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Country-wide mapping and assessment of ecosystem condition and services in Estonia

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Estonian Environment Agency

LIFE EcosystemServices project conference "Value of Nature – practices and experiences in use of ecosystem services assessment"

15.01.2020, Riga, Latvia

Introduction

- **Estonian Nature Conservation Development Plan 2012–2020** obliges performing assessment and mapping of ecosystem condition and services, and integrating it into decision-making and reporting systems by 2020.

ELME* project

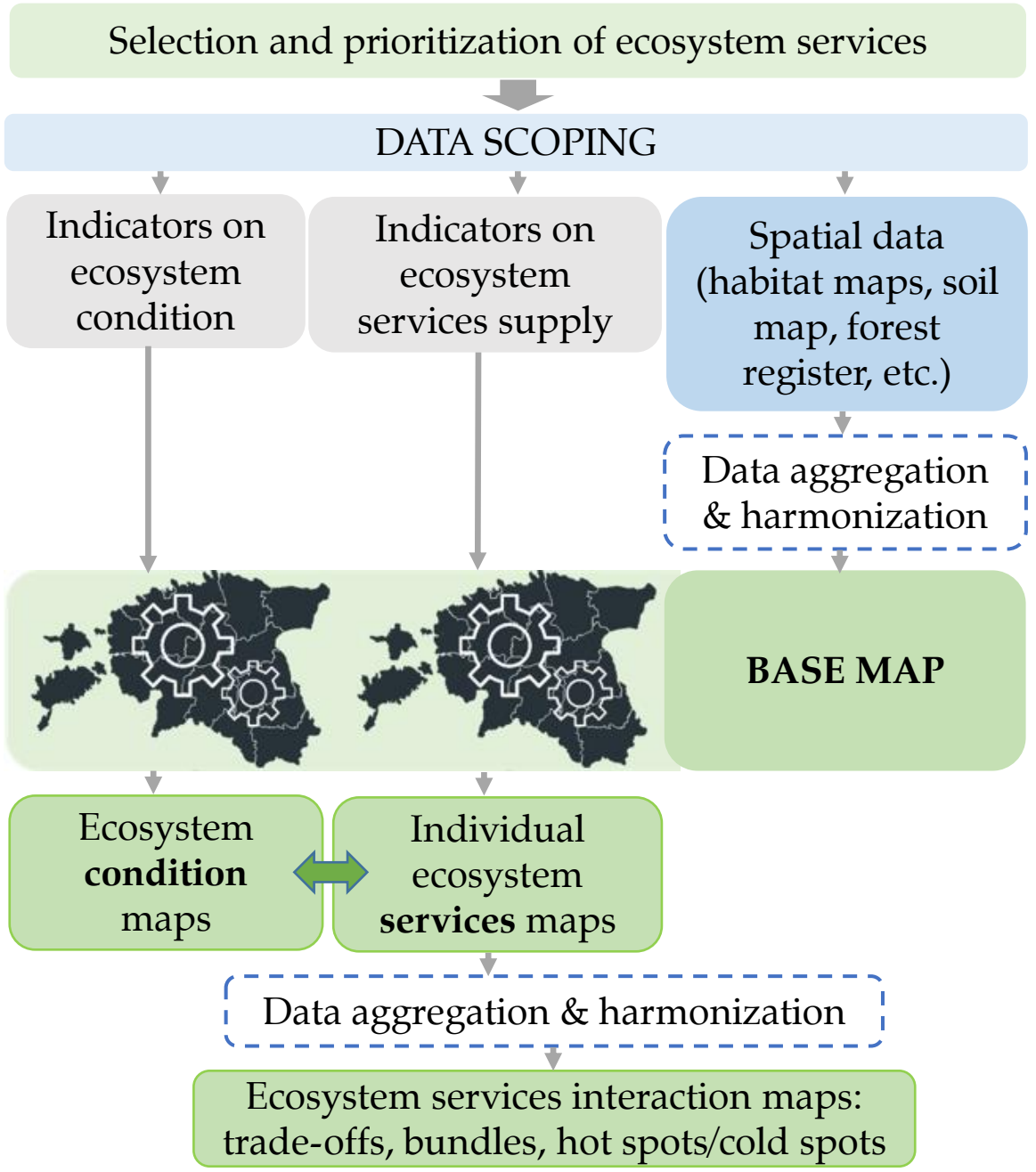
- Duration: 2015 to (2020) 2023
- Coordinated by the **Estonian Environment Agency**
- ELME's main objectives are:
  - **mapping and assessment of priority ecosystem services by ecosystems on national scale**;
  - developing, testing and implementing **novel methods** (eDNA, camera traps, drones, acoustic sensors, etc.) for monitoring biodiversity;
  - establishing **tools** (incl. the new portal for dissemination of biodiversity data) for integrating socioeconomic and climate change data into assessing and forecasting biodiversity status, and ensuring data availability.

** „Establishment of tools for integrating socioeconomic and climate change data into assessing and forecasting biodiversity status, and ensuring data availability"*

Funded by the EU Cohesion Fund and the foundation Environmental Investments Centre

MAIN GOAL of ELME – countrywide mapping and assessment of the ecosystems and their services (2019–2020):

- ✓ focus on 4 ecosystem types: **grasslands**, **wetlands**, **forests** and **agro-ecosystems**;
- ✓ about 75 priority **ecosystem services** have been recognized in Estonia, from which the ones to be assessed and mapped have been chosen;
  - ✓ **potential supply** is assessed and mapped;
- ✓ **ecosystem condition** is assessed and mapped;
- ✓ links between the condition and services supply are created;
- ✓ methodologies are developed and agreed with stakeholders;
- ✓ biophysical (**spatially explicit**) **countrywide** as well as pilot-area based assessments are given, maps are generated (resolution **10 × 10 m**);
- ✓ the system will be made available for users, incl. decision-makers.



DEFINING ECOSYSTEM BOUNDARIES

The BASE MAP provides the geographic reference to the ecosystem services data, informing the user on location while simultaneously providing a sense of the actual map scale.

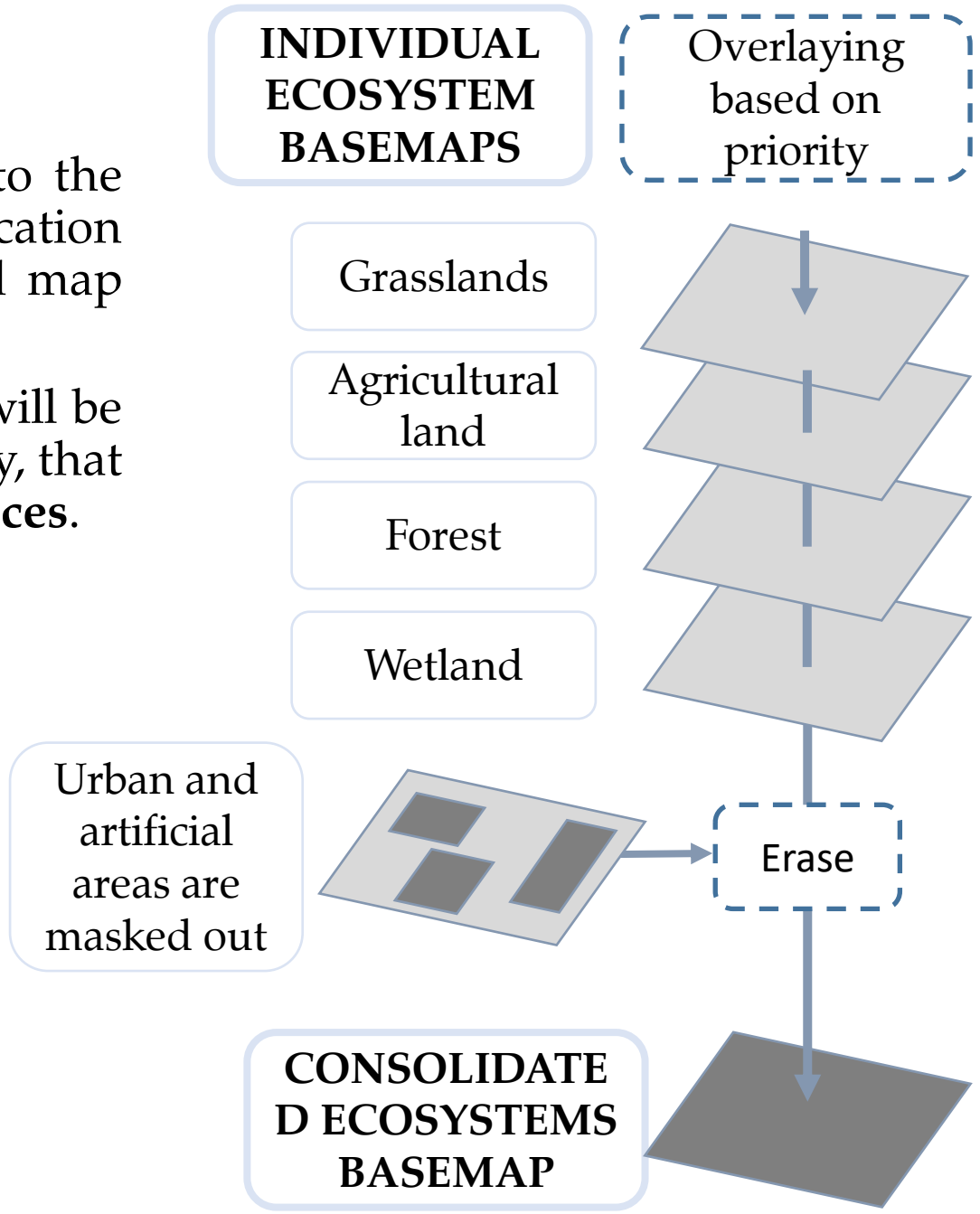
The key element for an ecosystem services base map will be the choice of **geographic units**, determined thematically, that will be later on **linked to the supply of ecosystem services**.

