# Extent Account

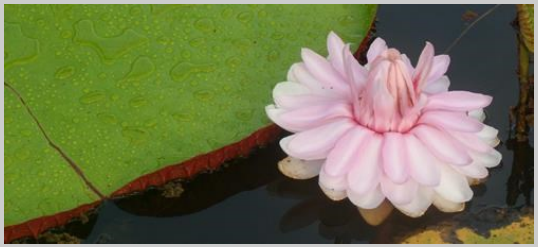
(Levels 1 and 2)

Project: Advancing the SEEA
Experimental Ecosystem Accounting

United Nations
UNEP
Convention on Biological Diversity
NORWEGIAN MINISTRY OF FOREIGN AFFAIRS

# Overview: The Extent Account

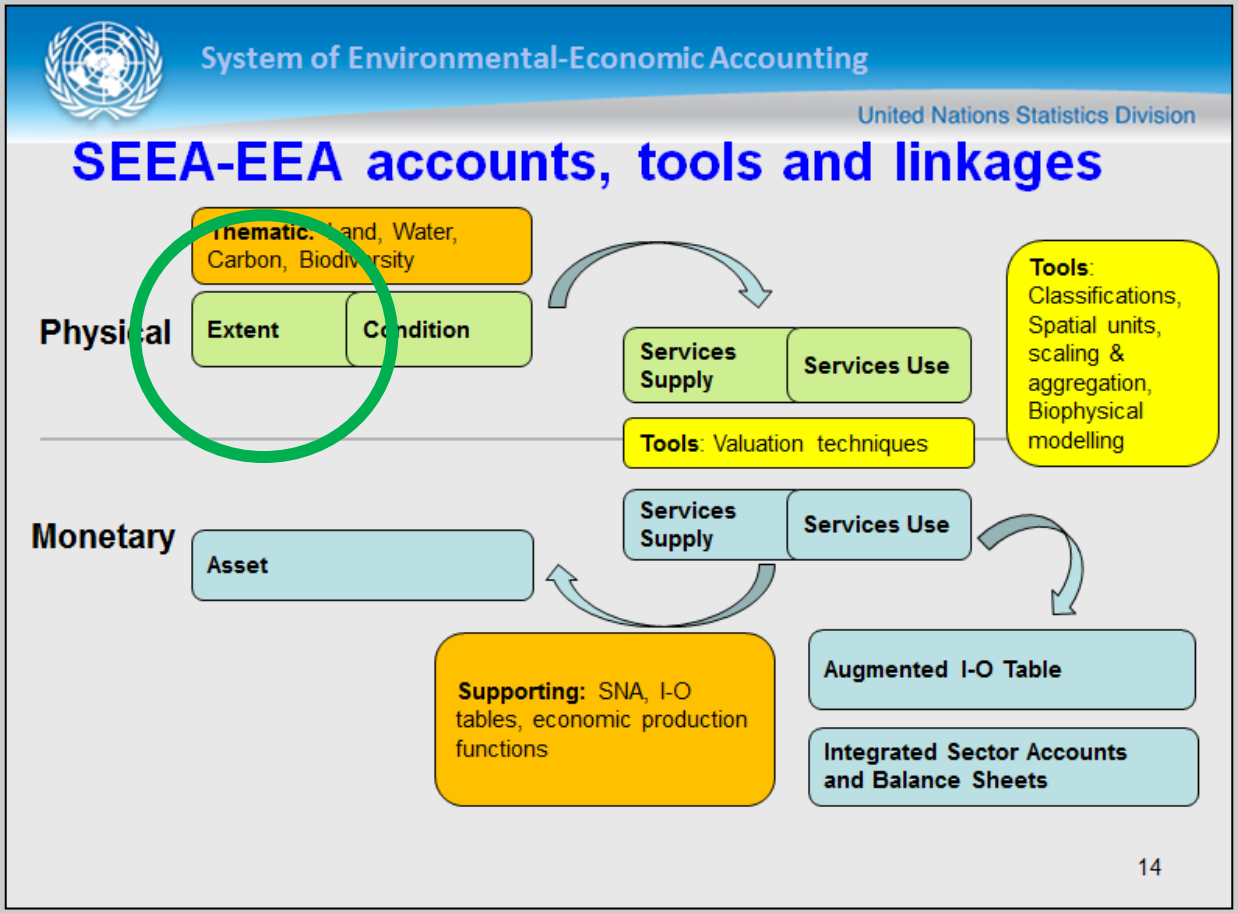
1. **Learning objectives**
2. **Review of Level 0 (5m)**
3. **Level 1 (Compilers)**
   - Concepts (15m)
   - Group exercise & Discussion (30m)
4. **Level 2 (Data providers)**
   - Data options, examples & issues (15m)
   - Group exercise & Discussion (15m)
5. **Closing Discussion (10m)**



# SEEA-EEA Training Levels 1 and 2

- **Learning objectives**
  - Level 1:
    - Understand the basic concepts of the Extent Account
    - Learn the steps of compiling an Extent Account
  - Level 2:
    - Understand the data options and sources
    - Understand the important conceptual issues
    - Be aware of how other countries have approached measuring Extent

# Account 1: Extent



# Review of Level 0: Extent Account

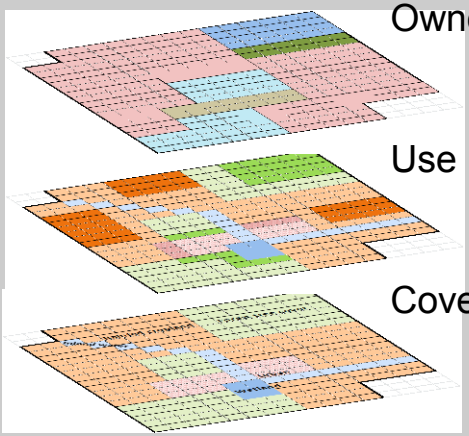
# Level 0: Account 1: Extent

- **What?**
  - ***Ecosystem assets*** *are spatial areas containing a combination of biotic and abiotic components and other characteristics that function together* (SEEA-EEA Sections 2.31, 4.1)
  - **National** coverage of land cover, land use, ownership (terrestrial, freshwater, coastal and marine areas)
- **Why?**
  - Land management, conservation policies
  - Spatial foundation for other accounts
    → basis for allocating macro data to spatial units
  - Builds on SEEA-CF (land, forest, water)
  - Indicators:
    - Land cover change → where changes occurring
    - Land cover/use intensity → who owns it

