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Radiative balance of a sparse deciduous forest with a seasonal snow pack

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Snow in Boreal and Arctic ecosystems plays an important role in the determination of energy, water and carbon fluxes in the winter. The interaction between the surface energy budget, snow cover and vegetation are poorly understood and can be inaccurately represented within hydrological and climate models. Given the climatic warming predicted for the Arctic and subsequent changes in the snow cover duration and vegetation cover, it is important to improve our understanding of these land surface processes at high latitudes.

This presentation describes meteorological and field observations taken to quantify the radiation balance of the sparse deciduous birch forest canopy, with a seasonal snow pack in Abisko, sub-arctic Sweden. Analysis of above and below canopy radiation measurements, combined with hemispherical photography and detailed snow surveys, are demonstrated to accurately quantify the radiative balance of the snow pack beneath the sparse deciduous canopy. During the spring snow-melt, the sun angle is low in these high latitudes, the dark leaf-less branches cast shadows across the snow surface and direct radiation may not reach the snow pack until the middle of the day. The exact time and duration depends on the time of year and the spatial distribution of canopy gaps. Several examples of this shading process have been analysed and are presented.

JULES (Joint UK Land Environment Simulator) is the land surface model used in the Hadley Centre GCMs (HadCM3 and HadGEM). JULES has been modified to account for this temporal variation in the radiative penetration through the birch canopy. The impact on the duration of snow cover has been quantified using both idealised and realistic radiation time-series based on the field and meteorological measurements. The model shows that the time to snow melt is extended due to this shading effect, making the model results more realistic with respect to the in situ data. The performance of the land surface-snow-vegetation interactions of JULES can be improved by using these representations of the land-surface radiation in the climate-sensitive Arctic regions.