Abstract Submitted
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Numerical Simulations of Cumulus and Mammatus Clouds[1] S. RAVICHANDRAN, Nordita, KTH Royal Institute of Technology and Stockholm University, SE-106 91 Stockholm, Sweden — Cumulus, or 'heap-like', clouds are crucial to mass and energy transport in the atmosphere. We model these clouds as transient diabatic plumes carrying water vapour, and show that their formation and evolution are governed by the balance between ambient stratification and the release of latent heat by condensation. The latter is governed by the ambient relative humidity and the boundary conditions at the plume base (1). We show how anomalous entrainment in cumulus clouds may be studied using the present formulation. Mammatus, or lobe-like, clouds develop underneath cloudy layers called cumulonimbus anvils. As water droplets settle out of the anvil, they evaporate and cool the layer of air immediately below the anvil, creating a density overhang and leading to an instability. The nature of this instability is governed by the density excess and depth of the overhang, which in turn are functions of the size and number concentration of liquid water droplets in the anvil. We show that the size of the water droplets plays a greater role in the formation of mammatus-like lobes, thus explaining why evaporative cooling is necessary but not sufficient for mammatus cloud formation (2). (1) SR and Narasimha, arXiv:2004.09631 (2) SR, Meiburg and Govindarajan, J. Fluid Mech. (2020), 899,

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