

## → **POLINSAR 2013**

The 6th International Workshop on Science and Applications of SAR Polarimetry and Polarimetric Interferometry

# Workshop Background, Objectives and Organization

**Yves-Louis Desnos, Andrea Minchella, Ulla Vayrynen**

EO Science, Applications & New Technologies Department

Directorate Of Earth Observation Programmes

- Workshop objectives and themes
- POLinSAR 2011 Recommendation Status
- Workshop organisation
- SEOM element action lines
- POLINSAR 10<sup>th</sup> anniversary



- Provide a forum for **scientific exchange**
- Present exploitation results from fully polarimetric airborne and spaceborne systems
- Present **latest studies** in the field and ESA POLSARAP results
- Report on progress/status of **POLinSAR 2011 recommendations**
- Demonstrate **benefits of fully polarimetric systems** (vs. dual or single polarization)
- Present **future missions** in preparation
- Present final PI results from **ESA/CSA SOAR EU** initiative

1. Theoretical Modelling
2. SAR Polarimetric Interferometry (Pol-InSAR)
3. Polarimetry and DInSAR, Persistent Scatterer Interferometry (PSI)
4. Polarimetry and Tomography
5. Applications of SAR Polarimetry
  - Land: Forest, Agriculture, Environment and Wetlands
  - Ocean: Pollution Monitoring, Ship detection, Ocean Parameters Retrieval, Sea Features
  - Cryosphere: Snow, Land Ice and Sea Ice Monitoring
  - Hazards: Fire Monitoring, Volcanoes, Flooding, Earthquake
  - Other applications
6. Past, Current and Future SAR Missions
7. Airborne and Spaceborne campaigns

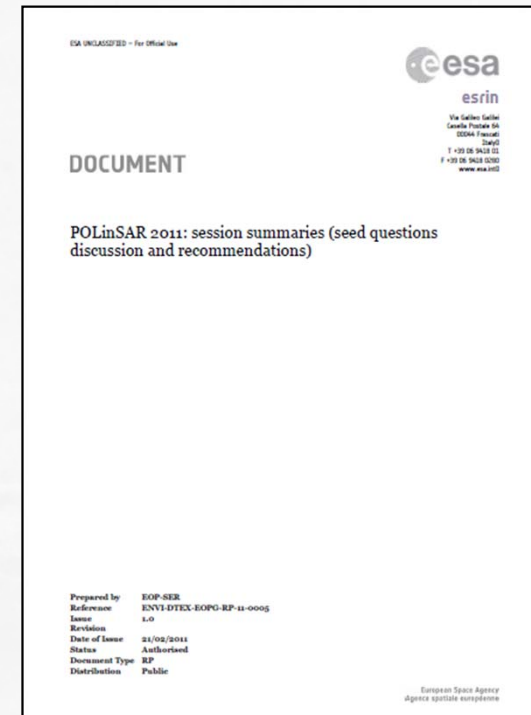
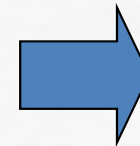
- Workshop objectives and themes
- POLinSAR 2011 Recommendation Status
- Workshop organisation
- SEOM element action lines
- POLINSAR 10<sup>th</sup> anniversary



