SAR Tomography for Forest Structure Characterization: Comparison of Temperate and Tropical Forests at L band

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In order to contribute to a better understanding of Earth system processes, the need to extract 3D information of forests at a global scale has already been identified as a priority. Responding to this need, several spaceborne missions are planned to be launched in the next years aiming to shed light on several unknowns regarding global carbon cycle processes. Among these missions, special focus is driven here to the ones based on SAR systems at low frequencies, BIOMASS and Tandem-L missions, with a clear focus on biosphere applictions. Despite the essential differences between these two systems in terms of features, they both have the capability to monitor the 3D evolution of forest structure.

In particular, SAR Tomography (TomoSAR) at L band has proven after several airborne experiments in the last 15 years to be able to provide measurements reflecting forest structure [1] [2]. In order to provide an ecological interpretation of vertical radar reflectivity, a new framework for the estimation of 3D forest structure from TomoSAR profiles has been proposed, which is consistent with the notions employed in ecology for forest structure assessment from field data [3]. It relies on two complementary measures, one for the horizontal and one for the vertical structure. This framework has been applied to a temporal series of TomoSAR airborne data at L band over a temperate forest in Germany. It has proven to be able to distinguish unambiguously between forest stands at different growth stages and to retrieve a robust estimation under different system configurations and different weather and seasonal conditions. Also, when applied to a temporal series of 5 years, the method identifies changes in structure produced by local logging actions for management purposes [4].

However, the definition of a framework for forest structure estimation settles requirements on the system mainly in terms of vertical and horizontal resolutions, on the techniques employed for the TomoSAR inversion [5] and the methods proposed for information retrieval. And, in the context of biosphere applications, the rigor of the requisites is not independent on the type of forest considered. Thus, for example, complex multilayered stands with a rich structure demand higher vertical resolutions and larger unit areas should be considered. This poses a challenge for the

acquisitions planning, the data processing and the methods subsequently employed for the extraction of biophysical information for a mission aiming to offer consistent information at global scale for scenarios with drastically diverse, but yet comparable characteristics. Also, up to now, mainly due to the limited scale of the available field inventory plots with respect to the SAR resolutions, a complete assessment of the characteristics of the method proposed for forest structure estimation from TomoSAR data with respect to ground data was not possible. Hence, this paper explores first the validity of the method over a different temperate forest scenario, consisting on a mega-plot test site in Germany, where intensive field data has been collected in the last months. And then its behaviour will be studied when applied to tropical forest scenarios in Gabon, where data has been acquired in the framework of the AfriSAR campaign [6].

References

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