Measuring snow with a low-power K-band radar (Micro Rain Radar) at the Schneefernerhaus

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The Micro Rain Radar (MRR) is a low-cost, low-power vertically pointing Frequency Modulated Continuous Wave (FM-CW) radar operating at 24 GHz which is widely used to measure rainfall. Kneifel et al., 2011 [1] recently reported that it can also be used to measure snowfall and it compares well with a pulsed Ka-band cloud radar for reflectivities exceeding 0 dBz. Events with smaller reflectivities are not detected, due to limitations of the hardware design and rain-specific MRR noise processing.

This fact limits the use of MRR for snowfall statistics, because, according to Cloudsat measurements [2], almost half of all snow events have reflectivities lower than 0 dBz, even though they contribute insignificantly to the accumulated amount of precipitation. On the other hand, MRR has broad potential applications, due to the lightweight and robust design, which makes it also feasible for remote areas. Thus, MRR would be an appropriate tool to discuss and compare snowfall climatologies from various climate zones, if its sensitivity could be increased. For this, also data from existing MRR networks could be reprocessed.

For this study, data from January to March 2012 of DLR's MRR at the Schneefernerhaus are analysed. As a reference, the 35.2 GHz MIRA36 cloud radar is used, which has a much higher sensitivity of -44 dBz and is capable of detecting the full range of hydrometeors from ice clouds to precipitation. The software processing of the MRR was completely redesigned using the raw Doppler spectra. The key is an improved noise algorithm which increases the sensitivity of the MRR several dB and allows the use of the full potential of the hardware. The obtained results are used to revaluate MRRs capabilities of observing snow.

[1] Kneifel, S., Maahn, M., Peters, G. and Simmer, C. Observation of snowfall with a low-power FM-CW K-band radar (Micro Rain Radar). Meteorology and Atmospheric Physics 113, 75-87 (2011).
[2] Kulie, M.S. and Bennartz, R. Utilizing Spaceborne Radars to Retrieve Dry Snowfall. Journal of Applied Meteorology and Climatology 48, 2564-2580 (2009).