Geophysical Research Abstracts
Vol. 15, EGU2013-7218, 2013
EGU General Assembly 2013

Studying the active deformation of distributed plate boundaries by integration of GNSS networks

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In the last decade GNSS networks installed for different purposes have proliferated in Italy and now provide a large amount of data available to geophysical studies. In addition to the existing regional and nation-wide scientific GNSS networks developed by ASI (http://geodaf.mt.asi.it), INGV (http://ring.gm.ingv.it) and OGS (http://crs.inogs.it/frednet), a large number (> 400) of continuously-operating GPS stations have been installed in the framework of regional and national networks, both publicly-operated and commercial, developed to provide real-time positioning capability to surveyors. Although the quality of the data and metadata associated to these stations is generally lower with respect to the "scientific" CGPS stations, the increased density and redundancy in crustal motion information, resulting in more than 500 stations with more than 2.5 years of observations, significantly increase the knowledge of the active deformation of the Italian territory and provides a unique image of the crustal deformation field. The obtained GPS velocity field is analysed and various features ranging from the definition of strain distribution and microplate kinematics within the plate boundary, to the evaluation of tectonic strain accumulation on active faults are presented in this work. Undeforming, aseismic regions (Sardinia, Southern Apulia) provide test sites to evaluate the lower bound on the accuracy achievable to measure tectonic deformation. Integration of GNSS networks significantly improves the resolution of the strain rate field in Central Italy showing that active deformation is concentrated in a narrow belt along the crest of the Apennines, consistently with the distribution of the largest historical and recent earthquakes. Products derived from dense GPS velocity and strain rate fields include map of earthquake potential developed under the assumption that the rate of seismic moment accumulation measured from geodesy distributes into earthquake sizes that follow a truncated Gutenberg-Richter distribution of given b-value and Mmax. The advantage is that, being purely strain-rate based, geodetic models of earthquake potentials require few subjective constraints. In addition, the maps have well-defined error bounds and the approach may apply over regions where poor fault informations are available. This approach provides independent verification of the rates of deformation in regions where geologists have documented faults and allows to evaluate the consistency of the contemporary deformation field and the historical earthquake record. We believe that GNSS networks integration represents an important reality in the framework of the EPOS infrastructure and we strongly support the idea of an European research approach to data sharing among the scientific community.