2B.5 TARGET IDENTIFICATION BY DUAL-POLARIZATION RADAR IN AN OPERATIONAL ENVIRONMENT

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1. OVERVIEW

Two years ago, the McGill S-band scanning radar has been upgraded to dual-polarization. Since the McGill radar is part of the Canadian network of operational radars, dual-polarization work was focused on issues of most pressing relevance to operations: the removal of ground clutter and target identification.

On the clutter removal front, we evaluated whether operational-radar quality data of Doppler velocity and polarization parameters could be used to identify ground clutter. Using a fuzzy-logic based classification scheme, we were able to remove most of the ground targets, to the point where it was virtually impossible for trained personnel to identify ground targets that had not been detected by the algorithm (Fig. 1).

Target identification of hydrometeors proved reasonably pleasing in convective situations, especially since all our data are collected by scanning at 6 rpm or 36 °/s (Figs. 2 and 3). Complications occurred in stratiform precipitation where the melting layer proved to be particularly difficult to detect *in its entirety* with a high degree of certainty. This is primarily due to the fact that although the bright band has a clear signature visually, its polarization properties vary considerably with depth, making an automatic classification challenging (Fig. 4). Yet, proper target identification is proving to become an important issue, as data assimilation experiments done in parallel illustrate that the proper phase (liquid vs solid) of targets must be supplied to the models for short term forecast of convection to work properly.

Interesting questions on the variability of information are risen by data in stratiform precipitation. Figure 5 shows the vertical profile of polarization parameters in four bright band cases. The difference in the vertical profiles of Z_{DR} for comparable profiles of Z is striking. Much less information seems to be contained in ρ_{HV}. Whether the differences in the profiles are indicative of differences in snow growth will be investigated in the future.

2. REFERENCE

Bellon, A., and A. Kilambi, 1999: Updates to the McGill RAPID (Radar data Analysis, Processing and Interactive Display) System. Preprints, 29th Int. Conf. on Radar Meteorology, AMS, Montreal, Canada, 121-124.

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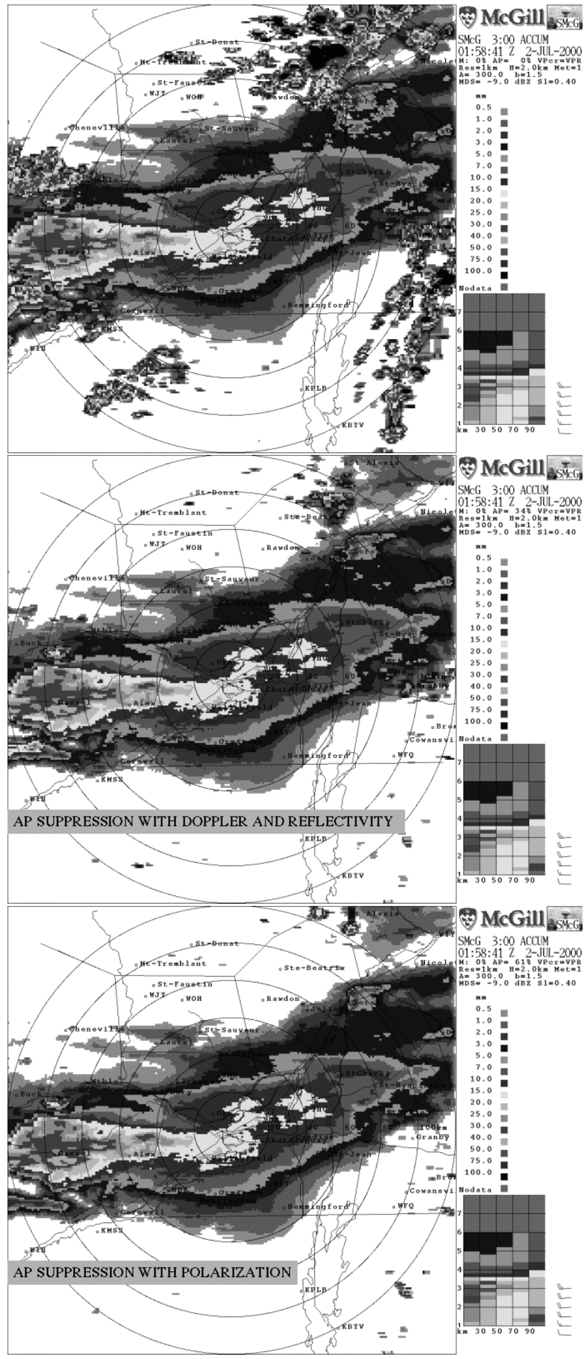

Fig. 1: Accumulations of three hours of precipitation in a situation where a considerable amount of echoes from anomalous propagation (A.P.) can be observed. Top: Accumulation derived without removing A.P. echoes. Middle: A.P. echoes removed using Doppler information (Bellon and Kilambi 1999). Bottom: A.P. echoes removed using dual-polarization information.

