Organising data for ecosystem accounting

Richard Mount, Bureau of Meteorology, Australia

Environmental accounting special advisor to
Australian Bureau of Statistics, Department of the Environment and Energy and CSIRO

SEEA-EEA Revision, Glen Cove, New York. 18-21 June 2018
Content based on SEEA-EEA 2013 and
SEEA-EEA Technical Recommendations 2017

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

multiple account subjects and concepts

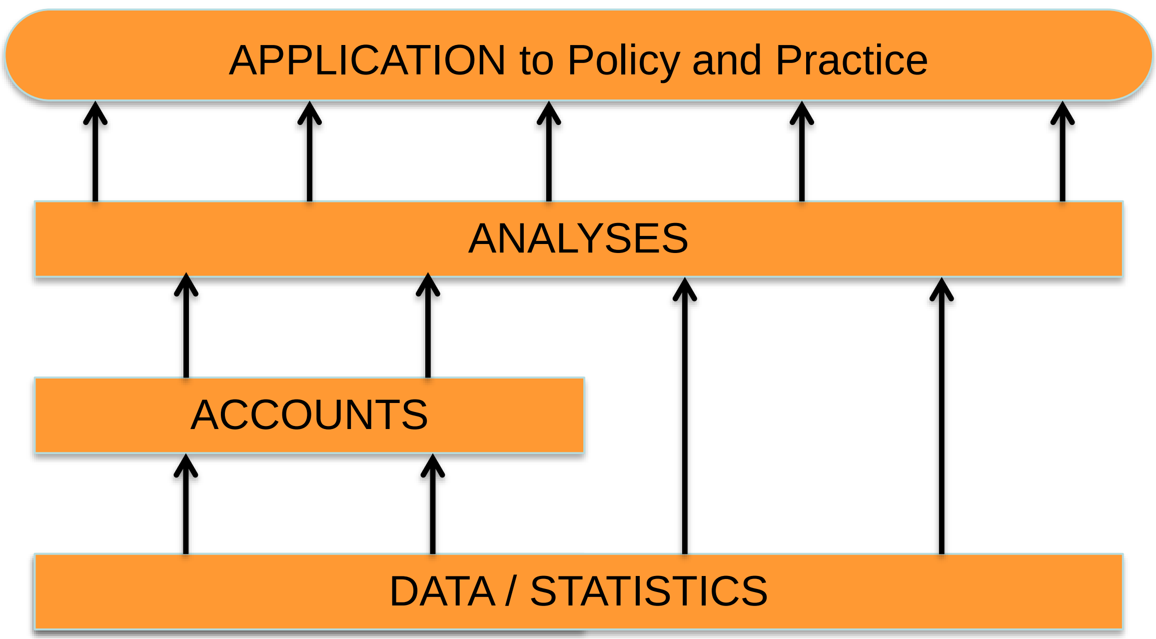
multiple data sources: variable resolutions and quality

