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Abstract: **Quantifying the Snowfall Detection Performance of GMI Channels and GPM Constellation Radiometers over Land**

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This study used Global Precipitation Measurement (GPM) Microwave Imager (GMI) and Ka-precipitation radar observations to quantify the snowfall detection performance for different channel (frequency) combinations. Results showed that the low frequency channel set contains limited snow detection information with a 0.34 probability of detection (POD). The high frequency channels are added to the low frequency channel set one by one to illustrate the importance of the high frequency channels for snowfall detection. Adding the 183±3 channel presents the largest POD improvement (from 0.34 to 0.50). The reason for this is that the surface contamination is most effectively alleviated for the 183±3 channel due to the presence of water vapor, which largely masks the surface. Therefore, the relatively weak scattering signature from the snowfall is better captured. Data analysis and model simulation support this explanation. Further, the GPM constellation radiometers are grouped into six types based on the channel availability and their snowfall detection capability is estimated, using channels available on GMI. It is found that type 4 radiometer (all channels) has the best snowfall detection performance with a POD at 0.77. The POD values are only slightly smaller for the type 3 radiometer (high frequency channels) and type 5 radiometer (all channels except 183 channels). Finally, it is demonstrated that the 166 channels are indispensable for any channel combination with POD greater than 0.70, by analyzing 8191 all possible GMI channel combinations. This again suggests that the scattering signature, not the water vapor effect, is essential for snowfall detection.