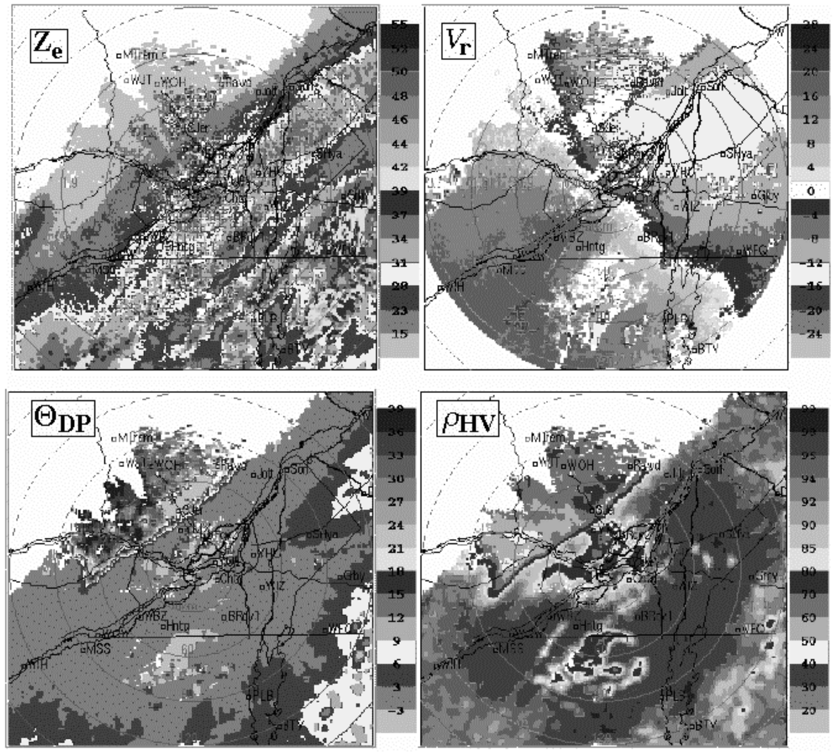

Fig. 2: Example of dual-polarization data collected by our radar system during the passage of the remnants of hurricane Floyd. While most of the echoes are associated with rainfall, ground targets south of the radar (white patch on the velocity map corresponding to the low correlation region on the ρ_{HV} map) and migrating birds taking advantage of the tail wind (high θ_{DP} and low ρ_{HV} region in the north-west) can also be observed.

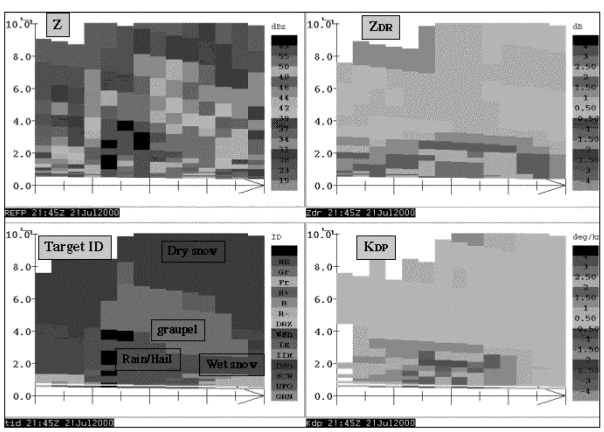

Fig.3: Cross-section of dual-polarization parameters and target ID map through a small hailstorm.

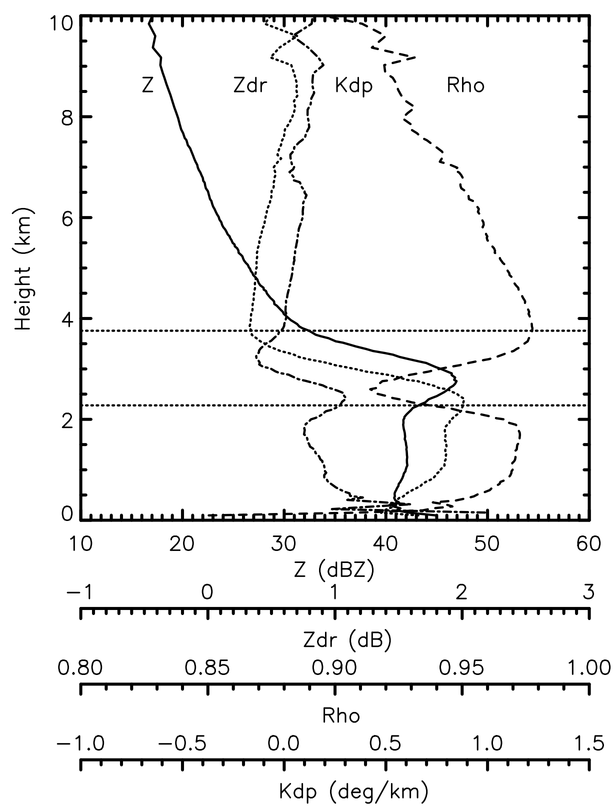

Fig. 4, right: Vertical profiles of reflectivity (Z, solid line), differential reflectivity (Zdr, dotted line), cross-correlation between the H and V channels (rho, dashed line), and measured differential phase (Kdp, dash-dot line) in stratiform precipitation on 10 May 2000. The dotted lines at 2.3 and 3.7 km outline the limits of the bright band as determined from the reflectivity information. Note that while the bright band has a typical signature associated to it (higher Z and Zdr, low rho), the top third of the bright band has polarization characteristics close to that of snow except for its enhanced reflectivity.

