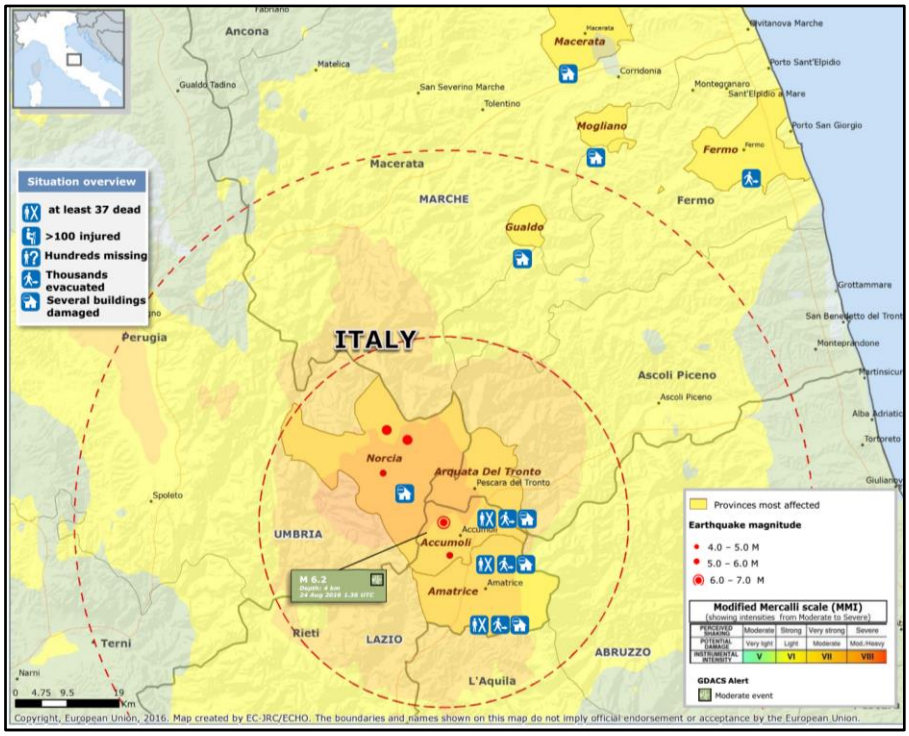
EUROPEAN COMMISSION
JOINT RESEARCH CENTRE

24 Aug 2016, 12:30

Mw. 6.0 Earthquake in Italy

24 Aug 2016 01:36 UTC

Situation Report



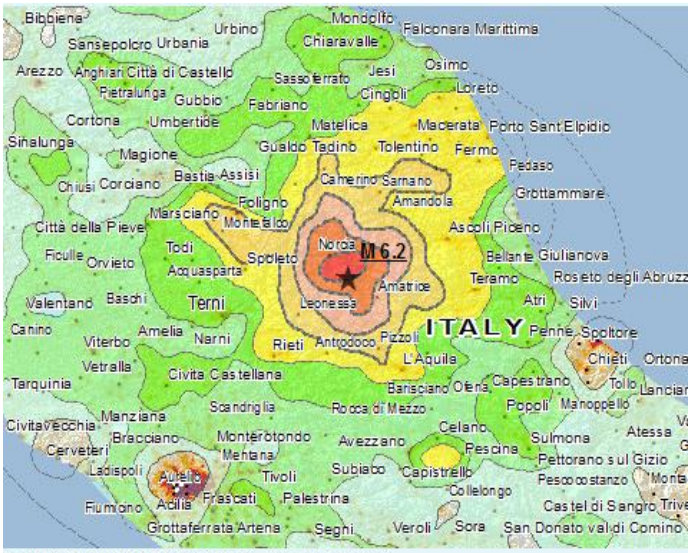
1 Executive Summary

A strong **Mw. 6.0** earthquake at a shallow depth of **4 km** occurred at **01.36 UTC** (03.36 local time) in Italy, in the province of Rieti (Lazio), at the border with Umbria and Abruzzi regions. The earthquake caused extensive damage in the area around the epicentre with a number of fatalities reported to be at least 37 and a number of people under rubble or still missing as of 11.00 UTC (13.00 CET). Severe damage has been reported in the villages of Amatrice, Accumoli, Arquata del Tronto and Pescara del Tronto. A number of aftershocks continued after the main event, the largest one of Mw 5.5. Search and Rescue operations are under way in the area. The risk of the earthquake is increased by the time of day, the holiday season and the fragility of many old buildings in the area.

The JRC is following the event since this morning, providing preliminary information and assessment to ERCC. EMS Copernicus was activated in the morning of August 24 to provide satellite imaging of the affected places.

2 Situation Overview

Event Details: the main earthquake of a moment magnitude of **Mw 6.0** happened at **01.36 UTC** (**03.36 local time**) in the early morning of 24 August. The depth of the earthquake was 4 km - this very small depth increases the seismic hazard. Intensities of up to "Severe" in the Modified Mercalli Scale (MMI VIII) have been estimated to affect the area; this shaking can induce moderate to heavy damage, especially to vulnerable or old structures. INGV has measured peak ground accelerations (PGA) of up to 45% of 1g in the epicentre area. Based on the intensity map of USGS, GDACS estimates 13,000 people exposed to "Severe" (MMI VIII) shaking and another 150,000 to "Very Strong" shaking.



