

## HRL verification report template for Water and Wetness

### I. Administrative part

HRL	<i>Water and Wetness</i>
Country (and region, if regions are verified separately)	Finland
Institution carrying out the work	Finnish Environment Institute (SYKE)
General overview of data quality done by (name, position and e-mail)	Minna Kallio Coordinator <a href="mailto:minna.kallio@ymparisto.fi">minna.kallio@ymparisto.fi</a>
Look-and-feel analysis done by (name, position and e-mail)	Minna Kallio Coordinator <a href="mailto:minna.kallio@ymparisto.fi">minna.kallio@ymparisto.fi</a>
Statistical verification done by (name, position and e-mail)	Markus Törmä Research Engineer <a href="mailto:markus.torma@ymparisto.fi">markus.torma@ymparisto.fi</a>  Minna Kallio Coordinator <a href="mailto:minna.kallio@ymparisto.fi">minna.kallio@ymparisto.fi</a>
In situ data used	<i>Colour/black and white orthophotos Resolution: 0.25-0.5m: Reference years: 2012-2015 (partial coverage)</i>
	<i>The Shoreline10 based on the topographic database of the National Land Survey, scale of 1:5 000-1:10 000</i>
	<i>The Lake and River Depth Profiles including bathymetric lines 2013</i>
	<i>IMAGE 2017 Sentinel-2 satellite image mosaics for spring and summer 2017</i>
	<i>The National HR Corine land cover 2012 raster, 20 m x 20 m</i>
	<i>The peatlands of the topographic database of the National Land Survey, scale of 1:5 000-1:10 000 from year 2014</i>
Internal quality control done by (name, position and e-mail)	Pekka Härmä Senior Researcher <a href="mailto:pekka.harma@ymparisto.fi">pekka.harma@ymparisto.fi</a>  Markus Törmä Research Engineer <a href="mailto:markus.torma@ymparisto.fi">markus.torma@ymparisto.fi</a>  Iida Autio Coordinator <a href="mailto:iida.autio@ymparisto.fi">iida.autio@ymparisto.fi</a>
Date and place of writing the report	15.2.2018 Helsinki

## Summary

The General overview was performed by overlaying national high resolution (HR) Corine Land Cover 2012 (HR CLC12) with HRL WAW. HR CLC12 is a combination of the most relevant datasets describing the Finnish land cover. The area of WAW permanent water covers 96,5 % on HR CLC12 water bodies.

There are no remarkable shifts in the data according to visual inspection. Based on statistical verification omission error is 23 % and commission error 0%. Especially lake inlets and small water areas seem to be mapped smaller in size compared to the in situ-data.

According to the look and feel evaluation the WAW data is insufficient, because the temporary water and permanently and temporary wet classes contain serious problems. The area of Finland is mostly covered by forests and semi-natural areas, and misclassifications in these areas cover large areas. In the Northern Finland many fell tops and slopes are misinterpreted as permanently and temporary wet.

## II. General overview of data quality

The total area of the HRL Permanent water is 29 965 km<sup>2</sup>. The official statistics tell that inland waters covers 34 533 km<sup>2</sup> in Finland. There are about 188 000 lakes over 500 m<sup>2</sup> in Finland. About 10 % of Finnish territory is covered by lakes. According to the national high resolution (HR) Corine Land Cover 2012 permanent water bodies and water courses cover 33 098 km<sup>2</sup>

The differences in the banks of water bodies can be noticed in the visual comparison of datasets and in the statistical verification. Small-scale landscape features are missing in the HRL. They are typical for Finnish landscape, and should be better captured in a HRL product.

The content of the HRL was analysed by calculating distribution of land cover classes within each class in WAW as mapped in the HR CLC12 dataset. The distribution shows critical strata and potential errors in WAW, which were further evaluated in the look and feel verification.

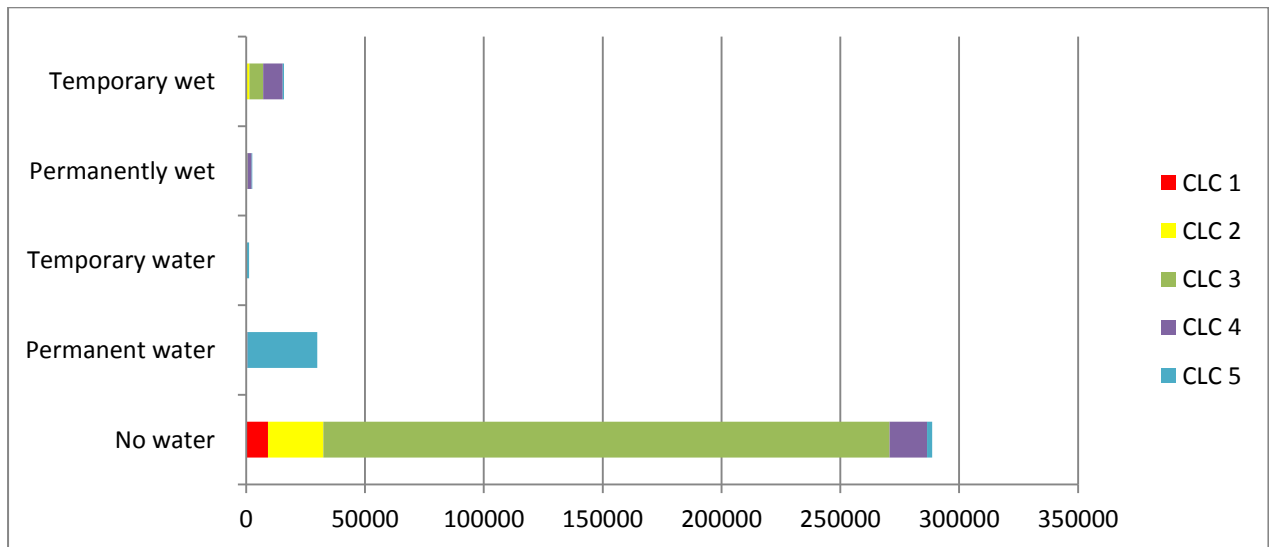


Figure 1. The overall distribution of HR CLC12 Level 1 classes in WAW classes as km<sup>2</sup>. 1=Artificial surfaces, 2=Agricultural areas, 3=Forests and semi-natural areas, 4=Wetlands, 5=Water bodies

Table 1. The distribution (percentage of area of HRL classes) of national HR CLC 2012 in Water and Wetness (WAW) classes.

National HR CLC 2012 classes	WAW classes			
	Permanent water	Temporary water	Permanently wet	Temporary wet
Continuous urban fabric	0,0 %	0,0 %	0,0 %	0,0 %
Discontinuous urban fabric	0,0 %	0,0 %	0,1 %	0,2 %
Commercial units	0,0 %	0,0 %	0,0 %	0,1 %
Industrial units	0,0 %	0,0 %	0,2 %	0,1 %
Road and rail networks and associated land	0,0 %	0,0 %	0,0 %	0,1 %
Port areas	0,0 %	0,0 %	0,0 %	0,0 %
Airports	0,0 %	0,0 %	0,0 %	0,0 %
Mineral extraction sites	0,0 %	0,1 %	0,0 %	0,0 %
Open cast mines	0,0 %	0,1 %	0,0 %	0,0 %
Dump sites	0,0 %	0,5 %	0,0 %	0,0 %
Construction sites	0,0 %	0,0 %	0,0 %	0,0 %
Summer cottages	0,0 %	0,1 %	0,8 %	0,2 %
Sport and leisure areas	0,0 %	0,0 %	0,0 %	0,0 %
Golf courses	0,0 %	0,0 %	0,0 %	0,0 %
Racecourses	0,0 %	0,0 %	0,0 %	0,0 %
<b>Non-irrigated arable land</b>	0,0 %	0,1 %	<b>0,9 %</b>	<b>7,6 %</b>
Fruit trees and berry plantations	0,0 %	0,0 %	0,0 %	0,0 %
Pastures	0,0 %	0,0 %	0,0 %	0,0 %
Natural pastures	0,0 %	0,0 %	0,0 %	0,1 %

