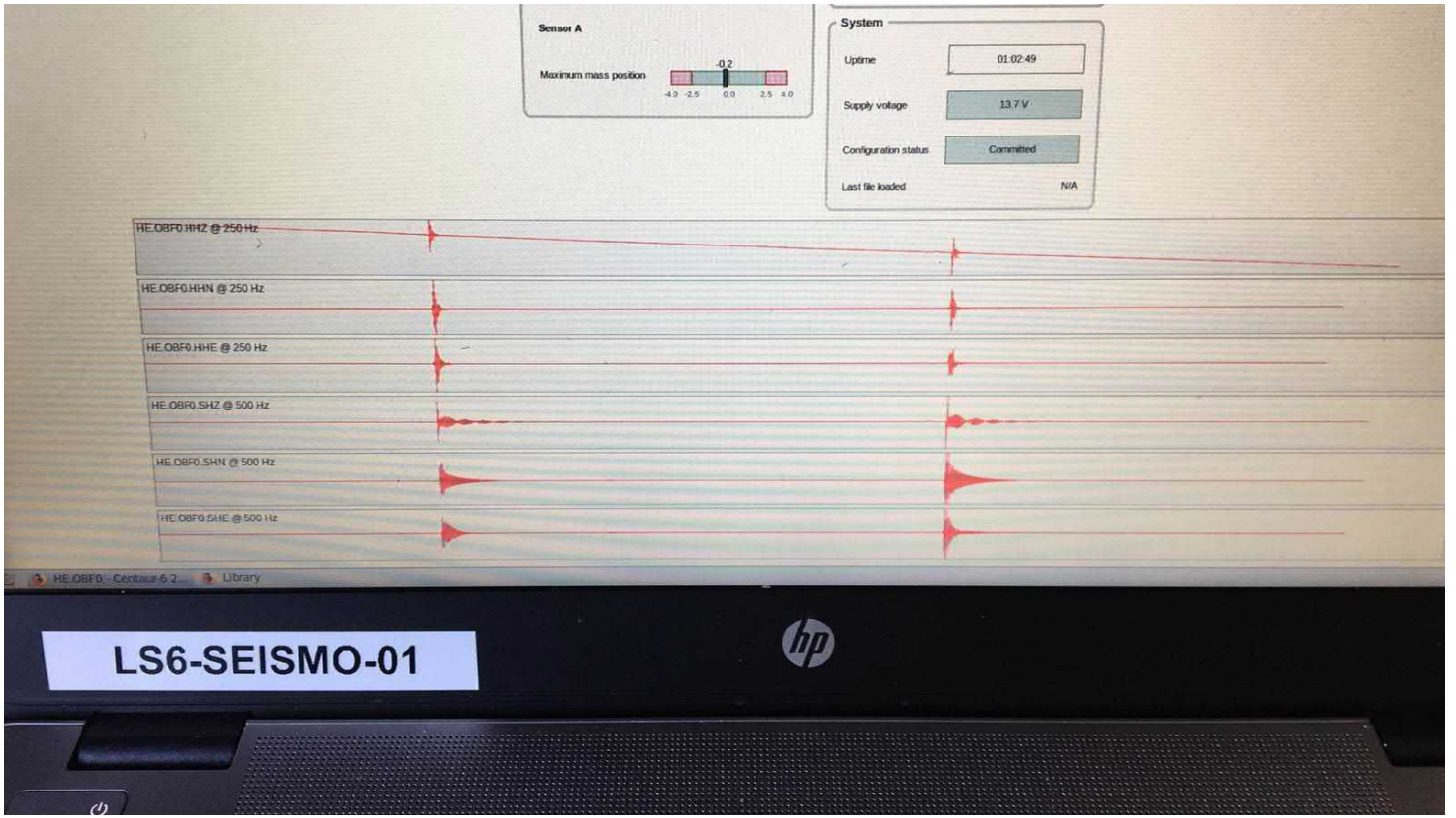
Finnish National Seismic Network:
Recent development of configuration and data analysis