Population Shakemap Overview . (*Source: USGS*)

Interactive map: Open

PERCEIVED SHAKING	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	None	None	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
INTENSITY	≤ III	IV	V	VI	VII	VIII	IX	X+

Event Location: The epicentre of the main shock was located in the NE area of the province of Rieti, ca. 2.5km NW of the village of Accumoli, and circa 100 km NE of Rome. The provinces of Perugia, Ascoli Piceno, L'Aquila and Teramo were also affected. This is a zone of very high seismic risk that has seen very damaging earthquakes in the recent past, including the L'Aquila event of 2009 that killed more than 300 people and rendered more than 60,000 people homeless. It was felt up to Rome (110 km) and Bologna (250 km).

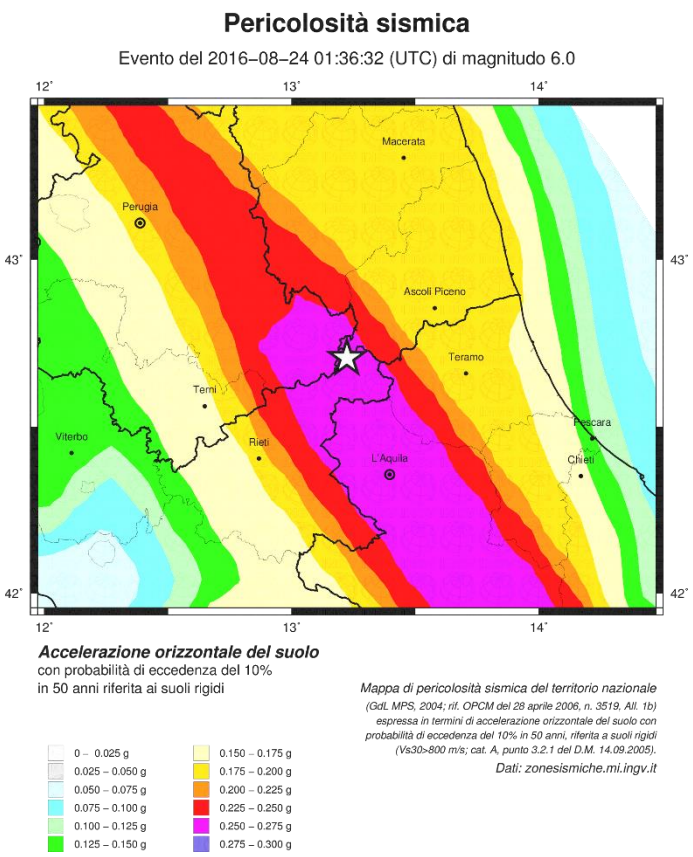
Impact: According to media reports as 10:30 UTC (12:30 CET) heavy damage and casualties have been inflicted in the villages of Amatrice, Accumoli and Pescara del Tronto. Aerial photos of Amatrice show a very large percentage of the old part of the village destroyed (see Section "News Summary" later in this report. A total of at least 37 people killed have been reported in National and International News Agencies (ANSA, BBC) and another 150 (unofficial number) were missing. A lot of old buildings have collapsed in these three and other villages of the epicentre area and people are reported to be still under rubble. Search and Rescue operations by local and national authorities are under way.

The current fatalities data distribution is the following, for a total of about 40 as of 12:30 CET:

- **27-28 in the area of Accumoli – Amatrice**
- **10 in the area of Arquata del Tronto – Pescara del Tronto**

Accumoli	>6	**27-28**
Amatrice	>5	
Pescara del Tronto	2-10	**10**
Arquata del Tronto	2-3	
TOT		**37-38**

Risk overview: The high risk posed by this earthquake is a result of a number of factors: the magnitude and the depth that result in high intensity and thus increasing the hazard, the time of the event that increased the exposure and the type of buildings in the area that increases the vulnerability.



1. **Seismic hazard**: The magnitude of the earthquake (Mw and ML both equal to 6.0 according to INGV) was well within the magnitude limits of strong earthquakes produced in the past in this region. The shallow depth (4 km according to INGV that has the local expertise and most instruments in the area, 10 km according to USGS) increases the intensity (shaking) produced by an earthquake of a given magnitude. In this case, as mentioned also above, peak ground accelerations of up to 0.45g were measured, giving a shaking of "Severe" in the Modified Mercalli Scale (MMI VIII).
2. **Secondary hazards**: The area of the epicentre is mountainous (located in the Apennine range) and this increases the risk of avalanches and landslides that might damage critical infrastructure. Indeed, minor rockfalls were reported in many local roads that might impede the access of Search and Rescue and Relief teams (see relevant section on National Response later in this Report). A more significant landslide was reported near Gran Sasso, the highest massif in the Apennines, a 2,910m-high peak 40km SE of the epicentre, but without any impact on roads or buildings at least as of 12.00 CET on 24 August. A large dam, 300 million cubic mt on the lake of Campotosto, located 18.6 km from the epicentre should be verified.
3. **Increased exposure and reduced alertness**: The event took place at 03.36 in the early morning, when most population are at home and sleeping, thus increasing the number of people in buildings and reducing their alertness and time to respond and evacuate. Another factor that increased population exposure in this case is the time of year: many tourists and vacationers from the nearby cities (like the capital Rome) were in the area. Additionally, there were no significant fore-shocks that might put the population and authorities into increased alert.
4. **Building vulnerability**: The villages and small towns around the epicentre possess a large number of old and traditional buildings that can be particularly vulnerable to strong shaking. The particular vulnerability of historic centres of Italian cities has been long known and has been the subject of many studies (See the site of the Italian Civil Protection on the matter)

