中国气象局地球系统数值预报中心
CMA EARTH SYSTEM MODELING AND PREDICTION CENTRE

A Regional TC Model for Northwest Pacific and North Indian Ocean

Suhong Ma
Anxiang Qu Jin Zhang Minghua Sun Ruichun Wang
LI LI Liping Huang Dapeng Wang

CMA Earth System Modeling and Prediction Centre

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OUTLINES

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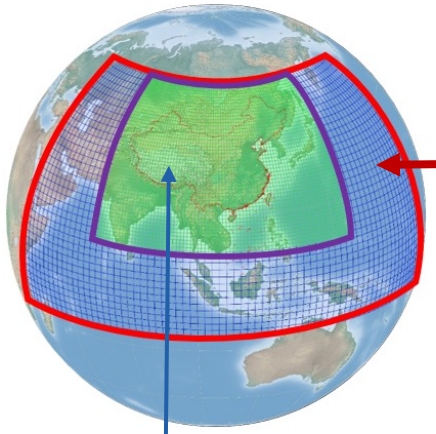
1. Overview of A Regional Typhoon Prediction Model In CEMC (CMA-TYM)
2. Performance in 2024
3. Upgrading of Base Model from MESOV5.0 to MESOV6.0
4. Future Plans

1. Overview of Regional TC Prediction Model in CEMC

➢ Development of CMA-TYM (GRAPES-TYM before Sep. 2021)



Put into operation
15km/L32
Northwestern Pacific

2012
建立与业务化
分辨率：0.15°/L32
海域：西北太平洋

2014
对流参数化升级
涡旋初始化改进

2015
12km/L50
分辨率提升：0.12°/L50
海气交换系数优化

2017
水平平均参考大气研发
对流参数化升级
涡旋初始化方案调整

2018
参考大气方案优化
输入输出并行化

2019
分辨率提升：0.09°/L68
海域：西北太平洋+北印度洋
垂直扩散方案参数优化

2021
对流参数化升级
陆面过程更新
云分析应用

9km/L68
Northwestern Pacific and North Indian Ocean

Provide TC prediction for North Indian Ocean

V5.0

CMA-MESO(GRAPES-MESO)

V6.0

1km/L71/24/day

2024

15km/L32/2/day

2006

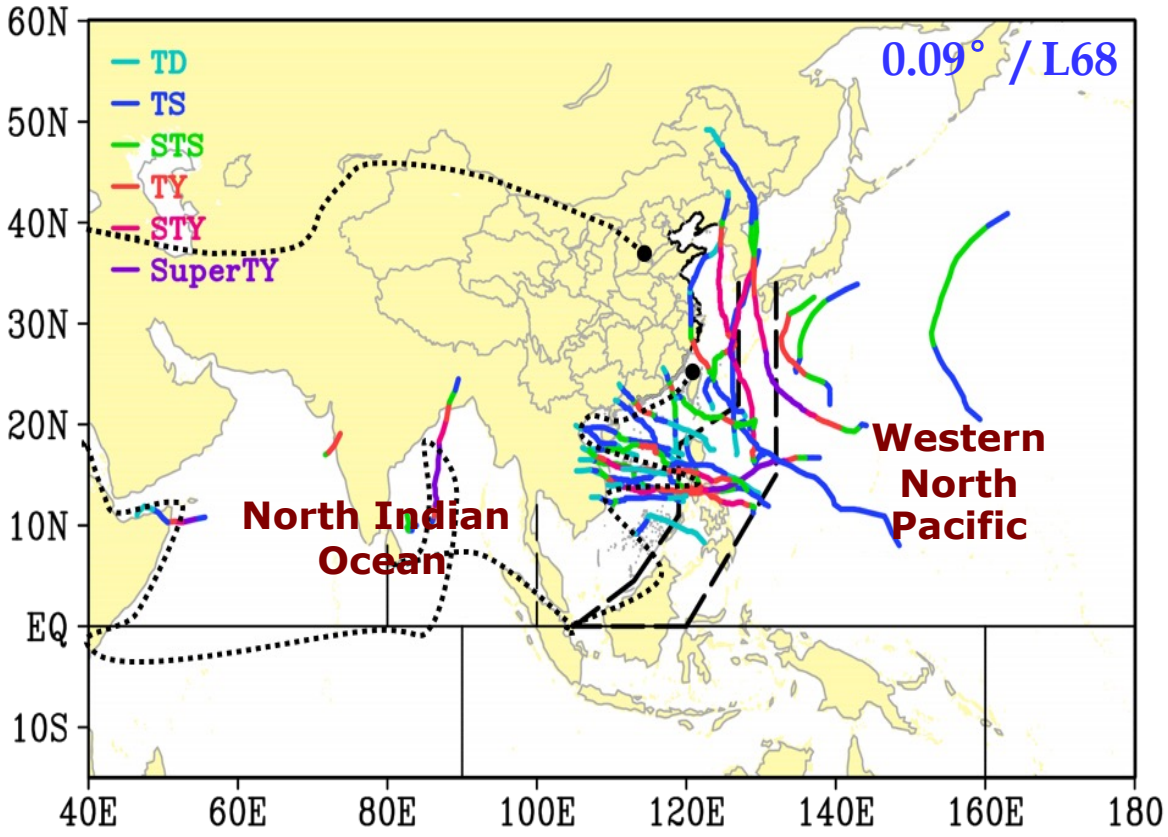
1． Overview of Regional TC Prediction Model in CEMC

➢ Development of CMA-TYM (GRAPES-TYM before Sep. 2021)

Configuration of CMA-TYM

horizontal/vertical resolution	0.09°/68levels
Integration Domain	40°E-180.04°E、15°S-60.06°N
Initial and boundary	GFS forecast
Model physics	WSM6、Scale-SAS、YSU、Noah、MO 、Goddard and RRTM
Vortex initialization	Intensity correction
Forecast length and Interval	120h，4/day(00,06,12,18UTC)
Products interval	1h
Model products	GRIB2 data for all fields，TC track、intensity ,rainfall and other figure products

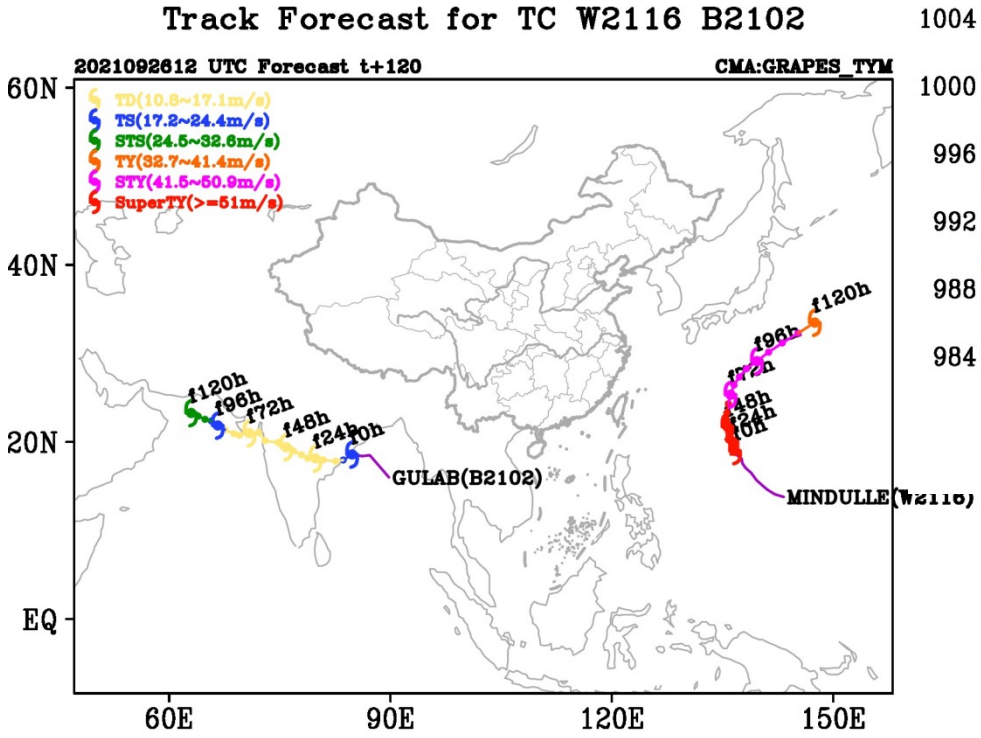
Model domain and TCs in 2020

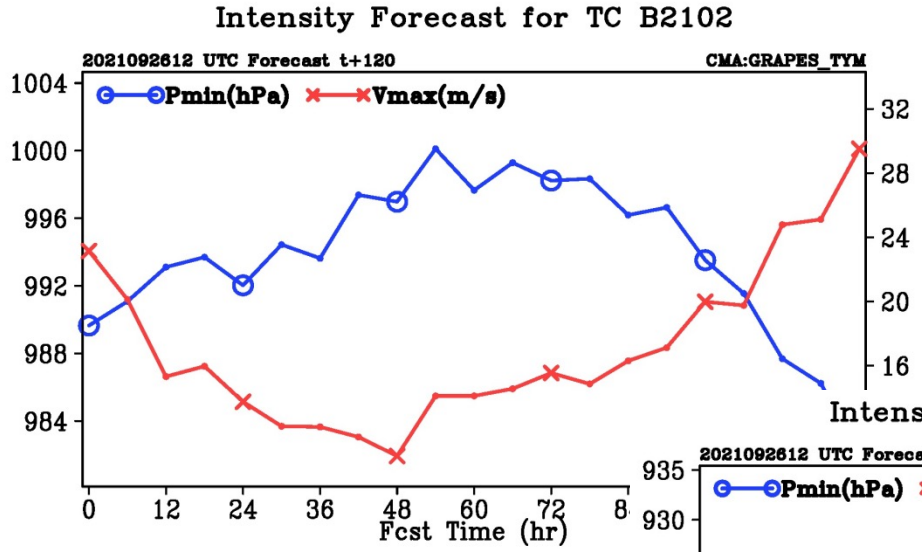


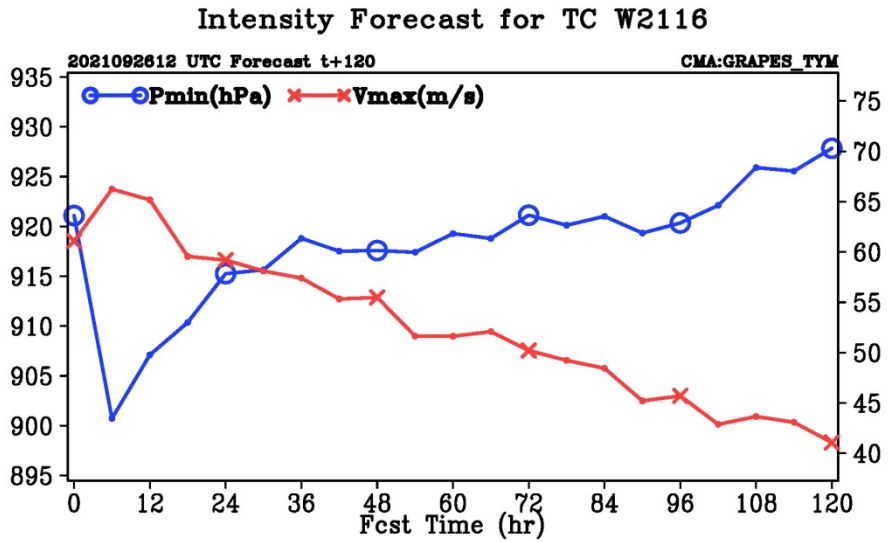
1．Overview of Regional TC Prediction Model in CEMC

