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Spatially explicit estimates of land surface albedo response under different levels of global warming in Norway

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The snow albedo feedback (SAF) is consensually one of the main reasons for the observed enhanced climate sensitivity in high latitudes, yet the strength of this climate feedback remains debated. Albedo change in a warming climate as simulated by the land surface component of general circulation models (GCMs) has been shown to heavily depend on the parameterization of effective snow albedo in the individual models, resulting in a large intermodel spread in SAF strength. On local to regional scales, the magnitude of the albedo response is strongly mediated by the land-cover specific difference between snow-free and snow-covered surface albedo as well as by the effect of topography on spatial patterns of snow accumulation and melt, and small-scale variability in both factors is poorly captured in regional and global transient climate simulations. Here, we make use of empirically-derived land-cover specific albedos and fine scale snow cover projections for mainland Norway to complement and refine the results from large-scale, coupled model simulations by estimating the contribution of different land-cover types and elevation bands to the overall regional albedo response under increasing levels of global warming in a spatially explicit manner.

We employ ensemble simulations of 21st century snow cover and snow water equivalent which were driven by bias-corrected EU-CORDEX regional climate projections. The 10-member ensemble is analyzed according to global mean temperature (GMT) increase in the underlying GCM simulation by extracting 30-year time slices representing 1.5, 2, and 3 K GMT increase compared to pre-industrial levels. Projected seasonal cycles of snow cover are combined with high resolution present-day land cover information obtained from the ESA CCI LC product (v2.0.7 2015) which has been enhanced by 12 structural forest types (Majasalmi et al. 2017) to better-account for fine-scale variation in forest structure and species composition. These structural types enable more accurate quantification of the snow masking effect of tree cover within forested areas. Preliminary results point to a strong spring albedo response at mid-altitudes (500-800m) for all warming scenarios which is accompanied by strong SAF, although the magnitude of the SAF is dampened in the longer term owed to an increasing atmospheric emissivity resulting from increased specific humidity.

Majasalmi, T., Eisner, S., Astrup, R., Fridman, J., & Bright, R. M. (2017). An enhanced forest classification scheme for modeling vegetation-climate interactions based on national forest inventory data. Biogeosciences, https://doi.org/10.5194/bg-2017-301, Forthcoming.