Geophysical Research Abstracts
Vol. 13, EGU2011-11267, 2011
EGU General Assembly 2011

Assessment of the Effects of Acid-Coated Ice Nuclei on the Arctic Cloud Microstructure, Atmospheric Dehydration, Radiation and Temperature during Winter.

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Owing to the large-scale transport of pollution-derived aerosols from the mid-latitudes to the Arctic, most of the aerosols are coated with sulphuric acid during winter in the Arctic. Recent laboratory experiments have shown that acid coating on dust particles substantially reduces the ability of these particles to nucleate ice crystals. Simulations performed using the Limited Area version of the Global Multiscale Environmental Model (GEM-LAM) are used to assess the potential effect of acid coated-ice nuclei on the Arctic cloud and radiation processes during January and February 2007. Ice nucleation is treated using a new parameterization based on laboratory experiments of ice nucleation on sulphuric acid-coated and uncoated kaolinite particles. Results show that acid coating on dust particles has an important effect on cloud microstructure, atmospheric dehydration, radiation and temperature over the Central Arctic, which is the coldest part of the Arctic. Mid and upper ice clouds are optically thinner while low-level mixed-phase clouds are more frequent and persistent. These changes in the cloud microstructures affect the radiation with a net longwave negative cloud forcing ranging between 0 and 6 Wm-2 over the region covered by the Arctic air mass.