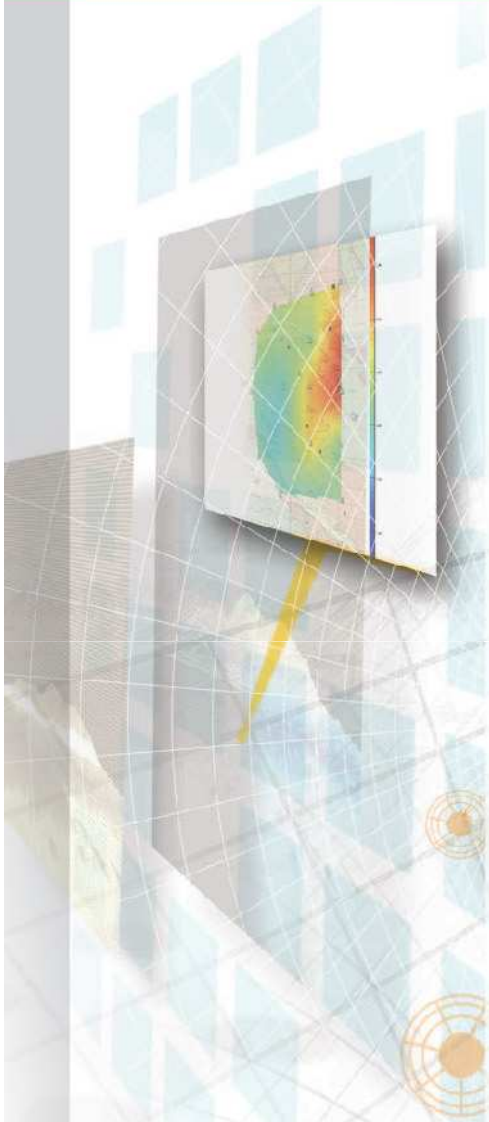

Nanometrics

Noise Characterization

Investigating the effects of site noise near Sweetwater, Texas

N. Spriggs and W. Greig

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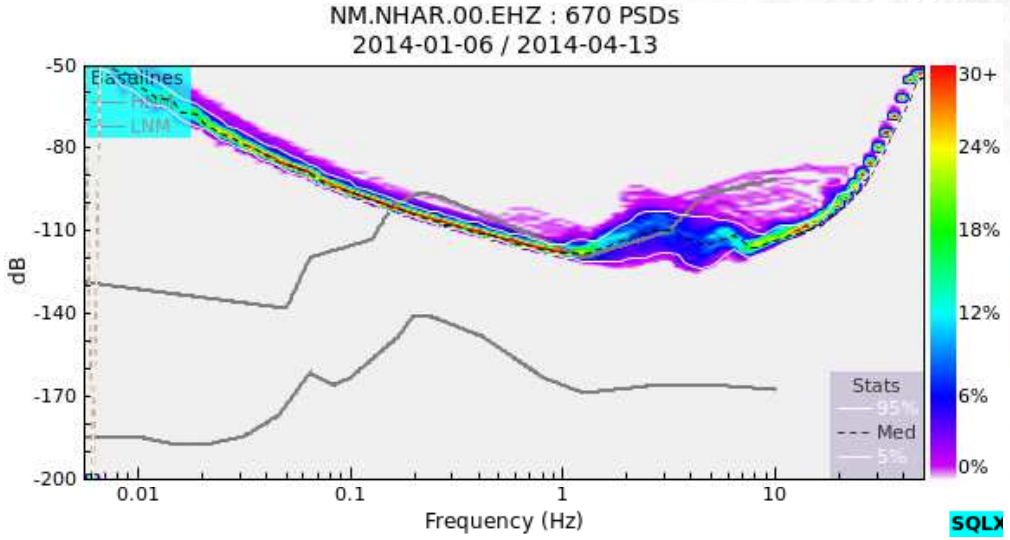
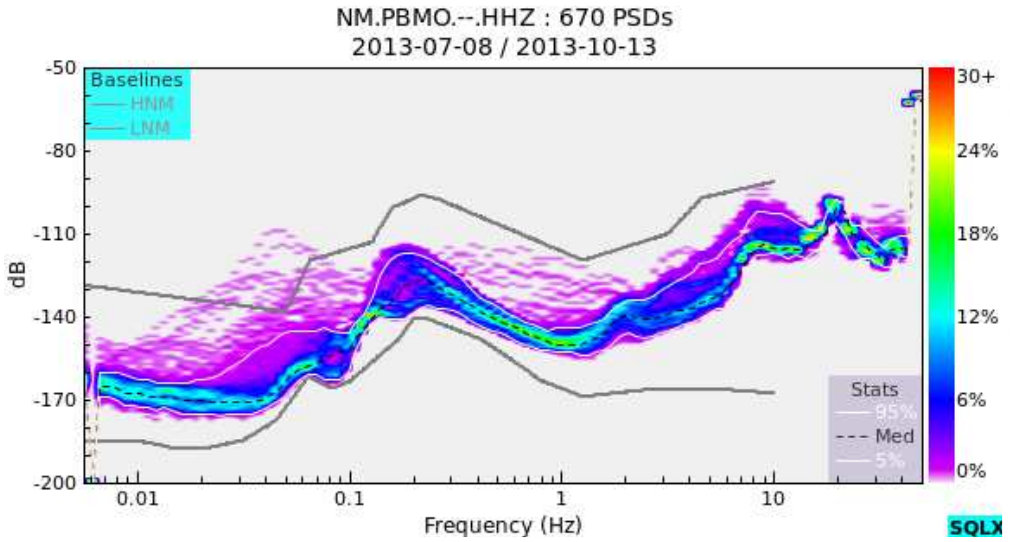
Why study noise?

- Determines detection threshold
- Model network
- Optimize station locations
- Compare instrument performance
- Imaging applications

Why study noise?

