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How robust are estimates of lithospheric parameters from satellite and surface data: A case study of Altai 27.09.2003 Earthquake.

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Satellite interferometry data were already used to investigate rupture surface geometry and displacement field on it for Altai (Chuya) 27.09.2003 earthquake [Nissen et al., 2007, Barbot et al., 2008]. In our study in addition to ENVISAT ASAR images we employed regional GPS data (Gol'din et al., 2005). Rupture surface was approximated by number of planes. For every plane displacement field was calculated using Okada elastic half-space formulae. Every plane has nine free parameters: three coordinates of specified point (e.g. one of its angles), dimension along strike and deep, deep and strike angles, and components of displacement vector along strike and deep. For the elastic half space, displacement field is linear function of components of displacement vector and non-linear function of all other parameters. For data inversion we suggested a special modification of the Monte-Carlo method which generates trial vectors sampling space of non-linear parameters. At every step components of displacement vector determine by solution of system of linear equations. To verify this approach we also developed a method for full sampling of the non-linear parameters within specified limits with specified step, which ensures finding of the global minimum.

We tested our methods on a case of Altai earthquake. Specific feature of the satellite data for this event is that interferometry LOS displacements were obtained only in flat not-forest-covered parts of the epicenter area in Kurai and Chuya depressions. The earthquake ruptured south-west border of these depressions, thus SAR satellite data mostly characterize displacement field at one side of the rupture. GPS network is not dense but its data appeared to be very useful to constrain SAR data inversion. We present results obtained only from SAR data, joint SAR and GPS inversion with and without constraints from surface seismotectonic data to demonstrate importance of the ground control especially for areas with rough topography.

Another problem is that SAR and GPS data characterize different time periods and in addition to co-seismic they include different amount of post-seismic displacements. We used data on seismic energy release to estimate possible errors caused by this factor under assumption that post-seismic displacements were caused by post-seismic slip [Barbot et al., 2008].