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

Workshop Organisers

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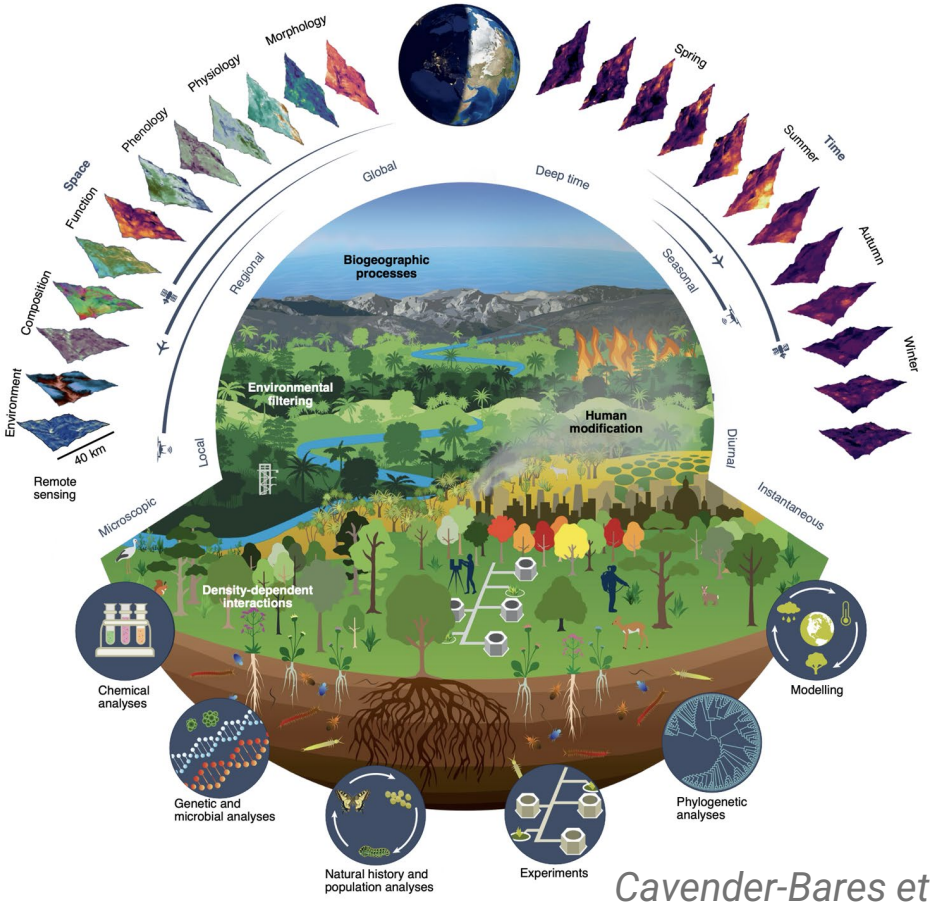
Agenda

Session 1: 15:00 - 16:30	
15:00 - 15:30	Welcome and setting the scene presentations
15:30 - 16:30	Breakout discussion
Coffee Break: 16:30 - 17:00	
Session 2: 17:00 - 18:30	
17:00 - 18:15	Breakout group reporting back and plenary discussion
18:15 - 18:30	Reflections and wrap up

Integrating *in situ* (field data) with Earth Observations



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

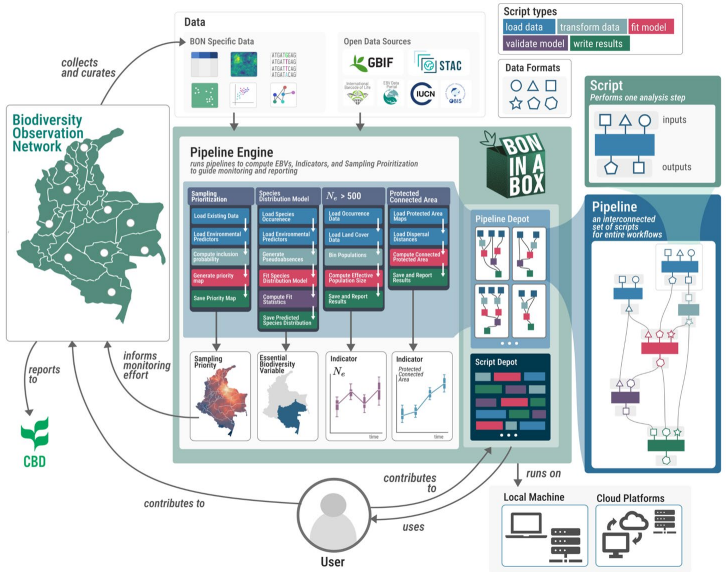
Most large-scale data products involve integration of *in situ* and Earth Observations

