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The thermal field across the Alpine orogen and its forelands and the relation to seismicity

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The Alpine orogen and its forelands comprise a multitude of crustal blocks from different tectonic providences and different physical properties. This implies that the thermal configuration of the lithosphere would also be expected to vary significantly throughout the region. Temperature is a key controlling factor for rock strength via thermally activated creep and it exerts a first order influence on the depth of the brittle-ductile transition zone, the lower bound to the seismogenic zone and the spatial distribution of seismicity. Here we present new results from INTEGRATE, a project in the DFG priority program Mountain Building in 4 Dimensions, as part of the AlpArray initiative, which aims to gain a better understanding of the structure, temperature and rheology of the crust and the uppermost mantle beneath the Alps and their forelands using multiple 3D modelling techniques. The overall goal is to test different hypotheses on the configuration of the lithosphere and its relation to the distribution of deformation and related seismicity in the Alpine region. We build on previous work of a 3D density differentiated structural model of the region that is consistent with deep seismic data and gravity, to calculate the 3D conductive steady state thermal field of the Alps and their forelands. The model is unique in using different thermal parameters for different tectonic domains and is validated with a dataset of wellbore temperatures from across the region. Comparing recorded seismicity to the calculated thermal field we find a systematic clustering of the deep seismic activity that correlates with different isotherms within individual crustal blocks, reflecting the presence of different dominant lithologies. These inferred lithologies in conjunction with the calculated temperatures and the previous 3D density-structural model of the region, can be used to shed light on the lateral changes in crustal strength within the Alps and their forelands, helping to explain the observed patterns of deformation.