Seismic monitoring with DAS at the Irpinia NFO

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Irpinia Near-Fault Observatory

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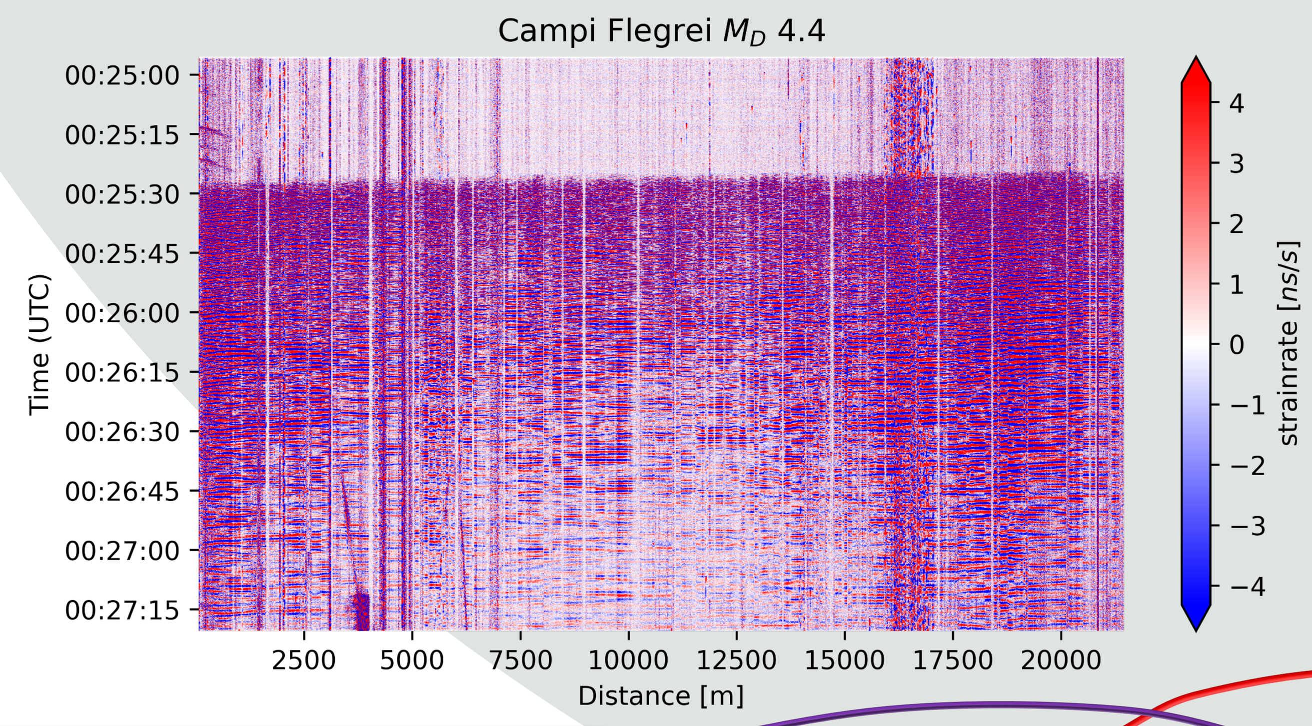