The steps towards a consolidated base map:

- definition of thematic classes,
- overlapping rules,
- filtering/classification rules,
- enhancing/updating,
- aggregation.

The spatial units, the base map classes must be:

- mutually spatially exclusive (no overlaps, no gaps);
- ecologically relevant;
- mappable (data available);
- linkable to other classifications;
- understandable in essence.



Example of the workflow – grasslands

Historical semi-natural grasslands

Other grassland types

Natura habitat types database

Estonian Nature Infosystem

Estonian Seminatural Community Conservation Association meadows database

Inventory outside protected and Natura areas

Estonian Basic map

Estonian digital soil map

4 main types (+subtypes)

+ separate rules

WETLANDS

YES

Habitat type 7230 defined as mire

NO

Interim layer

Other open areas on mineral soils

Estonian agricultural register database

Areas overlapping with cropland

Exclude agro-, forest and wetland ecosystems, urban and coastal areas, artificial surfaces

+ separate rules

5 types

AGRO-ECOSYSTEM

YES

NO

LiDAR-based map

LiDAR-based map

overgrown

tree and bushes coverage <70%

YES

NO

YES

grasslands with restoration potential

Historical semi-natural grasslands

13 types

+

Other grasslands

1 type

Consolidated GRASSLANDS base map

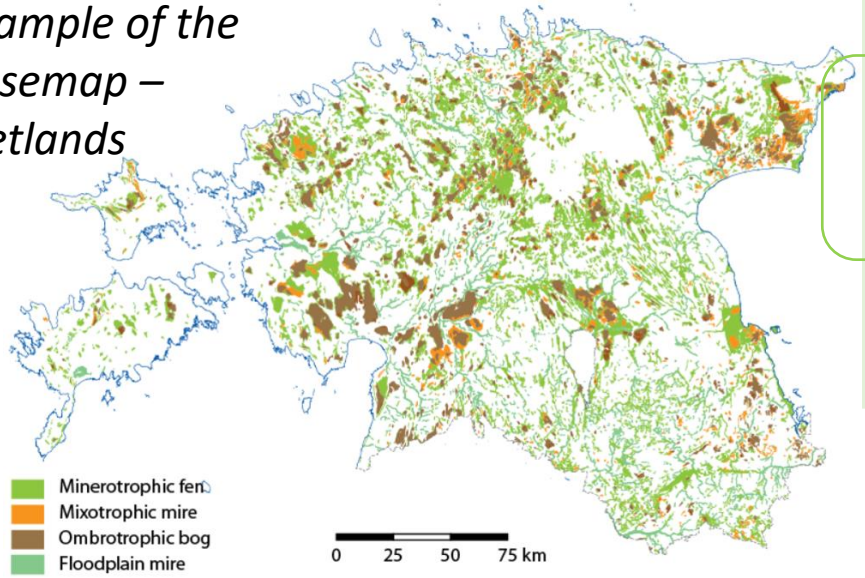
NO

FOREST

+ separate rules

10 types

Example of the basemap – wetlands



DEFINING AND MAPPING ECOSYSTEM CONDITION

Grasslands, 5 classes:
- ✓ Protection status
- ✓ Validity of data
- ✓ Nature protection value estimation, preservation of functions, structure
- ✓ Maintenance: mowing, grazing
- ✓ Historical habitat continuity
- ✓ Overgrowth rate
- ✓ Restoration status/potential

Wetlands, 5 classes:
- ✓ Protection status
- ✓ Distance to the nearest drainage system
- ✓ (Rate of) human impact (cutting, mowing, grazing)
- ✓ Restoration status/potential

Differences in potential supply between these classes

What is the **good** or **reference** condition – is it what (and then, when?) it was before? Or **naturalness**?

Agro-ecosystems, 4 classes:
- ✓ Organic/non-organic farming
- ✓ % of non-arable areas
- ✓ Landscape elements >6 m bordering field
- ✓ Presence of meadows in good condition in the vicinity (<300 m)
- ✓ Environment-friendly management, subsidies
- ✓ Etc.

Forests, 6 classes:
- ✓ Protection status
- ✓ Validity of data
- ✓ Nature protection value estimation
- ✓ Historical habitat continuity
- ✓ Cutting information
- ✓ Drainage
- ✓ Stand composition
- ✓ Alien tree species
- ✓ Deadwood
- ✓ Age

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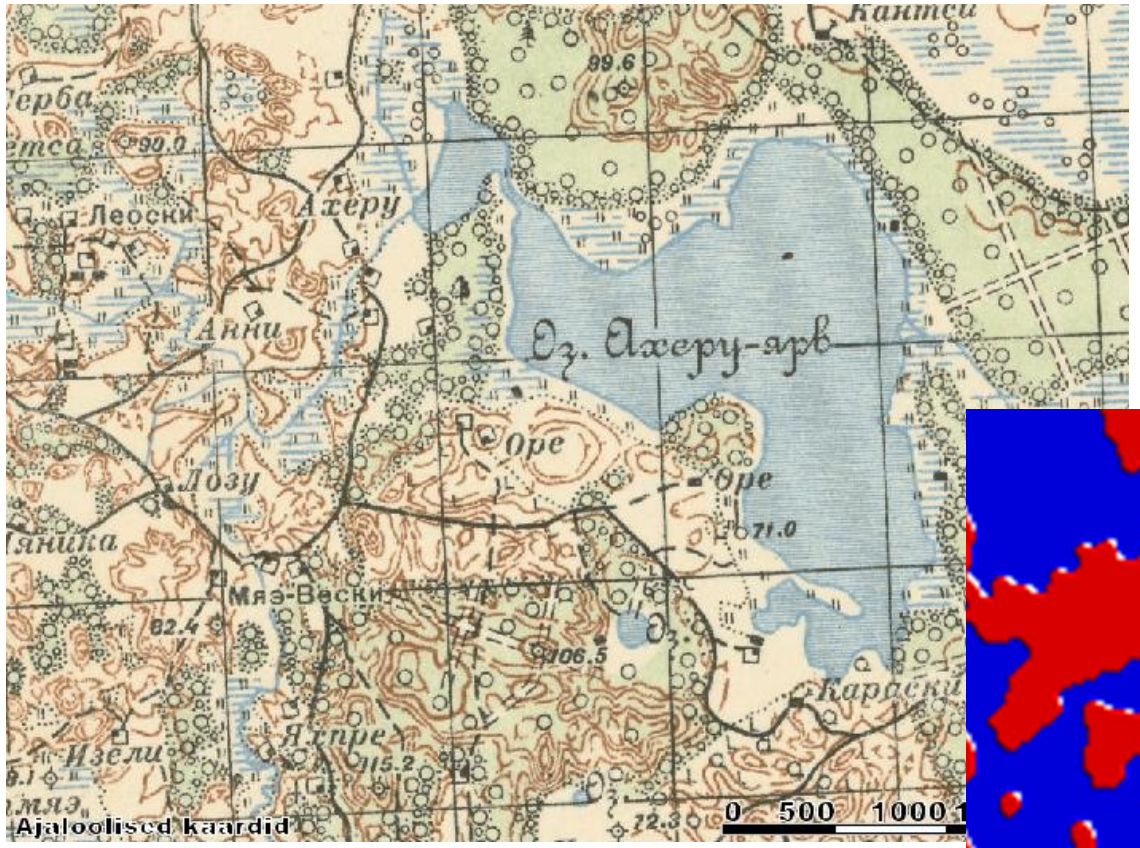

