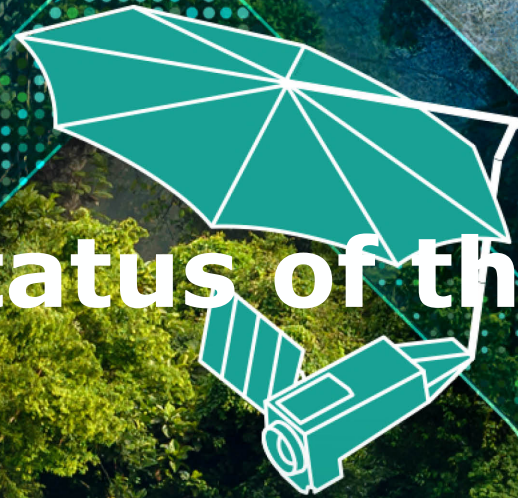


# The preparation status of the BIOMASS mission



The BIOMASS MAG: Shaun Quegan, Thuy Le Toan, Jerome Chave, Jorgen Dall, Philippe Paillou, Kostas Papathanassiou, Markus Reichstein, Bjorn Rommen, Sassan Saatchi, Klaus Scipal, Hank Shugart, Stefano Tebaldini, Lars Ulander and Mathew Williams



# Fate of anthropogenic CO<sub>2</sub> emissions (2011–2020)

## Sources



9.5 ± 0.5  
GtC/yr  
90%



$L_E = 3.8 \pm 0.6$   
 $L_U = 2.7 \pm 0.4$   
Net = 1.1 ± 0.7  
GtC/yr  
10%

## Sinks



5.1 ± 0.02  
GtC/yr  
48%



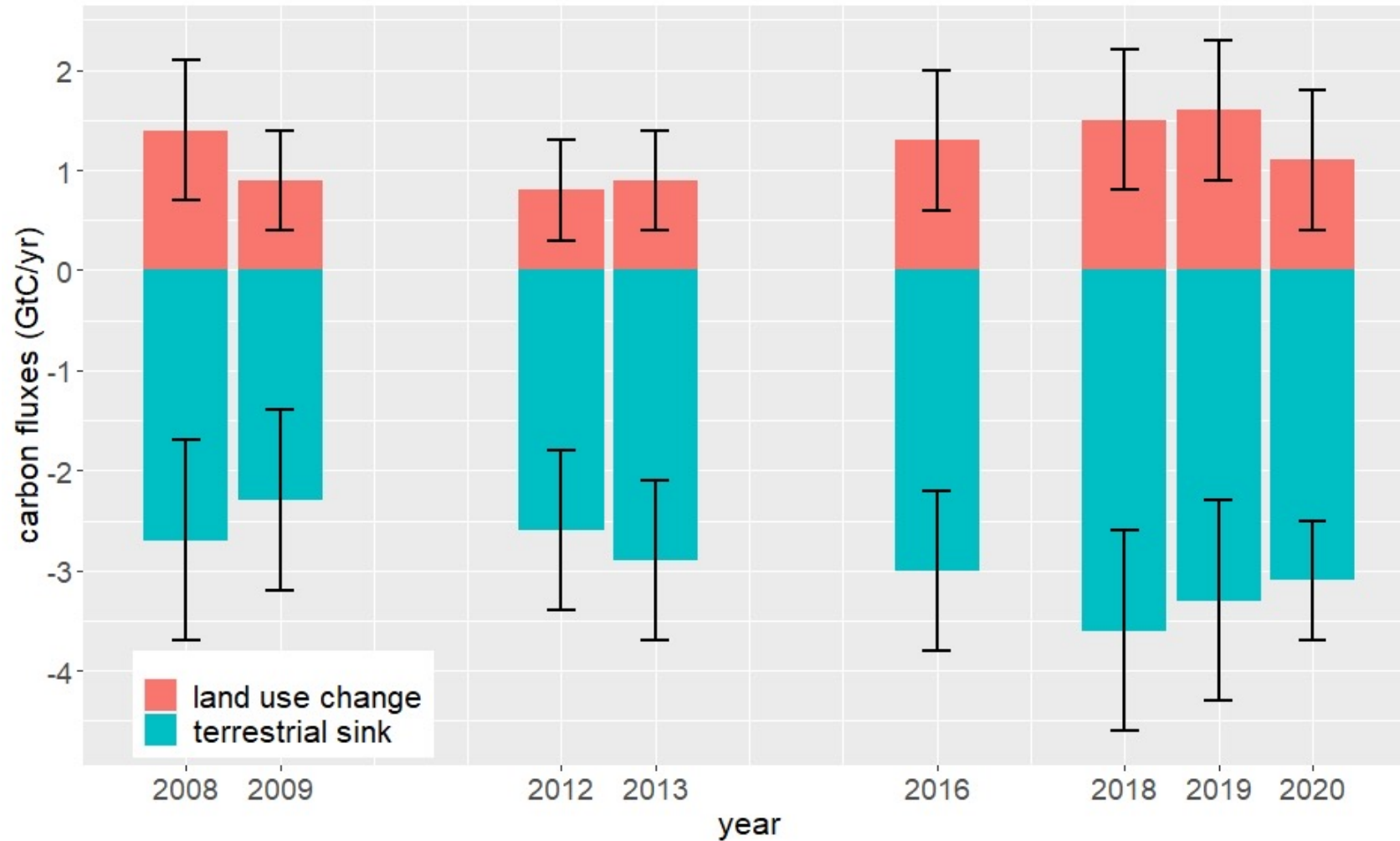
3.1 ± 0.6  
GtC/yr  
29%



2.8 ± 0.4  
GtC/yr  
26%

Sum of sources ≠ sum of sinks, indicating bias in at least one of the estimates.

