Conditioning Event Occurrence

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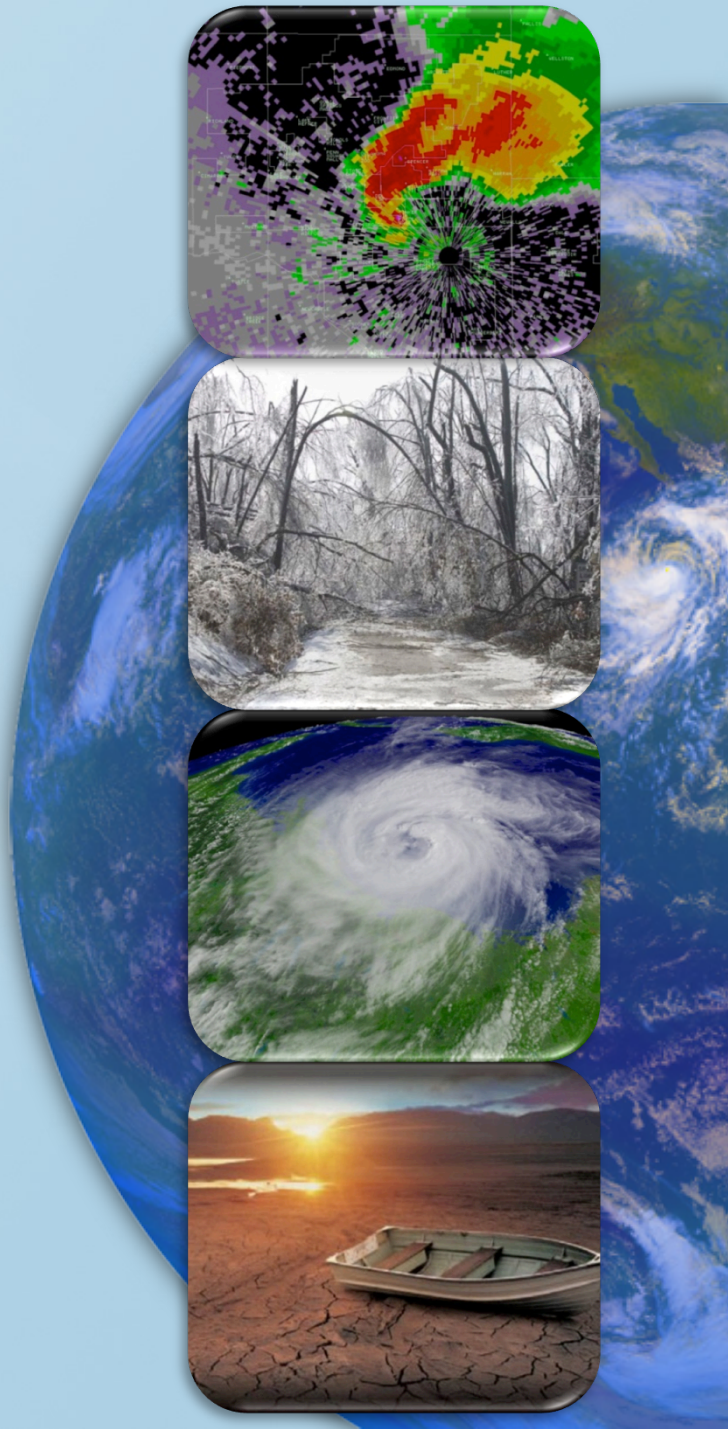
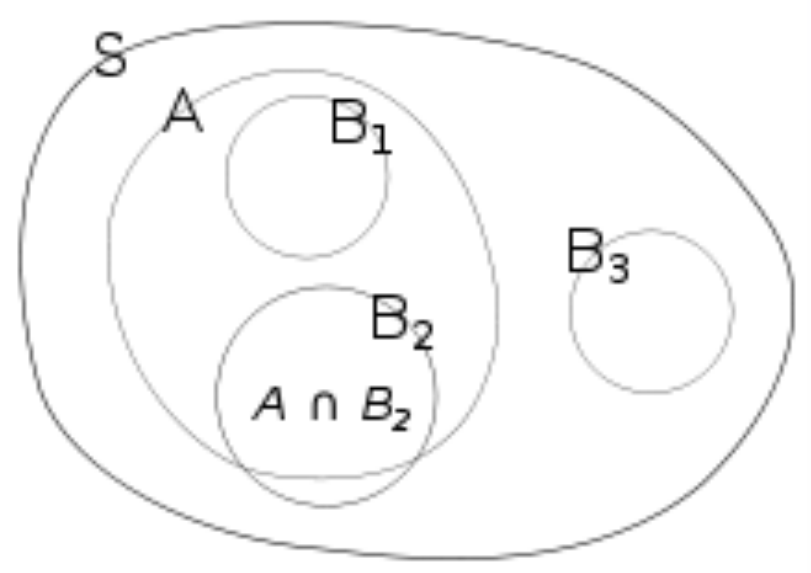
NOAA Earth System Research Laboratory
12 September 2012



