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EFFECTS OF PAST EARTHQUAKES

Seismic history is one of the aids used in conjunction with the laws of intensity attenuation and seismotectonic considerations to draw up seismic risk maps which show how likely it is that an area will suffer an earthquake of a given intensity (e.g. grade VIII on the Mercalli scale), and how often. Though essential in macrozoning, it is not very useful on a small scale. The smallest unit taken into consideration for risk maps is the territory of the commune which, furthermore, is deemed to be homogeneous.

The objective in San Lorenzello was to use the information provided by its seismic history to highlight differences in seismic response within the territory of the commune, which was not considered as homogeneous.

Seismic history can make a twofold contribution to assessing the local earthquake culture and reducing the vulnerability of the system. To begin with, it refreshes memories of past earthquakes and prevents traditional methods from being abandoned because it reduces people's tendency to forget, something which not only leads them to abandon traditional methods but also renders modern methods increasingly superfluous. It can also help to identify any pattern of repeated damage in relation to specific areas or methods and help to decide which of the various recognisable danger signs are the most dangerous because they were seen at the time of previous earthquakes, etc.

Research method

In analysing the seismic history of the San Lorenzello area our first step was to find and compare all the direct and indirect sources of information available. We consulted several bibliographical sources, contemporary and modern, and we analysed unpublished documents from national, parish and private archives.

The next stage was to identify the private buildings and areas of the urban fabric described in those sources.

From the quantity and detail of the information assembled we were able to place these on a map of the buildings in existence at the time of the major earthquakes. We did not find any historical maps specifically detailing each individual earthquake. We thus used a map dating from 1876 (the oldest we could find), one from 1930 and one from 1987. To identify the individual dwellings mentioned in our sources we compared the maps first against the original documents and then with each other, drawing on the knowledge of municipal technical officers, local experts and the memories of the oldest inhabitants.

From the MMI scale data we were thus able to identify the categories of buildings, and then to deduce categories of damage from the descriptions given in the sources we examined:

1) Total collapse ("houses completely destroyed");
2) Partial collapse and major damage ("houses extensively damaged and rendered uninhabitable").

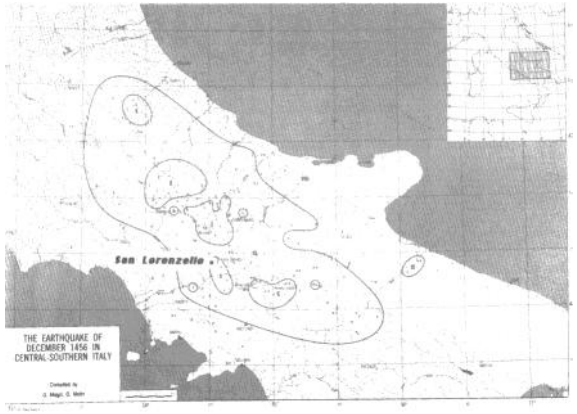
This investigative method was used to ascertain the effects on buildings of the earthquakes of June 1688, July 1805 and November 1980.

The major earthquakes

December 1456

The 1456 earthquake is arguably one of the most disastrous in the whole of Italy's seismic history. The regions hardest hit were Molisa, Campania, part of the Abruzzi, Basilicata and Apulia. This earthquake prompted a wide variety of interpretations due to the fact that numerous sources were discovered which offered conflicting information.

The number of victims was put at between 12,000 and 100,000, but the most probable figure for fatalities is 30,000. Benevento was almost entirely destroyed, losing 500 inhabitants. There are no exact figures for San Lorenzello but the chances are that it was serious damaged. By way of an indication, 400 people were killed in the neighbouring village of Cerreto Sannita.

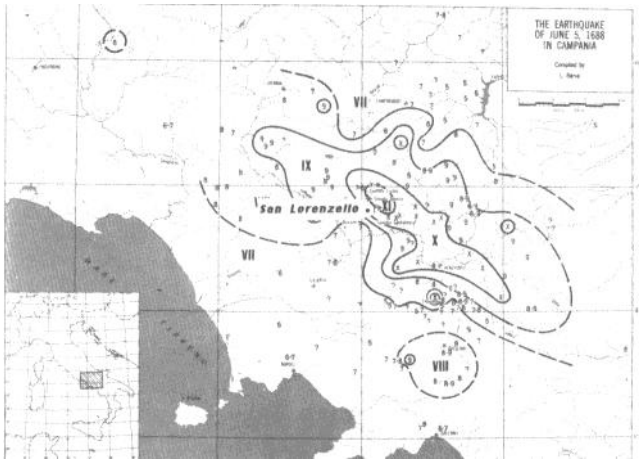


June 1688

This earthquake devastated the whole of the Benevento region, especially all the communes on the south-eastern side of the Matese, and it was felt very strongly in Irpinia. The number of victims was variously put at between 8,000 and 16,000.

