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A multisensor synergistic approach for the analysis of volcanic eruptions: the 2015 Calbuco eruption test case

S. Corradini[1], F. S. Marzano[2,3], L. Mereu[2,3], M. Montopoli[4], D. Cimini[3], A. Kylling[5], L. Merucci[1]

[1]INGV, Rome, Italy

[2]DIET, Sapienza University of Rome, Rome, Italy

[3]CETEMPS, University of L'Aquila, L'Aquila, Italy

[4]CNR, ISAC, Rome, Italy

[5]NILU, Kyeller, Norway

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The complementarity of microwave (MW) and thermal infrared (TIR) spaceborne observations is considered in this study to analyze the April 2015 Calbuco volcanic eruption and to give information on the ash cloud from the source to the atmosphere. Due to high Ash Optical Depth (AOD) in the proximity of the volcanic vent, the TIR sensors tend to saturate. In this region, where the ash particles are coarser, satellite-based MW radiometric sounding, aboard Low-Earth-Orbit (LEO), may be used to estimate both the volcanic ash mass erupted and the plume height. Conversely, in the a distal region, where the ash particles are finer, MW systems can hardly detect the volcanic cloud. Here the TIR systems, aboard both LEO and Geostationary (GEO) satellites, are used to retrieve the ash parameters as the volcanic cloud ash mass, AOD and effective radius. In this work the measurements from the LEO sensors ATMS, VIIRS and MODIS, on board the NASA-NPP and the NASA-Aqua satellites and the GEO-GOES data are considered. The TIR retrievals of the distal ash cloud height and mass loading are also quantitatively compared with the retrievals carried out from the LEO spaceborne nadir-looking visible Near infrared (VIS-NIR) lidar CALIOP, by applying the volcanic ash lidar retrieval (VALR) algorithm. Finally, the ash cloud thickness derived from CALIOP is used to compute the ash concentration, an important parameter needed to the institutions aimed to oversee the safety of air flight as the Volcanic Ash Advisory Centers (VAAC).