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Infrared observation of volcanic ash and estimation of ash emission profiles of the 2010 Eyjafjöll eruption

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As volcanic eruptions and unrest are among the main natural hazards influencing human health, nature und aviation, a permanent global monitoring of active volcanoes and the knowledge of eruption source parameters for dispersion forecast modelling in case of an eruption is essential. The combination of satellite observations and atmospheric transport modelling can provide global information on the emission, dispersion and transport of volcanic ash.
The Infrared Atmospheric Sounding Interferometer (IASI) operating on the METOP-A satellite enables day and night ash detection due to the exploitation of thermal infrared observations. Singular vector decomposition (SVD) is applied to IASI brightness temperature difference observations in the thermal infrared (8-12μm) window region. The use of singular vectors enables to separate the signal of volcanic ash (also above clouds) from other atmospheric influences. Second degree polynomial fitting of the sum of weights of ash-related singular vectors to brightness temperature spectra disturbed with ash extinction from the literature is used to estimate the infrared optical depth of the airborne ash. First results of the estimated IASI ash AOD at 10 μm are shown for the 2010 eruption of the Icelandic Eyjafjöll volcano.
Based on these satellite observations eruption source parameters such as the effective emission height as a function of time were estimated using a robust and simplified backward trajectory ensemble technique. To overcome limitations of this technique due to small vertical wind shear, a reliability index was developed. Effective emission height profiles of volcanic ash for the eruption of the Eyjafjöll eruption will be discussed. Comparisons of the results obtained by applying different meteorological models (ECMWF vs. GFS) proving the robustness of our approach will also be presented. For a first validation the estimated emission parameters were used as a first guess to initialize a Lagrangian particle dispersion model.