## RECOMMENDATIONS

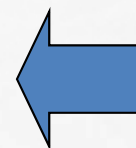
### POLinSAR2011 WORKSHOP

<http://www.polinsar2011.com>



## ACTION

Campaign
Training
Toolbox
Algorithms



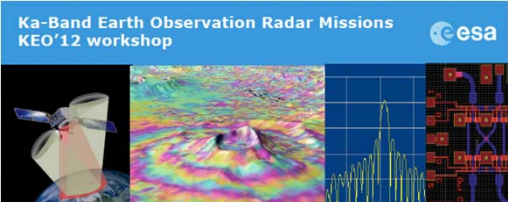
### REPORTING POLinSAR2013 WORKSHOP

<https://earth.esa.int/polinsar2013>



# PolInSAR 2011 Recommendations



Session	Recommendation	Action
MISSION	<ul style="list-style-type: none"> <li>• <b>Quadpol modes</b> remain of central importance to future SAR missions for new science and commercial product developments. <b>All future missions should provide such a capability</b>, even if they also provide a complementary compact or dualpol mode.</li> <li>• New operational high frequency sensors (TerraSAR-X) have seen sensitivity to storm/severe weather events. We therefore recommend <b>early consideration of a future high frequency Polarimetric Radar mission</b> aimed at sensing atmospheric/aerosol properties.</li> </ul>	<p>Use of Polarimetry in future: Science objective driven e.g. <b>BIOMASS mission at P-Band</b></p> <p>User requirements driven for operational missions providing services -&gt;need to demonstrate the benefits vs drawbacks</p> <p><b>ESA POLSARAP study</b></p> <p><b>CSA-RCM approach</b></p> <p><b>First ESA Workshop on Ka-Band Earth Observation Radar Missions</b></p> 



# ESA PolSAR-Ap contract

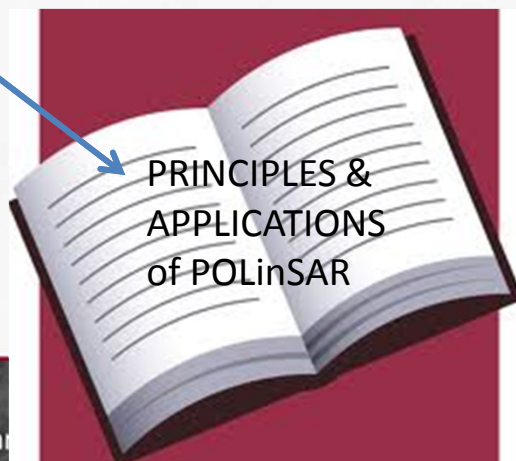


PolSAR-Ap: Exploitation of Fully Polarimetric SAR Data for Application Demonstration I. Hajnsek (German Aerospace Center - DLR)

2003-2013 : 10 years of the PolSARpro v5.0 Software. New updates and its link with the ESA POLSAR-Ap project. E. Pottier (University of Rennes1 - France)

POLSARap: investigating the benefits of polarimetry for urban applications using X-band SAR images. E. Koeniguer (ONERA – France)

PolSAR-Ap: exploitation of fully polarimetric SAR data for oil and target at sea monitoring. F. Nunziata (Università di Napoli Parthenope - Italy)



