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Contemporary tectonic behavior of the northern Upper Rhine Graben: a combined approach of 3D Finite Element modeling and geomorphology

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This study aims towards a better understanding of the contemporary tectonic behavior of the northern Upper Rhine Graben (URG), effects of tectonics on landscape evolution and the reactivation potential of key local structures using 3D Finite Element (FE) modeling and techniques used in geomorphology (terrace mapping, analysis of morphology). A multi-scale FE approach is used addressing: (1) contemporary kinematics of the northern URG and surroundings, and (2) role of 2^{nd} order structures (i.e. graben interior faults) to URG kinematics. For this multi-scale approach an initial regional scale model covering the entire URG and surrounding morpho-tectonic blocks was used to simulate the far field boundary conditions affecting the URG system. The results of this initial model have been evaluated against available calibration data (in-situ stress measurements and basin subsidence). A detailed local scale model of the northern URG, driven by boundary conditions extrapolated from the final deformation state of the regional model, was then used to demonstrate the contribution of 2^{nd} order structures to the kinematic behavior.

In order to gain more detailed information on the neotectonic activity the geomorphological records of fault movements were studied on the basis of fluvial terrace mapping, morphological fault mapping and the determination of the characteristics of the drainage system. Comparing these results shows that areas of potentially higher Quaternary tectonic activity and potentially active faults can be identified in the northern URG. First results indicate regions of recent uplift and subsidence. The results of this

geomorphological study were then used to benchmark the FE modeling results, including the comparison of the modeled surface displacement and fault kinematics with the relative vertical motions and sense of fault movements obtained from displaced terraces and disturbed stream profiles. This benchmarked model has then enabled the identification of the reactivation potential of key local structures.