Possible combination of measurements to characterize snow

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Remote sensing of precipitation using both ground-based and space-based radars is used in many areas, such as weather forecasting, land and sea surface monitoring, flood prediction, and estimating the impact of precipitation on the global hydrological cycle. At high latitudes, most of the measured precipitation is snow during the winter months. Snow is still a large unknown factor in the global circulation, and therefore it is important to estimate its impact in both local and global scale. However, due to the large morphological variation of falling snow, the local impact is highly dependent on the type of snow that reaches the ground.

In recent years, the available frequency range of operational and research radars has increased, and can typically cover frequencies between 2.7 GHz (S band) and 94.0 GHz (W band) with many intermediate frequency bands, such as C, X, Ku, and Ka bands. Also, many of these radars can provide dual-polarization measurements, which sometimes provides additional information about the type of precipitation. The polarization signatures have been used in precipitation classification. There are also many studies indicating that the use of a combination of dual-frequency ratios can improve the identification of snow type.

In this paper, we make a comprehensive analysis to evaluate the various combination of frequencies to classify and quantify snow types. The main obejective of this study is to understand the performance of different combination of frequencies for snow retrieval. For example, target of opportunities could enable a dual-frequency radar (such as the NASA D3R radar) next to a S or W band radar. The results of this study will document the usefulness of two types of retrievals. In addition, we will discuss the impact of dual polarization on the retrievals in combination with multiple frequencies.