

Workshop of the GEO Initiative on Earth Observation for Ecosystem Accounting (EO4EA)

27-29 March 2017 at EEA, Copenhagen, Denmark

Using earth observation for describing and measuring ecosystems – experiences in Europe

EO data /
Copernicus



Ecosystem
assessment



Ecosystem extent
and condition
accounts

EU Policy Objectives and Assessments

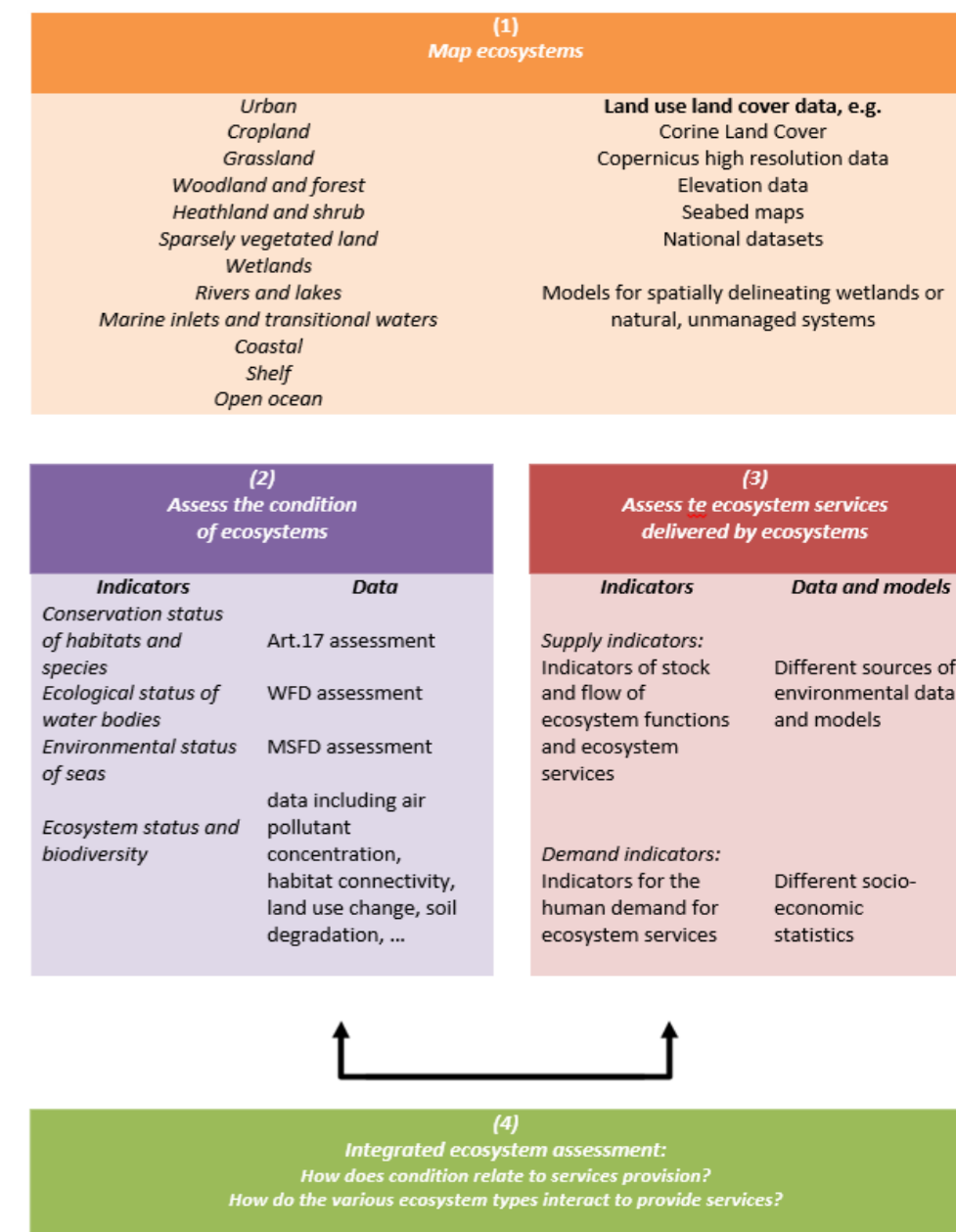
EU 7th Environmental Action Programme to 2020 ‘Living well, within the limits of our planet’:

Objective 1: 'protect, conserve and enhance the European Union’s natural capital'

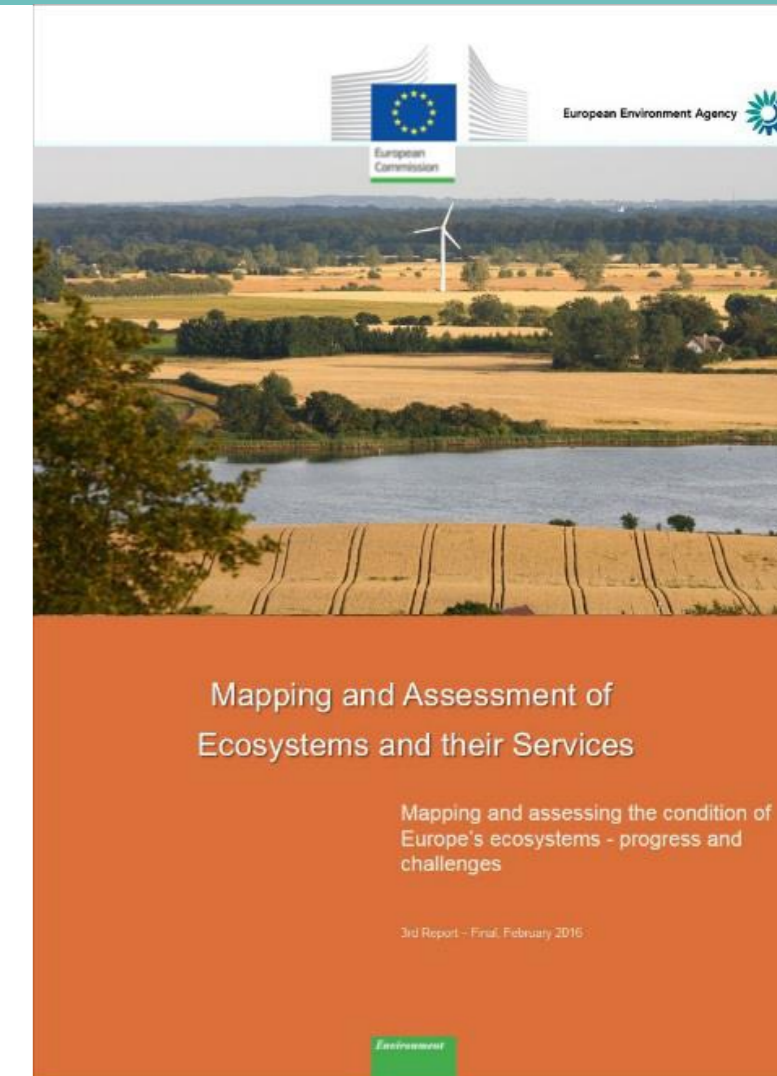
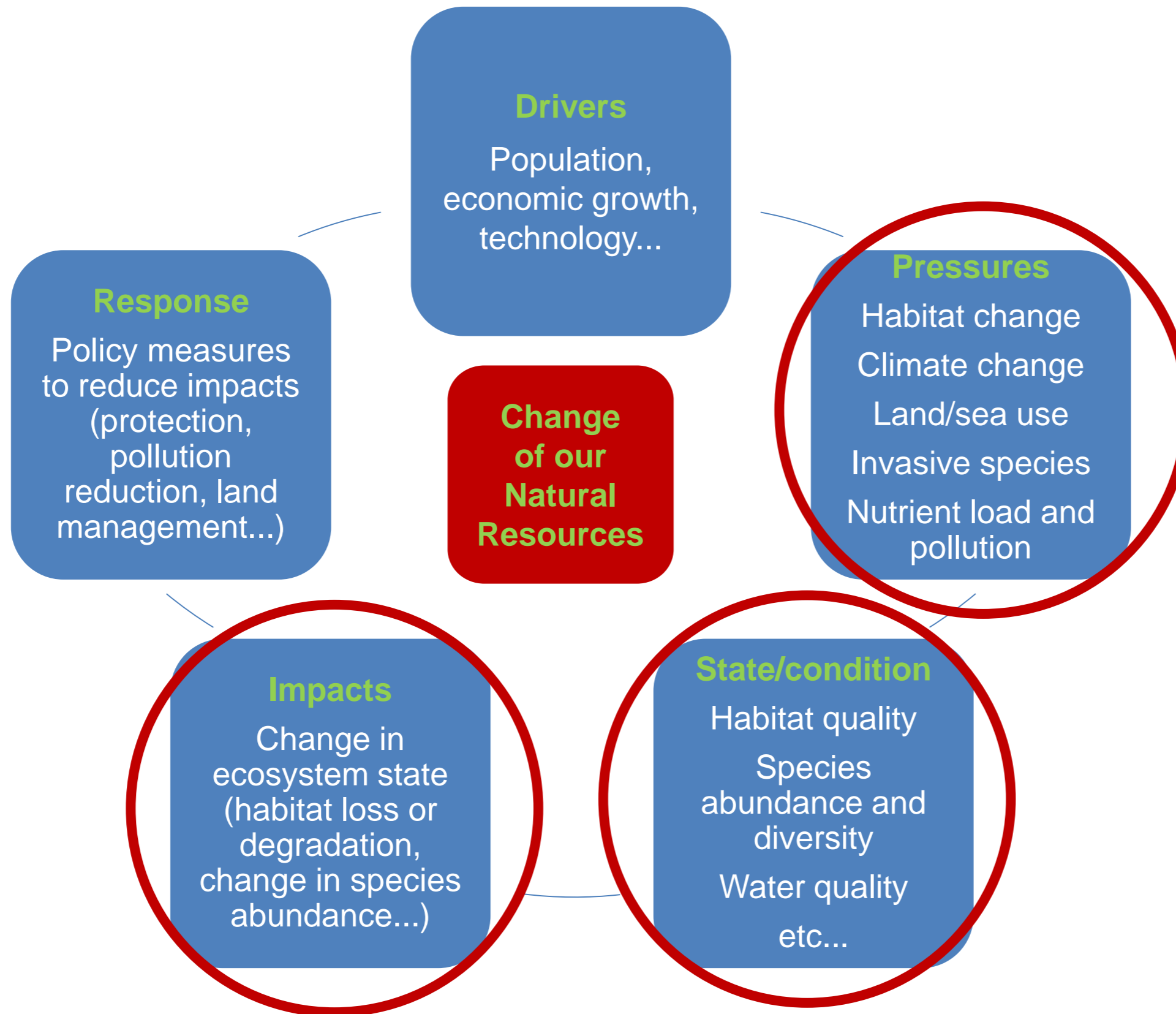
Objective 5: build environmental knowledge base

Building blocks for an integrated assessment

- Improving the knowledge base
uptake of new information, interpretation, integration ...
- Mapping and assessing ecosystems and their services
mapping ecosystem extent, assessing condition, ecosystem service modelling
- Linking ecosystem condition and ecosystem services
sensitivity of service assessments to condition changes
- Providing input and using accounting and valuation (KIP-INCA)
ecosystem extent and condition data transfer in accounting system

