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My Climate Risk

Draft for the 42nd Session of the WCRP Joint Scientific Committee

1. Introduction

The objective of the My Climate Risk Lighthouse Activity is to develop and mainstream a 'bottom-up' approach to regional climate risk, which starts from the decision context (and the decision scale) and enables relevant climate information to be brought into that context. By 'risk' we mean the combination of hazard, vulnerability and exposure that is particular to a given regional context. By developing 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.), climate information will be made 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 region, etc.) and intended to become a much-needed support for the development of climate services. At the same time, the Activity can identify needs to be addressed by the WCRP homes Core Projects and other Lighthouse Activities (e.g., implications of model biases).

Specific objectives include:

I. Understand what regional climate information is needed (different from desired) by stakeholders.
II. Understand what regional climate information can be provided based on existing observations, models and knowledge.
III. Inform the WCRP community about which model and experiment developments may best serve user needs closing the gap between (I) and (II), better integrating the use of models and observations.
IV. Provide a framework for bringing different information (including contradictory climate outcomes) together within a particular risk context in a way that others can work with.
V. Understand how climate change can push a low-risk situation into a high-risk situation.
VI. Help develop prototypes through particular case studies, in partnership with others.
VII. Develop 'risk map guidelines' for different hazard types in different regions and contexts.
VIII. Improve the collaboration between WCRP activities.
IX. Foster capacity building, in particular in developing countries.

The Activity will primarily use a case-study approach, in the form of labs (communities of practice), where labs are understood to be dynamic, exploratory, transdisciplinary environments, and not physical infrastructure. Some labs could link with Core Project activities and embrace some successful Grand Challenge activities that are due to be sunset, whilst others would be distinct from these and include some ways of co-development with partner organizations. One example of such a lab could be an evaluation of different national or regional climate risk assessments, to compare methodologies. Another could target a

specific region whose risks have not been properly assessed, by bringing together relevant stakeholders to distil the existing information. A canonical activity would be to discuss current risk in a given situation, with proximate explanations, and then develop storylines of future climate-related risk based on those explanations. In this way, the past can be related to the future within a risk framing. The past can even include (recent) paleoclimates, for low-frequency behavior such as drought.

Importantly, whilst the whole point of My Climate Risk is to take a risk perspective on climate variability and change, the non-hazard aspects of risk represent a huge (and very complex) scope, largely beyond WCRP expertise. Thus, we propose the focused goal of enabling climate scientists to bring climate knowledge to bear in specific local decision contexts, drawing on expertise from across WCRP. These local decision contexts, which are where the applications to risk would occur (and in which the climate scientists would typically be a minority), would not be coordinated; they would emerge in a bottom-up manner, as opportunities arise. Since many WCRP scientists are already working in specific risk applications, there are many potential points of contact with local decision contexts and this bottom-up approach should be eminently workable.

Other aspects of the scope of the Activity are discussed later, in Section 4.

2. Relevance to the World Climate Research Programme (WCRP)

The My Climate Risk Lighthouse Activity draws upon and integrates research on the three WCRP Scientific Objectives "fundamental understanding of the climate system," "prediction of the near-term evolution of the climate system," and "long-term response of the climate system" to address the scientific objective "bridging climate science and society." The latter objective is new to WCRP, as it involves collaboration with stakeholders (see partnerships below). There is a need to engage with other partners to assess societal needs and to bridge the gap between the science and the stakeholders/end users. The question is how. There is now a general acceptance that starting from the needs of the stakeholders/end users is a better approach than the "predict then act" approach.

The science required includes the points listed below:

- Climate information distillation, including the analysis of hierarchies of model ensembles, assessing the fitness of models for a range of projection purposes, attribution of uncertainties, development of approaches to synthesize and reconcile multiple lines of evidence (observations, reanalyses, model simulations, better understanding, etc.), as well as region- and purpose-specific model selection.
- It is important to gain further understanding of model biases, uncertainties, etc., and how much we can sensibly say about climate risks for distinct regions/sectors/stakeholders, within the context of the core research expertise of WCRP. This might take the form of coordinated experimentation to assess the capability to simulate heat waves in Europe or Australia, and then to uncover the model shortcomings.
- Model errors are pervasive and long-lasting and, even if we could easily fix them, that would not necessarily lead to perfect predictions and projections. A crucial task seems to

be to understand if, e.g., the user requires quantitative information at very fine time and space scales or if they can work with a set of physically reasonable scenarios or storylines of future changes. We should not let perfect be the enemy of good.

