From Top to Bottom-Seismicity, Motion Patterns & Stress Distribution in the Alpine Crust

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The aim of our proposal is to investigate the processes which control the seismicity of the Alps. We hypothesize that patterns of stress and motion can be quantified from the seismicity which is observed with unprecedented resolution by AlpArray.

A major challenge is the detection and analysis of weak seismic events which are of prime importance for establishing the link between near-surface and deep crustal processes. We face this by the integration of regional-scale and local-scale data and a consistent application of modern waveform-based seismological techniques for event detection, location and moment tensor inversion.

On a regional scale (AlpArray, AF-A), seismic source studies are planned for weak to moderate seismicity (magnitudes Mw>3.0), in order to provide an enhanced seismicity catalog of the entire orogen. The application and advancement of moment tensor and stress inversion will provide a comprehensive 3-D image of present-day faulting and stress field of the Alpine crust.

On a local scale, we intend to characterize the microseismicity (Mw>0.5) for the dense AF-D network at the transition between Eastern and Southern Alps, and we will intensify the German station network at two existing sites in the Molasse and the Staufen massif. The characterization of microseismicity aims to unravel the roles of rainfall, snowload and post-glacial and tectonic effects. Also, elastic parameters and seismicity rates related to the natural transients may exhibit seasonal variations, and their study will facilitate a first seismic hazard assessment of the study region.

For two sites (the geothermal field in the Molasse and the Staufen massif), a good knowledge of seismicity and possible forcing effects already exists, and meteorological data and fluid temperatures and volumes are available. These excellent preconditions make both perfect cases for testing recently developed monitoring methods for estimating deformation changes in the shallow crust from seismicity and answering the question how the deformation and stress from the shallow crust transfer to the surface deformation field measured by geodetic sensors.

The observed seismicity will also illuminate the structure of faults and their kinematics at depth, and the here proposed combination of both regional and local seismic source studies will provide an important and unique link between surface deformation and deep crustal processes.

Our research project relies on the seismological data recorded by AlpArray, AF-A (DSEBRA) and AF-D (SWATH D). It directly addresses three of the key targets of the MB- 4D priority program: RT2- Surface response, RT3- Deformation of crust & mantle, and RT4- Motion patterns & seismicity. In close cooperation with MB-4D projects from other disciplines, this will enable us to derive spatial and eventually temporal patterns of motion, deformation and stresses and finally contribute to an improved understanding of the Alpine mountain building process.

