Local seismic networks WEBNET and REYKJANET: current state and near future upgrade

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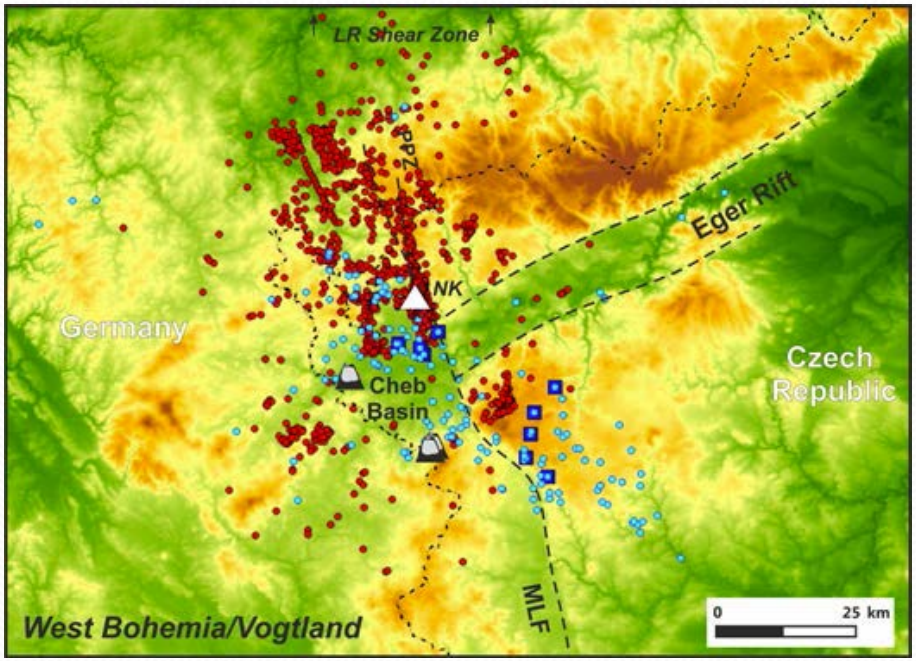
WEBNET
(West Bohemia Network)

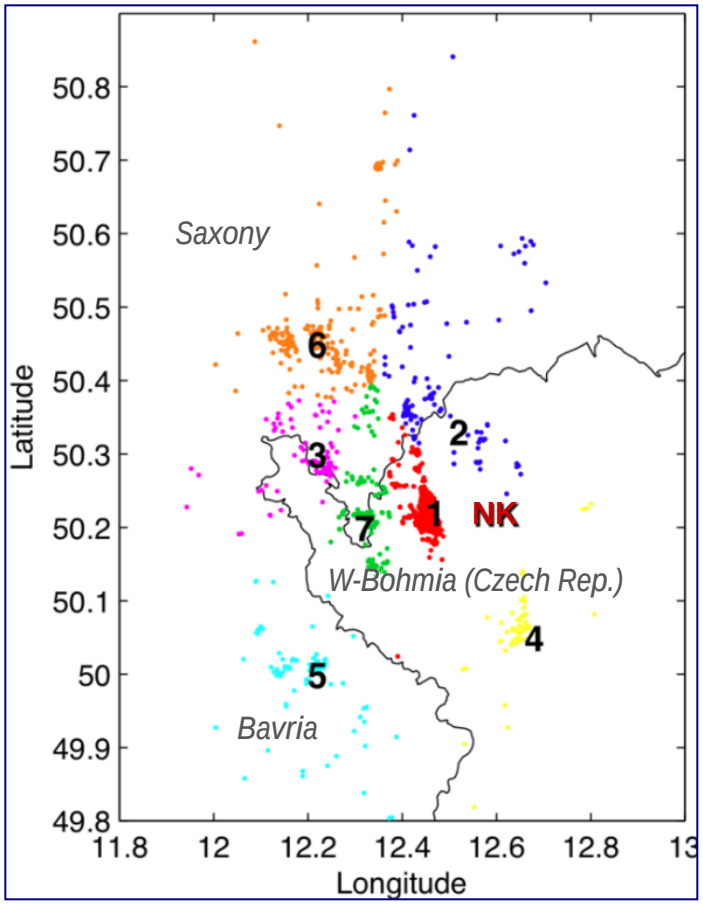
- W-Bohemia/Vogtland (Lat: ≈ 49.8°N to 50.7°N, Long: ≈12°E to 13°E) - an intraplate geodynamically active area

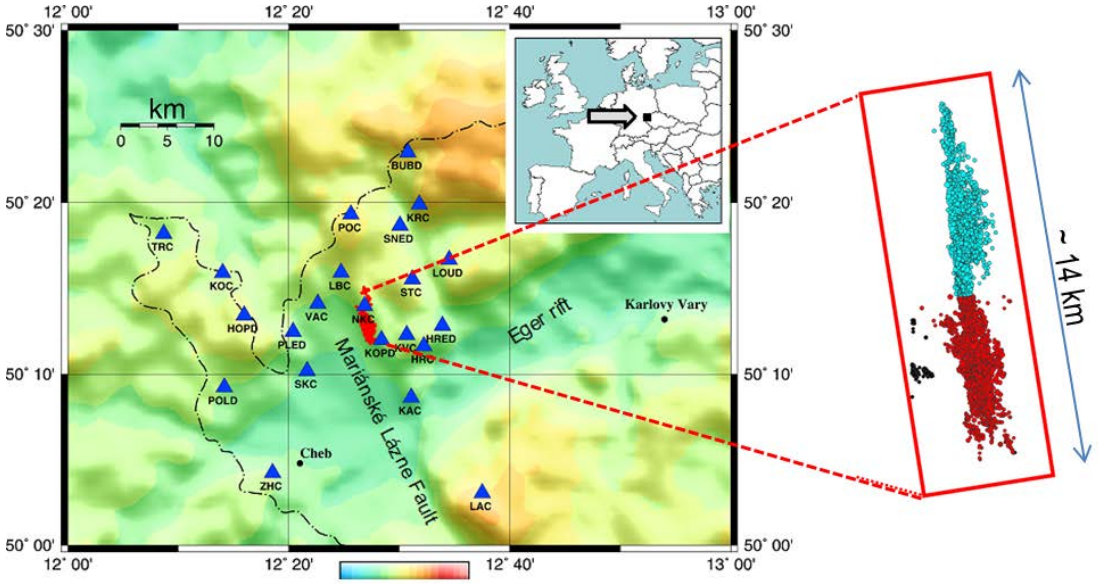
- earthquake swarms – specific type of seismicity
  sequences of seismic events closely clustered in space and time, without a single outstanding earthquake

