GC Climate Extremes

Lisa Alexander, Xuebin Zhang, Gabi Hegerl, Sonia Seneviratne

GC Climate Extremes

Led by GEWEX, in consultation with CLIVAR

White paper (February 2014): X. Zhang, G. Hegerl, S. Seneviratne, R. Stewart, F. Zwiers, L. Alexander

Implementation plan (December 2014): L. Alexander, X. Zhang, G. Hegerl, S. Seneviratne

Contributions: G. Stephens, F. Zwiers, D. Carlson, J. Sillmann, A. Behrangi

GC Climate Extremes

Understanding and predicting weather and climate extremes

Status:

White paper draft circulated to CLIVAR and GEWEX SSGs paper in December 2013/January 2014

Final white paper posted February 2014

First version of implementation plan is being completed

Many types of weather and climate extremes, different space/time scales

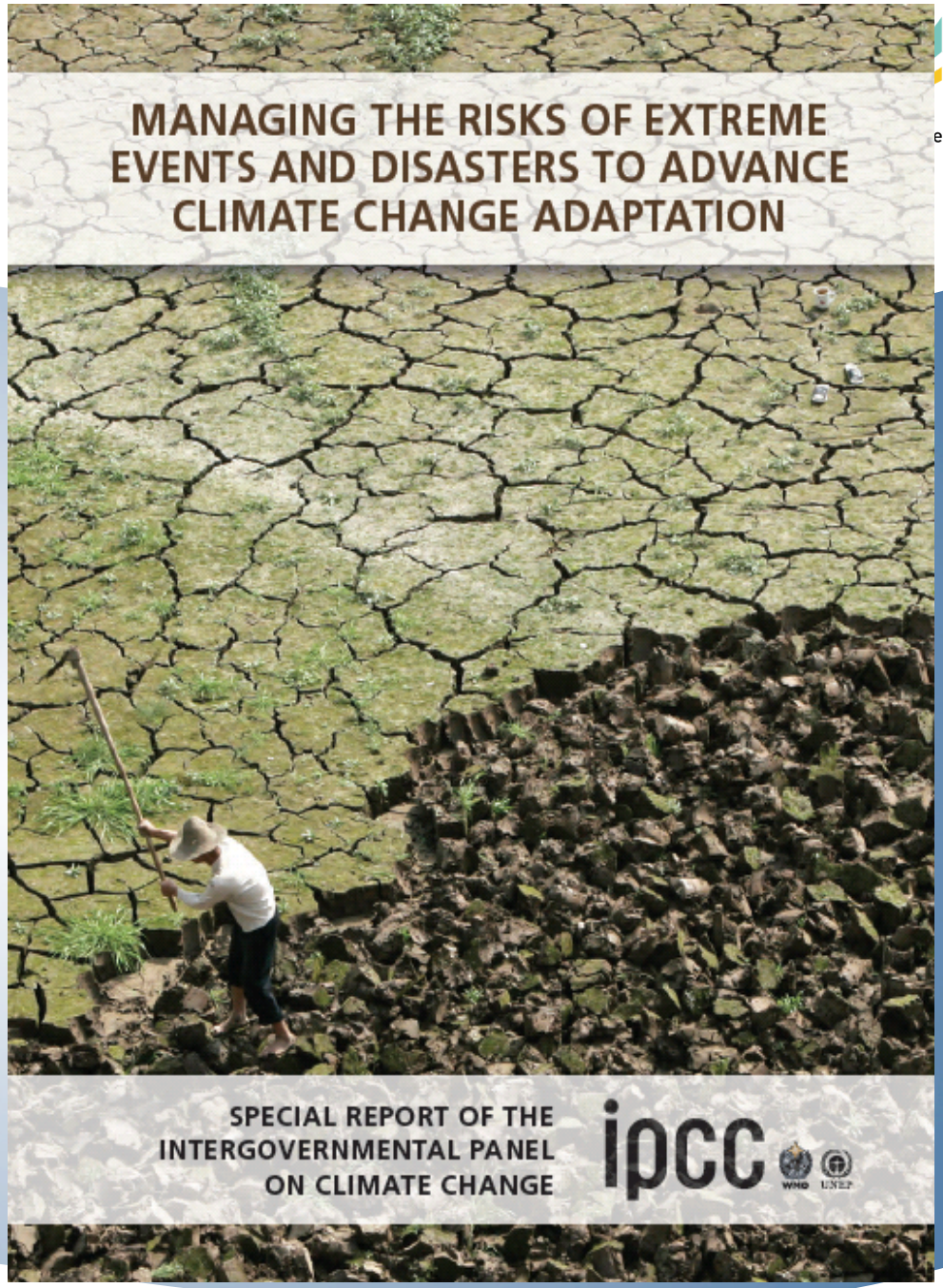
- Heat wave (days, over large region)
- Drought (year to decade or longer, continental)
- Major flood (days to month, over large region)
- Ice storm (day, over small region)
- Tornadoes (minutes and several kilometers)
- Marine storms (hours to days and thousand kilometers)






