The PolInSAR Course

…an (experimental) **SAR training course**

Course No 10: 13th of April 2026 – 17th of July 2026

… first course after BIOMASS launch !!!

Prepared by DLR-HR's Pol-InSAR Team

German Aerospace Center (DLR), Microwaves & Radar Institute (HR), Pol-InSAR Research Group

Course Organisation: ESA, DLR, EEBIOMASS

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Motivation

A rapidly growing (scientific and commercial) community with limited or no SAR background is getting more and more confronted with multi-parameter SAR data:

… as a new generation of multi-parameter SAR missions with open data policy is already operational in orbit or about to be launched;

… and synergies between SAR and optical remote sensing data (or products) developed in recent years confront users with the use of multi-parameter SAR data.

The interpretation of SAR data is less intuitive than that of optical data, and the available literature is often either 'too mathematical' or oversimplified. However, understanding the information content of SAR data and the basic principles and algorithms of SAR processing is neither difficult nor complex. With a reasonable investment of energy, anyone can achieve both. And this is what this course supports!

The Pol-InSAR course is an online hands-on course that aims to develop understanding for the information content of multi-parameter SAR data and at the same time to eliminate the “respect” for SAR data processing in an interactive way, without assuming any prior / background knowledge on SAR.

The course covers a wide range of SAR topics, techniques and applications, and this edition explores the data and techniques relevant to ESA’s BIOMASS mission.

As the course is run on ESA's Multi-Mission Algorithm and Analysis Platform (ESA-MAAP), there are no hardware or software requirements for participants.

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Course Outline: 5 SAR (2D and 3D) Techniques in 11 Units

Synthetic Aperture Radar - SAR

1. **Focusing in Range:** Spatial resolution in Range, Matched filter, 1D and 2D focusing, …
2. **Focusing in Azimuth:** Spatial resolution in Azimuth, Synthetic aperture, 1D and 2D focusing, …

SAR Polarimety - PolSAR

1. **Scattering matrix:** Polarimetric SAR, physical interpretation of scattering mechanisms, ...
2. **Covariance matrix:** Distributed scatterers, depolarization, polarimetric eigen-decomposition, …

SAR Interferometry - InSAR

1. **Interferogram formation:** Image co-registration, flat earth removal, geometric interpretation, …
2. **Interferometric coherence:** InSAR decorrelation, volume decorrelation, forest height inversion, …
3. **Differential Interferometry:** D-InSAR principles, LOS change, propagation effects, …

Polarimetric SAR Interferometry – Pol-InSAR

1. **The Pol-InSAR space:** Pol-InSAR observation space, interpretation and representation, …
2. **Model based Pol-InSAR inversion:** forest height inversion, dual-pol implementation, …

SAR Tomography - TomoSAR

1. **3D Focusing:** Vertical aperture formation, 3D resolution, 3D focusing, …
2. **3D Refelectivity:** Reconstrucion algorithms, polarimetric extension, interpretation, …

Each Unit = A Week with 3 Sessions !

Mon	**Theoretical Background (~60min) + Break + Introduction of Exercise(s) (~60min)**
Tue	
Wed	**Check Point: Discussion of problems & results, questions & answers (~60min)**
Thu	
Fri	**Closing Session: Discussion of results, questions & answers (~90 + min)**
Sat	
Sun	► Zoom Link: https://zoom.us/j/98253602750?pwd=U0xBOXUrSFY2NHZ6bzBuU3oyWWUxdz09 ► The sessions are recorded and the recording is distributed after each session.

Important Note: The consent to audio and video recording of the sessions and thre distribution of the recordings is mandatory.

Proposed Course Timeline

Synthetic Aperture Radar - SAR

1. Focusing in Range	Week 16	13.04 - 17.04.26
2. Focusing in Azimuth	Week 17	20.04 - 24.04

SAR Polarimety - PolSAR

1. Scattering matrix	Week 18	27.04 - 01.05
2. Covariance matrix	Week 19	04.05 - 08.05

SAR Interferometry - InSAR

1. Interferogram formation	Week 20	11.05 - 15.05
2. Interferometric coherence	Week 21	18.05 - 22.05
3. Differential Interferometry	Week 25	15.06 - 19.06

