GEO BON's Next Big Thing:

A Global Biodiversity Observation System

NASA Biodiversity and Ecological
Forecasting
Team Meeting
20-22 September 2022

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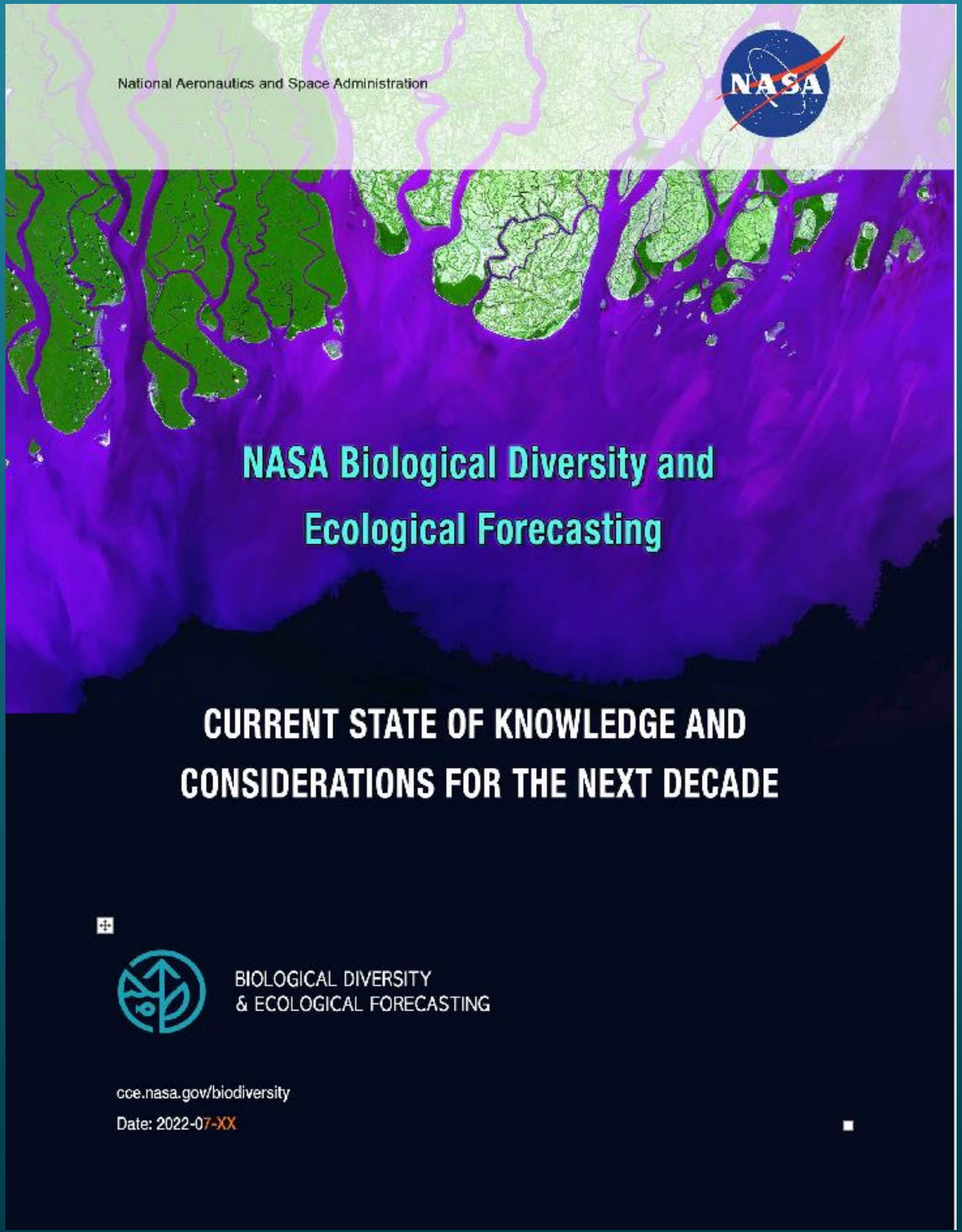
But First….

The BDEF Report

- ❑ Identify program opportunities for next decade
  - "Considerations for NASA"
- ❑ Demonstrate value of SRS

- ❑ Audience
  - NASA: program managers and others
  - The Outside World



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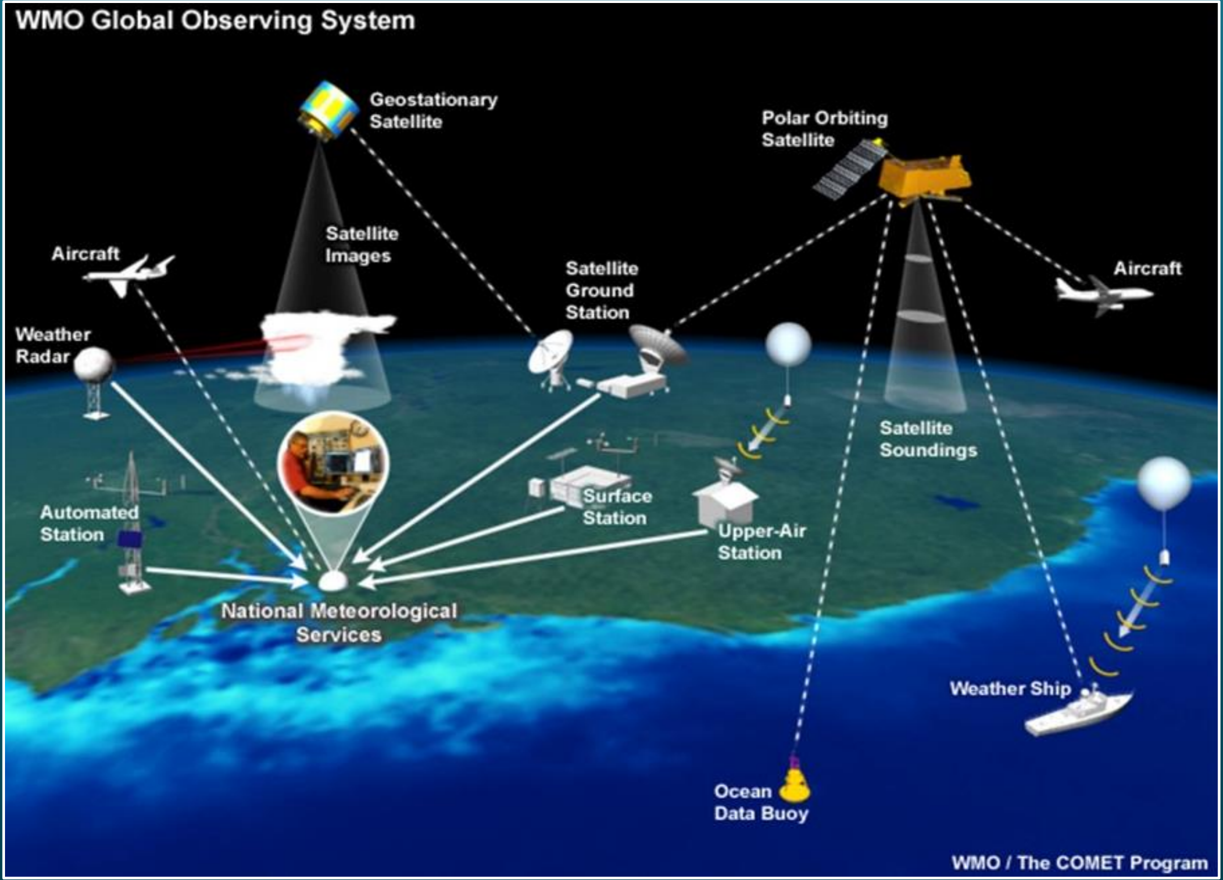
Global Biodiversity Observation System (GBiOS)

