



**WCRP Workshop on Seasonal Prediction
4-7 June 2007, Barcelona, Spain**



IAP Dynamical Seasonal Prediction System and its applications

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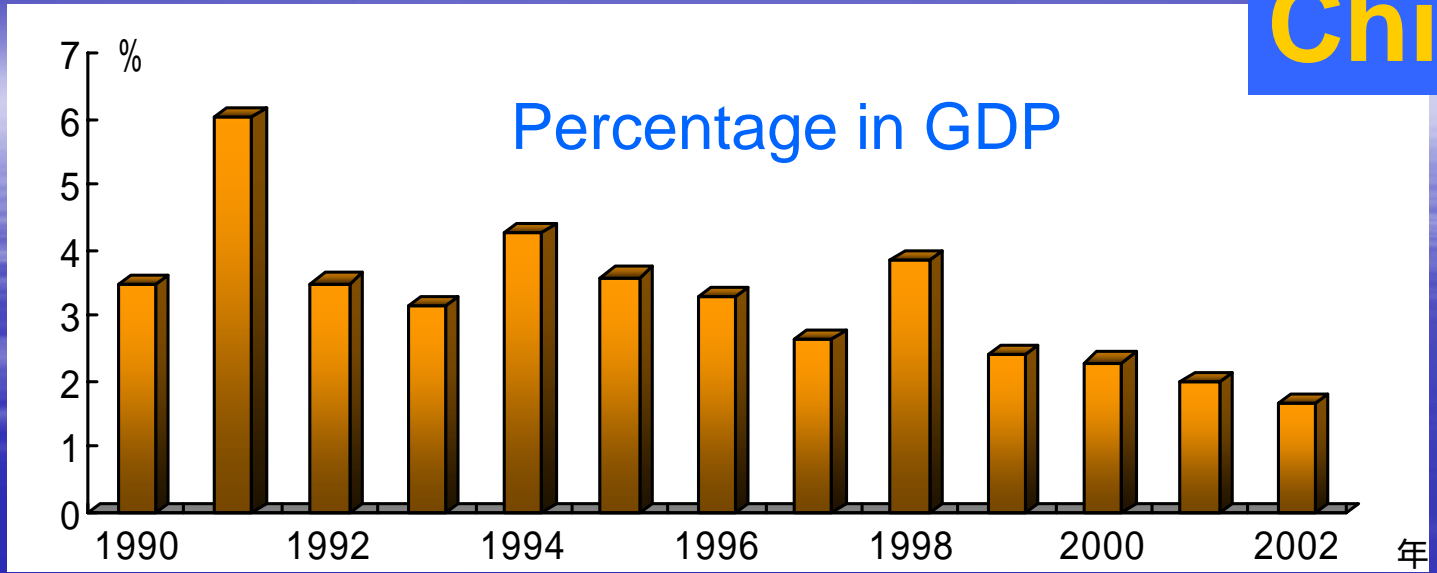
Outline

- **Introduction**
- **IAP Dynamical Seasonal Prediction System**
- **Hindcast experiments**
- **Real-time Prediction and verification**
- **Summary**

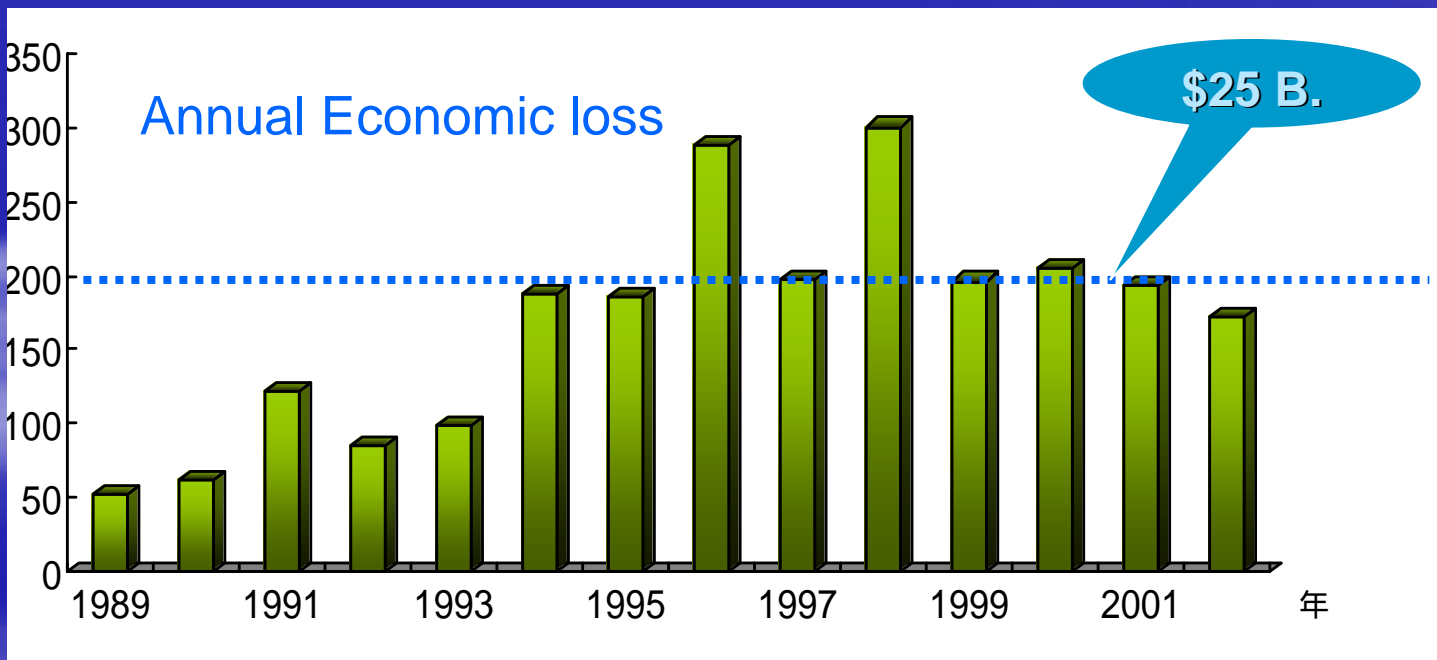
Economic loss caused by the climate disasters

China

Percentage



Chinese Yuan (Billion)



IAP Dynamical Seasonal Prediction System

- **First Extraseasonal Prediction by Numerical Climate Models in 1989**

Zeng et al., 1990

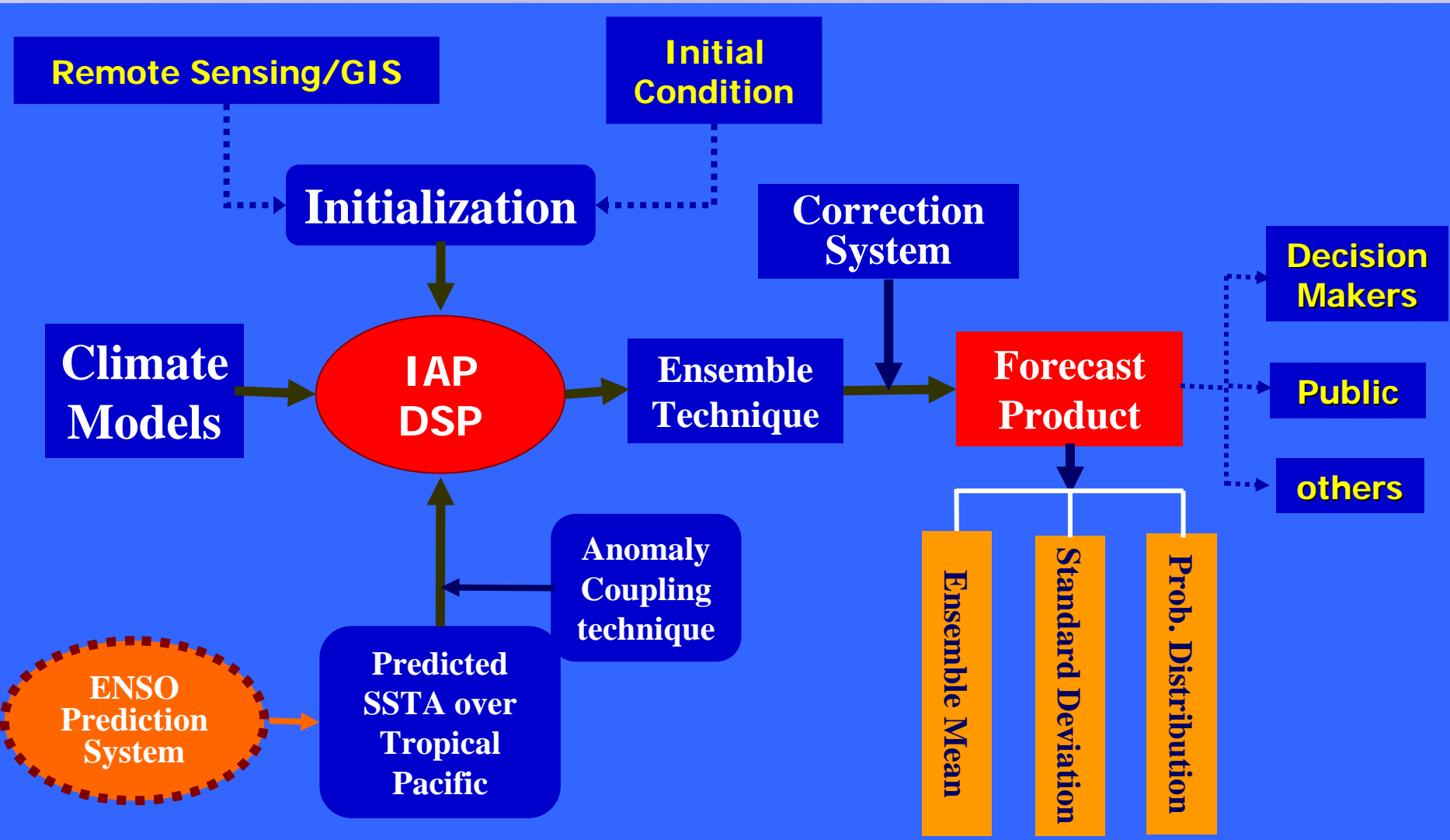
- **Establishment and improvement of IAP Dynamical Seasonal Prediction System**

e.g., Li, 1992; Zeng et al., 1994, 1995; Zeng et al, 1997;
Lin et al, 1998 ; Zhou et al. 1998, Zeng et al., 2003;
Chen et al, 2003 ...

- **Experimental Seasonal prediction of summer climate anomalies since 1990 by IAP DCP**

e.g., Zeng et al., 1990; Yuan et al., 1996; Zeng et al., 1997;
Lin et al., 1998, 1999, 2000; Zhou et al., 2001, ...

