

Supplementary Material: Towards high-resolution land-cover classification of Greenland: a case study covering Kobbefjord, Disko and Zackenberg

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Table S1: Sentinel-2 spatial and spectral resolution. *not used in this study

Band # and description	Centre wavelength (nm)	Bandwidth (nm)	Spatial resolution (m)
B1 Coastal aerosol*	443	20	60
B2 Blue	490	65	10
B3 Green	560	35	10
B4 Red	665	30	10
B5 Red-edge 1	705	15	20
B6 Red-edge 2	740	15	20
B7 Red-edge 3	783	20	20
B8 NIR	842	115	10
B8A Narrow NIR	865	20	20
B9 Water vapor*	945	20	60
B10 Cirrus*	1374	30	60
B11 SWIR 1	1610	90	20
B12 SWIR 2	2190	180	20

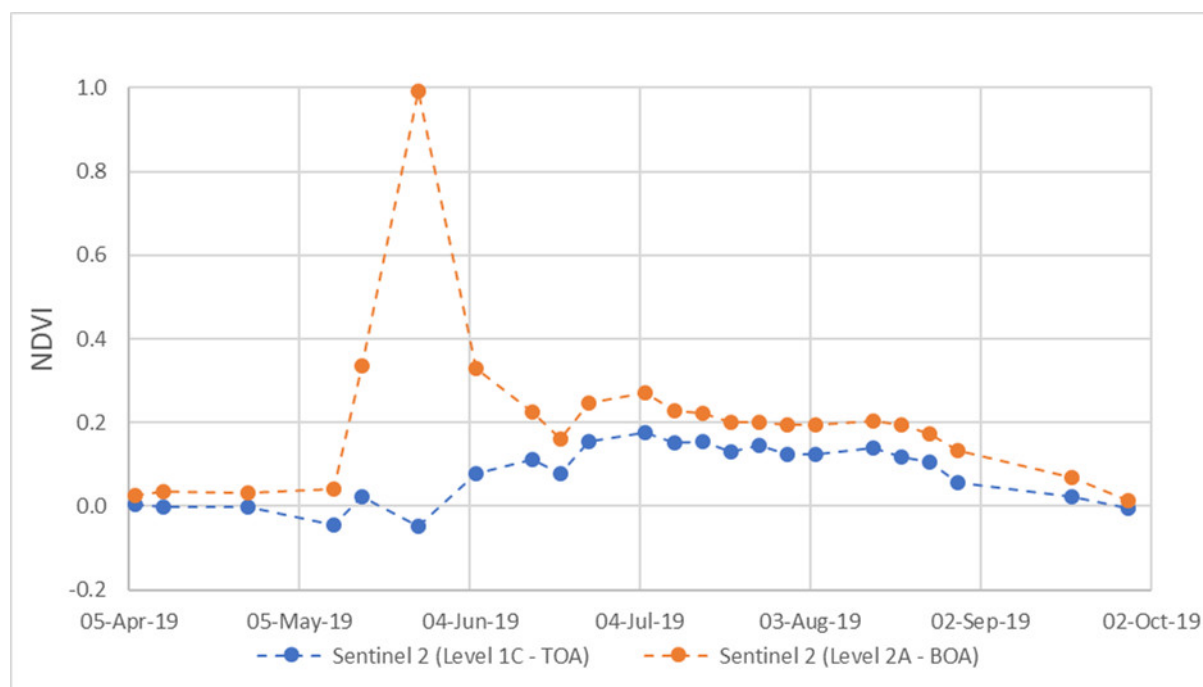


Figure S1: Sentinel-2 Level 1C vs. Level 2A. NDVI time-series of a pixel in Zackenberg (NE Greenland). As observed, the L2A product shows an obvious error of NDVI reaching the value 1. This was observed on several occasions, and most often in the time-frame where snowmelt occurred. As this was not just the case of a single image, it was found that using the atmospherically corrected product was not feasible for the classification approach based on phenology metrics.

