Developing a Shared Spatial Data Platform for Ecosystem Accounting in the EU

Paper submitted to the SEEA-EEA Expert Forum, New York, 18 – 20 June 2018

FINAL DRAFT

Authors: Jan-Erik Petersen, EEA & Steven King, WCMC

Introduction

This paper provides a summary of the steps taken to produce a technical proposal for developing a shared spatial data platform for a regular EU ecosystem accounting system. This activity is part of the EU project for an integrated system for natural capital and ecosystem services accounting (KIP INCA). The KIP INCA partners comprise EUROSTAT, the European Commission's Directorate-Generals for Environment (DG ENV) and Research and innovation (DG RTD), European Environment Agency (EEA) and the EU Joint Research Centre (JRC). KIP INCA also links with Member State activities and the EU Mapping and Assessment of Ecosystem Services (MAES) initiative. [1]

The paper is structured into four sections:

1) Summary of technical advice provided in the SEEA-EEA Technical Recommendations
2) EU data and system context
3) KIP INCA objectives and steps taken to develop the technical proposal
4) Outlook on next steps in developing the foreseen spatial data platform

[1] Further details and publications associated with KIP-INCA are available at: http://ec.europa.eu/environment/nature/capital_accounting/

1) Key tenets from the SEEA-EEA Technical Recommendations

Ecosystem accounting is predicated on the integration of different information on ecosystems and the economy. As set out in the SEEA-EEA TR (Section 3.6), the conceptual units for such integration comprise of spatially delineated contiguous areas of the same ecosystem type (Ecosystem Assets). As such, the calculation of ecosystem accounts using the SEEA-EEA framework will be dependent on the availability of geospatial data that accurately describes the distribution and condition of ecosystems, as well the services they provide they supply and the beneficiaries that use them. Whilst the SEEA-TR sets out a **spectrum of minimum to fully spatial approaches**, it also acknowledges that the range of policy applications are greater when a fully spatial approach is implemented. However, this 'fully spatial' approach also requires **geospatial data at sufficient spatial resolution to capture the key ecosystem features of policy interest in a harmonised and fully compatible format**. This raises challenges of data quality and aggregation that must be overcome if the full potential of the SEEA-EEA for understanding interactions between ecosystems, the economy and society is to be realised.

In this regard, the SEEA-TR highlights the role of **national spatial data infrastructures (NDSIs)** for integrating the information underlying ecosystem accounts as part of a co-ordinated spatial data system. A theme within the SEEA-TR is that work to establish the spatial areas required for ecosystem accounting should be undertaken within a broader context of work, already completed or planned, to establish such a NSDI. As a wide range of policy and management insights are possible by establishing such systems for integrated geo-spatial analysis of the environment, economy and society, NSDIs are likely to have been considered by a number of government agencies. (Para 3.67) Therefore, as the SEEA-TR suggests, the starting point for using an NSDI for ecosystem accounting should be creating an **inventory of what spatial data infrastructure** already exists, in particular within government agencies such as spatial planning or environmental agencies. (Para 3.68).

As data sharing and capacity are also often key bottlenecks, the SEEA EEA TR further recommends that establishing **data sharing arrangements** should be a first priority in the development of an NSDI. This should consider the data formats used by the various agencies and to assess if similar formats and coordinate systems can be aligned within an NSDI (Para 3.76). Furthermore, achieving a quality assured spatial data infrastructure that can readily integrate updated information sources also requires **establishing data reporting procedures across multiple institutions responsible for maintaining various geospatial data**.

In order to resonate best with practitioners interested in applying the SEEA EEA, the summary of the approach to developing the proposal for a European spatial data platform discusses as much as possible the main steps discussed in Section 3.6 of the SEEA EEA (see bold text above). We group this discussion under three main issues in the following section:

a) Inventory of (national) spatial data infrastructures

b) Data sharing arrangements and data reporting procedures across multiple institutions

c) (Harmonised) geospatial data at sufficient spatial resolution

The points a) to c) provide a useful structure for discussion although the EU approach comprises additional aspects - see section 3 below. It is hoped that this paper can be helpful input to the development of data system infrastructures in many regional, national and subnational contexts for ecosystem accounting, as well as a wide range of other analytical uses.

2) EU data and system context

a) Inventory of spatial data infrastructure

There is a variety of organisations and instruments at EU-level that play a role in its 'spatial data infrastructure' – if one gives a wide interpretation to the term 'infrastructure'. These have been established for various analytical and reporting purposes without being designed to support ecosystem accounting. Nevertheless, they provide the EU with important elements that can support the development of a fully spatial approach to ecosystem accounting.

