

Enhancing the user uptake of Land Cover / Land Use information derived from the integration of Copernicus services and national databases „InCoNaDa”

WP4: LCLU for agriculture management

WP5: LCLU for Environmental Monitoring

Norway (NIBIO)

WP5&5 HRL-WAW comparison with national data
in Poland (IGiK)

Enhancing the user uptake of Land Cover / Land Use
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LCLU for agriculture management
Norway (NIBIO)

Report on the **potential** and **accuracy** of HRL-WAW for assessment of agricultural landscapes and Ecological Focus Areas



Monitoring program	(3Q)
Land resource map	(AR5)
Topographic map	(N50 water)

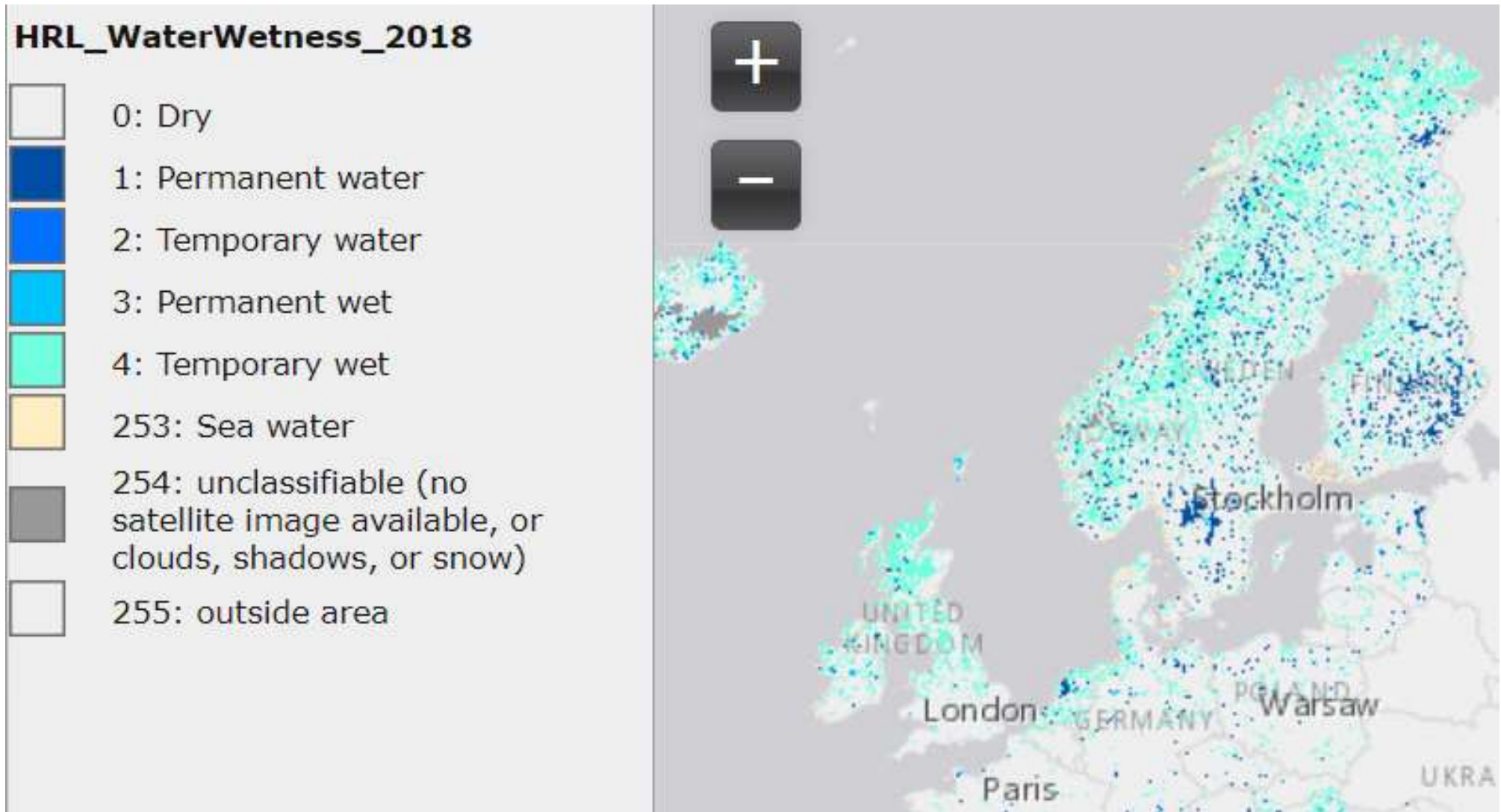
High Resolution Layer: Water & Wetness (WAW) 2018

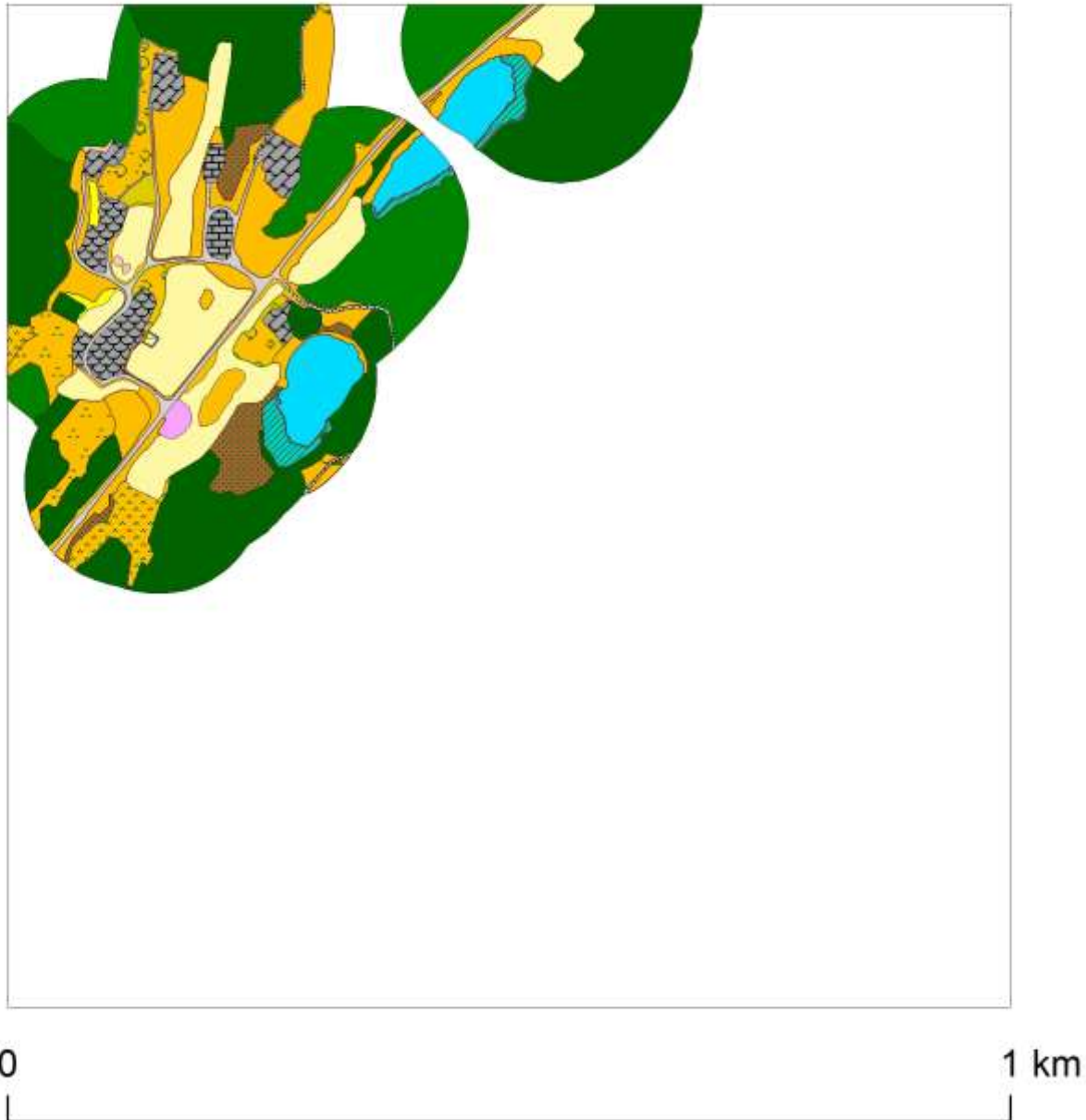
10 x 10 m
100 x 100 km tiles
Norway 70 tiles
Poland 48 tiles

Reference year
2018 (2012-2018)

- Input
- Sentinel-2
 - Sentinel-1
 - ...

- Production
- NDWI
 - Soil moisture
 - ...





