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Satellite-based VIS/IR multispectral screening of precipitating clouds: A case study during summer at mid-latitudes

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Precipitation is a fundamental component of the water cycle and essential to the biosphere as a primary source of fresh water. It regulates very diverse phenomena as floods and droughts, soil moisture, ocean salinity and atmospheric circulation associated to the release of latent heat. For these reasons in recent years many studies have focused on the detection of precipitating clouds, in particular by exploiting the VIS/IR spectral channels of the geostationary satellite sensors, in order to provide a characterization of precipitating cloud systems on time scales consistent with their nature and development and oriented to potential operational applications.
A precipitating cloud (PC) detection methodology based on Thies et al. (2008) was implemented, by exploiting MSG spectral channels and rain rates from the NIMROD radar network, and its performances were evaluated against NIMROD data and other satellite based PC detection techniques. The methodology is based on a statistical approach. Probability Index (PI) Look Up Tables are calculated as a function of combinations of MSG VIS/NIR/IR channels, selected on the basis of the analysis of coincident MSG and rain radar data, and by taking into account the different illumination conditions (daytime, nighttime, and twilight). The PI represents the probability to detect a pixel covered by a PC. PI threshold values to discriminate between precipitating and non-precipitating clouds are determined using radar data and statistical analysis. A three month dataset from summer 2009 over the NIMROD radar network area (North-West Europe) is employed, composed by spatially and temporally collocated, parallax-corrected MSG data and radar rain rates. The algorithm set up is done for the months of July and August. The algorithm outputs are then compared for the month of June with the Precipitating Clouds PGE04 product from the Satellite Application Facility on Support to Nowcasting and Very Short Range Forecasting and the rainfall intensities from the 183-WSL algorithm (Laviola and Levizzani, 2011) to investigate strengths and limitations of the methodology.
Despite of the short time span of the evaluation data set, some preliminary conclusions can be drawn. The daytime version of the algorithm exhibits the best skills in identifying PCs with cold tops, optically thick and associated with moderate-intense rain intensities. In addition, it also shows a certain ability to detect stratiform precipitating water clouds. The algorithm has a tendency to slightly overestimate the rainfall areas, but, on the other hand, the missed events are generally associated with low average rain rates ($0.6 - 0.8$ mm h^{-1}).
Finally, a discontinuity in the PC algorithm performances is noted when switching from twilight to daytime conditions and vice versa due to the different algorithm set up for daytime and twilight.

Laviola S., and V. Levizzani, 2011: The 183-WSL fast rain rate retrieval algorithm. Part I: Retrieval design. Atmos. Res., 99, 3–4, 443-461.

Thies B., T. Nauss, and J. Bendix, 2008: Discriminating raining from non-raining clouds at mid-latitudes using Meteosat Second Generation daytime data. Atmos. Chem. Phys., 8, 2341-2349.