ACE
Attribution of climate-related extremes

Conditioning Event Occurrence

At the Core of Event Attribution Science

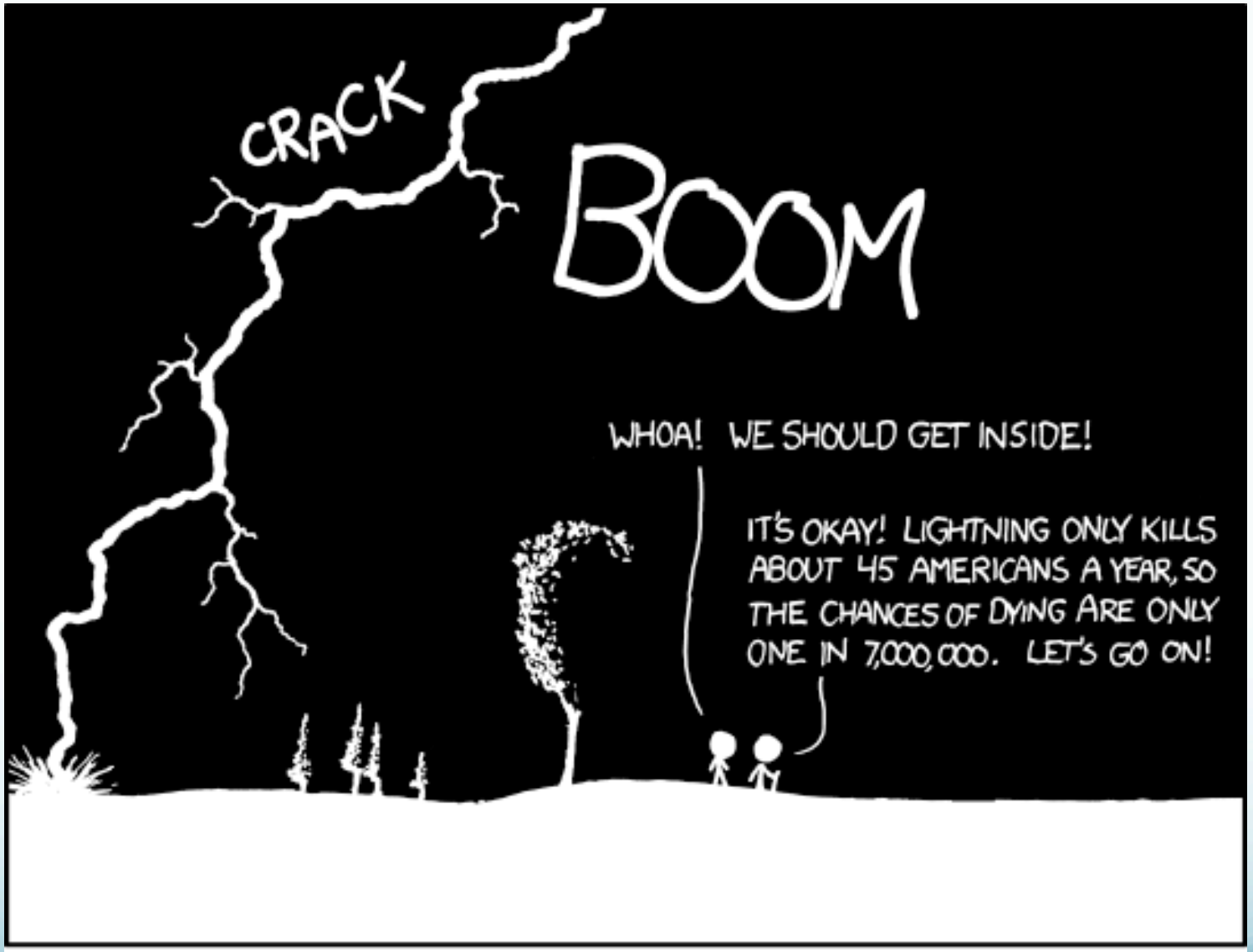


In probability theory, the **conditional probability** of A given B is the probability of A if B is known to occur (or have occurred).

$$P_B(A) = P(A \cap B)/P(B)$$

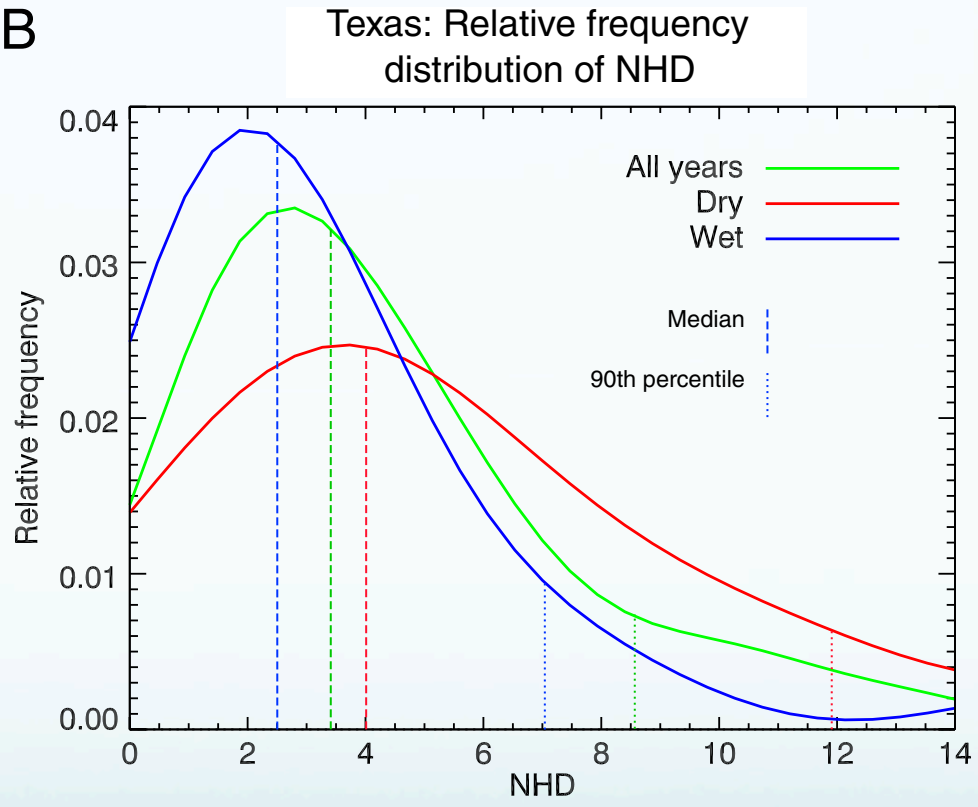
Conditional probability is so named because the ultimate chance of A occurring is conditioned on B occurring, with the practical notion (for predictive understanding) that B occurs first.

Conditional Risk



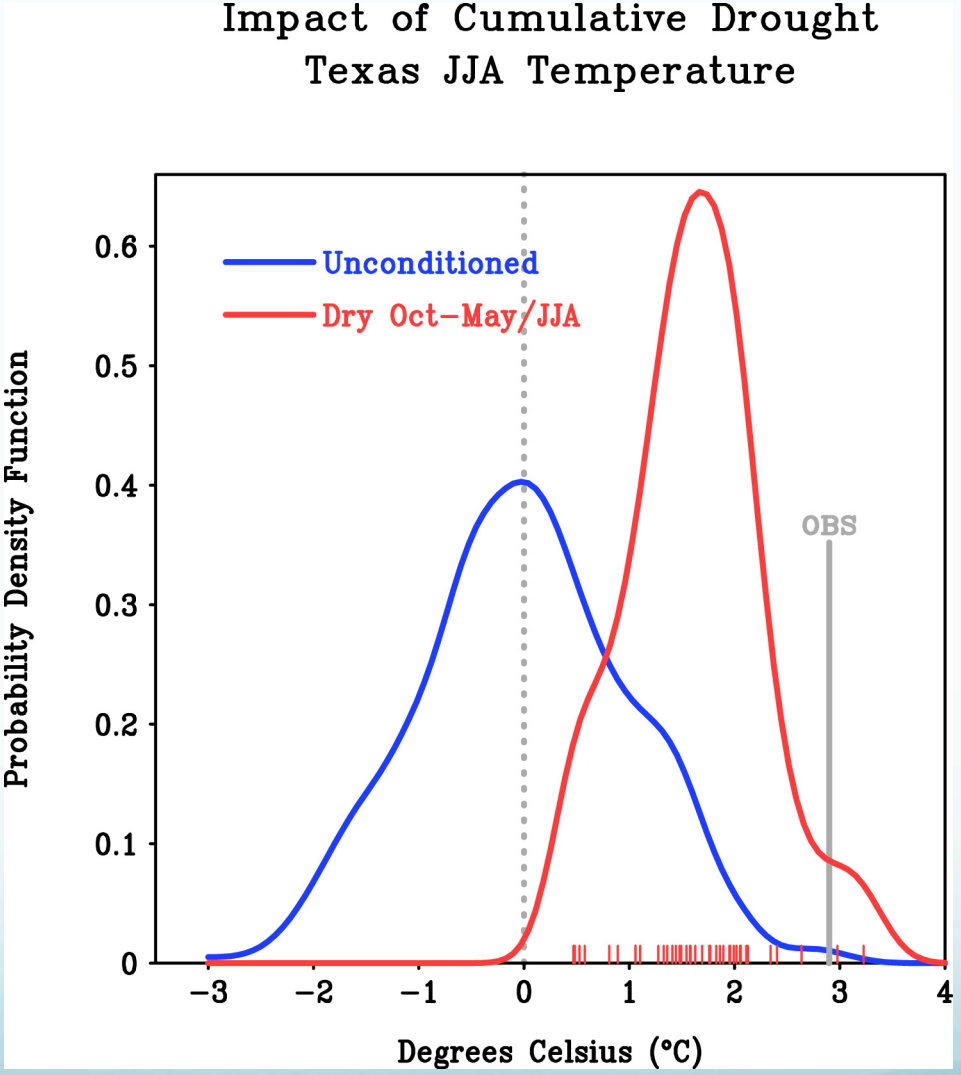
Land Surface Conditioning of Event Occurrence

