# ESTIMATION OF FOREST VERTICAL SRUCTURE BY MEANS OF MULTI-BASELINE POL-INSAR AT L-BAND

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## ABSTRACT

The estimation of forest vertical structure by means of SAR, especially when addressed in terms of a space-borne mission implementation, is a challenge. While conventional SAR tomography has demonstrated the potential to "image" vertical structure by means of multiple acquisitions, the lack of multiple space-borne SAR configurations able to perform these acquisitions, combined with (temporal) scene decorrelation that limits the temporal baseline of the acquisitions, reduce the number of suitable (i.e. coherent) acquisitions in a realistic space-borne scenario drastically. Therefore, the application of conventional tomographic imaging becomes rather limited at least in terms of the actual state-of-art in space-borne SAR missions.

Given the availability of only a limited number of acquisitions, alternative approaches have to be used in order to assess vertical structure information by means of SAR. The proposed techniques can be distinguished into two main classes:

1. Interferometric approaches are based on the fact that the (volume) interferometric coherence is directly related to the vertical distribution of scatterers seen by the radar and thus to the vertical structure of forests. This information can be either extracted by model based inversion or by approximating the structure function through a weighted sum of a series of (orthogonal) basis functions.

2. (Complex) Reflectivity approaches separate the location of the phase centers associated to the individual vertical structure components. This is then used to reconstruct the vertical structure of forest scatterers.

Common in both approaches is the necessity to parameterize the vertical structure function using a limited number of parameters, a step that is challenging when accounting the complexity of forest structures. The individual parameterization has then to be inverted using a (limited) number of interferometric or reflectivity measurements at the same or different polarizations.

The pros and cons of the different approaches with respect to individual application requirements are discussed and the performance in terms of required acquisitions, acquisition geometry and instrument characteristics is assessed. The role of polarization diversity in the acquisition is discussed. The importance of absolute phase calibration and the impact of temporal decorrelation is addressed. The performance of individual techniques is demonstrated using multi-baseline SAR data acquired by DLR's E-SAR airborne sensor in the frame of different actual experiments.