



Explaining Extreme Events of 2015 from a Climate Perspective

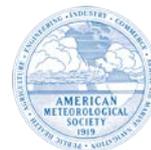
Jeff Rosenfeld, Editor in Chief, Bulletin of the American Meteorological Society

Stephanie C. Herring, NOAA's National Centers for Environmental Information

Martin P. Hoerling, NOAA, Earth Systems Research Laboratory, Physical Science Division

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Environmental Change Institute

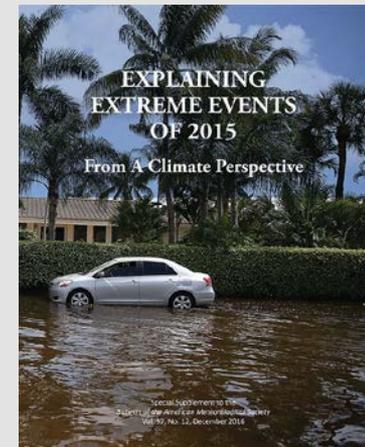
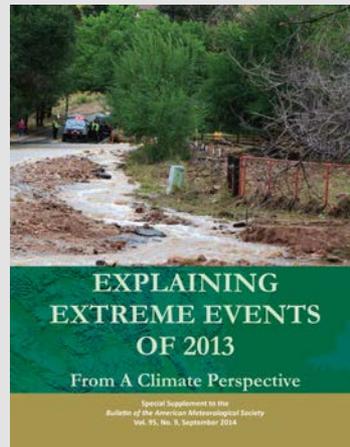
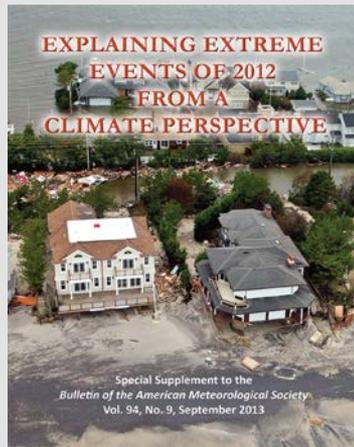


AMS
American Meteorological Society



BAMS Explaining Extreme Events

This is the fifth annual “Explaining Extreme Weather and Climate Events” of the past year, published by the *Bulletin of the American Meteorological Society* (BAMS)



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Why Do Attribution Research?

- To improve understanding of the drivers of extreme weather and how they are changing.
- To inform decision makers by linking our knowledge of the changing climate to societal impacts.



