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. 7 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).

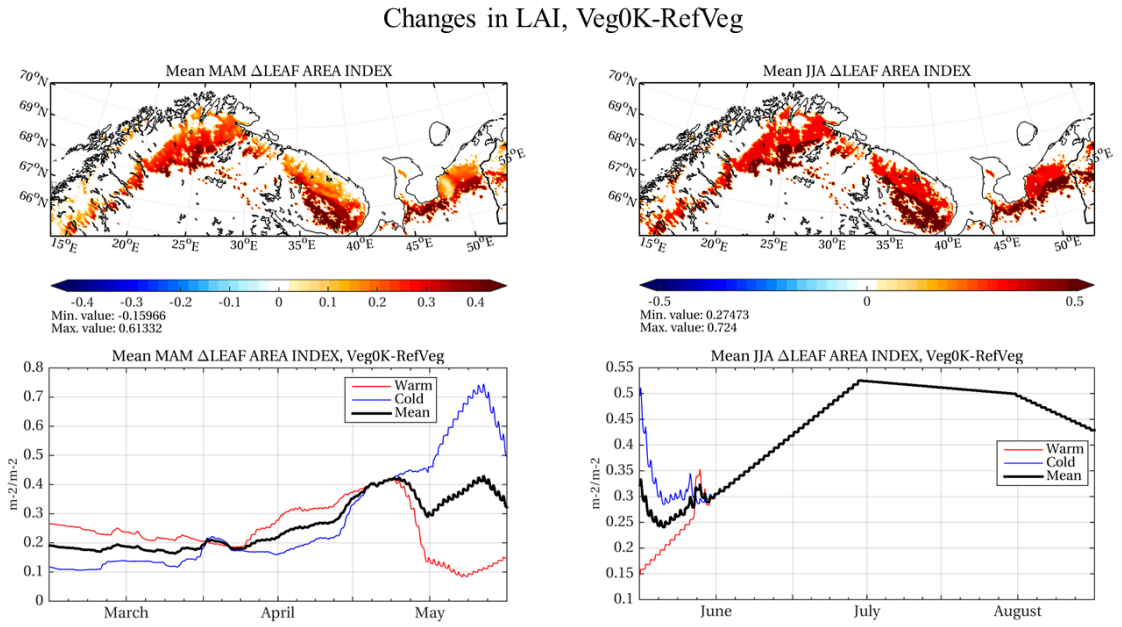

Figure S1: Effects on leaf area index (LAI) for the spring (left column) and summer season (right column) resulting from increased shrub cover. Note that scales differ among panels.

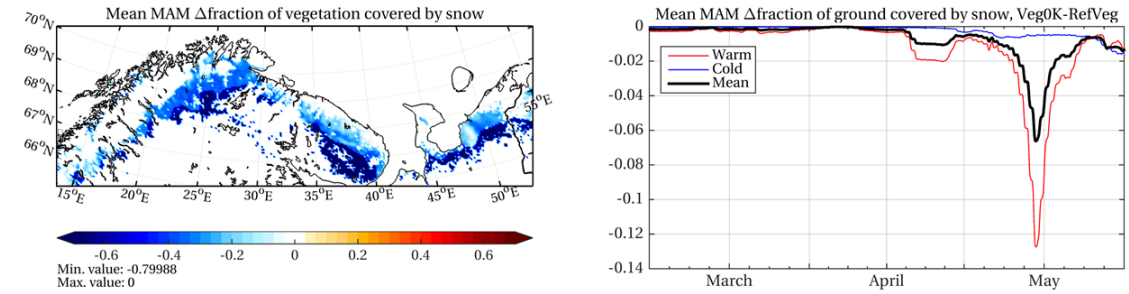

Figure S2. Mean MAM season change in fraction of vegetation canopy buried by snow (left panel) and changes in fraction of ground covered by snow, as averaged over all areas with vegetation changes (right panel). (Veg0K-RefVeg).

