Present-day strain distribution across a segment of the central bend of the North Anatolian fault zone from a Persistent Scatterers InSAR analysis of the ERS and Envisat archives

M. Peyret (1), F. Masson (2), H. Yavasoglu (3), S. Ergintav (4), R. Reilinger (5)

(1) Université Montpellier 2, Géosciences Montpellier, CNRS UMR-5243, 34095 Montpellier, France.
(2) EOST, Université de Strasbourg, France.
(3) ITU, Faculty of Civil Engineering, Department of Geomatics, Maslak-Istanbul, Turkey.
(4) TUBITAK, Marmara Research Center, Earth and Marine Sciences Institute, Gebze 41470, Turkey.
(5) Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA 02139, USA.
Corresponding author: Peyret, M., (peyret@gm.univ-montp2.fr)

The North Anatolian Fault Zone (NAFZ) is the major transform system that accommodates the westward movement of the very few deforming Anatolian block relatively to Eurasia. Mitigating the hazard associated with devastating earthquakes requires understanding how the NAFZ accumulates and releases the potential energy of elastic deformation both in space and in time. In this study, we focus on the central bend of the NAFZ where the strike of the North Anatolian Fault (NAF) changes from N75° to N105° within less than 100 km, and where a secondary fault system veers southward within the interior of Anatolia. We present interseismic velocity fields obtained from a Persistent-Scatterers (PS) Interferometric radar analysis of ERS and Envisat radar archives. Despite the high vegetation cover, the spatial density of measurements is very high (~6-15 PS/km2). Interseismic velocities presented below indicate a velocity change of ~6-8 mm/yr along the satellite line-of-sight (LOS) mainly centered on the NAF surface trace, and are in good agreement with the GPS velocity field published previously. The observed deformation is accommodated within a zone of less than 10 km width close to the Ismetpasa creep segment, to a more typical zone of ~30 km width where surface creep has not been reported. Although less conspicuous, ~2-3 mm/yr (~1 mm/yr along the LOS) of the total deformation seems to be localized along a structure which partly coincides with the Lacin Fault. The overall agreement with horizontal GPS measurements suggests that the vertical component of the ground deformation is minor. However, a specific pattern of the PS velocity fields suggests that an area, enclosed between two faults with roughly south-north orientation, experiences uplift. The PS analyses of radar time-series both prior and posterior to the Izmit and Dûzce earthquakes indicate that these events did not induce detectable velocity changes in this Central Bend. The only temporal changes we identify are due to a moderate local earthquake (Mw 5.7, 14 August 1996) whose precise location and coseismic deformation are determined here. Finally, we propose a model of slip-rate distribution at depth along the NAF from the inversion of the PS mean velocity fields. This model suggests a long-term slip-rate of ~23 mm/yr for locking depths in the range of 20 – 30 km. However, the locking depth exhibits systematic lateral changes, notably decreasing close to the Ismetpasa creeping segment to the west, and in the central section of the Central Bend. This lateral evolution is in general agreement with the earthquake distribution at depth from three different catalogues.