Summer Hot Days Conditioned by Antecedent Rainfall



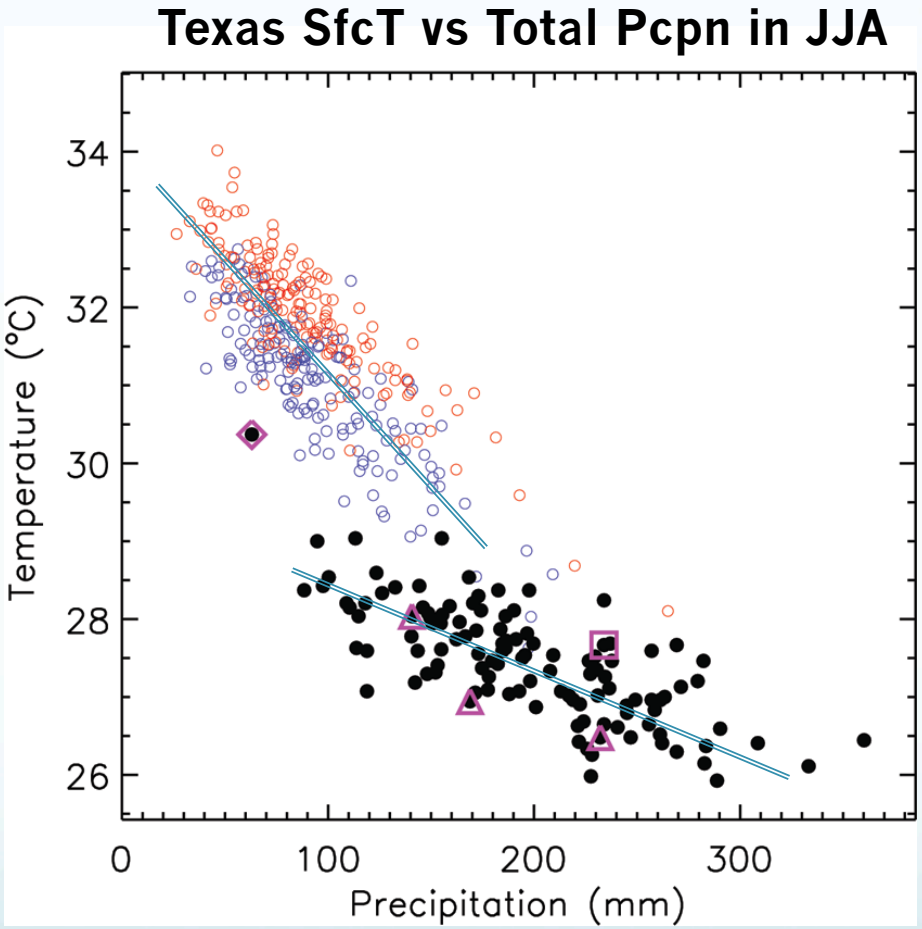
Mueller and Seneviratne 2012, PNAS

Summer Mean Temperature Conditioned by Drought



Hoerling et al. 2012, JClimate

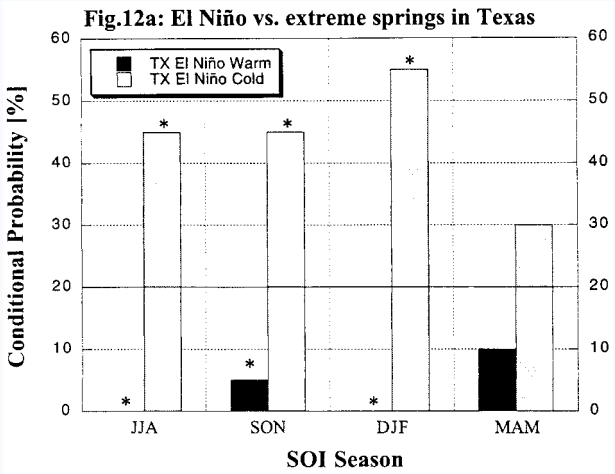
Model Biases : Implications for Event Attribution

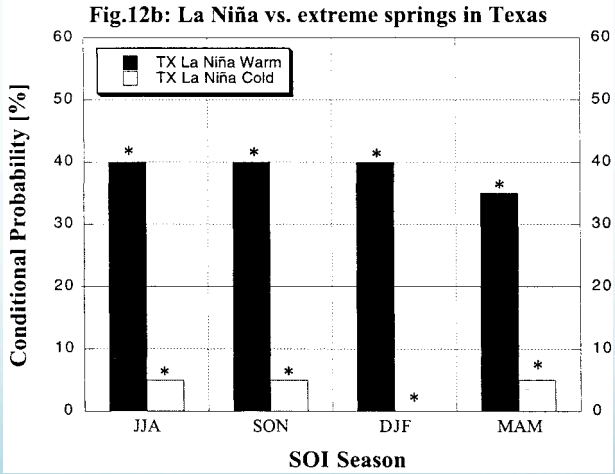


Rupp et al. 2012, BAMS: *Fig. 8*

SST Conditioning of Event Occurrence

Extreme Quintile Seasonal Temperature Conditioned by ENSO





Wolter et al. 1999, JClimate

Extreme Daily Rainfall Conditioned by ENSO

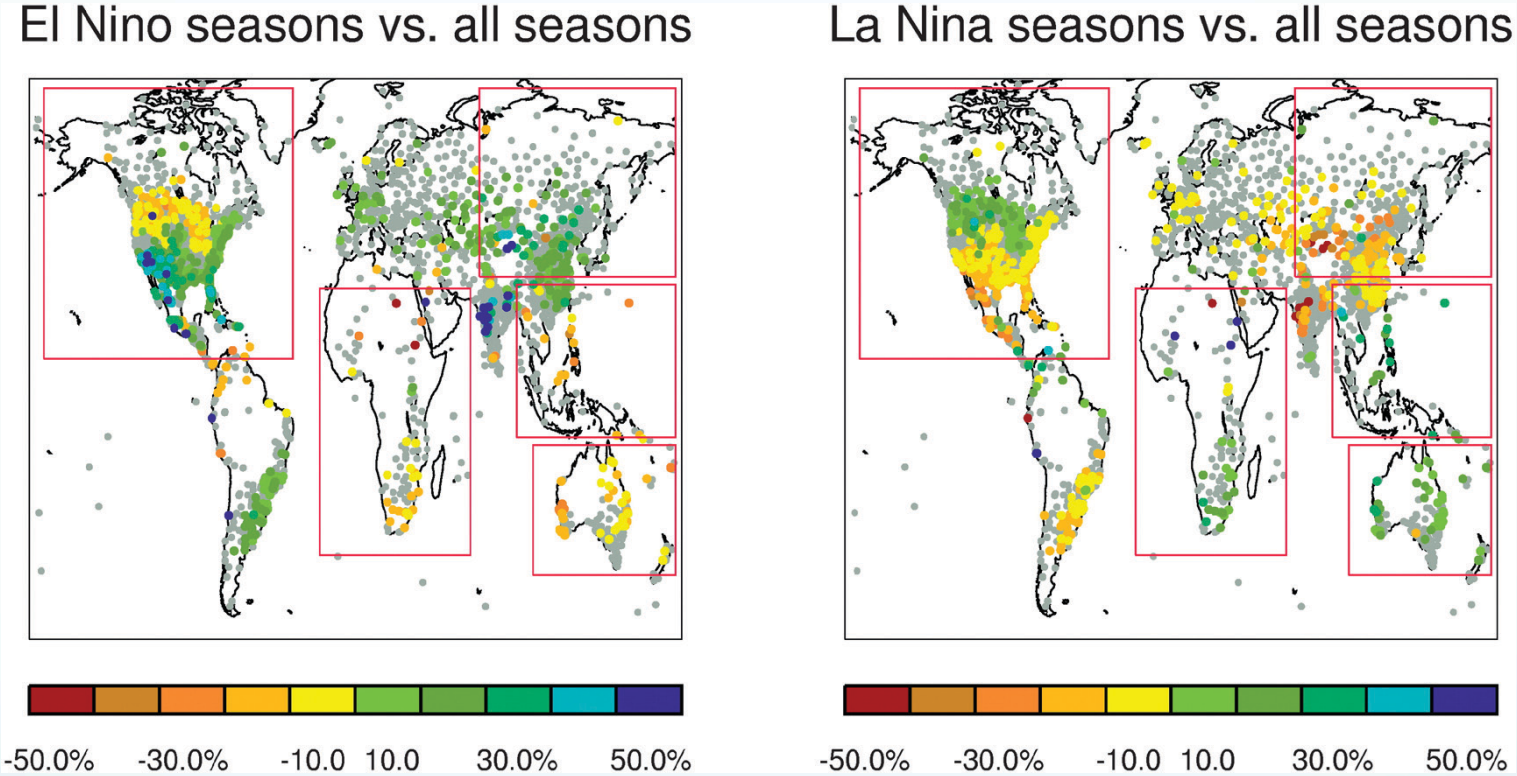
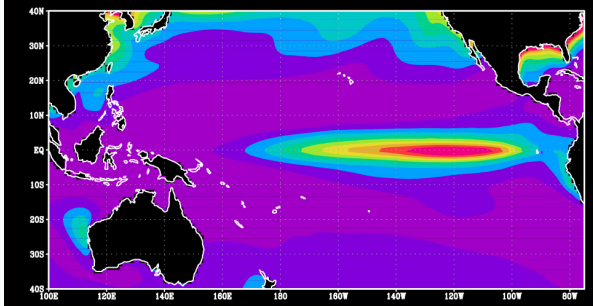
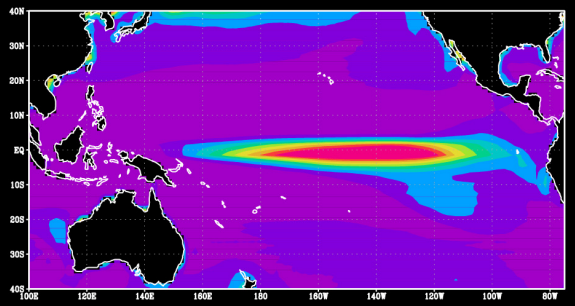