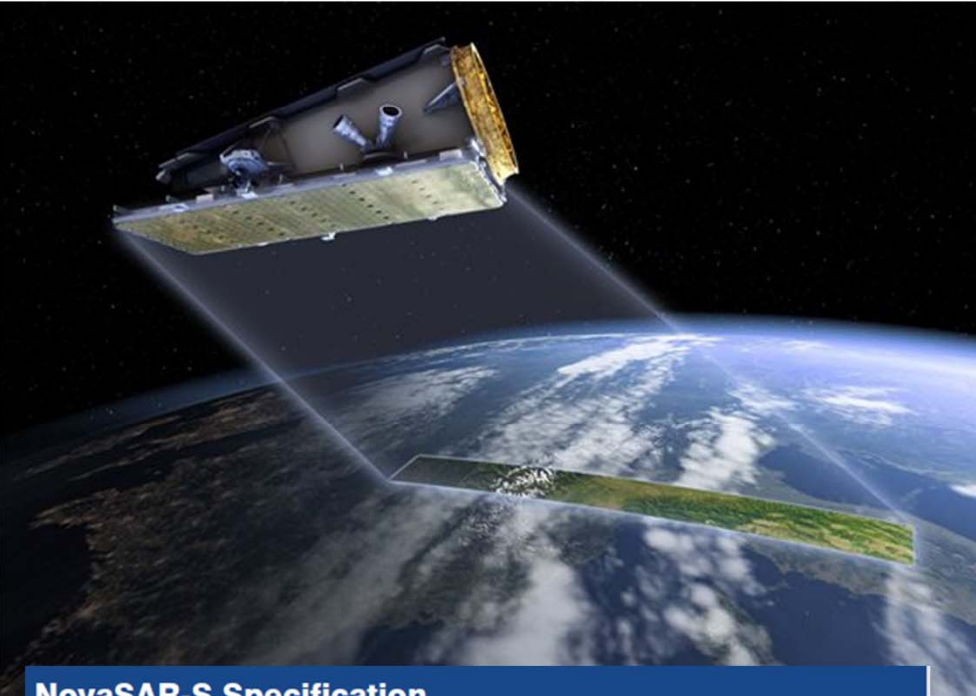


# PolInSAR 2011 Recommendations



Session	Recommendation	Action
<p><b>MISSION</b></p>	<ul style="list-style-type: none"> <li>• We recommend that agencies <b>maintain research/development in technology for low frequency L, P and S band missions;</b></li> <li>• particularly we propose a challenge for industry to develop new technologies to demonstrate operational wide-swath quadpol capabilities from space.</li> <li>• As regards Data Policy, we recommend that “FREE AND OPEN” should be the objective, and every agency should provide ‘best effort’ to maintain this into the future.</li> </ul>	<p>NOVASAR (UK) S band                      HJ-1C (China) S band                      ALOS2 (Japan)                      BIOMASS phase A P band                      Technology activities                      Campaigns activities</p> <p>Digital Beam forming                      TandemL studies</p> <p>Revised ESA Data Policy for ERS, Envisat and Earth Explorers Missions (ESA/PB-EO(2010)101)</p> <p>Joint Principles for a Sentinel Data Policy [ESA/PB-EO(2009)98, rev. 1] and the pending GMES data policy.</p>

