

Status of the seismic sensor development in Poland

Tomek Bulik

University of Warsaw

Mariusz Suchenek, Tomek Starecki

Warsaw University of Technology

Introduction to the project

- Goal: measure the seismic noise at candidate locations for construction of ET
- Means: develop inexpensive seismic sensors, and deploy them at sites.
- Requirement: the sensitivity in the 1-10Hz band should be sufficient to measure the KAGRA noise level.
- Low cost!

Solution

- Use geophone based sensors
- Develop custom electronics – amplifier, analog to digital converter, and data logger.
- Test, improve
- Mass produce sensors, and deploy at sites.

Potential sensors

4.5 Hz geophone

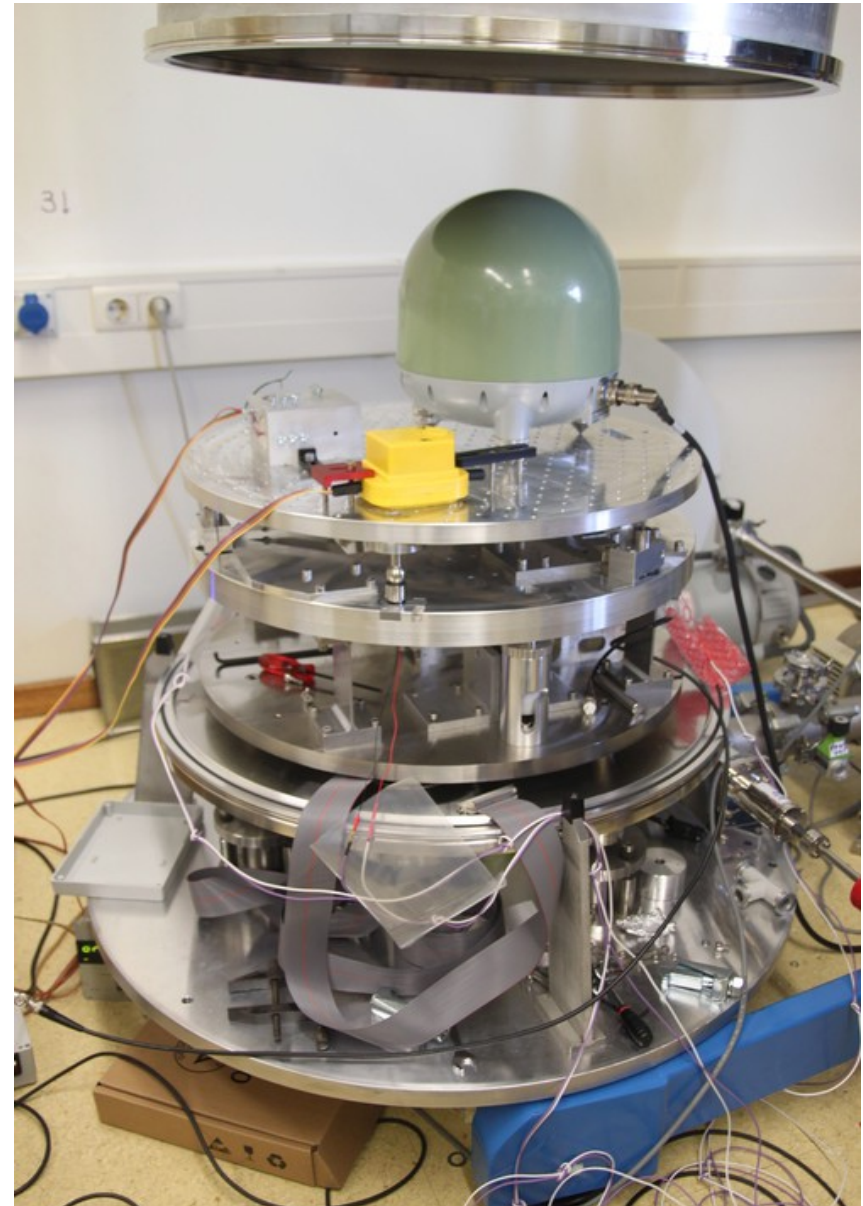


2.5 Hz geophone

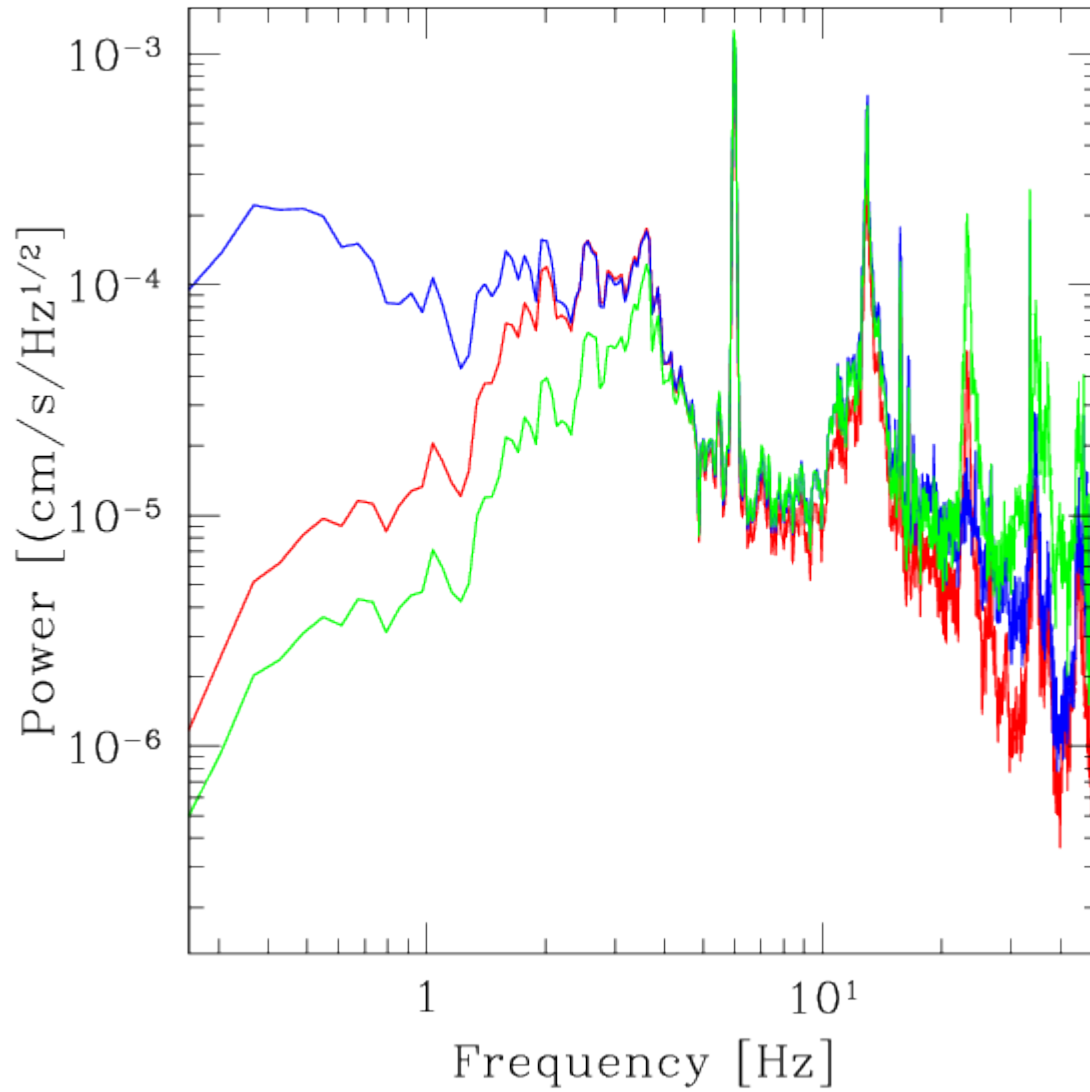


Tests and results

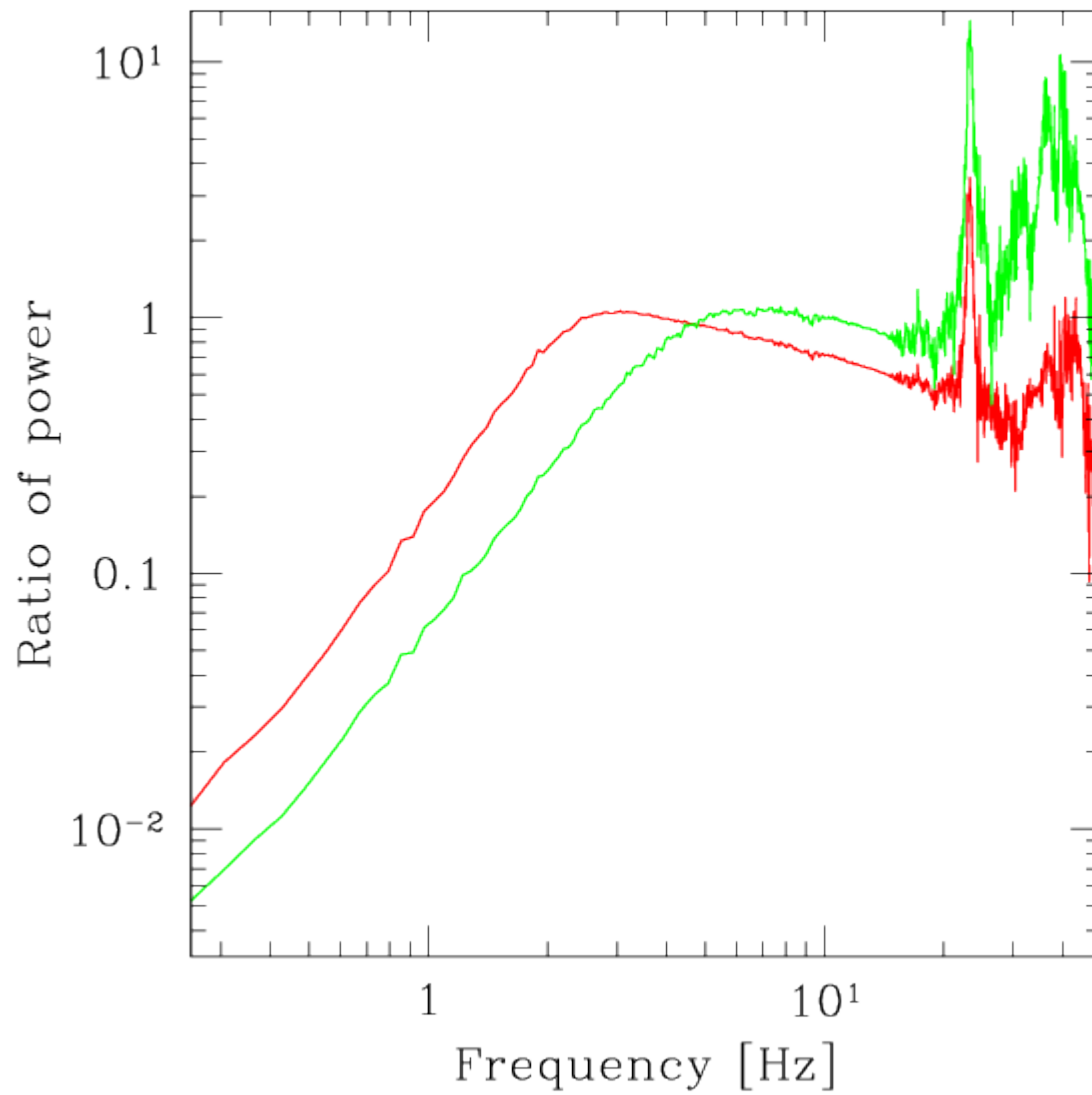
- Performed at NIKHEF in July.
- Compared the sensors to Trillium 240.
- Noise tests in seismically isolated vacuum chamber.



