# Calibration Concepts for Future Low Frequency SAR Missions

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Several new SAR missions are considered operating at – for the SAR community - low frequencies. Tandem-L is a DLR mission currently being studied in a Phase A. It consists of two fully polarimetric SAR satellites which are using an active phased array antenna to feed a parabolic reflector. The combination of digital beamforming techniques with the large reflector allows swath widths up to 350 km at 3 m resolution. This unprecedented imaging capacity enables weekly observations of dynamic processes on the Earth surface. Biomass is an upcoming mission of ESA's Living Planet Program. The first space borne P-Band SAR sensor also employs a large reflector and is designed to provide the scientific community with maps for tropical, temperate and boreal forest biomass which are needed to understand the global carbon cycle.

New calibration concepts have to be developed for these new missions to achieve the stringent calibration requirements. First of all the sensor architecture based on large deployable reflector antennas complicates the antenna pattern calibration. Contrary to phased array antennas these patterns cannot be described by main cuts in elevation and azimuth but have to be considered as fully two-dimensional. Due to the offset geometry cross-polarization performance is deteriorated. The well-proven antenna model based calibration approach [1], [2] might be an efficient solution for this problem. It allows predicting the two-dimensional antenna radiation pattern (amplitude and phase for both co- and cross-polarization) from simulations. As for the phase arrays the effort in the commissioning phase could then be reduced to the verification of this model. In the case of Tandem-L the model has to be extended further to include the digital beam forming.

The influence of the ionosphere is a challenge at these low frequencies. Geometric calibration is affected by ionospheric delay, while Faraday rotation is influencing polarimetric calibration. Only near the equator the effect of Faraday rotation can be partly neglected, which may affect the selection of suitable calibration sites. The Faraday rotation can be as higher as 360° at high latitude in P-band and is still some dozens of degrees at L-band.

The low frequency of all these new missions requires huge passive targets or makes their use even infeasible. Due to their flexibility and high RCS, active transponders will certainly play a major role in the calibration strategies for these SAR systems.

This paper will present a short overview of these upcoming low-frequency SAR missions and their calibration requirements and will then concentrate on new (or extended) concepts to achieve the anticipated performance.

**References**

[1] M. Schwerdt, B. Bräutigam, M. Bachmann, B. Döring, D. Schrank, J. Hueso Gonzalez, "Final TerraSAR-X Calibration Results Based on Novel Efficient Methods," Vol. 48, no.2, IEEE Transaction on Geoscience and Remote Sensing, February 2010.

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