3 EU/EC institutes response and JRC involvement

JRC is following the event since this morning answering ERCC requests of more information and providing a quick overview of the event. The **Global Disaster Alerts and Coordination System** (GDACS) detected the event 6 minutes after the main event indicating it as Green Alert. The alert level in GDACS takes into account the potential need for International Humanitarian Support. Considering the resilience of the Italian society, the population density and the earthquake magnitude, this resulted in a low need for humanitarian support (Green Alert).

The GDACS website presented updated information with indication of potentially affected locations, related situation maps, shakemaps, indication of major facilities and media analyses from the Europe Media Monitoring system.

The media page of GDACS also indicated the analysis of Twitter messages. The first messages mentioning collapsing building occurred about 50 min after the event.

The **Copernicus Emergency Mapping Service** (EMS) has been activated by the Italian Civil Protection at 10:00 AM local time (08:00 UTC). The Italian National System also activated the COSMO SKy-Med to support the acquisition and the multitemporal analysis by SAR data.

4 Involvement with other services of the European Commission, the EEAS or other institutional stakeholders

DG-ECHO Emergency Response and Coordination Center is following the event in close collaboration with the Italian Civil Protection. The ARISTOTLE service, the new service being established by ERCC is not yet operational but the coordinator (INGV) has been contacted and has shared the first report that was produced internally for the Italian Civil Protection.

5 Response of National Authorities

The Italian Civil Protection has activated at 4 a.m. the "**Comitato Operativo**" (Operational Committee) at the Headquarter in Rome to coordinate the activities at national level. All the National Authorities and Institutions in charge of supporting the national emergency management are present, including national authorities of Critical Infrastructures and Research Centres. The Head of the Department, Eng. Fabrizio Curcio, has personally coordinated the Operational Committee Meetings during the preliminary activities of the Search and Rescue phase.

The map on the right indicates the affected regions and the national regional authorities that are moving to the affected area with Emergency Management teams.

The Head of the Italian Civil Protection and the Ministry of Transports and Infrastructures are moving to the most

affected area to assess the way forward to coordinate the emergency management activities together with the three Regional Authorities directly affected.

Regional authorities directly affected: **Lazio, Umbria, Marche**.

Regional Authorities involved at the moment to support the emergency management by field emergency team: **Tuscany, Emilia-Romagna, Friuli-Venezia Giulia**.

Scientific Institutions involved in this preliminary phase by the National Civil Protection Department in the Emergency Management activities:

- INGV (seismic analysis)
- EUCENTRE (structural damage assessment)
- ASI (Italian Space Agency): (satellite acquisition – Cosmo-SkyMed)
- CNR (National Research Centre)
    - IREA (Satellite images analysis)

5 References and contact points within JRC

For updated information on the disaster, please consult the following web site:

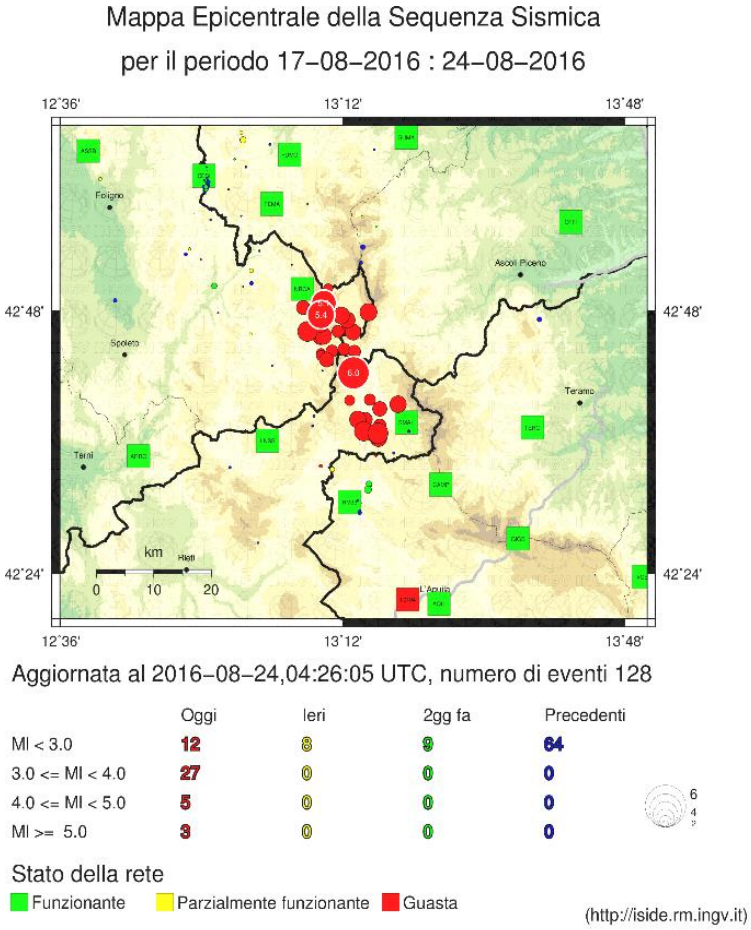
- http://mic-echo.jrc.ec.europa.eu
- http://www.gdacs.org/report.aspx?eventid=1092422&episodeid=1137574&eventtype=EQ
- http://www.protezionecivile.gov.it/jcms/it/redirect.wp Italian Civil Protection
- http://terremoti.ingv.it/it/ultimi-eventi/1001-evento-sismico-tra-le-province-di-rieti-e-ascoli-p-m-6-0-24-agosto.html Italian Seismological Centre INGV

