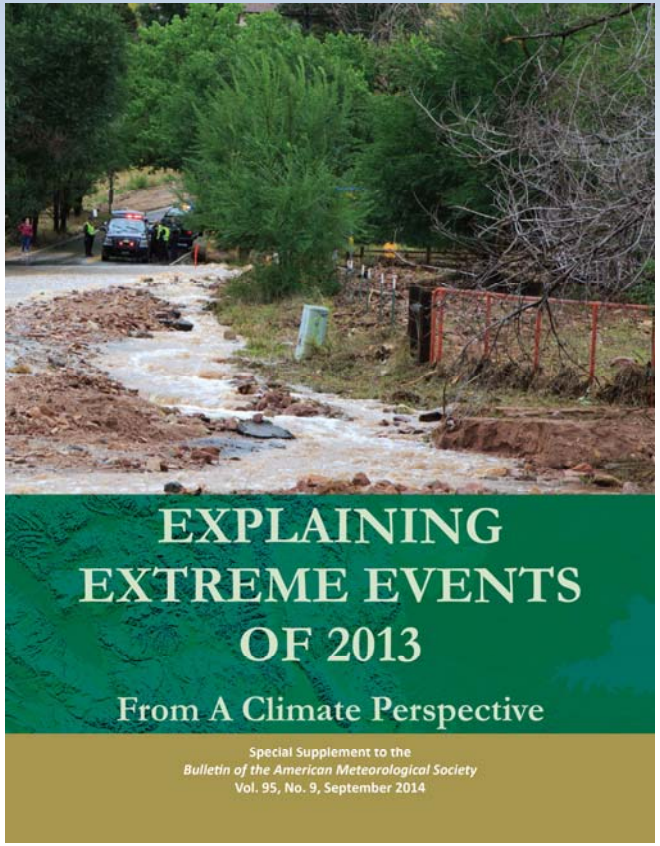
Explaining Extremes of 2013 from a Climate Perspective



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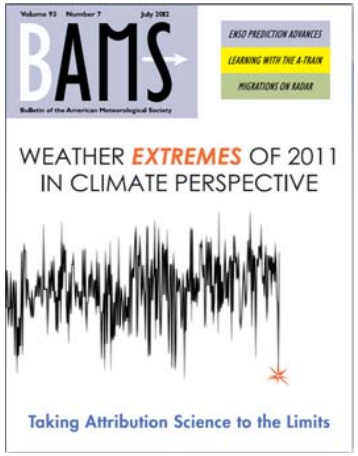
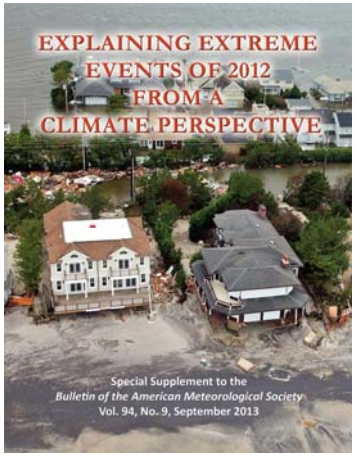
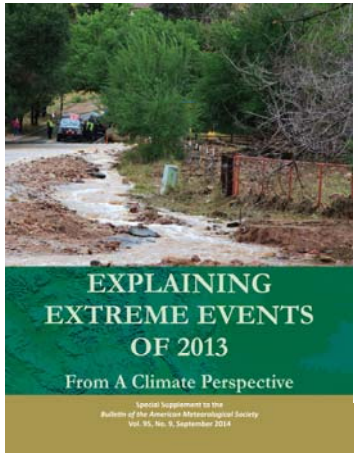
Report Background

- Third year of publishing research on "Explaining Extreme Weather and Climate Events" of the past year in the *Bulletin of the American Meteorological Society* (BAMS)
- Each event is assessed and written by independent author teams who select the events they will examine
- Each paper is independently peer reviewed by BAMS editors and scientific reviewers





