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Simulation of regional fog event with WRF in North China and evaluation of visibility equations

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The fog events are adversely affecting transportation due to worsening visibility, affecting the air quality and health through accumulation of pollutants near the ground. Forecasting the fog events successfully is helpful to reduce their disadvantageous impact on visibility, air quality and health etc. The forecasting ability of numerical model for fog is currently limited. Successful simulation of fog events and evaluation of visibility equations leading to an improvement of the forecasting ability of numerical model is the focus of the paper. The fog models can almost only simulate a local fog event, but the regional fog event is more and more. So in the paper the weather research and forecast (WRF) model is used to simulate and forecast the regional fog event in North China. The fog events form in atmospheric boundary layer (ABL), even in a hundreds-meters layer near surface. So 9 σ levels are added in ABL mainly below 500 meters and appropriate parameterization schemes are adopted to localize WRF in North China. During the period of Nov. 29th to Dec. 2nd of 2009 a regional fog event is burst in North China. Using GFS 0.5ºx0.5º forecasting dataset as the initial and boundary conditions a two-way and three domains nested simulation of the fog event is run with localized WRF model. The simulated weather type is very similar to the observing one. The simulated distribution of liquid water content (LWC) on the bottom levels of model matches basically the fog area according to the stations which report fog weather. The comparisons between the model results and observing meteorological data show a good potential forecasting ability of localized WRF model for fog events in North China. Visibility is the main judging parameter for the fog event. A few visibility equations functioned by LWC or combining of LWC and number concentration of droplets (N_d) which are derived from the former studies are added into the simulation of the fog event. The derived visibility results are evaluated according to the observing visibility. The forecasting ability of the visibility method combining of LWC and N_d is better than that of the LWC one.