Norway grants

The National Centre for Research and Development

Quality control of Copernicus High Resolution Layers for monitoring agricultural landscapes and wetlands

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

https://www.inconada.eu/

Project Promoter: Polish Institute of Geodesy and Cartography (IGiK)

Project Partners: Norwegian Institute of Bioeconomy Research (NIBIO)

Lodz University of Technology

Institute of Environmental Protection (IOŚ-PIB)

Eversis

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High Resolution Layer: Water & Wetness (WAW)

Aim: to explore the potential of HRL-WAW for monitoring water and wetland features in agricultural landscapes and throughout the country in Norway and Poland.

- Peatland and wetlands are important for biodiversity
- Organic soils store large amounts of carbon
- Many drivers of change: building, infrastructure, climate change, drainage, new cultivation, afforestation…
- Existing national maps are not sufficiently accurate and updated to allow monitoring

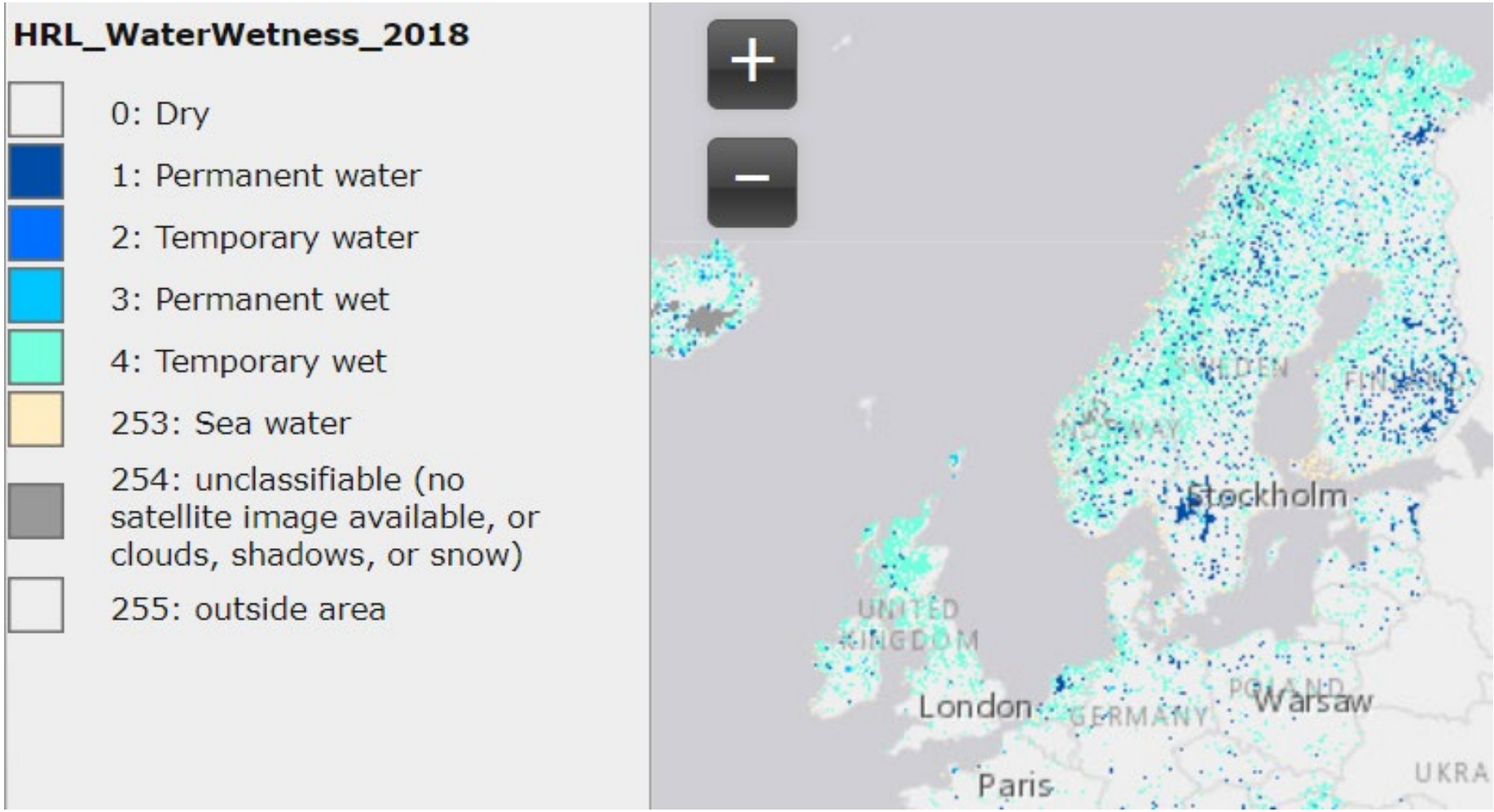
High Resolution Layer: Water & Wetness (WAW)

Spatial resolution
10 x 10 m

Reference year
2018 (2012-2018)

Input
- Sentinel-2
- Sentinel-1
- …

Production
- NDWI
- Soil moisture
- …



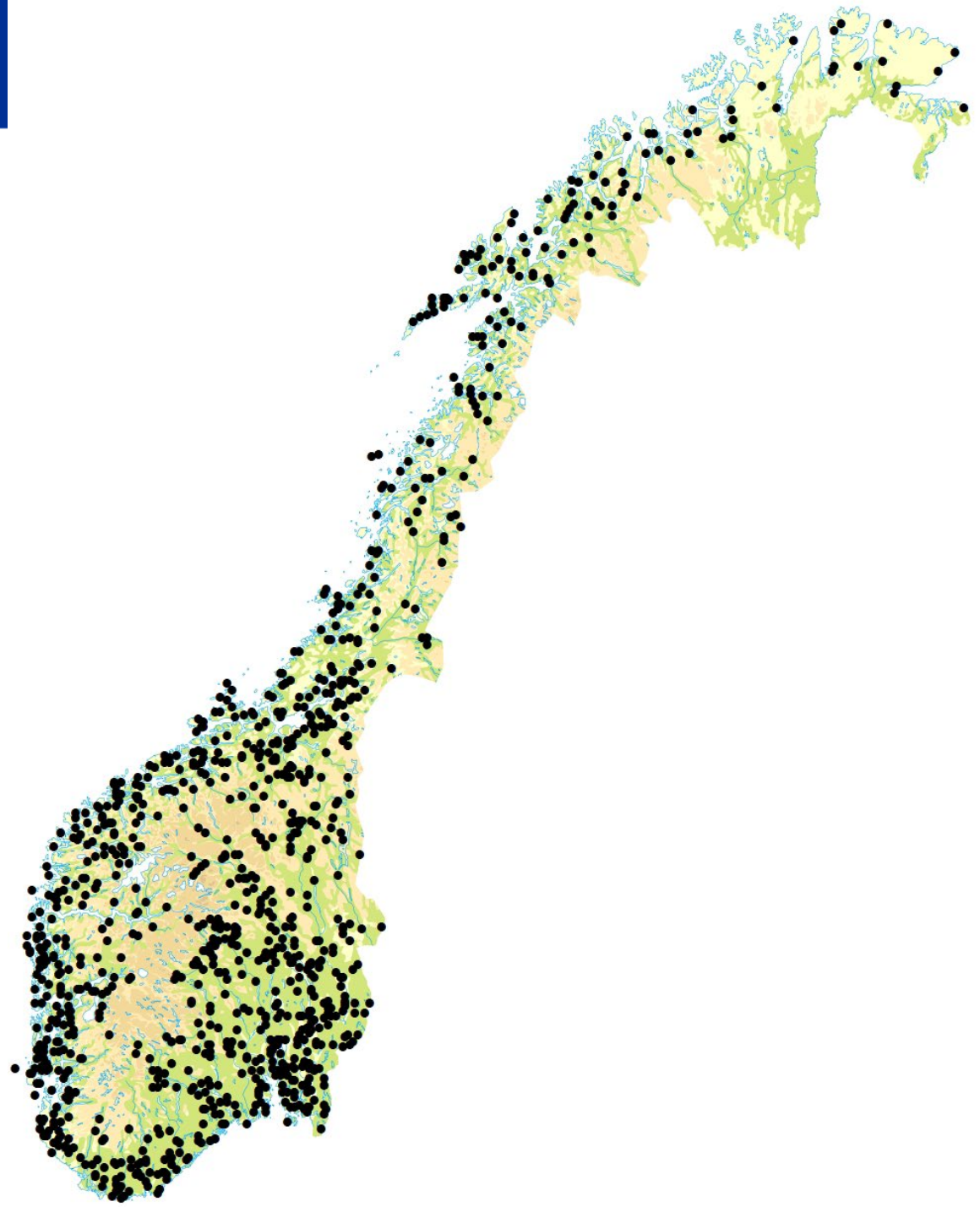
HRL-WAW accuracy and potential in Norway