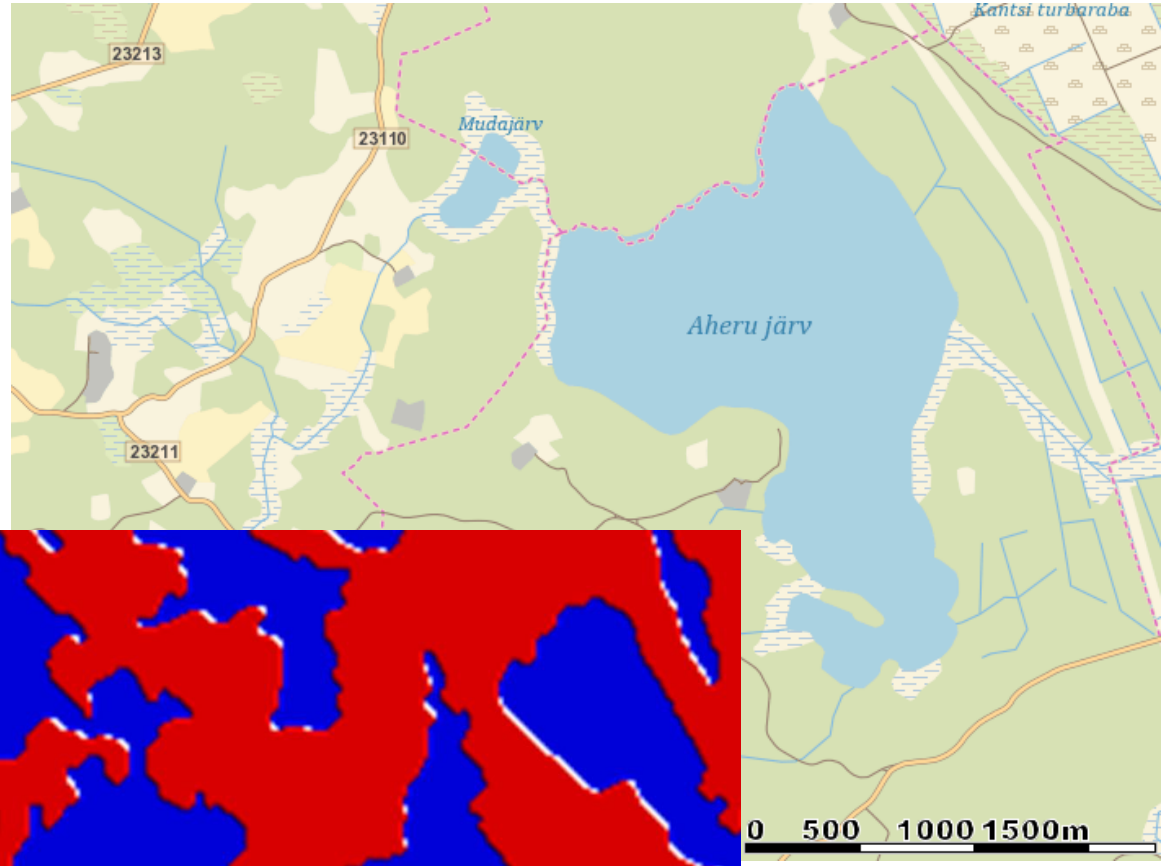

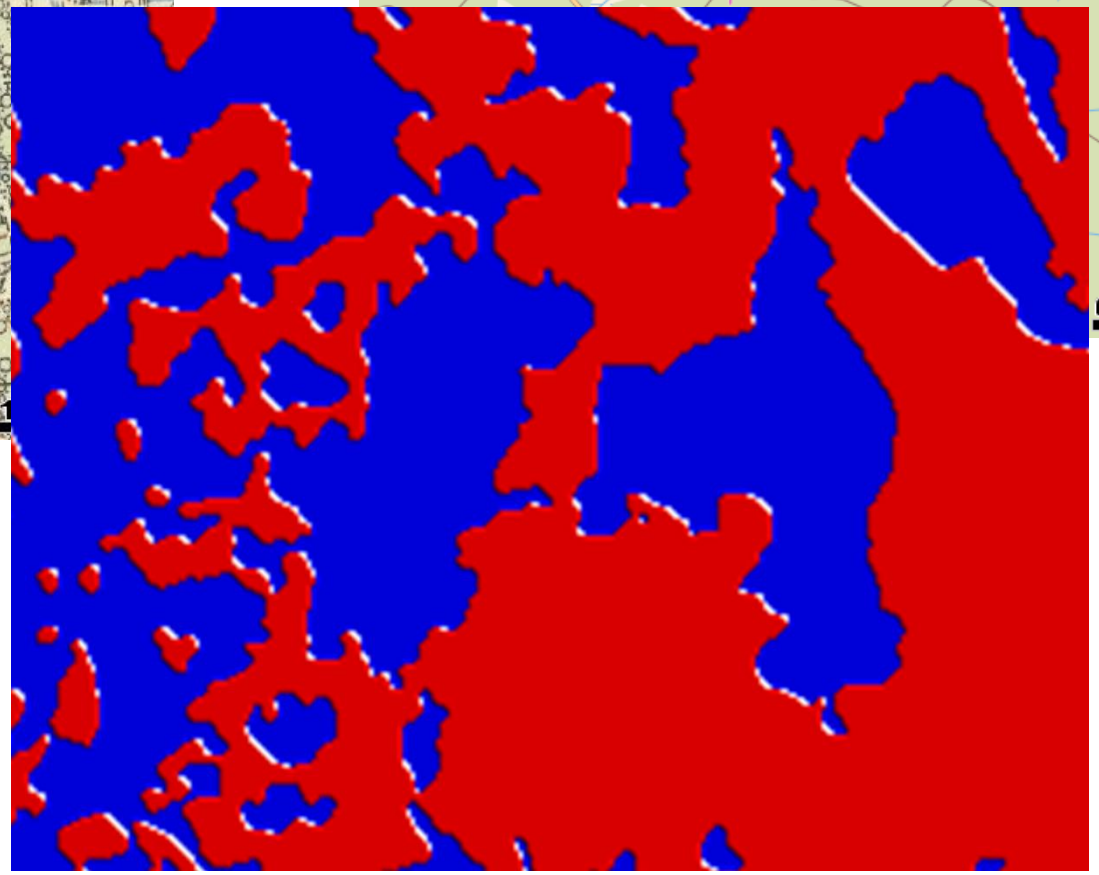

Machine learning to identify continuous forest areas based on historical maps

DEFINING AND MAPPING ECOSYSTEM CONDITION

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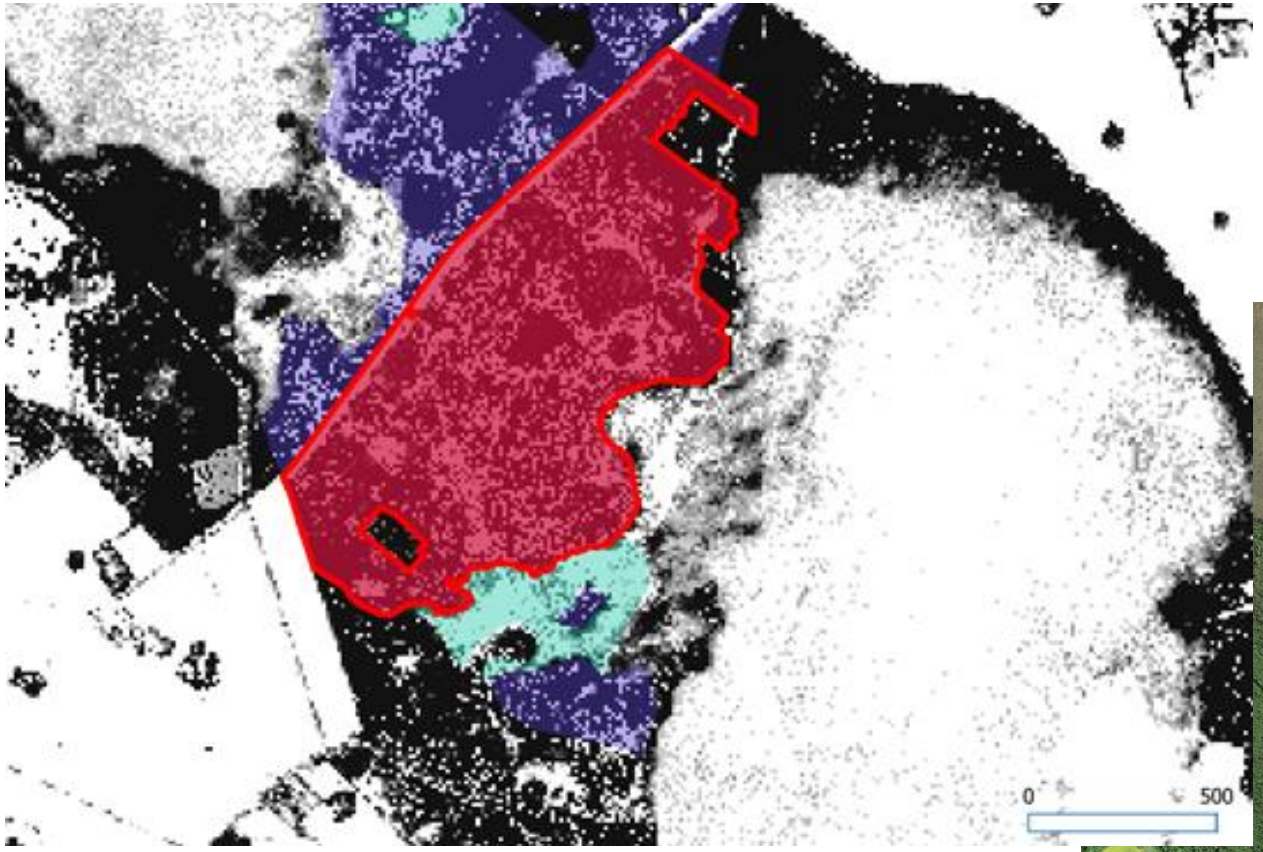
DEFINING AND MAPPING ECOSYSTEM CONDITION



