



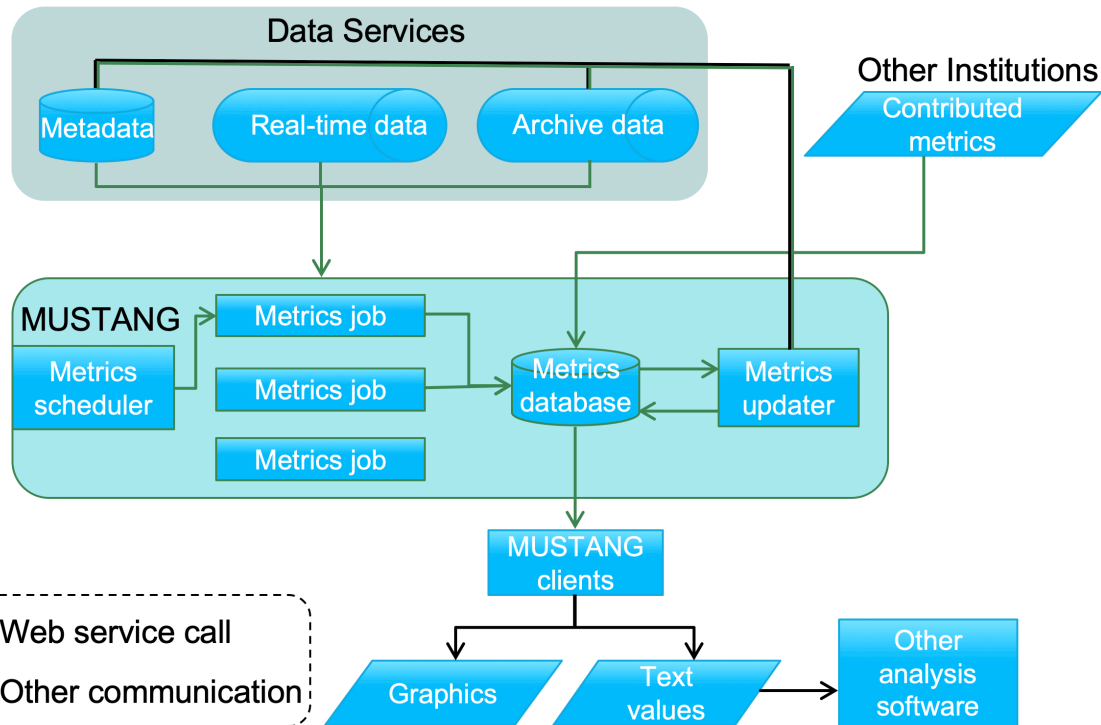
MUSTANG Quality Assurance System: Metrics and Tools

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ANSS NetOpsX
November 4, 2019

Introduction to MUSTANG



- An analytics database containing data quality metrics, Power Spectral Densities (PSD), and Probability Density Functions (PDF) for seismic data in the IRIS DMC archive
- A collection of algorithms that continually process incoming waveform data and metadata
- A suite of web services providing data quality metrics on demand
- A set of tools for data quality exploration, visualization, and assessment



- Latency metrics run every 4-hours on real-time data
- Other metrics queued to run one day after data is archived
- Metrics available 2-3 days after the data arrives at IRIS DMC
- PASTURE system for updating metrics runs every day
- PSD response updater runs twice a week

<http://service.iris.edu>

MUSTANG is accessed
through web services

- 8 web services in total
- retrieve values through URL queries
 - Text, XML, CSV, JSON, JSONP, PNG
- convenient to use in scripts and tools



Incorporated Research Institutions for Seismology

Web Services

IRIS DMC Web Services

Service Implementations

MUSTANG

- measurements
- noise-psd
- noise-pdf
- noise-pdf-browser
- noise-mode-timeseries
- spectrogram
- metrics
- targets

What Kinds of Metrics are Available?

MiniSEED Flag Counts

amplifier saturation
 calibration signal
 clock locked
 digital filter charging
 digitizer clipping
 event begin/end
 event in progress
 glitches
 missing padded data
 spikes
 suspect time tag
 telemetry sync error
 timing correction

Other

timing quality (blockette 1001)
 metric error

Data Latency

real time data latency
 real time feed latency
 real time total latency

Data Availability

percent available
 channel up time
 maximum gap length
 maximum overlap length
 number of gaps
 number of overlaps

Simple Data Statistics

maximum sample value
 minimum sample value
 median sample value
 mean sample value
 sample rms variance
 unique sample count

Noise Analysis

Power Spectral Density (PSD)*
 Probability Density Function (PDF)*
 PSD/PDF statistics*
 percent above high noise model
 percent below low noise model
 dead channel indicators

Signal Anomalies

cross talk
 DC offset change
 signal-to-noise ratio
 maximum STA/LTA
 number of spikes
 pressure effects

Metadata Checks

orientation check
 polarity check
 transfer function

All IU stations that have signal-to-noise-ratio > 10
for the 2018-03-25 20:14:47 Mw=6.4 Banda Sea event

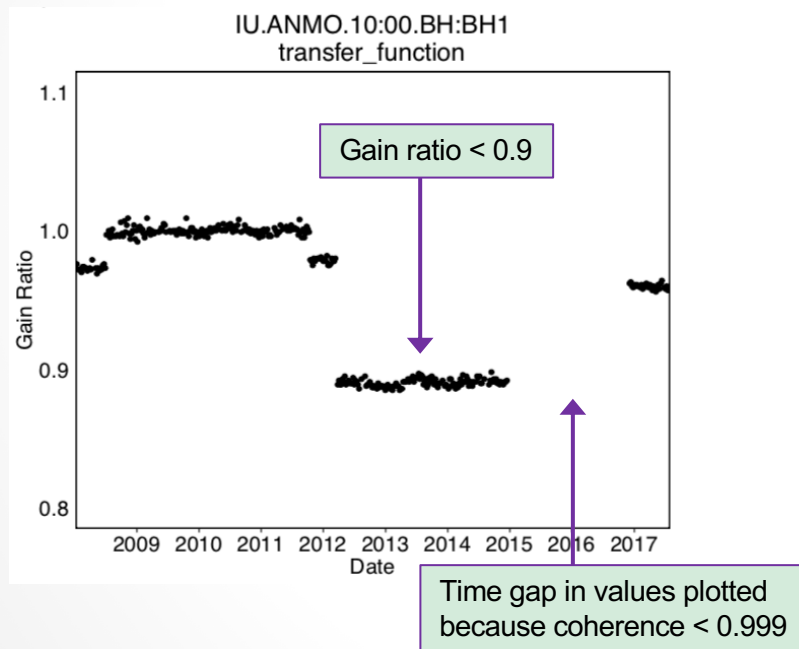
[http://service.iris.edu/mustang/measurements/1/query?metric=sample_snr
&net=IU&cha=BHZ&format=text&startafter=2018-03-25T20:14:17
&startbefore=2018-03-25T20:34:47&value_gt=10&orderby=value_desc](http://service.iris.edu/mustang/measurements/1/query?metric=sample_snr&net=IU&cha=BHZ&format=text&startafter=2018-03-25T20:14:17&startbefore=2018-03-25T20:34:47&value_gt=10&orderby=value_desc)

Measurements Query Example

```
"Sample SNR from 2018/03/25 20:14:17 to 2018/03/25 20:34:47"
"value","target","start","end","lddate"
"107.871","IU.PMG.60.BHZ.M","2018/03/25 20:18:06","2018/03/25 20:19:08","2018/04/16 13:06:14"
"106.253","IU.PMG.00.BHZ.M","2018/03/25 20:18:06","2018/03/25 20:19:08","2018/04/16 13:06:14"
"105.704","IU.PMG.10.BHZ.M","2018/03/25 20:18:06","2018/03/25 20:19:08","2018/04/16 13:06:14"
"82.1549","IU.MAKZ.00.BHZ.M","2018/03/25 20:24:57","2018/03/25 20:25:59","2018/04/16 12:58:38"
"55.9803","IU.CTAO.00.BHZ.M","2018/03/25 20:18:44","2018/03/25 20:19:46","2018/04/16 23:35:27"
"55.9276","IU.CTAO.10.BHZ.M","2018/03/25 20:18:44","2018/03/25 20:19:46","2018/04/16 23:35:27"
"54.7265","IU.KBL..BHZ.M","2018/03/25 20:25:12","2018/03/25 20:26:14","2018/04/16 12:56:45"
"31.9765","IU.ULN.10.BHZ.M","2018/03/25 20:23:51","2018/03/25 20:24:53","2018/04/16 13:01:42"
"31.5041","IU.ULN.00.BHZ.M","2018/03/25 20:23:51","2018/03/25 20:24:53","2018/04/16 13:01:42"
"21.3301","IU.GNI.10.BHZ.M","2018/03/25 20:26:58","2018/03/25 20:28:00","2018/04/16 13:05:49"
"21.2458","IU.GNI.00.BHZ.M","2018/03/25 20:26:58","2018/03/25 20:28:00","2018/04/16 13:05:49"
"17.8204","IU.HNR.00.BHZ.M","2018/03/25 20:20:07","2018/03/25 20:21:09","2018/04/16 13:05:49"
"16.3439","IU.HNR.10.BHZ.M","2018/03/25 20:20:07","2018/03/25 20:21:09","2018/04/16 13:05:49"
"13.4055","IU.MBWA.10.BHZ.M","2018/03/25 20:18:08","2018/03/25 20:19:10","2018/04/16 12:58:38"
"13.1943","IU.MBWA.00.BHZ.M","2018/03/25 20:18:08","2018/03/25 20:19:10","2018/04/16 12:58:38"
"11.6853","IU.MA2.10.BHZ.M","2018/03/25 20:24:58","2018/03/25 20:26:00","2018/04/18 09:42:27"
"11.6473","IU.MA2.00.BHZ.M","2018/03/25 20:24:58","2018/03/25 20:26:00","2018/04/18 09:42:27"
"10.9973","IU.DAV.00.BHZ.M","2018/03/25 20:17:31","2018/03/25 20:18:33","2018/04/16 13:05:49"
"10.8583","IU.DAV.10.BHZ.M","2018/03/25 20:17:31","2018/03/25 20:18:33","2018/04/16 13:05:49"
```

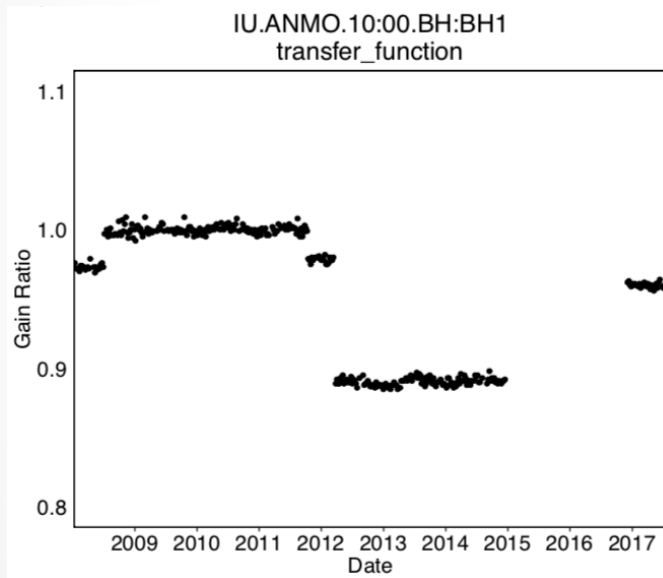
Example: transfer function gain_ratio values for ms_coherence > 0.999

