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The use of IASI in the measurement of volcanic SO_2: degassing and lower tropospheric emission.

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Sulphur dioxide (SO_2) is an important atmospheric constituent that plays a crucial role in many atmospheric processes. Volcanic eruptions are a significant source of atmospheric SO_2 and its lifetime and impact depend on the SO_2 injection altitude. Measurements of volcanic SO_2 emissions can offer critical insight into the current and near-future activity of volcanoes, however, the majority of active volcanoes lack regular ground-based monitoring. We exploit the spectral range of IASI, from 1000 to 1200 cm^{-1} and from 1300 to 1410 cm^{-1} (the 7.3 and 8.7 μm SO_2 absorption bands), to study volcanic SO_2.

The IASI-A dataset was analysed using a rapid linear retrieval algorithm as a global survey tool to show that IASI observations detect SO_2 emissions from anthropogenic sources, volcanic eruptions and certain persistently degassing volcanoes over the IASI time series. Using this linear retrieval hundreds of potential degassing volcanoes are identified around the world.

An iterative optimal estimation retrieval scheme was then employed to produce a more detailed analysis of the data, with a comprehensive error budget. This algorithm is significantly more computationally intensive but allows for the estimation of both the SO_2 amount and altitude of volcanic plume from recent explosive and effusive eruptions.

Thermal infrared spectrometers are particularly valuable in regions where shorter wavelength observations are limited, such as during polar winter.

In particular here we present two case studies:

1) The vertical distribution of SO_2 during the Bardabunga eruption from September 2014 to February 2015.

2) The monthly mean trends in SO_2 emission over Ecuador and Northern Kamchatka. Over Ecuador, Tungurahua showed the most persistent signal, with a strong correlation between IASI, ground-based and OMI datasets. Over Kamchatka, IASI detected clear peaks in SO_2 emissions coincident with reports of elevated volcanic activity.