Update ecosystem services analysis in SEEA Experimental Ecosystem Accounting

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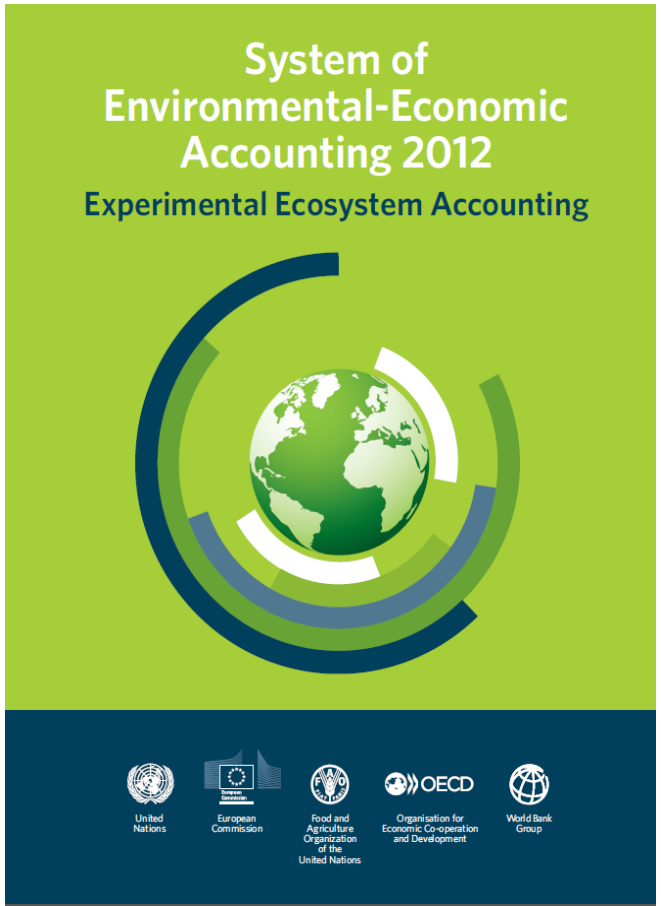
With materials produced by or in collaboration with CBS, Statistics the Netherlands

Contents

- Ecosystem services
- Ecosystem services in the SEEA
- Ecosystem services in the SEEA revision process
- ES definition and classification

Ecosystem accounting

UN Framework and technical recommendations published



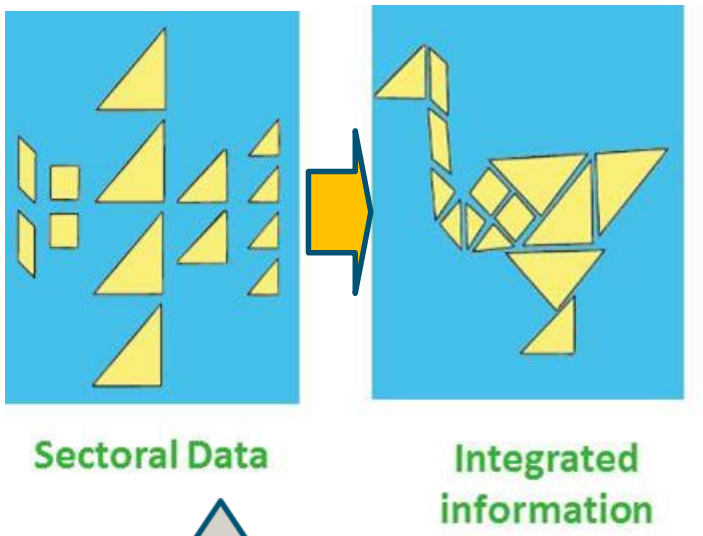
Implementation in many countries, e.g.

- Australia
- Canada
- Indonesia
- Japan
- Mexico
- Netherlands
- Norway
- The Philippines
- United Kingdom
- United States

The ecosystem accounts

Core accounts

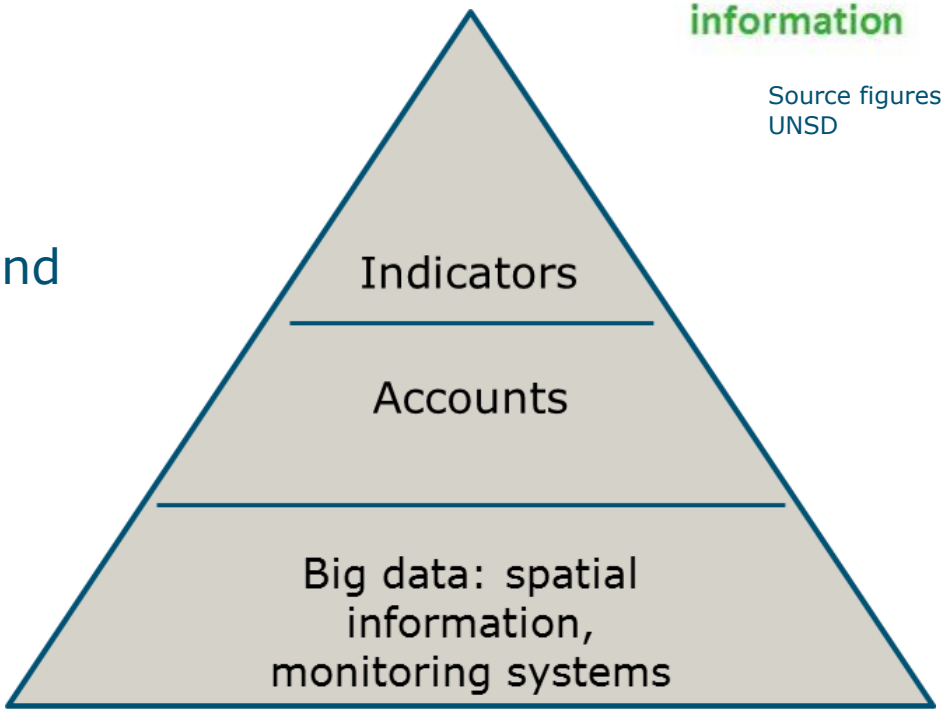
- Ecosystem extent;
- Ecosystem condition;
- Ecosystem services supply and use;
- Monetary ecosystem assets