Metrics query December 2017

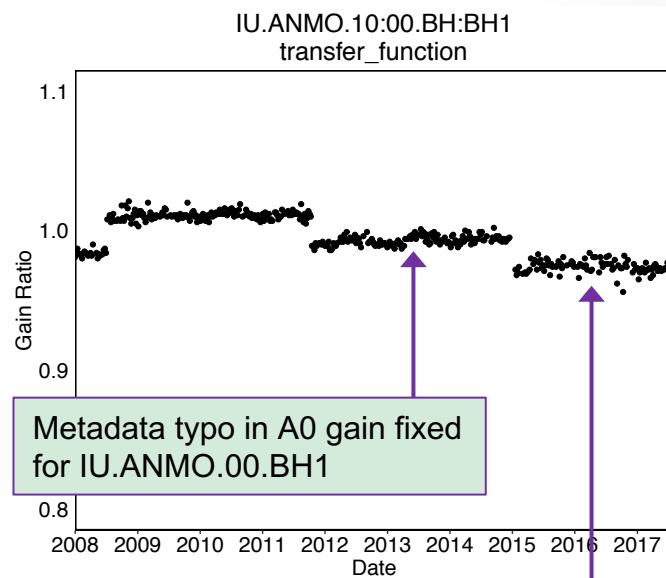


Example: transfer function gain_ratio values for ms_coherence > 0.999

Metrics query December 2017



Metrics query April 2018
(metadata updates in February, March)



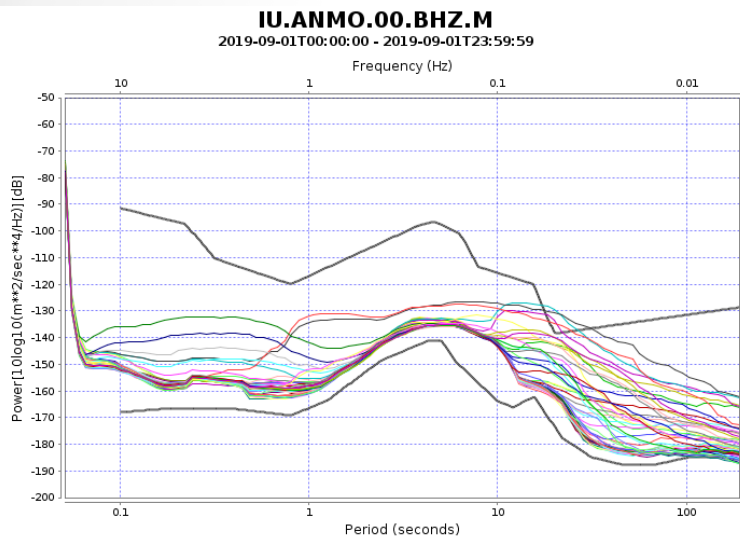
Metadata typo in A0 gain fixed
for IU.ANMO.00.BH1

Orientation re-measured for both loc 00 and 10
sensors, resulting in coherence > 0.999

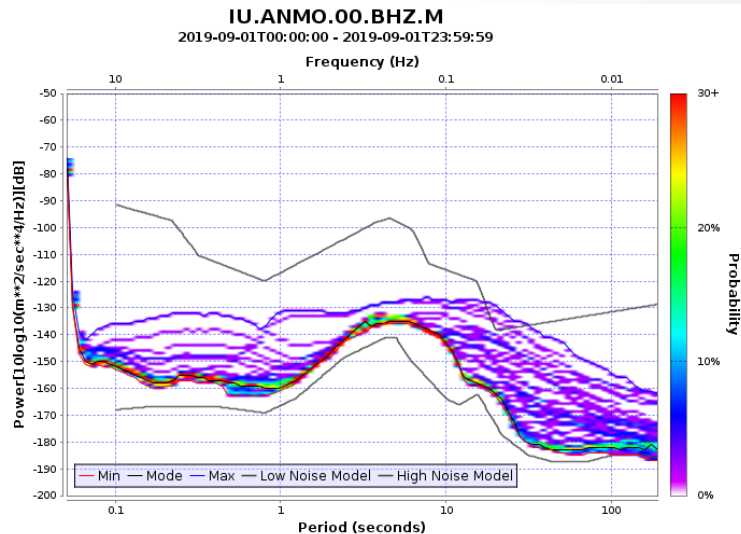
<http://service.iris.edu/mustang/noise-psd/1/>

<http://service.iris.edu/mustang/noise-pdf/1/>

Power Spectral Densities



Probability Density Functions



Plot

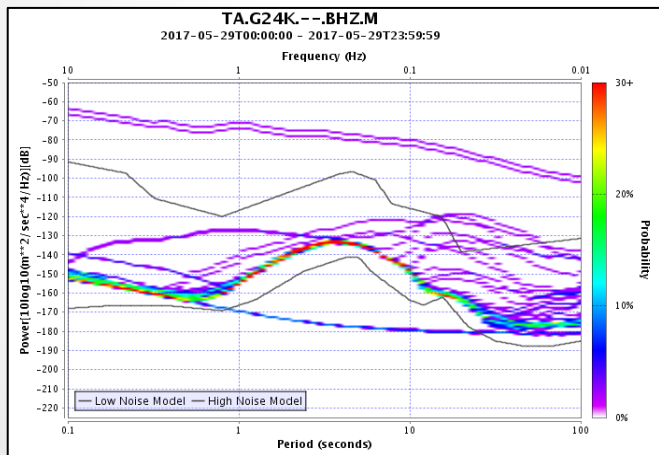
Text

XML

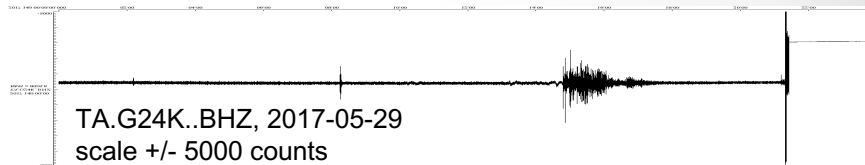
also: statistics

PDF-derived metrics

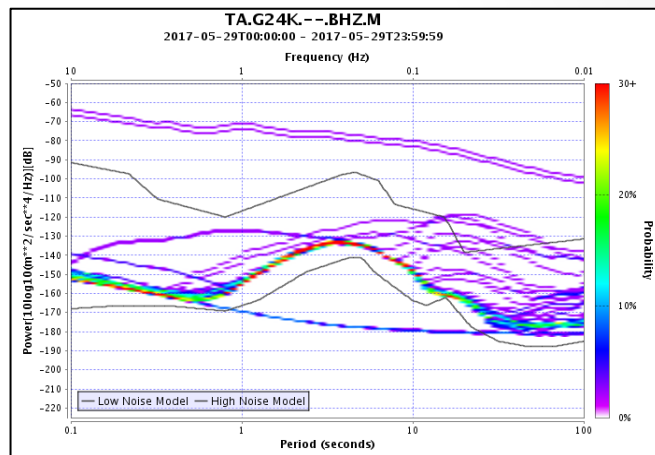
pct_above_nhnm



- Percentage of PDF matrix hits above the New High Noise Model
- pct_above_nhnm = 5.706



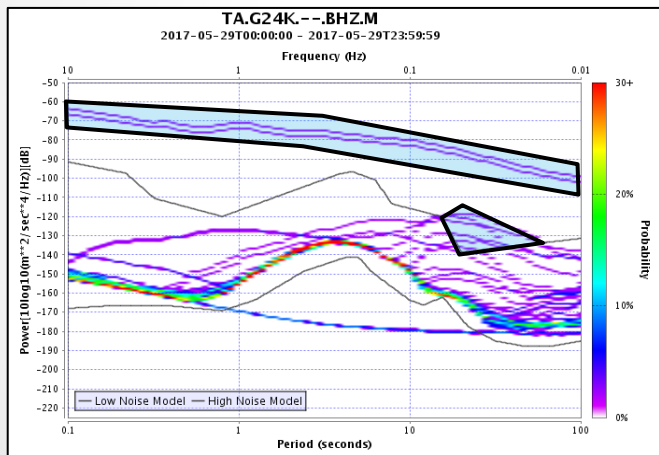
pct_below_nlnm



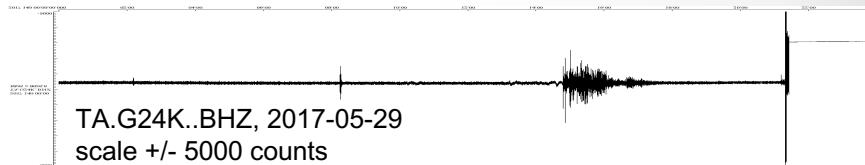
- Percentage of PDF matrix hits below the New Low Noise Model
- pct_below_nlnm = 3.820

PDF-derived metrics

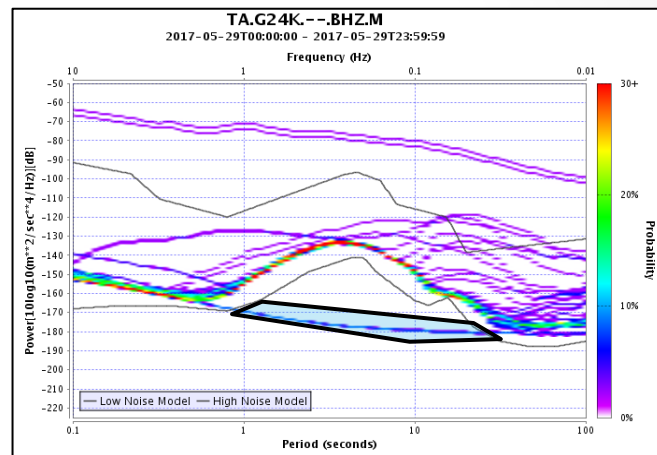
pct_above_nhnm



- Percentage of PDF matrix hits above the New High Noise Model
- pct_above_nhnm = 5.7



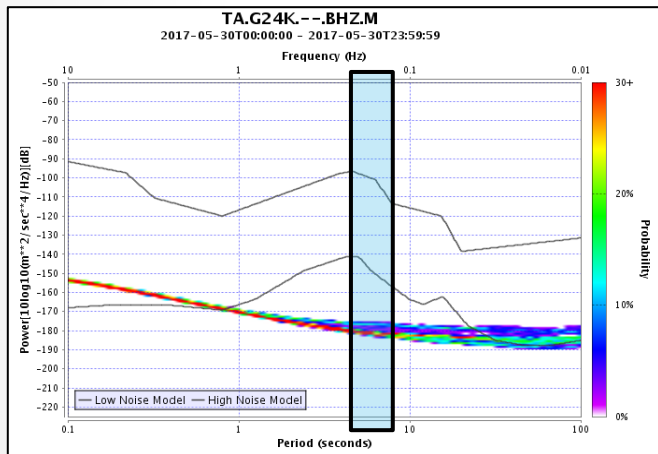
pct_below_nlnm



- Percentage of PDF matrix hits below the New Low Noise Model
- pct_below_nlnm = 3.8

PDF-derived metrics

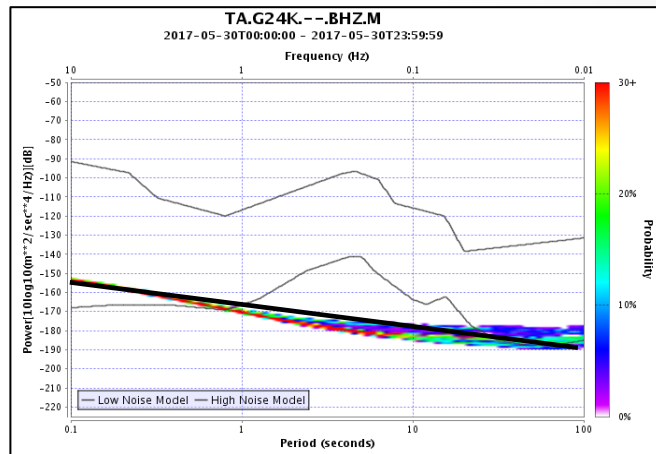
dead_channel_gsn



- difference the median PSD from the New Low Noise Model for periods 4-8 seconds, average the values
- $\text{dead_channel_gsn} = 1$ if $>$ than 5 dB below the NLNM, $\text{dead_channel_gsn} = 0$ if $<$ 5 dB below NLNM

pct_below_nlnm=52.9
pct_above_nhnrm=0

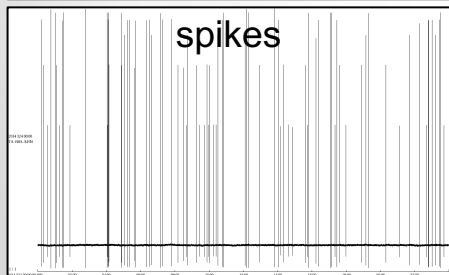
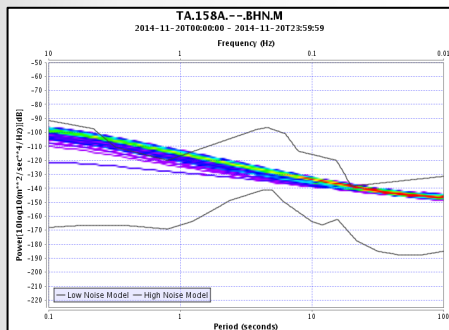
dead_channel_lin



