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Simultaneous body and surface wave retrieval from the seismic ambient field and discrimination from unavoidably arising spurious artifacts

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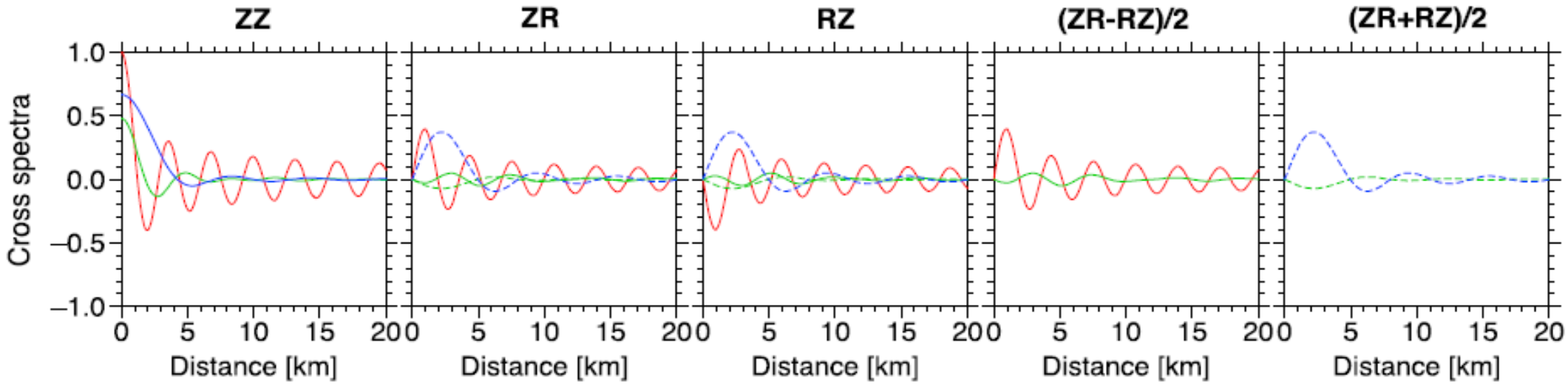
Passive seismic methods

- ✓ Using earthquakes
  - ➢ Micro-earthquakes → Local tomography → Velocity structure
  - ➢ Teleseismic earthquakes → Receiver functions → Image the deep structures
- ✓ Using seismic ambient noise
  - ➢ Retrieving the surface waves → Surface wave tomography → S wave velocity model
  - ➢ Retrieving the direct P phase → P-wave arrival-time tomography → P wave velocity model → Study of anisotropy, attenuation and monitoring
  - ➢ Retrieving the direct S phase → S-wave arrival-time tomography → S wave velocity model
  - ➢ Retrieving the reflection P phase → Imaging → Identification of the layers

What is the main aim of this research?

- ✓ Using the polarization method, we retrieve both P and surface waves from recorded seismic ambient fields.

Advantage of polarization method in retrieving of the seismic phases



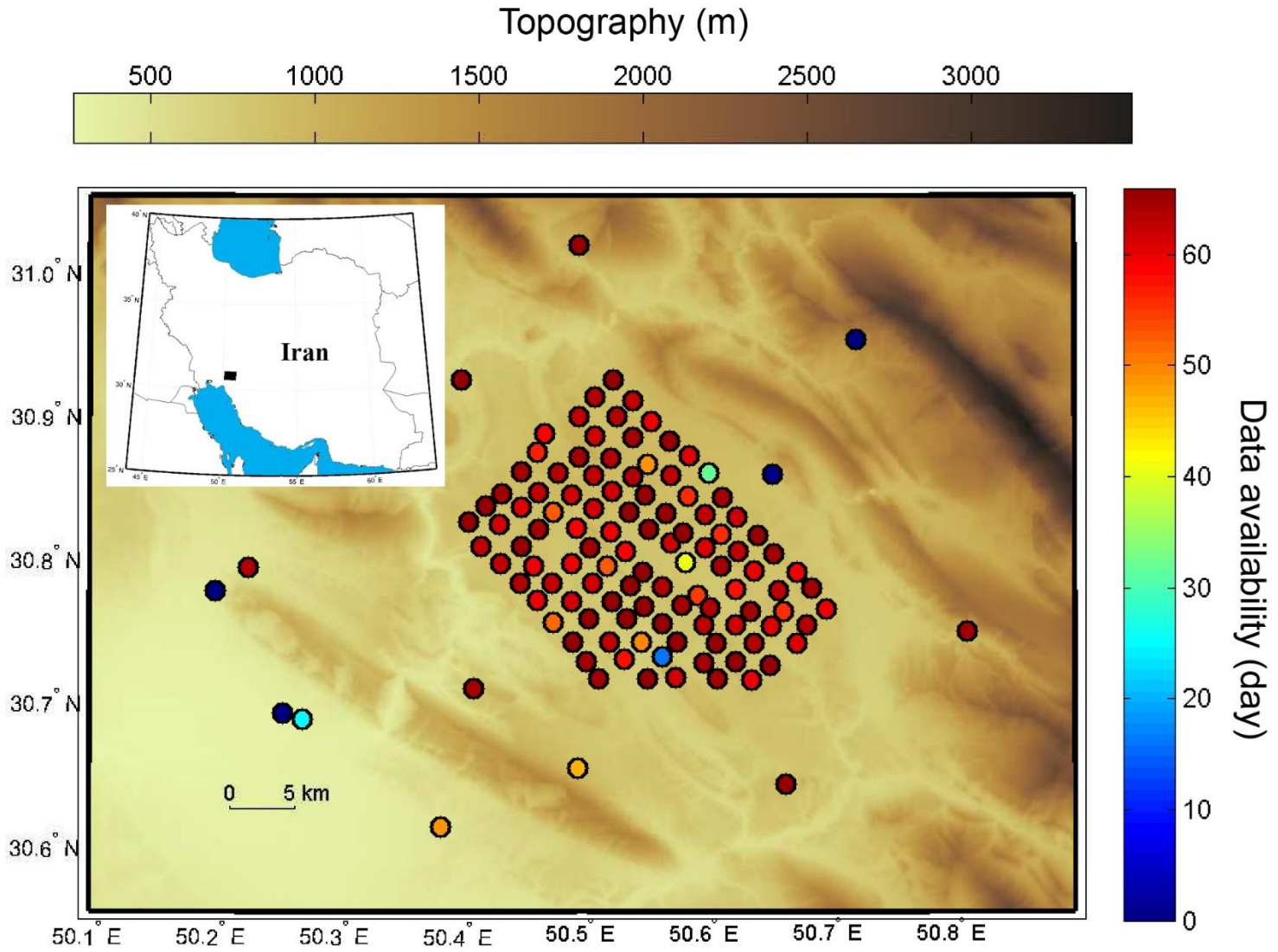
Red: Rayleigh wave
Blue: P wave
Green: S wave
Solid line: real part
Broken line: imaginary part

