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Experimental Seasonal Prediction of Spring Dust-storm Activities over Northern China

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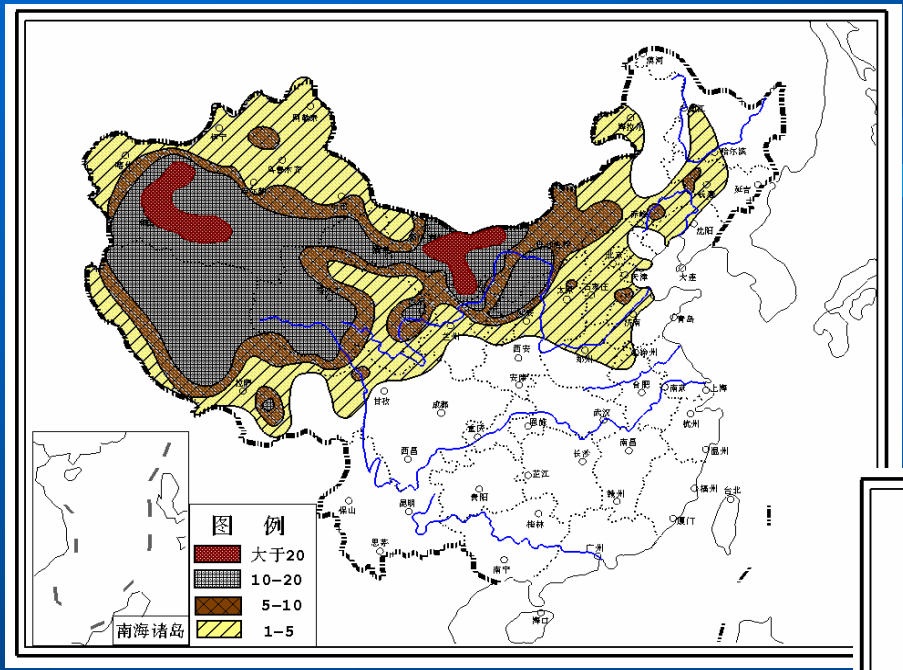
Observed Annual-mean Dust-weather Occurrence Frequency over China (Unit: days) during 1956-2000