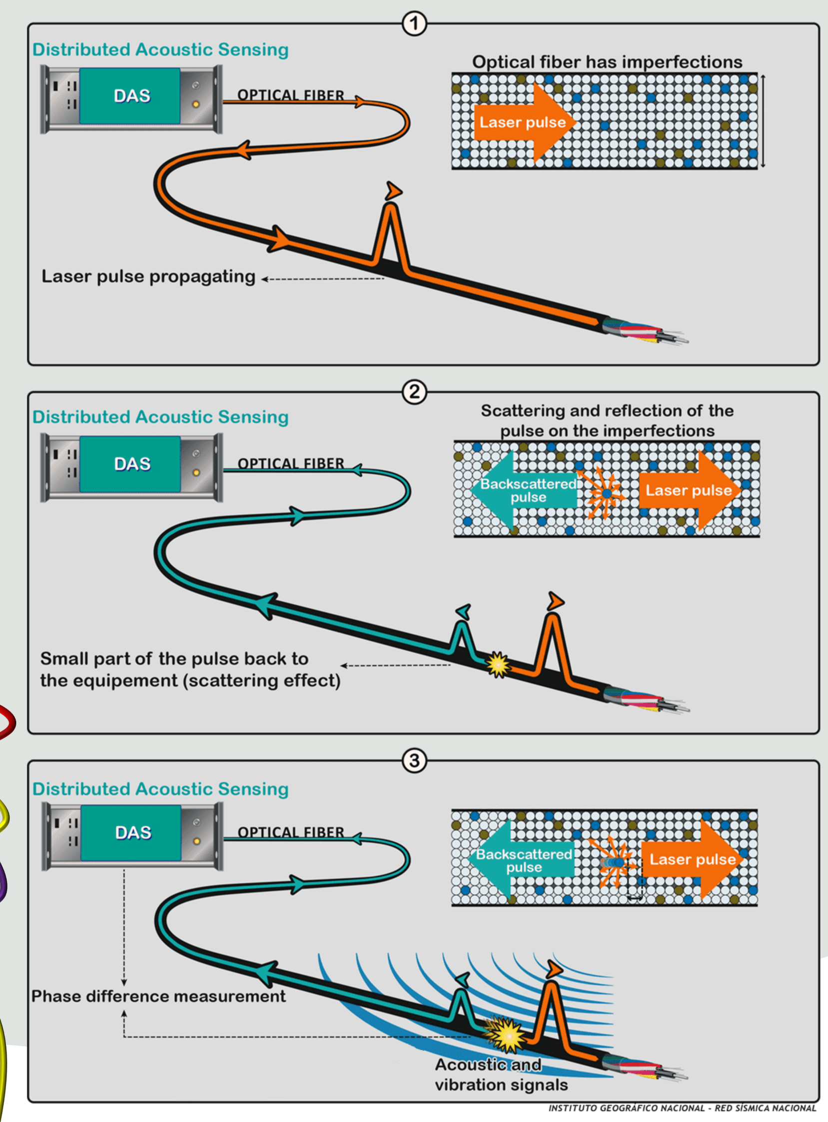
Distributed Acoustic Sensing is a novel technique that allows to turn **fiber optic cables** into linear deployments of single component sensors, giving **space-time continuous recordings** of earthquakes.