<b>Arable land outside farming subsidies</b>	0,0 %	0,1 %	<b>0,3 %</b>	<b>0,3 %</b>
Agro-forestry areas	0,0 %	0,0 %	0,0 %	0,0 %
Broad-leaved forest on mineral soil	0,0 %	0,0 %	0,1 %	<b>4,5 %</b>
Broad-leaved forest on peatland	0,0 %	0,0 %	0,0 %	0,1 %
<b>Coniferous forest on mineral soil</b>	<b>0,3 %</b>	<b>2,3 %</b>	<b>6,3 %</b>	<b>5,4 %</b>
Coniferous forest on peatland	0,0 %	0,3 %	1,1 %	2,2 %
Coniferous forest on rocky soil	0,0 %	0,2 %	0,4 %	<b>0,1 %</b>
Mixed forest on mineral soil	0,0 %	0,3 %	0,8 %	<b>1,8 %</b>
Mixed forest on peatland	0,0 %	0,1 %	0,3 %	0,6 %
Mixed forest on rocky soil	0,0 %	0,0 %	0,0 %	0,0 %
Natural grassland	0,0 %	0,0 %	0,0 %	0,0 %
<b>Moors and heathland</b>	<b>0,0 %</b>	<b>0,5 %</b>	<b>1,1 %</b>	<b>5,6 %</b>
<b>Transitional woodland/shrub cc &lt;10%</b>	0,0 %	<b>0,4 %</b>	<b>1,9 %</b>	<b>2,8 %</b>
<b>Transitional woodland/shrub, cc 10-30%, on mineral soil</b>	0,0 %	<b>0,1 %</b>	<b>4,0 %</b>	<b>7,8 %</b>
Transitional woodland/shrub, cc 10-30%, on peatland	0,0 %	0,1 %	1,8 %	3,7 %
<b>Transitional woodland/shrub, cc 10-30%, on rocky soil</b>	0,0 %	0,0 %	0,0 %	<b>0,1 %</b>
Transitional woodland/shrub under power lines	0,0 %	0,0 %	0,0 %	0,0 %
Beaches, dunes, and sand plains	0,0 %	0,0 %	0,0 %	0,0 %
<b>Bare rock</b>	0,0 %	0,2 %	<b>0,7 %</b>	<b>0,9 %</b>
<b>Sparsely vegetated areas</b>	0,0 %	0,1 %	<b>0,3 %</b>	<b>0,1 %</b>
Inland marshes, terrestrial	0,0 %	0,7 %	0,8 %	0,5 %
Inland marshes, aquatic	0,9 %	10,0 %	3,2 %	1,5 %
Peatbogs	0,1 %	2,8 %	38,3 %	47,8 %
Peat production sites	0,0 %	0,1 %	23,7 %	1,6 %
Salt marshes, terrestrial	0,0 %	0,0 %	0,0 %	0,1 %
Salt marshes, terrestrial	0,0 %	0,2 %	0,4 %	0,4 %
Water courses	1,8 %	4,2 %	0,6 %	0,6 %
<b>Water bodies</b>	<b>96,5 %</b>	<b>76,2 %</b>	10,3 %	2,4 %
Sea and ocean	0,1 %	0,3 %	1,2 %	0,6 %
<b>TOTAL</b>	<b>100,0 %</b>	<b>100,0 %</b>	<b>100,0 %</b>	<b>100,0 %</b>

#### Remarks:

-WAW water and wet classes do not contain significantly CLC artificial surfaces, except summer cottages. The summer cottages in Finland lie usually very near to the coastline.

-Arable land contains permanent and temporary wet areas, but most of the arable areas are on dry land. Some low-lying croplands and pastures can be wet especially in the spring and thus may correctly belong to WAW.

-Large areas, totally 932 km<sup>2</sup> of CLC class 'Moors and heathland' are found in the WAW permanent and temporary wet areas, although this class exists only in the fell areas in

Northern Finland. Also parts of bare rocks on the fell tops are classified as HRL wet areas, totally 157 km<sup>2</sup>.

- WAW permanent and temporary wet areas occur frequently in transitional woodlands on mineral soils, which are mostly clear-cuts and young forests in Finland.

- Over 5% of both permanent and temporary wet areas lie in coniferous forest on mineral soils. This is also the case with broad-leaved forests on mineral soils. The total area of forests on mineral soils classified in the WAW permanent and temporary wet areas is over 4000 km<sup>2</sup>.

-Water bodies are well covered by WAW permanent water class (96,5%).

-Water bodies include also most of the WAW Temporary water areas (76 %), which should not be the case according to the guidelines.

Table 2. The distribution subclasses in Wetlands and Water bodies according to the national HR CLC 2012 within WAW No water areas (percentage of the total area).

Wetlands and water bodies in HR CLC 2012	WAW No water areas
Inland marshes, terrestrial	0,04 %
Inland marshes, aquatic	0,08 %
Peatbogs	5,22 %
Peat production sites	0,07 %
Salt marshes, terrestrial	0,03 %
Salt marshes, aquatic	0,03 %
Water courses	0,12 %
Water bodies	0,56 %
Sea and ocean	0,08 %
<b>TOTAL</b>	<b>6,25 %</b>

#### Remarks

-According to the product specifications CLC marshes should be classified as HRL water or wet areas. However 15 835 km<sup>2</sup>, over 6% of WAW no water areas are located in CLC wetlands and water bodies.

- Significant areas of WAW no water areas are located in CLC peatbogs. This is possible, since water level can be so low on some peat bogs, that no wetness can be detected on the surface. However, significant amounts of wet peat bogs are not detected and are thus located in HRL No water class.

### III. Look-and-feel

### Delineation of the production area of WAW

The coastline used in the delineation of WAW production area is based on a hybrid version of the EBM v11 and the GISCO boundaries. Since these data are not publicly available, the quality and characteristics of the data are difficult to evaluate. When comparing the production area of WAW with HR CLC2012 altogether 566 km<sup>2</sup> HR CLC 2012 land and inland water bodies are excluded.

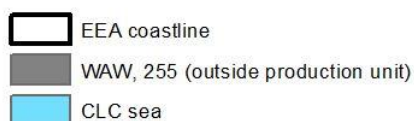
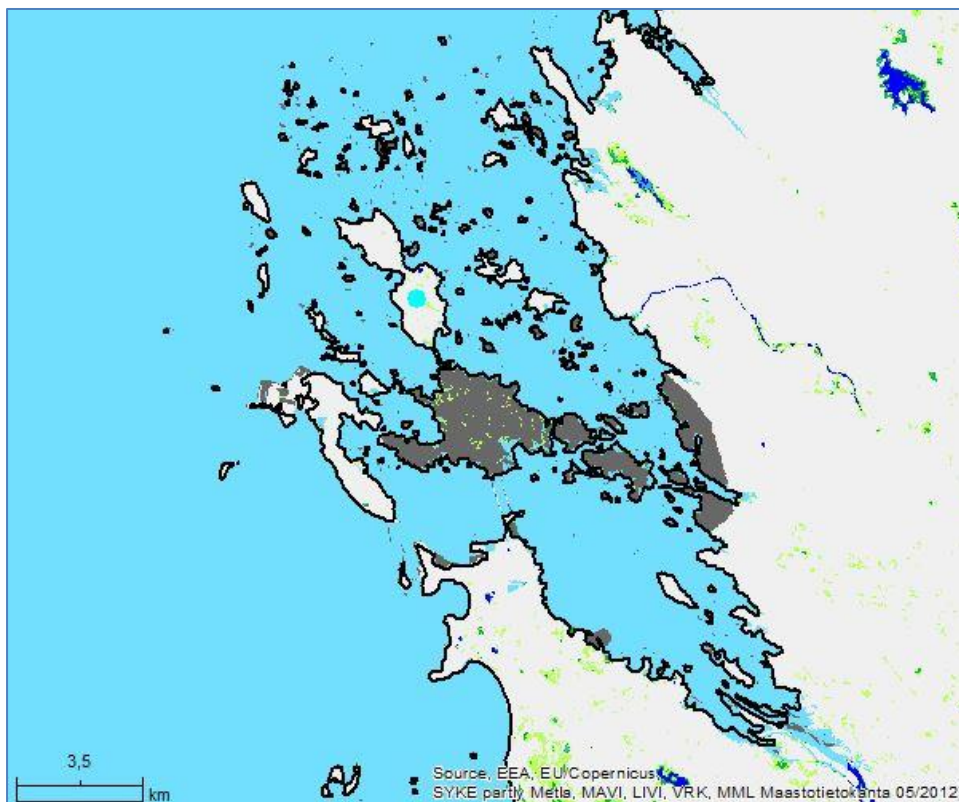


Figure 2. The WAW product does not include all islands and also some land areas close to the coastline are left outside the WAW product (value 255). Coordinates of the point: X=206740,1 ; Y=6848864

Table 3. The results of the look-and feel verification.

