Quantifying the influence of natural climate variability on in situ measurements of seasonal total and extreme daily precipitation

Mark Risser

RGMA All-Hands Meeting

October 14, 2020

Extremes and Impacts Breakout

Co-authors: Michael Wehner, J.P. O'Brien, Travis O'Brien, Christina Patricola, Chris Paciorek, Huanpung Huang, and William Collins

Climate & Ecosystem Sciences
EARTH & ENVIRONMENTAL SCIENCES AREA

CRD

BERKELEY LAB

Motivation: explore joint influence of climate drivers

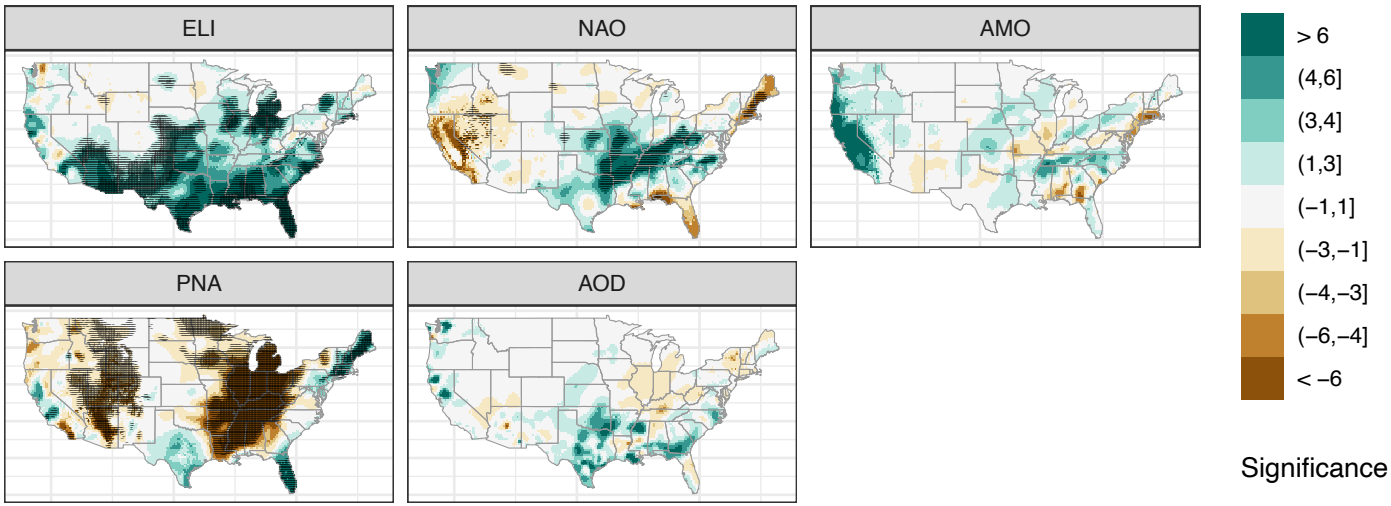
- Need improved understanding of how modes of climate variability **simultaneously/jointly** influence precipitation in the observational record across the contiguous United States (e.g., D&A, seasonal prediction, etc.)
- In situ measurements are the "right" data source for extremes (gridded daily products underestimate daily extremes by up to 30%) → but need to resolve relationships to their native scales
- **Methodological innovation:** develop a single framework for characterizing the historical signal (anthropogenic forcing, GHG concentrations) and "noise" (natural variability: ENSO, PNA, NAO, AMO, AO, volcanic aerosols) in seasonal mean and extreme precipitation
- Important feature: simultaneously **isolate the individual effects** of seven modes of variability while **explicitly controlling for joint inter-mode relationships**
  - Climate "drivers"/modes of var.: GHGs, ENSO, PNA, NAO, AMO, AO, volcanic aerosols

Extreme daily precipitation: isolate drivers + significance

Results: isolated relationships vs. Rx1Day

- Strong signal for ELI (extremes larger for El Nino)
- Strong signal for PNA (extremes generally larger in the −ve phase)
- Positive NAO makes wintertime extremes larger in Ohio River Valley
- Volcanic SAOD/AMO have minimal impact

DJF: change in 10-year return values (mm)