- Noise fields can differ greatly depending on site and instrument
- E.g. New Madrid Seismic Zone
- We consider an example network near Sweetwater, Texas





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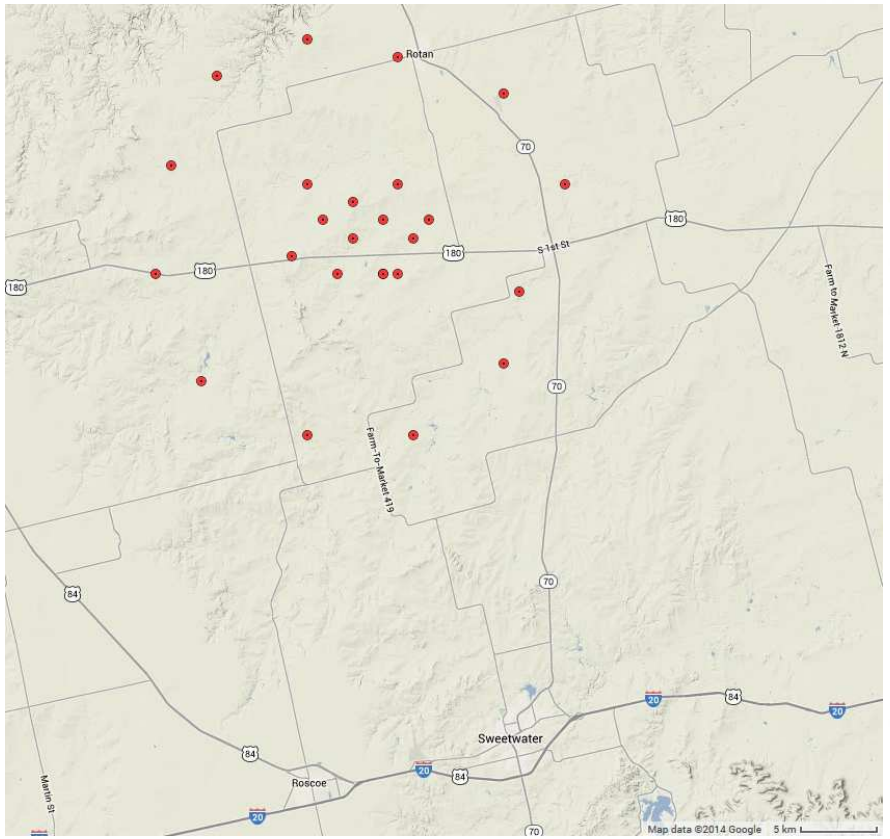
Case study: Sweetwater, Texas

- Located ~20 km north of Sweetwater
- Network of 25 broadband sensors
  - 21 Trillium Compact Postholes
  - 4 Trillium 120 Postholes
- Includes a dense geophone array
- What are the goals of the network?



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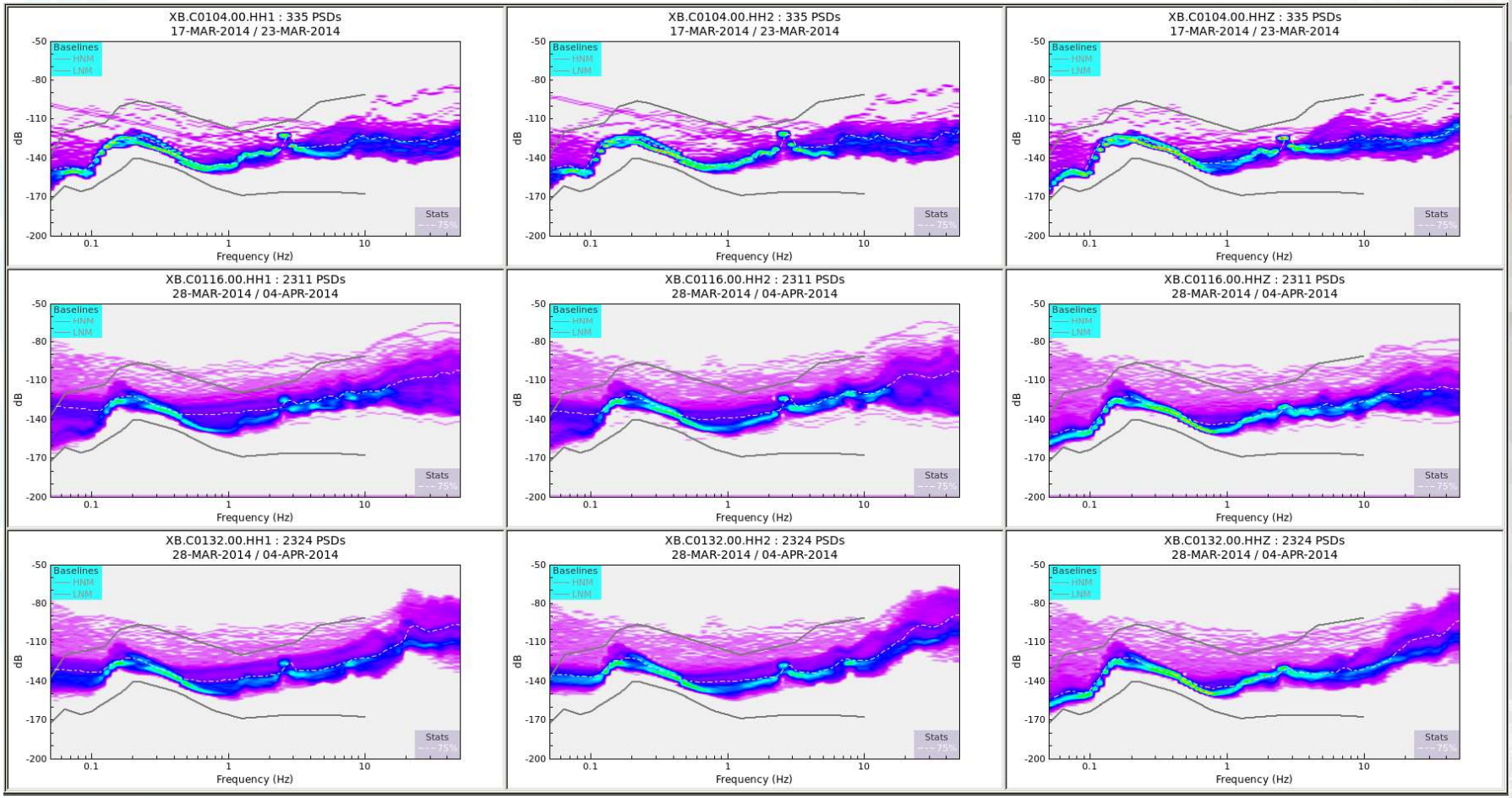
Network goals

- Generate a detailed public data set for use in a wide variety of studies
  - Vibroseis active source
  - Passive source

