Shear-wave splitting as diagnostics of variable tectonic fabrics across the Eastern Alps – Bohemian Massif contact zone

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AlpArray and AlpArray-EASI data set

The swath about 200 km broad and 540 km long along 13.3° E longitude was selected to study the large-scale anisotropy in the mantle lithosphere beneath the Bohemian Massif (BM) and the Eastern Alps.
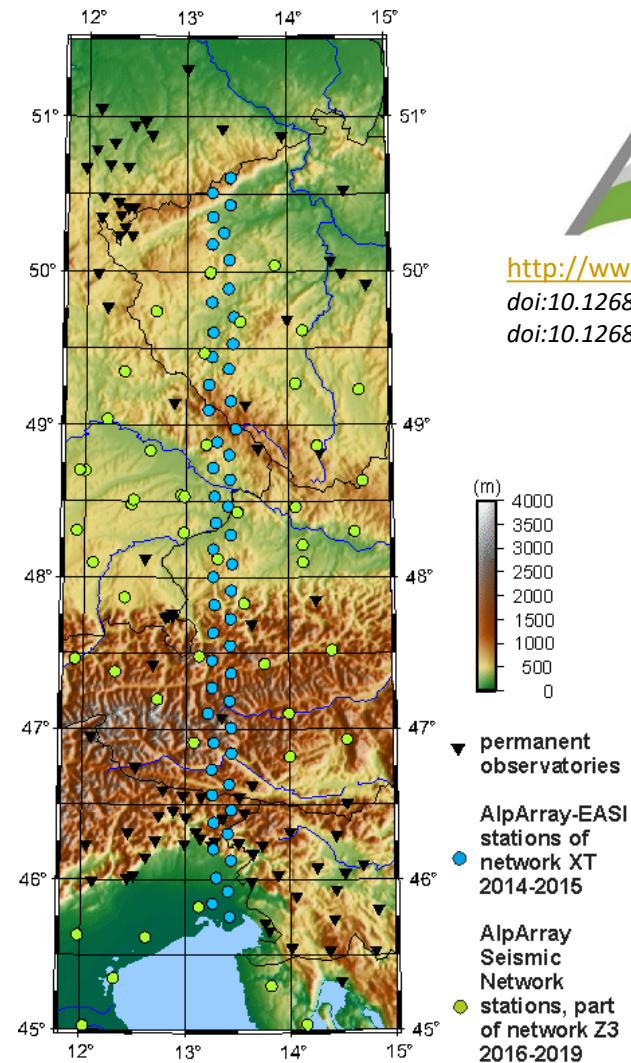
The region is covered by about 200 broad-band permanent stations and temporary stations from passive seismic experiments AlpArray-EASI (2014-2015) and AlpArray Seismic Network (2016-2019).

▼ permanent observatories

● AlpArray-EASI stations of network XT 2014-2015

● AlpArray Seismic Network stations, part of network Z3 2016-2019
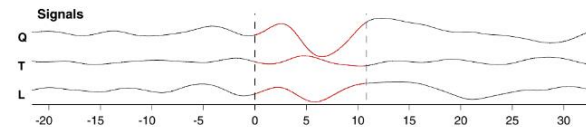
Processing

o Automatic XKS waveform selector

- demean, resample

- response correction

- sensor orientation correction

- zero-phase filtering

- XKS wave identification and selection

o Particle motion regional variations

o Splitting evaluations

o Corrections for dynamic back-azimuth
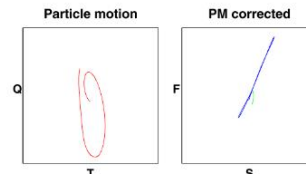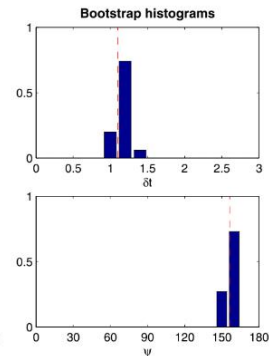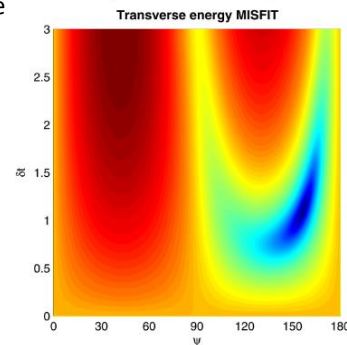
Automated selection of SKS wave
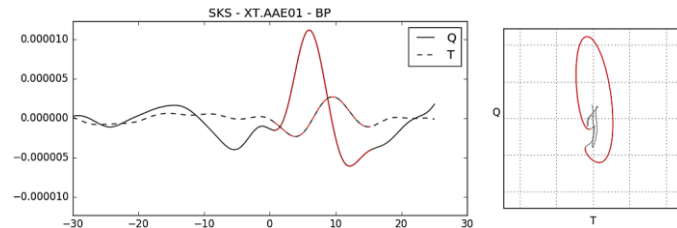
Splitting evaluation

