

Scaling and integration

3rd of the Meeting of the
Policy and Technical Expert Committee
Washington, DC
29-31 October 2014

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Overview of presentation

- Background
- Spatial and economic units
- Scaling up and down
- Integration of economic and environmental data
- Data quality and fit-for-purpose
- Lessons and way forward

Background

- The production of environmental and ecosystem accounts requires a range of information of physical scientific and economic information from a range of sources
- An understanding the statistical units (basic information building blocks) is needed to enable data from different sources to be integrated and scaled to produce accounts

What are statistical units?

A statistical unit is the object of measurement.

- For example an individual person can be measured, e.g. age, height, weight, sex, hair colour, income, etc.

Some units are found within other units.

- E.g. a person is also part of a household (a group of people living together). In this the household can be measured, e.g. by number of members (or persons) and household income (the sum of the income of all members of the household)

Complexities arise can when different types of units overlap (e.g. household and persons) and particularly if you are trying to aggregate or disaggregate one type of unit to make other

Types of statistical units

Economic units

- Households
- Institutional units
- See the System of National Accounts, Chapters 4 and 5, <http://unstats.un.org/unsd/nationalaccount/sna2008.asp>

Spatial units

- Grids (raster), e.g. 1km x 1 km, 30m x 30m,
- Polygons (vector), river basins, states, countries, etc.
- See SEEA Experimental Ecosystem Accounting, Chapter 2, http://unstats.un.org/unsd/envaccounting/eea_White_cover.pdf

Economic units

Households

- Persons living together pooling some or all income and wealth

Institutional units

- An economic entity, capable of transacting in the economy
 - Enterprises (single or multi-establishment)
 - Establishments (an enterprise or part of enterprise at particular location)

Classification of economic units

- Industry (agriculture, mining, manufacturing, education, etc)
- Sector (Households, Government, Not-for-profit, corporations)

Spatial units

Basic spatial units

- Grids (raster), e.g. 1km x 1 km, 30m x 30m, etc.
- Legal property boundaries (vector, polygons) e.g. the cadastre.

Land cover/ecosystem functional units (vector, polygons)

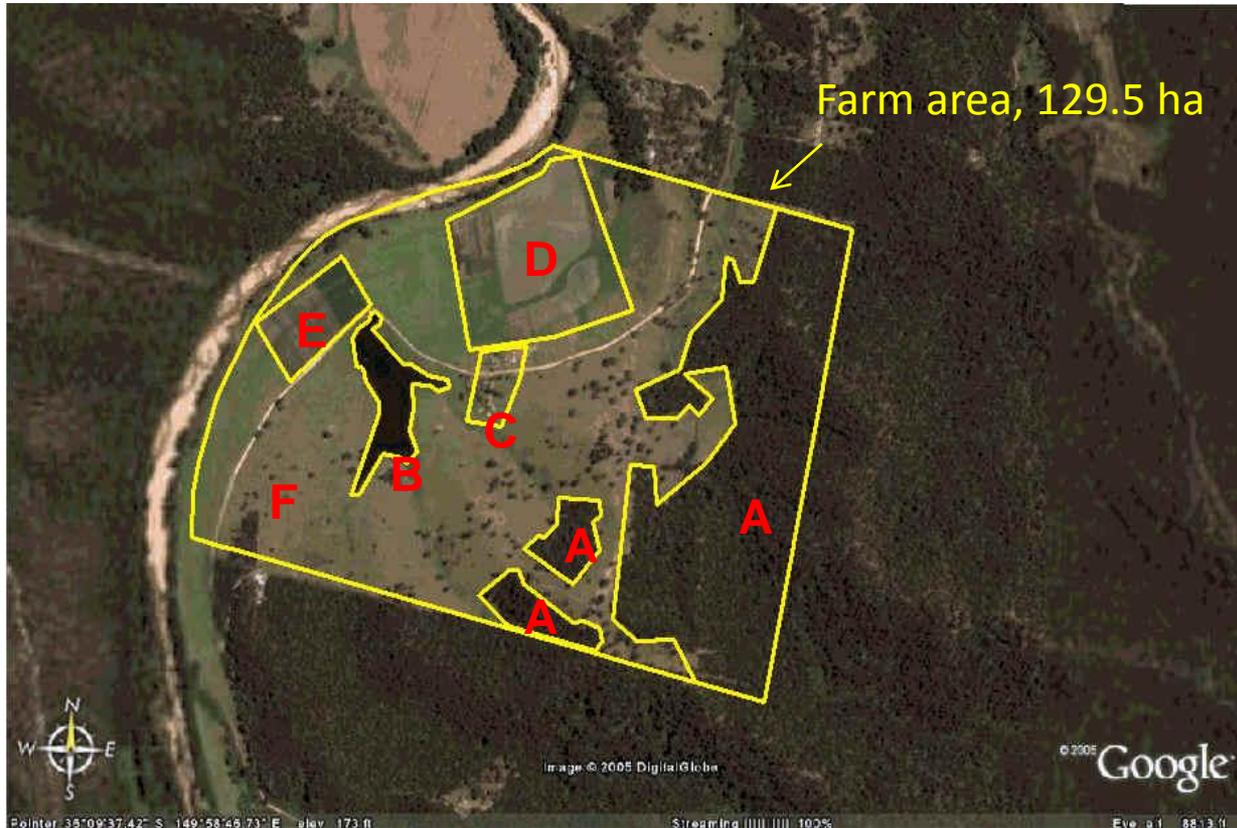
- Vegetation classes (e.g. forests, shrub lands, grasslands, wetlands, etc.) or biomes/bioregions (alpine, coastal, intertidal, tundra, desert, etc.)

