Transition process of parent cloud causing tornadoes accompanied by Typhoon, 'Neoguri'

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Two tornadoes simultaneously occurred near Kochi airport when the outer rainband of ‘Neoguri’ passed through the Kochi plain on 10 July 2014 (Yuasa and Sassa 2014). These tornadoes correspond to the vortices in their parent cloud, mc1 and mc2. The parent cloud was found to one of mini supercell when mc1 was observed at first. However, it did not have the feature of supercell when it landed (Yuasa and Sassa 2015). The present analytical study aims to clarify the transition process of the parent cloud with the data of Muroto Doppler radar.
We used the polar coordinates data of JMA Muroto radar obtained from NICT archives and analyzed with Draft software developed by MRI. We also used the initial GPV data of JMA meso scale model obtained from the RISH archives.
Fig.1 shows the PPI scan data of elevation angle 0.4 deg. Strong wind of over 38 m/s in Doppler velocity approached to the parent cloud from southwest and weak echo region was observed just south side of mc1 until just after mc2 appeared as shown in Fig. 1a,b. Moreover, the strong echo more than 40 dBZ formed hook like echo pattern around mc1. The diameter of mc1 was about 10 km which corresponded to that of mesocyclone. These features of the parent cloud in the horizontal plane show those of supercell though the arrangement of hook echo is opposite to that of normal supercell. The diameter of mc1 became rapidly smaller at 5:45 JST, and then strong echo in the south portion of the parent cloud left from the parent cloud and hook echo disappeared as shown in Fig. 1c. The strong echo in the south portion disappeared when the parent cloud landed and the cyclonic horizontal shear in which the southerly wind at the east side was stronger than that at the west side. The MSM data also showed the cyclonic horizontal shear in the outer rainband in which the parent cloud located (Yuasa and Sassa 2015).
Figure 2 shows the vertical cross section of the parent cloud around mc1. Just after the genesis of vortices, vault structure was clearly observed around mc1 as shown in Fig.2a,b. But, the strong wind of more than 30 m/s approaching to the vault from southwest became weaken at 5:41JST. Though the area of strong horizontal wind was still observed at 5:45JST after mc1 became smaller, vault structure already disappeared and the echo top was apart from mc1 as shown in Fig. 2c. The parent cloud did not have the feature of supercell at all when it landed but it had the cyclonic horizontal shear as shown in Fig. 2d.
Conclusively, the parent cloud was founded to have the feature of supercell at first and then lost it because the strong inflow from south. The cyclonic horizontal shear, however, still existed in the outer rainband and it kept the vortices. Finally, the tornadoes were kinds of non-supercell ones but their generation process was different from that of the ordinal non-supercell tornadoes (Wakimoto and Wilson 1989).

