Products of operational models

Hu Jiangkai

Hujk@cma.gov.cn

Numerical Weather Prediction Center, CMA

The Main NWP system

Deterministic NWP system

- T639 Global medium-range prediction system
- GRAPES-Meso Short range prediction system
- GRAPES-RUC prediction system
- Tropical cyclone track prediction system

Probability NWP system

- T213 global ensemble prediction system
- WRF-based regional ensemble prediction system

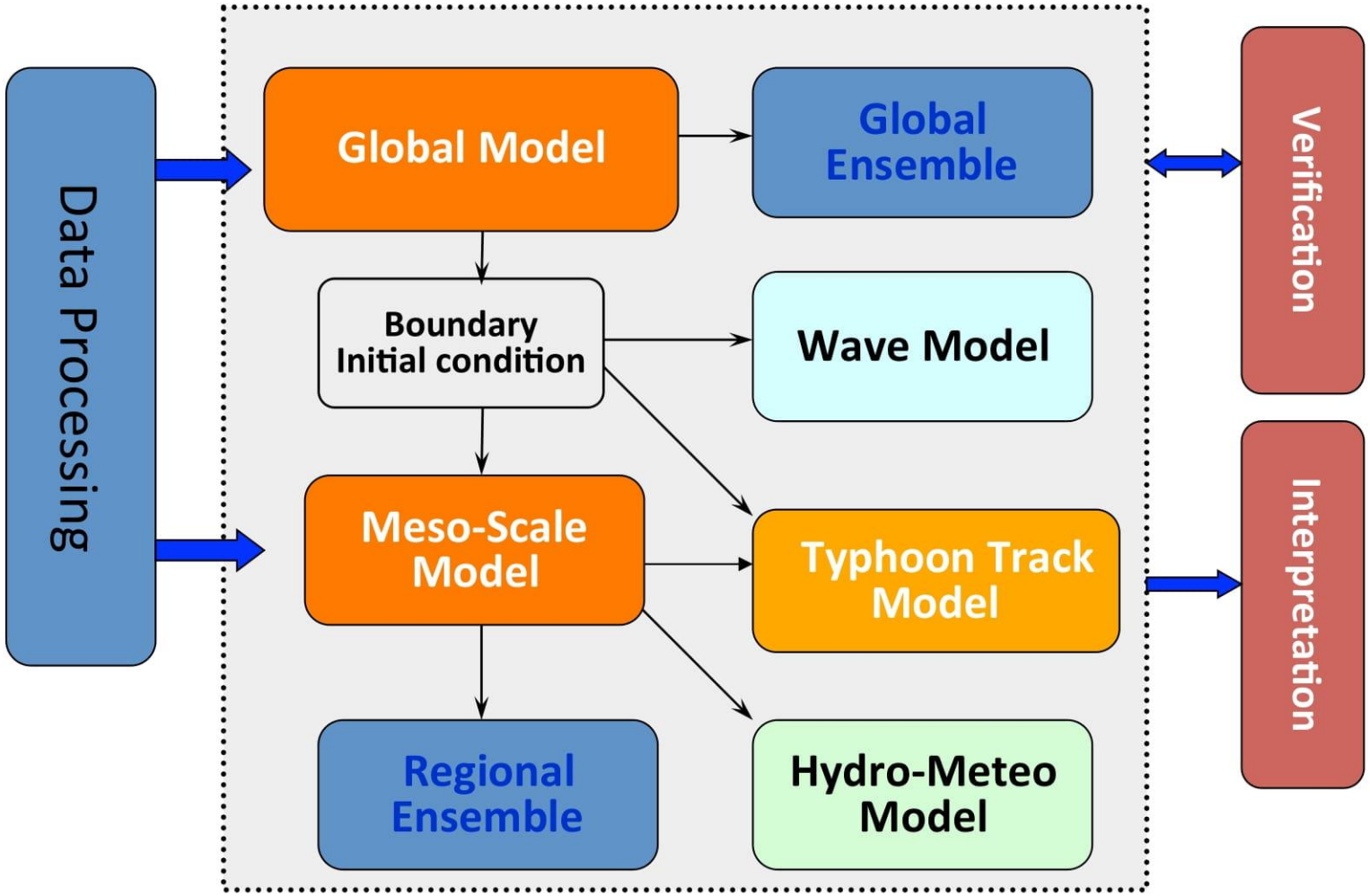
Others

- Specialized atmospheric dispersion model (RSMC Beijing)
- TIGGE Archive Center

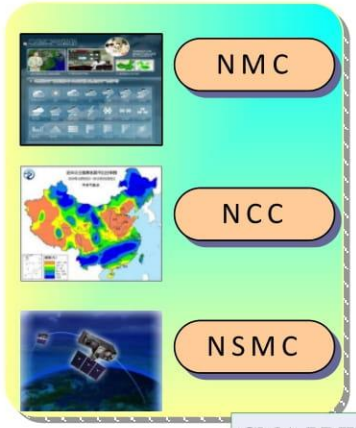
The products focused respects of Numerical Weather Prediction (NWP)system

Model	The focused respects of NWP system
GLOBAL MODEL (T639)	Focused on 1-10 days' evolution of the atmospheric general circulations and the large-scale precipitation, such as the upper trough ridge, subtropical high pressure zone, surface high/low pressure zone, cold/warm front, large-scale rain belt et al.
GRAPES-Meso/ WRF	the Chinese regional, short-term (0-60 hours) forecast of precipitation, such as the zone, strength and of precipitation
Typhoon Model	Focused on the Chinese coastal (western Pacific) typhoon, providing the short-term/medium-term (72-120 hours) forecast of typhoon eye and track, wind and precipitation forecast. In addition, the ensemble forecast products for typhoon are available, including the probability of tracks
T213 Medium-range Ensemble Forecast System	The 1-10 days' forecast products, special for the probability products of atmospheric general circulation and precipitation for 5-10 days' forecast
Regional WRF Ensemble Forecast System	Providing the probability forecast products for regional precipitation and surface meteorological variable products in China
Atmospheric Transportation Model forecast System	NOAA HSYPLIT forced by T639/WRF is used to provide the dispersion products, such as trajectory, concentration, and wet/dry deposition

Structure of NWP System



Operational dissemination

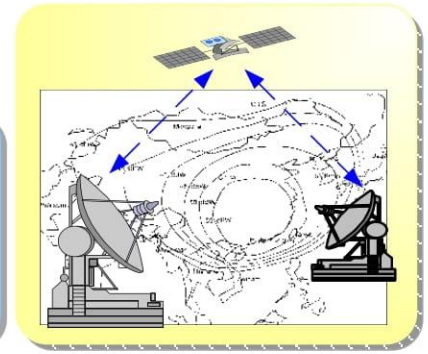


National Operational Cneter

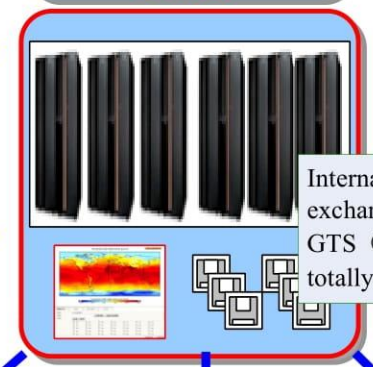
Local net with 1000Mbps

CMACAST covers China and surroundings with 70Mbps

Satellite cast



Numerical Prediction Center

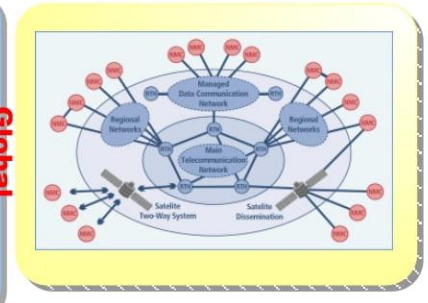


CMA PRIVATE NET with about 10Mbps

Regional/Province Operation Center

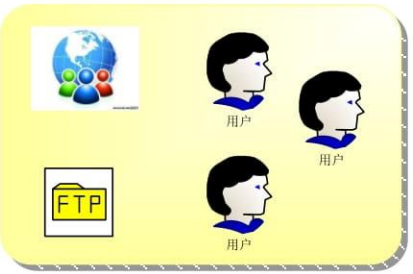
International exchange with GTS（6Mbps totally）

Global Telecommunication System

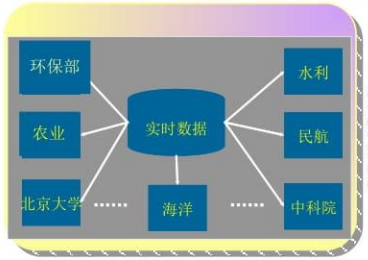


Internet

Global public



Leased line with 100Mbps



National ministries/universities

Human services （calldesk）

Web browse and FTP download by internet

Global medium-range forecasting system
T639L60

The roles of CMA's GFS

- Forecasting of large-scale circulation situation for 1 to 10 days ahead, such as large-scale rainfall , upper trough, Subtropical high pressure, surface high- and low- pressure, cold and warm frontal, large area of rain etc.
- Provide 3hr interval forecasting products to 120hrs
- Provide most products according to the requirement of forecasting and services
- Provide products for driving meso/regional model in NWPC and 8 regional meteorological centers of CMA
- Provide products for driving environment prediction systems in NWPC
  - Global Wave (NCEP WAVEWATCH III)
  - Nuclear Pollution transport and dispersion model system(HYSPLIT4)
  - Regional Dust-Storm Prediction System
  - UV-I ,Forest fire-Alert etc. special systems

T639L60 System

- From July 2007, T639L60 system began experimental operation on the new computing platform——IBM/SP 1600.
- From January 2008, it began quasi-operational running.
- T639L60 system was put into full operation in place of previous operational system (T213L31) on June 1st 2008.
- T639L60 produces routine global analyses for the four main synoptic hours 00, 06, 12 and 18 UTC and global 10-day forecasts based on 00 UTC and 12 UTC,84hours forecasts based on 06,18UTC

Configuration of T639 Global model Forecast system

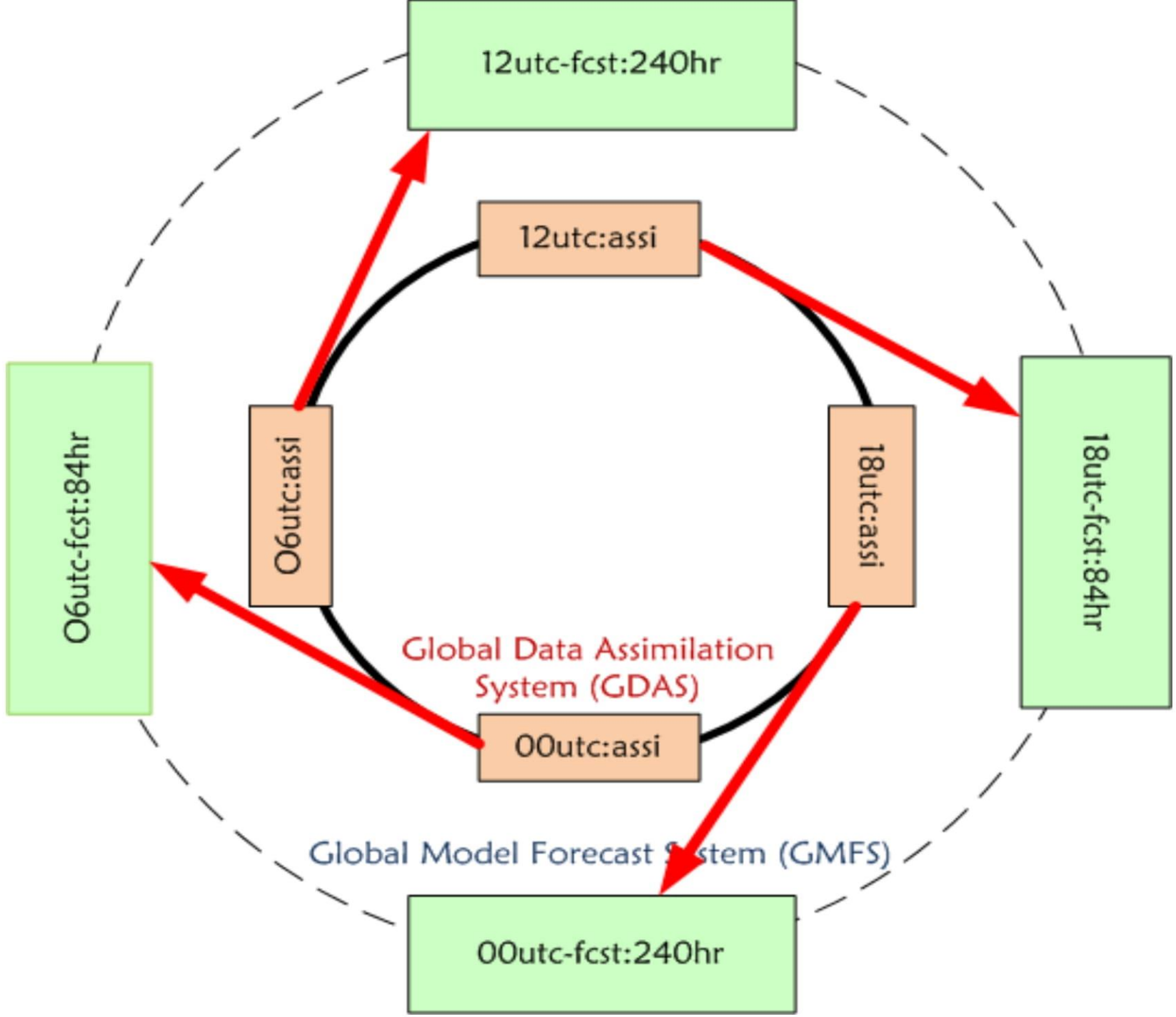
Dynamic	Global Spectral Model (T_L639L60)
Forecast range	Short- and Medium-range forecast
Forecast domain	Global
Horizontal resolution	T_L639(0.28125 deg)
Vertical levels / Top	60 0.1 hPa
Forecast Hours (Initial time)	240 hours (00、12 UTC) 84hours （06、18UTC）
Initial Condition	Global Analysis (NCEP GSI)

T639 DA: GSI/NCEP

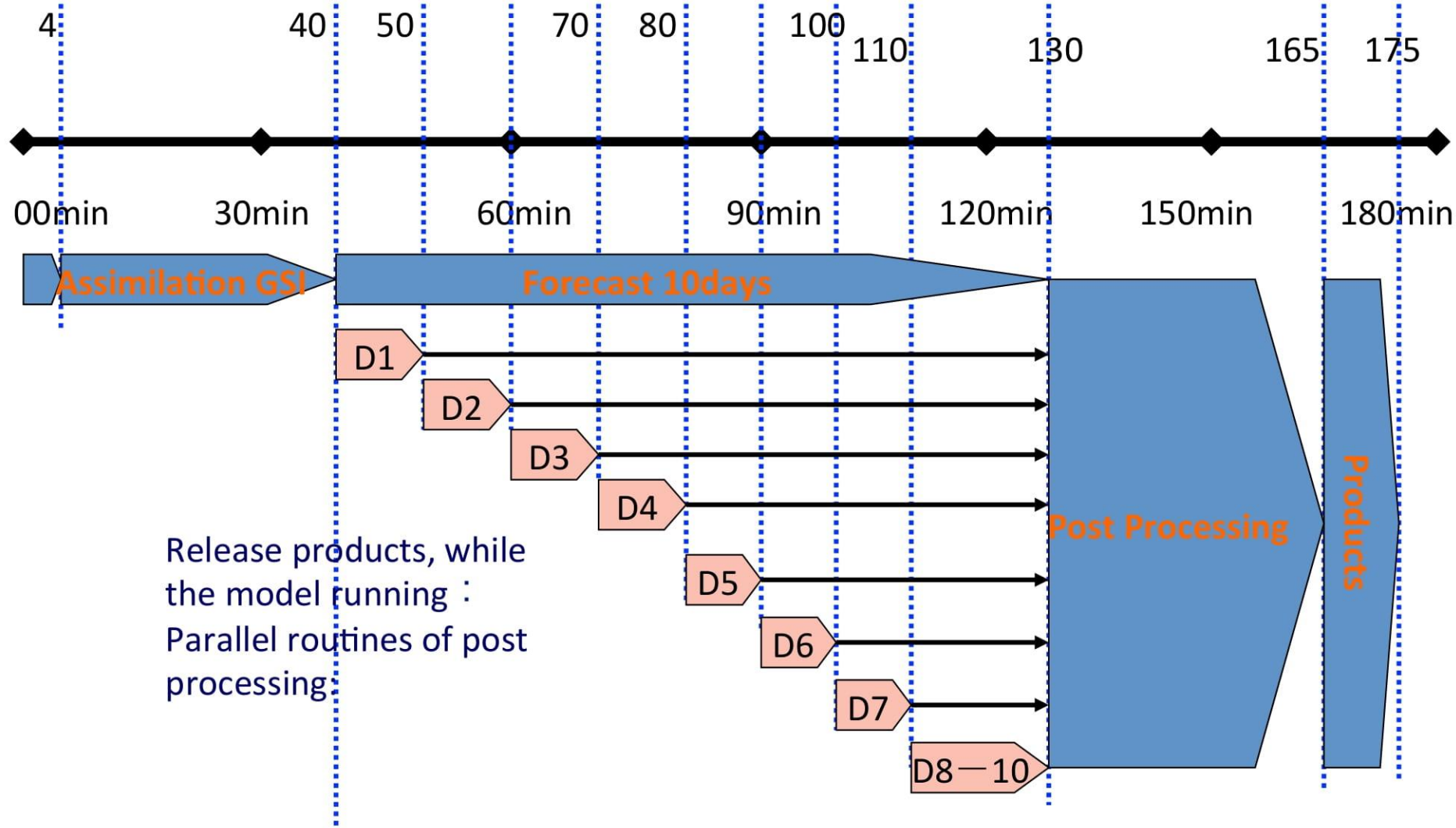
(grid-point statistical interpolation: *Wan-Shu Wu, R. James Purser and David F. Parrish, 2002*)

