# Spatial aspects of ecosystem services supply and use

- **Ecosystem services** (ES) are the contributions of ecosystems to benefits used in economic and other human activity.

- All ES are treated as being **supplied by ecosystems**, either individually (e.g. a forest providing air filtration services to a neighbouring town) or in combination (e.g. ecosystems within a catchment providing water regulation services).

  [after UN SEEA EEA (2020) Draft Document for Global Consultation; Chapter 6]

- Thus, **all** ES are supplied and used by/in ecosystems, therefore all of them are **spatial phenomena**

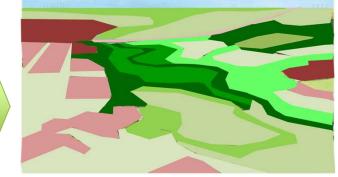# Spatial aspects of ecosystem services supply and use

- Mapping and analysing **related patterns** helps to understand ES supply and use, to identify relevant areas, hot and cold spots as well as ES supply-use mismatches

- **Modelling and mapping** ES supply and use provides an operational tool for ecosystem accounting and for ES-based policy and decision making, conservation and land use planning

# Spatial aspects of ecosystem services supply and use

## Challenges for spatial modelling of ecosystem services for biophysical accounts

- Provide information about ES supply and use patterns

- Be spatially and temporally explicit

- Be robust, consistent, transparent and logical

- Harness and integrate information of different quality and quantity, resulting from various quantification approaches

- Be understandable for a broader, transdisciplinary audience

- Be policy-/decision-making problem-relevant



https://recreation.ucsd.edu/adventures/challenge-course

# Spatial aspects of ecosystem services supply and use

## Ecosystem services supply

- In most cases, but particularly for regulating services, certain **factors determine supply**
- Both **ecological** and **human factors** should be considered in describing those factors
- Where there are cases of **joint production** of benefits (e.g. in agriculture), it will be relevant to consider human inputs (e.g. energy, water, fertilisers, machines, labour)

## Ecosystem services use

- In addition to describing the factors involved in ES supply, it is relevant to describe **how and where** people and economic units are engaged with the ecosystem in order to use the ES.
- In many cases, relevant factors concerning use are the **number of people** in proximity to the relevant type of ecosystem supplying the service to be used.

[after UN SEEA EEA (2020); Chapter 6]

# Spatial aspects of ecosystem services supply and use

Ecosystem services are supplied and used on **various scales:**

- **Spatial scales:** i.e. local, regional, national, continental, global
- **temporal scales:** 'moment', hourly, daily, monthly, annualy, decades, centuries

**Selection of appropriate scales** is important when modelling ES:

- Ecological processes occur at different spatial and temporal scales
- Resulting ES are thus supplied (and often also used) at different times and spaces
- Thus, they require different quantification approaches and are measured for different spatial units
- Results vary across scale and spatial units, which need to be harmonised and brought together for accounting and decision making purposes
- Such harmonisation may introduce uncertainties

# Spatial aspects of ecosystem services supply and use

## Ecosystem services stocks and flows

- ES are realised when humans benefit from them, **when and where supply meets use** and ES "flow"

- **Flows** can be **dynamic** over space and time and are therefore rather difficult to capture

- **Stocks** exhibit **less dynamics** and are therefore (relatively) easier to map



James T. Harwood (1890) *Harvest Time in France*

# Spatial aspects of ecosystem services supply and use

- Ecosystem services are supplied in **Service Providing Areas** (SPAs; sometimes referred to as Service Providing Units SPUs or [in accounting] *ecosystem assets*)

- Ecosystem services are used in **Service Benefiting Areas** (SBAs)

