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VARIABILITY OF HV ON NOISE AND EARTHQUAKE DURING THE SEISMIC SEQUENCE OF MW 7.2 NIPPES, HAITI, EARTHQUAKE (AUGUST 14TH, 2021)

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CONTEXT and GOAL :

Soon after the Mw 7.2 earthquake that struck the southern part of Haiti on August 14th 2021 (Calais et al., 2022), 12 broad band stations were installed to complement the permanent network and record the aftershocks sequence (Douilly et al., 2023; Paul et al., 2023).

We take advantage of this dataset to investigate, for the first time, the site resonance frequencies in the southern peninsula by means of the Horizontal-to-Vertical spectral ratio analysis (H/V) on continuous noise and on earthquakes (Vassallo et al. 2023). We also aim to analyse the variability of H/V with time and its dependence on the shaking level (Vassallo et al., 2022).

SEISMOTECTONIC CONTEXT

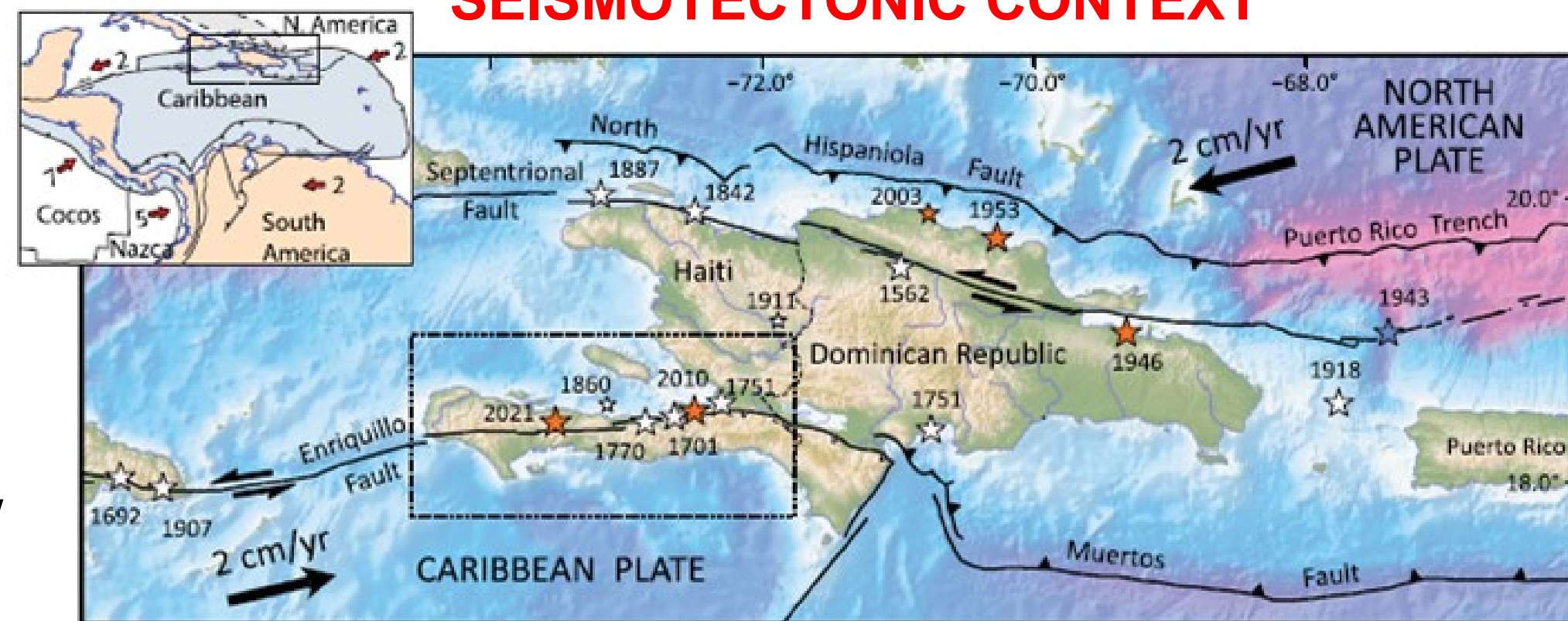


Fig. 1 - Seismotectonic context of the Caribbean–North American plate boundary: main active faults are shown with black lines; stars indicate major destructive historical (white) and instrumental (red) earthquakes; large arrows show the relative motion between the Caribbean and North American plates (modified from Calais et al., 2022). The black dashed rectangle displays the area shown in Fig.2.