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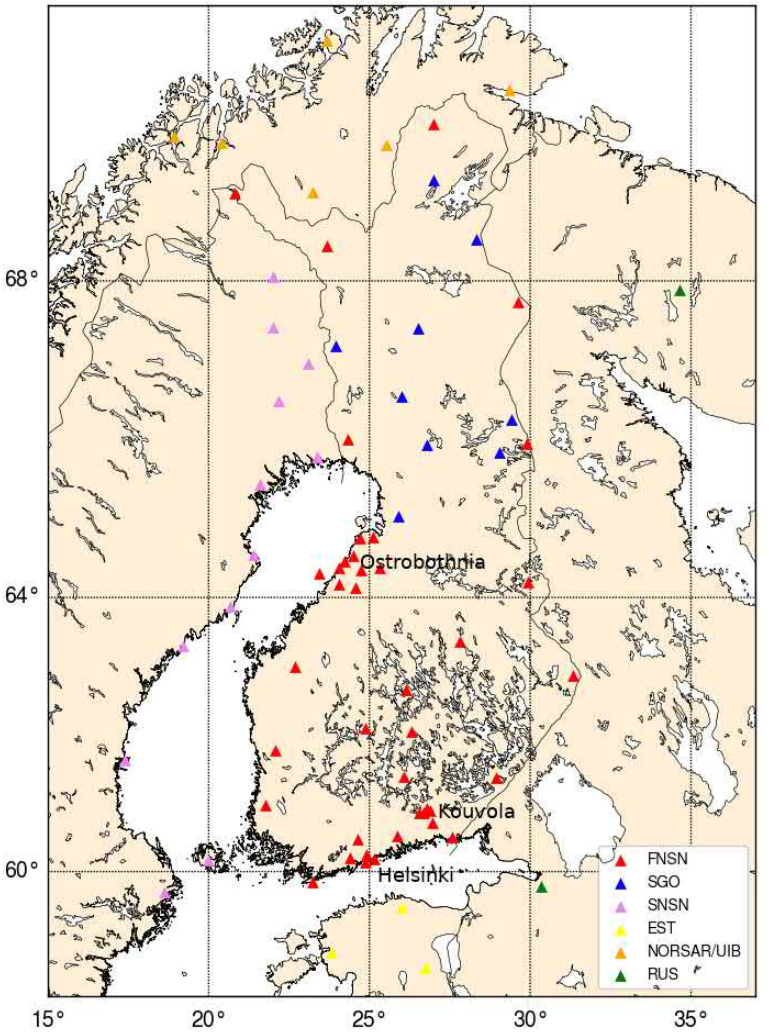
51st Nordic Seminar in Seismology
30.9.2020

T. Veikkolainen and T.Luhta

Seismic networks in Finland and adjacent areas

- The map shows Finnish permanent and semi-permanent seismic stations and other seismic stations with constant data delivery to Finland
- Data from other foreign stations may be fetched upon request
- Kouvola, Helsinki and Ostrobothnia regions have densified local networks
- Temporary networks have been established not only for research projects but also for monitoring the induced seismicity related to the deep heat project of St 1 Inc. in Espoo, Finnish capital region
- Data from all these stations can be used in the daily analysis at the institute
- Growing interest in geothermal energy and high-rise construction projects may result in further seismic networks to urban areas – the Helsinki network was established by the initiative of the city



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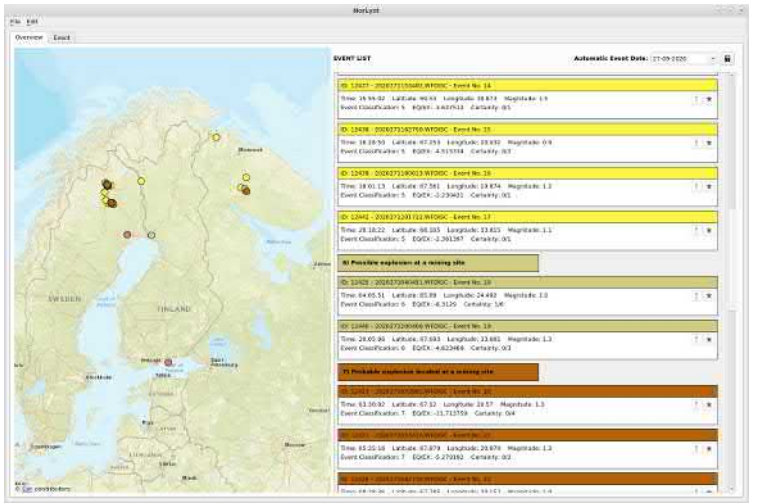
NorDB database and Norlyst analysis tool

