Supplement of Biogeosciences, 14, 4209–4227, 2017
https://doi.org/10.5194/bg-14-4209-2017-supplement

Biogeosciences Open Access EGU

Supplement of

Effects of shrub and tree cover increase on the near-surface atmosphere in northern Fennoscandia

Johanne H. Rydsaa et al.

Correspondence to: Johanne H. Rydsaa (j.h.rydsaa@geo.uio.no)

Supplementary material

To support the findings described in the results chapter, some extra figures are attached, along with Table S1, containing details of key shrub category parameter values.

Cloud fraction which is shown in Fig. 6 is parameterized based on a modified computation as suggested by Xu and Randall (1996). It depends on the cloud ice and water content, large scale RH and saturation vapor pressure. The cloud fraction is given as a value between 0 and 1.

The effect on LAI changes resulting from increased shrub cover is shown in Fig. S1, as averaged over each season (top row) and as averaged over areas with vegetation changes (bottom row).

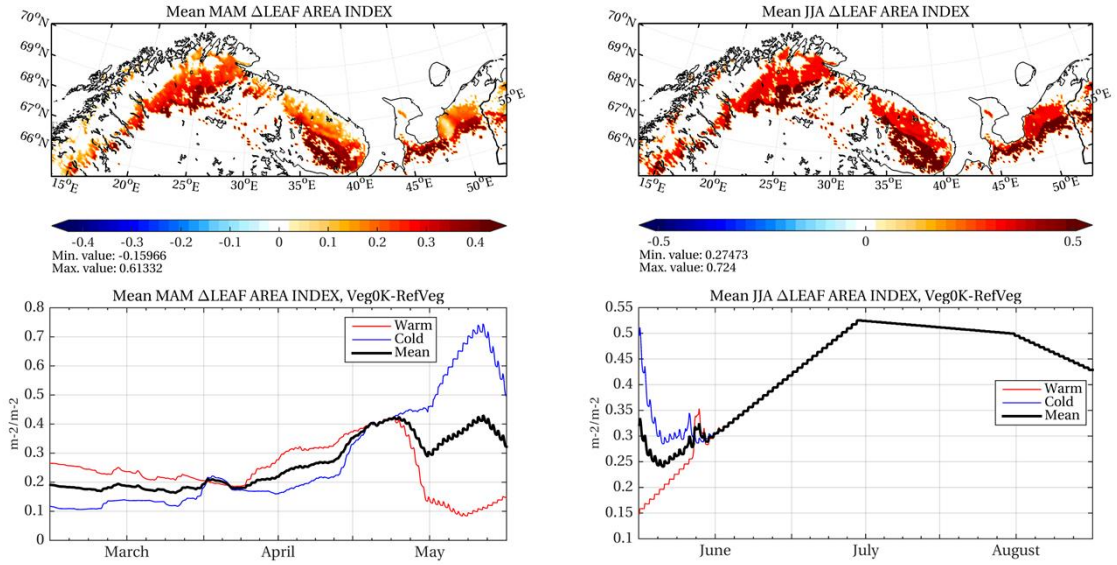

Figure S1: Effects on leaf area index (LAI) for the spring (left column) and summer season (right column) resulting from increased shrub cover (Veg0K-RefVeg). Note that scales differ among panels.

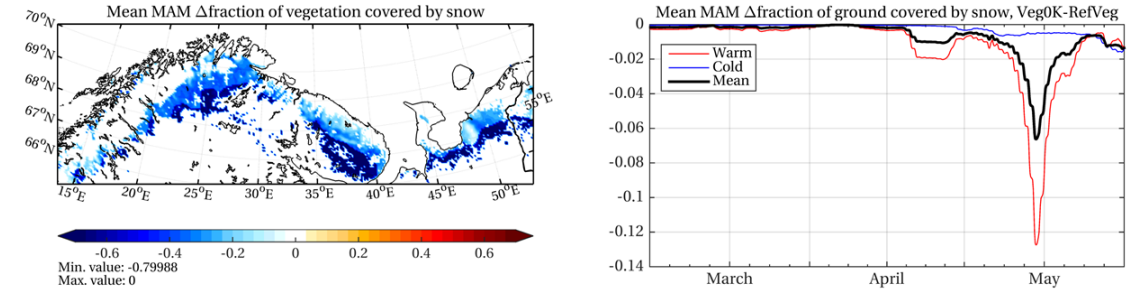

Figure S2. Mean MAM season change in fraction of vegetation canopy buried by snow (left panel) and changes in fraction of ground covered by snow, as averaged over all areas with vegetation changes (right panel) (Veg0K-RefVeg).