Weather



https://public.wmo.int/en/programmes/global-observing-system

Biodiversity

Panek, Wikimedia Commons

Top 10 Global Risks by Severity

Over the next 10 years

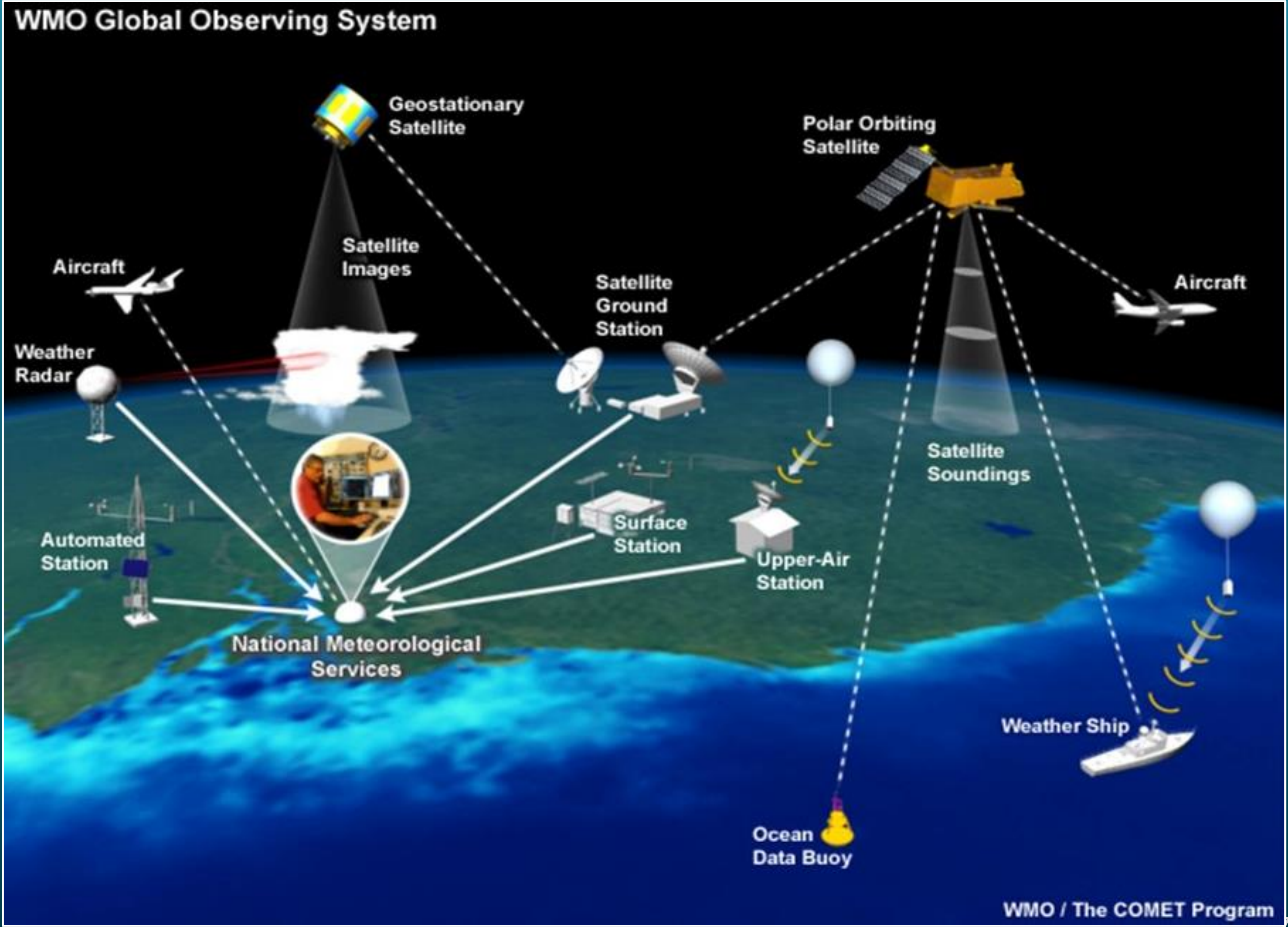
WORLD ECONOMIC FORUM

Global Risks Report 2022

1st	Climate action failure
2nd	Extreme weather
3rd	Biodiversity loss
4th	Social cohesion erosion
5th	Livelihood crises
6th	Infectious diseases
7th	Human environmental damage
8th	Natural resource crises
9th	Debt crises
10th	Geoeconomic confrontation