IAP Dynamical Seasonal Prediction System



Models:

- **Atmospheric General Circulation Models :**

1. **IAP AGCM-1.3 (2L, 2°x 2.5°)** (Zeng, Liang(Now in UIUC), Lin ..)
2. **IAP AGCM-2.0 (9L, 4°x 5°)** (X.Z. Liang and X.Q Bi, Lin, Zhang, ..)
3. **IAP AGCM-3.0 (21L, 2°x 2.5°)** (Zeng, Zuo,)

- **Coupled Tropical Pacific – Global Atmosphere CGCM** (Zeng QC, R.H. Zhang, G. Q., Zhou):

Tropical Pacific Ocean General Circulation Model

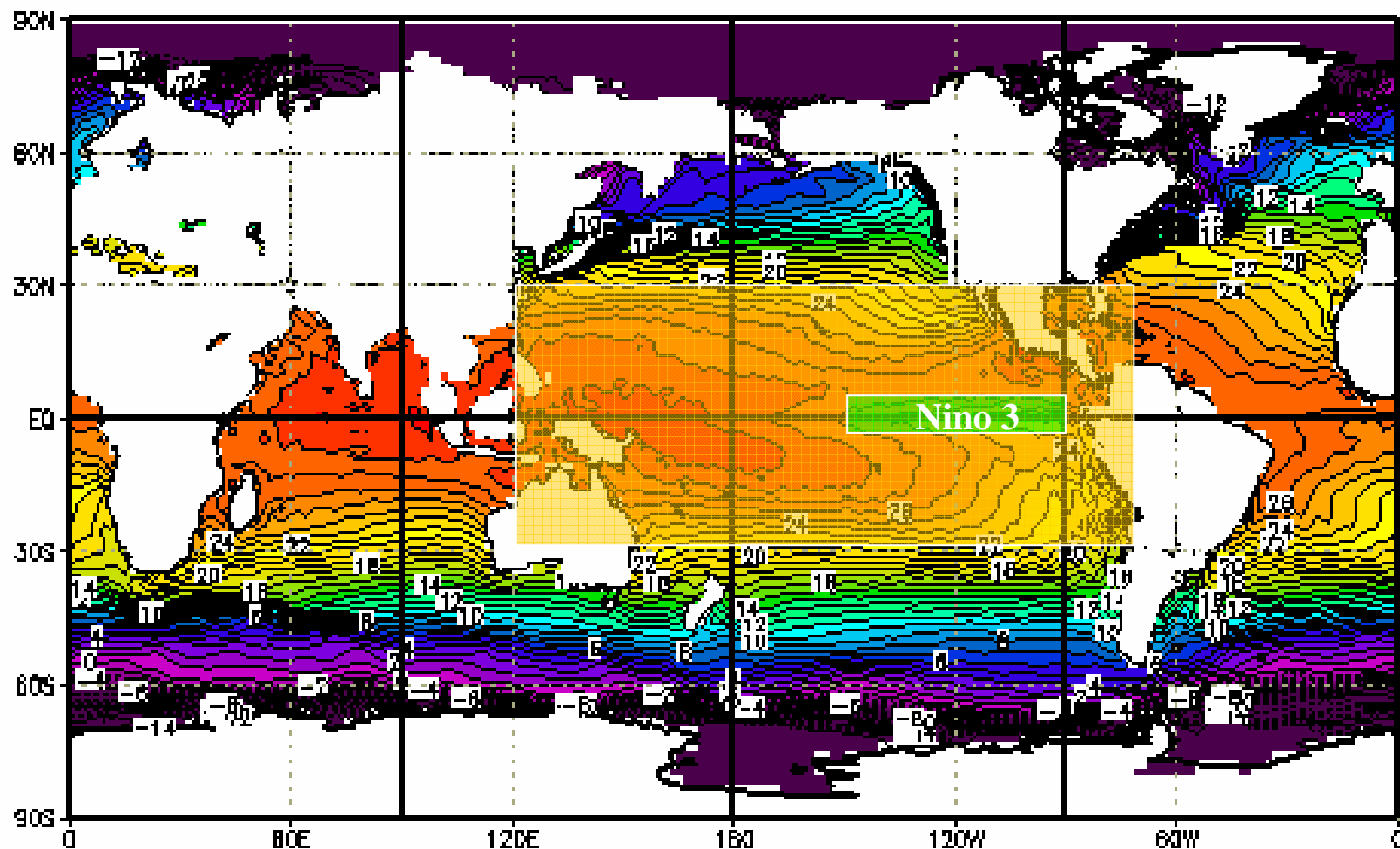
Region: 120°E - 70°W, 30°S - 30°N

Horizontal Resolution: 1° x 2°

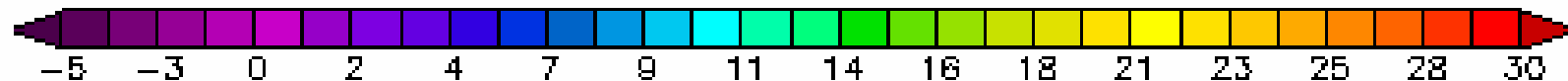
Vertical: Unequal 14 Layers from Surface to 4000m Depth

9 Layers in the Upper 240m

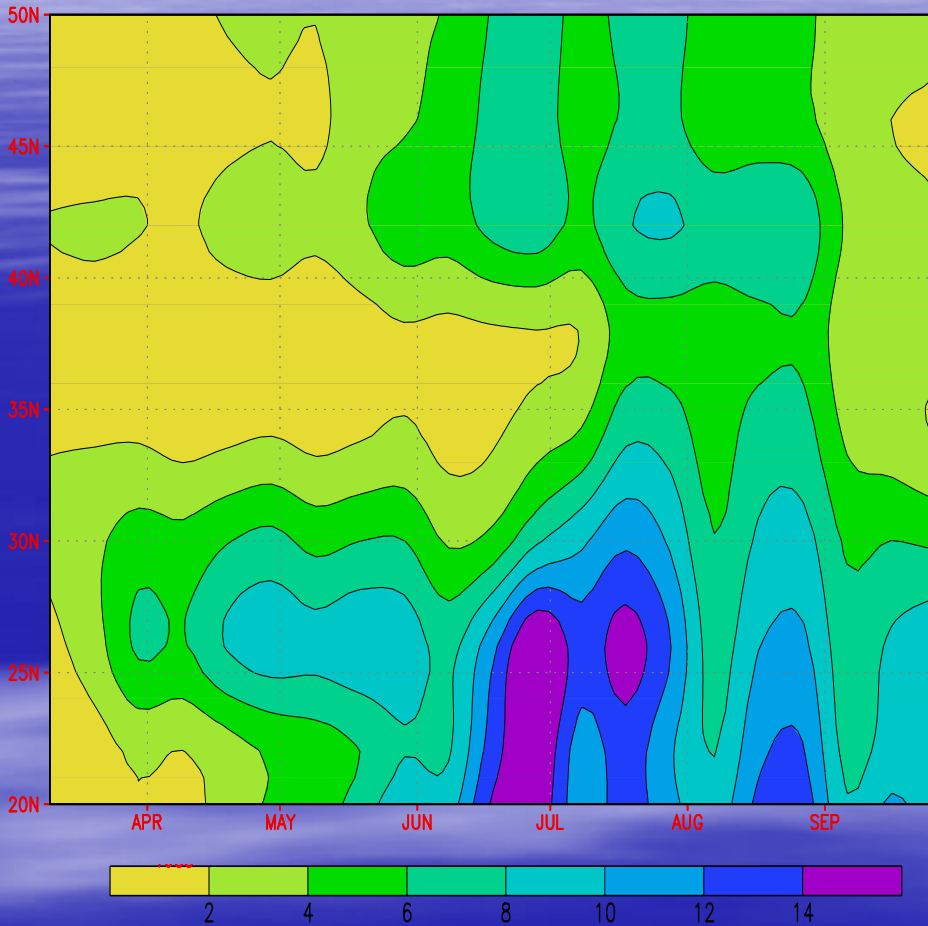
NCEP/NCAR Reanalysis



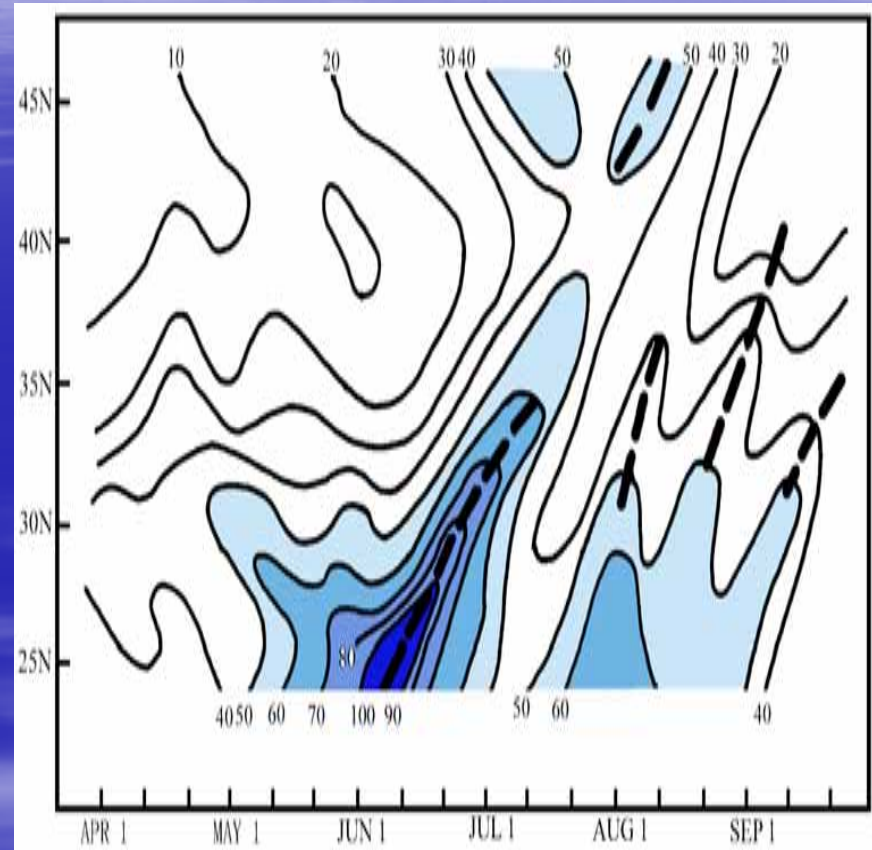
Sea Surface Temperature (C) Long-term Mean
Jan to Dec: 88-98 LTM



Latitude-time cross section of the 10-day precipitation over Eastern China

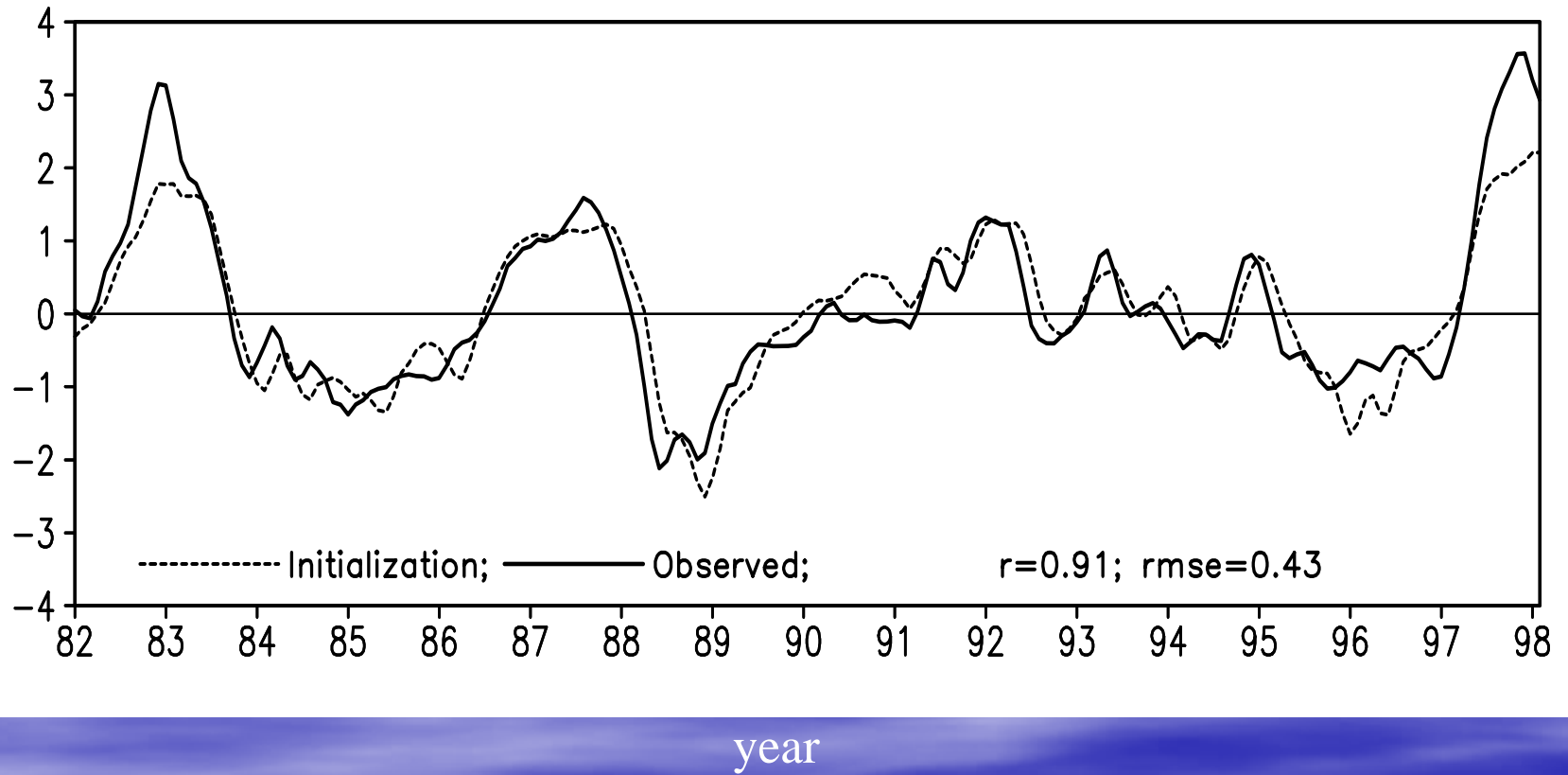


Simulation
(110E-130E)