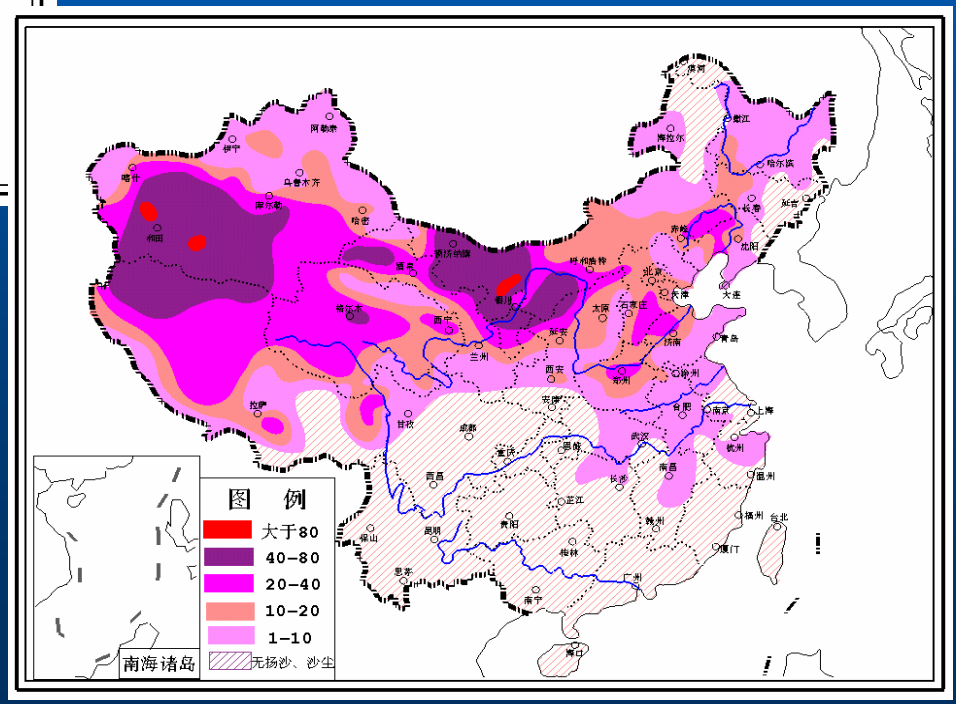


Dust Storm

Visibility < 1 km

Blowing Dust

Visibility ~ 1-10 km



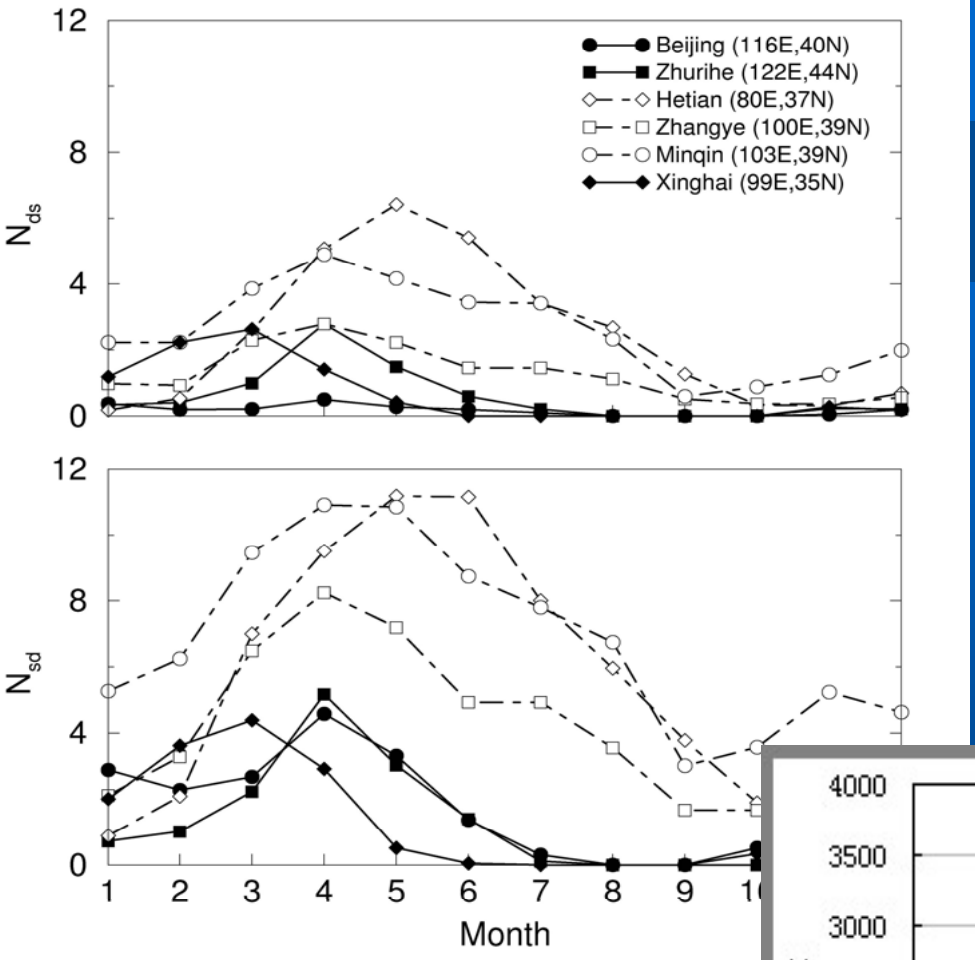
Wulumuqi, Xinjiang

Lanzhou, Gansu

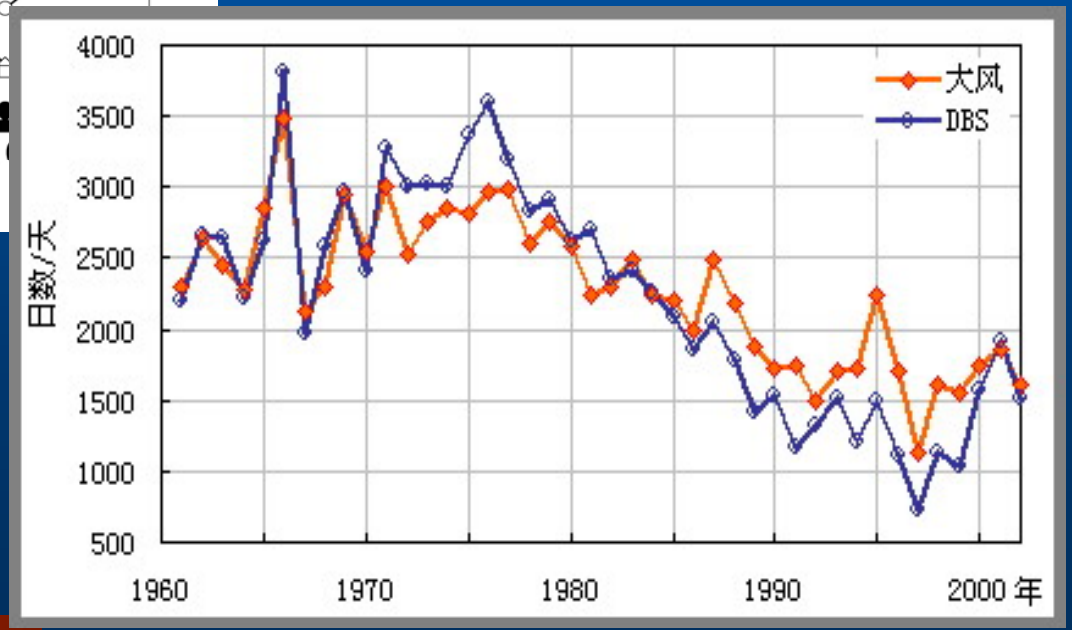
Luoyang, Henan

Beijing

Seasonality of dust activities



Relationship between strong wind and days of blowing dust



Dust storm Activities During 2001-2005

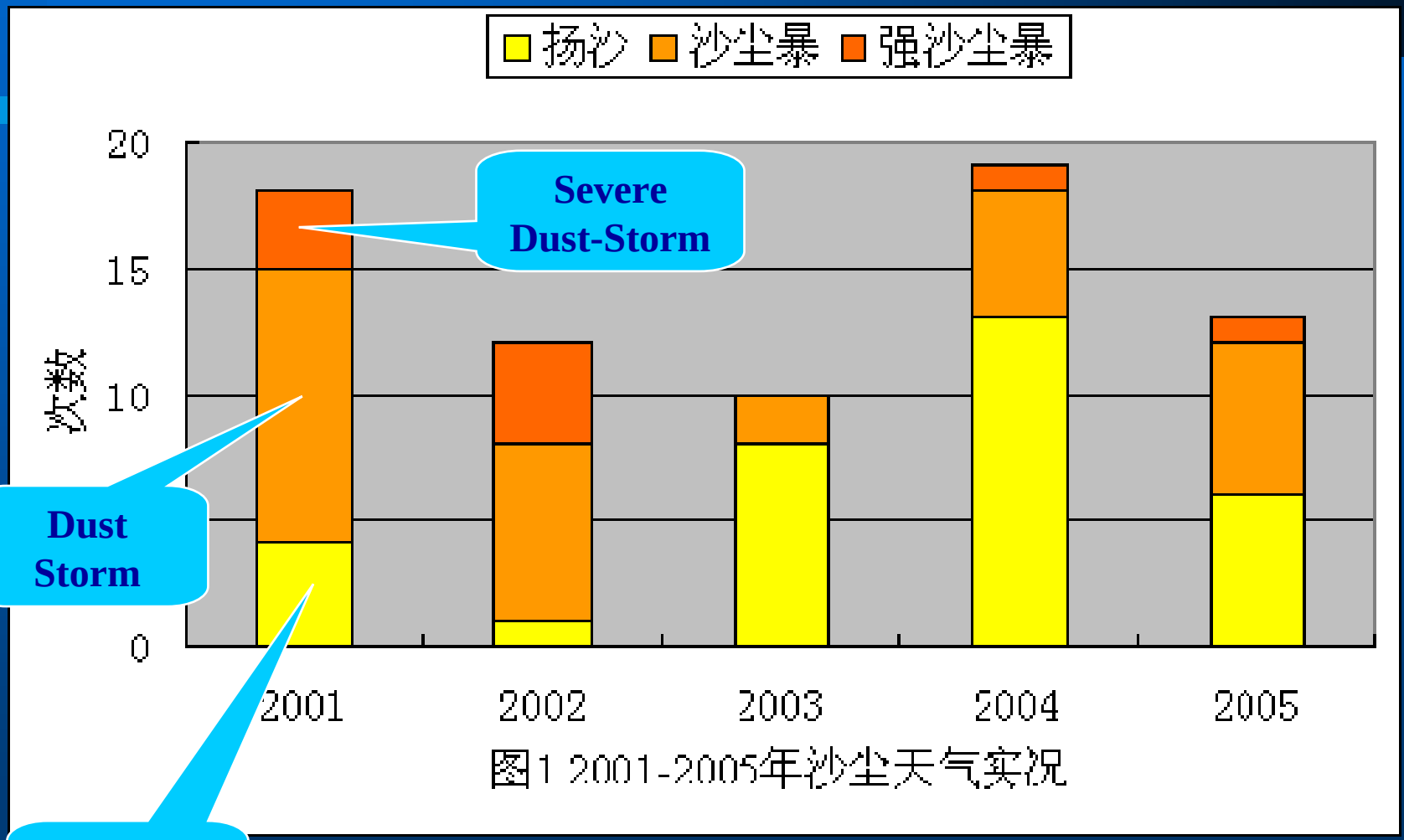
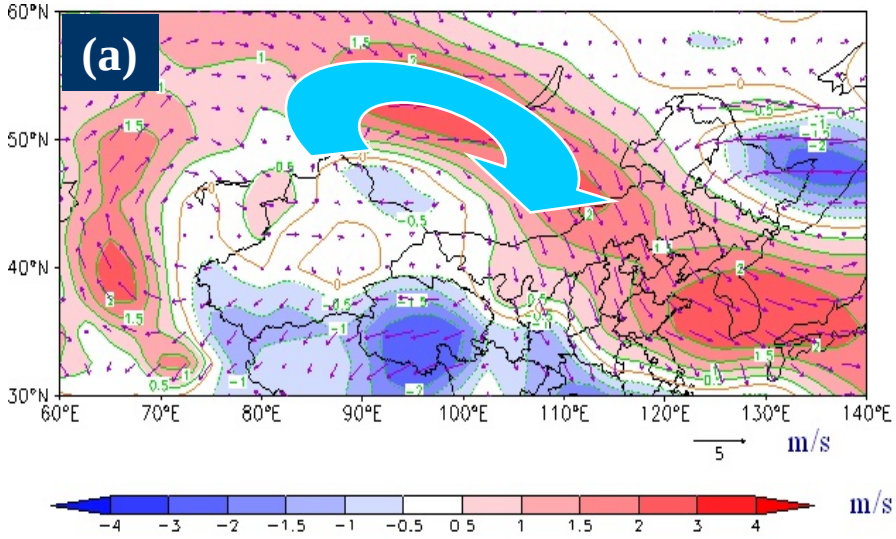
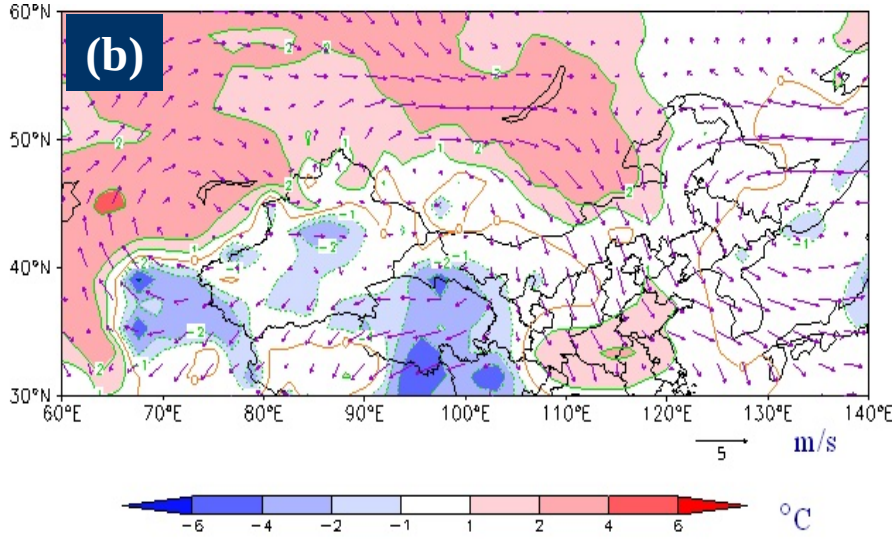
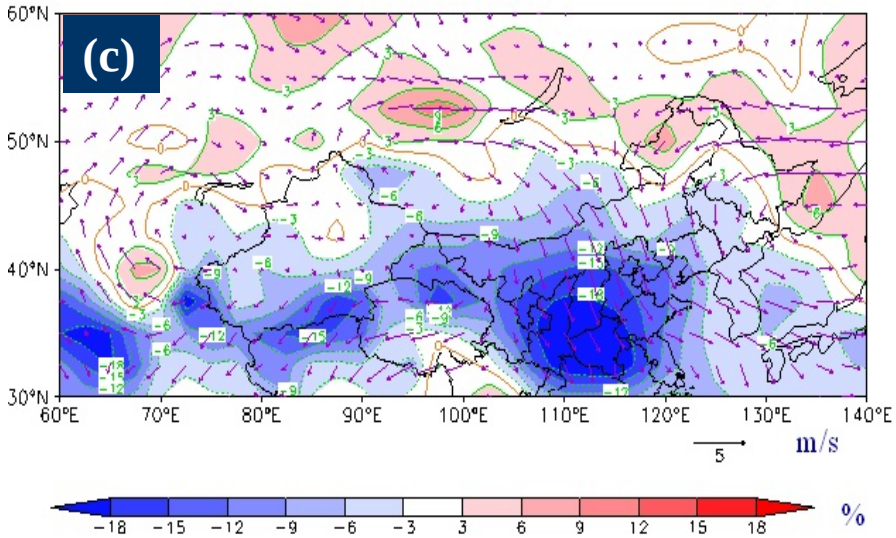


图1 2001-2005年沙尘天气实况

Observed springtime climate anomalies over East Asia (March & April, 2000)
（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, 2001)
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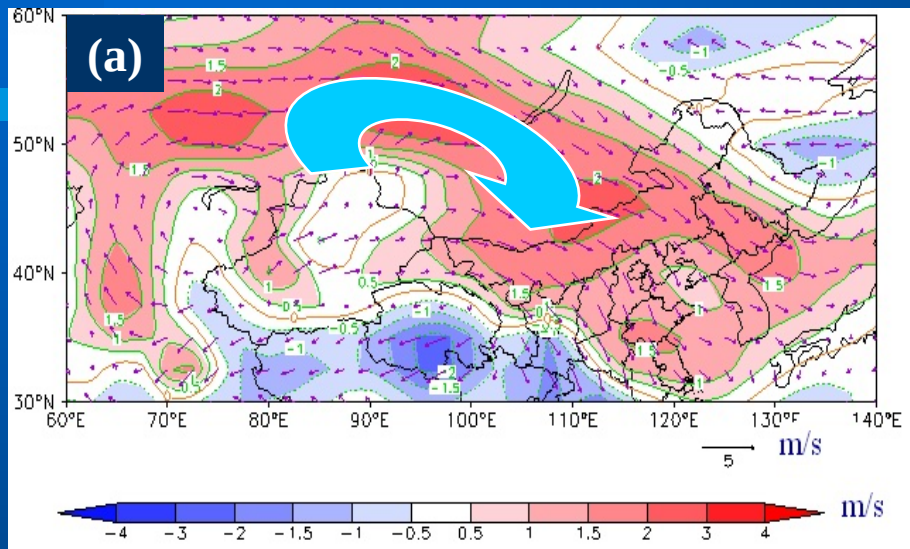

