Geophysical Research Abstracts
Vol. 19, EGU2017-13705-2, 2017
EGU General Assembly 2017

Monitoring fugitive CH_4 and CO_2 emissions from a closed landfill at Tenerife, Canary Islands

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Solid waste must be managed systematically to ensure environmental best practices. One of the ways to manage this huge problem is to systematic dispose waste materials in locations such as landfills. However, landfills could face possible threats to the environment such as groundwater pollution and the release of landfill gases (CH_4, volatile organic compounds, etc.) to the atmosphere. These structures should be carefully filled, monitored and maintained while they are active and for up to 30 years after they are closed. Even after years of being closed, a systematically amount of landfill gas could be released to the atmosphere through its surface in a diffuse and fugitive form. During the period 1999-2016, we have studied the spatial-temporal distribution of the surface fugitive emission of CO_2 and CH_4 into the atmosphere in a cell in the Arico's municipal landfill (0.3 km^2) at Tenerife, Canary Islands, Spain. This cell was operative until 2004, when it was filled and closed. Monitoring these diffuse landfill emissions provides information of how the closed landfill is degassing. To do so, we have performed 9 gas emission surveys during the period 1999-2016. Surface landfill CO_2 efflux measurements were carried out at around 450 sampling site by means of a portable non-dispersive infrared spectrophotometer (NDIR) model LICOR Li800 following the accumulation chamber method. Landfill gases taken in the chamber were analyzed using a double channel VARIAN 4900 micro-GC. CH_4 efflux measurements were computed combining CO_2 efflux measurements and CH_4/CO_2 ratio in the landfill's surface gas. To quantify the total CH_4 emission, CH_4 efflux contour map was constructed using sequential Gaussian simulation (sGs) as interpolation method. In general, a decrease in the CO_2 emission is observed since the cell was closed (2004) to the present. The total CO_2 and CH_4 diffuse emissions estimated in the 2016 survey were 4.54 $\pm$ 0.14 t d^{-1} and 268.65 $\pm$ 17.99 t d^{-1}, respectively. These types of studies provide knowledge of how a landfill degasses and serves to public and private entities to establish effective systems for extraction of biogas. This aims not only to achieve higher levels of controlled gas release from landfills resulting in a higher level of energy production but also will contribute to minimize air pollution caused by them.