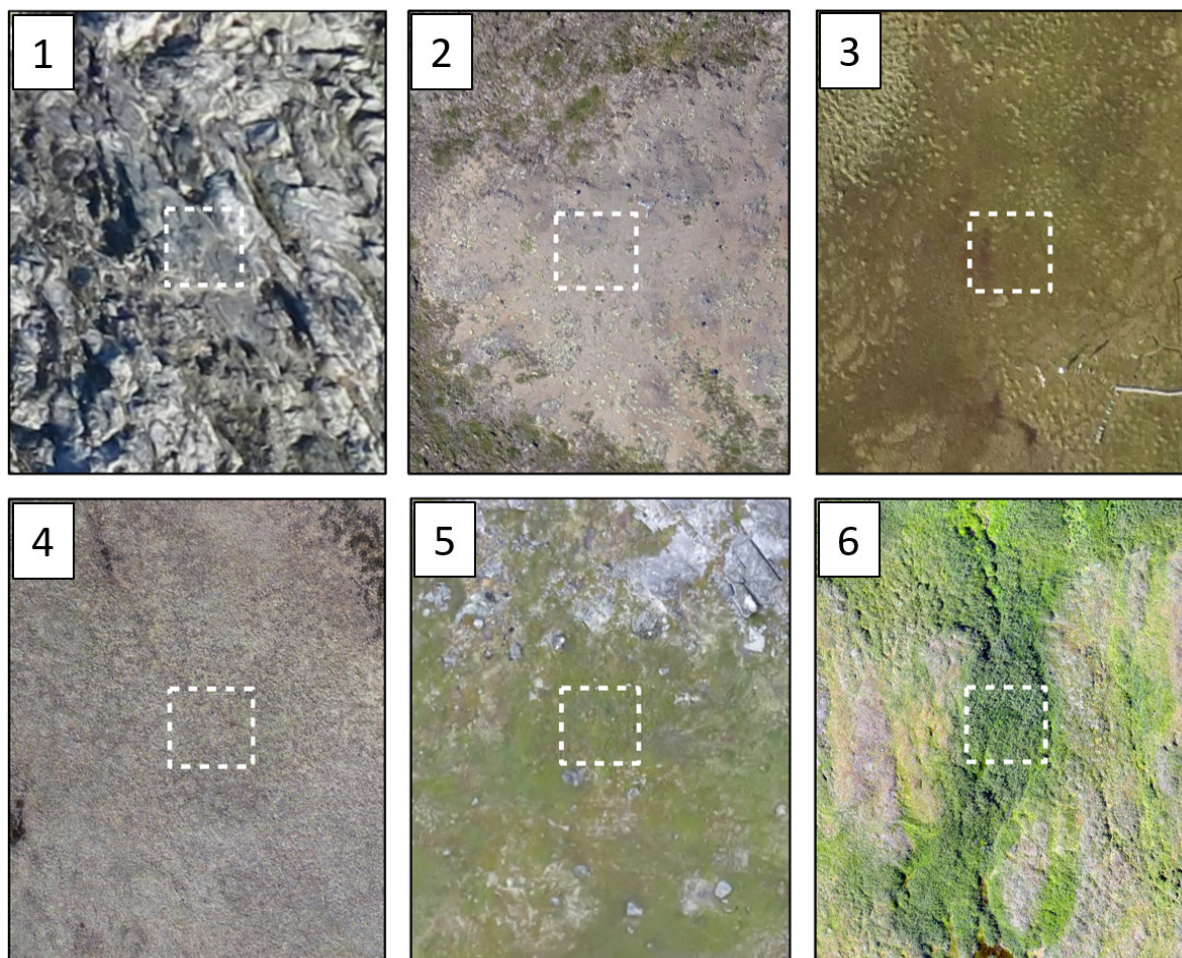


Figure S2: Examples of the six land cover classes. The background is from high-resolution drone images. The white squares represent the spatial extent of one Sentinel-2 pixel (10 m).

- (1) Barren ground – Kobbefjord.
- (2) Abrasion surface – Disko.
- (3) Fen – Zackenberg.
- (4) Dry heath and Grassland – Zackenberg.
- (5) Wet heath – Kobbefjord.
- (6) Tall shrubs and Copse – Disko.