# Land Use Change Emissions & the Terrestrial Sink



The BIOMASS mission brings together many elements:

- The satellite and launcher
- L1 products and calibration
- L2 products: algorithms and implementation
- Product validation
- Dissemination and interaction with the community
- Science exploitation
- BIOMASS within a global observing system for carbon and climate.

# The satellite is close to being fully built



The BIOMASS satellite at Airbus Toulouse for vibration, noise and thermal testing.

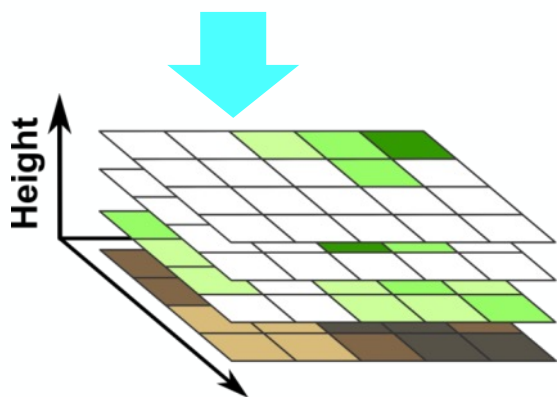
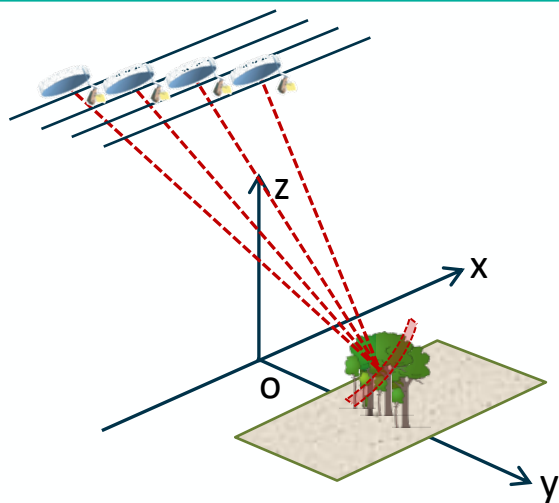
All tests were successfully passed.

Launch date has slipped beyond 2024.

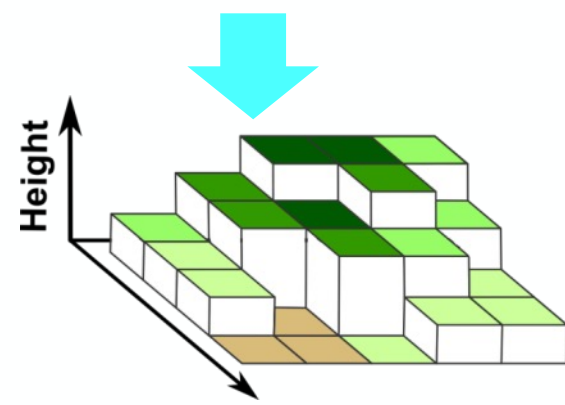
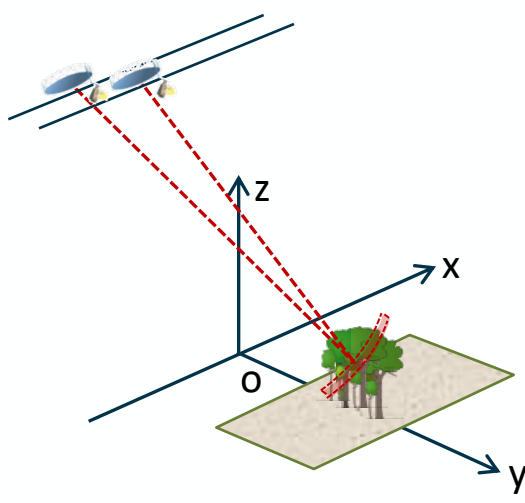
# BIOMASS mission phases

Tomographic Phase:  
7 x 3-day repeat  
16 months for global coverage

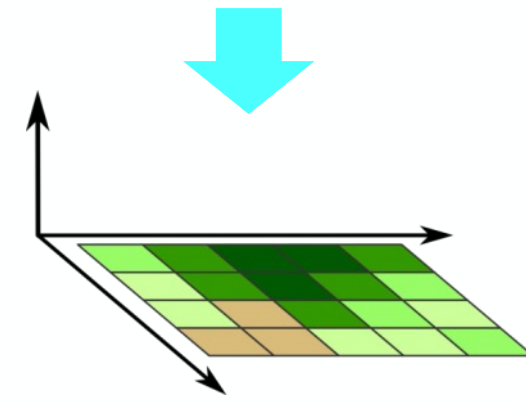
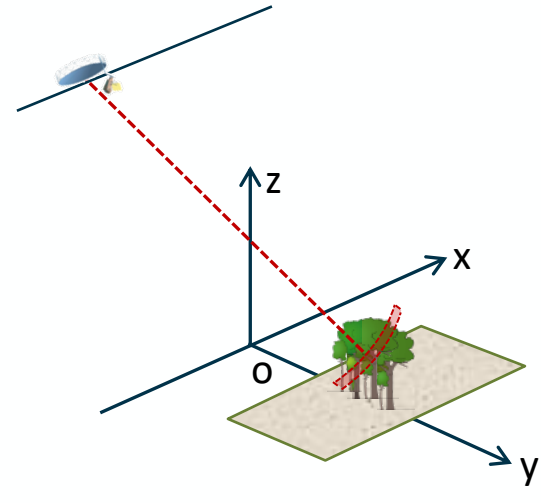
Interferometric Phase:  
3 x 3-day repeat; 8 months for global coverage