The August 14th 2021, Mw 7.2, Nippes earthquake struck southern Haiti 11 years after the devastating Mw 7.0 in 2010.

SEISMIC NETWORKS & AVAILABLE DATA

At the time of the 2021 sequence, 3 seismic networks were installed in the area:

- Vertical short-period and 3-components accelerometric low cost sensors as part of a citizen seismology experiment (HY) (Paul et al., 2023);
- Broad-band permanent stations managed by Bureau de Mines et de l'Energie in Haiti (CN);
- Broad-band temporary network, deployed after the Nippes earthquake (Z2) (Douilly et al., 2023)

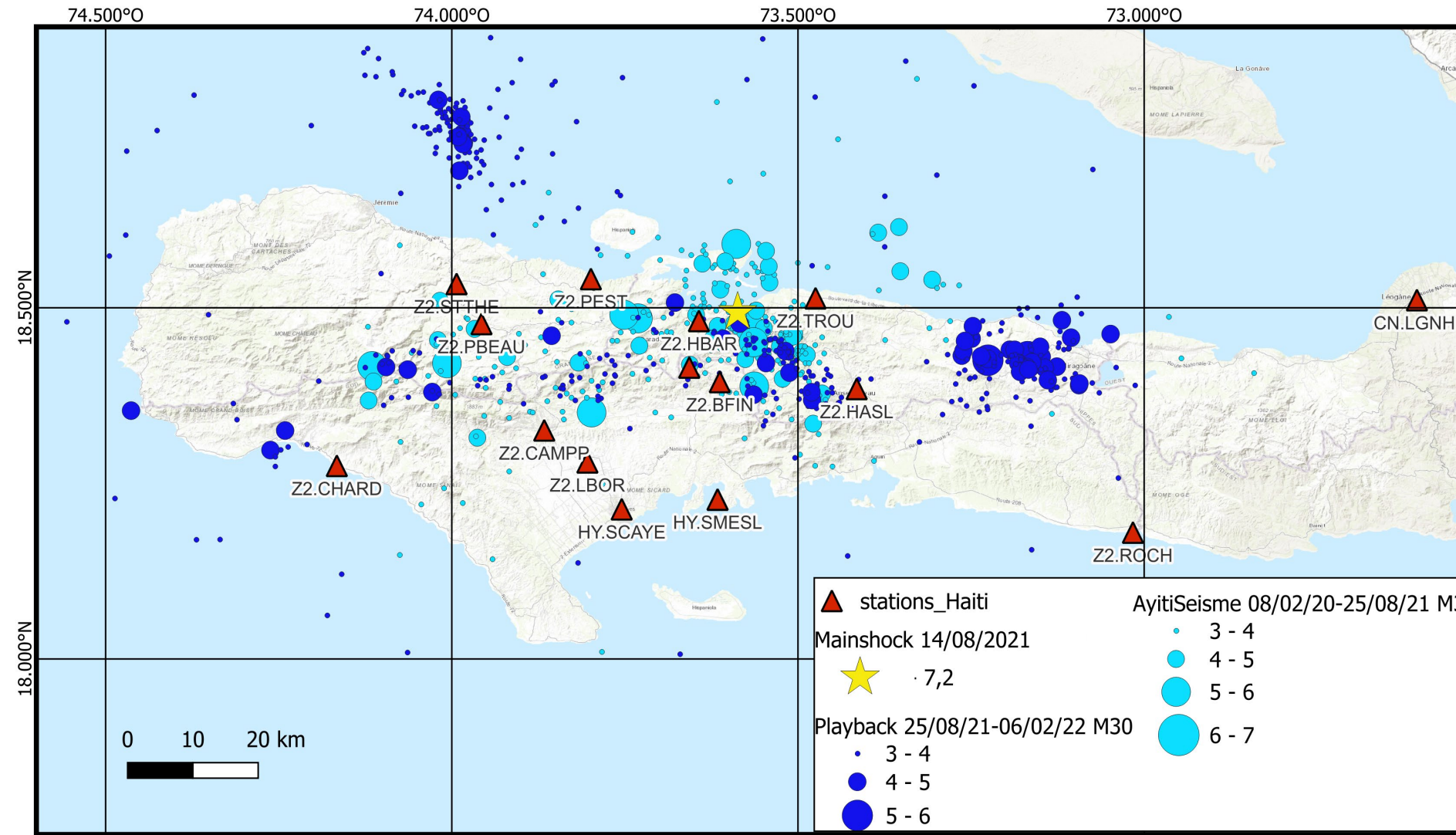


Fig. 2 - Map of seismic stations and earthquakes used in this study.

