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Short Oral Presentation:

Investigation of non-linear behavior of hard rocks using relative seismic velocity changes - a case study at the GERES array in Germany

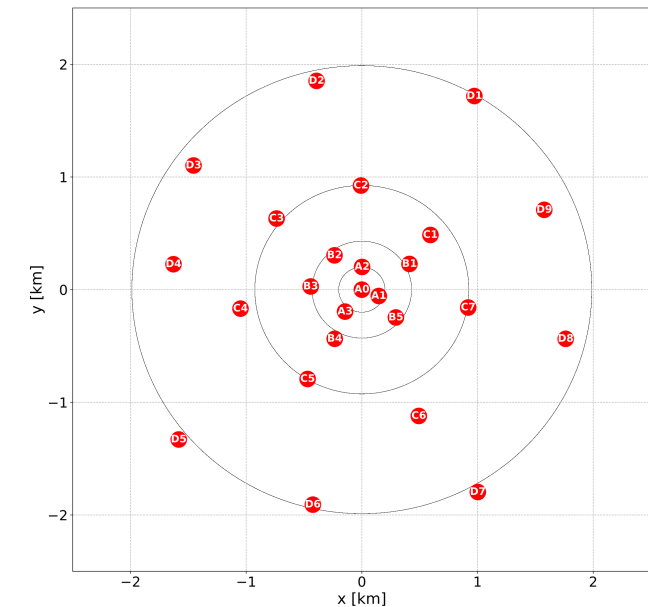
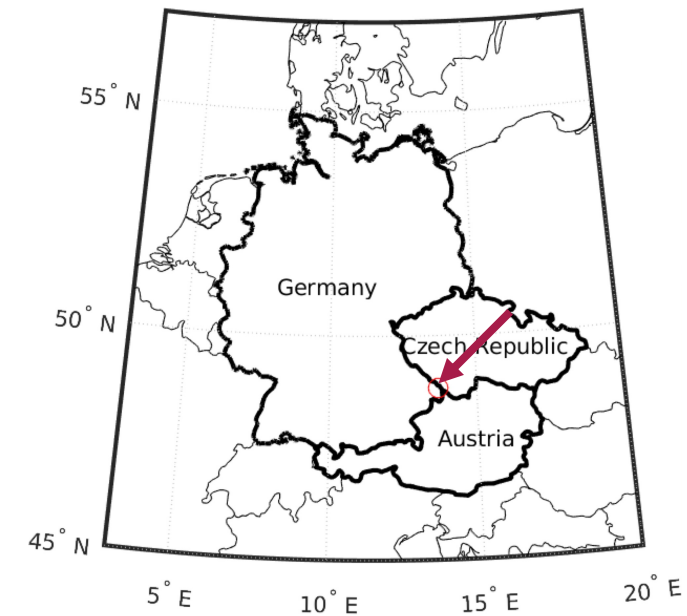
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Why GERES Array?

- permanent Array (part of the „**C**omprehensive Nuclear-**T**est-**B**an **T**reaty **O**rganization“)
- small aperture (max. 4 km) enables high temporal resolution monitoring
- far away from strong noise sources (oceans, ..)



Idea and Methodology?

