HRL 2018 look & feel verification report for Wetness and Water (WaW)

I. Administrative part

HRL	*Wetness and Water 2018*
Verified area, region	*Finland, in national projection clipped to country area.*
Institution carrying out the work	SYKE
Overall visual checking done by (name, position and e-mail)	*Minna Kallio* *Coordinator* *minna.kallio@syke.fi*
Look & feel verification done by (name, position and e-mail)	*Minna Kallio* *Coordinator* *minna.kallio@syke.fi*
In situ data used.	*Topographic Database/The National Land Survey* *Waters and wetlands, Vector data* *Reference year: 2018*
	Data-5 Colour infrared (CIR) ortho-imagery, years 2017-2019 /The National Land Survey
	Image2018 VHR Satellite image mosaic/ Copernicus *Planet / Pleiades / Spot-6/7* *Spatial resolution: 4m / 2m / 4m* *Reference year: 2018 / 2018 / 2018*
	Land Cover on Wetlands 2018
	National high resolution Corine Land Cover 2018 (HR CLC2018)/Finnish Environment Institute *National Corine raster dataset* *Resolution 20x20m* *Reference year: 2018*
	Cartographic Depth-to-Water (DTW) index maps for Finland, 2mx2m, 2020 /LUKE
	The Lake and River Depth Profiles, Vector data, SYKE
	The estimated flood coverage area, Vector data, 2020 SYKE
	European Hydrological database, 2020, EEA
Reporting done by (name, position and e-mail)	Minna Kallio *Coordinator* *minna.kallio@syke.fi*
Date and place of writing the report	2021-07-16

II. General overview of the verified data

Finland is rich in surface waters, with 187 888 lakes (larger than 500 square metres) and tens of thousands of kilometres of rivers and streams. Almost a tenth of the country area is covered with

water (https://www.ymparisto.fi/en-us/waters/State_of_the_surface_waters). The freshwater area is 34 527 km^2 according to Statistics Finland.

Finland is also covered with different kinds of wetlands, 28 % of the land area. The wetness of the mires and bogs varies a lot both spatially and temporally. There are no in-situ data on the moisture of wetlands. Therefore, the verification concentrates on the most obvious possible errors in the WaW product.

There is no tide in Finland, and typically sea water level changes are related to ice, wind, currents and atmospheric pressure. There is still a lot of alteration of wet and water on shores of both lakes and the sea, but not much GIS data to measure it except modelled data.

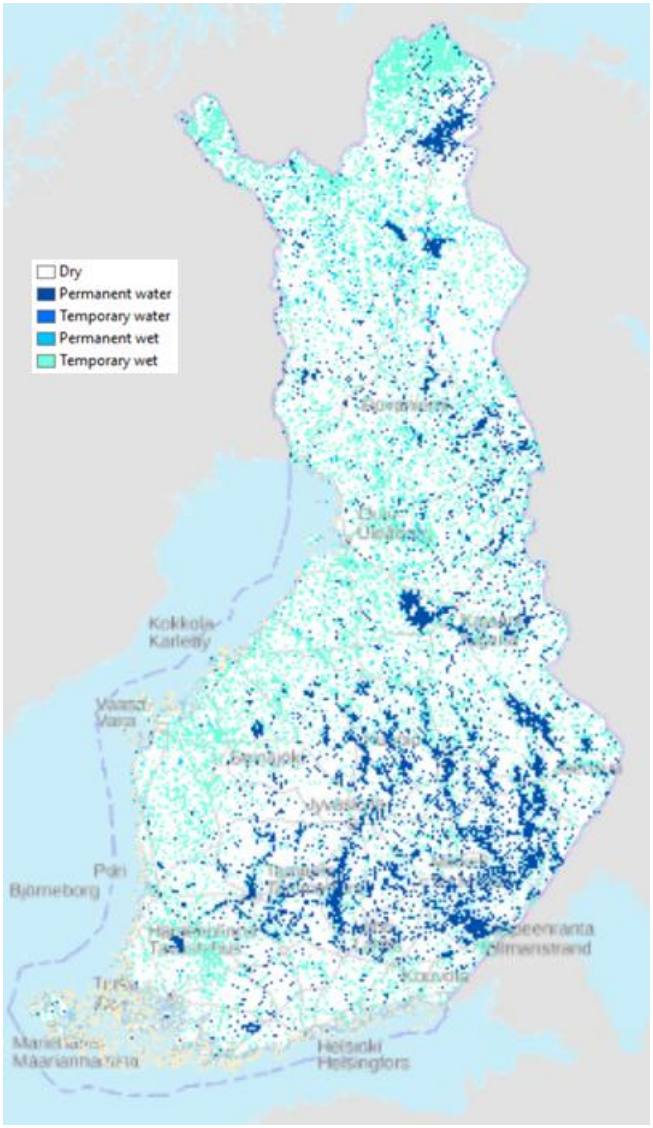
The Water and Wetness (WaW) dataset consists on classes on permanent and temporary water as well as permanent and temporary wet surfaces (Table 1). The total area of Permanent water is smaller than in the official statistics. The largest area of the WaW classes in Finland is Temporary wet.

