ECHO Project

Multi-parameter calibration of the GeoLab DAS fibre, Madeira, Portugal

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OPTODAS
NEKAPI
Seismometer to link ground motion
WAVE BUOY
AQUA
DEPLOYED: 28/04/2026
ADCP and wave buoy to link waves and currents
Ship noise
Whale calls
Internal tides
DORY
CTD to link density and temperature
GLOWY
Earthquakes and T-waves
OBS to link ground motion, temperature, and pressure
NEMO
Madeira Island
GEOLAB

The problem:

$$\varepsilon_{ap} = \underbrace{g(\theta, GL)C(t_a)a(t_a)\varepsilon}_{\text{Strain term}} + \underbrace{\alpha\beta\Delta T}_{\text{Temperature term}} + \underbrace{J(t_p)(p_S + p_T)}_{\text{Pressure term}}$$

Apparent strain is not strain

Where?

GeoLab, a single 56 km-long dark optical fibre exclusively used for scientific purposes

Why?

Distributed Acoustic Sensing (DAS) is capable of extremely high spatial and temporal sampling rates, and offers a completely new perspective into Earth and Ocean dynamics

But DAS exhibits non-linear cross-sensitivity to strain, temperature, and pressure; decoupling these contributions is essential for reliable quantitative interpretation

Accurate local transfer functions enable absolute calibration and robust separation of the underlying physical fields at discrete positions

What?

Seismology

Transfer functions for ground motion using OBS and broadband land stations

DAS seismic waveforms portfolio based on fibre earthquake detections and catalogue events

T-wave source locations

Soundscape

Labelled whale calls catalogue

Detection algorithms tailored to the GeoLab fibre

Etology and population density estimates

Outreach

Scientific engagement activities tailored to Year 5 students, including instrument naming (NEMO, DORY, GLOWY, AQUA, and NEKAPI)

Promoting awareness of Earth Sciences and environmental conservation

Oceanography

DAS proxies for wave height and current velocity based on transfer functions between ADCP measurements and apparent strain

Transfer functions for temperature based on CTD and OBS data

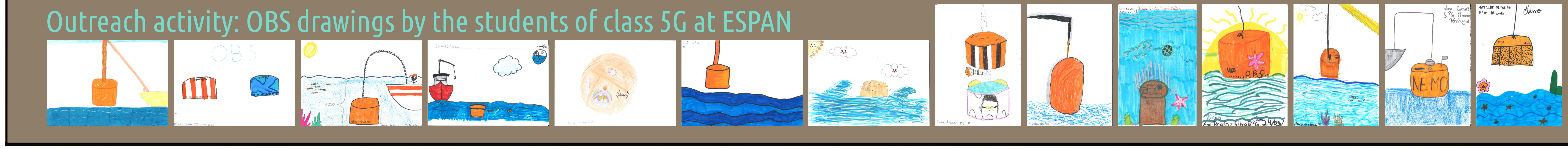
How?

Transfer functions determined from correlation between DAS and reference instruments

A short duration exploratory project to characterize sections of the GeoLab fibre in terms of ground motion, temperature and pressure response

Aimed at better integrating DAS data with the models and datasets produced at Madeira's Oceanic Observatory

Outreach activity: OBS drawings by the students of class 5G at ESPAN



This work is supported by the ECHO project - Earthquakes, Hydroacoustics, Currents and Oceanography with Distributed Acoustic Sensing (DOI: 10.54499/2024.13655.PEX), by FCT, I.P./MCTES through national funds (PIDDAC) (LA/P/0068/2020 - DOI: 10.54499/LA/P/0068/2020, UID/50019/2025 - DOI: 10.54499/UID/50019/2025, UID/PRR/50019/2025 - DOI: 10.54499/UID/PRR/50019/2025, UID/PRR2/50019/2025 - DOI: 10.54499/UID/PRR2/50019/2025), and by the European Union (NextGenerationEU) (UID/PRR/50019/2025 - DOI: 10.54499/UID/PRR/50019/2025, UID/PRR2/50019/2025 - DOI: 10.54499/UID/PRR2/50019/2025) and (SUBMERSE, GA 101095055). Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

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Funded by the European Union
NextGenerationEU