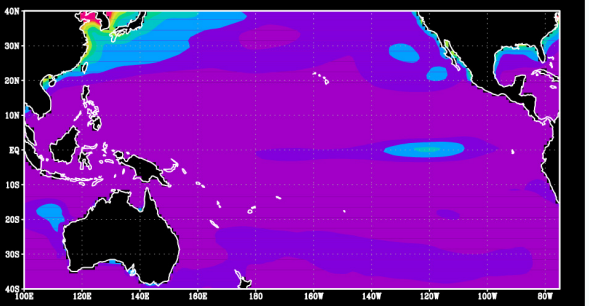
FIG. 3. Impact of (left) El Niño and (right) La Niña on the intensity of the largest 1-day precipitation event monthly in the November–April half of the year. Based on station data from the Global Historical Climatology Network-Daily (GHCN-D) for 1949–2003. From Kenyon and Hegerl (2010).

Kenyon and Hegerl 2010, JClimate

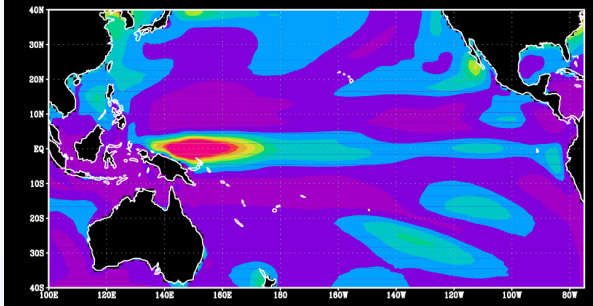
CMIP5 Simulated and Observed Variance of DJF SST