Eurostat is responsible for the Spatial Data Infrastructure of the Commission and operates the geospatial reference database of the Commission, the GISCO database. All Eurostat and in fact Commission geospatial resources can be searched via the Commission Internal GeoPortal https://webgate.ec.europa.eu/inspire-sdi/srv/eng/catalog.search#/home. Eurostat's catalogue is connected with the catalogues of the JRC (https://data.jrc.ec.europa.eu/) and the European Environment Agency (https://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search#/home. This means that users browsing those catalogues are enabled to detect all Commission resources.

An important part of the (spatial) data infrastructure are also the EU 'Environmental data centres' at EEA, Eurostat and JRC that are focal points for certain types of environmental information, such as the soil data centre at the JRC or the water data centre at the EEA. The EU has also developed standards that help to make the format of (spatial) data more uniform and compatible, e.g. via the INSPIRE directive in 2007 that established the framework for an EU Infrastructure for Spatial InfoRmation in Europe, by setting standards for relevant, harmonised and quality geographic information[2].

b) Data sharing arrangements and data reporting procedures across multiple institutions

A key feature for establishing a spatial data infrastructure is a set of analytical units for organising and integrating spatial data, termed basic spatial units in the SEEA EEA. In this regard, the use of standard grids has been recognised as key point for the integration of different sources of data. This approach has been tested by the EEA in early ecosystem accounting activities and is utilised for geospatial databases in the EU generally.

All geospatial data in the GISCO database of Eurostat are available in the projections based on the ETRS89 Coordinate Reference System which enables efficient integration of spatial data. Eurostat supports the statistical grid as defined in INSPIRE[3] under the Theme Statistical Units i.e. in ETRS89-LAEA projection. Currently the default grid cell size for European statistics is 1km but smaller or larger grid cells may became available in the future and for other statistics than census statistics. Eurostat will ensure that all statistical grids used for European Statistics are hierarchical.

By attributing information to these grid cells, integrated analysis can be readily undertaken using multiple datasets and data can readily aggregated to provide accounts for different reporting units (or individual Ecosystem Assets or Ecosystem Accounting Areas in SEEA EEA parlance). As an example, in order to support the EEA Land and Ecosystem Accounting (LEAC) approach[4], a 1km x 1km European

[2] Further information on INSPIRE is provided in the following EEA briefing note: https://www.eea.europa.eu/about-us/what/seis-initiatives/inspire-briefing

[3] Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services (OJ L 323, 8.12.2010, p. 11).

[4] More information on the LEAC is available from the EEA website: https://www.eea.europa.eu/data-and-maps/data/land-cover-accounts-leac-based-on-corine-land-cover-changes-database-1990-2000

grid was created to provide the basic spatial units required for implementing a fully spatial approach for ecosystem accounting.

EEA runs a project called Integrated Data Platform (IDP), which is an example of a shared data architecture to enable analytical cooperation between EEA staff and the EEA's Topic Centres. The project supports the integrated analysis and assessment of geospatial data. It ensures populating EEA's spatial data catalogue ('SDI') with harmonized, quality controlled and quality assured spatial data, and offers advanced options (semantic inventory and network analysis) for querying and understanding the datasets. The metadata of these datasets can be queried in the SDI metadata catalogue. Additionally, the EEA is developing the 'JEDI' tool set (Joint Environmental Data Infrastructure), a web-based system. This performs spatial data integration and conversion into a tabular format ready for computing statistics (using the Tableau software environment).

Further relevant initiatives include the European Commission's Joint Research Centre's Metadata Catalogue[5] and the EU Committee for Geographical Information. All the above provide very useful building blocks to support a fully spatial approach to ecosystem accounting but they do not automatically enable an efficient integration of data for ecosystem accounting. Hence reflections are ongoing whether targeted system connections need to be built for a (virtual) spatial data platform for the EU KIP INCA project.

c) (Harmonised) geospatial data at sufficient spatial resolution

While Europe is comparatively data-rich it needs to be acknowledged that existing statistical data collection systems or environmental monitoring were not designed for monitoring ecosystem trends for example ecosystem extent or condition. And where ecosystem-related variables are being collected the spatial referencing of existing reporting systems, e.g. under the Birds Directive, is generally only sufficient for reporting on national level trends in many cases.

Figure 1 illustrates the need to bring different types of data together in one common spatial frame, ranging from biodiversity monitoring data to agricultural statistics and land cover data.

