



**Sixth Meeting of the UN Committee of Experts
on Environmental-Economic Accounting
New York, 15-17 June 2011**

**Approach to
Simplified Ecosystem Capital Accounts**

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Simplified ecosystem capital accounts

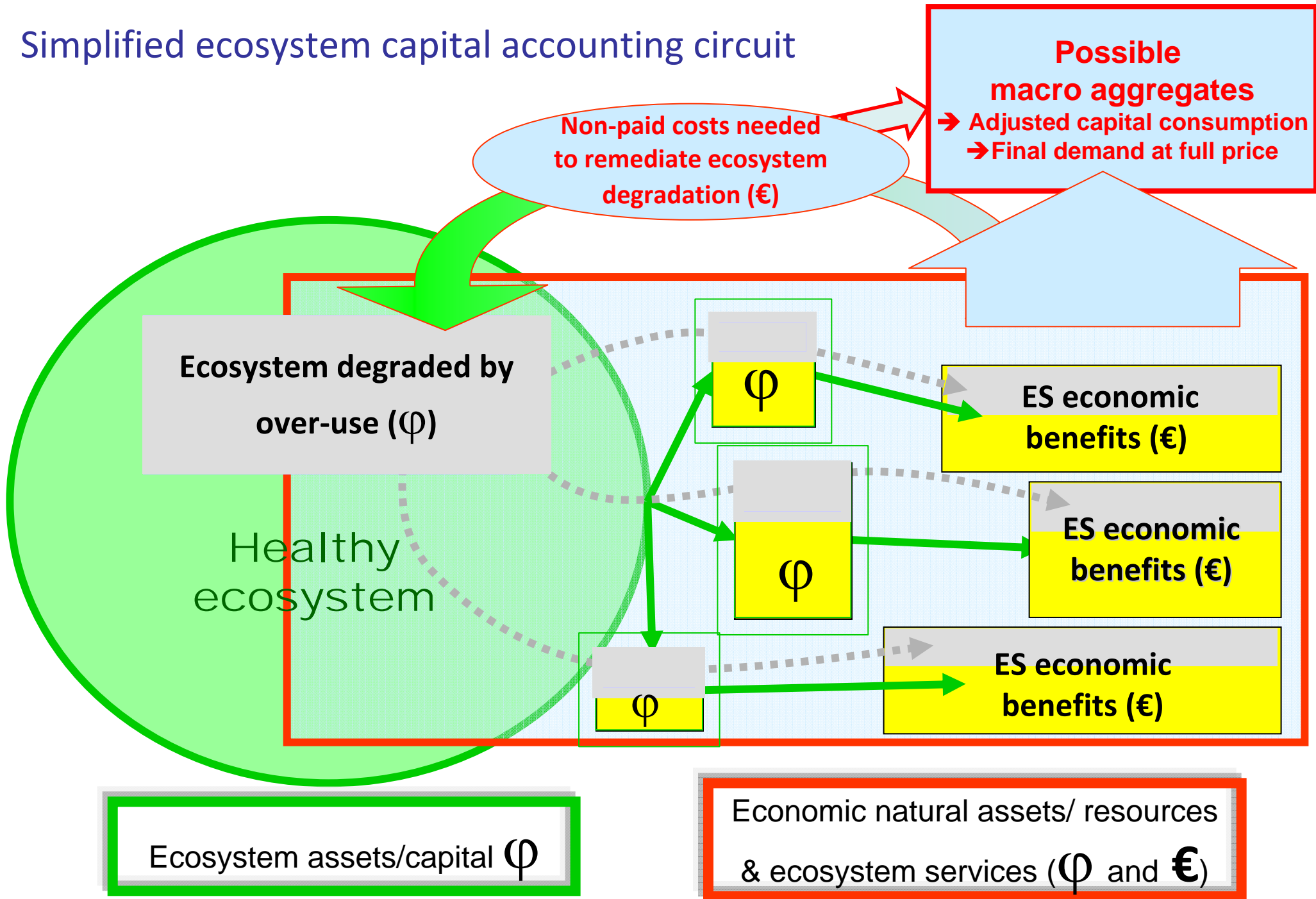
- Make it feasible NOW – keep it simple
- Don't miss important issues: need a good checklist
- All ecosystems: land/sea/atmosphere, and for land: urban, agriculture, forest, other natural and soil.
- 6 accounts/indexes for 1 diagnosis:
 - 1-Land // 2-Biomass-Carbon // 3-Water // 4-Biodiversity // 5-Dependency // 6-Disease prevalence
 - Diagnosis (instead of mere additions) and quantification: the “ecosystem distress syndrome” approach combined with basic balances of land, carbon, water...
- Physical accounts first, followed by valuation of selected flows and of ecosystem depreciation (on the basis of physical degradation and restoration costs – no valuation of stocks)



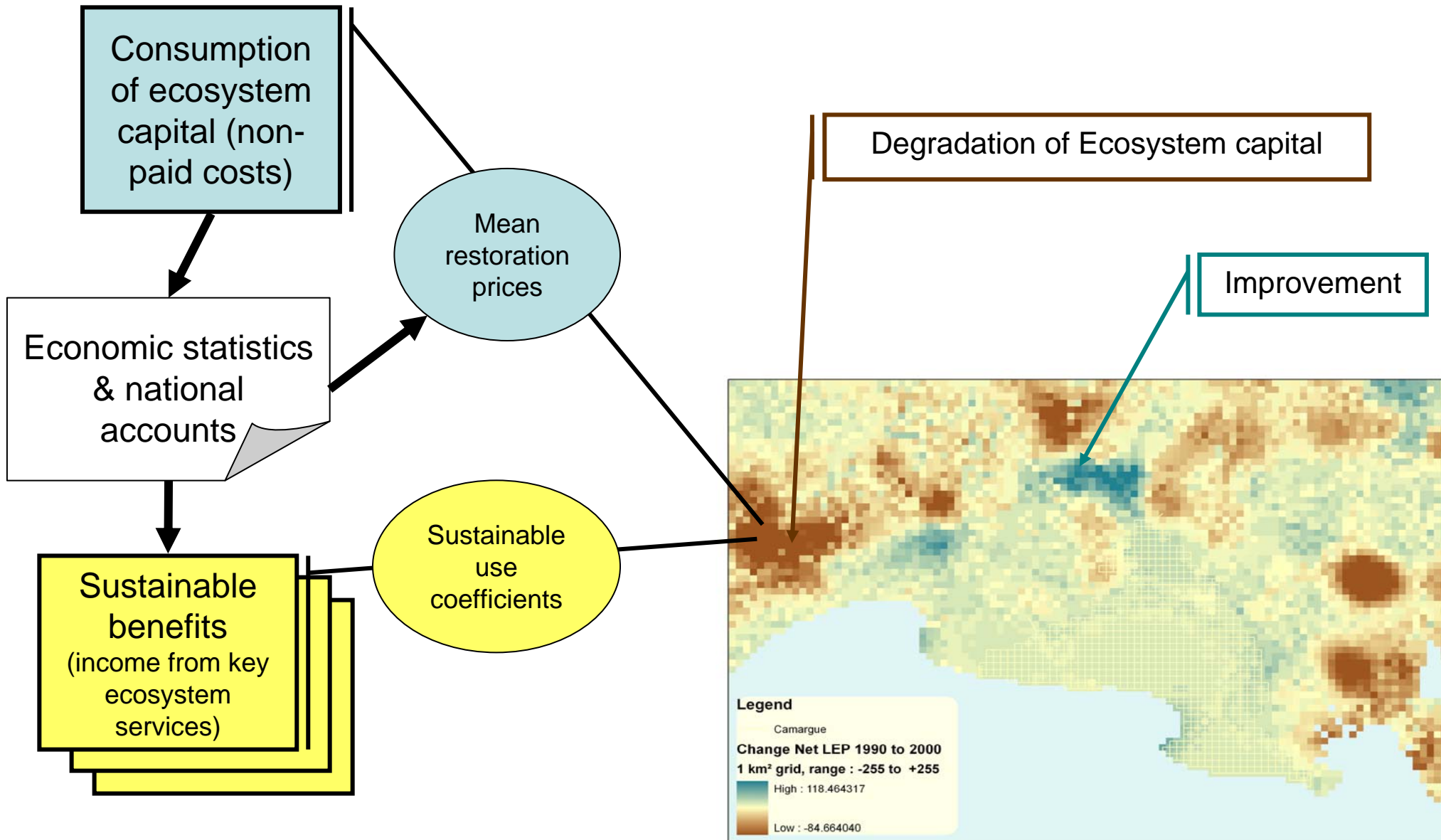
Characteristics of ecosystem capital accounts

- Top-down approach: accounts compiled at the European scale first, then country level applications (national and local)
- Starting from physical accounts of ecosystem assets and degradation (comprehensive) and of selected ecosystem services
- From physical accounts are derived macro-economic aggregates: sustainable benefits supported by ecosystem services & consumption of ecosystem capital
- Meet the policy demand: annual updates for $t - 1$
- Deep rooted in the best available datasets:
 - Socio-economic statistics
 - Monitoring by satellites (land use, biomass, climate variables...)
 - Best available in situ monitoring data
- Additional estimations need to be transparent and reproducible
- Relevance matter more than accuracy

Simplified ecosystem capital accounting circuit



Ecosystem physical degradation, sustainable benefits from ecosystem services and non-paid maintenance costs





From theory to statistics and accounts

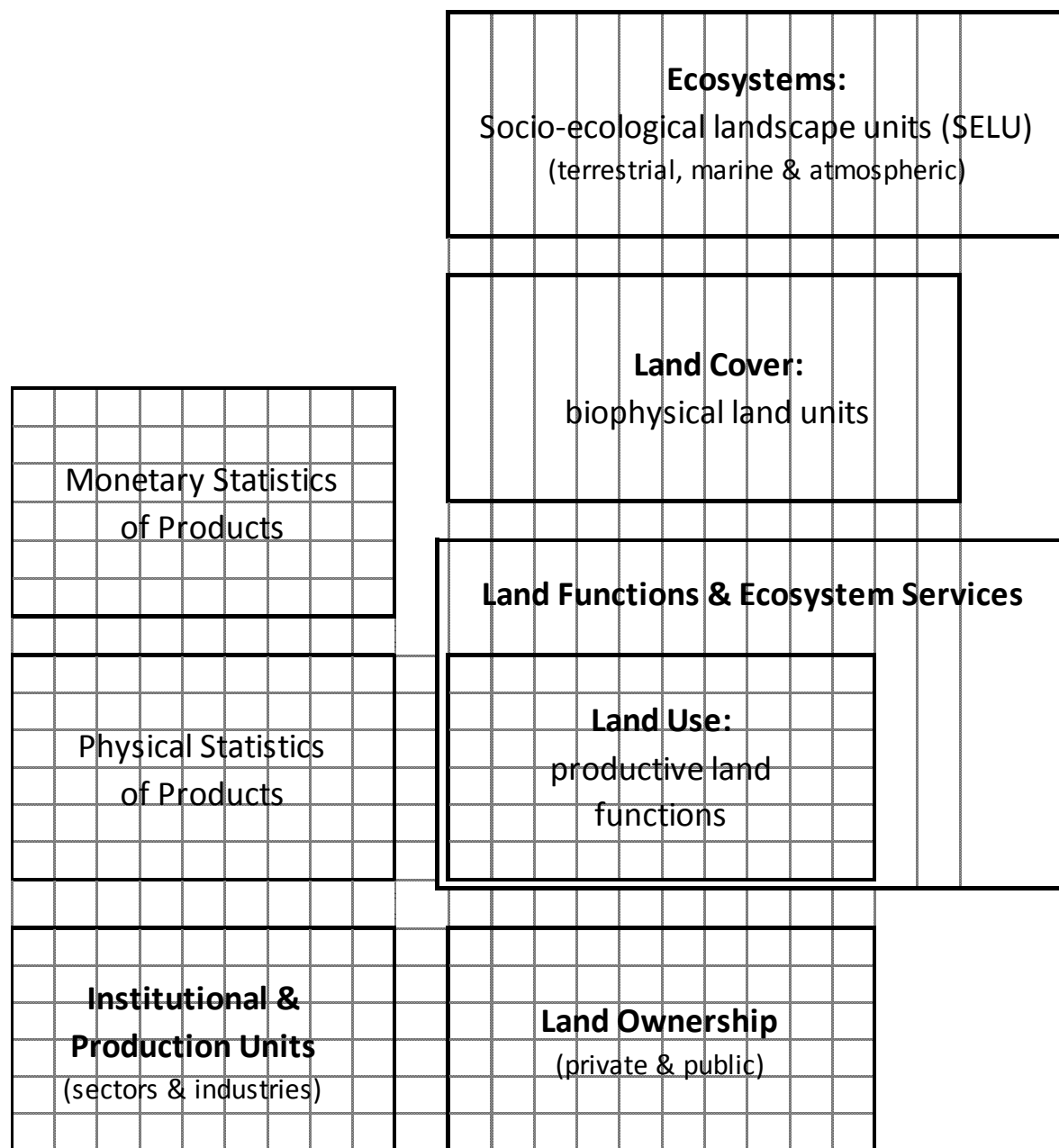
Theoretical background (very incomplete...):

