Geophysical Research Abstracts
Vol. 14, EGU2012-10087, 2012
EGU General Assembly 2012

Influence of snow on evergreen coniferous forest albedo

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The low shortwave albedo of evergreen coniferous forests increases net radiation and thus the local temperature in compared to open areas. This is especially true in winter and spring, when these forests mask the reflective ground snow. However, also the albedo of coniferous forests changes as a function of amount and properties of snow in the ground and canopy. Here, we estimated the shortwave albedo of a Scots pine forest in southern Finland in different snow conditions and quantified the effect of different snow conditions on the annual radiant energy balance. We used a three year period of data from SMEAR II measurement station in southern Finland, including radiation measurements, ground snow depth information and daily canopy photographs. The photographs were used to classify the canopy into different snow classes. Canopy snow cover was noticed to substantially influence the albedo, increasing it by about 0.2 compared to snow free conditions. If only ground was snow covered, the increase was on average 0.1. However, albedo varied greatly within and between the canopy snow classes, probably due to differences in illumination conditions and snow quality. During midwinter months, most solar radiation was reflected during days with a lot of snow in the canopy. The total amount of reflected radiation between the winters with least and most snow was 54 MJ m-2, which was also close to the difference (55 MJ m-2, 1.79 W m-2 throughout a year) between the reflectance of an average winter and that of a simulated snow free winter, corresponding to less than 2 % of the annual solar irradiance. The albedo of the forest was greatest in midwinter, when the cold weather and little solar radiation caused the falling snow to remain on the tree branches. The albedo decreased in the late winter as snow was sublimated or falling of the branches. As the solar irradiance in the midwinter months is very low but canopy snow cover in the late winter is limited, the positive feedback to climate warming in case of a potentially decreased snow cover in this boreal pine forest would probably remain small.