Impact dimension, extremes definition

IPCC SREX report (2012) Climate Extremes, or even a series of non-extreme events, in combination with social vulnerabilities and exposure to risks can produce climate related disasters



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)*

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)*

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4: role of ... ility for changes ... *LIVAR)*

Implementation plan requires focus on selected themes/topics

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)*

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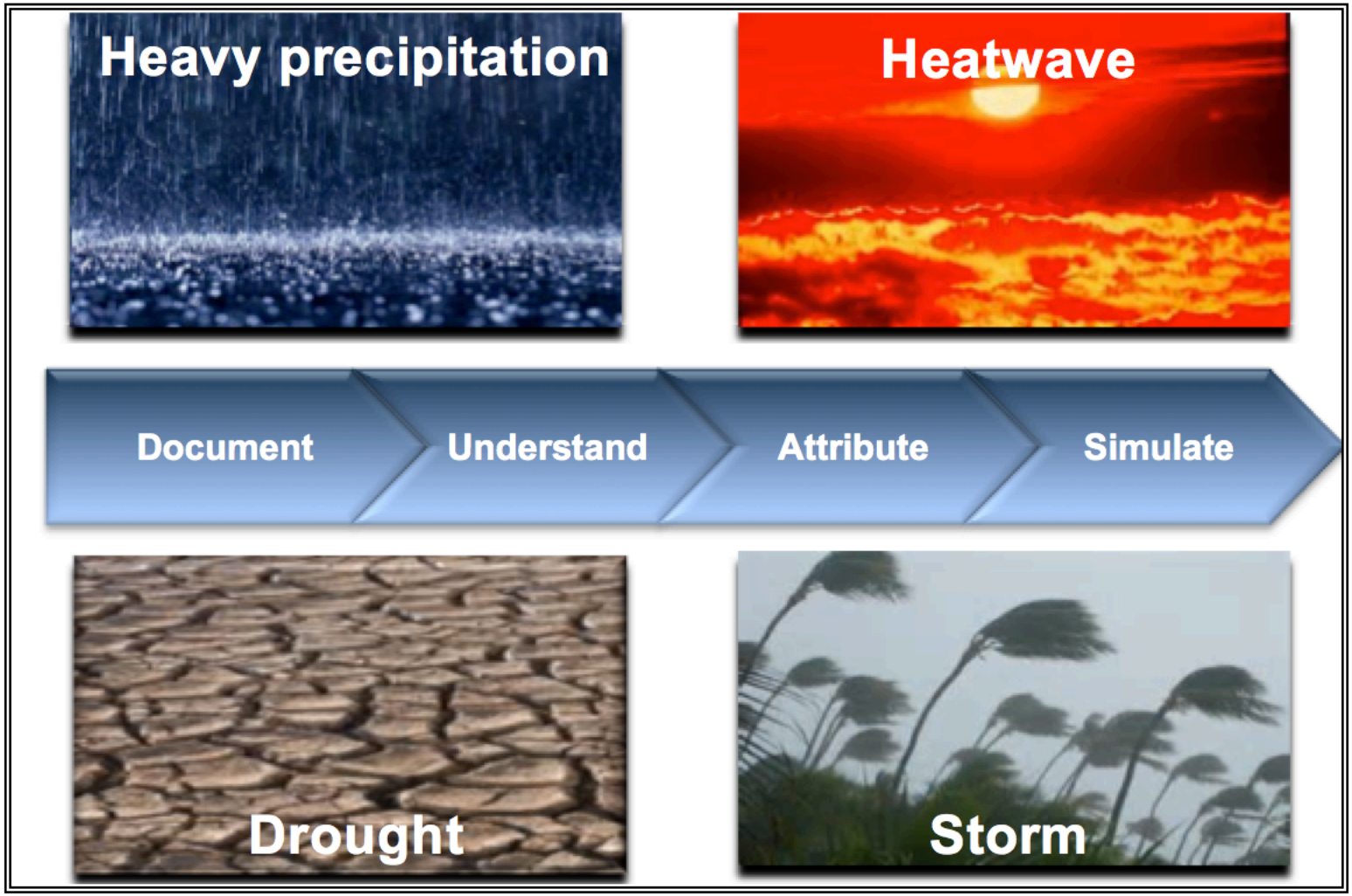
4 main extremes, 4 core themes



