P1.92 PERFORMANCE OF NAVY'S GLOBAL MODEL IN PREDICTING TROPICAL CYCLONE FORMATIONS IN THE WESTERN NORTH PACIFIC

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1. Introduction

In Cheung and Elsberry (2002), a set of criteria was developed to identify tropical cyclone (TC) formations in the Navy Operational Global Atmospheric Prediction System (NOGAPS) analyses and forecast fields. Then the NOGAPS forecasts of TC formations in the western North Pacific (WNP) during 1997–1999 were verified. It was found that NOGAPS successfully predicted a formation within a maximum separation threshold of 4° latitude about 70%–80% for 24-h forecasts, but only about 20%–30% for 120-h forecasts. The number of false alarms (FAs) in the NOGAPS forecasts was also examined, and a large growth in FAs occurs between 24 h and 48 h before reaching a near saturation at later times. As a follow-up to this work, further verifications will be performed on NOGAPS during 2000–2003. This period is chosen because the Emanuel cumulus parameterization scheme replaced the Arakawa-Schubert scheme in NOGAPS during June 2000. Thus, a focus of this study will be the impact of this modification on NOGAPS' predictions of TC formations.

2. TC Formations in 2003

Another finding in Cheung and Elsberry (2002) is that the success rate of predictions is higher for formations in the South China Sea and between 160°E and 180°, but is generally lower between 120° and 160°E. With respect to this model behavior, 2003 is an appropriate year to examine since most of the TC formations in this year are within 120° and 160°E (Fig. 1). As detailed statistics is lacking at the moment, several examples are picked out for illustration in the following.

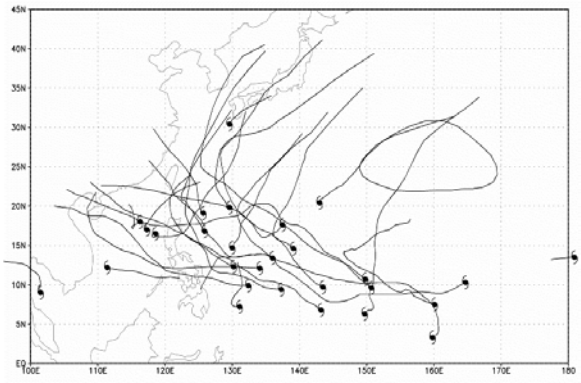

Fig. 1 TC formation locations and tracks in 2003 (adapted from http://aposf02.cityu.edu.hk/~mcg/tc_forecast/).

Super Typhoon Kujira (02W) formed at about 00UTC 9 April (here after 040900), and located at 3.5°N, 160°E. The NOGAPS forecasts starting at 040812 successfully simulate the position and development of Kujira (48-h forecasts shown in Fig. 2). It can be seen that Kujira is a typical formation case with strengthened easterlies to the north and cross-equatorial flows from the south. Usually NOGAPS performs well for this type of formations, which is consistent with the results from Cheung and Elsberry (2002).

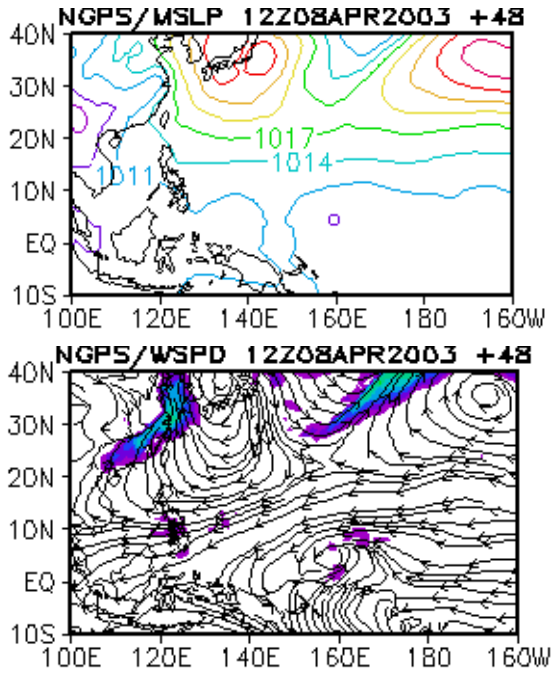

Fig. 2 NOGAPS 48-h forecasts of the mean-sea-level pressure and 1000-hPa flow starting at 1200UTC 8 April 2003. The regions with wind speed larger than 12.5 m s^{-1} are shaded.

However, NOGAPS did not perform well in some cases formed more to the west. For example, Typhoon Etau (11W) formed at 080300, and located at 12.4°N, 140°E. NOGAPS' forecast started 12 h earlier (at 080212, 48-h forecasts shown in Fig. 3) still cannot predict its formation well, but have to wait until the TC vortex was explicitly initialized later by synthetic data in the model. As judged from the synoptic situation related to Etau, its formation is

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closely related to the monsoon shear line at about 10°N, and also possible energy dispersion from Typhoon Morakot (10W) in the South China Sea.

