Geophysical Research Abstracts
Vol. 14, EGU2012-10391-2, 2012
EGU General Assembly 2012

Measurement of interseismic strain accumulation in the Southern Andes (25°-35°S) using Envisat SAR data

G. Ducret (1), M. P. Doin (1), R. Grandin (1), A. Socquet (2), C. Vigny (1), M. Métois (1), and M. Béjar-Pizzaro (3)

(1) Ecole Normale Supérieure de Paris, Laboratoire de Géologie, Paris, France, (2) Institut des Sciences de la Terre, Grenoble, France, (3) Instituto Geologico y Minero de Espana, Madrid, Spain

The Chilean subduction zone is one of the most active in the world. The Nazca plate subducts under the South America plate with a velocity around 7 cm/year. Along-strike and along-dip variations of interseismic coupling suggest that the subduction interface is divided into segments. Rupture of one or several consecutive segments may produce earthquakes of magnitude greater than 8.0. However, the definition of the segmentation in the particular case of the Chilean subduction and its relation to earthquake nucleation in general is a debated topic.
We focus on an area extending over 1000 km in latitude, located between Taltal (∼25°S) and Constitution (∼35°S), which has been accumulating tectonic strain since the mid-20th century. Three main earthquakes occurred in the last decade around the boundaries of this segment : the 1995 Antogagasta (M=8.1) and the 2007 Tocopilla (M=7.7) earthquakes to the North and the 2010 Maule (M=8.8) earthquake to the South. A few seismic swarms occurred in recent years : the episode of Valparaiso (∼33°S) in 1985, the Puntaqui (∼30°S) crisis in 1997, and the swarms in the Copiapo (∼27°S) region in 1973 and 2006. The 25-35°S part of the subduction zone experiences since 38 years a background seismicity (given by USGS catalog), that is mainly located along the plate interface and less frequently within the overriding plate. The seismicity rate is varying from South to North with a maximum seismicity located around La Serena area (∼30°S). There, the coupling distribution is constrained by an important GPS dataset that indicate a lower coupling (less than 60%) compared with areas further North and South. Similarly, GPS data suggest that the Copiapo area also corresponds to a local minimum of coupling. However the GPS network is too sparse further North to constrain coupling variations between 28° and 25°S.
We use InSAR (Interferometric Synthetic Aperture Radar) to provide additional insights on interseismic strain accumulation and the coupling coefficient along the Chilean subduction. We exploit all ENVISAT satellite images (2002-2010) on 4 tracks (53, 96, 282 and 325) between 25°S and 35°S of latitude and with longitude varying from 73°W to 67°W. We compute interferograms with a small baseline strategy, which requires a closure of the interferometric network. Due to the small number of acquisitions per track, this constraint leads us to include interferograms with perpendicular baselines reaching up to 500 m and temporal baselines exceeding 7 years, thus limiting the interferometric coherence. The interferograms are corrected prior to unwrapping from DEM errors effects and from stratified atmospheric delays. The unwrapping starts in areas with the highest coherence and proceeds with a decreasing coherence threshold. Unwrapped interferograms are then flattened in range and azimuth, before being inverted to yield a time series of displacement maps in the satellite Line Of Sight (LOS) direction. The time series inversion allows us to separate patterns of atmospheric turbulence from the deformation signal, and to isolate the interseismic component from the earthquake-related deformation (including the seismic swarm of Copiapo in 2006). The average interseismic LOS velocity map is compared to GPS velocity vectors projected on the same direction. The GPS field is used to re-estimate the InSAR azimuth and range ramp. The continuous geodetic data set allows us to constrain the deformation occurring perpendicular to the subduction zone at different latitudes in order to identify lateral variations of the location and width of the transition zone at the downdip termination of the coupled subduction interface.