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Using meso-scale meteorological modeling to reduce errors in gas flux measurements from volcanoes

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Gas emissions from volcanoes carry information related to the volcanic activity and can therefore be used in predicting volcanic events. Several methods for quantitative measurements of sulphur dioxide emission from volcanoes have been developed. These includes the COSPEC instrument developed in the 70ties, as well as recently developed instruments based on DOAS spectroscopy applied in different modes (mobile or scanning). Recently a global network for volcanic gas monitoring based on Scanning DOAS instruments, NOVAC, has been implemented. The network presently comprises 56 instruments installed on 23 volcanoes in Europe, Africa and Latin America.

One of the major error sources for calculating fluxes using these techniques is accurate knowledge of the wind field where the volcanic plume is located. The flux scales linearly with the wind speed normal to the intersecting plane. In real world situations the wind is very difficult to measure accurately with conventional techniques and even more so at volcanic sites. This is partly due to the remoteness of the volcanic locations and the altitude of the volcanic plumes. More advanced methods based on SODAR or LIDAR are expensive and technically complicated.

Under favourable meteorological conditions, with a stable plume located over the instrument, Dual-beam DOAS spectroscopy offers a possibility to quantitatively measure the plume speed at plume height, using a time-correlation technique.

Using a meso scale meteorological model as the source for wind speed and wind direction offers an interesting alternative and has the advantage of delivering wind field data at high temporal and spatial resolution. In this presentation a meso-scale meteorological model WRF (Weather Research and Forcast) has been implemented on 3 volcanoes in the NOVAC network, Popocatepetl, Etna and Tungurahua. The modeled wind data are compared to plume speed data obtained from the dual-beam DOAS method, and an estimate of the error obtained using WRF-modeled wind data is given.