1-yr position: Seismicity detection from continuous data recorded on dense seismic arrays deployed in the French Rhône Valley

Context and Mission

The DARE project is a French-German joint project funded by ANR and DFG national research agencies (2020-2023). This project focuses on the so-called site effects that correspond to the modification of the seismic motion by the local geological configuration and that can lead to dramatic seismic amplifications. The DARE project exploits data from 2 complimentary dense passive experiments on a km-scale sedimentary basin located in the area of the Tricastin nuclear site (French Rhône valley, Figure 1). The knowledge acquired in the area suggests that this geological structure is a good candidate for generating site effects (Gélis et al., 2022). The 2 datasets are used to investigate the contribution and interest of acquiring and exploiting such kind of data to perform site-specific studies for seismic hazard applications in low-to-moderate seismicity areas. In the DARE project, we adopt a multi-approach estimation of site effects using different seismic observations (noise & seismicity) and approaches (numerical & empirical). This will allow us to confront alternative methods; evaluate their own interests, uncertainties and limitations in the estimation of seismic site effects.

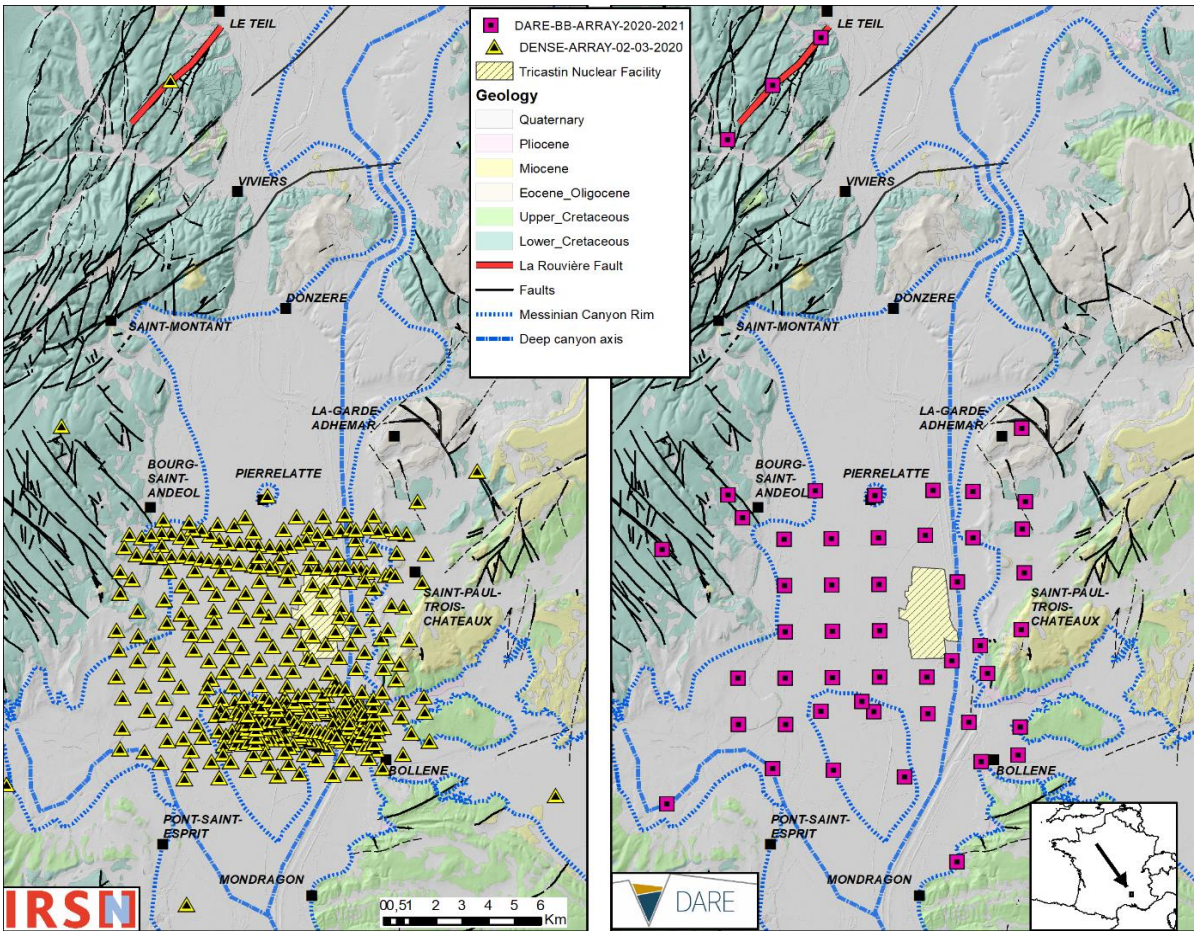

Figure 1: Location map of the 2 DARE deployments.

This position is part of the empirical component of the project, using the recorded seismicity to estimate the local seismic amplification. The candidate will work on the longer dataset (Right panel in Figure 1). The first step of such analysis is to build a seismicity catalogue from our dataset. A first version of such catalogue is already available. The starting point was the ISC (International Seismological Centre) catalogue. Criteria based on lower-bound magnitude thresholds (relative to the epicentral distance), on the signal-to-noise ratio as well as a visual inspection were used to select seismic signals. This analysis was performed on data from one station of the array, chosen because of its overall quality and its location on quiet hard rock site. This led to a selection of 424 events.

To complete this first version, we would like to construct a data-driven catalogue, based on the direct analysis of the continuous data recorded by the whole array. Several approaches may be adopted to detect seismic events within the continuous data based on the extraction of features of interest in the seismic signal. Depending on the kind of signals targeted we may consider Kurtosis-based methods, spatial coherence of the wavefield over the array, etc. as well as recent AI-based methods (for feature extraction, detection and picking). Once detected, we will need to gather information regarding this seismic signal (« metadata »), necessary for their processing in the context of the estimation of the local seismic amplification (information about the source location, signal-to-noise ratio, etc). The procedure will be decided and constructed in concertation with the candidate and the different people involved in this mission.

References

Gélis, C., Cauchie, L., Cushing, E.M. et al. Estimation of the Local Seismic Amplification on an Industrialized Site in the French Rhône Valley. Pure Appl. Geophys. 179, 2119–2145 (2022). https://doi.org/10.1007/s00024-022-03069-x.

Thouvenot, F., Jenatton, L. & Gratier, J.-P. 2009. 200-m-deep earthquake swarm in Tricastin (lower Rhône valley, France) accounts for noisy seismicity over past centuries, Terra Nova 21, 203–210

Organization and application

The candidate will be based at IRSN (Fontenay-aux-Roses, Paris area, France). IRSN is the French public service expert in nuclear and radiation risks. It is a research institute that provides technical and operational support to the French public nuclear safety authority. In this context, IRSN fosters a specific research group dedicated to seismic hazard assessment geared toward nuclear facilities including the study of site effects.

The position will start in fall 2022 for 1 year.

The candidate will mainly work in collaboration with Bérénice Froment (seismology), Céline Gélis (seismology), Yann Richet (Machine Learning). Interactions are also planned with the other partners of the project (ISTerre, University of Potsdam and GFZ) and seismologists from IPGP.

This position requires a Master or PhD degree. Applicants should have a good expertise in python and seismic signal analysis with an interest for applications on large datasets.

Applications including cover letter (explaining background and motivation) and CV must be sent to berenice.froment@irsn.fr before November, 10 2022.