Environment Agency

Evidence

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Feasibility of aerial measurements of methane emissions from landfills

Project summary SC130034

This desk-based study has identified the most suitable aerial system, instrumentation and methods to measure the quantity of methane emitted to the atmosphere from UK landfill sites.

It will help the Environment Agency and other government bodies to make an informed judgement on how best to utilise the potential of aerial measurements to determine how much methane is being emitted to the atmosphere from UK landfills. The report's findings will also help to direct future research and development activity in this area.

The anaerobic decomposition of biodegradable solid waste in landfills is a major source of methane emissions in the UK. However, there is considerable uncertainty over the amounts currently emitted and not captured for energy generation. The project's aim was to determine whether the current state of remote sensing technology, in particular unmanned aerial vehicle (UAV) mounted techniques, would enable a cost-effective method to be developed to quantify how much methane is emitted to the atmosphere from a particular landfill site.

The report examines existing and emerging technology for the measurement of methane concentrations in the atmosphere using instruments carried in unmanned aerial vehicles (UAVs). It looks at the necessary combination of sensors and complementary data, such as wind speed and direction, which together would enable methane flux from a landfill to be calculated with a known uncertainty.

The review of the techniques currently in use highlights their advantages and drawbacks for use in UAVs. Constraints include power, weight, size, measurement accuracy and sampling methods. Techniques for simultaneous measurement of wind are also described, as is the regulatory framework governing the use of UAVs in the UK.

Possible methods for the derivation of net methane surface flux at the scale of a typical UK landfill site (<100 hectares) include eddy covariance (the measurement and calculation of vertical turbulent fluxes) and mass balancing (the measurement of what goes into and out of some volume of air). The mass balancing approach is considered the optimum method for use with small UAVs.

The report recommends using a closed path cavity ring-down spectroscopy (CRDS), to measure methane concentrations, combined with wind sensors to provide a measurement of upstream and downstream methane fluxes.

Such a system could be placed on a fixed-wing or a multi-rotor small UAV. A small (that is, <20 kg maximum take-off weight) fixed wing UAV is the recommended platform.

The suggested system would provide precision continuous measurements that would enable flux calculation across the scale of typical landfill sites with an uncertainty estimated to be within 20%. Tailored sampling design would be necessary to optimise the measurements for flux calculation.

Advice is also given in the report on the steps and costs involved in making the recommended instrumented platform into a useful and viable operational tool. Itemised cost estimates are provided for each step, that is, capital investment, field validation and operational deployment.

This summary relates to information from project SC130034, reported in detail in the following output:

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