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Retrieval of volcanic ash and ice cloud physical properties together with gas concentrations from IASI measurements with the help of the AVL model

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Observation and tracking of volcanic aerosols are important for preventing possible aviation hazards and determining the influence of aerosols on the climate. The useful information primary includes the concentration, particle size and altitude of aerosol load. Moreover, volcanic eruptions are usually accompanied by strong emissions of SO_2 and enhanced concentrations of H_2O in the atmosphere. Volcanic ash particles can also catalyze the formation of ice clouds by serving as cloud nuclei. Hyperspectral infrared sounders, such as IASI (Infrared Atmospheric Sounding Interferometer), have proven to be a powerful tool for capturing volcanic aerosol/ice cloud signatures and enhanced volcanic gas concentrations. Information on atmospheric constituents is extracted from hyperspectral measurements with the help of radiative transfer (RT) codes capable of solving both direct and inverse RT problems.

We will demonstrate the retrieval of aerosol and ice cloud physical properties together with gas concentrations from IASI measurements with the help of the AVL RT model. AVL is one of the 'code combination packages' which are becoming more and more popular in the scientific domain. It consists of several codes, each of which handles a specific set of physics-related tasks. The codes function smoothly as a whole through the use of a special interface. Molecular absorption is calculated by the high-resolution line-by-line code ASIMUT, developed by Vandaele et al., BIRA-IASB, Belgium. ASIMUT also handles general input/output, instrument convolution/apodisation, optional graphic representation of the results (with the help of incorporated MATLAB functions) and the retrieval algorithm on the basis of Rodger's optimal estimation method. Volcanic ash and ice cloud properties are calculated using the SPHER code developed by M. Mishchenko, NASA GISS, USA. The RT problem is solved by the advanced linearized code VLIDORT, created by R. Spurr, RT solutions, USA. VLIDORT also generates fields of analytical derivatives of radiance (Jacobians) with respect to different aerosol/ice cloud parameters, required as input to the ASIMUT retrieval algorithm.

The retrievals are performed for IASI measurements (radiance, Level 1C product) carried out over Eyjafjallajökull volcano, Iceland, in April 2010.