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Evaluation of the new infrastructure for French Permanent Broadband Stations in Auvergne

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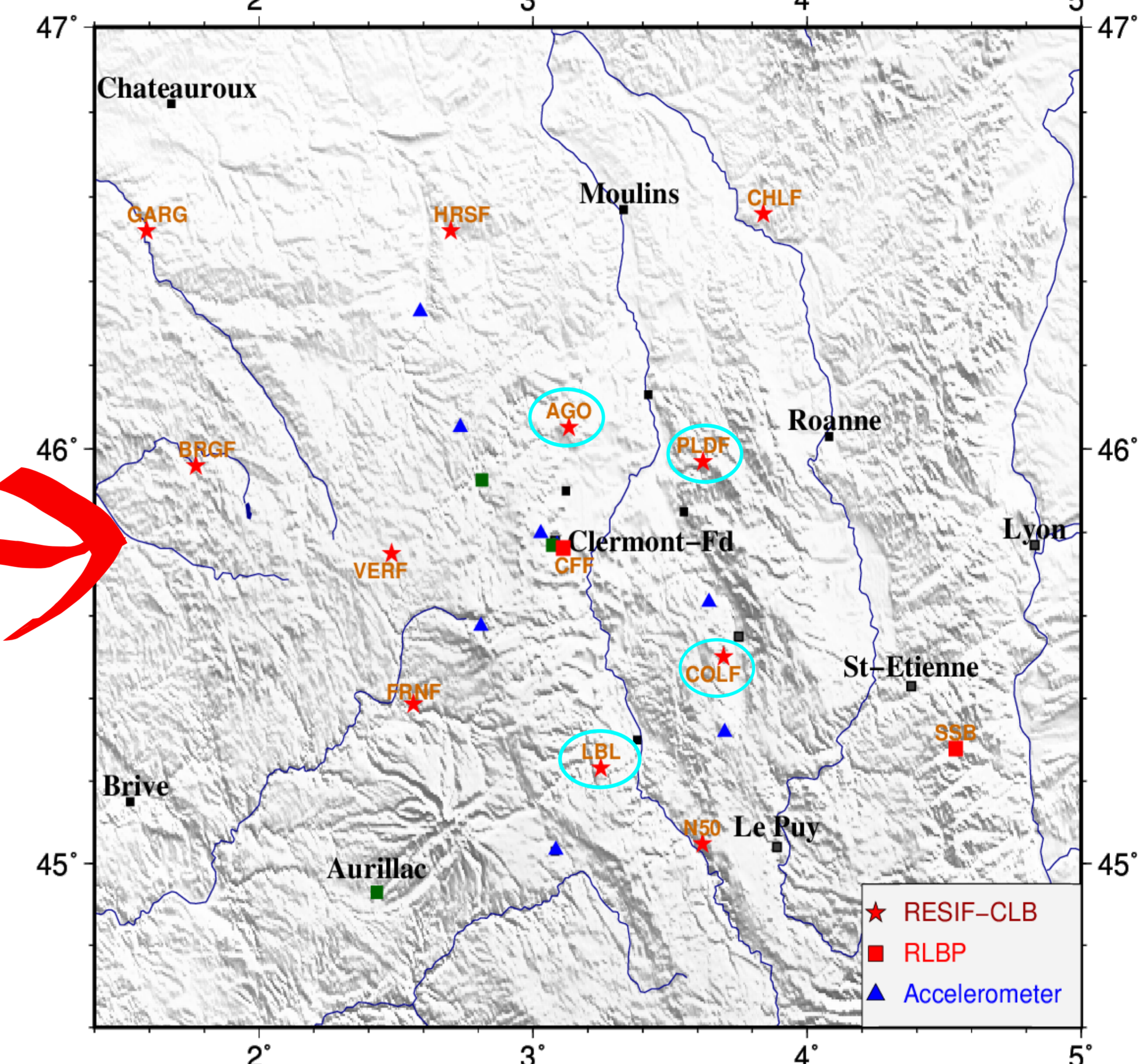
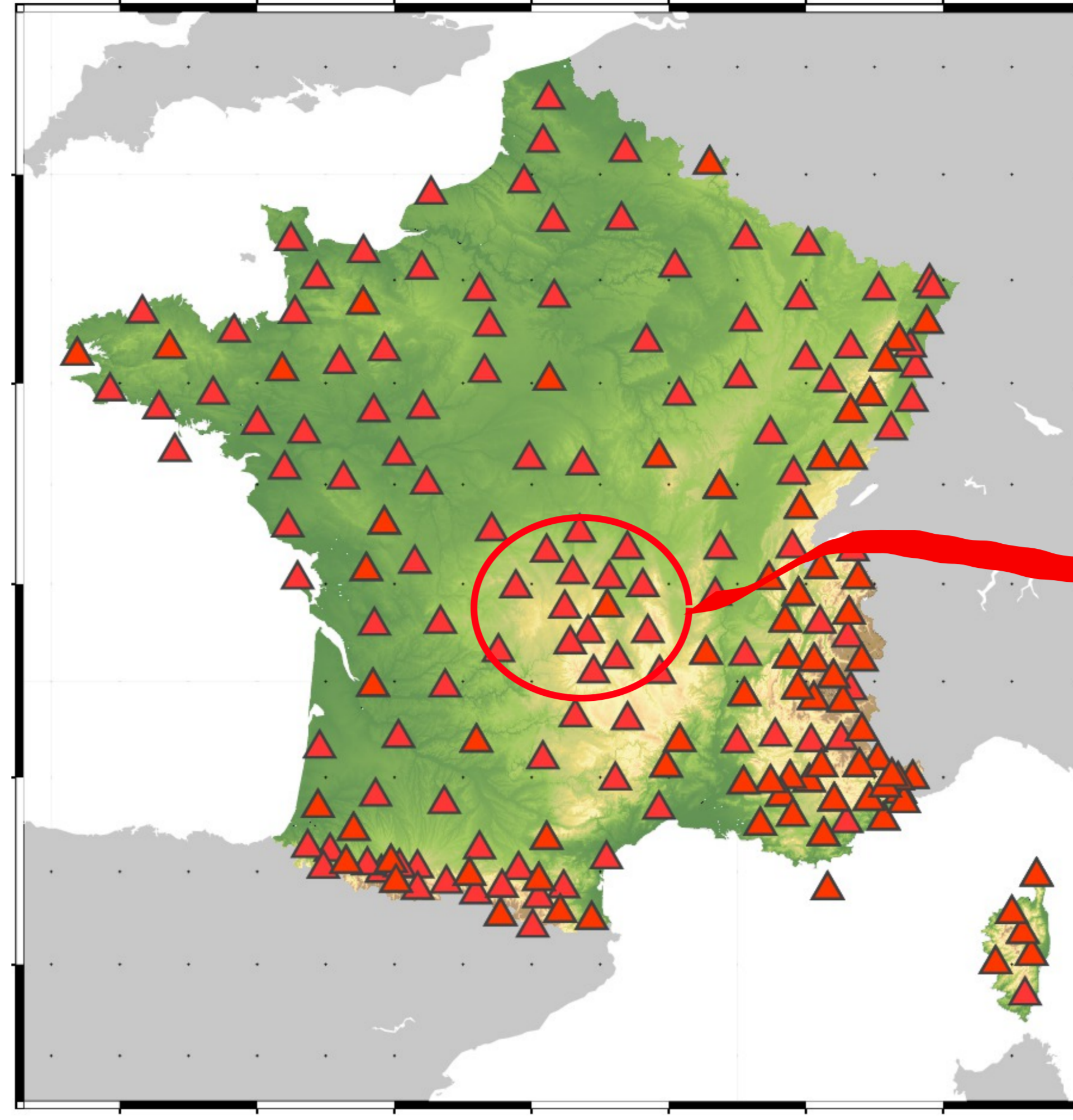
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National/Régional Network :

