FAULT2SHA Working group – 3nd Annual Report – 2018-2019

By Oona Scotti & Laura Peruzza

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PARTICIPANTS AT THE 4TH WORKSHOP - BARCELONA

SCOPE & KEY ISSUES

Scope and Key Issues of the Working Group remain the ones declared in the home page of the FAULT2SHA website (http://fault2sha.net/info/), and quoted in the 1st Annual 2016-17 Report. We refer to it for the description of the initial activities.

The annual reports can be accessed online here: http://fault2sha.net/what/.

2018 – 2019 EXPANDING THE COMMUNITY

The third year of activity continued the process of enlargement of the community inside and outside Europe, the consolidation of natural test areas, and the search of funds to support the network. The third year activities culminated with the 4th FAULT2SHA meeting that was held in Barcelona in June 2019.

SUBSCRIPTIONS AND GOVERNING BOARD

People are asked to join to Fault2SHA working group by a form, accessible since Jan 2018 on a fully renewed website (http://fault2sha.net/join-fault2sha/). As of June 2019, about 114 members from 27 countries had signed; they regularly receive news and infos about the ongoing activities, via e-mail messages and social platforms (Twitter, Facebook) too.

The nine people that offered to act as governing board (Executive Committee, ExCom), and were elected with a ballot in 2017, continue their duties of leading some activities, always as voluntary, non-paid contributors. The FAULT2SHA ExCom is composed of the following members:

- Oona Scotti and Laura Peruzza (coordinators of the Working Group activities and responsible for reporting to the ESC)
- Bruno Pace
- Francesco Visini
- Lucilla Benedetti
- Julian Garcia-Mayordomo
- Maria Ortuño
- Graeme Weatherill
- Joanna Faure Walker

MEETINGS & WORKSHOP

The WG continues in the organization of sessions during well-known International Conferences; here we list only those organized between July 2018 to August 2019, if they explicitly use the "brand" FAULT2SHA. Some details about the target and the participants will follow.

- ESC 36th General Assembly – Malta 2-7 Sep. 2018 "*S14 Fault2SHA: so what?*, conveners: L. Peruzza, O. Scotti, B. Pace, F. Visini: 15 presentations (8 oral, 2 invited) http://www.escmalta2018.eu/page/home
- AGU Fall meeting 2018 – Washington, D.C. (USA) 10-14 Dec. 2018 "*Beyond the earthquake cycle – field and modeling constraints of earthquake rupture along complex-geometry fault systems and implications for seismic hazard assessment*", first convener Olaf Zielke. https://agu.confex.com/agu/fm18/preliminaryview.cgi/Session48938
- EGU General Assembly - Wien (A) 7-12 Apr. 2019: "*TS5.1 Paleoseismicity, active faulting, surface deformation, and the implication on seismic hazard assessment (Fault2SHA)*, first convener E. Hintersberger; about 50 contributions coming from all over the world https://meetingorganizer.copernicus.org/EGU2019/session/30171
- SSA Annual Meeting 2019 – Seattle (USA) 23-26 Apr. 2019 "*Explore the Fault2SHA paradigms across the Ponds*", first convener Laura Peruzza https://www.seismosoc.org/annual-meeting/

In November 2018, a workshop to bring together geologists, PSHA modellers and physics-based researchers was held in KAUST Campus in Thuwal (SA). Thanks to the efforts of the local organizers (O. Zielke, M. Mai) and to the funds provided by the KAUST University, many FAULT2SHA members benefitted of the initiative (see the Annual Report 2017-18 for more information).

On June 3-5, 2019, the 4th FAULT2SHA Workshop was held in Barcelona, Spain. About 70 participants contributed to the three Sessions and the final Round-Table; the focus selected for this workshop was the complexities of fault interaction. Pre-workshop proceedings have been released online (available at http://fault2sha.net/4th-workshop/); a final summary report will be spread among the participants and online in September 2019.

Finally, Oona Scotti presented the activities of the WG at the INQUA 20th Dublin (Ireland) 25th- 31st July 2019 "FAULT2SHA - "*Linking field geologists with seismic hazard modelers*" Oona Scotti, Laura Peruzza

FUNDING

As mentioned in previous reports, the ESC WGs are not financially supported, their activities and member participation are based on voluntary contributions, in terms of time or economic resources. The funds for organizing sessions and workshops derive from research resources of the promoters. In particular for the Barcelona Workshop, we acknowledge the efforts done by the local Organizing Committee and related institutions (Fig.1).

