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Long-term continuous monitoring of CO_2 emission from the summit cone of Teide volcano, Tenerife, Canary Islands

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Tenerife (2034 km^2) is the largest of the Canary Islands and is characterized by three main volcano-tectonic axis: the NS, NE and NW dorsals and a central caldera, Las Cañadas, hosting the twin stratovolcanoes Pico Viejo and Teide. Although Teide volcano shows a weak fumarolic system, volcanic gas emissions observed in the summit cone consist mostly of diffuse CO_2 degassing.
With the aim of improving the volcanic monitoring system and providing a multidisciplinary approach to the surveillance program of Teide volcano, the first continuous automatic geochemical station in Canary Islands was installed at the southeastern foot of summit cone of Teide volcano in 1999. We report here the results of the first 12 years of the time series of diffuse CO_2 flux, recorded on a hourly basis by the station.
The 1999-2011 time series show anomalous changes of the diffuse CO_2 emission with values ranging between 0 and 62.8 kg $m^{-2}d^{-1}$, with a mean value of 4.7 kg $m^{-2}d^{-1}$. The CO_2 efflux increases remained after filtering the time series with multiple regression analysis (MRA). We found that the physical properties of the soil (soil temperature and soil water content) and atmospheric variables (wind speed and barometric pressure) explained 16.7Historically, most of the earthquake's epicentres have been clustered in and offshore area SE of Tenerife with low- to moderate-magnitude events (M<2.5) and a monthly rate of located seismic events less than one from 1997 to the middle of 2001. However, since middle of 2001 there was a significant increase of the seismic activity, specially during 2004 and 2010, characterized both by an increasing number of small earthquakes occurring, respectively, mostly along the NW dorsal and in the southern part of the NW dorsal of Tenerife.
Our data show in 2002 a marked peak of the filtered CO_2 signal. The beginning of this increase is nearly coincided with a similar signals on the data of CO_2 emission, coming from periodic surveys performed yearly on the Teide summit cone since 1997 (Pérez et all, 2013). We interpret these signals as an "early warning" associated to the 2004 volcanic unrest alert in Tenerife. A similar coincidence was observed also for the interval 2006-2009, which was followed by an increase in the local seismicity of Tenerife as well.
Our study reveals that the continuous CO_2 efflux measurement could provide early warnings of possible impending volcanic unrest and/or eruptions. Furthermore the data presented in this work, constitute one of the longest time series of CO_2 efflux in an active volcanic areas, hence providing an important benchmark for similar measurements worldwide.

References:
Melián et al., 2012. Bull. Volcanol.
Pérez et al., 2013. J. Geol. Soc.