P7.112 **Multiple Doppler analysis of the Tsukuba tornado on May 6, 2012 - A supercell tornado in convergence line -**

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1. Introduction

On March 6, 2012, four tornadoes occurred around Kanto-area in Japan. The number of casualties by the tornadoes was 59 and 978 houses were completely or partially destroyed. The Tsukuba tornado, the strongest of the four, was rated at F3 by the Japan Meteorological Agency (JMA) and the other tornadoes were rated at F0-F2.

Yamauchi et al. (2012) observed the tornado by Meteorological Research Institute (MRI) C-band polarimetric radar at close range (about 15 km) and showed that a mesocyclone signature was detected in the parent storm of the tornado and the observed characteristics of polarimetric parameters such as differential reflectivity (Z_{dr}) and correlation coefficient (ρ_{hv}) were consistent with those of tornadoes in Ryzhkov et al. (2005).

The detected mesocyclone and the characteristics of polarimetric parameters suggest that the parent storm of the tornado was a supercell. On the other hand, surface analysis shows that the supercell was collocated with a pre-existing convergence line. In Kanto-area, such supercell tornadoes collocated with pre-existing convergence line/zone were reported (e.g., Suzuki et al., 2000), but the details of the tornadogenesis remain unknown. In order to clarify the tornadogenesis, multiple Doppler analysis with a dense network of radars was conducted.

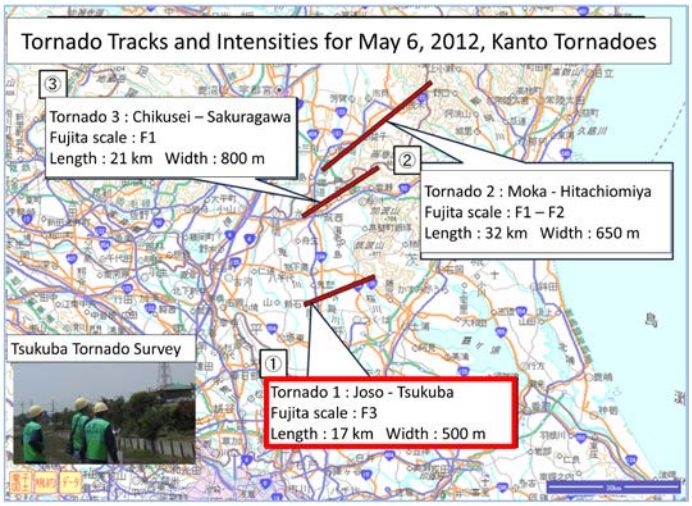

Fig.1 Tornado tracks(adapted from JMA, 2012).

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2. Meso-β scale Environment

In Kanto area, a convergence line which had baro-clinicity was made in the morning (Fig.2). From about 12JST (Japan Standard Time) to 13JST, a squall line which was orthogonal to the convergence line passed through Kanto area. Then, a cell which was in the southernmost part of the squall line turned into a super cell about noon, and a tornado was generated by the supercell at 12:35JST. To be precise, the tornado was made in the south of the triple point.

