EGU2020-2810
https://doi.org/10.5194/egusphere-egu2020-2810
EGU General Assembly 2020

The mantle flow below the Alps from isolated mantle anisotropy based on differential Ps – XKS Splitting

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SKS-splitting measurements in the European Alps show an anisotropic fast axes parallel/subparallel relative to the mountain-belt. This indicates a mantle flow with a rotational component according to the orogeny under the assumption that the fast axes directly reflect the flow direction. This might be misleading due to a possible crustal contribution of anisotropy. Therefore, we isolate the crustal anisotropy using an improved receiver function method that accounts for anisotropic and structural properties.

The analysis for the crustal anisotropy is based on the stacking method proposed by Kaviani & Rümpker (2015). We modify their approach by introducing a time-selective splitting analysis of the crustal Ps- and PpPs-phases. The stacking is performed to the phases after correction of the anisotropic effect according to the model parameters H, the crustal thickness, κ, the P-to S-wave velocity ratio, a, the percentage of anisotropy and φ, the fast axis orientation.

The Alps show a considerable Moho-topography due to its mountain root and its complex tectonic history. This can significantly deflect the crustal phases introducing a dominating appearance in the receiver functions. We therefore analyse for a dipping interface (not accounting for anisotropy) and then use an improved model in our analysis to infer the anisotropic properties of the crust.

Knowing the crustal anisotropic contribution we correct for this effect on the XKS-waveforms to isolate the anisotropy of the mantle. The remaining splitting shows an improved approximation of the flow patterns in the asthenosphere, while complexities might still imply an effect of the lithospheric mantle.

We apply our approach to stations of the AlpArray network resulting in a detailed distribution of the crustal anisotropy in the European Alps and show first results for the isolated mantle anisotropy from the corrected XKS-waveforms and the crustal anisotropy from the receiver-function analysis.