WMO World Weather Watch Programme

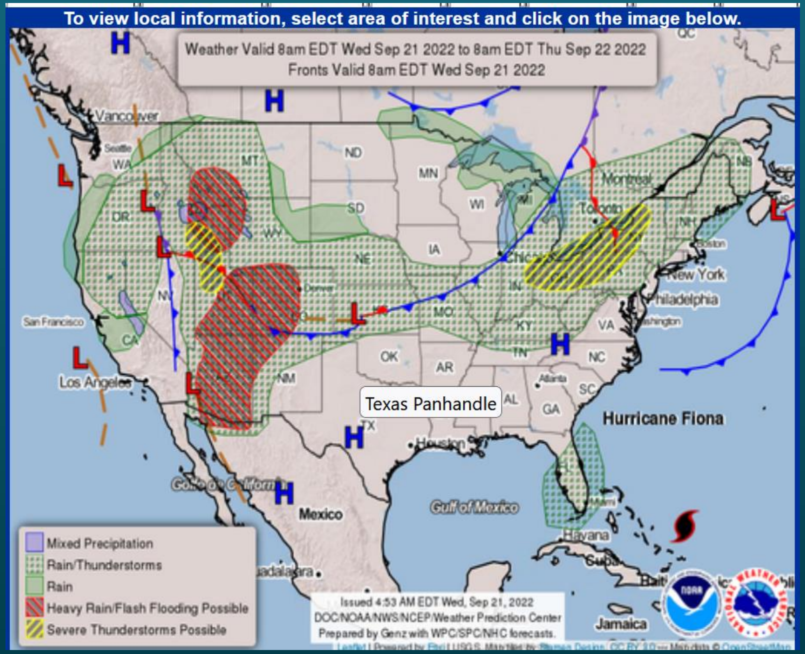
Regional scale



Three Scalable Components

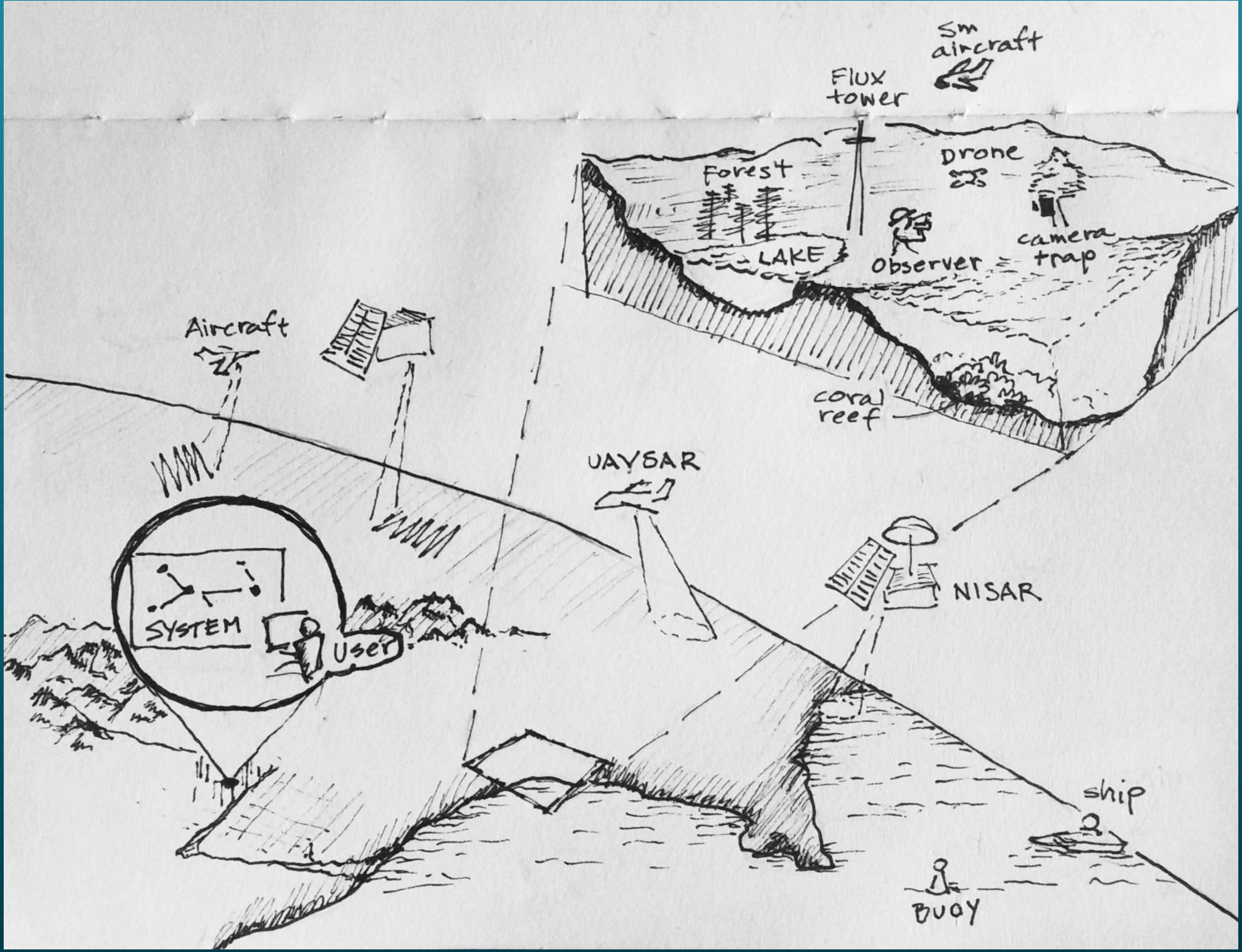
1) Observations
2) Product generation
3) Connections

- ❑ Global
- ❑ Regional
- ❑ National
- ❑ Local



GBiOS Concept

Scalable



Three Scalable Components

1) Observations
2) Product generation
3) Connections

- ❑ Global
- ❑ Regional
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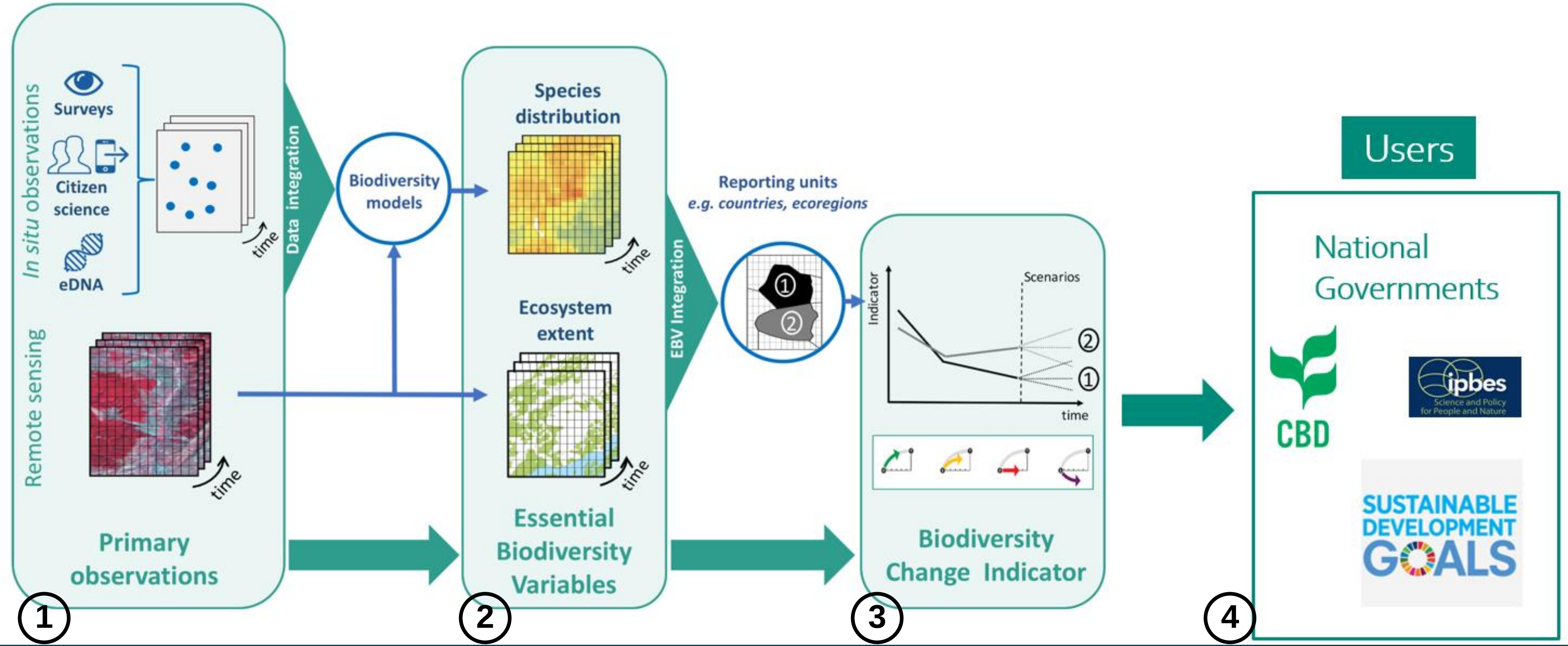
- ❑ Local

