Strategy for studying the tropical convective activities associated with disasters occurred in China

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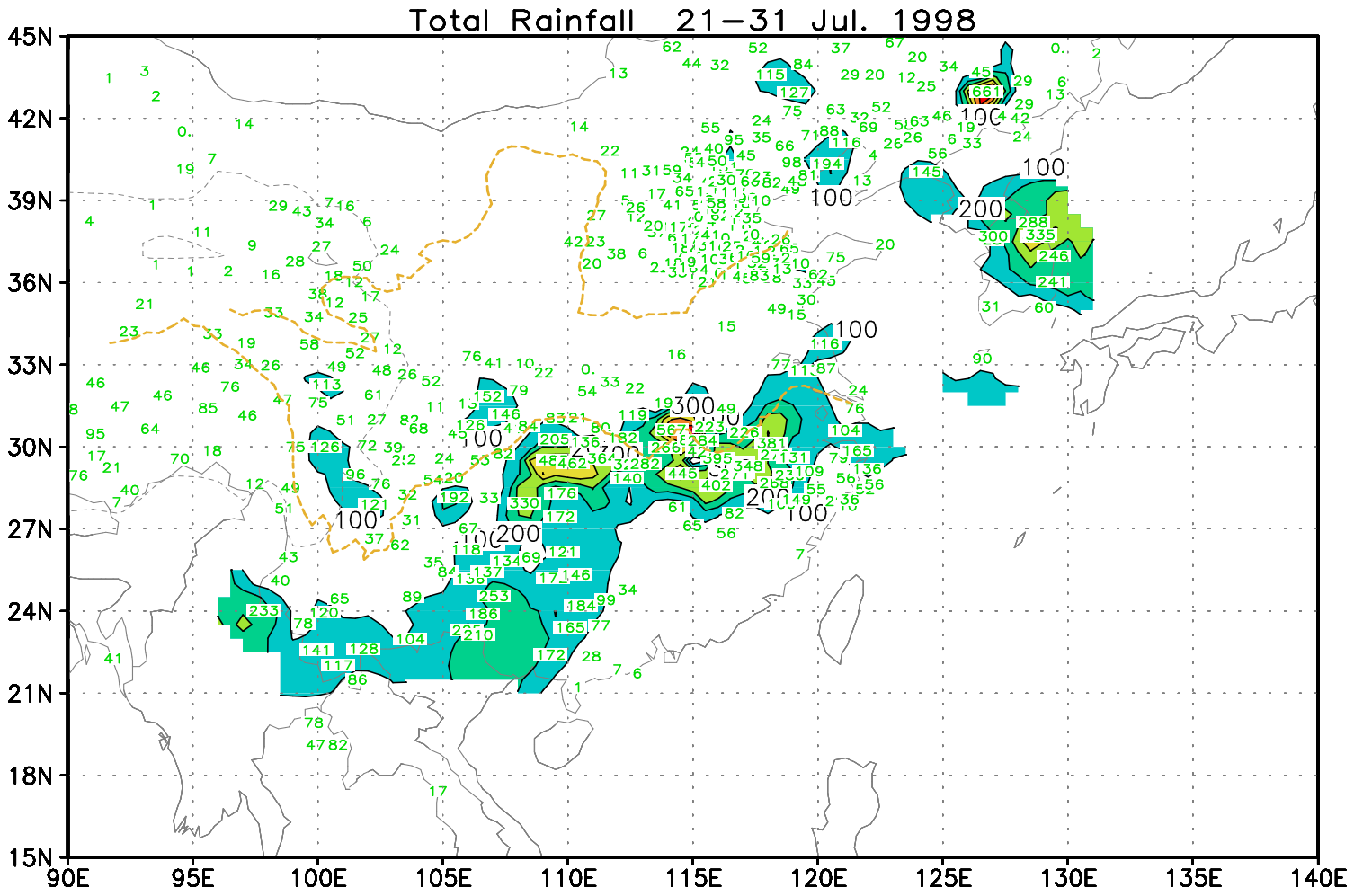
OUTLINE

- Disaster Phenomena Occurred in China
- Relation between Disaster and Convections
- Adaptive Observations
- Data Analysis
- Numerical Simulation
- Summery

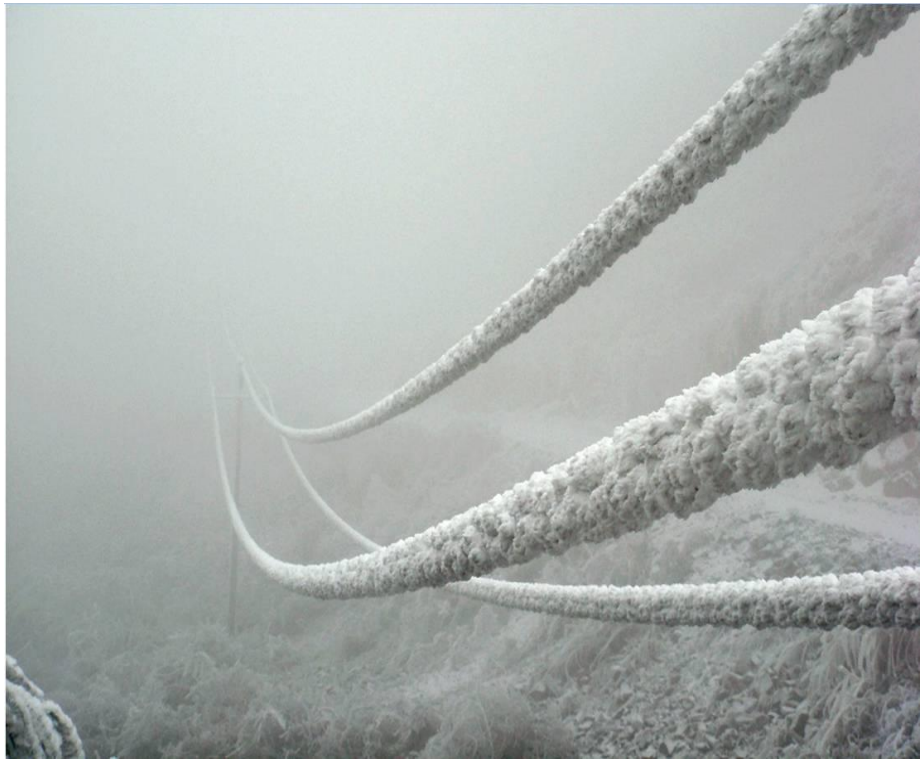
Disaster Phenomena Occurred in China

Flooding in July 2007, China



Total rainfall (mm) from 21 to 31 July in 1998

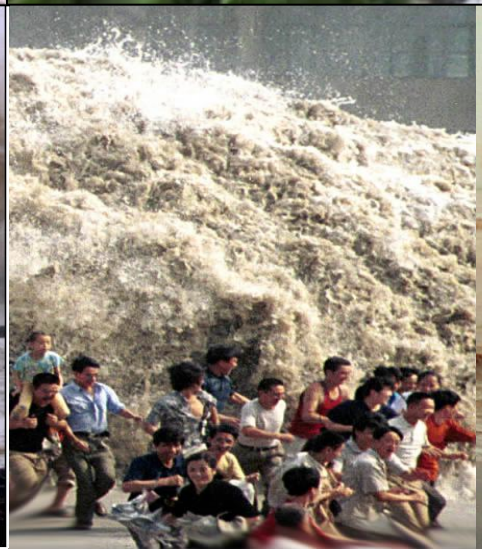
Frozen Rain Disaster in Year 2008



Typhoon

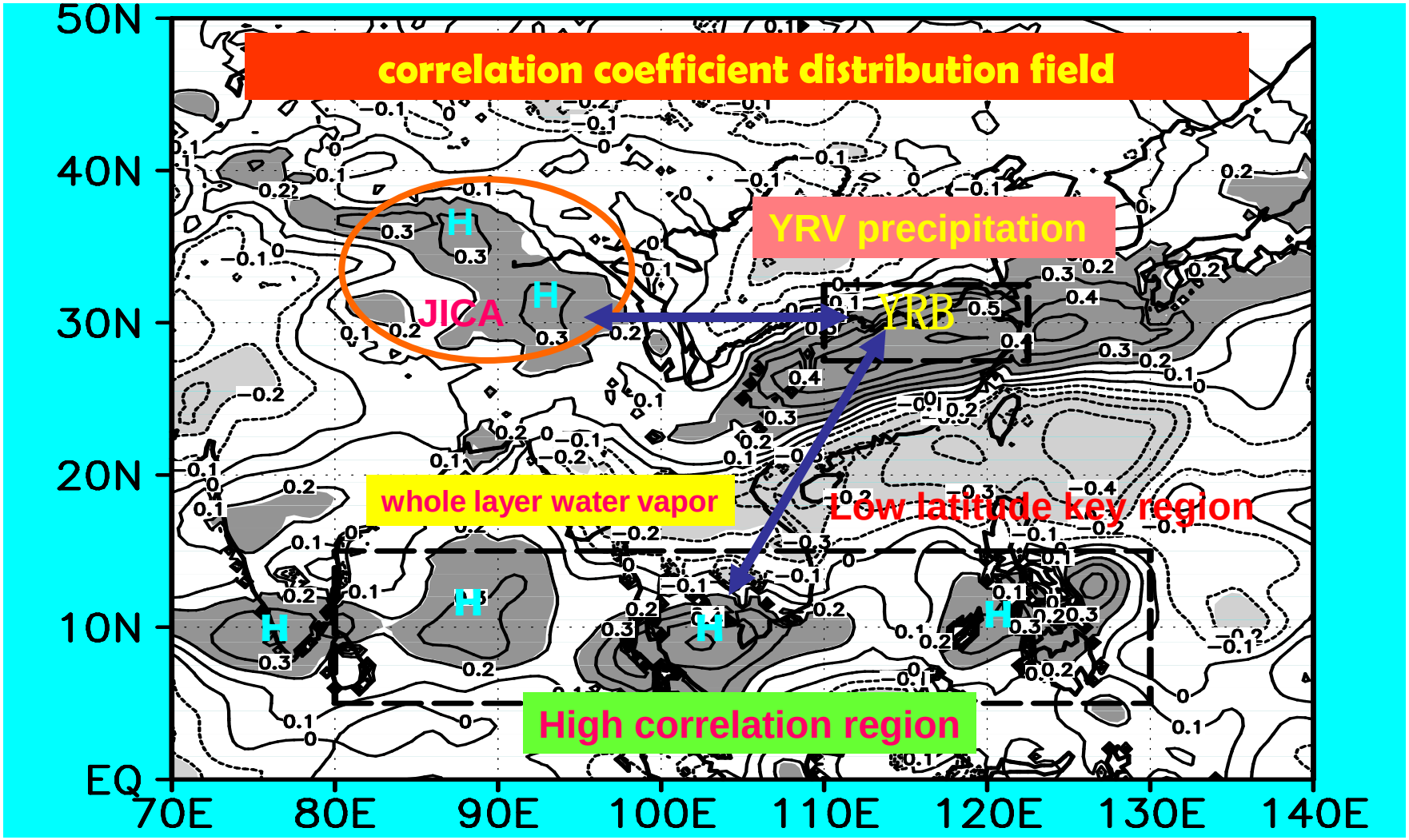
Typhoon （No. 0606）

Typhoon (No. 0216)