Land types

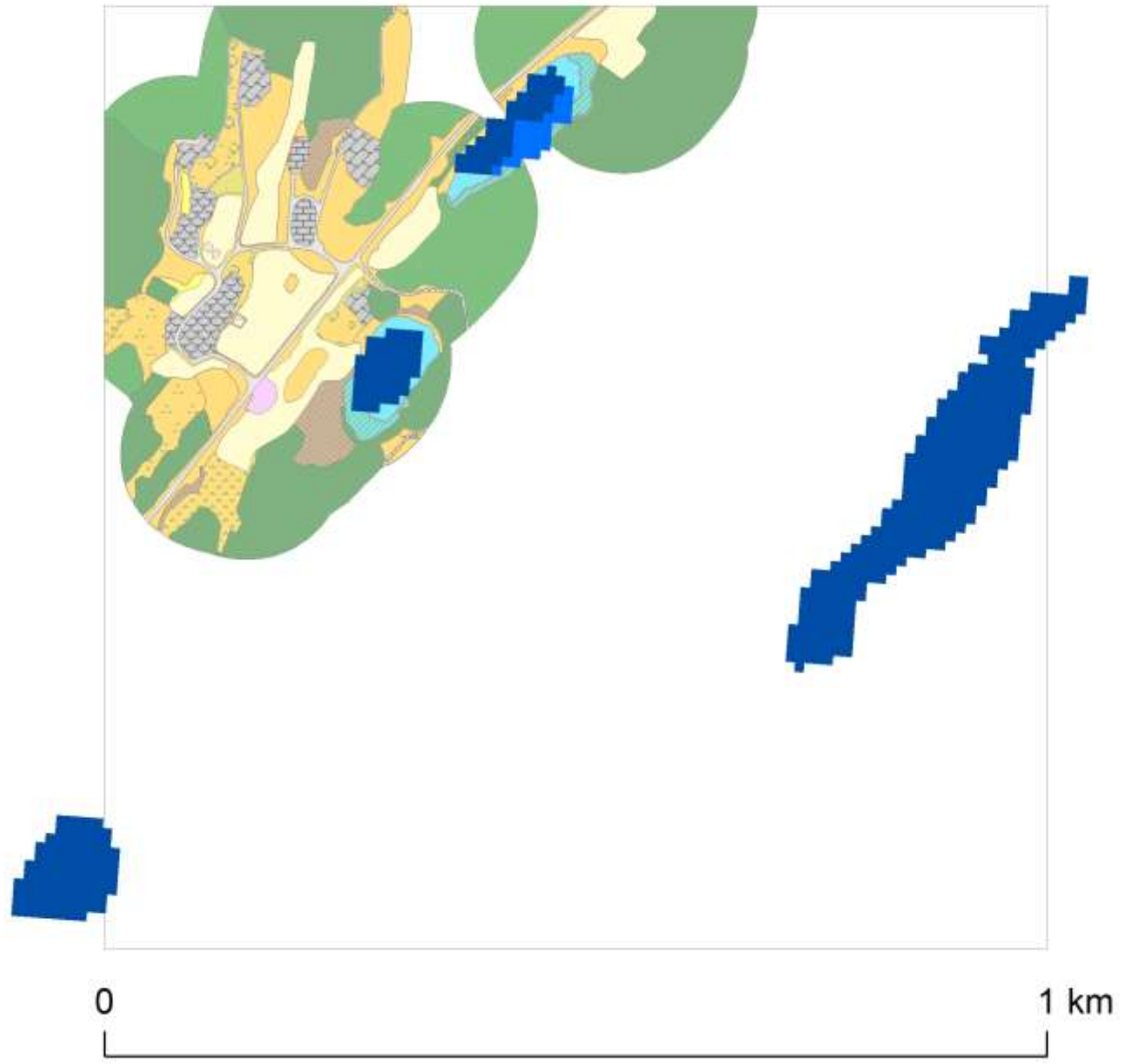
- Freshwater
- Seawater
- Wetlands

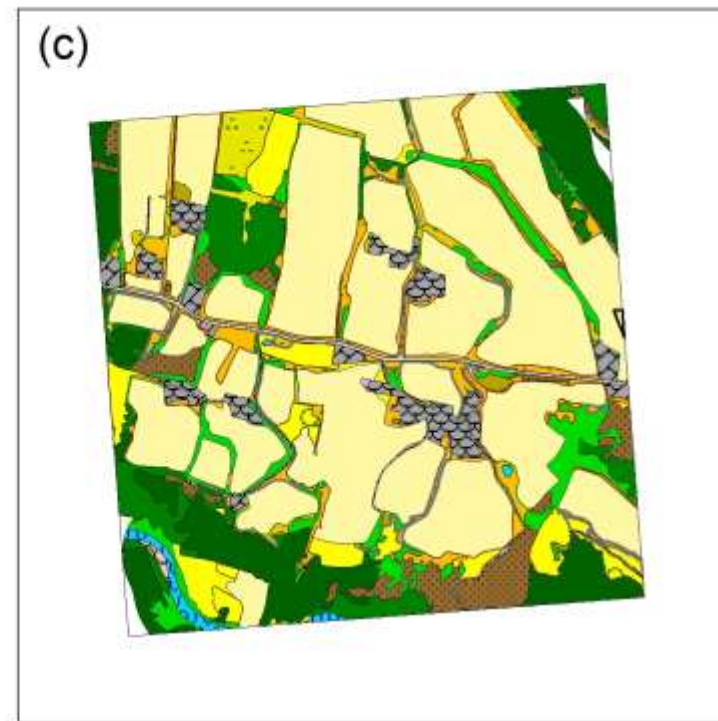
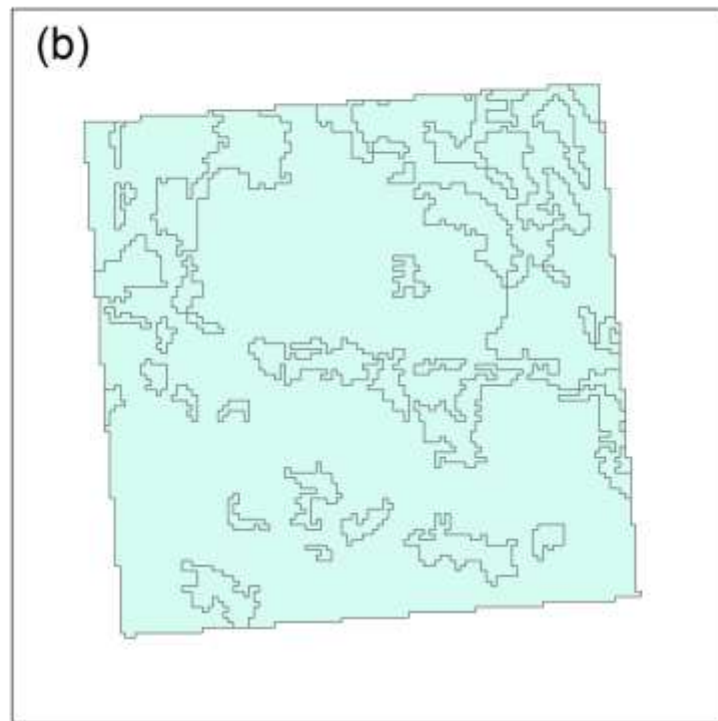
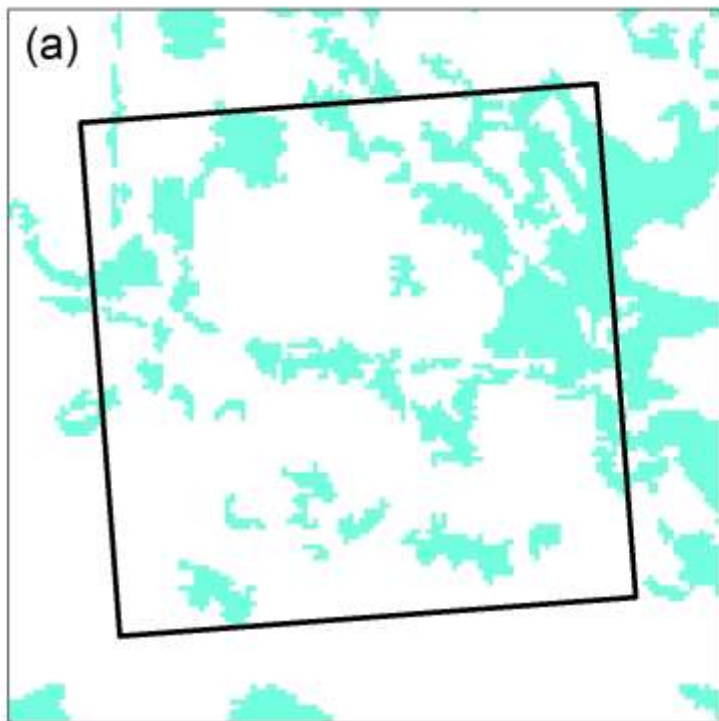
Point objects

- Water habitat island
- Wetland habitat island
- Farm pond

Linear objects

- Stream
- Ditch





0 1 000 m

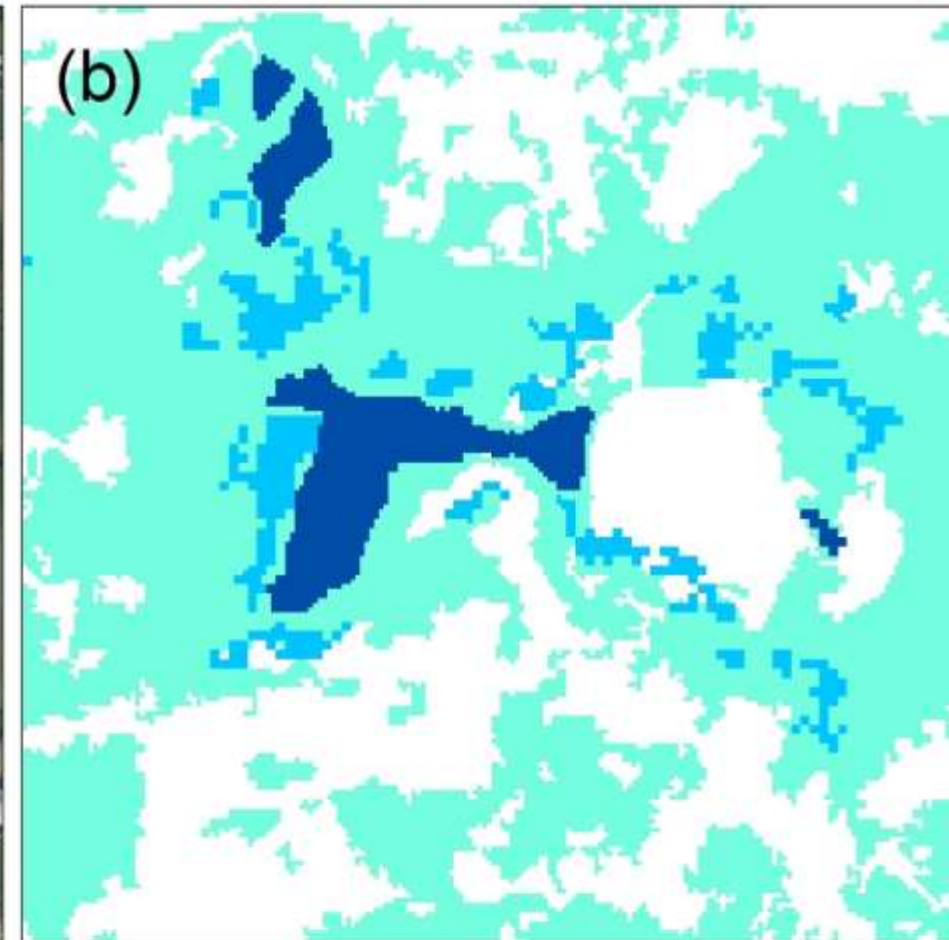


A scale bar indicating a distance of 1 000 m, starting from 0.