Contact point in JRC: Tom De Groeve (email: tom.de-groeve@jrc.ec.europa.eu)

Annex with additional information

A1: Seismological Context of the region and historical seismicity

The 6.2M earthquake in Central Apennines is the result of seismic activity in the region caused by normal faults. The area affected by today's earthquake is part of the high hazard area that runs along the axis of the Apennines. The Apennines is a mountain range that runs from the Gulf of Taranto in the south to the southern edge of the Po basin in northern Italy The general east west extensional tectonics which dominates in the area, has created those NW- SE oriented faults capable to generate moderate to strong earthquake events. Today's earthquake is considered a typical event along a NNW-SSE normal 25 km long fault. A typical event for the area is considered a seismic motion along a NW-SE fault with a size of 20 km. More than 80 aftershocks have been recorded in less than 6 hours after the main shock. A rich aftershock sequence is expected for a period of several months.



Epicentral Map of the Seismic Sequence

The central Apennine region has experienced a number of significant historical earthquakes:

L'Aquila 1915: On 13 January 1915 an earthquake of magnitude 6.7 M was instrumentally recorded near Avezzano approx. 68 km south-southwest from today's earthquake. The earthquake killed approximately 32 000 people.

Norcia 1979: On 19 September 1979 an earthquake of magnitude 5.9 M at a depth of 15 km hit the municipality of Norcia (Umbria Region), causing damage. The earthquake caused the death of 5 people, injured 10 and a further 2 000 were evacuated.

Umbria 1997: In 1997 a series of earthquakes occurred in the Regions of Umbria and Marche namely "Marche seismic sequence". The main earthquake on 26 September 1997 at 0.33 UTC was of magnitude 5.5 M at a depth of 8 km, followed by two earthquakes of magnitude 5.8M at 9.40 UTC, and 4.7 M at 9.46 UTC respectively in Foligno Municipality (Umbria Region). The Marche seismic sequence caused the death of 11 people, injured 100 and damaged 80 000 houses. The 1997 Umbria Marche seismic sequence include eight events of magnitude greater than 5 M during a two-month period between September to November which also damaged the Basilica of St Francis in Assisi.

L'Aquila 2009: On 6 April 2009 at 0.32 UTC an earthquake of magnitude 6.3 M at a depth of 10 km occurred in the province L'Aquila (Abruzzo Region). Due to the earthquake 309 people died, 1 600 got injured, 65 000 were evacuated, 11 000 homes were damaged.

Other historical earthquakes in the region include one in 1639 6.2M, one in 1946 5.9M, 1703 6.9M

http://www.meteoweb.eu/2015/09/accadde-oggi-il-26-settembre-1997-il-violento-terremoto-in-umbria-e-nelle-marche/549125/

http://legacy.ingv.it/roma/reti/rms/terremoti/italia/umbria/terre.htm

http://www.meteoweb.eu/2015/09/accadde-oggi-il-26-settembre-1997-il-violento-terremoto-in-umbria-e-nelle-marche/549125/

http://www.ingv.it/ufficio-stampa/stampa-e-comunicazione/Galleria-immagini/archivio-immagini-terremoti/photo_album.2010-04-28.5429963019/photoalbum_photo_view?b_start:int=4

http://www.tuttosport.com/news/attualit/cronaca/2016/04/06-10215152/terremoto_dellaquila_sette_anni_dopo_litalia_ricorda_le_309_vittime/?cookieAccept

http://s3.amazonaws.com/academia.edu.documents/45414194/The_1997_Umbria-Marche_Italy_earthquake_20160506-1678-hbltx.pdf?AWSAccessKeyId=AKIAJ56TQJRTWSMTNPEA&Expires=1472031474&Signature=a5T67A8EI9ELa22TL%2Fh%2FwCr5%2F90%3D&response-content-disposition=inline%3B%20filename%3DThe_1997_Umbria-Marche_Italy_Earthquake.pdf

The Operational Committee is informed in real time of the meteorological evolution by the responsible of the National Functional Centre for meteo-hydro and hydraulic risk.

The forecast for today and tomorrow are "Assenza di criticita'" (Absence of critical situations), both from the meteorological than hydro-geological events.