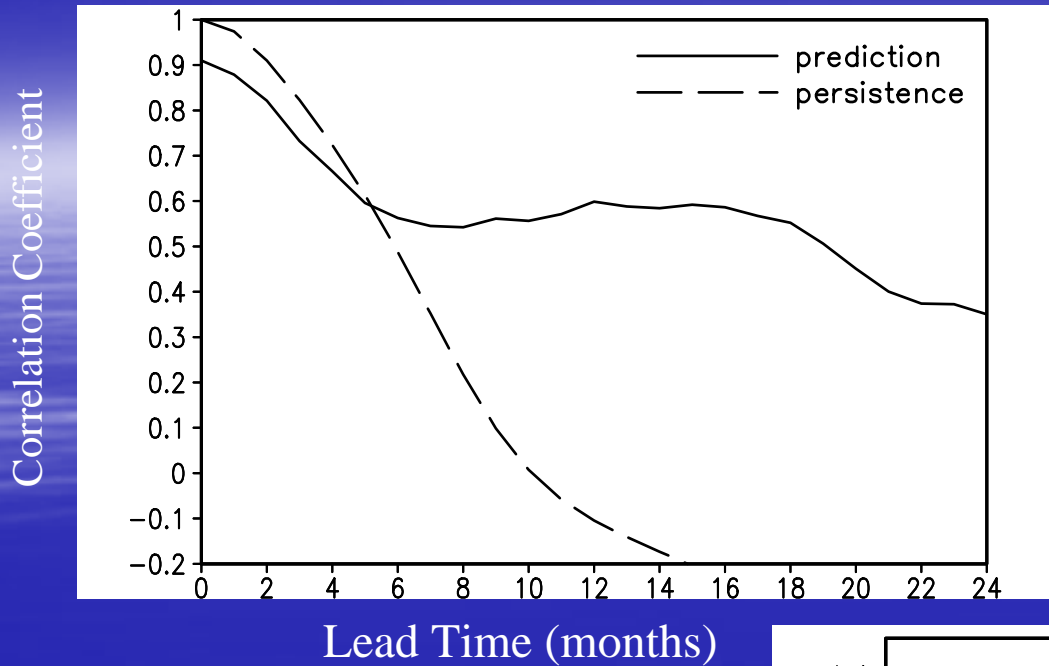


Observation

SSTA for Nino 3



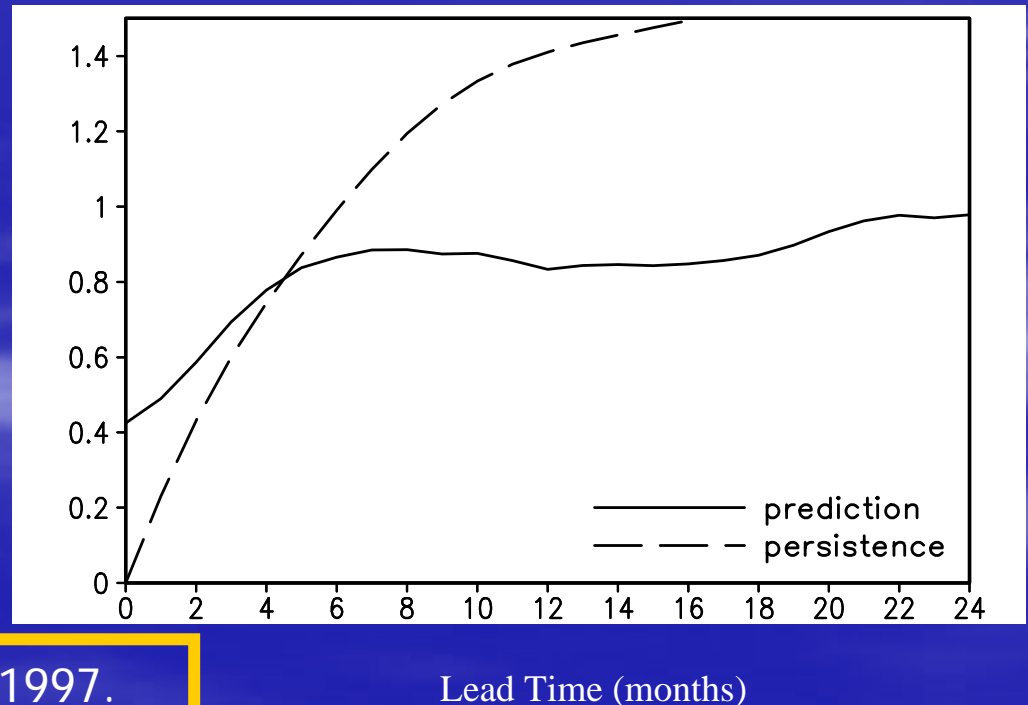
Comparison for the Initialized SSTA and Observed SSTA



Corr. Coef. Between Forecasts (Model and Persistence) and Observation for Nino3 SSTA

Lead Time (months)

RMS Error (°C) in Nino 3

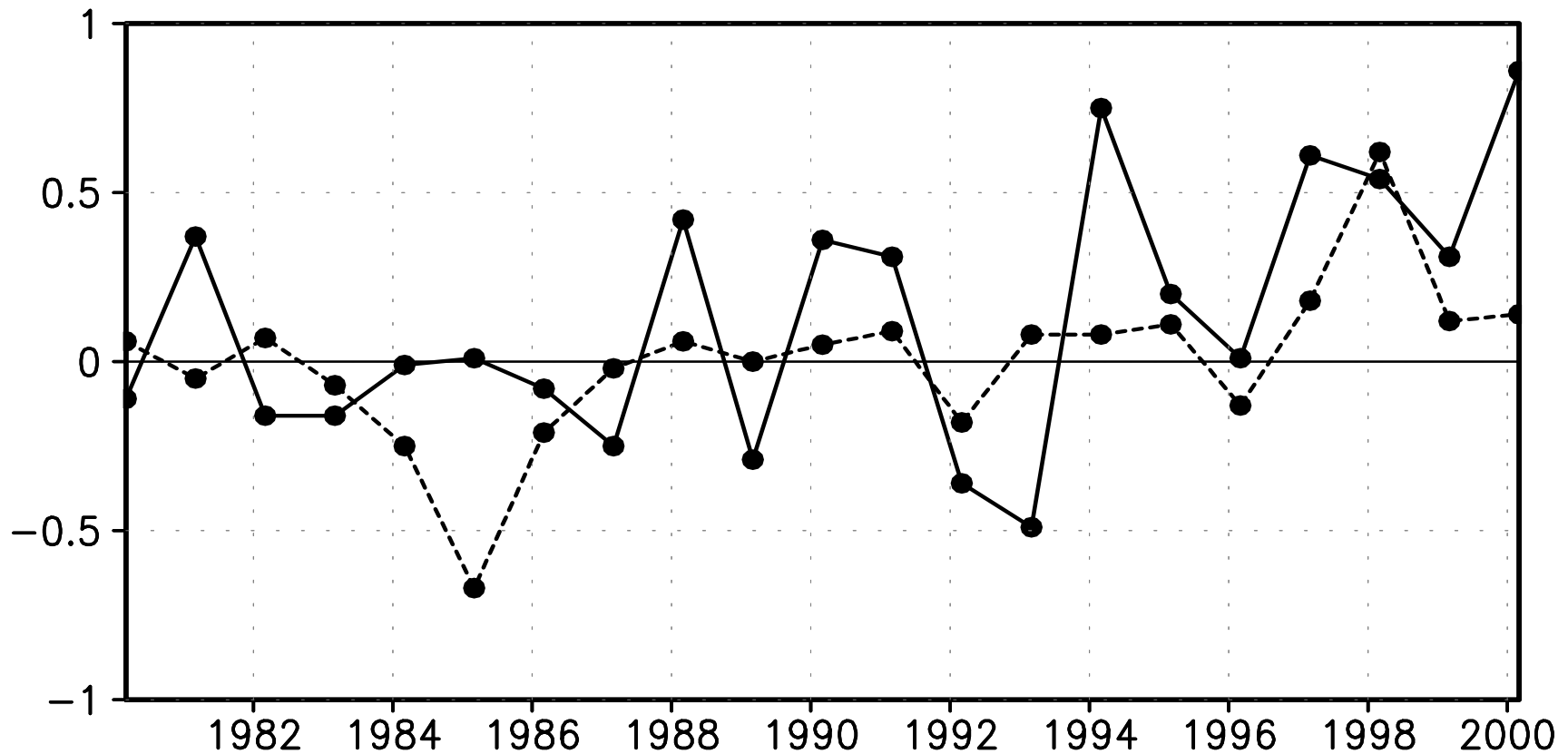


Lead Time (months)

Hindcast period: Nov. 1981 to Dec. 1997.

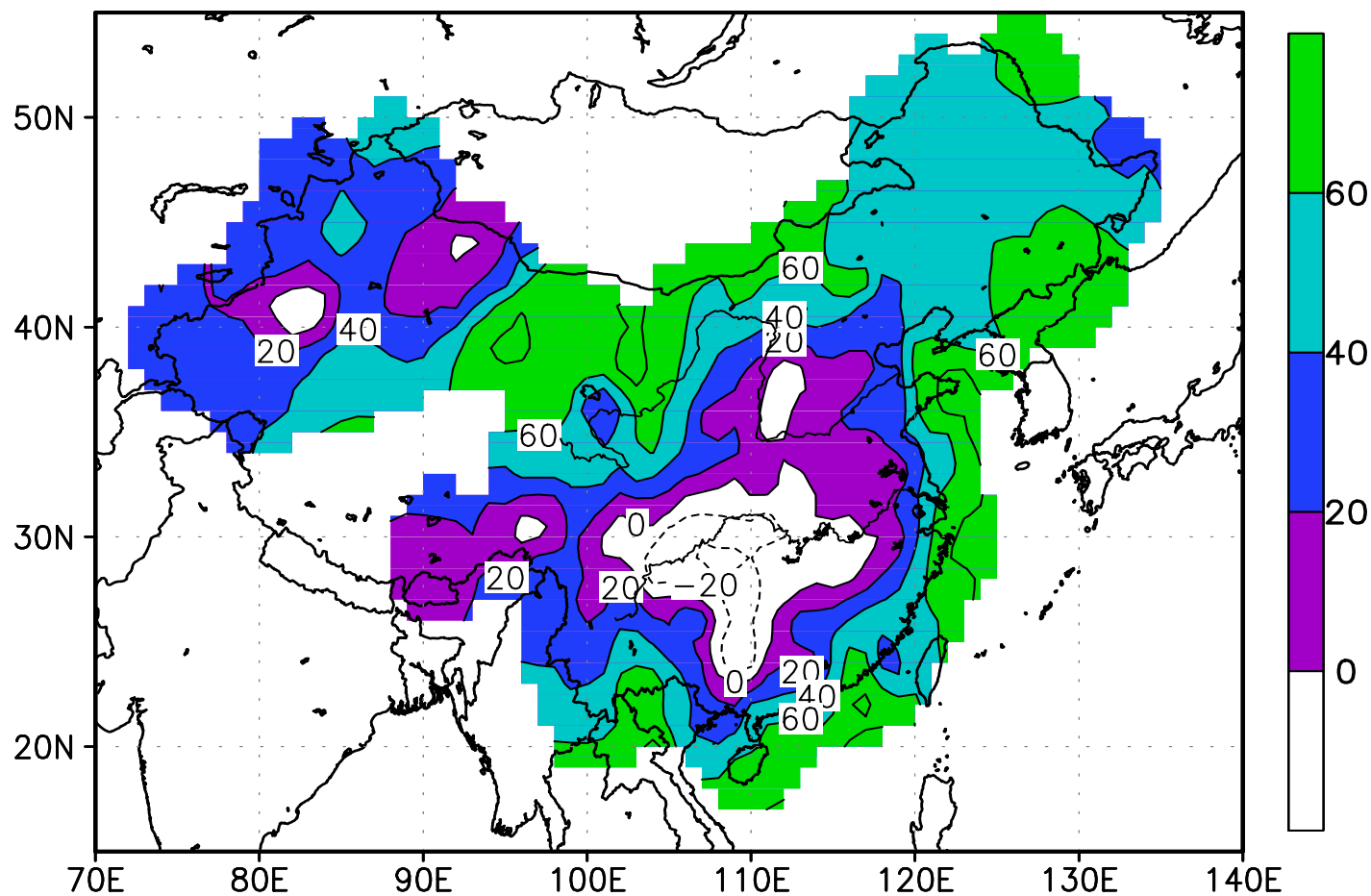
Observed(solid) and Hindcast(dashed) summer temperature anomalies over China

