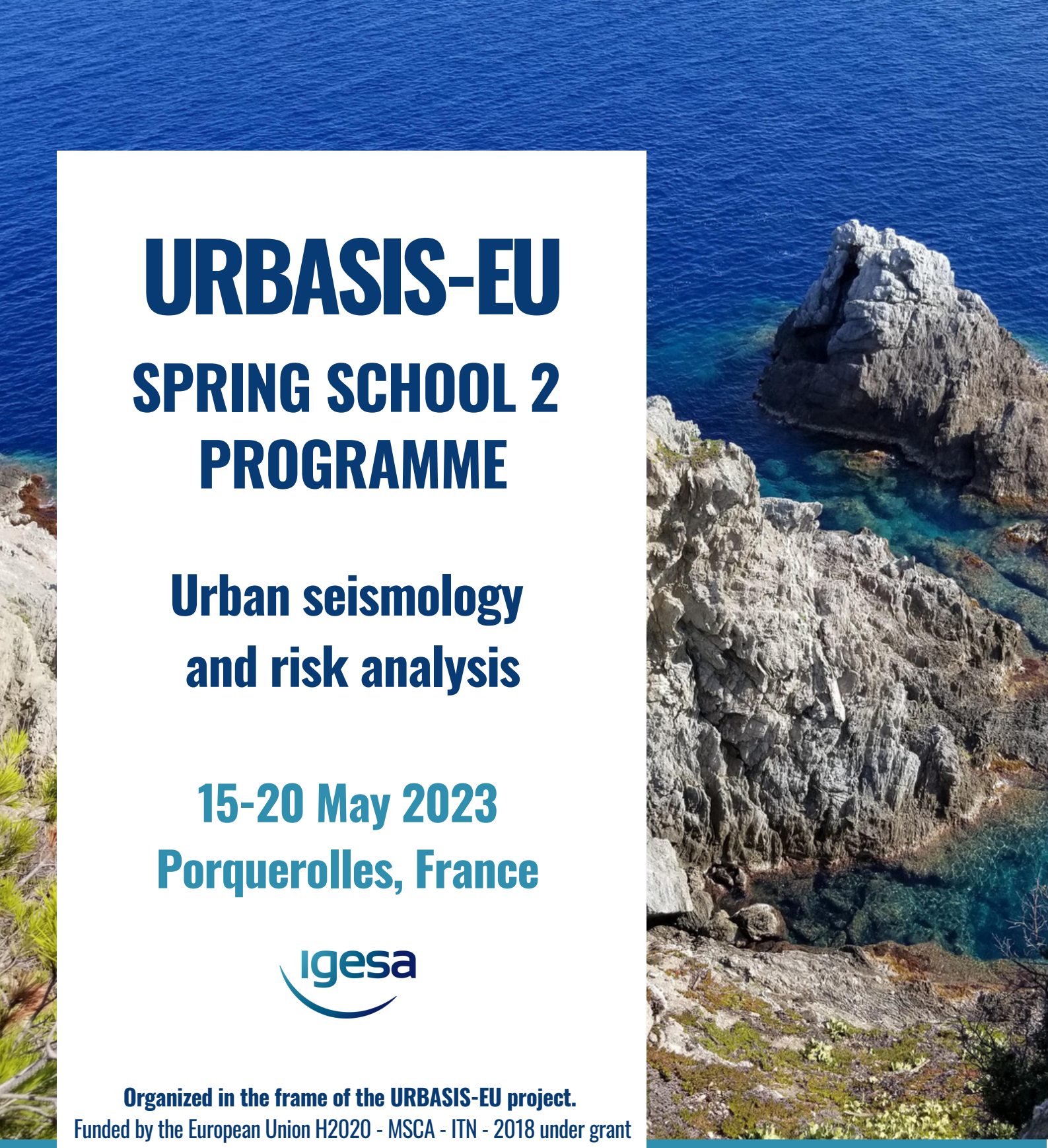

URBASIS-EU

SPRING SCHOOL 2 PROGRAMME

Urban seismology and risk analysis

15-20 May 2023

Porquerolles, France

igesa

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URBASIS-EU

HORIZON 2020

MARIE CURIE ACTIONS

MONDAY, 15 MAY

GENERAL OVERVIEW

12:00 **Lunch**

14:00 **Propagating uncertainties in probabilistic seismic hazard assessment (PSHA) due to uncertainties in earthquakes catalogues**

Oona Scotti, Institut de Radioprotection et Sûreté Nucléaire (IRSN), PSE-ENV, SCAN, BERSSIN, Fontenay-aux-Roses

PSHA aims at evaluating the probability that a ground motion intensity measure exceeds a threshold level in a given period of time. PSHA requires estimating earthquake forecast models (EFM) and selecting appropriate ground motion models. The focus of this talk will be on EFMs which require an in-depth analysis of earthquake catalogues. We will discuss the epistemic uncertainties that affect such analysis and propose a method for propagating them in PSHA using a user-friendly workflow (PUSH) we're developing.