Stratum	Name of the stratum	Number of samples verified	Results of the verification by strata (excellent, good, acceptable, insufficient, very poor): see chapter 6.3 of the guidelines
<b>Strata to reveal commission errors</b>			
1	Water bodies	(*)10 (**)	Good, the statistical verification did not find any commission error. With National HR CLC 2012 some errors can be found
2	Temporary water	10 (**)	Insufficient, because of areas classified as temporary water can be found in water bodies with over 3m depths.
3	Forests and transitional woodlands	20 (**)	Insufficient, because there are clear-cuts on slopes and forests classified as wet areas.
4	Fell areas	10 (**)	Poor, fell tops and slopes on mineral soil are classified as wet areas although the Topographic Wetness Index (TWI) has been used according to the Technical specifications.
<b>Strata to reveal omission errors</b>			
5	Water bodies	(*)	Acceptable, although the areas of permanent water are smaller in WAW than in the in situ data.
6	Peatbogs	10 (**)	Insufficient, there are peatbogs classified as dry areas. In the guidelines they belong to the Permanently wet areas.
7	Marshes	10 (**)	Acceptable, although there are marshes classified as dry areas.
Overall evaluation			Permanent waters in HRL WAW are acceptable. The other classes are insufficient.
Comments			Usage of DEM in the production of WAW would have increased the quality

(\*) See statistical verification

(\*\*) See examples visualized in chapter V Documentation of errors and critical findings

In addition, we re-classified the national HR CLC 2012 data on 4<sup>th</sup> Level into 5 binary thematic layers according to the look-up-table (see Annex 1). The information content of each new layer corresponds as well as possible to the content of 5 WAW classes i.e. Permanent water, Temporary water, Permanently wet areas, Temporary wet areas, No water/no wet area. Next, a confusion matrix was computed by cross-tabulating these data. Although there are many incompatibilities/thematic mismatch/etc. between these data sets, indicative thematic accuracies could be computed (see table 5.).

Table 5. Indicative overall accuracies WAW classes based on national HR CLC 2012.

WAW Class	Indicative overall accuracy of each WAW class, %
No water	99
Permanent water	99
Temporary water	14
Permanently wet	71

The indicative accuracies of No Water and Permanent water classes exceed the target accuracy 85%. The most problematic WAW class is Temporary water with indicative accuracy of only 14 %. The total area of this class is 1224 km<sup>2</sup> and most of it falls into CLC water bodies, which is not allowed according to the product specifications. Variation of water levels of water bodies can explain part of this mismatch, but this was impossible to verify with ancillary data available in this task.

The Permanently and Temporary wet areas can be compared to HR CLC classes according to the soil and wetness information, which are mainly based on the Topographic database. Since the definition of the WAW classes are based occurrence of water and wet surfaces, it is not always easy to verify the output. There are still clear misinterpretations of these WAW classes, and the 80% target accuracy is not reached.

#### IV. Statistical verification

The statistical verification was applied only to permanent water class / No water area.

Stratification	<i>The stratification was performed according to the guidelines. Samples for determining omission errors were concentrated in areas of potential errors. We selected the samples from areas where the National HR Corine 2012 raster data was permanent water bodies and WAW class was No water area. The water classes of Corine data were buffered with one pixel (<math>\pm 20</math> m). The coastal waters (sea) were accepted to 200 m from the coastline. The areas of temporary water and wet classes of HRL were removed.</i>
Comment on stratification	<i>The sample points of omission error are not always fulfilling the demands of the guidelines. The patches should have size of minimum 3x3 pixels around the sample (Figure 7 b, p.33), but this would have led to abandonment of over 50% of the samples. Therefore the class covering the majority of the pixel area was used to define the verification value when possible.</i>
Number of random samples for finding omission errors	<i>Total number of selected samples 280</i>
Number of valid (applicable) samples for finding omission errors	<i>Total number of valid (applicable) samples 261</i>
Omission error (%) <sup>1</sup> with uncertainty	<i>22,61% <math>\pm</math> 5,07%</i>
Comment on omissions	<i>The extent of lake inlets and small water bodies is</i>

<sup>1</sup> Producer's accuracy (%) = 1 – omission error (%)



	<p><i>underestimated in WAW compared to the in situ-data.</i></p> <p><i>Formulas used in calculation:</i></p> <p><i>E = erroneous samples/N</i></p> <p><i>U = 1.96*sqrt(1/N *E*(1-E))</i></p> <p><i>N= number of valid samples</i></p> <p><i>The omission error rate was calculated without area estimations. In case they are needed:</i></p> <p><i>Area of strata sampling for omission: 1 sample = 1 pixel ( 20 m * 20 m) = 261*20*20/10000 =10 ha</i></p> <p><i>HRL class area: 299 647 256 ha</i></p>
Number of random samples for finding commission error	280
Number of valid (applicable) samples for finding commission error	279
Commission error (%) <sup>2</sup> with uncertainty	0,00% ± 0
Comment on commissions	<i>There are no commission errors in the data based on this sample.</i>
Overall evaluation	<p><i>User's accuracy = 100%</i></p> <p><i>Producer's accuracy = 77,39%</i></p> <p><i>General overview, look-and-feel as well as statistical verification indicate that Permanent waters as part of HRL Water and wetness layer is acceptable.</i></p> <p><i>There are errors in all the classes, but the majority of the data is relatively in accordance with the national datasets. For some of the classes there are not proper validation data available.</i></p> <p><i>The future improvements of the product should concentrate on removing the omission error of the permanent water class. The temporary water class and sea coastline should be reconsidered because of serious mistakes. Permanently and temporary wet areas on fells should be removed. Using good elevation model would give better results.</i></p>

<sup>2</sup> User's accuracy (%) = 1 – commission error (%)