➢ Development of CMA-TYM (GRAPES-TYM before Sep. 2021)

Track and Vmax for W2116 at WNPO and B2102 at North Indian Ocean in 2021

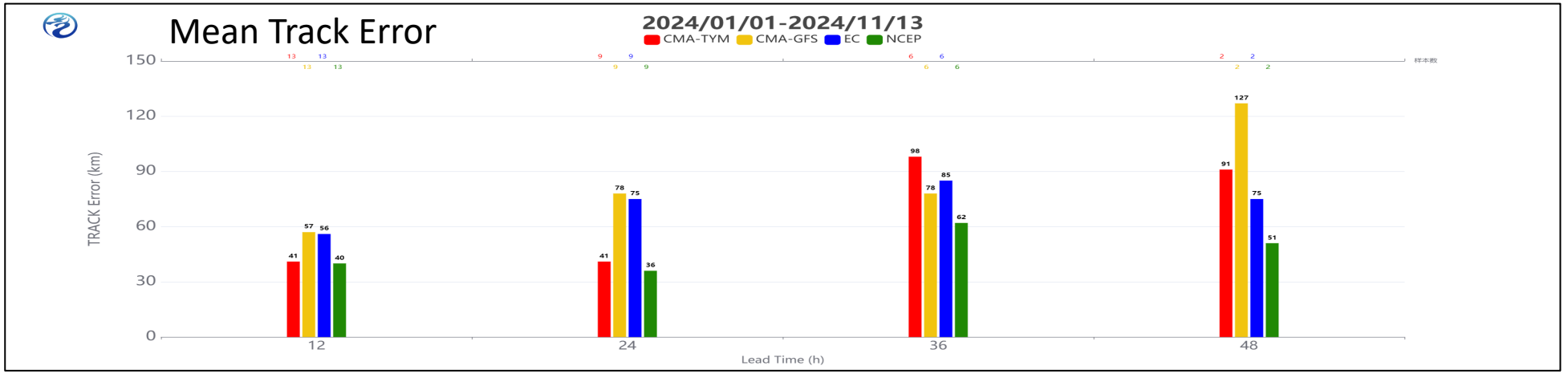


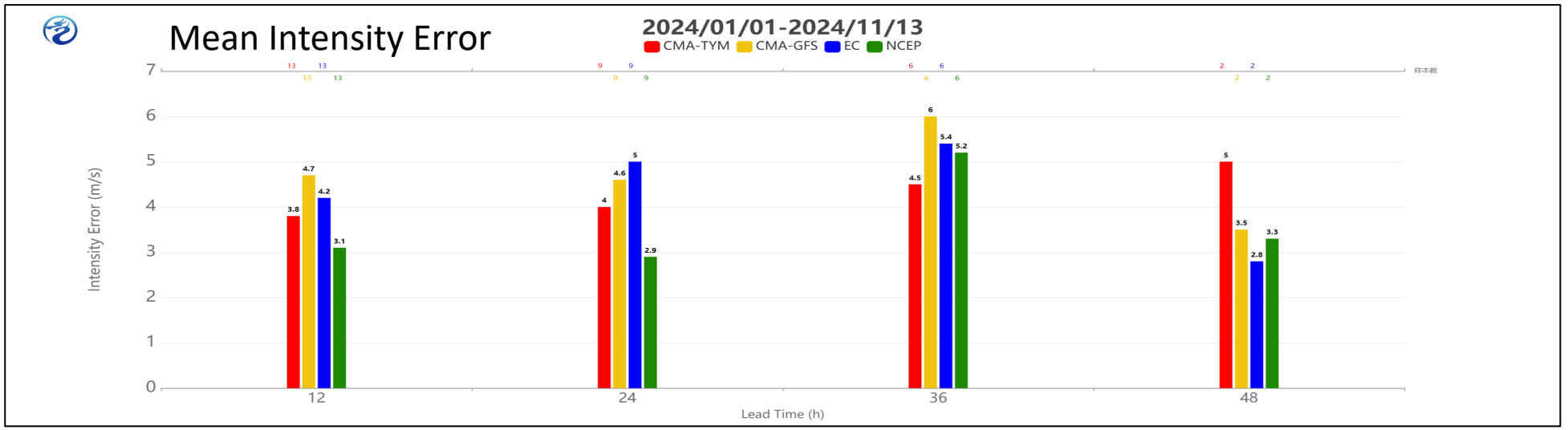




2． Performance in 2024

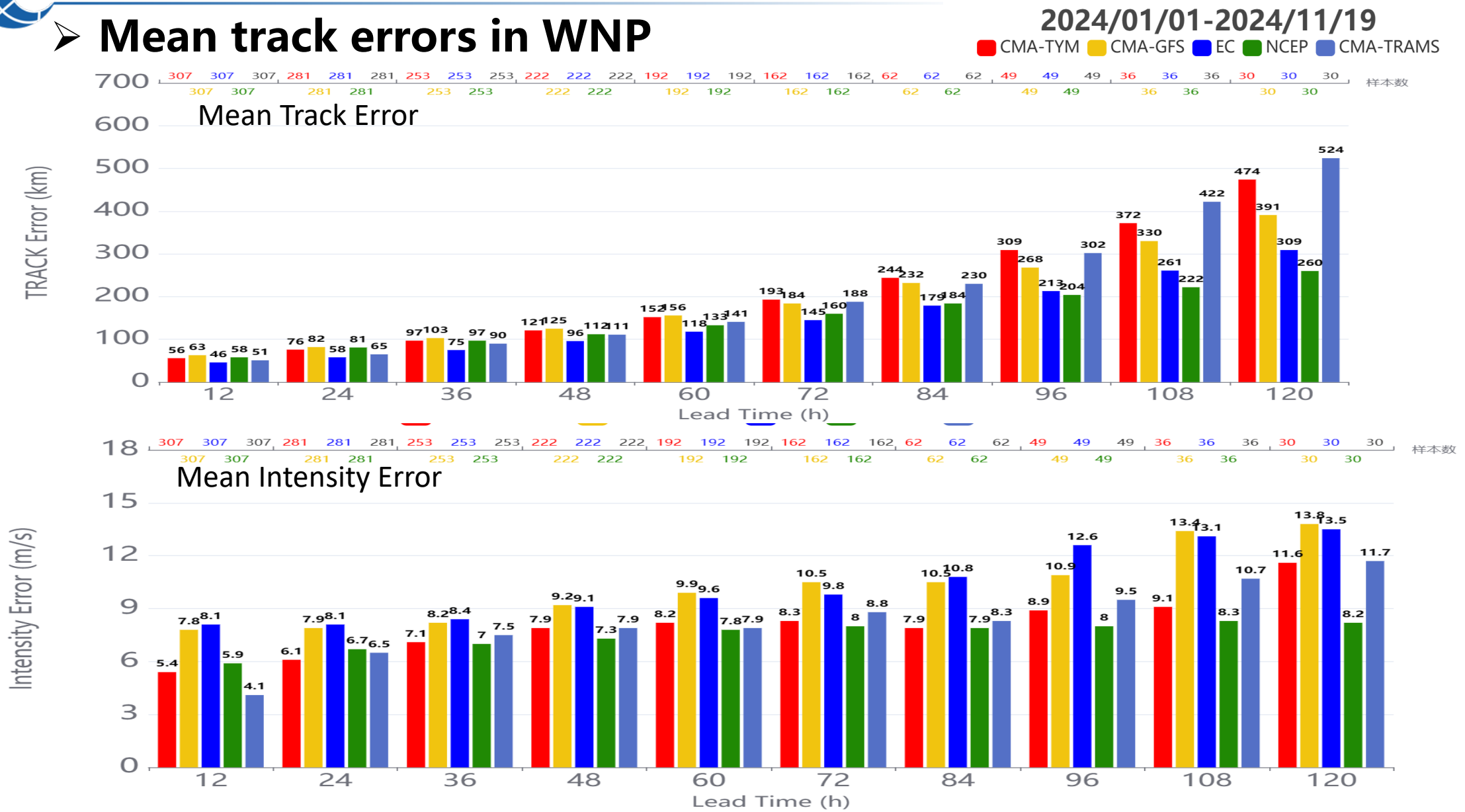
➢ Mean track errors in Bay of Bengal





2． Performance in 2024

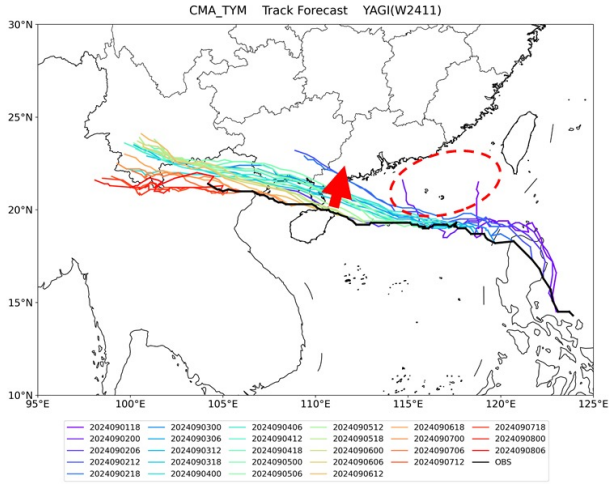
➢ Mean track errors in WNP

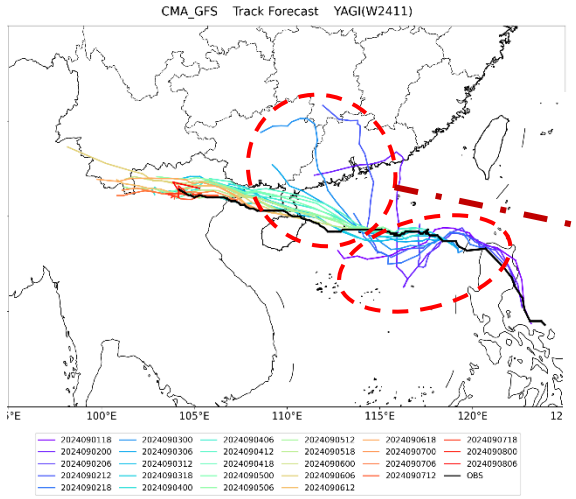


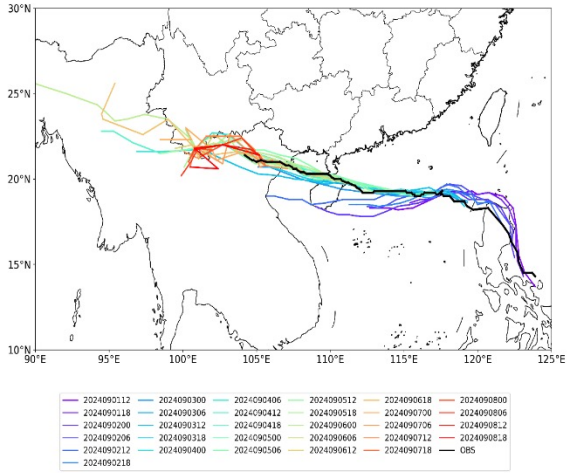
2． Performance in 2024

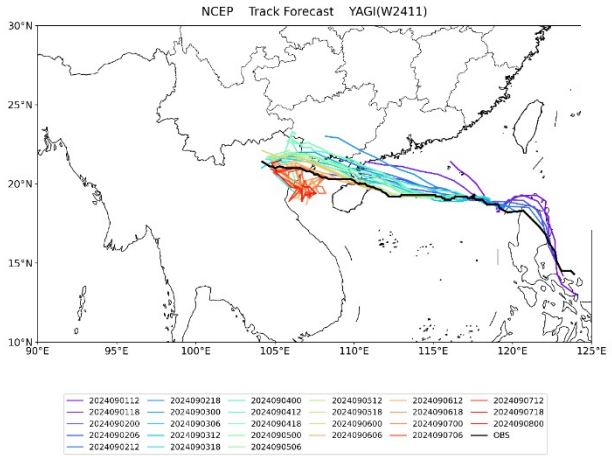
➢ Typhoon “YAGI”