Splitting parameters:
- delay time
- polarization direction of the fast split wave

Eigenvalue method
– for shear waves with a linear PM

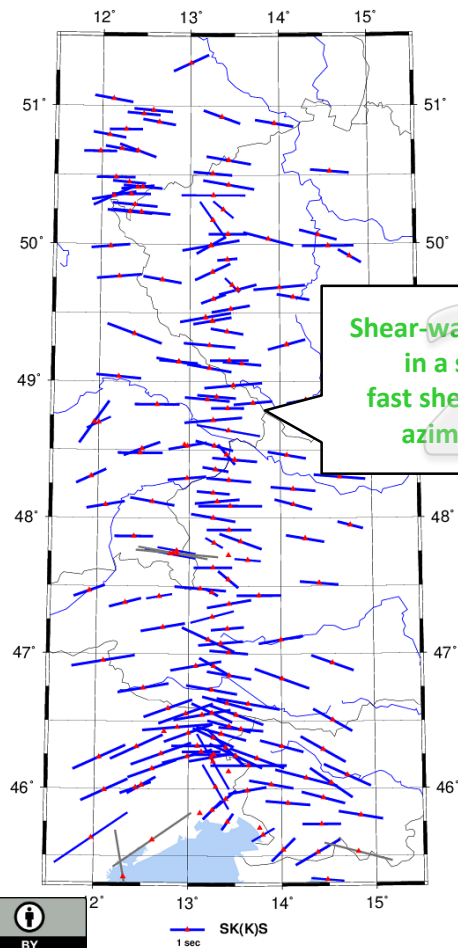Transverse energy method
– for XKS waves

SKS waveforms at EASI stations

Waveforms on Q component centered around their main peak. Displacement signal corrected for a seismometer response and filtered by 7-30 s bandpass Butterworth filter.

