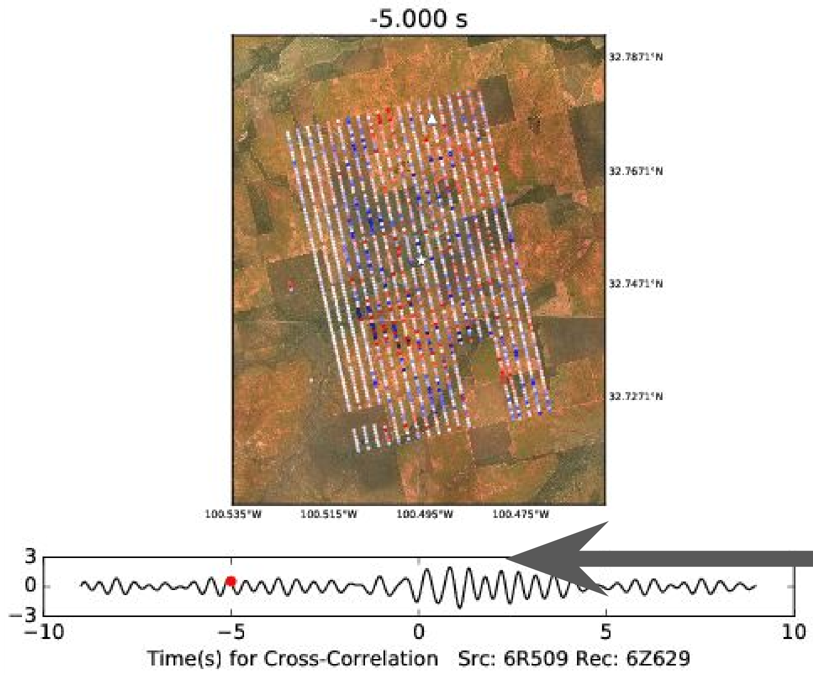
Instructor: Fan-Chi Lin

Quantify the Particle Motions of Oklahoma Array

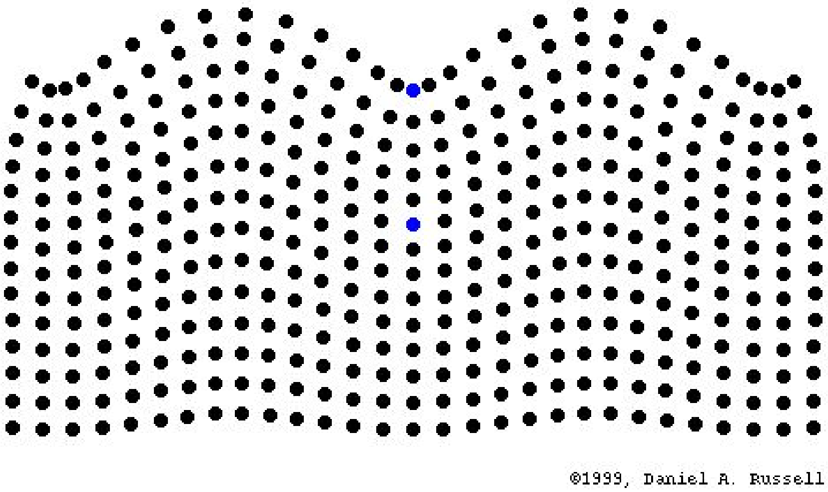
Chenyu Lisa Elizabeth Weisen

Quantify the Particle Motions of Oklahoma Array

Particle motions observed at Sweet Water Array
(ambient noise cross-correlations)
Courtesy of Fan-Chi



