Norway grants
The National Centre for Research and Development

Testing CLMS products for environmental monitoring

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Environmental Monitoring

Can CLMS data be used for environmental monitoring in Norway and Poland?

- Wetlands: HRL Water and wetness (HRL-WAW)
- Vegetation along streams and waterways: Riparian Zones
- High Nature Value Grassland: HRL-GRA

Spatial overlays between HRL-WAW and national datasets

National data for Poland:

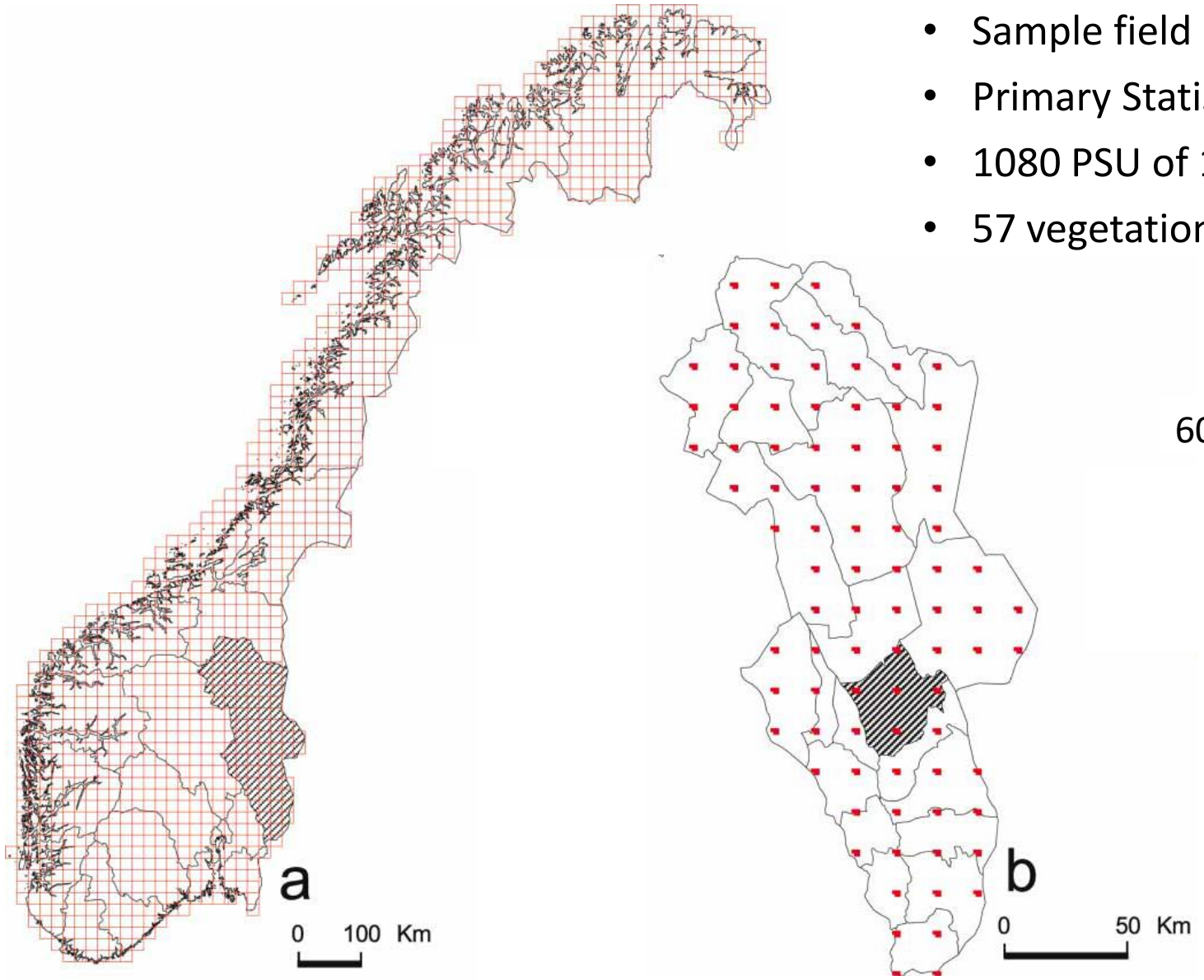
- Topographic database: BDOT10K
- Land Use/Cover Area frame Survey: LUCAS
- National Wetlands GIS database: GIS Mokradla
- Database of protected wetlands