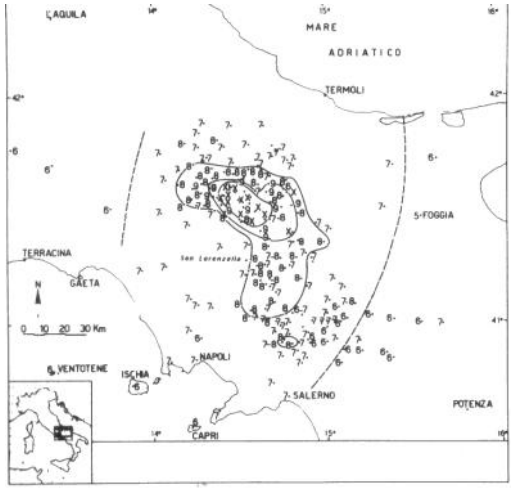
Cerreto Sannita and Civitella Licinia suffered the worst damage which was rated grade XI on the Mercalli scale. Cerreto Sannita was rebuilt on a different site, whilst Civitella virtually ceased to exist as an autonomous commune (it is now a hamlet attached to Cusano Mutri).

San Lorenzello lost 400 out of 1,000 inhabitants and suffered serious material damage. From a study of the sources it seems that the effects were aggravated by landslides triggered by the earthquake.



26 July 1805
(The Santa Anna earthquake)

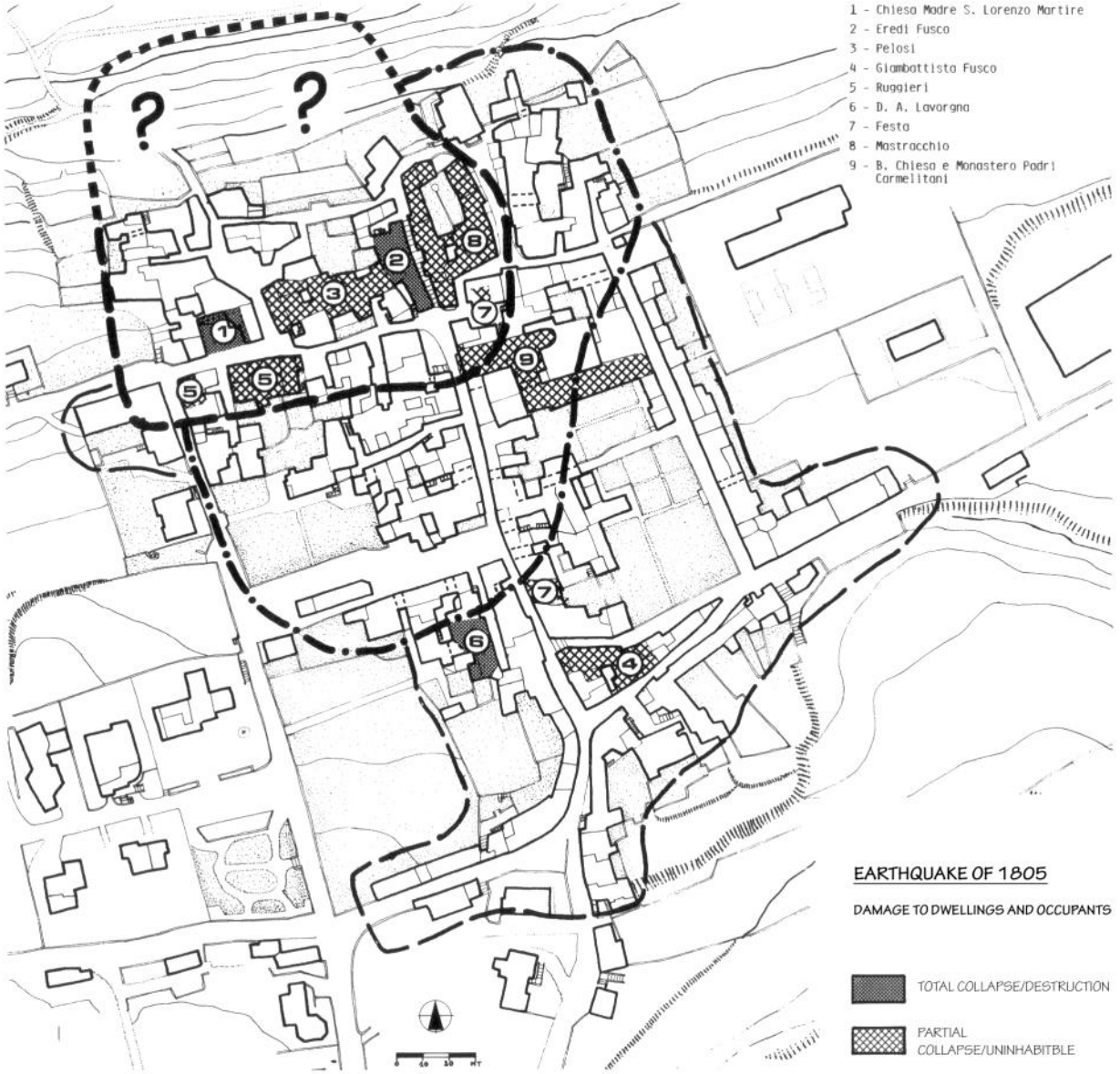
The provinces worst hit were those of the "Contado del Molise" and "Principato Ultra", but the province of Naples was affected too. Estimates of the number of victims range from 4000 to 6000. The earthquake caused considerable geological and hydrogeological changes such as ground fractures, liquefaction, landslips, changes in the level and clouding of well water, rivers changing course. The worst damage was in Frosolone where the intensity recorded was