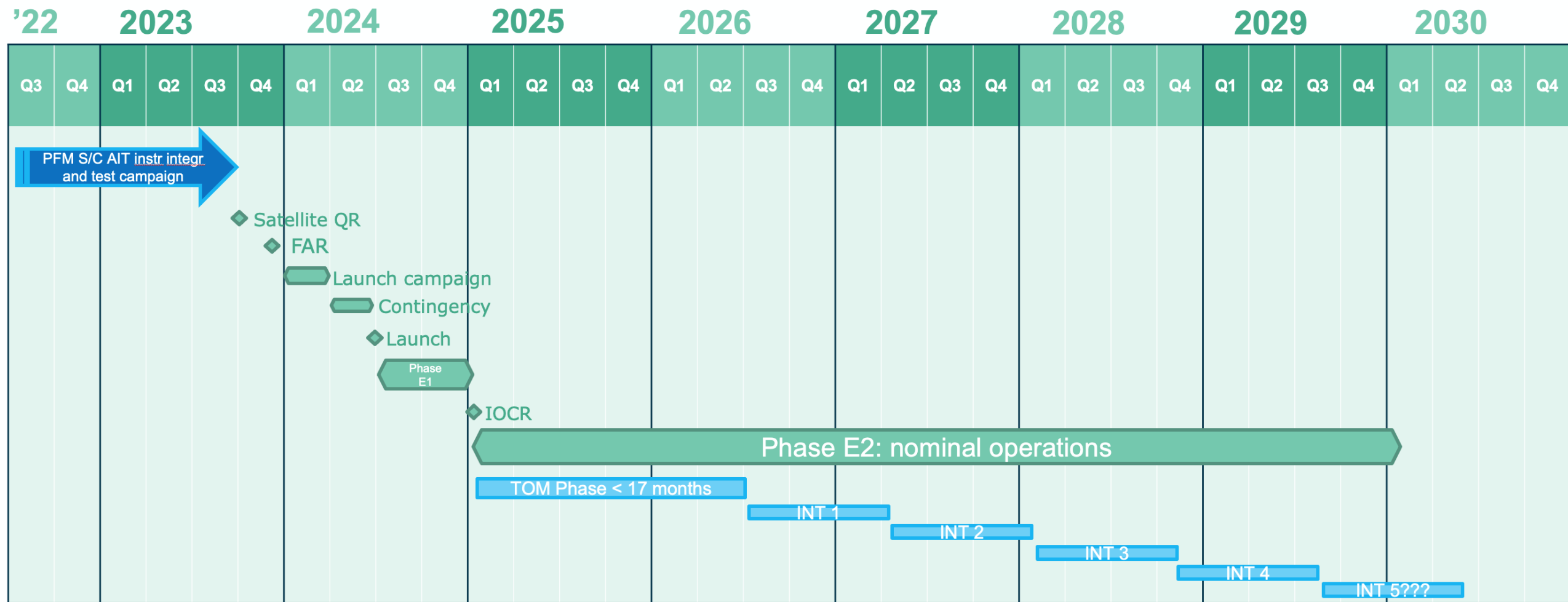
Pol-InSAR



PoSAR



# Assumed mission schedule (7 Major Cycles)





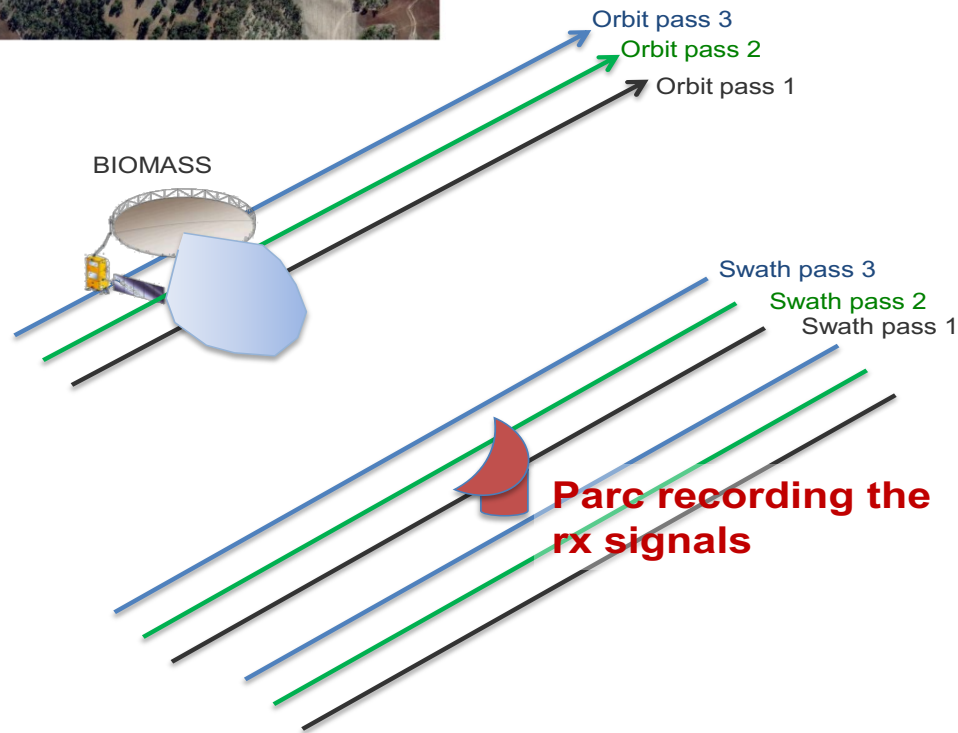
## New Norcia site, NSW



# PARC used in Commissioning Phase & occasional revisits during the mission

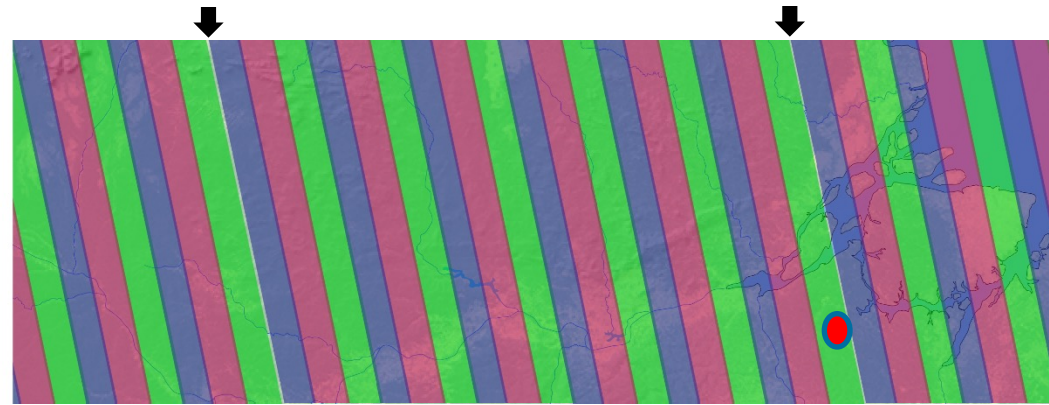
Three major aims of Commissioning Phase:

1. Estimation of the full 2-D antenna pattern using 21 passes over a PARC at New Norcia.