- *Georgescu-Roegen (The Entropy Law and the Economic Process (1971), Odum (emergy), Hollin (panarchy, interaction between scales)*
- Co-evolving systems (Norgaard)
- Ecosystem services: Long (1972), Costanza and De Groot, Millennium Ecosystem Assessment (2003)
- Landscape ecology (UK)
- Ecosystem units: socio-ecological systems (Gallopín, Carpenter, Rockström, Stockholm Resilience Centre, MA2003...)
- Ecosystem health (D. Rapport), resilience (the Resilience Alliance)

➔ from economic-ecological theory to statistical practice and accounts : statistical units and classifications



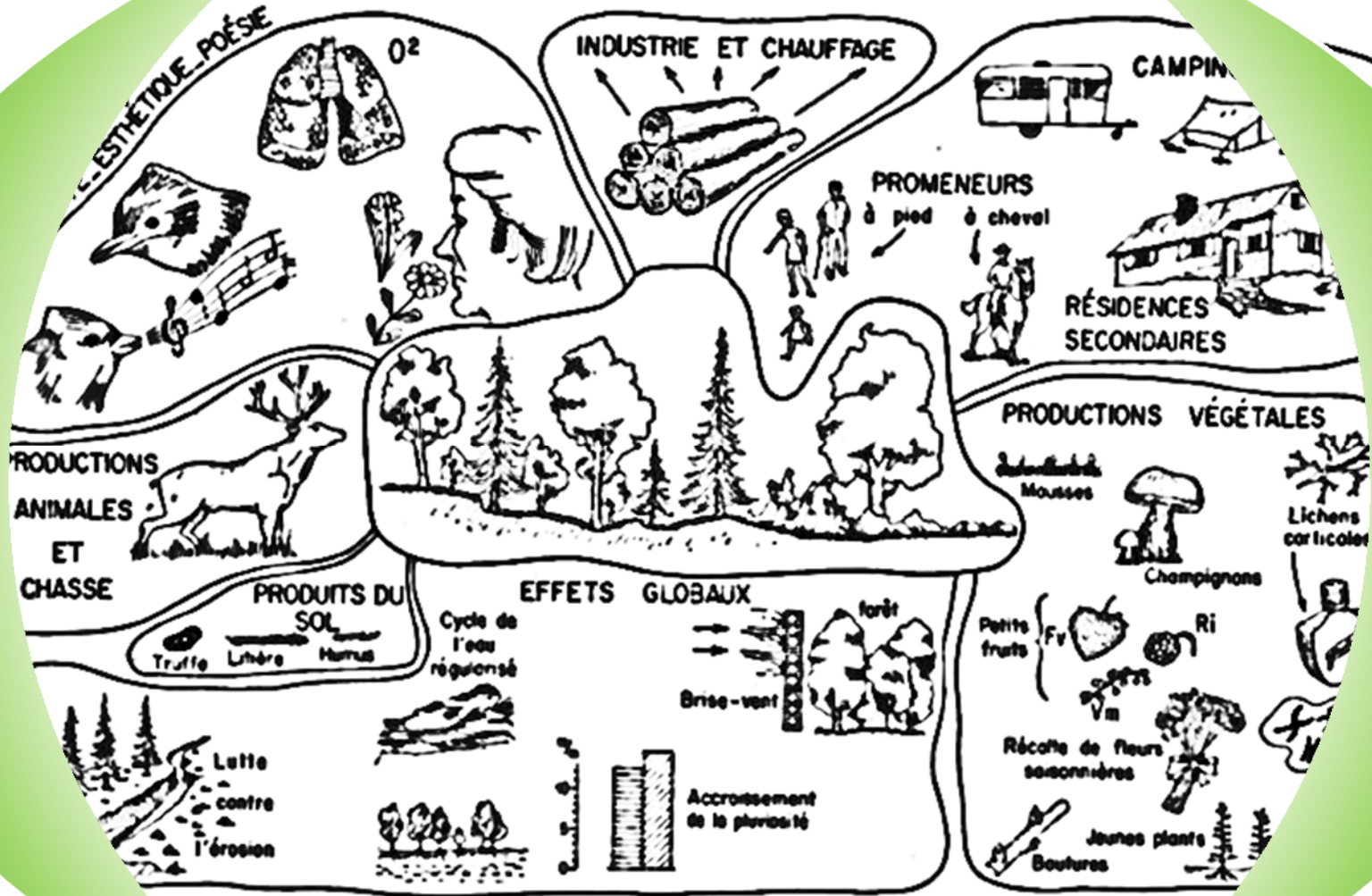
Main relations between classifications & accounting units



Ecosystem services



Options Méditerranéennes • 13 • Juin 1973



Source: Gilbert Long, 1972



Common International Classification of Ecosystem Services (draft)

Theme	Class	Group
Provisioning	Nutrition	Terrestrial plant and animal foodstuffs
		Freshwater plant and animal foodstuffs
		Marine plant and animal foodstuffs
		Potable water
	Materials	Biotic materials
		Abiotic materials
	Energy	Renewable biofuels
		Renewable abiotic energy sources
Regulation and Maintenance	Regulation of wastes	Bioremediation
		Dilution and sequestration
	Flow regulation	Air flow regulation
		Water flow regulation
		Mass flow regulation
	Regulation of physical environment	Atmospheric regulation
		Water quality regulation
		Pedogenesis and soil quality regulation
	Regulation of biotic environment	Lifecycle maintenance & habitat protection
		Pest and disease control
		Gene pool protection
	Cultural	Symbolic
Religious and spiritual		
Intellectual and Experiential		Recreation and community activities
		Information & knowledge

CICES: Table E.2: Proposed Thematic, Class and Group Structure
 – source: EEA & Roy Haines-Young

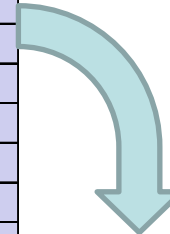
Land cover classification based on FAO LCCS3



Land Cover Types

and derived Land Cover Functional Units

A	Herbaceous crop
A1	<i>Herbaceous crop/ Small size fields rainfed (< 2 ha)</i>
A2	<i>Herbaceous crop/ Medium to large size fields rainfed</i>
A3	<i>Herbaceous crop/ Medium to large size fields irrigated</i>
B	Tree or shrub crop
C	Multiple or layered crop
D	Tree covered area
E	Shrub covered area
F	Herb covered area
G	Sparse natura l vegetation (terrestrial/aquatic/regularly flooded)
H	Aquatic or regularly flooded tree covered area
I	Aquatic or regularly flooded shrub or herb covered area
J	Bare areas (terrestrial or regularly flooded)
K	Artificial surfaces and associated areas
L	Inland water bodies
M	Glacier and perennial snow



mapping

01	Urban and associated developed areas
02	Medium to large fields rainfed herbaceous cropland
03	Medium to large fields irrigated herbaceous cropland
04	Permanent crops, agriculture plantations
05	Agriculture associations and mosaics
06	Pastures and natural grassland
07	Forest tree cover
08	Shrubland, bushland, heathland
09	Sparsely vegetated areas
10	Natural vegetation associations and mosaics
11	Barren land
12	Permanent snow and glaciers
13	Open wetlands
14	Inland water bodies
15	Coastal water bodies
16	Sea (per memory)

sampling

Ecosystem accounting and statistical units



SNA statistical units don't record ecosystem degradation → need for other units...

Theoretical units vs. observation units
(proxies for collecting data)

- **Theoretical units**: characteristic systems into which natural and socioeconomic elements interact to transform ecosystem functions into goods and services:
 - Functional units producing elementary services
 - “Socio-ecological systems”, “socio ecosystems” or “Socio-ecological production landscapes” (the Japanese satoyama and satoumi) →
- **Observation units**:
 - For which we can collect data in a systematic way
 - Mostly surface units: “geo-systems”, land cover units, functional administrative units, ownership units...