Table 1. The class distribution on WaW dataset in Finland.

Class name	Area, km^2	Area, %
Dry	246513	71,0
Permanent water	31105	9,0
Temporary water	385	0,1
Permanent wet	4106	1,2
Temporary wet	57189	16,5
Sea water	7730	2,2
Unclassifiable (no satellite image, clouds, shadows, or snow)	1	0,0
Total		100,0

The general visual impression of the dataset shows the lake district and the mire dominated wet areas on the coast stand out (Figure 1). There is also a lot of temporary wet area in the north.

Figure 1. Overview map of WaW dataset. Background map MML/WMTS 05/2021.



The WaW dataset was compared to National high resolution Corine Land Cover 2018 (HR CLC2018). The distribution of the WaW dataset on HR CLC2018 shows, that most permanent water areas (PWA) fall in water bodies class and are the 72 % of the permanently wet areas (PWE) are wetlands in the HR CLC2018 (Tables 2 a and 2 b). Temporary water (TWA) and temporary wet (TWE) classes are more dispersed in HR CLC2018 main classes. Of the total area the PWA and Dry classes meet the 85 % target.

*Table 2. The national high resolution CORINE Land Cover 2018 raster (20x20 m) (*HR CLC2018*) raster and WaW classes in Finland. a) hectares b) percentage.*

a)

HR CLC2018	Wetness and Water, ha					
Level 1	DRY	PWA	TWA	PWE	TWE	SWA
Artificial surfaces	807 509	2 861	1 083	4 065	150 696	563
Agricultural areas	894 210	221	540	22 947	1 495 141	95

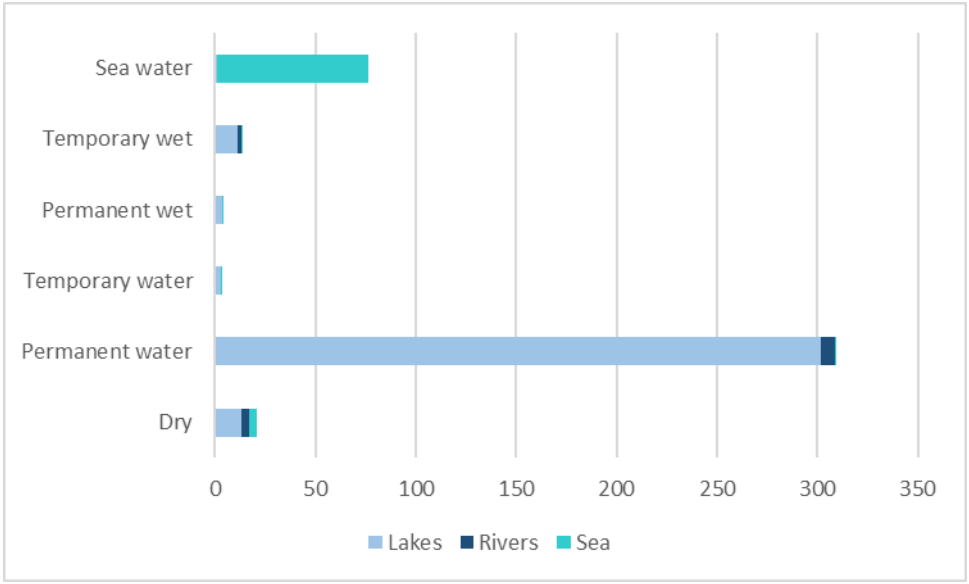
Forests and semi-natural areas	22 336 576	13 689	4 103	56 676	2 503 919	4 567
Wetlands	409 679	39 114	6 481	296 501	1 452 737	9 891
Water bodies	163 569	3 043 836	26 225	29 532	105 333	757 258
Total	24 611 543	3 099 720	38 433	409 721	5 707 827	772 373

b)