4 core themes

improved quality of ground-based and remote-sensing based datasets for extremes (strong involvement of GHP/GDAP/GDIS)

DOCUMENT

interactions between large-scale drivers and regional-scale land surface feedbacks affecting extremes (strong involvement of GLASS/GDIS)

UNDERSTAND

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

ATTRIBUTE

improved models for simulations of extremes

SIMULATE/PREDICT

4 core themes

improved quality of ground-based and remote-sensing based datasets for extremes (strong involvement of GHP/GDAP/GDIS)

DOCUMENT Subdaily precipitation, Extremes from RS data, Drought monitoring, Data collection (e.g. linked to RHPs, GRDC)

interactions between large-scale drivers and regional-scale land surface feedbacks affecting extremes (strong involvement of GLASS/GDIS)

UNDERSTAND CMIP6 "LandMIPs" (LS3MIP, LUMIP), DICE, CORDEX experiments, GDIS assessments, Diagnostics of land-atmosphere coupling

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

ATTRIBUTE

improved models for simulations of extremes

SIMULATE/PREDICT

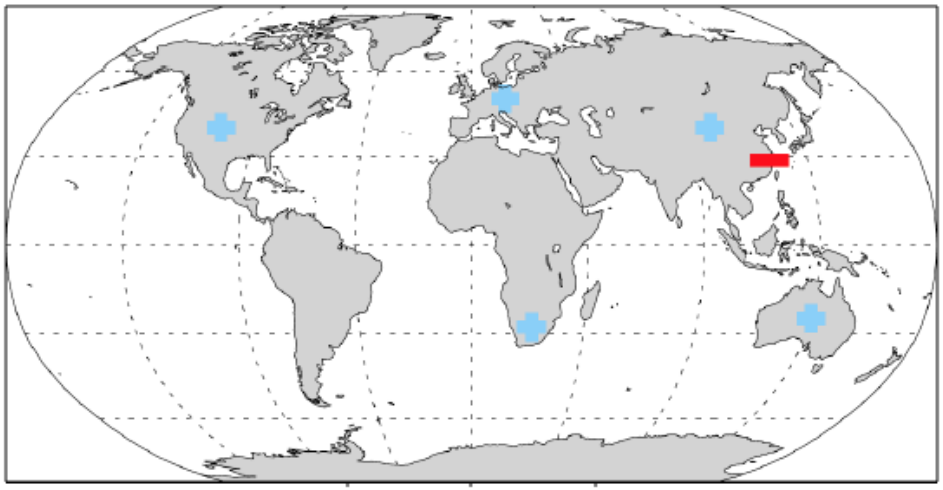
Improved observations

Sub-daily precipitation Cross-cut project

- GHP: Review of sub-daily precipitation covering observations and modelling with focus on extremes (subm. to Rev. of Geophysics)

- While only limited regions of the globe have been studied, most show an increase in sub-daily extreme rainfall over the last few decades (but with regional and seasonal variations)

GEWEX/GHP



Regional trends in observed sub-daily extreme rainfall based on published studies

