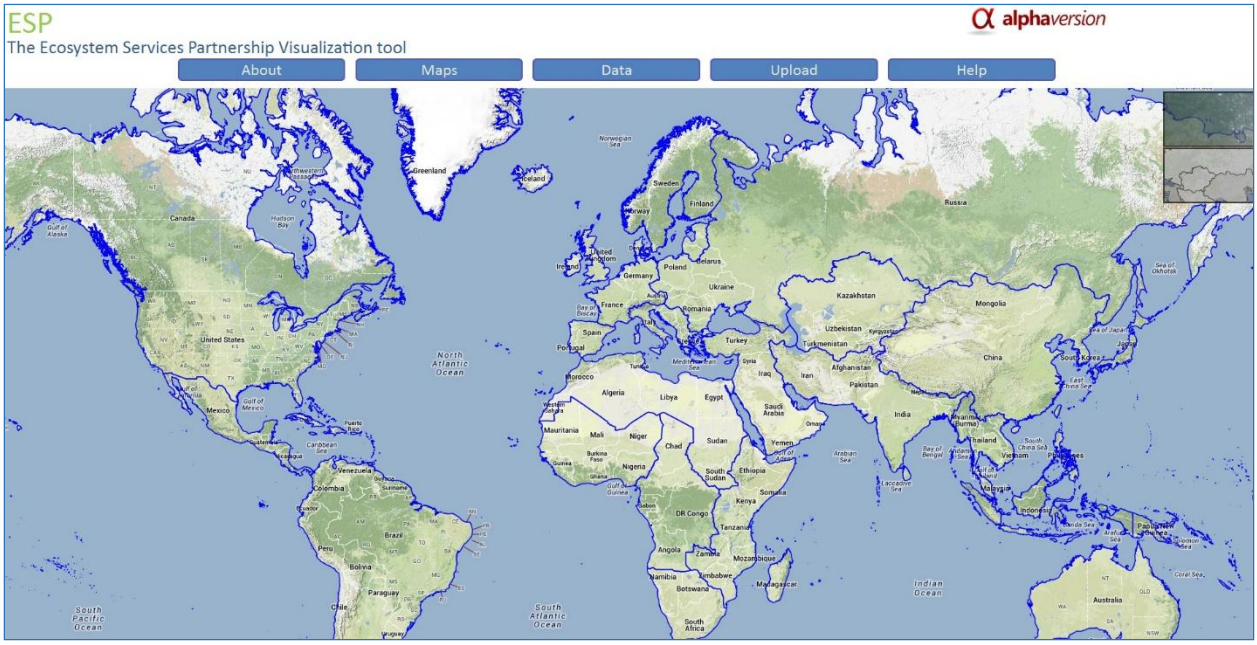
# ESP Visualization Tool




## Technical Guide v.4

Authors: Evangelia G. Drakou, William H. Temperley, Bart Verbeeck, Louise Willemen, Benjamin Burkhard, Neville Crossman, Ignacio Palomo, Joachim Maes, Rob Alkemade, Stoyan Nedkov

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# ESP Visualisation Tool Technical Guide

## Background of the tool

Ecosystem services (ES) are the benefits that humans derive from nature. Human survival and well-being depend on these services, and therefore on the conservation and the best management of ecosystems that provide them. Ecosystem services link ecological with sociological data, assess the interactions among them and are used to inform policy and decision-making by standing on the science-policy interface (Maes et al., 2012; Martínez-Harms & Balvanera, 2012; Sutherland et al., 2012). They can be assessed through simple or more complex models and indicators (Egoh et al., 2012; Müller & Burkhard, 2012), which are the basis for map generation. The great variety of existing approaches, leads to a variety in methods and models used, classification systems and terminologies (Boyd & Banzhaf, 2006; Wallace, 2007; Hauck et al., 2012). This variety calls for a system that gathers all the existing information on indicators used to map ecosystem services, and facilitates the communication and data sharing among the different parties involved. To address these needs, we constructed a blueprint for modeling and mapping ecosystem services (Crossman et al., 2013) which in collaboration with the Thematic Working Groups (TWG) on Mapping and Modelling ES (TWG 4 and 5) of the Ecosystem Service Partnership (ESP), are being used as a basis to develop the ESP Visualization Tool.