Agriculture



Energy

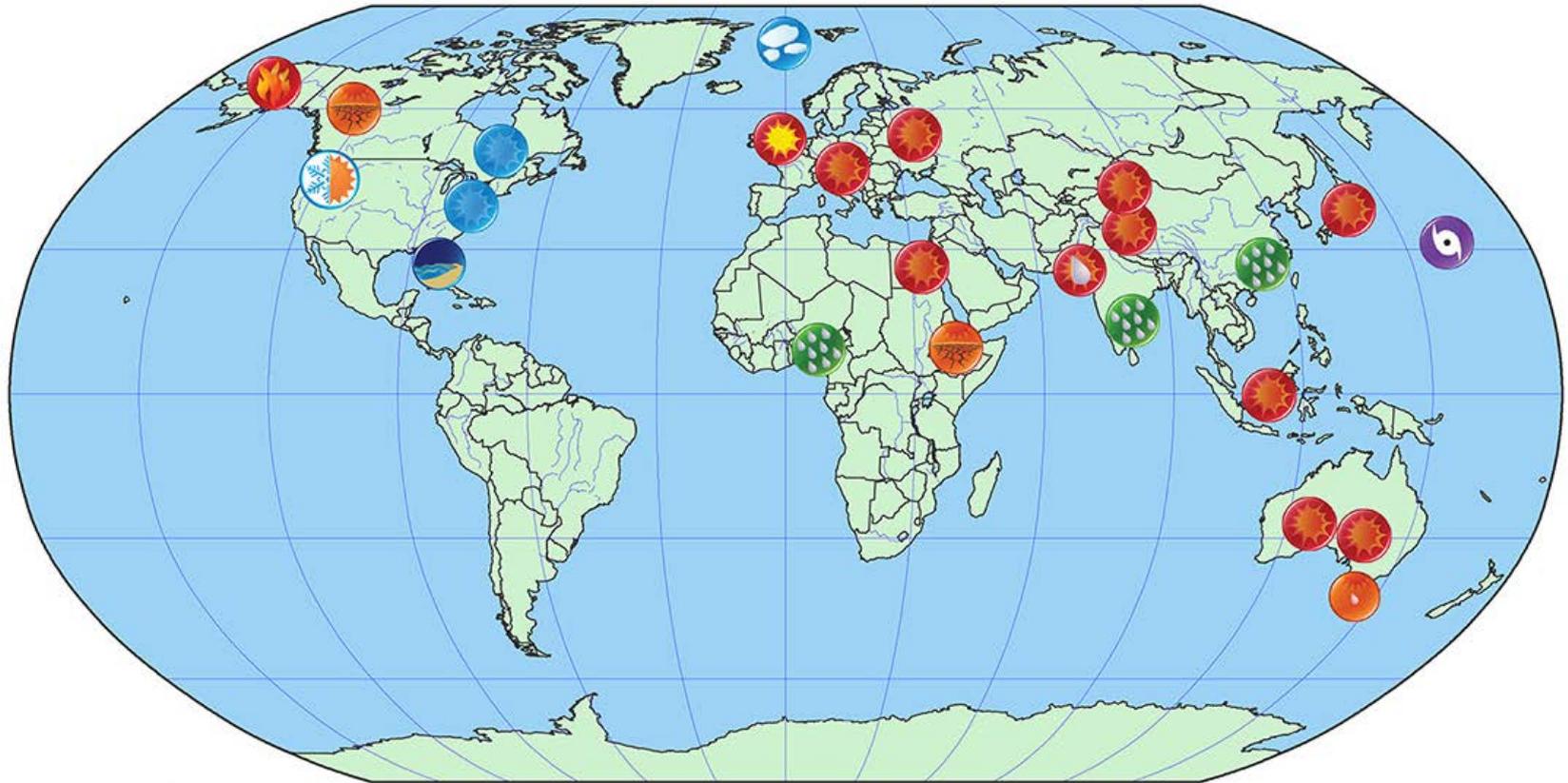


Health



Transportation

Extreme Events of 2015



- Drought
- Heat
- Heat and Humidity
- Fire
- Dry
- Snowpack Drought
- Cold
- Sea Ice Extent
- Sunshine
- Tropical Cyclones
- Tides
- Heavy Rain

