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This outline is an outcome of a workshop held in Hamburg in February 2020. For more details see the full report. The outline is provisional.

My Climate Risk

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Description of the activity
The objective is to develop a new framework for assessing and explaining regional climate risk using all the available sources of climate information (observations, reanalyses, model simulations, better understanding, etc.) in order to construct decision-relevant and scale-relevant information – in other words, climate information that is *meaningful* at the local scale. Whilst any application of the framework will inevitably be specific and tailored to local concerns, the framework itself will be generic, hence flexible and applicable across a number of region types (large scale, urban, typical SREX[1], etc.) and intended to become a much-needed support for the development of climate services.

Form of activity
It will involve *several case studies, in the form of labs*; where labs are understood to be dynamic, exploratory, transdisciplinary environments, and not physical infrastructure. One such lab could be an evaluation of different national or regional climate risk assessments, to compare methodologies. Another could target specific regions whose risks have not been properly assessed, by bringing together relevant stakeholders to distil the existing information. It is important not to underestimate the effort required by the labs as they can only work with the sustained involvement of experts on different aspects of climate research such as observational uncertainty, detection and attribution, climate prediction and projection, process understanding, etc. The outcomes of the case studies could be published in collections of journal papers.

What will it deliver and/or achieve?
This Lighthouse Activity will help develop a new way of practice to synthesize climate information from different, sometimes contradictory, lines of evidence. Chapter 10 of the IPCC WG I AR6 report is already assessing what the literature offers to undertake this objective for the physical climate system, whereby different methodologies like storylines (explanations) of observed trends and events as well as traditional probabilistic descriptions are constructed, reconciled with information from various sources, and their implications for future risk articulated.

This is a notable departure from the traditional detection/attribution/projection framework, in which the different steps are performed separately – in particular, the observational analysis is largely divorced from the modeling – and where the aim is to construct singular, definitive scientific findings.

The activity would mainstream the new approach and extend it into the production of consolidated regional (in the widest sense possible) climate information based on different

[1] Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)

lines of evidence for the decision space. The ambition is that the regional case studies would develop into ongoing regional 'communities of practice' (definition: a group of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly), which would continue to drive research methodologies that can be taken up by the climate service community to be transposed to a wide number of cases requiring regional climate information for risk management. Involvement of scientists from both the Global North and the Global South in the regional case studies will lead to capacity exchange, and best practice can be shared between the different groups and assessed in meta-analyses.

The labs will be linked via a coordination mechanism set by WCRP. Full traceability of the way the different lines of evidence are consolidated into climate information will be required. A repository of the outcome of the labs will be created to enable the meta-analysis that will lead to the development of a methodology for the generalization of the creation of regional climate information.

Relation to the World Climate Research Program Strategy, including as appropriate any aspect that is new or novel.
Understanding climate change at the regional scale and connecting it to societal needs is a core part of the WCRP Strategy. WCRP has been attempting to deal with the regional climate risk landscape for many years, with limited success. A new approach is urgently needed. The development of new research paradigms in recent years (see 'what will it deliver' above) offers an opportunity.

The present paradigm for regional climate risk assessment is "predict then act", with contextualization of climate information performed mainly as a post-processing step. This new activity will be a paradigm shift, by bringing together regional actors with all available sources of climate data (observations, reanalyses, regional and global models, and many other sources of both data and knowledge) and with the specific scientific expertise on the best way to use each of these sources of information to distil plausible explanations of past behavior and implications for the future, within a specific risk-based or decision-oriented context. The scientific expertise required lies squarely within the scope of WCRP, which is the only international research community with expertise in all the data sources mentioned above, as well as with knowledge on their merits and limitations.