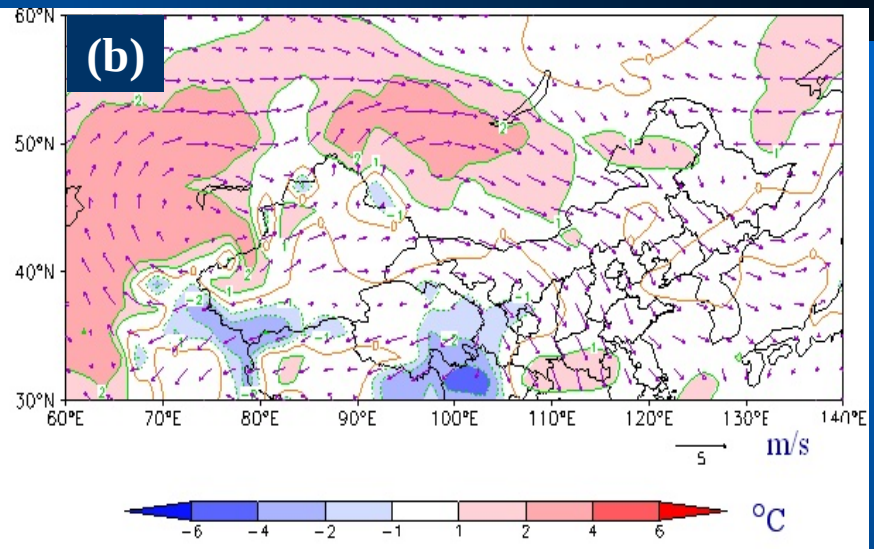

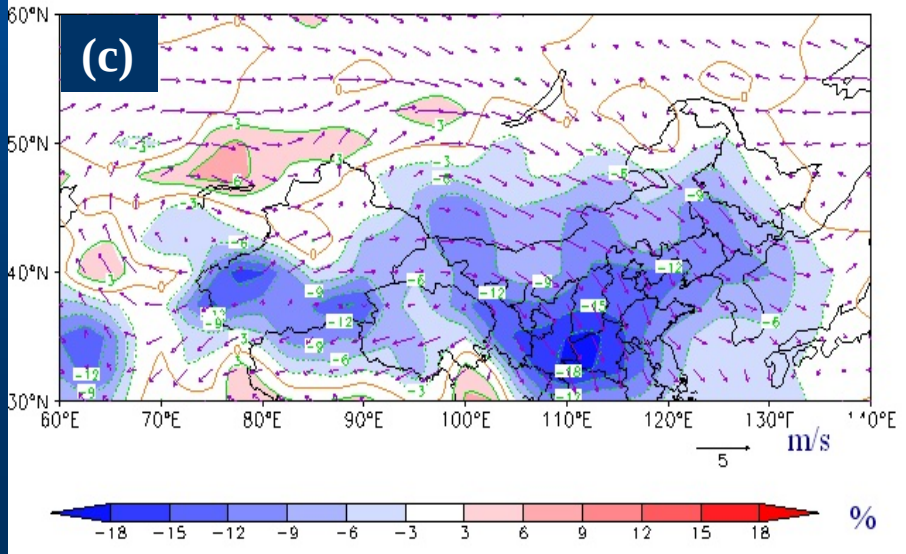

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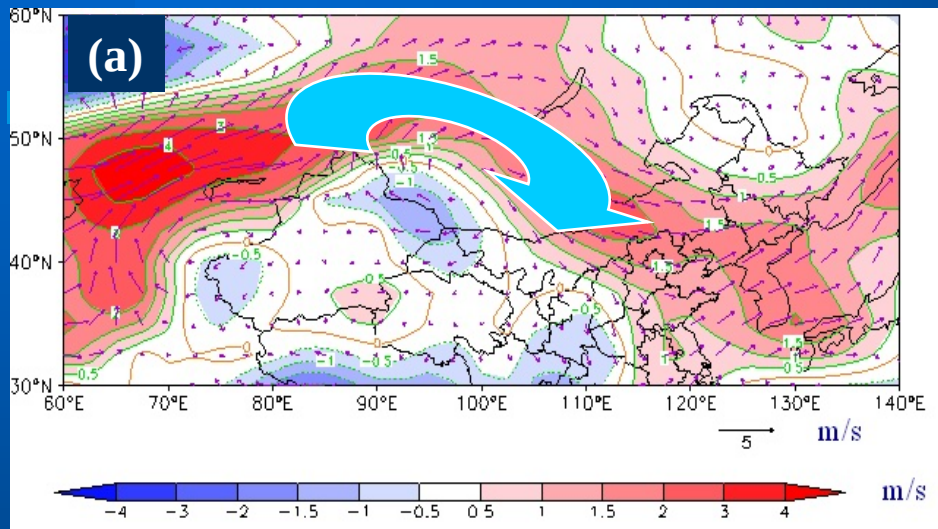

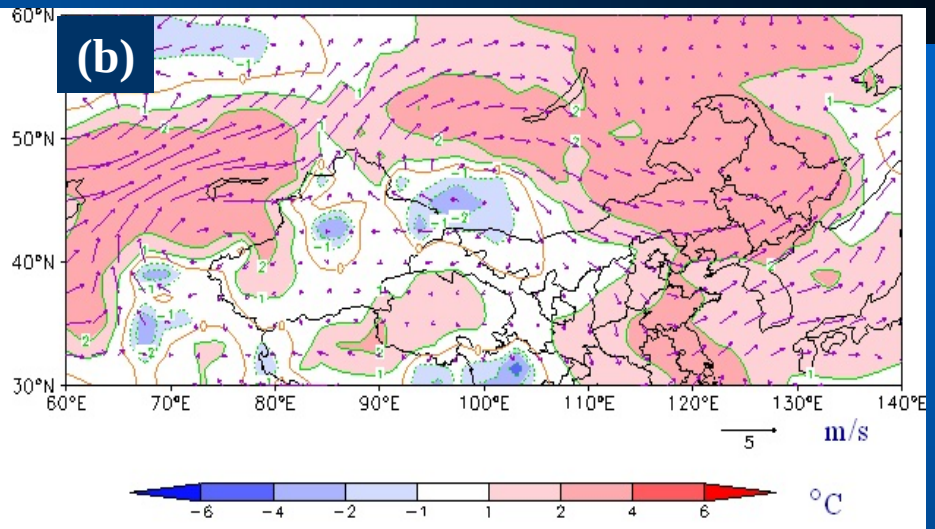

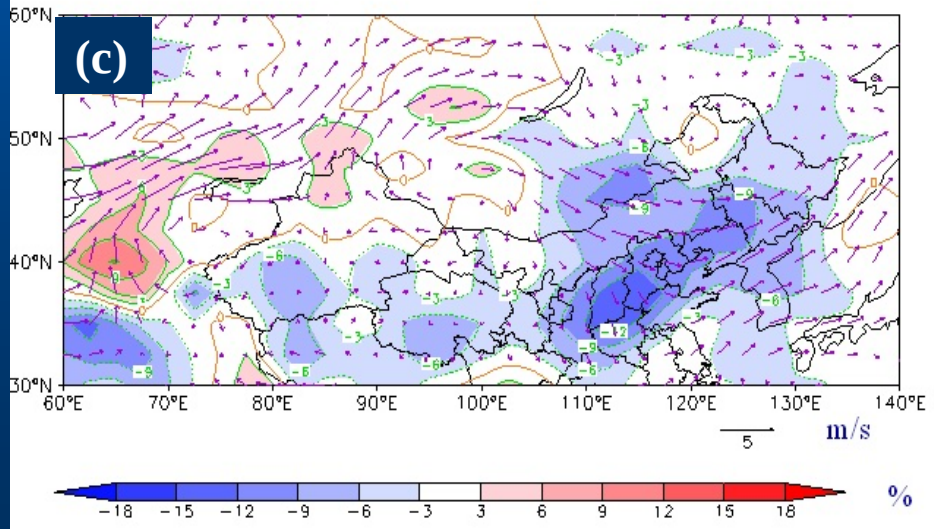

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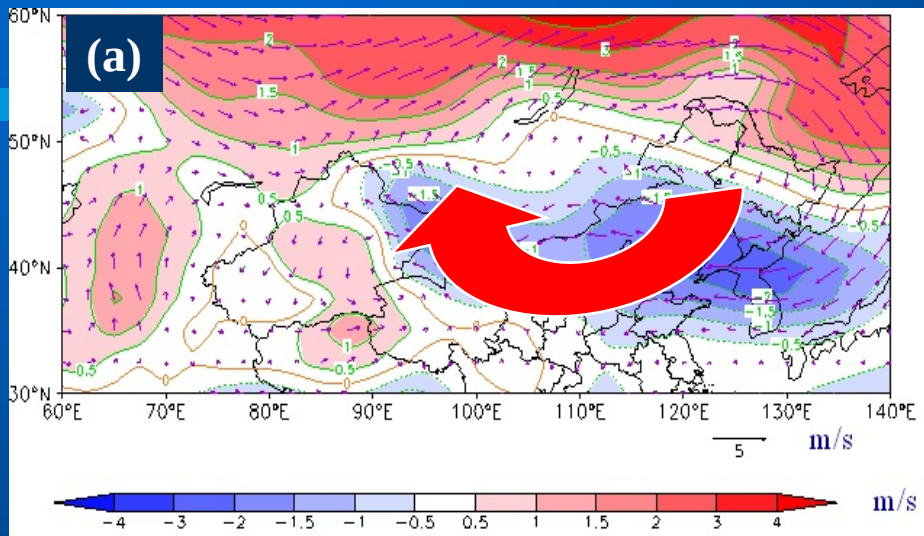
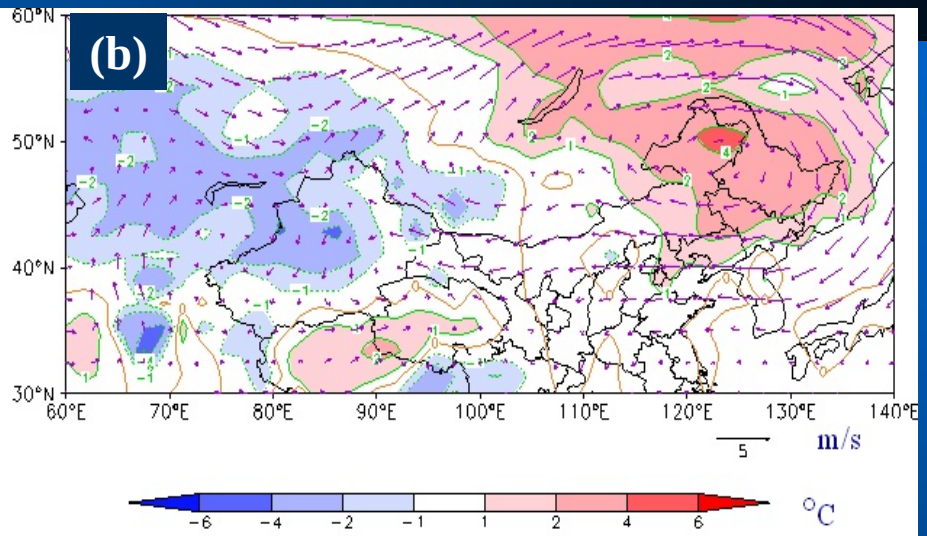
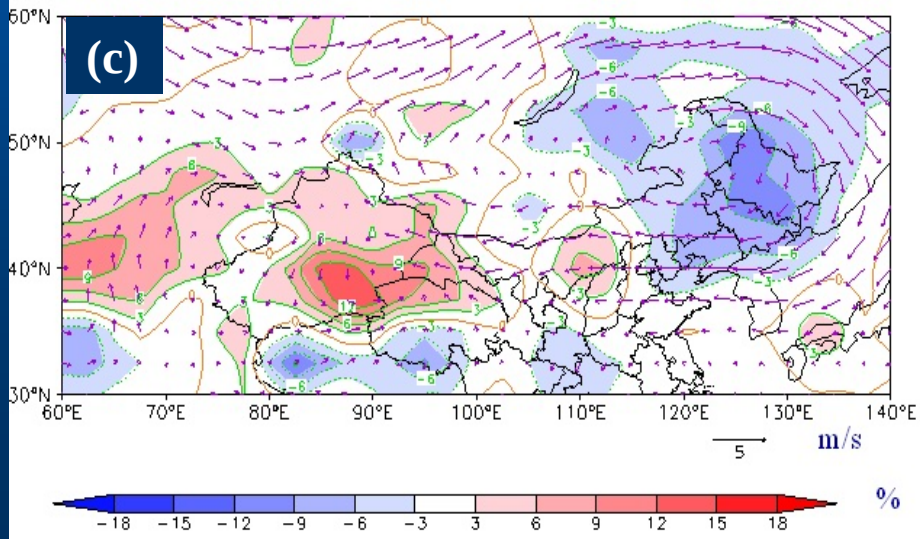
Observed springtime climate anomalies over East Asia (March & April, 2003)
（Weak and less dust-storm activities)