	Global Analysis
Analysis scheme	GSI 3DVAR
Analysis time	00, 06, 12, 18 UTC
Data cut-off time	3 hours 29 minutes(00, 12 UTC) 5 hours 45 minutes (06, 18 UTC) [Early Analysis] 10 hours (00, 12 UTC) 7 hours 40 minuts (06, 18 UTC) [Cycle Analysis]
Resolution	TL639L60
Assimilation window	-3 hours to +3 hours of analysis time

Conventional data
radiosondes,
aircraft,
synop,
ship,
buoy,
AMVs-Infrared
Satellite data
NOAA-15,-18 AMSUA
NOAA-15, AMSUB
NOAA-18, MHS


12utc-fcst:240hr
12utc:assi
O6utc-fcst:84hr
O6utc:assi
18utc:assi
18utc-fcst:84hr
Global Data Assimilation
System (GDAS)
00utc:assi
Global Model Forecast System (GMFS)
00utc-fcst:240hr

SYSNAME	CUT-OFF TIME (UTC)	RUNNING (UTC)	COMPUTER
(T639L60_GSI)	01:40 （18Z_ASSIM+9HR_FCST）	01:40～02:55	IBM Cluster 1600
	03:30 （00Z_ASSIM +240HR_FCST）	03:30～06:30	IBM Cluster 1600
	10:00 （00Z_ASSIM+9HR_FCST）	10:00～11:15	IBM Cluster 1600
	11:15（06Z_ASSIM+84HR_FCST	11:15～12:45	IBM Cluster 1600
	13:40 （06Z_ASSIM+9HR_FCST）	13:40～15:00	IBM Cluster 1600
	15:30 （12Z_ASSIM +240HR_FCST）	15:30～18:30	IBM Cluster 1600
	22:00 （12Z_ASSIM+9HR_FCST）	22:00～23:15	IBM Cluster 1600
	23:45 （18Z_ASSIM +84HR_FCST）	23:45～01:15	IBM Cluster 1600



Only one and half hours after the starts, the 0-72 hours forecast products are available for users

Performance of T639L60

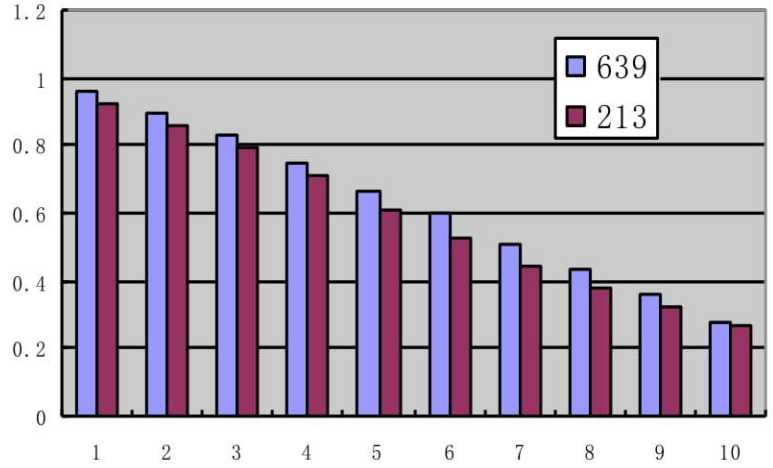
The valid forecast time has been extended 1 more day than that of T213L31(old) system.

- Anomaly Correlation Coefficients(ACC) of the 500-hPa height forecasts:

  The valid forecast time of T639L60 is 7 (6) days in the winter/spring and 6 (5) days in the summer over NH (over EA).

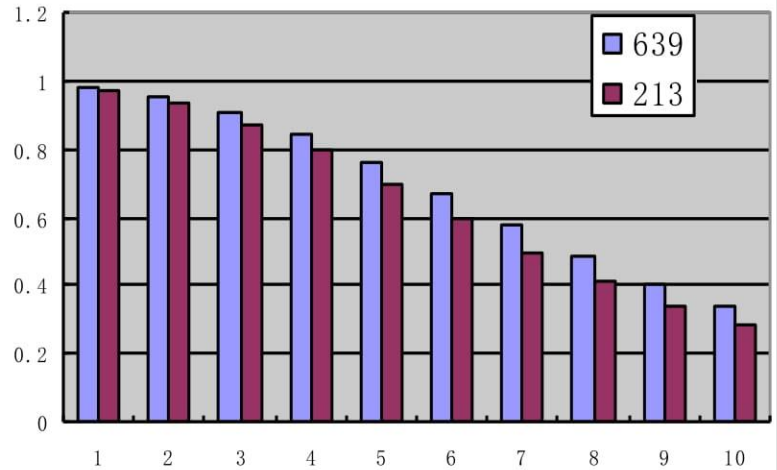
- RMSE of 500-hPa height forecasts decrease through 1 to 10 day forecasting times

East Asia 500hpa ACC



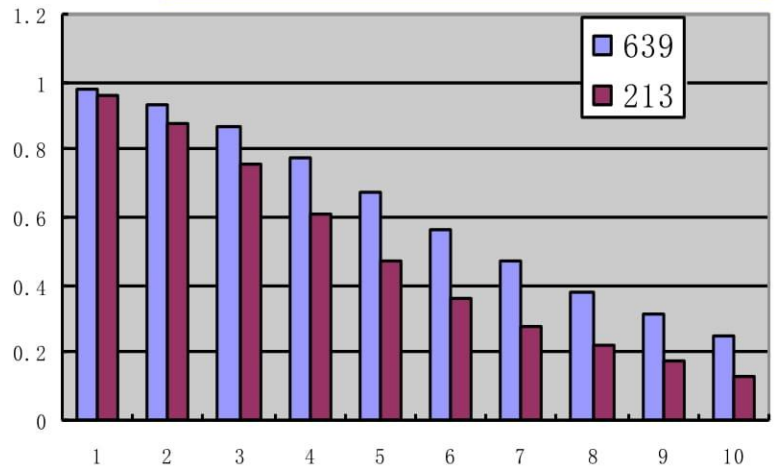
Annual mean

NH 500hpa ACC

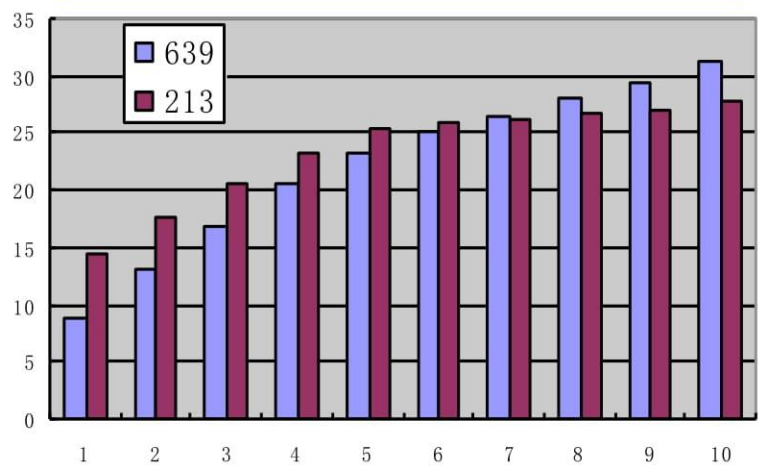


南半球

SH 500hpa ACC



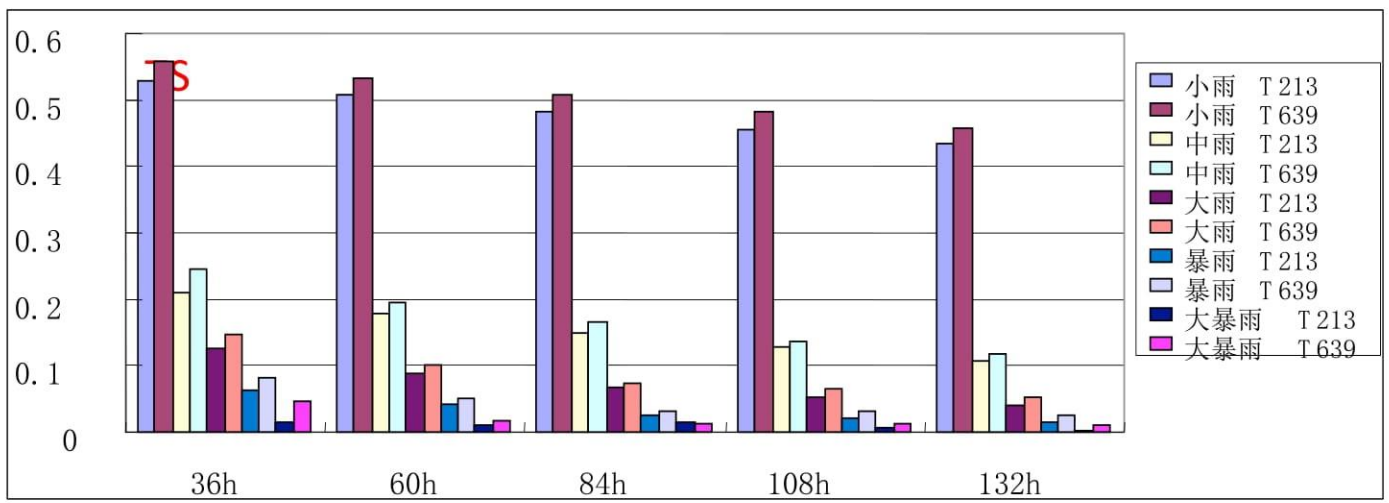
Tropical 500hpa RMSE



Performance of T639L60

Precipitation forecast skill was improved

- Threat Scores (TS) of light rain forecast of T639L60 is 5-10 percent higher than that of T213L31, while bias decreases lightly, which shows that the rainfall region forecast of T639L60 model is improved obviously .



post-processing

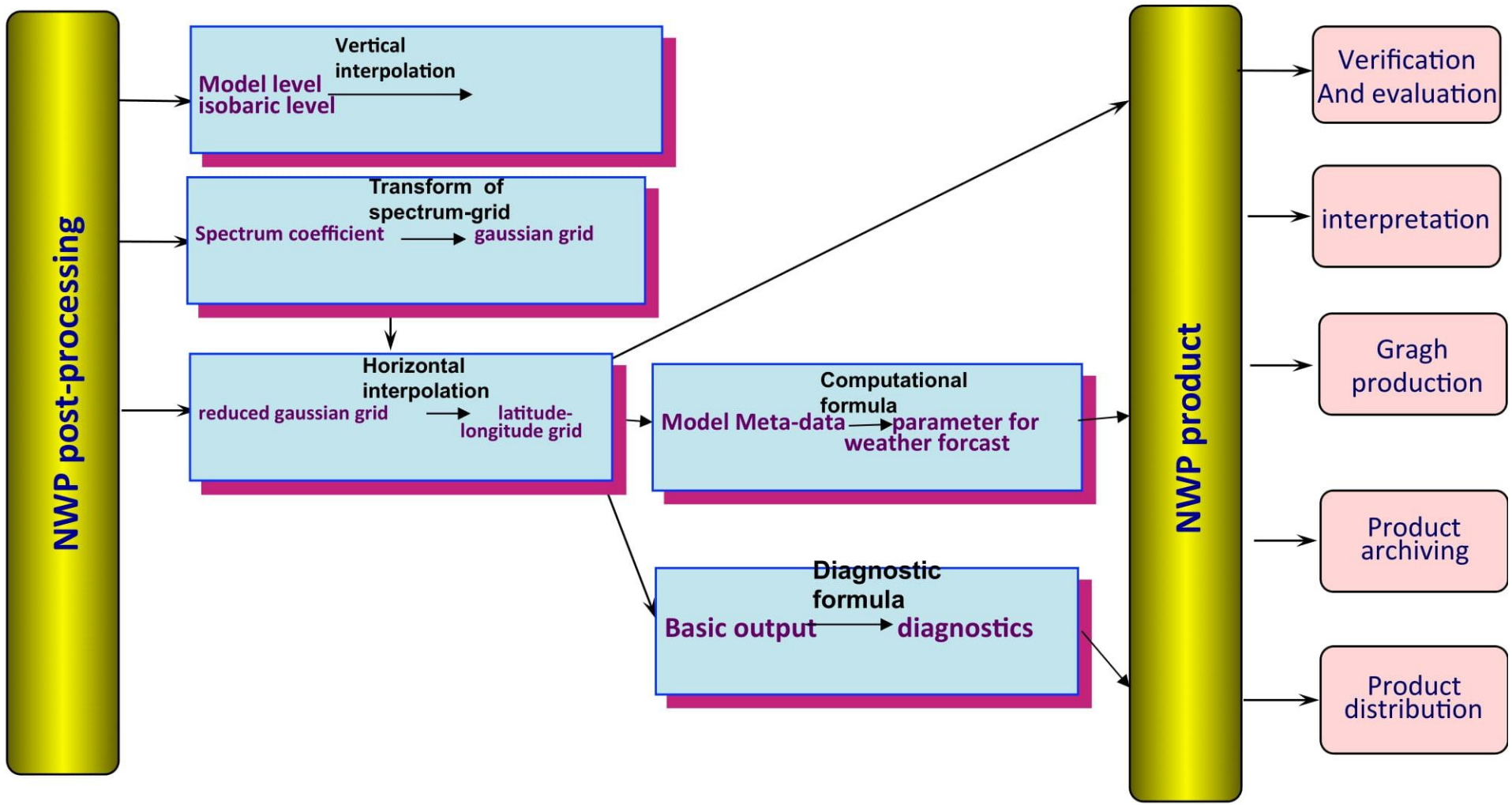
- The meta-data that Model output directly: in 3D scattered grid.

  They need to interpolate to regular latitude-longitude grid and isobaric level.

- And the variables from model output directly : unsuitable for the need of weather forecast.

  They need to transform according to the need(e.g. accumulated precipitation, diagnostics, 24 hours variable temperature)

Process diagram of NWP post-processing and product （e.g.T639）



Post-processing process

Computational formula

Model Meta-data → parameter for weather forcast

- （1） vorticity — U wind
  divergence — V wind
- （2） potential temperature — temperature
- （3） 2m temperature
  2m dewpoint temperature — 2m relative humidity
  surface pressure
- （4） large-scale precipitation — accumulated precipitation
  convective precipitation

Diagnostic formula

Basic output → diagnostics

temperature
wind
specific humidity

→

Temperature advection
Vorticity advection
T-Td
Moisture flux
Moisture flux divergence
Θ se
K-index

Diagnostics caculations

- Model diagnostics can explain quantitatively kinetic and thermodynamic feature of synoptic systems and synoptic processes and provide reliable information for weather forecast.
- Model diagnostics are divided into thermodynamic factor, kinetic factor and moisture factor according to their physics features.