Tracks for “YAGI”

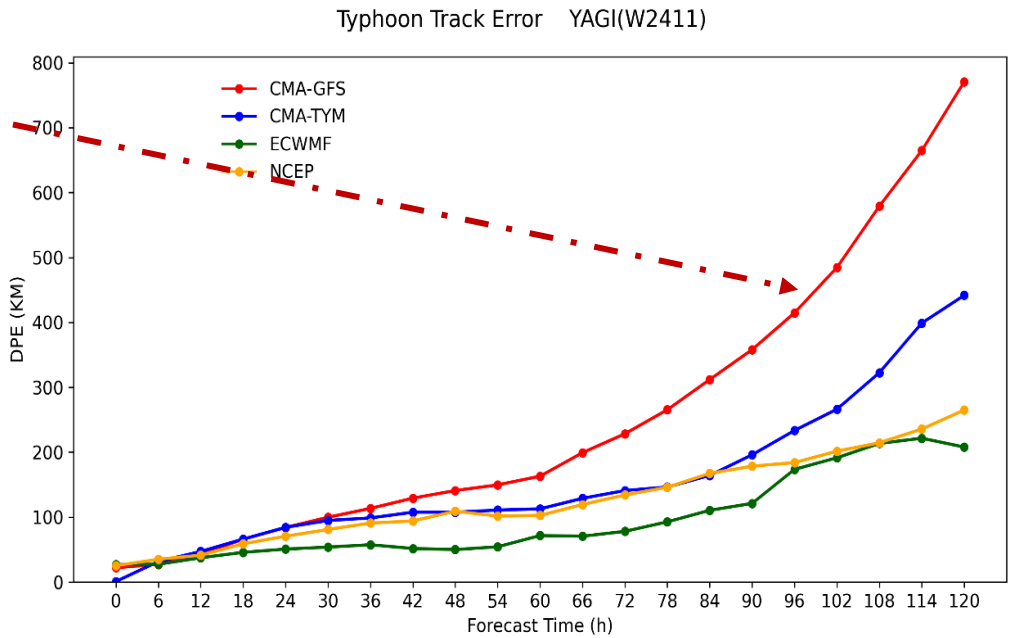








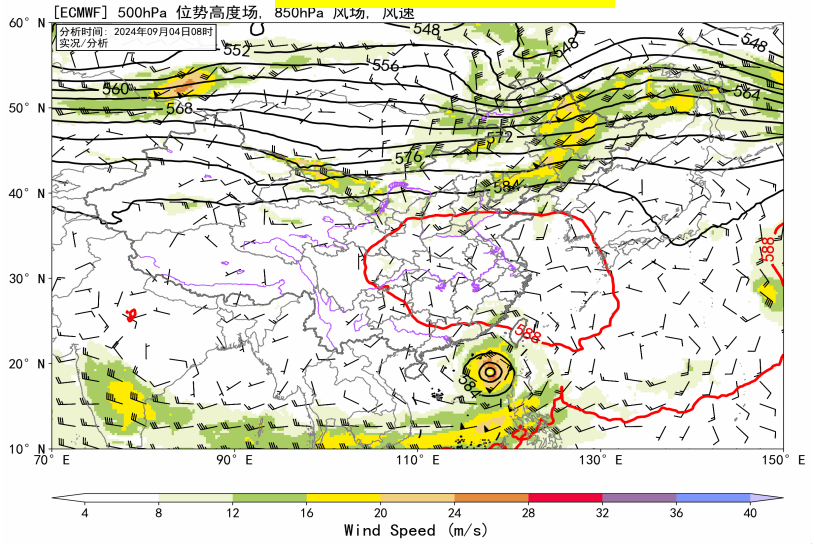
Mean track error



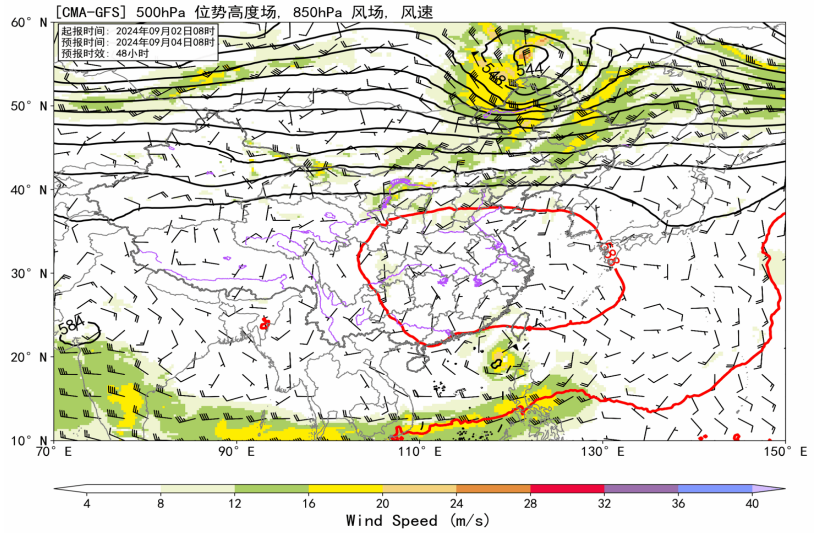
2． Performance in 2024

➢ Typhoon “YAGI” Geopotential height at 500hPa and wind at 850hPa

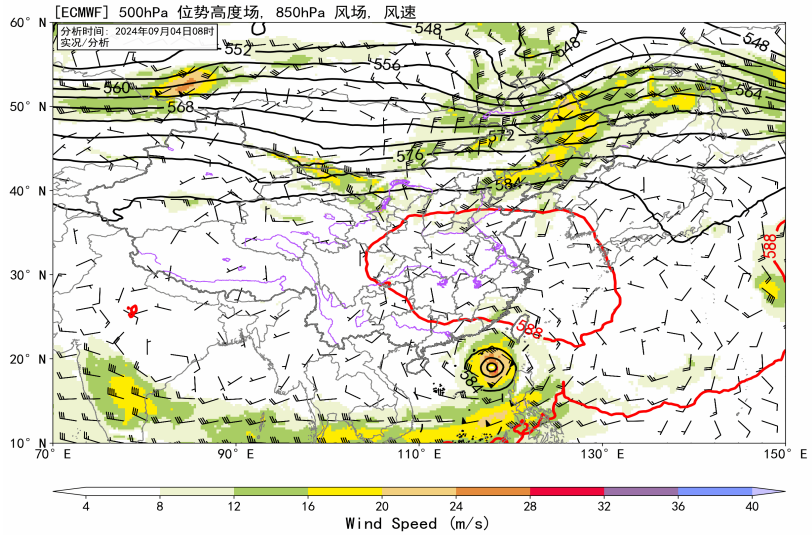
ECMWF Analysis



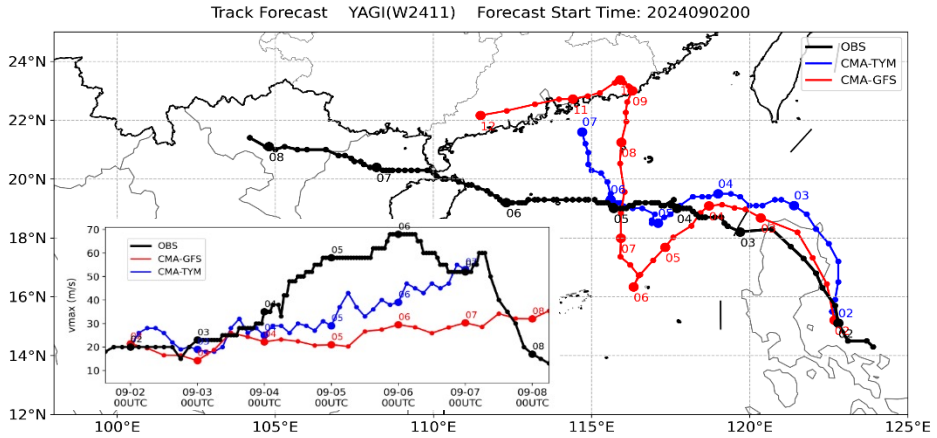
CMA-GFS



ECMWF



Initial time:
20240902 00UTC



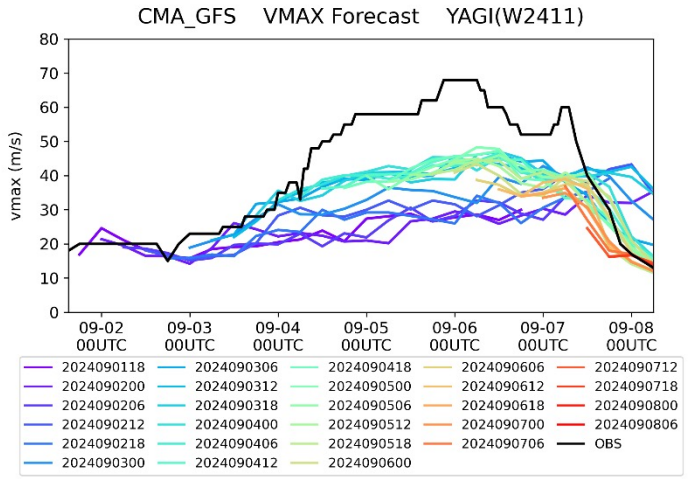
“摩羯”东侧有另一个涡旋发展
影响“摩羯”路径强度

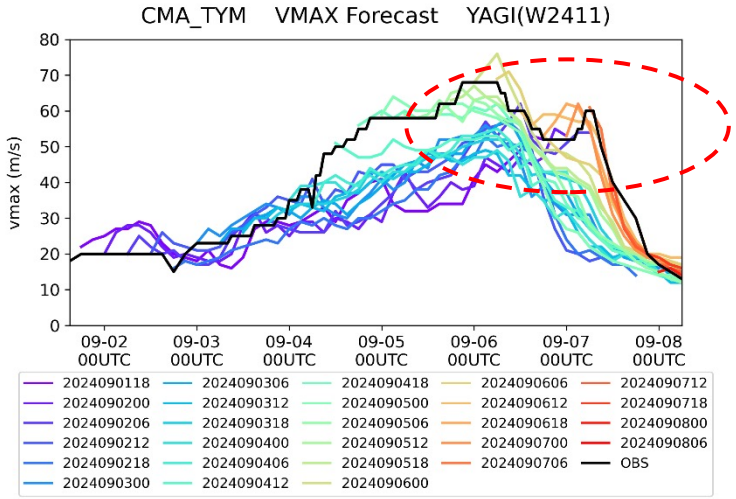
A low developed to the east
of “YAGI”

