EGU21-2167
https://doi.org/10.5194/egusphere-egu21-2167
EGU General Assembly 2021

Impact of the Christmas 2018 Mount Etna Eruption on the Regional Air Quality

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Volcanic eruptions are events that can eject several tons of material into the atmosphere. Among these emissions, sulfur dioxide is the main sulfurous volcanic gas. It can form sulfate aerosols that are harmful to health or, being highly soluble, it can condense in water particles and form acid rain. Thus, volcanic eruptions can have an environmental impact on a regional scale.

The Mediterranean region is very interesting from this point of view because it is a densely populated region with a strong anthropogenic activity, therefore polluted, in which Mount Etna is also located. Mount Etna is the largest passive SO_2 emitter in Europe, but it can also sporadically produce strong eruptive events. It is then likely that the additional input of sulfur compounds into the atmosphere by volcanic emissions may have effects on the regional atmospheric sulfur composition.

We are particularly investigating the eruption of Mount Etna on December 24, 2018 [Corradini et al, 2020]. This eruption took place along a 2 km long breach on the side of the volcano, thus at a lower altitude than its main crater. About 100 kt of SO_2 and 35 kt of ash were released in total, between December 24 and 30. With the exception of the 24th, the quantities of ash were always lower than the $SO_{2.}$

The availability of the TROPOMI SO_2column estimates, at fine spatial resolution (7 km x 3.5 km at nadir) and associated averaging kernels, during this eruptive period made it also an excellent case study. It allows us to follow the evolution of SO_2 in the volcanic plume over several days.

Using the CNRM MOCAGE chemistry-transport model (CTM), we aim to quantify the impact of this volcanic eruption on atmospheric composition, sulfur deposition and air quality at the regional scale. The comparison of the model with the TROPOMI observation data allows us to assess the ability of the model to properly represent the plume. In spite of a particular meteorological situation, leading to a complex plume transport, MOCAGE shows a good agreement with TROPOMI observations. Thus, from the MOCAGE simulation, we can evaluate the impact of the eruption on the regional concentrations of SO_2 and sulfate aerosols, but also analyse the quantities of dry and wet deposition, and compare it to surface measurement stations.