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An Improved Multi-Temporal Insar Method for Increasing Spatial Resolution of Surface Deformation Measurements

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Abstract. The multi-temporal interferometric synthetic aperture radar (InSAR) technology has proven very useful in extracting surface deformation with time series of SAR images over a study area. To increase spatial resolution of deformation information, this paper presents an improved multi-temporal InSAR (MTI) method by tracking both the point-like targets (PTs) and the distributed targets (DTs) with temporal steadiness of radar backscattering. The valid pixels corresponding to PTs and DTs are identified mainly by thresholding of the amplitude dispersion index (ADI) and the Pearson correlation coefficient (PCC). To efficiently reduce error propagation, a hierarchical analysis strategy is applied to extract deformation rates at the valid pixels. For the pixels with lower ADI values, the deformation rates are estimated on an optimized network by a least squared estimator and a region growing method. For the pixels with higher ADI values, they are classified into several groups by the ADI intervals, and the deformation rates are estimated through the multi-levels of processing. The nonlinear deformation values at all the valid pixels are estimated by spatiotemporally filtering and spatially integrating. The proposed MTI algorithm has been tested for subsidence detection over Tianjin in China using the 40 high resolution TerraSAR-X images acquired between 2009 and 2010, and validated by using the ground-based leveling measurements. The testing results indicate that the spatial resolution and coverage of subsidence data can be increased dramatically by the hierarchical analysis, and the accuracy in subsidence values derived from the MTI solution can reach up to a millimeter level.

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