

Phased Array Weather Radar Observations of Mesocyclone Structures in Okinawa

*Shinsuke Satoh¹, Hironori Iwai¹, Fusako Isoda¹, Seiji Kawamura¹, Katsuhiro Nakagawa¹, Hiroshi Hanado¹, Minoru Kubota¹

1. National Institute of Information and Communications Technology

We have developed phased array weather radar (PAWR) which can perform the three-dimensional dense observation (100 m range resolution, 100 elevation angles) every 30 seconds. The aim of the PAWR is to watch and predict localized heavy rainfall, tornadoes, and gust of wind. In the observation range of the first PAWR installed at Osaka University, Suita in 2012, it is very rare that tornadoes occur. However, it has been expected that the next PAWR installed at NICT Okinawa in 2014 detects tornadoes in addition to Typhoons and subtropical severe storms. In this study, we investigate a typical mesocyclone, which size is less than several km in diameter, occurred in a linear rainfall band, although there is no evidence of tornado occurrence.

In the afternoon, December 6, 2016, a linear rainfall band accompanied by a stationary front passed over the Okinawa main Island. The rainfall band was composed of some echo cells, which moved from SW to NE along the band direction. A kink echo was found on the CAPPI at 1 km height on 15:29 JST. It changed into a vortex echo, which diameter is 3 to 5 km, on 15:34, and maintained the vortex structure up to around 15:38. The distribution of Doppler velocity showed the two eyes of maximum and minimum of velocity that indicates Rankine's vortex. This feature indicates a mesocyclone (MC) existence. From the maximum and minimum velocities of +17 m/s and -20 m/s, respectively, and the diameter of 3 km, the vorticity of 0.025 s^{-1} is calculated. The MC appeared between 0.25 km and 1.75 km in height, and convergence flow in the lower layer and divergence flows in the upper layers were found. Another stronger MC was found at between 4.0 and 5.0 km in height, which was accompanied by a precipitation core in the upper levels. The echo top height was over 12 km, and anvil echoes extended to the backward (NW) of the linear rain band.

The MC was also observed by C-band polarimetric radar (COBRA), it is possible more advanced data analysis such as dual-Doppler. Although the observed MC has a large vorticity, which is able to generate tornadoes, there are no structures of supercell and there is no evidence of tornado occurrence. From the first kink echo and the next vortex echo may indicate the horizontal wind shear. It seems that the MC has the similarity of the vortex echo appeared in the winter monsoon reported by Fujiyoshi, 2001 (Tenki). However, we have to investigate more carefully about the cause of the upper level MC.

Keywords: Phased Array Weather Radar, Mesocyclone, Three-dimensional Structure