Signal measured



Ratio to Trillium



Estimate of the noise level.

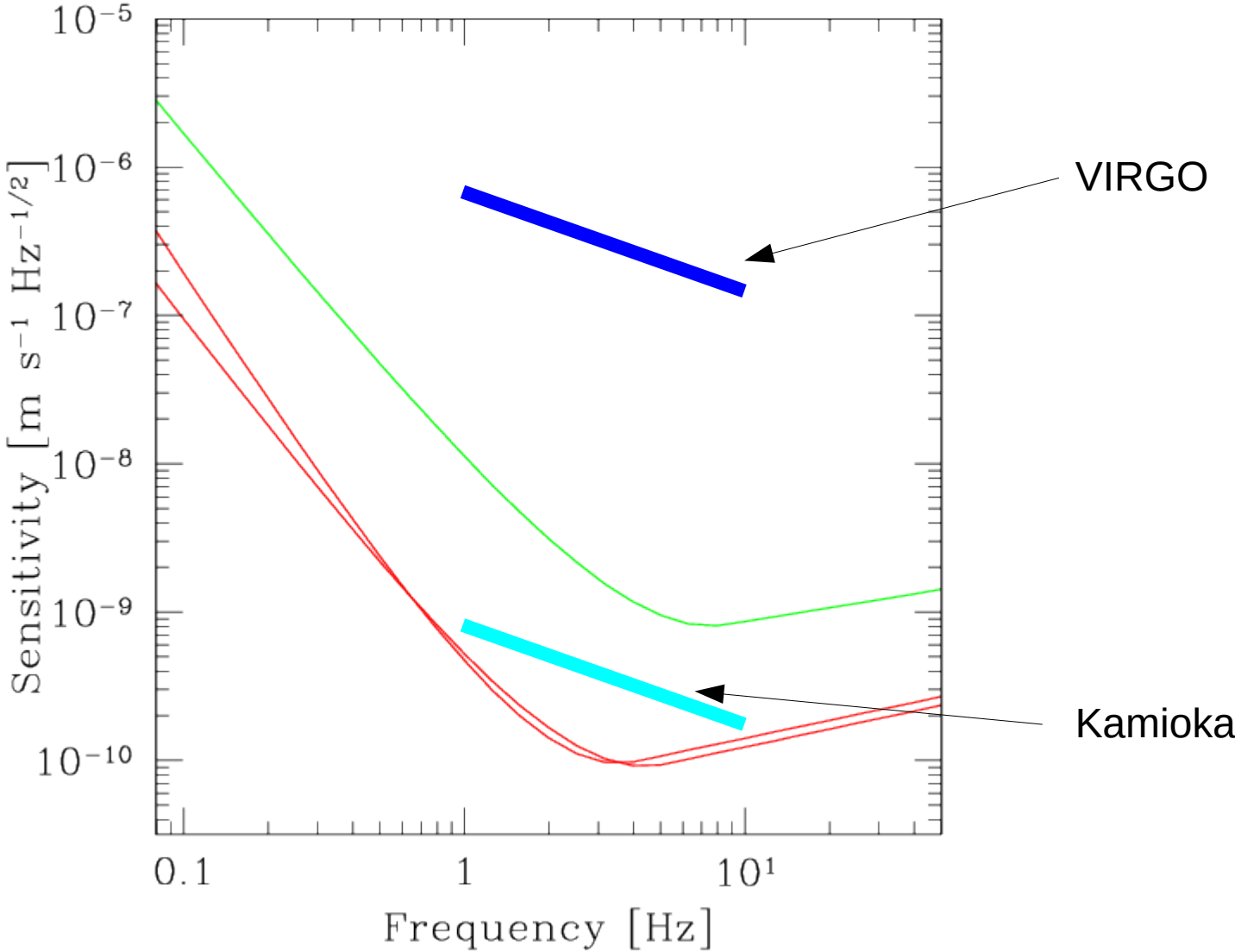
- Measurement in the seismically isolated vacuum chamber
- Very low frequency noise present.
- Electronic noise at

$$\approx 2 \times 10^{-5} \text{ mV Hz}^{-1/2}$$

Sensitivity estimate

- Assume that noise is at the electronic level
- Trillium response is flat in frequency
- Calculate the sensitivity using the measured ratios.

