

Basic Seismology



Part 4: A Preliminary Data Collection for Example Earthquake Events



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M_w 5.2 New Mirpur Earthquake

24th September 2019



September 24, 2019 Mirpur Earthquake (M 5.4)

USGS Event Page:

<https://earthquake.usgs.gov/earthquakes/eventpage/us60005mqp/executive>

IRIS Event Page:

<http://ds.iris.edu/ds/nodes/dmc/tools/event/11121410>

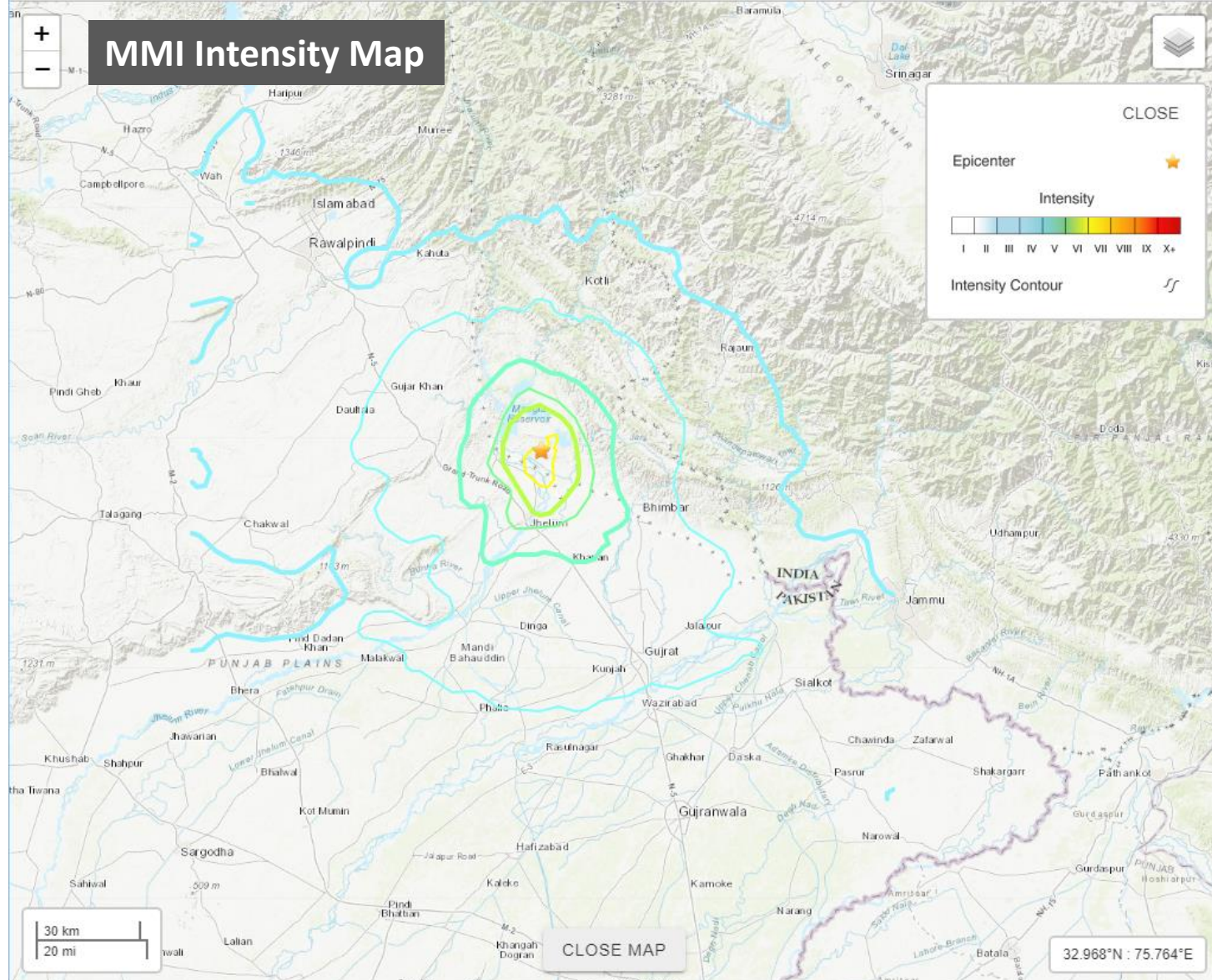
Time History Data from Wilber 3 (IRIS):

http://ds.iris.edu/wilber3/find_stations/11121410

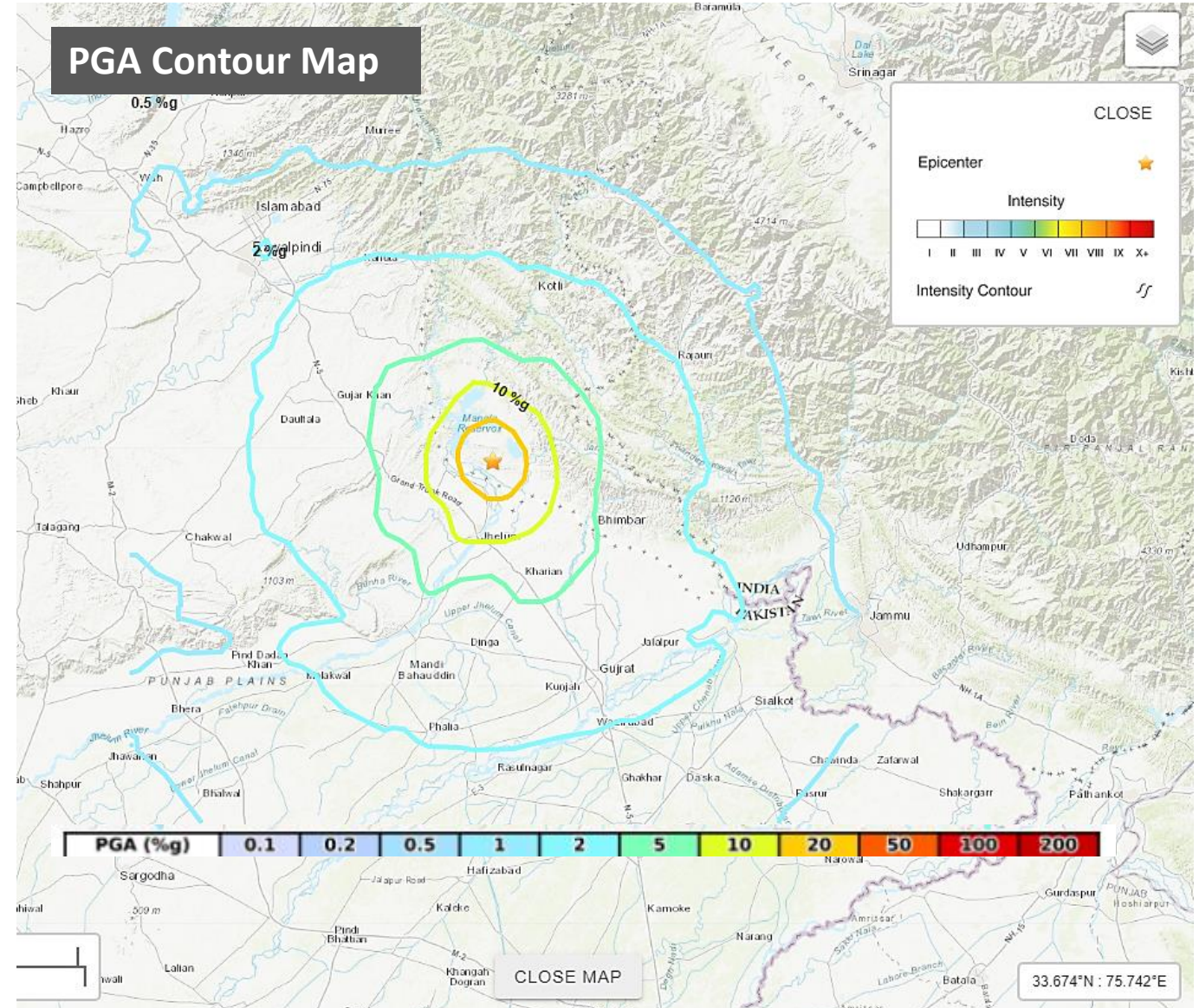
Event Summary

Mwb	5.6 Pakistan
Date/Time	(UTC) 2019-09-24 11:01:55 UTC
Location	Pakistan
Magnitude	Mwb 5.6 (IRIS) (Mww 5.2, USGS)
Latitude	33.1062° N
Longitude	73.7655° E
Depth	10.0 km
Casualties	19 deaths, over 300 injuries

MMI Intensity Map



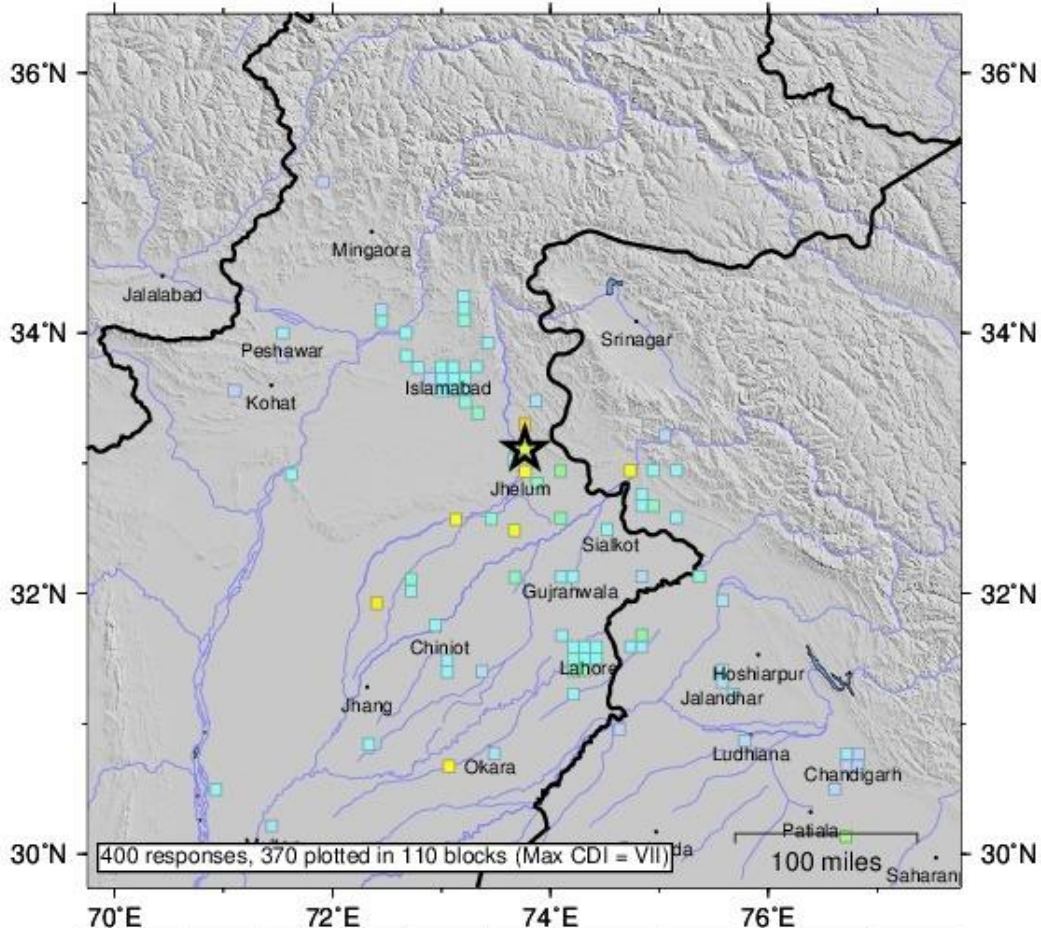
PGA Contour Map



USGS Community Internet Intensity Map

PAKISTAN

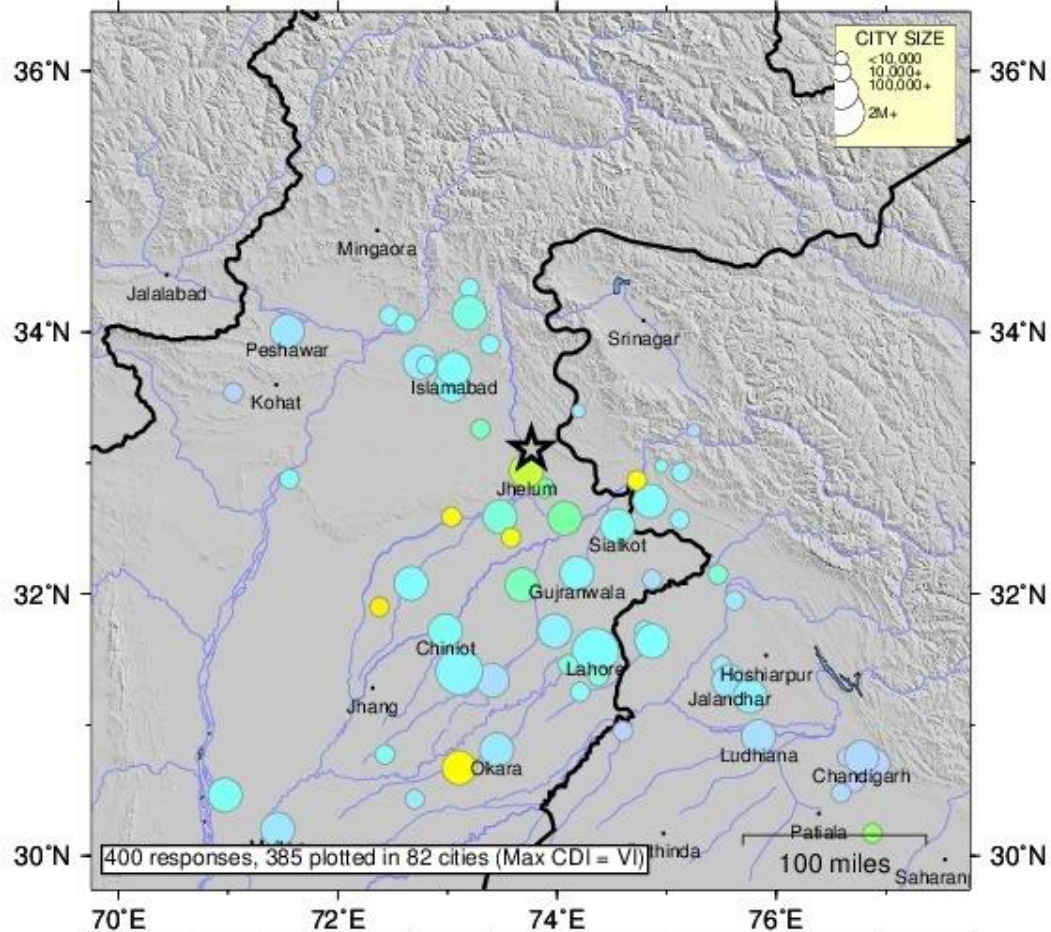
2019-09-24 11:01:55 UTC 33.1062N 73.7655E M5.2 Depth: 10 km ID:us60005mqp



USGS Community Internet Intensity Map


PAKISTAN

2019-09-24 11:01:55 UTC 33.1062N 73.7655E M5.2 Depth: 10 km ID:us60005mqp



Recorded Time History Data

- Mangla Dam is located at a distance of 10.74 Km from epicenter.
- The dam structure is reported to remain safe during the earthquake event.
- The closest IRIS Station is installed at Nilore, Islamabad (75.25 Km from Epicenter).

