OBSGESSION Observation of Ecosystem Changes for Action

# Observation of Ecosystem Changes for Action (OBSGESSION)

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# The Call & the Consortium

- Finnish Environment Institute (Syke)
- Universiteit Twente (UT-ITC)
- UN Environment Programme World Conservation Centre (UNEP-WCMC)
- University of Zurich (UZH)
- Lund University (ULUND)
- Vlaamse Instelling Voor Technologisch Onderzoek N.V. (VITO)
- STICHTING WAGENINGEN RESEARCH (WR)
- Centre National de la Recherche Scientifique (CNRS)
- Pensoft Publishers (PENSOFT)
- Brockmann Geomatics (BG)
- Brockmann consulting GmbH (BC)

## Call

HORIZON-CL6-2023-BIODIV-01-3 — Interdisciplinary assessment of changes affecting **terrestrial and freshwater ecosystems**, building on observation programmes, RIA, **6M€**

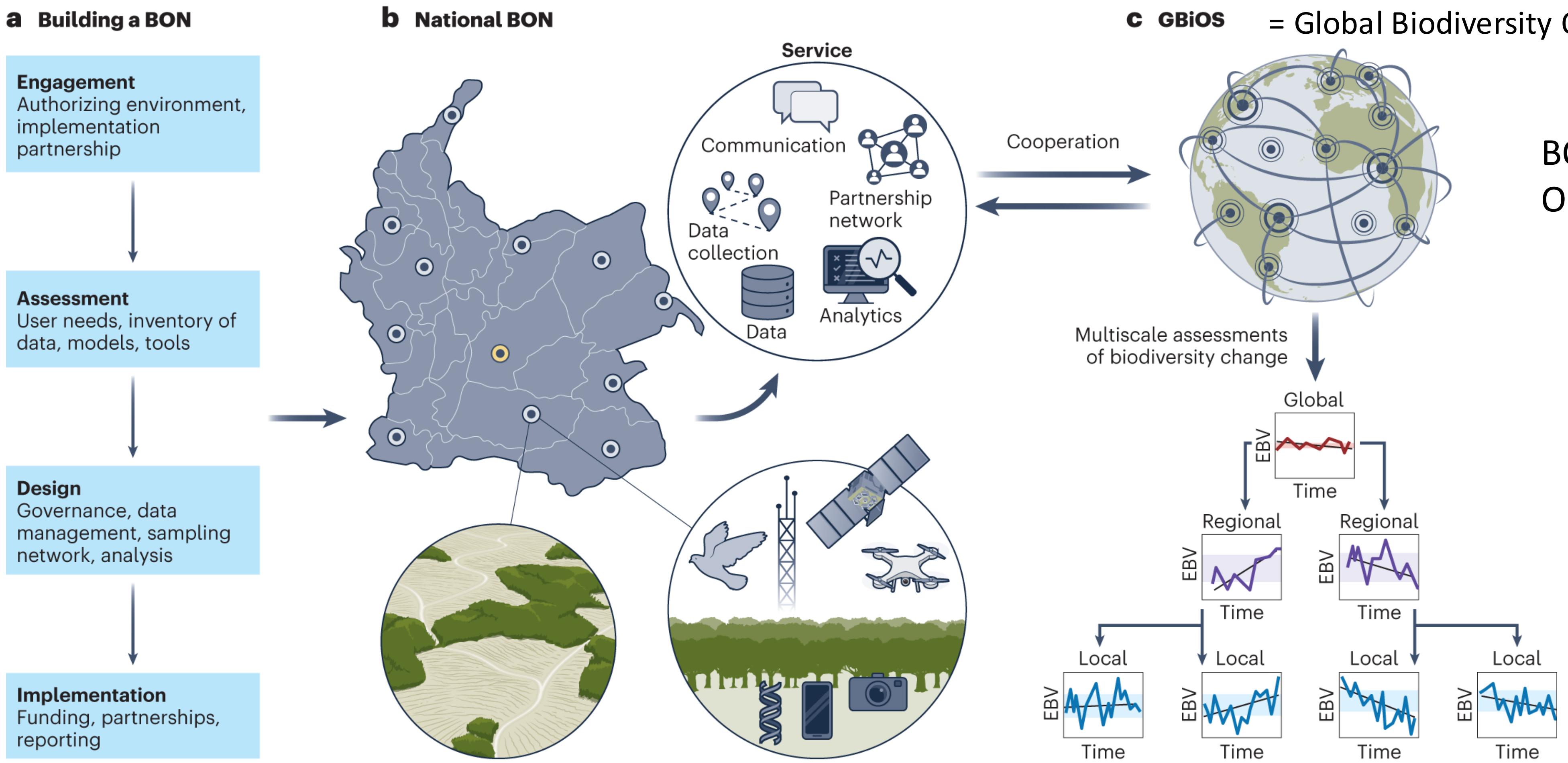
## Key words

RS-EBVs, Earth Observation, in situ, ecological models, detection & attribution, ecosystem change, biodiversity

