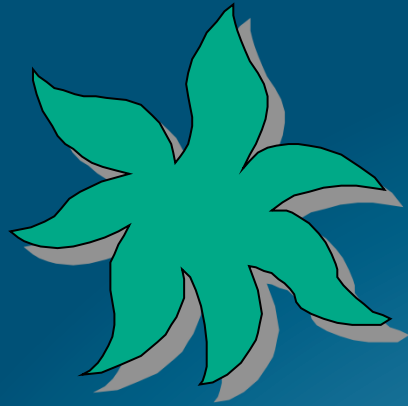


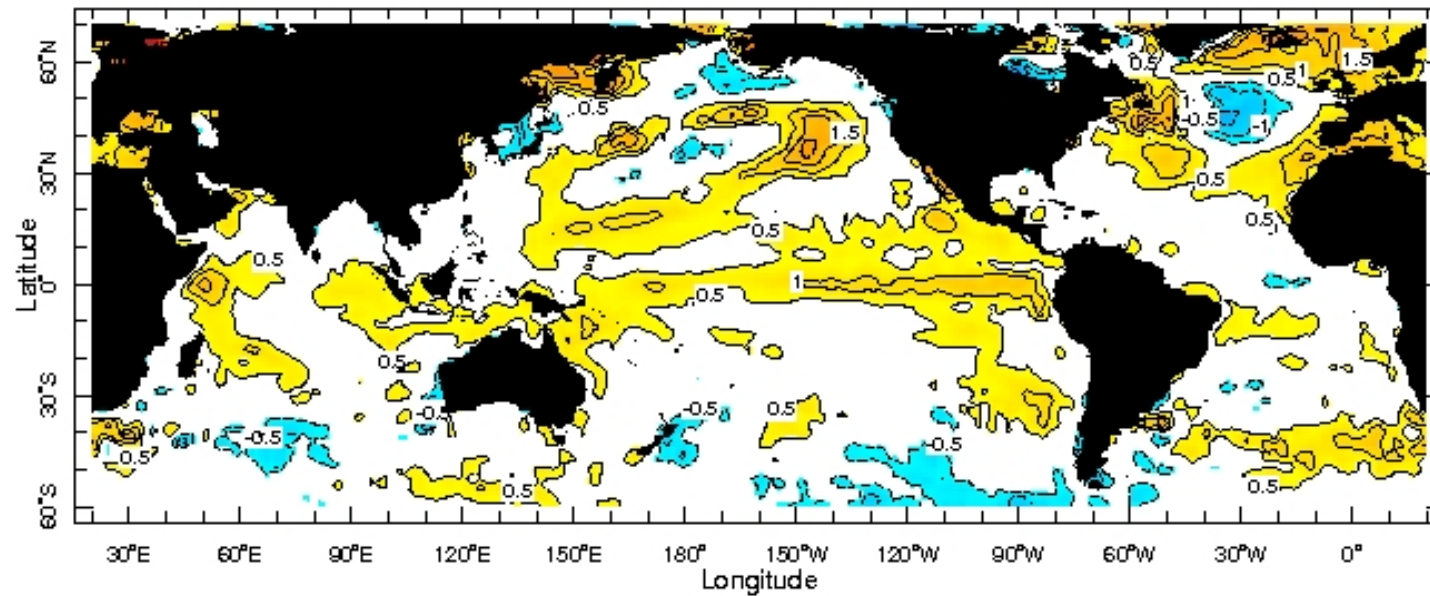
The Unusual El Nino of 2009



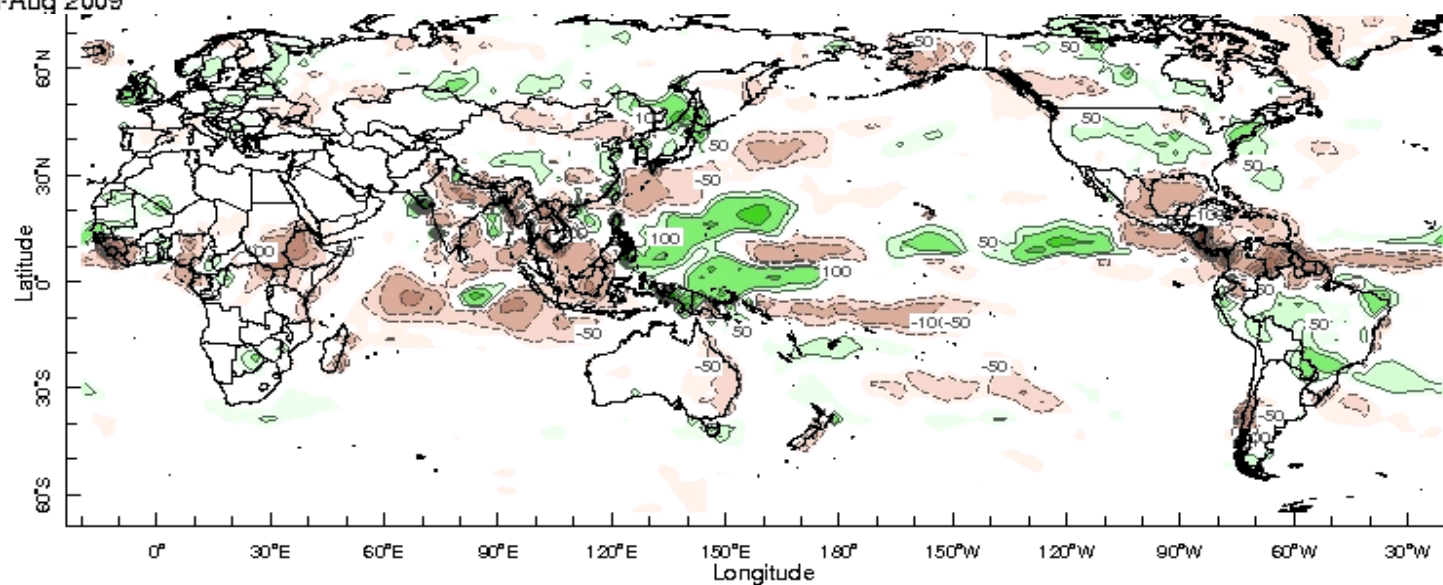
**Swadhin Behera, Jing-Jia Luo, Yukio Masumoto
and Toshio Yamagata**

*Research Institute for Global Change/JAMSTEC, Yokohama, Japan
Application Laboratory, JAMSTEC, Yokohama, Japan
University of Tokyo, Tokyo, Japan*

2009 June-August Ocean-Atmosphere Conditions



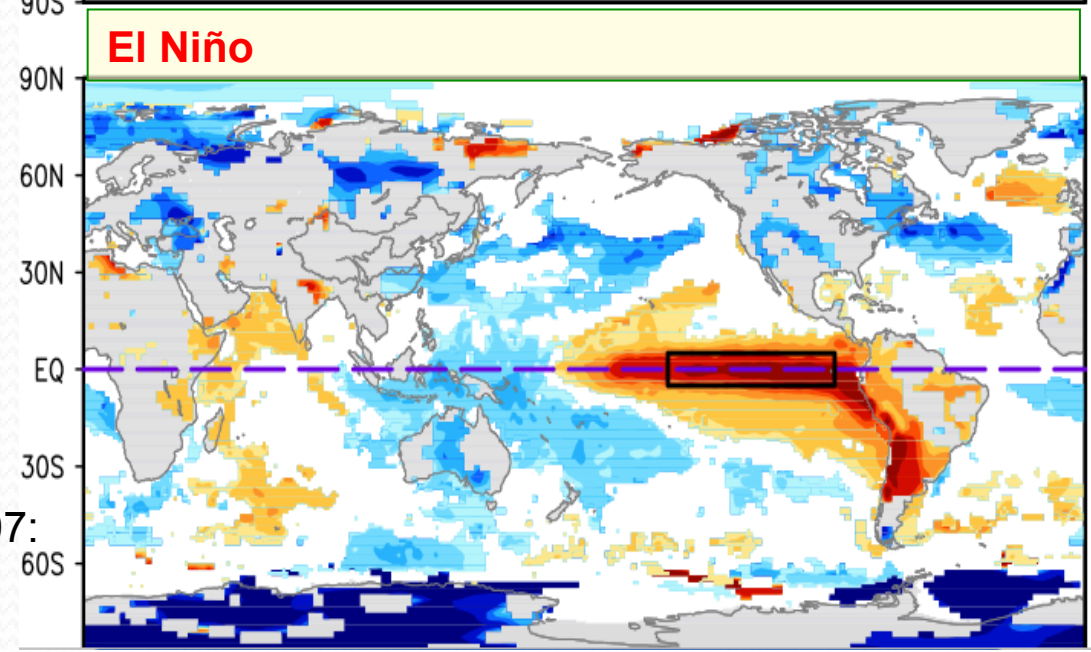
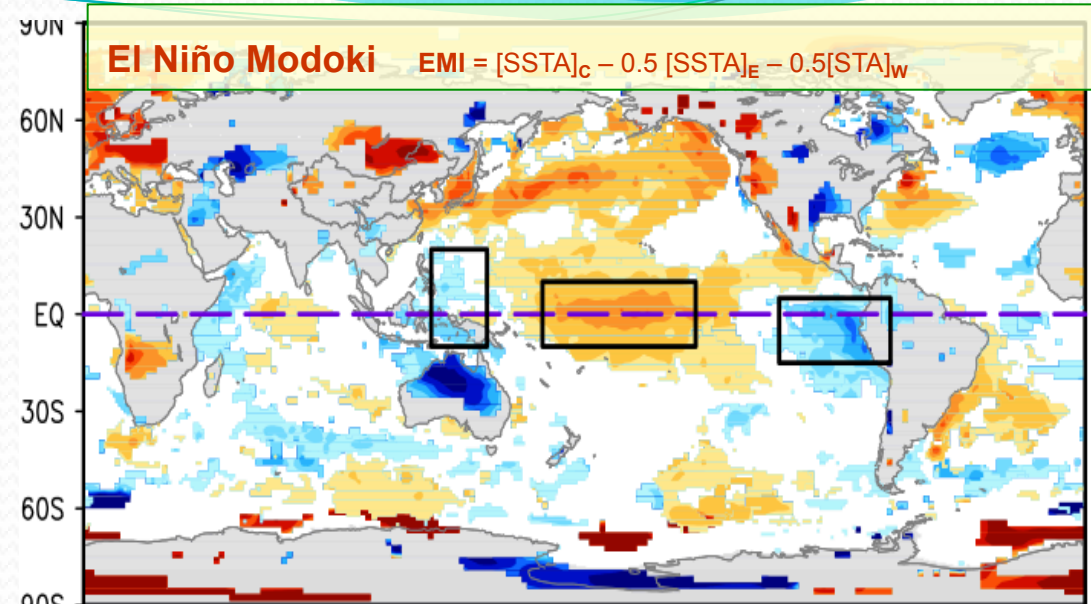
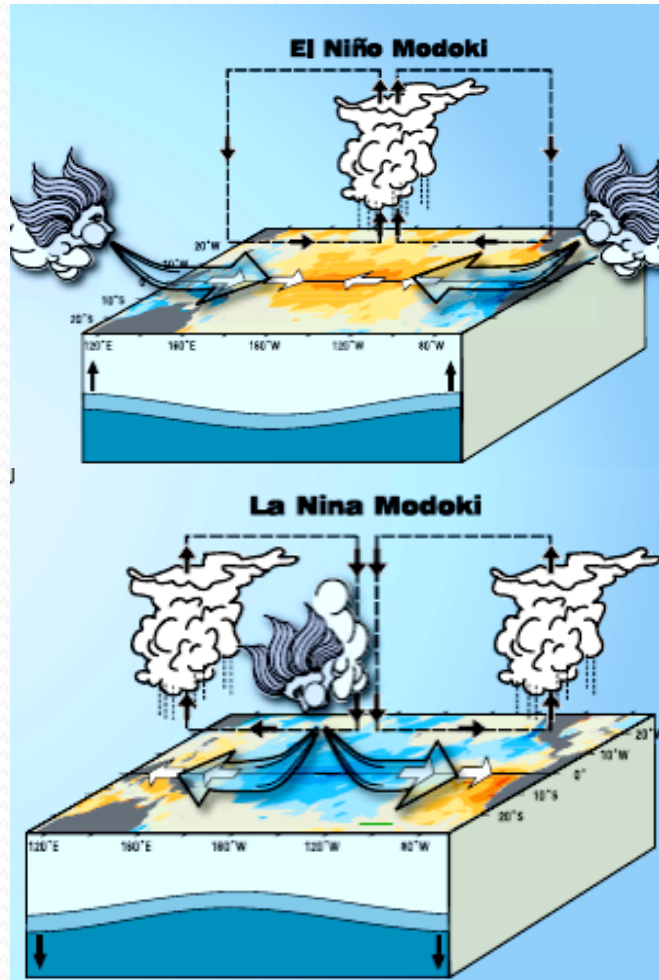
Jun-Aug 2009