# Level 0: Account 1: Extent

- **What does an Extent Account look like?**

## Maps




## Tables

| Cover | Urban and associated | | Rainfed herbaceous cropland | | Forest tree cover | | Inland water bodies | | Open wetlands | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Use | Infrastructure | Residential | Permananet crops | Maintenance | Forestry | Protected | Infrastructure | Aquaculture | Maintenance | |
| Ownership | Government | Private | Private | Private | Private | Government | Government | Private | Government | |
| Units | hectares | | | | | | | | | |
| **Opening Stock** | | | | | | | | | | |
| Additions to Stock | | | | | | | | | | |
| *Managed expansion* | | | | | | | | | | |
| *Natural expansion* | | | | | | | | | | |
| Reductions to stock | | | | | | | | | | |
| *Managed regression* | | | | | | | | | | |
| *Natural regression* | | | | | | | | | | |
| **Closing stock** | | | | | | | | | | |

**Spatial units**
**Classifications**

# Level 0: Account 1: Extent

- **What does an Extent Account look like?**
  - An integrated spatial (GIS) database that overlays:
    - Land cover: forest, wetland, lake…
    - Use and intensity of use: agriculture, forestry, protected…
    - Ownership: business, private, government
  - Classified into **Spatial Units**
  - At high resolution (30m to 100m, maximum 500m) with national coverage
  - For two or more periods (change over time)
  - Based on comparable **Classifications**, quality, methods and **Spatial Units**
  - Units: hectares
  - Records: opening stock, closing stock, additions, reductions

# Level 0: Account 1: Extent

- **What do you need to compile an Extent Account?**
  - GIS platform: software, protocols, spatial units
  - Classifications: land cover, land use, ownership
  - National level data:
    - Existing land account would be useful
    - Satellite: land cover, aerial photography
    - Census: agriculture, population, settlements
    - Forest inventories
    - Hydrological, topographic (rivers, drainage areas, elevation, coastlines)
    - Cadastral (ownership, tax)
  - Expertise:
    - Land managers, ecologists, geographers (GIS, satellite imagery, integration)

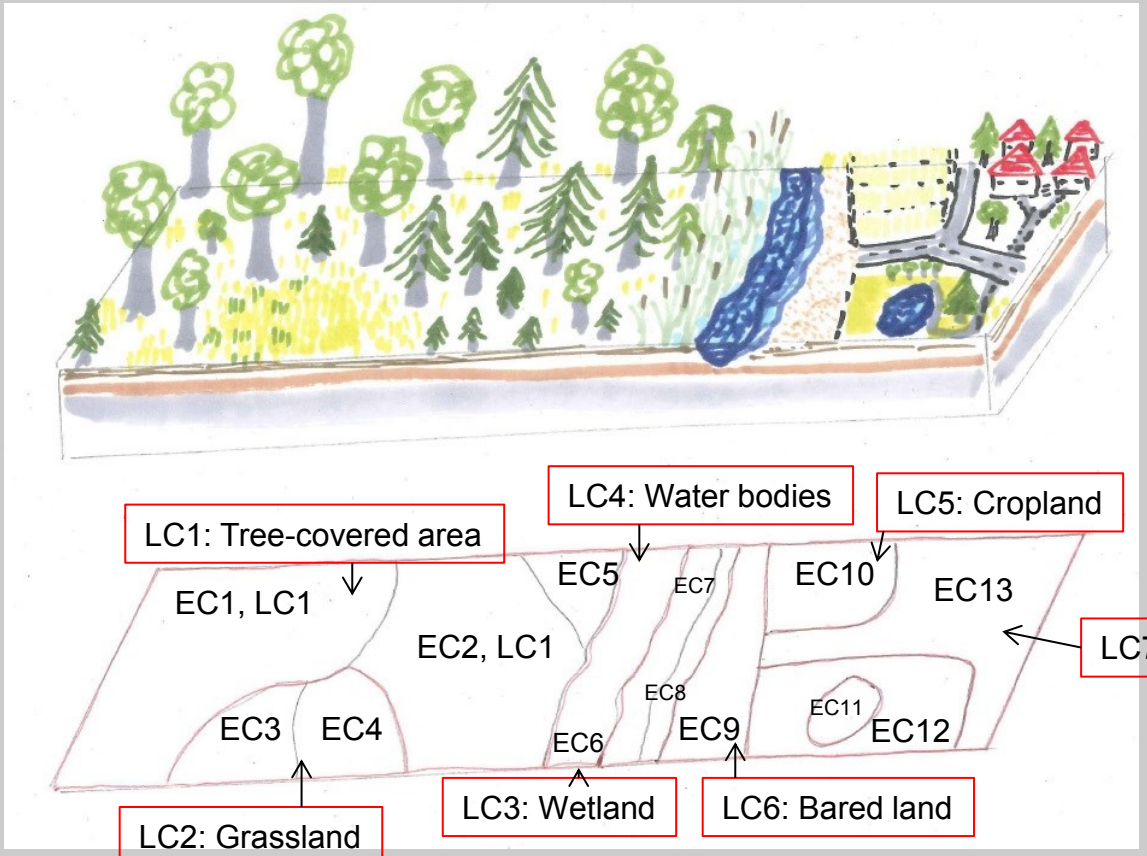
# Level 1: Account 1: Extent Account

# Level 1: Account 1: Extent

- Concepts:
  - Ecosystem types and their location:
    Extent measures
  - Land cover, land use and land ownership:
    Classifications in the SEEA
  - Compiling Extent Accounts:
    Opening stocks
    - Reductions
    + Additions
    = Closing stock

