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Mass distribution and thermal field across the Alpine orogen and its forelands

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Although crustal and sub-crustal structures in the Alps are some of the best studied of any orogen in the world, different hypotheses still exist regarding plate architecture and the nature of the subduction system. Additionally, rheological configurations of the different crustal units and of the lithospheric mantle, isostasy in the orogen-foreland system, and variations of flexural rigidity along and across the mountain belt are, at the present-day, poorly constrained with relation to spatial patterns of seismicity and deformation. The primary goal of INTEGRATE, a project in the DFG priority program Mountain Building in 4 Dimensions, a part of the AlpArray initiative, is to provide insights into these questions by integrating different 3D modelling techniques. Here we present a gravity constrained, 3D, density differentiated, structural model of the Alps and their respective forelands derived from integrating numerous existing geological and geophysical datasets. Results indicate the existence of lateral heterogeneities within the crust of the studied area, particularly in regards to the difference in thickness and density of the European and Adriatic crusts. Within the plates, some density heterogeneities correspond to well-studied tectonic features such as the Vosges, Black Forest and Bohemian massifs, along with the Ivrea geophysical body. However, in keeping with similar modelling works, the location of these density contrasts do not always correspond to present day tectonic structures, instead indicating older, inherited crustal features. A positive correlation between these inherited crustal density contrasts and present day deformation maps of the region was identified, a trend noted here for the first time. Additionally, we used the 3D density model together with information on seismic velocities to derive lithologies for the different crustal units and calculate the 3D conductive field of the system. As temperature is a key controlling factor for rock strength, we also assess the correlation of temperature variations and deformation within the region.