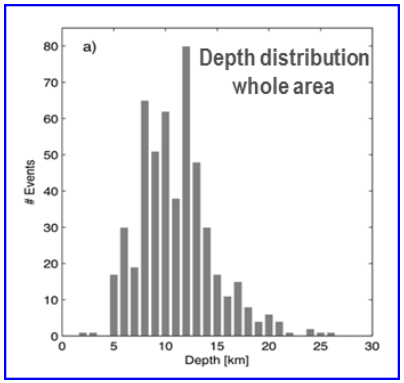
The origin of earthquake swarms still unclear.

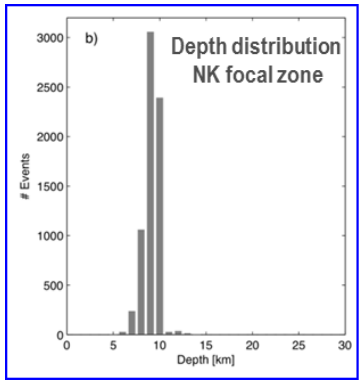


W-Bohemia/Vogtland region and local earthquake swarms









Basic characteristics:

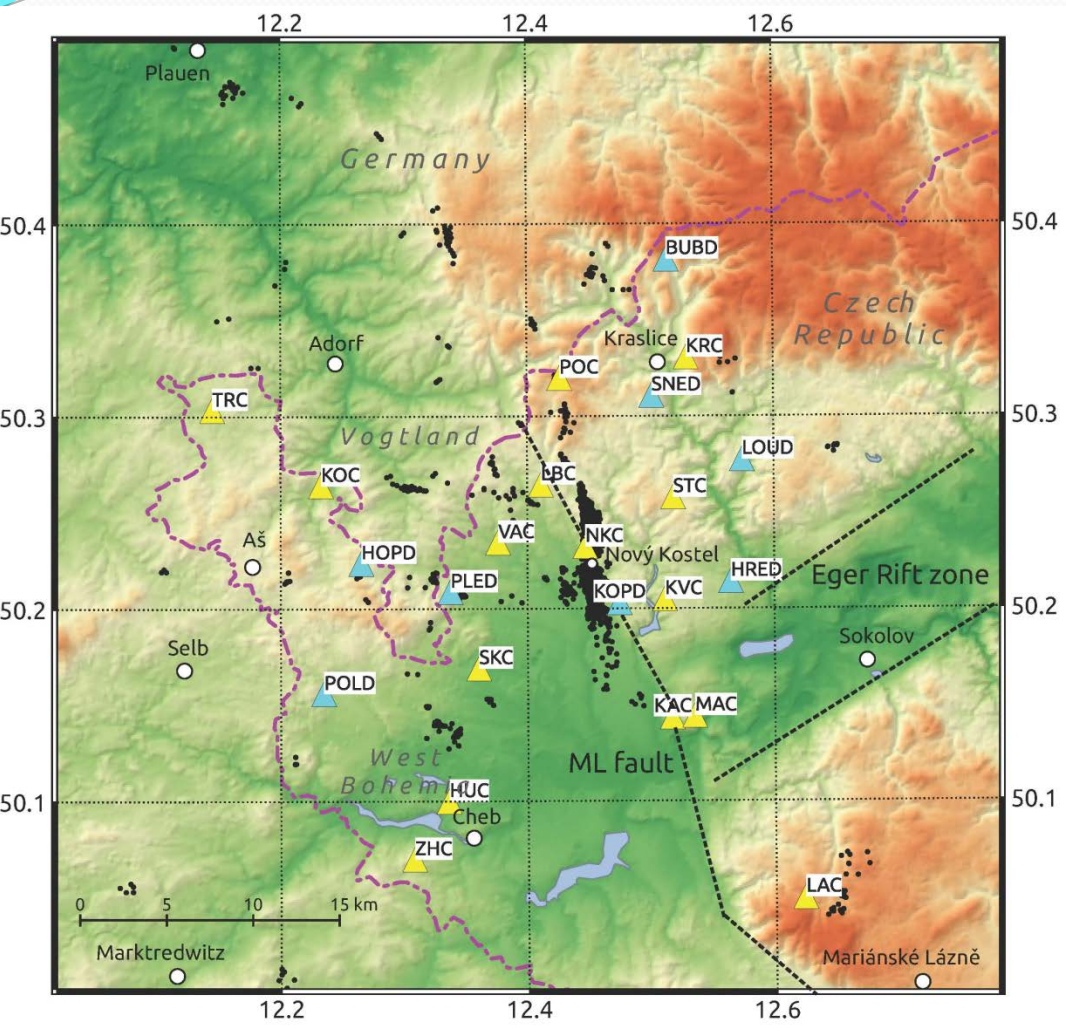
- Western part of the Bohemian Massif
- Intersection of Eger rift and Mariánské Lázně fault
- Quaternary volcanism , crustal-fluid activity
- Frequent occurrence of $M_L < 4.0$ intraplate earthquake swarms
- Swarm-like seismicity scattered in the area ≈ 40 x 60 km but mainly concentrated in a few epicentral areas

