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Volcanic ash cloud detection from space: a preliminary comparison between RST approach and water vapour corrected BTD procedure

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Volcanic eruptions can inject large amounts (Tg) of gas and particles into the troposphere and, sometimes, into the stratosphere. Besides the main gases (H2O, CO2 , SO2 and HCl), volcanic clouds contain a mix of silicate ash particles in the size range 0.1µm to mm or larger. Interest in the ash presence detection is high in particular because it represents a serious hazard for air traffic. Particles with dimension of several millimeters can damage the aircraft structure (windows, wings, ailerons), while particles less than 10µm may be extremely dangerous for the jet engines and are undetectable by the pilots during night or in low visibility conditions.

Satellite data are useful for measuring volcanic clouds because of the large vertical range of these emissions and their likely large horizontal spread. Moreover, since volcanoes are globally distributed and inherently dangerous, satellite measurements offer a practical and safe platform from which to make observations. Two different techniques used to detect volcanic clouds from satellite data are considered here for a preliminary comparison, with possible implications on quantitative retrievals of plume parameters. In particular, the Robust Satellite Techniques (RST) approach and a water vapour corrected version of the Brightness Temperature Difference (BTD) procedure, will be compared.

The RST approach is based on the multi-temporal analysis of historical, long-term satellite records, devoted to a former characterization of the measured signal, in terms of expected value and natural variability and a further recognition of signal anomalies by an automatic, unsupervised change detection step. The BTD method is based on the difference between the brightness temperature measured in two channels centered around 11 and 12 mm. To take into account the atmospheric water vapour differential absorption in the 11–12 µm spectral range that tends to reduce (and in some cases completely mask) the BTD signal, a water vapor correction procedure, based on measured or synthetic atmospheric profiles, has been applied. Results independently achieved by both methods during recent Mt. Etna eruptions are presented, compared and discussed also in terms of further implications for quantitative retrievals of plume parameters.