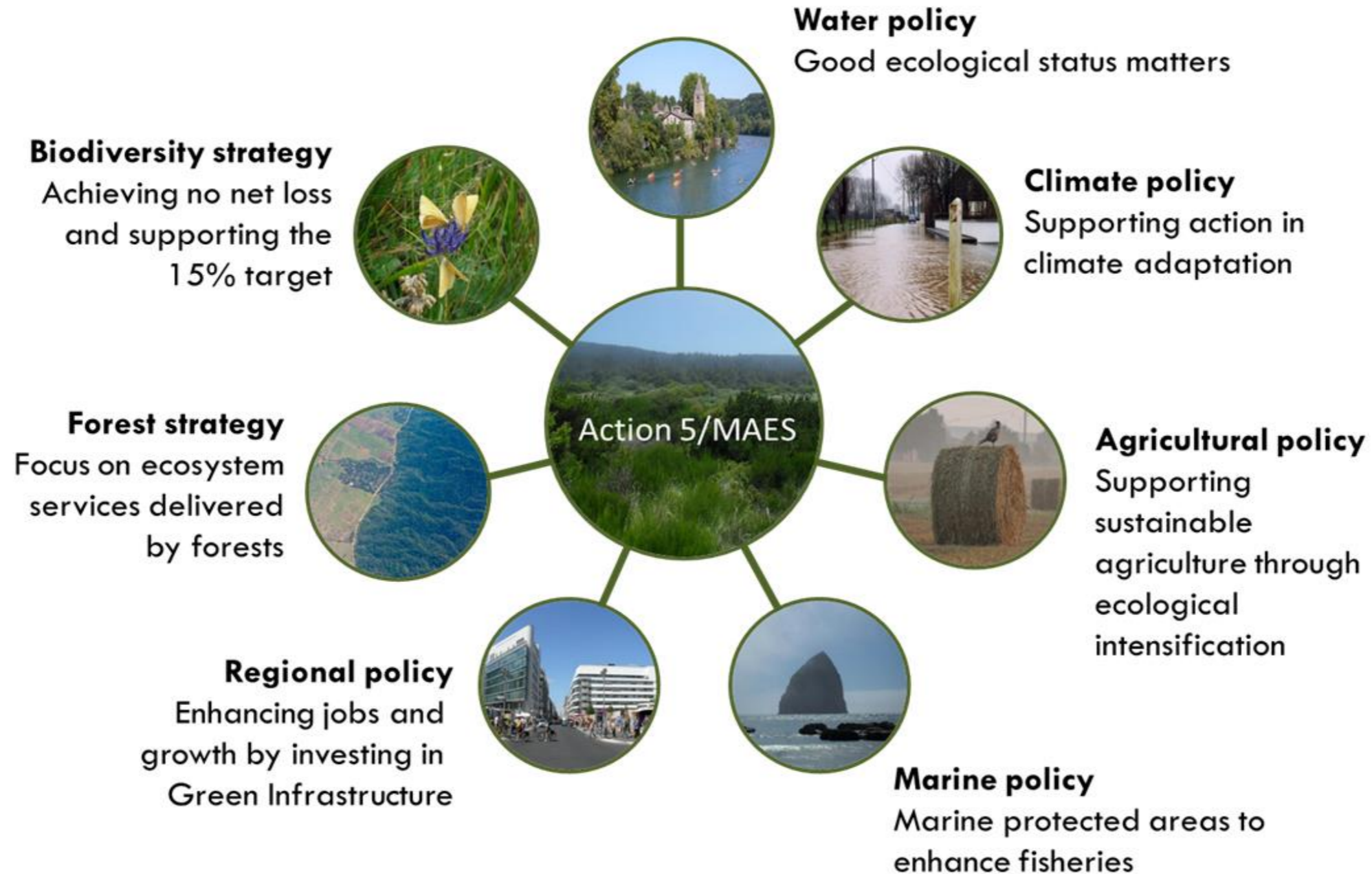


DPSIR Framework – Understanding the Causalities



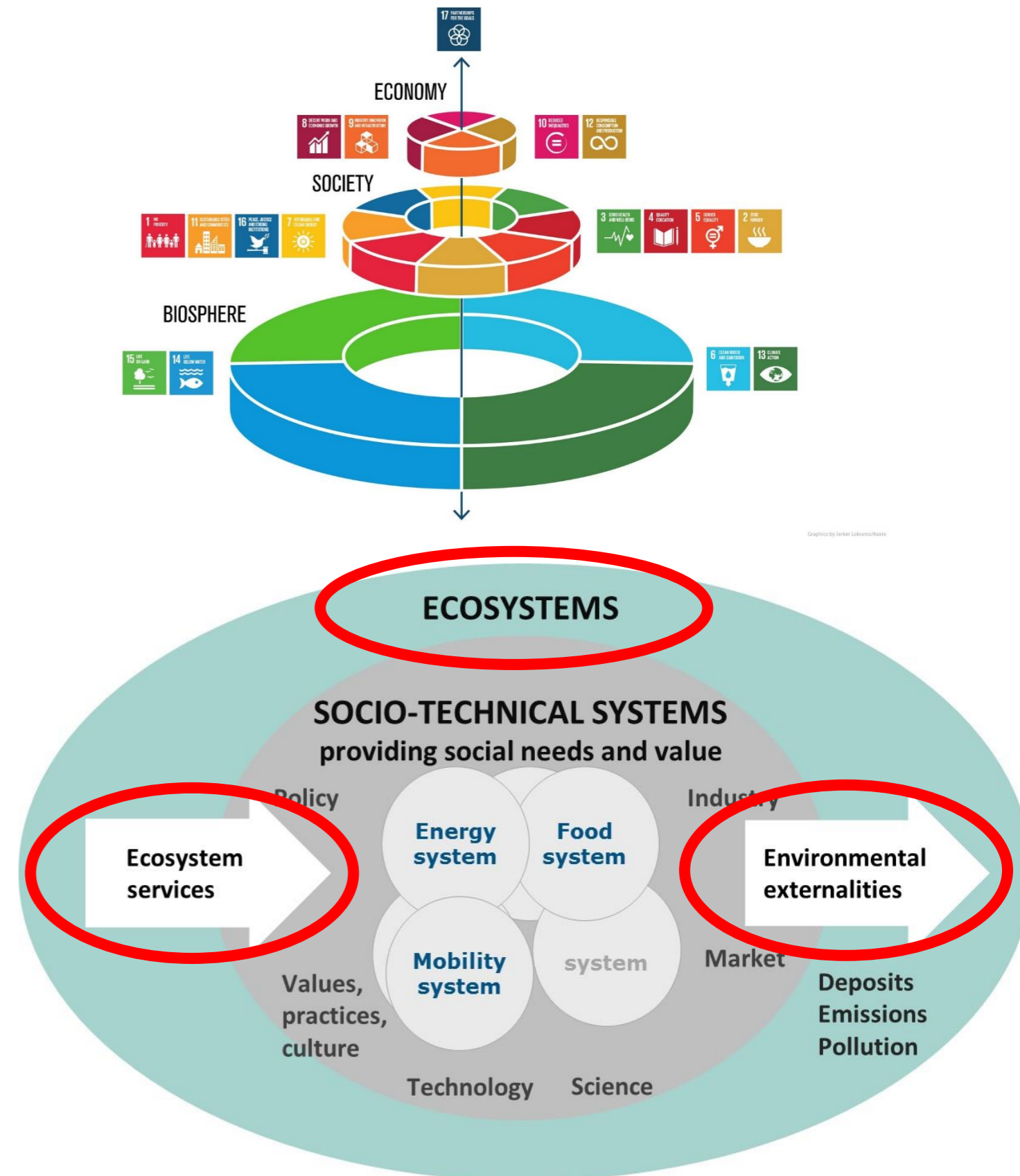
Policy Mainstreaming - Integration

European environmental policies



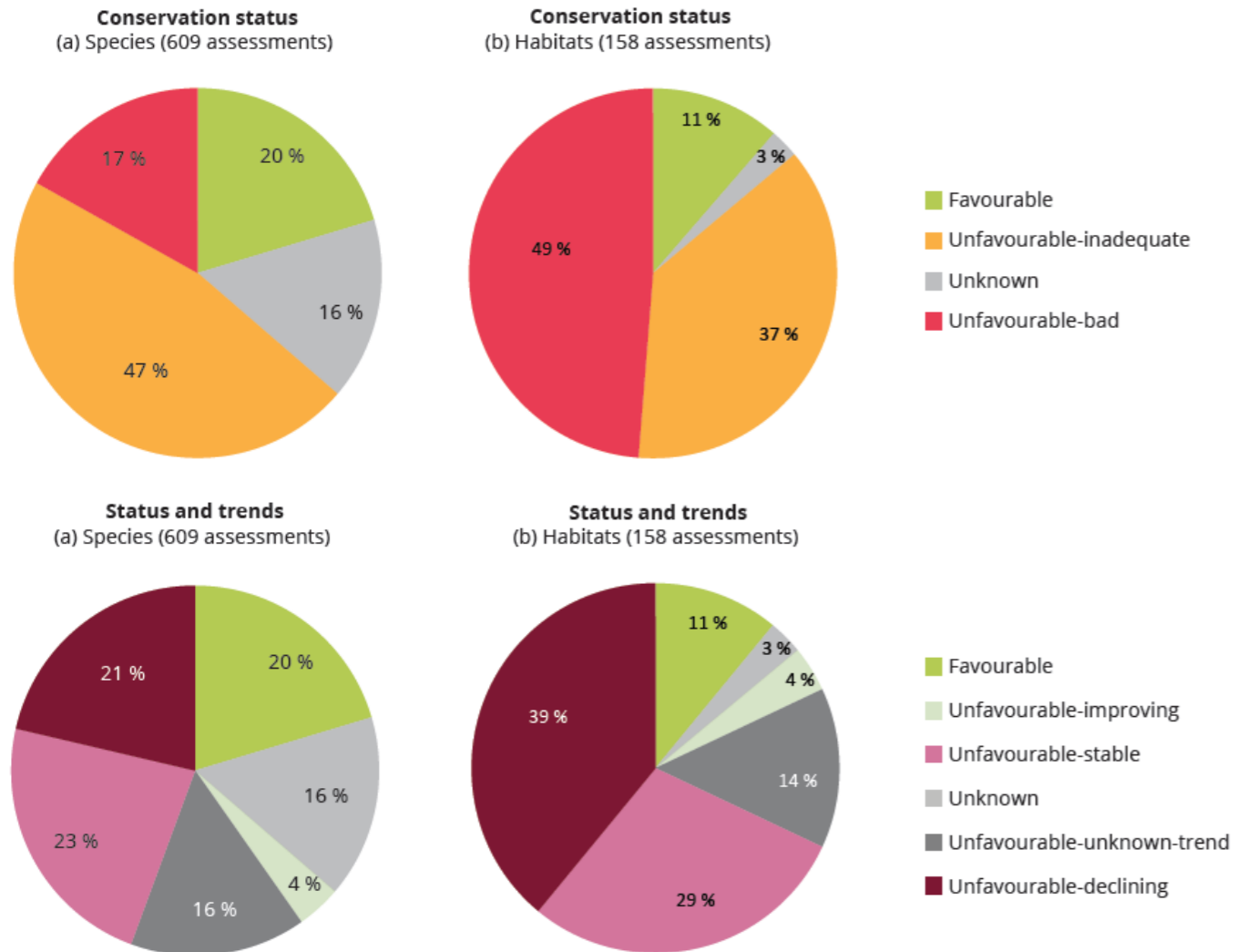
Using results in broader context

- NEC Art. 9 air pollution and biodiversity
- Climate change mitigation (LULUCF) and adaptation
- UN Sustainable Development Goals (SDGs)
- Systemic changes and natural capital



