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Short-term variations of diffuse CO_2 emission from the summit crater of Teide volcano, Tenerife, Canary Islands

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Teide volcano in Tenerife, Canary Islands, is characterized by the presence of a weak fumarolic system, steamy ground, and high rates of diffuse CO_2 degassing all around this area. The temperature of the fumaroles (83˚C) corresponds to the boiling point of water at discharge conditions. Previous diffuse CO_2 surveys have shown to be an important tool to detect early warnings of possible impending volcanic unrests at Tenerife Island (Melián et al., 2012; Pérez et al., 2013). During June, July and August 2016, twelve soil gas surveys were performed at the summit crater of Teide volcano in order to evaluate short-term variations of diffuse CO_2 degassing pattern. Soil CO_2 efflux and soil temperature were always measured at the same 38 observation sites homogeneously distributed within an area of about 6,972 m^2 inside the summit crater. Soil CO_2 diffuse effluxes were estimated according to the accumulation chamber method and using a non-dispersive infrared (NDIR) LICOR-820 CO_2analyzer. Soil CO_2 efflux values presented a range from non-detectable ($\sim$0.5 g·m^{-2}·d^{-1}) to 10.8 kg·m^{-2}·d^{-1}, with an average value of 2.7 kg·m^{-2}·d^{-1}, while soil temperature ranged from 13.1 to 83.6˚C with a mean value of 55.6˚C. Sequential Gaussian simulations (sGs) were used for mapping and estimate the volcanic diffuse CO_2 emission at each survey. The highest values of diffuse CO_2 efflux were measured along the east ($>$8 kg·m^{-2}·d^{-1}) and west ($>$5 kg·m^{-2}·d^{-1}) sectors of the crater. Areas with highest diffuse CO_2 effluxes were also characterized by a relatively high soil temperature ($>$60˚C) and by an intense hydrothermal alteration. Weekly diffuse CO_2 emission variations from the summit crater during the study period showed a range between 13.5 and 24.7 t·d^{-1} with an average value of 18.9 t·d^{-1}. During these 3 months, the seismic activity rate was about 10 seismic events per month registered by the Instituto Geográfico Nacional (IGN; http://www.ign.es). We compared these observed weekly variations with monthly variations of a longer period with similar seismic rate such as 2014 (about 8 seismic events per month, and values ranged from 15.6 to 22.4 t·d^{-1}, and an average value of 19.0 t·d^{-1}. These values are in the same order than the observed during our study. However, for a longer period of observation, from 1999 to 2010, diffuse CO_2 emission rates varied from 2.2 to 36.3 t·d^{-1}, with a mean value of 15.7 t·d^{-1} (Melián et al., 2012). The long-term variations observed in the diffuse CO_2 emission rates during this period of 10 years were significantly higher than short-term variations observed in the period of study. It is also important to note that the volcanic-seismic crisis of 2004 occurred with an increase on the CO_2 emission from Teide summit crater (Melián et al., 2012). This study shows that during periods of seismic tranquility, diffuse CO_2 emission rates will not suffer significant variations, whether performed on a weekly or monthly basis.

References:

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