

Testing the performance of the Metrozet STS1 Very Broadband sensor clone

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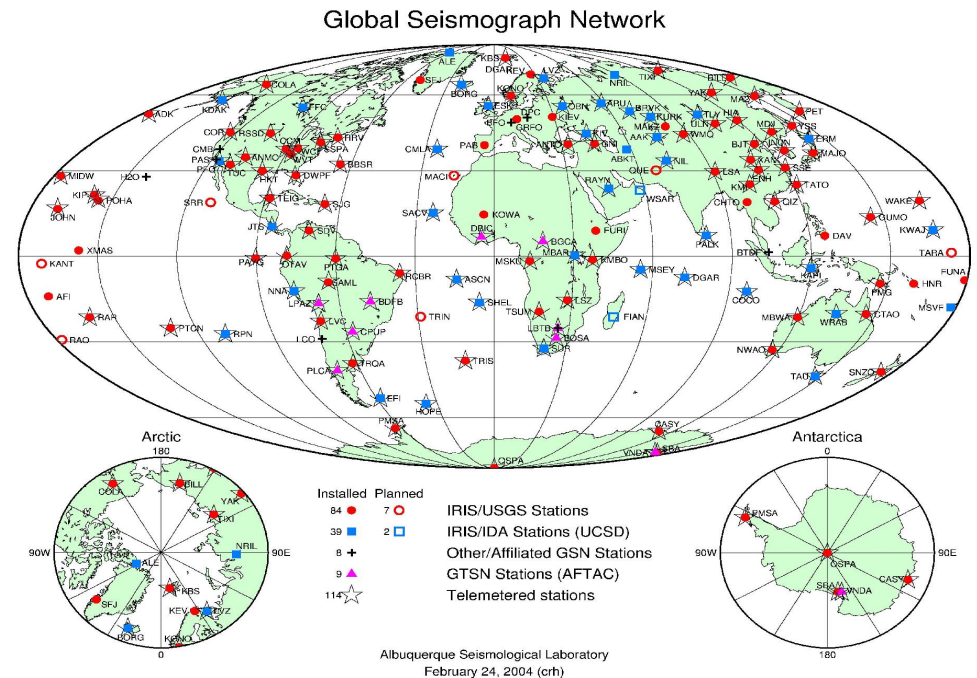
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²Metrozet, LLC

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Motivation

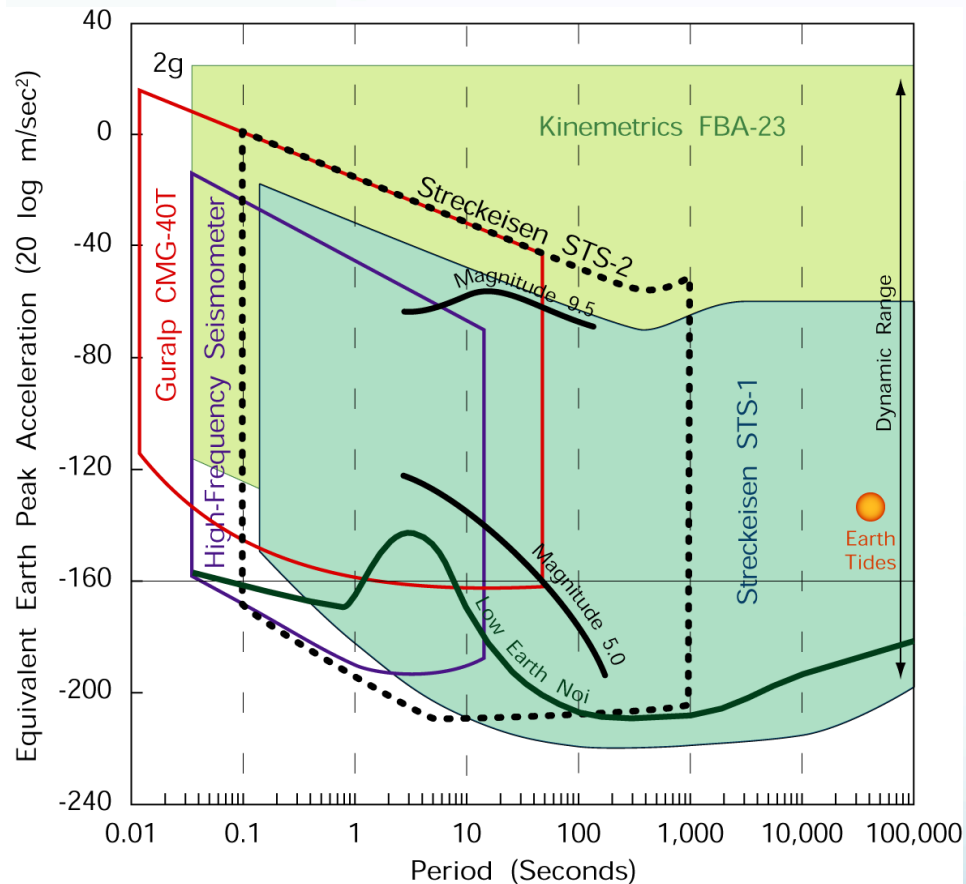
- The STS-1 VBB seismometer is currently the principal seismometer used in most global networks and some regional networks and comprises approximately 250 stations.
- Many older sensors installed 20-25 years ago are starting to experience operation failures and age related degradation.
- Streckeisen is no longer supporting the instruments



Map from S. Ingate (IRIS) et al.

