Online Resource 3 of "A site amplification model for Switzerland based on site-condition indicators and incorporating local response as measured at seismic stations" by Paolo Bergamo, Donat Fäh, Francesco Panzera, Carlo Cauzzi, Franziska Glueer, Vincent Perron, Stefan Wiemer; Bulletin of Earthquake Engineering.

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This Online Resource 3 describes the comparison between the national amplification model from this study and three existing local (city-scale) Fourier soil amplification models: Lucerne, Sion, and Visp.

We present here the comparison between the national amplification model from this study and three existing local (city-scale) Fourier soil amplification models: Lucerne (Janusz et al., 2022), Sion (Perron et al., 2022b) and Visp (Panzera et al., 2022: Fig OR3.1a). These soil response layers were obtained by applying different techniques: for two of them (Sion and Lucerne) the prediction of amplification is based on its correlation with a dense network of single-station ambient noise measurements (the correlation method is the hybrid site-to-reference spectral ratio, Perron at al., 2018). As for Visp, the soil amplification was derived by reconstructing a 3D geophysical model of the subsurface based on geological information and geophysical measurements (Panzera et al., 2022). These local models are therefore based on extensive, locally acquired geophysical datasets and they are therefore considered on a higher degree of reliability than the global national model issued by this study; besides, they generally achieve a higher spatial resolution.

The comparison national versus local models is biased by the fact that in the latter ones the soil amplification is modelled in the Fourier domain, while in the national model it is expressed in PSA (pseudo-spectral acceleration); therefore, the comparison cannot be as rigorous as for the city of Basel (see section 7.0 of the main text of the manuscript) but it can nevertheless provide an indication of compatibility between the two models. The comparison was performed for the city-scale Fourier amplification maps at 1.00, 1.67 and 3.33 Hz, juxtaposed with the national maps for PSA(1.0s), PSA(0.6s) and PSA(0.3s) amplification, respectively (see examples in Fig. OR3.1b-j).

Overall, as shown by Table OR3.1, the mean cell-by-cell difference (in $\log_{10}$ scale) local minus national model is generally close to 0 for all areas and periods, suggesting that no systematic bias exists between the two datasets. The absolute distance between the two models is measured by the root mean squared difference (RMSD, Table OR3.1); globally (all models, all periods) the RMSDs range between 0.198 and 0.345 $\log_{10}$ units with a median of 0.271. These values are generally higher than those obtained for the area of Basel (RMSD = 0.173 and 0.235 $\log_{10}$ units for PSA(1.0s) and PSA(0.3s), respectively; see Table 3 in the main body of text); we ascribe this higher discrepancy to the inconsistency in the modelling of soil response (Fourier versus PSA). The highest degree of discrepancy is met for Lucerne (highest RMSDs in Table OR3.1); most of the sedimentary basin of Lucerne is in fact covered by fine-grained sediments (LG1), a lithotype represented in our study by the lowest number of stations (11, see Table 1 and Fig.3a in the main body of text), hence possibly less robustly constrained than other lithologies. As observed for Basel (section 7.0 in the main body of text), disagreement between predicted amplification factors are preferentially located at the borders between different lithological units, possibly because of the inevitably large scale of the geological map used in this study (1:500000; Swisstopo 2005); see for instance in Fig. OR3.1g and OR3.1h the areas of larger difference at the interface between the Rhone valley bed (where Sion and Visp are located) and the surrounding mountain flanks.

When the difference local – national amplification is collated with the overall variability φ estimated for the latter ($=\sqrt{\varphi_{S2S}^2 + \varphi_{SS}^2}$), the majority of the overlap area falls in the range +/- φ and the RMSD normalized by φ is generally close to 1 (Table OR3.1; for the higher values of Lucerne, see earlier comments).

