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Space-borne constraints on SO_2 fluxes for recent volcanic eruptions in 2011

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Magmatic gases (H_2O, CO_2, sulphur and halogenated species) are the driving forces of volcanic eruptions. These emissions can strongly impact the local biosphere (through acid deposition) and also affect significantly the chemical composition of the atmosphere and climate.
Sulphur dioxide (SO_2) measurements have been used to characterize and monitor volcanic activity for decades. However, remote-sensing methods based on absorption spectroscopy generally provide integrated concentration of already dispersed plumes of SO_2. In the last years, consolidated measurements of total emission fluxes of SO_2 have been made possible for active degassing volcanoes using ground-based measurements. For non-monitored volcanoes or explosive volcanic eruptions, space-based measurements of SO_2 are more adequate but unfortunately fluxes estimates are sparse.
The motivation for this study is an effort to constrain volcanic SO_2 fluxes using satellite measurements of dispersed and large-scale plumes of SO_2. We combine different approaches and investigate the temporal evolution of the total emissions of SO_2 for a number of recent volcanic events in 2011: Nyamuragira (Congo), Nabro (Eritrea) and Puyehue (Chili). High spectral resolution satellite instruments operating both in the UV-visible (OMI/Aura and GOME-2/MetOp-A) and thermal Infrared (IASI/MetOp-A) spectral ranges are used in a synergistic way. Although the primary objective of this study is the calculation of SO_2 fluxes, it also enables to assess the consistency of the SO_2 products from the different sensors used. Moreover, our estimates of SO_2 fluxes are confronted to magma fluxes constraints obtained from independent thermal measurements.
This work is performed in the frame of the European Volcano Observatory Space Services (EVOSS) EU FP7 project whose aim is to develop and demonstrate a portfolio of GMES Downstream Services, based on Earth Observation data products, to monitor volcanic activity and relevant hazards at a global scale. The region of interest of EVOSS (EU and Africa) is monitored for ground-deformations, thermal, SO_2 and ash detection using state-of-the-art remote sensing techniques.