Upper: Initiated from Feb.; Lower: Initiated from preceding October



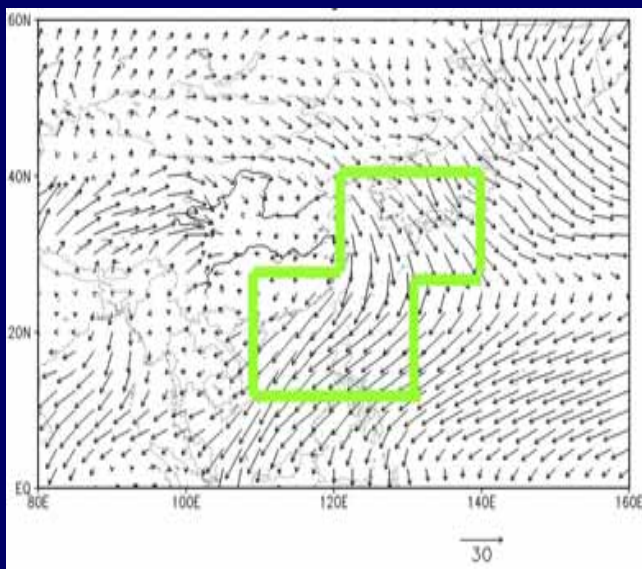
ACC for JJA temperature between observation and hindcast results (initiated from Feb) by IAP DCP.

ts coef. in JJA (2x2.5, ini_feb)



East Asian Winter Monsoon Index (EAWMI)

- Averaged v component over the area from the East China Sea to the South China Sea (10-25N , 110-130E) and (25-40N,120-140E)



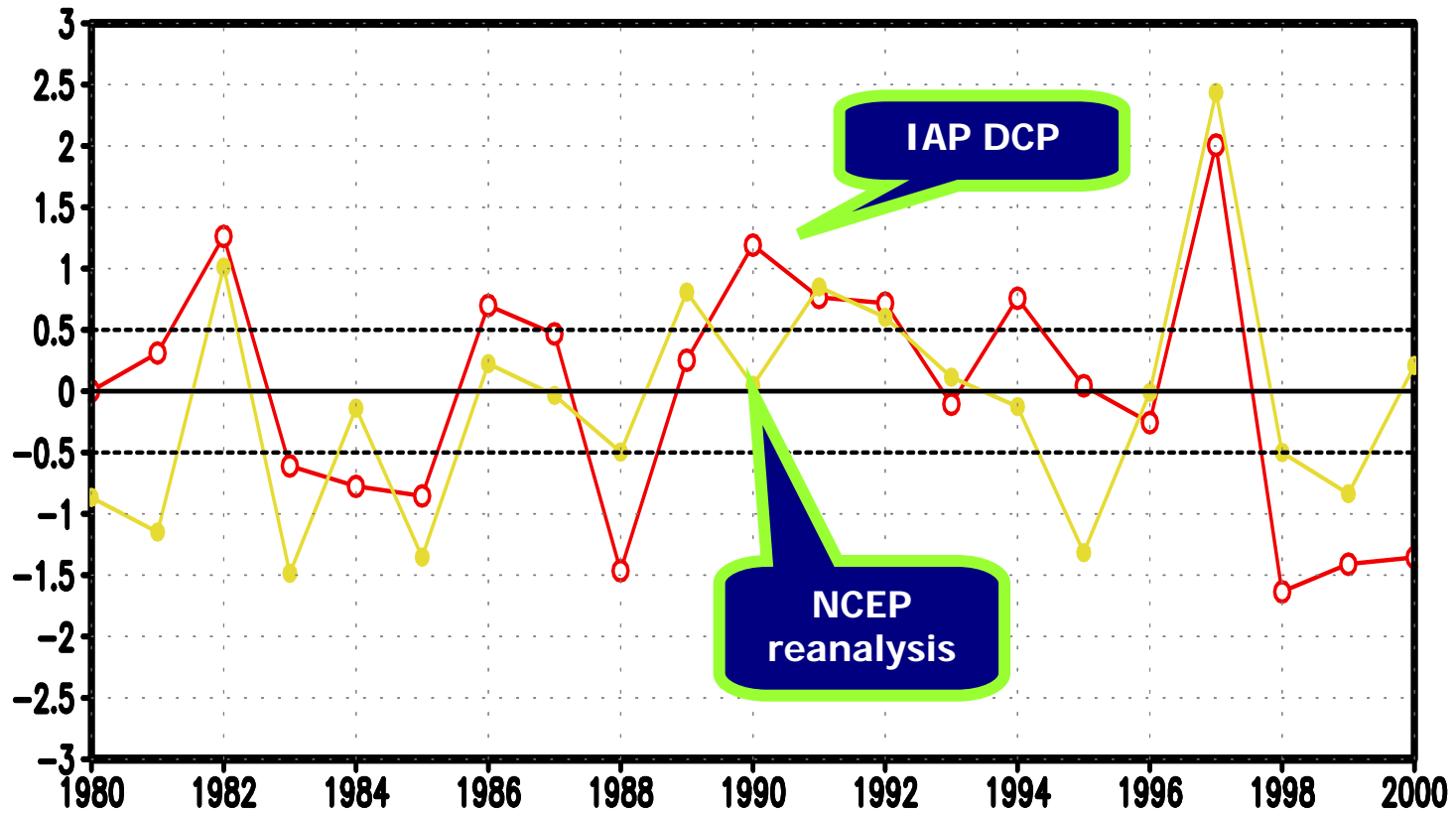
Averaged over December to February for the calculation of EAWMI

$$EAWMI = \frac{(V_i - \bar{V})}{|\bar{V}|}$$

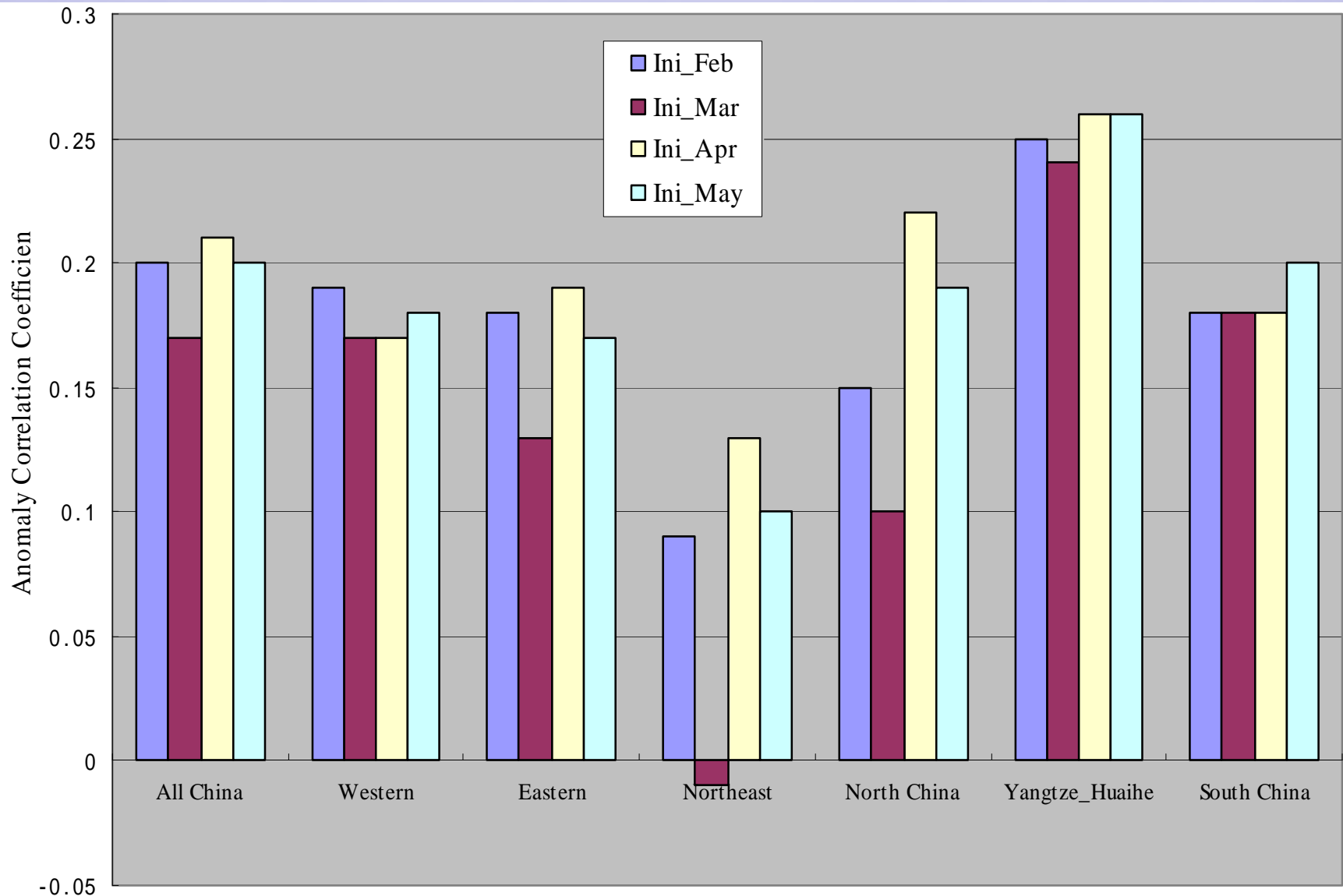
Normalized Index:

$$EAWMI = \begin{cases} I \geq 0.5 & \text{Weak winter Monsoon} \\ -0.5 \leq I \leq 0.5 & \text{Normal winter Monsoon} \\ I \leq -0.5 & \text{Strong winter Monsoon} \end{cases}$$

Normalized inter-annual variation of EAWMI averaged for DJF for NCEP reanalysis (Light grey with closed circle) and for hindcast experiment results by results by IAP DCP (Red with open circle) from 1980-2000

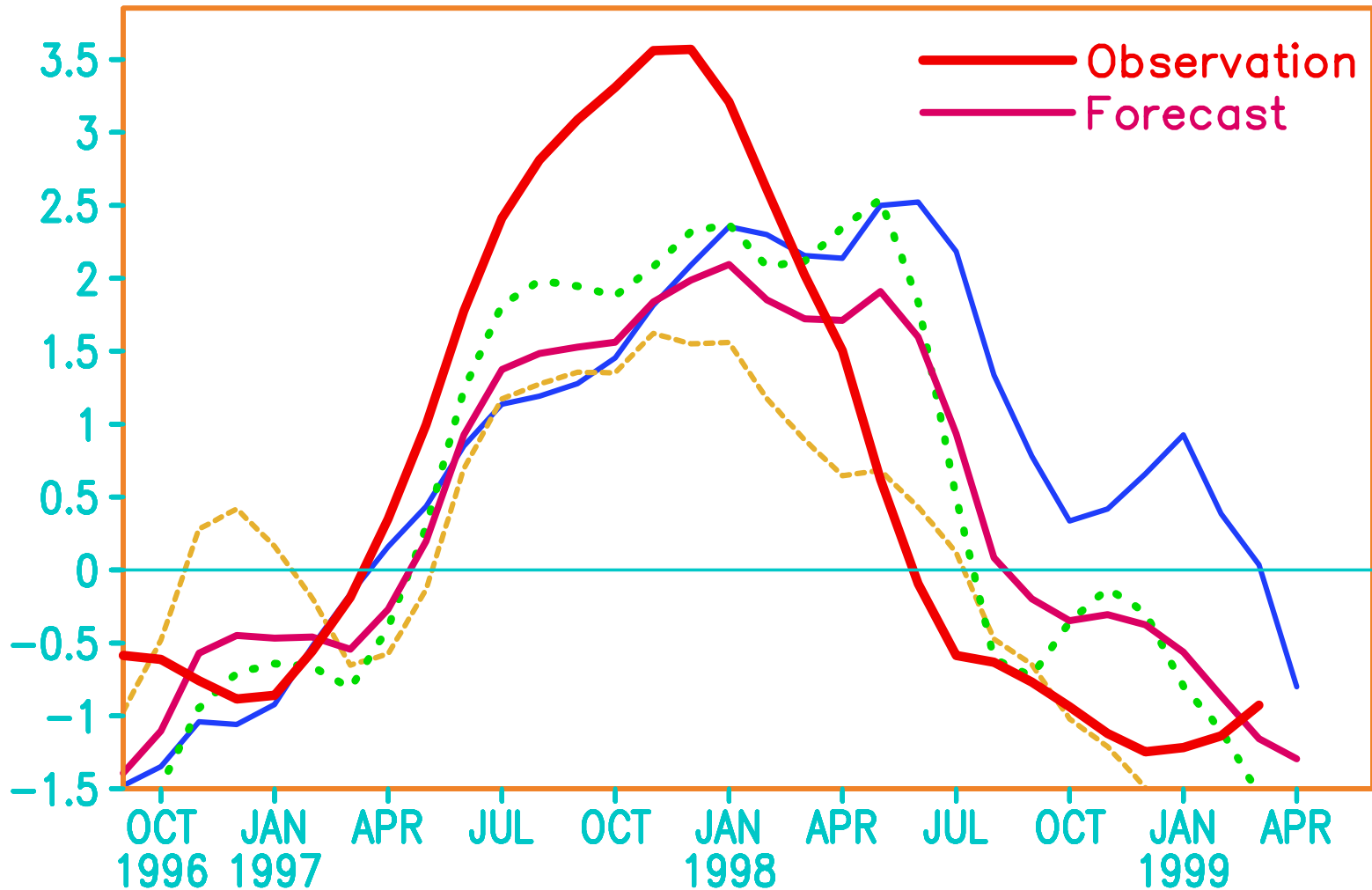


Comparison of ACC for JJA precipitation between observation and prediction by IAP DCP initiated from Feb., Mar., April and may respectively

