Abstract Submitted
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Falling snow behaves as inertial particles in turbulence[1] FILIPPO COLETTI, ETH Zurich, CHENG LI, KAEUL LIM, TIM BERK, ALIZA ABRAHAM, MICHAEL HEISEL, MICHELE GUALA, JIARONG HONG, St Anthony Falls Laboratory, University of Minnesota — The effect of turbulence on snow precipitation is not incorporated in present weather forecasting models. Here we show that turbulence is in fact key to determine both fall speed and spatial distribution of settling snow. We consider three snow fall events under vastly different levels of atmospheric turbulence. We characterize the size and morphology of the snow particles, and we simultaneously image their velocity, acceleration, and concentration over vertical planes about 30 square meters in area. We find that turbulence-driven settling enhancement explains otherwise contradictory trends between the particle size and velocity. The estimates of the Stokes number and the correlation between vertical velocity and local concentration indicate that the enhanced settling is rooted in the preferential sweeping mechanism. When the snow fall speed is large compared to the characteristic turbulence velocity, the crossing trajectories effect results in strong accelerations. When the conditions of preferential sweeping are met, the concentration field is highly non-uniform and clustering appears over a wide range of scales. These clusters display the signature features seen in canonical settings: power-law size distribution, fractal-like shape, vertical elongation, and large fall speed that increases with the cluster size. These findings demonstrate that the fundamental phenomenology of particle-laden turbulence can be leveraged towards a more predictive understanding of snow precipitation.

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