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# Observed microphysical changes in Arctic mixed-phase clouds when transitioning from sea-ice to open ocean

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The Arctic sea-ice is intricately coupled to the atmosphere[1]. The decreasing sea-ice extent with the changing climate raises questions about how Arctic cloud structure will respond. Any effort to answer these questions is hindered by the scarcity of atmospheric observations in this region. Comprehensive cloud and aerosol measurements could allow for an improved understanding of the relationship between surface conditions and cloud structure; knowledge which could be key in validating weather model forecasts. Previous studies[2] have shown via remote sensing that cloudiness increases over the marginal ice zone (MIZ) and ocean with comparison to the sea-ice; however, to our knowledge, detailed in-situ data of this transition have not been previously presented.

In 2013, the Aerosol-Cloud Coupling and Climate Interactions in the Arctic (ACCACIA) campaign was carried out in the vicinity of Svalbard, Norway to collect in-situ observations of the Arctic atmosphere and investigate this issue. Fitted with a suite of remote sensing, cloud and aerosol instrumentation, the FAAM BAe-146 aircraft was used during the spring segment of the campaign (Mar-Apr 2013). One case study (23rd Mar 2013) produced excellent coverage of the atmospheric changes when transitioning from sea-ice, through the MIZ, to the open ocean. Clear microphysical changes were observed, with the cloud liquid-water content increasing by almost four times over the transition. Cloud base, depth and droplet number also increased, whilst ice number concentrations decreased slightly. The surface warmed by $\sim$13 K from sea-ice to ocean, with minor differences in aerosol particle number (of sizes corresponding to Cloud Condensation Nuclei or Ice Nucleating Particles) observed, suggesting that the primary driver of these microphysical changes was the increased heat fluxes and induced turbulence from the warm ocean surface as expected.

References:
[1] Kapsch, M.L., Graversen, R.G. and Tjernström, M. Springtime atmospheric energy transport and the control of Arctic summer sea-ice extent. Nature Clim. Change 3, 744-748, doi:10.1038/nclimate1884 (2013)
[2] Palm, S. P., Strey, S. T., Spinhirne, J., and Markus, T.: Influence of Arctic sea ice extent on polar cloud fraction and vertical structure and implications for regional climate. Journal of Geophysical Research (Atmospheres), 115, D21209, doi:10.1029/2010JD013900 (2010)