BioSpace25 - Biodiversity insight from Space
10 - 14 February 2025 | ESA-ESRIN | Frascati - Italy

From Uncertainty to Action: Integrating *In Situ* and Remote Sensing Campaigns for Open Biodiversity Data Products

tinyurl.com/biospaceuncertainty

Check out the workshop website

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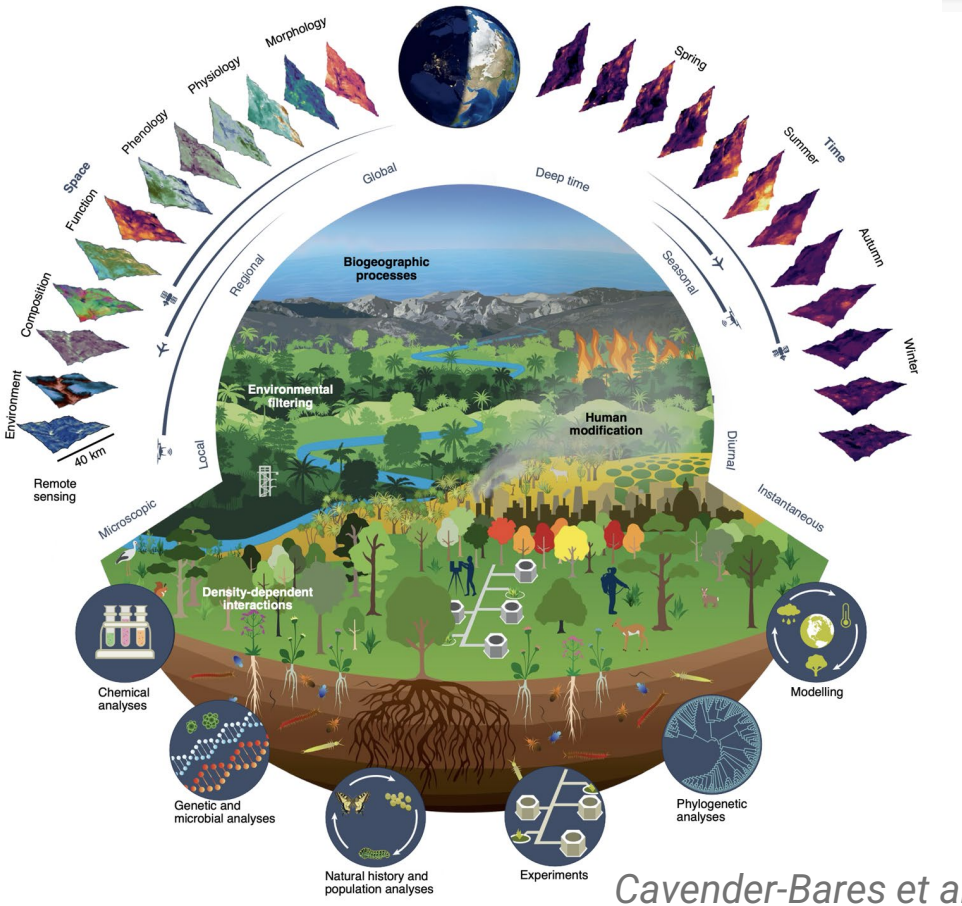
Why is this important?



Demand for biodiversity knowledge across society: Countries (GBF), land managers, sustainability reporting, nature-related finance

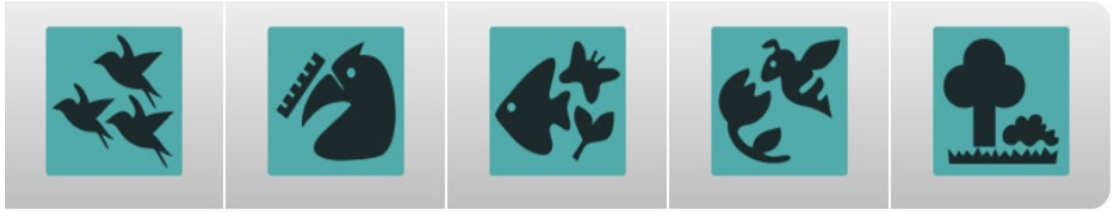
Most large-scale data products involve integration of *in situ* and Earth Observations

Seldom propagate or communicate uncertainties

Cavender-Bares et al. 2022

Workshop Objectives: The task of the breakout groups

- What applications of integrated *in situ*/RS biodiversity data products need better uncertainty quantification?
- What are the priorities to reduce uncertainty in integrated *in situ*/RS biodiversity data products?



Species populations | Species traits | Community composition | Ecosystem functioning | Ecosystem structure

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All materials are on the workshop website - check it out!

Workshop Finding/Recommendation 1: **Harness existing data**

Existing *in situ* data needs to be mobilised, harmonised and standards and protocols developed for key variables to be collected in the future

Problem: Much in-situ data exist but are scattered, inconsistently formatted with inconsistent metadata and a lack of standardisation in data collection protocols. Data harmonization is resource intensive and under-invested.

Recommendations:

- Community: Incentivize open *in situ* data
- Agencies: Mandate open *in situ* data
- Enhance and invest in harmonization efforts to allow existing datasets to be aligned with standardized formats
- Ensure common standards and protocols for *in situ* data collection
- Promote common metadata standards ensure these accompany data
- Ensure future *in situ* data is collected in a way that aligns with SRS (e.g. multi-scale sampling)
- Train local scientists, build local capacity for data collection, and empower local communities to create SRS-aligned data

Workshop Finding/Recommendation 2: **Develop uncertainty methods**

Develop methods for propagation of uncertainty through processing steps from in-situ and SRS data

Problem: Uncertainties exist at all levels (e.g., measurement, model assumptions, sensor calibration) but are rarely communicated effectively. *In situ* data are treated as “truth,” but they vary.

Recommendations:

- Develop methods for propagating uncertainty through different processing levels
- Improve training & education in uncertainty propagation and analysis
- Ensure that uncertainty estimates are transparently included in final EO products - provide explicit uncertainty layers or confidence measures alongside gridded products
- Standards for uncertainty estimation and reporting standards are essential to facilitate fair downstream consideration
- Enable community integration to encourage knowledge sharing between *in situ* and SRS data communities.
- Develop guidance on how to interpret and use uncertainty information effectively.
- Encourage user engagement to ensure uncertainty estimates are accessible and actionable

Workshop Finding/Recommendation 3: **Fill gaps**

Fill *in situ* data gaps

Problem: Large geographic, ecosystem- and variable-specific gaps exist in in-situ measurements

Recommendations:

- Prioritize new observations in underrepresented regions and ecosystems, such as savannahs, semi-arid grasslands, tropical regions, Africa, and South America.
- Use value of information approaches e.g. sensitivity of products to new observations to strategize new data collection.
- Consider shifting the mandate of agencies to include the necessary *in situ* data collection
    - Inter-agency and intergovernmental coordination and leadership is necessary to unlock much existing data
    - Learn from successful models of global coordination for *in situ* data (e.g., Aeronet)
- **There was a near-unanimous vote to prioritize *in situ* data mobilisation over new satellite development**

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