### Project numbers

| 11 | 7 | 4 | ~7.3 million EUR |
| --- | --- | --- | --- |
| Project partners | Countries | Years duration | Financial contribution |

# A global biodiversity observing system needed




= Global Biodiversity Observation System

BON = Biodiversity Observation Network

**Fig. 1: A GBiOS as a global network of interconnected national and regional BONs to assess biodiversity trends worldwide.**

Gonzalez, A., Vihervaara, P., Balvanera, P. *et al.* A global biodiversity observing system to unite monitoring and guide action. *Nat Ecol Evol* (2023). https://doi.org/10.1038/s41559-023-02171-0

# Modelling of detection and attribution of biodiversity change

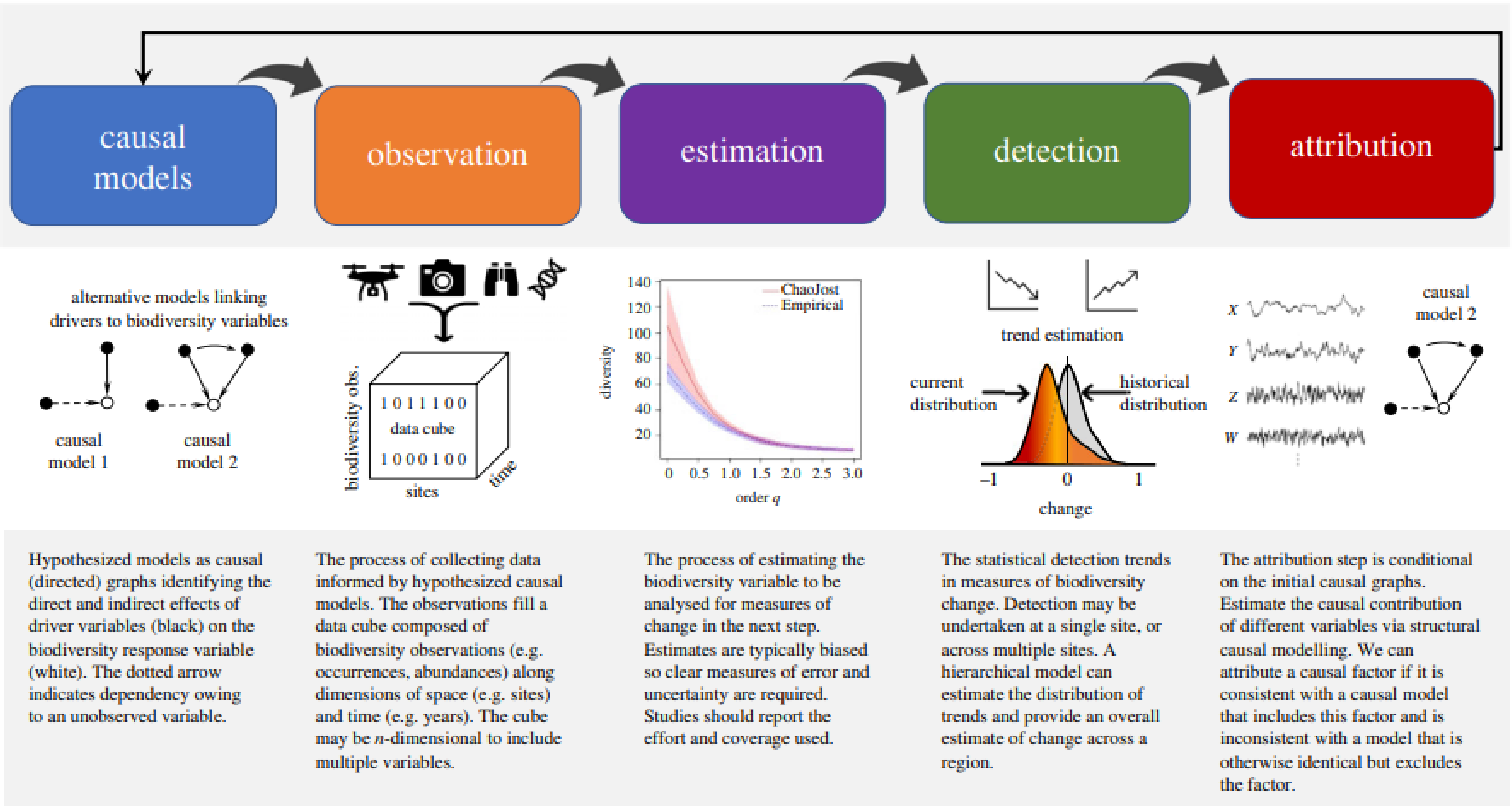



**Figure 3.** The five steps in the detection and attribution workflow. The process begins with causal models of our understanding of biodiversity change, which in turn guide the work of observation, estimation of essential biodiversity variables and their use in the detection and attribution steps. Information generally flows from left to right, but the workflow is repeated iteratively as new data are collected, technologies