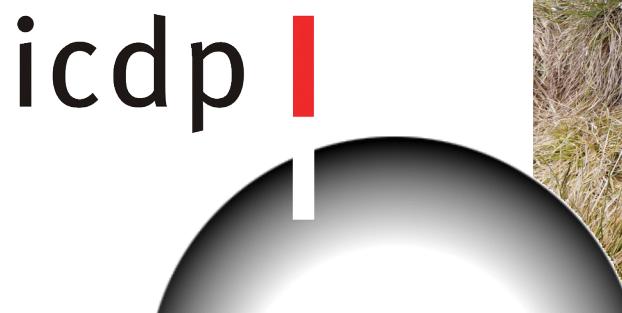


Imaging fluid channels within the NW Bohemia/Vogtland region using ambient seismic noise and MFP analysis

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AIM

Imaging and characterization of fluid channels within the Cheb Basin in a depth range of several 10th of a meter (NW Bohemia/Vogtland region).

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... an array processing method derived from ocean acoustics. It is based upon a correlation of **synthetic data (forward modelling)** with recorded **noise data** in the field. MFP aims at the localization of noise sources.

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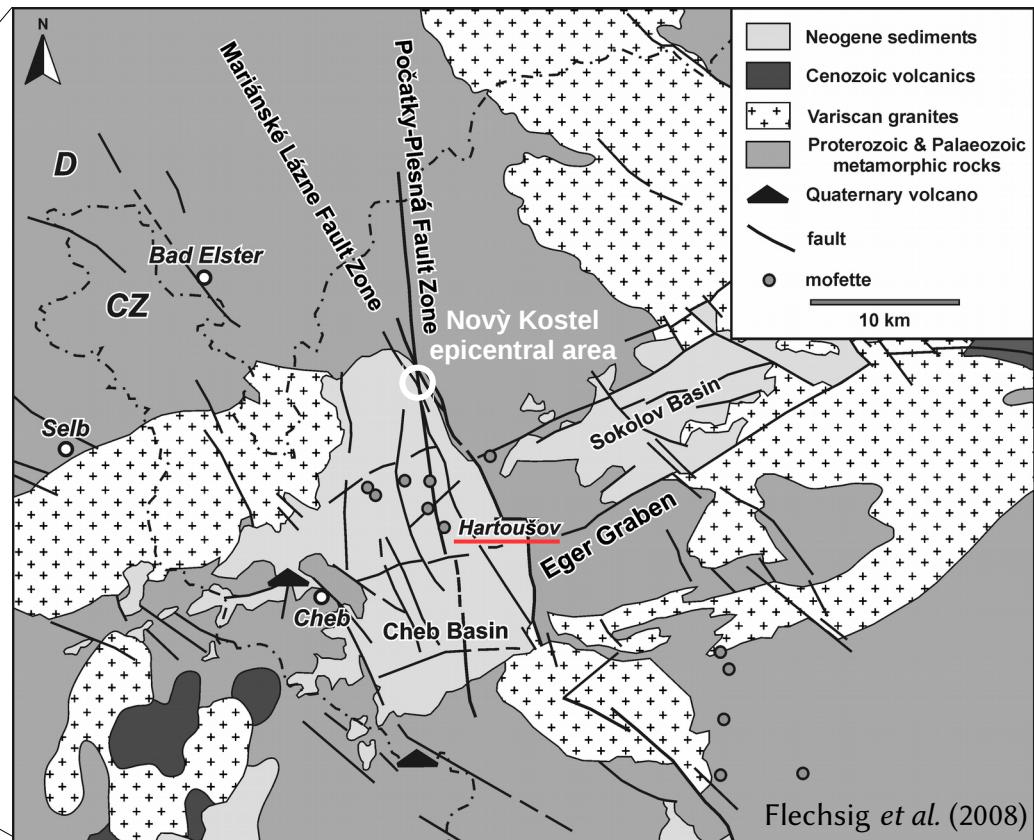
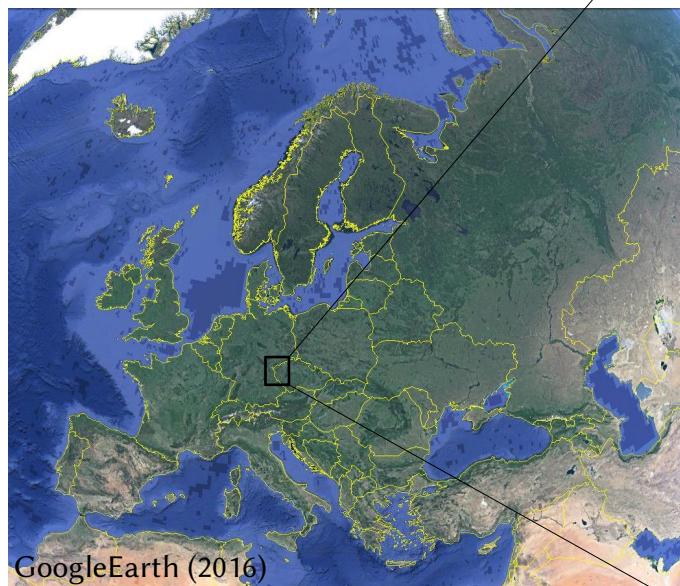
MEASUREMENTS