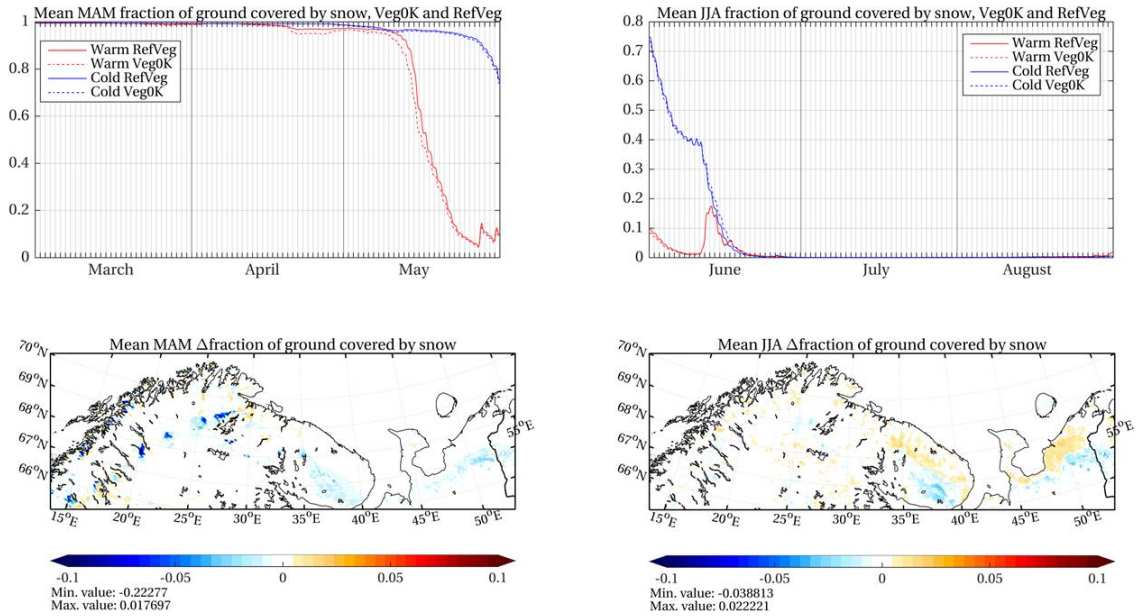

Figure S3. Mean seasonal changes in fractional snow cover resulting from increased shrub and tree cover. (Veg0K-RefVeg).

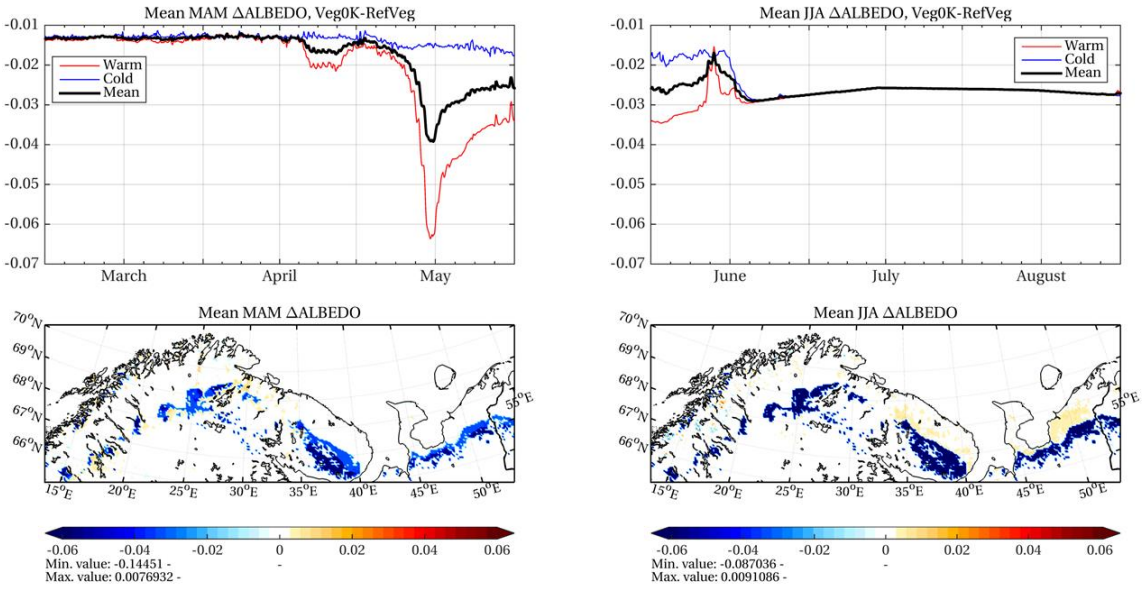

Figure S4. Mean seasonal albedo changes resulting from increased shrub and tree cover. (Veg0K-RefVeg).

