

Does the physical phase of organic aerosols matter when atmospheric processes are considered?

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Atmospheric secondary organic aerosols (SOA) result from gas-phase oxidation of volatile organic compounds (VOC), which are emitted from anthropogenic and biogenic sources. Chemical aging of the SOA particles in the atmosphere controls their physical and chemical properties such as phase state, volatility and hygroscopicity. All these factors can affect the particles' ability to act as cloud condensation nuclei (CCN) and ice nuclei or to scatter and absorb solar radiation.

Several recent studies have shown that SOA particles can be in a semisolid physical phase depending on the particle composition and surrounding humidity conditions (Virtanen et al. 2010, Renbaum-Wolff et al. 2013, Pajunoja et al. 2015). The phase state of amorphous material is typically represented by the viscosity of the material: materials with viscosities less than 10^2 Pa s are considered liquids, with $10^2 - 10^{12}$ Pa s as semisolids, and viscosities greater than 10^{12} Pa s represent amorphous solid, glassy, material. Material's viscosity depends on temperature and relative humidity as particle-phase water can act as a plasticizer and can decrease the viscosity of the material. The semisolid or solid phase state of the SOA particles may affect the atmospheric processes of the particles. The solid phase can limit the diffusion of condensable gas-phase molecules from the surface into the particle bulk and *vice versa*. This may affect inner mixing and disturb the equilibrium in gas/particle partitioning and result in slower evaporation of the particles than expected (Vaden et al. 2011, Yli-Juuti et al., 2016). The transport of small molecules (e.g. H₂O and oxidants) within the particle phase may also be affected by the diffusion limitations. This may in turn slower the chemical reactions in the organic matrix of SOA particles (Hinks et al., 2016; Marshall et al., 2016). In this presentation the relevance of the semisolid phase of the organic particles for the most central atmospheric aerosol processes is reviewed based on laboratory and atmospheric measurements of SOA particles.

References

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