Jun-Aug 2009

Surface temperature anomaly

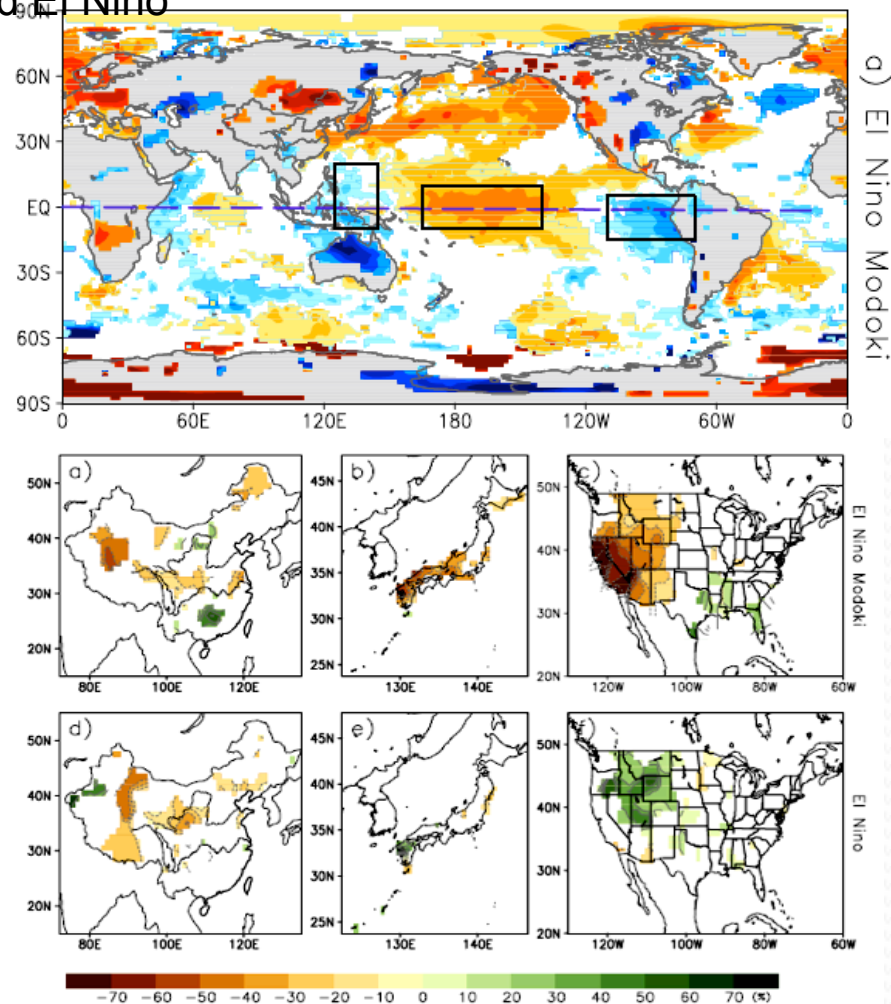
Schematic of El Nino/La Nina Modoki



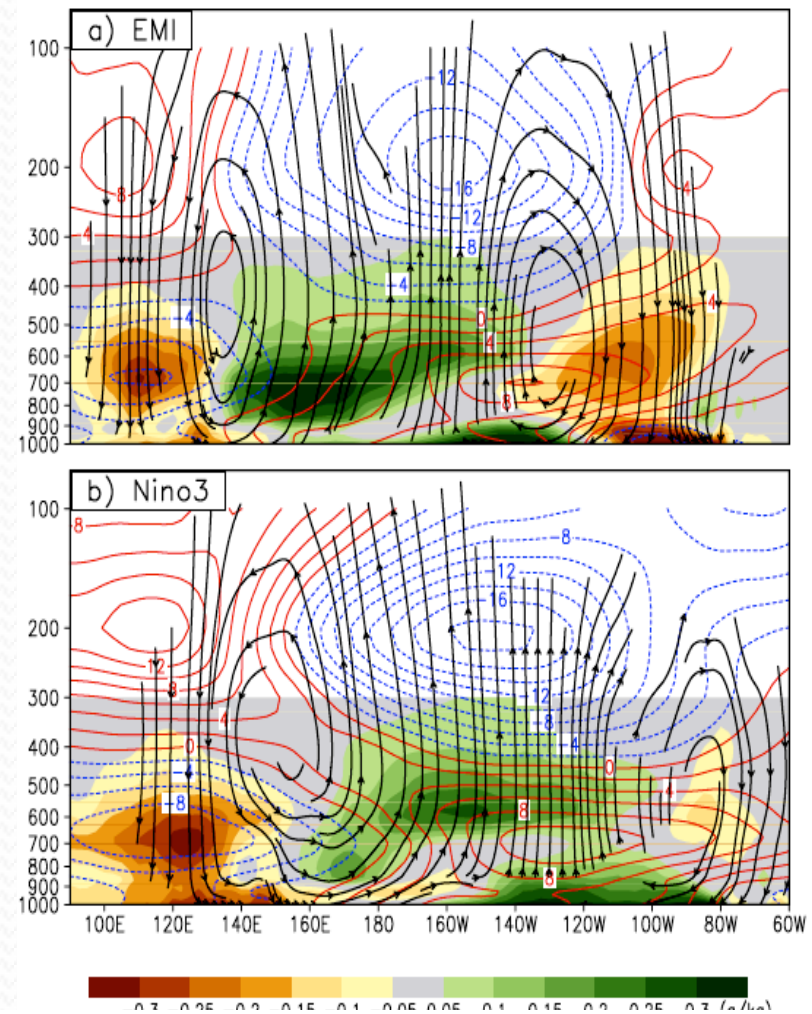
Ashok et al 2007: JGR, Weng et al. 2007: Clim Dynamics, Ashok and Yamagata 2009: Nature, Yeh et al. 2009: Nature

The El Nino Modoki Teleconnection

Composite of surface temperature for El Nino Modoki and rainfall composites for El Nino Modoki and El Nino



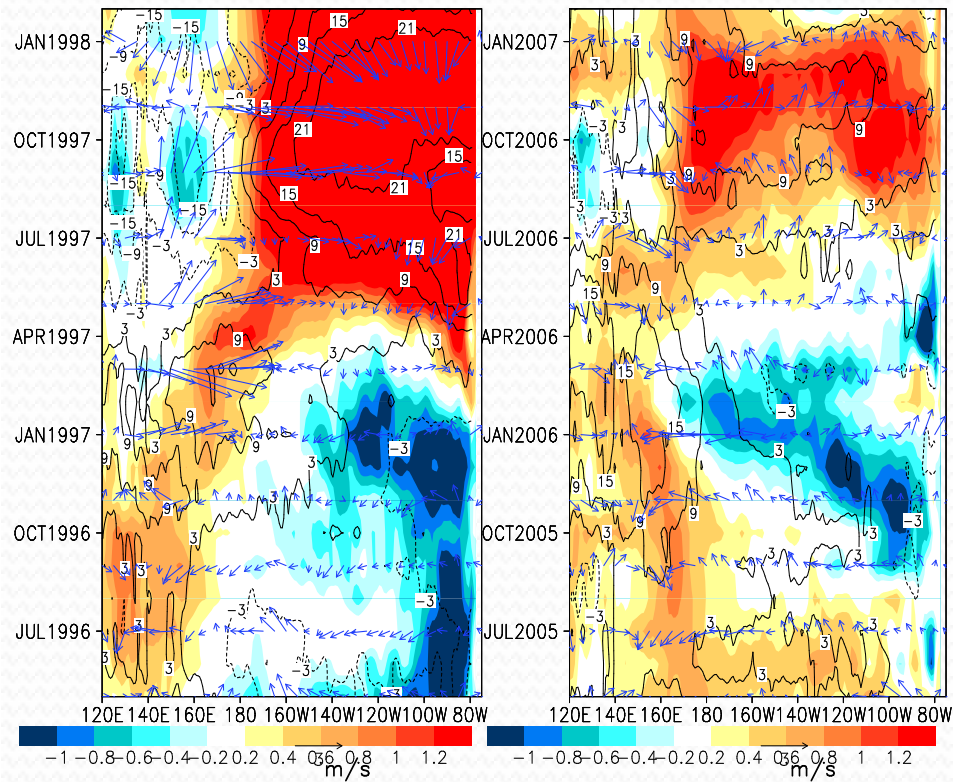
Walker circulation related to El Nino Modoki and El Nino



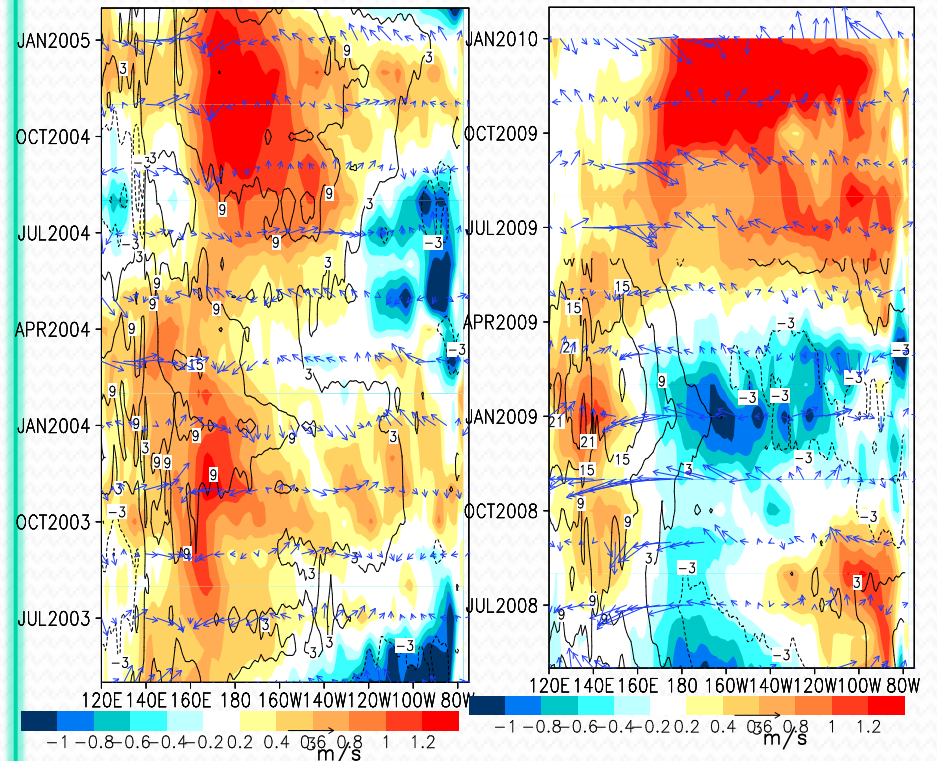
Ashok et al. 2007; JGR, Weng et al. 2007, 2008; Clim. Dyn.; Ashok and Yamagata 2009 Nature