Methods

ecosystem accounts


Bison
Canard
Ail
St Nectaire
Olives
Noisette
Fenouil
Chataignes
Sanglier

organising data for environmental accounting: defining the challenge

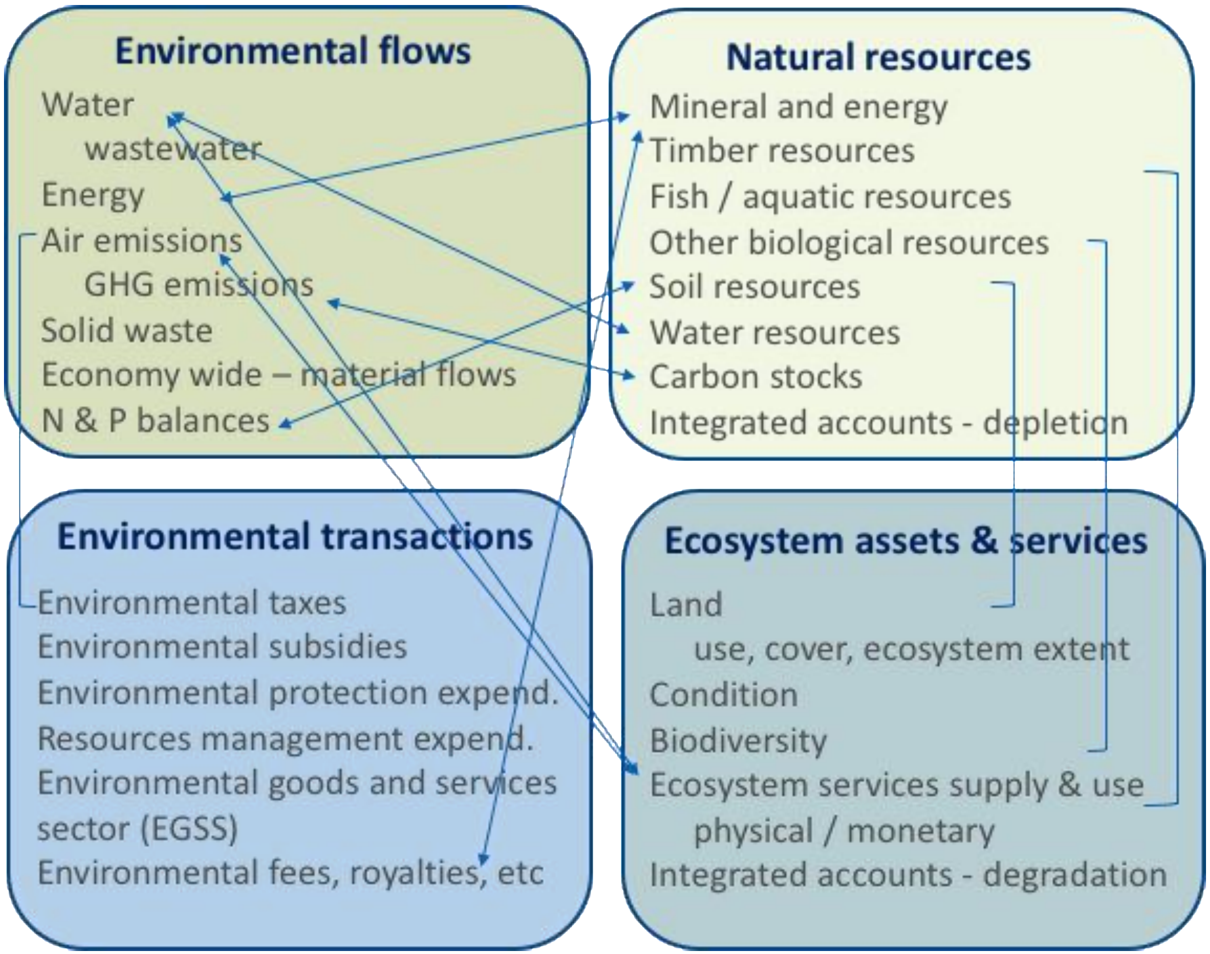


data have many different roles and uses in SEEA accounting…

There are many possible SEEA accounts

Source: IDEEA

…with many possible linkages



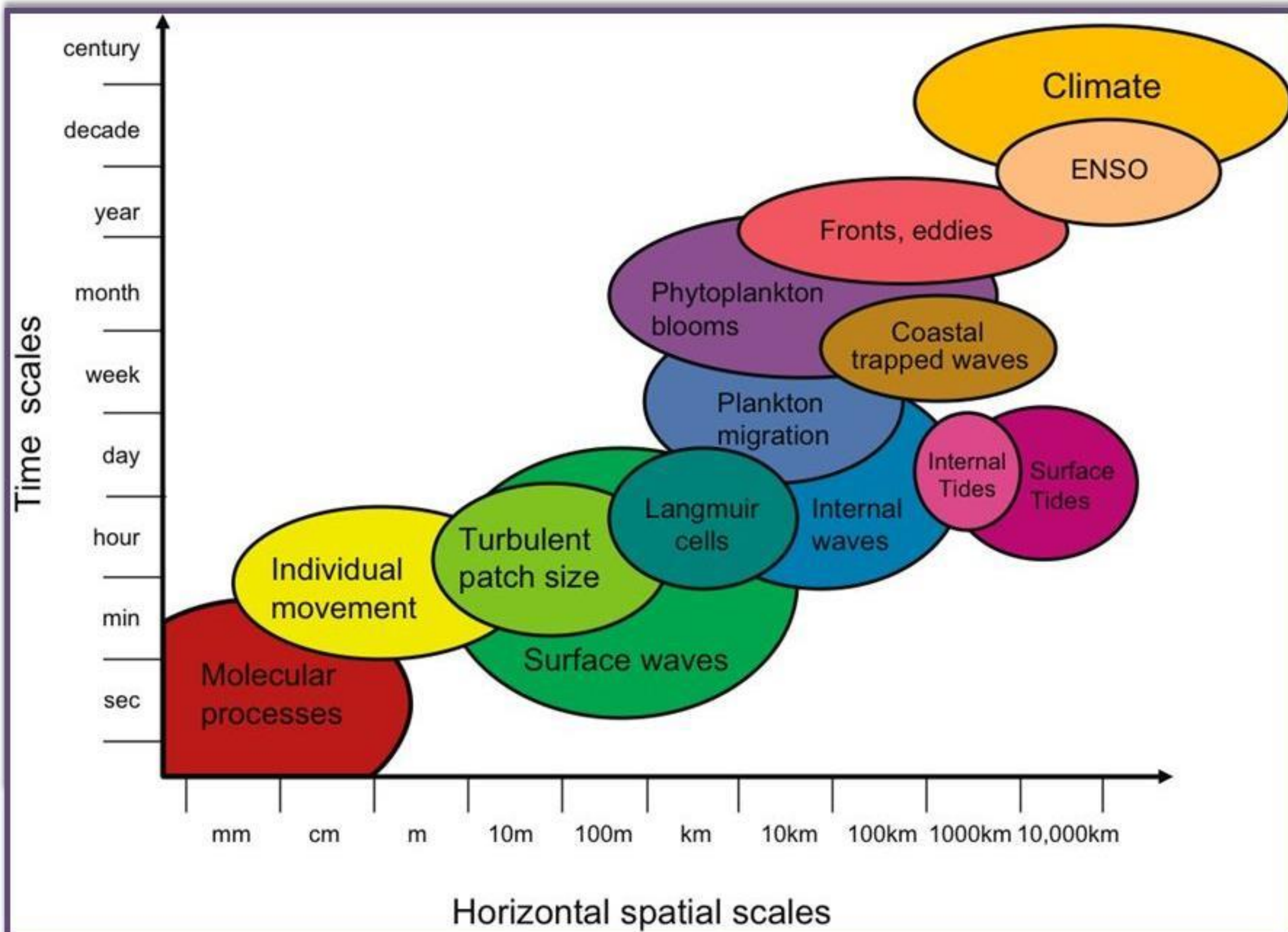
Source: IDEEA

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 …

Image: Wolfgang Glowacki

defining ecosystems is challenging


century
decade
year
month
week
day
hour
min
sec
Time scales
Climate
ENSO
Fronts, eddies
Phytoplankton blooms
Coastal trapped waves
Plankton migration
Internal Tides
Surface Tides
Langmuir cells
Internal waves
Turbulent patch size
Individual movement
Surface waves
Molecular processes
mm
cm
m
10m
100m
km
10km
100km
1000km
10,000km
Horizontal spatial scales

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."

