WCRP Grand Challenge
Understanding and Predicting Weather and Climate Extremes

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Current Status

- Draft Implementation plan Dec. 2014 (still evolving)
  - 4 main extremes, 4 over arching themes
- Early success
  - WCRP Summer School on Climate Extremes (Trieste, July 2014) and associated special issue
- A long list of activities (workshops, meetings, etc.) being coordinated
- Main issue: Open Science Conference on Climate Extremes 2018 (JSC endorsement?)

Driven largely by service needs

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

- From *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?

- Implementation needs to be focused

4 main extremes, 4 over arching themes

Implementation plan: 4 themes

improved quality of ground-based and remote-sensing based datasets for extremes
DOCUMENT

interactions between large-scale drivers and regional-scale land surface feedbacks affecting
UNDERSTAND

role of external (e.g. anthropogenic) forcings vs internal variability for changes in intensity and frequency of extremes
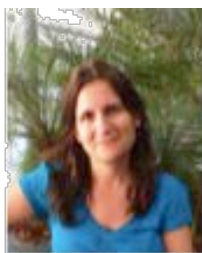*ATTRIBUTE*

Evaluate and improve models for simulations of extremes
SIMULATE/PREDICT

Leads

Early Successes:
WCRP-ICTP summer school

236 applications for 35 places. About half of the attendees from developing countries.

A special issue of "Weather and Climate Extremes" in progress

Workshop on GC-Extremes Data Requirements

Improving the collation, dissemination and quality of observations and assessing what new observations are required for extremes

Representation from major international data centres

Deliverables set over the next 3 years

Workshops and Meetings: Bringing diverse communities together

- GDIS drought workshop Pasadena Dec 2014
- IDAG meeting Jan 2015
- IUGG/M22: Understanding and Predicting High-impact Weather and Climate Extremes, Prague Jun 2015
- EUCLEIA meeting, Paris Jul 2015: event attribution
- ETCCDI work planning meeting, Paris Jul 2015
- M-CLIX workshop, Oslo Oct 2015: Process understanding, model validation
- Land modeling meeting, Zurich Oct 2015

Workshops and Meetings: Bringing diverse communities together

- High Impact Weather joint WCRP/WWRP (Columbia University, 2016): focus on TCs, ETCs and severe local storms

- Modeling Workshop (TBA, 2016): synthesizing results of first modeling experiments and dedicated analyses, and planned special issue and review article

- 13th International Meeting on Statistical Climatology (Canmore, Jun 2016): major session on statistical analyses, methods/tools for extremes,

- "Uncertainty modeling in the analysis of weather, climate and hydrological extremes" (Banff International Research Station, June 15-19 2016)

Connection to core projects & other GCs

- ***DOCUMENT*** : GEWEX , CLIVAR

- ***UNDERSTAND*** : GEWEX, SPARC, CORDEX, CLIVAR

- ***ATTRIBUTE***: GEWEX, CLIVAR

- ***SIMULATE*** /***PREDICT***: Core projects, WG of modeling community

- CORDEX, Regional Information GC, Sea Level GC

WCRP Open Science Conference on Extremes, 2018

- A milestone for the climate research community to report their progress

- Major input for the 6th Assessment

- Still some time to fill in Gap for the 6th Assessment

- Major input for WCRP at mid-term

- Need to advertise early and widely

- Need to involve core projects, panels etc

- Need JSC endorsement to start planning

Thank You

A 2-pronged approach

- Coordination needs to be across and between existing activities
  - Who is already doing what
  - Enabling existing projects, avoiding duplication

- What new activities, research or data gathering needs to be undertaken?