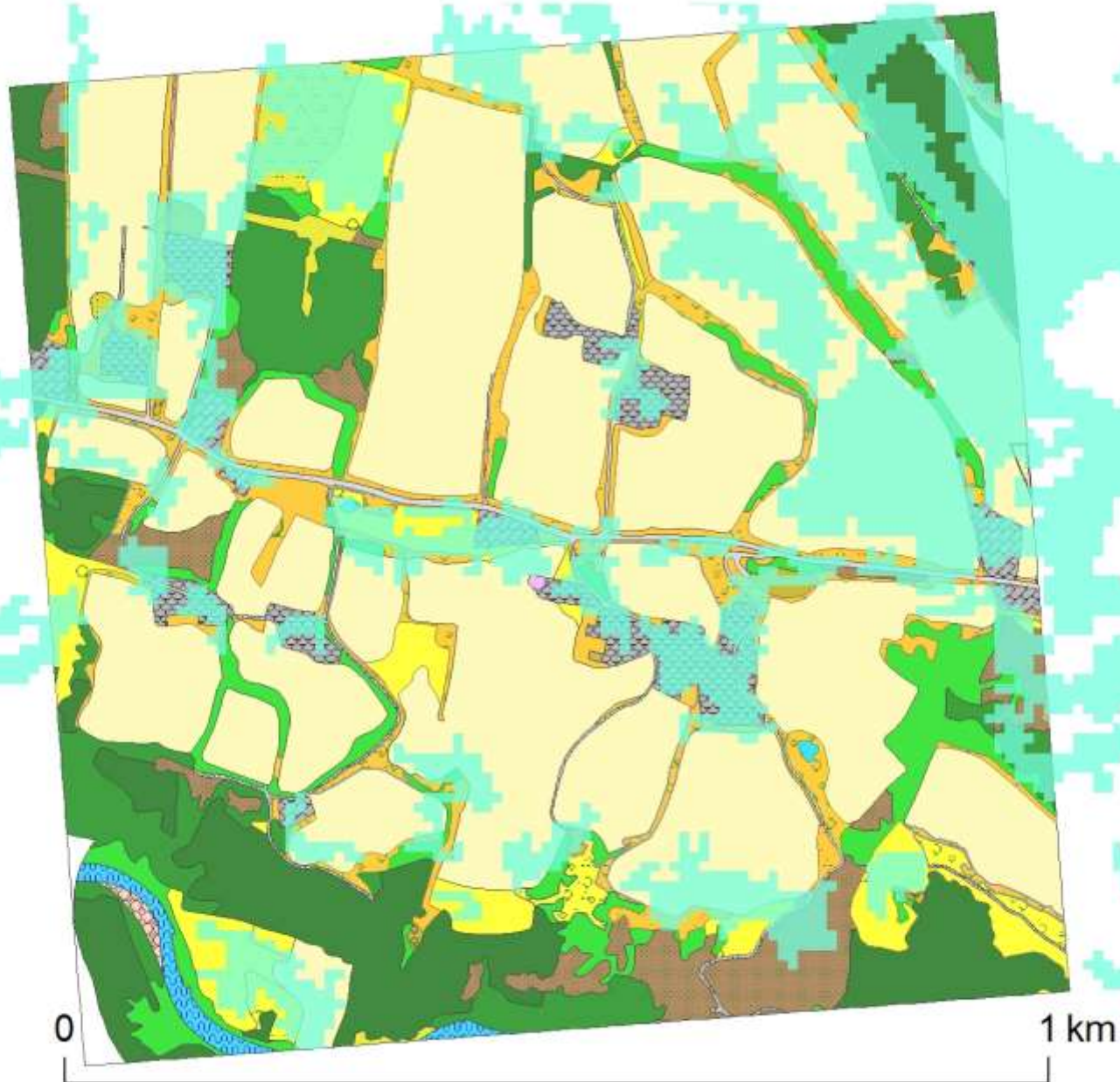
Table 17: Producer accuracy: how often water and wetness in the 3Q Monitoring Programme is correctly shown in HRL-WAW, i.e. the percentage distribution of each 3Q class among the WAW classes, where 100 % is the total area in each 3Q class (row sums). Grey cells are sub-classes under the main category 'Water'.

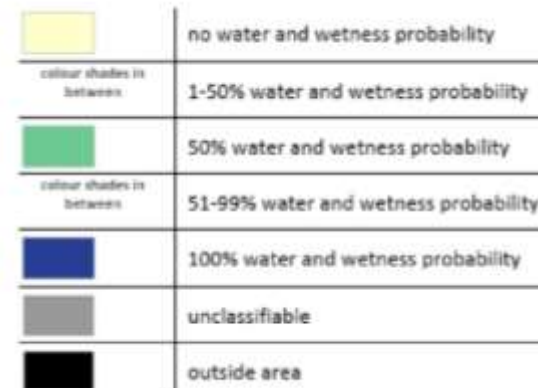
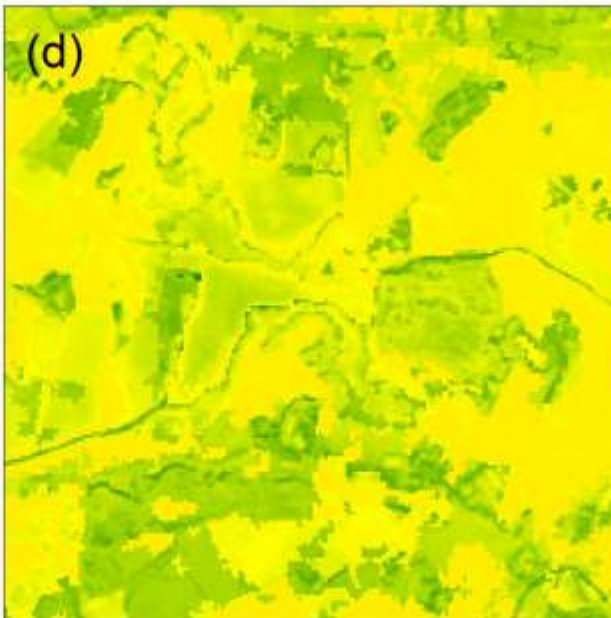
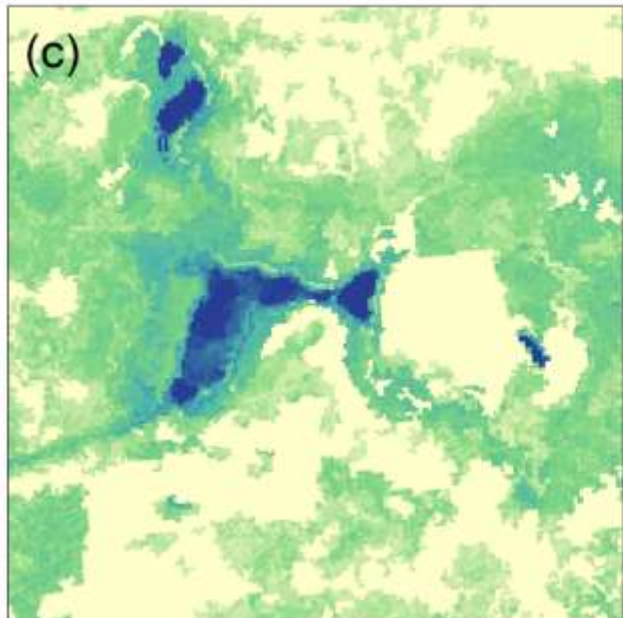
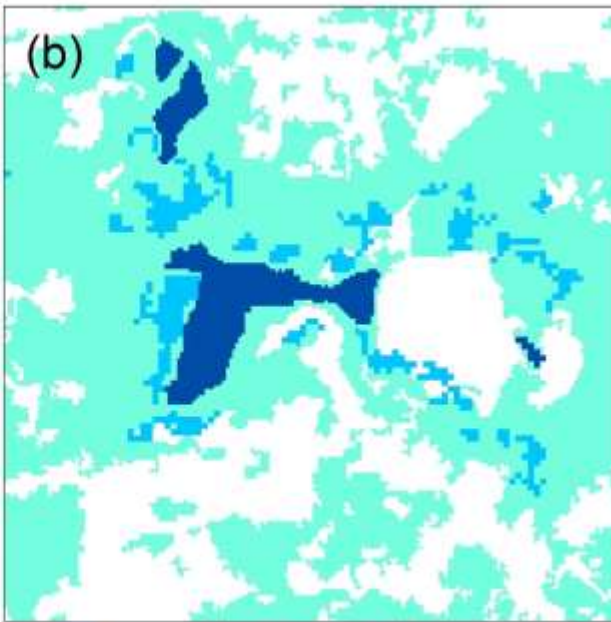
	Dry	Permanent water	Temporary water	Permanent wetness	Temporary wetness	Sea water	Total
Built-up/transport	68.3	0.0	0.0	0.1	31.4	0.1	100
Agricultural land	52.6	0.0	0.0	0.3	47.0	0.0	100
Forest and tree-covered land	93.6	0.1	0.0	0.2	6.1	0.0	100
Natural bare ground	63.3	2.5	0.4	0.0	22.5	11.2	100
Permanent unforested dry-land vegetation	63.1	0.1	0.0	0.2	36.7	0.0	100
Wetland	40.9	0.4	0.2	0.6	57.8	0.0	100
Fresh water	24.9	58.2	1.0	0.2	15.7	0.0	100
Rivers and streams	36.1	41.8	1.7	0.3	20.0	0.1	100
Canals and other artificial waterways	44.4	0.9	0.0	0.9	53.8	0.0	100
Tarns, ponds and lakes	16.4	70.7	0.5	0.1	12.3	0.0	100
Sea water	24.9	0.9	0.1	0.0	1.4	72.8	100
Total	67.3	1.9	0.1	0.2	28.8	1.8	100

Temporary wetness



Patterns?