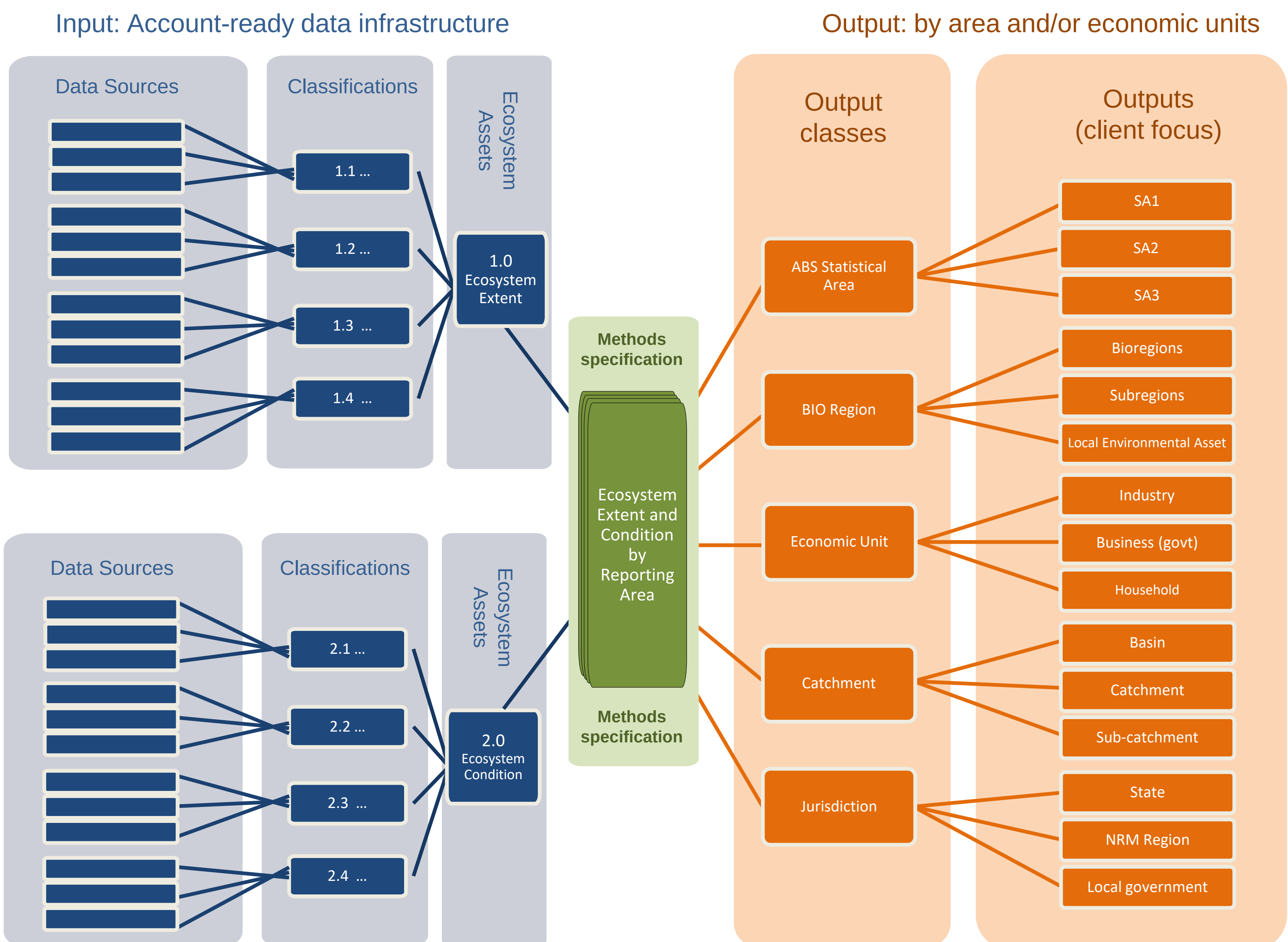
- SEEA-EEA proposes the use of **basic spatial units** (BSUs) to structure the data – deceptively powerful approach!

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!

