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RADIATION BUDGET IN THE ANTARCTIC FROM SATELLITE AND GROUND-BASED OBSERVATIONS (ABSTRACT)

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The role of the Antarctic in global climate is characterized by the continental ice sheet, surrounding sea ice and cloud cover. Radiative effects of the ice sheet, sea ice and clouds, which are also major determinants of the radiation budget, were examined as significant subjects of the Antarctic Climate Research (ACR) project (1987–1991). NOAA AVHRR data received at Syowa Station were analyzed for cloud amount and cloud radiative effects in East Antarctica, and the Earth Radiation Budget Experiment (ERBE) data were analyzed for the effects of clouds, ice sheet and sea ice on the radiation budget together with SSM/I, ISCCP data and ground surface observations at Antarctic stations. Cloud radiation was found to heat the surface throughout the year and strongly cool the atmosphere over Antarctica. At the top of the atmosphere the cloud effect was cooling by longwaves in winter in the interior of the continent and cooling by shortwaves in summer. The ice sheet is known to have a strong albedo effect; however, it also had a strong longwave radiation effect because of its high elevation, reducing the surface temperature and then the outgoing longwave radiation (OLR), and also reducing the atmospheric effect, making the radiation budget in both polar regions asymmetric. The OLR was reduced at the rate of 5 to 10 $W/m^2/km$ below 2 km; above 2 km, the rate was about 20 $W/m^2/km$. Sea ice, which is a critical climate feedback factor, had a possible impact on radiation that was about equal to or less than that due to clouds. Between 60° and 65°S in October, the albedo at the top of the atmosphere was increased by about 0.2 and the OLR was reduced by 7 to 10 W/m^2 by the effect of sea ice; this seems smaller than the cloud forcing, which increased the albedo by 0.3 and reduced the OLR by 30 to 40 W/m^2. However, these numbers did not fully differentiate independent effects of sea ice and cloudiness. A more detailed analysis showed that clouds were masking the radiative effect of sea ice by more than half.

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