Regional variations are more impressive for SKS waves incoming from ENE (blue arrow, back-azimuth 71°) than from WSW (green arrow, back-azimuth 248°).
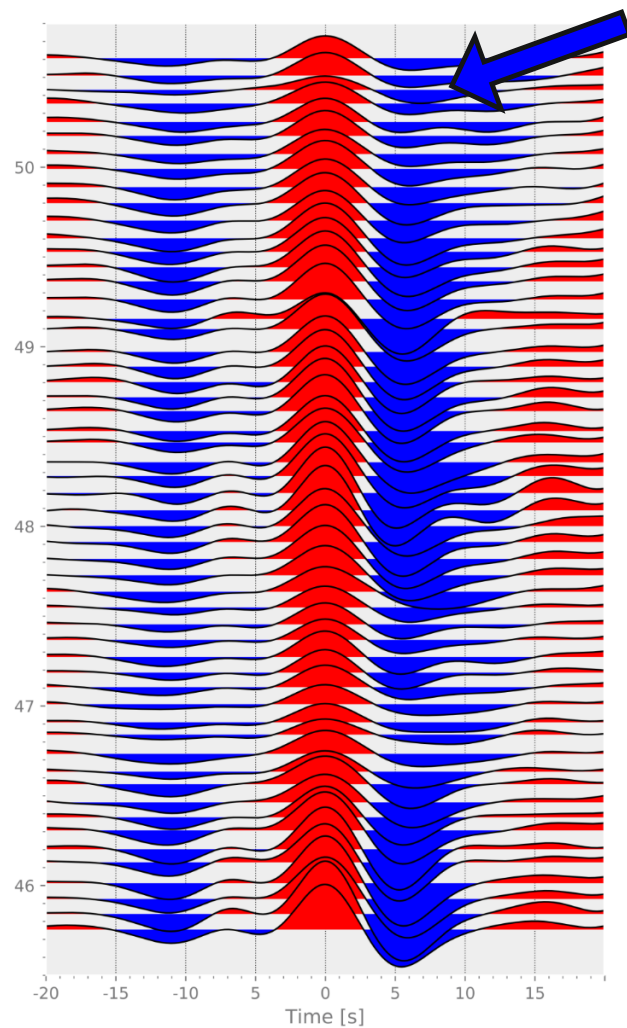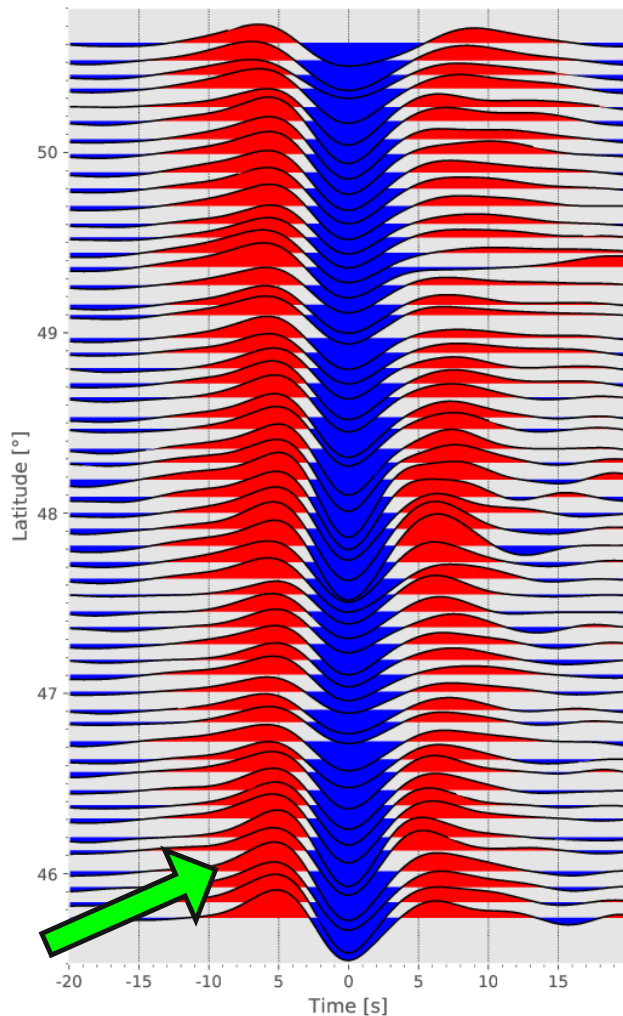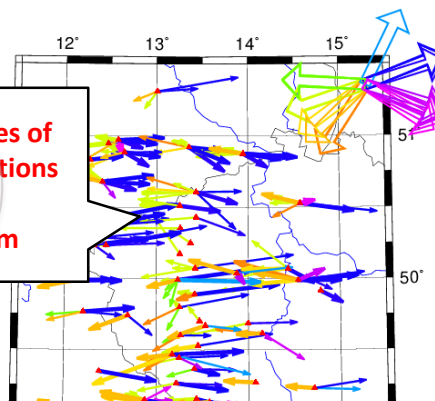
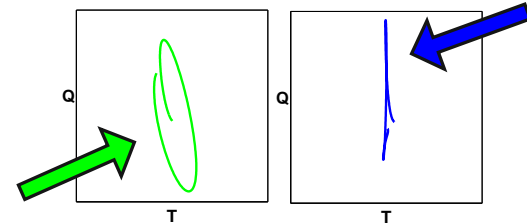# SKS splitting corrected for sensor mis-orientations

Station AAE08

Particle motions of two SKS waves incoming from (PM) opposite directions.