Enhance of the P: $\frac{ZR+RZ}{2}$

Enhance of the Rayleigh wave: $\frac{ZR-RZ}{2}$

Takagi et al., (2014)

Dehdasht: the studied area

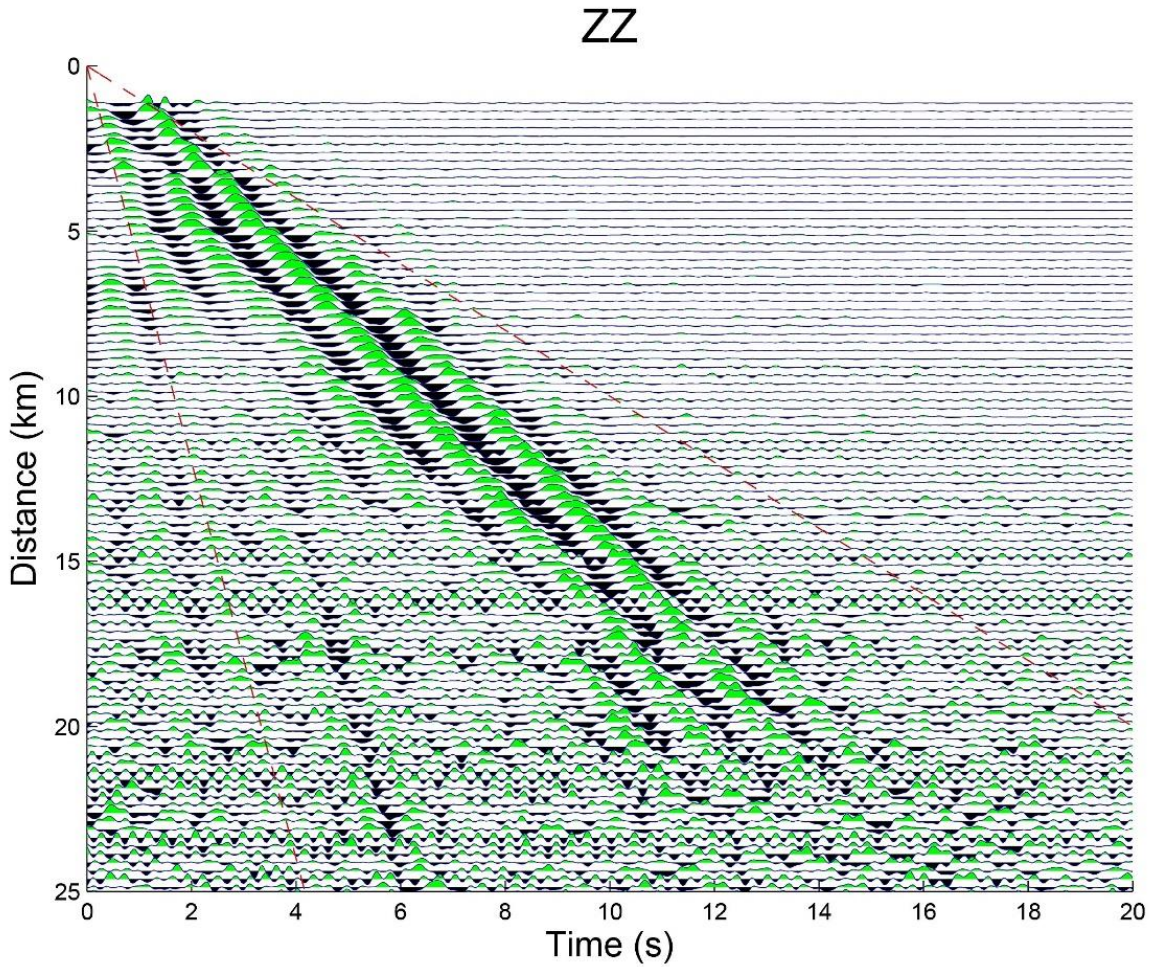


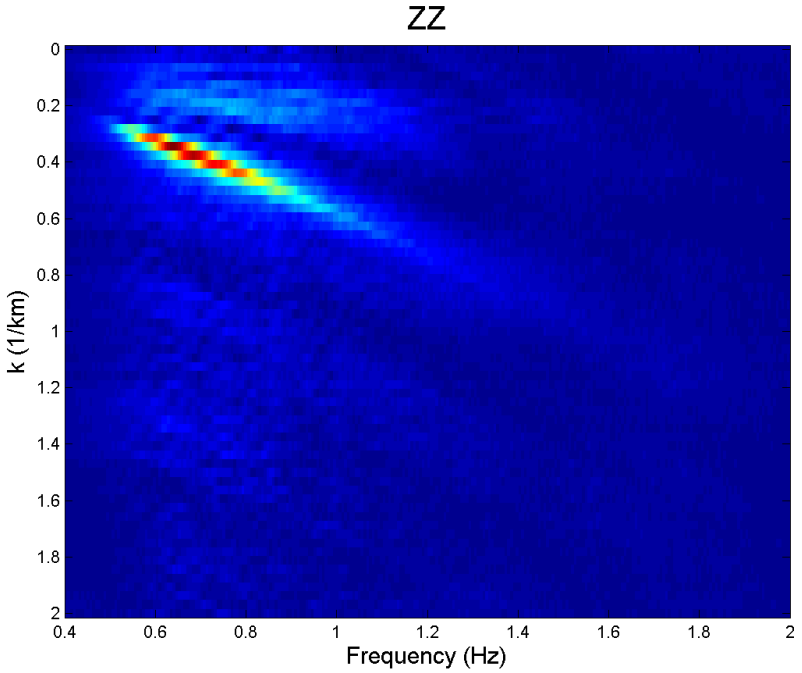
Here we only used 15 consecutive days data

Pre-processing and calculation of the empirical Green's function

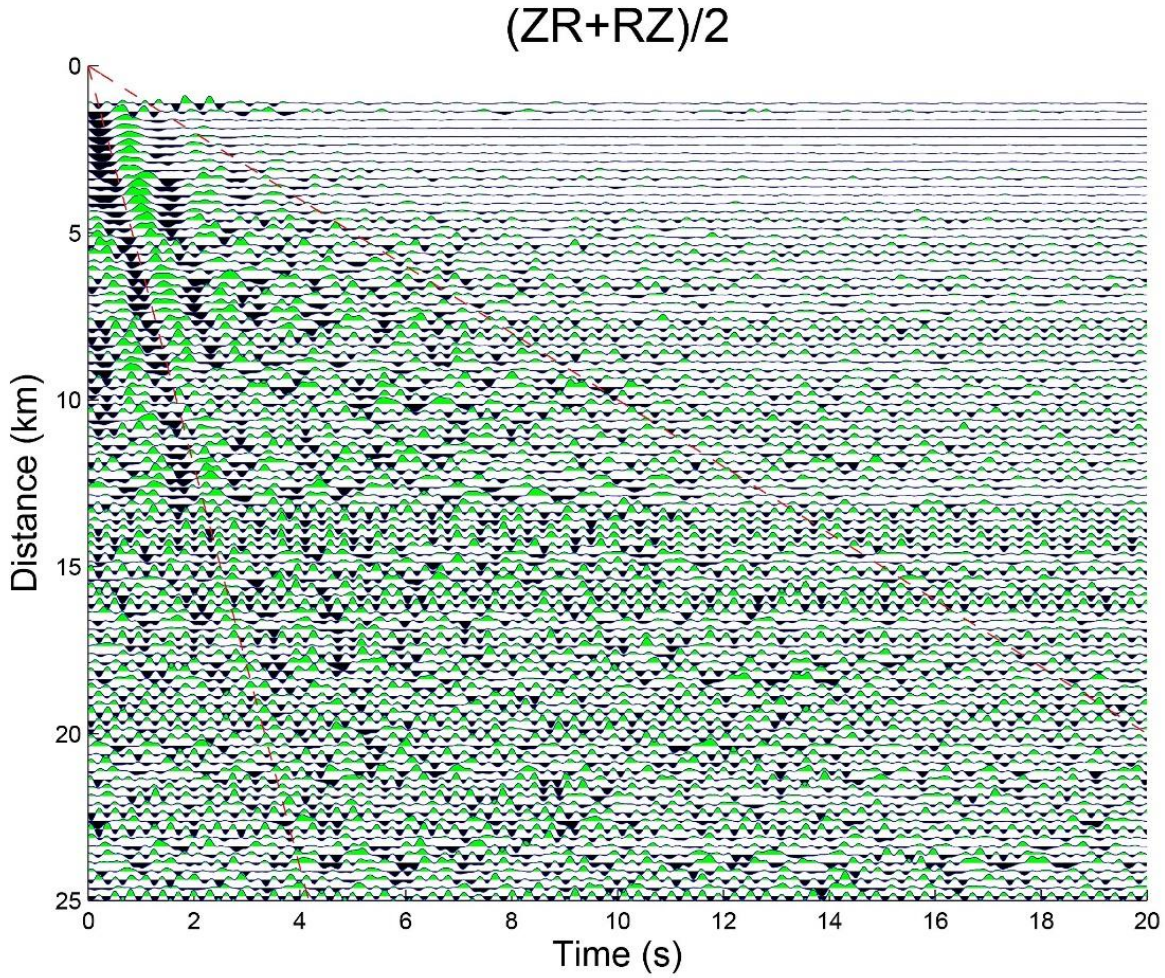
- Decimation of the data to 25 sps
- 10 min windowing (with no overlap)
- Removing the base-line and trend offsets
- Filtering the signals in the frequency range of 0.5-12 Hz
- Applying one-bit normalization
- Calculating the empirical Green's functions between pair of stations for ZZ, ZR, RZ, and TT, using cross-coherency method of Nakata et al., (2015)
- Calculating the (ZR+RZ)/2 and (ZR-RZ)/2 to enhance P and Rayleigh waves, respectively (Takagi et al., 2014)
- Bin-stack of all the virtual sources – all the virtual receivers with bin space of 250 m