HR CLC2018	**Wetness and Water, %**					
Level 1	DRY	PWA	TWA	PWE	TWE	SWA
Artificial surfaces	3	0	3	1	3	0
Agricultural areas	4	0	1	6	26	0
Forests and semi-natural areas	91	0	11	14	44	1
Wetlands	2	1	17	72	25	1
Water bodies	1	98	68	7	2	98
Total	100	100	100	100	100	100

The WaW was also compared to Topographic Database Waters vector data 2018 of The National Land Survey Finland (MML), which is the most accurate dataset available (Figure 2). PWA dominates Topographic database lakes and rivers and WaW Sea water the Topographic database sea. All WaW classes have some area in the Topographic database lakes class. Some Topographic database rivers are TWE or Dry on WaW.

Figure 2. The distribution of WaW classes in Topographic Database water areas in Finland.

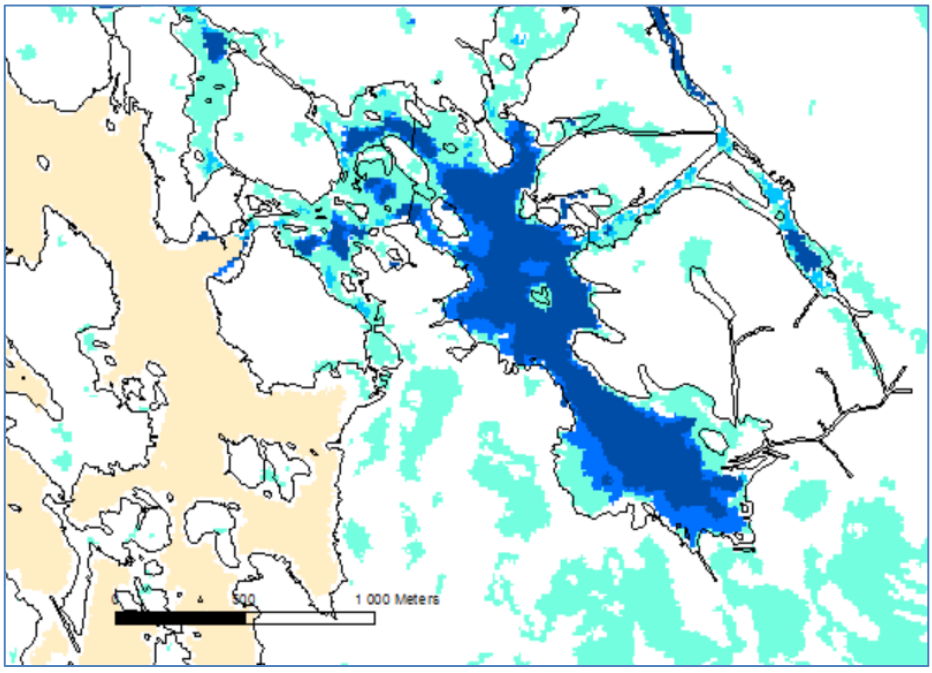


The WaW Permanent water area is 83-93 % of the Topographic Database freshwater area There are no major regional gaps in the data.

The visual scanning of the WaW Permanent water shows that the narrow rivers and lake inlets are not caught in the WaW product (Figure 3). The absence of small or narrow waters explains partly

the difference of WaW permanent water area from the national dataset. In the product description the spatial resolution is 10m x 10m, but even 40 m rivers can be missing from the product.

Figure 3. The WAW classes and Topographic Database water areas (MML 2019) have difference in rivers and narrow areas. Sea water with beige, PWA with dark blue and Topographic database waters with black outline. Wet areas and temporary waters are with green and light blue. Centre point ETRS Laea x 4927591 y 4351943.



