10. EXTREME CALIFORNIA RAINS DURING WINTER 2015/16: A CHANGE IN EL NIÑO TELECONNECTION?

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Failure of heavy rain in Southern California during the 2016 strong El Niño compared to flooding rains during the 1983 strong El Niño does not constitute a climate change effect.

Introduction. This is a story of two extreme events—one that was expected *but failed to occur* and the other that actually *did occur* but was not anticipated. The one that failed was extreme wetness over Southern California (SCAL) during winter 2015/16, which was predicted by seasonal forecasts. The extreme event that did occur was dryness whose considerable magnitude exacerbated one of the worst droughts on record over SCAL.

Ranked among the three strongest historical El Niño events, the 2015/16 event fueled apprehensions for flooding rains over California. Analogs were drawn from abundant winter rain during the strong El Niño events of 1982/83 and 1997/98. NOAA's winter outlook indicated a greater than 60% probability that rain totals over SCAL would be in the upper tercile of the historical distribution (www.cpc.ncep.noaa.gov/products/archives/long_lead/llarc.ind.php).

December 2015–February 2016 precipitation over SCAL was 112 mm, which ranked in the lower tercile of the historical distribution of winter precipitation since 1895 (Fig. 10.1). While not unusual from a historical perspective (Fig. ES10.1a), this dryness was an extreme event when taking account of precipitation likelihoods during strong El Niño conditions (e.g., Hoell et al. 2016). We pose the attribution question whether a transformation of El Niño teleconnections has occurred due to climate change, the effect of which may have made such an extreme dry outcome during 2015/16 more likely than during 1982/83 and 1997/98. Such a transformation could arise from changes in atmospheric circulation that mediates trajectories of tropically forced waves (e.g., Diaz et al. 2001; Meehl and Teng 2007), or from shifts in the intensity and longitude of equatorial Pacific rainfall during El Niño events (e.g., Kug et al. 2009; Wang et al. 2015; Zhou et al. 2014). In this study, we explore whether SCAL rainfall sensitivity to a strong El Niño occurring in 2016 has changed compared to a comparably strong El Niño in 1983.

Datasets and methods. Observed monthly precipitation for 1901–2016 is from the GPCC gridded 1° resolution analysis (Schneider et al. 2013). Monthly atmospheric circulation for 1948–2016 is from the NCEP/NCAR Reanalysis (Kalnay et al. 1996). Monthly sea surface temperature (SST) and sea ice concentration (SIC) data are based on Hurrell et al. (2008).

Two ensemble suites of climate simulations are analyzed. The first is a 40-member historical transient simulation of the NCAR Community Earth System Model version 1 (CESM1; Kay et al. 2015). These "All-Forcings" simulations span 1920–2005, and use RCP8.5 for 2006–2100. The second is a 20-member ensemble of atmospheric model simulations (AMIP) generated from the atmospheric component of CESM1, named Community Atmospheric Model version 5 (CAM5; Neale et al. 2012). In these AMIP-style experiments spanning 1871–2016, observed time evolving lower boundary conditions (SSTs and SIC) are prescribed globally, while time varying external radiative forcings identical to those used in CESM1 are also specified. The atmospheric model uses horizontal resolution of 0.94° × 1.25° and 30 vertical levels for all simulations.

While the historical AMIP ensemble size is 20-members, the ensemble size was increased to 50 members for the strong El Niño cases of 1982/83 and 2015/16. A parallel set of 50-member AMIP-style runs were conducted for these two strong El Niño events in which SST forcing over an El Niño-core region (15°N–15°S, 175°E–South America) only was specified, while

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