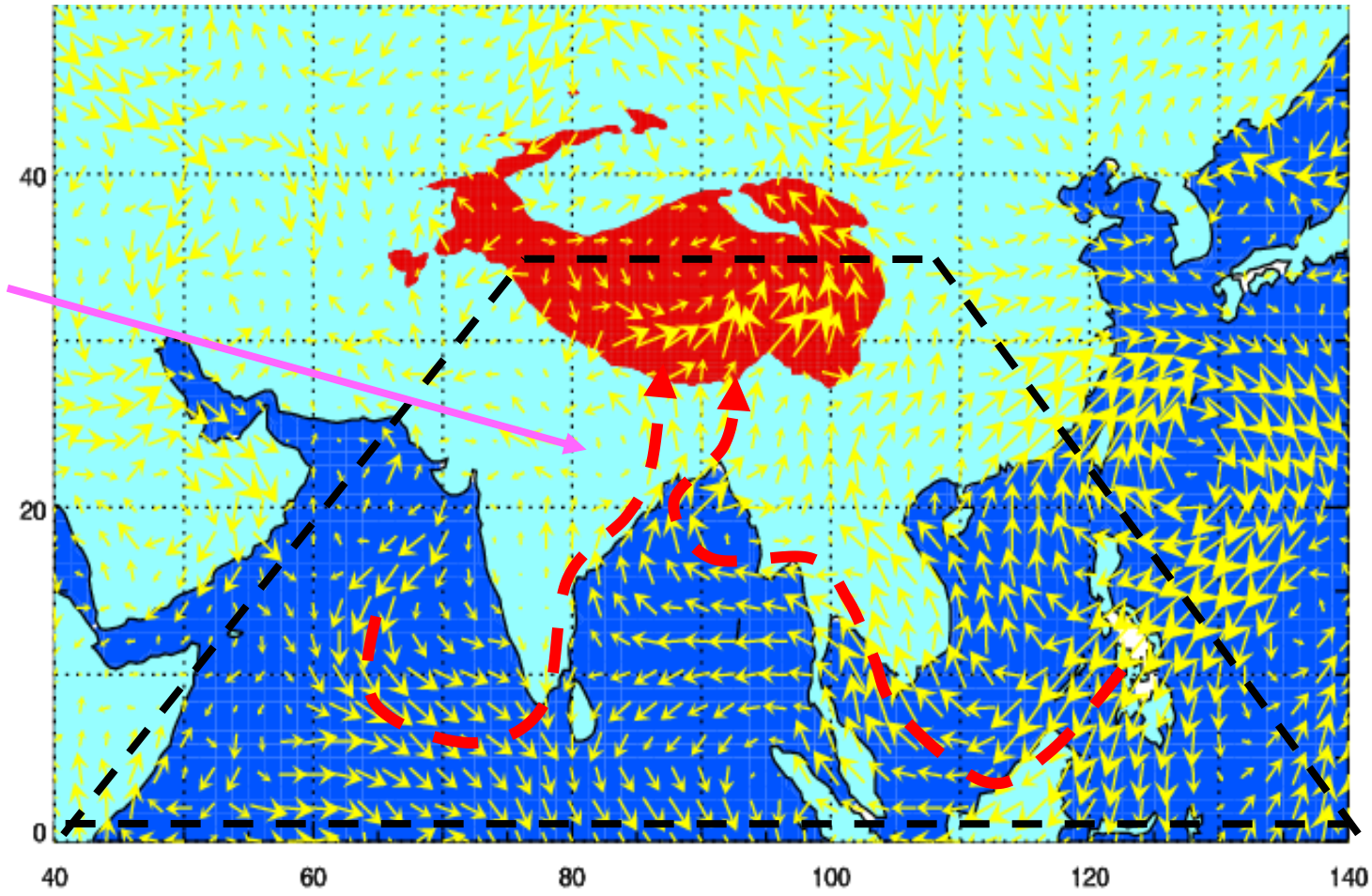


Relation between Disaster and Convections

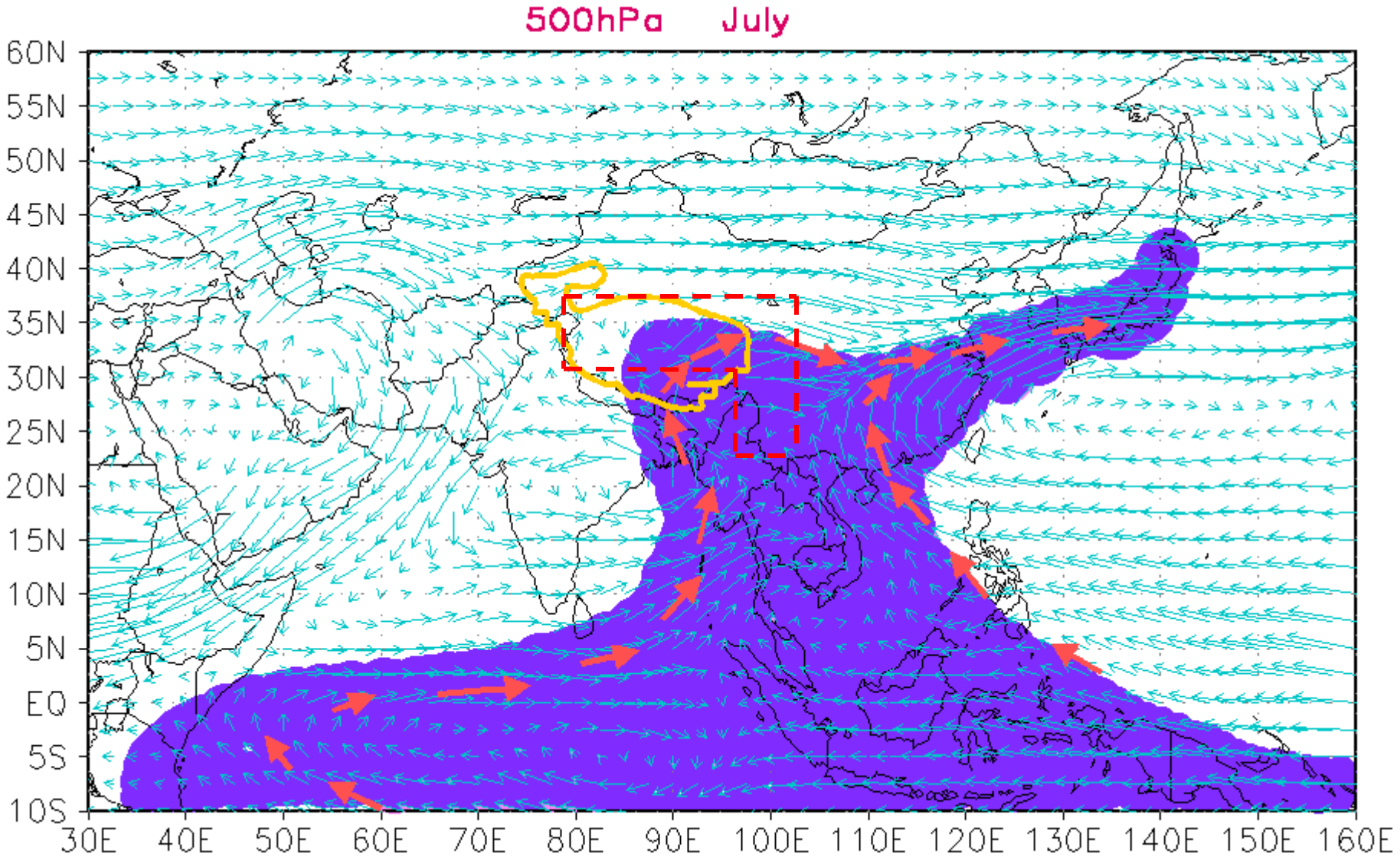
the correlation between the daily precipitation in the YRV and the whole layer water vapor in East Asia



The spatial distribution of the correlation coefficient between the daily precipitation in the YRV and the whole layer water vapor in East Asia during June 1 and July 31, 1998. The shaded areas are with correlation coefficients at 0.1 significance level and above.

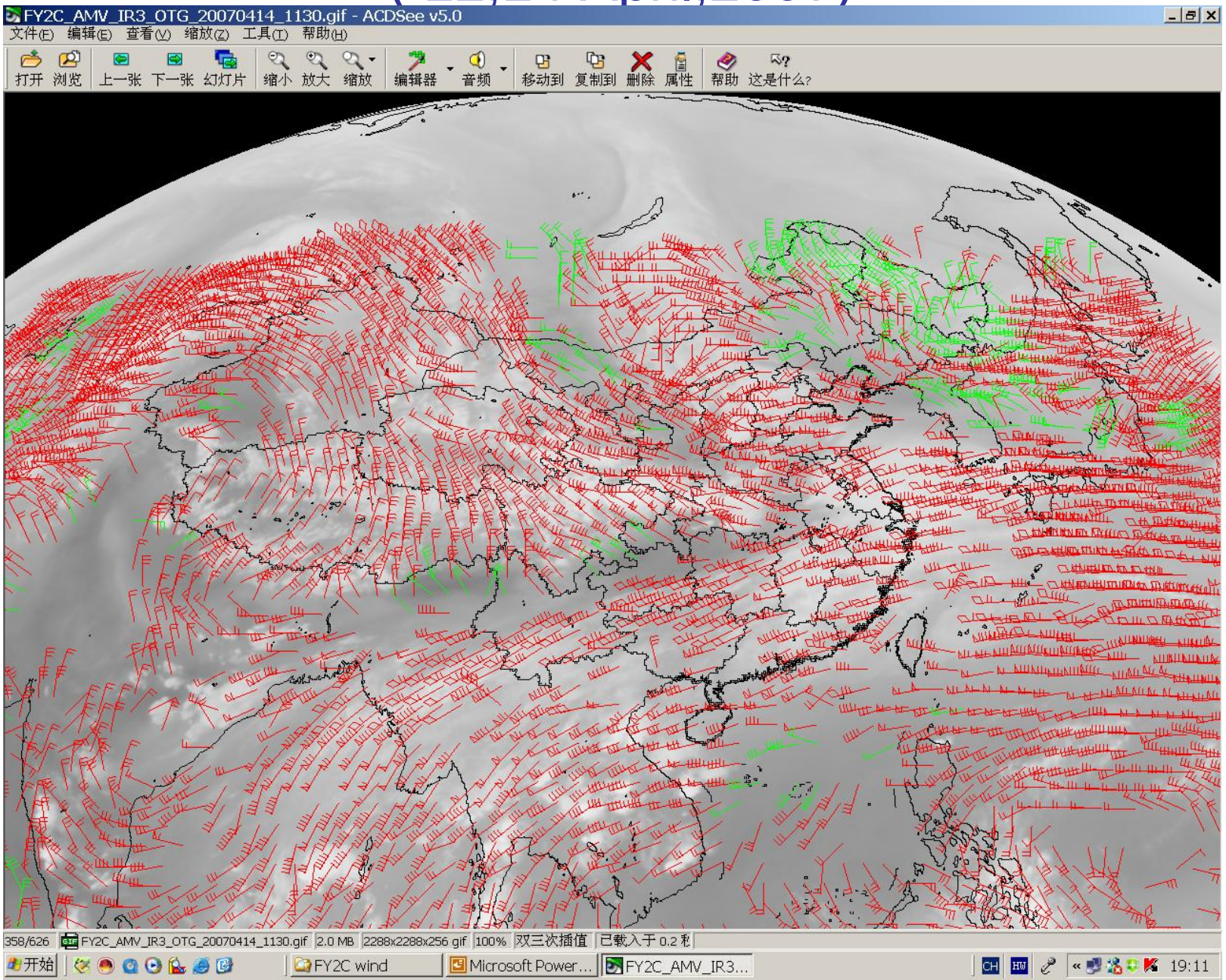


16-19 July 2007, water vaper passage

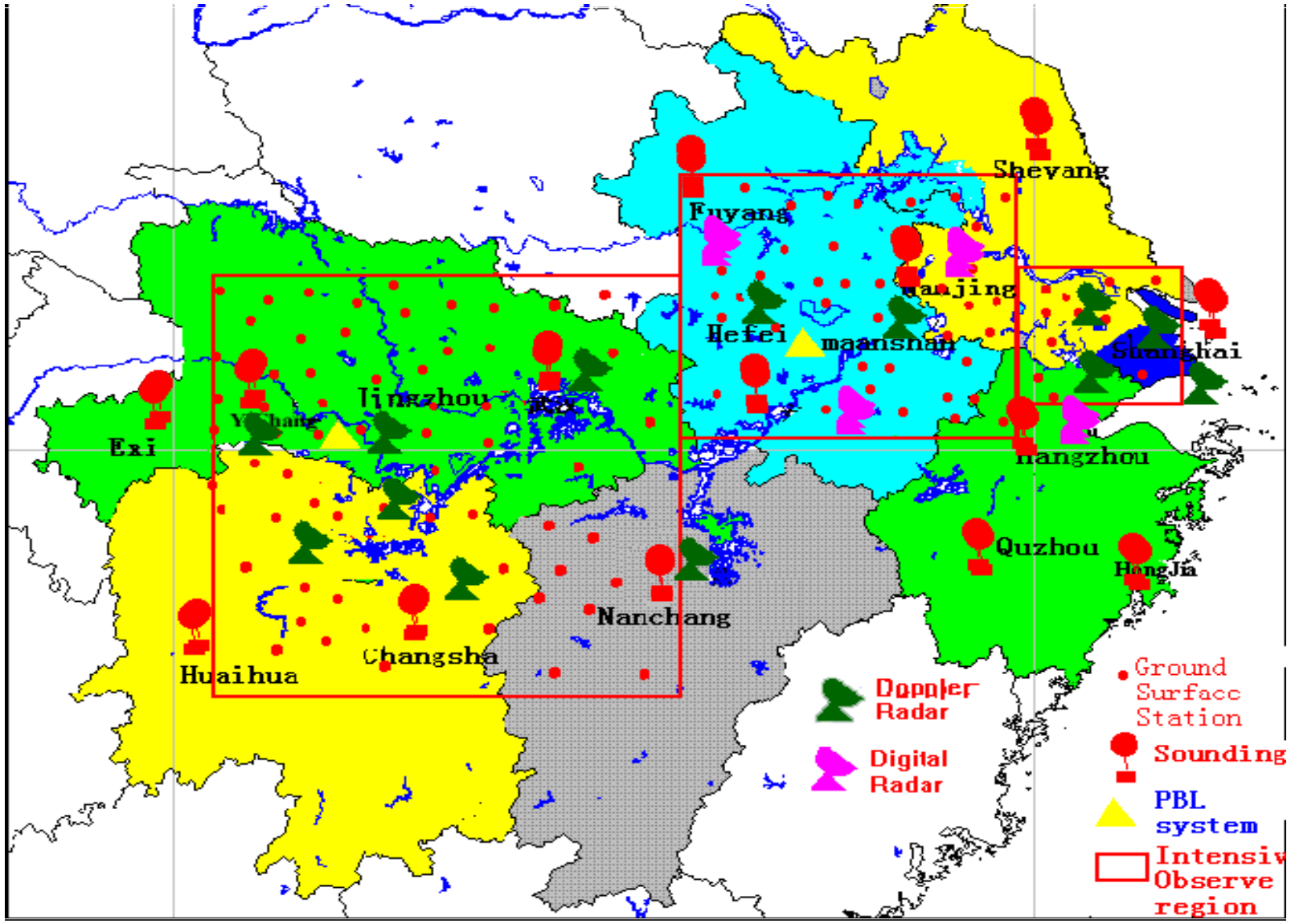


Water vaper passage Averaged in July, 1998

Clouds, water vaper and winds from satellite image (12,14 April,2007)