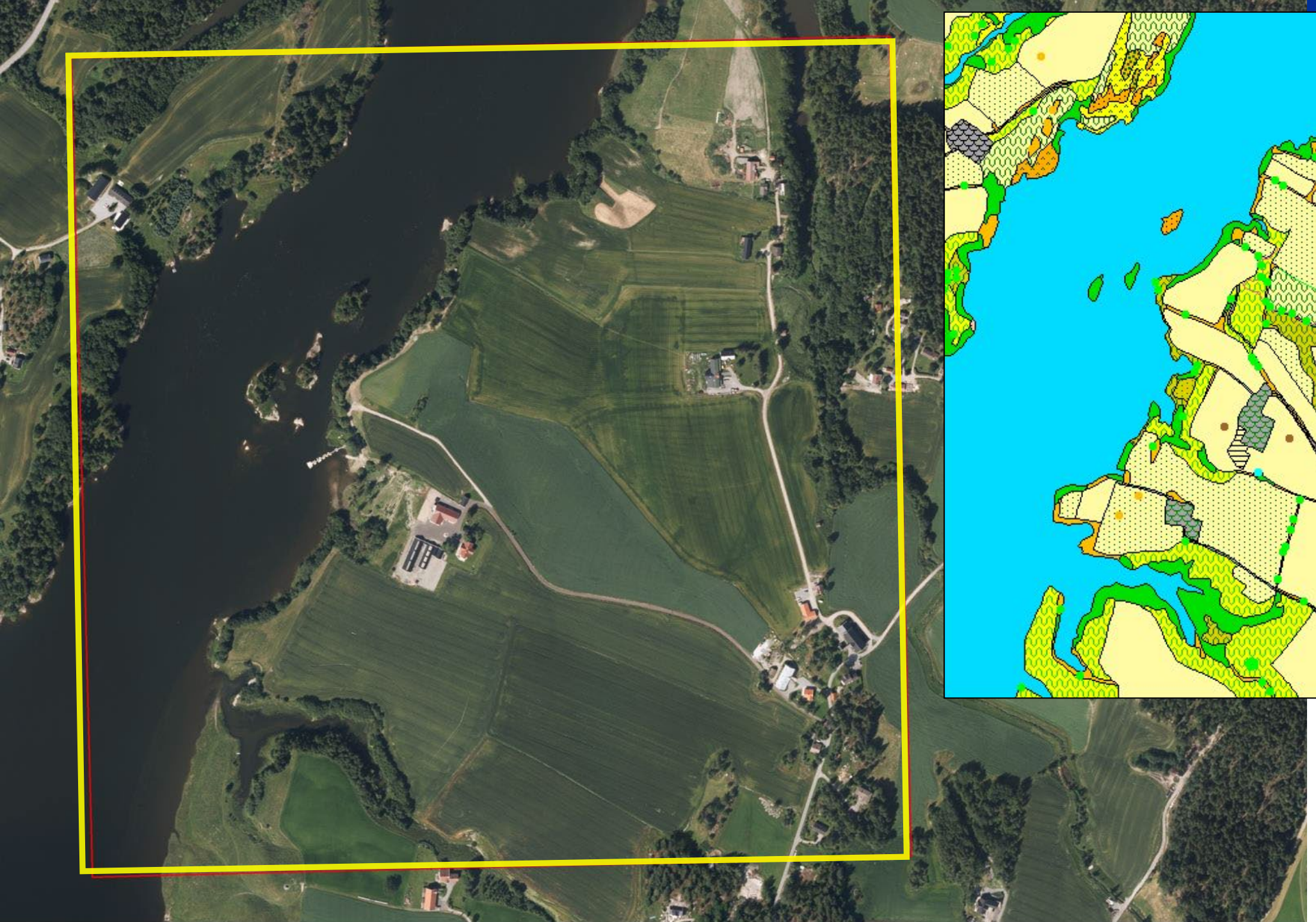
For Norway, we compared with 3 national datasets:

- Agricultural monitoring program: 3Q – 1000 sample squares mapped from aerial photos, stratified sample
- Area Frame Survey: AR18x18 – 1000 sample squares mapped in the field, systematic sample
- Topographic map (N50 water)

Agricultural monitoring program 3Q

- Statistical sampling survey
- 1 x 1 km monitoring squares
- 1 000 squares
- 5-year interval
- Mapped from aerial photos
- Record state and monitor changes in Norwegian agricultural landscapes



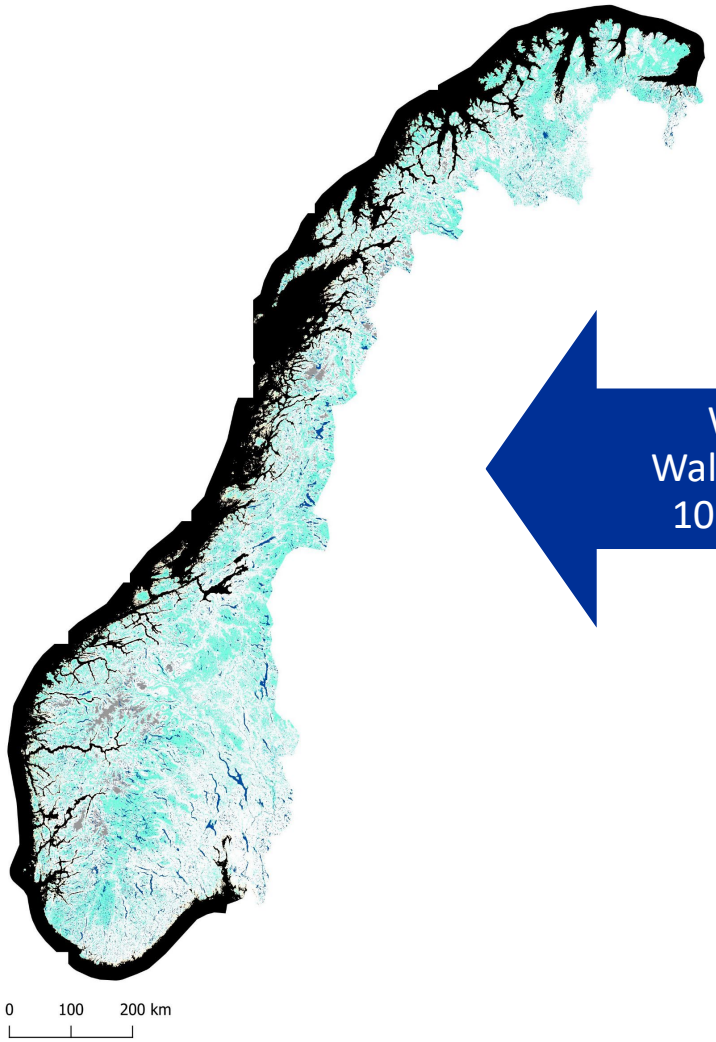


Streams and ditches

	Change
Østfold/Akershus	1.6 %
Oppland/Buskerud	0.2 %
Vestfold/Telemark	1.2 %
Rogaland	2.3 %
Vestlandet	0 %
Troms	1.0 %