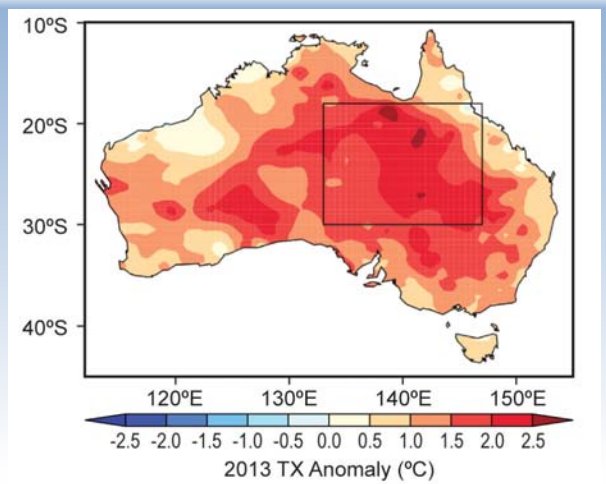


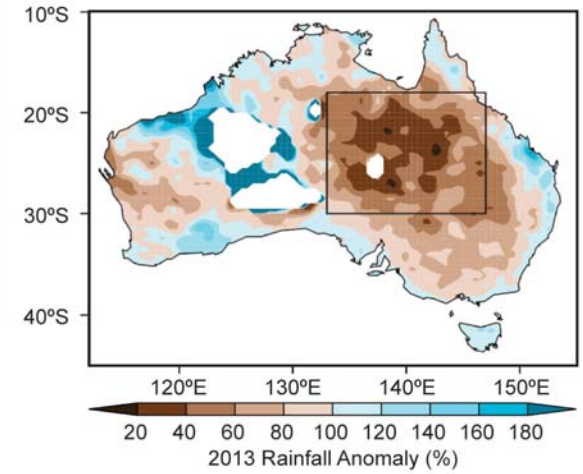
The Value of Attribution Research

- Supporting prediction and projection science
  - The physical understanding of extreme events is critical to help build confidence in our ability to predict and project future weather and climate extremes
  - Assessments of extremes can show strengths and limitations of models
- Understanding the evolution of extremes in a changing climate is an important tool in preparing for future weather and climate extremes
- Scientific event attribution can help inform the public's understanding of our changing environment

The Value of Multiple Studies

- Extreme events are often complex and influenced by multiple factors
  - Some variables are more difficult to discern whether there was a human influence than others (e.g., precipitation vs. temperature)
- Any single factor that influences an event is accompanied by other variables that have supporting/opposing influences and need to be considered
- Multiple studies that use different methods and examine different factors can give us a more robust understanding of the role of climate change