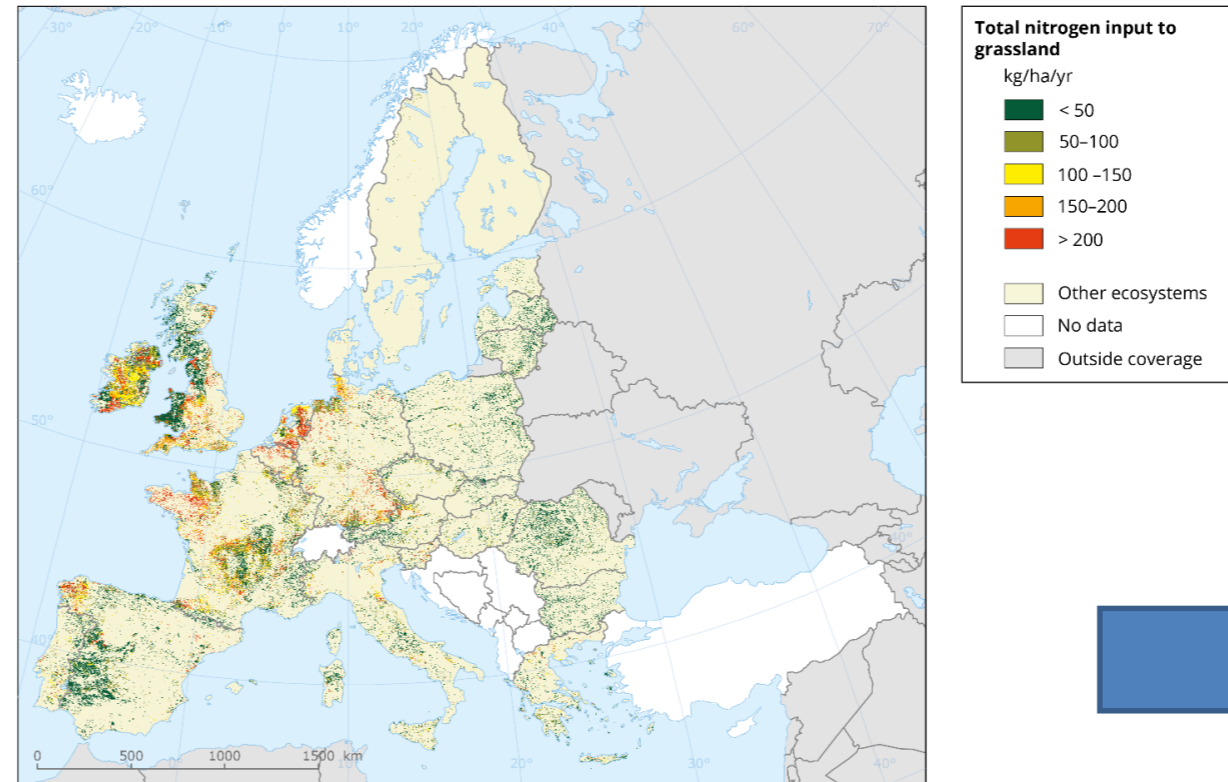
Causalities - developing story-lines e.g. grassland

Grassland ecosystems:
non-bird species and habitat conservation status
and trends

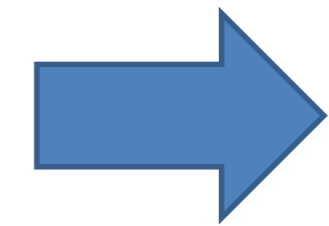
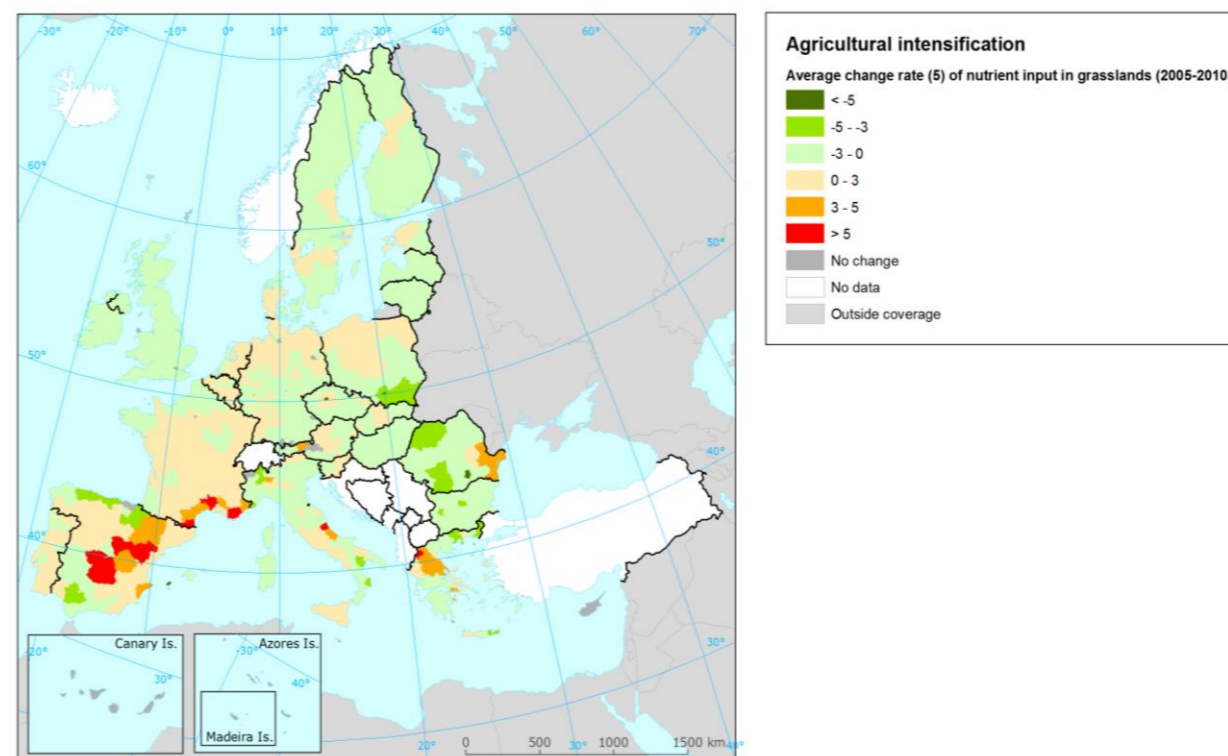


Nature report (EEA,2015)

Nitrogen input 2010



Change in nitrogen input 2005-2010



Joint data base
for
assessment
and
accounting

Ecosystem multi-functionality - condition – ecosystem services

Illustrative Examples

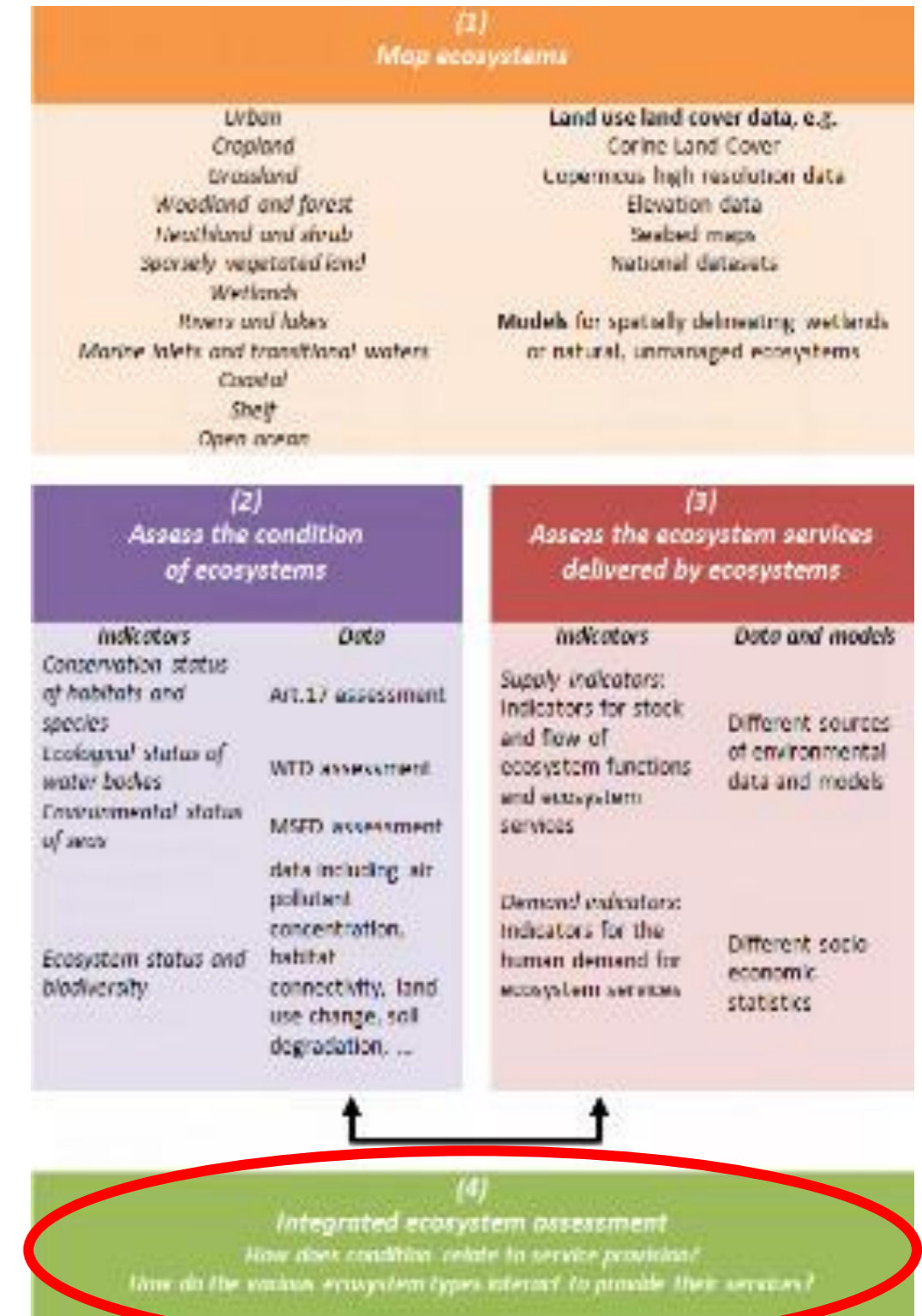
Ecosystem services

timber
 cropland soil productivity
 grassland soil productivity
 NO₂ removal (air quality)
 Erosion control
 water retention
 pollination
 pest control by birds
 Net ecosystem productivity
 recreation
 maintaining habitat quality (forests)
 maintaining habitat quality (farmland)