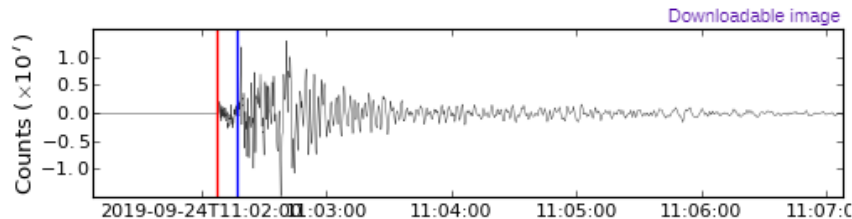
Network	Station Code	Latitude	Longitude	Elevation	Data Center 
II	NIL	33.65°	73.27°	629 m	IRISDMC

Select an instrument to preview waveform data:

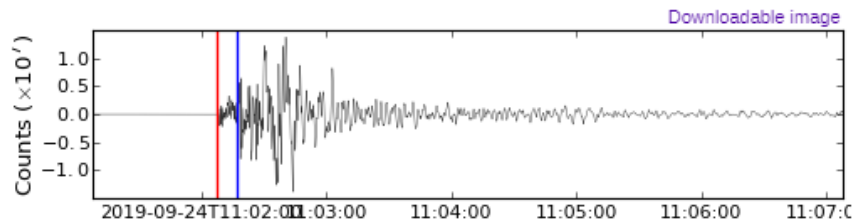
00: Geotech KS-54000 Borehole Seismometer

Channels

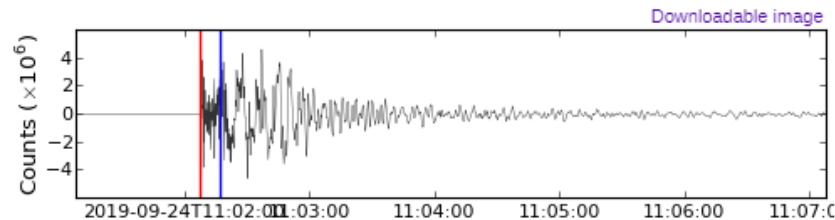
BH1



BH2



BHZ



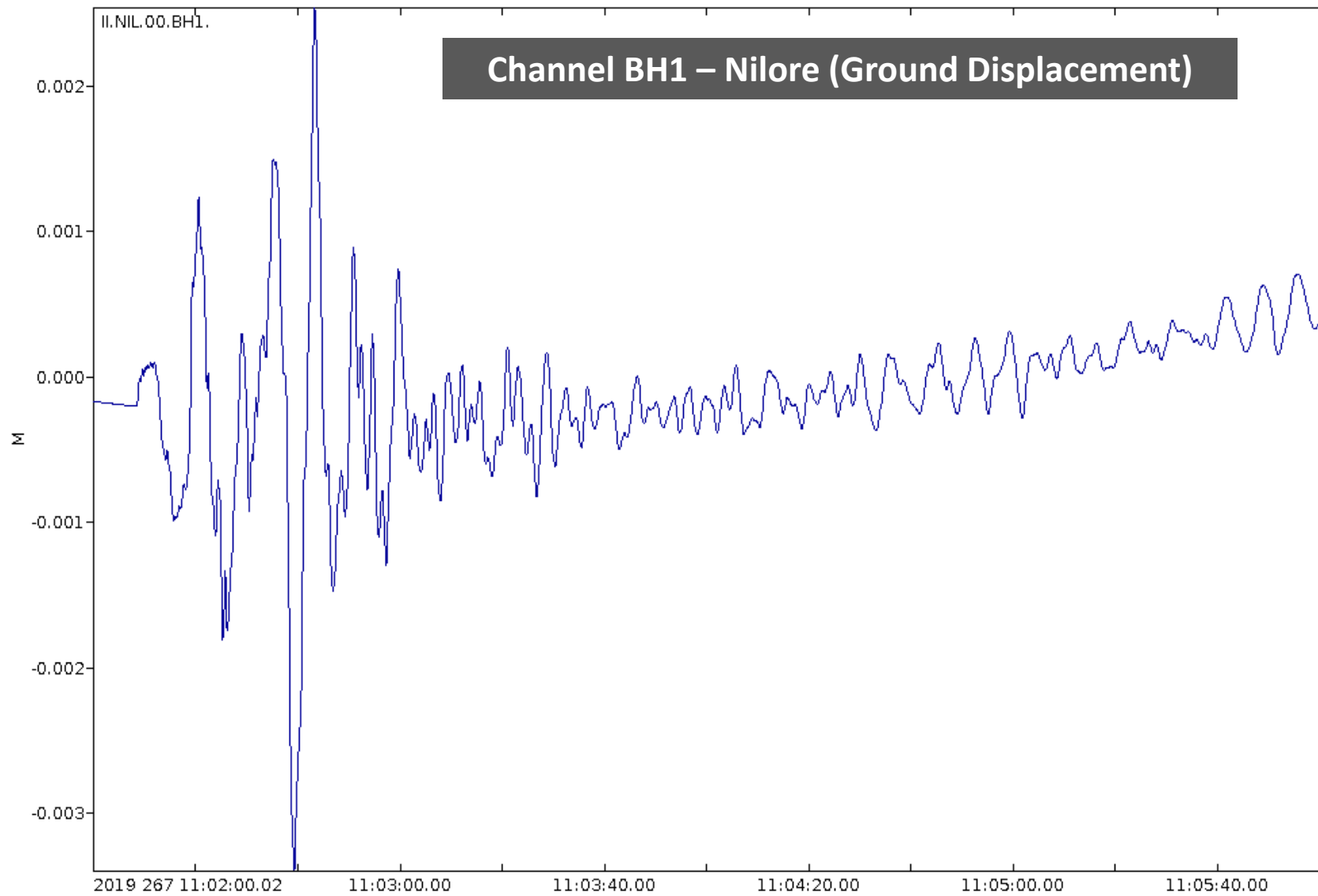
Phase Arrivals

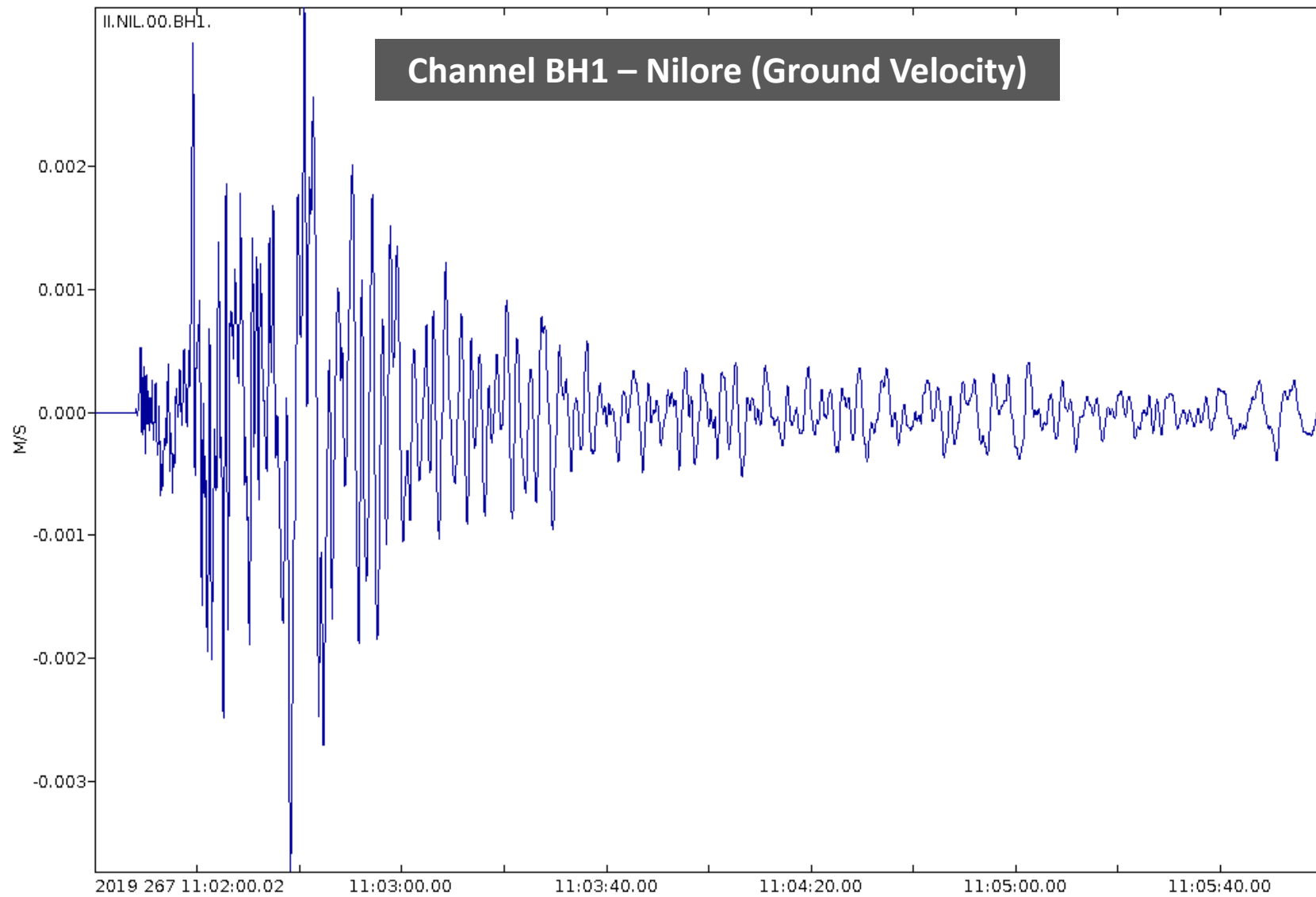
P	+13s 2019-09-24 11:02:08
S	+22s 2019-09-24 11:02:17

