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Arctic clouds – numerical modeling versus airborne measurements

Anne Sandvik (1), Marina Biryulina (2), Jakob Stamnes (3), Knut Stamnes (4), Nils Gunnar Kvamstø (1,3) and Michael Kanhert (5)

(1) Bjerknes Centre for Climate Research , (2) Geminali AS, (3) University of Bergen, (4) Stevens Institute of Technology, (5) SMHI

The Arctic is known to be a highly variable and sensitive region in the global climate system and large model-to-model discrepancies are found. One key issue in numerical modeling of the Arctic is the parameterization of clouds and radiation. As mixed phase clouds have a significantly different impact on radiation than single-phase clouds it is of critical importance to understand the cloud/radiation feedback, the properties of these clouds, and the ability to simulate them properly. The focus of the present work is on the characteristic features of Arctic cloud fields, determined from observational data, and how well these are simulated with a numerical model.

In situ airborne cloud measurements was performed as part of the First International Satellite Cloud Climatology Project (ISCCP) Regional Experiment - Arctic cloud Experiment (FIRE ACE), April 1998, and constitute together with data from a numerical model the basis for the present work. The liquid water content (LWC) was obtained from the FSSP probe, whereas the ice water content (IWC) was obtained from the Nevzorov LWC/TWC probe. The IWC data was adjusted using the Cloud Particle Imager (CPI) particle size distributions. The numerical integrations for April 1998 were performed with the numerical mesoscale model MM5, using the Reisner 2 and CCM2 schemes for the microphysical and radiation calculations respectively.

A comprehensive comparison between the measurements and the model data has been carried out. Similarities and discrepancies will be reported and future needs in terms of improved treatment of mixed phase cloud/radiation interactions in numerical models will be discussed.