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Dual-beam mini-DOAS spectroscopy, a novel approach for volcanic gas emission monitoring

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One of the most widely used techniques for routine geochemical surveillance at volcanoes is the Correlation Spectrometer (Cospec), developed in the 1960s and first described by Moffat and Millan [1]. Since the development of the Cospec, technological development has given us sensitive and fast multi-channel array detectors, powerful computers, and algorithms for modelling of radiative transfer and accurate analysis of differential absorption spectra. These achievements have led to an excellent alternative to Cospec: a miniature fiber optic ultraviolet differential optical absorption spectrometer: the mini-DOAS.

In 2001 the first successful measurements of volcanic gas emissions using a mini-DOAS system was demonstrated [2]. Since then several systems based on this concept has been developed and the technique has been applied on measurements of gas emissions on numerous volcanoes worldwide. A second major development was to couple the mini-DOAS instrument to a scanning device, providing time resolved measurement of the gas emission [3]. This opened up the possibility to correlate gas emission data with other geophysical data, e.g. seismic signals. A third major improvement was the recently demonstrated possibility to simultaneously measure SO_2 and BrO from volcanic gas spectra [4]. This opens up the possibility to make time resolved measurements of the ratio BrO/SO2, and reduces the need for more complicated and expensive equipment as FTIR spectrometers.

The main source of error in both mobile and scanning mini-doas measurements, as well as COSPEC measurements, is determination of wind-speed at plume height. In the scanning measurements, also knowledge of the plume height is crucial in order to correctly calculate the number of gas molecules in a cross-section of the volcanic gas plume. This paper describes a novel approach; the Dual Beam mini-DOAS, to mea-

sure wind speed and plume height in connection with mini-DOAS measurements of volcanic gas emissions. The concept has been tested in field campaigns in Nicaragua, Mexico, Spain and Italy and examples from these campaigns will be given.

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