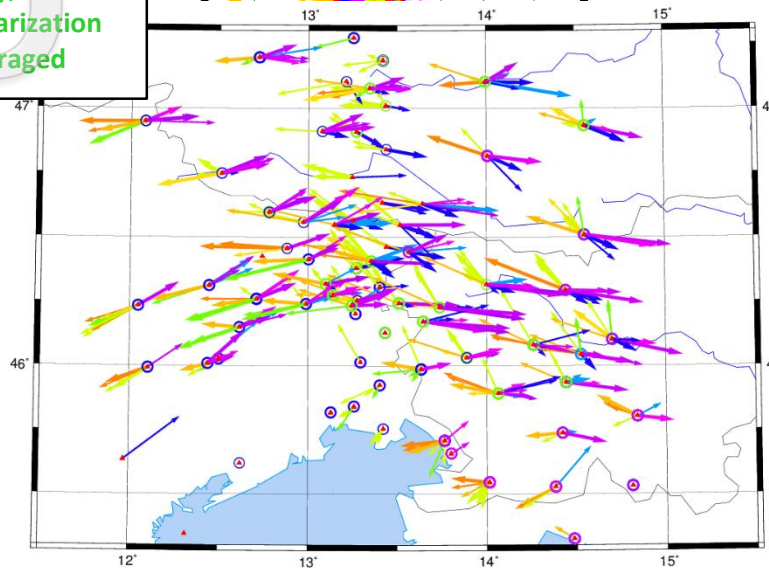**Azimuths and delay times of fast shear-wave polarizations evaluated in the LQT coordinate system**

Shear-wave splitting presented in a standard way, the fast shear-wave polarization azimuths are averaged

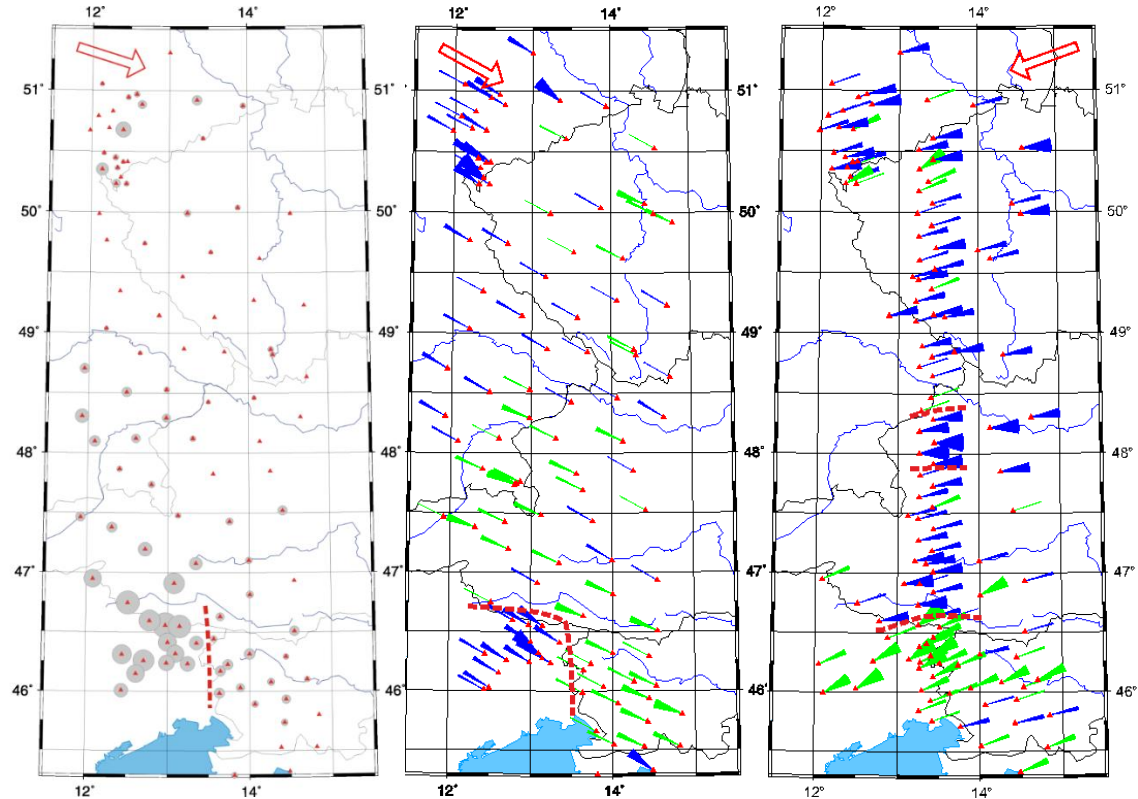Splitting variations with back-azimuths and linear and elliptical PMs from opposite directions indicate complex anisotropy structure, e.g., with a **dipping symmetry axis**.