Inconada project

<https://inconada.eu/>

Work package 4: Land Cover / Land Use for agricultural sector

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The research leading to these results has received funding from the Norway Grants 2014-2021 via the National Center for Research and Development

Enhancing the user uptake of Land Cover / Land Use
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**WP5: LCLU for Environmental Monitoring
Norway**

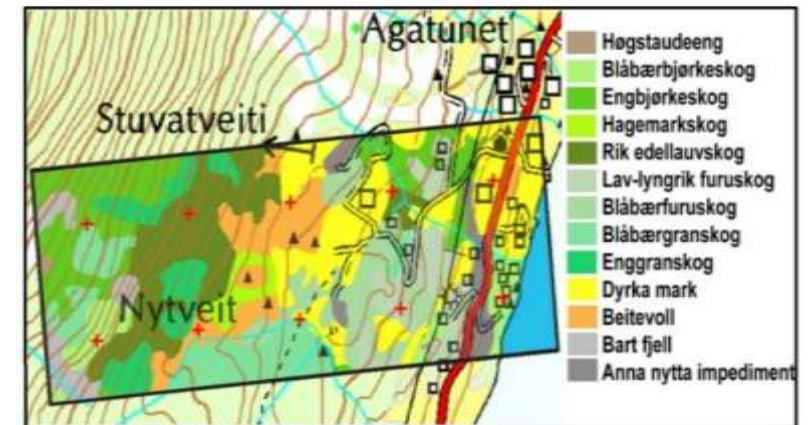
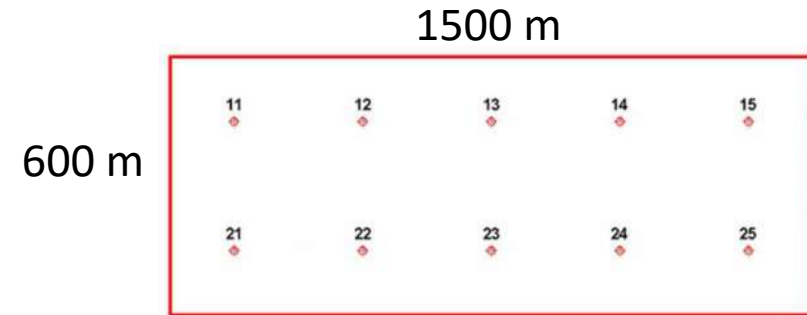
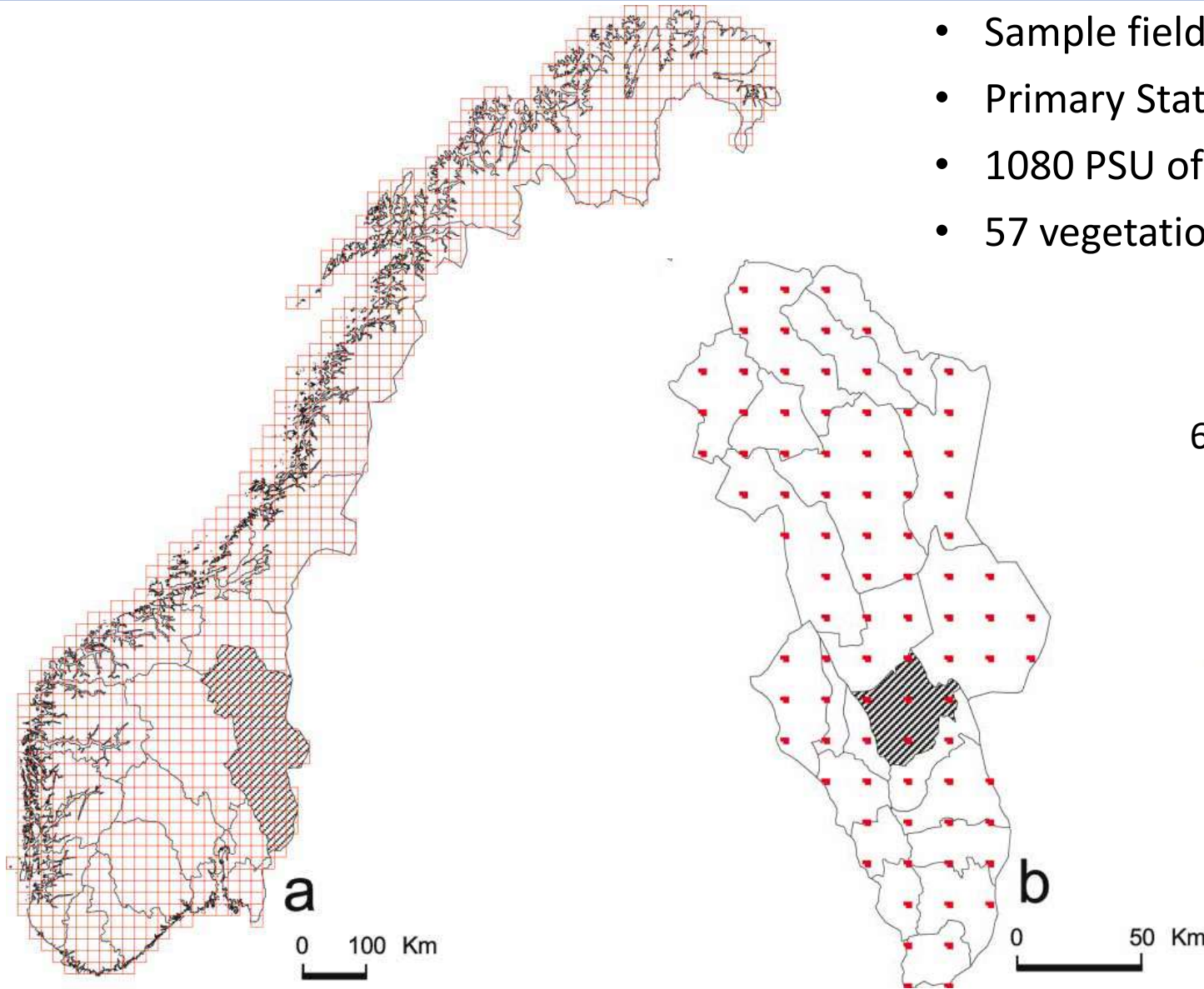
WP5 Task 5.1 - HRL Water and Wetness

Exploring the potential of HRL WAW for peatland and wetland detection and monitoring

- Peatland and wetlands are important for biodiversity
- Organic soils store large amounts of carbon
- Many drivers of change (building/infrastructure, climate change, expanding bioeconomy, new cultivation, abandonment of outfield grazing...)
- Norway's National Land Resource Map (AR5) covers 60 % of the country - primarily land below the treeline
- We do not have a good map of wetlands in the mountains

Area Frame Survey for Norge - AR18 x 18

- Sample field mapping
- Primary Statistical Unit at centre of 18×18 km squares
- 1080 PSU of 1500×600 m (0.9km^2)
- 57 vegetation types



Which WAW classes do we find in each vegetation type?

Producer's accuracy - how often are real features on the ground correctly shown on the map

	Dry	Permanent water	Temporary water	Permanent wetness	Temporary wetness	Sea water	Unclassifiable	Total
Built-up land	83.8	0.3	0.2	0.0	15.6	0.1	-	100
Farmland	56.0	0.0	0.0	0.1	43.9	0.0	-	100
Dry open land below the treeline	44.2	0.0	0.1	0.1	54.8	0.8	-	100
Damp heath/meadows below treeline	45.1	0.1	0.1	0.1	53.6	1.0	-	100
Alpine meadow communities	37.5	0.1	0.2	0.0	61.9	0.2	0.1	100
Alpine dry heath communities	38.2	0.1	0.1	0.0	61.4	0.0	0.2	100
Alpine damp heath	48.9	0.0	0.0	0.0	51.0	-	0.1	100
Forest	89.0	0.1	0.0	0.0	10.8	0.0	-	100
Peatland forest	81.6	0.1	0.0	0.3	18.0	0.0	-	100
Wetlands	26.0	0.2	0.1	0.8	72.9	0.0	-	100
Barren land, boulders, bedrock	77.9	0.4	0.4	0.0	8.7	0.4	12.2	100
Snow-bed vegetation	62.9	0.1	0.2	0.0	35.4	0.0	1.3	100
Glaciers and perpetual snow	24.5	-	-	-	0.0	-	75.4	100
Freshwater	11.2	76.2	2.2	0.1	9.9	0.0	0.4	100
Seawater	7.5	0.0	0.0	0.0	0.7	91.8	-	100
Total	58.1	4.1	0.2	0.1	31.7	4.3	1.6	100

Key points:

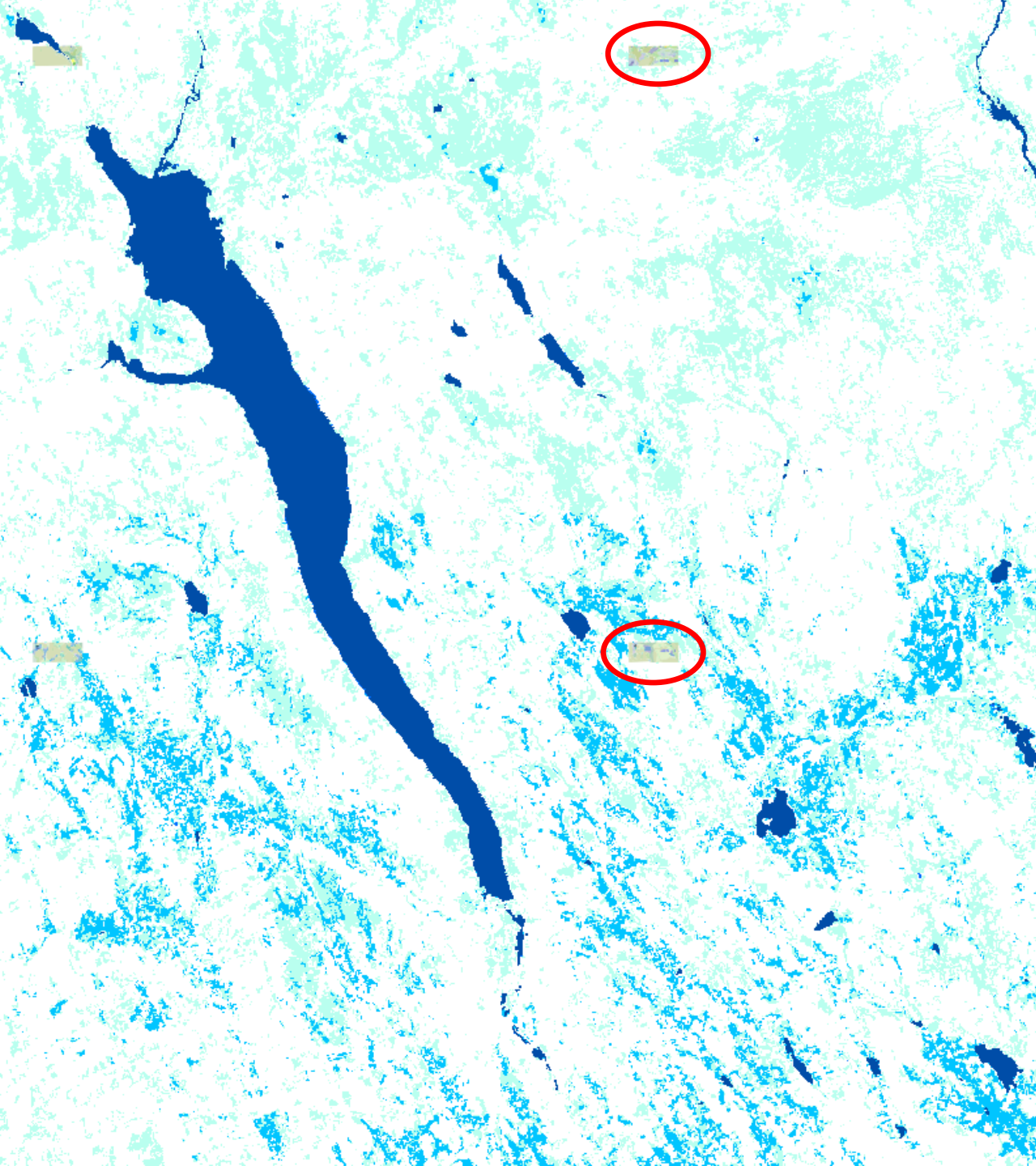
- Permanent water in WAW is usually correct
... but some water is missing (11 % in class 0)
- 67 % of permanent wet (class 3) is wetland
... but only 0.8 % of wetlands are classified as permanent wet
- 73 % of wetlands are classified as temporary wet
... but 26 % are classed as dry
- There seems to be too much temporary wet: over half of heath, meadows and other open dry land

