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[Perron, Vincent](#) ; [Bergamo, Paolo](#); [Panzera, Francesco](#) ; [Hammer, Conny](#); [Fäh, Donat](#)

**Publication date:**

2020-11

**Permanent link:**

<https://doi.org/10.3929/ethz-b-000479032>

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## **EMPIRICAL EARTHQUAKE'S SITE RESPONSE ASSESSMENT IN THE SION AREA, SWITZERLAND**

Vincent Perron\*, Paolo Bergamo\*, Francesco Panzera\*, Conny Hammer\* & Donat Fäh\*

\* Swiss Seismological Service (SED), ETH Zürich, Sonneggstrasse 5, CH-8092 Zürich, Switzerland ([vincent.perron@sed.ethz.ch](mailto:vincent.perron@sed.ethz.ch))

The Sion area in Canton Valais is one of the most seismically active areas of Switzerland. Moreover, the thick and soft sedimentary deposits of the Rhône valley are prone to increase significantly both the amplitude and the duration of the seismic signal. This study aims to evaluate the so-called “site effects” in Sion area in order to better define the seismic hazard locally. It is carried out in the framework of the “Site Response” module of the “Earthquake Risk Model for Switzerland”.

Five long-term seismic stations were deployed in addition to four permanent stations of the Swiss Strong Motion Network (SSMNet) already present in the area of Sion. Several tens of mostly local and small magnitude earthquakes were recorded successfully at these nine stations, including those of the 2019 seismic cluster north of Sion. This allows the use of the Empirical Spectral Modelling (ESM) approach of Edwards et al. (2013) at these nine stations. This approach accounts for the source and for the propagation term of the ground motion in order to provide amplification values with respect to the Swiss rock reference (Poggi et al., 2011). The site response is also estimated locally at seven stations by performing Standard Spectral Ratios (SSR - Borchardt, 1970) with respect to two of the stations located on rock that are used as references, assuming that the source and the propagation term are similar for close stations.

In order to estimate site effects with high spatial resolution, a very dense measurement campaign was performed in 2019 in the area of Sion, along the Rhône valley from Vétroz to Saint-Leonard. Ambient vibrations were recorded for about 1h at around 300 points of a 250 m side grid. A detailed map of the fundamental frequency of resonance of the soil can be deduced from these measurements using the Horizontal-to-Vertical Spectral Ratio method (HVSr, Nakamura 1989). It helps addressing the spatial distribution of the seismic-wave resonance in the Rhône valley, and it is used to improve the resolution of the geological model locally. Moreover, we attempt to assess the site amplification with high spatial resolution at every frequency by applying the hybrid SSR techniques (SSRh - Perron et al., 2018). This approach uses the spectral ratio of ambient vibration recorded between stations located inside the sedimentary valley to estimate the spatial variation of the site response, and the classical SSR based on earthquakes recorded at few stations only to make the rock referencing. For sites where both the SSR and the SSRh could be computed, a good agreement is found between the two approaches. Moreover, the fundamental resonance frequency model, and the amplification model are consistent with the geological model proposed by Swisstopo for the area of Sion. This is confirming the validity of analysing ambient vibration to determine both the fundamental resonance frequency and the amplification function of the sites. Amplification factor up to 12 are observed for frequency higher than 0.5 Hz along the Rhône valley in the area of Sion. Such amplification of the seismic waves drastically increase the seismic hazard in some parts of the city of Sion. From the

measurements, we also propose a site for a new permanent seismic station in the SSMNet renewal project, which shows high amplifications due to shallow layers with very soft sediments, which can be found at some sites in the region of interest.

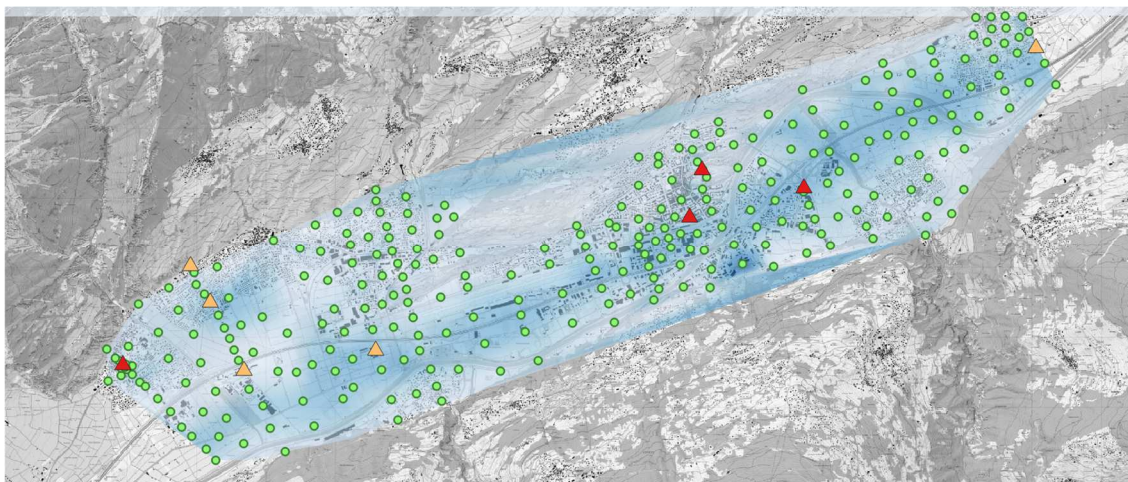


Figure 1 Map of the Sion area. The red triangles are the permanent stations of the SSMNet, the orange triangles long-term stations and the green dots represent the location of the 1h ambient vibration recording. The colormap represent the amplitude of the HVSR at 0.5 Hz which is the fundamental resonance frequency at the centre of the Rhône valley (the deeper the blue the higher the amplitude).

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