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Ten years of continuous monitoring of soil CO_2 flux: results and implications from the first geochemical monitoring network on Mount Etna.

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Throughout the Mediterranean area, Mt. Etna is well known for its frequent eruptions and considerable lava flows, being, among all of the basaltic volcanoes, one of the most active in the world. The frequent activity of the last two decades has induced the scientific community and the Civil Defence to pay more attention to the surveillance of the volcano and, in view of this, a diverse range of monitoring systems have been developed, making Mt. Etna one of the most intensively studied volcanoes in the world.
The measurement of soil CO_2 flux for the purpose of identifying a possible correlation between CO_2 flux variations and volcanic activity has been carried out for a long time on several active volcanoes around the world. Whilst almost all of these measurements have been made using direct sampling methods in the field, various kinds of automatic devices have more recently been developed to record real-time data, allowing a continuous remote monitoring of volcanic areas.
On Mt. Etna the first network of continuous monitoring of geochemical parameters was developed in 2002 by the Istituto Nazionale di Geofisica e Vulcanologia (INGV) of Palermo to monitor CO_2 flux from the soil (EtnaGAS network) and was installed at various sites (18 in total) on the flanks of Mt. Etna. The very large quantity of soil CO_2 flux data recorded by the network, during which several interesting eruptive phenomena took place, has provided the possibility to make an extensive statistical analysis, the outcome of which strongly suggests that anomalous measurements of CO_2 flux was attributable to a volcanic origin and, in almost all cases, preceded the onset of volcanic activity. Here we present an interpretative model of the expected behaviour of CO_2 flux from the soil (in terms of cycles of increase-decrease) during and between eruptions, and the actual data-series recorded by EtnaGAS which we found corresponded well with our model. A comparative multidisciplinary approach, incorporating both volcanological and geophysical data puts the global soil CO_2 flux trends into a coherent framework that further highlights how the time flux variations are closely related to volcanic activities. This insight into CO_2 flux variations, based upon approximately 10 years of uninterrupted data, permit us to conclude that the continuous monitoring of volcanic soil degassing may facilitate the forecasting of imminent eruptive activity or the temporal evolution of an in-progress eruption and, therefore, play an important contributory role in the planning of Civil Defence actions in volcanic areas under high-hazard conditions.