Several Convective Events in Guilin China between 2013 and 2014

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Introduction

Affected by the cold and warm air, several convective events occurred in Guilin between 2013 and 2014. A tornado generated at 2300 UTC on 16 Apr. 2013 in Chaoyang village Guilin, along with the downburst and gale. The hour rainfall of Chaoyang station reached 52mm and the temperature dropped by 1.5℃.

The flash floods also occurred in Longhu village and Yongan village Guilin. The 3 hours rainfall of Longhu reached 293 mm at 15-17UTC on 15 May 2013. The hourly rainfall of Yongan reached 95 mm for 1800-1900 UTC on 21 May 2014.

A downburst occurred in Yangshuo county at 1825 UTC on 30 Mar. 2014. In only six minutes the strong reflectivity core descended down from 9km to 3km lower level.

Serious hail storms occurred in 7 counties in Guilin in the night on 23 Mar 2014. The hail storms were associated with the bow echo. The VIL reached 60 kg·m^{-2} .

Base on the radar data of the Guilin and Liuzhou radar, some characteristics of the convective events of Guilin, such as tornado, flash flood, downburst and hail between 2013 and 2014 were analyzed comparatively, to improve the accuracy of nowcasting.

Flash Flood

➢ **Flash flood on Longhu village on 15 May 2013**

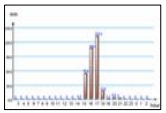

Fig 1. Hourly rainfall bar of Longhu village on 15 May 2013

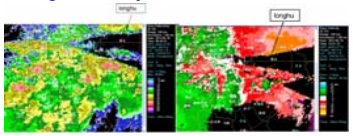

Fig 2. The reflectivity (a) and radial velocity (b) at 2.4° elevation at 12:40UTC 15 May 2013

The 3 hours rainfall of Longhu village from1500 to1800 UTC on 15 May 2013 was 293 mm (Fig. 1). The reflectivity reached 53dBZ on the Longhu(Fig. 2a). 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 heavy precipitation supercell (Fig. 2b).

➢ **Flash floods on Yong'an village on 21 May 2014**

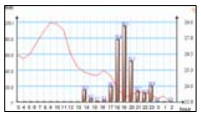

Fig 3. Hourly rainfall bar and temperature of Yongan village on 21 May 2014

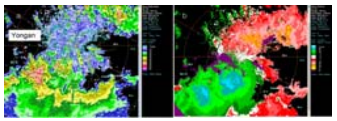

Fig 4. The reflectivity (a) and radial velocity (b) at 2.4° elevation at 18:02 UTC 21 May 2014

The hourly rainfall from1800 to1900 UTC 21 May 2014 reached 95mm (Fig.3). The reflectivity at 2.4° elevation(Fig.4a) reached 53-58dBz near Yongan village. And the adverse wind regions existed at the corresponding position (Fig. 4b).

The Tornado

➢A tornado occurred on 16 Apr. 2013 in Chaoyang village Guilin China

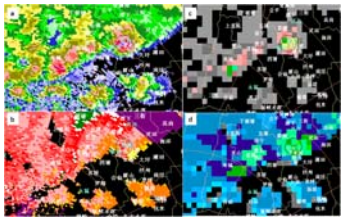

Fig.5 The reflectivity (a), radial velocity (b), vertical integrated liquid (c), echo top (d) on Liuzhou radar

The plan radial velocity of the convective cell near Guilin reaches 27m·s^{-1}. The VIL reached 43kg·m^{-2} ,echo top up to 1.1-12.2km.

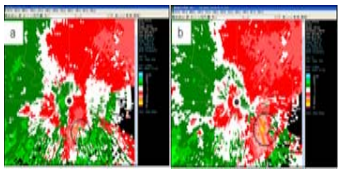

Fig. 6 The radial velocity at 2305UTC on 16 April (a) , at 2317UTC on 16 April (b)) on Guilin radar

There were intensity outflow, the maximum velocity reached to 17m·s^{-1}, inflow was weak, the imbalance indicated the existence of the tornado. And the positive-negative velocity pair showed the mesocyclone.

