Turbulent transport at a simplified clear air/cloud interface.

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We consider the local turbulent transport at a simplified clear air/cloud interface by means of direct numerical simulations. In particular, we focused on the small scale part of the inertial range as well as on the dissipative range of the power spectrum which are important to the micro-physics of warm clouds (Re_lambda= 250). The simulations were performed by solving the Boussinesq equations together with the passive scalar transport equation, which was used to model the water vapor transport. We have separately investigated both the top and bottom interfaces of a typical stratocumulus by varying the density stratification level. Cloud and clear air are represented as two isotropic regions with different turbulent kinetic energy, with an energy ratio equal to seven. The physical parameters are set to typical values met at an altitude of about 1000 meters (Pr=0.74, Sc=0.64, Fr [0.8-8]).Comparison with works on the non-stratified turbulent mixing (Shraiman&Siggia 2000; Ma&Warhaft 1994; Holzer&Siggia 1994, Tordella&Iovieno 2008, 2011; Iovieno *et al* 2014;) allows to identify the role of buoyancy in the mixing process.
The initial evolution resembles the mixing in a non-stratified flow. However, as the buoyancy term becomes of the same order of the inertial one, the phenomenology of the system changes. We observe a spatial redistribution of the kinetic energy and a concomitant onset of a well of kinetic energy in correspondence of the low energy side of the mixing layer. In this situation, the mixing contains two interfacial regions with opposite energy gradient, which in turn produce two intermittent layers in the velocity field. This generates a change in the structure of the fluxes, dissipation rate, temperature and water vapor with respect of the non stratified mixing: the communication between the two turbulent region is weak, and the growth of the mixing layer stops. These results are discussed and compared with laboratory and numerical results (Jayesh&Warhaft 1994; Mellado *et al* 2009; Gerashchenko et al 2011).