## Goals of the tool

The goal of the tool is to provide the user with a catalogue of information on existing ecosystem service mapping and modelling assessments. The tool gathers and shares information on ecosystem service maps and relevant metadata, from indicators chosen, models used to primary data.

## Objectives of the tool

There is already a broad range of systems available online that distribute information on ecosystem services which are either generic, such as the ES Indicator database by the World Resources Institute (WRI)[2], or more focused on specific biomes and services, such as the the Blue Carbon Initiative[3] or the BioCarbon Tracker[4] and many more. This tool's nature is more generic, as it gives the chance to the users to access ecosystem service maps directly or indirectly (access to other web sites, email etc). It also gives the users the possibility to search in the available data while allowing for information sharing through the system. The ESP Visualization tool (ESPVT) has two main components:

1. ES Map Documentation Database. The database consists of various fields describing the ES map metadata (based on the ES Blueprint by Crossman et al., 2013). Users can make their map

[2] http://www.esindicators.org/indicators_overview

[3] http://bluecarbonportal.org/

[4] http://tracker.biocarbontracker.com/interface/#

available through the website. When this is not possible due to copyright issues, a link to the location where this map is available is being provided.

2. ES Maps. The web interface consists of a global map depicting the density of ES assessments per region. Based on selection criteria the user can search, visualize, download and give feedback on the map. In cases where the map is available elsewhere, the user will be redirected to the corresponding website.

## Key definitions

**Ecosystem services (ES):** contributions of ecosystem structure and function—in combination with other inputs—to human well-being (Burkhard et al., 2012). The classification of ES used is currently the TEEB classification, but this is subject to future change/adjustments.
**Ecosystem Service Indicator**: a measure that serves to indicate or give a suggestion of something of interest and is derived from simple or more complicated measures (TEEB, 2010; Egoh et al., 2012b). The indicator attribute asks for a short name or description of the main indicator used to map the ecosystem service, such as surface water extraction (water), timber production (raw materials), carbon sequestration (climate regulation), soil organic carbon (maintenance of soil fertility), or overnight visitors (tourism) (Crossman et al., 2013).

**Ecosystem processes:** changes or reactions occurring in ecosystems; either physical, chemical or biological; including decomposition, production, nutrient cycling and fluxes of nutrients and energy (Millennium Ecosystem Assessment, 2005).

**Ecosystem structures**: biophysical architecture of ecosystems; species composition making up the architecture may vary (TEEB, 2010).

**Ecosystem functions**: intermediate between ecosystem processes and services and can be defined as the capacity of ecosystems to provide goods and services that satisfy human needs, directly and indirectly (de Groot et al., 2010).

**Ecosystem Service supply**: refers to the capacity of a particular area to provide a specific bundle of ecosystem goods and services within a given time period (Burkhard et al., 2012b). Depends on different sets of landscape properties that influence the level of service supply (Willemen et al., 2012).

**Ecosystem Service demand**: is the sum of all ecosystem goods and services currently consumed or used in a particular area over a given time period (Burkhard et al., 2012a).

## Tool Description

1. The interface is a global map classified by regions (GAUL 2008 classification), each of which is coloured based on the number of available ES maps in the database. Each time new data is entered to the database the global map is being populated accordingly.

2. The "About" button is clicked and basic info on the tool is shown.

3. The functions of the tool are; A. Data view/selection B. Map view and C. Data upload.

***A. Data view/selection***

1. On the Data tab, select **Filter** and a list of the four filters shows up;

a. ***Ecosystem Services***. Select either an entire ES category or select one or more ES. The names and ES classification followed is currently based on the TEEB classification (TEEB, 2010).

b. ***Biomes***. Select among a broader or more specific category of ecosystems/biomes for which ES have been mapped. The classification followed is based on the ESP Biome working groups.

c. ***Spatial Scale***. Select among the different spatial scales from local to global, for which ES have been mapped.

d. ***Study purpose***. Filter the ES, based on the purpose of the study, for instance mapping for conservation purposes or economic valuation. The classification followed is based on that adopted by Egoh et al., 2012.