- About 95 % of the total seismic-moment released in the **NK zone** ⇒ focal belt 10 x 7 km

Basic characteristics of significant W-Bohemia/Vogtland seismicity

	Duration [days]	***Total number of detected ev.***	***Characteristics***	***ML_{max}***
1985/86	70	8000 M_L>0.5	swarm	**4.6**
1997	20	1 800	swarm	3.0
2000	125	25 000	swarm	3.2
2008	70	25 000	swarm	3.8
2011	120	25 000	swarm	3.7
2013	20	1 500	mini-swarm	2.5
2014	14	4 000	3 mainshock-aftershocks sequences	3.6 **4.4** 3.5
2017	16	2 500	swarm	3.1
2018	15	7 000	swarm	3.8
background: 1997-2018	-	10 000	micro-swarms & single events	2.0

Distribution and parameters of the WEBNET stations current state



- BB networked stations
- SP autonomous stations

- WEBNET configuration:
  12 BB networked and
  10 SP autonomous 3C stations
- records proportional to the ground velocity
- frequency band:
  0.03-80 Hz for the BB stations
  1.0-80 Hz for the SP stations
- sampling rate: 250 Hz

Area covered by stations ≈ 900 km^2

WEBNET: instrumentation and data – current state

BB stations:

Sensors: Güralp CMG3-ESP, T_0 = 30s, f_{LP} =100 Hz
Data acquisition systems: Centaur by Nanometrics
Connected to Internet by WaveLan, Satellite, GSM LTE

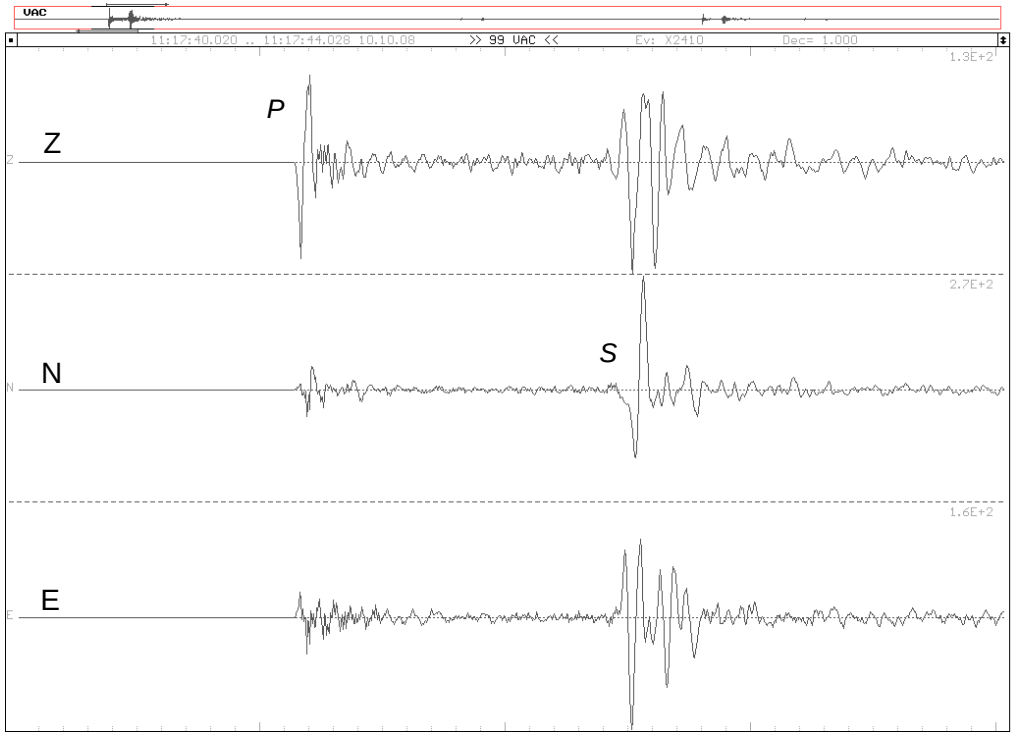
SP stations:

Sensors: Lennartz LE3-D, T_0 = 1s, f_{LP} = 80 Hz,
Data acquisition systems: Gaia II, by Vistec (domestic provenience)
Recording media: SD cards
data downloaded once in 2 months or if needed

All the stations operated in continuous mode

Data format: miniSEED
Data stored on data server SILO,
Date access: catalogs available on Internet
seismograms on reques.