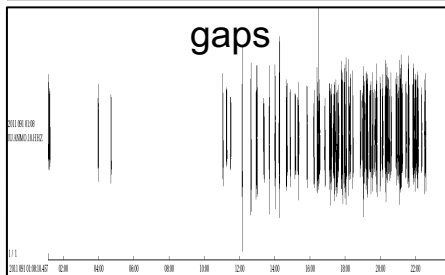
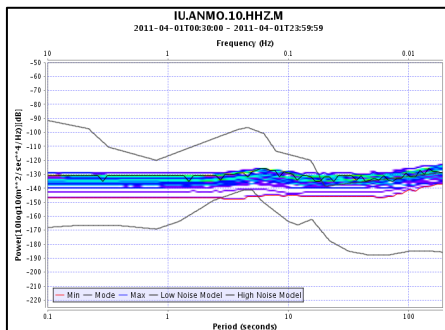
- linear fit to the PSD mean
- return standard deviation of the residuals
- $\text{dead_channel_lin} = 2.8$

PDF-derived metrics

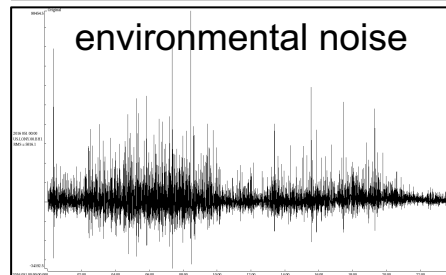
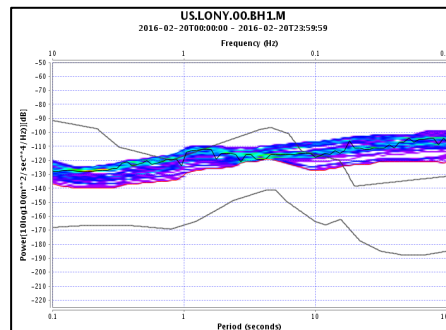
dead_channel_lin=0.91



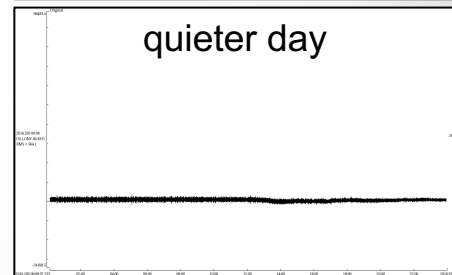
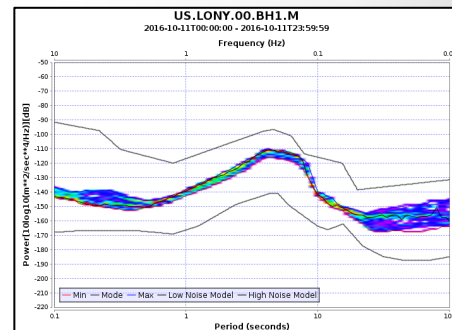
dead_channel_lin=0.91



dead_channel_lin=1.79



dead_channel_lin=14.13




```

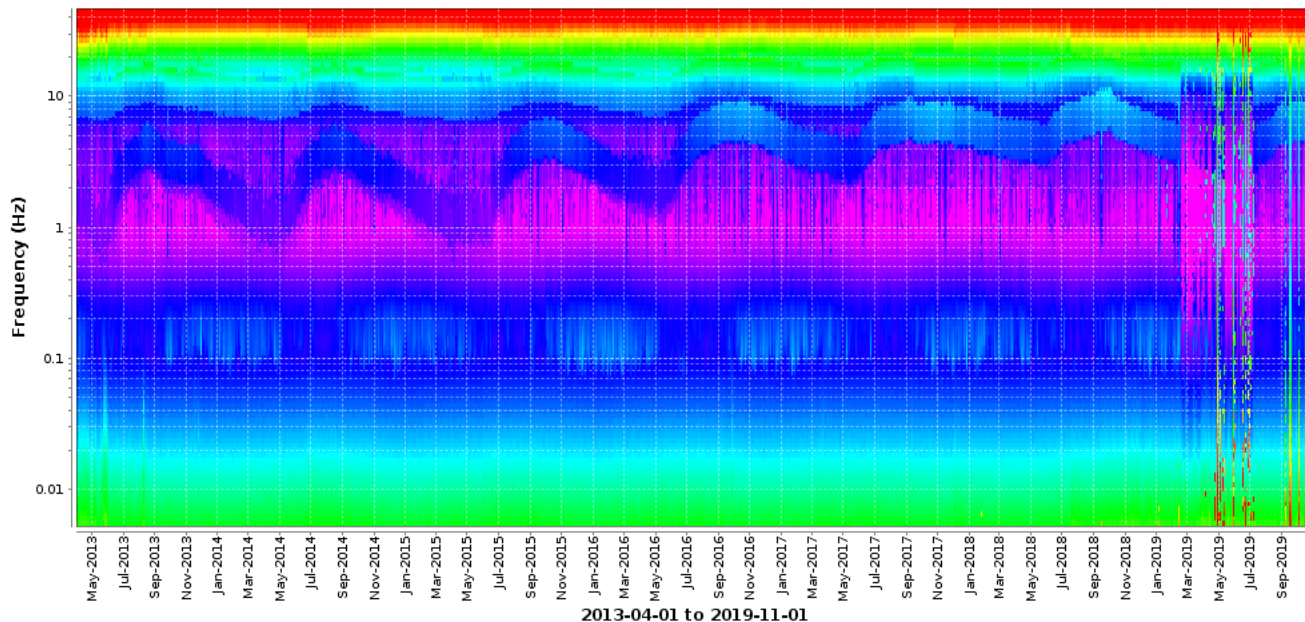
-<PdfModes>
<Created>2019-11-02T21:07:28.416Z</Created>
<Target>UU.IMU.01.EHZ.M</Target>
-<SelectedDateRange>
<Start>1980-01-01T00:00:00.000Z</Start>
<End>2049-01-01T23:59:59.000Z</End>
</SelectedDateRange>
-<AnalyzedDateRange>
<Start>2013-04-01T00:00:00.000Z</Start>
<End>2019-10-31T23:59:59.000Z</End>
</AnalyzedDateRange>
-<Days>
-<Day starttime="2013-04-01T00:00:00.000Z">
<value hertz="0.0052556" power="-85"/>
<value hertz="0.0096388" power="-95"/>
<value hertz="0.032421" power="-118"/>
<value hertz="0.10000" power="-129"/>
<value hertz="0.30844" power="-137"/>
<value hertz="1.0375" power="-150"/>
<value hertz="3.2000" power="-139"/>
<value hertz="9.8702" power="-120"/>
<value hertz="33.199" power="-46"/>
<value hertz="46.951" power="-16"/>
</Day>
-<Day starttime="2013-04-02T00:00:00.000Z">
<value hertz="0.0052556" power="-81"/>
<value hertz="0.0096388" power="-95"/>
<value hertz="0.032421" power="-117"/>
<value hertz="0.10000" power="-128"/>
<value hertz="0.30844" power="-137"/>
<value hertz="1.0375" power="-143"/>
<value hertz="3.2000" power="-146"/>
<value hertz="9.8702" power="-121"/>
<value hertz="33.199" power="-42"/>
<value hertz="46.951" power="-13"/>
</Day>
-<Day starttime="2013-04-03T00:00:00.000Z">
<value hertz="0.0052556" power="-83"/>
<value hertz="0.0096388" power="-95"/>
<value hertz="0.032421" power="-115"/>
<value hertz="0.10000" power="-130"/>
<value hertz="0.30844" power="-137"/>
<value hertz="1.0375" power="-143"/>
<value hertz="3.2000" power="-146"/>
<value hertz="9.8702" power="-121"/>
<value hertz="33.199" power="-42"/>
<value hertz="46.951" power="-12"/>

```

noise-mode-timeseries & spectrogram

-157  -42 [dB]

UU.IMU.01.EHZ.M



<http://service.iris.edu/mustang/noise-spectrogram/1/query?target=UU.IMU.01.EHZ.M>

Spectrogram Color Palettes

	name	type	colorblind-friendly?	color printer-friendly?	greyscale-compatible?
	rainbow	diverging	no	no	no
	RdYIBu	diverging	yes	yes	no
	BrBG	diverging	yes	yes	no
	RdBu	diverging	yes	yes	no
	YlGnBu	sequential	yes	yes	no
	viridis	sequential	yes	no	yes
	OrRd	sequential	yes	yes	yes