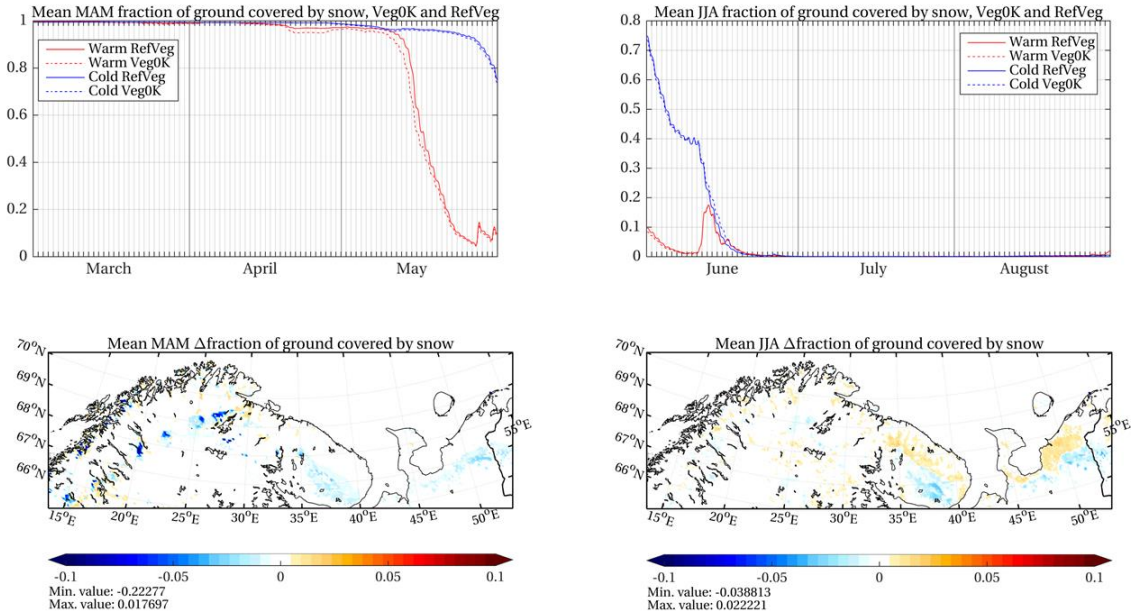

Figure S3. Mean seasonal changes in fractional snow cover resulting from increased shrub and tree cover (Veg0K-RefVeg). Spring (left column) and summer season (right column).

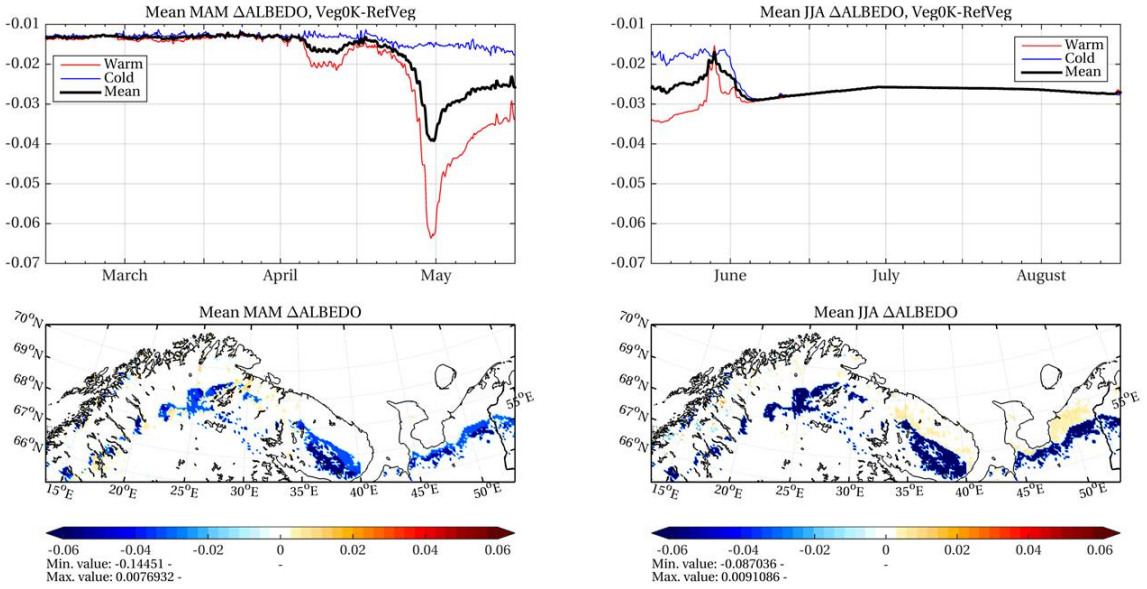

Figure S4. Mean seasonal albedo changes resulting from increased shrub and tree cover (Veg0K-RefVeg). Spring (left column) and summer season (right column).

