Insights into rapid explosive volcanic processes from ground- and space-based intraday SO_2 flux measurements.

L.Merucci, M. Burton, S. Corradini, G.Salerno

Observations of volcanic degassing yield insights into the sub-surface magmatic processes which control volcanic activity during both quiescent and eruptive phases. By combining information on volcanic gas flux with constraints on original dissolved volatile contents the volume of degassing magma can be determined. Comparisons between the volume of degassing magma, erupted volume, and ground deformation allow mass balance calculations to be performed, providing insight into the shallow volcanic plumbing system dynamics. For these reasons there is great interest in improving the quality and frequency of volcanic gas flux measurements.

Ultraviolet and infrared remote sensing techniques allow determination of SO_2 column amounts within volcanic plumes. By calculating SO_2 column amounts in a profile orthogonal to the plume-wind direction and multiplying the integrated SO_2 cross section by the wind speed the SO_2 emission rate can be retrieved. There are currently three main approaches for determining volcanic SO_2 fluxes; (i) ground-based mini-DOAS systems, (ii) ground-based SO_2 imaging cameras, and (iii) satellite-based infrared and ultraviolet imaging.

Here we examine SO_2 fluxes obtained by the Flux Automatic Measurement (FLAME) network of scanning mini-DOAS instruments installed at Mt. Etna and by the MODIS instrument aboard the NASA EOS satellite AQUA during the 2006 eruption of Mt. Etna, Sicily, Italy. Mt. Etna produced a highly variable eruptive activity from the South-East crater, characterised by explosive sequences, which could be either ash-rich or ash-poor, lava effusion, partial flank collapse and periods of quiescence. We examined intraday variations in SO_2 flux measured with FLAME and MODIS during both ash-rich and ash-poor explosive phases. In general, good agreement was found between the datasets. Of particular interest was the successful recalculation and validation of temporal variations in SO_2 flux recorded in a single image from MODIS. By examining the temporal evolution of gas emissions our results provide insight in the eruption mechanism driving the explosive activity.