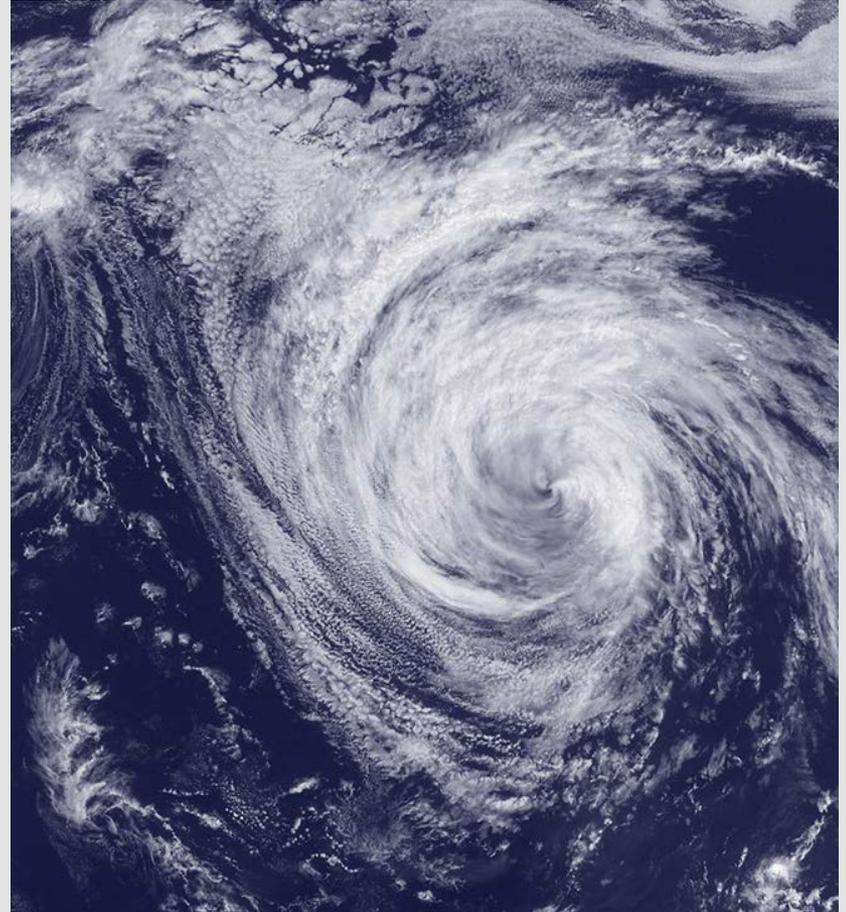
U.S. Event Highlights

- **Risk of flooding during high tides**, on otherwise sunny days in the coastal Miami region, has increased by more than 500% in the past two decades. – *Sweet et al.*
- **Eastern U.S. cold winter** was not linked to climate change. – *Trenary et al.*
- **Snowpack Drought in WA:** Exceedingly high temperatures, related in part to human caused warming, reduced the overall regional snowpack. - *Fosu et al.*
- **AK Wildfire:** The 2015 Alaska fire season burned 5.1 million acres, the second-most since records began in 1940. Human-induced climate change may have increased the risk of a fire season of this severity by 34%–60%. – *Partain et al.*

