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The microphysical characteristics of a heavy precipitation event as revealed from the polarimetric radar and disdrometer in East China

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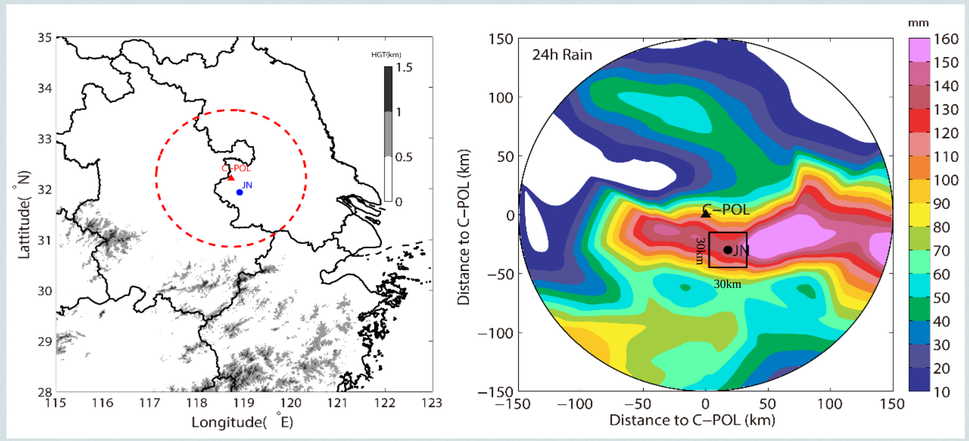
Introduction

A heavy rainfall event occurred over the Yangtze-Huaihe River Basin in East China during the period of 2015 OPACC. This event lasts for about 18 hours from 02:00 LST to 22:00 LST on 2 June 2015, causing the maximum accumulated rainfall over 100 mm and the significant flash flood in the urban area of Nanjing.

Previous works focus mainly on the precipitation structure of heavy rainfall as a whole and only a few researchers pays attention to the difference of microphysical characteristics between different stage of the precipitation, i.e. the frontal and the warm sector.

In this study, using the observations from a C band polarimetric radar and a two dimensional video disdrometer, a comparative analysis of the microphysical characteristics of the warm sector ahead of the cold front and the frontal zone precipitation is revealed.