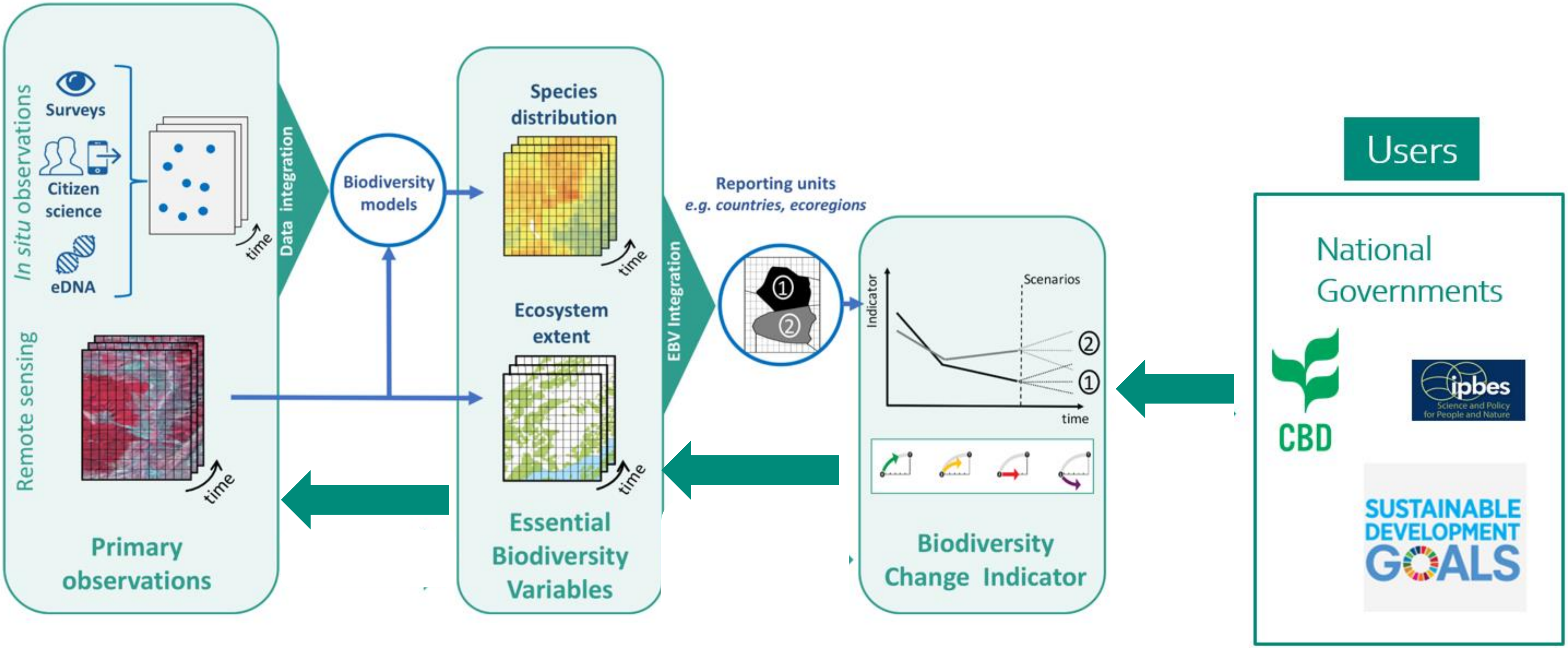
Joe Parks from Wikimedia

Processing Workflow: Works at any Scale



Based on Navarro et al. 2017

Requirements Development

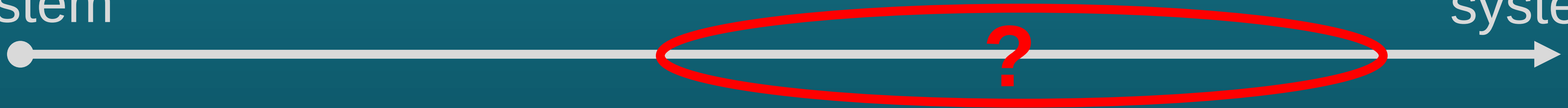


Based on Navarro et al. 2017

Development Approach

1) **Grow** rather than build
2) **Federated** system

Single large system



Federated system

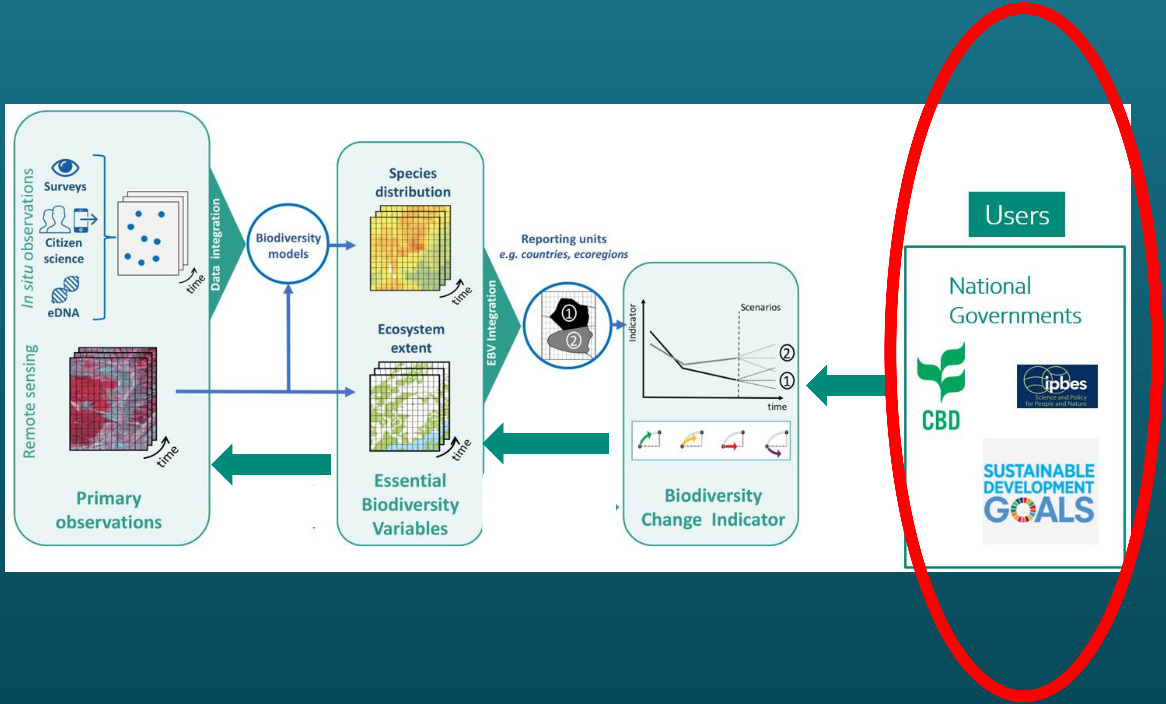
- One or few organizations
- Design & build
- Internal interfaces
- Manage the system

- Many organizations
- Grow rather than build
- Externally exposed interfaces
- Manage the interfaces
- High component autonomy

Some of the Challenges

- ❑ Data access (FAIR principles)
- ❑ Data standards (collection, format)
- ❑ Systems interoperability

- ❑ Who are the users?
- ❑ What products are needed?



Interesting?

Thoughts to share?

