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Different Flavors of Normals:
Accounting for ENSO and Climate Change

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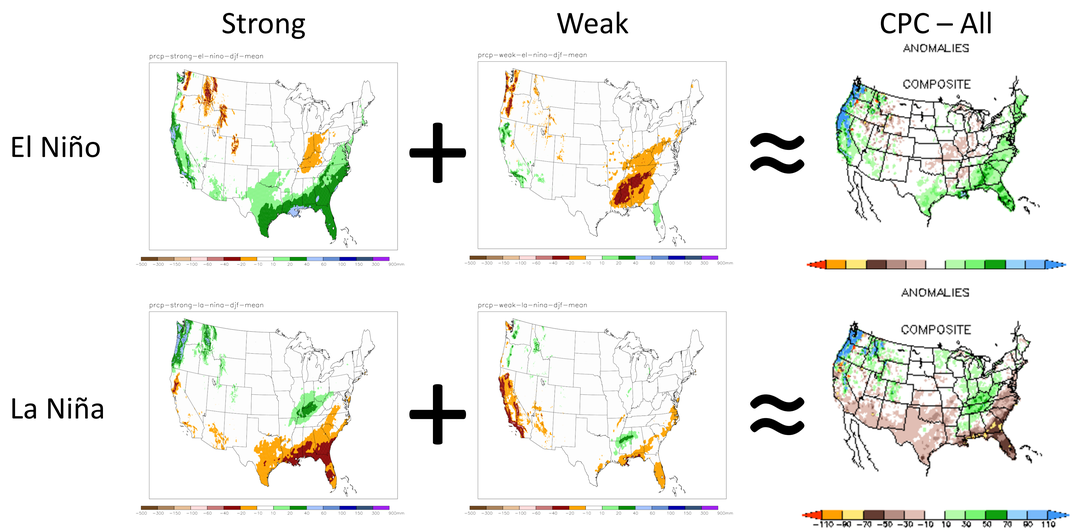
Motivation

- Traditional normals just represent the mean over some defined period
- Climate variability is complex, but some parts are well known
  - Emissions produce relatively stable trend
  - Models have some skill forecasting ENSO and the impacts can persist for month
- Much of climate prediction skill comes from these two modes
- To what degree were the anomalies in 2016/17 a combination of the two?

Proposed Algorithm

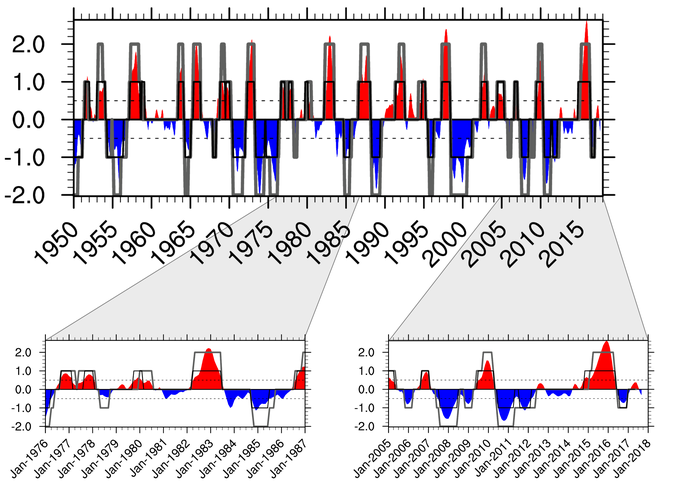
1. Use hinge fit or another alternative normal to identify the component associated with climate change
2. Subtract the climate change component from the data to obtain non-secular variability
3. Use monthly Oceanic Niño Index (ONI) to bin ENSO based on monthly percentiles
   a. ≥ 83rd percentile: Strong El Niño
   b. ≥ 67th, < 83rd percentile: Weak El Niño
   c. > 33rd, < 66th percentile: Neutral
   d. > 17th, ≤ 33rd percentile: Weak La Niña
   e. ≤ 17th percentile: Strong La Niña
4. Apply 5-month rule to each category
5. Composite resulting events and add to #1 to produce ENSO normal

Results



- Strong and weak events can have very different rainfall patterns
- CPC and NCEI composites use different datasets, which main cause some differences, esp. in mountainous terrain
- Combinations between strong and weak roughly explain the total CPC composites
  - Notably in lower Mississippi valley and California

ENSO Events



- Shading shows ONI values
- Black lines show CPC's events with 0.5°C criteria
- Gray lines show NCEI's events with tercile criteria
- Most events align well, but thresholds (below) are a bit different, lower than 0.5°C in Summer, higher in winter
- Some differences:
  - Some shifted, like 1979/80 El Niño,
  - Some lengthened, like 1976/77 and 1977/78 El Niños
  - Some new events like 2005/06 and 2008/09 La Niñas

	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ	DJF
17%	-0.9	-0.7	-0.7	-0.5	-0.6	-0.5	-0.6	-0.6	-0.8	-0.8	-0.9	-0.9	-0.8
33%	-0.5	-0.4	-0.3	-0.3	-0.2	-0.2	-0.3	-0.3	-0.3	-0.4	-0.5	-0.5	-0.5
66%	0.5	0.4	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.6	0.6
83%	0.9	0.7	0.6	0.6	0.6	0.6	0.5	0.7	0.8	0.9	1.0	1.1	0.9

Proposed Deliverable

- Provide gridded maps of adjusted normals for each 3-month period
- User selects a grid point to get monthly normals at that point
- Initial variables will be monthly max/min temperature, mean precipitation, and Heating/Cooling/Growing degree days
- Future work may include days above/below thresholds, such as:
  - Min < 32°F, Max > 90°F, Precipitation > 1"

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