Determination of semi-natural grasslands overgrowth rate using airborne LiDAR based maps

DEFINING AND MAPPING ECOSYSTEM CONDITION

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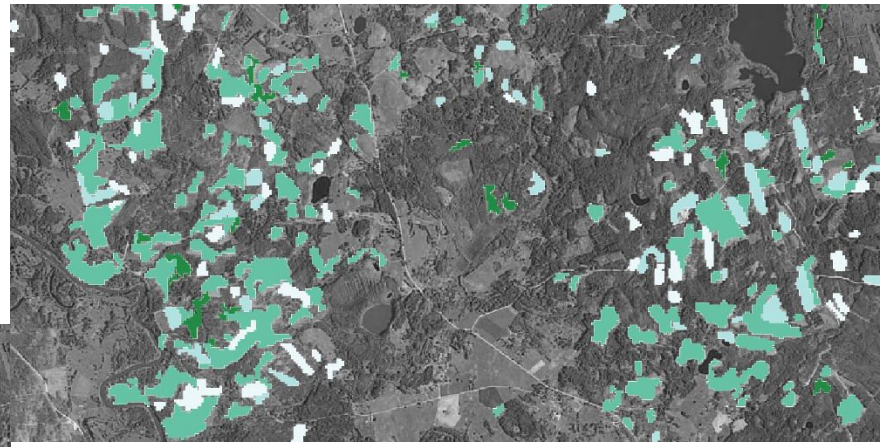
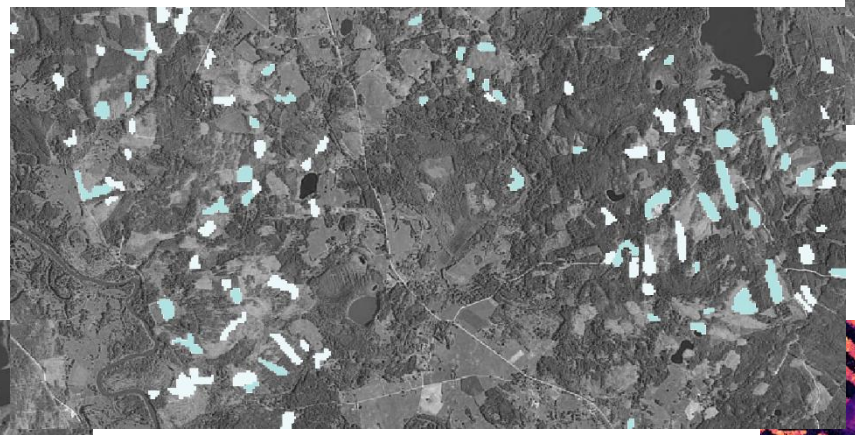
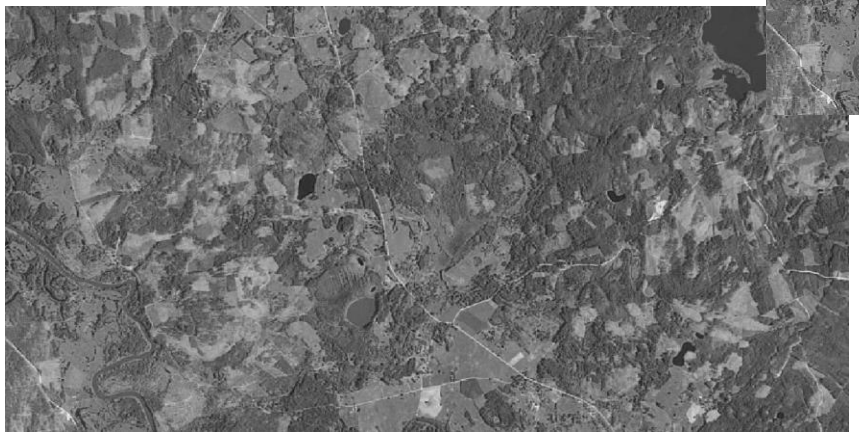
DEFINING AND MAPPING ECOSYSTEM CONDITION

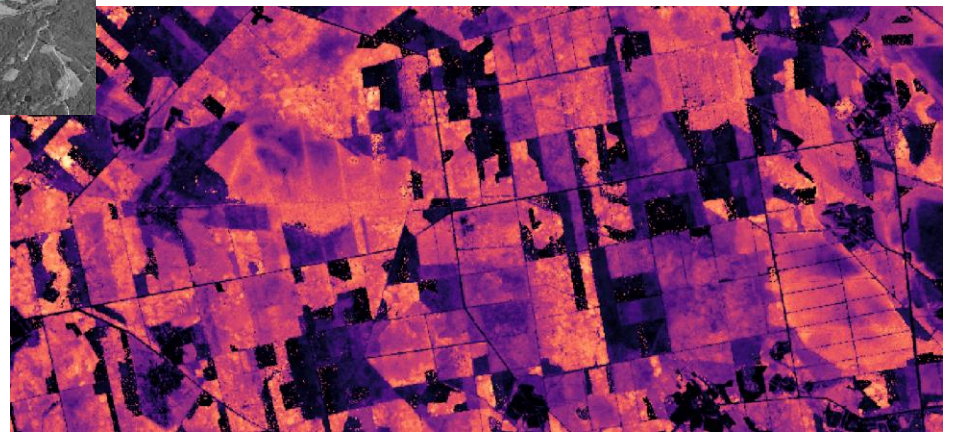
Peterson et al, 2011

Identifying forest clearcuts using yearly maps based on the detected changes between Landsat/Sentinel image pairs of two years









