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Severe thunderstorm developed on 28 June 2007 over northeast Bulgaria

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A slow-moving shallow low-pressure system passed over east Bulgaria and west part of the Black sea on 28 June 2007. The 0000 UTC 500 hPa analyses showed a deep low over Scandinavian Peninsula and the Baltic Sea with strong south-westerly flow over Balkan Peninsula. Additionally, based on the 0000 UTC real aerological sounding at Bucharest, it was assumed that thunderstorms producing hail may develop in the afternoon. However in the morning hours on that day the severe thunderstorm developed. Egg-size hail particles and severe wind gusts up to 28 m/s were observed around 0830 UTC and caused a lot of damages to the crops in several villages near Dobritch. According to radar data around 0800 the cloud top reached up to 14 km and maximum reflectivity was above 65 dBz.
The motivation to study this case came from the unusually severe thunderstorm, which was not predicted. This study aims to investigate if additional analyses could be helpful to the forecast of similar severe events.
Three instability indices (CAPE, Lifted Index and K Index) were calculated using aerological sounding performed in Bucharest at 0000 UTC, as well as the proximity soundings, obtained by the numerical model GFS at 0000 UTC, 0300 UTC and 0600 UTC in places close to the severe storm location. Additionally, classification function F, combination of the above mentioned indices was calculated. This function was derived based on discriminant analyses, using calculated indices for 112 days with precipitating clouds developed over east of Bulgaria. In case of F>0 the convective cloud has to be classified as thunderstorm, while at F$\leq$0 - as ordinary (without lightning) cloud.
Aerological sounding from Bucharest at 0000 UTC was characterized by relatively low CAPE (278 J/kg) and low absolute value of Li (-1.2 deg), which is indication for weak instability and only the calculated K value (41 deg) indicated the probability of high convective potential. Using proximity soundings for two stations in northeast of Bulgaria at 0000 UTC, 0300 UTC and 0600 UTC, based on the calculated CAPE (between 1642 J/kg and 2821 J/kg) and Li (between -3.7 deg and -7.8 deg) moderate to strong instability was expected. Based on the calculated K index (between 30 deg and 38 deg) the moderate convective potential is predicted.
The analyses also showed that using aerological sounding from Bucharest F=0.15, and based on the proximity soundings the calculated values of F were between 1 and 3.2. Thus, according to classification function F the thunderstorms were likely to develop.
Our results indicated that the combination of instability indices is promising supplementary tool in the improvement of nowcasting of severe weather. Our study revealed the importance of using proximity soundings close in place and time to the development of severe event. This work is based only on one case study. The above procedure has to be tested to several similar weather events to validate its usefulness for operational nowcasting.