First experiences of operational use of a dual-polarisation weather radar in Finland

1. Finnish Weather Radar Network

The FMI radar network consists of 8 C-band Doppler radars. The maximum coverage range of 250 km is plotted as a circle around each site. Vantaa radar (upgraded 2009) used in the examples of this paper, is in the middle of the south coast. Two other radars (upgraded 2009 and 2010) are located east of Vantaa and isalustrial northwest of Vantaa (marked with triangles). Our experience after a few months of usage is illustrated with three case studies in weather situations typical of the Finnish climate.

2. The measurement schedule

- Twelve PPI scans per group
- Two RHI scans per group
- Different pulse widths
- Different processing modes
- STAR and LDR modes
- To be repeated at least once every 15 minutes

3. Applications: appraising the benefits from the new data retrieved in different weather situations

3.1 A case of stratiform precipitation (Oct 3, 2009)

At 21:00 UTC, when the surface front had reached the radar site, a very sharp melting layer is seen in the vertical reflectivity profile as well as in the RHIs (Fig. 3b, right). The bright band extends from 400 m to 1000 m with an altitude of 50 dBZ. Reflectivity peaks 40 dBZ at 800 m. In the melting layer, RhoHV decreased to 0.8 (not shown) and ZDR increased up to 0.15 dB (Fig. 3c, left).

In the hydrometeor classification based on these indicators (Figs. 3a, 3b, and 3c, right panels), the shift from dry snow to wet snow is consistent with this melting layer signature. The bright band is more pronounced near the radar than further away. At a height of 800 metres the beam is full of melting snow, and above that, at a height of 1000 metres, it is full of dry snow.

The areas of high LDR and low ZDR are sometimes, but not always, co-located (Fig. 3c).

The wind profiles (Fig. 3b, right) show veering and increasing with height, consistent with warm advection and classification of the case as a warm front.

3.2 A cold front (September 4, 2009)

A cold front passed over the radar with reflectivity up to 45 dBZ being observed within rain bands in the large scale precipitation area. The area itself was much longer than the 500 km coverage of the radar, but only 50-100 km wide.

Convective cells were observed north of the radar at a distance of 50-100 km. As seen in the reflectivity image (Fig. 4a), an area of clear air echoes (CAE) is seen out to 50 km from the radar in this image, but only out to 30 km in the random phase tests (Fig. 4, left).

4. Discussion

The three cases show that dual-polarisation reveals properties of precipitation events not seen with conventional radar data.

The first case illustrates the challenge of precipitation type classification; even though all surface observations show rain, most of the radar measurements are made in snow, due to the measurement geometry and the spherical shape of the earth.

In the second case, it was possible to detect hail and graupel within the precipitation system. A short test of the attenuation scheme showed on average, that the dual-polarisation (PhiDP) based attenuation correction scheme performed as well as the conventional attenuation correction scheme.

In the third convective case, the echo from non-precipitation targets are correctly identified, but at the moment there is no procedure to clean up the rainfall intensity images by removing such echoes.