Rayleigh wave particle motion



Rayleigh waves

Quantify the Particle Motions of Oklahoma Array

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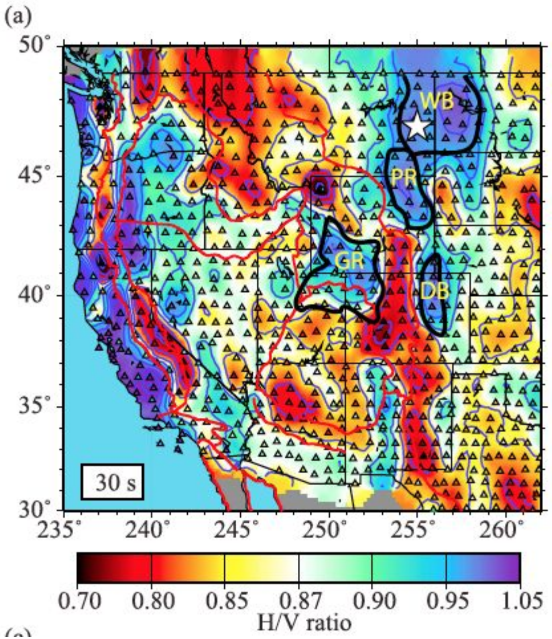
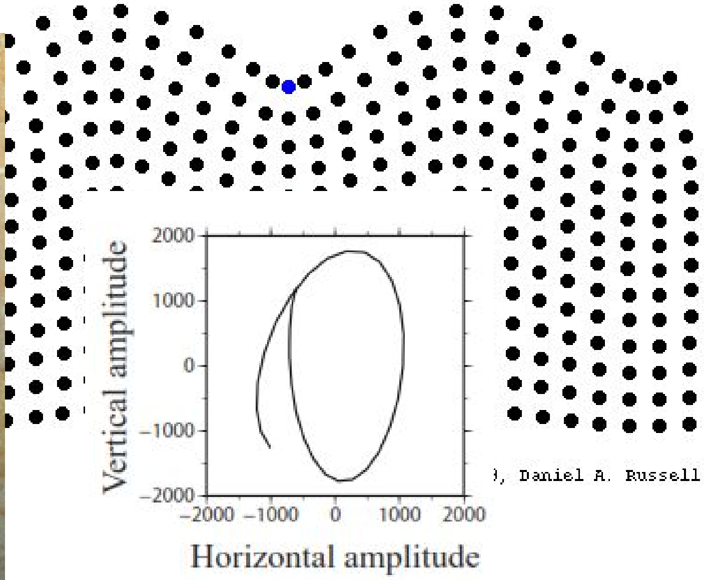
Joint inversion of Rayleigh wave phase velocity and ellipticity using USArray: Constraining velocity and density structure in the upper crust

Fan-Chi Lin,[1] Brandon Schmandt,[1] and Victor C. Tsai[1]

