4.083 Impacts of cloud aqueous processes on chemistry and transport of biogenic VOC.

Early Career Scientist

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Abstract:

Biogenic volatile organic compounds (BVOC) are crucial precursors in the formation of ozone and secondary organic aerosols, and serve as an important radical reservoir in the atmosphere. Recently, the role of aqueous processing of biogenic VOC has received attention, and convective transport and aqueous-phase processing in clouds can influence gas-phase reactivity and organic aerosol formation. We select a convective weather condition with non-precipitating cumulus clouds to understand the effects of cloud aqueous processes on vertical distributions of key BVOC species and their role on BVOC oxidation. We simulate the event utilizing the National Center for Atmospheric Research's Large Eddy Simulation (LES) model. Updated aqueous chemistry, including the oxidation of isoprene, methyl vinyl ketone, and methacrolein, and the formation and oxidation of acetic acid, glycolic acid, glyoxylic acid, pyruvic acid and oxalic acid, is coupled to the chemical mechanism in the LES model to examine the effect of the multi-phase chemistry. High-resolution LES modeling that resolves the strong turbulent environment and fast aqueous-phase reactions in clouds can accurately represent the cloud formation in the atmosphere and provide detailed turbulent transport in different regions of the cloud. Generally, the cloud formation induces upward transport of chemical species with downdrafts along the edges of clouds. We examine the role of physical turbulent processes with aqueous chemistry to investigate and explain the change in distributions and the OH reactivity of BVOC species in clouds. Besides turbulence-induced segregation for isoprene and OH near the surface, we find much stronger segregation and reaction rate reduction in clouds due to aqueous-phase chemistry, which can further affect ozone production and SOA formation time scales.