Sea areas were compared to coastal areas (included in the EU-Hydro dataset) in the look and feel assessment. The definition of sea and coastline is different between national data and the WaW product. This produces sea water areas to be classified as lakes and vice versa. The Topographic database contains some 4 300 ha freshwater that is classified as sea in the WaW product. The WaW sea class contains 11 750 ha freshwaters according to Topographic database. The datasets agree on 754 269 ha. The difference is mostly local, and it was ignored in the verification, Sea water was accepted in the look and feel evaluation if it was water in the Topographic water database. Delineation of sea waters was not validated.

Finland is usually covered with snow in winter. All the country could then be characterized as Temporarily inundated areas (due to snow melt, floods or rain). Northern Finland has snow cover over two months later in the spring than Southern Finland, see https://en.ilmatieteenlaitos.fi/snow-statistics. High altitude slopes in Lapland are incorrectly classified as TWE areas in the product. National moisture index and national high resolution CLC suggest those areas to be dry after snow melt. Bare rock and sparsely vegetated areas on the fell tops are correctly classified as dry.

There were many classes demanded in the instructions. GIS data available for verification is often a combination of many of those classes. For example, the metadata of the Topographic water database tells that water areas the size of which is at least 1000 m^2 (0,1 ha) are marked as lakes. This includes channels and natural ponds. Also, there is not much GIS data to find the temporary water surfaces to compare. Flood areas are modelled using elevation and hydrological data.

The Topographic database includes forested and open peatlands and classified according to passability. Low passability indicates very wet areas. Cartographic Depth-to-Water (DTW) index maps were used to support the estimating of peatland wetness. The index is calculated based on digital elevation model and stream networks.

National dataset 'Land Cover on Wetlands' includes wetlands (inland and coastal), peatbogs and water bodies with vegetation cover (including reeds). The dataset helps to find vegetated areas near and on water bodies. The data is interpreted from satellite images and using Topographic database.

The demand for a good WaW product is high in Finland, but northern characteristics should be taken properly into account for higher usability. Also, the verification is demanding since the product is interpreted using time-series of EO data and thus includes temporal information. There are ongoing national projects to produce more data on wetlands.

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 is excellent. The Unclassifiable areas (gaps) are not an obstacle for the verification (58 ha).
Thematic accuracy			
Classification correctness	Simple look & feel thematic check (identifying basic thematic mistakes)	*NOK /not correct,*	Permanent water areas seem to be correctly classified. Large areas in Lapland are classified as temporary wet.

IV. Look & feel verification results

Details of look & feel verification

1.Included elements, possible OMISSIONS

Stratum	Name of the stratum (see proposed strata in Tables 5.2.2.x.b)	Number of samples verified	*Results of the verification by strata (excellent, good, acceptable, insufficient, very poor): see chapter 5.2 of the guidelines*
1	Permanent inland lakes (natural) + Channels	20	*Very poor*
2	Natural ponds	10	*Good*
3	Reservoirs, artificial ponds	10	*Acceptable*
4	Rivers, width > 20 m	10	*Very poor*
5	Coastal water surfaces: lagoons, estuaries	10	*Excellent*
6	Flood areas	10	*Insufficient*
7	Vegetation in water including reeds	10	*Very poor*
8	Peat land	10	*Very poor*
9	Inland wetlands (Wet mires)	10	*Very poor*
10	Coastal wetlands	10	*Very poor*
11	Temporarily wet agricultural fields	10	*Good*
12	Temporarily wet grasslands and pastures	10	*Acceptable*
Overall evaluation			*There are omission errors in many of the strata and therefore the overall quality of the look and feel verification is Insufficient (2,4). Some classes like lagoons and estuaries are excellently found. Also, artificial ponds and wet agricultural areas are better caught than natural environments.*
Comments, overview of results			*Look and feel evaluation concentrates on possible errors. Therefore, the results based on the strata are biased. If the whole area was looked at f. ex. PWA in lake class, the result would be better.* *Correction needs are found in water surfaces with floating or emergent vegetation, narrow sounds, inlets and small lakes, wet mires and peat land.*

