Several Convective Events in Guilin China between 2013 and 2014

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Affected by the cold and warm air, several convective events occurred in Guilin between 2013 and 2014.

1 Tornado

A tornado generated about at 2300 UTC on 16 April 2013 in Chaoyang village, Qixing block, Guilin China, along with the downburst, gale and flash flood. The hourly rainfall from 2300UTC 16 to 0000 UTC 17 April 2013 at Chaoyang gauge was 52mm and the temperature dropped by 1.5℃. The radial velocity on Liuzhou radar showed, when the tornado occurring, the plan radial velocity of the storm cell near Guilin reached 27m·s^{-1}. The VIL reached 43 kg·m^{-2}. The echo top was up to 1.1-12.2km (Fig.1). There was strong outflow, the velocity strength reached to 17 m·s^{-1}, and a week inflow in Guilin radar which was only 10 km away from the tornado. The imbalance between outflow and inflow approved the existence of the tornado. And the positive and negative velocity opposite showed the mesocyclone existing (Fig.2).

The radar radial velocity section showed the low-layer convergence and high-layer divergence, and the leaning forward characteristic of tornado's structure.

The reflectivity section showed a hook structure at the initial primary stage (Fig. 3a, b and c). The reflectivity maximum was at about 6 km height. When the ground wind enhanced, the hook structure became not obvious, the reflectivity maximum descended down to 3km low level. It was a typical character of downburst.

2 Flash floods

The flash floods occurred in Longhu village. The 3 hours rainfall of Longhu reached 293 mm from 1500 to 1800UTC on 15 May 2013 (Fig. 4). The hourly rainfall reached 132mm from 1600 to 1700UTC. The reflectivity of Longhu reached 53-58dBZ (Fig. 5a). It may be use as a warning index for 1 hour short-time rainfall reaching 100mm. The radial velocity displayed positive-negative velocity opposite at the raining region. This was the heavy precipitation supercell (Fig. 5b).

Another flash flood occurred in Yongan village Guilin. The hourly rainfall of Yongan reached 95 mm for 1800-1900 UTC on 21 May (Fig.6). The reflectivity at the raining region reached 53-58dBz near Yong'an village. And the adverse wind regions existed at the corresponding position (Fig. 7b). The maximum radar reflectivity in two cases was 53-58dBz. The VIL and reflectivity of flash floods were not as strong as the tornado, the maximum echo top were only 6km height.

3 Downburst

A downburst occurred in Yangshuo about at 1825 UTC 30 Mar. 2014. In only six minutes the maximum reflectivity core descended downdraft from 9 km to 3 km height. A north-south squall line was located in the south of Guilin (Fig. 8a). A

mesocyclone appeared in Yangshuo (Fig. 8b). The inverse wind region appeared in Lipu. The mesocyclone might also be existed. The section display that the maximum reflectivity core was located at 9 km height at 1824UTC (Fig. 8c), the strong echo became weaken and widen, the maximum reflectivity descended down to 3 km low level at 1830UTC (Fig. 8d). At 1835UTC the gale appeared. At 1842UTC, the strong reflectivity core extended down to the ground. According to these radar echo characteristics observation, the conclusion was that the downburst can lead the gale.

4 Hail storm

Serious hail storm occurred on 7 counties in north Guilin at the night of Mar 23 2014. The hail storms were associated with the bow echo and mesocyclone (Fig. 9a, b, c and d). The reflectivity section showed weak hook characteristic. The maximum VIL reached 60 $kg \cdot m^{-2}$.

5 Contrast analysis of the characteristics of convective cells

Cell type	Cyclone scale (km)	Cell character	Radial velocity shear (m/s)	Echo length (km)	Echo strength (dBz)	Echo top (km)	VIL ($kg.m^{-2}$)	OHP	characteristic	Accompany weather
tornado	5-7	single cell	35	10	68	1.3	43	50	Hook echo	Down burst hail
Flash flood	15	Multi cells	24	15	53-58	0.8	27	100	Inverse wind area	Lighting gale
downburst	3-5	Single cell	30	7	55	1.0	50	50	Strong reflectivity core down	Lighting flash flood
hail	7-10	Single cell	24	10	68	1.1	60	50	Hook echo	Lighting flash flood gale

6 Summary

The analysis showed that the inflow and outflow of the tornado cyclone is not balanced. The maximum radial wind shear reached 35 $m \cdot s^{-1}$. At the initial primary stage of tornado, the section of reflectivity displayed hook structure. The velocity section displayed convergence at the 3 km lower layer and divergence at 6 km higher layer. The divergence area tilted upward the convergence area. The maximum reflectivity centroid descended downdraft sharply, along with downburst. The flash floods super cells often generated in the warm zone jet in stratiform cloud. The radial velocity showed adverse wind area characteristic. The magnitude of VIL and reflectivity of floods obviously were not more than that of the tornado. The maximum height of flood was only 6 km height. The downburst had the strong reflectivity centroid descended rapidly characteristic. Large area hail often associated with the bow echo and mesocyclone with significant positive-negative velocity opposite pair. When the CAPE on Guilin was only 367$J.kg^{-1}$, the K index was only 26K, to forecast a tornado would generate in 11 hours is a difficult work. To estimate the accurate rainfall of the heavy precipitation super cell is also a challenge.

Keywords: tornado, hook echo, flash flood, adverse wind region