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Surface Non-linear Material Behaviour due to Coupling of Atmospheric Pressure and Solid Earth

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Variations in strain/stress and fluid content can change seismic velocities in the subsurface. Monitoring velocity changes, e.g. using ambient seismic noise, may thus constrain these variations as well as the material elastic properties and their non-linear behaviour. In our study we investigate variations of seismic velocity on a short time scale. We use coda wave interferometry to inspect continuous data from the GERES array (CTBTO network) in southern Germany. This results in relative seismic velocities (dv/v) that show temporal variations on the order of 10^{-4}. Spectra of the velocity time series contain strong daily and sub-daily behaviour indicating that the daily and sub-daily changes in the seismic velocity are primarily caused by the coupling of atmospheric processes and solid earth. We also note the influence of temperature changes on daily variations, but as a second-order effect. The explanatory model focuses on depth variations of the groundwater table, linking atmospheric pressure (loading and de-loading the Earth's surface) to variations in seismic velocity. Our results highlight an important environmental influence on seismic velocity that needs to be considered before seismic velocity variations can be used for inspecting fluid and stress variations in situ.

E-mail

richard.kramer@univie.ac.at

Promotional text

Studying the near-surface zone with ambient noise provides insights into how environmental effects impact the Earth. Our study shows that ambient seismology finds connections between solid earth deformation, the atmosphere and one of our most important resources: groundwater.

Oral preference format

Primary author: KRAMER, Richard (University of Vienna)

Co-authors: LU, Yang (University of Vienna); BOKELMANN, Götz (University of Vienna)

Presenter: KRAMER, Richard (University of Vienna)

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