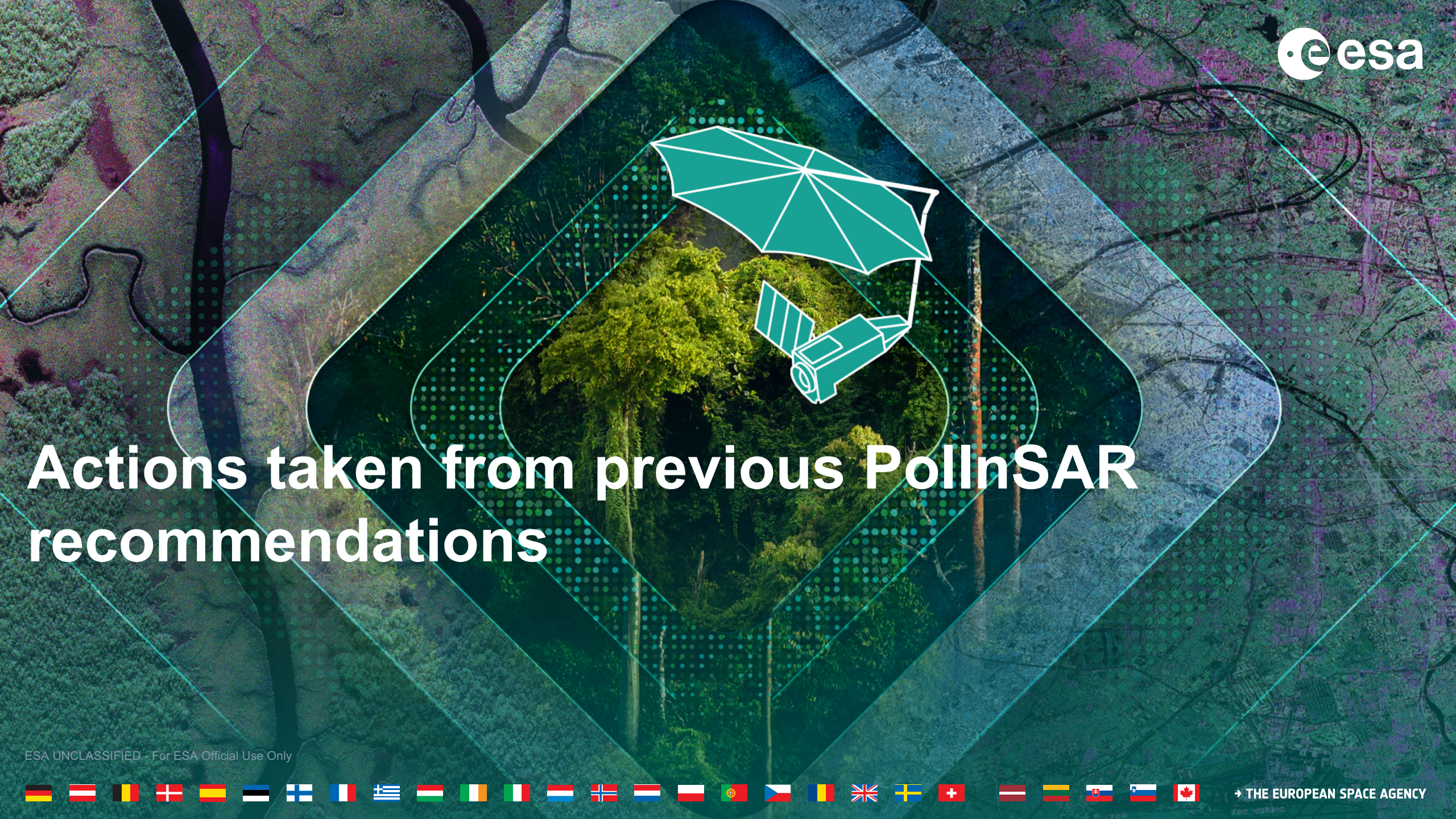