White paper: 8 key questions

1. Improved quality of ground-based and remote-sensing based datasets for extremes *(GEWEX: GHP and GDAP)*

2. Improved models for simulations of extremes *(WCRP-wide theme)*

3. Interactions between large-scale drivers and regional-scale land surface feedbacks affecting extremes *(GEWEX: GLASS)*

4. Role of external (e.g. anthropogenic) forcings vs internal variability for changes in intensity and frequency of extremes *(ETCCDI/IDAG/CLIVAR*
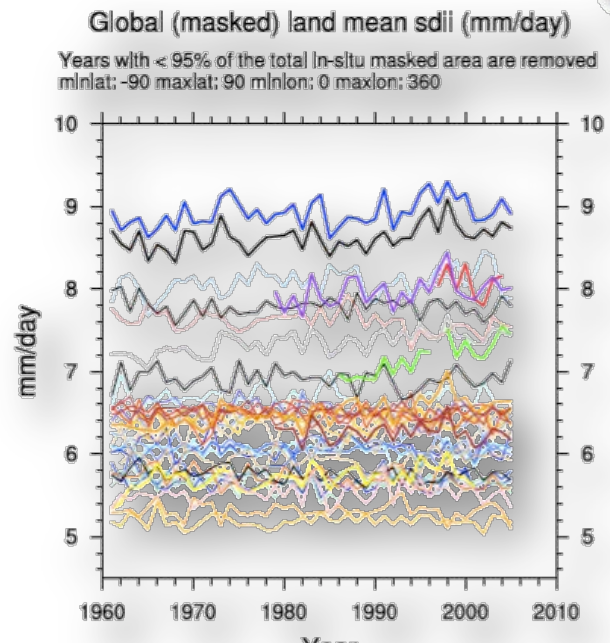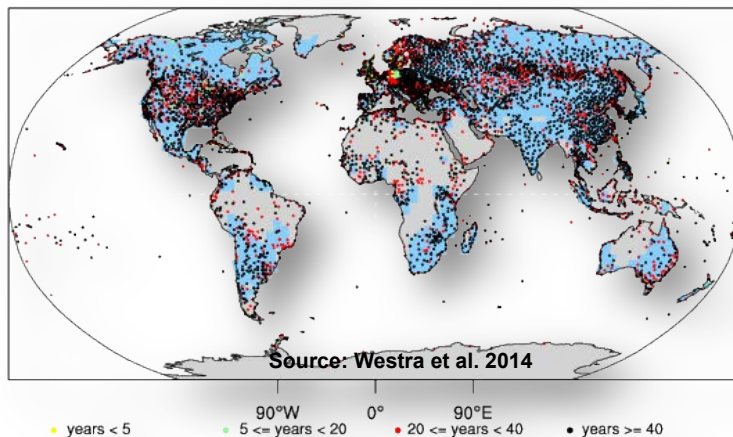
White paper: 8 key questions

5. Factors contributing to the risk of a particular observed event *(ACE/ETCCDI/IDAG/CLIVAR)*

6. Causes of drought changes in past and future *(GDIS/GEWEX/CLIVAR)*

7. Predictability of changes in frequency and intensity of extremes at seasonal to decadal time *scales (WGSIP/CLIVAR/GEWEX)*

8. Role of large-scale phenomena (monsoons, modes of variability) for past and future changes in extremes *(CLIVAR/GEWEX Monsoon panel)*

Document

Observations provide crucial underpinning but are often not well-constrained and critical gaps exist in the amount, quality, consistency and availability, especially for extremes

Sub-daily precip stations (HadISD) and SDII coverage (HadEX2)

Source: Westra et al. 2014

years < 5   5 <= years < 20   20 <= years < 40   years >= 40

Global (masked) land mean sdii (mm/day)
Years with < 95% of the total in-situ masked area are removed
minlat: -90 maxlat: 90 minlon: 0 maxlon: 360

