Corso di Laurea Magistrale in

Geoscienze per l'Ambiente, le Risorse e i Rischi Naturali

Modello di richiesta di assegnazione del team project

Il sottoscritto

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Iscritto al 2° ANNO del corso di laurea GEOSCIENZE PER L'AMBIENTE, LE RISORSE E I RISCHI NATURALI

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Chiede di poter svolgere il team project insieme ai seguenti studenti:

Nome e Cognome	Matricola
RAFFAELE MOLO	P73000045
BARBARA MANDATO	P73000060
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Tra le tematiche disponibili, indica il seguente ordine di preferenza

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2) .....

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4) .....

Allega un breve curriculum vitae con l'elenco degli esami sostenuti per il corso di Laurea magistrale

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Project Title: Development of an Operational Earthquake Forecasting System using the simplETAS Model

1. Introduction

Earthquake forecasting is a critical undertaking in seismology. It is essential for quantifying and better understanding earthquake risks, which ultimately improves disaster preparedness. This project aims to develop an **operational earthquake forecasting system** (Marzocchi et al. 2014) using the **simplETAS (Simplified Epidemic-Type Aftershock Sequence) model** (Mancini and Marzocchi 2023) to forecast seismicity in the next few hours/days in real-time based on recently observed seismicity. The target area will be the Italian territory.

ETAS is a widely used statistical model class for earthquake forecasting, which simulates the occurrence of earthquakes based on the size, time, and spatial distribution of prior earthquakes. This model is capable of capturing the clustering effect of earthquakes that drive foreshock-mainshock-aftershock sequences, making it ideal for real-time forecasting applications.

The system will be developed in Matlab or **Python**, with a focus on making it both operational and scalable for use in earthquake-prone regions in Italy.

2. Project Objectives

- **Objective 1**: Create an interface to download, on request, an updated seismic catalog of the target region.
- **Objective 2**: Provide a short-term forecast for the selected area, calculated with simplETAS using the updated seismic catalog.
- **Objective 3**: Create an interface to display real-time forecasts, including event probability for different magnitudes and ground motion forecasts.

3. Method

3.1 Data Collection and Preprocessing

The first step in developing the forecasting system is to gather historical earthquake data. This data can be sourced from the INGV earthquake catalog. The data will include:

- Earthquake magnitudes (Ml or Mw)
- Epicenter locations (latitude, longitude)
- Time of occurrence

5. Work Plan

The project will be carried out over a 3-month period, and involves a total workload of 150 hours (6 CFU) for 3 students, for a total of 450 hours.

The work will be divided into the following phases:

1. **Phase 1 (25 hours)**: Lecture-style teaching to introduce to the project and to assign individual tasks (group work)
2. **Phase 2 (90 hours)**: Implementing the codes, adapting the simplETAS model, and create a real-time forecasting system (individual work with interactions)
3. **Phase 3 (35 hours)**: Group work for integrating and testing the different components (group work)

The project will involve prof. Jacopo Selva, prof. Warner Marzocchi, and Dr. Marcus Herrmann.

References

Bindi, D., Pacor, F., Luzi, L., Puglia, R., Massa, M., Ameri, G., Paolucci, R., 2011. Ground motion prediction equations derived from the Italian strong motion database. Bull. Earthq. Eng. 9, 1899–1920.

Mancini, S., and W. Marzocchi (2023). SimplETAS: A Benchmark Earthquake Forecasting Model Suitable for Operational Purposes and Seismic Hazard Analysis, Seismol. Res. Lett. https://www.doi.org/10.1785/0220230199.

Marzocchi W., Lombardi A.M., Casarotti E., 2014. The establishment of an operational earthquake forecasting system in Italy, Seismol. Res. Lett., 85(5), 961–969..10.1785/0220130219