- We need to understand what constitutes real possibilities of future changes (in particular on low likelihood high impact changes/events)?
- We must improve our understanding of stakeholders needs and science on e.g. governance, economics, engineering, etc., and further expertise needs to be built beyond the current core expertise of WCRP.
- Denser (both temporal and spatial) observation networks need to be built. Some new observational approaches (e.g., sensors in the car, or mobile phones) may be developed to collect more climate information.
- We need a better understanding of the role of teleconnections/climate phenomena as a driver for regional scale climate variability and change. This combines the core research expertise of WCRP (including the Climate and Ocean Variability, Predictability and Change (CLIVAR), Stratosphere-troposphere Processes And their Role in Climate (SPARC), and Regional Information for Society (RIfS) Core Projects).
- It will be important to develop a better understanding of ocean climate risks that goes beyond the risks presented by sea-level rise, i.e., taking into consideration the risks from ocean extremes, and working in the context of the UN Ocean Decade (2021-2030).
- Research on compound events and complex risks (interactions between sectors, between hazard, vulnerability and exposure, mitigation and adaptation, etc.) will be important. The latter aspect is of course beyond the scope of WCRP activities and can only be addressed in collaboration with impact modellers/stakeholders within specific case studies.
- Similarly, research collaborations in case studies should address knowledge gaps in transdisciplinary research (integration of user context, needs and values; co-design, co-production and co-exploration processes; communication of climate information; upscaling of climate services from case studies, where a full distillation process is feasible, to large-scale data provision for a broad range of stakeholders).

3. Partnerships

My Climate Risk partners will include:

Internal to WCRP:

- All Core Projects, including the new Regional Information for Society (RIfS) and Earth System Modelling and Observations (ESMO) Core Projects
- Coordinated modelling activities (Coupled Model Intercomparison Project (CMIP), Coordinated Regional Climate Downscaling Experiment (CORDEX), Subseasonal-to-Seasonal (S2S) Prediction Project)
- Grand Challenges (currently in the process of sunsetting)
- Other Lighthouse Activities (Digital Earths, Safe Landing Climates, etc.)

External to WCRP (the list is not exhaustive):

- Future Earth (Risk KAN, Ocean KAN, Coasts, Surface Ocean – Lower Atmosphere Study (SOLAS)), World Meteorological Organization (WMO) (Global Climate Observing System

(GCOS), World Weather Research Programme (WWRP), Global Atmosphere Watch (GAW), Regional Climate Outlook Fora), World Health Organization (WHO), World Bank, Food and Agriculture Organization (FAO), Red Cross/Red Crescent, Intergovernmental Oceanographic Commission (IOC) of UNESCO (Ocean Decade), International Science Council (ISC), etc.
- Regional meteorological services, NGOs, engineering associations, etc.
- Himalayan University Consortium/ International Centre for Integrated Mountain Development (ICIMOD)
- Local or regional funding agencies
- End users

The partners within WCRP are largely represented in the science plan development team, with the exception of the Grand Challenges. The partners outside WCRP have not yet been much involved in the design of the science plan, but My Climate Risk has been presented at a number of external fora (pre-Sustainability Research & Innovation Congress mini-workshop with the Belmont Forum and Future Earth; Subsidiary Body for Scientific and Technological Advice Research Dialogue (SBSTA)) as well as at the WCRP Climate Research Forums, and the feedback has been positive. The draft science plan will be circulated more widely for feedback following the 42nd Session of the WCRP Joint Scientific Committee. Virtual workshops, held together with partners, will also help inform the further development of the science plan, although these have proven to be challenging to organize under the present COVID-19 circumstances. My Climate Risk will be WCRP-led. However, the labs could well be jointly led with external partners.

