HRL 2018 look & feel verification report for Dominant Leaf Type (2018) Norway

I.   Administrative part

HRL	Dominant Leaf Type 2018
Verified area, region	Norway
Institution carrying out the work	NIBIO Survey and statistics
Overall visual checking done by (name, position and e-mail)	Hanne-Gro Wallin, Senior Engineer, Head of Dept. hgw@nibio.no
Look & feel verification done by (name, position and e-mail)	Hanne-Gro Wallin, Senior Engineer, Head of Dept. hgw@nibio.no Geir-H Strand, Director R&D, ghs@nibio.no
In situ data used..	National ortophoto database Norge-i-bilder Ref: http://www.norgeibilder.no
	National spatial data infrastructure Ref: http://kilden.nibio.no
	AR18X18, a Norwegian area frame survey of land cover resembling LUCAS
	Ortophoto, topographic and thematic maps available as wms services were integrated with the HRL data using qGIS
Reporting done by (name, position and e-mail)	Hanne-Gro Wallin, Senior Engineer, Head of Dept. hgw@nibio.no Geir-H Strand, Director R&D, ghs@nibio.no
Date and place of writing the report	Ås 10.04.2021

II.   General overview of the verified data
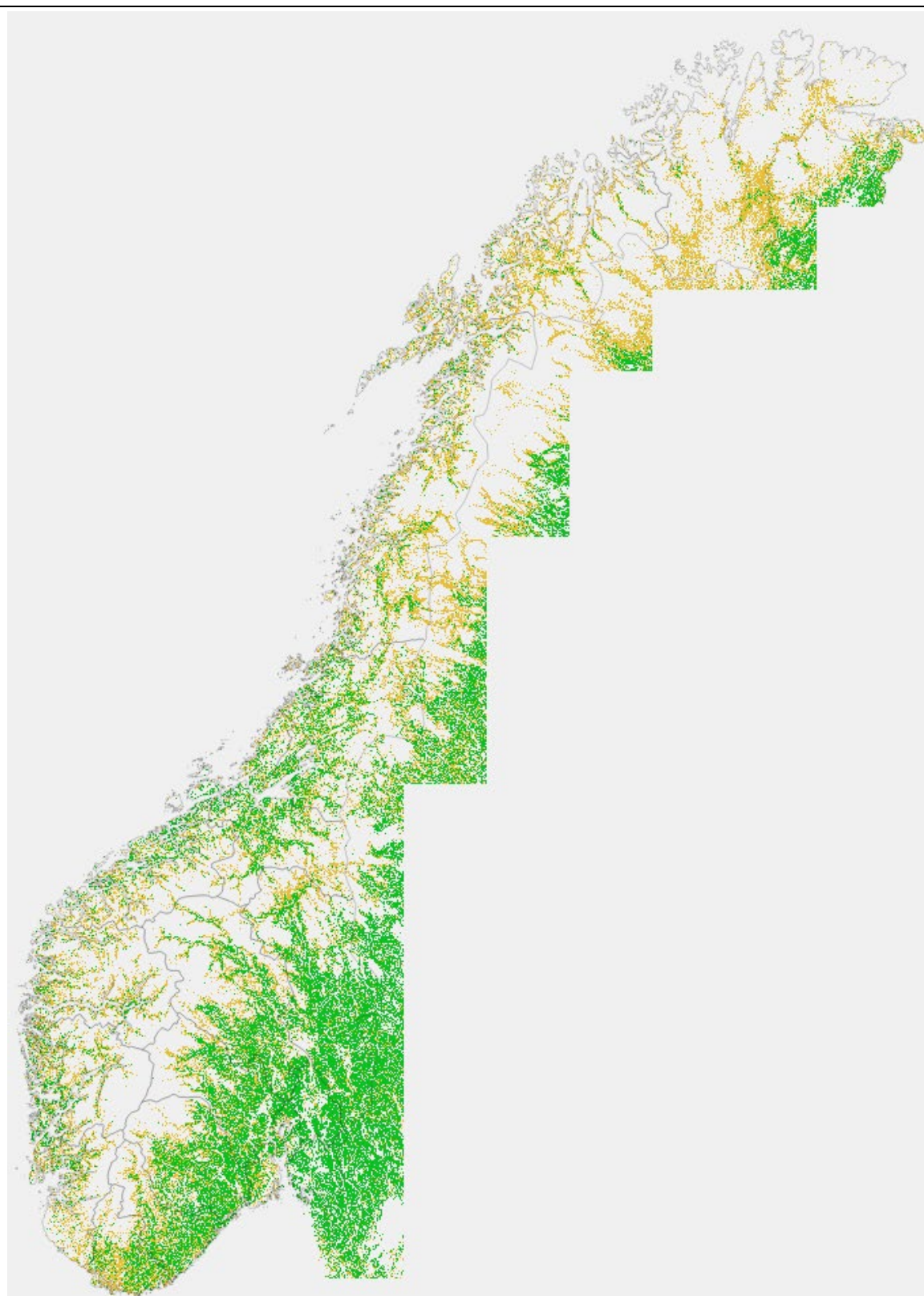
Dominant leaf type (DLT2018). The tiles extend into Sweden and Finland but only the part covering Norway has been subject to verification