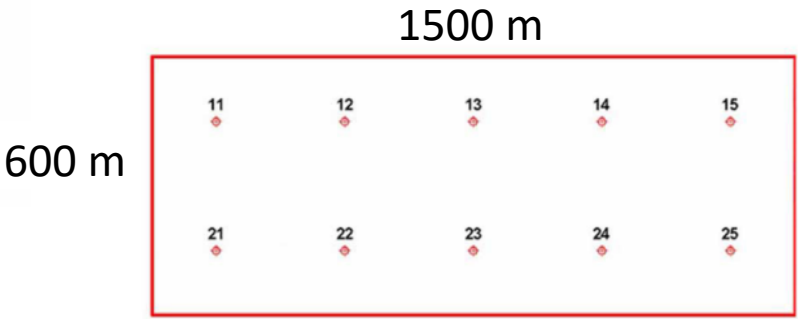
National data for Norway

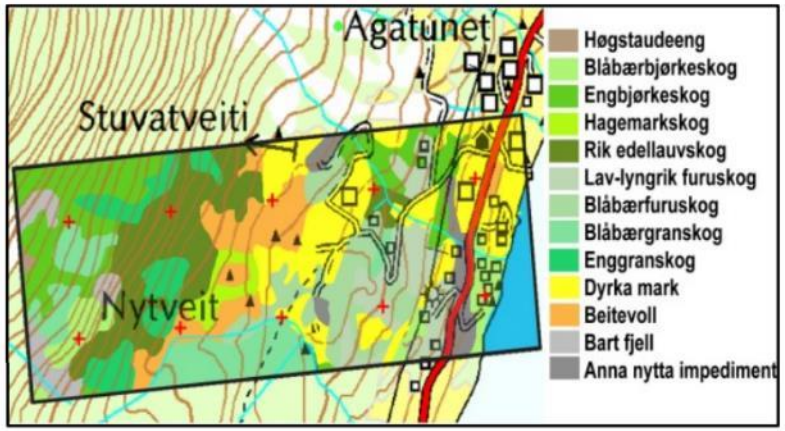
- The National Land Resource Map: AR5
- The Area Frame Survey of Norway: AR18x18
- Database of wetlands important for biodiversity: Naturbase

Norway: Area Frame Survey - AR18x18

- 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.

«Accuracy» is a matter of definition…

- HRL-WAW describes the occurrence of water and wet surfaces in satellite images over a period of seven years (2012 to 2018) - it is not intended to indicate habitat
- But we expect wet areas to develop wetland plant communities
- To be useful for monitoring or to identify unmapped wetlands we need to see correspondence between WAW and our ground truth data

Findings – wetlands in general

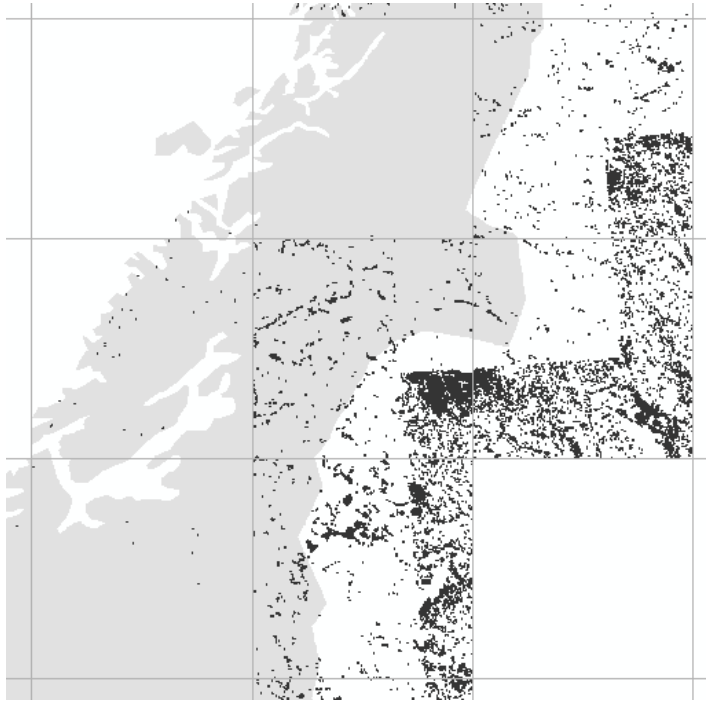
- Very little correspondence between WAW classes and national wetland data
- Only 18 % of wetlands in Poland were classified as Permanent Wetness
- Only 0.3 % of Norway was classified as Permanent Wetness but almost 9 % of the country is wetland
- 30 % of wetlands in Poland and 73 % in Norway were classified as Temporary Wetness
- … but 96 % of Temporary Wetness in Poland and around 80 % in Norway was on other, non-wetland areas
- Over half of wetlands in Poland and a quarter in Norway were classed as Dry in WAW

Findings – protected wetlands

- 82 % of peat-bog nature reserves in Poland were classified as Dry
- 35 % of important wetlands in Norway were classified as Dry, 60 % as Temporary wetness
- Most protected wetlands, both in Poland and Norway, are small. Small polygons are poorly detected in HRL-WAW
- Using the current HRL-WAW to identify wetlands would be likely to miss a large proportion of ecologically important areas
- Even if HRL-WAW could indicate possible changes in wetness, it would still be insufficient for monitoring the most important wetlands - they should be monitored in the field
- We see no role for HRL-WAW in this kind of monitoring.

