A Novel Approach for Simulating Droplet Microphysics in Entraining Clouds

Steven Krueger
Department of Atmospheric Sciences, University of Utah

The physics of cloud droplet growth involves a huge range of scales, from those individual cloud droplets (a few microns) to the turbulent eddies the size of cumulus clouds (a few hundred meters or more). Current 3D simulation approaches such as LES or DNS cannot encompass the entire range of relevant scales. But by reducing the dimensionality of the turbulence representation to just one dimension, it is possible to represent this entire range of scales while still representing the essential physics of turbulent deformation (stirring) and molecular diffusion (mixing). It also allows the growth of individual cloud droplets due to condensation and collision-coalescence to be included. With this approach individual cloud droplets grow or evaporate according to their local environments which can be strongly inhomogeneous at the smallest turbulent scales due to mixing of entrained air. This approach can also be extended to allow collision and coalescence growth of droplets, including the inertial effects of turbulence on droplet motion which can lead to clustering and enhanced collision rates.