

# Ambient Noise Study at CRSN and AlpArray\_CZ Stations



INSTITUTE  
OF GEOPHYSICS  
ASCR

Jiří Kvapil, Jaroslava Plomerová  
and AlpArray WG



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MINISTRY OF EDUCATION,  
YOUTH AND SPORTS

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# Introduction

- We are using ambient noise CC routine to build crustal  $V_s$  velocity model of the Bohemian Massif (BM)
- In this study we are using data from seismic stations located in the Czech Republic
- In the first part of this presentation are shown some test results from processing flow
- In the second part is evaluated horizontal resolution, spatial extent and depth sampling of resulting crustal velocity model.

# Outline

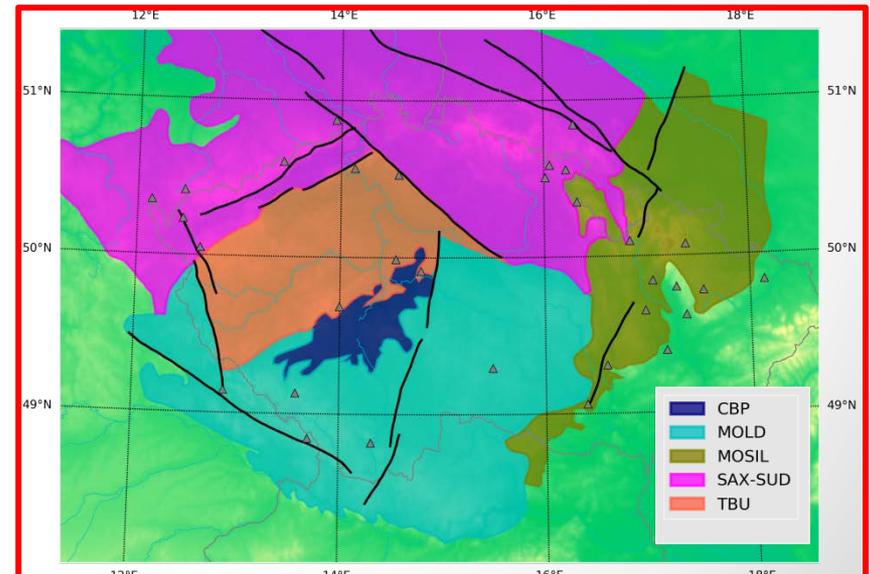
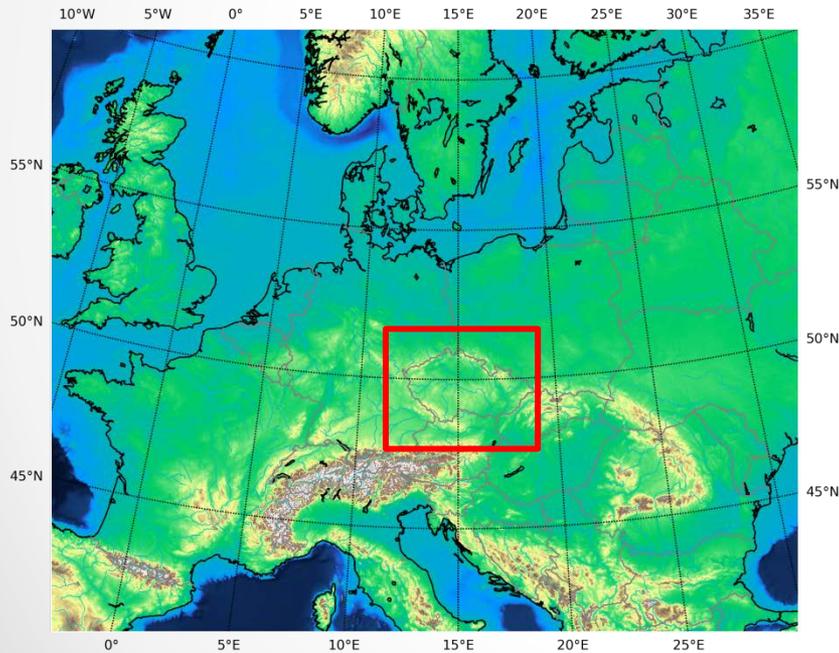
- Introduction
- Data used in the study
- Processing Flow
  - Instrument Designature
  - Station-Pairs Processing
    - Cross-correlations
    - Stack
    - FTAN
    - Dispersion Curve Picking
  - Dispersion Curve Inversion
- Data resolution
- Conclusions

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# Data used in the study

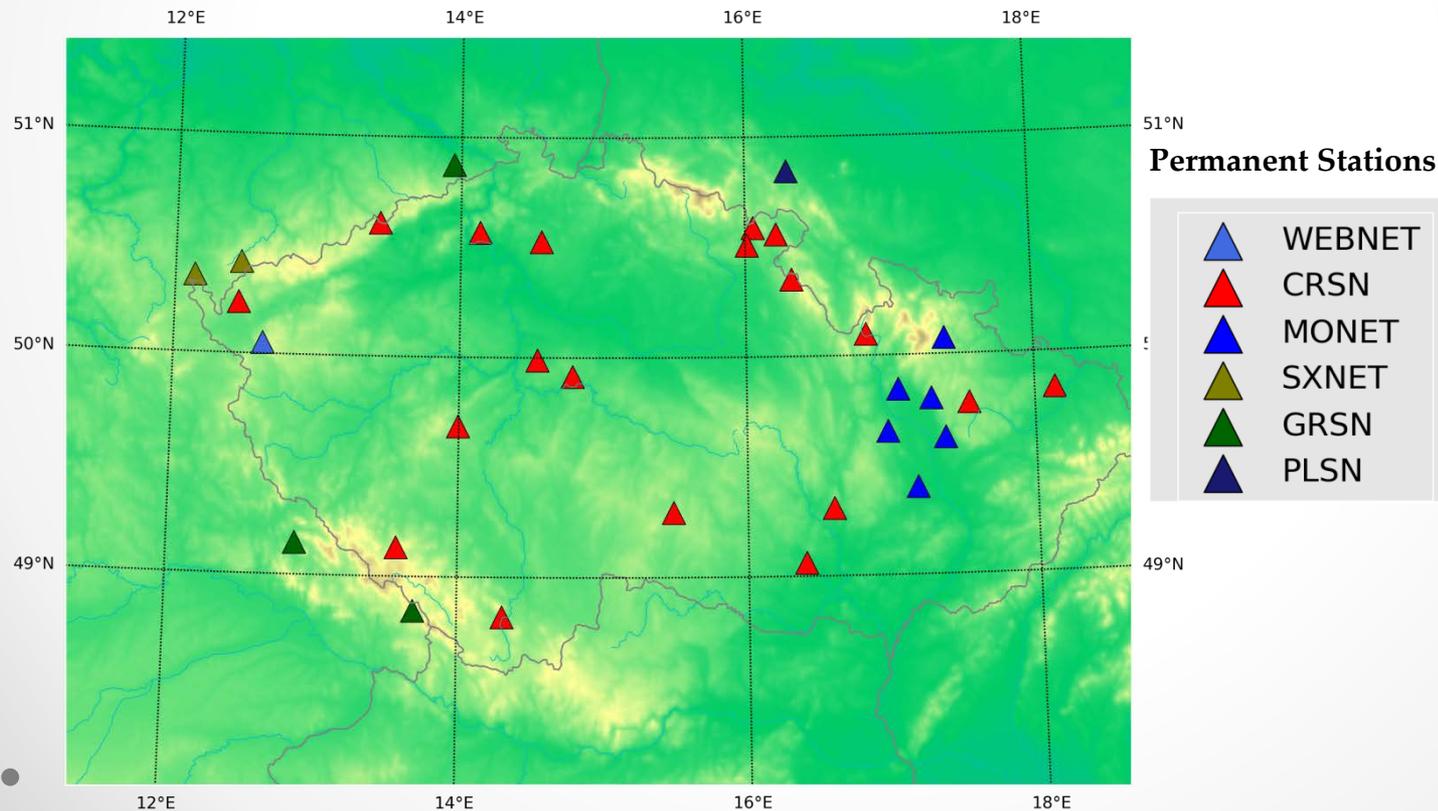
- In this study we are using data recorded in the Czech Republic along with few cross-border stations.
- The target of this study is Bohemian Massif



