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iFit and Light Dilution: Ultraviolet volcanic SO_2 measurements under the microscope

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Volcanic SO_2 flux measurement systems are a staple of volcano monitoring networks, as this volcanic gas flux reflects the magma input rate into the volcano's feeding system. SO_2 flux monitoring has been used since the seventies, with some notable successes at Pinatubo, Mt. St. Helens, Montserrat and Italian volcanoes. However, there are some subtle aspects of the atmospheric radiative transfer processed inherent in the technique which have been ignored for many years; or perhaps better, they have been forgotten, as these subtleties were clearly spelt out in early COSPEC papers by Millán and co-workers.

Recent work by Kern et al. (2010, 2012) has re-focussed attention on the light dilution effect during SO_2 plume measurements. This occurs when solar radiation is scattered into the slant column observed by a UV spectrometer or imaging system below the height of the volcanic plume, such that it has not passed through the plume. This below-plume light dilutes the SO_2 absorption produced by light passing through the plume from above, apparently reducing the amount of SO_2 present.

Fortunately, the light dilution process leaves a signature in the shape of the SO_2 absorption spectrum, due to the non-linear behaviour of absorption lines with respect to gas amount, following the Beer-Lamber law. This signature can be used to quantify the magnitude of the light dilution in real field spectra.

We developed a new intensity spectrum UV fitting code called iFit that allows fitting of the light dilution signature, and applied this to examples from Stromboli and Etna. here we summarise the results from these studies and highlight the importance of this previously ignored process for quantify SO_2 gas emissions from volcanoes.