Model diagnostics ---Thermodynamic factor

parameter	**unit**	**Computational formula**
Temperature advection	K/s	$-\vec{V}\cdot\nabla T=-(u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y})$
Total index	℃	$TT=T_{850}+T_{d850}-2T_{500}$
pseudo-equivalent potential temperature **Θse**	K	$\theta_{se}=\theta\exp(\frac{Lq}{C_pT_L})=T\exp(\frac{Lq}{C_pT_L})(\frac{1000}{P})^{R_d/C_p}$ $\frac{L}{Cp}=2500K, T_L=\frac{4715-36D}{17.27-D}, D=\ln\frac{p\cdot q}{3.8}$

Model diagnostics ----Moisture factor

parameter	units	Computational formula
Moisture flux	g/cm·hPa·s	$FH = \frac{1}{g}\lvert\vec{V}\rvert \cdot q = \frac{1}{g}(\sqrt{u^2 + v^2}\, q)$
Moisture flux divergence	g/ cm2·hPa·s	$D_q = \nabla \cdot \mathrm{FH} = \frac{1}{g}\nabla \cdot \vec{V} \cdot q = \frac{1}{g}(\frac{\partial uq}{\partial x} + \frac{\partial vq}{\partial y})$
depression of the dew-point **(T-Td)**	℃	Iterative method

Model diagnostics ----Moisture factor

vorticity advection	1/s2	$A = -\vec{V} \cdot \nabla \zeta - (u \frac{\partial \zeta}{\partial x} + v \frac{\partial \zeta}{\partial y})$
Convective Available Potential Energy (CAPE)	J/kg	$CAPE = g \int_{z_c}^{z_e} \frac{\theta_v'}{\theta_{vs}} d_z$
Convection inhibition energy	J/kg	$CIN = g \int_{z_i}^{z_{LFC}} \frac{T_e - T_p}{T_b} dz$
lifting condensation level (LCL)	hPa	$z = \frac{T(z_i) - T_d(z_i)}{r_d + \frac{dT_d}{dz}}$
Lifting index	℃	LI＝T500－T"
K-index	℃	$K = (t_{850} - t_{500}) + t_{d850} - (t - t_d)_{700}$

Basic NWP model products of Deterministic model (e.g.T639)

No.	parameter	Units	Level(hpa)	Forcast hour	Base Time	Data size
1	Geopotential	M^2s^{-2}	0.1, 0.2, 0.5, 1, 1.5, 2, 3, 4, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 925, 950, 975, 1000.	0，3，6，9，12，15，18，21，24，27，30，33，36，39，42，45，48，51，54，57，60，63，66，69，72，75，78，81，84，	06 18	(1280，641，36） 0°E—360°E， 90°N—90°S。
2	temperature	K				
3	U-velocity	m/s				
4	V-velocity	m/s				
5	Vertical velocity	Pa/s				
6	Vorticity(relative)	s^{-1}		87，90，93，96，99，102，105，108，111，114，117，120，126，132，138，144，150，156，162，168，180，192，204，216，228，240	00 12	
7	Divergence	s^{-1}				
8	Specific humidity	Kg/kg				
9	Relative humidity	%				

Basic NWP model products of Deterministic model ----surface level(T639)

No.	parameter	units	No.	parameter	units	size
10	10m U-velocity	m/s	26	Convective preciritatipn	m	（1280，641） 0°E—360°E 90°N—90°S
11	10m V-velocity	m/s	27	Large scale precipitation	m	
12	2m temperature	K	28	Low cloud cover	0-1	
13	Skin temperature	K	29	Medinm cloud cover	0-1	
14	Mean sea level pressure	Pa	30	High cloud cover	0-1	
15	Surface pressure	Pa	31	Maximum temperature at 2m since previous post-processing	K	
16	2m relative humidity	%	32	Minimum temperature at 2m since previous post-processing	K	
17	Precipitation	mm	33	Surface sensible heat flux	W m-2 s	
18	Soil temperature level 1	K	34	Surface latent heat flux	W m-2 s	
19	Soil temperature level 2	K	35	Surface solar radiation	W m-2 s	
20	Soil temperature level 3	K	36	Surface thermal radiation	W m-2 s	
21	Soil temperature level 4	K	37	Snow fall	m	
22	Soil wetness level 1	m(H_2O)	38	Skin reservior content	m(H_2O)	
23	Soil wetness level 2	m(H_2O)	39	Evaparation	m(H_2O)	

Diagnostic products of T639

No.	parameter	units	Total levels	levels	Forcast hour	Start time	Data size
1	Temperature advection	10^{-6} K/s	6	200，500，700，850，925，1000	0，3，6，9，12，15，18，21，24，27，30，33，36，39，42，45，48，51，54，57，60，63，66，69，72，75，78，81，84，87，90，93，96，99，102，105，108，111，114，117，120，126，132，138，144，150，156，162，168，180，192，204，216，228，240	00，12	（641，321，6）
2	Vorticity advection	10^{-11} /s^2	6				
3	T-Td	10^{-1} °C	4	500，700，850, 925			（641，321，4）
4	Moisture flux	10^{-1} g/cm·hPa·s	4				
5	Moisture flux divergence	10^{-7} g/cm^2·hPa·s	4				
6	Θse	K	4				
7	K-index	°C	1				（641，321）

Diagnostic products for severe weather forecasts

parameter		units	time	Forecast length	Data size
Sweat index	SWEAT		00 12	000, 003, 006, 012, 018, 021, 024, 027, 030, 036, 039, 042, 045, 048	Resolution: 0.28125°×0 .28125°
Convective Available Potential Energy	CAPE	J/Kg			
Convection inhibition energy	CIN	J/Kg			
Lifting index	LI	ºC			
lifting condensation level	PC	hPa			
Total index	TTI	ºC			
Height of Zero degree	ZHT	m			

graphics products on web

area		Output time			Output time
North hemisphere	200hpa height	0, 12, 24, 36,48,60, 72,84,96, 108,120, 144,168, 192,216, 240	Eastern Asia（10N—60N, 60E—140E）	500hpa height＋850hpa wind	（000,003 ,006,009,0 12,015,01 8,021,024, 027,030,0 33,036,03 9,042,045, 048,051,0 54,057,06 0,072,084, 096,108,1 20,132,14 4,156,168, 192,216,2 40)
	850hpa temperature			850hpa relative humidity＋ 850hpa wind	
	200hpa specific humidity＋ 200hpa wind field			700hpa streamline	
	Sea level pressure			K-index	
Asia Europe(20E-170E, 0N-70N)	500hpa height＋slp	0, 6,12, 18,24, 30,36,42, 48,54,60, 66,72,84, 96,108,12 0,132,144 156,168,		700hpa、 850hpa relative humidity	
	500hpa height＋500hpa temperature			500hpa、 850hpa temperature advection	
	500hpa height＋850hpa wind			500hpa vorticity advection	
	700hpa specific humidity＋ 700hpa wind			500hpa、 850hpa vorticity	
	850hpa specific humidity＋ 850hpa wind			700hpa、850hpa Θse	
				700hpa、850hpa moisture flux	
	500hpa height＋slp			700hpa、850hpa moisture flux divergence	
	Sea level pressure			500、700、850hpavertical velocity	
	700hpa、 850hpa wind field				

文件(F) 编辑(E) 查看(V) 收藏(A) 工具(T) 帮助(H)

后退 搜索 收藏夹

地址(D) http://www.nmc.gov.cn/publish/nwp/t639/ea/500hPa-hgt-850hPa-wind.htm 转到 链接

紫光华宇 输入想要搜索的内容 搜索

- 气象灾害预警
- 天气实况
- 强对流天气预报
- 1-3天降水量预报
- 高温雾霾预报
- 降温大风沙尘预报
- 台风
- 台风实时路径显示
- 中期天气预报
- 城市天气预报
- 国外天气预报
- 海洋气象
- 农业气象
- 水文气象
- 交通气象
- 地质灾害
- 环境气象
- 航空气象
- 文字产品
- 数值预报
  - T639L60
  - GRAPES_MESO
  - T213集合预报

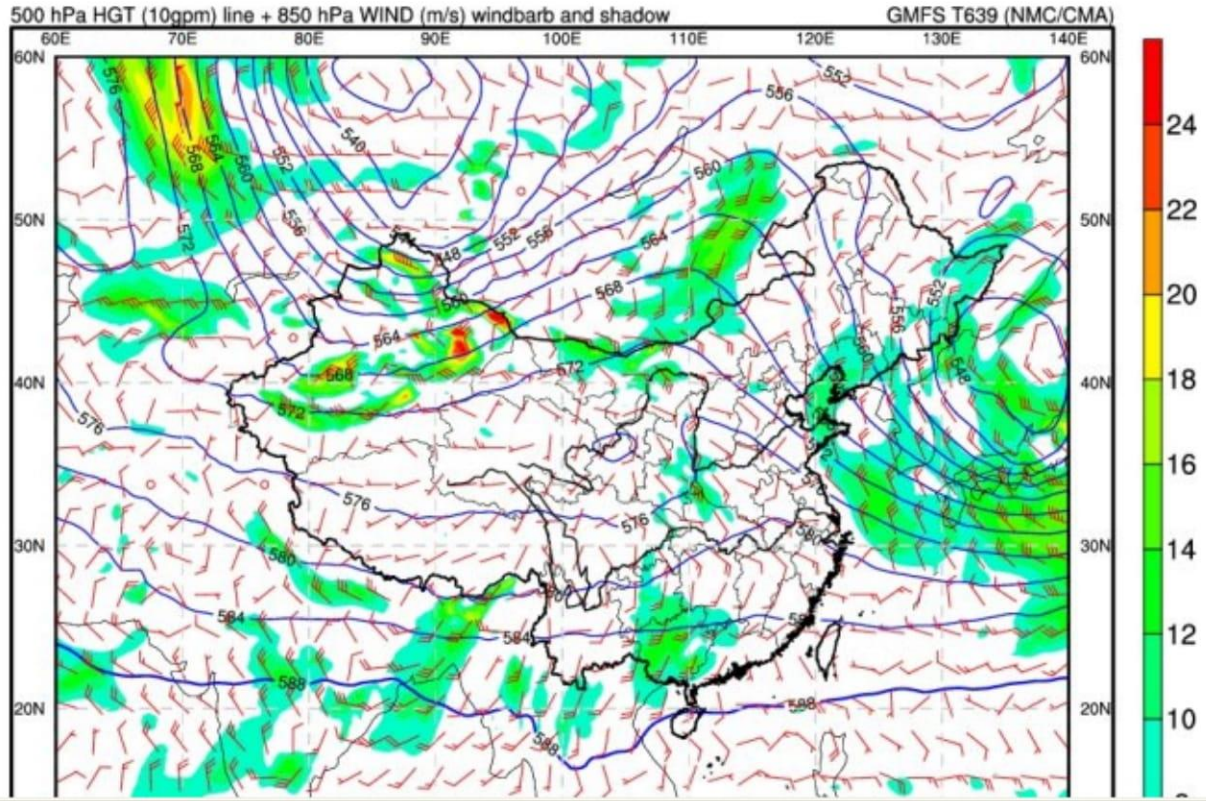
北半球 亚欧 东亚

500hpa高度+海平面气压 海平面气压 700hpa 风场

850hpa 风场 500hPa高度场+850hPa风场 500hPa高度场 点击更多↓

00 12 预报时效 >> 000

1秒 播放 上一张 下一张 打印 放大

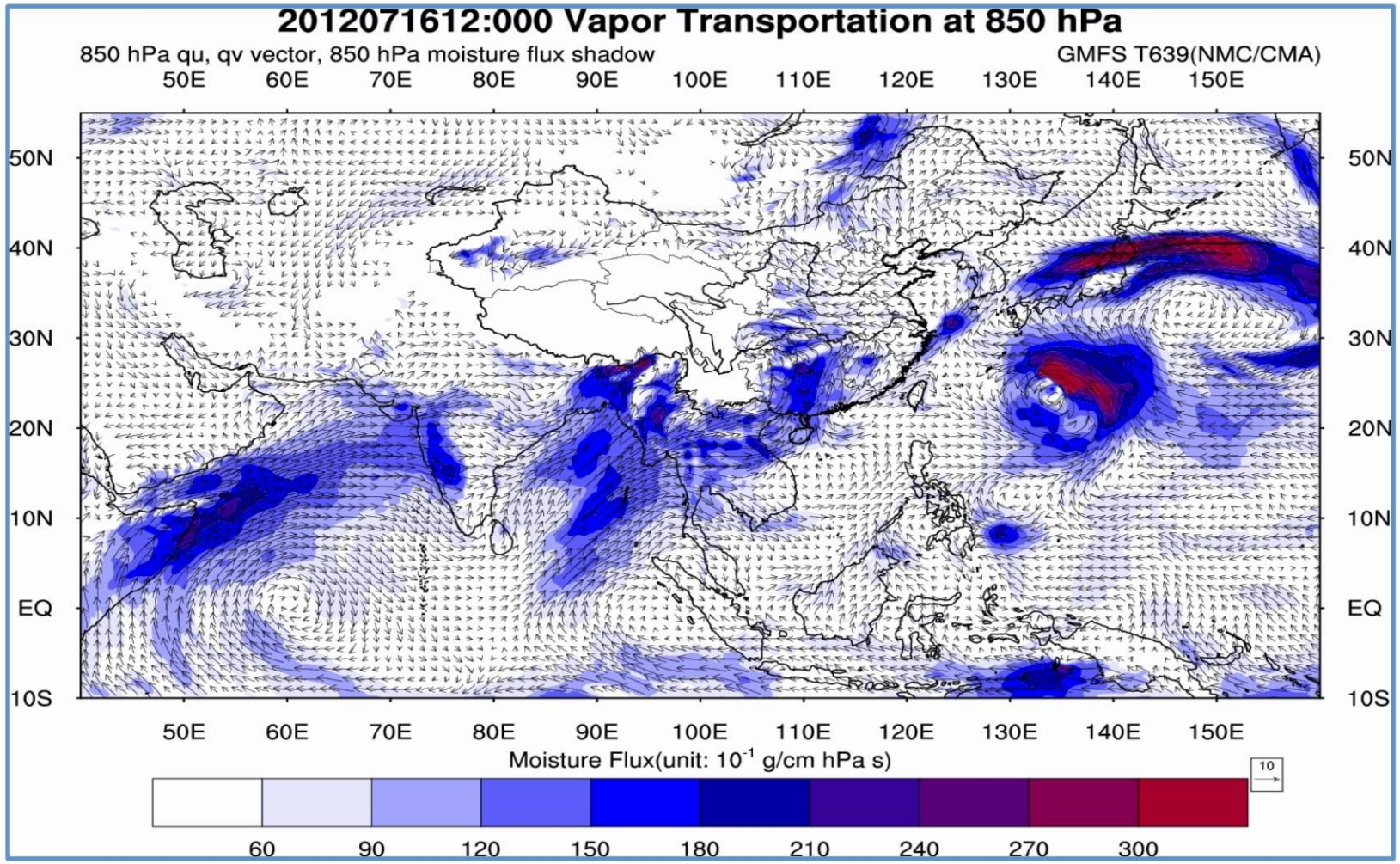


http://www.nmc.gov.cn/publish/observations/index.htm Internet

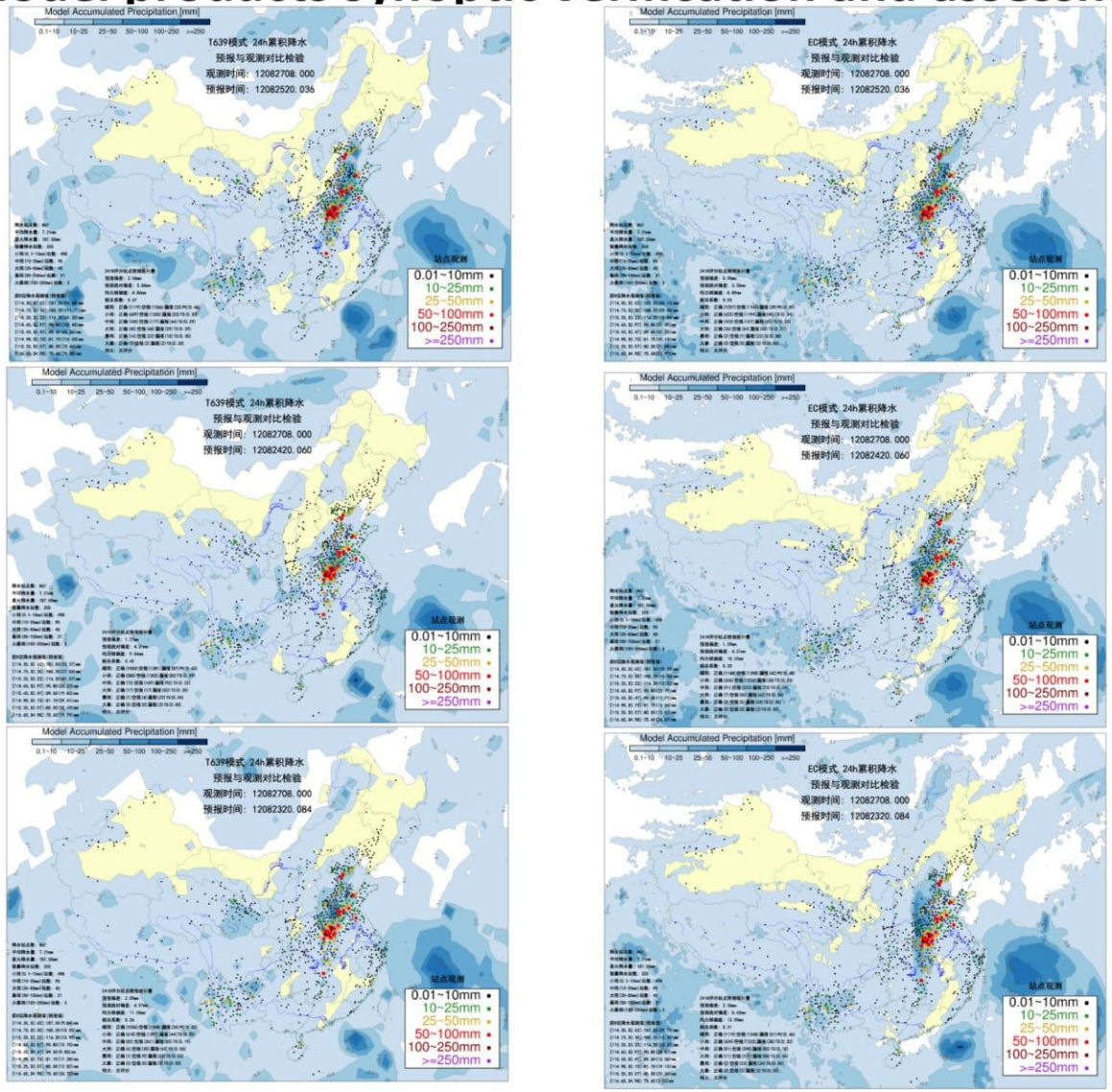
开始 2 SecureCR... 2 Windows ... 2 Internet... 3 Microsof... MICAPS 3.1 13:59

http://www.nmc.gov.cn/publish/nwp/t639/ea/850hPa-evt.htm

Vapor Transportation



Forecaster evaluation products
-model products synoptic verification and assessments(NMC)