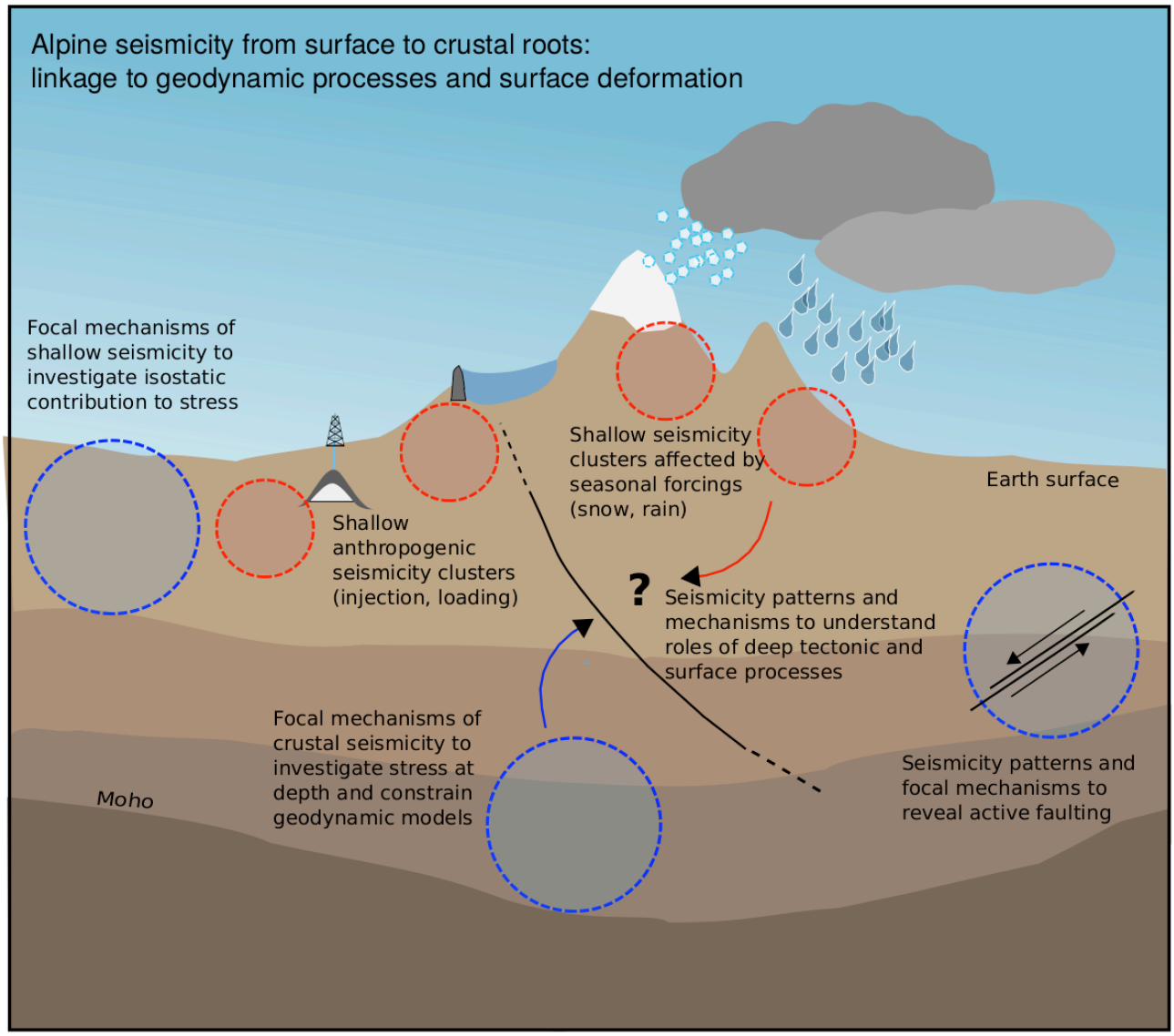

Fig. 1: Sketch of the main components of our proposed project. We aim to derive patterns of motion, deformation and stress at different scales and depths from seismicity in the Alps. Our working program splits into two parts: One will provide the larger picture, including the deeper crustal seismicity (blue circles). This part uses mainly data recorded by AlpArray/AF-A. The other is dedicated to the local, expectedly shallow micro seismicity and its causes with focus on

Relationship to other projects of 4D-MB

Our project will provide unique seismological outcomes, such as an enhanced seismic catalogue and a spatial mapping of stress, which are important contributions to other SPP projects. In this sense, our project will be tightly linked to various other proposed projects of the SPP from multiple disciplines. We seek particular close cooperation with the **glacial/climate** groups to compare deformation rates, and **geodynamic modeling** groups for integrating our large-scale 3-D stress field as an important constraint for the 3-D geodynamic modeling of the lithosperic deformation of the Alps. The derived 3-D stress field is also of particular interest for seismological projects dealing with **anisotropy of the crust and upper mantle**. We will produce high- resolution mapping of seismically active faults and the related motion patterns; this implies co-work with several other **seismic imaging** and **structural & thermo-chronological geology projects**, in particular in the vicinity of the AF-D (SWATH D) region. Our detailed seismicity study in the northern Alpine foreland offers close collaboration with the project on **stress transfer and Quaternary faulting** (Reicherter & Ritter).