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Snowflakes aggregation in turbulent flows: a case limit under dynamically critical Stokes conditions MICHELE GUALA, St. Anthony Falls Laboratory, CEGE, University of MInnesota, JIARONG HONG, St. Anthony Falls Laboratory, ME, University of MInnesota — A simple theory, based on observations of snowflake distribution in a turbulent flow, is proposed to model the growth of inertial particles as a result of dynamic clustering at scales larger than the Kolmogorov length scale. Particles able to stick or coalesce are expected to grow in size in flow regions where preferential concentration is predicted by a critical Stokes number $St = \tau_p/\tau_f \simeq 1$. We postulate that, during growth, St remains critical, with the particle response time τ_p evolving according to the specific flow time scale τ_f defined by the vortices around which progressively larger particles end up orbiting, colliding and aggregating. This mechanism leads to the prediction of the limiting size of droplets and snowflakes in a turbulent flow. Such limit, determined by the extent of the turbulent inertial range, can be formulated as a function of the r.m.s. velocity fluctuation and the integral length scale. The proposed dynamically critical Stokes growth provides a framework to interpret hydrometeor aggregation and, in general, particle size growth in geophysical multi-phase flows.

Michele Guala
St. Anthony Falls Laboratory, CEGE, University of MInnesota

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