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European Space Agency Campaign Activities in Support of Earth Observation Projects: Examples for Snow and Ice

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In the framework of its Earth Observation Programmes the European Space Agency (ESA) carries out groundbased and airborne campaigns to support geophysical algorithm development, calibration/validation, simulation of future spaceborne earth observation missions, and applications development related to land, oceans and atmosphere. Campaigns in support of future mission development have technological, geophysical and simulation objectives while exploitation projects need validation for the assessment of the quality of the earth observation products and of the service provision.

ESA has been conducting airborne and ground measurements campaigns since 1981 by deploying a broad range of active and passive instrumentation in both the optical and microwave regions of the electromagnetic spectrum such as lidars, limb/nadir sounding interferometers/spectrometers, high-resolution spectral imagers, advanced synthetic aperture radars, altimeters and radiometers.

These campaigns take place inside and outside Europe in collaboration with national research organisations in the ESA member states as well as with international organisations harmonising European campaign activities. For the different activities a rich variety of datasets has been recorded, are archived and users can access campaign data through the EOPI web portal [http://eopi.esa.int].

In 2005, ESA released a call for the next Earth Explorer Core Mission Ideas with the aim to select a 7th Earth Explorer (EE7) mission to be launched in the next decade. Twenty-four proposals were received and subject to detailed scientific and technical assessment. During the so-called Phase 0, six concepts were selected and further investigated. A down-selection was made after the User Consultation Meeting held in Lisbon, Portugal in January 2009. Three candidate mission concepts were selected for further feasibility phase (phase A) investigation. Each of the candidate missions are being elaborated through two parallel industrial studies at phase A level for further down-selection in 2013.

The Candidate missions under consideration are:
-BIOMASS - Global measurements of forest biomass and extent,
-CoReH$_2$O - (Cold Regions Hydrology High-resolution Observatory) – Detailed observations of key snow, ice and water cycle characteristics,
-PREMIER - (PRocess Exploration through Measurements of Infrared and millimetre- wave Emitted Radiation)– Understanding the processes that link trace gases, radiation, chemistry and climate in the atmosphere.

This paper focuses on describing the current setup for campaign execution in the context of CoReH$_2$O and BIOMASS focusing on applications for Snow and Ice.

The CoReH$_2$O primary mission objectives are to observe snow water equivalent, to improve the modelling of snow and ice processes, and to advance the prediction of stream flow in regions where snow and glacier melt are important components of the water balance. Snow cover and glaciers are not only key components of the water balance in high latitudes, but are also vital resources of fresh water for many densely populated areas at mid and low latitudes. A dual frequency SAR, operating at X-band (9.6 GHz) and Ku-band (17.2 GHz), VV and VH polarizations, with a swath width of about 100 km, has been selected for this mission. It will operate in two consecutive mission phases to deliver snow and ice information over two temporal scales (3 days and 12-15 days).

The BIOMASS primary mission objectives are to improve estimates of carbon stocks and fluxes over land through global measurements of forest biomass and changes in this biomass with time. The mission concept is

based on novel spaceborne P-band synthetic aperture polarimetric radar operating at 435 MHz and with 6 MHz bandwidth. Among the additional application areas of the mission, the potential of BIOMASS to provide ice sheet motion products and subsurface structure maps is considered of highest scientific interest as – with the longer wavelength at P-Band –the potential exists to greatly improve knowledge of ice sheet dynamics and extend the areas over which ice motion products can be generated.

For both mission concepts experimental data on backscattering signatures of snow and ice are needed for testing theoretical backscatter models and for validating and advancing retrieval algorithms. To tackle this need different campaigns have been initiated by means of airborne synthetic aperture radars (SAR) operating at the relevant frequencies. These activities will aid in demonstrating and documenting the potential of both missions to monitor the seasonal development of snow water equivalent ($CoReH_2O$) and ice motion and subsurface structure on the relevant time scales for BIOMASS.

We will discuss the general setup and current status of the campaigns together with first findings. Furthermore, we show how users can access campaign data through the EOPI web portal [http://eopi.esa.int].