From Linsdey et al., 2020

What information can we get from DAS amplitudes?

From space integration of DAS strain rate data we can get a reliable displacement representation of the wavefield after spatial mean removal (Trabattoni et al., 2023) and time integration. This leads to the **possibility of estimating local Magnitudes using DAS** (*Figure 1*). **Displacement enhances fast waves**, while strain domain measurements are dominated by slow scattered waves. The conversion quality depends on the rectilinearity of the cable.

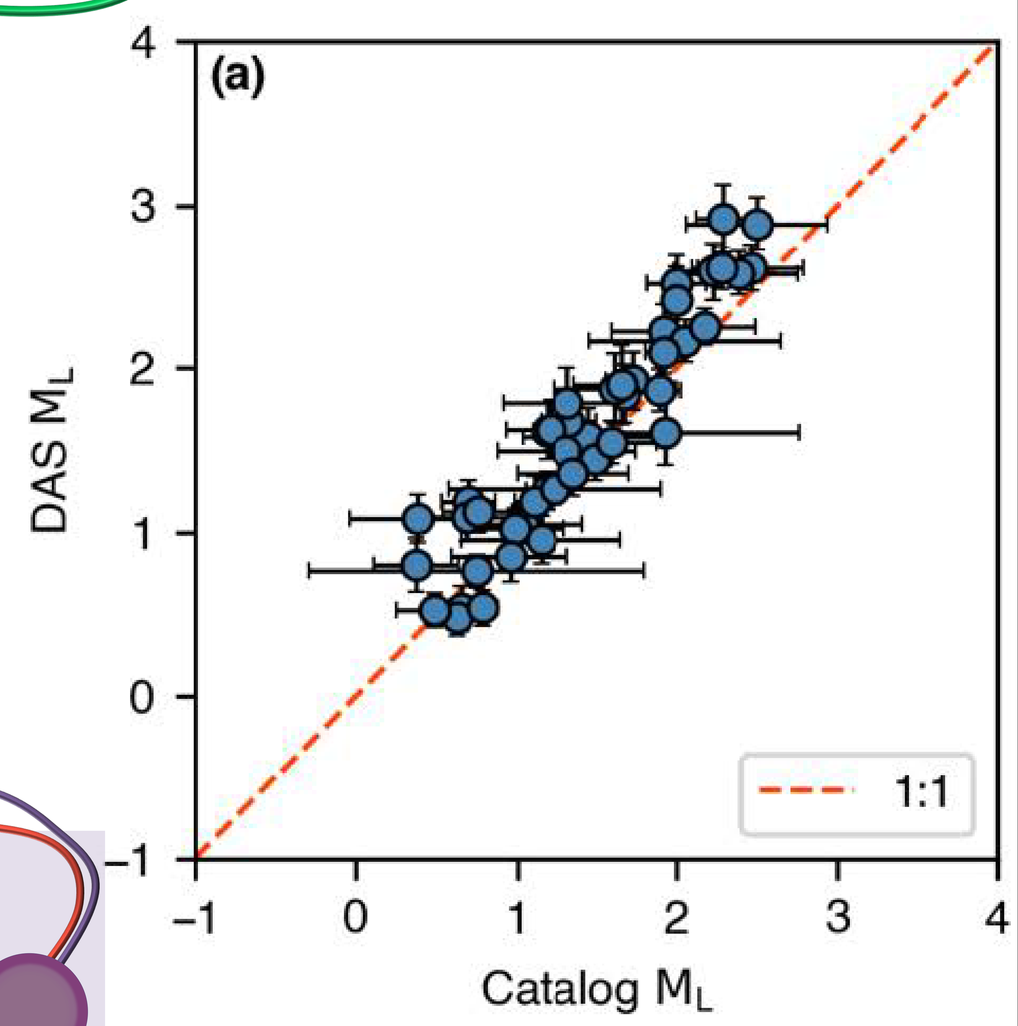


***Figure 1**: Comparison between M_L estimations using DAS and from standard seismometers at the Irpinia Near Fault Observatory. From Trabattoni et al., 2023.*

Modeling the amplitude spectra in the strain domain allows for **estimation of moment magnitude and source size** (*Figure 2*).

$$\xi^{FF,S}(r,f) = \frac{R^{FF,S}_{\theta\phi,ii}}{8\pi\beta_H^{5/2}\beta_R^{3/2}}\frac{1}{r}S(f;M_0,f_c)A(r,f;Q,k^c)$$

- β_R, β_H are the velocities at the receiver and at the hypocenter, respectively.
- $R^{FF,S}_{\theta\phi,ii}$ represents the S-wave radiation pattern for the DAS
- $B^{FF,S}_{\theta\phi}$ represents the S-wave radiation pattern in the displacement formulation