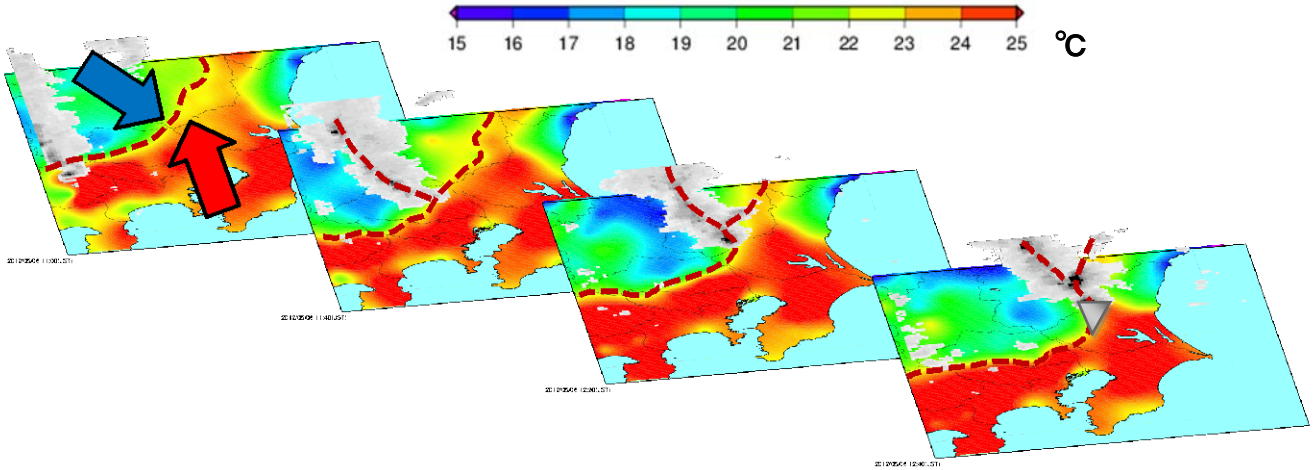

Fig.2 Surface temperature modified to sea level. Dashed lines are convergence line and squall line.

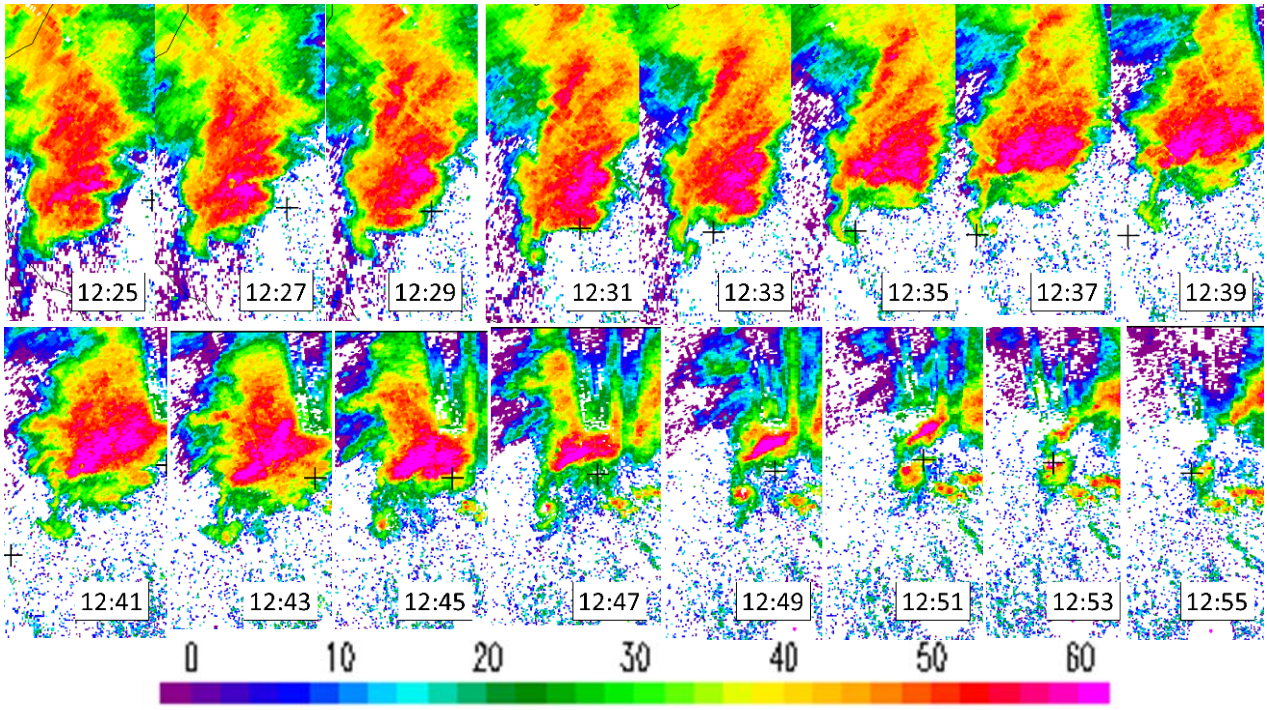

Fig.3 PPI displays of reflectivity with elevation angle of 0.5(MRI C-band radar).

