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# The problem with magnitudes calculated using nearby stations

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In April 2011, fracking near Blackpool caused a 2.4 ML earthquake at a shallow depth. This was felt by local people and there was considerable public concern. The British Geological Survey (BGS) installed temporary seismic stations close to the epicentre and recorded several subsequent, smaller events. There was, however, some ambiguity over the magnitude of these later events. The magnitudes calculated for the temporary stations were too high for unfelt events that were not, in general, recorded on the national network. A single induced earthquake was recorded both by the temporary stations and by a few stations of the UK national network. The local magnitude calculated from amplitudes recorded on the more distant stations was1.2 ML but the very nearby stations recorded amplitudes corresponding to a magnitude of 2.3 ML. In subsequent studies, this one event was used to scale amplitudes from the nearby stations to magnitudes that were probably similar to the magnitudes that would have been calculated using distant stations – a most unsatisfactory solution.

The regulatory approach adopted in the UK to manage the risk of induced seismicity is a ‘traffic light’ monitoring scheme, with a remedial action level, or ‘red light’, set at 0.5 ML. As the UK national network has at a nominal detection level of ML > 2, the installation of local seismic stations is critical for the operation of this scheme. However, the suitability of the current UK local magnitude scale is questionable, given that it was not calibrated using very near-receiver events. In fact, the evidence of magnitude discrepancies demonstrated near Blackpool and elsewhere suggests that the scale is not suitable.

The single event recorded on both nearby and distant stations at Blackpool is not sufficient to base any further work on. However, analysis of the BGS catalogue shows that this affect has been observed on several other occasions. In particular, over 500 small earthquakes were recorded by a network installed within a few kilometres of the New Ollerton coal mine in 2014. Those events that were also recorded by stations of the UK national network had magnitudes calculated using the local network much larger than those calculated at more distant stations. We use this data to analyse amplitudes recorded very close to earthquakes and test various ideas. We then discuss possible alternatives to the current UK ML scale that might allow near event seismic data to be used to calculate robust magnitudes.