Grand Challenge
Understanding and Predicting Weather and Climate Extremes

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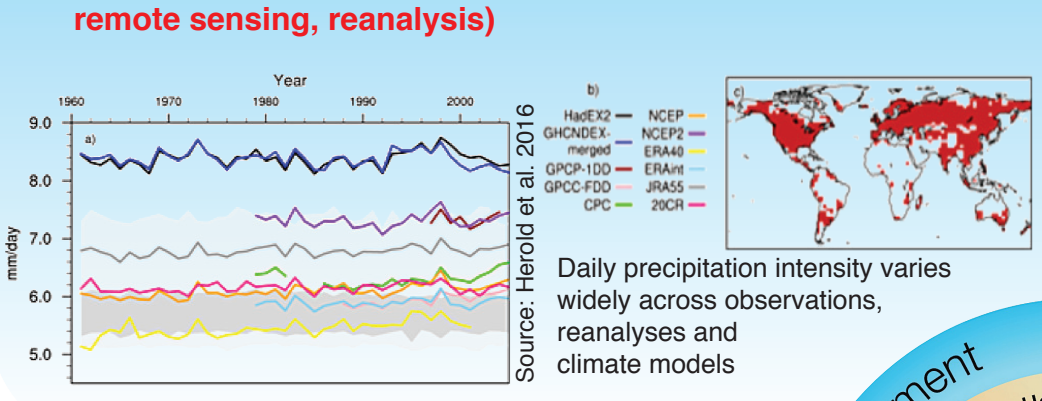
Supporting Climate Adaptation through Science Understanding

Service perspective: *What are frequency and magnitudes of various impact-causing extremes in the near and long term?*

Science perspective: *How can we better understand the causes and mechanisms of variability and change in extremes, and improve the prediction of changes in extremes?*

Are existing observations sufficient to underpin the assessment of extremes?

- **Critical gaps in the amount, quality, consistency, availability**
- **Big gains from international coordination effort to improve datasets underpinning the assessments of extremes (in situ, remote sensing, reanalysis)**

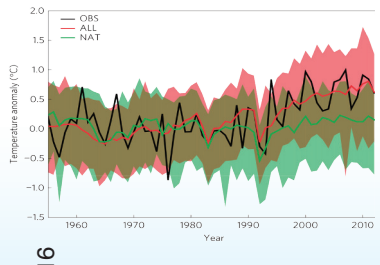


Source: Herold et al. 2016

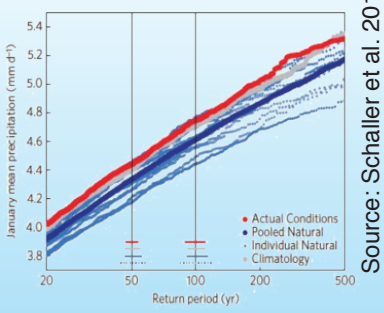
Daily precipitation intensity varies widely across observations, reanalyses and climate models

2013 East China summer heatwave

Anthropogenic influence has caused a more than 60-fold increase in the likelihood of this event, and similarly hot summers will become even more frequent in the future



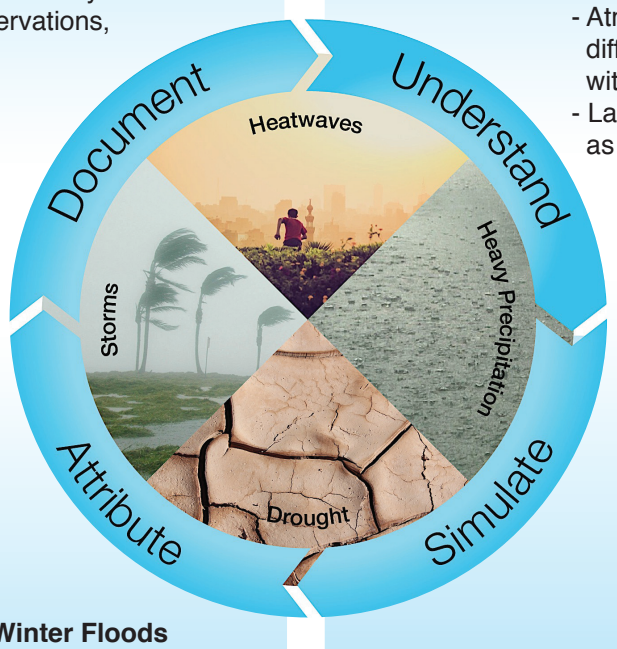
Source: Sun et al. 2014



Source: Schaller et al. 2016

2014 Southern England Winter Floods

Climate warming increased moisture and shifted circulation patterns in the atmosphere, boosting the risk of heavy precipitation