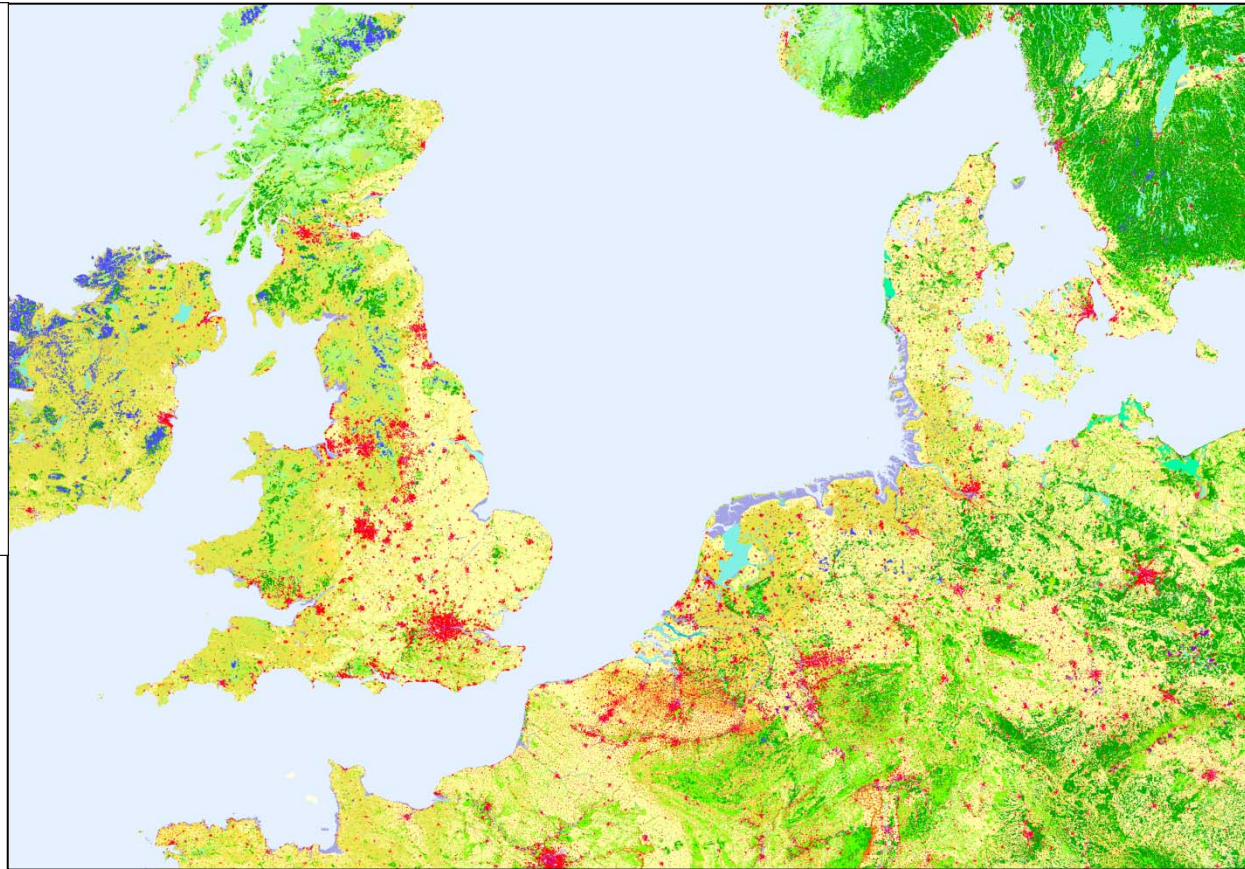


Japan *Satoyama Satoumi* Assessment, 2010.
Satoyama-Satoumi Ecosystems and Human Well-being: Socio-ecological Production Landscapes of Japan – Summary for Decision Makers.
United Nations University, Tokyo, Japan.



Corine land cover classes

1. Artificial surfaces	3. Forest and seminatural areas
1.1 Urban fabric	3.1 Forests
1.1.1 Continuous urban fabric	3.1.1 Broad-leaved forest
1.1.2 Discontinuous urban fabric	3.1.2 Coniferous forest
1.2 Industrial, commercial and transport units	3.1.3 Mixed forest
1.2.1 Industrial or commercial units	3.2 Shrub and/or herbaceous vegetation associations
1.2.2 Road and rail networks and associated land	3.2.1 Natural grassland
1.2.3 Port areas	3.2.2 Moors and heathland
1.2.4 Airports	3.2.3 Sclerophyllous vegetation
1.3 Mine, dump and construction sites	3.2.4 Transitional woodland/shrub
1.3.1 Mineral extraction sites	3.3 Open spaces with little or no vegetation
1.3.2 Dump sites	3.3.1 Beaches, dunes, and sand plains
1.3.3 Construction sites	3.3.2 Bare rock
1.4 Artificial, non-agricultural vegetated areas	3.3.3 Sparingly vegetated areas
1.4.1 Green urban areas	3.3.4 Burnt areas
1.4.2 Sport and leisure facilities	3.3.5 Openers and perpetual snow
2. Agricultural areas	4. Wetlands
2.1 Arable land	4.1 Inland wetlands
2.1.1 Non-irrigated arable land	4.1.1 Inland marshes
2.1.2 Permanently irrigated land	4.1.2 Peat bogs
2.1.3 Rice fields	4.2 Coastal wetlands
2.2 Permanent crops	4.2.1 Salt marshes
2.2.1 Vineyards	4.2.2 Salines
2.2.2 Fruit trees and berry plantations	4.2.3 Inland fens
2.2.3 Olive groves	5. Water bodies
2.3 Pastures	5.1 Inland waters
2.3.1 Pastures	5.1.1 Water courses
2.4 Heterogeneous agricultural areas	5.1.2 Water bodies
2.4.1 Annual crops associated with permanent crops	5.2 Marine waters
2.4.2 Complex cultivation patterns	5.2.1 Coastal lagoons
2.4.3 Land primarily occupied by agriculture	5.2.2 Estuaries
2.4.4 Agro-forestry areas	5.2.3 Sea and ocean



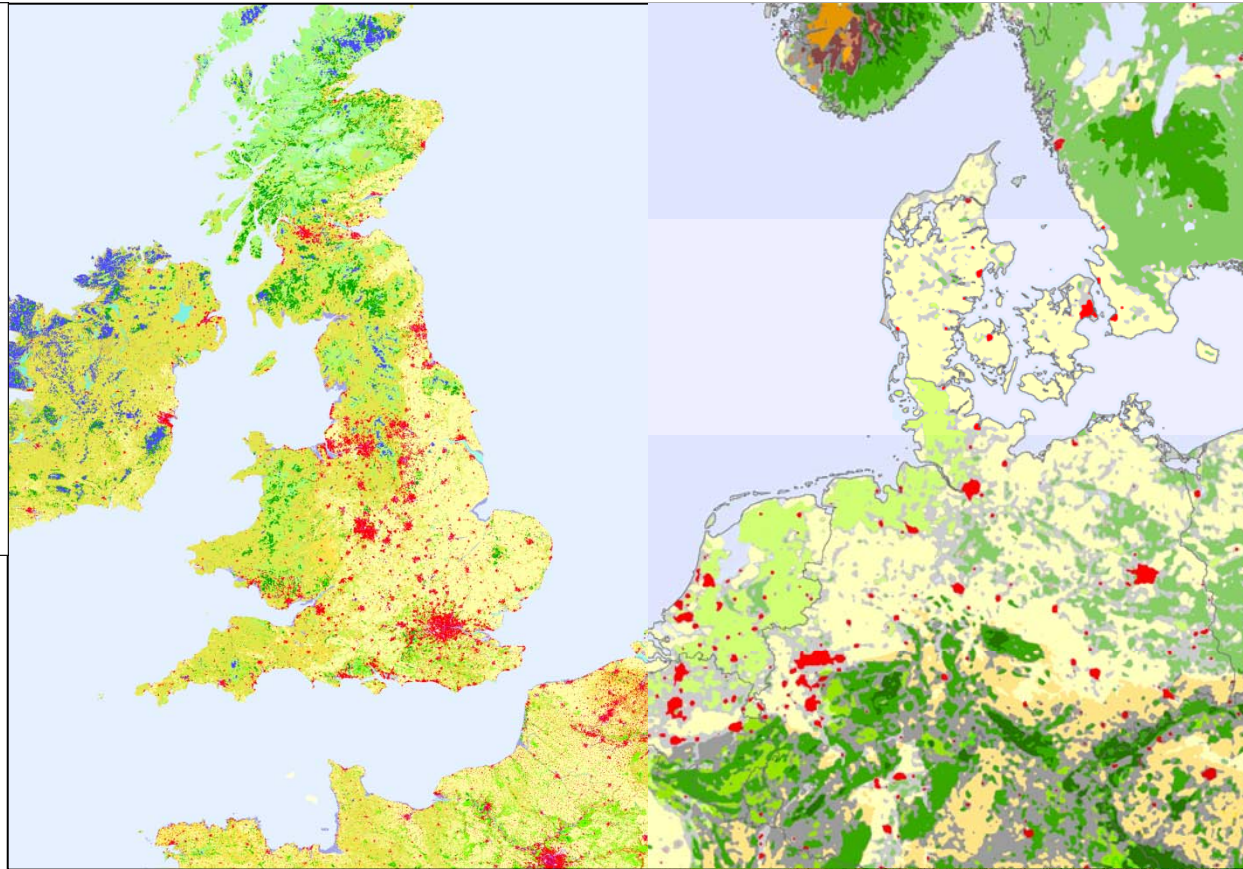
Land cover functional units: example of Europe

Land cover units are homogenous considering production of ecosystem services: crops, timber, water...



Corine land cover classes

1. Artificial surfaces	3. Forest and seminatural areas
1.1 Urban fabric	3.1 Forests
1.1.1 Continuous urban fabric	3.1.1 Small wooded forest
1.1.2 Discontinuous urban fabric	3.1.2 Coniferous forest
1.2 Industrial, commercial and transport units	3.1.3 Mixed forest
1.2.1 Industrial or commercial units	3.2 Shrub and/or herbaceous vegetation associations
1.2.2 Road and rail networks and associated land	3.2.1 Natural grassland
1.2.3 Port areas	3.2.2 Moors and heathland
1.2.4 Airports	3.2.3 Scabrous vegetation
1.3 Mines, dump and construction sites	3.2.4 Transitional woodland/shrub
1.3.1 Mineral extraction sites	3.3 Open spaces with little or no vegetation
1.3.2 Dump sites	3.3.1 Beaches, dunes, and sand plains
1.3.3 Construction sites	3.3.2 Bare rock
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2.1.3 Rice fields	4.2 Coastal wetlands
2.2 Permanent crops	4.2.1 Salt marshes
2.2.1 Vineyards	4.2.2 Salines
2.2.2 Fruit trees and berry plantations	4.2.3 Intertidal flats
2.2.3 Olive groves	5. Water bodies
2.3 Pastures	5.1 Inland waters
2.3.1 Pastures	5.1.1 Water courses
2.4 Heterogeneous agricultural areas	5.1.2 Water bodies
2.4.1 Annual crops associated with permanent crops	5.2 Marine waters
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2.4.3 Land primarily occupied by agriculture	5.2.2 Estuaries
2.4.4 Agro-forestry areas	5.2.3 Sea and ocean



