ENSO Forecast for 2019

Climate Forecast Applications Network

March 25, 2019

Forecast Summary: CFAN's 2019 ENSO forecast is for a transition away from El Niño conditions as the summer progresses. The forecast for Sept-Oct-Nov 2019 calls for 60% probability of ENSO neutral conditions, with 40% probability of weak El Niño conditions.

Introduction

CFAN's early season ENSO forecast is motivated by preparing our seasonal forecast for Atlantic hurricane activity. ENSO forecasts made in spring have traditionally had very low skill owing to the ENSO 'spring predictability barrier.'

During fall 2018, there was warming in the Central Equatorial Pacific, leading to a weak El Niño Modoki pattern, which impacted the latter part of the Atlantic hurricane season. This transitioned to a weak (conventional) El Niño in February 2019 and the atmospheric anomalies became more consistent with a conventional El Niño pattern.

NOAA's latest forecast: Weak El Niño conditions are likely to continue through the Northern Hemisphere spring 2019 (~80% chance) and summer (~60% chance).

CFAN's ENSO forecast analysis is guided by the ECMWF SEAS5 seasonal forecast system and a newly developed statistical forecast scheme based on global climate dynamics analysis.

ENSO statistics

Figure 1 illustrates the recent ENSO history as depicted by monthly Niño 3.4 anomalies from 1980 to February 2019. Highlighted are 20 El Niño Februaries (Niño 3.4 > 0°C), including the most recent (+0.5°C) in February 2019. The Niño 3.4 anomalies surrounding each February El Niño event are plotted in Figure 2, showing the index evolution from the previous July to the following December. The February events that are followed by December El Niño conditions (El Niño persistence) are plotted in red, while those events that reverse to December La Niña conditions are plotted in blue. The Niño 3.4 evolution of 2018-2019 is shown with heavy black markers.

ENSO behavior in late 2018 is remarkable for a steep increase from slightly negative Niño 3.4 SST anomalies in July to moderately positive anomalies (+1 °C) by October. Typically, fall El Niño intensification occurs with the growth of high-amplitude events that peak around +2°C before undergoing major reversals to La Niña throughout the following calendar year (blue lines in Fig. 2).

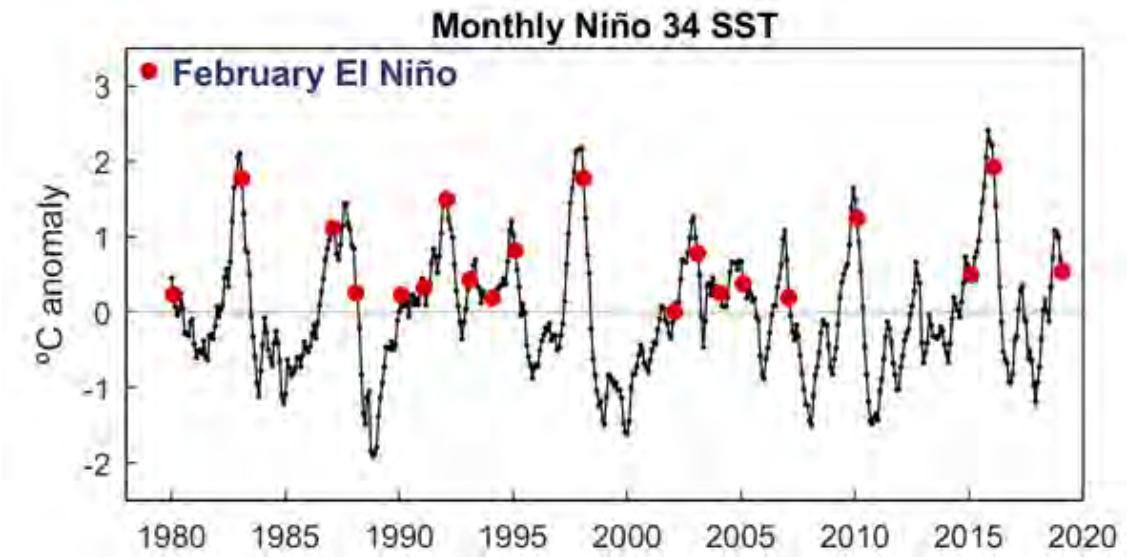

Figure 1. Time series of the monthly Niño 3.4 SST index (5°N-5°S, 170°-120°W), with warm February El Niño anomalies (<0°C) highlighted by red markers.

