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 (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 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
• 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
The Effect of MJO on Typhoon genesis
From June to September, 2005
The Effect of MJO on Typhoon genesis
From June to September, 2006

Data updated through 28 Aug 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.

South China sea Monsoon onset

Variation of Zonal wind and Potential pseudo-equivalent temperature over monitoring region
Climate Diagnostics and Prediction Division/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.


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

中国气象局 中央气象台

全国降雨量实况图
2006年07月14日14时--18日14时

单位：毫米

无降水
0~9.9
10~24.9
25~49.9
50~99.9
100~249.9
≥250

(引自国家气候中心)

永兴 504毫米

漳州412毫米

博罗 569毫米
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)
计算机模拟的暴雨
计算机中的暴雨结构
Topography
Frozen rain simulation (3km resolution WRF) at 12UTC 26 Jan. 2008
Topography
Frozen rain simulation (3km resolution WRF) at 00UTC 28 Jan. 2008
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 ($P_x$) and vertical ($P_z$) 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!