System of Environmental Economic Accounting

Virtual Expert Forum on SEEA Experimental Ecosystem Accounting 2020

Session: Biophysical modelling

GUIDANCE ON BIOPHYSICAL MODELLING FOR ECOSYSTEM ACCOUNTING

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United Nations

Outline

- Purpose
- Scope, audience
- Process
- Overview of version 1.0.
  - Outline
  - Illustration of content
- Next steps

Purpose

- Why guidelines on biophysical modeling?
  - Data needed to assemble ecosystem accounts are not typically captured in data sources statistical offices rely on
  - Ecosystem accounting being spatially explicit requires mapping
    - regularly collected information used to measure ecosystem services (e.g. agricultural surveys) needs to be spatialized.
    - water quality (from monitoring stations)
- Niche
  - Guidance already exists e.g. how to select tooling (e.g. Invest, SWAT, ARIES, SolVES) (e.g. CI - Neugarten et al 2018), but none address specific needs of the statistical community.
- Challenges: (1) very rapidly developing field (2) SEEA EEA not stable yet (3) multi-disciplinary

Scope and audience

- Scope
  - Terrestrial ecosystems, including primarily terrestrial datasets, definitions, modelling approaches and challenges.
  - Biophysical, mostly on provisioning + regulating services
  - Core accounts (not carbon / species etc.)
- Audience
  - Ecosystem accounts compilers + managers
  - Assumes familiarity with SEEA Ecosystem Accounting, but does not assume knowledge of biophysical modelling.

Outline of the guidelines

1. Introduction
2. Process guidance for institutions
3. Modeling for ecosystem accounts
4. Modeling for extent accounts
5. Modeling for condition accounts
6. Modeling for ecosystem service accounts
7. Data quality
8. Future of biophysical modeling
9. Annexes
    1. Global data sources + data portals
    2. Modelling techniques
    3. Cartography essentials
    4. Literature list (16 pages)

Process

- Output of the Natural Capital Accounting and Valuation of Ecosystem Services project, developed under the auspices of the SEEA EEA Technical Committee.
- Editorial Board:
  - Rosimeiry Portela (Conservation International, Chair);
  - Stephanie Tomscha (Victoria University of Wellington, Editor),
  - Bethanna Jackson (Victoria University of Wellington),
  - Ken Bagstad (USGS),
  - Francois Soulard (Statistics Canada),
  - Justin Johnson (Stanford University),
  - Michael Bordt (former UNESCAP);
  - Lars Hein (Wageningen University);
  - Glenn-Marie Lange (World Bank).
  - Bram Edens (UNSD) acted as project manager and provided the secretariat to the Editorial Board.
- In addition, experts involved in the revision process of the SEEA EEA provided comments on are contributed to various drafts.

Selected content Chapter 2 – process guidance

- Based on SEEA implementation strategy
- 4 stages in continuous process

SEEA

Selected content Chapter 3

- Tiered approach -> recognizing countries in different circumstances
- To facilitate a progressive approach

Tier 1

Ecosystem services modelled from global datasets with no or little user input data

Tier 2

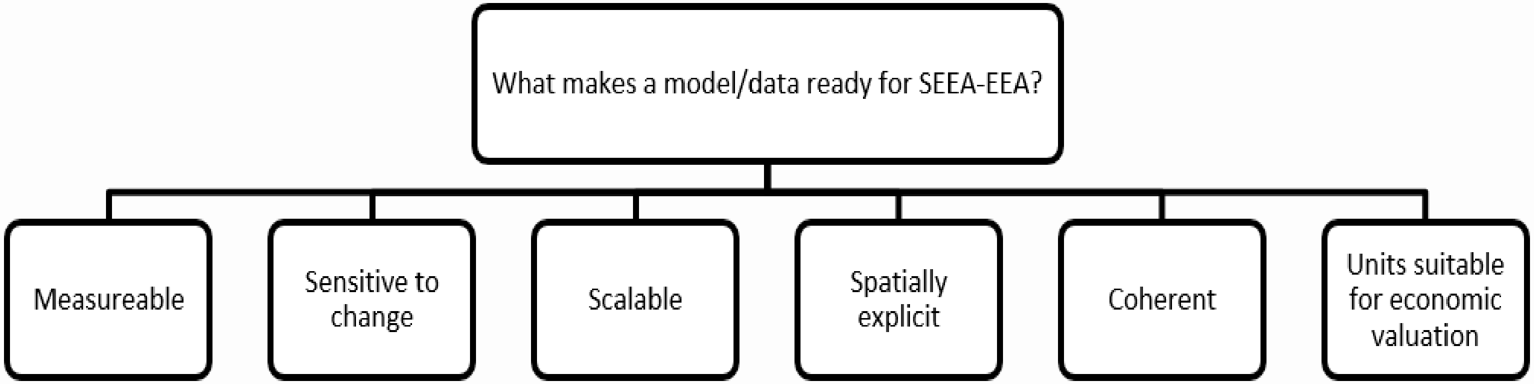
Ecosystem services modelled from national datasets customized for national contexts, some validation

