ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

il Direttore

Istituto Nazionale di Geofisica
e Vulcanologia
AOO INGV
Protocollo Generale - U
N. 0002318
del 20/02/2020

Gestione WEB

Alla Dott.ssa FRANCESCA PACOR

Ai Direttori di Dipartimento
Ai Direttori di Sezione
Al Direttore della Direzione Centrale Affari Generali e Bilancio
Al Responsabile del Centro Servizi Contabilità e Bilancio
All'Ufficio Bilancio
Al Responsabile del Centro Servizi per il Coordinamento delle Attività a Supporto della Ricerca
Alla Segreteria della Presidenza

Oggetto: Pubblicità atti

Si notifica in copia l'allegata Delibera n. 29/2020 del 30/01/2020 - Allegato M al Verbale n. 01/2020 – concernente: "Research Contract tra Istituto Nazionale di Geofisica e Vulcanologia (INGV) e Charles University of Praha.

Dott. Giovanni Torre

DIREZIONE CENTRALE
AFFARI DEL PERSONALE

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Delibera n. 29/2020
Allegato M al Verbale n. 01/2020
Oggetto: Research Contract tra Istituto Nazionale di Geofisica e Vulcanologia (INGV) e Charles University of Praha.

IL CONSIGLIO DI AMMINISTRAZIONE

- VISTO il Decreto legislativo 29 settembre 1999, n. 381, concernente la costituzione dell'Istituto Nazionale di Geofisica e Vulcanologia (INGV);
- VISTO il Decreto Leg.vo 25/11/2016, n. 218, concernente "Semplificazione delle attività degli Enti Pubblici di Ricerca ai sensi dell'art. 13 della Legge 7/08/2015, n. 124";
- VISTO lo Statuto dell'INGV, approvato con Delibera del Consiglio di Amministrazione n. 372/2017 del 9 giugno 2017, come modificato con Delibere del Consiglio di Amministrazione n. 424/2017 del 15 settembre 2017 e n. 501/2017 del 21 dicembre 2017, pubblicato sul Sito WEB istituzionale (Avviso di emanazione pubblicato sulla Gazzetta Ufficiale della Repubblica Italiana - Serie generale - n. 27 del 2 febbraio 2018), in particolare, l'art. 8, comma 6, lettera f), il quale prevede che il CdA *"omissis....delibera la partecipazione a società, fondazione e consorzi, nonché la stipulazione di accordi con organismi nazionali, europei e internazionali"*;
- VISTO il Regolamento di Organizzazione e Funzionamento dell'INGV, emanato con Decreto del Presidente n. 45/2018 del 21/2/2018, pubblicato sul Sito WEB istituzionale e, in particolare, l'art. 29 il quale disciplina le Collaborazioni con soggetti esterni, stabilendo al primo comma che: *"I rapporti di collaborazione nell'attività di ricerca tra l'Ente e soggetti pubblici e privati, italiani e stranieri sono regolati attraverso contratti aventi come riferimento di massima la seguente tipologia: protocolli d'intesa, accordi di programma quadro, convenzioni operative"*;
- VISTO il Regolamento del Personale emanato con Decreto del Presidente n. 118/2018 del 14/5/2018, pubblicato sul Sito WEB istituzionale;
- VISTO il Regolamento di Amministrazione, Contabilità e Finanza, emanato con Decreto del Presidente n. 119/2018 del 14/5/2018, pubblicato sul Sito WEB istituzionale;
- VISTO il Research Contract tra Istituto Nazionale di Geofisica e Vulcanologia (INGV) e Charles University of Praha;
- VALUTATA l'opportunità di procedere alla sottoscrizione dell'Accordo intercorrente tra Istituto Nazionale di Geofisica e Vulcanologia (INGV) e Charles University of Praha, finalizzato allo sviluppo di codici di calcolo per l'inversione e la simulazione del moto sismico, inter-operabili con le banche dati accelerometriche ITACA ed ESM, gestite dall'INGV;
- CONSIDERATO che le Parti, con il presente Accordo, istituiscono una cooperazione, a livello internazionale e che l'attività da espletare rientra tra i compiti scientifici e istituzionali dell'INGV;

- VERIFICATA la copertura finanziaria dell'importo di euro 30.000,00, sui fondi del progetto INGV-EDF "Modelli predittivi di movimento del suolo per siti di riferimento" (C.OBFU 0925.010), che presenta la necessaria disponibilità;
- VISTI i pareri favorevoli del Direttore di Sezione e del Direttore di Dipartimento,

DELIBERA

L'approvazione dello schema del Research Contract tra Istituto Nazionale di Geofisica e Vulcanologia (INGV) e Charles University of Praha, allegato alla presente quale parte integrante e sostanziale (all. 1).