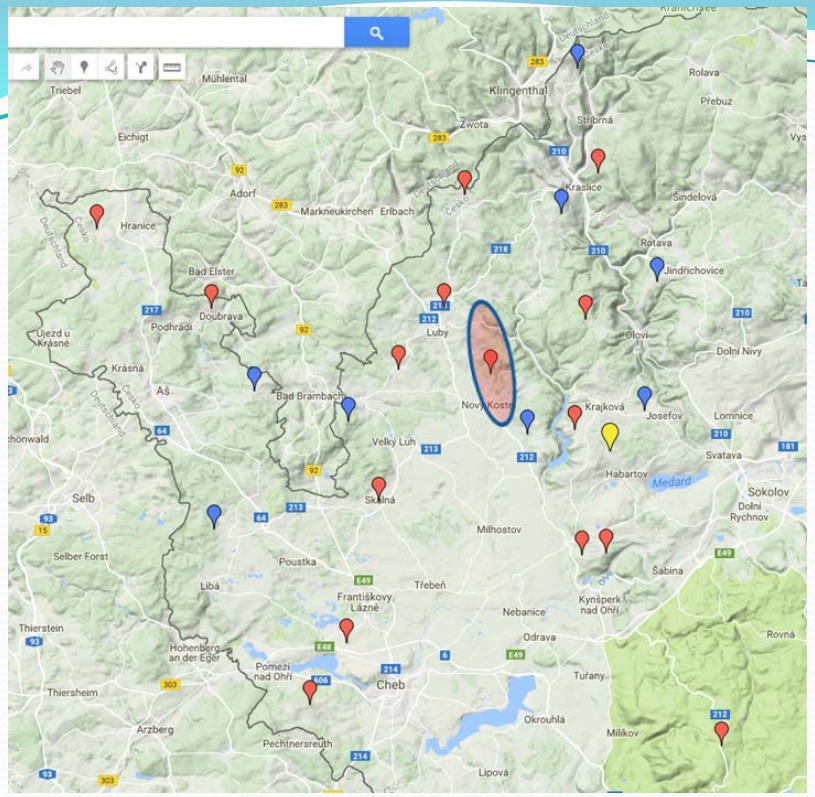
WEBNET stations and typical seismogram



The newest stations of WEBNET

Chlum sv. Maří (MAC)
First „green powered“ station with broad band sensor and online data streaming with GSM LTE.
Absolute independence of power net
Since 2017

Horka (HORC)
Supported by AV21 and
With cooperation
Vodní díla - TBD a.s.
Ground motion monitoring in
The Horka dam
Since 2018

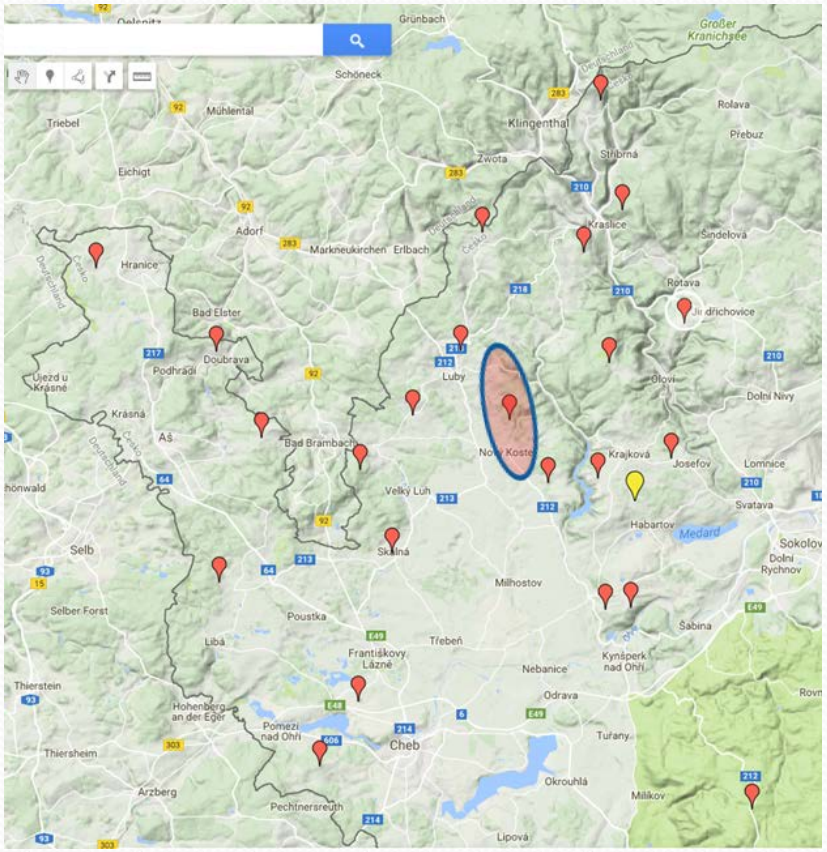


Near future upgrade of WEBNET:

Transformation of 8 SP autonomous stations (blue flags)into BB networked ones;

HRC station (yellow flag) will be established later on.

Instrumentation ordered (manufacturing in process).



