New approaches towards a better characterization of snowfall microphysics

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Snow is the predominant type of precipitation in sub-polar and polar latitudes, however, the measurement of snowfall quantities, especially from the satellite perspective remains highly uncertain. This is largely due to the unknown and strongly varying microphysical properties of snow, which make the interpretation of satellite signals ambiguous.
The DFG "Towards an Optimal estimation based Snow Characterization Algorithm" (TOSCA) project has addressed possible novel measurement synergies for better describing the vertical distribution of snowfall necessary for satellite retrieval applications as well as for numerical model evaluation. For this, microwave radiometers (22 – 150 GHz), 24 and 36 GHz radar, lidar, and in-situ optical disdrometers were deployed at the Environmental Research Station Schneefernerhaus (UFS at 2650 m MSL) at the Zugspitze Mountain in the Alps during the winter of 2008/2009.
We show that there is a high potential for an improved snow mass content retrieval by using the synergy of ground-based microwave brightness temperature enhancements during snowfall with cloud-radar-derived snow water path. Radiative transfer simulations also support these observations. The synergy of these measurements, however, needs to be augmented by a priori knowledge on water vapor, super-cooled liquid water, particle size distribution and shape, thus making clear the necessity of long-term synergetic remote sensing *and* in-situ measurements, optimally at one and the same location. The radiometric measurements also reveal the very frequent presence of super-cooled water within snow clouds and its importance to microphysical diffusion and aggregation growth of snow crystals.