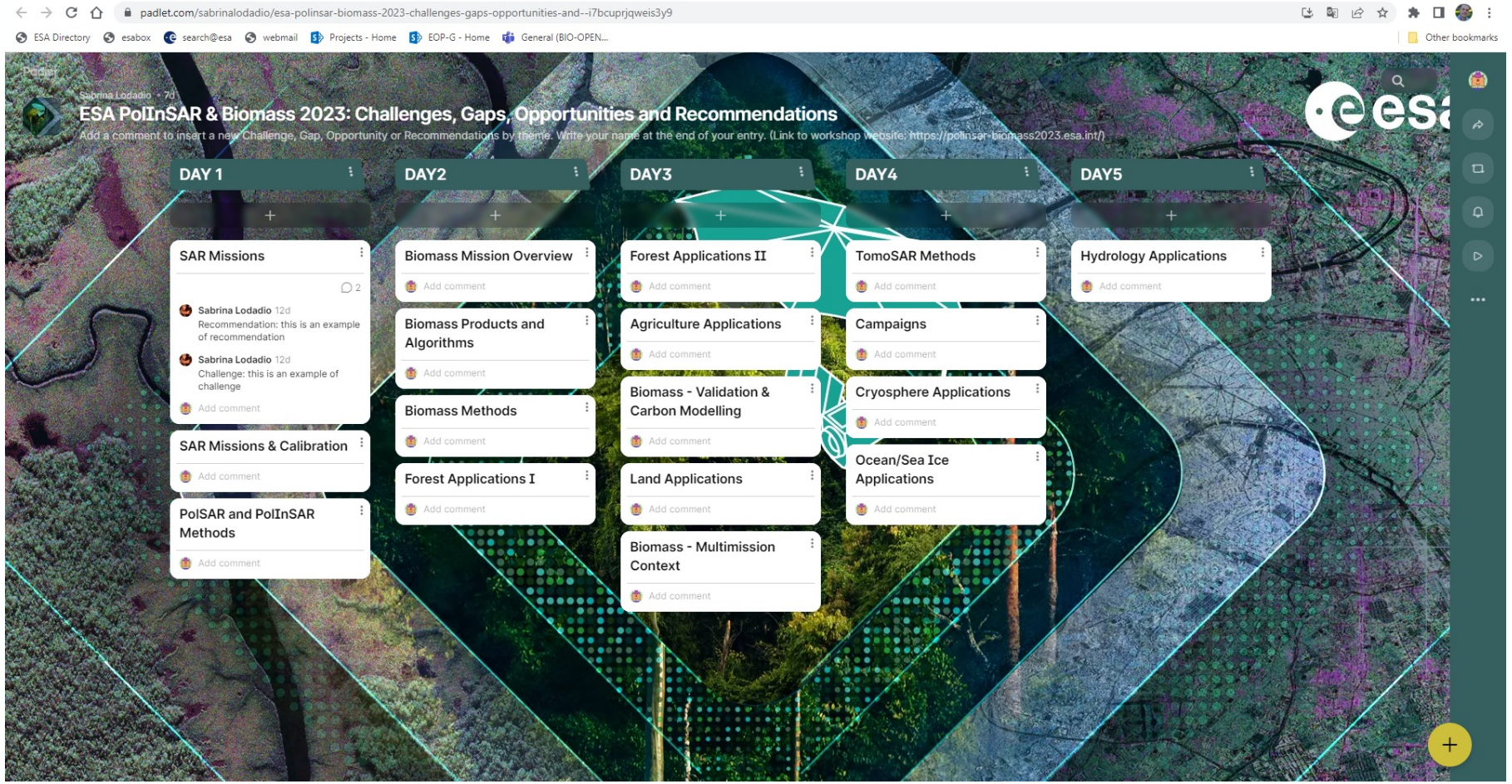


