Retrieval of local surface wave velocities from traffic noise – an example from the La Barge Basin (Wyoming)

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Aim of the study

• Analysis of a passive 3C data set by noise interferometry

• Focus on the *local structure* (km – scale) and local noise sources
PSD & 24 h spectrogram - Z
24h spectrograms - Z, N, E
24 h spectrograms

L29-Z

L29-E

L29-N
Interferometry (virtual source method)

\[ g_{AB}(t) = y_B(t) \times y_A(t) \]
Application to data

• Passive (noise) data: Stacking
  >> 5 days @ 120 s windows

• Pre-processing
  >> BP filter, amplitude & spectral normalization

• Frequency content
  >> 2 to 4 Hz

• 2,916 virtual source – receiver combinations; Z,N,E
• Clear arrivals, linear move out >> surface waves
• Noise source: state highway
• Limited f-spectrum (2 – 4 Hz)
• Love & Rayleigh waves?
Rotation to radial (R) & transverse (T) components
Common offset stacking of all interferograms

Vertical (Z)

Time [s]
Offset [km]

Common offset stacking of all interferograms

Radial (R)
Common offset stacking of all interferograms
Inversion of surface waves

- Travel times from inline and crossline interferograms (Z,T)
- Hilbert transform >> consistent picking
- Inversion for laterally varying Rayleigh and Love velocities
- Average group velocities of the upper 100 – 300 meters
Surface wave velocities

Rayleigh velocities $v_R$

Love velocities $v_L$

Ratio $v_L / v_R$
Conclusions

• 5 days of traffic noise on a state highway are sufficient to obtain surface waves up to 5 km distance
• Traffic noise is band-limited at offsets > 1000 m
• Rayleigh and Love waves
• Lateral mapping of near surface wave velocities (100 – 300 m depth) correlates with local geology
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