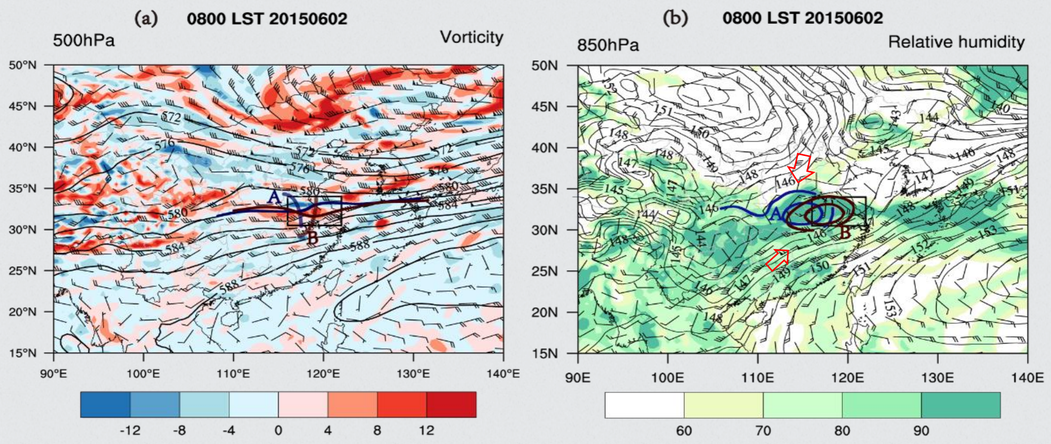
Data

1.C band Polarimetric Radar

2.JN Super-Site: Jiang-Ning sounding, 2DVD, wind profiler radar

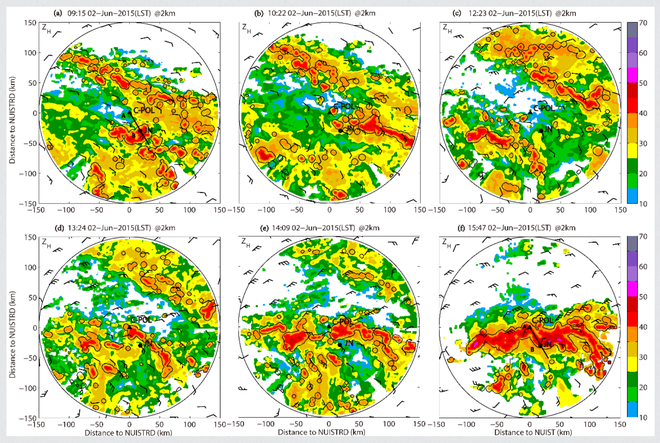
3.NCEP reanalysis data (0.5° ×0.5°)

Environment Analysis



Along with the eastward moving, the short-wave trough (500hPa) and the cyclone (850hPa) become deeper, the cold air moving southward to the observation area, causing the water vapor convergence in this region. (A: 08LST and B:14 LST)

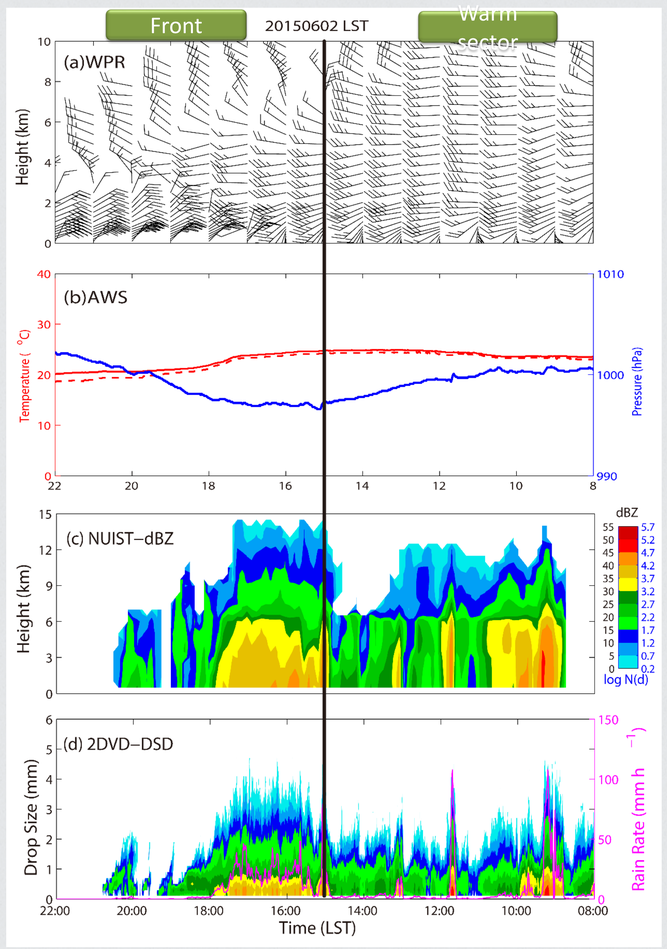
Case Description



In the observation area, the direction of the surface wind and the shape of precipitation echo are changed along with the frontal passage.

The front moves over JN site around 15:00 LST.

Time Series of Observed Properties

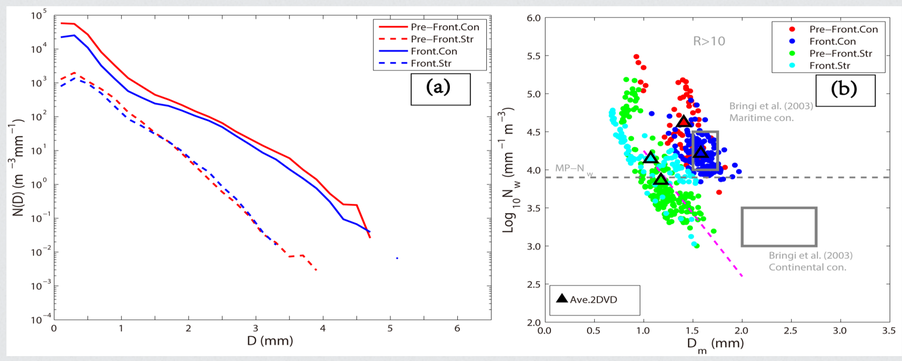


- The frontal passage occurred around 15:00 LST above JN site, with temperature decreasing and pressure increasing.
- Warm sector precipitation on characterized as embedded convection in wide spread stratiform precipitation while the frontal region shows a continuous convection precipitation.
- The DSDs near the ground shows similar temporal characteristics as radar observations.