Rayleigh wave particle motion

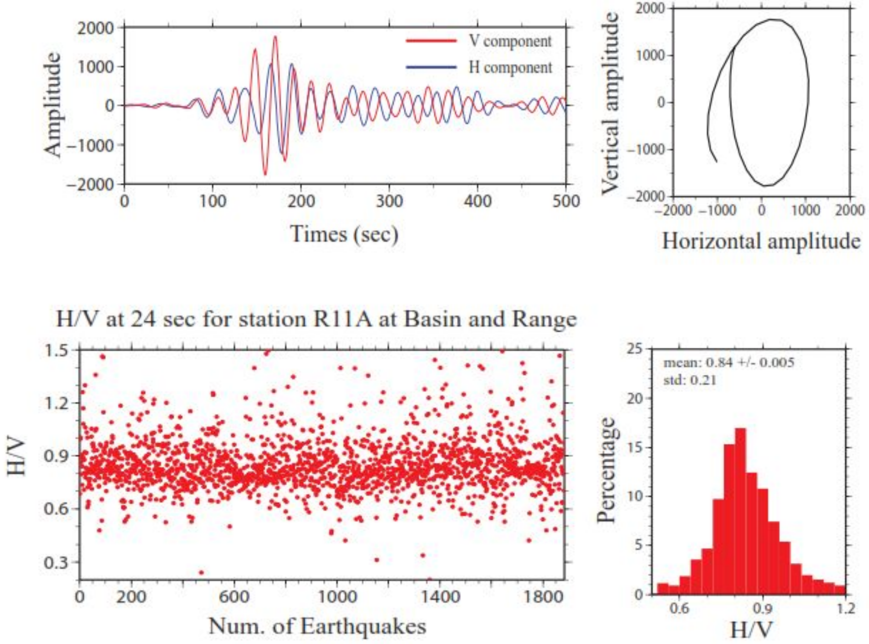


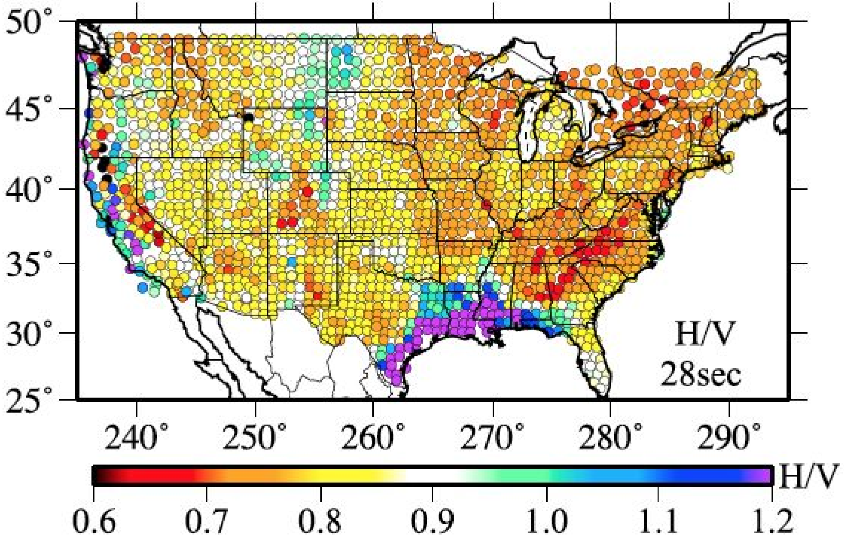


Quantify the Particle Motions of Oklahoma Array

How is it measured for USArray ?

Can it be measured for the Oklahoma array ?





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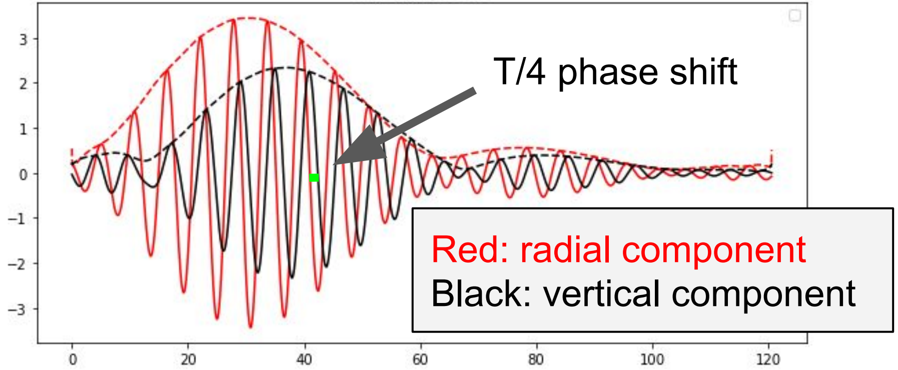
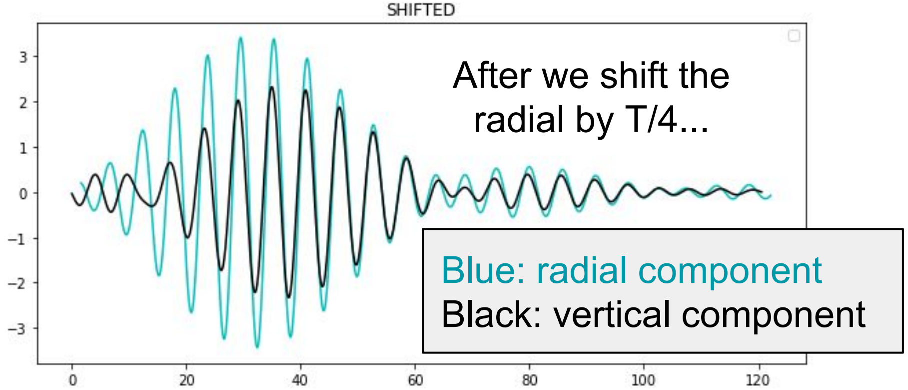
Can we observe surface wave at Oklahoma Array ?

Yes !

Station: Node 1001
Event: 2016-7-8T22:29:38
Bandpassed near 6 sec





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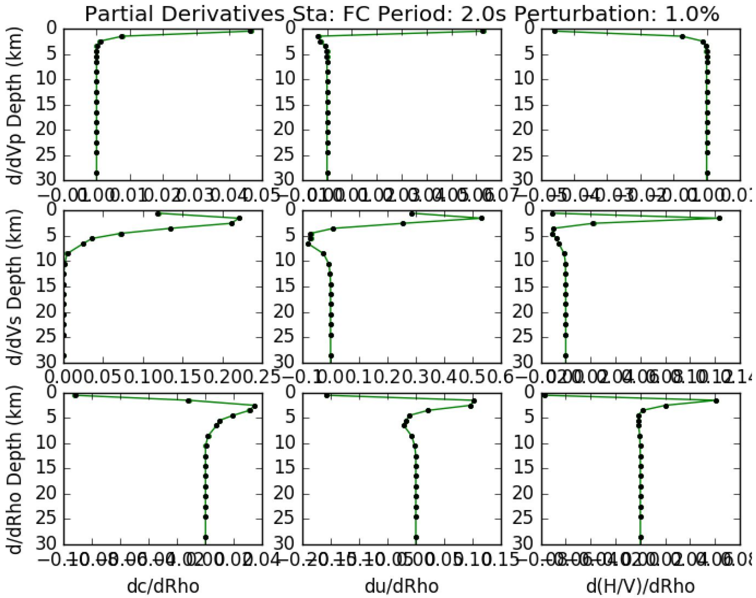
Sensitivity Kernels, group velocity, phase velocity and H/V are sensitive to Vp, Vs, density with depth