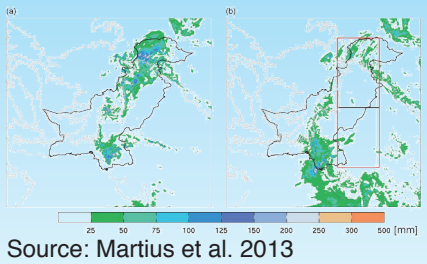


- **Extent of human's responsible for changes in extremes**
- **Likelihood of individual extreme weather events**

What are the contributions to observed extreme events and to changes in the frequency and intensity of the observed extremes?

What are the relative roles of large-scale, regional and local scale processes, as well as their interactions, for the formation of extremes?

- **Land-atmosphere feedbacks/forcing**

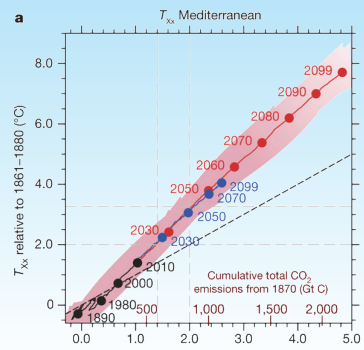


Source: Martius et al. 2013

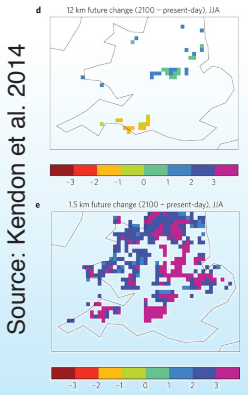
2010 Pakistan flood

- Atmospheric condition in different scales combined with boundary conditions
- Land moisture sources as strong contributor

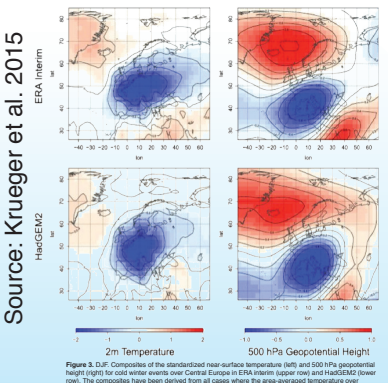
Processes and interactions are critical for extremes particularly on regional scales



Source: Seneviratne et al. 2016



Source: Kendon et al. 2014



Source: Krueger et al. 2015

- **Credible simulations by GCM and RCM – how to improve?**
  - High-resolution more critical for small-scale short-lived extremes (heavy precipitation, wind storms)
  - Land processes strong constraint for large-scale long-lived extremes (heatwaves, droughts)
- **Statistical methods for tails & knowledge of mechanisms**

Are models able to reliably simulate extremes and their changes, and how can this be evaluated and improved?

Early Success and Plans

2014

- GC White Paper
- **WCRP Summer School on Climate Extremes**

2015

- **GC Implementation Plan (4 main extremes, 4 overarching themes)**
- *Workshop on GC-Extremes data requirements, Sydney*

- **WCRP Special Issue, Weather and Climate Extremes Journal, Vol.9**
- Workshop on Understanding, modeling and predicting weather and climate extremes (MCliX), Oslo

2016

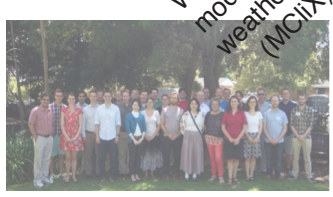
- LandMIP workshop, Zurich
- GC Implementation Plan ver.02
- Blocking workshop,Reading
- Multiple sessions on GC-Extremes themes at the 13th,IMSC, Canmore
- Workshop on Uncertainty Modeling in the Analysis of Weather, Climate and Hydrological Extremes, Banff

2017

- Event attribution workshop, Canmore
- **Workshop on compound extremes, Zurich**

2018

- **Perspective paper on Extremes (in progress)**
- MCliX-2 workshop, Oslo
- Sessions at the IAMAS-IAPSO-IAGA Conference, Cape Town
- **Open Science Conference**



https://www.wcrp-climate.org/understanding-and-predicting-weather-and-climate-extremes

WCRP
World Climate Research Programme