Seldom
propagate or communicate
uncertainties

Cavender-Bares et al. 2022

Collecting and using *in situ* data for uncertainty reduction

- Individual Research Projects
  - Valuable but fragmented and difficult to generalize.
- Long-Term Ecological Research (LTER):
  - e.g. eLTER and ICOS in Europe, TERN in Australia, NEON in US, CERN in China and SAEON/EFTEON in South Africa
  - GERI bring together LTER data for international analysis.
- Data Aggregators / Infrastructure
  - e.g. GBIF (Global Biodiversity Information Facility), TRY (plant trait database), OBIS (marine biodiversity), eBird, and iNaturalist facilitate broader data sharing.
- Biodiversity Observation Networks (BONs)
  - modular solutions for in situ biodiversity monitoring.
- Field Campaigns
  - Targeted field data collection

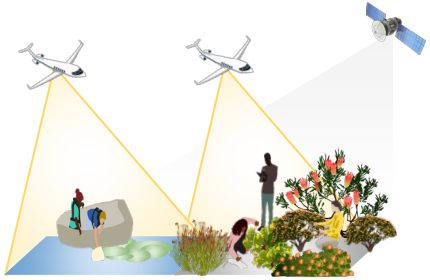


BON-in-a-Box Pipeline https://doi.org/10.32942/X2M320

New Data Collection Initiatives - Field Campaigns

Targeted, time-bound, and systematic data collection initiatives

- NASA Carbon Cycle & Ecosystems / Biological Diversity Program
  cce.nasa.gov/biodiversity



Expanding Temporal Coverage
NASA SHIFT campaign
Weekly imaging spectroscopy and repeated field observations to assess temporal reflectance variation with corresponding ecological variation

Expanding spatial & biological coverage
NASA BioSCape campaign
imaging spectroscopy with diverse biodiversity observations over South Africa
bioscape.io

Workshop Objectives: The task of the breakout groups

Outcome = recommendations for future investment:

- 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?

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

tinyurl.com/biospaceuncertainty

Uncertainties in *data* (*in situ* & remotely sensed)

Spatial/temporal uncertainties

- gaps in data coverage
- pre-processing uncertainties
- imprecise or inaccurate locations, timings, trajectories
- mismatching resolutions or extents
- conceptual/process uncertainties regarding what are sensible scales

Thematic uncertainties

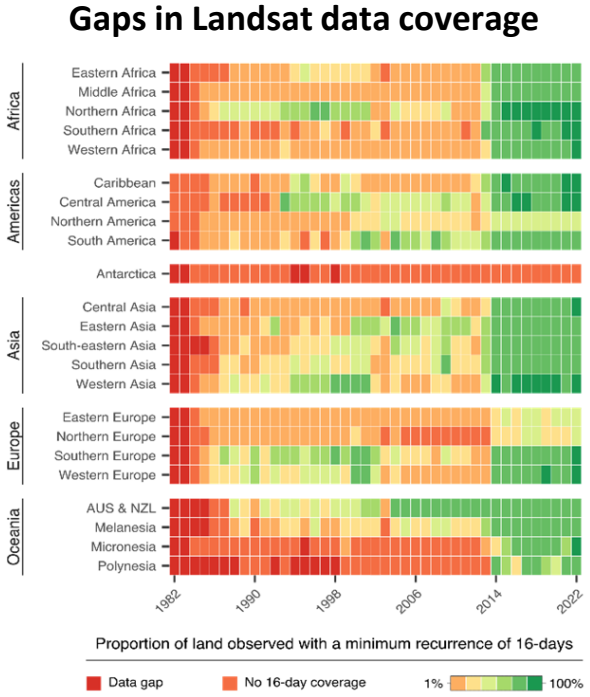
- ambiguous terms or definitions (e.g., taxon or ecosystem names) leading to uncertainty on which concepts were (or should be) adopted

Methodological Uncertainty

- Different preprocessing models, sensors, field sampling methods

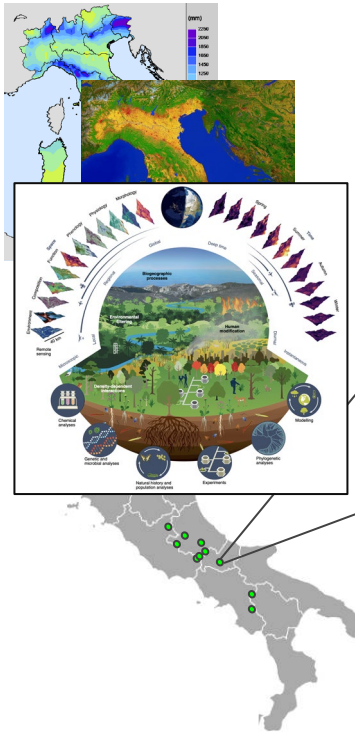
...