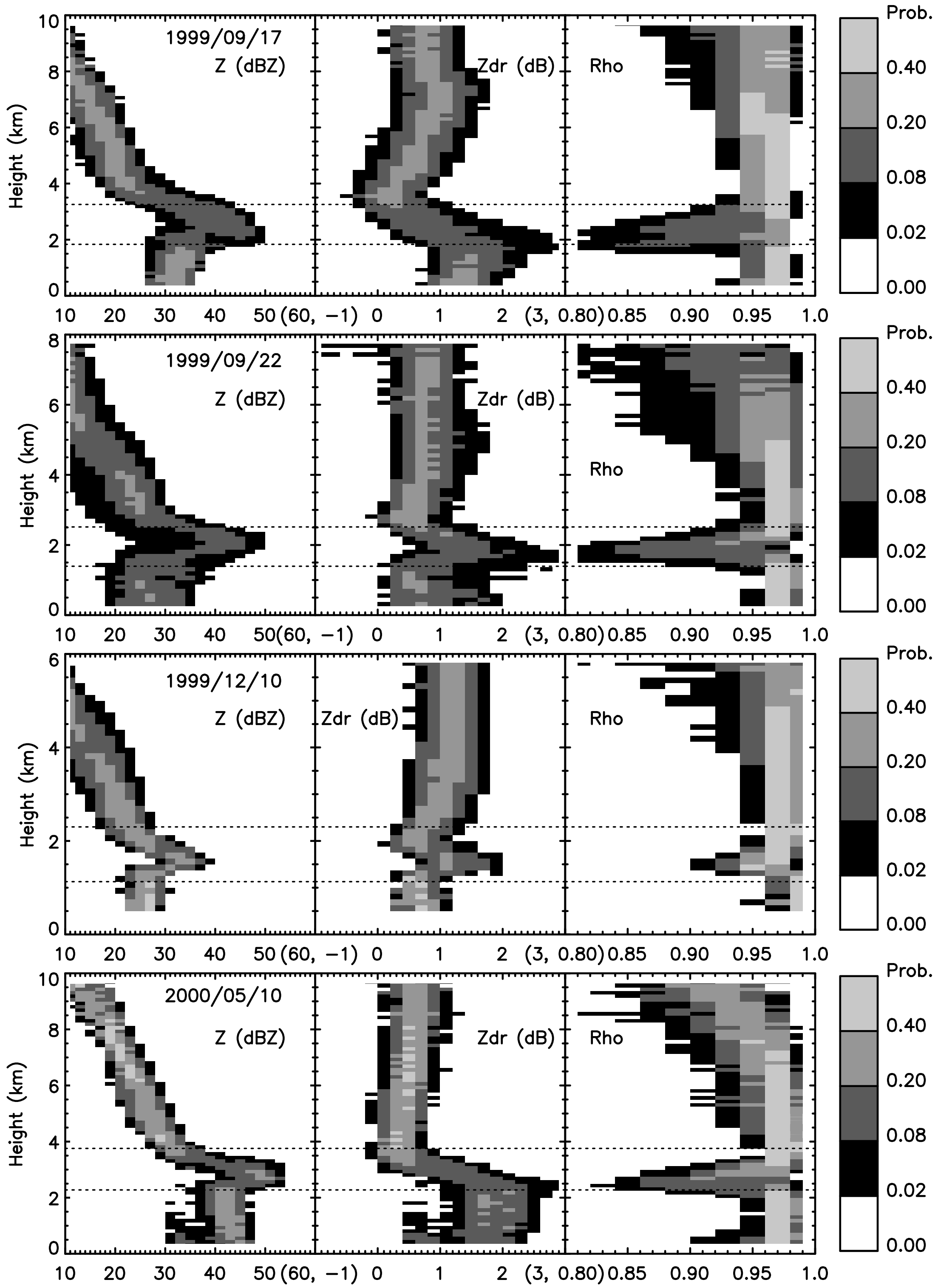

Fig. 5: Probability of occurrence of reflectivity (Z), differential reflectivity (Zdr) and cross-correlation between the H and V channels (rho) as a function of height for four different cases. The gray shade illustrates the probability that, at each height level, the radar parameter is within a certain interval 2 dB wide for reflectivity, 0.2 dB wide for differential reflectivity, and 0.02 wide for correlation. Horizontal dotted lines outline the limits of the bright band as determined from the reflectivity information. Note the variability of the three parameters within and above the melting layer between the four different cases.