	Channels and natural ponds are included in the Topographic database lakes. Lake and River Depth Profiles and area size were used to find the ponds. Artificial ponds are in the Topographic database a separate class. Rivers that are more than 5 meters wide are a separate class in Topographic database. *There are classes for which there is no data available: temporary natural and artificial lakes, intermittent rivers and wetlands, water-logged areas, intertidal areas, rice fields and saline marshes.* *Data on coastal water surfaces with lagoons and estuaries are nationally defined and not included f. ex in HR CLC2018, because there is no tide in Finland. The class concentrates on lagoons formed by land uplift and on river mouths.* *Flooded areas were searched using modelled data and evaluated using imagery.* *Inland wetlands contain wet mires, and peatlands in general are also evaluated. The classification and permissible values of peatlands in the evaluation is not fully compatible with Finnish classifications. Peatland evaluation concentrated on problem areas in the product.*

2. Excluded elements, possible COMMISSIONS

Stratum	Name of the stratum (see proposed strata in Tables 5.2.2.x.c)	Number of samples verified	*Results of the verification by strata (excellent, good, acceptable, insufficient, very poor): see chapter 6.3 of the guidelines*
1	Sea and ocean	10	*Excellent*
2	Small river channels and streams	10	*Good*
3	Permanent water surfaces (rivers, channels, lakes, lagoons, estuaries)	10	*Very poor*
4	Natural ponds	10	*Acceptable*
5	Water surfaces with floating or emergent vegetation	10	*Very poor*
6	Artificial ponds (Fishponds (permanent), Reservoirs,	10	*Acceptable*

	Liquid dump sites)		
7	Flooded areas	10	*Insufficient*
8	Temporarily inundated areas	10	*Very poor*
9	Peat land	10	*Insufficient*
10	Inland and coastal wetlands	10	*Very poor*
Overall evaluation			*Many of the strata on minor areas are good. The mean of the values is Insufficient (2,8) The commission errors in some of the strata cover large areas.*
Comments, overview of results			*Look and feel evaluation concentrates on possible errors. Therefore, the results are biased based on the strata. If the whole class area is looked at f. ex. in Permanent water surfaces, the result would be better.* *Small rivers are lines in the Topographic database layers, no commission error was found.* *Correction needs are found in water surfaces with floating or emergent vegetation, flood areas, temporarily inundated areas, peat land and inland wetlands.* *There are classes for which there is no data available: temporary natural and artificial lakes, intermittent rivers and wetlands, water-logged areas, intertidal areas, rice fields and saline marshes. Reeds cannot be separated from inland and coastal wetlands.* *Flood areas were searched using modelled data and evaluated using imagery.* *The TWE areas the northern fells are evaluated in Temporarily inundated areas.* *Peatlands were evaluated with peatland mask where moisture index DTW was high, but WAW product was classified as dry. The classification of peatlands in the evaluation is not fully compatible with Finnish classifications. Peatland evaluation concentrated on problem areas in the product.*

V. Documentation of errors and critical findings

PWA missing from narrow water areas and near shores or areas with emergent vegetation

There is a narrow strip of land near the shores in the WaW product which is water in national databases. (Figures 4-6). The total area of contradicting datasets is 425 721 ha, of which 28 % has vegetation and 72 % is without any vegetation cover according to Land cover on wetlands. Otherwise the lakes and rivers are well caught in the product.

Figure 4. Topographic Database Waters missing PWA with blue colour on Orthophoto (MML/WMTS 06/2021). Centre point ETRS Laea x 5223433 y 4527505.