Nanometrics

SQLX Analysis of Noise



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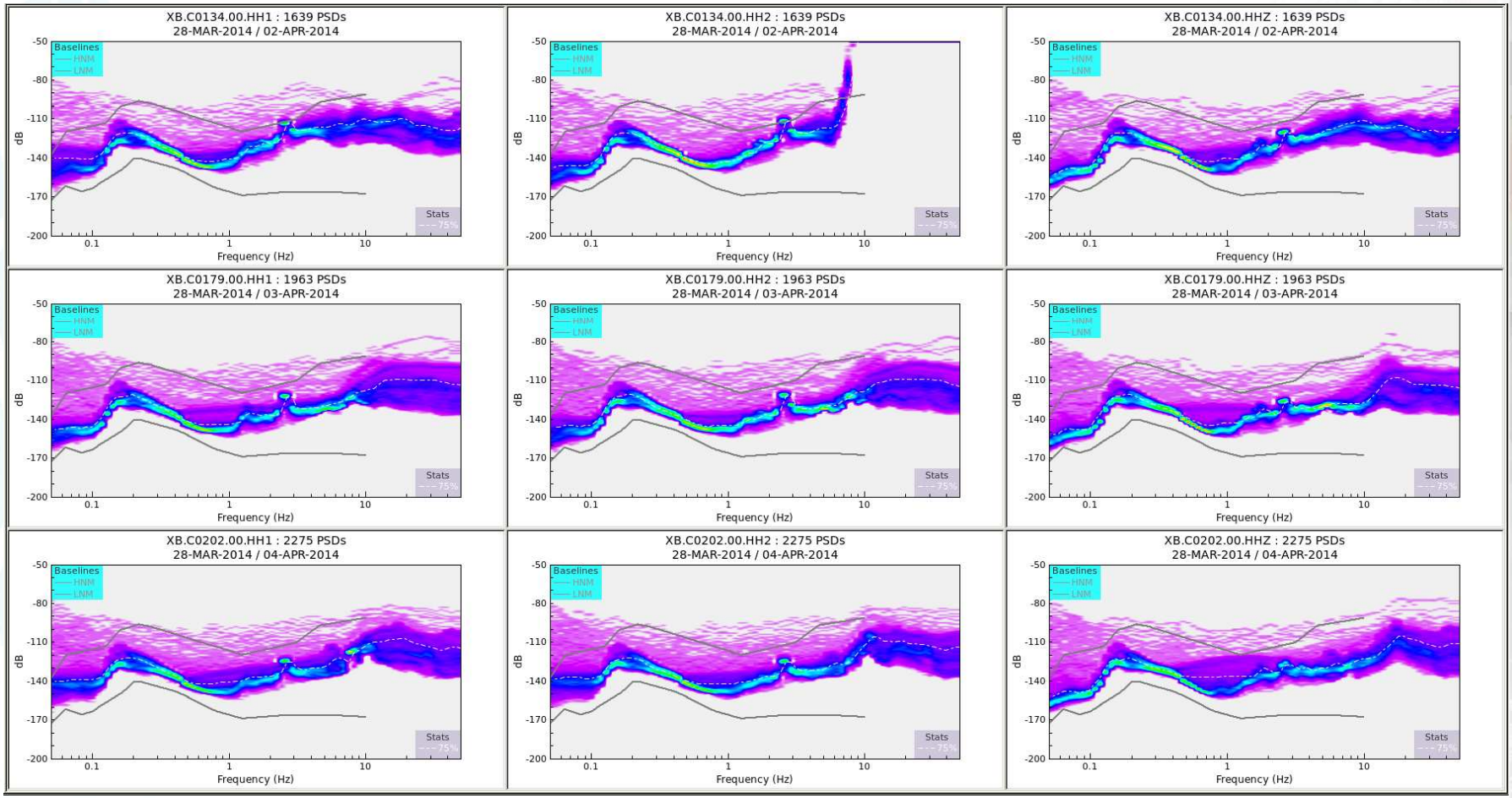
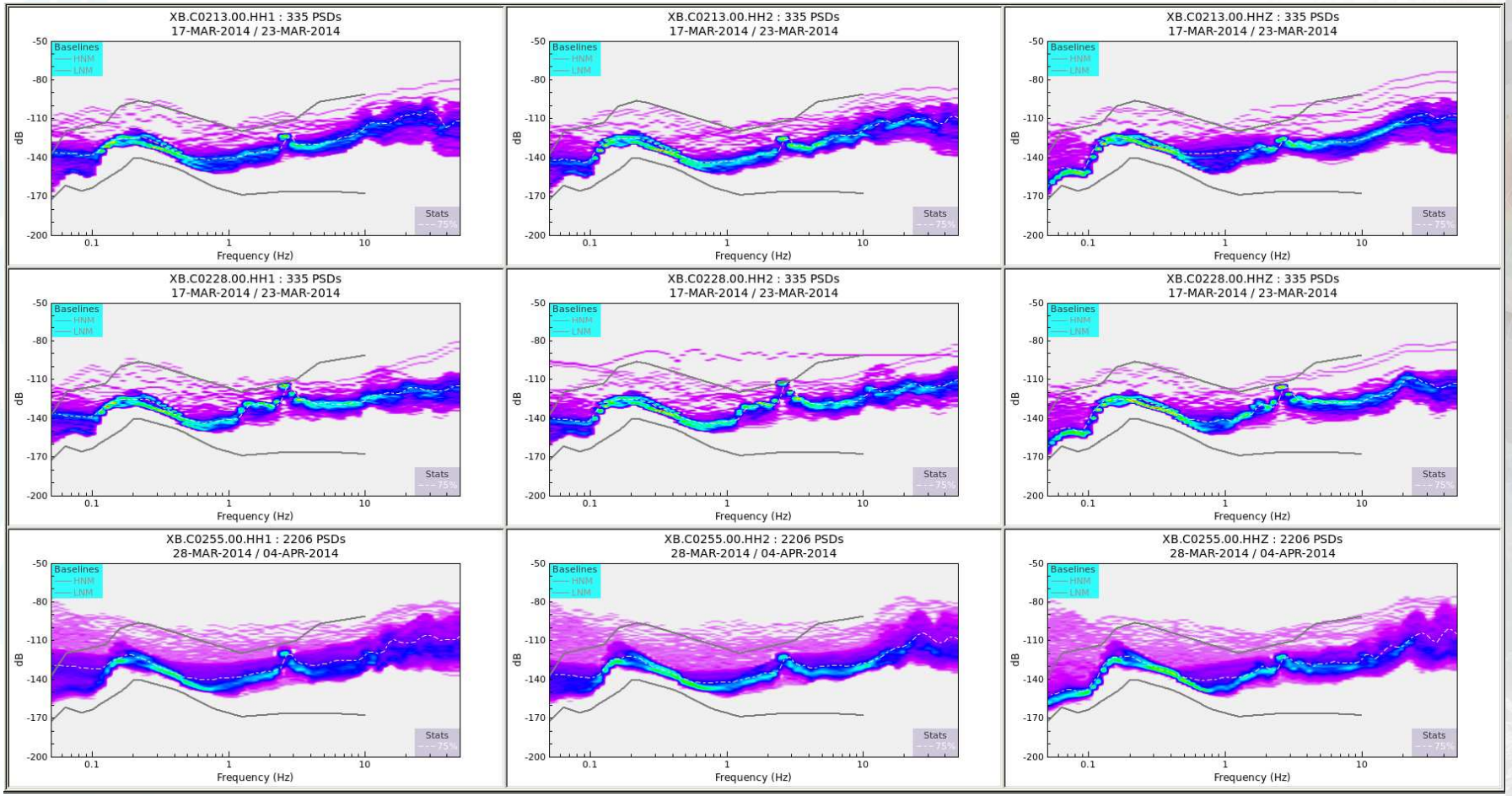
SQLX Analysis of Noise