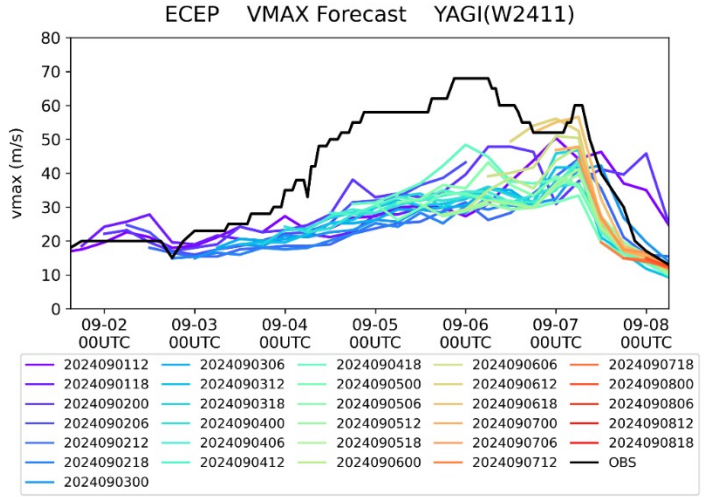
2． Performance in 2024

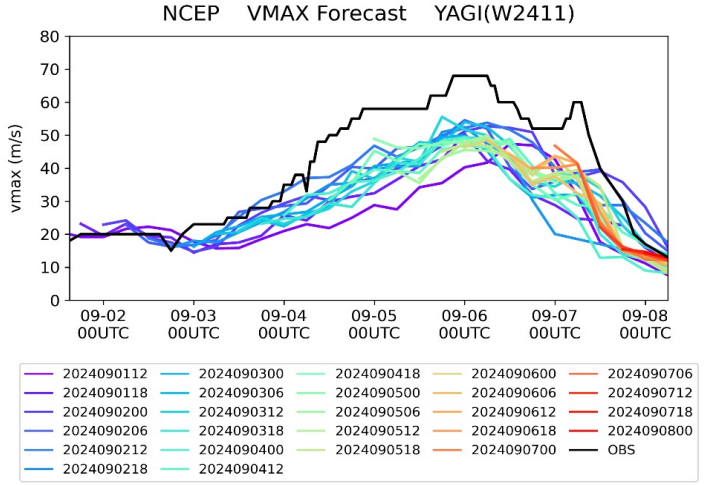
➢ Typhoon “YAGI”

Intensity for “YAGI”

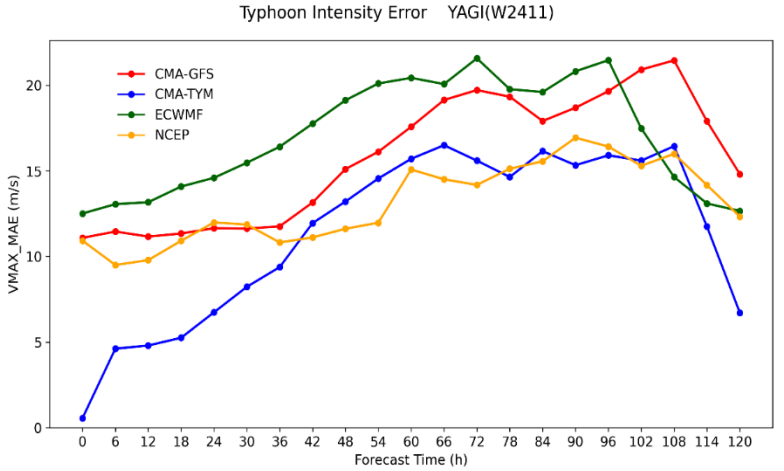




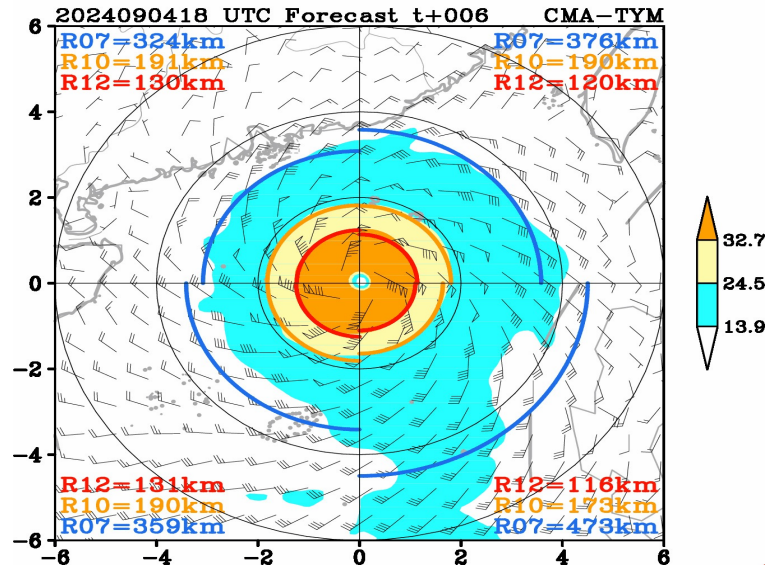




Mean intensity error



TC Radius for W2411



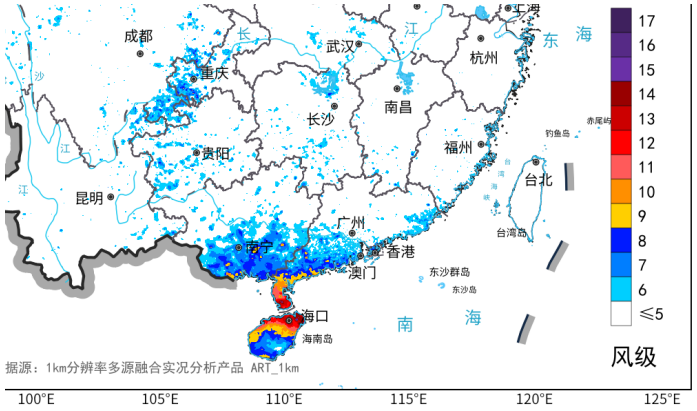
2． Performance in 2024

➢ Typhoon “YAGI”

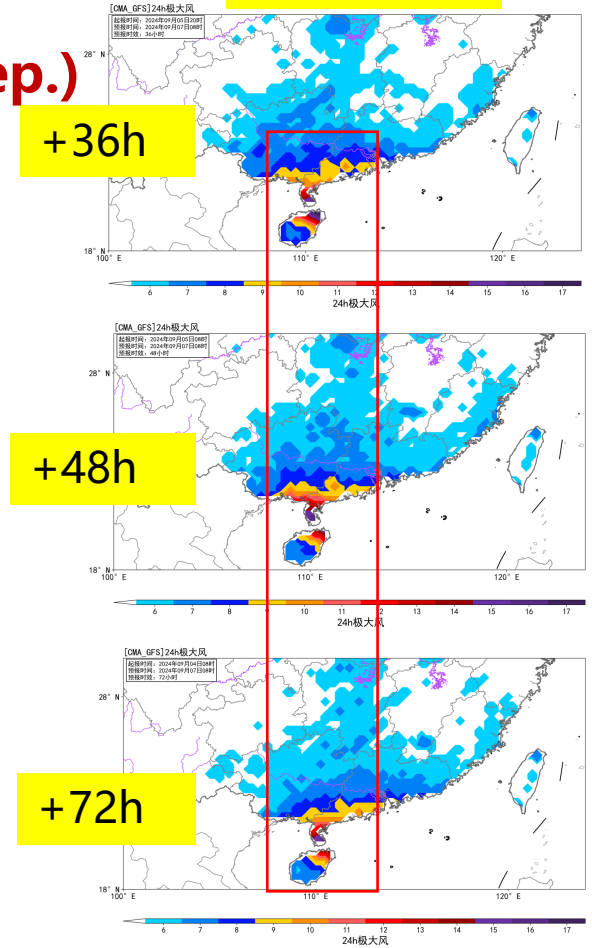
Wind speed during landfall

(00UTC 7 Sep.-00UTC 8 Sep.)