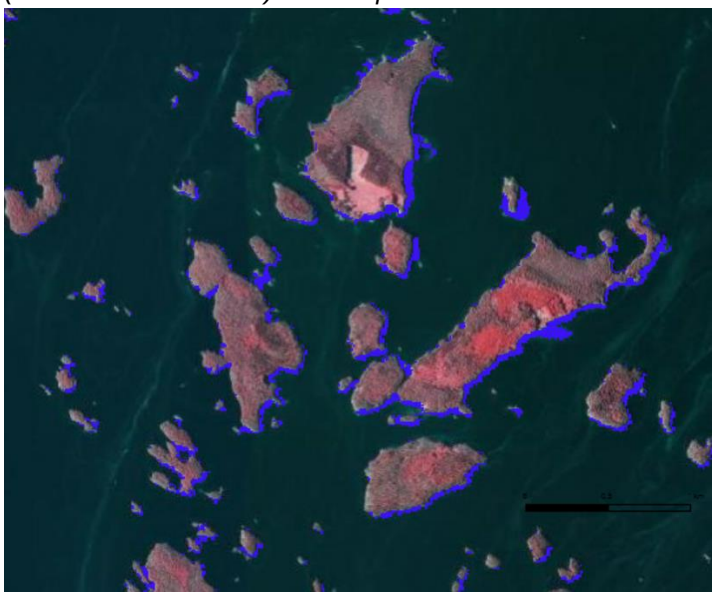


Figure 5 Topographic Database Waters missing from PWA with red colour, PWA with blue and TWE with light green. The width of the missing rivers is at least 30 m, also on imagery. Centre point x 4986374, y 4300714.

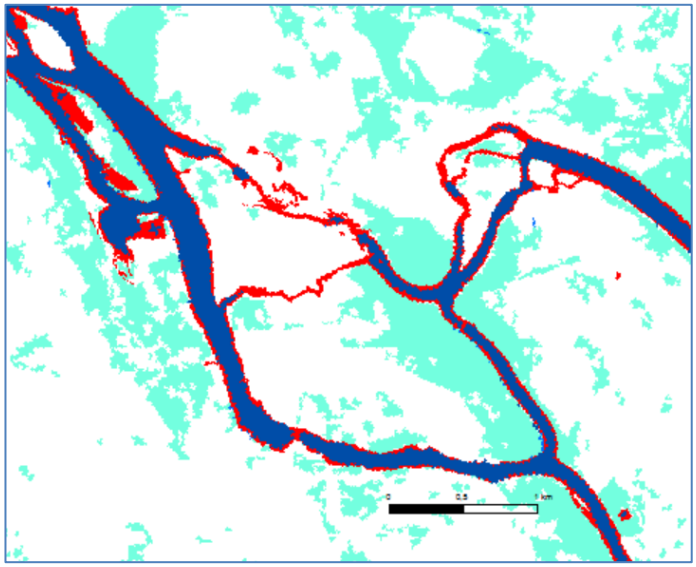
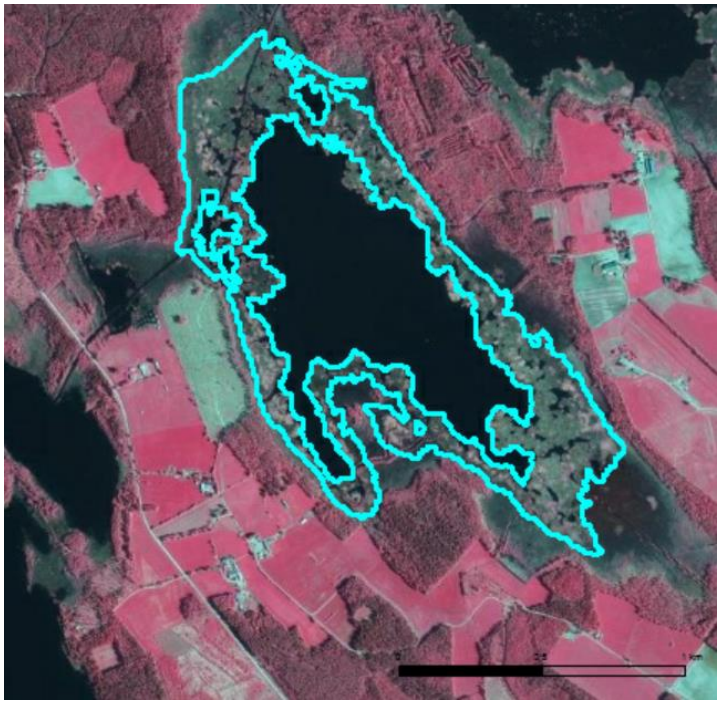