Ambient seismic noise

The degassing of CO₂ is considered to be a seismic noise source.

- instrumental arrays with 30 vertical geophones (4.5 Hz) + Reftek Recorders
- sampling rate: 250 samples per second
- continuous registration over night (~10 hrs)
- active seismic experiments with a hammer blow source (phase velocity)

- > Study Area: Cheb Basin (NW Bohemia/Vogtland region), Czech Republic
- > Presently ongoing geodynamic processes in the intra-continental lithospheric mantle cause different natural phenomena as earthquake swarms and degassing zones of mantle derived fluids (mofettes).



Noise Measurements

Cross Spectral Density Matrix

$$K_{ij}(\omega) = \frac{1}{N} \sum_{k=1}^N d_{i,k}(\omega) d_{j,k}^*(\omega)$$

Forward Modelling

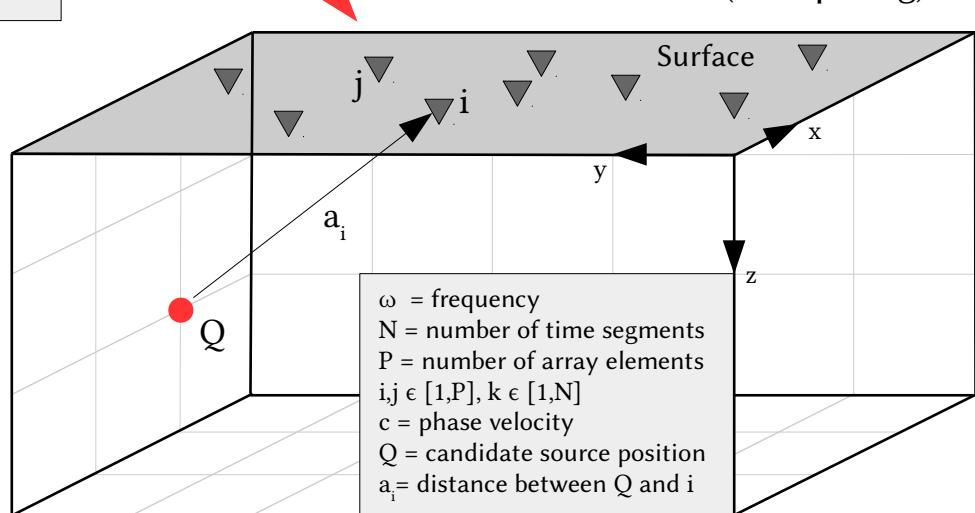
Replica Vector

$$\hat{d}(\omega, a_i) = \frac{1}{4\pi a_i} \exp(j \frac{\omega a_i}{c})$$

MFP Processor (Bartlett)

