Geophysical Research Abstracts
Vol. 19, EGU2017-4379, 2017
EGU General Assembly 2017

Noise source localization using Matched Field Processing: wind turbines, mofettes and geysirs.

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The Matched Field Processing (MFP) is a beamforming method, derived from ocean acoustics, that serves as a noise source localization and exploration tool in applied geophysics. Here, we present three case studies to explore the applicability of MFP in the presence of different source types, and using sensor arrays with different aperture and density.

First, we show the localization of a single wind turbine (Saxony, Eastern Germany), which acts as a point source at the surface generating continuous vibrations due to the rotation of their blades. Using 30 vertical sensors (Reftek Texans) randomly distributed within an area of approximately 50 x 50 m^2 around the wind turbine, we identified the turbine as the dominant noise source within the array. Therefore we verified that the MFP procedure gives useful results.

The second test was performed in Hartouŝov (NW Bohemia, Czech Republic). This area is characterized by several natural degassing areas of mantle-originating fluids and CO_2 (mofettes). Mofettes either appear as little sinks filled with bubbling groundwater or more extensive as vegetation anomalies. We located these mofettes, using the collapsing water bubbles as seismic noise source, and compared our results with CO_2 flux values of the same field measured by Nickschick et al. (2015). The array consisted of 130 stations in total (30 Reftek Texans, 50 Omnirecs Data-Cubes^3 and 50 Summit X-One channels) and covered an area of about 500 x 1000 m^2. Additionally to MFP, we perfomed a polarization analysis of surface waves to characterize the wave field generated by the the degassing process.

The last example is a geysering system in NE Java (Indonesia) which is called LUSI (Lumpur Sidoarjo). The geysir was surrounded by 5 stations (Trillium Compacts) arranged in a circle with about 1.5 km diameter. Here, we could successfully locate the surface position of the geysir as well as image its feeding channel to a depth of 100 m. This example shows the suitability of MFP to work with a smaller amount of stations and larger interstation distances compared to previous applications.