NOAA RESEARCH • ESRL • PHYSICAL SCIENCES DIVISION

Theme 2: Understanding the Physical System

Explaining Extremes to Improve Predictions - Overview

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Science Review
12-14 May 2015
Boulder, Colorado

Explaining Extremes to Improve Predictions

Key roles for PSD are to:

- Understand the physical basis for prediction of high-impact weather and climate events
- Communicate this understanding and its implications to decision-makers and the public
- Work within NOAA and with other organizations to advance predictive capability

In this session we focus on the explanation of observed trends, variability, and extreme events

- Climate-scale drivers
- The roles of predictable and unpredictable climate variability and anthropogenic change
- Interaction with regional processes and feedbacks

NOAA Strategic Objectives

- Improved scientific understanding of the changing climate system and its impacts
- Assessments of current and future states of the climate system that identify potential impacts and inform science, service and stewardship decisions

NOAA 5-Year Plan Objectives for R&D

- Identify the causes of climate trends and their regional implications

OAR Science Questions

- What causes climate variability and change on global to regional scales?
- How does climate affect seasonal weather and extreme weather events?
- What improvements in global and regional climate predictions are possible?

PSD Strategic Goals (2010)

- Understand, attribute and predict extremes in a variable and changing climate

Why Explain Observed Extremes?

Connecting "model world" to "real world" – esp. mechanisms that generate tail risk

Develop scientifically-supported narratives, situational awareness

Establish confidence in predictions

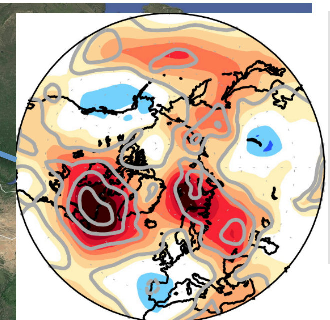
Improve characterization of uncertainty

Inform climate monitoring & nowcasting

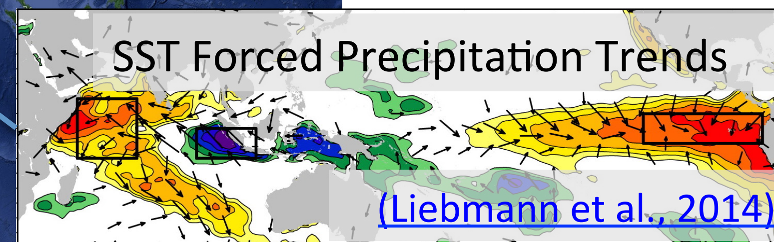
Identify needed model improvements

Support adaptation & preparedness on many timescales

PSD Trend and Extreme Event Assessments 2010-present



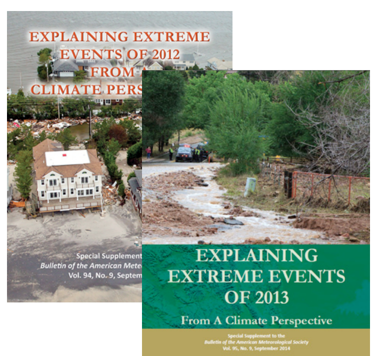
Arctic Tropospheric Warming - linkage to midlatitudes (Perlwitz et al. 2015)



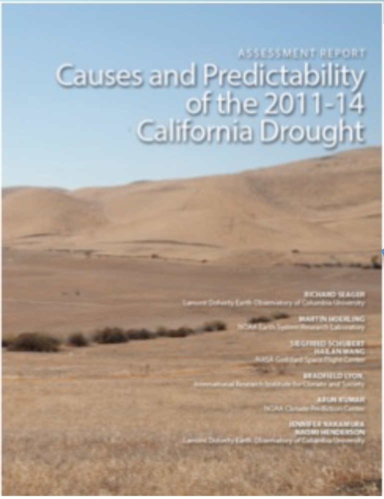
reference

PSD contributions (2010-present) to assessment of high-impact events and regional climate trends are outstanding in quality and quantity and have national and international exposure and impact