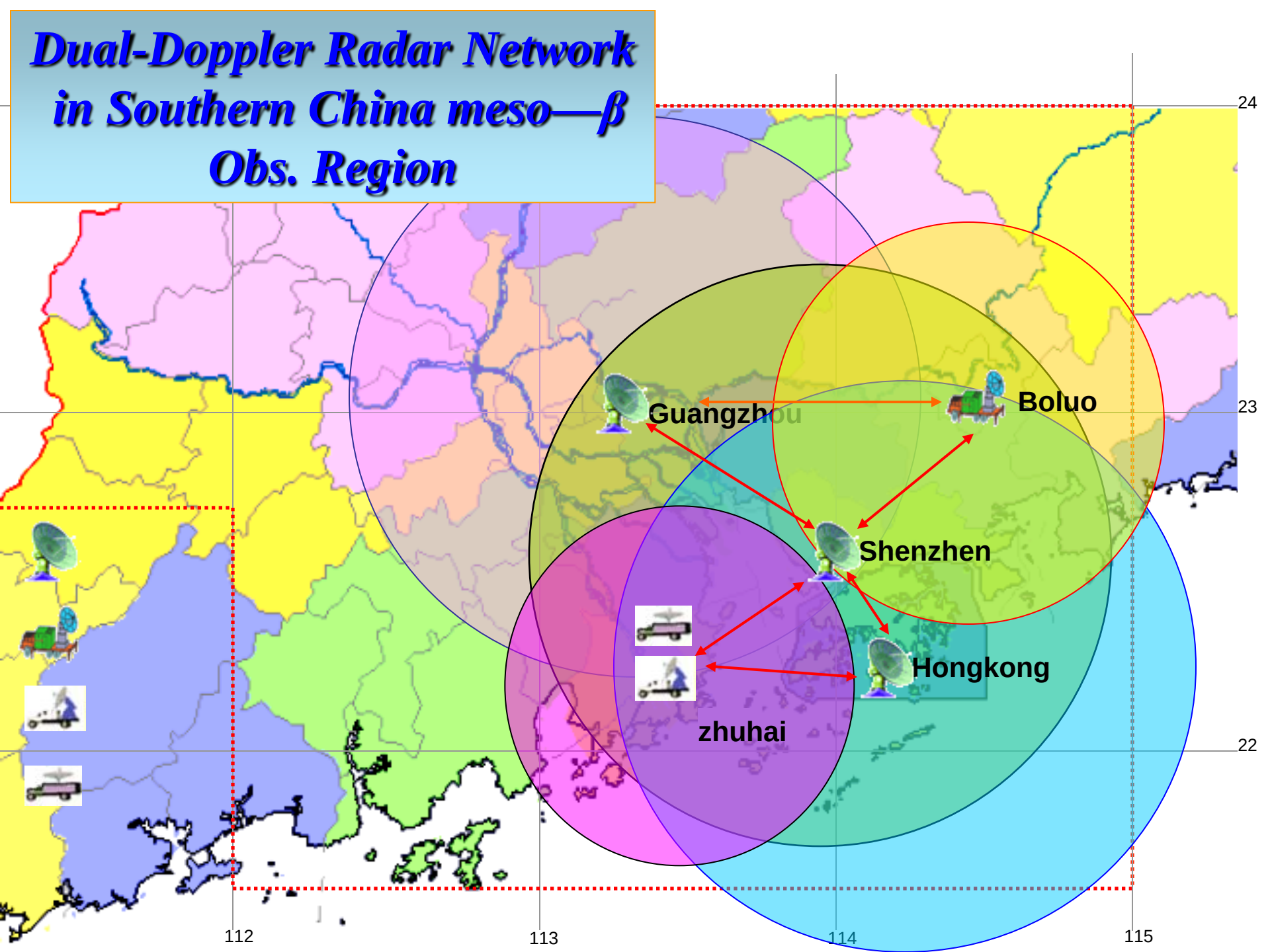


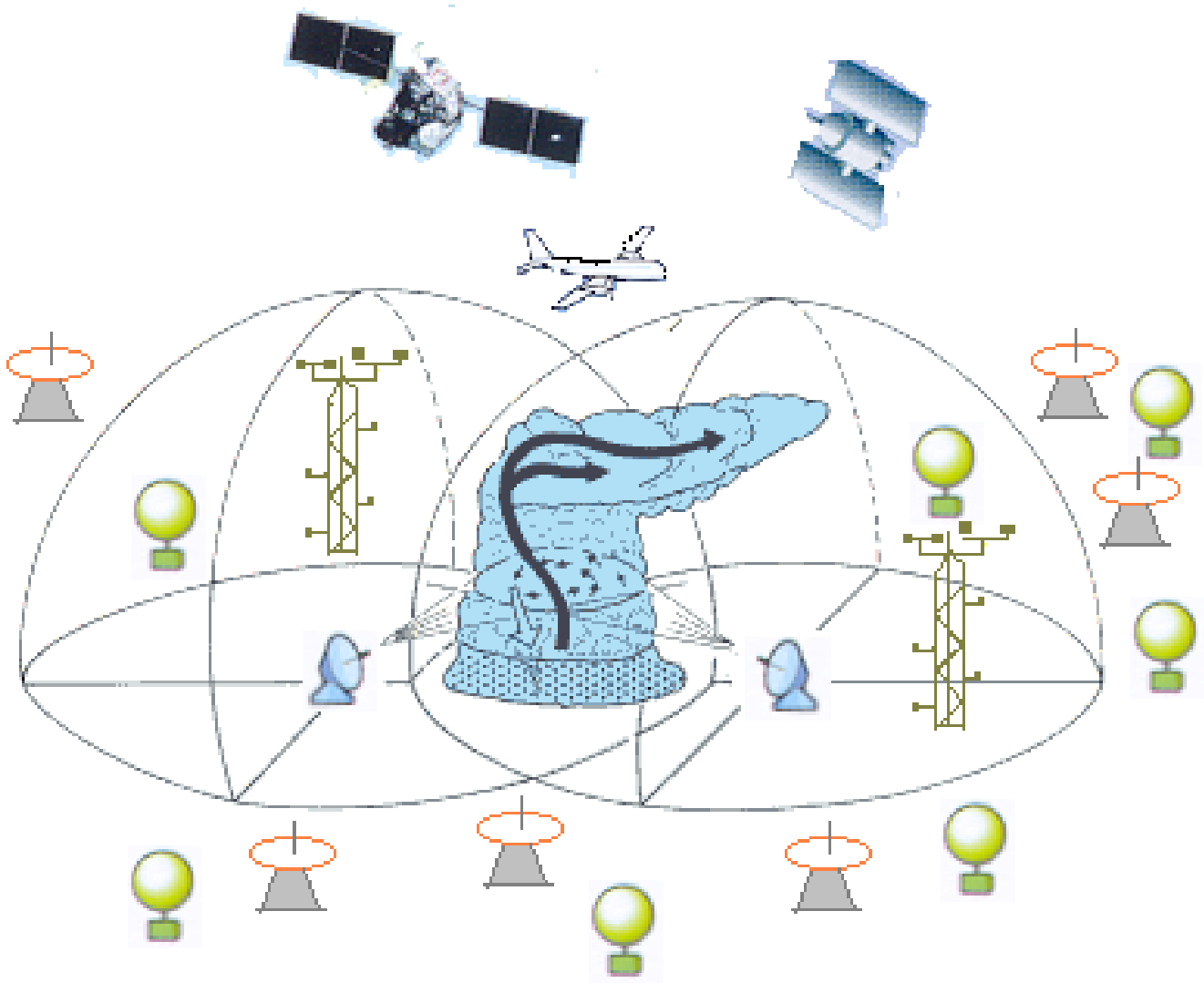
- Adaptive Observations



Three Meso-ß Intensive Observation Regions (2002-2008)

Dual-Doppler Radar Network in Southern China meso—β Obs. Region





Double doppler radar observation

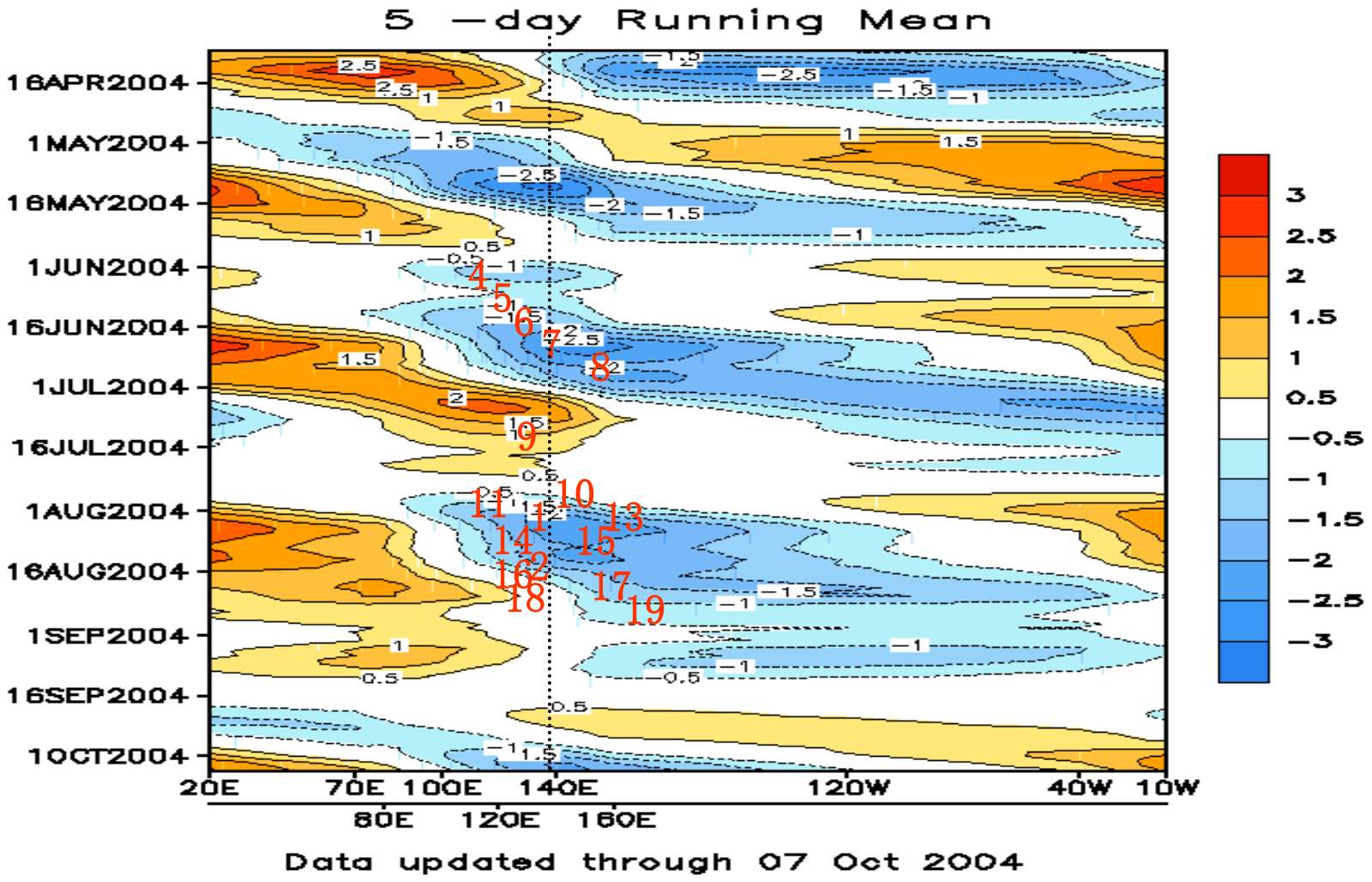
Doppler Radar

Radiosonde balloon

GPS

- Data Analysis

The Effect of MJO on Typhoon genesis From June to September, 2004

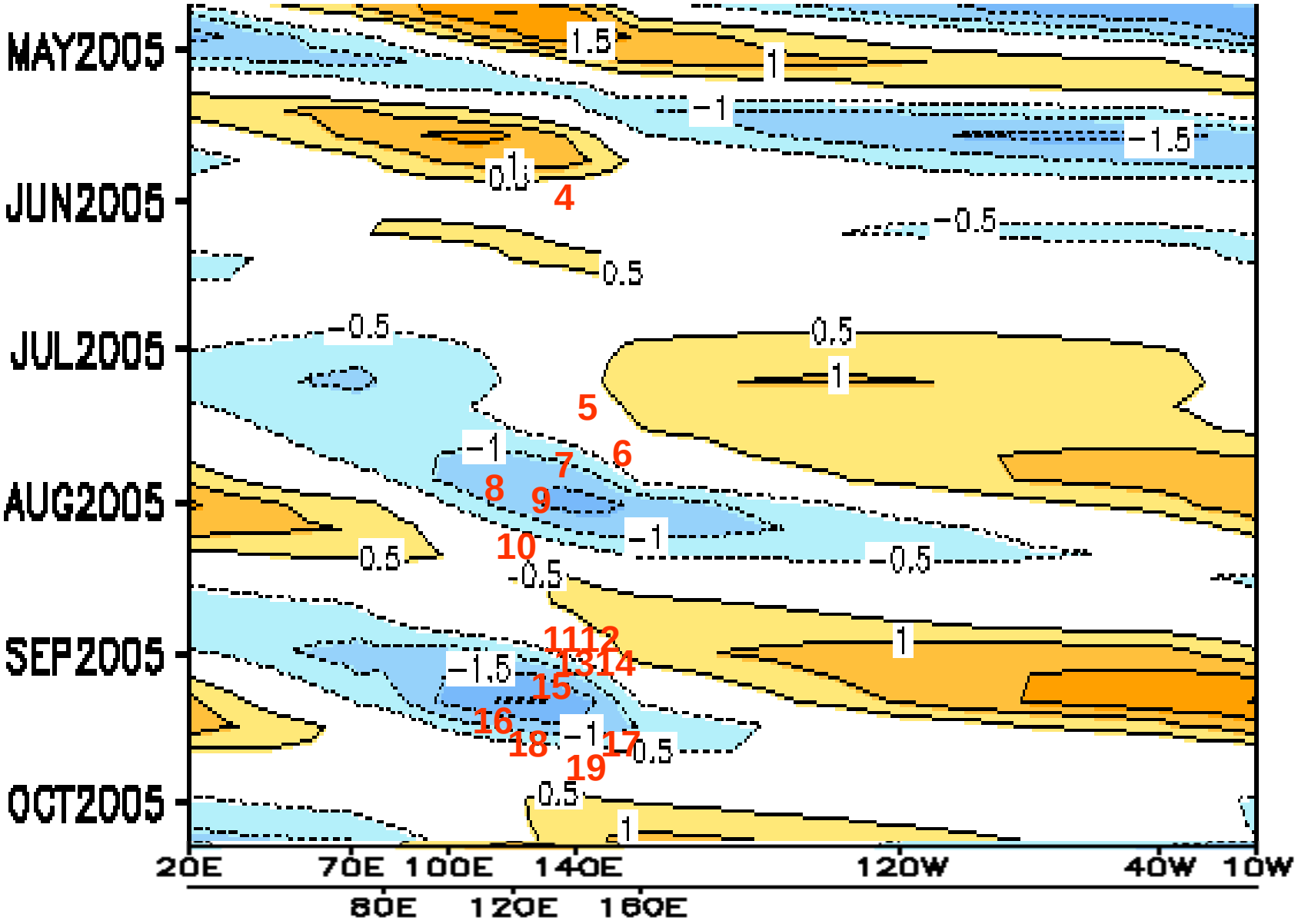


MJO（shaded: active phase）

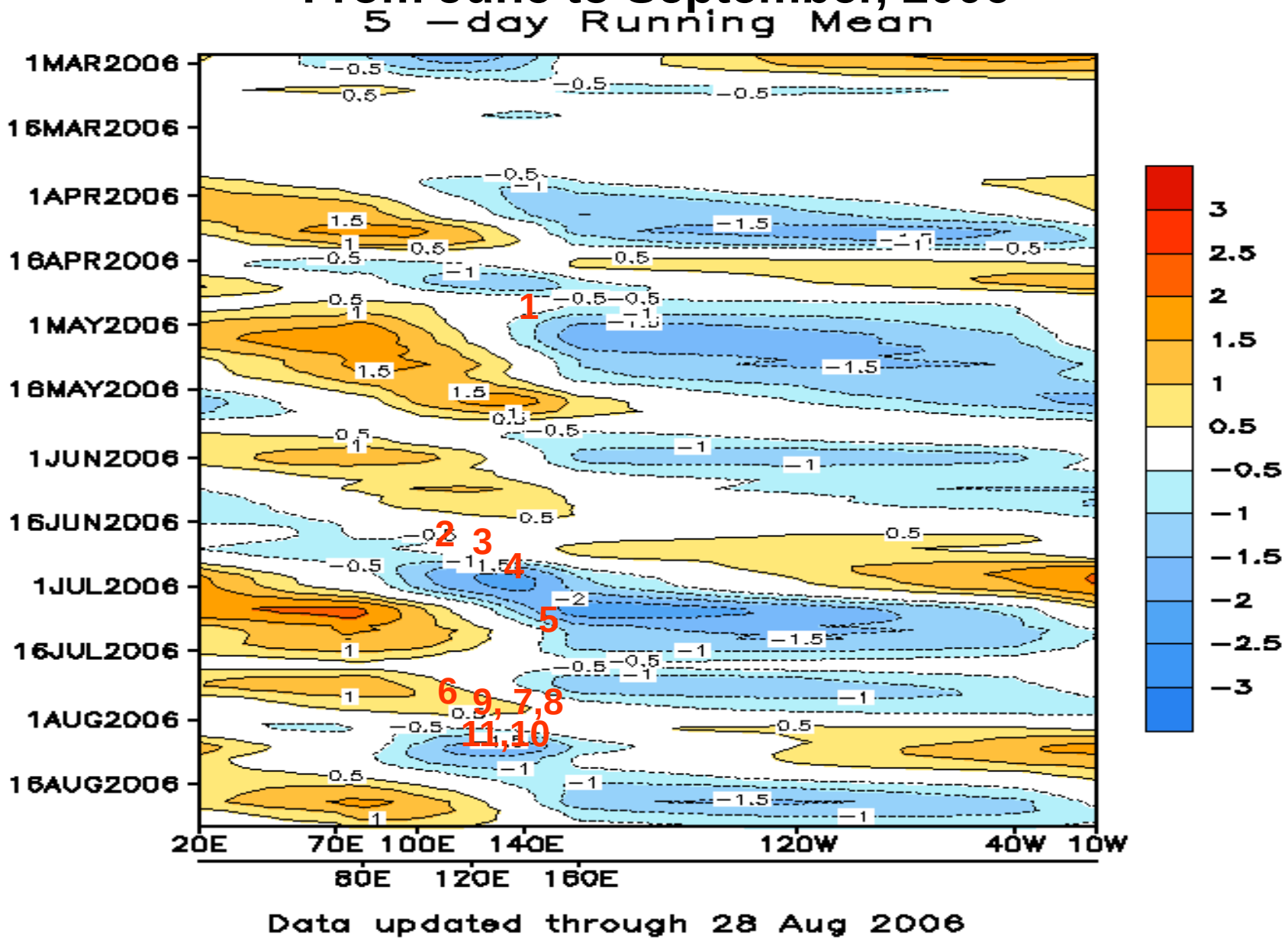
Website：http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_mjo_index/mjo_index.shtml

Wheeler, M. C., and H. H. Hendon, 2004: An all-season real-time multivariate MJO index: Development of an index for monitoring and prediction. *Mon. Wea. Rev.,* 132, 1917–1932.

