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New seismotectonic regionalization for Germany: comparison with existing regionalizations

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We have created a new seismotectonic regionalization for Germany including a 200 km zone around its borders, based on a new concept which initially processes geological information separately from modern seismicity. The identification of a region as a distinct seismotectonic unit is estimated from past deformation, not the present one as represented by earthquakes. This has been done by analyzing fault density and displacements separately for six time slices from 300 Ma to the Present. The final regionalization results from overlaying the six deformation intensity maps and contrasts regions that deformed either repeatedly or very strongly in the geological past with others that suffered very little deformation. The new regionalization is significantly different from existing regionalizations. The existing ones mostly relied on modern seismicity for defining areas while using geological contacts of varying type (surface traces of faults, but also erosional edges of stratigraphic units as represented on geological maps) to trace boundaries.

The new, geology-based regionalization comprises comparatively few regions. Ubiquitous small faults (cm- to m-displacements) in the geological record suggest that earthquakes of low magnitude can occur anywhere and need not be tied to large faults. Our regionalization concurs with earlier ones in identifying the Cenozoic rifts – Upper Rhine Graben, Lower Rhine Graben and Eger Rift – as zones of increased hazard. A 100-150 km wide, NW-SE-trending belt of intense Mesozoic deformation runs across northwestern and central Germany from the Emsland to the Erzgebirge where it bifurcates into two branches that continue along the borders of the Bohemian Massif. This belt coincides reasonably well with the relatively sparse earthquakes in central and northern Germany. The Tornquist Fault Zone running NW-SE from northern Denmark to Bornholm is another belt of increased past deformation and elevated seismic activity on the northeastern border of our region. Areas of particularly low past deformation comprise the Brabant Massif, the Rhenish Massif and Münsterland Basin east of the Lower Rhine Graben, the Alpine foreland south of the Danube river and the Bohemian Massif southeast of the Eger Rift. Earthquake clusters occurring in stable areas such as the Brabant Massif or the Swabian Jura highlight geologically unexpected events. They can be added to the regionalization as separate zones or accounted for via a logic tree. They should not be used to assign increased hazard to the larger regions of the geology-based regionalization.