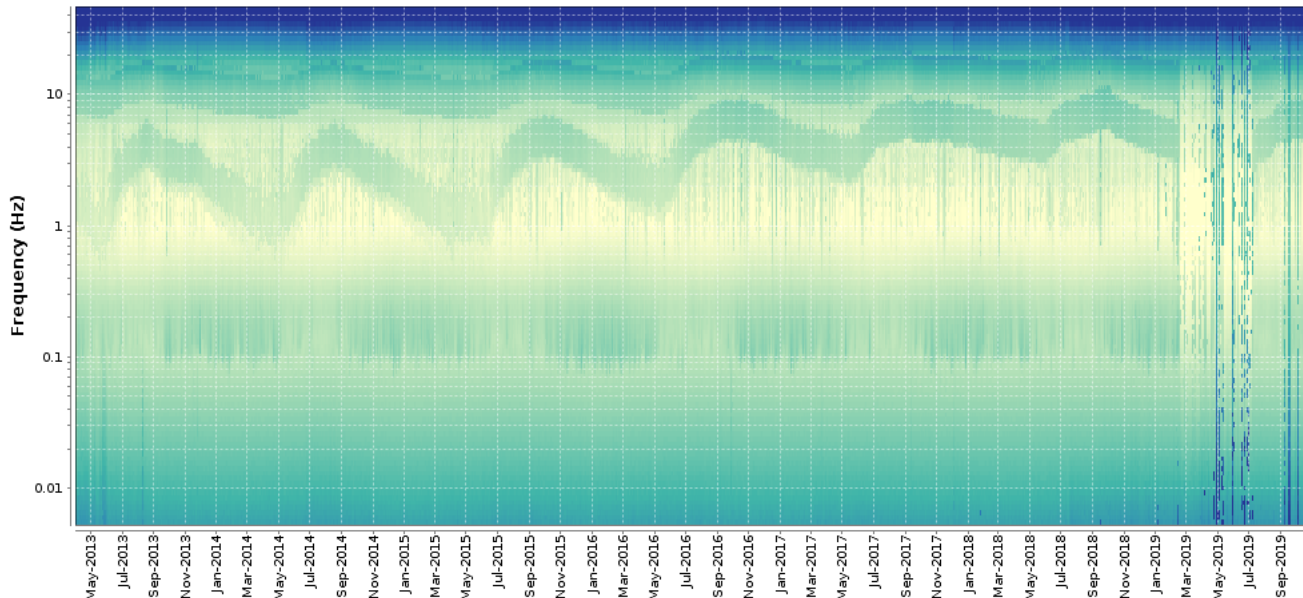
```

-<PdfModes>
<Created>2019-11-02T21:07:28.416Z</Created>
<Target>UU.IMU.01.EHZ.M</Target>
-<SelectedDateRange>
<Start>1980-01-01T00:00:00.000Z</Start>
<End>2049-01-01T23:59:59.000Z</End>
</SelectedDateRange>
-<AnalyzedDateRange>
<Start>2013-04-01T00:00:00.000Z</Start>
<End>2019-10-31T23:59:59.000Z</End>
</AnalyzedDateRange>
-<Days>
-<Day starttime="2013-04-01T00:00:00.000Z">
<value hertz="0.0052556" power="-85"/>
<value hertz="0.0096388" power="-95"/>
<value hertz="0.032421" power="-118"/>
<value hertz="0.10000" power="-129"/>
<value hertz="0.30844" power="-137"/>
<value hertz="1.0375" power="-150"/>
<value hertz="3.2000" power="-139"/>
<value hertz="9.8702" power="-120"/>
<value hertz="33.199" power="-46"/>
<value hertz="46.951" power="-16"/>
</Day>
-<Day starttime="2013-04-02T00:00:00.000Z">
<value hertz="0.0052556" power="-81"/>
<value hertz="0.0096388" power="-95"/>
<value hertz="0.032421" power="-117"/>
<value hertz="0.10000" power="-128"/>
<value hertz="0.30844" power="-137"/>
<value hertz="1.0375" power="-143"/>
<value hertz="3.2000" power="-146"/>
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<value hertz="33.199" power="-42"/>
<value hertz="46.951" power="-13"/>
</Day>
-<Day starttime="2013-04-03T00:00:00.000Z">
<value hertz="0.0052556" power="-83"/>
<value hertz="0.0096388" power="-95"/>
<value hertz="0.032421" power="-115"/>
<value hertz="0.10000" power="-130"/>
<value hertz="0.30844" power="-137"/>
<value hertz="1.0375" power="-143"/>
<value hertz="3.2000" power="-146"/>
<value hertz="9.8702" power="-121"/>
<value hertz="33.199" power="-42"/>
<value hertz="46.951" power="-12"/>

```

-157  -42 [dB]

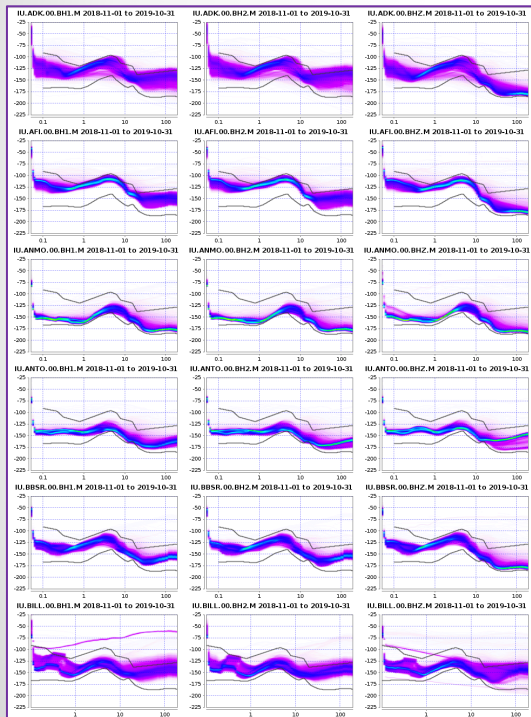
UU.IMU.01.EHZ.M



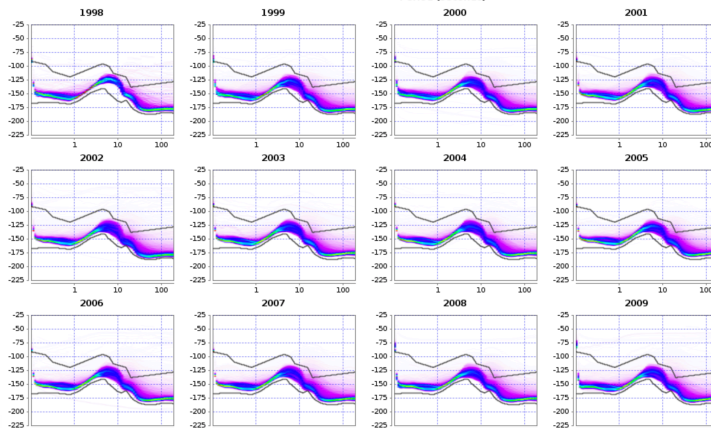
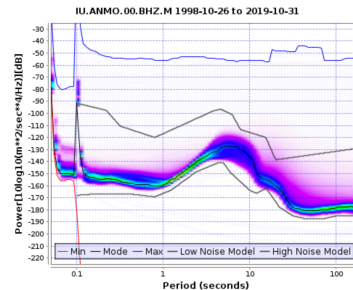
2013-04-01 to 2019-11-01

<http://service.iris.edu/mustang/noise-spectrogram/1/query?target=UU.IMU.01.EHZ.M&plot.color.palette=YIGnBu>

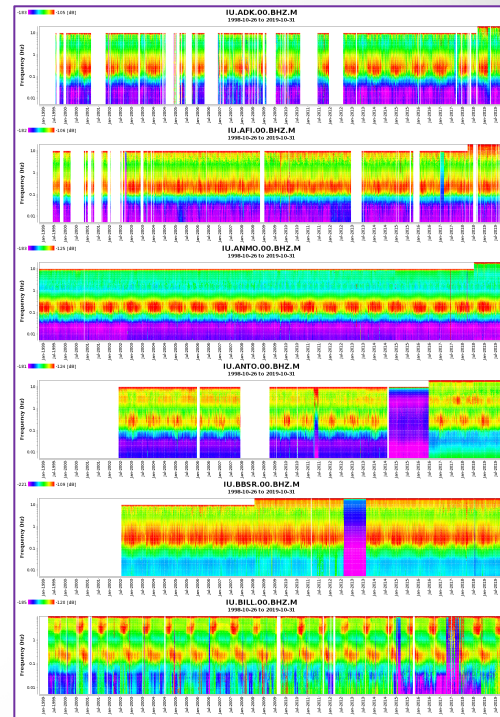
noise-pdf-browser



gallery



breakout



spectrogram


```
<!DOCTYPE HTML PUBLIC>
<html><body>
```

Example PHP script to create links to noise-pdf-browser in web page

```
<?php
    date_default_timezone_set('UTC');
    $start=urlencode(date('Y-m-d',time()-86400*30));
    $end=urlencode(date('Y-m-d',time()));

    $link='http://service.iris.edu/mustang/noise-pdf-browser/1/gallery?network=TA,AK&channel=BH?,HH?' .
        '&starttime=' . $start . '&endtime=' . $end . '&interval=all';
    echo "<p><a href=$link>TA-Alaska PDF Browser Broadband</a> Last 30 days: $start to $end</p>";

    $link2 = 'http://service.iris.edu/mustang/noise-pdf-browser/1/gallery?network=TA,AK&channel=BN?,HN?' .
        '&starttime=' . $start . '&endtime=' . $end . '&interval=all';
    echo "<p><a href=$link2>TA-Alaska PDF Browser Strong Motion</a> Last 30 days: $start to $end</p>";

    $start=urlencode(date('Y-m-d',time()-86400*365));
    $link3 = 'http://service.iris.edu/mustang/noise-pdf-browser/1/spectrogram?network=TA,AK&channel=BH?,HH?' .
        '&starttime=' . $start . '&endtime=' . $end . '&output=powerdmedian&color.palette=RdBu&powerrange=-25,25';
    echo "<a href=$link3>TA-Alaska Spectrogram Browser: Power Differenced from Median by Frequency</a>
        Last year: $start to $end</p>";
?>
```

```
</body></html>
```

Go to page

```
<!DOCTYPE HTML PUBLIC>
```

```
<html><body>
```

```
<?php
```

```
date_default_timezone_set('UTC');
```

```
$start=urlencode(date('Y-m-d',time()-86400*30));
```

```
$end=urlencode(date('Y-m-d',time()));
```

set time range for past month
using current date

```
$link='http://service.iris.edu/mustang/noise-pdf-browser/1/gallery?network=TA,AK&channel=BH?,HH?' .
```

```
'&starttime=' . $start . '&endtime=' . $end . '&interval=all';
```

```
echo "<p><a href=$link>TA-Alaska PDF Browser Broadband</a> Last 30 days: $start to $end</p>";
```

```
$link2 = 'http://service.iris.edu/mustang/noise-pdf-browser/1/gallery?network=TA,AK&channel=BN?,HN?' .
```

```
'&starttime=' . $start . '&endtime=' . $end . '&interval=all';
```

```
echo "<p><a href=$link2>TA-Alaska PDF Browser Strong Motion</a> Last 30 days: $start to $end</p>";
```

```
$start=urlencode(date('Y-m-d',time()-86400*365));
```

set time range for past year

```
$link3 = 'http://service.iris.edu/mustang/noise-pdf-browser/1/spectrogram?network=TA,AK&channel=BH?,HH?' .
```

```
'&starttime=' . $start . '&endtime=' . $end . '&output=powermedian&color.palette=RdBu&powerrange=-25,25 ';
```

```
echo "<a href=$link3>TA-Alaska Spectrogram Browser: Power Differenced from Median by Frequency</a>
```

```
Last year: $start to $end</p>";
```

```
?>
```

```
</body></html>
```

Go to page

```
<!DOCTYPE HTML PUBLIC>
```

```
<html><body>
```

```
<?php
```

```
date_default_timezone_set('UTC');
```

```
$start=urlencode(date('Y-m-d',time()-86400*30));
```

```
$end=urlencode(date('Y-m-d',time()));
```

```
$link='http://service.iris.edu/mustang/noise-pdf-browser/1/gallery?network=TA,AK&channel=BH?,HH?' .  
'&starttime=' . $start . '&endtime=' . $end . '&interval=all';
```

```
echo "<p><a href=$link>TA-Alaska PDF Browser Broadband</a> Last 30 days: $start to $end</p>";
```

← create URL

```
$link2 = 'http://service.iris.edu/mustang/noise-pdf-browser/1/gallery?network=TA,AK&channel=BN?,HN?' .  
'&starttime=' . $start . '&endtime=' . $end . '&interval=all';
```

```
echo "<p><a href=$link2>TA-Alaska PDF Browser Strong Motion</a> Last 30 days: $start to $end</p>";
```

← create URL

```
$start=urlencode(date('Y-m-d',time()-86400*365));
```

```
$link3 = 'http://service.iris.edu/mustang/noise-pdf-browser/1/spectrogram?network=TA,AK&channel=BH?,HH?' .  
'&starttime=' . $start . '&endtime=' . $end . '&output=powerdmedian&color.palette=RdBu&powerrange=-25,25 ';
```

```
echo "<a href=$link3>TA-Alaska Spectrogram Browser: Power Differenced from Median by Frequency</a>  
Last year: $start to $end</p>";
```

← create URL

```
?>
```

```
</body></html>
```

Go to page

MUSTANG Client Tools

- **MUSTANG Databrowser** - various plot types
- **LASSO** – rank and color-code stations based on multiple metric combinations
- **MUSTANGular** – view metrics on map
- **QuARG** – network quality assurance report generator (in development)