DLT2018 Norway. The delivery is organized as tiles partly extending into Sweden and Finland. The verification is limited to areas inside Norway.

Statistical overview

Class	Value	Haa	%	% of TCS
Non tree cover	*0*	*20 393 900*	*63,0%*	
Broadleaf	*1*	*6 382 700*	*19,7%*	*53,2 %*
Conifer	*2*	*5 604 300*	*17,3%*	*46,8 %*
Total		**32 380 900**	**100,0%**	
Tree covered surface		*11 987 000*	*37,0%*	

The National Forest Inventory (NFI) reported the statistics shown below for 2018

Class	Haa	%
Broadleaf forest	*5 006 879*	*41,0%*
Conifer forest	*6 960 783*	*57.0%*
Undetermined	*244 238*	*2,0%*
Total	**12 211 900**	**100,0%**

III.   Overall visual checking

Positional accuracy			
Relative positional accuracy	Quick visual comparison of HRL data with available EO imagery (identifying large positional errors)	*OK / correct,*	*The positional accuracy was checked by comparing the HRL and orthophoto for large roads and industrial areas with crisp outlines. Checks were carried out at several latitudes and the positional accuracy is **OK** (also in the far northern part of the country)*
Thematic accuracy			
Classification correctness	Simple look & feel thematic check (identifying basic thematic mistakes)	*OK / correct,* *NOK / not correct*	**OK** *for all major classes.*

IV. Look & feel verification results

1.Possible MISCLASSIFICATION

| Stratum	Name of the stratum	Number of samples verified	Results of the verification by strata (using qualitative evaluation as: Excellent, good, acceptable, insufficient, very poor).
1	Conifer	15	*Excellent*
2	Broadleaf	15	*Good*
3	Clear cutting	12	*Excellent* *No trees on recent clear-cuttings (0 to 3 years), Broadleaf (birch) dominate after 2-3 years until 10-15 years of regrowth. After 10-15 years spruce start to subdue the birch. The succession may be slower, depending on soil and climate.*
4	Conifer patches	10	*Excellent* *Planted spruce patches in forest otherwise dominated by birch*
5	Broadleaf patches	0	*Could not find any good examples, except clear cuttings inside conifer forests. Broadleaf (birch) usually dominate for 10-15 years before the planted spruce breaks through to subdue the birch. This succession seems to ne represented correctly*
Overall evaluation (based on look-and-feel)			*Excellent* *Major forest areas are present and correctly divided into broadleaf and conifer forest*
Comments			

2. Excluded elements, possible COMMISSIONS

Stratum	Name of the stratum	Number of samples verified	Results of the verification by strata (using qualitative evaluation as: Excellent, good, acceptable, insufficient, very poor).
6	Willow	14	Good
7	Alder	12	*Acceptable*
8	Broadleaf on wetland	20	*Acceptable*
9	Broadleaf on riverbank an lakeshore	15	*Good*
10	Fruit trees	14	*Insufficient*
11	Mountain shadow	8	*Insufficient*
12	Shadow of trees	8	*Excellent*
Overall evaluation (based on look-and-feel)			*Acceptable*
Comments			*Willow is (almost always) a bush in Norway. Large fens and mountain meadows can be covered by willow.*

V.   Documentation of errors and critical findings

Please include detailed descriptions, meaningful examples and screenshots of errors, critical findings. Please make sure the nature, location and frequency of the issue is described in some detail. Screenshots should contain ETRS1989 LAEA coordinates.

