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The importance of convective equilibrium and non-equilibrium conditions for the characterization of the predictability of severe storms in Italy

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The predictability of severe rainfall by means of high resolution numerical weather models is a long standing issue for meteorological community. This study intends to provide an objective system to single out heavy rainfall events and to classify them on the basis of duration, spatial extent and large/small-scale triggering. Italy has built up one of the densest hourly-reporting raingauge networks and its data are presently archived and available. The first part of the work was devoted to developing a procedure to identify extreme precipitation events and its application to the full set of raingauges (about 1700 stations) all over Italy for the period 2006-2008.
This method allowed for the classification of about 100 events, either as long-lived (if lasting more than 12 hours) and spatially distributed (more than 50x50 km2), or brief and localized, (having a shorter duration and a minor spatial extent). For each of aforementioned events, the observed rainfall distributions have been compared with COSMO-I7 forecasts using spectral and statistical analyses. The second part of the work examines the hypothesis that the differences in predictability between these two classes of event are associated with different mechanisms of control of the precipitation by dynamical processes in the atmosphere. In particular, we ask whether the forcing of convection is sufficiently homogeneous and slowly varying that the convection can be considered to be in equilibrium or, otherwise, the outbreak of convection is more abrupt and small-scale driven (Done et al., 2006).
Using ECMWF analysis (ERA-Interim) of convective available potential energy (CAPE), and precipitation analysed from the rain gauge network, we calculate the magnitude and time evolution of the timescale of convective adjustment for the severe events singled out in the first part. As expected, the events with higher predictability are mainly associated with short convective adjustment timescales which indicate equilibrium convection, while the short-lived, less predictable events have long convective timescales.