El Nino and El Nino Modoki

SST, SSH & Wind Anom 1997 SST, SSH & Wind Anom 2006

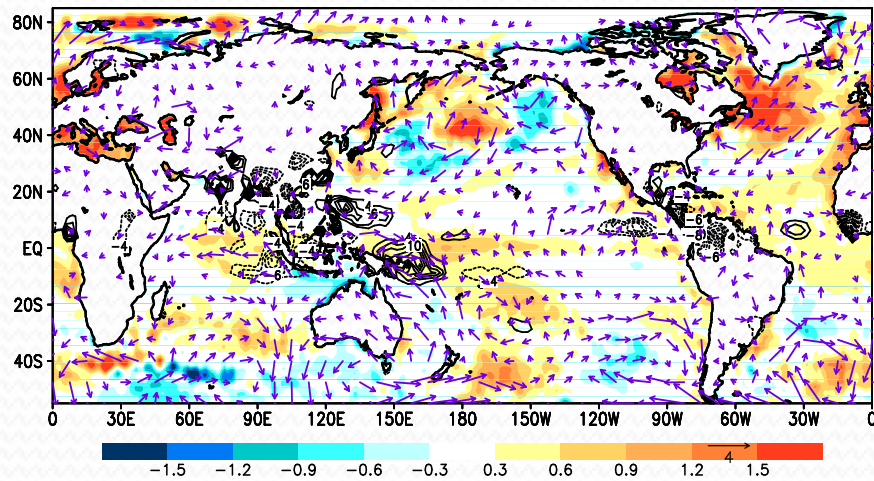


SST, SSH & Wind Anom 2004 SST, SSH & Wind Anom 2009

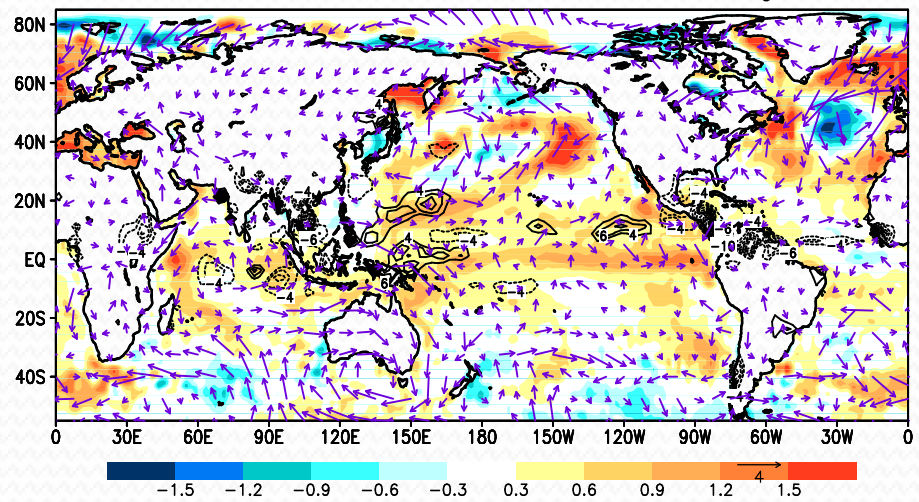


El Nino and El Nino Modoki in Boreal Summer

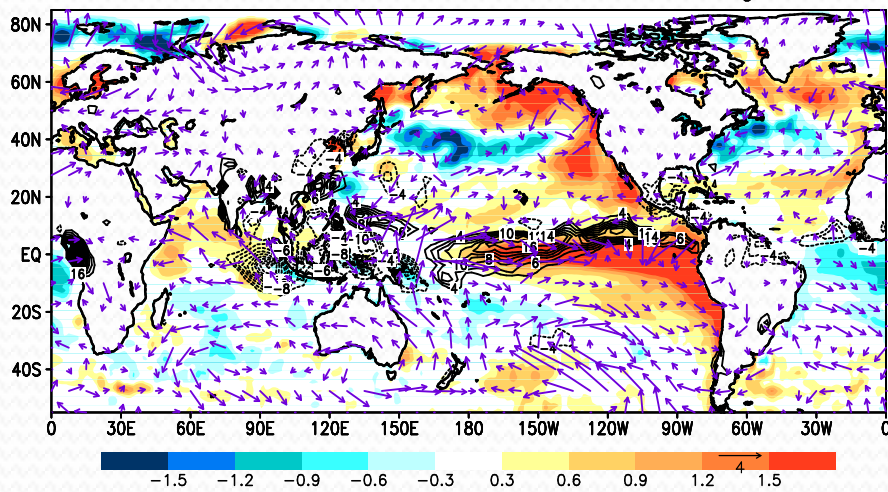
Anomalies of SST, Rain and Surf. Wind Jun–Aug 2006



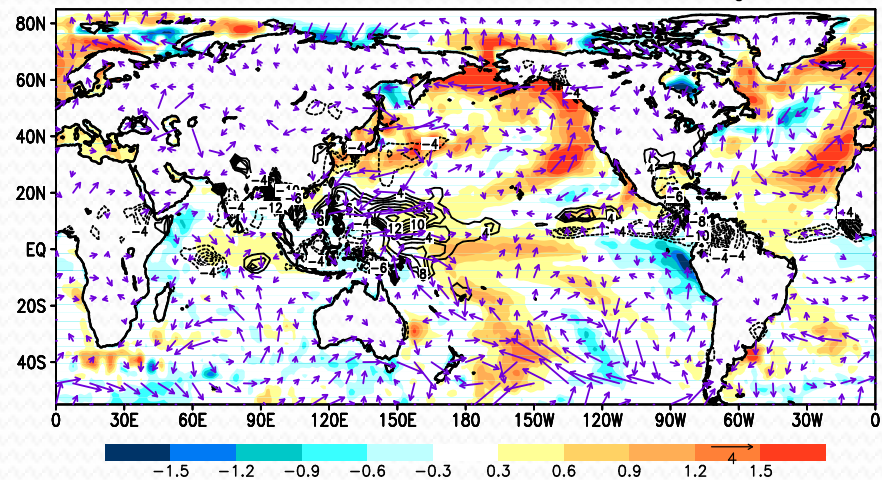
Anomalies of SST, Rain and Surf. Wind Jun–Aug 2009



Anomalies of SST, Rain and Surf. Wind Jun–Aug 1997

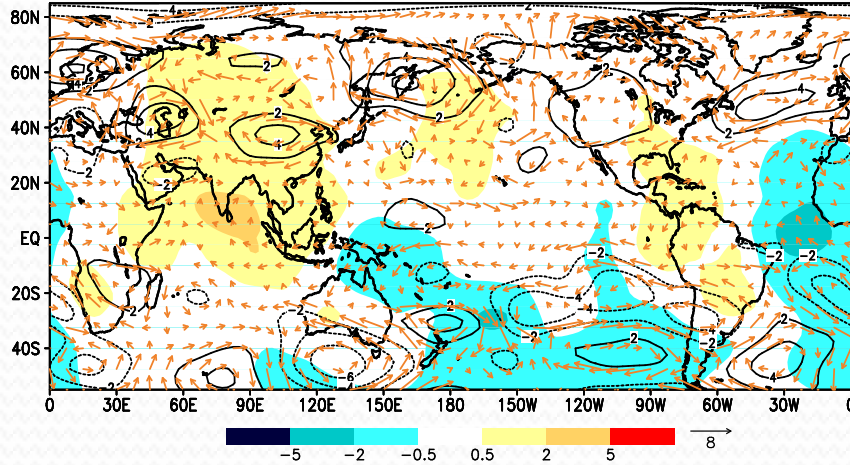


Anomalies of SST, Rain and Surf. Wind Jun–Aug 2004

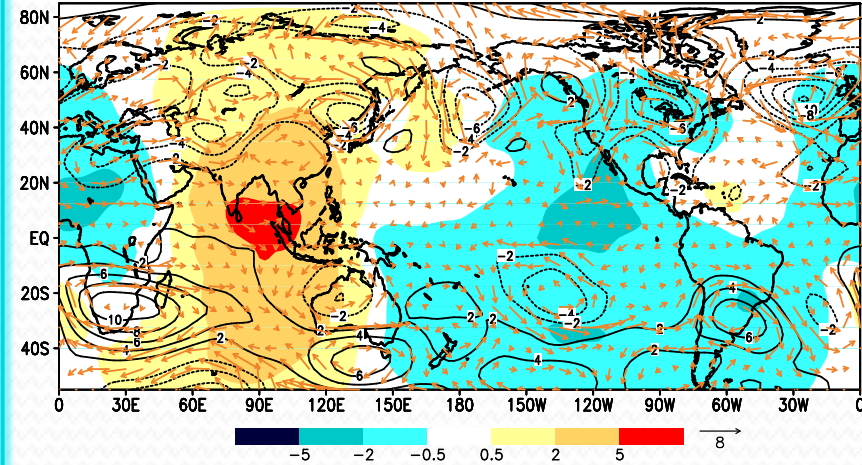


El Nino and El Nino Modoki in Boreal Summer

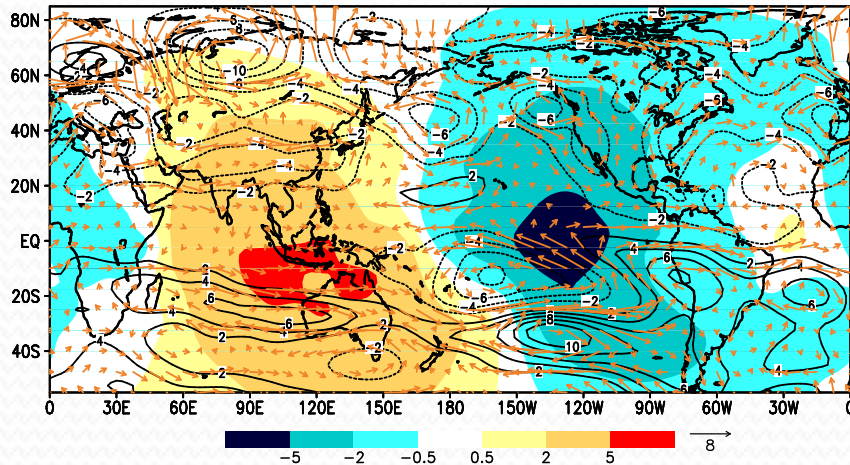
Anomalies of CHI200, PSI300 and Wind Jun-Aug 2006



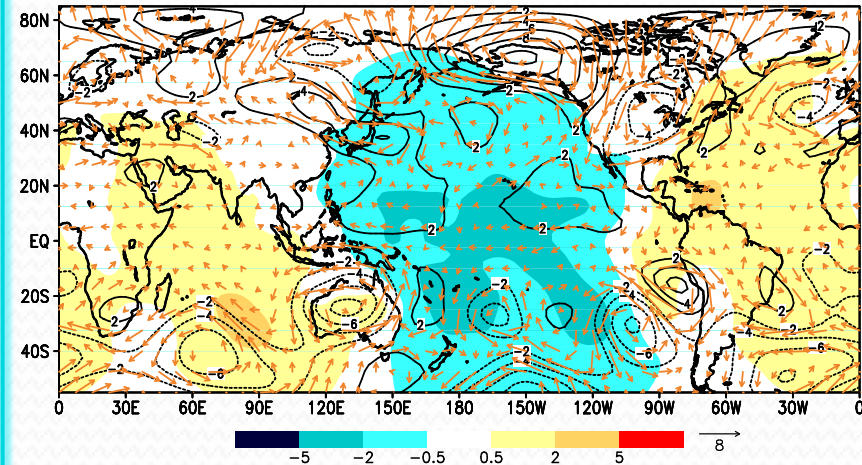
Anomalies of CHI200, PSI300 and Wind Jun-Aug 2009



