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Joana Martins[1,2], Anne Obermann[3], Arie Verdel[1], and Philippe Jousset[4]
[1]TNO Advisory Group for Minister of Economic Affairs and Climate/ Sustainable Geo-Energy, Utrecht, Netherlands
(joana.estevesmartins@tno.nl)
[2]Department of Geoscience and Remote Sensing, Delft University of Technology, Delft, The Netherlands (
(j.c.estevesmartins@tudelft.nl)
[3]Swiss Seismological Service, ETH Zurich, Zurich, Switzerland
[4]GFZ German Research Centre for Geosciences, Potsdam, Germany

Since the successful retrieval of surface-wave responses from the ambient seismic field via cross-correlation, noise-based interferometry has been widely used for high-resolution imaging of the Earth's lithosphere from all around the globe. Further applications on geothermal fields reveal the potential of ambient noise techniques to either characterize the subsurface velocity field or to understand the temporal evolution of the velocity models due to field operations.

Following the completion of the GeMEX[*] project, a European-Mexican collaboration to improve our understanding of two geothermal sites in Mexico, we present the results of ambient noise tomography (ANT) techniques over the Los Humeros geothermal field. We used the vertical component of the data recorded by the seismic network active from September 2017 to September 2018. The total network is composed of 45 seismometers from which 25 are Broadband (BB) and the remaining ones short-period stations. From the ambient noise recorded at the deployed seismic network, we extract surface-waves after the computation of the empirical Green's functions (EGF) by cross-correlation and consecutive stacking. After the cross-correlations, we pick both phase and group velocity arrival times of the ballistic surface-waves for which we derive independent tomographic maps. Finally, using both the retrieved phase and group velocities, we jointly invert the tomographic results from frequency to depth.

We identify positive and negative velocity variations from an average velocity between -15% and 15% for group and between -10% and 10% for phase velocities in the frequency domain. While the velocity variations are consistent for both the phase and group velocities (with expected group velocities lower than the phase velocities), the group velocity anomalies are more pronounced than the phase velocity anomalies. Low-velocity anomalies fall mostly within the inner volcano caldera, the area of highest interest for geothermal energy. This is consistent with the surface temperatures measured at the Los Humeros caldera, indicating the presence of a heat source. Finally, we compare our results with other geophysical studies (e.g geodesy, gravity, earthquake tomography and magnetotelluric) performed during the GeMEX project within the same area.

* http://www.gemex-h2020.eu/index.php?option=com_content&view=featured&Itemid=101&lang=en