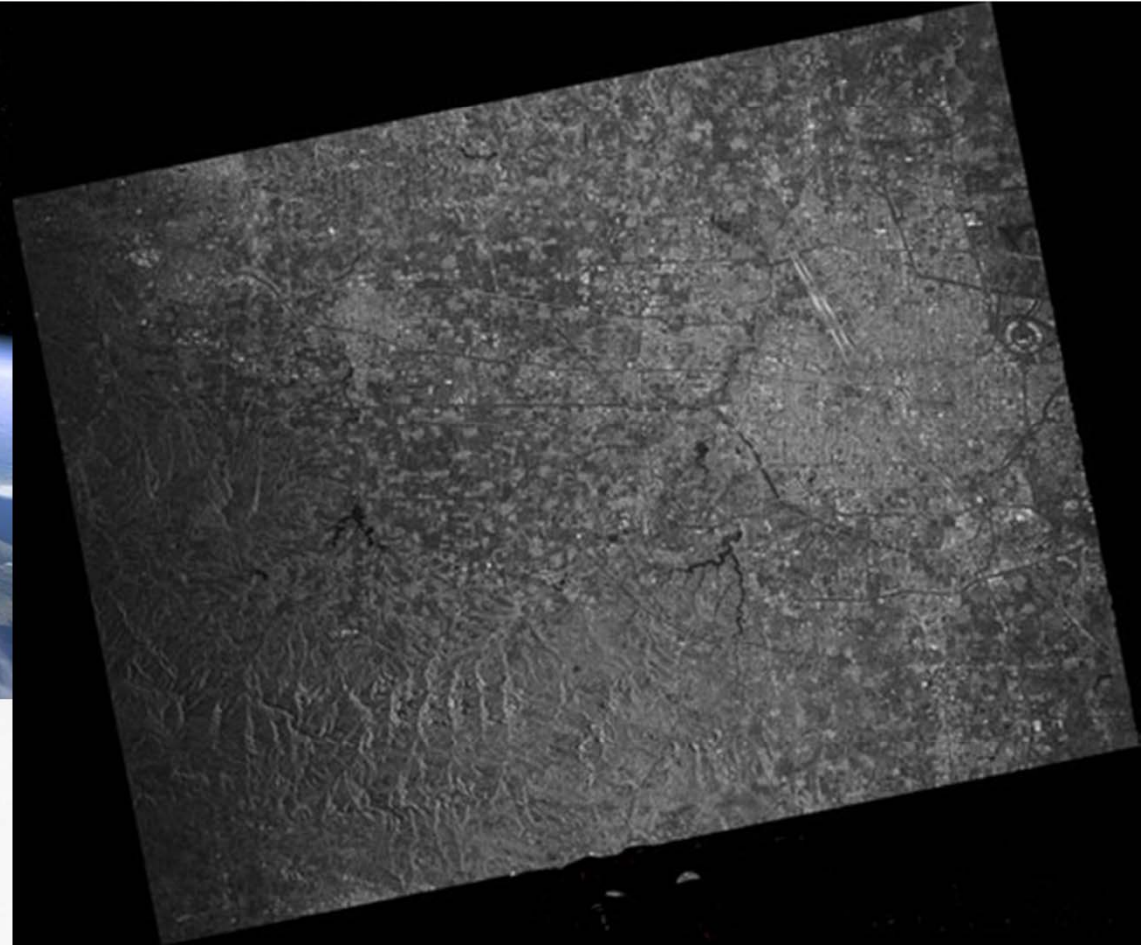
# New Mission and First image



## NovaSAR-S Specification

Imaging frequency band	S-band (3.1-3.3GHz)
Lifetime	7 years
Mass	<400kg
Lead time (KO to FRR)	24 months
Antenna	Microstrip patch phased array (3m x 1m)
Imaging polarisations	Single, dual or tri-polar (HH, HV, VH, VV)

<http://www.sstl.co.uk/NovaSAR-1>



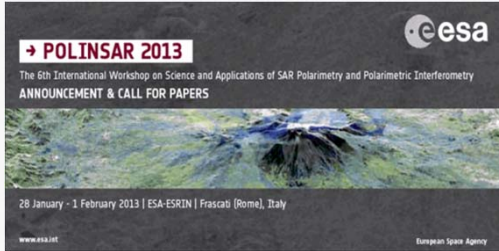
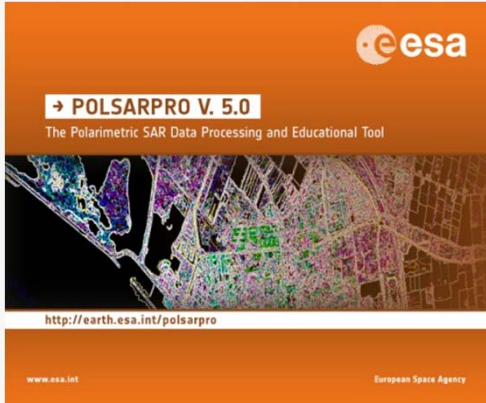
HJ-1 environmental satellite C, China's first independently developed civil synthetic aperture radar satellite, returns the first S-band synthetic aperture radar images on December 9 2012.

[http://english.cas.cn/ST/HT/ht\\_progress/201212/t20121211\\_96687.shtml](http://english.cas.cn/ST/HT/ht_progress/201212/t20121211_96687.shtml)




# PolInSAR 2011 Recommendations



Session	Recommendation	Action
<b>METHODS AND THEORETICAL MODELLING SESSION</b>	<ul style="list-style-type: none"><li>• Establish a unified theoretical basis for CP Pol-InSAR, in the same fashion as the founding basis for (quad-pol) Pol-InSAR</li><li>• “Require” multi-PI based objective quantitative comparisons of CP vs MP, DP, and FP for all Super Sites.</li><li>• Work system-engineering level analyses of CP issues</li><li>• Polarimetric radars have much to offer to the operational community. It would be constructive to encourage efforts aimed at preparing potential radar polarimetric tools for practical operational utility</li></ul>	 

# PoInSAR 2011 Recommendations




Session	Recommendation	Action
<b>METHODS AND THEORETICAL MODELLING SESSION</b>	<ul style="list-style-type: none"><li>• A future challenge concerning target decomposition is to focus on the model-based decomposition by developing new approaches based on application-specific physics (biomass + topography for example).</li><li>• The suggestion that logarithmic transformations may be exploited to simplify and enrich decomposition and segmentation analyses deserves further investigation.</li><li>• Filters developed and in use by particular investigators should be considered as “beta tools” as part of POLSARPRO.</li><li>• Bistatic data (e.g. TanDem-X) should be released to the community to encourage development of bistatic interpretation tools.</li></ul>	 <p><b>At POLINSAR 2013 recommendation needed for POLSARPRO continuation</b></p> <p>TanDEM –X AO <a href="https://tandemx-science.dlr.de/">https://tandemx-science.dlr.de/</a></p>



