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Listening to Manchester: using Raspberry Shake seismometers in urban environments to monitor traffic and improve atmospheric CO_2 estimates

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The widespread deployment of Raspberry Shake seismometers around the world has already been used to document global 'quieting' during COVID-19 lockdown (Lecocq et al., 2020). These devices are sensitive to high frequencies (>> 1 Hz) but much less so for lower frequencies (< 0.5 Hz). This instrument response can be put to good use in urban environments to record anthropogenic 'noise' from traffic. We are now in a climate emergency (IPCC, 2021). Global greenhouse gas (GHG) concentrations in the atmosphere have risen and are driving global warming. The key component in GHG is carbon dioxide (CO_2), generated by the burning of fossil fuels. In Manchester, transport is the largest contributor to atmospheric CO_2 (35% of total; BEIS, 2019). The 'data' used in the official government calculations are based on national traffic estimates (BEIS, 2019). Calibrated measurements of local traffic volumes could produce better estimates of CO_2 emissions. A separate issue is that student enrollments in undergraduate earth science degree programs are falling across the world. Anecdotal evidence suggests that this is due, in part, to the subject being seen as 'dirty' – i.e., contributing to environmental damage through polluting extractive industries which traditionally employ graduate geologists.

The Listen to Manchester project has been designed to tackle these issues. Raspberry Shakes have been deployed across Manchester to continuously record traffic 'noise'. The timeseries data have been analyzed to calibrate them to measured traffic volumes from traffic cameras and 'in person' traffic counts, and thereby provide a low cost, continuous alternative to existing methods. Earthquakes and volcanic eruptions are fascinating, but in the UK, we rarely experience events of major significance, and this makes it challenging to connect students with the impact of these processes. But there are many other acoustic signals that can be recorded, such as traffic noise, football crowds and even loading from ocean tides (e.g., Diaz et al., 2020). A key component of the project includes the involvement of local schools to show how skills in maths, physics and coding can be applied to tackle anthropogenic urban 'noise' and natural earthquake 'signal'. Preliminary results show that both the temporal patterns and magnitude of the seismological response correlate well with measured traffic counts. Data from the Manchester Urban Observatory is used to compare traffic counts and air quality indices to the Raspberry Shake response. Work is on-going to define quantitative relationships between the seismological signal and the traffic volumes for different sites through the implementation of the new Clean Air Zone.

For the Energy Transition to succeed we must leverage open citizen science technologies to foster social acceptability and community engagement. Given the centrality of traffic volumes to the actions required to reduce atmospheric CO_2, listening to the ‘noise’ transmitted by the Earth is a win-win option: for climate action around Manchester and for re-affirming the links between people and place by learning more about the ground beneath our feet.