A COST proposal has been submitted by the ExCOM German representative (Graeme Weatherill), in the call OC-2018-1: in November 2018, the evaluation process ended, with promising scores but a negative result.

To expand the community, to organize meetings and workshops, and to provide the group with a more long-term vision continued to be a central action of the FAULT2SHA ExCom members during the year 2018-2019 (see the Ongoing and Future Activities Session).

Figure 1 – Supporting institutions of the 4th Workshop, held in Barcelona (E) in June 2019.

FAULT2SHA TEST LABS

❖ CENTRAL ITALY LAB

The central Apennines Fault2SHA laboratory has been set up to provide a forum within the Fault2SHA ESC Working Group for collaboration between those with research relating to fault-based seismic hazard in the central Apennines region. In particular, the central Apennines Fault2SHA laboratory aims to resolve and understand discrepancies and make data accessible, bringing together fault data from different research groups.

The central Italian Apennines fault system is a good case study field area for conducting fault-based seismic hazard assessment due to the fault exposure, previous works providing constraints on the fault slip rates and timing of earthquakes, and long historical record. The normal faults capable of producing large magnitude earthquakes are mostly exposed at the surface. This allows the fault traces to be mapped with high precision and the constraining of the geometry, kinematics and rates of faulting. The age of the offsets and paleoseismic investigations have been determined along many of the known faults allowing long-term displacement-rates across the faults to be constrained. One barrier to using fault data in

seismic hazard assessment, including probabilistic seismic hazard assessment (PSHA), is a lack of consistency between how primary data is recorded. For instance, the precisions of data location and measurements are variable. There remains debate regarding how to reconcile discrepancies among authors and build an open-access database on active faults, in particular how to account for the debate regarding which faults are active.

Thus far, meetings of the central Apennines Fault2SHA laboratory have been devoted to discuss data-collection and their representation for hazard calculations. This has led to the amalgamated dataset created in a format that can be of use to those working on fault-based PSHA. Expanding the inclusion of fault data in seismic hazard assessments is one of the key aims of the Fault2SHA Working Group. Having primary, open-access, accountable and detailed data will allow modellers to compute uncertainties in their hazard modelling, end-users to know where the inputs for such models are coming from and allows comparisons between different modelling approaches at different stages of modelling because the outputs are based on the same inputs.

The database has been created and is in preparation for open-access publication. In addition, Faure Walker et al. have commenced drafting a paper to accompany the database for publishing in an international peer-reviewed journal. The database will provide primary information on fault traces in the central Apennines (such as the surface fault geometry and slip-rates). Furthermore, the structure of the database can act as a blueprint for those working in other geographical areas. In addition, the database will offer the opportunity to identify priorities for reducing the uncertainties on poorly known or debated/doubtful faults and thus where future fieldwork may be focused.

Once the work on the current database is complete, the central Apennines lab will focus on (1) expanding the database to cover a larger geographical region; (2) expanding the database to include details on palaeoseismicity in the region; and (3) deciding the next piece of work to be undertaken by the lab, focusing on modeling using the available data.

It is the hope that our academic research will help to reduce both the human and economic losses from earthquakes in the future.

❖ BETICS LAB

The Betics Lab group was established in November 2017 and is composed of 20 people with research interests in the earthquake geology of the Eastern Betic Shear Zone (EBSZ) and the application of geological data in fault hazard modelling. A main activity during 2019 has been the organization of the 4th Fault2SHA workshop in Barcelona. A specific session was particularly devoted to the Betics covering issues from data-collection in the field to fault modelling for hazard calculations. As a result of the interaction gained in the workshop among geologists and modellers, a research project is now being prepared to be presented in a forthcoming call of the Spanish Ministry of Science. Another outcome from the Barcelona

workshop was the agreement to extend the Betics Lab working area farther from strictly the EBSZ, in order to include other secondary faulting that may prove important, as well its offshore extension. A paper entitled "Modelling earthquake multi-fault ruptures across complex fault systems based on geological data: the Eastern Betics Shear Zone" by Octavi Gómez-Novell and others has been submitted to Engineering Geology. It is foreseen a research stay of the first author at Università degli Studi di Chieti with Bruno Pace during 2020.