MONDAY, 15 MAY

GENERAL OVERVIEW

15:00

Seismic behaviour of historical masonry structures – how well can we predict it?

Katrin Beyer, Associate Professor at Earthquake Engineering and Structural Dynamics Laboratory (EESD) at Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland

Many historical city centers are formed by aggregates, i.e., building conglomerates where adjacent buildings stand very close or even share walls. The walls of these historical buildings are typically constructed with stone masonry and the floors with timber beams and timber planks, resulting in one of the most vulnerable construction techniques with regard to seismic loading. In aggregates, the interaction between adjacent buildings makes the prediction of the seismic response particularly challenging. Because this building typology is so vulnerable and widely spread, it is important that the engineering community has confidence in the seismic performance evaluations. For this reason a blind prediction competition around a shake table test on a stone masonry aggregate consisting of two buildings built at approximately half scale was organized. This presentation summarises the findings from this blind prediction study and outlines lessons learnt and future research needs.

16:00

Break

17:00

State of the art on actuary and insurance engineering for CatNat

Florent Lobligeois, AXA Group Risk Management

This talk will be about the monitoring of the Natural Catastrophic risk within an insurance company.

19:30

Dinner

TUESDAY, 16 MAY

EARTHQUAKE ENGINEERING

09:00

Kinematic and Dynamic soil-structure interaction issues in the seismic response of shallow and deep foundations

Roberto Paolucci, Dept. of Civil and Environmental Engineering Politecnico di Milano

The lecture will provide an overview of dynamic soil-structure interaction (SSI) effects during earthquake ground motion. Particularly it will provide insights on: (i) the way the presence of a foundation may affect the input ground motion with respect to free-field conditions (kinematic interaction); (ii) the way the dynamic response of a structure is affected by foundation flexibility and energy radiation from the structure back to the ground (dynamic interaction); (iii) the evidence of dynamic SSI effects from field data; (iv) the practice-oriented approaches to account for the dynamic SSI for both shallow and deep foundations.

10:00

Break

TUESDAY, 16 MAY

EARTHQUAKE ENGINEERING

10:30

S2HM and damping variation in buildings

Philippe Guéguen, ISTerre, Université Grenoble Alpes, Université Gustave Eiffel

The earthquake engineering community has long recognized the value of earthquake recordings in civil engineering structures. For example, following the destructive 1971 San Fernando earthquake, the State of California enacted a law establishing, among other things, priority measures for the instrumentation of buildings, reinforced in 1997 following the 1994 Northridge earthquake. By improving our understanding of how structures behave in response to earthquakes, such recordings have led to the improvement of seismic design codes, in particular. They have also fostered a better understanding of specific processes, such as soil-structure interaction, nonlinear response and period-damping relationships for some specific structures. These recordings should also afford better understanding of the relationship between response and damage, which is an important step of the Performance Based Earthquake Engineering (PBEE) procedure and its underlying probabilistic framework. In this lecture, the objectives of the dynamic monitoring of buildings will be presented by the presentation of some auscultation techniques and methods and of fascinating physical processes related to the seismic response of buildings, including the nonlinear elasticity and the slow dynamics, as well as those related to the structural damping. In a context of increasing open-access data, perspectives in terms of forecasting operational damage will be introduced.

TUESDAY, 16 MAY

EARTHQUAKE ENGINEERING

11:15

Development of fragility curves for seismic risk analysis : comparison and integration of different approaches

Serena Cattarri, University of Genova – Department of Civil, Chemical and Environmental Engineering

Fragility curves constitute an essential tool for reliable seismic risk assessments. In the last decade, the number of research addressed to define them considerably increased and the analytical/numerical methods have developed more and more alongside those based on the empirical approach. Each method has pros and cons and selecting one of them depends on many factors. Various literature works have highlighted as results may turn out very different, thus leading to potentially large differences in the estimation of the consequences. The seminar will focus on these issues by comparing the results of various approaches and illustrating possible strategies for integrating them. As a practical exemplification, the experience carried out in the MARS project (Coord. Proff. A.MAsi and S.Lagomarsino, funded by the Italian Department of Civil Protection) will be illustrated with particular reference to the application of existing Italian school building stock (Task 4.7/4.4 – Coord. Prof. A. Masi, S.Cattari, V.Manfredi).

