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AN ESTIMATE OF THE AVERAGE STRAIN RATE IN THE ITALIAN CRUST INFERRED FROM A PERMANENT GPS NETWORK

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Surface horizontal displacements in an area bounded by the Alpine chain to the North and Mediterranean/Ionian sea to the south have been determined by computing and analyzing time series of 33 permanent GPS stations with data coverage from one to five years of continuous operation. The horizontal velocities are defined consistently with the ITRF97 velocity datum. The covered area is characterized by a wide range of tectonic phenomena, such as indentation of the Adria block into the Eastern Alp, lateral extrusion of the Tauern Window, possible unbending of the Adriatic lithosphere, opening of the Thyrrenian sea and subduction of the Ionian lithospere beneath the Calabrian arc. This ongoing tectonics is accompanied by a relatively intense volcanism and seismicity, which could result in horizontal and vertical displacements. The velocities and their uncertainties are estimated on the basis of a detailed investigation of the noise model most suitable for the time series. We show that the estimated velocities, never larger than 5 mm yr^{-1} relative to those predicted by the NUVEL1A NNR rigid body model, in several cases do reflect qualitatively the expected kinematics. Areas characterized by fracturing and faults with orientations changing on a short scale (Tauern window, Apennines) exhibit instead a more irregular distribution of velocities, probably associated with more local phenomena. Eigenvalues and eigenvectors of a mean strain rate tensor are computed by optimally – in a least squares collocation sense – interpolating the station velocities to locations baricentric to clusters of stations. The estimated strain is every where smaller than 29 x 10^{-9} yr^{-1} with a mean uncertainty of 5 x 10^{-9} yr^{-1} (1 sigma). The areas with largest strain are the central Apennines and NE Italy. The azimuths of the strain rate ellipse are qualitatively compared with the directions of the stress estimated from fault plane mechanisms and borehole breakouts, and with the strike of major faults. In all cases we observe that the observed orientations are consistent within the estimated uncertainties, and conclude in favor of evidence of a yet qualitative but significant correlation between broad scale (~300 km) stress and strain rate patterns, and orientation of large scale active lineaments.

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