

Mapping Arctic treeline vegetation using LiDAR data in the Mackenzie Delta area, Canada

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Related publication: Grünberg et al. 2020: Linking tundra vegetation, snow, soil temperature, and permafrost, Biogeosciences, doi: 10.5194/bg-17-4261-2020

HIT Permafrost – project aim

Within our *Helmholtz Imaging* project, we aim to map soil properties in a **permafrost** area. We combine field knowledge and soil data with three airborne data sets (I) multi-frequency fully polarimetric radar, (II) laser scans (LiDAR), (III) optical and NIR images. Our work on **vegetation** and topography helps to disentangle the complex radar signal. The main project goal is to quantify the spatial distribution of **subsurface properties** such as soil moisture, organic layer thickness, ice content, and unfrozen zones (taliks).

Vegetation mapping using LiDAR data

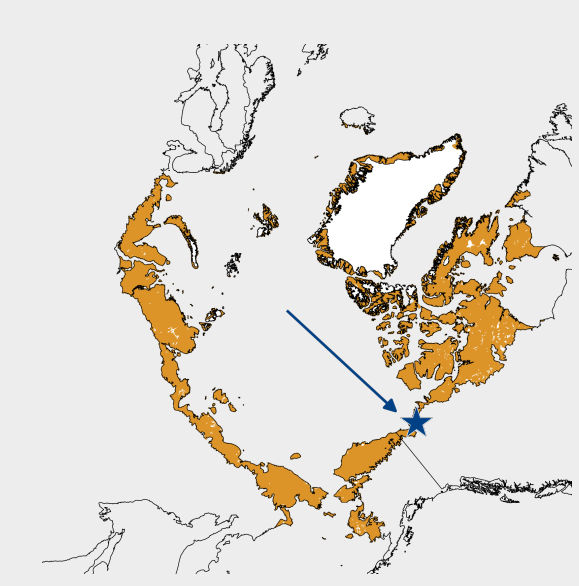
We combine aerial photos at 15 cm resolution and field data to define calibration and validation points of specific vegetation types. The final vegetation map is based on 1 m spatial resolution laser scanning (LiDAR) data.

- Airborne optical data: unevenly illuminated due to clouds
 - Vegetation types: largely defined by their structure
- Use structural information from airborne LiDAR data to map large areas

Study site

Our 164 km² study area is located between Inuvik and Tuktoyaktuk, NWT, Canada.

- Trail Valley Creek (68.742° N, 133.499° W)
- Gentle topography
- Continuous permafrost
- Tree line environment
- Mostly tundra vegetation ≤40 cm, shrubs ≤2 m, and trees ≤10 m



