

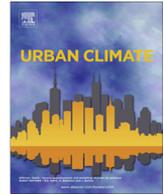


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Evidence of the effect of an urban heat island on air quality near a landfill



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ABSTRACT

In Guadeloupe (French West Indies), the main municipal solid waste is surrounded by highly urbanized areas. An urban heat island (UHI) behavior has been identified in the landfill environment. It has been measured and its intensity (up to more than 4 °C) has been shown to be negatively correlated with nebulosity and Tradewinds strength. Conditions for urban breeze detection have been examined. The breeze westerly direction brought some cool air over the urban area. The urban breeze generated by this UHI should also be responsible for a nocturnal pollution from the VOCs emitted by the landfill. Two different methods have been proposed for the breeze intensity estimation. The calculated breeze intensity values, about 1 m s⁻¹, was of the same order of magnitude as measured wind data. Temperature measurements performed during 2 weeks have shown no occurrence of temperature gradients between sea and land air masses, able to generate other breeze processes in the studied area.

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1. Introduction

Landfilling is the major method of municipal solid waste (MSW) disposal in the world as the most economical available waste management strategy. Open cells receive waste arriving in the landfill and are the main sources of VOC emissions into the ambient air through aerobic fermentation.

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The island of Guadeloupe (at the North of the Lesser Antilles; 16°15N, 61°35W; area 1800 km²; 440,000 inhabitants, Fig. 1) experiments an island tropical and humid climate. There are two seasons: a dry and colder season which runs from January to June and a rainy and hotter season that lasts from July to December. With an average temperature of 24 °C for the coldest month and an average of 27–28 °C for the hottest month, we note a narrow annual temperature range attributed to the nearly permanent Tradewinds flow throughout the year.

In Guadeloupe, La Gabarre (the main MSW) is an open field landfill of 36 ha with 215,000 tons of garbage every year, which constitutes a major source of anthropogenic pollution to surrounding areas.

It is located in a mangrove area that surrounds it. The mangrove is bordered by marine sites: the protected sites of Le Grand Cul de Sac Marin (North) and Le Petit Cul de Sac Marin (South), and on the West side by the Rivière Salée river (Fig. 2).

The MSW is sandwiched between the mangrove and inhabited areas (Fig. 3): the cities of Grand-Camp (800 m to South-East), Lauricisque (1200 m to South-West) and Raizet (700 m to East). Just a ring road with heavy traffic separates the MSW from populated areas.

Residents living close to the landfill often complain about rancid emanations especially during the night. About 80% of Grand-Camp residents surveyed declare bothering odors, 91% estimate these odors come from the landfill. Simultaneous gas measurements using a portable open path Fourier Transform IR spectrometer (Jock et al., 2008) in the landfill and in Grand-Camp confirmed the presence of the same pollutants in both sites, especially at night. VOCs detected by Jock et al. (2008) in Grand-Camp (chloroethane, 7.46 ppm; ethylbenzene, 7.75 ppm; ammonia, 0.03 ppm; propane, 1.24 ppm; trichloroethylene, 0.16 ppm; trifluoroethane, 1.15 ppm) are gas issuing from the fermentation of waste in an open landfill. Concentrations in Grand-Camp are lower than at La Gabarre landfill.

In 2012, we chose a number of VOCs characteristic of landfill waste emission: aromatic: benzene, ethylbenzene, toluene; organochlorine: trichlorethylene, tetrachlorethylene and 111-trichloroethane; aldehydes: acetaldehyde.

We measured them in the MSW of La Gabarre, in the urban adjacent area and the surrounding mangrove with a mass spectrometer MS 200.

These measurements show the strong presence of aromatic and organochlorine VOCs in the biogas. They are related to the nature of the waste. Indeed, for more than 30 years, this MSW collects

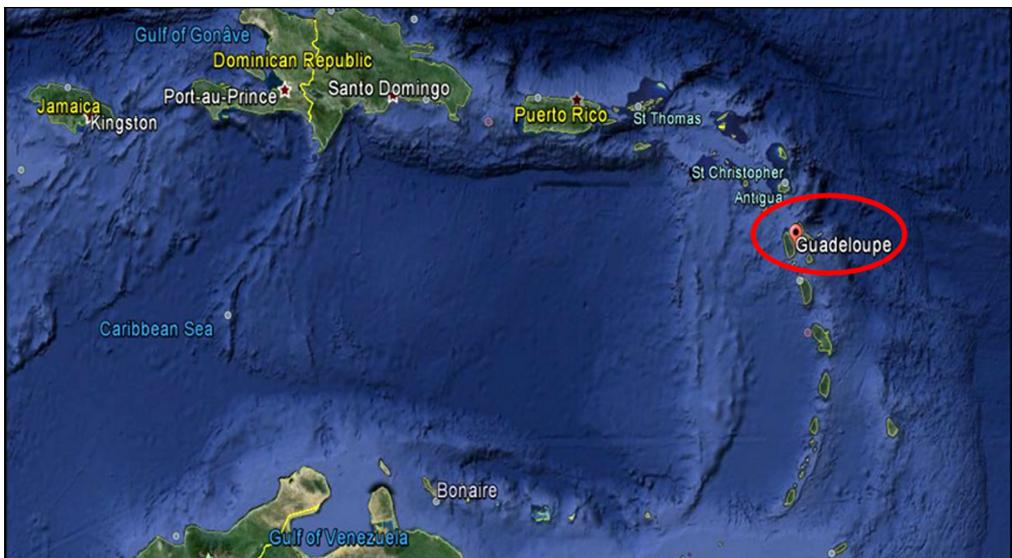


Fig. 1. Location of Guadeloupe in the Lesser Antilles.

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