Observation of the retrieved phases ZZ

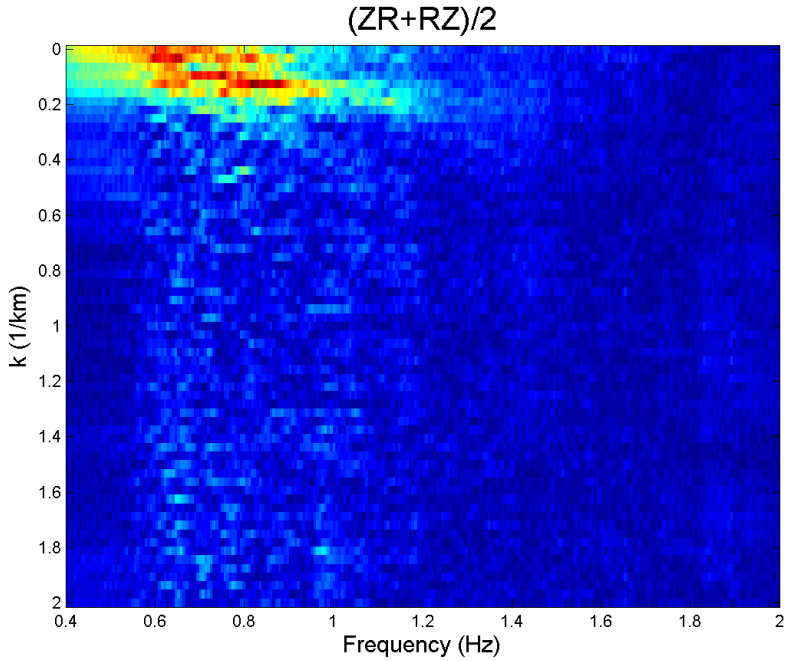




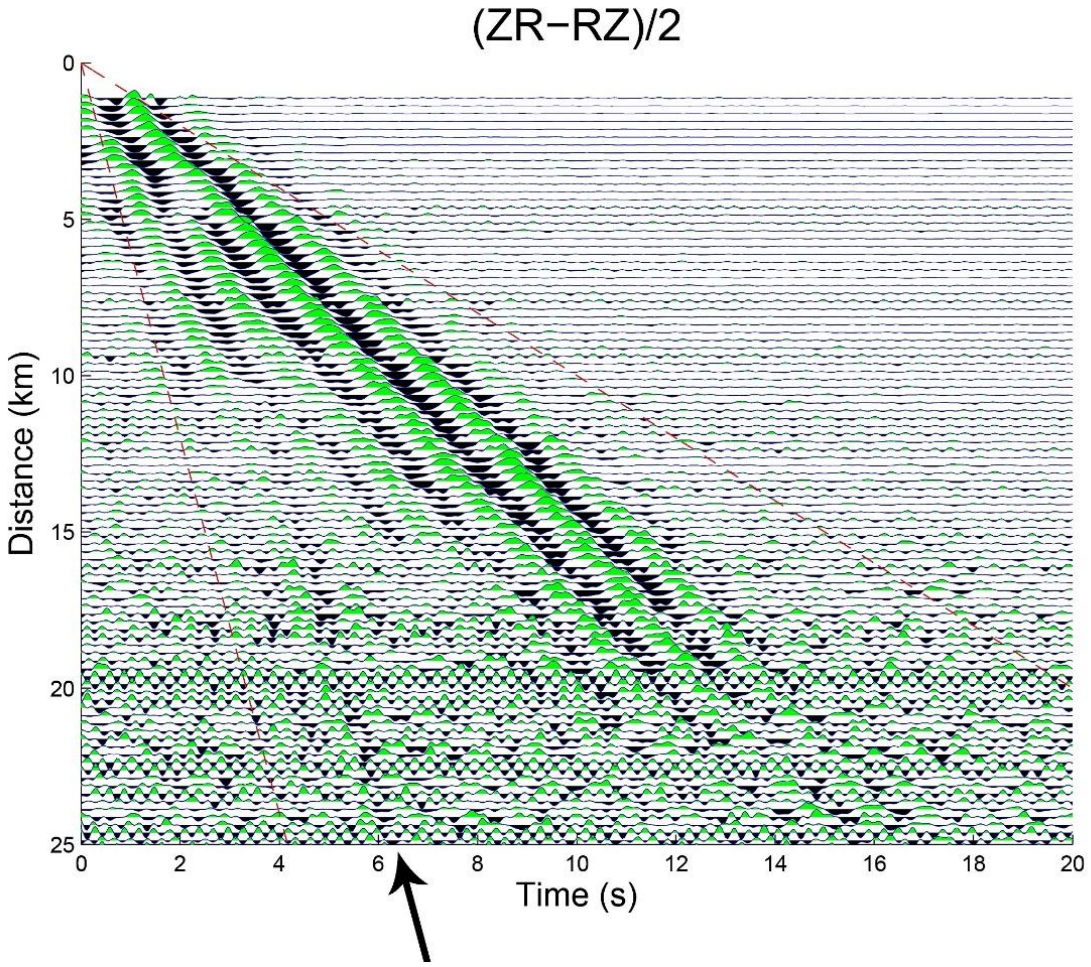
Observation of the retrieved phases (ZR+RZ)/2



