**Introduction:**
El Niño events are defined by unusually warm sea surface temperatures (SST) in the equatorial Pacific. This s also referred to as the warm phase of the El Niño Southern Oscillation (ENSO) and is measured using SST anomalies (SSTA). These events influence weather patterns across the globe and typically cause wetter than average winter conditions in Southern California. The El Niño in 2015-16 was a strong episode comparable to the major El Niño events in 1982-83 and 1997-98. Forecast models generally predicted above average winter precipitation for California during the 2015-16 El Niño event, similar to what occurred during the 1997-98 and 1982-83 events. Relief from drought conditions was expected, however anomalously dry conditions occurred instead. In this study we analyze and compare diabatic heating, upper level jet stream patterns and 200 hPa heights from the 2015-16 El Niño to other years and investigate why models failed to predict this event. The degree to which diabatic heating influenced model error was investigated as well.

**Methods:**
In this study we define Northern Hemisphere winter as December, January, February and March (DJFM). The ERA-Interim 1979 to 2017 reanalysis (Dee et al., 2011) is used for the observational analysis and the Climate Forecast System Version 2 (CFSv2) model is used for the model analysis (Saha et al., 2014). The CFSv2 is a coupled ocean-atmosphere model used for the seasonal outlook by the National Centers for Environmental Prediction (NCEP). Averages and differences are calculated for various variables. The estimated diabatic heating boreal winter mean and seasonal cycle were estimated from ERA-Interim six hour reanalysis and from the CFSv2 forecasts as a residual in the thermodynamic equation. (The method is similar to that used by Zhang and Hagos (2009), although we work with the original high-resolution reanalysis fields.)

This study also investigates the degree to which the model's failure to predict the dynamic circulation was due to the misrepresentation of model heating by performing intervention experiments. The ensemble mean error in the seasonal cycle of heating was subtracted from the model's internally generated heating during a new ensemble of integrations. The procedure is iterated until the ensemble mean diabatic heating is realistic. Similar experiments are carried out with the Community Earth System Model (CESM).

**Results:**
The large scale pattern that actually took place during the winter of 2015-16 showed differences from the earlier El Niño events, including a weaker enhancement of the Aleutian Low, and an Eastern Pacific jet shifted further to the south. In comparison to other El Niño years, the circulation in 2015-16 prompted a poleward shift in storm tracks as shown through the DJFM average variance (v'*v') at 300-hPa. There was an overall lower frequency of storm tracks in the observations through California resulting in low observed precipitation in this region.

Comparisons of the observations to the ensemble seasonal forecasts made with the CFSv2 for the winters of 2015-16 and 2016-17 showed that the model failed to fully capture the observed structure of the tropical vertically integrated diabatic heating as well as the jet stream and height field at 200-hPa during the 2015-16 winter. The circulation predicted by the model caused a shift in precipitation comparable to a typical El Niño in the model. By testing the degree to which diabatic heating influenced the large scale pattern, it was shown that the added heating runs created a canonical ENSO response. This resulted in more storms tracking through California, different than what is shown in observations. This experiment failed to show the unusually low precipitation anomaly, from which we conclude that this anomaly was not a forced response to the tropical heating, but was in some way due to internal variability.

**Conclusion:**

Many models predicted above average precipitation patterns over California for the El Nino winter of 2015/2016 , but this did not occur. This El Niño was unusual in the sense that it did not create a typical ENSO signal in the mid-latitudes. This pattern is defined by a low pressure system sitting off the coast and a strengthened jet that extends into California leading to conditions that allow for above average precipitation. However what we saw in 2015 is the low pressure system shifted to the northwest as well as a jet that does not extend into California. By comparing the observations to the CFSv2 model we can conclude that the model failed to fully resolve the structure of the diabatic heating as well as the 200-hPa jet stream and the 200-hPa height field. The circulation predicted by the model thus caused a shift in precipitation comparable to a typical El Nino in the model, and thus failed to match observations. It was shown that model failure was not attributed to the representation of diabatic heating.

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