2. Estimation of channel imbalance and cross-talk, and testing of geolocation correction.
3. Characterization of selected natural targets.



The PARC is not yet fully commissioned.

# The PARC and the orbit

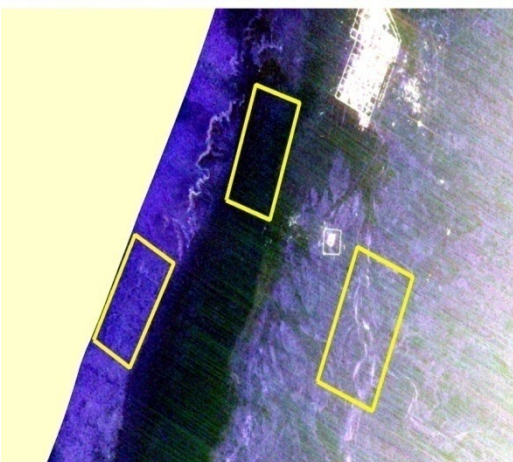
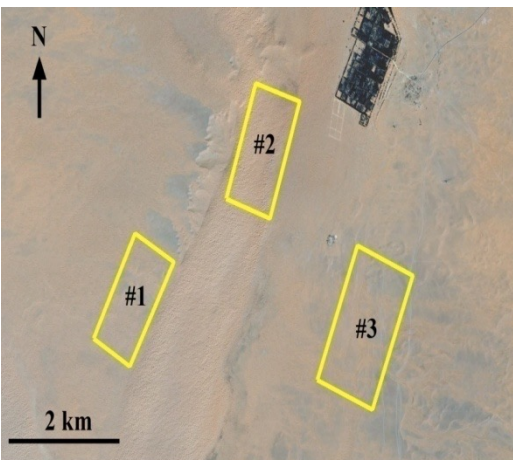


The transponder will be seen

- once in 16 months in the Tomographic phase
- once every 8 months in the Interferometric phase.

