How new fault data and models affect seismic hazard results?

Examples from southeast Spain

J.M. Gaspar-Escribano, M.B. Benito, A. Staller, S. Ruiz Barajas, L.E. Quirós

Earthquake Engineering Research Group

1 OBJECTIVE

Study the impact of different approaches to include fault data and models in a probabilistic seismic hazard assessment.

2 CONTEXT

- Area of application: Murcia, one of the most active areas in Spain
- Low-to-moderate seismic activity
- Availability of fault slip rates from paleoseismic data and from geodetic data (GPS-based measurements)

3 FAULT DATA

- Area-source model of the recent hazard map of Spain (Fig. 1)
- Paleoseismic data and fault geometries extracted from QAFI database (Fig. 2)
- Slip rates derived from GPS data (Table 1)

Fig. 1

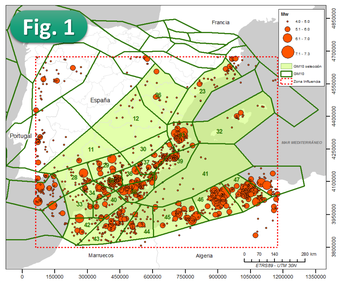


Fig. 2

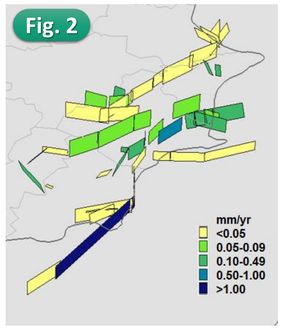
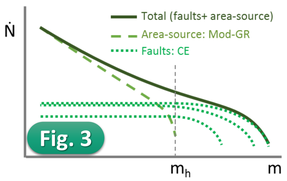


Table 1

ID	Fault Name	Mmax	Paleoseismic		Geodetic	
			SR	RP	SR	RP
ES626	Alhama de Murcia (1/4)	6.5-7.0	0.500	3166	1.350	1173
ES627	Alhama de Murcia (2/4)	6.4-6.8	0.300	4350	1.350	967
ES628	Alhama de Murcia (3/4)	6.3-6.5	0.000	-	1.000	1023
ES629	Alhama de Murcia (4/4)	6.5-6.9	0.000	-	0.200	7257
ES609	Palomares (1/2)	6.6-7.1	0.040	65583	0.150	17489
ES630	Carboneras (1/2)	6.8-7.7	1.101	2957	1.400	2325
ES610	Palomares (2/2)	6.5-6.8	0.050	39646	0.150	13215

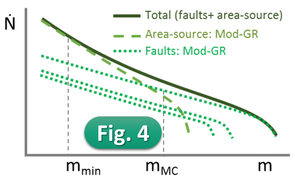
4 SOURCE MODELS

Model 1 Distribution of seismicity based on magnitude (m_h)



- **Faults sources** for big events ($m>m_h$) only and characteristic earthquake model (CE)
- **Area-sources** for small events ($m<m_h$) only and modified Gutenberg-Richter (mod-GR) recurrence model (Fig. 3)

Model 2 Distribution of seismicity based on moment rate ($\dot{M}_0$) [3]



- Distribution of seismic potential assigned to **faults** and **area-sources** within the magnitude interval [m_{min},m_{MC}] where the catalog is complete
- Mod-GR recurrence model for both **faults** and **area-sources** (Fig. 4)

5 PREVIOUS STUDIES

Fig. 5

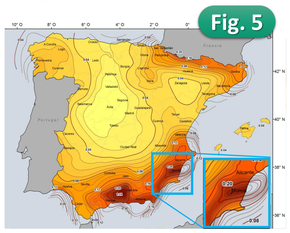
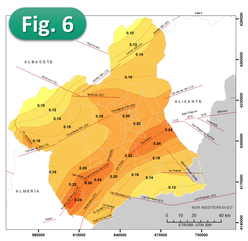