12:00 **Lunch**

14:00 **Time for meetings with lecturers**

15:00 **Optional classes of WP meeting**

TUESDAY, 16 MAY

EARTHQUAKE ENGINEERING

16:00

An earthquake early warning and early damage assessment tool for critical buildings

Dimitris Pitilakis, Associate Professor, Department of Civil Engineering, Aristotle University of Thessaloniki, Greece

An earthquake early warning and early damage assessment tool for critical buildings is becoming more and more timely. This innovative system for early warning, real-time damage assessment, and protection of essential structures, like schools, against an upcoming earthquake can also be used for other natural disasters. This user-friendly real-time risk assessment tool integrates continuous seismic waveforms from nationwide seismological networks and on-site permanent sensors monitoring critical buildings. Besides, the development of appropriate software, which, using the aforementioned seismic data and a library of vulnerability functions for each target building, allows the near-real-time estimation of the expected damage to critical buildings, with immediate notification of the end-users regarding the impending earthquake and prospecting damage.

17:30

Poster Session 1 with Welcome drink

19:30

Dinner

WEDNESDAY, 17 MAY

ENGINEERING SEISMOLOGY

09:00

Damping at high frequencies and impact on rock ground motion

Olga Ktenidou, National Observatory of Athens, Greece

Rock is usually assumed to have an ideal response in terms of attenuation and amplification. But at higher frequencies, ground motion on hard rock can he stronger than on soft rock, and rock sites typically considered as similar can exhibit significant variability. The implicit treatment of rock response as ideal has strong implications for seismology, cascading to engineering seismology and earthquake engineering.

10:00

Break

10:30

Exploring different criteria for selection of input motions for earthquake engineering analyses

Chiara Smerzini, Associate Professor, Department of Civil and Environmental Engineering, Politecnico di Milano

The development of performance-based methods to seismic design and assessment has boosted interest both in research and in engineering practice towards enhanced approaches for the definition of suitable sets of ground motion time histories to perform dynamic analyses of engineered systems. This talk aims at providing an overview of the different criteria, methods and tools for generating, selecting and scaling earthquake ground motions for the purpose of linear and non-linear response history analyses of structural and geotechnical systems. The challenge of complementing earthquake records with simulated broadband waveforms from physics-based simulation approaches is also discussed with practical examples.

WEDNESDAY, 17 MAY

ENGINEERING SEISMOLOGY

12:00 **Lunch**

14:00 **Time for meeting with lecturers**

15:00 **Optional classes of WP meeting**

16:00 **Strategies for site-specific seismic hazard assessment**

Donat Fäh, Swiss Seismological Service at ETH Zurich, Switzerland

Due to a variety of new methods and observational data, great progress has been made in local seismic hazard analysis and microzonation in recent years. This can lead to the fact that microzonings of the first generation no longer correspond to the state of the art in science and technology. In principle, before a decision is made on a local seismic hazard analysis, consideration should be given to whether a local seismic hazard analysis or its revision is necessary and what details it should include. This process can be done in stages, and begins with consideration of the soil class. Depending on the data, different methods can be used, based on geophysical measurements, measurements of the ground motion amplification at the site, and numerical simulations. All these methods have their strengths, costs and limitations, which will be illustrated by a few examples.

WEDNESDAY, 17 MAY

ENGINEERING SEISMOLOGY

17:00

Monitoring, modelling and forecasting ground motions from induced seismicity

Ben Edwards, University of Liverpool

In this talk I will summarise work that we have undertaken through the URBASIS and other projects on the topic of seismic hazard due to induced seismicity. I will discuss the monitoring of ground motions from induced seismicity at Preston New Road Shale Gas site in northern England and in the Groningen natural gas field in the Netherlands. I will then cover the modelling of these ground motions in terms of source-path- and site-effects, and finally, the calibration of ground motion models used for estimating the impacts of larger events.

19:30

Dinner

THURSDAY, 18 MAY

SHARING WITH OPERATIONAL STAKEHOLDERS

09:00

Informing policy decision-making in developing countries with science: the role of International Financial Institutions (IFIs)

Oscar Ishizawa, Urban, Disaster Risk Management, Resilience and Land Global Practice, The World Bank Group

More efforts to integrate and translate scientific information into development policies, planning and programs are needed to ensure their impact and sustainability of IFI financing in a changing climate. The keynote lecture will focus on experiences and lessons learned from Latin America and the Caribbean, Sub-Saharan Africa and the Maghreb regions.

10:00

Break

10:30

How catastrophe models are developed for and used by insurance industry

Peter Pazak, PhD, Aon Impact Forecasting Senior Earthquake Model Developer

In an increasingly risky world, insurers and reinsurers need more sophisticated tools to quantify and manage the risks facing their businesses. Aon's catastrophe model developers, Impact Forecasting, enable firms to analyze the financial implications of catastrophic events and achieve a greater understanding of their risks.

To develop earthquake catastrophe risk models, IF partners with GEM enabling us to bring the results of latest local scientific research to insurance industry. The presentation will include overview of model development and their use by the insurance industry.