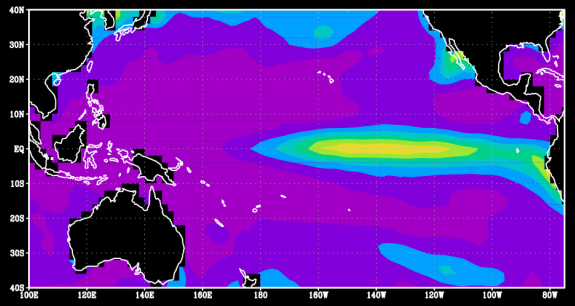


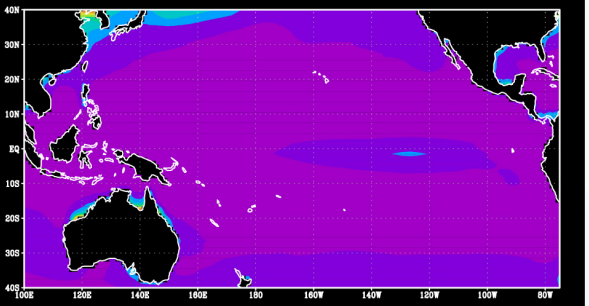


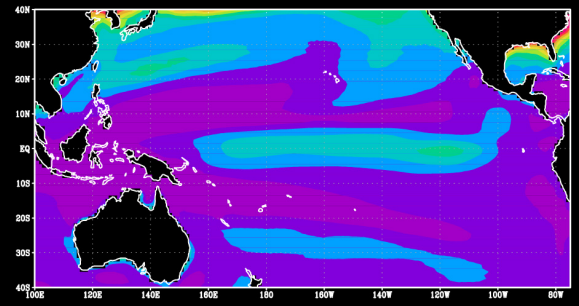


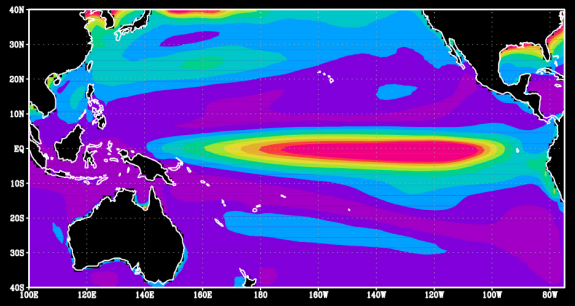
Observed

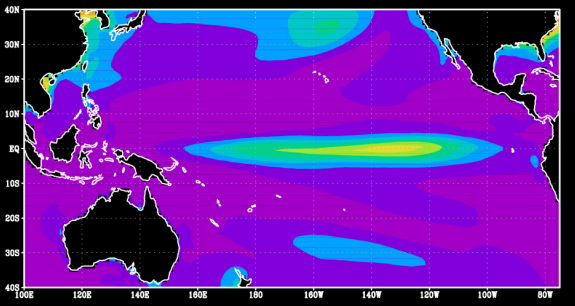






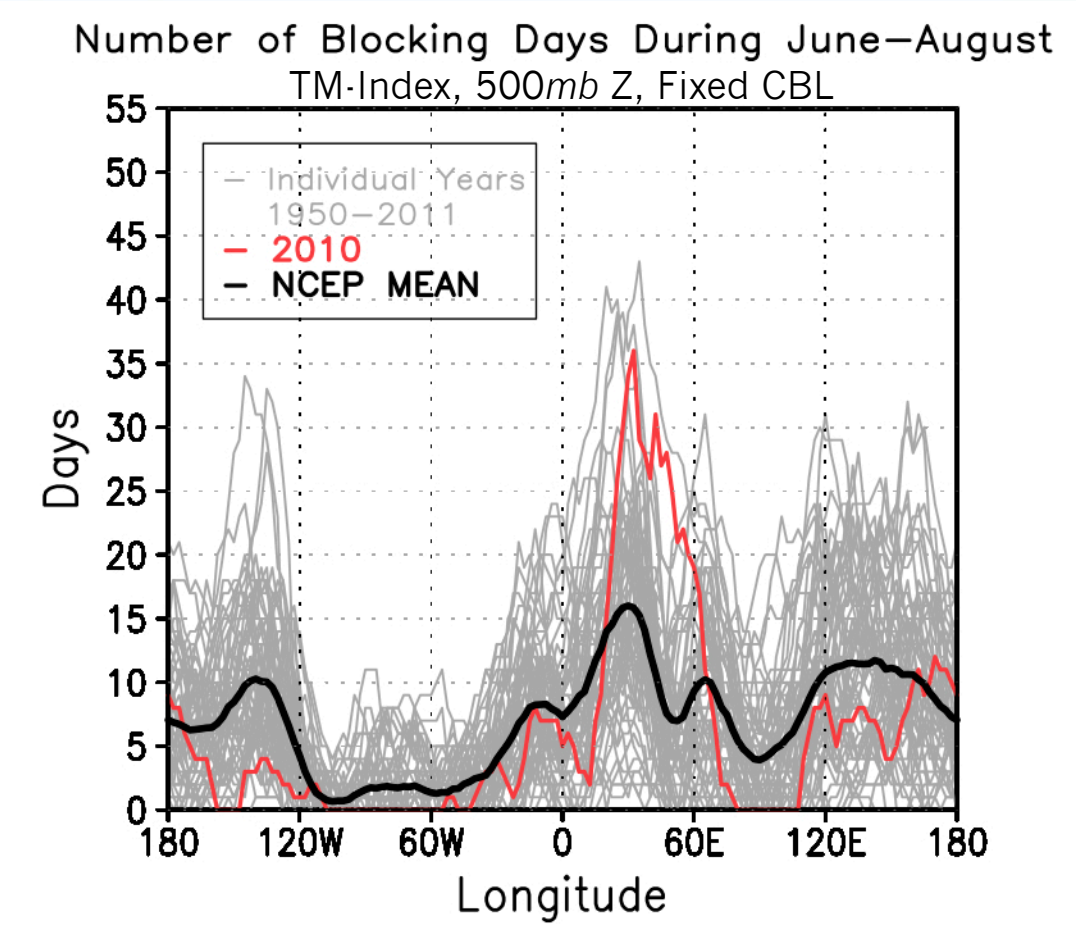






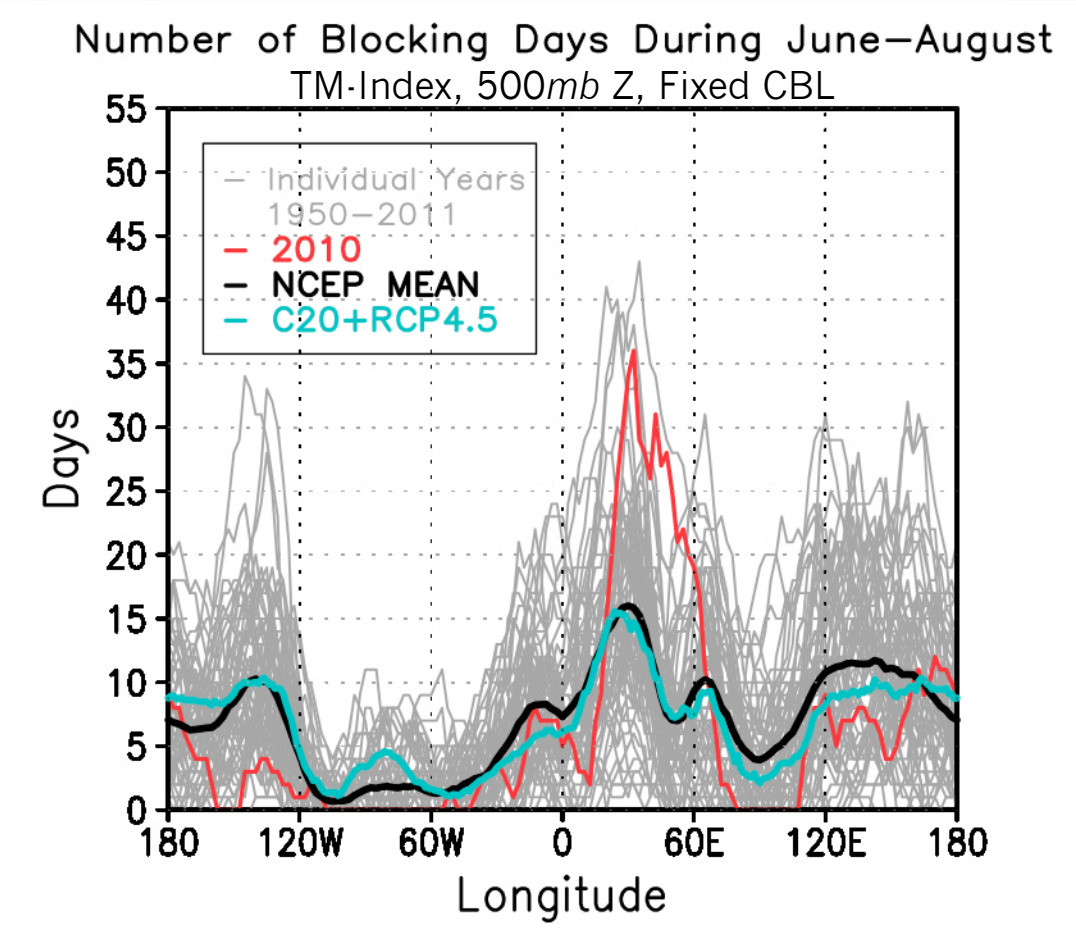
Degrees Celsius

Atmospheric Blocking Conditioning of Event Occurrence



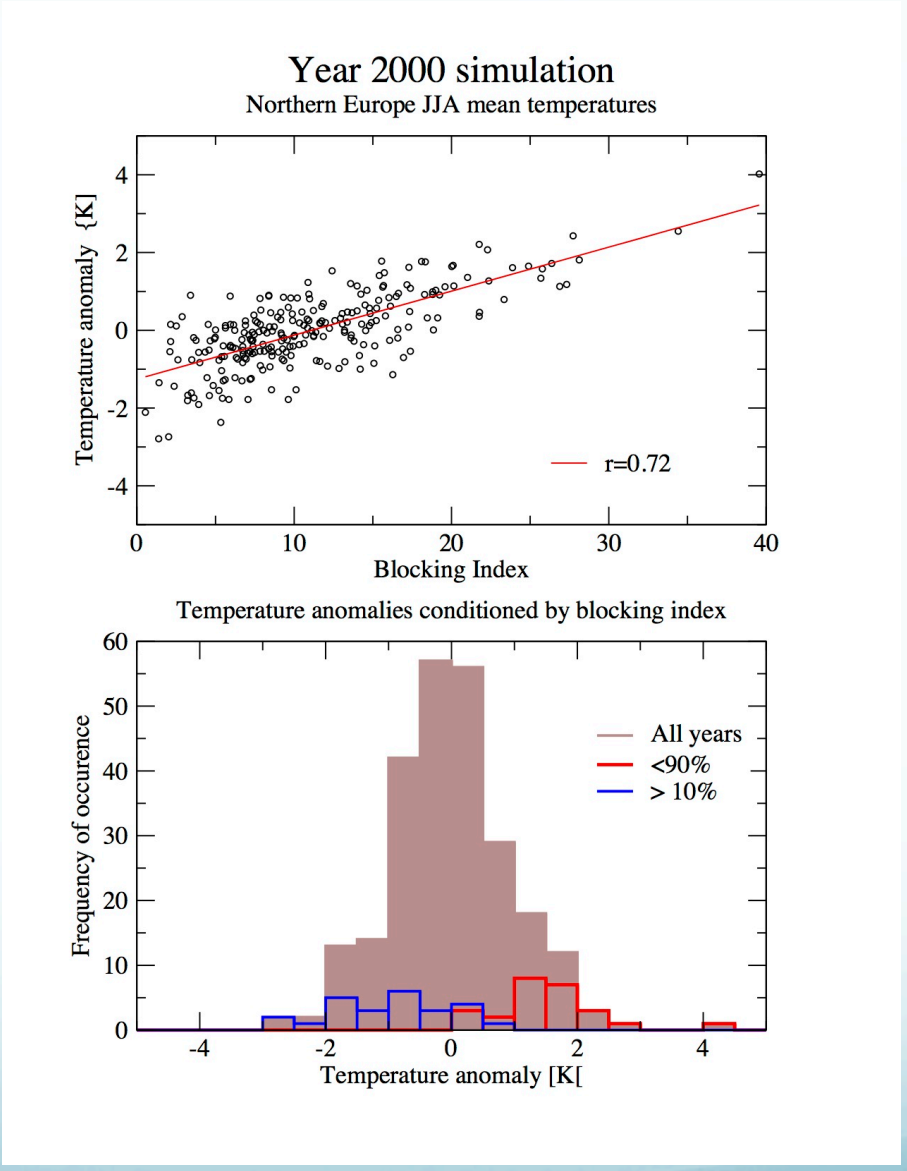
Dole et al. 2010, GRL

Atmospheric Blocking Conditioning of Event Occurrence



Dole et al. 2010, GRL

