Analysis of the hydrological and tectonic deformation in the eastern part of the Tibetan plateau, from FLATSIM automated time series analysis of Sentinel-1 InSAR

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The global and systematic coverage of Sentinel-1 radar images allows characterizing, by radar interferometry (InSAR), surface deformation on a continental scale.

Our study focuses on the eastern part of the Tibetan plateau, where a combination of major strike-slip and thrust fault systems accommodates part of the deformation related to the collision between the Indian and Eurasian plates.

We use an automated Sentinel-1 InSAR processing chain based on the NSBAS approach (Doin et al., 2011, Grandin, 2015) to measure the interseismic deformation across these fault systems. Processing is made on the CNES high-performance computer center in Toulouse in the FLATSIM project framework (ForM@Ter LArge-scale multi-Temporal Sentinel-1 Interferometric Measurement, Durand et al., 2019). We perform a time series analysis of the 2014-2020 Sentinel-1 InSAR data set, for 1200 km-long tracks (acquired along 7 ascending and 7 descending orbits), covering a 1 700 000 km² area, with a 160 m spatial resolution. From about 130 acquisitions per track, we perform about 600 interferograms, with short, three months, and one-year temporal baselines. After inversion, we obtain time series of line-of-sight (LOS) delay maps, including residual atmospheric delay and network misclosure measurements. The time series are fitted by a seasonal signal plus a velocity trend. The velocity field on overlap areas agrees within less than 1–mm/yr.

Finally, we decompose the LOS velocity maps into a vertical and a horizontal contribution.

InSAR velocity maps highlight surface deformation patterns mostly localized on known major faults, short-wavelength patterns attributed to slope instabilities phenomena, and hydrological signals.

The seasonal signal combines residual atmospheric phase delays and widespread hydrological
phenomena in sedimentary basins, which we interpret in parallel with the regional geological map. Masking areas affected by dominant gravitational slope or hydrological deformation allows to better focus on tectonic deformation.

We finally discuss slip partitioning on the various fault systems from the velocity maps and 2D profiles’ analysis.