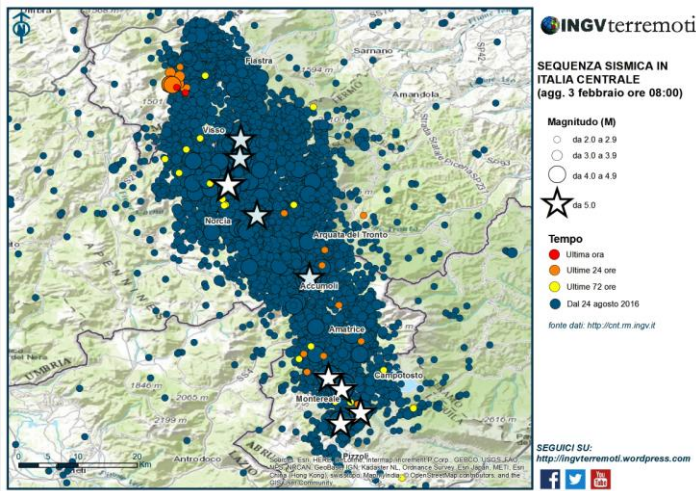


Central Italy Seismic Sequence 2016-17

Event characteristics

On August 24, 2016, at 3:36 AM (local time), a magnitude 6.0 earthquake struck Central Italy, producing extensive damage and killing more than 270 people in several municipalities of the Lazio, Umbria and Marche regions. This earthquake was followed by a long and intense sequence of seismic events in the area, which is still ongoing, with eight events of magnitude equal to or larger than 5.0. Among them, on October 30, 2016, at 7:40 AM (local time), a magnitude 6.5 earthquake struck 6 km north of Norcia; this is the largest earthquake occurred in Italy in 36 years, since the 1980 Irpinia earthquake. The entire sequence produced extensive damage in a large area comprising municipalities of the four Italian regions of Lazio, Umbria, Marche and Abruzzo. During the sequence peak ground accelerations up to 0.5g were recorded by the INGV station network. The following figure shows a map prepared by the Istituto Nazionale di Geofisica e Vulcanologia (INGV) with the geographical distribution of the epicenters of all the events above magnitude 2.0 occurred in the affected area from August 24, 2016 to February 3, 2017.



Source: INGV, <http://ingvterremoti.wordpress.com>

Using the ground motion information provided by INGV, the consortium ERN/RED applied the Italy module of its Pan-European probabilistic earthquake loss estimation model to quantify the potential size of the direct physical losses produced by the entire seismic sequence to residential, commercial, industrial and public buildings. Contents losses, business interruption losses, infrastructure losses, emergency losses and any other kind of indirect losses are not included in these estimates.

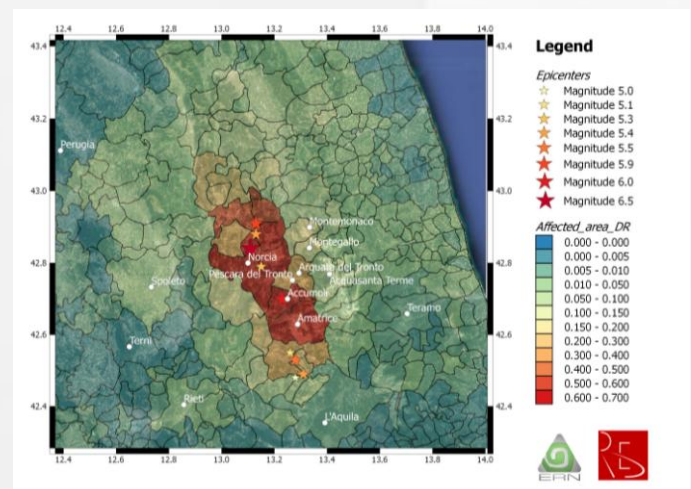
The main nine events having magnitude of 5.0 or larger were considered in this exercise. In table below are reported the main characteristics of the events modeled.

Date & Time (UTC)	Province/Area	Magnitude	Depth (km)
2017-01-18 - 13:33:36	L'Aquila	5	10
2017-01-18 - 10:25:23	L'Aquila	5.4	9
2017-01-18 - 10:14:09	L'Aquila	5.5	9
2017-01-18 - 09:25:40	L'Aquila	5.1	9
2016-10-30 - 06:40:17	Perugia	6.5	9
2016-10-26 - 19:18:05	Macerata	5.9	8
2016-10-26 - 17:10:36	Macerata	5.4	9
2016-08-24 - 02:33:28	Perugia	5.4	8
2016-08-24 - 01:36:32	Rieti	6	8

Unlike what is traditionally done, the losses for the entire sequence were computed by modeling the cumulative damage caused to buildings. ERN/RED used its own exposure database, complemented with the Italian bureau of statistics ISTAT data. With high probability, the modeled direct losses for the entire sequence range between 2'750 and 8'670 million euros, with an average of 5'716 million euros. The table below reports the loss estimates for the entire sequence divided by sector with associated uncertainty.

Line of Business	Sequence Loss (M €)		
	Expected Value	16th Percentile	84th Percentile
Residential	4,319	2,090	6,536
Industrial	929	441	1,417
Commercial	261	122	399
Public	208	96	320
Total	5,716	2,749	8,672

The geographical distribution of the average damage ratio per municipality is displayed in the following figure. The average damage ratio for a given municipality is computed by dividing the loss estimate by the total replacement cost of the assets in the municipality. These values are in very good agreement with those that can be inferred by the 150,000 inspections carried out by the Italian Department of Civil Protection since the events of August 24, 2016.



The earthquake insurance penetration in Italy is negligible in the residential sector and rather limited for industrial and commercial sectors. However, the mountainous area most severely hit by the quake does not have a large stock of industrial and commercial assets. Therefore, the insured losses are expected to be limited.

About ERN/RED

Consortium ERN/RED is formed by two companies dedicated to modelling catastrophic risk due to natural perils. ERN (Evaluación de Riesgos Naturales), a company based in Mexico City, has developed models for several perils and territories, mainly in Latin America; several of its models are used for regulatory purposes in various countries. RED (Risk Engineering + Design) is a company based in Pavia, Italy, with ample experience in catastrophic modelling. Together, both companies form the consortium ERN/RED, which has developed a Pan-European earthquake-loss estimation model that currently covers 44 countries of this continent. This consortium also acts as the Risk Management Specialist for CCRIF, the Caribbean Catastrophe Risk Insurance Facility.