The Alps revisited – 4D-MB, the German contribution to the AlpArray mission

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4D-MB is a multi- and interdisciplinary project that forms an integral part of the international *AlpArray* mission. It tests the hypothesis that re-organizations of Earth's mantle during the collision of tectonic plates have both immediate and long-lasting effects on earthquake distribution, crustal motion and landscape evolution in mountain belts. *AlpArray* consortium involves 64 institutions in 17 countries.

The target is the European Alps (**Fig. 1**) and its neighboring mountain belts (Apennines, Carpathians, Dinarides) in the central Mediterranean area.

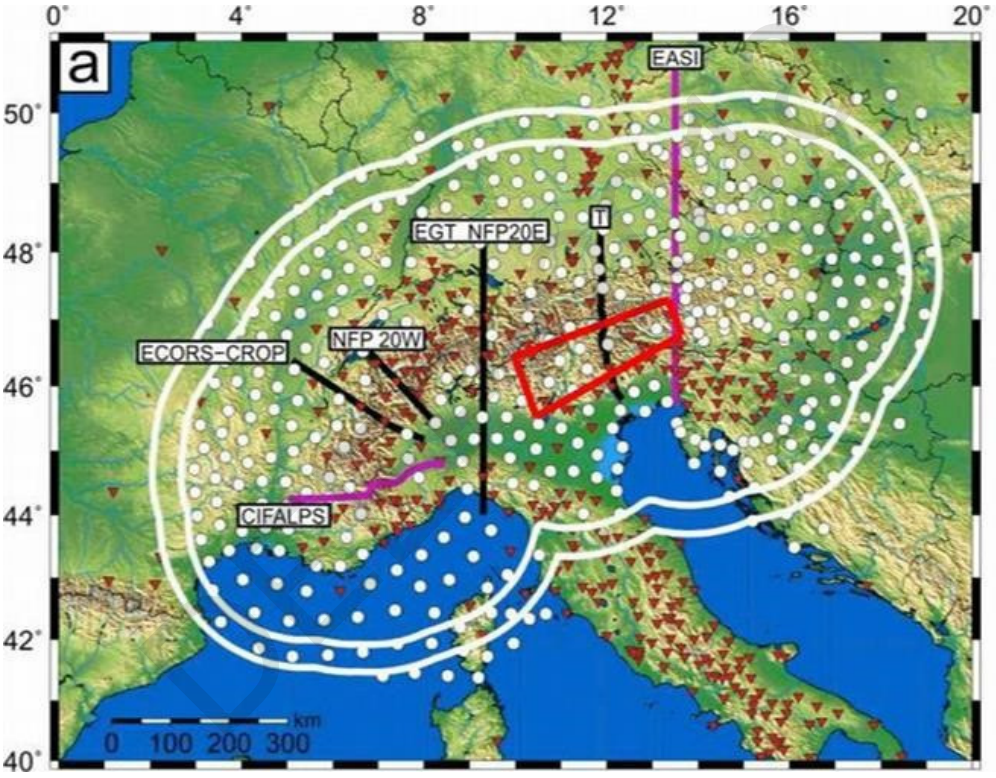

Figure 1. The Alpine domain with seismological experiments: (a) White lines delimit the international backbone network with all 579 broad-band seismometers. Purple lines - AlpArray passive seismic swaths with densified station configurations: EASI – Czech-Austria-Swiss swath, CIFALPS – China-Italy-France swath. Black lines – active seismic experiments of the 1980s and 90s, including T, the TRANSALP profile. Orange rectangle - Swath D with densified station networks.

The object is to investigate links between Earth's surface and mantle by integrating 3D-seismological imaging of the crust-mantle system beneath the Alps with geologic observations and modeling to enable us to look both backwards and forwards in time, the 4th dimension.

This integrated 4D approach entails **four research themes**:

1. **Reorganizations of the lithosphere during mountain building** uses high-resolution seismic imaging of lithospheric slabs beneath the Alps to determine the origin of switches in subduction polarity, particularly to understand how tears in lithospheric slabs nucleate and propagate in time and space.
2. **Surface response to changes in mountain structure on different time scales** tests the controversial idea that time-integrated denudation and uplift rates partly reflect slab-tearing and -breakoff events in the mantle.
3. **Deformation of the crust and mantle during mountain building** resolves the question of whether deep structures manifest early stages of mountain-building or primarily preserve the imprint of later events (indentation, lateral escape). This constrains rates of structural change in the crust and mantle.
4. **Motion patterns & seismicity** identifes the spatial and temporal patterns of faulting and seismicity to gain an overall motion picture from the present back in time. The aim is to understand whether present earthquakes are being established in response to a new tectonic regime.

4D-MB takes advantage of the Alps' unique exposure of different stages of orogenesis, from ongoing continental collision and indentation in the east to post-collisional rebound in the west. Our focus is on integrated geophysical-geological studies along a swath of 153 closely spaced broad-band seismometers deployed in the seismotectonically most active part of the orogen (Eastern & Southern Alps, Fig. 2). The 1st phase of the project is underway (2017-2020) and a 2nd phase is planned (2020-2023).

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