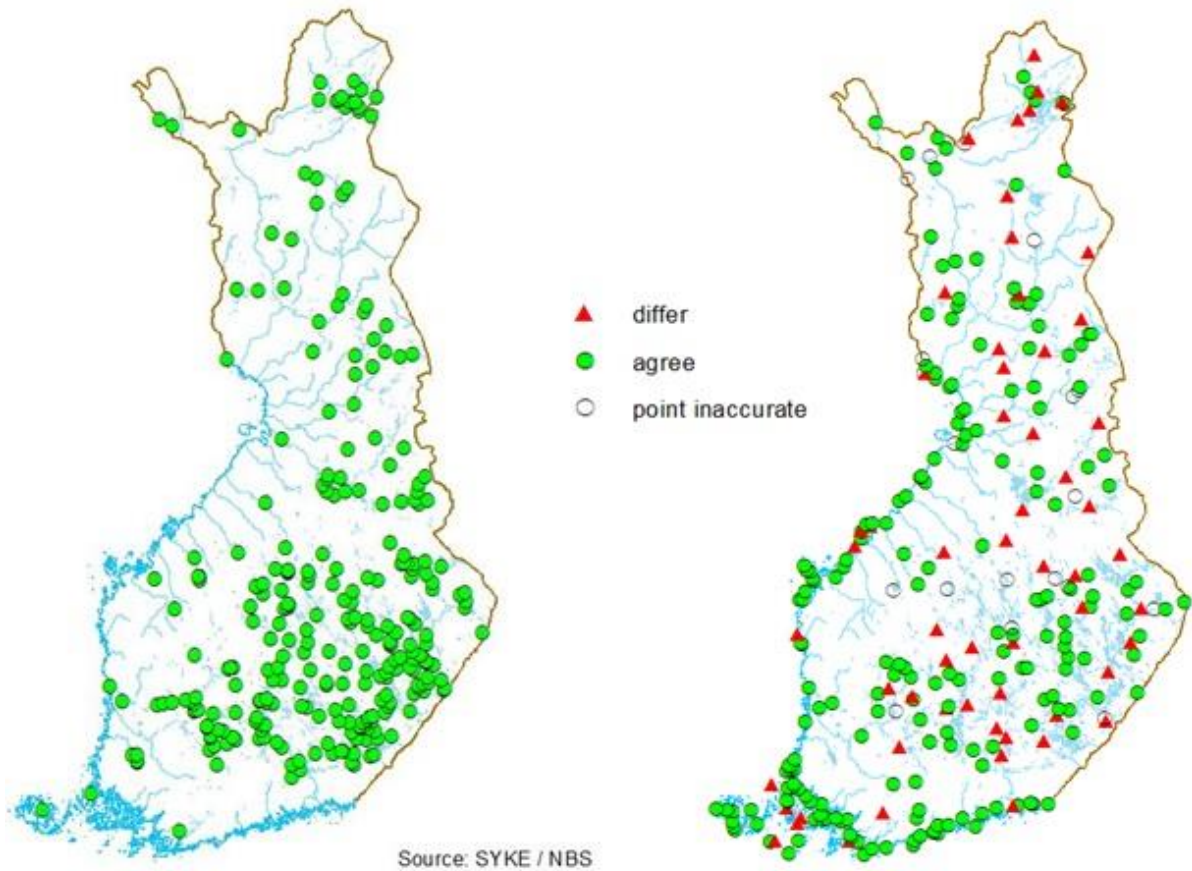


Figure 3. Areal distribution of sample plots in statistical verification, commission on the left and omission on the right side. Red triangles are omission errors, green dots are correctly interpreted sample plots.

## V. Documentation of errors and critical findings.

The samples are presented with coordinates. The coordinate system is EUREF\_FIN\_TM35FIN (WKID: 3067 Authority: EPSG, Projection: Transverse Mercator, False Easting: 500000,0, False Northing: 0,0, Central Meridian: 27,0, Scale Factor: 0,9996, Latitude Of Origin: 0,0, Linear Unit: Meter (1,0)).

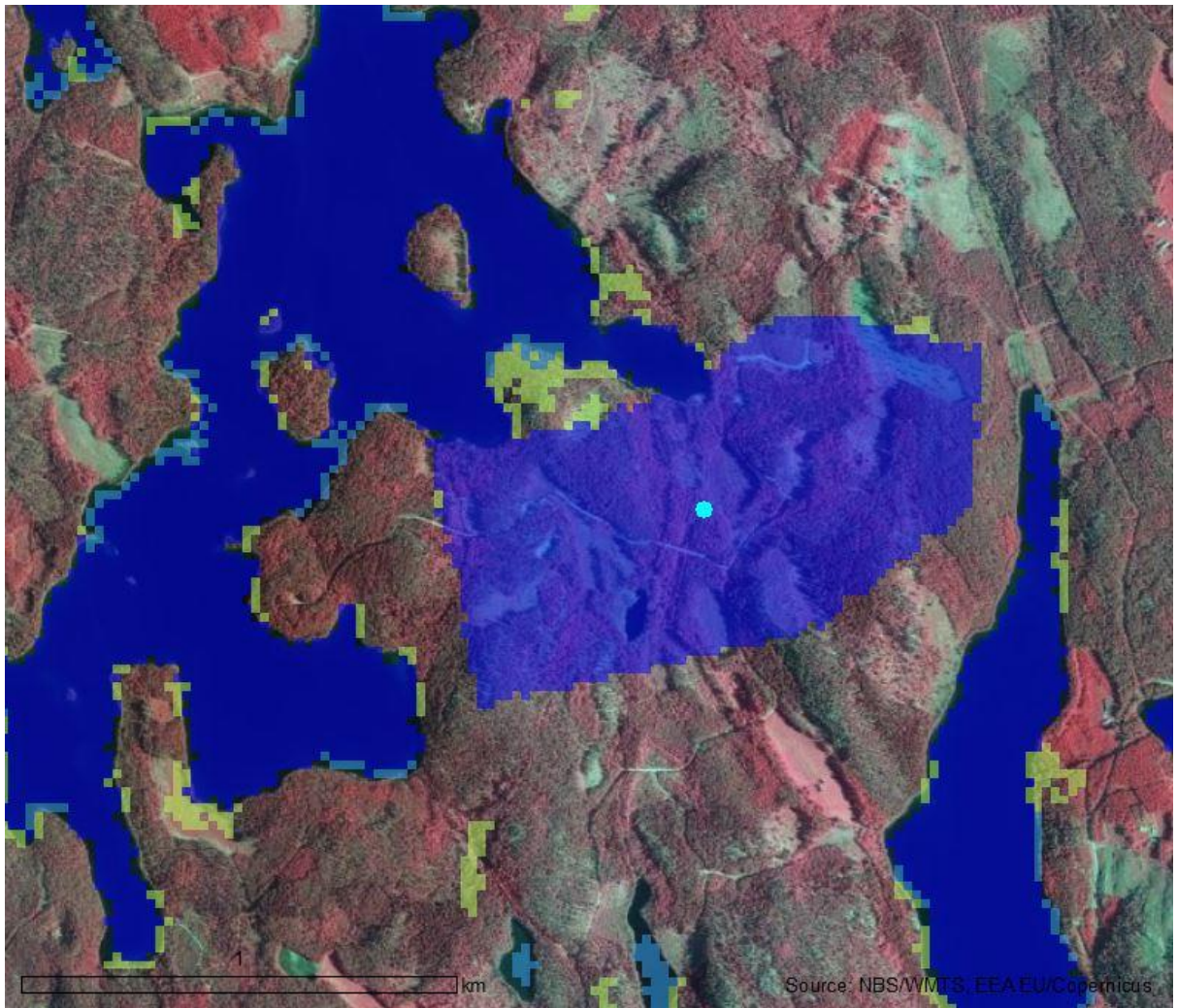


Figure 4. WAW permanent water (blue) in forests (background: orto-photo). Point coordinates: 574841, 833978

Coordinates of samples: 303370,7659550 ; 594164,7069847 ; 584915,6835821 ; 574854,6833985 ; 571422, 6833747; 580615,6833083 ; 578879,6833256 ; 576970,6832122; 581974;6831685; (also in some cases missing water in CLC:580035,6831450)

