Using SEVIRI derived cloud microphysical properties to infer cloud structure and ground precipitation

Roberto N.1, Celano M.1,2, Capacci D.1, Porcù F.1, Alberoni P.2 and F. Prodi1,3

1 University of Ferrara, Department of Physics, via Saragat, 1, 44100 Ferrara, IT
2 ARPA-SMR
3 ISAC-CNR, via Gobetti 101, 40100 Bologna, IT

Abstract

Several works have shown the importance of visible (VIS) and near-infrared (NIR) satellite measurements to characterize cloud-top structure and to delineate ground precipitation areas. Theoretical studies describe how cloud optical thickness and cloud-top effective radius are related to those measurements and indicate how they can be retrieved. The availability at geostationary scales of VIS-NIR radiances from SEVIRI makes possible to observe the evolution of cloud top parameters following the cloud lifecycle, and assess closer relations with precipitation at the ground. Polarimetric ground-based radars, on the other side, provide a detailed view of the vertical cloud structure, in terms of hydrometers classification and cloud water content.

This work aims to, at first, set up an elementary scheme to retrieve cloud optical thickness and effective radius from SEVIRI 0.65, 1.64 and 3.9μm channels. The retrieval algorithm uses SBDART (Santa Barbara Disort Atmospheric Radiative Transfer) computations of solar reflectances from 1-dimensional layers of clouds with different microphysical properties. The technique is based on a look-up table comparison between the measured up-welling radiances and the one simulated by the radiative transfer model. The procedure is validate against the MODIS product available online. Secondly, satellite observation of effective radius and optical thickness of convective clouds in the Mediterranean areas are co-located with polarimetric radar derived classification of cloud particles to: 1) assess the relative consistency of the two observations, 2) derive a reliable description of the cloud structure evolution and 3) evaluate the potential of such physical cloud top characteristics for satellite-based rainfall estimation algorithms.

Results show that satellite and radar observations agree for most of the cases in determining cloud particles phase and provide complementary observation suitable to be merged for a better description of convective cloud structure and dynamics. The relationship between cloud top particles effective radius and precipitation areas at the ground is quantitatively assessed.