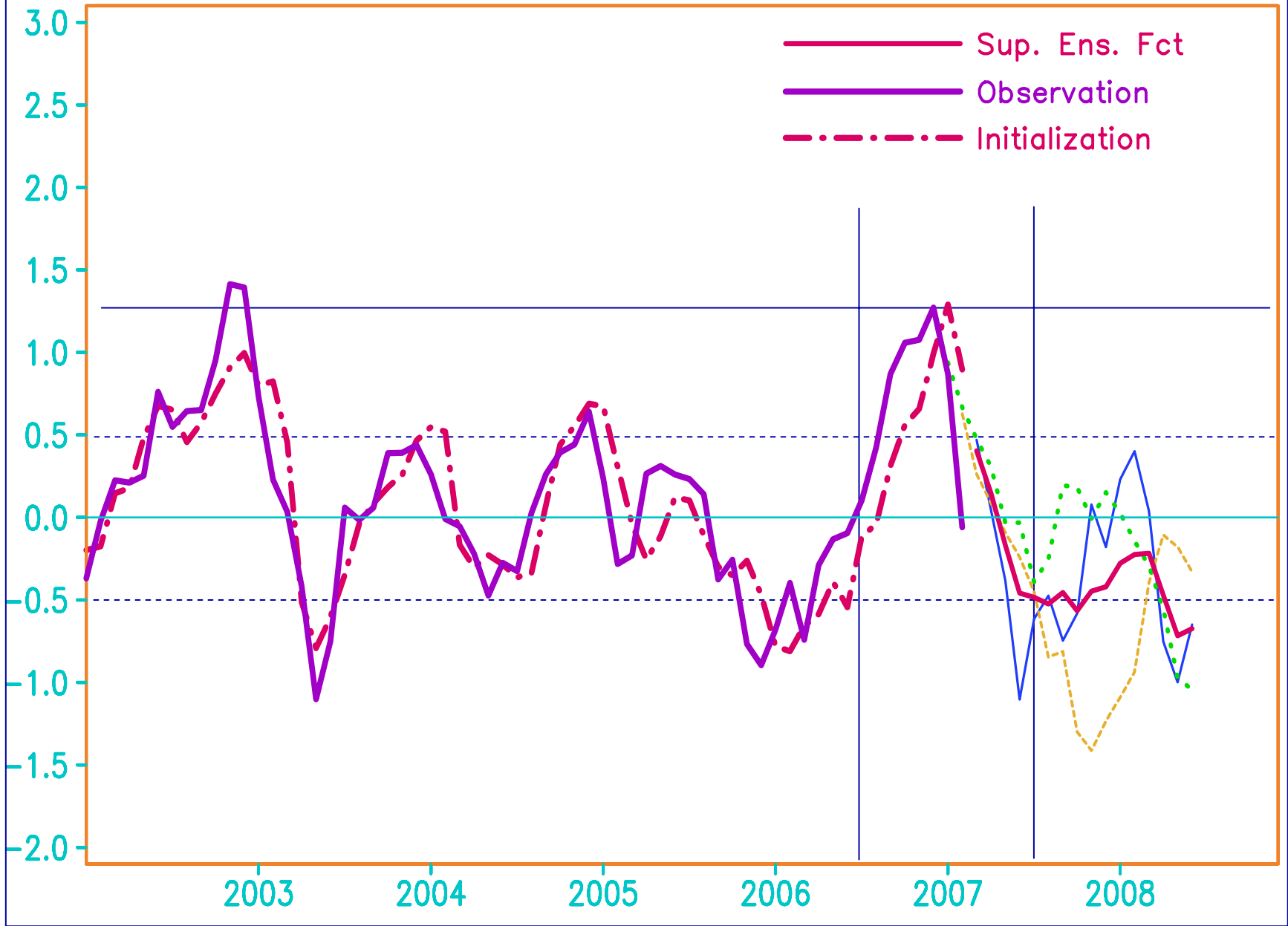


Observed and predicted SST Anomaly in Nino3

IAP/CAS CGCM: Predicted SSTA In Nino 3



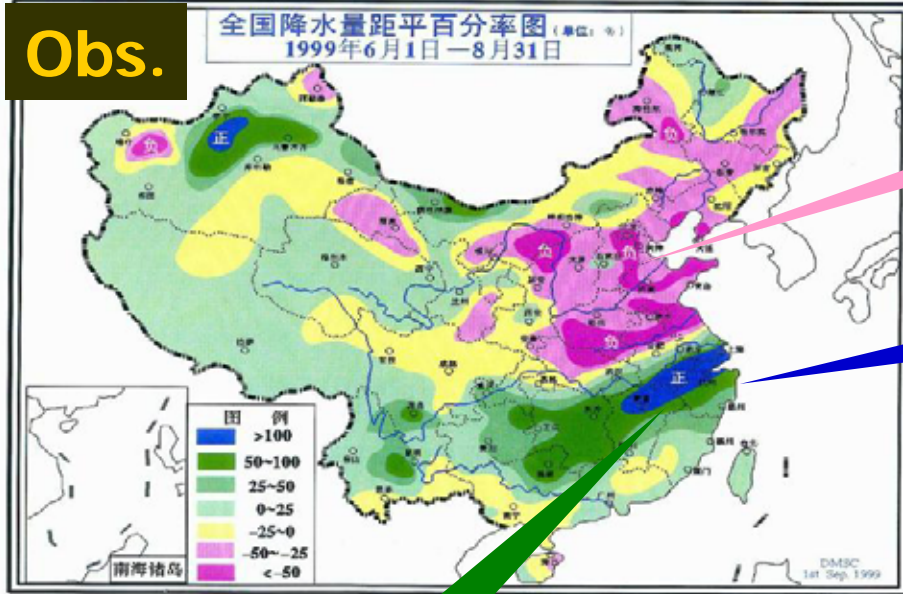
IAP/CAS CGCM: Predicted SSTA in Nino 3



Summer rainfall prediction

Percentage Summer Rainfall Anomaly for 1999

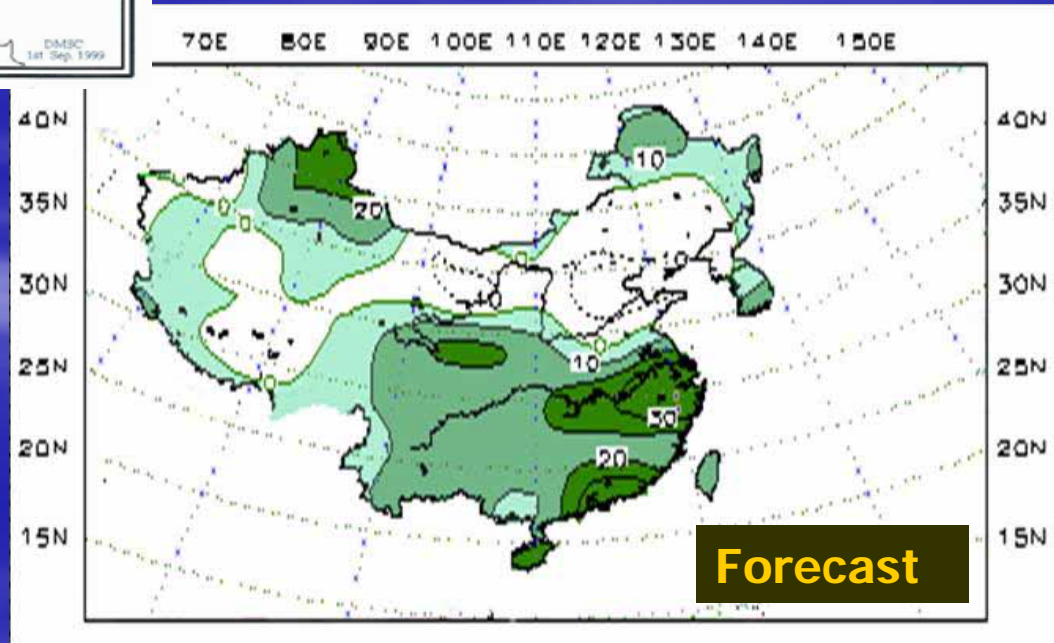
Obs.



Drought over North China

Flood over Middle and lower reach of Yangtze river valley

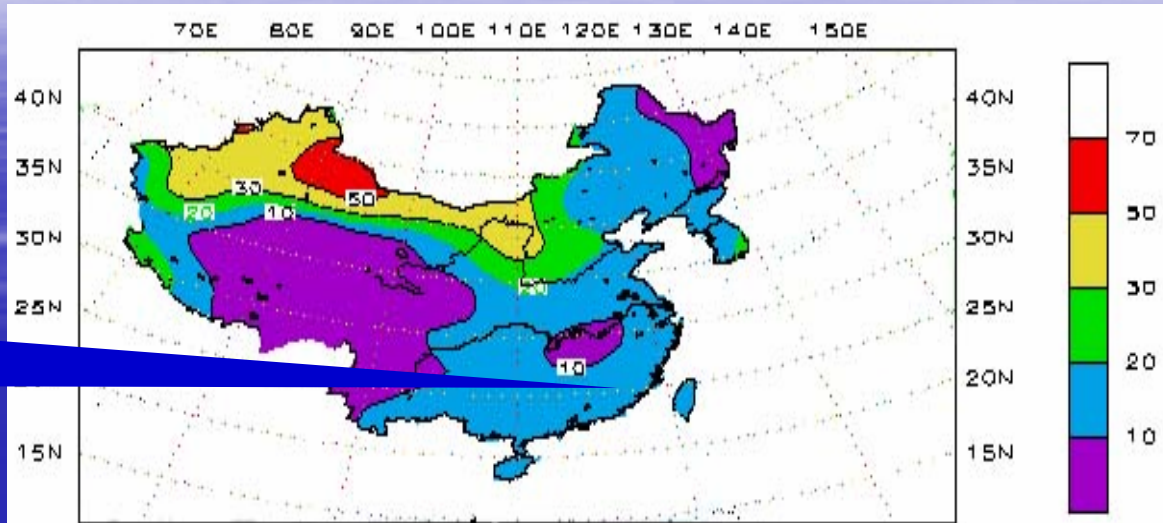
Positive Rainfall anomaly over Southern China