2. Select **Data**. The search results are depicted in a list. For each entry in the list the user can see the ES Indicator that has been mapped, the location for which it has been assessed, the name of the corresponding study, the year the study was carried out and the study purpose.

3. Click on the **Study name** to view the study metadata table.

4. For each ES map, the user can focus on:

a. The *Data*. Select one or more entries (each entry corresponding to an ES indicator and map). Click on 

. An .html opens in a new tab, showing all the indicators' metadata (based on the blueprint structure). By clicking on 

, the user can download all the search results in a .csv format.

b. The *Map*. Select one entry and then click on  to view the corresponding map, or click on 

or 

to download the maps on a Shapefile or GeoTiff format accordingly.

***B. Maps***

1. The ES Indicator mapping density per region is visualized at the global map.

2. Select one or more maps from the data filtering option and view them in the global map interface.

3. When viewing the map, on the right side of the screen select the background layer you want, view the map title and legend and change the map opacity. Keep in mind that you can only view one map at a time.

4. Close the map by closing the legend window.

***C. Data Upload***

1. Login through an active Google, Yahoo, myOpenIs or Stack Exchange account.

2. Two types of data are entered at this stage. The study metadata and the ES indicator metadata.

3. Enter information on the study metadata such as name and location of the study, references, funding source, project type and names and contact details of the main investigators. Remember to save your entries.

4. Add to each study the ES indicators that have been used/generated as well as the relevant metadata.

5. For each indicator upload information on Ecosystem services accounting definitions, units, data sources and methods use, spatial and temporal scale of assessment, as well as a self-evaluation on the success of the project.

6. In this section upload your map. The map can be either a zipped shapefile or a geotiff and the maximum size of it can be 150 MB.

***D. Give us your feedback function.***

This is the alpha version of the tool, so we need your feedback on the site functionality and contents.

You can either send an email to esp-mapping@jrc.ec.europa.eu or fill in our online questionnaire.

## Data standards

***ES Indicator Units***

- Qualitative (Score, Ranking)

- Quantitative
    - Monetary (EUR, USD, GBP, $/yr, $/ha/yr, etc.)
    - Area ($km^2$, ha, etc)
    - Time (1/yr, days, etc)
    - Counts (#species, visitors/yr, kills/$m^2$, etc)
    - Density (vol/ $m^3$, gr/$m^2$, MgC/ha/year, etc)
    - Energy (Kcal/person/yr, etc)
    - Others

***B. Biomes*** (base on ESP Biome expert groups division)

| | |
|---|---|
| **1. Marine & coastal systems (general)** | 1A. Open oceans |
| | 1B. Coral reefs |
| | 1C. Coastal systems |
| | 1D. Coastal wetlands |
| **2. Freshwater systems** | 2A. Inland wetlands |
| | 2B. Rivers & lakes |
| **3. Forests** | 3A. Tropical forests |
| | 3B. Temperate & boreal forests |
| **4. Drylands** | 4A. Wood- & Shrublands |
| | 4B. Grasslands |
| **5. Mediterranean-Climate Ecosystems** | |
| **6. Polar regions & high mountains** | |
| **7. Rural/cultivated systems** | |
| **8. Urban ecosystems** | |
| **9. Others** | |

***C. Spatial Scale***

- Local
- Sub-National
- National

- Supra-National
- Continental
- Global

***D. Study Purpose***

The classification followed here is based on that adopted by Egoh et al. (2012):

- Ecosystem Service Valuation
- Ecosystem Service Quantification
- Congruence
- Trade-offs
- Scenario impact assessment
- Prioritization of intervention areas
- Cost-benefit analysis

## Database structure

The database of the tool follows the blueprint structure (Crossman et al., 2013) with some adjustments for the better functionality of the tool. Below, an outline of the database structure.

A short discussion of the proposed database structure based on the ESP blueprint is presented here. Please refer to figure 1 for a schematic overview of the structure.