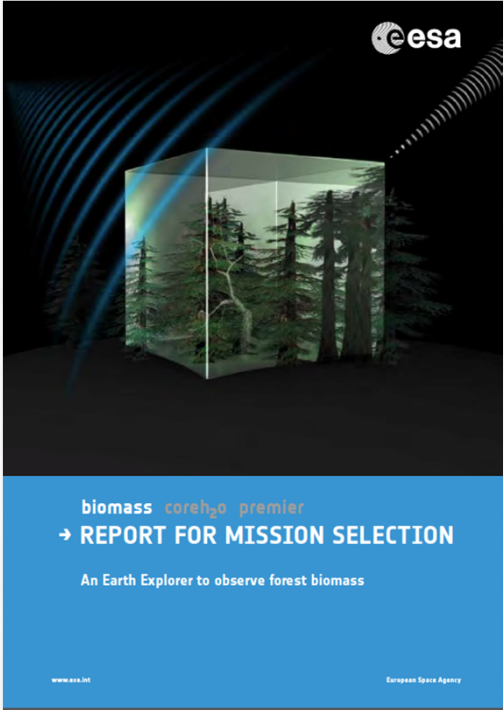
# PolInSAR 2011 Recommendations



Session	Recommendation	Action
<p>POL-InSAR</p>	<ul style="list-style-type: none"> <li>• Development of new - non forest - Pol-InSAR applications / products: Agriculture, Snow &amp; Ice, Arid regions.</li> <li>• Acquisition of Pol-Tomo datasets in future airborne campaigns.</li> <li>• Investigating link of tomographic products (profiles) and physical forest parameters.</li> <li>• Investigation of structure based biomass estimators.</li> </ul>	 <p>ESA AIRBORNE CAMPAIGNS data available to the research community at <a href="https://earth.esa.int/web/guest/pi-community/apply-for-data/campaigns">https://earth.esa.int/web/guest/pi-community/apply-for-data/campaigns</a></p>

# PoInSAR 2011 Recommendations




Session	Recommendation	Action
<p><b>APPLICATIONS ON FOREST</b></p>	<ul style="list-style-type: none"> <li>• <b>Classification:</b> To evaluate whether there is a need to develop classification methods to reduce uncertainty in radar interpretation (whether intensity or coherent studies). E.g. when using allometry.</li> <li>• <b>Biomass over time:</b> To extend verification of techniques across range of forest types/seasons.</li> <li>• <b>Forward Modeling:</b> There is a need to improve our ability to forward model all aspects of SAR measurements over a forest (and link these to forest ecology/process models).</li> <li>• <b>Field verification:</b> To (revisit) the issue of consistent/common field methodologies for radar product verification</li> <li>• <b>Vertical Structure:</b> To evaluate the widespread scientific need for global vertical structure (incl height), especially in terms of carbon and biodiversity and others (e.g. water cycle, degradation, fire, etc).</li> </ul>	<p>BIOMASS report available State of the art assessed</p>  <p>BIOMASS presentation User consultation 5-6 March 2013 Graz Austria</p>



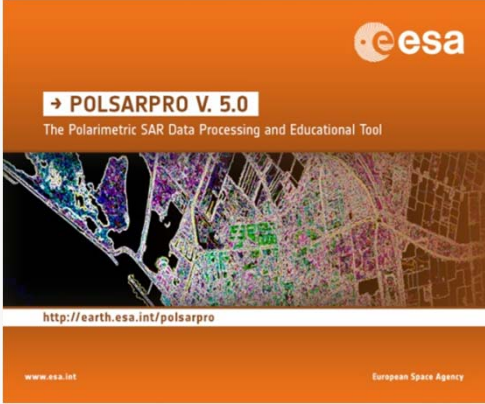
# PoInSAR 2011 Recommendations



Session	Recommendation	Action
<p><b>POLARIMETRY AND PSI TOMOGRAPHY</b></p>	<ul style="list-style-type: none"> <li>• There was a recommendation to have two calibrated sites for vegetation and urban applications with tomographic data sets available to test and cross compare algorithms.</li> <li>• Investigate the suitability for compact pol to provide sufficient PSI scattering mechanism discrimination for PSI.</li> </ul>	<p>Progress and status to be assessed at POLINSAR 2013</p>
<p><b>APPLICATIONS ON SOIL MOISTURE/WET LANDS SESSION</b></p>	<ul style="list-style-type: none"> <li>• <b>The operational use of polarimetric SAR is not demonstrated yet it is just at study levels. We should take advantage of the easier access to polarimetric data with the new satellite SAR (Radarsat2, ALOS, and TerraSAR-X) to conduct experiments and investigation that will demonstrate and create the need for operational use of fully polarimetric data in various applications.</b></li> <li>• There is an immediate need for the development and validation of new models that fully integrate all the polarimetric information provided by the quad-pol measurements.</li> <li>• Recommend the design of the future missions with low noise floor and high antenna isolation for accurate single, dual and full polarization information</li> </ul>	<p>This is the key objective of the ESA POLSARAP study</p>  <p>See performance parameters for new missions</p>

