DIPARTIMENTO
DI SCIENZE DELLA TERRA
SAPIENZA
UNIVERSITÀ DI ROMA

DOTTORATO DI RICERCA
IN SCIENZE DELLA TERRA

1. Research activity

Applying a Bayesian approach to study uncertainties and trade offs among the kinematic parameters describing the seismic sources of moderate-to-large earthquakes.
Studying and implementing a slip velocity function to be used in kinematic modeling (forward and inversion models) consistent with theoretical dynamic ruptures and laboratory experiments.
With this proposal I will develop kinematic models of the seismic source becoming dynamically consistent with the physical processes that govern the earthquake phenomenon. I will apply these kinematic models to several moderate-to-large events.
The results will improve our ability to characterize processes causing earthquake ruptures, and will give some inferences and constraints even on seismic hazard studies.

The research foresees the achievement of the main objectives through three phases:

1. Training of the kinematic methodologies to infer seismic sources

Use BEAT (Bayesian Earthquake Analysis Tool), a python open-source software to conduct source-parameter estimation analysis for crustal deformation events, such as earthquakes.
BEAT is written in the python programming language, and several tools are based on the pyrocko seismological toolbox (Heimann et al., 2017), that I already widely used in my master's thesis to analyze moment tensors solution for events with M> 3.0 in the Campotosto area.
An important aspect of BEAT's contribution is the integration of multiple methods in a unified platform. The intention behind providing such a unified framework to the geophysics community is to make research more reproducible and to accelerate the development of comprehensive tools for deformation source studies.
During the PhD I will use the inversion code at higher frequencies (up to 1 Hz) to obtain kinematic information on the finite source (sum of many point sources) with a spatial extent approximating earthquake fault planes.
During the training period, all the packages needed to run the kinematic models will be installed in a dedicated iCloud area of the Department of Earth Sciences.

2. Dynamic constraints on kinematic modeling and synthetic tests

Study of potential slip velocity functions to be implemented in the kinematic inversion code for finite source. The canonical sliding velocity functions (boxcar, triangular or trapezoidal functions) are applied in literature for simplicity but slip-velocity functions compatible with rupture dynamics are

generally preferable (Figure 3). These include the regularized Yoffe function (Tinti et al., 2005), the slip-velocity function used by Liu et al. (2006), and the exponential slip-velocity function developed by Dreger et al. (2007) and refined by Mena et al. (2010).
From the kinematic inversion code already adopted by kinematic modelers of Sapienza & INGV I propose to implement some slip-velocity functions dynamically consistent, and subsequently to study its effects with synthetic tests (also in terms of peak ground motion, e.g., PGV).

3. Applications to some recent event well recorded

The acquired knowledge will be subsequently applied to some moderate-to-large recent events:

- Four Mw>5.0 of 18-01-2017 events of Campotosto area, which is characterized by high structural complexity as a result of the overprint of subsequent deformational stages. For this reason, the purpose of my PhD is to clarify the kinematic model of this area starting from the analyzes made during my master's thesis;

- The Mw 7.0 of 30-10-2020, 12:51:26 event in the offshore of Samos Island, occurred in a high seismic activity area that crosses the Euro-Mediterranean region, with a widely heterogeneous tectonic configuration. Due to its position, this area is under observation by the CAT-INGV group, which deals with the tsunami hazard, the analysis of seismic sources and the geological processes that can potentially generate a tsunami;

- Other potential well recorded large events that could occur during the PhD in Italy and Mediterranean Sea first of all.