Geophysical Research Abstracts
Vol. 17, EGU2015-3201, 2015
EGU General Assembly 2015

Observations and Simulations of Three-Dimensional Radiative Interactions between Arctic Boundary Layer Clouds and Ice Floes

Michael Schäfer, Eike Bierwirth, André Ehrlich, Evelyn Jäkel, and Manfred Wendisch
University of Leipzig, Germany (michael.schaefer@uni-leipzig.de)

Based on airborne spectral imaging observations, three-dimensional (3D) radiative effects between Arctic boundary layer clouds and ice floes have been identified and quantified. A method is presented to discriminate sea ice and open water in case of clouds from imaging radiance measurements. This separation simultaneously reveals that in case of clouds the transition of radiance between open water and sea ice is not instantaneously but horizontally smoothed. In general, clouds reduce the nadir radiance above bright surfaces in the vicinity of sea ice - open water boundaries, while the nadir radiance above dark surfaces is enhanced compared to situations with clouds located above horizontal homogeneous surfaces. With help of the observations and 3D radiative transfer simulations, this effect was quantified to range between ΔL = 0 m and ΔL = 2200 m distance to the sea ice edge. This affected distance ΔL was found to depend on both, cloud and sea ice properties. For a ground overlaying cloud in 0200 m altitude, increasing the cloud optical thickness from τ = 1 to τ = 10 decreases ΔL from 600 m to 250 m, while increasing cloud base altitude or cloud geometrical thickness can increase ΔL; ΔL(τ = 1/10) = 2200 m/1250 m for 5001000 m cloud altitude. Furthermore, the impact of these 3D-radiative effects on retrieval of cloud optical properties was investigated. The enhanced brightness of a dark pixel next to an ice edge results in uncertainties of up to 90 % and 30 % in retrievals of cloud optical thickness and effective radius r_{eff}, respectively. With help of ΔL quantified here, an estimate of the distance to the ice edge for which the retrieval errors are negligible is given.