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# Identification of snowfall or blowing snow particles in Multi-Angle Snowflake Camera images

Mathieu Schaer, Christophe Praz, and Alexis Berne
EPFL, LTE, Lausanne, Switzerland (alexis.berne@epfl.ch)

Blowing snow is a highly relevant process in cryospheric sciences. In mountainous regions, strong winds can blow away large quantities of fresh snow which eventually impacts snowpack stability and avalanche hazard at the local scale. On the polar ice sheets, blowing snow is a recurrent process influencing the local surface mass balance through transport and sublimation. Blowing snow also plays a role in the surface energy balance by affecting the snow surface characteristics. In windy conditions, snowfall is frequently observed with blowing snow. It is therefore necessary to be able to identify and characterize both processes separately.

In this contribution, we introduce a new method to automatically discriminate falling hydrometeors from blowing snow particles based on Multi-Angle Snowflake Camera (MASC) images. The MASC is a ground snowflake imager which captures high-resolution photographs of particles from three coplanar angles while measuring their fall velocity. Whereas its initial purpose is to study the microphysical properties of solid precipitation, the device can also record blowing snow. The classification task is achieved by means of a Gaussian Mixture Model (GMM) with two components. The method relies on four selected descriptors related to the frame frequency, the number of particles detected as well as their size and geometry to classify each individual image. The GMM was trained on a representative dataset collected during two fields campaigns near Davos in the Swiss Alps and at the Dumont d'Urville French station in a coastal area of Antarctica. On this reference dataset, the classifier achieved high performance with an overall accuracy and Heidke Skill Score of 99.4% and 98.8%, respectively. In a second step, the probabilistic information (given as an output of the GMM method) is utilized to identify images where both precipitation and blowing snow particles are present and estimate under which proportions.

Preliminary results indicate that more than 50% of the images collected at Dumont d'Urville are composed of a mix of precipitation and blowing snow, hence the need to be able to separate the two processes. During the field campaign in Davos, the MASC was located in a Double Fence Intercomparison Reference (DFIR) which is a structure designed to minimize the impact of wind and turbulence on precipitation observations. Interestingly, our results suggest that despite the DFIR, a large fraction of the images collected are classified as mixed. Visual inspection of those images seems to indicate that blowing snow particles originate from accumulation on the fences of the DFIR. The proposed methodology opens new possibilities to study snowfall, blowing snow as well as their interaction at a high temporal resolution. The algorithm can run on a standard computer and is therefore easily transferable.