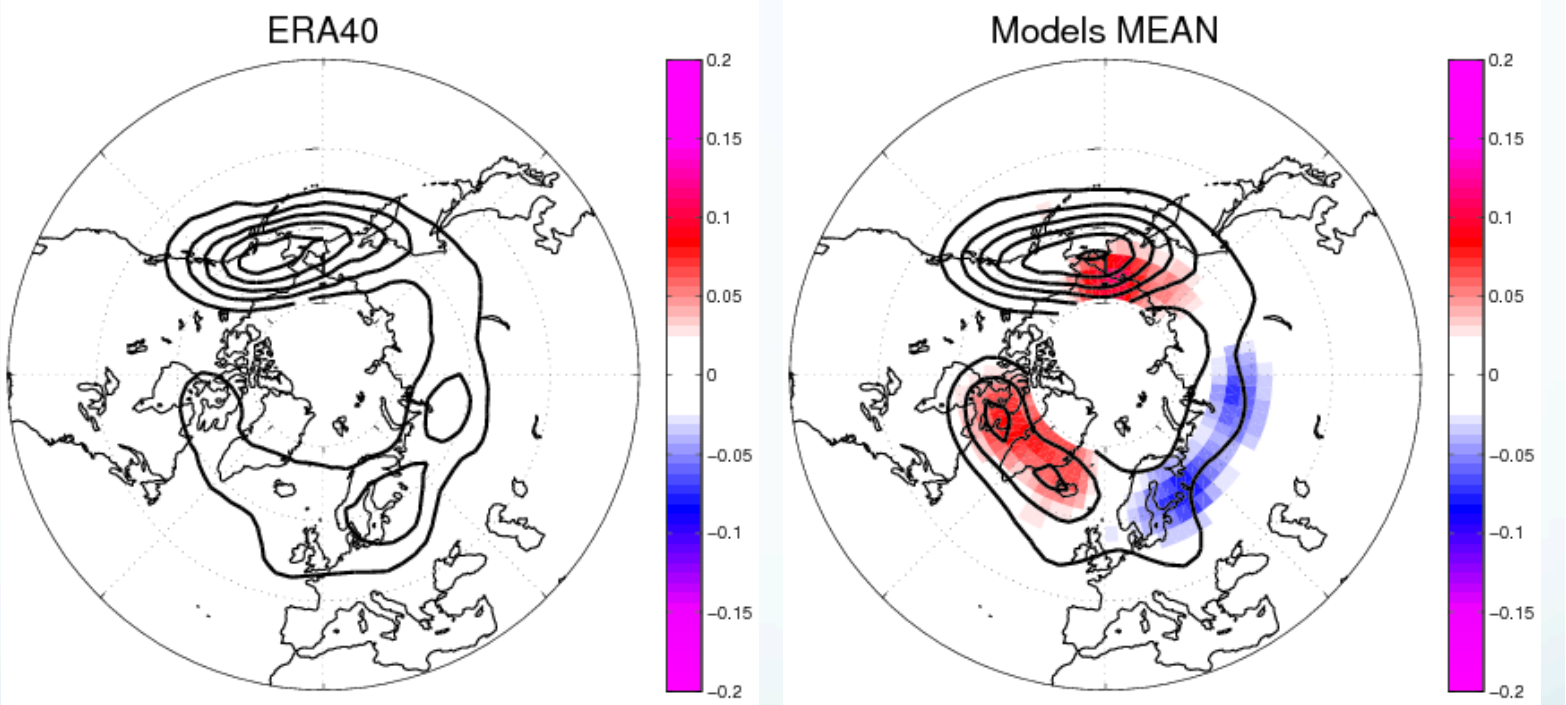
Blocking and Extreme Heat Waves of Northern Europe



Judith Perlwitz 2012, in preparation

Climatological Summer Blocking in CMIP5 Models

- *Dependency on Blocking Index*
- *Sensitivity to Anthropogenic Climate Change*



250*mb* Z, Variable CBL (see Pelly&Hoskins 2003)

Masato, Hoskins and Woolings 2012

Climate Change Conditioning of Event Occurrence

A Hypothesis for Record-breaking Temperatures in a Warming Climate

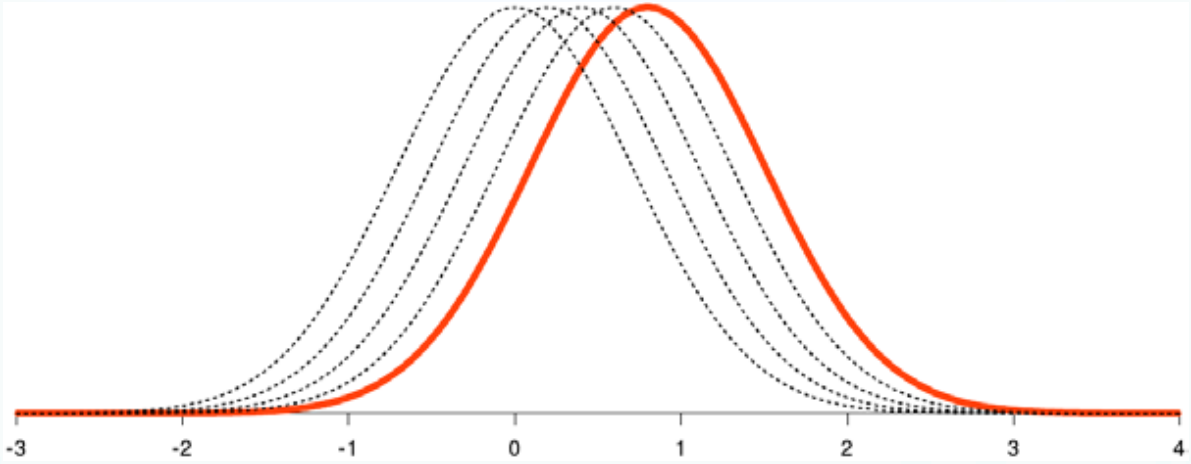
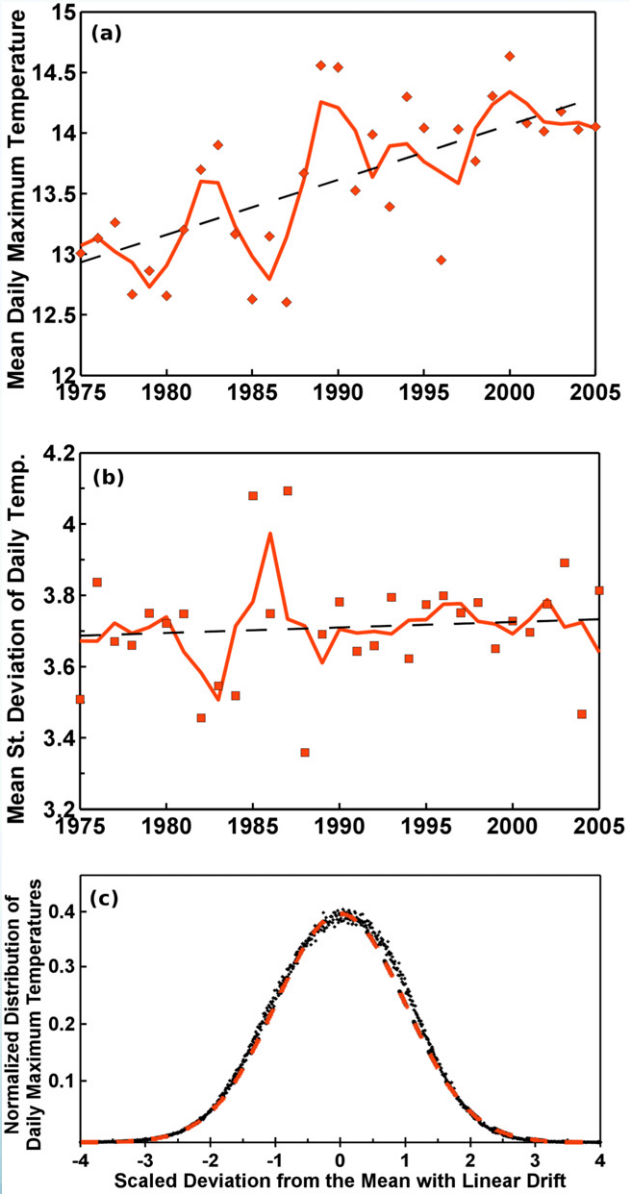


