

## Weather and Climate Extremes Grand Challenge Report

### 1. Highlights for JSC

- [RISK-KAN development](#) through collaboration with Future Earth and IRDR, Tokyo workshop (*direct contribution to new WCRP SP/IP implementation*)
- [GEWEX Open Science Conference](#) , 6-11 May 2018
  - Plenary talks on extremes research
  - Large gathering (~160 extreme-related abstracts) across topics and scales, addressing key science questions
  - Side events on Compound Events (Thursday 10 May) and RISK KAN (Friday 11 May), coordinated meeting with WWRP
- Contributions to IPCC AR6 assessment
  - GC-leads are among CLAs (3), LAs (3) and RE (1) for various chapters
- [Compound Events workshop](#) (April 2017) completed
- Nature Geoscience perspective paper accepted (new SP/IP), [Nature Communications paper on marine heatwaves](#)

### 2. Early success and/or planned activities in 2018/2019

- [Oslo workshop summary / review paper out](#) and well received.
- Joint WCRP GC Extremes/WWRP HIWeather meeting planned at OSC (*direct contribution to new WCRP SP/IP implementation*)
- [Contribution to WMO Space-based Weather and Climate Extremes Monitoring Demonstration Project](#)
- Nature Climate Change perspective article on compound events (accepted)
- Nature perspective article on climate extremes under 1.5°C climate (in revision)
- Process-understanding related modelling experiment (ExtremEx) initiated
- Many GC-coordinated publications (see examples below)
- Joint workshop with GEWEX GDAP on extreme precipitation (July 2018)
- H2020 bid submitted by part of the GC team on tipping points related to extremes.
- Future IAMAS sessions planned in coordination with HIWeather (Montreal, 2019)
- Planning of Institute of Advanced Studies in Climate Extremes and Risk Management (Nanjing, 2019 – see Annex for concept Note): **requires a JSC approval/endorsement, as a direct contribution to new WCRP SP/IP implementation**

### 3. Partners for GC implementation (within and outside WCRP community)

- GEWEX and CLIVAR provide the main frameworks in developing and implementing science questions
- Close and integrated implementation with ETCCDI and other WMO Teams and projects particularly for data, model evaluation and attribution, as well as capacity development

- Partnership between weather and climate research community, for example, WWRP High Impact Weather (HIWeather)
- Joint activities with international associations such as IUGG (particularly through IAMAS), Future Earth through E3S
- Nanjing University of Information Science & Technology (NUIST) for the conduct of 2019 activity – partial funding (c.a. ¥450kRMB) from NUIST approved – in coordination with Future Earth and IRDR; as part of the Extreme-GC contribution to RISK-KAN (see Annex for Concept Note)

#### 4. Overall GC timeline

- Major milestones achieved
  - Nature Geoscience perspective paper in final stages of preparation
  - Global daily precipitation dataset developed 1950 to present in collaboration with GPCP and NCEI
- Key scientific questions beyond 2018
  - Current questions remain (data, process understanding, modelling, detection and attribution)
  - Inclusion of compound events as a new theme
  - Development of guidance documents on future projection of extremes to be released after the conclusion of IPCC WGI AR6 report
  - Coordination of input into [IPWG](#) and IPCC

#### 5. Issues and challenges:

- Given that many groups have a major focus on “extremes” (including e.g. WWRP, WMO and many regional initiatives) our challenge is to coordinate, complement and advance existing activities, and ensure cross-fertilization and use of a coordinated approach while not being duplicative. This is particularly hard to do because of limited resources and will be difficult in a future without a standing committee (e.g. ETCCDI).
- How to involve scientists from developing world (funding/capacity issues)
- How to engage WMO/CCI (with CCI planning to close the ETCCDI): requires a JSC discussion, advice and/or action, to identify an appropriate international coordinating mechanism for research on climate change detection and attribution of extremes.
- This GC relies substantially on the monetary and in-kind support from outside of WCRP. This makes implementation heavily reliant on the motivation and funding support of the individuals involved. It is essential that we secure the WCRP umbrella for GCs both financially and programmatically, to continue this community-wide effort.

#### Selected GC-relevant publications:

Hauser, M., L. Gudmundsson, R. Orth, A. Jezequel, K. Haustein, R. Vautard, G. J. van Oldenborgh, L. Wilcox and S.I. Seneviratne (2017). Methods and model dependency of extreme event attribution: The 2015 European drought. *Earth's Future*, 5, 1034–1043

Hegerl G.C., Broennimann S., Schurer A., Iles C., Cowan T. (2017): The early 20th century warming. *WIREs climate change*, in press. (discusses early extreme events)

Herold, N., Behrangi, A., Alexander, L.V. 2017. Large uncertainties in observed daily precipitation extremes over land. *Journal of Geophysical Research*, 122 (2), pp. 668-681

Kharin, V.V., Flato G.M., Zhang X., Gillett N.P., Zwiers F.W., Anderson K.J. 2018. Risks from climate extremes change differently from 1.5°C to 2.0°C depending on rarity. *Earth's Future*. Accepted.