Tectonic Map of Bohemian Massif 5

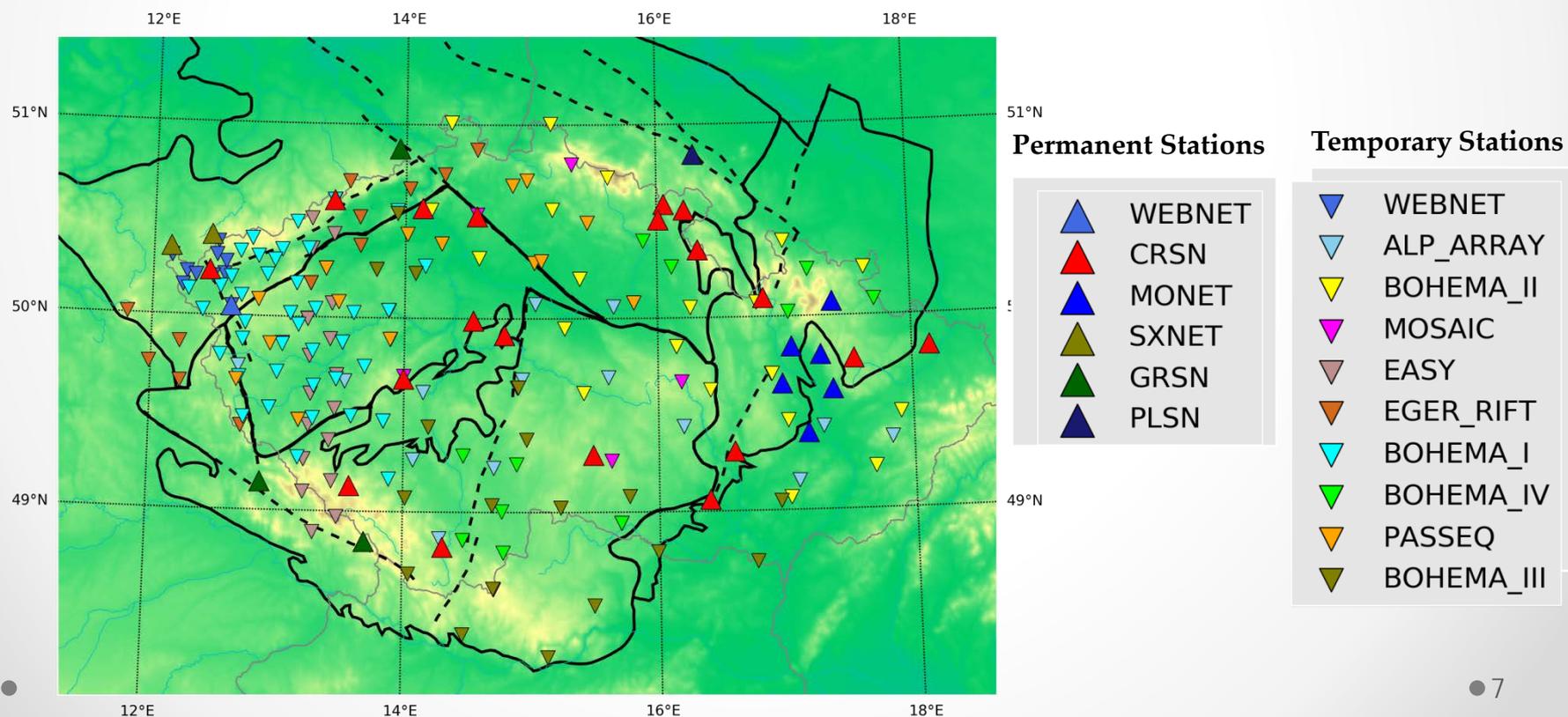
# Data used in the study

- Permanent stations
  - Czech Regional Seismic Network (CRSN including MONET & WEBNET)
  - Selected stations from nearby networks (SXNET,GRSN and PLSN)



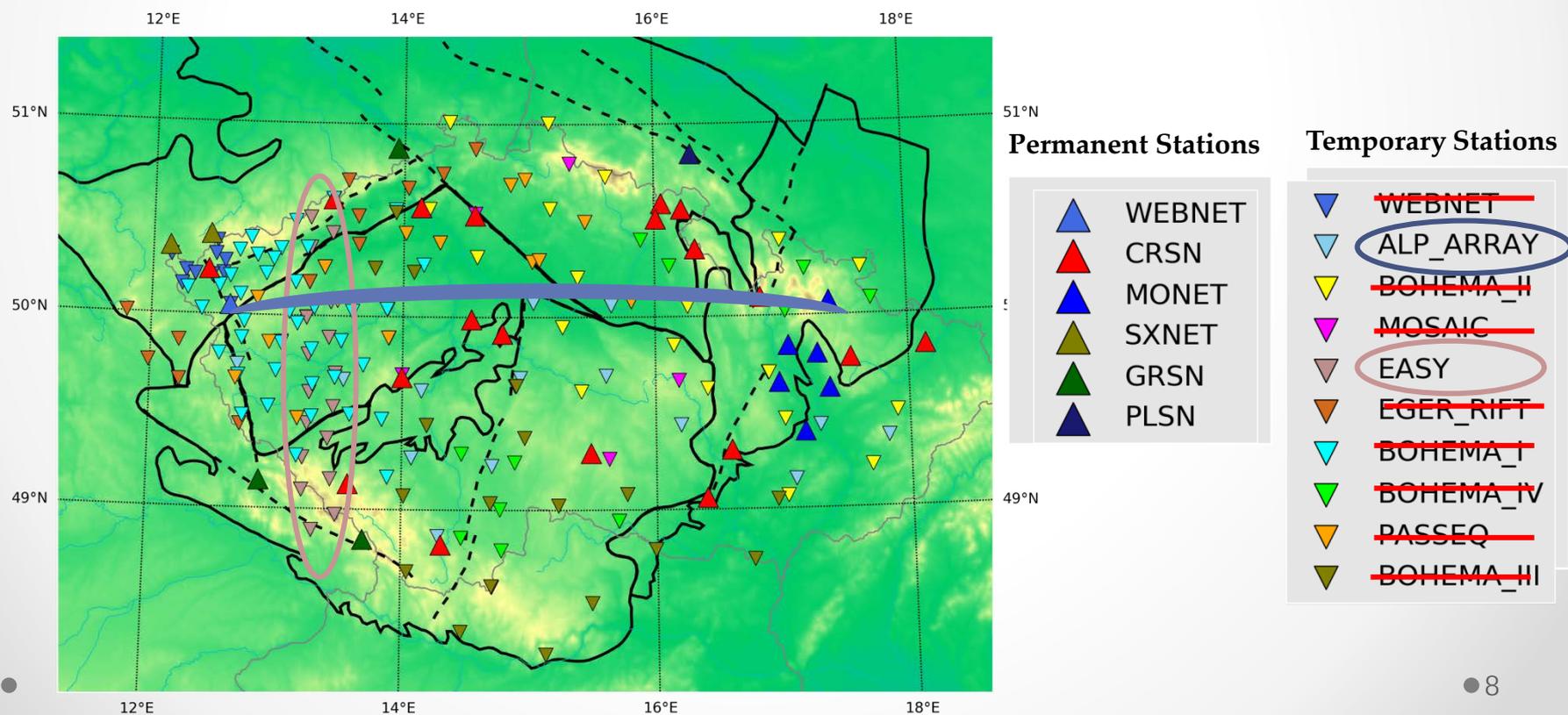
# Data used in the study

- Permanent stations
  - Czech Regional Seismic Network (CRSN including MONET & WEBNET)
  - Selected stations from nearby networks (SXNET,GRSN and PLSN)
- Temporary stations
  - Passive Experiments



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- Permanent stations
  - Czech Regional Seismic Network (CRSN including MONET & WEBNET)
  - Selected stations from nearby networks (SXNET,GRSN and PLSN)
- Temporary stations
  - AlpArray – CZ MOBNET IG (AAE01-20 and A071A-A090A)

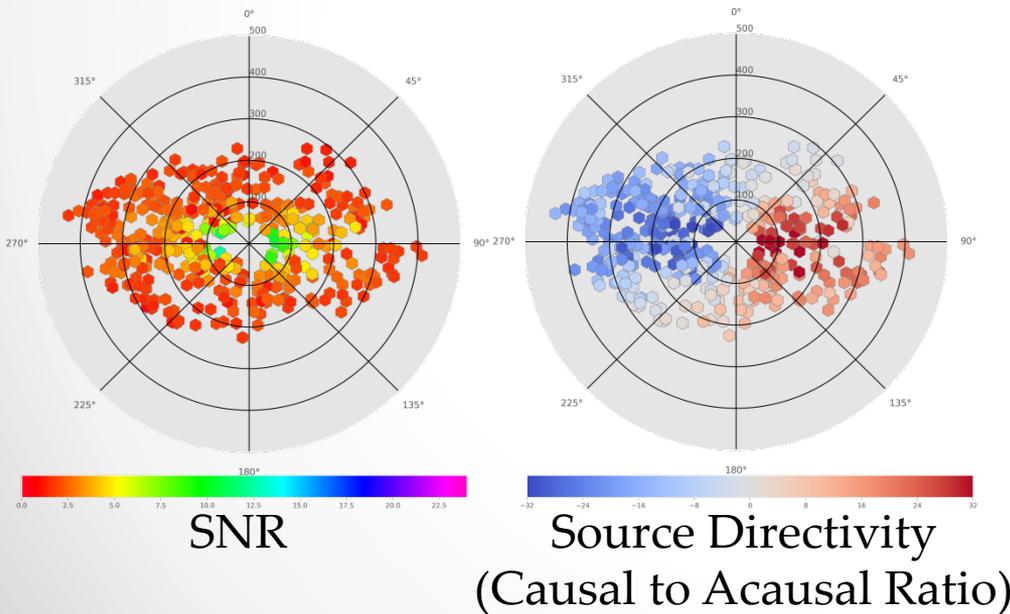


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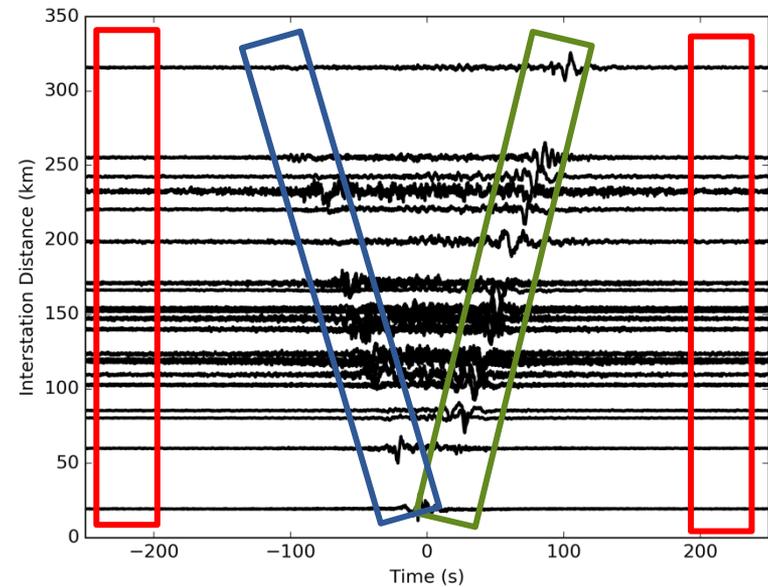
# Stack

- Length of data and seasonal variation test.
  - Measure SNR and directivity of sources