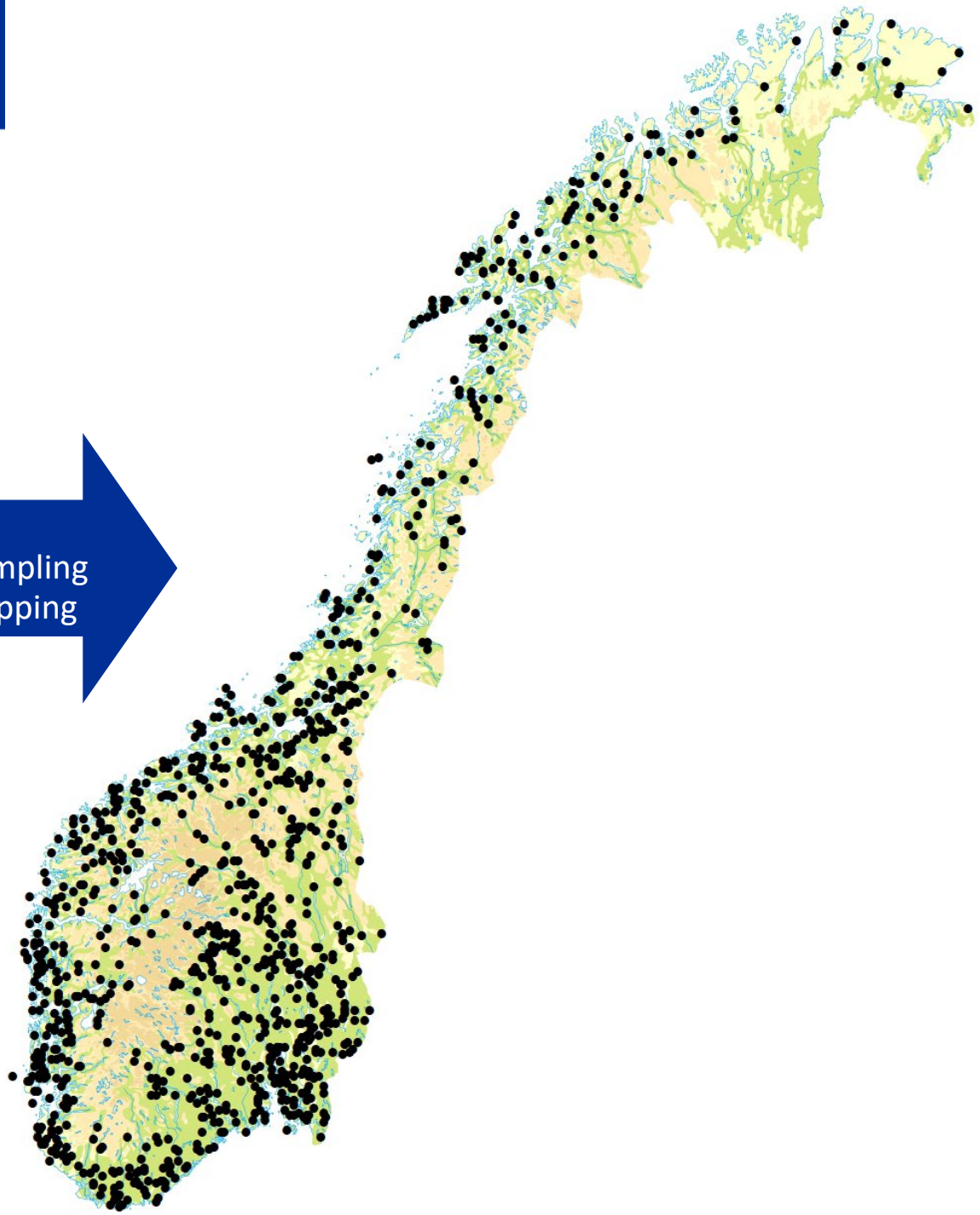
Photo: O. Puschmann (NIBIO)