4. Scope of the Activity

The scope of the Activity includes the following points:

- My Climate Risk will largely draw on existing stakeholder engagement studies that have already generated knowledge on stakeholder needs. Consultations will be undertaken where clear gaps in knowledge are identified.
- The goal is to enable a synthesis of all the available sources of climate information, and create meaningful information, possibly through distilling generic (rules of thumb/guidelines) vs. context-specific aspects. A key component will be to identify what is predictable, what is the cause of extreme events, how likely they are in the future, and how well they are depicted in the models, in a way that can be applied flexibly to a specific decision context.
- Hazard is the main focus within the common risk framework (not a focus directly on coping capacity/exposure/vulnerability).
- The overall goal is developing new approaches/paradigms for regional climate risk assessment studies.
- The key to this is process understanding of the variability/change of regional climate and climate extremes on targeted timescales, within a particular local context.
- We need to expand the scientific agenda to also address what is presently not doable, e.g. be explicit about where and why the state-of-the-art has not progressed and is difficult to progress any further.

Possible boundaries:

- Both of the Explaining and Predicting Earth System Change and Safe Landing Climates Lighthouse Activities will also be addressing climate risk, but on global to regional scales, and from more of a systemic perspective. My Climate Risk will take a more local perspective.
- My Climate Risk is not specifically focused on conducting (process-based) studies to reduce model errors/biases/uncertainties, though intends to connect to, and inform other relevant WCRP groups working on these problems.
- The goal is to provide climate information in order to understand one's risk, rather than directly assessing the risk of a particular stakeholder (e.g. a specific asset risk). We need the stakeholder engagement in order to take a holistic perspective on climate risk, but we are not organizing the stakeholders.

5. Gaps in knowledge and expertise

- Methodologies to synthesize climate information from a plethora of climate information sources. It is recognized that this is not so much a gap in the information itself as in how the information is produced and constructed.
- Bias and uncertainty assessment of climate risks including the cascade of uncertainty and communication of uncertainty.
- Understanding changes in regional climate in general, and in high impact low likelihood changes in particular.
- Connecting physical science to social science connections.
- Considering impacts, decision making and adaptation activities.
- Redressing the power imbalance between the larger amount of capacity directed at the global scale compared to comparatively little at the regional and local scales.
- Connecting the new risk framework and engaging with users who may want to ask questions like "what are the risks to my asset portfolio", "will my suburb flood" etc., without directly seeking to answer those questions.

6. Similar activities and integration

The need to take a bottom-up perspective on climate information is widely appreciated, and there are similar activities under discussion in the Future Earth Risk KAN (will sunset soon), Global Energy and Water Exchanges (GEWEX) Regional Hydroclimate Projects (RHPs), RIfS, and the Grand Challenge on Weather and Climate Extremes (will sunset in 2022). We will build on what currently exists, particularly ensuring synergy with the GEWEX-RHPs and RIfS, but drawing on the expertise across all the WCRP Core Projects.

We expect there to be a strong synergy between My Climate Risk and the WCRP Academy, since training is key to locally-based expertise; one of the early career researchers on our Science Team is acting as a liaison with the Academy.

There are a number of time-limited national programmes which have been trying to do something similar to this activity. The challenge is their time-limited nature (as is well

recognized). We thus seek to identify institutions that can act as regional 'hubs' for My Climate Risk and thereby provide the continuity that is required at the local scale. The Himalayan University Consortium has already agreed to act in this capacity, and we are actively looking for other institutions to collaborate with in other regions.

Our view is that the traditional WCRP approach of organizing an activity via a hierarchical structure of panels and working groups is not appropriate for My Climate Risk. Our vision is instead to develop an ecosystem of research clusters, anchored in regional hubs (which following the ecosystem analogy might be seen as 'mother trees'), with Labs emerging as Communities of Practice rather than as time-limited projects.

7. Timeline

We plan a soft implementation of the Lighthouse Activity Science Plan and the initial identification of a few regional hubs by late 2021. We then plan Lab activities by the middle to end of 2022, each with a duration of 4-5 years. The My Climate Risk Science Plan will be organic and adaptable, reevaluated approximately every five years.