The Effect of MJO on Typhoon genesis From June to September, 2005

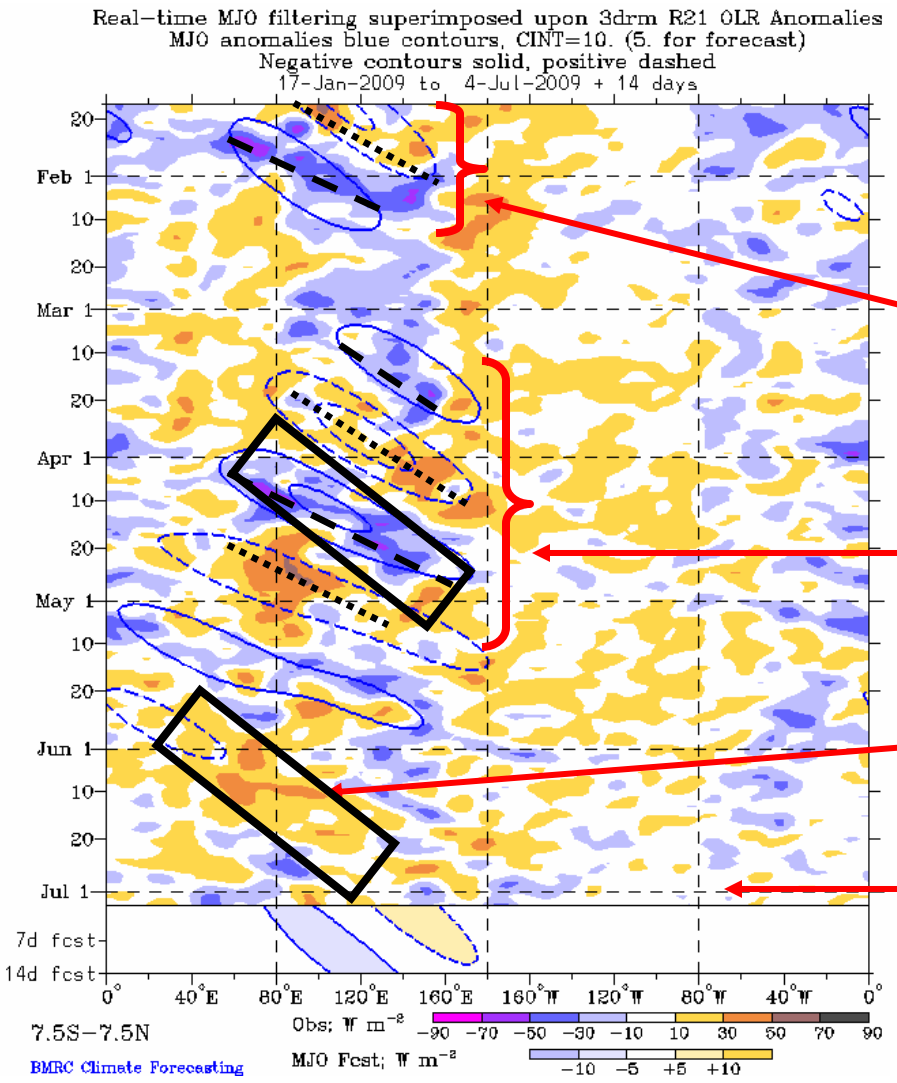


The Effect of MJO on Typhoon genesis From June to September, 2006



The Interaction between MJO and Asia Monsoon

Outgoing Longwave Radiation (OLR) Anomalies (7.5° S-7.5° N)



Drier-than-normal conditions, positive OLR anomalies (yellow/red shading)

Wetter-than-normal conditions, negative OLR anomalies (blue shading)

(Courtesy of the Bureau of Meteorology - Australia)

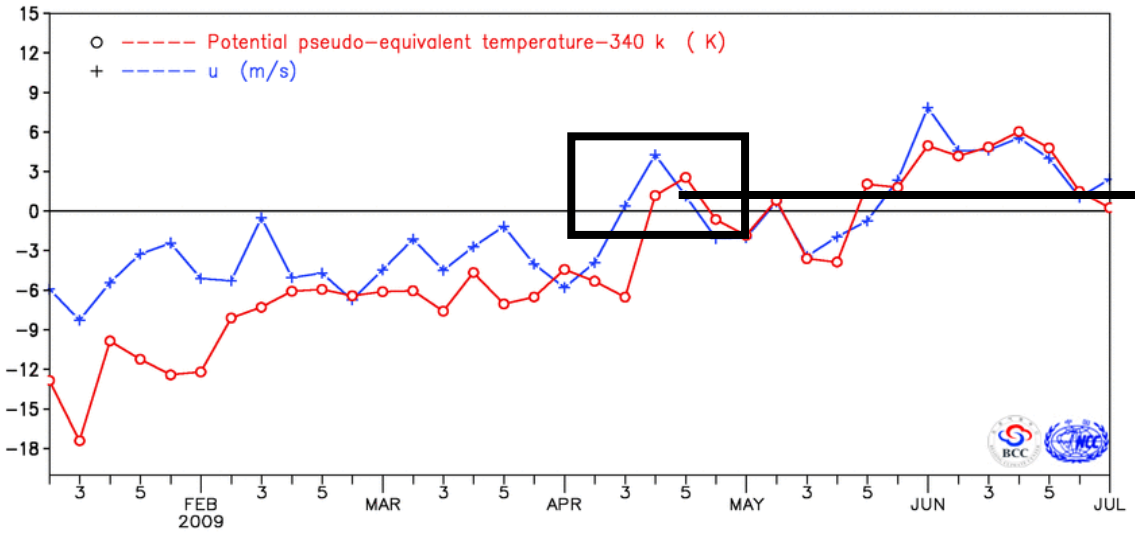
From mid-January to mid-February, eastward movement of suppressed (enhanced) convection is observed from the Indian Ocean to the western Pacific.

From mid-March into early May, areas of suppressed and enhanced convection shifted eastward in association with the MJO.

During the first half of June, suppressed convection prevailed across much of the Indian Ocean and Maritime Continent.

Most recently, equatorial convection is close to average across much of the Tropics.

http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml



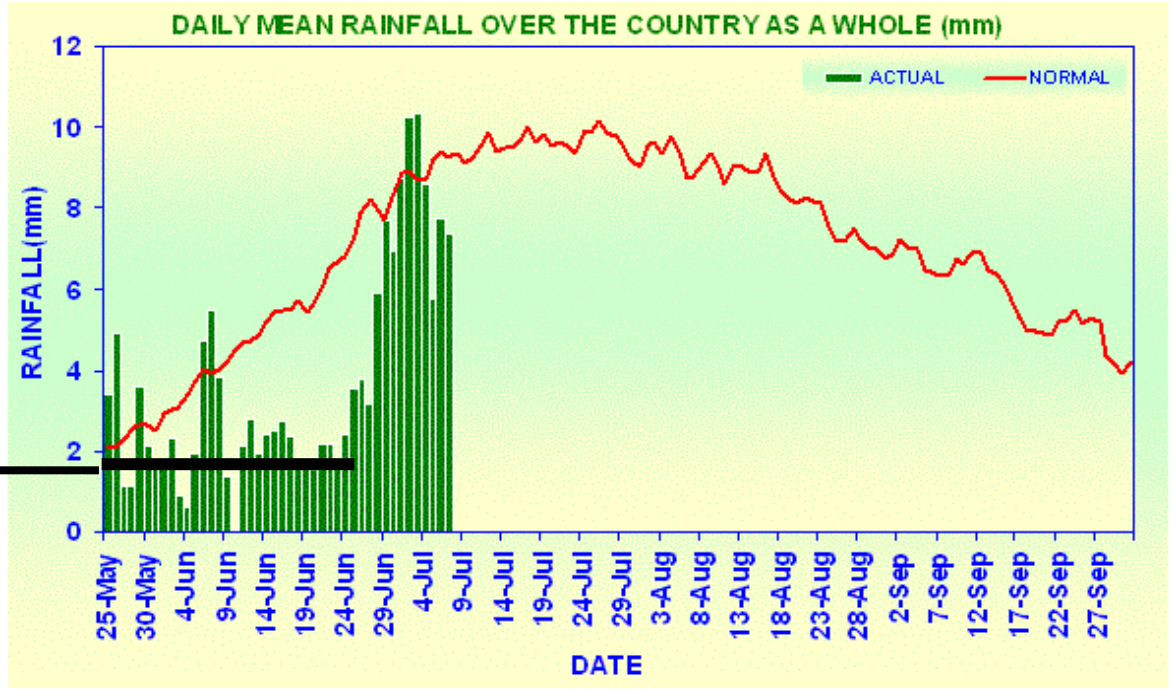
南海监测区纬向风和假相当位温变 化

Variation of Zonal wind and Potential pseudo-equivalent temperature over monitoring region

Climate Diagnostics and Prediction Division/NCC/CMA

South China sea Monsoon onset

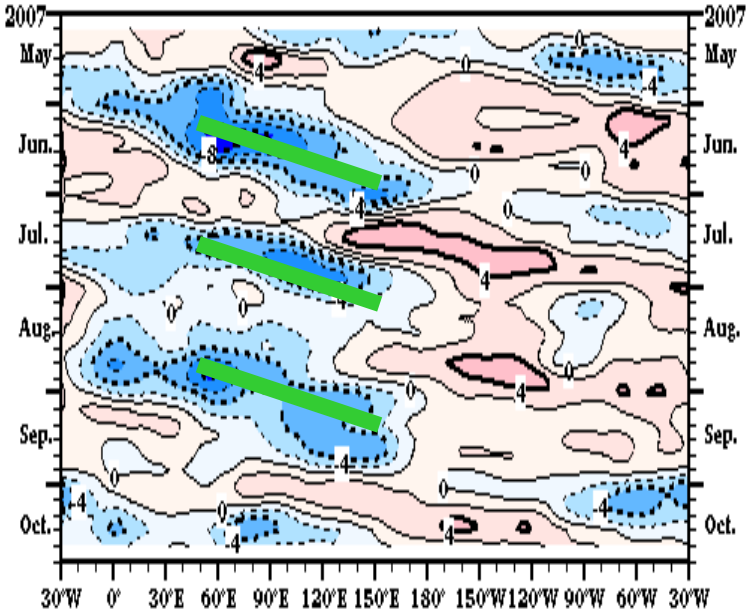
http://ncc.cma



India rain

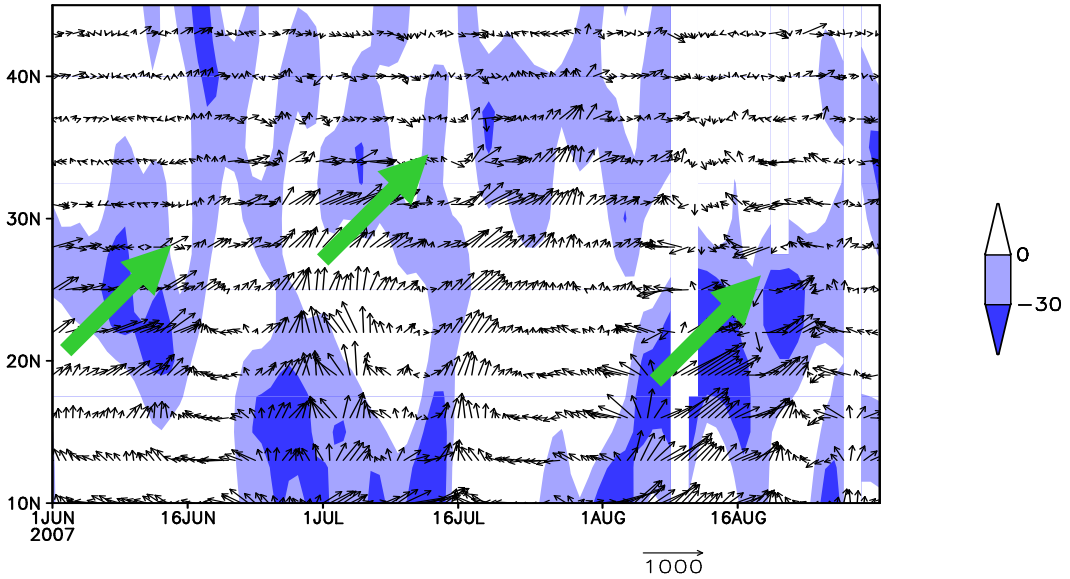
http://www.imdpune.gov.in/mons_monitor/all-India.gif

The Interaction between Asia Monsoon and MJO



Five day running mean time longitude sections of the 200-hPa velocity potential anomaly (5° N-5° S) calculated from daily anomalies: left) total anomaly, right) period mean removed at each longitude. Anomalies are departures from the 1971-2000 base period daily means.

