heating microgeneration, and instead pays householders per unit of heat they produce. It thereby operates in the same way as much more established schemes for electricity microgeneration (Feed-In-Tariffs (FiTs)), which are widely recognized to be an effective mechanism for increasing uptake of technologies (Burger et al. 2013, Connor et al. 2013, REN21 2016).

This paper contributes to scholarship on the uptake or acceptance of domestic microgeneration technology (Balcombe et al. 2013, Claudy et al. 2011, Michelsen & Madlener 2016, Sopha et al. 2011), focusing on the RHI and heating technologies in particular. However, much of this previous scholarship focuses on the economic rationale for installation and does not adequately acknowledge the ways in which such technology intersects with daily domestic practices. We seek to redress this oversight and ask not just about householders’ ‘motivations’ for saving energy or investing in renewables, but instead how these activities fit with more mundane routines and concerns (Shove and Walker 2014). This paper presents analysis of accounts of domestic energy prosumption in the UK to identify other reasons for uptake and hence improve the targeting of future policy. Our research will demonstrate the complexity and messiness of energy demand (Shove et al., 2012), and show how technical improvements cannot be understood in isolation from everyday domestic life (Ellsworth-Krebs et al. 2015).

Significance of your presentation to adaptation practice, policy and/or business?
We explore the prevalence of domestic microgeneration technology in the UK following introduction of the RHI. The RHI was designed to reduce household carbon emissions so we assess its effectiveness and explore the relevance of these types of policy intervention in the domestic context. This will be of interest to those developing, implementing and reacting to policies related to domestic energy demand (i.e. policy, practice and business).
Poster 149: Improving climate resilience in the urban environment: enhancing uptake of building to city-scale decision support models by policymakers and industry

Dr. Katie Jenkins¹, Ms Briony Turner¹, Dr Kathryn Janda¹
¹Environmental Change Institute, Oxford, United Kingdom

An increasingly rich array of models and data are being developed through engineering and climate sciences focused on supporting adaptation to climate change in the built environment at the building to city level. However, there is still discord between using these within a research environment and their practical application for policy and practice from a stakeholder perspective.

In the UK, the focus on the built environment and changing climate is a particularly pertinent area given the recent UK Climate Change Risk Assessment that identified and prioritised increasing temperatures, rising sea-levels and modified rainfall patterns as key risks posed by climate change to people and the built environment. This creates new challenges for those working in planning, community development, emergency response, and the health and social care system.

There is a wide and complex range of policies, strategies and measures for which the effects of climate change on the built environment need to be considered. Urban areas are seen as being at the forefront of innovative action. However, to address such challenges decision-makers at national, regional and local levels need access to new capabilities being developed, including relevant and credible information and evidence from the research community, in a format that can be used within policy and practice.

The research uses a review of 37 UK based academic research projects, centred on the built environment and options for adaptation and resilience under a changing climate, to explore the benefits and potential barriers to the current uptake of research models and data. Liaising with key stakeholders, and supported by the Adaptation and Resilience in the Context of Change network, strategies were developed to address such barriers and maximise the use of evidence from the research. Focusing on a sub-set of 7 existing models, these lessons were put into practice to expand and/or modify models, covering spatial scales from building to city-scale and tailored to different end users. The enhanced utility and potential impact of these models and data were demonstrated and further investigated through a range of stakeholder workshops. These real world examples highlight potential benefits to both researchers and stakeholders to ensure model outputs are tailored to stakeholder needs and are in formats that can meaningfully inform policy and practice. Benefits for stakeholders include a better understanding of potential utility of models from research, and an increased ability to access and use such models to support policy and practice.