Ecosystem accounting units (vector, polygons)

- river basins, states/provinces, management areas, countries, statistical output areas, etc.

A farm as an Example of units

The farm is basic spatial unit (polygon) and economic unit (establishment), the owner is an economic unit (enterprise) and the owner also resides on the farm (i.e. a household)



Accounting for the spatial unit

Land cover (by vegetation type)

A: Forest	39.0 ha
B: Water	3.5 ha
C: Residence	1.8 ha
D: Irrigated crop	13.5 ha
E: Other crop	3.8 ha
F: Grassland	68.0 ha

Land use (by industry/sector)

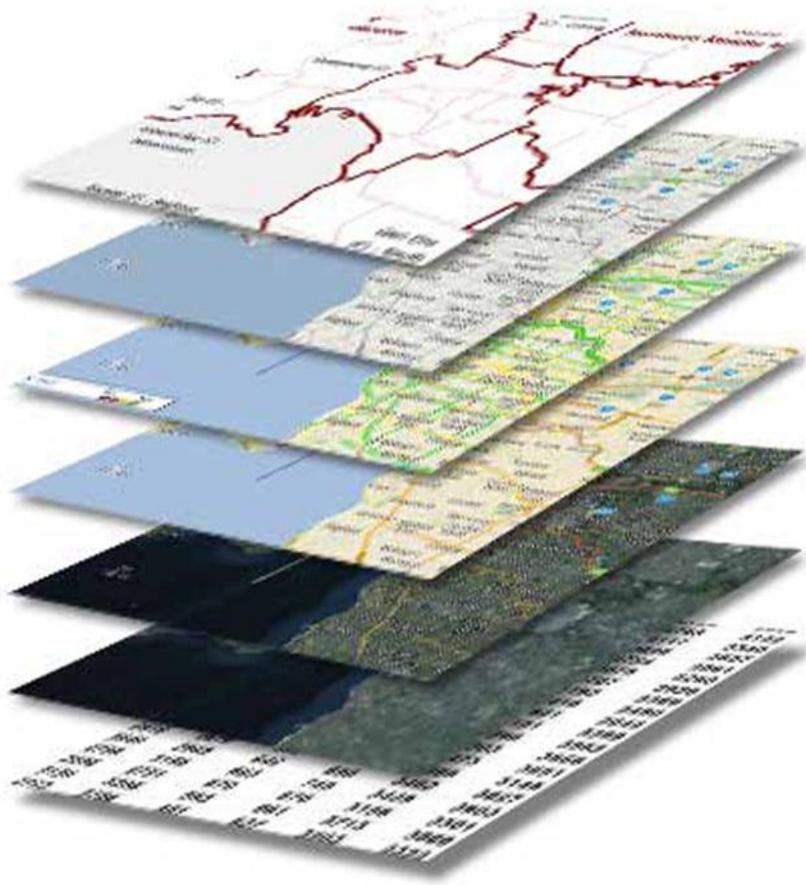
A: Forestry ?	39.0 ha
B: Water storage	3.5 ha
C: Household	1.8 ha
D: Agriculture	13.5 ha
E: Agriculture	3.8 ha
F: Agriculture	68.0 ha

Accounting for the economic unit

Enterprise: income, \$422,700, Expenses, \$183,400, inventory \$47,000 But this enterprise owns other farms (=establishments)

Household Income to household not the same as enterprise income plus off farm income from spouse and children

Data sources for ecosystem and environmental accounting – a mix of spatial and economic units



Remote censing (e.g. satellites)

- Land cover
- Rainfall
- Temperature
- Geography (mountains, plains, coasts, etc.)