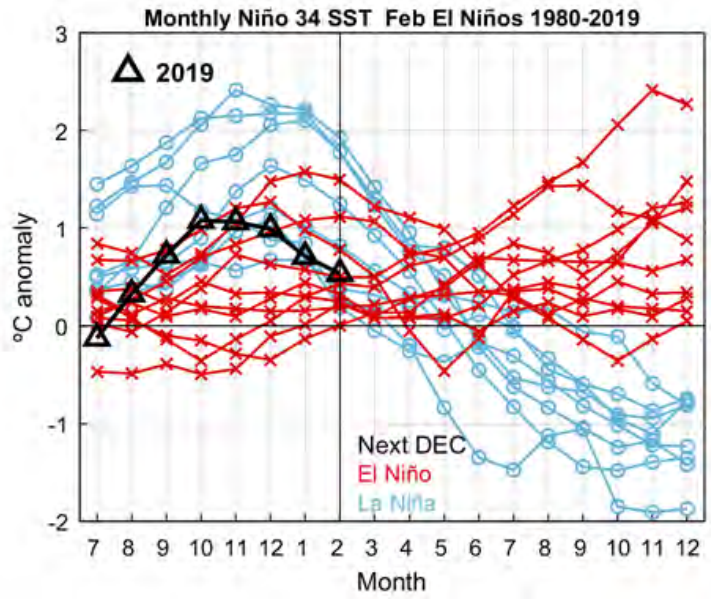

Figure 2. Seasonal Niño 3.4 SST anomalies surrounding February El Niño conditions (Niño 3.4 SST anomaly > 0). A. Lines trace monthly Niño 3.4 SST anomalies from July (year -1) to December (year 0) f for all February (year 0) El Niños. Lines are colored according the sign of December (year 0) Niño 3.4 SST anomalies, with December El Niños plotted in red and La Niña in blue.

ENSO forecasts from global models

The IRI/CPC plume of model ENSO predictions from mid-March 2018 is shown in Figure 1. The latest official CPC/IRI outlook (Figure 2) calls for a 80% chance of El Niño prevailing during Mar-May, decreasing to 60% for Jun-Aug.

