

# 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 with three airborne data sets (I) multi-frequency fully polarimetric radar, (II) laser scans, and (III) optical and NIR images. Our work on **vegetation** and topography helps our colleagues Irena Hajnsek, Ronny Hänsch, and Paloma Saporta from DLR 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

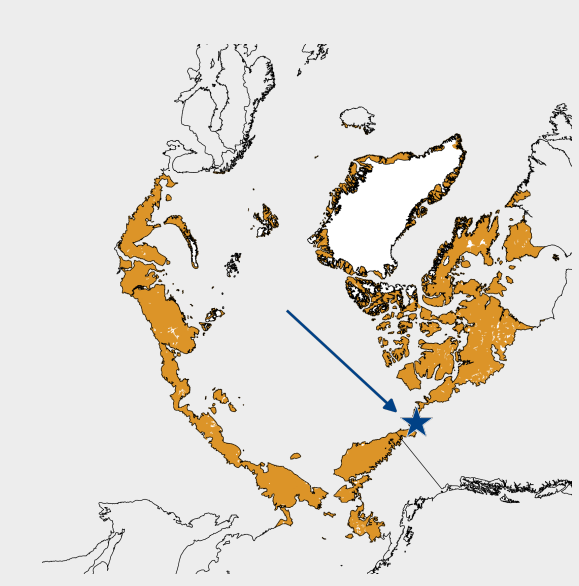
We combine aerial photos at 15 cm resolution and field data to define calibration and validation points of specific vegetation types. The final vegetation map is based on 1 m spatial resolution laser scanning (LiDAR) data.

- 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 km<sup>2</sup> 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

