Biomass and Species Composition Are Tightly Related to Forest Albedo in the Boreal Zone

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Forests act as pools of carbon dioxide, thus mitigating global warming. On the other hand, some recent studies have demonstrated that the positive effect of forests in the boreal region on the mitigation of climate change can be canceled by the biophysical effects of low surface albedo and evapotranspiration [1]. The relationship between albedo and forest land is, however, complex and little is known about the driving factors of albedo in the boreal zone [2]. Using a radiative transfer model and an extensive forest inventory database, we simulated the albedo of forest stands of the most abundant tree species of Fennoscandia – Scots pine, Norway spruce and Silver birch, including both monospecific and mixed stands. The use of a physically-based radiative transfer model allowed us to uncouple the different factors driving the forest albedo. We analyzed separately how biomass, canopy cover, and species composition influence the shortwave albedo of a boreal forest. The albedos of monospecific forest stands differed significantly between species. The albedo generally decreased with increasing stand biomass. The sharpest decrease in albedo was observed at low biomass values (i.e. growth of a young stand), after which the albedo remained relative stable. Also, an increase in canopy cover was accompanied by a decrease in the albedo. Finally, a significant increase in the albedo of mixed spruce-birch stands was achieved already at a modest fraction of birch. Our results confirm that forest management practices have a significant influence on the albedo of the boreal biome.

References

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