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SO_2 plume height retrieval from direct fitting of GOME-2 backscattered radiance measurements

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The use of satellite measurements for SO_2 monitoring has become an important aspect in the support of aviation control. Satellite measurements are sometimes the only information available on SO_2 concentrations from volcanic eruption events. The detection of SO_2 can furthermore serve as a proxy for the presence of volcanic ash that poses a possible hazard to air traffic. In that respect, knowledge of both the total vertical column amount and the effective altitude of the volcanic SO_2 plume is valuable information to air traffic control. The Belgian Institute for Space Aeronomy (BIRA-IASB) hosts the ESA-funded Support to Aviation Control Service (SACS). This system provides Volcanic Ash Advisory Centers (VAACs) worldwide with near real-time SO_2 and volcanic ash data, derived from measurements from space. We present results from our algorithm for the simultaneous retrieval of total vertical columns of O_3 and SO_2 and effective SO_2 plume height from GOME-2 backscattered radiance measurements. The algorithm is an extension to the GODFIT direct fitting algorithm, initially developed at BIRA-IASB for the derivation of improved total ozone columns from satellite data. The algorithm uses parameterized vertical SO_2 profiles which allow for the derivation of the peak height of the SO_2 plume, along with the trace gas total column amounts. To illustrate the applicability of the method, we present three case studies on recent volcanic eruptions: Merapi (2010), Grímsvotn (2011), and Nabro (2011). The derived SO_2 plume altitude values are validated with the trajectory model FLEXPART and with aerosol altitude estimations from the CALIOP instrument on-board the NASA A-train CALIPSO platform. We find that the effective plume height can be obtained with a precision as fine as 1 km for moderate and strong volcanic events. Since this is valuable information for air traffic, we aim at incorporating the plume height information in the SACS system.