Nanometrics

SQLX Analysis of Noise



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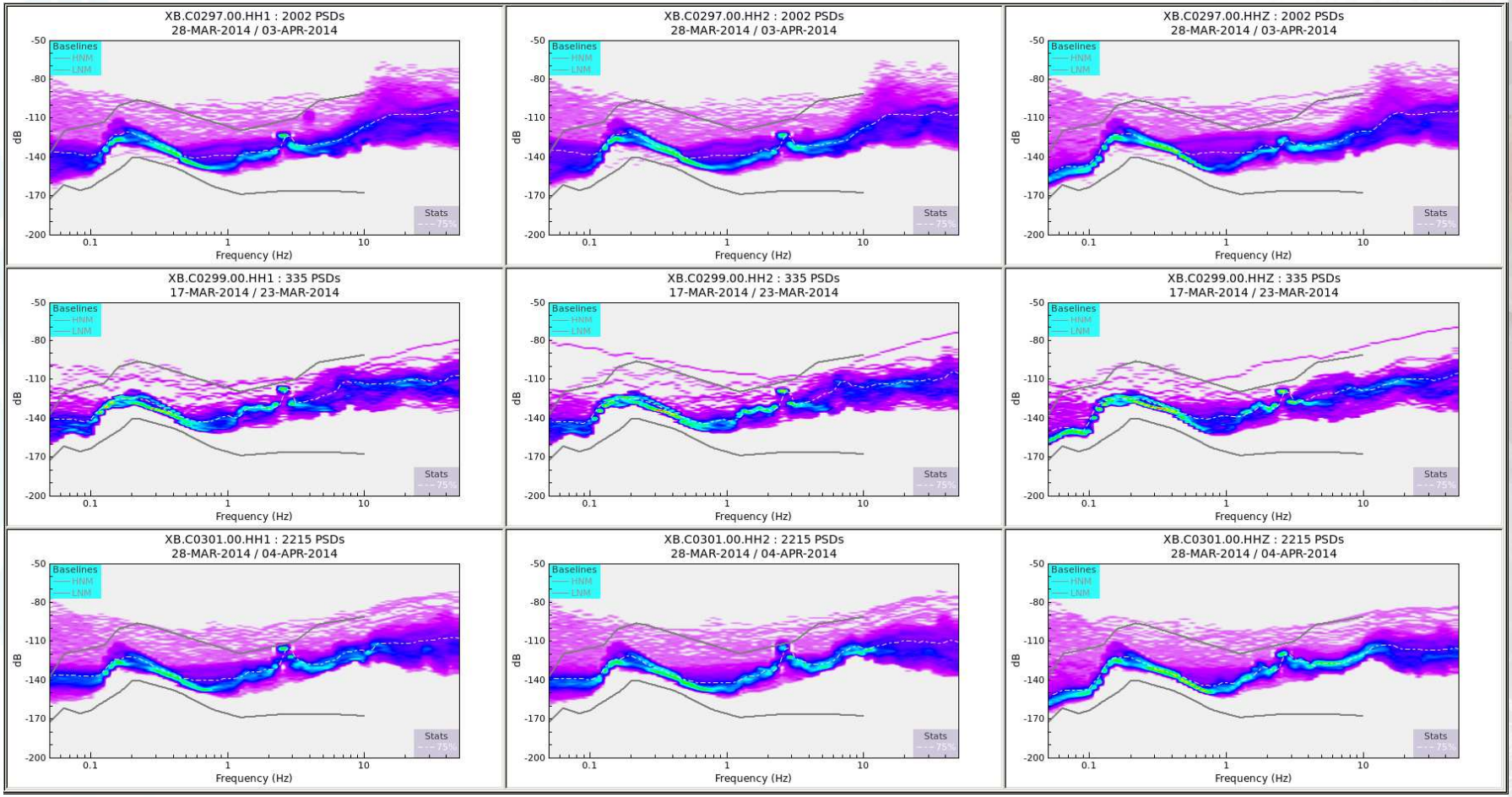
SQLX Analysis of Noise



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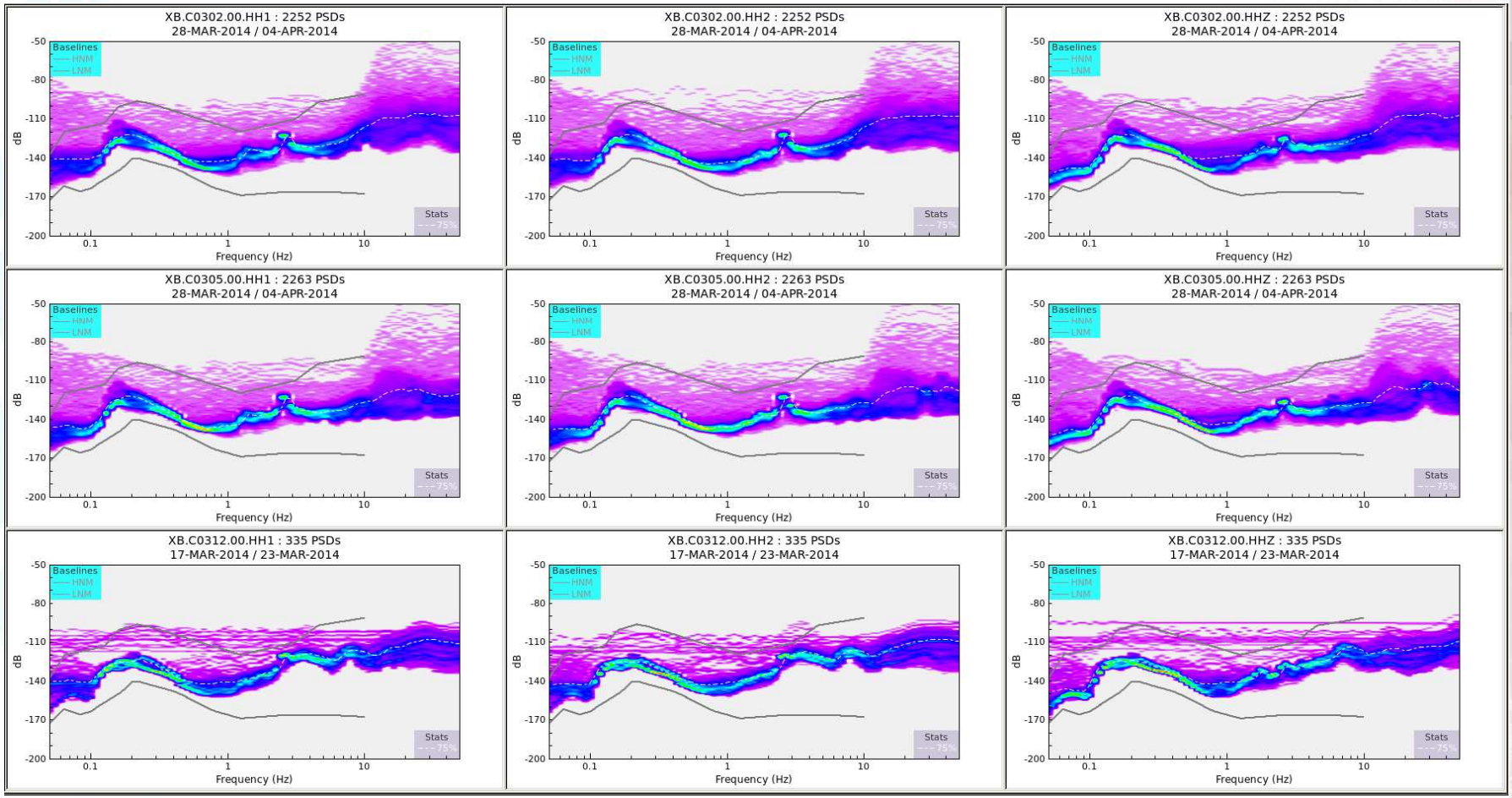
SQLX Analysis of Noise