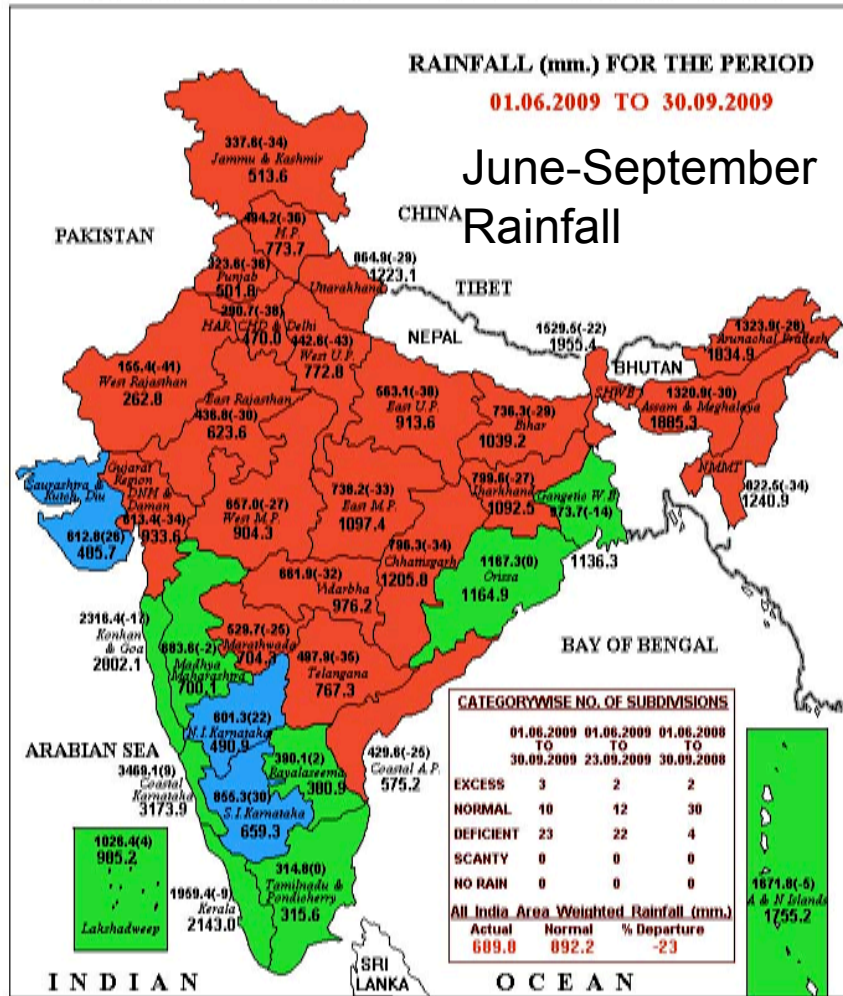
Anomalies of CHI200, PSI300 and Wind Jun-Aug 1997



Anomalies of CHI200, PSI300 and Wind Jun-Aug 2004



भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT



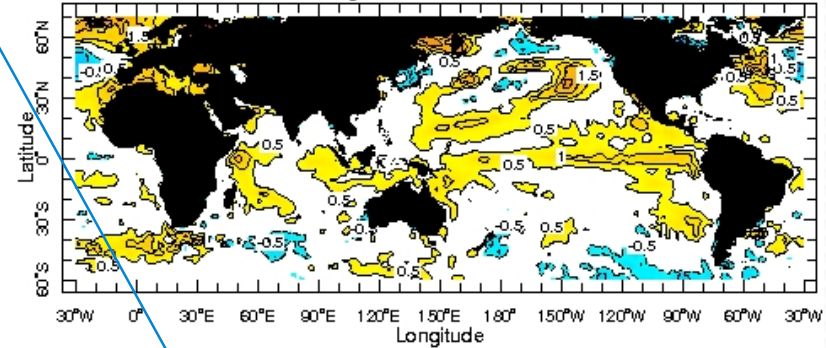
LEGEND: ■ EXCESS (+20% OR MORE) ■ NORMAL (+19% TO -19%) ■ DEFICIENT (-20% TO -59%)
■ SCANTY (-60% TO -99%) ■ NO RAIN (-100%) ■ NO DATA

NOTES:

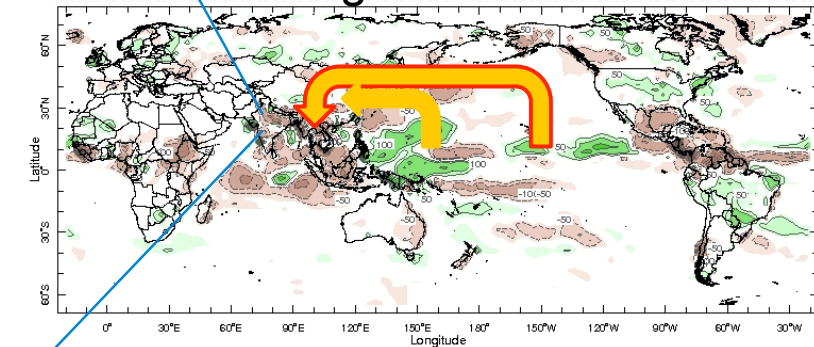
- (a) Rainfall figures are based on operational data.
- (b) Small figures indicate actual rainfall (mm.), while bold figures indicate Normal rainfall (mm.)
Percentage Departures of Rainfall are shown in Brackets.

India suffered from one of the worst droughts of recent times.

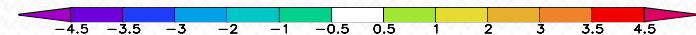
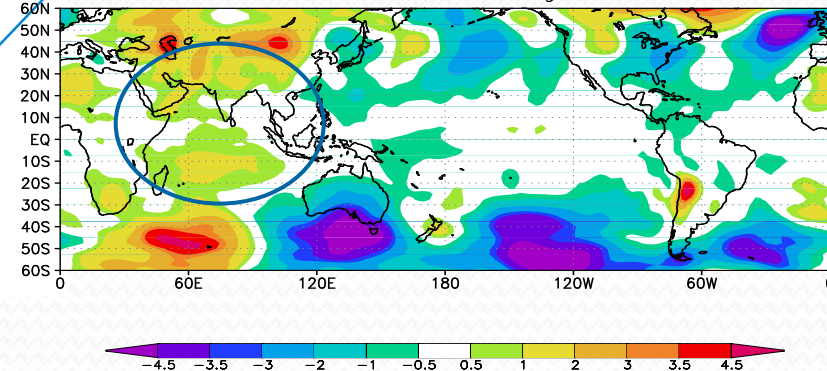
2009 June-August SST Anomalies



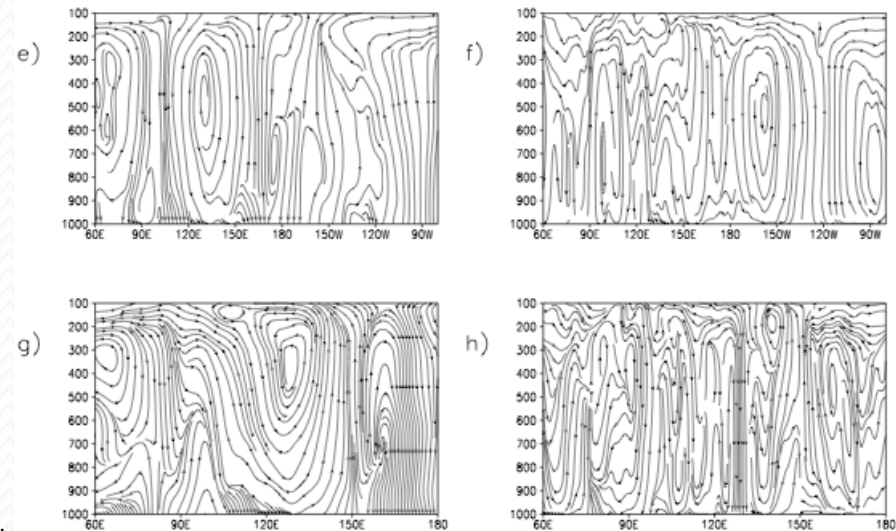
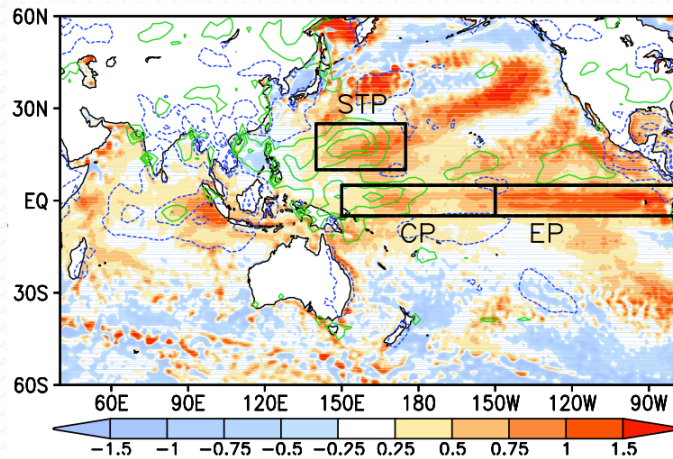
2009 June-August Rainfall Anomalies



SLP Anomalies June-Aug 2009

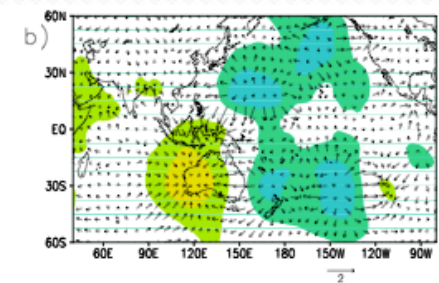
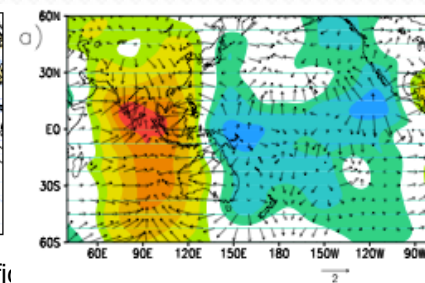
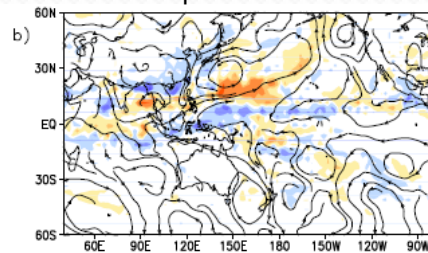
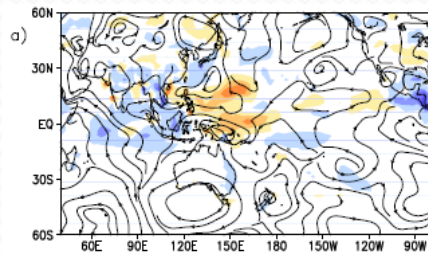


AGCM Experiments – 2009 Summer Monsoon



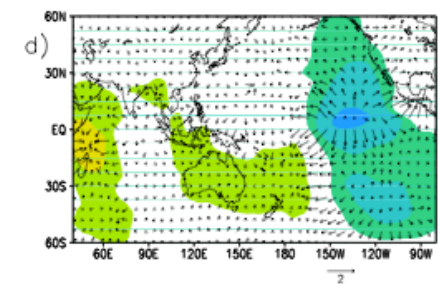
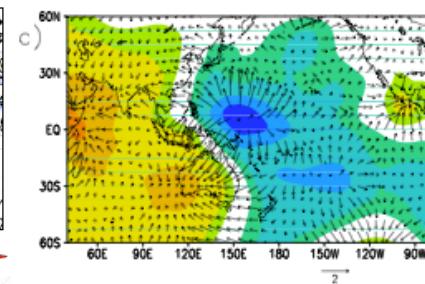
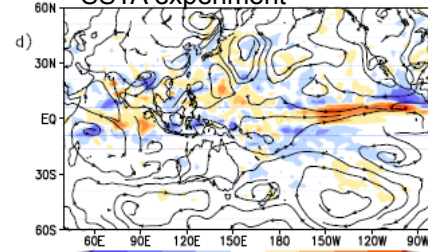
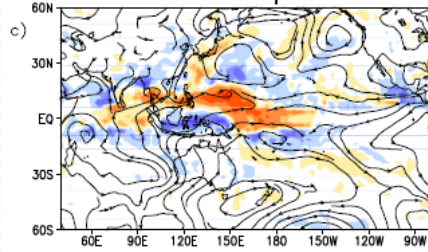
Observed rainfall anomalies and 850 hPa streamlines