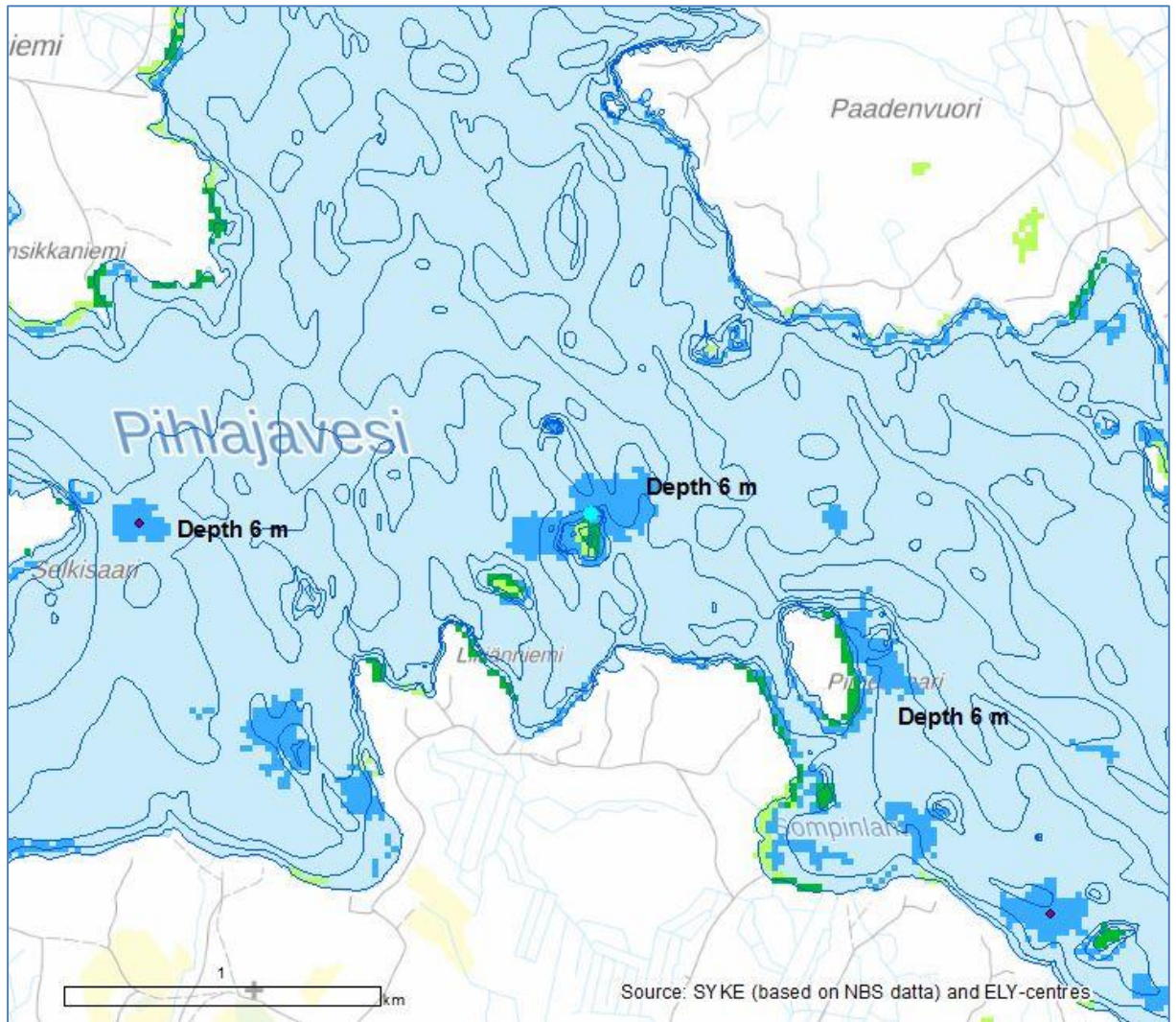


Figure 5. Temporary water over water body with over 3 meter depths. Point coordinates: 360506,6917290

Coordinates of samples: 543572,7686728 ; 441143,7438318 ; 359081,6917261 ;  
360506,6917290 ; 361958,6916030 ; 377026,6897171 ; 339757,6848048 ;  
339648,6847801 ; 339626,6847670 ; 339738,6847561 ; 358417,6761404 ;  
358032,6760992 ; 358101,6760916 ; 358317,6760902 ; 320042,6695135

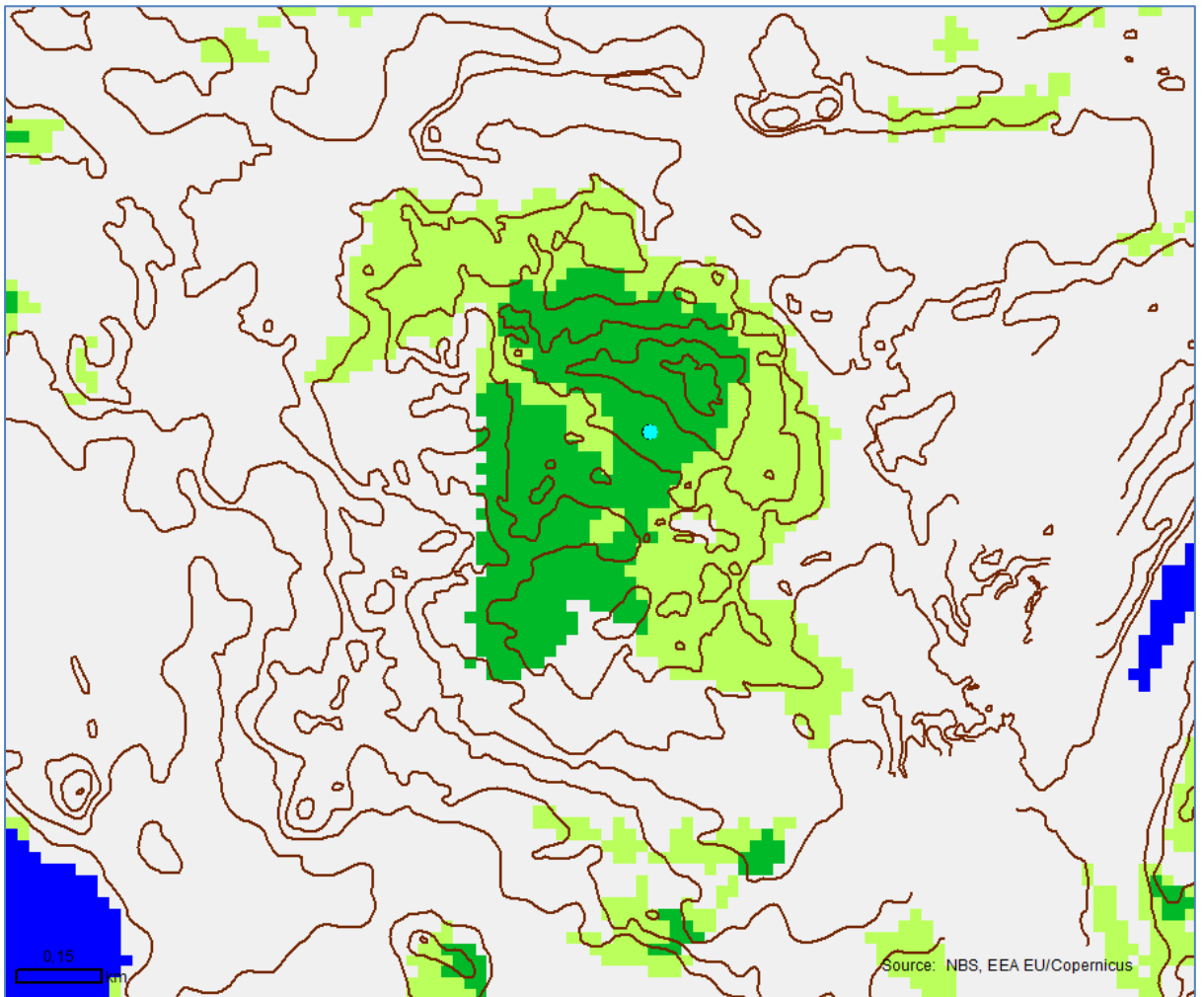


Figure 6a. WAW Permanent wet areas (dark green) and temporary wet areas (light green) on CLC transitional woodland mineral soil (background: elevation curves).  
Point coordinates: 530305, 711153



Figure 6b. Ortho-photo (covering the same site as in figure 6a) shows a clear-cut area. Point coordinates: 530305, 7111153

Coordinates of samples: 530196, 206000 ; 472824, 199200 ; 457909, 233200 ;  
575659, 280800 ; 470581, 51600 ; 648494, 321600 ; 647930, 251600 ; 599485,  
181200 ; 621565, 279200 ; 552420, 339600