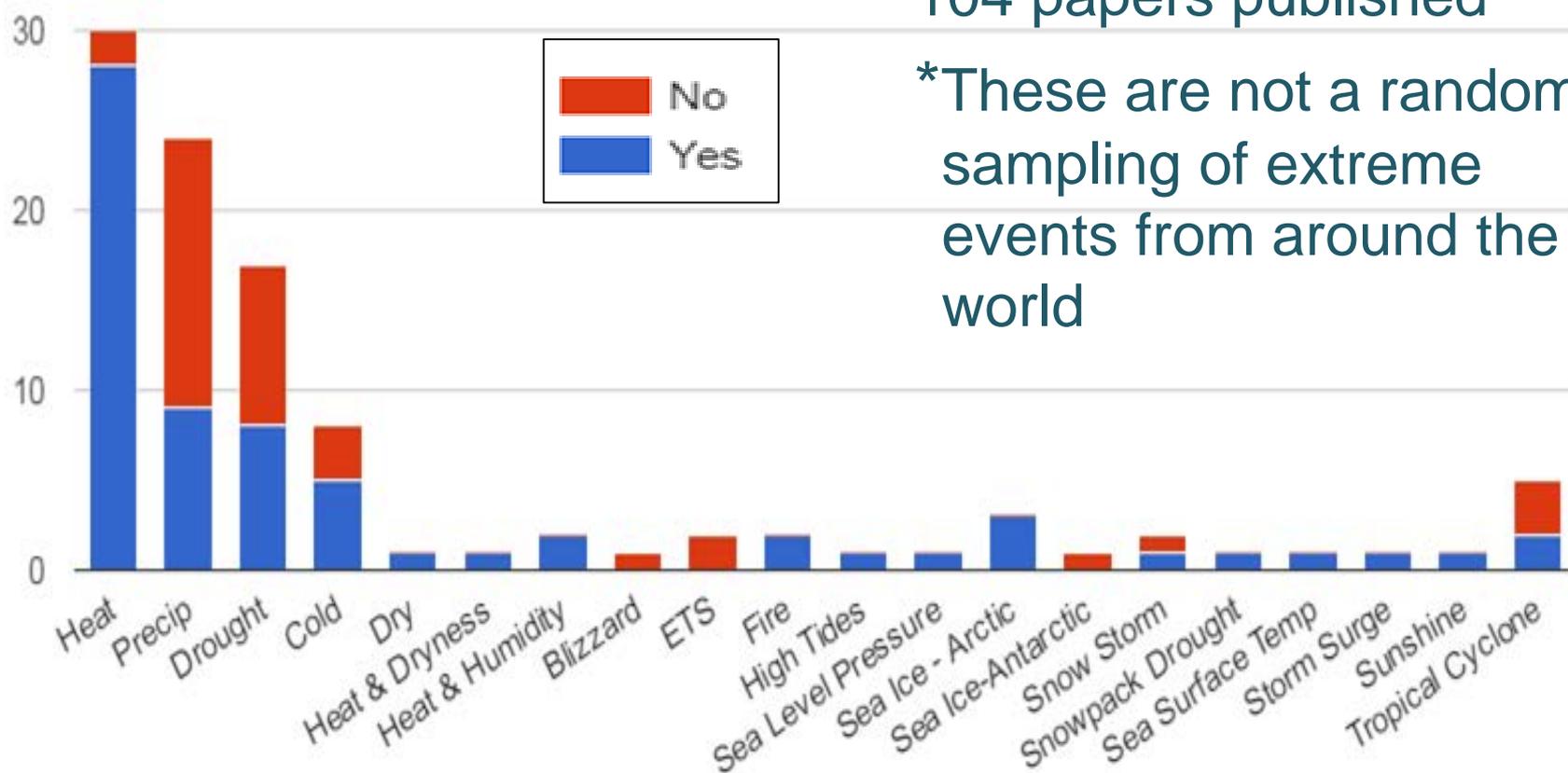


Global Highlights

- **Heat waves around the world** were made more intense by human-caused climate change.
- **Climate change contributed** to 2015 becoming the warmest year on record.
- **Extreme winter sunshine** like that over the United Kingdom in 2014/15, has become more than 1.5 times more likely under the influence of climate change. – *Christidis et al.*
- **Extreme cyclone activity in the N. Pacific** was made more likely because of climate change. – *Zhang et al.*



After Five Years



104 papers published

*These are not a random sampling of extreme events from around the world



When a climate change signal is not found

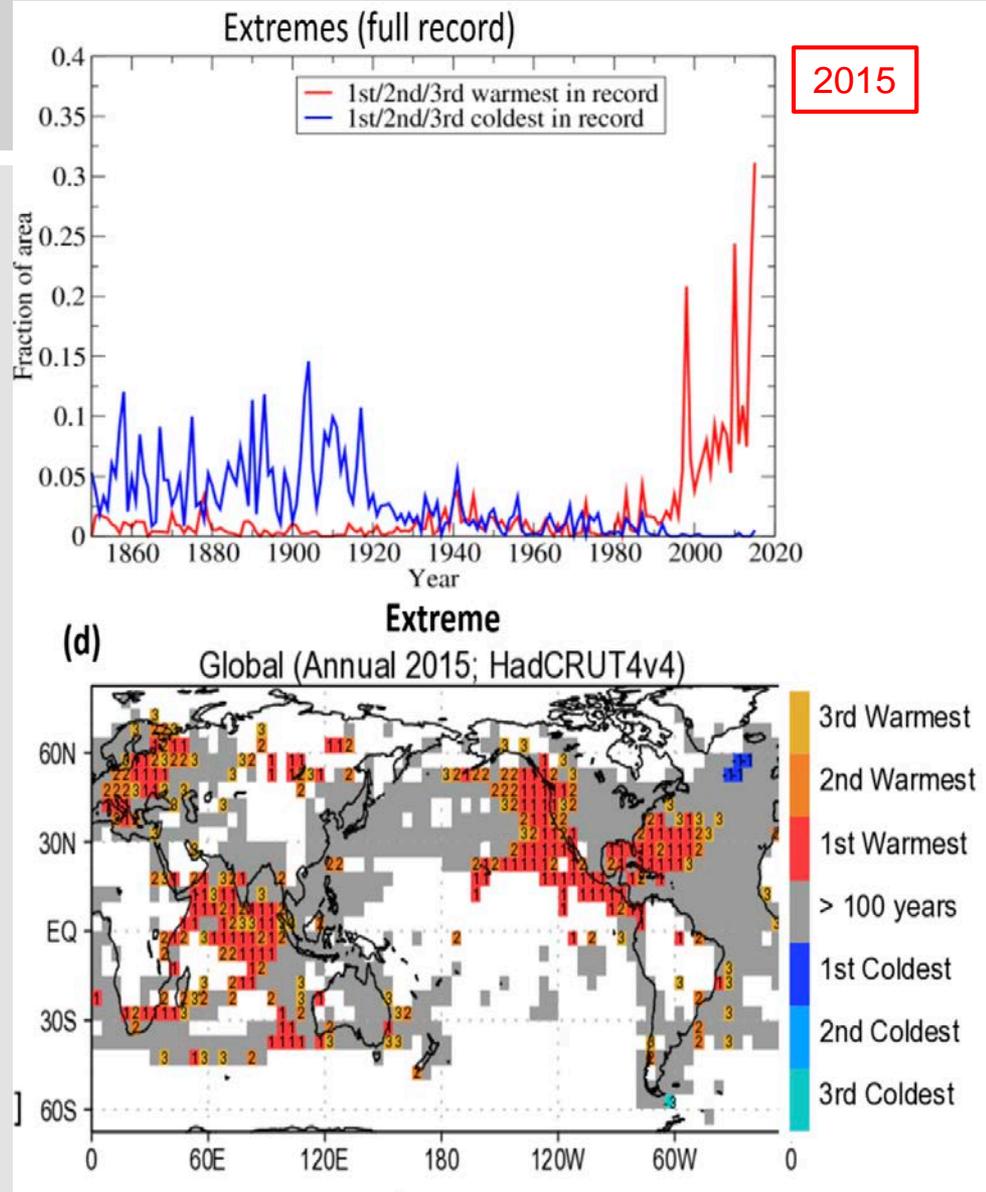
- Natural variability is always part of any weather and climate extreme. A human influence on an event is not always found in these studies.
- How should this be interpreted? Any of the following could explain the absence of a signal:
 - There was no human influence on the event
 - The particular factors investigated were not influenced by human-caused climate change
 - The human influence could not be identified with the scientific tools available today
- In all cases, as models, data, and analysis methods improve, future studies could yield new information.