SK(K)S
1 sec

Regional domains seen by SKS particle motions

Particle motion width
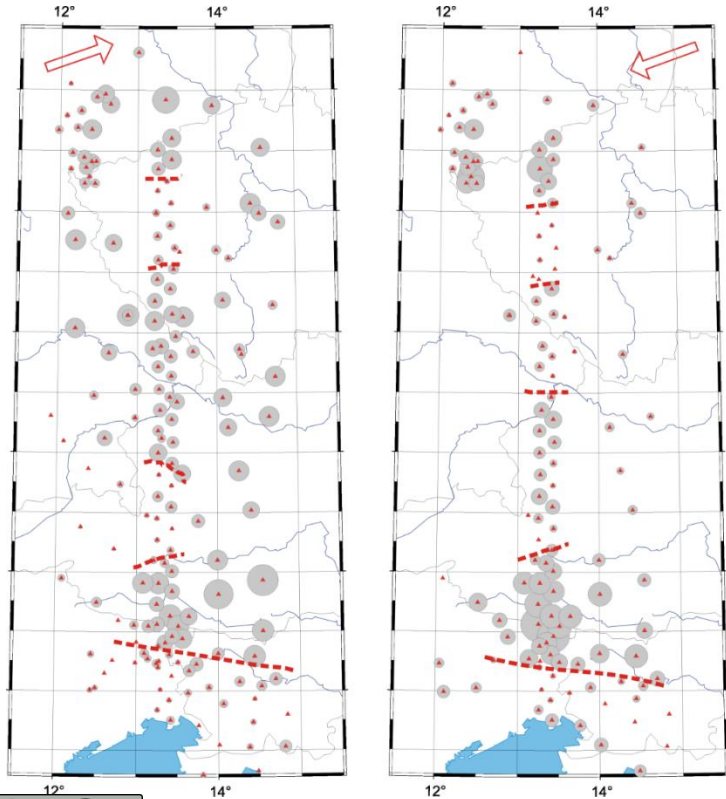
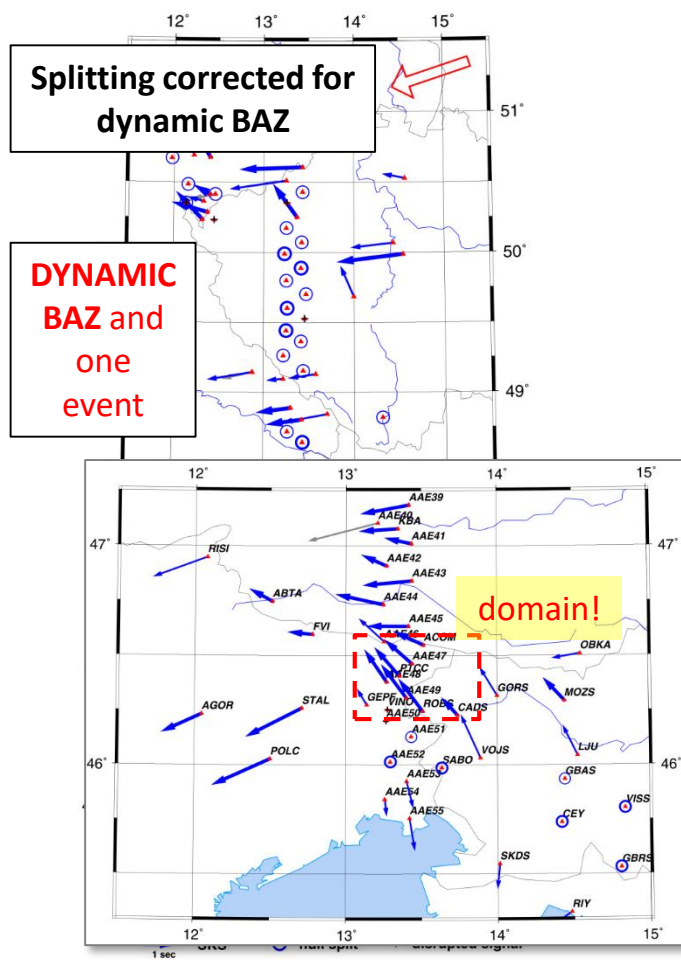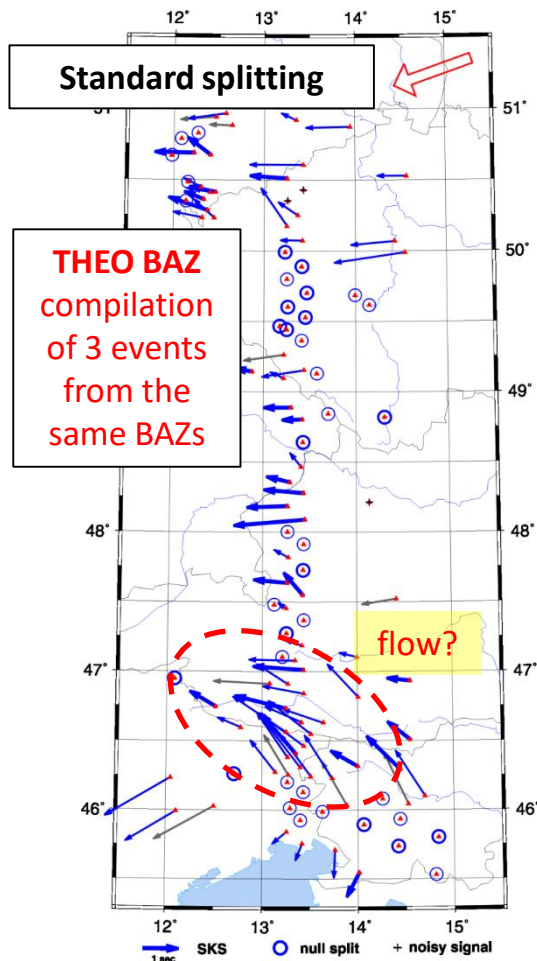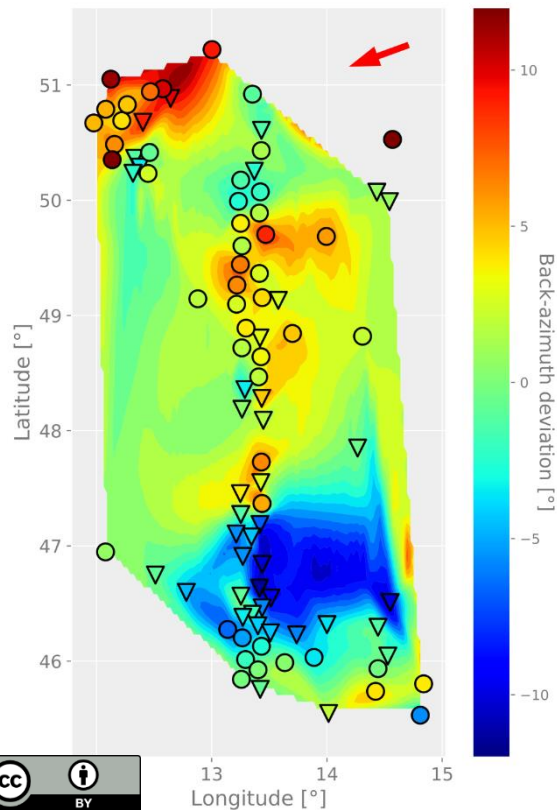Particle motion deviation