Keywords: radar observation, tornado, supercell

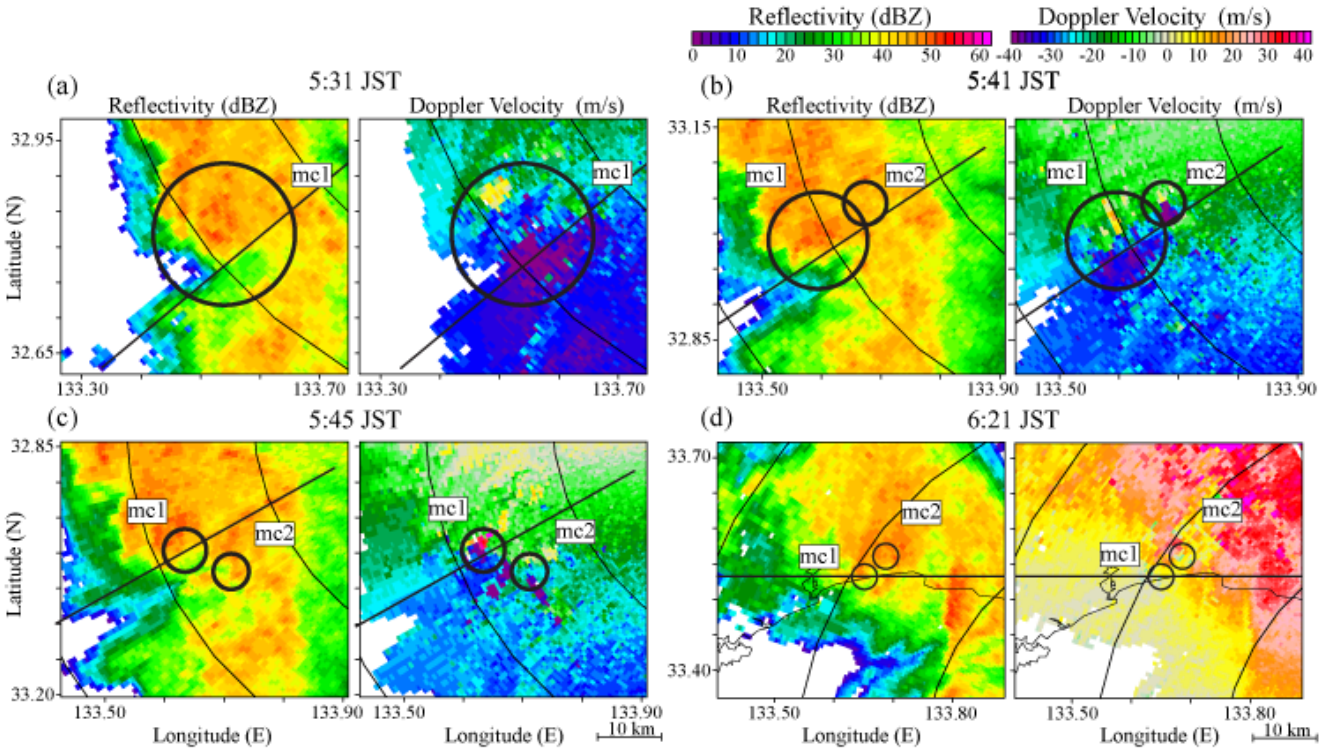

図 1　渦発生後の室戸レーダー画像 (仰角 0.4deg.)。(左；レーダー反射強度 , 右；ドップラー速度) 図中丸はドップラー速度の極大極小から判断した渦付近を囲んだもの。実線は図 2 の鉛直断面の領域。

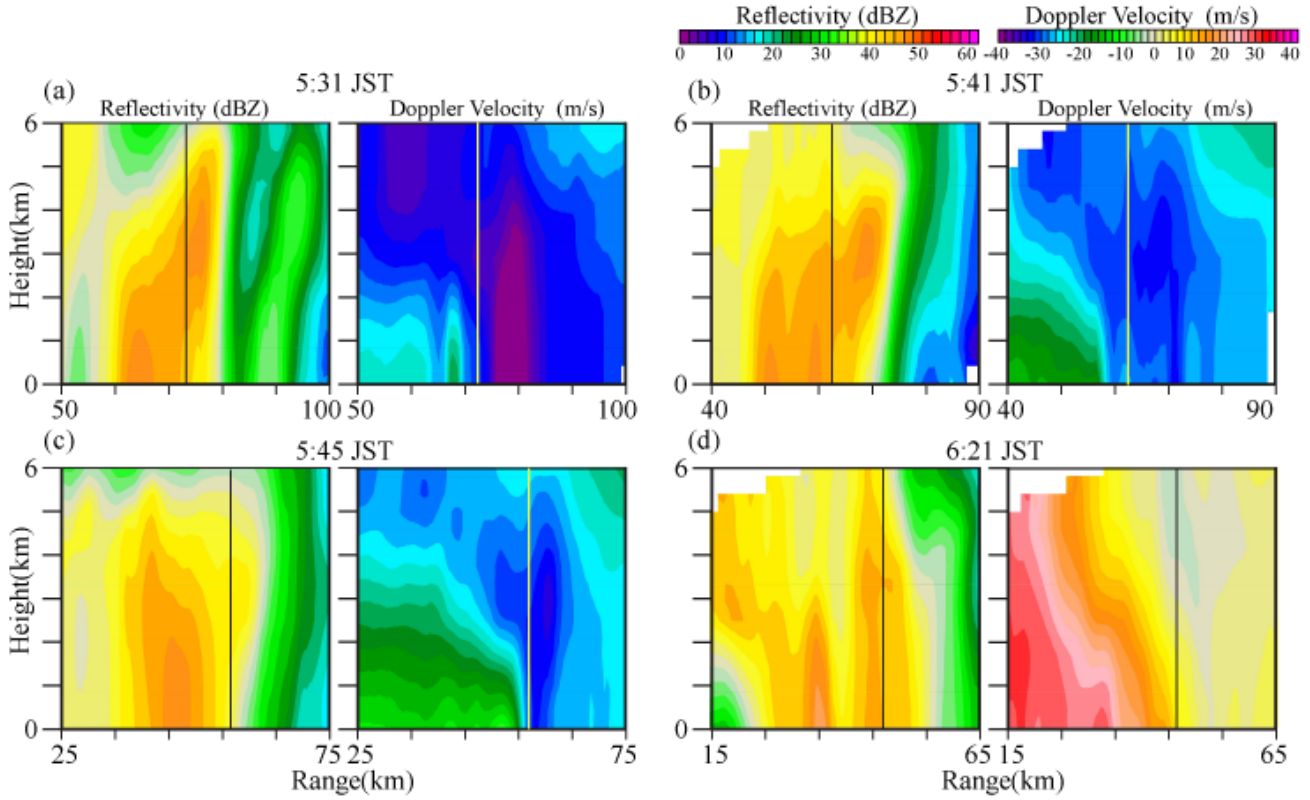

図 2　mc1 渦中付近の室戸レーダーの断面図。図 1 の実線部 (30km) を高度 6km まで切出し、北から見た断面を示す。実線は mc1 の渦中心。(左；レーダー反射強度 , 右；ドップラー速度)