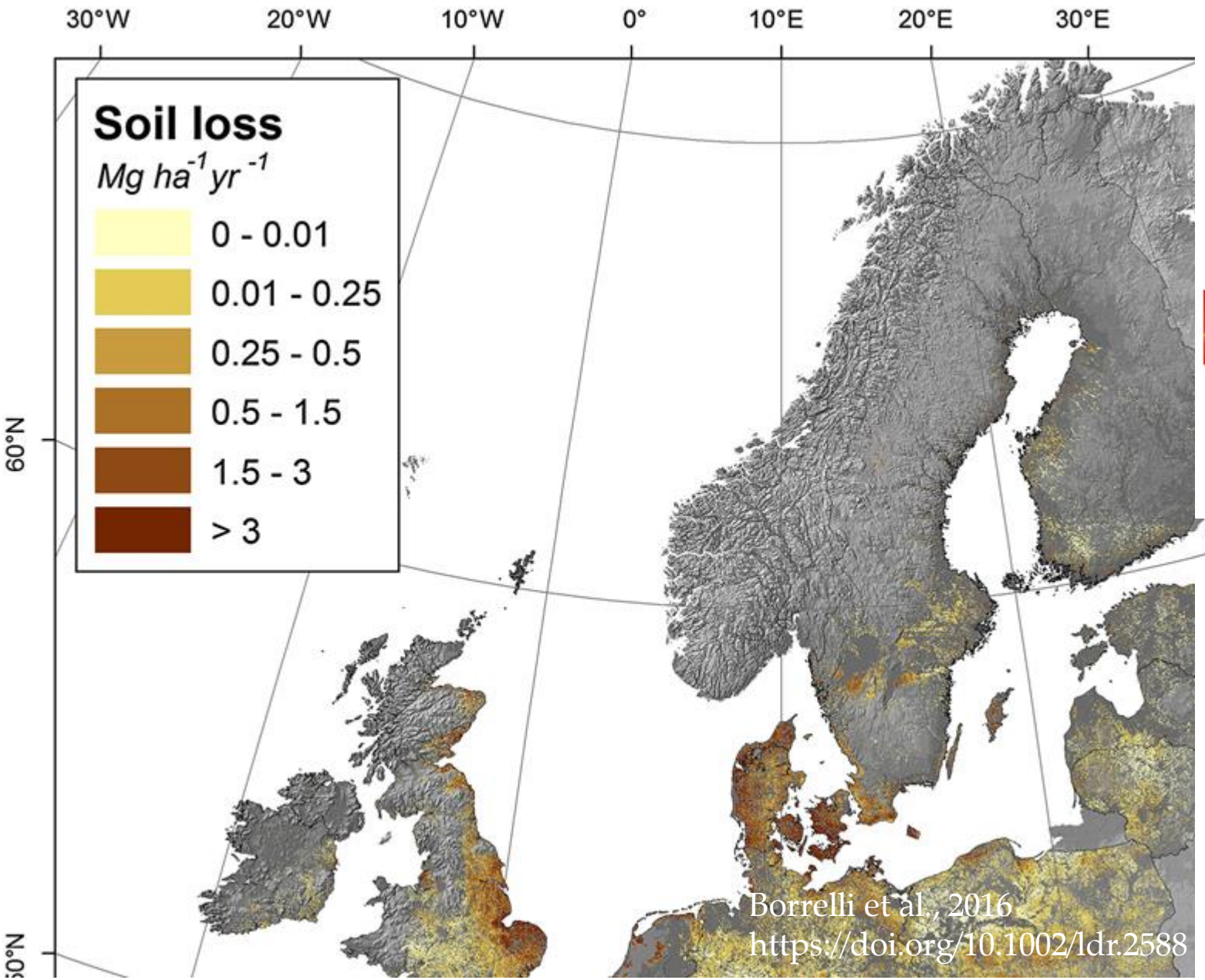
Ecosystem services

PROVISIONING (~15)		
CICES v5.1 code	**Service**	**indicators**
1.1.1.1	Cultivated terrestrial plants grown for nutritional purposes	cultivated crops
1.1.1.2	Materials from plants for direct use or processing	timber
1.1.1.3	Plant-based energy resources	hay, wood
1.1.3.1	Animals reared for nutritional purposes	cattle, sheep, etc.
1.1.3.2	Materials from reared animals for direct use or processing	honey, wool, milk, meat, skins
1.1.5.1	Wild plants used for nutrition	wild berries, mushrooms
1.1.5.2	Materials from wild plants for direct use or processing	peat for horticulture, medicinal plants, birch sap, chaga, etc.
1.1.5.3	Wild plants used as a source of energy	fuel wood, peat
1.1.6.1	Wild animals used for nutritional purposes	game (abundance, meat)
1.1.6.2	Materials from wild animals for direct use or processing	trophies
1.2.1.1	Plant materials collected for maintaining or establishing a population	local endangered species and varieties, common species
1.2.2.1	Animal material collected for the purposes of maintaining or establishing a population	local (endangered) strains
4.2.2.1	Ground (and subsurface) water for drinking	spatial vulnerability and infiltration patterns
4.3.2.4	Solar energy	long-term yearly potential
4.3.2.3	Wind energy	energy density

REGULATION AND MAINTENANCE (~10)		
CICES vs 5.1 code	**Service**	**indicators**
2.1.2.2	Noise attenuation	distance from different noise sources
2.2.1.1	Stabilisation and control of erosion rates	soil loss rates
2.2.1.3 / 5.2.1.2	Hydrological cycle and water flow regulation (flood control)	soil properties combined to drainage, etc.
2.2.1.4 / 5.2.1.3	Wind protection	roughness index, wind energy, etc
2.2.2.1	Pollination	combined pollination potential index
2.2.2.2	Seed dispersal	presence and distribution of wild animals (ar
2.2.2.3	Maintaining nursery populations and habitats (including gene pool protection)	distribution of habitats for specific wild plants and animals
2.2.3.1	Pest control (including invasive species)	presence and distribution of wild animals (arthropods) and their habitats
2.2.3.2	Disease control	presence and distribution of wild animals (arthropods) and their habitats
2.2.6.1	Climate regulation	carbon sequestration and storage in above- and below-ground biomass; carbon storage in soil; other greenhouse gases sequestration; micro- and regional climate differences

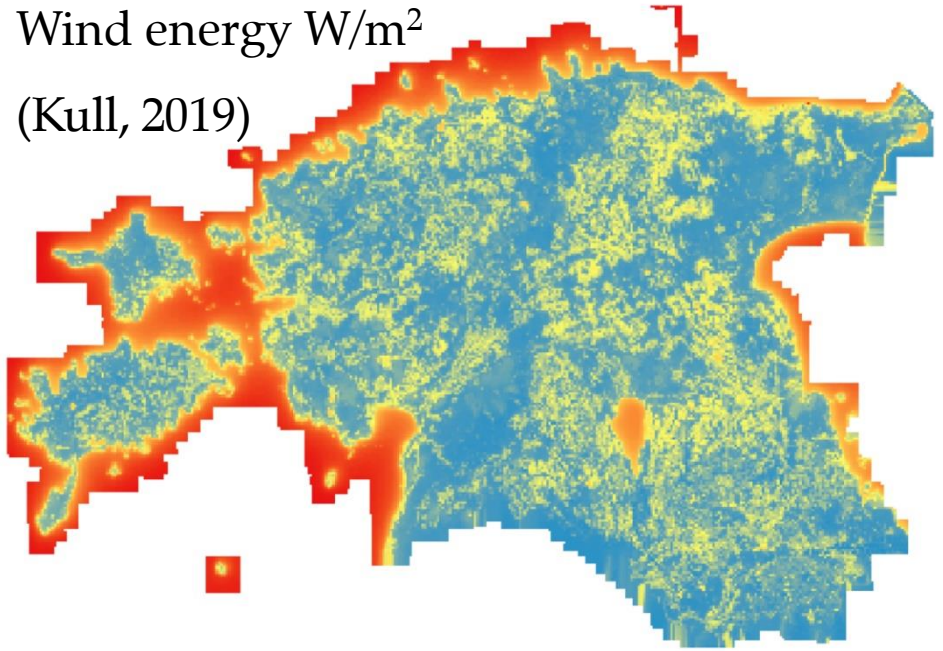
Pollination index inputs:

- ✓ habitat suitability to pollinators, considering characteristic plant species, their nectar productivity and the length of the flowering period;
- ✓ distribution of wild pollinators,
- ✓ landscape metrics,
- ✓ data on pesticides