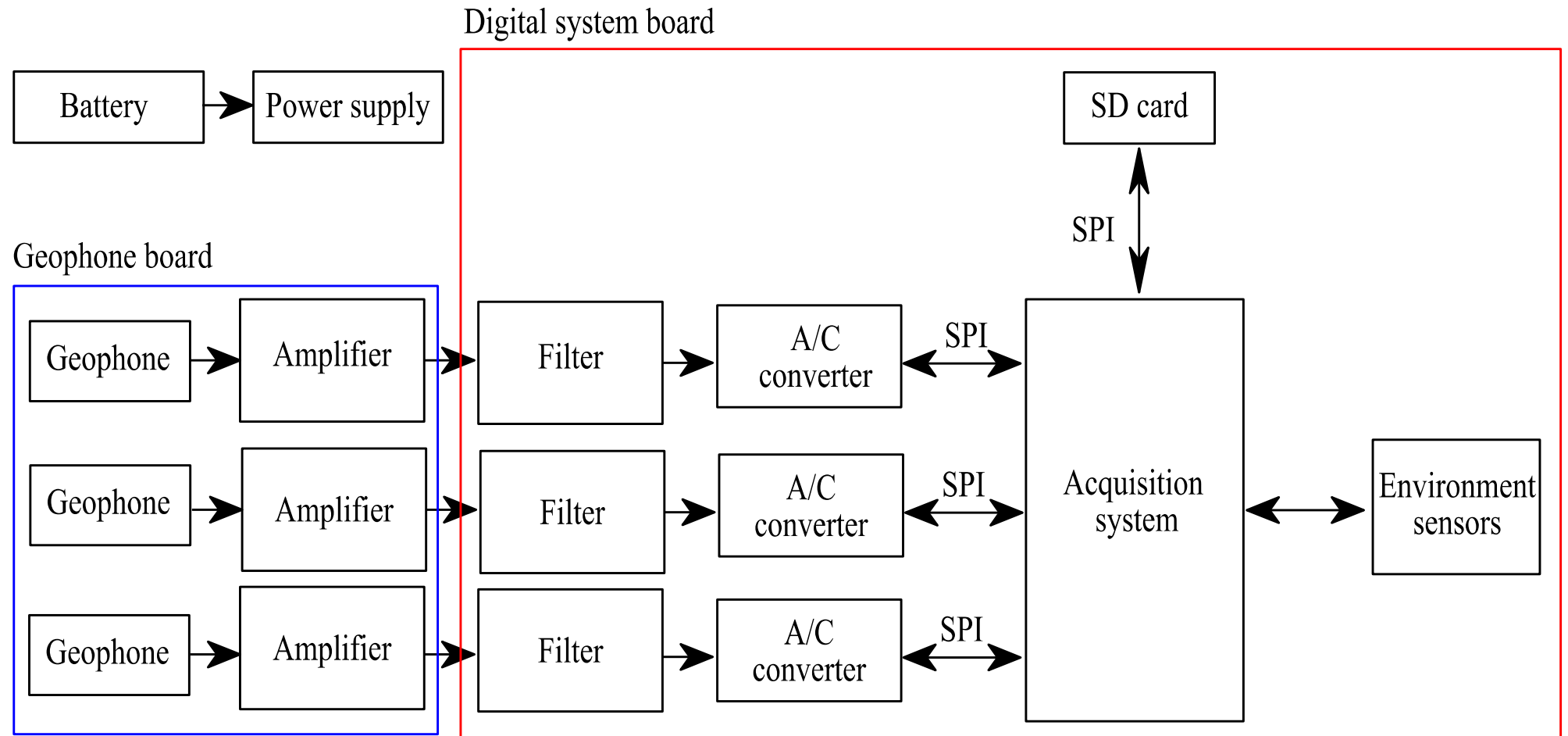
Sensitivity



Next steps

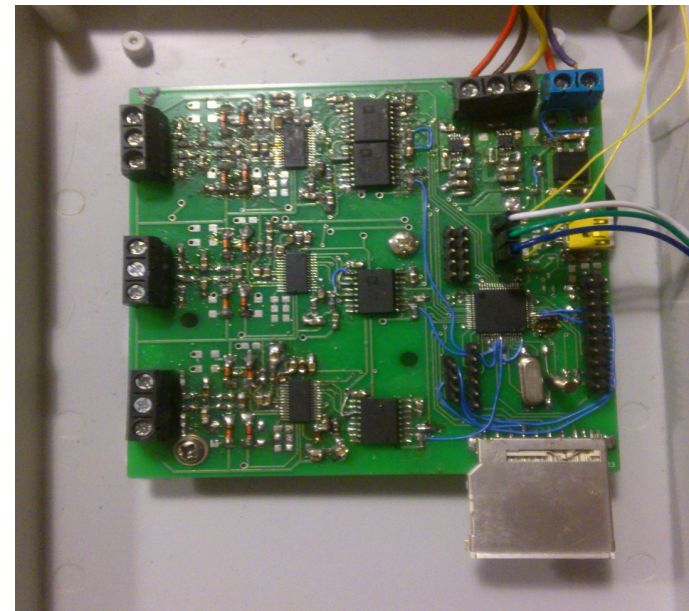
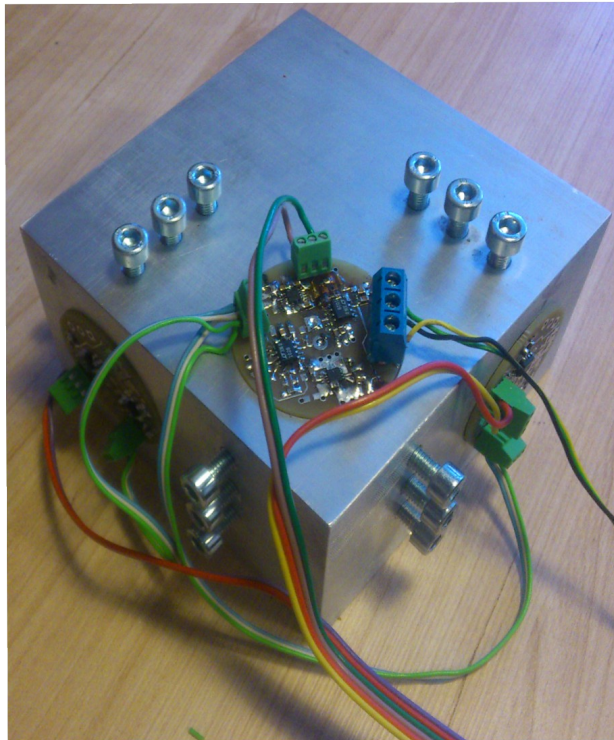
- Choice: the LGT-2.5Hz sensor
- Redesigned electronics: added accurate timing
- Currently assembling 21 units, each consisting of 3 detectors to obtain a 3D spectrum
- Will characterize them w/r to Trillium in January.