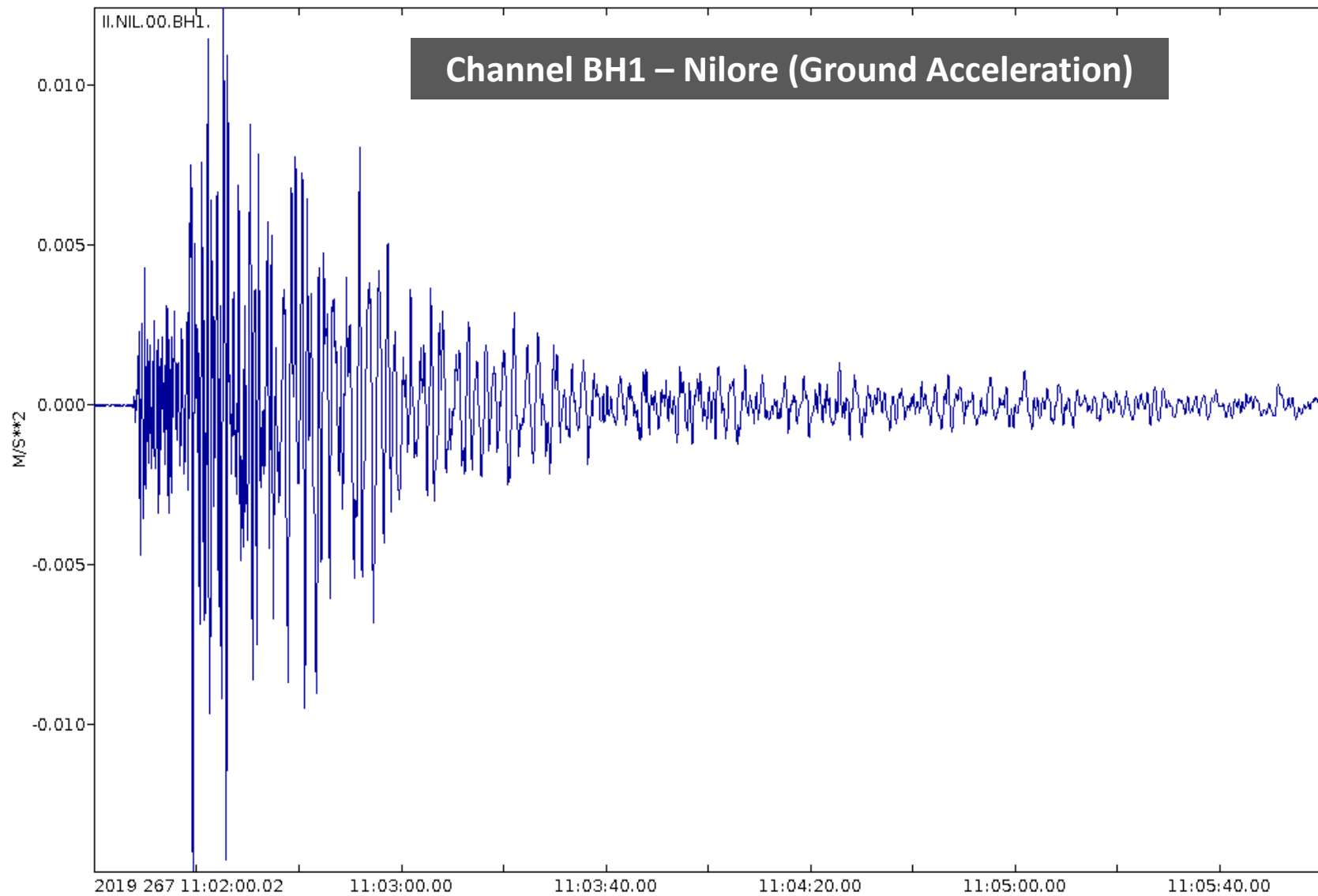
Time Range

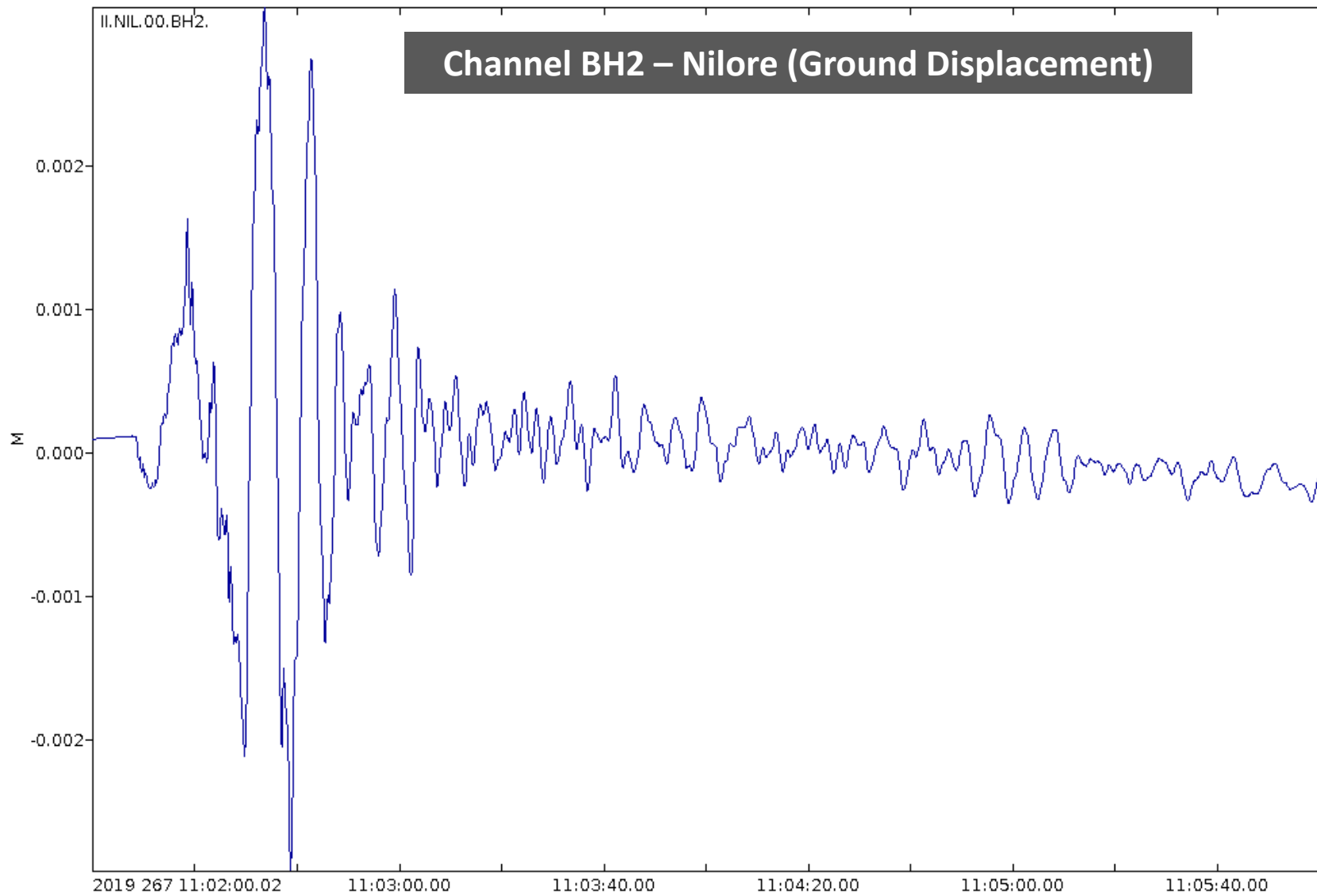
From minutes before

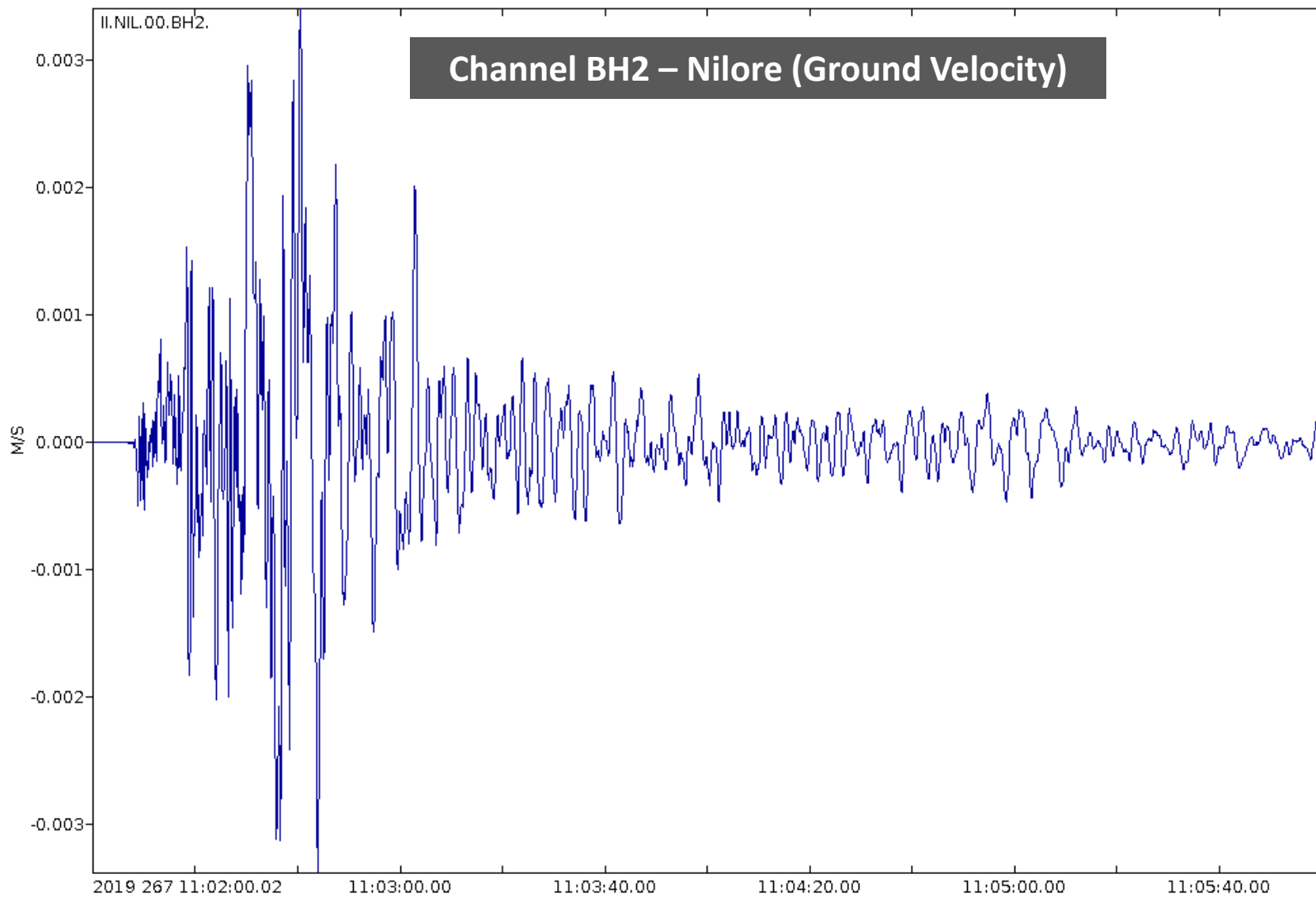
until minutes after

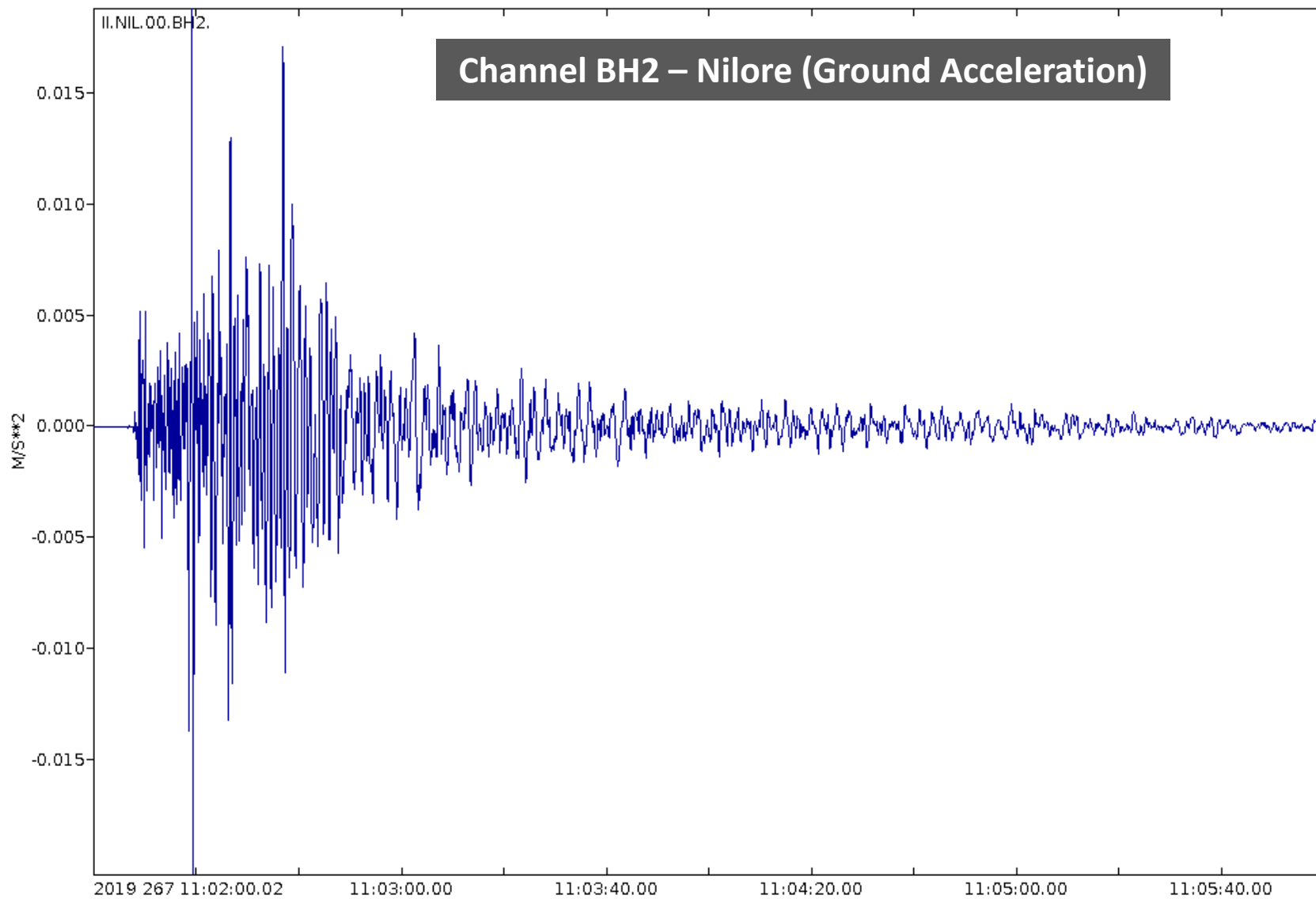


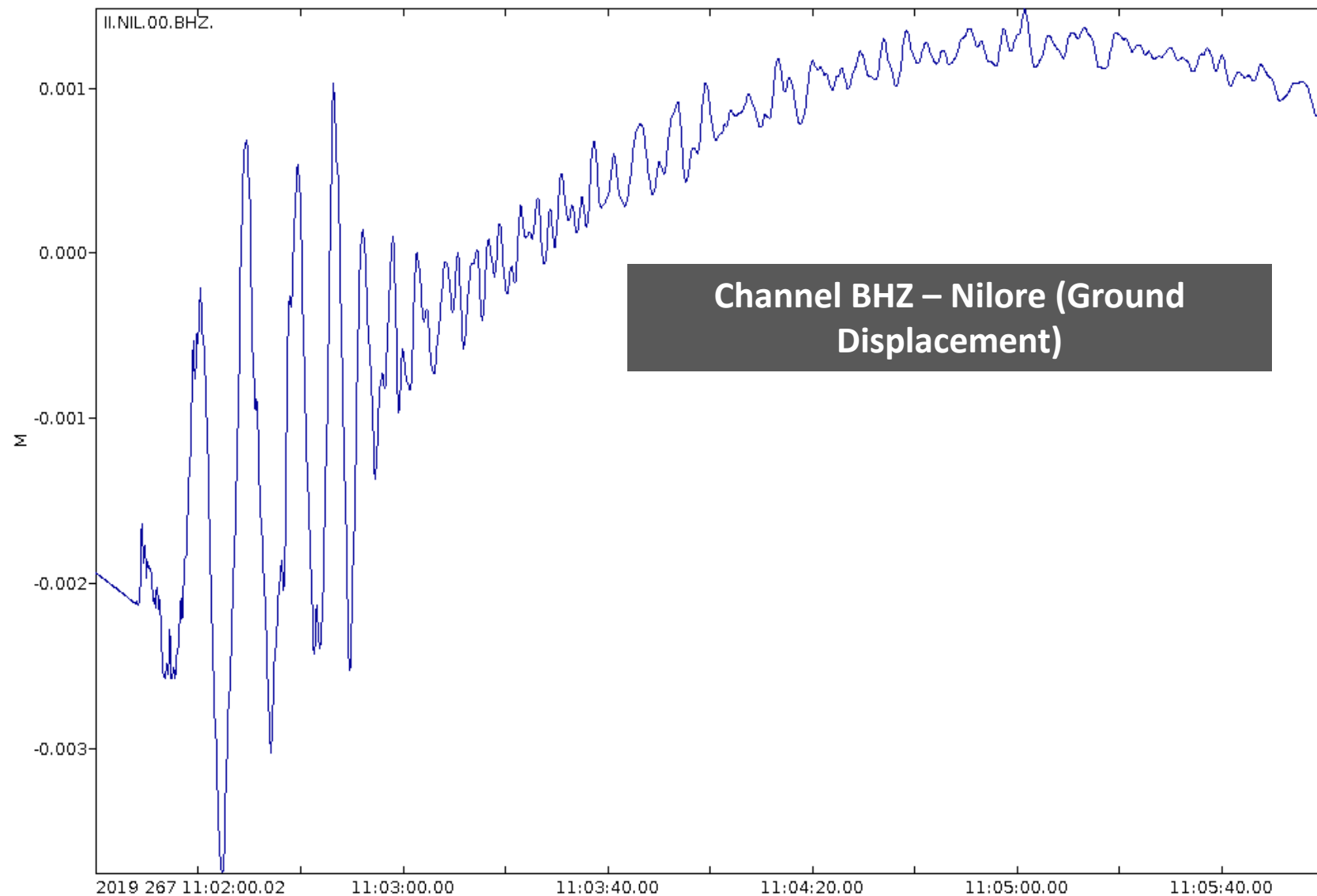


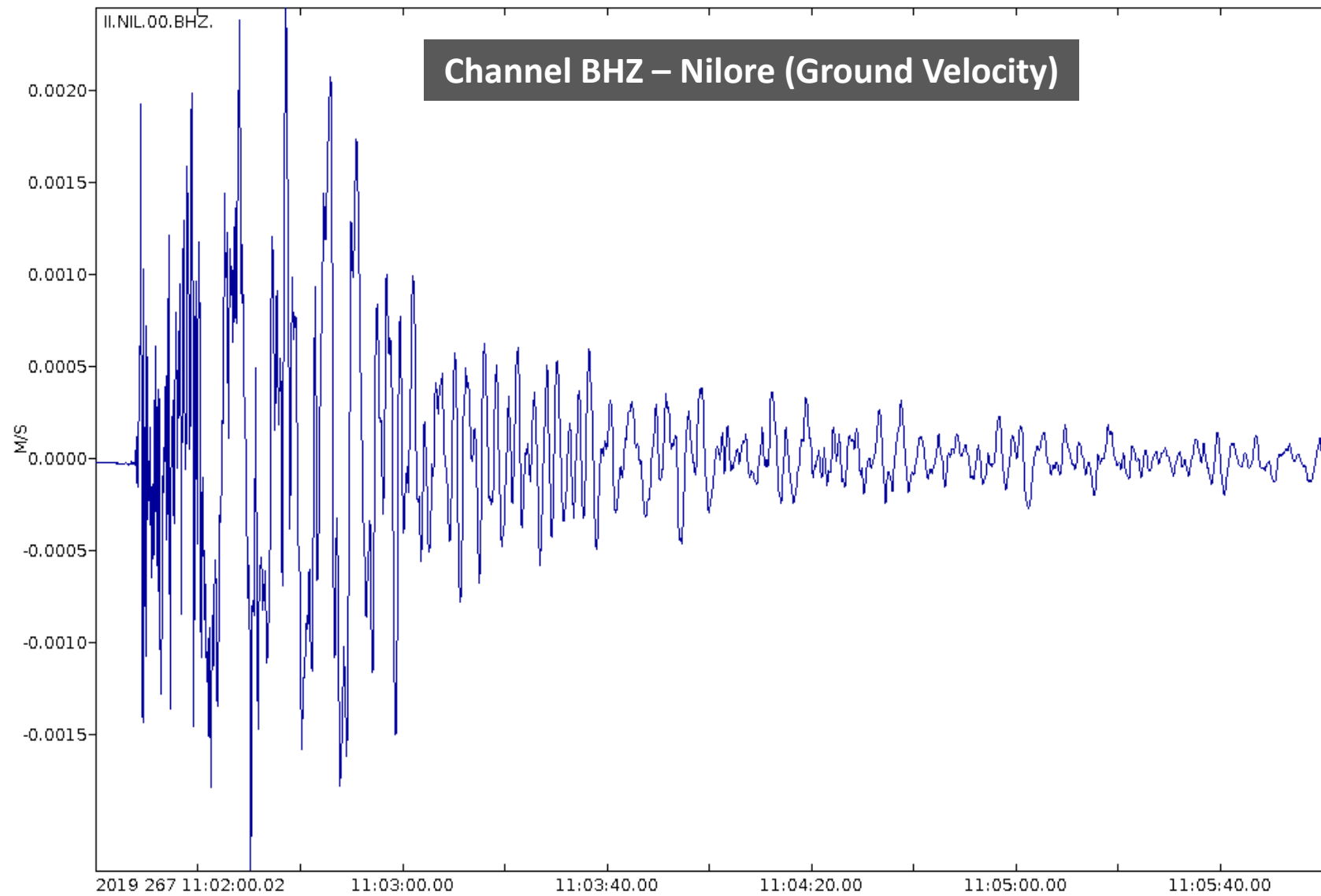


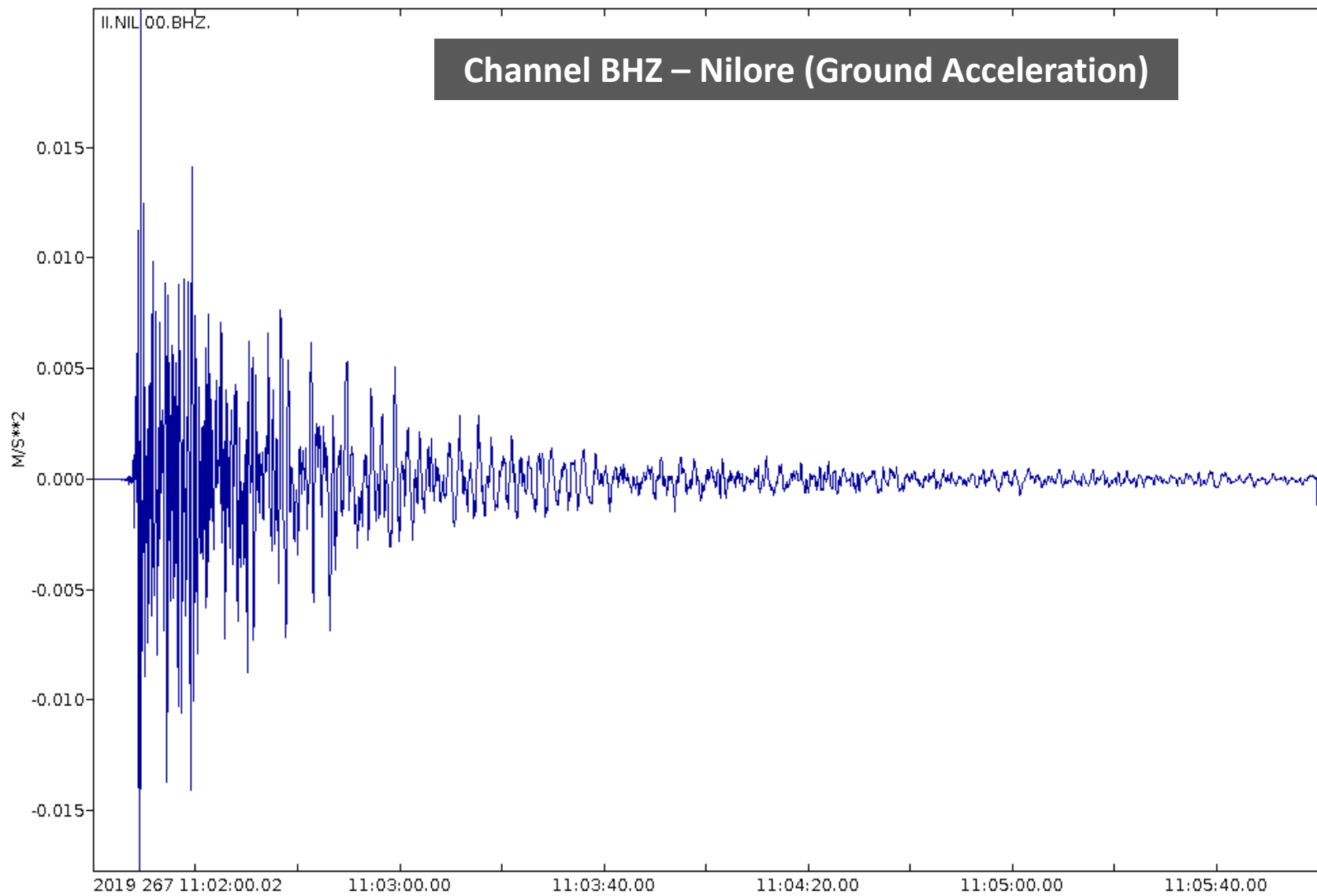












Damage to non-engineered construction built on slopes



Damage to road infrastructure



Damage to road infrastructure



