Abstract Submitted
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Interface-Resolving Simulation of Collision Efficiency of Cloud Droplets[1] LIAN-PING WANG, CHENG PENG, University of Delaware, BODGAN ROSA, Institute of Meteorology and Water Management, Poland, RYO ONISHI, Japan Agency for Marine-Earth Science and Technology, Japan — Small-scale air turbulence could enhance the geometric collision rate of cloud droplets while large-scale air turbulence could augment the diffusional growth of cloud droplets. Air turbulence could also enhance the collision efficiency of cloud droplets. Accurate simulation of collision efficiency, however, requires capture of the multi-scale droplet-turbulence and droplet-droplet interactions, which has only been partially achieved in the recent past using the hybrid direct numerical simulation (HDNS) approach. The HDNS approach has two major drawbacks: (1) the short-range droplet-droplet interaction is not treated rigorously; (2) the finite-Reynolds number correction to the collision efficiency is not included. In this talk, using two independent numerical methods, we will develop an interface-resolved simulation approach in which the disturbance flows are directly resolved numerically, combined with a rigorous lubrication correction model for near-field droplet-droplet interaction. This multi-scale approach is first used to study the effect of finite flow Reynolds numbers on the droplet collision efficiency in still air. Our simulation results show a significant finite-Re effect on collision efficiency when the droplets are of similar sizes. Preliminary results on integrating this approach in a turbulent flow laden with droplets will also be presented.

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