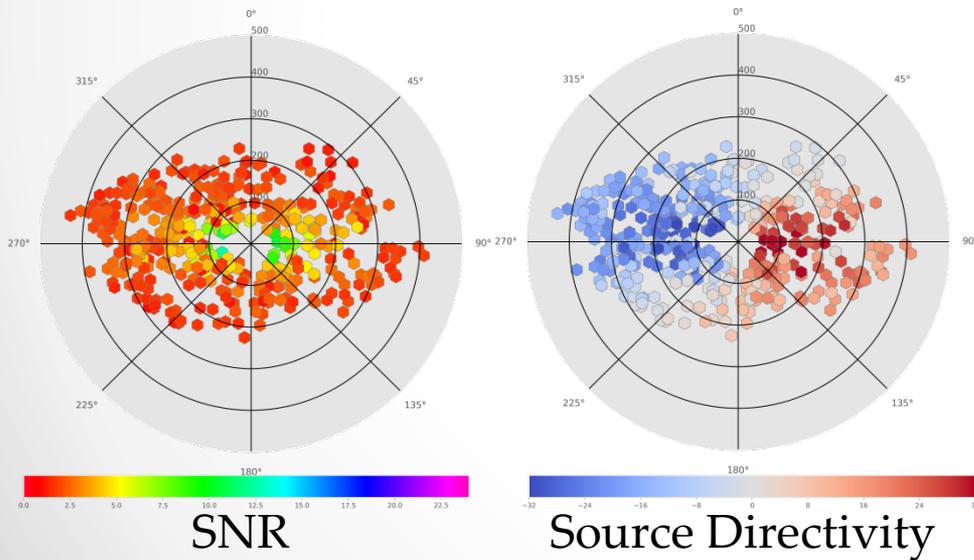
## Station-Pair CrossCorrelations

Noise Signal Signal Noise  
acausal causal



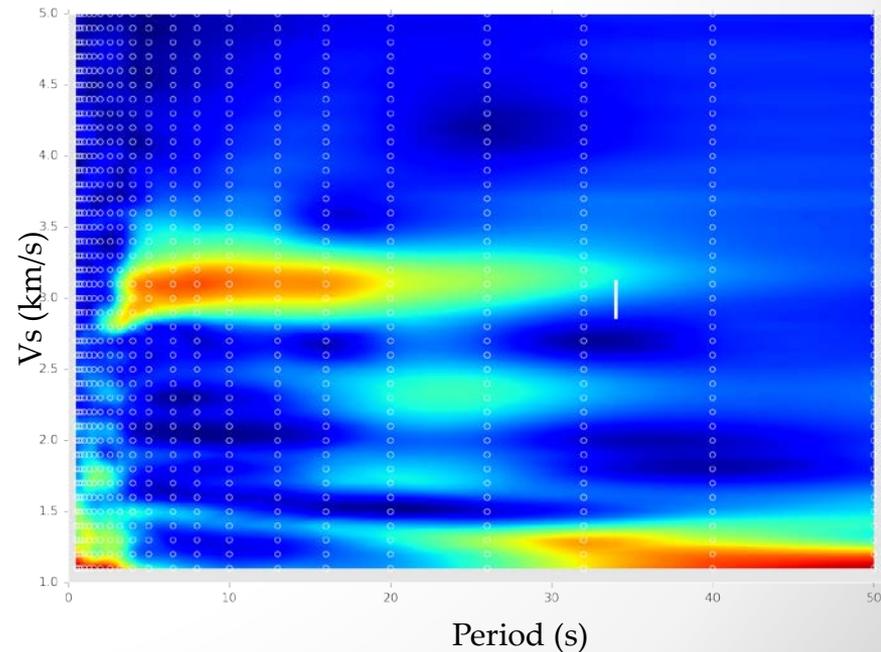
# Stack week01

- Length of data and seasonal variation test.
  - 1 Week winter / summer
  - 1 Month winter / summer
  - Half-Year (APR-SEP)
  - Full year



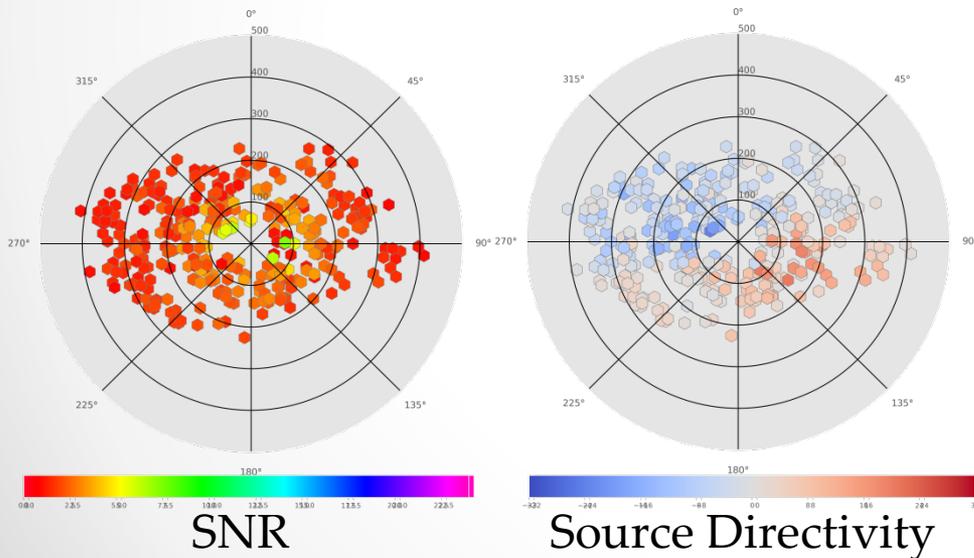
FTAN

FTAN PAIR: ANAC PRU (dist=203 oc=6 tmax=34.0)



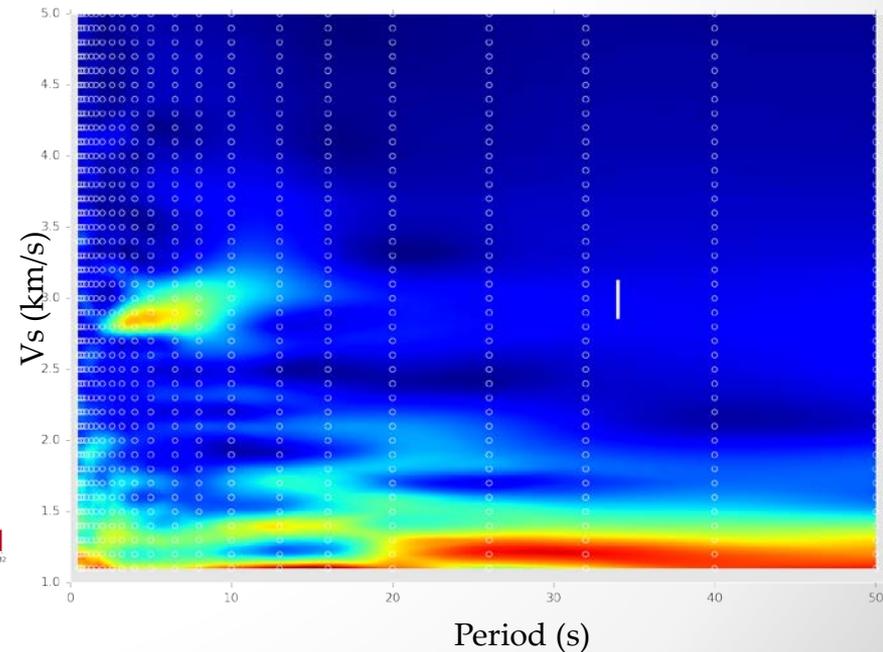
# Stack week 28

- Length of data and seasonal variation test.
  - 1 Week winter / summer
  - 1 Month winter / summer
  - Half-Year (APR-SEP)
  - Full year



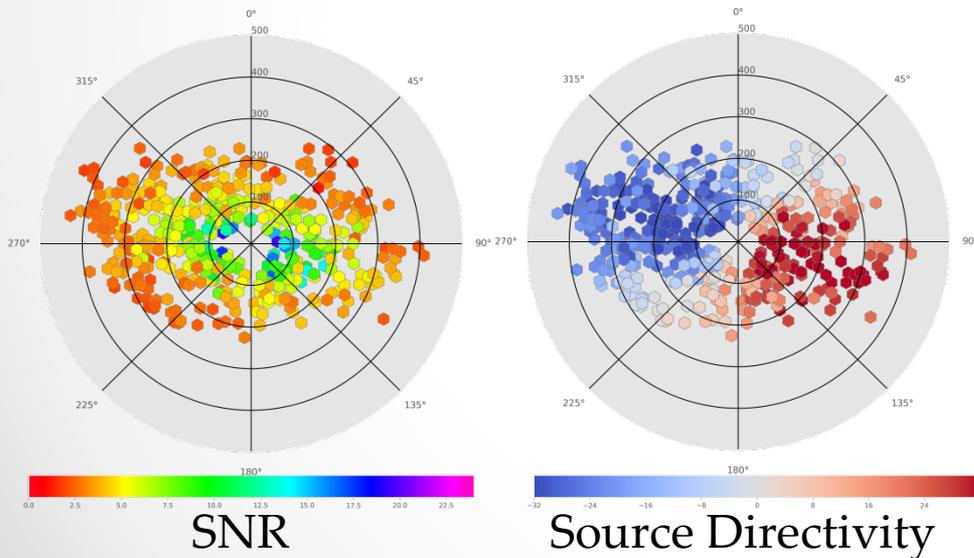
FTAN

FTAN PAIR: ANAC PRU (dist=203 oc=6 tmax=34.0)



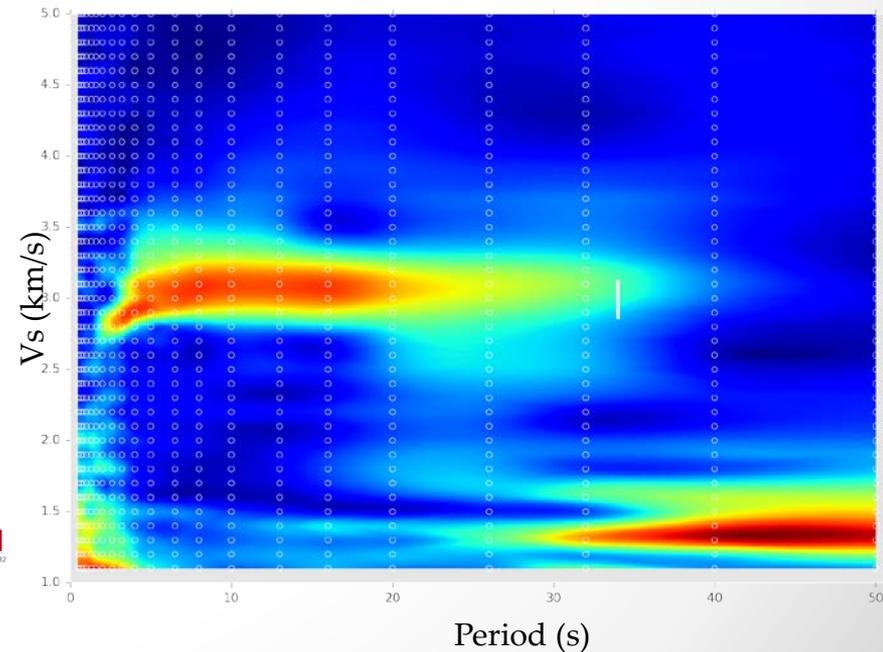
# Stack January

- Length of data and seasonal variation test.
  - 1 Week winter / summer
  - 1 Month winter / summer
  - Half-Year (APR-SEP)
  - Full year