8.5 % of Norway is wetland, but only 0.1 % of HRL-WAW is class 3

Little difference between wetland types

	Dry	Permanent water	Temporary water	Permanent wetness	Temporary wetness	Total	Area (km ²)
Peatland forest	81.6	0.1	0.0	0.3	18.0	100	35.1
Damp forest	71.1	0.0	0.0	0.0	28.8	100	9.2
Bog forest	73.1	0.0	0.0	1.3	25.6	100	6.2
Poor swamp forest	88.8	0.1	0.0	0.3	10.8	100	15.0
Rich swamp forest	90.0	0.1	-	0.0	9.9	100	4.7
Wetlands	26.0	0.2	0.1	0.8	72.9	100	78.4
Bog	29.9	0.1	0.0	0.8	69.2	100	21.0
Deer-grass fen	19.8	0.0	0.1	2.4	77.7	100	6.5
Fen	25.1	0.1	0.1	0.5	74.2	100	48.0
Mud-bottom fen and bog	25.7	1.4	0.1	1.9	71.0	100	2.2
Sedge marsh	29.5	14.7	2.9	0.4	52.5	100	0.7

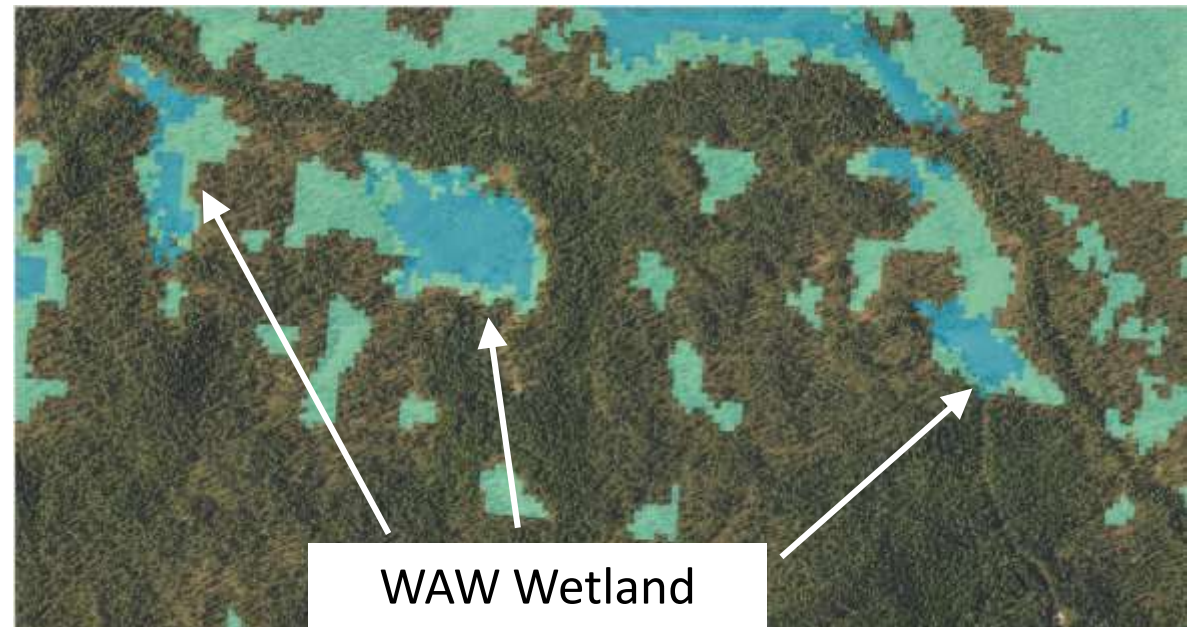
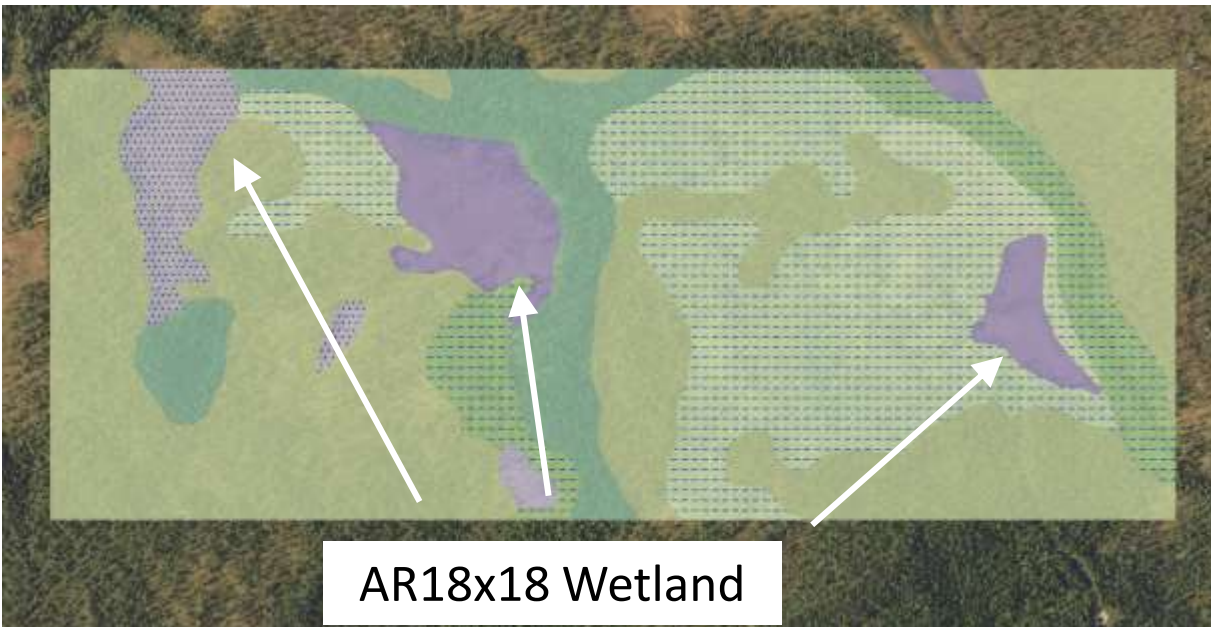
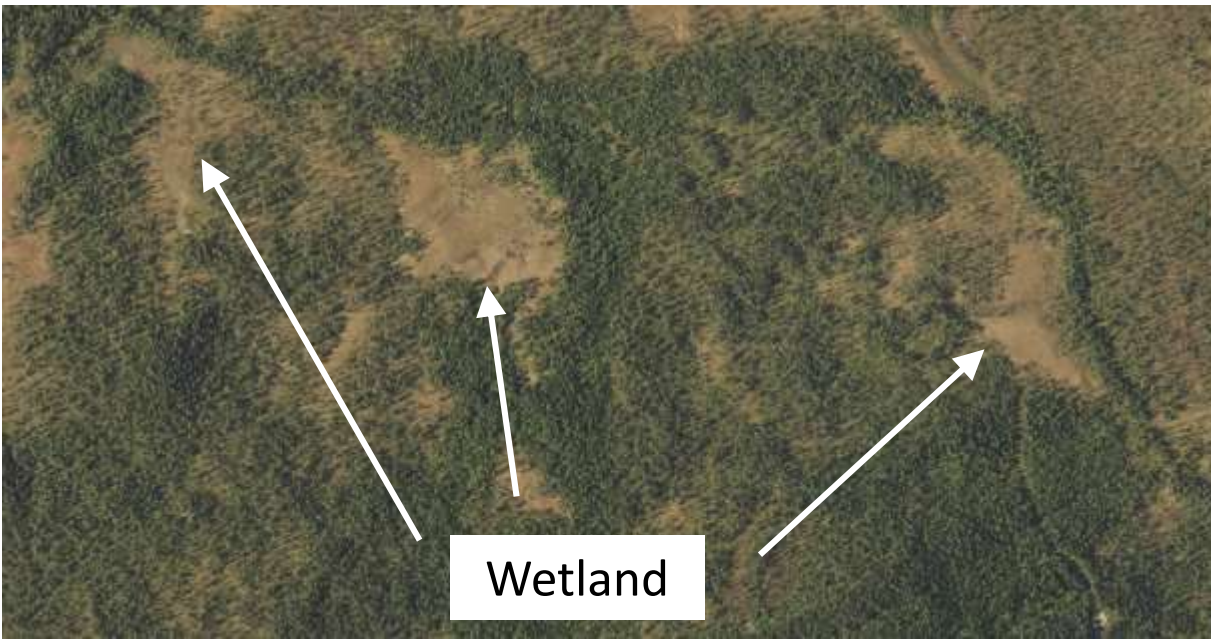




Class 3, permanent wetland, is almost absent

Class 3 is much more abundant in the lower part of the figure.