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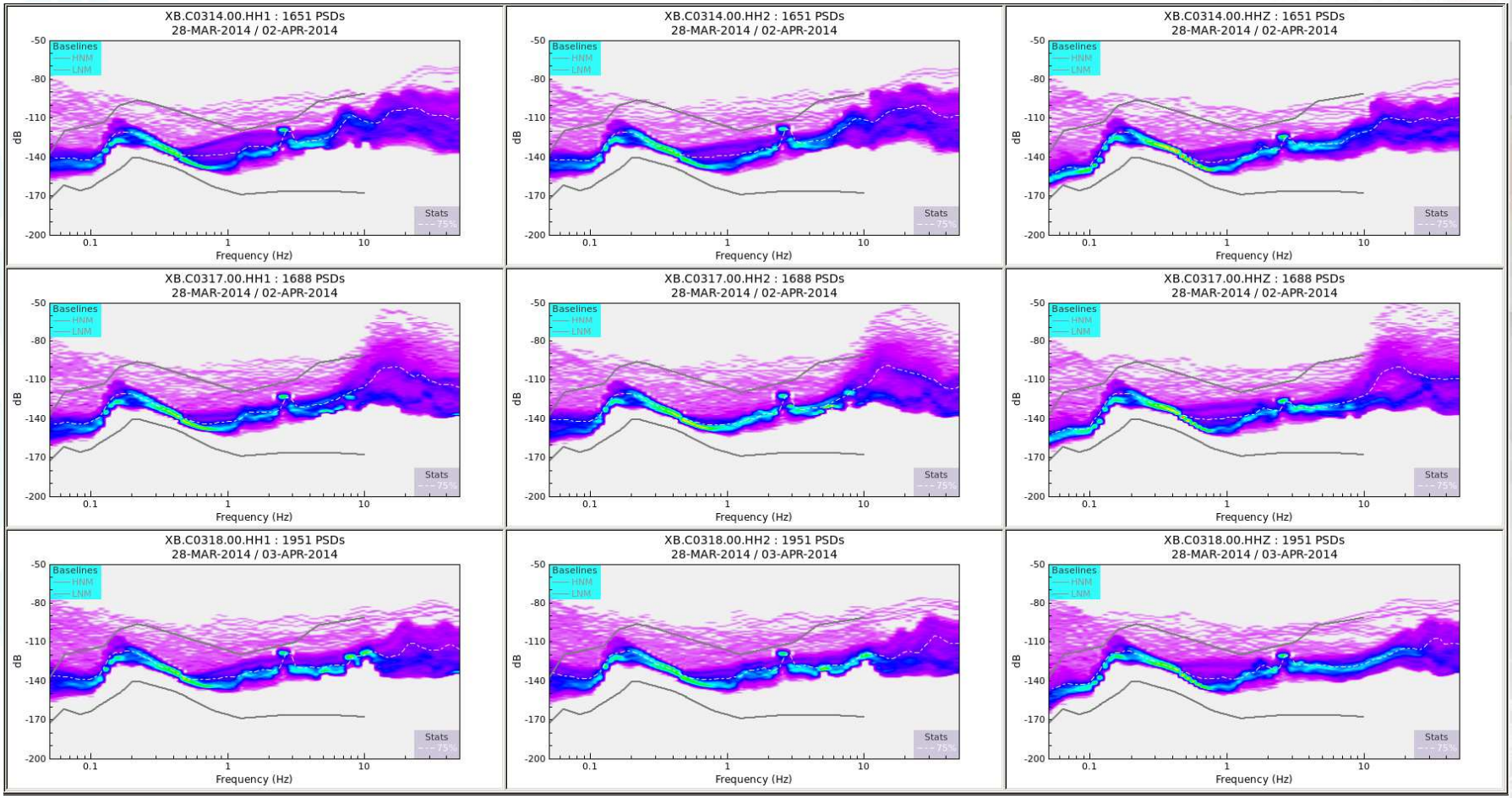
SQLX Analysis of Noise



