
Application of Optical Flow and Machine Learning Methods in Nowcasting and Early Warning of Strong Convective Weather

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Thunder, lightning, gale, tornado, and heavy precipitation caused by strong convection system are the main weather types leading meteorological disasters. We develop a nowcasting system to predict and provide early warning of these severe weather almost every kilometer every minute, based on the three-dimensional Doppler radar data mosaic, using the optical flow method, machine learning algorithm, and multithreading parallel computing method as well. In the nowcasting of strong convection, we first use the optical flow technique to back calculate the historical data, then put both the generated pixel-by-pixel optical flow field and RGB channel in the radar echo image into deep learning models, at the same time, take the previous 5 radar images (first 30 minutes) as input data, finally obtain the extrapolation of radar reflectivity factor within 2 hours via the optimization model. The advantage of machine learning model is to capture the characteristics of the growth and extinction of convective cells from recorded data. Compared to traditional algorithms like centroid tracking and optical flow methods, this method has certain predictive ability to the development of convective cells. Better prediction of the merging and separation of cloud images could be acquired, if the dynamic characteristics of rotation, convergence and divergence in the optical flow field are added as predictors in the process of machine learning extrapolation, which finally leading to the improved prediction effect and length of forecast.

Key words: three-dimensional Doppler radar data mosaic, optical flow method, machine learning method, strong convection, nowcasting