New seismicity models for updating the national Italian PSH model
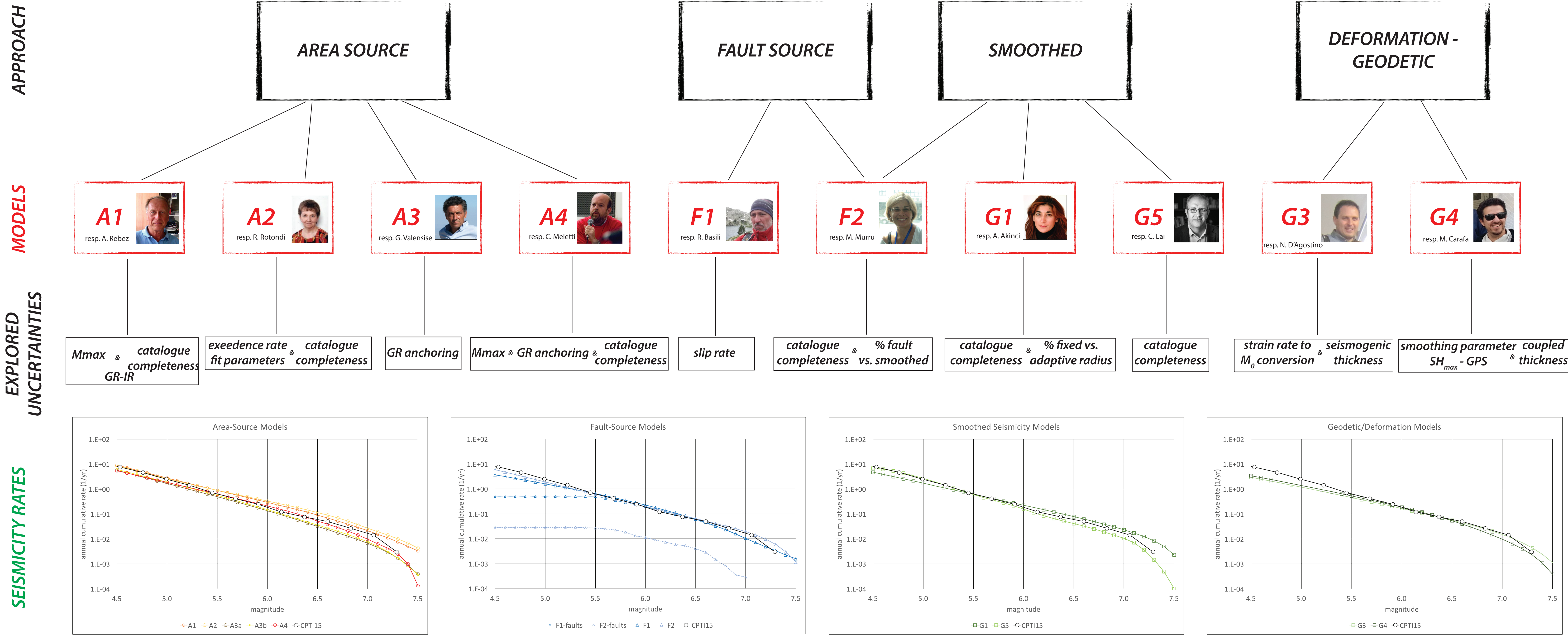
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ABSTRACT

We present the new seismicity models that contributed to update the national seismic hazard model for Italy in the framework of MPS16 Project. More than 30 researchers participated and gather together in 12 working groups, each group produced a seismicity model along with an analysis of the associated uncertainties. The common input data used by working groups in-cluded the most updated information about seismicity (historical and instrumental), seismo-genic faults and deformation (both from seismicity and geodetic data). The seismicity models have been elaborating in terms of classic source areas, fault sources and gridded seismicity based on different approaches in order to explore the uncertainty in defining seismic sources and related rates. Finally, 11 seismicity models cover the entire Italian territory and surrounding area, 1 seismicity model was built ad hoc for the volcanic Etna area. Moreover, a unique seismicity model for the sub-duction zone in the Tyrrhenian Sea was built, and the seismicity models recently developed for a European project (SHARE, www.share-eu.org) were used for the external territories. As regards the 11 national models, in particular: 5 models are based on area source and, with different approaches, on expected seismicity rates by means of fit of observations of the historical earthquake catalogue; 2 models are based on a mixed fixed-radius and adaptive radius and on Woo meth-odology for smoothing seismicity; 2 models used faults and background seismicity and; 2 models are based on geodetic data and they are independent from the historical seismicity. We compared expected seismicity rates derived from seis-micity models with the observed historical seismicity to understand pro and cons of each approach, and finally, formulated a methodology to weight and ensemble seismicity models including experts-driven elicitation and statistical tests.