Understand

Interaction between large-scale phenomena (weather types, modes of variability) and regional-scale land-atmosphere feedbacks or forcing can be critical
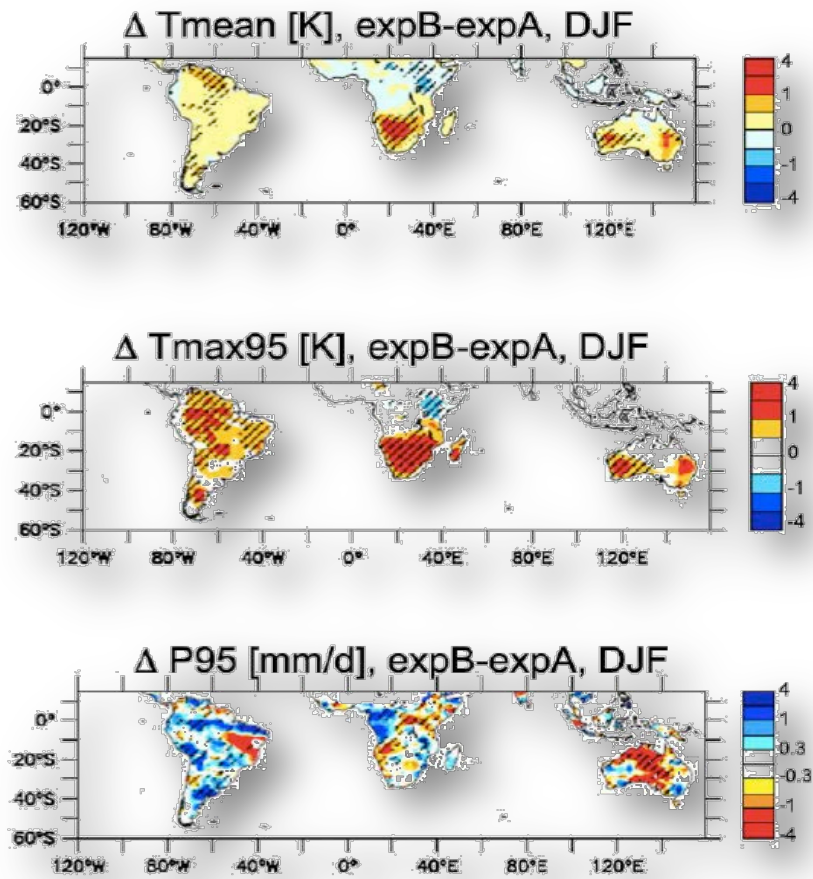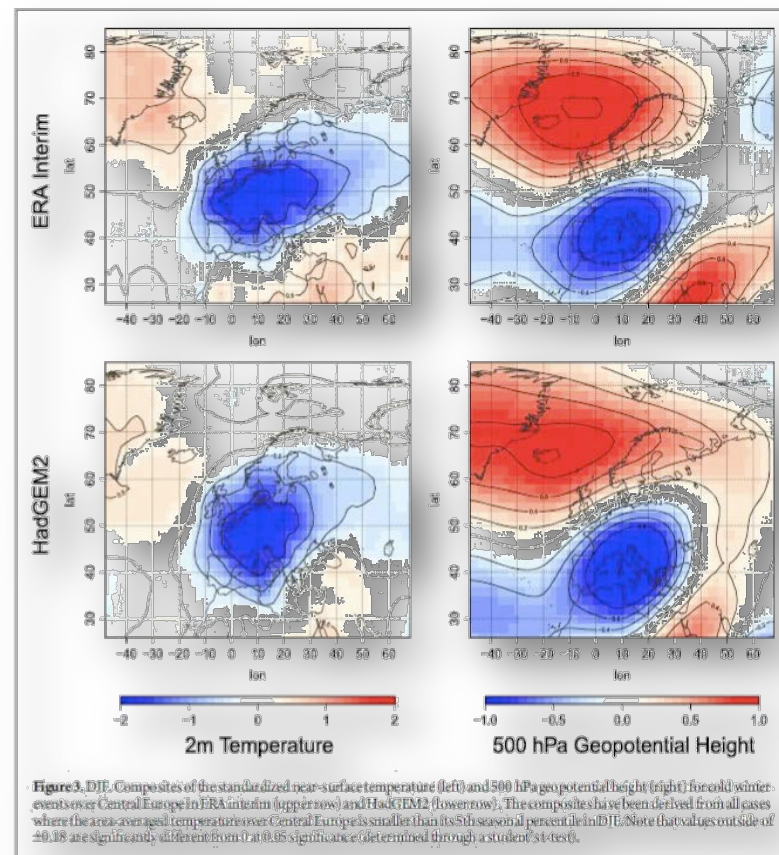
Attribute

