Earth surface response to Quaternary faulting and shallow crustal structure in the eastern Adria-Alpine collision zone and the Friulian plain

Christoph Grützner (Friedrich-Schiller-University Jena) christoph.gruetzner@uni-jena.de
Klaus Reicherter (RWTH Aachen University)
Friedhelm von Blanckenburg (GFZ Potsdam – Earth Surface Geochemistry)

The eastern Southern Alps-Dinarides region of the Alps is subjected to the strongest crustal motion in the entire Alps and thus allows to directly explore the response of Earth's surface to tectonic activity. As a consortium of geologists, geophysicists, and geochemists, we will investigate the geometry of major active faults, their sense of motion, and how they drive erosion using a set of interdisciplinary tools: a) new high-resolution digital elevation models from airborne LiDAR surveys, stereo satellite data, and low-cost local surveys with drones; b) near-surface geophysical surveys such as ERT, georadar, seismic reflection, and micro-gravimetry to image surface traces and the sub-surface structure of active faults; c) dating of the recent deformation in outcrops and palaeoseismological trenches to determine long-term slip rates, earthquake recurrence intervals, and palaeo-magnitudes; d) quantification of the erosional response to active faulting using catchment-wide erosion rates from in situ cosmogenic ^{10}Be in river sediment. This study will bridge the gaps between the distribution of seismicity (recorded with the seismograph array in the 4D-MB project), the surficial manifestation of Quaternary faulting, and erosion as driven by active tectonics. The research is linked to research theme 4 (motion patterns and seismicity) and theme 2 (surface response) of the SPP 4D-MB, and is within activity field E. This study will provide important insight towards analysing seismic risk and hazard in this densely populated area.

Research questions

- Which faults in Friuli and W Slovenia area actively accommodate the present-day convergence of Adria and Eurasia and is active tectonic deformation confined to a few major structures or is it widely distributed?
- What is the Quaternary faulting history of the active faults? What is the length of their earthquake recurrence intervals and what are the maximum magnitudes? Can we tie historical earthquakes to their causative faults?
- What is the mechanism of faulting? Is/was there slip-partitioning? Do some of these faults creep?
- How much does catchment-averaged erosion change in vicinity to seismically active faults (relative to an endmember scenario not affected by faulting) and what are there differences in erosion rates, for a given rock erodibility, for different fault types?
- Can we use erosion rates to identify regions of active tectonics where little is known about actual faults?
- How does the tectonic driver of erosion in the study area compare to the climatic driver elsewhere in the Alps?

Collaborations within the SPP

- We will integrate our results with studies on regional (micro-)seismicity, focal mechanisms, and we will check if seismicity can be tied to individual faults (e.g. **Kummerow et al.)**
- We will collaborate with groups that look at neotectonics and active crustal deformation elsewhere in the Alps: **Reicherter & Ritter**, **von Hagke et al.**
- We will compare our results with the work of **Handy et al.**, **Scheck-Wenderoth et al.**, **Glotzbach & Kley** who investigate how deep processes control the surface kinematics

International collaboration

Besides the collaborations within the SPP we co-operate with Stefano Parolai (OGS Trieste) in the fields of seismicity and geophysics, and with Austin Elliott (Univ. Oxford) for remote sensing. Our field studies are run with colleagues from the Geological Survey of Slovenia (Jure Atanackov, Petra Jamšek Rupnik, Manja Žebre) and the University of Ljubljana (Marko Vrabec).

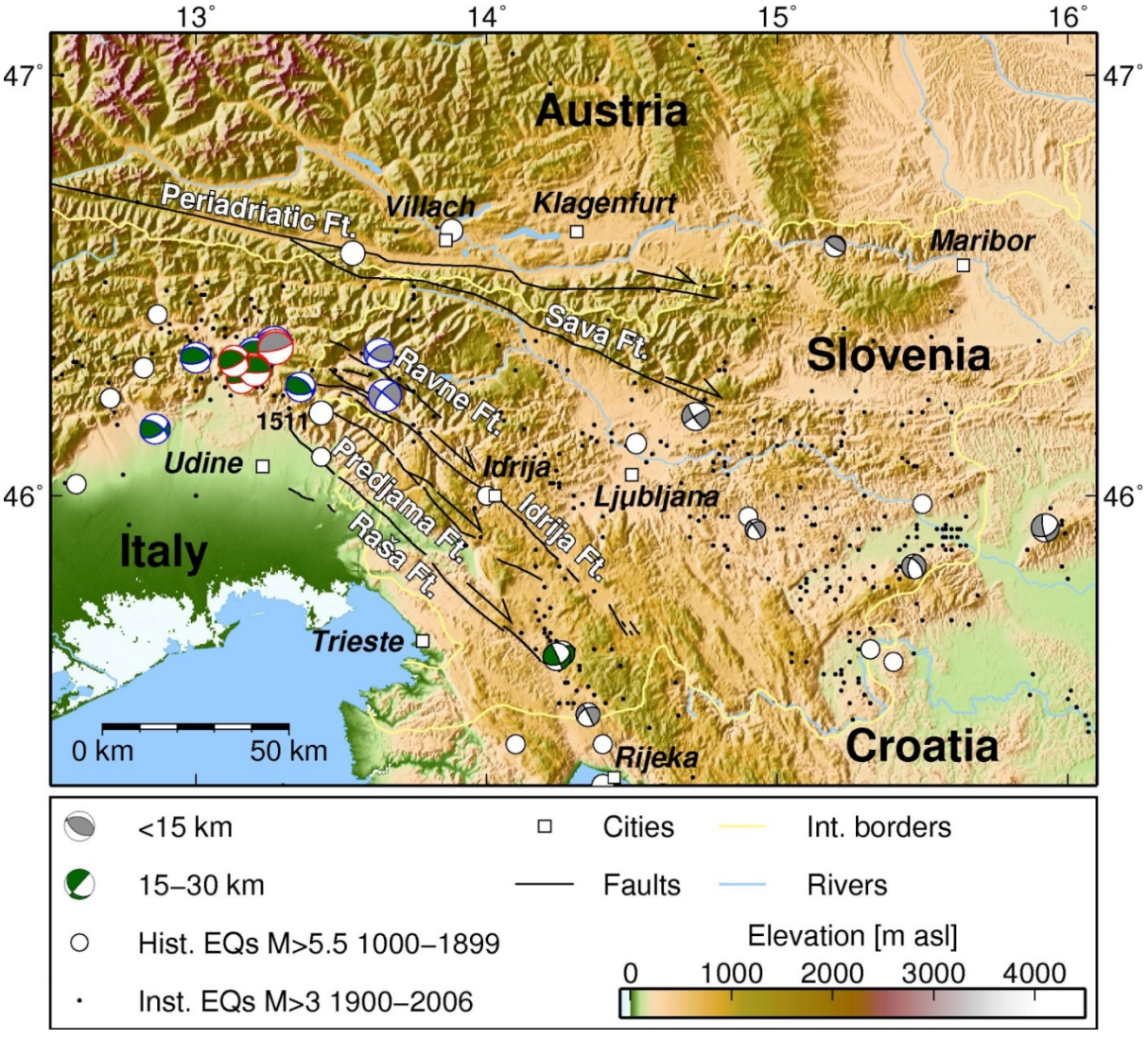

Figure 1: Our working area in the Alps-Dinarides transition zone. Here the style of faulting changes from head on thrusting on E-W striking faults in Italy to right-lateral strike slip and transpression on NW-SE striking faults in Slovenia. Main faults of interest (black lines) are labelled.