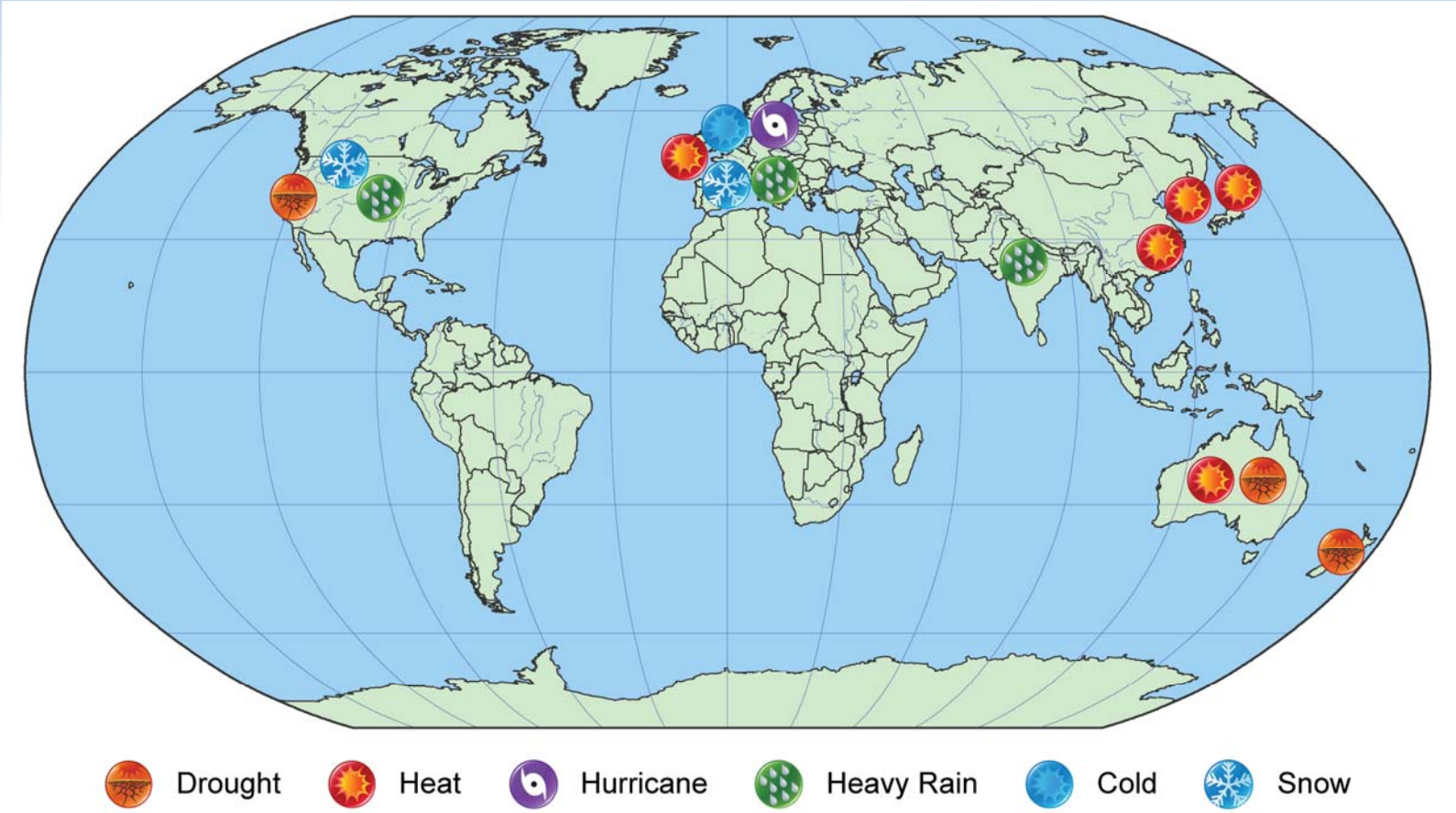


What If No Evidence for Human-Caused Climate Change Was Found?

- Natural variability is always part of any weather and climate extreme. Discerning the human influence for an event is not always found in these studies
- How should this be interpreted?
  - 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

What Is in the Report?

- Twenty different research groups explored the causes of 16 different events that occurred in 2013