- The NorDB database is our solution for storing seismic events and their metadata as well as station information
- The database runs Python and PostgreSQL in Unix-based operating systems
- Event detections are automatically pushed to database and backups are also generated to a remote location each night
- Seismic analysis tool Norlyst is installed separately but fetches data from NorDB
- The use of Norlyst in daily seismic analysis of the institute began in June 2020 and it has significantly smoothed the analysis workflow

```
[seismo@alps Desktop]$ nordb search -v id=12017
Event Search
Criteria:
 event_id: 12017
 2020 0921 0443 48.3 LP 67.730  20.553  0.0FFHEL  7 0.6 0.8LHEL                1
 GAP=246         0.6     2.900  13.000                                          5
 CSS:2020265044248.WFDISC  (det3c)                                              6
 FULLY AUTOMATIC, EVENT TYPE & LOCATION & MAGNITUDE CHECKED (ADV)               3
 SWEDEN                                                                         3
 KIRUNA, SWEDEN                                                                 3
 ID:12017                                                                       I
 STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO SNR AR TRES W  DIS CAZ7
 LANU BZ  Pg      0443 58.98                                    -0.710   70  59
 LANU BZ  Sg      0444 07.72                                    -0.110   70  59
 PAJU BZ  Pn      0444 10.93                 309.0          2 -1.3 0  135 124
 PAJU BZ  Sn      0444 29.88                                     0.010  135 124
 ERTU BZ  Pn      0444 14.13                                     0.110  149 151
 HEF  BZ  Pg      0444 13.32                 239.0         -2  0.810  150  58
 HEF  BZ  MSG     0444 29.00        0.8 0.17
 HEF  BZ  Sb      0444 30.68                                     0.510  150  58
 KTK1 BZ  Pg      0444 17.96                                     0.510  181  36
 KTK1 BZ  Sg      0444 37.70                                    -0.710  181  36
 ARA0 BZ  Pn      0444 31.60                 223.0         -4  0.810  285  43
 ARA0 BZ  Sb      0445 04.30                                    -0.910  285  43
 KEV  BZ  Sb      0445 20.36                                    -0.510  345  46
```



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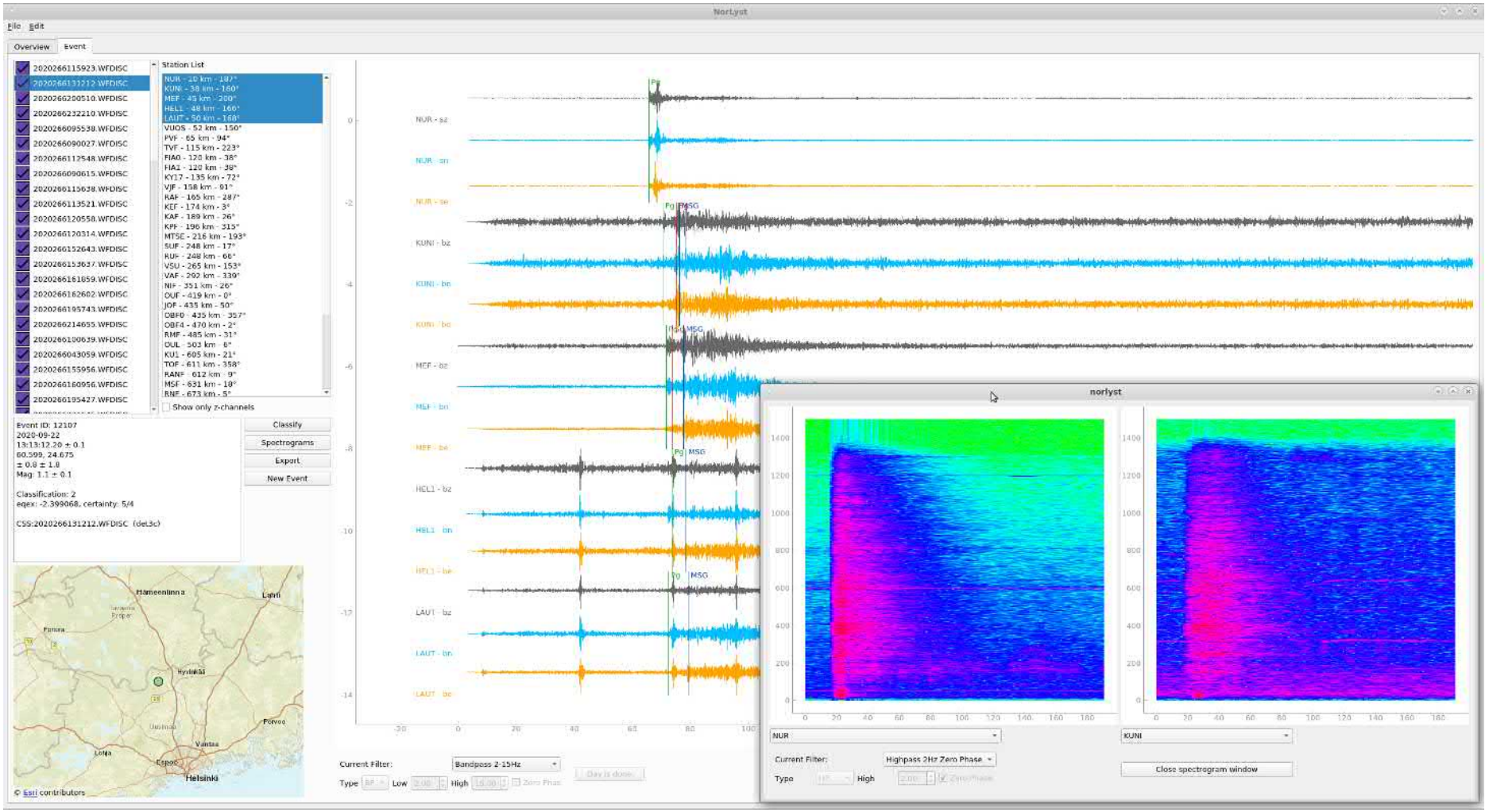
Daily seismic analysis using Norlyst