# PolInSAR 2011 Recommendations





Session	Recommendation	Action
<b>AGRICULTURE APPLICATIONS</b>	<ul style="list-style-type: none"><li>• The use of PolInSAR in agriculture has yet to be fully investigated</li><li>• Recommend that DRA acquisitions over agriculture should be requested with large baselines</li><li>• Better algorithms are required for monitoring and classifying different cereal crops (including classifiers that fully exploit the time dimension)</li><li>• Robust tools need to be developed for LAI, biomass and soil moisture products in support of crop yield prediction, possibly coupled with crop growth models.</li></ul>	<p>AGRISAR 2009 campaign data exploitation</p> <p>SOAR-EU initiative and results presentation at POLINSAR 2013</p> <p>POLSARAP study and presentations at POLINSAR 2013</p>  <p>The screenshot shows the POLSARPRO V. 5.0 software interface. It features the ESA logo at the top right, the title '→ POLSARPRO V. 5.0' and subtitle 'The Polarimetric SAR Data Processing and Educational Tool'. Below this is a SAR image with a color-coded overlay. At the bottom, there is a URL 'http://earth.esa.int/polsarpro' and the ESA website 'www.esa.int' and 'European Space Agency'.</p>



# PoInSAR 2011 Recommendations



Session	Recommendation	Action
<b>APPLICATIONS ON OCEAN, CRYOSPHERE AND HAZARDS</b>	<ul style="list-style-type: none"><li>• Improved formal coordination between nations with SAR space assets would help meet the operational information requirements from the ocean/ cryosphere/hazards user community.</li><li>• Typically, operational users are conservative in terms of the up take of new data and methods. Therefore, in order for operational users to benefit from new technology, both R&amp;D and technology transfer must be initiated well in advance of new missions.</li><li>• Results presented during the workshop relating to cryosphere applications point to a need for the development of new processing approaches that better exploit polarimetry alone or in combination with e.g. frequency, interferometry.</li></ul>	<p>On going coordination (ref Sentinel 1 presentation )</p> <p>Objective of the SEOM program for R&amp;D part</p>  

# PolInSAR 2011 Recommendations


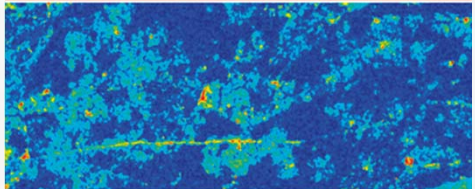


Session	Recommendation	Action
<b>AIRBORNE AND SPACEBORNE POL-INSAR CAMPAIGNS</b>	<ul style="list-style-type: none"><li>• It would be interesting to add a test site over Africa not only of forest biomass but also for resources estimation.</li><li>• Selecting specific areas where data is collected at specified and regular interval (continuity) would promote the addition of new datasets from different investigators as well as users.</li><li>• In terms of additional data that is needed, S and X-band data was suggested in order to assess their potential.</li><li>• The collection of bistatic radar data over some sites would be useful to assess its potential and develop new algorithms.</li><li>• To augment current and past campaigns, full waveform lidar, particularly for polinSAR applications is always desirable (or needed) for validation.</li></ul>	<p>ALOS 2 AO</p> <p>Airborne and Spaceborne Campaigns data available for R&amp;D</p> <p>Availability of long time series is the main limiting factors to develop robust Polarimetric applications (POLSAREX initiative in 2010)</p> <p>New CSA ESA SOAR EU2</p>



