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Seventeen years of monitoring diffuse CO_2 emission from the Tenerife North–West Rift Zone (NWRZ) volcano, Canary Islands

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Tenerife together and Gran Canaria are the central islands of the Canarian archipelago, which have developed a central volcanic complex characterized by the eruption of differentiated magmas. Tenerife is the largest of the Canary Islands (2100 km^2) and at present, the North-West Rift-Zone (NWRZ) is one of the most active volcanic structures of the three volcanic rift-zone of the island, which has hosted two historical eruptions (Arenas Negras in 1706 and Chinyero in 1909). In order to monitor the volcanic activity of NWRZ, since the year 2000, 49 soil CO_2 efflux surveys have been performed at NWRZ (more than 300 observation sites each one) to evaluate the temporal an spatial variations of CO_2 efflux and their relationships with the volcanic-seismic activity. Measurements were performed in accordance with the accumulation chamber method. Spatial distribution maps were constructed following the sequential Gaussian simulation (sGs) procedure. To quantify the total CO_2 emission from the studied area, 100 simulations for each survey have been performed. We report herein the results of the last diffuse CO_2 efflux surveys at the NWRZ undertaken in July and October 2016 to constrain the total CO_2 output from the studied area. During July and October 2016 surveys, soil CO_2 efflux values ranged from non-detectable up to 32.4 and 53.7 g m^{-2} d^{-1}, respectively. The total diffuse CO_2 output released to atmosphere were estimated at 255 $\pm$ 9 and 338 $\pm$ 18 t d^{-1}, respectively, values higher than the background CO_2 emission estimated on 144 t d^{-1}. Since 2000, soil CO_2 efflux values have ranged from non-detectable up to 141 g m^{-2} d^{-1}, with the highest values measured in May 2005 whereas total CO_2 output ranged between 52 and 867 t d^{-1}. Long-term variations in the total CO_2 output have shown a temporal correlation with the onsets of seismic activity at Tenerife, supporting unrest of the volcanic system, as is also suggested by anomalous seismic activity recorded in the studied area during April 22-29, 2004 and also during October 2-3, 2016. Spatial distribution of soil CO_2 efflux values also showed changes in magnitude and amplitude, with higher CO_2 efflux values measured along a trending WNW-ESE zone. Subsurface magma movement is proposed as a cause for the observed changes in the total output of diffuse CO_2 emission as well as for the spatial distribution of soil CO_2 efflux. The increasing trend of total CO_2 output suggests increasing pressurization of the volcanic-hydrothermal system, a mechanism capable of triggering dyke intrusion along the NWRZ of Tenerife in the near future or futures changes in the seismicity. This study demonstrates the importance of performing soil CO_2 efflux surveys as an effective surveillance volcanic tool.