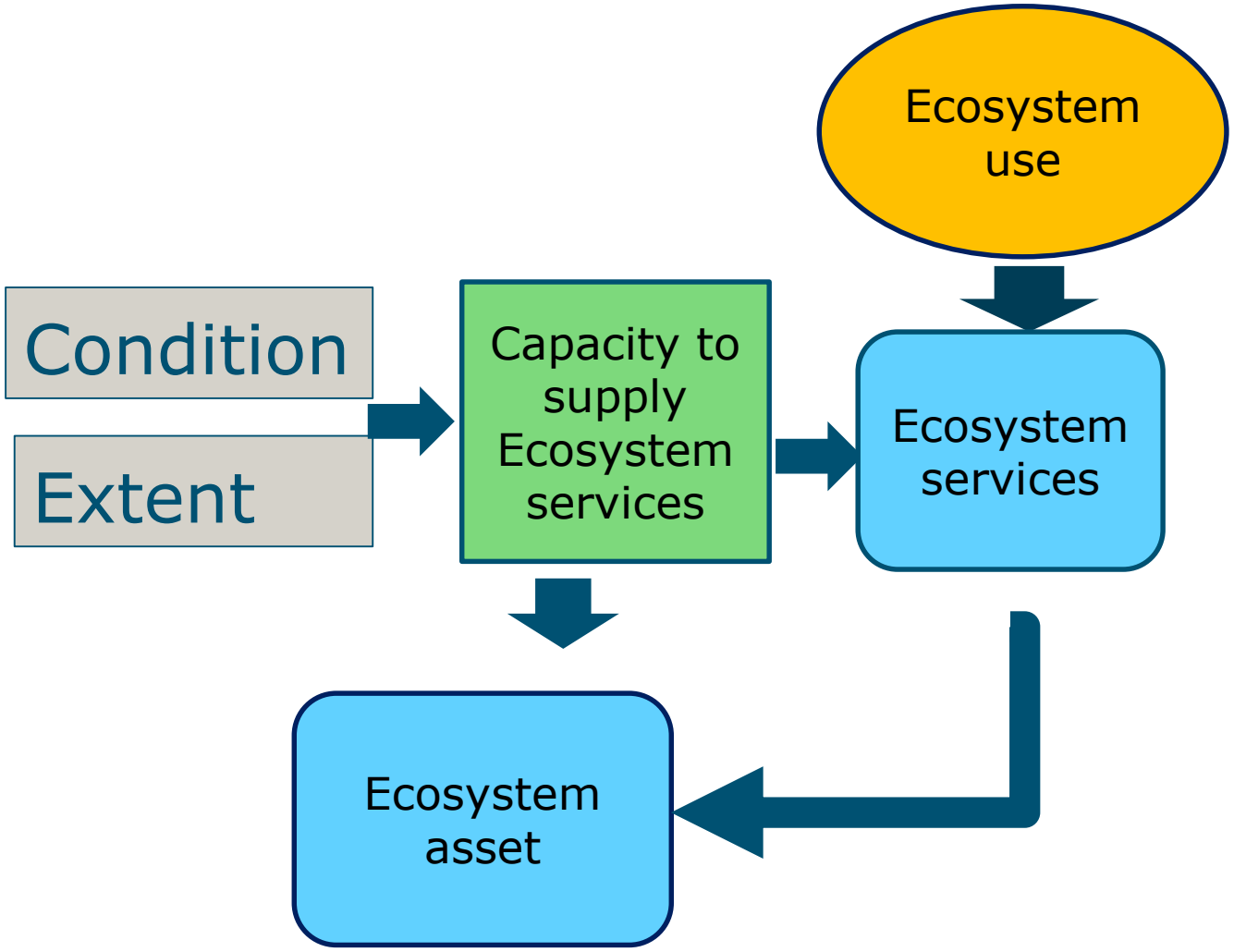
Source figures: UNSD

Thematic accounts

- Dealing with land, water, carbon and biodiversity



Ecosystem services in the accounts



Core accounts

- Ecosystem extent;
- Ecosystem condition;
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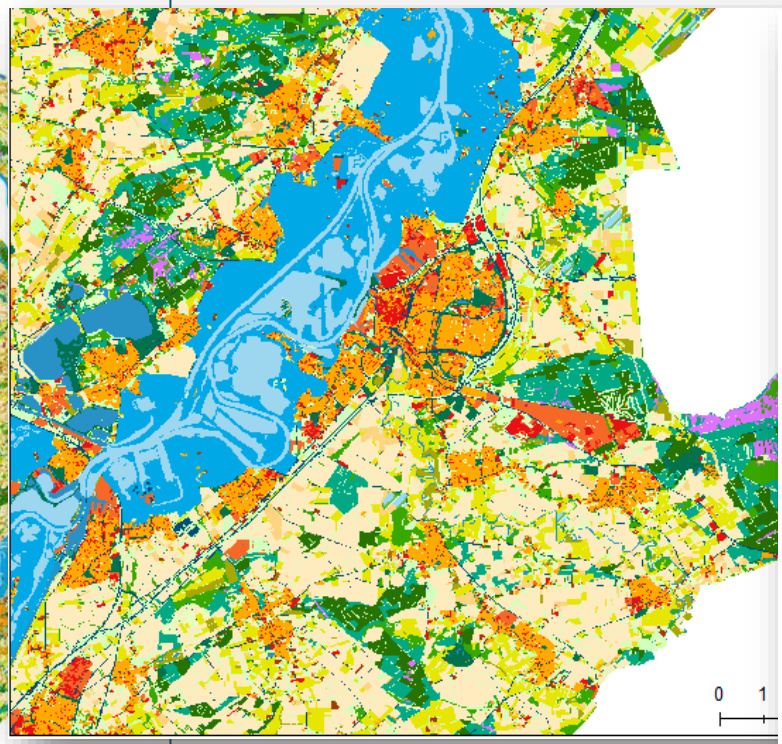
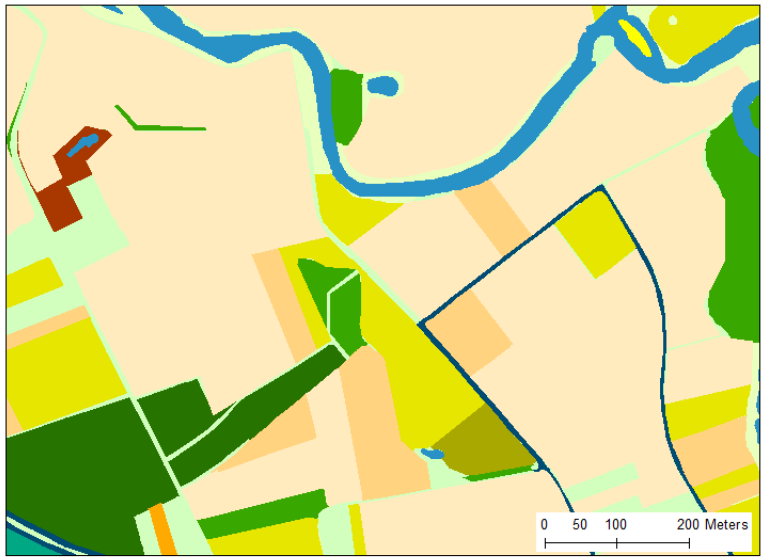
Thematic accounts

- Dealing with land, water, carbon and biodiversity

The basis : the ecosystem map





Legend

EU Units
- <all other values>

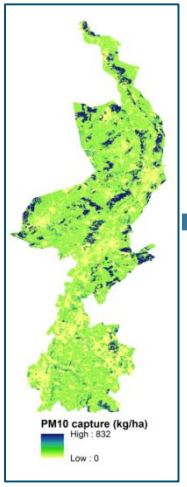
LCEU
- Landbouw: eenjarige gewassen
- Landbouw: meerjarige gewassen
- Landbouw: kassen
- Landbouw: grasland voor veeteelt
- Landbouw: faunarand
- Landbouw: bebouwd
- Duinen met vaste begroeing
- Strand, droogvallend zand en actieve duinen
- Loofbos
- Naaldbos
- Gemengd bos
- Heide
- Zand
- Wetlands
- Grasland, geen weiland
- Openbaar groen
- Overig onverhard terrein
- Uiterwaarden
- Kwelders
- Woongebied
- Kantoren en bedrijven; industrie
- Kantoren en bedrijven; services
- Kantoren en bedrijven; overheid
- Wegen, parkeerterrein, overig verhard terrein
- kantoren en bedrijven; bosbouw
- Kantoren en bedrijven; visserij
- Kantoren en bedrijven; niet-commerciële dienstverlening
- Zee
- Meren, plassen, overig binnenwater
- Rivieren
- Onbekend