Viene dato mandato al Presidente dell'INGV alla sottoscrizione definitiva dell'atto in questione.

Letto, approvato e sottoscritto seduta stante.

Roma, 30/01/2020

La segretaria verbalizzante
(Sig.ra Silvana TUCCI)
Silvana Tucci

IL PRESIDENTE
(Prof. Carlo DOGLIONI)

RESEARCH CONTRACT

BY AND BETWEEN

Istituto Nazionale di Geofisica e Vulcanologia, hereinafter referred to as "**INGV**", Taxpayer's Code no. 06838821004, with main office in Via di Vigna Murata, 605 – 00143 Rome, represented by its President, Prof. Carlo Doglioni, domiciled for his position in via di Vigna Murata, 605 – Rome;

AND

Charles University, Faculty of Mathematics and Physics, hereinafter referred to as "Contracting party", VAT number no. CZ00216208, with its main office in Prague, Ke Karlovu 3, Czech Republic, represented by the Dean, Prof. Jan Kratochvíl;

THE PARTIES COVENANT AND AGREE AS FOLLOWS:

Art.1 (Object)

Within the framework of activities carried out by the working group of INGV-Milano, aimed at simulating earthquake ground motions and inverting waveforms, INGV intends to assign to the Contracting Party the performance of a Research Project, described in Annex 1, which is full and substantial part of this contract, according to the regulations below.

Art.2 (Research Coordinator)

Dr. František Gallovič will be the research coordinator on behalf of the Contracting Party, and will be the sole responsible, in according to to the operational modes and with the research staff, indicated in Annex 1.

Dr. Francesca Pacor will be the scientific responsible on behalf INGV and will be engaged in following the research project.

Art. 3 (Duration)

The project will start on March 1, 2020, and finish on February 28, 2022. The duration of the contract is the same.

Art. 4 (Funding)

The Research Project will be financed by INGV, with the INGV-EDF Project "Predictive ground motion models for reference sites" funds (C.OBFU 0925.010).

The funds assigned to the whole Research Project amount to **€ 30,000.00** (Euro thirty Thousand/00) to be paid to the Contracting party as follows:

- **€ 15,000.00** (Euro Fifteen thousand/00) at the beginning of the first stage of the project (March **2020**);

- **€ 10.000.00** (Euro Ten thousand/00) at the beginning of the II year of the project **(March 2021)**;

- **€ 5.000.00** (Euro Five thousand/00) at the end of the II year of the **project (February 2022);**

The transfer of the amount at the end of the Research Project will be subject to the approval given by the INGV scientific responsible. To give approval, the compliance of the activities performed with those listed in Annex 1 shall be evaluated.

Art. 5 (Management)

Funds for the performance of the Research Project are managed by the Contracting Party according to its own institutional.

The Research Coordinator and the INGV scientific responsible will meet at least two times during the research project to organize the activities and discuss the results. To strengthen the cooperation, exchanges of personnel between the two Parties will be also envisaged. The parties will cover the travel costs for its own staff.

Art. 6 (Personnel)

The research program is performed by the staff indicated in the sheet under Annex 1, plus any other personnel that will be chosen and committed exclusively care of the Contracting Party, under its own institutional regulations.

The Contracting Party shall pay all the relative charges, without exclusions, also with the funds made available by INGV, without any possibility of claim against INGV, even partial, in the event of higher cost.

Art. 7 (Availability and confidentiality of data and results)

The Research Coordinator of the Project, undertakes to:

- make available to INGV the results of the earthquake simulation and inversion;
- make available to INGV the simulation and inversion codes developed within the Project;
- support INGV in the implementation of the simulation and inversion codes within the ITACA and ESM infrastructures managed by INGV-Milano;

Art. 8 (Privacy)

The parties mutually state that they have been informed (and for what concerns them, expressly accept) that "personal data" provided, also verbally for pre-contract activities or collected as a consequence of and during the execution of this contract, are exclusively processed for the aims of the contract, by means of consultation, processing, interconnection, comparison with other data and/or any further manual and/or automated treatment and also, for statistical purposes, with the exclusive processing of data in anonymous form, by means of the communication to public institutions, when they request so to pursue their institutional objectives, as well as to private entities, when the objective of the request is compatible with the institutional objects of the Institution, aware that the lack of acceptance may imply the non execution or partial execution of the contract.