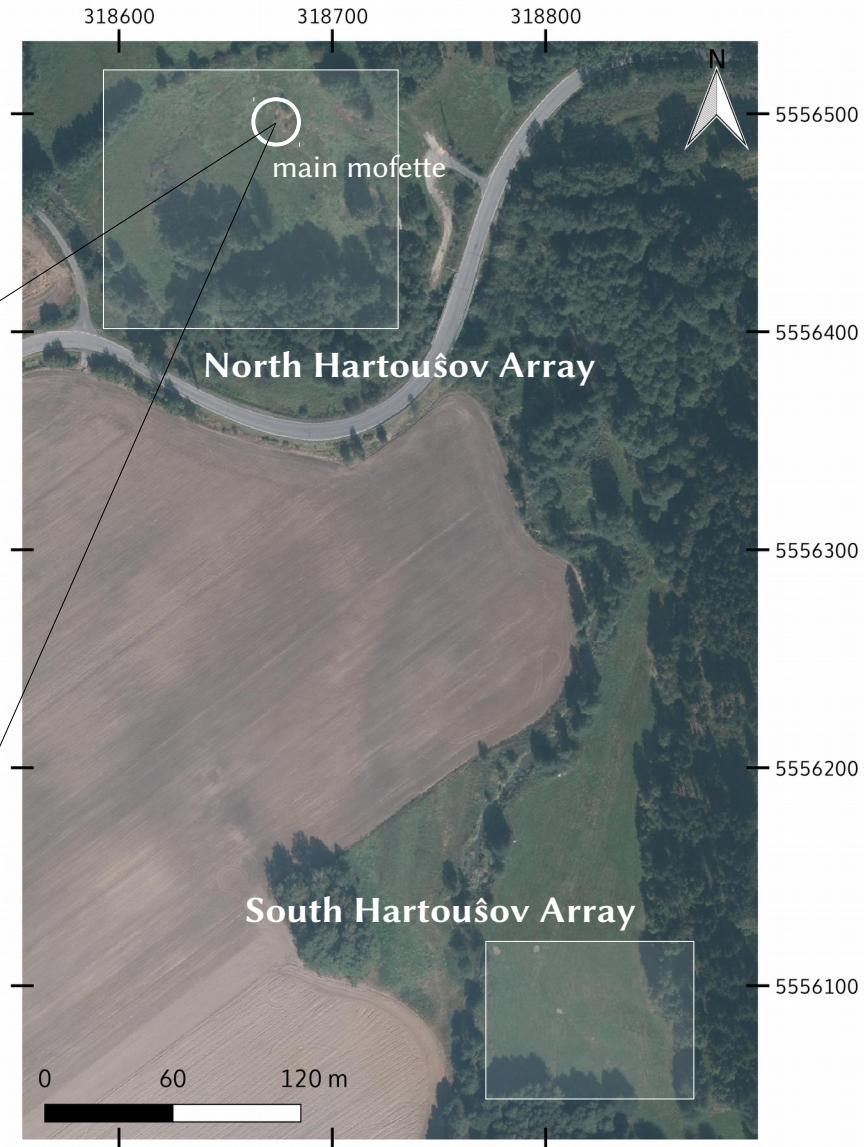
$$B(a) = \sum_{\omega} |\hat{d}^*(\omega, a_i) K(\omega) \hat{d}(\omega, a_j)|$$