<http://www.iris.edu/stations/seisWorkshop04/report.htm>

Objectives



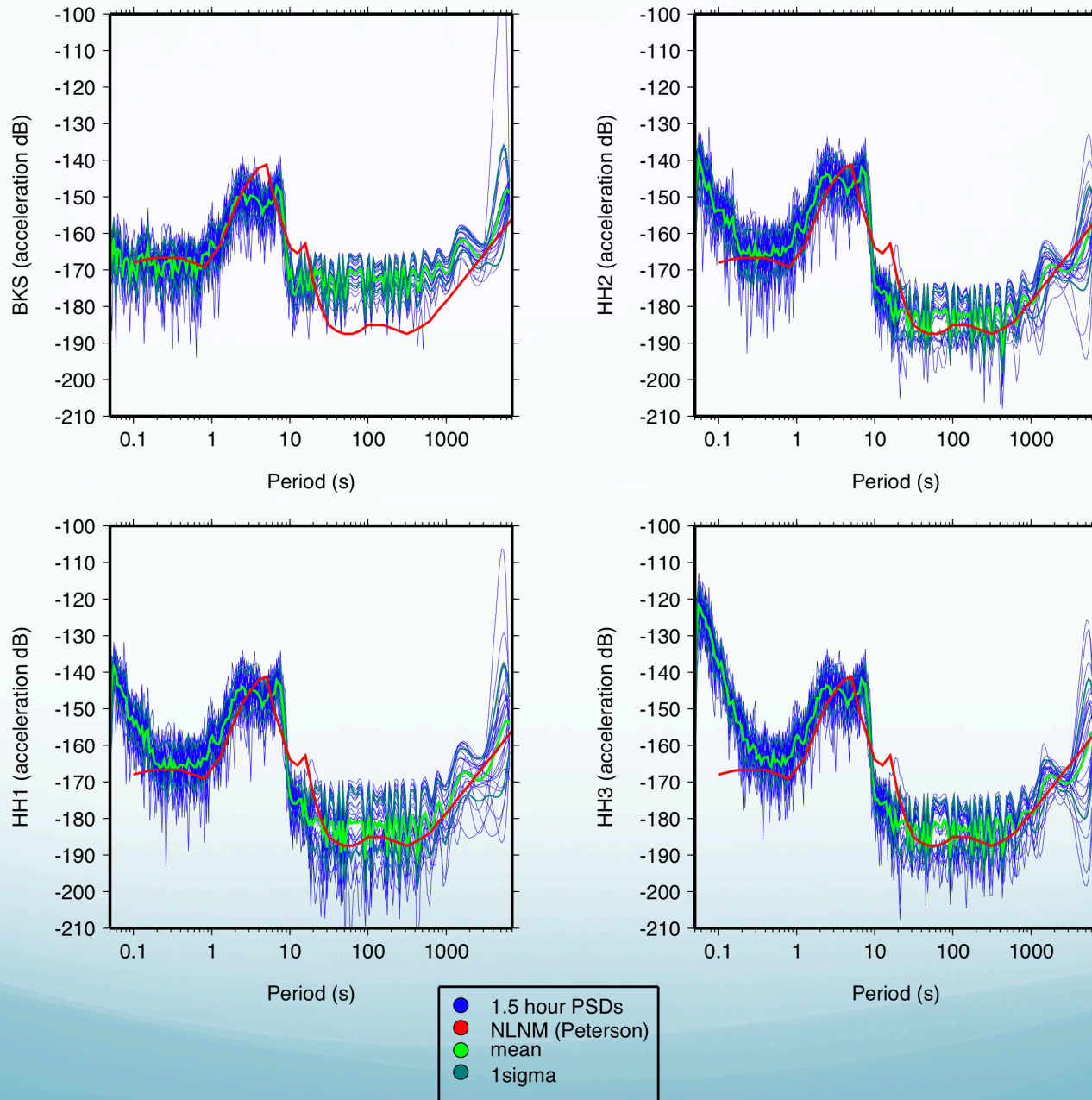
- Assess noise levels in the new Metrozet STS1-VBB sensor
- Compare the new sensor to the current STS1-VBB operating at station BKS since 1988
- Find potential problems in the new sensor and work with Metrozet to improve the noise floor of the sensors
- Assess the functionality of the new sensors to classical and new uses

Figure from S. Ingate (IRIS) et al.
<http://www.iris.edu/stations/seisWorkshop04/report.htm>