APPROACH

| AREA SOURCE | FAULT SOURCE | SMOOTHED | DEFORMATION - GEODETIC |

MODELS

A1 resp. A. Rebez | A2 resp. R. Rotondi | A3 resp. G. Valensise | A4 resp. C. Meletti | F1 resp. R. Basili | F2 resp. M. Murru | G1 resp. A. Akinci | G5 resp. C. Lai | G3 resp. N. D'Agostino | G4 resp. M. Carafa

EXPLORED UNCERTAINTIES

- A1: Mmax & GR-IR & catalogue completeness
- A2: exeedence rate fit parameters & catalogue completeness
- A3: GR anchoring
- A4: Mmax & GR anchoring & catalogue completeness
- F1: slip rate
- F2: catalogue completeness & % fault vs. smoothed
- G1: catalogue completeness & % fixed vs. adaptive radius
- G5: catalogue completeness
- G3: strain rate to M_0 conversion & seismogenic thickness
- G4: smoothing parameter coupled SH_max - GPS & thickness

SEISMICITY RATES

Area-Source Models — annual cumulative rate (1/yr) vs magnitude — A1, A2, A3a, A3b, A4, CPTI15

Fault-Source Models — F1-faults, F2-faults, F1, F2, CPTI15

Smoothed Seismicity Models — G1, G5, CPTI15

Geodetic/Deformation Models — G3, G4, CPTI15

SOME PRELIMINARY RESULTS
maps of PGA expected not to be exceeded in 50 yr at 90% probability level
GMPEs: Akkar et al. (2014) (Rhypo, logic tree weight 0.35); Bindi et al. (2011) (Rjb, 0.35); Cauzzi et al., (2015) (Rrup, 0.15); Boore et al. (2014) (Rjb, 0.15).

A1
Cornell approach
structural geology contribution to the zonation
maximum likelihood estimation
b-values on macroareas

A2
Cornell approach
zonation from A4
completeness and seismicity rates calculated using the bayesian "change-point" ap-proach

A3
Cornell approach
2 different zonations
b-value and corner magnitude following a tapered G-R distribu-tion on macroareas
maximum likelihood estimation

A4
Cornell approach
new seismotectonic zonation
b-values on macroareas
truncated G-R model
maximum likelihood estimation

F1
composite faults (DISS database) as sources
slip rates
seismic moment con-servation principle
off-fault seismicity from an empirical proximity function
tapered G-R distribu-tion

F2
individual faults (DISS database) as sources
seismic moment con-servation principle
smoothed seismicity + fault sources

PGA (g)
< 0.025
0.025-0.050
0.050-0.075
0.075-0.100
0.100-0.125
0.125-0.150
0.150-0.175
0.175-0.200
0.200-0.225
0.225-0.250
0.250-0.275
0.275-0.300
0.300-0.350
0.350-0.400
0.400-0.450
0.450-0.500
0.500-0.600
0.600-0.700
0.700-0.800
0.800-0.900
0.900-1.000
1.000-1.250
1.250-1.500
1.500-1.750
1.750-2.000

Acknowledgements

G1
Frankel approach
adaptive smoothing methods

G5
Woo approach
magnitude–dependent relationship defined by a kernel function

G3
geodetically-derived seismicity model
919 GPS derived horizontal velocities
tapered G-R distri-bution

G4
SHmax and GPS data
long-term deformation model (NeoKinema)
earthquake rates from SHIFT
tapered G-R distri-bution