Fig. (a) the wind profiler, (b) T 、T_d 、 p, (c) radar reflectivity and (d) DSD at JN site.

DSD Characteristic

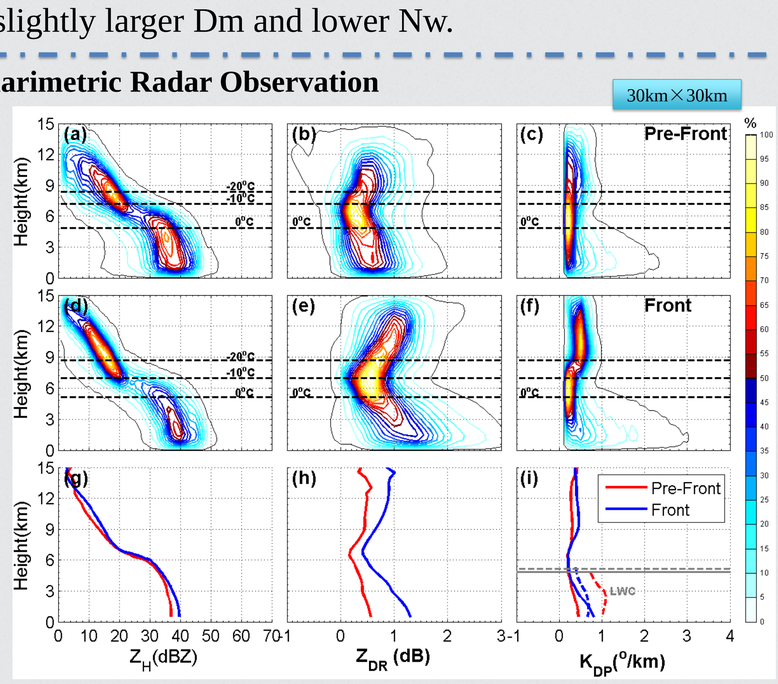
2DVD Observations



Warm sector convection is characterized with a large number of small to medium-sized raindrops. While, the frontal convection is characterized with a slightly larger Dm and lower Nw.

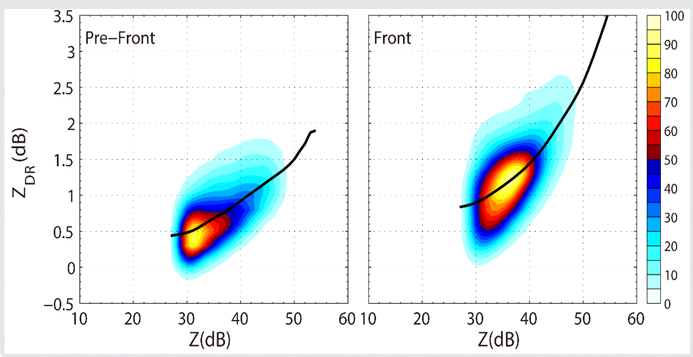
Polarimetric Radar Observation

30km×30km



Although both of them increase downward below the melting level, the Z_H, Z_{DR} and K_{DP} at the frontal stage is larger and increases faster. The LWC of frontal convection is smaller due to a relative lower number concentration. The result is corresponding with 2DVD observation.

30km×30km



Radar observation at elevation angle of 1.5° shows that frontal convection has a larger Z_{DR} than warm sector convection for a given Z, consistent with its larger raindrop as revealed by 2DVD.

Summary

The warm sector precipitation, which is characterized with a larger number of small- to medium-sized raindrops, are dominant by the warm rain process. While the frontal convection, which may have more chance to form from the melting of graupel and hail, has a slightly larger Dm and lower Nw.

The polarimetric radar observed Z- Z_{DR} consist well with 2DVD observations. The larger rain drop size in frontal zone convection can be attributed to the its higher updraft indicated by the higher echo top.