PUBLICATIONS & EDITORIAL ACTIVITIES

New functionalities were added to the Fault2SHA website, including availability of open source codes (http://fault2sha.net/what/tools/), a Paper Gallery (http://fault2sha.net/paper-gallery/), and multi task calendar (http://fault2sha.net/events/list/). The Paper Gallery is a list of publications not only of the FAULT2SHA WG, but also of any relevant paper fitting the aims and themes of the Working Group. All Fault2SHA members are invited to contact the web administrators (bruno.pace@unich.it, lperuzza@inogs.it) to suggest new entries to the Paper Gallery.

The editorial activities up to date are:

- The special issue in Natural Hazards and Earth System Sciences (NHESS) dedicated to FAULT2SHA themes (https://www.nat-hazards-earth-syst-sci.net/special_issue864.html) has been completed with the last papers published in Feb 2018, and the preface in May 2018.
- A special issue of Tectonics (AGU publication) dedicated to the 2016 earthquake sequence in Italy has been completed, the first paper published online in Sept 2017, the last one in February 2019. The table of content is accessible here: https://agupubs.onlinelibrary.wiley.com/doi/toc/10.1002/(ISSN)1944-9194.SEISMIC1

FAULT2SHA STUDENTS

- Alessandro Valentini - "Fault-based probabilistic seismic hazard analysis: issues and insights", Chieti University, Italy - 21 March 2019
- Thomas Chartier – "Modeling earthquake rates on faults for the probabilistic seismic risk assessment", Ecole Normale Supérieure de Paris and Institut de radioprotection et Sûreté Nucléaire, France – Planned for 31st October 2019
- Octavi Gomez-Novel – "Implications of the integration of paleoseismic data into seismic hazard assessments at the Eastern Betic Cordillera, SE Spain" – Facultat de Ciències de la Terra, Universitat de Barcelona, Spain – Contract ends April 2021
- Fiia NURMINEN - "Probabilistic fault displacement hazard: improved methodology

and applications" , Chieti University, Italy and Institut de radioprotection et Sûreté Nucléaire, France – Contract ends November 2021

2018 - 2019 ONGOING AND FUTURE ACTIVITIES

FUNDING/WORKSHOPS/MEETINGS/SESSION/WEBSITE

The 4th and namely last year of activity of the WG aims at improving further the network of interested researchers, the sharing of tools and information within and outside of the group. Efforts will be devoted to search for funds, by means of:

- the resubmittal of a COST proposal, initially leaded by the ExCOM German representative (Graeme Weatherill), in the call OC-2018-1: in September 2019, the new COST Action proposal will be leaded by Laura Peruzza (OGS, Italy), with a wider network of supporting members, and work packages.
- A IGCP-UNESCO proposal through the call "Earth Science for Society" focused on the request of funds to cover travel expenses of young scientist within the group and to begin an interaction between the group and modellers/data providers from Mexico and Colombia: the action is led by Maria Ortuño.

Another objective is the organization of the 5th FAULTSHA workshop. According to the exits of the previous one, this workshop should focus on the results from the two established natural laboratories, e.g. Betics and Central Italy, and/or to the formalization of a new one. The location and the local organizers of this venue are still being discussed.

The 37th General Assembly of the ESC will be held in Corfu, Greece from 6 to 11 September 2020. The WG is exploring the idea of proposing a dedicated session as well as a focused hands-on session in parallel of the meeting.

Bruno Pace and Oona Scotti are planning to submit a FAULT2SHA session at the EGU General Assembly 2020

LOGO CONTEST: Fault2SHA launched a contest for the working group logo. Anybody can contribute their creative ideas.

CHEESE[1]: Formal invitation for Fault2SHA to become a member of the ChEESE Center of Excellence Industrial User Board (IUB).

[1] ChEESE (cheese-coe.eu) is a European infrastructure project coordinated by the Barcelona Supercomputing Center. The main objective of ChEESE is to establish a new Center of Excellence in the domain of Solid Earth targeting the preparation for the upcoming pre-Exascale (2020) and Exascale (2022) supercomputers.