are deployed, and our confidence in the methods used to detect and attribute causes is improved. Increases in confidence will arise from observations and adaptive monitoring that are designed and coordinated to detect change and reduce uncertainty in the attribution of human drivers as causes for trends. (Online version in colour.)

royalsocietypublishing.org/journal/rstb Phil. Trans. R. Soc. B 378: 20220182

Gonzalez A, Chase JM, O'Connor MI. 2023 A framework for the detection and attribution of biodiversity change. Phil. Trans. R. Soc. B 378: 20220182. https://doi.org/10.1098/rstb.2022.0182

# Specific Needs

Harmonised Biodiversity Monitoring

Improved use of Earth Observation (EO) data

Knowledge on Drivers of Ecosystem Change

# Mission

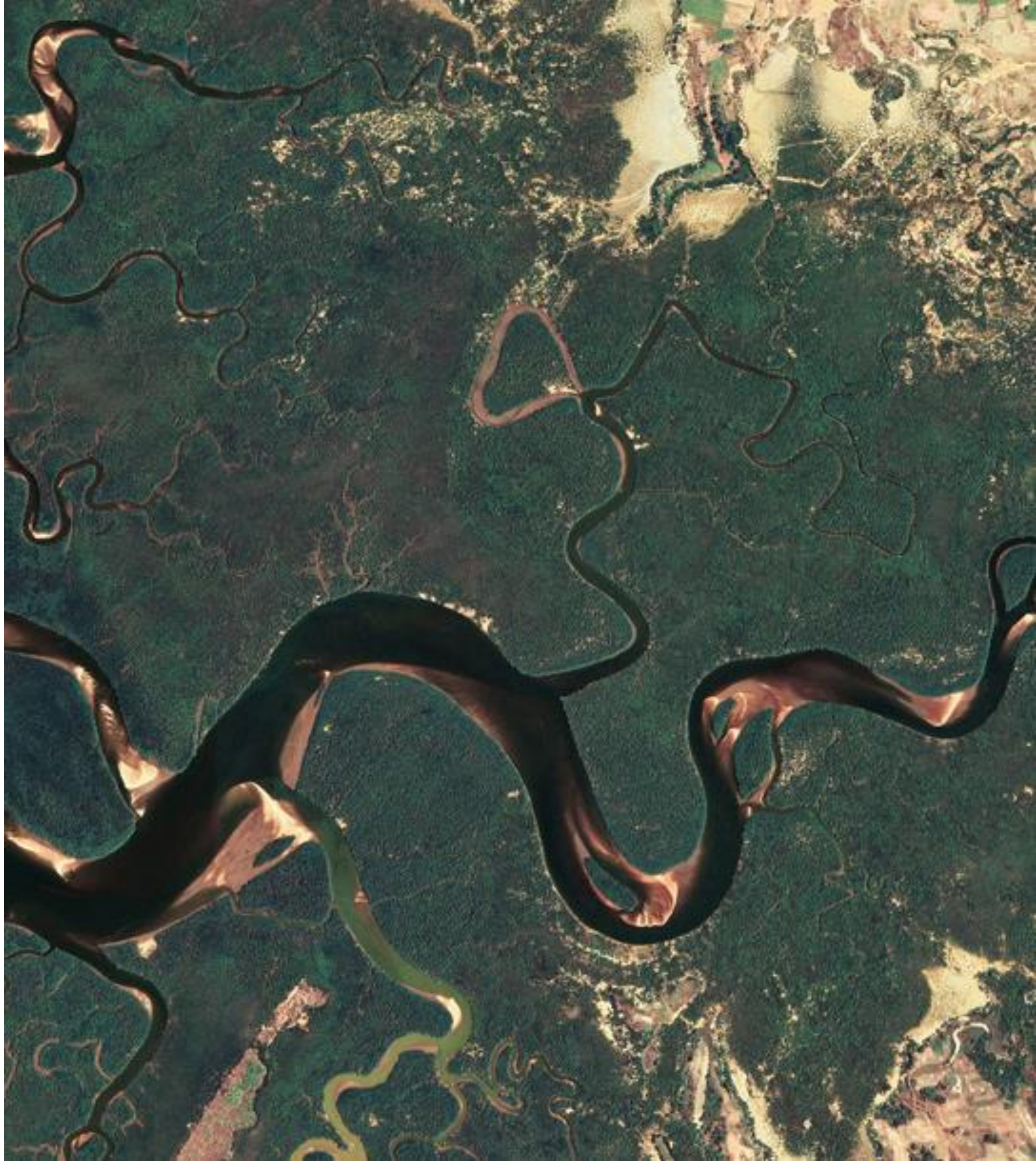
**Monitor and predict biodiversity change and its direct and indirect drivers in terrestrial and freshwater ecosystems** through **integration of** state-of-the-art multi-sensor **Earth Observation (EO)** data, innovative **in-situ** (including citizen science) data, together with next-generation **ecological models** that account for uncertainty.