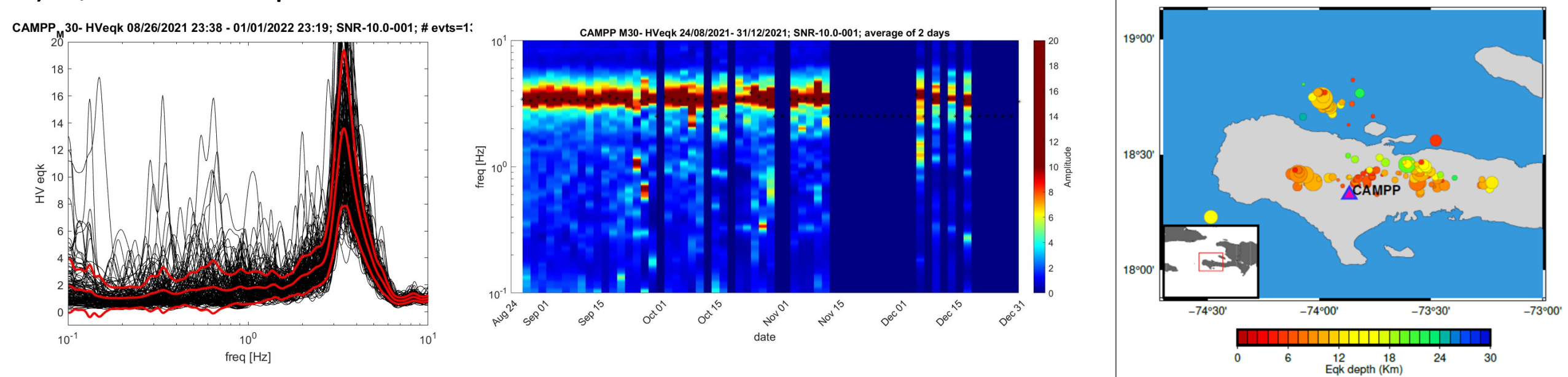
Earthquakes data have been selected by using two catalogs in the area delimited in Latitude [17, 19] and Longitude [-75, -73], in the period from 1/1/2020 to 24/08/2021 (Cat_AyitiSeisme) and from 25-08-2021 to 06-02-2022 (Cat_playback), from magnitude 3.0 and above. For HY stations only we considered the threshold of M 4.0 because of the low resolution of Mems sensors.

APPROACH

We compute at H/V on noise continuous data and earthquakes and represent it with time

CAMP : A station with a narrow and strong peak of amplification but several outage periods

a) H/V on earthquakes



b) H/V on noise (average)