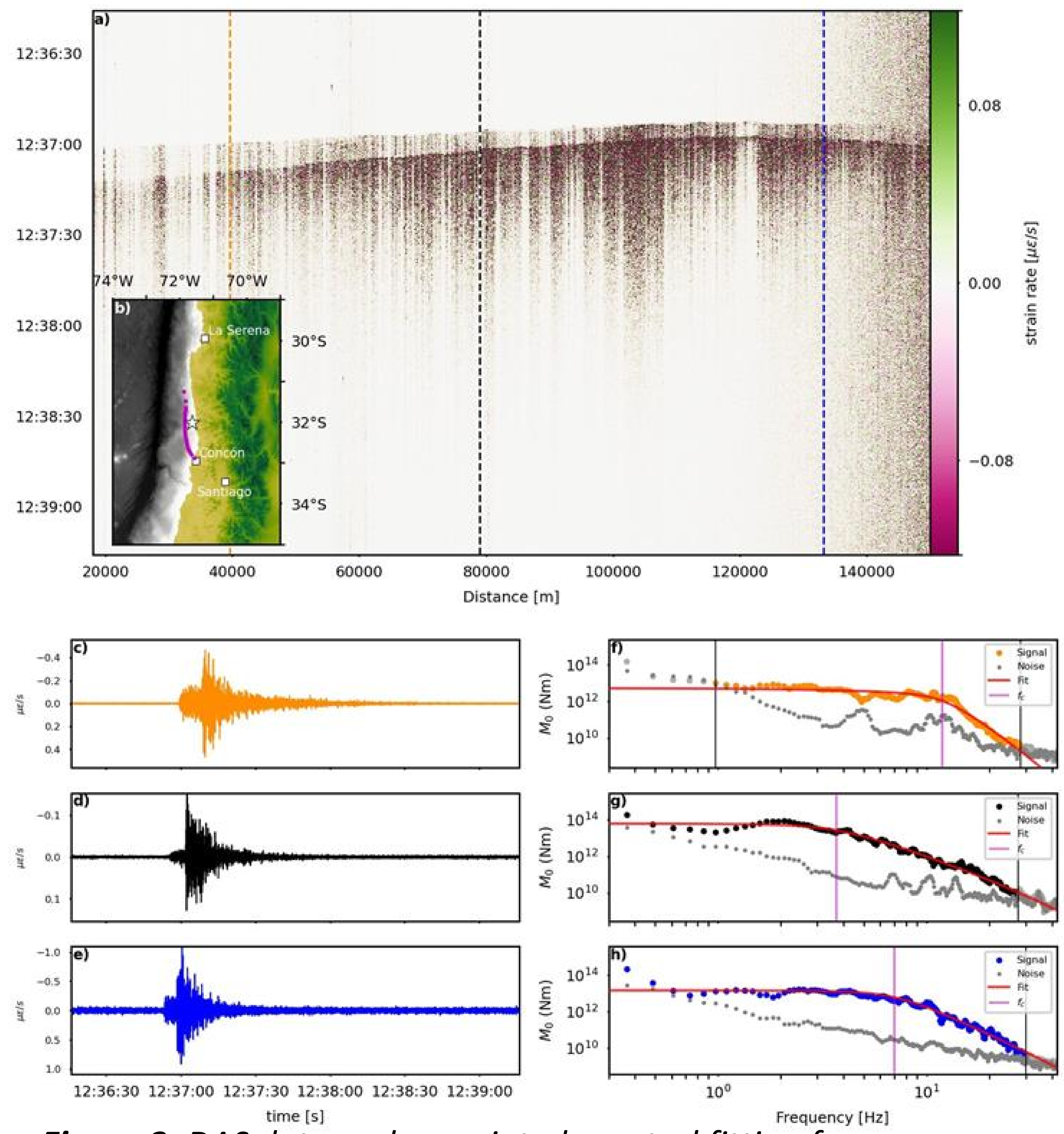


***Figure 2**: DAS data and associated spectral fitting for source parameter estimation. From Strumia et al., 2024.*

Peak amplitudes of DAS data in the first seconds of recordings carry the information on earthquake size, **making DAS a powerful asset for Earthquake Early Warning**, especially in offshore settings (*Figure 3*). Magnitude information is also contained in **secondary P to S converted waves**, which DAS is more sensitive to as compared to direct P waves.