Significance of your presentation to adaptation practice, policy and/or business?
The presentation draws on 37 UK based research projects that develop innovative research models and data, and are focused on adaptation to changes in the built environment at the building to city-scale. Seven case studies are used to showcase the additional steps taken to support the transition from the academic domain to practical applications required by stakeholders and industry. Through these case studies, guiding principles are provided and highlights of the subsequent impact are given. Overall, this approach has potential to shorten the lag time between research discovery and practical implementation, thus improving our built environment response to environmental change.
The mobility of citizens and goods depends on a complex system of infrastructure (road networks, railways, airport infrastructures and cycle lanes). This system begins to be in jeopardy by extreme weather events, which tend to be more dangerous than similar events in the past, as a result of changes prompted by climate change. The expected temperature increase between 1.1 to 6.4°C by 2100 does nothing but increase the likelihood of the frequency and intensity of extreme weather events.

Infrastructures, however, could cope with most of these extreme weather events with a proper design, construction and/or maintenance. To do this, the first step is to know the possible variations in climate, the potential risks and the degree or resilience of natural and human systems. This assessment is called vulnerability analysis. This analysis goes beyond traditional risk analysis since the study of climatic variables requires concrete and scientific and technical expertise. Besides, it is necessary to consider socio-economic variables to define the degree or adaptive capacity of natural and human systems.

The presentation aims to analyse possible models to reduce the vulnerability of the infrastructure system, ensuring safe mobility for citizens and goods at local level in Spain, by adjusting the local strategies for sustainable development of the Municipality. And, on the other hand, by incorporating criteria, which guarantee the resiliency of the infrastructures, into their procurement processes for the design, construction or maintenance of infrastructure.

The presentation will start with a brief introduction to the main risks derived from climate change which can affect mobility and how to assess them thanks to the vulnerability risk. The core of the presentation focuses on the different instruments to reduce the vulnerability of the infrastructures by local entities, developing resilient strategies and guarantee resiliency of new infrastructure through the introduction of the appropriate criteria in the public procurement. The fact that mobility is interrelated with other sectors requires an integrated approach posing the main challenge when developing strategies: the coordination with administration at different levels (local, regional and national) as well as departments and agencies at the local level. Regarding public procurement, the introduction of resilient criteria can be tricky. It will show how to deal with the governance challenge and the recent advances to help local entities to use criteria to guarantee the resiliency of the infrastructures. Lastly, the presentation will conclude with the main conclusion and suggestions.

Significance of your presentation to adaptation practice, policy and/or business?
The population living in urban areas is increasing worldwide and it is expected to represent 66% of the world population by 2050. This urban sprawl causes a raise on the demand of transport means. Furthermore, extreme weather events and other risks prompted by climate change jeopardize the safety of the mobility system.

Risks and impacts derived from climate change vary among regions and municipalities. Firstly, climate and seasonal patterns are regional. Secondly, it depends on territorial settings (urban/rural/coastal) and socioeconomic characteristics. And lastly, each sector has specific risks. Therefore local entities play an important role in the transport infrastructure adaptation.
Poster 151: Climate Change resilient Road Infrastructure – Strategies and Solutions

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Efficient road infrastructure is one of the essential requirements for sustainable mobility and economic growth. One of the challenges in this context is the increase of freight transport during recent years and the expected further growth. This has led to a situation where a significant proportion of bridges on Federal Roads in Germany have already reached their limit capacity. Furthermore, effects from Climate Change and resulting extreme weather have to be taken into account when planning new and upgrading existing road infrastructure.

To make sure that the future increase in freight traffic as well as the impacts from climate change can be managed strategies and solutions for a resilient road infrastructure are important. Resilience is the ability to survive in the face of a complex, uncertain and ever-changing future. It is a way of thinking about both short term cycles and long term trends. Using this concept owners and operators will be able plan and prepare for minimizing disruptions in the face of shocks and stresses, recover rapidly when they do occur, and adapt steadily. Resilience requires cyclical, proactive and holistic risk management practices.

Significance of your presentation to adaptation practice, policy and/or business?
Within the presentation the concept of resilience and its application to road infrastructure and Climate Change will be highlighted. Strategies and tools that support policy makers, owners and operators of road infrastructure in achieving resilient road infrastructure will be presented.

Poster 152: Local networks contribution to inner port climate adaption process. Lessons from trinational region of the Upper Rhine.