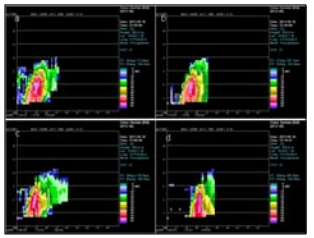

Fig. 7 The section of reflectivity of Liuzhou radar

At the initial primary stage (Fig. 7a, b and c), the reflectivity section showed a hook characteristics, the height of the strong reflectivity core was about 6 km. When the ground wind enhanced (Fig. 7d), the hook characteristics weakened, the strong reflectivity area descended downdraft, along with downburst.

Downburst

➢The downburst occurred about at 18:35 UTC on 30 Mar 2014 on Yangshuo

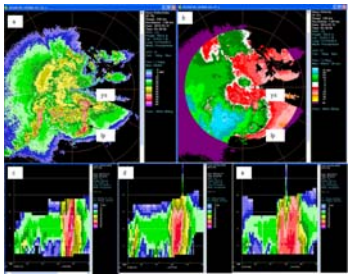

Fig.8 The reflectivity (a), radial velocity (b) at 1830UTC, reflectivity section at 1824UTC(c), at 1830UTC (d) and at 1842UTC (e) of Guilin Radar

A north-south squall line was located in the south of Guilin (Fig. 8a). A mesocyclone formed in the Yangshuo county (Fig. 8b), The inverse wind region exiced in Lipu county. The mesocyclon may be also existed. The section display that the maximun reflectivity core was 9km height level at 1824UTC (Fig. 8c), at 1830UTC, the strong echo became widen, the strong echo centre descended down to 3km (Fig. 8d). At 1835UTC the gale began appearing. To 1842 UTC, the Fig. 8e display that the strong echo extends down to the surface. According to these radar echo characteristic observation the conclusion was that the downburst may lead the gale.

Hail Storm

➢ In the night of March 23, 2013, Ziyuan, Quanzhou, Lingchuan, Yongfu, Gongcheng ,Yangshuo counties and Guilin Qixing District suffered the hail.

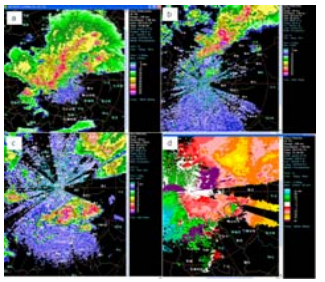

Fig. 9 The reflectivity and radial velocity of Guilin Radar (on 23 Mar 2014 (a,c,d) , on 19 Mar 2014 (b))

The serious hail storms were associated with the bow echo (Fig. 9a). Fig. 9b showed that the bow echo resulted in the hail in Ziyuan county. Fig. 9c showed that the hail strong reflectivity in Yangti village. Fig. 9d showed that the mesocyclone which formed the hail storm in Gongchen county. The reflectivity section of hail in Ziyuan showed weak hook echo.

Contrast analysis of the characteristics of convective cells

cell type	cyclone scale (km)	cell character	radial velocity shear (m.s^{-1})	echo length (km)	echo strength (dBZ)	echo top (km)	VIL (kg.m^{-2})	OHP (mm)	characteristic	accompany weather
tornado	5-7	single cell	35	10	68	1.3	43	50	hook echo	downburst 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

Summary

The analysis shows that the inflow and outflow of the tornado cyclone is not balanced. The maximum radial wind shear reached 35m/s. At the initial primary stage of tornado, the section of reflectivity displayed hook structure. The velocity section displayed convergence at the 3 kilometers lower layer and divergence at 6 kilometers higher layer. The divergence area tilted upward the convergence area. The strong 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 has the strong reflectivity centroid descended rapidly characteristic. Serious hail storms often associated with the bow echo, mesocyclone ,and significant positive-negative velocity opposite pair.

When the CAPE on Guilin was only 367J.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.