Investigating some practical implications of uncertainty in observed SSTs

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Project Summary

The purpose of this task is to evaluate the impact of uncertainty in observed SSTs on seasonal-to-interannual prediction. One of the important goals of the Sustained Ocean Observing System for Climate is to improve the SST accuracy over the global ocean. The activities described here are intended to provide feedback to the climate observing community on the apparent impact of that improvement for seasonal climate simulations and predictions.

The activity under this task explores the implications of uncertain SSTs prescribed as boundary forcing in AGCM experiments: an AGCM is forced with 'scenarios' of observed SSTs for one El Niño, one La Niña and one neutral case during the JFM season. The scenarios differ from one another by the magnitude of imposed "error" over the global oceans. Additional integrations will consider only errors over Indian Ocean and Western Pacific region, where SST variability is believed to impact climate over the United States, in situ data is low, and remotely sensed data is more problematic. Changes in AGCM response are then examined, including magnitude, spatial structure and uncertainty, for near-surface climate and large-scale circulation.

FY 2006 Progress

Model integrations using global error fields have been completed. For each of the three ENSO states, two scenarios have been run: one in which the estimated sampling error field is added to the observed SSTs and one in which the error field is subtracted. The years chosen are: JFM 1983 (El Niño), 1986 (ENSO-neutral), and 1988 (La Niña).

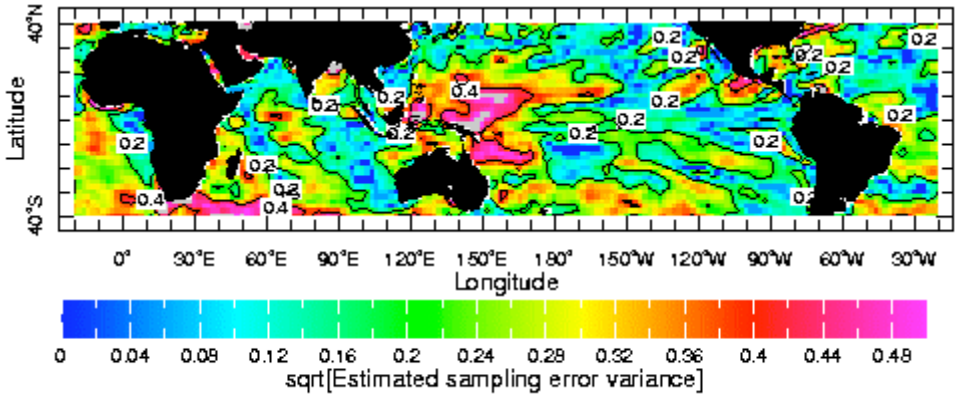
In all cases examined, the SST errors lead to a discernible modification of tropical precipitation anomalies (not shown), and often on extra-tropical anomalies also. The more noticeable impact is on global temperatures (not shown). In this first set of experiments, the error field is applied over the global ocean. Thus, it is difficult to discern how much of the temperature response is driven by errors in the tropics and how much due to fact that the global oceans are slightly cooler/warmer than "observed".

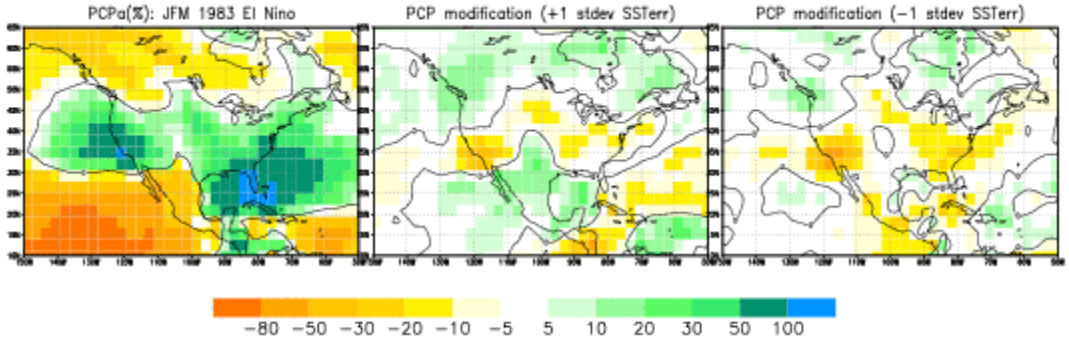
The attached figures focus on climate anomalies over the US, and indicate substantial modification of the simulated anomalies by the SST errors. In some cases, the temperature or precipitation modifications due to the 'error modified SST field' are of comparable magnitude to those forced by the 'true SST anomalies'. These differences due to uncertainties in the SSTs used to force the model have several implications for seasonal climate prediction. First, the added climate uncertainty confounds estimation of potential predictability of the climate. Second, if these SST uncertainties are not treated rigorously, the probabilistic calibration of models is

likely to be sub-optimal. Third, if the uncertainties are treated rigorously and the models calibrated accordingly the resulting seasonal probability distributions will be more diffuse than they would be with more precise estimates of the SST forcing. Finally, conclusions from diagnostic attribution exercises that estimate the causes regional climate variability will be somewhat degraded.