With respect to this article, the owners are the parties as defined, denominated and domiciled above.

The parties also state that they have been informed on the rights sanctioned by European Regulation UE 679/2016.

Art. 9 (Publications)

The publication of the Research Project results by means of free access web, as well as its communication to the population and public administrations must be agreed with INGV with respect to its modes and times. The publication of scientific articles produced as intermediate and final products of the activity of this research will be will be agreed between the parties.

Art. 10 (Termination)

The contract can be terminated in the event the Contracting Party states that it is impossible for it, for whatever cause, to fulfil the research program which is the object of this contract, without prejudice to the report of the amounts already utilized.

INGV can withdraw from the contract if during the execution of the research project there occur facts or decisions that make it impossible to fulfil the agreements included in this contract;

Art. 11 (Reference)

For that which is not expressly envisaged in this contract, reference is made to the provision of the Italian Civil Code.

Art. 12 (Litigation)

For all litigations or actions regarding the execution, termination and interpretation of this contract, reference is made to the Court of Rome.

Any form of arbitration is excluded.

This contract consists of 3 pages and one attachments:

Annex 1 – activity planning

Read, confirmed and signed

Rome, _____

The President of INGV

Prof. Doglioni

The Contracting Party

Prof. Jan Kratochvíl

INVERSION OF ACCELEROMETRIC WAVEFORMS AND GENERATION OF SEISMIC SCENARIOS: APPLICATION TO CASE STUDIES IN CENTRAL ITALY

PROJECT DESCRIPTION

1. Foreword

The INGV-Milan research group is involved in some national and European projects, with the aim of developing software and tools, devoted to simulate synthetic waveforms. This activity is planned to exploit and integrate the contents stored in the Engineering Strong Motion database and the ITalian ACcelerometric Archive, both managed by INGV. The long-term objective is to make available through the ESM and ITACA web portals (http://esm.mi.ingv.it/ and http://itaca.mi.ingv.it): 1) information about seismic source parameters of strong earthquakes (i.e. seismic moment, fault geometry, focal mechanism, slip model); 2) synthetic waveforms generated by means of physic-based broadband ground motion simulation techniques for past and future events.

The Charles University (Prague) research group has gained considerable experience in the field of inversion and modeling of strong-motion waveforms, developing and applying numerical codes suitable for the purpose such as ISOLA, a tool for centroid moment tensor inversion (Matlab version: http://seismo.geology.upatras.gr/isola/, and Python version: http://geo.mff.cuni.cz/~vackar/isola-obspy/), PSI for Bayesian slip inversion on possibly segmented fault with variable slip angle (Hallo and Gallovič, submitted), and HIC, a hybrid integral-composite (HIC) method introduced by Gallovič and Brokešová [2007] for generating synthetic seismograms from an extended fault.

To successfully integrate the skills of the two research groups in the field of the ground-motion simulation, a joint research program is planned, using events and records of central Italy as case studies. Objectives and activities are defined below.

2. Goals

The general objective is the development of packaged softwares, devoted to ground motion inversion and simulation, interoperable with ESM and ITACA strong-motion databases.

The intermediate goals are:

1. To link the ISOLA-ObsPy and PSI codes with the strong-motion databases, such as import/export of input/output data;
2. To improve the performance of the HIC simulation code to generate broad-band shaking scenarios, using as input-data the information stored in the strong-motion databases;
3. To test the inversion and simulation softwares for case studies in central Italy, focusing the attention on past (1915, Avezzano M_W=7.08), recent (2016, Norcia M_W=6.5), and future events.

3. State of the art

The accurate estimate of seismic source parameters is a key issue for the generation of ground shaking scenarios aimed at estimating losses and preventing disasters caused by earthquakes.