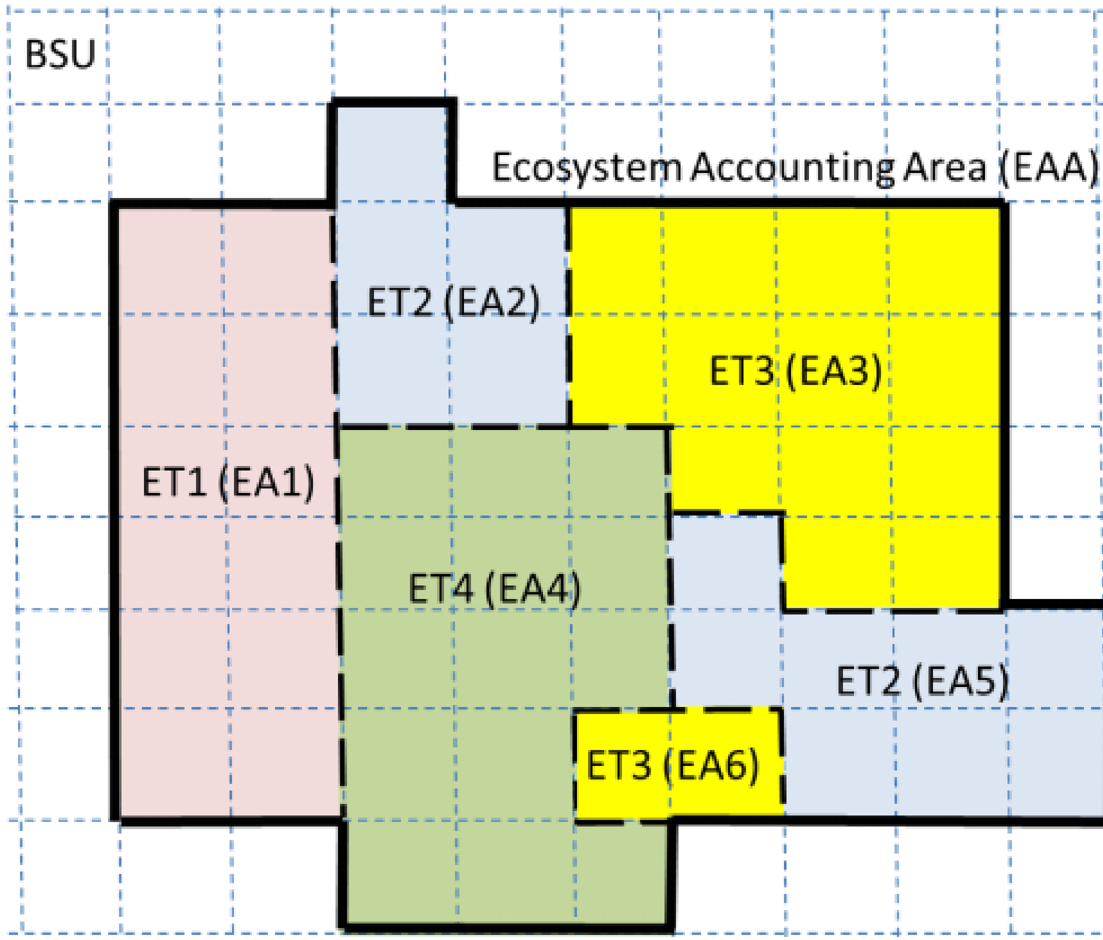


Input: Account-ready data infrastructure
Output: by area and/or economic units
Data Sources
Classifications
Ecosystem Assets
1.1 ...
1.2 ...
1.3 ...
1.4 ...
1.0 Ecosystem Extent
Data Sources
Classifications
Ecosystem Assets
2.1 ...
2.2 ...
2.3 ...
2.4 ...
2.0 Ecosystem Condition
Methods specification
Ecosystem Extent and Condition by Reporting Area
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

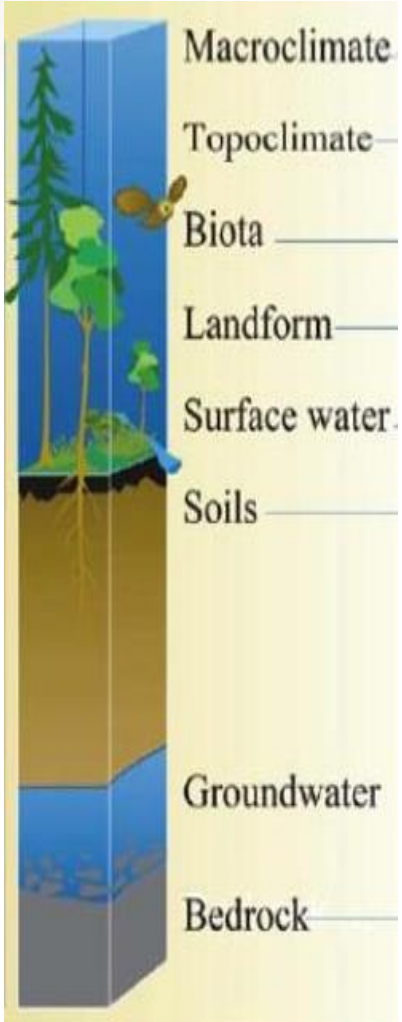
BSU, EA, ET, EAA

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)



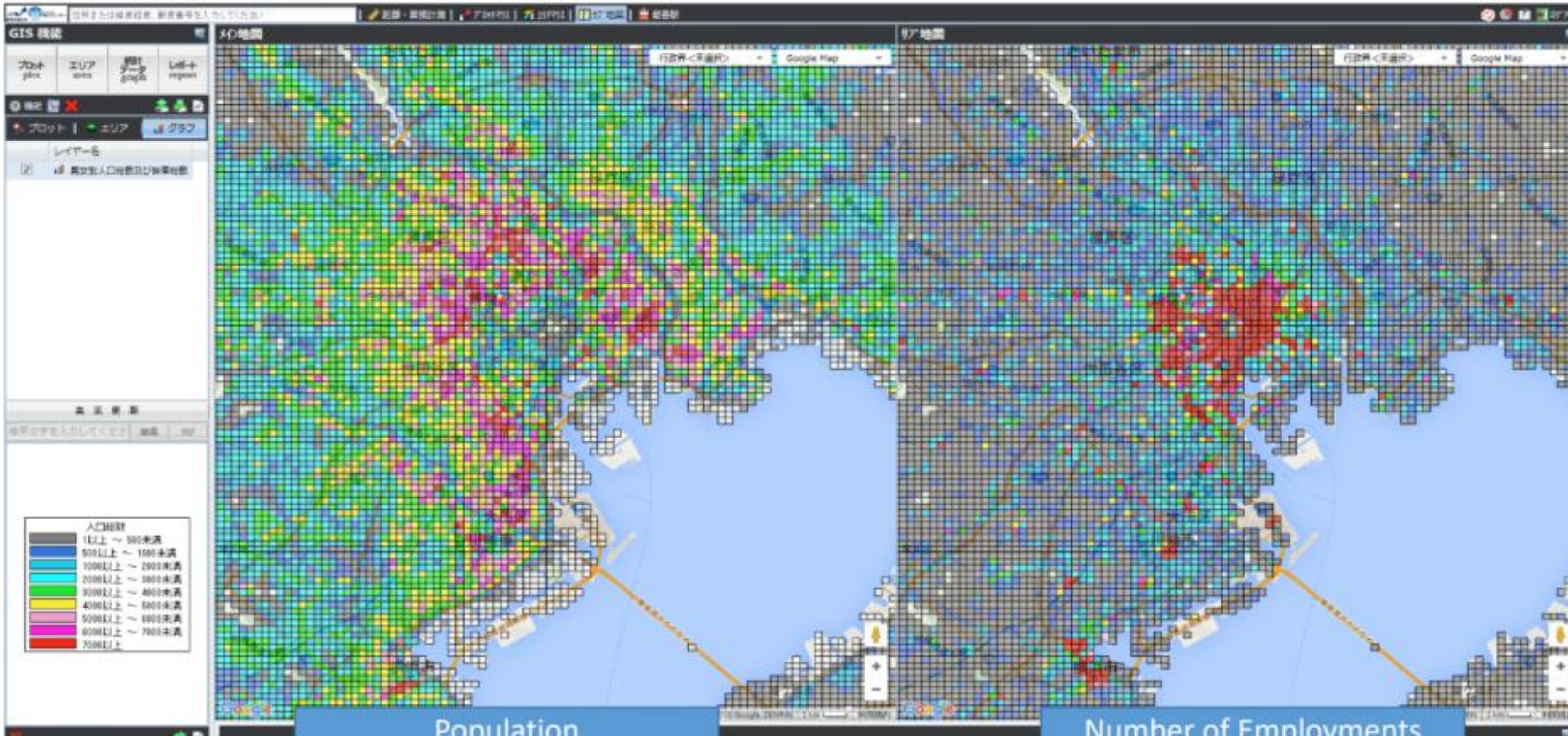
- Conceptually, we are chopping up the data about the world into tiny pieces (as BSU).
- These data pieces can then be easily organised (aggregated and re-aggregated) for accounting and analysis purposes.
- One way to structure these data is to use spatial *vector* tiles and store the multiple *attributes*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