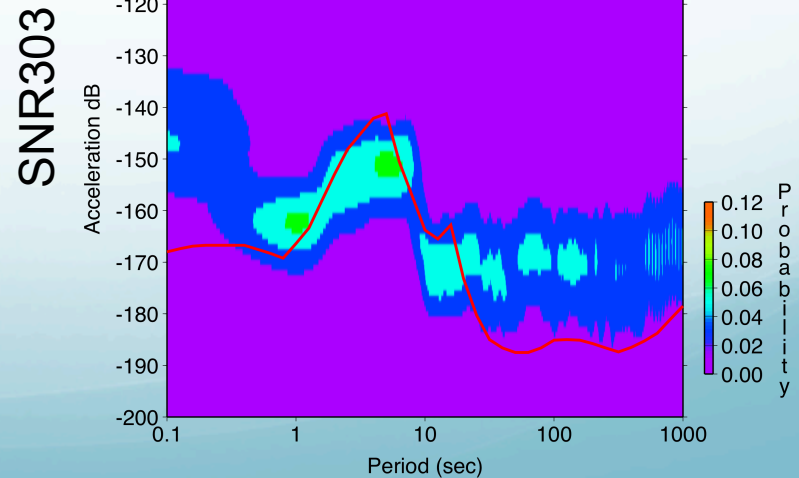
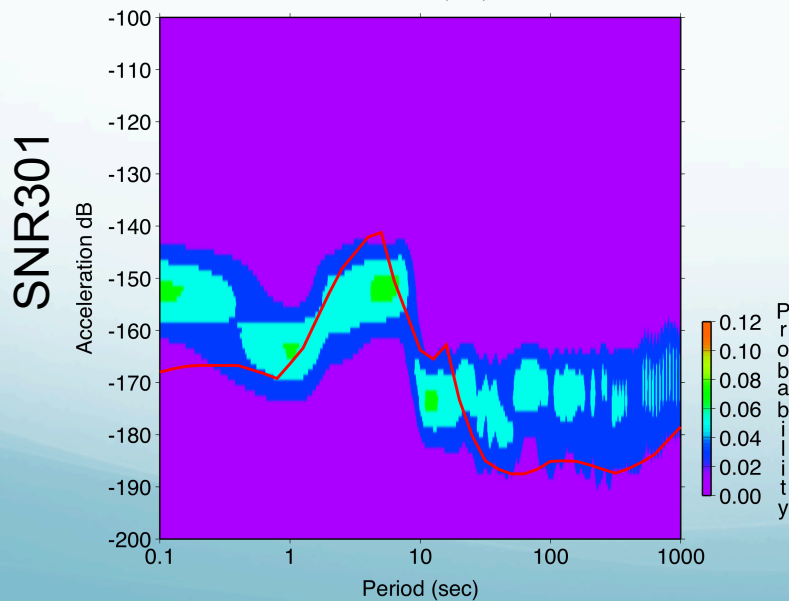
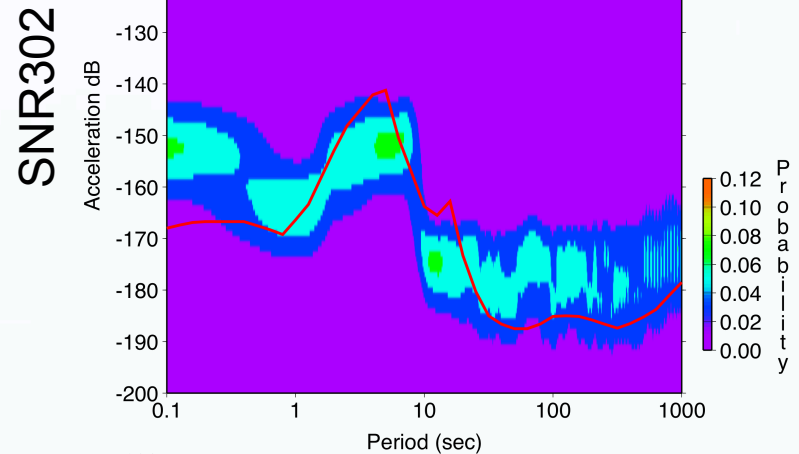
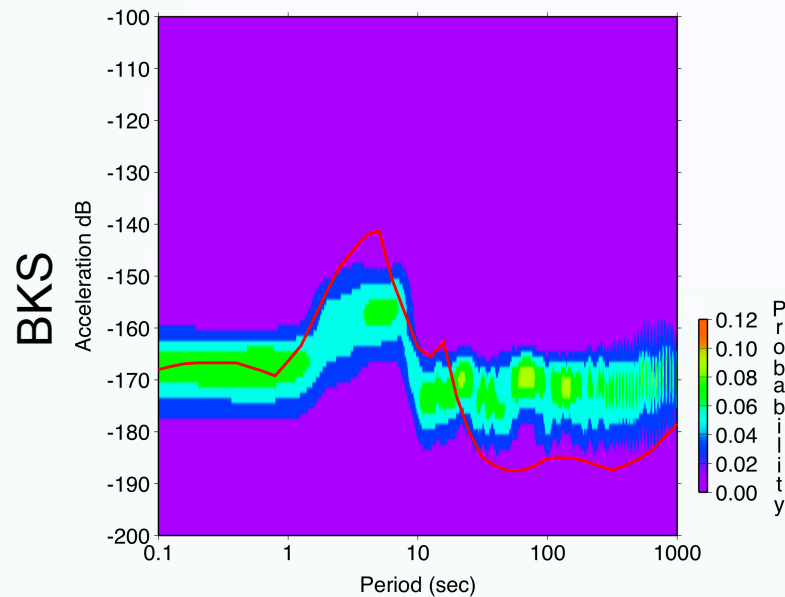
Methodology

- Noise floor – Acceleration Power Spectral Density as per McNamara and Buland 2004 and Peterson 1993
- Inter-sensor comparison – Coherence
- Probability Density Functions for variance