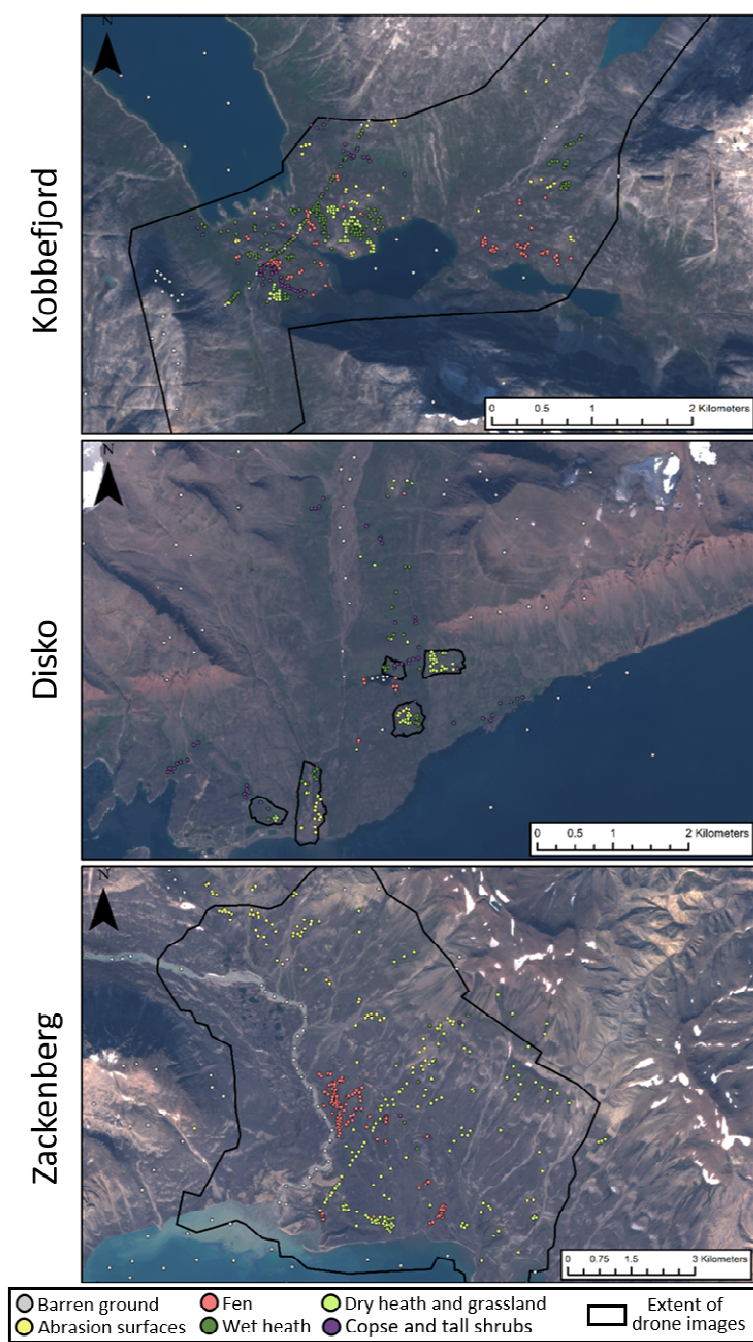


Figure S3: Spatial distribution of the ground reference data.