# Objective 1

Responding to current **science** and **policy** needs, as well as **technological gaps** while supporting relevant EU policies and directives related to biodiversity.

# Objective 2

Collect long-time Earth Observation, airborne, citizen science, and in-situ data to assess the impact of the main natural and human-derived pressures on ecosystems, and use it to develop **Essential Biodiversity Variable (EBV) indicators and models**.



# Objective 3

**Understand** the current and long-term dynamics of terrestrial and freshwater ecosystems through **improving** the modelling of ecological processes and biodiversity change.

# Objective 4

Create **science-based solutions** for planning and prioritisation of conservation and restoration actions, accounting for systemic uncertainties.

# Objective 5

**Share** findings and **promote** state-of-the-art research and policy support for biodiversity conservation and restoration.

# Remote sensing biodiversity products to EBVs

| Freshwater | | Terrestrial |
|---|---|---|
| • EQR of phytoplankton & macrophytes | Community Composition | • Invasive species, Species<br>• Functional<br>• Trophic diversity |
| • Ecosystem distribution of EUNIS habitats<br>• Structural complexity of riparian habitats<br>• River connectivity / free river flows | Ecosystem Structure | • Vertical structure (vegetation height)<br>• Ecosystem distribution of EUNIS habitats<br>• Ecosystem fragmentation and heterogeneity (variance) |
| • Primary Productivity<br>• Harmful freshwater algal blooms<br>• Freshwater phenology | Ecosystem Function | • Ecosystem phenology<br>• Primary productivity<br>• Fire disturbance / Irregular inundation |

# Expected Results

**Detection-attribution-modelling (DAM) framework** to understand the direct and indirect drivers to biodiversity and ecosystem change

**Harmonized biodiversity monitoring approaches and products**, such as RS-EBV algorithms

**Improved predictions** on ecological transitions and tipping points.

**Scalable cloud platform** where all data products will be hosted and openly available.

**Improved uncertainty assessment** of biodiversity products.

**Science-policy recommendations** for prioritization of restoration measures

# Impacts

**Destination:**
"Understand and address drivers of biodiversity decline…"

## Scientific

- The DAM framework for direct & indirect drivers of biodiversity change
- Operational EBV products & improved species & habitat distribution models
- Enhanced uncertainty assessments