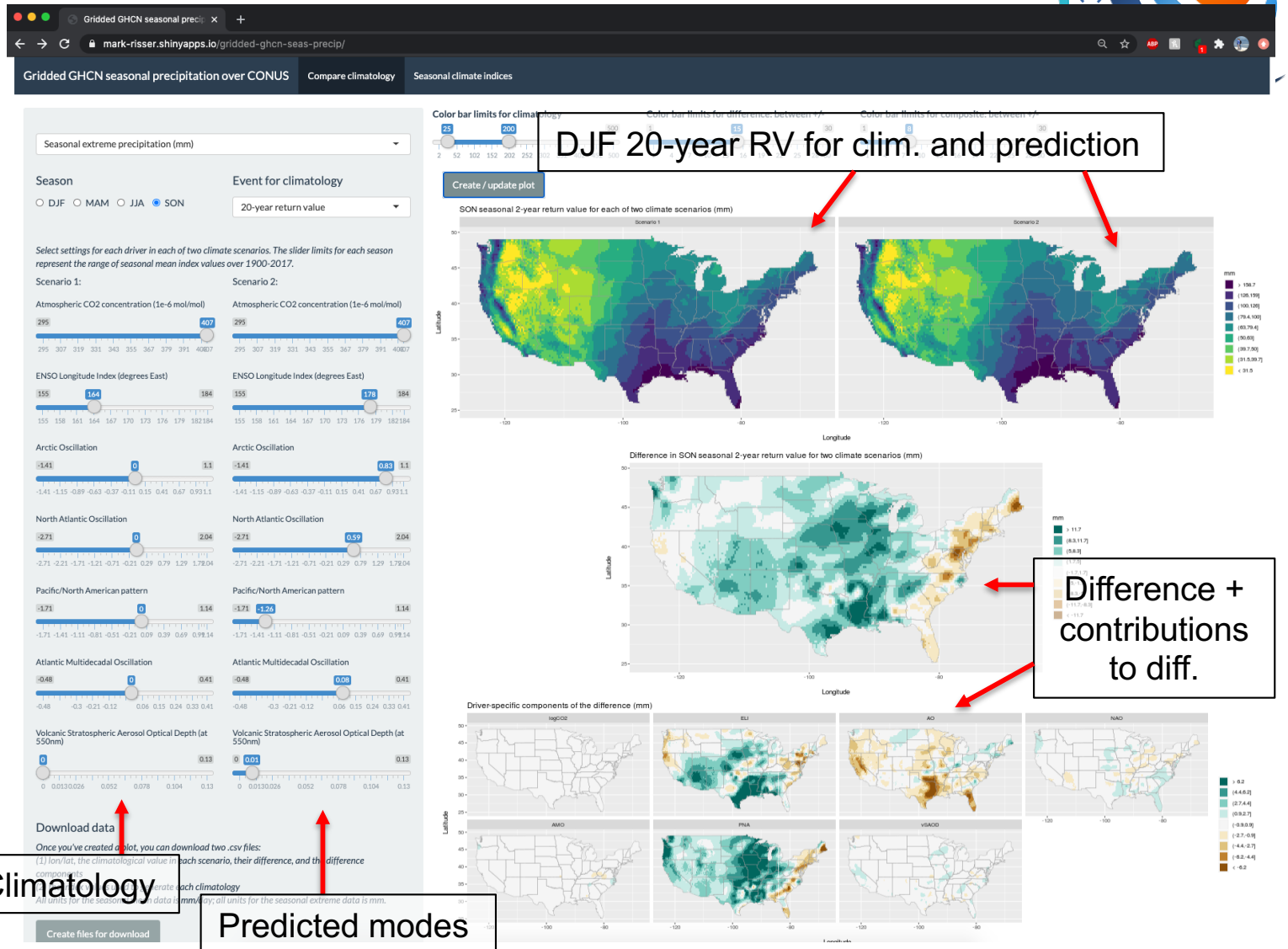


Green = extremes larger for large/+ve index;
Brown = extremes larger for small/−ve index

- **Note:** detectability even in light of large background variability (>95%) in extreme precipitation over CONUS

White paper: high-resolution "statistical prediction"

- Our approach can be considered a *statistical emulator* for generating climate scenarios
- **Extension**: if climate drivers can be predicted on the seasonal timescale, could use our framework for anticipating seasonal mean/extreme precipitation



See: https://mark-risser.shinyapps.io/gridded-ghcn-seas-precip/