Sensors: Güralp CMG3-ESP, $_0$ = 30s, f_{LP} =100 Hz

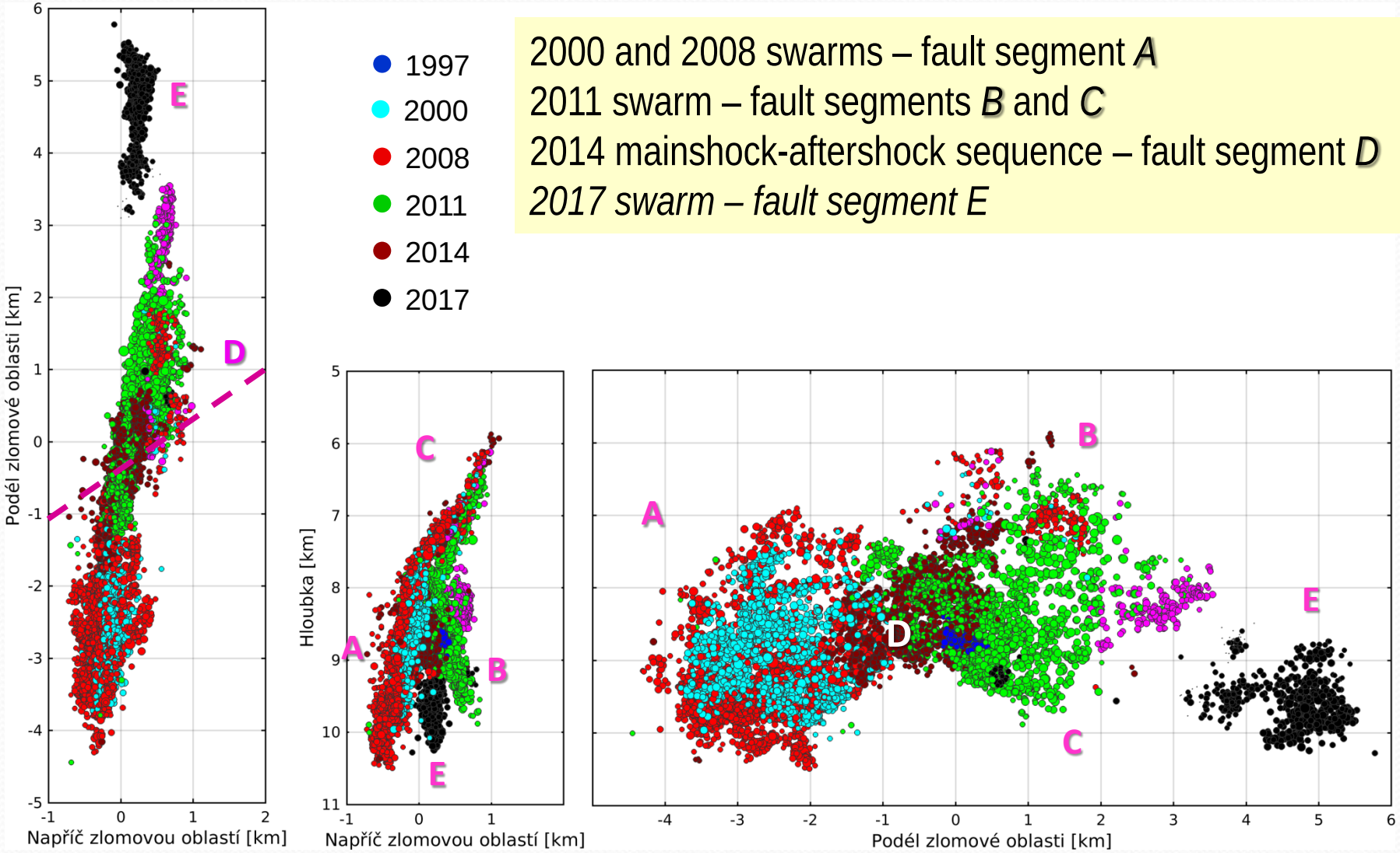
Digitizers: Centaur by Nanometrics

Connection to Internet: GSM LTE;

Batch data transmission due to lower power consumption

Power supply: batteries recharged by solar panels

Spatial distribution of earthquake swarms in the main focal zone NK



2000 and 2008 swarms – fault segment *A*
2011 swarm – fault segments *B* and *C*
2014 mainshock-aftershock sequence – fault segment *D*
2017 swarm – fault segment E