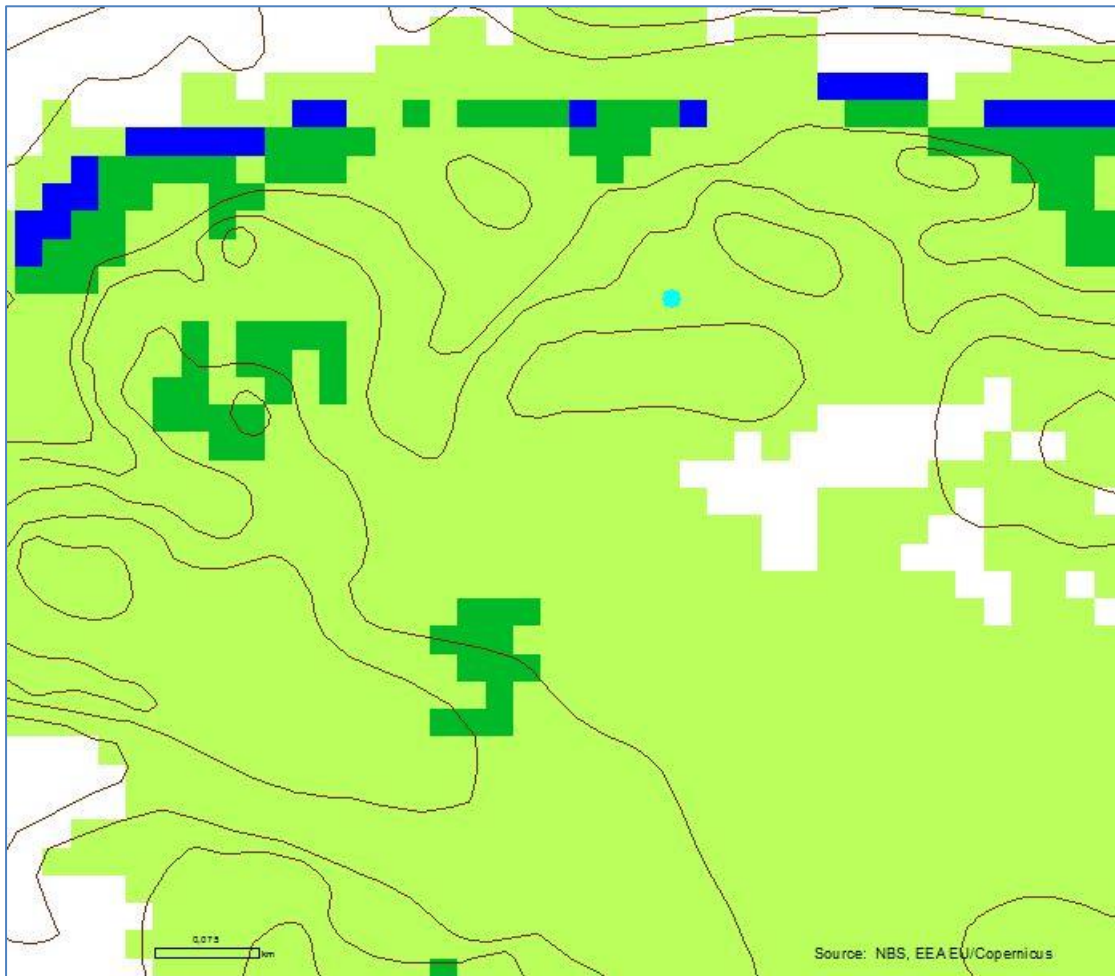


Figure 7a. Temporary wet areas (light green) and permanent wet areas (dark green) on forests in mineral soils and elevation curves. (Permanent water areas= blue) Point coordinates: 604162,7059023

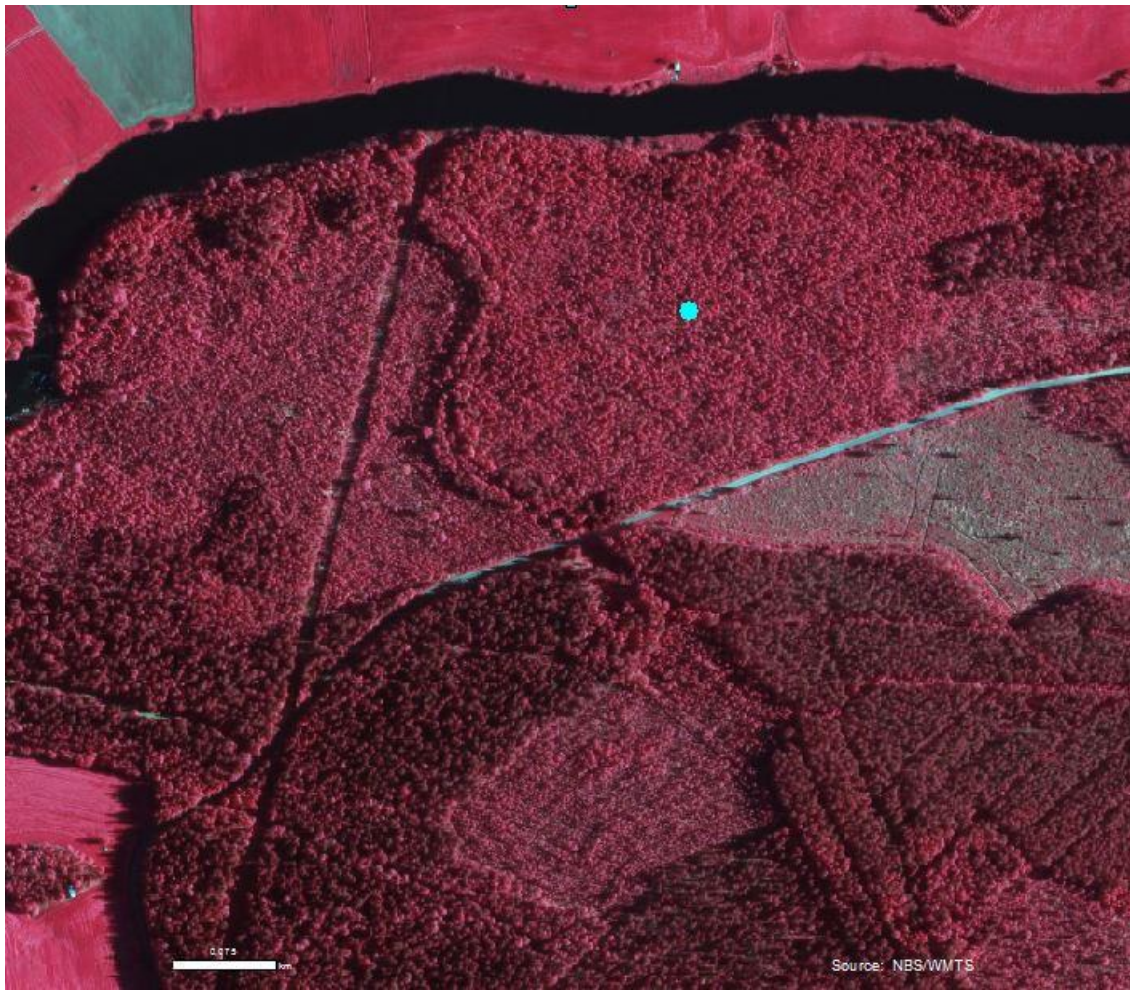
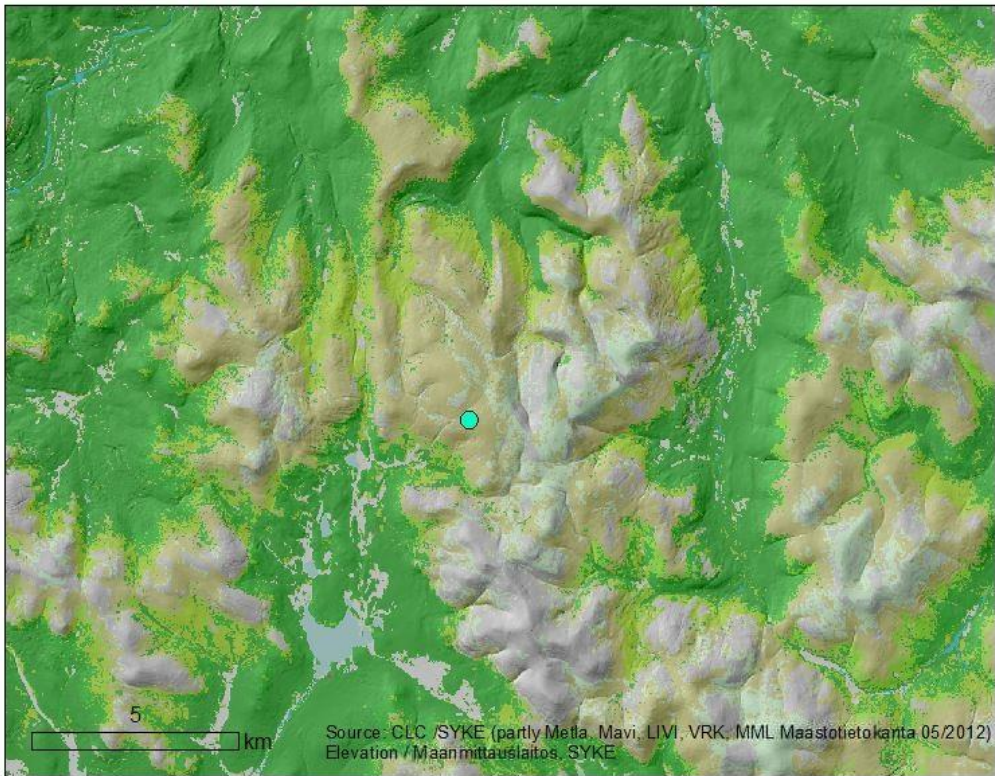