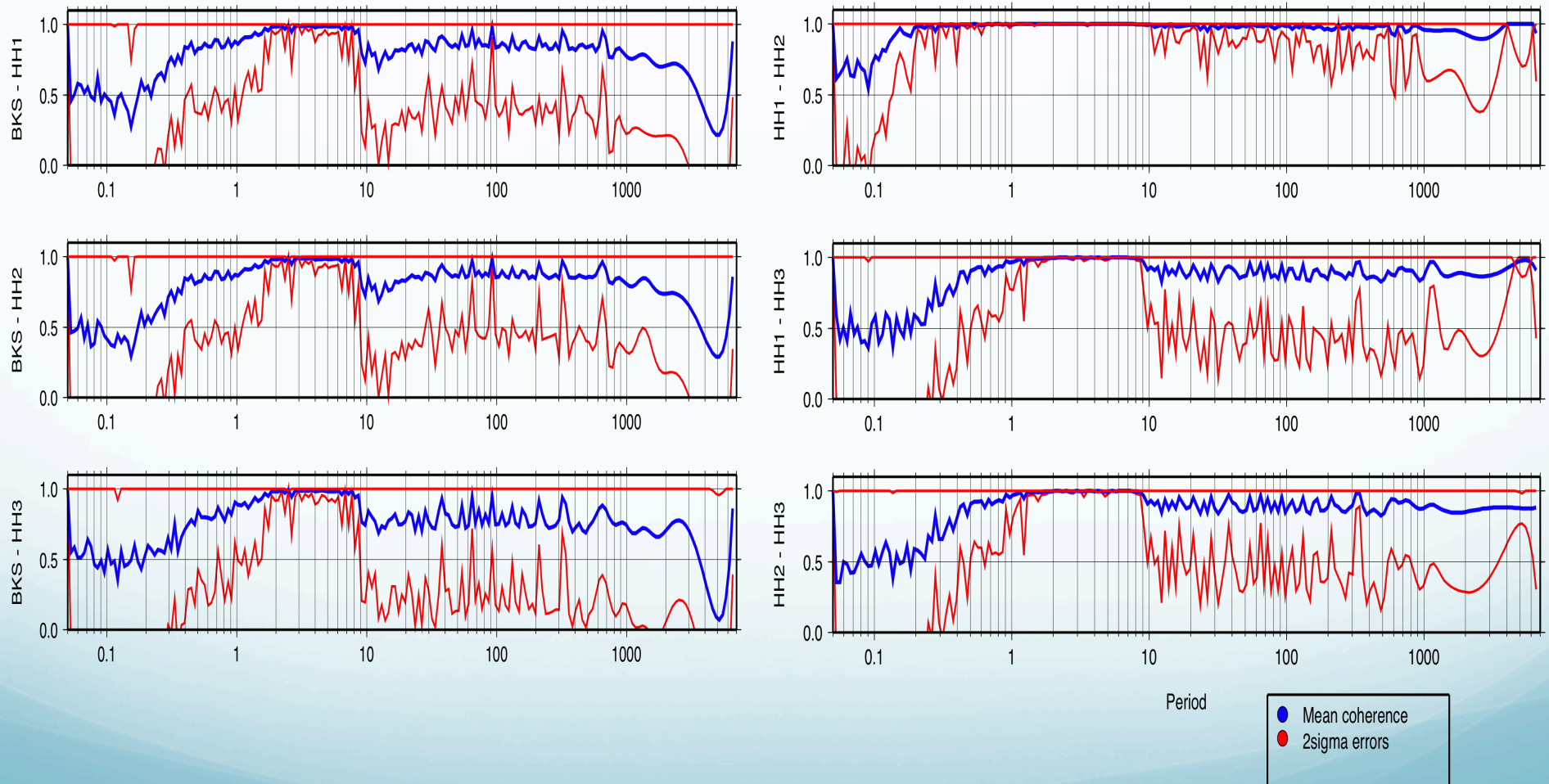
Initial Power Spectral Density



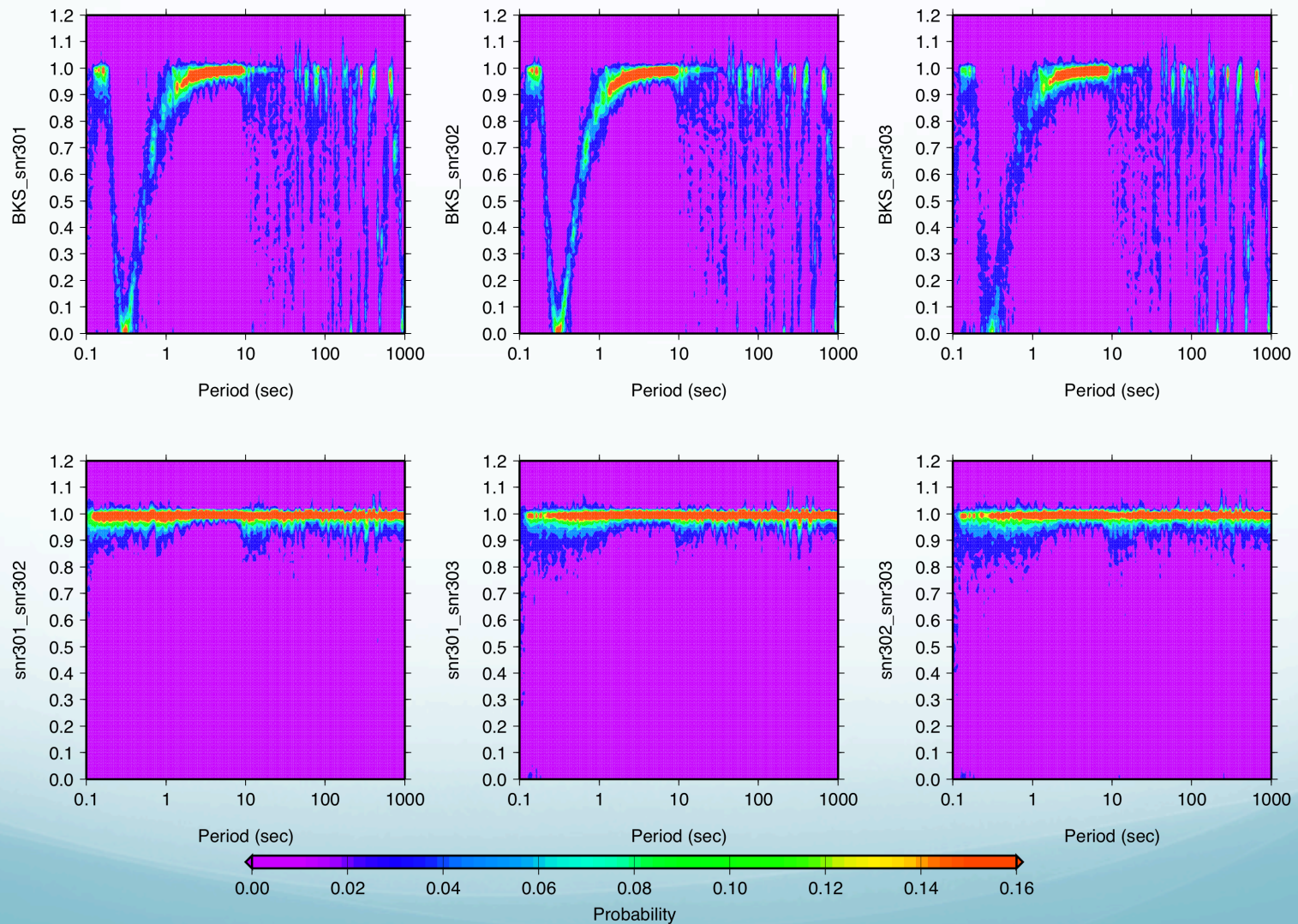
Initial Power Spectral Density PDF



Initial Inter-sensor Coherence



Inter-sensor coherence PDF



Calibration

SeisCal

File Help

Choose Action:

☒ Low Corner

☐ High Corner

☐ Power Spectral Density

☐ Coherence

Choose

Function parameters summary:

Action: Low Corner and Fraction of Critical Damping

Stimulus file: Stimulus File (theoretical)
Stimulus file type: SAC (alpha)

Response file: Response File (recorded)
Response file type: SAC (alpha)

Minimum Low Corner (seconds): 350.0
Maximum Low Corner (seconds): 370.0
Starting step size for low corner search: 5.0
Minimum step size for low corner search: 0.01

Minimum Fraction of Critical Damping: 0.6
Maximum Fraction of Critical Damping: 0.8
Initial step size for Fraction of Critical Damping: 0.05
Minimum step size for Fraction of Critical Damping: 1.0E-4

Polarity: Positive
Component: E
Leading Zeros: 100.0
Type of signal: V
Type of response: BRB
Number of points: 86400.0
Time step: 1.0

Output:

View Stimulus

View Response

View Calculated

View Residual

Write Poles and Zeros File

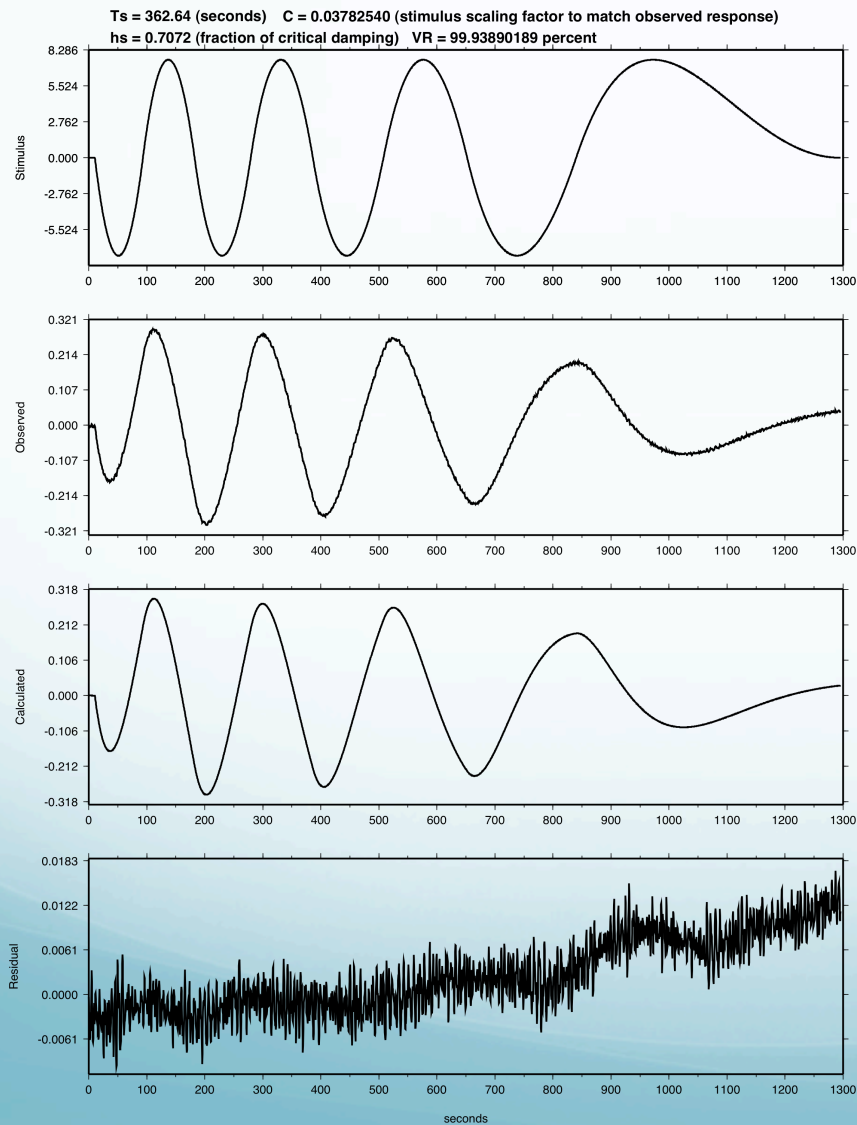
View PSD

View Coherence

Confirm and Go

Exit

Example of fitting the Low Corner



← Stimulus input to the sensor

← Observed response to stimulus

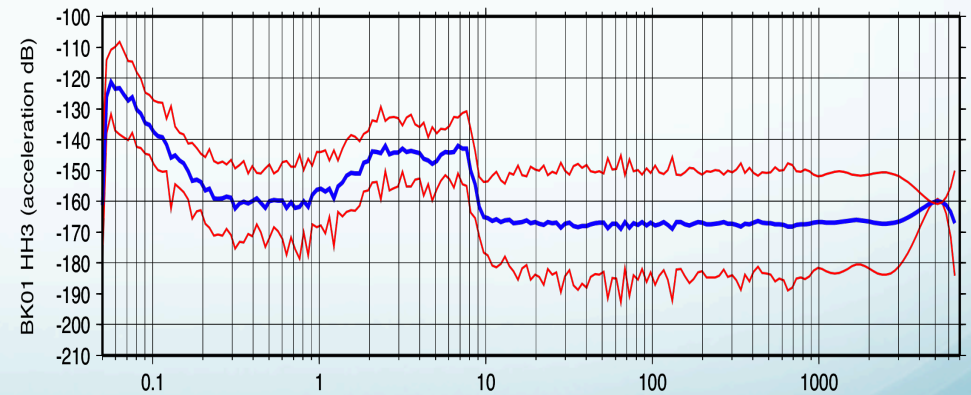
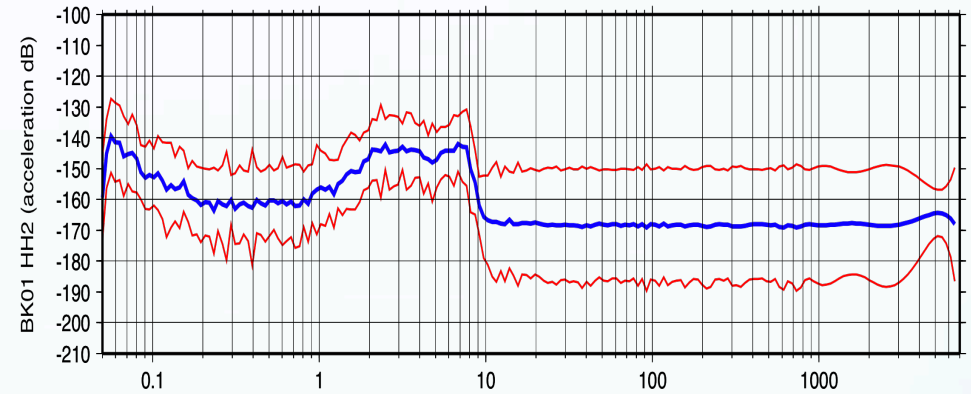
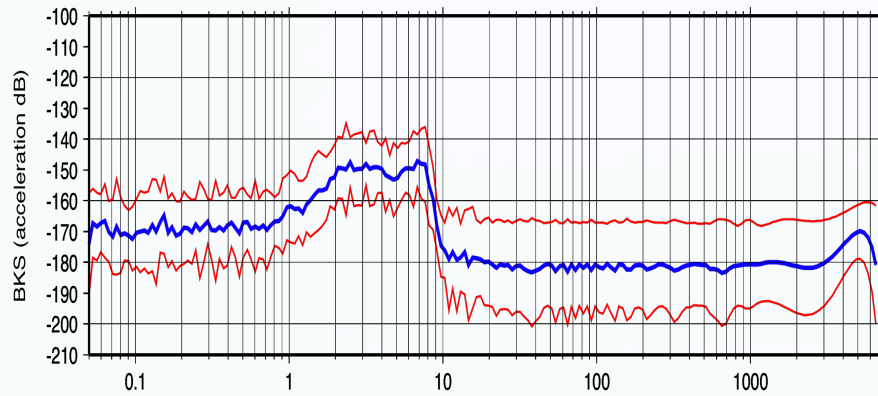
← Response calculated if $T_s \sim 362$ seconds and $h_s \sim .7072$

← Residual between recorded and calculated

Proposal

- Assess the spectrum of replacement horizontal components
- Analyze temporal PSD and coherence variance
- Analyze sensor self-noise
- Monitor noise levels at the ASL in the stable US interior of the new physical package
- Distribute an easy to use cross-platform calibration tool to end users

