

Case Studies of the Impact of Scatterometer Winds on the Analysis and Forecasting of Tropical Cyclones using a Non-hydrostatic Model

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Experiments to study the impact of scatterometer winds on forecasting tropical cyclones were carried out using the Advanced Regional Prediction System (ARPS), a non-hydrostatic modelling system originally developed by the Center for Analysis and Prediction of Storms in the United States (Xue *et al.*, 2000). Data were assimilated using the Bratseth method of successive correction type (Brewster, 1996). Besides conventional and QuikSCAT data, local observations from radar, automatic weather stations and wind profilers were also ingested. The model was run at 6-km resolution in the inner domain and was one-way nested to the outer 30-km model; both were set up with 40 vertical levels.

Tropical cyclones Utor (0104) and Yutu (0107) over the South China Sea in 2001 were used as test cases. The radii of strong, gale or storm force winds in different quadrants were objectively derived from the model's analyzed and predicted surface wind fields. In the case of Utor, the inclusion of QuikSCAT data produced a much more realistic distribution of high winds in the model analysis, particularly in the depiction of gale force winds over the northwestern quadrant of the cyclone circulation (Fig. 1). The onset of northwesterly gales in Hong Kong later that evening was consistent with the analysis containing QuikSCAT information. In the case of Yutu, unreliable QuikSCAT data in the proximity of land could have led to the displacement of the analyzed cyclone centre from its best track position prior to Yutu's landfall. This shows that rigorous quality control of QuikSCAT data is essential, especially when cyclones approach the coastal region.

Effects of tropical cyclone bogus data on the initial vortex representation in the presence of QuikSCAT data were also examined. The resultant analyses were quite sensitive to the inclusion of bogus data in some cases; e.g. the location and the strength of maximum winds showed significant differences in the analysis of Utor on the morning of 5 July 2001 (Fig. 2). It poses the question of whether or not bogus data should be dispensed with as more frequent and wider coverage of scatterometer wind data become available in the future.

Although improvement in surface wind distribution was found in the model analysis with the ingestion of QuikSCAT wind data, no significant difference was observed in the model forecasts more than a few hours ahead. For a more effective application of scatterometer winds in the model prediction of tropical cyclones, incorporation of retrieved sea surface pressure data into the model analysis will be explored.

References

- Brewster, K., 1996: Implementation of a Bratseth analysis scheme including Doppler radar. Preprints, 15th Conf. on Weather Analysis and Forecasting, AMS, Boston, 92-95.
- Xue, M., K.K. Droegemeier and V. Wong, 2000: The Advanced Regional Prediction System (ARPS) – A multi-scale nonhydrostatic atmospheric simulation and prediction model. Part I: Model dynamics and verification. *Meteor. Atmos. Phys.*, **75**, 161-193.