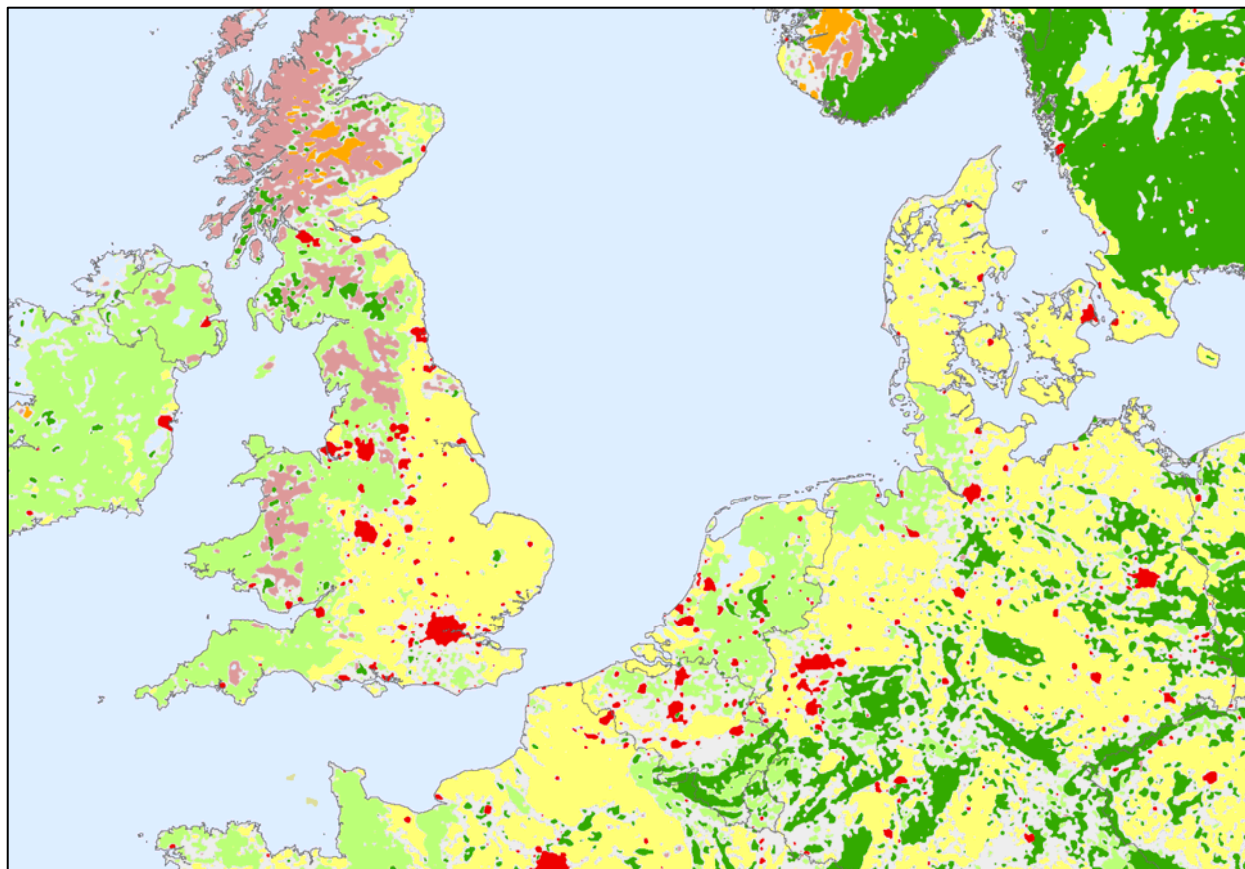
DLT51_00.img

11 - Lowland_Urban
12 - Lowland_Cropland
13 - Lowland_Grassland
14 - Lowland_Forest
15 - Lowland_Shrub
16 - Lowland_Barren
17 - Lowland_Water
18 - Lowland_No Dominance
21 - Highland_Urban
22 - Highland_Cropland
23 - Highland_Grassland
24 - Highland_Forest
25 - Highland_Shrub
26 - Highland_Barren
27 - Highland_Water
28 - Highland_No Dominance
31 - Mountain_Urban
32 - Mountain_Cropland
33 - Mountain_Grassland
34 - Mountain_Forest
35 - Mountain_Shrub
36 - Mountain_Barren
37 - Mountain_Water
38 - Mountain_No Dominance

From land cover units to ecosystem landscape units

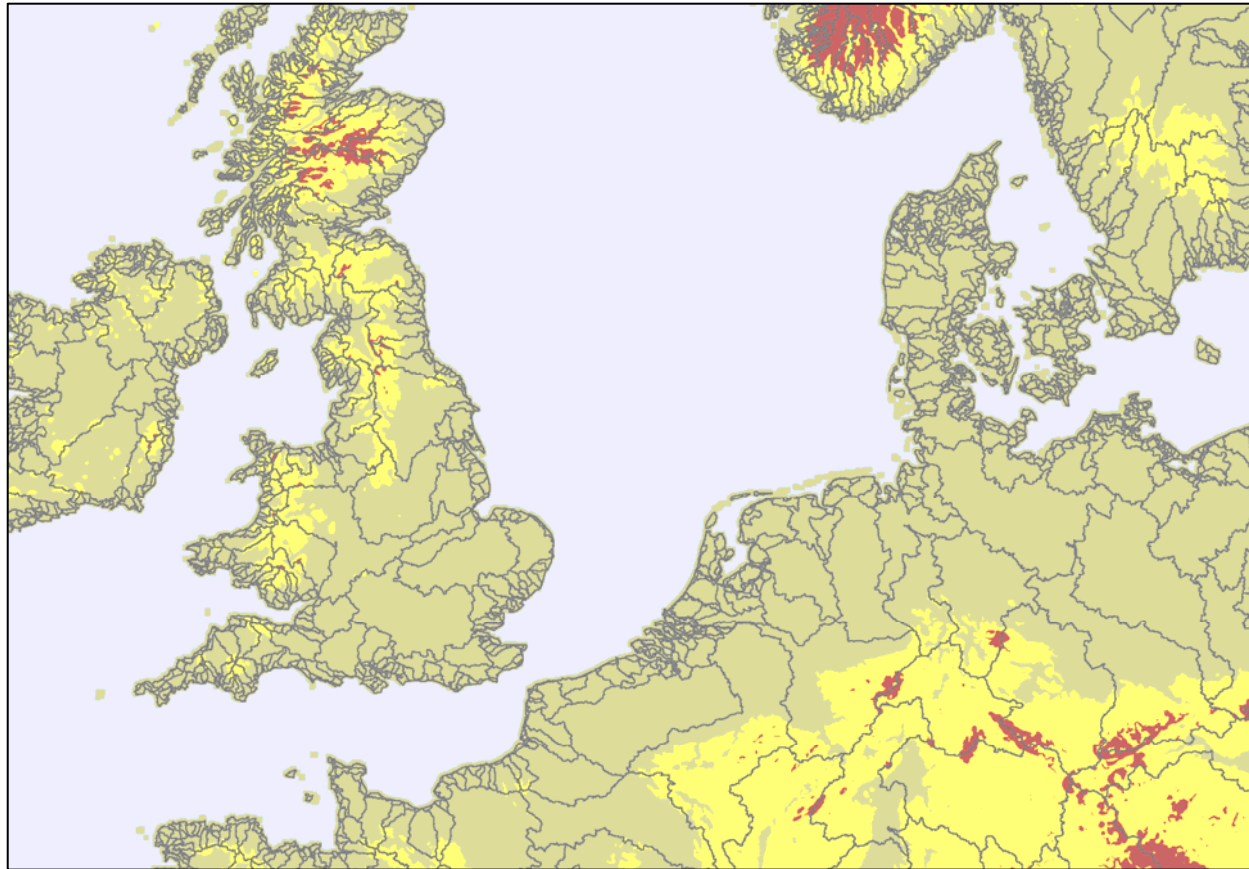


- Dom Land cover Types51_00
- 1 - Urban
 - 2 - Cropland
 - 3 - Grassland
 - 4 - Forest
 - 5 - Shrubland
 - 6 - Barren
 - 7 - Water
 - 8 - No Dominance

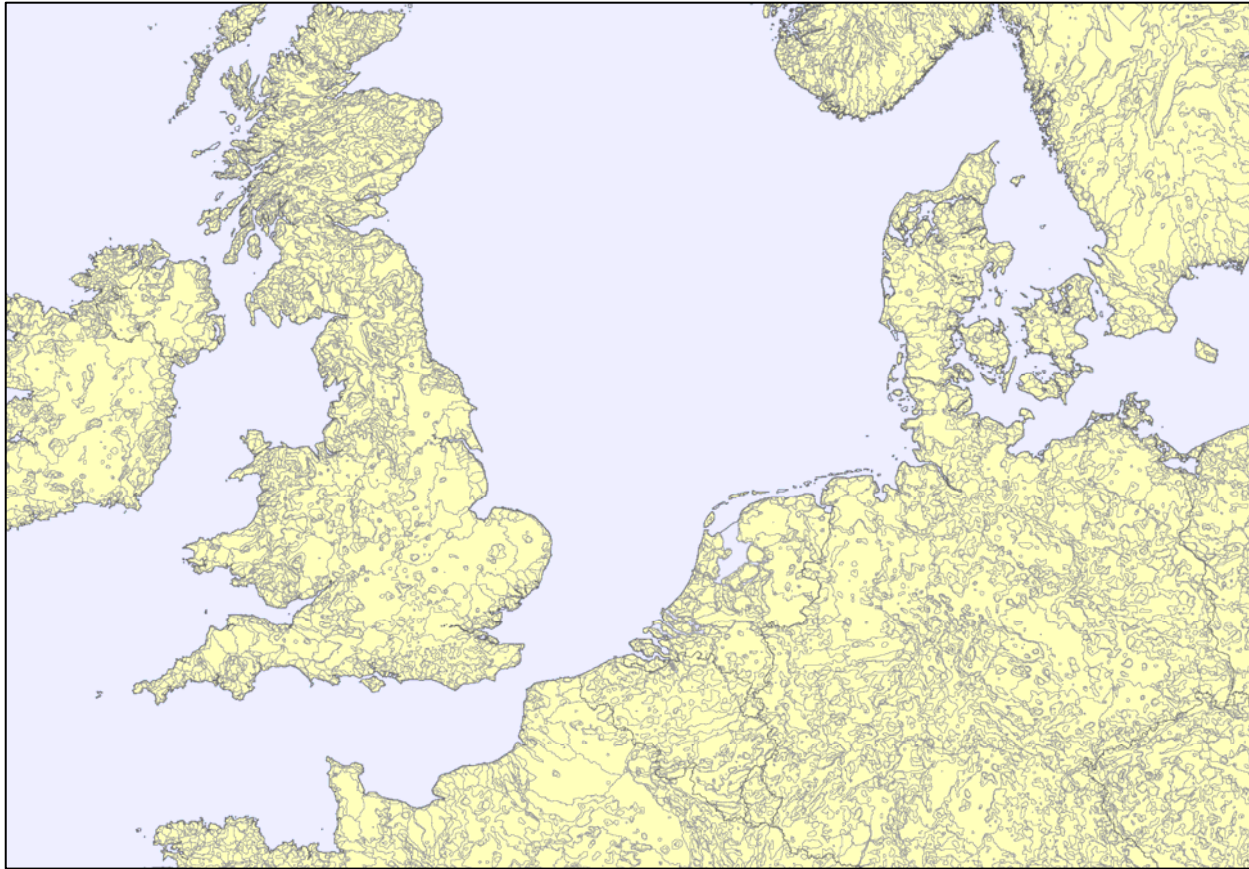


Dominant land cover types (more than 50% criteria)