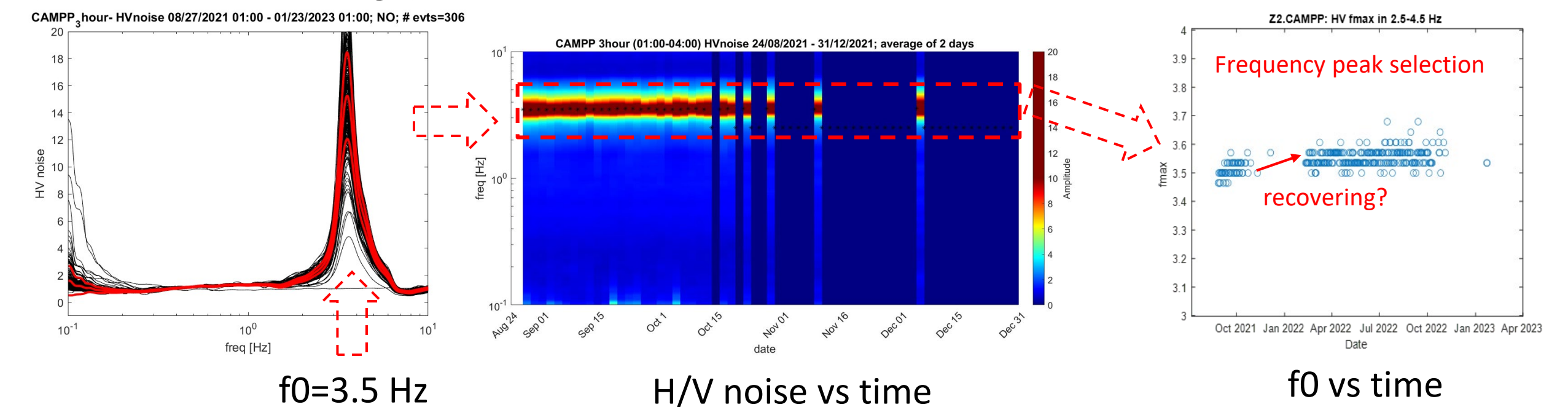
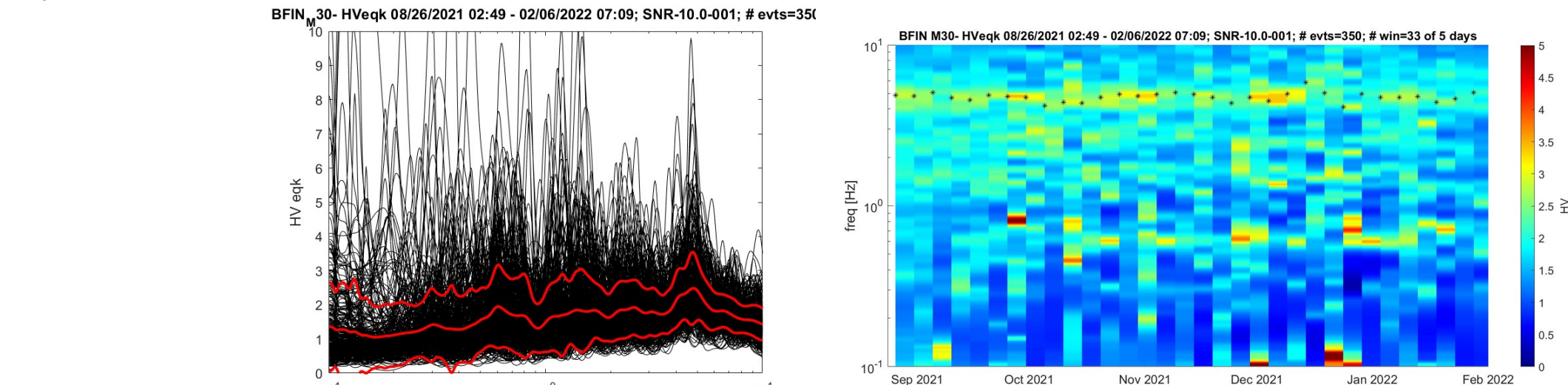


Fig. 3 - Example of H/V analysis at CAMPP station (Z2 network) for a) earthquakes signals and b) noise continuous data.

BFIN : A station with very good operability but a weak peak of amplification

a) H/V earthquakes



b) H/V noise (average)

