



Comparison between volcanic ash satellite retrievals and FALL3D transport model

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Volcanic eruptions represent one of the most important sources of natural pollution because of the large emission of gas and solid particles into the atmosphere. Volcanic clouds can contain different gas species (mainly H₂O, CO₂, SO₂ and HCl) and a mix of silicate-bearing ash particles in the size range from 0.1 μ m to few mm. Determining the properties, movement and extent of volcanic ash clouds is an important scientific, economic, and public safety issue because of the harmful effects on environment, public health and aviation. In particular, real-time tracking and forecasting of volcanic clouds is key for aviation safety. Several encounters of en-route aircrafts with volcanic ash clouds have demonstrated the harming effects of fine ash particles on modern aircrafts. Alongside these considerations, the economical consequences caused by disruption of airports must be also taken into account. Both security and economical issues require robust and affordable ash cloud detection and trajectory forecasting, ideally combining remote sensing and modeling.

We perform a quantitative comparison between Moderate Resolution Imaging Spectroradiometer (MODIS) retrievals of volcanic ash cloud mass and Aerosol Optical Depth (AOD) with the FALL3D ash dispersal model. MODIS, aboard the NASA-Terra and NASA-Aqua polar satellites, is a multispectral instrument with 36 spectral bands from Visible (VIS) to Thermal InfraRed (TIR) and spatial resolution varying between 250 and 1000 m at nadir. The MODIS channels centered around 11 and 12 mm have been used for the ash retrievals through the Brightness Temperature Difference algorithm and MODTRAN simulations. FALL3D is a 3-D time-dependent Eulerian model for the transport and deposition of volcanic particles that outputs, among other variables, cloud column mass and AOD. We consider the Mt. Etna volcano 2002 eruptive event as a test case. Results show a good agreement between the mean AOT retrieved and the spatial ash dispersion in the different images, while the modeled FALL3D total mass retrieved results significantly overestimated.