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

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



Conclusions:

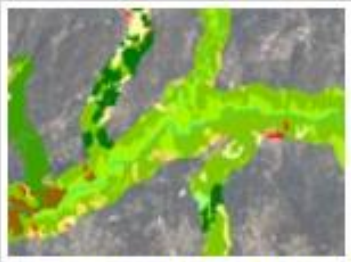
- We examined the potential of HRL-WAW both to help provide total national inventories of all wetlands, and to follow up wetlands identified as particularly important for biodiversity.
- We conclude that **the current version of HRL-WAW is not sufficiently accurate or reliable** to assist with these tasks.
- There is **still a need for more sufficient and reliable products** that could support the delineation and assessment of the status of the wetland ecosystems to support wetland-related policies.

Vegetation along streams and waterways

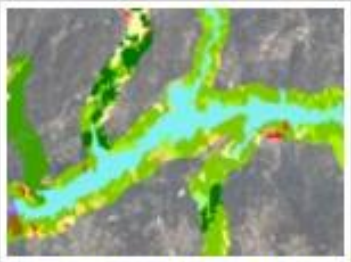
- Important for biodiversity
- Important for ecosystem functions (e.g. filtering sediment & nutrients, flood control, bank stabilization)
- Copernicus Priority Area Monitoring product **Riparian Zones** (RZ).
- Use existing data to verify the results and assess relevance for environmental monitoring

Riparian Zones: Vegetation along streams and waterways

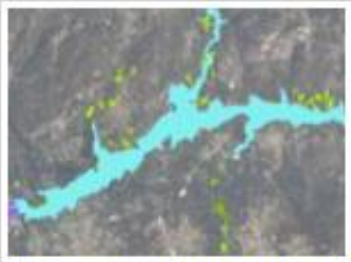
Riparian Zones (RZ)