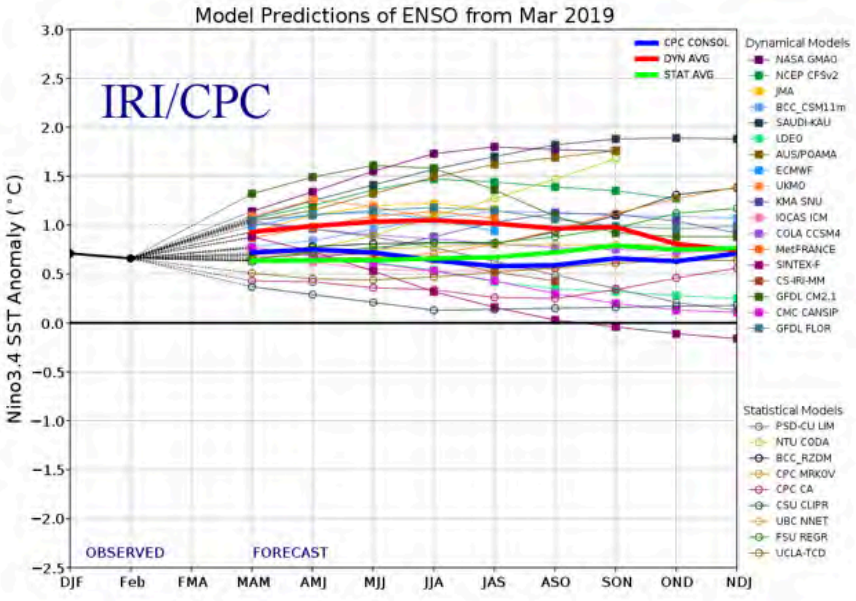

Figure 1. https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/

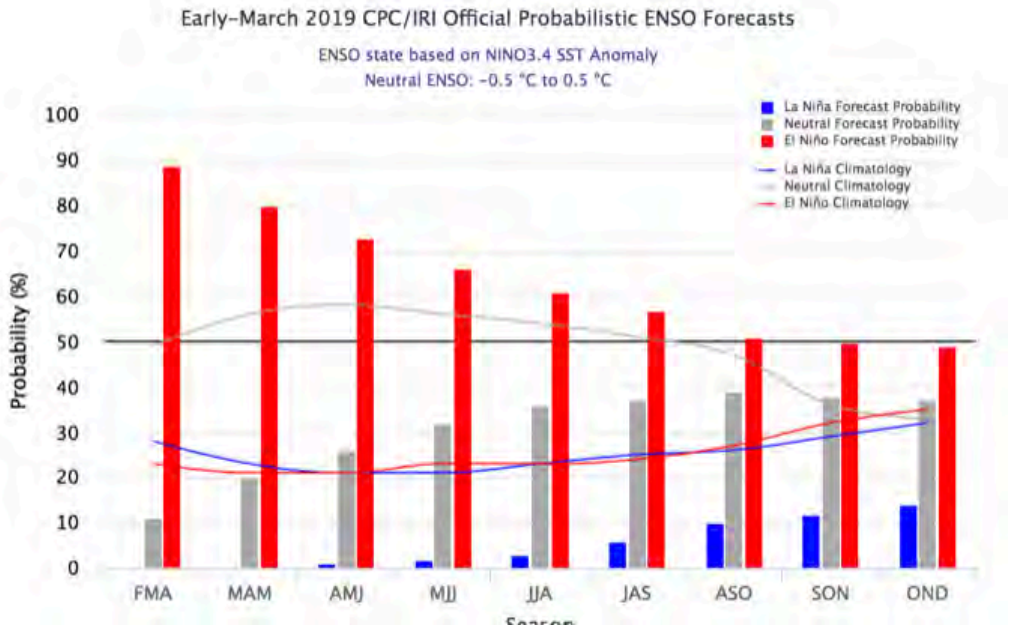

Figure 2. The official CPC/IRI outlook, with an El Niño advisory, calls for a 80% chance of El Niño prevailing during Mar-May, decreasing to 60% for Jun-Aug. https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/

CFAN's ENSO forecast plumes from ECMWF (initialized March 1) are shown in Figure 3, for Niño1.2, Niño 3, Niño4, and the Modoki Index. ECMWF shows a peak of Niño 3 in May 2019 and a peak in Niño 1.2 in April, with subsequent declining values. Niño 4 values peak in June, and there is a hint of a return to Modoki (> 0.5) by September.