- In this area, rather good correspondence with class 3 in WAW



- Very similar landscape
- Bogs and fens
- Only temporary wet in WAW
- Class 3 is missing
- The river (class 1) is also missing



WP5: LCLU for environmental monitoring

- We appreciate that definitions do not fully overlap, nevertheless...
- A third of Norway is classified as Temporary Wet – this is too much (to be useful)
- Only 0.1 % is classified as Permanent Wet – this is too little
- Ground truth = 8.5 % wetlands (+ 3.8 % peatland forest)



Inconada project

<https://inconada.eu/>

Work package 5: Land Cover / Land Use for Environmental Monitoring

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Enhancing the user uptake of Land Cover / Land Use information
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HRL-WAW comparison with national data in Poland

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Institute of Geodesy and Cartography

1. Work package 4: Land Cover / Land Use for agricultural sector:

Assessment of potential and accuracy of HRL-WAW for assessment of agricultural landscapes and Ecological Focus Areas (EFA):

- WAW vs national LC database (BDOT10K)
- WAW vs EFA elements

2. Work package 5: Land Cover / Land Use for Environmental Monitoring

Assessment of potential and accuracy of HRL-WAW for assessment of agricultural landscapes and Ecological Focus Areas.

In 2013, the European Commission introduced a green direct payment scheme (greening) as part of the CAP.

There are actions that farmers have to put in place:

Maintaining permanent grassland - the ratio of permanent grassland to agricultural land is set by EU countries at national or regional level (with a 5% margin of flexibility). Moreover, EU countries designate areas of environmentally sensitive permanent grassland. Farmers cannot plough or convert permanent grassland in these areas.

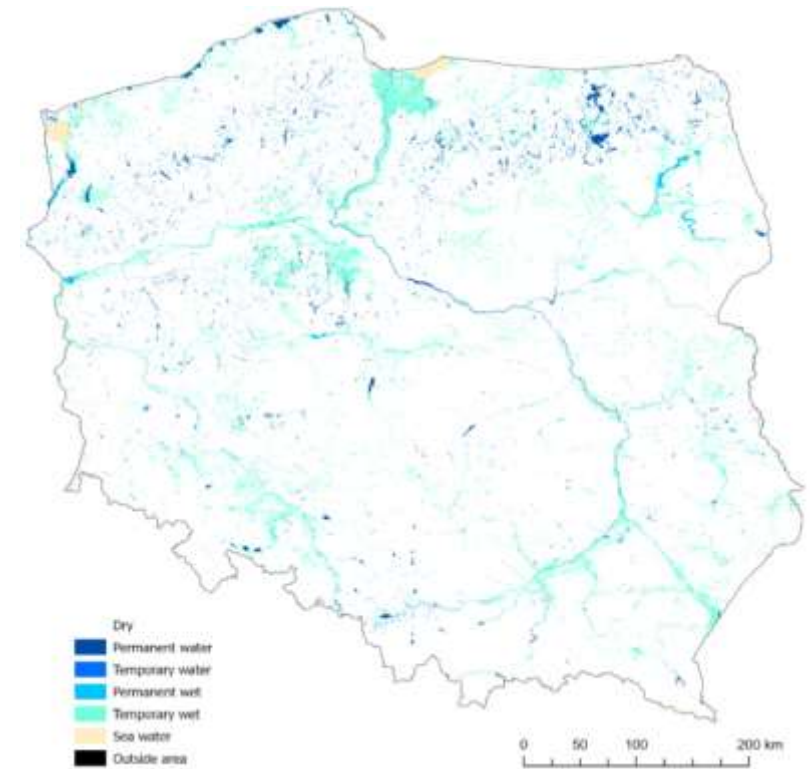
Ecological Focus Areas (EFA) - farmers with arable land exceeding 15 ha must ensure that at least 5% of their land is an Ecological Focus Area in order to safeguard and improve biodiversity on farms.

WAW_2018_010m_Poland_02180_V10

WWPI_2018_010m_Poland_02180_V10

WAWCL_2018_010m_eu_03035_V1_0 (48 tiles)

Analysis conducted at the country scale



Topographic database (BDOT10K)

Water areas class:

- Rivers and streams, with the minimum width of 5 m for running or standing water,
- Lakes and ponds, with the minimum width of 5 m and minimum area of 80 m², ponds smaller in size are included in other land cover classes.

Sea water – including the waters of ports defined seaward by a line connecting the furthest permanent port facilities that are an integral part of the port system.

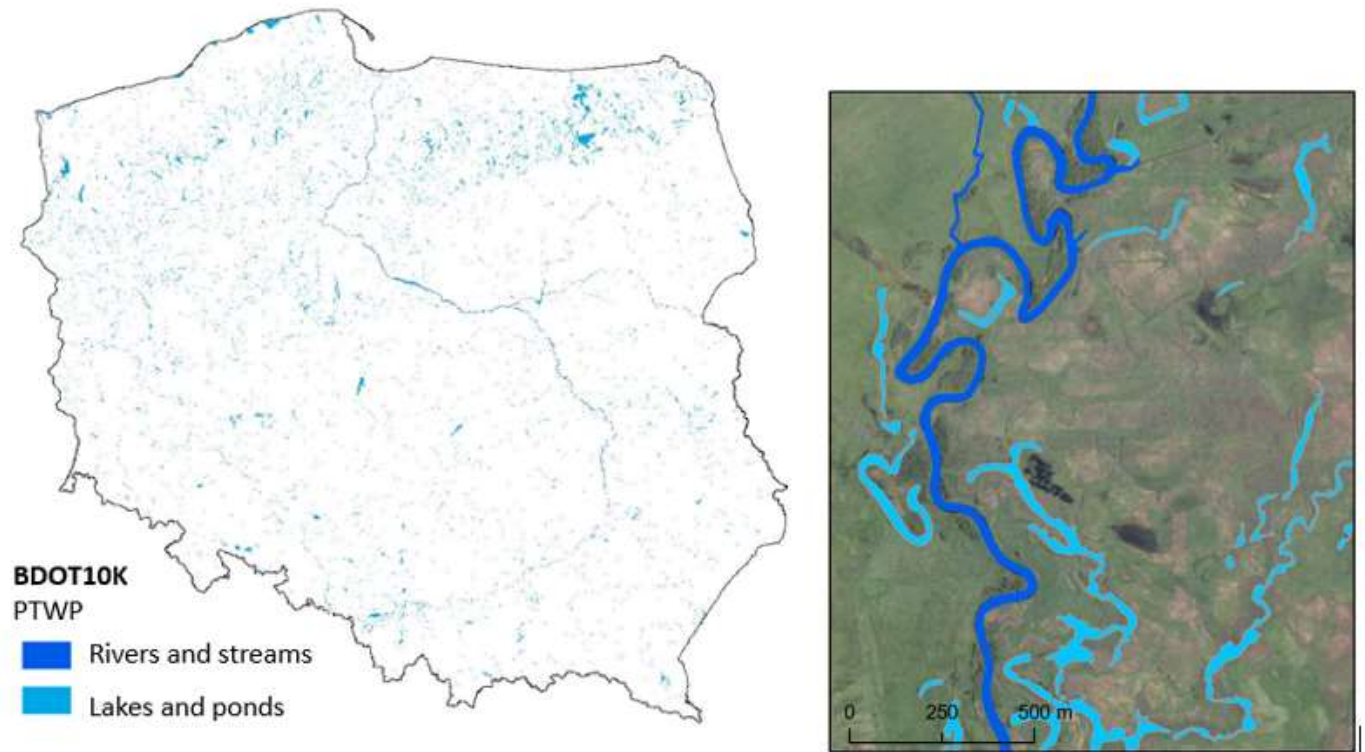
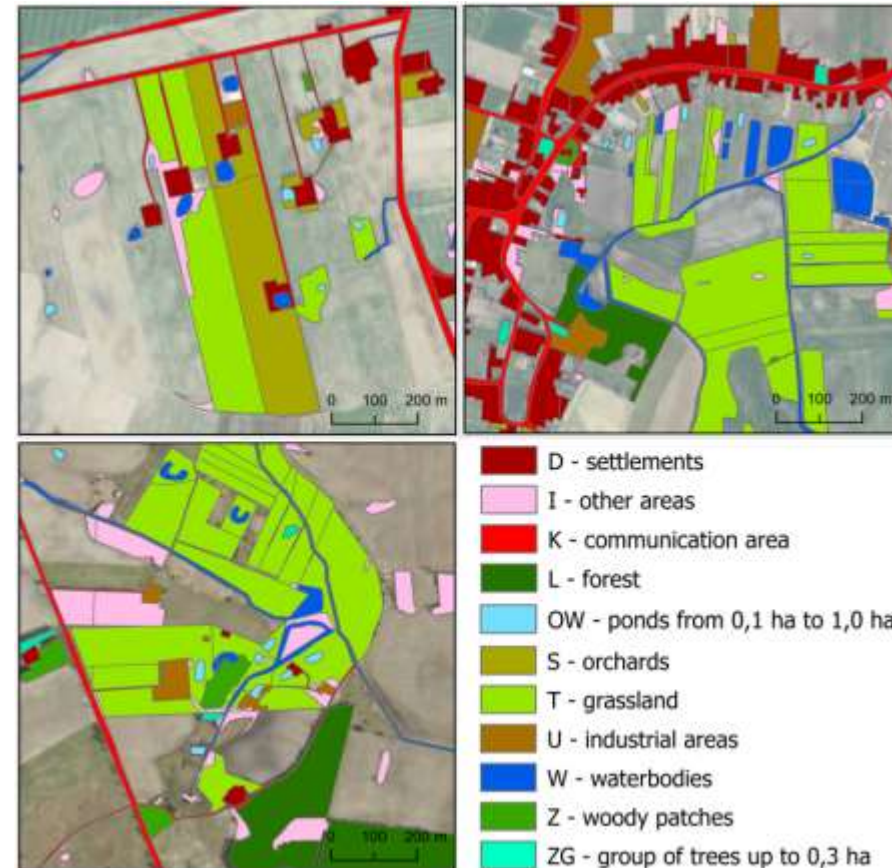


Figure 2: Visualisation of Fresh water areas (PTWP) divided into two classes: 1) rivers and streams, and 2) lakes and ponds derived from the BDOT10K database in Poland.