Scientific studies/research

- E.g. Species distribution and abundance, water flow and quality, soil, etc.

Administrative sources

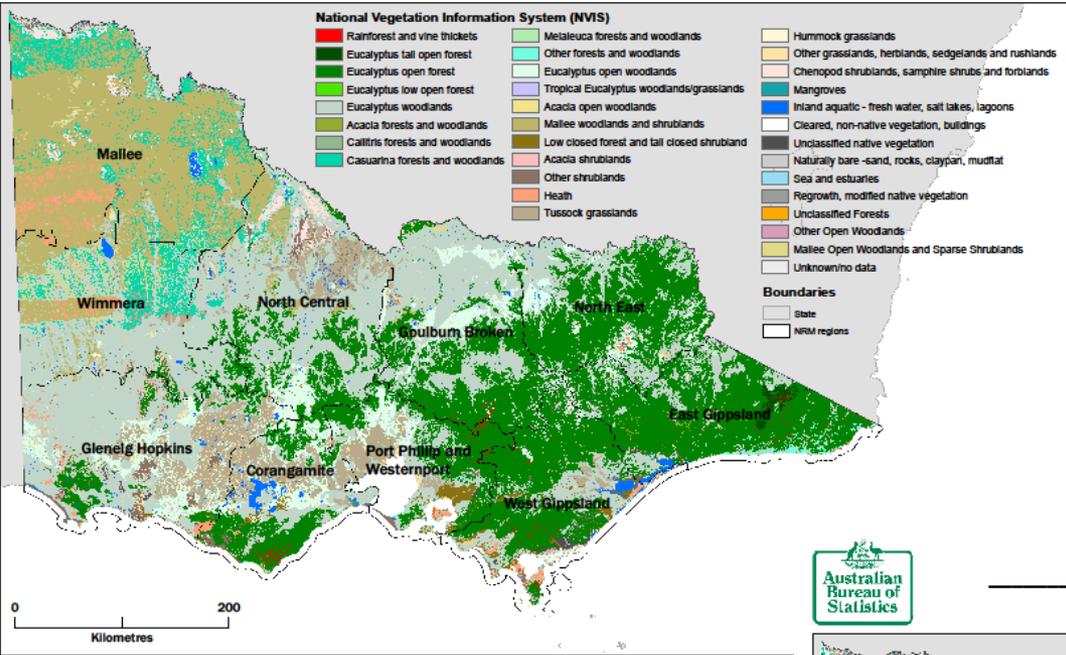
- Land title offices
- Business registers, Tax data
- Development applications
- Environmental Impact assessments

Annual reports from business

Statistical surveys/census

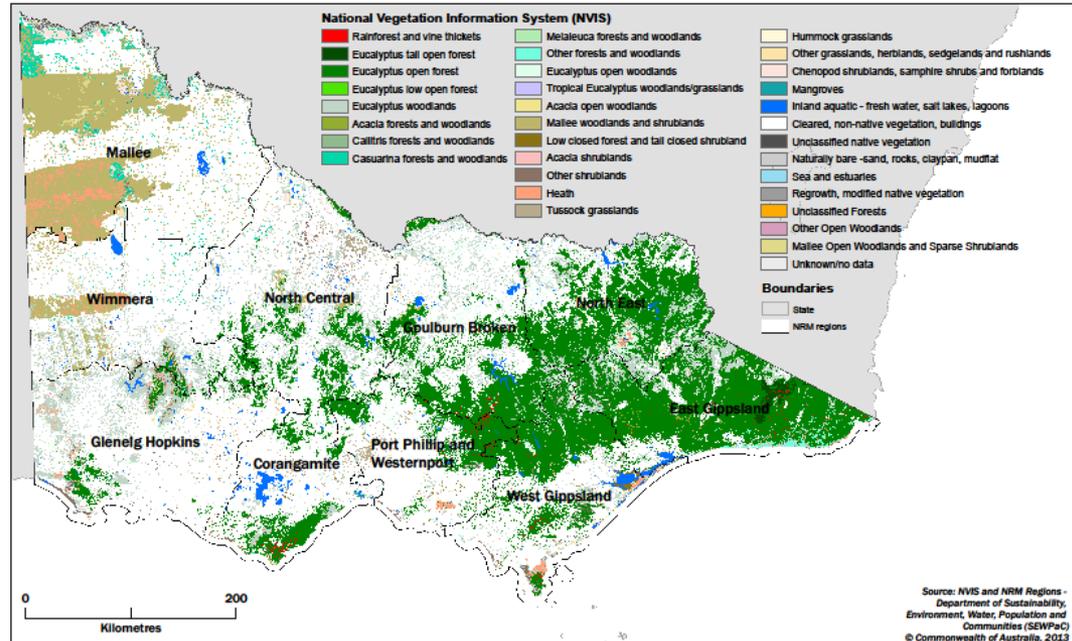
- Business surveys, including agriculture
- Population census, household surveys, etc.