The shaking scenarios can be generated by means of numerical methods characterized by different complexity levels depending on the final target to be reached. If a scenario has to be performed for a large earthquake (M>6.0) associated to geomorphologic complexities, the rupture process and the site conditions play a crucial role. In such case, a careful description of the expected ground motion at a site of interest can be obtained through numerical simulations able to model the rupture process over a finite-fault, the path effects, and the local seismic response. Several simulation techniques have been developed and applied successfully to

generate seismic scenarios for large earthquakes ([1, 2, 3, 4, 5, 6, 7, 8, 9, 10], among others). A number of studies ([7,8,11,12,13,14]) and projects (https://scec.usc.edu/scecpedia/CyberShake; http://hypsther.mi.ingv.it; https://cheese-coe.eu) promote the integration of the earthquake simulations with probabilistic seismic hazard assessment, as well as the scenarios simulation for urban areas ([15, 16, 17, 18]).
In last years, the increasing demand for strong-motion data, which are one of the primary sources of information used by engineering seismologists and earthquake engineers to predict ground shaking and to perform structural seismic analysis, has encouraged the development of national (ITACA, http://itaca.mi.ingv.it/) or international (ESM, http://esm.mi.ingv.it/) accelerometric database, which contain waveforms of seismic events with moderate to large earthquakes. The user-friendly interfaces of ITACA and ESM allow target users to query waveforms and related metadata, customize waveform processing ([19], https://esm.mi.ingv.it/processing/), and select a suite of seven accelerograms compatible with the spectral shapes of the Italian seismic code and the Eurocode 8 ([20], https://bit.ly/2YzCDzR).
The integration of recorded data with synthetic seismograms is a major challenge, aimed to provide new tools to predict seismic ground motion, especially in near source region of moderate-to-strong events where strong motion data are generally scarce.

4. Working Program

The project is organized in three working tasks

Task 1: Finite-Fault Inversion
The aim of this task is to apply the software packages ISOLA and PSI to investigate the source properties of selected earthquakes that occurred in central Italy, and to adapt the input/output formats with the standard adopted by the strong-motion databases. The proposed case studies concern some moderate events of the 2016 central Italy seismic sequence; sensitivity analysis will be performed to understand the robustness of the results regarding, e.g., the data coverage.

Task 2: Strong-Ground Motion Simulation
The aim of this task is to develop a software to generate broad-band shaking scenarios, starting from the simulation approaches implemented in HIC to combine the deterministic and stochastic components of the ground motions. The performance of the simulation code will be tested by modeling the recorded ground motions of the Mw6.1 Amatrice and Mw 6.5 Norcia events. Then, the code will be applied to generate scenario-events relative to:

- the 2016 Norcia earthquake; the ground motions will be simulated at bedrock and including the site contributions estimated by empirical methods. The simulated ground motion distributions will be compared with the spatially-correlated shaking scenarios, based on the application of regional ground motion prediction equation;
- the scenario event relative to the 1915 Fucino event; in this case, the validation of the simulations will be carried out using the macroseismic intensity data points (https://emidius.mi.ingv.it/CPTI15-DBMI15/).

Task 3: Integration with strong-motion database
The aim of this task is to assess feasibility of the following procedures based on the lessons learned from the other two tasks:

1. Automatization of the ESM and ITACA data and metadata as input for the source inversion and ground motion simulation codes used during the Task 1 and the Task 2 activities;
2. Automatization of uploading source inversion codes outcomes (e.g. seismic moment tensor, source geometry, slip model) to ESM and ITACA;

3. Realization of a web tool for slip model generation by means of automatic inversion of ESM and ITACA waveforms with emphasis on technical issues on input/output format and the interoperability degree between PSI and the database structure;
4. Design of a tool (SimWave) to be included in the ESM and ITACA web-portals for generating synthetic ground motions. The goal is the simulation of broadband seismograms suitable for seismic hazard assessment and engineering applications, using event and station metadata stored in the database (i.e., fault geometry and position of the nucleation point for the source, or amplification functions and soil category for the station). The tool should be also able to produce user request seismic scenarios and related synthetic waveforms, specifying a few of key fields, such as magnitude, fault geometry, focal mechanism, etc.

5. Time schedule

The Project will start on January 2020 and finish on December 2021. Two meetings will be held each year to planning and monitoring the activities. Moreover, visits of the Praha staff at INGV Institute and vice versa will be planned during the project to share knowledge and to jointly work on inversion and simulation codes.

Task	Semestre			
	I 2020	II 2020	I 2021	II 2021
T1				
T2				
T3				

6. Working Group

WG1. INGV - Milan: Francesca Pacor, Maria D'Amico, Sara Sgobba, Emiliano Russo
WG2. Charles University - Prague: František Gallovič, Ľubica Valentová, František Čejka

7. Products

1. Scientific paper to be submitted on JCR journal describing the Central Italy case studies;
2. Technical Report on the design of the SimWave tool;
3. Codes for the seismic source inversion (seismic moment tensor and slip model) and the synthetic waveforms generation for building the SimWave tool

Reference

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