Fig. 1: (Color online) Schematic of the evolution of the daily temperature distribution under linear drift of the mean.

Wergen and Krug 2010, EPL

Characteristics of Daily Maximum Temperatures: 1975-2005



Wergen and Krug 2010, EPL

Testing Hypothesis for Record-breaking Temperatures in a Warming Climate

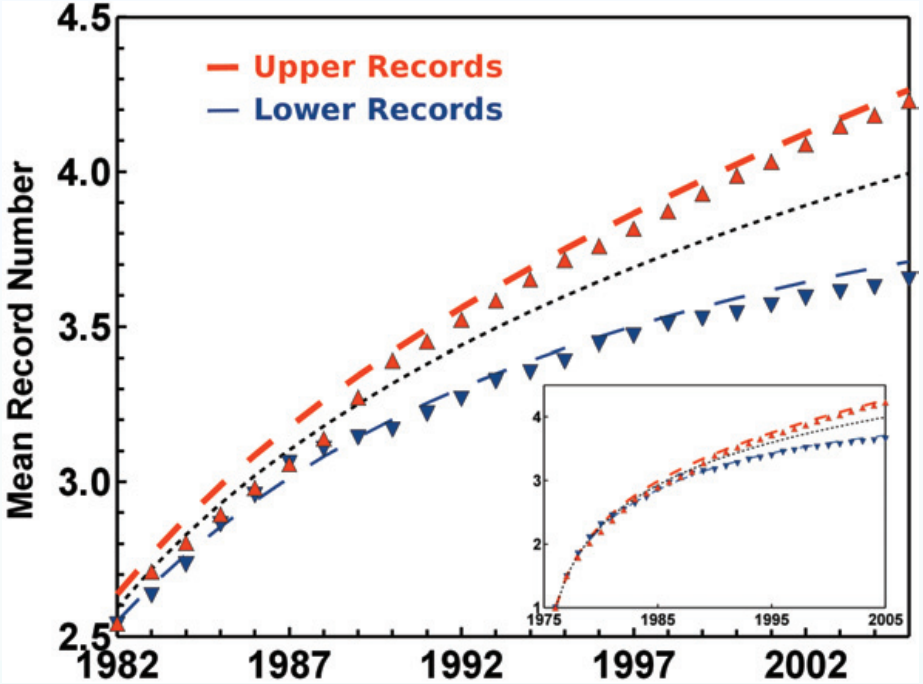


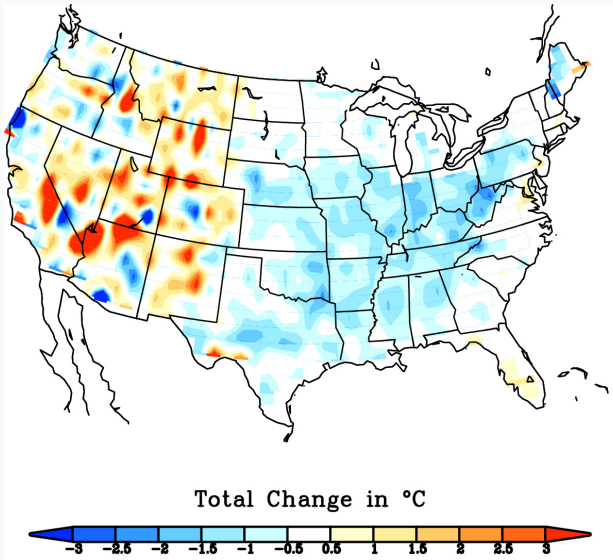
Fig. 4: (Color online) Mean record number at European stations (1976–2005). Symbols show the average number of upper ($\triangle$) and lower ($\triangledown$) records observed since 1976 at a given calendar year in the forward time analysis. The dotted line shows the prediction for a stationary climate, and dashed lines show the prediction for a constant rate of warming.

Wergen and Krug 2010, EPL

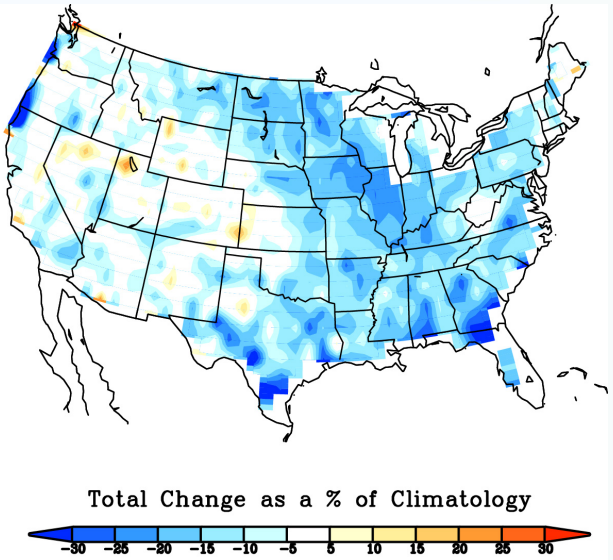
On the *Reduced* Variability of Daily Maximum Temperatures