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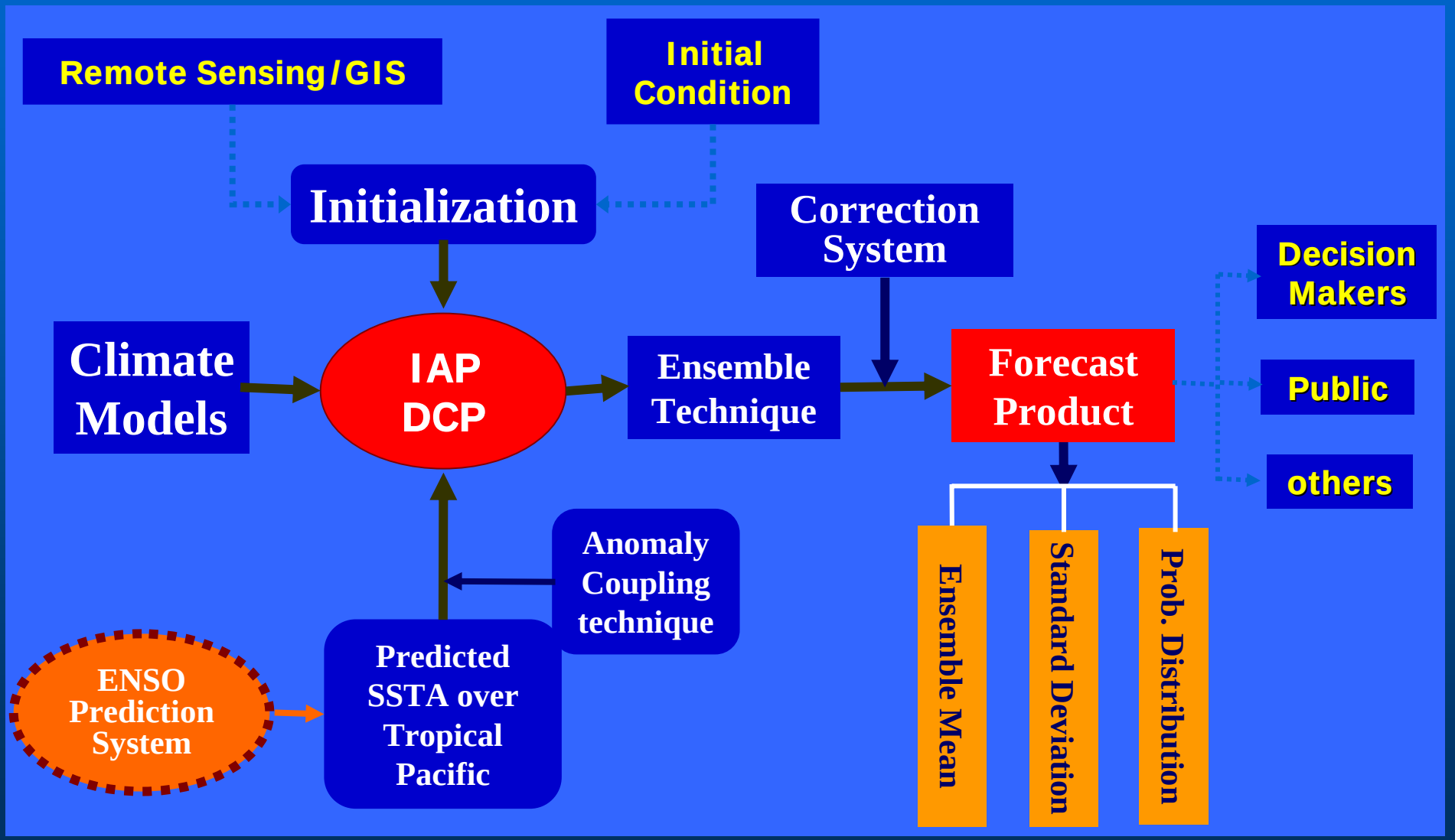
Experimental Seasonal Prediction of Spring Dust-storm Activities over Northern China

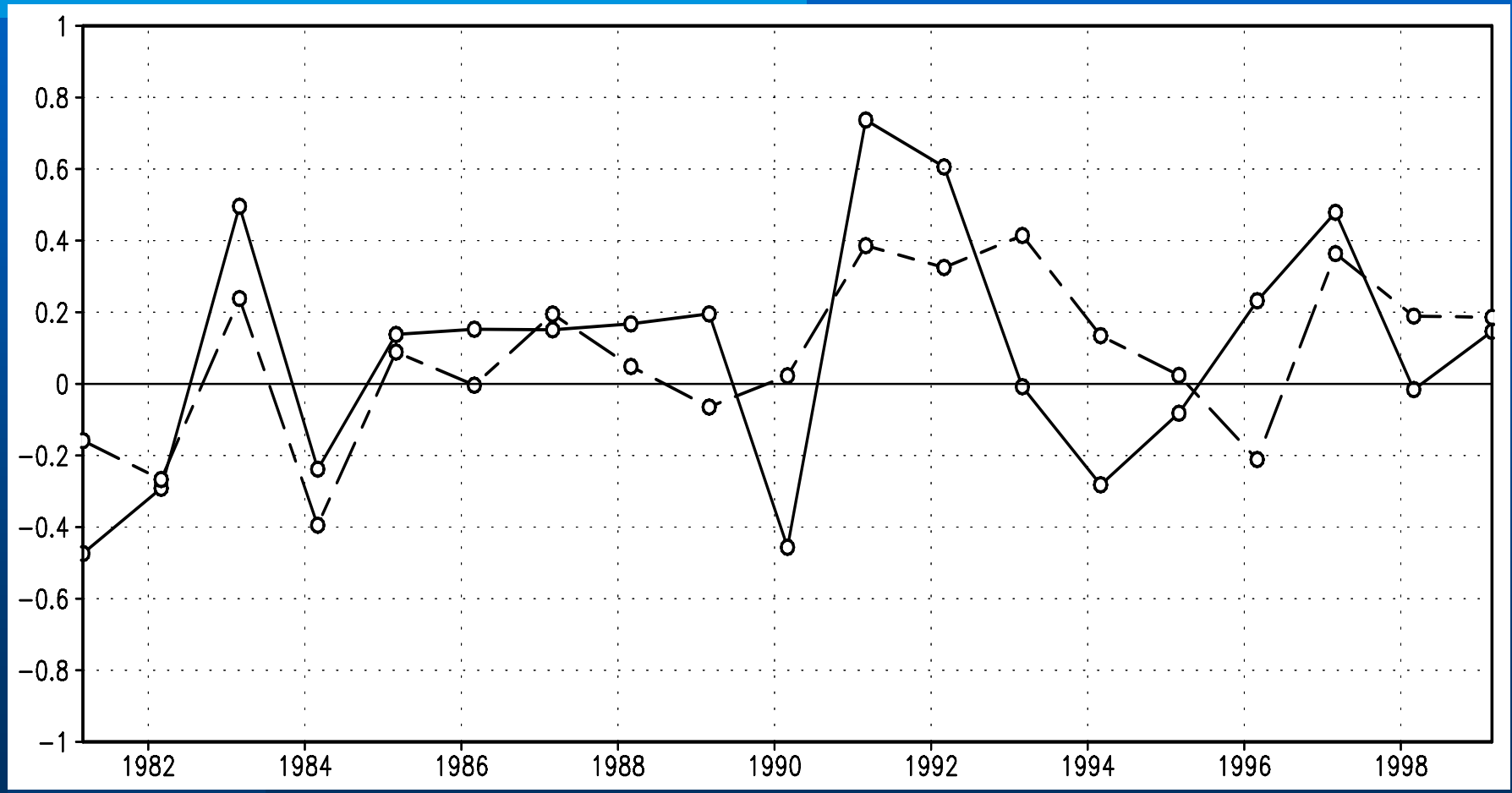
IAP Dynamical Seasonal-to-Interannual Prediction System