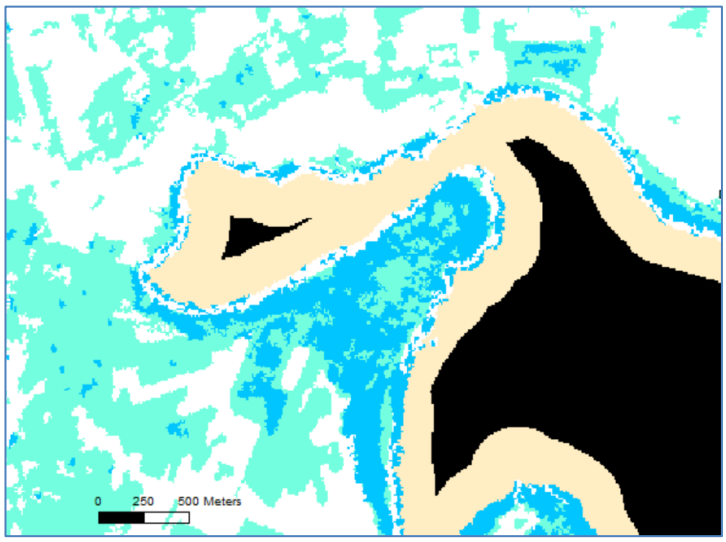
Figure 6. Vegetation on water as TWE or Dry *on Orthophoto (MML/WMTS 06/2021). Centre point x 5144852 y 4613512.*



Dry narrow areas beside the sea

On low-lying areas on the seashore there is sometimes a strip of dry land in the WaW, on national data and imagery these areas are either water or wet areas (*Figures 7 a and 7b)*. Being narrow, they were usually not caught in the samples. In general, the lagoons and estuaries were correctly classified as PWA or sea. The area is not remarkably large.

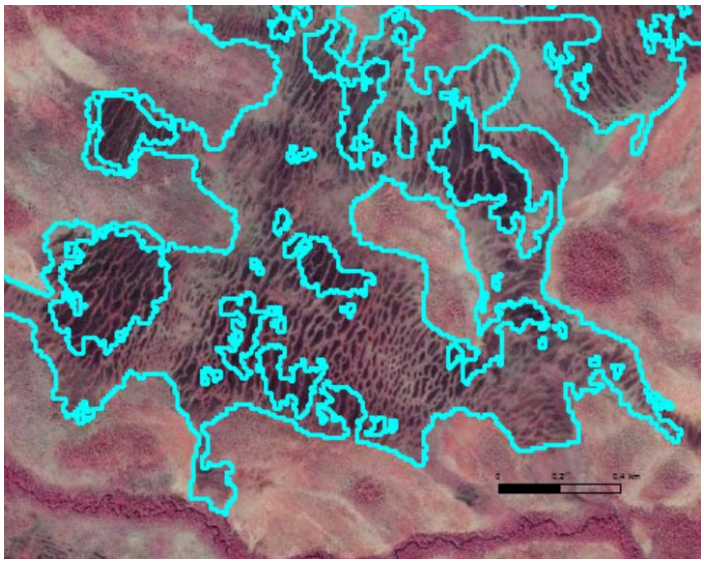
Figure 7 a. Dry stripe on seashores between sea and wet areas with white in the WaW product. 7 b. The orthophoto shows no sign of dry necks of land near the sea. Centre point x 5016480, y 4734328



Wet mires as TWE

There is a lot of very wet mires classified as Temporary wet areas. Imagery shows that there are small open water surfaces on the site (Figure 8). The total area of contradicting datasets is 36 5297 ha. The biggest areas concentrate in Northern Finland.

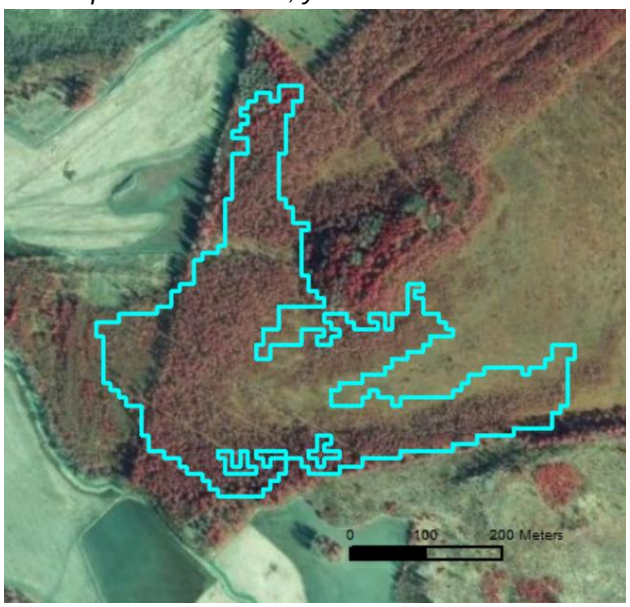
Figure 8. Wet mires as TWE on Orthophoto (MML/WMTS 06/2021).
Centre point x 5018356, y 5046832.



