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The value of InSAR Coherence in TanDEM-X and Sentinel-1 for monitoring world's forests

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Covering about 30 percent of the Earth's surface, forests are of paramount importance for the Earth's ecosystem. They act as effective carbon sinks, reducing the concentration of greenhouse gas in the atmosphere, and help mitigating climate change effects. This delicate ecosystem is currently threatened and degraded by anthropogenic activities and natural hazards, such as deforestation, agricultural activities, farming, fires, floods, winds, and soil erosion. In an era of dramatic changes for the Earth's ecosystems, the scientific community urgently needs to better support public and societal authorities in decision-making processes. The availability of reliable, up-to-date measurements of forest resources, evolution, and impact is therefore of paramount importance for environmental preservation and climate change mitigation.

In this scenario, Synthetic Aperture Radar (SAR) systems, thanks to their capability to operate in presence of clouds, represent an attractive alternative to optical sensors for remote sensing over forested areas, such as tropical and boreal forests, which are hidden by clouds for most of the year.

In this work, we will investigate the potential of SAR interferometry (InSAR) for mapping forests worldwide and retrieve important biophysical parameters, such as canopy height and above ground biomass. We will compare pros and cons of single-pass (bistatic) versus repeat-pass InSAR, discussing their main peculiarities and limitations. In particular, we will concentrate on the analysis of the interferometric coherence and on the relationship between volume and temporal decorrelation with respect to forest parameters estimation. We will present the work done at DLR for mapping forests worldwide at high spatial resolution using the TanDEM-X bistatic coherence, together with the potential of Sentinel-1 InSAR time-series for a regular monitoring of vegetated areas. We will discuss the algorithms which currently under development for the estimation of above ground biomass, by fusion of InSAR and multi-spectral optical data, based on the latest advances in the field of artificial intelligence and, in particular, of deep learning, presenting the first promising results for a more effective exploitation of current EO datasets.