4.021 Solid versus liquid phase state and glass transition temperature of secondary organic aerosols in the global atmosphere.

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Abstract:

Secondary organic aerosol (SOA) can adopt amorphous solid, semisolid or liquid phase states depending on chemical composition, relative humidity and temperature. The phase state plays a critical role in SOA formation and evolution as well as activation to cloud droplets and ice crystals. We developed a parameterization to estimate glass transition temperature of SOA as a function of molar mass and O:C ratio of SOA compounds, which can be applied in chemical transport models for the prediction of SOA phase state. Global maps of average molar mass, glass transition temperature and phase state of SOA were simulated using the atmospheric chemistry general circulation model. Global simulations show that the occurrence of amorphous solid or semi-solid phases is a general phenomenon, especially over dry areas. Liquid phase state is expected in the region with high relative humidity such as in the Amazonian and other tropical forests. Vertical simulation results show that the occurrence of solid phase increases at higher altitudes; almost all SOA particles are expected to be solid at 500 hPa.