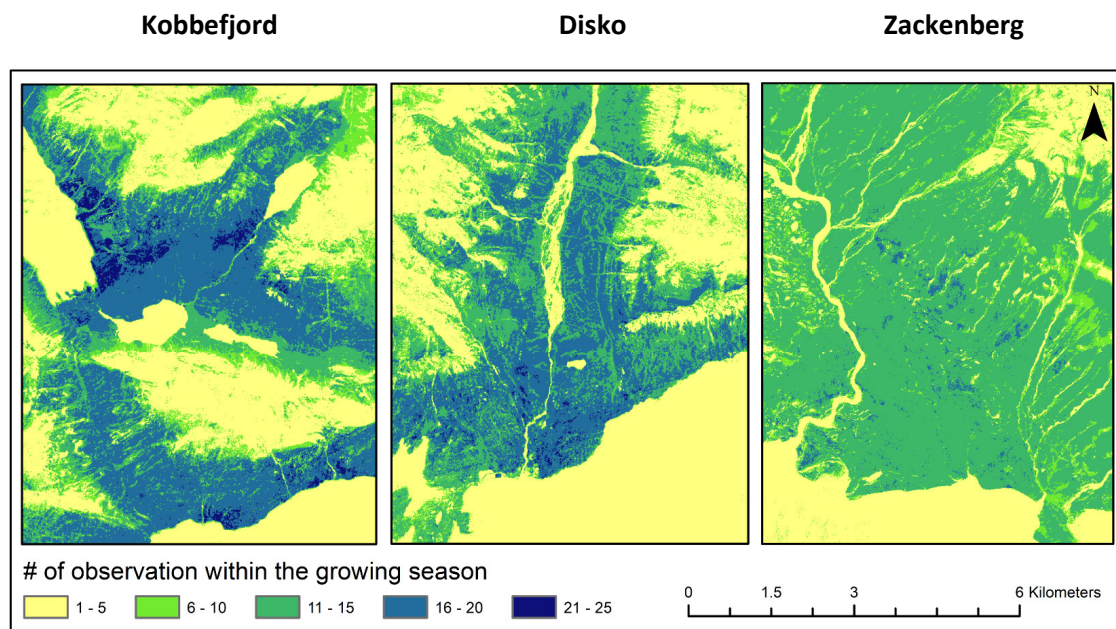


Figure S4: Per pixel number of observations within the growing season.

Table S2: Overview of all features applied for the RF classification.

Phenology	Variations	Number of features
Date of peak	DOY	1
LOS (Days)	Days	1
SOS	DOY, NDVI and slope	3
EOS	DOY, NDVI and slope	3
TI-NDVI	Sum	1
<u>Indicies</u>		
NDVI	Max, median, min and SD	4
NDVI (Narrow NIR)	Max, median, min and SD	4
VI RE1	Max, median, min and SD	4
VI RE2	Max, median, min and SD	4
VI RE3	Max, median, min and SD	4
NDMI	Max, median, min and SD	4
NBR	Max, median, min and SD	4
NBR2	Max, median, min and SD	4
ND RE1 & RE2	Max, median, min and SD	4
ND RE1 & RE3	Max, median, min and SD	4
ND RE2 & RE3	Max, median, min and SD	4
EVI	Max, median, min and SD	4
SAVI	Max, median, min and SD	4
NDWI	Max, median, min and SD	4
<u>Bands</u>		
Blue	Median	1
Green	Median	1
RED	Median	1
Red-edge 1	Median	1
Red-edge 2	Median	1
Red-edge 3	Median	1
NIR	Median	1
Narrow NIR	Median	1
SWIR 1	Median	1
SWIR 2	Median	1
<u>Topography</u>		
Elevation	Meters	1
Slope	Original, 100 m smoothed and 200 m smoothed	3
Total		79