***Ecosystem Service***

This table acts as the reference table for all ES, regardless of classification, which is indicated by a reference to a classification system. The single table approach simplifies the database structure whilst allowing for the accommodation of additional classification systems.

An ES record also references an ES category in figure 1.

***Ecosystem Service Indicator***

One record in this table would be equivalent to one row in the Blueprint spreadsheet – i.e. a mapped ES and associated metadata.

The spatial components of the indicator are in a separate table, for the following reasons:

- Supporting multiple instantiations of an indicator in time without duplication of the entire indicator record. The map would still be associated with the specific indicator.

- Support the possibility that authors have provided uncertainty surfaces

- Although an implementation detail, it may be a cleaner method of supporting multiple map types through table inheritance.

*The possibility of using the Extensible Observation Ontology (OBOE) to model an ES indicator was discussed, however this is a complex schema and would require a re-engineering of the Blueprint data model.*

***Indicator***

This is kept as free-text for now. The possibility of utilizing references from the Environment Ontology to environmental phenomena could be explored.

***ES indicator quantification unit***

The current status in Blueprint is:

**Quantity** (e.g. kg)

**Area** (e.g. ha or watershed)

**Time** (e.g. year)

The predefined fields are retrieved from the reviews carried out by Egoh et al. (2012) and Crossman et al. (2013).

***ES map spatial resolution (i.e. pixel size, minimal mapping unit [point, line, polygon])***

This information is kept alongside actual spatial data. The data type and pixel size are implicit in the data, however the minimum mapping unit is recorded.

***Data source (model output, measured/primary, aggregated statistics)***

As classified in the Egoh et al 2012 review.

***Quantification method (process, empirical, participatory + name of model)***

Free text.

***Mapped year or period***

Start year and end year.

Some studies include multiple time periods. To support this whilst preventing duplication of the entire indicator record, an indicator is modelled as having multiple instantiations in time - i.e. multiple maps per indicator.

***Study objective met***

This simply references a table of agreement levels (1-5) from Strongly Agree to Strongly Disagree.

***Biome***

See section B in paragraph on Data standards.

***Indicator surface***

Spatial data in a zipped shapefile format or a Geotiff is stored here.

***Study***

One study is being referenced by multiple ES indicators.