Polarimetric SAR Interferometry – Pol-InSAR

1. The Pol-InSAR space	Week 26	22.06 - 26.07
2. Model based Pol-InSAR inversion	Week 27	29.06 - 03.07

SAR Tomography - TomoSAR

1. 3D Focusing	Week 28	06.07 - 10.07
2. 3D Refelectivity	Week 29	13.07 - 17.07

Proposed Course Timeline

Synthetic Aperture Radar - SAR

1. Focusing in Range
2. Focusing in Azimuth

SAR Interferometry - InSAR

1. Interferogram formation
2. Interferometric coherence
3. Differential Interferometry

SAR Polarimety - PolSAR

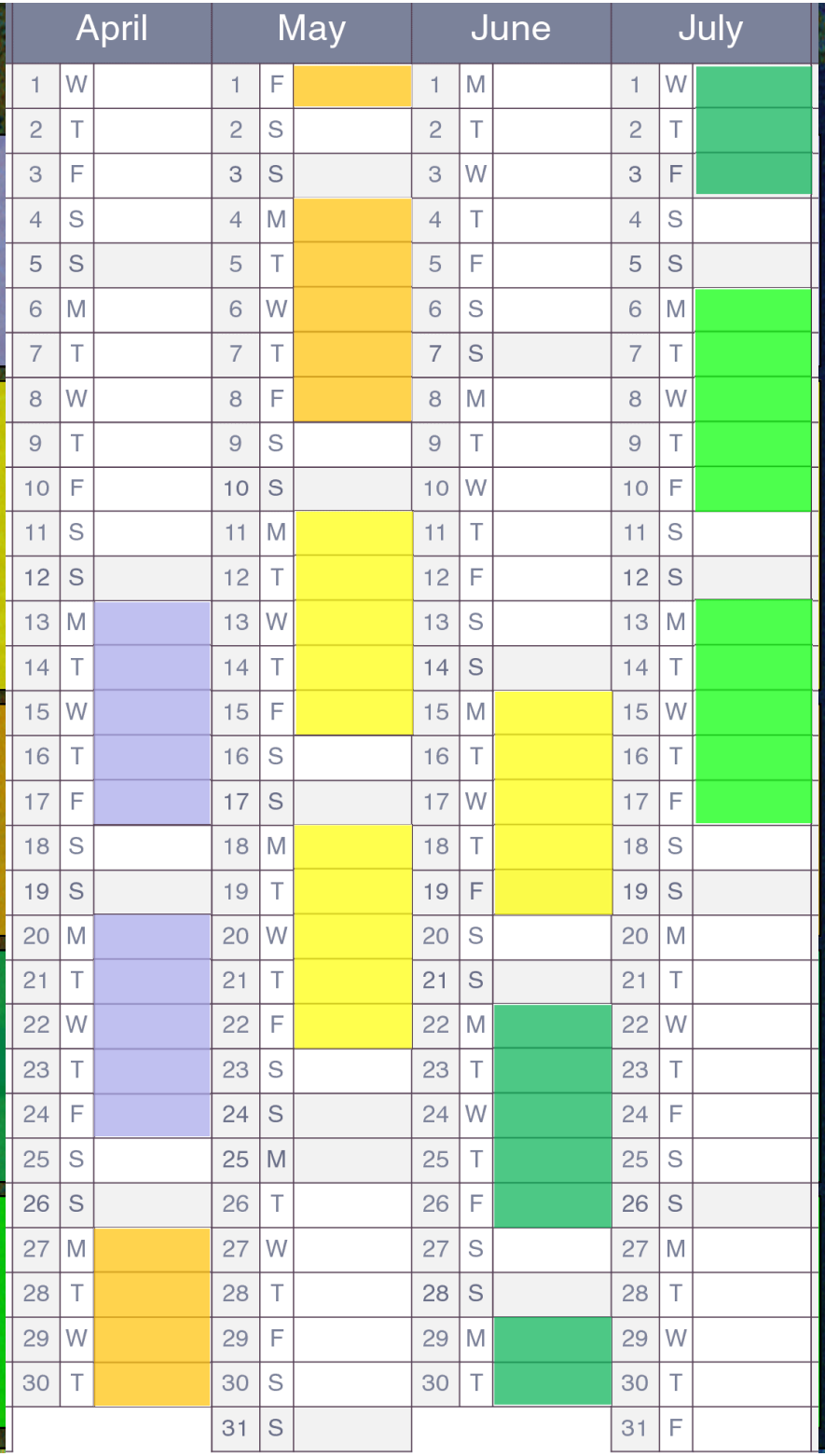
1. Scattering matrix
2. Covariance matrix

Polarimetric SAR Interferometry - Pol-InSAR

1. The Pol-InSAR space
2. Model based Pol-InSAR inversion

SAR Tomography - TomoSAR

1. 3D Focusing
2. 3D Refelectivity



ESA‘s Mission Algorithm and Analysis Plattform (ESA-MAAP)

The course is hosted by ESA‘s Mission Algorithm and Analysis Plattform (ESA-MAAP) that is a virtual open and collaborative environment that:

Enables researchers to easily discover, process, visualize and analyze large volumes of data.

Provides tools and infrastructures to bring data into the same coordinate reference frame to enable comparison, analysis and evaluation.

Provides a version-controlled science algorithm development environment that supports tools, co-located data, and processing resources.

Addresses intellectual property and sharing issues related to collaborative algorithm development and sharing of data and algorithms.

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Overview of Resources on the ESA-MAAP

Main user interface: JupyterLab

Main programming language: Python

Additional support for: R and Julia

Main packages: NumPy, SciPy, GDAL, Scikit-Learn, Dask, Xarray

Available resources per user:

RAM: 10GB

Storage: 30 GB

There are no hardware or software requirements for participants !!!

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