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Insights on Continental Collisional Processes from GPS Data: Dynamics of the Peri-Adriatic Belts

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Recent advances in GPS technology and processing strategies make now spatial geodesy a suitable tool to image intra-continental slowly deforming areas such as collisional mountain belts and to get further insights on their kinematics and dynamics. Here, using the peri-Adriatic belts as a test case, we propose a methodology based on accurate GPS velocities to discriminate whether the current day deformation pattern over a mountain belt is controlled at the first order by gravity through gradients of gravitational potential energy.

We calculate a new GPS velocity field covering the peri-Adriatic region and the entire Balkan Peninsula, taking advantage of newly available measurements coming from private networks operating since several years in this area. Based on these velocities, we derive the strain rate tensor and an interpolated velocity field using the method of Haines Holt (1993). Opposite to the commonly accepted hypothesis considering the Balkans as part of the stable Eurasia, we show that the peninsula experiences significant compression across the Dinarides belt and extension toward the Aegean domain South of 44°N. We image a clockwise rotation of the entire peninsula around North Albania, and propose that the lithosphere under the old Scutari-Peck transform zone is weak and acts as a pivot point for this rotation since early Miocene. The Hellenic slab suction and the release of stress in the northern Hellenides subduction zone may favour the southwestward motion of the inner Balkan lithosphere, flowing between the rigid Apulia and Black sea blocks consequently. Because our velocity field is unusually dense in Slovenia and Austria, we picture the Eastern Alps deformation with great details and show that the Austrian Alps are moving eastward together with the Alpine foreland and Bohemian Promontory relative to stable Eurasia. Based on these new GPS data, we investigate the dynamics of the peri-Adriatic mountain belts, in particular of Albania and Eastern Alps. Using strain-derived and topography-derived estimates of gravitational potential energy, we show that the Apennines and Albanides deform as a viscous lithosphere ($\eta \sim 5 \times 10^{21}$ Pas) in response to the gravitational body force. On the contrary, both the Dinarides and Eastern Alps are probably deforming in response to the North-East push of the Adria-Apulia indenter more than to GPE gradients. Furthermore, mantle dragging or rheological lateral contrasts inside the lithosphere may also influence the Eastern Alps current-day deformation pattern.