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# High-term resolution SO2 flux measurements using an automated UV scanner array: first 16-month results on Mt. Etna (Italy)

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Five automatic ultraviolet scanners were installed on the south and eastern flanks of Mt. Etna in October 2004. Each scanner measures a horizon-to-horizon profile of SO2 amount every 5 minutes. These profiles are transmitted via GSM modem to a base station where plume height is calculated, allowing geometric correction of the profiles and derivation of the plume cross-section. Combining the so2 cross-section with wind speed (obtained from a high resolution meteorological model) allows the flux of SO2 to be constrained. Here we present the first 16-month results of SO2 flux data (October 2004 - January 2006) from the UV scanning array, together with a critical evaluation of errors and limits of the automatic analysis system. Spectral evaluation is performed by non-linearly fitting a forward model to the observed spectrum, after removal of a dark spectrum which is collected anew for each profile. The forward model combines an averaged low-noise background spectrum with laboratory SO2 and solar Ring effect spectra. In this paper we present results from an investigation into the frequency with which the background spectrum must be updated in order to maintain an acceptable level of data quality. Accurate plume height derivation is of fundamental importance for obtaining low-error measurements of flux, and entails measuring the plume with at least two stations. With the current spacing of the stations and average plume height of approximately 1500m a.s.l, we find that plume heights can be constrained well about 40% of the time. For other measurements we can calculate a flux assuming an average plume-height or using a wind speed-calibrated plume height. It is also often the case that a scanner captures more than half but not a complete profile.

We have therefore developed a quality evaluation for each flux measurement, which allows the user to differentiate between optimal flux measurements and lower quality products. According to these two parameters, three quality classes of SO2 flux have been recognized; (i) SO2 flux derived from a profile with a complete plume and precise plume height; (ii) SO2 flux value from data with precise plume height but incomplete plume profile; and iii) SO2 flux derived from data with complete profile but without precise height. High temporal resolution SO2 flux data represents an important forward improvement in volcanic surveillance that provides real-time information of volcanic dynamics. Timesteps typical of the geophysical datastreams gain the opportunity of enquiring, in short-term and long-term, evidences of magma supply rates of volcanoes. Furthermore, real-time daylight volcanic plume scanning could provide an extremely useful tool for volcanic ash-cloud hazard assessments, essential for aircraft safety.