

The chemical evolution of secondary-organic-aerosol (SOA) particles and how this evolution alters their cloud-nucleating properties were studied. Simplified forms of full Koehler theory were targeted, specifically forms that contain only those aspects essential to describing the laboratory observations, because of the requirement to minimize computational burden for use in integrated climate and chemistry models. The associated data analysis and interpretation have therefore focused on model development in the framework of modified kappa-Koehler theory. Kappa is a single parameter describing effective hygroscopicity, grouping together several separate physicochemical parameters (e.g., molar volume, surface tension, and van't Hoff factor) that otherwise must be tracked and evaluated in an iterative full-Koehler equation in a large-scale model. A major finding of the project was that secondary organic materials produced by the oxidation of a range of biogenic volatile organic compounds for diverse conditions have kappa values bracketed in the range of 0.10 +/- 0.05. In these same experiments, somewhat incongruently there was significant chemical variation in the secondary organic material, especially oxidation state, as was indicated by changes in the particle mass spectra. Taken together, these findings then support the use of kappa as a simplified yet accurate general parameter to represent the CCN activation of secondary organic material in large-scale atmospheric and climate models, thereby greatly reducing the computational burden while simultaneously including the most recent mechanistic findings of laboratory studies.

Publications

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