Two earthquakes of magnitude 6.1 and 6.6 (Mw) struck Central Italy within 4 days of each other, approximately 60 km NNW the town of L’Aquila where a destructive magnitude 6.3 (Mw) earthquake occurred in April 2009.

The earthquakes occurred depths of 10 km or less on a crustal fault in the Apennine region in central Italy. The relatively shallow depth of these earthquakes has meant that they have been particularly destructive.
Magnitude 6.1 & 6.6, CENTRAL ITALY

Wednesday, 26th & 30th October, 2016 at 19:18 & 06:40 UTC

Shaking caused

There was Strong (VI) to Severe (VIII) shaking in much of Central Italy, while the earthquake was felt throughout the country. The second event (right panel) produced more violent shaking in a significantly larger area than the first event (left panel). The Mw 6.6 event has about 5.6 times the energy as the Mw 6.1.
The central Mediterranean is a complex and tectonically active region. As many of the earthquakes are in the crust, and the area is highly populated many of these earthquakes have a human impact. Notably the L'Aquila earthquake in April 2009 killed at least 308 people.

In August 2016, Amatrice was hit hard by a similar Mw 6.2 event and at least 300 people lost their lives.

Fortunately, the latest events have claimed very few lives despite the high levels of damage observed, particularly in the Norcia region.
The Visso and Norcia earthquakes occurred on the 26th and 30th October 2016. They are the result of a normal faulting structure in the central Apennines.

The M 6.2 in central Italy (Amatrice) on the 24th of August 2016 has led to about 40 aftershocks with a magnitude of greater than M 4.0. This earthquake is located 30km northwest of the August event, and is thought to be an aftershock of the August 24 event. It is currently the largest aftershock.
This region is tectonically and geologically complex, involving both subduction of the Adria micro-plate beneath the Apennines from east to west, continental collision between the Eurasia and Africa plates building the Alpine mountain belt further to the north and the opening of the Tyrrhenian basin to the west.

The Mediterranean region has active seismicity primarily because of the northward motion of the African plate, causing the closure of the Tethys Ocean, and subduction of the Tethys plate. The convergence rate varies from 4 to 10 mm/yr along the boundary.

The Apennine mountains of Southern Italy have a high risk of earthquakes due to the Subduction of the Mediterranean Sea floor beneath the Tyrrhenian Sea. There are also some active volcanoes located there above intermediate depth earthquakes.

Above: Map showing the location of the collision plate boundary fault and the earthquake
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Seismic waves recorded in the UK

• Above are the seismic waves emitted from the Italian earthquakes on the 26th and 30th of October. Both plots start at the time of the earthquake, and the P-waves are recorded in the UK around 3 minutes later, and the S-waves are recorded about 7 minutes after the earthquake.

• Note that the amplitude of the seismic waves from the second event is almost twice the amplitude from the first, slightly smaller earthquake.
Why are these events so different?

Although these earthquakes appear to be similar with size, style and location, their measured effects are clearly very different. Take for example the shake map and the measured waveforms in the UK. The effects are so much larger. This is because the earthquake has much more energy even though it is only 0.5 higher in the magnitude scale.

Magnitude scales are logarithmic so in terms of energy an Mw 6.6 event has 5.6 times more energy at the source than a similar Mw 6.1 event. When measured in the UK we can expect the signal amplitude of the 6.6 to be up to 3.1 times higher (for the P wave) than the 6.1! This is roughly in line with a factor of 2 that we see.

In summary, a small change in the magnitude scale can equate to a really big change in what is measured! Don’t be fooled by logarithmic scales.
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Find out more....

• BGS (British Geological Survey) – seismology and earthquakes – frequently asked questions
  http://www.earthquakes.bgs.ac.uk/education/faqs/faq_index.html

• IRIS (Incorporated Research Institutions for Seismology) – learning about earthquakes
  http://www.iris.edu/hq/programs/education_and_outreach/students

• UK School Seismology Project – classroom activities, videos and support documents
  http://www.bgs.ac.uk/schoolseismology/home.html

• USGS (United States Geological Survey) – FAQs, glossary, posters, animations
  http://earthquake.usgs.gov/learn/

• USGS summary of the earthquake
  http://earthquake.usgs.gov/earthquakes/eventpage/us10003re5#general_summary