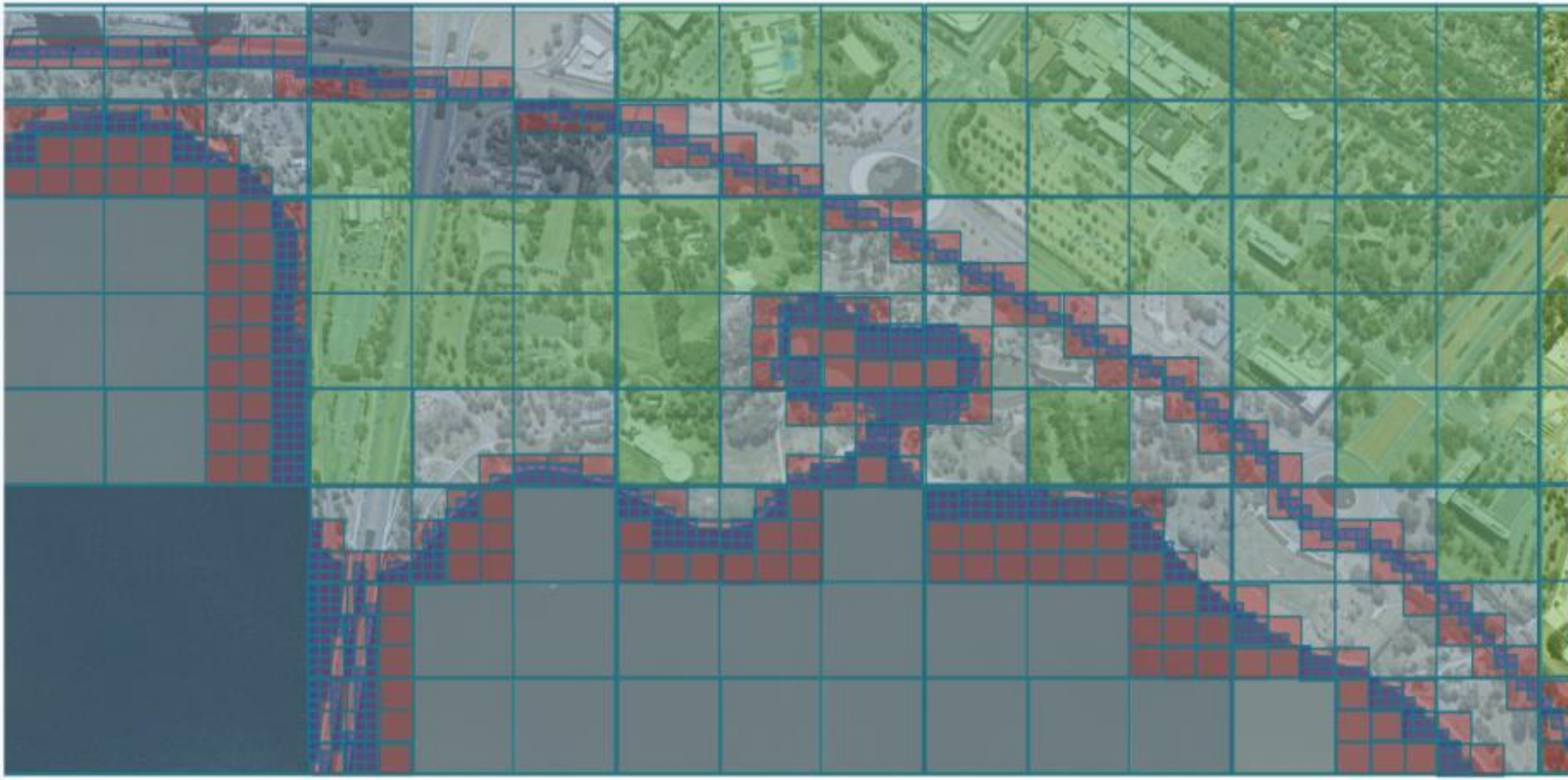
https://jstatmap.e-stat.go.jp



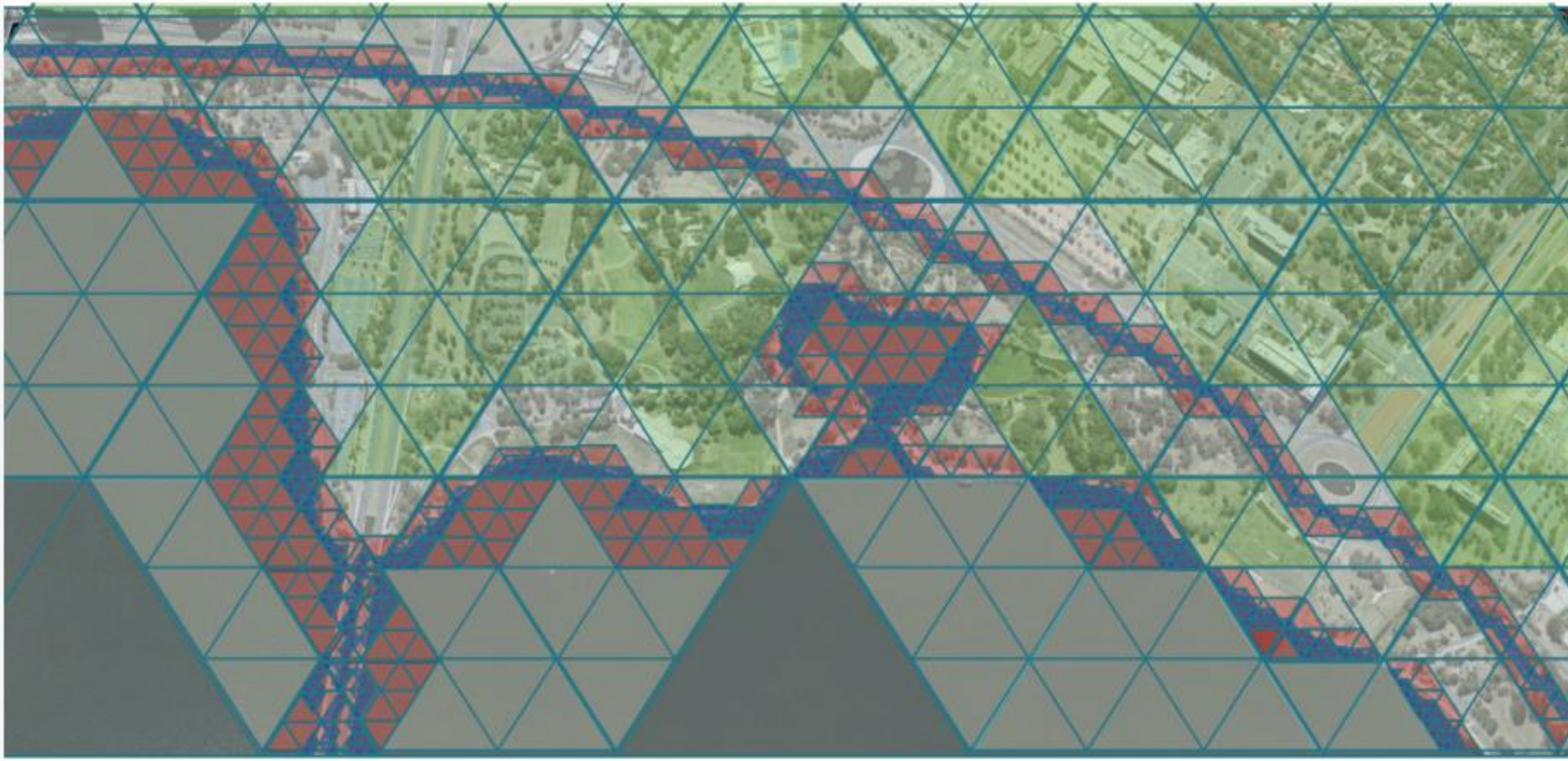
Population
(Population Census)

Number of Employments
(Economic Census)

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"

Purss, et. al. 2017, OGC Discrete Global Grid Systems Abstract Specification – Topic 21 [OGC 15-104r5]

Discrete Global Grid Systems DWG

Chair(s):
Sabeur, Zoheir (University of Southampton)
