





HRL 2018 look & feel verification report for Tree Cover density (2018) Norway

I. Administrative part

HRL	Tree Cover Density 2018
Verified area, region	Norway
Institution carrying out the work	NIBIO Survey and statistics
Overall visual checking done by	Karsten Dax, Senior Engineer
(name, position and e-mail)	Karsten.Dax@nibio.no
Look & feel verification done by	Karsten Dax, Senior Engineer
(name, position and e-mail)	Karsten.Dax@nibio.no
In situ data used	National ortophoto database Norge-i-bilder
	Ref: http://www.norgeibilder.no
	National spatial data infrastructure
	Ref: <u>http://kilden.nibio.no</u>
	AR18X18, a Norwegian area frame survey of land cover re-
	sembling LUCAS
	Ortophoto, topographic and thematic maps available as
	wms services were integrated with the HRL data using qGIS
Reporting done by	Karsten Dax, Senior Engineer, Karsten.Dax@nibio.no
(name, position and e-mail)	Geir-H Strand, Director R&D, ghs@nibio.no
Date and place of writing the report	Ås 26.03.2021









II. General overview of the verified data









Statistical overview			
Class	Value	Наа	%
Non tree cover	0	20 393 900	63,0%
Tree cover density 1-29 %	1	550 000	1,7%
Tree cover density 30-100 %	2	11 437 000	35,3%
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. The classification does not follow the density classification used in the HRL. The total area with TCD > 0 shown by the HRL is 11 987 000 haa. This slightly less than the total area characterized as "forest" by the NFI (12 211 900 haa). The difference amounts to 1,8 % of the forest area estimated by the NFI.

Class	Наа	%
Productive forest	8 667 700	71,0 %
Non-productive forest	3 544 200	29,0 %
Total	12 211 900	100,0 %

III. Overall visual checking

Positional accurac	у		
Relative positional accuracy	Quick visual compari- son of HRL data with available EO imagery (identifying large posi- tional 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 accu- racy is OK (also in the far northern part of the country)
Thematic accurac	у		
Classification cor- rectness	Simple look & feel the- matic check (identifying basic thematic mis- takes)	OK / correct, NOK / not correct	Mostly good, but there are omis- sion errors in open forest, espe- cially in mountain areas and other places with lichen or other sparse vegetation on the ground level. The northernmost county (Finn- mark) seems most error-prone. Most classification errors are found in low density forest (0 < TCD < 30). Omission and commission er- rors in this stratum seems to coun- teract. Notice, however, that the stratum is small (only 1, 7 % of the total area) and the impact on the total result is marginal.





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IV. Look & feel verification results

1.Included elements, possible OMISSIONS

Stratum	Name of the stratum	Number of samples verified	Results of the verification by strata (using qualita- tive evaluation as: Excellent, good, acceptable, in- sufficient, very poor).
1	Lowland for- ests, broad- leaved	10	Excellent
2	Lowland for- ests, conifer- ous	12	Excellent
3	Mountain for- ests (incl. for- ests on sun-lit side and in shadow), broadleaved	17	Good Omissions in open forest, increasing with lichen bottom
4	Mountain for- ests (incl. for- ests on sun-lit side and in shadow), conif- erous	15	Excellent
5	Forests under development	0	Stratum not understood
6	Transitional woodland, for- ests in regen- eration	16	Good New clearcuttings omitted, Older clearcuttings included
7	Orchards, olive groves, fruit and other tree plantations	11	Poor Most orchards are omitted
8	Forest compo- nent of agrofor- estry areas	0	Not present in Norway
9	Groups of trees within urban ar- eas (alleys, wooded parks, cemeteries and gardens)	12	Good Occasionally imprecise (only part of the area with trees included)
10	Trees in sport and recreation areas	12	Acceptable Commission error where soccer fields are mapped as trees (low coverage). Omissions when tree cover is low or understory is lichen
11	Forest along rivers & lakes	10	Excellent
12	Coastal forests	15	Excellent







13	Scattered small forest patches (if ≥ 0.5 ha) on grasslands or agricultural ar- eas	10	Excellent
14	Forest man- agement/use features inside forests (forest roads, fire- breaks, thin- nings, forest nurseries, etc.)	5	Good
15	Forest damage features inside forests (par- tially burnt ar- eas, storm damages, in- sect-infested damages, etc.)	6	Insufficient
Overall ev feel)	aluation (based or	look-and-	(excellent, good, acceptable, insufficient, very poor) Good The large lowland forest areas are present. Omissions are mainly found in open (low density) forest with sparse (often lichen) understory,
Comments	5		The main part of Norwegian forests are found in stra- tum 1 and 2. Strata with lower accuracy are not com- mon