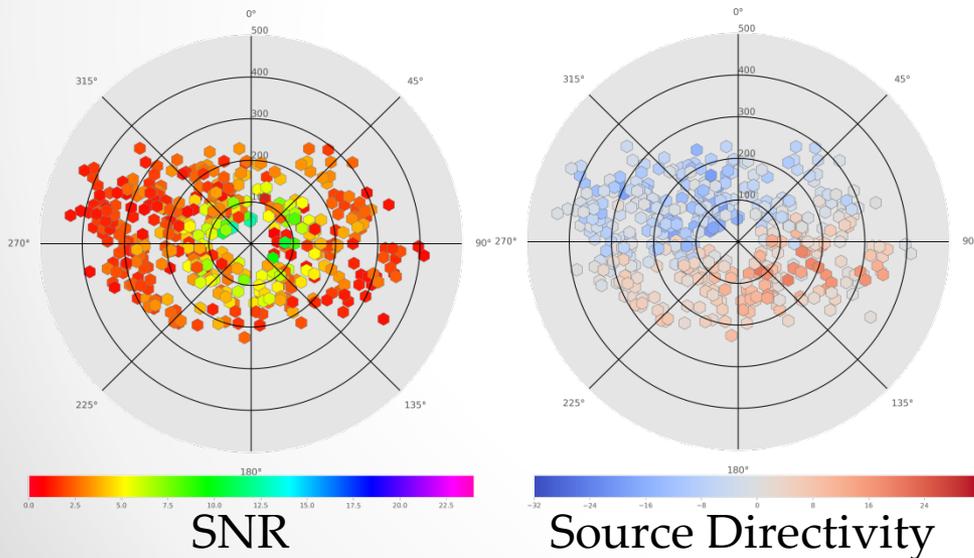
FTAN

FTAN PAIR: ANAC PRU (dist=203 oc=6 tmax=34.0)



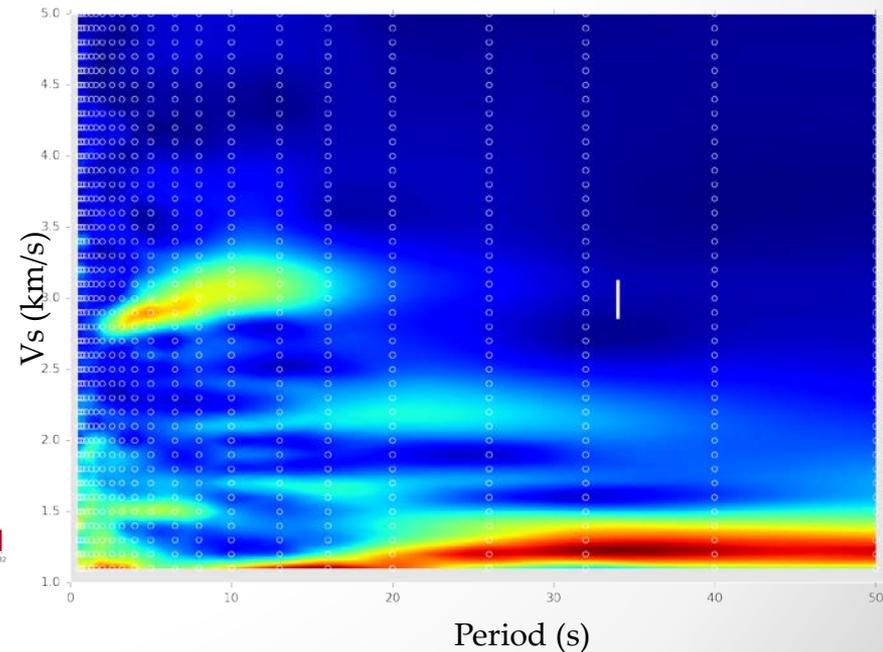
# Stack July

- Length of data and seasonal variation test.
  - 1 Week winter / summer
  - 1 Month winter / summer
  - Half-Year (APR-SEP)
  - Full year



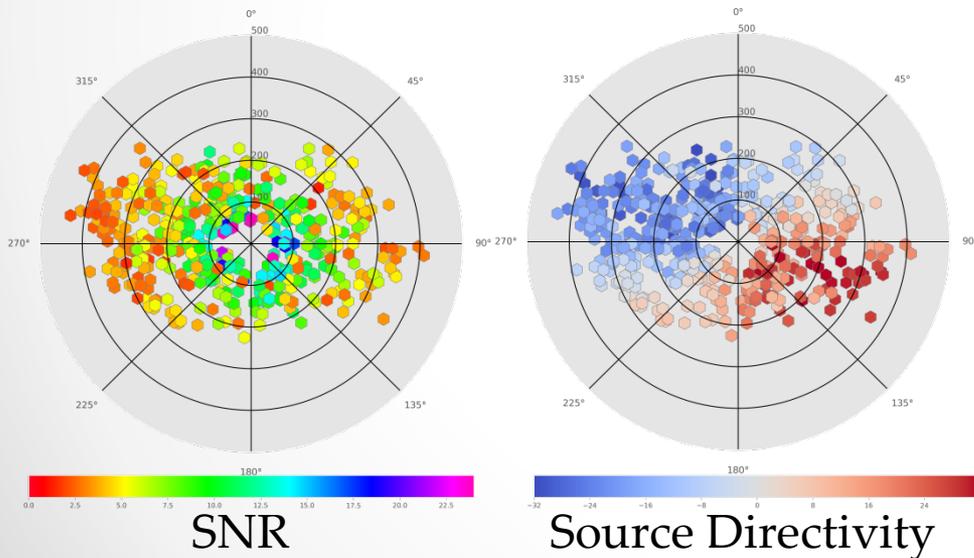
FTAN

FTAN PAIR: ANAC PRU (dist=203 oc=6 tmax=34.0)



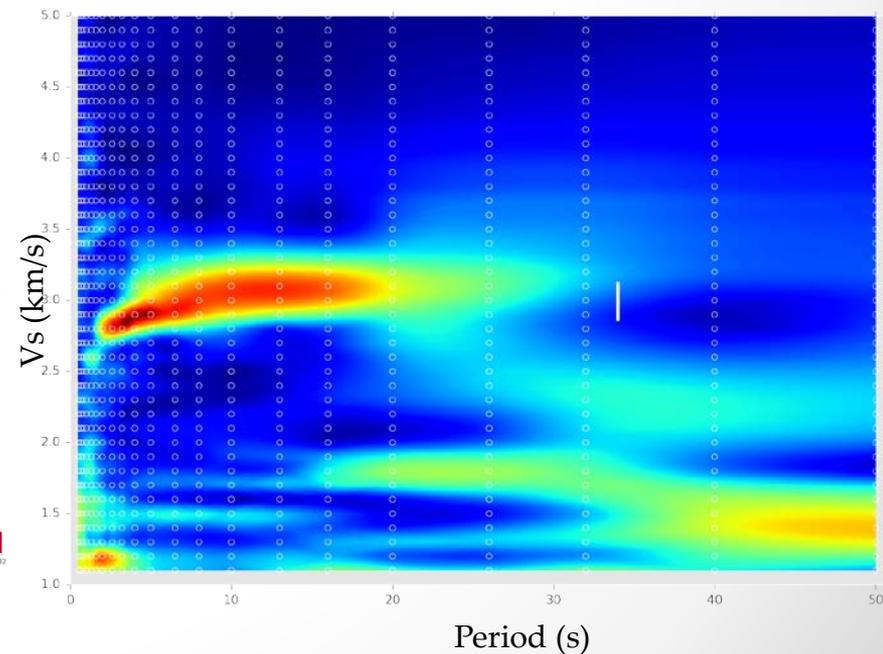
# Stack APR-SEP

- Length of data and seasonal variation test.
  - 1 Week winter / summer
  - 1 Month winter / summer
  - Half-Year (APR-SEP)
  - Full year



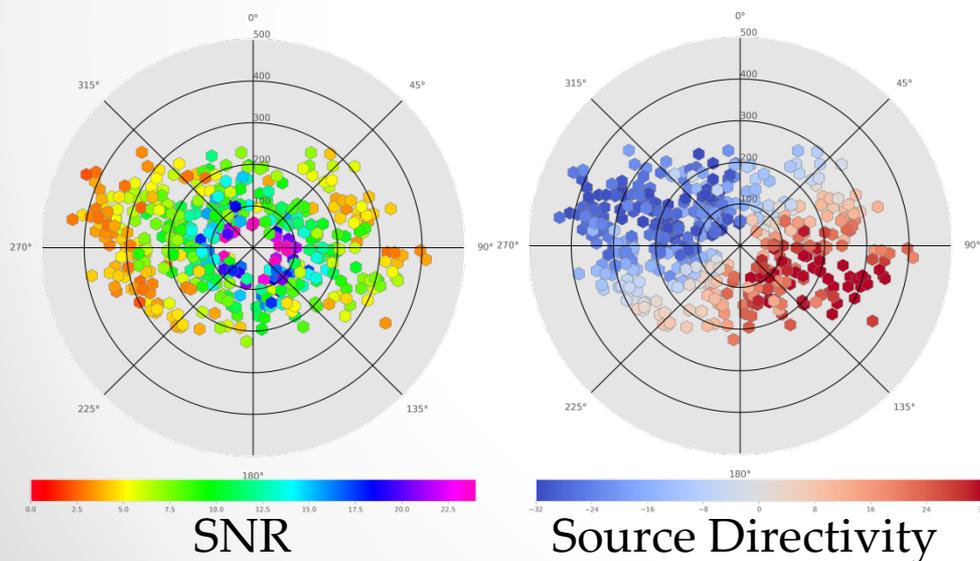
FTAN

FTAN PAIR: ANAC PRU (dist=203 oc=6 tmax=34.0)