Science requirement; including new science and how this draws upon the core research expertise of the WCRP community.
It is widely recognized that there is a knowledge gap between global aspects of climate change and the impacts on human and natural systems (see Figure 5), which occur at regional spatial scales. Bridging this gap requires connecting drivers of regional change through regional atmospheric circulation to local climate, which is all core WCRP expertise. There is a lot of research in this space, but it is not bridging the knowledge gap, because the traditional approach has been from the left to the right, which results in a 'cascade of uncertainty' and very weak statements of knowledge (Shepherd, 2019). In this activity, we will also work 'upstream', from the right to the left, to identify the most relevant pathways, or storylines, within a decision context, i.e. to adopt a risk-based approach, implicitly challenging the 'cascade of uncertainty' thinking.

This will draw on the following science (emphasizing mainly the WCRP components):

- Local observations, data rescue, traditional knowledge
- Remote sensing, reanalyses, and inter-comparison of all observation sources
- Observational uncertainty estimates and their use in model validation in the broadest sense

- Fully Earth System approach (human dimension included)
- km-scale / convection-permitting simulations
- CMIP and CORDEX and the full connection to cover all possible sources of uncertainty, including the generalized use of large ensembles
- Sub-seasonal, seasonal and decadal prediction, their potential use to constrain climate projections and methods to reduce the impact of initial shock and drift
- Understanding of extremes and related processes (e.g., land-atmosphere, aerosols, sea ice and snow, water cycle, ocean-atmosphere)
  - Process-based in addition to statistical approaches
  - Storyline approach, physically-based future changes
  - Compound events
  - Connection to observational knowledge & meso-gamma modeling
- Modeling and observations at the landscape scale (e.g., coastal, cities, etc.)
- Identification and attribution of long-term changes
- Regional predictability and its potential sources
- Broader characterization of uncertainty, i.e. beyond the concept of an error bar
- Bringing the concept of values and context into climate science
- Process-based model evaluation at the regional scale
- Better use of observations, because they can be treated in a conditional rather than an aggregated manner
- Establishing/Ensuring FAIR guiding principles for all data sources
- Connecting physical science and social science
- Construction of climate information on the basis of different lines of evidence
- Dedicated experiments, some of them particularly challenging (high resolution, full Earth System Model, large ensembles, etc.) will be needed depending on the labs

Partnerships needed to do this Activity; including if WCRP will be the Lead or if it will be a jointly-lead Activity (and if so, who are the key Partners).
WCRP would facilitate, but, especially for the regional case studies, engagement outside WCRP with the relevant stakeholders would be essential. Many scientists within the WCRP community are already engaged in regional or local risk assessments, so there will already be many partnerships to build on. However, the paradigm shift here is that the stakeholders' values would be the starting point, not the end point; the climate scientists would start by listening but become very active as soon as the challenge is identified, bringing together the different relevant components of WCRP.

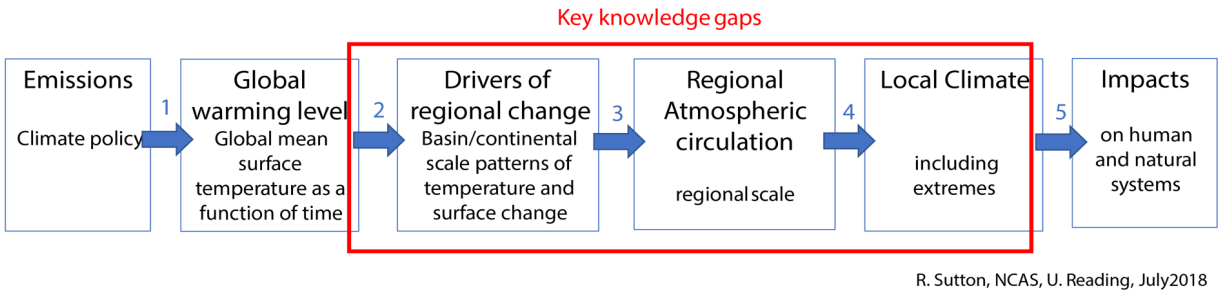

Figure 5: The global-to-regional knowledge gap (R. Sutton, NCAS, U. Reading, July 2018)

Links to IPCC (WG I and II), Future Earth, WMO, World Adaptation Science Programme (WASP) and climate services could be particularly useful, as well as to engineering communities, practitioners and consultants.