Active tectonic extension across the Alto Tiberina normal fault system from GPS data modeling and InSAR velocity maps: new perspectives within TABOO Near Fault Observatory

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The Alto Tiberina fault (ATF) is a low-angle (east-dipping at 15°) normal fault (LANF) 70 km long placed in the Umbria-Marche Apennines (central Italy), characterized by SW-NE oriented extension occurring at rates of 2-3 mm/yr. These rates were measured by continuous GPS stations belonging to several networks, which are denser in the study area thanks to additional sites recently installed in the framework of the INGV national RING network and of the ATF observatory. In this area historical and instrumental earthquakes mainly occur on west-dipping high-angle normal faults. Within this context the ATF has accumulated 2 km of displacement over the past 2 Ma, but at the same time the deformation processes active along this misoriented fault, as well as its mechanical behavior, are still unknown.

We tackle this issue by solving for interseismic deformation models obtained by two different methods. At first, through the 2D and 3D finite element modeling, we define the effects of locking depth, synthetic and antithetic fault activity and lithology on the velocity gradient measured along the ATF system. Subsequently through a block modeling approach, we model the GPS velocities by considering the major fault systems as bounds of rotating blocks, while estimating the corresponding geodetic fault slip-rates and maps of heterogeneous fault coupling. Thanks to the latest imaging of the ATF deep structure obtained from seismic profiles, we improve the proposed models by modeling the fault as a complex rough surface to understand where the stress accumulations are located and the interseismic coupling changes.

The preliminary results obtained show firstly that the observed extension is mainly accommodated by interseismic deformation on both the ATF and antithetic faults, highlighting the important role of this LANF inside an active tectonic contest. Secondarily, using the ATF surface "topography", we find an interesting correlation between microseismicty and creeping portions of the ATF.

Future perspectives within this study is to validate these models using velocity maps and temporal series provided by Differential Interferometric SAR (DInSAR) technique applied to a datasets of ERS 1-2 and ENVISAT SAR images. These data cover a time interval spanning from 1992 to 2010 and have been acquired along both ascending and descending orbit. In addition we will deploy a network of SAR passive Corner Reflectors (CRs) in the proximity of GPS monuments in order to calibrate the results of processing a set of COSMO-SkyMed SAR data and derive velocity maps. Thus the availability of high-resolution data will contribute to understand the mechanics of the LANFs and to evaluate the seismic potential associated to these geologic structures.