

## Grand Challenge on Weather and Climate Extremes Report (Draft 1)

### 1. Highlights for JSC

1. **WCRP contribution to RISK-KAN:** WCRP Institute of Advanced Studies in Climate Extremes and Risk Management (Nanjing, 2019). Supported by Nanjing University of Information Science and Technology, APN, IRDR. 29 international (from all continents) plus 10 local students at PhD level (senior PhD student and recent PhDs). Three student-led papers are in the works and will be submitted for peer reviewed publication. Six lecturers including 5 past/current IPCC WGI/II lead authors.
2. **IPCC AR6 contribution:** Coordinated key analyses on past and future changes in extremes, and detection and attribution studies to provide timely publications for IPCC AR6 assessments. Most key figures in Chapter 11 (dedicated to extremes) of the IPCC AR6 WGI report come from GC coordinated analyses. The GC-Extremes team contribution to AR6 includes 3 coordinating lead authors, 3 lead authors, one review editor, and several contributing authors.
3. **Extensive participation in CMIP6**, co-ordinating on multiple MIPs including LUMIP (Sonia Senevirante), VolMIP (Gabi Hegerl), LS3MIP, and providing inputs to other MIPs that pay particular attention to extremes such as DAMIP, highresMIP, and HAPPI.
4. **Datasets and tools:** Creation of unique global-scale [daily](#) and [sub-daily](#) precipitation datasets and a dataset of climate extremes indices and associated [web portal](#) along with the co-development with GEWEX of the [Frequent Rainfall on Grids \(FROGs\) database](#) containing consistently formatted in situ, satellite and reanalysis precipitation datasets and associated [Special Issue](#) in Environmental Research Letters.

### 2. Primary science issues (looking ahead, 3 to 5 years)

- High resolution modelling
- Extreme Earth/Digital Earth
- Defining and identifying safe climate spaces
- Compound events
- Process based attribution and prediction, including extremes
- Process understanding to inform future projection of some types of extremes such as extreme precipitation, extreme wind

### 3. Issues and challenges

- Extremes cross cut many core projects, working groups and Grand Challenges but they are not necessarily well-coordinated across all WCRP and non-WCRP activities. Extremes are also vital parts of many of the proposed new 'lighthouse' activities and are hence a key part of the new WCRP strategic plan and its implementation (examples include: defining and identifying safe climate spaces; process based attribution and predicting, digital earth.)
- The Expert Team on Climate Change Detection and Indices (ETCCDI) which formed a cornerstone of GC Extremes activities and much of the framework for the IPCC

assessment of extremes has ceased to be supported by WMO leaving WCRP as the sole sponsor. A positive of this could be an opportunity to reformulate the most important and innovative aspects of the ETCCDI program, particularly those clearly linked to the WCRP strategic plan and lighthouse activities, to form the 'Global Extremes Project'. Initial activities could include: a) Global and regional monitoring and global stocktake ( ETCCDI); b) Annual updates on the status of extremes and attribution; c) Cross-WCRP coordination and integration of extreme-related activities; identification of evolving new science questions and developments on mechanism, modelling, attribution and prediction of extremes including compound events; d) Capacity building for proper applications and developing true partnership with users. In particular, the key role of extreme events in several of the proposed 'lighthouse' activities require a coordinated approach.

- Observations is not a very visible activity in the proposed lighthouse activity. Observations remain a challenge including quality, availability and accessibility. Satellite data are now starting to offer 'climate scale' records but uncertainties around extremes remain large.
- Boundaries between partners within and outside of WCRP are also barriers for knowledge transfer and collaboration for extremes linking both climate science and users. True partnership and working as one is required but this is not always possible. The term 'extreme' is viewed differently depending on the application and therefore we do not necessarily have a common language across the programme on how extremes should be defined and definitions are often vague and/or ad hoc. This can make it difficult to collaborate.
- Funding always an issue (especially now and can be worse post-COVID19). Lack of WCRP funding means many activities have to piggy-back on other activities, hard to be systematic; but we managed to do some including the Nanjing summer school, IPWG/GEWEX/GC Extremes precipitation observations workshop.
- Capacity building is very challenging: a place that needs capacity is a place that needs resources (both financial and human) and resources especially financial resources are hard to come by; incentive to attract builders/trainers is low (more effort/time to train may mean lower productivity for publishing high impact papers for trainers).