Ice Nucleation in the Tropical Tropopause Layer: Implications for cirrus occurrence, cirrus microphysical properties, and dehydration of air entering the stratosphere

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Recent laboratory experiments have advanced our understanding of the physical properties and ice nucleating abilities of aerosol particles at low temperatures. In particular, aerosols containing organics will transition to a glassy state at low temperatures, and these glassy aerosols are moderately effective as ice nuclei. These results have implications for ice nucleation in the cold Tropical Tropopause Layer (TTL; 13-19 km). We have developed a detailed cloud microphysical model that includes heterogeneous nucleation on a variety of aerosol types and homogeneous freezing of aqueous aerosols. This model has been incorporated into one-dimensional simulations of cirrus and water vapor driven by meteorological analysis temperature and wind fields. The model includes scavenging of ice nuclei by sedimenting ice crystals. The model is evaluated by comparing the simulated cloud properties and water vapor concentrations with aircraft and satellite measurements. In this presentation, I will discuss the relative importance of homogeneous and heterogeneous ice nucleation, the impact of ice nuclei scavenging as air slowly ascends through the TTL, and the implications for the final dehydration of air parcels crossing the tropical cold-point tropopause and entering the tropical stratosphere.

Keywords: Ice nucleation, Heterogeneous nucleation, Dehydration