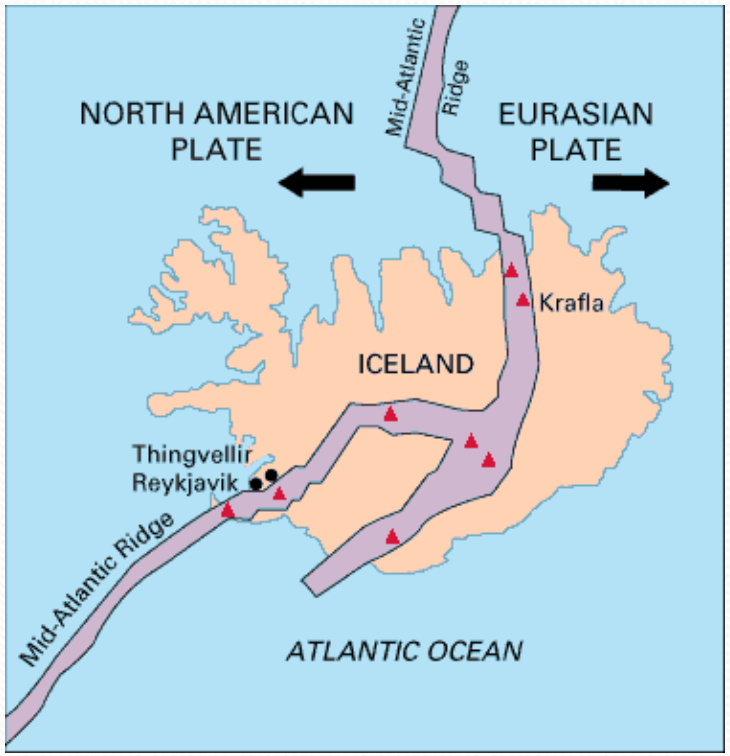
REYKJANET

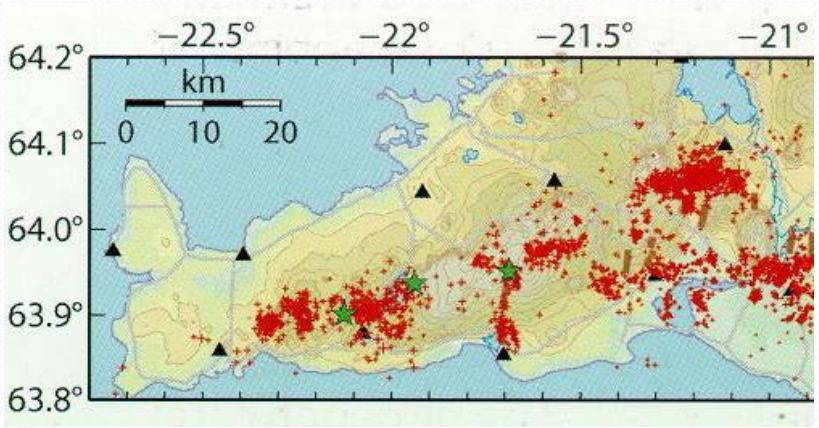
Reykjanes Peninsula Network, SW Iceland

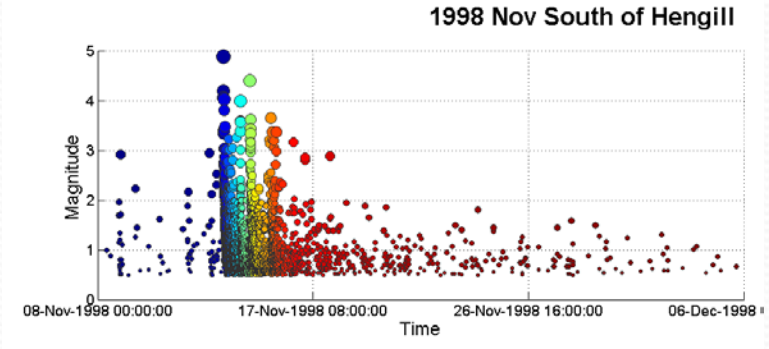
Reykjanes Peninsula: (Lat: ≈ 63.8°N to 64.1°N, Long: ≈21.5°W to 22.3°W)

- onshore continuation of the Reykjanes Ridge which is a part of the mid-Atlantic Ridge

- swarm-like seismicity at a contact of lithospheric plates
  earthquake swarms – up to magnitude M_L = 5+ Iceland