## Processing

## Main rasters

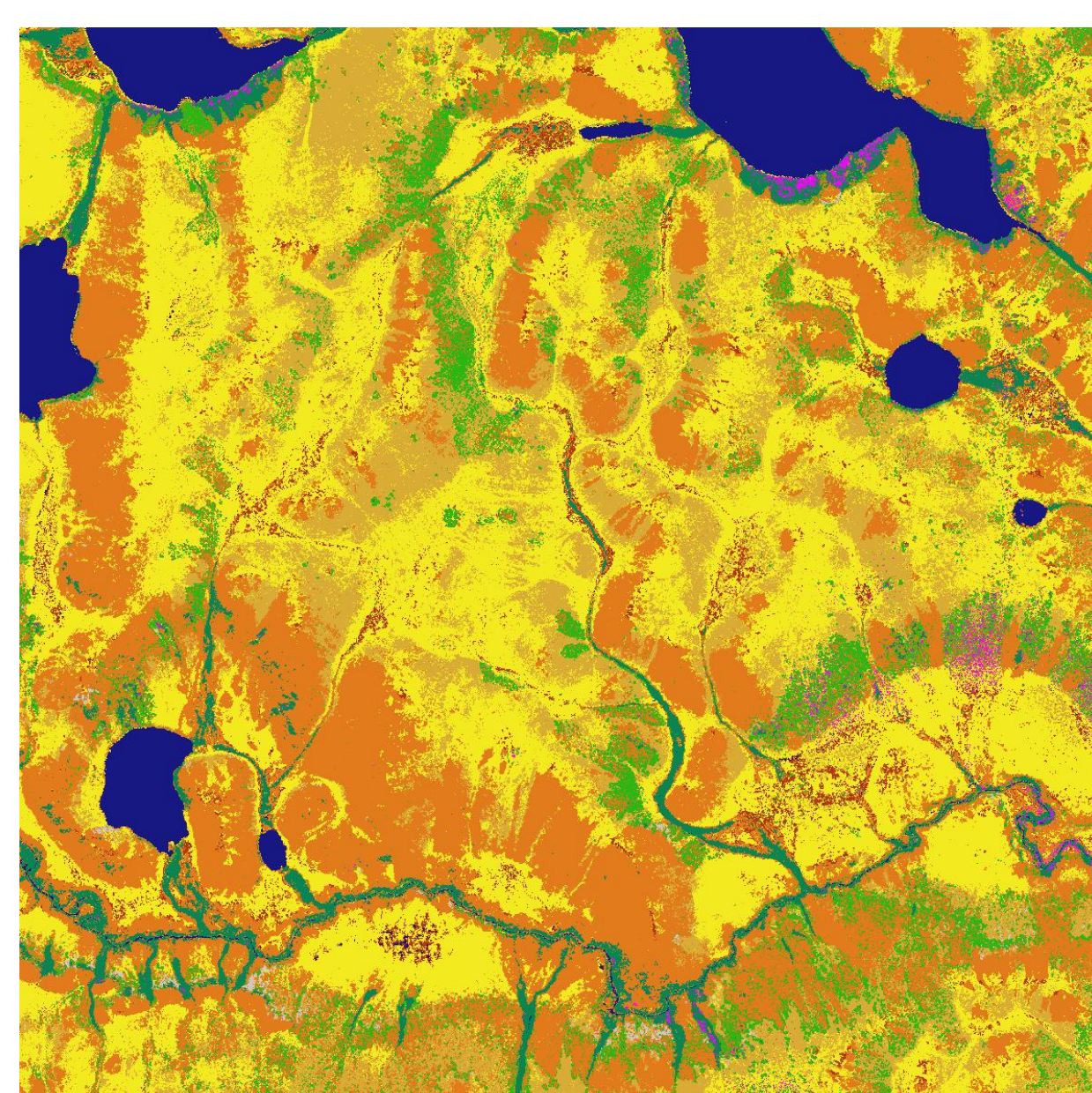
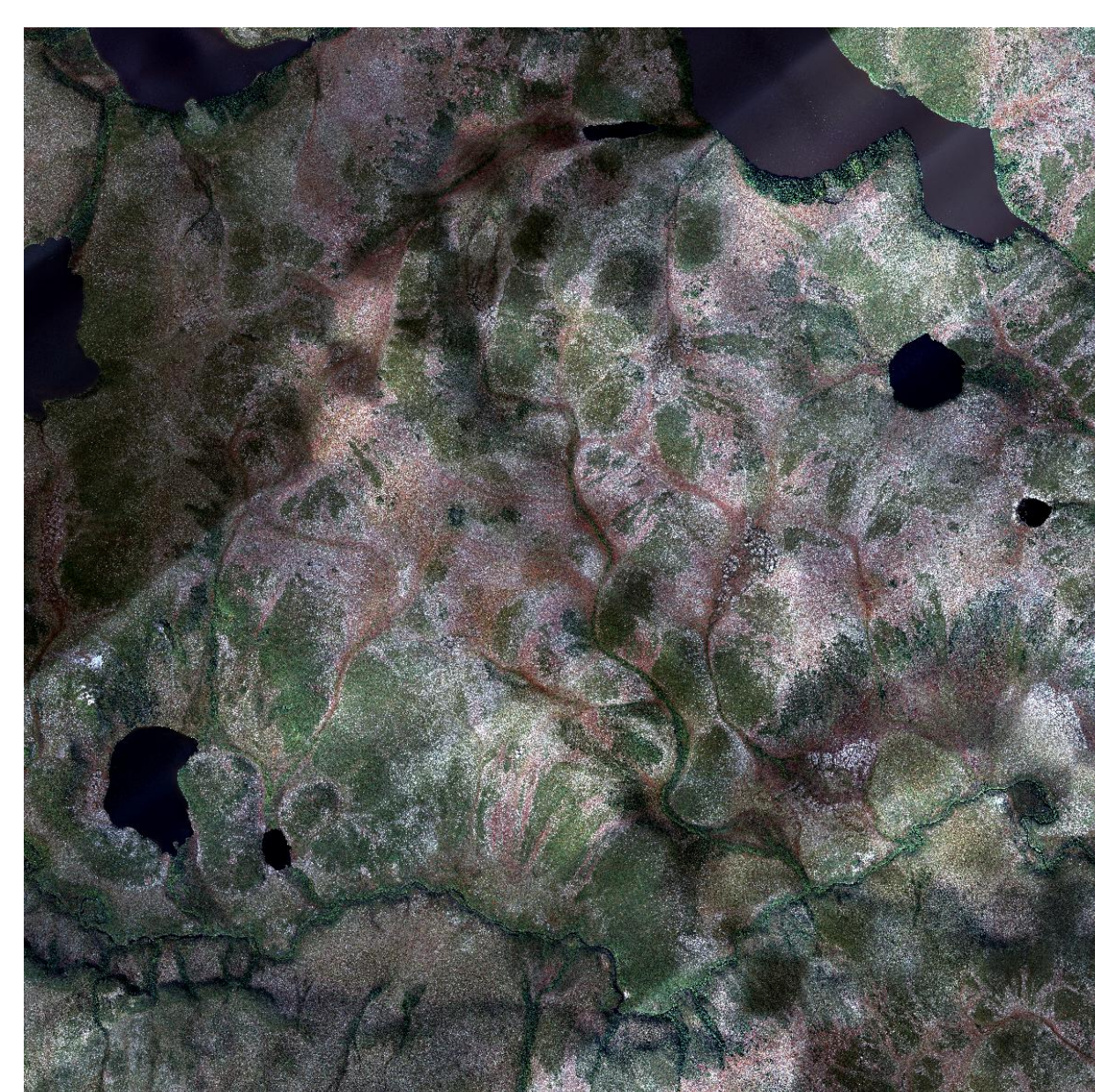
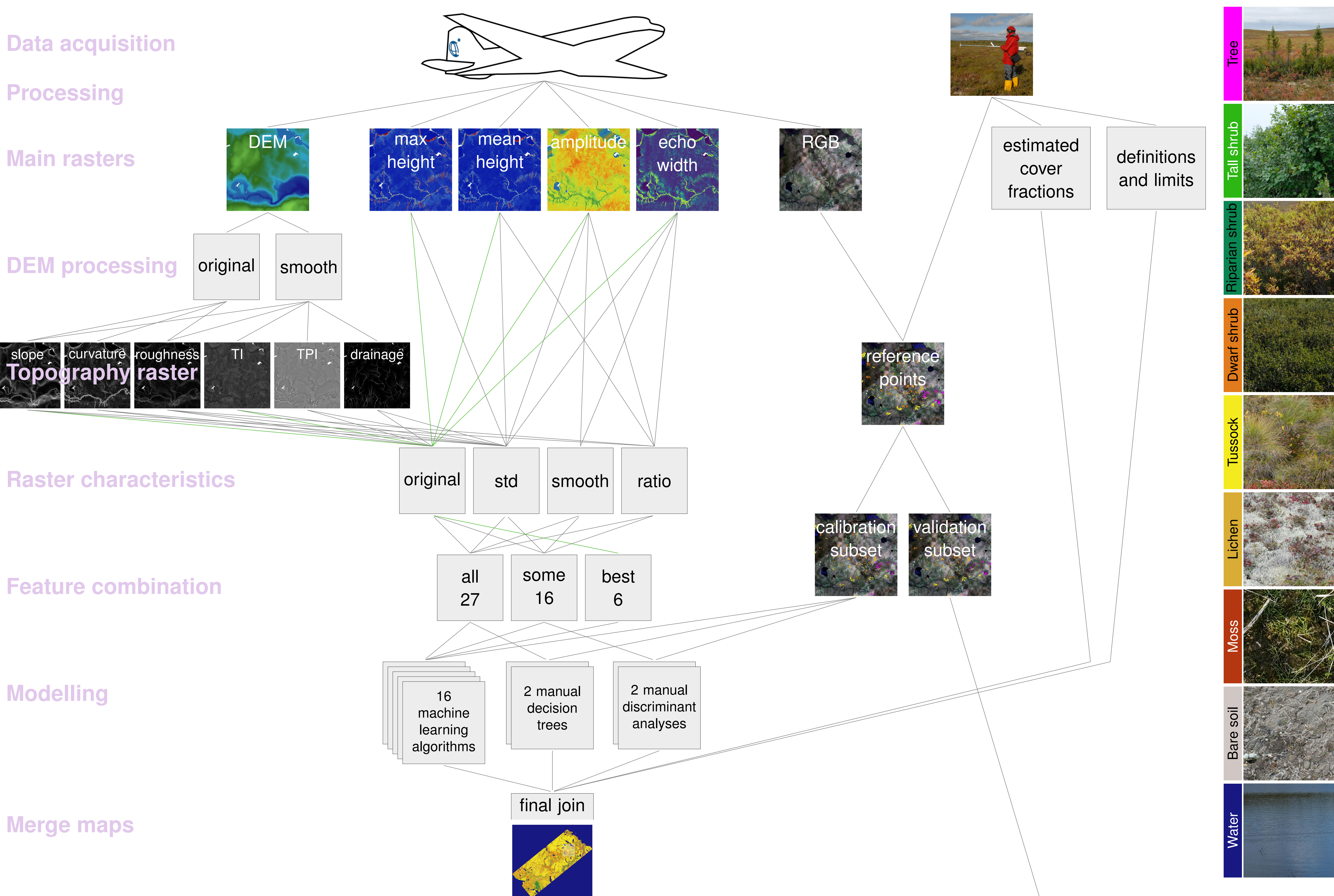
## DEM processing