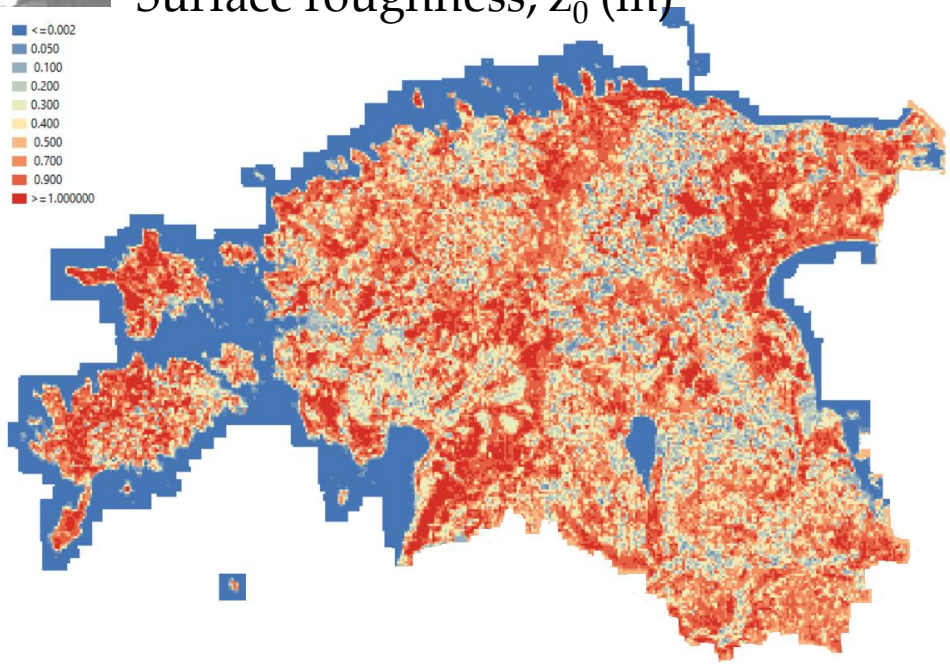


Wind energy W/m^2

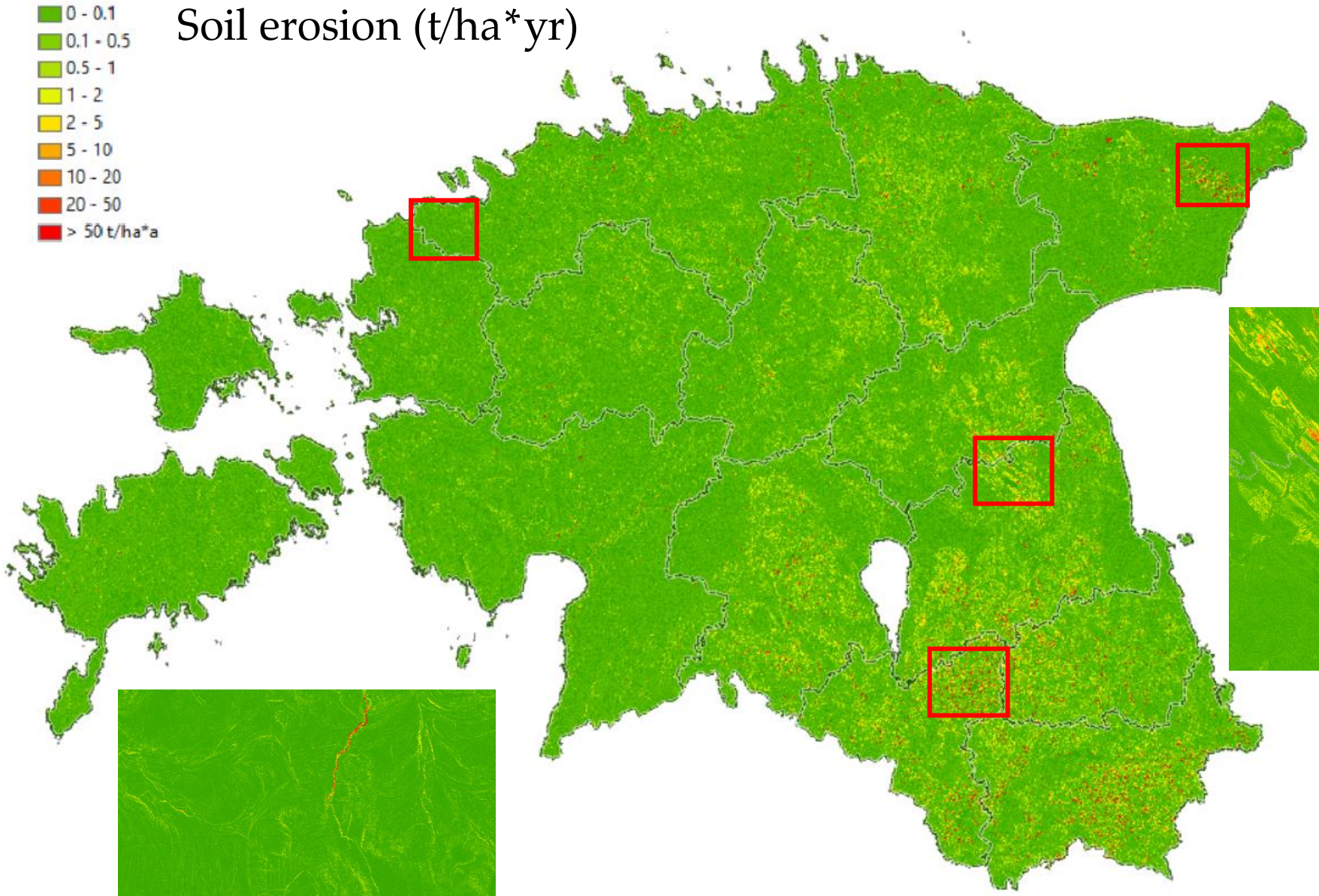
(Kull, 2019)

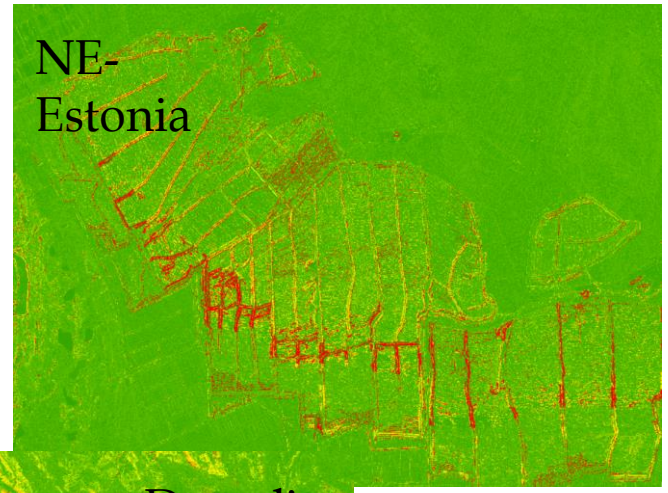


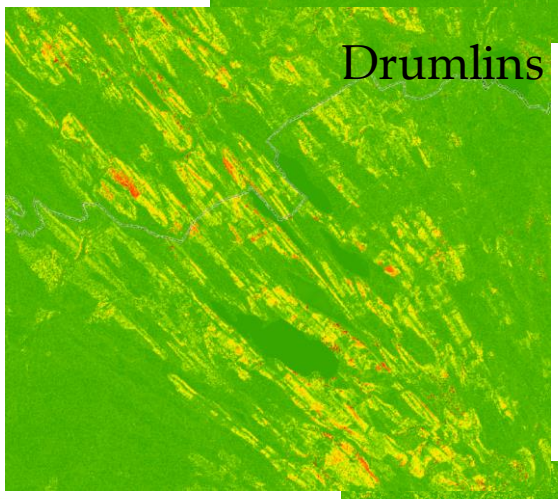
Surface roughness, z_0 (m)

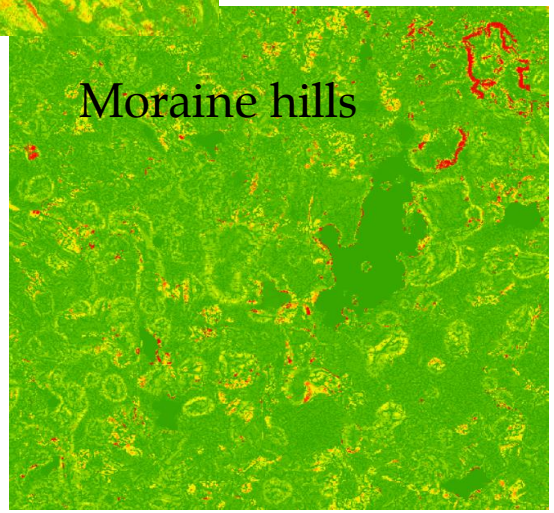


Soil erosion (t/ha*yr)

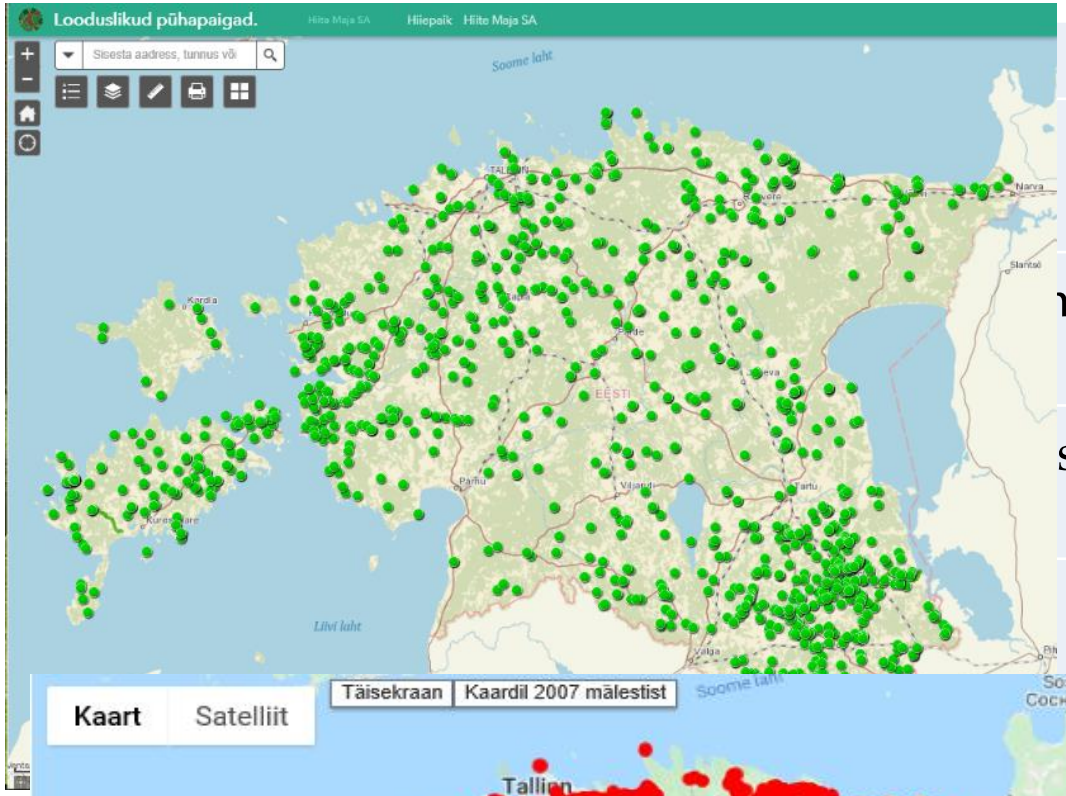








CULTURAL (~9)		
CICES vs 5.1 code	**Service**	**indicators**
3.1.1.1 / 6.1.2.1	Recreation through active or immersive interactions	hunting; suitability for the sport of foot orienteering, etc.
3.1.1.2 / 6.1.1.1	Recreation through passive or observational interactions	distribution of popular bird watching places; hiking trails
3.1.2.3	Natural and cultural heritage	distribution of selected cultural heritage objects
3.1.2.4	Aesthetic experiences	paintings, photos
3.2.1.1 / 6.2.1.1	Elements with symbolic meaning	spatial distribution of national symbols (wolf, barn swallow, cornflower), etc.
3.2.1.2	Elements with sacred or religious meaning	distribution of sacred natural sites
3.2.1.3	Entertainment, representation	movies, texts
3.2.2.1	Existence value	wilderness areas
3.2.2.2 / 6.2.2.1	Bequest value	endangered species, habitats



	indicators
ıersive	hunting; suitability for the sport of foot orienteering, etc.
servational	distribution of popular bird watching places; hiking trails
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	paintings, photos
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ıing	distribution of sacred natural sites
	movies, texts
	wilderness areas
	endangered species, habitats