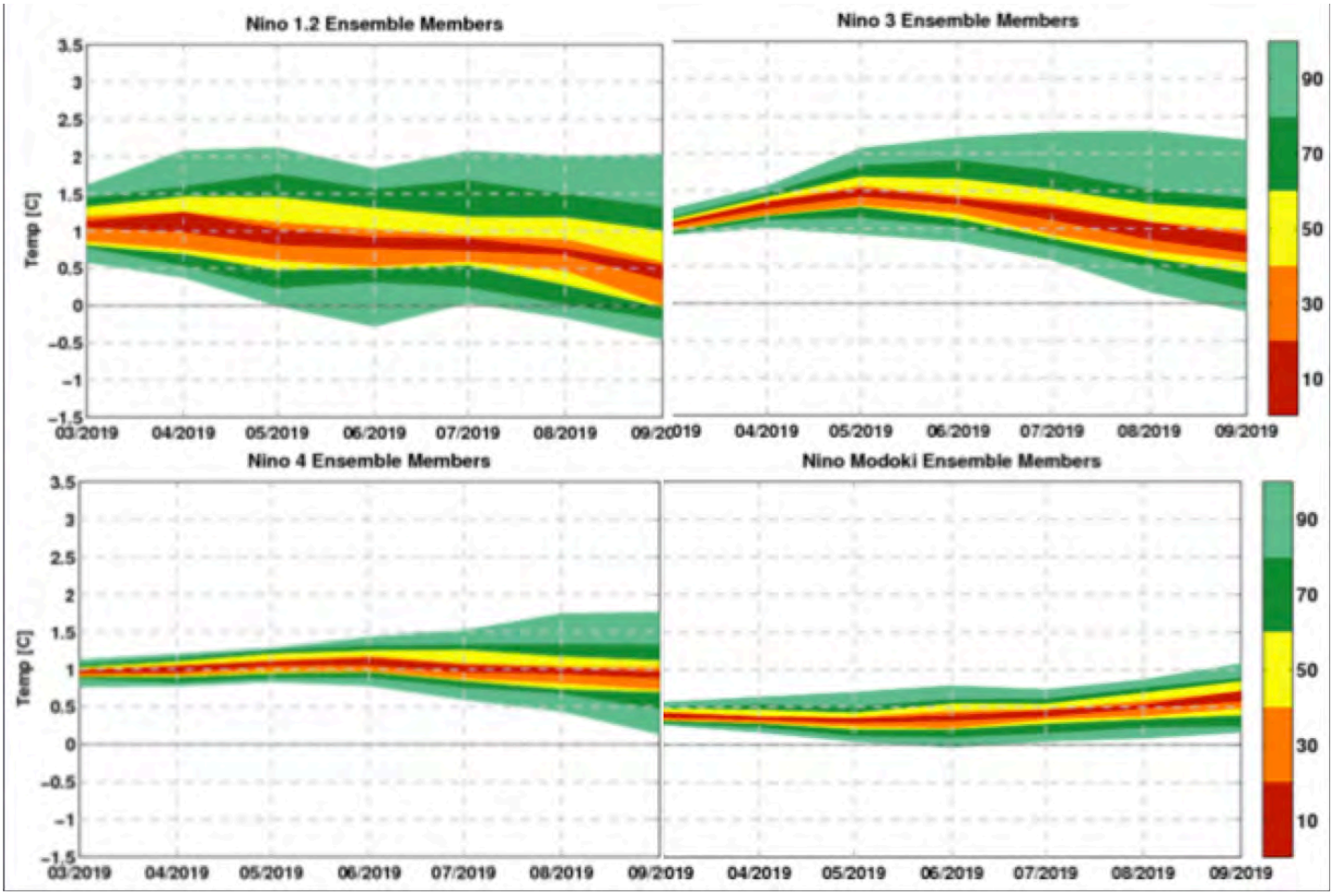

Figure 3: CFAN's analysis of ENSO forecasts from ECMWF SEAS5, initialized 3/1/19.

CFAN's analysis of the ENSO hindcast skill of the ECMWF SEAS5 seasonal forecast model (Figure 4) shows a correlation coefficient of 0.7 for Niño3 and 0.79 for Niño4 forecasts initialized in March for a seven month forecast horizon (September). For a forecast initialized on March 1, Nino4 shows greater predictability than Nino4 for a 6-7 month forecast horizon.