Model results from subtropical SSTA experiment



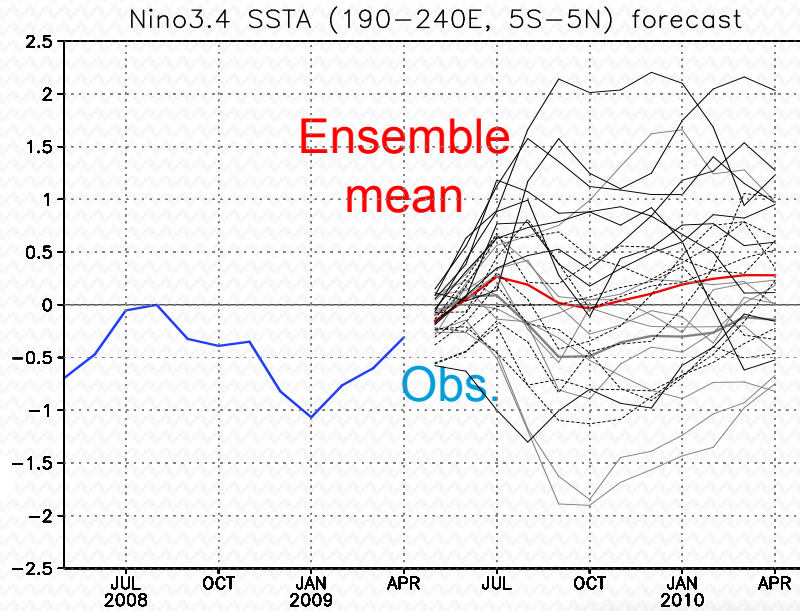
Model results from central Pacific SSTA experiment

Model results from east Pacific SSTA experiment

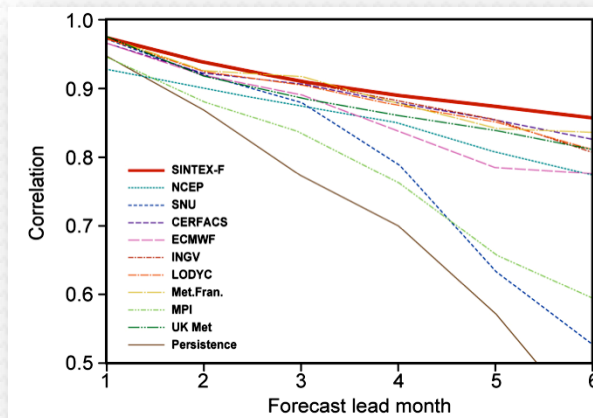
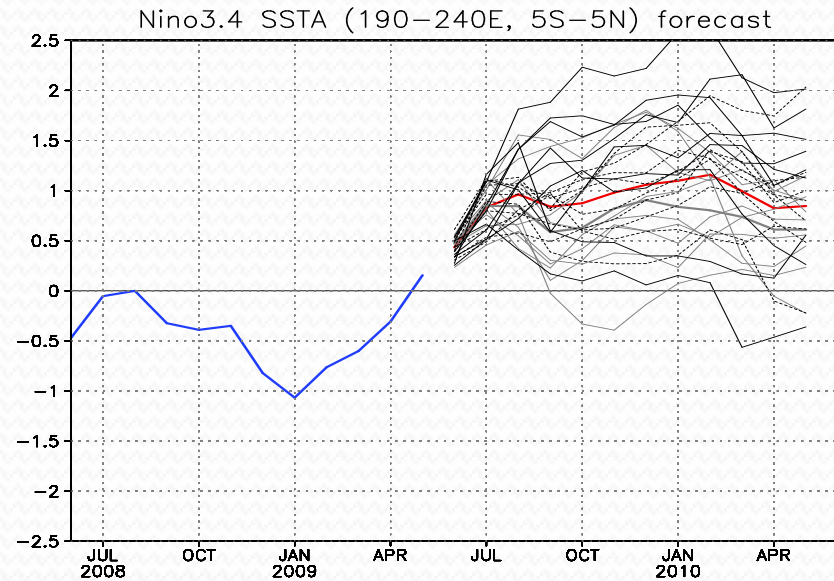


2009 El Nino Predictions

Nino3.4 (5°S-5°N, 120°-170°W) Forecasts (SINTEX-F CGCM) From 1 May 2009

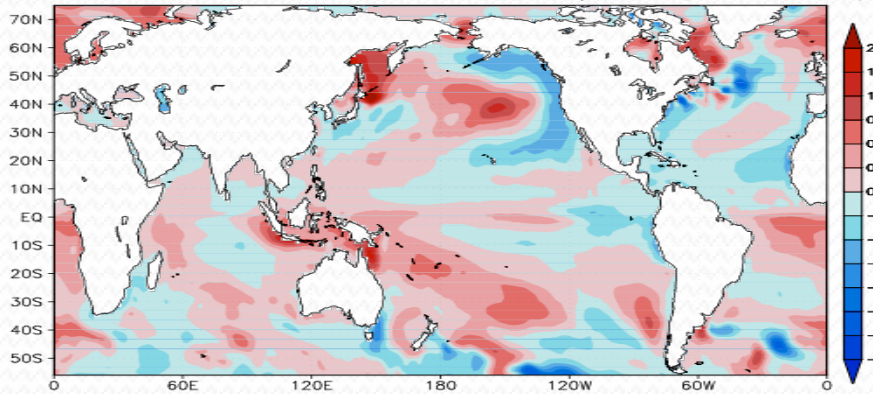


From 1 June 2009

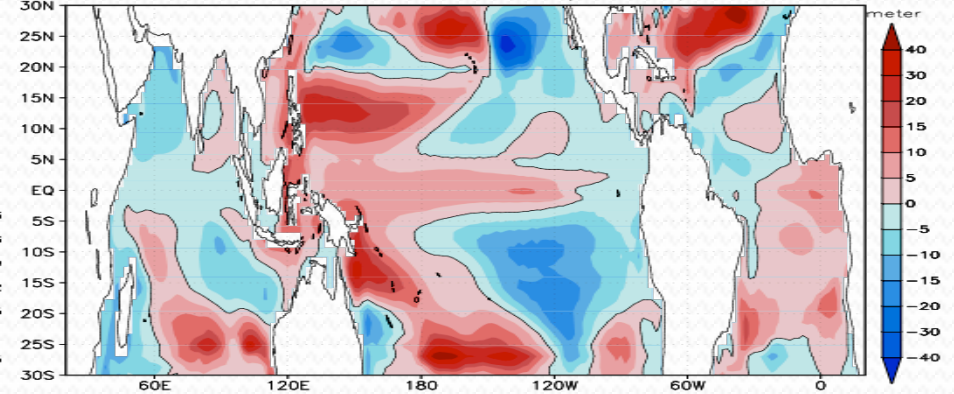


SINTEX-F CGCM Forecast from 1May2009 (27-member mean)

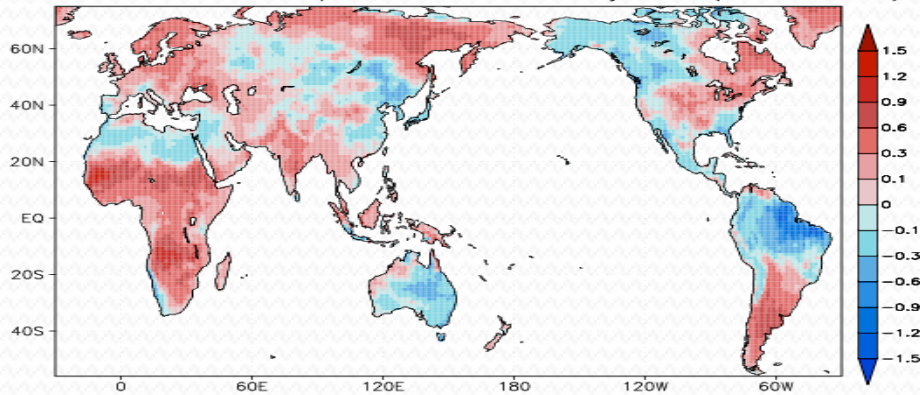
Predicted JJA2009 SST anom. from 1may2009 (27-member)



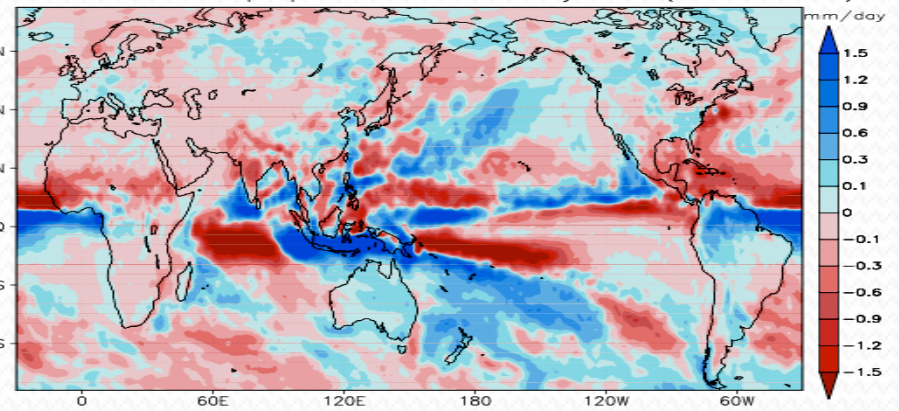
Predicted JJA2009 d20a from 1may2009 (27-member)



Predicted JJA2009 temp2 anom. from 1may2009 (27-member)

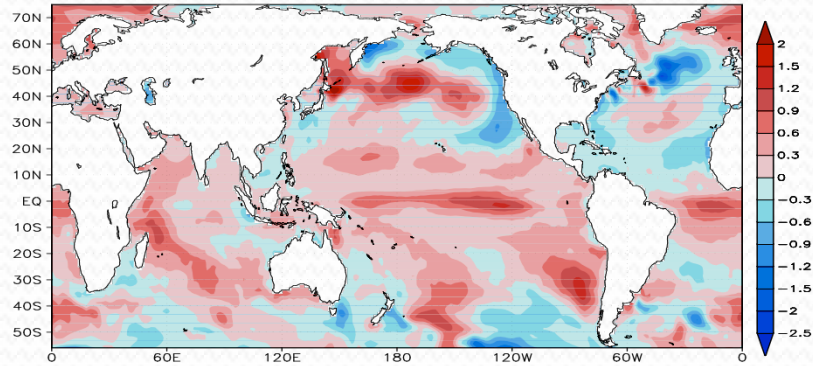


Predicted JJA2009 tprep anom. from 1may2009 (27-member)

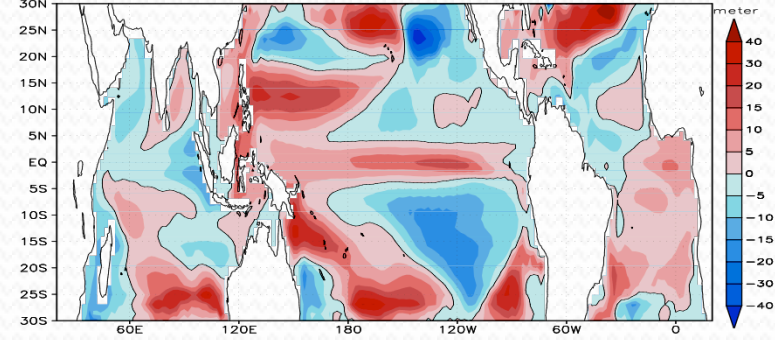


SINTEX-F CGCM Forecast from 1 Jun 2009 (27-member mean)