# PolInSAR 2011 Recommendations



Session	Recommendation	Action
<p><b>AIRBORNE AND SPACEBORNE POL-INSAR CAMPAIGNS</b></p>	<ul style="list-style-type: none"> <li>• There are areas where the use of polinsar should be developed and improved: wetlands (IUCN), semi-arid and permafrost.</li> <li>• Airborne campaigns specific to wetlands which have a significant importance in biodiversity. Changes in the permafrost will have an important impact on climate change and should be studied.</li> <li>• To develop the use of polinsar and radar products, in general, it is more important to make science products that can be understood by the user (e.g. not in the complex plane). These products should also be accompanied with tutorial and supported through workshops</li> </ul>	<p>Progress and status to be assessed at POLINSAR 2013</p>  <p>→ 2nd ADVANCED COURSE ON RADAR POLARIMETRY</p>  <p><a href="http://earth.esa.int/polarimetrycourse2013">http://earth.esa.int/polarimetrycourse2013</a></p> <p><small>www.esa.int European Space Agency</small></p>

- Workshop objectives and themes
- POLinSAR 2011 Recommendation Status
- **Workshop organisation**
- SEOM element action lines
- POLINSAR 10<sup>th</sup> anniversary



## **10 Thematic Sessions** with **72** oral presentations

- 20 minute oral presentation
- Round-table discussions with seed questions

## **Free Poster Session** with **65** posters

- Wednesday afternoon

## **Summary Sessions (last day of the workshop)**

- Session Chairpersons present their Summary and Recommendations

# Programme Overview



Day 1, Monday 28		Day 2, Tuesday 29		Day 3, Wednesday 30		Day 4, Thursday 31		Day 5, Friday 1	
08:30-09:30	Registration	09:00-10:40	Polarimetric SAR Interferometry (Pol-InSAR)	09:00-11:00	Polarimetry and Tomography	09:00-10:40	Applications of SAR Polarimetry on Land: Agriculture, Urban, Archeology	09:00-11:00	Sessions Summaries
09:30-11:00	Opening								
Coffee Break									
11:30-12:10	Opening & RT	11:10-13:50	Polarimetric SAR Interferometry (Pol-InSAR): Forest	11:30-11:50	Polarimetry and Tomography RT	11:30-12:30	Applications of SAR Polarimetry on Land: Agriculture, Urban, Archeology & RT	11:30-13:10	Sessions Summaries & Closing
12:10-13:50	Methods & Theoretical Modelling				11:50-13:30	Applications on Ocean & Cryosphere & RT	11:30-12:30		
Lunch									
15:00-16:40	Methods & Theoretical Modelling	15:00-17:00	Polarimetric SAR Interferometry (Pol-InSAR): Forest & Joint RT	15:00-17:00	Applications on Ocean Pollution monitoring & target detection & RT	15:00-15:50	Applications of SAR Polarimetry on Land: Soil Moisture and Wetlands & RT		
						15:50-16:50	Applications of SAR Polarimetry: Other		
Coffee Break									
17:10-18:30	Methods & Theoretical Modelling & RT	17:30-19:10	Polarimetry & DInSAR, Polarimetry & PSI & Joint RT	17:00-19:30	Poster Session	17:20-19:00	Applications of SAR Polarimetry: Other & RT		
18:30-19:45	Welcome Cocktail				Non hosted Workshop Dinner				



- No parallel sessions
- Workshop presentations in Building 1 – Magellan Room
- Poster session and Welcome drink are in Building 14 – Big Hall

## Oral presentations

- Allocated time 20 minutes including questions
- All presentations should be run from the presentation computer
- Please upload your presentation (**ppt** and **pdf** format for publication on the website) well before the start of your session using the computers in the **Annex room** (close to the registration Desk)

## Poster presentations

- Poster set-up from Monday 17:00 onwards
- Follow the instructions on where to mount your poster

Visit <https://earth.esa.int/polinsar2013>

- Up-to-date programme
- “POLinSAR 2013 Instructions for Presenters”

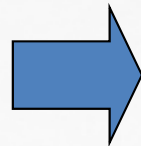
- Strict deadline for full paper submission: **15 February 2013**
- Papers are to be delivered by mail to: [esapub@gmail.com](mailto:esapub@gmail.com)
- The Proceedings of the Workshop will be published by ESA as Special Publication SP-713 on CD-ROM
- Further info at: <https://earth.esa.int/web/guest/polinsar-2013/author-instructions>