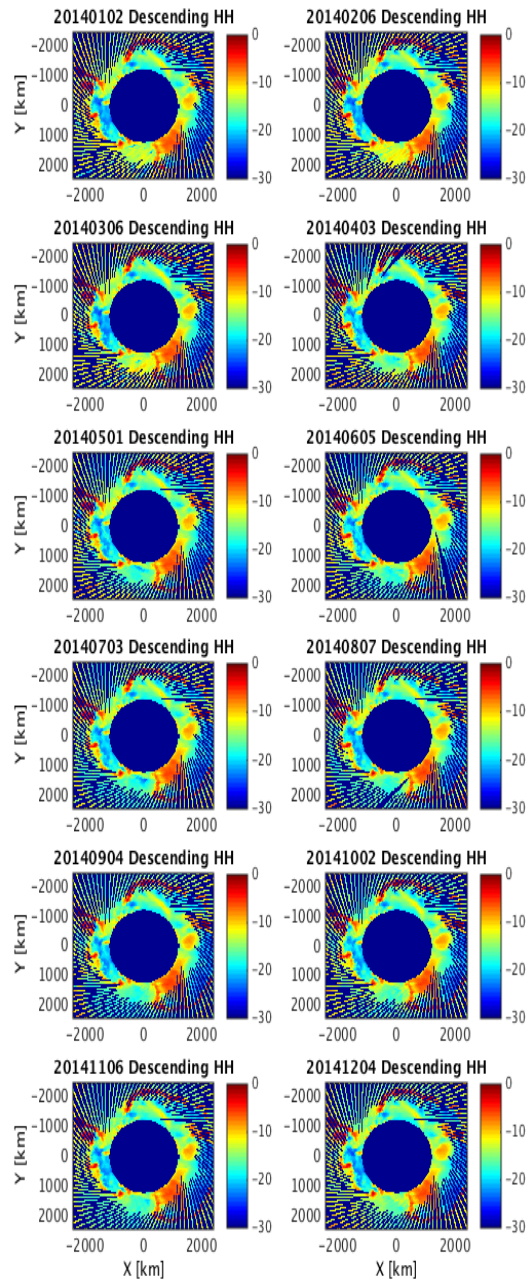
Hence **natural targets of opportunity have to be used** for routine radiometric and polarimetric calibration between visits to the transponder.

# Deserts as radiometric calibrators



Ksar Ghilane oasis (top Landsat), imaged at L-band by ALOS-2 (middle) and P-band by SETHI (bottom), with three regions of interest indicated as yellow boxes

	band	$\theta^\circ$	HH(dB)	VV(dB)	HV(dB)
Reg. 1	L	36.5°	-21.3	-20.3	-34.9
	P	33-36°	-21.0	-21.2	-39.5
Reg. 2	L	36.5°	-22.9	-21.9	-37.1
	P	40-43°	-26.7	-25.6	-38.8
Reg. 3	L	36.5°	-19.1	-17.9	-32.4
	P	53-57°	-19.0	-18.3	-27.6



## Icesheets as radiometric calibrators

Aquarius L-band scatterometer measurements were used to assess radar brightness, stability and homogeneity.

Dome C is bright and stable at L-band.

Is this also true at P-band?

Major progress at DLR on estimating system cross-talk and channel imbalance using only distributed targets.

The general applicability of these methods is still being investigated.

Likely to form the basis of routine polarimetric monitoring of BIOMASS system performance and may supersede the value of the PARC, but this is not finalized.

**BIOMASS Primary Objective:** reducing the major uncertainties in the role of forests and their changes in the Earth's carbon cycle and climate.

Three principal biophysical products:

Product	Resolution	Accuracy
Above Ground Biomass (AGB)	200 m	< 20% (or < 10 t/ha for AGB < 50 t/ha)
Forest Height	200 m	Biome-dependent, < 30% for trees higher than 10 m
Deforestation	50 m	Detection at a specified level of significance

## **AGB:**

- Baseline algorithm (CASINO) defined and implemented at ESRIN
- It uses ground-cancelled data in both the Tomo and Int phases
- Model-based but requires reference data to resolve a parameter ambiguity
- Error model and validation strategy not complete

## **Forest height:**

- Algorithm defined and implemented at ESRIN
- Error model and validation strategy not complete

## **Forest disturbance:**

- Algorithm defined and implemented at ESRIN
- Based on a significance test, so error model is implicit
- Environmental changes confuse the algorithm; work has been done at DLR when this occurs using polarimetry, but ensuing response is not yet defined

In several areas methods are not fully mature.

It is therefore important to involve the wider community in algorithm development.



# BIOMASS Product Algorithm Laboratory

The screenshot shows the GitHub profile for BioPAL, a repository for the BIOMASS Product Algorithm Laboratory. The profile includes a search bar, navigation links for Pull requests, Issues, Marketplace, and Explore, and a notification bell. The BioPAL logo is prominently displayed, along with the text "BioPAL BIOMASS Product Algorithm Laboratory". Below this, there are statistics for Repositories (6), Packages, People (15), Teams (1), Projects, and Settings. A search bar for repositories is present, along with filters for Type, Language, and Sort. The main content area lists four repositories: BioPAL (Python, 7 issues, updated 3 days ago), biopal.org (HTML, Apache-2.0, 1 issue, updated 3 days ago), governance (CC0-1.0, 3 issues, updated 18 days ago), and biopal.github.io (HTML, updated on Oct 26, 2020). A "Top languages" section shows HTML and Python. A "People" section displays 15 contributors with their profile pictures and an "Invite someone" button.