Map 11 - 1750 NVIS grid overlaid with NRM regions for Victoria



Data aggregation example
 Victorian land and ecosystem accounts:
 Native vegetation 1750 and 2006
 (Basic statistical unit is a raster grid)

Map 10 - 2006 NVIS grid overlaid with NRM regions for Victoria



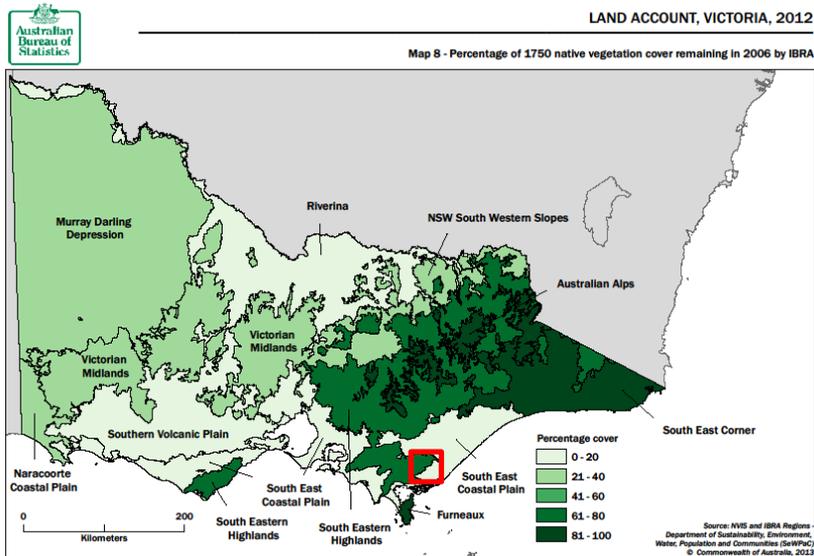
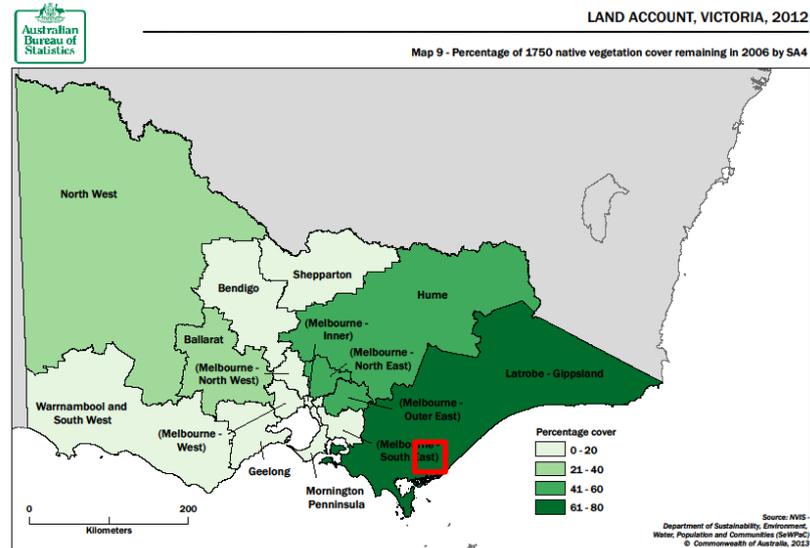
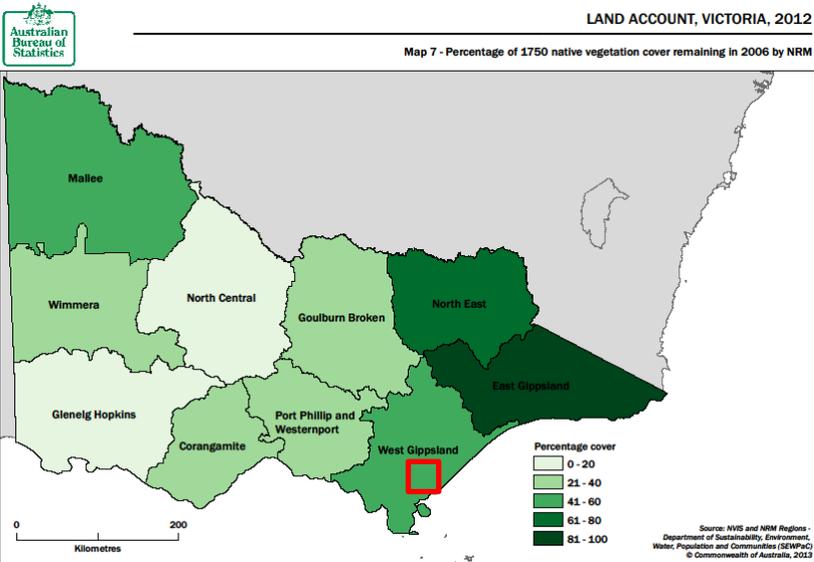
Land Accounts Victoria, Experimental Estimates

