# 15C.5 A Study on the Impact of Initial Fields on the Typhoon Track and Rainfall Simulation in the Vicinity of Taiwan

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## 1. Introduction

Taiwan was affected by several typhoons each year that caused significant economic losses. Timely forecast of the typhoon movement and rainfall is one of the most important tasks at the Central Weather Bureau in Taiwan (CWB). To provide guidance for the forecasts, numerical prediction models were developed and installed in the Bureau. And, to improve the performance of the numerical models is one of the key elements to advance the typhoon forecast of the Central Weather Bureau.

As many of the studies showed the advantage of reducing forecast errors by using ensemble approach(Aberson 1995 and Goerss 2000), similar idea were applied in the operational environment of the Central Weather Bureau. Meanwhile, the better initialization procedure is also important on the track and intensity(Zou and Xiao 2000, Xiao et al 2000). In this study different simulations were conducted to examine the possible application of typhoon track and rainfall forecast through ensemble approach. The impacts of the initial fields on the track and rainfall simulation were also analyzed and will be presented in the conference. In 2003, typhoon Melor experienced the anomalous track. Melor formed over North Western Pacific Ocean at the east of Philippine Inlands and moved toward the northwest, then made landfall on Luzon Island at 0000UTC November 1. However, the track transferred from northwestward to northeastward after leaving Philippine into Bashi Channel. In addition, the most of the operational forecasts made the extremely errors during the deflection period. Therefore, in this study we primary selected the case of typhoon Melor to realize the impact of initial fields on the typhoon track.

## 2. Model description and experiment design

This study was conducted by using the CWB's nonhydrostatic forecast system(NFS), and the MM5 model with different initial fields. The model configurations showed in table1. The initial fields tested here were generated by the CWB's global forecast system (GFS) and the NCEP's global model(AVN). We also tried to investigate the impact of bogussing vortex intensity on typhoon forecast. Consequently, base on the different models, initial fields and bogussing vortex intensity, ten experiments(table2) were simulated for 72 hours from 0000UTC October 31 to 0000UTC November 3.

Table 1. Model configurations

| | NFS | MM5 |
|---|---|---|
| resolution | 45/15/5km, s-30 | 45/15/5km, s-30 |
| cumulus parameterization | Kuo | Grell |
| planetary boundary layer | TKE-e closure, 1.5 order | MRF |
| microphysics parameterization | simple cloud/ice explicit | simple ice |
| initialization | Synthetic observation data | NCAR-AFWA scheme |

Table 2. Experiments design

| Acronym | Model | Initial field | Bogus vortex intensity |
|---|---|---|---|
| NGW | NFS | CWB GFS | Weak |
| NGM | NFS | CWB GFS | Medium |
| NGS | NFS | CWB GFS | Strong |
| MGM | MM5 | CWB GFS | Medium |
| MGS | MM5 | CWB GFS | Strong |
| NAW | NFS | NCEP AVN | Weak |
| NAM | NFS | NCEP AVN | Medium |
| NAS | NFS | NCEP AVN | Strong |
| MAM | MM5 | NCEP AVN | Medium |
| MAS | MM5 | NCEP AVN | Strong |

## 3. Results

The simulated tracks of experiments via the initial fields from CWB and AVN showed in Fig1 and Fig2, respectively. In Fig1, the anomalous deflections were successful simulated on MM5(MGS,MGM) and NFS model with strong(NGS) bogussing vortex. Both of the forecasts with weak(NGW) and medium(NGM) vortex bogussing in NFS model predicted typhoon Melor moved into South China Sea. Although the MM5 model could catch the deflection, the faster and too northward movement also caused typhoon Melor didn't make landfall on Philippine Islands. Overall, the forecast tracks of NFS and MM5 model with the medium bogussing vortex presented the better performance. Similar results were also showed in Fig2. Compared to Fig1, the experiments by using the initial fields of

