EGU25-11377, updated on 21 May 2025
https://doi.org/10.5194/egusphere-egu25-11377
EGU General Assembly 2025

Geodetic strain pattern analysis of northern-central Greece – Correlation to tectonically active structures

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The central-northern part of Greece (Northern Thessaly and Macedonia) is part of the active geodynamic regime of the Aegean (Eastern Mediterranean), occupied by numerous on land and offshore active tectonic structures. These are represented mostly by E–W to NE–SW striking normal dip-slip fault zones, documenting a dominant N-S to NW-SE oriented extensional stress field. Many of these structures are related to instrumentally recorded seismic events: the July 20, 1978 (Mw6.5) Thessaloniki, the December 21, 1990 (Mw6.0) Goumenissa, the May 13, 1995 (Mw6.5) Kozani – Grevena, and the March 3, 2021 (Mw6.3) Elassona – Tyrnavos earthquakes are typical cases of normal faulting. Our objective is to calculate crustal strain and link it to specific tectonic structures.

The strain estimation is based on satellite geodetic monitoring (GPS/GNSS) and the analysis of recorded raw data. With a rate of 30 s in a 24/7 operation, a dataset of 24 stations during a 7-year period of continuous monitoring (2008 – 2014) is compiled.

Regarding the geodetic data processing, it involves i) the triangulation method which combines geodetic data of three stations each time for calculating certain strain parameters (maximum horizontal extension, minimum horizontal extension, maximum shear strain and area strain) on each triangle barycenter (approximately, 150 different triangles were constructed for the study area), ii) the "VISR" method which is a Fortran-based code producing an interpolation scheme, and iii) a micro-blocking model for which the second invariant of strain rates is calculated.

Comparing the results of these methodologies, two distinct areas are highlighted: the western-central part, where low to medium values are documented, and the eastern part, which is characterized by higher values. The higher values can be related to active structures, documented in both areas; however, it is worth focusing on the eastern part, where the higher values are observed. Two major active faults/fault zones are noted: the E – W, dip-slip normal antithetic faults of Mygdonia basin, related to the 1978 Thessaloniki earthquake, the NW – SE dip-slip normal

antithetic faults of Strymon basin and the E – W, oblique-slip Kavala-Xanthi fault zone. No recent seismic events are linked to these structures, while additionally the high strain rates indicate the potential strain charge. Moreover, it is worth noting that all structures above are adjacent to the North Aegean Trough, which is one of the most active strictures globally, as it is the prolongation of the North Anatolian fault in the Aegean Sea, and therefore they are directly affected.