Mr. Alexandre Kudriavtsev¹, Mme Florence Rudolf¹
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The Clim’ability project is a cross-border partnership, with an international team of researchers, businessmen and experts dealing with climate development issues (both social and economic). The project is supported by the Interreg V EU program. The case of Upper Rhine river inland ports is among selected (high priority) case studies. The competitive nature of inland ports requires fast reaction to changing climate and socio-economic circumstances, whereas adaptation to climate deregulation can require planning on a time span of up to a 2-3 generations. But the typical planning horizons lifespan of major port infrastructure are around 10-50 years.

Research project is bringing in local stakeholders of the Autonomous Port of Strasbourg (PAS) in order to increase their understanding of the uncertainties of climate change and their responses in terms of climate change adaptation governance.

Project’s research is: “How new modes of sustainable coexistence and adaptation practices are emerging from a co-construction process?” We will observe whether new knowledge and data will recompose actor’s coalitions and shift conflict lines.
The aim of the research is to find out the role of local networks such as private sector, intermediary organizations and civil society in the decision-making process and to empower them in the development of climate adaptation strategies.

The opinions of different actor groups will be compared in order to find out their attitude to the climate adaptation processes promoted by PAS, and analyze the possible factors that influence these groups in the decision-making processes which are used in the PAS policy and strategies.

Quantitative data collection methods will be used – profound interviews and cross-case analysis with climate-sensitive businesses and local stakeholders of the Port.

The project will analyze how Port authorities are coordinating climate adaptation process experienced by different groups of private actors from their everyday activities to planning issues. The research is also aiming to show how specific research gaps become a common issue for this actor’s configuration.

Significance of your presentation to adaptation practice, policy and/or business?

The presentation will share knowledge about the common bottlenecks and solutions observed in this developing strategic area, and will debate to what extent the lessons learned in the Upper-Rhine Valley could contribute to the advancement of other inland ports in climate adaptation process. Benchmarking will be developed for more environmentally and societally responsible and climate resilient practices as well as for local policies.

Poster 153: Smart Mature Resilience

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Keywords: city resilience, resilience maturity, risk systemicity, resilience policies

The 21st Century has been termed “the century of disasters” (Jan Egeland, former United Nations Undersecretary-General for Humanitarian Affairs and Emergency Relief Coordinator, February 2011). Worldwide there were twice as many disasters and catastrophes in the first decade of this century as in the last decade of the 20th Century. Europe is no exception: our continent is affected directly and indirectly. And the trend continues, fuelled by climate change and social dynamics. As Europe’s cities continue to grow, there is an urgent need for far-reaching and holistic approaches to enhance cities’ capacity to resist, absorb, accommodate and recover from the potentially critical effects of hazards. Supporting and building on the nexus of key resilient cities across Europe can create a strong backbone for all of Europe’s cities to support one another in overcoming the challenges arising from risks ahead.

Smart Mature Resilience is a multi-disciplinary research project working for more resilient cities in Europe and is funded by the EU Commission. Smart Mature Resilience cities work closely together with research

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6 Around 300 companies based in the PAS
partners to develop and validate tools through pilot activities encompassing critical infrastructure security, climate change and social dynamics. The project consortium includes 13 partners from 9 different countries. These tools will enhance cities’ capacity to resist, absorb and recover from different types of acute shocks and chronic stresses. The tools include the Maturity Model, the Risk Systemicity Questionnaire, the Resilience Engagement and Communication Tool, a System Dynamics simulation Model, and a Portfolio of Resilience Building Policies, and these five tools will form a new Resilience Management Guideline.

**Significance of your presentation to adaptation practice, policy and/or business?**
Smart Mature Resilience is a large European project which brings together researchers and city representatives in the process of co-creation of five city resilience tools which will form a new Resilience Management Guideline. These tools are expected to inform the everyday practice in cities with respect to developing city resilience. The contribution of the SMR project, through its focus on practical policy suggestions, will also inform policy making in cites. Finally, the SMR tools are expected to serve as a resource for new business models and to find their application in consultancy and knowledge exchange.

