# 3D Shape Reconstruction of Winter Precipitation Particles Based on Multi-Angle Images Obtained by Two Advanced Optical Disdrometers

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This paper presents a continuation of our microphysical and scattering studies of winter precipitation based on in-situ and remote sensing observations and analyses aimed to improve characterization, classification, and quantification of ice particles and radar-based quantitative precipitation estimation. The studies are an integral part of the MASCRAD (MASC + Radar) project and its field site at the Easton Valley View Airport, south of Greeley, Colorado. The ground instrumentation at the site includes a multi-angle snowflake camera (MASC), 2D-video disdrometer (2DVD), and several other instruments installed inside a 2/3-scaled double fence intercomparison reference (DFIR) wind shield. The site operates under the umbrella of the dual-polarization CSU-CHILL Radar. Here we focus on three-dimensional (3D) shape reconstruction of winter precipitation particles based on multi-angle images obtained by advanced optical disdrometers, particle fall speed measurements and calculations, and processing of measured characteristics to arrive at geometrical, microphysical, and scattering models of natural snow and ice particles.

During the MASCRAD project, several teams of engineering students have designed, developed, and built a novel system for measurement and analysis of snow particles in free fall, constituting the Snowflake Measurement and Analysis System (SMAS). The main features the SMAS are: seven high-resolution cameras placed in a 3D fashion optimally for 3D visual hull reconstruction purposes, increased image capture rate, fall speed measurement for all captured hydrometeors including frames with multiple images, etc.

We present a discussion of the processed data from an expanded set of winter events recorded at the MASCRAD site by the MASC, as well as the SMAS when this new instrument was operating. The recorded snow data has been processed through the visual hull method for 3D reconstruction, which has been adapted for use with each of the systems. The resulting 3D meshes are then compared for accuracy of reconstruction. The fall speed measurements are also discussed, as well as further processing of measured data to form the basis for scattering analysis.