In grey are areas where **no** land cover type is dominant



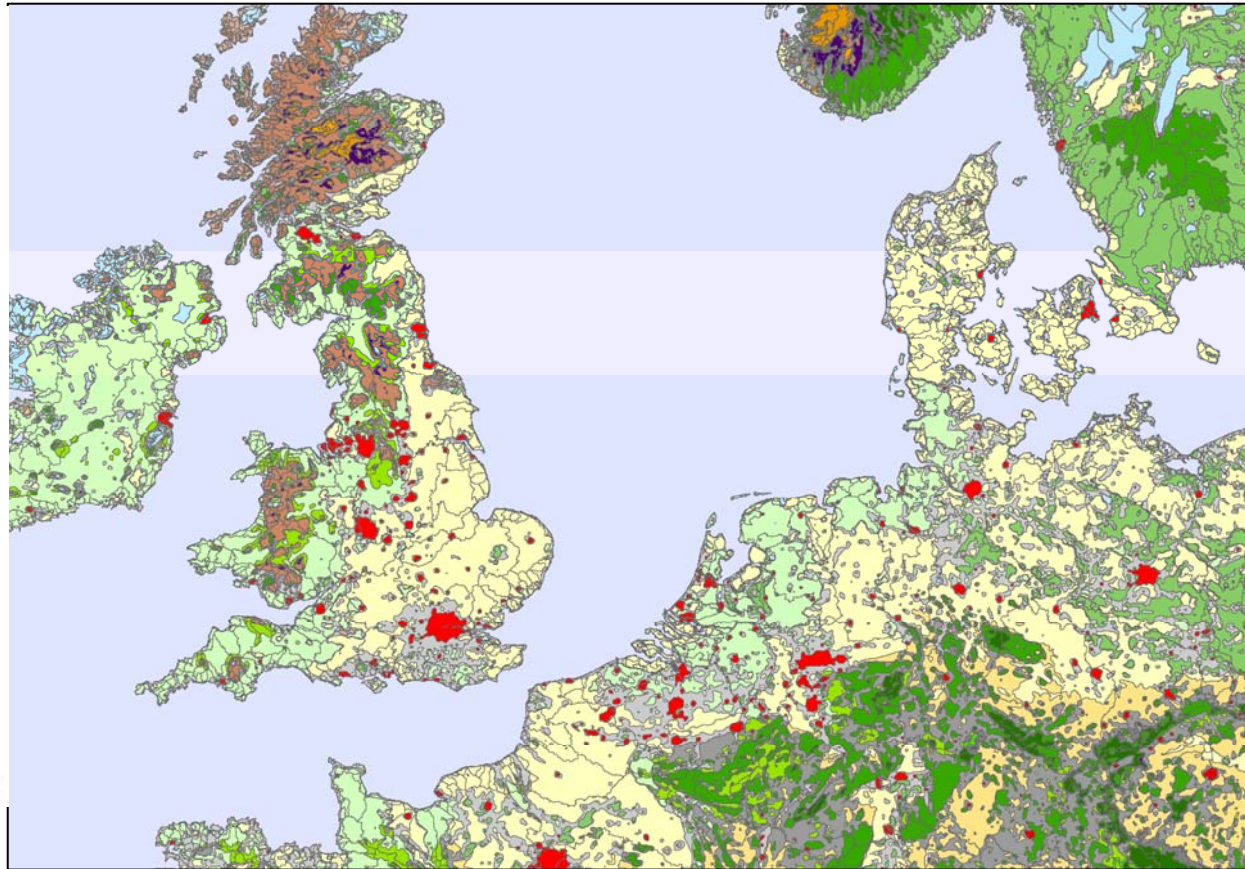
Relief and river basins limits



The SELU map/database



- DLT51_00.img
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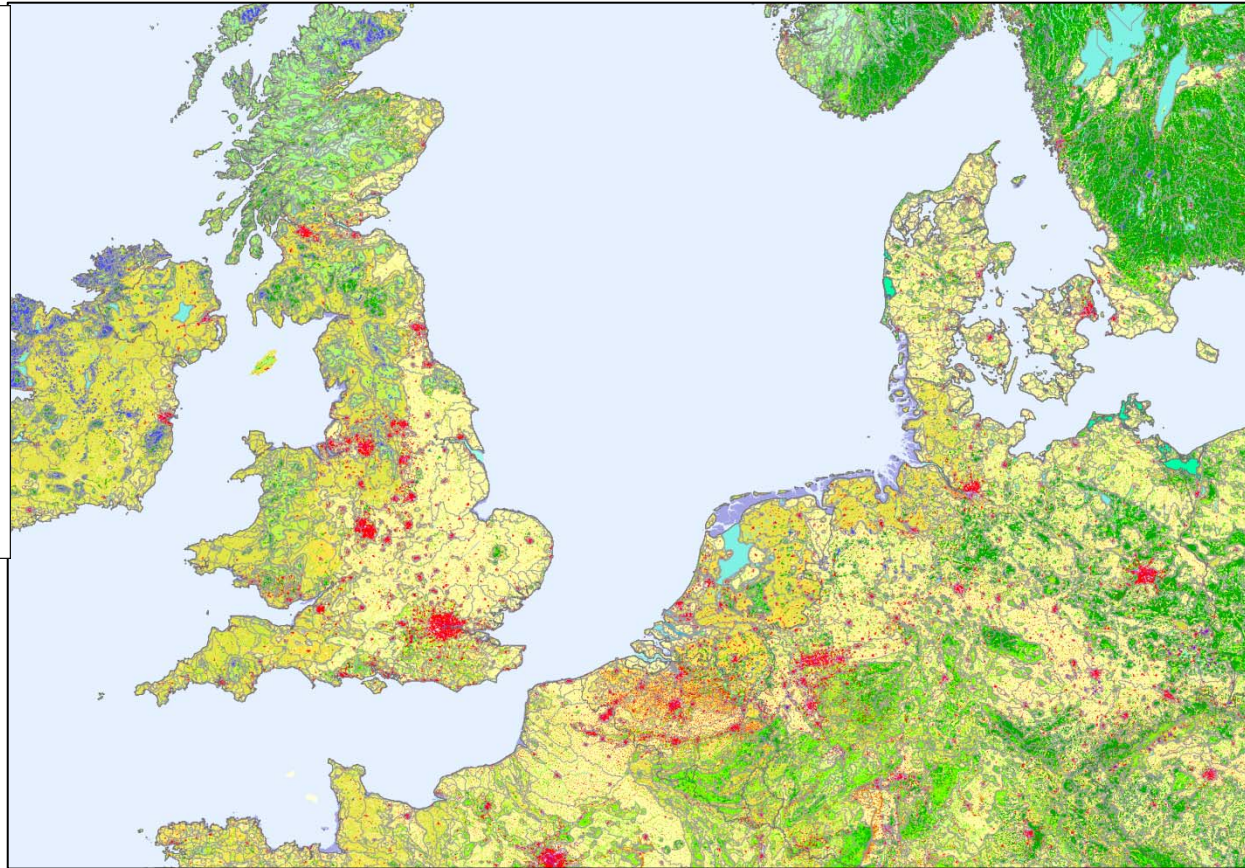


SELU classified by landscape types



Corine land cover classes

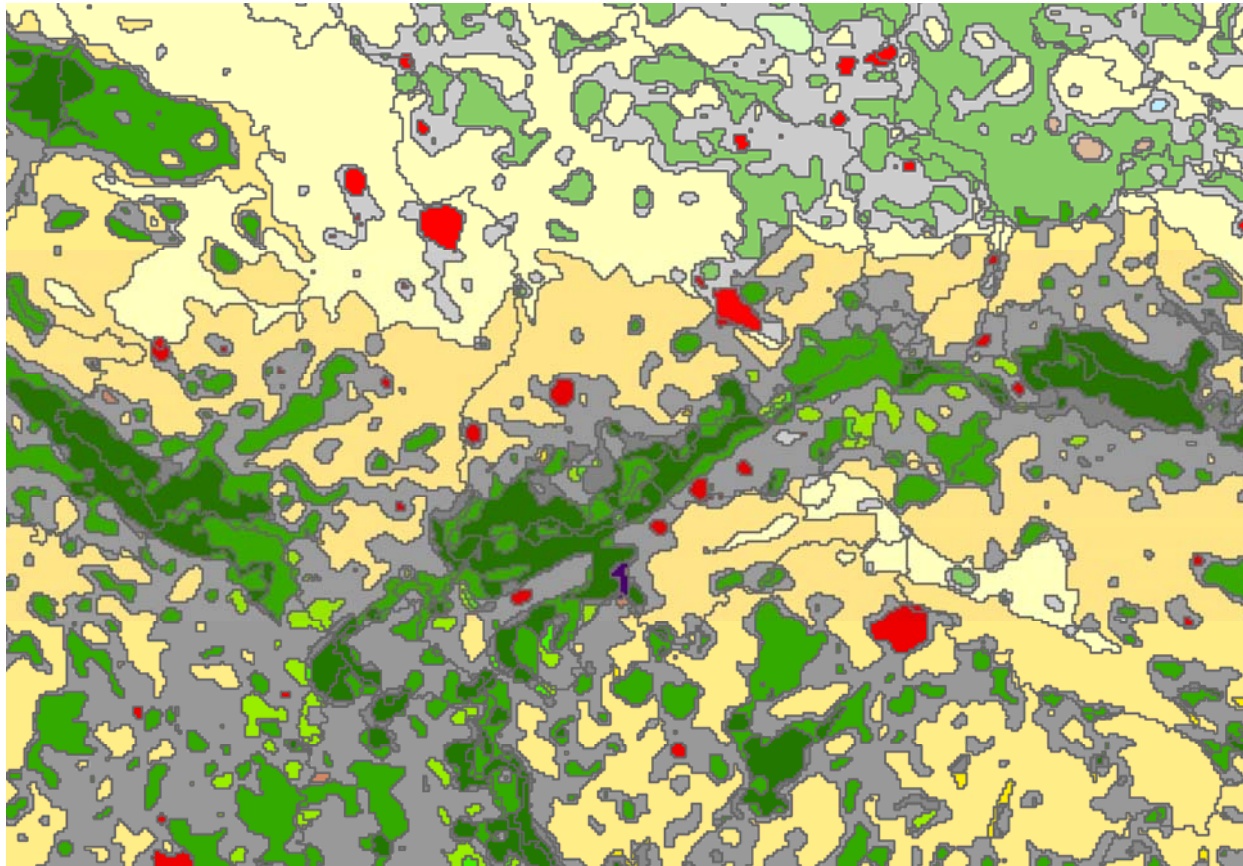
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1.1.2. Discontinuous urban fabric	3.1.2. Coniferous forest
1.2 Industrial, commercial and transport units	3.1.3. Woodland
1.2.1. Industrial or commercial units	3.2 Shrub and/or herbaceous vegetation associations
1.2.2. Road and rail networks and associated land	3.2.1. Natural grassland
1.2.3. Port areas	3.2.2. Mires and heathland
1.2.4. Airports	3.2.3. Sclerophyllous vegetation
1.3 Mine, dump and construction sites	3.2.4. Transitional woodland/shrub
1.3.1. Mineral extraction sites	3.3 Open spaces with little or no vegetation
1.3.2. Dump sites	3.3.1. Beaches, dunes, and sand plains
1.3.3. Construction sites	3.3.2. Bare rock
1.4 Artificial, non-agricultural vegetated areas	3.3.3. Sparsely vegetated areas
1.4.1. Green urban areas	3.3.4. Burnt areas
1.4.2. Sport and leisure facilities	3.3.5. Glaciers and perpetual snow
2. Agricultural areas	4. Wetlands
2.1 Arable land	4.1 Inland wetlands
2.1.1. Non-irrigated arable land	4.1.1. Inland marshes
2.1.2. Permanently irrigated land	4.1.2. Peat bogs
2.1.3. Rice fields	4.2 Coastal wetlands
2.2 Permanent crops	4.2.1. Salt marshes
2.2.1. Vineyards	4.2.2. Salines
2.2.2. Fruit trees and berry plantations	4.2.3. Inland fens
2.2.3. Olive groves	5. Water bodies
2.3 Pastures	5.1 Inland waters
2.3.1. Pastures	5.1.1. Water courses
2.4 Heterogeneous agricultural areas	5.1.2. Water bodies
2.4.1. Annual crops associated with permanent crops	5.2 Marine waters
2.4.2. Complex cultivation patterns	5.2.1. Coastal lagoons
2.4.3. Land principally occupied by agriculture	5.2.2. Estuaries
2.4.4. Agriculture area	5.2.3. Sea and ocean



