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Slipping New Prior Assumptions into Old Inversion Methods - Application to the Napa Valley Earthquake

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Modelling the slip distribution along fault planes is an essential part of earthquake investigations. These models give insight into stress distribution and frictional properties of a fault, as well as being important for understanding seismic hazard. Here we present a new approach for constraining earthquake slip using geodetic data, and apply our method to the Mw 6.0 Napa Valley, California, earthquake of 24th August 2014. The method relies on the inclusion of a prior based on von Karman correlation.

With the launch of ESA's satellite Sentinel-1A in 2014, the scientific community is now in a position to routinely investigate all large continental earthquakes using InSAR, and inverting for slip is a crucial part of that procedure. However, in order for the slip inversions to be useful we need to ensure that the inversion processes give results that are properly representing the slip distribution. Slip inversions are ill-posed and measurement noise results in unrealistically large fluctuations in the solution. To avoid this, an extra constraint such as minimum norm or Laplacian smoothing is usually employed to regularise the inversion. However, these constraints do not necessarily realistically represent earthquake slip.

There is growing evidence that many aspects of earthquakes are self-similar and that earthquake slip distribution is well described by a von Karman autocorrelation function, which incorporates fractal properties through the Hurst parameter. We add this constraint to the slip inversion as a prior assumption using a Bayesian approach.