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Pressure drop as a forecasting tool of eruption duration: 2021 La Palma eruption

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One of the main goals of the modern volcanology is produce accurate eruption forecastings. Not only from a scientific point of view, but considering that approximately 30 million people live in the vicinity of active volcanic areas and tens of thousands of people have lost their lives as a result of the direct effects of historical eruptions. Thus, in 2017 "The US National Academies of Sciences, Engineering and Medicine" considered the forecast of eruptions as one of the great challenges of Volcanology. Generally, the focus is on forecasting the eruption onset, however, forecasting the style, size and duration becomes relevant and properly manage long-duration eruption, e.g., during the 2021 La Palma (Canary Islands) eruption, whose main hazards were air pollution, ash fall and lava flows. In particular, the 2021 eruption of La Palma lava flows caused extensive devastation to the surrounding community: more than 2800 buildings and almost 1000 hectares of banana plantations and farmland were destroyed. In this study, we use co-eruptive GNSS series of deformation data to estimate the eruption's end. The forecast was based on the relationship between displacements and pressure changes provided by a purely elastic model of the medium. We also estimated the location of a magma reservoir. A depth of 10-15 km is inferred. This reservoir is consistent with the main seismogenic volume during the eruption. We interpret that the reservoir pressure dropped due the progressive withdrawal of magma that fed the eruption. We assumed that the magmatic plumbing responsible for the eruption was a closed system and that the magma contributions in this zone do not cause detectable deformations. Thus, we used the pressure drop as an indicator of the end of an eruption. With the benefit of the hindsight, we extensively tested our model considering different deformation time series spams in order to evaluate the feasibility of making near-real time predictions of the duration of the eruption, and derive some constraints about the magma system.