# Level 1: Account 1: Extent

- Ecosystem types can be derived from ecological classifications or from land cover data




What you see:

What you get:
Ecosystem = EC
Land cover = LC

# Level 1: Account 1: Extent

- Land cover, land use and land ownership

**Land cover classification** (SEEA-CF, Table 5.12, p.178)

1 Artificial surfaces (incl. urban and assoc. areas)
2 Herbaceous crops
3 Woody crops
4 Multiple or layered crops
5 Grassland
6 Tree-covered areas
7 Mangroves
8 Shrub-covered areas
9 Shrubs and/or herb. veg., aquatic or reg. flooded
10 Sparsely natural vegetated areas
11 Terrestrial barren land
12 Permanent snow and glaciers
13 Inland water bodies
14 Coastal water bodies and intertidal areas

**Land use classification** (SEEA-CF, Table 5.11, p. 176)

1.1 Agriculture
1.2 Forestry
1.3 Land used for aquaculture
1.4 Use of built-up and related areas
1.5 Land used for maintenance and restoration of environmental functions
1.6 Other uses of land n.e.c.
1.7 Land not in use
2.1 Inland waters used for aquaculture or holding facilities
2.2 Inland waters used for maintenance and restoration of environmental functions
2.3 Other uses of inland waters n.e.c.
2.4 Inland waters not in use

**Land ownership:** by industry (e.g. agriculture, mining) or by sector (e.g. public or private)

# Level 1: Account 1: Extent

- Compiling Extent Accounts (hectares)

| | 1 Artificial surfaces (including urban and | 2 Herbaceous crops | 3 Woody crops | 4 Multiple or layered crops | 5 Grassland | 6 Tree-covered areas | 7 Mangroves | 8 Shrub-covered areas | 9 Shrubs and/or herbaceous vegetation, | 10 Sparsely natural vegetated areas | 11 Terrestrial barren land | 12 Permanent snow and glaciers | 13 Inland water bodies | 14 Coastal water bodies and intertidal areas | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Opening Stock of Resources** | 14859 | 193019 | 0 | 14 | 135772 | 16830 | 0 | 11 | 504 | 0 | 0 | 0 | 9859 | 0 | 370868 |
| **Additions to stock** | | | | | | | | | | | | | | | |
| Managed expansion | | | | | | 3408 | | | | | | | | | 3408 |
| Natural Expansion | | | | | | | | | | | | | | | 0 |
| Upward reappraisals | | | | | | 120 | | | | | | | | | 120 |
| *Total additions to stock* | | | | | | | | | | | | | | | 0 |
| **Reductions in stock** | | | | | | | | | | | | | | | |
| Managed regression | | 3408 | | | | | | | | | | | | | 3408 |
| Natural Regression | | | | | | | | | | | | | | | 0 |
| Downward reappraisals | 112 | | | | | | | | | | | | 8 | | 120 |
| *Total reductions in stock* | | | | | | | | | | | | | | | 0 |
| **Clossing stock** | 14747 | 189611 | 0 | 14 | 135772 | 20358 | 0 | 11 | 504 | 0 | 0 | 0 | 9851 | 0 | 370868 |

Source: UNSD, Special tabulation.

# Level 1: Account 1: Extent

- Compilation Group Exercise (30m)
  - Situation:
    - Land cover units defined for two periods (Opening and Closing)
    - Need to calculate:
      - Land Cover **Opening** and **Closing** stocks,
      - Land Cover **Change** per class (with additions and reductions)
      - **Physical Account for Land Cover**
  - Objective (Groups of 3-5):
    1. Transfer Land Cover from map to table
    2. Calculate Land Cover Change Matrix
    3. Calculate Physical Account for Land Cover
    4. Report and discuss results

# Level 1: Account 1: Extent

## Group Exercise: Step 1 – Calculate Land Cover

**Opening Land Cover**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| M | M | M | M | M | S | G | G | S | S |
| G | M | M | S | S | S | G | S | S | S |
| T | G | S | G | G | G | G | S | S | S |
| T | G | A | A | G | G | S | T | T | T |
| T | G | A | A | A | A | T | T | T | T |
| T | T | T | A | A | A | C | C | C | T |
| E | T | A | P | P | A | A | C | C | T |
| S | S | A | P | P | P | C | C | T | T |
| S | A | A | P | R | R | R | G | T | T |
| S | S | A | R | R | R | R | T | T | T |

**Closing Land Cover**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| P | M | M | M | M | S | G | G | S | S |
| G | M | M | S | S | S | G | S | S | S |
| C | G | S | G | G | G | G | C | C | S |
| C | C | A | A | G | G | S | C | C | T |
| C | G | A | A | A | A | C | C | C | T |
| T | T | T | A | A | A | C | C | C | T |
| E | T | A | A | A | A | A | C | C | T |
| S | S | A | A | P | P | C | C | T | T |
| S | A | A | P | R | R | R | G | T | T |
| S | S | A | R | R | R | R | T | T | T |

**Land Cover Table**

| Opening Land Cover | | Code | Count |
|---|---|---|---|
| Artificial surfaces | | A | |
| Crops (a) | | C | |
| Grassland | | G | |
| Tree covered area | | T | |
| Mangroves | | M | |
| Shrub covered area | | S | |
| Regularly flooded areas | | R | |
| Permanent snow, glaciers and inland water bodies | | X | |
| **Total** | | | |

| Closing Land Cover | | Code | Count |
|---|---|---|---|
| Artificial surfaces | | A | |
| Crops (a) | | C | |
| Grassland | | G | |
| Tree covered area | | T | |
| Mangroves | | M | |
| Shrub covered area | | S | |
| Regularly flooded areas | | R | |
| Sparse natural vegetated areas | | P | |
| Terrestrial barren land | | E | |
| Permanent snow, glaciers and inland water bodies | | X | |
| **Total** | | | **100** |