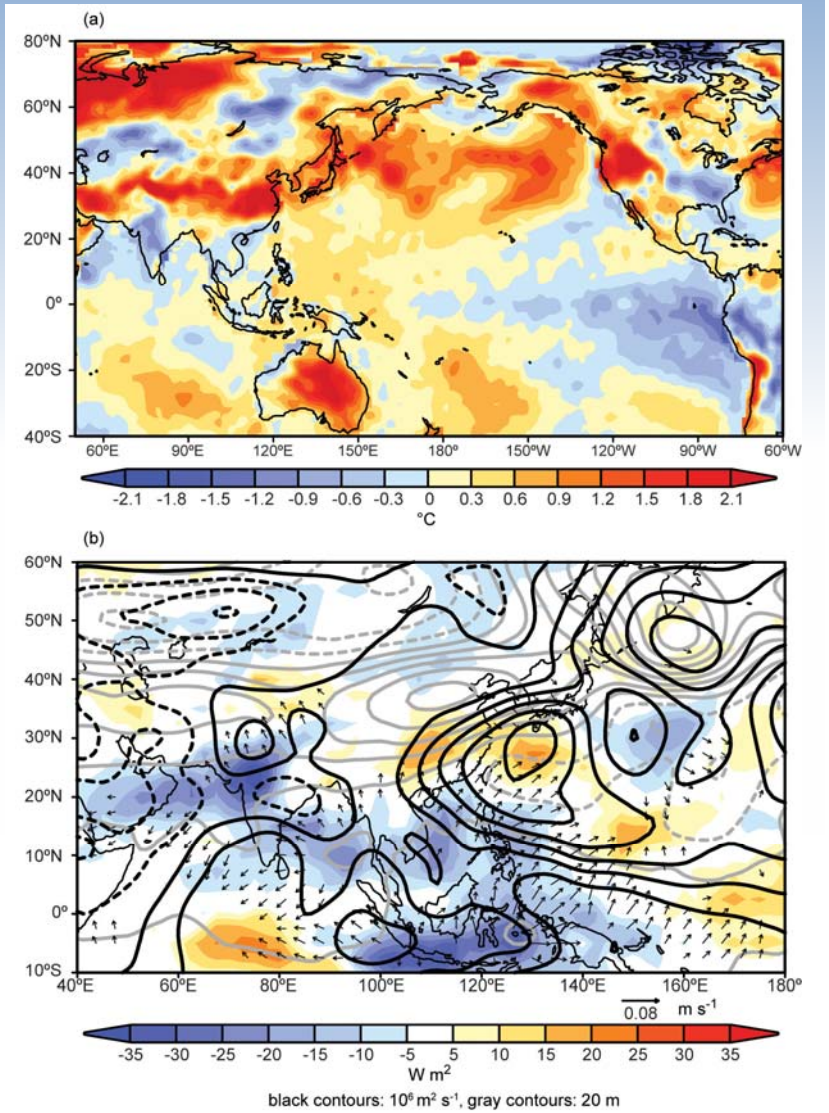


California Drought

- A combination of factors lead to a drought
  - Lack of precipitation, temperature, evaporation rates, soil moisture, etc.
  - Human activity such as land and water usage
- Multiple reports on the California drought looked at many variables, but a clear picture of how long-term climate change impacted the California drought is yet to emerge
  - Swain et al.: Influence on geopotential heights found
    - The influence on actual changes in precipitation or temperature remain uncertain
  - Funk et al.: No influence found
    - Long-term sea surface temperature warming did not contribute to the California drought risk
  - Wang and Schubert: Conflicting influences found with no NET impact
    - Found increases in anomalies that divert storms away from California (increase drought risk), but also found increases in humidity (decrease drought risk)

Temperature Extremes

- Nine analyses of extreme heat events overwhelmingly showed that human-caused climate change substantially influenced all of these events
  - Five analyses of Australia, Japan, Korea, China, and Europe
- Analysis of UK cold spring showed the probability of occurrence may have fallen 30-fold due to global warming

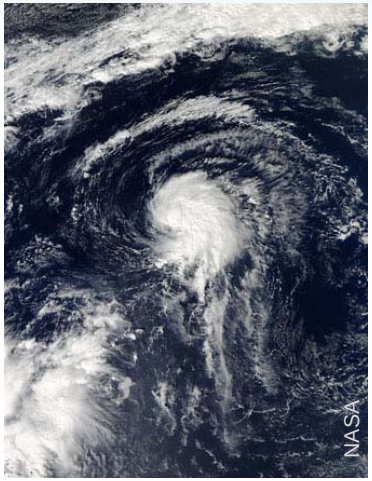


Precipitation Extremes

- In contrast to temperature extremes, the role of human influences on the extreme precipitation events analyzed is decidedly mixed
- Two papers showed an increasing risk, one showed a decreasing risk, and two showed no influence

Storms

- Unique contributions to this year's report
  - South Dakota blizzard
  - Cyclone "Christian" in northwestern Europe
  - Extreme snowfall event in the Pyrenees Mountains
- None of these analyses found a role for human-caused climate change
- However, attribution assessments of storm events such as these pose unique challenges due to the often limited observational record



Summary

- Attribution research has many values, including advancing our understanding of how events may change in the future
- There is great scientific value in having multiple studies analyze the same extreme event to determine the underlying factors that may have influenced it
- The science remains challenging, but the environmental intelligence it yields for decision makers is invaluable and the demand is ever-growing