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## Developing an integrated 3D geological-seismological model at urban scale in Basel, Switzerland

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Assessment of seismic risk at a local scale is fundamental to the adoption of efficient risk mitigation strategies for urban areas with spatially distributed building portfolios and infrastructure systems. An important component of such a study is to estimate the spatial distribution of the expected seismic ground motion induced by site response. The current work presents a detailed seismic site response study at urban scale, performed in the context of developing an earthquake risk model for the Swiss canton of Basel-Stadt. Different studies undertaken over last two decades in the area concluded that unconsolidated sediments were responsible for inducing resonances and significant amplification of seismic waves over a range of frequencies pertinent to engineering interest. Therefore, we make a step forward in this study by attempting to develop a three-dimensional (3D) integrated geological-seismological model, which will explicitly account for the complex geological conditions at the surface and at depth. Thanks to the past projects, there is an abundance of geological, geophysical and seismological data for Basel. Earthquake recordings are available from an operating network of more than 20 permanent stations as well as from several former and six current temporary stations. Ambient noise measurements are available from several hundred single stations and more than 25 passive seismic arrays. In addition, a number of active seismic measurements and borehole logs are also available. An updated 3D model of subsurface geological structure of the area has been provided by the team of Applied and Environmental Geology (AUG) of University of Basel.

We use dispersion characteristics of surface waves from ambient vibration array data for imaging subsurface shear wave velocity ( $V_s$ ) profiles. We apply a novel approach based on a Multizonal Transdimensional Inversion (MTI), formulated in the Bayesian probabilistic framework, in order to retrieve 1D  $V_s$  profiles from ambient vibration arrays. A joint inversion of multimodal Rayleigh and Love wave dispersion curves along with Rayleigh wave ellipticity curve is performed. This is a major improvement as such joint inversions were performed only for few sites in this area. The key advantages of MTI are that the model complexity in terms of number of layers and distribution of associated parameters are determined self-adaptively from the measured data, and model uncertainties can be assessed quantitatively. Additional constraints on the depths of intermediate layers are drawn from the 3D geological model and boreholes for the multizonal inversion. Moreover, the solution of the transdimensional Bayesian inversion enables reconstruction of the

posterior probability density function of prior model parameters and their properties from the ensemble of inverted models. Hence, the model uncertainty can be duly propagated from dispersion curves to Vs profiles. The initial results seem very promising in resolving the interfaces corresponding to major velocity contrasts, especially in the complex sedimentary structure of the Rhine Graben formation. The ongoing analysis will also better identify composition, geometry, thickness and topography of the surficial unconsolidated sediments as well as the underlying more consolidated layers, which will form the basis for future numerical simulations of earthquake ground motion.