C
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Ecosystems

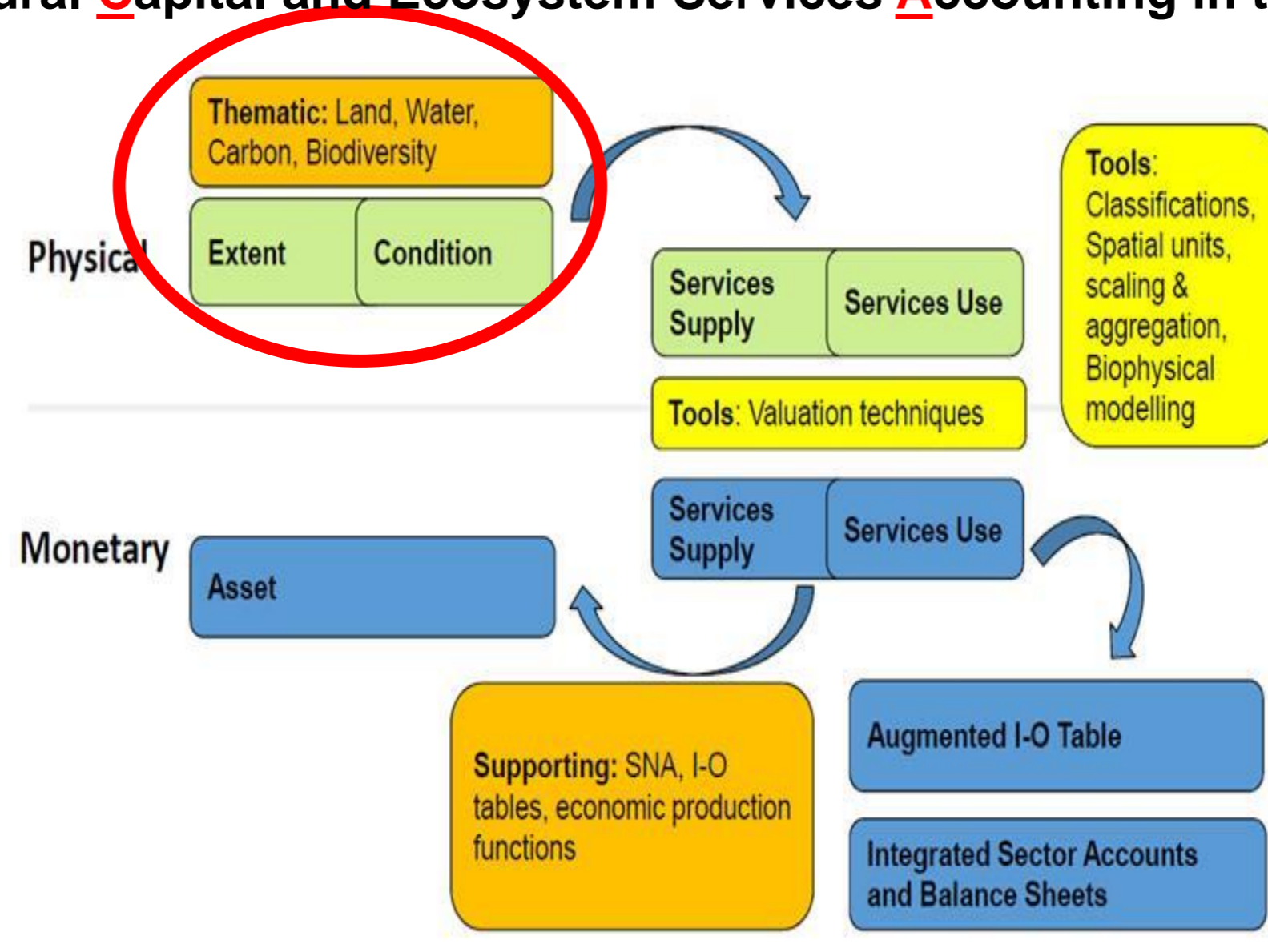
urban
 forest
 cropland
 grassland
 heathland/shrub
 wetland
 mires, bogs and fens
 coastal beach



Input Accounting

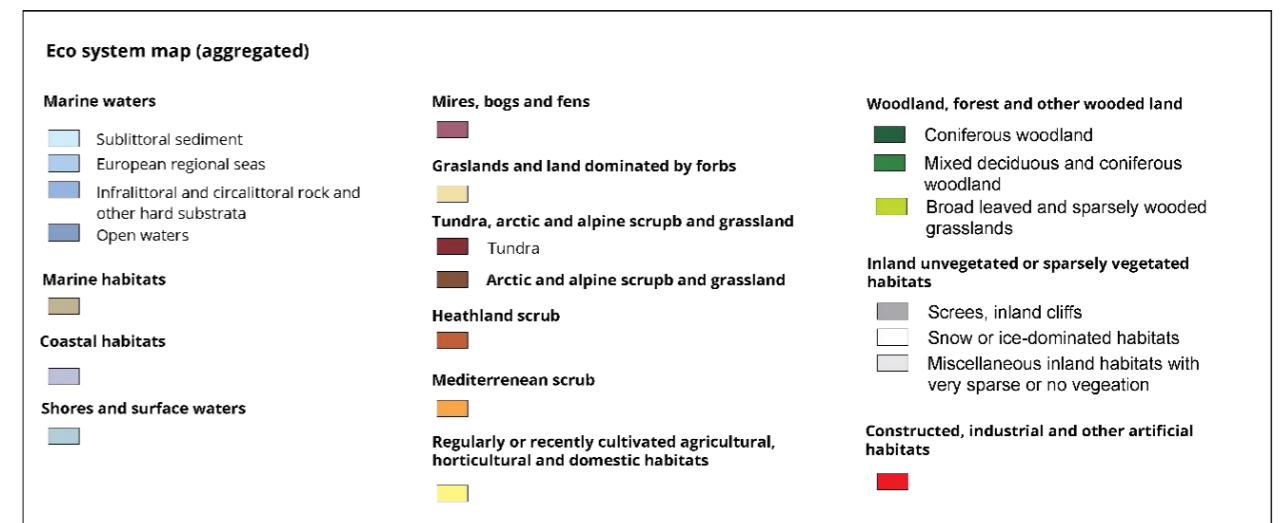
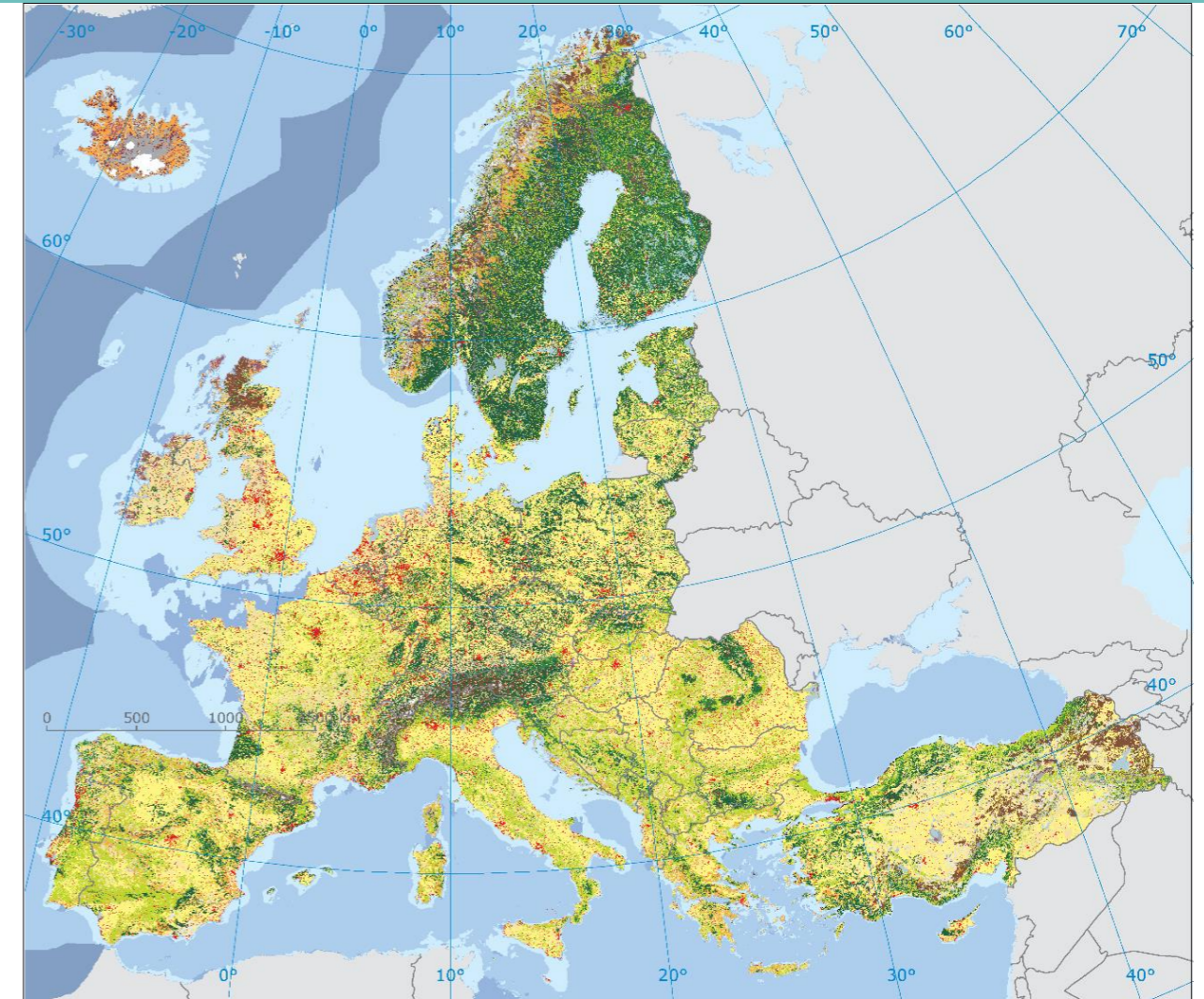


Knowledge Innovation Project on Integrated System for Natural Capital and Ecosystem Services Accounting in the EU