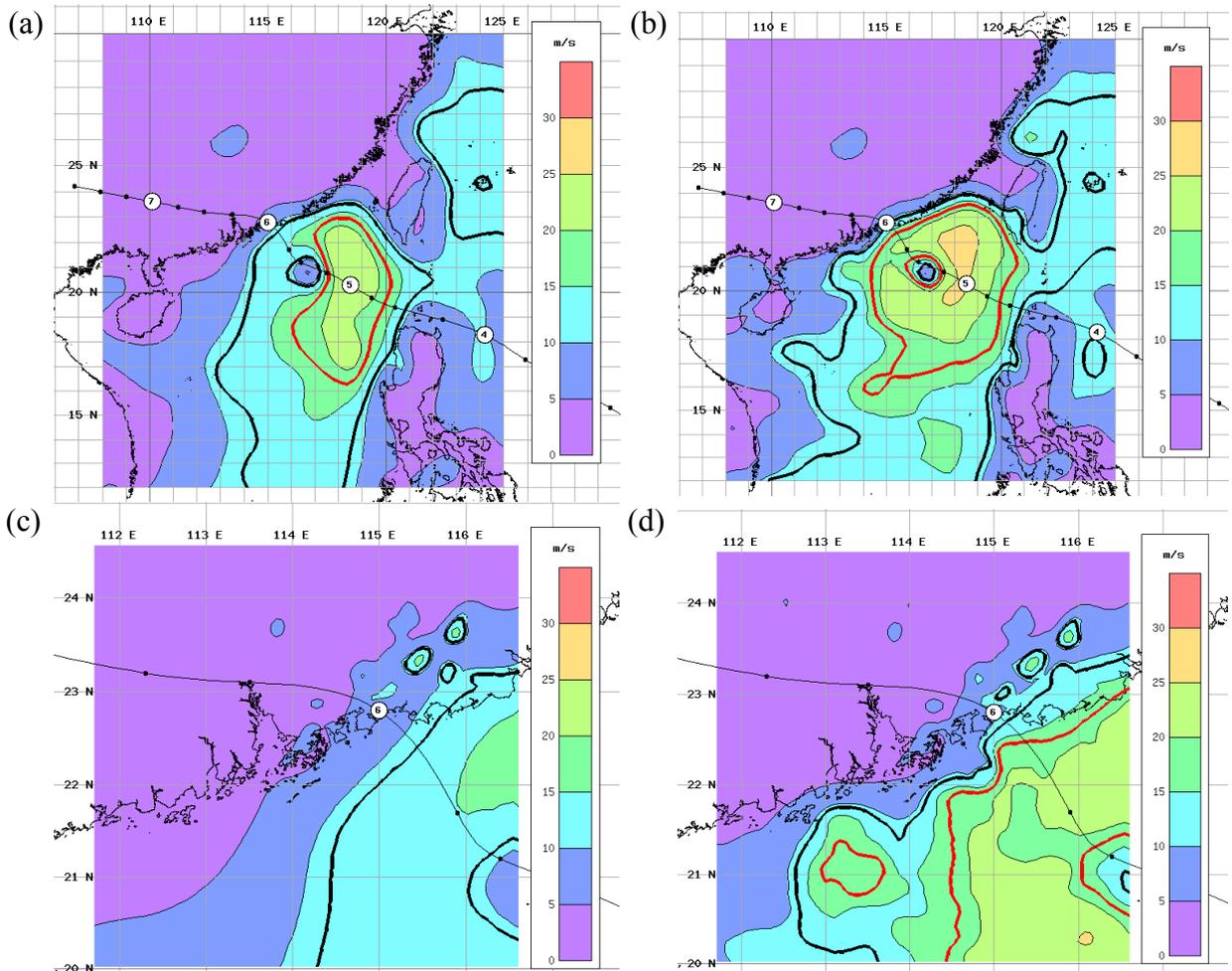


Fig.1 ARPS surface wind analyses for 12 UTC 5 July 2001: without QuikSCAT (left panels) and with QuikSCAT (right panels). Model resolution is 30 km in (a), (b) and 6 km in (c), (d). Isotach contours of 11.5 m/s (strong wind) and 17.5 m/s (gale) are highlighted in bold black and red respectively. Six-hourly best track positions of Utor analyzed by the Hong Kong Observatory are dotted along the solid line, with dated circles marking the daily positions at 00 UTC.

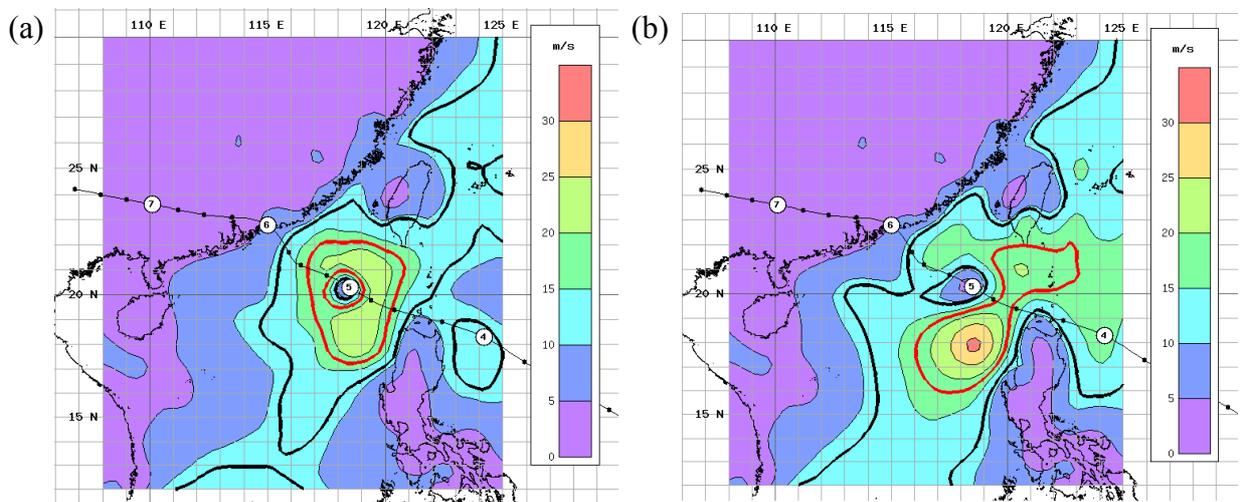


Fig.2 ARPS surface wind analyses for 00 UTC 5 July 2001: (a) with TC bogus and (b) without TC bogus. QuikSCAT data were used in both analyses.