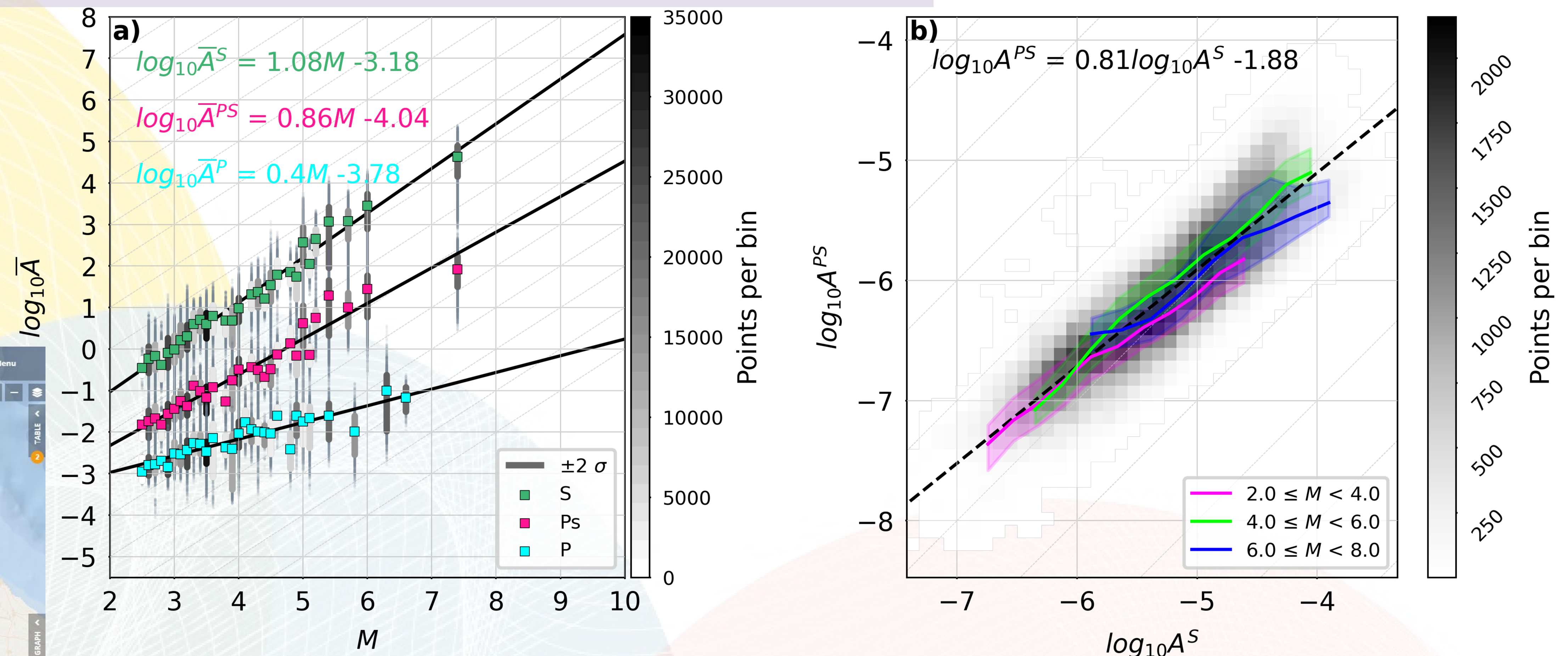


***Figure 3**: DAS peak amplitude scaling with magnitude (a) and relationship between peak amplitude of converted P to S waves and S wave peaks. (Strumia et al., 2025, in prep)*

