Identification of snowfall riming through analysis of radar echo spatial structure

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Weather radar-based quantitative precipitation estimation in snowfall is challenging given the number of unknowns. Radar observation of snow depends on size, orientation and density of the ice particles. The variability in these physical properties is one of the major uncertainty sources in radar based quantitative snowfall estimation.

In the recent studies we have argued that the observed difference in the continuity of radar reflectivity field is related to physical processes that are taking place and can be used as an indicator for presence of riming. Typical reflectivity field in riming cases exhibit higher spatial variability then in snow aggregation events. It is not clear what is the cause of the reflectivity variability. There are three potential mechanisms that can explain it. Riming typically occurs in updrafts and therefore is present in more convective conditions. In those conditions, particles growing in updrafts will be denser then those growing in downdrafts. Furthermore, because of difference in fall velocities those particles will separate space.

To further test the performance of the riming detection methodology, data collected during the Light Precipitation Validation Experiment, which took place in Helsinki in the fall of 2010 and winter 2011, was used. During the experiment, a large number of winter storms were sampled by dual-polarization weather radars, scanning microwave radiometer (ADMIRARI), and surface sensors. By comparing the detection outcomes to ADMIRARI LWP observations the riming detection algorithm is tested. The impact of the riming detection on winter precipitation QPE is demonstrated by comparing radar based LWE and gauge accumulations.