Events not requiring manual phase picking are analyzed in Norlyst. Manually picked events are analyzed in Geotool but imported to Norlyst.

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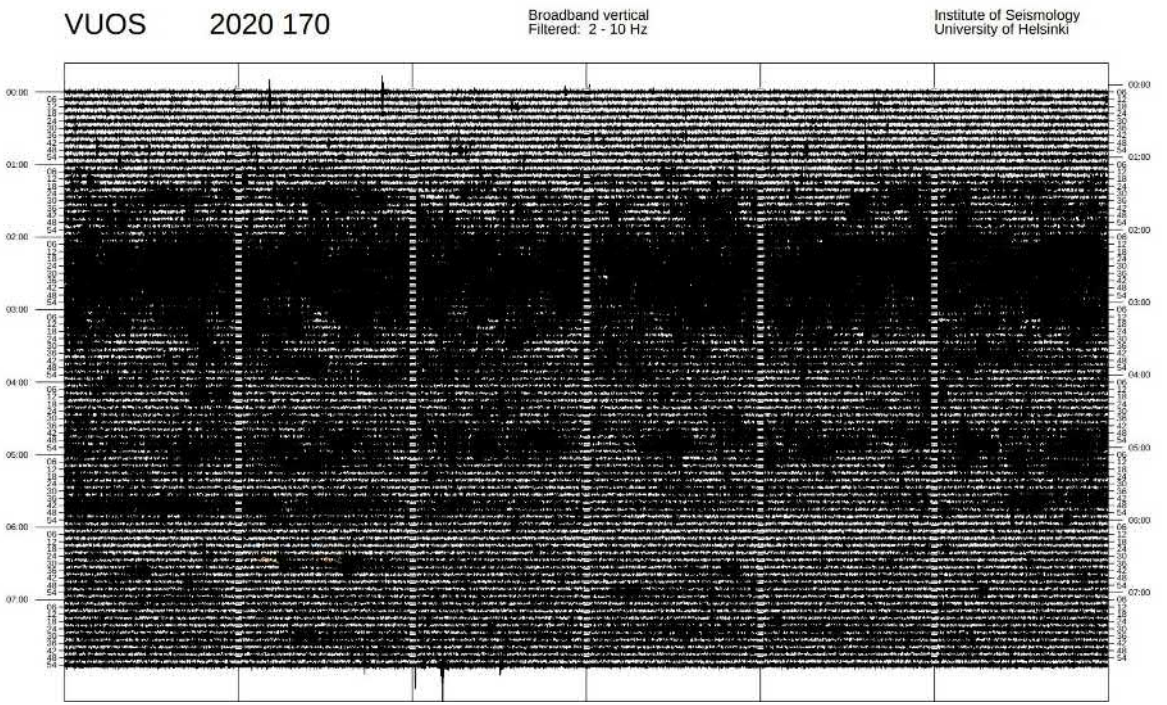
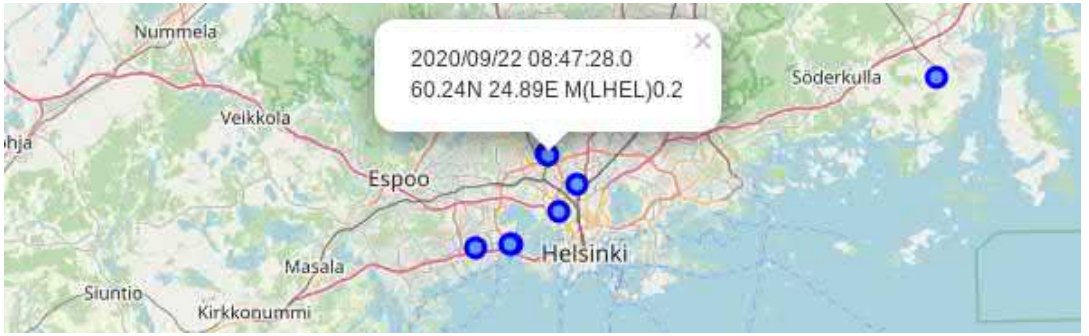
HelsinkiNet