Design of Hindcast Experiment

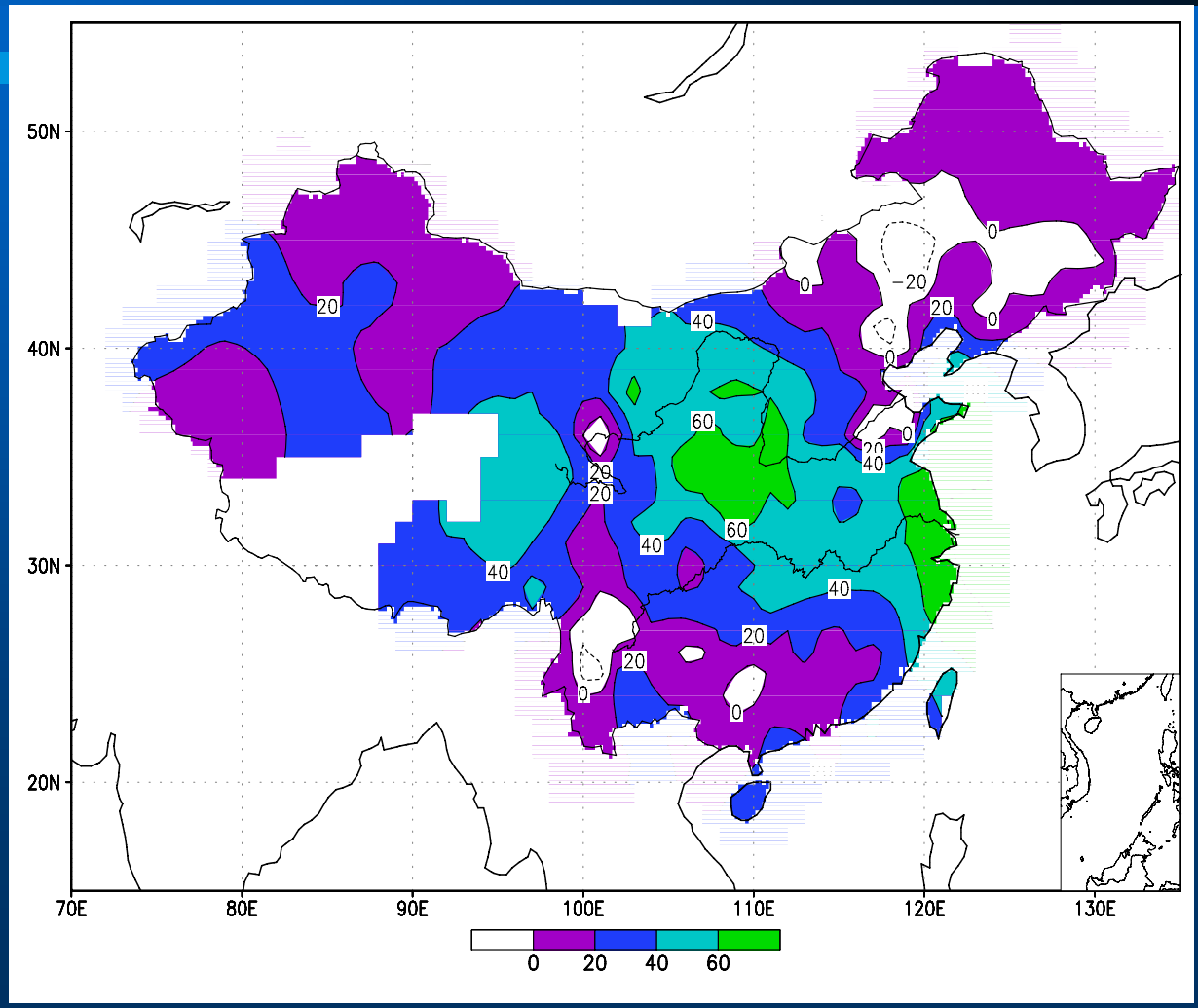
Climate Model	IAP AGCM1.3
Sea surface temperature	$(SST)_c+(SSTA)_{obs}$
Atmospheric initial conditions	**Wind, geopotential height, relative humidity are taken from NCEP real-time analysis, and then interpolated into the model grid-point with 2°×2.5° horizontal resolution.**
Hindcast period	**21 years (1980-2000)**
Ensemble Size	**31 ensemble members, With atmospheric initial conditions taken from October 1-31 respectively**
Duration of integration	**1 year (for each ensemble member)**
Verification data	**Observed rainfall data from 160 stations in China during 1980-2000; NCEP reanalysis data with 2.5x2.5 resolution.**

Inter-annual variation of the Anomaly correlation coefficient between the NCEP reanalysis and ensemble hindcast experiments for surface wind field averaged over China (Solid line: Zonal wind; Dashed line: Meridional wind)