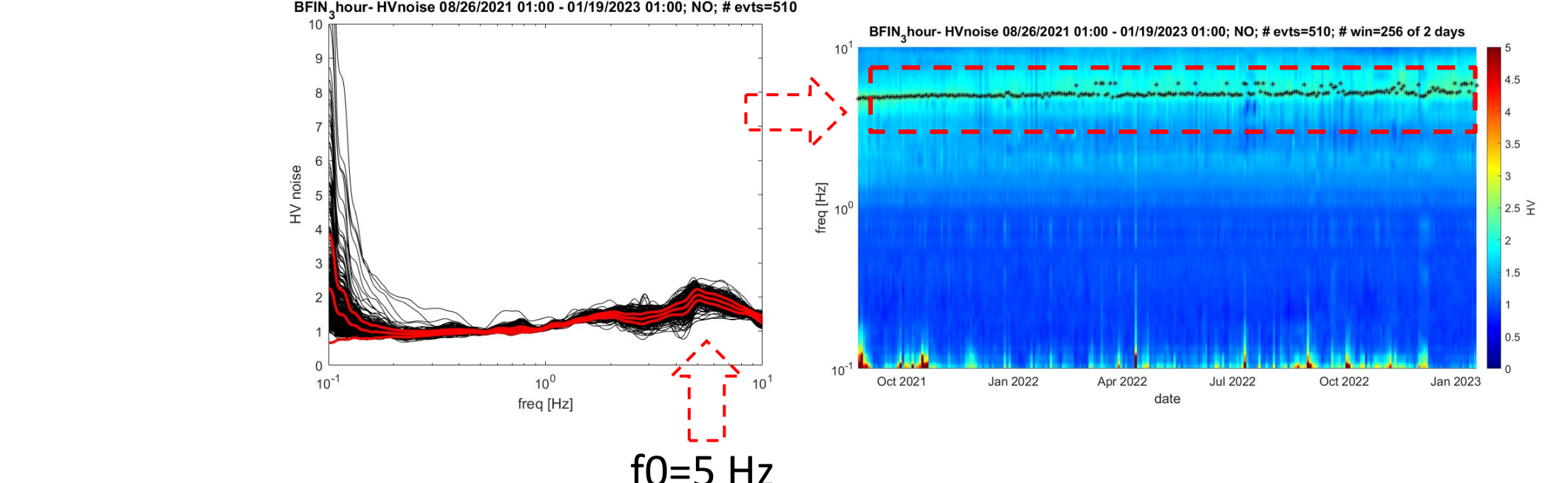


Fig. 4 - Example of H/V analysis at BFIN station (Z2 network) for a) earthquakes signals and b) noise continuous data.

PRELIMINARY RESULTS : Site Effects

- Some stations exhibits a clear amplification at frequencies from 0.6 to 5 Hz of engineering interest (HBAR, HASL, CHARD, CAVA, CAMP)
- Good stability of the results using noise