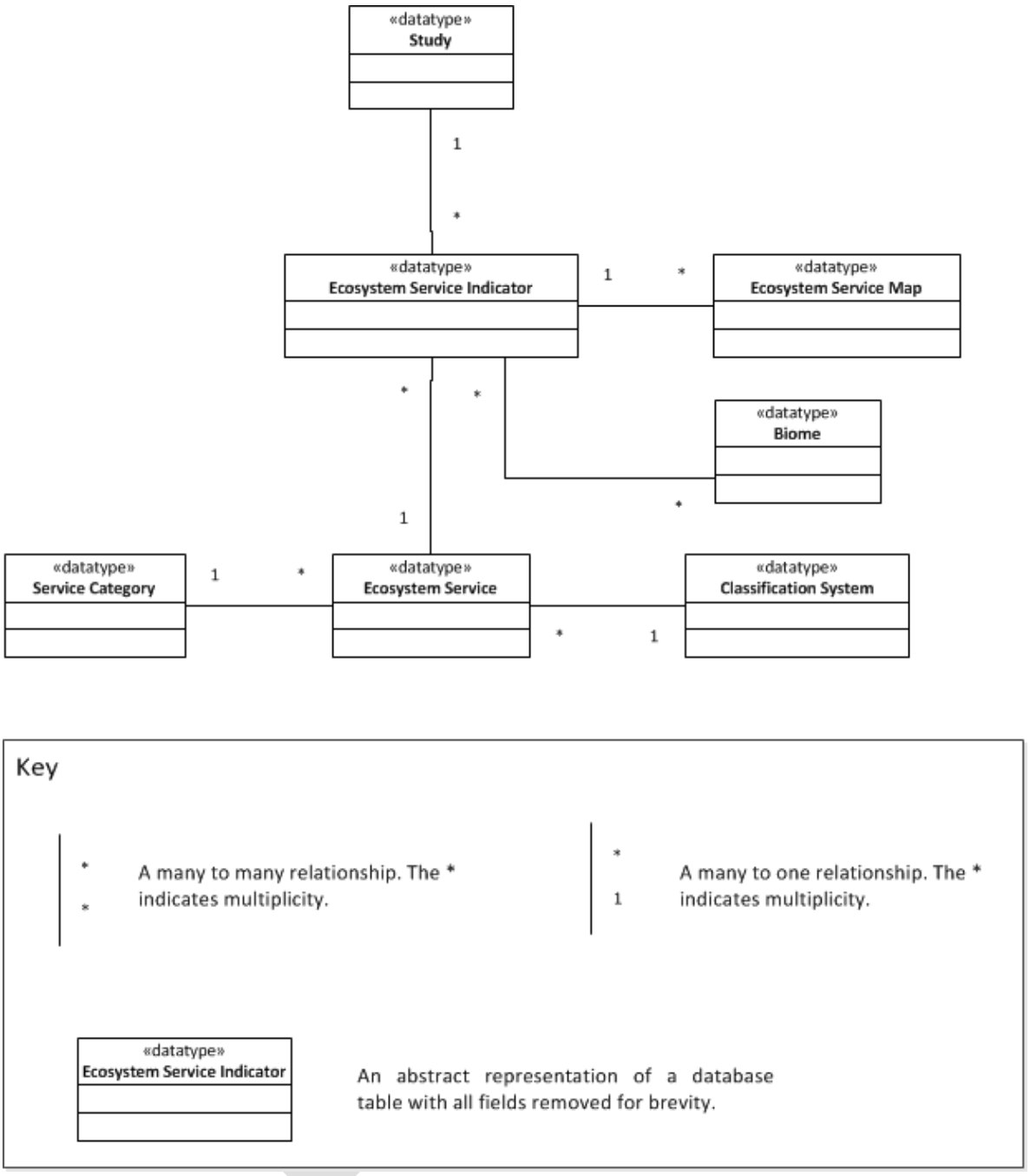


**Figure 1. Simplified database structure**

## Database example

| **Mapped ecosystem service** | | | **Indicator** | **ES indicator quantification unit** | | | **Data source** (model output, measured/primary, aggregated statistics) | **Quantification method** (process, empirical, participatory + name of model) | **Spatial extent ES map** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Supply of ES / Demand for ES** | | **Quantity** (e.g. kg) | **Area** (e.g. ha or watershed) | **Time** (e.g. year) | | | (global, national, regional, local) | (size) |
| **Provisioning services** | Timber | Supply | Timber standing stock | m3/ha | Regions | | Forest inventory | national reporting | continental | 4215100 km2 |
| | Timber | Supply | Timber annual growth rate | m3/ha/year | Regions | year | Forest inventory | national reporting | continental | 4215100 km2 |
| | Crops | Supply | Share of cropland | % | ha | | CORINE Land cover | Remote sensing | continental | 4215100 km2 |
| | Livestock | Supply | density of livestock | number km-2 | land pixels | | FAO gridded livestock | National statistics combined with land cover data | continental | 4215100 km2 |
| | Freshwater provision | Supply | surface water flow | mm/year | watershed | year | data of precipitation, vegetation and soil properties | model | continental | 4215100 km2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Freshwater provision | Supply | Share of freshwater bodies | % | ha | | CORINE Land cover | Remote sensing | continental | 4215100 km2 |
| **Regulating services** | Water regulation | Supply | Infiltration | mm | watershed | | data of precipitation, vegetation and soil properties | model | continental | 4215100 km2 |
| | Water regulation | Supply | Subsurface water flow | mm/year | watershed | year | data of precipitation, vegetation and soil properties | model | continental | 4215100 km2 |
| | Water purification | Supply | Nitrogen retention | % | watershed | | model based on nitrogen inputs and nitrogen concentrations | model GREEN | continental | 4215100 km2 |
| | Water purification | Supply | Nitrogen removal | ton/year | watershed | year | model based on nitrogen inputs and nitrogen concentrations | model GREEN | continental | 4215100 km2 |
| | Climate regulation | Supply | Carbon stock | ton/ha | ha | | based on look up tables of carbon stock per land cover type | | continental | 4215100 km2 |
| | Climate regulation | Supply | Carbon sequestration | ton/ha/year | ha | year | Normalized Difference Vegetation Index | model and remote sensing | continental | 4215100 km2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Storm protection | Supply | Share of coastal habitats | % | ha | | CORINE Land cover | Remote sensing | continental | 4215100 km2 |