MUSTANG Databrowser - Metric Timeseries Example

<http://ds.iris.edu/mustang/databrowser>

MUSTANG databrowser

IRIS DMC

Plot Type and Metric

Plot Type
Metric Timeseries

Metric
sample_max: maximum amplitude

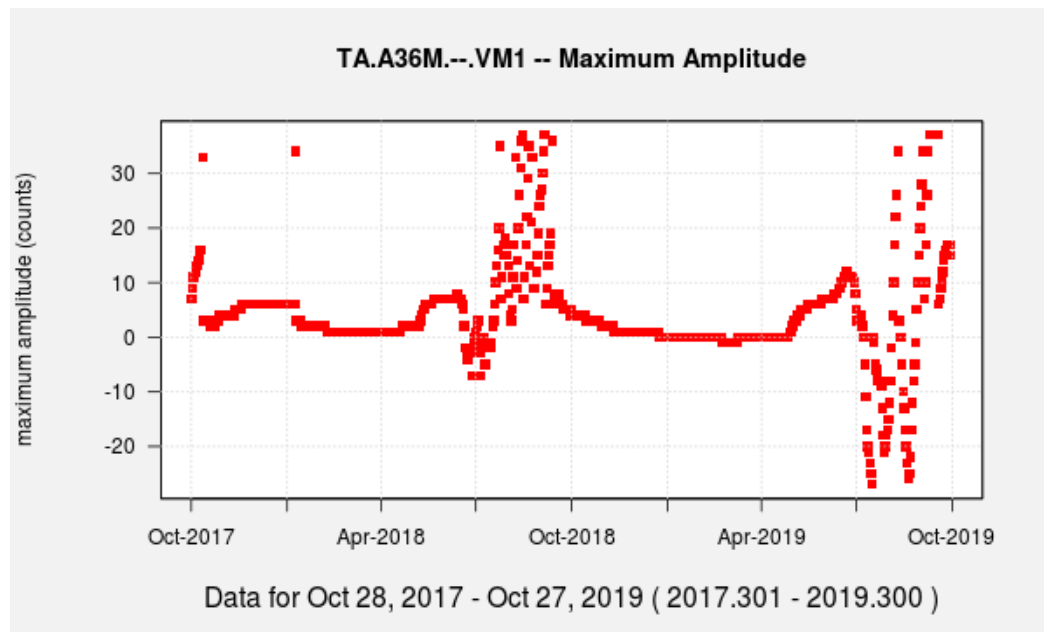
Plot Options for Metric Timeseries
☐ channel set
☐ scale by channel set

Timespan and Data Source

Time Span
Start: 2017-10-28
End: 2019-10-28

Network - Station - Location - Channel
Virtual Network: No virtual network
Network: TA
Station: A36M
Location: --
Channel: VM1

Activity:
Time (sec): data load=2.41, plot=0.42, R total=2.84
[data URL](#)



MUSTANG Databrowser - Gap Duration Plot Example

<http://ds.iris.edu/mustang/databrowser>

MUSTANG databrowser

IRIS DMC

Plot Type and Metric

Plot Type

Gap Duration Plots

Metric

gap_list: time durations for data gaps

No Plot Options for Gap Duration Plots

Timespan and Data Source

Time Span

Start: 2018-06-01

End: 2018-07-01

Network - Station - Location - Channel

Virtual Network: No virtual network

Network: TA

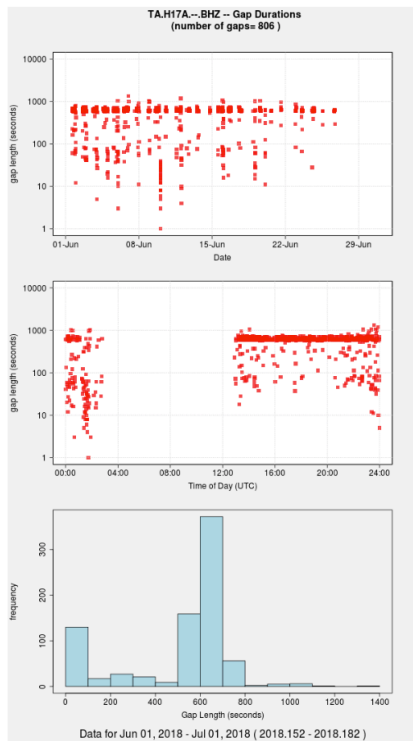
Station: H17A

Location: --

Channel: BHZ

Activity:

Time (sec): data load=1.17, plot=0.28, R total=1.45



Gap duration vs. date

Gap duration vs. time of day

Histogram of gap durations



LASSO

<http://lasso.iris.edu>

Latest Assessment of Seismic Station Observations (LASSO)



Basic Advanced About

Groups of MUSTANG metrics or LASSO derived metrics characterize the quality of seismic data. These are accessed by Network or Virtual Network.

View: Derived Data Availability

Metrics: percent_availability,dead_channel_gsn,derived_data_avail

Search: ☒ By Virtual Network ☐ By Network

Virtual Network: _GSN Global Seismographic Network stations and arrays

Location(s): Any

Channel(s): [B,H]H?

Ranking: ☒ Qualitative ☐ Quantitative

Display: ☐ Snapshot ☒ Mean ☐ Median

Start Time: Set to 2019-10-23 00:00:00

End Time: Set to 2019-10-30 00:00:00

Show Counts: ☐

Get Measurements

Download Table (.csv)

Derived Data Availability view of _GSN for 2019-10-23T00:00:00 thru 2019-10-30T00:00:00 requested at Sat Nov 02 2019 20:52:12 GMT-0700 (PDT):

Show: All entries Search:

Target	Rank	percent_availability	dead_channel_gsn	derived_data_avail
		? Performance Rule	? Performance Rule	? Performance Rule
AU.MCQ..BHE.M	Data 00,00,02	0.00		0.00
AU.MCQ..BHN.M	Data 00,00,02	0.00		0.00
AU.MCQ..BHZ.M	Data 00,00,02	0.00		0.00
BK.CMB.00.BHE.M	Data 01,02,00	80.87	0.00	80.87
BK.CMB.00.BHN.M	Data 01,02,00	80.87	0.00	80.87
BK.CMB.00.BHZ.M	Data 01,02,00	80.87	0.00	80.87
BK.CMB.00.HHE.M	Data 01,02,00	80.87	0.00	80.87
BK.CMB.00.HHN.M	Data 01,02,00	80.87	0.00	80.87
BK.CMB.00.HHZ.M	Data 01,02,00	80.87	0.00	80.87
CU.PASC.00.BHE.M	Data 03,00,00	99.99	0.00	99.99
CU.PASC.00.BHN.M	Data 03,00,00	99.99	0.00	99.99
CU.PASC.00.BHZ.M	Data 03,00,00	99.99	0.00	99.99
CU.PASC.00.HHE.M	Data 03,00,00	99.99	0.00	99.99
CU.PASC.00.HHN.M	Data 03,00,00	99.99	0.00	99.99
CU.PASC.00.HHZ.M	Data 03,00,00	100.00	0.00	100.00
CU.PASC.10.BHE.M	Data 03,00,00	100.00	0.00	100.00
CU.PASC.10.BHN.M	Data 03,00,00	100.00	0.00	100.00
CU.PASC.10.BHZ.M	Data 03,00,00	100.00	0.00	100.00
CU.PASC.10.HHE.M	Data 03,00,00	100.00	0.00	100.00
CU.PASC.10.HHN.M	Data 03,00,00	100.00	0.00	100.00
CU.PASC.10.HHZ.M	Data 03,00,00	100.00	0.00	100.00
CU.ANWB.00.BH1.M	Data 03,00,00	99.52	0.00	99.52
CU.ANWB.00.BH2.M	Data 03,00,00	100.00	0.00	100.00
CU.ANWB.00.BH3.M	Data 03,00,00	98.40	0.00	98.40
CU.ANWB.00.HH1.M	Data 01,00,02	7.30	0.00	7.30
CU.ANWB.00.HH2.M	Data 01,00,02	7.28	0.00	7.28
CU.ANWB.00.HHZ.M	Data 01,00,02	6.91	0.00	6.91
CU.BBQH.00.BH1.M	Data 03,00,00	100.00	0.00	100.00

Views in Basic Tab

Derived Data Availability

- percent_availability
- dead_channel_gsn

Mass Position Voltage

Signal Quality

- calibration_signal
- sample_rms
- sample_snr
- pct_above_nhn

Metadata Validity

- suspect_time_tag
- timing_quality
- timing_correction

Time Series Integrity

- num_gaps
- num_overlaps
- percent_availability
- max_gap

LASSO

<http://lasso.iris.edu>

Latest Assessment of Seismic Station Observations (LASSO)

Basic

Advanced

About

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View: Derived Data Availability

Metrics: percent_availability,dead_channel_gsn,derived_data_avail

Search: ☒ By Virtual Network ☐ By Network

Virtual Network: _GSN Global Seismographic Network stations and arrays

Location(s): Any

Channel(s): [B,H]H?

Ranking: ☒ Qualitative ☐ Quantitative

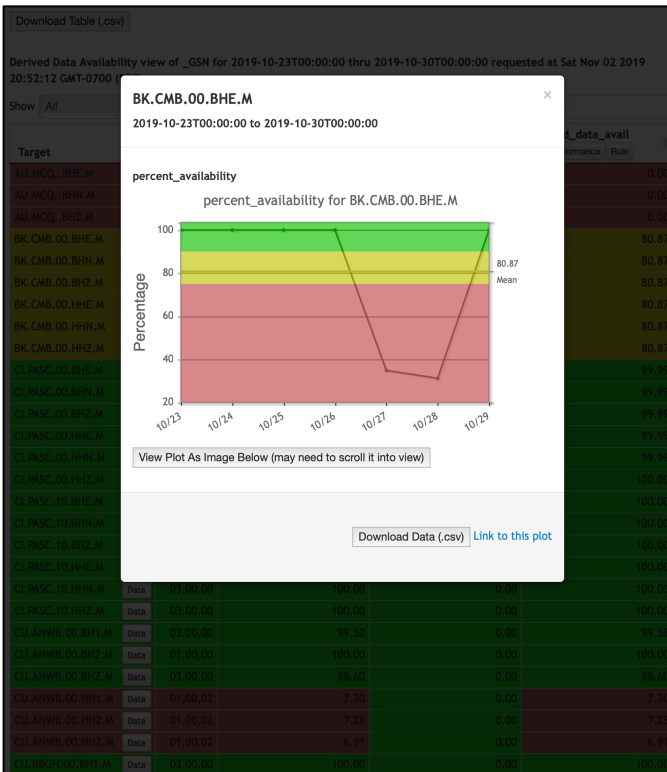
Display: ☐ Snapshot ☒ Mean ☐ Median

Start Time: Set to 2019-10-23 00:00:00

End Time: Set to 2019-10-30 00:00:00

Show Counts: ☐

Get Measurements



Views in Basic Tab

Derived Data Availability

- percent_availability
- dead_channel_gsn

Mass Position Voltage

Signal Quality

- calibration_signal
- sample_rms
- sample_snr
- pct_above_nhnm

Metadata Validity

- suspect_time_tag
- timing_quality
- timing_correction

Time Series Integrity

- num_gaps
- num_overlaps
- percent_availability
- max_gap

LASSO

<http://lasso.iris.edu>

Latest Assessment of Seismic Station Observations (LASSO)

Basic

Advanced

About



Groups of MUSTANG metrics or LASSO derived metrics characterize the quality of seismic data. These are accessed by Network or Virtual Network.

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Metrics: percent_availability,dead_channel_gsn,derived_data_avail

Search: ☒ By Virtual Network ☐ By Network

Virtual Network: _GSN Global Seismographic Network stations and arrays

Location(s): Any

Channel(s): [B,H]H?