Land cover functional units mapped by SELU



- 11 - Lowland_Urban
- 12 - Lowland_Cropland
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- 16 - Lowland_Barren
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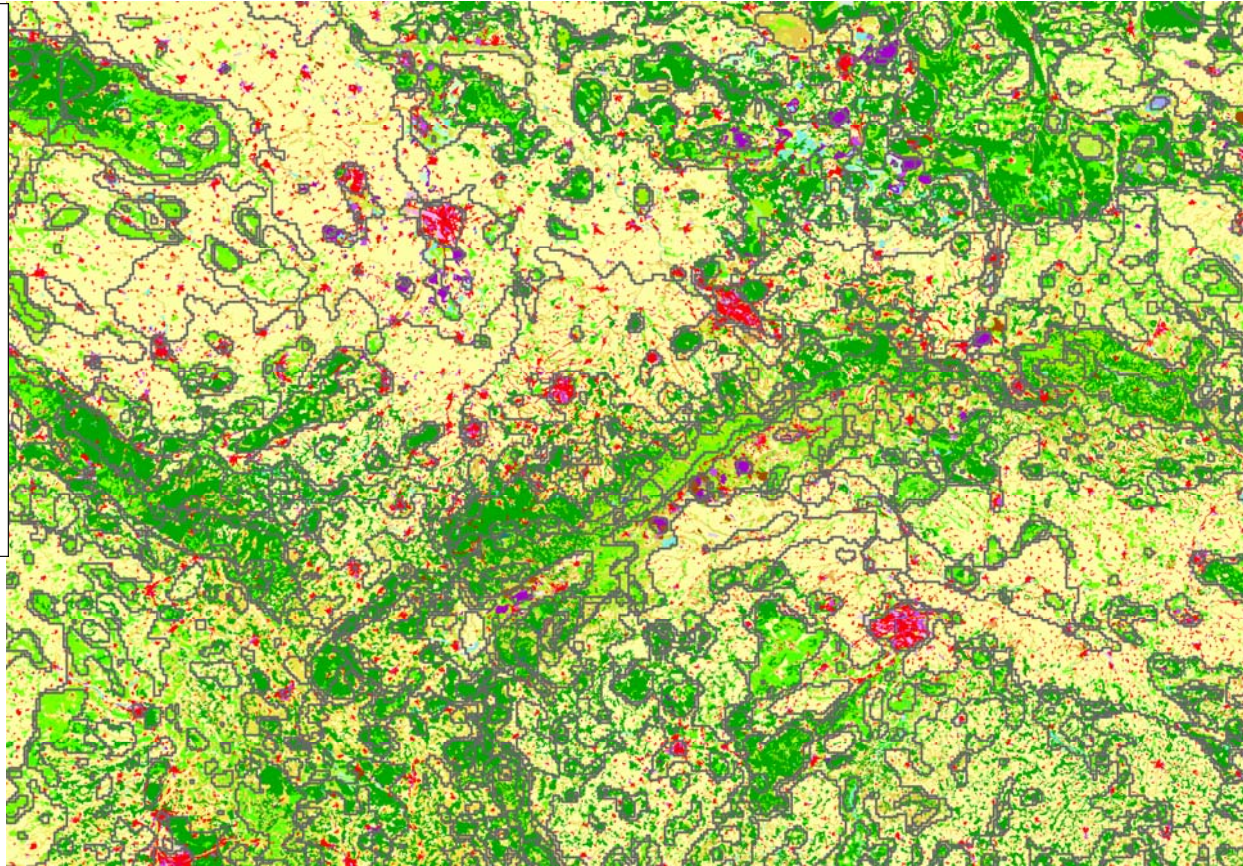


ZOOM: SELU in Central Europe



Corine land cover classes

- 1. Artificial surfaces**
 - 1.1 Urban fabric**
 - 1.1.1 Continuous urban fabric
 - 1.1.2 Discontinuous urban fabric
 - 1.2 Industrial, commercial and transport units**
 - 1.2.1 Industrial or commercial units
 - 1.2.2 Road and rail networks and associated land
 - 1.2.3 Port areas
 - 1.2.4 Airports
 - 1.3 Mine, dump and construction sites**
 - 1.3.1 Mineral extraction sites
 - 1.3.2 Dump sites
 - 1.3.3 Construction sites
 - 1.4 Artificial, non-agricultural vegetated areas**
 - 1.4.1 Green urban areas
 - 1.4.2 Sport and leisure facilities
- 2. Agricultural areas**
 - 2.1 Arable land**
 - 2.1.1 Non-irrigated arable land
 - 2.1.2 Permanently irrigated land
 - 2.1.3 Rice fields
 - 2.2 Permanent crops**
 - 2.2.1 Vineyards
 - 2.2.2 Fruit trees and berry plantations
 - 2.2.3 Olive groves
 - 2.3 Pastures**
 - 2.3.1 Pastures
 - 2.4 Heterogeneous agricultural areas**
 - 2.4.1 Annual crops associated with permanent crops
 - 2.4.2 Complex cultivation patterns
 - 2.4.3 Land principally occupied by agriculture
 - 2.4.4 Agro-forestry areas
- 3. Forest and seminatural areas**
 - 3.1 Forests**
 - 3.1.1 Broadleaved forest
 - 3.1.2 Coniferous forest
 - 3.1.3 Woodland
 - 3.2 Shrub and/or herbaceous vegetation associations**
 - 3.2.1 Natural grassland
 - 3.2.2 Mires and heathland
 - 3.2.3 Sclerophyllous vegetation
 - 3.2.4 Transitional woodland/shrub
 - 3.3 Open spaces with little or no vegetation**
 - 3.3.1 Beaches, dunes, and sand plains
 - 3.3.2 Bare rock
 - 3.3.3 Sparsely vegetated areas
 - 3.3.4 Burnt areas
 - 3.3.5 Glaciers and perpetual snow
- 4. Wetlands**
 - 4.1 Inland wetlands**
 - 4.1.1 Inland marshes
 - 4.1.2 Peat bogs
 - 4.2 Coastal wetlands**
 - 4.2.1 Salt marshes
 - 4.2.2 Salines
 - 4.2.3 Inland fens
- 5. Water bodies**
 - 5.1 Inland waters**
 - 5.1.1 Water courses
 - 5.1.2 Water bodies
 - 5.2 Marine waters**
 - 5.2.1 Coastal lagoons
 - 5.2.2 Estuaries
 - 5.2.3 Sea and ocean

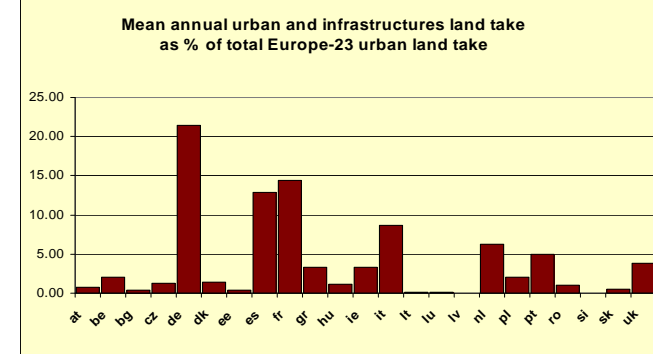
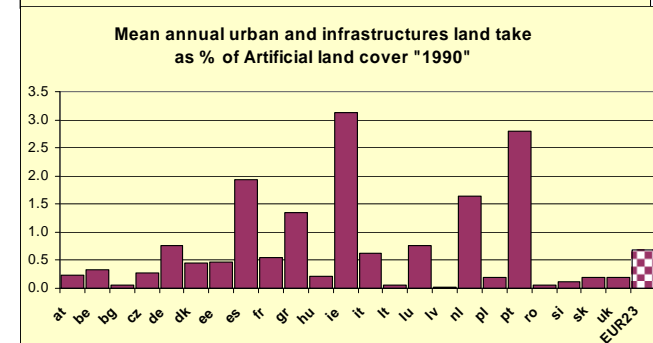
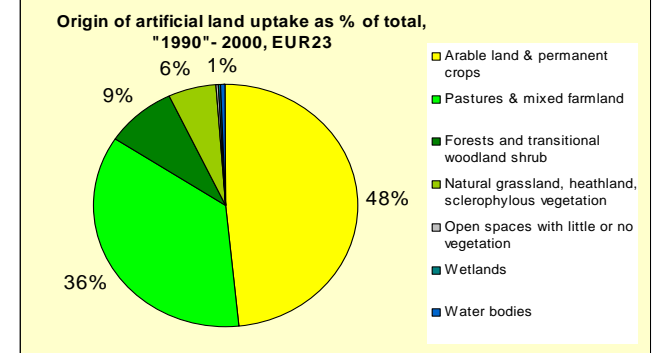
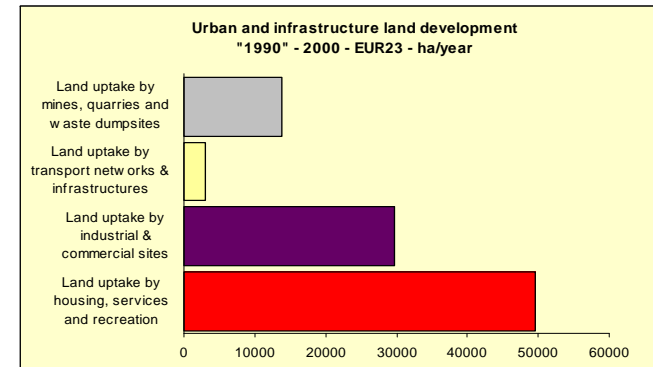
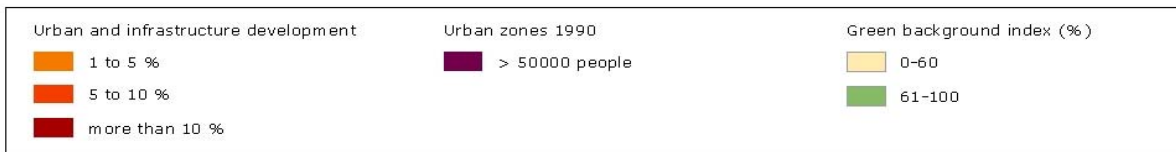
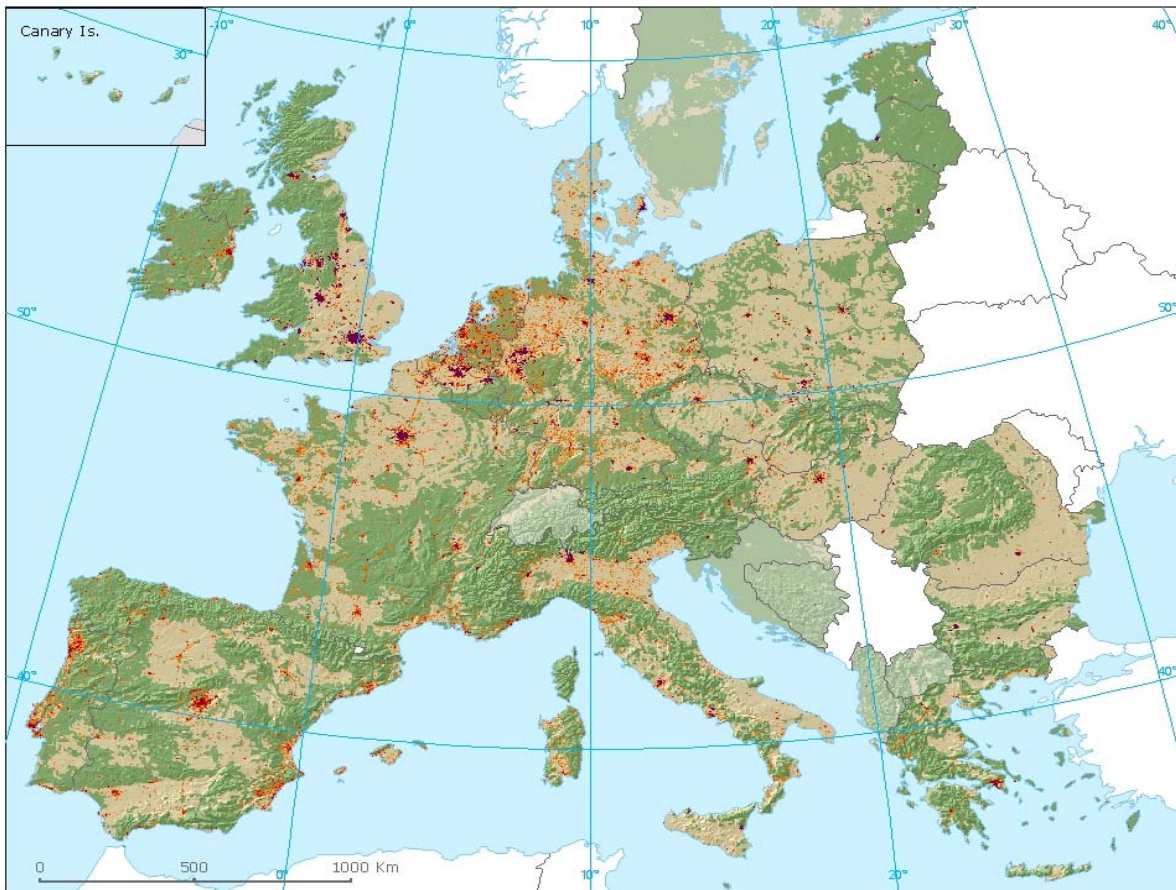