## Economic

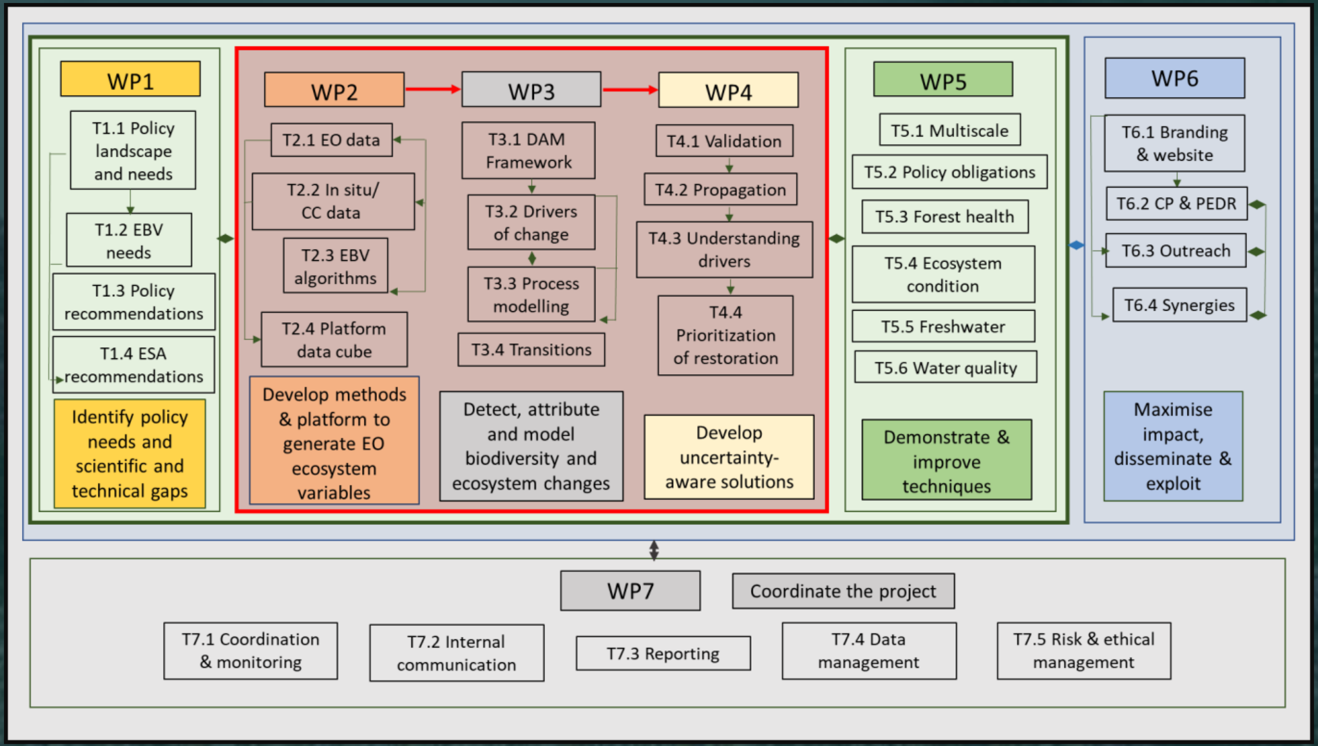
- Added value for current observation programmes (TRL 5-7)
- Increased TRL levels of future satellite mission data products.
- Green Economy and ecosystem accounting support.

## Societal

- Improved decision and policy-making for tackling harmful drivers of biodiversity change.
- Support the EU TEN-N target for restoring 30% of European nature.
- Contribute to networks such as Biodiversa+, EuropaBON, EBOCC, ESA FutureEO, ESA, etc.

# Work Packages

## Quick overview



# WP1 Policy and Science Needs (Lead: UNEP-WCMC)

The purpose of WP1, is to ensure that OBSGESSION responds to current policy needs and the scientific and technical gaps in meeting these needs.

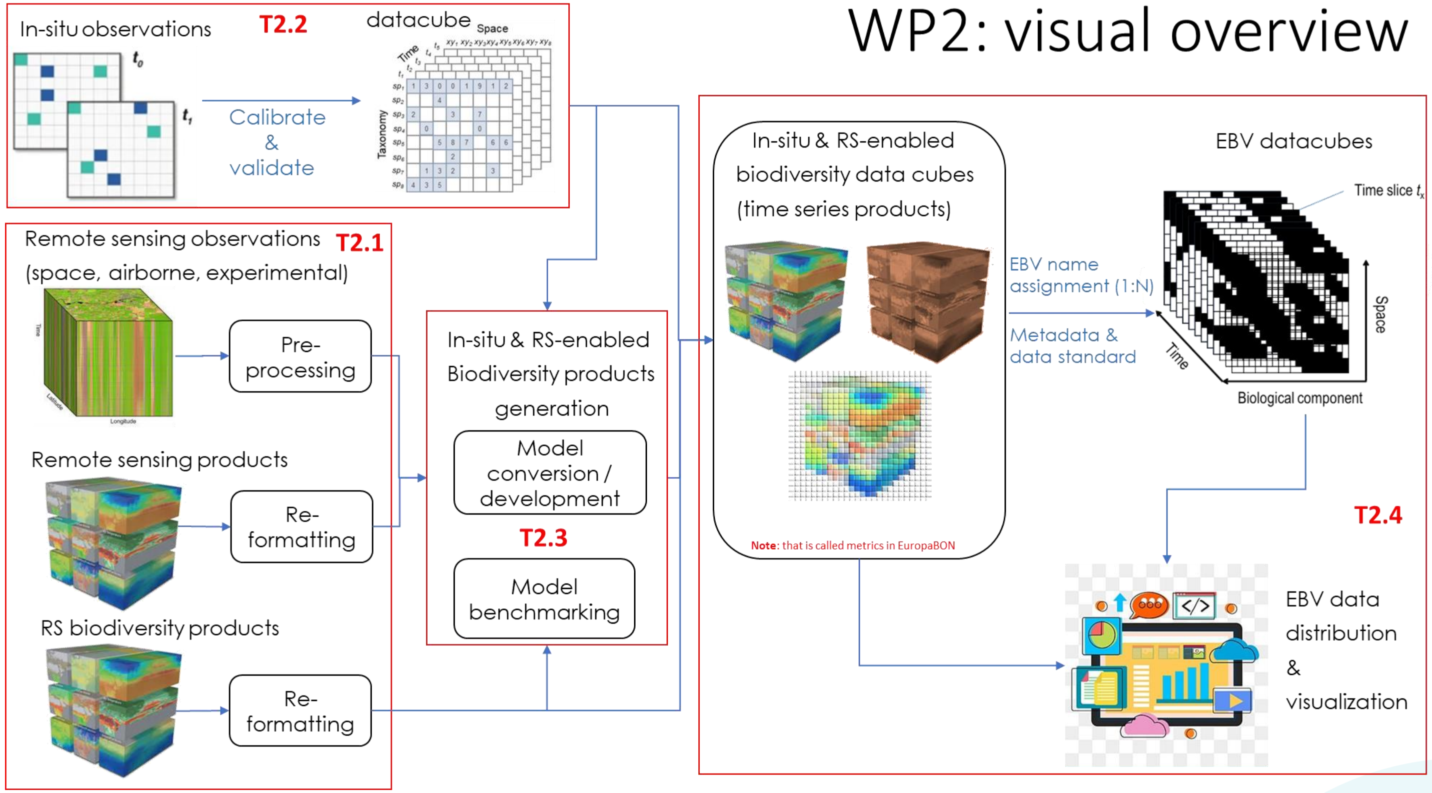
This will be achieved by:

