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Mapping tectonic strain in the central Alpine-Himalayan Belt with Sentinel-1 InSAR and GNSS observations

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Geodetic measurements of crustal deformation provide crucial constraints on a region's tectonics, geodynamics and seismic hazard. However, such geodetic constraints have traditionally been hampered by poor spatial and/or temporal sampling, which can result in ambiguities about how the lithosphere accommodates strain in space and time, and therefore where and how often earthquakes might occur. High-resolution surface deformation maps address this limitation by imaging (rather than presuming or modelling) where and how deformation takes place. These maps are now within reach for the Alpine-Himalayan Belt thanks to the COMET-LiCSAR InSAR processing system, which performs large-scale automated processing and time-series analysis of Sentinel-1 InSAR data. Expanding from our work focused on Anatolia, we are combining LiCSAR products with GNSS data to generate high-resolution maps of tectonic strain rates across the central Alpine-Himalayan Belt. Then, assuming that the buildup rate of seismic moment (deficit) from this geodetically-derived strain is balanced over the long term by the rate of moment release in earthquakes, we pair these strain rate maps with seismic catalogs to estimate the recurrence intervals of large, moderate and small earthquakes throughout the region. We also use arguments from dislocation modeling to identify two key signatures of a locked fault in a strain rate field, allowing us to convert the strain maps to "effective fault maps" and assess the contribution of individual fault systems to crustal deformation and seismic hazard. Finally, we address how to expand these approaches to the Alpine-Himalaya Belt as a whole.