

The use of damage records and coeval cadastre sources for improving the intensity assessment

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ABSTRACT: The 1846 Orciano (Pisa) earthquake has been studied using direct sources (government surveys), but some uncertainties in the intensity assessment are still present. A new research, still in progress, tries to solve the problem using an indirect source, the cadastre, that could give information on size and localization of the building. This paper shows the first results of this research.

The records of the damage survey

The earthquake which occurred in the area south of Pisa (Italy) in 1846 is listed in the Italian catalogue (Postpischl, 1985) with $I_0 = X$ MCS. A recent investigation of archive sources (Albini et al., 1991) has led to an improved intensity map of the earthquake (Fig. 1), which still shows some uncertainties; for instance, the maximum intensity (IX-X MCS) has been assigned to one locality only, Orciano, what causes some problems in assessing the epicentral intensity.

The uncertainty of the intensity estimate for Orciano is obviously due to the uncertainties of the data, which come from the official survey performed by the Tuscan government in order to support the repairs. The survey, that includes a short description of damage happened to each building, have been processed by defining five classes of damage, similar but not exactly coincident with those of the MSK scale (Tab. 1). The total number of buildings has been derived by archive (ASF, 1841) or narrative (Tabani, 1846) sources. Intensity has then been assessed using the criteria shown in Tab. 1 (Albini et al. 1991).

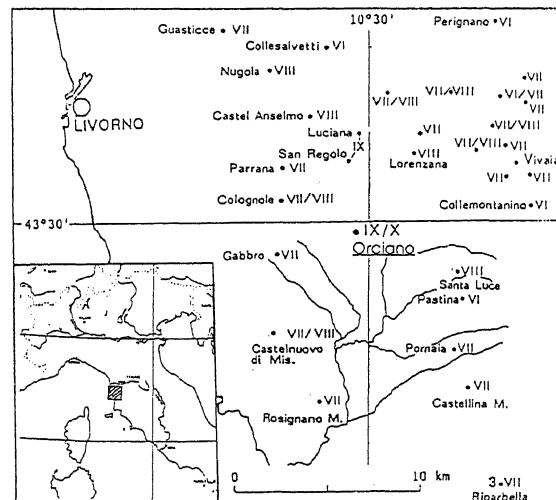


Figure 1. The intensity (MCS) map of the 1846 earthquake from the government survey documents.

Table 1. Classes of damage and criteria for intensity assessment used to process the damage survey.

classes of damage		estimated repair cost (Tuscan lire)	Criteria for the intensity assessment	
			Percentage of buildings with damage of class 5+4	I (MCS)
1	Fissures, slight repairs	120 ± 70	0	VI
2	Damage to inner walls, collapse of chimneys, utilization of chains to avoid the collapse of walls	250 ± 100	0	VI-VII
3	Collapse of some inner walls, partial collapse of the roof	750 ± 300	1-5	VII
4	Partial destruction of the building; collapse of upper floors, total collapse of the roof	1.500 ± 600	1-5	VII-VIII
5	Total destruction of the building	≥ 2.000	25	VIII
			25	VIII-IX
			50	IX
			50	IX-X
			75	X

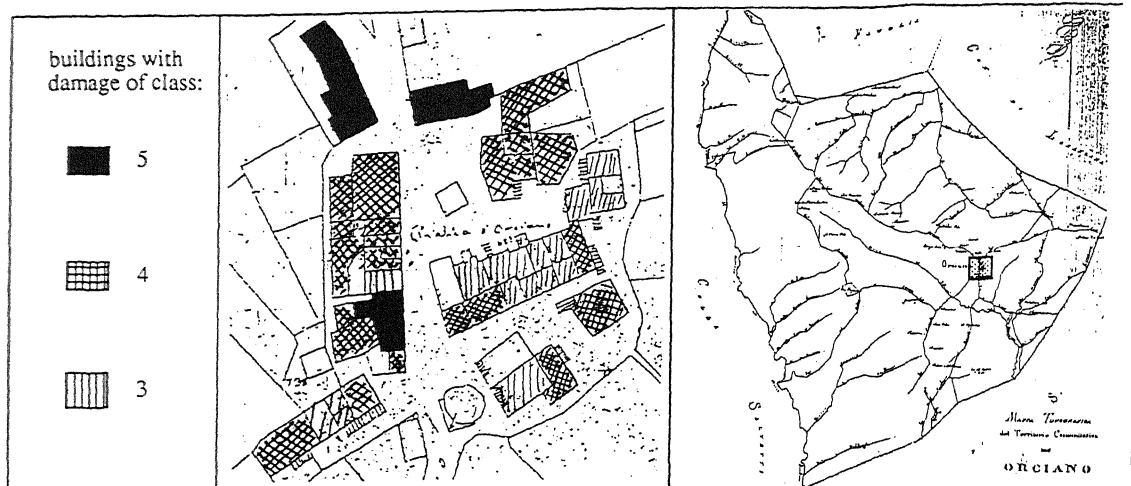


Figure 2. The damage data of the village of Orciano represented on the coeval cadastral map.

Table 2. Comparison of damage data and intensity estimates from the previous and the present research.

Data	number of buildings		Percentage of buildings for class of damage						total	I (MCS)
			5	4	3	2	1	5+4		
Albini et al., 1991	total	113	23	39	30	6	1	62	99	IX-X
new research	total	94	29	37	19	3	1	66	89	IX-X
	village	52	15	35	31	6	2	50	89	IX
	country	42	45	40	5	-	-	85	90	(X)

The contribution of the cadastre

As the intensity at Orciano is one of the keys for evaluating the size of the earthquake, which is by the way the strongest known in the area, further research, still in progress, has been undertaken.

From the cadastre compiled around 1823 (ASPi, 1823ca) it has been possible to check the settlement of Orciano at the time the earthquake occurred. Data from the cadastre have been cross-checked with those of surveys, using the name of the owners as a key. This has allowed to locate buildings on the cadastre map and to determine their size (Fig. 2). Unfortunately the cadastre does not contain data on the typologies of buildings, what makes uneasy the use of the MSK intensity scale.

Nevertheless, this source allows some progress, as it makes possible to separate the buildings in the village from those in the country. Processing the surveys, taking this division into consideration, gives the results shown in Tab. 2. The data of the total have not changed very much, leading again to an intensity of IX-X MCS. But, considering only the data from the village, which fit better the scale requirements in terms of statistical significance and limited area, leads to an intensity of IX. On the contrary the data from the country are scattered, and therefore less suitable for intensity assessment.

Conclusions

The intensity estimates from historical records can be improved by making use of indirect sources which supply data on number and distribution of buildings and, possibly, on their typologies. In some cases it is even possible to cross-check historical records with today evidences. Some uncertainties which may come from incorrect interpretation of damage descriptions, can be avoided by a strong collaboration between engineers and historians.

References

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