**Poster 154: Fit for Climate Change: The Climate Adaption Strategy in the City of Vienna**

**Ms Sylvia Berndorfer¹**

¹City Of Vienna, Vienna, Austria

For the past 16 years, Vienna has had a broad climate protection programme known as KliP Vienna. The current program is valid until 2020 and includes 385 individual measures in the fields of energy production and use of energy, mobility and city structure, procurement, waste management, agriculture and forestry, nature conservation and public relations. In addition KliP contains some considerations about Viennese climate adaption measures to elaborate more concretely in coming years.

Therefore 2011 the City of Vienna was starting a concrete adaption strategy based on KliP managed by the Executive Office for the Co-ordination of Climate Protection Measures.

There are a lot of adaption-measures which have been implemented independently. Especially concerning flood control Vienna has a long tradition, for instance on the Danube. Important steps were also done to improve fresh water supply and buildings.

Now we have to define what additional measures are necessary. These tasks will be done within the scope of working groups. They have to collect the existing adapting measures in Vienna and work out proposals for suitable measures. Then the measures will be submitted to stake holders and politicians for decision. The main topics are health, energy and water supply, urban planning, traffic, city vegetation, agriculture and forestry.

An important measure of the City of Vienna relating to urban planning is the construction and promotion of green roofs and green facades. This measure includes amongst others a special support programme since many years.

Vienna takes part in “Urban Heat Islands” (UHI), which is an EU-wide project. An UHI is a microclimatic phenomenon in the metropolitan or city areas. In these areas there are significantly higher temperatures than in the surrounding peri-urban and rural areas. The Viennese UHI-Strategy-Plan includes several measures how to cool down urban heat islands and offers indicators about the efficiency of these measures.
In the health sector, a heat guide for the Viennese population was published. A heat action plan is in process.

Within the scope of energy supply and consumption an Energy Security Plan and a Renewable Action Plan has been developed but have still to be agreed upon by the Viennese city council.

Due to the increasing summer temperatures in Vienna a special focus has been placed on the promotion of passive cooling.

**Poster 157: Effective Climate Adaption in Transportation Through a Multi-Level Governance Approach**

Mr. Ryan Bellinson, Mr. Timothy Migliore, Dr. Eric Chu

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Despite advancements in scientific understanding and policy developments on climate adaptation across different urban planning sectors and governance jurisdictions, adaptation actions have been unevenly distributed within government, with interventions in the transportation sector notably absent (Lambert et al. 2013; Wamsler et al. 2013; Boarnet 2010). Recent scholarship notes that transportation authorities are being impacted by climate change (Jaroszewske et al. 2010); however, there remains a theoretical void in untangling climate adaptation responsibility and action amongst transportation authorities (Marsden & Rye 2010). To address this practical and theoretical gap, we ask: how can multi-level governance theory be practically applied to better inform the structures and decision-making arrangements of transit authorities to facilitate climate adaptation planning efforts?

In answering this question, we first draw on the theories of multi-level governance, scalar politics, and metropolitan planning to untangle the complex interactions involved in governing climate adaptation in the transportation sector. Then we articulate a conceptual framework for a multi-level adaptive transit planning model. We apply this model to 11 cases in North America, Australia, and South Africa that were selected based on their status as urban centers governed within federal systems, economically important cities according to the Global Financial Centers Index, and vulnerable to sea level rise. Through policy document analysis and discourse analysis, the 11 case studies investigate the motivations, processes of assessment and prioritization, implementation, actor-networks, resources and capacities, and cross-sectoral interactions to explore implications for adaptive transit planning.

The results note that greater institutionalized flexibility, multi-level coordination, and cross-sectoral communication produce the most advantageous organizational structures to promote and further transit authorities’ ability to enact climate adaptation actions because transit infrastructures are trans-boundary and inter-jurisdictional. Across the 11 cases, we see that the level of adaptation policy development of transit authorities is directly linked to institutionalized cooperation between multiple levels of government. From these results, we argue that transit authority governing arrangements should involve multiple levels of governance actors through which strong cross-sectoral coalitions are developed to negotiate adaptation priorities and actions. In sum, these findings demonstrate the significance of generating greater dialogue between multiple entities in order to implement comprehensive climate adaptation plans. We conclude by arguing that transit authorities should develop climate adaptation mandates and mechanisms that require
broad multi-level, cross-sectoral coalitions to be involved throughout the transit planning process in order to reach adaptive outcomes.