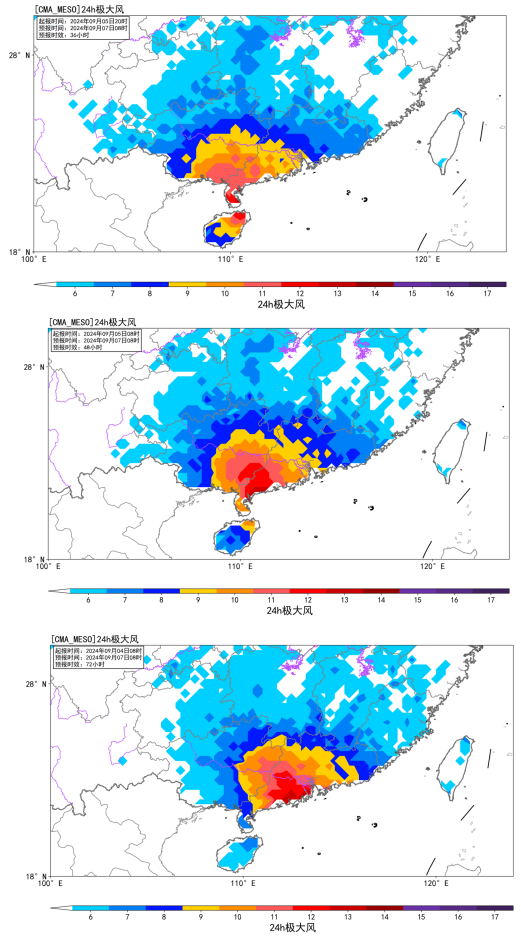
OBS



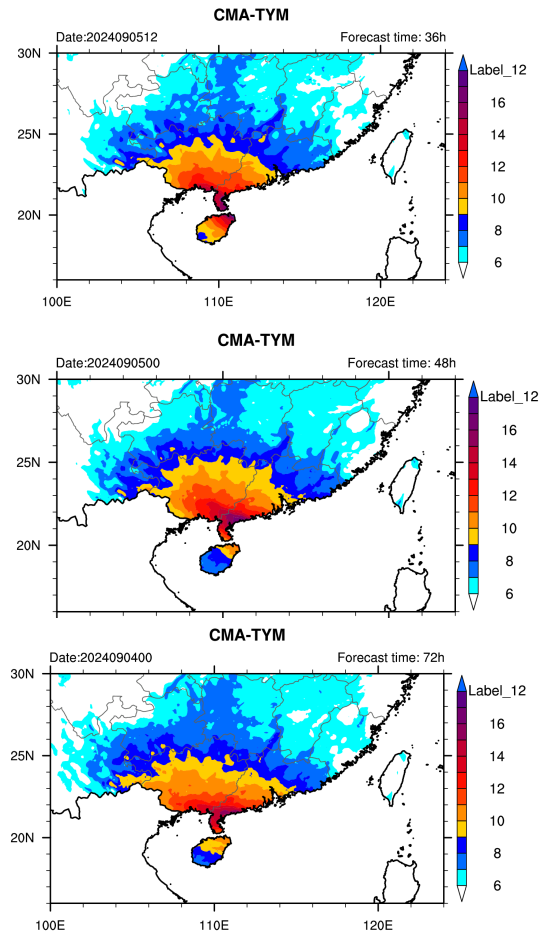
CMA-GFS



CMA-MESO



CMA-TYM

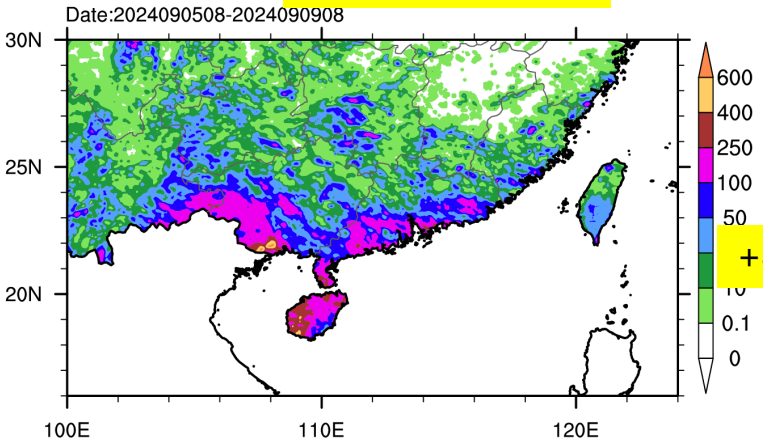


2． Performance in 2024

➢ Typhoon “YAGI”

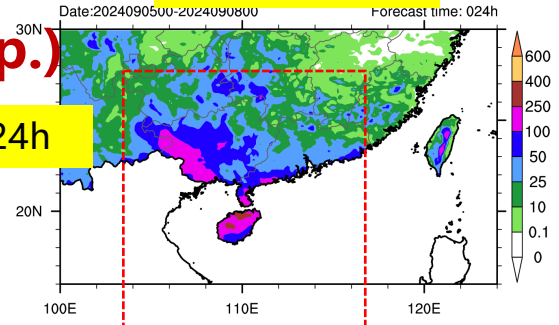
Cumulative precipitation (00UTC 5 Sep. -00UTC 9 Sep.)

OBS

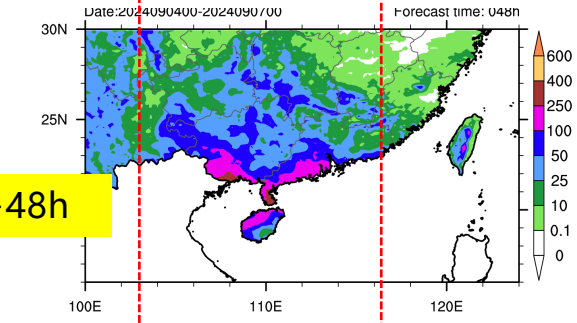


CMA-GFS

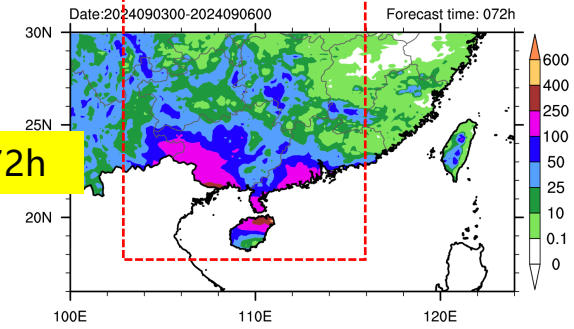
+24h



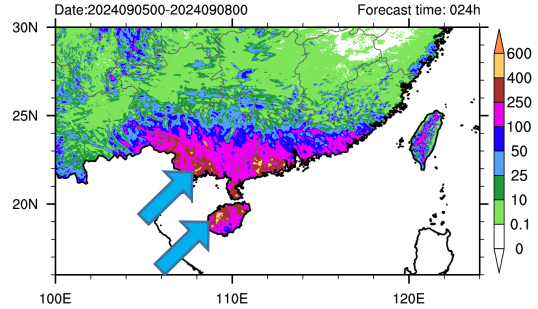
+48h

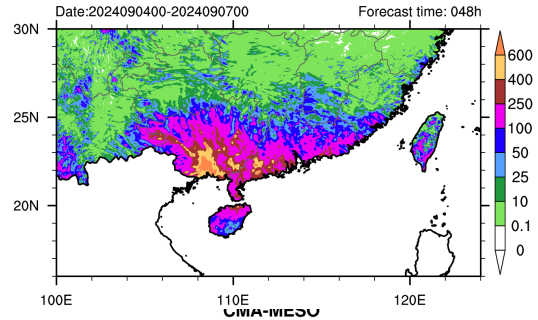


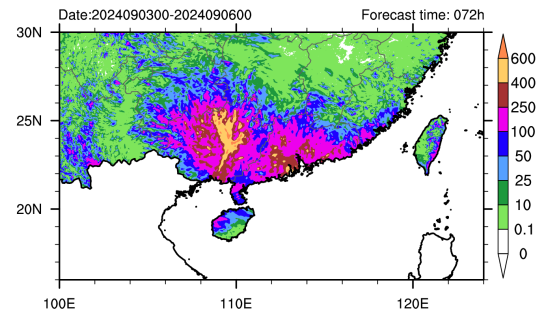
+72h



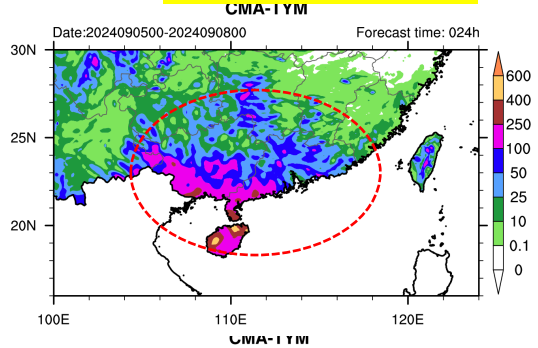
CMA-MESO

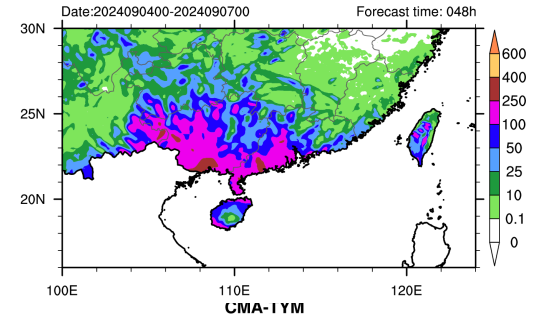


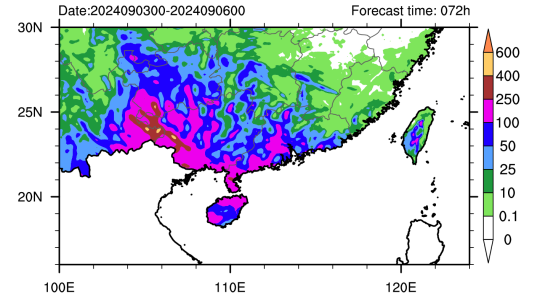




CMA-TYM







3． Upgrading of Base Model from MESOV5.0 to MESOV6.0

➢ General information of CMA-MESOV6.0

■ **Model resolution**

- **Horizontal: 1km**
- **Vertical level: 70 ,**
- **Model top 30km**

■ **Model physics**

- **Radiation: RRTM LW & Dudhia**
- **Microphysics: DM-ICE**
- **Cloud Scheme from EC**
- **Land surface :NOAH**
- **PBL: NMRF+EDMF**

■ **Dynamic core**

- **More accurate with predictor-corrector method**

■ **Operation schedule**

24times/day

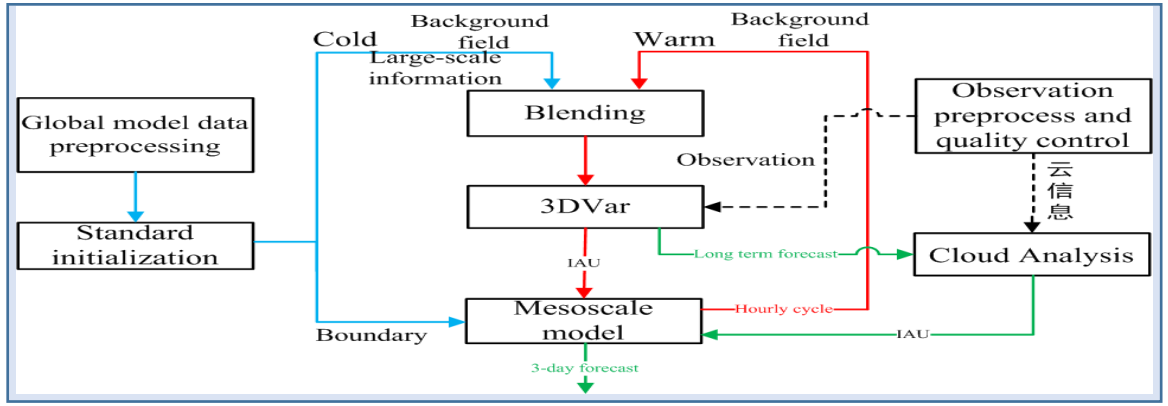
- forecast: 72h(00/12UTC)
/36h(others)

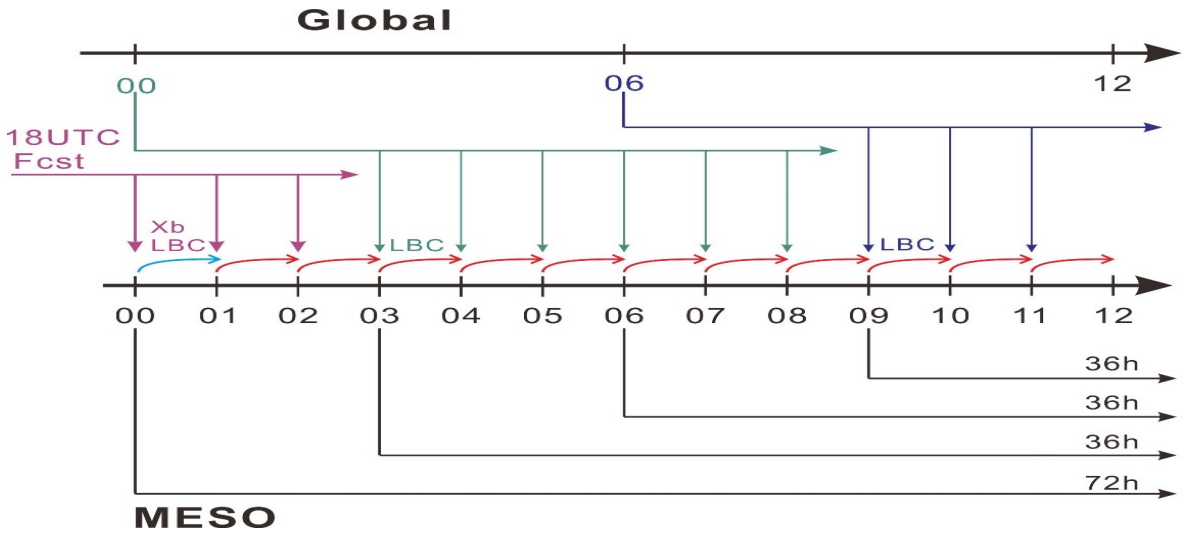
- Integration domain:
（70～145E；10N～60.1N）