T639（left column）、EC（right column）36h（top row）、60h（middle row）、84h（bottom row）8.26.08～8.27.08 daily accumulated precipitation forecasts(mm)。shaded line is for forecasting, dot is for station observation

GRAPES_Meso
short-range prediction system

- **GRAPES_Meso 3.0: 72 hour forecast (00,12UTC) over East Asia**
  - **GRAPES_Meso 15km L31 with model top at 10 hPa**
    - **Radiation: RRTM LW & Dudhia SW**
    - **Cumulus: Betts-Miller-Janjic**
    - **Grid-scale precipitation: WSM-6**
    - **Cloud: Xu & Randall diagnostic cloud**
    - **Land surface: NOAH**
    - **PBL: MRF PBL**
  - **GRAPES_3DVAR 15km, model grid space, incremental analysis**
  - **Assimilated Obs.**
    - GTS conventional data 89 + other 31 radio-sonde
    - 2400 surface obs.

SYSNAME	CUT-OFF TIME (UTC)	RUNNING (UTC)	COMP
(GRAPES)	04:15(00Z_ ASSIM +60HR_.FCST)	04:20～05:40	IBM Cluster 1600
	13:40(06Z_ ASSIM)	13:45～13:55	IBM Cluster 1600
	16:50(12Z_ ASSIM +60HR_.FCST)	16:55～18:15	IBM Cluster 1600
	22:30(18Z_ ASSIM)	22:35～22:40	IBM Cluster 1600

Archive data of regional product table

No.	parameter	units	level	Forcast hour	Base time	Forcast region
1	height	m	50 70 100 150 200 250 300 400 500 700 850 1000	00,03,06,09,12,18, 21,24,27,30,33,36,3 9,42,45,48,51,54,57, 60	00 12	¥ 64¥N—15¥N 70¥E--145¥E
2	temperature	K				
3	U-velocity	m/s				
4	V-velocity	m/s				
5	Verticel velocity	m/s	500 700 850			
6	Vorticity	s^{-1}	200 300 500 700 850			
7	Divergence	s^{-1}				
8	Relative humidity	%	300 400 500 700 850 1000			

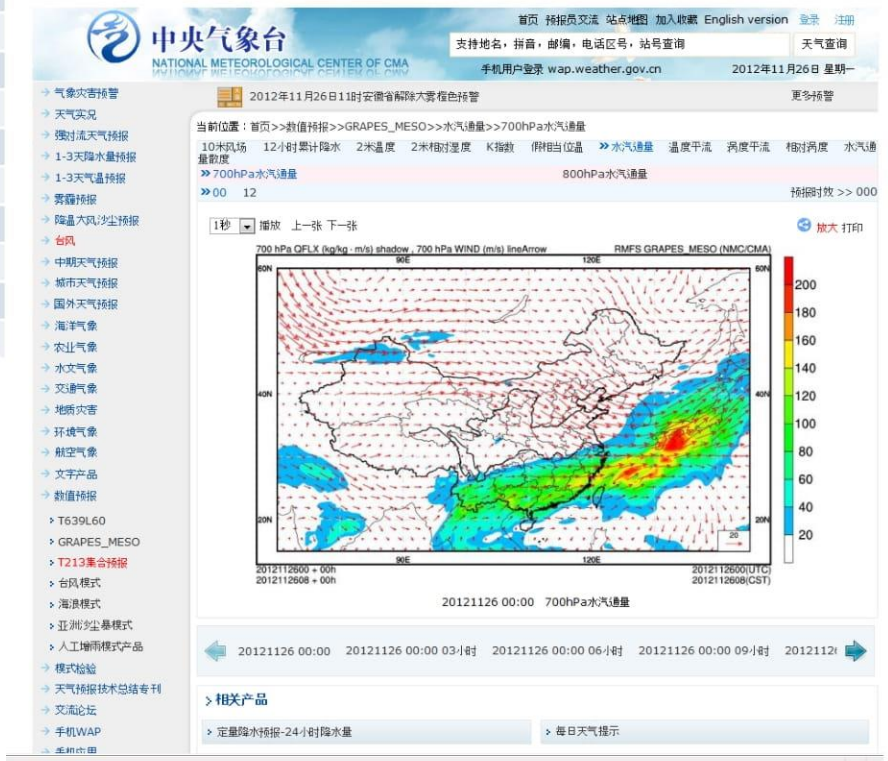
Archive data of regional product table

No.	parameter	units	Level(hpa)	Forcast time	Base time	Forcast rigion
1	Surface pressure	hpa		00,03,06,09,12,18,21,24,27,30,33,36,39,42,45,48,51,54,57,60	00，12	64°N—15°N 70°E--145°E
2	Mean sea level pressure	hpa				
3	T-td	K	500，700，850，			
4	Moisture flux	kg/kg*m/s				
5	Moisture flux divergence	kg/kg*1/s				
6	Theta_se	K				
7	Surface temperature	°C				
8	Accumulate precipitation	mm				

graphics products on web

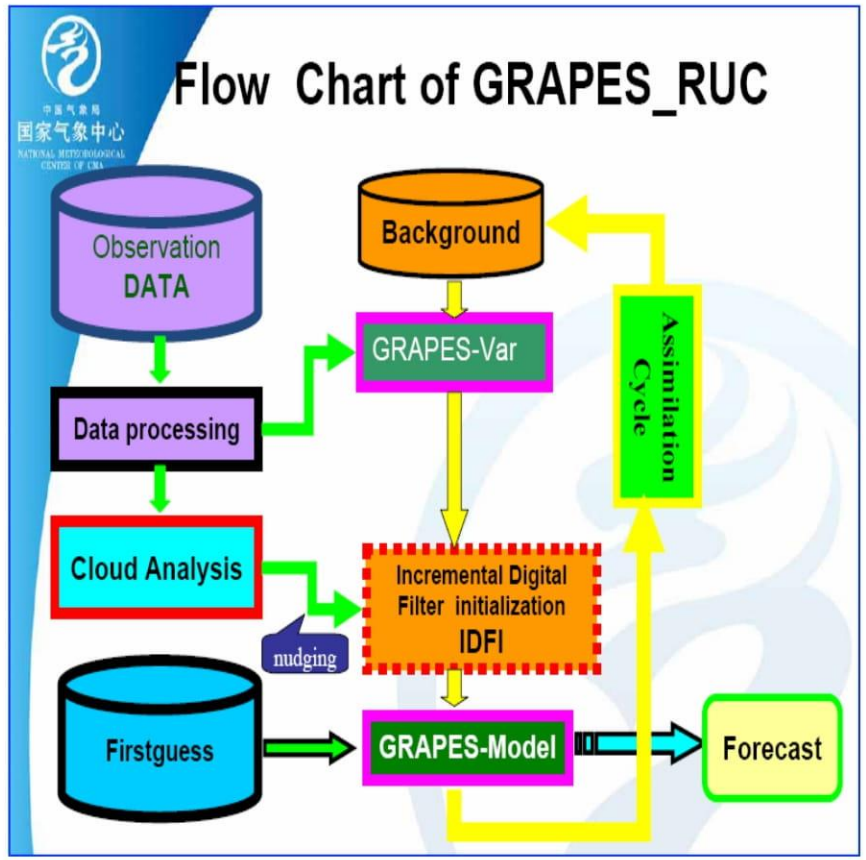
http://www.nmc.gov.cn/publish/nwp/grapes/

Chinese regional maps	K Index
	700hPa Pseudo-equivalent potential temperature
	850hPa Pseudo-equivalent potential temperature
	700hPa Water vapor flux divergence
	850hPa Water vapor flux divergence
	700hPa Water vapor flux
	850hPa Water vapor flux
	12h Accumulated precipitation
	2m Relative humidity
	500hPa Thermal advection
	850hPa Thermal advection
	2m Temperature
	500hPa Eddy advection
	850hPa Eddy advection
	500hPa Relative eddy
	850hPa Relative eddy
	10m Wind



GRAPES_RUC
Rapid Updated Cycle

- **GRAPES_RUC**: heavy-rainfall warning & disaster reduction
  - GRAPES_Meso 15km L31
  - GRAPES_3DVAR (model grid space)
  - 3-hourly cycle
  - 12 hour forecast (03,06,09,15,18,21UTC)
  - 24 hour forecast (00,12UTC)
  - GTS, local radio sonde, Doppler radar VAD, AWS, GPS/PW, FY-2C/2D cloud drift wind
  - Cloud analysis based on radar reflectivity



SYSNAME	CUT-OFF TIME (UTC)	RUNNING (UTC)	COMP
（GRAPES_RUC)	01:30(00Z_ASSIM+24HR_FCST)	01:30～03:00	IBM Cluster 1600
	04:30(03Z_ASSIM+24HR_FCST)	04:30～06:00	IBM Cluster 1600
	07:30(06Z_ASSIM+24HR_FCST)	07:30～09:00	IBM Cluster 1600
	10:30(09Z_ASSIM+24HR_FCST)	10:30～12:00	IBM Cluster 1600
	13:30(12Z_ASSIM+24HR_FCST)	13:30～15:00	IBM Cluster 1600
	16:30(15Z_ASSIM+24HR_FCST)	16:30～18:00	IBM Cluster 1600
	19:30(18Z_ASSIM+24HR_FCST)	19:30～21:00	IBM Cluster 1600
	22:30(21Z_ASSIM+24HR_FCST)	22:30～24:00	IBM Cluster 1600

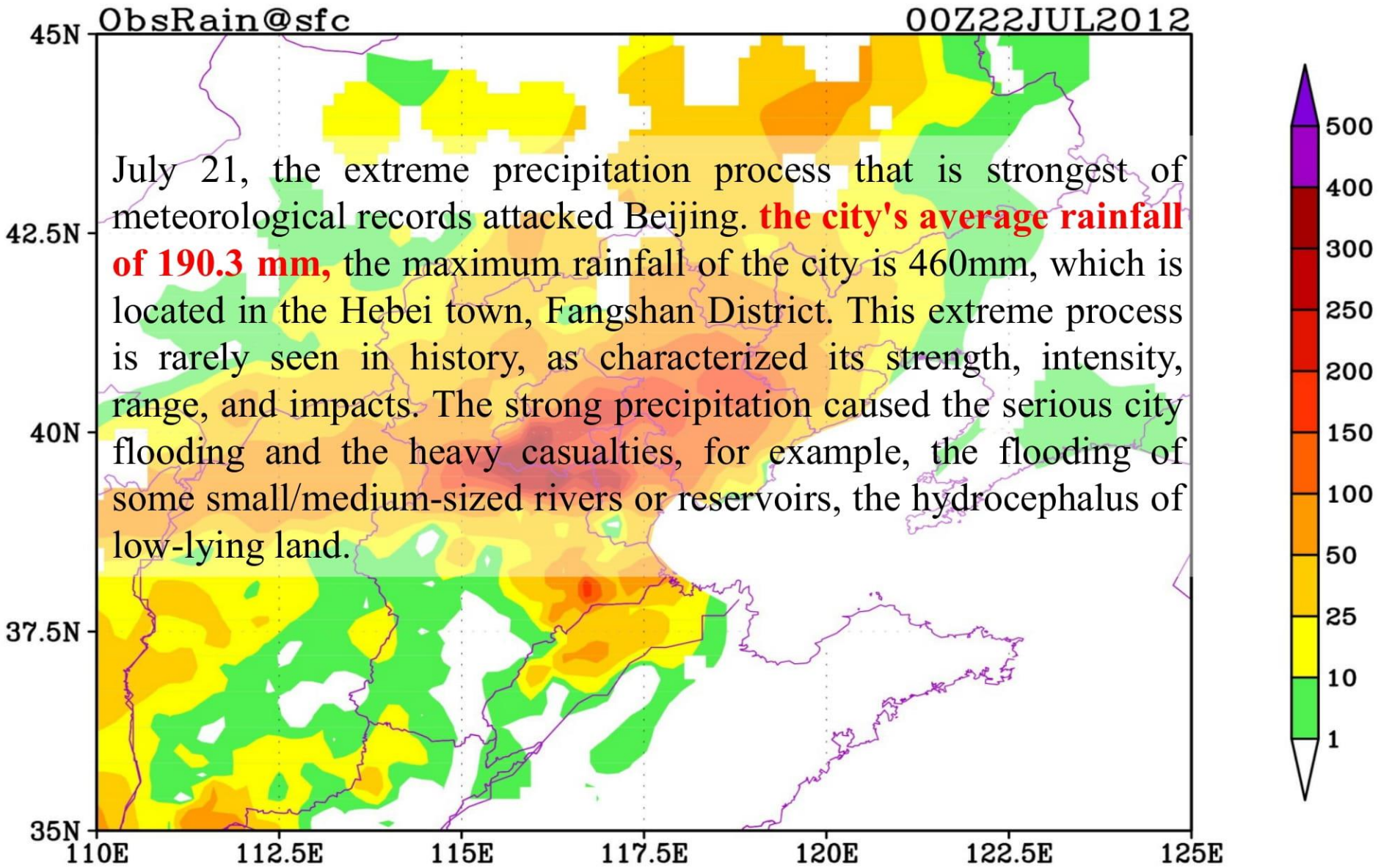
Diagnostic products listing of **GRAPES_RUC** system

Products	Units	Level
Equivalent potential temperature	K	10hPa, 20 hPa, 30 hPa, 50 hPa, 70 hPa, 100 hPa, 150 hPa, 200 hPa, 250 hPa, 300 hPa, 400 hPa, 500 hPa, 600 hPa, 700 hPa, 850 hPa, 925 hPa, 1000 hPa
dew point temperature	℃	Same as above
dew point temperature difference	℃	Same as above
vorticity	s^{-1}	Same as above
divergence	s^{-1}	Same as above
water vapor flux	$g \cdot cm \cdot hPa^{-1} \cdot s^{-1}$	500 hPa, 700 hPa, 850 hPa , 925 hPa
vapor flux divergence	$g \cdot cm^{2} \cdot hPa^{-1} \cdot s^{-1}$	Same as above
temperature advection	$10^{-5}℃ \cdot s^{-1}$	Same as above
Lapse rate of equivalent potential temperature	$℃ \cdot km^{-1}$	From 850hPa to 500hPa
vertical wind shear	$m \cdot s^{-1} km^{-1}$	0-1km, 0-3km, 0-6km
reflectivity	dBz	
composite reflectivity	dBz	
Convective available potential energy CAPE index	$J \cdot Kg^{-1}$	
Convective inhibition of energy	$J \cdot Kg^{-1}$	
K index	℃	
Severe weather threat index	dimensionless	
storm relative helicity	$m^{2} \cdot s^{2}$	
Lifting condensation level(LCL)	hPa	
condensation temperature	℃	
Conditions - convective stability index	℃	
Ground Frontogenesis	$10^{-11} K \cdot hPa^{-1} \cdot S^{-3}$	