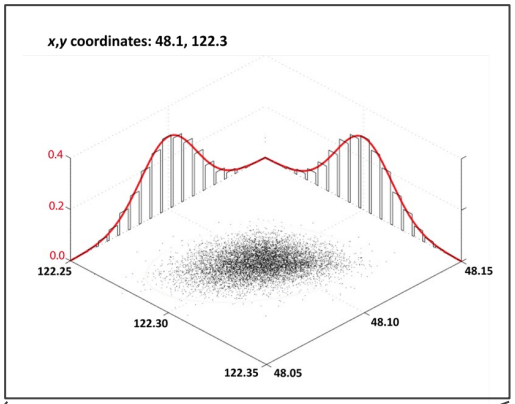
Uncertainties are often distributed non-randomly (... bias!)

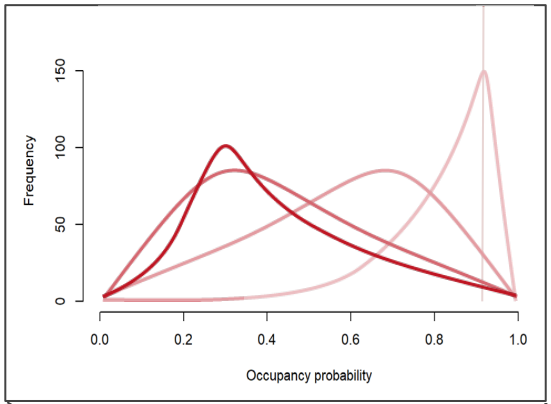


Remelgado et al., preprint at: is.gd/ISKVIP

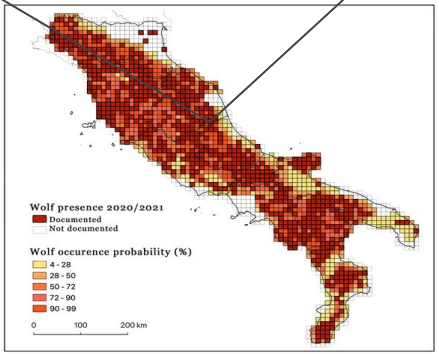
Uncertainties in gridded *products*







Some type of modelling



Future investments to reduce uncertainty

Role of space agencies, funding bodies, and researchers in addressing uncertainties

- Standards/Conformity
- Traceability
- Transparency
- Reporting
- Governance

Image by OpenAI

Workshop Objectives: The task of the breakout groups

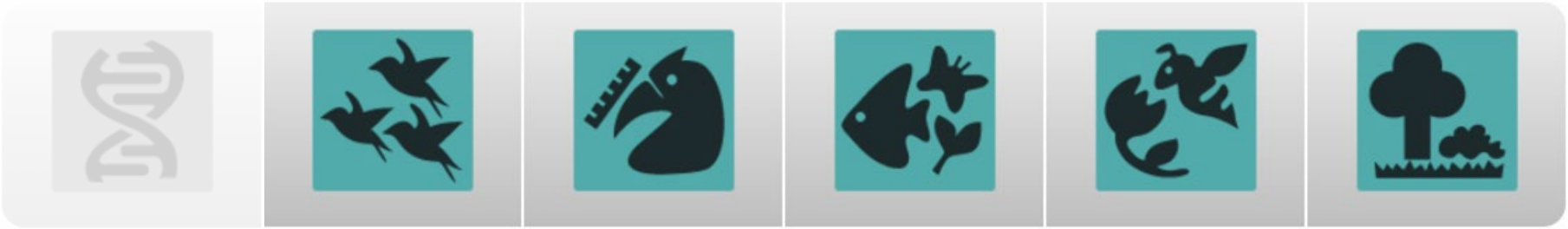
Outcome = recommendations for future investment:

- What applications of integrated *in situ*/RS biodiversity data products need better uncertainty quantification?
  - What is already there and could be built on?
  - How can we make uncertainty more palatable for different end users?

- What are the priorities to reduce uncertainty in integrated *in situ*/RS biodiversity data products?
  - What are the spatial, temporal, and biodiversity facet-specific priorities?
  - How can we maximize the utility of data collected in field campaigns?

Breakout groups

Essential Biodiversity Variables (EBVs)



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

- Where are we now: State of uncertainty for data products for this EBV?
- Where do we go: Priorities for improving uncertainty for this EBV?

