Analysis of Mesoscale Character on Bohai Ocean-effect Snowstorm by Doppler Radar Data

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Ocean-effect snow occurs when cold air flows over a relatively warm sea, generating snow bands over and downwind of the sea and coast. Shandong peninsula is the most distinct of ocean-effect snow by Bohai sea in the east of China. It occurs under the settings of North-west cold advection in low troposphere. Mesoscale narrow snowstorm band associates with ocean-effect snowstorm events, ranging from a few observation station, presents a difficult forecast challenge.
Analysis is conducted on the ocean-effect snowstorm which occurred from 6 to 7th,December 2005 in Shandong peninsula by EVAP retrieved wind method based on Doppler weather radar data, original radial velocity, reflectivity, automatic meteorological stations and high synoptic chart. Yantai and Weihai have measured record snowfall with 21.0 mm on 6th and 24.4 mm on 7th, respectively. This is the second snowstorm in December 2005 in Shandong peninsula, which is unusual persistent snowstorms. It is reported that the similar ocean-effect snowstorms occur in Japan at the same period. Severe cold air leads the snowstorms.
Doppler radar in the southwest of Yantai away 3.6 km lies in distinct of the ocean-effect snowstorm. It's in 37.500°N,121.388°E with above sea level of 0.41 km. The radar scans a time every 6 minutes. There is 9 elevation angles with 1°resolution every volume scan and the lowest one is 0.5°. The radial velocity and reflectivity factor resolution is 1.0 km. Radar detection radius is 230 km. This article studies the character of the snowstorm by the radar data. The results are as following.
(1)There are two types in radar reflection and radial velocity in the distinct of snowstorm. Firstly, obvious train effect in reflection is found with strong line echo moving very slowly. Strong reflection reaches 35~40dBZ. The belt crosses the same station like a train. At the same time, zero line in radial velocity shows broken. The second type of the reflection presents the English letter "L". Accordingly, there is long-lived adverse wind region in Doppler radial velocity images.
(2)Shear at low troposphere is the typical character for the Bohai ocean-effect snowstorm. Heavy snowfall in Yantai and Weihai occurs at different time. When snowstorm occurs in Yantai, zonal zero velocity line keeps close to the coastline, and it intersects with the radial zero velocity line near Yantai. So the shear is in Yantai nearby. By contrary, when snowstorm occurs in Weihai, the radial zero velocity line is far from the coastline, and it intersects with the radial zero velocity line in the north-east of Yantai. These show that horizontal wind at low troposphere play an important role in the area of snowstorm.
(3)Retrieved horizontal wind at various height shows mesoscale shear. It means that mesoscale vertical circulation occurs at the same time and adverse wind region in Doppler radial velocity is equal to shear. Strong echo belt lines in shear. There are three wind current with north-west, south-west and north-east wind, which leads to two types shear and strong ascending motion. It triggers heavy snowfall. The results reveals the dynamic condition from observation data. The south-west and north-east shear is thicker than north-west and north-east shear. The former is obvious between 0.8 km and 2.0 km, and the other is clear under 1.8 km.
(4)The position of shear determined the area of snowstorm. When shear is near or in the north of Yantai ,snowstorm will locates in Yantai.
As a result, shear at low troposphere is indicative well of snowstorm for ocean-effect snowstorm nowcasting. The character remarks at radar echo, while it can't be distinguished at synoptic chart because of low resolution.

Keywords: ocean-effect snowstorm, Doppler weather radar, mesoscale, wind shear, retrieved horizontal wind, nowcasting

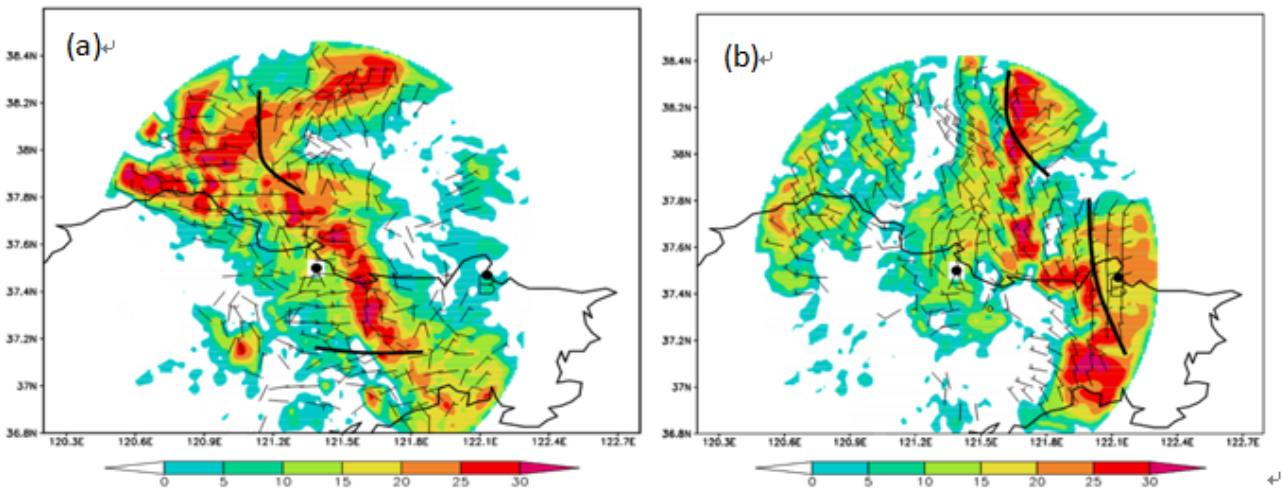

Fig.1 Reflectivity and retrieved wind field in 1.81km equivalent altitude
(a, 13:42 on 6th;b, 1:05 on 7th Dec,2005;Shaded denotes reflectivity, unit: dBZ ; thick line denotes wind shear; A denotes Yantai and B denotes Weihai)