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# A segment model for surface rupture scenarios in the eastern Rhine Graben Boundary fault (Upper Rhine Graben, Germany)

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The eastern Rhine Graben Boundary fault (eastern RGBF) constitutes the eastern margin of the Upper Rhine Graben (URG), the most seismically active area in the plate interiors of Europe. Our recent paleoseismic studies have revealed Late Pleistocene-Holocene surface-rupturing paleoearthquakes with magnitudes M 6–6.5 and cumulative surface displacements in the order of 1–1.2 m vertically and 4–6 m horizontally. Based on the empirical relationships of Wells and Coppersmith, these parameters suggest that the plausible rupture scenarios of those paleoearthquakes are linked to shorter fault segments within the 300 km long eastern RGBF rather than an entire rupture of the fault. Up to date, segmentation on faults of the URG has yet to be evaluated. We aim to define fault segments within the eastern RGBF and their relative tectonic activity to understand how deformation is distributed along the marginal faults and within the graben. To achieve this, we integrate seismicity data, morphotectonic observations (from SRTM, TanDEM-X and LiDAR-based DEMs), geology (Plio-Pleistocene sediment thickness), and interpretation of commercial seismic lines.

We define up to seven segments of varying lengths based on geometric and structural fault trace discontinuities (bend, gaps, and changes in strike and dip) and the occurrence and degradation state of tectonic landforms (triangular facets, beheaded channels, hanging valleys and offset alluvial fans), which we also take into account to define the relative level of tectonic activity at each segment. The most active segments are the South-Kraichgau and Freiburg segments, with potential magnitudes of M 7–7.5 (including the historical M 6.7 Basel eq of 1356). The northern area, comprising the Frankfurt-Darmstadt and Odenwald segments, constitute presently a seismic gap with quiescence in historical and instrumental seismicity but with tectonic expression in the landscape and thickest Late Tertiary-Pleistocene deposits, suggesting a potential hazard. Our results provide a basis to propose plausible rupture scenarios for the eastern RGBF for future PSHA studies.