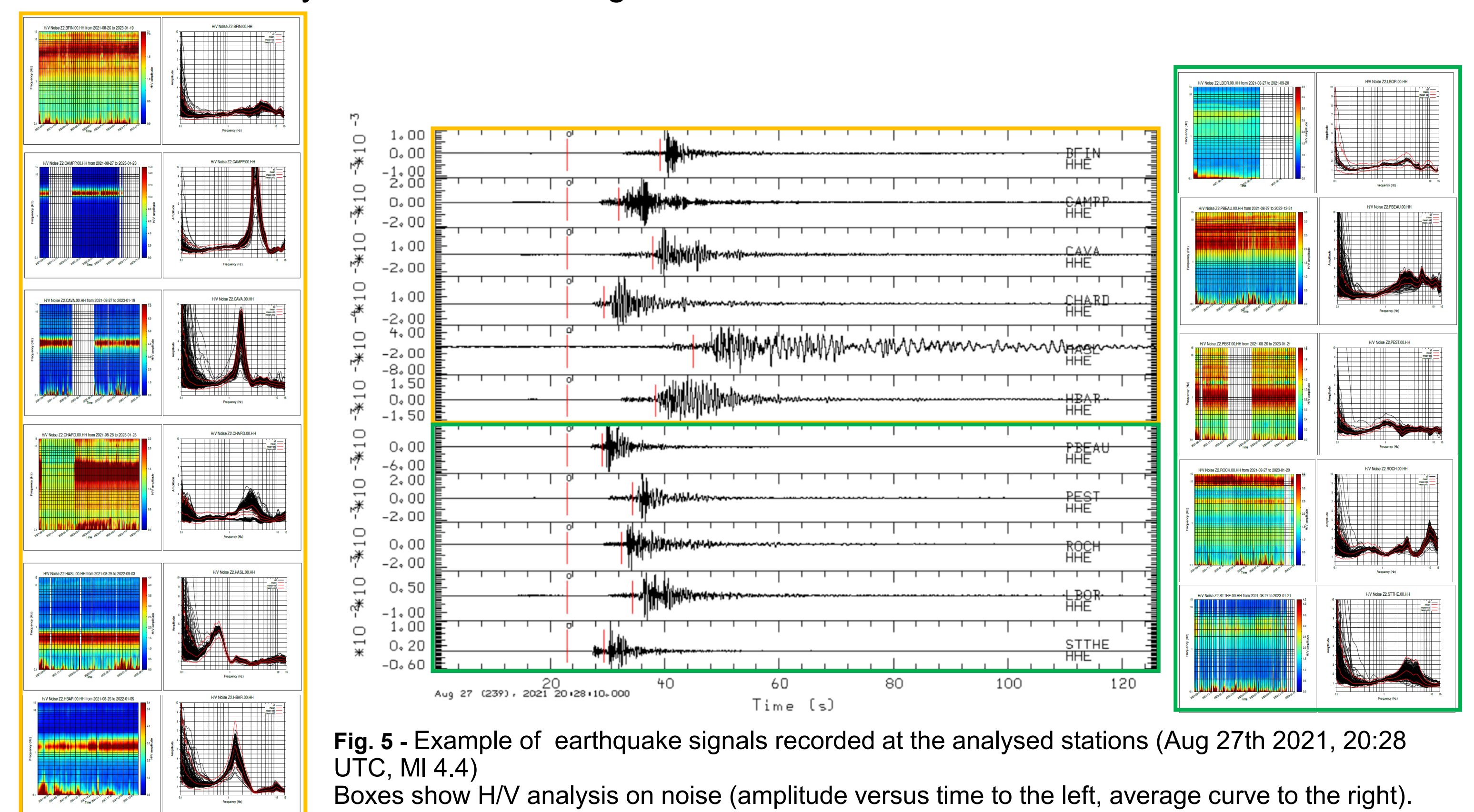


Fig. 5 - Example of earthquake signals recorded at the analysed stations (Aug 27th 2021, 20:28 UTC, MI 4.4) Boxes show H/V analysis on noise (amplitude versus time to the left, average curve to the right).

PRELIMINARY RESULTS : Frequency peak (f0) variability

Possible recovering with time for peak frequency at CAMPP(3.5 Hz) and BFIN (5 Hz)

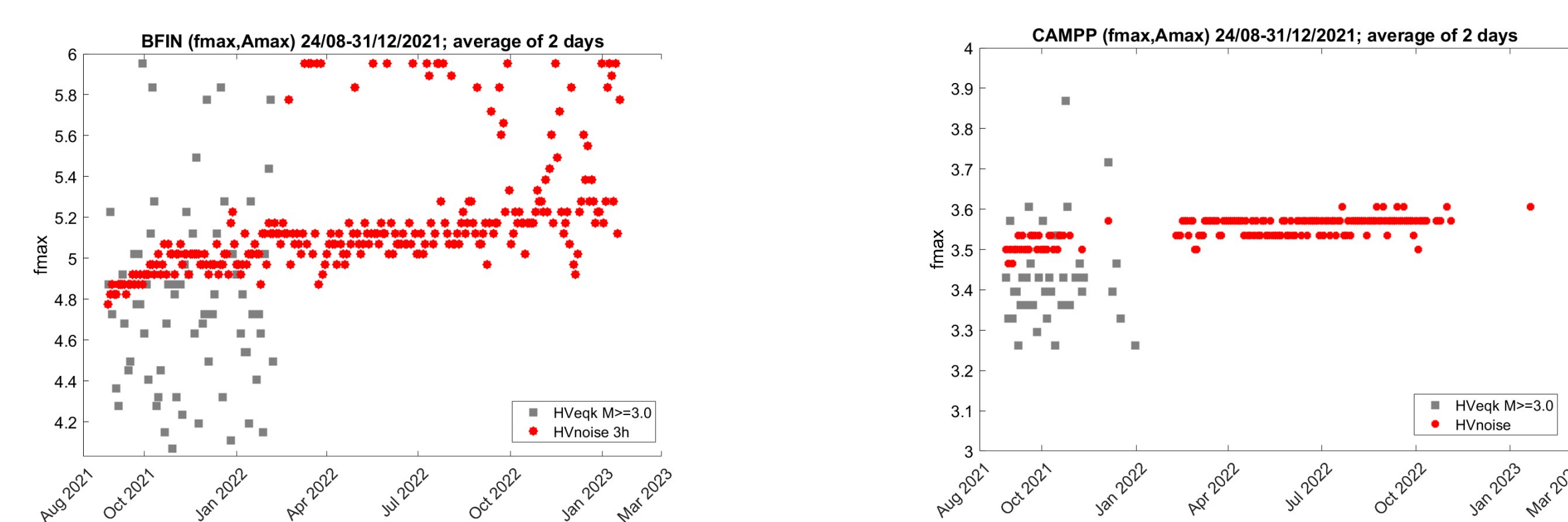


Fig. 6 -Variation of the value of the frequency Peak with time using noise (red) and earthquakes (grey) at stations BFIN and CAMP

Remarks :

- Earthquakes results (grey squares) show a large variability due to the lack of data
- Few recordings available before the mainshock, making it difficult to define the behavior of the ground before and after the strong shaking
- Seasonal variability is also not evident because of the absence of winter/summer seasonality at these latitudes.

CONCLUSIONS

- **Clear amplification effects on several stations**, which certainly increased the level of damages caused by the mainshock and the large aftershocks
- **The use of noise is more stable than earthquakes** for f0 determination (too few earthquakes well recorded at most of the stations)
- **Small evidences of recovering with time for peak frequency** at CAMPP(3.5 Hz) and BFIN (5 Hz)

→ The study of frequency peak variability with time needs a stable network that provides continuous data availability

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