Forecast of Tropical Pacific SST Using a Markov Model

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Forecasts of the tropical Pacific SST anomaly are presented here using a linear statistical model (Markov model). The Markov model is constructed in a reduced multivariate EOF space of observed sea surface temperature (SST), surface wind stress and sea level analysis (Xue et al. 2000). The model is trained for 1980-95 and verified for 1964-79.

The SST from 1964 to 1981 is the reconstruction of historical SST by Smith et al. (1996) and the SST from 1982 to present is the Optimum Interpolation (OI) SST analysis by Reynolds and Smith (1994); the surface wind stress is the FSU pseudo wind stress product (Goldenberg and O'Brien 1981); the sea level from 1964 to 1979 is from a model simulation which uses the GFDL MOM1 model forced by the FSU winds and the sea level from 1980 to present is from the ocean analysis at NCEP (Behringer et al. 1998). All the data are monthly values and cover the tropical Pacific region within 20^{O} of the equator.

The Markov model is built with three multivariate EOFs in which the anomalous fields of SST, wind stress and sea level are equally weighted. The model evolves linearly with a seasonally dependent and predetermined transition matrix. The cross-validated skill for 1980-95 and hindcast skill for 1964-79 have been published in the issue of September 1998 of the *Experimental Long-Lead Forecast Bulletin*. For the forecasts published during September 1998 to March 2003, the SST anomalies were calculated as departures from the 1950-79 adjusted OI climatology (Reynolds and Smith 1995). Since June 2003, the 1971-2000 SST climatology (Xue et al. 2003) is used. In addition, the SST data is changed from the OI.v1 to OI.v2 SST (Reynolds et al. 2002), and the wind stress data is changed from the FSU subjective to FSU objective pseudo wind stress analysis.
Starting from November 2004, the sea level field from the NCEP's global ocean data assimilation system (Behringer and Xue 2004) is used in replacement of that from the NCEP's Pacific ocean data assimilation system (Behringer et al. 1998).

Fig. 1 shows the time evolution of NINO3.4 forecasts up to 12 month leads by the Markov model initiated monthly from January 1998 to May 2006. Fig. 2 shows the seasonal mean SST anomaly forecast from the latest prediction initiated from May 2006. The forecast suggests a neutral condition for the tropical Pacific in next 6-9 months.

A monthly update of the Markov model forecast is accessible at http://www.cpc.ncep.noaa.gov/products/people/yxue/ENSO_forecast_clim71_00_godas.html. To assist users to understand the forecasts, detail information about the model and forecast results are included in the web page. The forecast NINO3 and NINO3.4 indices and SST spatial maps are available for downloading.

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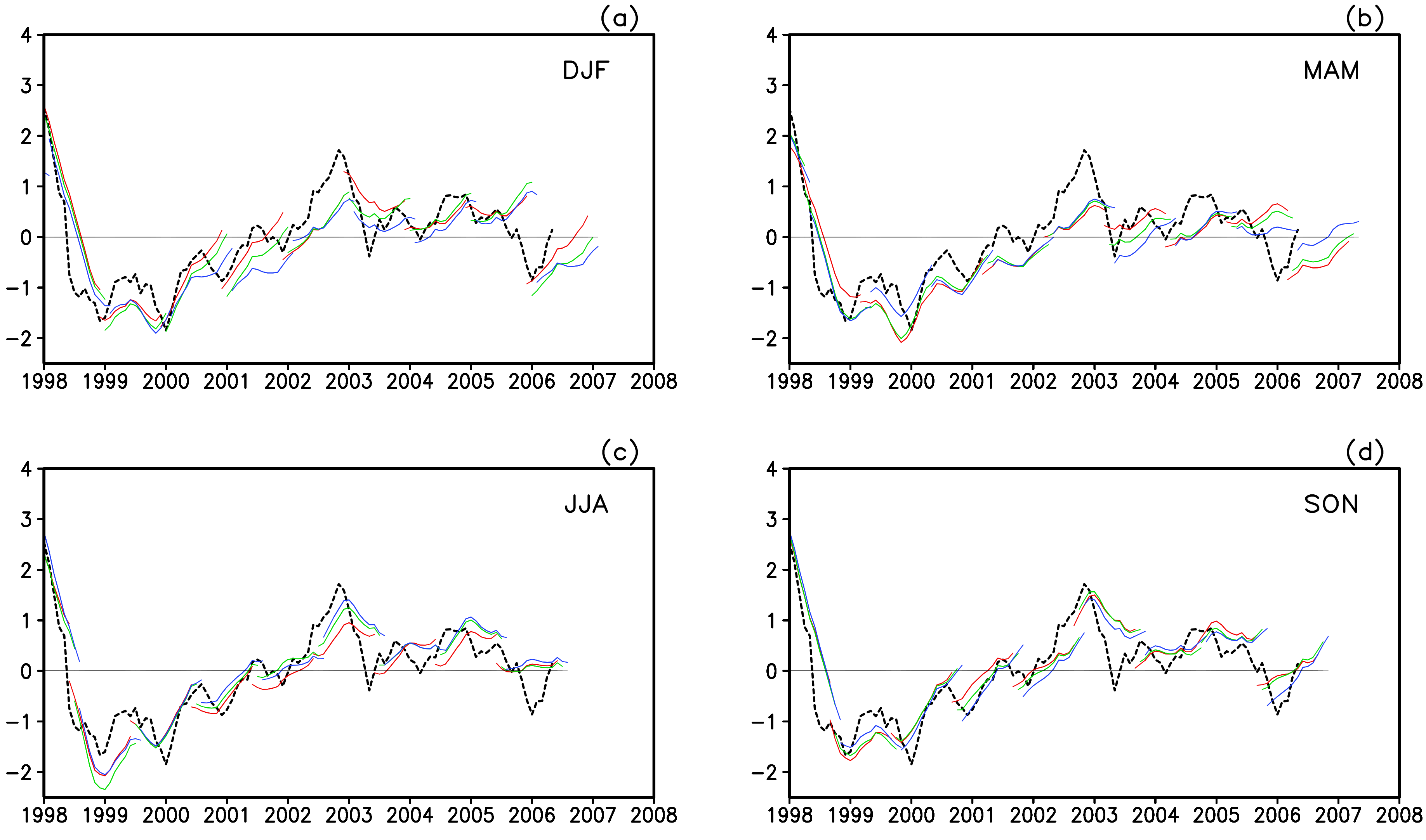

