

Daily monitoring of low-frequency earthquake activity

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Low-frequency earthquakes (LFEs)

- Small magnitude ($M \sim 1$)
- Dominant frequency low (1-10 Hz) compared with that of ordinary tiny earthquakes (up to 20 Hz)
- Source located on the plate boundary
- Grouped into families of events, with all the earthquakes of a given family originating from the same small patch on the plate interface
- Recurrence more or less episodic in a bursty manner

What we do now

- Download seismic data for a given period of time
- Analyze data and find time of occurrence of LFEs
- Create a catalog of LFEs for a given period of time and publish it

What we aim to do

- Low-frequency earthquake occur and are recorded by permanent seismic stations every day
- On a daily basis:
 - Download seismic data from the day before
 - Analyze data and find low frequency earthquakes
 - Update the catalog

First step: Python package

catalog

- Specific Python scripts for downloading data and finding LFEs
- Directory with templates for two LFE families

utils

General Python scripts for stacking and cross-correlation

data

- File with list of LFE families
- File with list of seismic stations
- Directory with instrument response from seismic stations



lfelib

- Specific Python scripts for downloading data and finding LFEs
- data : Templates, instrument responses, list of LFE families and seismic stations
- utils : General Python scripts for stacking and cross-correlation

tests

.github/workflows

- environment.yml
- pyproject.toml

Second step: Command line

- How to launch the scripts in a way that is both easy and fast?
- Create command lines to run Python functions

Third step: GitHub workflow

- Set up a workflow on GitHub
 - Check last version of GitHub repository
 - Get the appropriate version of Python
 - Install the Python package
 - Run the script
 - Save the results

Fourth step: Improving memory and computing time

- Instead of storing instrument response, download them before analyzing the data
- Analysis of several low-frequency earthquake families:
 - Loop on families: download data relevant to that family, analyze data, delete data
 - Loop on seismic stations: Download all data, store them, loop on families, delete data
 - Make sure that each chunk of data is downloaded only once

Fifth step: Saving results

To be completed

Future improvements

- Increase computing time by parallelization of the Python scripts
- GitHub CronJob offers a limited computing time → To analyze more data, we may use Amazon Lambda instead