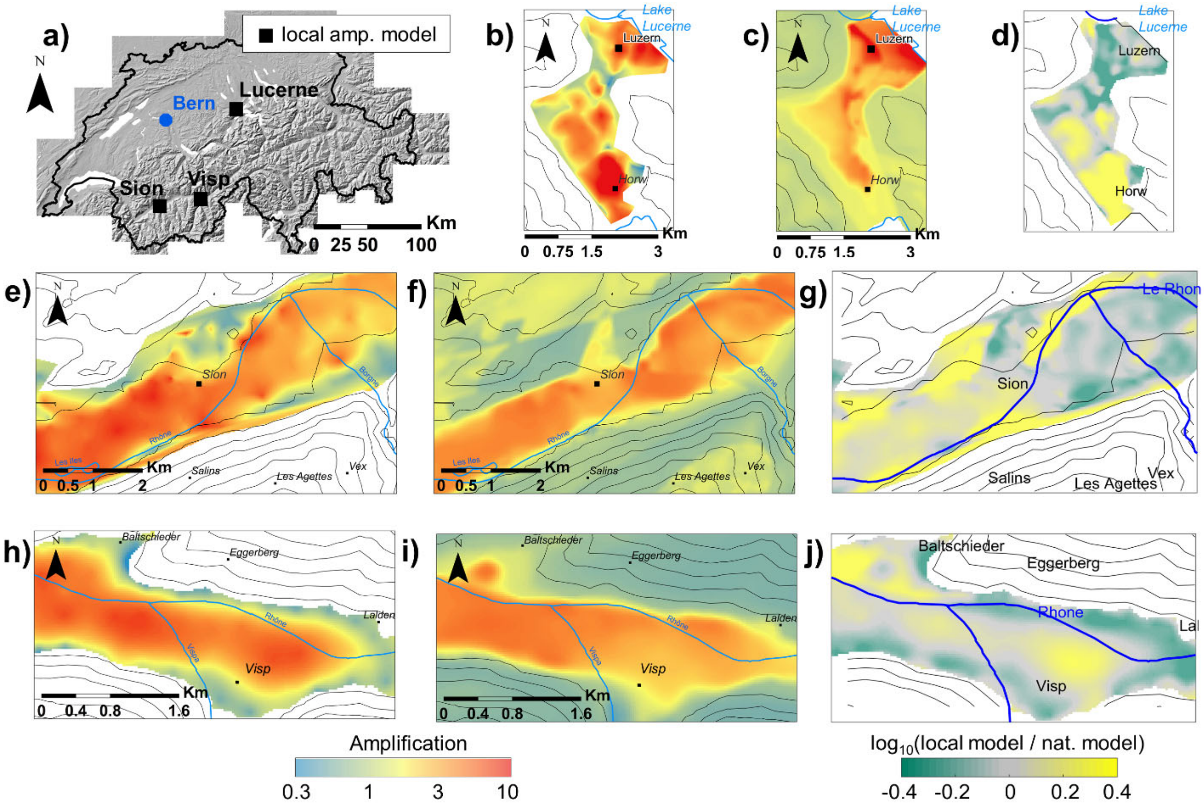

Fig.OR3.1 *Comparison of national ground motion amplification model (this study) with three local (Fourier) amplification models for the cities of Lucerne (Janusz et al., 2022), Sion (Perron et al. 2022), and Visp (Panzera et al. 2022). a) location of cities. b-d) Lucerne: comparison between local Fourier amplification model at 1Hz (b) and national PSA(1.0s) amplification map for the same area (c); in (d) we display the difference (in log_{10} scale) between the two models. e-g) Sion: comparison between local Fourier amplification model at 1Hz (e) and national PSA(1.0s) amplification map for the same area (f); in (g) we display the difference (in log_{10} scale) between the two models. h-j) Visp: comparison between local Fourier amplification model at 1Hz (h) and national PSA(1.0s) amplification map for the same area (i); in (j) we display the difference (in log_{10} scale) between the two models.*

Table OR3.1 *Summary statistics for the comparison between existing city-scale Fourier amplification models and the national model from this study*

Parameter	Mean difference in amplification ($\log_{10}$ units)	RMSD in amplification ($\log_{10}$ units)	Normalized RMSD in amplification (-)
Definition	$\overline{\boldsymbol{log_{10}}\left(\frac{\boldsymbol{local\ model}}{\boldsymbol{nat.model}}\right)}$	$\sqrt{\overline{\left[\boldsymbol{log_{10}}\left(\frac{\boldsymbol{local\ model}}{\boldsymbol{nat.model}}\right)\right]^{2}}}$	$\sqrt{\overline{\left[\frac{\boldsymbol{log_{10}}\left(\frac{\boldsymbol{local\ model}}{\boldsymbol{nat.model}}\right)}{\boldsymbol{nat.model}\ \boldsymbol{\varphi}}\right]^{2}}}$
Visp (T=1.0s)	-0.005	0.198	0.778
Visp (T=0.6s)	0.186	0.263	1.092
Visp (T=0.3s)	0.121	0.222	0.988
Lucerne (T=1.0s)	0.053	0.333	1.501
Lucerne (T=0.6s)	-0.005	0.345	1.267
Lucerne (T=0.3s)	-0.014	0.292	1.162
Sion (T=1.0s)	0.106	0.270	1.262
Sion (T=0.6s)	-0.140	0.278	1.140
Sion (T=0.3s)	-0.096	0.271	1.049

References

Janusz P, Perron V, Knellwolf C, Fäh D (2022) Combining Earthquake Ground Motion and Ambient Vibration Recordings to Evaluate a Local High-Resolution Amplification Model—Insight from the Lucerne Area, Switzerland. Front. Earth Sci. 10:885724

Panzera F, Alber J, Imperatori W, Bergamo P, Fäh D (2022) Reconstructing a 3D model from geophysical data for local amplification modelling: The study case of the upper Rhone valley, Switzerland. Soil Dynamics and Earthquake Engineering 155:107163

Perron V, Gélis C, Froment B, Hollender F, Bard P-Y, Cultrera G, et al. (2018) Can Broad-Band Earthquake Site Responses Be Predicted by the Ambient Noise Spectral Ratio? Insight from Observations at Two Sedimentary Basins. Geophysical Journal International 215(2):1442–1454

Perron V, Bergamo P, Fäh D (2022) Site Amplification at High Spatial Resolution from Combined Ambient Noise and Earthquake Recordings in Sion, Switzerland. Seismological Research Letters 93(4):2281–2298

Swisstopo, Swiss Federal Office of Topography (2005) Geological Map of Switzerland 1:500000 (GK500). https://www.swisstopo.admin.ch/en/geodata/geology/maps/gk500/vector.html accessed 25.10.2022