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AVN were more close to the realistic track, and all of the forecasts could simulate the deflection. In addition, MM5 model(MAS,MAM) also revealed the rapid motion and earlier northward deflection. Nevertheless, all of the NFS forecasts (NAS,NAM,NAW) with AVN initial field showed significantly better skill than with CWB's GFS, especially for the experiment NAM which simulated the least forecast error(71km for 72 hour forecast). In a word, the forecast errors in this case indicated that the AVN and NFS model were better than GFS and MM5 model, respectively. Due to stronger vortex embedded, the forecast tracks of MM5 model presented that the false location of deflection which didn' t make landfall on Philippine Islands and induced the fast bias on typhoon movement. In NFS model, the simulated tracks showed the worse performance for the weak and medium bogussing with CWB's GFS initial field. It was resulted from more southward typhoon center in the initial field of GFS(not showed). Since the typhoon intensity was not strong enough, the behavior of typhoon Melor were dominated by the steering flow of the easterly. Meanwhile, the ensemble forecast for the all experiments were showed considerably small forecast error (150km for 72h forecast). We' ll analyze the sensitivity of rainfall prediction ability at the next step. In this case, the intensity of bogussing vortex and initial feld in models were important on the typhoon forecast. Both of the initial fields were exhibited that the bogussing scheme of NFS model is weaker and MM5 is too strong. In the future, the bogussing schemes which were associated with the vortex intensity should be improved. In the initial fields, it was reasonable for the more realistic one were presented the better performance. Therefore, the more accurate initial field and more properly bogussing scheme will generate the positive impact on the typhoon forecast. On the other hand, ensemble forecast also provided the good way to typhoon operational forecast.

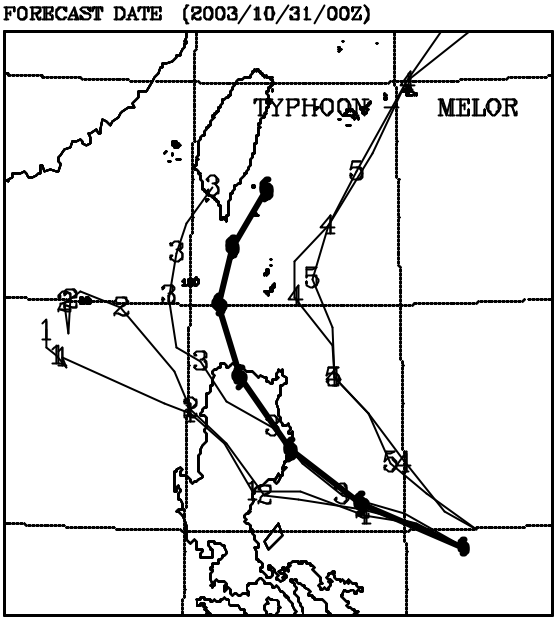


Figure 1 The simulated tracks of experiments associated with CWB's GFS initial field. Typhoon symbol is represented the realistic track, number 1, 2, 3, 4, 5 are represented NGW, NGM, NGS, MGM, MGS, respectively.

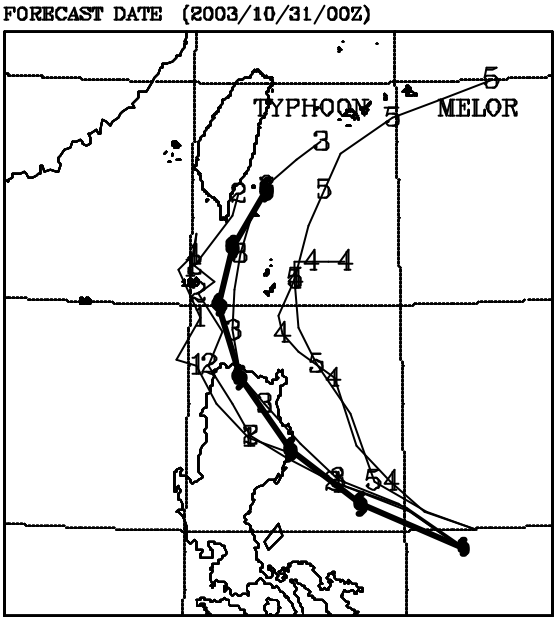


Figure 2 Same as Fig1, but with the AVN initial field, number 1, 2, 3, 4, 5 are represented NAW, NAM, NAS, MAM, MAS, respectively.

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