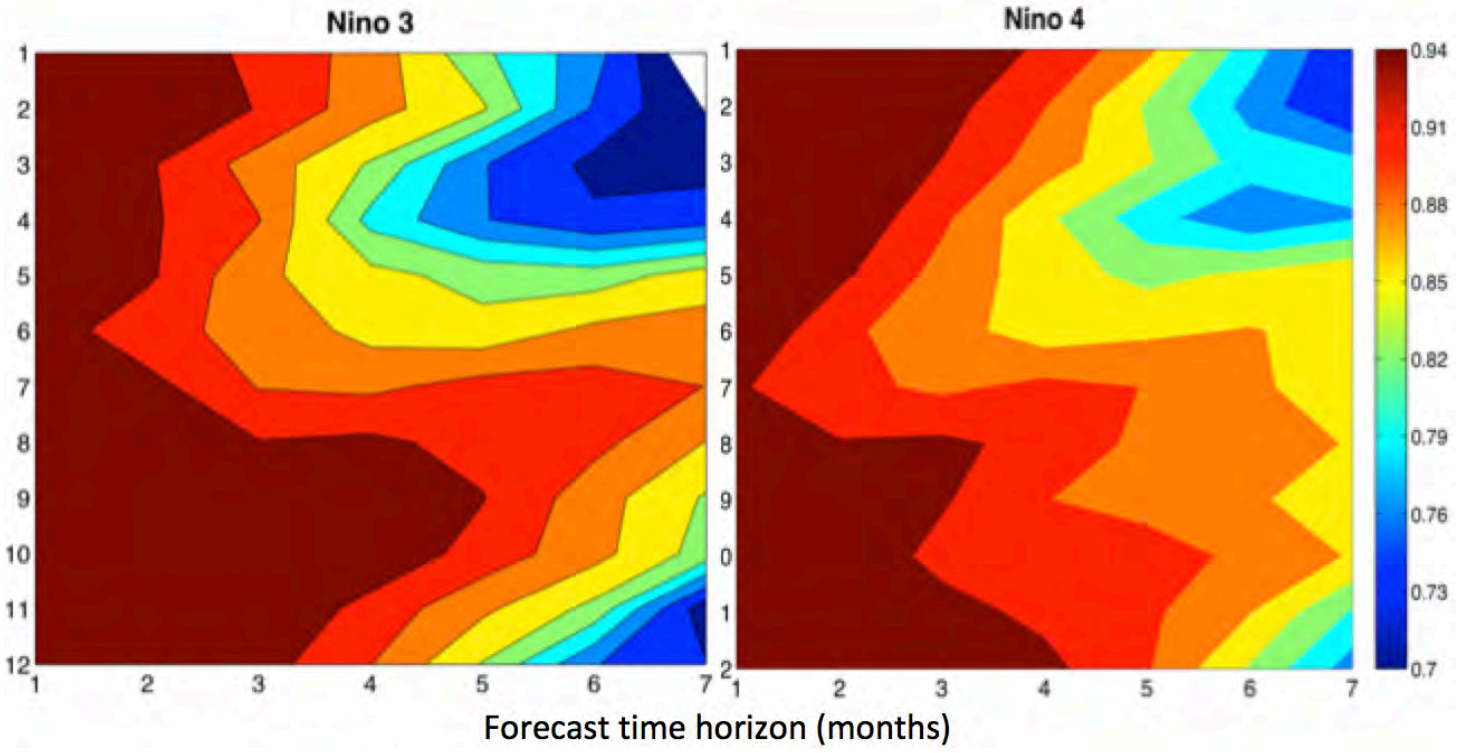

Figure 4: Evaluation of the predictability of the Niño 3 and Niño 4: correlation of observed versus predicted) from ECMWF SEAS5 as a function of initial month and lead-time. From Hirata, Toma and Webster, 2018: Updated quantification of ENSO influence on the U.S. surface climate. https://ams.confex.com/ams/98Annual/webprogram/Paper334884.html

ENSO statistical forecast model

Figure 5 shows the global sea surface temperature (SST) anomalies for January through February, 2019. Recent anomalies in the tropical Pacific reflect El Niño conditions (Niño 3.4 SST anomaly +0.5°C), with greatest local warmth evident in the equatorial central Pacific.

Two methods were used to forecast the seasonal anomalies and evolution of tropical Pacific SSTs during 2019. Niño 3.4 index anomalies (Figure 6) were forecast on the basis of recent February-March atmosphere-ocean anomalies and tendencies that systematically correlate with later ENSO anomalies. Climate precursors were identified in globally-gridded variables in the NCEP-NCAR Reanalysis at 17 vertical levels from the surface to the stratosphere. Additionally, we forecast full global SST fields (Figure 7) with a similar scheme based on the 4 leading Principal Components of global SST variability in each season. Both methods give similar forecasts of ENSO conditions throughout 2019.