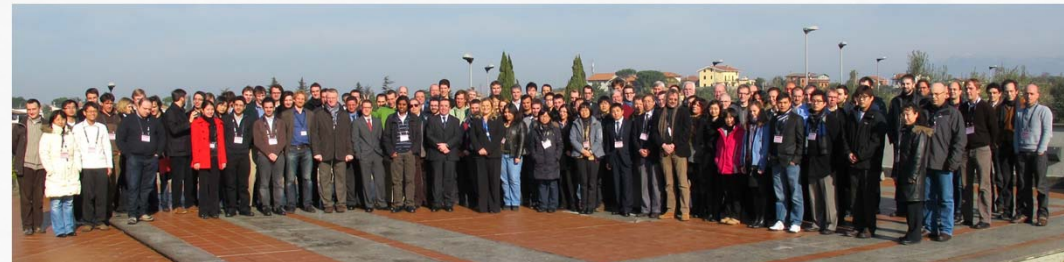
- Workshop objectives and themes
- POLinSAR 2011 Recommendation Status
- Workshop organisation
- SEOM element action lines
- POLINSAR 10<sup>th</sup> anniversary

## POLinSAR2013 WORKSHOP

<https://earth.esa.int/polinsar2013>



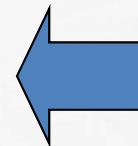
## RECOMMENDATIONS



**seom**

scientific exploitation  
of operational missions

Workplan 2013-  
2014



## ACTION

Campaign
Training
Toolbox
Algorithms



- **Federate, support and expand the research community** build up over the last 20 years
- **Strengthen the leadership of European EO research community** (by enabling them to extensively exploit future European operational EO missions)
- **Enable the science community to address new scientific research**(opened by data from operational EO missions)

Please visit [SEOM.ESA.INT](http://SEOM.ESA.INT)

Ref. ESA/PB-EO(2011)122, rev. 1A, 22-23 February 2012, EOEP-4 will span the period 2013-2017,

The SEOM element workplan is prepared annually for approval at ESA-PB-EO and includes :

- **RESEARCH and DEVELOPMENT**

Stimulating the development and validation of advanced EO methods and observation strategies that will enable scientific exploitation of the continued observations and innovative features of operational EO missions

- **SCIENTIFIC TOOLBOXES**

Developing, validating and maintaining open-source, multi-mission, scientific software toolboxes that will apply leading-edge, advanced EO retrieval techniques to new data coming from future operational EO systems, and make these tools freely available to scientists

- **USERS CONSULTATIONS and FEEDBACK**

**POLINSAR at ESA ESRIN 28 January 1<sup>st</sup> February 2013**

ESA Living Planet Symposium 2013, Edinburgh, United Kingdom 9 to 13 September 2013

- **TRAINING NEXT GENERATION SCIENTISTS**

**Advanced Course on Radar Polarimetry ESRIN, Frascati, Italy 21-25 January 2013.**

Advanced training on Land Remote Sensing at Harokopio University of Athens Greece 1-5 July 2013

Advanced training on Ocean Remote Sensing at University of Cork, Ireland, July or September 2013

- **PROMOTING SCIENCE DATA USE AND RESULTS:**

Promoting widespread scientific use of data freely available from forthcoming European (ESA and non-ESA) operational EO missions, by the international science community .

Ensuring a responsive ESA channel through which EO scientists can make regular, timely, high-quality scientific publications.



- Workshop objectives and themes
- POLinSAR 2011 Recommendation Status
- Workshop organisation
- SEOM element action lines
- **POLINSAR 10<sup>th</sup> anniversary**



# Celebrating 10 years of POLINSAR



→ POLINSAR 2013

28 January - 1 February 2013 | ESA-ESRIN | Frascati (Rome), Italy

European Space Agency



# Black & White



→ POLINSAR 2013

28 January - 1 February 2013 | ESA-ESRIN | Frascati (Rome), Italy

European Space Agency



Celebrating 10 years of POLINSAR



→ POLINSAR 2013

10th anniversary of POLinSAR

Enjoy the Workshop!

→ POLINSAR 2013

28 January - 1 February 2013 | ESA-ESRIN | Frascati (Rome), Italy

European Space Agency