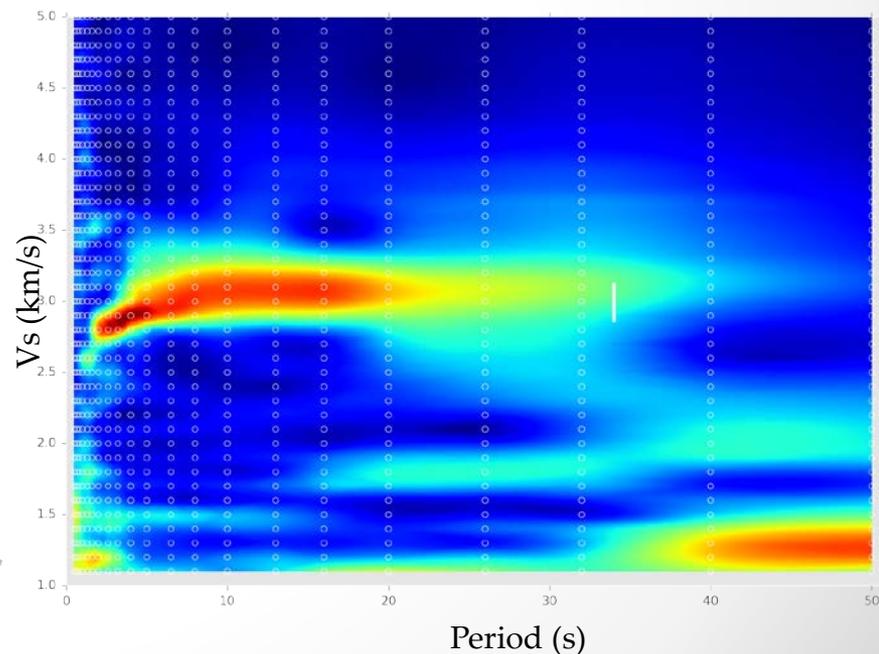
# Stack Whole Year

- Length of data and seasonal variation test.
  - 1 Week winter / summer
  - 1 Month winter / summer
  - Half-Year (APR-SEP)
  - Full year



FTAN

FTAN PAIR: ANAC PRU (dist=203 oc=6 tmax=34.0)

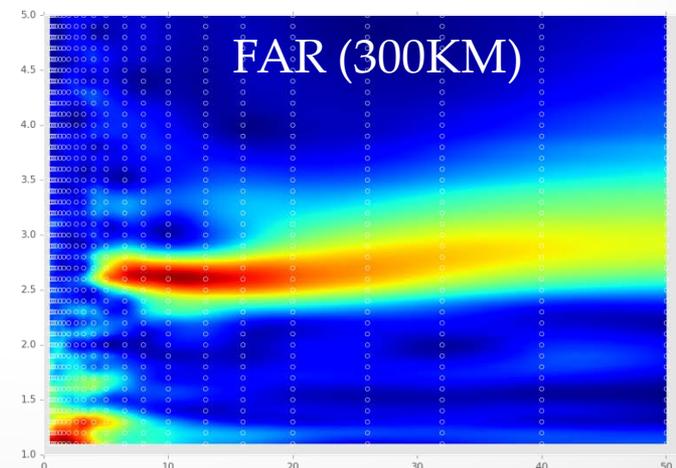
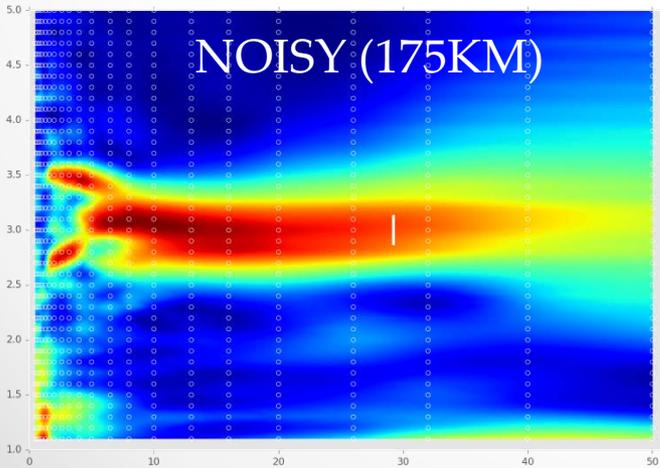
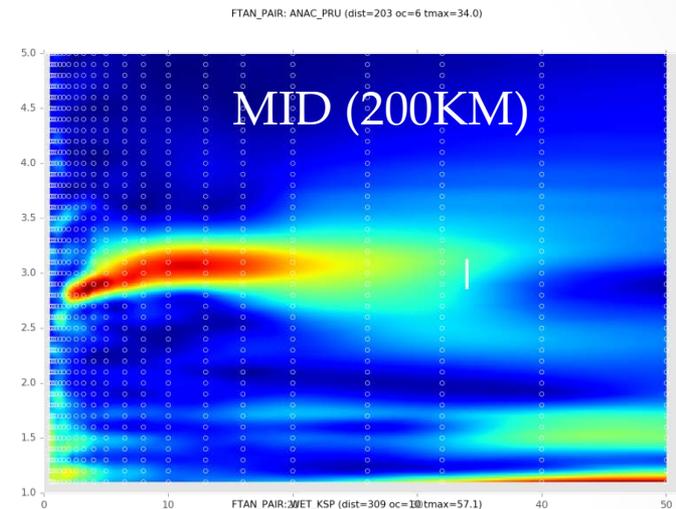
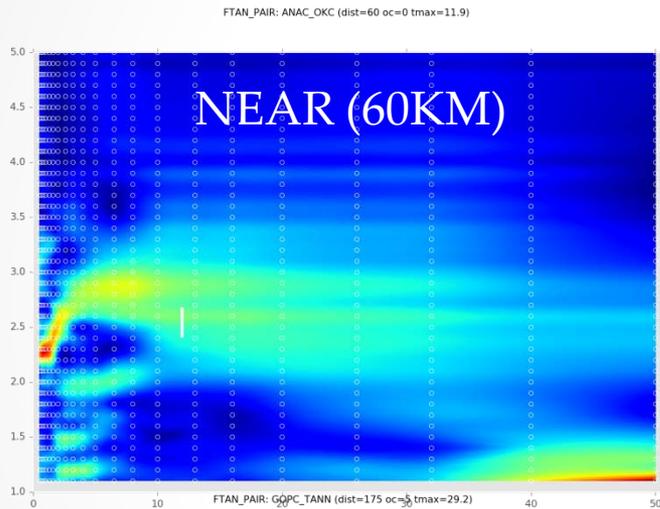


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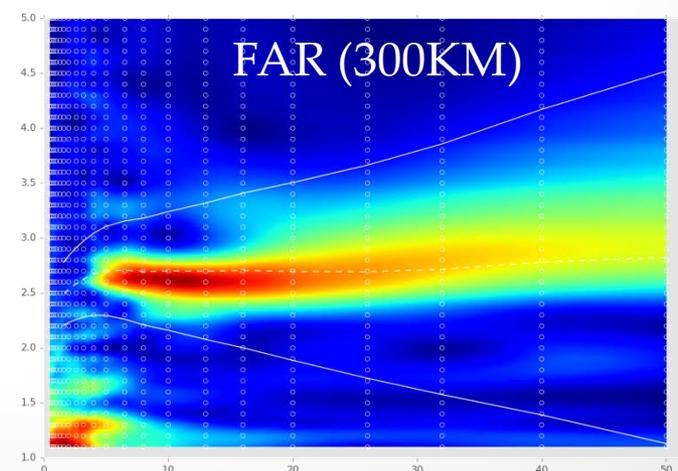
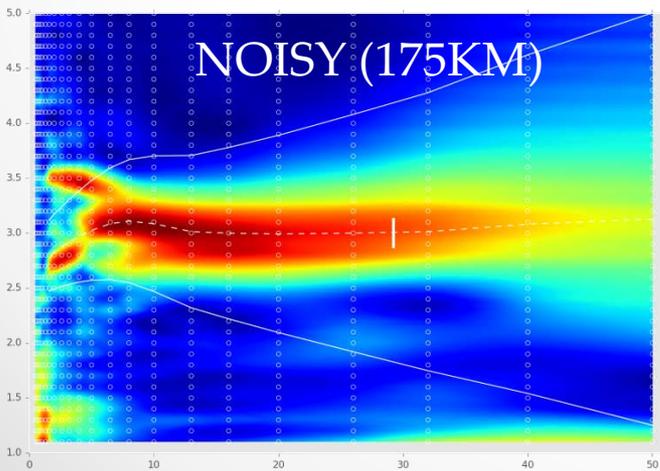
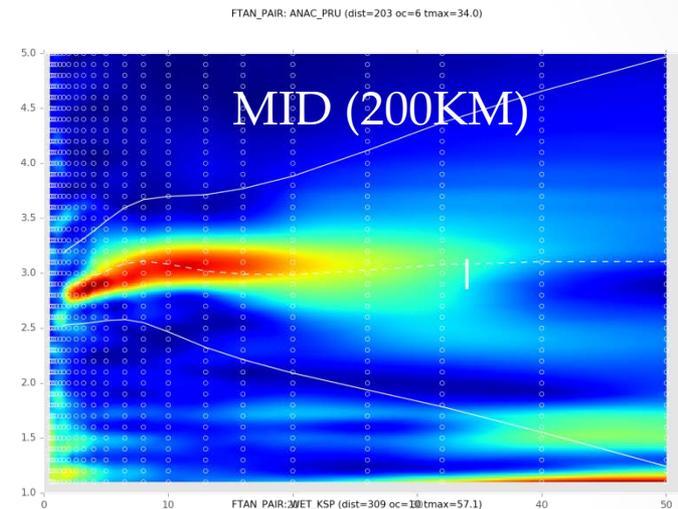
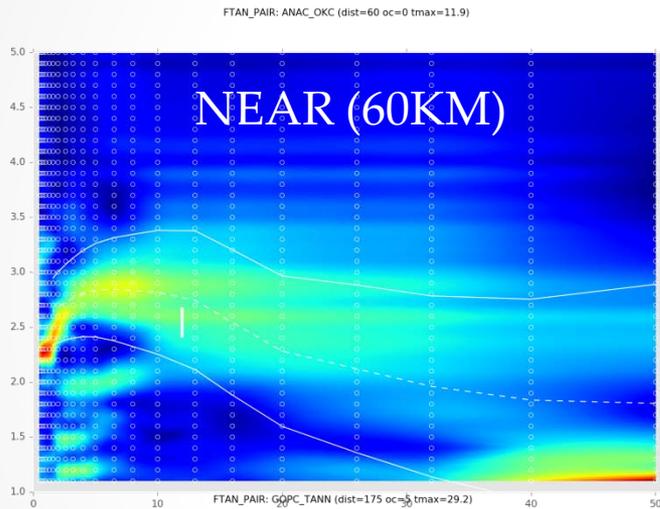
# Dispersion Curve Picking