Summer rainfall prediction

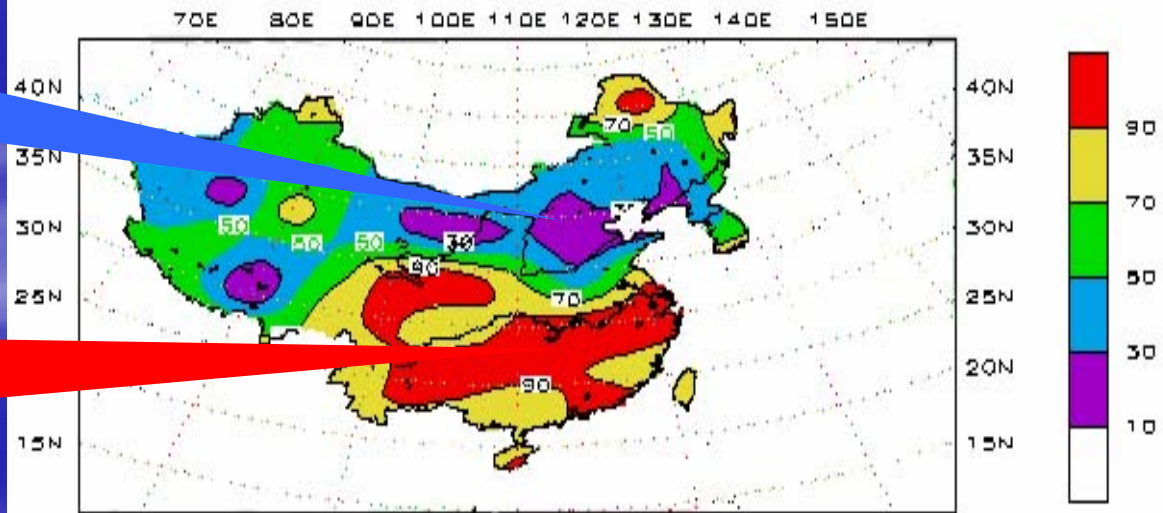
Standard Deviation and Probability Distribution for Ensemble Prediction

Small in Eastern and Southern China



SD

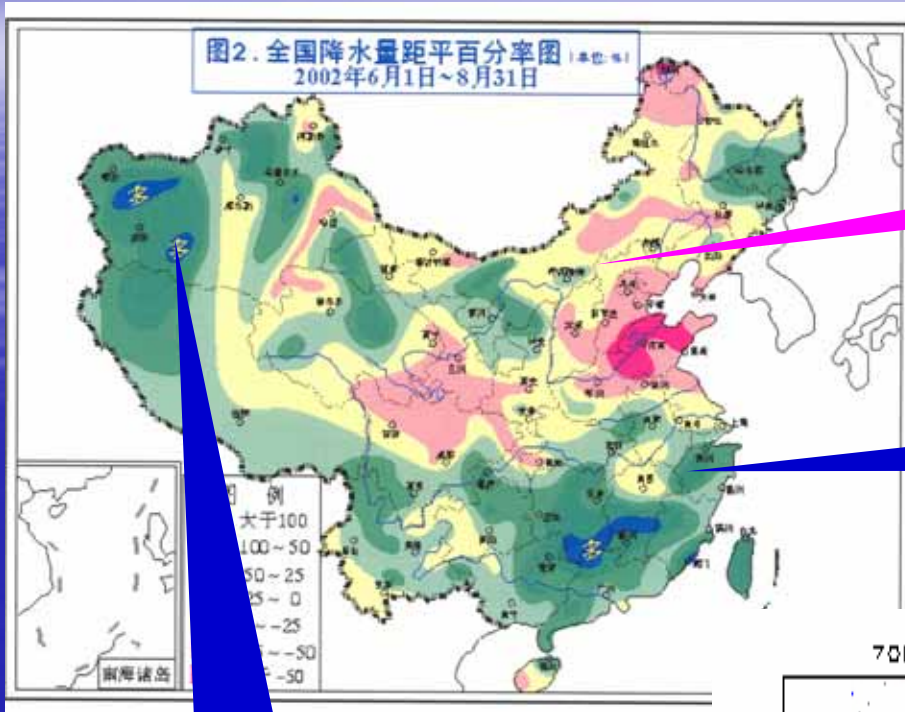
Large probability for negative rainfall anomaly over North China



$P(+)$

Large probability for positive rainfall anomaly over South China

Percentage Summer Rainfall Anomaly for 2002

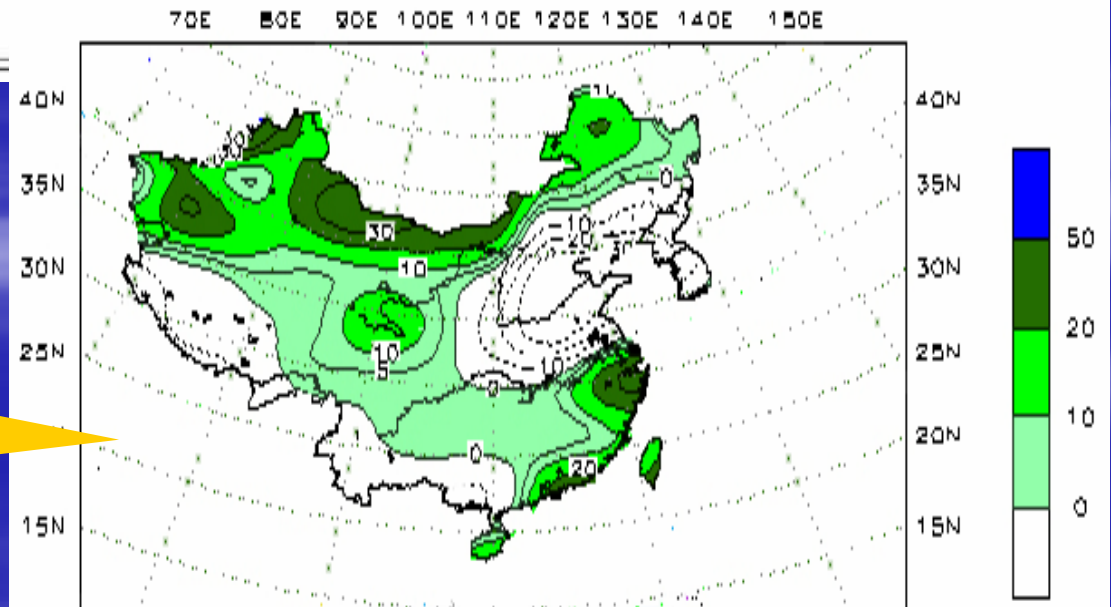


Drought conditions remain over most part of North China

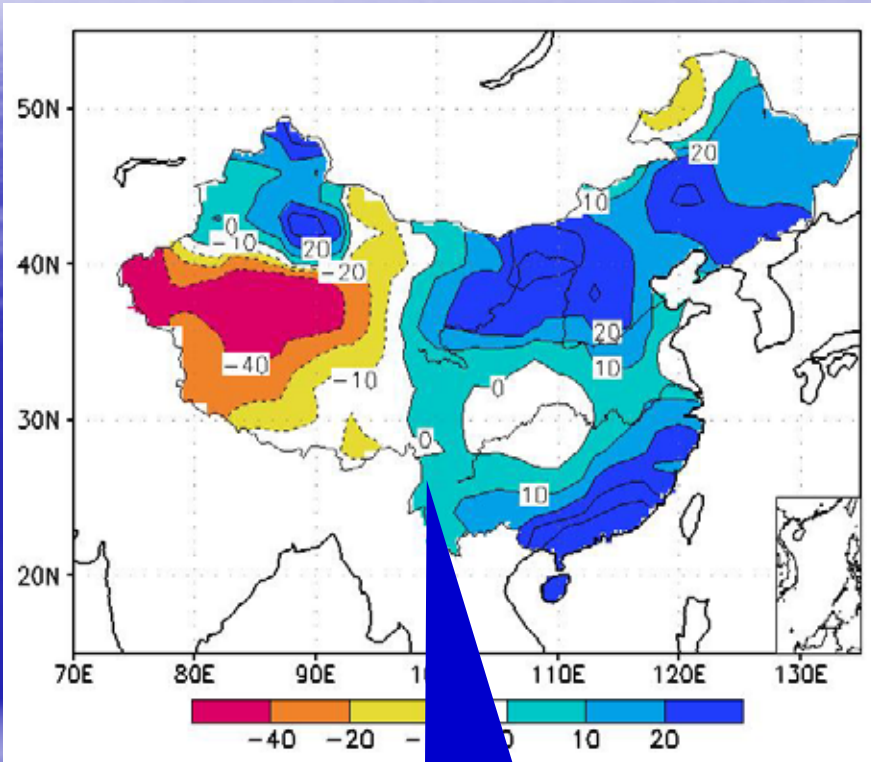
Positive rainfall anomaly over lower reach of Yangtze River

Positive rainfall anomaly over Northwest China

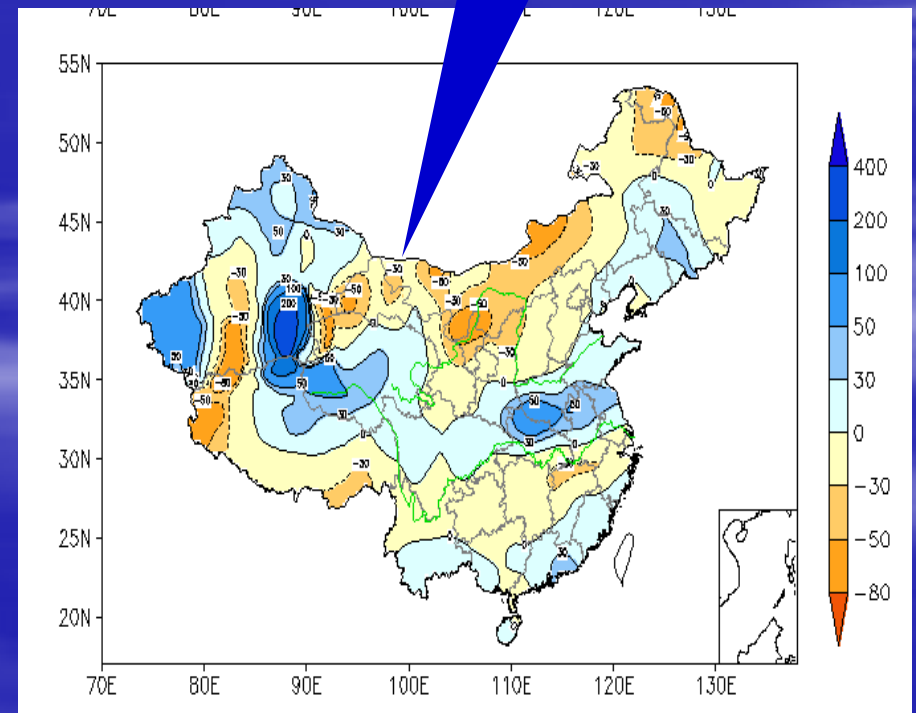
Predicted by IAP AGCM1.3



Percentage Rainfall Anomaly (JJA, 2005)