In Fig. S5 changes to surface variables resulting from vegetation changes corresponding to a 1 K shift in summer temperatures are presented. Average anomalies over the spring season in the left column, and summer in the right column. Increased shrub cover leads to higher ET and LH and acts to increase cloud cover and precipitation.

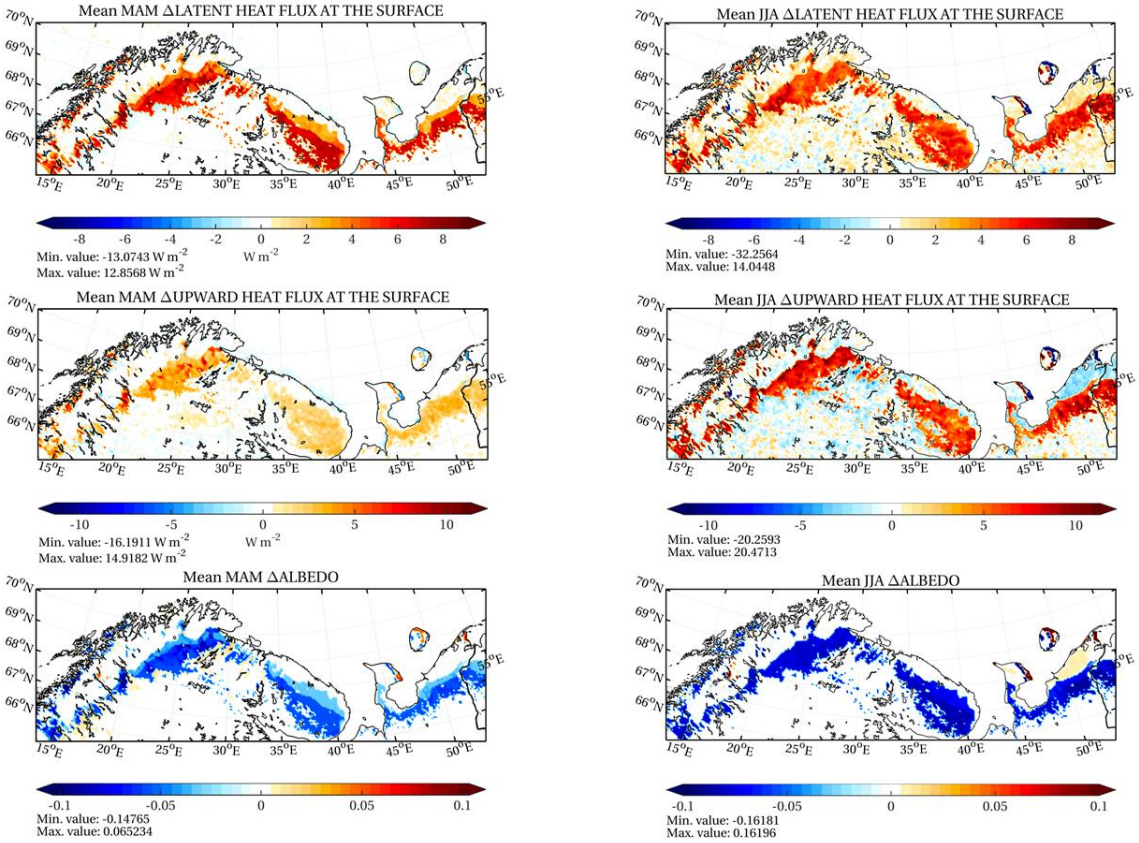

Figure S5: Changes in surface fluxes of heat and moisture (top two rows) and surface albedo (bottom row) resulting from a theoretical 1 K shift in shrub and boreal tree distribution (Veg1K-RefVeg). Spring (left column) and summer season (right column).