Compare WAW and 3Q



WAW
Wall-to-wall
10 x 10 m

3Q
Statistical sampling
Detailed mapping



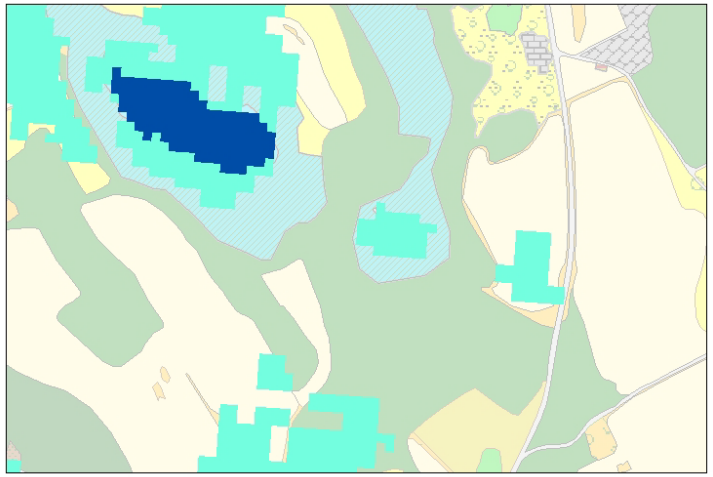
Overlay to check thematic accuracy

WAW Classes

- Permanent water
- Temporary water
- Permanent wet
- Temporary wet

WAW
Wall-to-wall
10 x 10 m

3Q
Statistical sampling
Detailed mapping



3Q Land types

- Freshwater
- Seawater
- Wetlands

Point objects

- Water habitat island
- Wetland habitat island
- Farm pond

Linear objects

- Stream
- Ditch

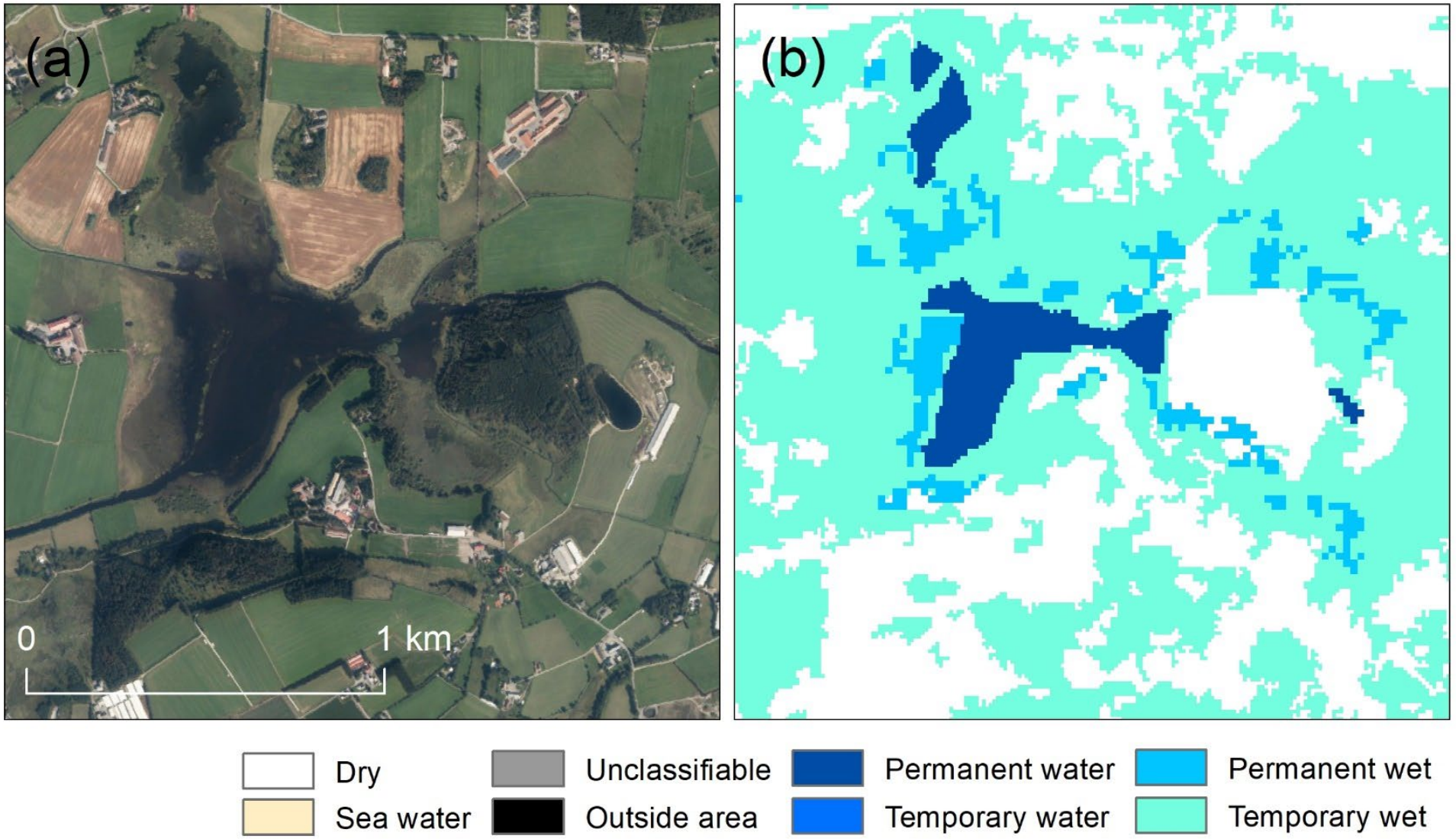
HRL-WAW for monitoring agricultural landscapes

Key findings:

- Permanent water in WAW was usually correct (96 %)
  … but water was missing: 42 % of fresh water in 3Q was not detected in WAW
- 46 % of Permanent wet was agricultural land
- 8 % of Permanent wet was wetland
  - 0.6 % of 3Q wetland was Permanent wet
  - 41 % of 3Q wetland was Dry
  - 58 % of 3Q wetland was Temporary wet
- 58 % of Temporary wet was agricultural land
  - 47 % of agricultural land was classified as Temporary wet

There was too much Temporary wet in the agricultural landscape

Temporary wetness



Small and narrow objects are not detected

- Low detection of point objects
  - Farm ponds: 74 % Dry
  - Wetland habitat islands: 38 % Dry
  - Water habitat islands: 41 % Dry
- Low detection of linear objects
  - Streams: 70 % Dry
  - Ditches/canals: 50 % Dry

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Now we move from agricultural landscapes to the rest of Norway…

Photo: W. Fjellstad

Water (whole country)

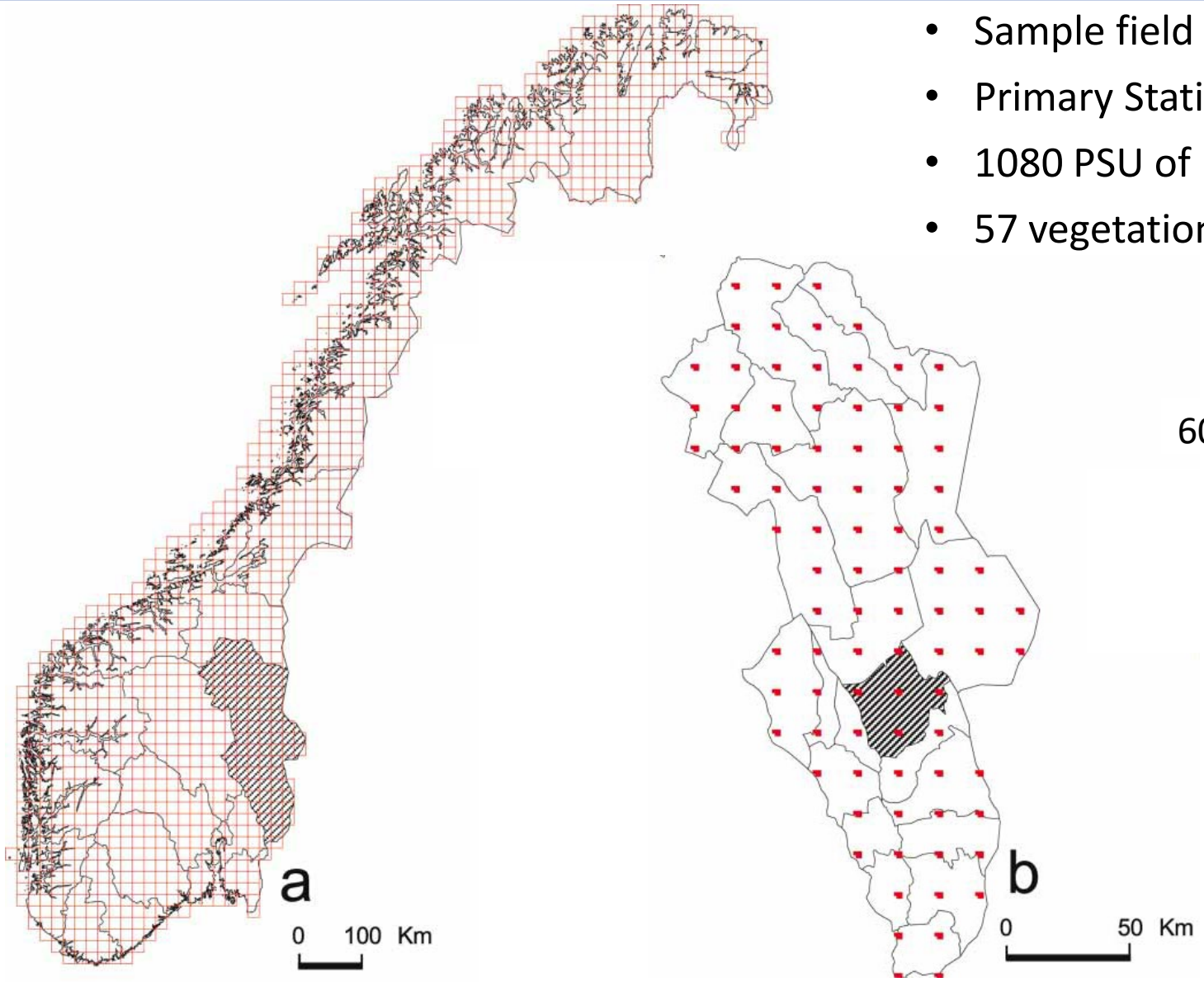
Class range (ha)		% of objects (lakes) containing at least one pixel of WAW cl. 1 or 2	% of area WAW cl. 1 and 2 contained in lake in a given class range
min	max	%	%
0.01	0.1	0.4	0.2
0.1	0.2	1.1	0.5
0.2	0.4	4.0	1.5
0.4	0.6	11.5	4.4
0.6	0.8	21.9	8.6
0.8	1	37.0	15.7
1	2	69.8	37.2
2	3	93.0	55.2
3	4	96.8	62.2
4	5	98.0	66.1
5	6	98.1	68.9
6	8	99.1	72.3
8	10	99.0	74.8
10	20	99.3	78.9
20	40	99.6	84.8
40	60	99.9	88.5
60	80	99.4	89.1
80	100	99.6	91.8
100	200	99.9	92.2
200	400	100.0	94.4
400	600	100.0	92.3
600	800	100.0	97.5
800	1000	100.0	89.9
1000		100.0	96.3
	Sum		