App of the products(GRAPES-MESO,GRAPES-RUC)

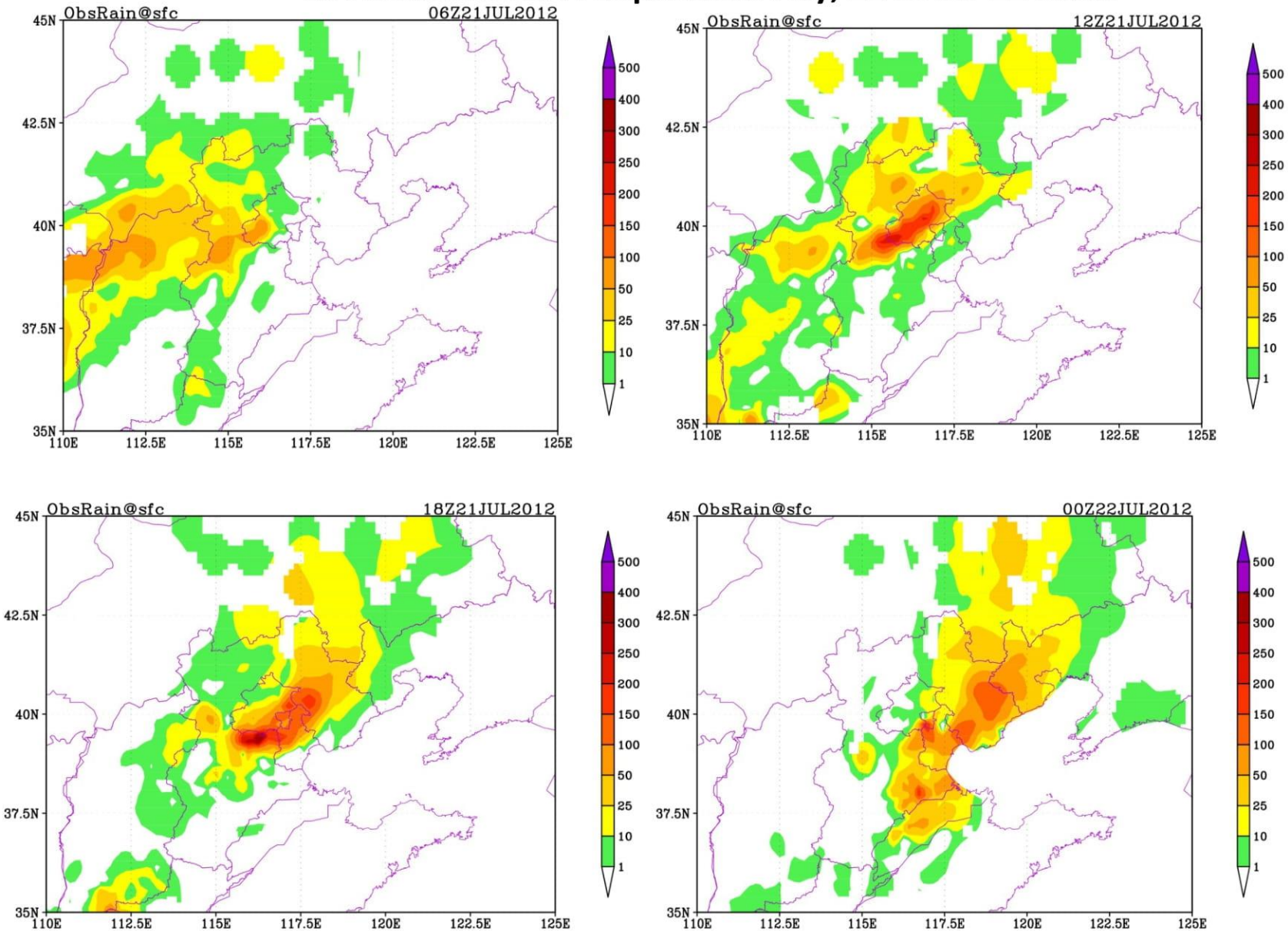
- The extreme heavy rain on 21,July 2012

24h Accumulated Precipitation: July, 21 08:00—22, 08:00



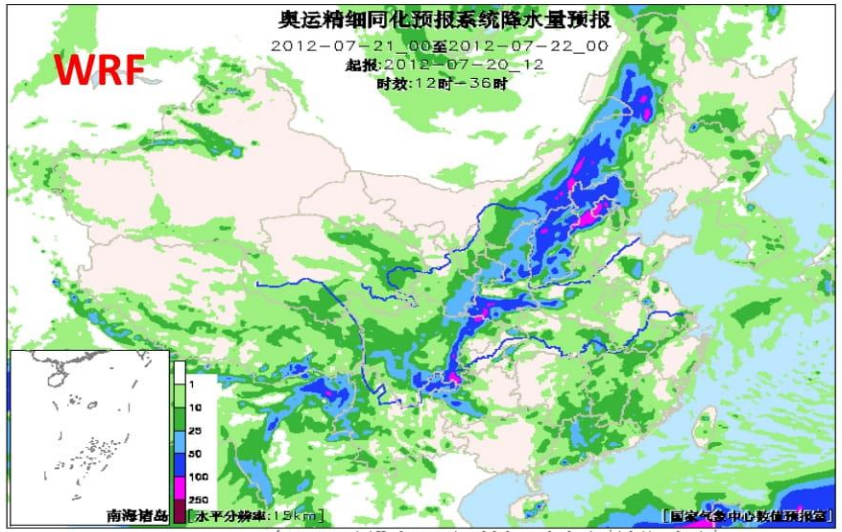
July 21, the extreme precipitation process that is strongest of meteorological records attacked Beijing. **the city's average rainfall of 190.3 mm,** the maximum rainfall of the city is 460mm, which is located in the Hebei town, Fangshan District. This extreme process is rarely seen in history, as characterized its strength, intensity, range, and impacts. The strong precipitation caused the serious city flooding and the heavy casualties, for example, the flooding of some small/medium-sized rivers or reservoirs, the hydrocephalus of low-lying land.

6h Accumulated Precipitation: July, 21 08:00-22 08:00

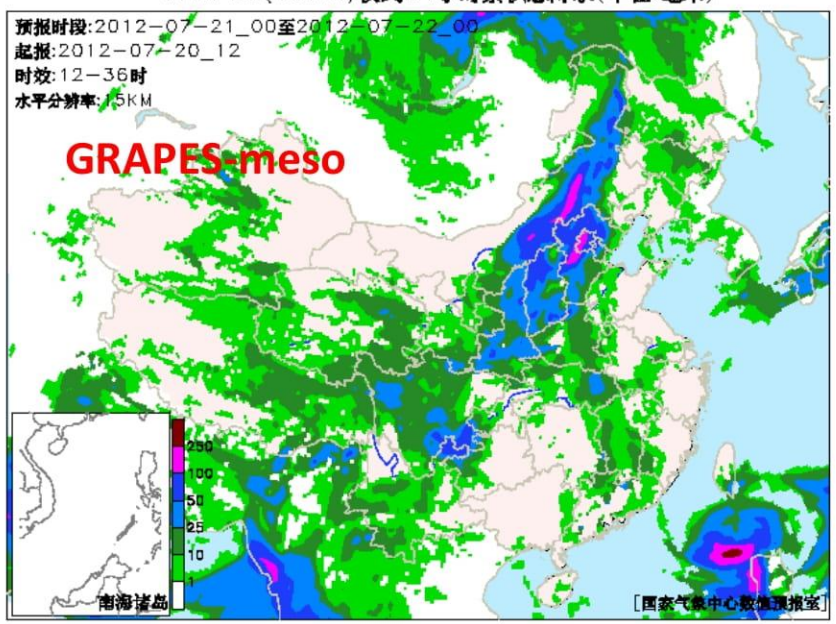


The comparison of Medium-range model WRF and GRAPES-MESO forecast

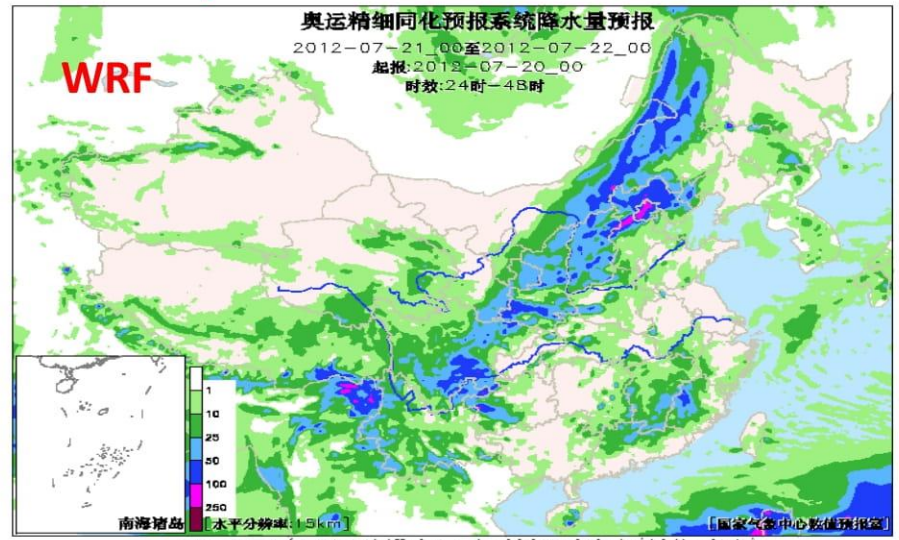
24h Precipitation



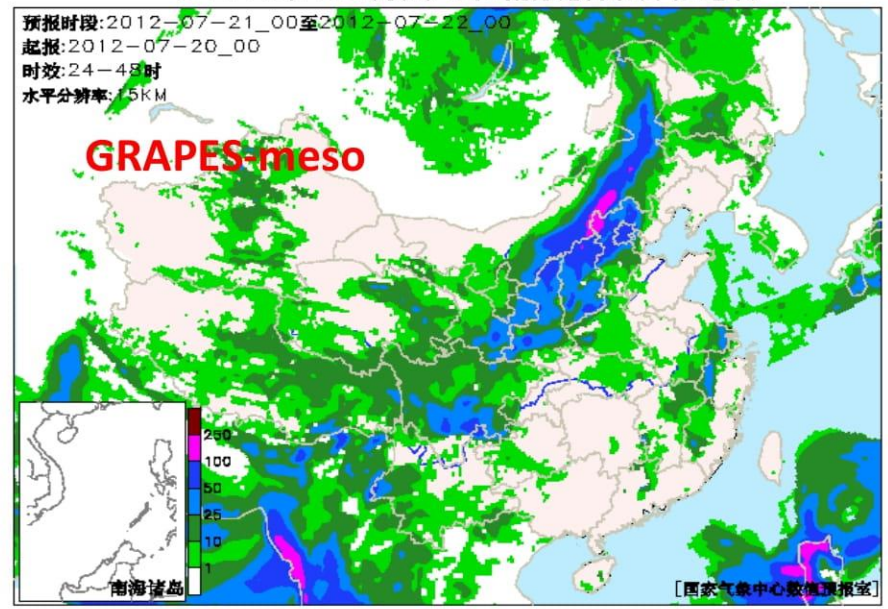
GRAPES(15KM)模式24小时累积总降水(单位:毫米)



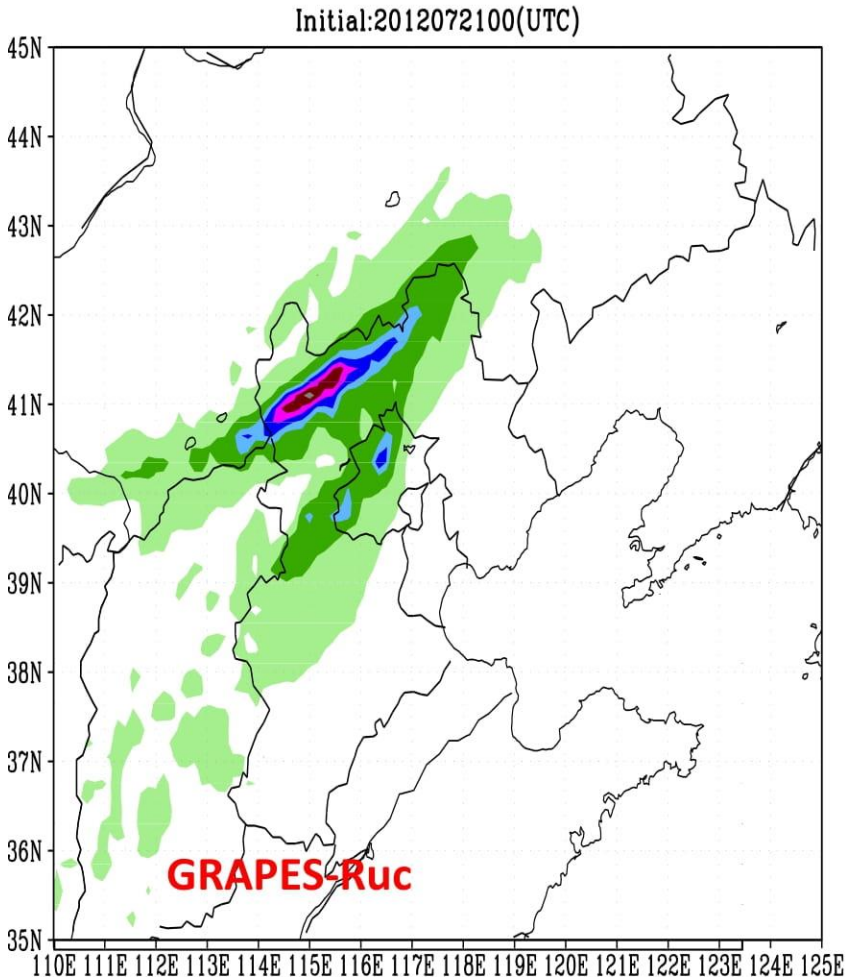
48h Precipitation

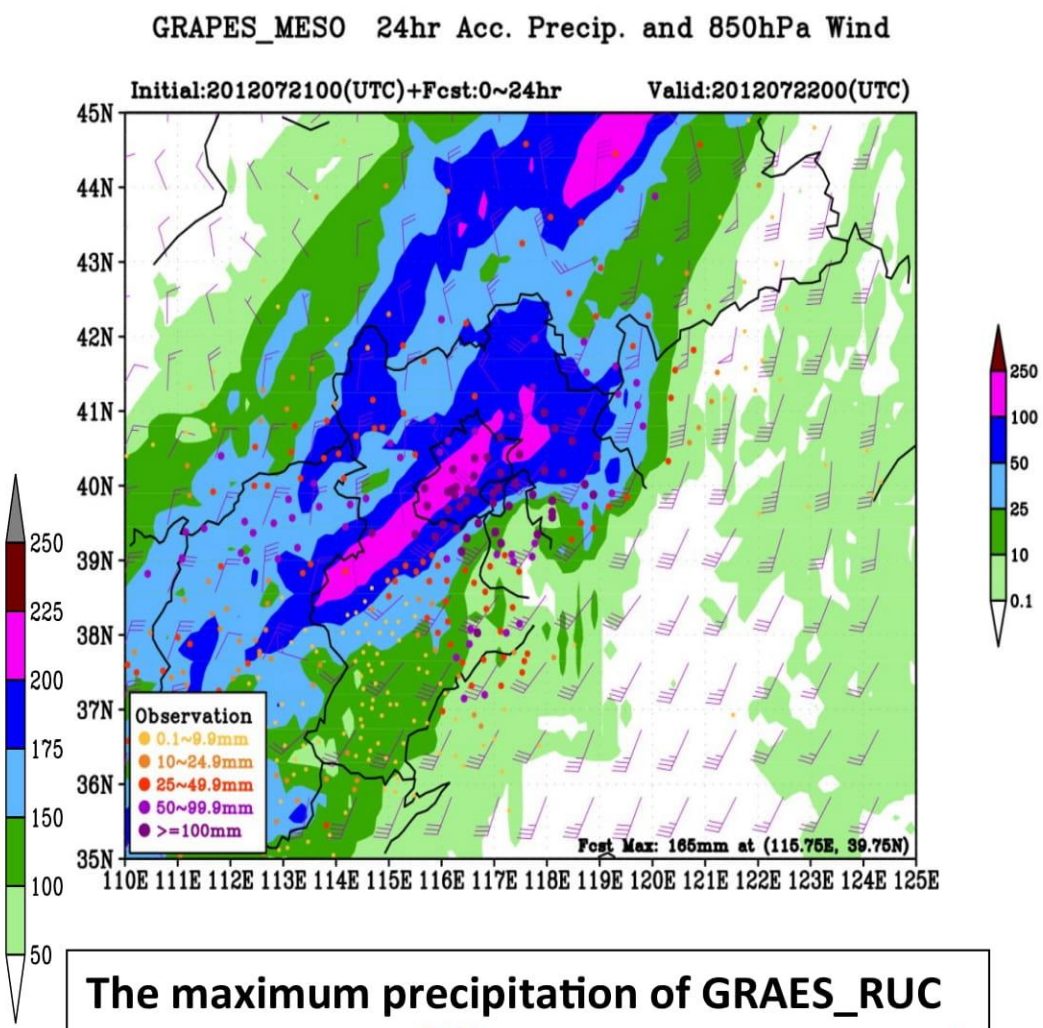


GRAPES(15KM)模式24小时累积总降水(单位:毫米)