P wave: 4.9±0.3 km/s

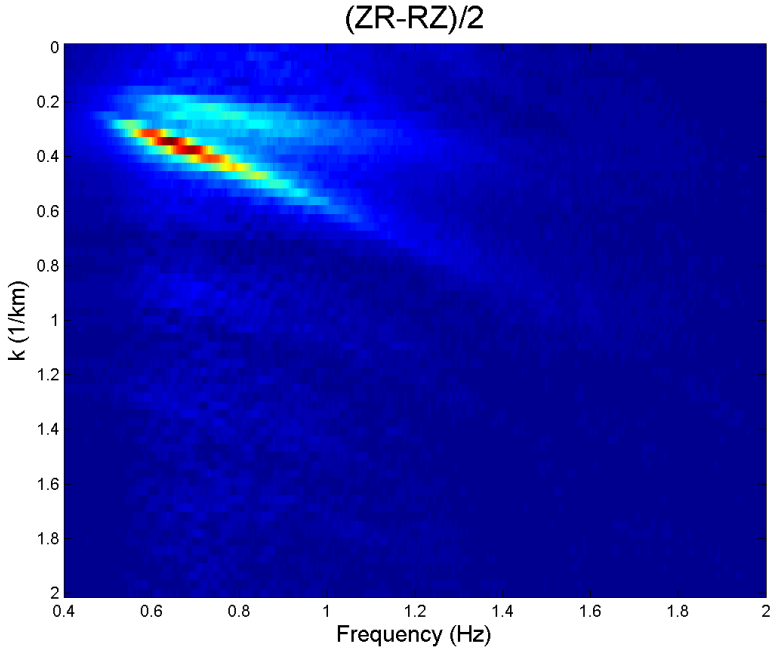


Observation of the retrieved phases (ZR-RZ)/2

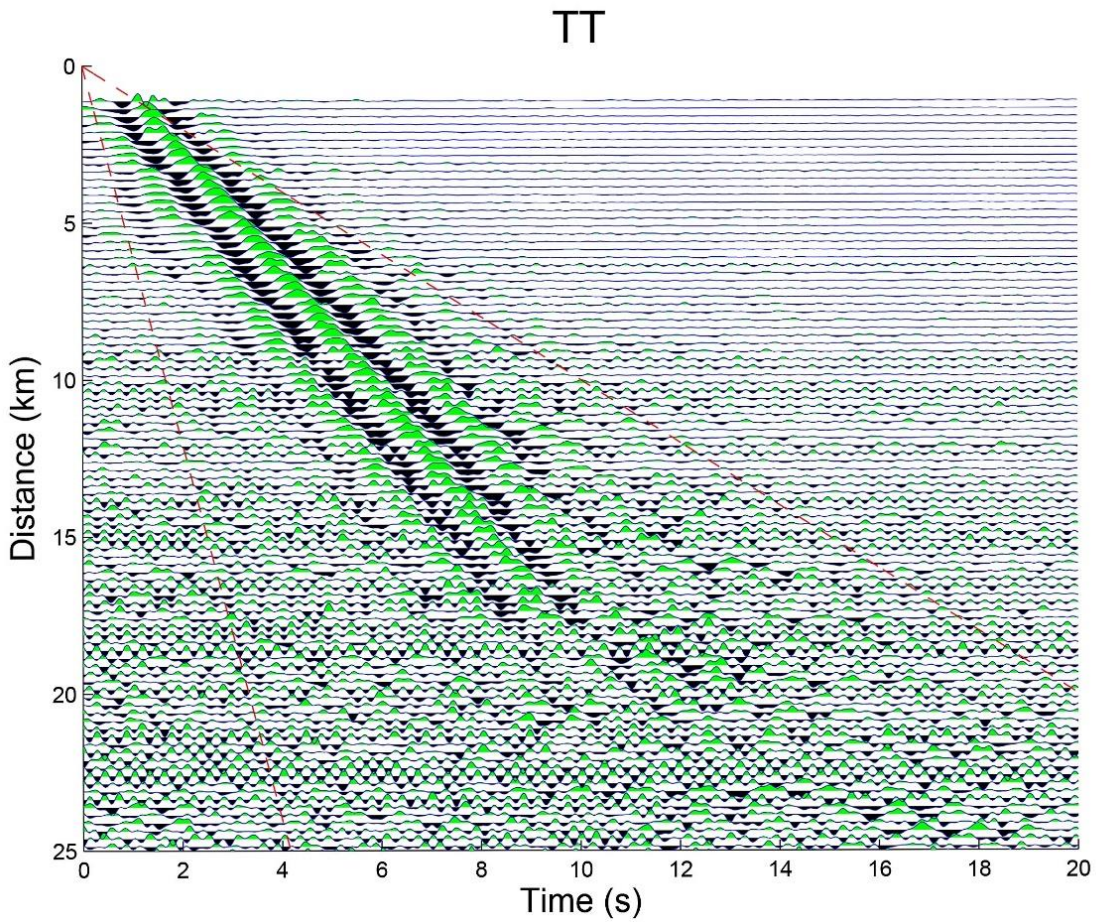


Rayleigh wave: 1.8±0.1 km/s

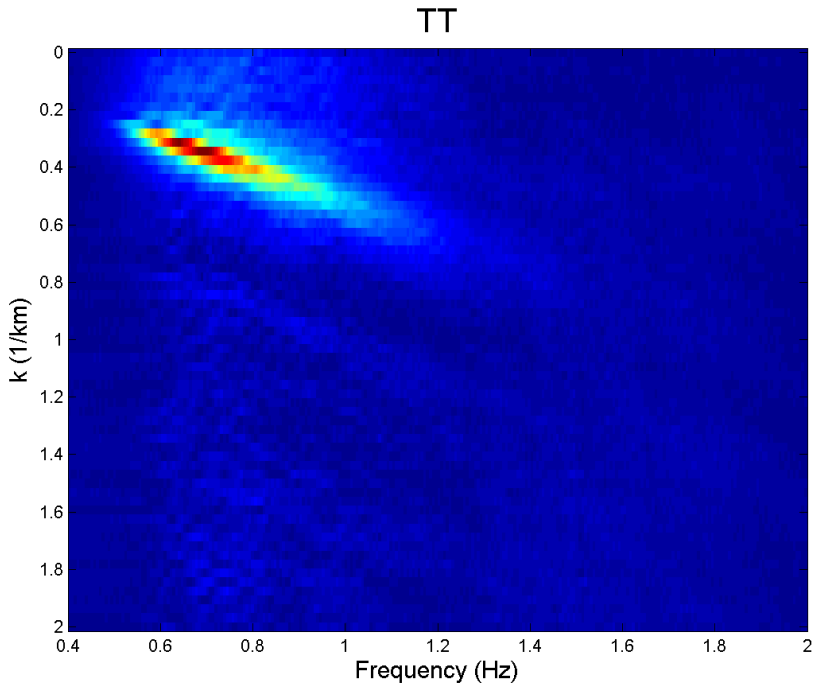