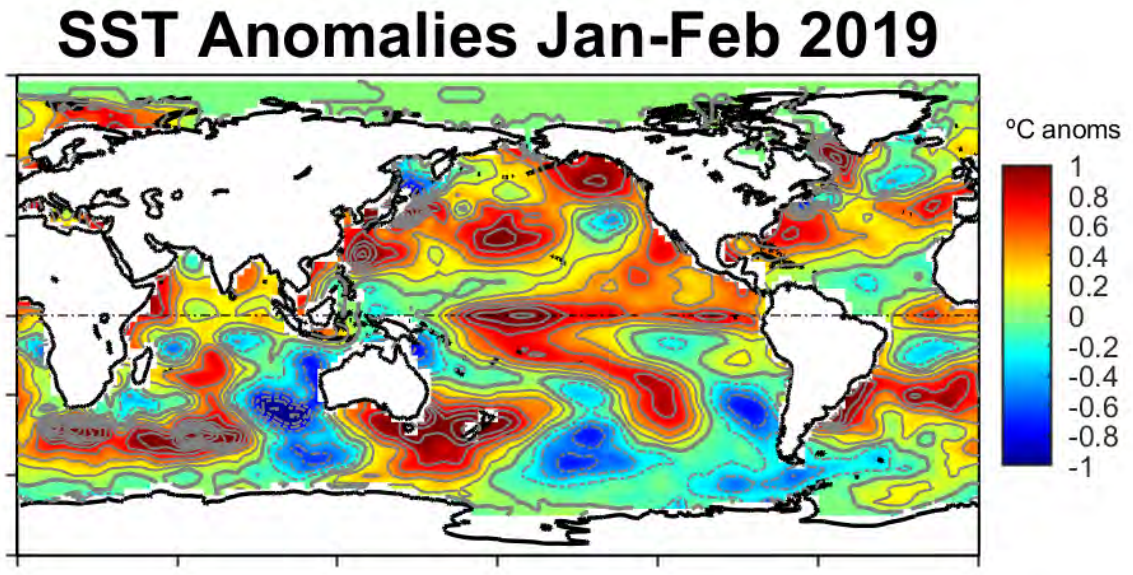

Figure 5. Observed global sea surface temperature anomalies for the period Jan-Feb 2019

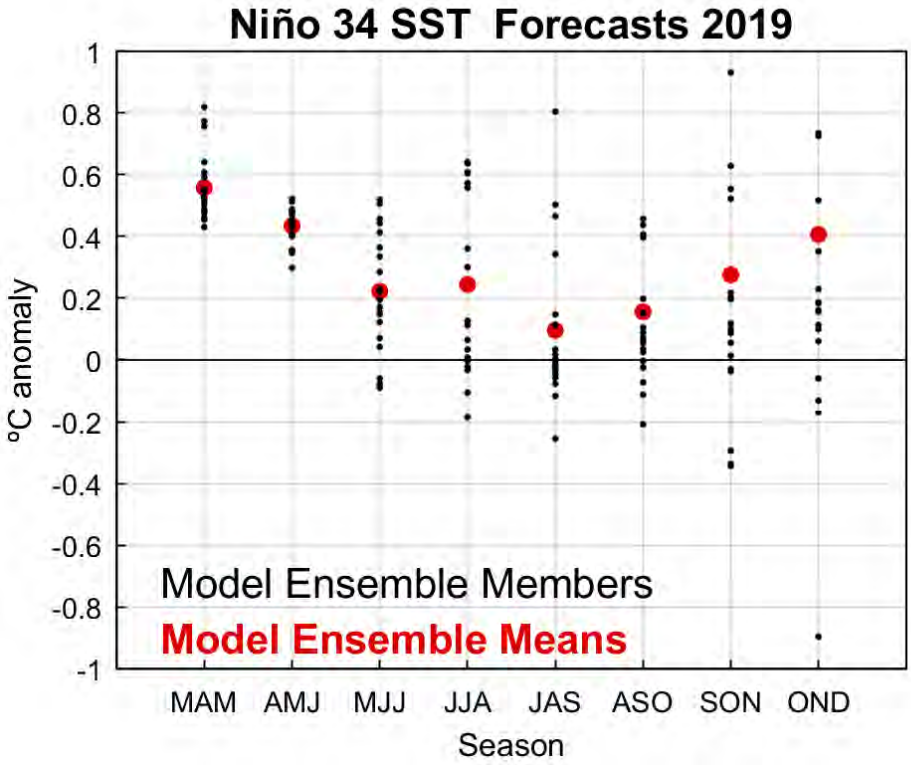

Figure 6. Statistical model projections of Niño 3.4 SST in three-month windows from March to December 2019. Black markers show estimates obtained from ensembles of 20 forecast models, with final forecasts indicated by ensemble means in red markers.