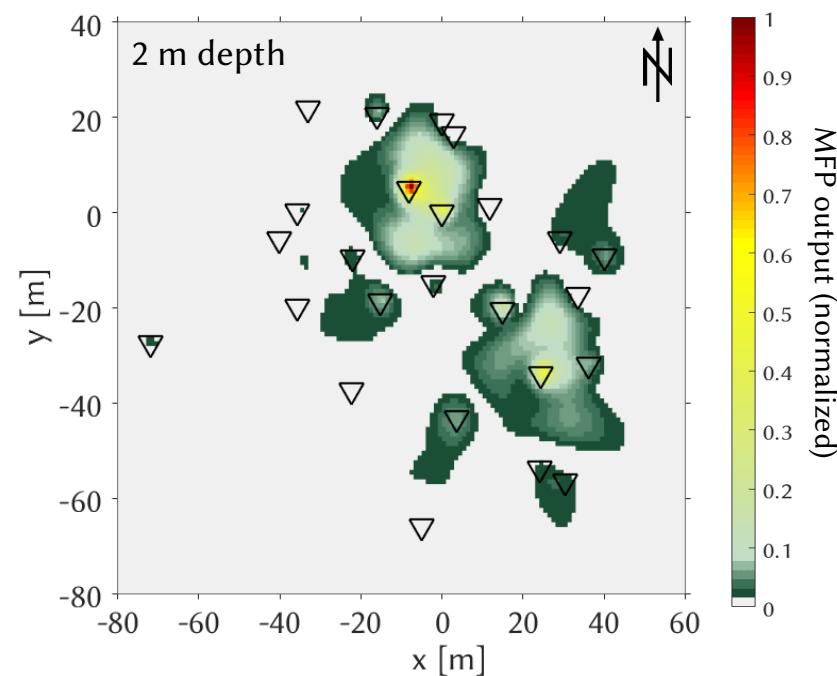
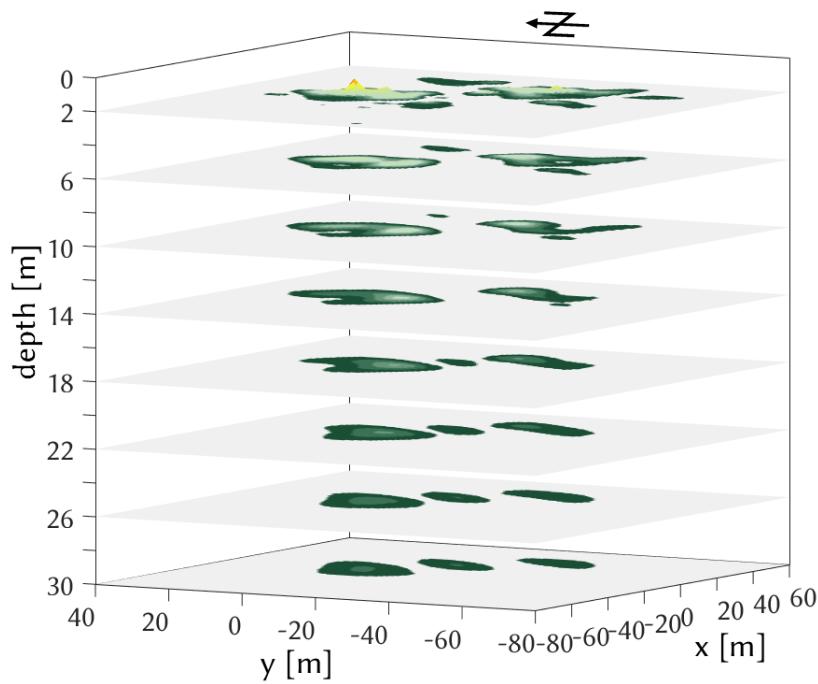
max. $B(a)$:
highest possibility of Q to be the
noise sources' position