# Level 1: Account 1: Extent

## Group Exercise: Step 2 – Calculate Land Cover Change

### Land Cover Table

| Opening Land Cover | | Code | Count (ha) |
|---|---|---|---|
| Artificial surfaces | | A | |
| Crops | | C | |
| Grassland | | G | |
| Tree covered area | | T | |
| Mangroves | | M | |
| Shrub covered area | | S | |
| Regularly flooded areas | | R | |
| Sparse natural vegetated areas | | P | |
| Terrestrial barren land | | E | |
| Permanent snow, glaciers and inland water bodies | | X | |
| **Total** | | | **100** |

| Closing Land Cover | | Code | Count (ha) |
|---|---|---|---|
| Artificial surfaces | | A | |
| Crops | | C | |
| Grassland | | G | |
| Tree covered area | | T | |
| Mangroves | | M | |
| Shrub covered area | | S | |
| Regularly flooded areas | | R | |
| Sparse natural vegetated areas | | P | |
| Terrestrial barren land | | E | |
| Permanent snow, glaciers and inland water bodies | | X | |
| **Total** | | | **100** |

### Land Cover Change Matrix

**Table 1: Net Land Cover Change Matrix (hectares)**

| | | Closing Land Cover | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Artificial surfaces | Crops | Grassland | Tree covered area | Mangroves | Shrub covered area | Regularly flooded areas | Sparse natural vegetated areas | Terrestrial barren land | Permanent snow, glaciers and inland water bodies | **Opening** |
| **Opening Land Cover** | Code | A | C | G | T | M | S | R | P | E | X | |
| Artificial surfaces | A | | | | | | | | | | | |
| Crops | C | | | | | | | | | | | |
| Grassland | G | | | | | | | | | | | |
| Tree covered area | T | | | | | | | | | | | |
| Mangroves | M | | | | | | | | | | | |
| Shrub covered area | S | | | | | | | | | | | |
| Regularly flooded areas | R | | | | | | | | | | | |
| Sparse natural vegetated areas | P | | | | | | | | | | | |
| Terrestrial barren land | E | | | | | | | | | | | |
| Permanent snow, glaciers and inland water bodies | X | | | | | | | | | | | |
| **Closing** | | | | | | | | | | | | |

Note: Rows represent reductions in stock; columns represent deletions in stock

Record “No change” in diagonal
Rows = No change + Reductions
Columns = No change + Additions

# Level 1: Account 1: Extent

## Group Exercise: Step 3 – Calculate Physical Land Cover

### Land Cover Change Matrix

Table 1: Net Land Cover Change Matrix (hectares)

| | | Closing Land Cover | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Artificial surfaces | Crops | Grassland | Tree covered area | Mangroves | Shrub covered area | Regularly flooded areas | Sparse natural vegetated areas | Terrestrial barren land | Permanent snow, glaciers and inland water bodies | Opening |
| **Opening Land Cover** | Code | A | C | G | T | M | S | R | P | E | X | |
| Artificial surfaces | A | | | | | | | | | | | |
| Crops | C | | | | | | | | | | | |
| Grassland | G | | | | | | | | | | | |
| Tree covered area | T | | | | | | | | | | | |
| Mangroves | M | | | | | | | | | | | |
| Shrub covered area | S | | | | | | | | | | | |
| Regularly flooded areas | R | | | | | | | | | | | |
| Sparse natural vegetated areas | P | | | | | | | | | | | |
| Terrestrial barren land | E | | | | | | | | | | | |
| Permanent snow, glaciers and inland water bodies | X | | | | | | | | | | | |
| **Closing** | | | | | | | | | | | | |

Note: Rows represent reductions in stock; columns represent deletions in stock

Additions to (A) Artificial surfaces

### Physical Land Cover Account

Table 2: Physical Account for Land Cover

| | Artificial surfaces | Crops | Grassland | Tree covered area | Mangroves | Shrub covered area | Regularly flooded areas | Sparse natural vegetated areas | Terrestrial barren land | Permanent snow, glaciers and inland water bodies | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Opening Stock | | | | | | | | | | | |
| Additions to Stock | | | | | | | | | | | |
| Reductions in Stock | | | | | | | | | | | |
| Closing Stock | | | | | | | | | | | |

Note: Reductions are sum of row, excluding areas that remained the same

Additions = Column total – no change
Reductions = Row total – no change

# Level 1: Account 1: Extent

- Is everyone clear on the objectives?
- 30 minutes group work
- Please ask questions!
- Results:
  - Each group report:
    - Additions to Stock
    - Reductions in Stock
    - What were the largest sources of change?

Table 2: Physical Account for Land Cover

| | Artificial surfaces | Crops | Grassland | Tree covered area | Mangroves | Shrub covered area | Regularly flooded areas | Sparse natural vegetated areas | Terrestrial barren land | Permanent snow, glaciers and inland water bodies | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Opening Stock | | | | | | | | | | | |
| Additions to Stock | | | | | | | | | | | |
| Reductions in Stock | | | | | | | | | | | |
| Closing Stock | | | | | | | | | | | |

Note: Reductions are sum of row, excluding areas that remained the same

# Level 2: Account 1: Extent Account

# Level 2: Account 1: Extent

- **Learning objectives (Level 2)**
  - Understand the important conceptual issues:

    More detail than Land Cover may be needed

    Introduction to the EU (Ecosystem Unit)
  - Understand the data options and sources

    In relation to scale of analysis, pilot project objectives, available resources
  - Be aware of how other countries have approached measuring extent