Project abbr.	Project long name	Period	Project leader(s) in Estonia	Ecosystems
ELME (EU Cohesion Fund project)	Establishment of tools for integrating socioeconomic and climate change data into assessing and forecasting biodiversity status, and ensuring data availability	2015–2020 (2023)	Estonian Environment Agency	grasslands, forest, wetlands, agro-ecosystems, marine* areas
LIFE Viva Grass	Integrated planning tool to ensure viability of grasslands	2014–2019	Baltic Environmental Forum Estonia, Estonian University of Life Sciences	grasslands
LIFE UrbanStorm	Development of sustainable and climate resilient urban storm water management systems for Nordic municipalities	2018–2023	Viimsi local government	urban
IRENES (Interreg Europe project)	Integrating RENewable energy and Ecosystem Services in environmental and energy policies	2019–2023	Estonian Environment Agency, Estonian University of Life Sciences	all relevant ecosystems
LIFE IP CleanEST	Development of an integrated water management and its modern tools in Estonia – strategic choices for future	2019–2028	Ministry of the Environment, Estonian Environment Agency	freshwater
LIFE Coastal GreenInfra		in evaluation process	Baltic Environmental Forum Estonia	coastal
Accounting pilot (EUROSTAT project)	Compilation of land accounts relevant for ecosystem services account and valuation of grassland ecosystem services	2019	Statistics Estonia	grasslands
Accounting pilot (EUROSTAT project)	Development of the ecosystem extent and services account	2020–2021	Statistics Estonia	grasslands, forest, wetlands, urban, agro-ecosystems

* *See next slide*

* Mapping and assessment of marine ES

- The preliminary **methodology** for **marine and inland water ecosystems** was worked out during the project "Development of methods for assessment and mapping of ecosystem services of marine and inland waters" that was conducted in 2014–2015 in Estonia.

- In the framework of **Estonian maritime spatial planning process**:
  - ✓ the selected marine ES were **modelled and mapped** (also under **ELME project in 2019**);
  - ✓ the results are integrated with developed **economic impact model** of marine areas;
  - ✓ close collaboration with the **Ministry of Finance** that is responsible of the maritime spatial planning process and developing the economic impact model.

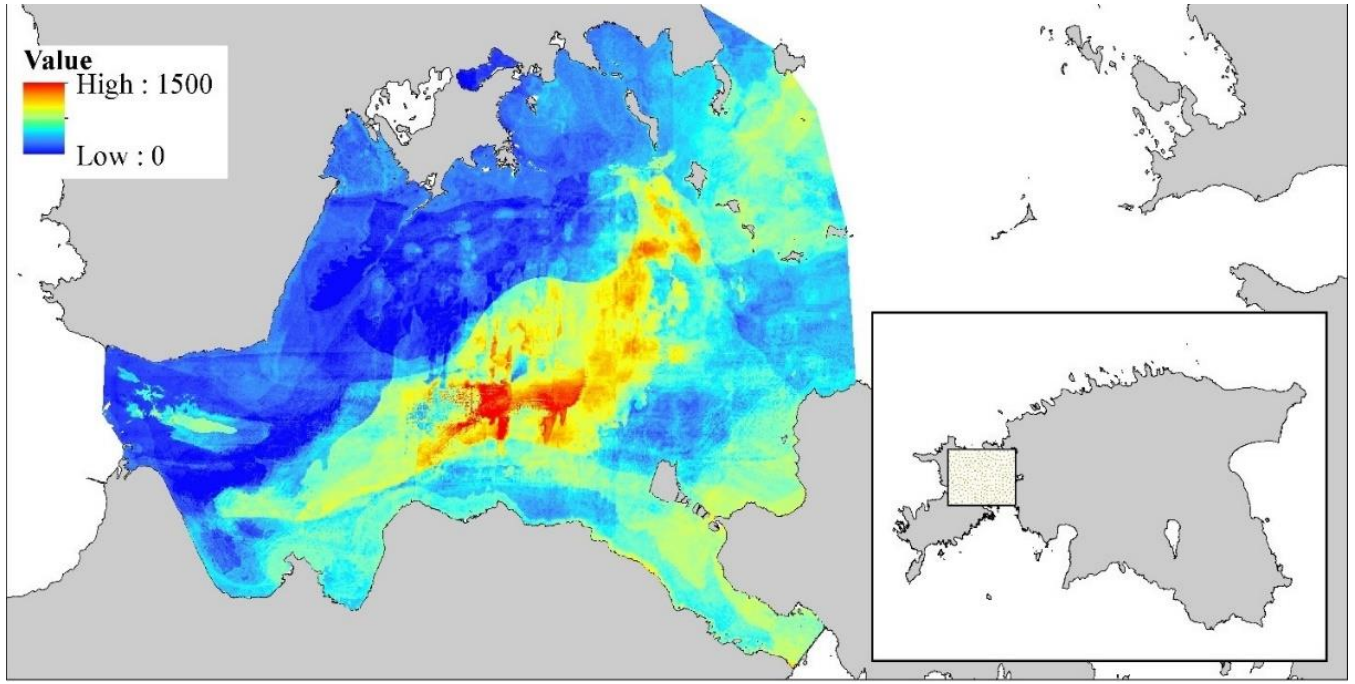
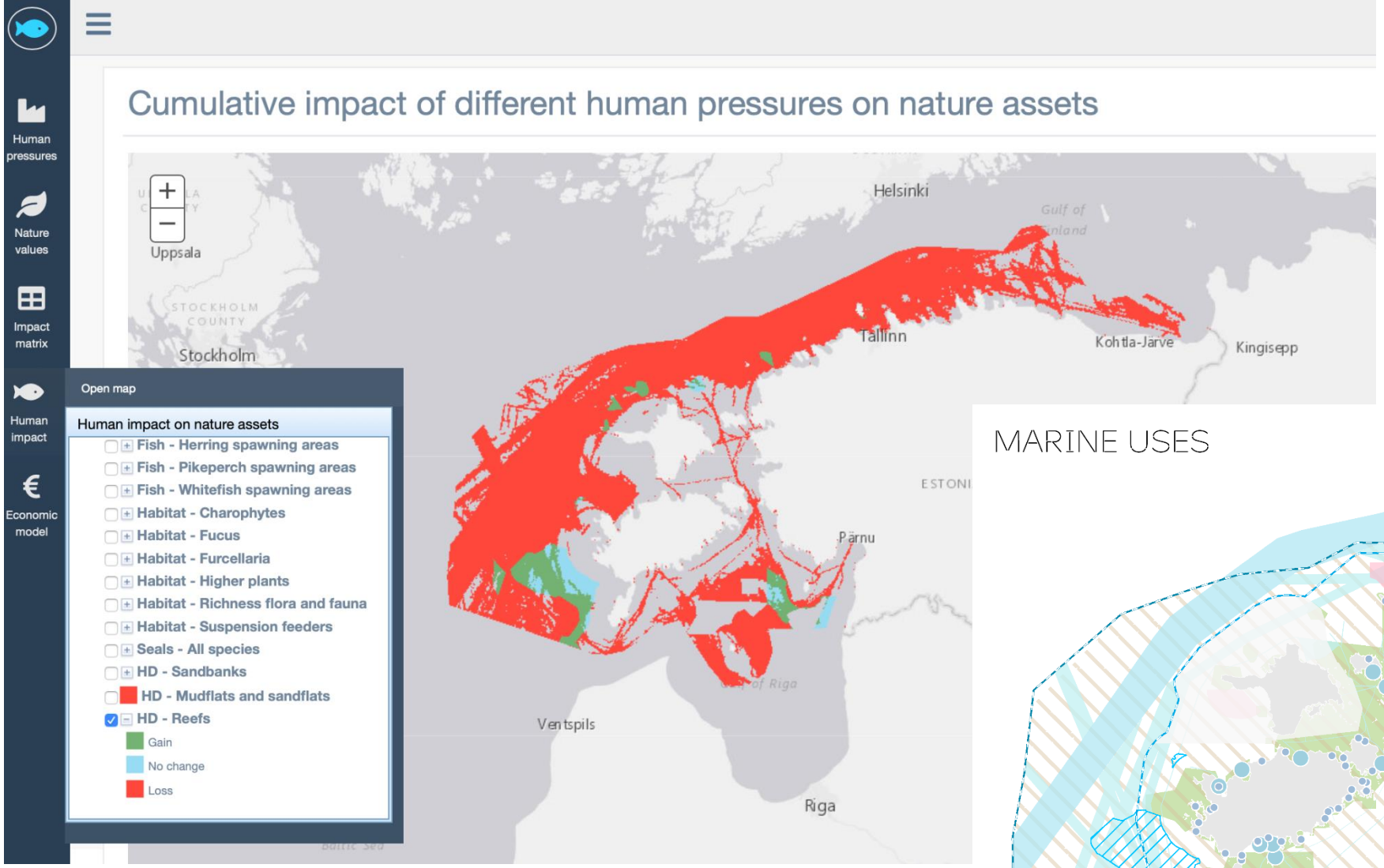
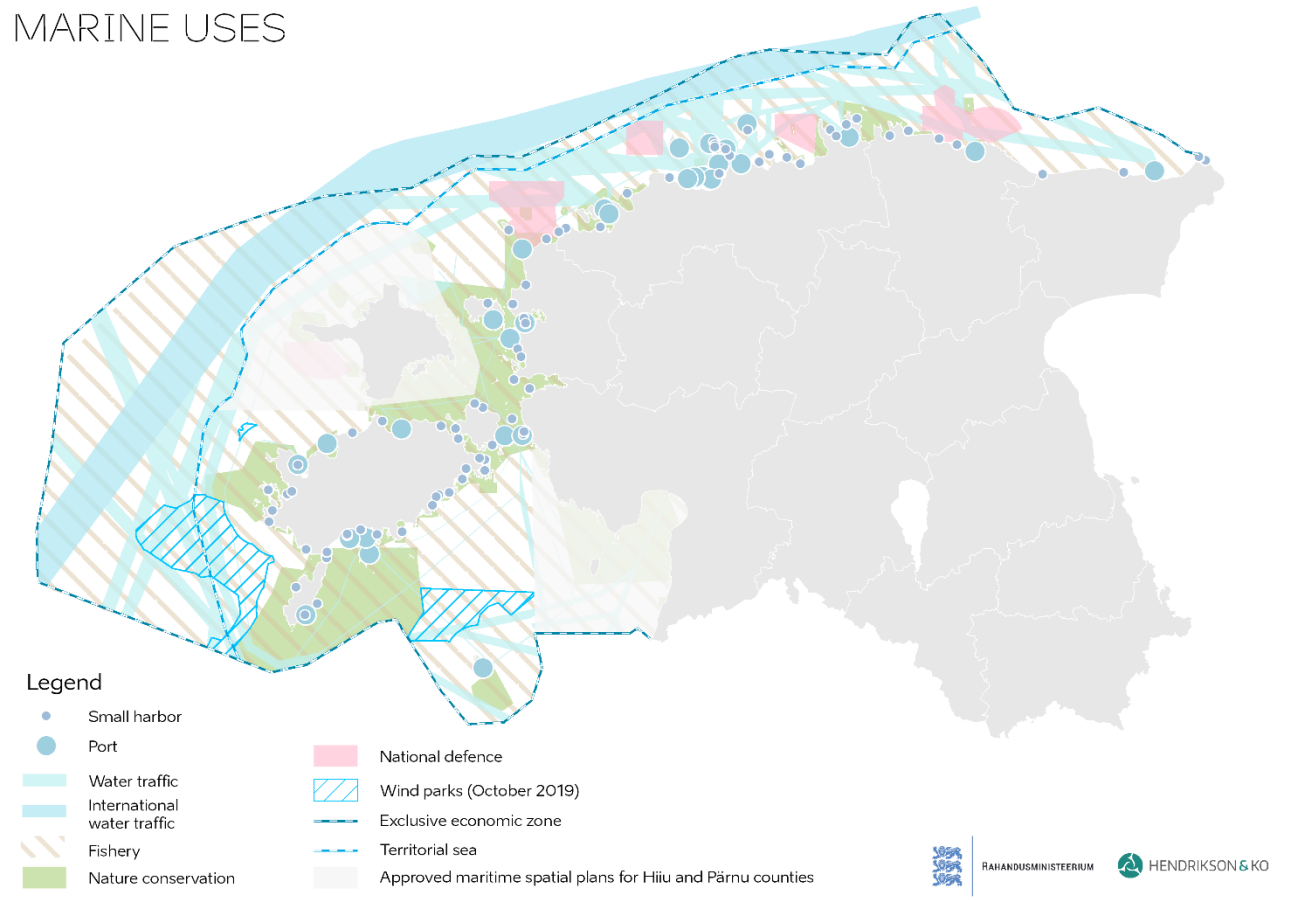


