Addressing Forest Change by means of Pol-InSAR Measurements at L- and P-band

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ABSTRACT (Abstract + references maximum 1000 words)

By coherently combining interferometric SAR acquisitions at different polarization states, Polarimetric SAR Interferometry (Pol-InSAR) [1] allows to locate in height different scattering mechanisms present in the resolution cell. Together with the use of scattering models of the vegetation, as the well-known two-layer Random Volume over Ground (RVoG) model [2], Pol-InSAR has demonstrated its potential in forest monitoring applications.

While the potential and limitations of Pol-InSAR measurements for reconstructing forest structure (parameters) are today well understood, the question of how to qualitatively and quantitatively characterize forest (structure) change using Pol-InSAR measurements is – besides first attempts [3, 4] – far from answered. This is primarily because of our incomplete understanding of how to parameterize forest change(s) and on how to resolve ambiguities arising from the superposition of structural and weather / seasonal changes. Both terms can be attributed to the lack of appropriate experimental "change" data sets as well as the absence of an established change processing methodology.

In this sense, this paper constitutes a first step into the characterization of forest change by exploring and analyzing new Pol-InSAR data sets. Experimental SAR data acquired at low frequency bands, i.e. L- and P-band, capable of penetrating through the forest canopy until the underlying ground, are evaluated. In particular, data acquired by the DLR's airborne F-SAR sensor in the frame of the TempoSAR22 campaign are available. The campaign is carried out over the temperate forest of Traunstein, in the South-East of Germany. The data set includes fully polarimetric multi-baseline data acquired at two different dates. In each date, different flights, each with different tracks (spatial / temporal baselines), were acquired. Therefore, this data set allows the study of dielectric changes throughout the daily cycle of the forest.

Possible changes in the daily cycle of the forest are evaluated by exploiting the geometrical representation of Pol-InSAR data on the complex plane, the so-called coherence region [5]. According to the RVoG model, the coherence region follows a line segment that models the vertical profile of the forest canopy at pixel level. Under this assumption, a Pol-InSAR technique that is able to separate the scattering response from the underlying ground and the volume of the forest canopy [6] is applied. The obtained ground and volume coherences are the extremes that define the RVoG model line segment.

A first evaluation is carried out over pixels corresponding to forest areas of data acquired at zero baseline, thus avoiding possible residual geometrical decorrelation effects. Under such conditions, a change in the ground and volume contributions translates into a change in the coherence region, and thus, into a change in the RVoG model

line. The changes are as well analyzed in terms of the different observations of the master and slave covariance matrices of the interferometric pair. This provides a link between possible interferometric and polarimetric [7] changes. The analysis of such changes will be extended to non-zero spatial baselines. Further results of this study aim to help devise new strategies for the exploitation of future SAR missions, as the upcoming ESA BIOMASS.

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