A key challenge is to understand the extent to which humans are responsible for changes in extremes and the likelihood of individual extreme weather events

2013 Summer East China Heatwave
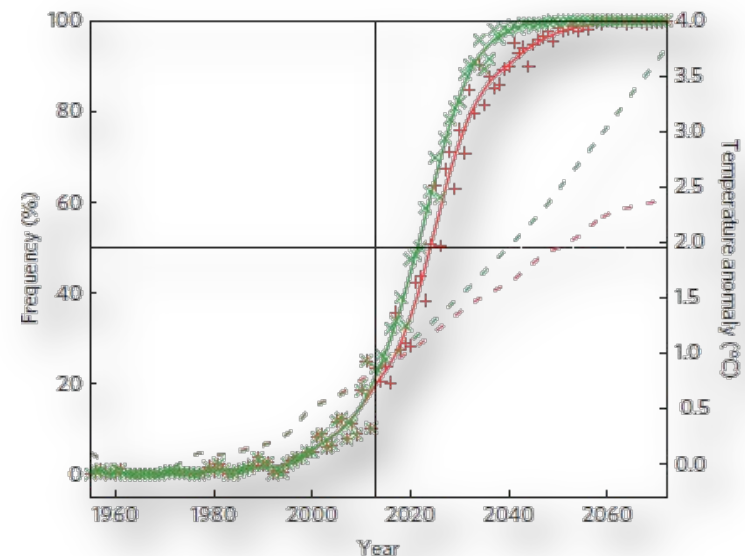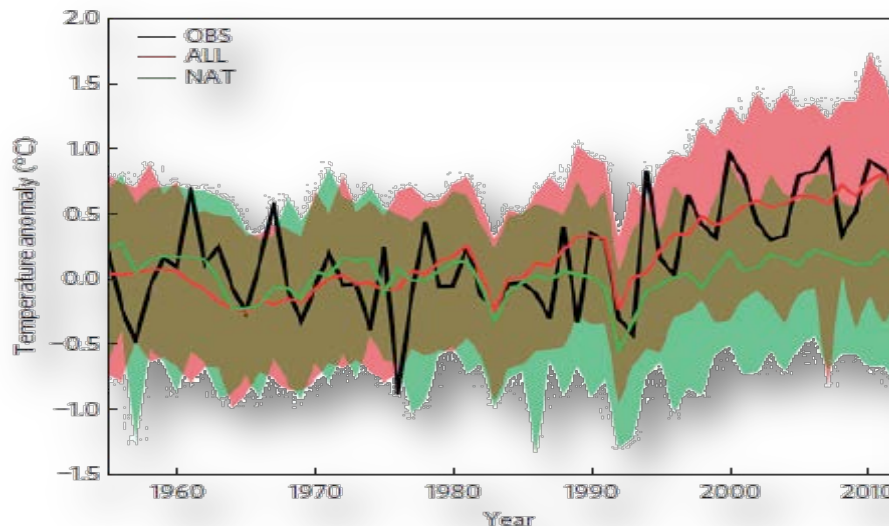
Simulate

To understand types of events that current GCMs and RCMs can credibly simulate and to identify key processes for weather and climate extremes that can be credibly simulated to improve prediction of large scale phenomena (weather types, modes of variability)

Source: Krueger et al. 2015