RZ Land Cover/ Land Use 2012



RZ Land Cover/ Land Use 2018



RZ Land Cover/ Land Use Change 2012-2018

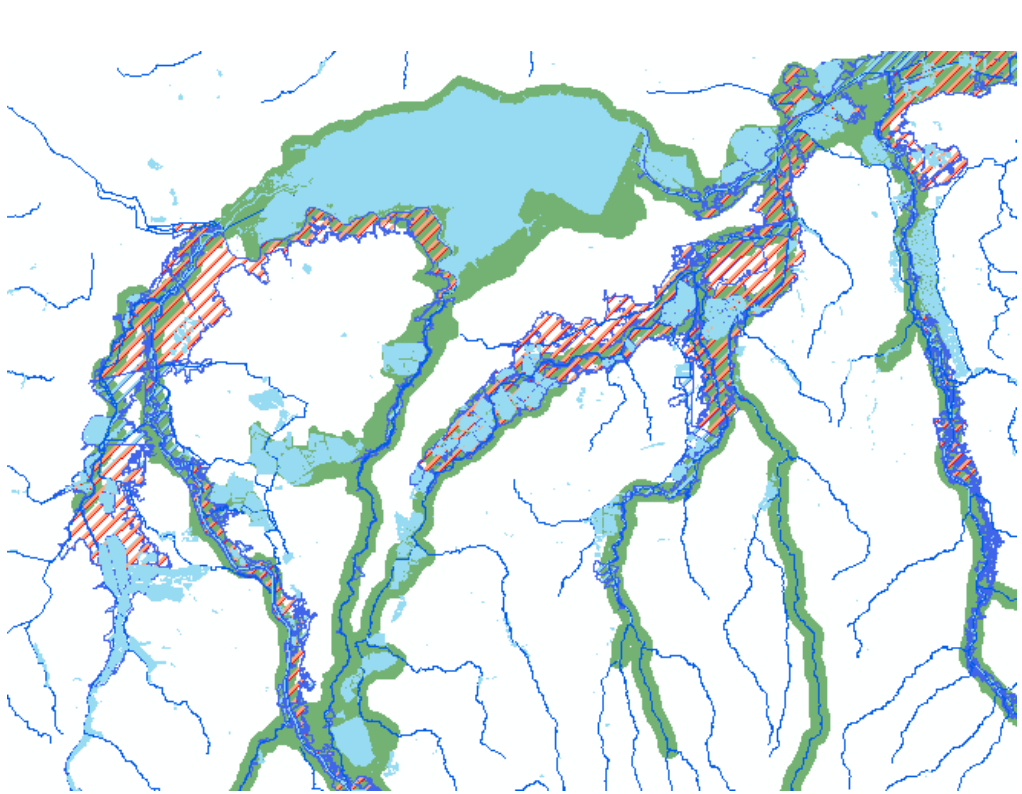
Delineation of Riparian Zones

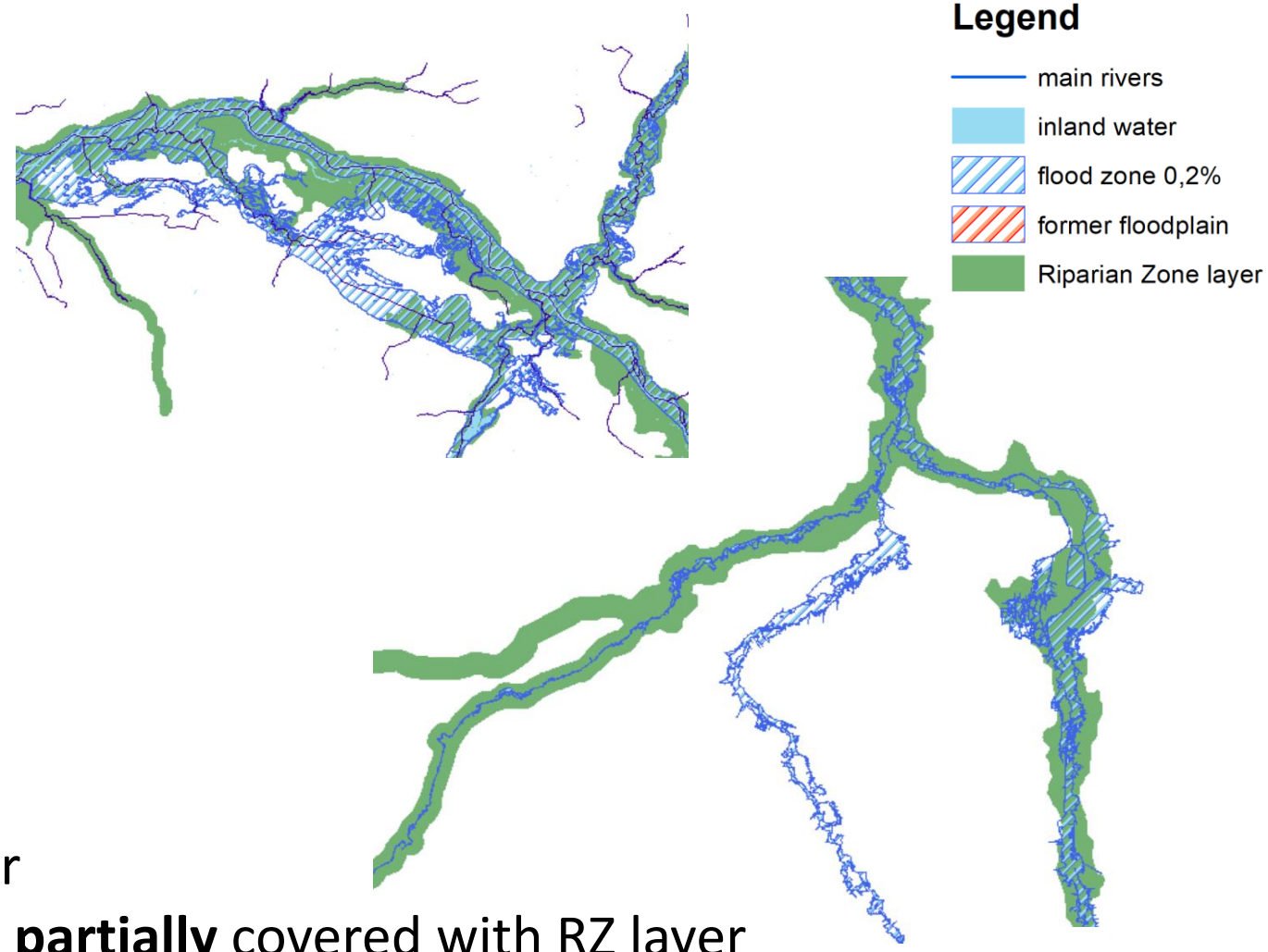
Riparian zones: transitional areas between land and freshwater ecosystems, characterised by distinctive hydrology, soil and biotic conditions and strongly influenced by the stream water.

"The Riparian Zones products will support the objectives of European legal acts and policy initiatives, such as the EU Biodiversity Strategy to 2030, the Habitats and Birds Directives and the Water Framework Directive".