http://www.cpc.ncep.noaa.gov/products/intraseasonal/vpot_tlon.shtml

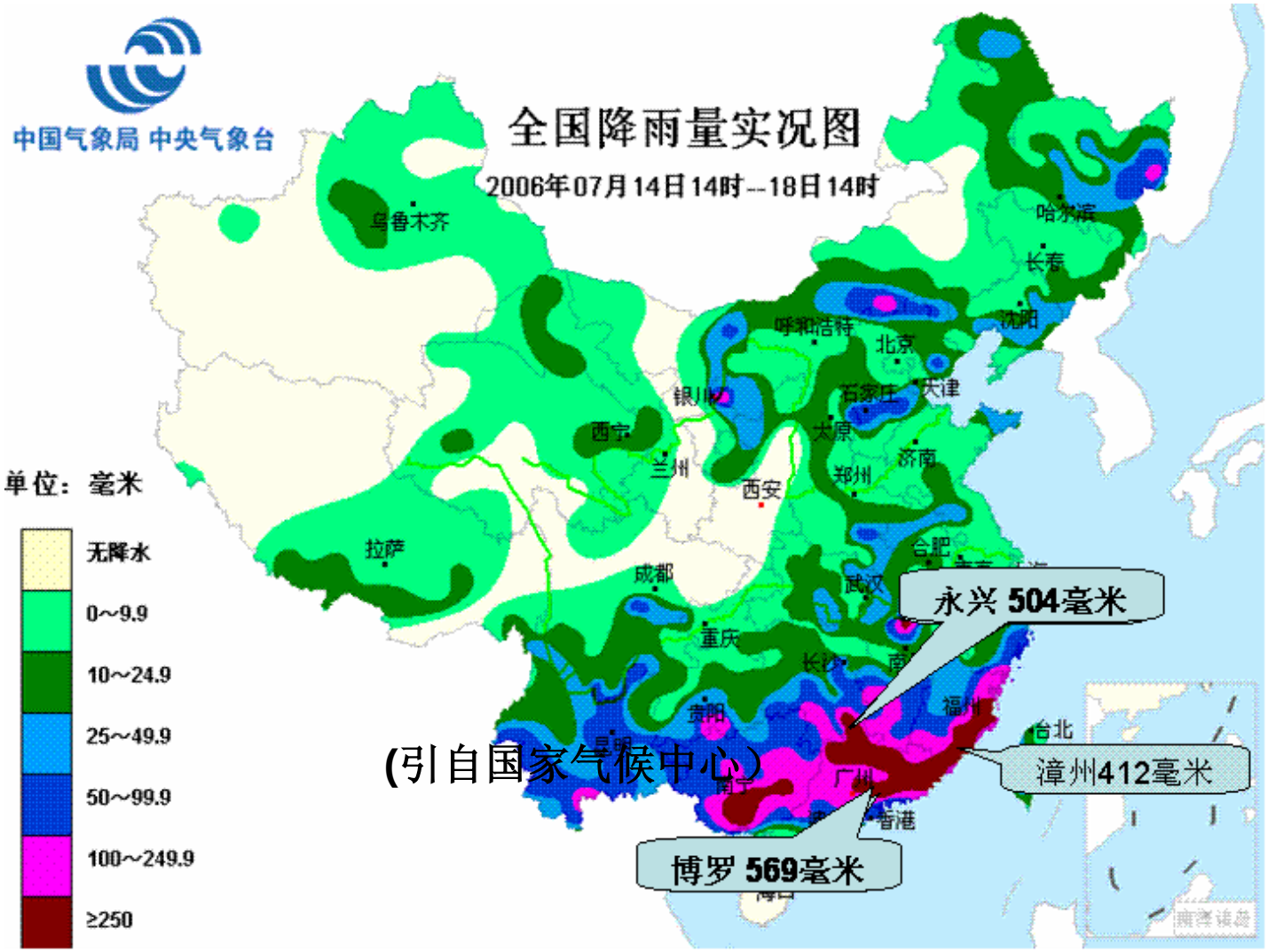


The time–latitude section: the vectors for vertically integrated moisture transports (units: kg·m-1·s-1) with the different darkness shaded area for OLRA (Outgoing Longwave Radiation Anomaly) <0 and -30 W·m-2 averaged over 110－120°E from June to August 2007

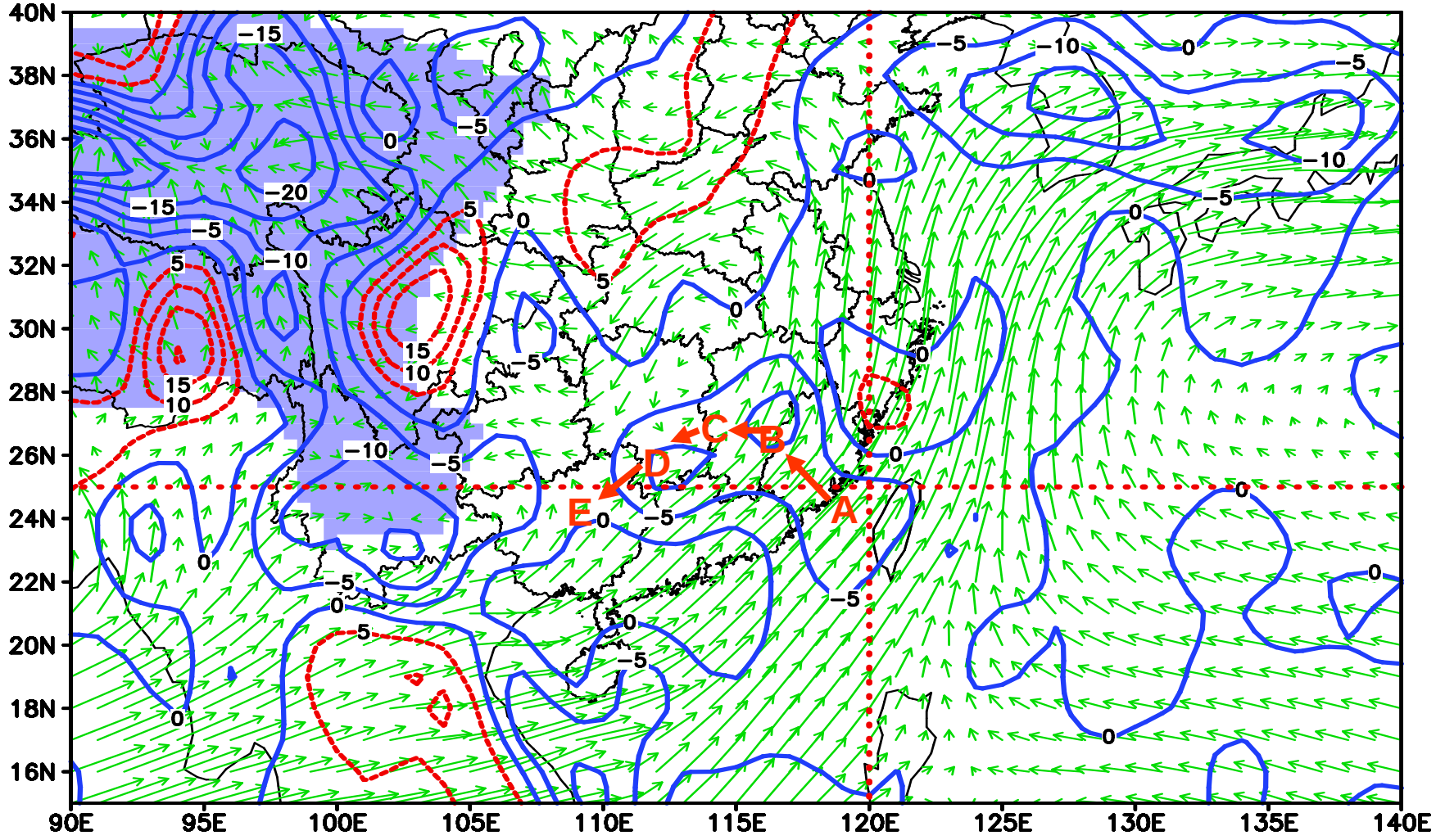
MJO

Summer monsoon in 2007

Heavy Rainfall induced by Bilis



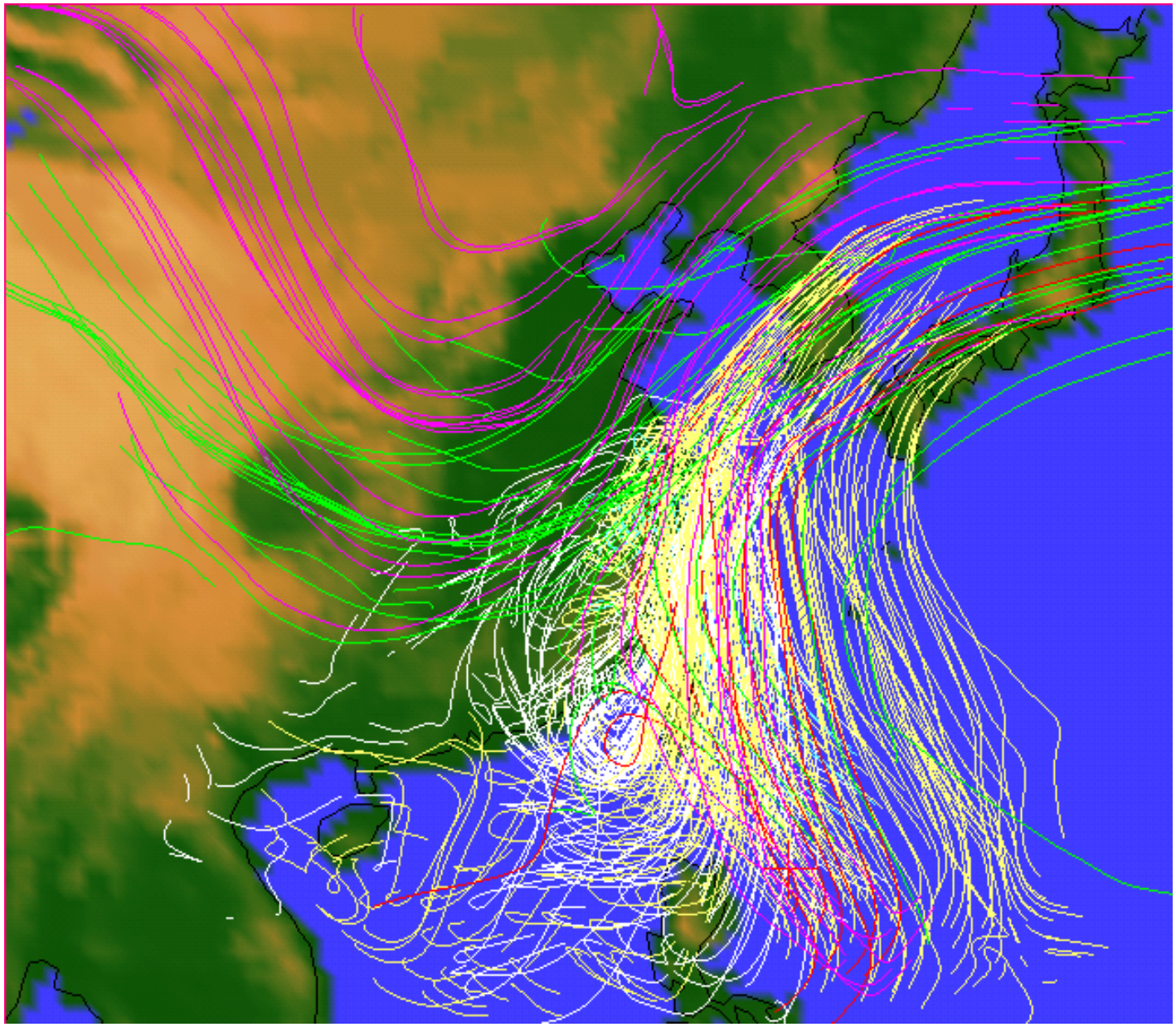
(引自国家气候中心)



Water vapor transportation to Billis at 850 hPa

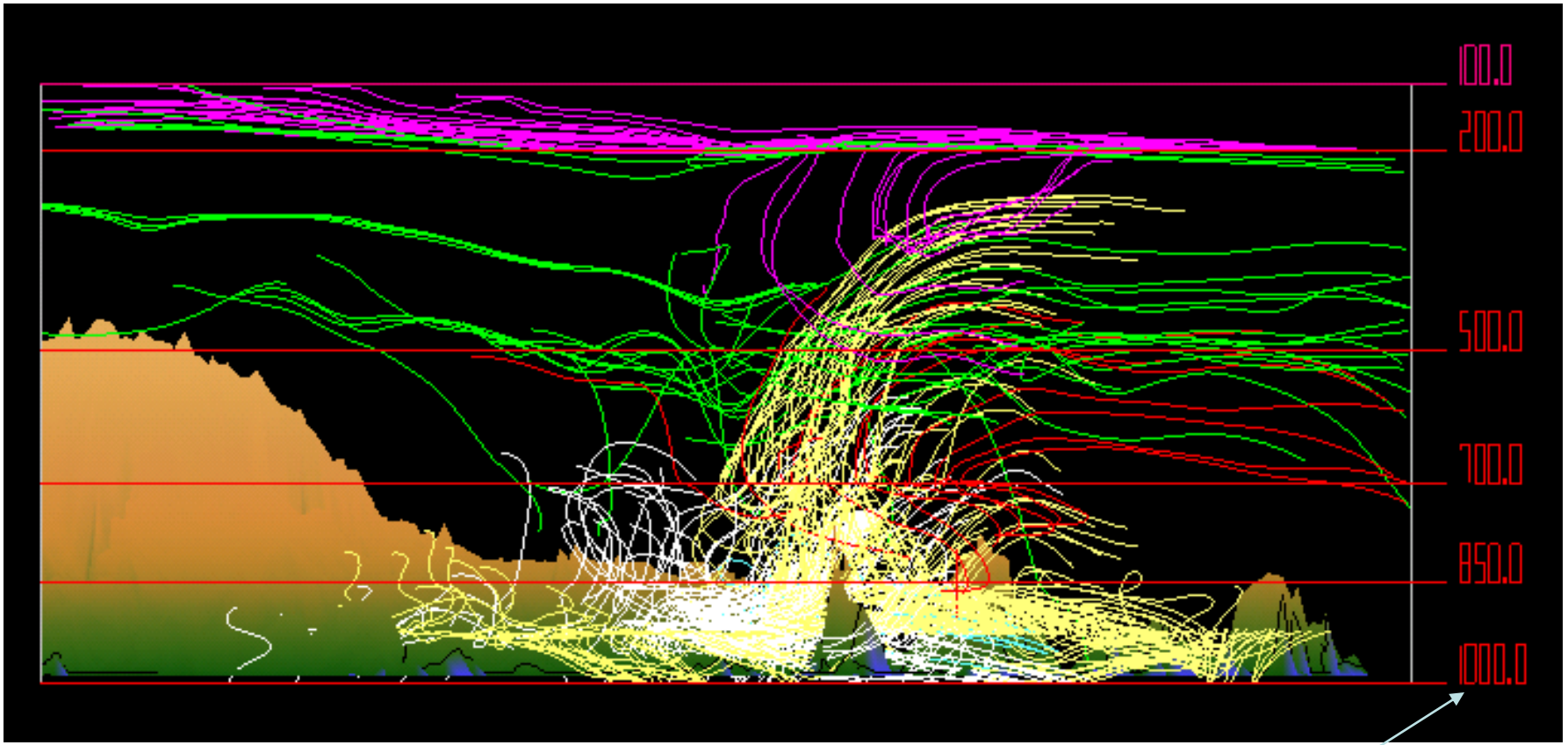
Numerical Simulation

Numerical simulation



Trajectory analysis (bird's-eye view)