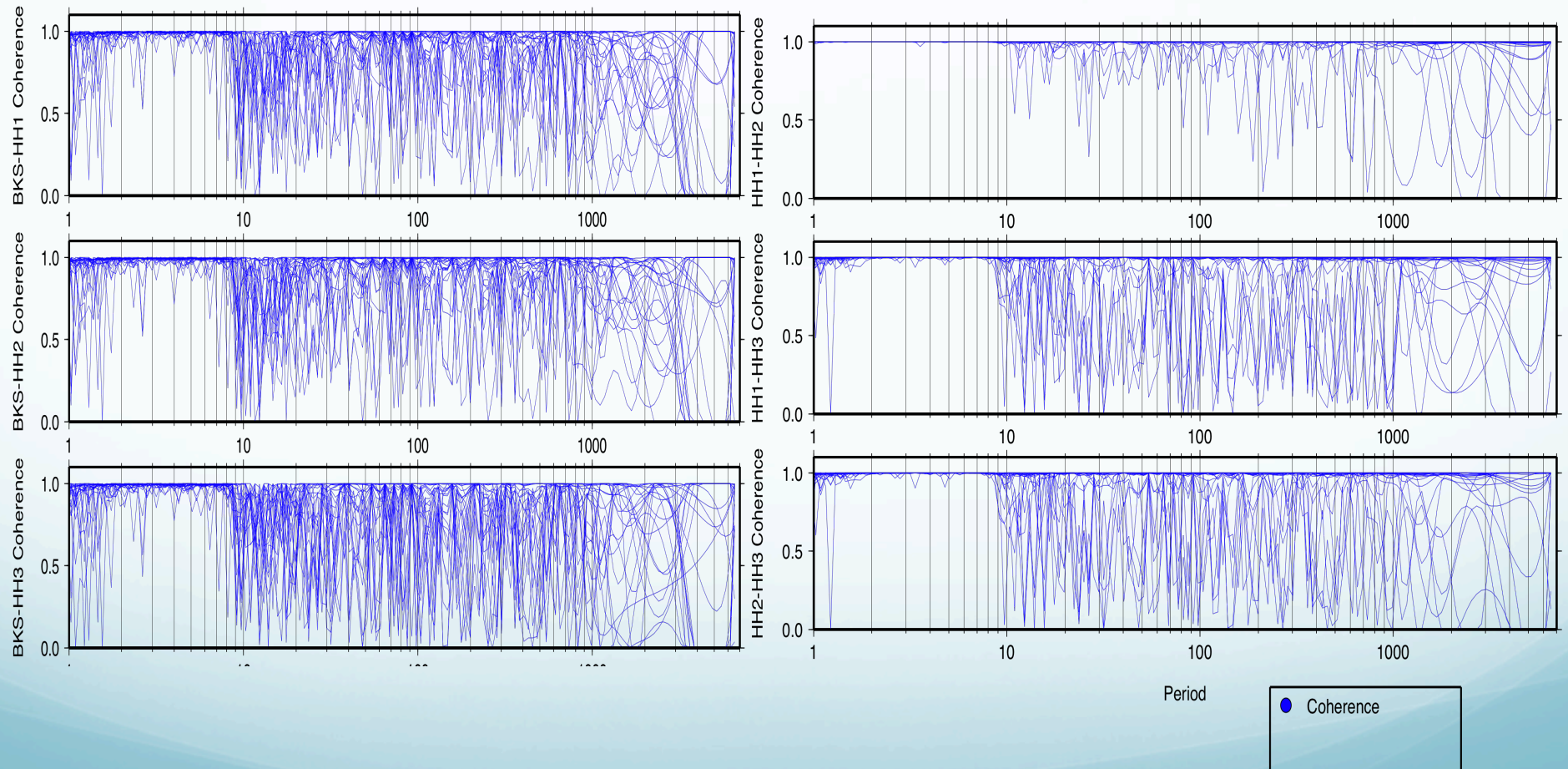
Initial Power Spectral Density



Period

● Mean PSD
● 2sigma errors

Initial Coherence (scatter)

