A Predictability study of a heavy rain event in Beijing using TIGGE

Xi Chen, Huiling Yuan, and Xiang Su

Key Laboratory of Mesoscale Severe Weather/Ministry of Education and School of Atmospheric Sciences, Nanjing University, Nanjing, China

On 21 July 2012, the heaviest rainfall in 60 years caused significant loss of economy and life in Beijing, China. The torrential rain occurred under favorable synoptic weather conditions with frontal systems and reached a maximum of 460 mm in 24 hours.

This study investigates the forecast quality and predictability of this high-impact weather event, using The Observing System Research and Predictability Experiment (THORPEX) Interactive Grand Global Ensemble (TIGGE) data (half degree resolution) from five operational forecast centers (ECMWF, UKMO, NCEP, CMA and CMC). The verification data is from the new merged precipitation estimate product of Climate Prediction Center's morphing technique (CMORPH) with dense rain gauge observations in China. Several physical quantities, including isentropic potential vorticity (IPV) and moist potential vorticity (MPV), are used to analyze the thermal and dynamical structure of this torrential rain. Ensemble sensitivity technique is applied to evaluate the relationship of predictability between large-scale fields (IPV and MPV) and the torrential rain.

The main conclusions from this study are: 1) the ensemble mean of 24-h accumulated precipitation forecasts (from 00UTC 21 July 2012 to 00UTC 22 July 2012) from each center (except CMC) is better than its control forecast; 2) There is a good correspondence between the torrential rain and the high value region of upper-level IPV; 3) The negative value region of low-level MPV has a good indication of the torrential rain in Beijing; 4) In the high value region of IPV at 320K, most models have larger root-mean-square errors than the ensemble spread (underdispersion); 5) Despite some differences in location and intensity, these five operational centers successfully forecasted the torrential rain event 2-3 days in advance.

Keywords: torrential rain, potential vorticity, predictability, ensemble sensitivity, TIGGE