2. Excluded elements, possible COMMISSIONS

Stratum	Name of the stratum	Number of samples verified	Results of the verification by strata (using qualita- tive evaluation as: Excellent, good, acceptable, in- sufficient, very poor).
16	Open areas within forests (roads, perma- nently open vegetated ar- eas, clear cuts, fully burnt ar- eas, other se- vere forest damage areas, etc	10	Good
17	Dwarf shrub- covered areas, such as moors and heathland	13	Acceptable







18	Dwarf pine / green alder in alpine areas	0	Not present in Norway (alder is only found in lowlands)
19	Vineyards	0	Not present in Norway
20	Mediterranean shrublands	0	Not present in Norway
21	Shrublands	10	Good
22	22 Wetland 15		Good
Overall ev feel)	aluation (based or	look-and-	Good
Comments	5		The main commissions are open areas inside forests and shrub (often willow) in wetlands mapped as forest. Open moor and heather with shrubs are also some times mapped as TCD > 0. A particular error (not seen in the Look and Feel exer- cise, but found during the statistical verification) is the occasional mapping of soccer fields with artificial sur- face as TCD > 0

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.









Northern Norway (Finnmark), inland: Dense forest (green) and no forest (lake, red) classified correctly, while the clearings are not classified as no forest. [4913811,5221959]



A soccer field (center) wrongly mapped as tree-cover (The lower patch is a recreational area correctly mapped with tree cover [4300188, 4005926]











Middle-Norway (Trøndelag), inland. The northern strip of forest is correctly classified as forest (green), and the southern strip has indeed no tree cover (red), while the green band inbetween should be no tree cover in the south and slight tree cover in the north. [UTM33: 4273658, 4433900]











Recent clear cutting correctly mapped as no tree cover [4421135, 4222700]



Burnt area (2006). A fen in the center is correctly left as TCD = 0, but the surrounding, burn area has scattered trees and should be mapped with a low TCD > 0. [4399900, 4169470]







VI. Statistical verification (optional)

Description of methodology and software	The HRL was classified into three classes
	Samples were obtained by stratified random sam-
	pling using the reclassified HRL as strata. The
	sampling sizes is found in the table below.
	Each sample point was examined on topographic
	maps and recent orthophoto using qGIS.
	Accuracy was calculated following standard meth-
	odology using SPSS
Stratification	The HRL was classified into three classes
	0: No tree cover
	1: Tree cover density 1-29 %
	2: Tree cover density 30-100 %
Comments	The interpretation of ground truth was conserva-
	tive. 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.

		Haa	%			
	0	20 393 900	62,98			
црі	1	550 000	1,70			
TKL	2	11 437 000	35,32			
	Total	32 380 900	100,00			
TCD2018 V	/erification raw	data confusio	n matrix			
			Ground	truth		
		0	1	2	Total	
	0	184	13	3	200	
UDI	1	51	130	19	200	
HKL	2	11	22	167	200	
	Total	246	165	189	600	
	-					







CD2018 V	erification weig	hted confusion	matrix		
			Ground t	ruth	
		0	1	2	Tota
	0	0,579427	0,040938	0,009447	0,629812
HDI	1	0,004331	0,011040	0,001614	0,016985
TINE	2	0,019426	0,038852	0,294924	0,353202
	Total	0,603184	0,090830	0,305985	0,999999
CD2018 V	erification Over	all accuracy			
		Accuracy	95% CI	Lower	Upper
		88,5 %	3,0 %	85,6 %	91,5 %
CD2018 V	erification User	's accuracy			
		Accuracy	95% CI	Lower	Upper
	0	92,0 %	83,8 %	8,2 %	175,8 %
HRL	1	65,0 %	6,6 %	58,4 %	71,6 %
	2	83,5 %	5,1 %	78,4 %	88,6 %
CD2018 V	erification Prod	ucer's accuracy	/		
CD2018 V	erification Prod	ucer's accuracy Accuracy	95% CI	Lower	Upper
CD2018 V	erification Prod	ucer's accuracy Accuracy 96,1 %	95% CI 1,8 %	Lower 94,3 %	Upper 97,9 %
CD2018 V	erification Prod 0 1	ucer's accuracy Accuracy 96,1 % 12,2 %	95% Cl 1,8 % 3,7 %	Lower 94,3 % 8,4 %	Upper 97,9 % 15,9 %