Group Phase H/V

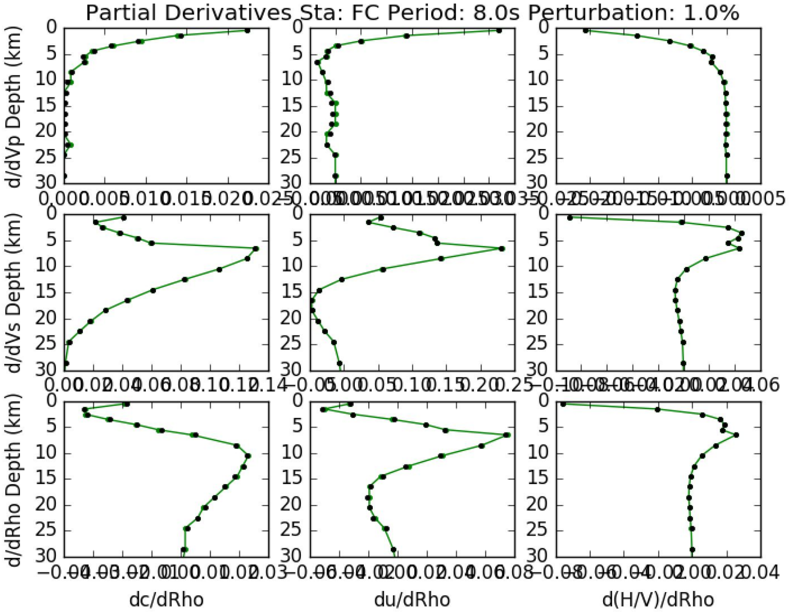
Vp

Vs

Density



Group Phase H/V



H/V of 2s is sensitive to Vs at ~2km
H/V of 8s is sensitive to Vs at ~5 to 10km

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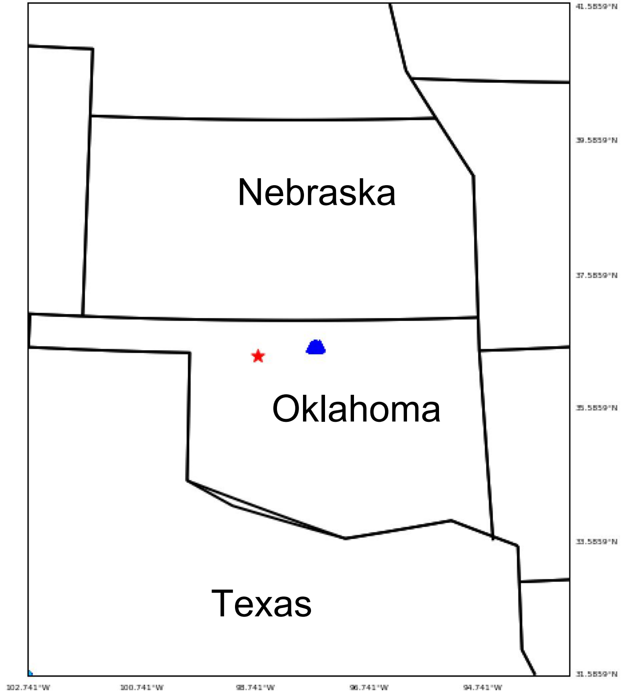
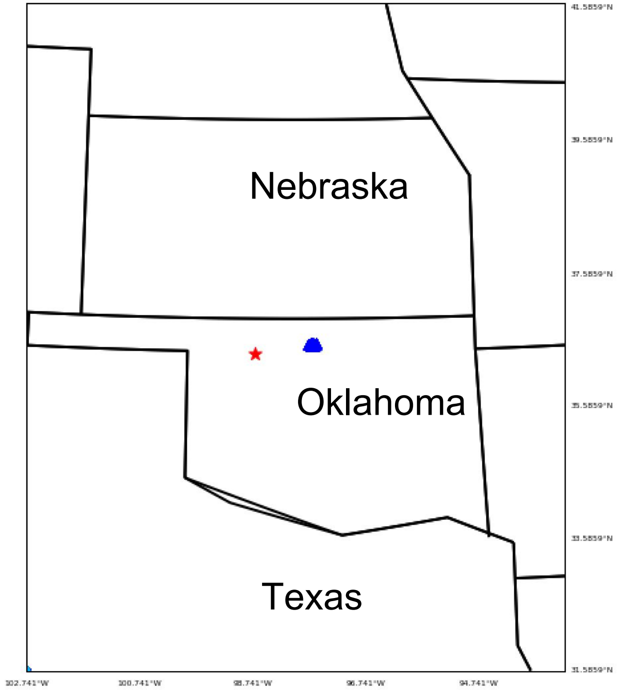
Event 1
2016/7/8,21:31:57
lon=-98.73901; lat= 36.47656

