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The ML 5.2 Lincolnshire earthquake in 2008: A high stress drop event

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An earthquake of local magnitude ML 5.2 occurred on 27 February 2008 in Lincolnshire, eastern central England. This was the largest onshore earthquake in the UK since 1984. It was widely felt across the UK and caused minor damage over a relatively wide area. The distribution of macroseismic intensities was explained by the relatively large source depth of about 20 km, which was determined both from local travel time data and tele-seismic array observations. The mechanism of the earthquake was determined through regional moment tensor inversion. The moment magnitude determined was MW 4.4. The best fitting double-couple mechanism shows a predominantly strike-slip solution (with thrust component) with a left-lateral mechanism in north-south and a right-lateral mechanism in east-west direction. Overall, this mechanism conforms with the regional pattern of compressive stress in NW-SE direction from the Mid-Atlantic ridge. A total of 11 aftershocks were recorded on a network of temporary stations deployed after the mainshock. These events were tightly clustered around the mainshock, and did not align in the direction of either of the nodal planes. We determined the stress drop and rupture dimensions of the event by modelling the source displacement spectra, correcting for attenuation using a regional attenuation model for the British Isles. The stress drop determined was above 200 bars, significantly higher than the average stress drop found for other UK earthquakes. The UK is an area of low to moderate intraplate seismicity with a relatively diffuse distribution of earthquakes. In contrast to the earthquake in 2008, a shallow (5 km) earthquake with ML 4.3 near the town of Folkestone in 2007 had a much lower stress drop of about 30 bars. Damage from this event was restricted to near the epicentre and the event was felt throughout south-eastern England. The higher stress drop for the 2008 earthquake corresponds to a larger slip relative to the shallower earthquake, while the fault area is about the same for the two events. The relatively high corner frequency for the 2008 event, resulted in greater energy release. The nearest peak ground motion recordings at about 100 km distance from the source are of the order of 100 mm/s$\hat{2}$. For comparison, we used the source parameters and attenuation model to compute peak ground acceleration for both earthquakes using the stochastic method. The stress drop of the 2008 earthquake was well above the observed values from other UK earthquakes, and may represent the upper limit of what can be expected. Although events of this type are of low probability, its existence may have implications for seismic hazard computation in intraplate regions such as north-western Europe.