Source:
CBS

Ecosystem services in the landscape

Ecosystem servives supply and use

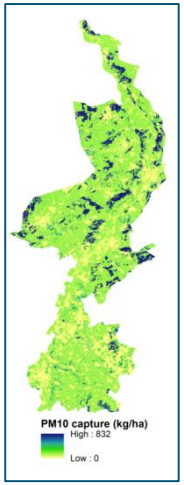
Physical data



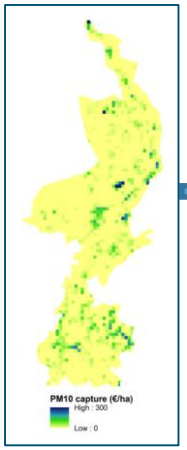
Supply and Use (physical)

Physical supply, totals

Ecosystem services	Ecosystem Units	1 Non-perennial plants	2 Perennial plants	4 Meadows (for grazing)	5 Hedgerows	21 Deciduous forest	22 Coniferous forest	23 Mixed forest	24 Heath land	26 Fresh water wetlands	27 Natural grassland	28 Public green space	31 River flood basin	Totals
	extent (ha)	53.600	8.100	27.100	2.900	11.400	7.100	10.400	2.100	900	3.100	4.800	14.100	**220.900**
Crops	tonnes/yr	1.427.300	65.000	-	-	-	-	-	-	-	-	-	-	**1.492.400**
Fodder	tonnes/yr	140.800	4.700	328.700	-	-	-	-	-	-	-	-	66.900	**541.100**
Meat (from game)	kg/yr	11.500	1.500	5.900	800	2.500	1.700	2.900	600	200	800	900	2.400	**36.800**
Ground water (drinking water only)	in 1000 m3/yr	9.000	1.400	4.200	500	1.900	100	500	100	-	700	400	1.300	**27.000**
capture of PM10	tonnes/yr	400	100	200	-	300	400	500	-	-	-	100	100	**2.300**
Carbon sequestration	tonnes C/yr	-	2.400	4.900	500	16.500	10.300	15.100	400	200	600	1.200	2.800	**59.000**
Recreation (cycling)	1000s of bike trips/yr	1.800	300	1.000	100	600	200	400	-	-	100	200	600	**9.100**
Nature tourism	# tourists/yr	94.000	22.000	136.800	57.000	160.300	93.800	147.400	22.700	11.600	55.400	11.800	94.500	**974.300**



Monetary data



Supply and use (monetary)

		Non-perennial plants	Meadows (for grazing)	Hedgerows	Deciduous forest	Coniferous forest	Mixed forest	Heath land	Fresh water wetlands	Natural grassland	Public green space	Other unpaved terrain	River flood basin	Totals
extent	ha	53.629	27.066	2.940	11.414	7.091	10.437	2.149	936	3.121	4.761	22.591	14.126	**220.922**
Crops	€	35.303.100	-	-	-	-	-	-	-	-	-	-	-	**37.908.400**
Fodder	€	1.960.900	4.587.100	-	-	-	-	-	-	-	-	-	942.300	**7.556.200**
Meat (from game)	€	817.700	223.400	-	186.800	192.700	261.100	35.600	12.700	32.900	14.700	211.200	136.000	**2.249.400**
Ground water	€	3.861.200	1.802.300	193.900	824.200	63.500	218.700	57.300	11.200	295.700	192.600	1.041.100	545.700	**11.602.800**
Capture of PM10	€	301.200	173.700	30.400	200.200	185.700	200.700	27.200	2.400	46.700	78.100	258.200	85.900	**2.275.900**
Carbon sequestration	€	300	165.700	18.000	562.500	350.300	515.000	13.200	6.400	19.300	40.500	139.000	95.600	**2.006.100**
Nature tourism	€	4.410.000	6.349.100	2.357.700	6.930.100	3.162.500	5.443.100	917.000	392.800	2.488.900	625.900	2.870.600	3.162.100	**41.816.200**
Recreation (cycling)	€	NA												NA
	€	**46.654.400**	**13.301.400**	**2.600.000**	**8.703.800**	**3.954.700**	**6.638.800**	**1.050.400**	**425.400**	**2.883.500**	**951.700**	**4.520.200**	**4.967.500**	**105.415.000**
value per ha (excl. Amenity)	€/ha	**870**	**491**	**884**	**763**	**558**	**636**	**489**	**454**	**924**	**200**	**200**	**352**	**477**
value per ha (incl. Amenity)*	€/ha	**870**	**491**	**884**	**1.193**	**988**	**1.066**	**489**	**454**	**924**	**688**	**220**	**352**	**553**

Ecosystem services in the NLs

Provisioning services

- Crop production
- Fodder production
- Timber production
- Other biomass
- Water supply

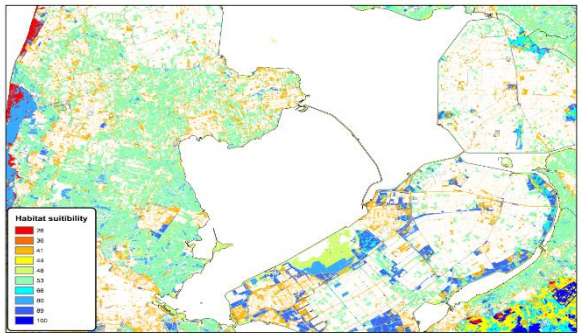
Regulating services

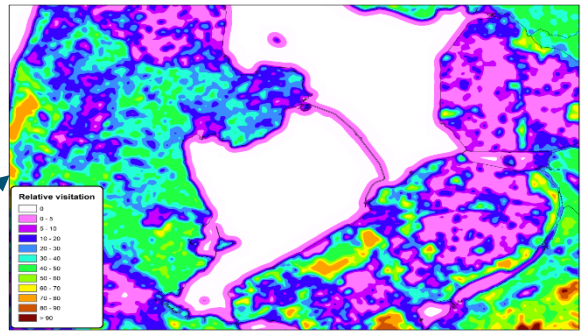
- Carbon sequestration
- Erosion control
- Air filtration
- Water infiltration
- Pollination
- Pest control