Land Parcel Identification System (LPIS)

- LC layer called 'management fields', which contains the basic land cover classes: arable land, settlements, forest, orchards, communication area, grasslands, high value grasslands, industrial areas, waterbodies, woody patches and other areas, agroforest areas, short rotation woodlands
- Ecological Focus Areas (EFA) elements:
 - group of trees up to 0.3 ha (compared vs SWF)
 - ponds less than 0.01 ha
 - ponds from 0.01 ha to 0.1 ha
 - ponds from 0.1 ha to 1.0 ha



- Detailed analysis of the nomenclature and definitions of the water and wetness classes in the national databases.
- Thematic accuracy:

User accuracy: how often the WAW class is actually present in the national dataset, i.e. the percentage distribution of each WAW class amongst the national dataset classes (where 100 % is the total area in the WAW class).

Producer accuracy: how often water and wetness in the national dataset is correctly shown in HRL-WAW, i.e. the percentage distribution of each national water or wetness class among the WAW classes (where 100 % is the total area in the national water or wetness class).

- Spatial accuracy

The **thematic accuracy** was assessed using the rasterised national land cover classes, whereas the **spatial accuracy** was performed using the vector format.

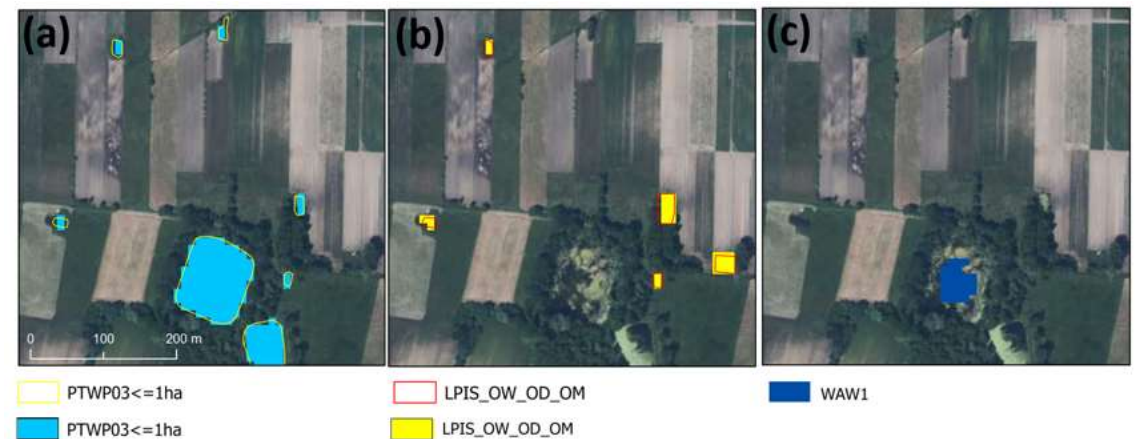


Figure 8: In Poland, the spatial overlay was done using raster data. Example of the rasterised BDOT PTWP- Water class (a), LPIS-EFA ponds (b) and HRL-WAW (c).

WAW classes vs. BDOT Land Cover classes in Poland (total area 312 472 km²).

- WAW underestimates water area WAW (Permanent water and Temporary water) occupy 1.5 % (4 272 km²) ; water classes in BDOT cover 2 % (6 100 km²)
- 7% of Poland covered by WAW (exc. Dry cl.)
- WAW - Temporary water class covers just 0.04 % of the country area (118 km²), which indicates large underestimation of this class

WAW class	%	BDOT LC class	%
Dry	92.7	Dry land	97.8
		Built-up land	4.7
		Agricultural land (Grasslands arable land)	57.4
		Forest and tree cover land	34.1
		Permanent crop	1.3
		Unused land	0.1
		Mine, dumps	0.1
		Other non-built-up areas	0.1
Permanent wetness	0.3		
Temporary wetness	5.3		
Permanent water	1.4	Fresh water	2.0
		Rivers and streams	0.3
		Lakes, ponds	1.7
Temporary water	0.04		
Sea water	0.2	Sea water	0.2
Total	100.0	Dry land + Water areas	100.0

Table 5: Producer accuracy: how often the BDOT10K Land Cover is correctly shown in HRL-WAW, i.e. the percentage distribution of each LC class among the WAW classes, where 100 % is the total area in each BDOT LC class (row sums); grey cells are sub-classes under the main category 'Fresh water'.

	Dry	Permanent water	Temporary water	Permanent wetness	Temporary wetness	Sea water	SUM
Built-up areas	99.6	0.0	0.0	0.0	0.4	0.0	100.0
Forest, and tree cover land	99.5	0.0	0.0	0.2	0.3	0.0	100.0
Permanent crop	98.0	0.0	0.0	0.0	2.0	0.0	100.0
Agricultural land	90.9	0.0	0.0	0.4	8.7	0.0	100.0
Unused land	91.4	2.6	0.6	0.3	4.0	1.2	100.0
Mine, dumps	88.9	3.4	2.4	0.7	4.5	0.0	100.0
Other non-built-up areas	94.8	3.0	0.5	0.1	1.6	0.0	100.0
Fresh water	19.9	69.2	0.8	1.5	8.3	0.3	100.0
Rivers and streams	28.7	55.0	1.0	2.4	12.8	0.1	100.0
Lakes, ponds	18.1	72.2	0.7	1.3	7.4	0.3	100.0
Sea water	1.2	0.7	0.0	0.4	0.1	97.7	100.0
SUM	92.7	1.4	0.0	0.3	5.3	0.2	100.0

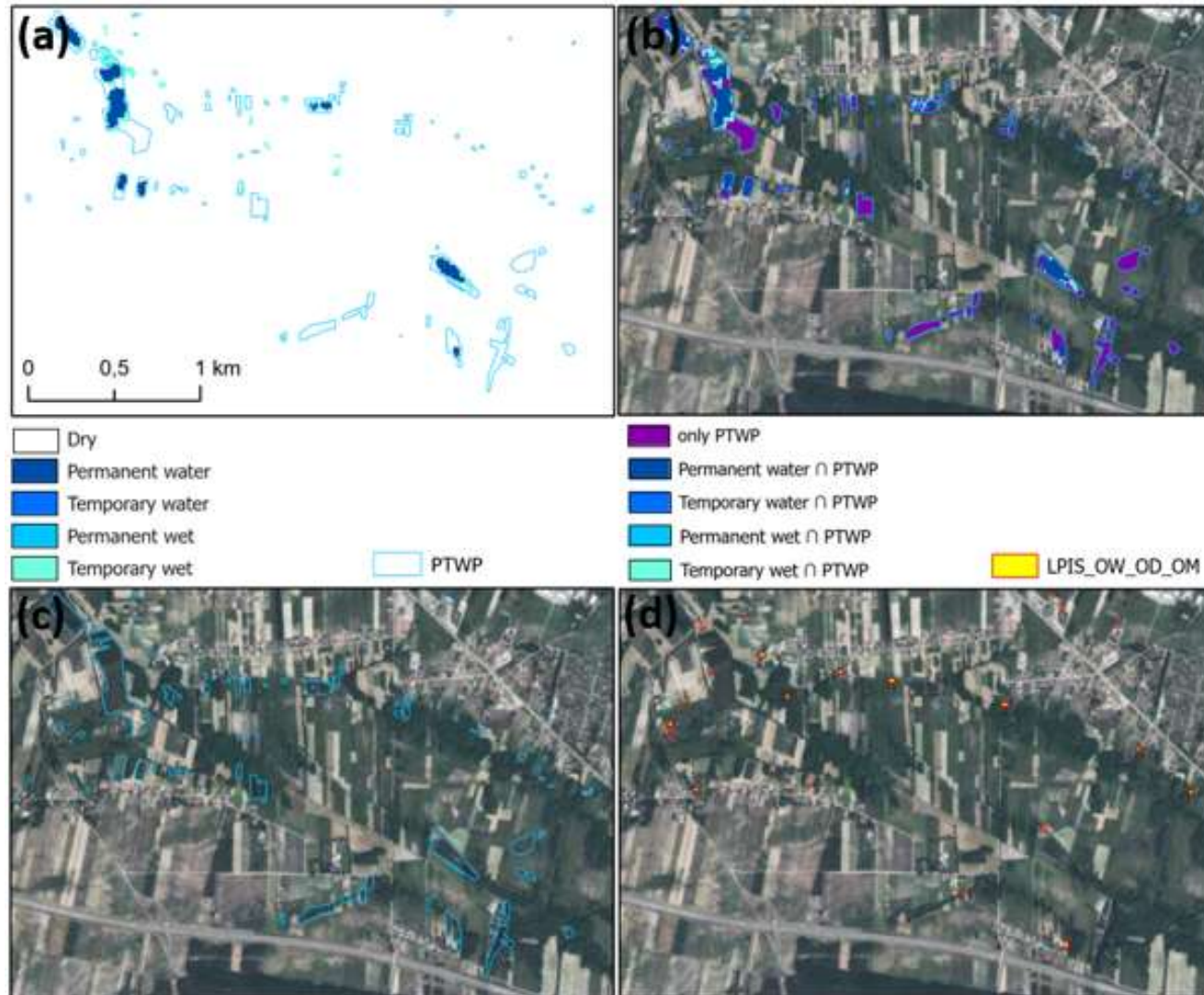


Figure 12: Lakes and ponds: (a) WAW four classes, (b) the result of the comparison of WAW classes with BDOT-PTWP), and (c) BDOT-PTWP, (d) LPIS-EFA ponds overlay on the aerial orthophotos

The area (in hectares) and proportion (in %) of each LPIS-EFA ponds: OM, OD, OW classes among the WAW classes, where 100 % is the total area in each LPIS-EFA class