    EU's MAES process, Canada's MEGS, Australian land accounts

# Level 2: Account 1: Extent

- Ecosystem Units (EU)
  - Can also be defined by the structural elements of terrestrial and aquatic ecosystems
    - Terrestrial – plant community associations (or vegetation complexes), following Brown-Blanquet classification model
    - Aquatic – habitat or biotic communities (such as corals, mussel banks, kelp, reefs etc.)
  - Can be aggregated into Land Cover classes in a nested hierarchy

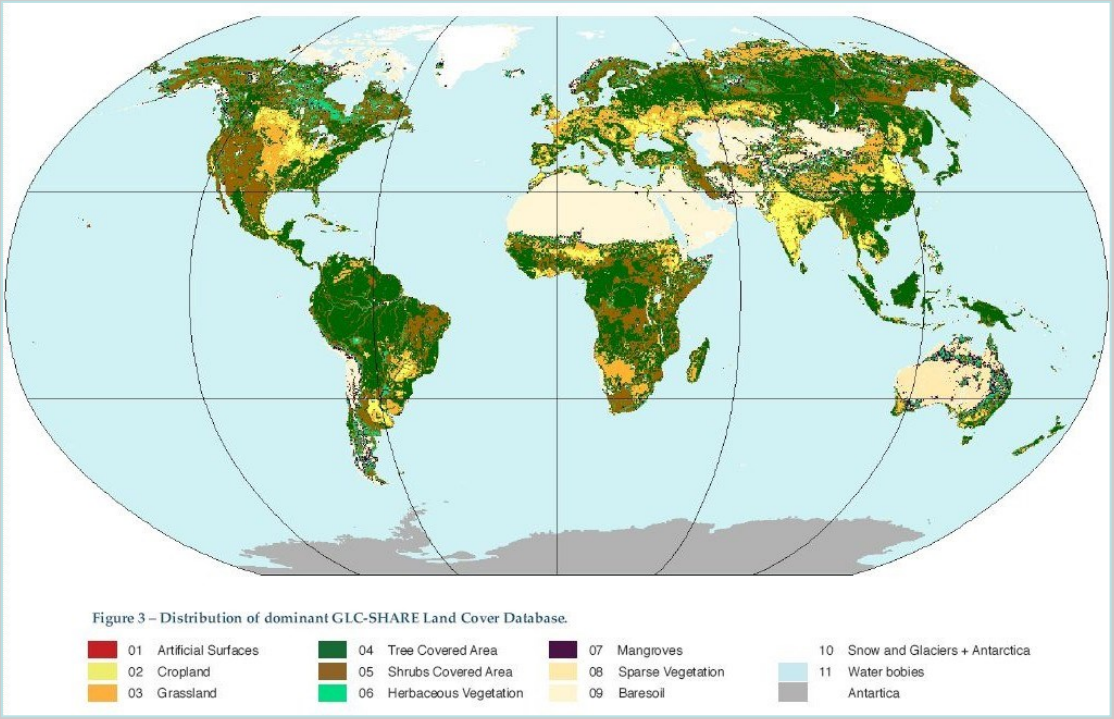
# Level 2: Account 1: Extent

- Data options for EU mapping
  - Detailed mapping of habitats and vegetation complexes would be best completed through *in-situ* inventories
  - Remote sensing can be applied to update the base map:
    - Very-high resolution remote sensing imagery (such as QuickBird and Ikonos) and aerial imagery
  - Intermediate solution: produce detailed land cover and use maps that distinguish vegetation types at the level of community (e.g. with dominant species)
    - Using High- and medium- resolution imagery such as Landsat, SPOT, etc.

# Level 2: Account 1: Extent

- Global land cover datase ts

**FAO Global Land Cover-SHARE**




The FAO product Global Land Cover-SHARE (year 2014 Beta-Release 1.0) is constructed using the best quality national and international data sources.

11 land cover classes were harmonized and reclassified according to the SEEA-CF land cover classification

