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Retrieval of volcanic ash properties from the Infrared Atmospheric Sounding Interferometer (IASI)

Lucy Ventress, Elisa Carboni, Andrew Smith, Don Grainger, Anu Dudhia, and Catherine Hayer
University of Oxford, Oxford, United Kingdom (ventress@atm.ox.ac.uk)

The Infrared Atmospheric Sounding Interferometer (IASI), on board both the MetOp-A and MetOp-B platforms, is a Fourier transform spectrometer covering the mid-infrared (IR) from 645-2760cm^{-1} (3.62-15.5 μm) with a spectral resolution of 0.5cm^{-1} (apodised) and a pixel diameter at nadir of 12km. These characteristics allow global coverage to be achieved twice daily for each instrument and make IASI a very useful tool for the observation of larger aerosol particles (such as desert dust and volcanic ash) and the tracking of volcanic plumes.

In recent years, following the eruption of Eyjafjallajökull, interest in the the ability to detect and characterise volcanic ash plumes has peaked due to the hazards to aviation. The thermal infrared spectra shows a rapid variation with wavelength due to absorption lines from atmospheric and volcanic gases as well as broad scale features principally due to particulate absorption. The ash signature depends upon both the composition and size distribution of ash particles as well as the altitude of the volcanic plume.

To retrieve ash properties, IASI brightness temperature spectra are analysed using an optimal estimation retrieval scheme and a forward model based on RTTOV. Initially, IASI pixels are flagged for the presence of volcanic ash using a linear retrieval detection method based on departures from a background state. Given a positive ash signal, the RTTOV output for a clean atmosphere (containing atmospheric gases but no cloud or aerosol/ash) is combined with an ash/cloud layer using the same scheme as for the Oxford-RAL Retrieval of Aerosol and Cloud (ORAC) algorithm. The retrieved parameters are ash optical depth (at a reference wavelength of 550nm), ash effective radius, layer altitude and surface temperature.

The potential for distinguishing between different ash types is explored and a sensitivity study of the retrieval algorithm is presented. Results are shown from studies of the evolution and composition of ash plumes for recent volcanic eruptions.