

Novel retrieval of volcanic SO₂ abundance from ultraviolet spectra

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Abstract

The recent development of fixed networks of scanning ultraviolet spectrometers for automatic determination of volcanic SO₂ fluxes has created tremendous opportunities for monitoring volcanoes but has brought new challenges in processing of the substantial data flow they produce. A particular difficulty in standard implantation of differential optical absorption (DOAS) methods is the requirement for a clear-sky (plume-free) background spectrum. Our experience after four years of measurements with two UV scanner networks on Etna and Stromboli shows that wide plumes are frequently observed precluding simple selection of clear-sky spectra. We have therefore developed a retrieval approach based on simulation of the background spectrum. We describe the method here and tune it empirically by collecting clear, zenith sky spectra using calibration cells containing known amounts of SO₂. We then test the performance of this optimised retrieval using clear-sky spectra collected with the same calibration cells but for variable scan angles, time of day, and season (through the course of 1 year). We find in all cases acceptable results (maximum ~12% error) for SO₂ column amounts. The method is therefore very suitable for automated SO₂-plume monitoring.