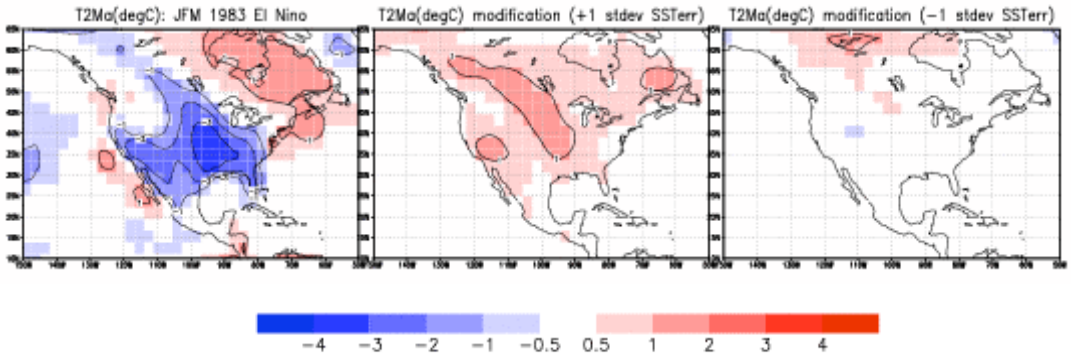
Additional model integrations isolating SST errors in the Western Pacific and Indian Oceans are currently underway. This will allow more explicit statements on the contribution of the observing array in those regions.

JFM 1983 (El Nino): Imposed SST error (i.e. positive)





Precipitation: % deviation from average

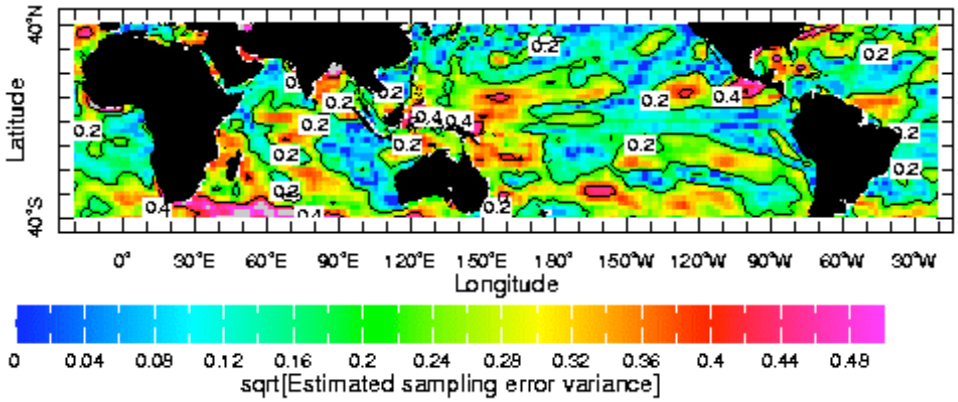


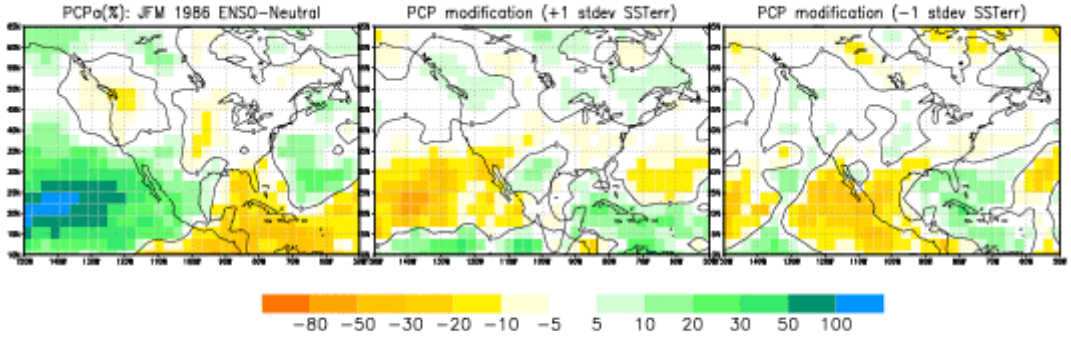
2m Temperature: Degrees C departure from average

Figure 1. Top panel: Square root of estimated sampling error variance in ERSSTv2 data for JFM 1983, during a strong El Niño. This field was added to/subtracted from the 'observed' monthly SST data and applied to the ECHAM4.5 AGCM.
Middle panel: Precipitation anomalies from control experiment, +1 error field experiment, and -1 error field experiment (going from left to right). Anomalies are plotted as % deviation from average, such that 0=average, 100%=2 x average, etc. The "modification panels" indicate additional anomaly, on top of that in left panel, due to imposed SST error.

