

Earth Observation for Ecosystem Accounting

Bruno Smets (VITO)

Norway remote sensing seminar, 19 Jan 2023



Introduce VITO (1/2)

VISION ON TECHNOLOGY FOR A BETTER WORLD

VITO is an independent Flemish research organisation in the area of cleantech and sustainable development. Our goal? To accelerate the transition to a sustainable world.

THEMES



New value chains from renewable and circular resources

Process Transformation

TECHNOLOGIES

DATA SCIENCE

Data Architectures

Artificial Intelligence

Ethics and Trust



SUSTAINABLE LAND USE Water

> Remote sensing Air & climate Land use

REMOTE SENSING



Data Products & Services

Expertise



SUSTAINABLE HEALTH



Interfaces for electrical storage **Buildings & Districts** Energy markets & strategies Optimisation of thermal energy systems Circular economy strategies Getting value out of waste Structured materials

HEALTH

Health monitoring technologies

LAND, WATER & AIR

Software tools & models

SUSTAINABLE MATERIALS



See https://remotesensing.vito.be/





WATER AND COASTAL MANAGEMENT



Genomic selection & Trait development Breeding data Seed production data Farmers, Market, Competitors Regional & Global trends

Land cover 3.0 Policy support (i.e. grasslands) Forestry Essential Biodiversity Variables

Marine litter Water quality Atmospheric correction on water Coast/Harbour infrastructure

Ecosystem Extent (i.e. habitat maps) Ecosystem Condition Ecosystem Services Ecosystem Valuing



International & Europe

UNSD System of Environmental-Economic Accounting (SEEA)







European Natural Capital Accounting



Support mainstream of EA in Europe







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EO complexity problem for EA (e.g. DMP)

- the vast amount of EO data, image processing technology and applications can create barriers to the use of EO data in ecosystem accounting
- e.g. Dry Matter Productivity (DMP) represents the overall growth rate or dry biomass increase of the vegetation → is directly related to ecosystem Net Primary Productivity (NPP) → useful in Condition & Service accounts





Temporal profile of PROBA-V DMP products over site damaged by fires in 2019 in Spain. The green dashed line locates the date of the event.

Maps of PROBA-V Collection 300m DMP before (left) and after (right) the event in 2019: fire in Portugal (top) and

a vegetation re-greening after flood in Australia (bottom).

remote sensing

Contains modified Copernicus Service information [2022]



EO complexity problem for EA (e.g. DMP)

- to come from the satellite raw data to a validated and regularly updated DMP product is a complex workflow
- luckily, this processing is automated, and products are available via data providers like Copernicus Global Land Monitoring Service
- BUT still several collections exists & mainly global datasets in 10daily intervals
- → for accounting we need annual datasets and maybe further processing (e.g. reprojection, resampling, cutting to AOI, unit switch...) PLUS indicator of uncertainty







EO complexity problem (e.g. population grid)

- a variety of tools exist to help the user, but the lack of interoperability between these platforms pose a challenge and a risk of lock-in to the user
- Nevertheless, most of the existing tools/platforms are not optimized to the needs of EA which can lead to huge uncertainties in data processing (e.g. statistics extraction from absolute data sources like population grids)

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SEE
THEPioneer Earth Observation Applications (PEOPLE)BIGGER
PICTUREfor Ecosystem Accounting

Study the relevance of EO for ecosystem accounts **in terrestrial and freshwater ecosystems**, and develop, validate and showcase a number of advanced EO solutions to produce ecosystem accounts, in physical terms, on ecosystem extent, condition and services.

- 1. Conduct a comprehensive review of the opportunities and challenges to integrate Earth Observation in SEEA compliant national accounting on ecosystem extent, condition and services in terrestrial and freshwater ecosystems,.
- 2. Develop, validate and showcase, with some Early Adopters, a number of "EO for Ecosystem Accounting" demonstrators that show the value of Earth Observation in national ecosystem accounting of ESA/EU Member States.
- 3. Integrate EO data processing and analytics workflows on existing cloud computing platforms, following the FAIR principles, to enable their use by countries (NSOs and National Environmental Agencies).
- 4. Develop a R&D agenda that identifies the critical areas where further research is needed to bring EO-integrated solutions to the required level of accuracy and reliability for their adoptions in national ecosystem accounting.



PEOPLE-EA: Pioneer integrating more & setup European Tier-2/3 SEEA EA cloud service

Based on state-of-art technologies



process for Sentinel-2 <u>_</u> <u>@</u> #1 #4 #2 Search for Sentinel 2 Download all tiles fo tiles in Level 1C timespan of interest Researcher identifies study area Ħ #8 #7 #6 #5 Apply algorithme to the subset Create a subset in Resample to arget spatial

Traditional remote sensing product

import openeo from openeo.extra.spectral_indices import compute_indices

c=openeo.connect("openeo.cloud").authenticate_oidc()

s2 = c.load_collection('SENTINEL2_L2A',

temporal_extent=["2017-04-11","2020-12-31"], bands=["B04","B08","SCL"])

s2_cloudmasked = s2.process("mask_scl_dilation", data=s2, scl_band_name="SCL")

ndvi_cube_cloudmasked = compute_indices(s2_cloudmasked, ["NDVI"])

ndvi_10daily.polygonal_mean_timeseries(polygons).download("timeseries.csv")

SEE THE BIGGER PICTURE

The primary **Early Adopters** consist of National Statistical Offices (NSOs) and National Environment Agencies from EU/ESA Member states, which have the formal mandate of monitoring the selected ecosystems at national level and producing the proposed ecosystem accounts.

- a) participate actively to the project as an Early Adopters of the novel EO solution,
- b) contribute to the **refinement and consolidation of the user requirements**,
- c) participate to the **co-design of the EO solution** following a user participatory approach,
- d) facilitate **access to existing user data** (e.g., national data) that can support the development, production, validation and quality assessment of the EO data products,
- f) contribute to the validation and quality assessment of the demonstrators,
- g) perform an assessment of the **adequacy and suitability of the added value** for use in national Ecosystem Accounting,
- h) analyse the way to **integrate the results of the project into SEEA-EA processes and systems**, capitalising on existing activities undertaken by the Early Adopters;



Provisional list of accounts for PEOPLE-EA



Account/indicator	Extent	Condition	Services
Country			
Norway	Mapping rural ecosystem extent	Forest condition - Standing biomass	Global climate regulation,
	in 3 counties (tentatively Møre	- Disturbance (three counties)	wood provisioning,
	og Romsdal,		recreation infrastructure
	Irøndelag, Nordland ⁴ ;	Urban and peri-urban green (focus on Oslo)	
	Mapping urban and peri-urban extent		
	Year: 2021	Year ~2020	Year 2021

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