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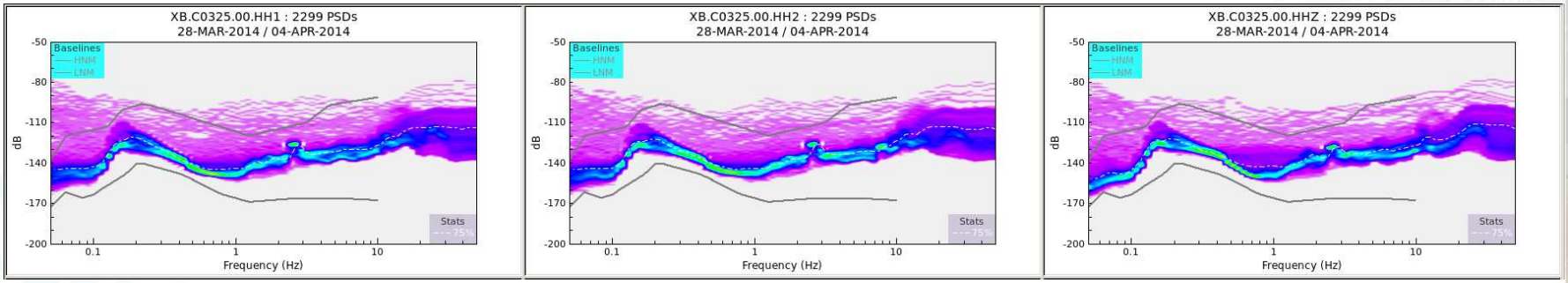
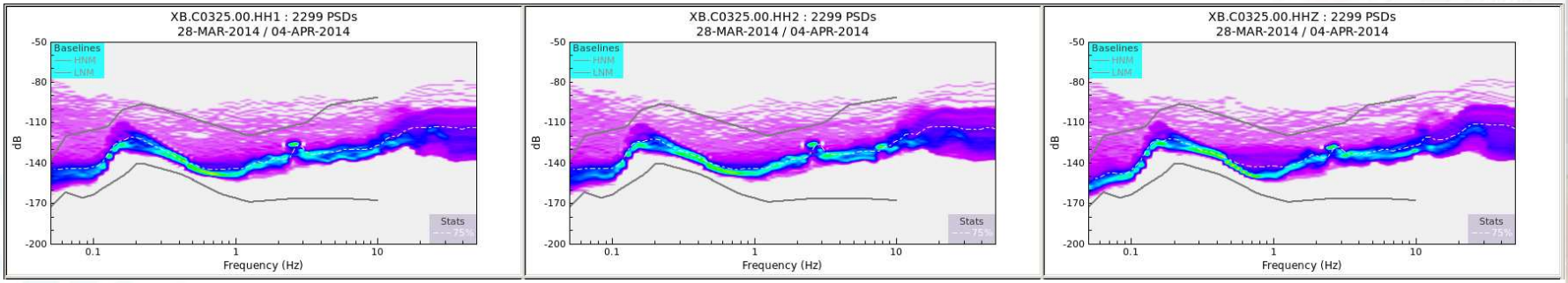
SQLX Analysis of Noise



- Generally three distinct partitions of noise
  - Instrument and installation noise (low Hz)
  - Microseismic peak
  - Human or cultural noise (high Hz)

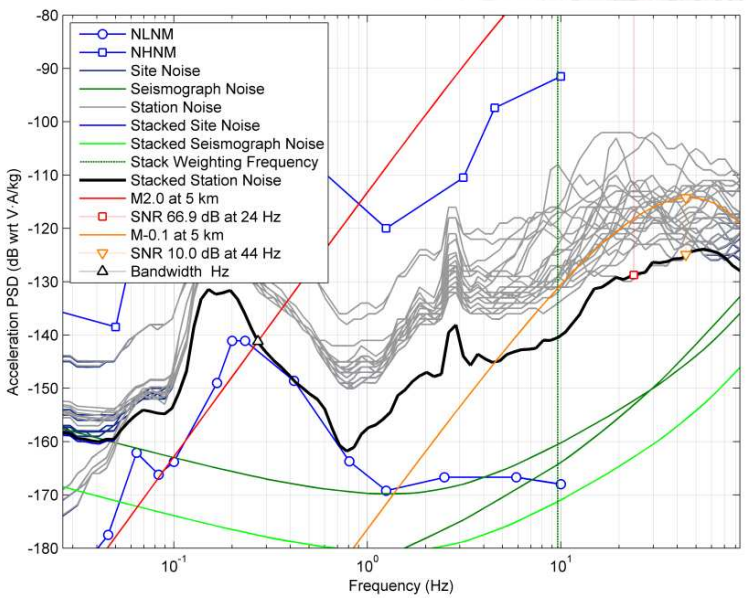
SQLX Analysis of Noise

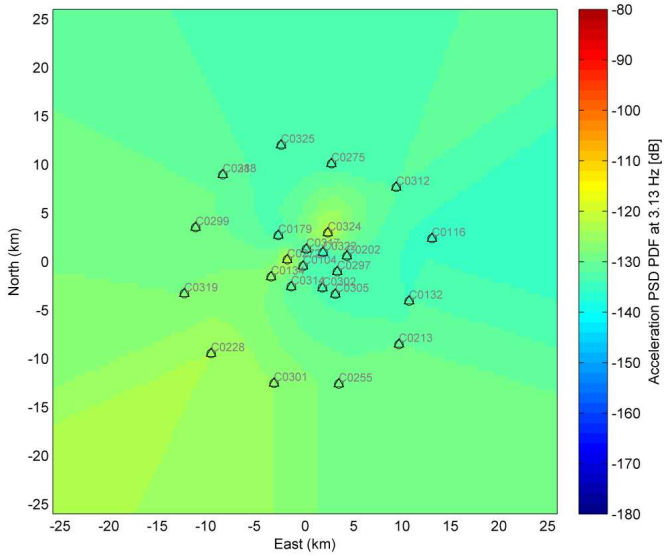


- Interesting things to notice
  - Compact and 120 discrepancy is obvious only at long periods
  - Consistent spike ~ 3 Hz

Analysis of noise

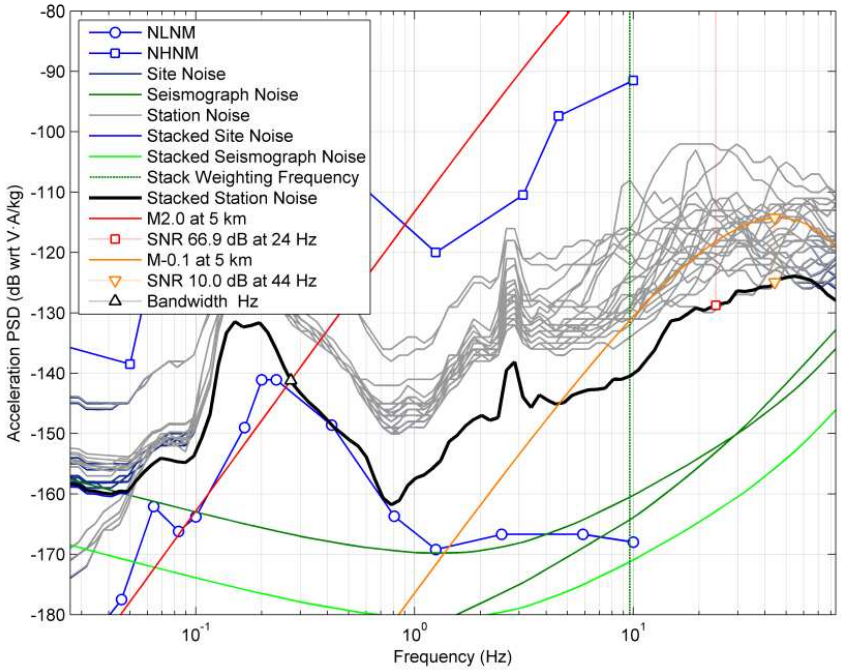
- Spike at 3 Hz likely related to human activity (wind farm)
- At long periods Trillium Compact is impaired by instrument noise floor
- High frequency variability related to road proximity (e.g. C0319)