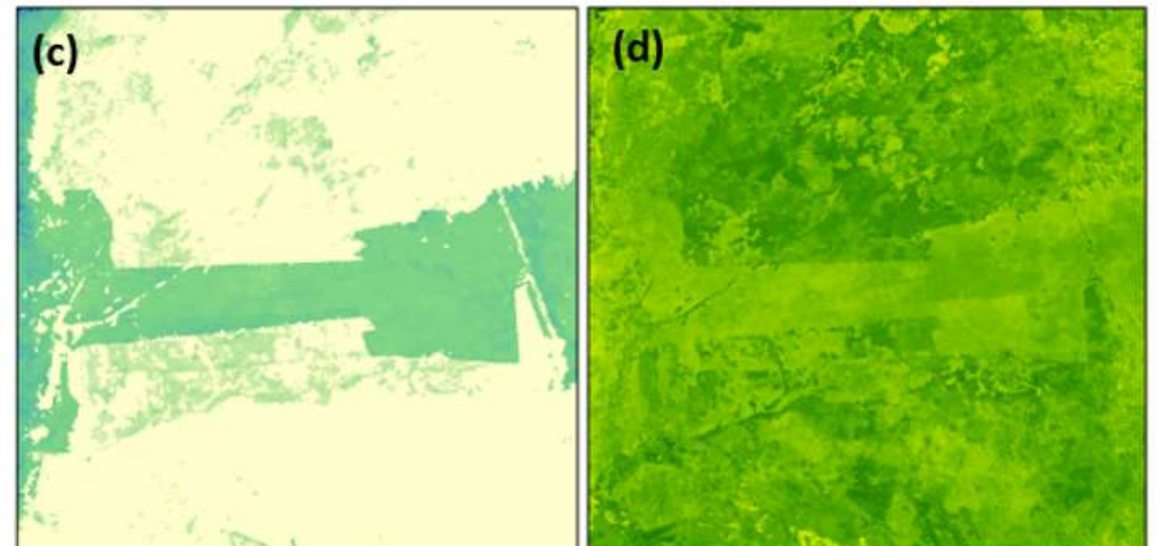
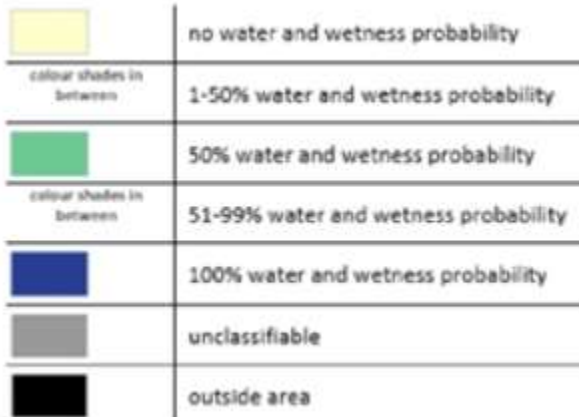
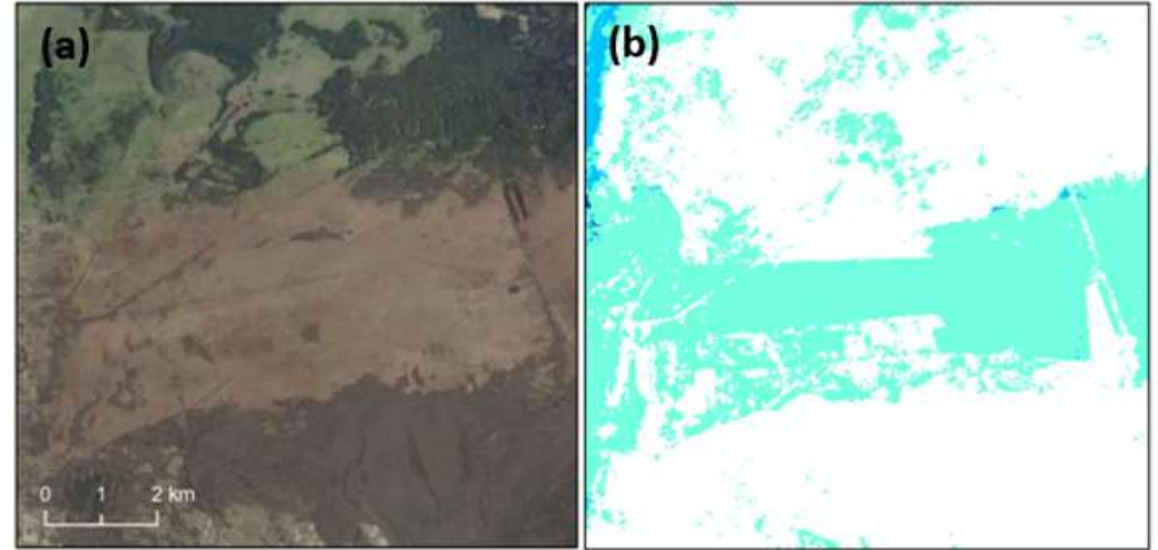
Class	Permanent water	Temporary water	Permanent wetness	Temporary wetness	Dry	SUM (all classes)
	hectares					
OM: ponds ≤ 0.01 ha	0.03	0.02	0.54	7.08	103.97	111.64
OD: ponds 0.01 - 0.1 ha	4.40	2.62	17.62	292.59	6 522.27	6 839.50
OW: ponds 0.1 – 1.0 ha	0.00	0.00	0.00	0.39	2.40	2.79
SUM	4.43	2.64	18.16	300.06	6 628.64	6 953.93
	%					
OM: ponds ≤ 0.01 ha	0.03	0.02	0.48	6.34	93.13	100.00
OD: ponds 0.01 - 0.1 ha	0.06	0.04	0.26	4.28	95.36	100.00
OW: ponds 0.1 – 1.0 ha	0.00	0.00	0.00	13.98	86.02	100.00
SUM	0.06	0.04	0.26	4.31	95.32	100.00

The area (in hectares) and proportion (%) of BDOT EFA-corresponding ponds among the WAW classes, where 100 % is the total area in each BDOT pond size

Class	Permanent water	Temporary water	Permanent wetness	Temporary wetness	Dry	SUM (all classes)
	hectares					
BDOT ponds ≤ 0.01 ha	0.23	0.06	0.61	5.30	116.00	122.20
BDOT ponds 0.01 - 0.1 ha	19.39	11.88	131.24	917.56	15 704.97	16 785.04
BDOT ponds 0.1 – 1.0 ha	3 073.28	405.88	1 089.23	5 724.48	30 367.76	40 660.63
SUM	3 092.90	417.82	1 221.08	6 647.34	46 188.73	57 567.87
	%					
BDOT ponds ≤ 0.01 ha	0.19	0.05	0.50	4.34	94.93	100.00
BDOT ponds 0.01 - 0.1 ha	0.12	0.07	0.78	5.47	93.57	100.00
BDOT ponds 0.1 – 1.0 ha	7.56	1.00	2.68	14.08	74.69	100.00
SUM	5.37	0.73	2.12	11.55	80.23	100.00

A meandering river surrounded by grasslands: (a) orthophoto map, (b) WAW, (c) WWPI and (d) WAWCL

Position: 22,5603647°E 53,2817549°N

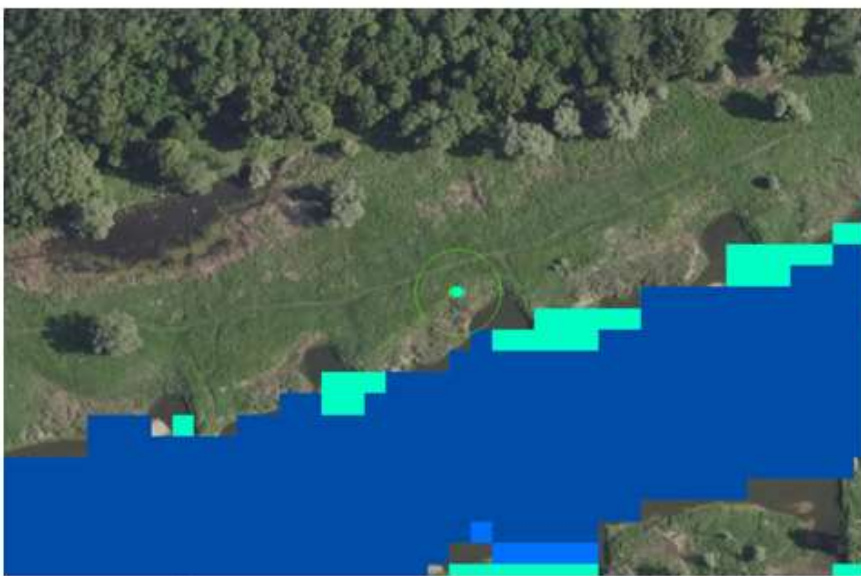
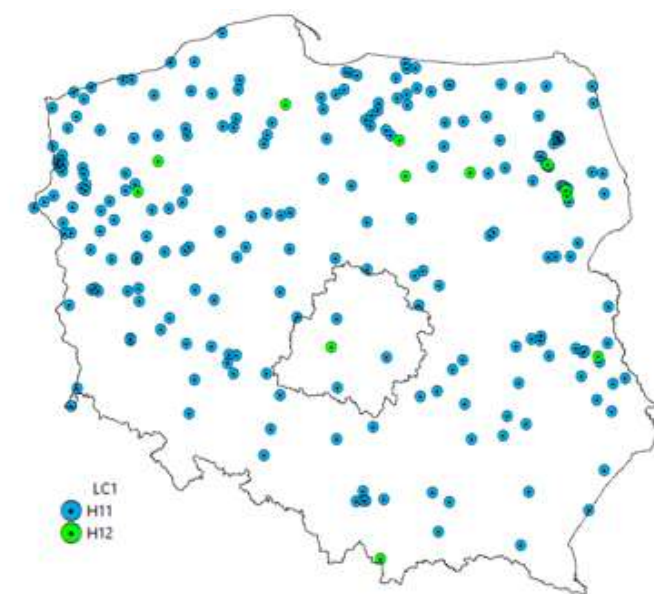


WAW vs. BDOT wetlands

HRL Water and Wetness vs. LUCAS H11+ H12

	HRL WAW	LUCAS
0 Dry	0	136
1 Permanent water	1	6
2 Temporary water	2	0
3 Permanent wet	3	37
4 Temporary wet	4	53
253 Sea water	253	0

LUCAS	232
compatible %	38,79
incompatible %	61,21



- Class_Name
- Dry
- Outside area
- Permanent water
- Permanent wet
- Sea water
- Temporary water
- Temporary wet

POINT ID	LC1	LC1 SPEC	LC1 PERC	LU1	LU1 TYPE	LU1 PERC	WAW 2018 010m pl 02180 V1 01	WWPI 2018 010m pl 02180 V1 01
48403330	H11	8	100	U420	8	100	1	50
49583458	H11	8	100	U420	8	100	1	18
48443412	H11	8	100	U420	8	100	1	54
51683456	H11	8	100	U420	8	100	1	27
52503054	H11	8	100	U420	8	100	1	80
46823328	H11	8	100	U420	8	100	1	63

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