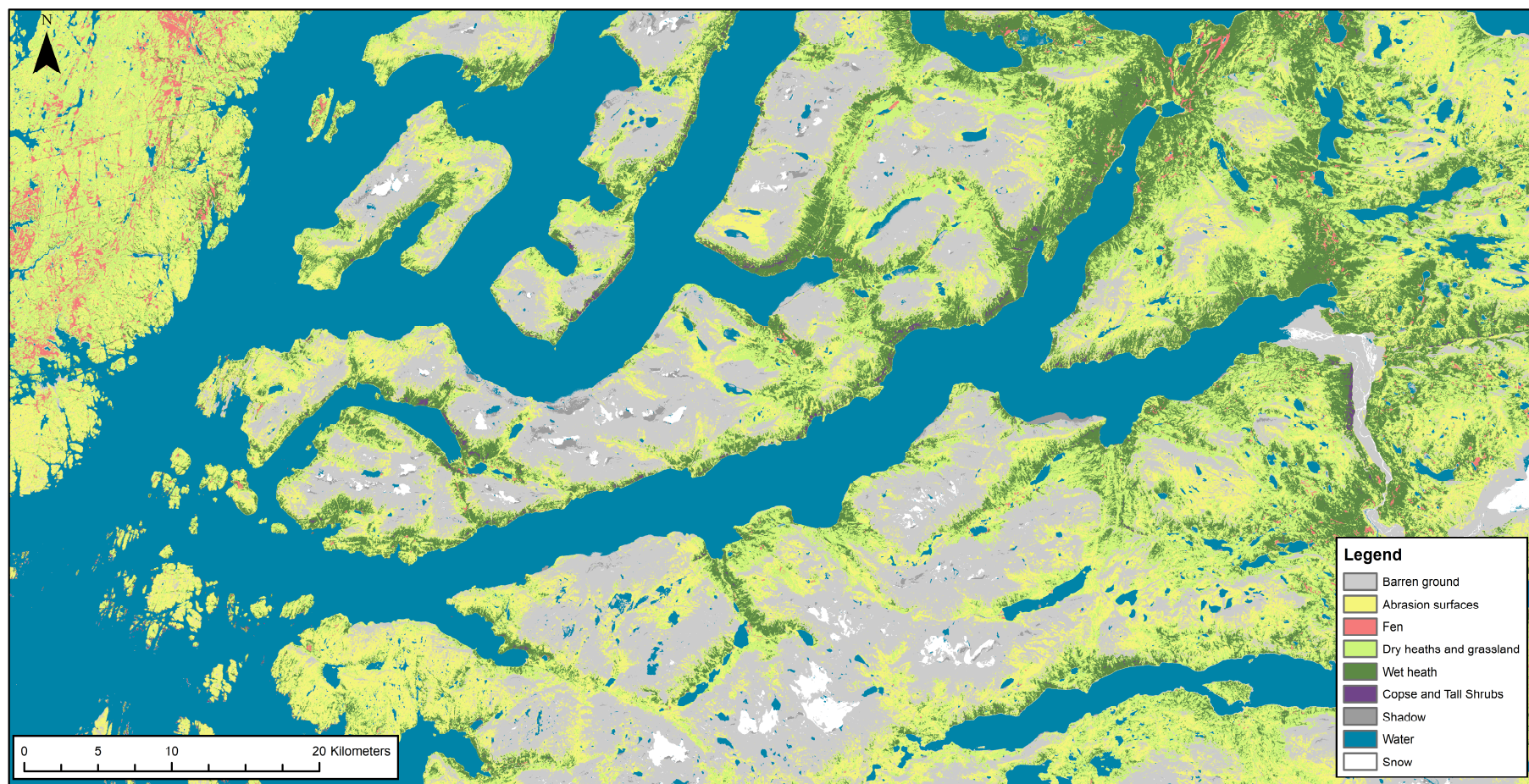


Figure S5: Final classification of the “Kobbefjord” area.