Dry bogs as PWE

Many dryer bogs are classified as permanently wet in the product. The other sources show that the sites can be quite dry, although seasonal wetness can be found (Figure 9).

Figure 9. Dry bogs as PWE on Orthophoto (MML/WMTS 06/2021).
Centre point x 5100446, y 4193212.



TWE areas on high Northern slopes

Many high altitude areas in Lapland are classified as TWE areas in the product (Figures 10 a and 10 b). The HR CLC2018 class is Moors and heathland and the according to DTW moisture index these areas are very dry. The inspection of satellite imagery and Orthophotos does not reveal site wetness either. The area of the combination is 244 377 ha.

Figure10 a. TWE areas (light green) on fell slopes, HR CLC2018 Moors and heathlands combined with low moisture in DTW with black outline. Centre point x 4997454, y 5429772

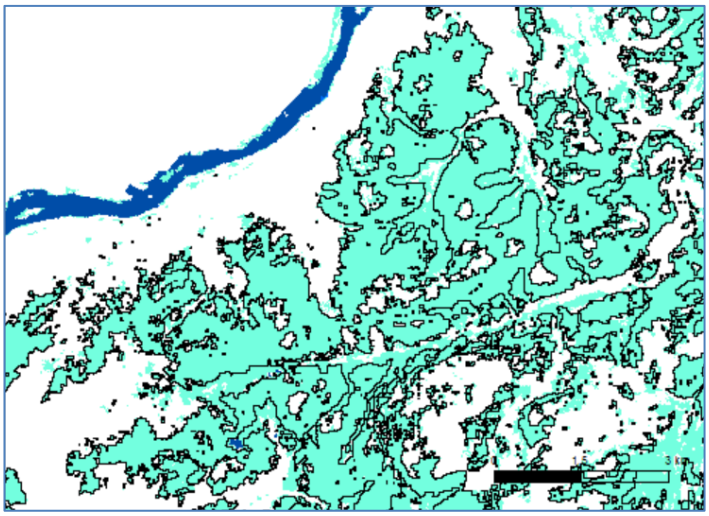
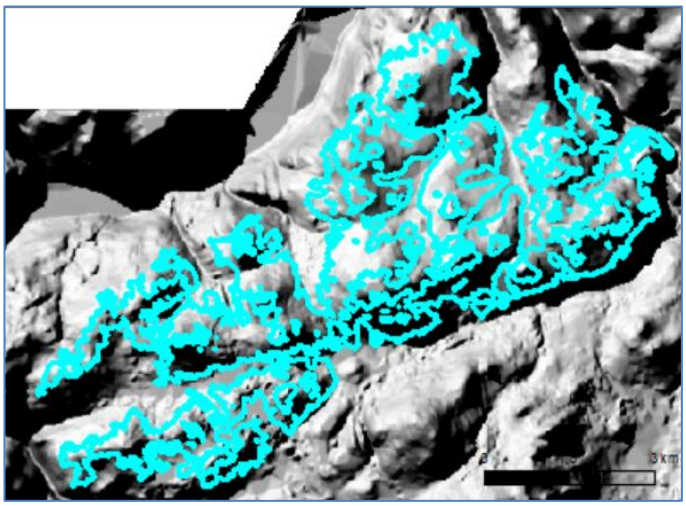


Figure 10 b. Same pattern on light blue on visualization of elevation. Background source: Maanmittauslaitos, SYKE



Attachments: WAW02018_QuantitativeSamples_FI.shp, WAW02018_QuantitativeSamples_lines_FI.shp, WAW02018_QuantitativeSamples_points_FI.shp