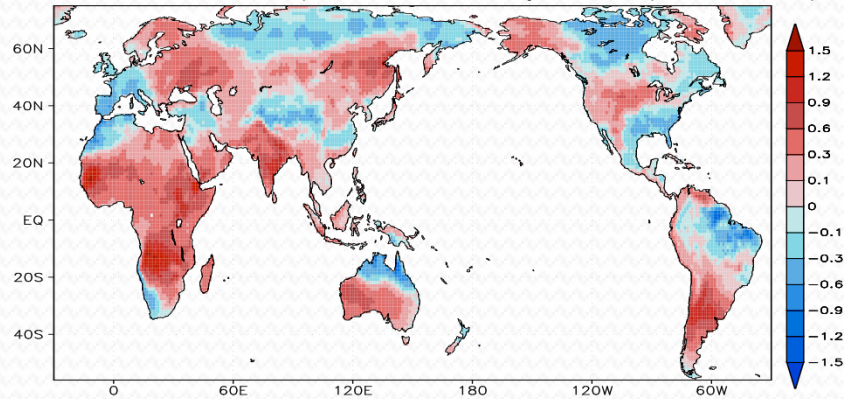
Predicted JJA2009 SST anom. from 1jun2009 (27-member)



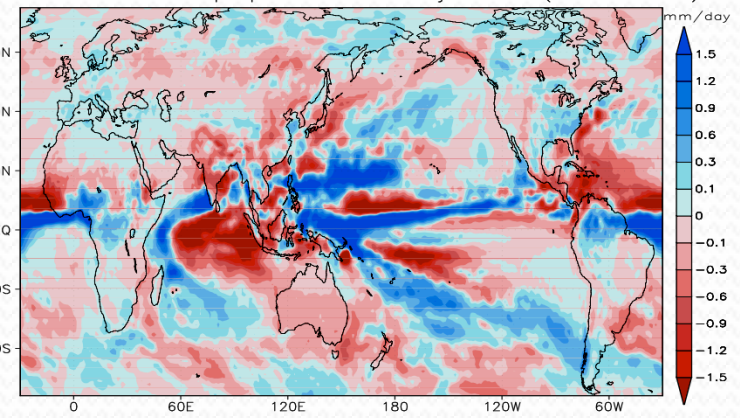
Predicted JJA2009 d20a from 1jun2009 (27-member)



Predicted JJA2009 temp2 anom. from 1jun2009 (27-member)

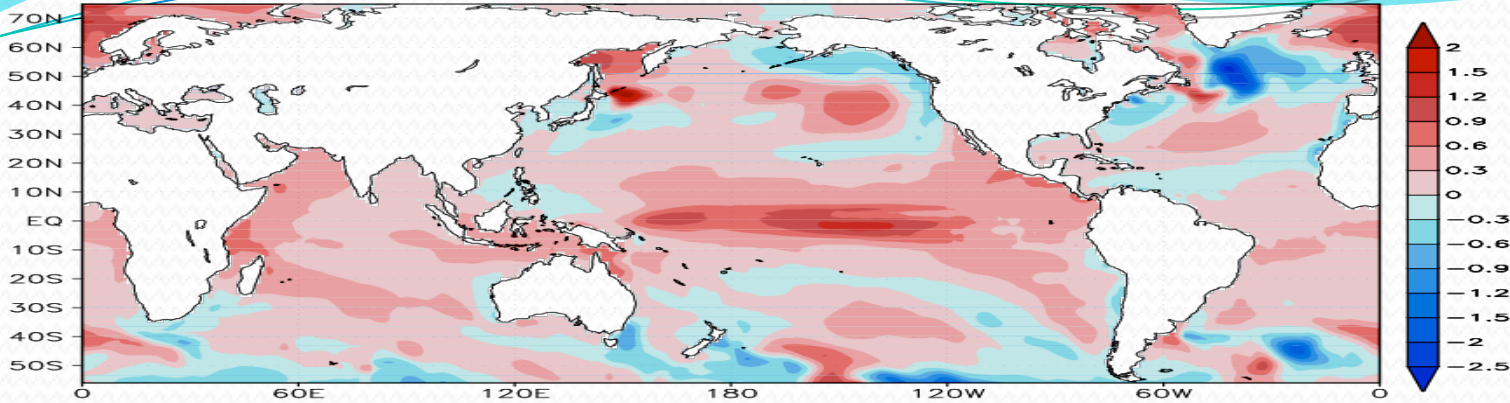


Predicted JJA2009 tprep anom. from 1jun2009 (27-member)



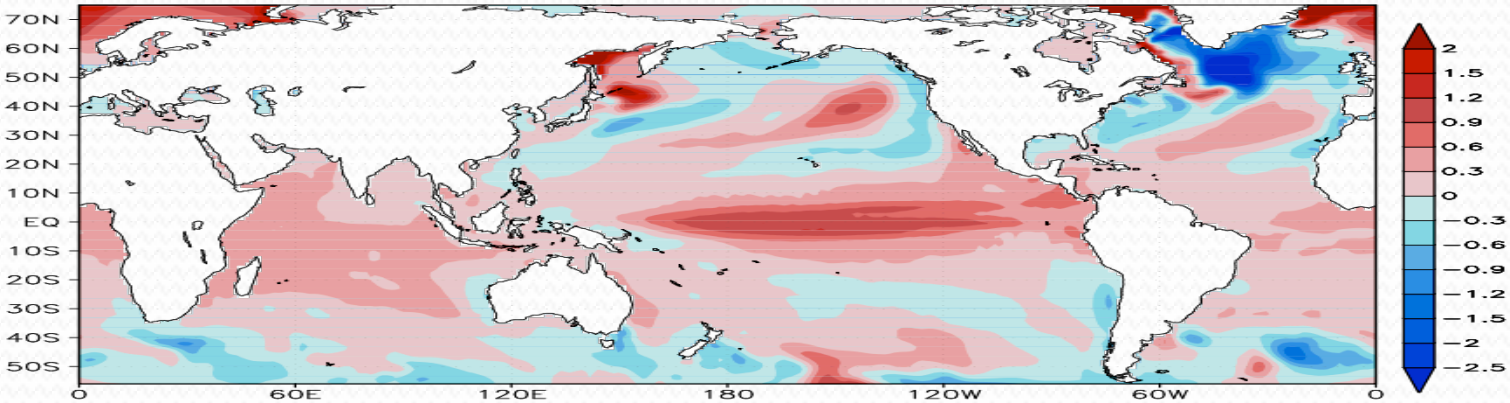
Global SSTA forecasted from 1 Jul 2009 (27-member mean, SINTEX-F CGCM)

Predicted SON2009 SST anom. from 1 Jul 2009 (27-member)



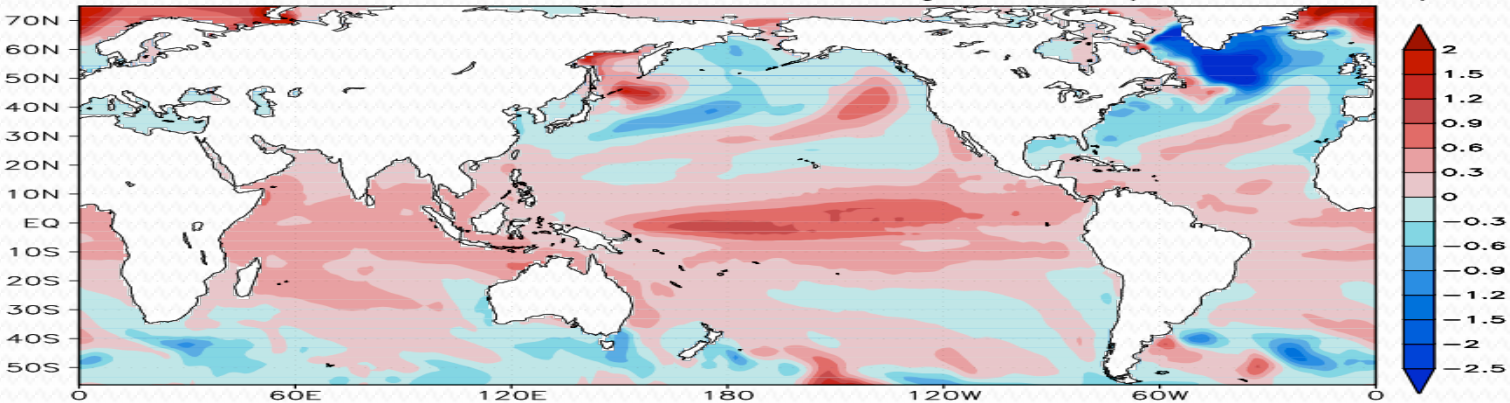
SON2009

Predicted DJF2009/2010 SSTA from 1 Jul 2009 (27-member)



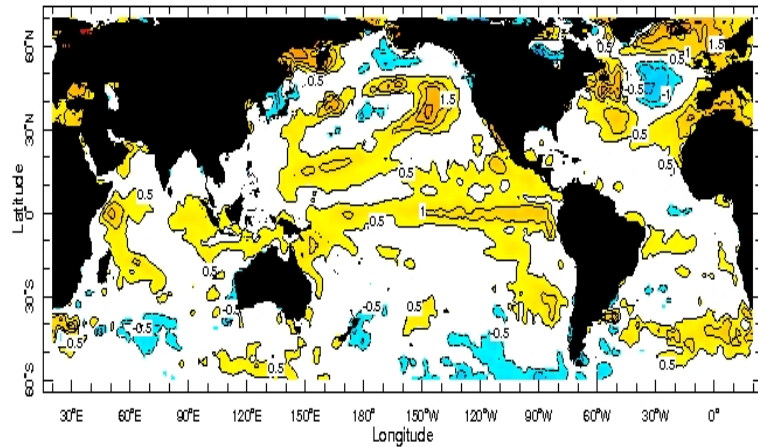
DJF09/10

Predicted MAM2010 SST anom. from 1 Jul 2009 (27-member)