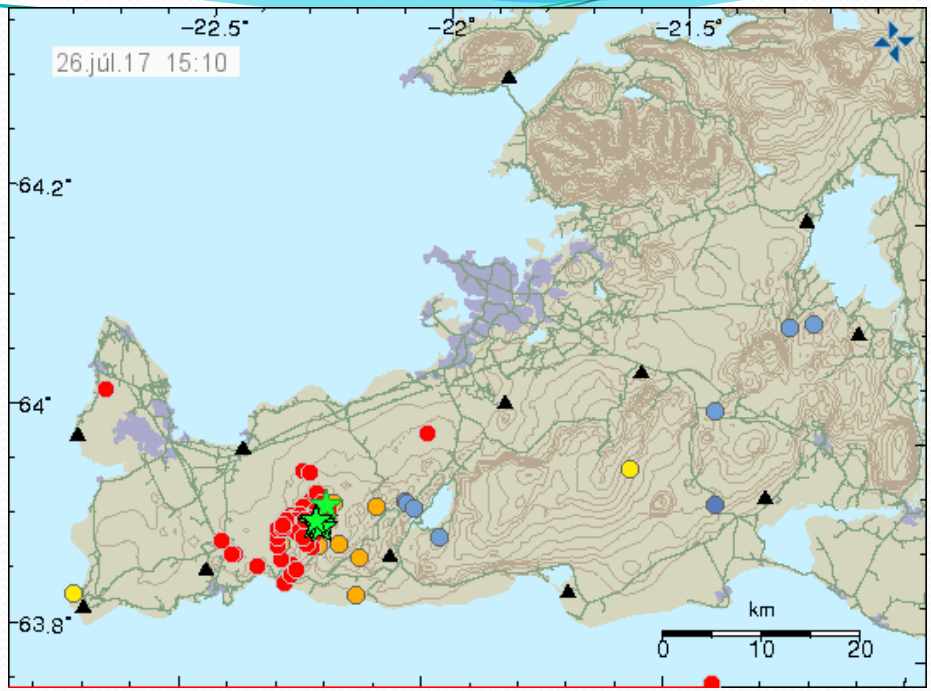


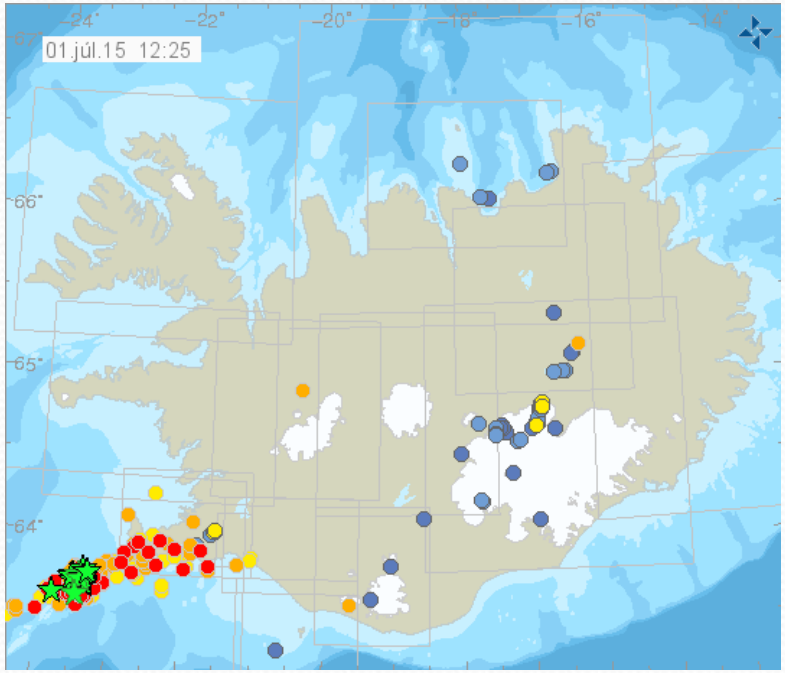


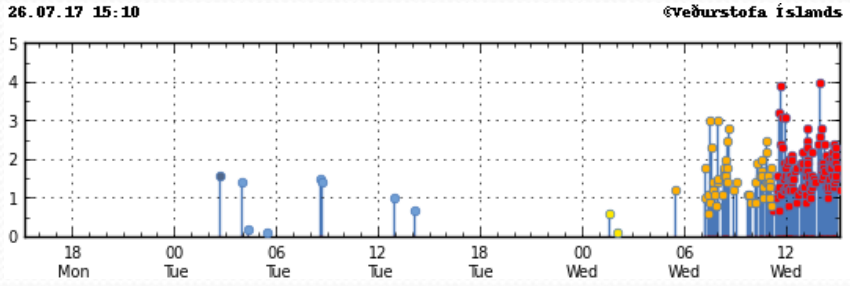


Seismic activity concentrated along the ridge

Earthquake swarms typical of the Reykjanes Peninsula and Hengill volcanic complex





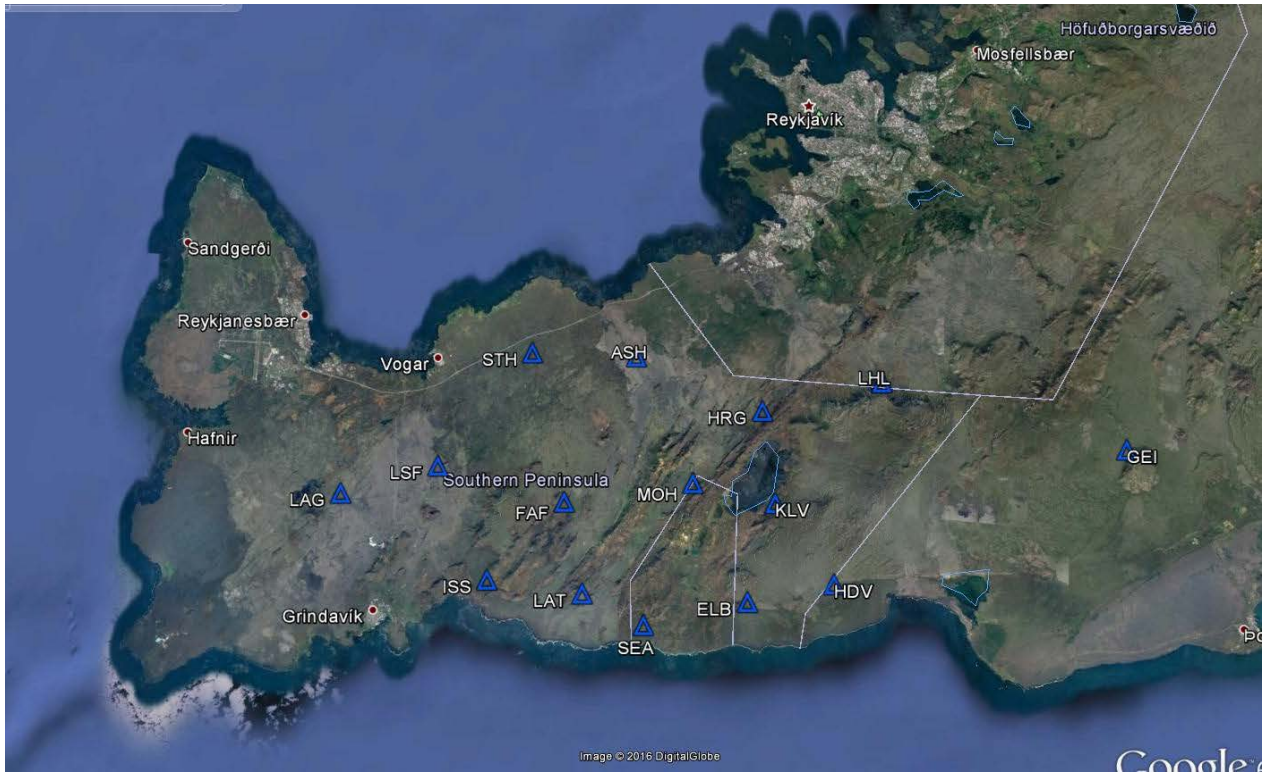


Basic characteristics of the Reykjanes Peninsula, SW Iceland

- Plate motion rate ≈ 20 mm/year in E-W and ≈ 5 mm/year in N-S.
- Interaction between volcanic and tectonic activity.
- Most of the Reykjanes Peninsula surface covered by lava.
- The largest recent swarms: *Mw* = 5.9 in 2000, *Mw = 5.3* in 2003, *Mw* = 5.0 in 2013.
- At the present time the seismicity is of diffused character along the plate boundary.
- High fluid activity - many fumaroles and geothermal systems
- Brittle/ductile transition at about 7 km depth, temperature of at least 650°C.
- Magmatic activity occurred at intervals ≈ 1000 years; the latest eruptive period ended in 1240 AD.