<http://www.abs.gov.au/ausstats/abs@.nsf/mf/4609.0.55.002>

Victoria Experimental Ecosystem Accounts

<http://www.dse.vic.gov.au/conservation-and-environment/ecomarkets/ecomarkets-science>

Aggregation of spatial unit data. Area of native vegetation remaining



Aggregation of data from basic spatial unit (raster data) on native vegetation to:

- Natural resource management regions
- Biogeographic regions
- Statistical output areas

□ Same space, same data, three different aggregations, three different answers.

Scaling down

Economic data from economic units are collected by national statistical agencies for the primary purpose of national economic estimates (e.g. of GDP)

- Economy is subdivided in industries and sectors
- Subnational spatial referenced data is generally not provided
- Statistical agencies reluctant to general subnational spatially referenced estimates of macro-economic aggregates (e.g. of GDP)
- Development of subnational macro-economic estimates is possible using additional data sources (e.g. spatially references registers of land owners, business surveys, business registers, tax and other administrative data)
- This is a top down approach

Scaling up

Environmental data from spatial units is collected for multiple purposes by multiple government agencies (e.g. water, forests, geoscience, etc.)

- Subnational and small scale data are typical
- Aggregation and disaggregation of physical science data is common

Researchers collect economic and environmental data from both economic and spatial units for local studies

- Not usually designed to account for the whole economy or environment and hence cannot be scaled up (and hence why benefit transfer is debated in economic studies)
- Additional data from national macro-economic or physical science sources may provide a way to scale up
- This is bottom up approach

Integration

- Different data sources usually have different statistical units and different classifications of statistical units
- Assumptions and modelling are used to enable aggregation and disaggregation of data as well as integration of economic and environmental data
- Direct large scale linking of economic and spatial units is rare.
 - Linking to spatially referenced land ownership registers is a way forward

Data quality and fit-for-purpose

- When data are combined the individual data source are invariably modified and degraded
- The combination of the individual data sources produces a new integrated data source
 - This new data source can be used for purposes that the original data could not support
 - Producers of the original data are typically reluctant for modification and re-purposing of data
- Data quality assessment for fit-for-purpose is important

Data quality assessment

Six dimensions of data quality

- Relevance, Accuracy, Timeliness, Interpretability, Accessibility, Coherence
- See Statistics Canada: <http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?l=eng&loc=/pub/12-539-x/12-539-x2003001-eng.pdf>

Academic studies tend to be focused accuracy (how right is the answer, i.e. $\pm 5\%$) and coherence (how well does it fit the theory?)

National economic data agencies tend to be more focused on relevance, timeliness and accessibility

Lessons learnt and way forward

Cooperation is essential between agencies and between professions (e.g. academics, public officials, accountants, economists and ecologists) for the scaling and integration of data

- Experimental or pilot studies are useful for developing methods of scaling and integration and for understanding top down and bottom up approaches
- Need to focus on repeatability (i.e. the regular production of accounts and the data that supports them)

Spatially referenced environmental and economic data are needed for environmental and ecosystem accounts

- Macro-economic data is generally national and needs to be scaled down
- Academic studies of ecosystem services and natural capital generally needs to be scaled up
- National land cover data, spatially referenced property registers, business registers and surveys provide a means for scaling up and down

There will be criticism – the work necessarily requires integration of data and trade-offs between the different dimensions of data quality