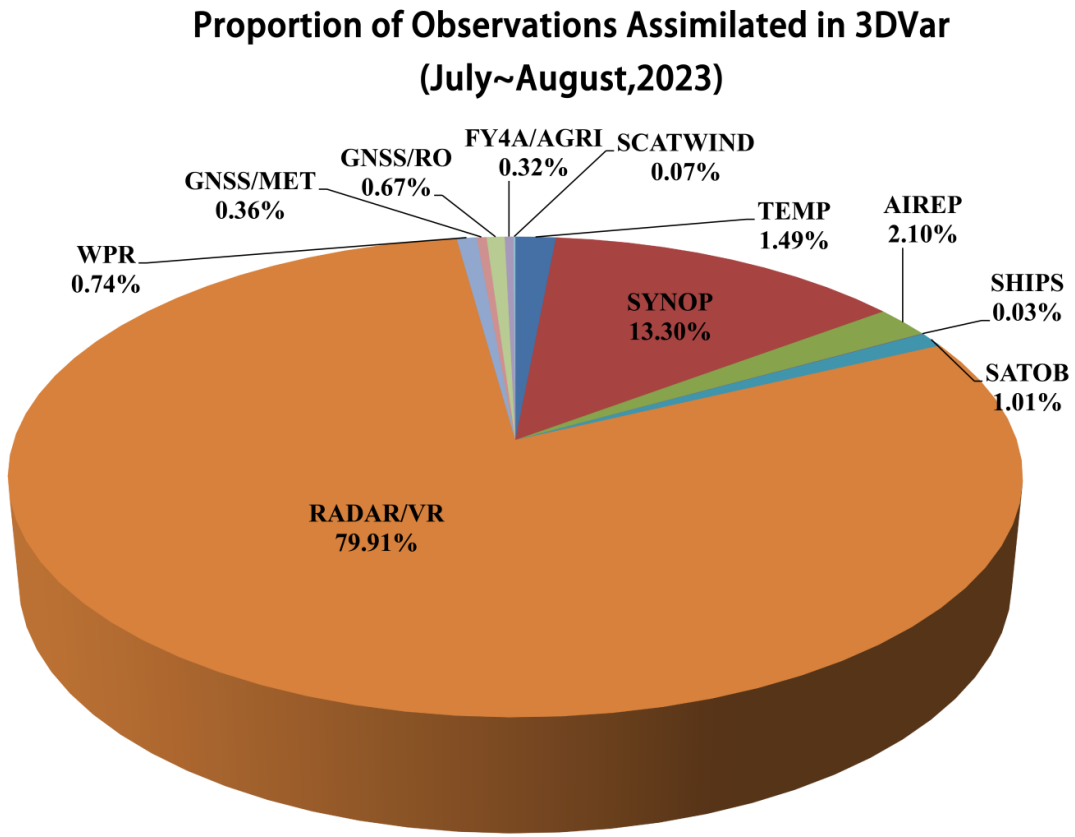
3. Upgrading of Base Model from MESOV5.0 to MESOV6.0

➢ General information of CMA-MESOV6.0

3Dvar data assimilation system and Data used

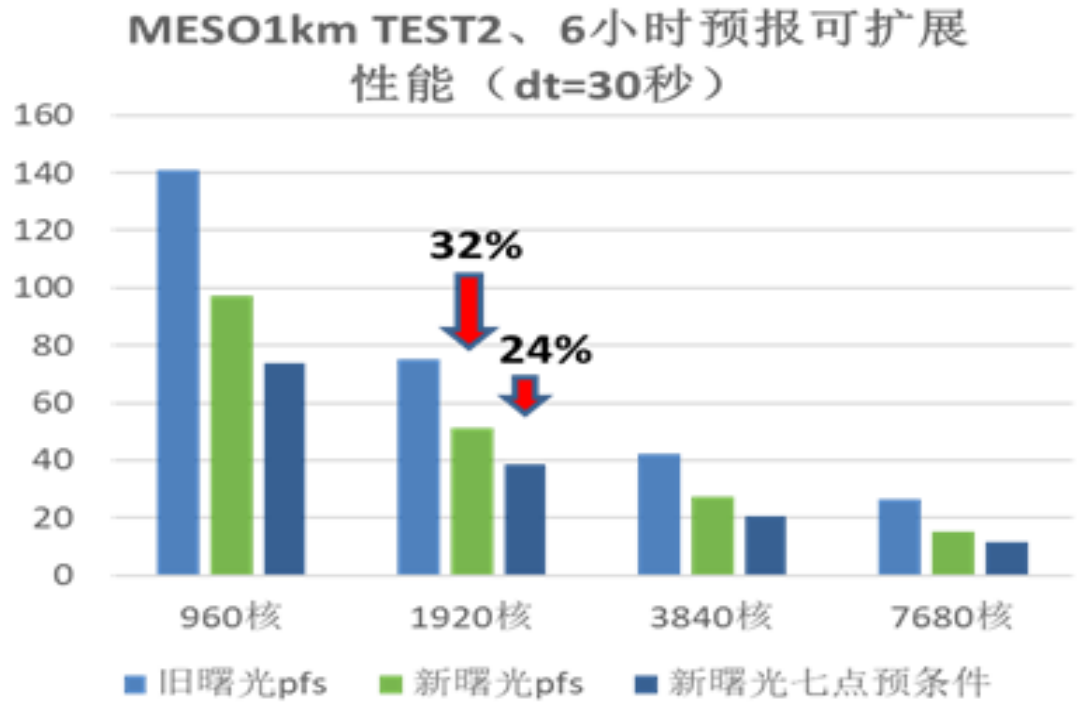


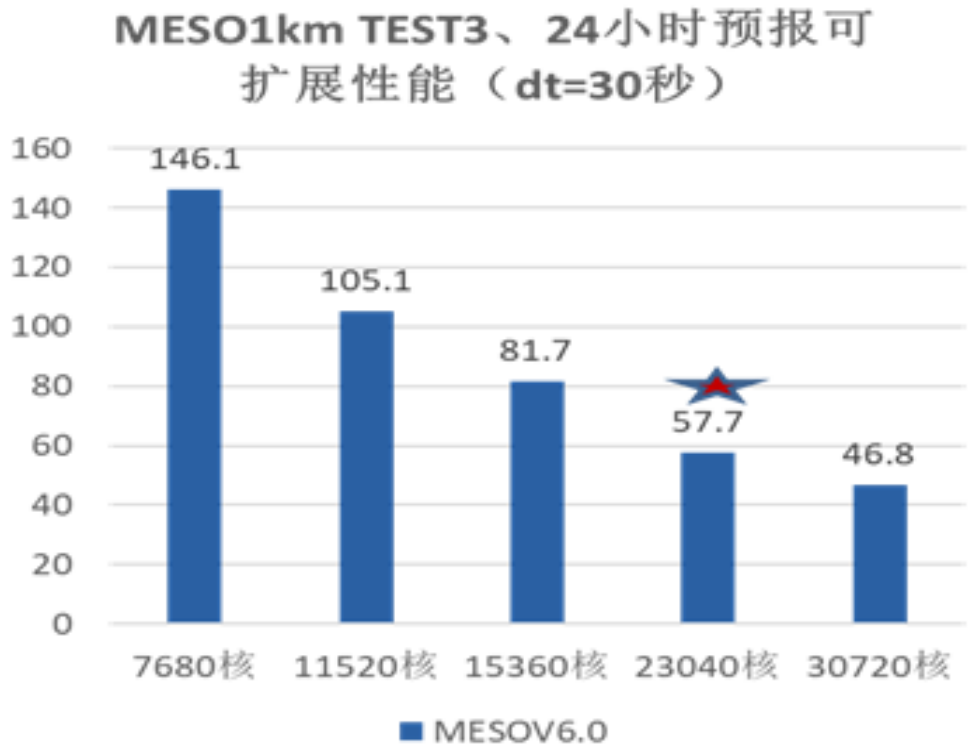




3．Upgrading of Base Model from MESOV5.0 to MESOV6.0

➢ General information of CMA-MESOV6.0

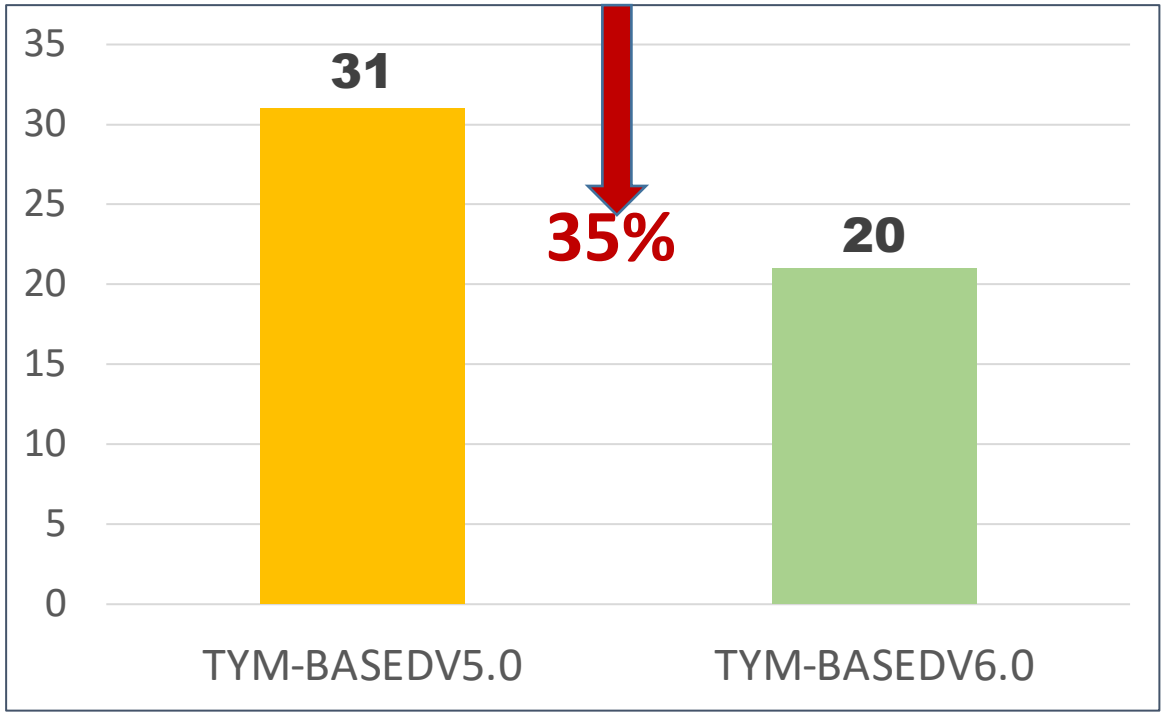




TEST2 - scale 3301x3301x70（: TEST3 - scale 7501x5001x70. 2. New machine + optimization, the computing efficiency of the 1-kilometer eastern area of the regional mode is increased by 50%; 1 km national area uses 23040 nuclear 24-hour forecast to complete within 1 hour