- We agreed with City of Helsinki on the establishment of a seismic network in the city area
- The main goal is to better understand the influence of seismicity on the built environment
- Three stations (KUNI, VUOS, LAUT) now in operation close to the borders of the city
- Detection threshold in Helsinki region far below the national level (M_L=1)
- In June 18, a thunderstorm struck the coast of Finland – we could clearly see it in the seismogram of VUOS!





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HelsinkiNet Stations

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ED challenges vol 1

Mon 7/29/2019 7:48 AM
To: seismo-staff@helsinki.fi

Moi

Huonoja uutisia

Kaikki Seismon ja OBF verkon ED-digitoijat kadottivat ajastuksen. Ohessa lista toimimattomista asemista:

OBF1 2099/12/13 04:19:43
OBF2 2099/12/13 04:19:43
OBF3 2099/12/13 04:19:44
OBF4 2099/12/13 04:19:43
OBF5 2099/12/13 04:19:42
OBF7 2099/12/12 17:08:38
OUF 1963/11/06 21:51:25

KAF 2099/12/13 04:25:37
KEF 2099/12/13 04:25:36
KEV 2099/12/13 04:25:37

MEF 1963/11/06 21:57:20

NUR 2099/12/13 04:25:38

OUF 1963/11/06 21:57:19
OUL 1963/11/06 21:57:21
RAF 2099/12/13 04:25:38

TOF 1963/11/06 21:57:16
VJF 1963/11/06 21:57:21

VAF 2099/06/18 04:03:51

Lisäksi OUL, KLF ja KMNF ovat sekaisin

- Week Number Rollover issue caused our EarthData digitizers to lose timing

- problem was solved within two days (thanks to Anders Heinloo, GFZ Potzdam and our own technical team)

- The fix will work 1024 weeks (until 2038)

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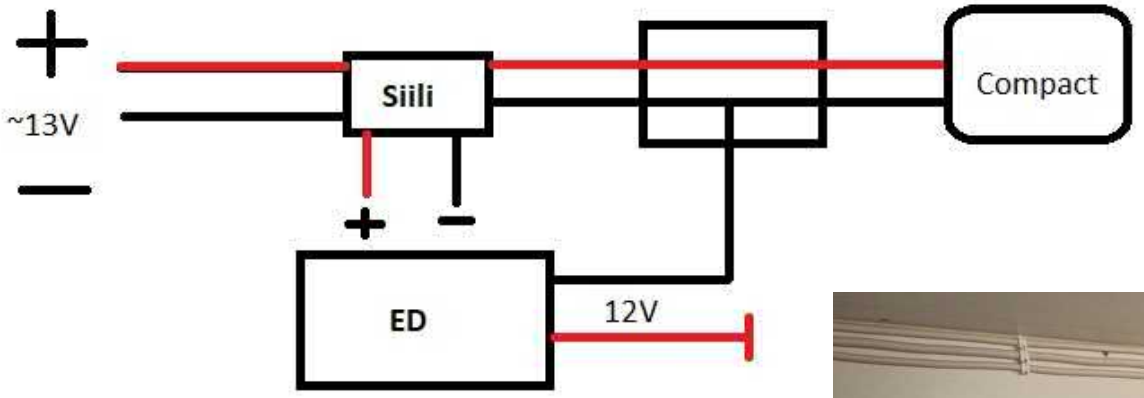
ED challenges vol 2