A Global Context for Extreme Events of 2015

- All events selected a posteriori, and did not necessarily exist in authors' minds before event occurrence.
- Extreme events studied for the last year were not exhaustive of all events that occurred in 2015.
- It is important to learn if these case studies speak to more general characteristics of extremes that also took place in 2015, but went unexamined in this report.

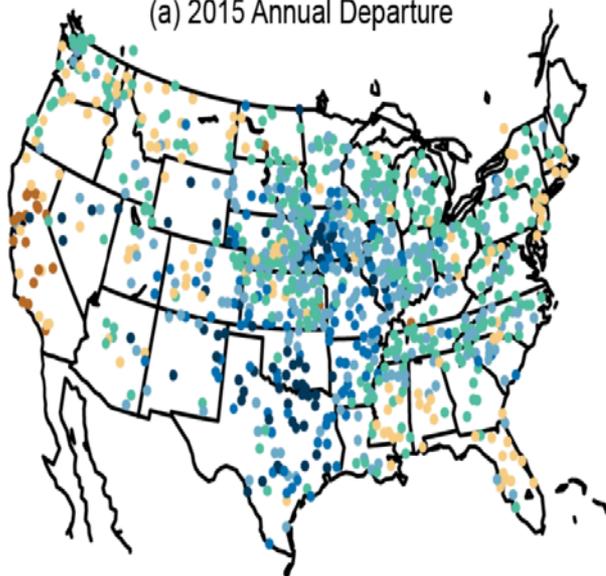
Fraction of World with Warm vs Cold Annual Extremes