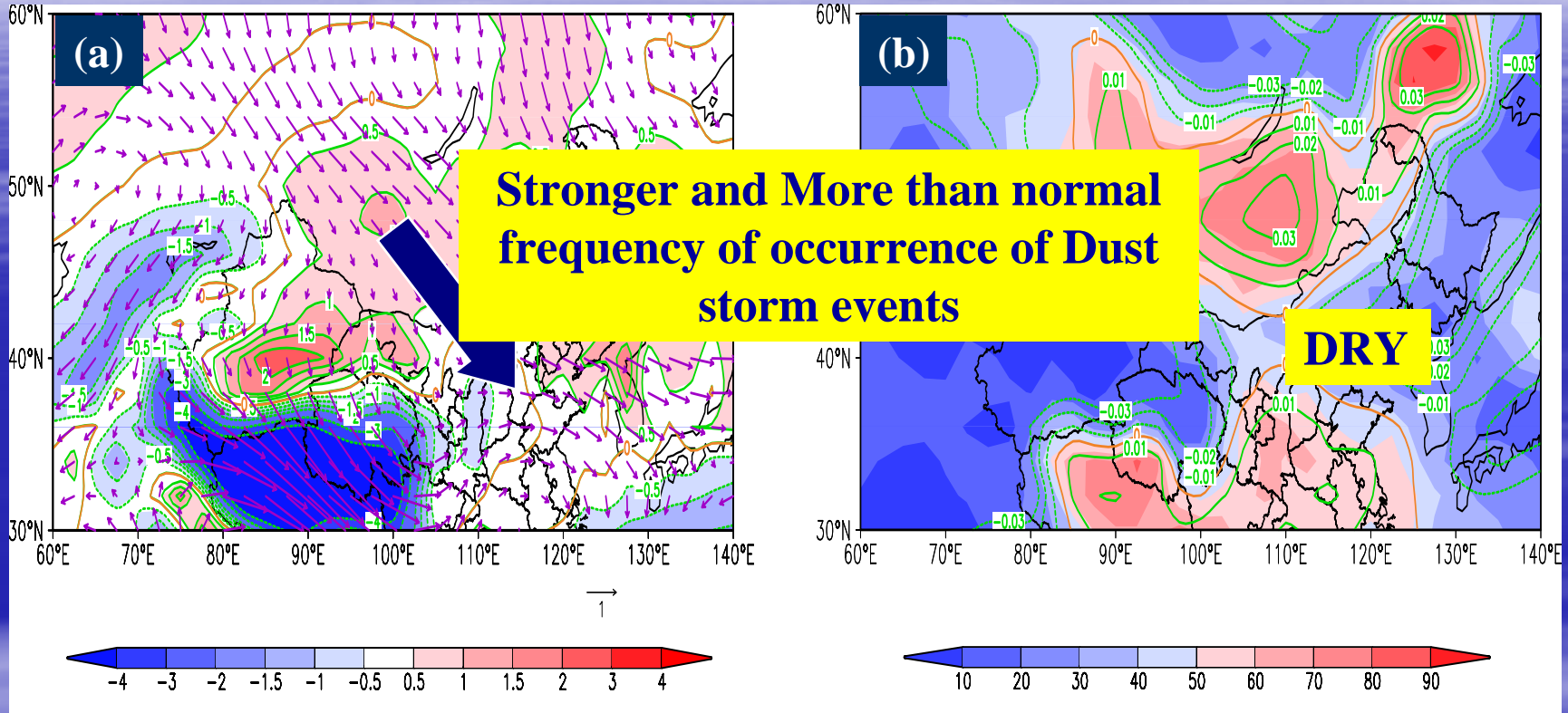


Observation



Prediction

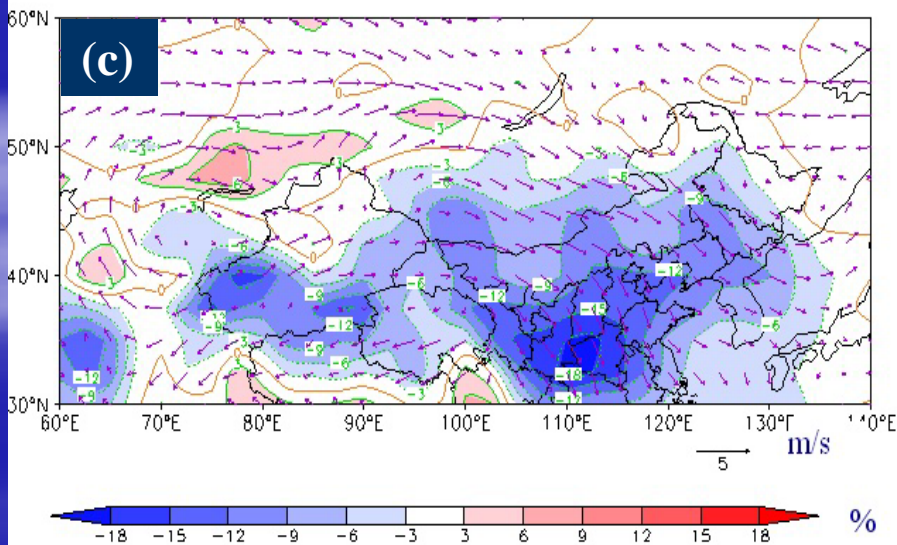
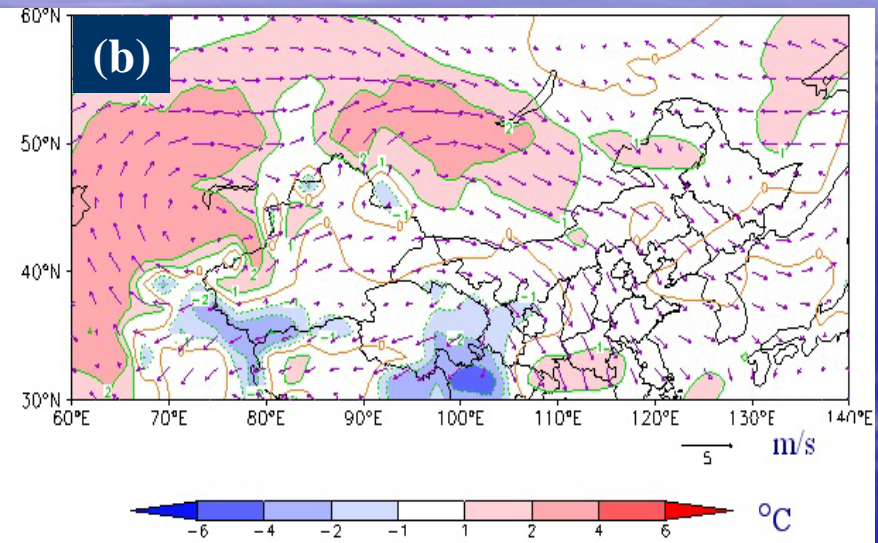
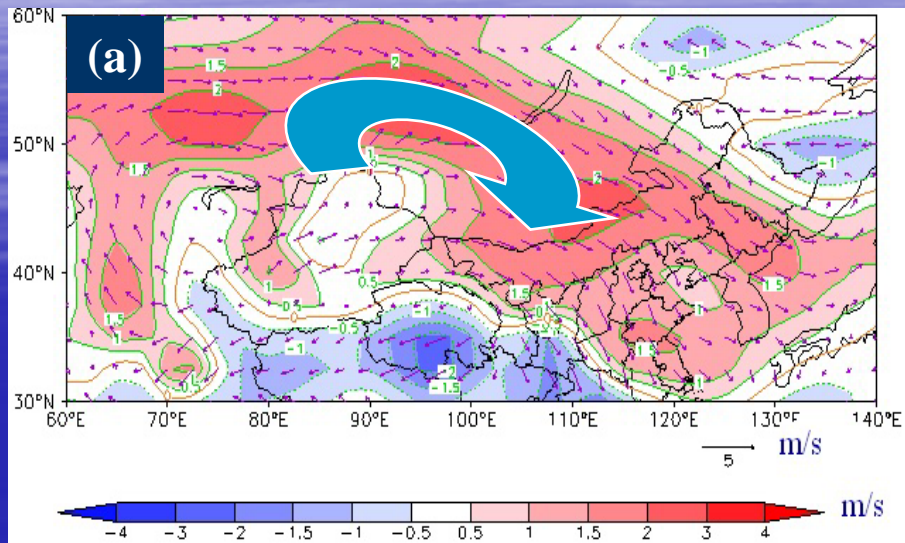
Prediction by IAP DCP (Mar. & Apr. of 2001)



(initiated from Oct. 2000)

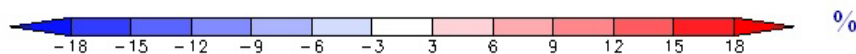
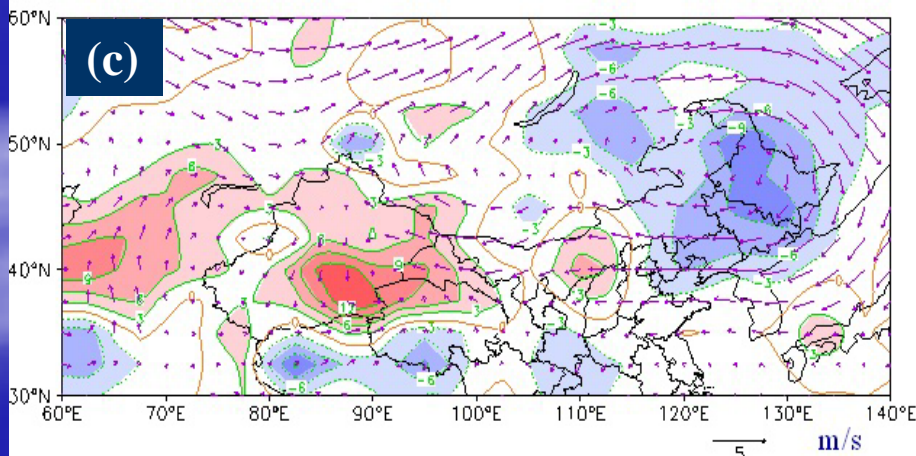
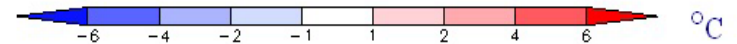
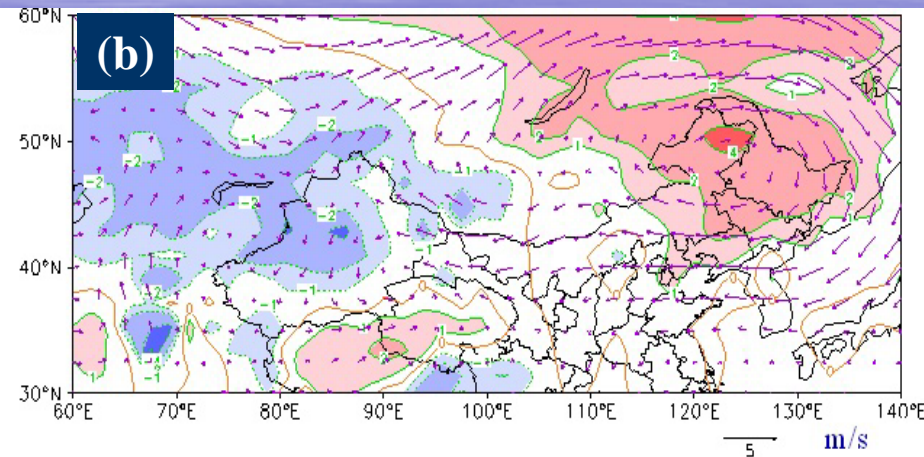
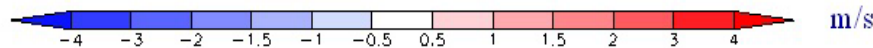
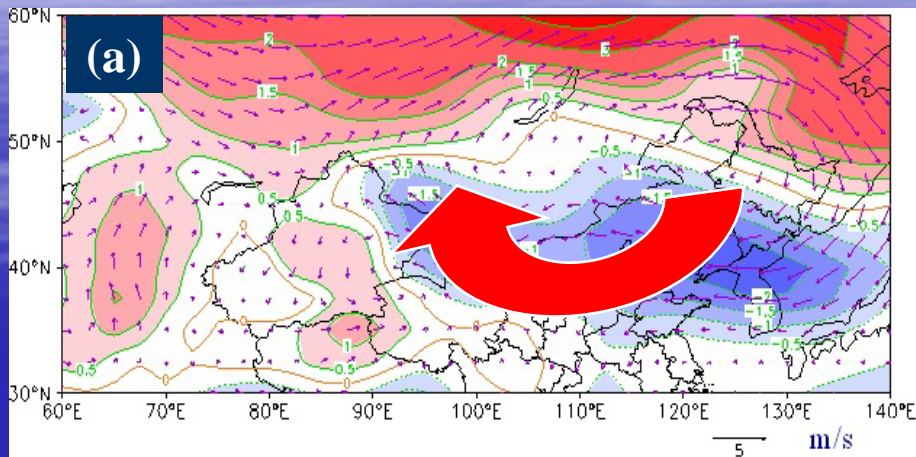
- (a) 850hpa wind vector and wind speed anomalies (red: positive anomaly, blue: negative anomaly).
- (b) Soil wetness anomalies and the probability for positive soil moisture anomalies (red: >50%, blue: <50%)

Observed springtime climate anomalies over East Asia (March & April, 2001) (Frequent and stronger dust-storm activities)