Actions taken from previous PolInSAR recommendations


POLINSAR / BIOMASS 2023
19–23 June 2023 | Espaces Vanel, Toulouse, France
MONDAY 19
9:00–10:30 Registration / Coffee
10:30–11:10 Workshop Opening
11:10–12:50 SAR Missions
12:50–14:10 Lunch Break
14:10–15:50 Missions & Calibration
15:50–16:20 Coffee Break
16:20–18:00 PolSAR / PolInSAR Methods
18:00–19:30 Icebreaker
TUESDAY 20
9:00–10:40 Biomass Mission Overview
10:40–11:10 Coffee Break
11:10–12:50 Biomass Products and Algorithms
12:50–14:10 Lunch Break
14:10–15:50 Biomass Methods
15:50–16:20 Coffee Break
16:20–18:00 Forest Applications I
WEDNESDAY 21
9:00–10:40 Forest Applications II
10:40–11:10 Coffee Break
11:10–12:50 Agriculture Applications | Biomass - Validation & Carbon Modelling
12:50–14:10 Lunch Break
14:10–15:50 Land Applications | Biomass - Mulitmission Context
16:20–18:00 Posters - Aperitivo
THURSDAY 22
9:00–10:40 TomoSAR Methods
10:40–11:10 Coffee Break
11:10–12:50 Campaigns
12:50–14:10 Lunch Break
14:10–15:50 Cryopshere Applications
15:50–16:20 Coffee Break
16:20–18:00 Ocean/Sea Ice Applications | GEO-TREES community engagement
FRIDAY 23
9:00–10:40 Hydrology Applications
10:40–11:10 Coffee Break
11:10–12:50 Recommendation & Summary
12:50–14:10 End of Workshop
BLUE: PLENARY ROOM
GREEN: GRAND TOULOUSE
PROGRAMME
PADLET

Workshop Recommendations

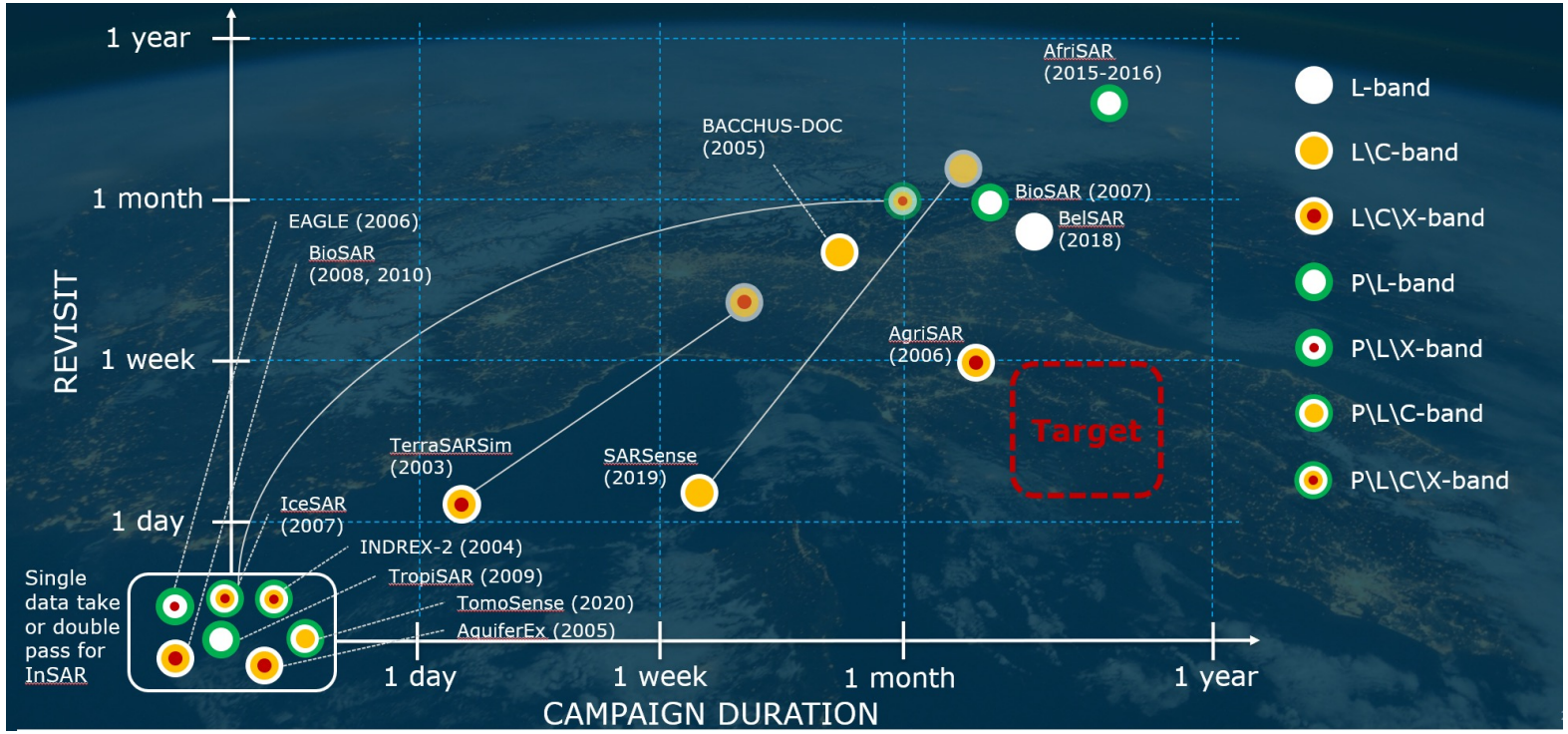
Please provide feedback on Gaps, Opportunities, Recommendations