Tier 3

Ecosystem services modelled with local data or direct surveys, better validation, and best available tools

Selected content Chapter 3

- Many models / platforms abound, but few developed with accounting objectives in mind
- Aligned with emerging ideas towards
  - ARD (analysis ready data – context of EO)
  - Accounting ready data



Selected content Chapter 3 - techniques

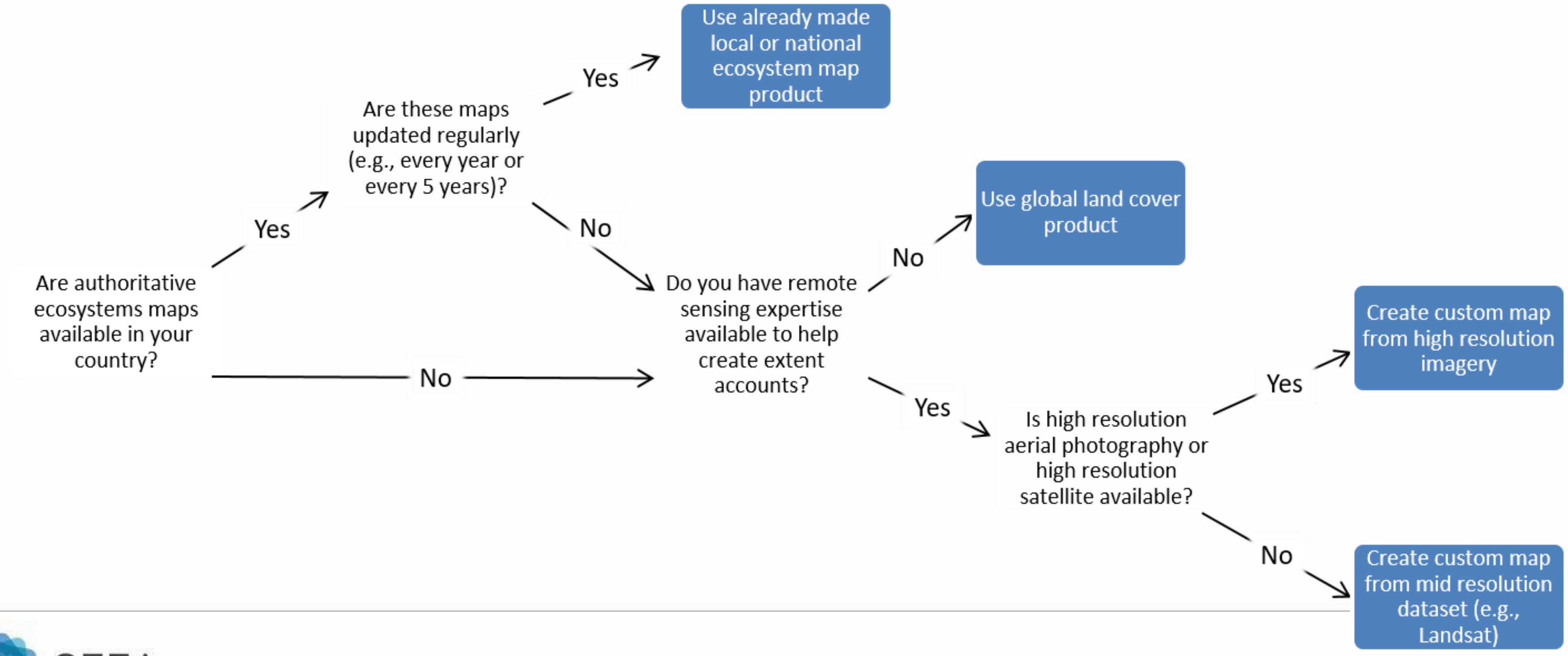
Model technique	Definition	Data needs	Efforts involved in applying the model
Lookup Table	Specific values for an ecosystem service or other variable are attributed to every pixel in a certain class, usually a land cover, land use, or ecosystem type class	Limited	Easy
Spatial interpolation	Creates surfaces from measured points	Moderate	Moderate
Geostatistical models	Statistical algorithms predict the value of un-sampled pixels based on nearby pixel values in combination with other characteristics of the pixel	Moderate	Moderate
Statistical models	Values of pixels are assigned based on a set of underlying variables. The relation between the value and the independent variables is developed with a regression analysis.	Moderate	Moderate
Dynamic systems (such as Process-based models)	Dynamic systems modelling uses sets of differential equations to describe responses of a dynamical system to all possible inputs and initial conditions. The equations include a set of state (level) and flow (rate) variables in order to capture the state of the ecosystem, including relevant inputs, throughputs and outputs, over time. Most process based models are examples of dynamic systems models that predict ecosystem services supply or other variables based on a mathematical representation of one or several of the processes describing the functioning of the ecosystem.	High	High
Machine learning	A type of artificial intelligence. Machine learning uses training data to build algorithms to make predictions without explicit programming.	Limited	Moderate

