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Combining InSAR with other independent data to improve models of fault slip

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In the past 15 years, the capabilities of InSAR for measuring tectonic displacements have been demonstrated for a range of different earthquakes and/or fault systems. Recent advances in modelling methodology have enabled us to estimate uncertainties and tradeoffs in our model parameters, using the properties of the InSAR data, such as the amplitude and wavelength of correlated noise. Where these tools are combined with more traditional means of estimating model effectiveness, such as resolution kernels, or are compared to independent estimates of the same parameters from other data sources, we are in a position to evaluate the quality of our model results.

In certain situations, we find that models derived from InSAR data can have limiting problems - for instance where orbital uncertainties trade off against long-wavelength deformation signals (e.g. deep fault slip); where the relative proportions of horizontal and vertical displacement cannot be distinguished from the 1D InSAR measurement (e.g. when only a single interferogram is available); or where an interferogram contains additional deformation signals (e.g. postseismic as well as coseismic deformation) which are difficult to separate out. In all cases, such problems can be alleviated through the addition of independent data, whether geodetic or seismic.

We present here methods through which independent data sources can be combined into joint inversions, using a Bayesian framework to estimate objectively key parameters such as the relative weights assigned to each data set. We will show examples from California, Tibet and South America, showing how the incorporation of GPS or teleseismic waveform data can improve our models of interseismic or coseismic

deformation, respectively.