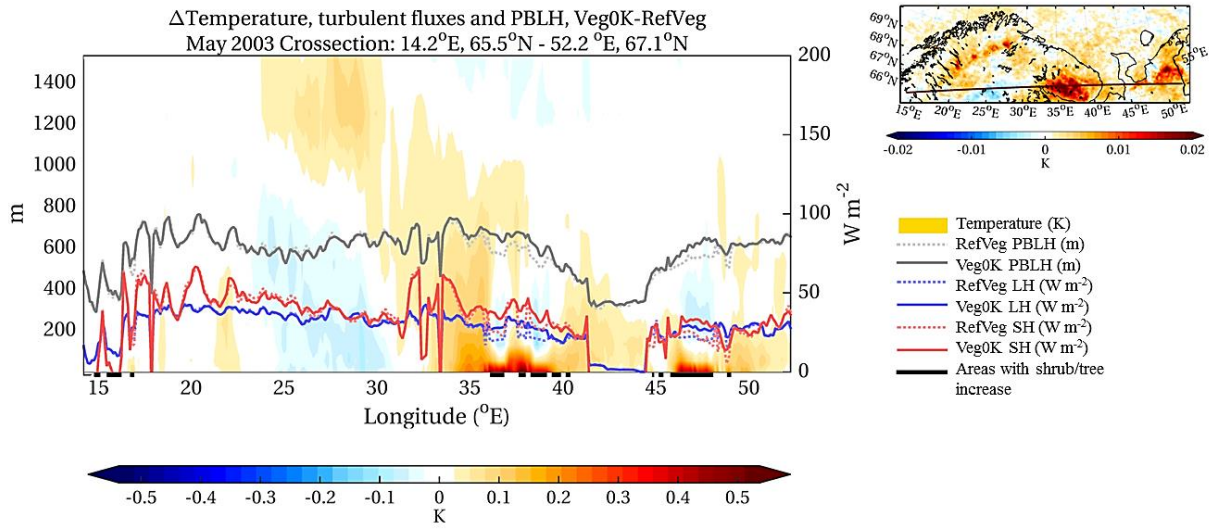

Figure S6: Cross section showing anomalies resulting from increased shrub cover (Veg0K-RefVeg) as averaged over the warm May month. The air temperature anomaly ΔT is shown in colors, and PBL height in grey lines, left axis. Blue and red lines show LH and SH, respectively (in W m^{-2}, right axis). Stippled lines show RefVeg values, and solid lines show Veg0K values. Black lines along the bottom line indicate areas with shrub expansion along the cross section. The placement of the cross section line is shown in the inset, along with mean monthly bottom model layer air temperature anomalies.

It is clear from Fig. S6 that the changes in LH and SH fluxes are local to the areas with vegetation changes, as is the increase in PBL height. The values are mean monthly May values from the warm spring season, and as such they represent one of the months with the largest heating anomaly. The heating anomaly extends well beyond the PBL, however the main heating is occurring within the lower 200 meters.

Parameter values for biophysical properties of the key vegetation categories in this study are presented in Table S1.

Table S1. Key vegetation categories and corresponding parameter values.

Vegetation type *(original name/usage in model system)*	*Shdfac*[a]	*Nroots*[b]	*Rs*[c]	*Snup*[d]	*Max albedo (with snow)*	*LAI*		*Emissivity*		*Albedo*		*Z_0*		*Can. height*	
						Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*
Sub-alpine tall shrubs/trees (2-5m) *(Mixed tundra)*	0.60	3	150	0.025	60	0.41	3.35	0.920	0.920	0.15	0.20	0.15	0.15	0.1	5.0
Below tree line shrubs/trees (>5m) *(Wooded tundra)*	0.60	3	150	0.025	55	0.41	3.35	0.930	0.930	0.15	0.20	0.30	0.30	0.1	10.0
Low-alpine shrubs (0.5-2m) *(Open shrubland, adjusted)*	0.70	3	170	0.035	65	0.60	**3.00**	0.930	0.950	0.22	0.30	0.01	0.06	0.1	**2.0**
Mid-alpine shrubs (0.1-0.5 m) *(mixed shrubland/grassland)*	0.70	3	170	0.035	65	0.60	2.60	0.930	0.950	0.22	0.3	0.01	0.06	0.1	0.5
High-alpine (tundra/barren) *(Barren/Sparsely vegetated)*	0.01	1	999	0.02	75	0.1	0.75	0.900	0.900	0.38	0.38	0.01	0.01	0.01	0.02

[a]*Shading factor,* [b]*Number of root layers,* [c]*Minimum stomatal resistance,* [d]*Snow water equivalent for total snow cover*