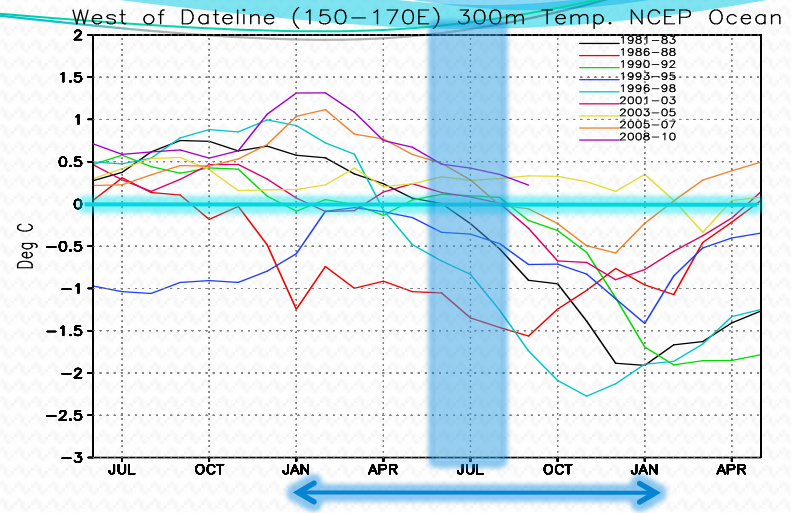


MAM2010

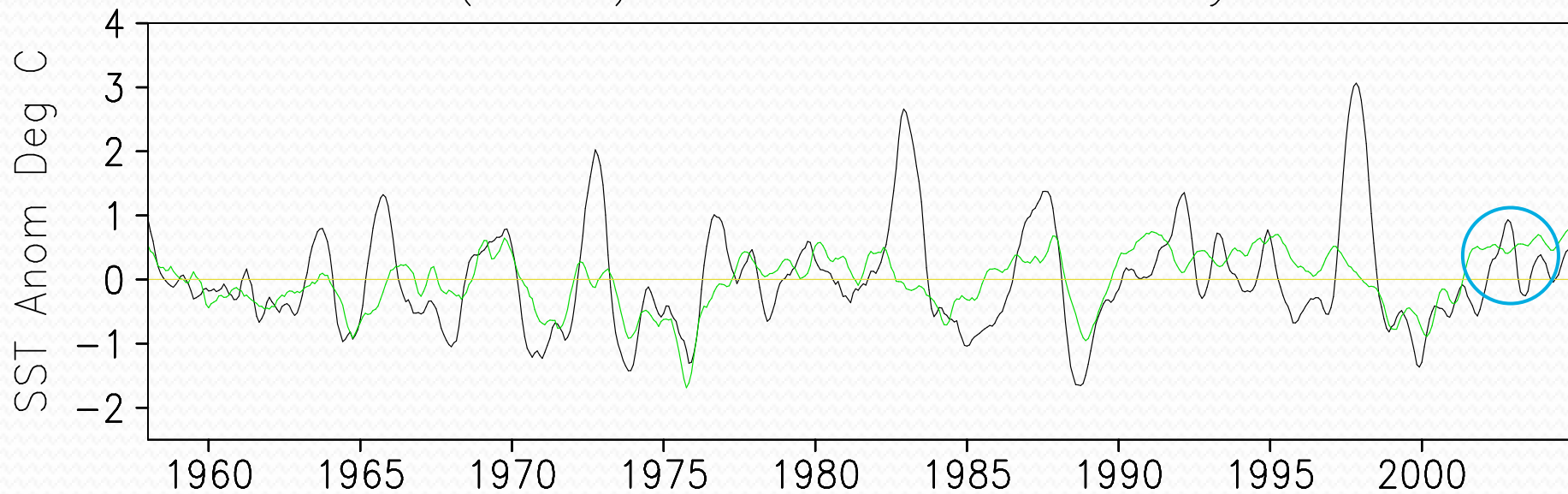
Warm SST Anomalies in Western Pacific



Jun-Aug 2009

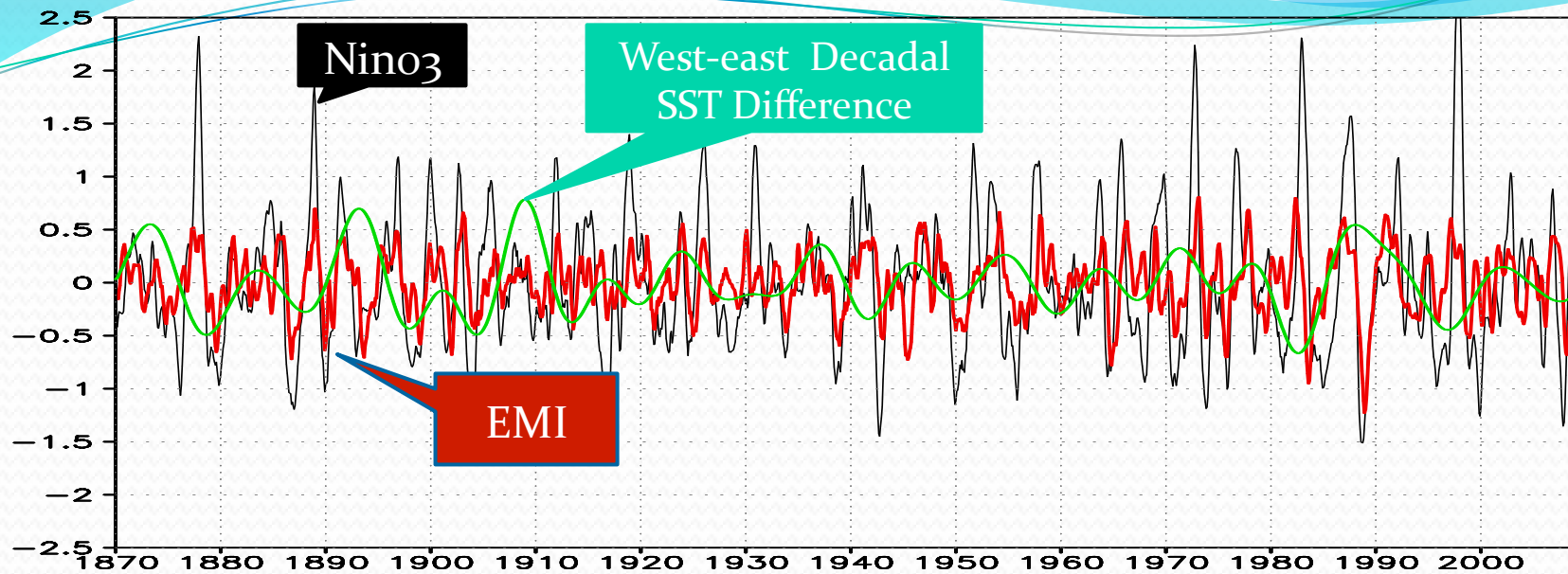


Nino3 (black) and WP SST Anomaly Indices

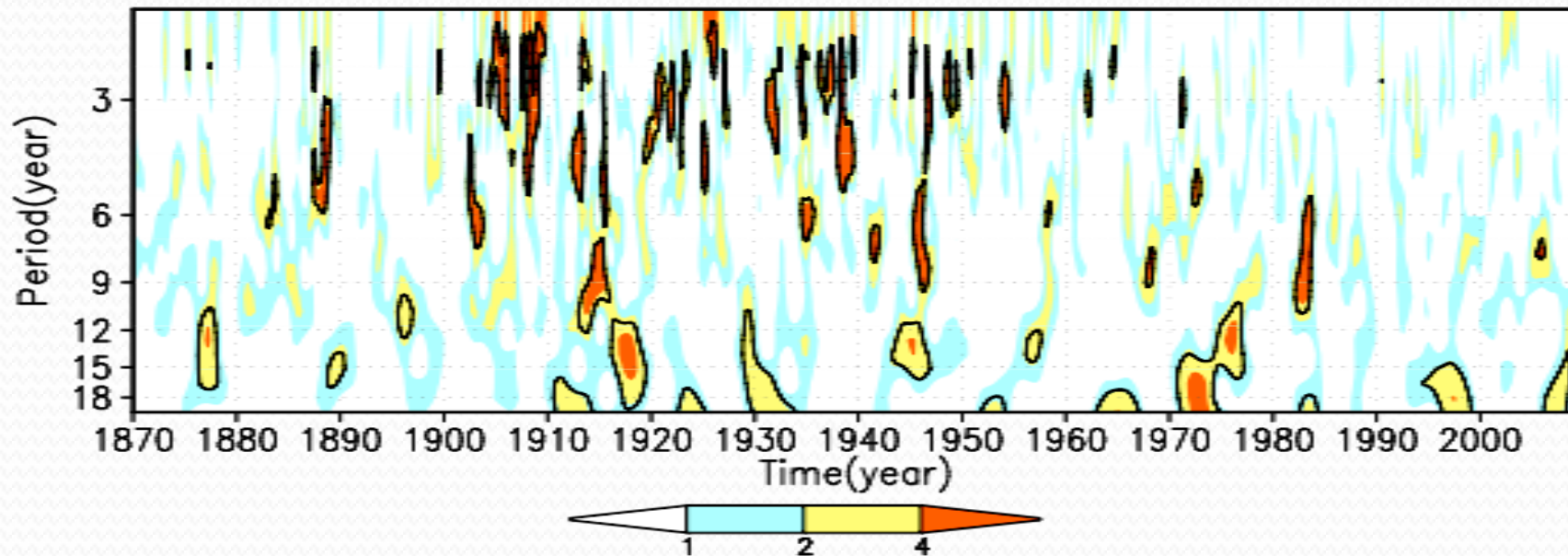


Behera et al. 2010

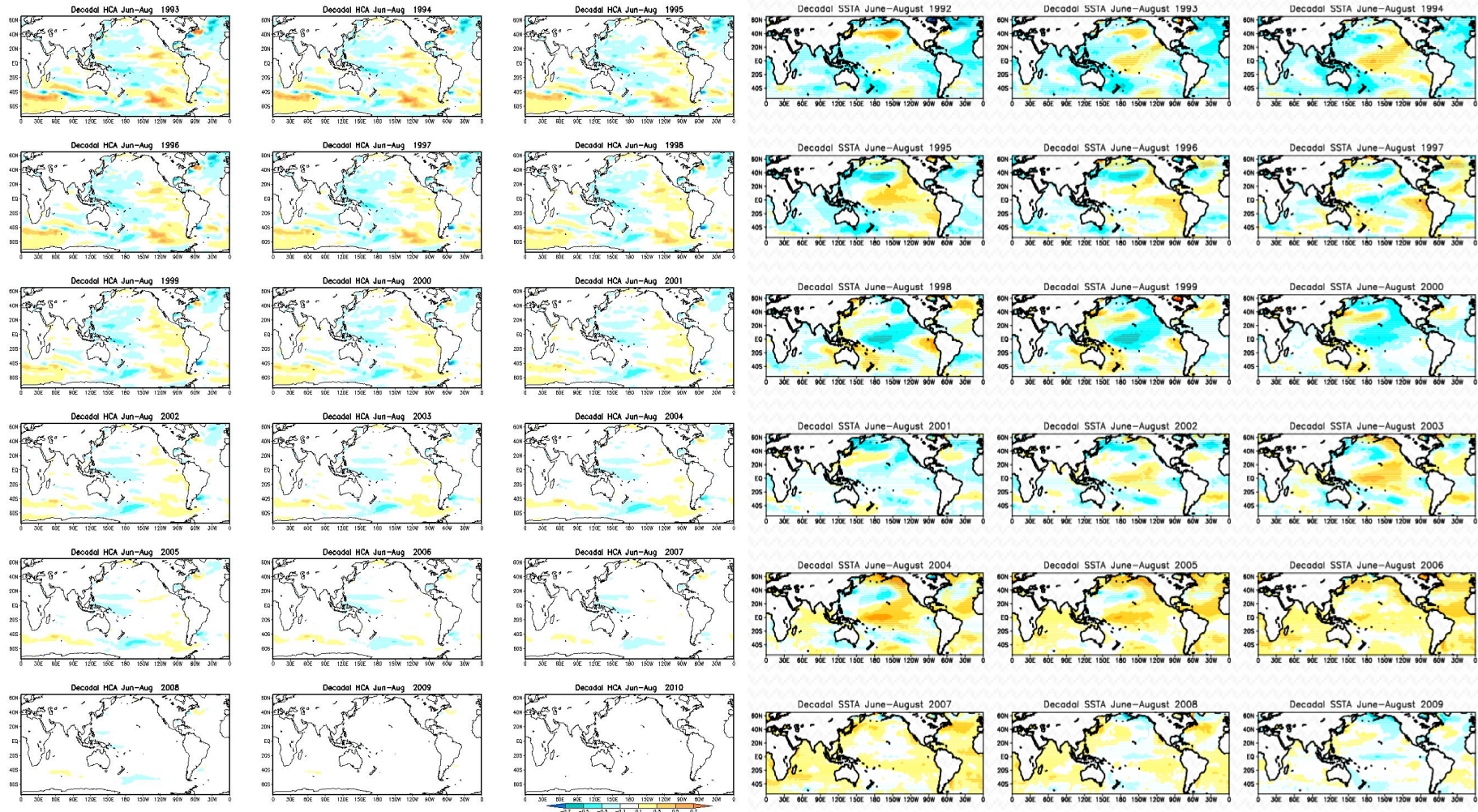
ENSO and ENSO Modoki with Relation to Decadal Pacific SST



