Environment Agency

Evidence

Validation of landfill methane measurements from an unmanned aerial system

Project summary SC160006

This project tested the accuracy of methane measurement using an unmanned aerial system. We released known amounts of methane and measured these emissions using an unmanned aerial system (UAS).

Background

Landfill gas is made up of roughly equal amounts of methane and carbon dioxide. Modern UK landfills capture and use much of the methane gas as a fuel. But some methane escapes and is emitted to the atmosphere. Methane is an important greenhouse gas and controls on methane emissions are a part of international and national strategies to limit climate change. Better estimates of methane emissions from landfills and other similar sources would allow the UK to improve the quantification and control of greenhouse gas emissions.

Previous work showed that UAS are a viable approach to quantify methane emissions from landfills. In this project we ran a field trial to validate the UAS method and compare it with other low cost methods of measuring methane.

Method

In the project we emitted controlled amounts of methane gas in order to test how well the UAS approach evaluated the controlled release.

The validation field trial took place over 5 days in autumn 2016 at the Cardington Met Office site in Bedfordshire

We analysed a total of seven UAS flights. These sampled methane concentrations downwind of the controlled emission source. The calculations of the methane emission were conducted without knowing the emission rate of the controlled source. The methane gas was emitted at a maximum rate of just over 10 kg per hour.

In parallel with the UAS measurements, the University of Southampton and the Technical University of Denmark independently measured the controlled methane releases using a completely different approach: a tracer gas dispersion method. This approach is based on the assumption that a tracer gas (in this case acetylene) released at a methane emission source will disperse in the atmosphere in exactly the same way as the emitted methane. When the gases are fully mixed, the ratio of the methane emission rate and the known tracer gas release rate should be the same as the ratio of the downwind measurements of the methane and tracer gas concentrations.

Results

The UAS experiments successfully measured the methane releases. The measured methane emission, taking into account the uncertainty in the measurements, always overlapped with the controlled methane emission release. For the seven flights, the average difference between the measured and emitted methane was an over estimate of 6% (so, on average, the measurements suggested 0.4 kg per hour more methane than was actually emitted).

In both tracer experiments the tracer gas dispersion method was able to determine actual release rates to within the measurement uncertainties for all but one of the tests. Even for that one test, the difference between the actual and measured methane rates was only 1 kg per hour.

Conclusions

This work showed that the UAS and the tracer gas dispersion methods were successful in matching the known methane releases and both these methods are considered suitable for quantifying methane emissions.

The UAS and the tracer gas dispersion methods have different operational limitations. There will therefore be some landfills where the conditions may be more suitable for one method than the other. Together, the two methods represent different measurement options that should allow methane emissions from landfills to be quantified.

Other experiments undertaken as part of the field trial demonstrated that the UAS method can detect very low methane emissions at a level comparable to the fugitive emissions that may be expected from natural gas infrastructure. The UAS method may therefore be useful for the monitoring and measurement of fugitive methane emissions from other types of UK industrial infrastructure.

This summary relates to information from project SC160006, reported in detail in the following output:

Report: SC160006/R
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