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Automated analysis of SKS shear-wave splitting for regional seismic networks

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Seismic anisotropy is a characteristic feature of the upper mantle. It may be caused either by present asthenospheric mantle flow or by frozen signatures of former deformation and stress conditions in the lithosphere. Upper mantle anisotropy can be detected and analysed by shear-wave splitting of distinct wave-types, mainly SKS and SKKS phases, of teleseismic earthquakes in the distance range from about 90 to 130 degrees.

Today more and more waveform data are available by enlargement of seismic networks. For example the German Regional Seismic Network (GRSN) is delivering more than 14 years of continuous data. The number of earthquakes between magnitude 5.0 and 8.4 and adequate distance range is higer than 5.300.

Manual analysis is quite time-consuming: selection of events with sufficient energy at the SKS phase, extraction of the data, choice of proper filter and clipping the best window for inversion. So former investigations for Germany (e.g. Brechner et al. [1998], Vinnik et al. [1994]) based only upon data of the first years of the GRSN (up to 1994) or on subsets of stations and small time spans. The authors found considerable splittings for most of the stations. For some of the stations the direction of the fast axis of the anisotropic mantle material is in agreement with directions of tectonic units, boundaries and stress directions. Others show variations in respect to back azimuth indicating complex anisotropy conditions (e.g. multi-layer) or the influence of heterogeneities.

Our program framework combines reliable FK-methods and correlates to the Harvard moment-tensor database. Thereby, we are able to select earthquakes with sufficient energy without using any picking algorithm. Also all other steps for determination of the splitting parameters (angle of fast axis and delay time) are fully automated. In background the “Seismic Handler” is used via a python gateway. So it is possible, to analyse larger datasets in a repeatable way.

By using multiple servers via network and multi-threading software we take advantage of up-to-date multi-core computer architectures to achive a high processing speed. Nearly Instantaneous we gain inversion results of many window lengths, positions and even several filter intervals.

In our poster we will present this method, its limitations and applications to synthetic and real datasets.