A Study on Typhoon-Induced Rainfall in Beijing

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Outline

• Motivation
• Statistical features
• Comparative analysis of two typhoon cases
• Impact of Typhoon Vicente on Beijing torrential rain in 21 July, 2012
• Summary
The annual rainfall (mm) distribution averaged on 1949-2003 (from Cheng Zhengquan)
Statistical Features

- 1949-2006 typhoon best track data from STI/CMA
- Daily precipitation
  4 weather stations
Annual variation of rainfall processes in Beijing associated with typhoons
(the number on the column indicates the precipitation day)
Typhoon track at 6 h interval in Beijing rainfall days (a) and rainstorm days (b)
Temporal variation of typhoon minimum sea level pressure during its affecting period
Comparative analysis

Typhoon Freda (8407)
1984.8.8-9 204mm in total

Matsa (0509)
2005.8.8-9 12mm in total
500 hPa wind vectors and geographic potential height (gpm)
700 hPa wind vectors and equivalent potential temperature (K)
TBB distributions (°C) of Freda (top panels) and Matsa (bottom panels)
Vertical-temporal sections of equivalent potential temperature (k) and horizontal wind vectors (a) (b), specific humidity (shaded, g/kg) and vertical speed (10-3hPa/s) (c) (d) averaged on 115-116°E, 39-40°N
Topographic effect

Freda
00UTC 8 Aug. 4 1984

Matsa
00UTC 8 Aug. 2005
Impact of Typhoon Vicente on Beijing

Torrential rainfall in 21 July 2012
Background circulation

- 500 hPa situation

00Z 21 JUL 2012 500 hPa HGT - wind
Background - 850 wind vectors (shaded indicates wind speed, m/s)
NOAA HYSPLIT MODEL
Backward trajectories ending at 1400 UTC 21 Jul 12
GDAS Meteorological Data
Fe Fs Fw Fn indicate water vapor from the east, south, west and north lateral boundary of Beijing region respectively and F is the total.
Numerical Simulation by WFR 3.1

Simulation Daily Rain 21JUL2012

Precipitation amount of 08Z21–08Z22JUL
Sensitivity Experiments

Simulation Daily Rain 21JUL2012

Control Exp.

TC intensified

TC weakened
Conclusion (1)

- Statistical results show that a rainfall event associated with typhoon occurred in Beijing about every three years during June to September averaged on 58 years.

- Typhoon ET process resulted in structure change, that contributes to the distinct rainfall difference in Beijing, which locates in the different area of typhoon.
• Beijing topography also plays an important role in the rainfall difference between the two typhoons. The southerly (northerly) would be lifted (sunk) under the topographic effect of Beijing.

• The remote typhoons have an impact on Beijing rainfall
Thanks for your attention!