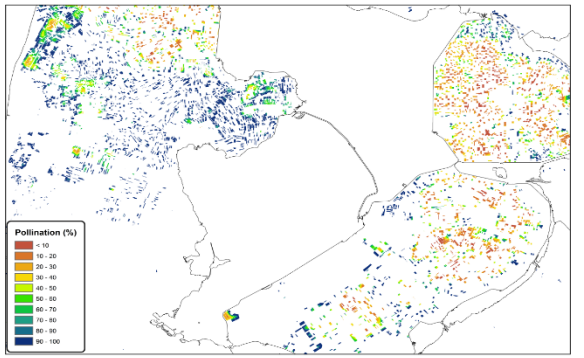
Cultural services

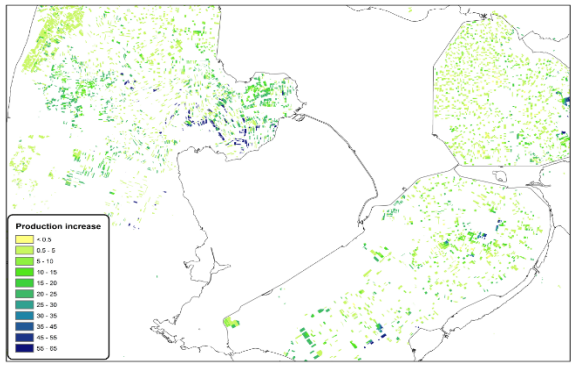
- Nature recreation (hiking)
- Nature tourism

