Geophysical Research Abstracts
Vol. 18, EGU2016-9763, 2016
EGU General Assembly 2016

3D displacement field of the 2015 Mw8.3 Illapel earthquake (Chile) from across- and along-track Sentinel-1 TOPS interferometry

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Wide-swath interferometric mode has become standard acquisition mode for the two main Earth-observing radar missions that will be active in the coming decade, namely Sentinel-1 and ALOS-2. Increased swath width, compared to classical Stripmap imaging mode, is achieved at the expense of azimuthal resolution. This makes along-track displacements, and subsequently north-south displacements, difficult to measure using standard split-beam (multiple-aperture) InSAR or image correlation techniques. Alternatively, we show here that the along-track component of ground motion can be deduced from computing a double-difference between backward- and forward-looking interferograms within regions of burst overlap. In addition to the cancellation of tropospheric disturbance by the double-difference operation, angular diversity of Sentinel-1 line-of-sight measurements ($\sim 1^\circ$ compared to $\sim 0.25^\circ$ with ENVISAT) allows for measurements of the along-track component of ground motion with sub-decimetric accuracy. We demonstrate the efficiency of this method using Sentinel-1 data covering the 2015 Illapel M_w8.3 earthquake (Chile) from which the full 3D displacement field has been retrieved and validated against observations from a dense network of GPS sensors.