Oliver ECJ, Donat MG, Burrows MT, Moore PJ, Smale DA, Alexander LV, Benthuysen JA, Feng M, Sen Gupta A, Hobday AJ, Holbrook NJ, Perkins-Kirkpatrick SE, Scannell HA, Straub SC, Wernberg T. 2018. Longer and more frequent marine heatwaves over the past century. *Nature Communications* DOI: 10.1038/s41467-018-03732-9

Sillmann, J., Thorarinsdottir, T., Keenlyside, N., Schaller, N., Alexander, L.V., Hegerl, G., Seneviratne, S.I., Vautard, R., Zhang, X., Zwiers, F.W. 2017. Understanding, modeling and predicting weather and climate extremes: Challenges and opportunities. *Weather and Climate Extremes*, 18, pp. 65-74.

Zscheischler, J., and S.I. Seneviratne, 2017: Dependence of drivers affects risks associated with compound events. *Science Advances*, 3(6).

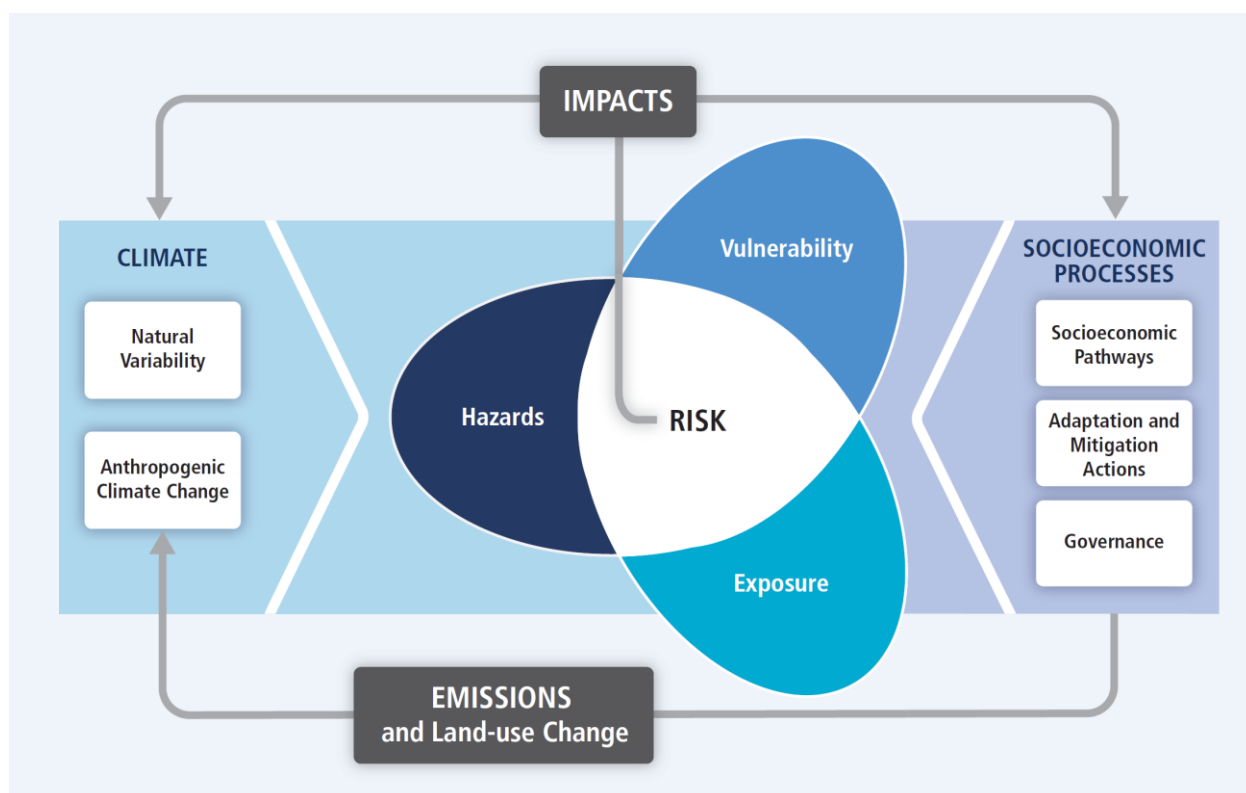
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*Draft Concept Note*

**The World Climate Research Program, Nanjing University of Information Science and Technology, Future Earth, and International Research on Disaster Risk**

**Institute of Advanced Studies in Climate Extremes and Risk Management**  
2019, Nanjing, China

Overall economic losses caused by natural disasters are increasing worldwide. Many of these natural disasters are weather and climate extremes related. Yet, the impacts and disasters are the results of complex interplay of climatic, environmental, and human factors. The severity of impacts from weather and climate extremes depend not only on the extremes themselves but also on exposure and vulnerability. Weather and climate extremes are and will be changing due to human-induced climate change. Exposure and vulnerability are also changing because of social and economic development and as responses to weather and climate extremes. These together make it challenging than ever to manager disaster risks.



