TURBULENT ANISOTROPIC TRANSPORT IN A MODEL CLOUD INTERFACE

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Small-scale turbulence in cumuli can make a significant contribution to the droplet growth by coalescence (Grabowski & Wang, ARFM 2013, Wang & Grabowski Atm.Sci.Lett. 2009), with a consequent significant impact of the onset of warm rain. We study the transport of energy and water vapour at the interface between two turbulent regions with a different kinetic energy and vapour concentration in a stratified environment through direct numerical simulations by applying the Boussinesq approximation. This configuration (Iovieno et al. JoT 2014, Gallana et al. JoP:CS 2015) mimics the inhomogeneity observed at the edge of a cloud between a more energetic cloud and the calmer drier ambient. Both stable and unstable stratifications are considered. In presence of a stable stratification we show the onset of two intermittent layers which confine a low kinetic energy sublayer, which acts as a barrier and blocks entrainment. On the opposite situation, a fast growth of an intermittent mixing layer enhances the entrainment till the bouyancy forces overcome inertial forces. We consider also the motion of droplets subject to the Stokes drag, gravitational acceleration and condensational growth. Their motion is coupled with the advection-diffusion of vapour in the air by using Mason's model (Villancourt et al., J.Atm.Sci. 2000, Devenish et al. QJRMS 2012, Kumar et al. TCFD 2013). Unlikely most simulations, which use the "ghost collision approximation" (e.g. Ayala et al. 2008), we assume coalescence of the droplets. By means of this formulation, we will verigy our ansatz that the concentration of fluid elements across the cloud interface (shearless mixing layer) can ehnance collision rate and coalescence. We will show how the flow inhomogeneity influences the droplet growth and their spatial distribution. Collision kernels and the spectral density function of particle size will be also given.

Mean kinetic energy, vertical flux of turbulent kinetic energy and velocity of the vapour front.

Longitudinal derivative: (a,b) skewness, (b,c) normalized thord moment in presence of stratification