High-resolution digital mapping of soil organic carbon in permafrost terrain using machine-learning: A case study in a sub-Arctic peatland environment

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Supplementary material

TableA. 1: Description of the individual land cover classes adapted from Andersson (2016)

Land cover class	Description
Bare ground	Exposed bedrock, blockfields, rock fragments covered ground or barren unvegetated soil with no or very little vegetation cover; vegetation includes mosses in patches of few centimeters in diameter and lichens.
Alpine heath tundra	Areas above the tree line >~500 m a.s.l., covered by low growing vegetation from few centimeters to few decimeter height, often alternating with exposed bare soil or rocks; low growing deciduous and evergreen shrubs, including *Betula nana*, *Empetrum sp.,* mosses and lichens. Can be associated with cryoturbation landforms such as solifluction lobes and mud boils.
Alpine willow	Alpine areas above the Birch tree line covered by low growing willow (*Salix sp.*) shrubs mostly confined to wind protected depressions along river pathways with wet soil conditions and micro-climate.
Birch forest	Forest dominated by mountain birch (*Betula pubescens ssp. czerepanovii*); tree height is 2–15 m; trees can have single stems (monocormic) or grow with many stems divided near the ground (polycormic); birch forest is restricted to areas below ~600 m altitude.
Sparse birch forest	Lower elevation areas with spread-out clusters of birch trees (*Betula pubescens ssp. Czerepanovii*) over boulder fields with disrupted soil cover.
Dwarf shrub	Areas covered by small shrubs up to ~50 cm high. Mainly in subalpine terrain at the transition from birch forest to alpine heath tundra, but also adjacent to lowland wetland areas over boulder terrain.
Forested wetland	Forested areas with trees higher than 2 m (*Betula pubescens ssp. Czerepanovii* and *Salix sp.*) and seasonally waterlogged ground conditions. The ground has significant peat accumulation. On alluvial fans fern can cover the ground.
Lowland shrub wetland	Fen areas with substantial growth of dwarf shrubs, mostly low growing willow (*Salix sp.);* ground cover is tall graminoids and *Sphagnum sp.* Found close to streams and rivers.
Sphagnum wetland	Waterlogged fen areas with continuous *Sphagnum sp.* ground cover and some graminoids. No distinction between ombrotrophic and minerotrophic areas was made.
Sedge wetland	Waterlogged wetland areas with standing water and sedges (*Eriophorum angustifolium* and *Carex spp*). Often transitions into lakes and ponds. Mostly minerotrophic areas surrounding the peat plateaus or small wetlands surrounded by birch forest.
Peat Bog	Dry elevated ombrotrophic wetland areas, mostly in form of palsa plateaus elevated by the occurrence of permafrost; vegetation includes growing evergreen and deciduous shrubs such as *Empetrum hermaphroditum* and *Betula nana, Rubus chamaemorus*, mosses and lichens.

Water	Water bodies with a minimum area of 130 m² including rivers, ponds and lakes. Including Torneträsk lake; masked layer.
Artificial surfaces	Street, railway and buildings including a buffer margin; masked layer.

TableA. 2: Confusion matrix of the land cover classification based on 108 ground control points.