RZ vs. national flood zone maps

Mismatch between national flood zones and Copernicus Riparian Zones





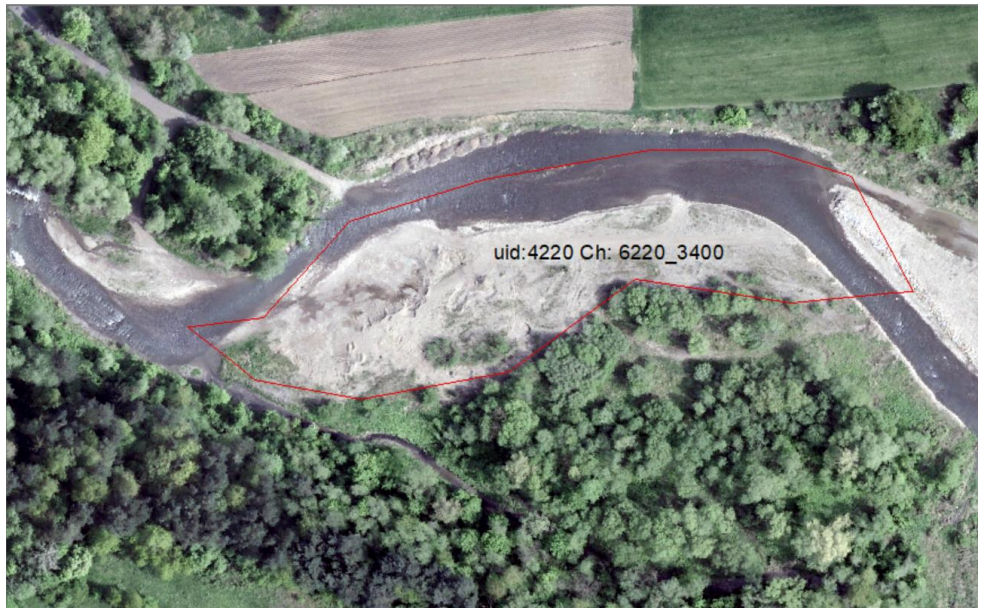
- Some floodplains **not included** in RZ layer
- Some floodplains and former floodplains **partially** covered with RZ layer
- Some river corridors of smaller rivers not included in floodplain maps but **included** in RZ layer

RZ change “2012 – 2018“ vs. Polish orthophotos

4220: Beaches dunes, river banks

2011

2013



3400 Transitional woodland and scrub

2018

2019

RZ change “2012 – 2018“ vs. Polish orthophotos

RPZ change layer from 2012 to 2018

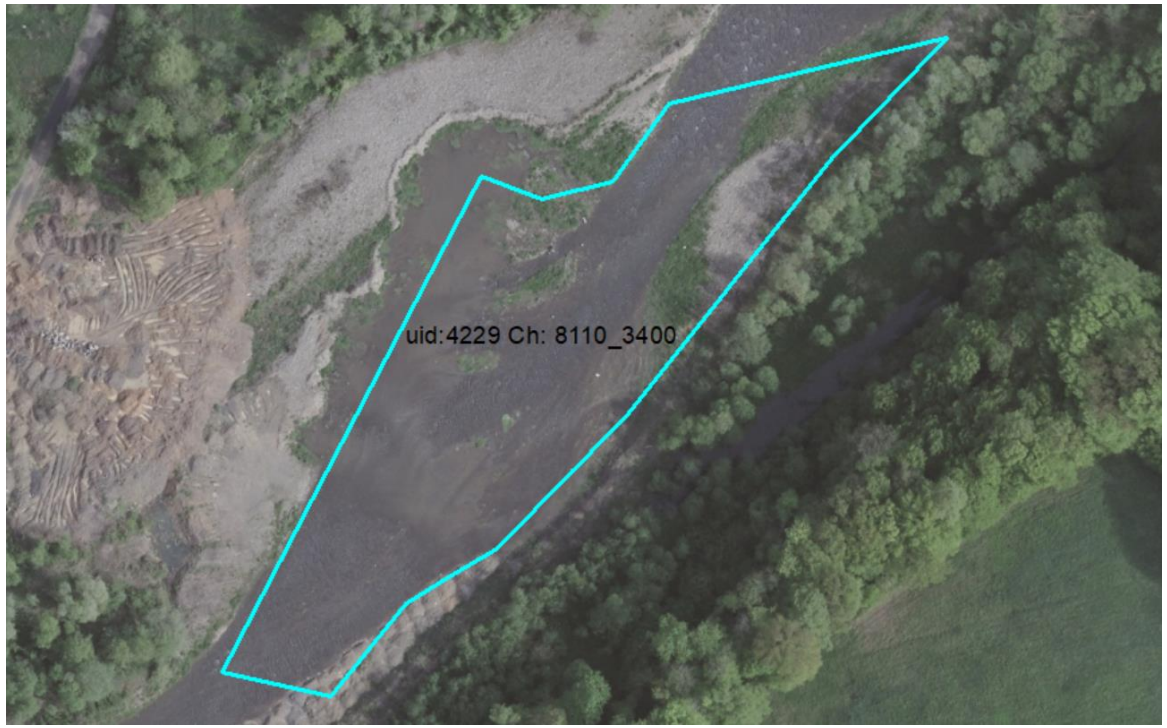
2012 8100: Natural and semi-natural water courses