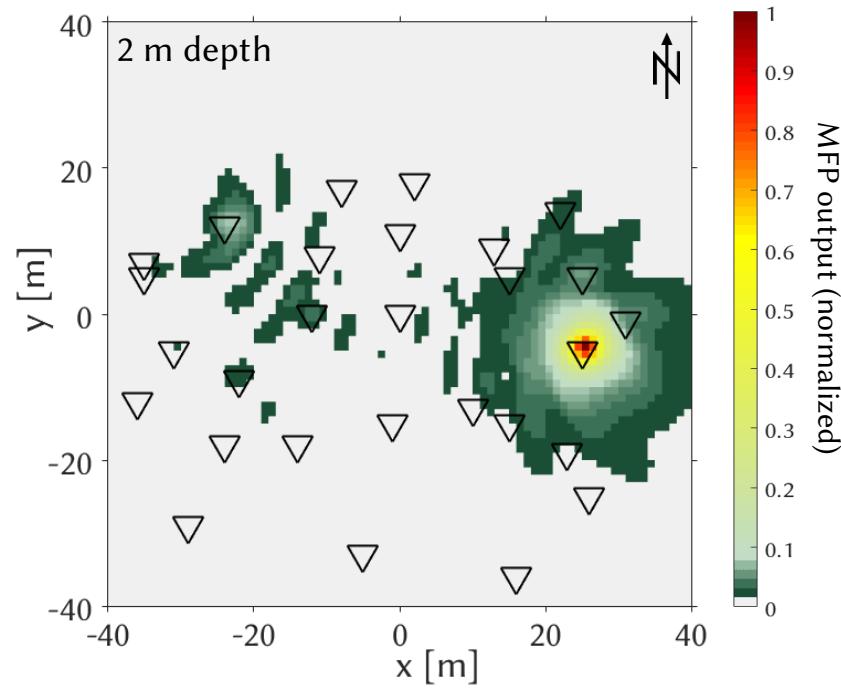
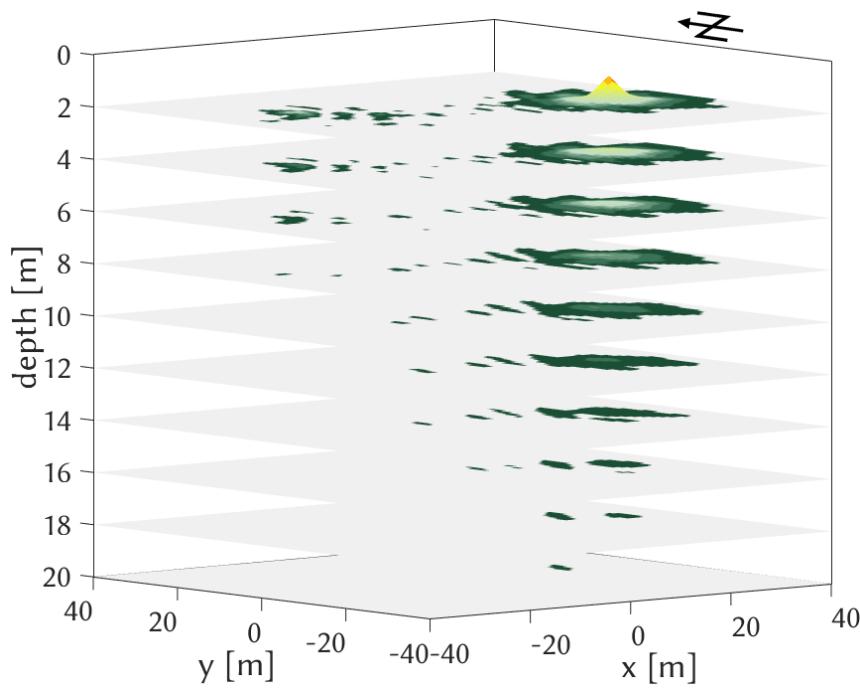


