Organising data for ecosystem accounting

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What to think about when organising data for operational ecosystem accounting?

- multiple account subjects and concepts
- multiple data sources: variable resolutions and quality
- ecosystem accounts
- Methods
organising data for environmental accounting: defining the challenge
data have many different roles and uses in SEEA accounting...
There are many possible SEEA accounts

Environmental Flows
- water
- energy
- emissions

Natural Resources
- timber
- fish
- minerals

Environmental Transactions
- expenditure
- rebates
- taxes

Ecosystem Assets & Services
- land & soil
- biodiversity
- hydrology

Source: IDEEA
...with many possible linkages
multiple complex subjects: what do you see?

... timber, trees, an ecosystem, a landscape element, a beautiful view, shade, water filtration system, carbon reservoir, gene bank, iconic forest, weeds, a bushwalking opportunity, fire hazard ...
defining ecosystems is challenging
defining ecosystems is complicated

- Tech Rec 2017:
  - "A delineation of the area that defines an ecosystem asset is required for accounting purposes and should be considered a statistical representation of ecosystems, which by their nature are not discrete systems that align to strict spatial boundaries."

- SEEA-EEA proposes the use of basic spatial units (BSUs) to structure the data – deceptively powerful approach!
data characteristics for SEEA accounting

• different resolutions
  – spatial, temporal, thematic
  – modelled estimates e.g. pressures, production

• multiple and changing sources
  – e.g. earth observation satellites and mapping programs come and go

• original collection purposes are different to the accounting purpose
data have many roles and uses in SEEA accounting…

• …while compiling accounts
  – as input: compiled into content directly or through combination with other data
  – when processing and cross-checking: providing context and confronting other data

• …after the accounts are made, they become data for:
  – extensions: IO and integration with SNA accounts
  – analysis: integration with social and economic data and other environmental data to link to policy uses (e.g. SDGs etc.)
  – further analysis: there are a very large number of potential questions!
**Ecosystem Condition and Extent**

**Input:** Account-ready data infrastructure

**Data Sources**

1. **Classifications**
   - 1.1 ...
   - 1.2 ...
   - 1.3 ...
   - 1.4 ...

2. **Method specification**
   - 1.0 Ecosystem Extent

3. **Method specification**
   - 2.0 Ecosystem Condition

**Classification**

- 2.1 ...
- 2.2 ...
- 2.3 ...
- 2.4 ...

**Methods specification**

**Output classes**

- ABS Statistical Area
- BIO Region
- Economic Unit
- Catchment
- Jurisdiction

**Outputs (client focus)**

- SA1
- SA2
- SA3
- Bioregions
- Subregions
- Local Environmental Asset
- Industry
- Business (govt)
- Household
- Basin
- Catchment
- Sub-catchment
- State
- NRM Region
- Local government
Need for ‘low cost’ and ‘flexible’ data structures
Figure 3.1: Relationships between spatial areas for ecosystem accounting in ecosystem extent accounting

Source: (adapted from SEEA EEA Figure 2.4 (UN et al., 2014b). Note that Ecosystem Assets (EA) represent individual, contiguous ecosystems. Ecosystem Types (ET) are EA of the same type.)
basic spatial unit (BSU)

- Conceptually, we are chopping up the data about the world into tiny pieces (as BSU).
- These data pieces can then be easily organised (aggregated and re-aggregated) for accounting and analysis purposes.
- One way to structure these data is to use spatial vector tiles and store the multiple attributes about the location for each tile in a relational database.
promising solutions…

• simple partitioning of geographic data
  – Areas
    • vector tiling with unique ID
    • push most attributes into relational databases
    • e.g. Bioregional Assessment (BA) methods
  – Rivers
    • linear river network with associated sub-basins (catchments)
    • e.g. GeoFabric
  – Modelling and data management systems
    • e.g. EnSym, etc.
  – Examples
    • Brazilian, Norwegian, Japanese, Australian NSOs
    • EAGLE Group for EEA, OGC’s Discrete Global Grid System, etc.
    • etc.
Grid Square demonstration of Government statistics on e-Stat (Official Statistics Portal Site of Japan)

https://jstatmap.e-stat.go.jp
Hierarchical addressing / tessellation
Hierarchical addressing / tessellation
Open Geospatial Consortium (OGC) standards

OGC defines a DGGS as:

“…a spatial reference system that uses a hierarchical tessellation of cells to partition and address the globe.

DGGS are characterized by the properties of their cell structure, geo-encoding, quantization strategy and associated mathematical functions”

recent example: Bioregional Assessments

- systematic assessment of the impacts of coal seam gas and coal mining on Australia’s water resources (groundwater and surface water)
- 1.6 million km$^2$
- surface and subsurface ecological, social and economic *water-dependent* assets
problem – sheer number of potential queries

• input features:
  • ~ 2.5 million assets over ~0.5 million km²
  • input groundwater, surface water and ecological model results

• output queries: **massive number** of queries due to many potential questions by user

= (conventional) geo-processing is **very slow** when joining, selecting, clipping, dissolving and displaying for each query

= **very** limited numbers of queries
the solution: simple partitioning (tiling) of areal and linear features

• spatial features transformed and simplified via vector tiling (partitioning)
  – choice of tile resolution very important

• most spatial attributes moved from the geometries and passed into a relational database with a unique TileID
  – area, length, count

• allows spatial re-assembly of features to user's areas or questions of interest

• retains sub-tile information
reassemble via SQL query, then add geometry

dry eucalypt woodlands in Darling Downs

geometry partitioned, most data in tables

SQL query then geometry reassembled
the results

• circa 1,500+ pre-canned queries per subregion available for scientists and assessment teams
  – query amendment in seconds/minutes
  – query/data amendment and total refresh: 2-4 hours

• interactive enquiry-based spatial website for policy users

• system honours very high data provenance standards

• (almost) all data available for download from data.gov.au at completion of the project
**BA Explorer** web site:

wet sclerophyll groundwater dependent ecosystem (GDE)
take home message

- organise data for environmental accounting to enable faster, cheaper, more flexible *analyses*, not only accounts
Thanks