http://www.glcn.org/databases/lc_glcshare_en.jsp

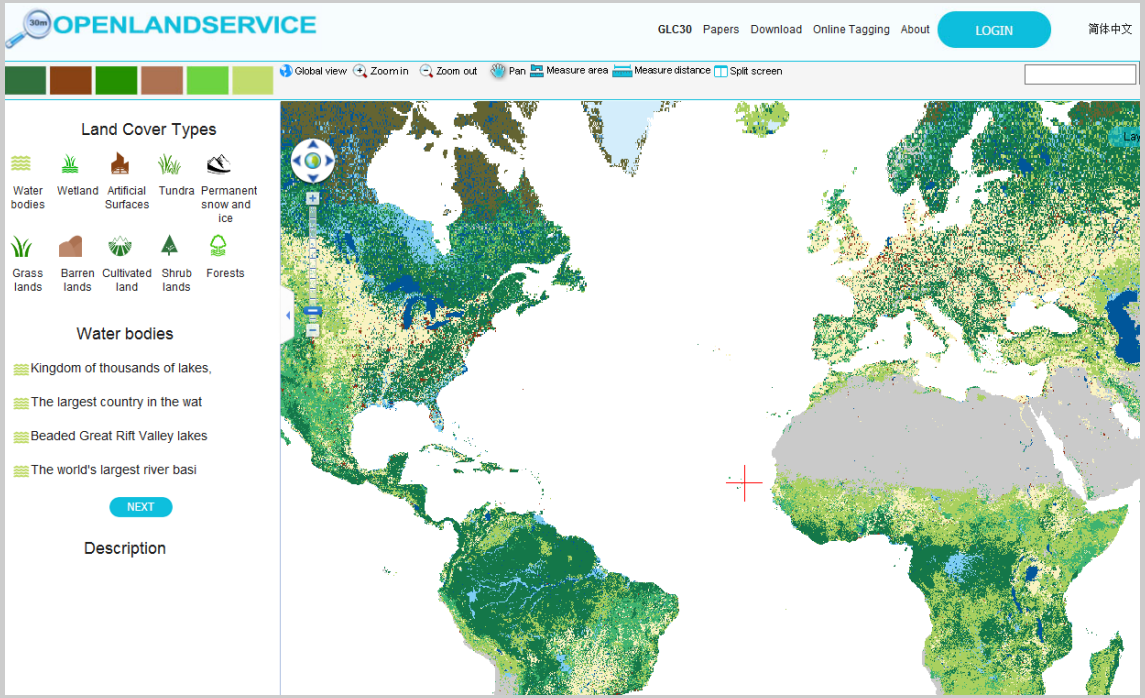
# Level 2: Account 1: Extent

- Global land cover datasets
- **MODIS Land Cover**
  - 'Land Cover Type Yearly L3' (version 51 is the latest)
  - Annual products based on NASA's MODIS imagery
  - Available at 500m x 500m spatial resolution.
    - Land Cover Type 1: IGBP global vegetation classification scheme
    - Land Cover Type 2: University of Maryland (UMD) scheme
    - Land Cover Type 3: MODIS-derived LAI/fPAR scheme
    - Land Cover Type 4: MODIS-derived Net Primary Production (NPP) scheme
    - Land Cover Type 5: Plant Functional Type (PFT) scheme
  - Downloadable from http://reverb.echo.nasa.gov/

# Level 2: Account 1: Extent

- Global land cover datasets

**GlobeLand30** (new product)

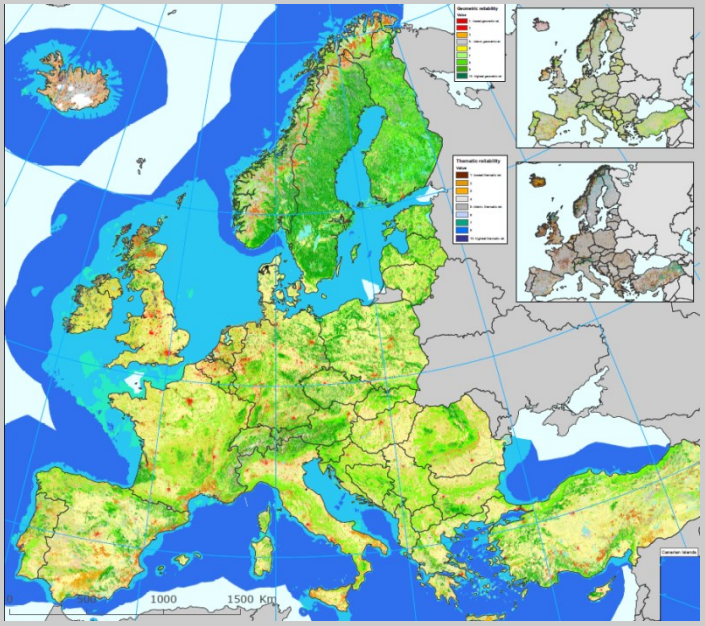



Very high resolution global land cover maps were produced by China, known as GlobeLand30, for years 2000 and 2010, with 10 classes and 30 m resolution, based on the freely available imagery from NASA's Landsat satellite instruments.

http://www.globallandcover.com/GLC30Download/index.aspx

# Level 2: Account 1: Extent

## EU (MAES) Ecosystem types:

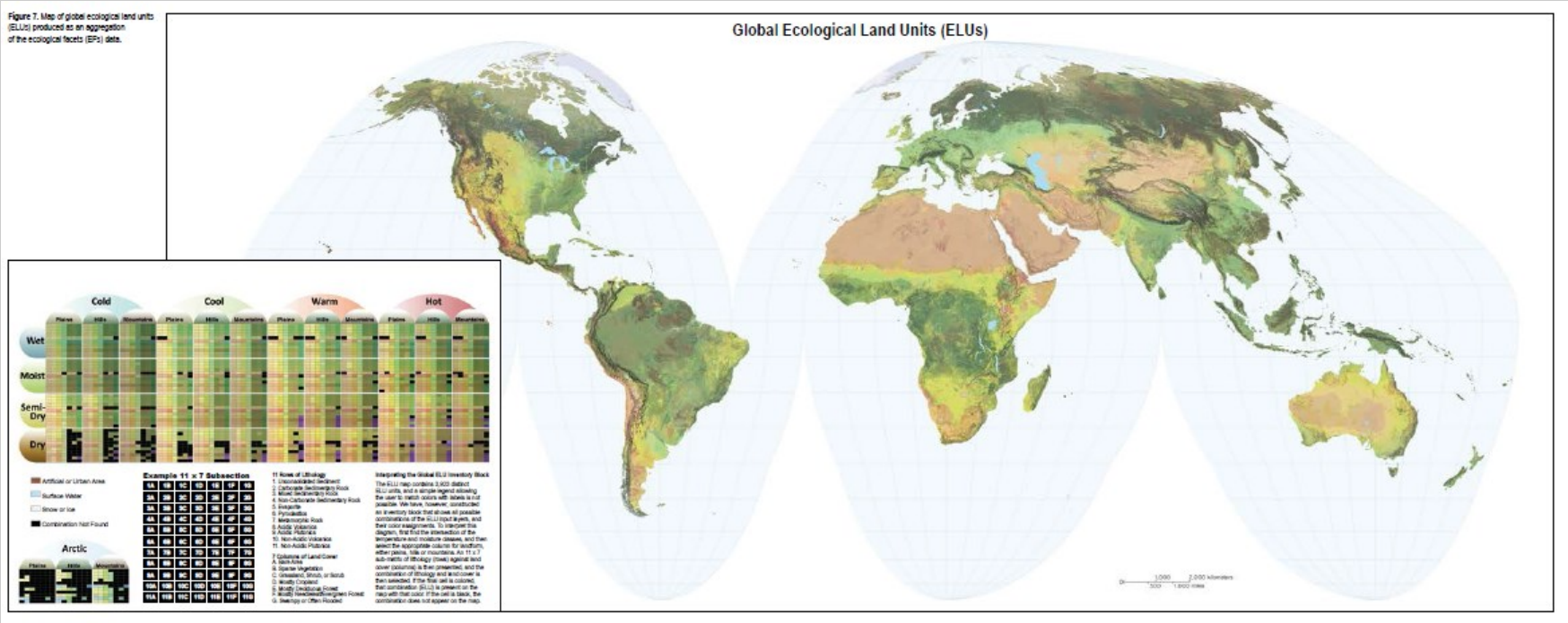



Source: European Environment Agency
**Spatial resolution:** 100*100 m
**Data sources:**
* CLC 2006, HRL sealing 2006, JRC-Forest 2006, OSM 2013
* CLC 2000 (Greece)
* EU-DEM
* ESDB, Art. 17 (2006), pot. nat. vegetation ((c) BfN),
* env- strata (Metzger)
* HANTS-MODIS (Alterra, GISAT)
**Crosswalk**
* CLC-EUNIS crosswalk, method: ETC-SIA (c) 2013