biopal@esa.int



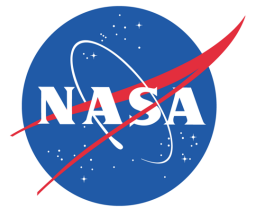
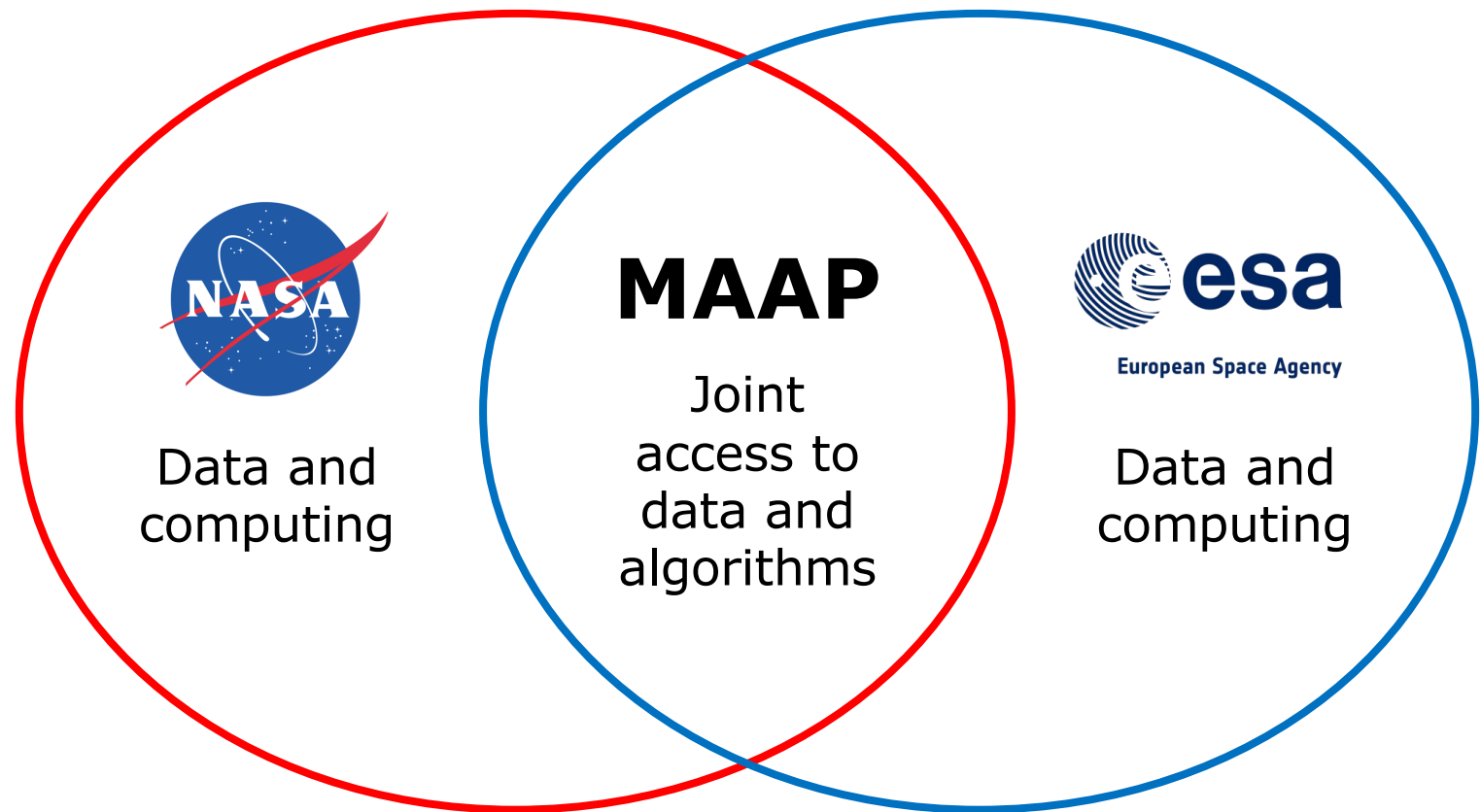
biopal.org