- SPAs and SBAs can be linked by **Service Connecting Areas (SCAs)**

SPA

SBA
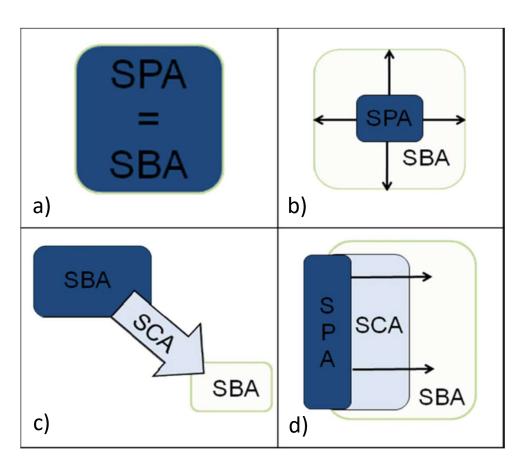
SCA

# Spatial aspects of ecosystem services supply and use

**Ecosystem assets:**

- Contiguous spaces of a specific ecosystem type (e.g. a forest or a wetland)

- Each ecosystem asset supplies a set or bundle of ES

- ES are recorded as flows between ecosystem assets and economic units

- Economic units encompass various institutional types included in the national accounts, such as businesses, governments and households.

- Where relevant for description and measurement purposes, it may be useful to highlight particular ecological characteristics of the ecosystems that are relevant to ES supply (e.g. presence of particular species, soil type).

[after UN SEEA EEA (2020); Chapter 6]

# Spatial aspects of ecosystem services supply and use



**Spatial relationships** between:
- Service Providing Areas (SPA) (or 'SPU' or 'ecosystem assets')
- Service Benefiting (use) Areas (SBA)
- Service Connecting Areas (SCA)

a) *in situ*
b) omnidirectional
c) directional with slope dependence
d) directional

(from Syrbe & Walz 2012)

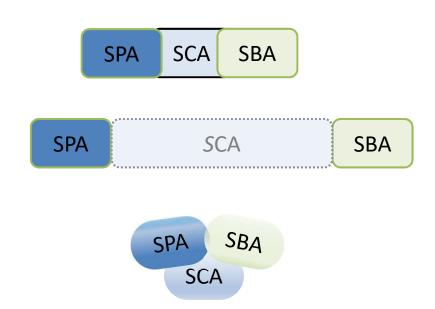# Spatial aspects of ecosystem services supply and use

Typical **supply-use patterns** of the different ES categories:

- Regulating services: SPA and SBA often physically connected (via a SCA)

- Provisioning services: most of them can be traded, thus SPA and SBA often spatially decoupled

- Cultural services: often more complex SPA – SBA relations, due to the intangible, often cognitive nature of cultural ES benefits

# Spatial aspects of ecosystem services supply and use

Examples of SPAs, SBAs and SCAs on different spatial scales

| Ecosystem service | Spatial scale | SPA | SBA | SCA |
|---|---|---|---|---|
| Timber | Local | Tree | Household | Transport path |
| Timber | Regional | Forest | Village | Transport path |
| Flood protection | Regional | Watershed | Village | Water (non) flow paths |
| Pollination | Regional | Pollinator habitats | Plants in need of pollination | Pollinator flight ranges |
| Air filtration | Local/regional | Trees | Village | Clean air flow paths |
| Landscape asthethics | Local | Mountain | View point | Viewshed |

# Spatial aspects of ecosystem services supply and use

**Methods to map and assess spatial aspects of ecosystem services**

- **Broad range of methods is available**, based on long-term experience from ecological, social-cultural and environmental-economic sciences

- Usually, in order to assess multiple services, **various approaches are applied**, combined and the strength of each method can thus be harnessed (respective selection methods and data bases will be demonstrated in the second part of the webinar)

- Methods range from comparably **simple methods** ('tier 1' - e.g. using land cover data as proxies for ecosystem services supply and use; value-transfer methods) to **more complex** indicator-based approaches ('tier 2') and **complex process-based models** ('tier 3' - see following presentation)

# Spatial aspects of ecosystem services supply and use

**Spatial modelling applicable for ecosystem services biophysical accounts, but also other core and thematic accounts**

Core accounts

- Ecosystem extent ✅
- Ecosystem condition ✅
- Ecosystem services supply and use ✅
- Monetary ecosystem assets ❌

Thematic accounts

- Land, water, carbon and biodiversity ✅

# Thanks a lot for your attention!

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*Mapping & Assessment for Integrated ecosystem Accounting*
*http://maiaportal.eu/*