- Fully automatic dispersion curve picking routine
  - FTAN sampling in 3<sup>rd</sup> Octave Bands



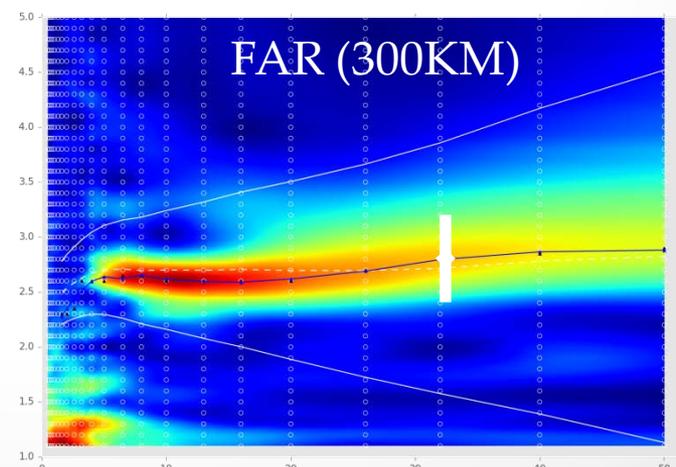
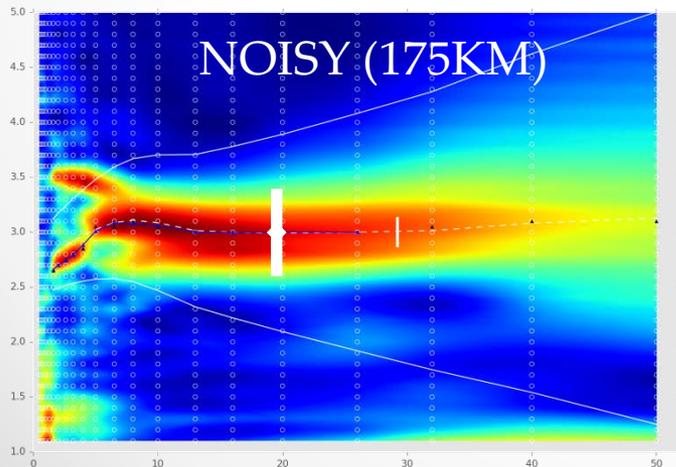
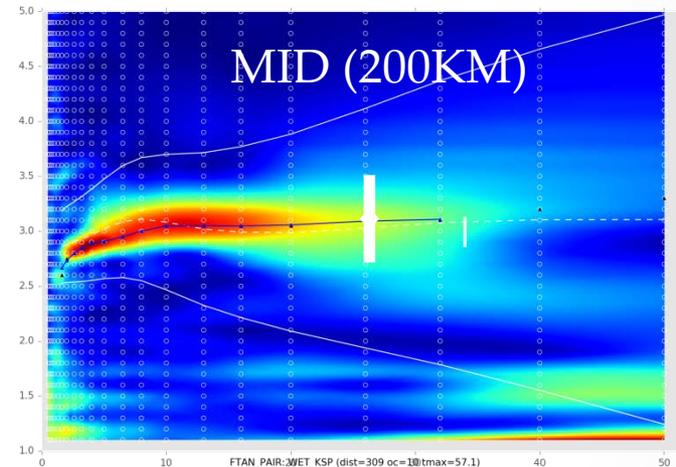
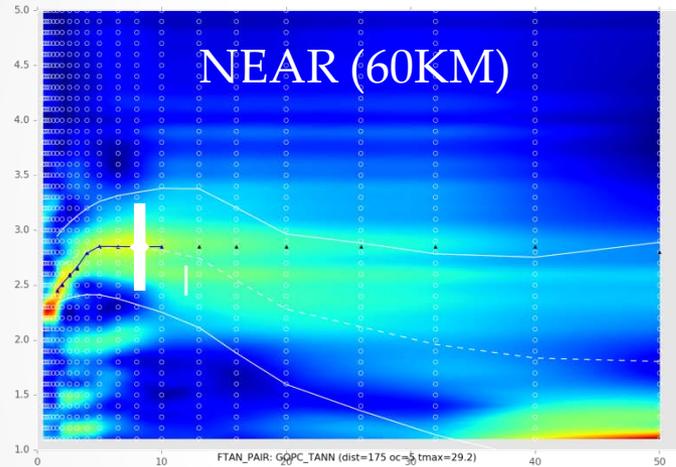
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# Dispersion Curve Picking

- Fully automatic dispersion curve picking routine
  - FTAN sampling in 3<sup>rd</sup> Octave Bands
  - Using picking corridor based on interstation distance dependent mean
  - Progressive max-amplitude picking with fundamental mode priority



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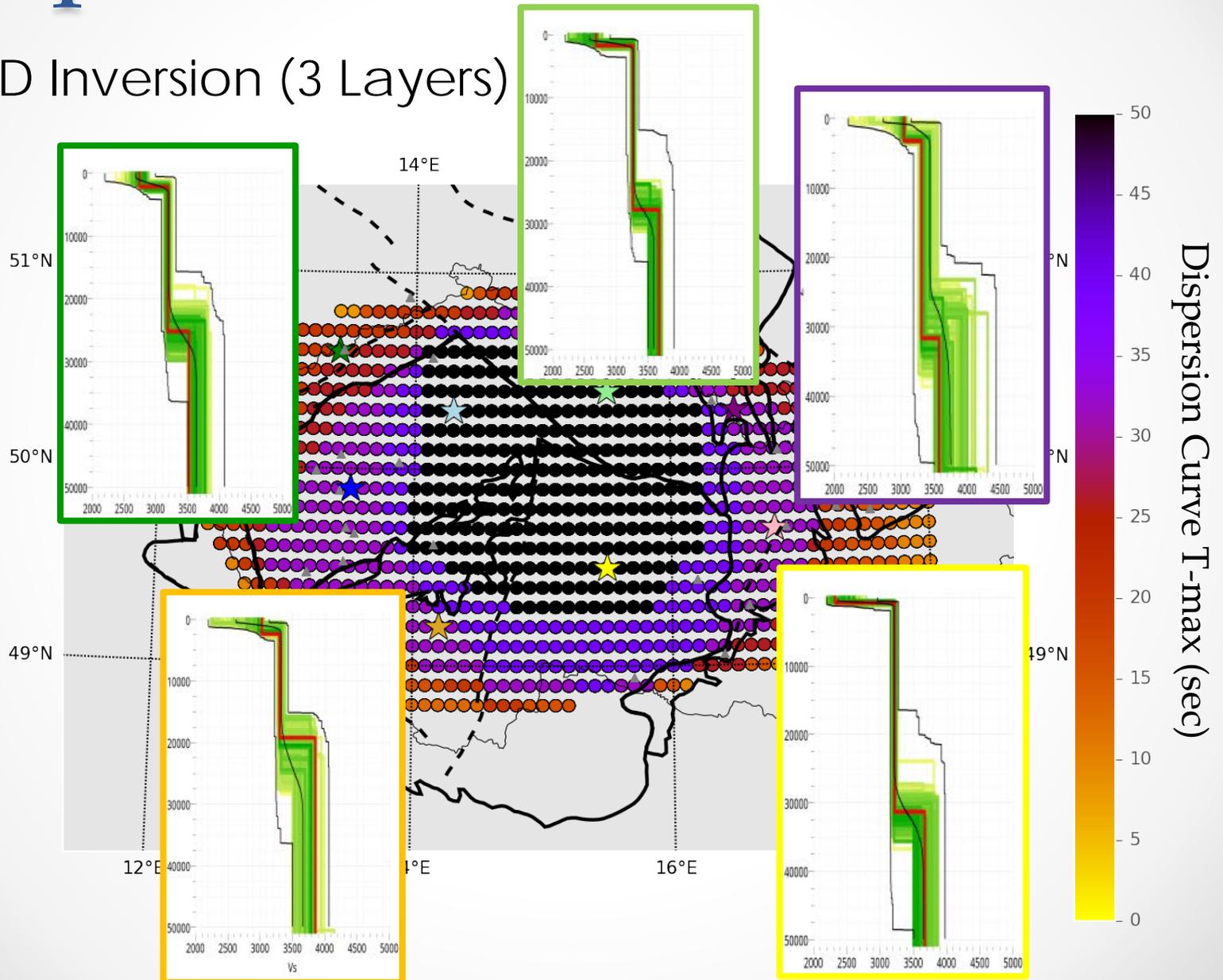
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# Dispersion Curve Inversion

- Fast Marching Surface wave Tomography (FMST)
  - Reconstruct sparse dispersions curves at regular surface locations
- Stochastic inversion (Geopsy)
  - 1D None-Linear Monte Carlo (Neighborhood Algorithm)
    - surface grid size 6' lon x 6' lat (aprox. 7x11km)
    - 3 layered model
    - 400 initial models x 300 iteration → 120 000 models