Recommendations/actions

R.1	**Multi-mission, multi-frequency datasets**	• Create and make available free & open multi-frequency fully polarimetric and interferometric SAR data (spaceborne and airborne), user-friendly open reference datasets (well coregistered on the same grid, at L1 & L2) providing a single data access to users for all different missions, acquired on some characteristic sites like agricultural sites, forest, ocean, desert, covered with snow, coastal areas/wetlands • Inter-agency issue to be discussed in the frame of CEOS

Airborne Campaigns



QUADPOL SATELLITE MISSIONS
- ALOS/PALSAR
- RCM
- COSMO SKYMED 2ND GEN.
- SAOCOM <- PUMAS AGREEMENT

FUTURE SATELLITE MISSIONS :
- BIOMASS
- ROSE-L
- S1 NG

Contact point: Lorenzo Lanini/Malcolm

Recommendations/actions

R.2	**Tools for multi-mission data processing**	Provide tools for multi-mission data processing/exploitation (precise coregistration, data fusion with machine learning, etc.)

- **Next version of SNAP (with new readers for SAOCOM, ICEYE, etc)**
- **PolSARpro + next Python version (see R.9)**
- **ESA/NASA MAAP**
- **ESA Platforms in development for higher level product data (DeepESDL, EDC etc), however, no SLC data**
- **On-going efforts in ESA to integrate low level SAR (L0,L1) data in Cloud environment with dedicated open-source processing**

Contact point: Anca

Recommendations/actions

R.3	**Synergy of satellite systems**	· A trade-off between full pol versus dense time series (or wider swath) needed · Minimise time difference between acquisitions using different satellite missions (ideally simultaneous), to exploit synergy. For Agriculture: Small temporal baseline. For Forests: better separate acquisitions if same frequency; if multifrequency: better as close as possible (ideally simultaneous) · If different missions were synchronised (eg Rose-L & S-1 NG) this would help L-C-band synergy applications enormously. Ideally acquisition synchronization or at least coordination could be attempted also between missions of different agencies: e.g. align orbits of different missions like Rose-L and ALOS, acquire with same incidence angles (idem for Rose-L and S1 NG)