Ranking: ☒ Qualitative ☐ Quantitative

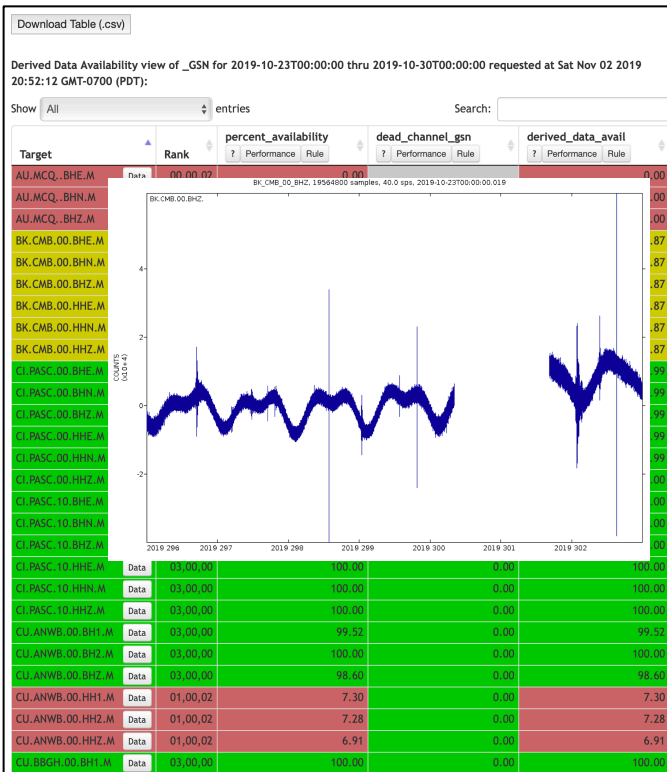
Display: ☐ Snapshot ☒ Mean ☐ Median

Start Time: Set to 2019-10-23 00:00:00

End Time: Set to 2019-10-30 00:00:00

Show Counts: ☐

Get Measurements



Views in Basic Tab

Derived Data Availability

- percent_availability
- dead_channel_gsn

Mass Position Voltage

Signal Quality

- calibration_signal
- sample_rms
- sample_snr
- pct_above_nhn

Metadata Validity

- suspect_time_tag
- timing_quality
- timing_correction

Time Series Integrity

- num_gaps
- num_overlaps
- percent_availability
- max_gap



MUSTANGular

MUSTANGular v2.0

An app for displaying IRIS MUSTANG metrics on a map. [More info...](#)

Enter your query below

Network(s)

_US-TA

Station(s)

Location(s)

Channel(s)

BHE,BHN,BHZ

Quality(s)

Start Date *

10/1/2019

End Date *

11/2/2019

Dates start at beginning of day.

2 metrics selected.

Num Gaps Metric

Num Overlaps Metric

Num Spikes Metric

Pct Above Nnhm Metric

Pct Below Nnhm Metric

Percent Availability Metric

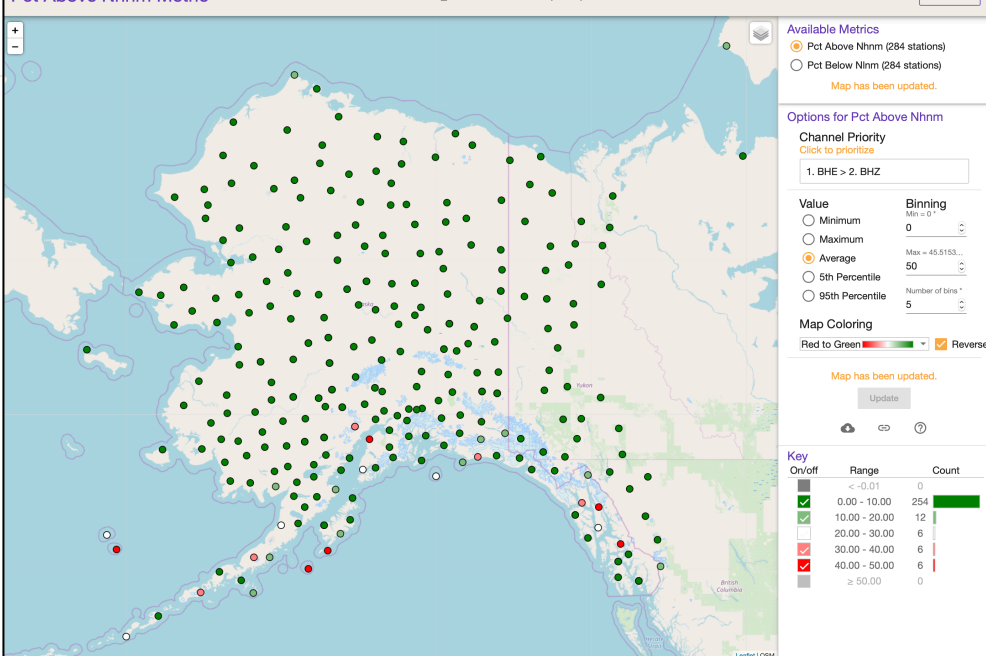
Polarity Check Metric

Pressure Effects Metric

Empty fields, comma separated lists, and wildcards (?) and (*) allowed.

Submit

Pct Above Nnhm Metric Dates: 2019-10-01 - 2019-11-02 Net: _US-TA Cha: BHE,BHN,BHZ





MUSTANGular

MUSTANGular v2.0

An app for displaying IRIS MUSTANG metrics on a map. [More info...](#)

Enter your query below

Network(s)

_US-TA

Station(s)

Location(s)

Channel(s)

BHE,BHN,BHZ

Quality(s)

Start Date *

10/1/2019

End Date *

11/2/2019

Dates start at beginning of day.

2 metrics selected.

Num Gaps Metric

Num Overlaps Metric

Num Spikes Metric

Pct Above Nnm Metric

Pct Below Nnm Metric

Percent Availability Metric

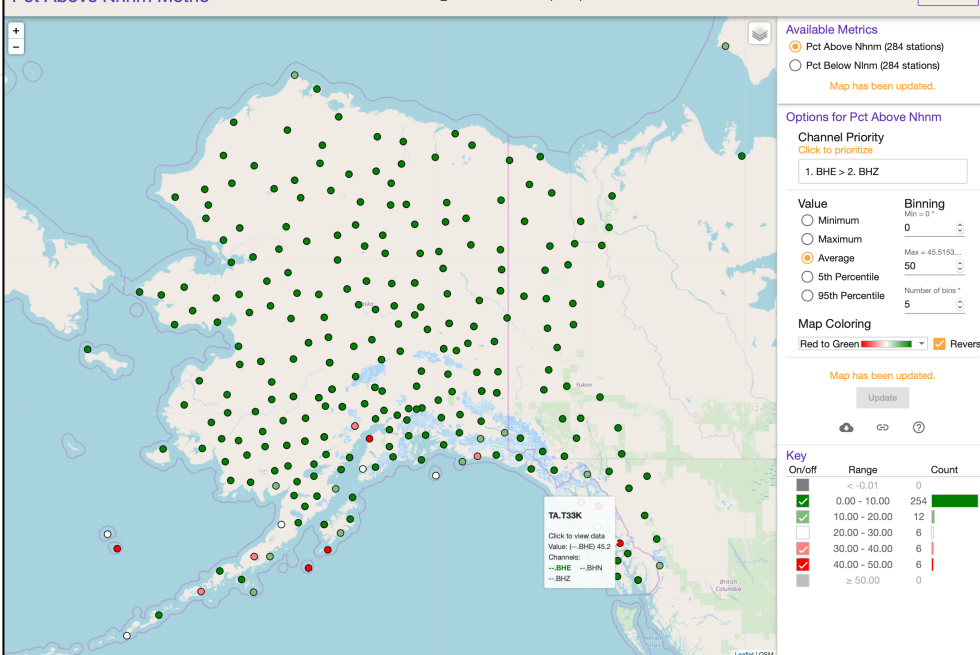
Polarity Check Metric

Pressure Effects Metric

Empty fields, comma separated lists, and wildcards (?) and (*) allowed.

Submit

Pct Above Nnm Metric Dates: 2019-10-01 - 2019-11-02 Net: _US-TA Cha: BHE,BHN,BHZ





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Enter your query below

Network(s)

_US-TA

Station(s)

Location(s)

Channel(s)

BHE,BHN,BHZ

Quality(s)

Start Date *

10/1/2019

End Date *

11/2/2019

Dates start at beginning of day.

2 metrics selected.

Num Gaps Metric

Num Overlaps Metric

Num Spikes Metric

Pct Above Nnm Metric

Pct Below Nnm Metric

Percent Availability Metric

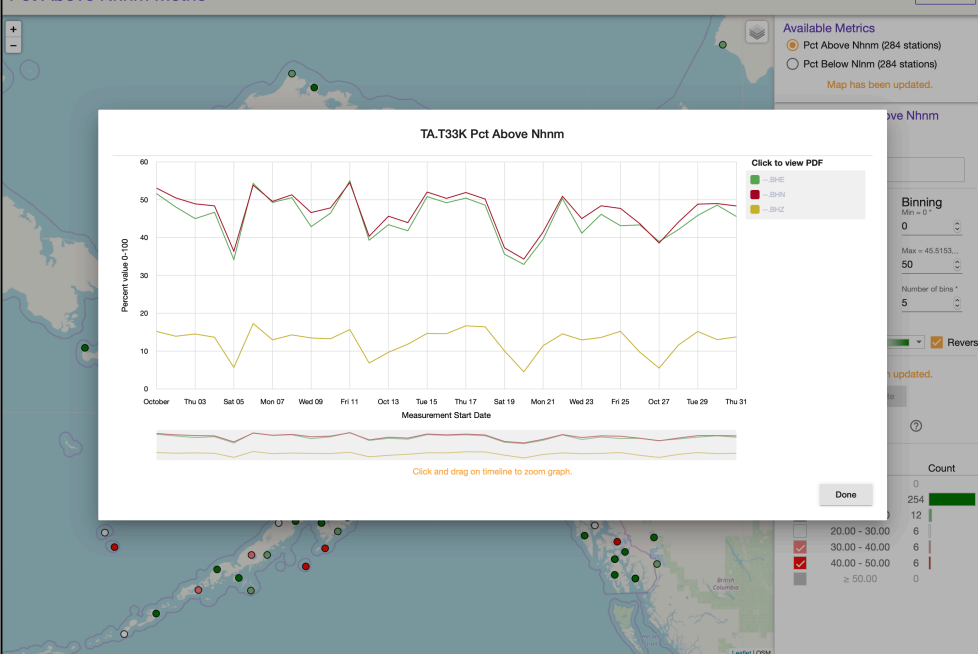
Polarity Check Metric

Pressure Effects Metric

Empty fields, comma separated lists, and wildcards (?) and (*) allowed.

Submit

Pct Above Nnm Metric Dates: 2019-10-01 - 2019-11-02 Net: _US-TA Cha: BHE,BHN,BHZ





MUSTANGular

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Enter your query below

Network(s)

_US-TA

Station(s)

Location(s)

Channel(s)

BHE,BHN,BHZ

Quality(s)

Start Date *

10/1/2019

End Date *

11/2/2019

Dates start at beginning of day.

2 metrics selected.