2019 3400 Transitional woodland and scrub

RZ change “2012 – 2018“ vs. Polish orthophotos

RZ change layer from 2012 to 2018

2013 8100: Natural and semi-natural water courses



2019 3.400 Transitional woodland and scrub

- Reference year “2012” includes data from 2010-2013, and reference year “2018” includes 2017-2020.
- The actual year for a specific polygon is not given so it is almost impossible to verify the data.
- River ecosystems are highly dynamic, delineation of a river is dependent on hydrological state.
- This is a challenge for useability…

Riparian Zones: Vegetation along streams and waterways

Findings:

- For both Poland and Norway, the accuracy of LC/LU in the Riparian Zones datasets was quite good at level 1 for Water, Cropland and Woodland and forest.
- Misclassifications between Cropland and Grassland are understandable, since managed grassland can look very similar to cultivated forage crops.
- Urban land use – low accuracy - misclassification to Grassland (Poland) and Woodland and forest (Norway)
- The highest accuracy was obtained for the Woodland and forest class, however the forest types in the RZ are mixed up
- Heathland and scrub and Open spaces with little or no vegetation were very poor in both countries
- Visual comparison of RZ with orthophotos and maps in agricultural landscapes clearly showed that narrow bands of vegetation along the river are not captured in RZ

Conclusions:

- Riparian Zones datasets do not match the national data
- Could still be useful if they are calculated consistently from one time period to the next and capture real change
- Before the RZ datasets can be used in monitoring, it is essential that they are verified as reflecting the true situation – not possible now due to lack of time stamps and the fact that the data were taken from a reference period of three or four years
- One challenge that is particularly difficult for dynamic river systems, is that the rivers alter their course over time

ENHANCING THE USER UPTAKE OF LAND COVER / LAND USE INFORMATION DERIVED FROM THE INTEGRATION OF COPERNICUS SERVICES AND NATIONAL DATABASES (InCoNaDa)

Deliverable 5.2

Report on the potential use of Riparian Zones to map and monitor vegetation along streams and waterways.

Deliverable	D5.2	
Work Package / WP leader	5 / Norwegian Institute of Bioeconomy Research (NIBIO)	
Due date		
Authors	NIBIO: Wendy Fjellstad, Svein Olav Krøgli, Linda Aune-Lundberg IGIK: Milena Chmielewska, Agata Hościło	
Distribution		NCBR:
Issue		
Revision		
Date		

High nature value grassland

- Semi-natural grasslands are species-rich and of high biodiversity value
- Hay meadows are assessed as Critically Endangered on the Norwegian red-list of ecosystem types
- Threatened due to changes in agriculture
- Difficult to make an inventory of these areas

Photos: Y. Rekdal

Photo: Oskar Puschmann

HRL-GRA

HRL-GRA

- Binary: grassland or not
- (2015 and) 2018
- Time since ploughing (up to 6 years)
- ALL grassland, from natural to intensely managed…
- Sentinel-2A, Sentinel 1A and 1B and Landsat 8 OLI data
- …+ publicly available auxiliary data: LUCAS, Corine, national / regional thematic maps (e.g. LPIS), & other HRL of past reference years 2012 and 2015 (TCD, IMD, WAW)

HRL-GRA

HRL-GRA definition of grassland:

- herbaceous vegetation with at least 30 % ground cover, of which at least 30 % graminoid species such as Poaceae, Cyperaceae and Juncaceae
- can include additional non woody plants such as lichens, mosses and ferns
- scattered trees and shrubs may be present, covering a maximum 10 %.

- Includes natural, semi-natural, agricultural / managed grass- covered surfaces
- Does NOT include grasslands that have been observed as tilled in the reference year or a certain period before, in that case they are considered as arable fields

HRL-GRA

It is not realistic to determine the occurrence of high nature value grassland from Copernicus products. However, if HRL-GRA is accurate and reliable it could be used as a control/warning when high value grasslands have changed status

Therefore, we focused on verification

Overlay against AR18x18 for Norway (our most detailed dataset)

Norway: HRL-GRA vs. AR18x18

Producer accuracy: the percentage of GRA for each the classes of AR18x18

Survey land cover groups and classes	NOT GRA	GRA
Snow-bed vegetation	91.9	8.1
Alpine heath communities	87.6	12.4
Alpine meadow communities	66.9	**33.1**
Boreal deciduous forest	92.7	7.3
Broad-leafed deciduous forest	100.0	0.0
Pine forest	99.6	0.4
Spruce forest	99.9	0.1
Peatland forest	98.8	1.2
Wetlands	92.0	8.0
Non-forested dry land below the treeline	88.2	11.8
Farmland	93.4	6.6
Non-productive areas	99.2	0.8