8. Requirements

- Resources and support to produce a white paper, strategy documents and implementation plan.
- Support from the WCRP Secretariat and international project office staff.
- Collaborations with existing institutions that can act as regional hubs to provide long-term continuity for the My Climate Risk Labs in different regions.
- Engagement with WCRP Climate Research Forums and early career and training programmes to bring in the diverse and motivated workforce that will be needed to address the Lighthouse objectives.

9. Budget

Support for workshops and participation of early career researchers from WCRP and science councils.

10. Deliverables and outcomes

The deliverables of this Lighthouse Activity should be user-oriented methodologies on how to deliver climate information and the success of the outcomes should also be measured by the user engagement. More specifically this should include:

- A new framework for assessing and explaining [regional] climate risk using all the available sources of climate information in order to construct decision-relevant and scale-relevant information. This will possibly include guidelines/rules of thumb on available information and data and their usage ("value-chains of data"), as well as outlining the main purposes/limitations of the data sets/information. It will also possibly follow a two-layered approach, generic vs. context-specific climate data/information.

- Case study/lab examples of the development/application of the risk framework, but leading to scalable and operational activities, i.e. not 'pilot studies.'
- Application of this risk framework in existing and new risk assessment/management structures.
- The implementation plan shall clearly specify how we measure success and provide details on the evaluation methods.

11. Communication and capacity exchange

My Climate Risk has been actively involved in several of the WCRP Climate Research Forums. Possibly these Forums can become ongoing engagement activities for the WCRP as a whole. We organized a 'My Climate Risk' session at the Sustainability Research & Innovation (SRI 2021) Congress in June 2021, which attracted about 40 participants, and we have proposed a 'My Climate Risk' session for the 2021 AGU Fall Meeting. We believe that working with early career networks could be a powerful way to establish and maintain engagement.

12. Risks

Potential risks include:

- Engagement with societal actors (not within core WCRP expertise), although this also offers an opportunity to engage with other groups working in this area
- Overlap with many risk approaches/actors/communities
- Power imbalances, both Global North/Global South and within-country
- Ever-increasing demands on people's time
- Contesting/lack of (credible) climatic information
- The enormity of the tasks. Is it too large to be successful?
- How to differentiate this activity from the proposed goals of RIfS (still in development)

13. Steering Committee

- Lisa Alexander, Climate Change Research Centre (CCRC), University of New South Wales
- Mat Collins, University of Exeter
- Jens Hesselbjerg Christensen, Niels Bohr Institute
- Hanne Hvidtfeldt Christiansen, University Centre in Svalbard (UNIS)
- Francisco Doblas-Reyes, Barcelona Supercomputing Center
- Amadou Thierno Gaye, Ecole Superieure Polytechnique (ESP) University, Senegal
- Paola Arias Gomez, Universidad de Antioquia
- C. Kendra Gotangco Gonzalez, Ateneo de Manila University
- Harry Hendon, Australian Bureau of Meteorology
- Daniela Jacob, Climate Service Center Germany (GERICS)
- Gaby Langendijk, Climate Service Center Germany (GERICS)
- Sakshi Mankotia, Jamia Millia Islamia University
- Douglas Maraun, Wegener Center for Climate and Global Change, University of Graz
- Ali Nazemi, Concordia University

- Regina Rodrigues, Universidade Federal de Santa Catarina
- Somnath Baidya Roy, Indian Institute of Technology, Delhi
- Ted Shepherd, University of Reading
- Susann Tegtmeier, University of Saskatchewan
- Lin Wang, Institute of Atmospheric Physics, Chinese Academy of Sciences

Diversity:

- Early/mid-career (11), Senior-career (8)
- Female (9), Male (10)
- Europe (8), North America (2), South America (2), Africa (1), Asia (4), Australasia (2)

We have been enlarging the team following its initial formation, in order to improve our regional representation. This process is ongoing. Over the coming year we anticipate a reduction in the current over-representation from Europe. It is possible that some of the people serving liaison roles with other parts of WCRP would be best seen as 'ex officio', which would allow us to further diversify our regional representation.