Figure 7b. Ortho photo (covering the same site as in figure 7a) shows a mixed forest. Point coordinates: 604162,7059023

Coordinates of samples: 495198, 7571346 ; 495423, 7570948 ; 496452, 7568761 ;  
356265, 7559113 ; 583712,7520074 ; 581105, 7517340 ; 580030,7517161 ; 556094,  
7514708 ; 546821 ; 7436278 ; 501923,7268093

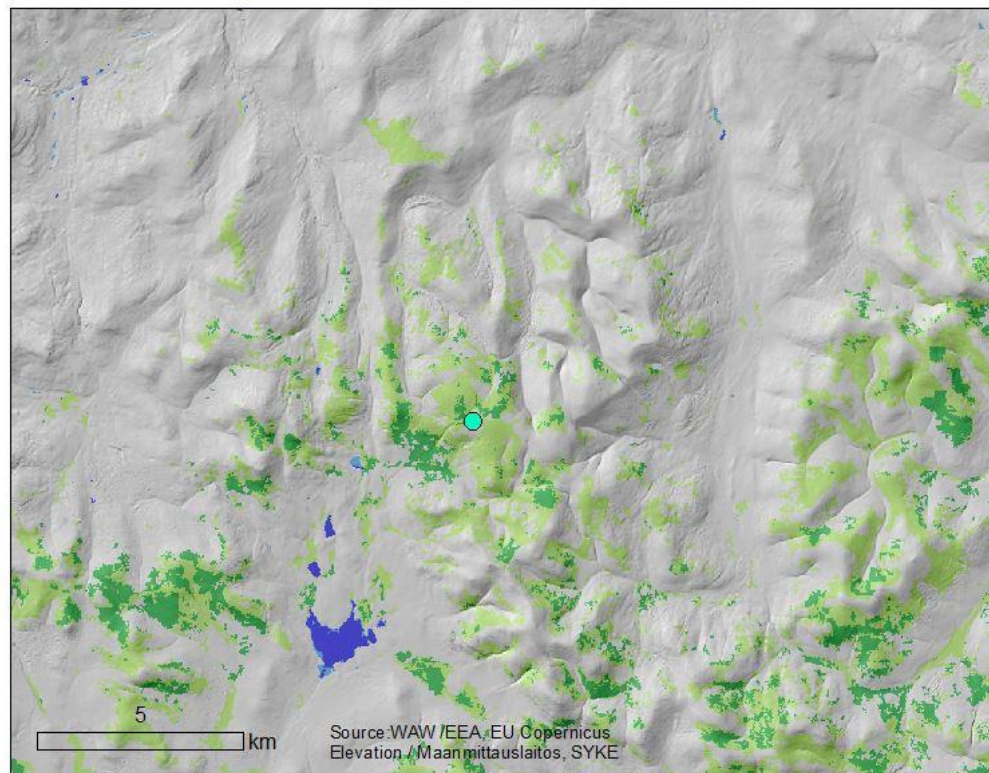




HR CLC 12

-  moors and heathland
-  bare rock
-  forest

Figure 8 a. Fell tops in Lapland in national HR CLC 2012 with elevation model.  
Point coordinates 545826, 7572796



WAW


 permanent wet temporary wet

Figure 8b. WAW permanent and temporary wet areas covering fell tops and slopes (covering the same site as in figure 8a). Point coordinates 545826, 7572796

Coordinates of strata:

534529, 7773051 ; 533247, 7766998 ; 531216, 7762050 ; 543818, 7754030;  
518659, 7593443 ; 520668, 7587442 ; 417764, 7585961 ; 520136, 7583208 ;  
527099, 7579408 ; 521115, 7579545

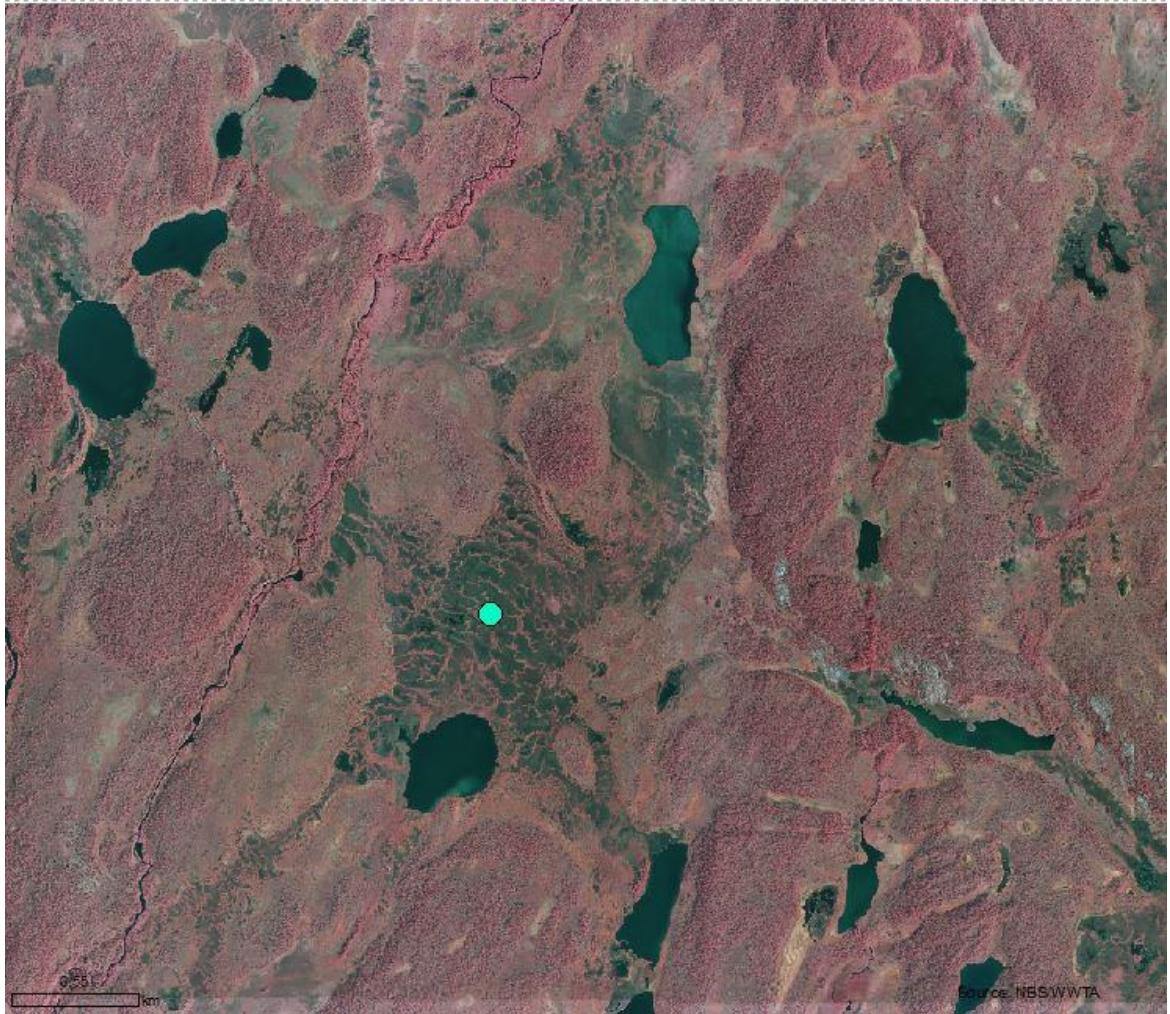


Figure 9. Ortho-photo shows a wet peatbog, that is “no water” class in WAW. Point coordinates: 335663, 7614602

Coordinates of strata:

335722, 7614964 ; 330721, 7608738 ; 453735, 7596534 ; 441835, 7585595 ;  
447596, 7584609 ; 478542, 7515817 ; 473536, 7468947 ; 476418, 7291402 ;  
577166, 7240659 ; 394985, 7150227



Figure 10a. Marsh on orthophoto (year 2015). WAW class is No water. Point coordinates: 270172, 6937863.