Norway: HRL-GRA vs. AR18x18

User accuracy: the percentage distribution of GRA amongst the classes of AR18x18

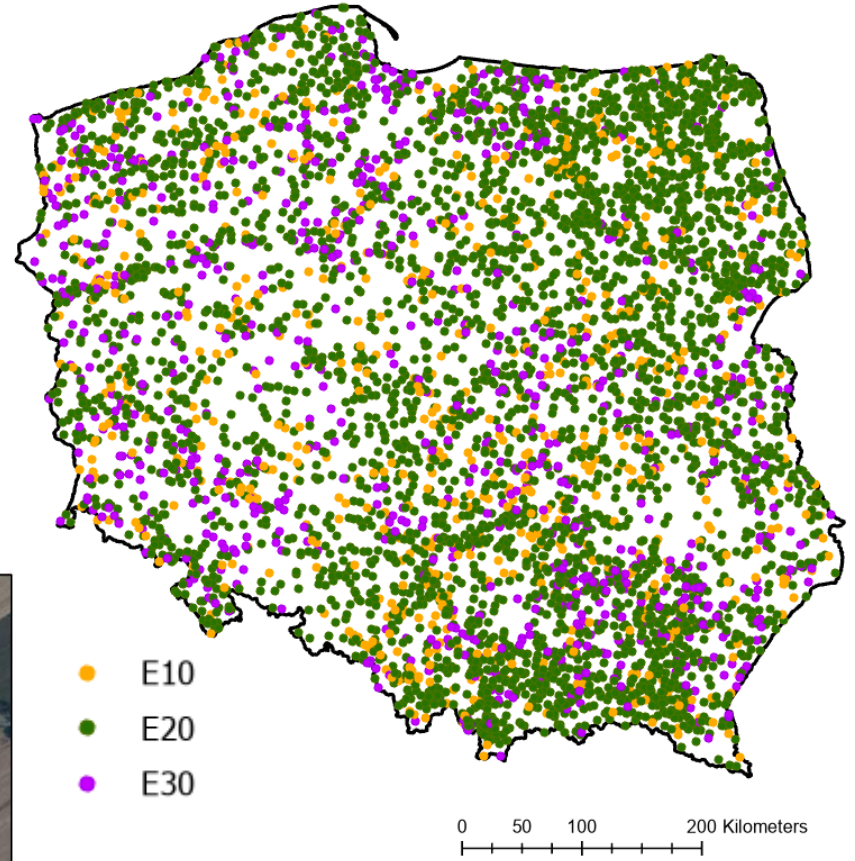
Survey land cover groups and classes	NOT GRA	GRA
Snow-bed vegetation	6.0	6.9
Alpine heath communities	24.0	**45.0**
Alpine meadow communities	1.9	12.2
Boreal deciduous forest	14.7	15.3
Broad-leafed deciduous forest	0.5	0.0
Pine forest	10.9	0.6
Spruce forest	11.7	0.2
Peatland forest	4.2	0.7
Wetlands	9.0	10.4
Non-forested dry land below the treeline	2.2	3.9
Farmland	4.0	3.7
Non-productive areas	10.9	1.2
	100	**100**

Poland: HRL-GRA vs. LUCAS & BDOT10K

LUCAS E00 Grassland	Name	Number of points
E10	Grassland with sparse tree/shrub cover	694
E20	Grassland without tree/shrub cover	3 914
E30	Spontaneously revegetated surfaces	778
Suma		5 386

Data preparation:

- For LUCAS vs. BDOT10K analyses we used a buffer of 1.5m radius.
- For LUCAS vs. HRL GRA analyses we used a buffer of 10m radius.



Poland: HRL-GRA vs. BDOT

HRL GRA vs BDOT10K:

Database	Area [km2]	% area of Poland
BDOT10K PTTR01	55 262	18
HRL GRA	59 256	19

User accuracy:

