**Name:** Marco Pilz

**Institution:** Helmholtzzentrum Potsdam - Deutsches GeoForschungsZentrum

**Title of the work:** Site effect analysis by means of seismic noise and earthquake data analysis in the large urban area of Santiago de Chile

**Overall project:** Risk Habitat Megacity

**Supervisor:** Prof. Dr. J. Zschau

**Expected working time frame:** 3 years

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Situated in an active tectonic region, the densely populated urban area of Santiago de Chile with more than six million inhabitants faces significant seismic risk. Due to the dimension of the investigated area, the application of invasive procedures for a detailed analysis would lead to disproportionate costs. Therefore, other approaches (H/V method analysing both earthquake (EHV) and ambient seismic noise data (NHV) as well as the standard spectral ratio (SSR) technique) that allow to derive at least a rough classification of the soil response have to be taken into account. The results are compared in terms of predominant frequencies and amplitudes. Therefore, our contribution to the mitigation of earthquake risk includes a microzonation study using ambient seismic noise as well as EHV and SSR techniques of earthquakes at characteristic sites to validate the results.

In order to estimate the site response of several representative areas inside the city, a network composed of eight seismological stations was installed for recording earthquake signals over a period of ten weeks. 40 events with good signal-to-noise ratio have been recorded allowing a detailed analysis to both P- and S-waves. A large variability of the site response in the investigated area with respect to local geology is observed. In some parts of the basin, irrespective of the thickness of the sedimentary cover, the peak ground velocity is largely amplified with respect to a reference station installed on rock, and also the duration is increased on average by a factor of two. However, the spectral analysis of earthquake data shows that significant amplification of ground motion may also occur at frequencies higher than the fundamental one even when thick sediments are present. Using the H/V ratio applied to ambient seismic noise at the seismological stations, for most cases, we obtained an estimate of the fundamental resonance frequencies consistent with that from earthquakes. Furthermore, also NHV shapes were found to be in good agreement with those results. Nonetheless, NHV amplitudes are always smaller than those from earthquake data. The difference can be as much as a factor of two.

Additionally, measurements of seismic noise at 146 sites have been carried out in the city of Santiago de Chile to determine the fundamental frequency of the sites. NHV peaks mainly occur at low frequencies below 1 to 2 Hz, but slight amplification also affects frequencies from 2 Hz to 13 Hz. A general trend in the variation in the frequency range of amplification estimated from NHV peaks and the thickness of the sedimentary cover, known from previous gravimetric investigations, can be seen. However, differences can be explained by considering the local structure varying over short distances. With the help of an inversion procedure, the S-wave velocity profile below the sites can be derived under the constraint of the thickness of the sediments. These profiles and additional geotechnical and geophysical information can then in turn be used to derive site responses and to obtain a detailed 3D structure of the investigated area of the Santiago basin.