Significance of your presentation to adaptation practice, policy and/or business?
It is clear the transportation sector needs to more adequately address climate adaptation on a policy level. This study will help provide policy recommendations and propel the discourse towards greater multi-level coordination amongst transportation authorities which will in turn lead to more adaptive transportation systems. Climate change possesses a systemic threat to many transportation authorities around the globe and it is the aim of this presentation to provide organizational structural architectures in order for transportation authorities to become more adaptive to climate risks and hazards.

Poster 159: Scottish Water’s Renewable Energy and Carbon Reduction programme

Mr. Chris Toop

Scottish Water, Stirling, United Kingdom

In providing essential services, Scottish Water uses a lot of electricity, around 440GWh per year at a cost of £49m.

Our approach to energy and carbon management is focused on:

Reducing consumption by improving the capability of our assets and operations
We have installed over 4,000 smart meters to measure consumption and help target opportunities. Over the last 5 years we have reduced base electricity consumption by over 5%. We have made changes to operational practices and our asset base to reduce consumption and participate in national grid balancing schemes that save customers money and bolster security of electricity supplies. We are also deploying low energy, low carbon treatment solutions. These initiatives support climate adaptation by reducing our reliance on the electricity grid and enabling the National Grid to better meet to supply demand fluctuations during extreme weather.

Increasing renewable energy self-generation
SW has more than doubled its installed renewable capacity to over 50GWh from over 70 sites. We currently have 31 hydro turbines, 18 small scale wind schemes, 24 photovoltaic schemes, two sites heated by biomass and three sites with combined heat and power (CHP). Last year SW became the UK’s first company to transfer heat from sewage - benefiting 5,500 students at Borders College campus though a commercial partnership between SW Horizons and SHARC Energy. Most of these schemes help to offset the amount of electricity we need from the grid, with several treatment works now self-sufficient. By becoming self-sufficient in our electricity requirements we become more resilient to interruptions in electrical supplies due to the effects of more extreme weather and climate change.

We are also supporting local businesses and communities become more sustainable and more resilient to climate change by supporting their own renewable generation. SW has enabled development via land, access, water resources and even connected our own treatment plants to locally owned decentralized renewable generation.

Hosting private renewable investment
Scottish Water already hosts third party wind turbines on our estate and is working with developers to increase this to around 900GWh from schemes in construction and with planning consent. By 2018 we will be generating and hosting renewable generation equivalent to over twice the level we consume annually.

Significance of your presentation to adaptation practice, policy and/or business?
As a result of our efforts to reduce electricity use and accommodate renewable energy on our assets our carbon footprint has dropped by over 15% since 2006/07 and we now have the lowest operational carbon use for water and wastewater services in the UK.

This strategy is aligned with the Government’s ambitions for a low-carbon Hydro Nation, and adaptation to climate change through increased service resilience. It is also an essential part of reducing the long-term cost of delivering our services. Our programme is now benefiting customers by over £7m annually.

Poster 161: Why smart might not be resilient – The relevance of cascading effects for adapting critical urban infrastructures to climate change

PD Dr. Steffen Bender¹, Dr. Jörg Cortekar, Dr. Markus Groth¹
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Cities all over the world are increasingly trying to become smarter. Therefore also urban critical infrastructure sectors need to be smarter in a sense that they are more intelligent and interconnected in order to integrate multiple information as well as new information and communication technologies (ICT) to manage city’s assets. Smart cities are often seen as a city model both in the long term economic growth and well-being of citizens, as well as to deal with climate change. However, smart cities mostly focus on making infrastructure smart in normal operation and everyday use. But will these smart city infrastructure elements still be smart and resilient when they are exposed to external shocks like natural disasters, climate change impacts, terrorist attacks or human failure? Are smart cities by definition also resilient cities? Or will smart cities finally be even more vulnerable due to the growing complexity of critical infrastructure and their multiple dependencies?