? : 4.1±0.1 km/s



Observation of the retrieved phases
TT

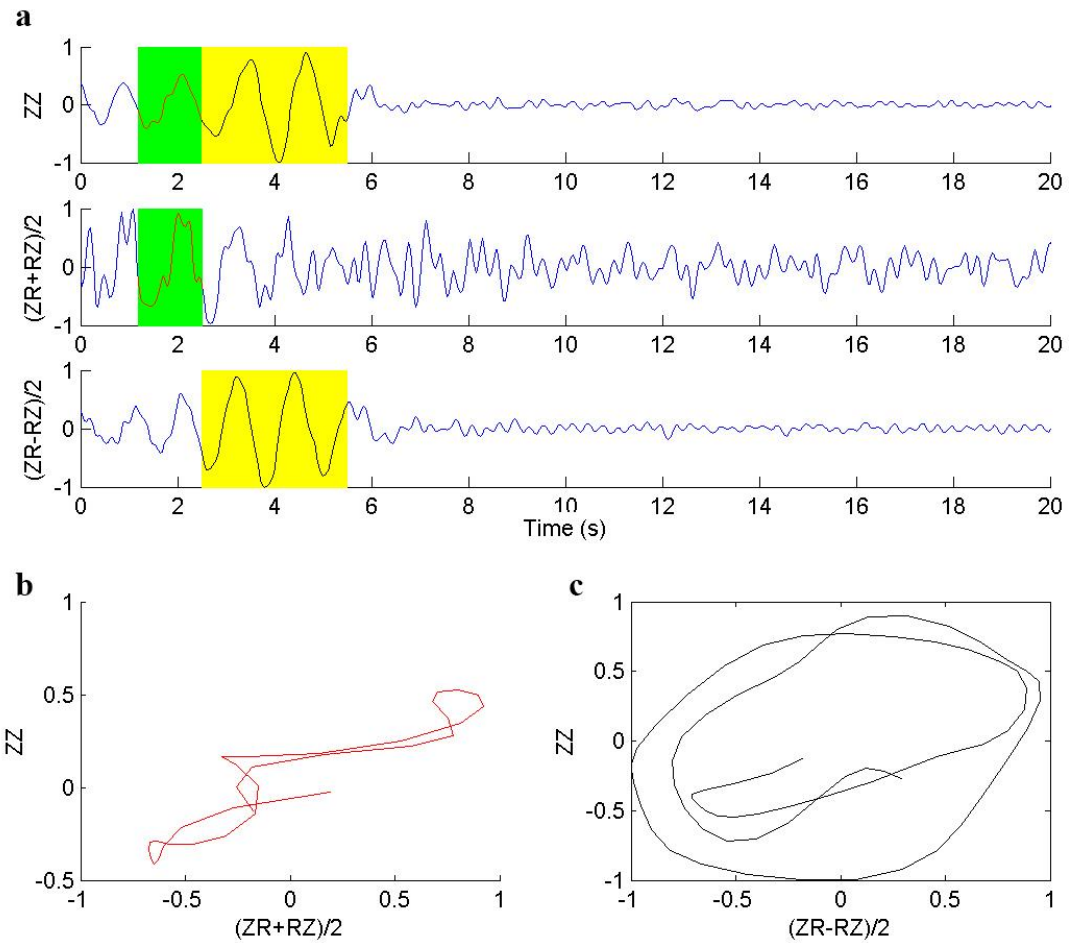


Love wave: 2.0±0.1 km/s



Cross-checking the results by investigation of the particle motion

That traces related to the distance of 6.375 km