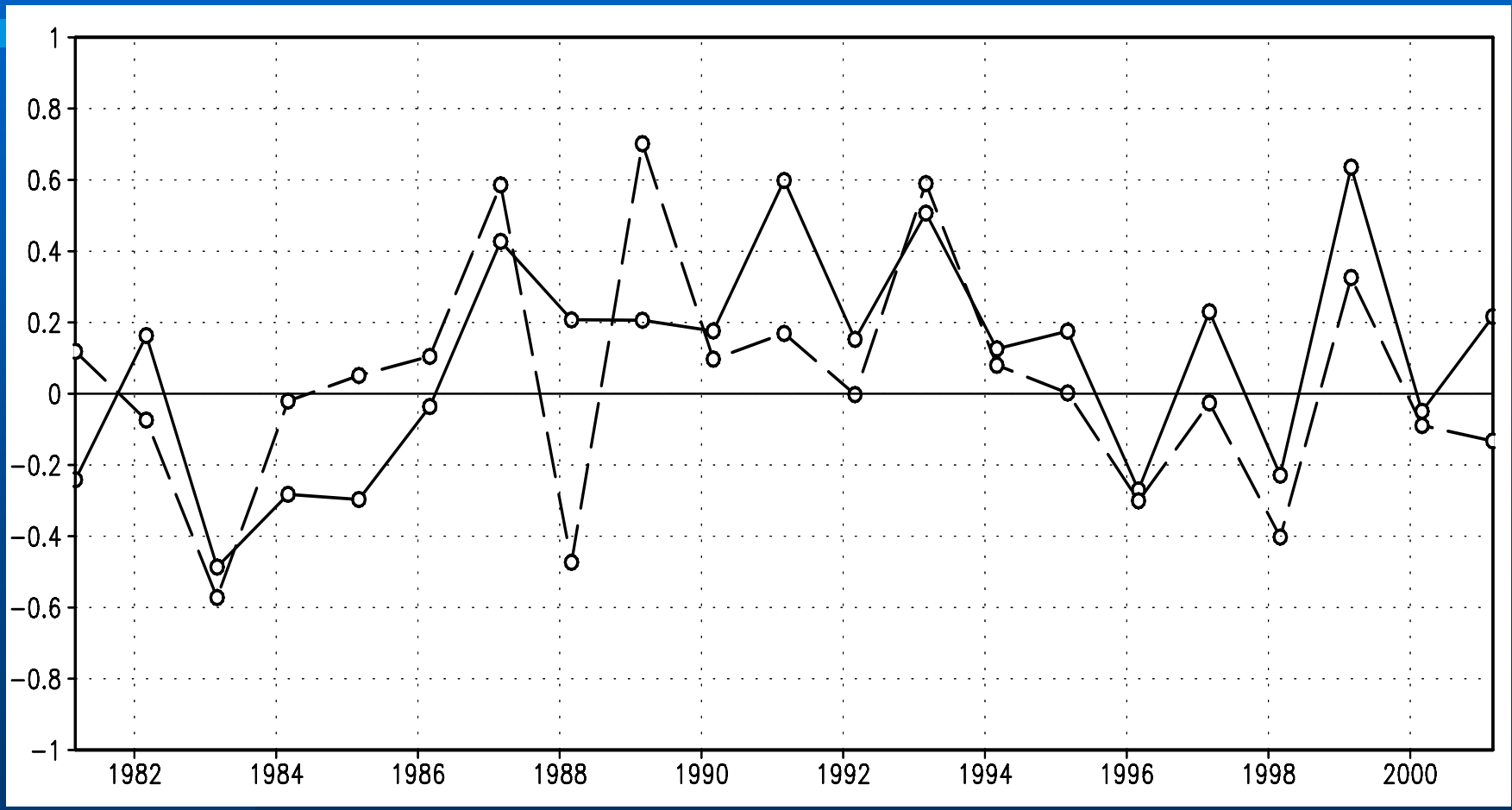


ACC distribution for spring surface temperature

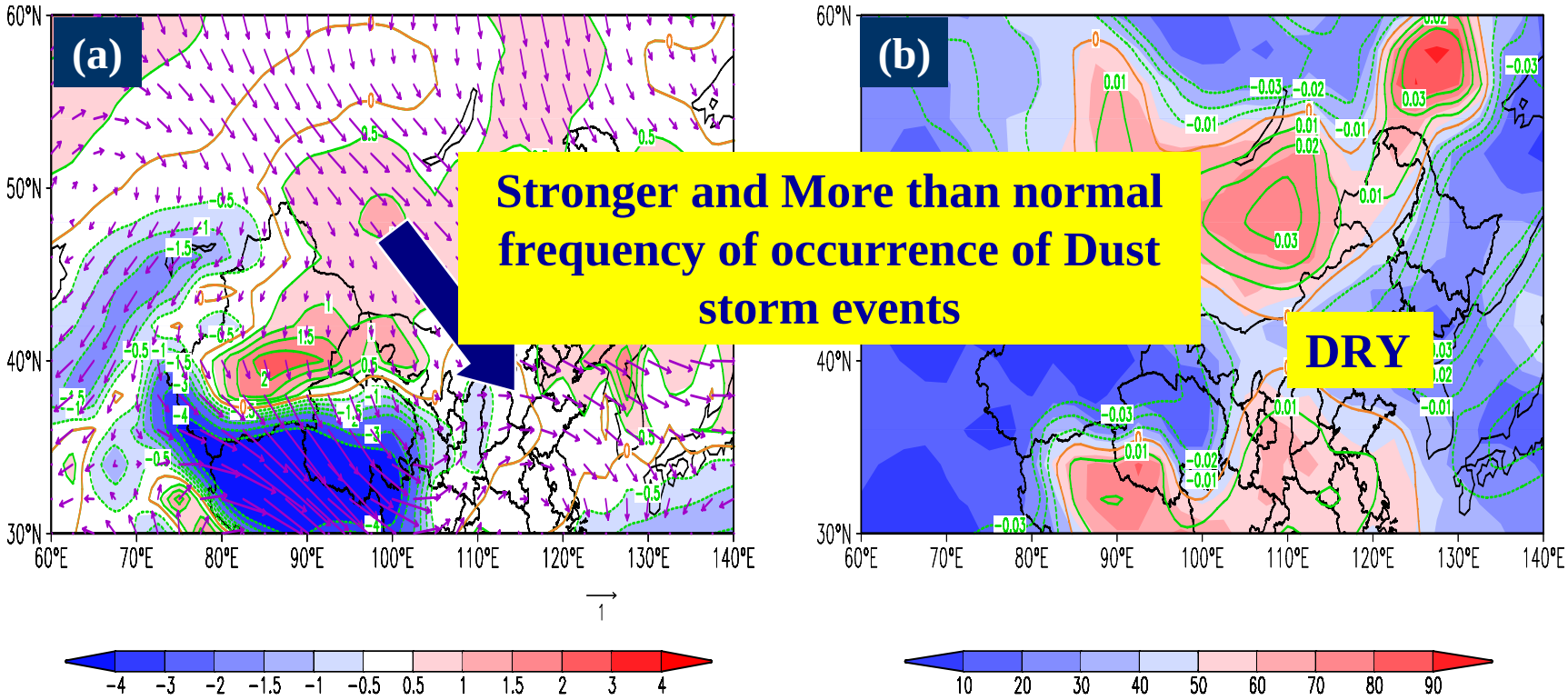
Positive ACC over Most Areas, with high ACC values located in Central part of China. There are 89 stations (out of total 160 stations) with ACC larger than 0.20.



Inter-annual Variation of the ACC for spring precipitation
Solid line: Northwest China； Dashed Line: Northern China



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

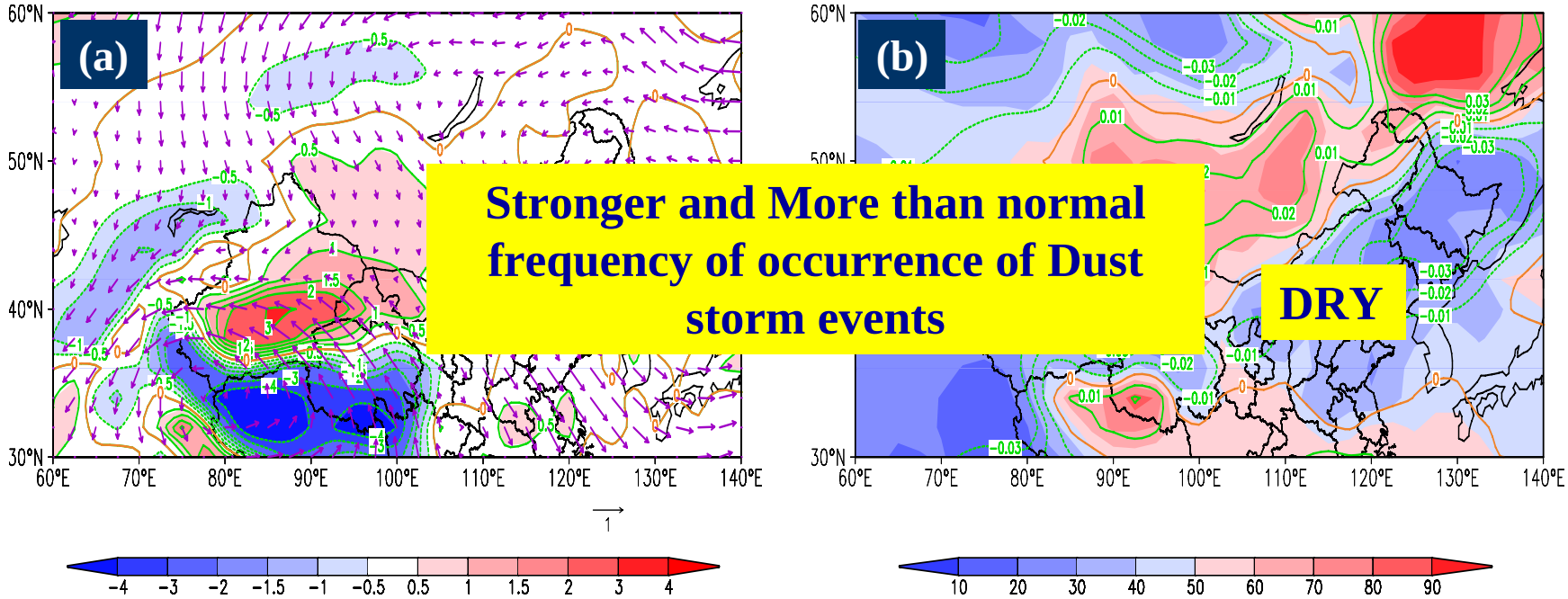


(initiated from Oct. 2000)

(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%)

Prediction by IAP DCP (Mar.& Apr.of 2002)



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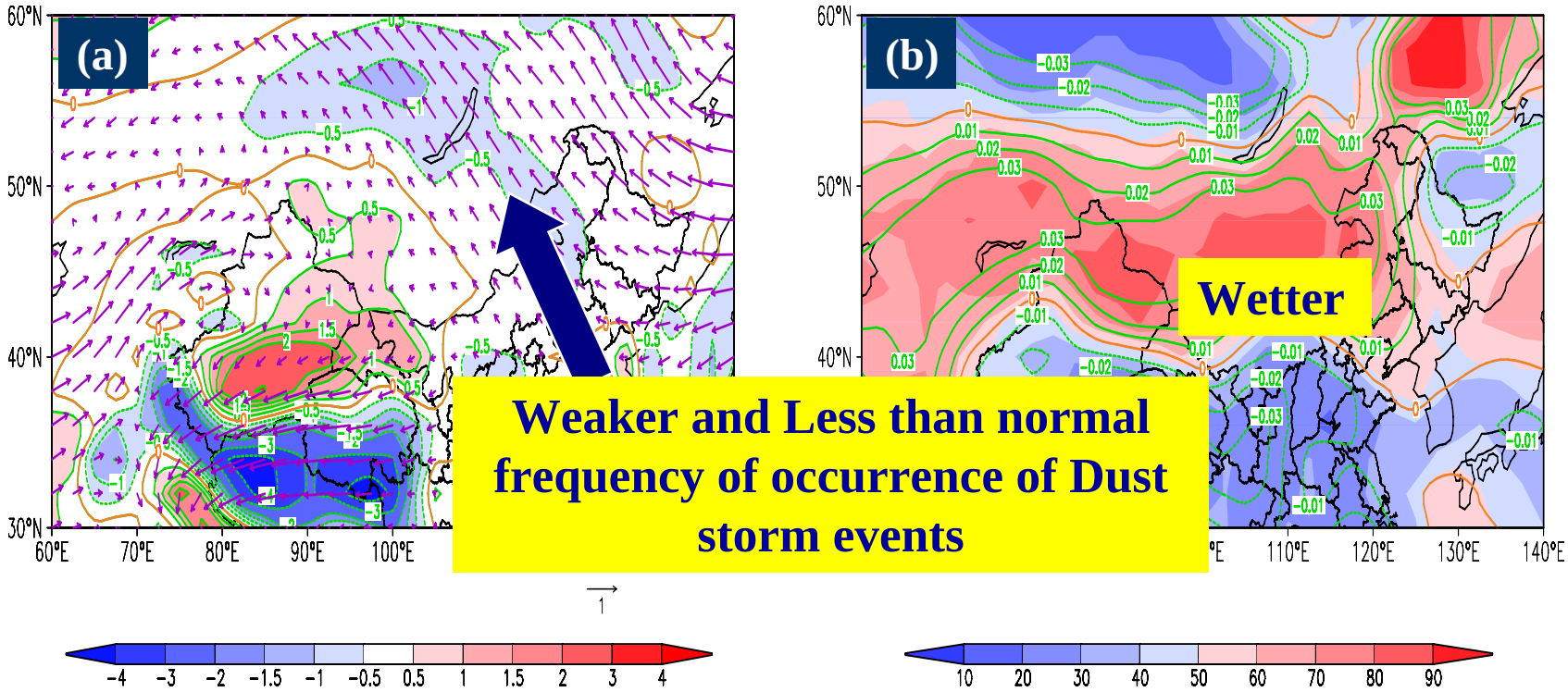

