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Spatial distribution of the timing of rainfall extremes derived by remote sensing and raingauges data assimilation

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Severe rainfall events are quite common in the coastal areas of the Mediterranean basin during autumn season, despite its generally mild climate. Very often meteorological conditions responsible for these kinds of events are quasi-stationary convective systems, characterized by very localized development, hard to detect with traditional rain gauge networks. In order to improve prediction and management capabilities, progress must be made in understanding the mechanism that govern the development of these kind of precipitation systems at the different scales.

Rainfall product from the Tropical Rainfall Measuring Mission (TRMM) are commonly adopted in different branches of the environmental sciences due to the high spatio-temporal resolution and to the quasi-global nature of the data. Building upon the success of TRMM, NASA and JAXA deployed the GPM Core Observatory that, after just two years of activity, seems to allow for great improvement in the accuracy of rainfall products.

We developed a methodology aimed at exploiting the timing information derived from high-resolution remote sensing products to analyze the characteristic of severe rainfall systems in the Mediterranean basin. The spatial analysis from satellite, combined with the historical information from the rain gauge network, allows us deepening the knowledge of the spatial extension of extreme rainfall phenomena. All those information, merged together in a hierarchical framework, lead to the definition of Intensity-Duration-Frequency curves "informed" on the nature of the events for each location of the domain, without the need to adopt classical interpolation techniques, unable to represent the complexity of the rainfall systems.

The case study refers to a database of daily rainfall measurements extracted from the NOAA GHCN-Daily dataset, recorded during the 20th century by 700 rain gauges distributed in the Mediterranean basin. TRMM and GPM images are used to calibrate the event timing over the existing raingauges, so that they can provide information in areas with no rainfall measurements.

The results, compared with those obtained with the classic techniques of frequency analysis and spatial interpolation, demonstrate an increased understanding coming from the combination of different sources of information, ensuring more reliable and accurate spatial assessment of extreme thunderstorm probability.