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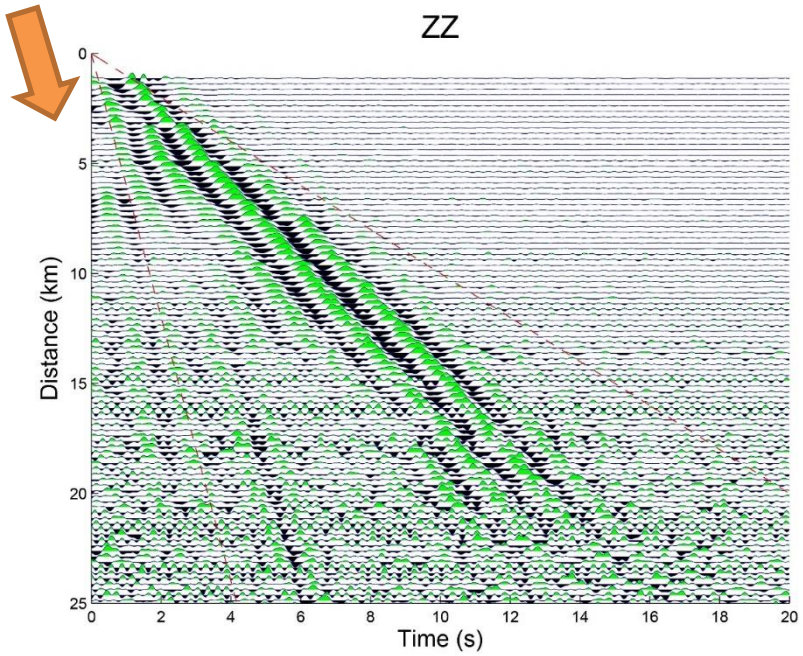
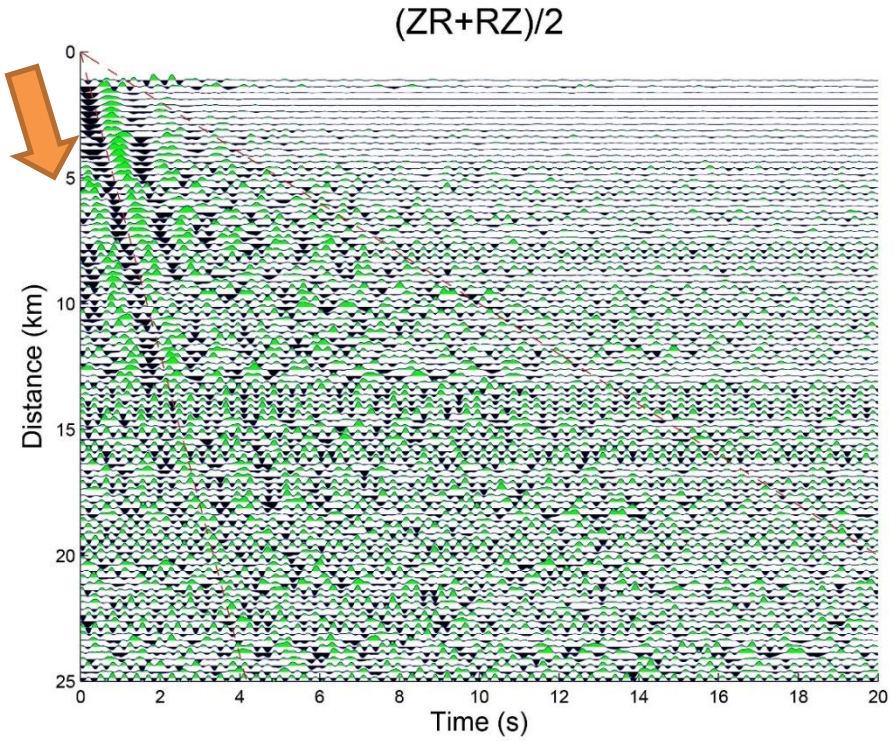
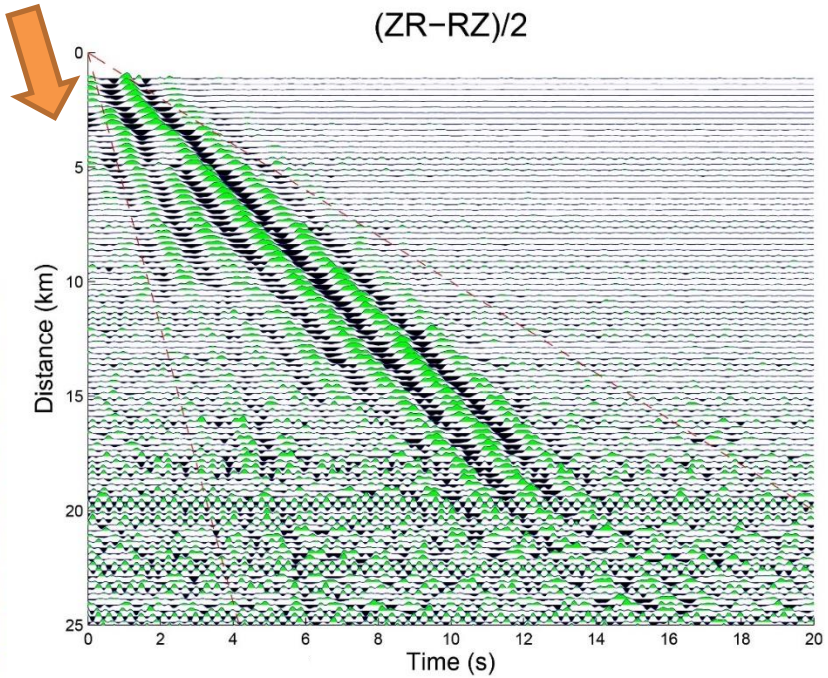
Observation of the artifact cross-terms