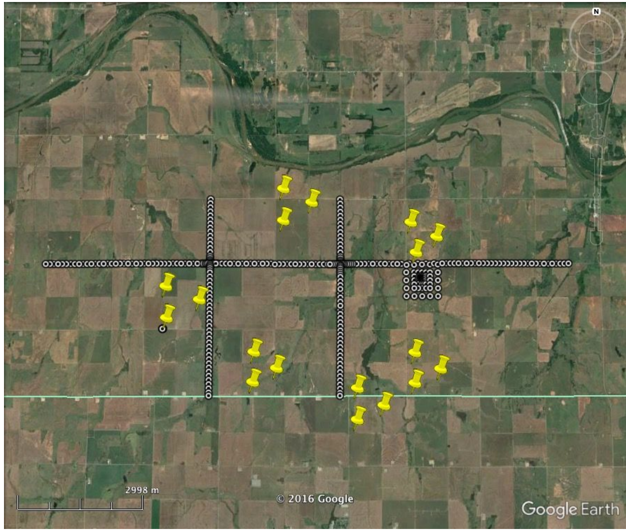


Event 2
2016/7/8,22:29:38
lon=-98.7459; lat=36.4749



Stations

Events



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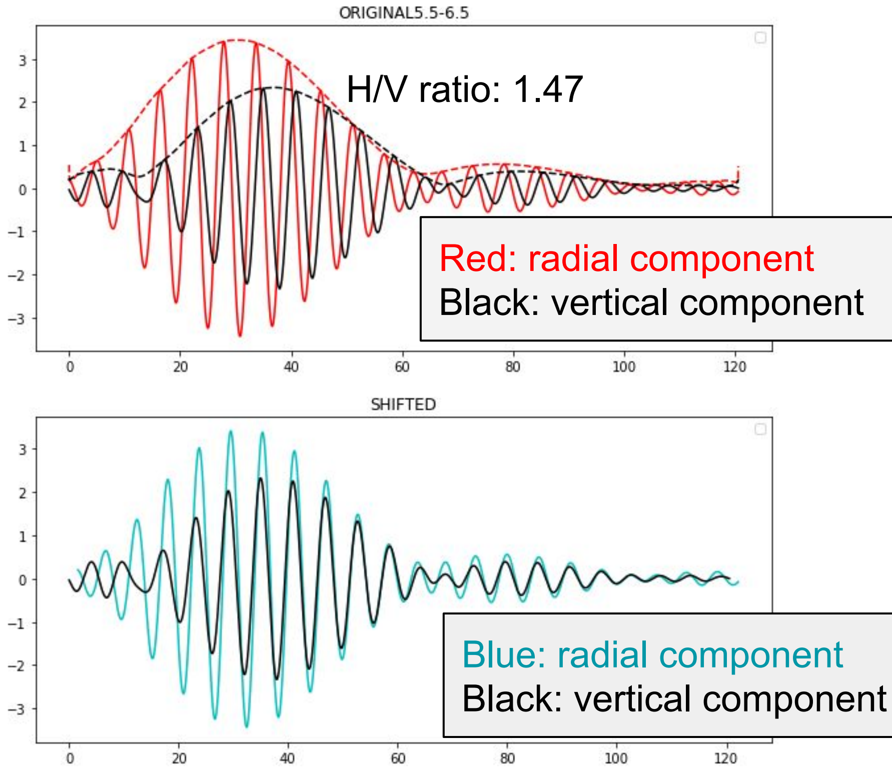
Traditional Method:

Calculate the envelope function of Rayleigh wave for radial and vertical components;

Find the peak amplitudes of each envelope;

Divide them.