# Level 2: Account 1: Extent

## USGS/ESRI Global Ecological Land Units (2014)

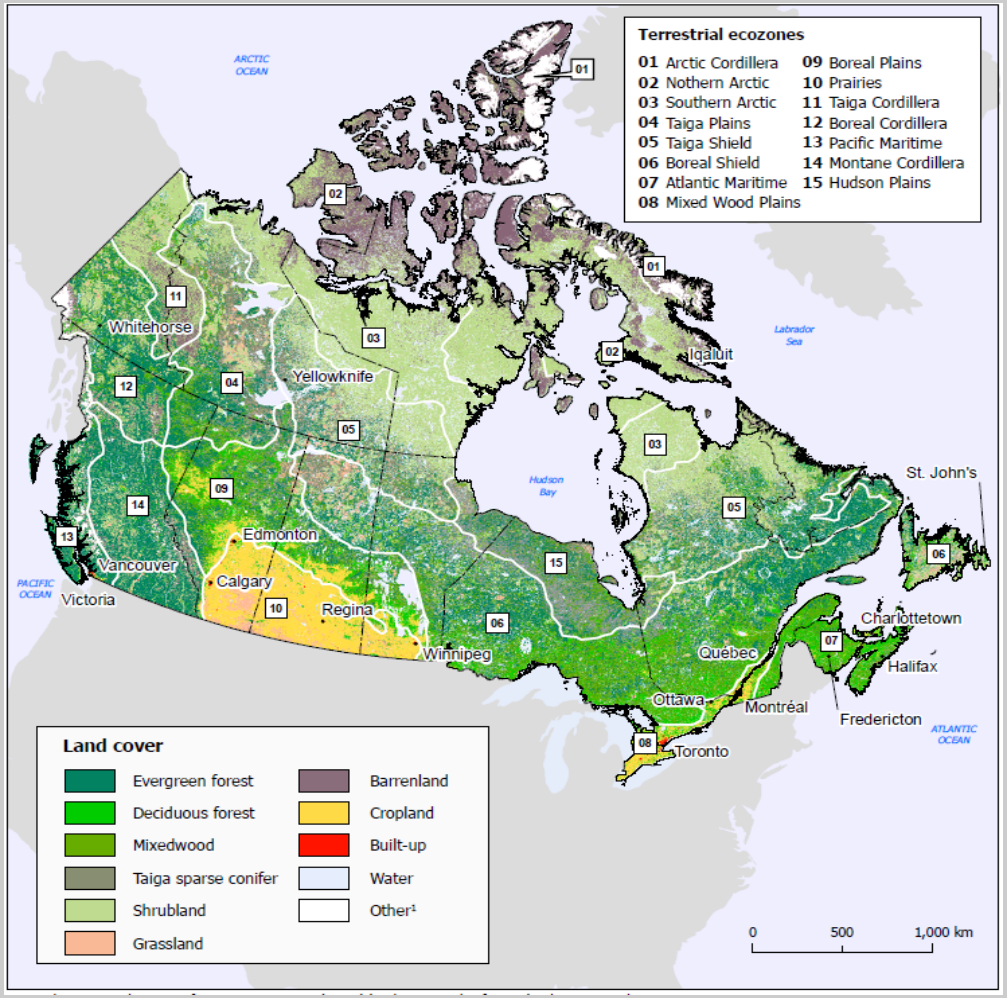
- Ecological classification based on bioclimate, land form, lithology (rocks) and land cover
- At 250m resolution




See: http://ecoexplorer.arcgis.com/eco/ available in ArcGIS Online

# Level 2: Account 1: Extent

- **Statistics Canada (Measuring Ecosystem Goods and Services – MEGS)**
- Based Extent Account on existing National Ecological Classification
- Further sub-divided Ecodistricts and Soil Landscape Units to EUs (See Spatial Units)
- Using MODIS (at 250m resolution), hydrology, topography, roads…