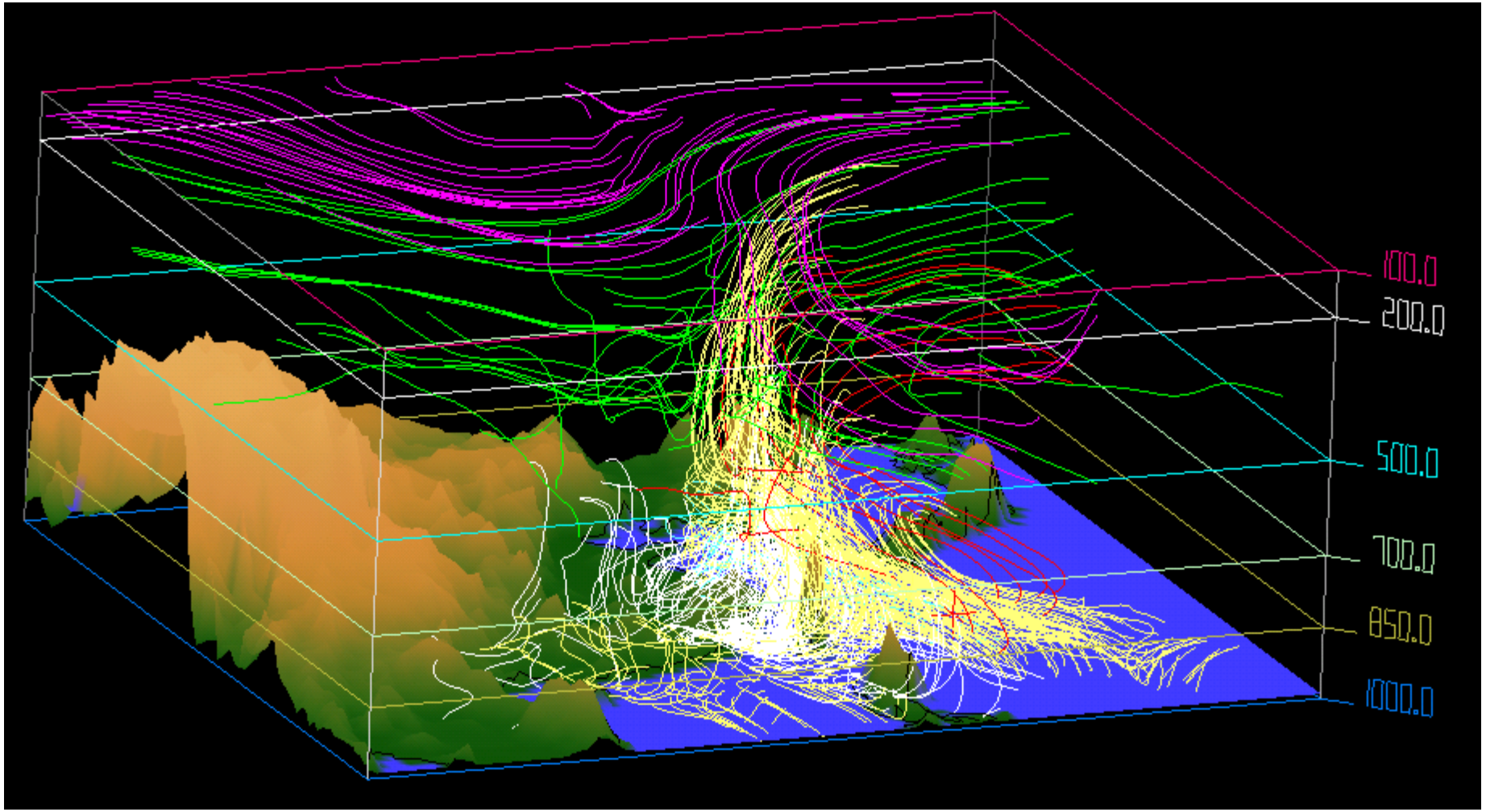
Trajectory analysis (watched from west)

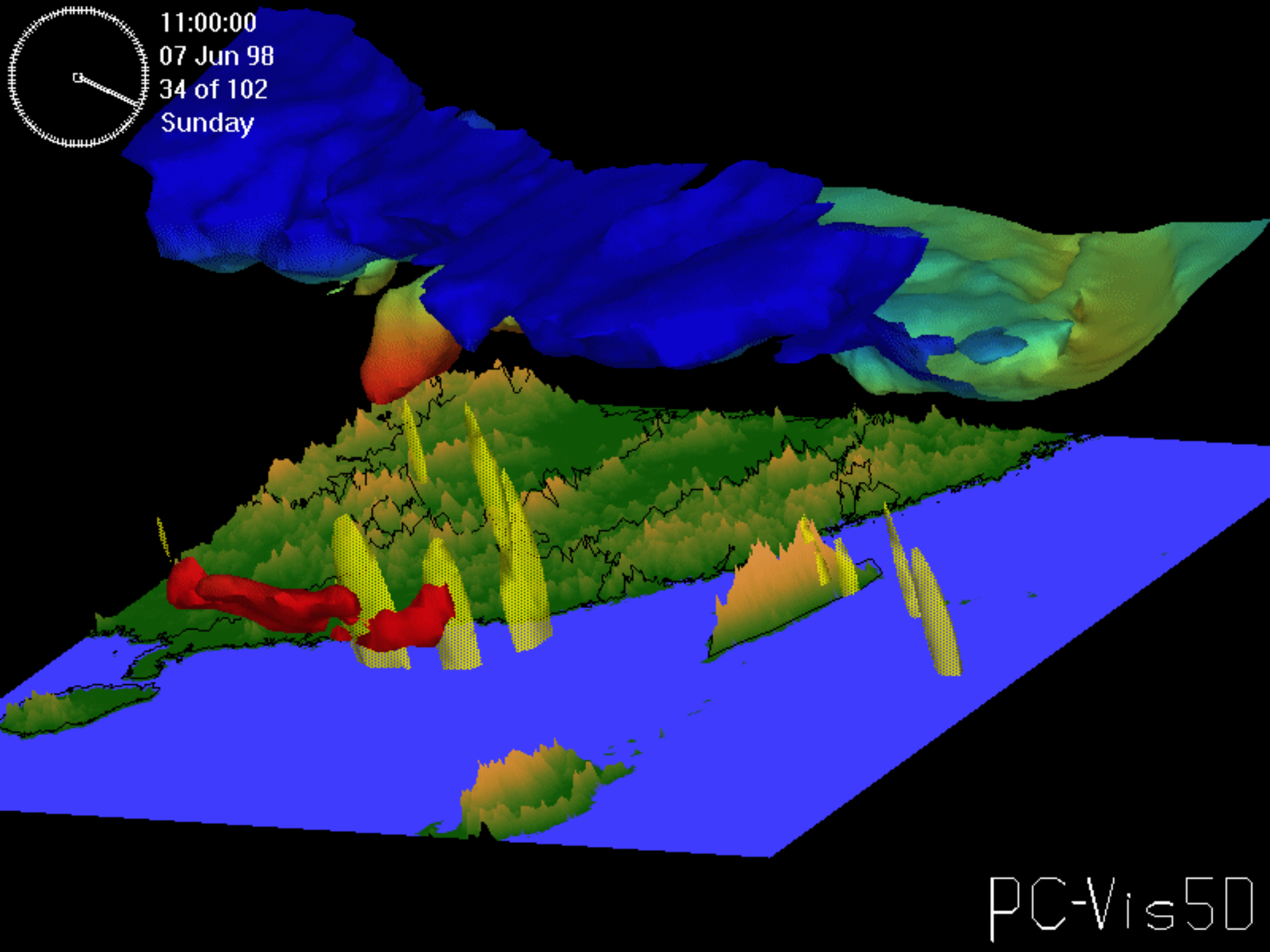


Air parcels at 5 levels

Trajectory analysis (three-dimension plot

(watched from left)

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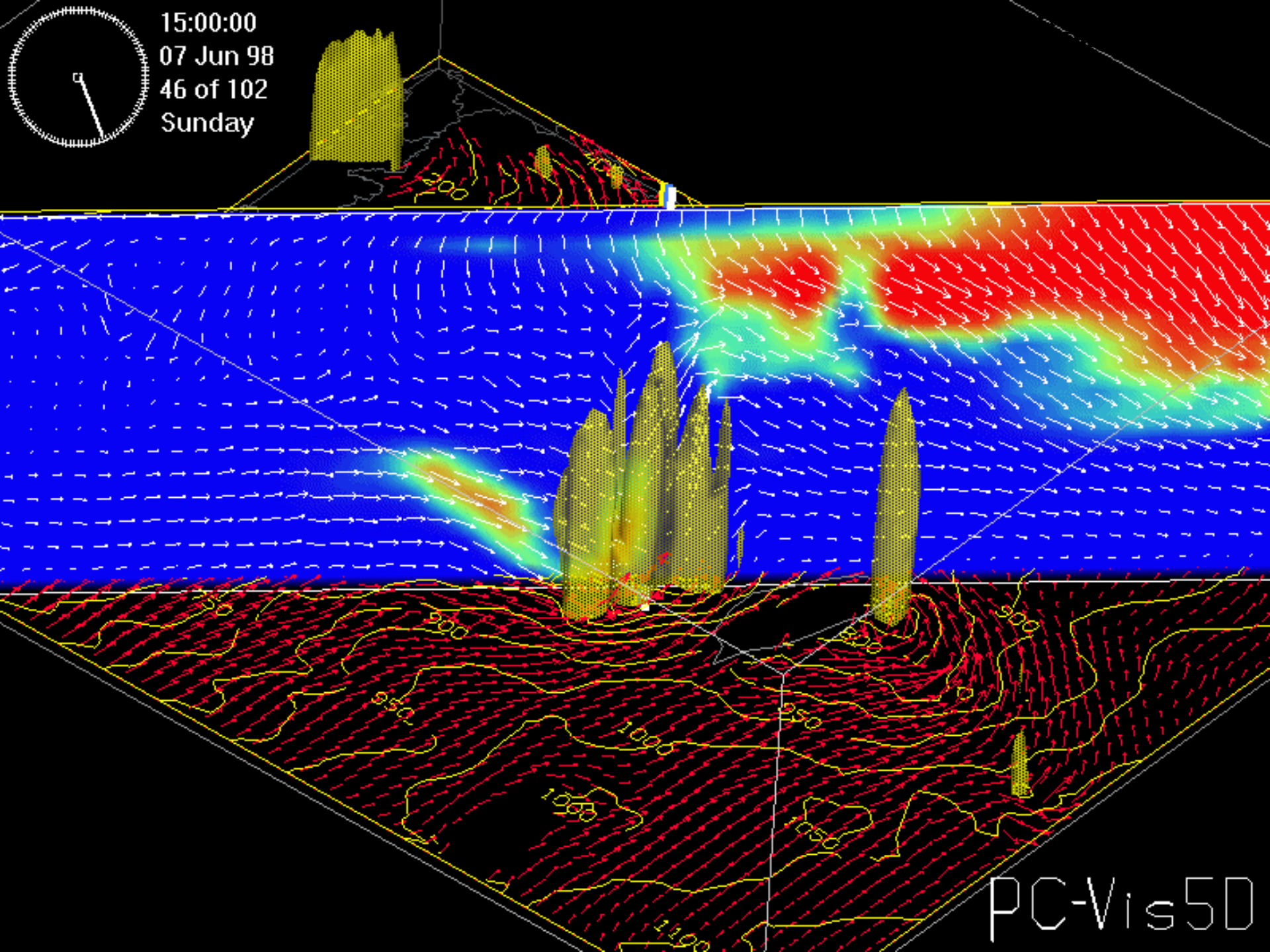
07 Jun 98
34 of 102
Sunday
PC-Vis5D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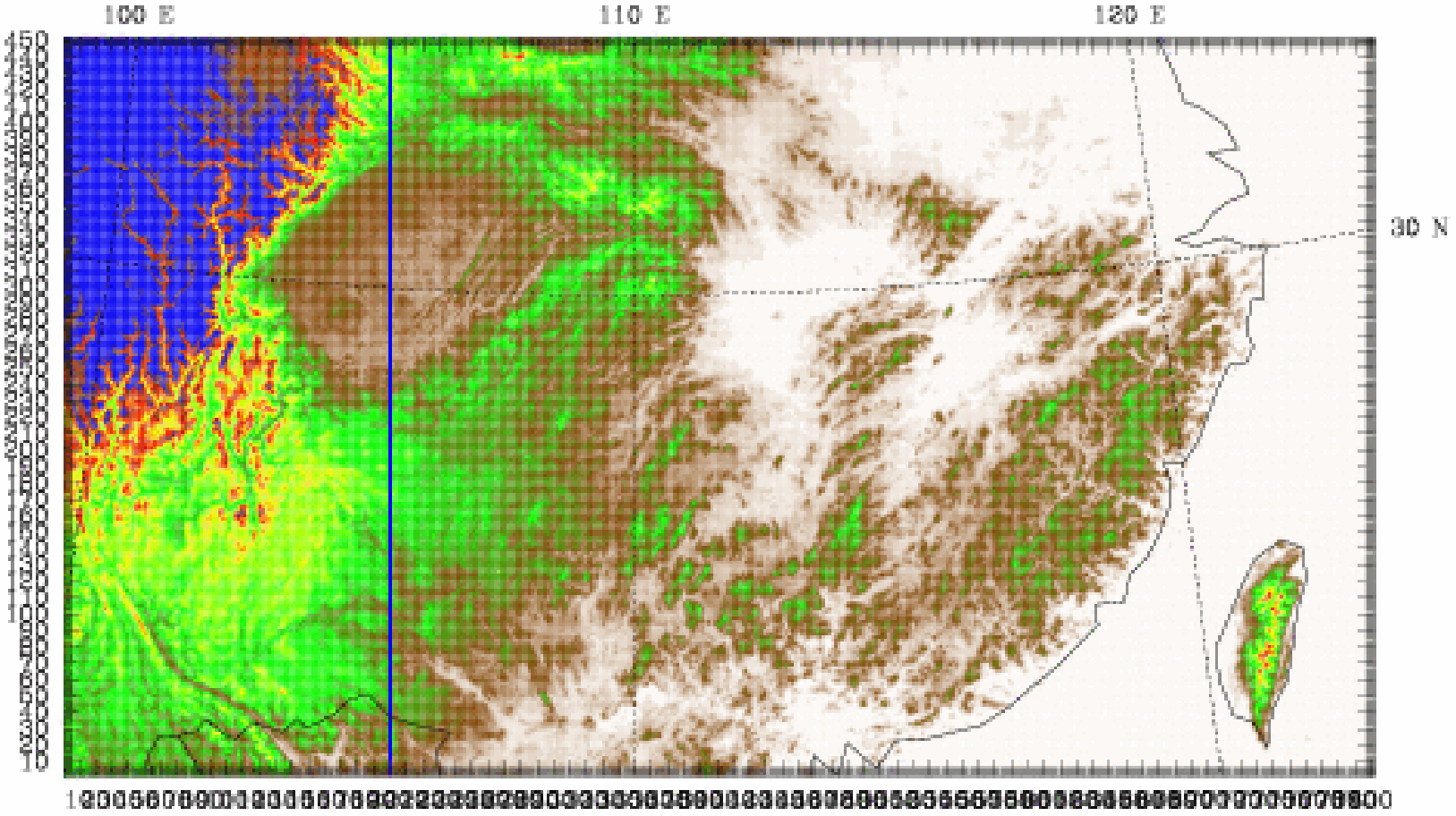
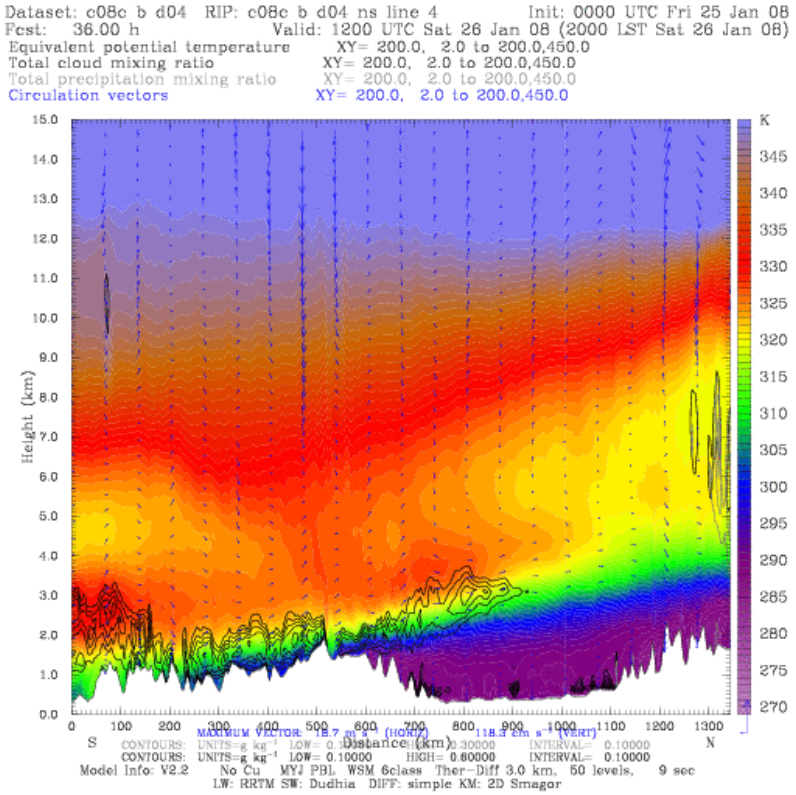
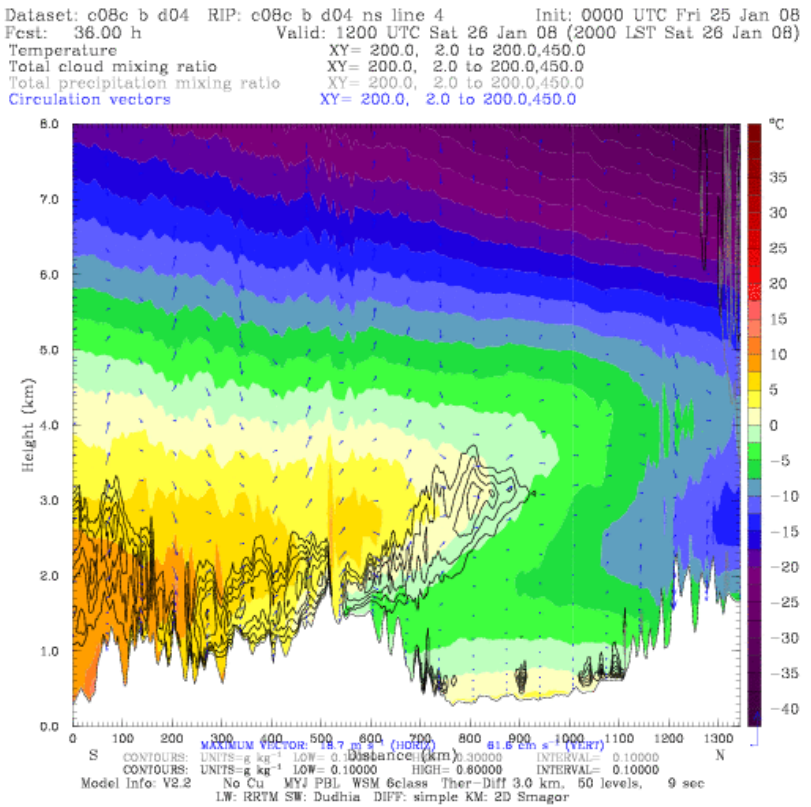
46 of 102
Sunday
PC-Vis5D