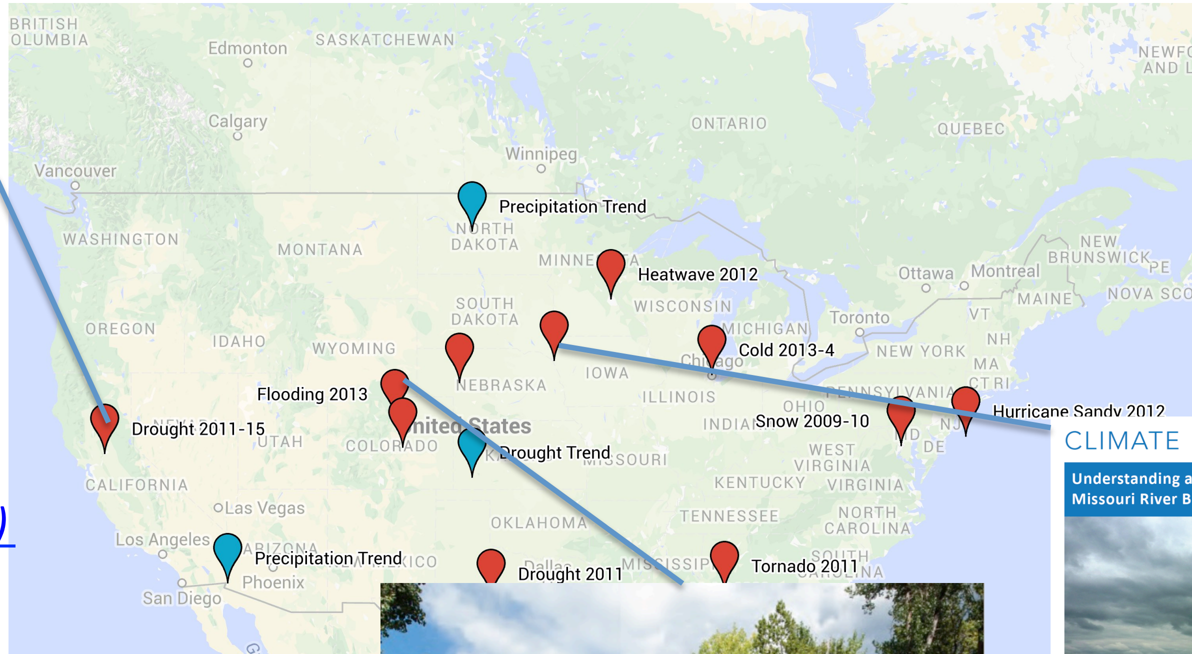
Explaining Extreme Events from a Climate Perspective



Publicaions at http://www.esrl.noaa.gov/psd/csi/pubs

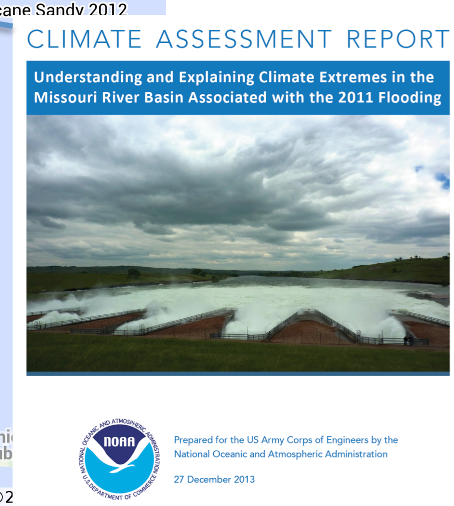


California 2011-?
[(Seager et al., 2014)](#)



PSD Trend and
Extreme Event
Assessments
2010-present


Colorado 2013
[(Hoerling et al., 2014)](#)



