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Improvements in fog predictions via a modified reconstruction of moisture distribution using the Weather Research and Forecasting(WRF) model

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Since fog is an important weather phenomenon affecting the traffic safety, accurate fog forecasting should be attained to minimize meteorological disasters. Most fog forecasts determine only the presence or absence of fog based on less visibility than 1 km, which is known as the visibility diagnostic method. During this process, fog could be predicted by the visibility calculated in the numerical weather prediction (NWP) model using the cloud liquid water content (LWC) near the surface. In this study, we investigated to increase the accuracy of fog forecast by optimizing the reconstruction of moisture distribution method, which can simulate the intensity of fog as well as the presence or absence of fog. The performances of the fog simulations were examined by modifying the relative humidity threshold at a height of 2 m and the stability parameters which affect turbulence and also one of the important criteria for fog occurrence. When we applied the optimize parameters to fog prediction in the winter seasons, the probability of detection (POD) has been increased significantly from 0.21 to 0.54. These improvements were attributed to the corrected relative humidity threshold and the stability parameters. Although the false alarm rate (FAR) remained almost unchanged, the critical success index (CSI) has been improved slightly lesser than those of the POD. When we analyzed the life cycle of fog, it takes time for the NWP model to simulate water droplets in the fog-developing stage. Therefore, the accuracy of the fog simulation is intimately related to the reconstruction of moisture distribution. The NWP model, however, showed a better performance in the process of fog dissipation than the reconstruction of moisture distribution method that was sensitive to temperature and turbulence. In conclusion, the reconstruction of moisture distribution led to a considerable improvement of the fog prediction in the generation and development stage since we used the optimized humidity threshold. It is also expected that accurate fog prediction could be achieved in the future by considering the aerosol effects, which is another importance factor for the fog generation.