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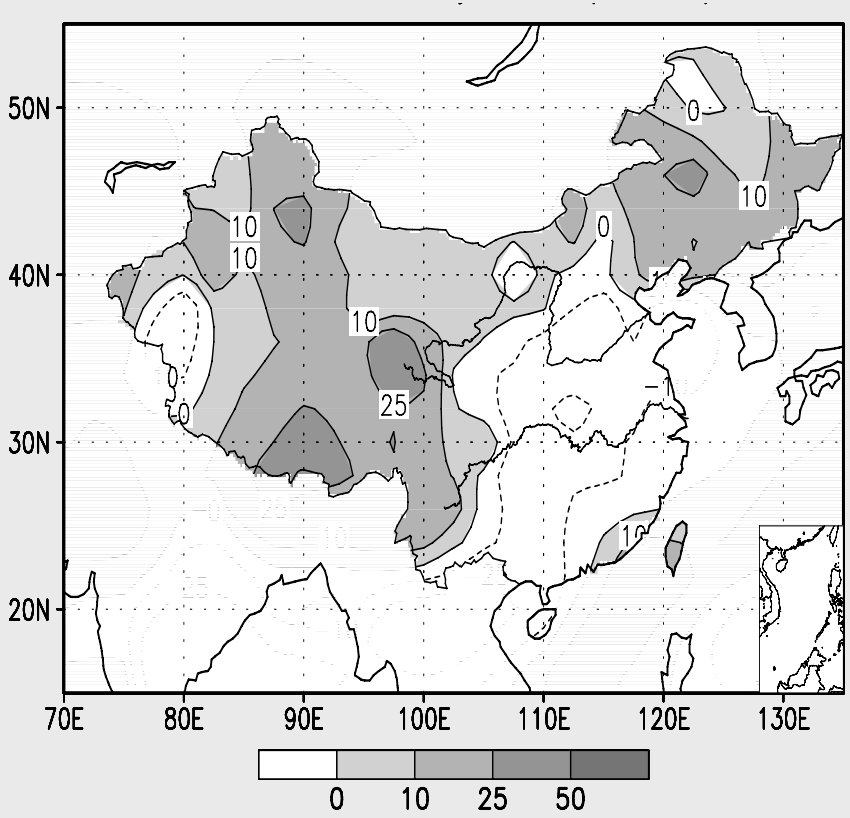
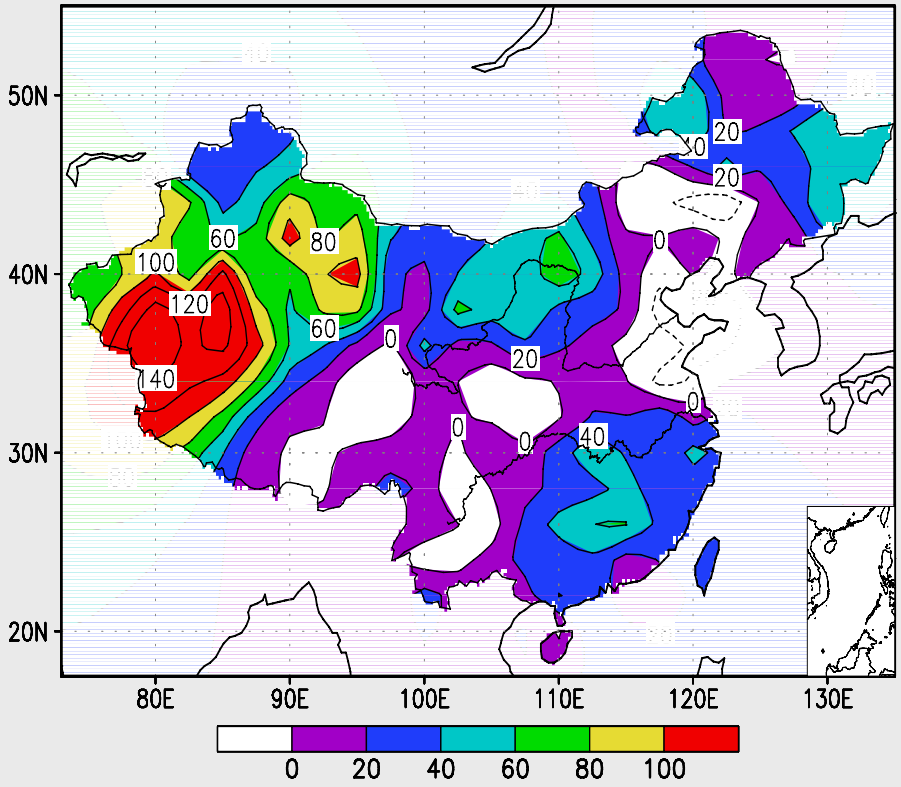
(a) 850hpa wind vector and wind speed anomalies (red: positive anomaly, blue: negative anomaly).

(b) Soil wetness anomalies and the probability for positive soil moisture anomalies (red: >50%, blue:<50%)

Predicted spring rainfall anomalies over China for spring of 2003 by IAP DCP (initiated from the October of year 2002)



Prediction



Observation

More than Normal rainfall over Northern China during the spring of 2003

Dust storm Activities During 2001-2005

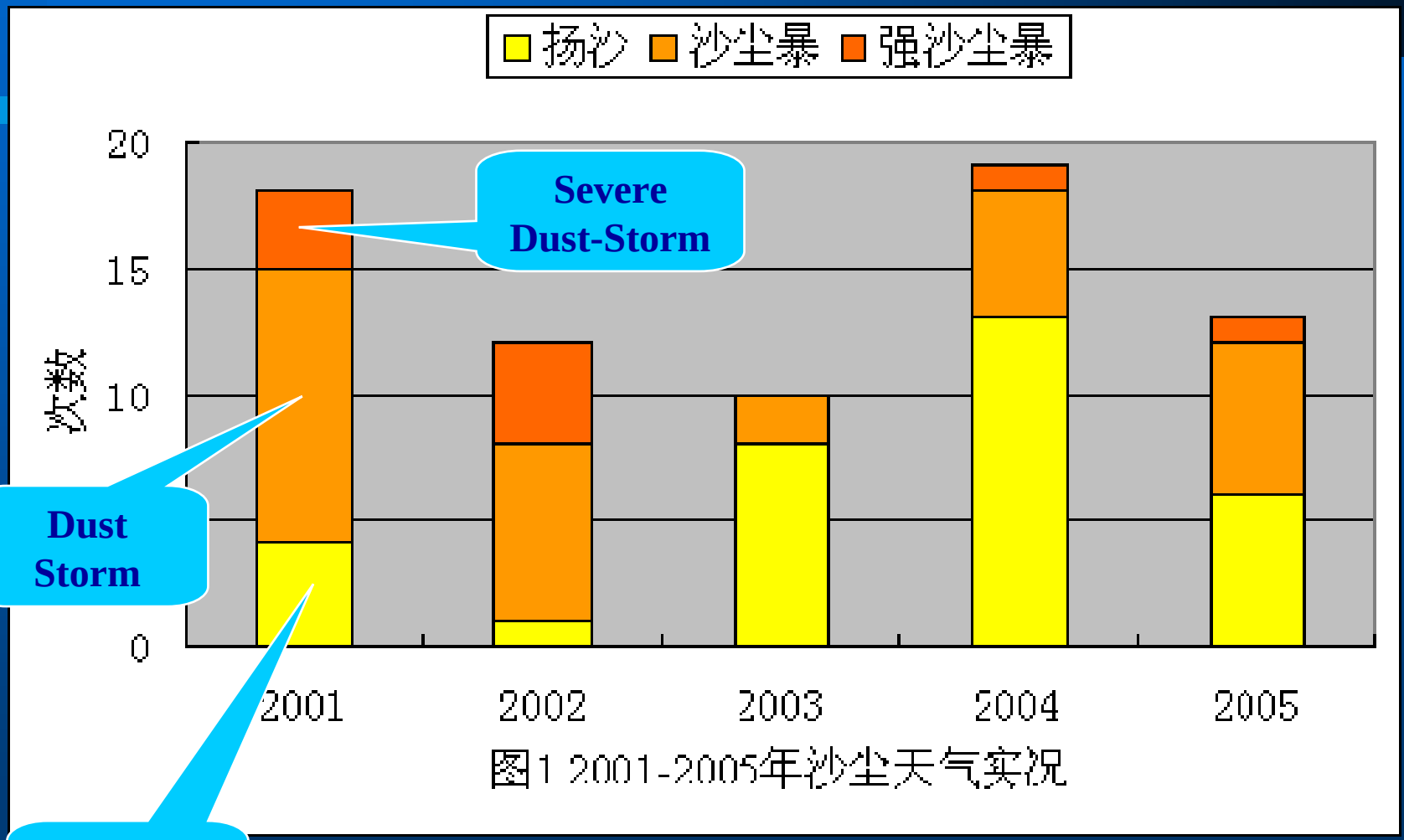
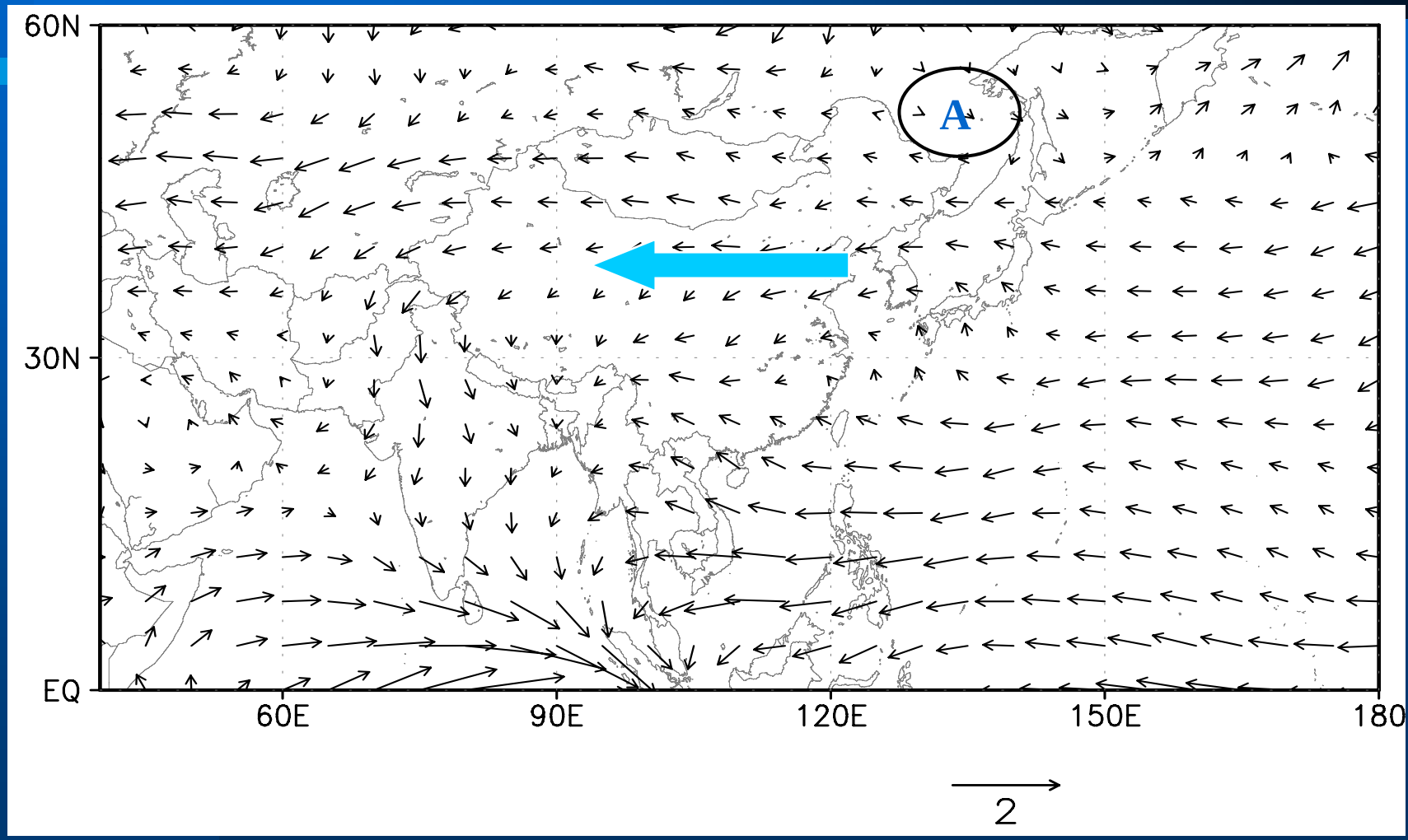
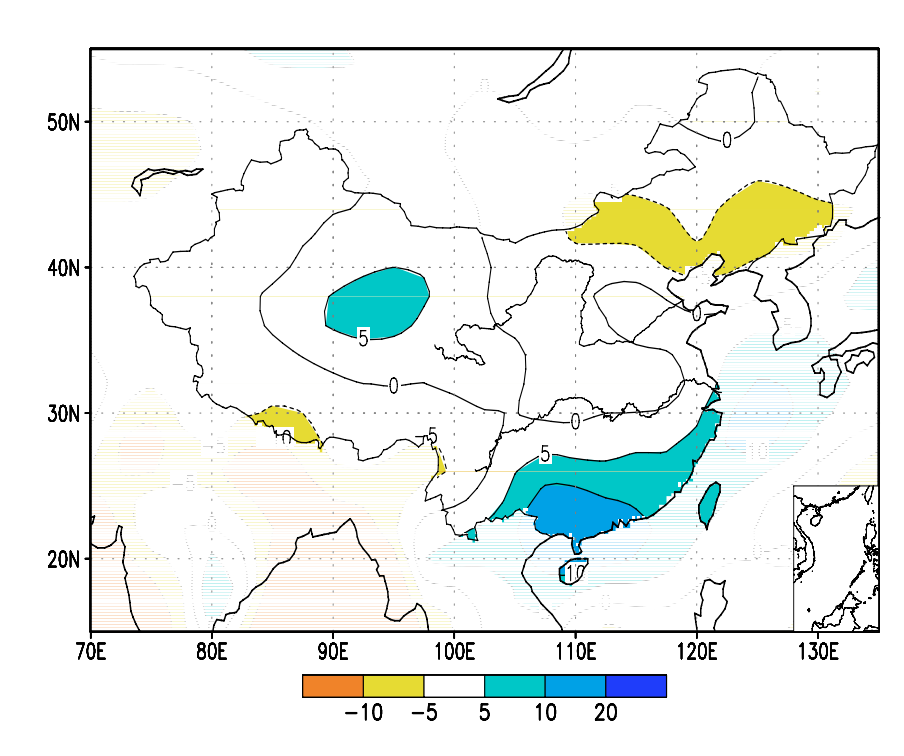