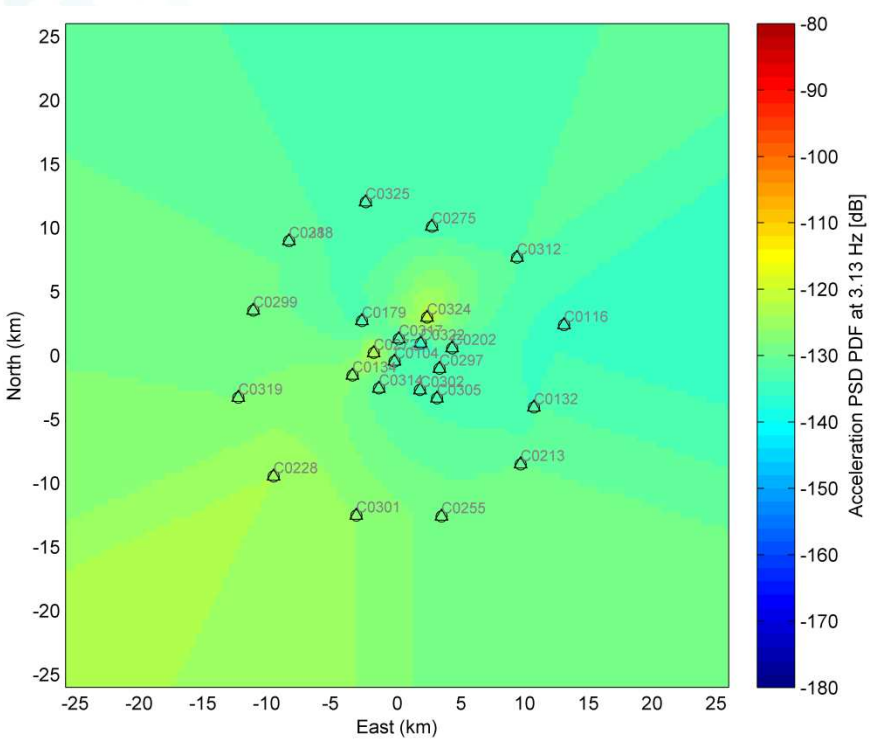
Effects of noise on performance

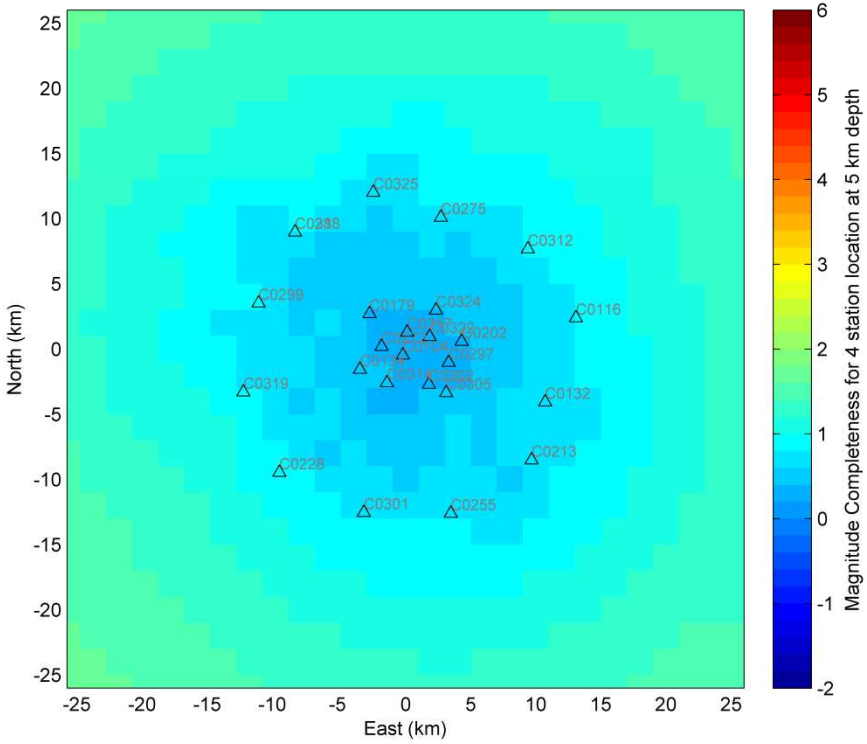
- Effects of noise on detection threshold are obvious
  - M-0.1 is lowest magnitude at 5 km that can be detected by any station with 10 dB SNR
  - Noisier stations can only detect higher magnitudes (at 5 km)



Model network performance

- E.g. Model magnitude of completeness
- Station additions have more impact in low noise areas





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What signals can we expect to see

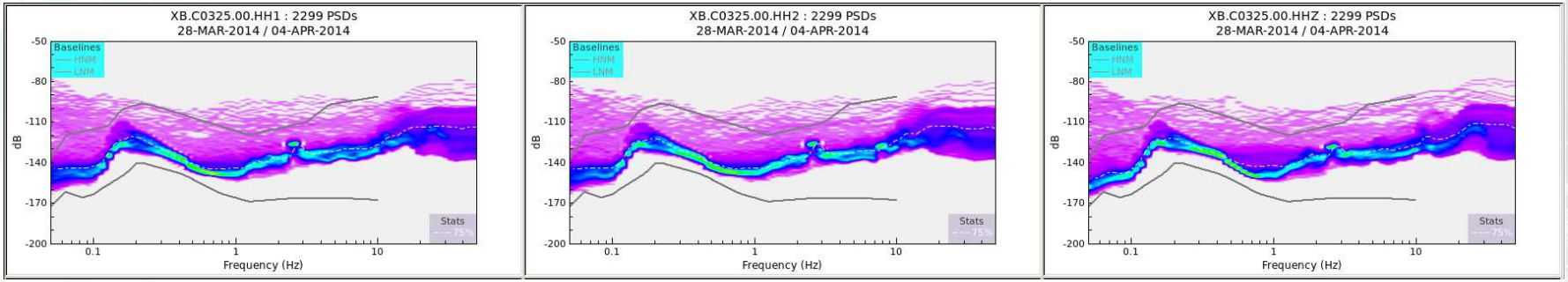
- Vibroseis signal
- Wind farm signal
- Teleseismic or distant regional event signals
- Local or nearby regional event signals

Vibroseis signal

- Vibroseis frequency range – 10 to 200 Hz
- Will provide images of greatest detail of shallow features, geophones will form the bulk of data
- Low frequencies key in waveform tomography convergence (cycle skipping)