- **On-going joint research between JAXA and ESA on using SAR data products for selected areas and applications**
  - Improvement of observation frequency and coordination in Japan and Europe
  - Explore synergies between C- and L-band
  - Data exchange via dedicated ftp-site under ESA responsibility
  - Project Implementation Plan (PIP) outlines specific Joint Research Activities to be conducted as part of the ESA-JAXA cooperation
- **Activities/agreement between ESA and SAOCOM for preparation of ROSE-L and investigate synergies**
- **Acquisition coordination need between S1 NG and ROSE-L being taken into account**
- **International Coordination Group for Spaceborne Synthetic Aperture Radar (SAR) Missions** http://intl-sar-coord-group.space/
  - Example of Thematic groups: Polarimetric and Multi-frequency SAR, inSAR, Program and Mission coordination

Contact point: B. Rommen, K. Scipal

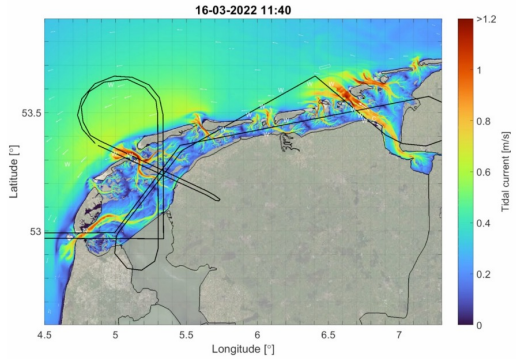
Recommendations/actions

R.4	**Multistatic experiments and simulations**	Wish for multistatic experiments (like Harmony) but also coordination between different missions. Simulations in preparation for Harmony are desirable (ground-based, airborne)

Preparation for EE10 HARMONY (target 2030)

- **WaddenSea**

The aim of the **airborne** campaign, called WaddenSAR, is to support the development of ESA's Harmony Earth Explorer satellite mission.



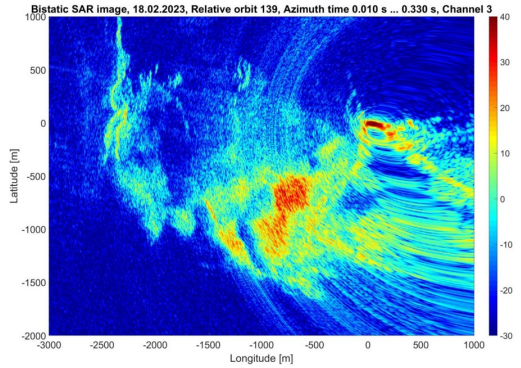
Flight paths and tidal current

MetaSensing, Deltares, the Royal Netherlands Institute for Sea Research and the Paracentrum Texel
https://blogs.esa.int/campaignearth/2022/03/15/flying-over-the-wadden-sea-for-harmony/

- **COBIS4Harmony**

In the French Alps, **Ground-based** bistatic reception (H+V) over a glacier using S-1A illumination.
→ Acquisition of a time series of bistatic SAR data to retrieve vertical motion over la Girose glacier and study snow/firn penetration.

Sample bistatic products – Amplitude image CH3 (V pol)



Contact point: B. Rommen

Recommendations/actions

R.5	**Studies regarding retrieval & EM models**	Put significant efforts in modelling to prepare studies (and tools) on multi-frequency mission data (presently we cannot easily distinguish if a change in polarimetric behaviour is due to differences in frequencies, incidence angles or temporal changes). Studies/opportunities for the research on retrieval & EM models (forward and inverse) should be launched

PolSARpro already have vegetation scattering models:

- **PolSARproSIM and its different flavours**

Some ESA activities have been launched recently in this direction:

- **GAFA : Geometry- and Frequency-agnostic SAR processor (forward and backward)**
  - **Developed by NORCE (Norway)**
  - **Fully open-source policy**
- **Ocean Electromagnetic model**
  - **Developed by Igence (UK)**

Contact point: B. Rommen

Recommendations/actions

R.6	**New research sites**	Include Wetland & Coastal Areas among sites for multifrequency acquisitions since of great importance for many nations, incl. Australia – CSIRO

S1 Mission manager, SAOCOM Mission managers have been informed but difficulties to adapt acquisition plans due to many different constraints (including our present difficulties due to S1B failure and half capacity of the S1 mission).