Peterson, Perry (the PYXIS innovation)
Purss, Matthew (Geoscience Australia)
Strobl, Peter (Joint Research Centre (JRC))

Australian Government
Bureau of Meteorology

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 km^2
  - 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

= <u>very</u> limited numbers of queries

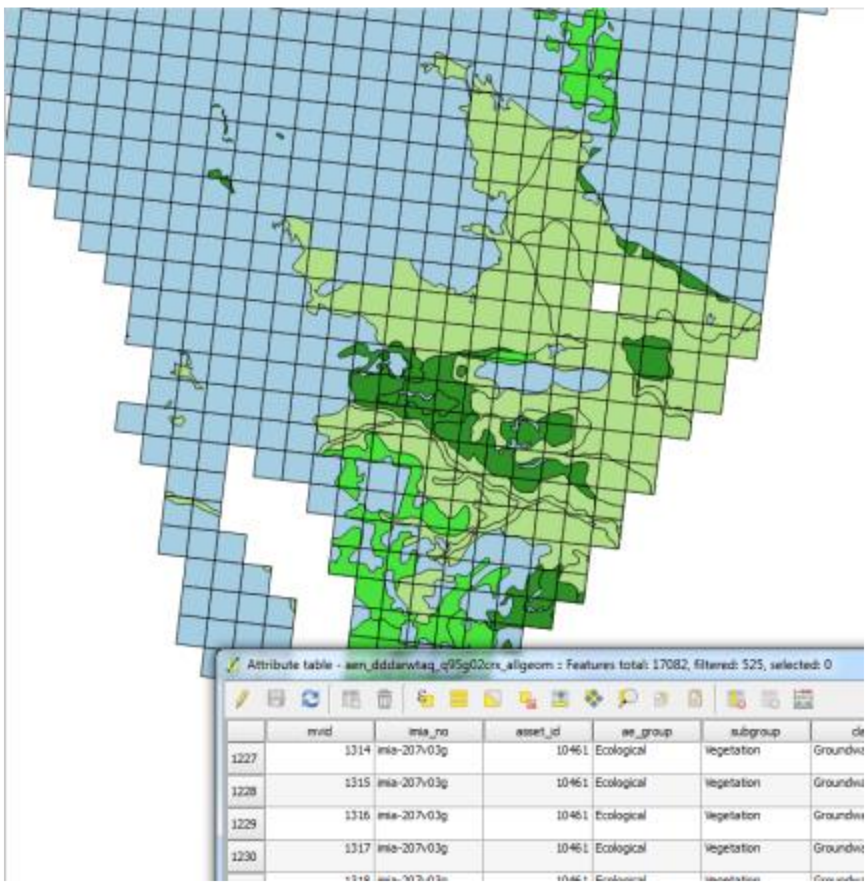
the solution: simple partitioning (tiling) of areal and linear features