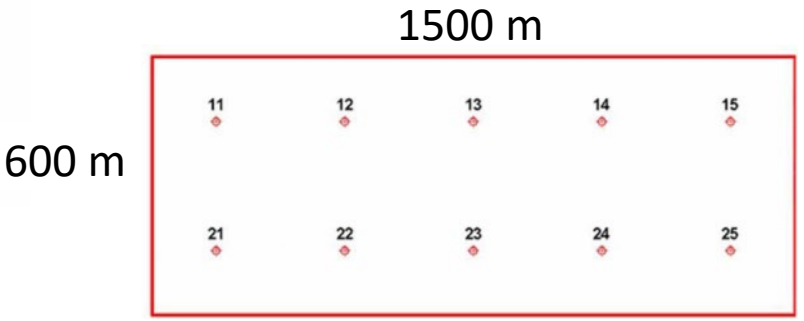
We analysed waterbodies according to their size:

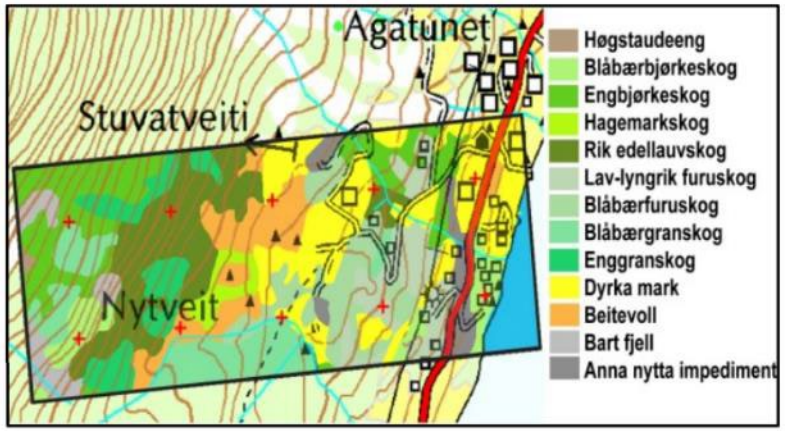
- Small lakes are not detected in HRL-WAW
- Lakes above 2 hectares are detected
- The area of WAW water exceeded 80 % of lake area first for lakes larger than 20 hectares

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







Kilde: Strand G.-H. 2013. The Norwegian area frame survey of land cover and outfield land resources. *Norsk Geografisk Tidsskrift* 67(1), p. 24-35.

HRL-WAW for Wetland Detection and Monitoring

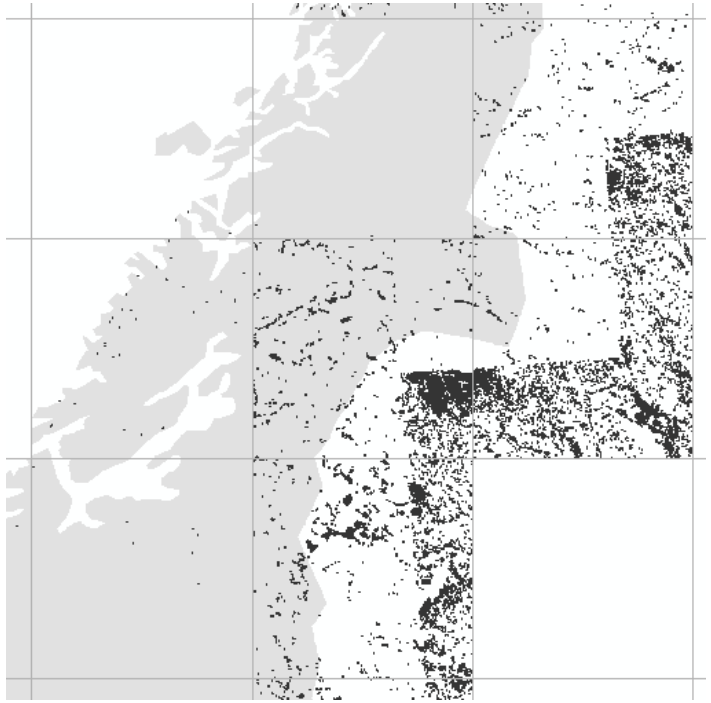
Key points:

- Permanent water in WAW was usually correct
  … but some water was missing: 11 % was classified as Dry
- 67 % of Permanent wet was wetland
  … but only 0.8 % of wetlands were classified as Permanent wet
- 73 % of wetlands were classified as Temporary wet
  … but 26 % were classed as Dry
- There was 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

The location of Permanent wet in Norway and the tiles of HRL-WAW

Evidence of problems with the underlying data and/or production errors



HRL-WAW 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)

HRL Water & Wetness (WAW) in Poland

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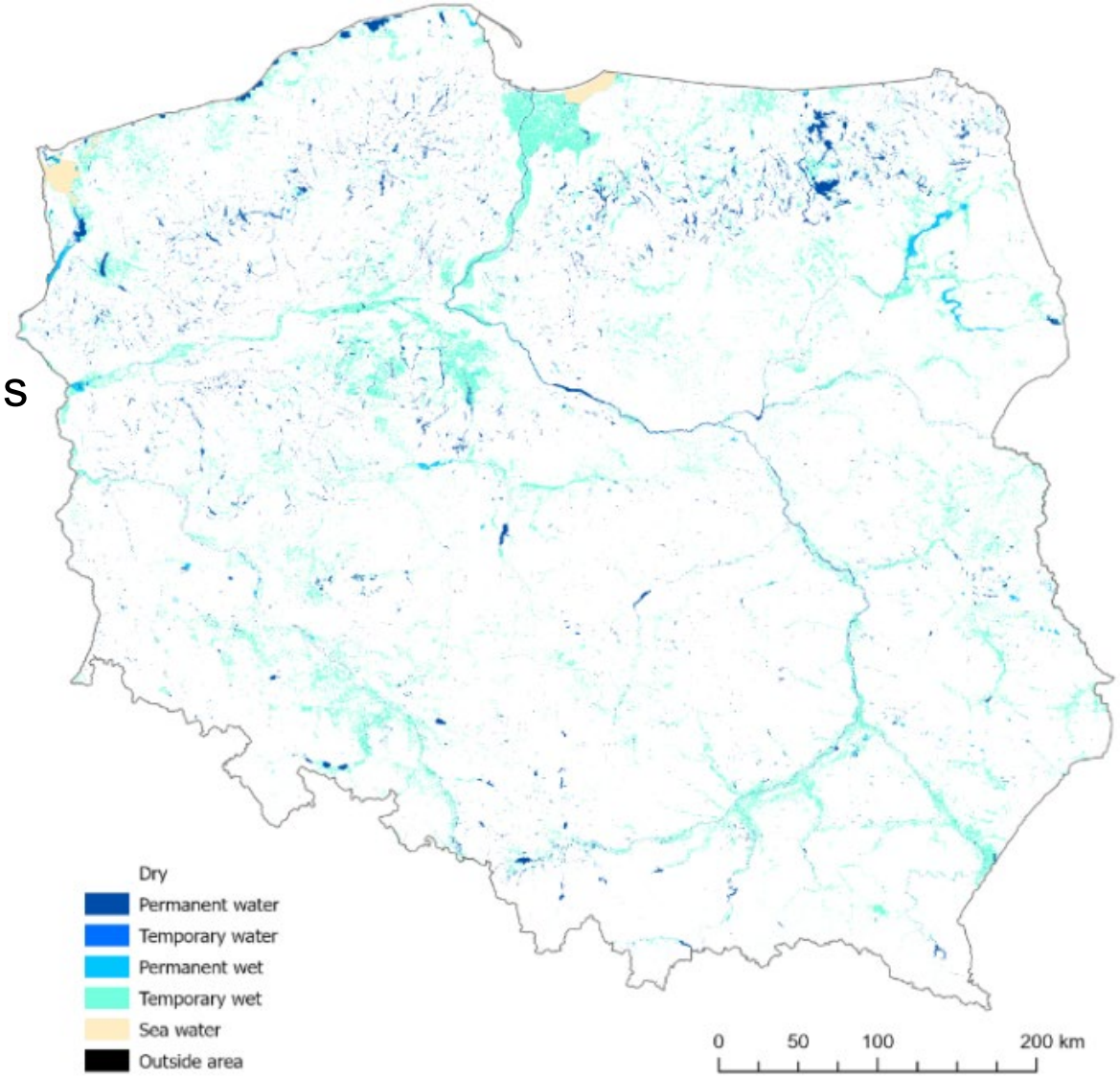
Analysis against national datasets:

