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Detecting and tracking dust outbreaks by using high temporal resolution satellite data

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A dust storm is a meteorological phenomenon generated by the action of wind, mainly in arid and semi-arid regions of the planet, particularly at subtropical latitudes. Dust outbreaks, of which frequency increases from year to year concurrently with climate change and reduction of moisture in the soil, may strongly impact on human activity as well as on environment and climate. Efficient early warning systems are then required to monitor them and to mitigate their effects. Satellite remote sensing thanks to a global coverage, to a high frequency of observation and low costs of data represents an important tool for studying and monitoring dust outbreaks. Several techniques have been then proposed to detect and monitor these phenomena from space, analyzing signal in different bands of the electromagnetic spectrum. In particular, methods based on the reverse absorption behaviour of silicate particles in comparison with ice crystals and water droplets, at 11 and 12 micron wavelengths, have been largely employed for detecting dust, although some important issues both in terms of reliability and sensitivity still remain. In this work, an optimized configuration of an innovative algorithm for dust detection, based on the largely accepted Robust Satellite Techniques (RST) multi-temporal approach, is then presented. This optimized algorithm configuration is tested here on Spinning Enhanced Visible and Infrared Imager (SEVIRI) data, analyzing some important dust events affecting Mediterranean basin in recent years. Results of this study, assessed on the basis of independent satellite-based aerosol products, generated by using the Total Ozone Mapping Spectrometer (TOMS), the Ozone Monitoring Instrument (OMI), and the Moderate Resolution Imaging Spectroradiometer (MODIS) data, show that when the spectral resolution of SEVIRI is properly exploited dust and meteorological clouds may be better discriminated. These results encourage further experimentations of the proposed algorithm in view of a possible future implementation in operational monitoring systems.