

How do turbulence and temperature influence hydrometeor fallspeed ?

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The vertical velocity of hydrometeors is one of the most important parameters to get right in weather and climate models. Frozen hydrometeors are particularly challenging since their shapes are infinitely variable and their fallspeeds correspondingly difficult to predict. Many parameterizations for fallspeed have been developed as a function of hydrometeor habit. Yet, even though snow clearly swirls, measurements or theory have contrived or assumed conditions for still air. Also, even though the density of accreted deposits on graupel and hail is known theoretically to be a function of temperature, the most widely used formulae for graupel fallspeed are a function only of particle size.

I will discuss recent Multi-Angle Snowflake Camera observations that shed light on this problem. The MASC is a new instrument that takes high resolution photographs of hydrometeors in freefall while simultaneously measuring their fallspeed. Millions of snowflake images collected in Utah show remarkably weak correlation between particle size or shape and fallspeed. There appears to be a nearly equal preference for particles to fall at about 1 m/s whether the particles are compact graupel or aggregate flakes, or whether the particles are small or large. However, the spread in measured velocities grows in proportion to ambient turbulence and lower temperatures are associated with generally slower graupel fallspeeds. There may be a need for revisions to commonly used parameterizations for precipitation in weather and climate models.