3．Upgrading of Base Model from MESOV5.0 to MESOV6.0

- **Upgrading of base model : Computational efficiency increased 35%**



9km/L68

Grid numbers: 1557*835*68

Cores: 2048

Computing efficiency increased 35%

More opportunities for Atmosphere-Ocean-Wave

3. Upgrading of Base Model from MESOV5.0 to MESOV6.0

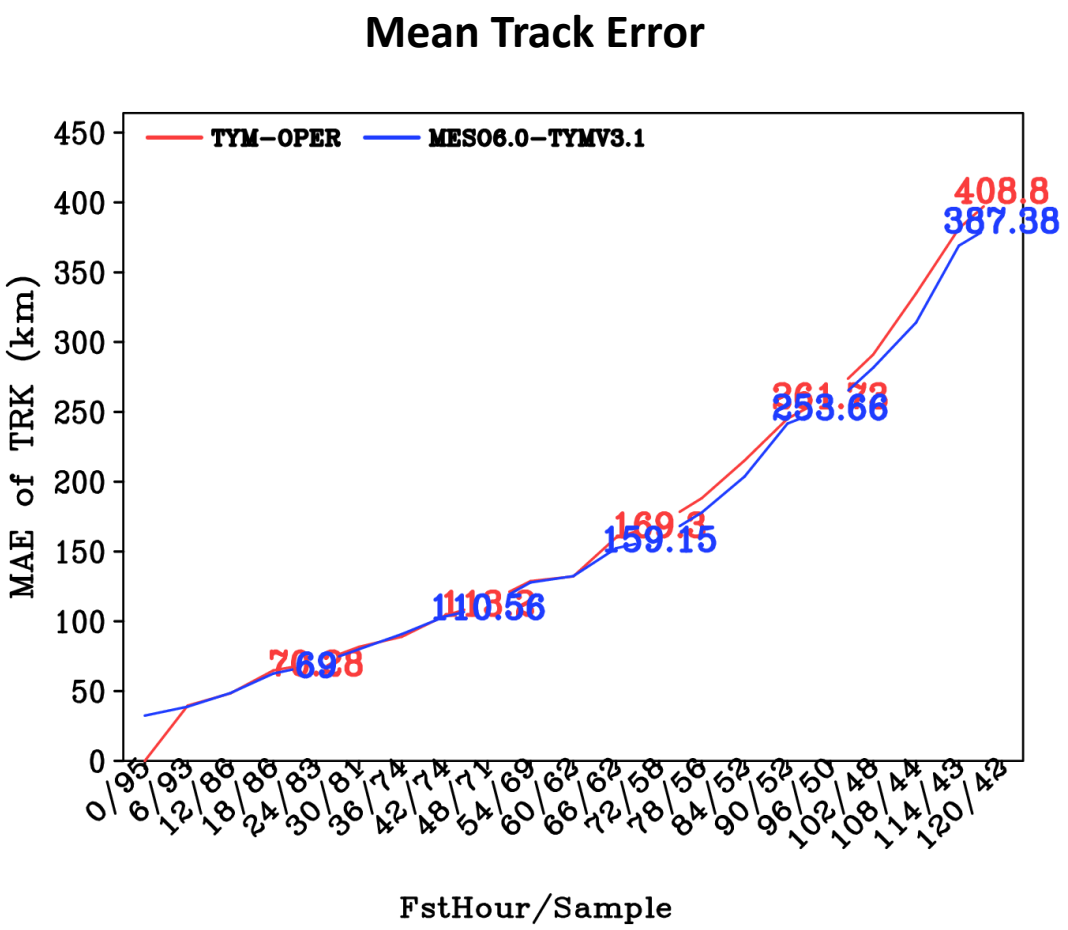
➢ Results from upgrading of base model

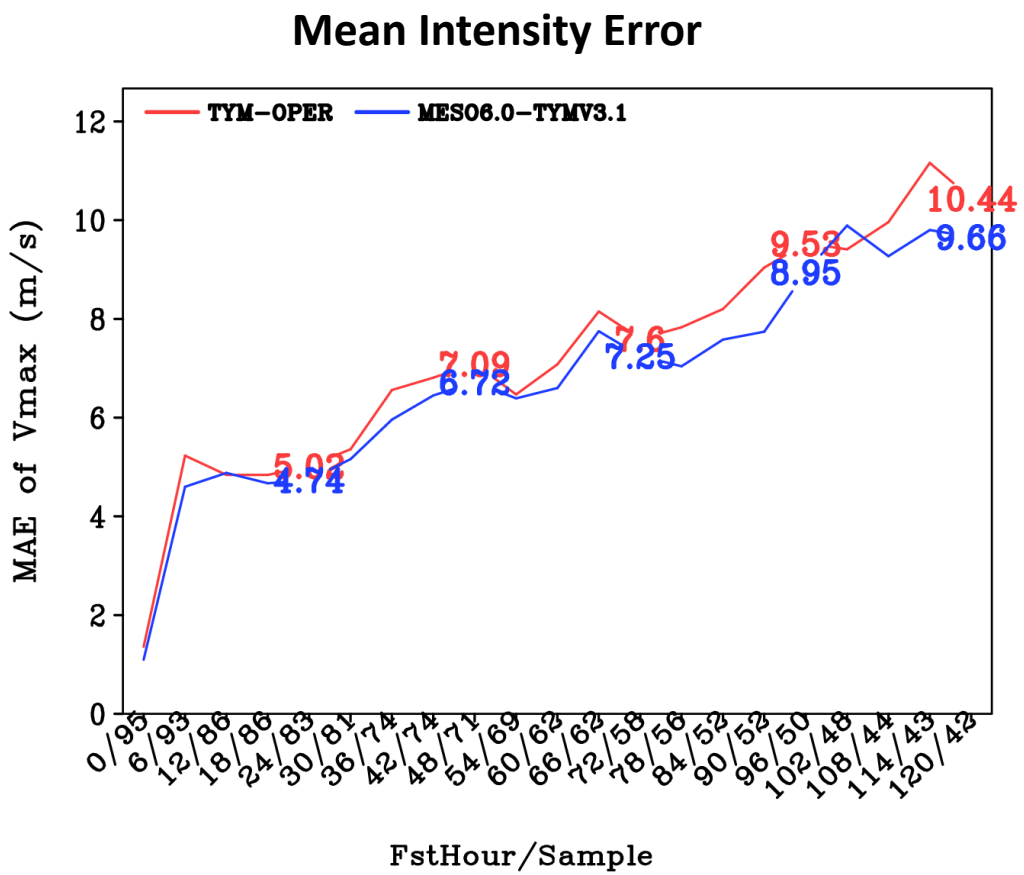
Configuration of Experiment

	TYM-OPER(TYMV3.1)	TYM-V4.0.1
Base model	MESO V5.0	MESOV6.0
Vertical level	68	68
PBL	YSU(edmf=0, dis_heat=0,topdown=1)	YSU(edmf=0, dis_heat=0,topdown=1)
Cumulus convection	Revised Han et al.(2017)	Revised Han et al.(2017
Vortex Initialization	Vortex intensity correction (Ma et al. 2019)	Vortex intensity correction（Ma et al. 2019)

