Updated quantification of ENSO influence on U.S. surface climate
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Introduction & Motivation
We have updated the analysis of ENSO – precipitation relationships in the U.S. by analyzing shifts in the statistical distribution of rainfall during warm (El Niño) and cold (La Niña) phases of the Southern Oscillation for the period 1981-2016.

We also discuss the shift in the statistical distribution in the 5\textsuperscript{th} generation of the ECMWF Seasonal Forecasting System (SEAS5) using 1981-2016 hindcast data.

Data and methodology
- Accumulated three-month (seasonal) precipitation from the NCDC GSOD data is calculated for each station, and then averaged regionally to determine percentiles.
- ECMWF SEAS5 seasonal forecasts of Nino3.4 SST and surface temperature and precipitation are used.
- The predictability of Nino 3.4 in ECMWF SEAS5 was investigated using correlations between predicted and observed SST anomalies (Figure 2).

ENSO-precipitation relationship
- Extended predictability of Niño 3.4 shows corr. coeff > 0.7 for all seasons more than 5-6 months in advance (Fig. 2).
- \textbf{Southeast} - a shift in median precipitation of approximately 50 mm during the winter (DJF) of warm events. SEAS5 captures the obs behavior but overestimate values (Figs 3a,b).
- \textbf{South Central} - a shift in median during the winter of EN events smaller than that of RH1996 (around 35 mm). SEAS5 captures obs behavior but overestimate values (Figures 3c,d).
- \textbf{Southwest} - strong positive shift for JJA of warm(+1) with the 10th percentile close to the median of the base period. SEAS5 does not capture the behavior of anomalies (Figures 3e,f).
- \textbf{Northwest} - strong shift for JJA of warm(+1) with the 10th percentile above the 70th percentile of the base period. SEAS5 does not capture behavior of anomalies (Figure 3g,h).

Figure 1. Location of the 269 US stations used in this study. Northeast, Southeast, Midwest, South Central, Plains/Rockies, Southwest and Northwest.

Figure 2. Evaluation of the predictability of the Niño 3.4 index (correlation of observed versus predicted) index as a function of initial month and lead-time.

Figure 3. Distributions of observed and forecast accumulated seasonal precipitation averaged for (a,b) Southeast in DJF, (c,d) South Central in DJF, (e,f) Southwest in JJA, and (g,h) Northwest in JJA. Forecasts were generated in May for JJA and November for DJF. Crosses indicate 10\textsuperscript{th} and 90\textsuperscript{th} pctl, thick lines indicate the 30\textsuperscript{th} to 70\textsuperscript{th} pctl interval, and the horizontal indicates the median (50\textsuperscript{th} pctl). Panel (a) displays this information. Warm or warm(0) [Cold or cold(0)] refer to the year of EN [LN] event start. Warm(+1) [Cold(+1)] refer to the following year.