New InSAR velocity maps highlight large-scale tectonic deformation in the Balkan Region

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Résumé

As a hotspot of European seismicity, the Balkan Peninsula experiences frequent destructive earthquakes, with recent Mw ≥6 events causing substantial societal impacts. These searthquakes, of all types of focal mechanisms, occurring at interplate boundaries and intraplate domains, highlight the intricate geodynamic framework of the region. Despite monitoring efforts in GNSS suggesting very low strain rates, the region remains underinstrumented relative to other parts of Europe, limiting our understanding of the geodynamic processes at play and associated hazards.
To address this spatial limitation, we take advantage from a new InSAR time series processed by the FLATSIM service based on Sentinel-1 data over the western Balkans. Leveraging high spatial resolution (240m) and frequent revisit times (6-12 days) of these time series, we produce the first large-scale InSAR surface velocity field over the 2014-2021 time span for the Balkans Peninsula, referenced in ITRF14 , with very limited use of GNSS data. These velocity maps complement GNSS by identifying localized tectonic deformation previously unresolved.

By applying 3D decomposition to InSAR tracks, we provide vertical and horizontal velocity maps that constrain both the location and amplitude of velocity gradients across active structures.In the south, our analysis helps characterize the known transtensional area in the inner Albanides, showing ~3 mm/yr of extension over ~80 km along a N–S axis. Farther southeast, in Central Greece, it reveals a major lithospheric shear zone extending more than 250 km and accommodating ~2 cm of E–W dextral shear, potentially linked to NAF interaction or deep mantle processes. Within the slowly deforming north area (1-3 mm/yr), the data illuminate uplift at about ~1.5 mm/yr over the Dinarides and constrain the interplay between the Albanides front and the Scutari-Peć Zone, known as the structural boundary separating the Albanides and Dinarides.
Using new InSAR horizontal velocity maps, we first compute strain rates with the Bstrain code to enhance strain rates characteristics. We use simple block models to mimick the first order of our observed deformation for: (a) active dextral shearing along the Central Greece, and (b) active flat subduction beneath the Dinarides, ultimately proposing a first-order geodynamic interpretation of Balkan deformation dynamics.

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Mots-Clés: InSAR, Balkans, interseismic, tectonics, faults, strain, shear, subduction, NAF, slab