J. Kam et al.: MULTIMODEL ASSESSMENT OF ANTHROPOGENIC INFLUENCE ON RECORD GLOBAL AND REGIONAL WARMTH DURING 2015



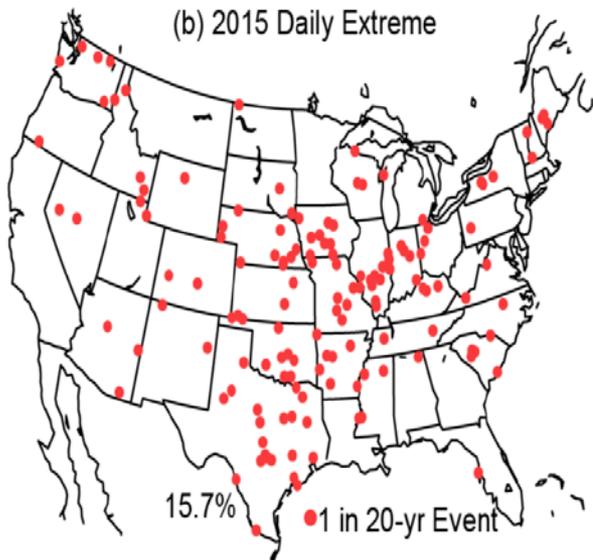
(a) 2015 Annual Departure



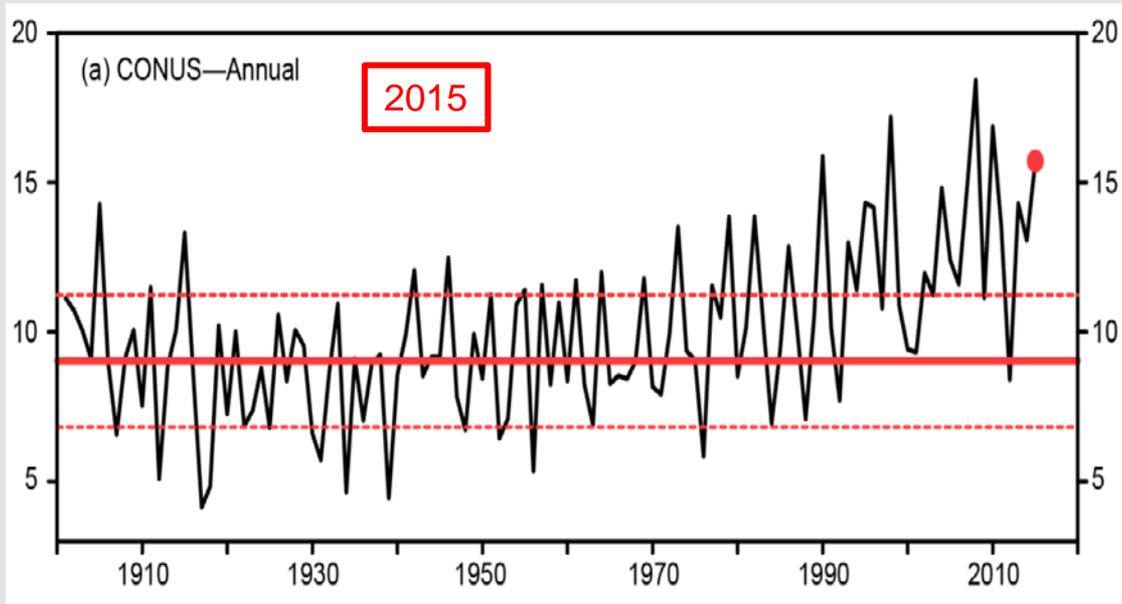
% of Climatology



(b) 2015 Daily Extreme



Fraction of US Stations w/Daily Rainfall Extremes (1-in-20yr)