Fig. 1. Time evolution of NINO3.4 forecasts up to 12 lead months by the Markov model initiated monthly up to May 2006 . Shown in each panel are the forecasts grouped by three consecutive starting months: (a) is for December, January and February, (b) is for March, April and May, (c) is for June, July and August and (d) is for September, October and November. The observed NINO3.4 SST anomalies are shown in the heavy−dashed lines.

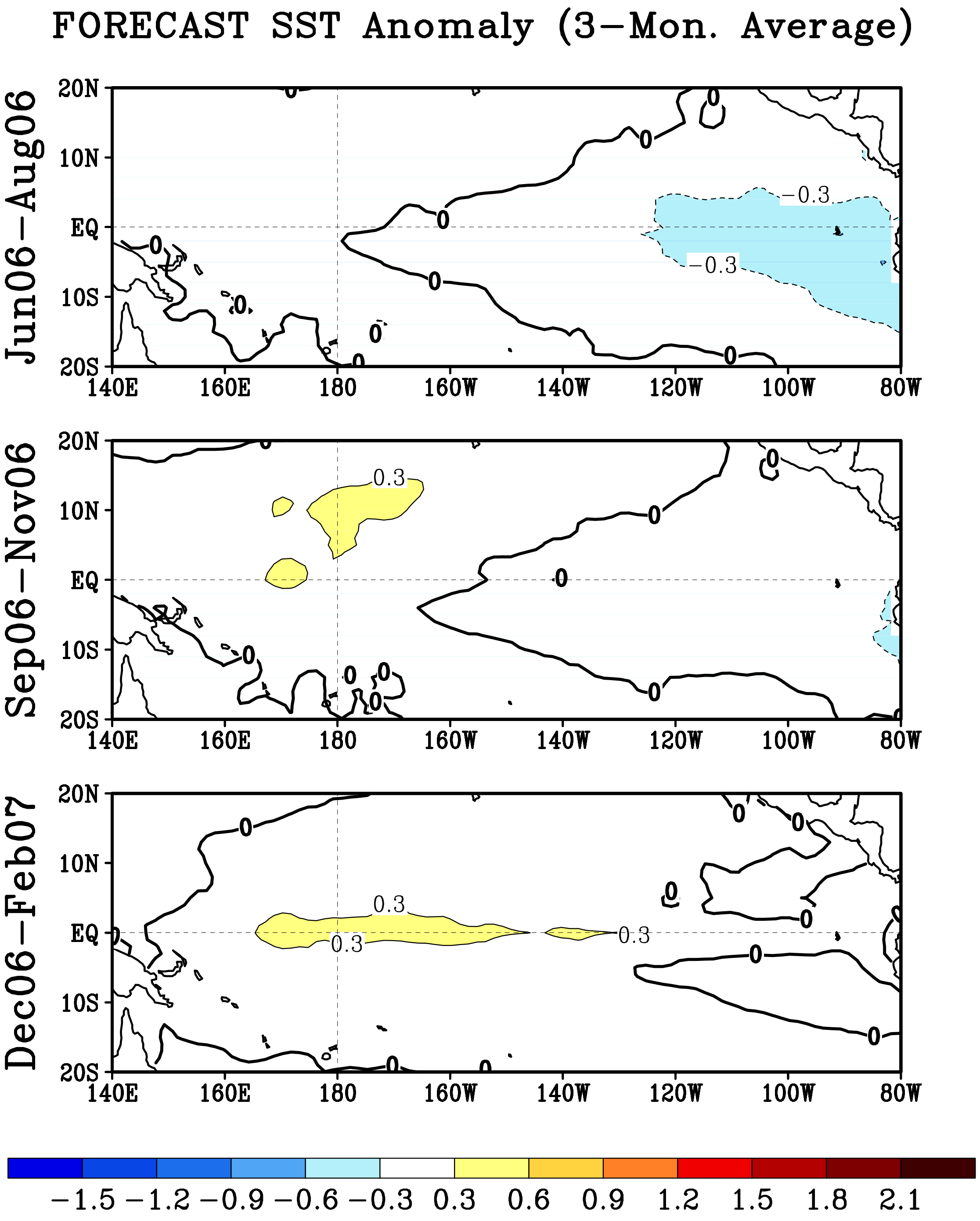

Fig. 2. Seasonal mean SST anomalies forecast by the Markov model initiated from May 2006 . The three target periods are indicated.