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Model Intercomparison of CCN-Limited Arctic Clouds During ASCOS

Robin Stevens (1), Chris Dearden (2), Antonios Dimetrelos (3), Gesa Eirund (4), Anna Possner (4,5), Tomi Raatikainen (6), Katharina Loewe (7), Adrian Hill (8), Ben Shipway (8), Paul Connolly (2), Annica Ekman (3), Corinna Hoose (7), Ari Laaksonen (6), Gerrit de Leeuw (6), Pekka Kolmonen (6), Giulia Saponaro (6), Paul Field (8), and Ken Carlsaw (1)

(1) Institute for Climate and Atmospheric Science, University of Leeds, Leeds, United Kingdom, (2) School of Earth and Environmental Sciences, University of Manchester, Manchester, UK, (3) Department of Meteorology, Stockholm University, Stockholm, Sweden, (4) Institute for Atmospheric and Climate Science, Eidgenössische Technische Hochschule, Zürich, Switzerland, (5) Department of Global Ecology, Carnegie Institution for Science, Stanford, CA, (6) Finnish Meteorological Institute, Helsinki, Finland, (7) Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, Germany, (8) Met Office, Exeter, UK

Future decreases in Arctic sea ice are expected to increase fluxes of aerosol and precursor gases from the open ocean surface within the Arctic. The resulting increase in cloud condensation nuclei (CCN) concentrations would be expected to result in increased cloud albedo (Struthers et al, 2011), leading to potentially large changes in radiative forcings.

However, Browse et al. (2014) have shown that these increases in condensable material could also result in the growth of existing particles to sizes where they are more efficiently removed by wet deposition in drizzling stratocumulus clouds, ultimately decreasing CCN concentrations in the high Arctic. Their study was limited in that it did not simulate alterations of dynamics or cloud properties due to either changes in heat and moisture fluxes following sea-ice loss or changing aerosol concentrations.

Taken together, these results show that significant uncertainties remain in trying to quantify aerosol-cloud processes in the Arctic system. The current representation of these processes in global climate models is most likely insufficient to realistically simulate long-term changes.

In order to better understand the microphysical processes currently governing Arctic clouds, we perform a model intercomparison of summertime high Arctic (>80N) clouds observed during the 2008 ASCOS campaign. The intercomparison includes results from three large eddy simulation models (UCLALES-SALSA, COSMO-LES, and MIMICA) and three numerical weather prediction models (COSMO-NWP, WRF, and UM-CASIM). The results of these experiments will be used as a basis for sensitivity studies on the impact of sea-ice loss on Arctic clouds through changes in aerosol and precursor emissions as well as changes in latent and sensible heat fluxes.

Browse, J., et al., Atmos. Chem. Phys., 14(14), 7543–7557, doi:10.5194/acp-14-7543-2014, 2014.

Struthers, H., et al., Atmos. Chem. Phys., 11(7), 3459–3477, doi:10.5194/acp-11-3459-2011, 2011.