3. Upgrading of Base Model from MESOV5.0 to MESOV6.0

➢ Results from upgrading of base model

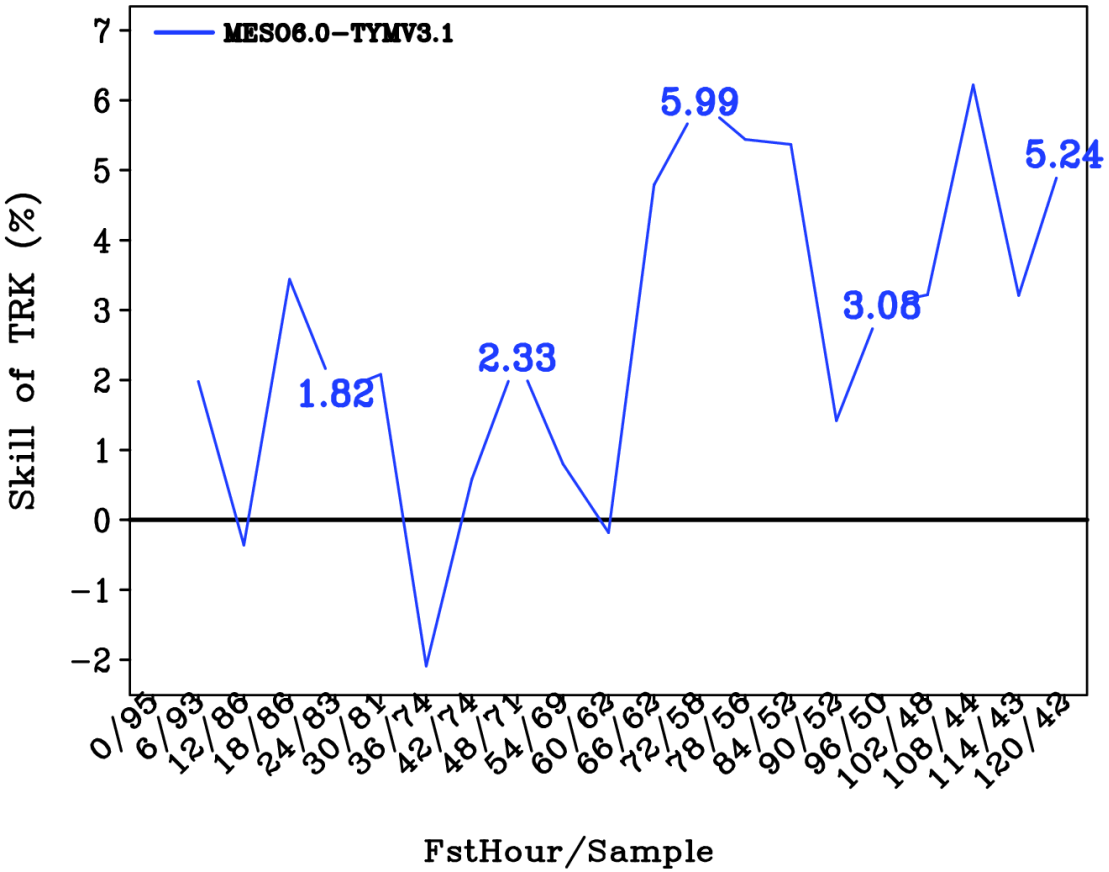




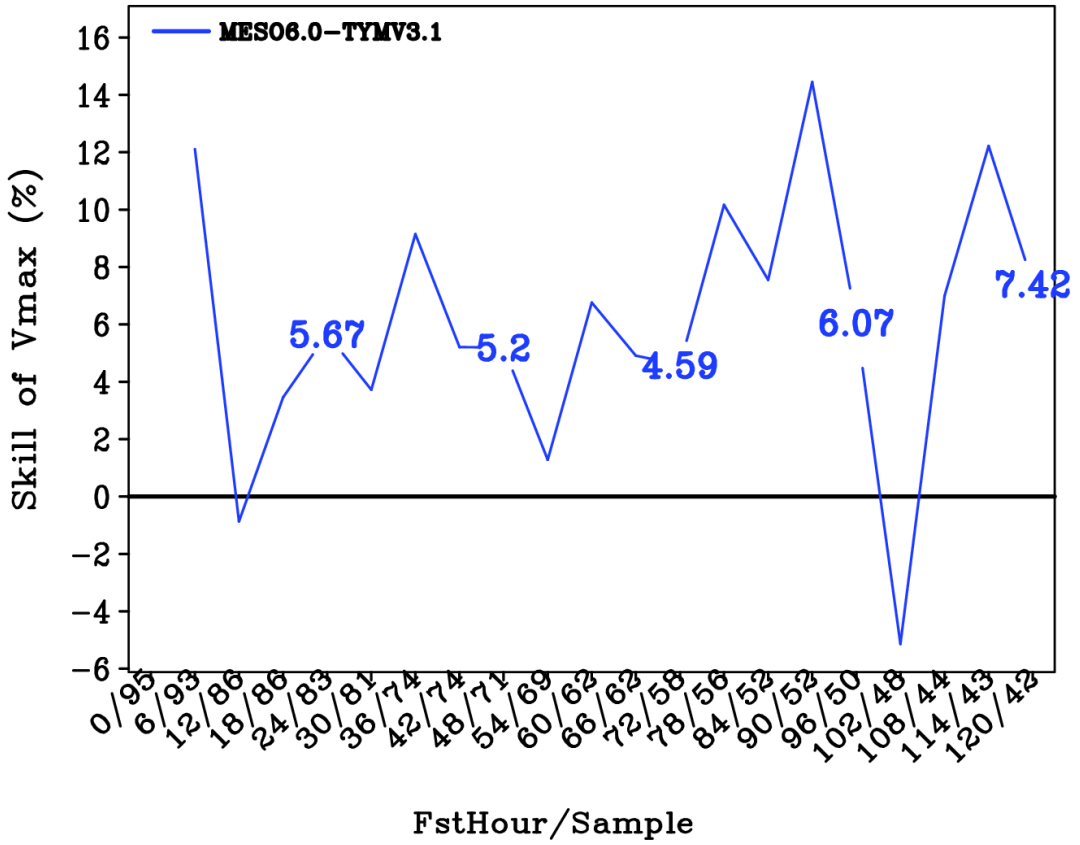
3. Upgrading of Base Model from MESOV5.0 to MESOV6.0

➢ Results from upgrading of base model

Skill-track



Skill -intensity

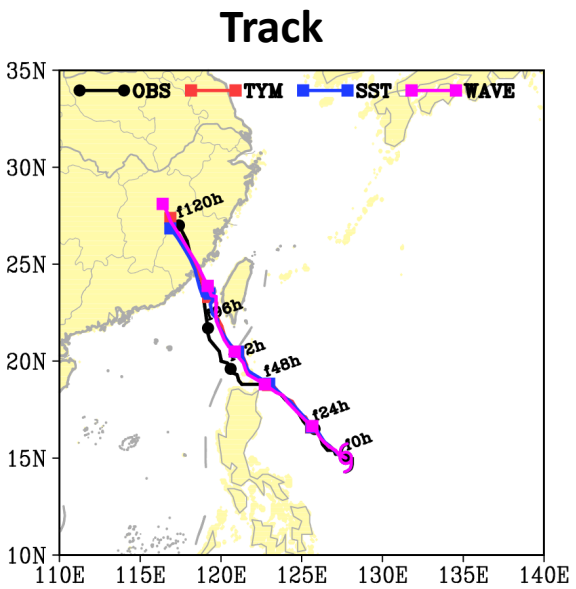


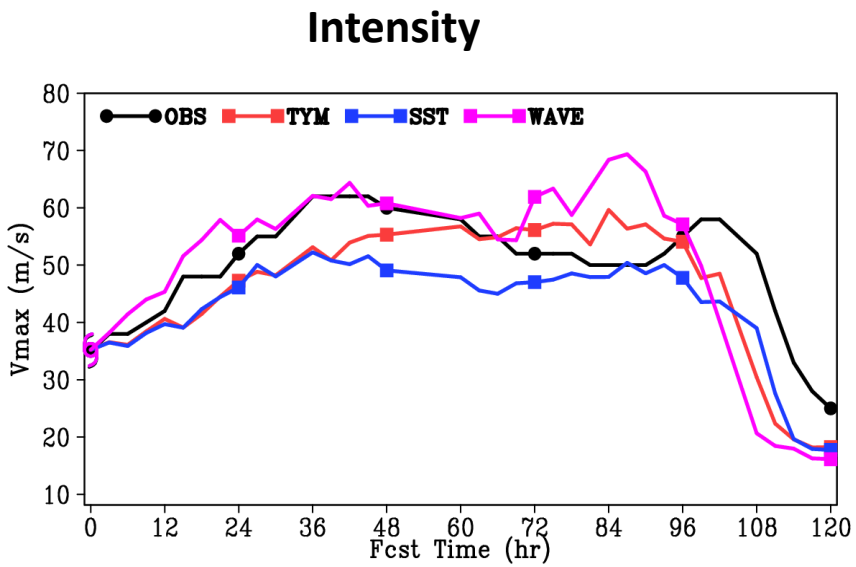
4． Future Plans

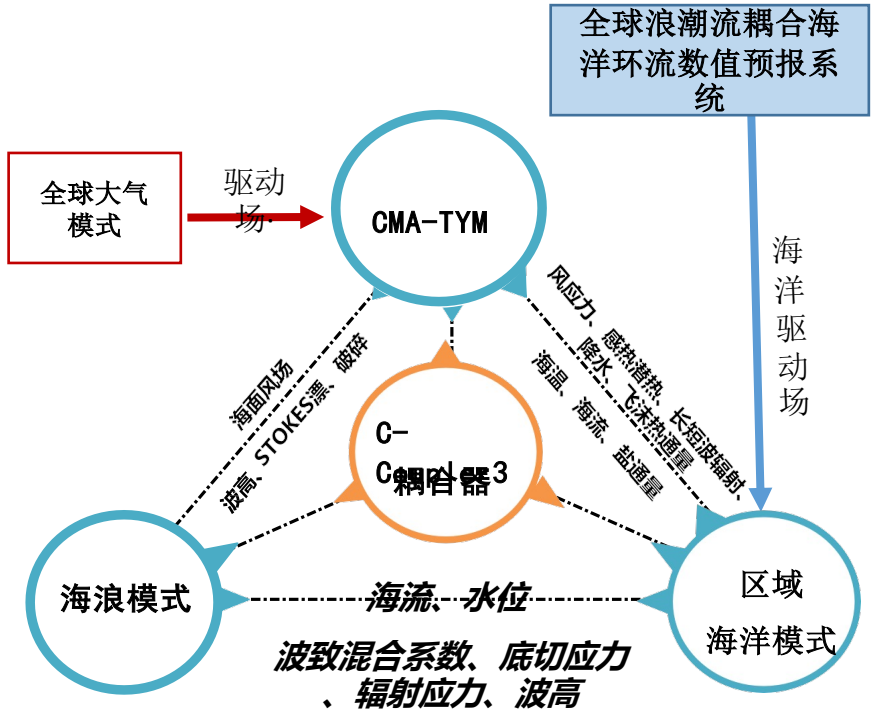
■ Further improvement will be carried out on this new version

- ✓ Model vertical level (L68 and L71)
- ✓ Cumulus Convection parametrization
- ✓ TC initialization

■ Air-ocean-Wave model development







Schematic diagram for the regional air-ocean-wave coupling model

THANKS

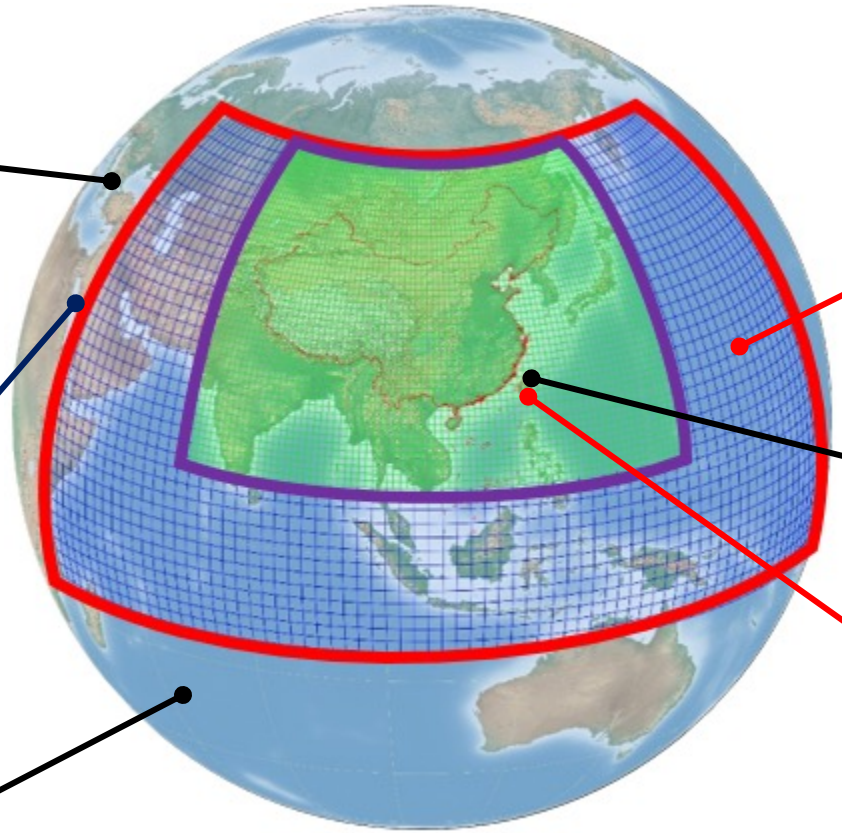
CMA Earth System Modeling and Prediction Centre

1. Overview of CMA NWPS

CMA-GFS:
- Global -12.5km/L87, 0.1hPa
- Data assimilation -4DVAR
- 10 day forecast（00,12UTC）
- 5 day forecast（06,18UTC）
- TC prediction

CMA-GFS=Ocean Model
- Global 10km resolution
- Data assimilation -EAKF
- 10 day forecast（12UTC）

CMA-GEPS:
- Global-50km/L87
- CTL+30 Members
- 15 day forecast（00,12UTC）
- TC EPS for NWP and IND.



CMA-TYM:（RegionalTyphoon Model）
- 40-180° E,-15-60° N
- 9km/L68
- 4/day (00,06,12,18Z)
- 120h forecast

CMA-MESO:（Regional data assimilation and forecast system）
- 70-145°E,10-60°N
- 3km/L50
- 8/day (00,03,06，09,12,15,18,21Z)
- 72h(00,12UTC)
- 36h at the other initial time

CMA-REPS:（Regional EPS）
- 70-145°E,10-60°N
- CTL+14 Members
- 2/day (00,12UTC)
- 3.5 day forecast