SKS splitting corrected for dynamic back-azimuths

Differences between dynamic and theoretical back-azimuths

Standard splitting

THEO BAZ compilation of 3 events from the same BAZs

flow?

Splitting corrected for dynamic BAZ

DYNAMIC BAZ and one event

domain!

Conclusions

➢ We prepared an **automatic waveform selector for core-mantle refracted shear waves**. The procedure includes a signal pre-processing, detection and qualification of near seismic phases and a careful wave selection itself with respect to edges and rapid changes in a wave's particle motion (PM). The automatic selector checked about 700 events, 32 events were found with good XKS signals at some stations, and 22 events with the good signals at most stations.

➢ We **improved a method for determination of sensor orientations** from Rayleigh-wave polarizations. Automatic procedures were tested on data from 187 permanent and temporary stations located in the area of the AlpArray project.

➢ **PM of shear-wave** allows to follow regional variations of mantle structure even for waves with weak signals on the T component (narrow PM). Moreover, it is **invariant** to sensor mis-orientations and effects connected with dynamic back-azimuths.

➢ Corrections for sensor mis-orientations and differences between dynamic and theoretical back-azimuths enhance **resolution** of evaluated splitting parameters.

➢ Distinct regional variations along the AlpArray-EASI line imply **complex domain-like architecture** of the south-central part of the European plate.