Multiple datasets and models per service



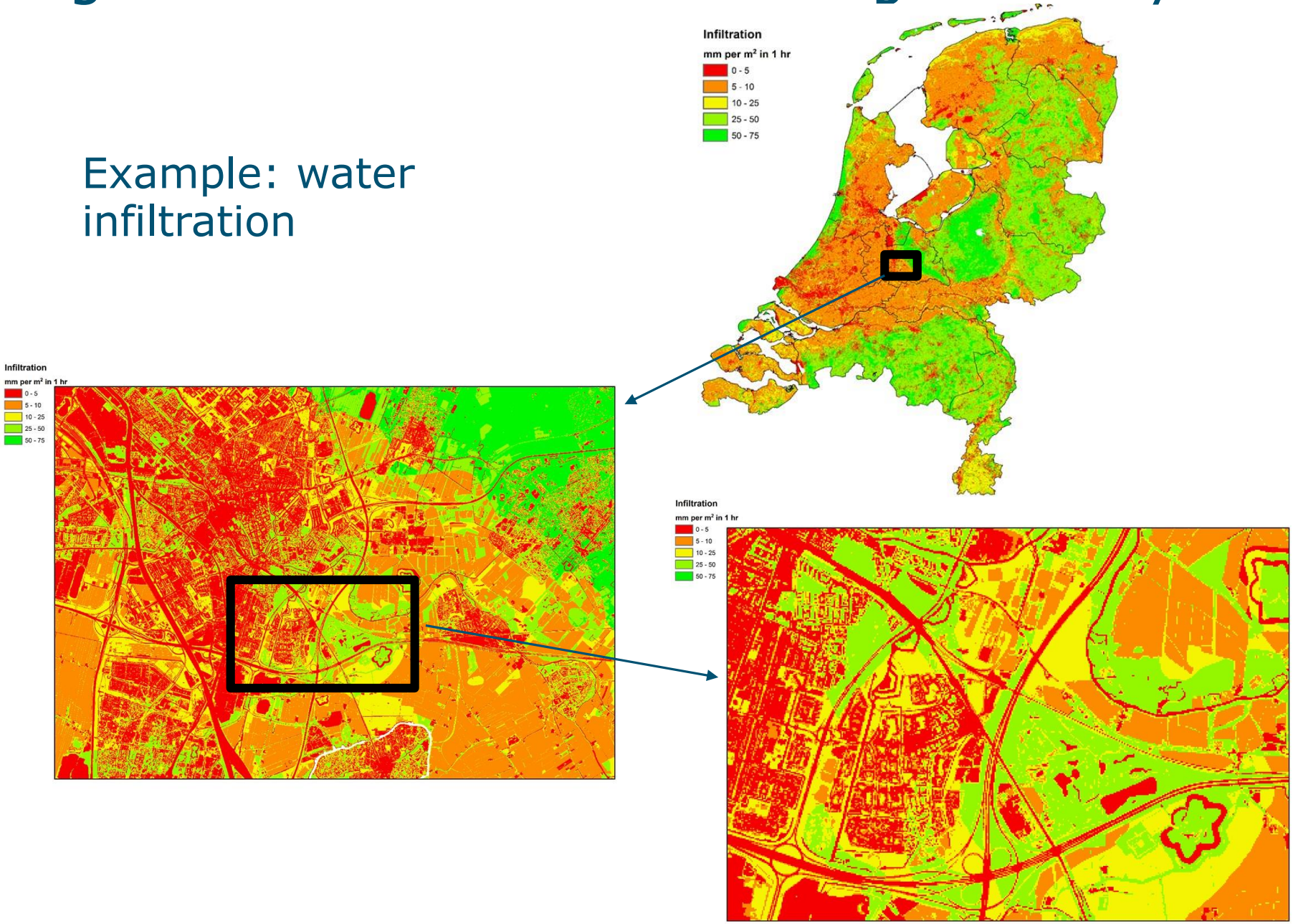




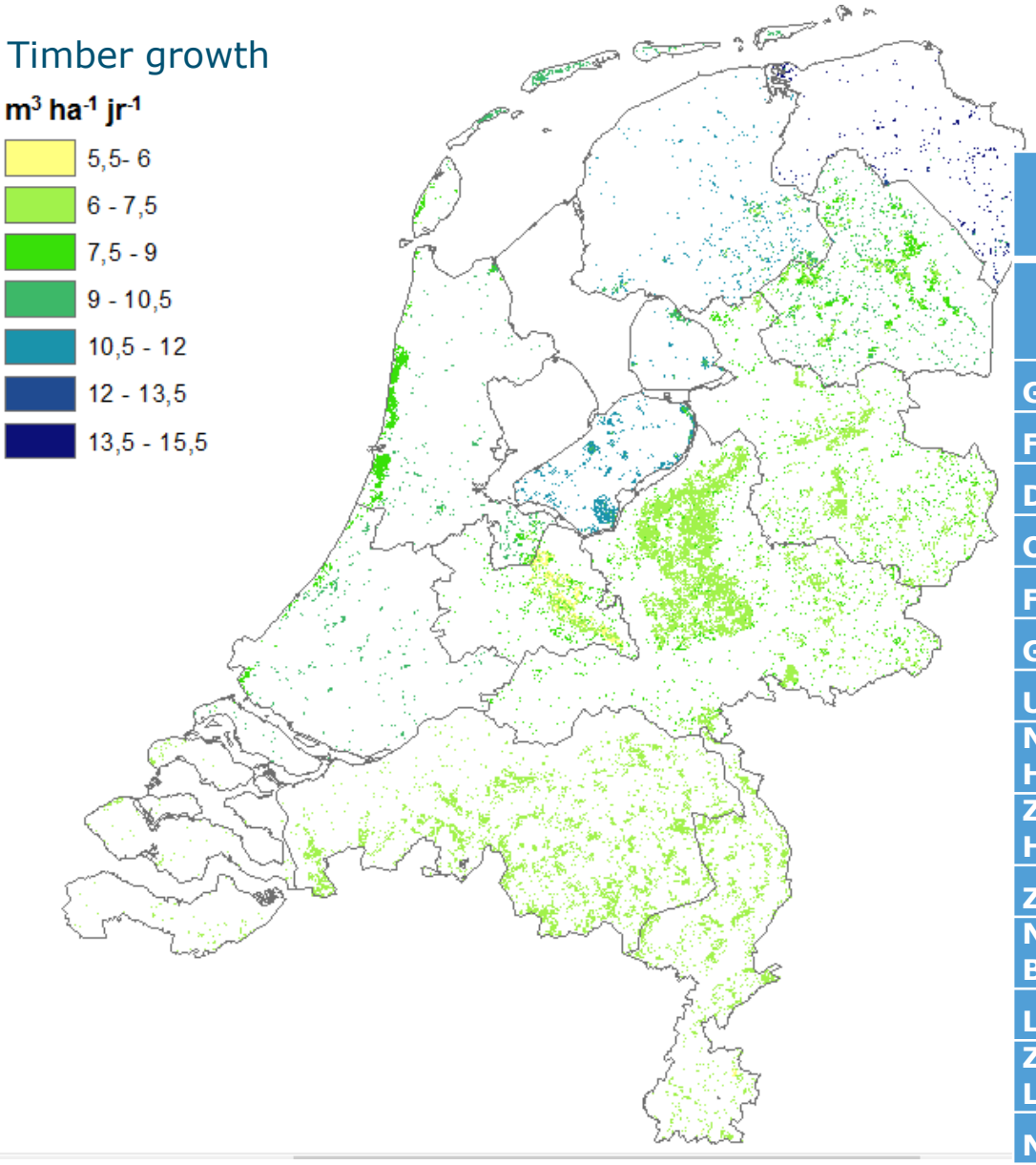


High resolution allows zooming in locally

Example: water infiltration

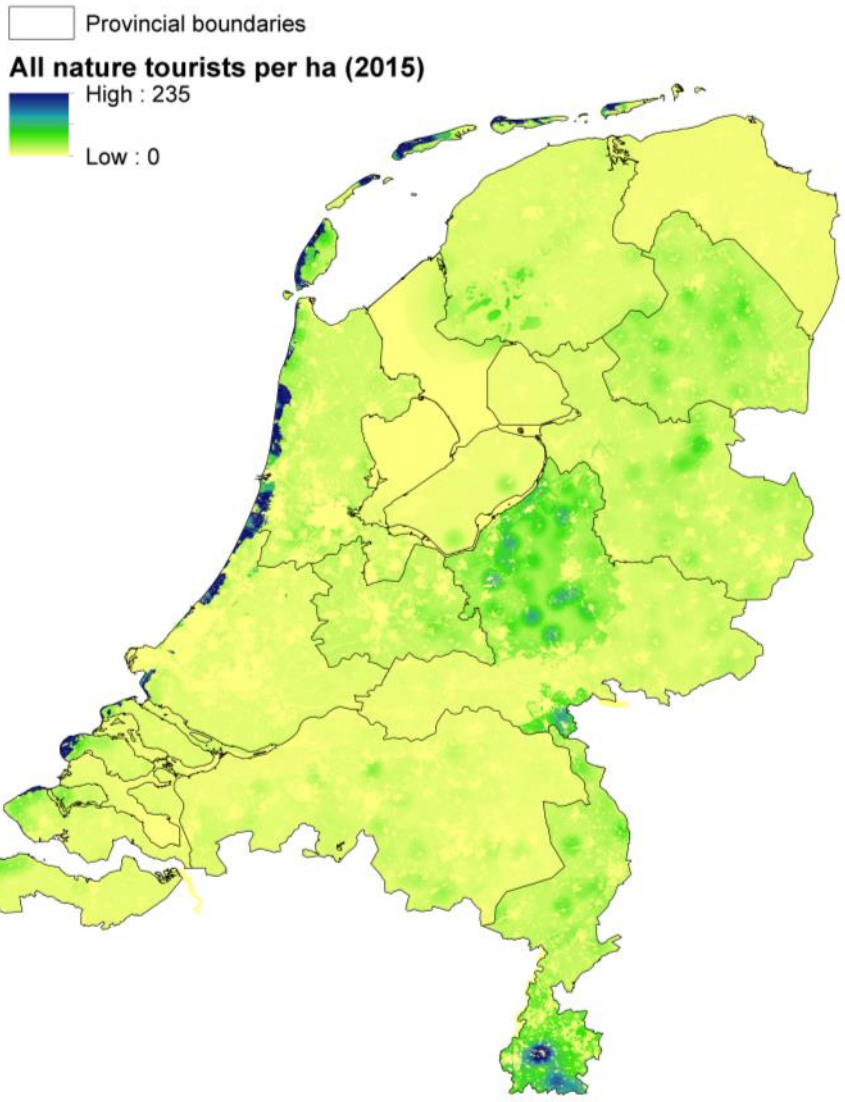


Timber production



	Forest area	Timber Stock	Growth	Harvest
	(1000 ha)	(1000 m3)	(1000 m3/yr)	(1000 m3/yr)
Groningen	6	1,221	58	19
Friesland	14	2,918	111	40
Drenthe	31	6,633	253	129
Overijssel	34	7,723	243	106
Flevoland	14	2,910	113	73
Gelderland	88	20,411	641	308
Utrecht	17	3,526	117	53
Noord-Holland	17	4,478	130	38
Zuid-Holland	8	1,420	53	18
Zeeland	4	553	25	11
Noord-Brabant	65	12,358	444	215
Limburg	24	5,147	156	73
Zuid-Limburg	5	1,436	32	13
Netherlands	326	70,726	2,375	1,097

