Constraints on Quaternary processes in the Eastern Alps from a new detailed image of seismicity

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This project is aimed at estimating the deformation in the Alpine crust in the transition zone between the Eastern Alps and the Southern Alps/Dinarides from a multi-parameter study of local earthquake sources. This region hosted most of the largest Alpine earthquakes in historical and instrumental times (magnitude M ≥ 6). The here intended high-resolution map of seismic slip direction and slip rate will help to better understand how the crust reacts to the mountain building forces. We assume that the controversely debated possible drivers of the Alpine orogeny, i.e. tectonics, climate and erosion, have different imprints on the seismicity patterns, and their detailed analysis will enable us to decipher the different contributions. In combination with cooperating projects from geodesy and paleo-seismology it will also provide important constraints on the locations of paleo-, historical, and possibly of future large earthquakes in the Alps and on their recurrence intervals. The distribution of deformation from this earthquake study will be combined with observations from GPS and InSar (project By S. Metzger), which will allow to decipher the roles of seismic vs. aseismic deformation. Comparison of seismicity and geodesy with kinematic studies from structural analysis, paleo-earthquakes and erosion rates will help to determine if deformation has persisted for a longer time-scale or if motion patterns have changed over time.
The study relies on the new rich seismological data recorded during the first phase of this Priority Programme (AlpArray, SWATH-D). We will also benefit from our own previous work within the first phase, where we have developed an efficient event detection work-flow suitable for application to the big data volume of the Alpine networks and an implementation of moment tensor inversion capable of analyzing small magnitude events (so far Mw~3). Our aim of quantifying the crustal deformation requires accurate measurements of seismicity-based parameters, which can be grouped in two parts: Precise hypocenters and their spatial and temporal patterns on the one hand and an assembly of source parameters (seismic moment tensors, scalar seismic moment, stress drop and rupture directivity) on the other hand. The first group will provide the locations, geometry, orientation and structural heterogeneity of active faults and their segmentation. The second group will contribute the complementary information of slip direction and slip rates. Both imply the application of robust, well-established methods, but also of novel approaches for a better characterization of the observed seismicity (seismicity clustering by tools adopted from Graph theory; combination of moment tensor inversion and rupture directivity). The two packages will be finally merged to compose a map of seismic slip distribution in the Eastern Alps and the Southern Alps/Dinarides.

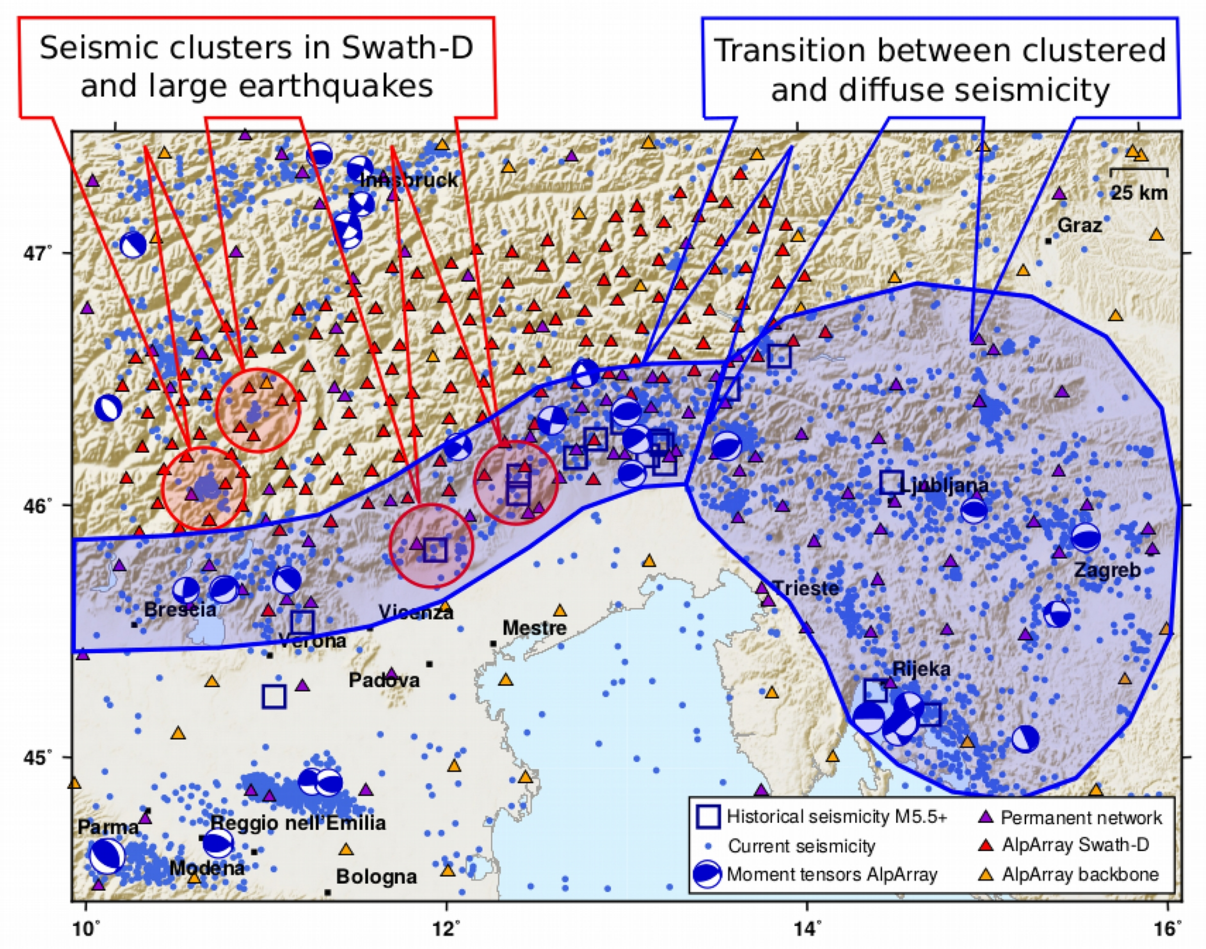

Fig.1: Sketch of the study region in the transition zone between Eastern and Southern Alps/Dinarides and available data after the AlpArray seismic deployment. We plan a detailed image and quantitative characterization of the different seismicity patterns.