FAQS: Monitoring seismicity locally

Seismologists in the University undertake research across the world to further our understanding of the fundamental structure, processes and geodynamics of the Earth.

Here they share some of their knowledge of their work monitoring seismicity locally:

1. What is seismicity and how is it measured?

Seismicity describes the rate, location and magnitude of earthquakes. Seismologists use sensitive instrumentation (seismometers) to monitor small movements in the ground in order to detect and locate earthquakes. Local Magnitude (also known as the Richter Magnitude) is a common scale for characterising the strength of small to moderate, shallow (less than 30 km) events at local to regional distances (up to several hundreds of km).

2. How does the Traffic Light System (TLS) work for monitoring seismic activity relating to hydraulic fracturing?

The current UK Traffic Light System (TLS) forms part of the regulatory framework which the Oil and Gas Authority (the regulator) requires operators to adhere to. The TLS stipulates that if a seismic event of magnitude 0 to 0.5 M_L (local magnitude) is induced by hydraulic fracturing, increased seismic observation must be put into effect. If a magnitude of 0.5M_L or above is induced, then operations must be temporarily paused (for at least 18 hours) and pressure released while the situation is assessed. An earthquake of 0.5M_L cannot be felt at the surface. Sensitive instrumentation is therefore used to detect such small events

3. What magnitude earthquakes can be felt at the surface?

In addition to the energy released at the source (related to the magnitude), the degree to which earthquake ground motion is felt depends, among other factors, on the distance from their hypocentres and the local geology. According to the British Geological Survey, typically only events greater than at least 2 to 3 M_L can be felt by people, and at the lower end only by people in the immediate vicinity of the epicentre.

4. What work have you been doing to monitor seismicity in the local area?

Since 2017 the University of Liverpool seismologists have independently operated a seismic monitoring network across the Blackpool-Preston region. The aim of this network is to determine pre-, during- and post-fracking seismicity to better understand its nature, and to improve scientific understanding and further public understanding of natural and potentially induced micro-seismicity.

In order to put potentially induced earthquakes, and the Traffic Light System, into context researchers are also carrying out an investigation into ground movements induced by everyday human activity in the Blackpool area. Examples included vibrations from passing traffic, such as a bus, cars passing and a tram.

Interestingly, we discovered that standing beneath “The Big One” rollercoaster is comparable to ground vibrations felt directly above a 1.6M_L earthquake occurring at a depth of 2km below ground and that the ground vibrations felt when standing 2m away from a passing tram are the same as

standing directly above a 1.8M_L seismic event. Ground vibrations from the largest induced earthquake at Preston New Road to date (M_L = 1.1) are equivalent those created by dropping a bag of flour and the red-light threshold (ML = 0.5) is equivalent to the vibrations in the pavement from passing cars.

5.Do examples such as traffic, dropping items equate to what is happening at depth?

The examples are designed to provide a meaningful context in terms of what is *felt at the surface*. Researchers therefore aimed to create vibrations of various strengths at floor level using a range of scenarios.

Clearly, since a person is so close to the source of the vibrations (the dropped items, the traffic), the energy is much less than that associated to the comparable earthquake at 2-3 km depth. However, the amplitude of the vibrations at our feet – and therefore the felt effect – will be the same for a ML 1.1 earthquake at 2.5 km and dropping a bag of flour.