Let me know

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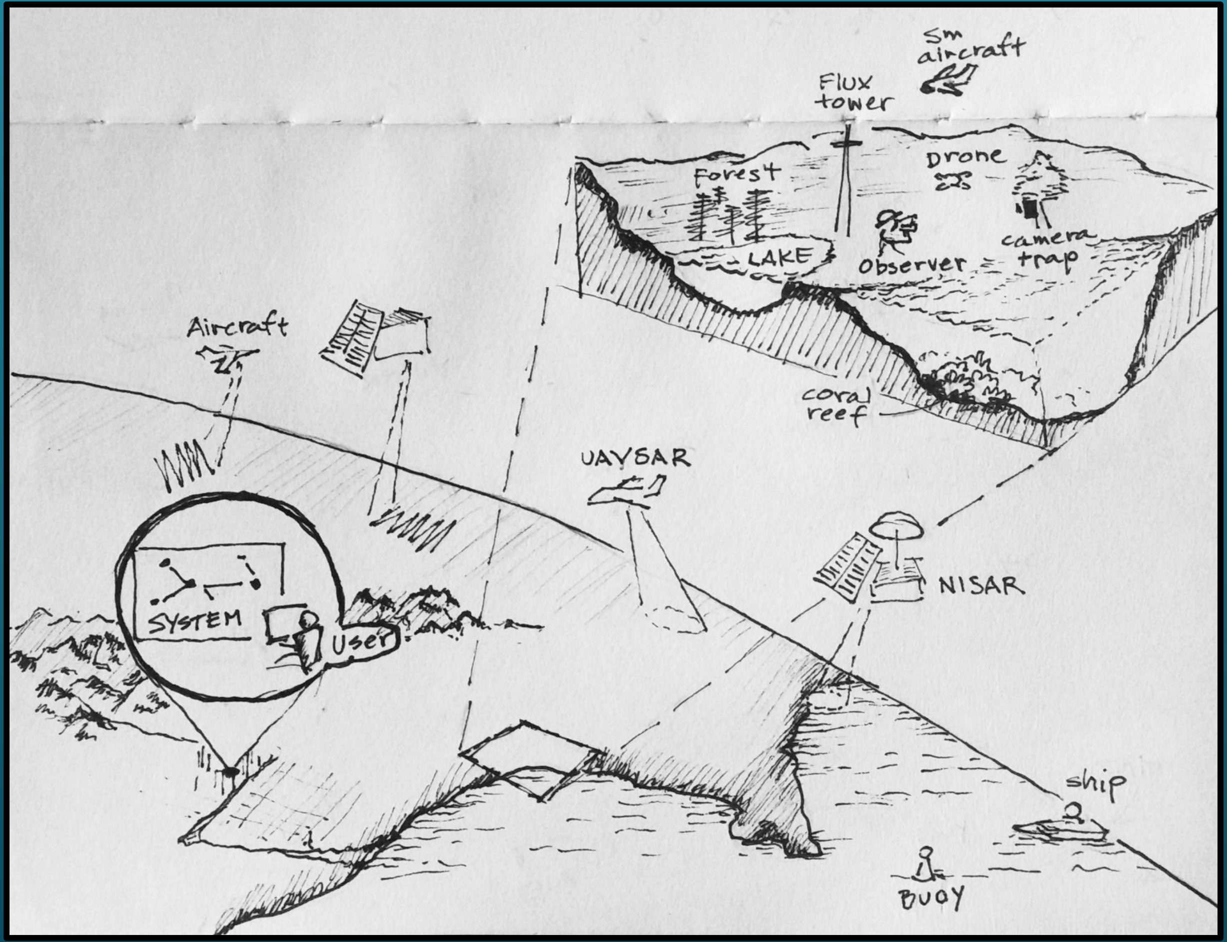
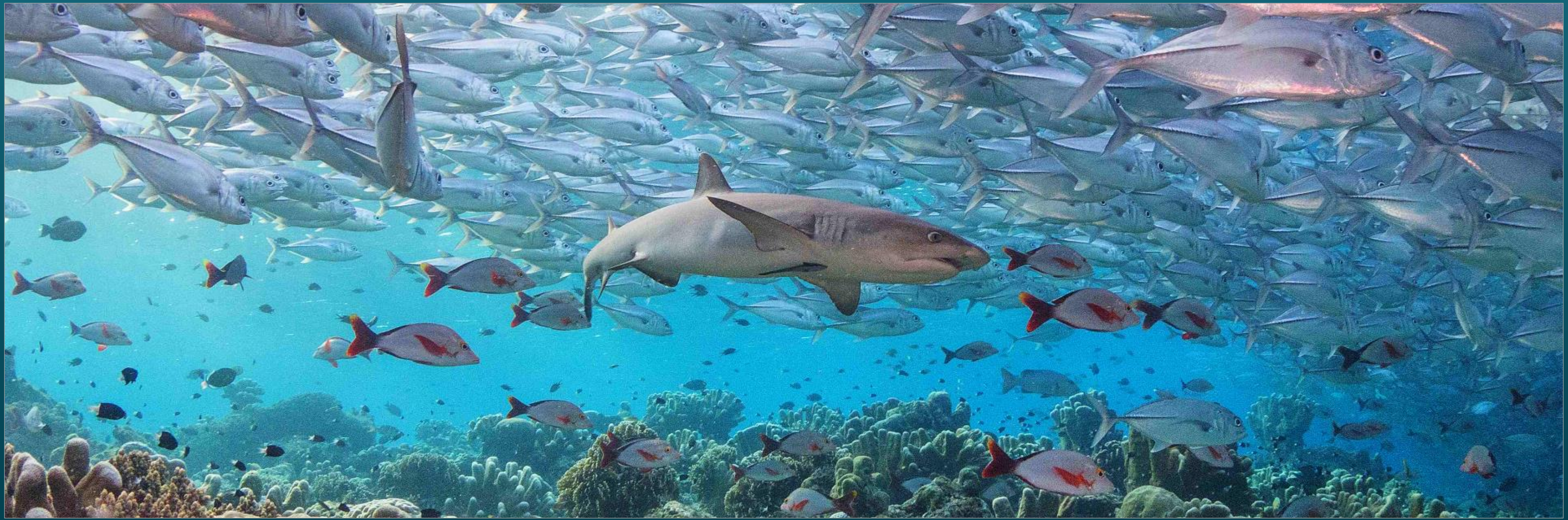


Backup Slides



Wikimedia Avoini

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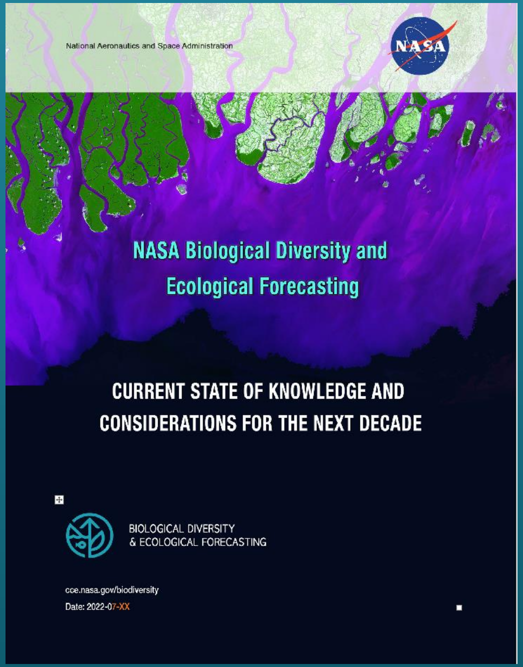


BDEF Considerations for NASA Summary

- 45 total, consolidated into six themes*

- Biodiversity data products
- Biodiversity observations *in situ*
- Biodiversity observations from space
- Biodiversity and ecological modeling and forecasting
- Partnership and collaboration on biodiversity activities
- Capacity for biodiversity research, applications, and monitoring

** Impossible to capture all Considerations*

Key Points

- Long-term activity
- Guided by shared vision among many stakeholders
- Grow rather than build, based on existing systems
- “Federated” approach probably appropriate
- Key stakeholders include
  - CEOS & member agencies
  - National governments
  - GEO BON/biodiversity community
  - CBD, SDGs, UNSEEA, Ramsar, other IEAs, NGOs, private sector…
  - Data product producers and distributors
- Many known and unknown unknowns

What Roles Should Space Agencies Have?

