NWS08-2008-020004

Abstract for an Invited Paper for the NWS08 Meeting of the American Physical Society

Climate Change and Aerosol Feedbacks

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Climate instability is expected as mixing ratios of greenhouse gases in the Earth's atmosphere increase. The current trend in rising temperature can be related to anthropogenic greenhouse gas emissions. However, this trend may change as feedback mechanisms amplify; one of the least-understood aspects of climate change. Formation of cloud condensation nuclei from rising sulfate concentrations in the atmosphere may counteract the current warming trend. A key point is where the sulfate, and cloud condensation nuclei are formed. Is cloud formation widespread or localized near sulfate emission sources? A major source of atmospheric sulfate is dimethylsulfide, a compound related to biotic turnover in the surface ocean that constitutes a widespread natural source of aerosols over the remote ocean. A second major source contributing a significant proportion of atmospheric sulfate in the northern hemisphere is produced over continents from industrial activities and fossil fuel combustion. Distinguishing the source of sulfate in well-mixed air is important so that relationships with cloud formation, sea-ice in polar regions, and albedo can be explored. This distinction in sulfate sources can be achieved using isotope apportionment techniques. Recent measurements show an increase in biogenic sulfate coincident with rising temperatures in the Arctic and large amounts sulfur from DMS oxidation over the Atlantic, potentially indicating a widespread biotic feedback to warming over northern oceans.