Damage to road infrastructure



Damage to road infrastructure



Damage to road infrastructure



Damage to masonry infill walls (Mirpur University of Sciences and Technology)



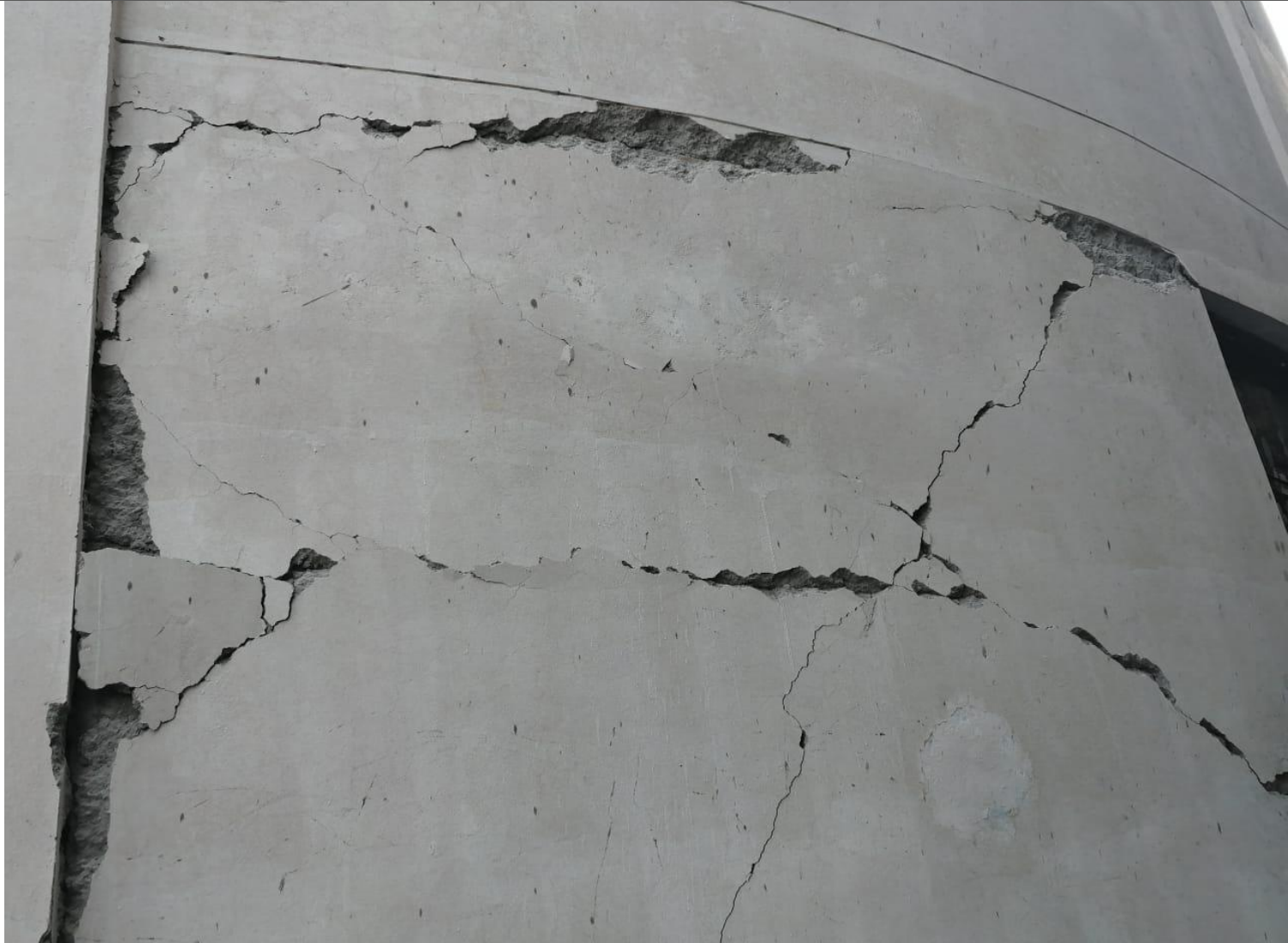
Damage to masonry infill walls (Mirpur University of Sciences and Technology)



Damage to masonry infill walls (Mirpur University of Sciences and Technology)



Damage to masonry infill walls (Mirpur University of Sciences and Technology)



