# THE VERTICAL STRUCTURES WITHIN A WINTER TORNADIC STORM DURING LANDFALL OVER THE JAPAN SEA AREA

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## INTRODUCTION

The Shonai area railroad weather project has investigated fine-scale structure of wind gust dynamics and kinetics such as tornadoes, downbursts, and gust fronts. The volume scan radar data were obtained at very close range (<1km) in one tornado on 25 January 2008. In this presentation, the detailed vertical structures of the high-resolution reflectivity and velocity fields of this tornado during landfall are described.

## RESULTS

The reflectivity from the JR-E radar reveals a pronounced hook echo, which was not resolvable by JMA radar, embedded within the snowband (FIG. 2). At about 5 minutes after the landfall, the Shonai airport was close to the area over which passage of the vortex was identified with the JR-EAST radar (FIG. 3). Associated with the passage of the vortex, surface observations at the Shonai Airport confirmed wind gusts (28.8ms-1; FIG. 4). A surface pressure drop also confirmed with the passage of the vortex.

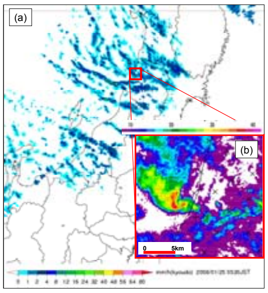


FIG. 2 (a) JMA radar image of the snowbands at 05:20 LST on January 25, 2008. (b) PPI scan of reflectivity (dBZ) from the JR-E radar at 05:24:12 LST.

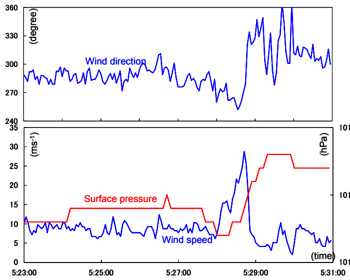


FIG. 4 Time series of surface wind speed, direction, and surface pressure from the Shonai Airport.

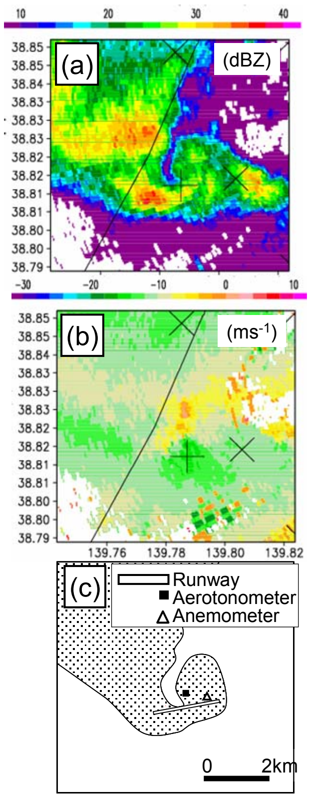


FIG. 3. (a) PPI scans of reflectivity (a) and (b) Doppler velocity (center) from the JR-E radar at elevation angle of 3.0 at 05:27:07. (c) The shaded region represent reflectivities greater than approximately 30 dBZ.

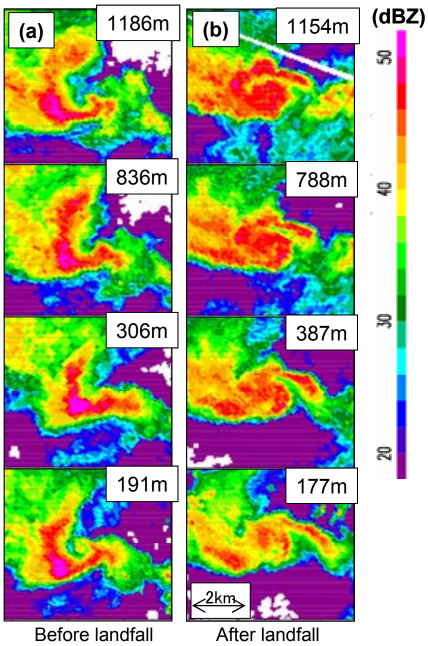


FIG. 5 PPI scans of radar reflectivity from the XPOD. (a) Before landfall. 5:20:35-5:23:55 LST. (b) After landfall. 5:30:35-5:32:14 LST Numbers in boxes denote heights of the center in meters AGL.

## INSTRUMENTATION AND STUDY AREA

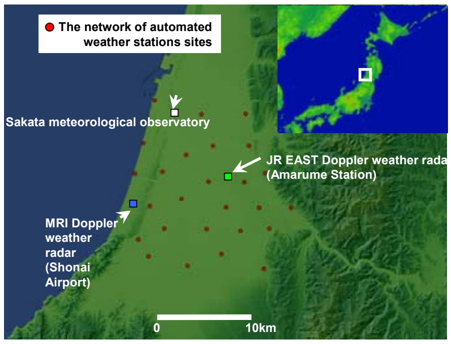


FIG. 1 Map of the Shonai area. Closed circles are the network of automated weather station sites. The inset shows the locations of the Sea of Japan and the study area (in the square).

The vertical structures of reflectivity fields during landfall are shown in FIG. 5. Before landfall, the reflectivity field revealed a characteristic hook shape that the center of the tornado had a weak-echo eye partially surrounded by an eyewall (FIG. 5(a)). The hook echo embedded within the vortex extended vertically through the volume-scan data. The diameter of the hook echo was approximately 2700-3300m. After landfall, the eyewall was transformed to spiral structures spiralling outward from the eye (FIG. 5(b)). The diameter of the reflectivity spiral was approximately 1700-2700m.

Figure 6 shows vertical structures of core diameters (distance from peak inbound to peak outbound Doppler wind speeds) before and after landfall. The tornado vortex before landfall had a core diameter from 320-490m with very little tilt with height. After landfall, a core diameter contracted from 320m to 160m at the height near 300m. This indicates that the tornadic vortex was tilted downstream. Figure 7 shows the vertical profiles of the vorticities estimated from observed Doppler velocities. After the vortex arrived over the Shonai Plain, the vorticities at lower altitudes rapidly intensified reaching a maximum vorticiticy of over 3.1x10-1sec at 125m height. This intensification was accompanied by shrinking of the vortex diameter. It is suggested that during the landfall the vortex tube tilted downstream and shrinked at lower altitudes since the near surface vortex modified and decelerated by the changes in the roughness.

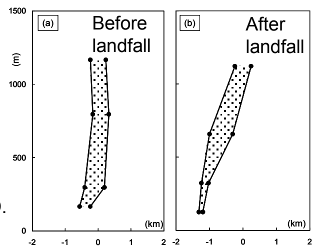


FIG. 6 Vertical structures of core diameters.(a) Before landfall. 5:20:35-5:23:55 LST. (b) After landfall. 5:30:35-5:32:14 LST.

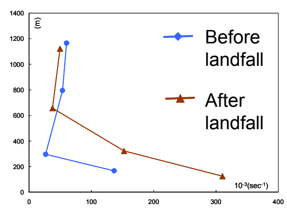


FIG. 7 Vertical profiles of the vorticities estimated from observed Doppler velocities.