The Ground-Based Velocity Track Display (GBVTD) technique was developed to estimate the primary circulations of landfalling tropical cyclones (TCs) from single-Doppler radar data. This study explores, for the first time, the assimilation of GBVTD-retrieved winds into a TC prediction model, and examines its impact relative to that of directly assimilated radial velocity data. Super Typhoon Saomai (2006), the most intense landfalling typhoon ever recorded in China, is chosen as the test case, and data from the coastal operational radar at Wenzhou, China are used. The 3DVAR within the Advanced Regional Prediction System (ARPS) is used to assimilate either the radial velocity data directly or the GBVTD-retrieved winds, at 30-min intervals for 2 hours.

The assimilation of the GBVTD-retrieved winds results in much improved structure and intensity analyses of Saomai compared to those in the Japan Meteorological Agency mesoscale reanalysis as well as that assimilating radial velocity (Vr) data directly. The ability of the GBVTD method in providing wind information covering the full circle of the inner-core circulation is the primary reason for its superior performance over direct assimilation of Vr data; for the latter, the azimuthal data coverage is often incomplete. With the improved initial conditions, the subsequent forecasts of typhoon intensity, track and precipitation are also improved. Subjective and quantitative evaluations of the precipitation and circulation patterns show consistent results. The assimilation of axis-symmetric wind components is primarily responsible for the improvement, while the asymmetric wind component has small impact. Furthermore, the incorporation of reflectivity data through complex cloud analysis within the ARPS system can bring about additional improvement to intensity and precipitation forecast, but degrades the track forecast slightly. Similar experiments to examine the impact of GBVTD-derived winds on the prediction of hurricane Ike (2008) show consistent results.