Data acquisition

Point cloud processing

Main rasters

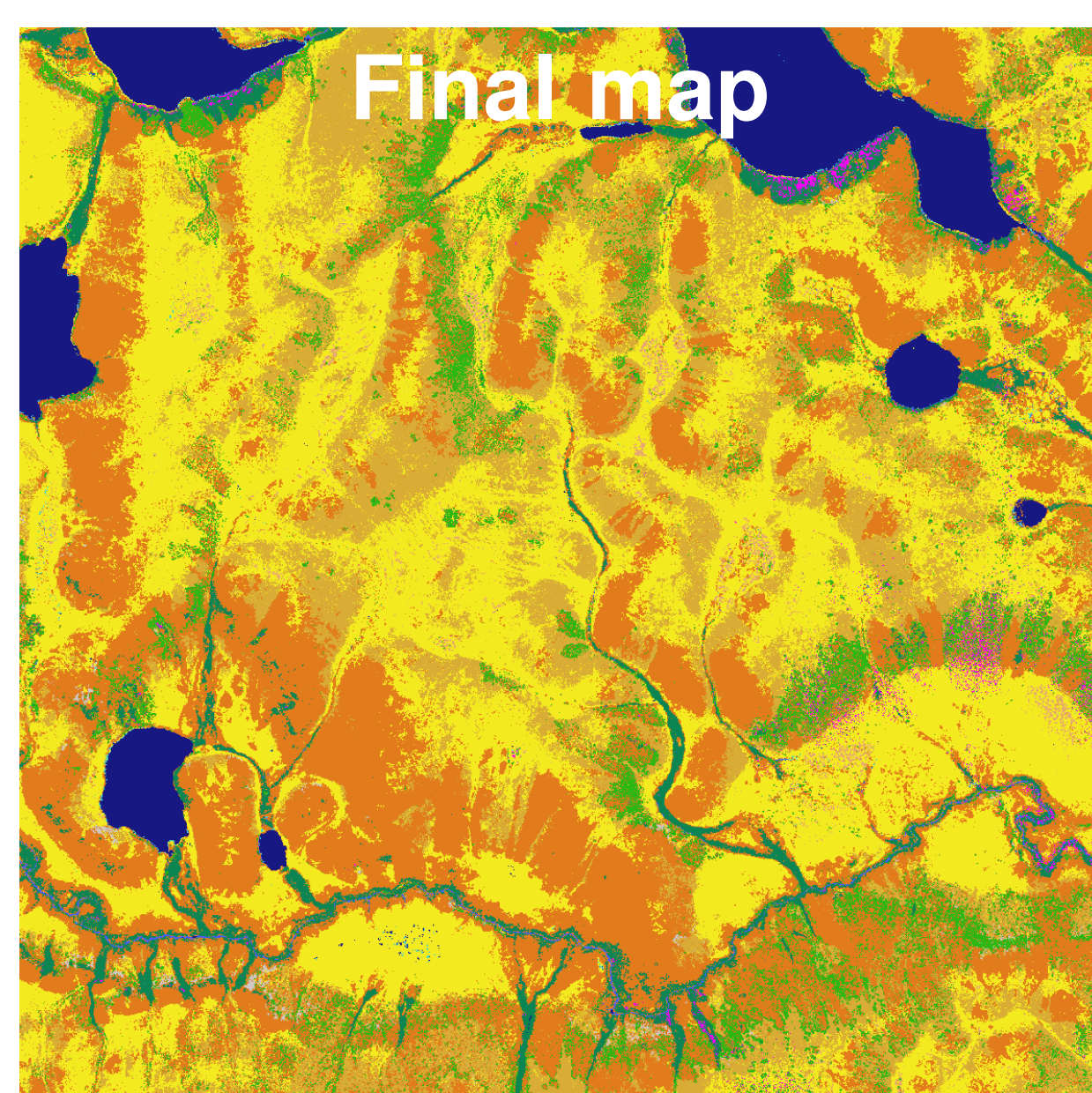