- Topographic database: BDOT10K
- Land Parcel Identification System - Ecological Focus Areas (EFA)
- National wetland database: GIS Mokradła
- Land Use/Cover Area Frame Survey: LUCAS
- Database of protected peatlands



Results: WAW vs BDOT10K

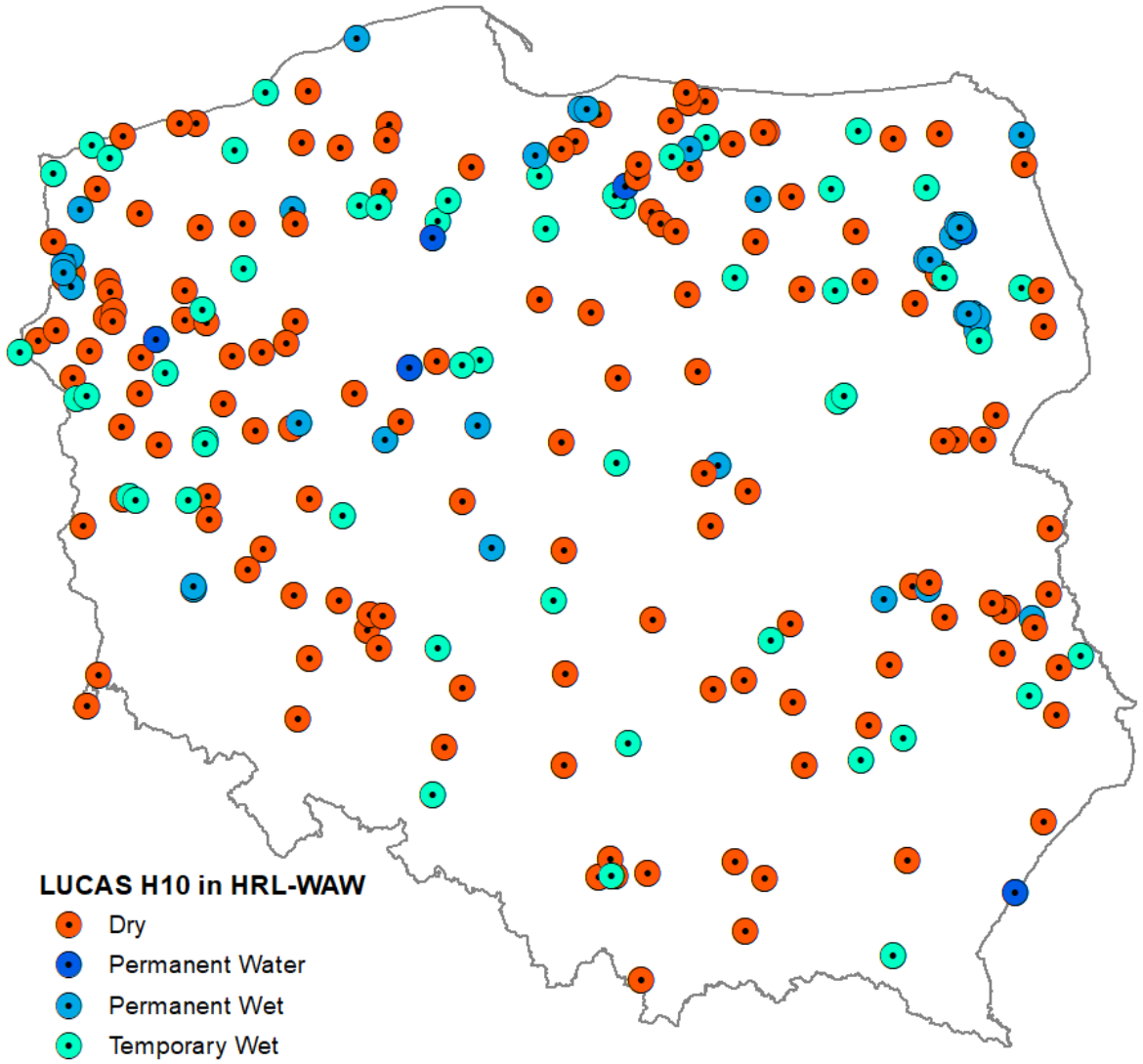
Comparison of HRL-WAW (class 1+2) with BDOT lakes and ponds, for waterbodies in different size classes

Class range [m2]		Number of objects PTWP (lakes, ponds) in a given class range	% of objects PTWP (lake, pond) containing at least one pixel of WAW cl.1 or cl.2	% of area WAW cl.1 and cl. 2 contained in PTWP (lake, pond) in a given class range
min	max	#	[%]	[%]
100	1 000	398 570	0,23	0,18
1 000	2 000	80 644	1,51	0,78
2 000	4 000	42 640	8,50	3,97
4 000	6 000	14 996	25,09	10,93
6 000	8 000	7 712	39,34	17,89
8 000	10 000	4 895	50,38	23,65
10 000	20 000	10 258	65,31	33,04
20 000	30 000	3 819	81,59	44,25
30 000	40 000	2 128	89,00	51,47
40 000	50 000	1 394	90,82	54,68
50 000	60 000	990	93,43	58,50
60 000	70 000	774	95,87	62,19
70 000	80 000	603	95,02	63,46
80 000	90 000	478	95,61	66,10
90 000	100 000	376	97,07	66,47
100 000	200 000	2 177	97,93	70,58
200 000	400 000	1 418	99,29	76,82
400 000	600 000	576	99,65	80,36
600 000	800 000	291	100,00	82,49
800 000	1 000 000	178	99,44	84,25
1 000 000	2 000 000	340	100,00	86,42
2 000 000	4 000 000	166	100,00	87,59
4 000 000	6 000 000	48	100,00	89,46
6 000 000	8 000 000	23	100,00	92,48
8 000 000	10 000 000	13	100,00	91,70
10 000 000	150 000 000	43	100,00	93,19
	Sum	575 550		72,91

- Small lakes are not detected in HRL-WAW
- 50 % of lakes of 0.8-1ha are detected
- Lakes > 2 hectares are detected
- The area of WAW water exceeded 80 % of lake area first for lakes larger than 40 hectares

HRL-WAW for wetlands detection and monitoring

- 60 % of LUCAS wetland points are classified as Dry
- 37 % as Permanent or Temporary wet in WAW
- 3 % Permanent water



