Tropical Pacific SST Forecasts Utilizing Multiple Coupled GCMs

contributed by David G. DeWitt[1], Edwin K. Schneider[2,3] and Daniel Paolino[3]

[1]*International Research Institute for Climate Prediction, Columbia University*
[2]*George Mason University*
[3]*Center for Ocean-Land-Atmosphere Studies*

We describe forecasts for tropical Pacific sea surface temperature (SST) made by combining the forecasts produced by multiple independent coupled atmosphere-ocean general circulation models (CGCMs). This initial forecast framework uses two CGCMs. The two CGCMs utilize the same ocean component model and are initialized using the same ocean data assimilation product. This work is an extension of the combined CGCM forecasts described in Schneider et al. (2003). Differences between that work and the current forecasts include use of an extended period for developing prior statistics, use of fewer models, and employment of a different technique for combining the SST forecasts from the different models. This manuscript gives the real time forecast starting from July 1, 2007. In a previous version of the ELLFB, retrospective forecast skill for July 1 IC forecasts has been documented.

The model descriptions have been given in previous versions of the Extended Long-Lead Forecast Bulletin (ELLFB) and are skipped here for brevity. The atmospheric GCM (AGCM) component models used are the ECHAM4.5 AGCM of the Max Planck Institute for Meteorologie (Roeckner et al., 1996) and the Center for Ocean-Land-Atmosphere (COLA) studies AGCM version 2 (Schneider, 2002). The ocean GCM (OGCM) component model is version 3 of the Geophysical Fluid Dynamics Laboratory (GFDL) modular ocean model (MOM) (Pacanowski and Griffes, 1998). The ocean initial conditions are taken from an ocean data assimilation system produced at GFDL using a variational optimal interpolation (Derber and Rosati, 1989).

Procedure for Producing the Forecast

Retrospective forecasts using 7 ensemble members for the period January 1982 to present have been made using the coupled system with ECHAM AGCM component.
Similar retrospective forecasts using 5 ensemble members have been made using the coupled system with COLA AGCM component. The variance of SST anomalies differs between the two models and is also not the same as found in nature. The retrospective forecasts from both of the coupled systems have been normalized by the observed variance. At each point a bootstrap cross validation procedure is applied to bring the forecast variance closer to observed. In this calculation, the forecast for a particular year is not used to compute the mean or the standard deviation for either the model or the observations. The forecast anomaly for that year is taken as the difference from the model climatology made without using that year multiplied by the ratio of observed to model standard deviation also calculated without the data from the year of the forecast. The final SST forecast is the simple arithmetic mean of the normalized forecasts from the two coupled models.

Current Forecast

The current forecast for the Nino indices averaged SST anomalies made from July 1, 2008 is shown in Figure 1. The combined coupled forecast calls for both Nino regions to have warm conditions which intensify near the beginning of the forecast. The SST in Nino3 is warmer than that of Nino3.4 by up to 0.75ºC at the beginning of the forecast but Nino3.4 SST continue to get warmer over the period while Nino3 SST plateaus very early in the forecast.

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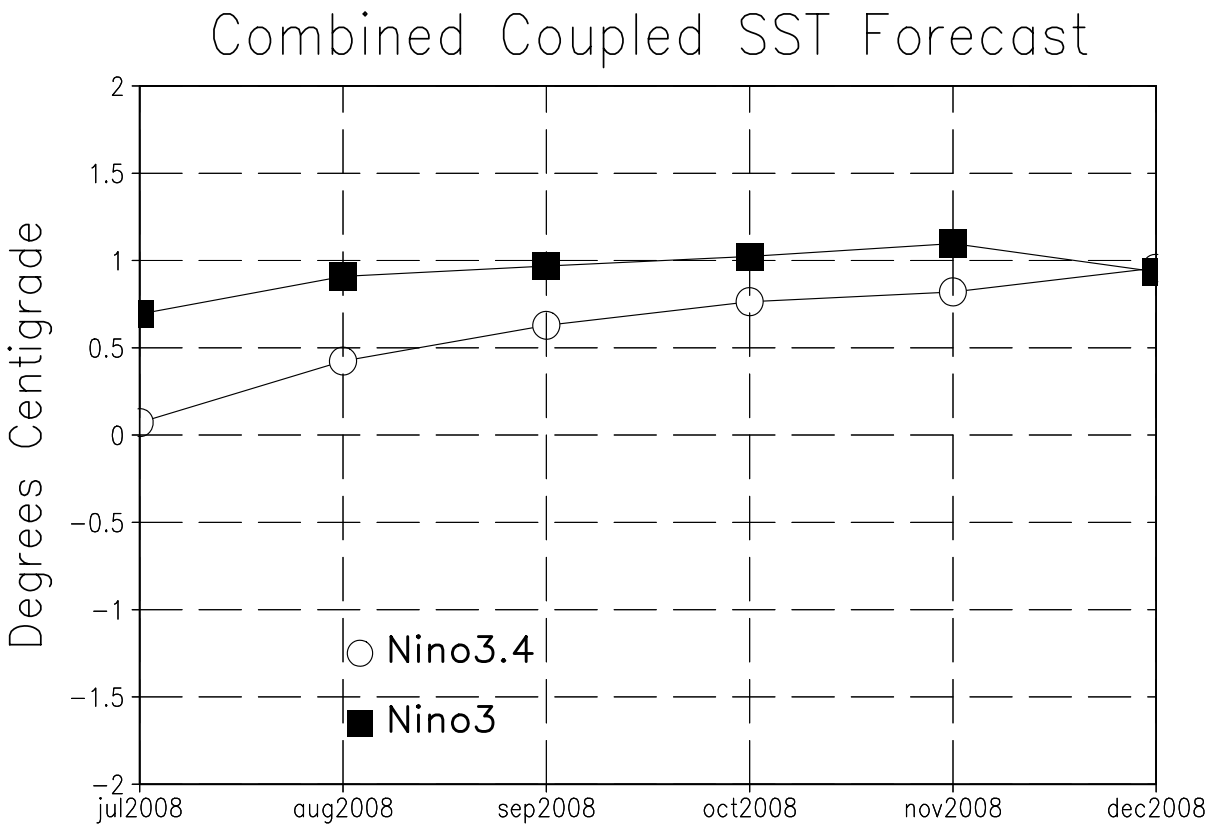
Figure Captions

Figure 1. Combined coupled model forecast for the Nino3 and Nino3.4 regions from July 1, 2007 initial conditions.


Combined Coupled SST Forecast
Degrees Centigrade
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
Nino3.4
Nino3
jul2008
aug2008
sep2008
oct2008
nov2008
dec2008