Industry - academia links in the BIOMASS mission

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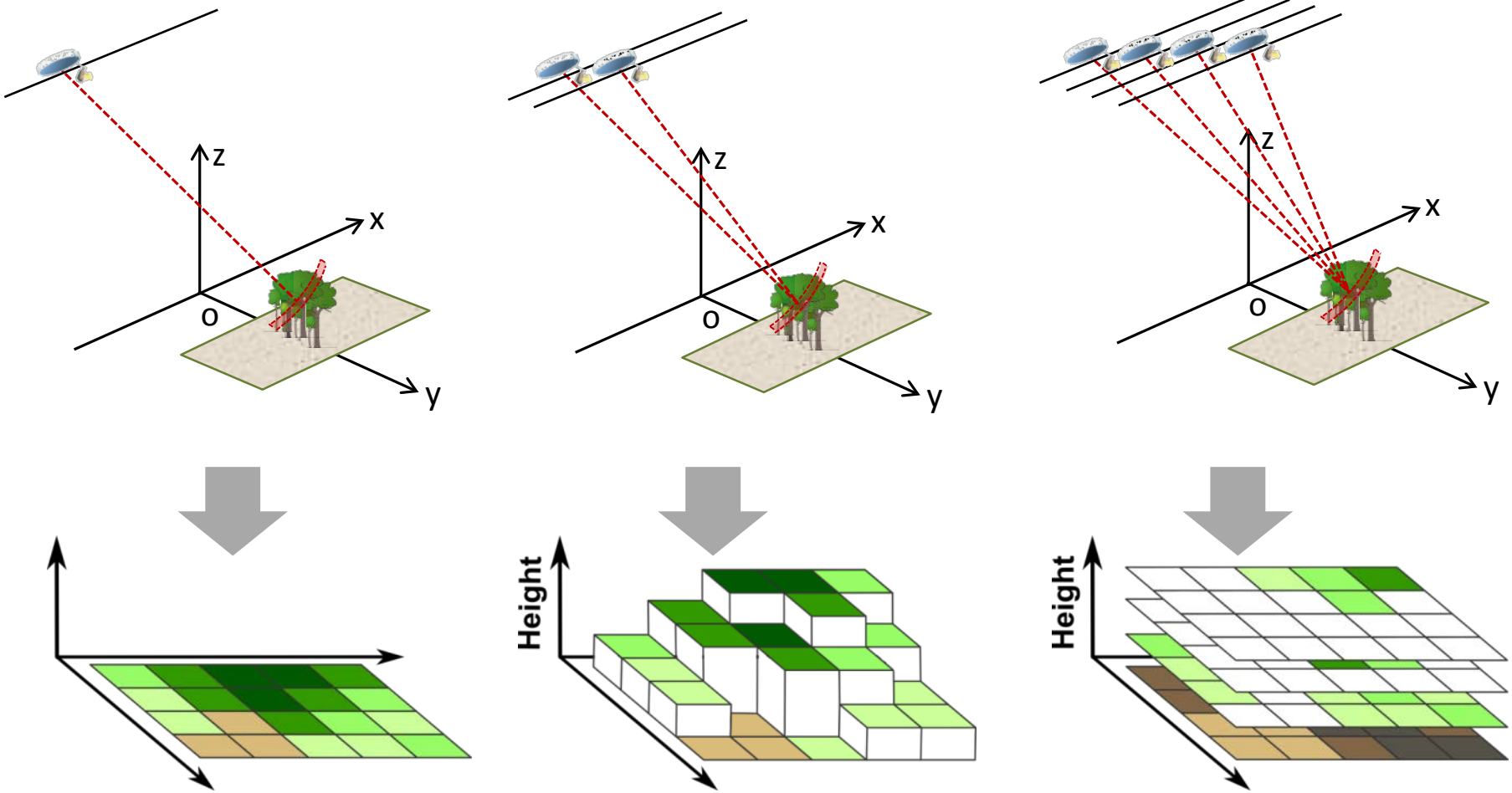
BIOMASS measurement modes

Level-1 Level-2

PolSAR
(SAR Polarimetry)

PolInSAR
(Polarimetric SAR Interferometry)

TomoSAR
(SAR Tomography)



BIOMASS products

- 5-year mission lifetime, launch 2021
- Products:

	Forest AGB	Forest height	Deforestation
Resolution	200 m	200 m	50 - 60 m
Accuracy	20%, or 10 t/ha for AGB < 50 t/ha	20 - 30%	Classification accuracy of 90%

- 1 near-global map of biomass and height from tomography in first 14 months
- Updated biomass and height maps from polarimetry and interferometry every 7 months for rest of mission
- Annual maps of deforestation

Industrial consortium

- Airbus Defence and Space – UK
  - Project Management and PA
  - System Engineering
  - Satellite AIT
- Airbus Defence and Space – Germany
  - Instrument Engineering
  - Instrument AIT
- Airbus Defence and Space – France
  - Avionics
  - Satellite AIT
- Core team partners
  - GMV – Poland, DLR – Germany, Harris – USA, UMS – Germany

Funding

Total: 470M€

Industry (consortium led by Airbus UK): 276 M€

The difference between these numbers is due to:

- ESA internal cost
- Payload Data Ground Segment development
- Flight Operations System development
- launcher
- contingency, etc.

