DLR's multi-mode airborne SAR campaigns for environmental parameter estimation

Irena Hajnsek, Kostas Papathanassiou, Rolf Scheiber, Ralf Horn, Pau Prats, Alberto Moreira

German Aerospace Center
Microwaves and Radar Institute
PO BOX 1116, 82234 Wessling
Email: irena.hajnsek@dlr.de, kostas.papathanassiou@dlr.de, rolf.scheiber@dlr.de, ralf.horn@dlr.de, pau.prats@dlr.de, alberto.moreira@dlr.de

ABSTRACT

The main focus of this paper is to present application results obtained form airborne campaigns in preparation to future European and International space borne SAR missions that were performed in the last 3 years with the DLR's multi-mode *E*xperimental *SAR* (E-SAR) system.

During the last decade airborne repeat-pass SAR interferometry has become the most demanded technique for the development of new application products (e.g. model based forest heights derived from polarimetric SAR interferometry). Other techniques like differential SAR interferometry and SAR tomography are also based on multipass SAR acquisitions providing direct measurements of the quantities of interest, i.e. surface displacement or forest structure. With the improvement of motion compensation, especially by taking into account the topography and estimation of residual motion errors, the generation of data products from repeat-pass airborne interferometry is now quasi-operational.

Since the first acquired images the E-SAR system has been continuously improved and extended towards a multi-frequency (X-, C-, L- and P-band) and polarimetric and interferometric SAR system [1]. Due to a precise navigation system is E-SAR able to perform repeat-pass SAR interferometry at baselines of less than 10m, allowing the realization of advanced and innovative techniques like multi-baseline Pol-InSAR, SAR tomography and differential SAR interferometry (DInSAR). A new P-band subsystem was built, including antenna, IF converter and front-end sections with a shifted center frequency to 350MHz to avoid excessive radio frequency interference. It was primarily used within the INDREX-II and BIOSAR [3] campaigns in support for the Earth Explorer Core Missions BIOMASS mission investigated by ESA. In support of the Sentinel-1 C-band program, important campaigns were carried out serving for agricultural parameter retrieval (AGRISAR, 2006 [4]) and for ice studies (ICESAR, 2007 [2]).

Spaceborne SAR system concepts and mission design is based on the experience gathered from these airborne SAR experiments and from dedicated campaigns. DLR's E-SAR system is supporting these activities since the late 1980-ties by providing high resolution multi-frequency and multi-polarisation data sets to a large user community. Triggered by the scientific needs and also by the recent advancements in motion compensation techniques several new operating modes are now available for

the E-SAR system on a quasi-operational basis. This paper gives an overview of these techniques and presents innovative application examples as well as space borne simulation results.

2. REFERENCES

[1]. Scheiber, Rolf; Hajnsek, Irena; Horn, Ralf; Papathanassiou, Kostas; Prats, Pau; Moreira, Alberto (2008): Recent Developments and Applications of Multi-Pass Airborne Interferometric SAR using the E-SAR System. In: Proceedings of the European Conference on Synthetic Aperture Radar (EUSAR), VDE Verlag GmbH, Berlin, Offenburg, S. 4, European Conference on Synthetic Aperture Radar (EUSAR), Friedrichshafen, Germany, 2008-06-02 - 2008-06-05, ISBN 3-8007-3084-1

[2]. Hajnsek, Irena; Horn, Ralf; Scheiber, Rolf; Sharma, Jayanti (2008): ICESAR 2007: Technical Assistance for the Deployment of Airborne SAR and Geophysical Measurements during the IceSAR 2007. In: ESA Study Final Report, Final Report, 20655-07-NL-CB, 130 S.

[3]. Hajnsek, Irena; Scheiber, Rolf; Lee, Seungkuk; Ulander, Lars; Gustavsson, Anders; Tebaldini, Stefano; Monte Guarnieri, Andrea (2008): BIOSAR 2007: Technical Assistance for the Development of Airborne SAR and Geophysical Measurements during the BioSAR 2007 Experiment. In: ESA Study Final Report, Final Report, 20755-07-NL-CB, 219 S.

[4]. Hajnsek, Irena; Horn, Ralf; Scheiber, Rolf; Bianchi, Remo; Davidson, Malcolm (2007): The AGRISAR Campaign: Monitoring the Vegetation Cycle using Polarimetric SAR Data., ESA ENVISAT Symposium, Montreux, Switzerland, 2007-04-23 - 2007-04-27