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1 Airborne monitoring of landfills CH_4 emissions

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The disposal and treatment of waste produces emissions of greenhouse gases (GHGs), which contribute to global climate change. In particular, large quantities of Methane are released in the breakdown of organic matter in landfills.

In this work we present a new payload of the Sky Arrow ERA aircraft and an original methodology to compute methane emissions, based on the atmospheric mass budget approach. The payload is presently being used for intensive measurements in the area known as "*Terra dei fuochi*". In this area, located between the provinces of Naples and Caserta (Southern Italy), urban waste combined with industrial toxic waste has been illegally dumped in old quarries or buried in the nearby countryside for decades. This led to patchy sources of methane, with several hot spots spread over a heterogeneous land. In this context, the use of aircraft allows for the investigation at the landscape as well as at the regional scale, taking into account all sources, including those of small dimensions.

The Sky Arrow ERA is equipped with the Mobile Flux Platform, capable of deriving the 3D wind vector at 50 Hz, while CO_2 and water vapor densities are measured by an infrared gas analyzer (Licor 7500).

A new configuration of the Licor 7700 open path fast methane gas analyzer was developed, based on enclosing the sensor within a cylinder exposed to the external air in-flow. This set-up allows for fast response measurements, while avoiding external modifications, subjected to restrictions.

Ambient methane mixing ratios in excess of 7 ppm were measured during landfills overpasses; performing grid flight plans at different heights, to describe a virtual box enclosing the study area, and applying interpolation procedures, it was possible to reconstruct wind components and scalar concentrations in a 5x5 kilometers domain containing 6 different landfills, with a resolution of 50 m horizontal and 20 m vertical.

For each flight the methane mass flows along and across the wind direction have been computed as products of gas densities and wind speed, while contributions of each individual landfill to total flows were computed with a GLM (general linear model) approach. More than 15 flights were performed from October 2015 to December 2016. Results revealed high methane emissions ranging from 150 g s^{-1} to 400 g $s^{-1}$for the entire domain with a mean value of 240 g s^{-1}; no seasonal variation was observed over the whole measuring period.