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Organic aerosols in the Earth System: An overview of our understanding

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Organic material is present in the atmosphere both in the particulate and in the gas-phase as result of emissions, atmospheric transport and physico-chemical transformations and deposition to the surfaces. Due to their impact on air quality, the oxidizing capacity of the atmosphere, visibility, climate, human health and the ecosystems, atmospheric organics have attracted extensive attention from the scientific community.

Organic aerosol (OA) components differ in volatility, solubility, hygroscopicity, chemical reactivity and physical and optical properties. Only simplified representations are introduced in global chemistry climate models. Ideally, the net effect of the complex mixture of OA is described by a limited number of representative compounds or mixtures. Comparisons of individual models with OA observations have shown large model underestimates of the OA component that is very high in the free troposphere. To bridge the gap between models and observations, several models have been improved to account for secondary OA, intermediate volatile organic compounds, multiphase chemistry and the semi-volatile nature of primary emitted OA.

Overall there is increasing evidence that OA is chemically processed in the atmosphere by both gas-phase and multiphase chemistry. This ageing of aerosols is documented by recent high performance observations of size segregated chemical, physical and optical characteristics of the OA. Such observations provide a new picture of OA in the climate system and push forward chemistry/climate model developments. These findings are outlined, the extent to which they are incorporated in global models is presented and implications for chemistry/climate modeling are discussed.