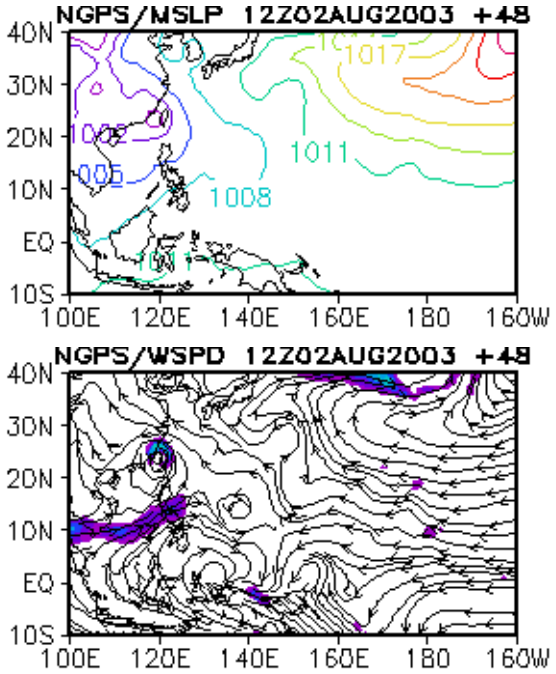

Fig. 3 As in Fig. 2 except for forecasts starting at 080212.

Another example is Typhoon Krovanh (12W) that formed at about 081512 in a stream of easterly waves. After becoming a tropical depression at 10°N, 150°E, it remained at such an intensity for about 5 days before intensifying to a tropical storm at a longitude of about 130°E. Usually it is difficult for numerical models to maintain a weak TC steadily, and it is also the case in NOGAPS. During the 5 days between 081512 and 082012, NOGAPS keeps generating disturbances like that shown in the 48-h forecasts started at 081412 in Fig. 4. However, these disturbances usually dissipated eventually in the subsequent forecast times until Krovanh intensified to a tropical storm at about 082012. By that time, synthetic data is used to initialize the TC vortex. Therefore, the initial positions and strong-wind regions of Krovanh during its tropical depression stage are not well predicted by NOGAPS.

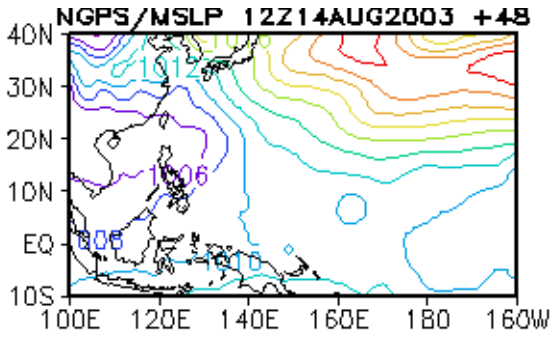

Fig. 4 As in Fig. 2 except for forecasts starting at 081412.

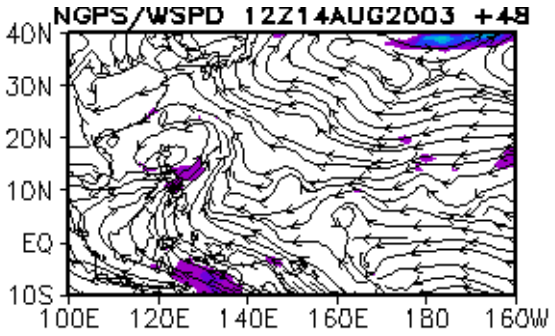

Fig. 4 (continued)

Speculation from the examples illustrated above is that NOGAPS quite successfully handle formation cases in the monsoon shear line with enhanced cross-equatorial flow. However, for cases without cross-equatorial flow, and those associated with easterly waves and energy dispersion from another cyclone, NOGAPS' skill may be reduced. Although not the major formation pattern, these formation cases as in Typhoon Etau and Krovanh are also important patterns in the WNP (Ritchie and Holland 1999).

Another possibility is that the failure cases in NOGAPS actually belong to situations with inherently low predictability, a fact that has to be verified by models comparison and consensus forecasts.

3. Future work

Besides an extension in verification period, another improvement over Cheung and Elsberry (2002) from this study is that a more sophisticated tracking algorithm will be used to examine the entire life span of the vortices instead of a single-time verification. An advantage of this approach is a more realistic account of the FA rate. As in the previous study, detailed diagnostics of the failed prediction cases and FAs will be performed. Particular attention is paid to attributing the reasons of failed predictions and FAs to the model configurations and physics, and what characteristic synoptic patterns existed during these model failures. Comparison of the performance of NOGAPS with other global numerical models will also be conducted.

Acknowledgements

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