French seismologic and geodetic network (RESIF) is a national equipment for the observation and understanding of the solid Earth. It is an instrument aimed at acquiring new top-quality data for disciplines like seismology, geodesy and gravimetry to advance the understanding of the dynamics of our planet.

The seismology component of RESIF, with its **homogeneous coverage** of the territory, will allow **better localization** and characterization of seismic activity over a wide range of magnitudes as well as provide **high quality data** for research.

The **Auvergne Seismic Network (ASN)** manages seismic stations in the center of France since the beginning of the 80's and continuously upgrades them. Nowadays, 21 stations are deployed to monitor the Massif Central seismic activity. In the future, the ASN will include 15 broadband stations that will be part of RESIF network. In June 2017, 4 permanent seismic stations have been upgraded to the new standard installation type for open environment. The chosen infrastructure is a 5 meter drilling equipped with a posthole broadband sensor. Prior to these final installations, on each site, Trillium 120 PA have been installed for 2 temporary experiments.



Data processing :

We present comparative noise performances between the three types of installations calculated for vertical (Z) and horizontal (N) components. Experiments do not overlap. We compare probability density functions to evaluate noise levels. Spectral Power Density (PSD) uses the MacNamara and Buland method (2004). Solid lines, in the figure below, represent the median value of PSDs and dotted lines, the 10th and 90th percentiles. The shaded lines describe Peterson's New High Noise Model and New Low Noise Model (1993). Number of triggers per hour are given as an indicator of the presence of HF perturbations. We also present spectrograms to illustrate noise spectral content during windy days.

Installations :

Direct Burial

Prospecting sites. Duration : 3 weeks to 1 month

- Solar Panels : 100W
- AGM Battery : 110 Ah
- Digitizer : Q330
- Depth : 80cm
- 25 cm of sand 0/4mm
- Natural Ground
- Sensor : Trillium 120PA

Seismic Vault

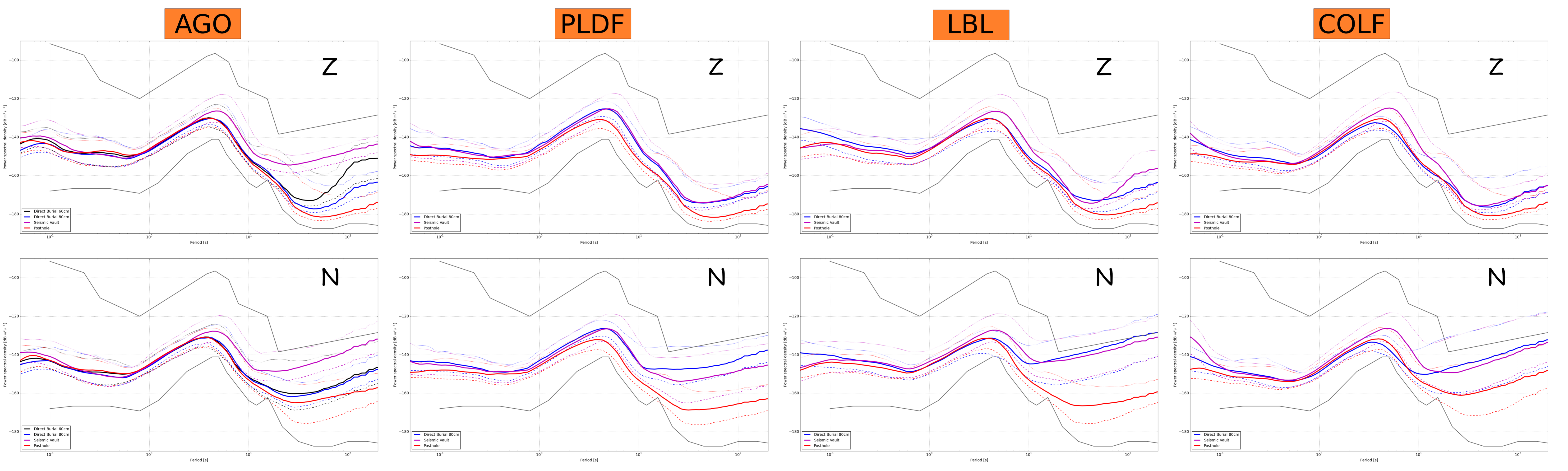
Temporary Instrumentation. Duration : 6 months

- Solar Panels : 150W
- AGM Battery : 2x 85Ah
- Digitizer : Taurus
- Depth : 0 to 80cm
- Natural ground
- Plastic container filled with rockwool for thermal insulation
- Sensor : Trillium 120PA
- Pad of concrete

Posthole

Permanent Installation, data since 3 months

- Enclosure
- Manhole for futur sensors
- Depth : 5m
- Concrete Wellhead
- Metal pipe
- Sensor in 40cm corundum
- Electrical cabinet :
 - Power supply
 - 2 AGM batteries
 - Communications : ADSL
 - Digitizer : Centaur 6
 - Sensor : Trillium 120PH



AGO station is located 1 km from a highway which was undergoing road works during the experiments, increasing seismic noise at High Frequencies (HF). At Long Periods (LP), the **posthole** sensor reduces noise by nearly 10 dB on Z and H sensors.

