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Combining dual-polarization radar and ground-based observations to study the effect of riming on ice particles

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Recently a new microphysical scheme based on a single ice-phase category was proposed for the use in numerical weather prediction models. In the proposed scheme, ice particle properties are predicted and vary in time and space. One of the attributes of the proposed scheme is that the prefactor of a power-law relation that links mass and size of ice particles is determined by the rime mass fraction, while the exponent is kept constant. According to this the maximum dimensions of ice particles do not change during riming until graupel growth phase is reached.

The dual-polarization radar observations given an additional insight on what are the physical properties of ice particles. Often, it is assumed that differential reflectivity should decrease because of riming. The motivation for this is that heavy riming would transform an ice particle to graupel. A graupel particle typically would have an almost spherical shape and therefore the differential reflectivity will become smaller. On the other hand, at the earlier stages ice particle shape may not change much, while its mass and therefore the density increases. This would lead to the increase of the differential reflectivity, for example.

By combining ground-based observations, which allow to quantify the effect of riming on snowfall, and dual-polarization radar observations we investigate the impact of riming on ice particle properties, i.e. mass, density and shape. Furthermore, a connection between, bulk properties of ice particles, liquid water path, radar equivalent reflectivity factor and precipitation rate observations is established. The study is based on data collected during US DOE Biogenic Aerosols – Effects on Clouds and Climate (BAECC) field campaign that took place in Hyytiala, Finland. A detailed analysis of two events is presented to illustrate the method.