Selected content Chapter 3 – modeling platforms

Modelling platform	Primary goal of platform	Annual time step feasible	Spatially explicit	Scalable	Economic valuation tools	Coverage
ARIES (Villa et al 2014)	ARIES (Artificial Intelligence for Ecosystem Services). Provides easy access to data and models through a web-based explorer and using Artificial Intelligence to simplify model selection, promoting transparent reuse of data and models in accordance with the FAIR principles	Yes	Yes	Yes	Yes	Extent, Condition, Ecosystem Services
EnSym	EnSym (Environmental Systems Modelling Platform) is a decision support tool that is designed to answer questions about where organizations should invest in their natural resources. EnSym was specifically designed with SEEA EEA in mind.	Yes	Yes	Yes	No	Extent, Ecosystem Services
ESTIMAP (Zulian et al 2014)	ESTIMAP (Ecosystem Services Mapping tool) is tool for mapping ecosystem services in Europe	Yes	Yes	Yes	No	Ecosystem Services
InVEST (Sharp et al 2018)	A compilation of open-source models for mapping and valuing ecosystem services. InVEST is the flagship tool of the Natural Capital Project and has been the most widely used ecosystem service modelling tool globally.	Yes	Yes	Yes	Yes	Ecosystem Services, Condition
iTree	iTree is a tool developed by the USDA Forest Service with capabilities of modelling ecosystem services related to trees, particularly in urban settings (i.e., air filtration, carbon storage urban heat island mitigation, and rainfall interception and infiltration).	Yes	Yes	Yes	Yes	Ecosystem Services (forest related)
LUCI (Jackson et al 2013)	LUCI (Land Utilization Capability Indicator) provides a suite of high spatial resolution ecosystem services models designed to improve decision making around restoration and land management. LUCI is a hydrology-based tool and is well suited for mapping hydrologic process at high resolution.	Yes	Yes	Yes	No	Extent, Condition, Ecosystem Services (hydrological, soil)
SWAT (USDA ARS 2018)	SWAT (soil and water assessment tool) is a widely used watershed model for predicting the impact of land management on soil erosion and water quality	Yes	Yes, for Hydrological Response Units (i.e. semi distributed)	Yes	No	Ecosystem Services (hydrological + soil)

