World Academy of Science, Engineering and Technology
International Journal of Geological and Environmental Engineering
Vol:10, No:05, 2016

Thermodynamics of Water Condensation on an Aqueous Organic-Coated Aerosol Aging via Chemical Mechanism

Authors : Yuri S. Djikaev

Abstract : A large subset of aqueous aerosols can be initially (immediately upon formation) coated with various organic amphiphilic compounds whereof the hydrophilic moieties are attached to the aqueous aerosol core while the hydrophobic moieties are exposed to the air thus forming a hydrophobic coating thereupon. We study the thermodynamics of water condensation on such an aerosol whereof the hydrophobic organic coating is being concomitantly processed by chemical reactions with atmospheric reactive species. Such processing (chemical aging) enables the initially inert aerosol to serve as a nucleating center for water condensation. The most probable pathway of such aging involves atmospheric hydroxyl radicals that abstract hydrogen atoms from hydrophobic moieties of surface organics (first step), the resulting radicals being quickly oxidized by ubiquitous atmospheric oxygen molecules to produce surface-bound peroxyl radicals (second step). Taking these two reactions into account, we derive an expression for the free energy of formation of an aqueous droplet on an organic-coated aerosol. The model is illustrated by numerical calculations. The results suggest that the formation of aqueous cloud droplets on such aerosols is most likely to occur via Kohler activation rather than via nucleation. The model allows one to determine the threshold parameters necessary for their Kohler activation. Numerical results also corroborate previous suggestions that one can neglect some details of aerosol chemical composition in investigating aerosol effects on climate.

Keywords : aqueous aerosols, organic coating, chemical aging, cloud condensation nuclei, Kohler activation, cloud droplets
Conference Title : ICESCC 2016 : International Conference on Earth Science and Climate Change
Conference Location : Montreal, Canada
Conference Dates : May 16-17, 2016

Open Science Index, Geological and Environmental Engineering Vol:10, No:05, 2016 publications.waset.org/abstracts/43796.pdf