The comparison of Medium-range model GRAPES_RUC and GRAPES-MESO forecast

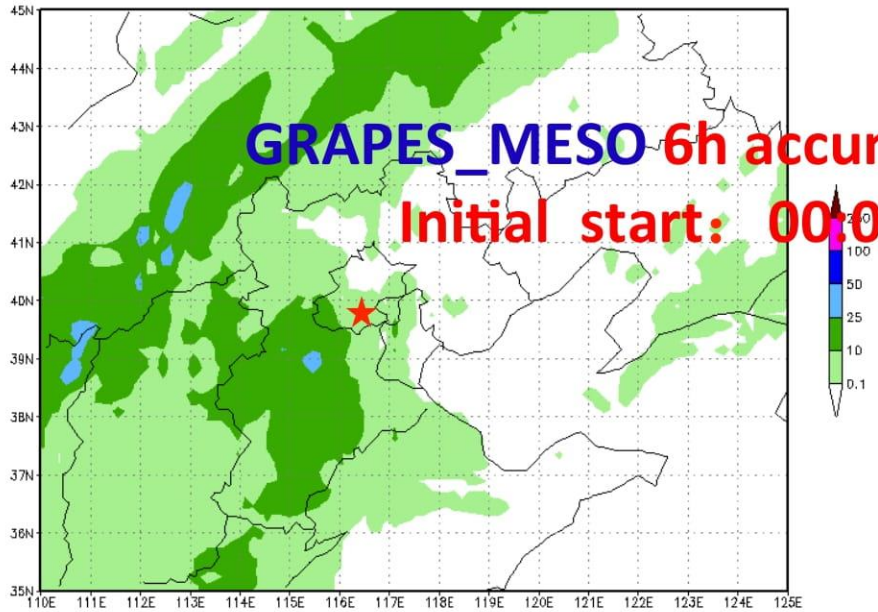


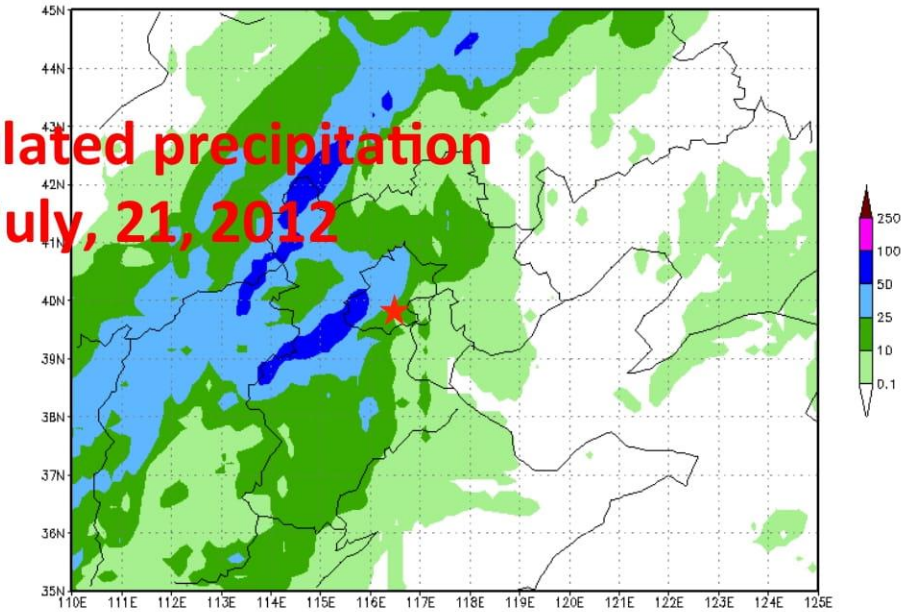


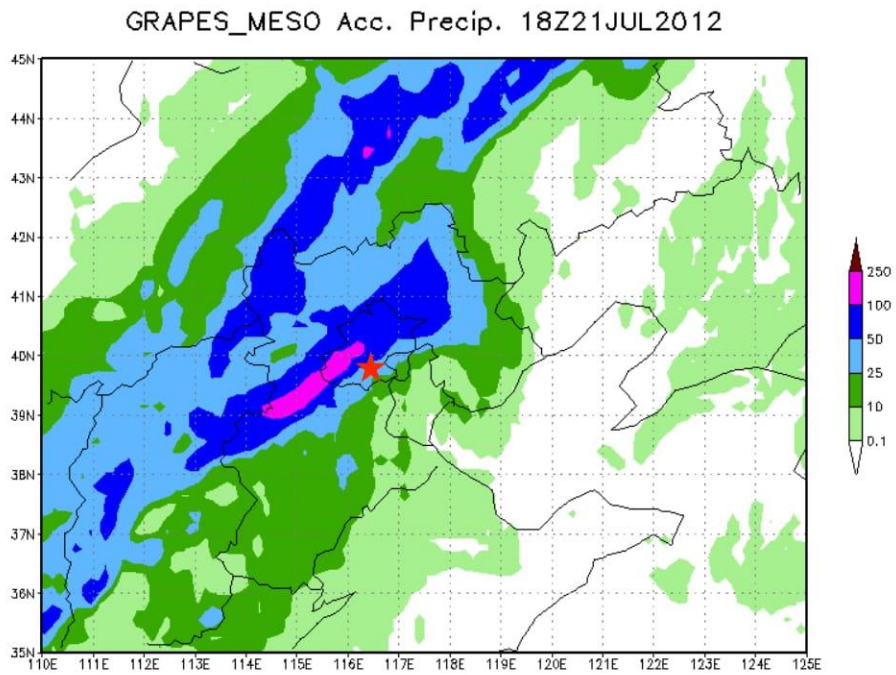
The maximum precipitation of GRAES_RUC products is over 260mm， and the averaged accumulated precipitation for Beijing is also over 175mm.

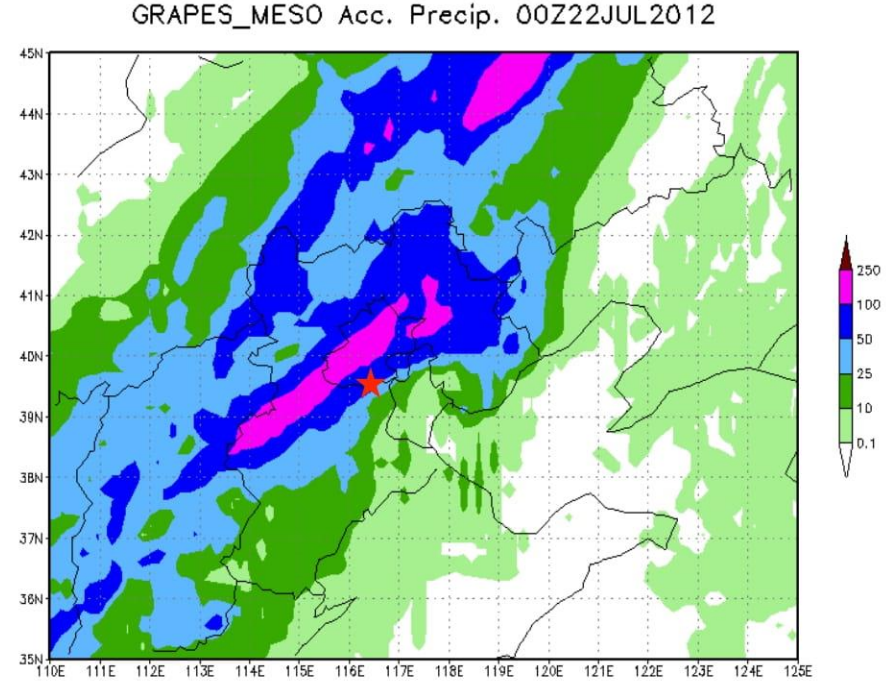
GRAPES_MESO 6h accumulated precipitation

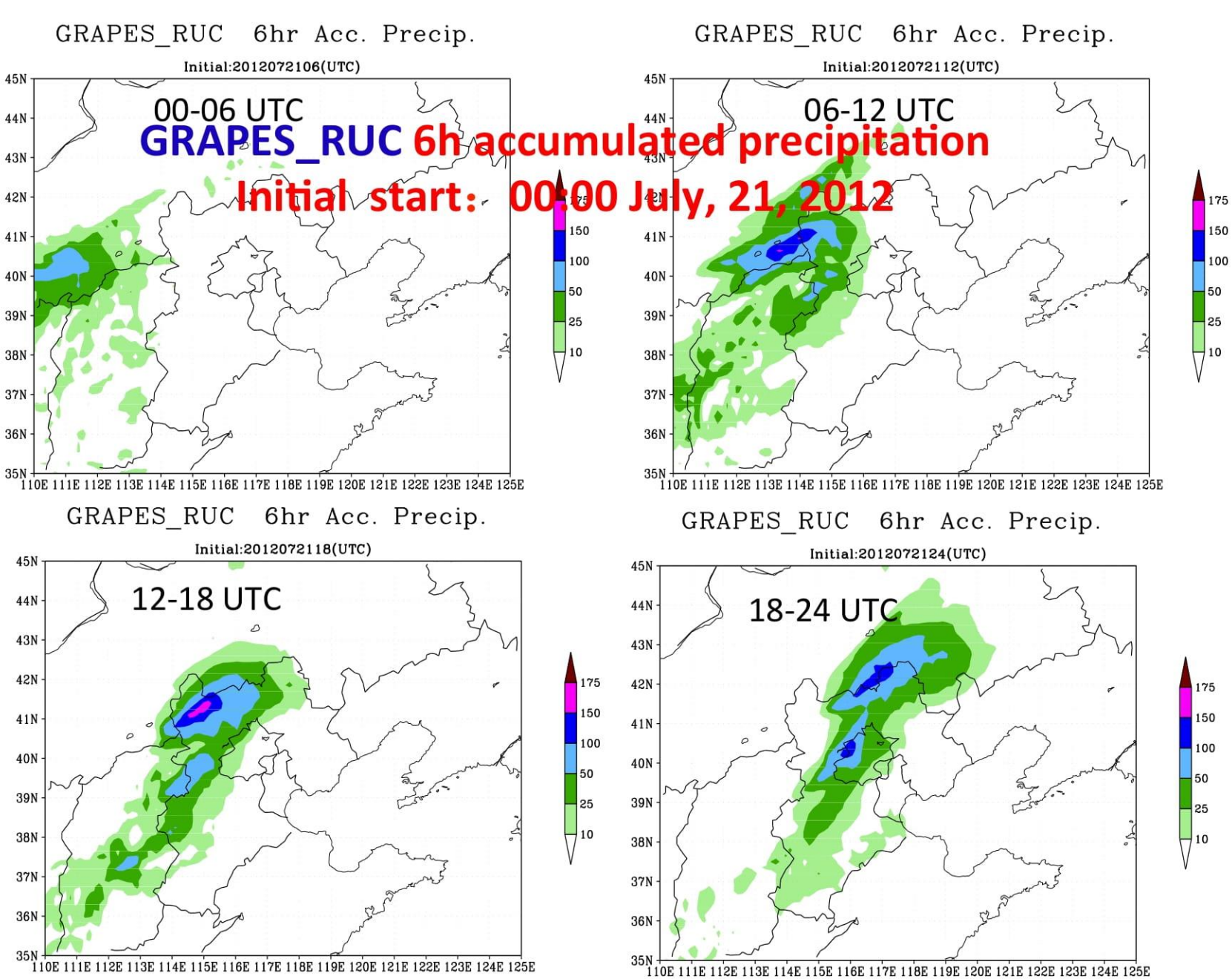
Initial start： 00:00 July, 21, 2012










GRAPES_RUC 6hr Acc. Precip.
Initial:2012072106(UTC)
00-06 UTC
GRAPES_RUC 6hr Acc. Precip.
Initial:2012072112(UTC)
06-12 UTC
GRAPES_RUC 6hr Acc. Precip.
Initial:2012072118(UTC)
12-18 UTC
GRAPES_RUC 6hr Acc. Precip.
Initial:2012072124(UTC)
18-24 UTC
GRAPES_RUC 6h accumulated precipitation
Initial start: 00:00 July, 21, 2012
175
150
100
50
25
10
45N
44N
43N
42N
41N
40N
39N
38N
37N
36N
35N
110E 111E 112E 113E 114E 115E 116E 117E 118E 119E 120E 121E 122E 123E 124E 125E

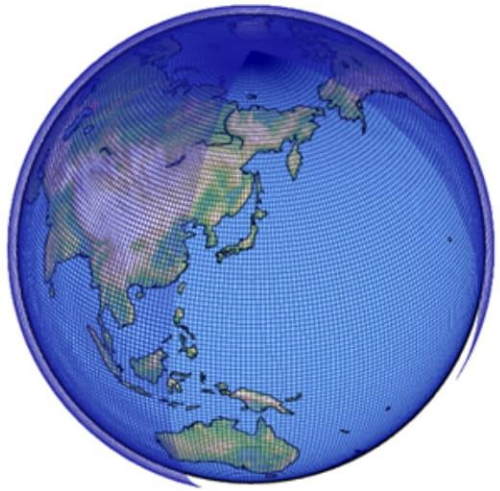
Summary

- The precipitation forecast of GRAPES_meso is very well for the rainfall area, but the intensity and occurrence of forecast are a little weaker and later, respectively.
- The maximum precipitation of GRAES_RUC products is over 260mm and the averaged precipitation for Beijing is also over 175mm, which are the maximum precipitation forecasts among all NWP models.
- The occurrence of GRAPES_RUC forecast is in good agreement with the observation, but the rainfall has an offset. In addition, the averaged precipitation of Beijing is over 50mm, the strongest is over 150mm.

