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On Convective Local Severe Weather Forecasts. Empirical relations vs the theoretical approach.

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It is well known that, at mid latitudes, the occurrence of the majority of local severe weather episodes are related to deep atmospheric convection. Among the convective severe weather phenomena, strong downdrafts, tornadoes, hailstorms, lightning strikes and flash floods are the most worldwide known atmospheric hazards. This intense and localized phenomena almost always produce significant damages, sometime casualties and they also catch the attention of people because of their fast evolution. Since nowadays forecasts of the intense convection in the troposphere, both numerically and subjective ones, have good quality and nowcasting techniques perform even better, it is expected that convective local severe weather forecasts improve as a consequence. In spite of this deductive speculation, local severe weather episodes are still difficult predictable events. Concerning tornadoes and strong winds at the ground, their dynamics has been studied for decades (Davies-Jones, 1982; Brooks and Doswell, 2000) and some general aspects concerning the environment in which they develop have been identified. For hail, lightnings and intense precipitation, supercell formation model is based on three elements considered fundamental: atmosphere instability, convection initiation trigger and vertical wind shear (Giaiotti et al. 2007). On these considerations, many studies have been carried out to find empirical rules for the identification of the environments prone to local severe weather development (Thompson et al. 2003; Brooks et al. 1994). Relations between convective available potential energy (CAPE), storm storm-relative environmental helicity (SREH), or wind shear (WS), are commonly used for operational forecasts in met-offices. Unfortunately those relations are not able to explain the totality of the hazardous events occurred so far, in fact there are several cases of significant severe weather, lets say tornadoes with intensity greater than F0 in the Fujita scale, whose environment is not identified as to be local severe weather prone. This evidence weakens the usefulness of the empirical forecasting rules because the missing alarm of an intense hazardous phenomenon, like a tornado, has to be completely avoided; conversely, false alarms should be minimized as much, but they can be accepted as an manageable shortcoming. So, an improvement in the convection forecasts goodness does not imply an improvement in the tornado forecasts. A possible interpretation for that relies on the interaction between the assumed three fundamental elements characterizing the environments hosting tornadoes. A critical revision of the relations commonly used in forecasting activity starts from the analysis of those episodes that result as missing alarms (Bechini et al, 2001; Bertato et al, 2003). In this work a summary of the empirical rules commonly used in daily operational local severe weather forecasts is presented, then some cases of missing alarm and false alarm are discussed. Theoretical analysis of troposphere instability, wind shear and boundary conditions interplay for the generation of an environment prone to local severe weather is used to highlight weak aspects in the use of the empirical rules. Finally the fruitfulness of the interdisciplinary approach for the improvement of the severe weather forecasts is briefly mentioned attempting to link microscopical laboratory vortex formation and evolution experiments (Sommer 2007) with atmospheric supercells dynamics.

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