- 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

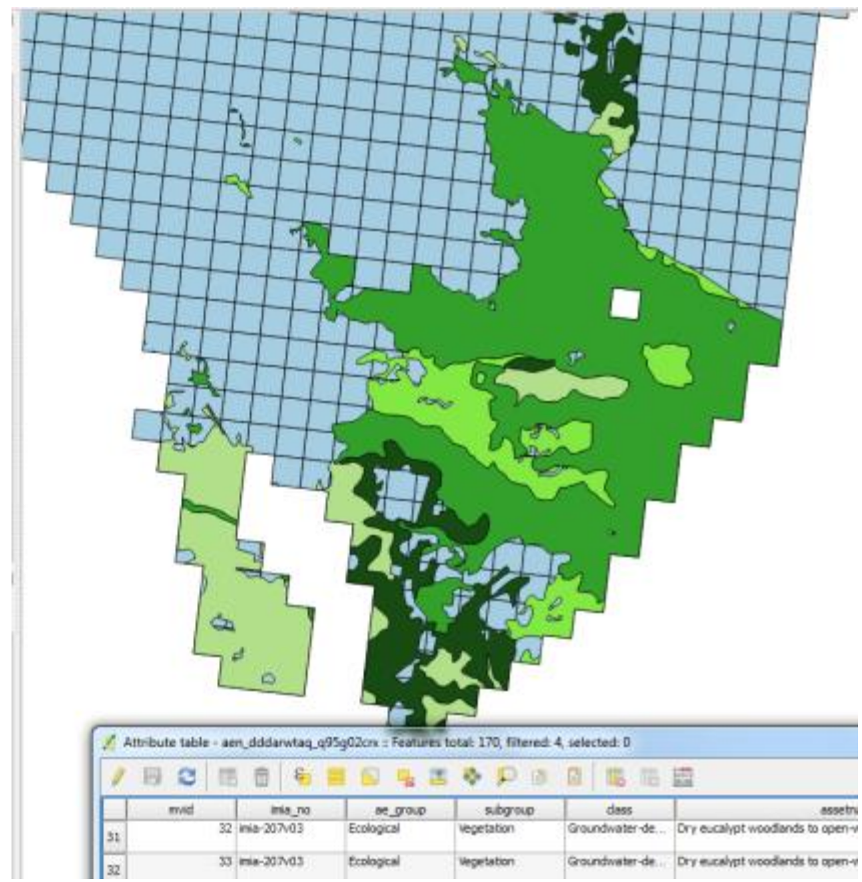
reassembly via SQL query, then add geometry