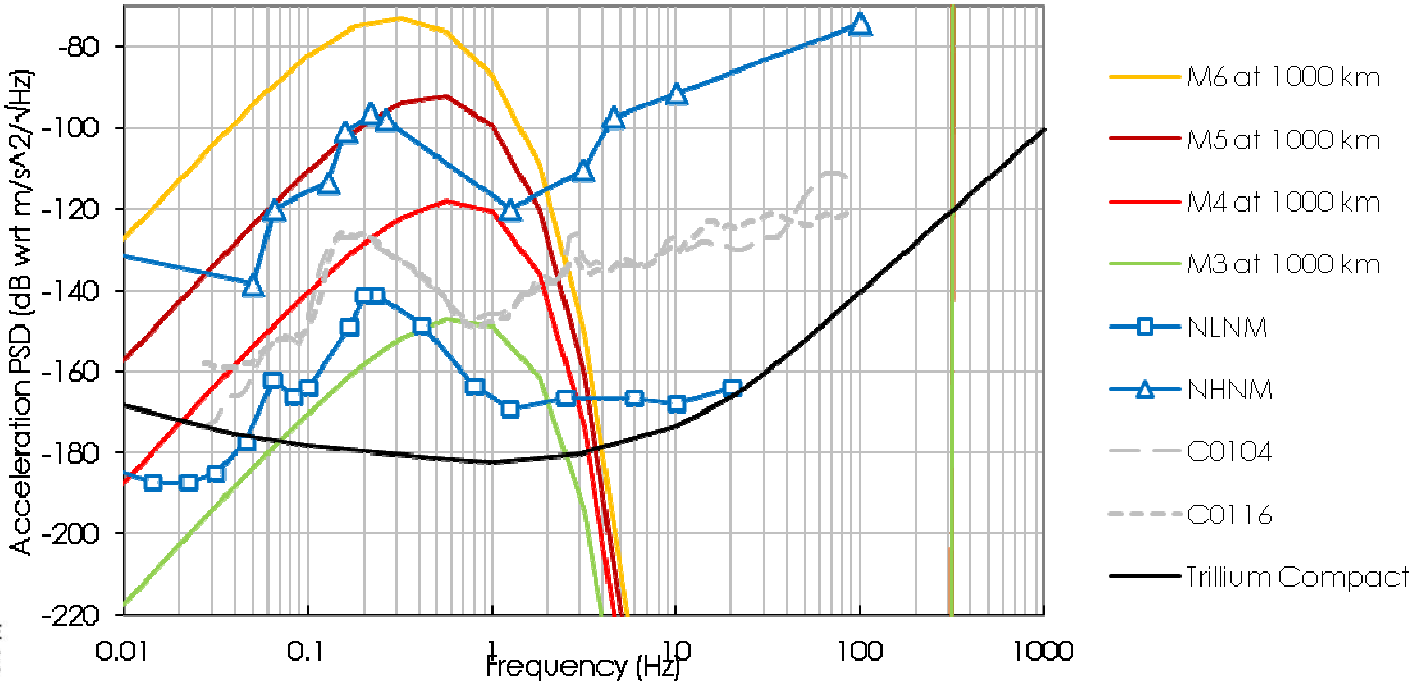
Wind farm signal

- Appears to be ~3 Hz
  - Below geophone corner frequency and detection threshold
- Imaging applications will rely on seismometer data
- Alternatively signal could be removed with a filter



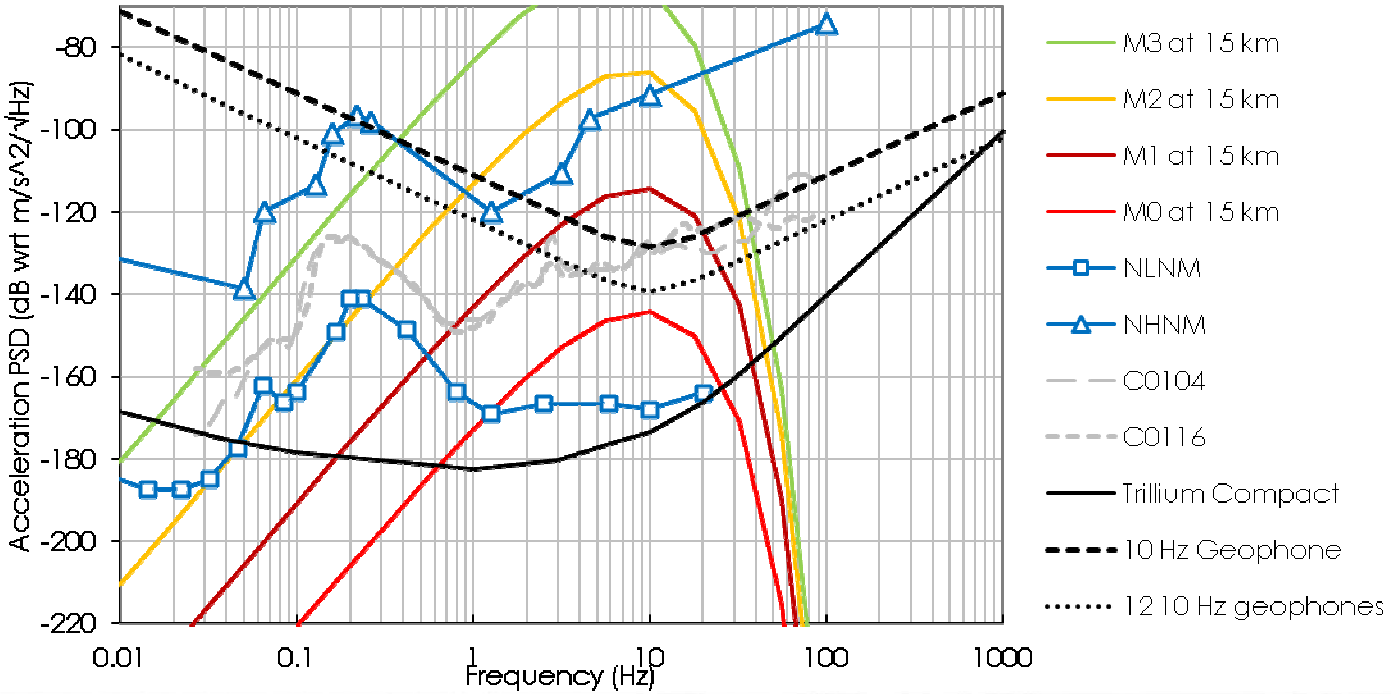
Teleseismic signals

- Low frequencies (below microseismic peak)
- Useful data almost exclusive to Trillium 120's
- May provide details on the deep crust and/or upper mantle



Local or nearby regional events

- Frequency range event specific
- All instruments may aid in detection/location
- Low frequencies from seismometers vital in seismology applications (Moment tensors)



Conclusions

- Studying noise allows
  - Modeling of network performance
  - Optimization of network design
  - Comparison of different instrument types
  - Imaging based on coherent noise signals
- Each type of instrument will have specific applications for future studies

Questions?

- NeilSpriggs@nanometrics.ca
- WesGreig@nanometrics.ca