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A new model to link the present-day kinematics of the Central Mediterranean and the Eastern Mediterranean

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The Mediterranean is a diffuse plate boundary zone between Eurasia and Nubia plates where microplates interact (Adria, Apulia and Anatolia plates) and subduction processes occur (Calabria and Hellenic). Horizontal crustal motion derived from geodesy has been diversely interpreted, since distinguishing whether surface movements are due to rigid blocks interaction, distributed deformation or mantle flows drag associated to subduction zones dynamics is not straightforward. Previous kinematic studies have focused either on the Eastern or Central Mediterranean kinematics. We propose here a kinematic model that encompasses both areas and provides accurate boundary conditions to investigate the kinematics of the area located at the northwestern edge of the Hellenic subduction zone.

We use Haines and Holt (1993) method to derive a continuous velocity and strain rate field by interpolating model velocities that are fitted in a least square sense to published GPS velocities. In the interpolation, seismic moment tensor of the Harvard CMT and Regional Centroid Moment Tensor catalogue are used to constrain the style and direction of the model strain rate field. Eurasia and Nubia plate are modelled as rigid areas whereas all other cells are free to deform.

Our model shows that the southwestern Balkans do not belong to the Eurasia plate and seem to be dragged toward the south: the velocity vectors relative to Eurasia are N-S directed and gradually increase from $\sim$ 1mm/yr in SW Bulgaria to $\sim$10mm/yr in the north Aegean sea, leading to distributed N-S directed extension in this area. The modelled strain rates show an expected pure dextral motion along the North Anatolian Fault (NAF) from its eastern segment to the Marmara Sea. At the tip of the NAF, the modelled strain tensor turn into transtensional or extensional (N-S directed extension), at the location where the southward motion of southwestern Balkans starts. The net result is that the southward motion of the Aegean block with respect to Eurasia is gradually accommodated in the Balkans, so that the propagation of the NAF throughout is not required. Following d'Agostino et al. (2008), we minimize the motion of the Hyblean plateau in Sicily and Apulia to derive a pole of rotation for the Ionian block, and confirm that the Ionian/Nubia pole is located in the Ionian Sea. The predicted motion is millimetric extension in the Pelagian rift (1-2mm/yr), and no more than 2-3 mm/yr of convergence between the Ionian Sea and the Calabria Arc.

The southward motion of the southwestern Balkans can be described as a surface clockwise toroidal motion as it occurs at the northwerstern edge of the Hellenic subduction zone. Recent studies have proposed, for the Alaska and the eastern Hellenic subduction zone, that surface plate motions can be coupled with toroidal mantle flow around slab edges. The clockwise toroidal field that we find may be the result of the fast retreat of the African subducting plate: at the edge of the plate, the Eurasian mantle follows the retreating Hellenic slab and drives a surface toroidal flow that mimics the mantle flow at depth.