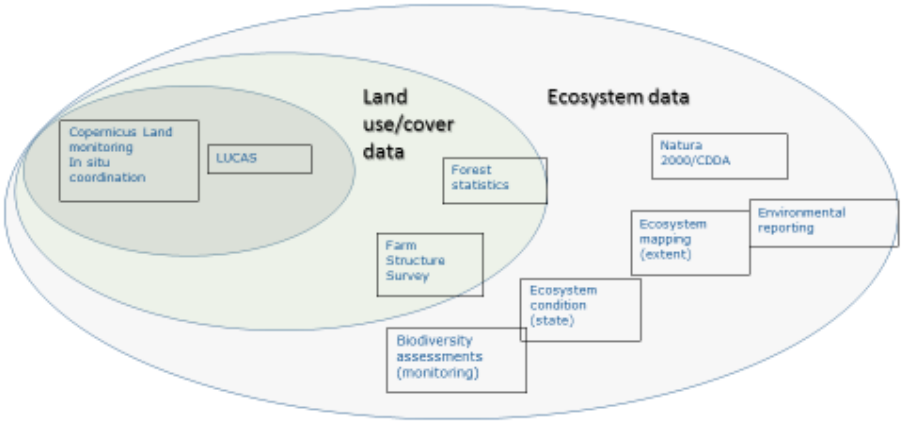


Figure 1: Data types relevant for ecosystem accounting in EU

[5] https://ec.europa.eu/jrc/communities/community/eovalue/useful-link/geoportal

A key aspect of the implementation of the EU activities on natural capital accounting is therefore a focus on improving the usefulness of existing source data and extending the source data available. Some efforts are already ongoing, for example in revising the EU LUCAS land use survey or in the implementation of the EU Copernicus programme on earth observation, but an area that needs substantial further investment is the development of in-situ biodiversity monitoring programmes that are designed for a good spatial referencing of the source data.

Overall it can be said that a lot of elements exist in Europe that help to underpin the 'spatial data infrastructure' required for ecosystem accounting. However, none of these, nor the underpinning data collection regimes, were designed for ecosystem accounting, and the SEEA EEA framework potentially requires more effective exchange and standardisation than is currently feasible at European level. This is precisely one of the reasons why the EU KIP INCA project was set up and why the technical development of a (virtual) spatial data platform for regular ecosystem accounting is a central task within the KIP INCA frame.

3) KIP INCA objectives and steps taken to develop the technical proposal

A first step in establishing a spatial data infrastructure for ecosystem accounting should be to agree and define its objectives and priorities (Step 1, Figure 3.2, SEEA EEA TR). These need to be derived from the overall objectives of the KIP INCA project. The 'integrated system for natural capital and ecosystem services accounting' that KIP INCA aims to establish comprises all key components of SEEA EEA, i.e. accounts for ecosystem extent and condition, ecosystem service accounts as well as monetary accounts. These cover a wide range of bio-physical and economic data that need to be analysed in a coherent spatial frame. Figure 2 broadly sets out how the overall requirements can be broken down into individual components:

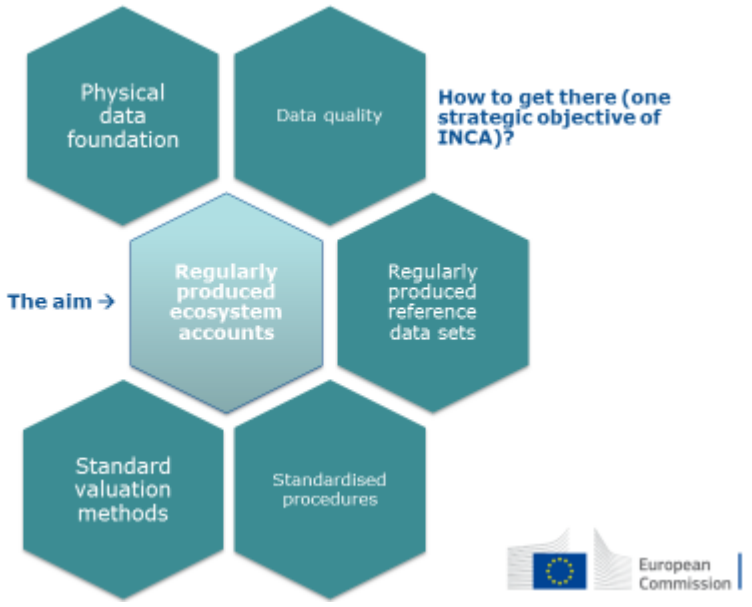


Figure 2: Requirements for a regular production of ecosystem accounts in the EU

On the basis of the overall project objectives the KIP INCA partners have discussed which key functionalities a shared spatial data infrastructure ('shared data platform' in INCA parlance) should

have and to what degree these functionalities are already delivered by existing systems. The current set of objectives agreed for the KIP INCA (virtual) shared spatial data platform is set out below:

- The aim is to develop a shared platform that is stable, 'institutional' and achieves full integration of systems and sharing data sets (as far as appropriate)
- Facilitate the calculation of accounts underpinned by harmonised, geo-referenced and QA/QCd datasets
- Provide a semantic inventory of spatial datasets placing data in their context.
- Serve as common spatial reference framework; with a 1km grid as the core accounting grid
- Ensure transparency, traceability and accountability of the datasets and models used to compute the accounts
- Facilitate greater efficiency in sharing of spatial data and related joint analysis, thus enabling a pooling of resources between KIP INCA partners and synergies
- Achieve the above making best use of the present capacity and resources

The following steps are being undertaken on the basis of EEA resources and consultancy support to develop a technical proposal for a KIP INCA (virtual) shared spatial data platform during 2018:

a) A workshop in March 2018 to discuss the key objectives and relevant options for developing a shared spatial data platform for EU ecosystem accounting with KIP INCA partners and selected experts.[6] This included exploring the key functionalities for the platform, reviewing existing systems and identifying potential technical solutions.

b) Documentation of selected 'data architecture test cases'. These use the example of the concrete production of component accounts to establish the data sources used and to document the working steps to share data and transform / derive data sets for the purpose of EU ecosystem accounts. This gives insight into what is working well and where there are data, processing and/or resource bottle necks.

   All test cases document the current approach to account production. This is to be complemented with a proposed scenario that would describe an approach that is ecologically more accurate and based on richer and/or better spatially referenced data sets (where necessary). Contrasting the two allows an estimate of the (ideal) investment required into the data foundation for regular ecosystem accounts (and assessment and other purposes).

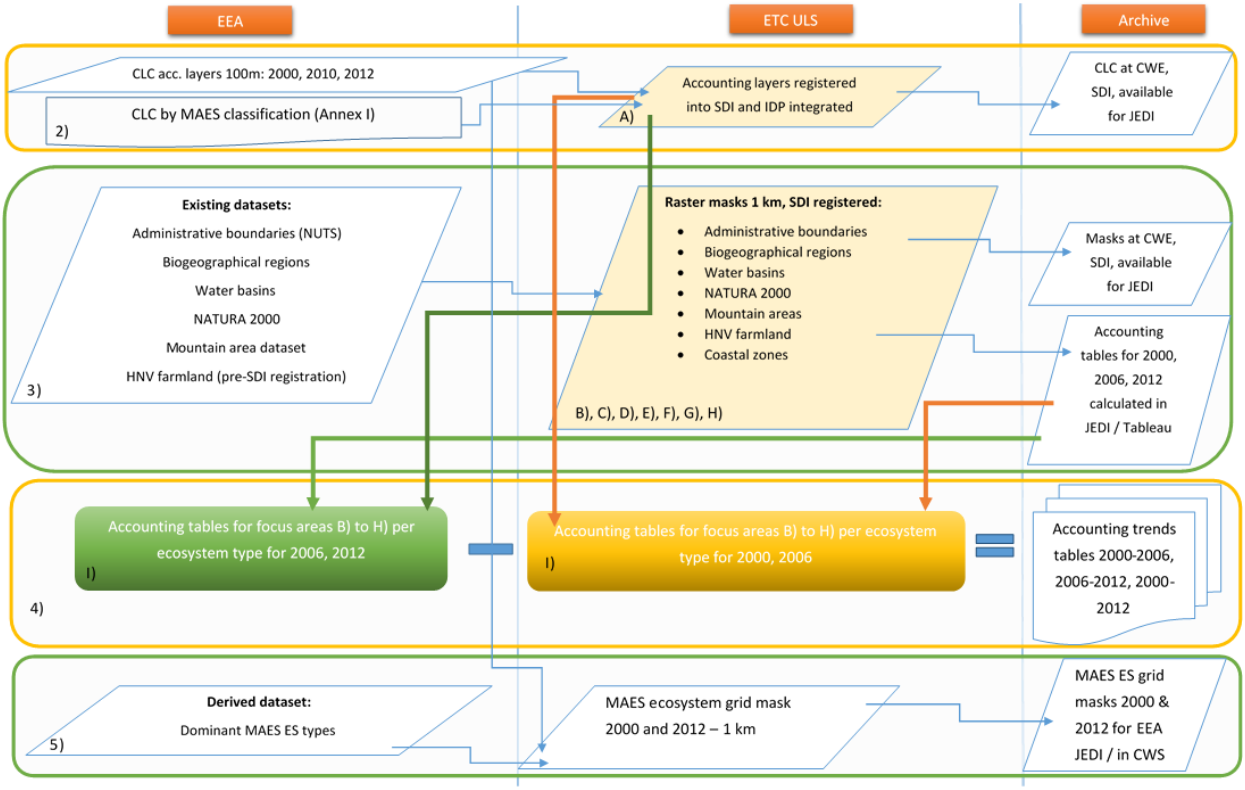
   The test cases provide concrete example workflows, which can be examined and used to inform the model and design for the shared spatial data platform. Figure 3 gives an example for Tier I ecosystem extent accounts.