1. Understanding where specific EBVs can be utilised during the implementation, reporting and review of different policies
2. Identifying the scientific and technical gaps for a set of prioirtised EBVs
3. Identifying pathways and recommendation for EBVs use by policy makers
4. Identifying action for ESA to continue to strengthen the technical underpinnings of EBVs

# WP2 Earth Observation networks for biodiversity and ecosystems (Lead: VITO)

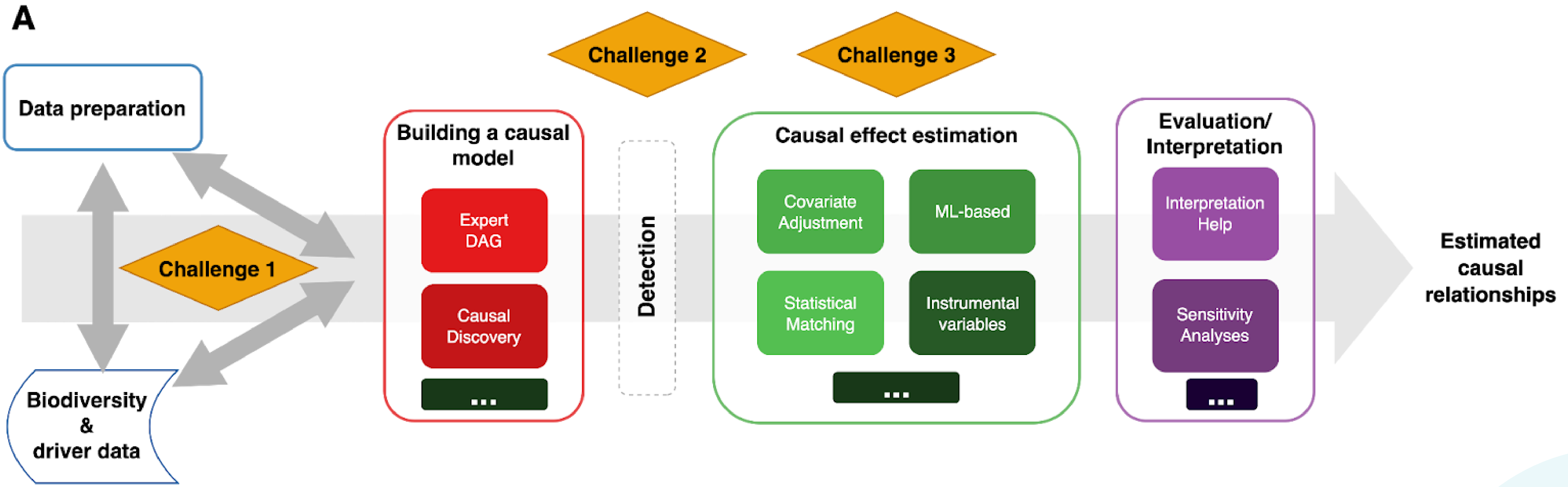
- Develop methods and a platform to generate Earth-Observation (EO) derived ecosystem variables as input to detect drivers of change (WP3).
- A comprehensive set of long-time series of EO satellite and airborne datasets, in-situ and citizen-science datasets and innovative methods
- Generate ecosystem focused Essential Biodiversity Variables (EBVs).