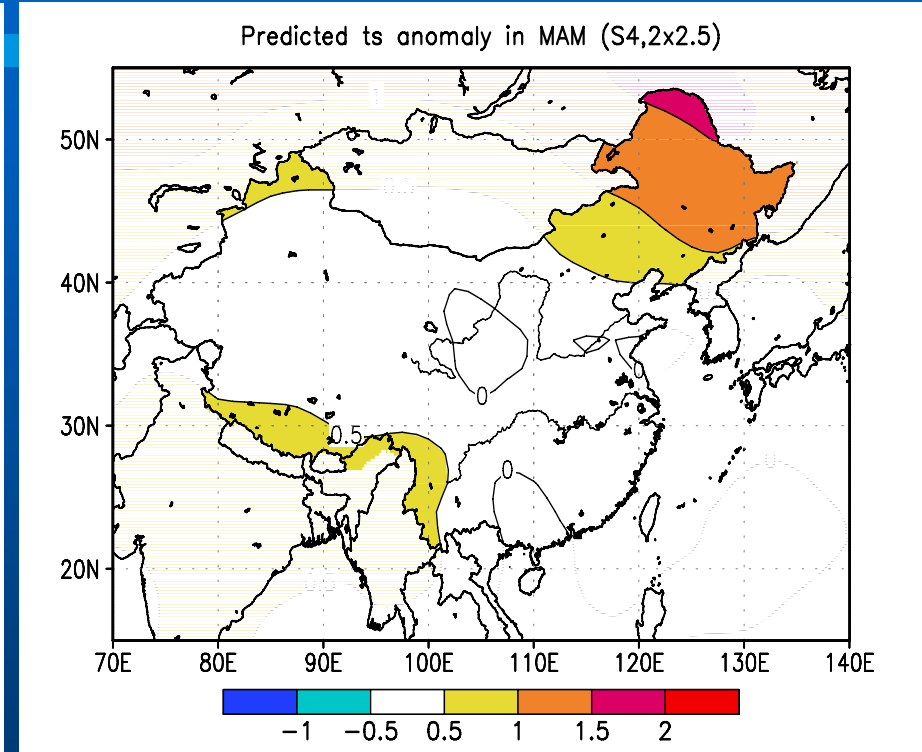
图1 2001-2005年沙尘天气实况

Predicted surface wind anomalies for the spring of 2006 (Initiated from Oct. 2005)



Predicted rainfall and temperature anomalies over Spring of 2006





rainfall

Temperature

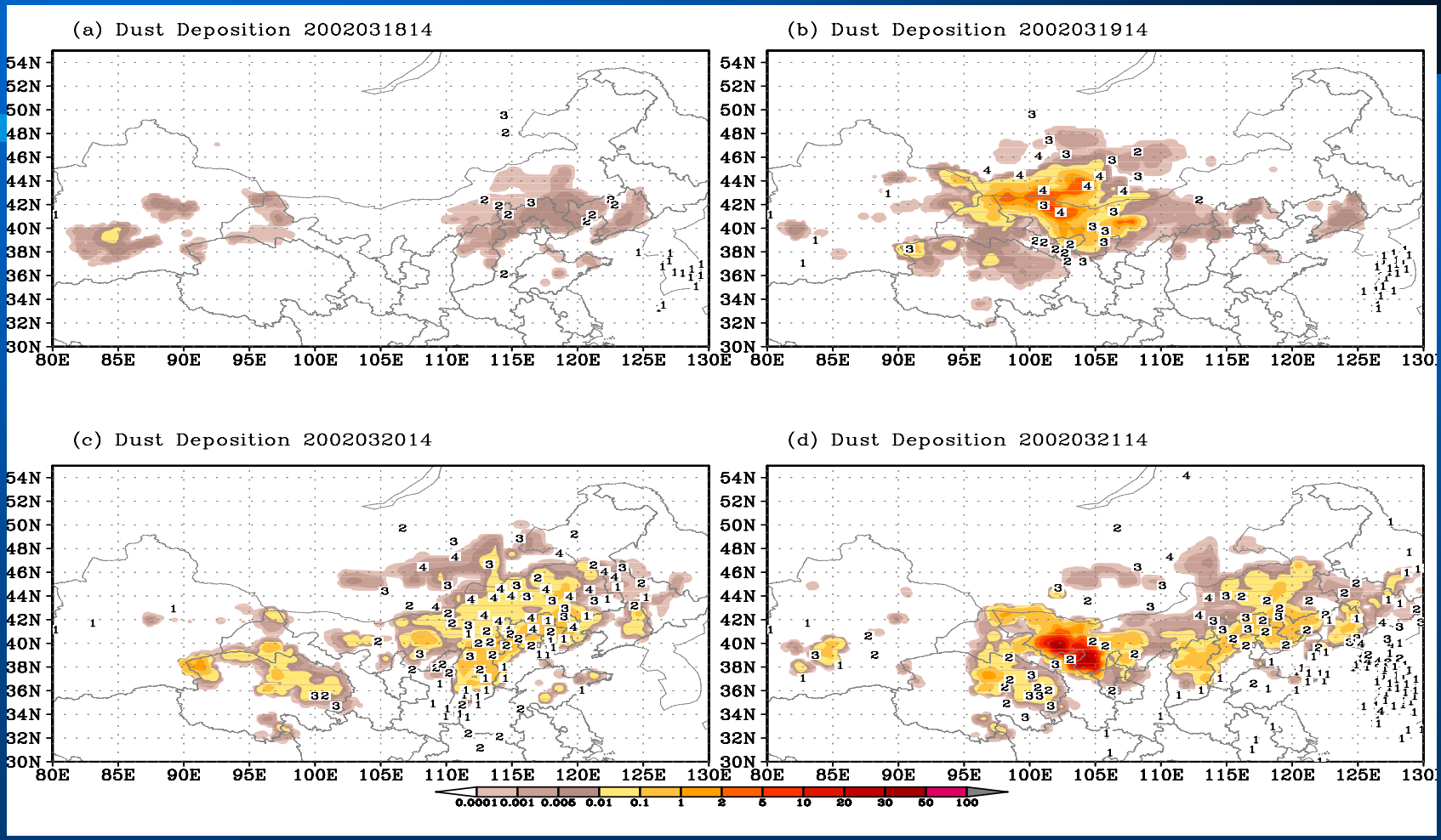
Weaker and Near normal dust activities over Northern China during the spring of 2006

Summary

- Through analyzing the NCEP/NCAR reanalysis data, the climatological features related to the spring dust storm activities have been investigated. It's found that the most important factor is the surface wind anomalies over dust source regions and along the dust transportation passage; Meanwhile, the soil moisture anomalies (or surface relative humidity) and surface vegetation cover anomalies may also play roles in the dust storm activities.
- Hindcast results show that, IAP DCP does show certain skill in predicting the anomalies of rainfall, surface wind and temperature over Northern China during Spring time.
- Dynamical prediction of climate condition favorable (or suppressive) for the occurrence frequency of dust storms is encouraging.

Thank you!

Simulation of the dust-storm activities (14:00)



Simulation of the dust-storm activities for (a) 14Z, Apr.18, 2002 (b) 14Z, Apr.19, 2002. (c) 14Z, Apr.20, 2002 (d) 14Z, Apr.21, 2002. by IAP dust-storm prediction system. Numbers in the figures indicate the observed dust weather situation 1: Floating dust 2: Blowing Dust 3:Dust Storm 4: Severe Dust Storm