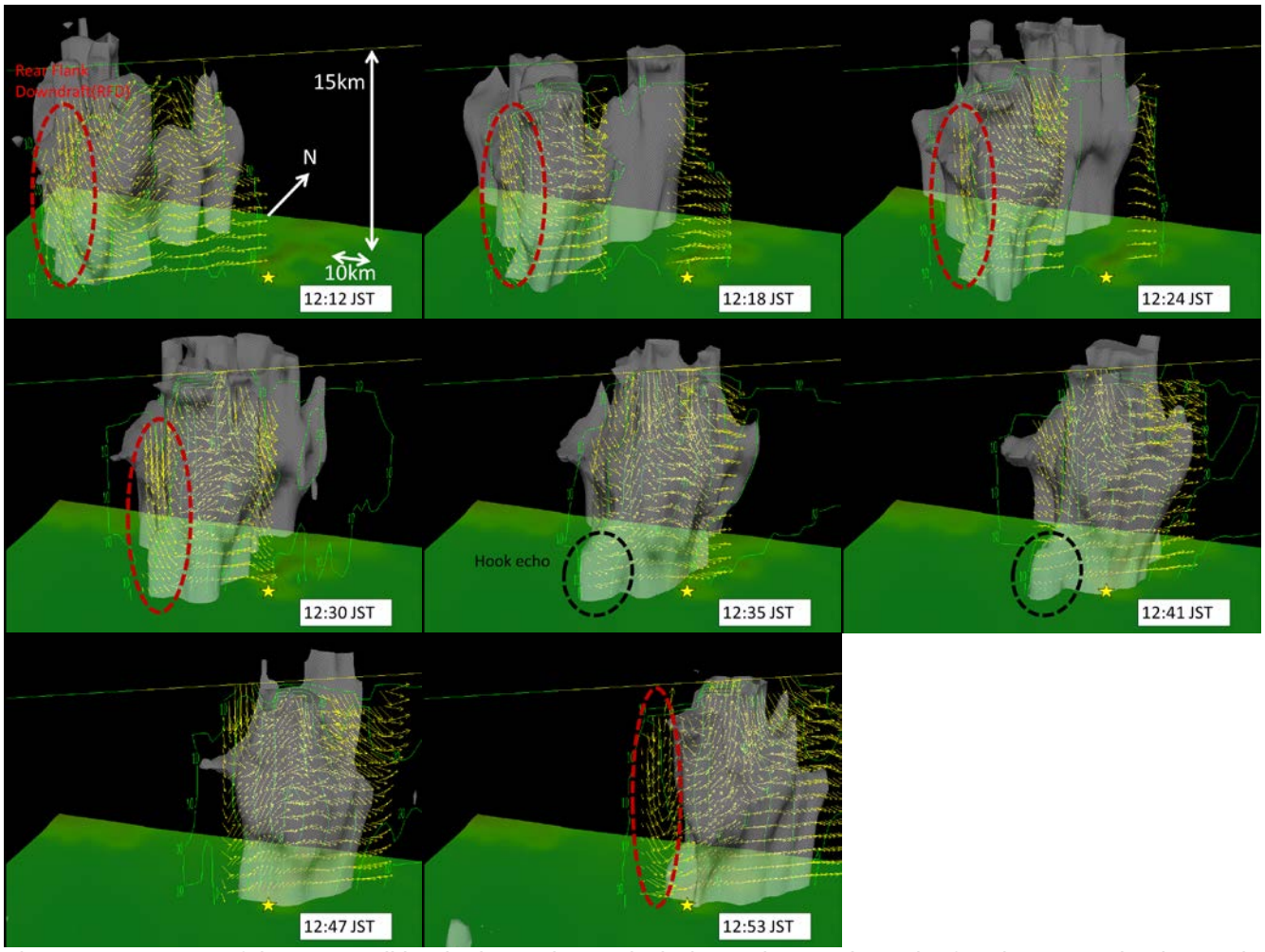

Fig.4 3D structures of the supercell by dual Doppler analysis (Haneda Doppler radar for airport weather(DRAW) and Narita DRAW). 3D iso-surface is 25 dBz(reflectivity). Vectors and contours represent velocity and reflectivity (every 10dBz) along the path of the supercell, respectively.