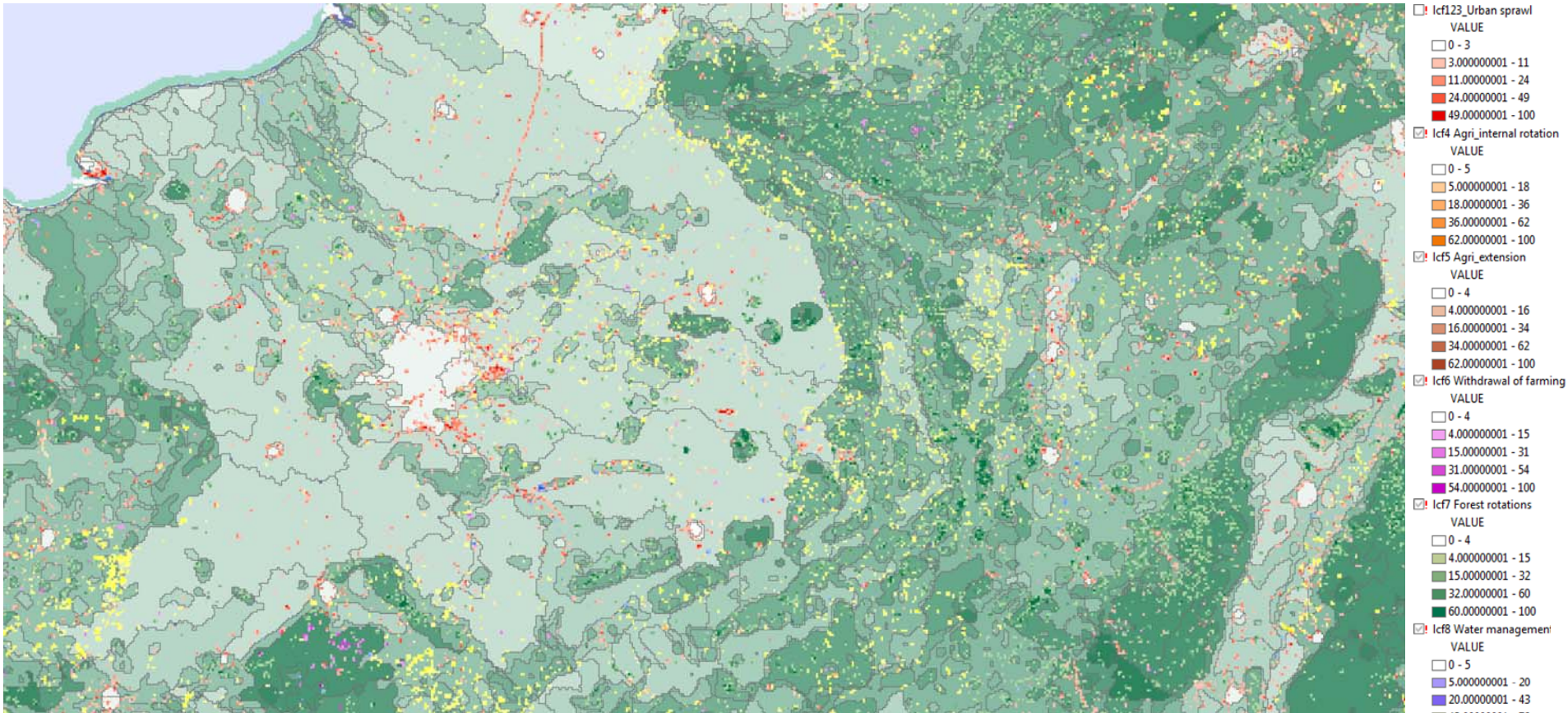
ZOOM: Land cover functional units by SELU

The land/ landscape account



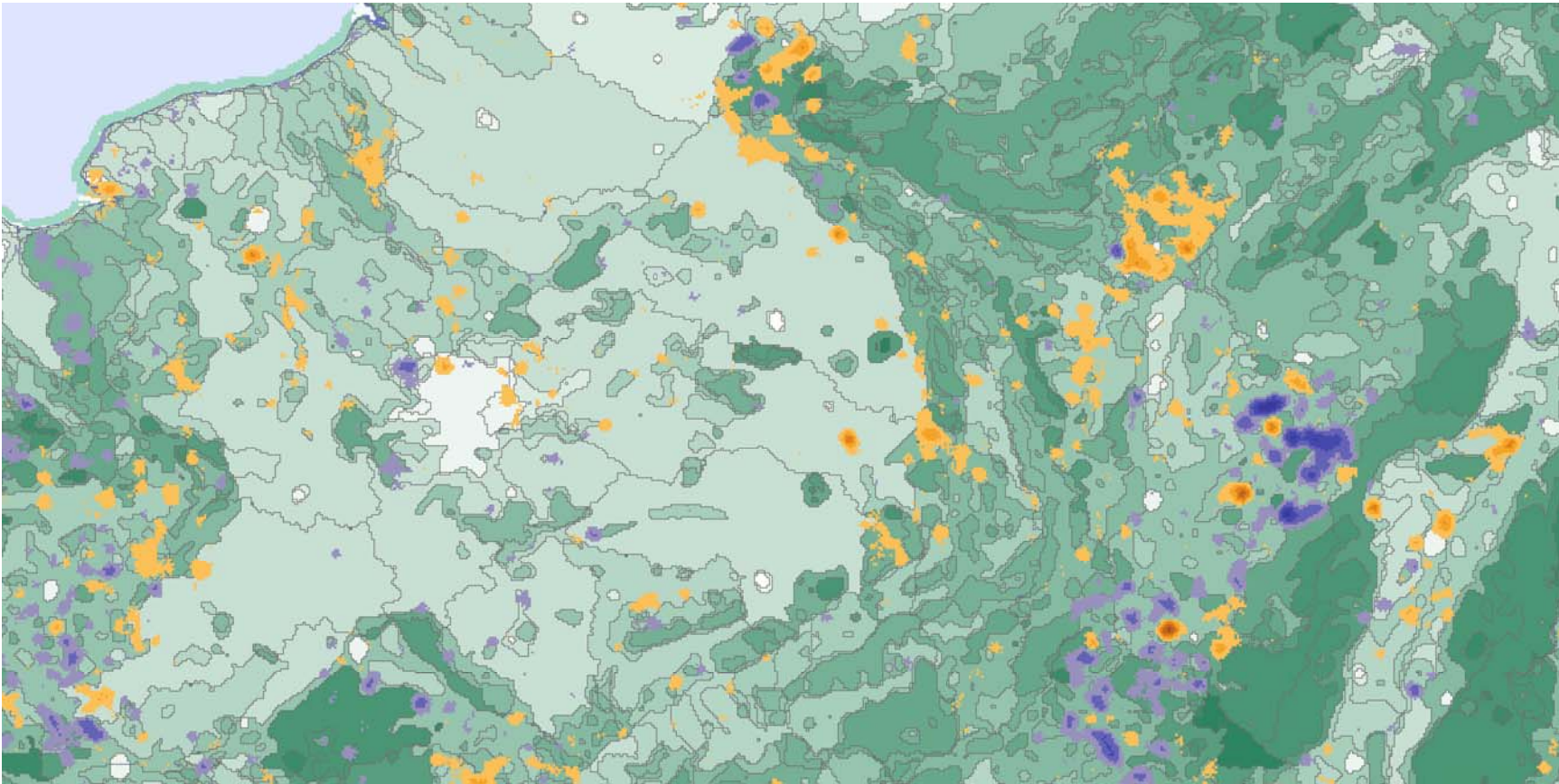
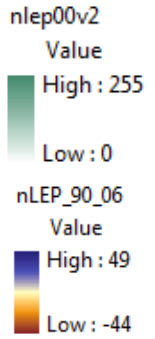
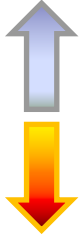
Sprawl of artificial areas 1990-2000





Land cover flows 1990-2006 and mean Landscape Ecosystem Potential (LEP) by ecosystem landscape unit

Land cover flows are measured according to the EEA LEAC methodology based on Corine land cover (J-L Weber and E. Ivanov, 2011)



Landscape Ecological Potential change 1990-2006, by ecosystem landscape unit

(J-L Weber and E. Ivanov, 2011)

The biomass/carbon account





Net Primary Production of biomass/carbon
(2000, in tons of carbon)



Harvest of crops
(2000, in tons of carbon)



Harvest of timber
(2000, in tons of carbon)



Net Ecosystem Carbon Balance (NECB) (2000, in tons of carbon)

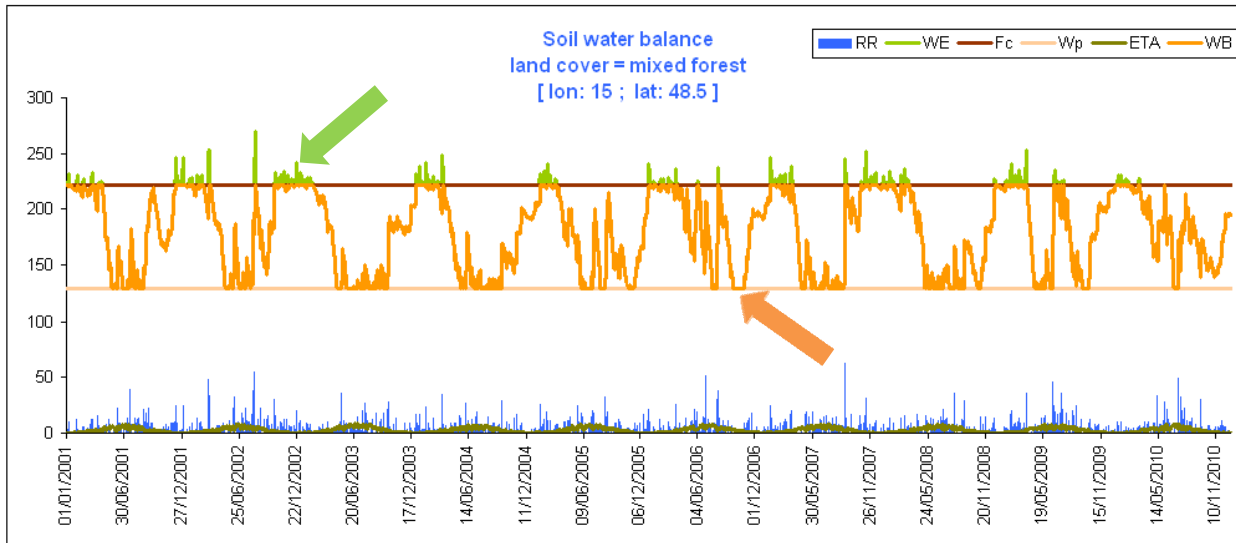
NECB = NPP – Harvest of crops and Timber + - minor flows (organic fertilization, erosion, emissions to air from decomposition...)