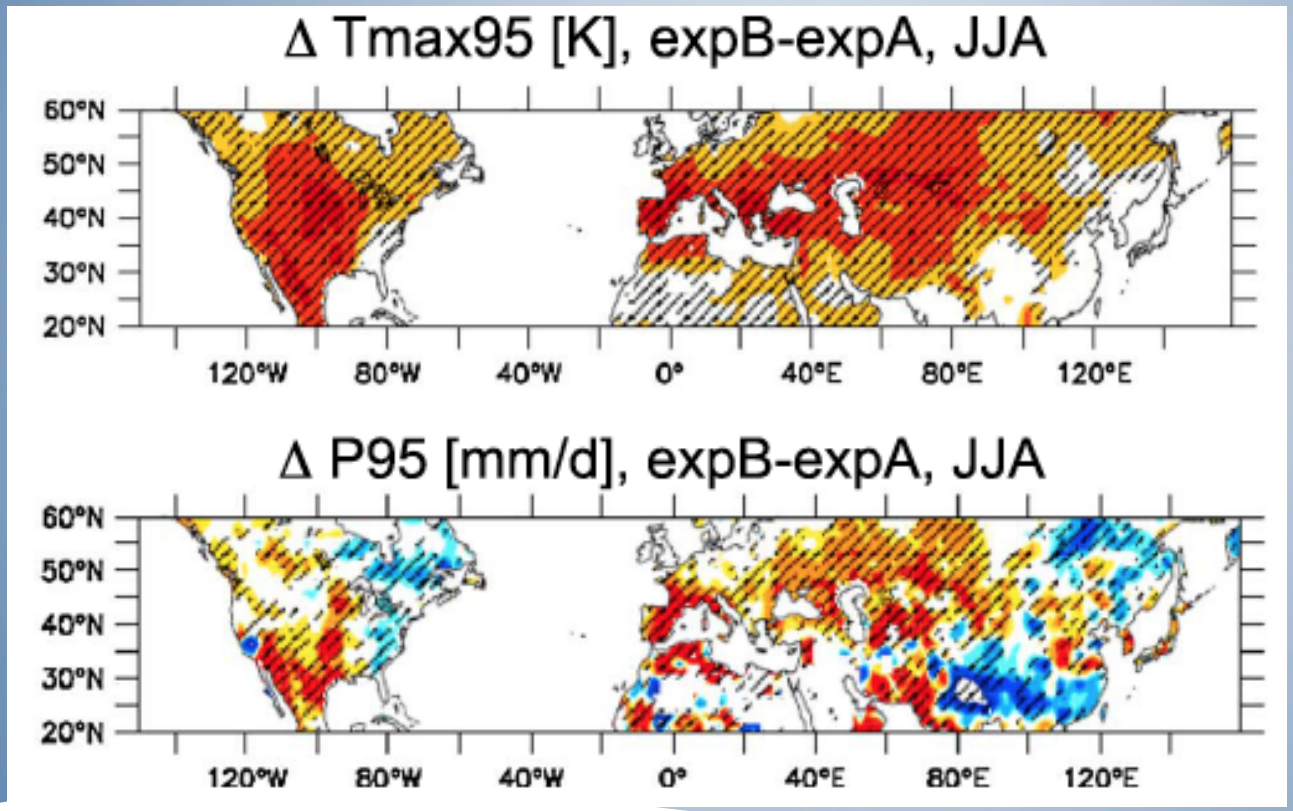
(Westra et al., 2014; Rev. Geophysics)

LandMIPs: e.g. GLACE-CMIP5

GEWEX/GLASS

Contribution of mean soil moisture change to change in T and P extremes (late 21st century-late 20th century): GLACE-CMIP5

6 participating ESM modeling groups, >10 are planning to take part in LS3MIP



Seneviratne et al. 2013, GRL

LandMIPs

that provide a deeper understanding of mountain precipitation processes, and to facilitate improvements in numerical weather prediction models, climate models, and hydrological models. The development of observational data sets will be a central activity. In particular, MOUNTerrain will focus on a collation of existing digitized observational data for high-elevation precipitation, and data rescue of high-elevation precipitation records (including quality control), including undigitized meteorological station records and ski-field and alpine clubs records, global and regional reanalysis products, and climate model precipitation fields from CMIP5 and 6.