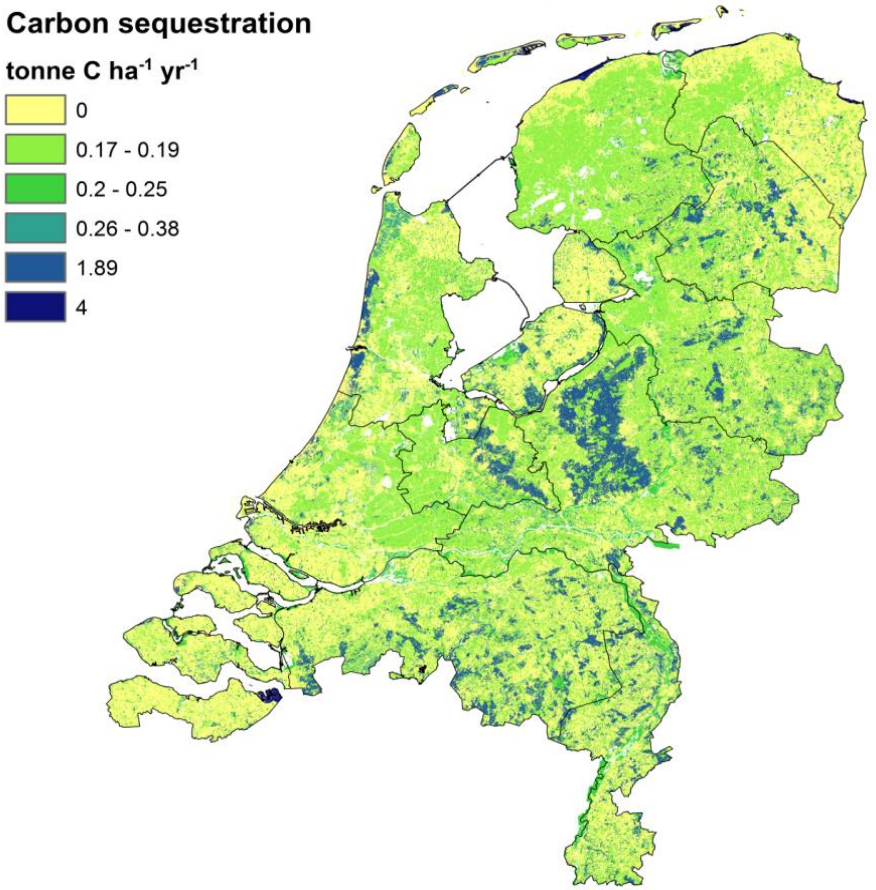
Nature tourism

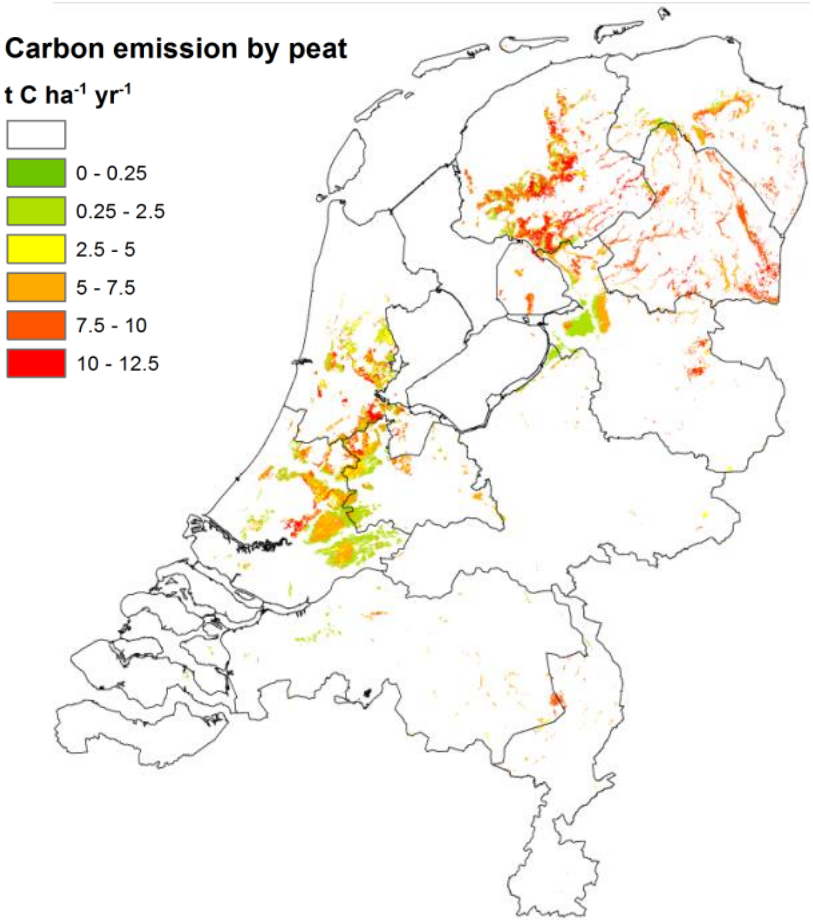


Overnight stays x 1000	Nature and active holidays	Beach holidays	Water sport	Total
Groningen	66	2	1	69
Friesland	263	135	66	464
Drenthe	378	11	0	389
Overijssel	353	6	5	364
Flevoland	61	8	8	77
Gelderland	797	12	0	809
Utrecht	151	3	0	154
Noord Holland	293	343	6	642
Zuid-Holland	151	150	18	319
Zeeland	145	356	16	517
Noord Brabant	278	6	0	284
Limburg	446	22	8	476
Totaal	**3382**	**1054**	**128**	**4564**

Carbon account

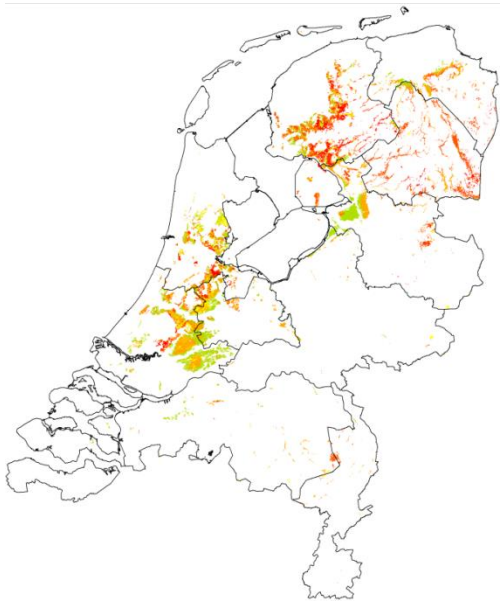
Stocks, emissions and sequestration of CO_2

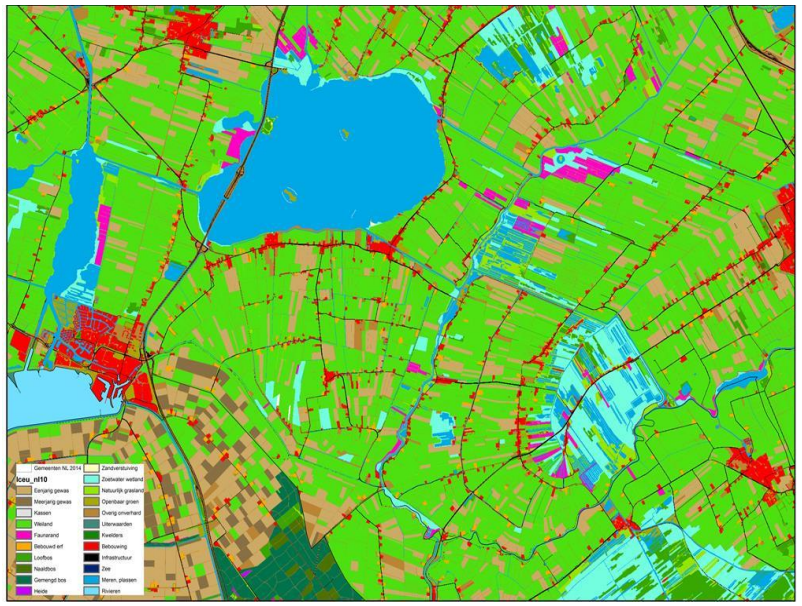


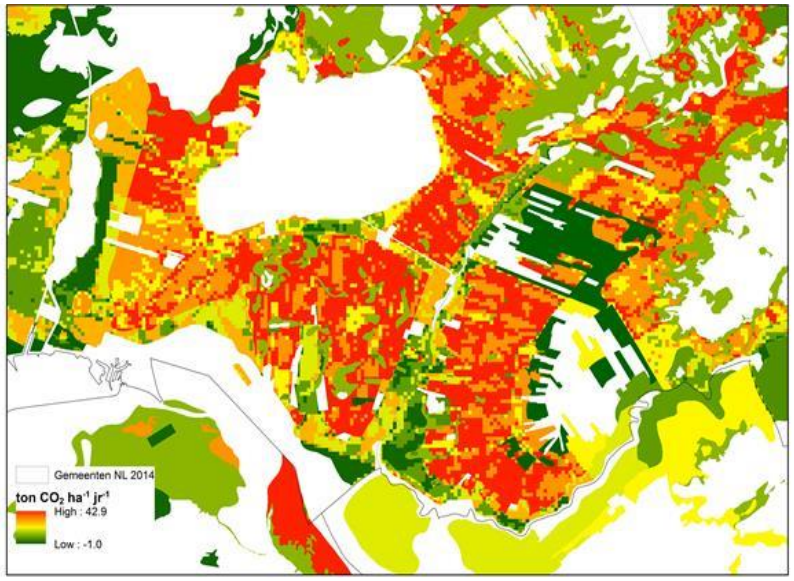


Total sequestration in vegetation: 4 Mton CO_2/year; Total emissions: 7 Mton CO_2/year