Action to be possibly discussed also at CEOS level, like R1 and R3 as well (appropriate WG: CalVal? Land?)

Recommendations/actions

R.7	**Science and research opportunities**	New Science Opportunities could include, on top of other suggestions from each session: • Sub-surfaces studies: multi-modal data (combined with frequency, polarimetry and interferometry) will open incredible opportunities to monitor biophysical parameters at different depths (in preparation for Biomass and Rose-L) • Forest Disturbances studies (including Forest Fire Risk) will benefit from full-pol SAR by combining different bands.

- For the sub-surface studies - the DESERTSAR campaign was planned for 2022 with L- and P-band SAR data acquisitions in the Namib desert. Unfortunately the campaign had to be cancelled as the Namibian government did not provide the required flight permissions after long negotiations
- Antarctic Ice campaign with the POLARIS system expected end of 2023 (BIOMASS prep.)
- Forest disturbance studies: ongoing “S1 for Science: Amazonas” project using space-time data cube (the StatCubes) for extraction statistical information on time-series
- The Gabon-X campaign was flown in May 2023, revisiting AfriSAR sites after 7 years (BIOMASS prep.)

Contact point: Magda, B.Rommen, K. Scipal

Recommendations/actions

Recommendations about PolSARpro and about the polarimetric processing tools for MAAP		
R.8	**Programming language**	Language for the PolSARpro functionalities implementation to be included in the MAAP: Python preferred with the use of efficient computing libraries (NumPy, xarray, zarr).

Following the recommendations of POLINSAR 2021 in November 2022 we have launched the project (24 months)

“Re-implementation of selected PolSARpro functions in Python, following the scientific recommendations of POLINSAR 2021”

Recommendations/actions

R.9	**Polarimetric decompositions**	More polarimetric decompositions that are already available in PolSARpro on the top of the ones already proposed internally (see Annex 1) (e.g. Van Zyl, NNED) shall be added to MAAP.

In the first phase of the project (12 months)

- H/A/α
- Freeman-Durden
- Cloude
- Generalized Freeman –Yamaguchi 3-components decomposition
- Yamaguchi 4-components decomposition (2007)
- Freeman 2-components decomposition (2006)
- ANNED
- NNED
- Van Zyl decomposition

In the second phase of the project (12 months)