Spalling of brick tiles





Collapse of block/brick masonry



Spalling of tiles

Seems like a collapse of
improperly supported overhangs





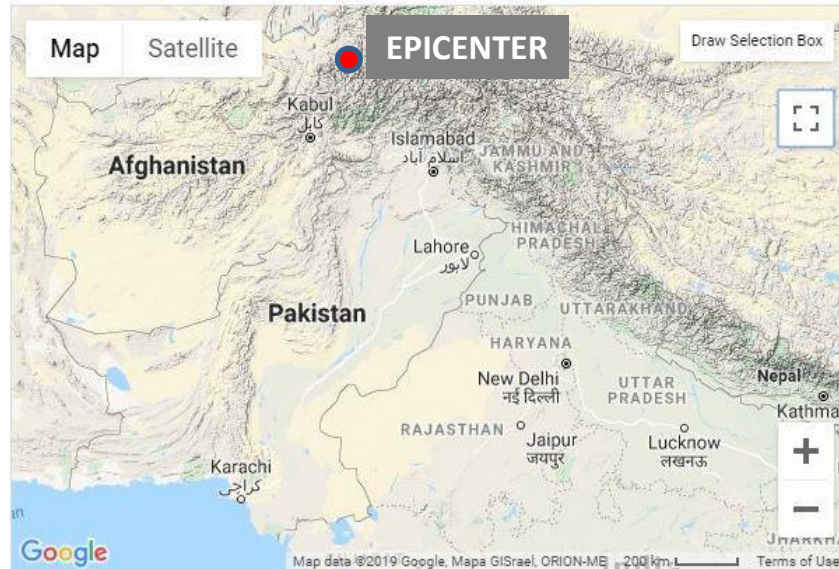
Nonstructural damage - Contents

M_{ww} 6.1 Jarm, Afghanistan Earthquake

20th December 2019

Hindukush Region, Afghanistan

Date (UTC)	Region	Magnitude	Latitude	Longitude	Depth
2019-12-20 11:39:52	Hindu Kush Region, Afghanistan	Mww 6.1	36.53°	70.44°	210.22 km



Event Summary

Magnitude	6.1 (\pm 0.1) Mww
Date/Time	2019-12-20 11:39:52.941 UTC
Location	Hindu Kush region, Afghanistan
Latitude	36.534°N
Longitude	70.437°E
Depth	210.2 km

6.4-magnitude earthquake rocks northern Pakistan, Afghanistan

Dawn.com | AFP | Sirajuddin | Updated December 20, 2019

[f](#) 399 [t](#) [p](#) [e](#) [m](#) 19

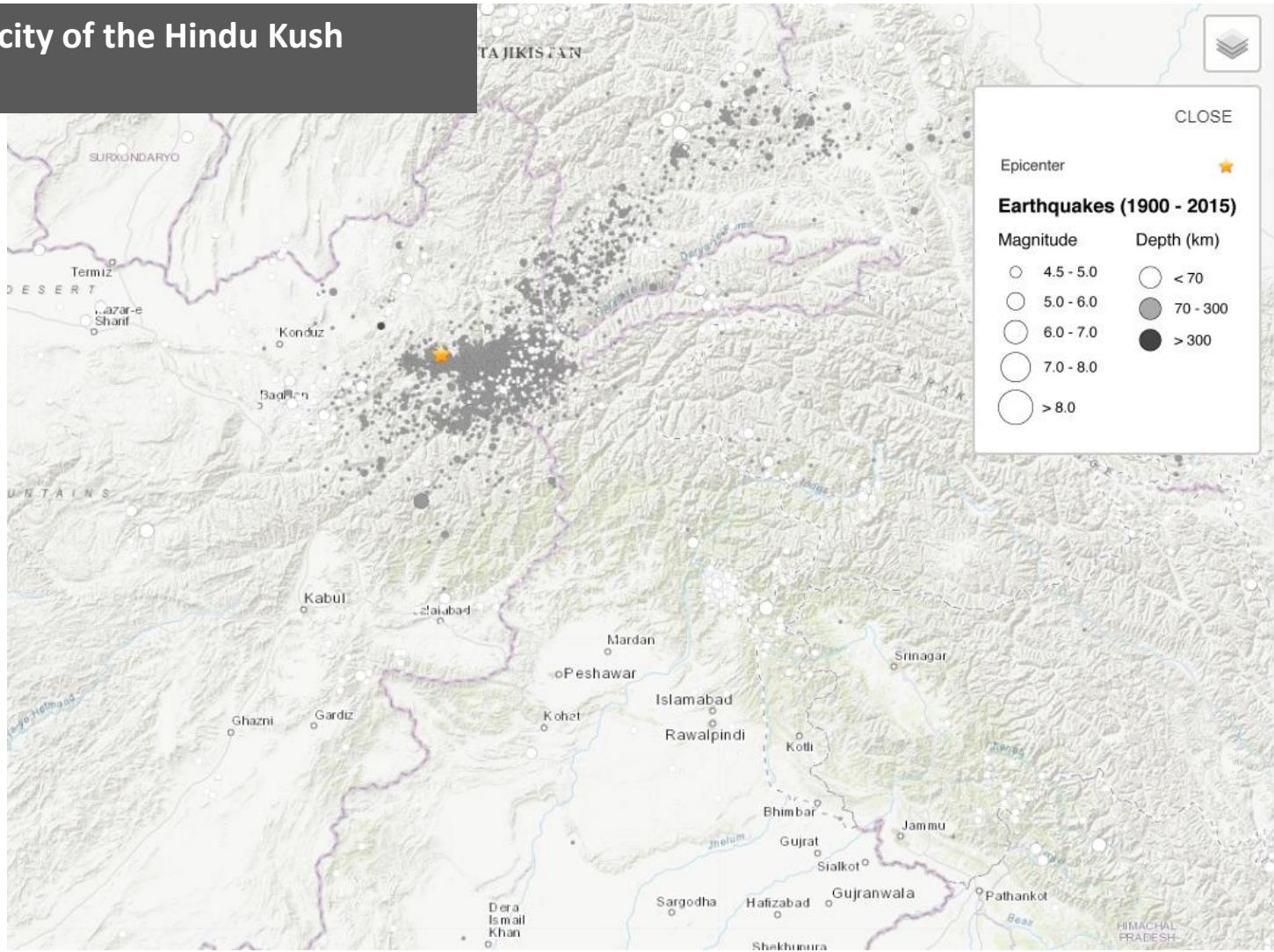


People gather outside buildings after an earthquake in Islamabad on Friday. — AFP

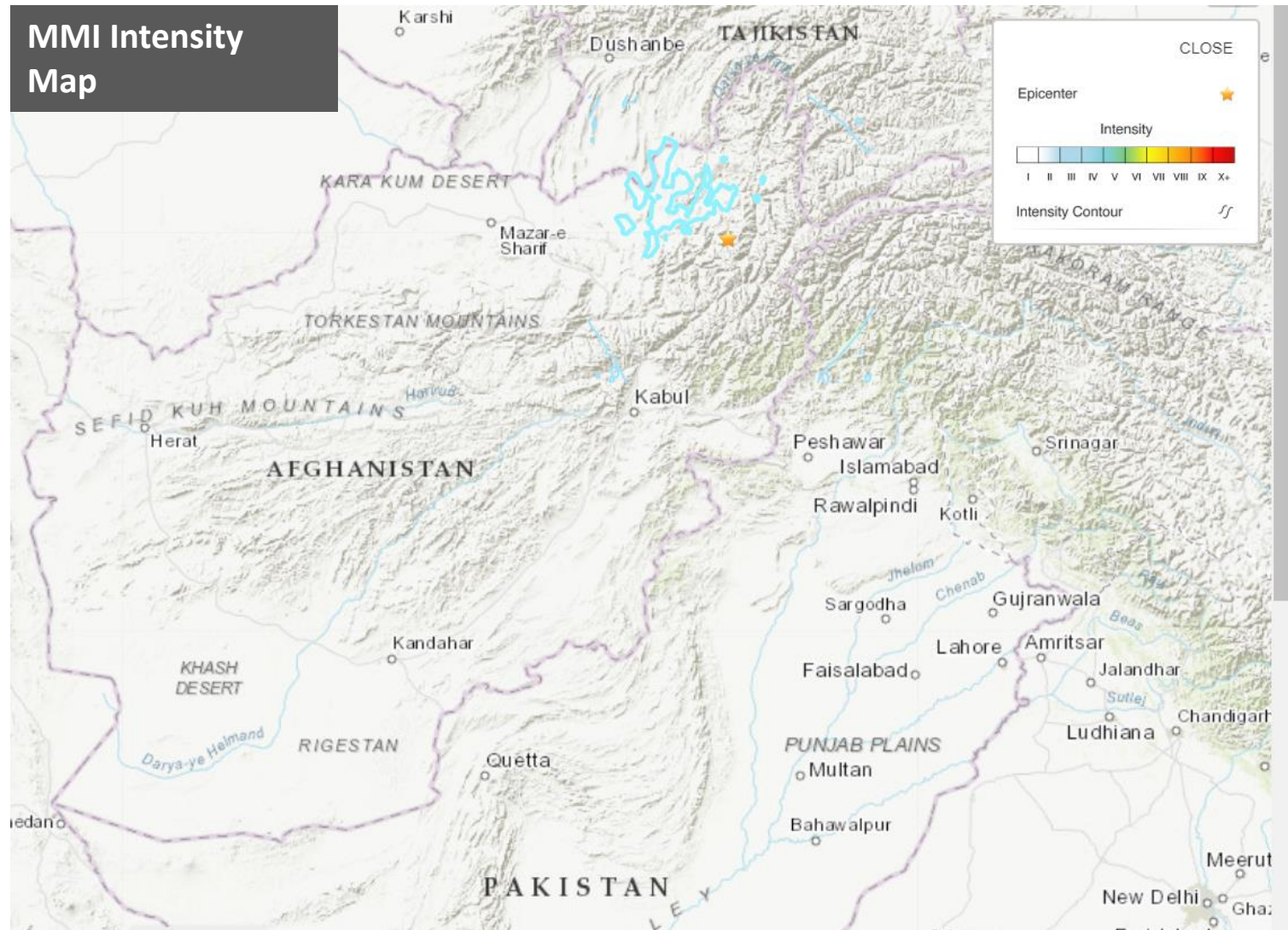
The northern areas of the country, as well as parts of Afghanistan, were jolted by a 6.4-magnitude earthquake on Friday, according to the National Seismic Monitoring Centre in Islamabad.

The earthquake struck at a depth of 210km with the epicentre in a sparsely populated, remote mountain area in Badakhshan province in the northeast of Afghanistan, said the USGS, which put the quake at 6.1 on the Richter Scale.

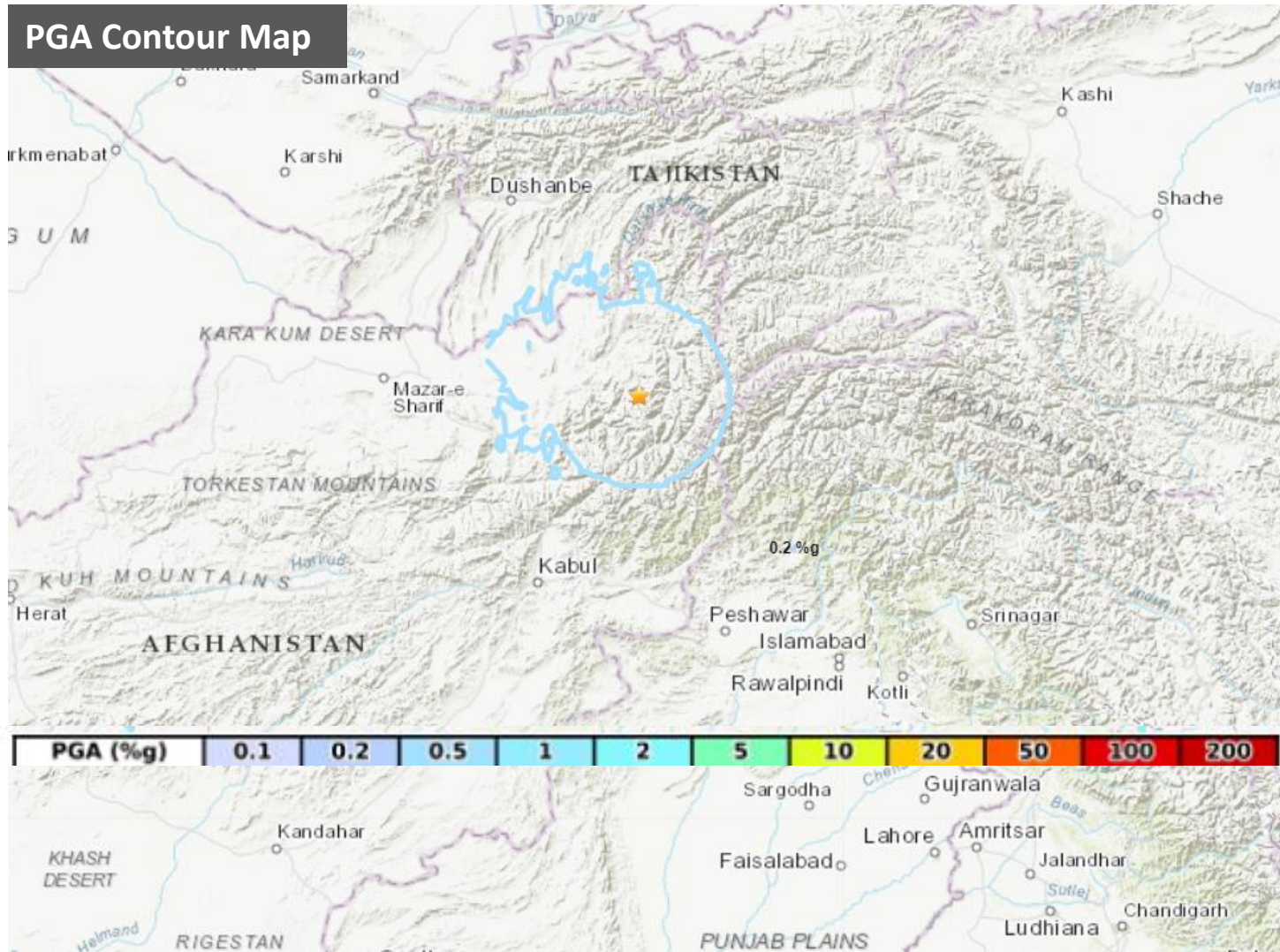
Historical Seismicity of the Hindu Kush Region



