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Dual ice crystal imager for measurements of snow ice crystal properties and fall speed

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Better predictions of snowfall require good knowledge of the microphysical properties of snow ice crystals and snow particles. Shape is an important parameter as it influences strongly the scattering properties of these ice particles, and thus their response to remote sensing techniques such as radar measurements. The fall speed of ice particles is another important parameter for both numerical forecast models as well as representation of ice clouds and snow in climate models, as it is responsible for the rate of removal of ice from these models.

We describe a new ground-based in-situ instrument to determine snow ice crystal shape and fall speed simultaneously. The instrument, the dual ice crystal imaging (D-ICI) probe takes two high-resolution pictures of the same falling ice particle from two different directions. Both cameras use a microscope-like set-up resulting in an image pixel resolution of approximately 4 μm/pixel.

One viewing direction is horizontal and is used to determine fall speed by means of a double exposure. For this purpose, two bright flashes of a light emitting diode behind the camera illuminate the falling ice particle and create this double exposure. The vertical displacement of the particle between the two flashes is used to calculate its fall speed.

The other viewing direction is close to vertical and is used to provide size and shape information from single-exposure images. This viewing geometry is chosen instead of a horizontal one because shape and size of ice particles as viewed in the vertical direction are more relevant than those properties viewed horizontally because the vertical fall speed is more strongly influenced by these vertically viewed properties. In addition, a comparison with remote sensing instruments that mostly have a vertical or close to vertical viewing geometry is favoured when the particle properties are measured in the same direction.