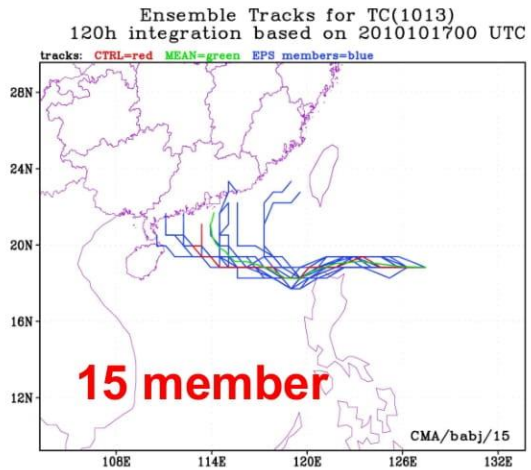
NWPC/CMA's Tropical cyclone track prediction System

Overview

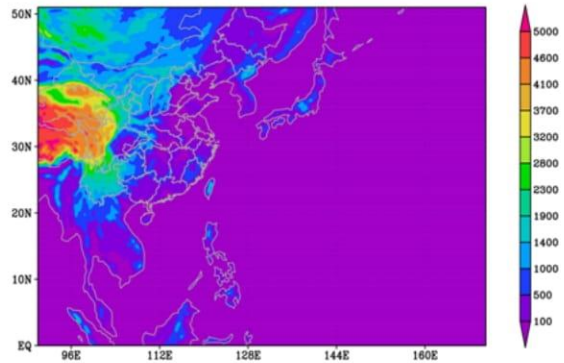
☐ the NWP systems for TC prediction



2006
GMTTP-T213L31
FT=120h
(00,06,12,18UTC)



2007
TC-EPS:T213L31
FT=120h (00,12UTC)

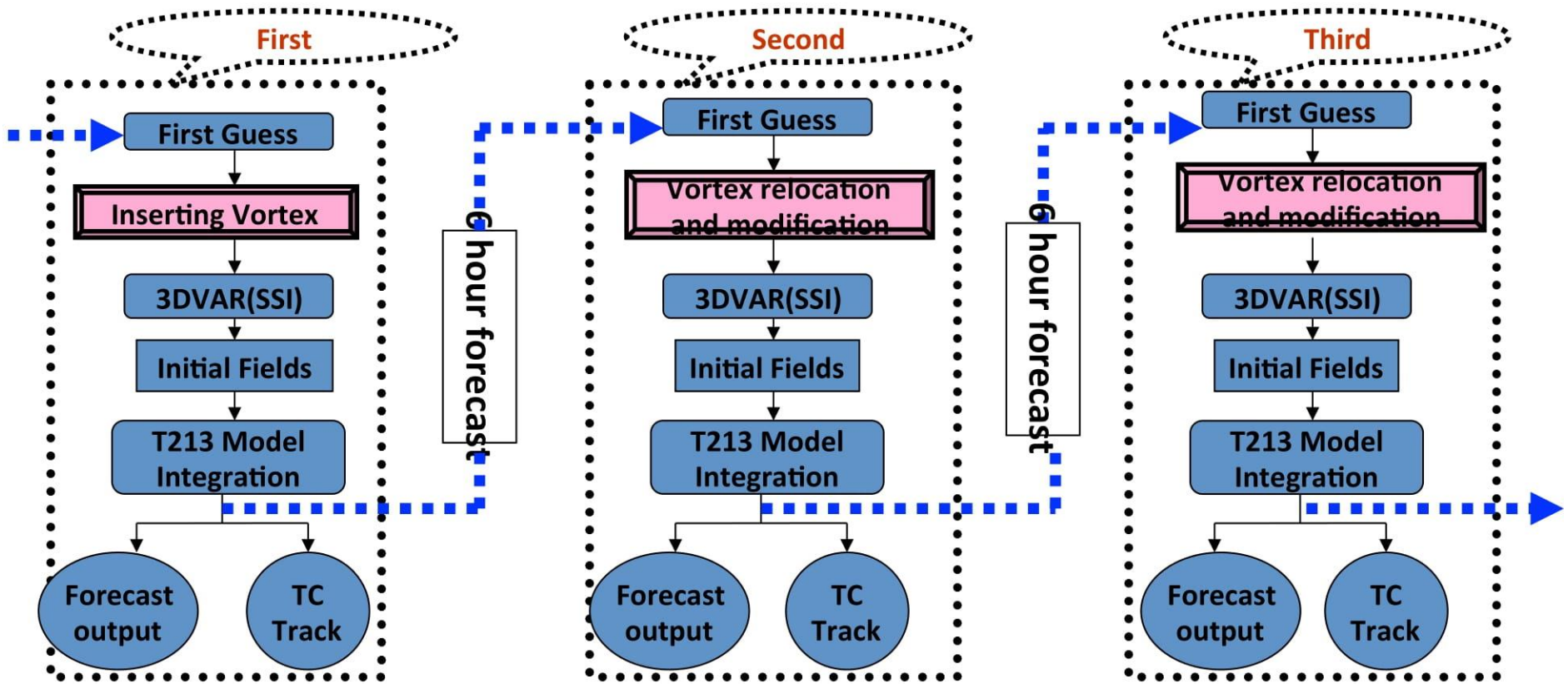


2011
GRAPES_TYM(0.15/31/NMC)
2006
GRAPES_TCM (0.15/31/STI)
2006
GRAPES-TMM (0.36/31/GZH)

Global model configuration

Model	resolution	Data assimilation	Votex initialization	Forecast
Global spectral (GMTTP)	T213L31	3DVAR	BOGUS+Relocation+ intensity modification	120h

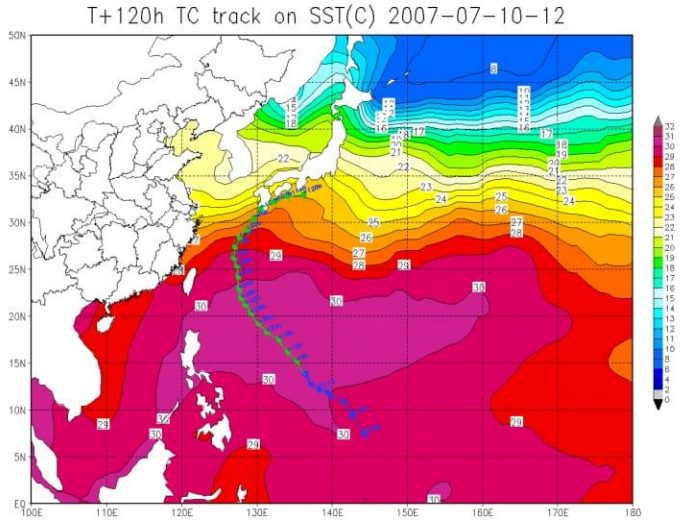
Flow chart

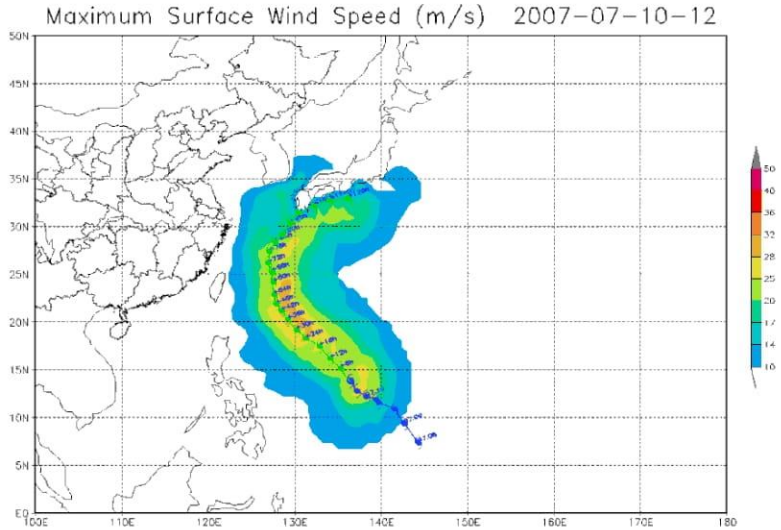


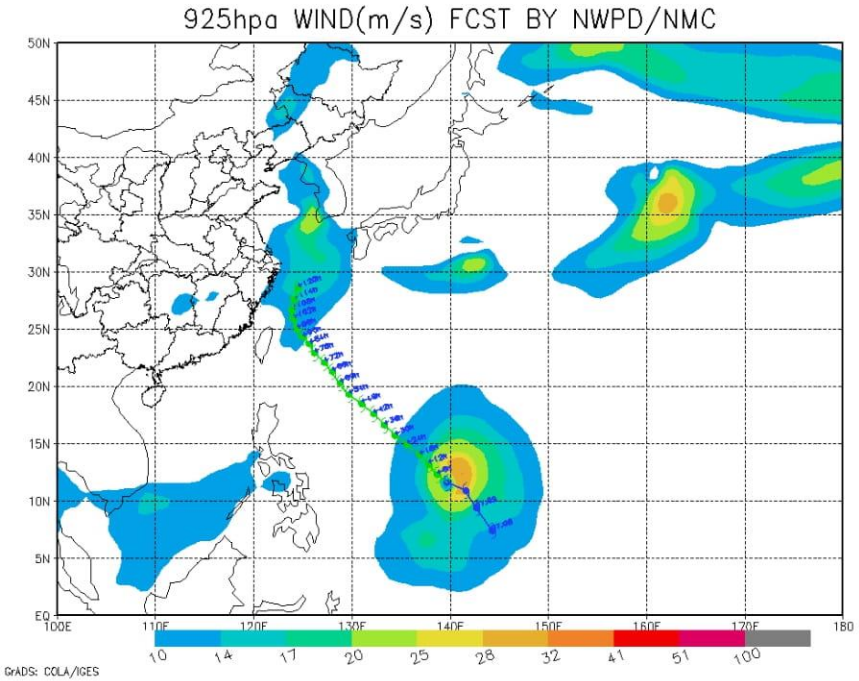
SYSNAME	CUT-OFF TIME (UTC)	RUNNING (UTC)	COMP
（T213L31_SSI）	05:00（00Z_ ASSIM +120HR_FCST）	05:00～05:40	IBM Cluster 1600
	11:00（00Z_ASSIM. +9HR_FCST）	11:00～11:15	IBM Cluster 1600
	12:00（06Z_ASSIM.+120 HR_FCST）	12:00～12:30	IBM Cluster 1600
	16:00（06Z_ASSIM.+9HR_FCST）	16:00～16:15	IBM Cluster 1600
	17:00（12Z_ASSIM. +120HR_FCST）	17:00～17:40	IBM Cluster 1600
	22:00（12Z_ASSIM. +9 HR_FCST）	22:00～22:15	IBM Cluster 1600
	22:30（18Z_ASSIM. +120 HR_FCST）	22:30～23:00	IBM Cluster 1600
	04:00（18Z_ASSIM. +9 HR_FCST）	04:00～04:15	IBM Cluster 1600

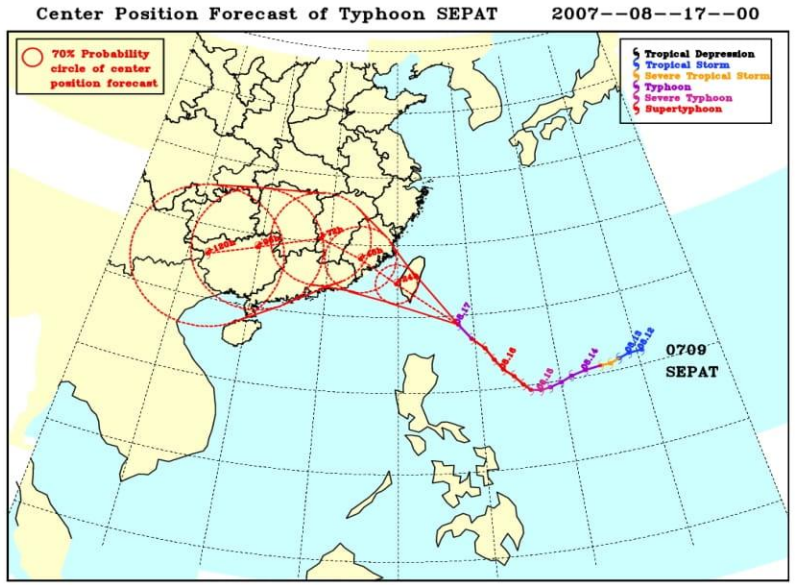
SYSNAME	CUT-OFF TIME (UTC)	RUNNING (UTC)	COMP
15members （T213L31+Bogus）	07:30(00Z_120HR_FCST)	07:30～08:30	IBM Cluster 1600
	19:30(12Z_120HR_FCST)	19:30～20:30	IBM Cluster 1600

The products



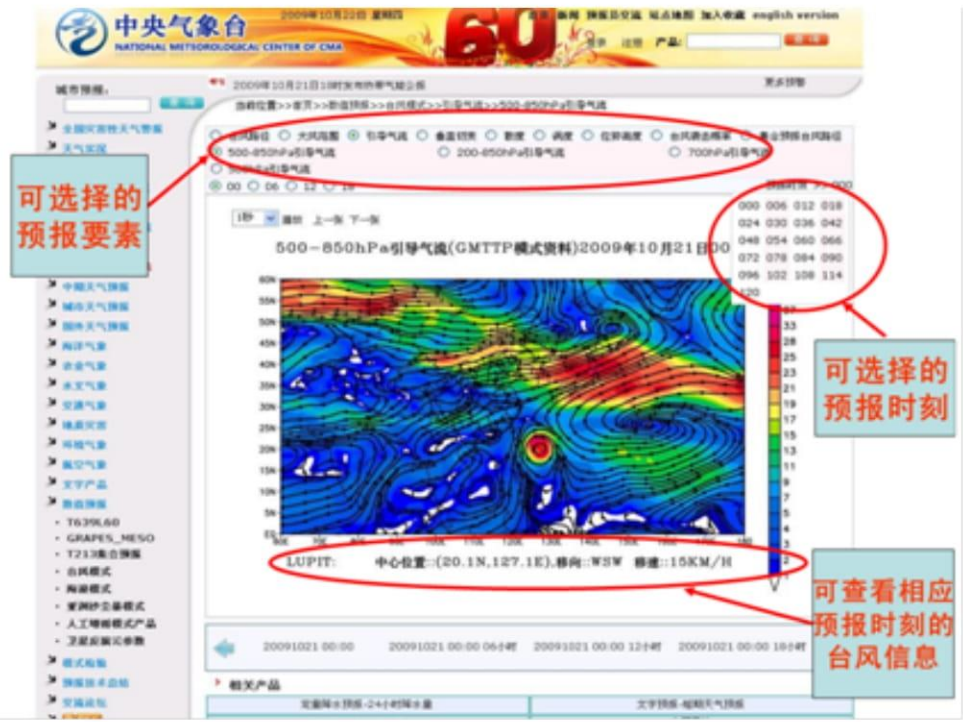


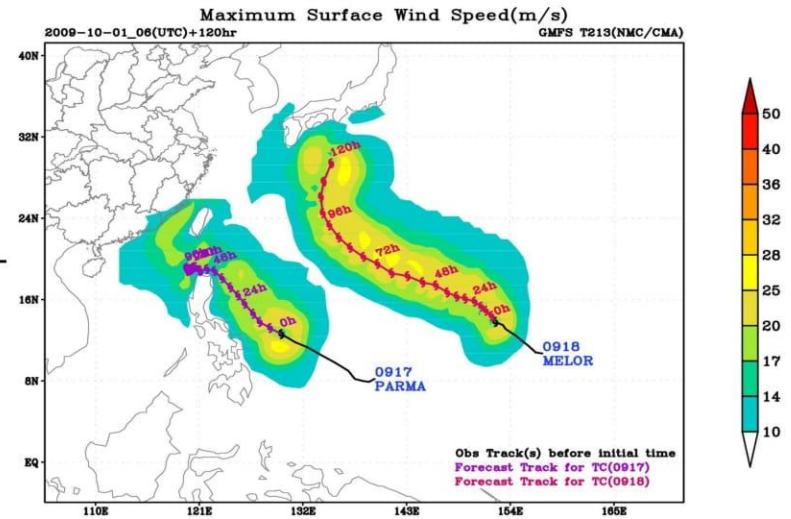


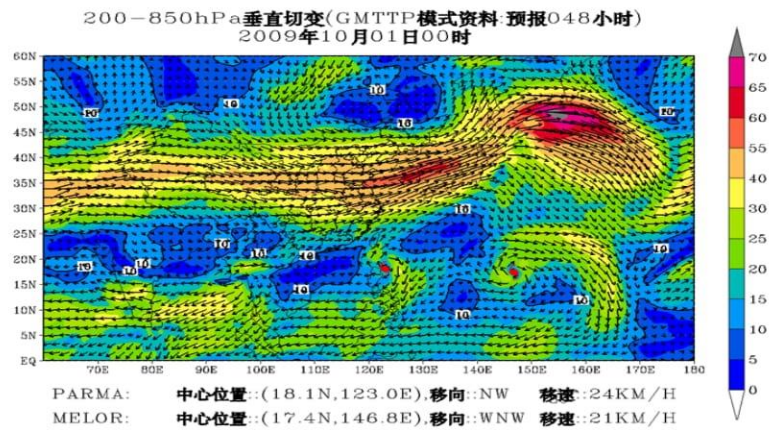


The product of TC NWP Model

- TC track with 120 hour forecast period
- The distribution of maximum surface wind with 120h forecast period
- TC steering flow of 850hpa/700hpa/500hpa wind fields
- TC mean steering flow of wind fields at between 850hpa and 500hpa level
- TC vertical shear of 850hpa-200hpa wind fields
- Vorticity of 850hpa level
- Divergence of 200hpa level
- Height of 500hpa level