1) Gap filling
   - Global coverage of in situ data is unlikely
   - Fill gaps with SRS
   - Probably better than no product (thoughts?)

2) Broader, integrated role for monitoring

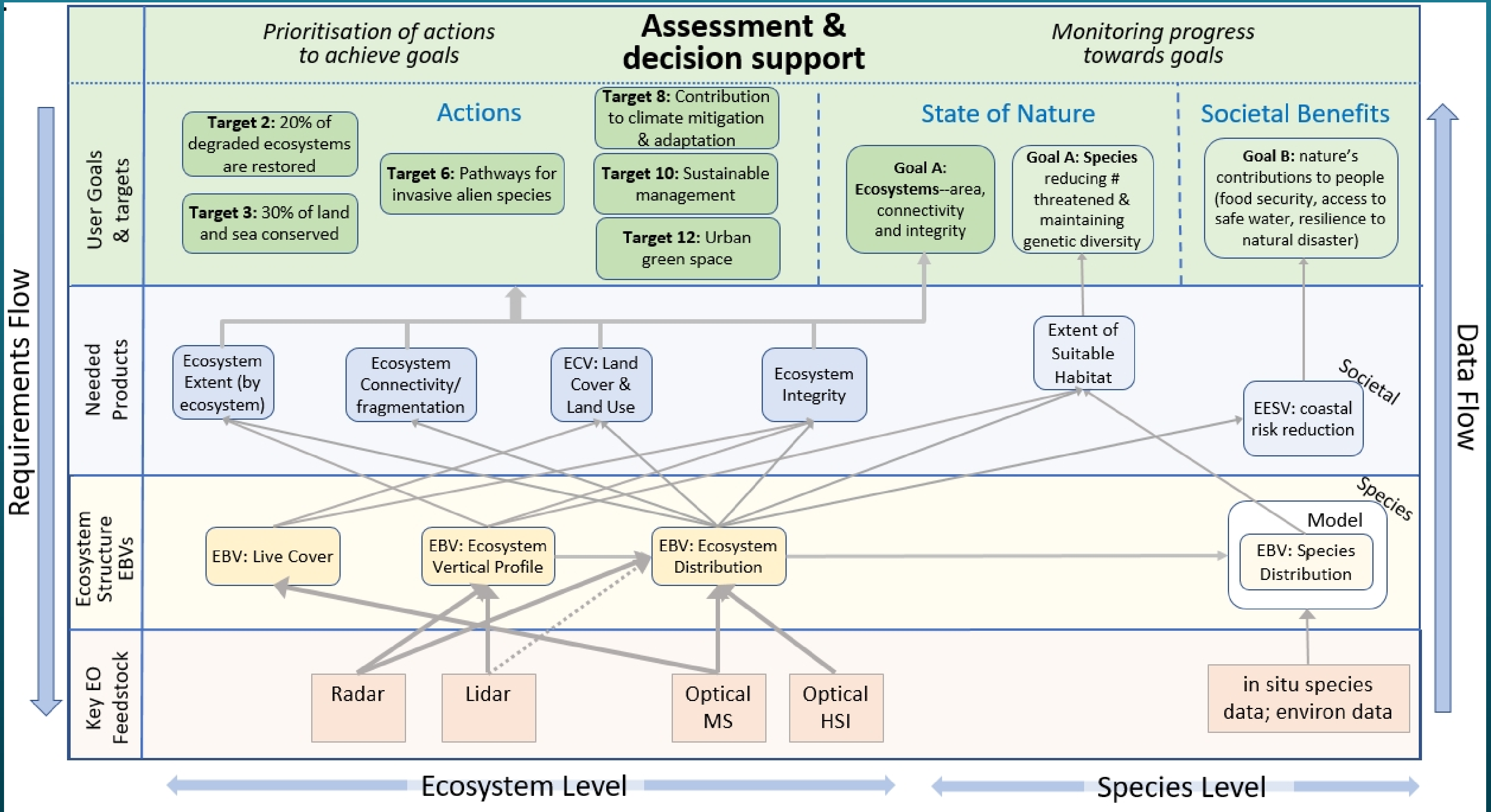
Connecting GEO BON to the CBD Policy Framework

