The BIOMASS mission

K. Scipal
PolInSAR 2019
1. ESA’s 7th Earth Explorer Mission, to be launched in 2022
2. A full polarimetric, interferometric P-band SAR
3. Designed to observe global forest height and biomass
Biomass Mission Concept

- Single satellite, operated in a polar sun-synchronous orbit
- Full polarimetric P-band (435 MHz) Synthetic Aperture Radar with 6 MHz bandwidth
- Two mission phases: Tomography (year 1), Interferometry (year 2-5)
- Multi-repeat pass interferometry (3 passes in nominal operations) with a 3 days repeat cycle
- Global coverage in ~7 months (228 days) on both asc. and des. passes
- 5 years lifetime
Development status - summary

1. The System and Instrument Preliminary Design Review has been concluded in 2018. System performance fully achieved apart from:
   - Non conformance to the channel imbalance requirement
   - Descending node coverage

2. The industrial consortium is now fully in place and is working on all mission elements and flight items

3. Started to work on the Level-1 and Level-2 processors.
## Biomass Mission Requirements

<table>
<thead>
<tr>
<th>Key Parameters</th>
<th>Requirement</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (NESZ)</td>
<td>( \leq -27 \text{ dB} )</td>
<td>✔️</td>
</tr>
<tr>
<td>Total Ambiguity Ratio</td>
<td>( \leq -18 \text{ dB} )</td>
<td>✔️</td>
</tr>
<tr>
<td>SLC resolution</td>
<td>( \leq 60\text{m x 8m} )</td>
<td>✔️</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>35 dB</td>
<td>✔️</td>
</tr>
<tr>
<td>Radiometric Stability</td>
<td>( \leq 0.5 \text{ dB} )</td>
<td>✔️</td>
</tr>
<tr>
<td>Radiometric Bias</td>
<td>( \leq 0.3 \text{ dB} )</td>
<td>✔️</td>
</tr>
<tr>
<td>Crosstalk</td>
<td>( \leq -30 \text{ dB} )</td>
<td>✔️</td>
</tr>
<tr>
<td>Channel Imbalance</td>
<td>( \leq -31 \text{ dB} )</td>
<td>❌</td>
</tr>
</tbody>
</table>
Payload Functional Architecture

Biomass SAR Payload

Instrument

Electronics Assembly

InES

Central Electronics Subsystem CES

Chirp generation and Tx

Frequency generation and distribution

H-pol Rx

V-pol Rx

Power Amplifier Subsystem PAS

SSPA

Filters LNA

Receive Amplifier Subsystem RAS

Feed Array FA

Patch

Patch

Patch

Patch

Reflector
Instrument hardware start to be available...

Feed Array EM under test in TASI facility

Digital Control Unit EFM (Airbus GmbH)

Solid Sate Power Amplifier EM (Leonardo)

European GaN transistor fully qualified by UMS/TESAT
Global Revisit Pattern

BIOMASS INT phase revisit pattern along the 15° E meridian
(sampling distance: 0.5°)
Coverage

1. Systematic Acquisitions for forested land (red area) on both ascending and descending orbits
2. Global coverage in 7.5 months (INT phase) and 14 months (TOM phase).
3. Best effort acquisitions for non forested areas (yellow + ocean/sea ice ROIs)
4. Acquisition mask restricted by US Space Objects Tracking Radar (SOTR)

(Red = Primary objective coverage mask, Yellow = Secondary objective coverage mask)
An innovative operations concept: users access a work environment containing the data and resources required, as opposed to downloading and replicating the data ‘at home’.

→ a scenario for data intensive exploitation gradually complementing the traditional operations concept for the **Exploitation platform**

= **Virtual open and collaborative environment**

bringing together:
- Data storage (EO and non-EO data)
- Computing and network resources, hosted processing
- Concurrent design and test bench functions
- Collaborative tools (processing tools, user toolboxes, …)
- Communication tools (social network) and documentation
DesertSAR

1. P- and L-band campaign in the Namib desert
2. Airborne acquisitions by DLR’s F-SAR in mid 2020
3. Ground work by Univ. Bordeaux in May 2019 and during airborne campaign
DesertSAR Data Acquisition

1. Ground data
   - Ground Penetrating Radar
   - High res optical image & DEM
   - Dielectric measurements
   - Surface and subsurface scattering levels

2. SAR @ P- and L-band
   - PolSAR (Green),
   - PolInSAR (Yellow),
   - TomoSAR (Blue)
TomoSense campaign

1. National Park Eifel

2. SAR Data acquisition by MetaSensing in late spring 2019 (TBC)
   - Single pass multibaseline bistatic C- and L-band
   - Repeat pass multibaseline P-band SAR

3. Available reference data
   - Airborne Lidar data
   - Airborne hyperspectral images
   - National Forest Inventory Plots on a 250 m grid (size 0.05 ha)
   - Terrestrial lidar scans of selected plots
Kermeter National Park
1. BIOMASS implementation started in Nov. 2013. We just kicked-off Phase-C with the next Milestone – Critical Design Review - planned in 2019. We are working towards a launch in 2022.

2. BIOMASS will be the first P-band SAR mission in space; it is a true Earth Explorer with a lot of unknowns and exciting science for global biomass mapping and beyond (ice, topography, subsurface geomorphology in deserts, ionosphere, ...).

3. The new unique P-band vision of the Earth have large scientific potential, which we will support by an open and free data policy and the development of the Biomass Mission Algorithm and Analysis Platform.