WP2: visual overview



# WP3 Detection, attribution, and modelling biodiversity and ecosystem changes (Lead: CNRS)

- The main aim: to develop DAM framework to understand the direct and indirect drivers to biodiversity and ecosystem change



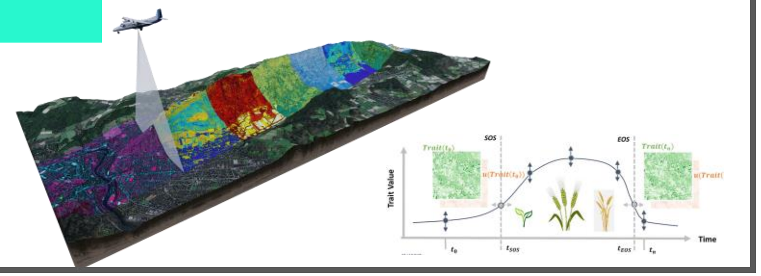

- Two articles are being finalized and will be shared/submitted soon:
  - -An opinion paper on Detection-Attribution framework: Advancing Causal Inference in Ecology: a practical guide for biodiversity change detection and attribution, **Schrodt et al., in prep.**
  - -A perspective paper: *Integrating macroecology with temporal and trait-based perspectives* : Toward better attribution of human drivers to diversity changes, **Gaüzère et al. In prep.**

# WP4 Science-based solutions (Lead: UZH)

- Integration of uncertainty diagram for CHIME L2A for airborne data
- Test with AVIRIS4 data CH and FR (2024, 2025), and maybe with APEX time series over SNP and LG
- Collection of in-situ spectral and trait data to calibrate and validate biodiversity products

