The statistical analysis of geodetic deformation (velocity and strain rate) derived from the space geodetic measurements (1992-2000 ITRF data sets) in central Mediterranean and Western Europe

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Abstract

With the new space geodetic techniques, such as GPS, VLBI, SLR and DORIS, positions and change rates of network stations can be accurately determined from the regular measurement campaign, which is acknowledged as an accurate and reliable source of information in Earth deformation studies. This fact suggests that the components of deformation measures (such as the stress or strain tensor, etc.) can be estimated from the highly accurate geodetic data and analyzed by means of the proper statistical testing procedures. While station velocity diagrams demonstrate relative motions among stations, strain rate diagrams show the in-situ strain concentration rate which is directly connected to local stress concentration rates and possibly also to seismic hazard potentials. Therefore, the strain analysis can be considered as a basis of a dynamic model whereas the classical deformation analysis is similar to a kinematic model. We begin with discussion of the geodynamic setting of the Earth and especially the selected investigated regions: the central Mediterranean and Western Europe. Then the space geodetic observations are introduced. Thirdly the selection of ITRF sites is performed after the history and quality of the ITRF realization series and the related residual velocities of selected ITRF sites are computed. Further the methods of derivation, the two- and three-dimensional geodetic strain rates are introduced and applied to derive the strain rates from the residual velocities, which are based on the Finite-Element-Method (FEM). In a case study both BLUUE and BIQUUE models and hypothesis tests are applied to the eigenspace components of two-dimensional strain rate tensor observations in the area of central Mediterranean and Western Europe, which are derived from ITRF92 to ITRF2000 series station positions and velocities. Further detailed analysis of the results is also performed with respect to geodynamical and statistical aspects.