



The effect of existence of snow at forest floor on boreal forest albedo diurnal variation

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Surface albedo is the fraction of incoming solar radiation reflected hemispherically by the surface. It is directly related to the global energy budget. Changes in the surface albedo can be used as an indicator of a climate change, so it is important that all the factors affecting the measurements or calculations of the albedo values are properly taken into account. The boreal forest zone is an important component to the carbon budget in the northern hemisphere and it also affects the surface albedo values in a large area. One of the major factors affecting surface albedo in the boreal forest zone is the snow cover. Determining correctly the snow cover or lack of it on the boreal forest floor is crucial for reliable albedo estimation. In addition, the canopy and the forest floor scattering has to be modeled properly in order to get reliable albedo estimates.

We studied the effect of snow covered and snow-free forest floor to the total black-sky albedo values theoretically by using the extended PARAS albedo model. The model takes into account all the different photon absorption and scattering events of and between canopy and the forest floor. We simulated the broadband black-sky albedo values with varying leaf area index (LAI) values for the latitudes range 40N-70N in the northern hemisphere. The LAI map used was provided by the Copernicus Global Land Service. The canopy type, i.e. distinction between the coniferous and deciduous forests, was provided by the land cover map GlobCover 2009.

We discovered that the snow cover in the forest floor can change the albedo values from around 0.15 (snow-free) up to around 0.5 (snow covered), depending on the latitude, season and the LAI values. The differences are larger for smaller LAI values and lower latitudes (closer to 40N), where the sun elevation at midday is higher so that the direct forest floor illumination is larger. We also discovered that there are local maxima in the albedo values at the noon when there is snow on the forest floor, whereas in snow-free conditions the opposite takes place. Treating the forest as a chess board of dark canopy and bright snow at the forest floor leads into an underestimation of 70% and overestimation of about 50% depending on latitude of the total forest albedo.