- Power supply inside the ED is getting tired → a bypass needed

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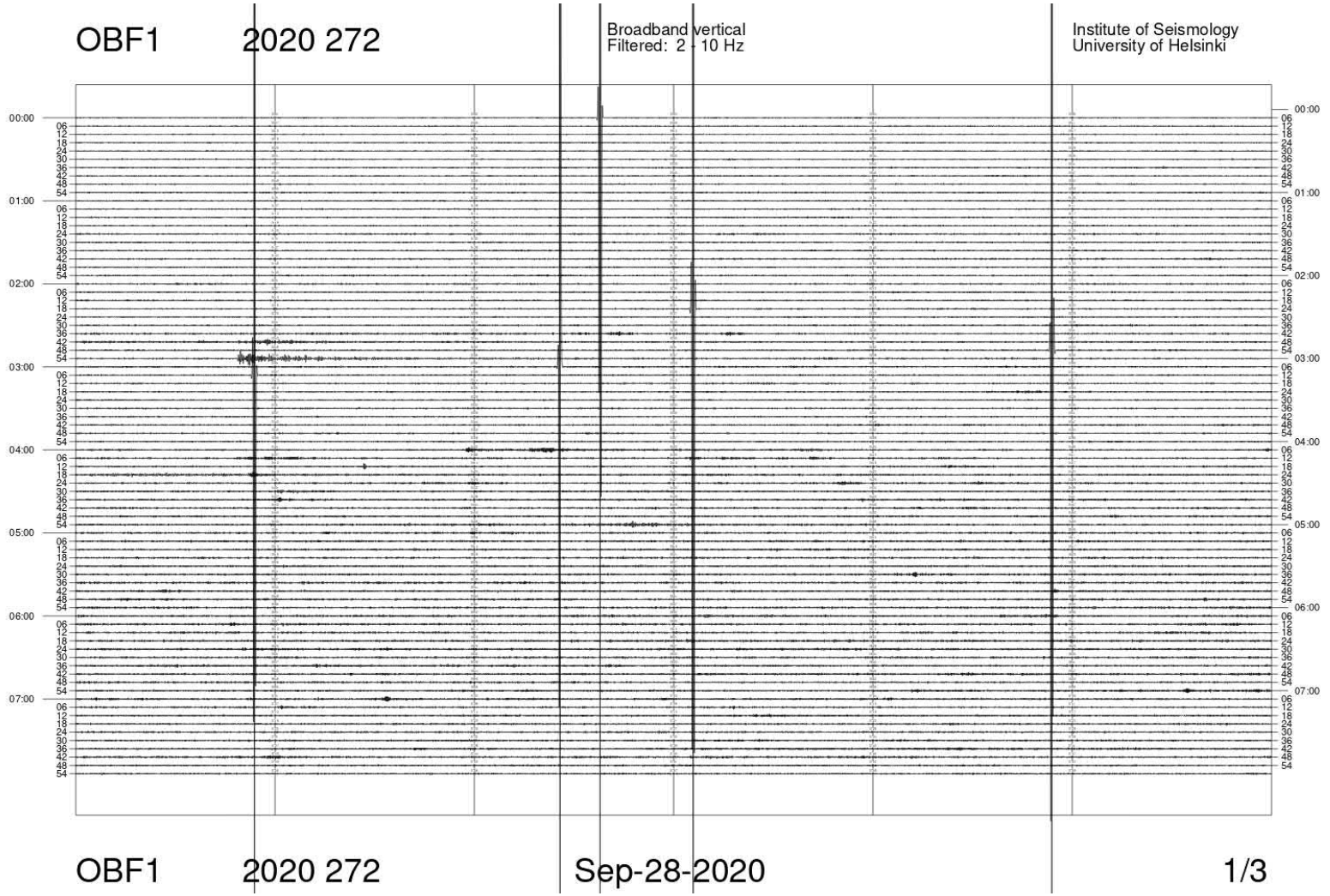
ED challenges vol 3



- Spikes are caused by the mini PC (IPC-401) attached to the ED
- CentOS 8 or hardware problem?