The climate research community has significantly advanced the understanding of past and future changes in weather and climate extremes. The disaster risk research community has also significantly developed their understanding of causes of disaster risk. Yet, there is a barrier in the flow of knowledge between the two communities. Disaster risk management towards reducing exposure and vulnerability and increasing resilience to the potential adverse impacts of weather and climate extremes requires the integration of knowledge from both communities.

## **Objective**

The Institute of Advanced Studies in Climate Extremes and Risk Management aims at filling this gap by prompting active knowledge exchanges and integration across climate research and disaster risk reduction research communities. This objective will be achieved by the two-pronged approaches. One is to provide a forum and environment in which world-leading experts from the two communities are brought together to learn from each other on weather and climate extremes and disaster risk reduction. Another is to train future leaders in the two disciplines such that they both are familiar with aspects of the other disciplines. Understanding disaster risk will enable climate experts to generate more tailored climate knowledge and information for risk reduction action. Similarly, understanding past and future changes and uncertainty in the projection of weather and climate extremes will enable risk management experts to use climate information more properly and more effectively.

## **Organizers and scope:**

This Institute of Advanced Studies is organized by three international research programs and Nanjing University of Information Science and Technology. The international programs include the World Climate Research Program (WCRP), Future Earth, International Research on Disaster Risk (IRDR), with the WCRP Grand Challenge on Weather and Climate Extremes taking the lead. It is envisioned that the topics would include detection and attribution of changing frequency and intensity of extreme event, attribution of individual events, projection of climate extremes for risk reduction and compound events. Collaborative and collective planning would enable due deliberation on exposure, vulnerability and resilience in changing climate, in particular, from both academic and applications points of view.

### **Budget:**

- Provided by NUIST: Budget is estimated based on 40 international participants (Chinese students are local and are expected to be able to cover their own expense). 1) meals and room, and small expense for other activities, ¥10,000RMB for each participant for two weeks, sub-total ¥400,000RMB; 2) Economic return air-fair for 5 lecturers, estimated at ¥10,000RMB on average, sub-total ¥50,000. 3) Total budget approved by NUIST ¥450,000RMB.
- International air-fare for about 35 participants should be identified from other funders, e.g., WCRP, ICSU/ISC, and other partners.

### **Format:**

For each topic, we envision lectures that cover the basics from both communities and that would be accessible to most participants. In addition, the school will include a limited number of 'guest' lectures which would provide in depth excursions to the current frontiers of some aspects of research on extremes. Lectures would occur in the morning of each day, with occasional lectures in the evenings. The afternoons and remaining evenings would be devoted to the practical application of the material covered in the lectures. This will be accomplished both through the use of structured tutorials, and a set of research problems that will form the core of the institute and serve to produce an important part of its long term legacy.

Research problems will, therefore, be a key aspect of the institute. It is envisioned that 5-7 teams, each with 4-6 students, will work to tackle 5-7 problems that are to be developed specifically for the institute by its lecturers. Problems will be carefully selected by the institute's steering committee with the following considerations. 1) They will be tractable via teamwork with the resources that are anticipated to be available at the NUIST. 2) Students working in teams with experienced lecturer-advisors will be able to advance the problems over the 2-week duration of the school. 3) The results are likely to be publishable. 4) An aspect from both communities such that there will be real cross-fertilization. Participants: 10 leading experts from climate and disaster risk research communities; 40 students at PhD level (recent PhDs or senior PhD students), including 30 international students, 7 students from NUIST, 3 Chinese students from other institutions, additional audition opportunities for NUIST students.

An international steering group will oversee the selection of lecturers and students.

The steering group, in close coordination with the selected lecturers and students, will plan in advance a pre-event and legacy activities to ensure solid outcome from the planned event. The planning will focus on promoting, facilitating and maintaining interactions and information exchange in the areas of extremes and risk studies, among international experts and students across the generation. Once successfully initiated, WCRP – through the ongoing GC-Extremes activities and coordinated support for early career scientists – in coordination with NUIST and other partners will provide an international framework.

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