A2 Weather Forecast for the next 3 days in central Italy

24-27 August 2016

Fair (locally partly cloudy) with no significant rainfall forecasted over the next 3 days. The detailed weather forecast for the areas most affected by the earthquake (Accumoli, Amatrice) is shown below.

ACCUMOLI, Rieti (42.7°, 13.25°)

Fair weather. The max. temperature is expected to reach 21 °C on 25 August and 22 °C on 26 August, with minimum temperature of around 14 °C, during the early hours of the day.

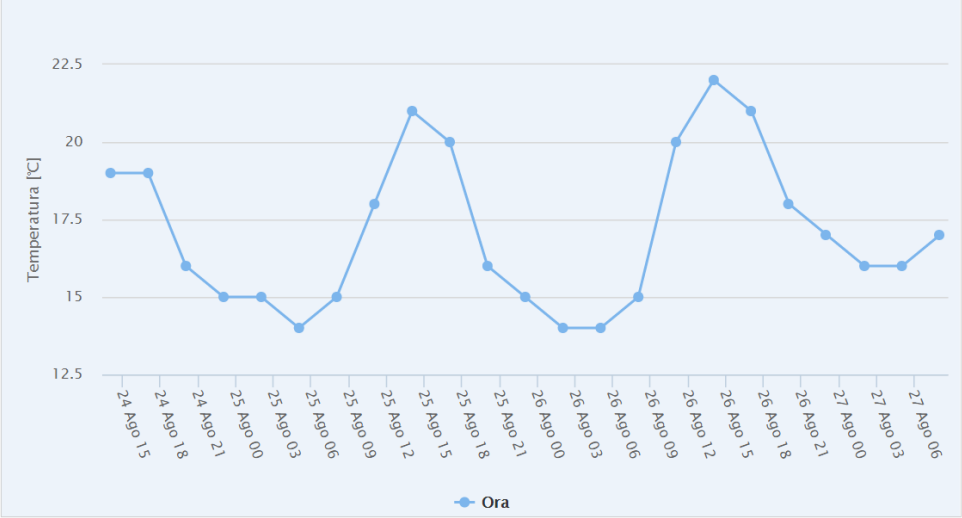
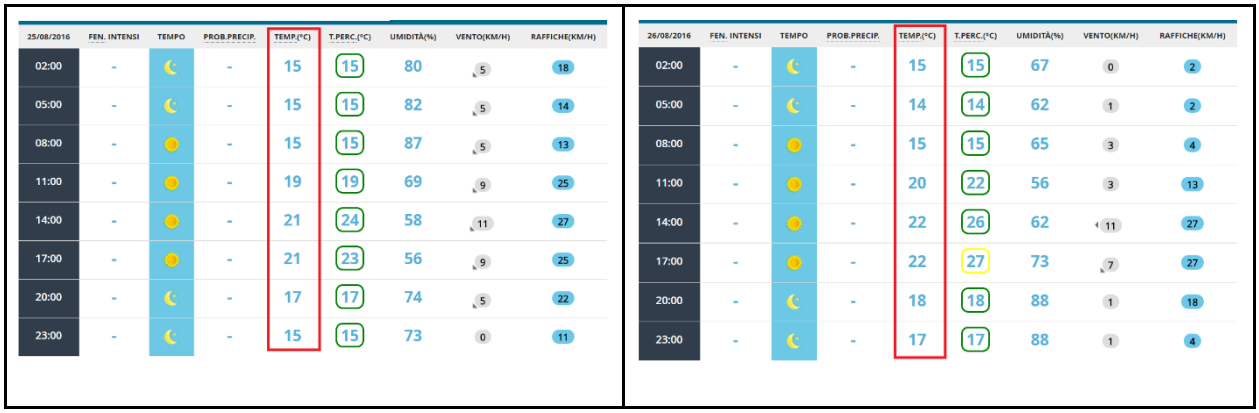


Figure 1 *- Forecast: Temperatures in Accumoli (source: MeteoAM - http://www.meteoam.it/ta/previsione/5285/accumoli)*



25/08/2016	FEN. INTENSI	TEMPO	PROB.PRECIP.	TEMP.(°C)	T.PERC.(°C)	UMIDITÀ(%)	VENTO(KM/H)	RAFFICHE(KM/H)
02:00	-		-	15	15	80	5	18
05:00	-		-	15	15	82	5	14
08:00	-		-	15	15	87	5	13
11:00	-		-	19	19	69	9	25
14:00	-		-	21	24	58	11	27
17:00	-		-	21	23	56	9	25
20:00	-		-	17	17	74	5	22
23:00	-		-	15	15	73	0	11

26/08/2016	FEN. INTENSI	TEMPO	PROB.PRECIP.	TEMP.(°C)	T.PERC.(°C)	UMIDITÀ(%)	VENTO(KM/H)	RAFFICHE(KM/H)
02:00	-		-	15	15	67	0	2
05:00	-		-	14	14	62	1	2
08:00	-		-	15	15	65	3	4
11:00	-		-	20	22	56	3	13
14:00	-		-	22	26	62	11	27
17:00	-		-	22	27	73	7	27
20:00	-		-	18	18	88	1	18
23:00	-		-	17	17	88	1	4

Figure 2*- Detailed weather forecast (temperatures: red box) for Accumoli on 25 August (left) and on 26 August (right). (source: MeteoAM - http://www.meteoam.it/ta/previsione/5285/accumoli)*

AMATRICE, Rieti (42.63°, 13.29°)

Fair weather. The max. temperature is expected to reach 24 °C on 25 August and 26° C on 26 August, with min. temperatures of 14 °C during the early hours of the morning.

