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Displacement Patterns in Bucharest (Romania) using PS and SBAS Approaches

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Detecting nonlinear dynamic in empirical data is a complex process, with several problems to be considered (i.e. the quantity and quality of data, the level of noise and the best metric and topological invariants that can be correctly estimated for the considered data). An important restriction in detecting non-linear ground movements was the lack of a technical support up to the early 1990s. Synthetic Aperture Radar Interferometry technique (InSAR) proves to be a solution for the shortcoming of adequate data, through precise and repetitive measurements over large areas, especially in urban environments, subjects to a high density of coherent points in time. The research focusing on Bucharest was based on SAR data acquired between 1992 and 2014 by ERS-1/-2, ENVISAT, and TerraSAR-X satellites. The recent SAR imagery was validated using terrestrial monitoring techniques. The proposed interferometry methods were the Permanent Scatterers (PS-InSAR) and the Small Baseline Subset (SBAS-InSAR) to provide maps of satellite line-of-sight displacements. Both are multi-temporal techniques capable to depict millimetre-level movements between two passes of the satellite. Regarding the capacity of studying ground dynamic patterns, the main difference between PS-InSAR and SBAS-InSAR is that the latter is able to identify non-linearity in ground surface evolution, by using cubic or even quadratic models. A wealth of statistical and numerical tests (stationarity, interpolation, chaos test, Lyapunov and Hurst exponents) was employed on SBAS data to find evidence of non-linear dynamics and asymptotic attractors. Trends based on the estimated ground displacement in Bucharest are characterised by long-term memory, indicated by Hurst exponents, which in the long-term form interesting closed and limited attractors. We hypothesize these attractors to be an active northwest-southeast oriented transpressional system.