100 E
110 E
120 E
30 N
0 250 500 750 1000 1250 1500 1750 2000 2250 2500 2750 3000 3250 3500 3750 m
Model Info: V2.2 No Cu MYJ PBL WSM 6class Ther-Diff 3.0 km, 50 levels, 9 sec
LW: RRTM SW: Dudhia DIFF: simple KM: 2D Smagor

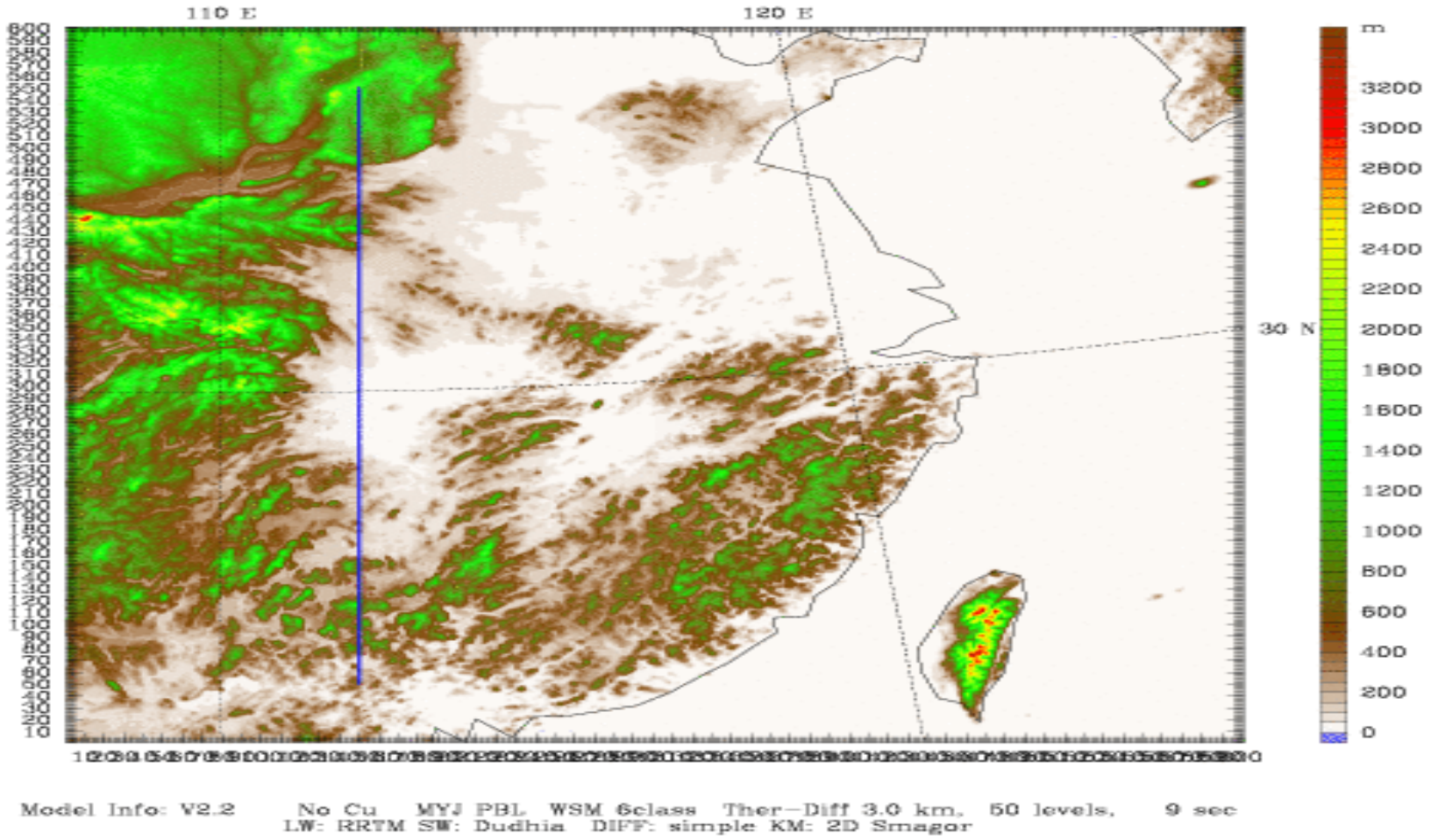
Topography



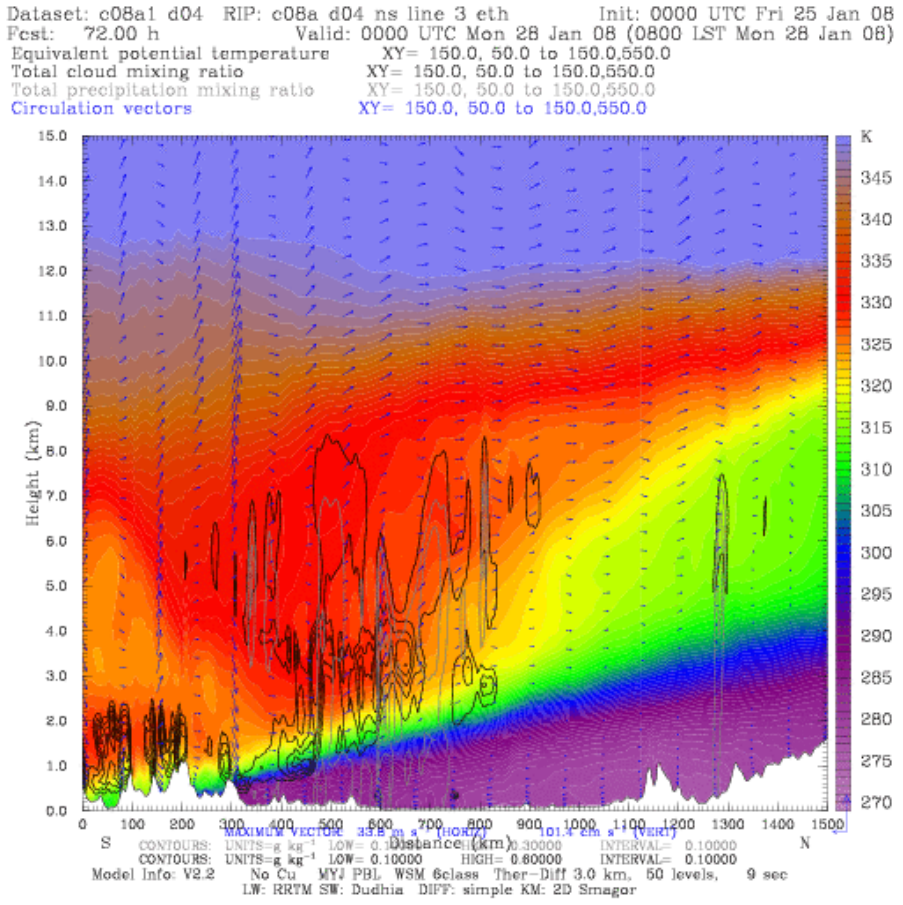


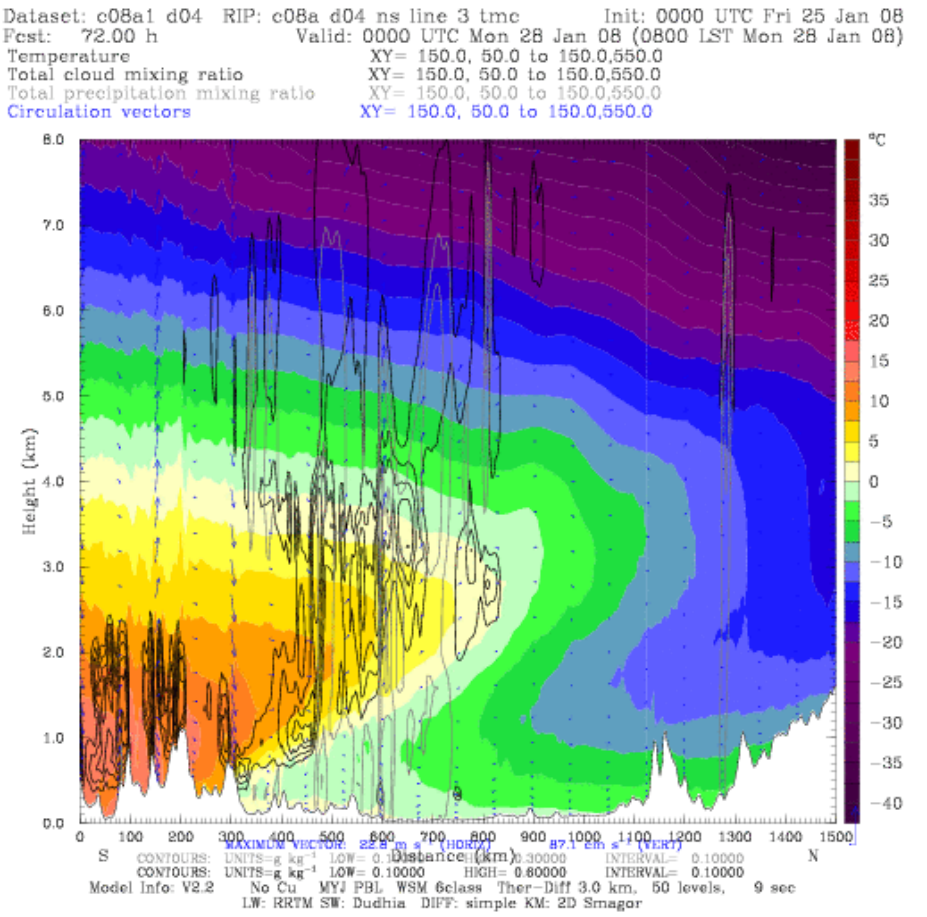
Frozen rain simulation (3km resolution WRF)

at 12UTC 26 Jan. 2008


110 E
120 E
30 N
m
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Model Info: V2.2 No Cu MYJ PBL WSM 6class Ther-Diff 3.0 km. 50 levels, 9 sec
LW: RRTM SW: Dudhia DIFF: simple KM: 2D Smagor

