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Measuring SO2 emissions of Eyjafjallajökull with the infrared images of ASTER satellite.

Robin Campion, Lieven Clarisse, and Alain Bernard
Université Libre de Bruxelles Belgium (Robin.Campion@ulb.ac.be)

The eruption of the Eyjafjallajökull was a complex multistage event that had a profound effect on the life of hundreds of thousands of air travellers. ASTER is a multispectral visible and thermal infrared (TIR) imaging sensor flying on EOS-Terra satellite with a polar orbit. ASTER is a programmable sensor. Thanks to the high latitude of the volcano, and to the urgent acquisition protocol of ASTER, numerous images of the eruptions were acquired from March to June 2010. These images were processed with the band ratio algorithm to obtain distribution maps of the SO2 in the eruption plume. This algorithm has minimal sensitivity to surface emissivity and altitude, sulfate aerosol in the plume and atmospheric humidity, four variables that often complicate SO2 retrievals in the TIR. SO2 fluxes computed from these maps provide insightful information about the eruptive dynamics.
Three regimes of SO2 emissions could be distinguished, which reflected the three main phases of the eruption. In March 2010, SO2 was emitted at a moderate rate of ∼35kg/s in a small plume that was bearing high concentrations of SO2 but no volcanic ash. On 17th April, while the eruption was at its highest ash production phase, very little SO2 was detected by ASTER in the quite large eruption plume. We propose that magma-meltwater interaction promoted SO2 dissolution and transformation into sulfate, so that only a small fraction of it was released into the atmosphere. Starting on 19th April copious amounts of SO2 were again measured, indicating that the magma had found a dry pathway to the surface. Radiated energy was also significantly higher, a further evidence that only limited magma ice interaction was occurring. Flux in that last phase peaked at 200 kg/s. This value could still be slightly underestimated due to high ash content in the plume, which appeared nearly opaque in its proximal parts.