equivalent to grade XI on the Mercalli scale. In San Lorenzello there was only one victim but the damage was that of grade VIII.

23 November 1980

The earthquake of 23 November 1980, magnitude 6.9, struck mainly Campania and Basilicata, killing 3,500 people. Its peak intensity reached grade X on the MSK scale in San Angelo dei Lombardi, Lioni,



Laviano, Santomenna, Castelnuovo di Conza and Conza. The intensity chart is based on 1,300 monitoring stations located at points throughout the country. Isoseismal tracings of grade X to III on the MSK scale were recorded, with a pattern of movement towards the Apennines. There were major effects on the ground and on water courses: liquefaction in the alluvial plains, wide fluctuations in the output of springs (Caposele), fracturing of the ground and landslips both at the epicentre and in the surrounding area.

A few notes

When we processed the data it became apparent that the original sources were nearly always more detailed and more reliable than later information and accounts. They often give a full picture of the situation immediately after the earthquake, whereas recent bibliographical sources tend to give a personal interpretation of the original sources rather than reproduce the raw data concerning the earthquake.

But even if we analyse the original sources these are not always very useful in helping us to piece together the history of the architecture. For example, the map of the 1688 earthquake shows only the area which suffered the greatest damage, whilst that for 1805 distinguishes the damage to secular buildings from that to ecclesiastical property, which information is still available in the archives.

Despite the highly detailed nature of the information obtained, some dwellings could not be pinpointed because all trace of them had been lost.

By analysing the documents we were able, however, to identify some aspects of the community's behaviour (seen at the time of other earthquakes too) which took the form of organisational measures by the authorities and the setting up of committees of local experts. These experts described in great detail the degree of damage and its possible causes, which meant that to some extent they were using "macrozoning" techniques.

In many instances, seismic history can also be useful in compiling maps which chart the effects of an earthquake on the ground and water courses and can be used as a basis for preventing secondary effects. For the commune, conclusions can also be drawn regarding the most serious phenomena, such as liquefaction and the risk of landslides which might make the local damage worse. Negative findings should also be made use of here. In San Lorenzello, for example, the original sources reveal that "throughout the territory, neither fractures, nor upfolds nor landslips were observed."

The objective in compiling several damage maps is to identify any repetition of damage within a given area. This is the first observation recorded by the community and thus helps to build up the local earthquake culture.

In any case, the purpose of compiling several maps is to ascertain whether damage always occurs at the same sites or not.

This observation is the first step in the process of shaping a local earthquake culture: "*The ground on which the Village (.....) built is of two kinds. The part (.....) from the centre is built on a bank of (.....), which was washed down by the rain from the Mountain which (.....), and (.....) as the (.....) did not form a solid and stable base, all the houses built on this site are either totally or partially destroyed. The lower part, however, which is built on tuff, has largely escaped, as it did even in the terrible earthquake of 5 June 1688, and this should convince the inhabitants to abandon a site which has been hit by earthquakes twice already*" (excerpt from a report drawn up after the earthquake of 26 July 1805).

It is clear that today this is no longer good enough. The systematic repetition of damage in one and the same area has to be examined in relation to the state of preservation of its buildings, but also in relation to geomorphological maps, so that the factors possible responsible for any anomaly in the local seismic response can be identified.