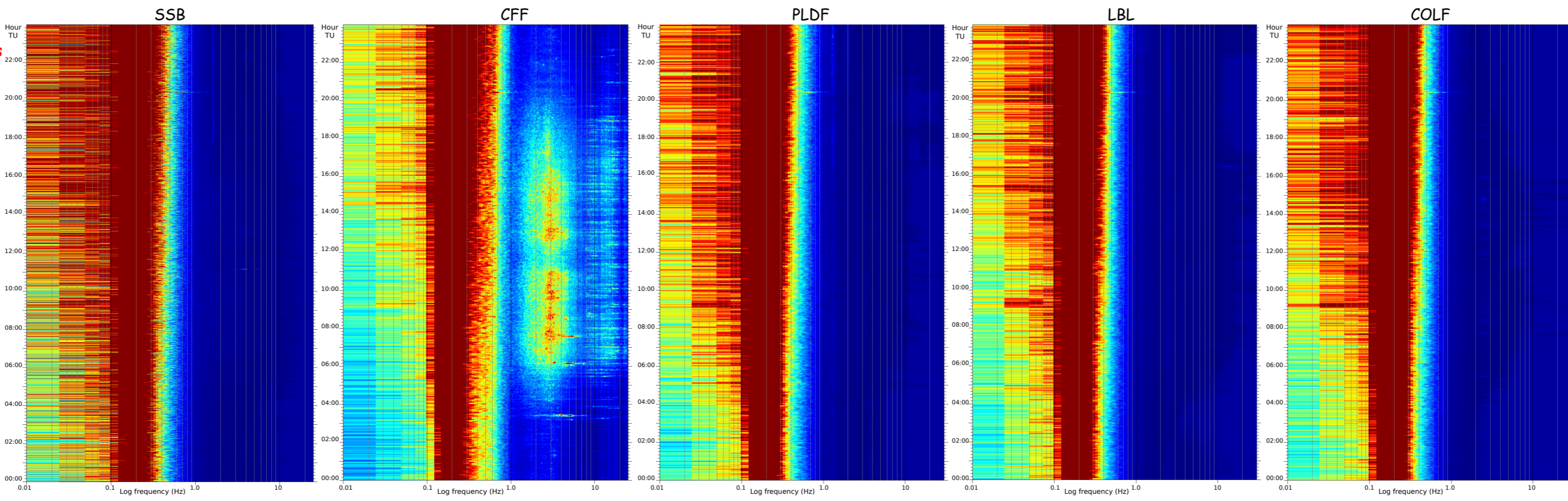
PLDF is near a 30m high mast and its oscillations (~1Hz) are not observed on PSD. The drilling allows the installation of the sensor inside dense rock, improving signal quality :
 ➤ HF : ~ 5dB on Z and H sensors
 ➤ LP : 10dB on Z sensor, 20dB on H sensors.

Due to the presence of hard bedrock at shallow depth, the **seismic vault** could not be digged deep enough. This explains the high detection rate. With the 5m drilling, the detection number stays high. Seismic signals aren't affected by wind turbines 3.5 km away.

Drilling improves COLF station signal :
 ➤ Vertical : HF : 5dB, LP : 10dB
 ➤ Horizontal : HF : 5dB, LP : 15-17dB.

Spectrograms :

A windy day (2017.11.22 - Max speed : 72km/h at 8:00 pm) was selected to compare **spectrograms** between 3 RESIF stations and two reference stations such as SSB and CFF. SSB is part of Geoscope Global Network and located in the countryside, in a granite tunnel. It is a reference station for very low seismic noise. CFF signal is very noisy at HF because, it is located in the suburbs of Clermont-Ferrand (250 000 inhabitants). Both equipments are Q330 coupled with STS-2 sensors. Spectrograms show urban noise on posthole stations only at low amplitudes. Despite the presence of :
 ➤ a 30m high mast near PLDF,
 ➤ wind generators 3.5 km away from LBL,
 ➤ surface fences at all stations,
 posthole stations offer a **great signal to noise ratio** to locate events.



Conclusion :

- ➔ RESIF installations greatly improve data quality.
- ➔ Auvergne installations on shallow bedrock are well isolated from anthropic noise.