



Tandem-L: A Highly Innovative Bistatic SAR Mission for Monitoring Earth's System Dynamics

Alberto Moreira, Gerhard Krieger, Carolina Gonzalez, Matteo Nannini, and Manfred Zink
German Aerospace Center (DLR), 82234 Oberpfaffenhofen, Germany

Tandem-L is a proposal for a highly innovative L-band SAR mission for the systematic observation of dynamic processes on the Earth's surface with hitherto unparalleled quality and resolution. Thanks to the novel imaging techniques and the vast recording capacity of up to 8 terabytes per day, it will provide vital information for solving pressing scientific questions in the biosphere, geosphere, cryosphere, and hydrosphere and will make an essential contribution for a better understanding of the Earth system and its dynamics.

The mission concept is based on the use of two SAR satellites operating in L-band with variable formation flight configurations and is distinguished by its high degree of innovation. Examples are: 1) the use of polarimetric SAR interferometry (Pol-InSAR) for measuring forest height, multi-pass coherence tomography for determining the vertical structure of vegetation and ice, 2) the utilization of the latest digital beamforming techniques in combination with a large deployable reflector for increasing the swath width and imaging resolution, and 3) the formation flight of two cooperative radar satellites with adjustable baselines for single-pass interferometry.

The systematic acquisition concept is based on two imaging modes: 1) the 3-D structure mode with a bistatic radar operation and 2) the deformation mode with differential SAR interferometry (D-InSAR), allowing the following mission objectives to be achieved:

- global measurement and monitoring of 3-D forest structure and biomass for a better understanding of ecosystem dynamics and the carbon cycle,
- systematic recording of small and large scale deformations of the Earth's surface with millimetre accuracy for earthquake, volcano and landslides research as well as risk analysis and mitigation,
- quantification of glacier movements, 3-D ice structure and melting processes in the polar regions for improved predictions of future sea level rise,
- fine scale measurements of soil moisture and its variations close to the surface for a better understanding of the water cycle and its dynamics,
- systematic observation of coastal zones and sea ice for environmental monitoring and ship routing,
- monitoring of agricultural fields for crop yield forecasts, as well as,
- generation of highly accurate global digital terrain and surface models which form the basis for a wide range of further remote sensing applications.

Primarily for geodetic applications the deformation mode allows precise measurements of topographic changes on the Earth's surface within the millimetre range. This mode is designed to map the deformation in swaths of 350-kilometre width. The substantial swath width facilitates repeated imaging within short intervals, which is necessary to minimise the impact of potential errors such as temporal decorrelation. In combination with DEMs generated from bistatic single-pass interferometric acquisitions the deformation mode will provide highly valuable data for geo- and lithosphere research.

In this presentation, we provide an overview of the current status of this innovative mission and its main application areas.