



1ST TRAINING SCHOOL
27 MAY - 01 JUNE 2024
SAMBUCA DI SICILIA (AG) – ITALY

1ST TRAINING SCHOOL TREAD PROJECT **(COORD. BRUNO PACE)**

Organized by Laura Peruzza (OGS, Trieste, Italy), Celine Beauval (UGA, Grenoble, France), Raffaele Azzaro (INGV, Catania, Italy), Paola Cesaroni and Simona Farnetani (Innovacta, Italy)

The 1st Training school of TREAD Project was planned to give the consortium students a common background on earthquakes, from causes to consequences, at the Euro-Mediterranean scale. Sicily is selected as it hosted the deadliest earthquake known in Euro-Med area, and because the traces of past events are still strong in the landscape and cultural assets. At short distance from the location selected, one can travel through the timeline of damaging earthquakes that goes back to the ancient Greeks, tackle the ruins of differently sized events, taste some resilience and risk management aspects.

The lectures include many disciplines that nowadays are needed to evaluate the earthquake related risks, in detail covering these topics:

- Specificities of the Euro-Med area from point of view of geodynamic settings, with case studies of complexities in fault ruptures and earthquake interaction;
- ABC on instrumental seismology and physics of the fault rupture, with hands-on exercise on some existing databases;
- Paleoseismology and macroseismology, with field trips at the Selinunte temple, and in the ghost towns in the Belice valley;
- State-of-the-art of seismic hazard and risk assessment;
- Communication practices during emergency and in peace time;
- Some sessions of collaborative learning are scheduled too, to compare the different expertises of data gathering and to establish a stronger connection of the activities among the students.



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AGENDA

Day 1 (27/5)

10:00-17:00

Arrival of participant

16:00-17:30

ICE-BREAKING SOFT DRINK AND SNACK

17:30-18:00

Introduction to the school, organization and logistics

Bruno Pace, Laura Peruzza

18:00-19:00

Earthquake cycle, from long-term deformation to earthquake. Example of the Dead Sea fault

Yann Klinger

Addressing earthquake cycle involved to be able to put in perspective very different time scales, from the averaged long-term deformation rate to the earthquake. The technics used to address those different time scales are divers and, most of time they are implemented by different scientific communities that do not communicate so much together. Here, using the example of the Dead Sea fault as the archetype of a large continental strike-slip fault, we will go through the classic approaches used to address those different time scales to try to emphasise the added value of considering those different time scales together.

20:00-21:00

DINNER

21:30-22:30

Team building activities

Massimo Crescimbene

The team building activity aims to encourage open communication, a spirit of collaboration in the group and to have anyone work recognized as part of a common purpose that also optimizes the ones from the others. The principles that underlie a collaborative and winning team are: common goals, sense of belonging, cohesion, serenity, recognition of the importance of all members in achieving team goals. There must be mutual trust and respect within the team, which will ensure that members have no qualms about expressing their opinions, taking responsibility or taking initiative.

Day 2 (28/5) | Earthquakes from the past to the present - part I

09:00-10:00

ABC of instrumental seismology - Part 1: earthquake sources, ground motion and statistics

Men-Andrin Meier

Addressing the rupture process as source of seismic waves; different wave types and how they are used to infer details of rupture process, different source descriptions (e.g., point vs. finite), earthquake statistics, scaling relations, and source descriptions/characterizations; feasibility of (short-term) forecasting (models of rupture initiation/propagation).



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- 10:30-11:00 MORNING COFFEE BREAK
- 11:00-12:00 **ABC of instrumental seismology - Part 2: source inference and rupture physics**
Olaf Zielke
Using seismic wavefield to learn about rupture process (kinematic source inversion, dynamic rupture modeling); seismic wave source and path effects; further details on rupture process and fault friction; limitations in instrumental seismology (e.g., catalog completeness/length), earthquake-cycle simulations.
- 13:00-14:00 LUNCH
- 14:30-16:30 **Collaborative Learning Adopt a quake:** the first, the last, the deadliest, the costliest ... short presentations of some Euro-Med earthquake, given by students (8-12 slots, max 10' each) to discuss about how we can gather prompt and reliable infos about earthquakes in different part of the Euro-Med area.
PhD students
FORMS TO BE FILLED BY STUDENTS:
<https://docs.google.com/forms/d/e/1FAIpQLSegDC8bNA-A0cMpGUxQwGQDtshSByXULtRAEccmdLwZ0jLDSQ/viewform>
- 16:30-17:00 **Fault geometry, complex rupture, and deformation, what did we learn from from recent earthquake observations - Part 1**
Yann Klinger
In this lecture we will review what could be learned from studying in detail surface ruptures for large continental earthquakes, especially about fault geometry and distribution of deformation. Several examples will be derived from recent studies using optical satellite imagery.
- 17:00-17:30 AFTERNOON TEA BREAK
- 17:30-18:00 **Fault geometry, complex rupture, and deformation, what did we learn from from recent earthquake observations - Part 2**
Yann Klinger
- 18:30-19:30 **Hands-on exercises for exploiting instrumental databases** (international/national)
All participants
- 20:00-21:00 DINNER
- 21:30-22:30 SPARE TIME WITH THE LECTURERS



