Kite - bridging InSAR displacement analysis and earthquake modelling: the 2019 Ridgecrest earthquakes

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We present a modular open-source software framework - Kite (http://pyrocko.org) - for rapid post-processing of spaceborne InSAR-derived surface displacement maps. The software enables swift parametrisation, post-processing and sub-sampling of the displacement measurements that are compatible with common InSAR processors (e.g. SNAP, GAMMA, ISCE, etc.) and online processing centers delivering unwrapped InSAR data products, such as NASA ARIA or LiCSAR. The post-processing capabilities include removal of first-order atmospheric phase delays through elevation correlation estimations and regional atmospheric phase screen (APS) estimations based on atmospheric models (GACOS), masking of displacement data, adaptive data sub-sampling using quadtree decomposition and data error covariance estimation.

Kite datasets integrate into forward modelling and optimisation frameworks Grond (Heiman et al., 2019) and BEAT (Vasyura-Bathke et al., 2019), both software packages aim to ease and streamline the joint optimisation of earthquake parameters from InSAR and GPS data together with seismological waveforms. These data combinations will improve the estimation of earthquake rupture parameters. Establishing this data processing software framework we want to bridge the gap between InSAR processing software and seismological modelling frameworks, to contribute to a timely and better understanding of earthquake kinematics. This approach paves the way to automated inversion of earthquake models incorporating space-borne InSAR data.

Under development is the processing of InSAR displacement time series data to link simultaneous modelling of co- and post-seismic transient deformation processes from InSAR observations to physical earthquake cycle models.

We demonstrate the framework’s capabilities with an analysis of the 2019 Ridgecrest earthquakes from InSAR surface displacements (provided by NASA ARIA) combined with GNSS displacements using the Bayesian bootstrapping strategy from the Grond inverse modelling tool.