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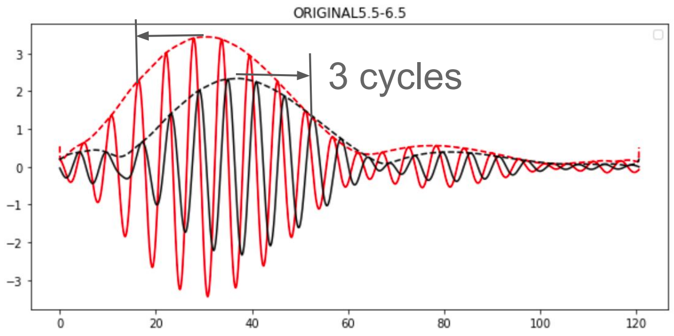
For every station at 10 frequency ranges (1-10s):

- download the data, rotate
- narrow bandpass
- calculate the envelope
- Recut to 3 cycles of either side of the H,V envelopes
- Then we shift by 90º to align the R and Z seismograms
- linear regression



ObsPy
A Python Framework for Seismology

jupyterhub

SciPy.org
Sponsored By ENTHOUGHT

spyder

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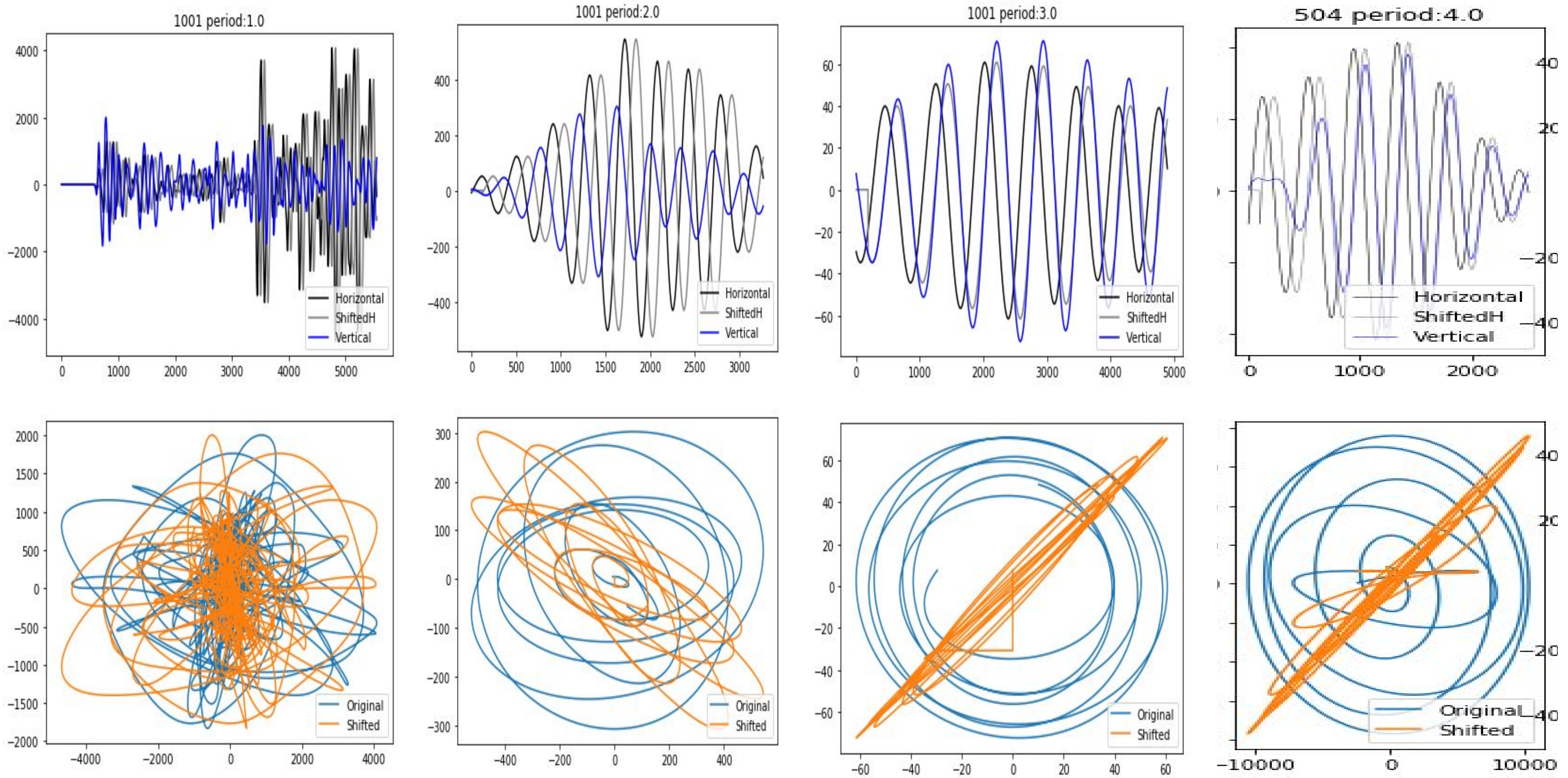

