## Near-global three-dimensional hail signals detected by using GPM-DPR observations

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A hailstone is a large, dense ice particle, and its particle size often reaches more than 1 cm. Hail is known to be associated with intense storms and causes severe damage to cars, buildings, and croplands. In general, hail has been observed by weather radar systems or reported from visual checks on the ground. Such observations are limited to developed countries and populated regions, and hence, the global three-dimensional structure of hail has not yet been analyzed.

This study proposes a method to detect three-dimensional hail distribution by using the GPM (Global Precipitation Measurement) DPR (Dual-frequency Precipitation Radar) products in combination with the atmospheric temperature from a reanalysis product. The ZKu (radar reflectivity at the Ku-band) and DFR (dual-frequency ratio) values are examined for hydrometeor classification at the five atmospheric temperature ranges by comparison to the ground radar product in a test hail storm case. The hail signals lie along the collisional growth curves on the scatter plot of ZKu and DFR. The five-year dataset of the GPM-DPR observations illustrates that hail is widely distributed over the ocean and is frequently observed near the freezing level. Most oceanic hail layers are found to be thin (i.e., less than 1500 m) and, hence, have been potentially missed by ground observations.

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