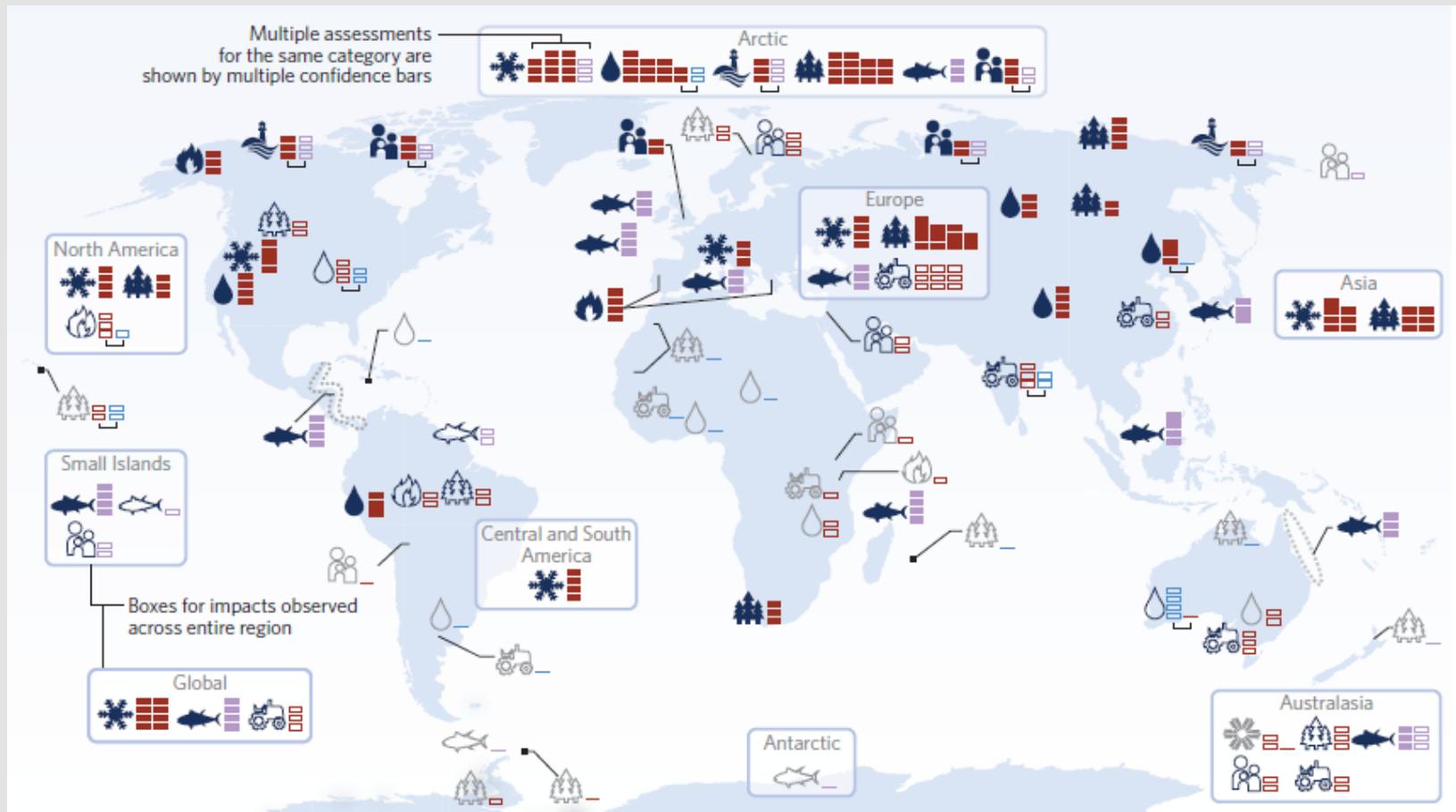
Wolter et al. : WHAT HISTORY TELLS US ABOUT
2015 U.S. DAILY RAINFALL EXTREMES



Towards attributing the *impacts* of anthropogenic climate change

Friederike Otto
University of Oxford

Assessment of impacts of *anthropogenic* climate change



In the short term, the largest impacts and highest damages are through extreme weather events.



Otto 2016, NCC

Environmental Change Institute



climateprediction.net

the world's largest climate forecasting experiment for the 21st century

NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION

What happened? Event definition



Heat Wave Kills Around 1,400 in Andhra Pradesh, Telangana;
| Read

PUBLISHED ON: MAY 27, 2015 | DURATION: 2 MIN, 01 SEC



Trade-off between what causes the impacts and what we can simulate reliably, what data is available