Science: 10.2 M€ (2.2% of total cost)

Responsibilities: industry

1. Biomass platform
2. Platform avionics
3. Biomass instrument payload and Large Deployable Reflector
4. **Mission design and analysis**
5. **End-to End system calibration including ionospheric correction**
6. On-ground calibration equipment, e.g. transponder
7. **BEEPS – Biomass End-to-End Performance Simulator including ground processor**
8. Responsibility for verifying that requirements met up to the **Level 1b** product

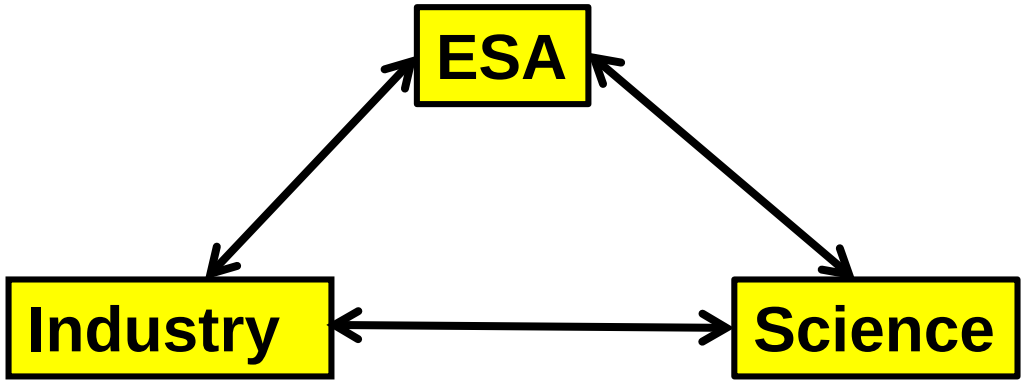
Responsibilities: science

1. **Mission Advisory Group (advice on whole mission concept)**
2. Campaigns
3. Science studies
   a. **External calibration**
   b. **Ionospheric correction**
   c. Development and breadboarding of **Level-2** product algorithms
   d. Algorithm training and validation methodology, etc.
4. Workshops

ESA–industry-science links

Linkage model:

NOT:



Calibration 1

Calibration is needed to account for:

- the antenna pattern
- temporal variation in the system

Relies on **frequent** visits to **stable** reference targets with **known backscatter** and **sufficient SNR.** For distributed targets, we also need **spatial homogeneity.**

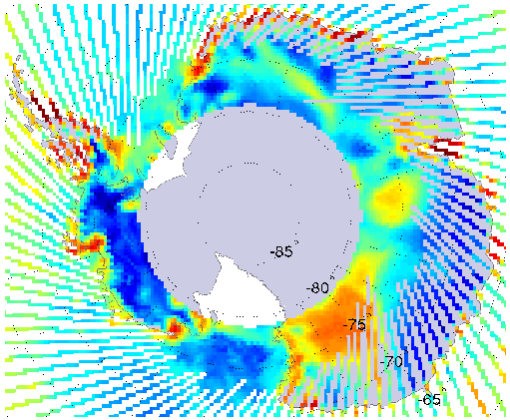
Where are such targets? This is a **science** question whose answer is essential for the industrial calibration strategy.

Transponder – fails the frequency condition because of the BIOMASS orbit pattern, but essential in Commissioning Phase.

Calibration 2

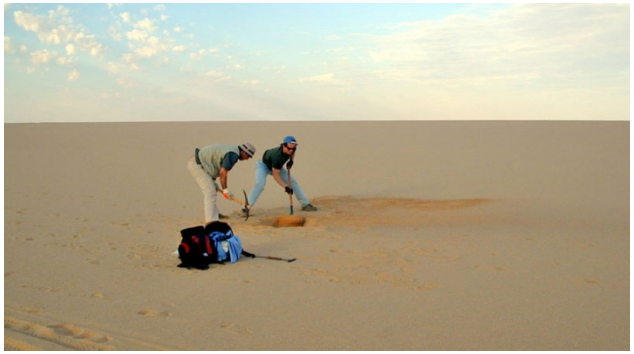
1. Antarctic icesheets, Dome-C:

- stable, good SNR, large
- homogeneous?



2. Eastern Sahara:

- stable, homogeneous, large
- sufficient SNR?



3. Permanent Point Scatterers (urban areas, Atacama desert, Tanzanian savannah)

Inferences from L-band: do they transfer to P-band?

Polarimetric calibration & ionospheric correction

True scattering matrix is **S** but measured matrix is **M**.

1. If no ionosphere, **M** = **RST**.

   Can be solved for **R** and **T** using distributed targets to recover **S**.

2. The ionosphere causes Faraday rotation: **M** = **FSF**

   (if no polarimetric distortion).

   F, the Faraday matrix, can be calculated from **M**, and we can recover **S**.

Polarimetric calibration & ionospheric correction

3. Unfortunately, for BIOMASS we have **M** = **RFSFT**.

   This is a much tougher problem which neither ESA nor industry have the ionospheric or algorithmic knowledge to solve.

The science team have solved this problem for both distributed targets and a transponder, but under this model:

As a result, key information did not flow into industry, and key constraints understood by industry have not flowed to the science team, e.g. what are the issues that affect the location of a transponder for calibration purposes?

Summary

1. Many of the issues faced by industry to meet their contractual commitments require significant science input.
2. Science solutions may not capture constraints or considerations important to industry.
3. The ESA model for industry-science links can (and has) caused misunderstandings and loss of time.
4. Our aim is to form a more efficient and effective modus operandi, in agreement with ESA.