The maps provide local relevant information







Carbon emission by peat

t C ha^{-1} yr^{-1}

- 0 - 0.25
- 0.25 - 2.5
- 2.5 - 5
- 5 - 7.5
- 7.5 - 10
- 10 - 12.5

1 km

- CO_2 emissions from peat are around 4% of the national CO_2 emissions
- These CO_2 emissions depend upon drainage of the peat
- With different water management substantial reductions in CO2 emissions are possible, at low costs.
- The maps facilitate local action and allow monitoring of progress

Biophysical modelling of ecosystem services

- **Why?**
  - Accounts require a full spatial cover of ecosystem condition, services flows or asset values. Hence – condition indicators, services, and asset need to be defined for the total area of the accounting area.
  - Often – for some services or condition indicators - data are only available for specific locations. Usually, data from various sources and scales need to combined (e.g., point field data and satellite data)
  - **Spatial models** can be used to integrate point and spatial data and obtain full spatial cover of information, and to model ecosystem services flows.
  - **Temporal models** are required for the asset account, where the flow of services during asset life needs to be considered. This may involve linking changes in condition to changes in ecosystem services flows

Spatial modelling: how (1)

Spatial models have been developed over decades, and are available for a wide range of services. They are usually integrated in a GIS:

- GIS = Geographical Information System: integrated system combining hardware, software and spatially georeferenced data.
- The two most widely used GIS systems are:
  - ArcGIS: commercial product, high processing capacity, many add on models available
  - QuantumGIS (also called QGIS): freeware, add on models are also available.
  - Information can be exchanged easily between the two systems.
- Which one to select?: depends upon currently used systems and budget

Spatial modelling, how (2)

Spatial modelling is done in a GIS and involves:

- A coordinate system to link the various datasets in the GIS (can be a global or national coordinate system)
- Storing data (from remote sensing images, existing topographic and/or thematic maps, georeferenced spot data, processed data)
- Models/algorithms to:
  - Inter and extrapolate data in order to obtain full spatial cover
  - Models for specific condition indicators & ecosystem services

Stand alone GIS model or Modelling Platform? (1)

- Instead of stand alone GIS packages, the use of modelling platform has been proposed. Modelling platforms include predefined models for analysing ecosystem services
- Modelling platforms include, e.g. Aries, EnSYM, INVEST, Luci, etc.
- There are large differences between these modelling platforms, in terms of scope/level of detail/accuracy/data needs and flexibility of the modelling approaches

Stand alone model or Modelling Platform? (2)

Advantages of Modelling platforms:

- Easier start with SEEA EEA by using predefined models
- Some platforms (e.g. Aries) offer sophisticated ecosystem services models

Disadvantages of modelling platforms

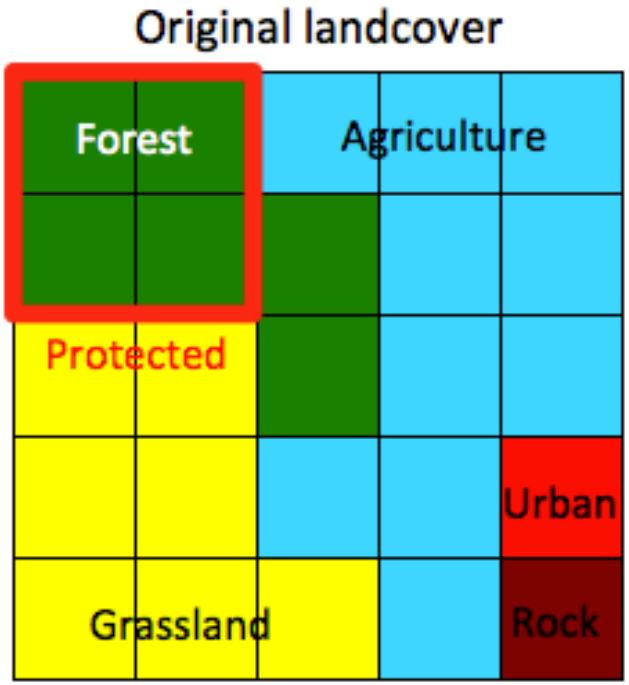
- Need to learn to use modelling platform (which usually also involves applying ArcGIS or QGIS). Some platforms are complex (e.g. Aries)
- Dependency upon platform developers for technical support, updates, etc.
- Lack of flexibility of platforms to accommodate differences in ecosystem characteristics, data availability and technical capacities between countries (except Aries)
- Some of the models quite simplistic (e.g. in InVEST), can only be used as an entrée to EEA

Modelling ecosystem services

- A wide range of models is available to model specific elements of the ecosystem condition or services accounts.
- These models may require somewhat different data or may have different functionalities that make them more or less appropriate in specific contexts.
- For instance there are many models for modelling hydrology and water related ecosystem services
- Often, there are national experts experienced in the use of some of these models. It is recommendable to consider the available expertise and data when selecting models for SEEA EEA.

Biophysical modelling types

- **Model types**:
  1. **Look-up tables**
  2. Statistical approaches
  3. Geostatistical interpolation
  4. Process-based modeling



Attribute values for an ecosystem service (or other measure) to every **Spatial Unit** in the same class (e.g., a land cover class).

- Example: **Carbon storage**
- *one ha of forest = X tonnes*
  → attribute to each ha of forest

Biophysical modelling approaches

- **Approaches**:
  1. Look-up tables
  2. **Statistical approaches**
  3. Geostatistical interpolation
  4. Process-based modeling

Estimate ecosystem services, asset or condition based on known explanatory variables such as soils, land cover, climate, distance from a road, etc., using a statistical relation.