Some of the key questions to be addressed include:

- How useful are (and how best to use) remotely sensed and gridded data sets, such as TRMM, GPCP, and reanalyses for characterizing high-elevation precipitation?
- How well are we measuring solid precipitation in moun-

Land Processes, Forcings, and Feedbacks in Climate Change Simulations: The CMIP6 "LandMIPs"

Sonia I. Seneviratne[1], Bart van den Hurk[2], Dave Lawrence[3], Gerhard Krinner[4], George Hurtt[5], Hyungjun Kim[6], Chris Derksen[7], Taikan Oki[6], Aaron Boone[8], Michael Ek[9], Victor Brovkin[10], Paul Dirmeyer[11], Hervé Douville[8], Pierre Friedlingstein[12], Stefan Hagemann[10], Randal Koster[13], Nathalie de Noblet-Ducoudré[14], and Andrew Pitman[15]

[1]ETH Zurich, Switzerland; [2]KNMI, The Netherlands; [3]NCAR, USA; [4]CNRS/LGGE & U. Grenoble, France; [5]U. Maryland, USA; [6]U. Tokyo, Japan; [7]Environment Canada; [8]CNRM-GAME, Météo-France; [9]NOAA/NCEP, USA; [10]MPI for Meteorology, Germany;[11]George Mason University, USA; [12]U. Exeter, UK; [13]NASA/GSFC, USA; [14]LSCE/IPSL, France; [15]UNSW & ARC CoECCS, Australia

(upcoming GEWEX newsletter)

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4: role of external (e.g. anthropogenic) forcings vs internal variability for changes in intensity and frequency of extremes *(ETCCDI/IDAG/CLIVAR)*

5: factors contributing to the risk of a particular observed event *(ACE/ ETCCDI/*

6: cause

The 4 core themes stem from 4 questions from white paper

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)*

White paper: 8 key questions

1: improved quality of ground-based and remote-sensing based datasets for extrem

2: imp

3: inte ace feedbacks affecting extremes *(GEWEX: GLASS)*

Other 4 topics are covered by on-going activities / established communities

4: role of external (e.g. anthropogenic) forcings vs internal variability for changes in intensity and frequency of extremes *(ETCCDI/IDAG/CLIVAR)*

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Timeline of activities

Date	Activity	Title	Location	Coordinator(s)	Expected concrete outcomes
July 2014	Summer school	Attribution and Prediction of Extremes Events	Trieste, Italy	Sonia Seneviratne, Francis Zwiers	Special Issue Weather and Climate Extremes
Sep 2014	Workshop	Lessons learnt for Climate Change Research and WCRP (invitation-only)	Bern, Switzerland	Xuebin Zhang, Gabi Hegerl	Break out group summary
Dec 2014	Drought workshop	An International Global Drought Information System Workshop: Next Steps (invitation only)	Pasadena, USA	GDIS – Siegfried Schubert et al.	TBA
Feb 2015	Data workshop	Data requirements to address the WCRP Grand Challenge on Weather and Climate Extremes: Observations and Models (invitation-only)	Sydney, Australia	Lisa Alexander, Xuebin Zhang, Gabi Hegerl, Sonia Seneviratne	Data inventory. Best Practice documentation for gridding data. Data intercomparison

Timeline of activities

Mar 2015	RClimdex/FClimdex updates	ETCCDI software updated to incorporate new relevant indices	N/A	Xuebin Zhang, Lukas Gudmundsson	Standardised, tested and documented software available for the community
May 2015	Process understanding and model evaluation workshop	Advancing our understanding and modeling of climate extremes by combining physical insights with statistical methodology	Oslo, Norway	Jana Sillmann	storylines and set of metrics developed
Jun 2015	IUGG 2015	Joint Symposium on Extreme Hydrological Events and IAMAS Symposium on Understanding and Predicting High Impact Weather and Climate Events	Prague, Czech republic	Christophe Cudennec, Richard Swinbank	TBA

Timeline of activities

Jul 2015	2015 United Nations Climate Change Conference	Proposed sessions on extreme events research	Paris, France	Session 1: Robert Vautard, Peter Stott, Fredericke Otto; Session 2: Jana Sillmann	TBA
Aug 2015	Summer School	Climate extremes	Ticino, Switzerland	Sonia Seneviratne, Reto Knutti	TBA
Nov 2015	Summer School	Climate extremes	France	Pascal Yiou	TBA
Dec 2015	AGU	Special Session on extremes	San Francisco, USA	TBA	TBA
2016	TC and the severe local weather workshop	Tropical Cyclones and High impact weather and climate change (small targeted but not closed)	New York, USA	Adam Sobel, WWRP	
2016	Conference	13th International Meeting on Statistical Climatology	Vancouver, Canada	Xuebin Zhang	TBA
2017	Open Science conference (similar to WCRP OSC but focusing only on extremes)	Grand Challenge on Extremes	TBA	TBA	Input to IPCC AR6

4 main extremes, 4 core themes