HRL-WAW for wetlands detection and monitoring

- 11 % of protected peatlands are classified as WAW Permanent wet, 5 % as Temporaty wet
- ...but 83 % as WAW Dry

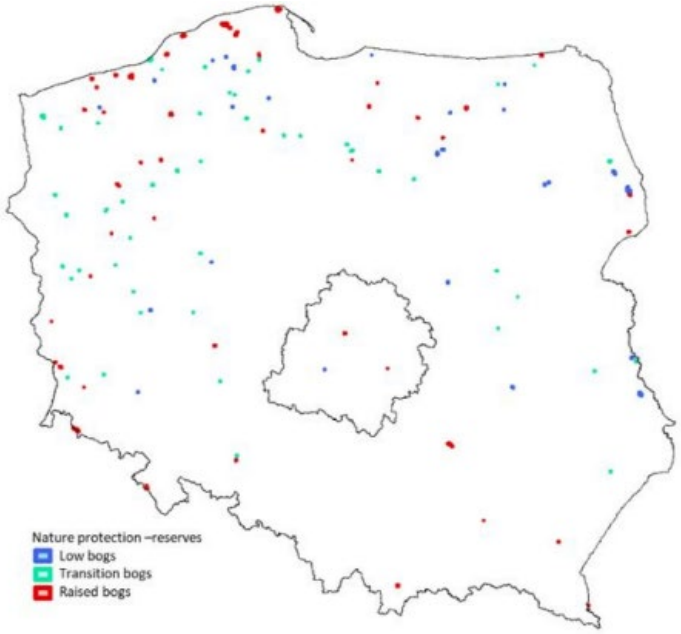
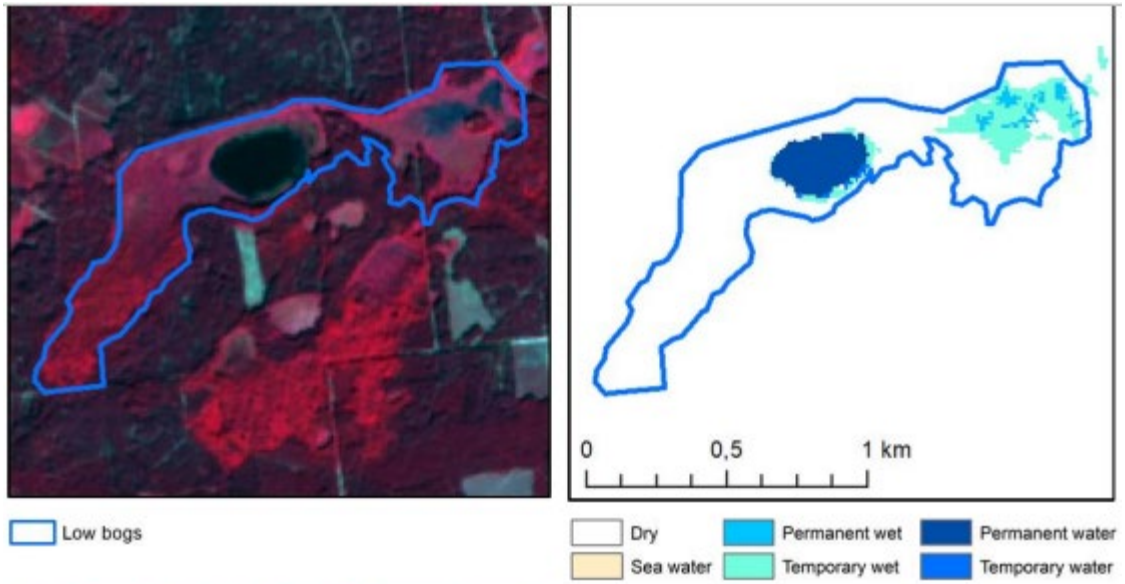
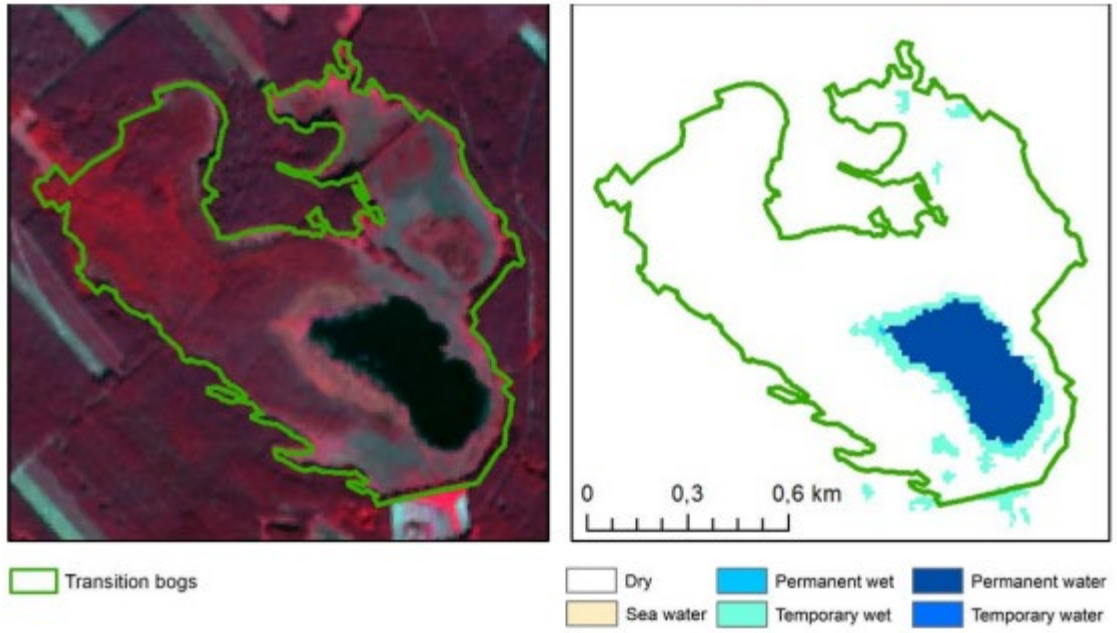


Figure 5: Location of the peat-bog nature reserves in Poland.





HRL-WAW Conclusions for Norway and Poland

- Currently, HRL-WAW is not sufficiently accurate or reliable to assist with mapping or monitoring in either Norway or Poland.
- In Norway, we already have a good monitoring system for agricultural landscapes. However, we lack detailed, regularly updated information in more remote landscapes, especially above the treeline.
- In Poland, the existing wall-to-wall national topographic database provides high quality data, but it is not updated systematically for the whole country at any given point in time.
- In both countries, HRL-WAW could play a role if the current weaknesses and errors can be resolved.
- Could service providers work more closely with national experts to validate and adapt products and thus increase usefulness and user uptake?