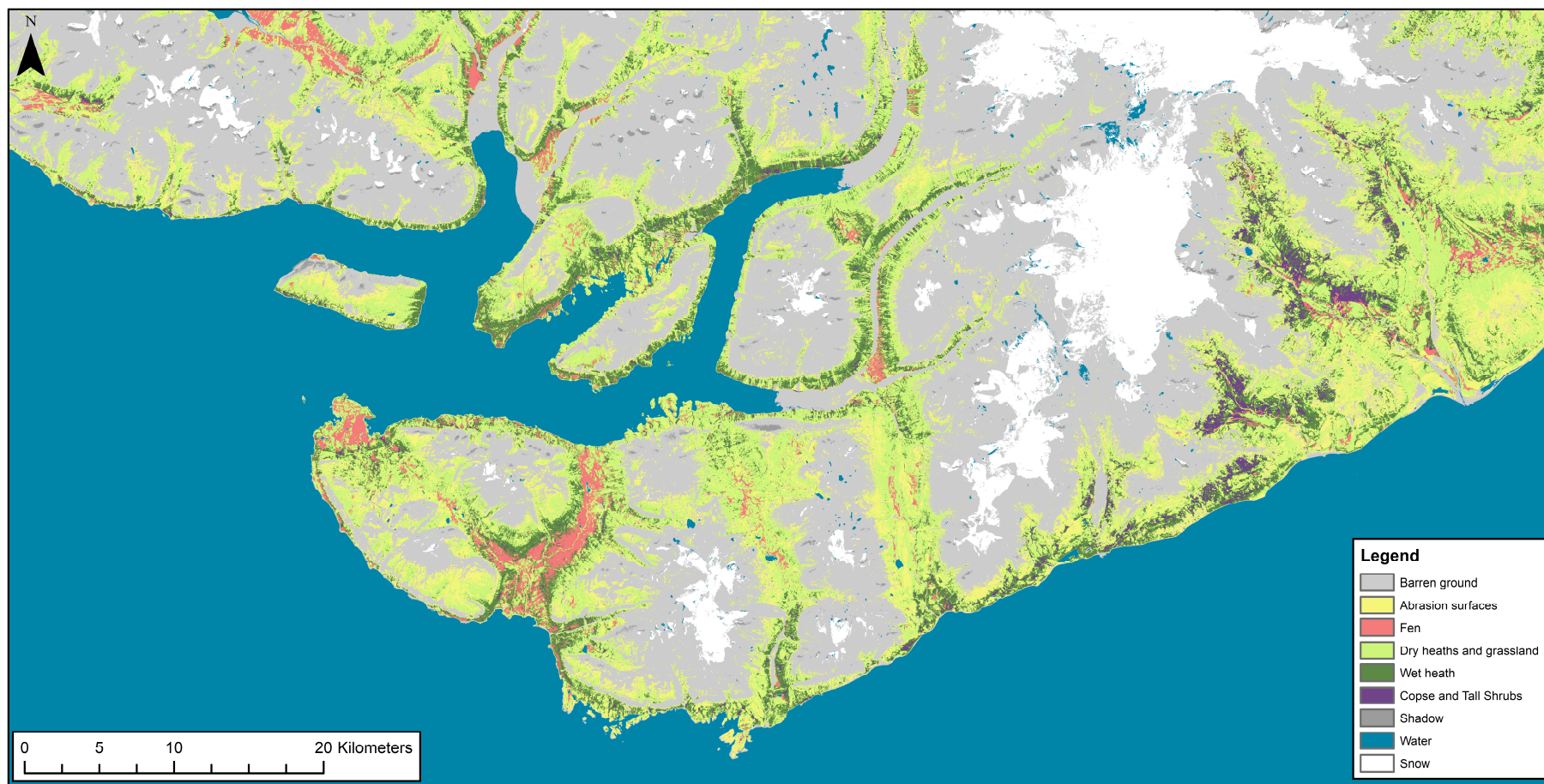


Figure S6: Final classification of the “Disko” area.