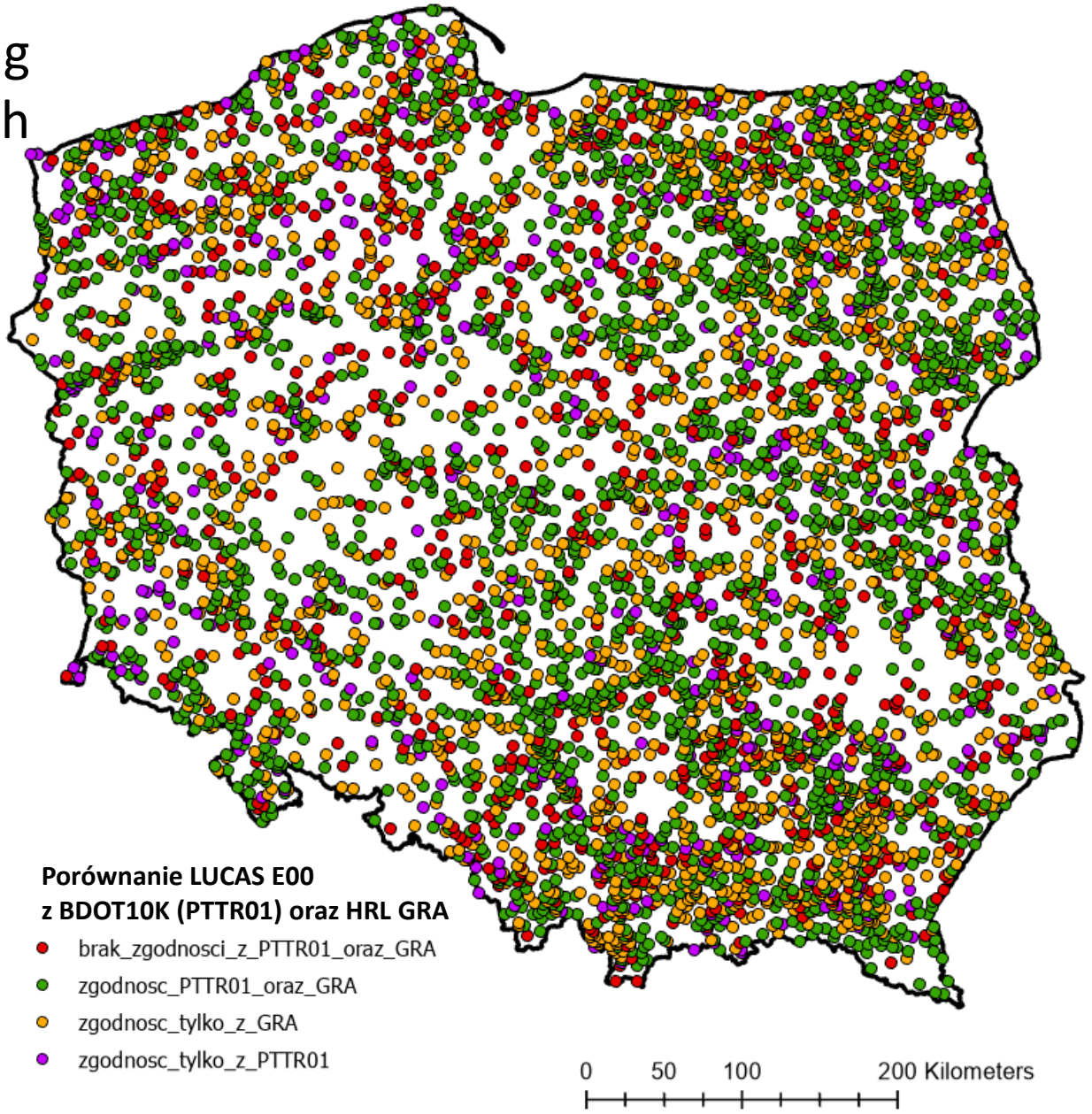
- 54 % of grassland area in HRL-GRA is grassy vegetation (PTTR01) in BDOT10K
- 34 % of grassland area in HRL-GRA is agricultural area (PTTR02) in BDOT10K
- 4 % of grassland area in HRL-GRA is built-up area (PTZB) in BDOT10K
- 4 % of grassland area in HRL-GRA is woodland area (PTLZ) in BDOT10K

Producer accuracy:

- 58 % of grassy vegetation (PTTR01) in BDOT10K is grassland in HRL-GRA
- A high proportion of GRA is also visible in the classes permanent crops (PTTR02 – 27 %), landfill (PTSO – 26 %), built-up area (PTZB – 21 %), arable land (PTTR02 – 16 %), land under rail and airports roads (PTKM – 15 %), shrubby vegetation (PTRK – 14 %), unused land (PTGN – 13 %), remaining undevelopment land (PTNZ – 12 %).

Poland: HRL-GRA vs. LUCAS & BDOT10K

- 76 % of LUCAS points (4 114) representing areas of grassy vegetation are consistent with HRL-GRA.
- 56 % of LUCAS grass points were consistent with grassland in the BDOT10K PTTR01
  - 15 % of LUCAS points E00 (829) are not compatible with either HRL GRA and BDOT10K PTTR01
  - 48 % of LUCAS points E00 (2 579) are compatible with both HRL GRA and BDOT10K PTTR01.
  - 29 % of LUCAS points E00 (1 535) are compatible only with HRL GRA
  - 8 % of LUCAS points E00 (443) are compatible only with BDOT10K PTTR01.



Overall conclusions

- 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!
- Products have developed over time - it wasn't always clear which version of the guidelines applied to which dataset, causing uncertainty about how the classes were created
- There are definitely weaknesses and errors in the Copernicus products… but also in the national datasets!
- Good quality data, with timely updates, are definitely needed
- More communication is needed between data producers and national experts to validate and adapt products and thus increase their usefulness and user uptake