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Surface kinematics in the Alpine-Carpathian-Dinaric and Balkan region inferred from a new multi-network GPS combination solution

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The understanding of the intraplate tectonics of Central Europe requires a detailed picture of how stress is transferred from the interaction of the Eurasian, Nubian and Anatolian plates to the Alpine, Carpathian, Pannonian and Dinaric regions. Recent strain distribution is controlled by the Adria horizontal push, by the Vrancea vertical slab pull and associated horizontal displacements, and by the Aegean/ Anatolia extension and slab-roll back. Local GPS networks can certainly contribute to constrain the horizontal, and possibly vertical velocity field at continental level provided that sufficient homogeneity is granted in the reduction of raw data, so that velocities obtained from the different networks can be combined. We present a horizontal velocity field for the Alpine-Carpathian-Pannonic-Dinaric and Balkan region resulting from a new combination of seven different GPS networks formed of permanent and campaign stations. The backbone is the CEGRN network, operational since 1994 and which includes permanent stations from the European Permanent Network (EPN) of EUREF and of IGS, assuring accurate alignment to the International Terrestrial Reference Frame. Five additional networks at the national level complement and densify the EPN and CEGRN networks thanks to a standardized processing scheme adopted by the CEGRN analysis centers for CEGRN, EPN and local network processing. Dedicated velocity profiles in two specific regions are studied in detail. One is the Alpine Pannonian region, with a detailed picture of the NS indentation of the Adria microplate into the Southern Alps, in NE Italy, the deformation in the Tauern Window and the eastwards kinematics of a Pannonian plate fragment. The second study region includes Transylvania, the Southern Carpathians up to the Aegean sea and Albania, where a major right lateral shear deformation exists as a consequence of the NE convergence of the Apulia platform towards the Dinarids, and the SSW motion of Macedonia, Western Bulgaria and Rumania, related to the Hellenic arc dynamics in the Eastern Mediterranean.
The profiles in the Alpine-Pannonian area indicate that a velocity drop of 2.5 +/- 0.4 mm/yr associated with the Adria indentation concentrates on a segment of some 50 km south of the Periadriatic fault. The deformation becomes extensional by a similar amount just north of the Periadriatic fault, in the Tauern Window, where the updoming of the Tauern Window implies vertical motion which could well be associated to surface extension. In the EW profile, we observe a sudden velocity change of 1.5 +/- 0.2 mm/yr in 20 km, in correspondence to the right lateral Lavant fault, which seems to mark the border between dominant indentation kinematics to the West and dominant extrusion kinematics to the East.

Three profiles are considered in the Balkan and SE Carpathians: one across the lower Adriatic sea from Apulia in Italy to the southern Dinarides, which enables to constrain the velocity drop associated to the subduction of the Adria microplate into the Dinarides to 3.2 +/- 0.5 mm/yr in 140 km. The second profile is longitudinal and constrains the velocity inversion of 7.4 +/- 1.0 mm/yr in 350 km associated to right lateral shear faults in Macedonia, a highly seismic region. The third profile crosses the Transylvania with a shortening2.3 +/- 1.0 mm/yr in 220 km, and the Wallachian-Moesian region up to the Chalcidic peninsula in N Greece. This lower part of the profile implies an extensional stretch of the upper crust of 3.2 +/- 0.9 mm/yr in 440 km, culminating in the Hellenic arc.