In general, critical infrastructure describes assets that are essential to maintain vital societal functions. Therefore, failures or functional impairments can have immediate and high impacts on several sectors as well as to the whole society. On a regional level, electricity blackouts as a consequence of a failure in the power supply can for example cause significant economic losses. If electricity supply would decrease by one GWh, Berlin is expected to suffer losses of around 12.86 Mio € on average. Furthermore, interactions between critical infrastructures in different sectors like communication, information technology, water and wastewater, transportation, healthcare and public health as well as emergency services have become a growing phenomenon as they are not only a point of potential vulnerability but may also compound existing vulnerabilities and carry them across multiple infrastructure sectors and elements. Thereby climate change is a main trigger of cascading effects related to critical infrastructures.

Based on examples of past as well as possible future cascading effects in cities, the presentation analyses where critical interdependencies of different components exist and how they interact with other critical infrastructure sectors or elements. Thereby the specific relevance of cascading effects for critical infrastructure will be highlighted. Furthermore, practical solutions to deal with climate change impacts will be derived, in order to make cities not only smart but also resilient – because cities not being resilient will never be smart.
**Significance of your presentation to adaptation practice, policy and/or business?**
Adapting critical infrastructure in cities to climate change in practice is a complex, highly context specific, multifaceted issue, especially when it comes to dealing with cascading effects between different sectors. Therefore the presentation is of relevance for practical solution in order to deal with current knowledge gaps regarding how infrastructural interdependencies operate and how procedures and policies might improve the adaptation to climate change – especially focussing on making smart cities resilient. These results will be useful both for responsible infrastructure operators but also for decision maker in cities.

**Economics and business**

**Poster 162: Losses and expenditures caused by extreme events in Poland as first step to assess adaptation capacity**

**Ms Ewelina Siwiec**

1Institute of Environmental Protection - National Research Institute, Warsaw, Poland

This presentation covers three aspects: an assessment of direct losses caused by extreme events and an assessment of expenditures on recovery and prevention of their impacts in Poland in 2001-2011 as well as an assessment of the manner of collecting information on the losses and expenditures in Poland in terms of their reliability and completeness.

According to the Polish sources damage arise as a result of a direct impact of extreme events (loss of property). Losses represent damage in monetary form (direct losses). Losses can also be of an indirect nature (indirect losses) when its effects reveal themselves with a delay and cover a much greater area that the one directly affected by the event. According to the GARDRR, indirect losses represent 50 percent of direct losses, while the Polish sources suggest 60 percent (Siwiec 2015).

The data on losses and expenditures were collected by the questionnaire method from selected national and regional/local administration units. The estimates given in the presentation are the first presentation of losses and expenditures caused by all the extreme events in the Polish territory (floods, drought, heavy rain, winter survival, spring freeze, hail, frost, lightning, landslide) which has been prepared on the basis of so many official information sources.
The direct losses in 2001-2011 were estimated at more than PLN56 (EUR14) billion. The greatest losses were estimated in agriculture and infrastructure. Assuming that indirect losses represent about 60 percent of direct losses, it can be calculated that the total losses caused by extreme events which occurred in Poland in 2001-2011 amounted to about PLN 90 (EUR 23) billion. However, only PLN 45 (EUR 11) billion has been spent in the period examined on the recovery from the impacts of disasters related to weather and climate and preventive measures with a large part of it consisting of damages and benefits paid out by insurance companies.

Given the limitations related to the method for collecting information adopted at the national level, the results may be underestimated, because the estimates presented here do not include the losses and expenditures incurred by enterprises and individuals uncovered by insurance. Another reason is the incompleteness of the materials submitted. In Poland, there is no national monitoring system to ensure a systematic collection of data on losses and expenditures caused by extreme events. In order to improve the manner of calculating information on losses and expenditures, a countrywide system has to be established.