Typical relief of the Reykjanes Peninsula

Distribution an parameters of the REYKJANET stations



Built up:
September 2013

Area covered by
the REYKJANET stations:
≈ 60 km x 20 km

- 14 BB and 1 SP autonomous 3C stations
- records proportional to the ground velocity
- frequency band: 0.03- 80/50 Hz for the BB stations
  1.0-80 Hz for the SP station
- sampling rate: 250 Hz.

REYKJANET: instrumentation and data - current state

14 BB stations:

Sensors: Güralp CMG 40-T, T_0 = 30s, f_{LP} = 100/50 Hz (liable to resonance at frequencies > 50 Hz); *various amplification (gain) of the sensors used*

1 SP station:

Sensor: Lennartz LE3-D Lite, T_0 = 1s, f_{LP} = 80 Hz

Infra-sonic sensors at 7 stations: micro-barographs ≈ 0 – 25 Hz

Data acquisition systems: Gaia I, III, by Vistec (domestic provenience)
Recording media: SD cards, data downloaded once in 3 months
All the stations operated in continuous mode

Power supply: solar panels – air turbine

Data format: miniSEED
Data stored on data server SILO
Date access: seismograms on request

Expert and technical support: Iceland GeoSurvey - ÍSOR
Icelandic Meteorological Office - IMO

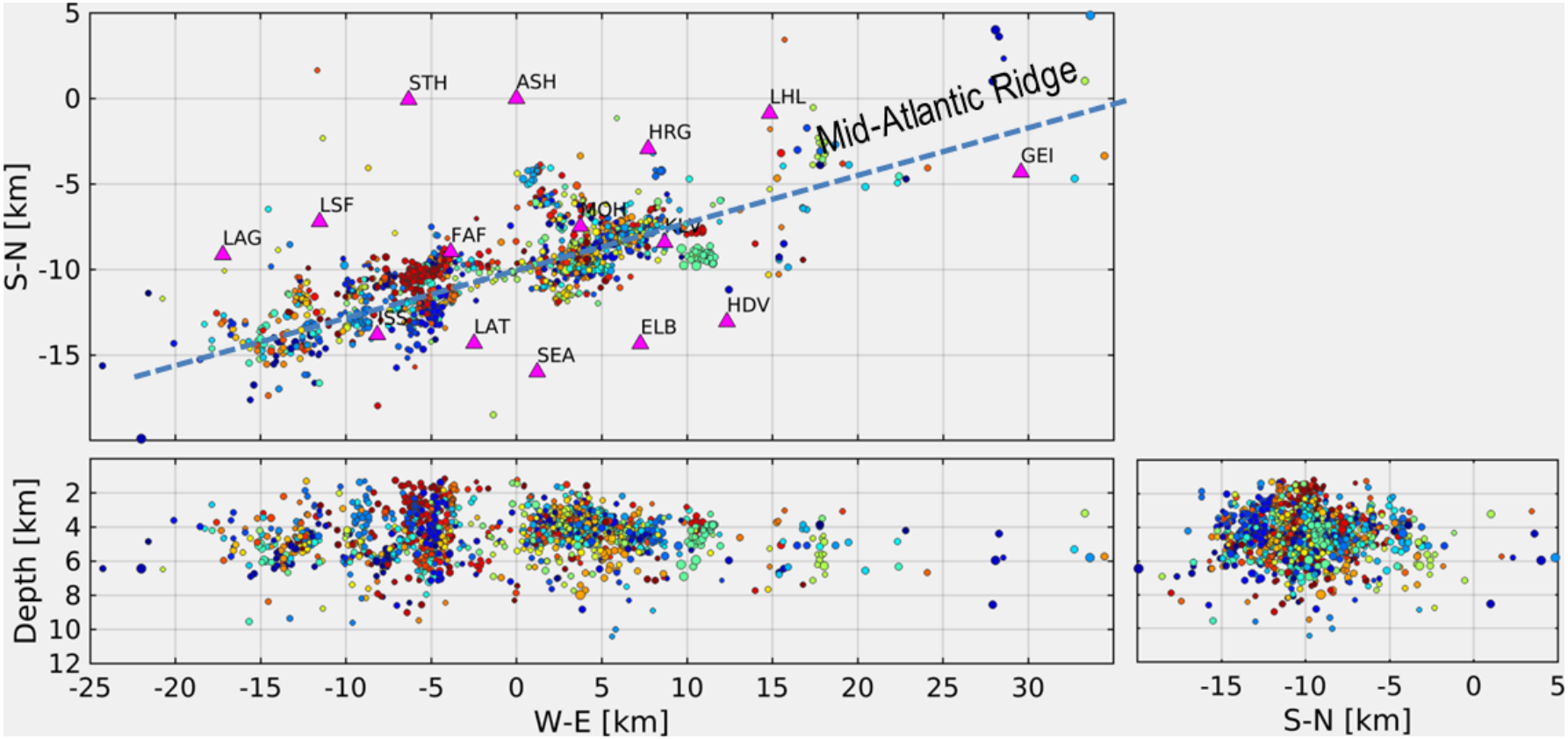
Near future upgrade of REYKJANET:

Complete replacement of the current instrumentation by:

Sensors: Güralp CMG3-ESP, $_0$ = 30s, f_{LP} =100 Hz
Digitizers: Centaur by Nanometrics
Connection to Internet using GSM LTE / WaveLan (subject of accesibility)
Batch data transmission due to lower power consumption (similar to the WEBNET upgrade)

Sensors delivered
Digitizers ordered will be delivered by the end of 2018

Space distribution of the swarm-like seismicity on the Reykjanes Peninsula



Diffused „swarm-like“ seismicity along the rift, M_{Lmax} = 3.6

REYKJANET station KLV