Breakout Groups: two key questions

- **What are the key uncertainties associated with integrating existing *in situ* and remote sensing data for your variable and application?**
  - *Why* do we need to capture uncertainties (e.g. what applications need this information)?
  - For your variable and application, which types of uncertainties are currently tackled and how well/often is this done?
  - What are *tolerable levels of uncertainty* for each application of gridded products of your variable?

- **What are your recommendations for investment in new data collection to reduce uncertainty for your noted applications?**
  - *Where* would you focus new observations?
  - *What* would you measure there?
  - Would you prioritise *spatial* or *temporal* or *spectral* coverage, or something else?
    - Other priorities: e.g. is capacity building and/or integrating existing data and/or harmonisation more important here than new data, new sensors/technology?

Breakout Groups: Shared notes

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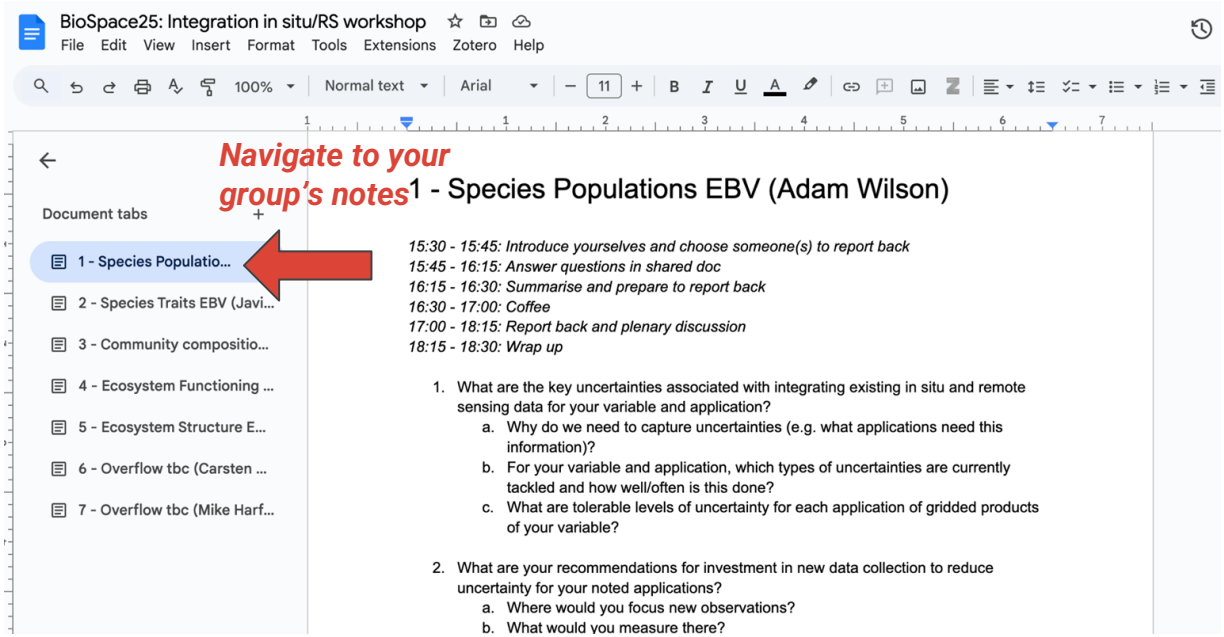

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Breakout groups: Structure

- Each breakout group has a facilitator
  - Help them keep things moving - don’t get too stuck on questions
  - Help them take notes in the shared doc - good notes are invaluable

15:30 - 15:45	Introduce yourselves and choose someone(s) to report back
15:45 - 16:15	Answer questions in shared doc
16:15 - 16:30	Summarise and prepare to report back
16:30 - 17:00	Coffee
17:00 - 18:15	Report back and plenary discussion
18:15 - 18:30	Wrap up

Breakout groups: Code of conduct

Respect & Professionalism

- Listen actively and respect diverse perspectives—allow others to speak without interruption.
- Communicate constructively—critique ideas, not people; harassment or discrimination will not be tolerated.

Inclusion & Collaboration

- Encourage participation and accommodate different communication styles.
- Be welcoming—value diversity and ensure all voices are heard.

Curiosity & Learning

- Ask questions and challenge assumptions—stay open to new ideas.
- Embrace feedback as a tool for growth and innovation.

Breakout Groups: tinyurl.com/biospaceuncertainty

Stage	
 **1 - Species Populations EBV** (Adam Wilson)	**2 - Species Traits EBV** (Javier Pacheco-Labrador) 
 **3 - Community composition EBV** (Christian Rossi)	**4 - Ecosystem Functioning EBV** (Erin Hestir) 
 **5 - Ecosystem Structure EBV** (Kyla Dahlin)	**6 - Overflow tbc** (Carsten Meyer) 
 **7 - Overflow tbc** (Mike Harfoot)	