	Bare rock	Alpine heath tundra	Dwarf shrub	Alpine willow	Sparse Birch Forest	Birch Forest	Forested wetland	Sedge wetland	Lowland shrub wetland	Sphagnum wetland	Peat bog	Samples (N: 108)
Bare rock	5	3	1	0	0	0	0	0	0	0	0	9
Alpine heath tundra	0	6	0	0	0	0	0	0	0	0	0	6
Dwarf shrub	1	1	4	1	0	0	0	0	0	0	0	7
Alpine willow	0	1	1	3	1	1	0	0	0	0	0	7
Sparse Birch Forest	0	0	1	0	11	0	0	0	0	0	0	12
Birch Forest	0	0	1	1	4	21	0	0	0	0	0	27
Forested wetland	0	0	0	0	0	0	6	0	0	0	0	6
Sedge wetland	0	0	1	0	0	0	0	7	0	1	3	12
Lowland shrub wetland	0	0	0	0	0	0	1	0	4	0	0	5
Sphagnum wetland	0	0	0	0	0	0	0	0	0	2	2	4
Peat bog	1	0	0	0	0	0	0	0	0	1	11	13
Overall Accuracy	74%											
Kappa	0.71											
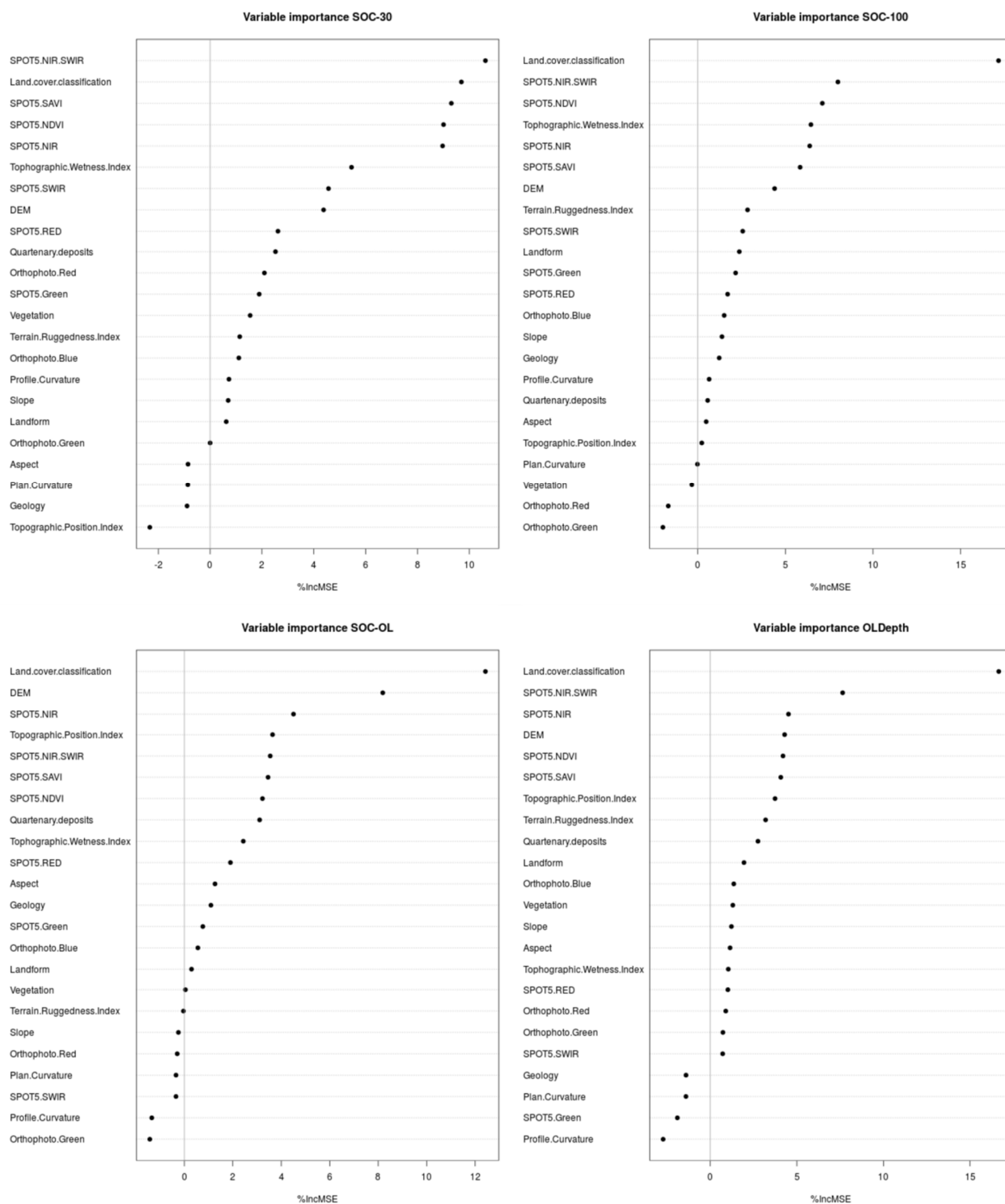
Fig.A. 1: Variable importance plots for individual random forests prediction models of SOC–30, SOC 0–100, SOC– OL and OL–Depth measured in mean decrease in accuracy (% IncMSE).