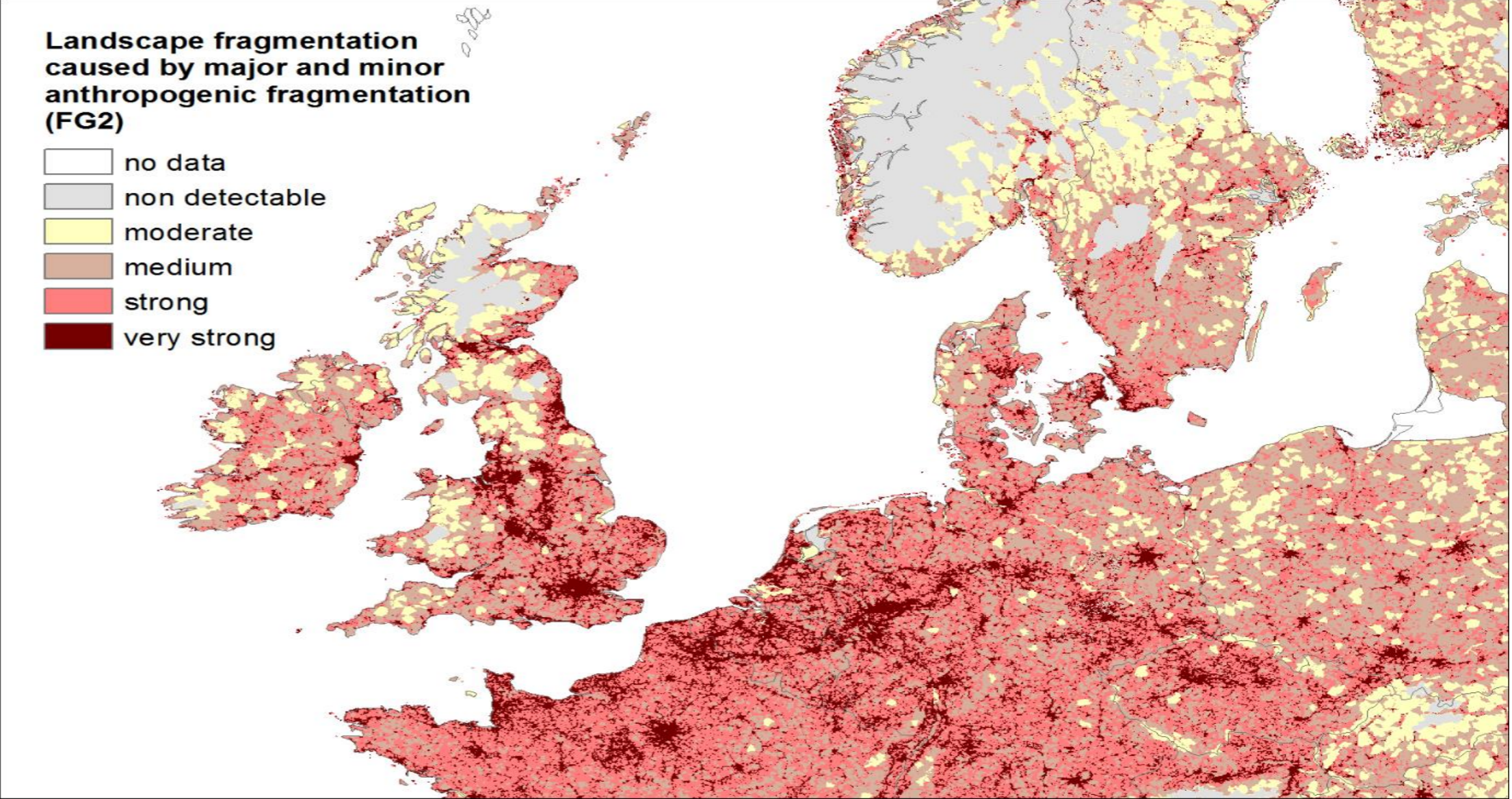
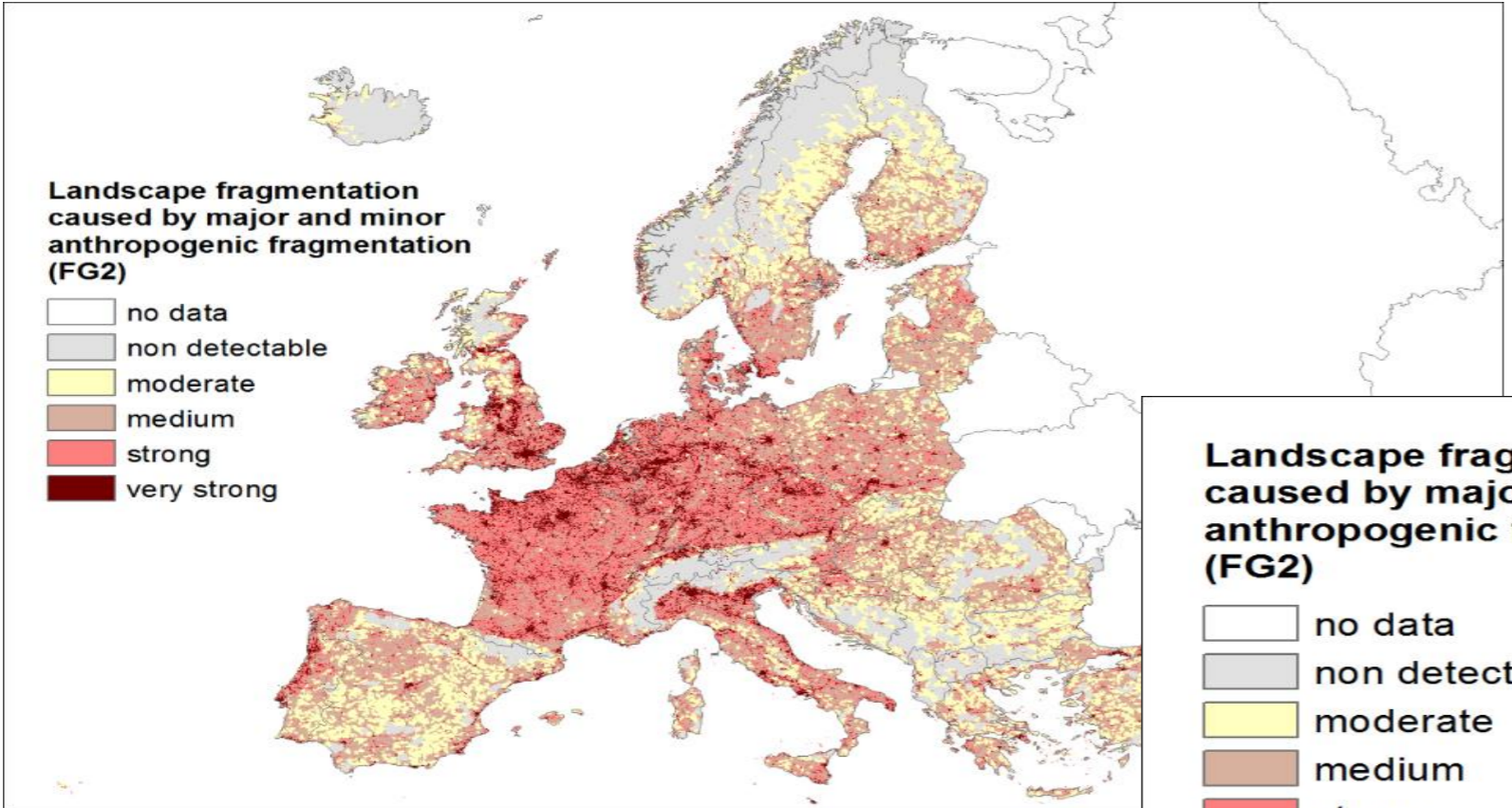
Key issues for ecosystem extent and condition in Europe

- Area: ca 12.1 Mio km²
6 Mio km² land, 6.1 Mio km² sea
- Spatial and temporal resolution of land cover / land use as basic information for ecosystem extent
- Spatial and temporal resolution of indicators of ecosystem condition
- Quantification of ecosystem condition descriptors for accounting