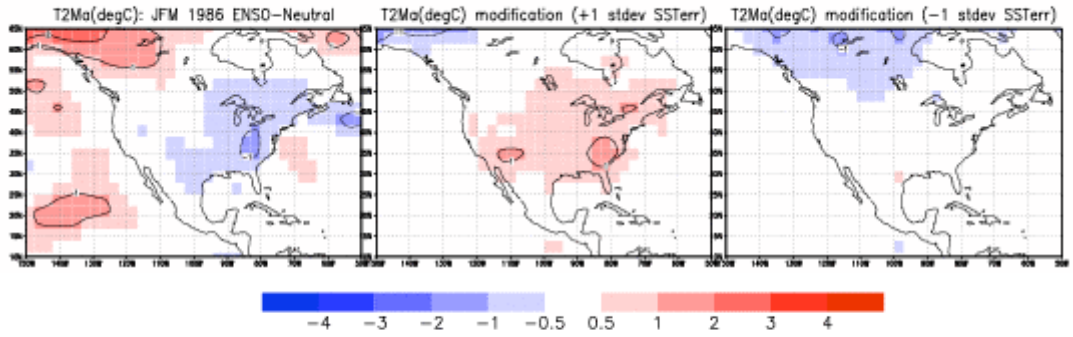
Bottom panel: Temperature anomalies (deg. C), panel layout similar to that for precipitation.

JFM 1986 (ENSO-Neutral): Imposed SST error (i.e. positive)





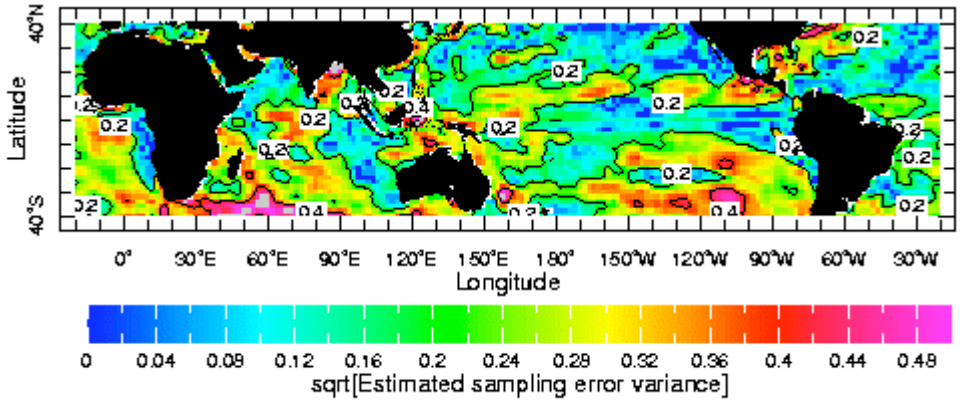
Precipitation: % deviation from average

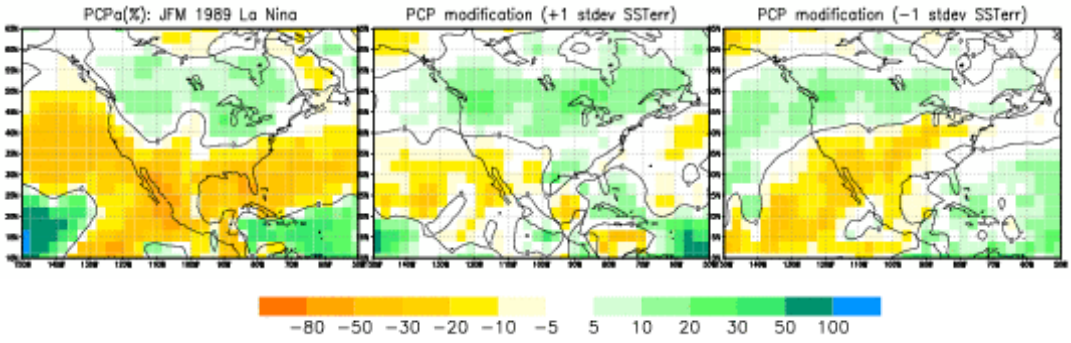


2m Temperature: Degrees C departure from average

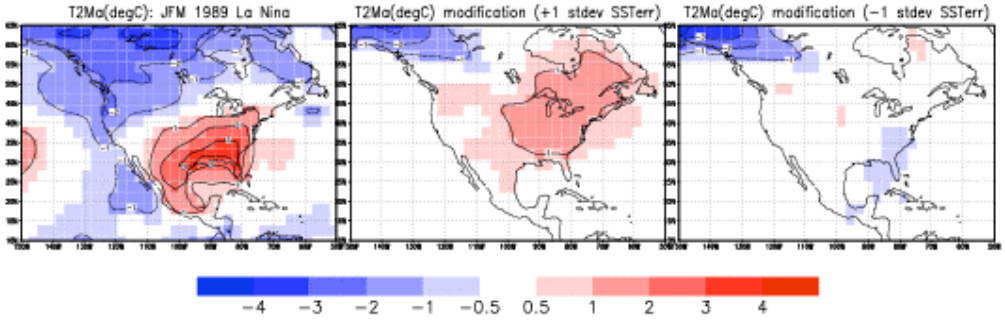
Figure 2. Similar to Figure 1, except for JFM 1986, during ENSO-neutral conditions.

JFM 1989 (La Nina): Imposed SST error (i.e. positive)





Precipitation: % deviation from average



2m Temperature: Degrees C departure from average

Figure 3. Similar to Figure 1, except for JFM 1989, during a strong La Niña.