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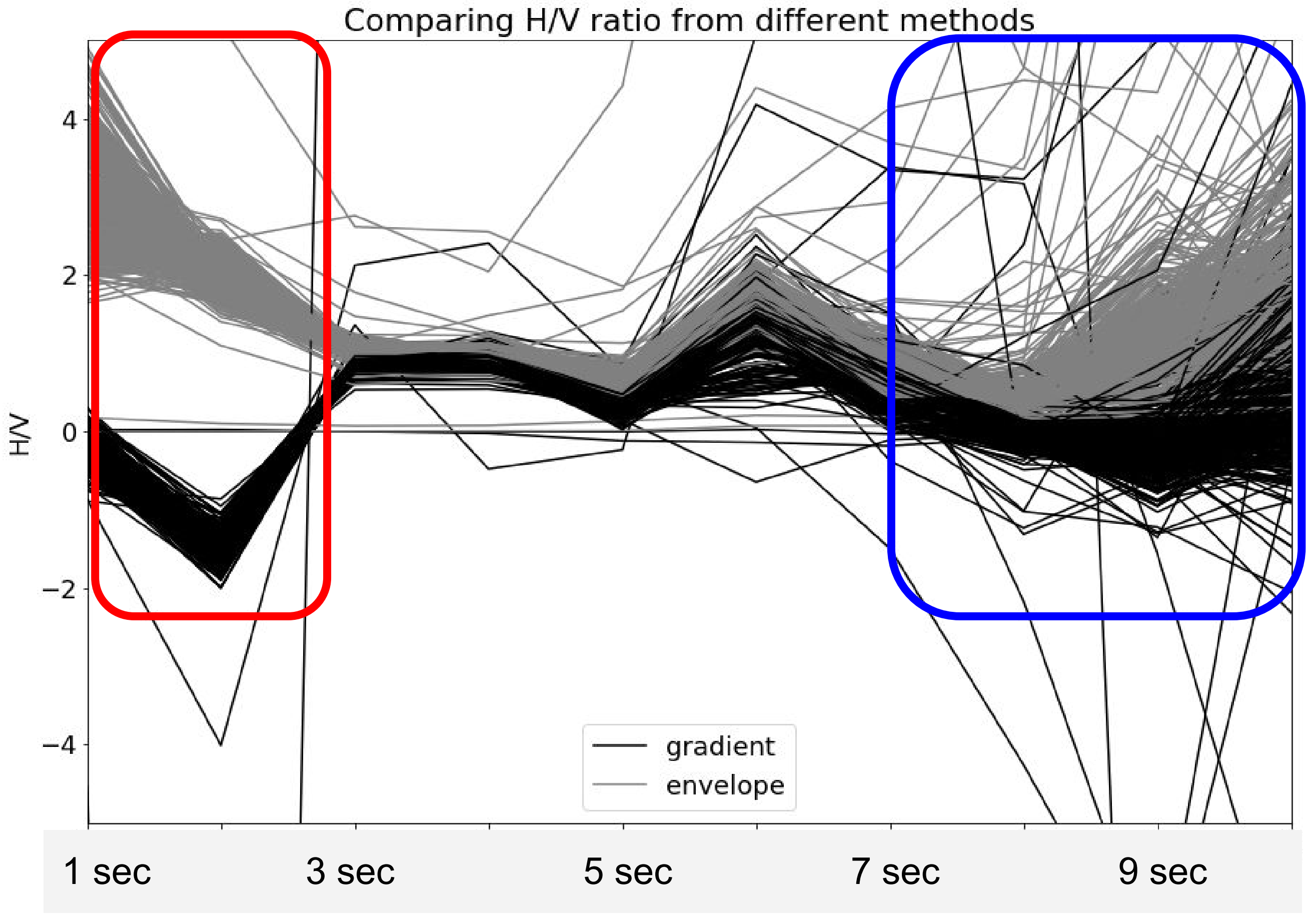

Results

Interference with body wave?

Scattering period band (The sensor's amplitude becomes less reliable?)

