4–8 November 2019, Kraków, Poland
ECSS2019-188-1

Quantifying Hail Size Distributions from the Sky: Application of Drone Aerial Photogrammetry to an Argentinian Hail Storm

Joshua Soderholm (1), Matthew Kumjian (2), Nicholas McCarthy (3), and Paula Maldonado (4)

(1) Radar Science and Nowcasting, Australian Bureau of Meteorology, (2) The Pennsylvania State University, Department of Meteorology and Atmospheric Science, United States, (3) University of Queensland, Australia, (4) University of Buenos Aires, Argentina

Measurements of hail size distributions (HSD) are incredibly challenging to obtain owing to the infrequent and hostile nature of hailstorms; however, such observations are necessary to constrain microphysics parameterization schemes and hail detection and sizing algorithms from weather radar. Ground-based sensors are most frequently used to capture the HSD either using a time-integrated (e.g., hail pads) or time-recording (e.g., hail disdrometers) hardware; however, both techniques are limited by a small sample area and the difficulty in deploying them in the path of a hailstorm. These limitations result in poor sampling of the HSD when hail fall is sparse and/or it the hail swath has large spatial variability.

To overcome these issues, advances in Unmanned Aerial Vehicle (UAV) photogrammetry have be applied to capture the HSD over large areas (> 1000 m^2) immediately following hail fall. We demonstrate this application with results from a hail survey conducted during the RELAMAPGO project in Argentina, using both traditional hail pads and a 'HailPixel' UAV survey that sampled $> 15\,500$ hailstones at a 2.5-mm pixel resolution. The significant increase in sample size provides more robust statistics for exploring trends in aspect ratio, diameter, and frequency. The results are compared to X-band, dual-polarization, dual-frequency Doppler on Wheels radar data. On radar, the storm displayed characteristic signatures of hailstorms, including weak anticyclonic shear indicative of the midlevel mesoanticyclone, three-body scattering signatures (TBSSs), and reduced co-polar correlation coefficient ρ_{hv} values in the hail growth region. The evolution of the storm as inferred from the radar data will be discussed in the context of hail production and the results of the UAV photogrammetric hail survey.