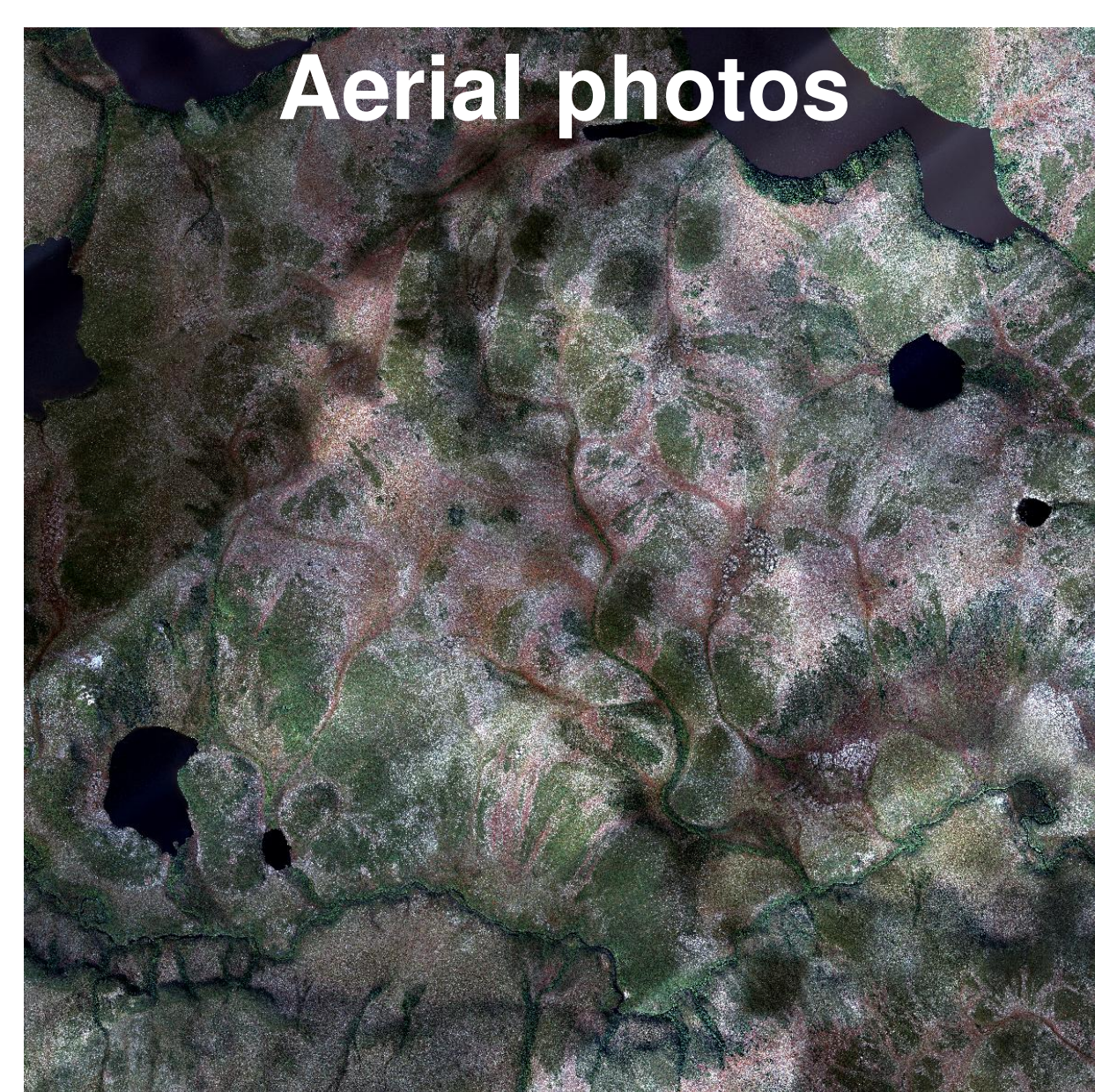
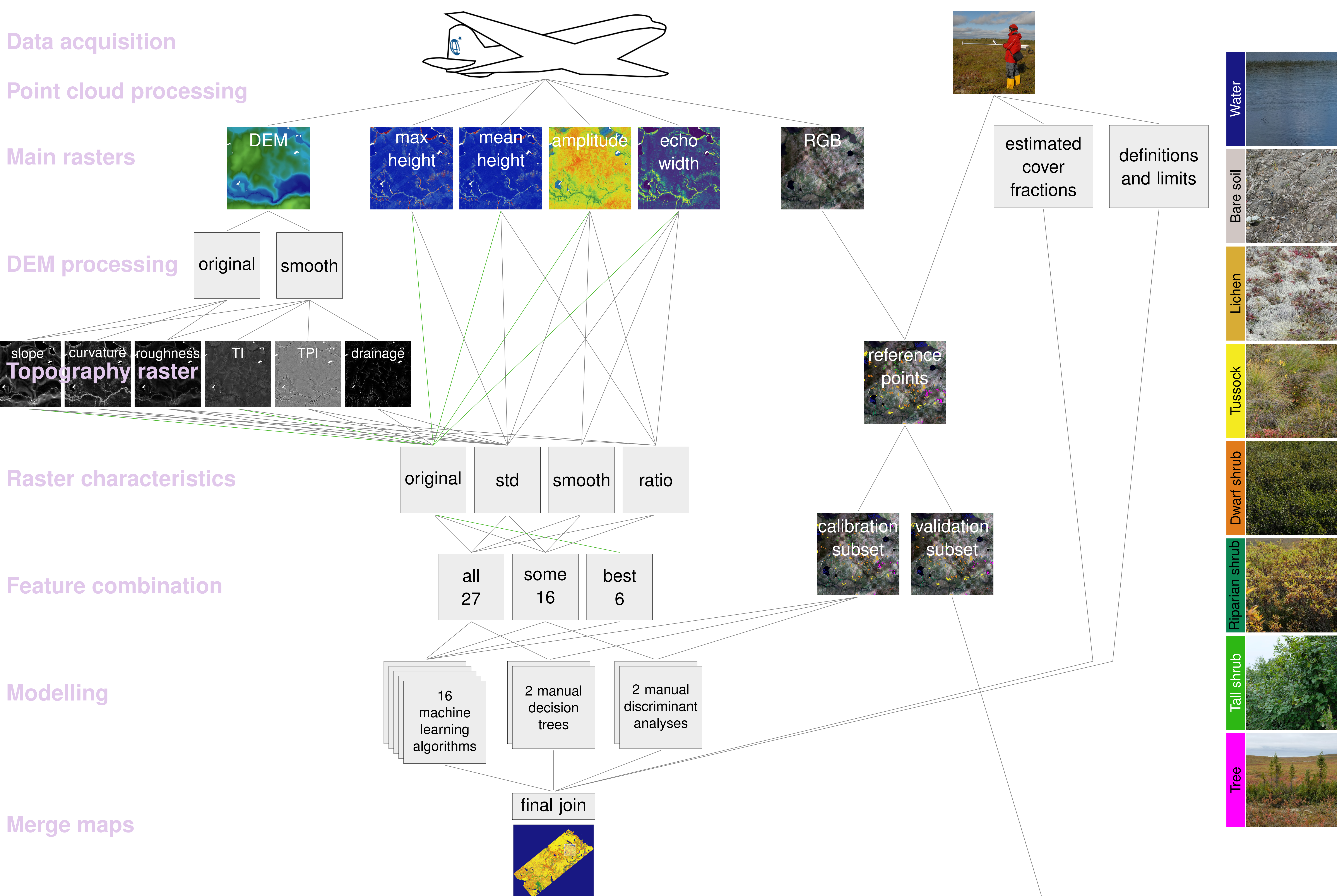
DEM processing

