HAZA-133 - The variation in strain accumulation along the North Anatolian Fault

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Studies of interseismic strain accumulation are crucial for our understanding of continental deformation, the earthquake cycle and seismic hazard. The interseismic period is the longest portion of the earthquake cycle, often spanning decades to centuries. It has therefore, been difficult to measure the variation in strain accumulation at different stages of the interseismic period. In this study we address this issue by investigating the surface deformation along the North Anatolian Fault (NAF) in Turkey.

The NAF is a 1300 km long, mature right-lateral continental transform fault that accommodates a significant fraction of the motion between central Turkey and Eurasia. Together with the East Anatolian Fault it facilitates the motion of Anatolia away from the Arabia-Eurasia collision zone westwards towards the Hellenic subduction zone.

In the last century the fault has accommodated 8 large earthquakes (Mw 6.7 and above), with a dominant westward progression in seismicity culminating in the M7.4 Izmit and M7.2 Duzce earthquakes in 1999. This earthquake sequence provides a unique opportunity for us to investigate the surface deformation and strain accumulation as each previous rupture segment is at a different stage of the earthquake cycle.

In this study, we perform a time series InSAR analysis of 22 Envisat tracks in both ascending and descending geometries that cover the entire continental extent of the North Anatolian Fault. Our InSAR dataset spans an 8 year time window from 2003 to 2010. We use a small baseline processing strategy using the StaMPS software, where we also implement an iterative unwrapping procedure that tracks well-unwrapped pixels for each subsequent iteration. The latter relies on checking for unwrapping errors by summing the residuals around closed interferometric loops.

By combining our InSAR results with existing GPS measurements, and assuming negligible vertical motion, we create a high resolution map of the horizontal velocity field in northern Turkey. Our results confirm the presence of two aseismically creeping segments at the Izmit and Ismetpasa sections of the NAF. We find that the remainder of the fault appears to be fully locked and accumulating strain throughout the crust.

We calculate the strain rate from our velocity field and use elastic dislocation models to determine the fault slip rate and locking depth at various locations along the fault. We investigate how these parameters vary at each of the previous rupture segments.