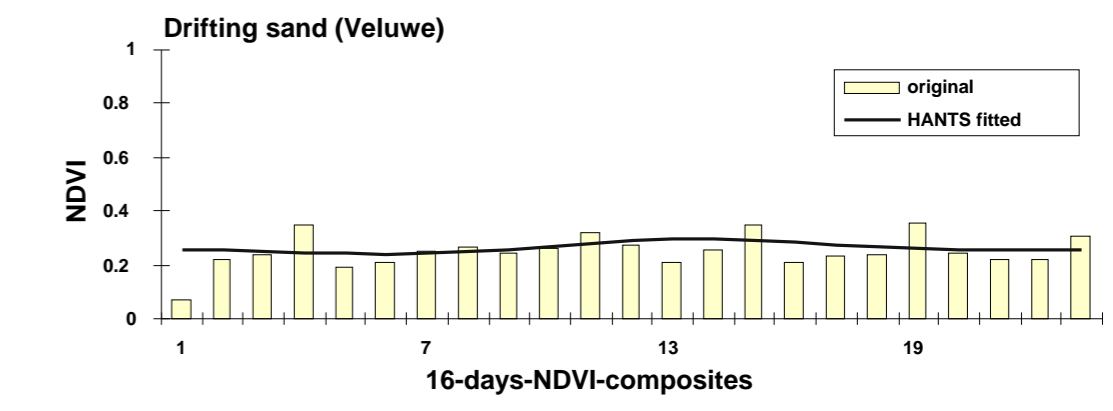
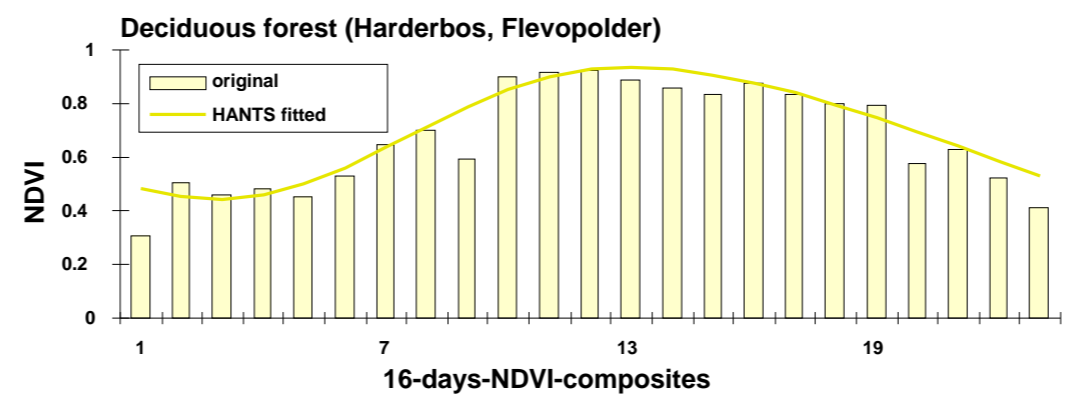
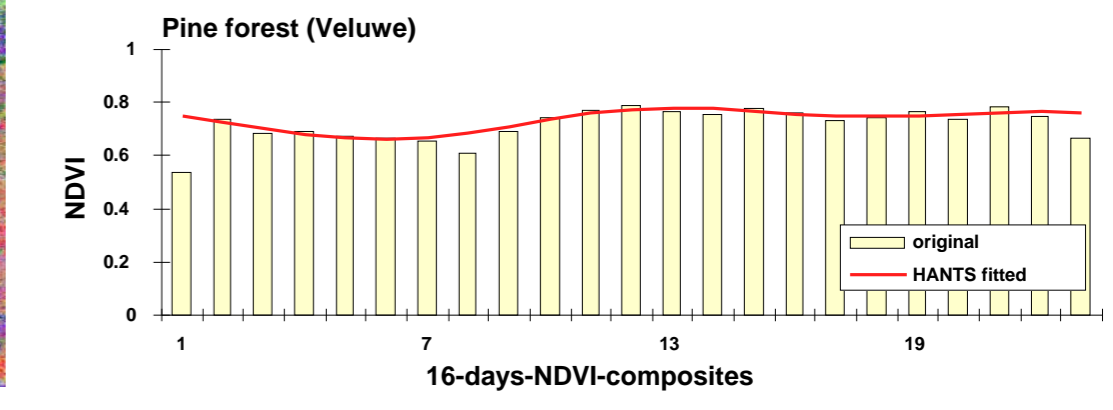
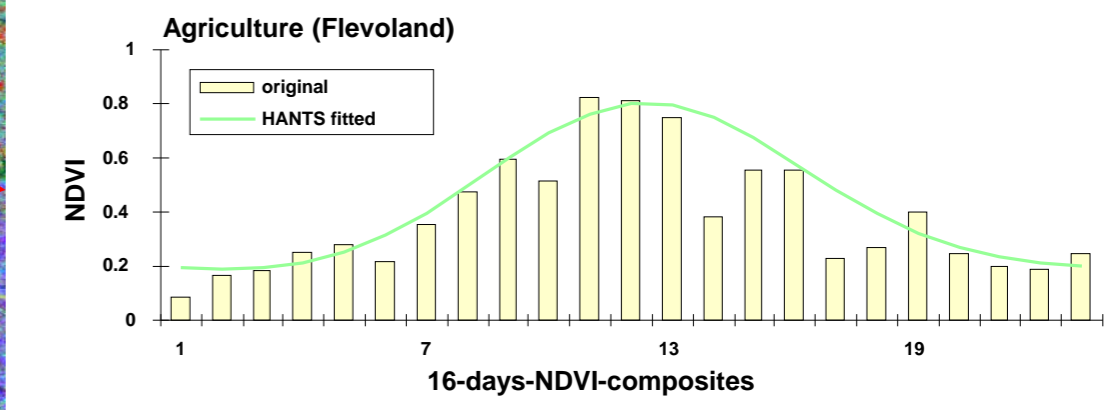
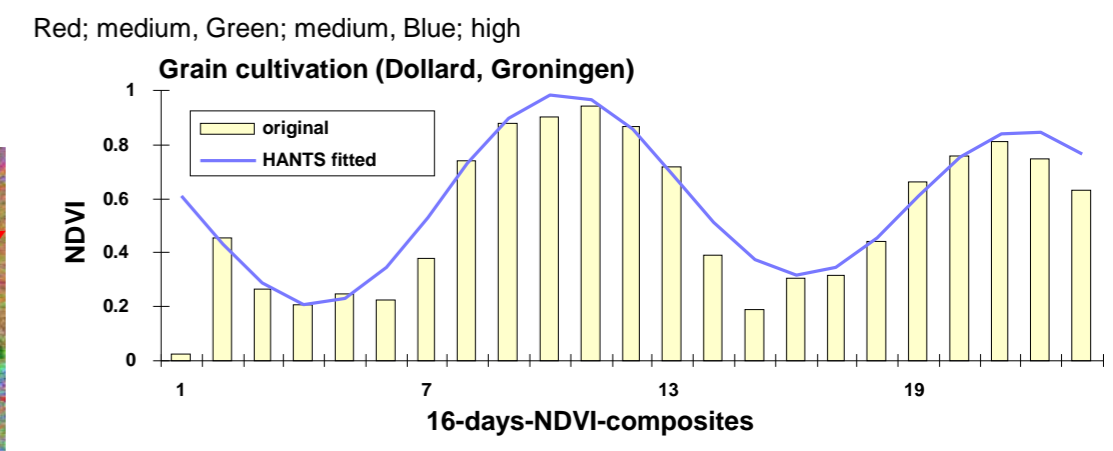
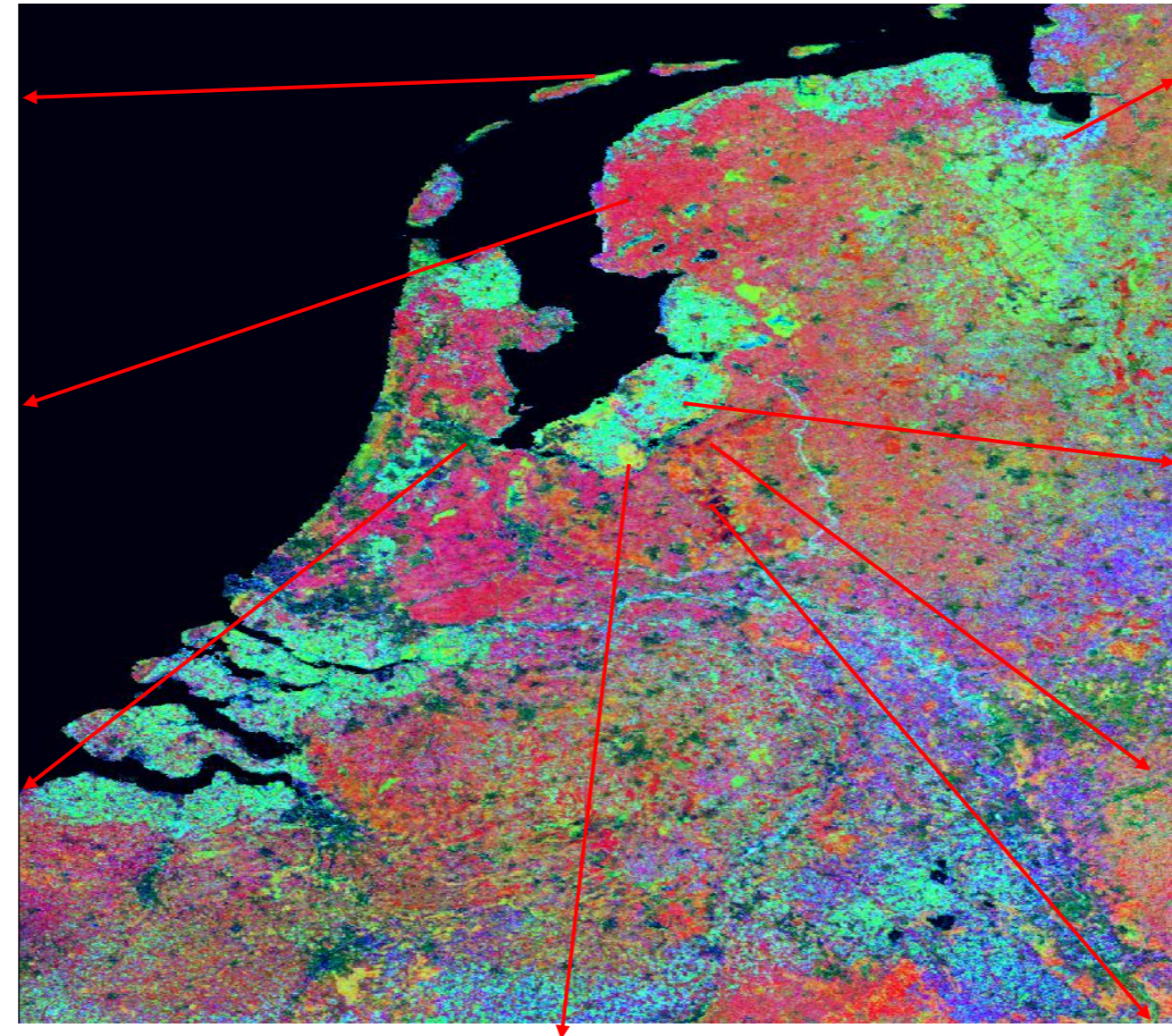
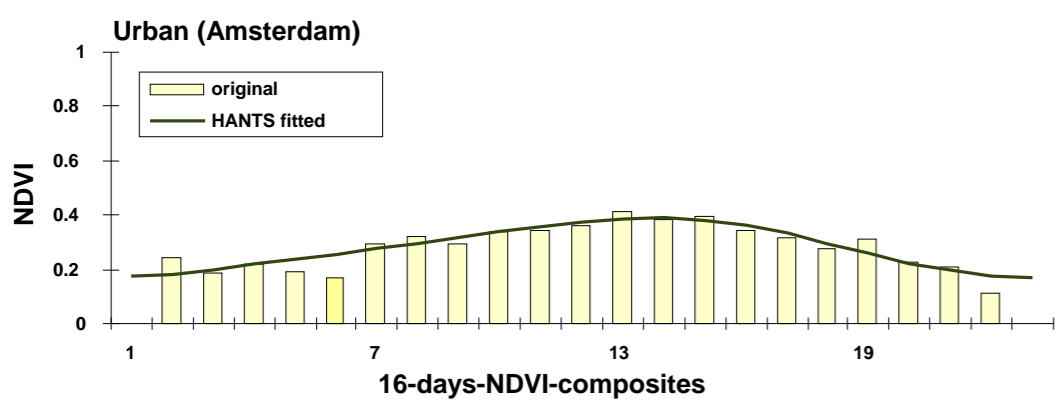
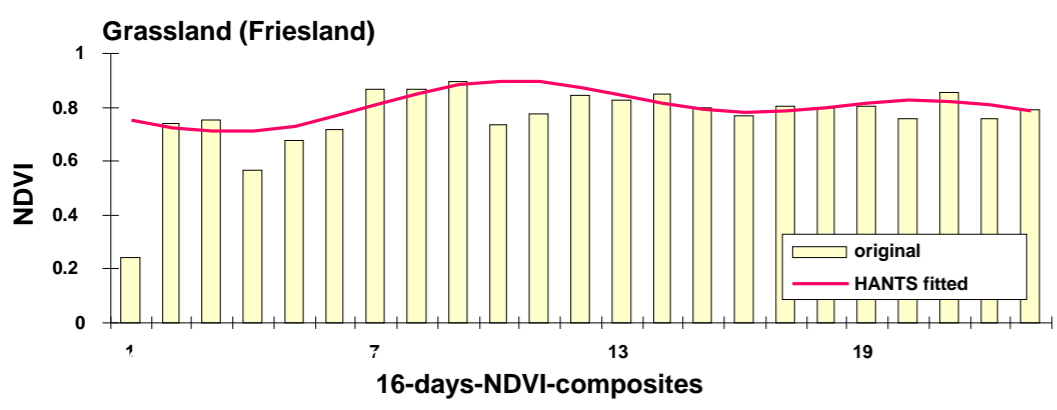
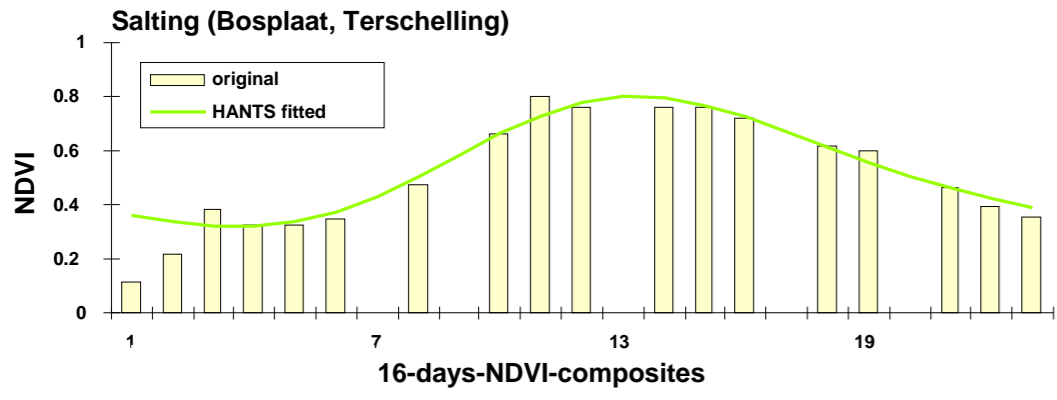
Effect of mobility and urbanisation on the fragmentation of ecosystems

→ Change in ecosystem extent and condition



Land use - vegetation characterization

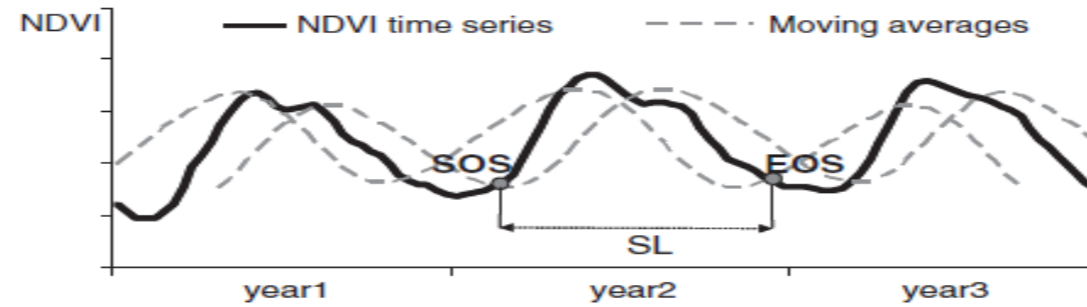
Netherlands based on MODIS



Red = average NDVI
 Green = Annual Amplitude
 Blue = Six months Amplitude

Condition: Phenological shifts of European ecosystems

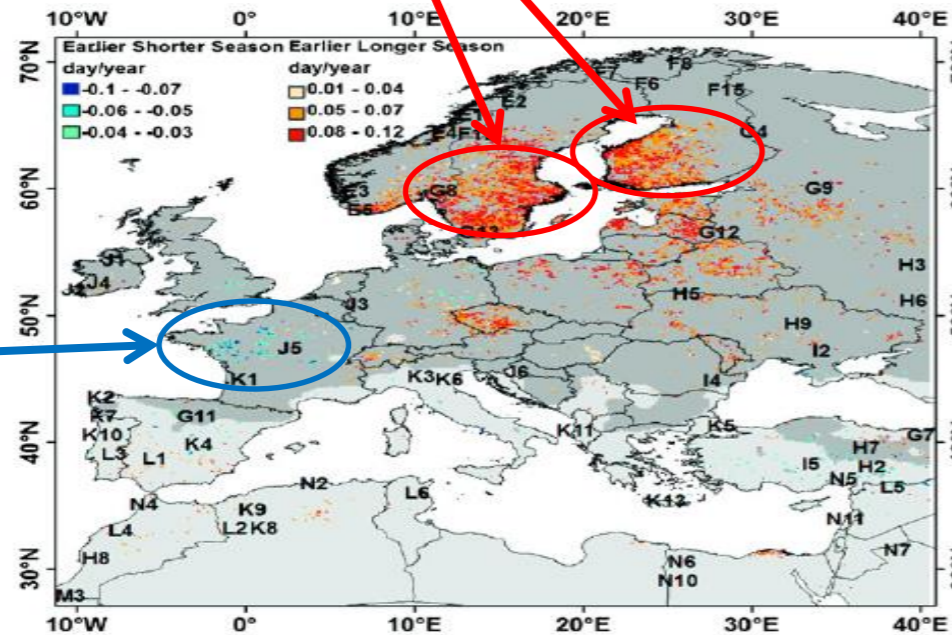
(AVHRR GIMMS3g 1982-2006)