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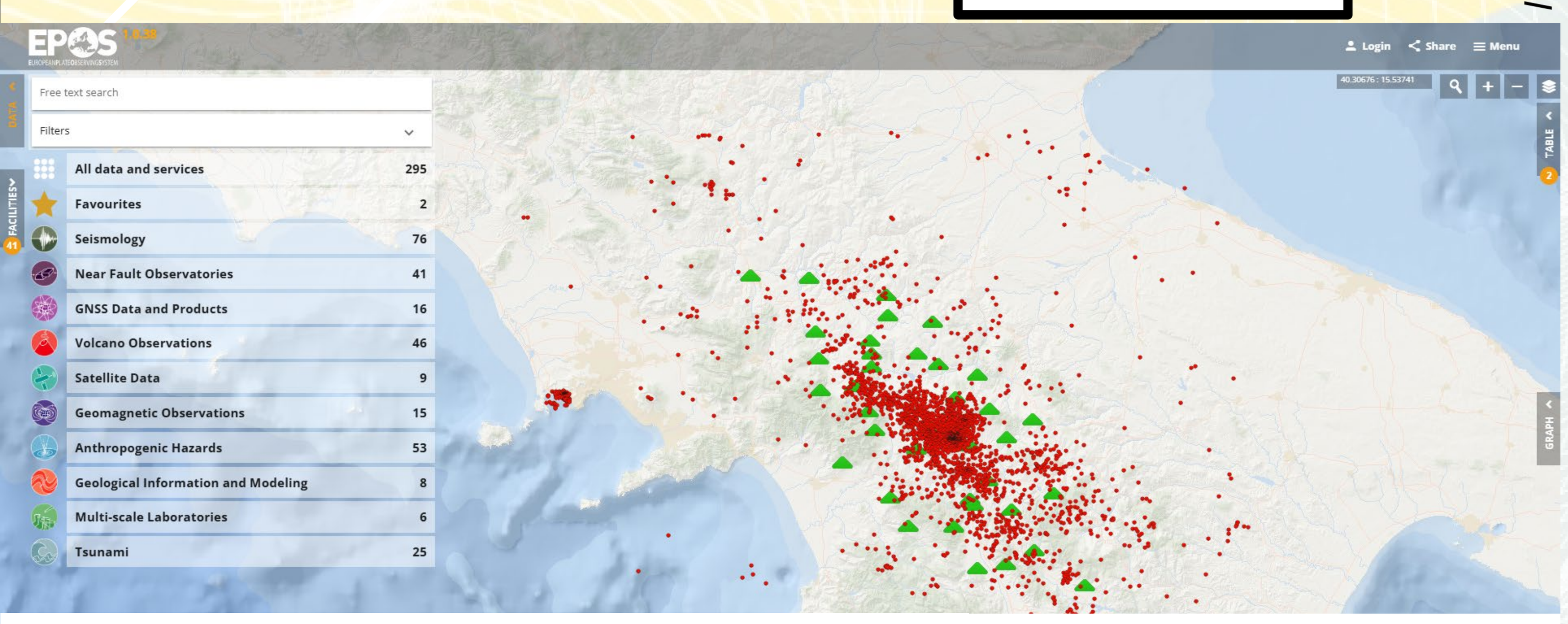

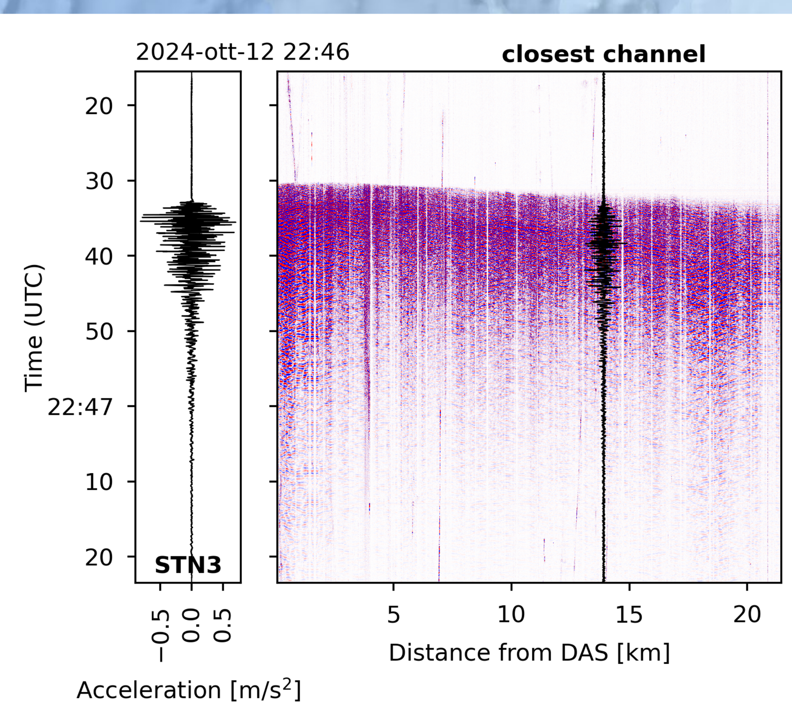

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