Raster characteristics

Feature combination

Modelling

Merge maps



Cover fractions

Water	9.4%
Bare soil	0.6%
Lichen	19.4%
Tussock	40.1%
Dwarf shrub	22.0%
Single shrub	4.3%
Riparian shrub	3.8%
Tree	0.4%

Map accuracy: 0.82

Predicted:	Water	Bare soil	Lichen	Tussock	Dwarf shrub	Single shrub	Riparian shrub	Tree	#	Producer accuracy
Actual:										
Water	0.95	0.00	0.00	0.00	0.04	0.00	0.02	0.00	56	0.95
BareSoil	0.00	0.59	0.21	0.09	0.07	0.04	0.00	0.00	56	0.59
Lichen	0.00	0.00	0.63	0.38	0.00	0.00	0.00	0.00	56	0.63
Tussock	0.00	0.00	0.21	0.79	0.00	0.00	0.00	0.00	56	0.79
DwarfShrub	0.00	0.00	0.02	0.04	0.93	0.00	0.02	0.00	56	0.93
SingleShrub	0.00	0.00	0.00	0.02	0.07	0.88	0.02	0.02	56	0.88
RiparianShrub	0.00	0.00	0.00	0.00	0.07	0.00	0.93	0.00	56	0.93
Tree	0.00	0.00	0.00	0.05	0.00	0.04	0.02	0.89	56	0.89
# estimated	53	33	60	76	66	53	56	51		
User accuracy	1.00	1.00	0.58	0.58	0.79	0.93	0.93	0.98		