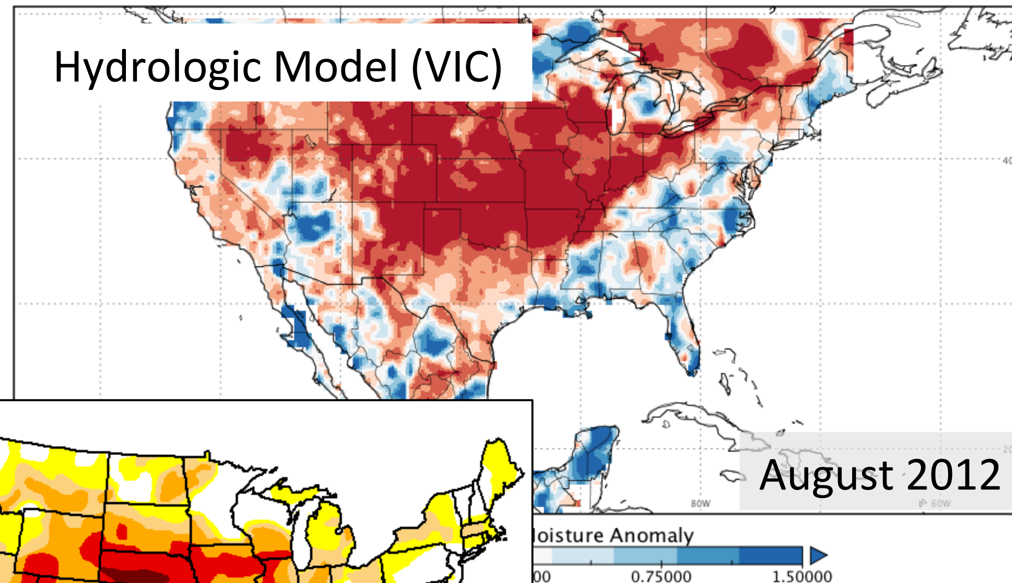
Missouri River 2011
[(Hoerling et al., 2013)](#)

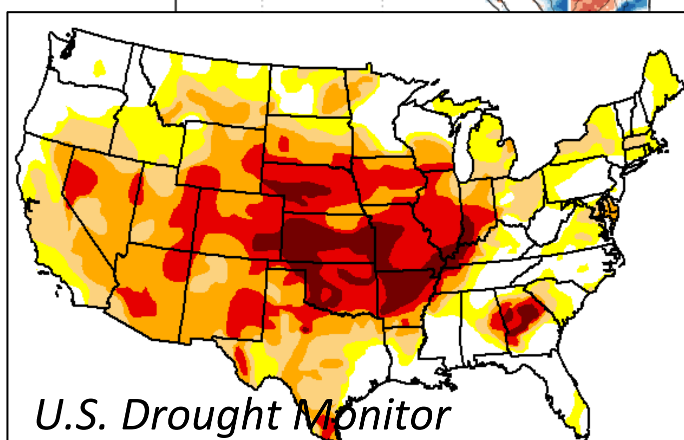
- Science Collaboration
- Stakeholder Involvement

Regional Factors and Models

To explain high impact events we also need to understand the local and regional factors that make extremes "extreme"

Example: Soil Moisture and Drought



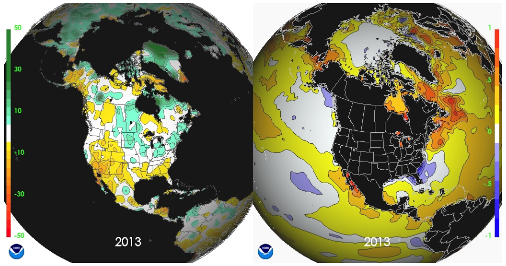


More examples:

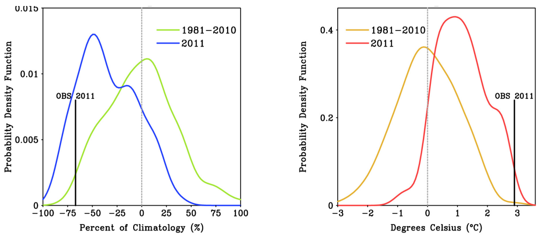
- Vegetation response
- Evapotranspiration
- Snowpack evolution
- Orographic precipitation

Livneh et al., 2013

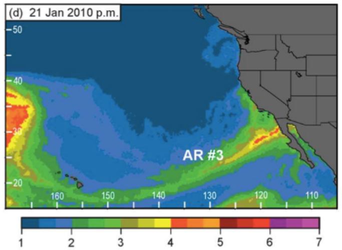
Talks: From trends to events, large scale drivers to local processes



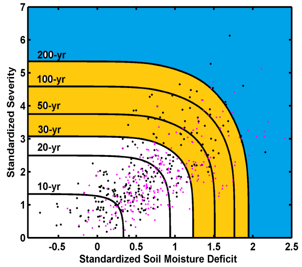
How have sea surface temperatures been driving the trends and multi-decadal precipitation variability in the US? (Marty Hoerling)



Could we have anticipated the 2011 Texas drought and heatwave event? (Judith Perlwitz)



How critical is the wind direction during atmospheric rivers for heavy orographic precipitation? (Mimi Hughes)



What can soil moisture tell us about the drought response to temperature and precipitation? (Linyin Cheng)