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The effect of Arctic sea-ice extent on the absorbed (net) solar flux at the surface, based on ISCCP-D2 cloud data for 1983–2007

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Abstract. We estimate the effect of the Arctic sea ice on the absorbed (net) solar flux using a radiative transfer model. Ice and cloud input data to the model come from satellite observations, processed by the International Satellite Cloud Climatology Project (ISCCP) and span the period July 1983–June 2007. The sea-ice effect on the solar radiation fluctuates seasonally with the solar flux and decreases interannually in synchronisation with the decreasing sea-ice extent. A disappearance of the Arctic ice cap during the sunlit period of the year would radically reduce the local albedo and cause an annually averaged 19.7 W m^{-2} increase in absorbed solar flux at the Arctic Ocean surface, or equivalently an annually averaged 0.55 W m^{-2} increase on the planetary scale. In the clear-sky scenario these numbers increase to 34.9 and 0.97 W m^{-2}, respectively. A meltdown only in September, with all other months unaffected, increases the Arctic annually averaged solar absorption by 0.32 W m^{-2}. We examined the net solar flux trends for the Arctic Ocean and found that the areas absorbing the solar flux more rapidly are the North Chukchi and Kara Seas, Baffin and Hudson Bays, and Davis Strait. The sensitivity of the Arctic absorbed solar flux on sea-ice extent and cloud amount was assessed. Although sea ice and cloud affect jointly the solar flux, we found little evidence of strong non-linearities.

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