Single unit hardware



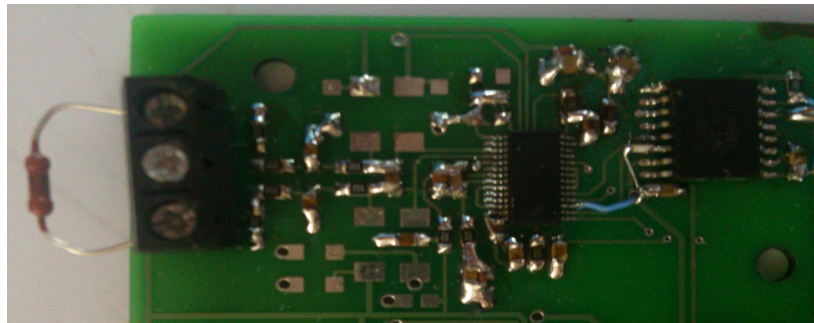
System properties

- 3x ADC, X Y Z axis
- sampling frequency 200 Hz, resolution 32 bit
- Data stored to SD card (~4 Gb per month),
32 Gb will last for 8 months

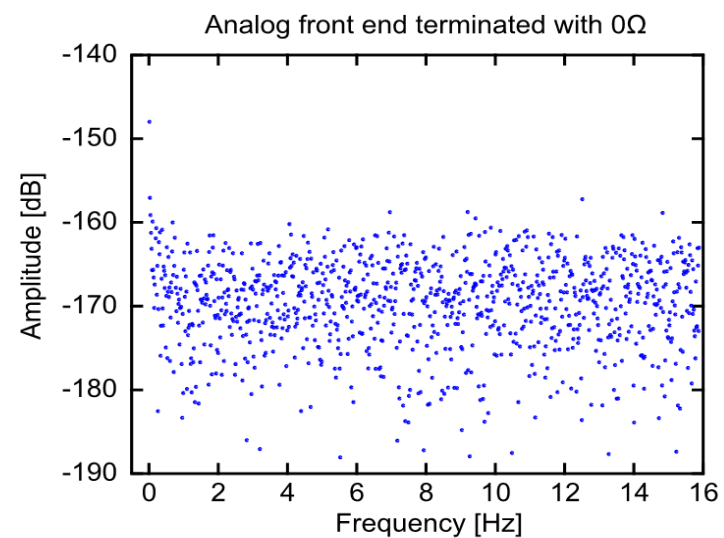


Analog Front End

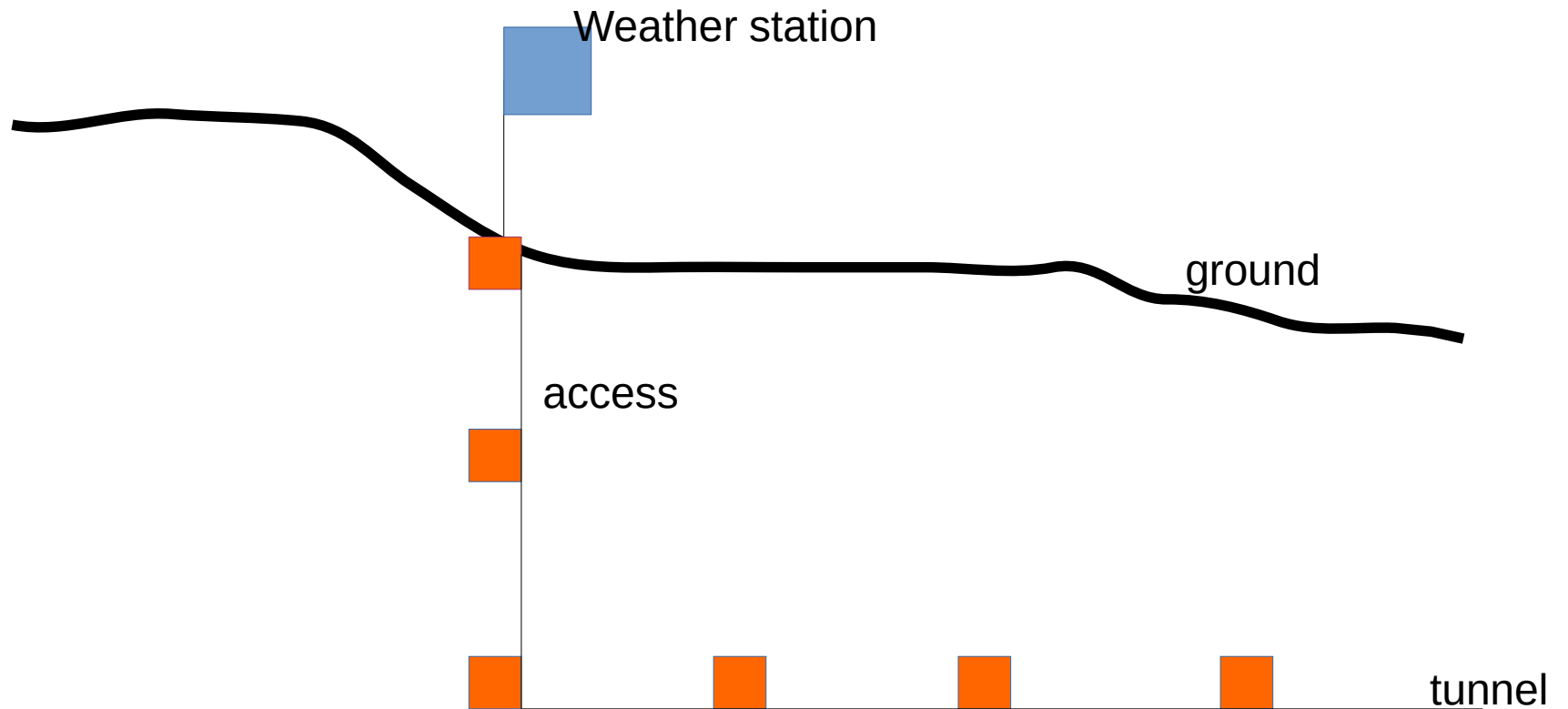
Hardware design:



Measurement:



Planned layout



 -seismometers

Conclusions

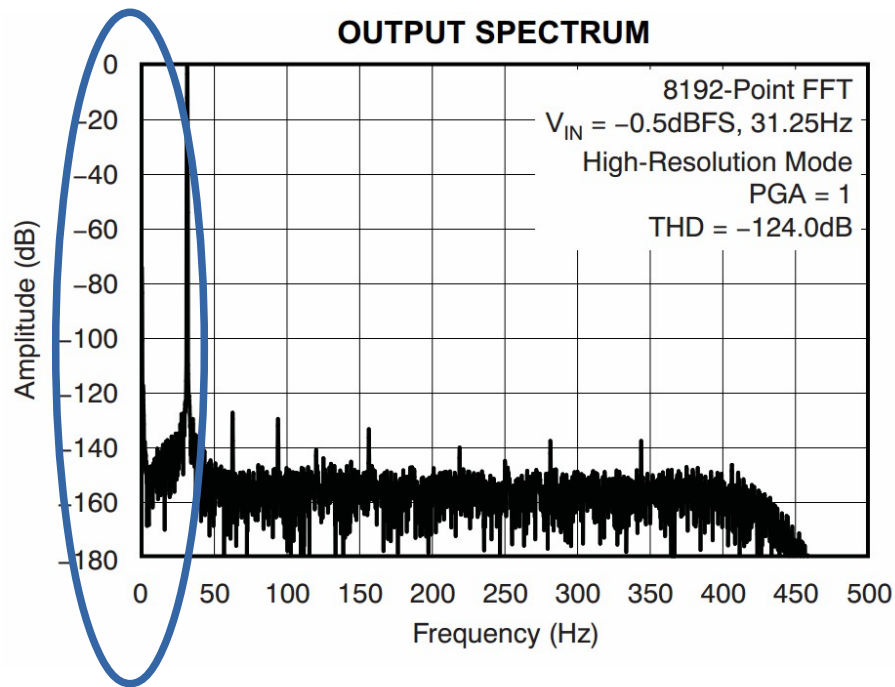
- The sensors are tested
- Currently in production phase
- We will produce three or four sets.
- Deployment early next year.
- Can be moved to other locations after gathering the data.
- Need to decide where to place them

Additional slides

High Sensitivity Analog Front End

Datasheet

Measured



160 dB analog signal resolution