- Science and Applications Traceability Matrix

Post-2020 Global Biodiversity Framework

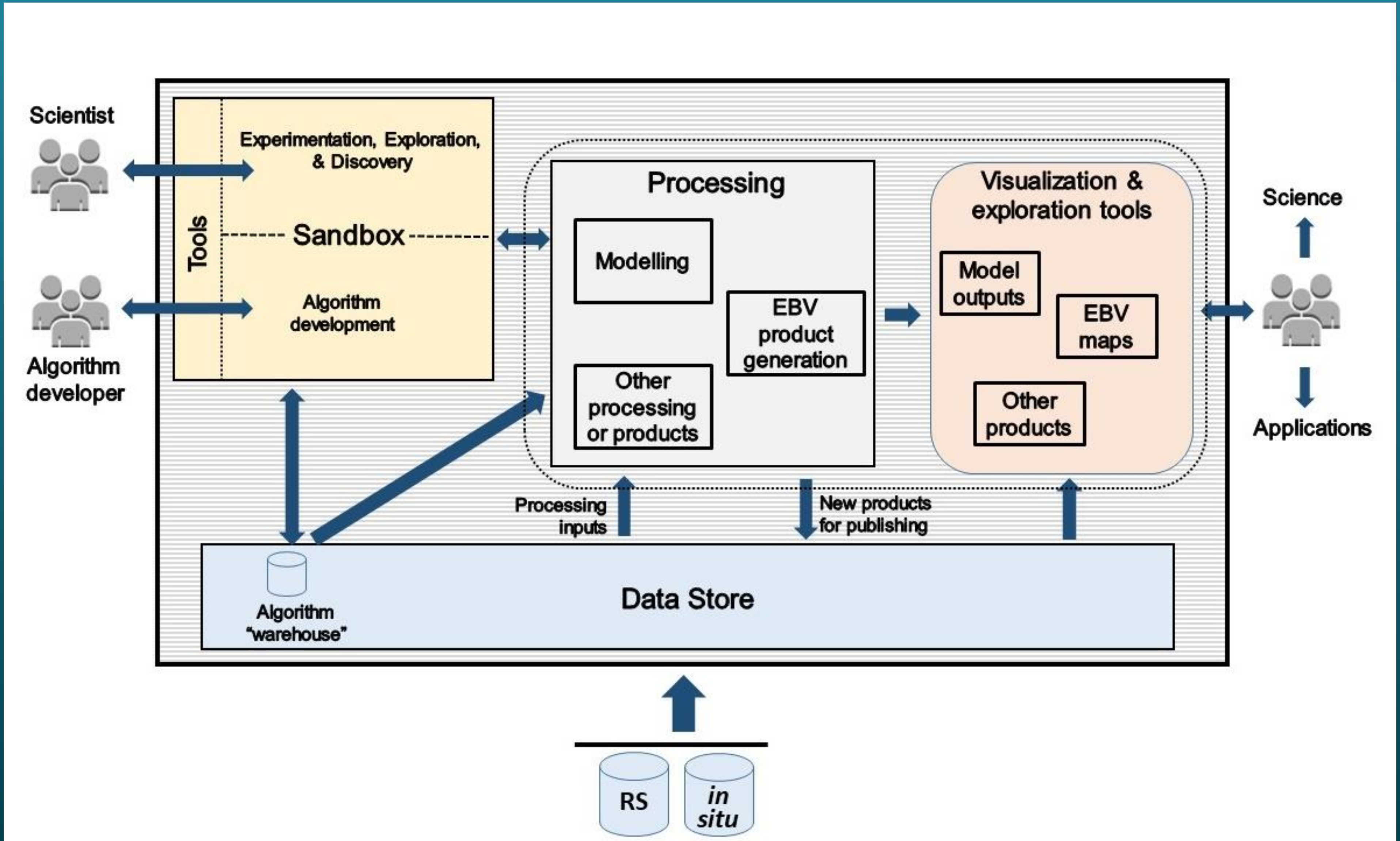
Products

Sensors & Observations



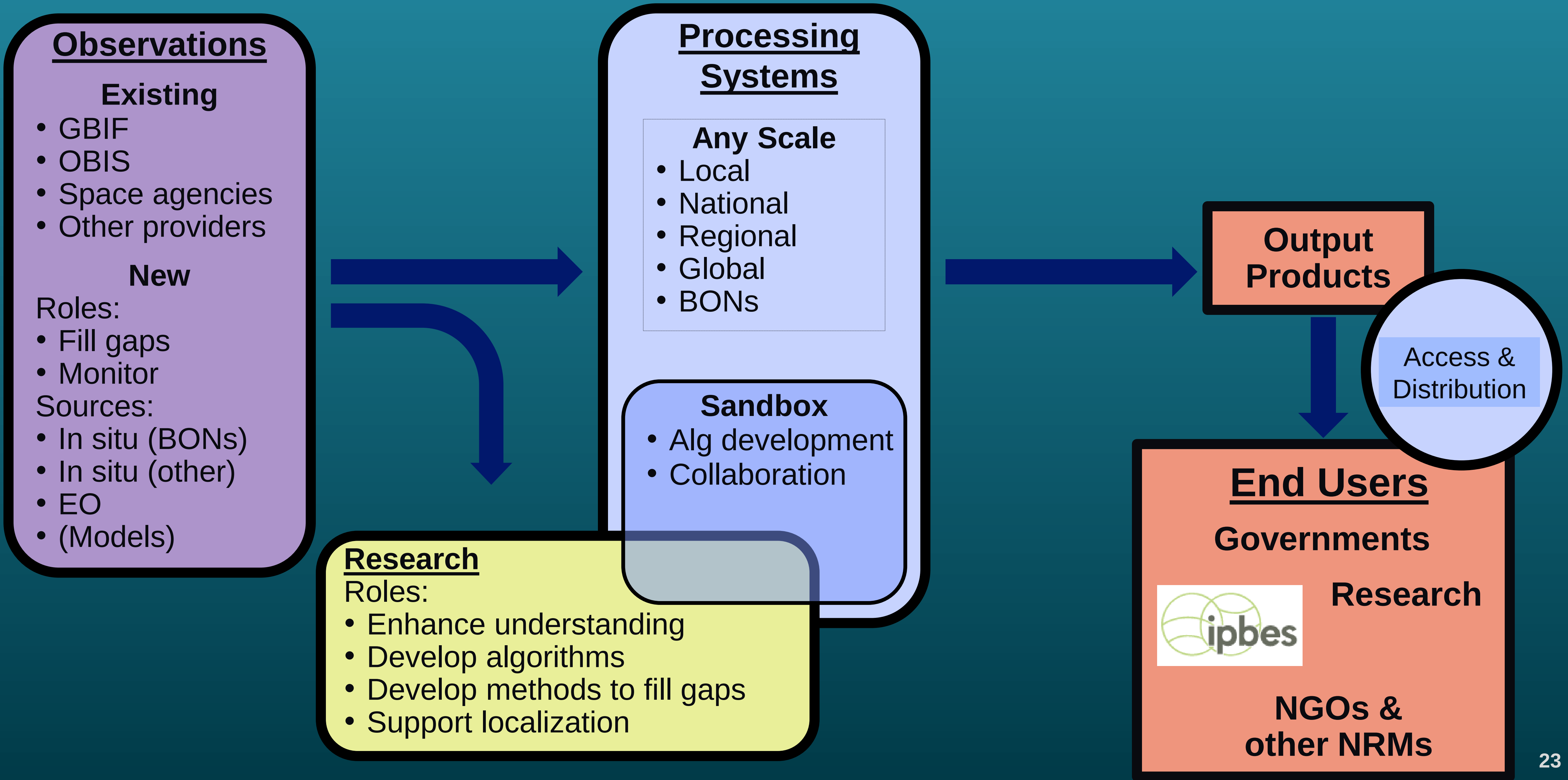
Inspired by: Kim et al. *In prep.* Essential Biodiversity Variables and Essential Ecosystem Services Variables for Post-2020 Policy Development and Implementation, CBD SBSTTA24 Inf Doc

Possible Conceptual Architecture (Virtual View)



