

## Battles or earthquakes? 1D versus 3D hybrid modelling for the archaeological site of Augusta Raurica, Switzerland

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Numerical modelling using 1D and 3D techniques has been applied to the Roman city of Augusta Raurica, located East of Basel, Switzerland. One important topic of the city's history concerns the hypothesis of an earthquake striking the city in the middle of the third century A.D. The 3D finite-difference (FD) method computes the full 3D wave field by a hybrid approach on an irregular grid. Topography is included in the modelling. The 1D-matrix method is used to model the P-SV response for 195 x 213 1D structures extracted from the 3D computational model by retrieving a vertical profile under each surface point. The incoming wave field is realized by a vertically incident planar wave for a family of sources. The established three-dimensional velocity structure for the studied area comprises (as geophysical bedrock) a limestone unit (Muschelkalk), tertiary sediments (Keuper), and Quaternary gravel layers. The area is characterized by a pronounced topography. The soft-sediment cover is typically not thicker than 50m.

Pseudo-spectral response amplification (PSAA, 5%-damping) for frequencies between 0.1Hz and 10Hz shows values up to factor 4.6 in the 1D case and up to factor 9.1 in the 3D computations. The locations of the largest amplifications differ between the 1D and 3D method. Thus the 3D vs. 1D amplification is expressed by a ratio of about 2.5, usually at the top of the most pronounced topographic features within the Quaternary formation.