github.com/BioPAL



# Unified user access to the functions of a joint ESA/NASA Mission Algorithm and Analysis Platform model



Data and computing

**MAAP**

Joint access to data and algorithms

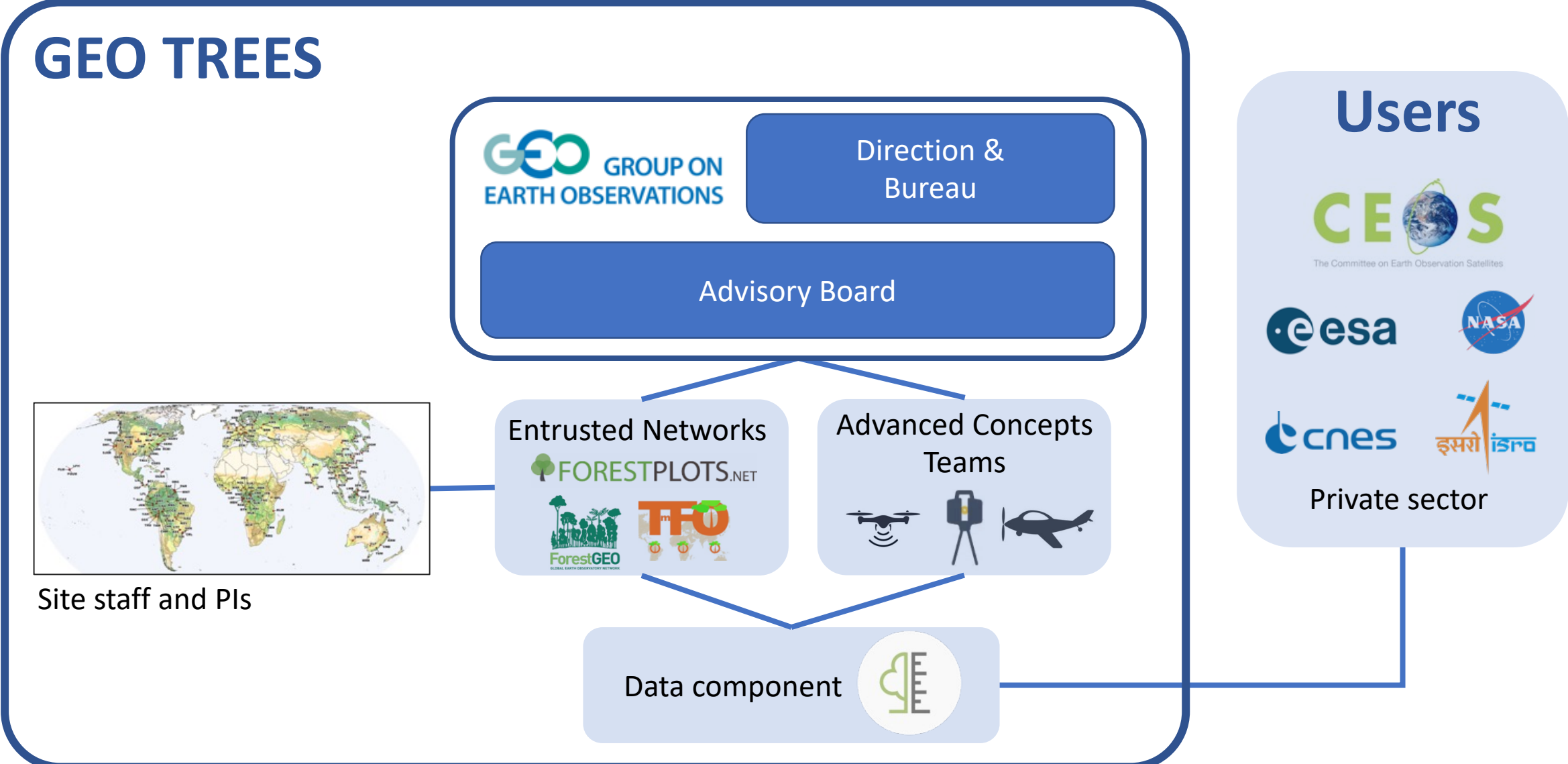


Data and computing

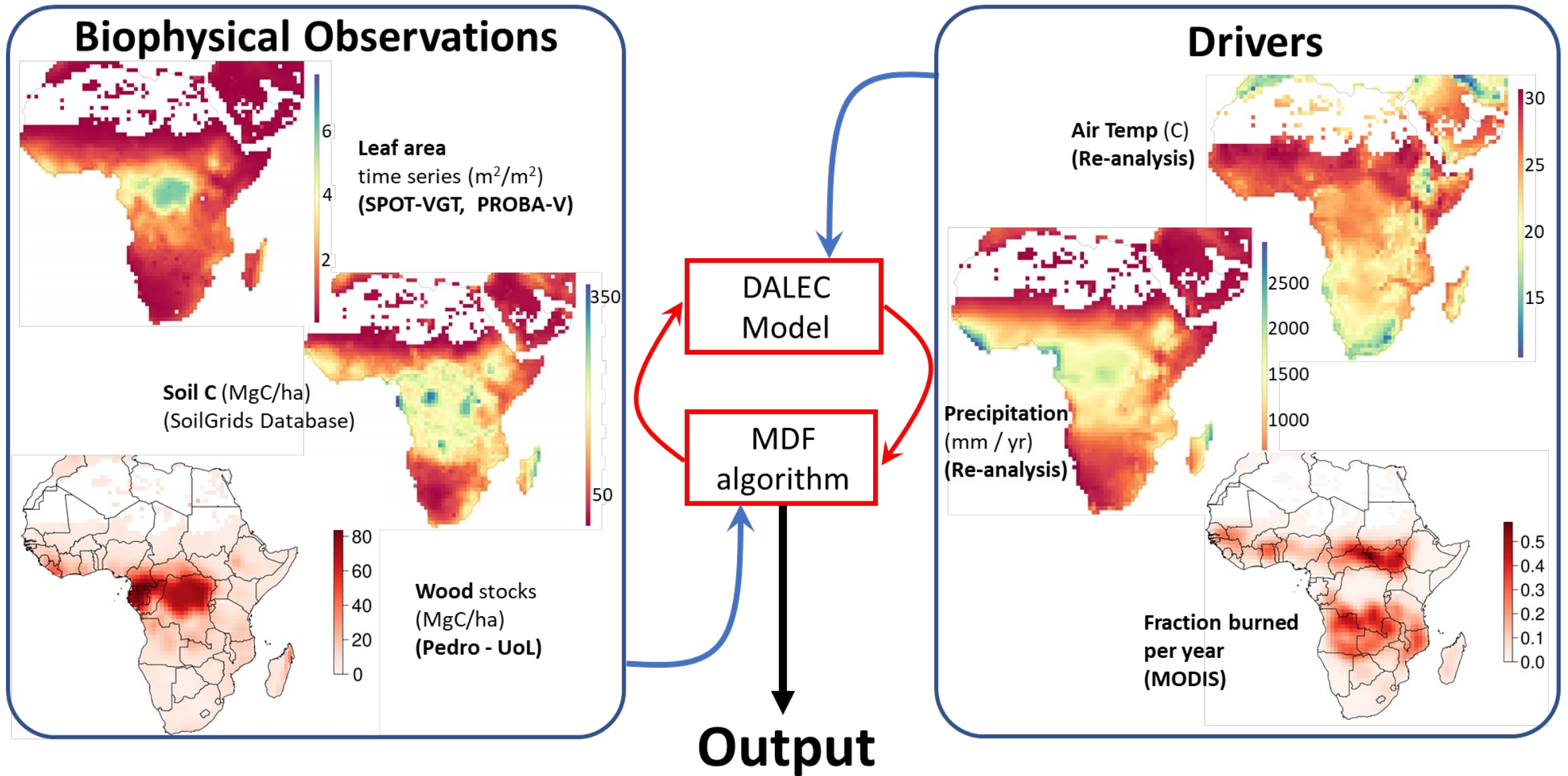