- Huynen
- Barnes
- Holm
- Krogager
- Cameron

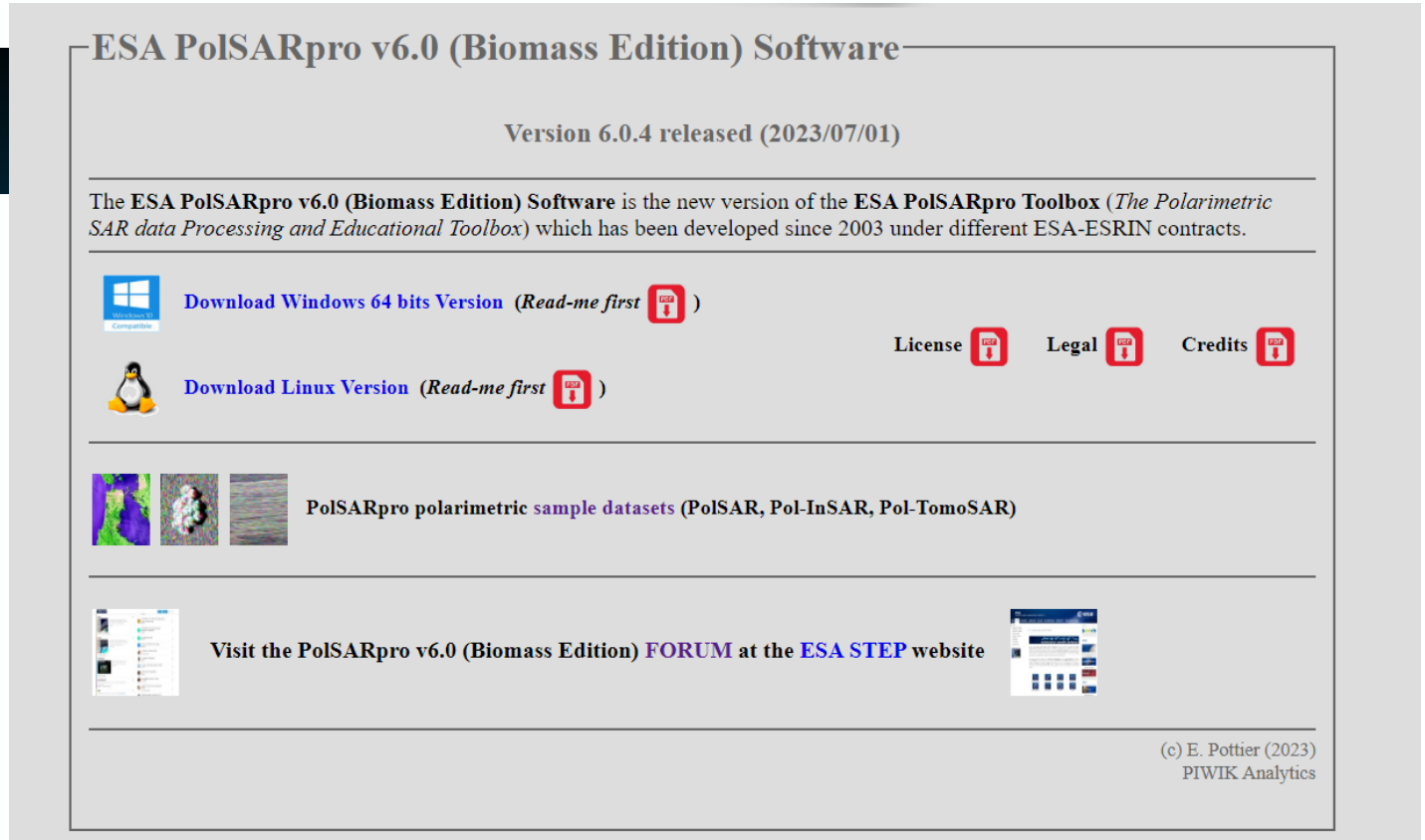
Recommendations/actions

R.10	**PolSARPro BIO continuation**	PolSARPro should remain a separate toolbox (e.g. for education, research) in parallel of its availability in MAAP (PolSARpro could be completely recoded in Python).

PolSARpro v6.0 (Biomass Edition) Toolbox Download

https://step.esa.int/

PolSARpro software + sample quadpol data



Recommendations/actions

R.11	**PolSARpro – SNAP**	We should avoid to duplicate the efforts (between PolSARpro and SNAP) and not reengineer a functionality already available in BioPAL (coregistration).

Existing polarimetric functionalities in SNAP are maintained, in the current SNAP contract there are no plans for the development/implementation additional polarimetric functionalities. No specific bridge between PolSARpro-BIO and SNAP will be maintained (issues with the updates of PolSARpro when new version of SNAP is released)

R.12	**PolSARpro support for new missions**	PolSARpro – BIO shall address future ESA polarimetric missions like ROSE-L, Sentinel-1 NG.

SAOCOM toolbox in PolSARpro is almost ready (few bugs to be fixed)
Support for future ESA missions will depend on the availability of sample data

Contact point: Magda