## Other related tools

| Tool | Description | Link to ESP visualization tool | Availability | Released by… |
|---|---|---|---|---|
| **Digital Observatory for Protected Areas** | DOPA is a set of distributed databases combined with open, interoperable web services that provides end-users with means to assess, monitor and forecast the state and pressure of protected areas at the global scale | The mapping services used for DOPA will be fed by ESP web client as regards to the ES component and vice versa. Currently only the Carbon Calculator is available online. | Online | JRC |
| **ACP (Africa Caribbean Pacific) Observatory** | ACP Observatory provides access to information on themes related to sustainable development in the ACP region | The mapping services used for DOPA will be fed by ESP web client as regards to the ES component and vice versa. Currently only the Carbon Calculator is available online. | Online | JRC |
| **IPBES Catalogue of Assessments** | Development of a "Catalogue of Assessments on Biodiversity and Ecosystem Services" was called for by the meeting which established the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES). The primary intention was to learn lessons from existing and ongoing assessment processes so as to inform the future development of IPBES, and a critical review of assessments to be delivered to the first IPBES Plenary will draw heavily on the catalogue | The IPBES has been developing this database in order to help countries report on their ES and Biodiversity assessments. The project is new, thus the structure/ functions/ use of the tool have not been finalized yet. | Online but the database is incomplete | UNEP-WCMC |
| **Ecosystem Service Valuation Database** | An online system that provides information on ES valuations that have been | The system can be linked to ESP web client through | DEMO available online | ESP |

| | | | | |
|---|---|---|---|---|
| | done globally, but also gives the user the chance to upload data | redirected links. The regions for which this system has assessments, will be marked on the global map by a specific sign. | | |
| **Marine Ecosystem Service Valuation Database** | Same as above just specialized to the marine environment. Only economic values given and the rest of info are not very detailed | The system can be linked to ESP web client through redirected links. The regions for which this system has assessments, will be marked on the global map by a specific sign | Online | ESP-<br><br>Duke University |
| **Blue Carbon Portal** | A geographic overview about global blue carbon activities | The system can be linked to ESP web client through redirected links. The regions for which this system has assessments, will be marked on the global map by a specific sign | Online | UNEP-WCMC |
| **The South East Queensland (SEQ) framework** | The main aim of the Project is to develop an 'agreed' framework for assessing the ES derived from the SEQ region and to incorporate this information into natural resource management, policy and planning | They have developed an ecosystem reporting tool, which can give feedback to ours and vice versa | Online | The SEQ Ecosystem Services Project Team: Simone Maynard; Andrew Davidson; David James; Shannon Mooney; Mik Petter; Darren McPherson; and Melissa Walker. |

## Who is it for?

The tool is a platform for information exchange on ecosystem service maps and indicators, from data, models and methodologies used, to the specific purpose these serve. The target audience are researchers,

students and ecosystem services practitioners. The data is also available to the general public. The goal of the tool is to serve as a guide for people who wish to map ecosystem services and allow for an exchange of ideas on methodologies and data used. It is also a tool for gap analysis, allowing researchers to map what has been already done, how and where. That way duplication of work can be avoided and mapping of the ongoing research can be made feasible. Also, the possibility given to the users to comment on the available information, is a way to validate the maps that have already been uploaded and use the tool as a platform that allows for discussions among the ES practitioners.

## What the tool is not for

This is not a mapping tool by itself, i.e. it does not provide the users with tools to map ecosystem services. It stores information and links to data and models which can be shared and used for mapping.

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