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Day 3 (29/5) - Earthquakes from the past to the present: part II

9:00-10:00

ABC on Catastrophe Risk Modeling – state of the practice and future perspectives

Salvatore Iacoletti

As our world undergoes rapid transformation, the need for accurate catastrophe risk modeling has never been more crucial. This presentation delves into the basics of risk/loss assessment in the context of earthquake modeling, highlighting inherent challenges in predicting future losses and exploring avenues for improvement. Within the (re)insurance industry, where catastrophe models are indispensable, innovation must balance with practicality. Through case studies of individual events, this presentation will dive deep into aftershocks and damage accumulation, navigating the complexities of integrating these factors into existing models.

10:30-11:00

MORNING COFFEE BREAK

11:00-12:00

ABC on Archaeoseismology: Methodological Insights and the Selinunte Case Study, Western Sicily

Carla Bottari

Archaeoseismology, also known as earthquake archaeology, is a specialized field within Earth science focused on documenting past seismic events, often unrecorded in seismic catalogs. This discipline analyzes damage patterns, displaced structures, and seismic indicators in archaeological remains to reconstruct the impact of ancient earthquakes on human settlements. Archaeoseismological research aims to understand a region's seismic history by investigating key questions such as the likelihood of seismic ground motions causing observed damage and determining earthquake characteristics. By employing a multidisciplinary approach that integrates geological, archaeological, and geophysical data with finite element modeling, archaeoseismologists may reconstruct the seismic history of the site under investigation, providing crucial information for earthquake hazard assessment. The site of Selinunte, located in western Sicily and well-known for its ancient temples, preserves evidence of past seismic activity among its ruins. Examining the ancient collapsed structures of Selinunte yields valuable insights into seismic events that influenced its history. Further exploration of this case study could lead to a deeper understanding of ancient seismic activity. Indeed, the recurrence of earthquakes in the past suggests a significant temporal gap between major seismic events in the surveyed area, a factor often overlooked in catalogs, except for the 1968 seismic sequence in the Belice Valley. These findings play a crucial role in refining assessments of seismic hazards, providing valuable insights into historical seismic events, and enhancing our understanding of seismic risks in the region.

12:45-14:30

TRANSFER AND PIC-NIC



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14:30-18:00 **Visit to the Selinunte temple**

18:00-18:30 TRANSFER

20:00-21:00 DINNER

21:30-22:30 **Emergency management role-playing games**

Massimo Crescimbene

During the role-play, students will have to play out scenes in which they will have to take on the roles of various parties (homeowners, relief workers, government officials, scientists, etc.) affected by a major earthquake in an urban area. The game develops in different subgroups who are asked to prepare to respond to certain situations that occur in the event of a seismic emergency. The game aims to introduce the participants to the different roles involved in a seismic emergency situation. The proposed situations aim to promote reflection on some kind of response and on communication problems in a seismic emergency.

Day 4 (30/5) - Macroseismology

08:30-09:30 **ABC on Macroseismic intensity: the perspective of a seismic hazard modeller**

Oona Scotti

Macroseismic intensity data provide information on ground shaking that can span hundreds of years and cover regions that lack dense instrumental networks. This lecture will cover three main aspects of macroseismic intensity data : (1) a brief historical evolution of the collection strategies through time, (2) what these data entail and what are its the limitations and (3) its present day and future use. A deep understanding of what is behind macroseismic intensity data is important as its exploitation spans several fields that range from, investigating past earthquakes, characterizing their sources, compiling long-term catalogs, characterizing long-term seismicity for probabilistic seismic hazard assessment, estimating expected shaking levels through intensity attenuation models, relating ground motion parameters and macroseismic intensity, testing and retrospective evaluation of seismic hazard estimates and shaking scenarios and last but not least constraining path effects in ground motion models.