West-East SST Difference Wavelet spectrum



Decadal changes in SSH and SST

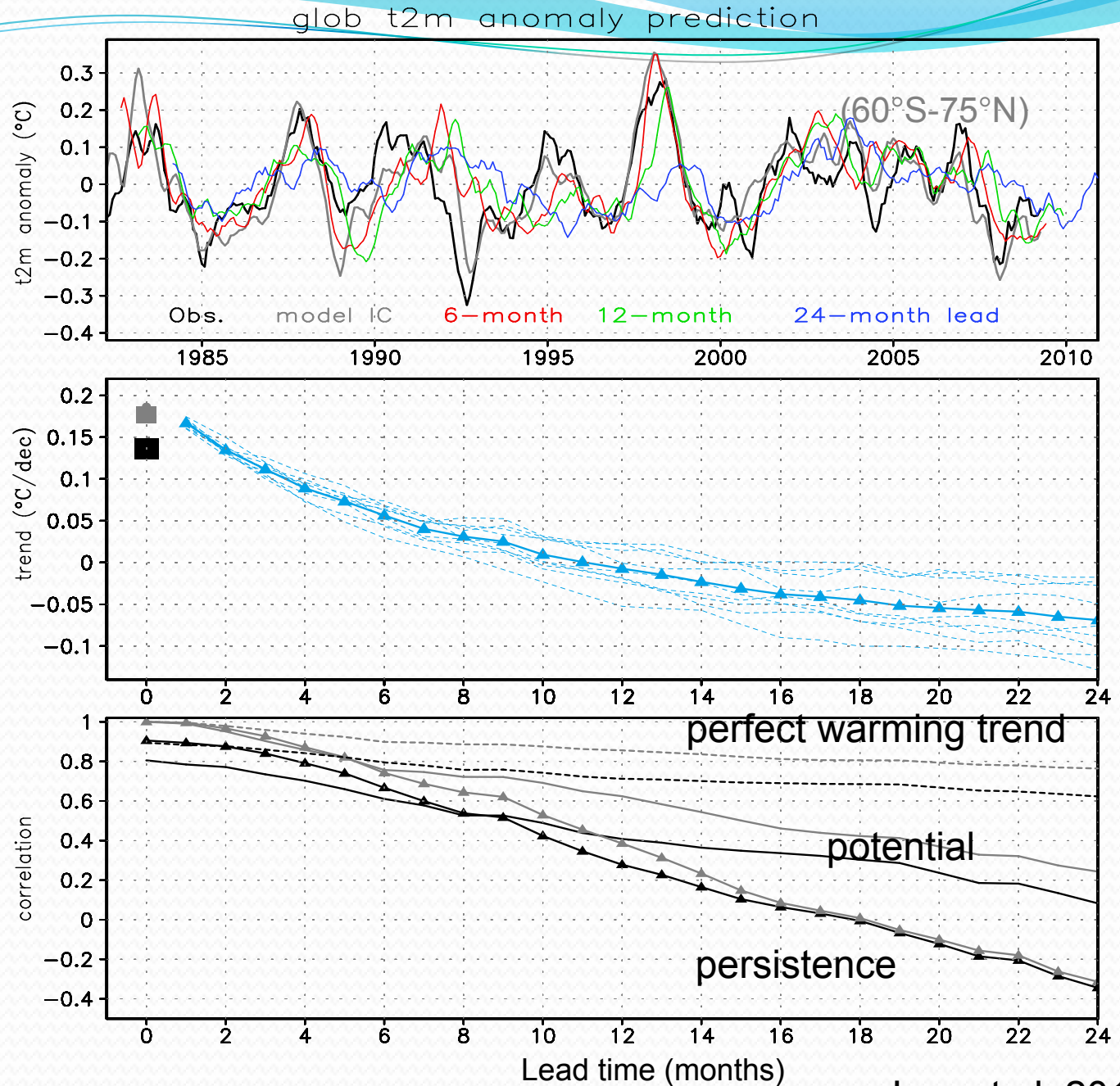


Role of Warming Trend on Seasonal-to-Interannual Global Climate Prediction

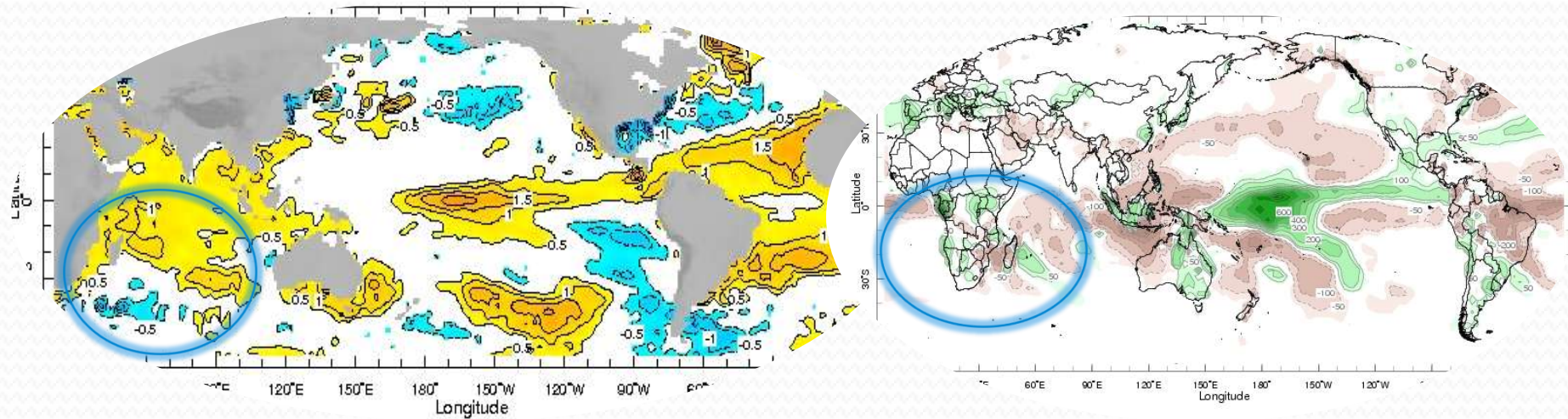
Detrended global mean surface air temperature (5-month running mean)

Trend (1982-2008)

Skills for original, detrended, and "perfect trend" time series

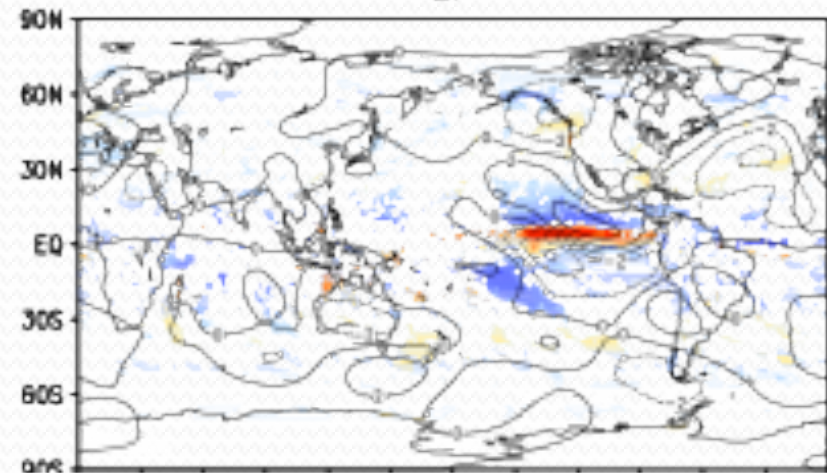
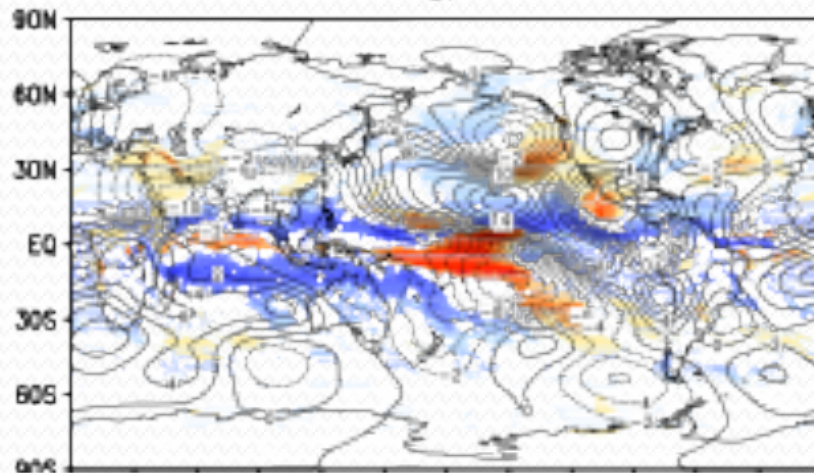


January-March 2010 Anomalies of SST and Rainfall

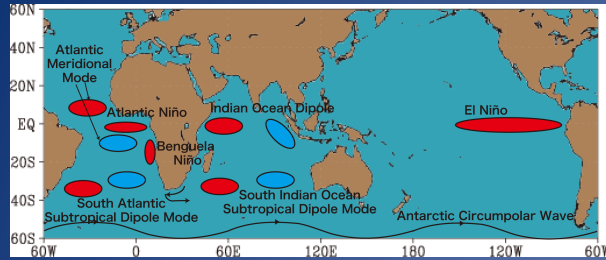
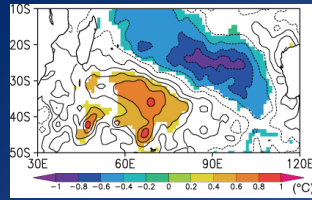


CP

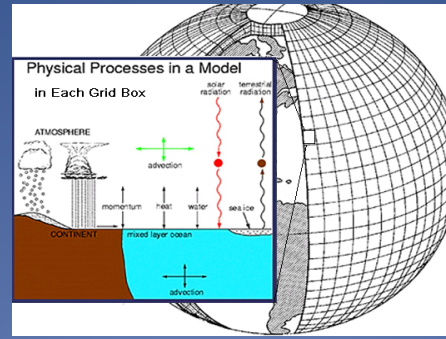
EP



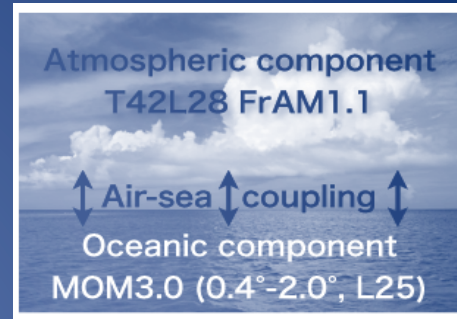
SATREPS South Africa Project



Evaluating Predictability



Global-scale climate prediction



Improving CGCMs



Network



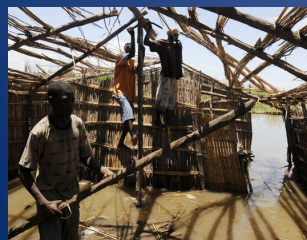
Regional climate prediction



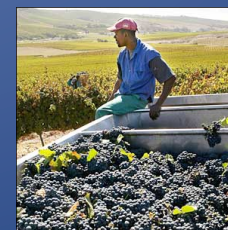
Science and Technology
Research Partnership for
Sustainable Development

JAMSTEC, U. Tokyo, ACCESS, U.
Cape Town, U. Pretoria, ARC, CSIR

Capacity of seasonal climate prediction in South Africa is enhanced so that it can be applied to management of environmental problems in the Southern African Region.



Improving
Early
Prediction
System



Summary

- The unusual summer conditions of 2009 were mainly caused by an unusual El Nino, which has warm SST anomalies over whole of tropical Pacific.
- The blend of El Nino and El Nino Modoki caused unusual rainfall in several parts of Asia.
- The prediction of Nino3.4 was affected at longer lead time as a result of the unusual event of 2009.
- It is important to understand decadal variations and warming trends for better predictability.