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Surface radiation budget and cloud radiative forcing on sea ice during the spring snowmelt period in the Baltic Sea

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This study investigates the evolution of surface radiation budget and cloud radiative forcing during the crucial and rapid process of spring snowmelt over sea ice in the Gulf of Botnia (Baltic Sea). Observations on radiative fluxes, cloud cover, wind, air temperature and humidity were made during a four-week field experiment over first-year sea ice in spring 2004. Although cloud and synoptic conditions were highly variable and the vertical component of the downward solar radiation at the top of the atmosphere increased by more than 200 W/m^{-2} during the campaign, the daily mean surface radiation budget (Rn) was almost always positive and small (below 20 W/m^{-2}). It increased to 60 W/m^{-2} only in the last week of the measuring period, when all snow had melted and the surface albedo had dropped to 0.3. Rn was negative only during three days with a high surface albedo and high optically thin clouds (Cirrus) or clear sky. The cloud radiative forcing, calculated only for the overcast days, showed a large change during the measurement campaign: from 50 W/m^{-2} at the beginning it dropped to –43 W/m^{-2} at the end. Most previous studies on cloud radiative forcing over snow/ice-covered surfaces have been made in Polar Regions. The present data set collected in the Baltic Sea gave the unique opportunity to study the cloud radiative forcing over snow and ice under the contemporary effects of alternation between daylight and night time, strong seasonal trend in solar radiation and surface albedo, and strong influence of air mass advection from different climate zones (as e. g. Central Europe and northern Scandinavia).