 Shadow of trees (probably also present in satellite image) correctly mapped as class 0 [4374330, 4181510]
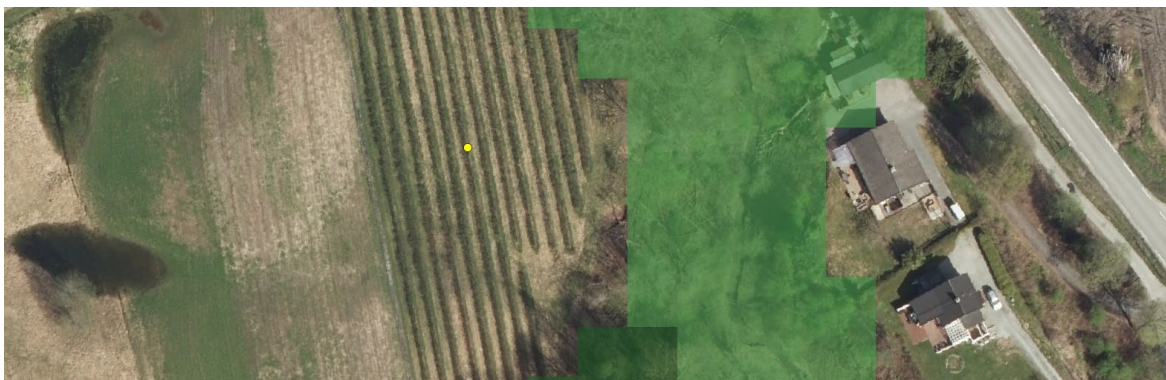
Fruit trees mapped as class 0 [4333600, 4078265]

Recent clear cutting, not yet any regrowth. Mapped a class 0 [4421825, 4219130]

Old clear cutting (approximately 1995). The patch is planted with spruce, now 5-6 meters tall, but has been dominated by birch during this first part of the forest regrowth. A new clear cutting (class 0) is seen to the right. The HRL is considered as correct for the entire image. [4420250, 4224300]

A small river with alder forest along both riverbanks [4332190, 4116920]

The upper right third of the island is a tall forbs meadow covered with willow shrub (should be class 0). The lower left two thirds of the island is a birch forest, correctly classified as class 1. [4849050, 5192900]

VI. **Statistical verification** (optional)

Description of methodology and software	*Samples were obtained by stratified random sampling.* *Each sample point was examined on topographic maps and recent orthophoto using qGIS.* *Accuracy was calculated following standard methodology using SPSS*
Stratification	*0: No tree cover* *1: Broadleaf* *2: Conifer*
Comments	*The interpretation of ground truth was conservative. The HRL was accepted as correct when the analyst was in doubt. Misclassification was only recorded when the analyst was confident that an error was present.*

Please copy here the (weighted) confusion matrix and main accuracy parameters and provide the corresponding Excel file in attachment.

DLT2018 Verification strata sizes

			Haa	%
HRL		0	20 393 900	62,98
		1	6 382 700	19,71
		2	5 604 300	17,31
	Total		32 380 900	100,00

DLT2018 Verification raw data confusion matrix

			Ground truth			
			0	**1**	**2**	**Total**
HRL		0	6 879	182	80	7 141
		1	139	1 602	193	1 934
		2	35	87	1 558	1 680
	Total		7 053	1 871	1 831	10 755

DLT2018 Verification weighted confusion matrix

		Ground truth			
		0	**1**	**2**	**Total**
HRL	0	0,606705	0,016052	0,007056	**0,629813**
	1	0,014167	0,163276	0,019671	**0,197114**
	2	0,003606	0,008963	0,160506	**0,173075**
	Total	**0,624478**	**0,188291**	**0,187233**	**1,000002**

DLT2018 Verification Overall accuracy

	Accuracy	**95% CI**	**Lower**	**Upper**
	93,1 %	0,5 %	92,6 %	93,5 %

DLT2018 Verification User's accuracy

		Accuracy	**95% CI**	**Lower**	**Upper**
HRL	0	96,3 %	0,4 %	95,9 %	96,8 %
	1	82,8 %	1,7 %	81,2 %	84,5 %
	2	92,7 %	1,2 %	91,5 %	94,0 %

DLT2018 Verification Producer's accuracy

		Accuracy	**95% CI**	**Lower**	**Upper**
HRL	0	97,2 %	0,4 %	96,8 %	97,6 %
	1	86,7 %	1,4 %	85,3 %	88,1 %
	2	85,7 %	1,2 %	84,5 %	87,0 %