Fig. 6



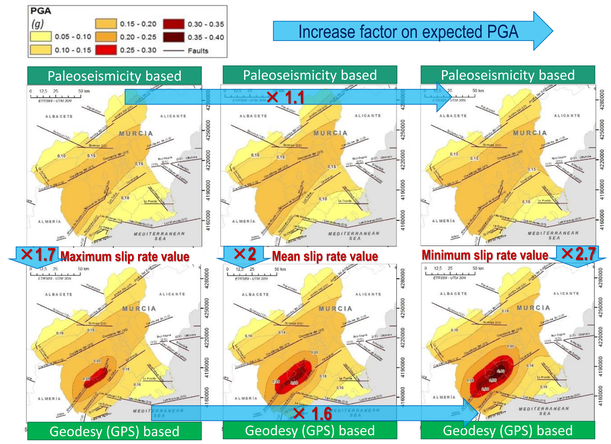
- The new hazard maps of Spain (Fig. 5) based on an area-source model, and the updated hazard map for the risk plan of the study area (including fault sources as in Model 2 and paleoseismic data (Fig. 6)) provide expected PGA values of 0.10 - 0.24 g (for a return period of 475 yrs on rock conditions)

6 WORK FLOW

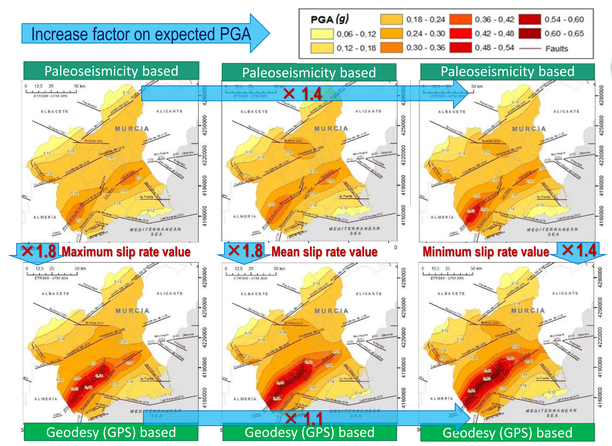
1. Select input choices
2. Compose models
3. Compute seismic hazard
4. Make sensitivity analysis
5. Compare with previous studies

7 RESULTS AND SENSITIVITY ANALYSES

7.a. Model 1. Sensitivity to slip rate values



7.b. Model 2. Sensitivity to slip rate values



7.c. Sensitivity to source models

- High COV values along fault traces (Fig. 7) imply a strong variability related to slip rate values.
- High COV values along fault traces (Fig. 8) show a strong variability related source model.
- Both sources of variability are comparable (Fig. 9)

Fig. 7

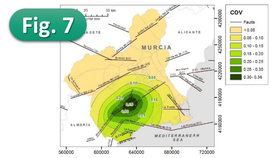


Fig. 8

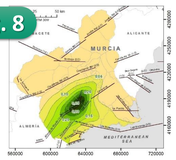
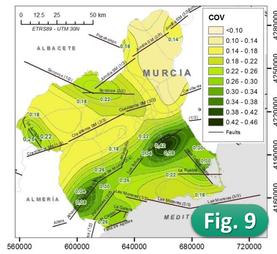
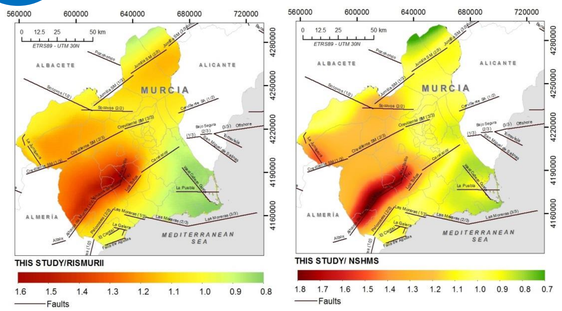


Fig. 9



8 COMPARISON WITH PREVIOUS STUDIES



- Increase by a factor up to 1.8 in relation to recent work

9 CONCLUSIONS

- Geodetically derived slip rates yield much larger PGA values than paleoseismic slip rates.
- Model 2 (mod-GR to fault sources) leads to much higher expected PGA values
- Expected PGA values from recent studies are exceeded by a factor of up to 1.8

This work is part of the MERISUR project, (ref. CGL2013-40492-R), with funding from the Spanish Ministry of Economy and Competitiveness

CONTACT

ETSI Topografía, Geodesia y Cartografía, Campus Sur UPM, c/ Mercartor 2, E-28031 Madrid, Spain
jorge.gaspar@upm.es
+ 34 913366441