Num Gaps Metric

Num Overlaps Metric

Num Spikes Metric

Pct Above Nnm Metric

Pct Below Nnm Metric

Percent Availability Metric

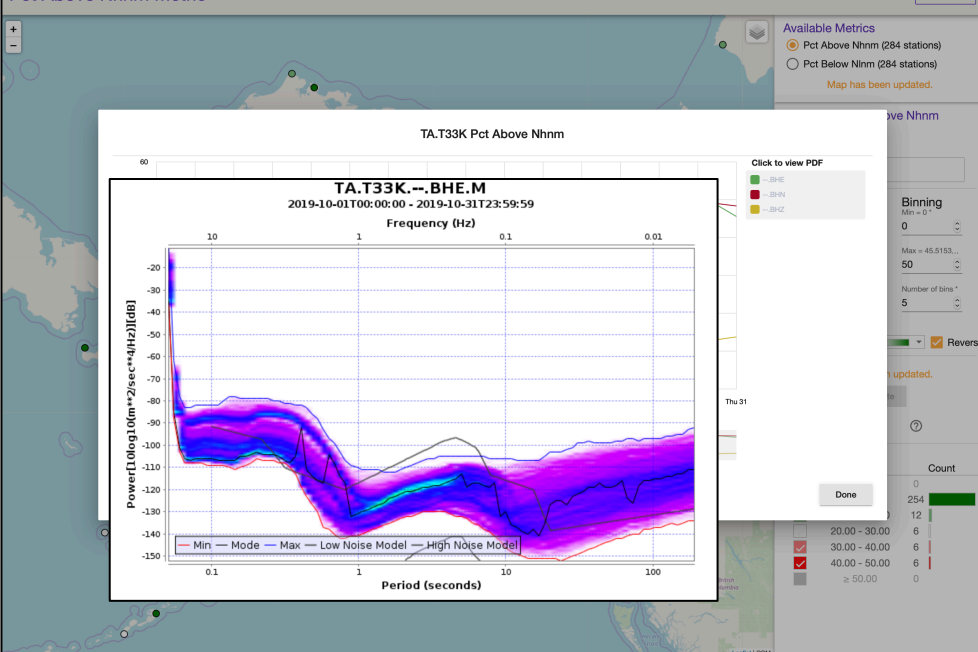
Polarity Check Metric

Pressure Effects Metric

Empty fields, comma separated lists, and wildcards (?) and (*) allowed.

Submit

Pct Above Nnm Metric Dates: 2019-10-01 - 2019-11-02 Net: _US-TA Cha: BHE,BHN,BHZ



Network Quality Reports and QuARG (Quality Assurance Report Generator)

- Identify metric threshold values that indicate a station problem
- Use scripts to compile metrics and flag potential issues
- Analyst review and issue tracking (ticketing system)
- Compile information into a readable report
- Highlight and prioritize areas where quality can be improved

(thanks goes to _GSN, AK, and UU networks for being guinea pigs and providing feedback)

Metric threshold categories:

- Completeness
- Amplitudes
- State of Health
- Timing
- Metadata

Completeness

noData: percent_availability = 0

gapRatioGt12: num_gaps/percent_availability > 12

avgGaps: average gaps/measurement >= 2

Amplitudes

dead: dead_channel_lin < 3.5 && pct_below_nlnm > 20

pegged: abs(sample_mean) > 6e+6 && sample_rms < 1000

lowAmp: dead_channel_lin >= 3.5 && pct_below_nlnm > 20

lowRms: sample_rms < 25

flat: sample_unique < 200

xTalk: abs(cross_talk) >= 0.9

noise1: dead_channel_lin < 2.25 && pct_above_nlnm > 20

noise2: dead_channel_lin < 2 && pct_below_nlnm <= 20 && num_gaps < 10

hiAmp: sample_rms > 50000 && pct_above_nlnm > 30

rmsRatio: sample_rms ratio E/N, or N/E, or Z/((E+N)/2) > 10

badRESP: pct_above_nlnm > 90 || pct_below_nlnm > 90

nonCoher: ms_coherence <= 0.990

dcOffsets: dc_offset > 10

avgSpikes: average num_spikes/measurement >= 100

nSpikes: num_spikes > 500

Metric threshold categories:

- Completeness
- Amplitudes
- State of Health
- Timing
- Metadata

State of Health

ampSat: amplifier_saturation > 0
filtChg: digital_filter_charging > 2
clip: digitizer_clipping > 0
spikes: spikes > 0
glitch: glitches > 0
padding: missing_padded_data > 0
tsync: telemetry_sync_error > 0

Timing

noTime: clock_locked = 0
poorTQual: 0 <= timing_quality < 60
suspectTime: suspect_time_tag > 1

Metadata

gainRatio: ms_coherence >= 0.999 && (gain_ratio <= 0.95 || gain_ratio >= 1.05)
polarity: polarity_check <= -0.5
zDip: Z Dip > -90
horDip: Horizontal Dip != 0
zeroZ: Elev = Depth = 0
lowScale: Scale <= 0
nonMSUnits: Input units != M/S

Example Network Quality Report

Summary Section

Data Quality Report for UU Q4 2018 (October-December)

Laura Keyson
dmc_qa@iris.washington.edu
Issued January 31, 2019

Summary

Clicking on each issue Summary link takes you to a more detailed description of that issue, including the metrics used to identify the problem. Sorted by category, then station.

UU :: University of Utah Regional Network

Category	Channel(s)	Status	Start Date	Summary
Amplitudes	UU.BEL01.EHZ	Resolved	12/03/2018	Low Amplitudes
Amplitudes	UU.BHU01.EHZ	Open	06/01/2017	Dead Channels
Amplitudes	UU.BMUT01.EHZ	Open	10/07/2018	Low Amplitudes
Amplitudes	UU.BRPU01.HH{ENZ}	Resolved	08/07/2018	Masses Off Center
Amplitudes	UU.BTU01.EHZ	Open		Moderate Amplitude Pulses
Amplitudes	UU.CCUT01.HH{EZ}	Resolved	10/16/2018	Masses Off Center
Amplitudes	UU.DBD01.EHZ	Open	05/08/2014	Fluctuating Amplitudes
Amplitudes	UU.DCU01.EHZ	Open		High Amplitude Signal
Amplitudes	UU.ECUT01.HH{ENZ}	Open	10/24/2018	Masses Off Center
Amplitudes	UU.EKU01.EHZ	Open		High amplitude Pulses and digitizer noise
Amplitudes	UU.FPU01.EHZ	Open	04/01/2013	High Amplitude Pulses
Amplitudes	UU.FOR201.HH{ENZ}	Resolved	12/17/2018	Spikes
Amplitudes	UU.FOR401.HH{ENZ}	Closed	08/07/2018	Bad Response
Amplitudes	UU.FORU01.HH{ENZ}	Resolved	10/07/2018	Identical Signals
Amplitudes	UU.FPU01.EHZ	Open	04/01/2013	High Amplitude Pulses
Amplitudes	UU.FSU01.EHZ	Open	10/09/2014	Low Amplitudes
Amplitudes	UU.GMU01.EH{ENZ}	Open	12/01/2017	Low amplitudes with repeating signal
Amplitudes	UU.GZU01.EH{ENZ}	Open	09/22/2016	Dead Channels
Amplitudes	UU.HCSU01.EHZ	Resolved	05/01/2018	High Amplitudes

Details

Detailed description of the issues. Sorted by station, with resolved issues at bottom

UU :: University of Utah Regional Network

UU.BSUT.01.HH{ENZ} Data Outage -- 11/05/2018 to 11/07/2018

STATUS: Closed

Diagnostics: percent_availability ([what is this?](#))

Thresholds: noData ([what is this?](#))

Outage began on 2018/11/05 and data returned on 2018/11/07.

[\(Top\)](#)

UU.BSUT.01.HH{ENZ} Data Outage -- 11/12/2018 to 11/16/2018

STATUS: Closed

Diagnostics: percent_availability ([what is this?](#))

Thresholds: noData ([what is this?](#))

Outage began on 2018/11/12 and data returned on 2018/11/16.

[\(Top\)](#)

UU.BSUT.01.HH{ENZ} Data Outage -- 10/15/2018 to 11/03/2018

STATUS: Closed

Diagnostics: percent_availability ([what is this?](#))

Thresholds: noData ([what is this?](#))

Outage began on 2018/10/15 and data returned on 2018/11/03.

[\(Top\)](#)

UU.FOR4.01.HH{ENZ} Bad Response -- 08/07/2018 to 10/26/2018

STATUS: Closed

Diagnostics: pct_above_nlnm ([what is this?](#))

Thresholds: badRESP, hiAmp ([what is this?](#))

The noise profile looks pretty normal but at higher-than-expected amplitudes. Perhaps the response is incorrect? This difference is noted when the station came back from a long outage, and prior to that had more usual amplitudes. This is being closed because the signal stops recording normally and I am opening a new ticket.

[\(Top\)](#)

UU.BHU.01.EHZ Dead Channels -- 06/01/2017

STATUS: Open

Diagnostics: pct_below_nlnm, sample_rms, sample_unique ([what is this?](#))

Thresholds: flat, lowAmp, lowRms ([what is this?](#))

These channels stopped recording seismic energy on this start date. [PDFs for UU.BHU for Oct 2018 forward](#)



QuARG Tool

Start Date: 2019-10-01		End Date: 2019-11-01	
Find Issues	Examine Issues	View Tickets	Generate Report
Preference File:	./preference_IU.py	Browse	Autofill
Issue File:	./20191001/issues.txt	Browse	
Network:	IU		
Stations:	*		
Locations:	*		
Channels:	BH?		
Find Issues			
Exit			

QuARG Tool – Find Issues

Start Date: 2019-10-01		End Date: 2019-11-01	
Find Issues	Examine Issues	View Tickets	Generate Report
Preference File:	./preference_IU.py	Browse	Autofill
Issue File:	./20191001/issues.txt	Browse	
Network:	IU		
Stations:	*		
Locations:	*		
Channels:	BH?		
Find Issues			
Exit			

Compiles list of station-days that meet metric threshold criteria and writes to the Issue File



Start:	2019-10-01	Create Ticket	To-Do	New	Closed	Existing	Support	No Ticket	False Positive
End:	2019-11-01		Status	Threshold	Target	Start	End	Days	Notes
Metrics:		Databrowser	TODO	rmsRatio	IU.CHT0.00.BH2/1	2019/10/02	2019/10/06	5	
Threshold:		Waveforms	TODO	rmsRatio	IU.CHT0.00.BH2/1	2019/10/08	2019/10/08	1	
Network:	IU	Metrics	TODO	rmsRatio	IU.CHT0.00.BH2/1	2019/10/10	2019/10/13	4	
Station:	CHT0	Metric Plot	TODO	noise2	IU.CHT0.00.BH2.M	2019/10/13	2019/10/13	1	
Location:	00	PDFs	TODO	rmsRatio	IU.CHT0.00.BH2/1	2019/10/15	2019/10/15	1	
Channel:	BH1,BH2,BHZ	Spectrograms	TODO	rmsRatio	IU.CHT0.00.BH2/1	2019/10/17	2019/10/17	1	
	Go To Target	Noise Modes	TODO	noise2	IU.CHT0.00.BH2.M	2019/10/21	2019/10/21	1	
	Go To Threshold	GOAT	TODO	rmsRatio	IU.CHT0.00.BH2/1	2019/10/21	2019/10/24	4	
		Events	TODO	noise2	IU.CHT0.00.BH2.M	2019/10/23	2019/10/23	1	
Notes:		Station	TODO	rmsRatio	IU.CHT0.00.BH2/1	2019/10/26	2019/10/26	1	
			TODO	rmsRatio	IU.CHT0.00.BH2/1	2019/10/28	2019/10/28	1	
			TODO	polarity	IU.CHT0.10.BH1.M	2019/10/29	2019/10/29	1	
	Add Notes	Select All							
	See Notes	Deselect All							
	Next	To Do							
	Previous	All Remaining							
Save			Return				Exit		

QuARG Tool – Examine Issues

Start:	2019-10-01	Create Ticket	To-Do	New	Closed	Existing	Support	No Ticket	False Positive
End:	2019-11-01		Status	Threshold	Target	Start	End	Days	Notes
Metrics:		Databrowser	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/02	2019/10/06	5	
Threshold:		Waveforms	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/08	2019/10/08	1	
Network:	IU	Metrics	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/10	2019/10/13	4	
Station:	CHTO	Metric Plot	TODD	noise2	IU.CHT0.00.BH2.M	2019/10/13	2019/10/13	1	
Location:	00	PDFs	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/15	2019/10/15	1	
Channel:	BH1,BH2,BHZ	Spectrograms	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/17	2019/10/17	1	
	Go To Target	Noise Modes	TODD	noise2	IU.CHT0.00.BH2.M	2019/10/19	2019/10/19	1	
	Go To Threshold	GOAT	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/21	2019/10/21	4	
		Events	TODD	noise2	IU.CHT0.00.BH2.M	2019/10/23	2019/10/23	1	
Notes:		Station	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/26	2019/10/26	1	
			TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/28	2019/10/28	1	
			TODD	polarity	IU.CHT0.10.BH1.M	2019/10/29	2019/10/29	1	
	Add Notes	Select All							
	See Notes	Deselect All							
	Next	To Do							
	Previous	All Remaining							
Save			Return			Exit			