HRL-SWF: Small Woody Features

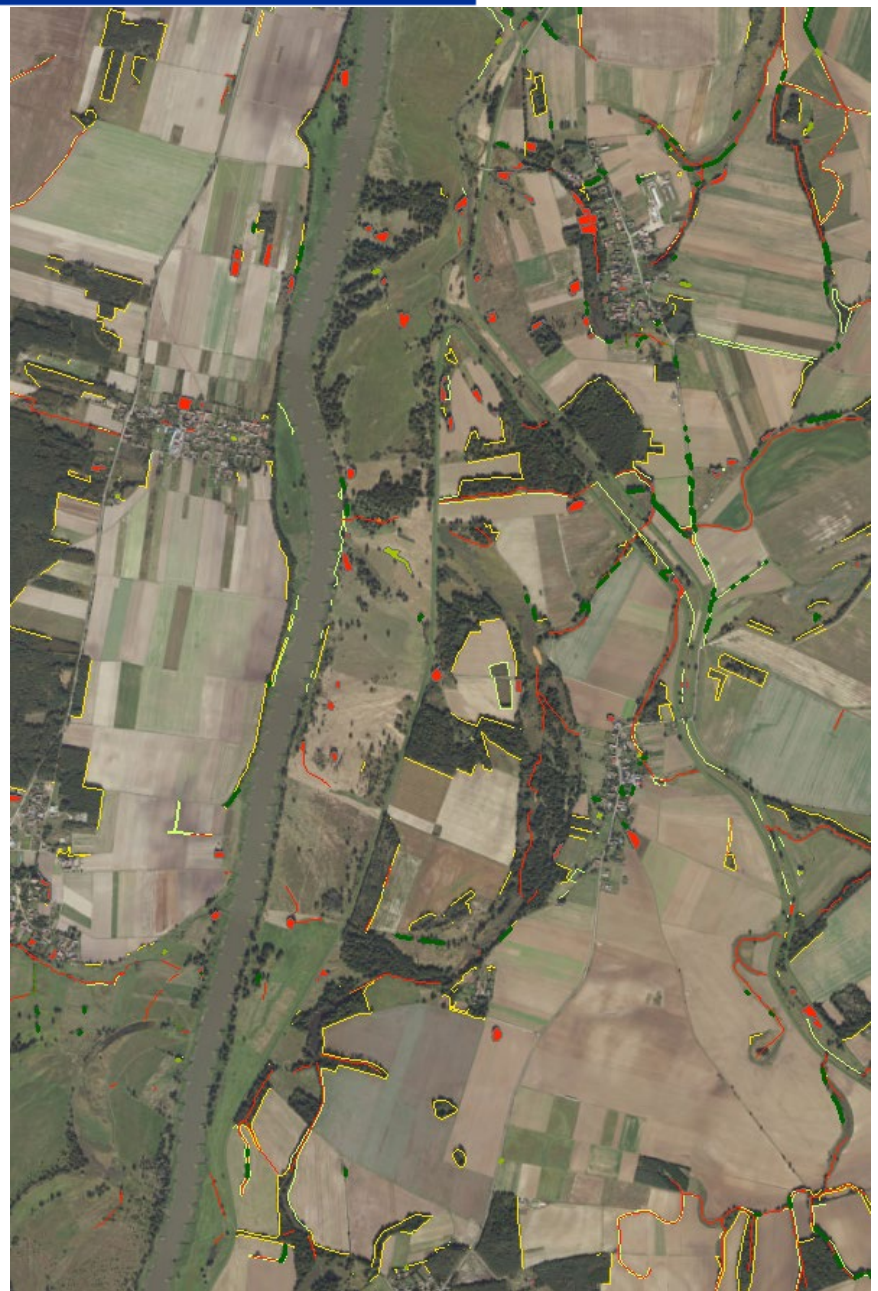
Analyse the potential and accuracy of HRL-SWF for assessment of agricultural landscapes and Ecological Focus Areas

- Linear woody features
  - Width ≤ 30 m, Length ≥ 30 m
  - Compactness ≤ 0.785
- Small patchy woody features
  - Area 200 m2 – 5000 m2
  - Compactness ≥ 0.785
- Derived from Very High Resolution (2-4 m) satellite imagery from Copernicus Contributing Missions

Poland - SWF vs. EFA

To receive green direct payments, the Common Agricultural Policy (CAP) requires EU farmers to dedicate 5% of arable land to areas beneficial for biodiversity: Ecological Focus Areas (EFA)

One category of landscape elements in Poland that is eligible as EFA is: “group of trees up to 0.3 ha”



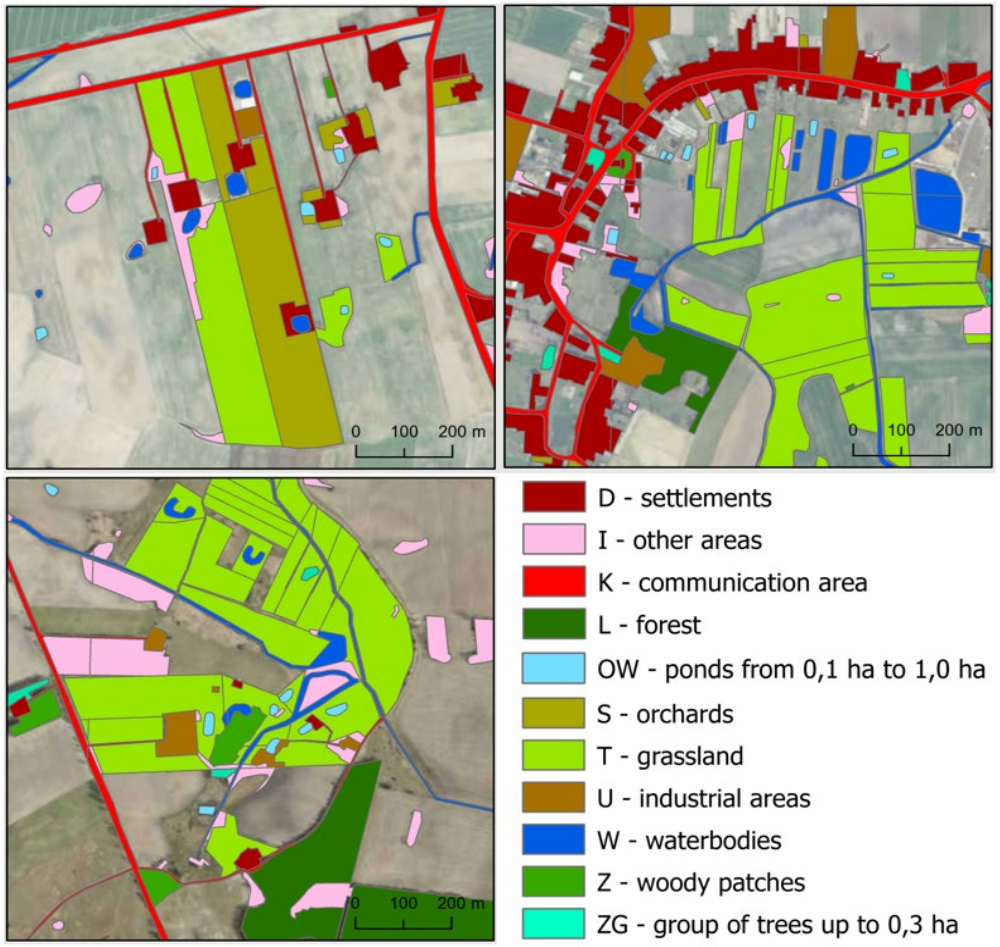
Poland - SWF vs. EFA

Land Parcel Identification System (LPIS)

In Poland, the EFA “group of trees up to 0.3 ha” covers 1 167 km^2

53 % of the area is classified as SWF
19 % falls in the Forest Mask
28 % is neither SWF nor FM

- Next step: examine discrepancies.
- SWF may help assess the quality of the LPIS data (2018)…
- Important that future versions are available more quickly
- Preferably from eXtreme High-Resolution images (50 cm spatial resolution)



Conclusions so far from InCoNaDa project

- Data users must be very careful to check quality and limitations of data
- Copernicus products have different definitions and mapping rules than national datasets
- Both Copernicus and national datasets may span multiple years of data
- Verification is difficult …but necessary!
- There are definitely some weaknesses and errors in the Copernicus layers
- If these can be corrected, the data could be useful…
- More communication is needed between data producers and national experts to validate and adapt products and thus increase their usefulness and user uptake

https://inconada.eu/

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