## Raster characteristics

## Feature combination

## Modelling

## Merge maps



## Cover fractions

Water	9.4%
Bare soil	0.6%
Moss	2.9%
Lichen	19.9%
Tussock	37.3%
Dwarf shrub	20.7%
Single shrub	4.7%
Riparian shrub	3.9%
Tree	0.5%

## Map accuracy: 0.73

Predicted:	Bare soil	Moss	Lichen	Tussock	Dwarf shrub	Single shrub	Riparian shrub	Tree	#	Producer accuracy
Bare soil	<b>0.55</b>	0.00	0.16	0.16	0.11	0.02	0.00	0.00	56	0.55
Moss	0.00	<b>0.27</b>	0.02	0.66	0.04	0.00	0.00	0.00	56	0.27
Lichen	0.00	0.02	<b>0.55</b>	0.41	0.02	0.00	0.00	0.00	56	0.55
Tussock	0.00	0.02	0.20	<b>0.79</b>	0.00	0.00	0.00	0.00	56	0.79
Dwarf shrub	0.00	0.02	0.02	0.02	<b>0.93</b>	0.00	0.02	0.00	56	0.93
Single shrub	0.00	0.00	0.00	0.02	0.04	<b>0.89</b>	0.02	0.04	56	0.89
Riparian shrub	0.00	0.00	0.00	0.00	0.02	0.00	<b>0.96</b>	0.00	56	0.98
Tree	0.00	0.00	0.00	0.05	0.00	0.02	0.02	<b>0.91</b>	56	0.91
# estimated	31	18	53	118	64	52	57	53		
User accuracy	1.00	0.83	0.59	0.37	0.81	0.96	0.95	0.96		