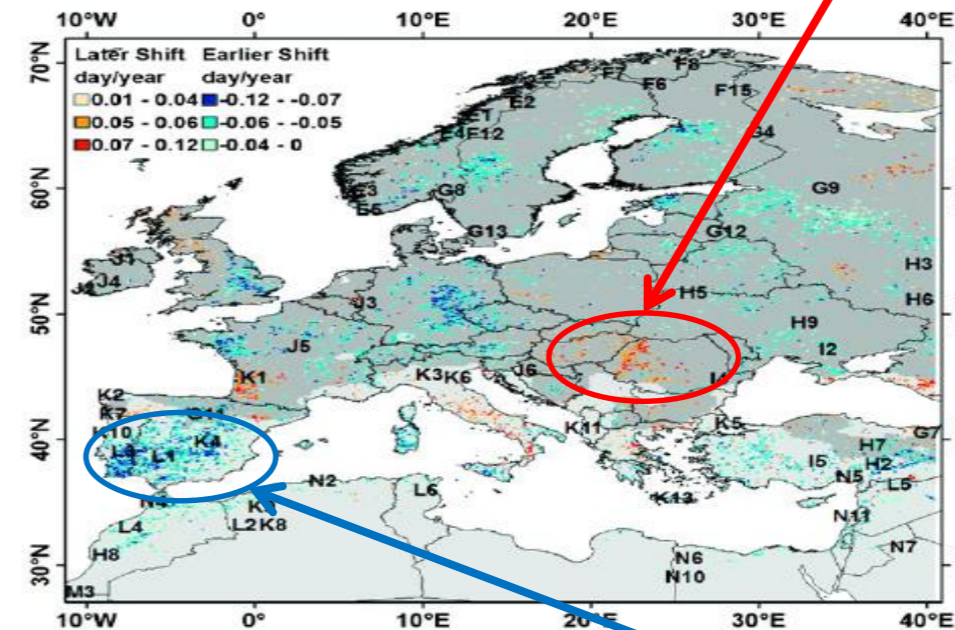
earlier and longer season

season length unchanged
entire season shifts later

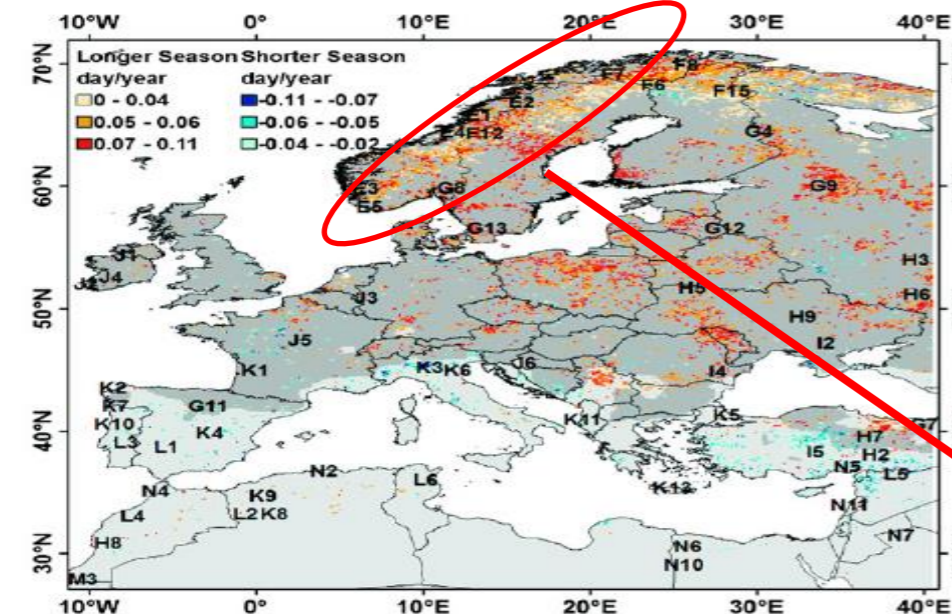
earlier
and
shorter
season



A: Earlier Longer Seasons and Earlier Shorter Seasons. Grey shaded areas: not significant trends and/or not significant spatial agglomerations



B: Earlier Shift of Season and Later Shift of Season. Grey shaded areas: not significant trends and/or not significant spatial agglomerations.

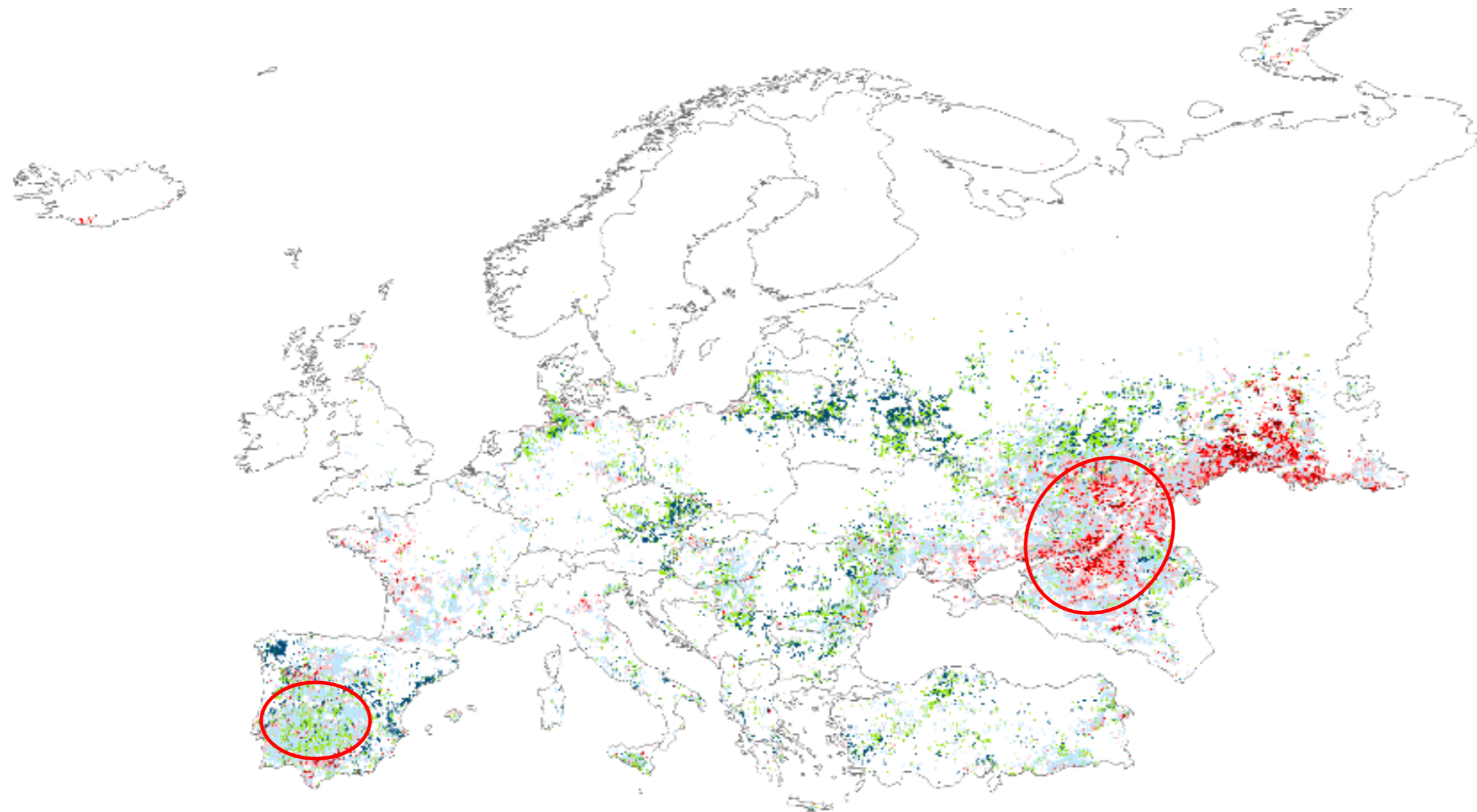


C: Longer Seasons and Shorter Seasons. Grey shaded areas: not significant trends and/or not significant spatial agglomerations.

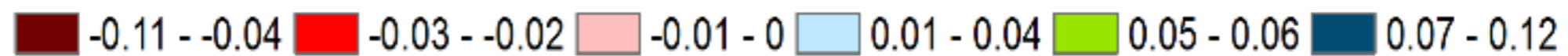
start of season unchanged
the growing season is longer

