InSAR time series analysis and slip inversion: quantifying the extent of aseismic slip along the central segment of the North Anatolian Fault from Sentinel data

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Résumé

The central creeping segment of the North Anatolian Fault extends along the 1944, M7.3, earthquake, located near the city of Ismetpasa. Since this event, this 80 km-long-section slips aseismically at a velocity of 7-8 mm/yr at least between the surface and a depth of 4 km, as predicted by the dynamic model developed for this fault section. Up to now, it was thought that slip was at a constant rate. But thanks to recent data acquired both from the SAR satellite constellation Cosmo-SkyMed and the Ismetpasa creepmeter, creep events have been detected. This suggests aseismic slip is not constant in time but occurs within days- to month-long slip episodes, hence calling for a new physical description of slip along this fault segment.
Until now, the monthly return period of previous satellite constellations (ALOS, ERS, ENVISAT) and the non-systematic acquisition planning resulted in scarce time series, not dense enough to capture slow slips events systematically. The recent launch of Sentinel 1 A and B satellites, respectively in 2014 and 2016, is an opportunity to measure surface deformations finely in space and time (6 days acquisitions, 100x300 km area).

We process 2 satellite tracks of this database, covering the creeping section between 2014 and 2017. We generate more than 240 interferograms with the InSAR Scientific Computing Environment (ISCE). We correct them for stratified tropospheric delays using the two latest global reanalysis models from ECMWF, ERA-Interim and ERA-5. The potential of the new ERA-5 dataset is shown by statistics. We estimate a linear function of range and azimuth to account for residual orbital errors. We perform a time series analysis and generate 2 Line-Of-Sight (LOS) maps of the ground velocity using GIAnT. We also test another time series analysis that takes into account all pixels and the associated covariances and compare the two velocity maps obtained by these methods. Finally we derive a preliminary slip Probability Density Function (PDF) from the velocity field using a Bayesian approach exploring the depth and along-strike extent of creep, in relationship with historical earthquakes.

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