Investigating Sea Ice Lead Contributions to Sea Salt Aerosol Concentrations in the Arctic

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Abstract

Aerosols in the Arctic have the potential to alter the climate by influencing cloud lifetime and albedo. Clouds in the Arctic trap longwave radiation during the winter, creating a net warming effect. Emissions from sea ice leads may be a prominent source of Arctic sea salt aerosols, particularly during colder months. To quantitatively evaluate the contribution of leads to total sodium concentrations, we evaluate satellite observations of sea ice conditions surrounding three stations with long-term measurements of sea salt aerosols in Utqiagvik, Alaska; Alert, Nunavut, Canada; and the Zeppelin Mountain in Svalbard, Norway from 2002-2011. Relationships between the time series of sea salt aerosol concentrations and lead area at the three stations are evaluated using signal processing techniques. Bayesian hierarchical modeling and resampling methods are used to determine the significance of sea ice lead area as a predictor of aerosol sodium concentrations at the three stations. We find a positive significant relationship between lead area and local observed sodium aerosol concentrations during the Arctic cold season from November through April. Our results indicate that the presence of sea ice leads increases the nearby concentration of sea salt aerosols.

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