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. (Veg0K-RefVeg).

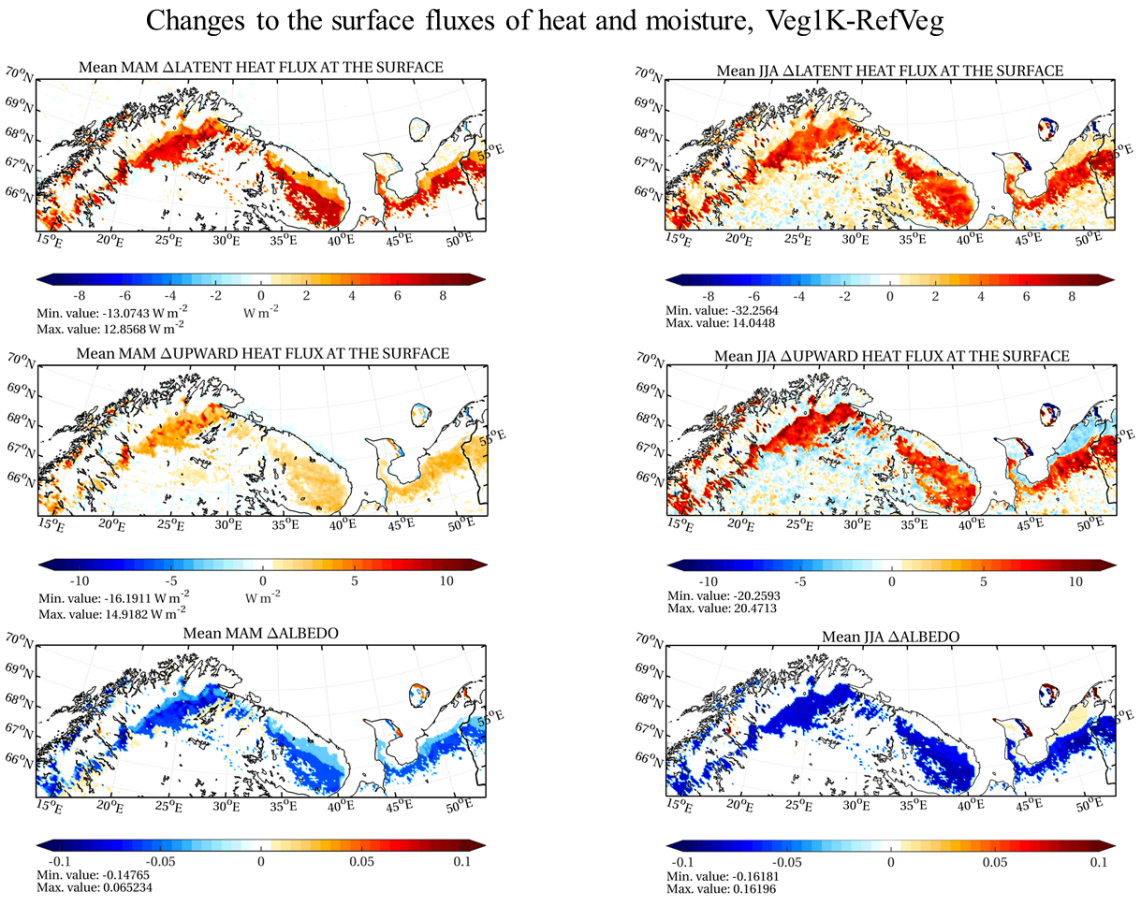

Figure S5: Changes in surface fluxes of heat and moisture (top two rows) and surface albedo (bottom row) resulting from a theoretical 1 K shift in shrub- and boreal tree distribution. (Veg1K-RefVeg).

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*