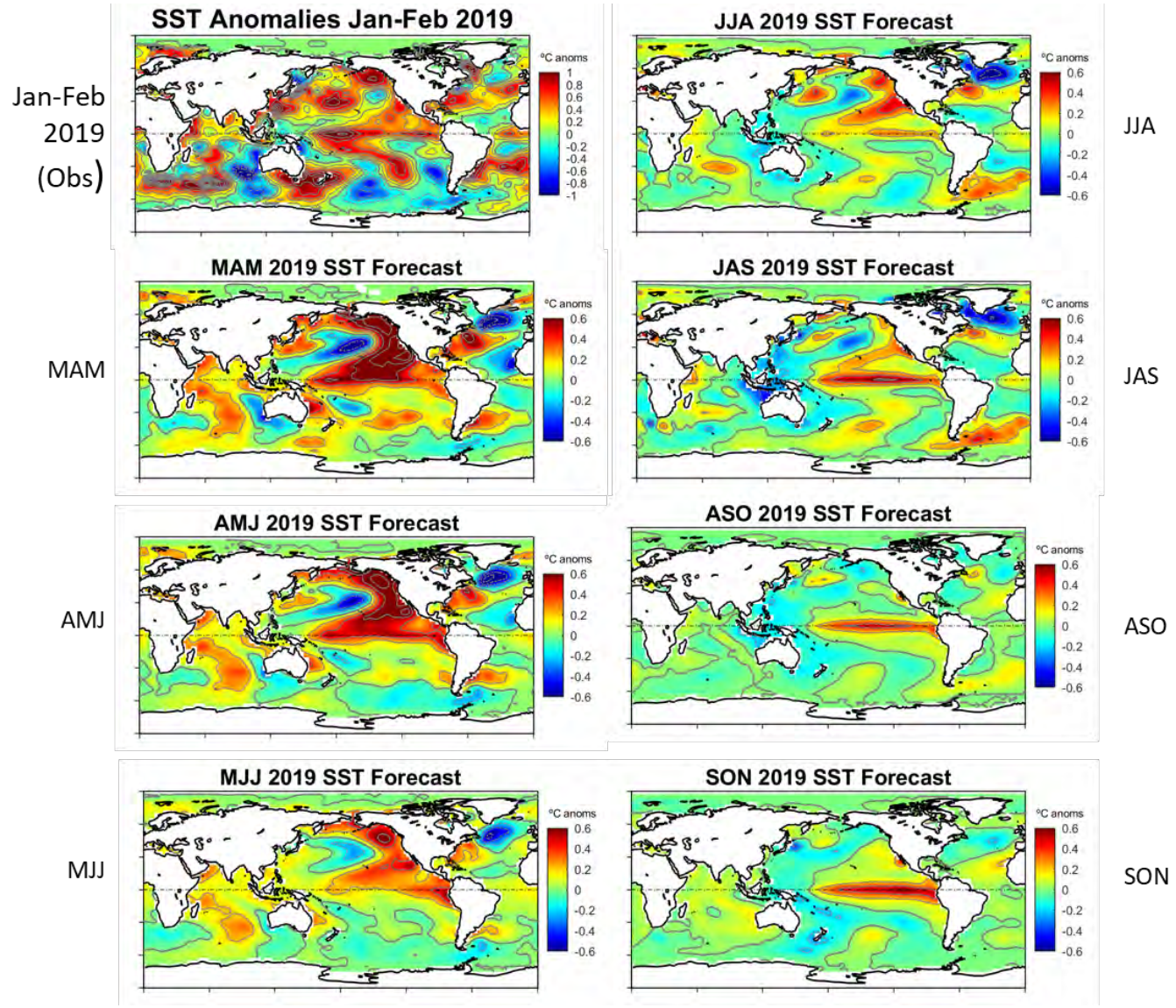

Figure 7. Statistical model projections of global sea surface temperatures in three monthly increments through November 2019.

Spring forecasts reflect persistence of current moderate El Niño conditions (Niño 3.4 ~ +0.5), and a gradual decay to near-neutral, slightly positive anomalies (+ 0.1 °C) by mid-summer (July-August-September). Spatial SST forecasts in Figure 7 suggest more rapid cooling in the tropical SE Pacific than in the NE Pacific. July-August-September SST anomalies are somewhat greater in the central equatorial Pacific than in the far east, suggesting an El Niño Modoki signature. From late summer to fall, models project a re-emergence toward typical El Niño conditions, charactetrzed by warming throughout the east-central equatorial Pacific to an October-November-December anomaly of +0.4°C.