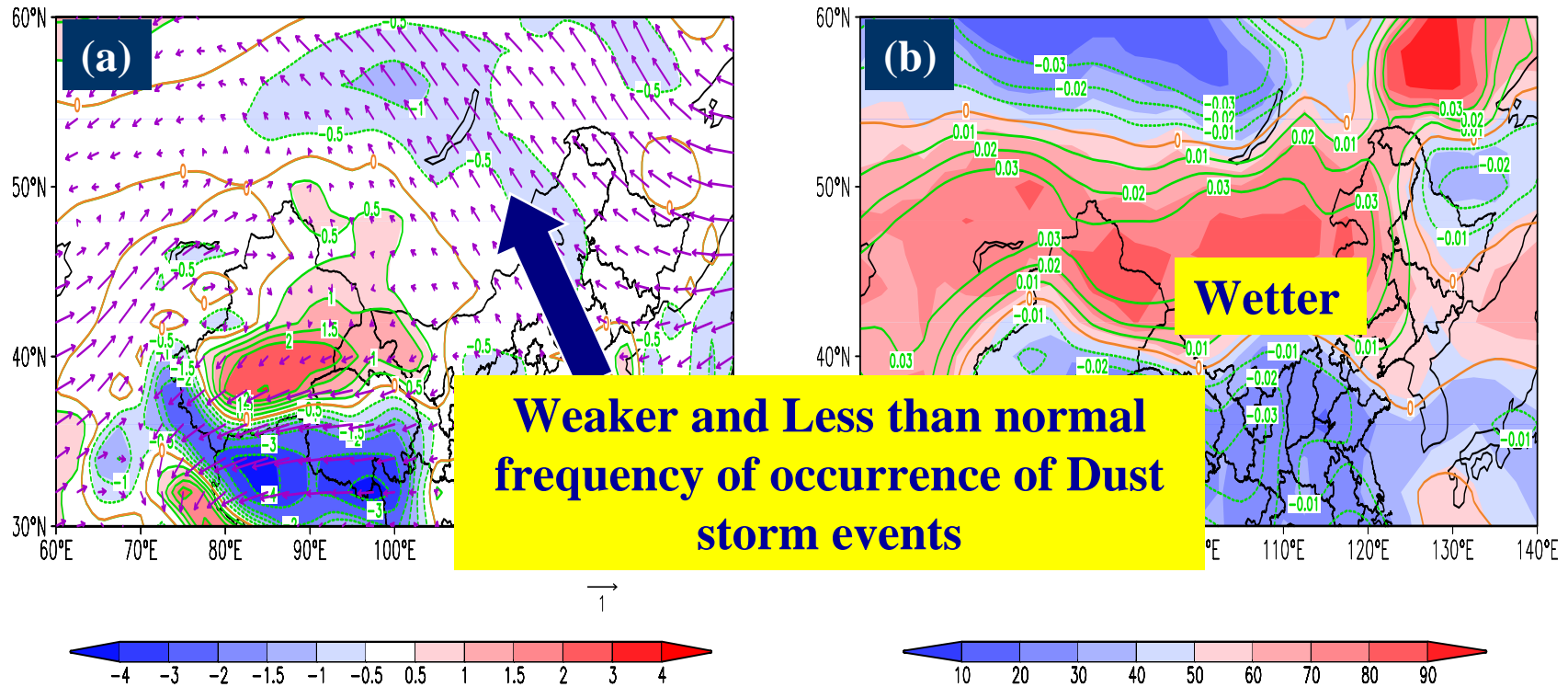
- (a) 850hpa wind anomalies**
 - (b) Anomalies of surface temperature (Shaded) and 850hpa wind**
 - (c) Anomalies of surface RH (Shaded) and 850hpa wind**
- Red: positive anomaly,
Blue: negative anomaly.**

Observed springtime climate anomalies over East Asia (March & April, 2003) (Weak and less dust-storm activities)



(a) 850hpa wind anomalies
(b) Anomalies of 850hpa wind and surface temperature.
(c) 850hpa wind anomalies and surface RH anomalies
Red: positive anomaly,
Blue: negative anomaly.

Prediction by IAP DCP (Mar. & Apr. of 2003)

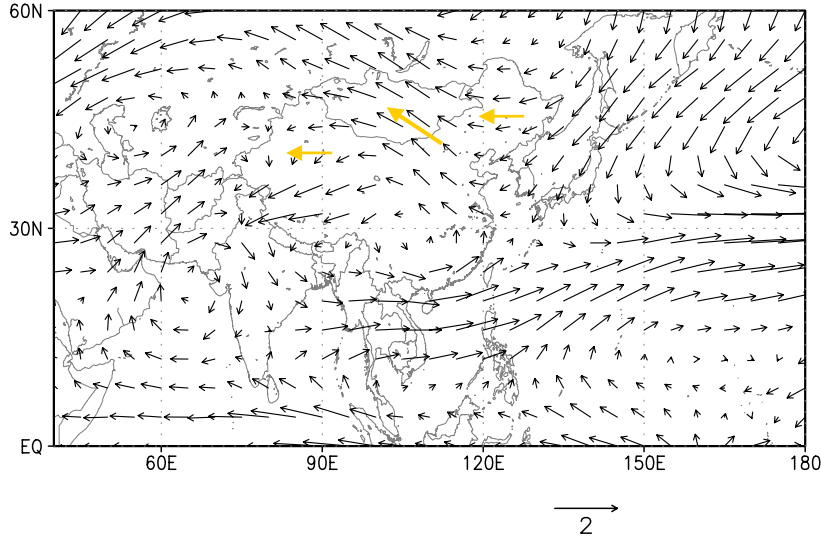


(initiated from Oct. 2002)

- (a) 850hpa wind vector and wind speed anomalies (red: positive anomaly, blue: negative anomaly).
- (b) Soil wetness anomalies and the probability for positive soil moisture anomalies (red: >50%, blue: <50%)

Wind 850mb

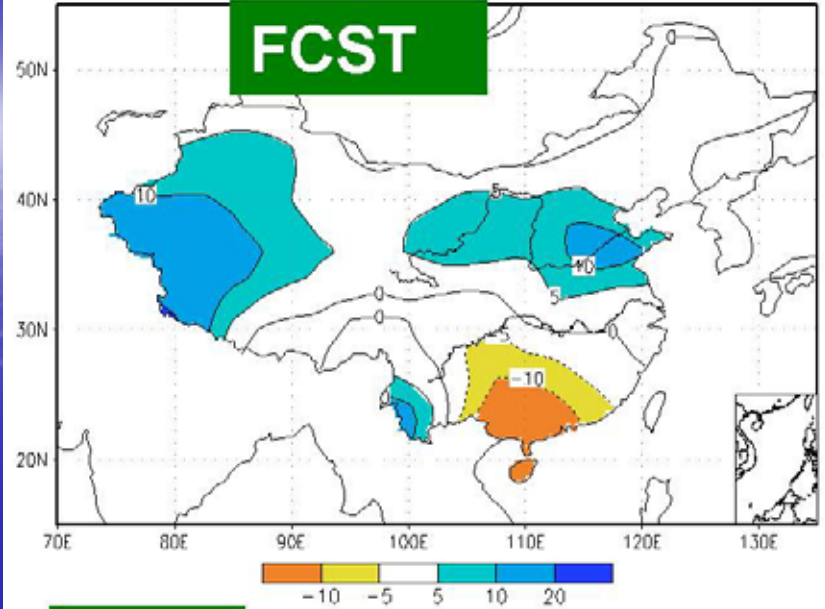
Predicted wind anomaly at 850hPa in MAM (S4,2x2.5)



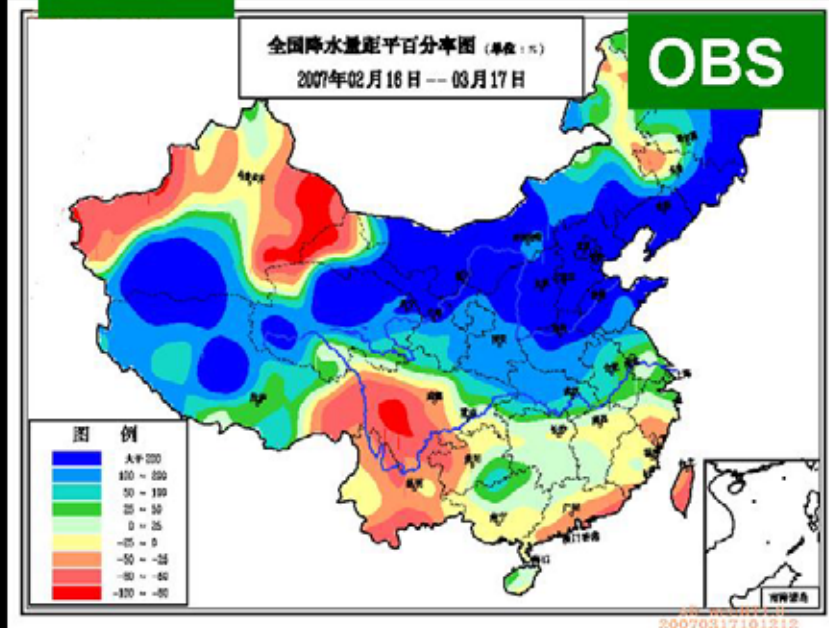
Issued on Oct. 2006

Less than normal dust-storm activities during the spring of 2007

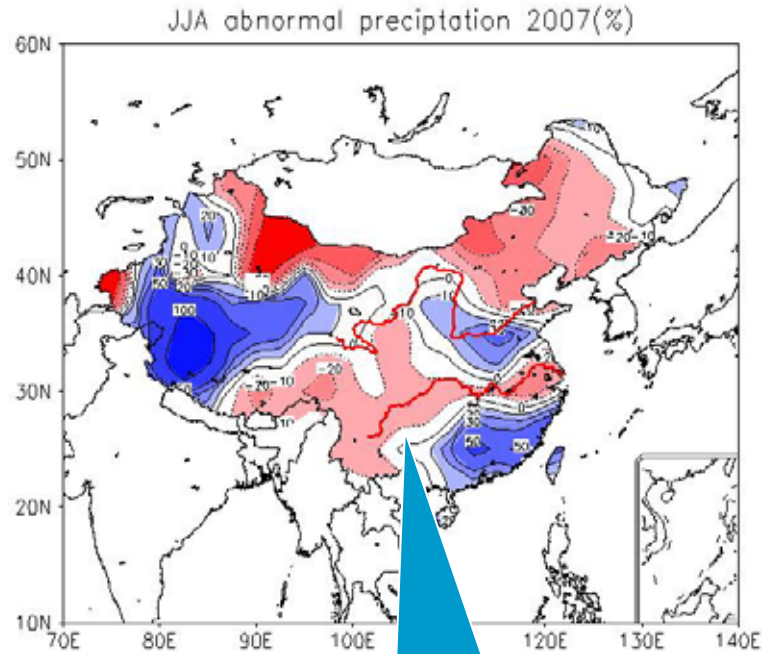
FCST



Prec

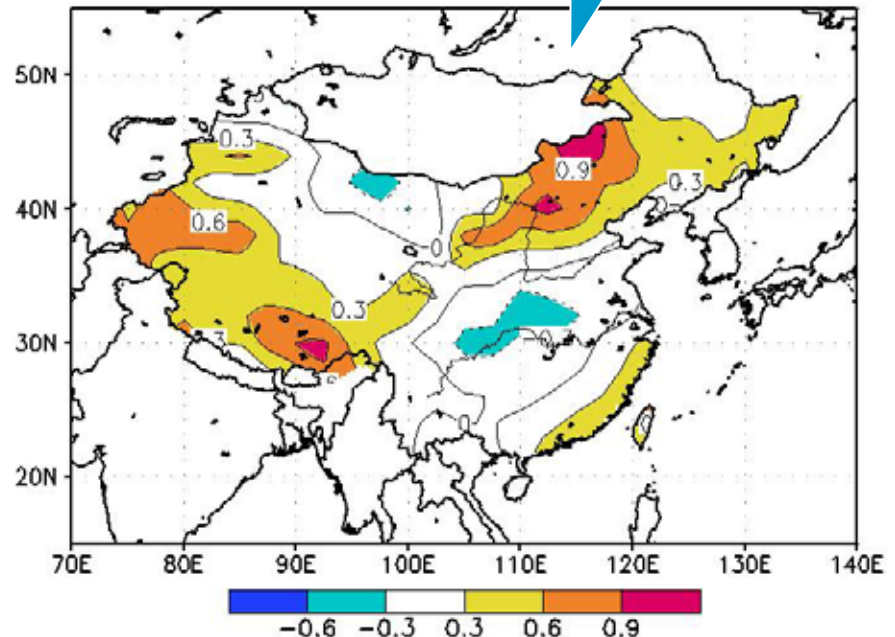


2007 summer prediction (issued on April)



temperature
anomaly (°C)

JJA precipitation
anomaly (in
percentage)



Summary

- The IAP dynamical seasonal prediction system has been introduced, and hindcast experiments suggest that, IAP dynamical seasonal prediction system does show certain skill in the prediction of summer rainfall and temperature anomalies over China, especially over Yangtze and Huaihe River valley. The predictive skill of East Asian winter monsoon by IAP DSP is also high.
- Since 1998, IAP DSP has been applied to the real time prediction of summer climate anomalies, spring dust-storm occurrence frequency etc, and the prediction results are encouraging.