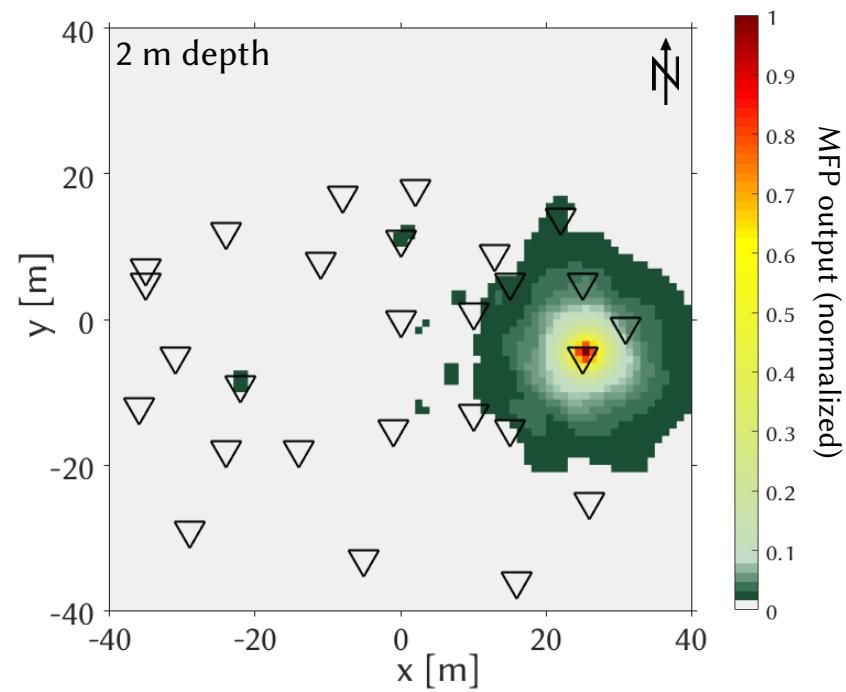
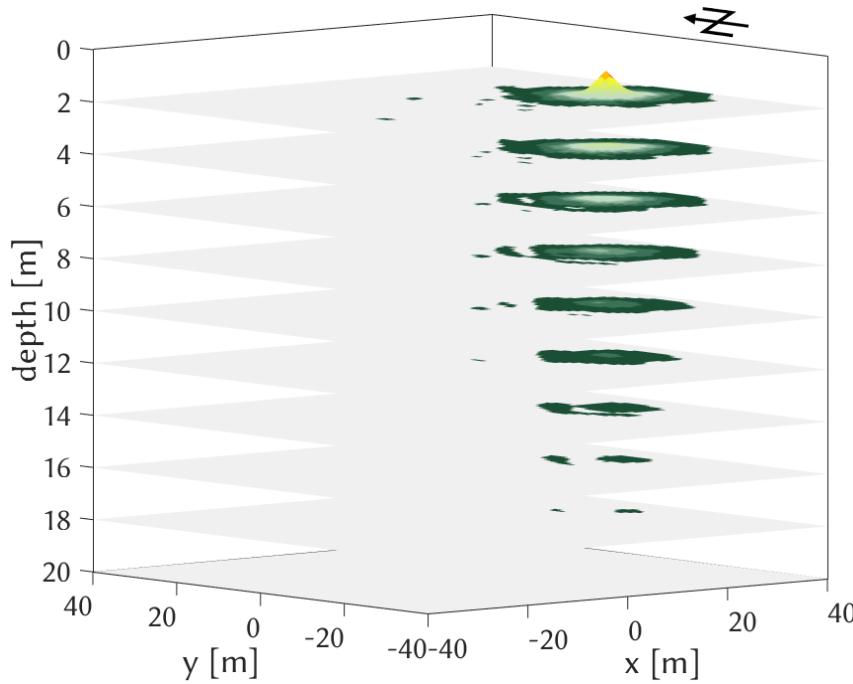