Figure 3 *- Forecast: Temperatures in Amatrice. (Source: MetoAM - http://www.meteoam.it/ta/previsione/494/amatrice)*

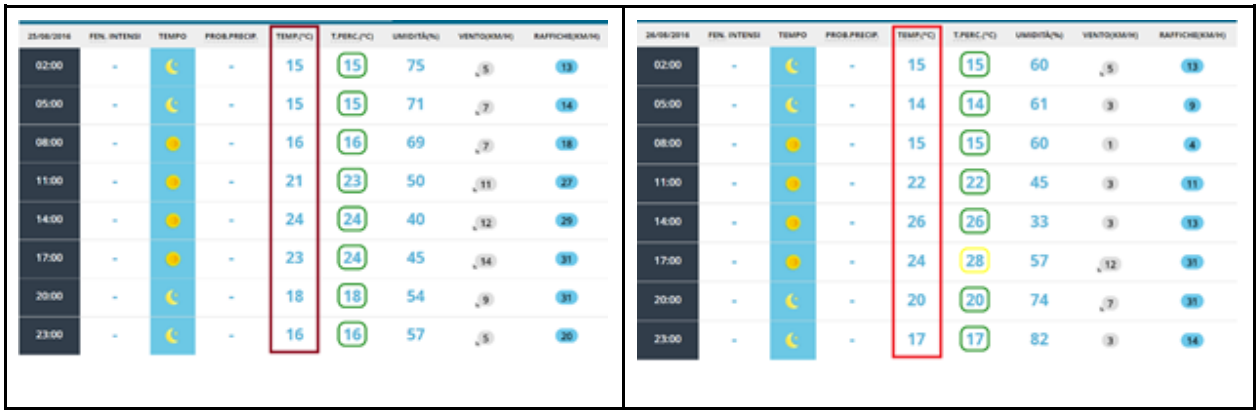


Figure 4*- Detailed weather forecast for Amatrice on 25 August (left) and on 26 August (right). (Source: MetoAM - http://www.meteoam.it/ta/previsione/494/amatrice)*

Sources:

Italian Air Force Meteorological Weather (MeteoAM): http://www.meteoam.it/previsioni/centro
MeteoAM ACCUMOLI: http://www.meteoam.it/ta/previsione/5285/accumoli
MeteoAM AMATRICE: http://www.meteoam.it/ta/previsione/494/amatrice

Daily National Hydro-Geological Bulletin for Early-Warning System (Impact forecasting on 24th August 2016 - assessed on 23rd August 2016)
http://www.protezionecivile.gov.it/jcms/it/view_bcr.wp?day=domani&contentId=BCR58665

A3: News Summary

The headlines below have been automatically extracted by the Europe Media Monitor.

At least 37 dead after earthquake rattles central Italy

Wed, 24 Aug 2016 12:39:00 +0200 nypost (en)

An earthquake devastated a string of mountainous towns over a swathe of central Italyearly on Wednesday, trapping reside believed killed and many missing. The quake struck in the early hours of the morning when most people were asleep, razin

People and organisations:

Strong quake in central Italy kills at least 21 people

Wed, 24 Aug 2016 12:31:00 +0200 xinhuanet_en (en)

ROME, Aug. 24 (Xinhua) -- The death toll in a strong earthquake in central Italy has risen to 21, authorities said Wednesda a.m. Wednesday (0132 GMT), with a shallow depth of 4.2 km, according to the National Institute of Volcanology and Seism

People and organisations:

Quake devastates mountain towns in central Italy, at least 38 believed killed (Update 3)

Wed, 24 Aug 2016 12:29:00 +0200 cyprus-mail (en)

An earthquake devastated a string of mountainous towns over a swathe of central Italy early on Wednesday, trapping resid believed killed and many missing. The quake struck in the early hours of the morning when most people were asleep, razin

People and organisations:

Major earthquake in central Italy leaves at least 21 dead, 100 missing

Wed, 24 Aug 2016 12:29:00 +0200 itartass_en (en)

ROME, August 24. /TASS/. A major earthquake that hit mountainous central Italy on Wednesday has left at least 21 people magnitude quake struck in the early hours of Wednesday devastating a number of mountainous towns and villages.

People and organisations:

Watch: Italy earthquake death toll rises to 38

Wed, 24 Aug 2016 12:28:00 +0200 timesofmalta (en)

Update 11.45am - Civil protection confirms death toll now stands at 38 Earthquake hit in the early hours of the morning; Re Maltese believed to have been affected - hotline set up; 'Deeply saddened' Pope prays for victims.

