Geophysical Research Abstracts
Vol. 12, EGU2010-13499-1, 2010
EGU General Assembly 2010

Modelling long range Aerosol transport to the Arctic using a global model of aerosol processes (GLOMAP)

Jo Browse (1), Kenneth Carslaw (2), Steven Arnold (3), and Olivier Boucher (4)

(1) School of earth and environment,University of Leeds,Leeds,UK,(eejb@leeds.ac.uk), (2) School of earth and environment,University of Leeds,Leeds,UK, (3) School of earth and environment,University of Leeds,Leeds,UK, (4) Uk Met office, Hadley centre, Exeter,UK

Local sources of aerosol in the Arctic are very few and occur predominately in the summer months when removal mechanisms (in particular wet deposition) are also at a maximum resulting in a short aerosol lifetime and a negligible effect on the Arctic climate. Since the 1950s however widespread haze events have been observed in the winter and springtime Arctic atmosphere. This haze sourced from outside of the Arctic is transported over long distances from the mid-latitudes. These transported pollutants affect the Arctic radiation balance by directly interacting with incoming and outgoing radiation and through interaction with clouds and the snow covered surface. The Arctic is warming at an accelerated rate to the rest of the earth and the effect of changing aerosol loading is a possible cause, however modelling of aerosol transport to the Arctic in general underestimates winter and springtime aerosol concentrations when compared with observations.

The Leeds university global model of aerosol processes (GLOMAP) has been found to underestimate winter and spring time surface concentrations of both black carbon and sulphate (SO4) at several Arctic ground stations (Point Barrow, Spitsbergen and Alert). Summertime mass concentrations are in much better agreement with observations and the model shows a maximum during this period. This would indicate a failure to simulate the long range transport of pollutants from outside the Arctic. It has also been found that winter and springtime aerosol is simulated as the smaller aitken mode compared with the observed much larger accumulation mode. Presented are the results of sensitivity studies performed with GLOMAP which indicate the microphysical processes important to modelled Arctic aerosol (in particular which scavenging and aging processes) and what modifications are required to accurately simulate the Winter/spring maximum in the Arctic aerosol load.

Black carbon and Sulphate were found to be most sensitive to wet (nucleation) scavenging with mean Arctic concentrations increasing by up to a factor of 10 for both Sulphate and black carbon between the surface and 500hPa after nucleation scavenging was switched off. This resulted in a much greater agreement with surface observations of black carbon and sulphate in the winter and spring. At higher altitudes the effect is less pronounced but aerosol concentrations still on average double. Reducing the wet deposition rate to zero also produced a winter and springtime accumulation mode. Black carbon was found to be sensitive to aging processes in particular monolayer aging (the number of molecular layers of soluble material required to make insoluble black carbon soluble).Between the surface and 500hpa black carbon tripled after a factor of 10 increase in the number of monolayers required for solubility.