Main (wet) mofette in North Hartoušov.



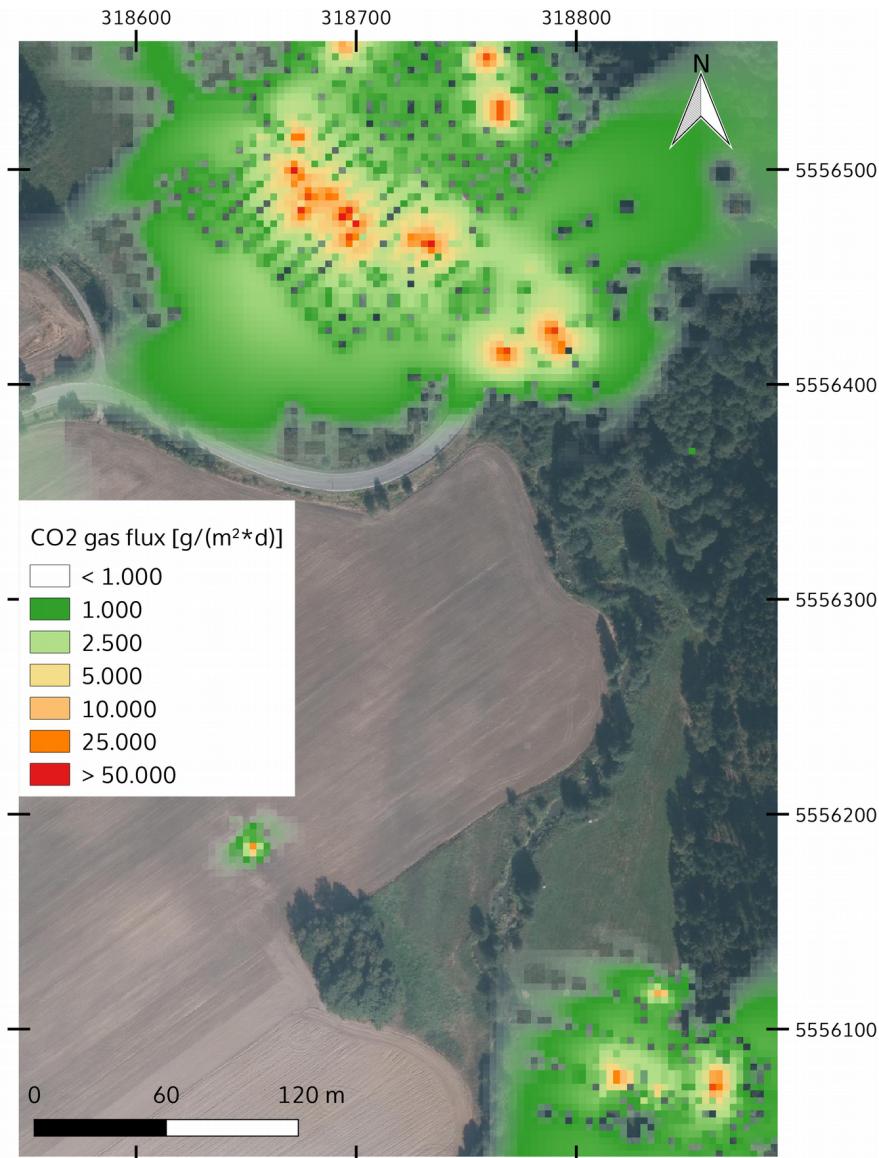


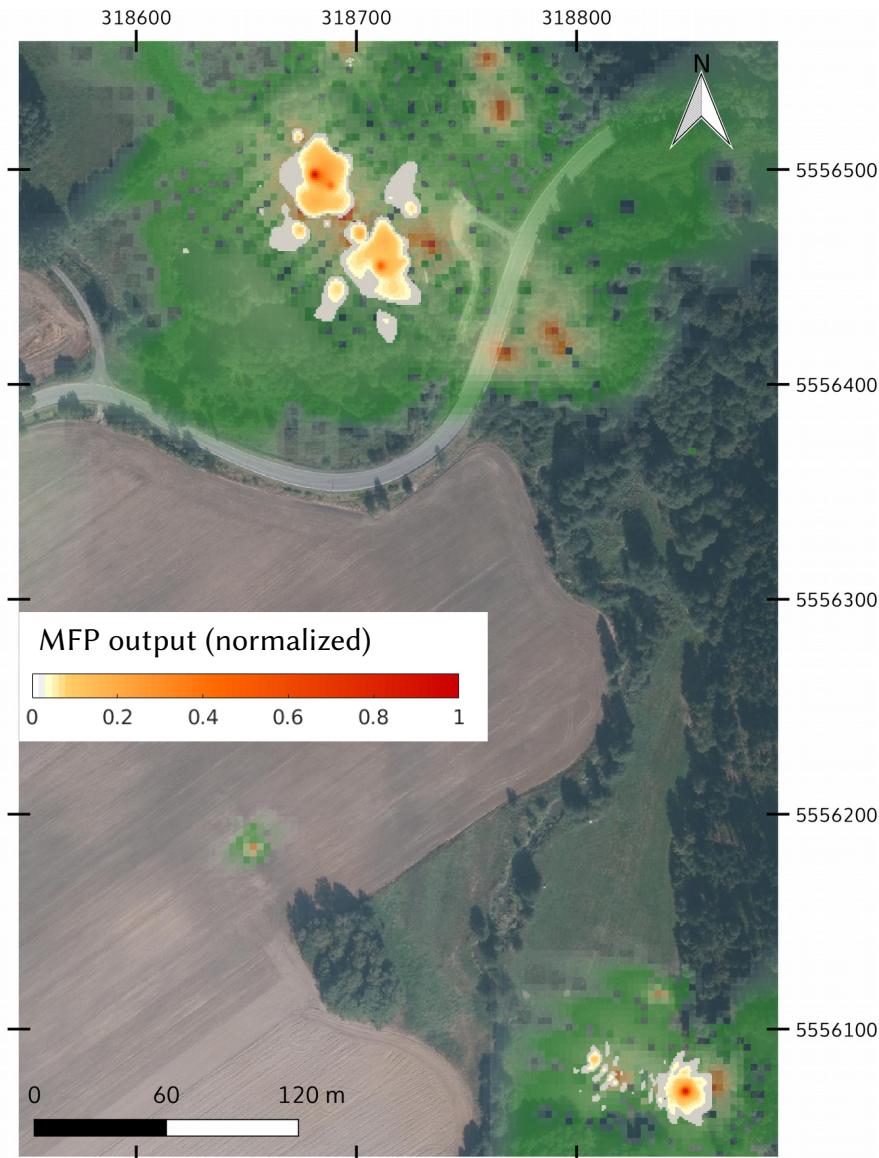
1st measurement campaign (14.07.2014)

2nd measurement campaign (15.07.2014)

CO_2 gas flux values measured by Nickschick *et al.* (2015) on the Hartoušov Mofette Field.