MMI Intensity Map

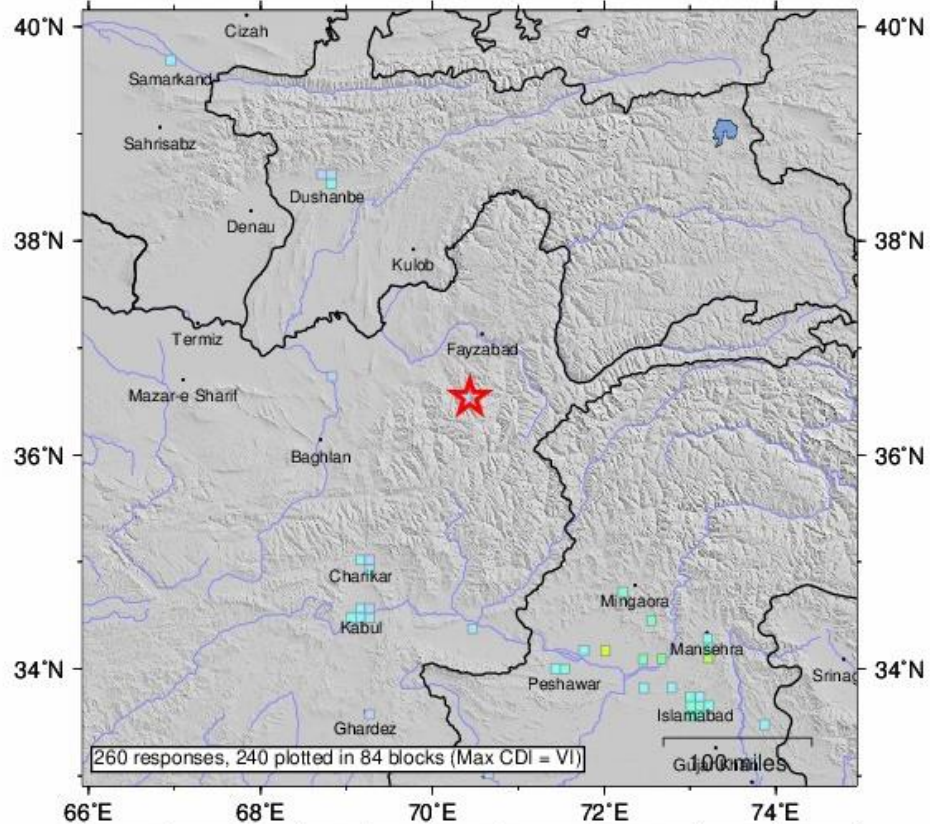


PGA Contour Map



USGS Community Internet Intensity Map
HINDU KUSH REGION, AFGHANISTAN

2019-12-20 11:39:52 UTC 36.5344N 70.4374E M6.1 Depth: 210 km ID:us70006p18

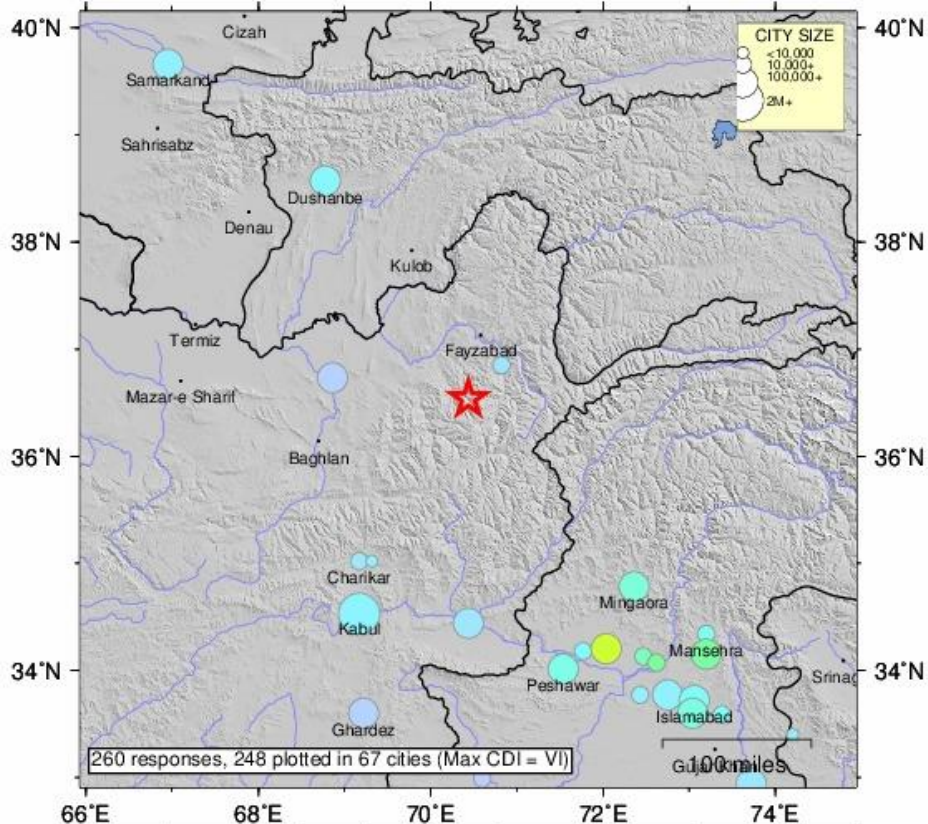


SHAKING	<i>Not felt</i>	<i>Weak</i>	<i>Light</i>	<i>Moderate</i>	<i>Strong</i>	<i>Very strong</i>	<i>Severe</i>	<i>Violent</i>	<i>Extreme</i>
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Processed: Wed Dec 25 06:06:34 2019 vmdyfi1

USGS Community Internet Intensity Map
HINDU KUSH REGION, AFGHANISTAN

2019-12-20 11:39:52 UTC 36.5344N 70.4374E M6.1 Depth: 210 km ID:us70006p18



260 responses, 248 plotted in 67 cities (Max CDI = VI)

SHAKING	<i>Not felt</i>	<i>Weak</i>	<i>Light</i>	<i>Moderate</i>	<i>Strong</i>	<i>Very strong</i>	<i>Severe</i>	<i>Violent</i>	<i>Extreme</i>
DAMAGE	none	none	none	Very light	<i>Light</i>	<i>Moderate</i>	<i>Moderate/Heavy</i>	<i>Heavy</i>	<i>Very Heavy</i>
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

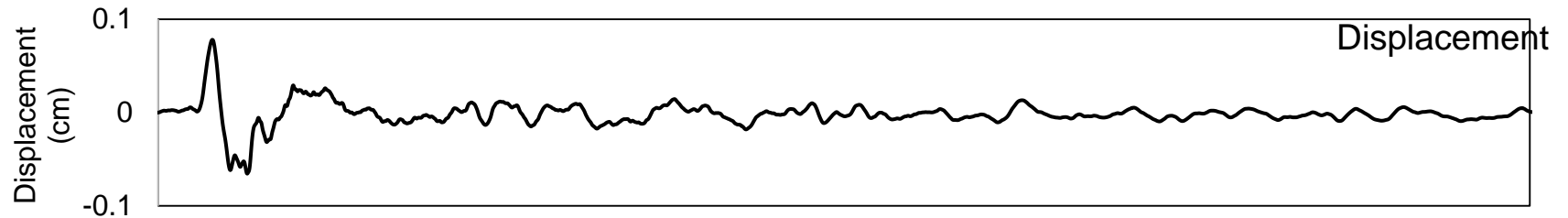
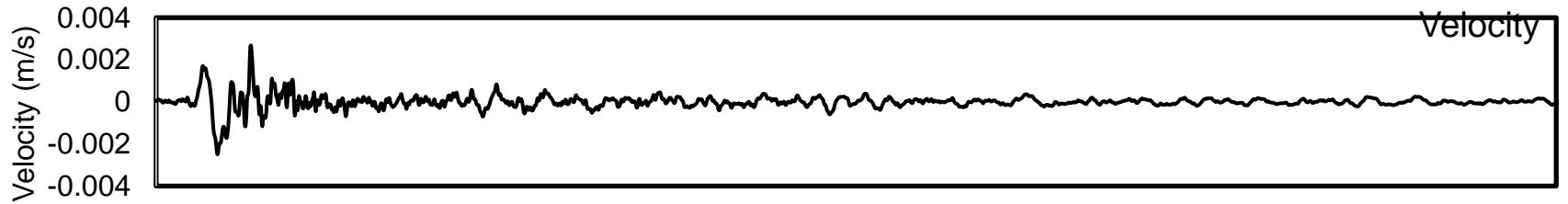
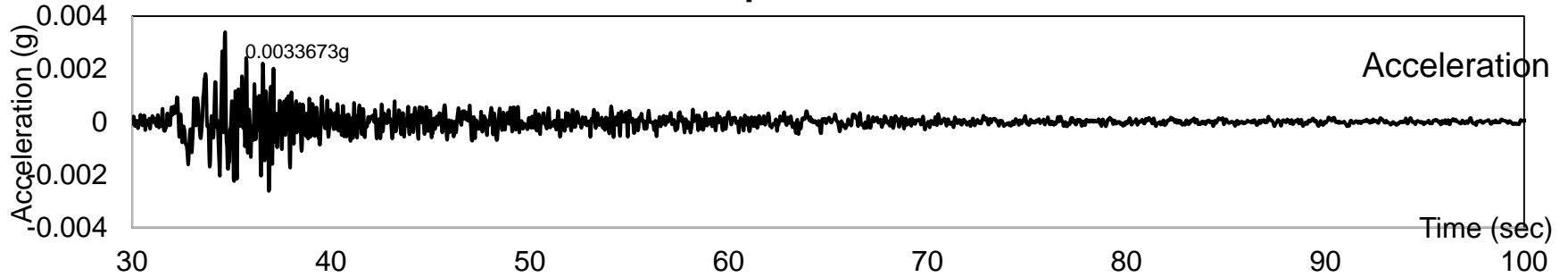
Processed: Wed Dec 25 06:06:32 2019 vmdyfi1

Recorded Time History Data

- The closest IRIS Station is installed at Kabul, Afghanistan (around 200 Km from Epicenter).
- Due to this large epicentral distance (and large hypocentral distance [focal depth = 210 Km]), the recorded data shows very low values of PGA and SA.
- The ground motion data from this station (for all three components) is shown as follows.

2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

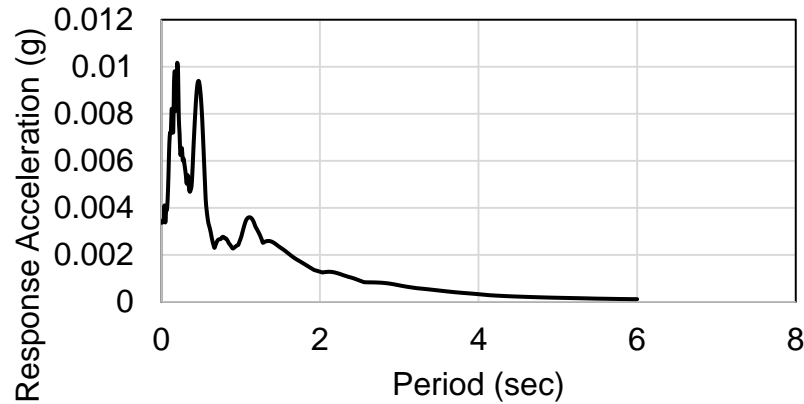
Component: BHE



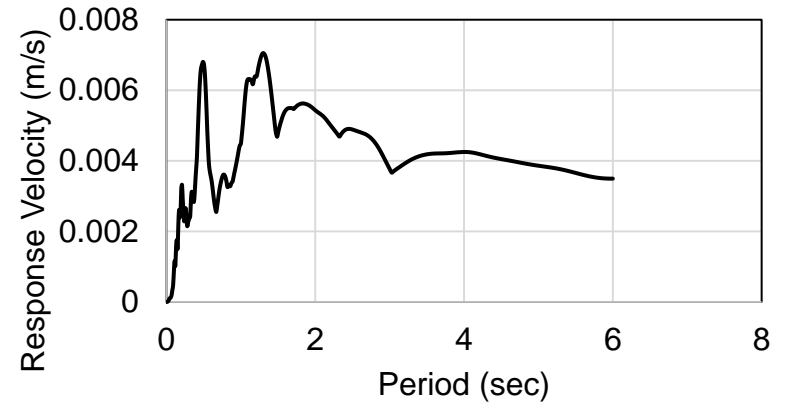
2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHE

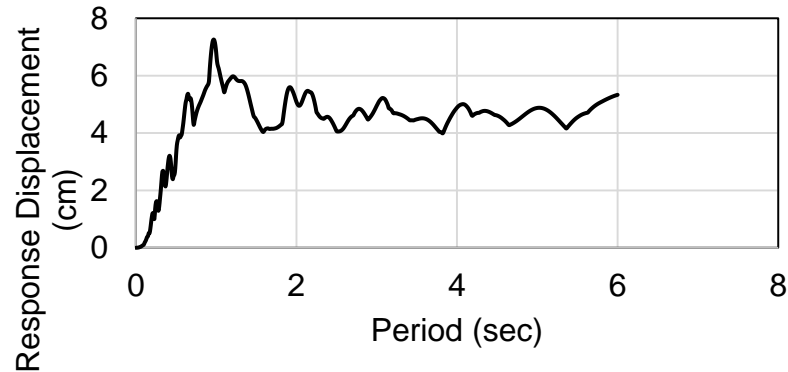
Acceleration Spectra



Velocity Spectra



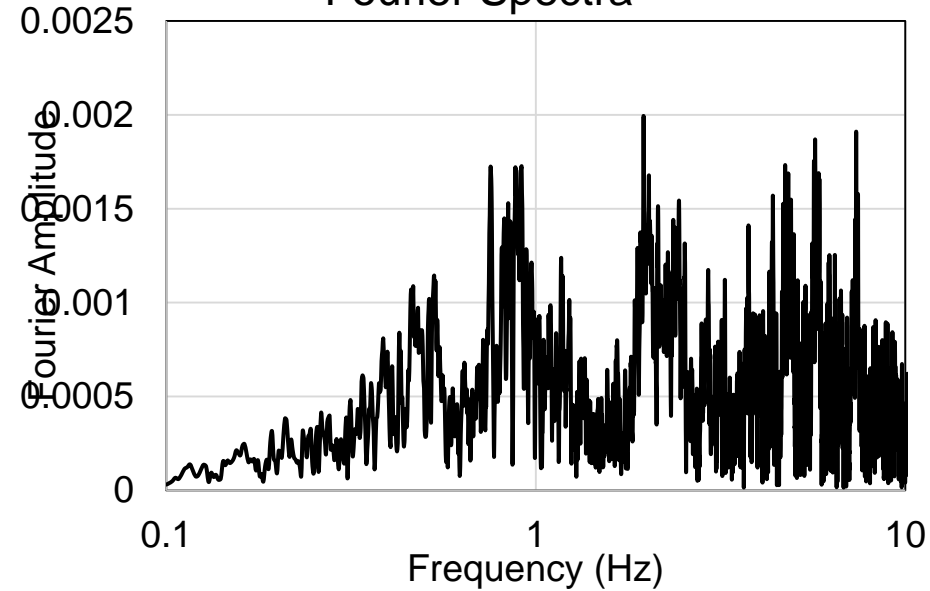
Displacement Spectra



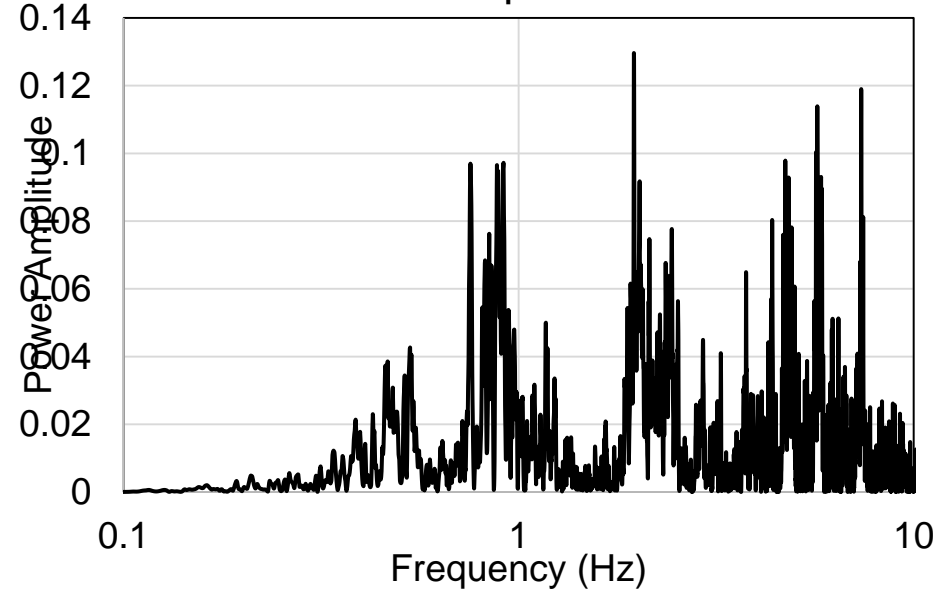
2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHE

Fourier Spectra



Power Spectra



2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHE

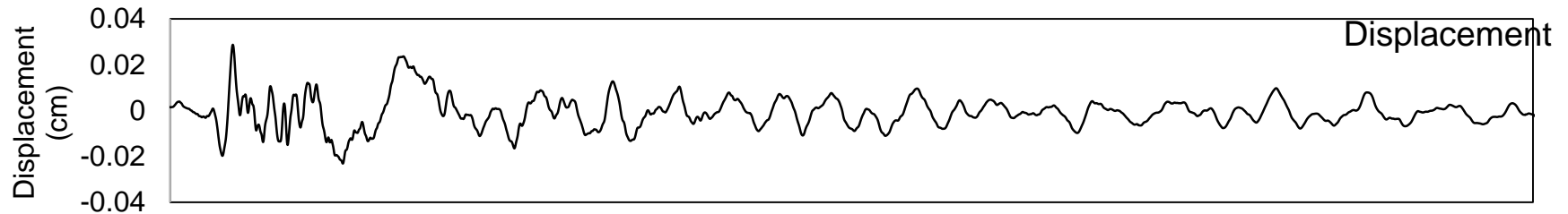
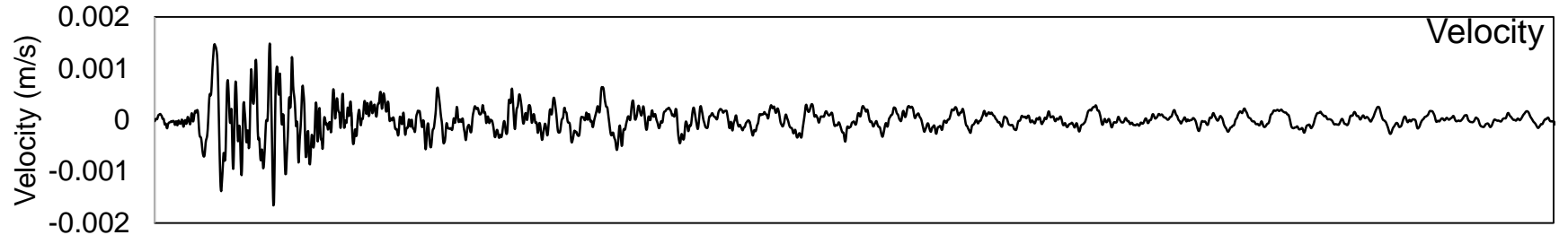
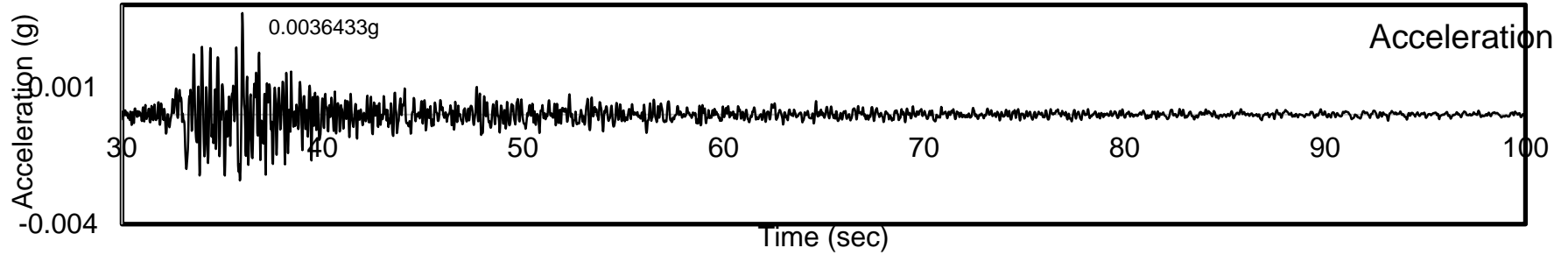
Ground motion parameters

Maximum Acceleration:	0.0033673g
at time t=	34.6800000sec
Maximum Velocity:	0.0026864m/sec
at time t=	34.7400000sec
Maximum Displacement:	0.0780516cm
at time t=	32.7600000sec
Vmax / Amax:	0.0813251sec
Acceleration RMS:	0.0001710g
Velocity RMS:	0.0001525m/sec
Displacement RMS:	0.0079901cm
Arias Intensity:	0.0001505m/sec
Characteristic Intensity (Ic):	0.0000409

Specific Energy Density:	0.0000078m2/sec
Cumulative Absolute Velocity (CAV):	0.1937502m/sec
Acceleration Spectrum Intensity (ASI):	0.0028865g*sec
Velocity Spectrum Intensity (VSI):	0.0114554m
Housner Intensity:	0.0101631cm
Sustained Maximum Acceleration (SMA):	0.0023905g
Sustained Maximum Velocity (SMV):	0.0017069m/sec
Effective Design Acceleration (EDA):	0.0035817g
A95 parameter:	0.0032907g
Predominant Period (Tp):	0.2000000sec
Mean Period (Tm):	0.3652123sec

2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

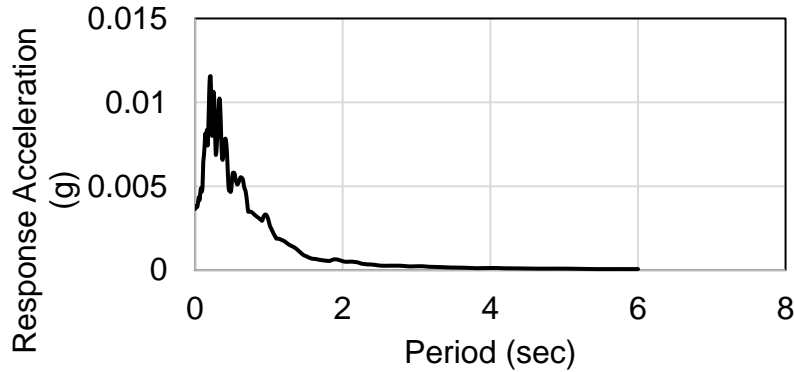
Component: BHN



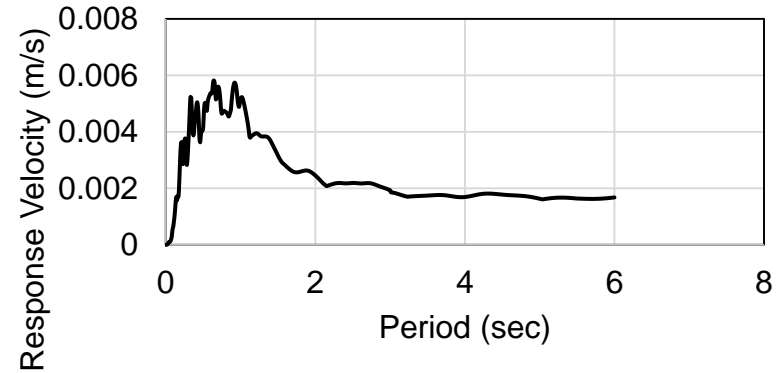
2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHN

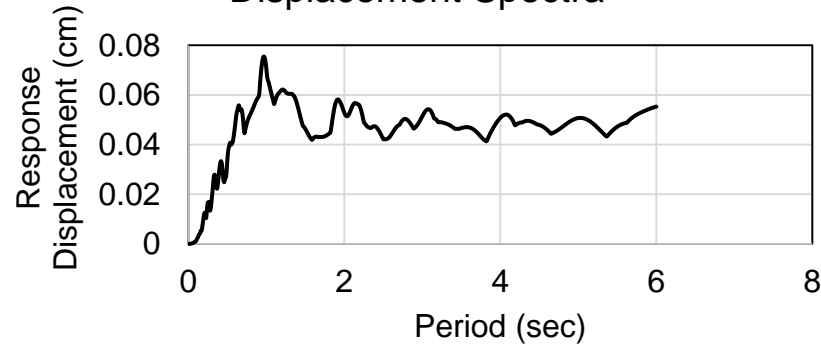
Acceleration Spectra



Velocity Spectra

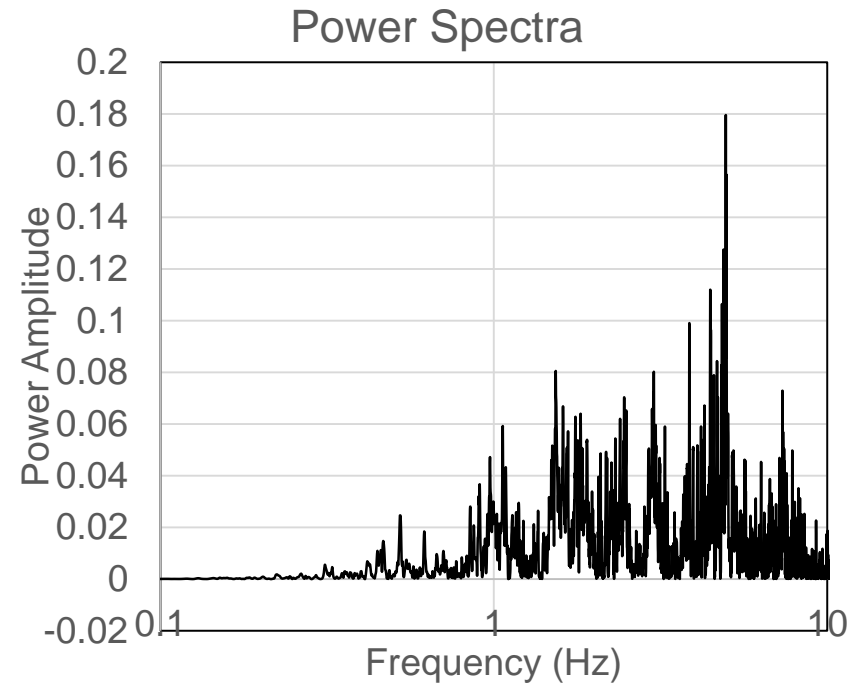
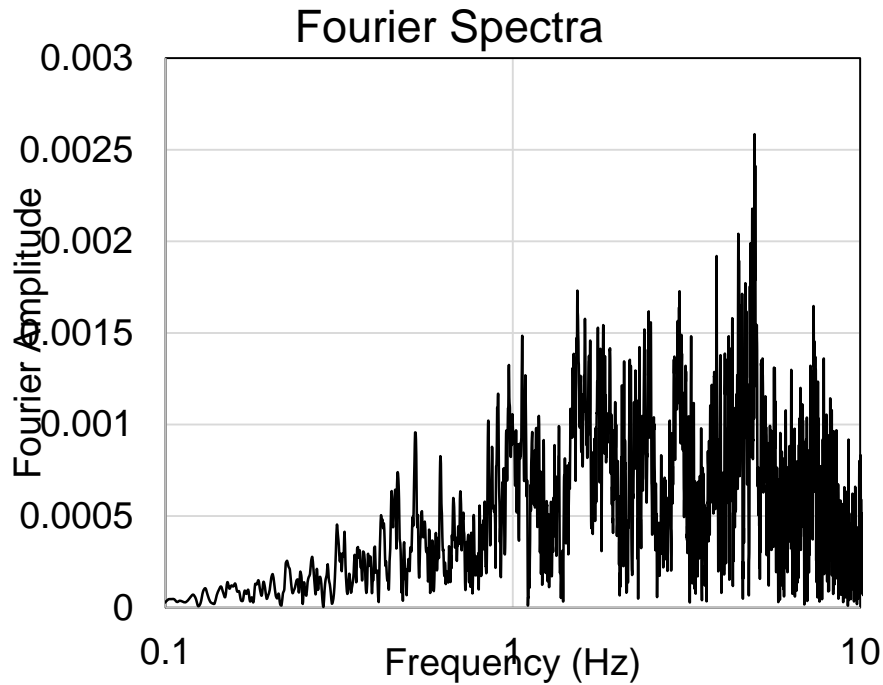


