



Spatial b-value variations in the Upper Rhine Graben

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The natural seismicity of the Upper Rhine Graben (URG) is of growing interest for science and society, since the management of deep geothermal power plants requires local hazard assessment. The availability of new bulletin data and the combination of catalogues from Germany, France and Switzerland allows us to analyse the spatial changes in the magnitude-frequency distribution along the Graben axis in detail.

We derive magnitude conversions between the different bulletins to obtain a uniform earthquake catalogue and decluster the data to extract fore- and aftershocks resulting in a Poissonian event distribution. Since the density of monitoring seismometers has improved over time, we determine several intervals of magnitude completeness. Generally, our catalogue is complete for magnitudes $ML \geq 2.0$ since 1982 for the entire URG. To incorporate high magnitude events it is essential to use historic earthquake data. Those magnitudes are estimated by their macroseismic intensity distribution, and thus, they have a high uncertainty compared to instrumental magnitudes. We show that historic earthquake magnitudes are overestimated by 0.4 magnitude units in the URG.

We apply a spatial window on the final dataset and move it along the Graben axis. For each set of 50 events we determine local variations of the magnitude frequency distribution after Gutenberg-Richter by a maximum likelihood estimation. The seismicity rate for $ML \geq 2.0$ varies between 2 per year per 1000 km² in the southern URG and 0.2 per year per 1000 km² in the northern URG. The b-values vary between 0.8 and 1.4 with the highest values around Freiburg, showing a high variability of the magnitude distribution in the URG. Additionally, we examine the hypocentral depth distribution along the Graben, which results in a seismically active upper and lower crust in the southern and northern parts, separated by the central part with missing seismicity in the lower crust. According to the spatial distribution of b-values and seismogenic depths we discriminate four zones of differing seismicity that cover the regions around Basel, Freiburg, the central and the northern URG.