season length unchanged
entire season shifts earlier

Drought footprints on European ecosystems



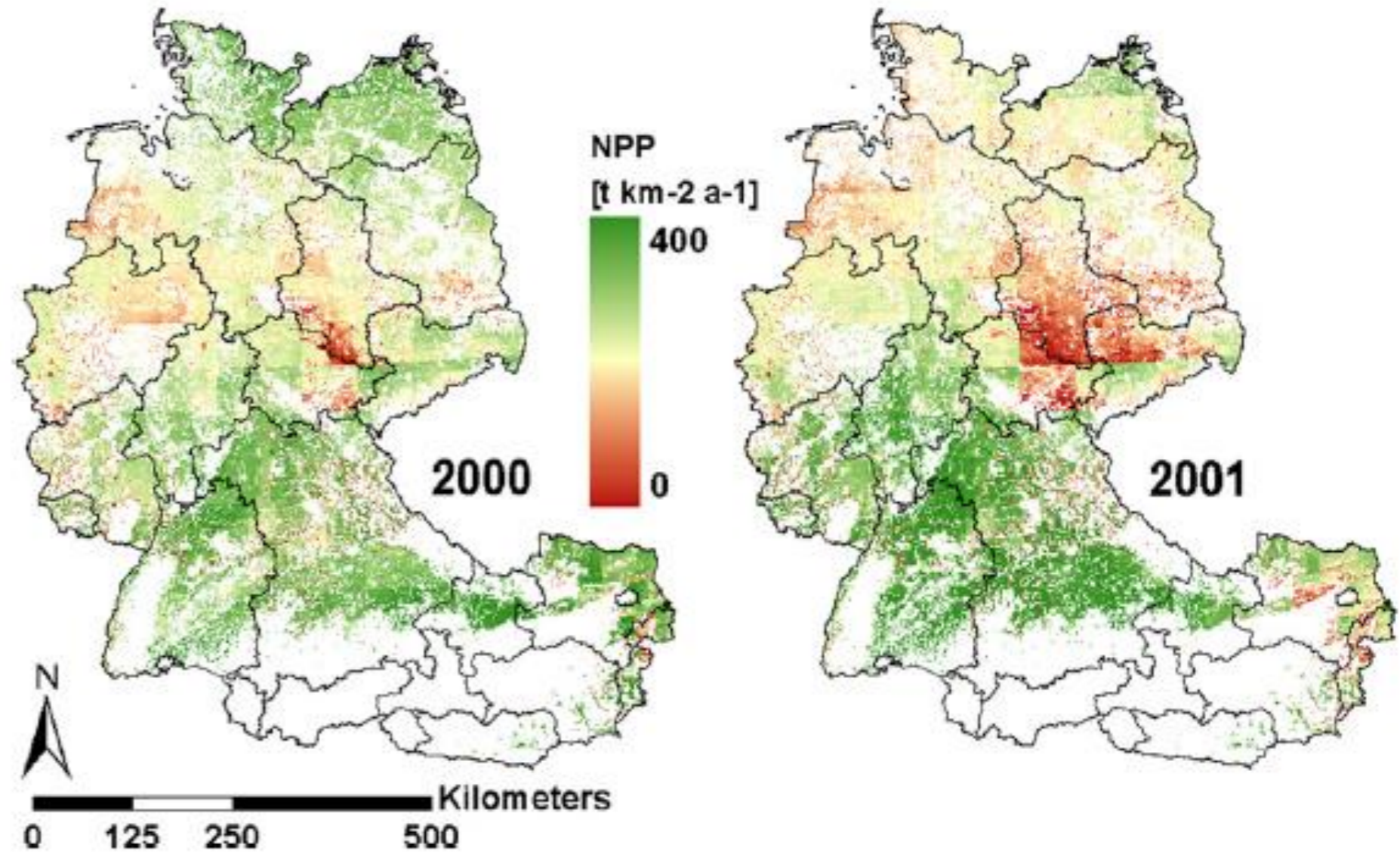
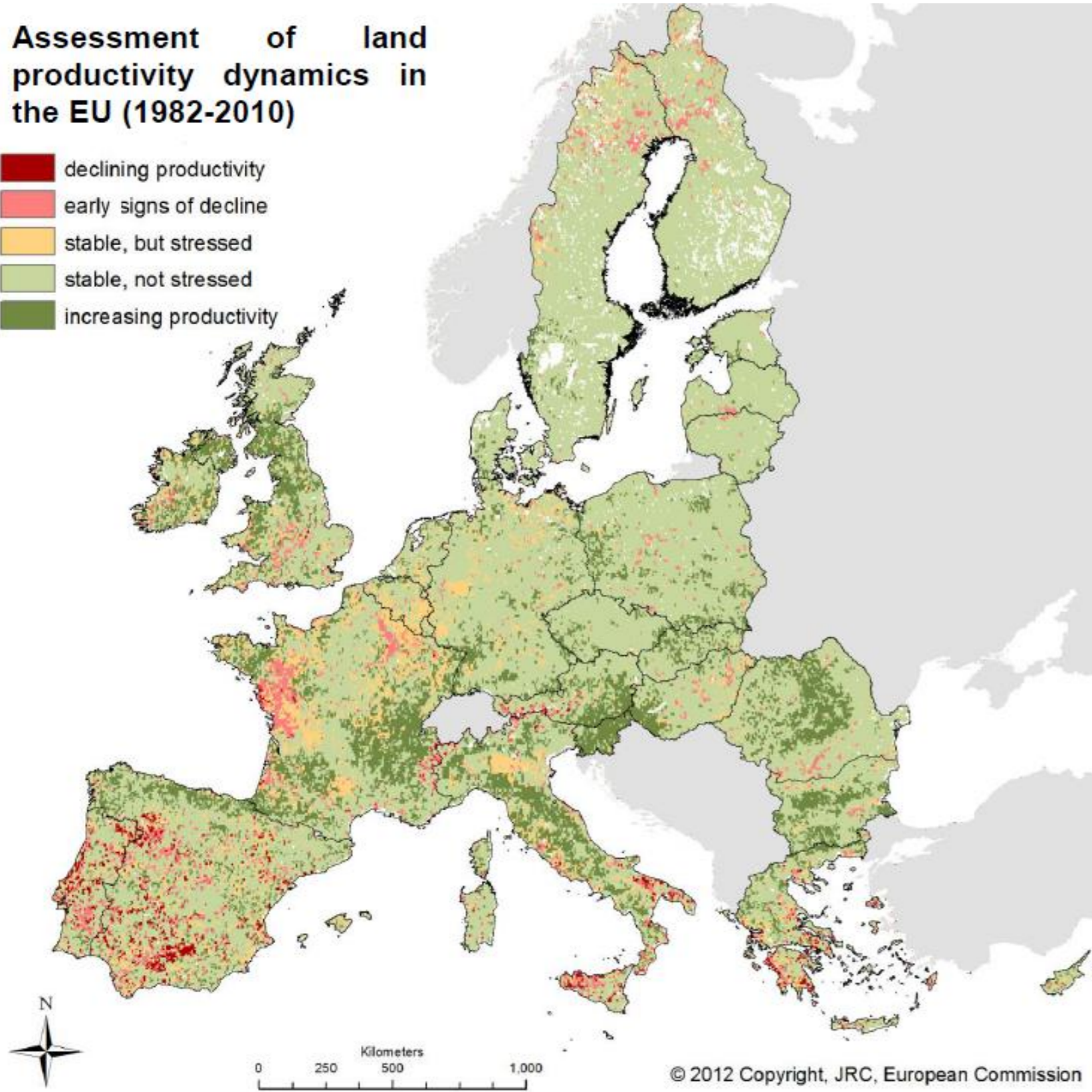
Z-score normalized linear biomass trends



Land productivity dynamics in Europe

Assessment of land productivity dynamics in the EU (1982-2010)

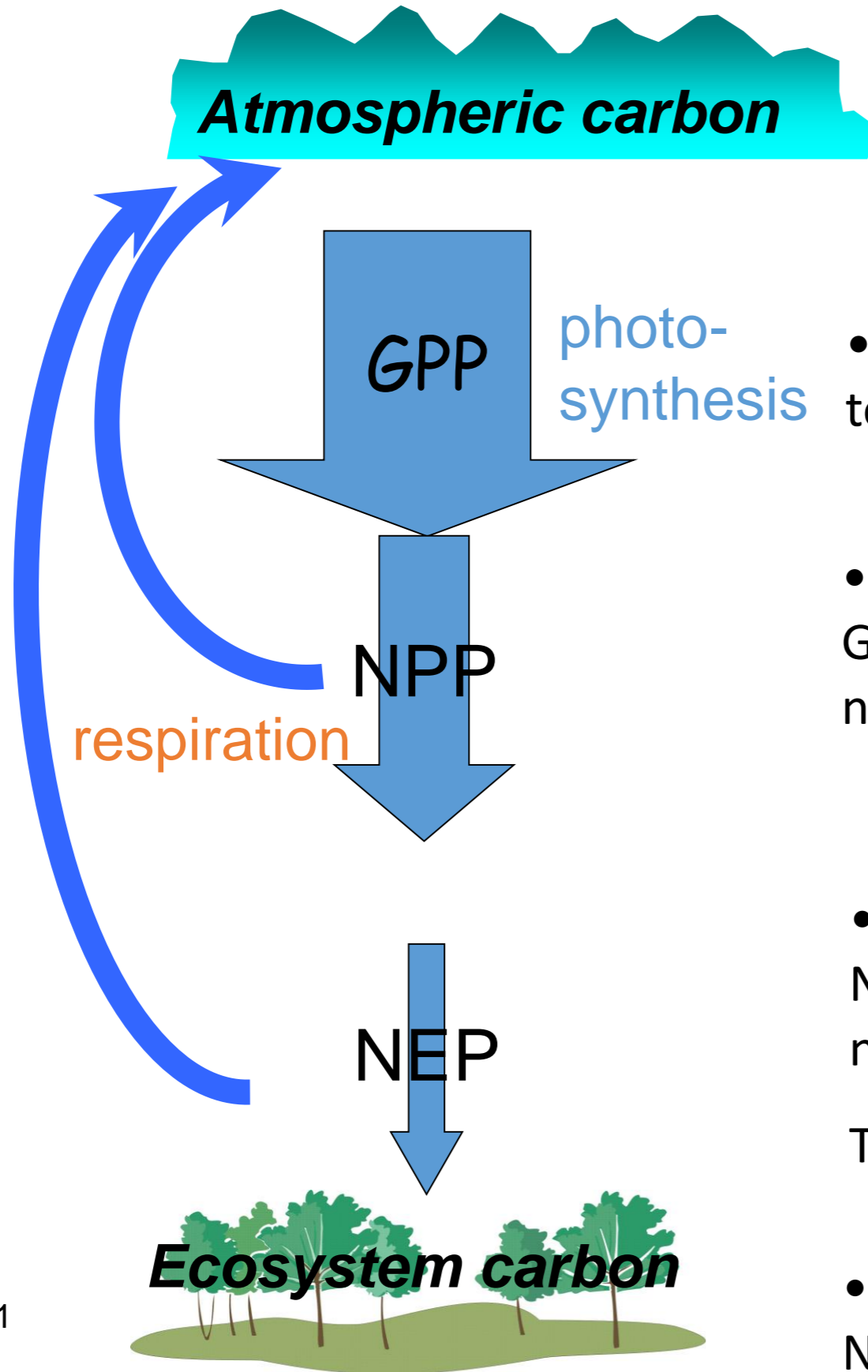
- declining productivity
- early signs of decline
- stable, but stressed
- stable, not stressed
- increasing productivity



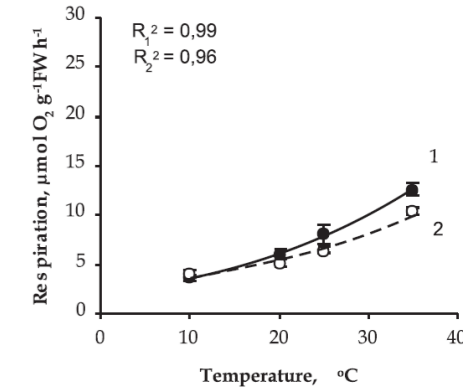
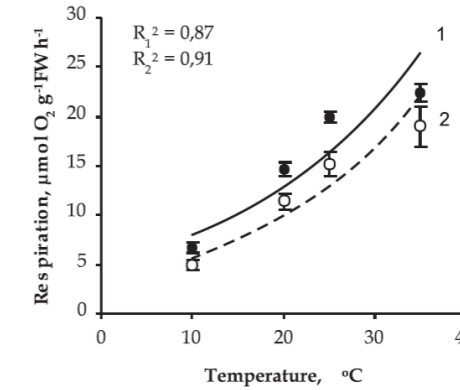
Source: Cherlet et al. / JRC Technical Report (2013)

Source: Tum & Günther 2011

From Vegetation indices to carbon monitoring



Temperature dependency of plant respiration



100%

Pystina & Danilov, 2002

- **Gross Primary Production (GPP):** total carbon fixed through photosynthesis

- **Net Primary Production (NPP):** GPP minus autotrophic respiration (plants); net plant growth

44-57%

- **Net Ecosystem Production (NEP):** NPP minus heterotrophic respiration (bacteria, roots); net ecosystem carbon balance

3-9%

This is measured by flux towers (**NEE**)

- **Net Biom Production (NBP):** NEP minus disturbance (fire, storm, harvesting...)

<1%

remaining stock for perennial ecosystems

EO



Courtesy: Lars Eklundh, Lund University, SE; modified with IPCC, 2001

Where we are going in Europe?

- ✓ Ecosystem extent – spatial delineation of ecosystems and habitats
 - quantitative, operational and improving
 - land cover monitoring revision (2022 onwards), improving delineation of habitats
(Copernicus land services)
- ✓ Ecosystem condition
 - qualitative, operational and improving e.g. phenology, drought stress
 - more work on characterisation of vegetation (land use, forest stocks)
 - Knowledge transfer and co-creation for parameterisation of productivity assessments
(beyond NPP)
- ✓ Ecosystem extent and condition change
 - Sentinel time series upcoming, more systematic use of existing data (Landsat)

**Thank you very much for
your attention**



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