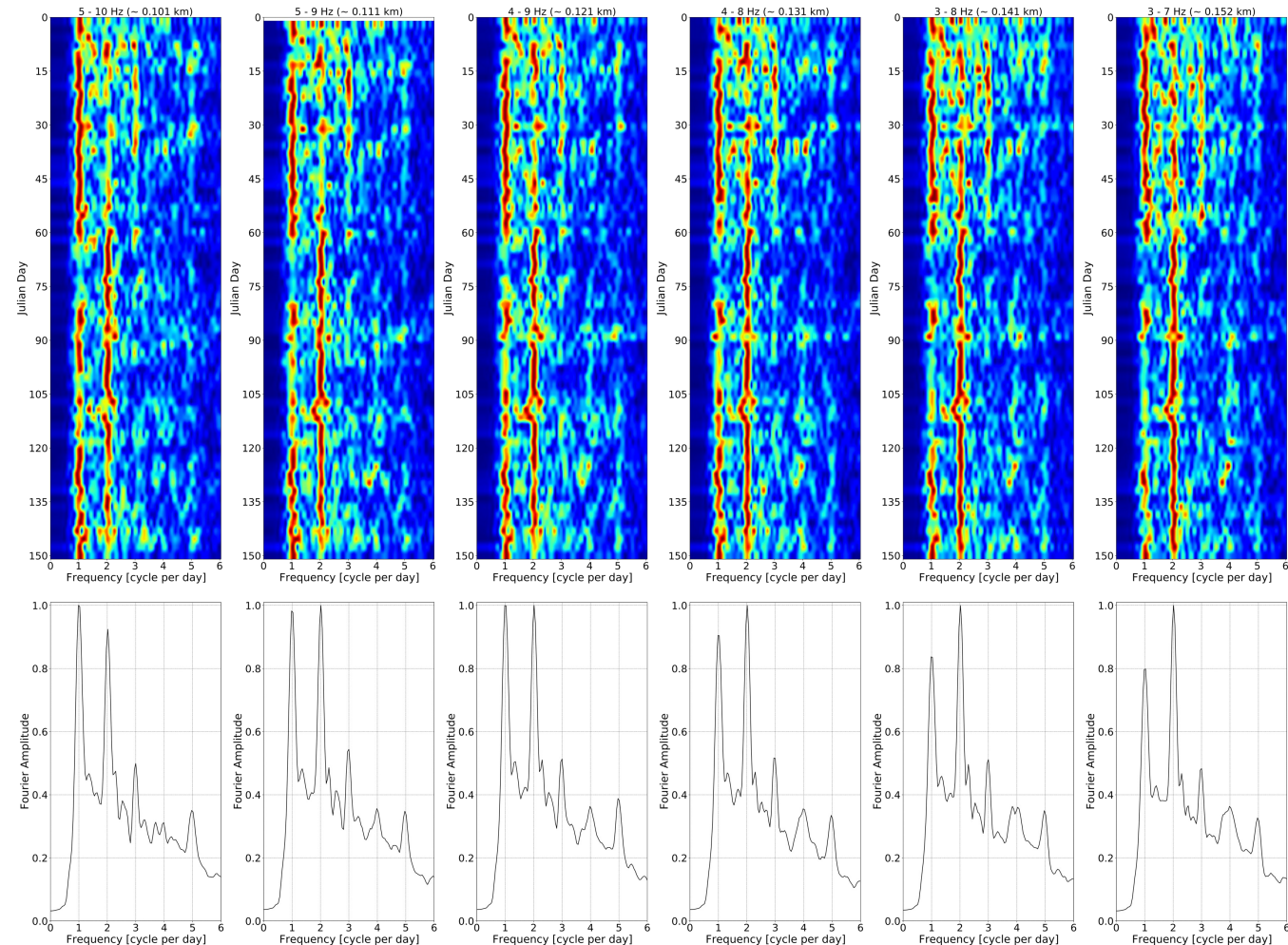
- monitoring of the subsurface behavior by using continuous ambient seismic noise
- investigation can be divided into three steps:
 - (1) estimation of Green's function from continuous ambient noise data
 - (2) calculation of relative seismic velocity changes (dv/v) in different frequency bands
(i) 3 - 7 Hz, (ii) 3 - 8 Hz, (ii) 4 - 8 Hz, (iii) 4 - 9 Hz, (iv) 5 - 9 Hz and (v) 5 - 10 Hz
→ different depth sensitivity of the coda waves
 - (3) spectral analysis of the resulting dv/v in a five days sliding window to reveal frequency contain

Expectations vs. Reality

- we expect a periodical behavior of the dv/v (e.g as shown in Mao et al., 2019 or Sens-Schönfelder and Eulenfeld, 2019)
 - assumption: strongest effects deforming the shallow crust show the same periodical pattern (Temperature or Earth Tides)
 - expectation: frequency spectrum of dv/v shows strong 1 cycle per day and 1.93 cycle per day peak
- reality:
 - every calculated spectra is missing the 1.93 cycle per day peak
 - instead showing a strong 2 cycle per day

Expectations vs. Reality

- which effect are we looking at?
 - temperature still possible
 - Earth tides not possible would show a strong 1.93 cpd peak instead of 2 cpd
- possible effect: **atmospheric tides**
 - strong 1 cpd and 2 cpd
 - strongest effect if water is included



What does it mean? Perspectives?

- dv/v measurements strongly effected by the presence of water in the near surface
- geothermal reservoir monitoring should show a strong background noise from this deformation by the atmospheric tides
- influence of the Earth Tide deformation smaller than expected?
- link to hydrogeophysics? Can we characterize groundwater aquifers by monitoring dv/v ?