10:00-10:50 **The Belice 1968 seismic sequence and the impact on territory and society**

Raffaele Azzaro

In 1968, six earthquakes with magnitude between 5.1 and 6.4 destroyed or heavily damaged several towns in the Belice area (western Sicily), causing some three hundred fatalities. Owing to the



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AGENDA

inadequacy of the seismic network operating in Italy in that period, intensity data are essential to study these seismic sequences. This lecture shows the critical issues in macroseismic studies produced over the years, since the MCS scale was used as an estimation of shaking rather than a representation of the damage scenario; in practice, intensity was assigned for each earthquake of the sequence disregarding the effect of the cumulative damage. The correct approach involves the critical analysis of the primary sources to reconstruct the evolution of the damage scenario during the sequence and assess intensity by using the European Macroseismic Scale EMS-98. The lecture also analyses the impact left by these events on territory and society. Post-earthquake reconstruction also implies abandoning a village and resettling in a new location deemed safer, a process producing a sudden traumatic change of great historical, cultural and anthropological impact. The case-study of the Belice area after the 1968 earthquakes represents the richness and complexity of this situation, that led to the genesis of the ghost towns.

- 11:00-11:30 MORNING COFFEE BREAK
- 11:30-13:30 **Transfer and visit to the ghost towns in the Belice area, Part 1**
- 13:30-14:30 PIC-NIC AND TRANSFER
- 14:30-19:00 **Visit to the ghost towns in the Belice area, Part 2**
- 20:00-22:00 DINNER IN THE ABBEY AND RETURN

Day 5 (31/5) - Earthquakes and society

- 9:00-10:00 **Integration of geodetic data into probabilistic seismic hazard assessment**

Celine Beauval

Probabilistic seismic hazard models rely on different types of observations, covering different time windows. Earthquake recurrence models may be established from earthquake catalogs that extend over several centuries, combined with geological data that extend over much longer time windows (thousands to hundreds of thousands of years). Every dataset casts some light on the seismogenic potential of the areas under study. Geodetic measurements cover much shorter observation time windows, but they deliver deformation rates that might be more representative of what may occur in the near future. The talk will highlight the challenges in earthquake recurrence models that are built for PSHA calculations and the way geodetic measurements can help constrain these models, with examples from different parts of the world.



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AGENDA

- 10:30-11:00 **Modelling earthquake occurrence on faults with the Openquake Engine. Part 1**
Marco Pagani
The structure of a probabilistic seismic hazard input model comprises two main components: the seismic source characterisation (SSC) and the ground-motion characterisation (GMC). The former describes the geometry of seismic sources of engineering interest and their ability to generate seismicity with the associated epistemic uncertainties. The latter defines the models through which it is possible - given a rupture - to compute the ground-shaking at the site, and the corresponding uncertainties. In this presentation, we will illustrate the main typologies of sources available in the Openquake (OQ) Engine (<https://github.com/gem/oq-engine>) an open-source software for probabilistic seismic hazard and risk analysis mainly developed by the Global Earthquake Model Foundation. Given the goals of the TREAD project, particular attention will be placed on fault source characteristics and methods available for the characterisation of its occurrence.
- 11:00-11:30 MORNING COFFEE BREAK
- 11:30-12:00 **Modelling earthquake occurrence on faults with the Openquake Engine. Part 2**
Marco Pagani
- 13:00-14:00 LUNCH
- 14:30-16:30 **Collaborative Learning:** How my PhD fits in the TREAD plot? Time slots (8-10 of 10'-15' each) open to the students, to discuss the transdisciplinary requirements of their work, the problems encountered, the results expected in the consortium, and they can be beneficial for the society
PhD students
- 16:30-17:00 AFTERNOON TEA BREAK
- 17:00-18:00 **Risk communication in emergency and in peace time**
Massimo Crescimbene
Effective risk communication should consider the psychological, social, cultural and political forces that influence how people understand, perceive and react to risk. We will see how the communication pragmatic of the Palo Alto school (Watzlavich) currently seems to be the most promising approach for risk communication. Is it safe to go home? This was the question faced by the New Zealand communities following the devastation caused by the Auckland floods and Cyclone Gabrielle last month. Red and yellow stickers have been pasted on homes and buildings



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deemed "dangerous, affected or unhealthy". Although the message on the stickers was clear, it left local communities confused and frustrated: several weeks after the disasters, many thought it would be safe to return home. The controversy illustrates very well the challenges of risk communication. It is not enough to share risk information. Information must be understood, trusted and acted upon.

18:30-19:30 **Open questions time, general discussion**
Bruno Pace, Laura Peruzza, Celine Beuval, Raffaele Azzaro, lecturers

20:00-21:00 DINNER

DAY 6 (1/6) - Wrap up and arrivederci

9:00-11:00 **Results of training school; collection of students requests for future events**
Bruno Pace, Laura Peruzza, Celine Beuval

TRANSFER TO PALERMO



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