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A Satellite and Numerical Model Combined Approach to Study Extreme Rain Events over the Mediterranean Basin

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The Mediterranean extreme rainfall events often develop at the end of the warm season when the sea surface temperature is higher than 15°C and the environmental conditions allow for the deepening of convection up to the formation of intense isolated cells and multicellular systems. Although the genesis of these phenomena are connected to the cold fronts in the westerlies with lifting of the oceanic systems operated by the Atlas mountains, the variation of a few local meteorological variables contributes to differentiate the developing stage of such systems. A study is proposed in which two heavy rain events over Mediterranean basin are analysed (Laviola et al., 2011). The investigation of cloud and precipitation properties are first assessed using a geostationary multifrequency satellite method for the identification of cloud type, hydrometeor phase, and cloud vertical extension. Then the study is carried out by means of a triple approach: (1) surface rain gauges, (2) satellite data, and (3) numerical model simulations. The satellite retrieval method 183-WSL (Laviola and Levizzani, 2009; 2011) is used to retrieve precipitation amount and classify precipitation type in terms of stratiform and convective rain. Furthermore, starting from two case studies, almost ten years of autumnal rain events over the Mediterranean are studied using a new method to identify the cloud type on the basis of the perturbation of the nominal signal in the microwave due to the presence of clouds. This technique exploits the properties of the three water vapour channels in the band at 183 GHz on board the NOAA-AMSU-B/MHS satellites. Due to the vertical development of the different cloud types, the typical extinction of radiation in clear sky conditions is perturbed as a function of cloud type and cloud top height. Stratified thin clouds, for example, usually impact less over the water vapour channels peaking at lower altitudes and often appear transparent or completely masked by the absorption of atmospheric water vapour on their top. On the contrary, convective cells due to their pronounced vertical development significantly perturb the radiation path. Therefore, from the analysis of the signal variations in the channels at 183.31±1/±3/±7 GHz, which peak at different altitudes in the atmosphere, it is possible to detect the presence of clouds by assessing their altitude and type in terms of convective or stratiform. This method is still in the experimental stage and seem to be useful as a proxy for cloud system definition both horizontally and vertically.