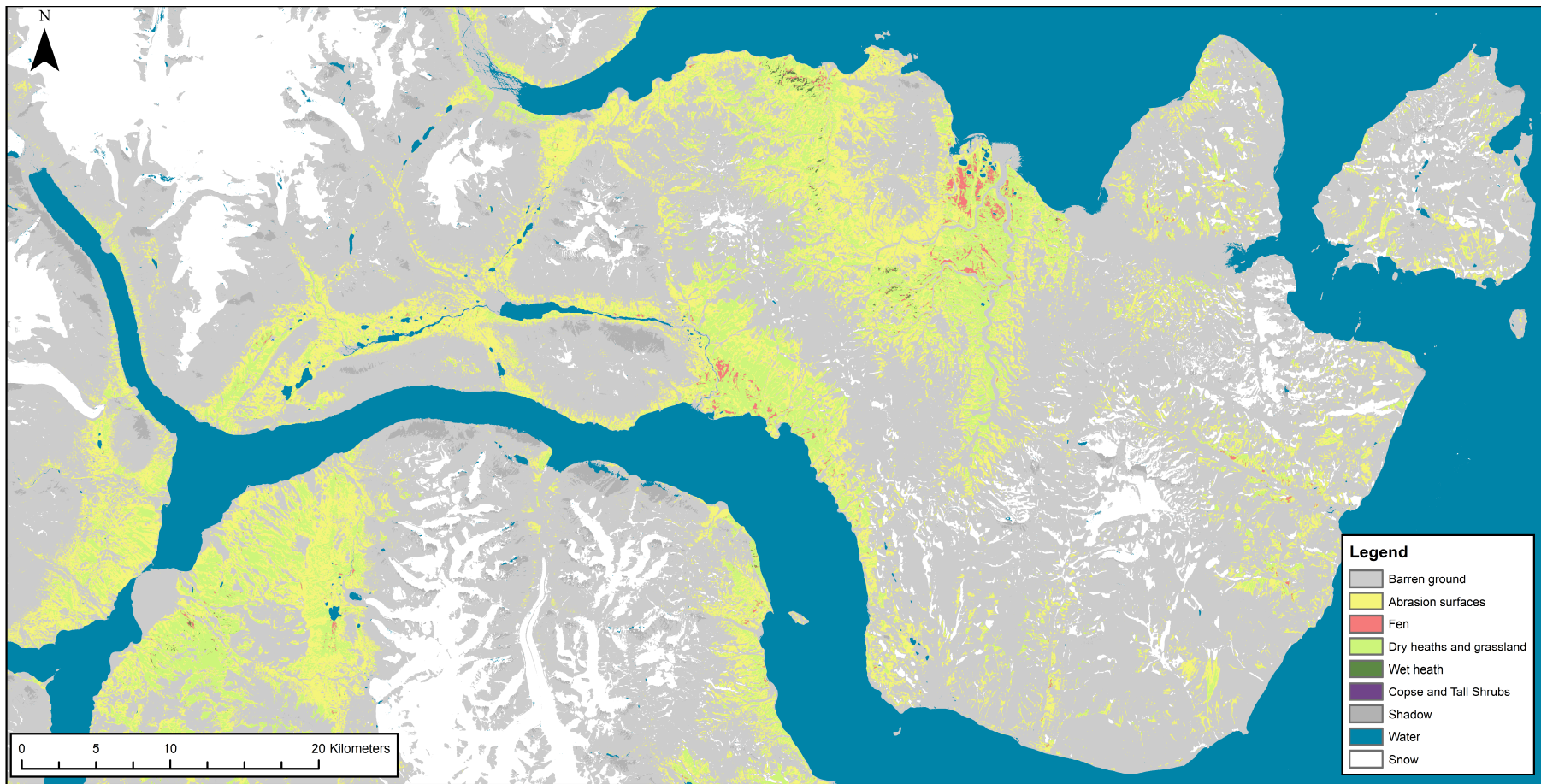


Figure S7: Final classification of the “Zackenberg” area.

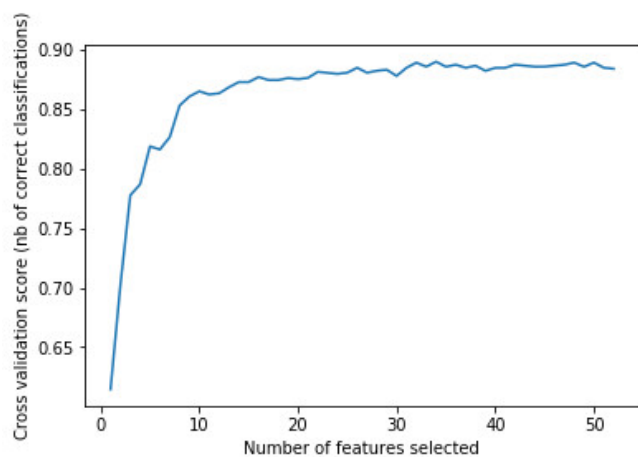


Figure S8: Output of the RFECV analysis without red-edge features.