Figure 10b. Marsh on Image 2017 (covering the same site as in figure 10a). WAW class is No water. Point coordinates: 270172, 6937863

Coordinates of examples: 423193, 7196689 ; 246835, 6971980 ; 216558, 6842933 ;  
217987, 6837117 ; 323335, 6764328 ; 314091, 6740525 ; 511271, 6716059 ;  
538463, 6708981 ; 400232, 6680630 ; 389002, 6677089

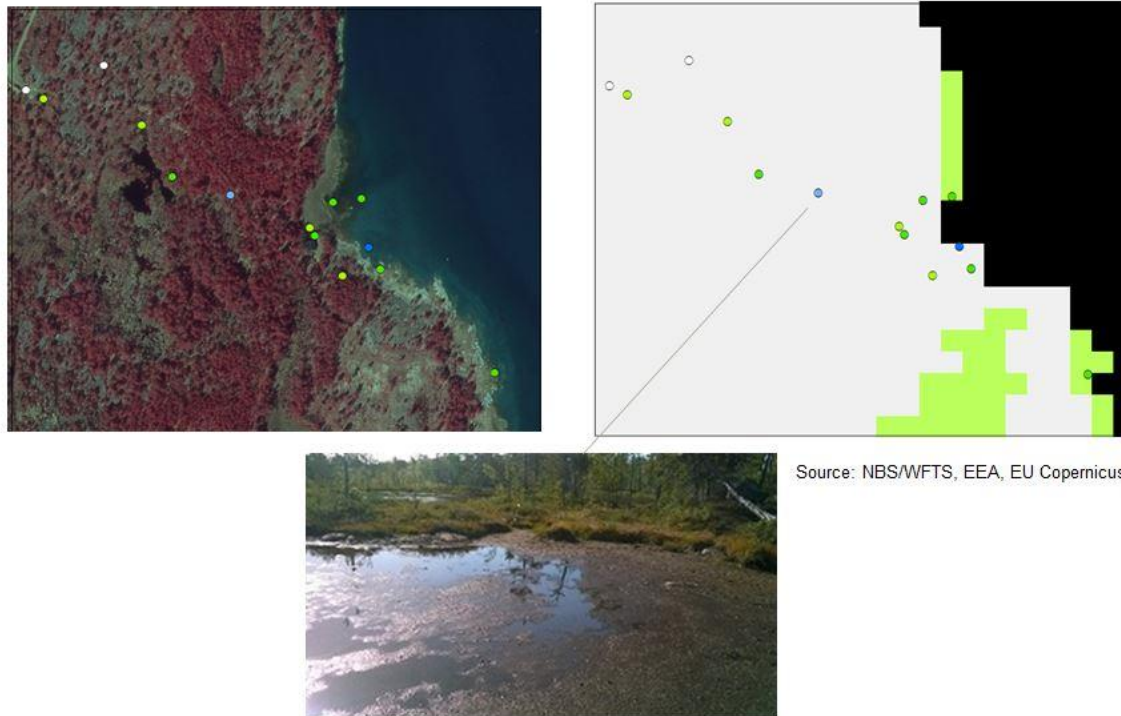


Figure 11. Bogs and water surfaces, which were verified in the field, classified as no water/no wet area in WAW. Blue and green dots were visited and mapped as temporary water and wet classes. In WAW data (upper right panel) they are mostly in No wet class. The width of the test area is 600 m. The photo point coordinates 93346, 6700287.

## VI Documentation of software used for verification

<p>The software type and exact version of software used for the validation:</p> <p>General overview &amp; Look-and-feel:</p> <ul style="list-style-type: none"> <li>• ArcGIS 10.5.1 desktop</li> <li>• Excel 2010</li> </ul> <p>Statistical verification:</p> <ul style="list-style-type: none"> <li>• ArcGIS 10.5.1 desktop</li> <li>• ERDAS IMAGINE 2016</li> <li>• Matlab R2016b</li> <li>• Excel 2010</li> </ul>
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## References

Copernicus land monitoring service – High Resolution Layer Water and Wetness: Product Specifications Document, version 1 of 2018-04-06. LANGANKE, Tobias 2016. EEA.

GIO Land Monitoring 2011 – 2013 in the framework of regulation (EU) No 911/2010. Pan-EU Component. Grant Agreement 3541/B2012/R0-GIO/EEA.55037.Final Report Finland.2015. Available at

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Guidelines for verification of High Resolution Layers produced by the CLMS (Copernicus Land Monitoring Service) as part of the 2015 reference year production Version 1.4

Metadata for SYKE open datasets:

[http://www.syke.fi/en-US/Open\\_information/Spatial\\_datasets](http://www.syke.fi/en-US/Open_information/Spatial_datasets)

Annex 1. The classification of WAW classes according to whether they can belong to a particular national CLC HR Level 4 class. Accepted="1" and Not accepted="0"

	WAW classes				
	No water	Permanent water	Temporary water	Permanently wet	Temporary wet
CLC 12 level 4					
Continuous urban fabric	1	0	0	0	0
Discontinuous urban fabric	1	0	0	1	1
Commercial units	1	0	0	0	0
Industrial units	1	0	0	0	0
Road and rail networks and associated land	1	0	0	0	0
Port areas	1	0	0	0	0
Airports	1	0	0	0	0
Mineral extraction sites	1	1	1	1	1
Open cast mines	1	1	1	1	1
Dump sites	1	0	0	0	0
Construction sites	1	0	0	0	0
Summer cottages	1	0	0	0	0
Sport and leisure areas	1	1	1	1	1
Golf courses	1	0	0	1	1
Racecourses	1	0	0	1	1
Non-irrigated arable land	1	0	1	1	1
Fruit trees and berry plantations	0	0	0	0	1
Pastures	1	1	1	1	1
Natural pastures	1	1	1	1	1
Arable land outside farming subsidies	1	0	1	1	1
Agro-forestry areas	1	1	1	1	1
Broad-leaved forest on mineral soil	1	0	0	0	0
Broad-leaved forest on peatland	1	0	0	1	1
Coniferous forest on mineral soil	1	0	0	0	0
Coniferous forest on peatland	1	0	0	1	1
Coniferous forest on rocky soil	1	0	0	0	0
Mixed forest on mineral soil	1	0	0	0	0
Mixed forest on peatland	1	0	0	1	1
Mixed forest on rocky soil	1	0	0	0	0
Natural grassland	1	0	1	1	1
Moors and heathland	1	0	0	0	0
Transitional woodland/shrub cc <10%	1	0	0	0	0
Transitional woodland/shrub, cc 10-30%, on mineral soil	1	0	0	0	0
Transitional woodland/shrub, cc 10-30%, on	1	0	1	1	1



peatland					
Transitional woodland/shrub, cc 10-30%, on rocky soil	1	0	0	0	0
Transitional woodland/shrub under power lines	1	0	0	0	0
Beaches, dunes, and sand plains	1	0	1	1	1
Bare rock	1	0	0	0	0
Sparsely vegetated areas	1	0	0	0	1
Inland marshes, terrestrial	0	1	1	1	1
Inland marshes, aquatic	0	1	1	1	1
Peatbogs	1	1	1	1	1
Peat production sites	1	1	1	1	1
Salt marshes, terrestrial	0	1	1	1	1
Salt marshes, aquatic	0	1	1	1	1
Water courses	0	1	0	0	0
Water bodies	0	1	0	0	0
Sea and ocean	0	1	0	0	0