Figure: *An example from the ELME marine ecosystem services study. Biomass of the red algae (Furcellaria lumbricalis) drifting form (g/m^{-2} in wet weight).*



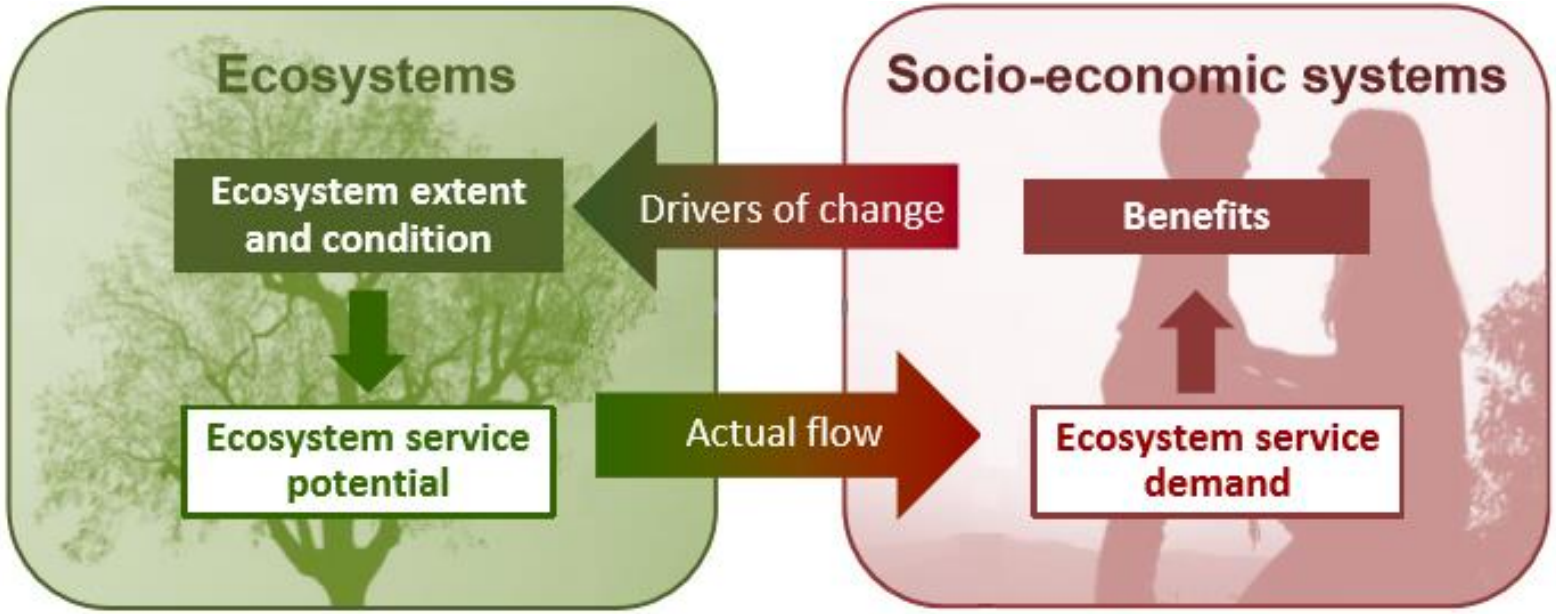
http://mereala.hendrikson.ee/en.htm



http://www.sea.ee/planwise4blue

Challenges

- Project-based actions, nation-wide though
- Harmonizing approaches of NCA and MAES (incl. clear definitions)
- Creating one whole system (from different projects as well as different approaches)



Vallecillo et al, 2019.

- Technical issues (calculation capacity, etc.)
- Integrating (national and open) data sources and methodologies that are soon there but not yet
- Integration into decision-making
- The latter being related to the (future) accessibility to the data and methodologies, understandability, reliability, repeatability, etc.

Thank you!

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- Agricultural Research Centre: Tambet Kikas
- Estonian Environmental Board: Kaja Lotman
- Ministry of Finance: Eleri Kautlenbach
- Ministry of Rural Affairs: Kaidi Jakobson

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