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FAULT2RISK User Manual Version 1.0

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This user manual guides through the different computational steps used in Scotti et al. (2020). Please note that SHERIFS input file (A_SHERIFS_CAD/input/ CAD_optionA1B1C1_10km/run.info) is here parametrized to run only 1 Montecarlo exploration of the multi-fault rupture model.

We strongly suggest to perform a first calculation with the given parameters and then, if needed, to modify Montecarlo exploration in the run.info file.

Data used in Scotti et al. (2020) are from the https://doi.pangaea.de/10.1594/PANGAEA.922582, Faure Walker et al. (2020, under revision), however, they have been also included this repository. Please note that here we only use the OPTION A1B1C1. The interested reader can re-run with alternative options, if necessary.

Citation

Complete or partial use of all the matlab scripts is allowed and has to be cited as: Scotti et al. (2020).

For SHERIFS and OPENQUAKE please cite their respective original manuscripts by Chartier et al. (2019) and Pagani et al. (2014).

Complete or partial use of the fault data is allowed and has to be cited as: Faure Walker et al. (2020, under revision).

Software requirements:

1. SHERIFS V1.2 (Python 3.7) - available in the supplementary material with the mfd_shape.py subroutine adapted for the CAD (Mrupt = 6.7). We suggest to run test_SHERIFS.py before running SHERIFS. Please refer to the User_Manual_SHERIFS_V1.1.pdf contained in the folder A_SHERIFS_CAD for details of the code, if necessary.

2. OPENQUAKE 3.9 (Python 3.6) - available at https://github.com/gem/oq-engine/#openquake-engine. Input and output format of the Openquake files can change in different versions, we refer to the OQ 3.9 version for the file formats.

3. MATLAB (R2016a - R2018a with mapping toolbox) - licence required

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Steps of the calculation:

1° Building the seismogenic sources

2° Running SHERIFS

2° Running OPENQUAKE

3° Visualizing results

1° **From primary data to seismogenic sources**

a. Open Matlab and move to the folder FAULT2RISK

b. Run A1_script_DB2SHERIFSinputs.m that will read and extract information from the DATABASE and prepare slip rate profiles, section parameters and input files for SHERIFS (it can take several minutes). At this step you have built a fault model based on OPTIONS A1B1C1. If you want to change options you need to go back to the Excel File of the database.

c. Run A2_script_Combine_Sections.m that will prepare a rupture list input file for SHERIFS (it can take several minutes). At this stage you have a fault model and possible rupture models based on given distance criteria and sections lengths.

2° Running SHERIFS:

d. Open a Terminal, move to the folder "A_SHERIFS_CAD" and type command line:

e. python 1_SHERIFS.py (this program can take more than 15 minutes).

f. python 2_Visualisation.py

At this stage you have explored magnitude frequency distributions for each sections of your fault system and for each rupture and you have created a earthquake rupture forecast model.

3° Running hazard and risk:

g. Open Matlab and move to the folder FAULT2RISK

h. Run B1_script_BuildSourceModelForEachScenario.m that will prepare input files for Openquake

i. Open a Terminal and type : source ~/openquake/env.sh

j. From the Terminal, move to the folder CentralApenninesLabFAULT2RISK-main and type :

oq engine --run B_OQ_JOB_GMPE_FRAGILTY_EXPOSURE/job_damage.ini --log-level info

(this run can take more than 30 minutes)

To export hazard and risk results:

k. From the terminal type : mkdir WORKING_DIRECTORY_A1B1C1_10km/OQoutputs

l. From the terminal type :

oq engine --export-outputs calculation# WORKING_DIRECTORY_A1B1C1_10km/OQoutputs/

NB: calculation# depends on your own computer. You can see this number during the OpenQuake execution. For example "calculation #2 completed in 2178 seconds", calculationNumber = 2

4° V Visualizing model results and data

m. Open Matlab and move to the folder CentralApenninesLabFAULT2RISK-main

n. Set the variable "OQ_RUN_ID" with the calculationNumber in the "user options" section of the following matlab scripts

- C1_hazard_maps.m,

- C2_risk_map,
- D1_PartecipationHazard_by_section
- D2_PartecipationRisk_by_section (note that D2_PartecipationRisk_by_section_aquila.m produces a figure centered on L'Aquila)

o. Run the Matlab codes

p. Figures are in WORKING_DIRECTORY_A1B1C1_10km/visualization/figures

We also provide extra mapping codes (O_name.m) (traces, faults, earthquake catalog, etc.).

Reference

Chartier et al. (2017). Methodology for earthquake rupture rate estimates of fault networks: example for the western Corinth rift, Greece. Natural Hazards and Earth System Sciences, European Geosciences Union, 2017, 17 (10), pp.1857 – 1869. https://doi.org/10.5194/nhess-17-1857-2017.

Faure Walker et al. (2020). Fault2SHA Central Apennines Database – Structuring active fault data for Seismic Hazard Assessment. Scientific Reports, under revision.

Pagani et al. (2014). OpenQuake engine: an open hazard (and risk) software for the global earthquake model. Seismol Res Lett 85(3):692–702.

Scotti et al. (2020). Which fault threatens me most? Bridging the gap between geologic data-providers and seismic risk practitioners, Frontiers, accepted 28th December 2020.