Statistical analysis of atmospheric components in ERS SAR data

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Abstract

As well know, the Permanent Scatterers (PS) InSAR technique (PSInSAR) is a multi-image algorithm for DInSAR analysis aimed at separating the different phase contributions of a set of interferograms and extracting surface deformation measurement on a sparse grid of coherent radar targets. One of the main differences between conventional interferometric techniques and PSInSAR is the capability of this approach to estimate the atmospheric contribution, generally referred to as Atmospheric Phase Screen (APS), affecting each analysed interferogram. The statistical characterisation of atmospheric phase components in SAR interferometry represent a fundamental task in order to develop better algorithms for multi-temporal interferometric analysis from multi-image SAR data-sets. The processing of thousands of SAR data carried out by TRE in the last few years has allowed to perform an in depth analysis and to retrieve interesting statistical parameters on the Atmospheric Phase Screen. In this paper the APS of more than 1,000 SAR data acquired at mid-latitudes is analysed. APS data is decomposed into three contributions, namely: (a) the ionospheric contribution, mainly due to variations of the Total Electron Content in ionosphere; (b) a phase contribution related to tropospheric turbulence phenomena (described by the Kolmogorov theory); (c) a phase contribution related to the local topography and the values of temperature, pressure and humidity in the troposphere at the time of the acquisition. This last contribution is negligible over flat areas, but becomes more and more significant over rough terrain as already observed in SAR literature related to (repeat-pass) InSAR DEM reconstruction. Methods for the identification and separation of the three components mentioned above are described. Special attention is paid to the variograms and the spectra of the different phase contributions, trying to extract information on the atmosphere starting form APS data and the DEM of the area under analysis. Finally, an optimized interpolator of APS data on a regular image grid (starting from a sparse grid of coherent scatterers) will be discussed. Preliminary results show that an increased density of measurement points (PS) can be obtained at the cost of an increased computational load.