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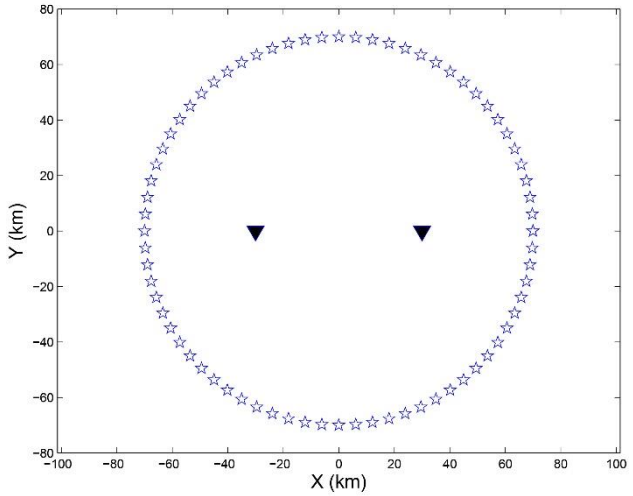
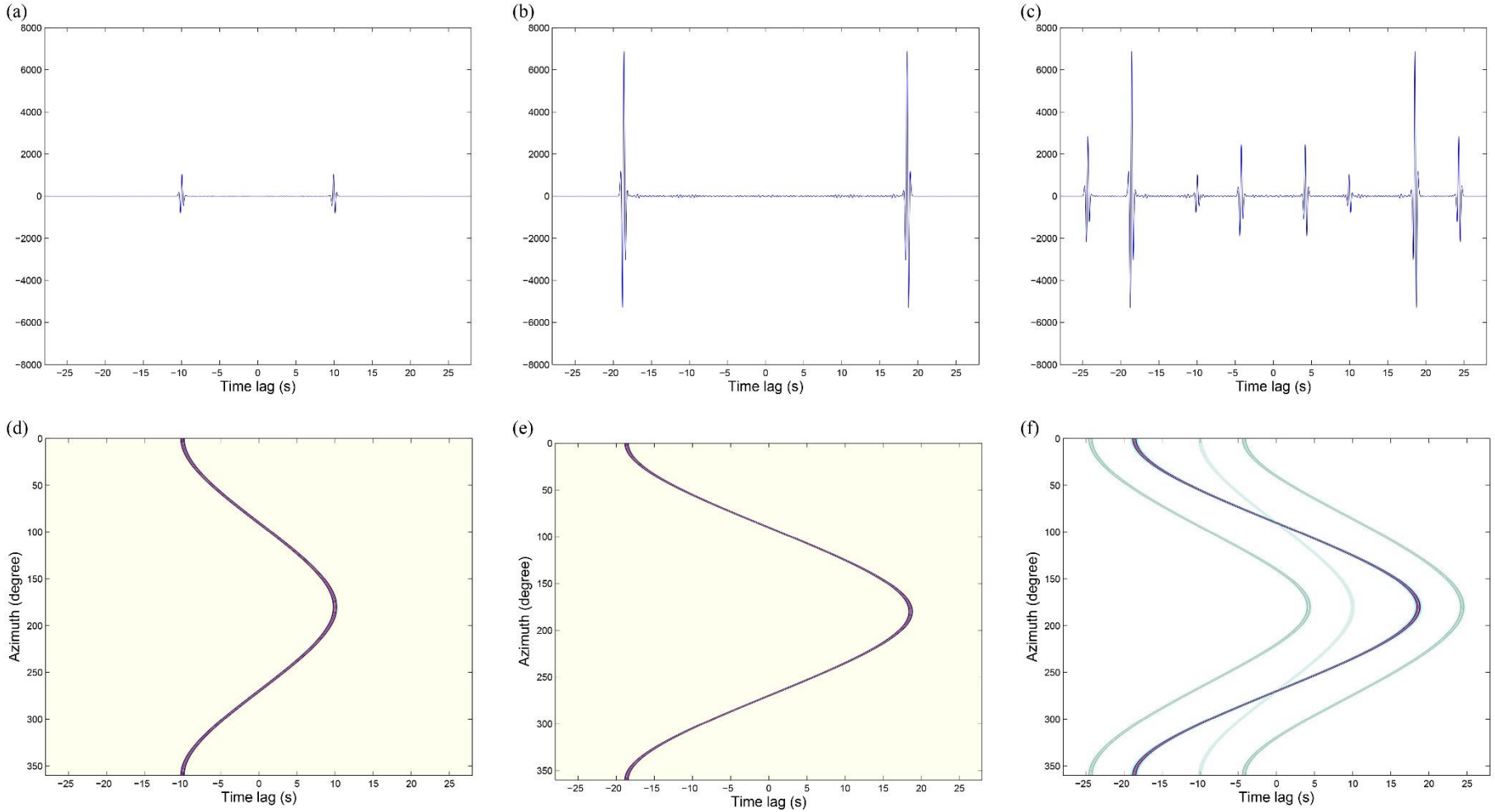
Synthetic test for deeper understanding the artifact cross-terms





Conclusions

- ✓ The observed apparent velocity of the P and Rayleigh wave in the Dehdasht area is around 4.9±0.3 and 1.8±0.1 km/s, respectively, as well as the observed S or high mode of Rayleigh wave apparent velocity is around 4.1±0.1 km/s.
- ✓ The energy of the retrieved direct P wave is limited up to around 1.2 Hz.
- ✓ Using the efficient processing and polarization properties, the direct P wave can be retrieved by using even a few days seismic ambient noise data.

What will we do next steps?

- ✓ Improving the synthetic test to further investigate the cross-terms characteristics and investigate the possibility of cancelation of them.
- ✓ Improving the retrieved P wave by applying selection filter and adaptive covariance filter
- ✓ Picking the retrieved P waves
- ✓ Providing the 3D tomography