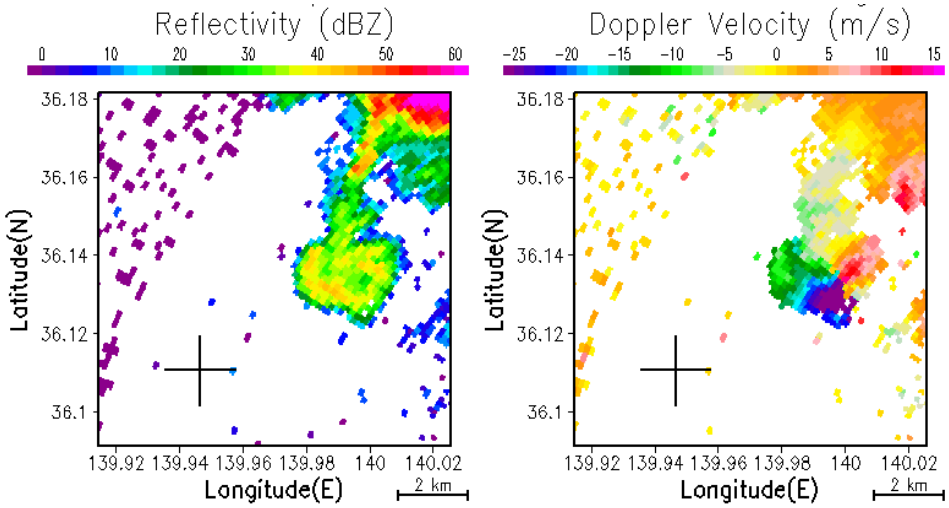

Fig.5 PPI displays of reflectivity(left) and Doppler velocity(right) with elevation angle of 4.8(MRI C-band radar) at 12:40JST.

3. Structure of supercell and tornado

Rear flank downdraft (RFD) was strengthened from 12:12JST, about 30 minutes before the tornadogenesis (Fig.4). At 12:35JST, a hook echo formed and the tornado occurred. The misocyclone associated with the tornado looked like multiple vortex at 12:40JST (Fig.5).

4. Conclusion

The supercell which spawned the Tsukuba tornado (F3) had characteristics as follows;

1. The supercell was made in the southernmost part of a squall line which was orthogonal to a pre-existing baroclinic convergence line.
2. RFD was strengthened from about 30 minutes before the tornadogenesis.
3. The misocyclone looked like multiple vortex.

Ackowledgement

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References

Japan Meteorological Agency, 2012: Tornadoes occurred on 6 May 2012(report) (in Japanese). [Available online at http://www.jma.go.jp/jma/menu/tatsumaki-portal/tyousa-houkoku.pdf.]

Suzuki, O., H. Niino, H. Ohno and H. Nirasawa, 2000: Tornado-producing mini supercells associated with Typhoon 9019. *Mon. Wea. Rev.*, **128**, 1868–1882.

Ryzhkov, A. V., T. J. Schuur, D. W. Burgess, and D. S. Zrnic´, 2005: Polarimetric tornado detection. *J. Appl. Meteor.*, 44, 557–570.

Yamauchi, H., Y. Shoji, E. Sato, A. Adachi and W. Mashiko, 2012: Polarimetric radar observation of the Tsukuba tornado on 6 May 2012(in Japanese), Preprints, *Autumn Meeting of Meteor. Soc*. Japan, Sapporo, Japan, Meteor. Soc. Japan, 44..