Based on MAAP concepts

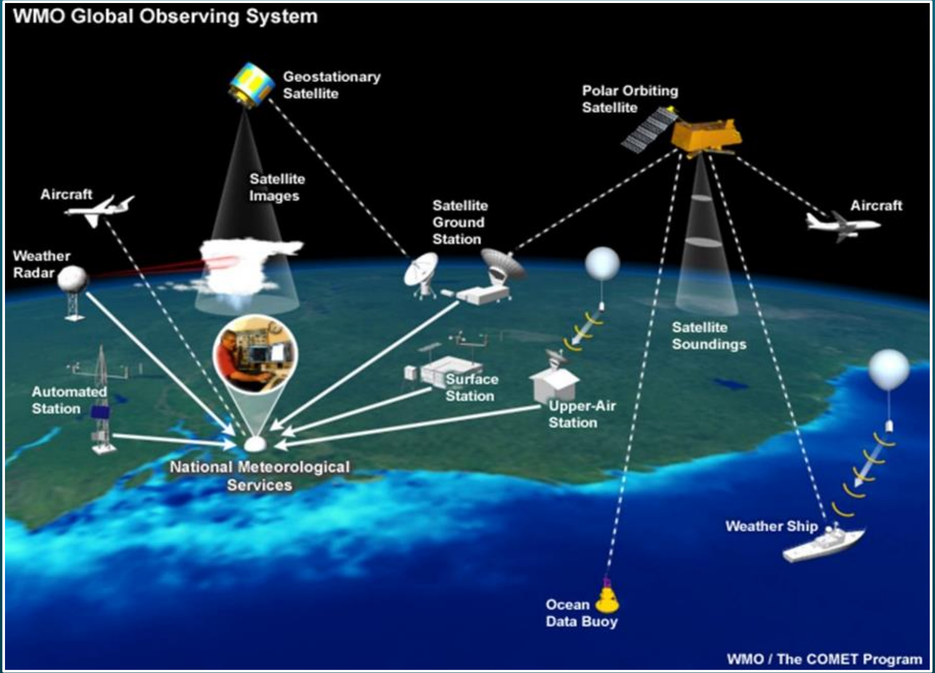
GBiOS Components: Details



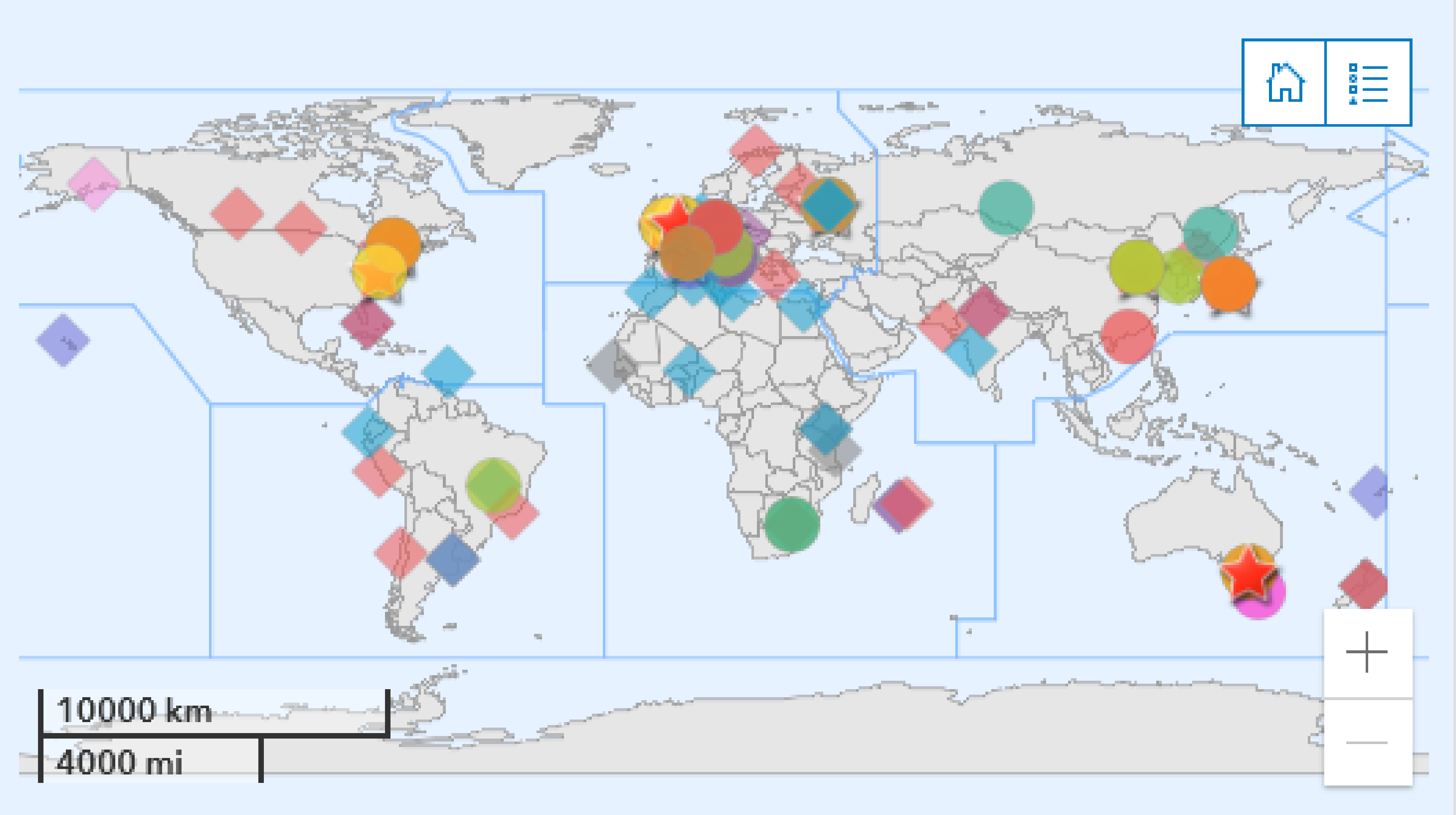
WMO World Weather Watch Programme

- ❑ Three components
  1) Observing System
  2) Data-processing and Forecasting System
  3) Telecommunications System

- ❑ Multiple scales: Each has a three-tiered structure
  - Global
  - Regional
  - National
- ❑ Highly cooperative
- ❑ Grew over a period of many decades



WMO Processing Centres



Legend

Designated GDPFS Centres

Activity

- World Meteorological Centre
- Global deterministic numerical weather prediction
- Limited-area deterministic numerical weather prediction
- Global ensemble numerical weather prediction
- Limited-area ensemble numerical weather prediction
- Global numerical long-range prediction
- Annual to decadal climate prediction

Different centers have different scope and specialties

History of Weather Forecasting

Year	What Happened
1780	**Network of 39 meteorological stations established in Germany**
1849	Telegraph first used to transmit weather observations—**start of data sharing**, enabling first weather maps, "downwind" forecasts
1854	**UK Met Office established, followed by other national offices**
1873	International Meteorological Organization (IMO), forerunner of WMO
1922	Operational NWP concept proposed using slide rules (required 64,000 people…)
1927	First radiosonde developed in France
Mid-1940s	First electronic computers
1948	Group at Princeton: combined physics, numerical methods, and computing
1950	First NWP-based forecast—24h (but took 24h); manual forecasts still better
1950	**WMO formally formed from IMO**
By 1960	• **Global forecasts used as feedstock for manual local forecasts** • Data assimilation starting (forecasts continually updated, using new data) • **More automation of input data**
1960s	• Continual advancements in forecast skill • Improved physics, numerical methods, computing power, input observations, communication • Key limiting factor: Computing power
70s	• 3 day max for "reasonable" forecasts • **Key limiting factor**s: Computing power and the **quality of observations**
80s, 90s, 2000s…	Huge, continual improvements in all facets of forecasts
Now	"Reasonable" 7 to perhaps even 10 day forecasts (**location dependent**…)

History of Numerical Weather Prediction

Year	What happened
1904	Use of NWP first proposed
1922	Operational NWP concept proposed using slide rules
Mid-40's	First electronic computers
1948	Meteorology Group at Princeton: combine physics, numerical methods, and computer
1950	First forecast—24h (but took 24h); manual forecasts still better
1954	US Weather Bureau/Air Force/Navy joint activity started
By 1960	• Predictions started to equal manual in quality • Global forecasts used for manual local forecasts • Data assimilation starting (forecasts continually updated as new data available) • More automation of input data
60's	• Continual advancements in forecast skill • Improved physics, numerical methods, computing power, input observations, communication • Key limiting factor: Computing power
80's	Key liming factors: Computing power, quality of observations
…..	Continued improvements in all areas
Now	Reasonable 10 day forecasts