**Significance of your presentation to adaptation practice, policy and/or business?**
Data on losses constitute a starting point for assessment the cost-benefit of adaptation measures and the implementation costs of adaptation measures. In turn, the information on the expenditures can suggest the real possibilities of their being finance with private and public resources. The determination of “bottlenecks” related to the method for collecting information is a first step toward its improvement which is important for government units collecting data and insurance companies. The results are necessary for identify adaptation measures included into national adaptation strategies and for the building of public awareness and the making of political and investment-related decisions especially.
Poster 163: Whose risk is it anyway – understanding risk ownership for future resilience

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Understanding and managing natural Hazard risk is a key aspect of current and future adaptation activities. However drivers such as changes in demographics, new technologies and climate change are changing the nature of these events and new and unexpected risks are emerging. These are driving change in how these events are managed as they require strategic approaches which build resilience which creates a considerable challenge because resilience is “everyone’s business” and approaches need to be collaborative. This means everyone is essentially a risk owner, so understanding who owns these risks, how they are owned and whether allocated ownership can be actioned is critical.

Risk ownership of natural hazard risk complex because it is systemic and can have multiple owners, lack clarity and change abruptly. Identifying risk ownership in this area requires an understanding of the broader risk landscape and how the different types of risk interact within this system. It is also requires an understanding of where there is agency to act and what types of decision making and governance best suit this task.

This presentation will show the key findings of research undertaken into risk ownership of natural hazards as part of the Bushfire and Natural Hazards Cooperative Research Centre program in Australia. It will outline the different characteristics of risk ownership and landscape, the relationship between values and risk from a decision making perspective and what the work to date has revealed about current institutional arrangements in Australia. It will also present the processed based framework developed as part of this work and outline the needs, implications and opportunities for adaptation policy makers and practitioners in understanding whose risk it really is.

Significance of your presentation to adaptation practice, policy and/or business?
Being able to ascertain risk ownership as part of strategic planning activities is critical as it determines who is responsible and how they are responsible. This work is important because it provides a values based approach to risk that can help practitioners and decision makers focus attention and resources by identifying what is important to communities and organisations.

Poster 164: Assessing impact of climate change and envisaging adaptation strategies in the hospitality sector. A case study for Lisbon and Algarve.

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Observed and expected changes in surface air temperature, precipitation and other climate variables, over two important touristic regions in Portugal, Lisbon and Algarve, were investigated using an ensemble of the high resolution climate simulations produced by the Euro-Cordex consortium. The simulations forced with the new IPCC AR5 emission scenarios RCP4.5 and RCP8.5, with a horizontal resolution of 12.5 km were used to evaluate the impact of climate change in the hospitality sector.
A methodology was defined and applied to several four and five stars rating hotels, in Lisbon and in Algarve. The results show a heterogeneous future increase in water consumption for green spaces and electricity consumption (mainly due to the increase in cooling) and a decrease in gas consumption (for heating). Moreover, the results provide useful information to be used in real-life adaptation and energy efficiency planning, in order to reduce the hotels vulnerability to water scarcity and energy (fossil fuel) demand for cooling in the warmer foreseen climate.

A vulnerability indicator was established and an adaptation plan was provided to the hotels. The sector can in a practical way anticipate the impacts and implement real actions, reducing risks of late adaptation.

**Significance of your presentation to adaptation practice, policy and/or business?**

Hotels are one of building types that consumes more energy and water per person and are vulnerable to climate change because in the occurrence of extreme events (heat waves, water stress) some failures could compromise the hotel services (comfort) and increase energy cost or compromise the landscape and amenities due to water use restrictions.

Climate impact assessments and the development of adaptation strategies require the knowledge about critical climatic variables and also the behaviour of building. This evaluation and vulnerability analysis was done using real data, measured in several zones inside the hotels, and by simulating the future needs.

Sharing real experiences can be useful to other companies and can enable the identification of ideas and advice on how to progress towards the development of a business adaptation strategy. The proposed presentation is a good case to exemplify the practice of identifying risks and opportunities of a changing climate in a big electricity company of an Latin America country that is considered vulnerable to climate change.