Displacement Spectra



2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHN



2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHN

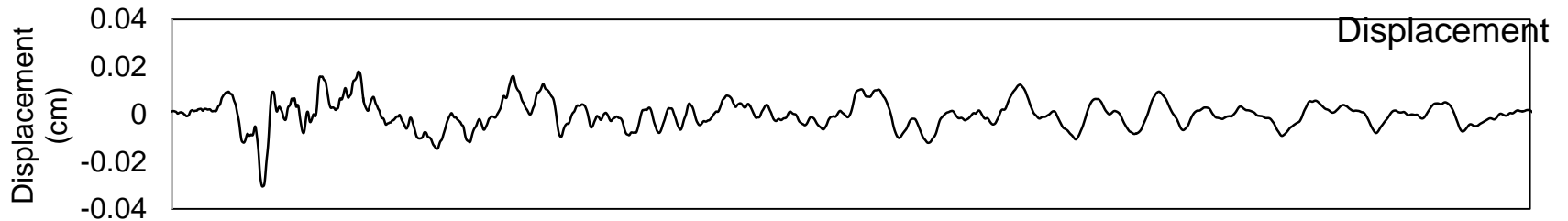
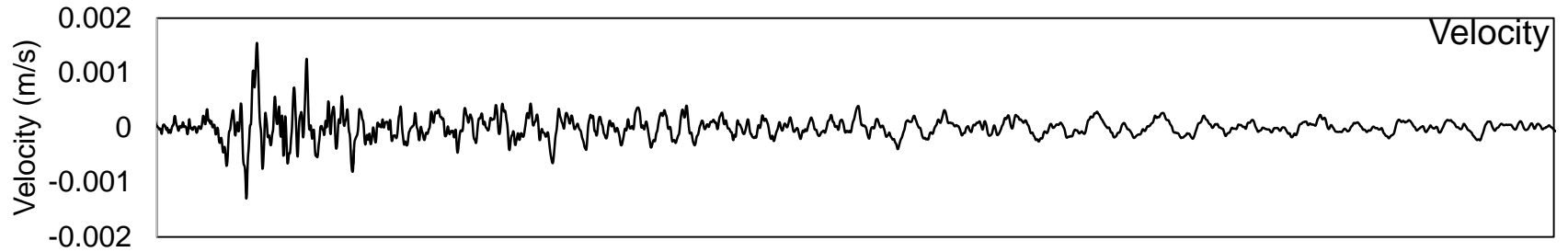
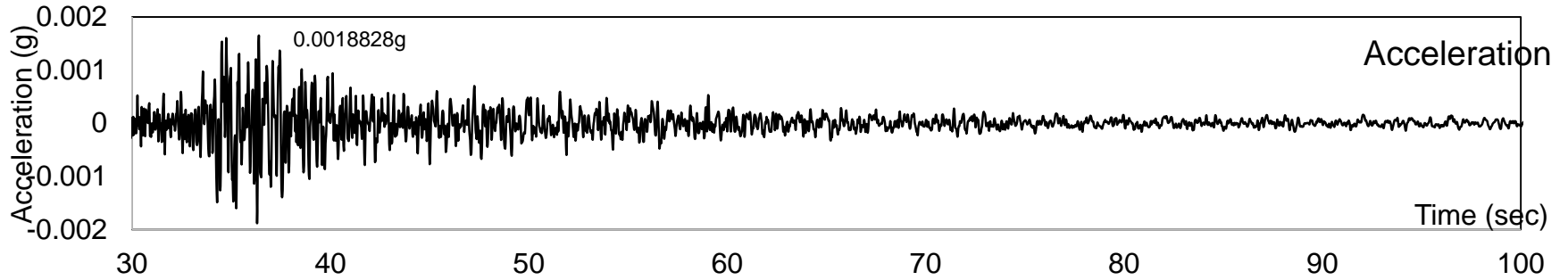
Ground motion parameters

Maximum Acceleration:	0.0036433g
at time t=	36.0000000sec
Maximum Velocity:	0.0016600m/sec
at time t=	35.9400000sec
Maximum Displacement:	0.0286992cm
at time t=	33.2100000sec
Vmax / Amax:	0.0464452sec
Acceleration RMS:	0.0001883g
Velocity RMS:	0.0001225m/sec
Displacement RMS:	0.0042933cm
Arias Intensity:	0.0001825m/sec
Characteristic Intensity (Ic):	0.0000472

Specific Energy Density:	0.0000050m2/sec
Cumulative Absolute Velocity (CAV):	0.2184728m/sec
Acceleration Spectrum Intensity (ASI):	0.0031498g*sec
Velocity Spectrum Intensity (VSI):	0.0083484m
Housner Intensity:	0.0067262cm
Sustained Maximum Acceleration (SMA):	0.0022570g
Sustained Maximum Velocity (SMV):	0.0012200m/sec
Effective Design Acceleration (EDA):	0.0035258g
A95 parameter:	0.0035604g
Predominant Period (Tp):	0.2000000sec
Mean Period (Tm):	0.3073556sec

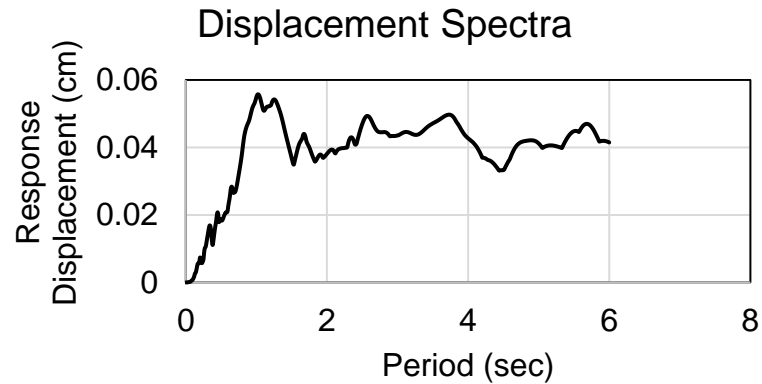
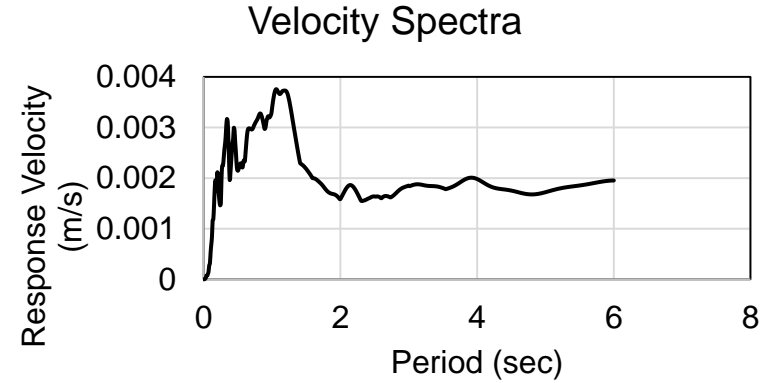
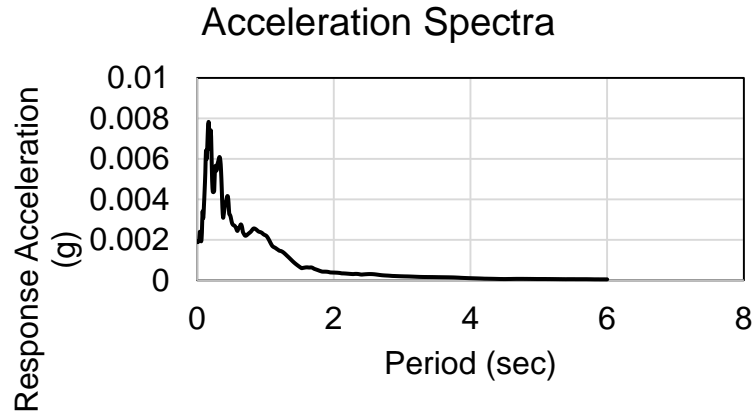
2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHZ



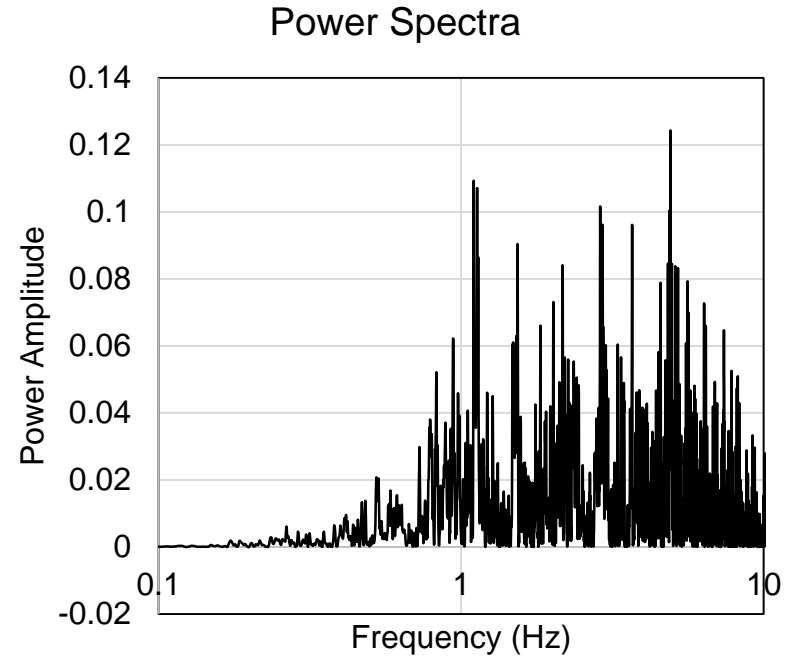
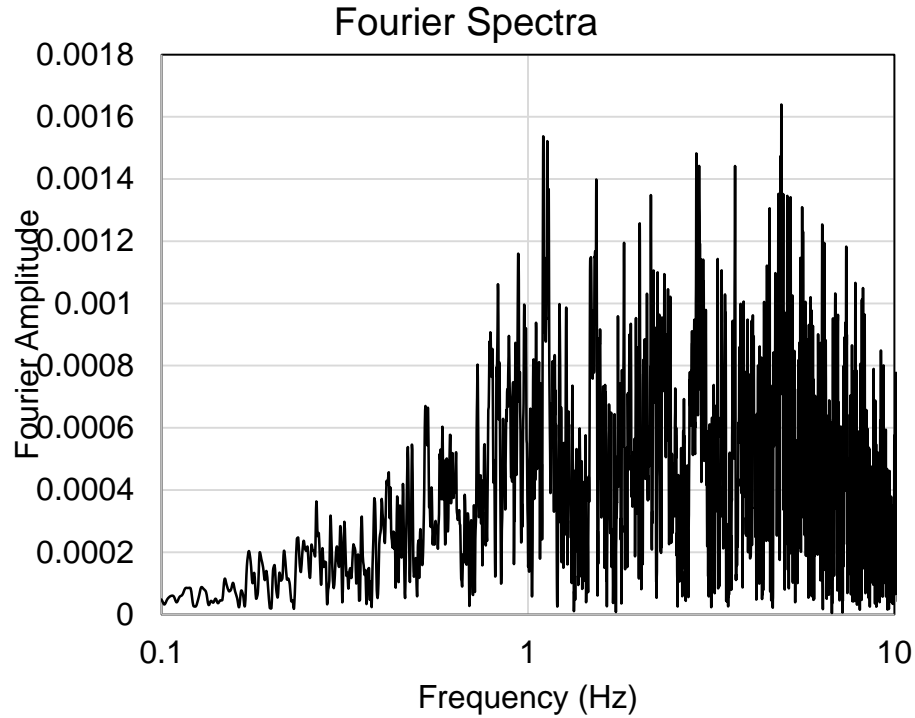
2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHZ



2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHZ



2019-12-20 - Mw 6.1 – IRIS Station: KBL (Kabul, Afghanistan)

Component: BHZ

Ground motion parameters

Maximum Acceleration:	0.0018828g
at time t=	36.3000000sec
Maximum Velocity:	0.0015471m/sec
at time t=	35.0100000sec
Maximum Displacement:	0.0305250cm
at time t=	34.6500000sec
Vmax / Amax:	0.0837621sec
Acceleration RMS:	0.0001436g
Velocity RMS:	0.0001028m/sec
Displacement RMS:	0.0037125cm
Arias Intensity:	0.0001061m/sec
Characteristic Intensity (Ic):	0.0000314

Specific Energy Density:	0.0000035m ² /sec ²
Cumulative Absolute Velocity (CAV):	0.1907171m/sec
Acceleration Spectrum Intensity (ASI):	0.0020147g*sec
Velocity Spectrum Intensity (VSI):	0.0056311m
Housner Intensity:	0.0048496cm
Sustained Maximum Acceleration (SMA):	0.0013939g
Sustained Maximum Velocity (SMV):	0.0008074m/sec
Effective Design Acceleration (EDA):	0.0017447g
A95 parameter:	0.0017911g
Predominant Period (Tp):	0.1600000sec
Mean Period (Tm):	0.3119476sec

Thank you for your attention