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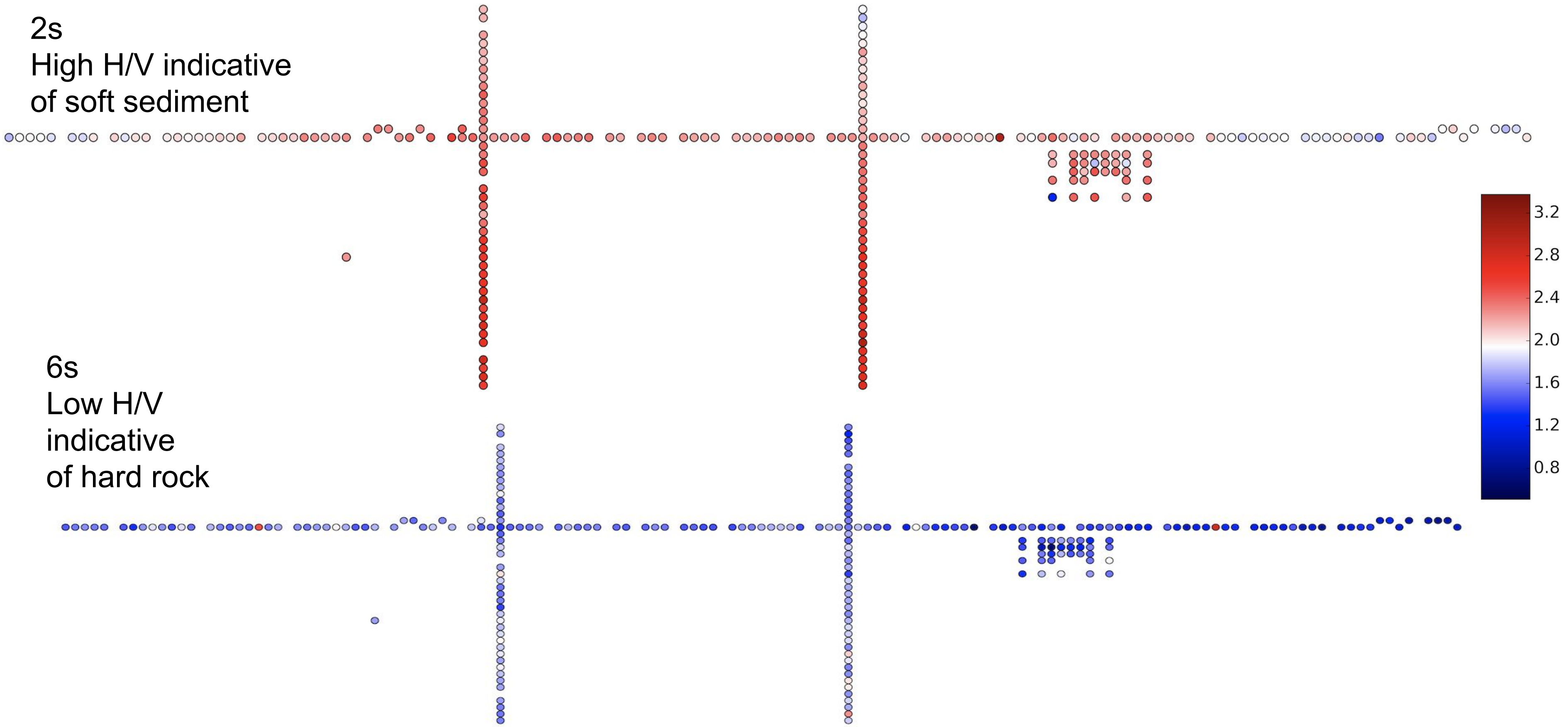

Traditional Method (matches New Method) demonstrates H/V gives expected result for geology in this area

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Lessons we learned:

Dip	90 :: (SEED convention: From horizontal, Z=-90, reversed=90)
Start	2016/06/21 (173) 16:43:57
End	2016/07/26 (208) 13:19:57
Sample Rate (Hz)	250.00
Max Drift (s)	0.000040000 :: (Seconds per sample)
Instrument	Zland 3C geophone/Zland 3C DAS est w/o anti-alias

Dip	-90 :: (SEED convention: From horizontal, Z=-90, reversed=90)
Start	2016/06/19 (171) 00:00:00
End	2016/12/30 (365) 23:59:59
Sample Rate (Hz)	100.00
Max Drift (s)	0.00010000 :: (Seconds per sample)
Instrument	Guralp CMG3T/Reftek 130 Datalogger

Day 1:

Day 2:

Day 3:

10am:

4pm:

Midnight:

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Caveats and Future Plan:

What we do not accomplish here:

- Careful data quality control
- Benchmark with ambient noise results
- Different events
- Seasonal Variation
- Azimuthal Variation