Nickschick *et al.* (2015): CO_2 degassing in the Hartoušov mofette area, western Eger Rift, imaged by CO_2 mapping and geoelectrical and gravity surveys. Int J Earth Sci (Geol Rundsch). DOI 10.1007/s00531-014-1140-4.





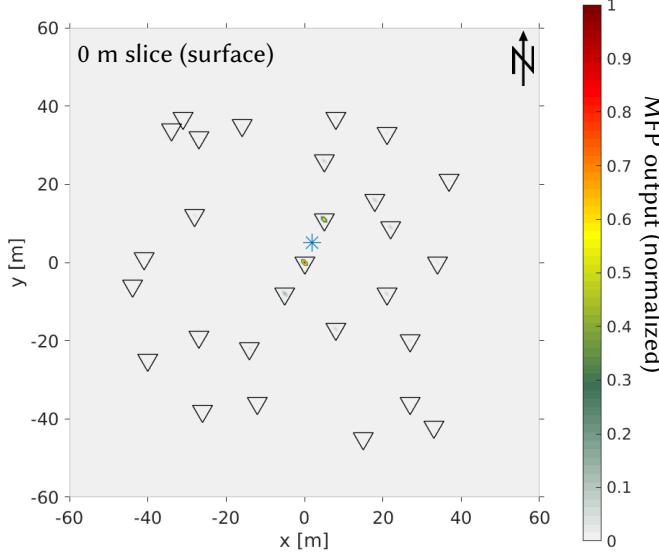
The comparison of the MFP surface output with the CO₂ gas flux values measured by Nickschick *et al.* (2015) shows a spatial fit and demonstrates that fluid flow acts as an ambient seismic noise source.

- > It was shown that...
 - fluid flow acts as an ambient seismic noise source (comparison of MFP results with punctual CO₂ flux values (Nickschick *et al.* 2015)).
 - the MFP method is capable of locating flowing fluids properly within the instrumental array configuration.
 - the fluid flow/ CO₂ degassing seems to be temporally variable (South Hartoušov).
- > We aim to...
 - investigate temporal changes within the fluid flow activity in comparison with meteorological/ hydrological parameters and earthquake events (ambient noise monitoring).
 - model the noise wavefield produced by the CO₂ flow along channels using SOFi3D with vertical sensors in a synthetic borehole, ~ 400 m depth (ICDP drilling program).
 - increase our survey depth with larger array configurations.

Thank you for your attention!



Back Up

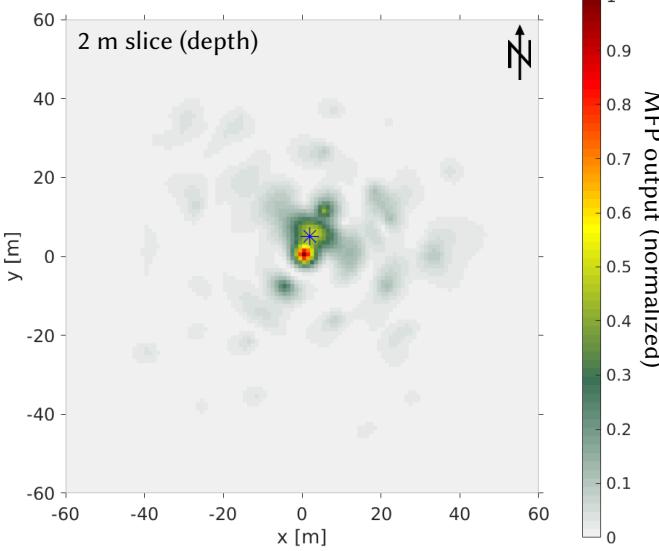


synthetic point source:

$x = 2 \text{ m}$

$y = 5 \text{ m}$

$z = 2 \text{ m}$



MFP source volume (half-width):

$x = 0.5 \pm 7 \text{ m}$

$y = 0.5 \pm 13 \text{ m}$

$z = 2 \pm 9 \text{ m}$