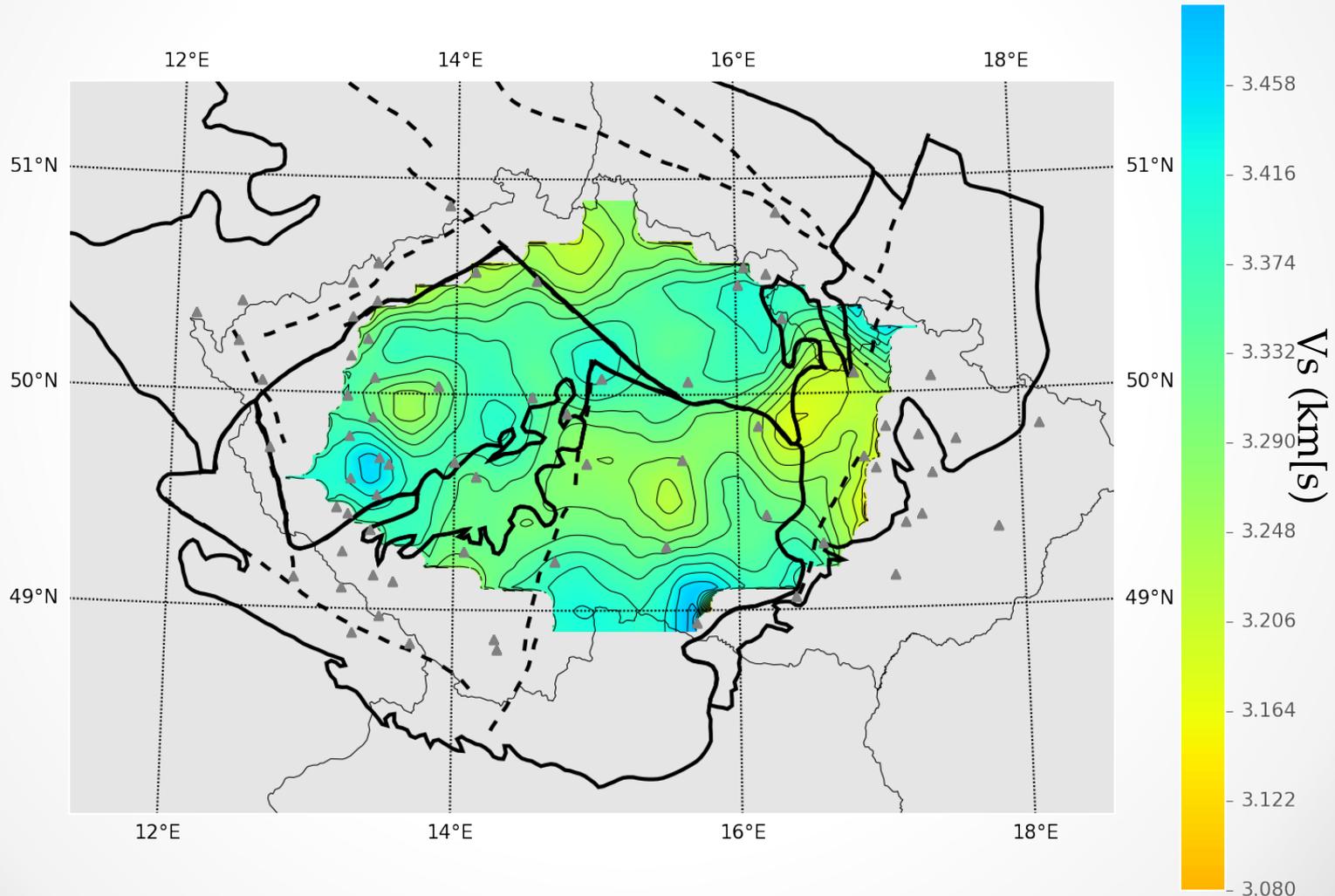
# Dispersion Curve Inversion

- 1D Inversion (3 Layers)



# Dispersion Curve Inversion

- V2 – “crust Vs”



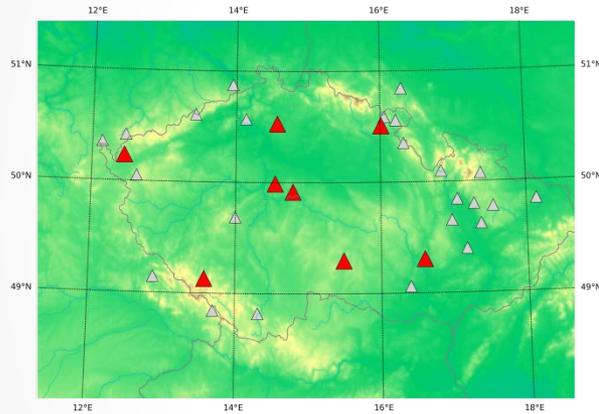
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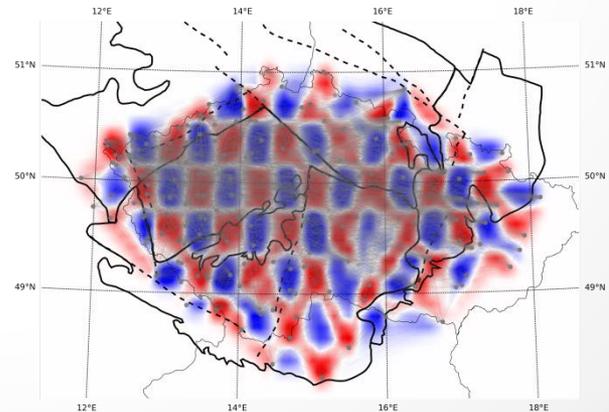
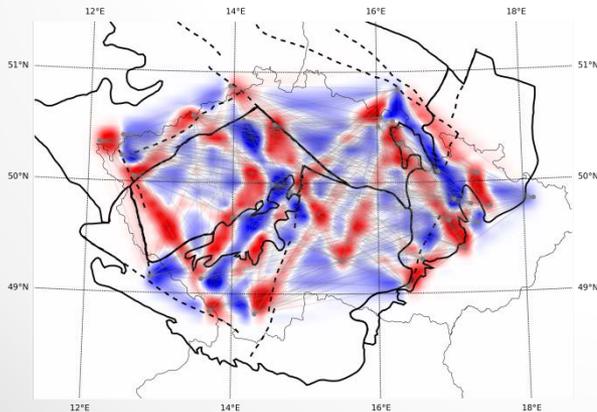
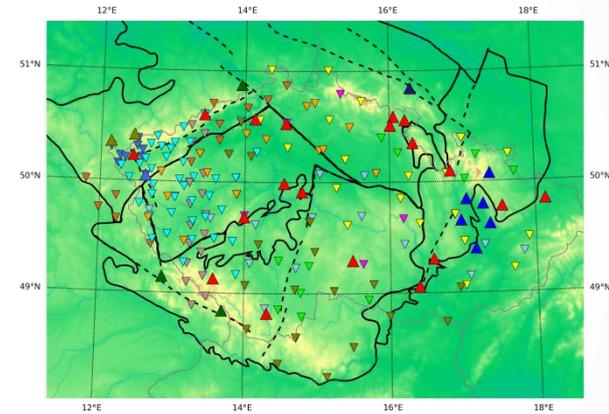
# Horizontal Resolution

- Checkerboard Test

Permanent stations only  
CRSN+

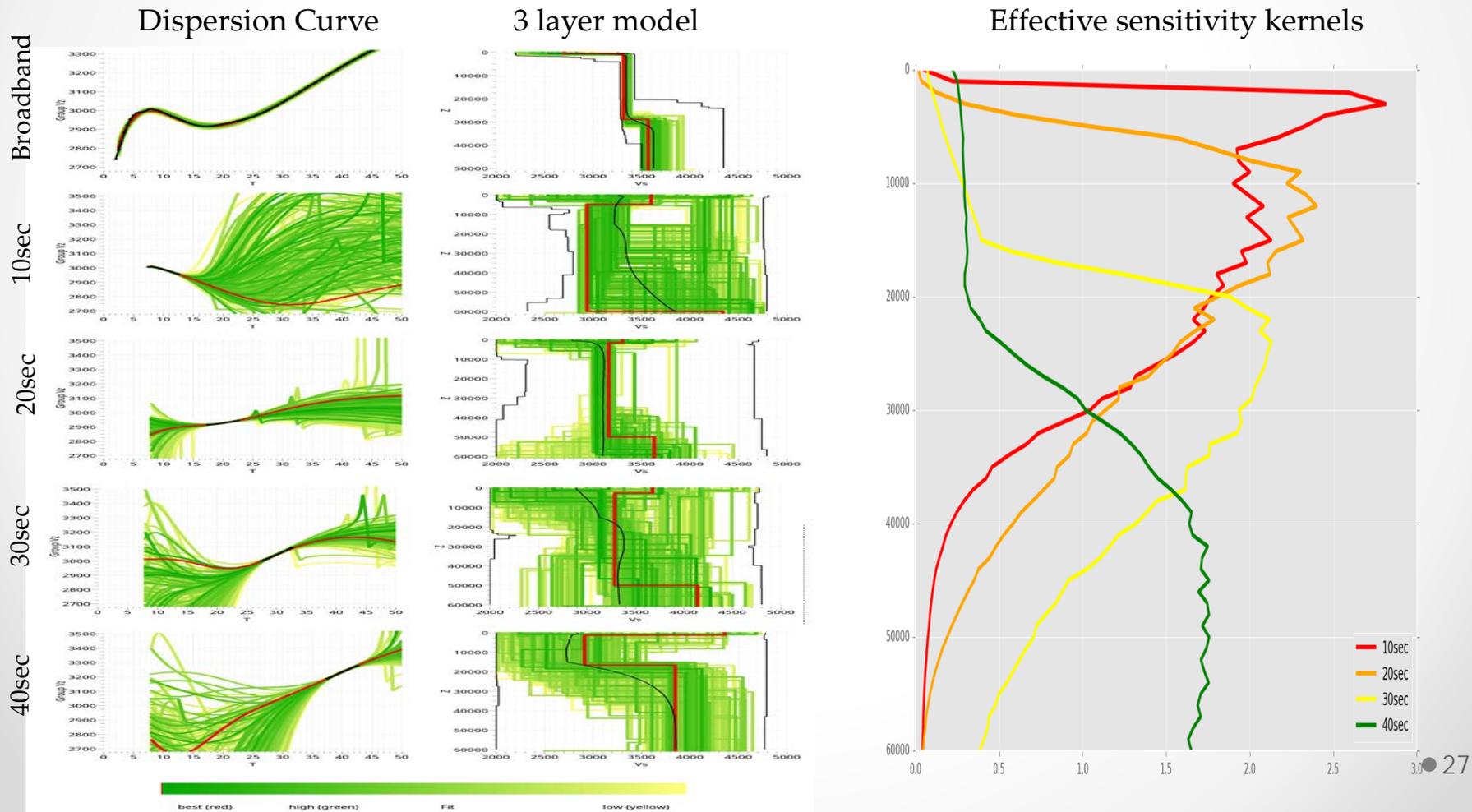


Permanent stations combined  
with temporary stations



# Depth Sensitivity

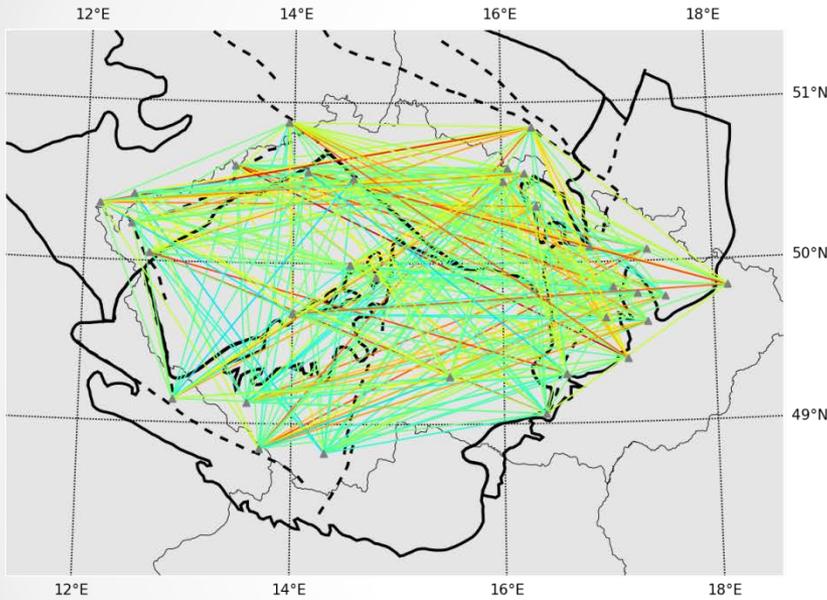
- Average BM dispersion curve split to narrow bands
- Explorative stochastic inversion
- Statistical measure of v-range(width) of 20% best models



