RADAR AND IN SITU OBSERVATIONS IN A WINTER BOW ECHO AND ASSOCIATED MESO-VORTICES 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. In this presentation, we will introduce radar and in-situ measurement in a winter bow echo on January 24 2008.

RESULTS

A bow echo associated with a winter convective line traversed across the Shonai area on 24 January 2008. Figure 2 indicates the bow echo observed with the JR-E Doppler radar. The orientation was south to north and moved to the northeast at about 25ms-1. At 03:18:04 LST, the radar pattern indicates that the maximum length of the bow echo was about 18km, with a sharp reflectivity gradient and enhanced low-level convergence ahead. It is clearly indicated that an intense wind core was located at the bow apex. During the declining stage (03:26:19-03:28:44 LST), the figure reveals clearly the transition from the bow shaped echo to comma-shaped echo.

The location of the intense wind core is consistent with the location of rear-inflow jets (RIJs) at the apex of bow echoes that previous radar studies have documented (e.g., Przybylinski 1995; Funk et al. 1999; Atkins et al. 2004).

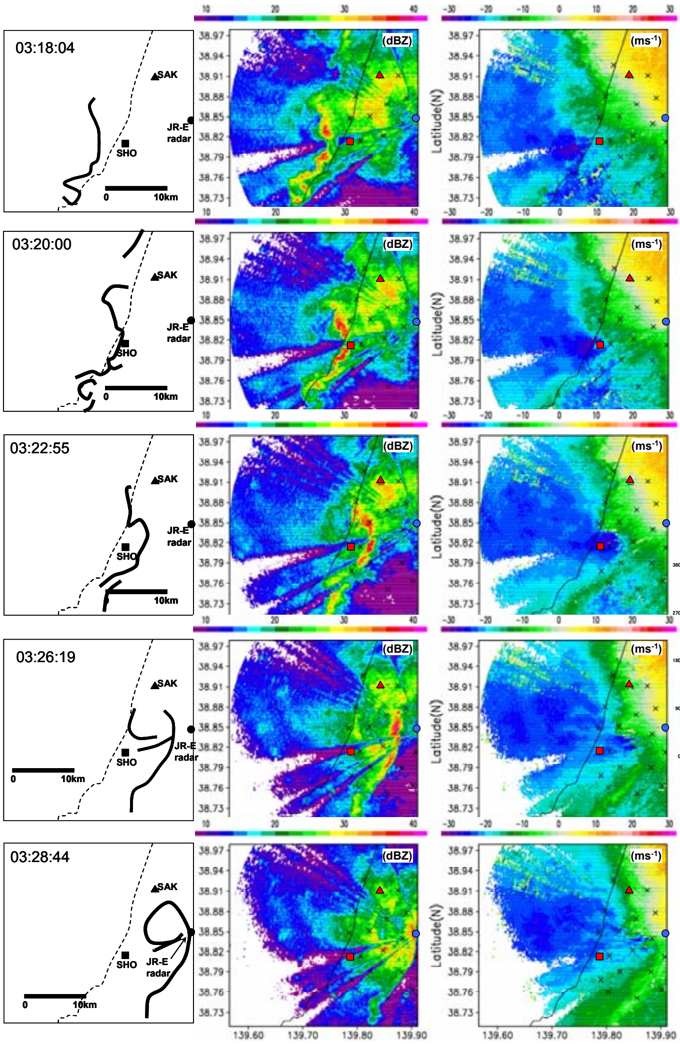


FIG.2 Color PPI scans of reflectivity (center) and Doppler velocity (right) from the JR-E radar located at the Amarume station at elevation angle of 3.0 at (a) 03:18:04 and (b) 03:26:19 LST. The bow and comma echo locations are shown in the left panel. The bold lines represent reflectivities greater than approximately 30 dBZ.

INSTRUMENTATION AND STUDY AREA

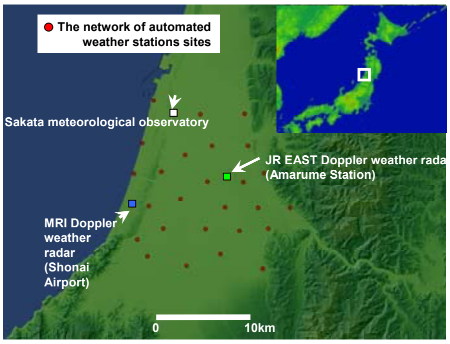
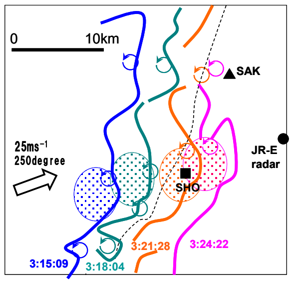


FIG. 1 Map of the Shonai area. Closed circles are the network of automated weather station sites. The inset shows the locations of the Sea of Japan and the study area (in the square).

FIG.3 The bow echo observed with the Doppler radar. Thick solid lines indicate bow echo locations at 3:15:09, 3:18:04, 3:21:28, and 3:24:22 LST 24 January 2008, respectively. Shading represents an intense Doppler velocity core exceeding 25 ms-1. Thin circular arrows depict the positions of mesovortices. White arrow indicates the direction of the bow echoed motion.



The region of the bow apex was passed over the Shonai Airport at around 0321 LST, which is located about 1.5 km from the shoreline. In situ surface data at the Shonai Airport for the bow apex are shown in Figure 4. Associated with the intense wind core, the wind data confirmed a maximum wind 22.6 ms-1 but little wind direction shift. This wind gust coincided with a rapid pressure rise and temperature and humidity drops, which closely resemble the kinematic character of gravity current. It is suggested that the intense straight-line wind may be created by a descending RIJ.

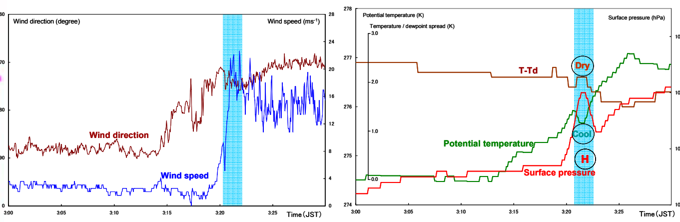


FIG. 4(a) Time series of surface wind speed and direction from the Shonai Airport. (b) Time series of surface pressure, temperature, and dewpoint depression (T-Td) from the Shonai Airport. The vertical hatchs indicate the wind gust period.

In situ measurement data for a mesovortex embedded were obtained (FIG. 5). Surface wind gust that coincided with a surface pressure drop confirmed with the passage of a mesovortex over the Sakata meteorological observatory. In this case, an interaction between the RIJ and mesovortices are not apparent.

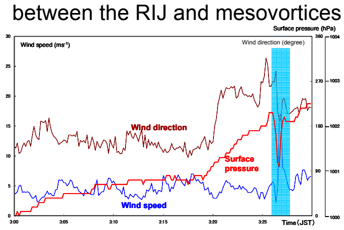


FIG. 5 Time series of surface wind speed, direction, and surface pressure from the Sakata meteorological observatory.