The water account (example of soil water)

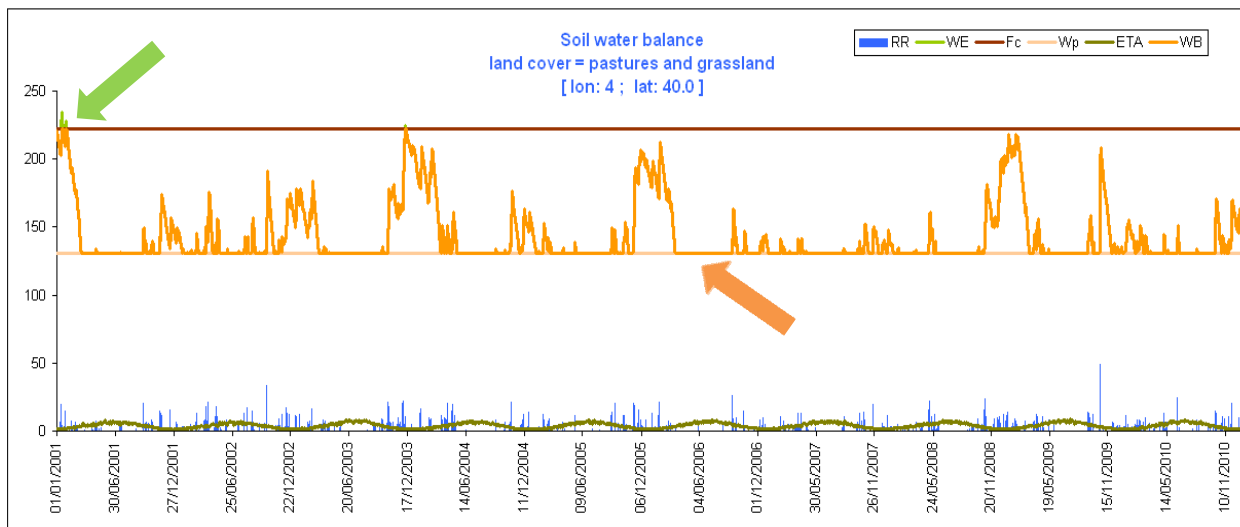


Soil water stress: % of days when no water is available for plants



One point in Germany

- ← Surplus streaming to rivers or infiltrating to groundwater
- ← No water available for plants below this point (Wilting point)



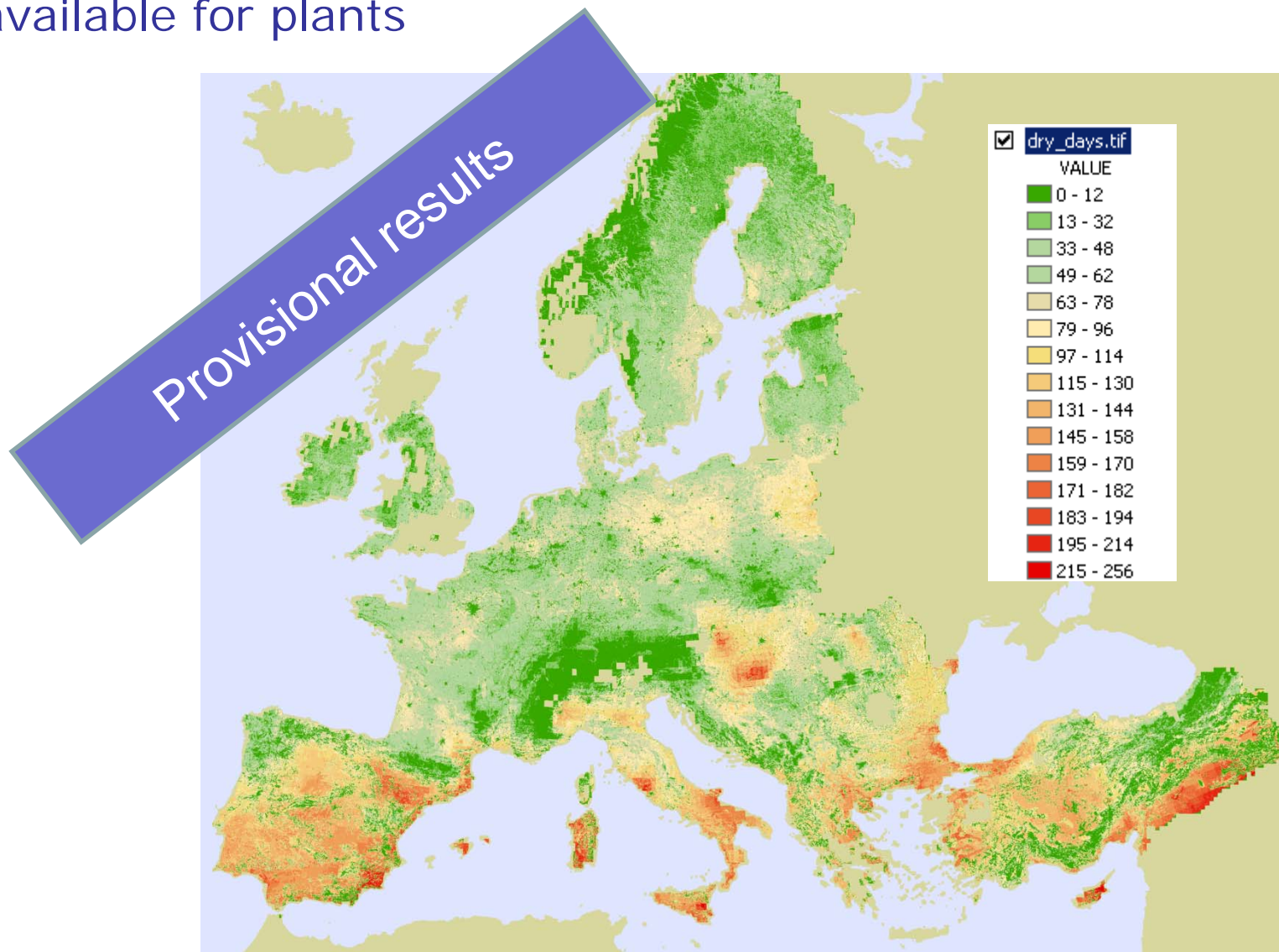
One point in Spain

- ← Surplus streaming to rivers or infiltrating to groundwater
- ← No water available for plants below this point (Wilting point)

Source: Blaz Kurnik, EEA, 2011



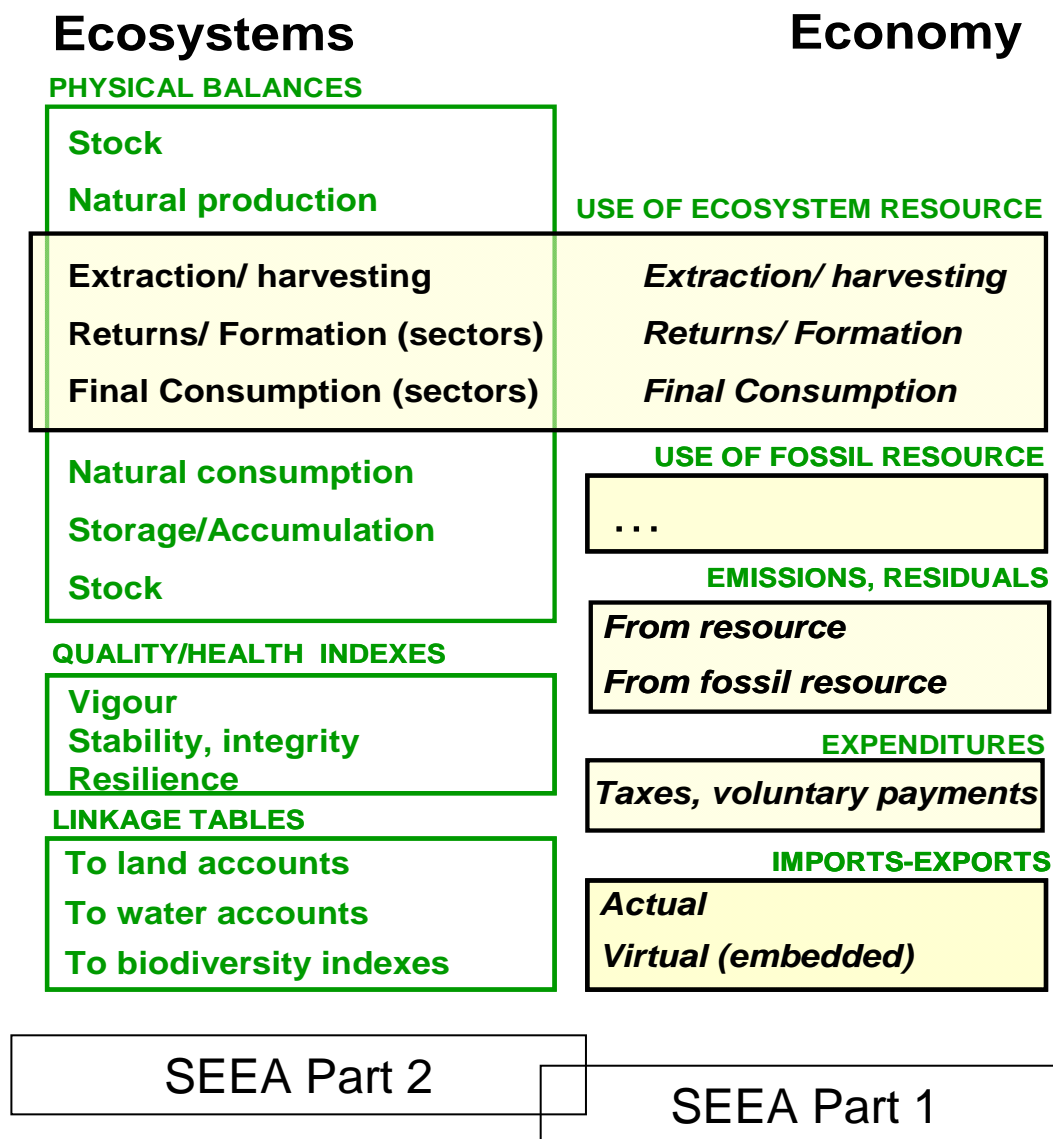
Soil water stress in 2001: number of days when no water is available for plants



Source: Blaz Kurnik, EEA, 2011



Ecosystem-Economy integrated accounts





SNA & SEEA: economic and ecosystem assets

Assets hold by ecosystem units (forests, agro-systems, wetlands...)	Assets hold by economic units (enterprises, government bodies, households...)										
	Produced assets					Non produced assets					
	Dwellings & other buildings and structures	Machinery and equipment	Cultivated biological resources	Inventories	Other products	Land	Mineral and energy reserves	Noncultivated biological resources	Water and other natural resources	Intangible assets (contracts, licences...)	
Land			x			x					
Land cover systems	x		x			O		x	x		
Biomass/carbon			x	x			O	x	O		
Water								O	x		
Biodiversity			O			O		O	O	O	
Self regulating capacity	O		O			O		O	O		
Health, overall regenerative capacity			N			N		N	N		
	x	explicitly recorded as economic asset									
	O	partly or indirectly recorded as economic asset									
	N	not recorded, externality									

