



# Passive monitoring of particulate matter and gaseous pollutants in Fogo Island, Cape Verde

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## ABSTRACT

An air quality monitoring campaign by passive sampling techniques was carried out, for the first time, between November 2016 and January 2017 on the Cape Verdean island of Fogo, whose volcanic mountain rises up to 2829 m. Levels of SO<sub>2</sub> and acid gases (HF, HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> and H<sub>3</sub>PO<sub>4</sub>) were, in most cases, below the detection limits. Alkylpentanes, hexane, cycloalkanes and toluene were the dominant volatile organic compounds. The m,p-xylene/ethylbenzene ratios revealed that air masses arriving at Cape Verde have been subjected to significant aging processes. High toluene/benzene ratios suggested extra sources of toluene in addition to vehicle emissions. Deposition rates of total settleable dust ranged from 23 to 155 mg/m<sup>2</sup>/day. On average, organic carbon accounted for 15.6% of the dust mass, whereas elemental carbon was generally undetected. Minerals comprised the dominant mass fraction. The dust levels were mostly affected by two main airflows: the westerlies and the Saharan Air Layer. These air masses contributed to the transport of mineral dust from desert regions, secondary inorganic constituents (SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup> and NH<sub>4</sub><sup>+</sup>) and tracers of biomass burning emissions, such as potassium. Sea salt represented 12% of the mass of settleable dust. Scanning electron microscope observations of several particles with different compositions, shapes and sizes revealed high silica mass fractions in all samples, as well as variable contents of carbonates, sulphates, aluminosilicates, Fe, Ti, F and NaCl, suggesting that, in addition to the already mentioned sources, dust is likely linked to industrial emissions in the northern and north-western coast of the African continent. Although some atmospheric constituents presented higher concentrations near the crater, the small fumarolic activity still present after cessation of the eruption in February 2015 has a limited impact on air quality, which is most affected by long range transport and some local sources at specific locations.

## 1. Introduction

Fogo is the island of the Sotavento group of Cape Verde that reaches the highest altitude: nearly 3000 m above sea level at its summit, Pico do Fogo. The island has an area of 476 km<sup>2</sup> and approximately 40,000 inhabitants. The economy is essentially based on agriculture and fishing. The largest city, São Filipe, is located to the west. The island is a stratovolcano that has been intermittently active. The volcanic cone rises from a plateau about 8 km in diameter, called Chã das Caldeiras, and the walls on the western side reach almost 1000 m and end in a crater 500 m in diameter and 180 m deep. After 19 years of quiescence, Fogo volcano erupted in November 2014. The eruption produced fast-

moving lava flows that travelled for several kilometres. Although the eruption of the volcano has ceased in February 2015, minor fumarolic activity is still present at the edge of the new crater. Moreover, the deposited ash is frequently remobilised by the wind causing significant health concerns. Fogo has a tropical savannah climate characterised by a relatively dry period and a wet period, the latter between August and October. Because of the altitude, temperatures are slightly lower than those of other islands of Cape Verde. The average annual temperature on the coast is roughly 23–25 °C, but decreases to values around 12–14 °C on the highest locations. There is an ever blowing, sometimes fierce sea wind on Fogo, which may temper temperatures. Nevertheless, when the dry and dusty Harmattan winds blow from the Sahara Desert

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