QuARG Tool – Examine Issues

Start: 2019-10-01

End: 2019-11-01

Metrics:

Threshold:

Network: IU

Station: CHTO

Location: 00

Channel: BH2

Notes:

Go To Target

Go To Threshold

Add Notes

See Notes

Next

Previous

Create Ticket

Databrowser

Waveforms

Metrics

Metric Plot

PDFs

Spectrograms

Noise Modes

GOAT

Events

Station

Select All

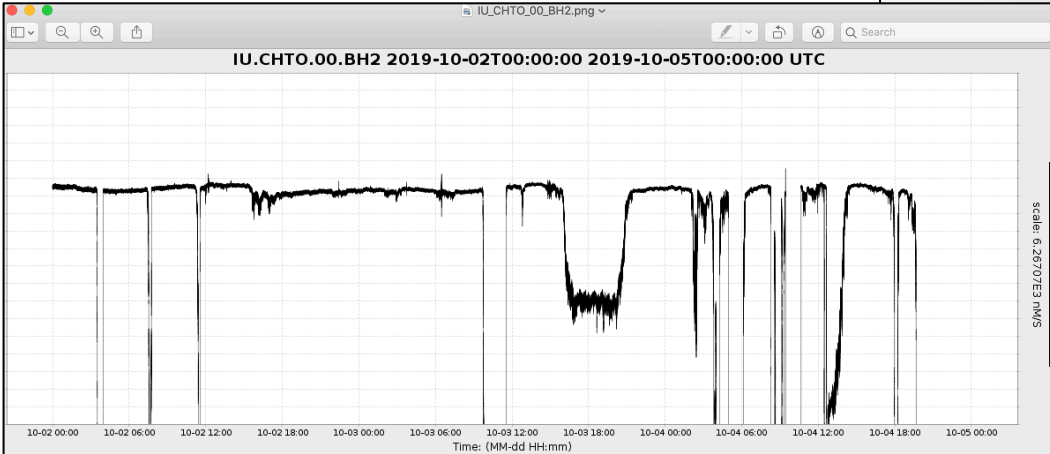
Deselect All

To Do

All Remaining

To-Do	New	Closed	Existing	Support	No Ticket	False Positive
Status	Threshold	Target	Start	End	Days	Notes
TOD0	rmsRatio	IU.CHTO.00.BH2/1	2019/10/02	2019/10/06	5	

IU.CHTO.00.BH2 2019-10-02T00:00:00 2019-10-05T00:00:00 UTC

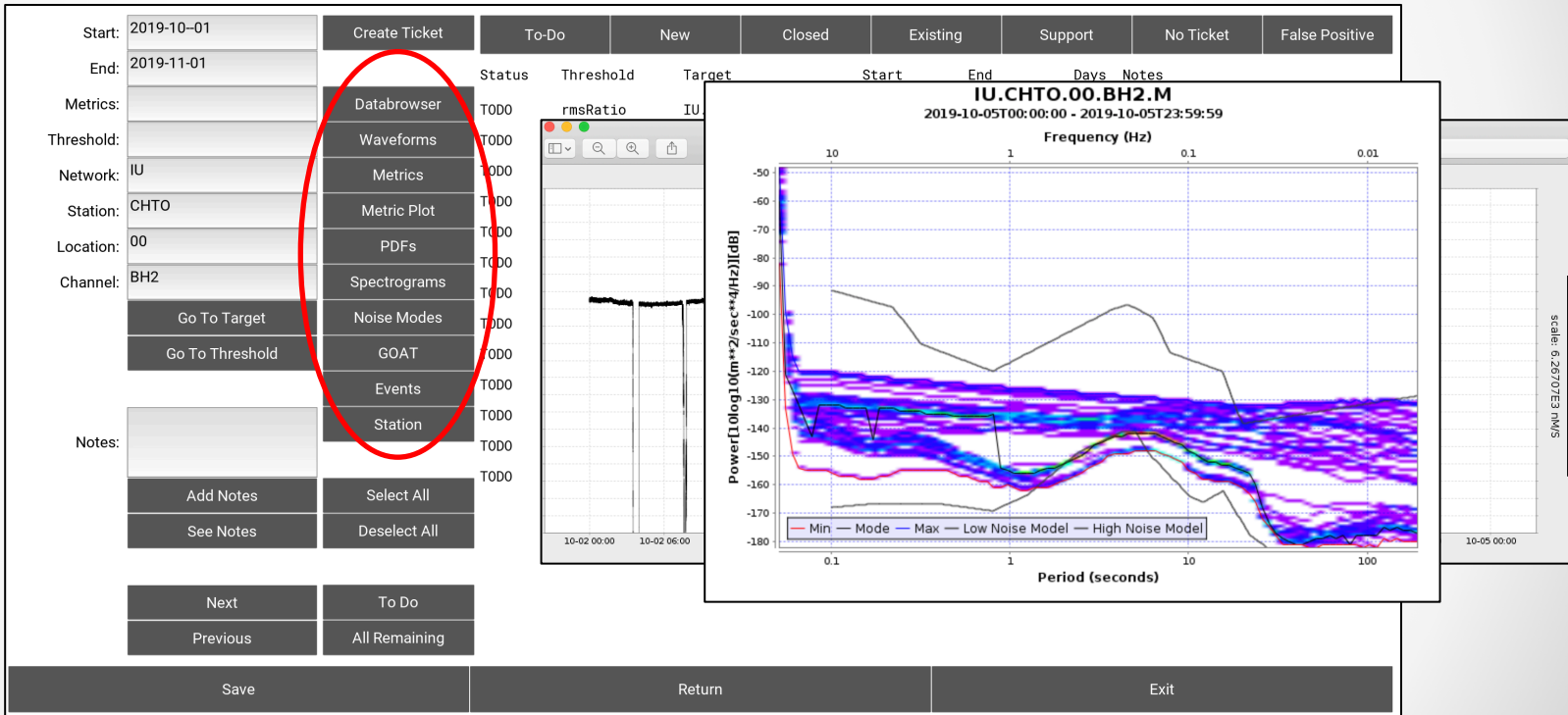


Save

Return

Exit

QuARG Tool – Examine Issues



QuARG Tool – Examine Issues

Start:	2019-10-01	Create Ticket	To-Do	New	Closed	Existing	Support	No Ticket	False Positive
End:	2019-11-01		Status	Threshold	Target	Start	End	Days	Notes
Metrics:		Databrowser	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/02	2019/10/06	5	
Threshold:		Waveforms	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/08	2019/10/08	1	
Network:	IU	Metrics	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/10	2019/10/13	4	
Station:	CHTO	Metric Plot	TODD	noise2	IU.CHT0.00.BH2.M	2019/10/13	2019/10/13	1	
Location:	00	PDFs	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/15	2019/10/15	1	
Channel:	BH1,BH2,BHZ	Spectrograms	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/17	2019/10/17	1	
	Go To Target	Noise Modes	TODD	noise2	IU.CHT0.00.BH2.M	2019/10/19	2019/10/19	1	
	Go To Threshold	GOAT	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/21	2019/10/21	4	
		Events	TODD	noise2	IU.CHT0.00.BH2.M	2019/10/23	2019/10/23	1	
Notes:		Station	TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/26	2019/10/26	1	
			TODD	rmsRatio	IU.CHT0.00.BH2/1	2019/10/28	2019/10/28	1	
			TODD	polarity	IU.CHT0.10.BH1.M	2019/10/29	2019/10/29	1	
	Add Notes	Select All							
	See Notes	Deselect All							
	Next	To Do							
	Previous	All Remaining							
Save			Return			Exit			

QuARG Tool – Examine Issues

Start:	2019-10-01	Create Ticket	To-Do	New	Closed	Existing	Support	No Ticket	False Positive
End:	2019-11-01		Status	Threshold	Target	Start	End	Days	Notes
Metrics:		Databrowser	TODD	hiAmp	IU.BBSR.10.BH1.M	2019/10/01	2019/10/01	1	
Threshold:		Waveforms	TODD	hiAmp	IU.BBSR.10.BH1.M	2019/10/06	2019/10/07	2	
Network:	IU	Metrics	TODD	rmsRatio	IU.BBSR.10.BHZ/12	2019/10/24	2019/10/24	1	
Station:	BBSR	Metric Plot							
Location:	10	PDFs							
Channel:	BH1,BH2,BHZ	Spectrograms							
	Go To Target	Noise Modes							
	Go To Threshold	GOAT							
		Events							
		Station							
Notes:									
	Add Notes	Select All							
	See Notes	Deselect All							
	Next	To Do							
	Previous	All Remaining							
Save			Return			Exit			



Tracker:	Data Problems		Load Ticket	
Subject:	not recording seismic energy			
	sensor noise, sudden dc shifts			
Description:				
Status:	New	Start:	2019-10-01	
Category:	Amplitudes	End:	2019-11-01	
Target:	IU.CHT0.00.BH2			
Image:	/Users/gilliansharer/Desktop/Screen Shot 2019-11-01 at 5.27.02	Browse		
Caption:			Thresholds:	
URLS:				pegged
				polarity
				poorQual
			rmsRatio	
			spikes	
			suspectTime	Clear Selection
Update		Delete Ticket		Return
				Exit

QuARG Tool – Generate Report

Start Date:		End Date:	
Find Issues	Examine Issues	View Tickets	Generate Report
Preference File:		Browse	Autofill
CSV File: /20191001/tickets.csv		Browse	
If creating CSV file internally:			
Status:	New	In Progress	Resolved
		Closed	Rejected
Tracker:	Data Problems	Support	
Start:		On/Before	On/After
End:		On/Before	On/After
Create CSV			
Generate Report			
Exit			

QuARG Tool – Generate Report

Start Date: End Date:

Find Issues Examine Issues View Tickets **Generate Report**

Preference File: Browse

CSV File: Browse

If creating CSV file internally:

Status: **New** In Progress Resolved Closed Rejected

Start: On/Before On/After

End: On/Before On/After

Generate Report

Exit

Data Quality Report for IU October 2019

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Summary

Clicking on each issue Summary link takes you to a more detailed description of that issue, including the metrics used to identify the problem. Sorted by category, then station.

IU :: Global Seismograph Network

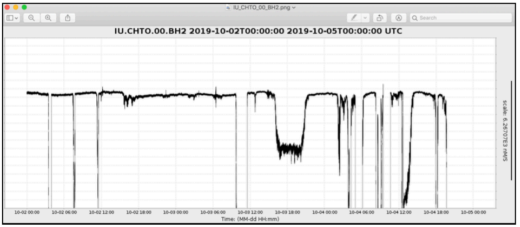
Category	Channel(s)	Status	Start Date	Summary
Amplitudes	IU.CHTO.00.BH2	Open	2019-10-01	not recording seismic energy

Details

Detailed description of the issues. Sorted by station, with resolved issues at bottom

IU :: Global Seismograph Network

IU.CHTO.00.BH2 not recording seismic energy -- 2019-10-01
 STATUS: Open
 Thresholds: rmsRatio, noise2 ([what is this?](#))
 sensor noise, sudden dc shifts



Contact us: dmc_qa@iris.washington.edu

MUSTANG Message Center Lists:

- MUSTANG Users – community discussion of QA
<https://ds.iris.edu/message-center/topic/mustang-users/>
- MUSTANG QA – announcements, problems, and discussion
<https://ds.iris.edu/message-center/topic/mustang-qa>