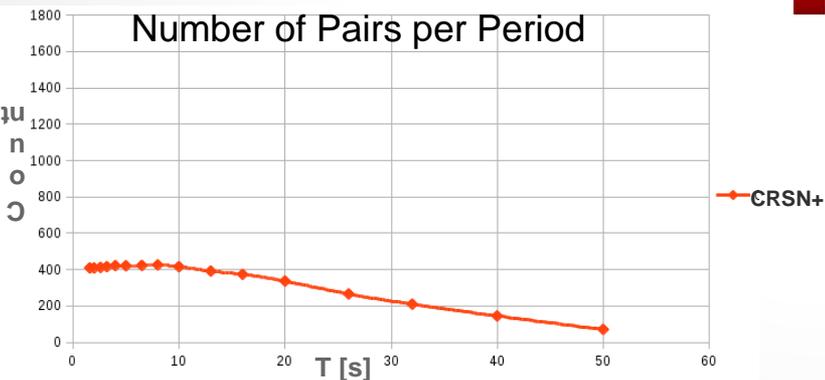
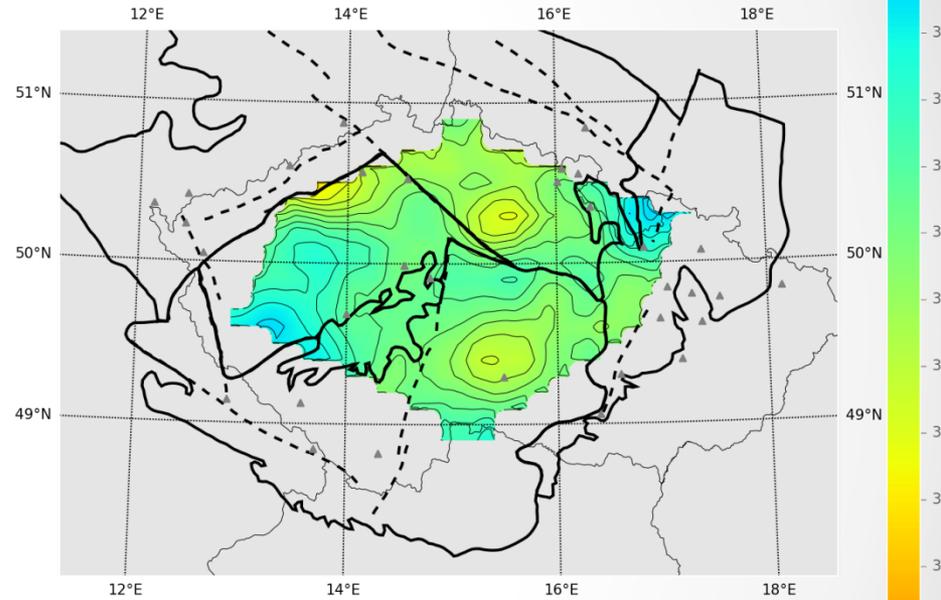
# Horizontal Resolution

- Permanent Stations only (CRSN+)

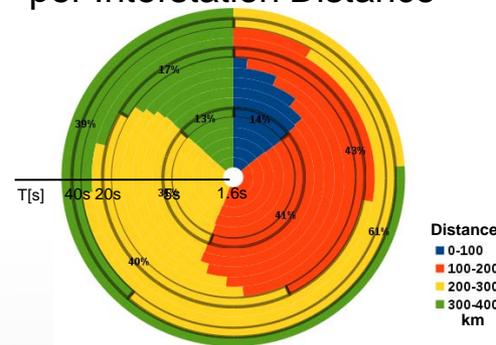
Group Velocity at T=20sec



Crust Vs (Best model V2)



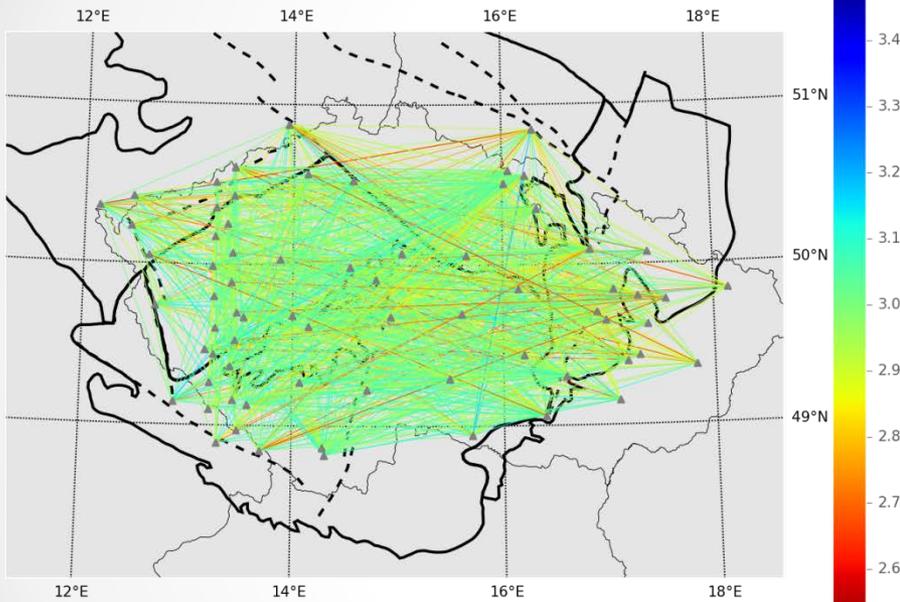
Number of Pairs per Period per Interstation Distance



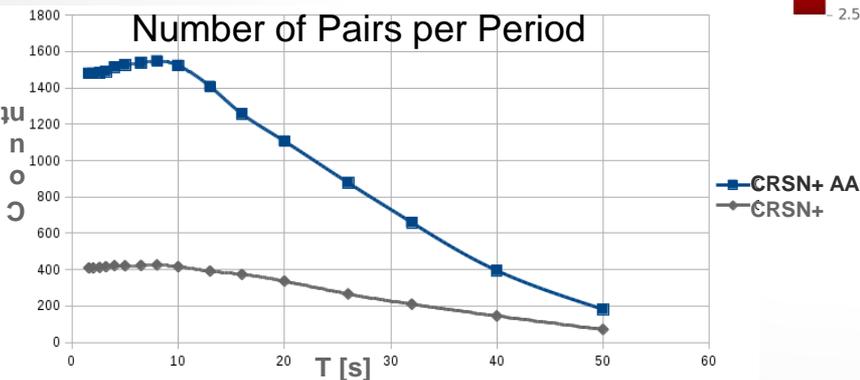
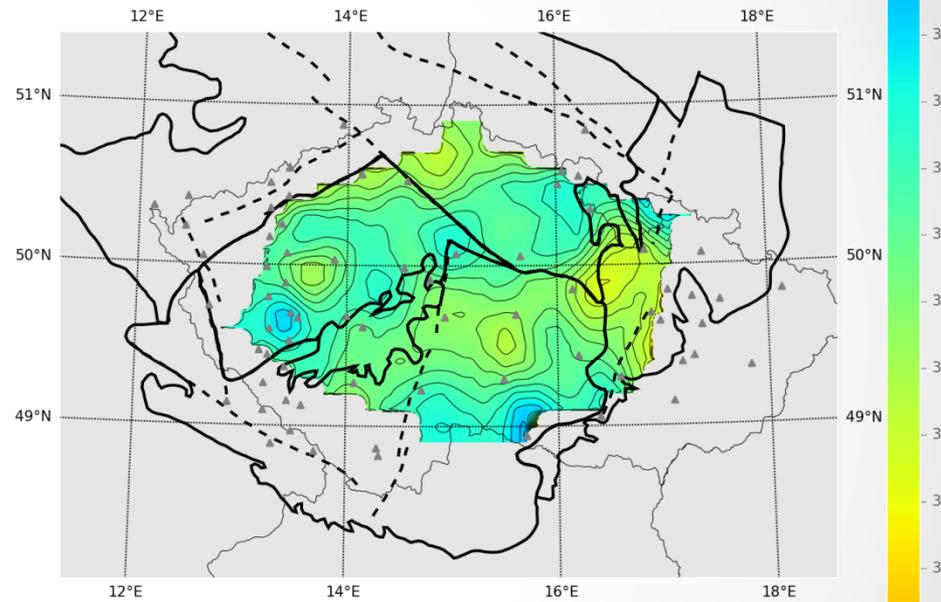
# Horizontal Resolution

- Permanent Stations combined with AlpArray (North)

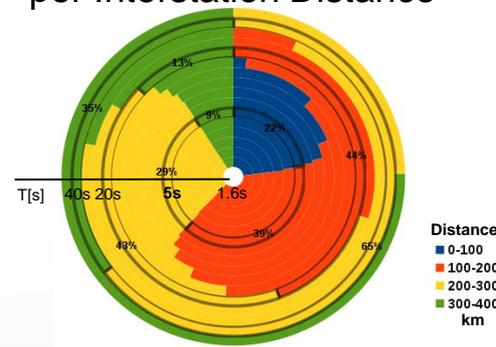
Group Velocity at T=20sec



Crust Vs (Best model V2)



Number of Pairs per Period per Interstation Distance



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# Conclusions

- Ambient noise tomography performed on data recorded in the Czech Republic gives fairly robust image of Crust velocity in the center of BM area.
- However, the spatial extent does not cover whole BM and depth sampling does not reliably reach lower crust / upper mantle boundary (MOHO).
- **In order to improve depth sampling and increase spatial extent of crustal Vs image we have to include data from surrounding international networks and large passive seismic experiments (e.g. AlpArray)**