People and organisations:

Earthquake leaves at least 37 dead, 150 missing in central Italy

Wed, 24 Aug 2016 12:28:00 +0200 armenpress (en)

14:04, 24 August, 2016 YEREVAN, AUGUST 24, ARMENPRESS. A magnitude 6.2 earthquake has struck central Italy , lea search for survivors, BBC reports. Many of the dead were in the village of Pescara del Tronto which was levelled to the gro

People and organisations:

Armenian MFA clarifies whether or not Armenians are among Italy earthquake victims

Wed, 24 Aug 2016 12:28:00 +0200 armenpress (en)

13:00, 24 August, 2016 YEREVAN, AUGUST 24, ARMENPRESS. The Foreign Ministry of Armenia is clarifying whether or victims of the earthquake in Italy . “The Armenian Embassy is in constant contact with the local authorities”, the MFA writes

People and organisations:

Fatalities, significant damage after strong quake in Central Italy

Wed, 24 Aug 2016 12:28:00 +0200 wlos (en)

WLOS — (ABC News) -- A magnitude 6.2 earthquake struck central Italy early Wednesday, with reports of fatalities and sig say the towns of Accumoli and Amatrice appear to be the hardest hit by the quake, which struck at 3:36 a.m. local time as r

People and organisations:

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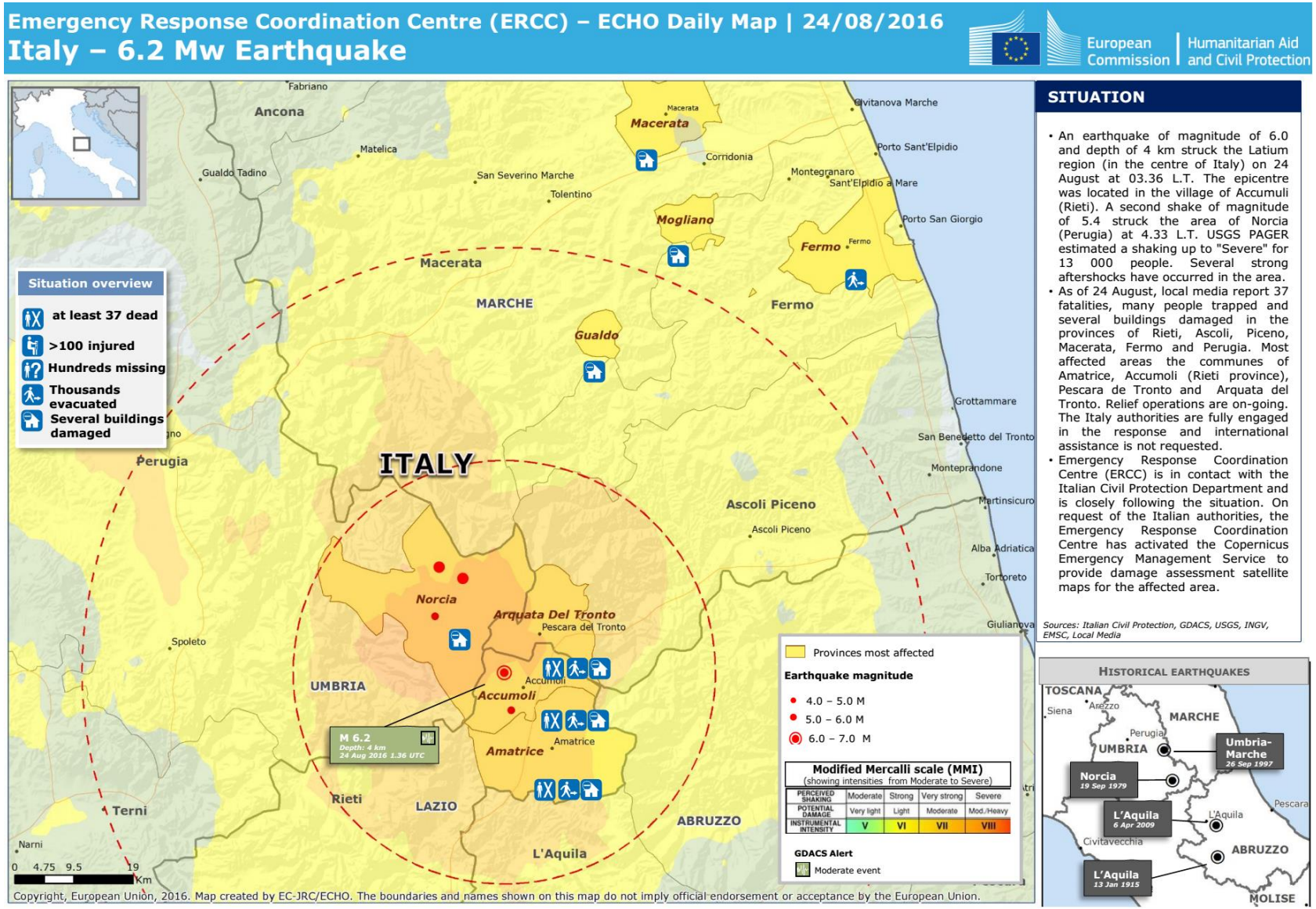
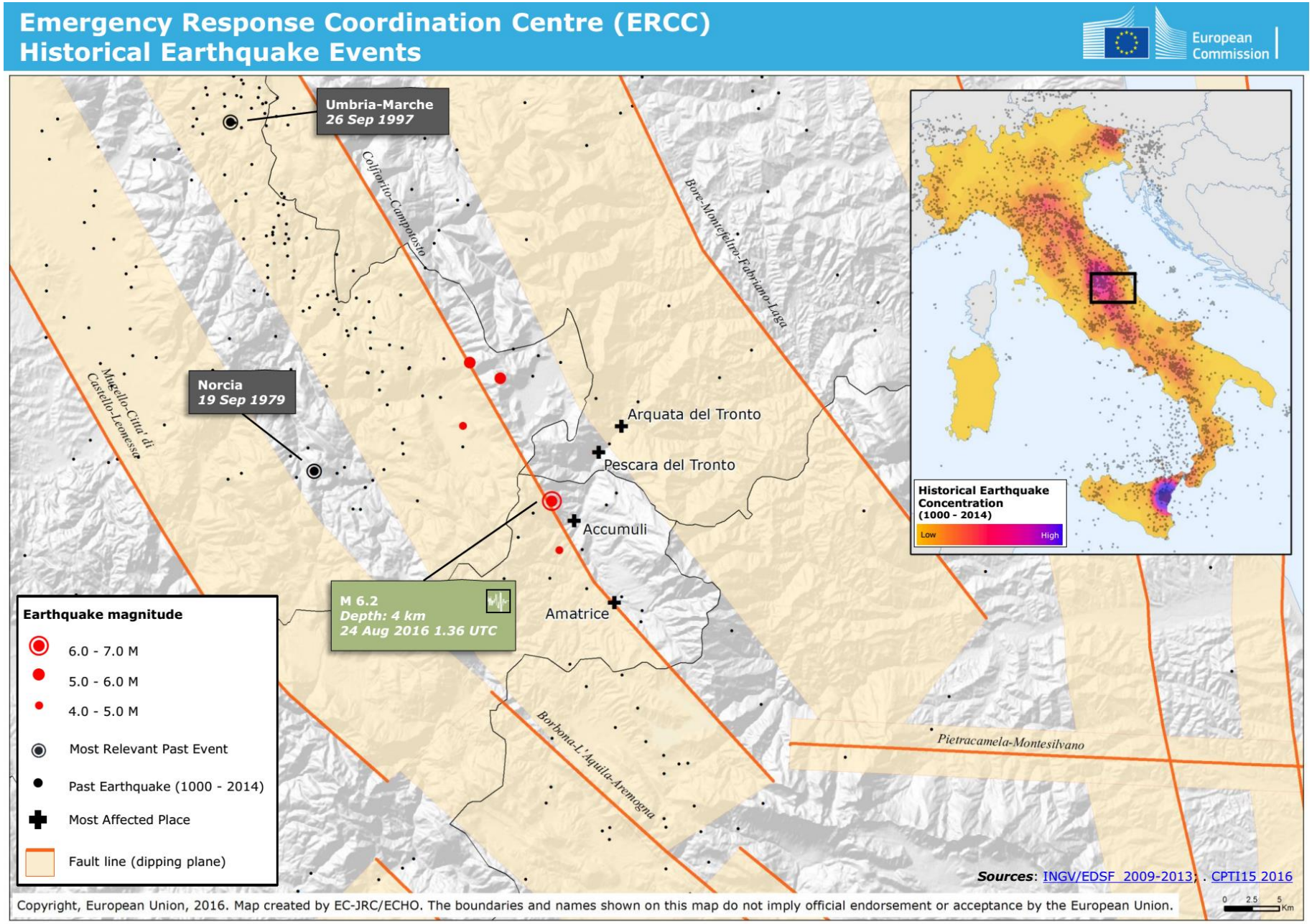
For a complete list of news: http://www.gdacs.org/media.aspx?eventid=1092422&episodeid=1137574&eventtype=EQ

Aerial survey by Italian Fire Brigade

Amatrice, the main street in ruins (courtesy BBC)

A4 Detailed Map of the Impact and Historical Earthquake Events




Emergency Response Coordination Centre (ERCC)
Historical Earthquake Events
European Commission
Umbria-Marche
26 Sep 1997
Norcia
19 Sep 1979
Colfiorito-Campotosto
Bore-Montelago-Fabriano-Laga
Mugello-Citta' di Castello-Leonessa
Arquata del Tronto
Pescara del Tronto
Accumuli
Amatrice
M 6.2
Depth: 4 km
24 Aug 2016 1.36 UTC
Borbona-L'Aquila-Aremogna
Pietracamela-Montesilvano
Historical Earthquake Concentration
(1000 - 2014)
Low
High
Earthquake magnitude
6.0 - 7.0 M
5.0 - 6.0 M
4.0 - 5.0 M
Most Relevant Past Event
Past Earthquake (1000 - 2014)
Most Affected Place
Fault line (dipping plane)
Sources: INGV/EDSF 2009-2013; . CPTI15 2016
Copyright, European Union, 2016. Map created by EC-JRC/ECHO. The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union.
0 2.5 5 Km