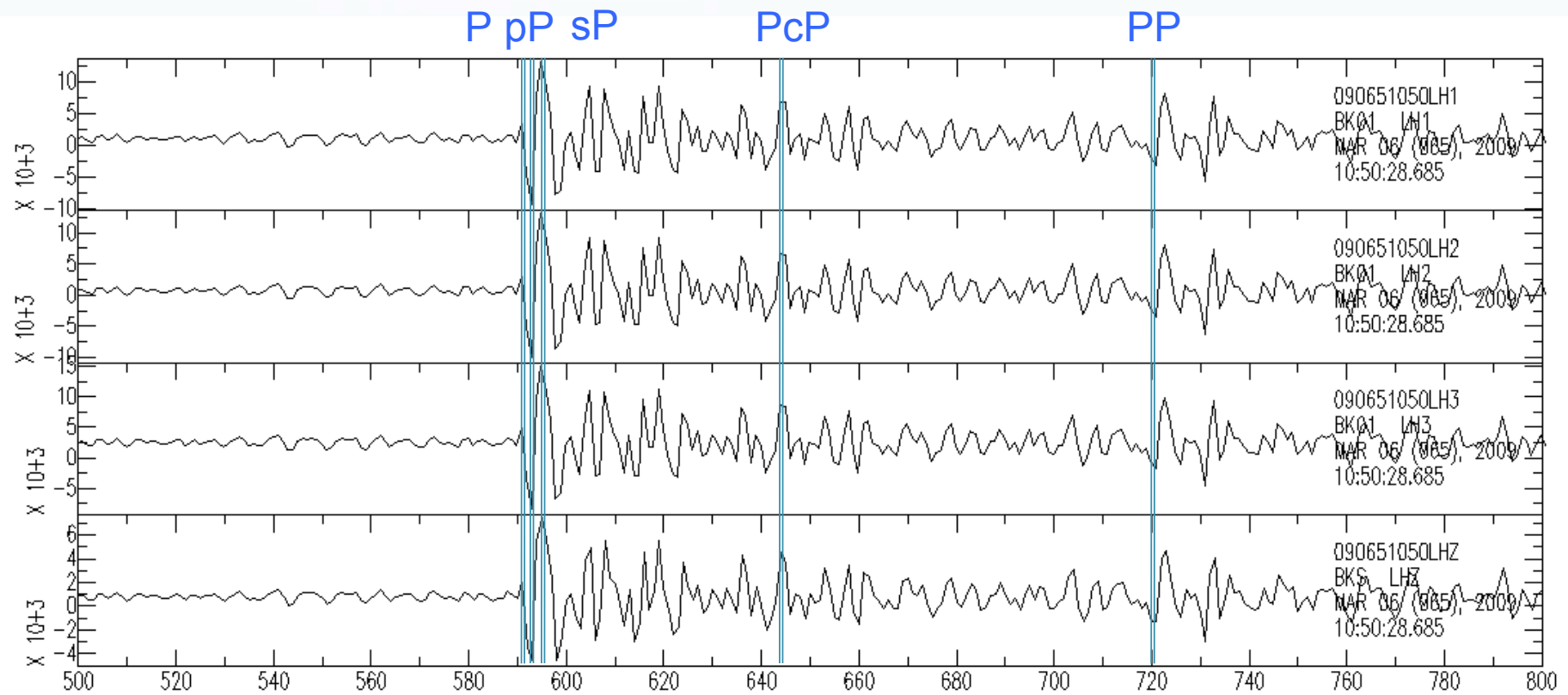


Testing reliability of sensors

- PDF?
- Control chart?
- Hypothesis tests?
- How to convey over the whole of the period band?

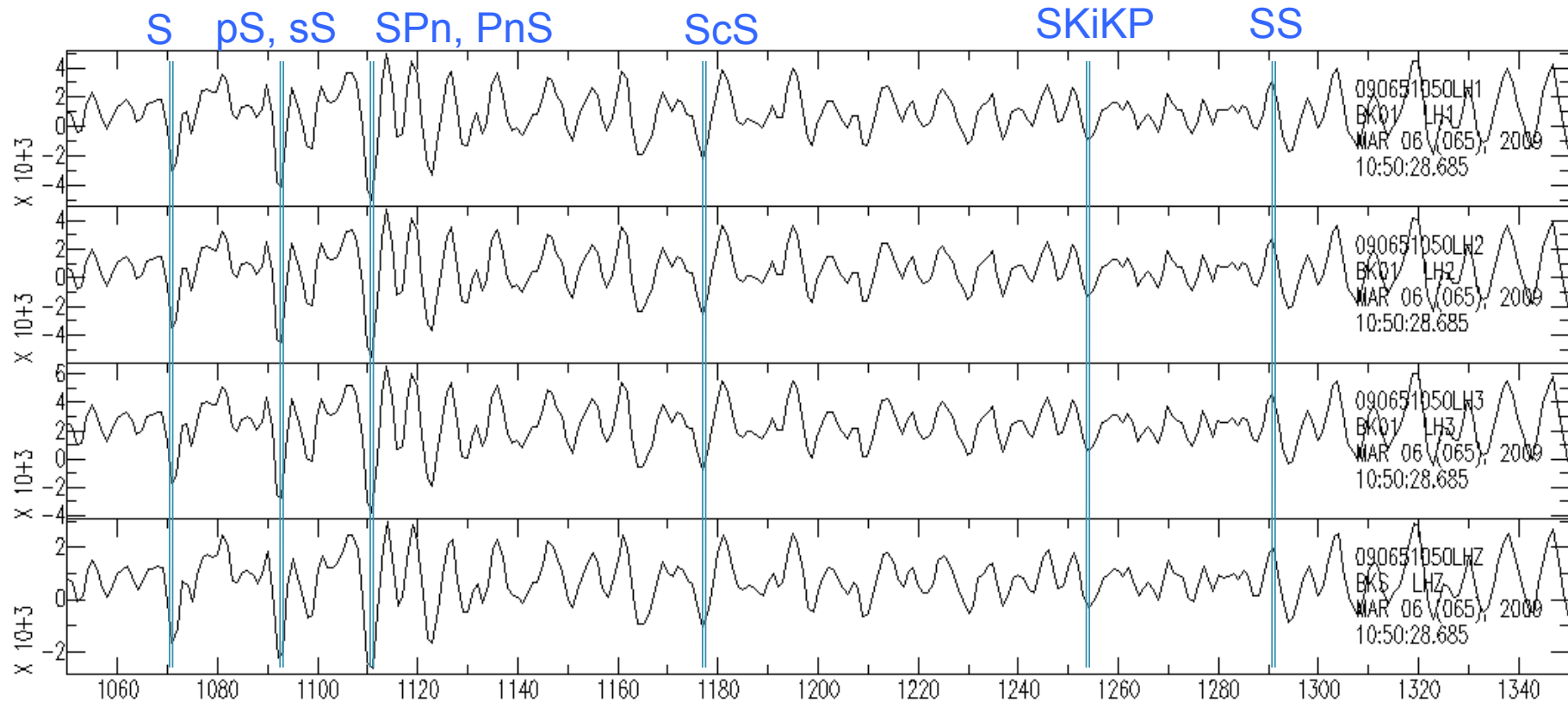
P - Phase Identification

- Mw6.5 Svalbard, March 6th, 2009



S – Phase Identifications

- Mw6.5 Svalbard, March 6th, 2009



Noise Correlation

Top to bottom:

3 month BKS-RAMR, 1 month BKS-RAMR, 1 month
RAMR-LH1, 1 month RAMR-LH2, 1 month RAMR-LH3

