EGU2020-4806
https://doi.org/10.5194/egusphere-egu2020-4806
EGU General Assembly 2020

Derivation of 3D deformation fields for the 2019 Ridgecrest Earthquakes (USA) based on Sentinel-1 TOPS data

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The advances of Sentinel-1 SAR data, like its open access policy and short revisit time, gives an outstanding opportunity to conduct in-situ mapping of large scale deformations. After the requisite calibrations and corrections (radiometric, terrain), geocoding, coregistration and phase unwrapping; the unwrapped phase can be converted to Line-of-site (LOS) displacements. Although it gives a characteristic picture of the investigated phenomena only in one-dimension, but to obtain tree-dimensional (East/North/Up – ENU) deformation, it requires a more complex approach.

To obtain the complete tree-dimensional displacement field, both ascending and descending LOS displacements shall be retrieved. As well as, the corresponding unit-vector of LOS look-vectors and its parallel, along-track azimuth vector in the direction of the azimuth offsets, from the SAR sensor to all measurements (pixel) in ENU format. This lead to four observations with different incident angles for each measurements, which can be generalized as an over-determined inverse problem. The estimated model vector of the complete tree-dimensional displacement can be obtained, if the Jacobi-matrix can be represented as the look-vectors in ENU basis and the observation vector as LOS deformations acquired from the unwrapped phase of the interferogram. Then the over-determined linear equation system can be solved in the L2 norm via the Gaussian Least Squares (LSQ) approach combined with Singular Value Decomposition (SVD).

Demonstrating the aforementioned, we present the continuation of DInSAR results of the two strike-slip earthquakes between 2019.07.04-06. with foreshock M_W =6.5 and mainshock M_W =7.1 in the Eastern Californian Shear Zone near Ridgecrest (US).