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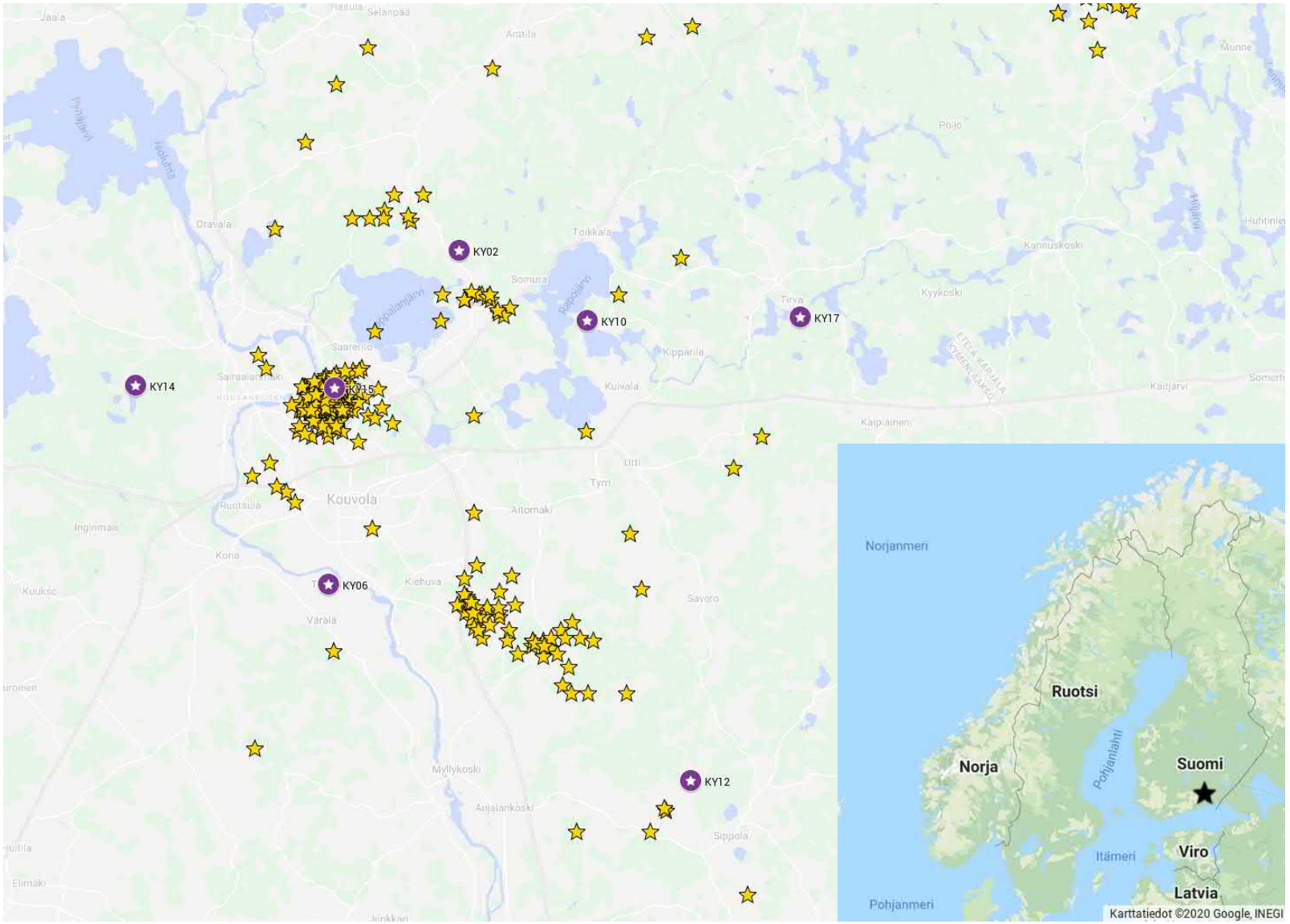
Kouvola Network and Kuusaanlampi Array