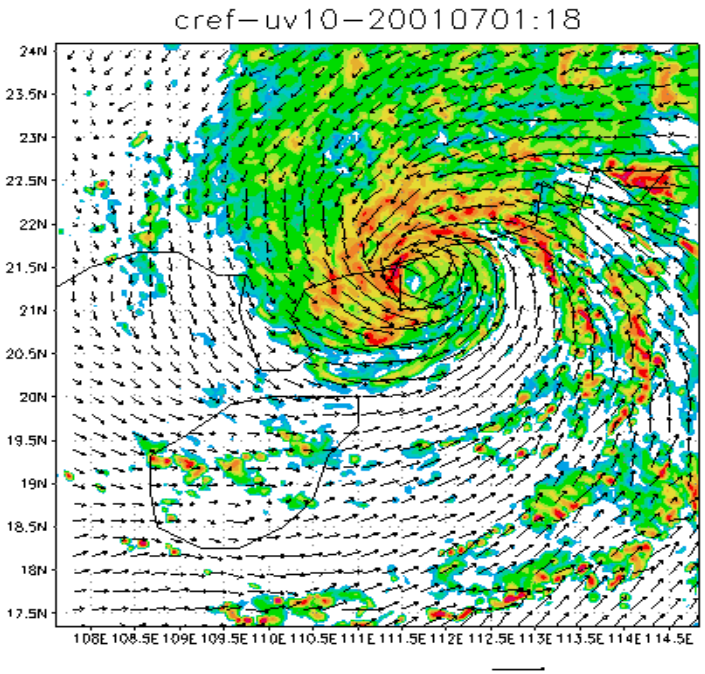
Topography





Frozen rain simulation (3km resolution WRF)

at 00UTC 28 Jan. 2008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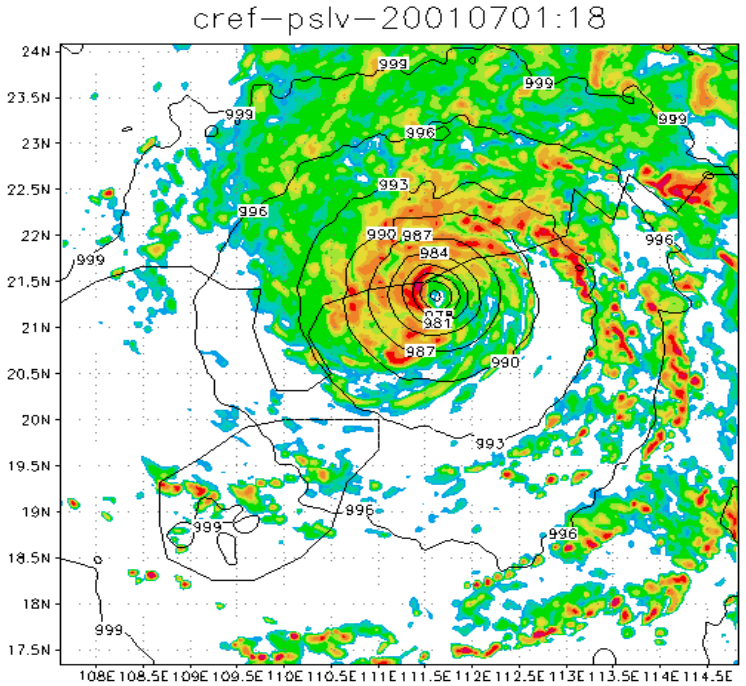
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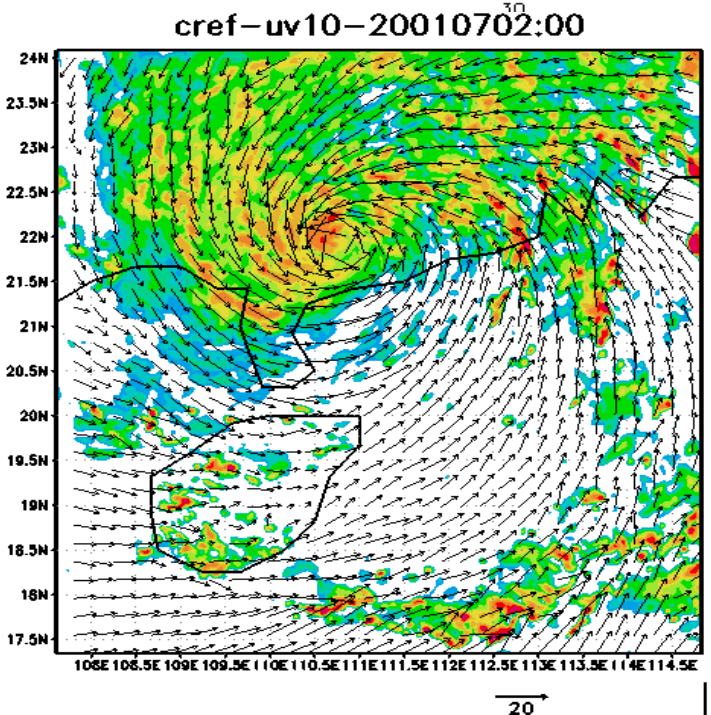
108E 108.5E 109E 109.5E 110E 110.5E 111E 111.5E 112E 112.5E 113E 113.5E 114E 114.5E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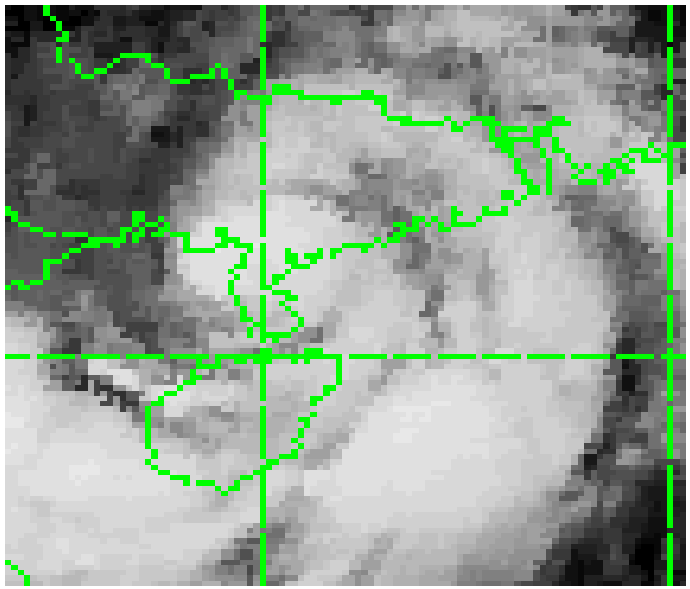


CRM Simulation

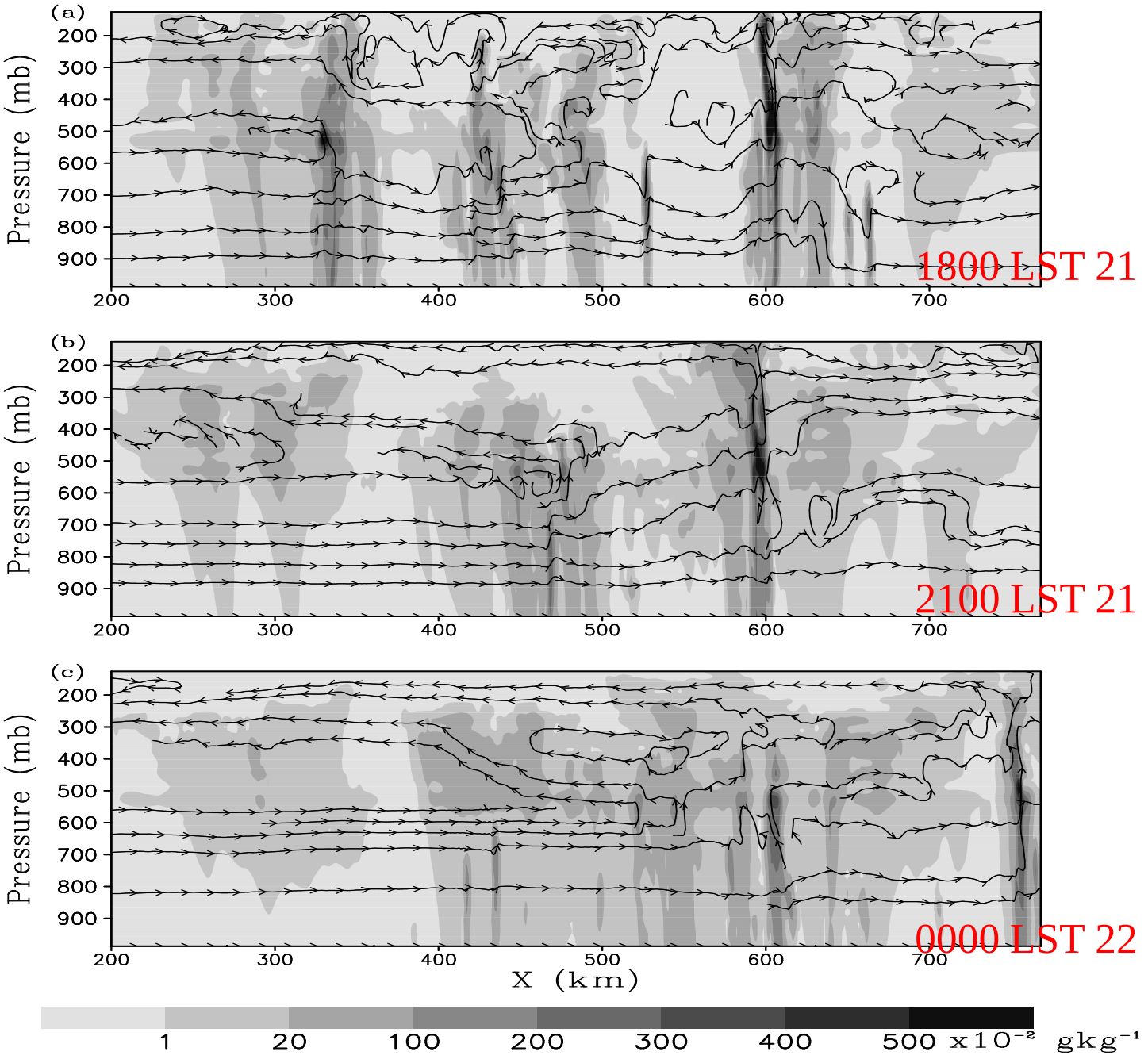
2-D cloud-resolving model, originally developed by *Soong and Ogura* 1980, *Soong and Tao* 1980, includes

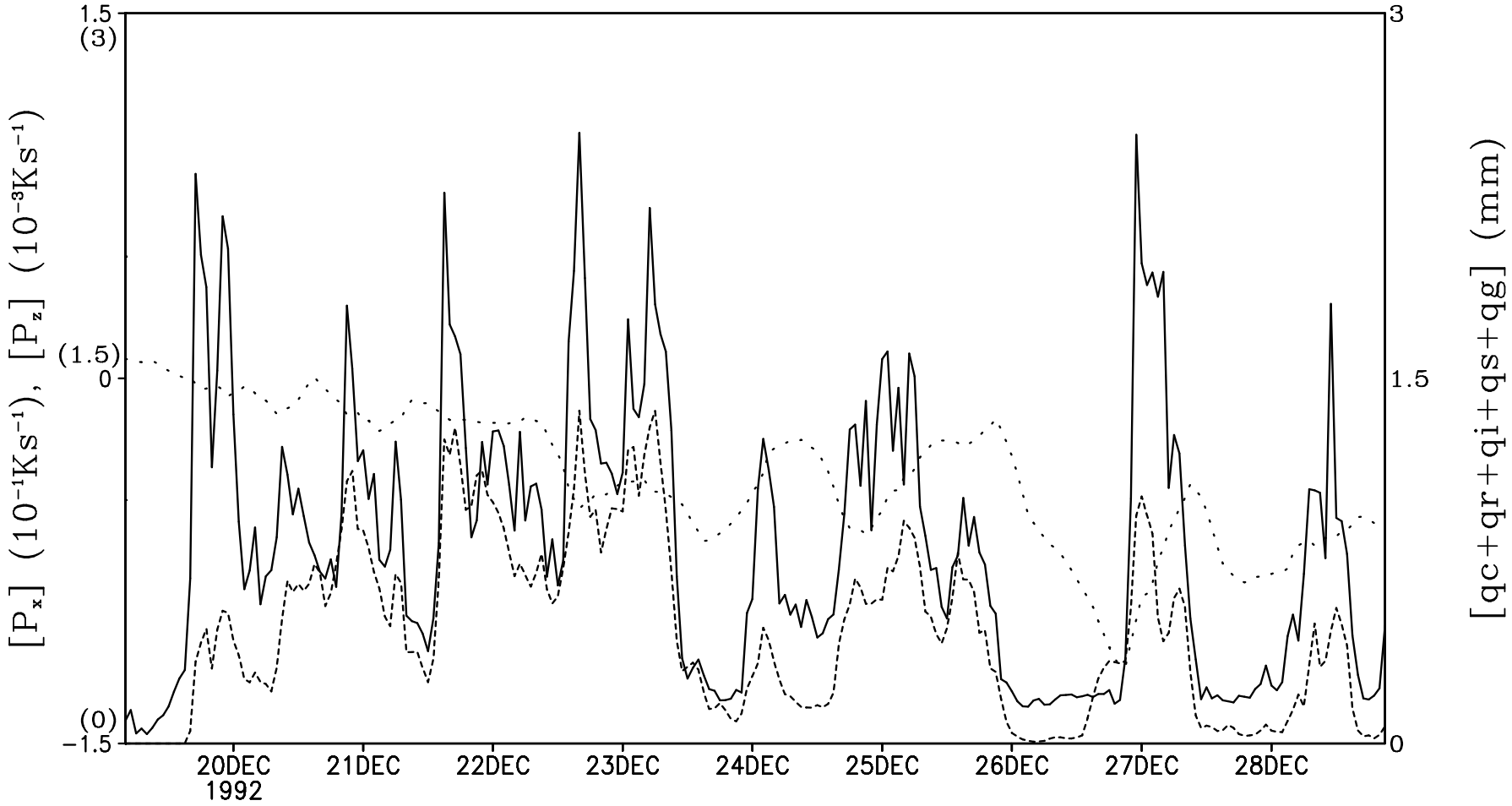
- **Two-dimensional, anelastic equations**
- **Prognostic cloud scheme**
- **Radiative parameterization**
- **Turbulence closure**
- **Zonally uniform forcing: vertical velocity, zonal wind, horizontal thermal and moisture advections, and sea surface temperature**

Simulation:

- **Horizontal resolution: 1.5 km**
- **Vertical resolution: 200 m near surface and 1 km near 100 mb**
- **Time step: 12 s**
- **Horizontal domain: 768 km**
- **Lateral boundary: cyclic**
- **Integration time: 0400 LST 19 December – 0400 LST 29 December 1992 (10 days total)**

Streamlines and sum of the mixing ratios of cloud hydrometeors (background shading)





Time series of zonally averaged, mass-integrated zonal (Px) and vertical (Pz) components of the CVV, and sum of mixing ratio of cloud hydrometeors in the deep convection during the 10-day integration.

SUMMARY

- Even disasters occurred in China, but their moisture source comes from the tropical region
- The typhoon genesis in the west Pacific has closely relation with active phase of MJO
- Asia monsoon surge is associated with MJO
- Adaptive observation, Data analysis and numerical simulation are good strategy for studying disasters occurred in China with the tropical convective activities


Thanks !