Winter Event Observations at Wallops Flight Facility in 2022 and Ongoing Analyses of Collected Data

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Surface in-situ observations of geometrical and microphysical properties of winter precipitation coupled with scattering measurements by means of scanning and vertically pointing radars, combined with machine learning models are essential for development of radar-based retrieval of liquid equivalent snow rate and accumulation maps. They are also crucial for development of numerical schemes that predict microphysical properties of ice particles and for advancement and execution of numerical models for simulations of ice clouds and frozen precipitation and of forecast models overall.

This paper presents our observations and ongoing analyses of four snowstorms that occurred during the winter season of 2021-2022 at Wallops Flight Facility, Virginia, USA. This case study was performed analyzing the data collected from multiple instruments ranging from optical instruments such as Snowflake Measurement and Analysis System (SMAS), Multi-Angle Snowflake Camera (MASC), and 2D-Video Disdrometer (2DVD), and 3D Sonic Anemometer to state-of-the-art radars such as NASA Dual-Pol Doppler Radar (NPOL) and Micro Rain Radar (MRR).

Particularly focusing on the snow event that occurred on January 3rd, 2022, using the above mentioned instruments, we collected information on rain rate, liquid water content of the atmosphere including clouds, fall speed and particle size of snowflakes, melted/dry state and riming estimation of snowflakes and snowflake geometry. The snow particles detected by SMAS and MASC, sorted by our trained convolution neural network, suggest the dominant shape during the observed event was small particle, followed closely by graupel. The estimated riming, also with a similar neural network, lies mostly between graupel-like and graupel indicating heavy ice buildup. Another similar neural network based on SMAS and MASC images, alongside MRR retrieved liquid water content indicating a layer of warm air between the clouds and the surface instruments, confirms a dominance of melted snowflakes. While the typical fall speed of a snowflake lies within 0.3 m/s to 2 m/s, the average estimation of fall speed measurement from the 2DVD was slightly faster than that, suggesting a mix of rain alongside snow during this particular event. The particle size distribution estimation indicates small equivalent particle diameter confirming the estimated dominance of small particles from SMAS and MASC. NPOL radar results further confirm a mix between frozen precipitation and rain for the event in focus.