Selected content Chapter 4 - extent

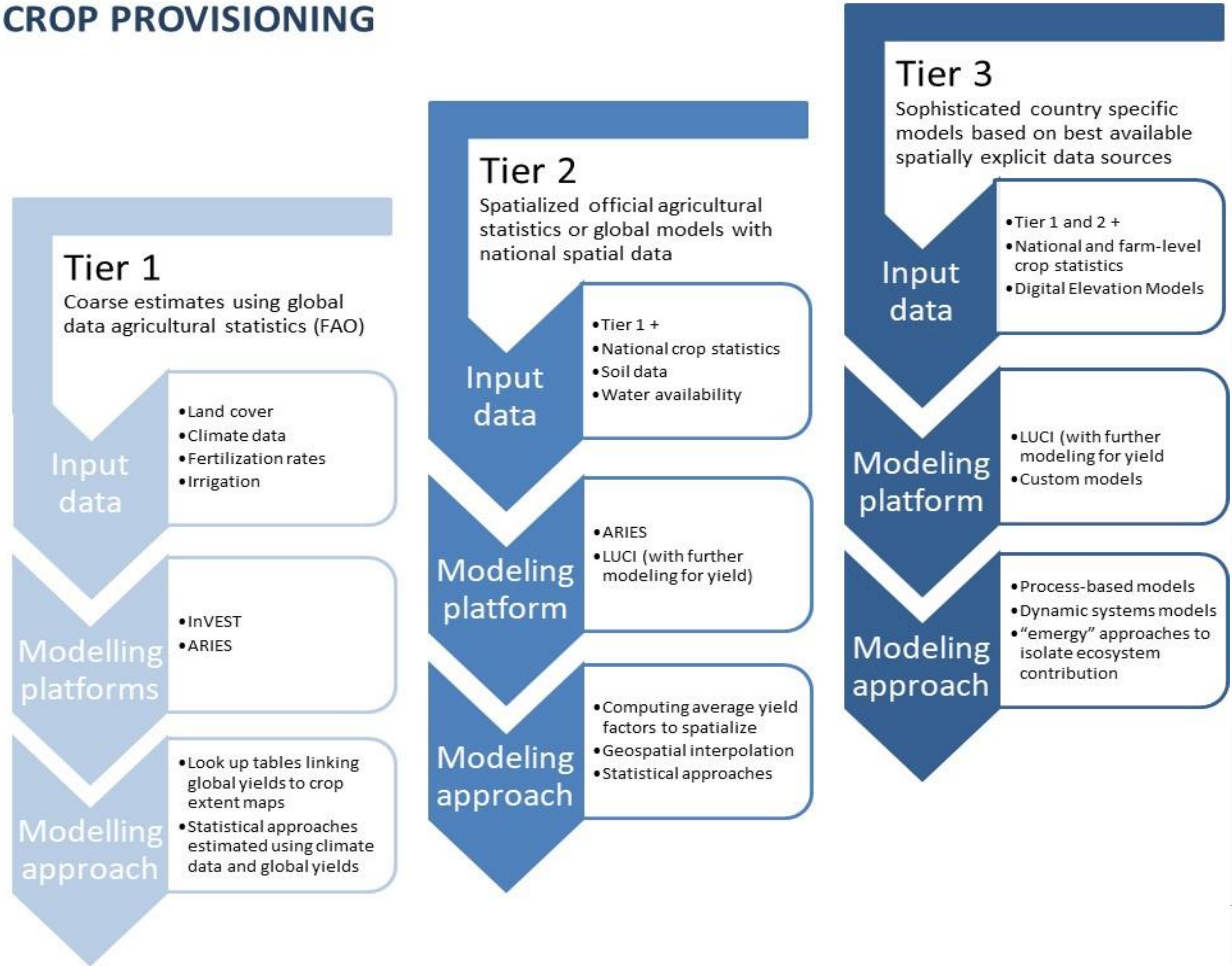
- IUCN GET as global reference classification, recognizing that many countries may have their own national classification
- Description of various global land cover products



Selected content Chapter 5 - condition

ECT groups	ECT class	Indicators category	Indicator examples
Abiotic ecosystem characteristics	1. Physical state characteristics (including soil structure, water availability)	Water availability	Hydrological flow
			Reservoir stock
			Groundwater table
		Soil	Impervious surface
			Soil Organic Carbon
	2. Chemical state characteristics (including soil nutrient levels, water quality, air pollutant concentrations)	Air quality	Pollutant concentrations
		Water quality	Pollutant concentrations
			Dissolved oxygen
			Chlorophyll-a
			Turbidity
		Soil quality	Nitrogen content
			Heavy metal content
Biotic ecosystem characteristics	3. Compositional state characteristics (including species-based indicators)	Species	Biodiversity
			Corals
			Macroinvertebrates
			Fish
			Birds
			Red-list indices/conservation status
	4. Structural state characteristics (including vegetation, biomass, food chains)	Vegetation /Biomass	
			Vegetation density
	5. Functional state characteristics (including ecosystem processes, disturbance regimes)	Processes	NPP
		Disturbance	Fire risk
			Invasive species
Landscape and seascape characteristics	6. Landscape and seascape characteristics (including landscape diversity, connectivity, fragmentation, embedded semi-natural elements in farmland)	Composition	Diversity
		Connectivity/fragmentation	Barrier density
			Patch size
			Shape

CROP PROVISIONING



Next steps

- Guidelines:
  - Versions 1.0 is ready, will be circulated to a wider group of experts (including participants of this Forum)
  - In October a revised version 2.0 made public for use and testing.
  - In 2021 after SEEA EEA is final, further feedback, global consultation and develop a final 3.0 version.
- (Ideas) Online live version of Annex (data portals - main global data sources)
- Ongoing discussions with data portals, modelling community, EO community (GEOBON, EO4EA) -> develop a strategy (e.g. towards interoperability and efficient "ecosystem")
- NB: all feedback is very welcome!
  - Contact: bram.edens@un.org; seea@un.org