THURSDAY, 18 MAY

SHARING WITH OPERATIONAL STAKEHOLDERS

11:15

Physics-based probabilistic seismic hazard and probabilistic risk assessment in urban areas

Marco Stupazzini, MunichRE, Germany

In the last decades, boosted by the increasing availability of computational resources, significant progress have been made worldwide in predicting the strong motion shaking thanks to the 3D physics-based numerical simulations (PBSs). Earthquake ground motion, including a full 3D seismic wave propagation model from the source to the site, have gained increasing consensus thanks to different verification/validation exercises, and they are becoming a valuable complementary tool at GMMs to provide realistic ground motion estimations.

The present work focuses on the recipe that was developed and recently presented to take advantage of physics-based approaches, on the one hand, within a classical Probabilistic Seismic Hazard Assessment (PSHA) framework and, on the other, in order to accomplish reliable Probabilistic Risk Assessment (PRA), especially suited for large urban areas.

The footprint-based PSHA adopts directly the PBSs, without postulating any specific probability distribution by simply taking all the realizations of the scenario earthquake within a logic-tree framework, as multiple branches, each equally weighted.

12:00

Lunch

THURSDAY, 18 MAY

SHARING WITH OPERATIONAL STAKEHOLDERS

14:00 **Time for meeting with lecturers**

15:00 **Optional classes of WP meeting**

16:00 **An overview of GEM and its main activities**

Marco Pagani, GEM Fundation Pavia

The Global Earthquake Foundation (GEM) is a non-profit foundation based in Pavia, Italy. GEM's principal goal is to develop scientific tools and datasets to support a transparent assessment of earthquake risk. In this presentation, I will provide an overview of GEM and describe examples of current activities and projects.

17:30 **Poster Session 2 with Welcome drink**

19:30 **Dinner**

FRIDAY, 19 MAY

CUTTING-EDGE TOPICS

09:00

Testing of Scientific Models from Earthquake Forecasting to Risk - Lessons Learned

Danijel Schorlemmer, GFZ Potsdam

The Collaboratory for the Study of Earthquake Predictability is a global collaboration to improve our understanding of earthquake predictability, advance forecasting model development, test key scientific hypotheses and their predictive power, and improve seismic hazard assessments. Since 2007, the collaboration has been conducting forecast experiments in a variety of tectonic settings to automatically and objectively evaluate models against prospective data, providing a multitude of results that are informing operational earthquake forecasting systems and seismic hazard models. Here, we report on the fundamental principles in testing models, the associated problems, and the lessons learned.

10:00

Break

10:30

Automatic knowledge inference from massive continuous geophysical data

Léonard Seydoux, Institut de physique du globe de Paris, Université Paris Cité, Paris, France

In recent years, the use of artificial intelligence in geosciences has gained increasing popularity. This lecture will provide an overview of both supervised and unsupervised machine learning techniques in the field of seismology. It will also discuss the use of mixed machine learning strategies to analyze large amounts of seismic and geodetic data in order to infer knowledge about slow earthquakes in various contexts. It will also show examples on how these cutting-edge methods can be used to improve the detection and characterization of slow earthquakes, in the particular case of Mexico.

FRIDAY, 19 MAY

CUTTING-EDGE TOPICS

11:15

Integration of geodetic data into probabilistic seismic hazard assessment

Céline Beauval, ISTerre, Grenoble, France

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.

12:00

Lunch

FRIDAY, 19 MAY

CUTTING-EDGE TOPICS

14:00

On the characteristics of nonlinear soil behavior from earthquake observations

Fabian Bonilla, Université Gustave Eiffel, Département GERS (Géotechnique, Environnement, Risques naturels et Sciences de la terre)

It is widely known that local geology strongly affects the earthquake ground motion. This is seen in terms of ground shaking amplification, having longer duration and spatial variability. However, when the incident wavefield is strong enough and the material has a low strength, nonlinear soil response is also observed. This means, a shift of amplification to lower frequencies. Furthermore, if the material is saturated, pore pressure effects may lead to cyclic mobility of dense sands or silty soils, and liquefaction in loose sandy soils. Most studies of nonlinear site response comes from laboratory analyses. However, in the last years with the increasing of high-quality seismic networks and the improvement of robust signal processing tools, it is possible to unveil nonlinear soil behavior using earthquake data. This is important because these studies perform in-situ analyses. These results show that nonlinear material behavior is rather ubiquitous, it is frequency dependent, and also shows temporal variability. In this presentation, I will show examples from earthquakes recorded by the KNET and KiK-net networks in Japan. In particular, the temporal variability of the predominant frequency and frequency-dependent velocity changes as tools to monitoring nonlinear soil behavior.

15:00

Project Balance