

Methane emission to the atmosphere from landfills in the Canary Islands

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Methane (CH₄) is one of the most powerful greenhouse gases, and is increasing in the atmosphere by 0.6% each year (Intergovernmental Panel on Climate Change, IPCC, 2013). This gas is produced in landfills in large quantities following the anaerobic degradation of organic matter. The IPCC has estimated that more than 10% of the total anthropogenic emissions of CH₄ are originated in landfills. Even after years of being no operative (closed), a significant amount of landfill gas could be released to the atmosphere through its surface as diffuse or fugitive degassing. Many landfills currently report their CH₄ emissions to the atmosphere using model-based methods, which are based on the rate of production of CH₄, the oxidation rate of CH₄ and the amount of CH₄ recovered (Bingemer and Crutzen, 1987). This approach often involves large uncertainties due to inaccuracies of input data and many assumptions in the estimation. In fact, the estimated CH₄ emissions from landfills in the Canary Islands published by the Spanish National Emission and Pollutant Sources Registration (PRTR-Spain) seem to be overestimated due to the use of protocols and analytical methodologies based on mathematical models. For this reason, direct measurements to estimate CH₄ emissions in landfills are essential to reduce this uncertainty. In order to estimate the CH₄ emissions to the atmosphere from landfills in the Canary Islands 23 surveys have been performed since 1999. Each survey implies hundreds of CO₂ and CH₄ efflux measurements covering the landfill surface area. Surface landfill CO₂ efflux measurements were carried out at each sampling site by means of a portable non-dispersive infrared spectrophotometer (NDIR) model LICOR Li800 following the accumulation chamber method. Samples of landfill gases were taken in the gas accumulated in the chamber and CO₂ and CH₄ were analyzed using a double channel VARIAN 4900 micro-GC. The CH₄ efflux measurement was computed combining CO₂ efflux and CH₄/CO₂ ratio. To quantify the diffuse or fugitive CO₂ and CH₄ emission, gas efflux contour maps were constructed using sequential Gaussian simulation (sGs) as interpolation method. Considering that (a) there are 5 controlled landfills in the Canary Islands, (b) the average area of the 23 studied cells is 0.17 km² and (c) the mean value of the CH₄ emission estimated for the studied cells range between 6.9 and 8.1 kt km⁻² y⁻¹, the estimated CH₄ emission to the atmosphere from landfills in the Canary Islands showed a range of 7.0 - 7.8 kt y⁻¹. On the contrary and for the same period of time, the PRTR-Spain estimates CH₄ emission in the order of 10.3 - 14.9 kt y⁻¹, nearly two times our estimated value. This result demonstrates the need to perform direct measurements to estimate the surface fugitive emission of CH₄ from landfills.

Bingemer, H. G., and P. J. Crutzen (1987). The production of methane from solid wastes, *J. Geophys. Res.* 92, 2182-2187