Identification of convective and stratiform precipitation events through reanalysis and lightning data

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Nowadays, studying heavy rainfall events, characterized by significant rainfall depth concentrated in short durations, and by the presence of lightning, downbursts, and hail, is extremely important. The increasing attention to these phenomena is due to the fact that they may determine serious impacts on the population, economic activities, and the environment. Among heavy rainfall events, high-intensity and short-duration ones, are usually associated with the occurrence of convective cells (Cipolla et al., 2020).

Since these events have been occurring in a more frequent way over the last two decades as a climate change effect and the Mediterranean area is considered one of the most prone areas to this type of event, this study focuses on the identification of heavy rainfall events over Sicily and their classification into convective or stratiform events. The events here studied have been extracted from rainfall time-series collected by 40 rain gauges of the *Servizio Informativo Agrometeorologico Siciliano* (SIAS) within the period 2002 - 2018.

The classification algorithm of rainfall events is based on the use of reanalysis and lightning data. In particular, after carrying out the ANOVA-1 statistical test to see the more suitable indexes for this classification, two ERA-5 reanalysis indexes of the European Centre for Medium-Range Weather Forecasts (ECMWF), i.e., the Convective Available Potential Energy (CAPE), and the K-Index, have been selected, since convective events are usually associated to high CAPE and K-Index. These indexes have been treated with a fuzzy approach, in order to avoid any subjectivity in the choice of thresholds for discriminating the two classes of events.

Given that convective cells are usually characterized by lightning activity, their detection has been improved by introducing a lightning dataset of *Blitzortung*, providing the location and time of lightning strikes for all of Europe on a daily scale since 2015. To reach this goal, different searching circles centered on the rain gauges have been considered. For instance, basing on Gaal et al. (2014) events with near lightning, i.e., strikes that occurred up to 3 km from the rain gauge, have been first identified as convective. Given that a high number of high-intensity and short-duration events are neglected by using only this criterion, a new condition has been added to the algorithm, according to which the number of lightning strikes is weighted as a function of the distance from the gauge.

The results of classification algorithm here presented have been compared with the results provided by the work of Sottile et al. (2021) through contingency tables and the evaluation of the Probability of Detection (POD) and the False Alarm Ratio (FAR).

References

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