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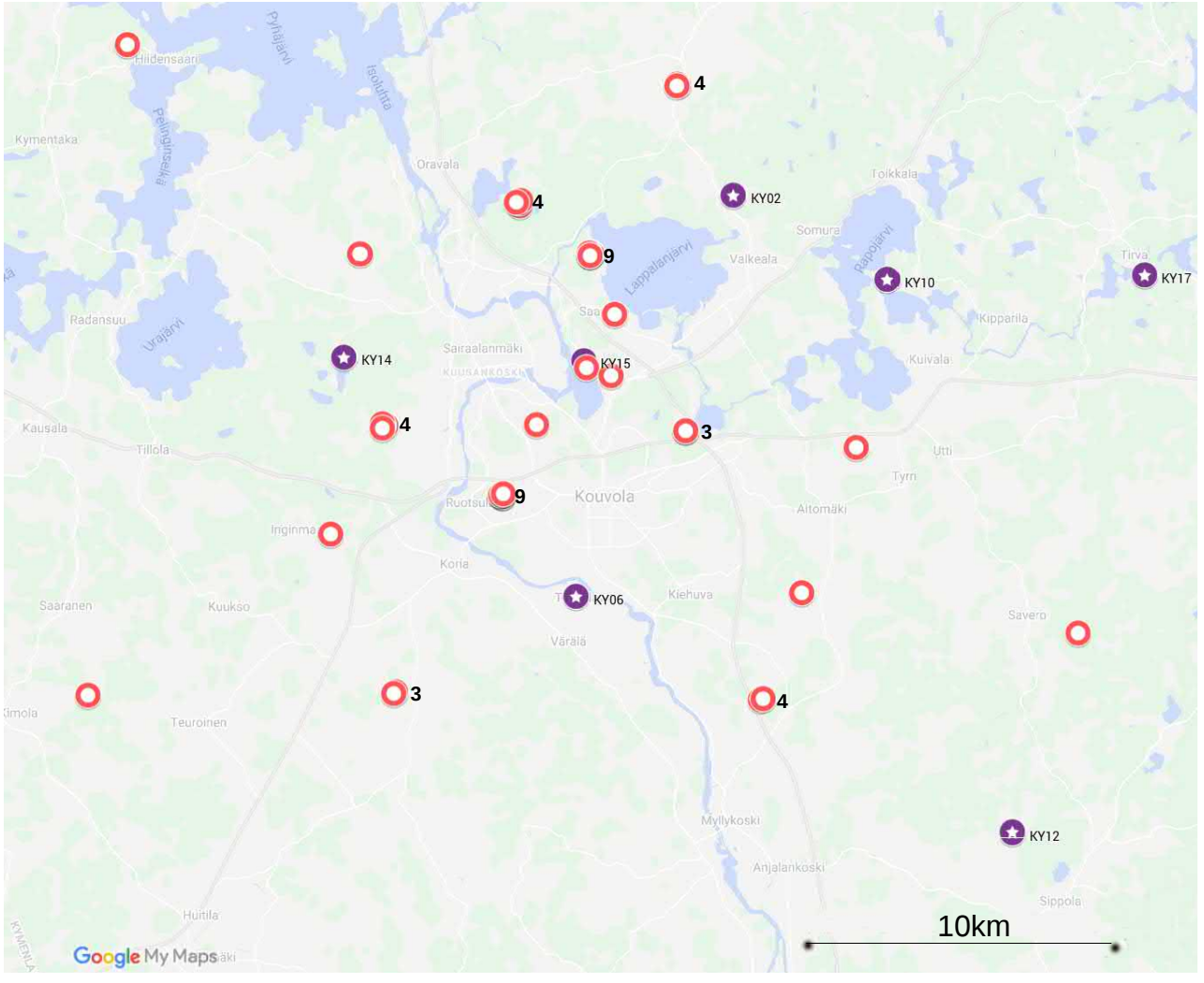
Kouvola Network and Kuusaanlampi Array



- Distances between subarray substations 3.6m-120m
- Stations measuring 7/2020-1/2021
- Earthquakes from Kuusaan-lampi area faults wanted
- Also measured noise will be utilized
- Detection capabilities of different size subarrays will be evaluated

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Thank you!
Kiitos!

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