**Up to date data and algorithms + Collaborative community**

# GEO-TREES: crucial involvement of the in situ community



# CARbon DAta MOdel fraMework (CARDAMOM)

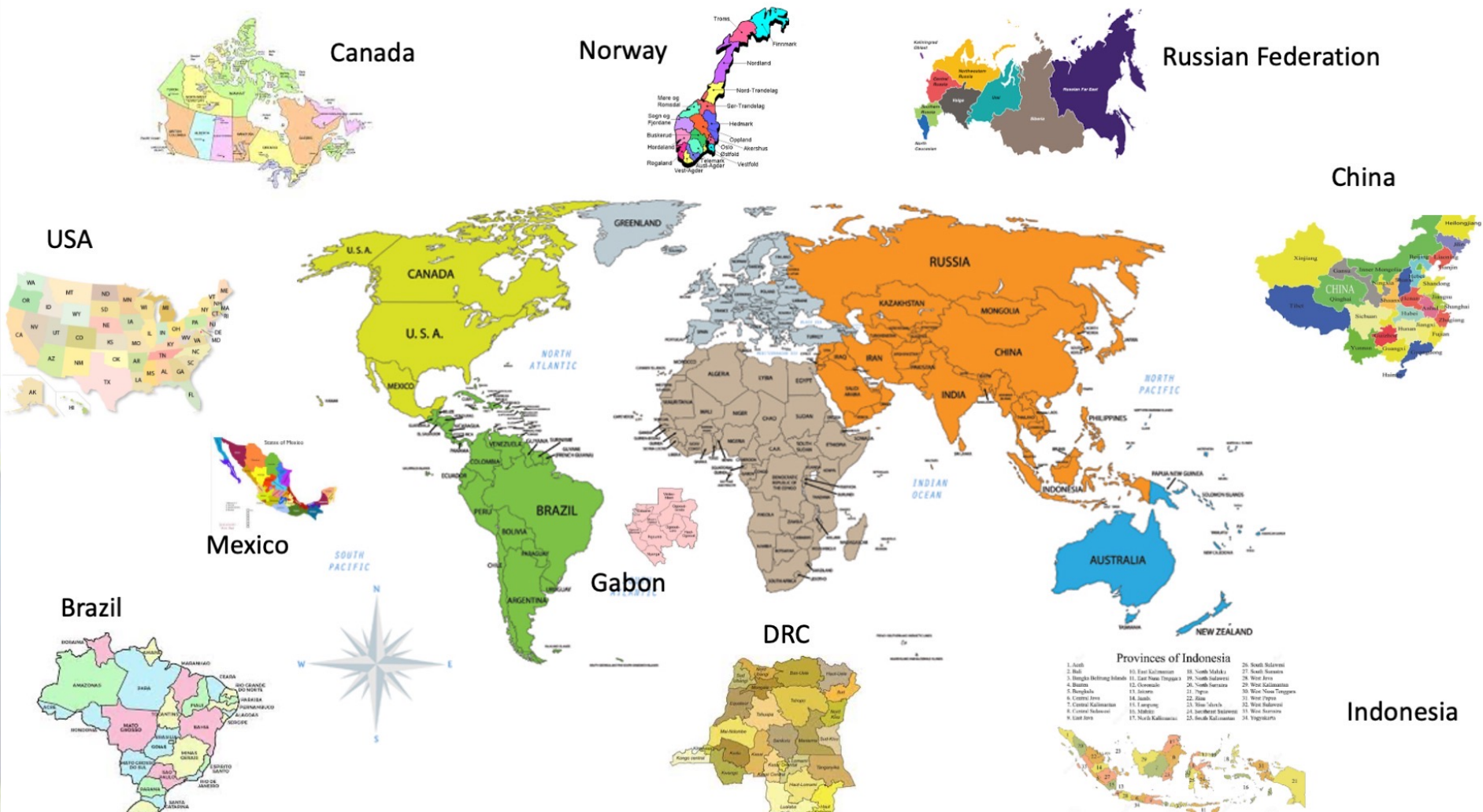


In good shape, but lots to do!!



# Biomass Harmonization Activities Under MAAP

<https://earthdata.nasa.gov/maap-biomass/>



# Summary

