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The lithospheric-scale 3D structural configuration of the North Alpine Foreland Basin constrained by gravity modelling and the calculation of the 3D load distribution

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The North Alpine Foreland Basin is situated in the northern front of the European Alps and extends over parts of France, Switzerland, Germany and Austria. It formed as a wedge shaped depression since the Tertiary in consequence of the Euro – Adriatic continental collision and the Alpine orogeny. The basin is filled with clastic sediments, the Molasse, originating from erosional processes of the Alps and underlain by Mesozoic sedimentary successions and a Paleozoic crystalline crust. For our study we have focused on the German part of the basin.
To investigate the deep structure, the isostatic state and the load distribution of this region we have constructed a 3D structural model of the basin and the Alpine area using available depth and thickness maps, regional scale 3D structural models as well as seismic and well data for the sedimentary part. The crust (from the top Paleozoic down to the Moho (Grad et al. 2008)) has been considered as two-parted with a lighter upper crust and a denser lower crust; the partition has been calculated following the approach of isostatic equilibrium of Pratt (1855). By implementing a seismic Lithosphere-Asthenosphere-Boundary (LAB) (Tesauro 2009) the crustal scale model has been extended to the lithospheric-scale. The layer geometry and the assigned bulk densities of this starting model have been constrained by means of 3D gravity modelling (BGI, 2012). Afterwards the 3D load distribution has been calculated using a 3D finite element method.
Our results show that the North Alpine Foreland Basin is not isostatically balanced and that the configuration of the crystalline crust strongly controls the gravity field in this area. Furthermore, our results show that the basin area is influenced by varying lateral load differences down to a depth of more than 150 km what allows a first order statement of the required compensating horizontal stress needed to prevent gravitational collapse of the system.

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