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Numerical Simulation and Diagnostic Analysis of a Severe Convective Storm Process with Tornado

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The tornado process occurred at Nantong of Jiangsu Province ,China. Around 17:30, July 12th 2004. Zhizhong and Henan villages, Baochang town, Haimen city in Nantong region suffered raid of tornado and hail. The hailstones were as large as broad beans and the hailstorm lasted for 10 minutes or so. The storm moved from northwest to southeast and large area of farmlands suffered serious loss.

This article has chosen the NCEP reanalysis data of horizontal resolution once every 6 hours between 02:00 July 12th and 08:00 July 13th of 2004 together with the routine sounding and ground data of the same period and performed numerical simulation with MM 5 V3.7 model to the process.

Some convection energy parameters with physical significance [U+FF0C] such as BCAPE, NCAPE, SRH, EHI, SWEAT indexes etc. are diagnosed and will try to use them alone or combined together to affirm the likelihood of strong convection.

It can be concluded from the observation analysis and simulation results that: the invasion of dry and cold air in upper layer and the intense convergence of warm and humid air at lower level brought about instable stratification. This provided energy condition for the generation of the tornado of Nantong on July 12th, 2004.

The diagnoses show that all above parameters have good correspondence upon the severe weather process. The effect will be better if the virtual temperature is replaced by density temperature. Concerning the vertical distribution of BCAPE, especially the lower level distribution, it is more reasonable to compute NCAPE than referring to the total value of BCAPE alone. EHI has synthetically considered SRH and BCAPE, which is favorable to distinguish the types of severe weathers. The time derivative of BCAPE, density temperature BCAPE, EHI and SWEAT indexes have distinct indicating significances upon severe weathers. Through utilizing numerical simulation and combining various convection parameters from every aspect, it is possible to capture the process of development of severe convective weather.

Calculating SWEAT index with simulation. This case has reconfirmed the statistical results of severe weather of Jiangsu Province in the recent decade. The SWEAT index also has distinct indicating significance upon strong convective weathers of China. Here, although the wind direction shearing term of SWEAT index does not account for a large proportion on the total magnitude, it has non - negligible indicating significance during its time-variation process. This indicates that the shearing of wind direction and speed have distinct effect on forming tornados.