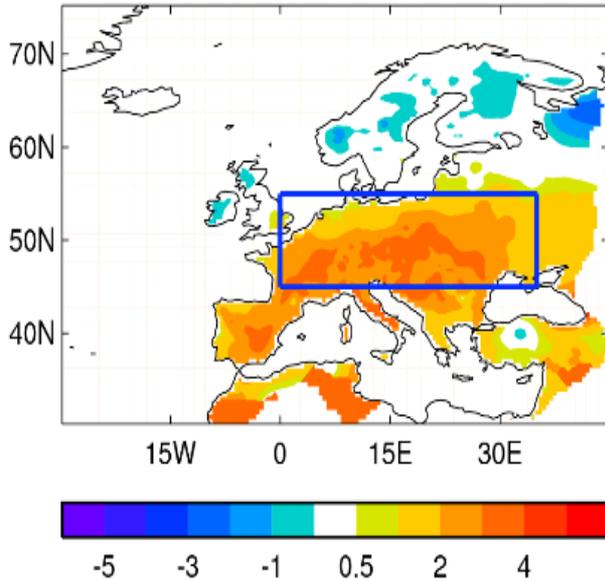


climateprediction.net

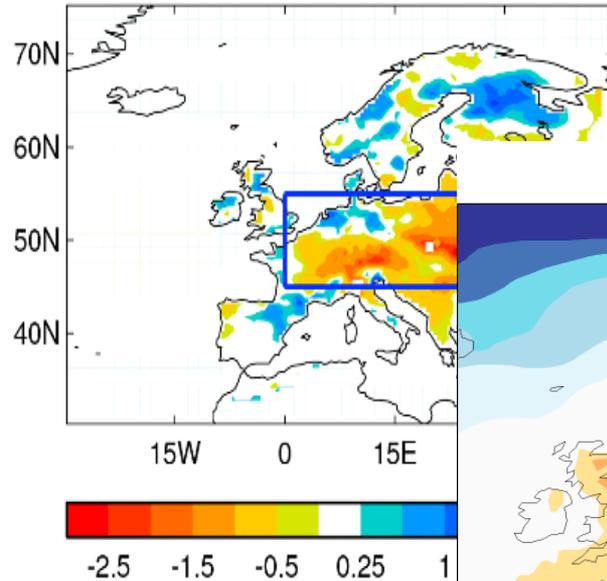
the world's largest climate forecasting experiment for the 21st century

What is an event? - Heat wave in EU 2015

(f) SAT anomalies in JJA 2015 (E-OBS)

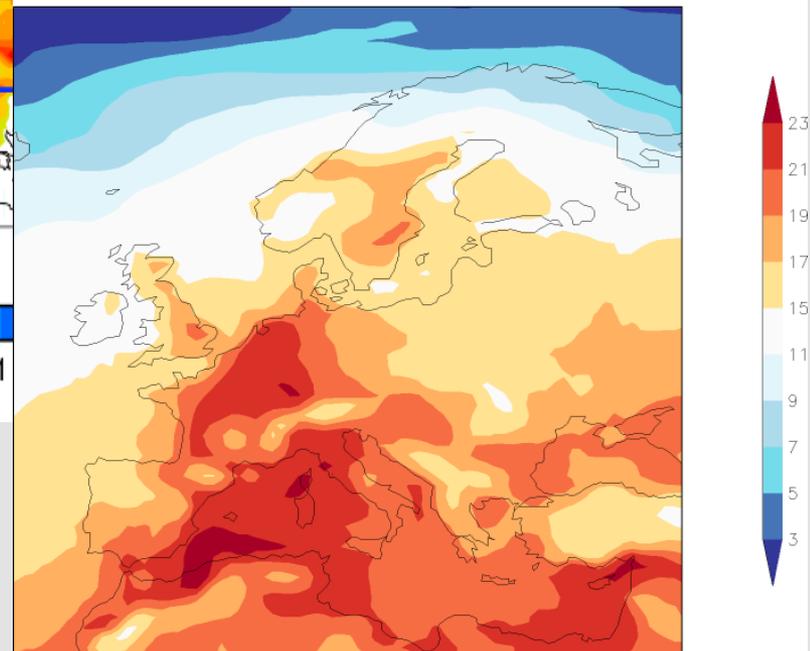


(g) Pr anomalies in JJA 2015 (E-OBS)



Heat Stress

Twetbulb 3-3Jul2015
ERA-int Twetbulb



Dong et al., 2016 BAMS

Sippel et al., 2016 BAMS



For More Information

- Full Report - BAMS “Explaining Extreme Events of 2015 from a Climate Perspective”
 - <https://www.ametsoc.org/ams/index.cfm/publications/bulletin-of-the-american-meteorological-society-bams/explaining-extreme-events-from-a-climate-perspective/>
- NCEI Web Story and Slides from today’s press conference
 - <http://www.ncdc.noaa.gov/news/explaining-extreme-events-2015>
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