c) A semi-structured survey of selected EU Member States regarding their data foundation and data management for natural capital accounting. This will cover 8 - 10 European countries and help to learn lessons from their experience as well as to consider country interests in developing the European approach.

[6] Further details on the Workshop on KIP INCA spatial data platform are available at: https://projects.eionet.europa.eu/ecosystem-capital-accounting/library/workshop-kip-inca-spatial-data-platform

d) Produce an overview of the state of play with building EU-level natural capital accounting reference data sets, including methodological options for improving the spatial scale and timeliness of such data; this will build on existing reviews of natural capital reference data for the EU MAES process (Mapping and Assessment of Ecosystems and their Services).

Figure 3: Flow diagram of contributors and processing steps for Tier I extent accounts at EU level



4) Outlook on next steps in developing the foreseen spatial data platform

The background analysis for developing a technical proposal for a potential shared spatial data platform is still ongoing. Likewise is the development of several of the SEEA EEA component accounts that will form the EU KIP INCA accounting output, in particular for ecosystem condition. The requirements of producing EU ecosystem accounts are what should drive the shape and approach to the spatial data platform. Nevertheless, it is likely that the technical proposal to be developed will address the following aspects:

1. ***Establishing a Governance System:*** In order for a shared spatial data platform to work well across multiple institutions, a system of governance needs to be in place. This should develop as the result of collaboration between the partners using their own tools.
2. ***Geo-referencing and harmonisation of spatial data sets:*** In order to integrate geospatial data for accounting spatial harmonization work is necessary. This comprises a common geographic reference system as well as a harmonized and controlled spatial geometry and spatial extent, including the alignment of metadata standards.

3. ***Establishing data integration or sharing processes:*** As illustrated via the pollination test, data will often be required from multiple sources to support ecosystem accounting. Engagement with data holders is required to establish institutional arrangements for data sharing. Broadly, two alternatives exists, using a central integrated data store or sharing data between different institutions / providers via a data platform.
4. ***Harvesting and integration of data sets from non-standardised sources:*** Consideration needs to be given on how to incorporate data from sources outside the main institutions contributing to ecosystem accounting (e.g., species distribution data from IUCN, data from UNEP or FAO, earth observation data managed by global providers).
5. ***Data processing and analysis:*** Various data processing and models will be brought together to calculate ecosystem accounts. This work is likely to be done on local servers, based on the harmonised data sets. These processes and they data they yield (e.g., additional geo-spatial layers) should be captured and searchable via the spatial data platform (including final accounting outputs). The updating of a processes or workflow should also be captured within platform.

Creating information about natural systems for ecosystem accounting requires a combination of various data sets – statistics, environmental monitoring data, land use and land cover information other in-situ observations and the analysis of satellite images. At the same time all these data sets need to be referenced at a spatial scale that corresponds to the ecosystem processes and units that are to be analysed. This means that the data-processing and analytical tools (whether for accounting or other tasks) need to be capable of handling geospatial data.

There is a number of organisations, well-structured geo-spatial data portals and agreed data standards in the EU that provide important elements to support the development of a fully spatial approach to ecosystem accounting. However, while Europe is comparatively data-rich, it needs to be acknowledged that existing statistical data collection systems or environmental monitoring were not designed for monitoring ecosystem trends.

This means that substantial work is likely to be necessary before an operational shared spatial data platform for ecosystem has been created at EU level. Current experience suggests that there is probably less need to work on connecting up existing systems but that a substantial effort may be required to produce, document and store the derived spatial data sets that are necessary for a regular production of ecosystem accounts at EU level. The KIP INCA partners would be happy to share the (future) experience gained in that process.