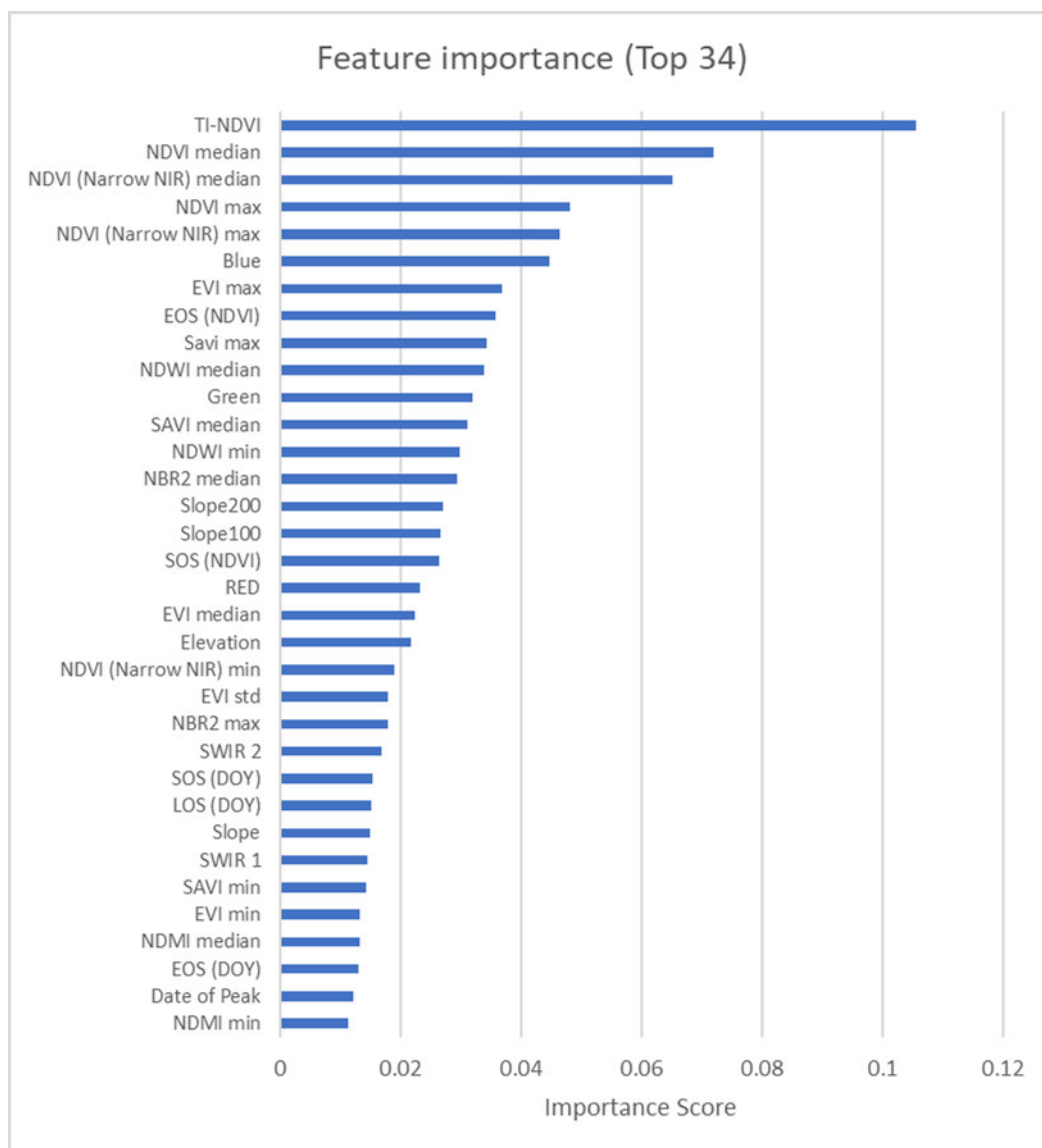


Figure S9: Results of the optimal combination of features (without red-edge).

Table S3: The confusion matrix of the optimal combination of features (without red-edge features) based on a 10-fold cross-validation.

		Reference						Total	Prod. acc. after proportion adjustment (%)	User's acc. after proportion adjustment (%)
		Barren ground	Abrasion surfaces	Fen	Dry heaths and grassland	Wet heath	Copse and Tall Shrubs			
Predicted	Barren ground	249	7	0	0	0	0	256	96.9	97.3
	Abrasion surfaces	17	126	0	14	2	0	159	85.1	79.2
	Fen	1	1	180	8	14	0	204	70.4	88.2
	Dry heaths and grassland	0	7	6	213	16	2	244	91.0	87.3
	Wet heath	0	1	17	10	161	6	195	77.6	82.6
	Copse and Tall Shrubs	0	0	0	1	6	99	106	53.4	93.4
	Total	267	142	203	246	199	107	1164		
Area-weighted OA									91.0	