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GIA induced intraplate seismicity in northern Central Europe

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Though northern Central Europe is regarded as a low seismicity area (Leydecker and Kopera, 1999), several historic earthquakes with intensities of up to VII affected the area in the last 1200 years (Leydecker, 2011). The trigger for these seismic events is not sufficiently investigated yet. Based on the combination of historic earthquake epicentres with the most recent fault maps we show that the historic seismicity concentrated at major reverse faults. There is no evidence for significant historic earthquakes along normal faults in northern Central Europe. The spatial and temporal distribution of earthquakes (clusters that shift from time to time) implies that northern Central Europe behaves like a typical intraplate tectonic region as demonstrated for other intraplate settings (Liu et al., 2000) We utilized Finite Element models that describe the process of glacial isostatic adjustment to analyse the fault behaviour. We use the change in Coulomb Failure Stress (dCFS) to represent the minimum stress required to reach faulting. A negative dCFS value indicates that the fault is stable, while a positive value means that GIA stress is potentially available to induce faulting or cause fault instability or failure unless released temporarily by an earthquake. The results imply that many faults in Central Europe are postglacial faults, though they developed outside the glaciated area. This is supported by the characteristics of the dCFS graphs, which indicate the likelihood that an earthquake is related to GIA. Almost all graphs show a change from negative to positive values during the deglaciation phase. This observation sheds new light on the distribution of post-glacial faults in general. Based on field data and the numerical simulations we developed the first consistent model that can explain the occurrence of deglaciation seismicity and more recent historic earthquakes in northern Central Europe. Based on our model, the historic seismicity in northern Central Europe can be regarded as a kind of aftershock sequence of the GIA induced-seismicity.

References

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