# Level 2: Account 1: Extent

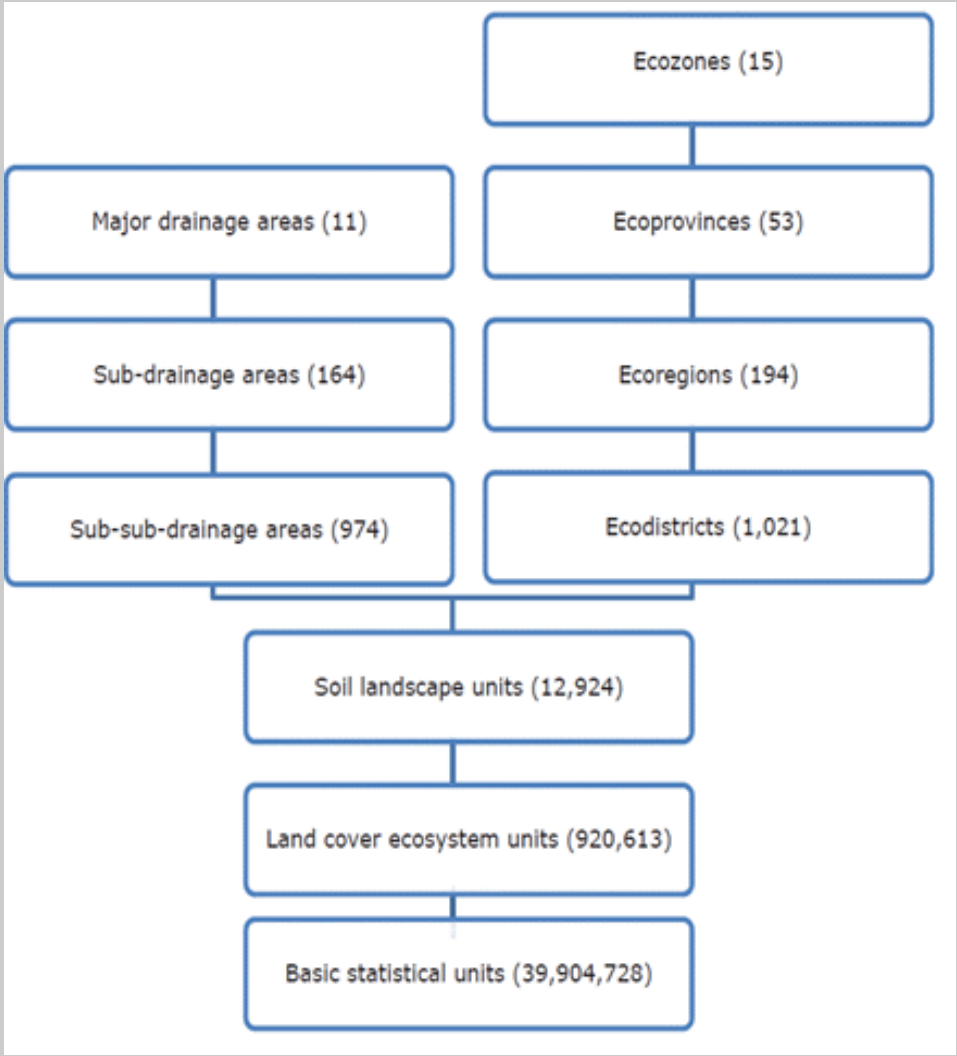
- Statistics Canada
  MEGS Spatial Infrastructure

- Developed a hierarchy of spatial units that was consistent with the SEEA-EEA classification

**ERA =**

**EU =**

**BSU =**



# Level 2: Account 1: Extent

- **Australia's Land Accounts**
- Based on MODIS 250m Land Cover, aggregating 25 classes to seven categories

| Australian Dynamic Land Cover | AEEA presentation |
|---|---|
| Built Up Areas | Built Up Areas |
| Rainfed Cropping<br>Rainfed Pasture | Rainfed cropping and pasture |
| Alpine Grasses - Open<br>Hummock Grasses - Open<br>Sedges - Open<br>Tussock Grasses - Open<br>Hummock Grasses - Sparse<br>Tussock Grasses - Sparse | Grasses and Sedges |
| Trees - Closed<br>Trees - Open<br>Trees - Scattered<br>Trees - Sparse | Trees |
| Irrigated Cropping<br>Irrigated Pasture | Irrigated cropping and pasture |
| Shrubs - Closed<br>Shrubs - Open<br>Chenopod Shrubs - Open<br>Shrubs - Scattered<br>Shrubs - Sparse<br>Chenopod Shrubs - Sparse | Shrubs |
| Extraction Sites<br>Inland Water bodies<br>Salt Lakes<br>Wetlands | Other |

# Level 2: Account 1: Extent

- Concepts group Exercise (15m) (Groups of 3-5)

1. What national data and classifications for Ecosystem Extent are already available for your country?
2. If there are no national ecological classifications, what data could you use to create an Ecosystem Extent Account?
3. Discuss and report your results

# Level 2: Account 1: Extent

- Concepts group Exercise (15m)

- Group reports:
  - National **data and classifications** for Ecosystem Extent already available for your country
  - Alternative sources of data for Ecosystem Extent Accounts?
- Discussion
  - Who would need to participate in creating a pilot Ecosystem Extent Account?

# Level 2: Account 1: Extent

- Discussion and questions
- Take home points
  - Land Cover data, classified by the recommended SEEA-EEA classification is a useful starting point for creating an Ecosystem Extent Account
  - Data need to be national and consistent
  - Alternatives exist to create more “optimal” units (such as the EU, based on ecological classifications
    - These can fit into the SEEA-EEA Land Cover classification
  - Global data for Land Cover and Ecological Units may be used if there is no national alternative

# Level 2: Account 1: Extent

- References


- EUROPEAN ENVIRONMENTAL AGENCY (EEA) (2006): Land accounts for Europe 1990–2000. Towards integrated land and ecosystem accounting. EEA report 11/2006, 107p, Copenhagen. (Authors: R. Haines-Young and Jean-Louis Weber)
- STATISTICS CANADA, 2013. Human Activity and the Environment: Measuring Ecosystem Goods and Services 2013. 16-201-XWE. Ottawa: Government of Canada
- AUSTRALIAN BUREAU OF STATISTICS, 2013. Land Account: Queensland, Experimental Estimates, 2013


- Further Information
  - SEEA Experimental Ecosystem Accounting (2012)
  - SEEA-EEA Technical Guidance (forthcoming)
    - Detailed supporting document on "Land Accounts and Ecosystem Extent" by UNSD

# Evaluation of the training module

- Please complete the online evaluation form for this module: http://tinyurl.com/pbopmy2
- For this module
  - What did you learn that you could apply in your work?
  - Was the presentation clear and informative?
  - Was it too simple? Too complex?
  - Was there anything you did not understand?
  - What additions or deletions would you suggest (recognizing that the unit is intended for a general audience)?
  - Do you have any suggestions as to how the SEEA-EEA may be improved (concepts, principles) in this area?

# Acknowledgements

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