Job Offer

Foundation Models for Seismology Using Distributed Acoustic Sensing

Scientific context

Advances in fibre-optic distributed acoustic sensing (DAS) are transforming seismological observations by enabling dense, continuous measurements of ground deformation along fibre-optic cables over tens of kilometres. These systems generate vast amounts of data, capturing signals from earthquakes, landslides, volcanic activity, oceanic processes and anthropogenic sources. However, much of the data remains unexplored because many traditional seismological workflows rely on supervised detection and predefined event classes. Recent advances in self-supervised and generative artificial intelligence offer new opportunities to learn general representations from large unlabelled datasets, enabling the systematic exploration of continuous seismic observations beyond known signal classes.

This research is part of **GenAI4Earth**, a Horizon Europe project developing generative AI tools for Earth sciences and deploying them as services within the European Open Science Cloud (EOSC).

Objectives

The project aims to develop a foundation representation model for large-scale fibre-optic DAS observations, capable of learning transferable representations across heterogeneous geophysical environments, both on land and offshore. Combining self-supervised and federated learning, the research will enable AI-based exploration, detection, characterisation and monitoring of continuous Earth system observations. The resulting tools will be integrated into EOSC infrastructures, including AI4EOSC and the Data Terra EOSC Node.

Research tasks

1. Self-supervised and federated representation learning for fibre-optic DAS data

Develop self-supervised approaches to learn transferable representations from large-scale DAS observations acquired in marine, volcanic, mountainous and urban environments. The objective is to extract meaningful representations directly from continuous waveforms without extensive manual labelling. Particular attention will be given to the transferability of learned representations across different observational contexts. Federated learning strategies will be developed and

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evaluated to enable collaborative model training across distributed DAS datasets held by different institutions, without requiring the centralisation of raw data.

2. AI-native discovery and exploration of environmental seismic signals

Use the learned representations to explore, organise and retrieve signals from continuous DAS datasets. This includes identifying recurrent patterns, discovering previously unrecognised signal classes and developing searchable representations of seismic and environmental activity. These approaches will support automated exploration and the construction of large-scale catalogues across diverse geophysical environments.

3. Towards a foundation representation model for environmental seismology

Develop a scalable, context-aware foundation model for DAS observations, supporting downstream applications such as seismic event detection, anomaly detection, signal classification, data compression and AI-assisted data exploration. Model distillation and optimisation will be investigated to facilitate deployment in operational workflows. The resulting framework will contribute to pilot AI services within the GenAI4Earth portfolio, integrated into the EOSC ecosystem.

Data and collaborations

The candidate will work with large-scale DAS datasets acquired across different geophysical environments, including submarine fibre-optic observations.

The research will involve an international collaboration between the Spanish National Research Council (CSIC), the French National Centre for Scientific Research (CNRS/EOST and Data Terra), the GFZ Helmholtz Centre for Geosciences and IFREMER, combining expertise in seismology, signal processing, artificial intelligence and research infrastructures.

Candidate profile

We seek a highly motivated candidate with a strong background in data science, artificial intelligence, signal processing, geophysics or applied mathematics, and an interest in applying AI to Earth and environmental sciences.

Candidates should hold a Master's degree (or equivalent) in a relevant discipline and demonstrate strong programming and data analysis skills. Experience with deep learning architectures, such as transformers, autoencoders, contrastive learning or generative models, would be highly valuable. Familiarity with seismic or geophysical data is appreciated but not mandatory.

Scientific curiosity, autonomy and the ability to collaborate in an international, interdisciplinary research environment are essential.

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The offer

The position offers a 28-month research programme at two institutions, comprising:

- 16 months at ICM-CSIC, Barcelona, Spain.
- 12 months at CNRS/EOST, Strasbourg, France, following the CSIC appointment.

Expected starting date: January 2027, subject to completion of the recruitment procedures.

The two phases will involve successive full-time employment contracts under the respective institutions' recruitment procedures. The definitive job title should match the category approved by CSIC and CNRS. Salary and benefits will follow the applicable CSIC and CNRS employment conditions.

Indicative gross annual salary: €40,245 at ICM-CSIC.

The work will be **co-supervised** by Jean-Philippe Malet and Clement Hibert (at CNRS), Arantza Ugalde (at CSIC) and Valentina Protopopova-Kakar, Wolfgang zu Castell and Lucas Paul von Chamier (at GFZ). Collaborations with Florian Lepape (Ifremer) are foreseen.

The candidate will benefit from access to diverse DAS observations, complementary scientific expertise and opportunities to develop reusable open-science tools within the GenAI4Earth project.

Application procedure

The candidate should send a detailed CV and a letter of motivation to a.ugalde@icm.csic.es. Applications will be reviewed upon receipt, and shortlisted candidates will be invited for an interview. The selected candidate will be required to complete the relevant CSIC recruitment procedures, including registration in the CSIC's Labour Exchange. Candidates holding degrees awarded outside Spain should verify the applicable equivalence or recognition requirements.

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