dry eucalypt woodlands in Darling Downs

geometry partitioned, most data in tables



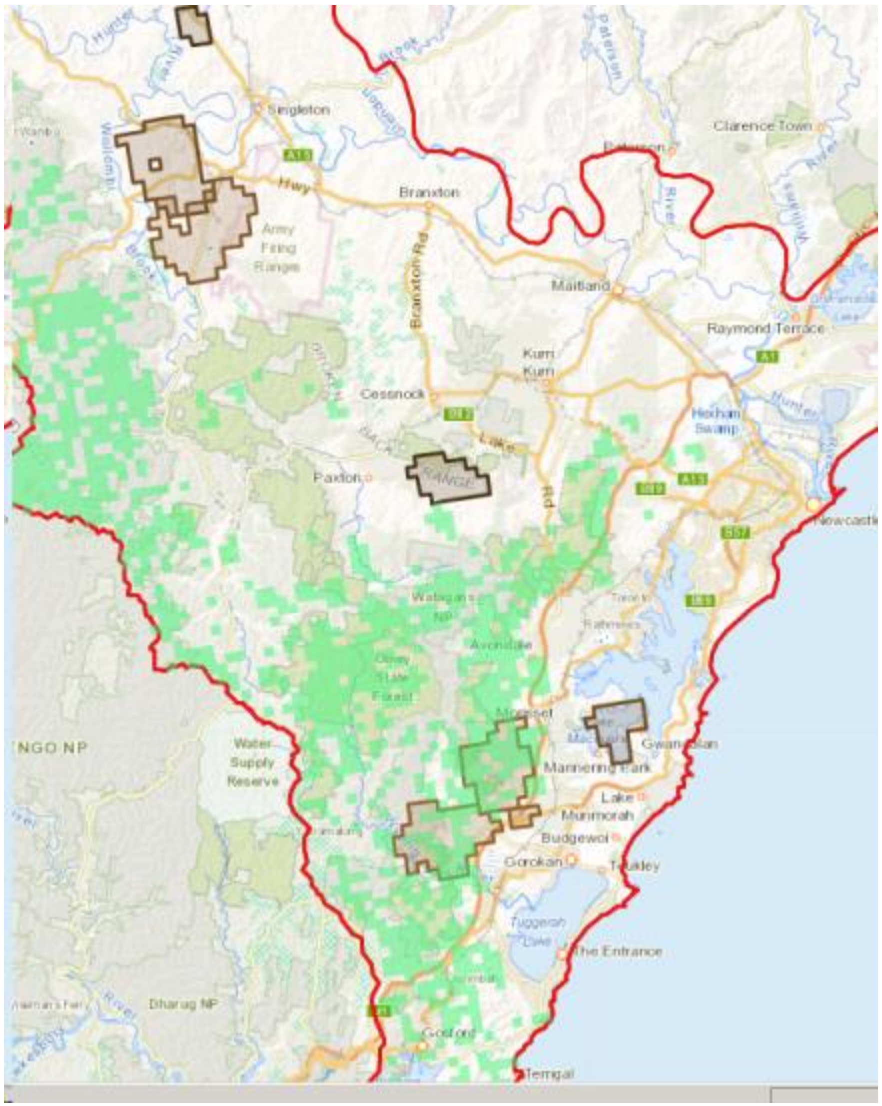
SQL query then geometry reassembled

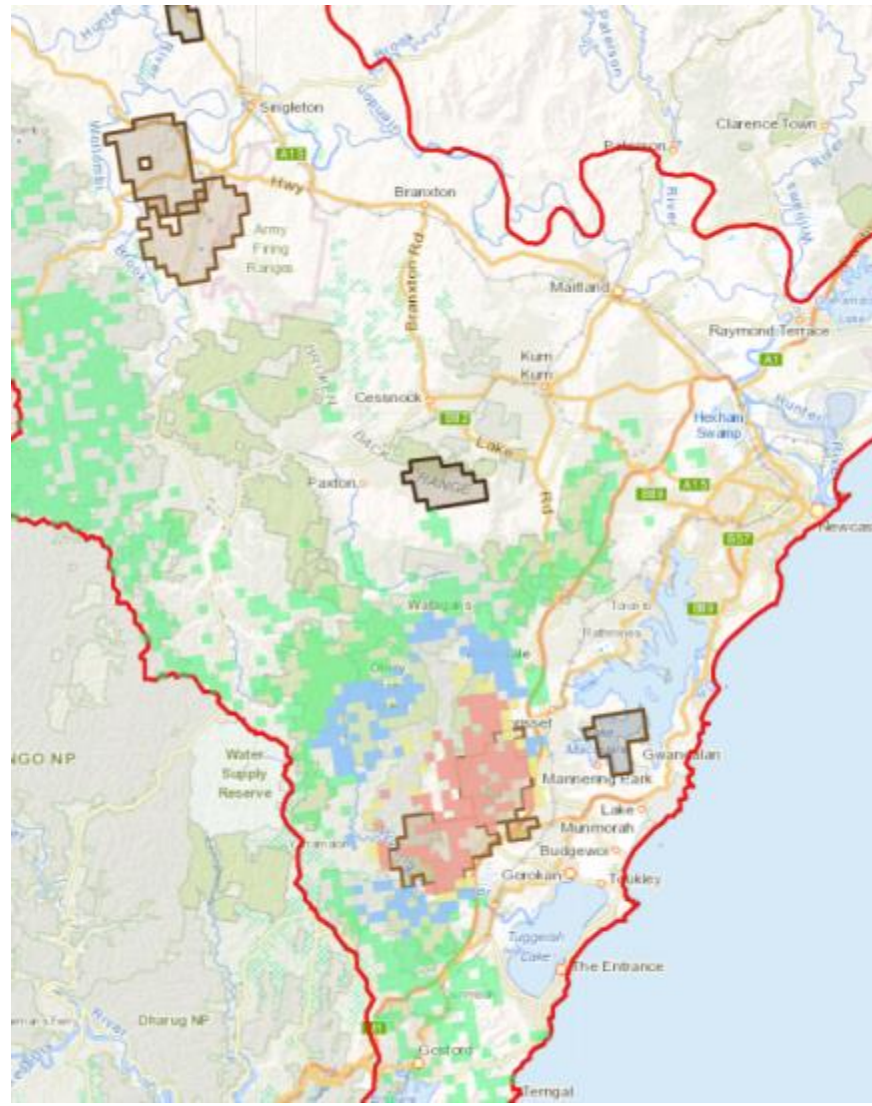


the results

- circa 1,500+ pre-canned queries per subregion available for scientists and assessment teams
  - query amendment in seconds/minutes
  - query/data amendment and <u>total</u> 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

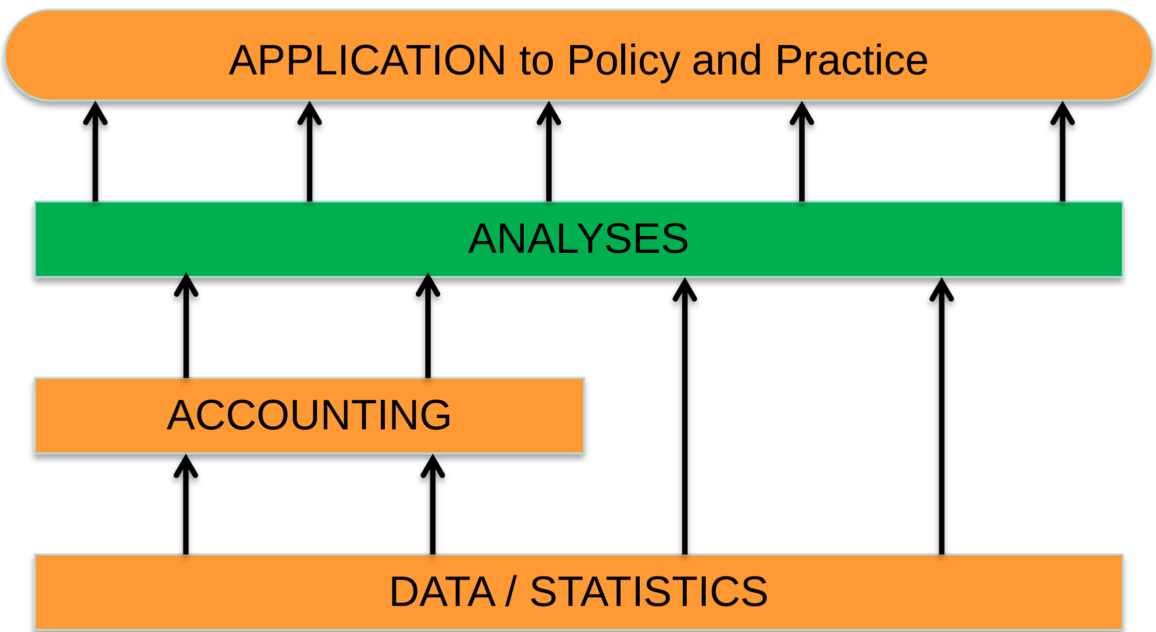
BA Explorer web site:
wet sclerophyll groundwater dependent ecosystem (GDE)





take home message

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



Australian Government
Bureau of Meteorology

Thanks