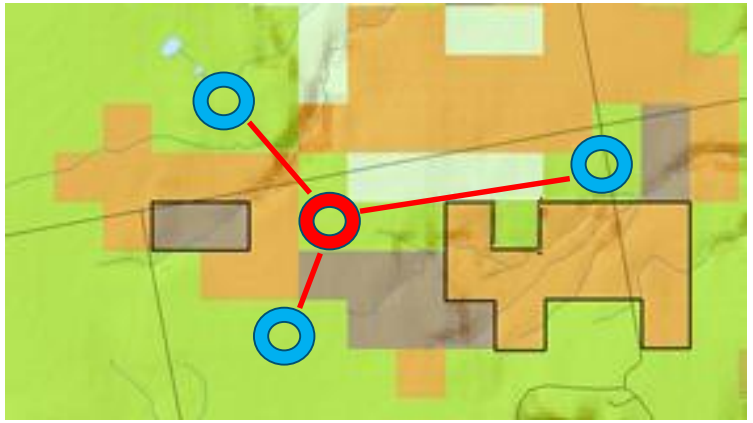
- Example: **Habitat quality**
- *value = f(land cover, population, distance to roads, climate,..)*

Biophysical modelling approaches

- **Approaches**:
  1. Look-up tables
  2. Statistical approaches
  3. **Geostatistical interpolation**
  4. Process-based modeling

Use algorithms to predict the measure of unknown locations on the basis of measures of nearby known measures:

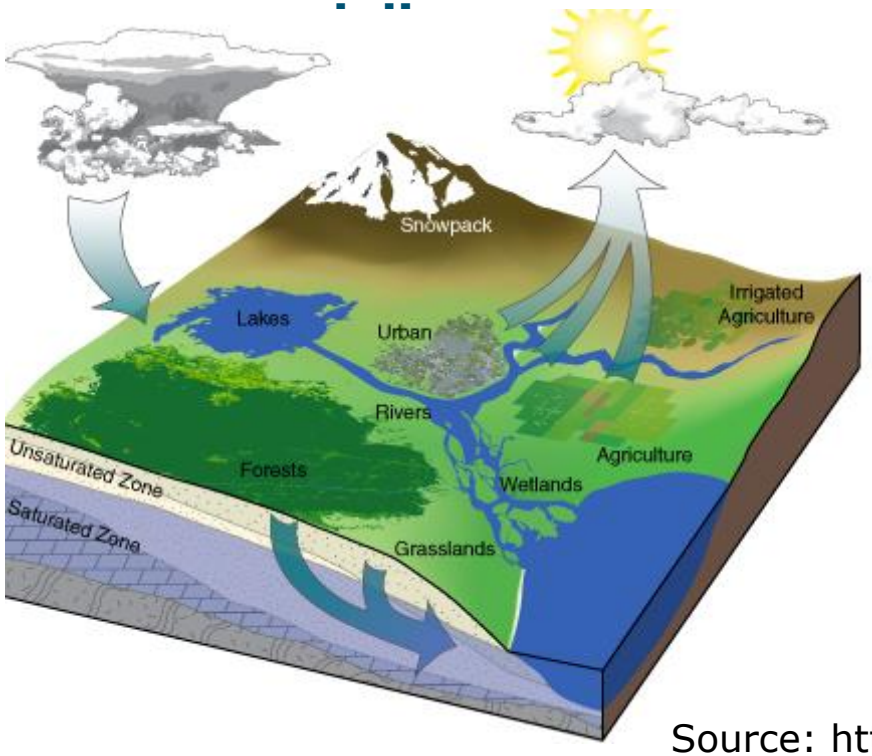
- **Timber**



Source:https://img.wikinut.com/img/3tpc523nbou--ksz/jpeg/0/Timber-and-Wood.jpeg

Biophysical modelling approaches

- **Approaches**:
  1. Look-up tables
  2. Statistical approaches
  3. Geostatistical interpolation
  4. **Process-based**



Predict ecosystem services based on modelling of processes involved in supplying the service:

- Example: carbon sequestration.
- Carbon sequestration can be modelled as the Net Primary Production of the vegetation minus the autotrophic respiration ("rotting leaves") minus the loss of carbon due to wood harvest and fire.

Source: http://hydrogeology.glg.msu.edu/research/active/ilhm

SEEA Revision Process

- Elements requiring further work when SEEA EEA progresses into a statistical standard
  - Spatial units
  - Condition
  - *ES definition / typology / classification*
  - Analysis of selected individual ecosystem services
  - Valuation
- Need to come to **common understanding** and **definition** of how to define ecosystem services for SEEA as well as a **typology / classification** of ecosystem services

Work on ES definition and typology

- A paper was prepared (Hein, Bagstad, Crossman, La Notte, Jacobs, Obst, UNSD)
  - Aims to support the writing of papers on individual ES
  - Based on a.o. Technical Recom., Glen Cove discussions
- Discussions + stakeholders consultations ongoing, number of experts involved increasing
- Once papers on individual ES have been prepared, need to bring insights together again and come up with a consistent approach to define ES for SEEA EEA

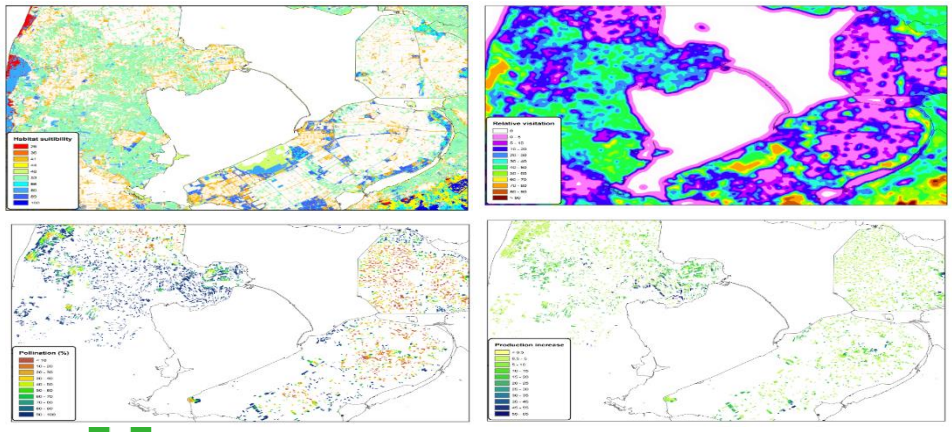
Classifications of ecosystem services

Needs to consider existing ecosystem services classifications

- Millennium Ecosystem Assessment
- The Economics of Ecosystems and Biodiversity
- National Ecosystem Services Classification System (NESCS) – US EPA
- Common International Classification of Ecosystem Services (CICES)
- Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES): Nature's Contribution to People

But keep in mind...

- Ecosystem services are being analysed for SEEA
- Countries are different
- Sometimes it helps to model and analyse the ES in order to increase understanding of how the ES can be defined



Mapping and modelling pollination in the NLs

Ecosystem Services in the NLs SEEA EEA

Provisioning services

- Crop production
- Fodder production
- Timber production
- Other biomass
- Water supply

Regulating services

- Carbon sequestration
- Erosion control
- Air filtration
- Water infiltration
- Pollination
- Pest control

Cultural services

- Nature recreation (hiking)
- Nature tourism

And (2) many answers are provided in the Technical Recommendations

- **Final services**: used by people
- **Intermediate services**: support functioning of **other** ecosystems, indirectly support the services provided by these ecosystems

- Why should we account for them?
  - E.g. forests regulate water flows and thereby support crop production, if accounting is used for spatial planning need to account for this
- Can we account for all of them?

Discussion points, e.g. biodiversity

- Discussed elaborately also in the context of SEEA
- Complex – many indicators are possible
- Highly policy relevant
- Part of condition but also appreciated in its own right
    - Hence the TR approach of allowing for a specific biodiversity account (very positive experience in the NLs)
- Stock not a flow – therefore akin to an asset - BUT
- Perhaps human appreciation of biodiversity is a flow
    - As is the case with the appreciation of cultural landscapes / amenity services, etc.

Thank you

- Questions?