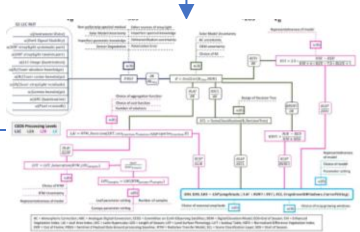
# WP4: Uncertainty-aware solutions

## T4.1 Uncertainty budget

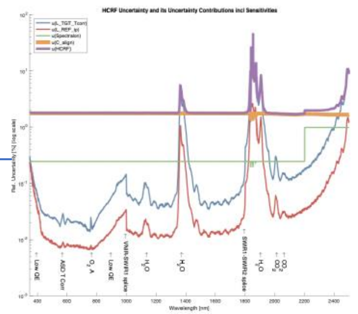



## T4.2 Uncertainty propagation

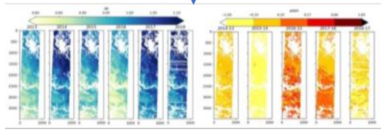
Pre-processing



Propagation

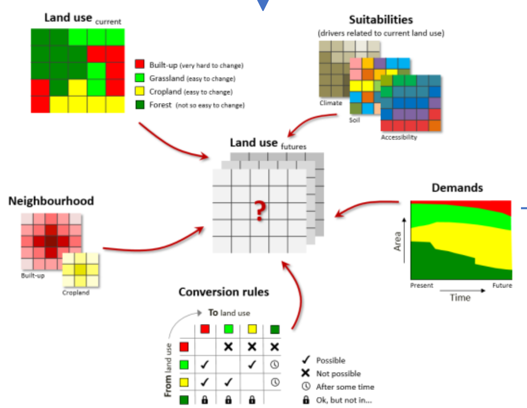



Biodiversity metrics

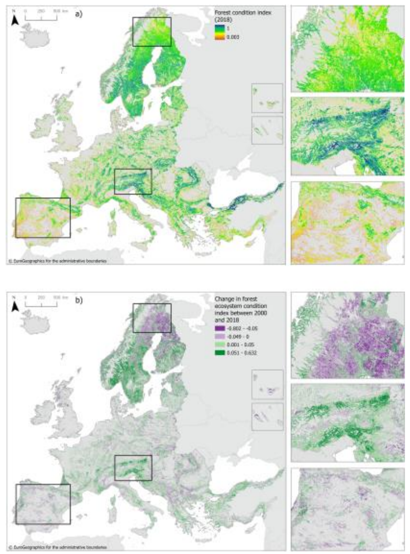


## T4.3 Understanding drivers

iCLUE




## T4.4 Prioritization of restoration



# WP5 Biodiversity Pilots (Lead: UTwente)

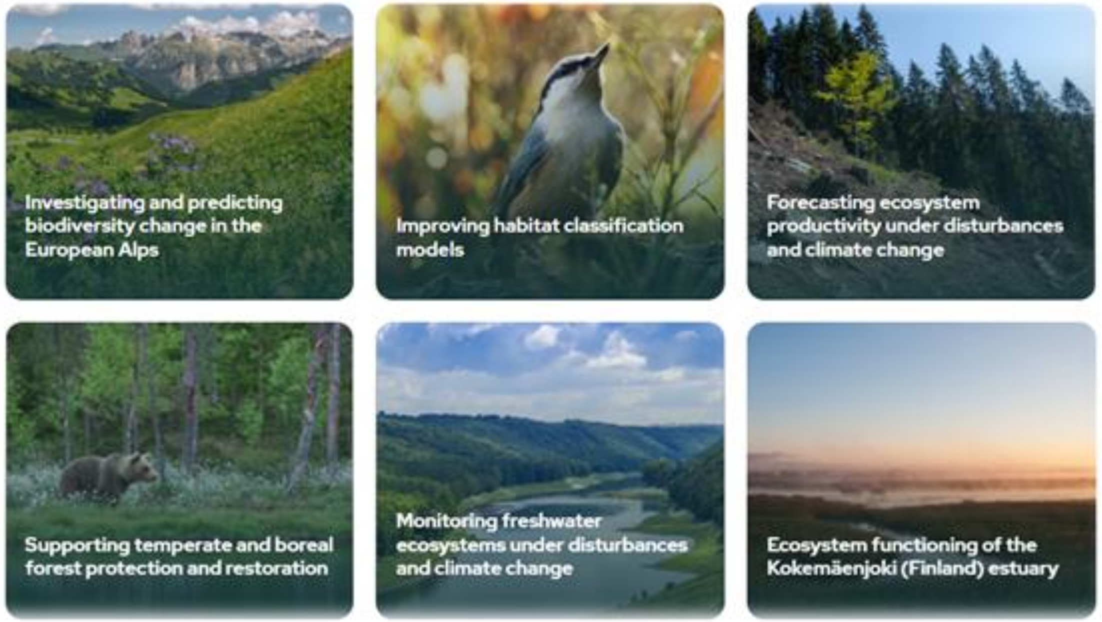
## PILOTS

- Investigating and predicting biodiversity change in the European Alps through multi-scale, multi-modal, and multi-temporal remote-sensed and in-situ data.
- Improving habitat classification models by going beyond the state-of-the-art in terms of accurate high-resolution mapping of Europe's habitats, powered by machine learning.
- Forecasting ecosystem productivity under disturbances and climate change by incorporating EBVs based on remote sensing to assess metrics of ecosystem structure and health.

**Objective**: To develop specific case studies based on applied science R&D aspects to demonstrate the implementation of techniques in WP2, WP3 and WP4 and to respond to the European (EU) Biodiversity Strategy for 2030 and the joint Flagship Action on Biodiversity and Vulnerable Ecosystems initiated by European Space Agency (ESA) and European Commission (EC).

- Supporting temperate and boreal forest protection and restoration through assessing ecosystem conditions via eDNA and image spectroscopy.
- Monitoring freshwater ecosystems under disturbances and climate change by utilising novel Thematic Ecosystem Change Indices (TECIs).
- Assessing the ecosystem functioning of the Kokemäenjoki (Finland) estuary and measuring water quality incorporating both in-situ and Earth Observation data.

# WP5 Biodiversity Pilots (Lead: UTwente)




**Objective**:
To develop specific case studies based on applied science R&D aspects to

- demonstrate the implementation of techniques in WP2, WP3 and WP4
- respond to the European (EU) Biodiversity Strategy for 2030 and the joint Flagship Action on Biodiversity and Vulnerable Ecosystems initiated by European Space Agency (ESA) and European Commission (EC).

# WP6 Dissemination, multi-stakeholder outreach, and synergies (Lead: Pensoft)

- Develop communication, dissemination, and exploitation strategies
- Establish synergies with biodiversity projects & initiatives
- Maximise outreach to relevant stakeholders
- Create an impactful project branding & website

# WP7 Coordination and project management (Lead: Syke)

The overall objective of WP7 is to ensure smooth and timely execution of the project according to the work plan and requirements set by the EC. Detailed objectives include ensuring that:

- the work flow is efficient and timely and the outputs are of high-quality;
- all the beneficiaries fulfil their duties and follow project practices;
- both the technical and financial reports are adequately verified and submitted to the EC in time;
- all data and other outputs are managed appropriately, their re-use is promoted, and IP is protected when needed;
- potential risks and conflicts are identified well in advance, and if realized, mitigated in a proper way.

# Thank you for your attention!

## Follow us for updates!

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