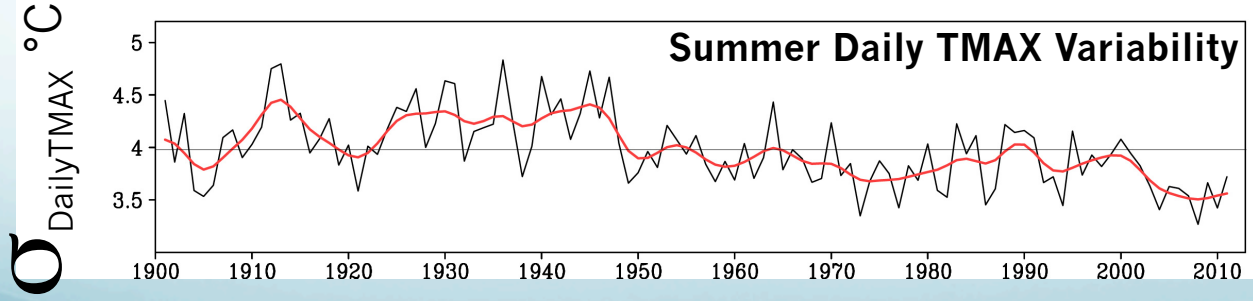
June-Sept

TMAX Trend



Daily TMAX Variability Trend





Courtesy of J. Eischeid, NOAA/CIRES

Tools & Concepts for Assessing Event Conditioning

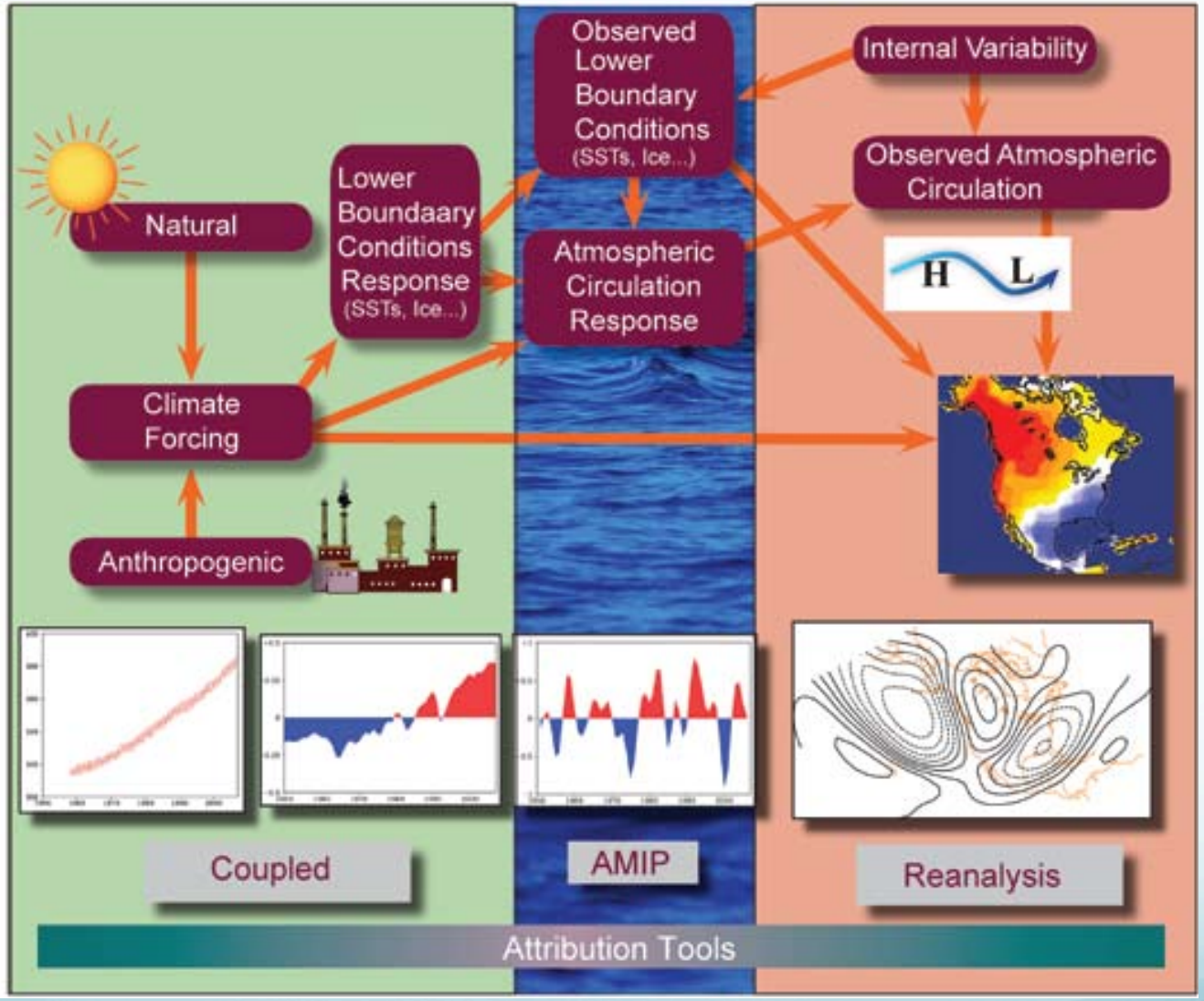


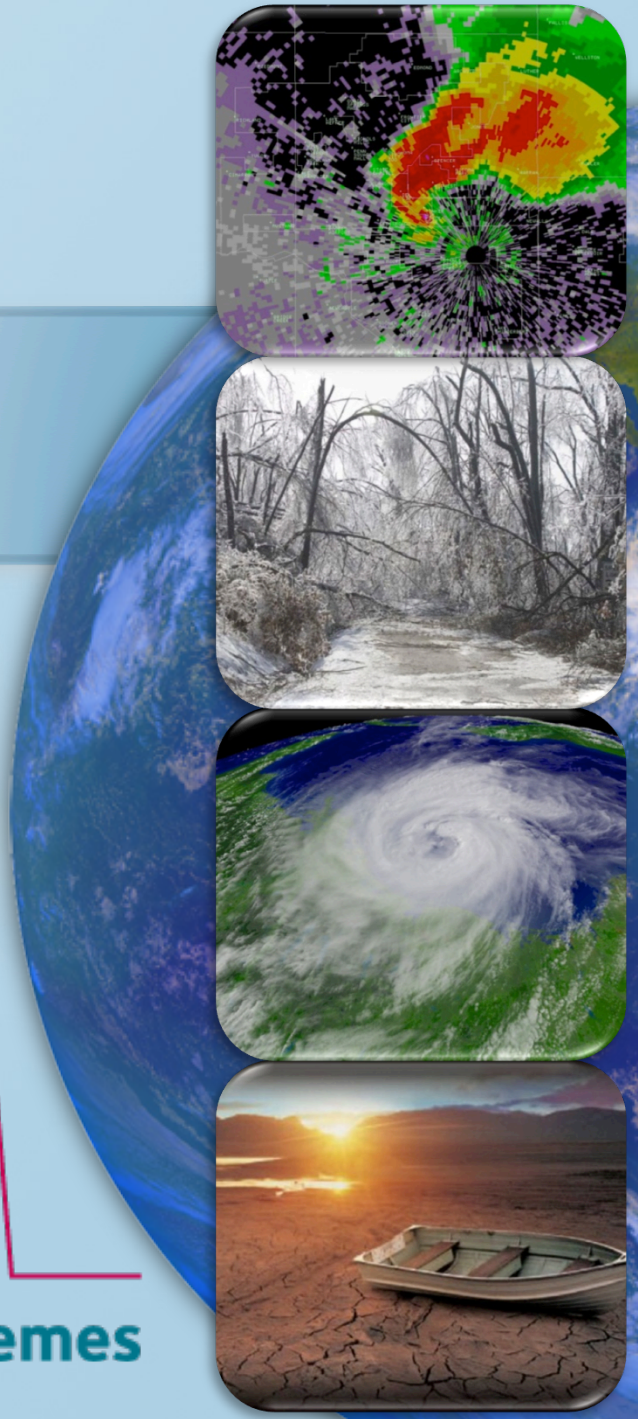
Figure 3.1 Schematic illustration of the datasets and modeling strategies for performing attribution.

US Climate Change Science Program : SAP 1.3 (2008)

Thank you

For further information go to :

http://www.esrl.noaa.gov/psd/csi/



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Attribution of climate-related extremes