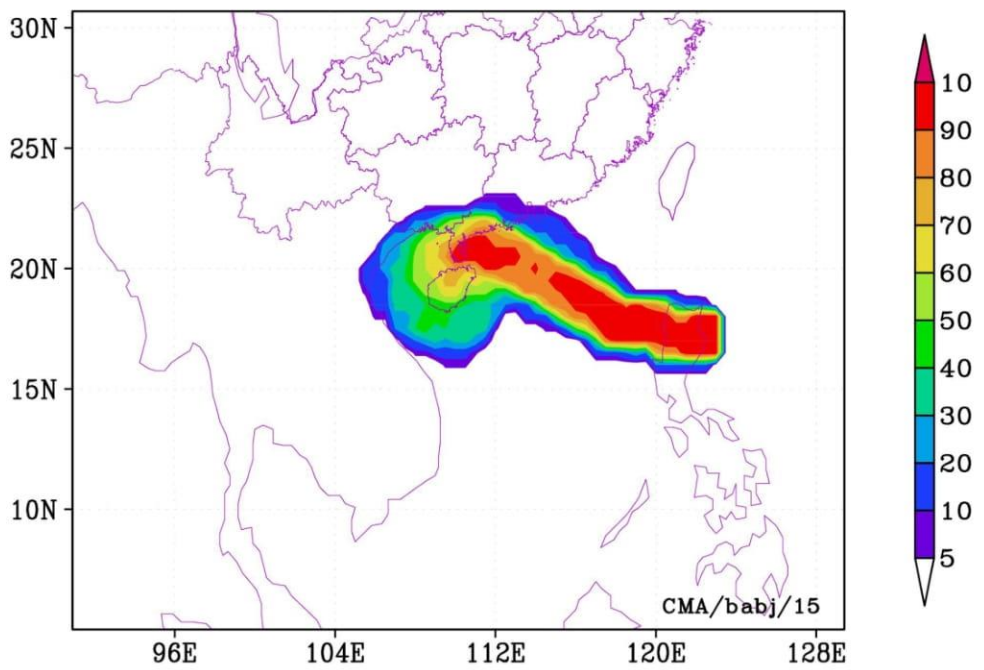


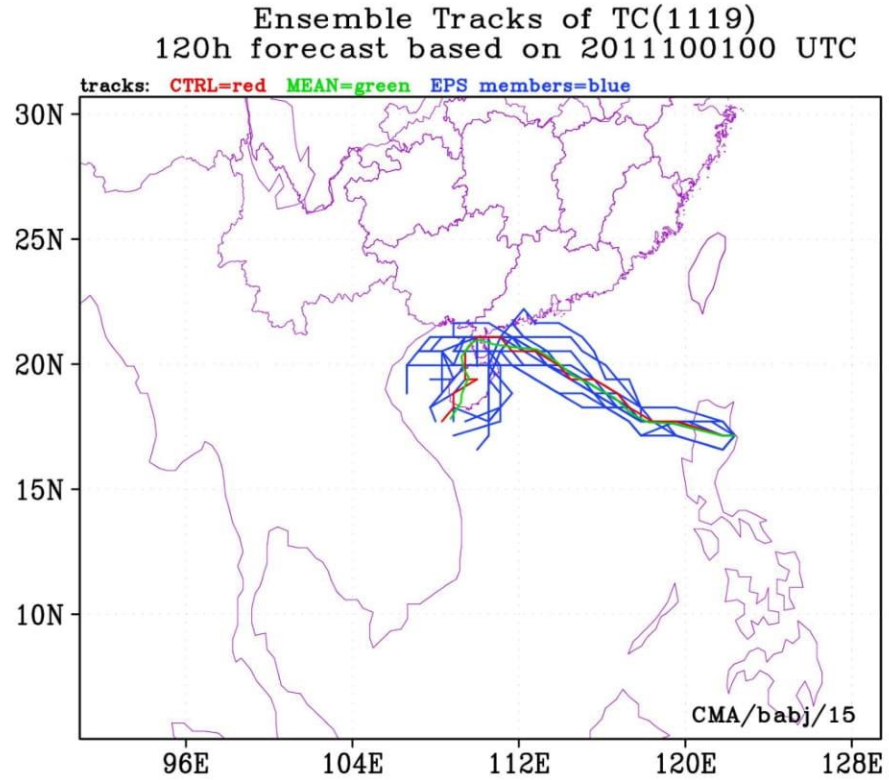




Ensemble Products

Strike probability

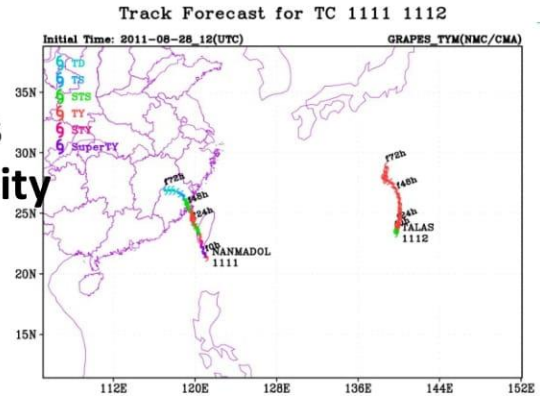


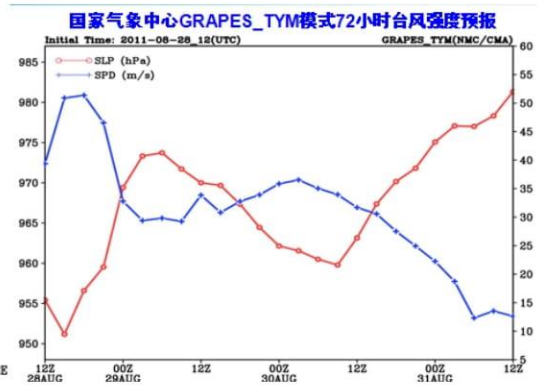


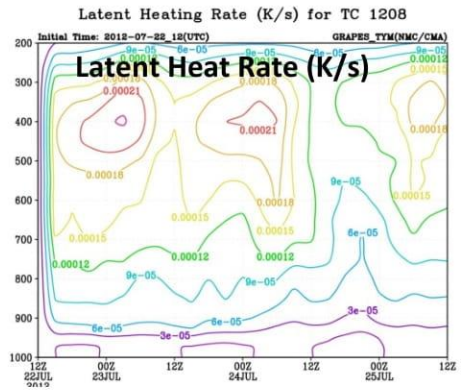
TC ensemble tracks

Regional TC model Products

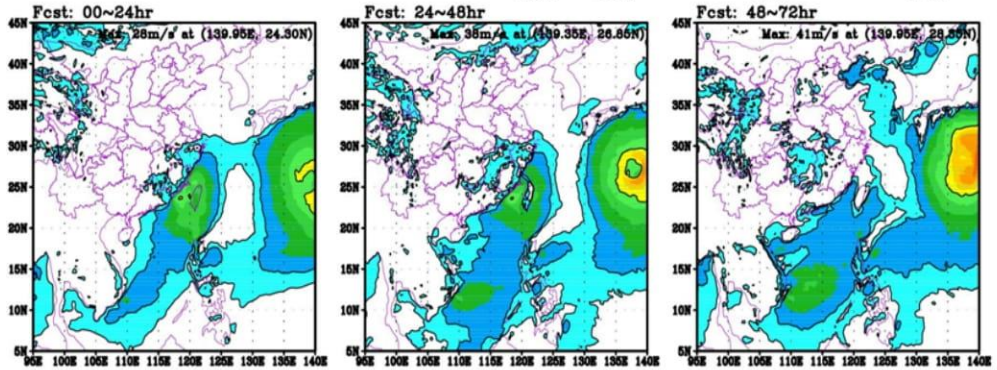
Tracks
Intensity

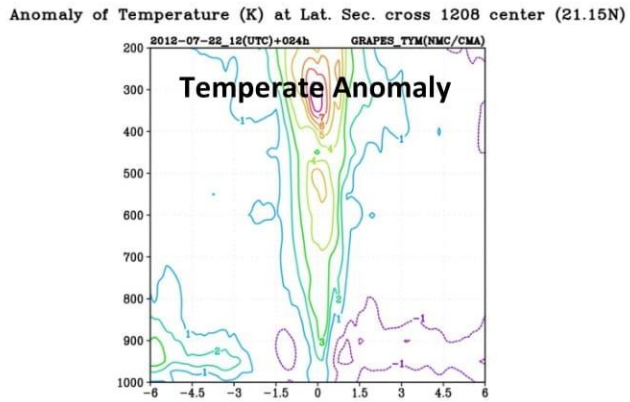




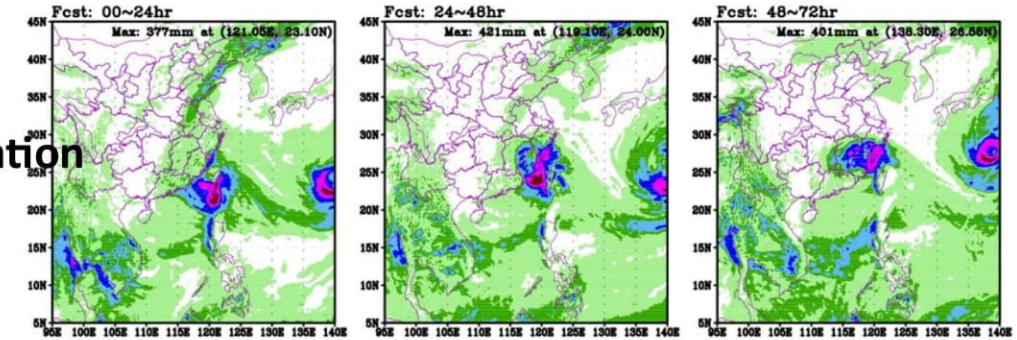


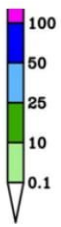
Wind

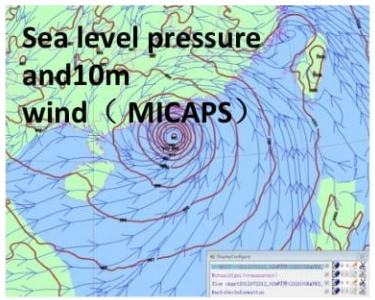




Precipitation

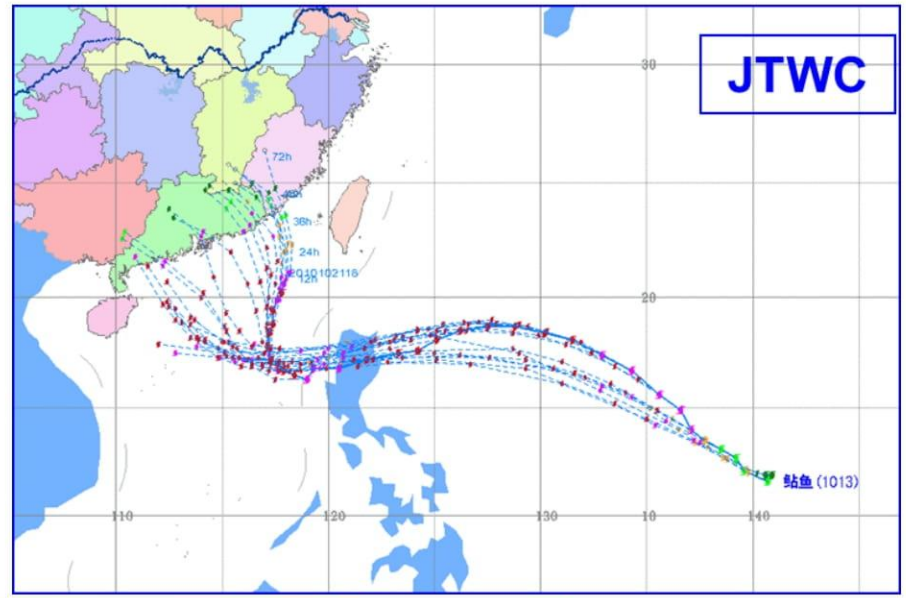


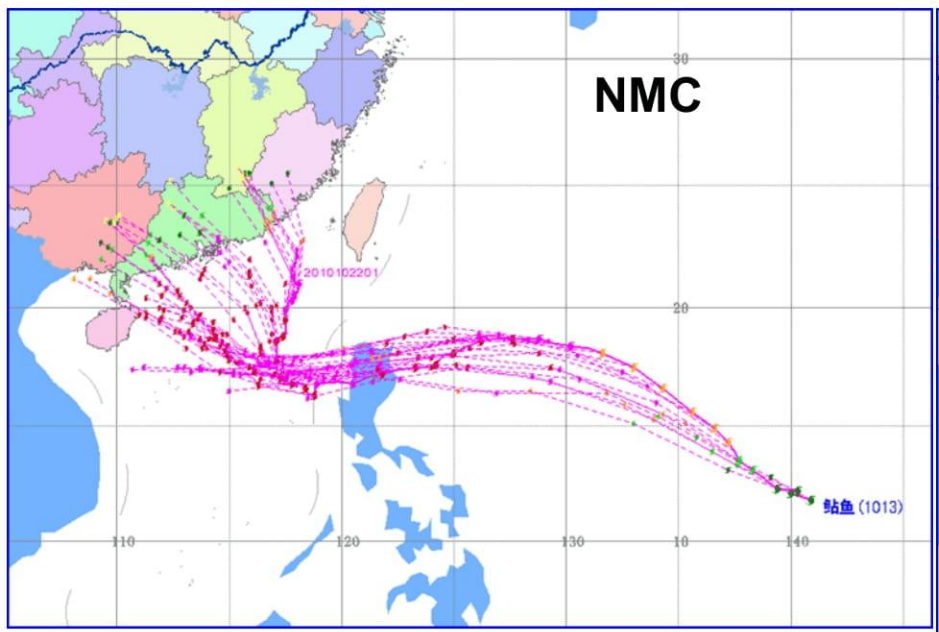


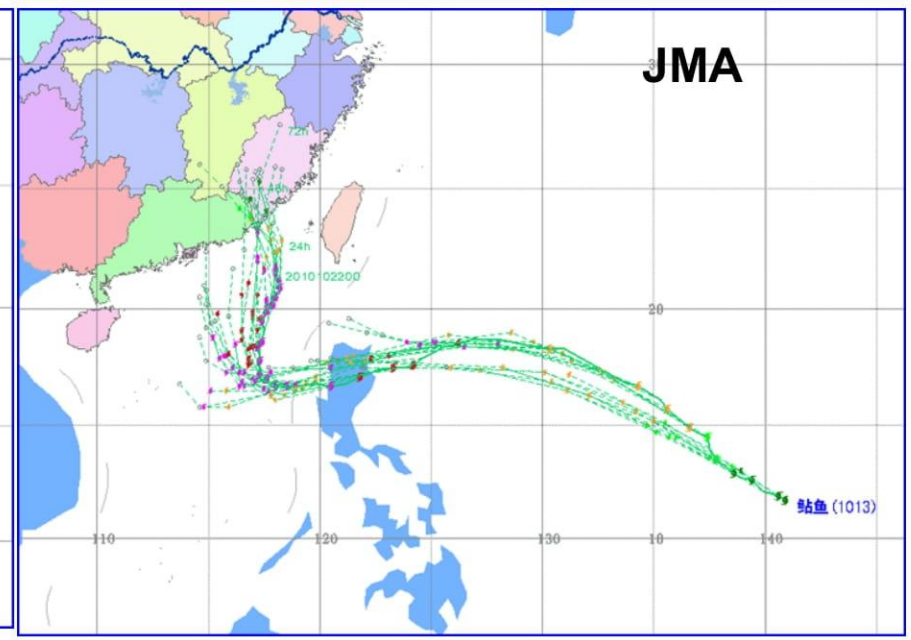


Unusual track behavior : case 1 MEGI (No.1013)

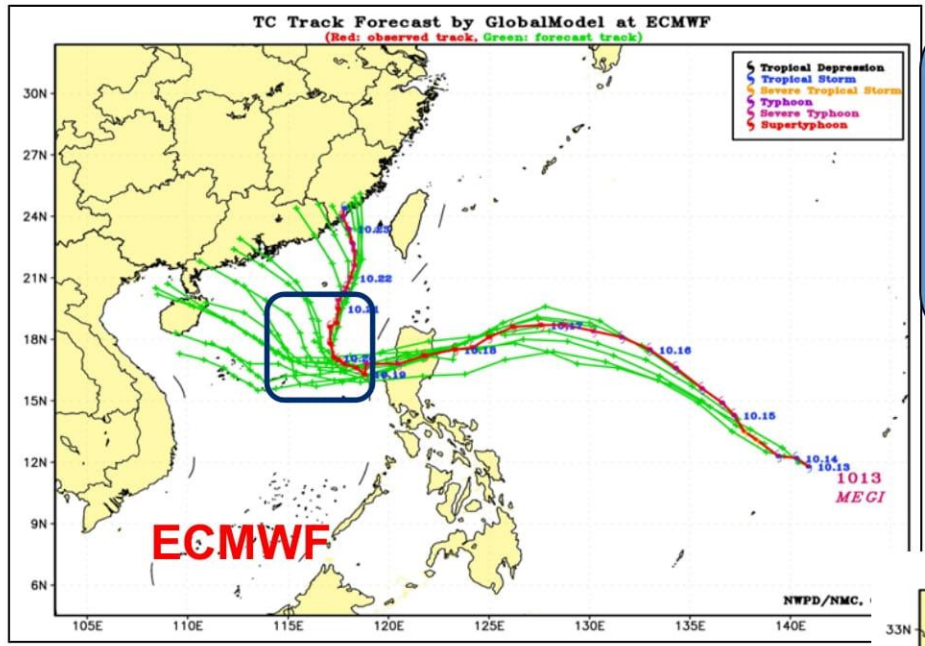
a) Official forecasts from NMC,JTWC and JMA







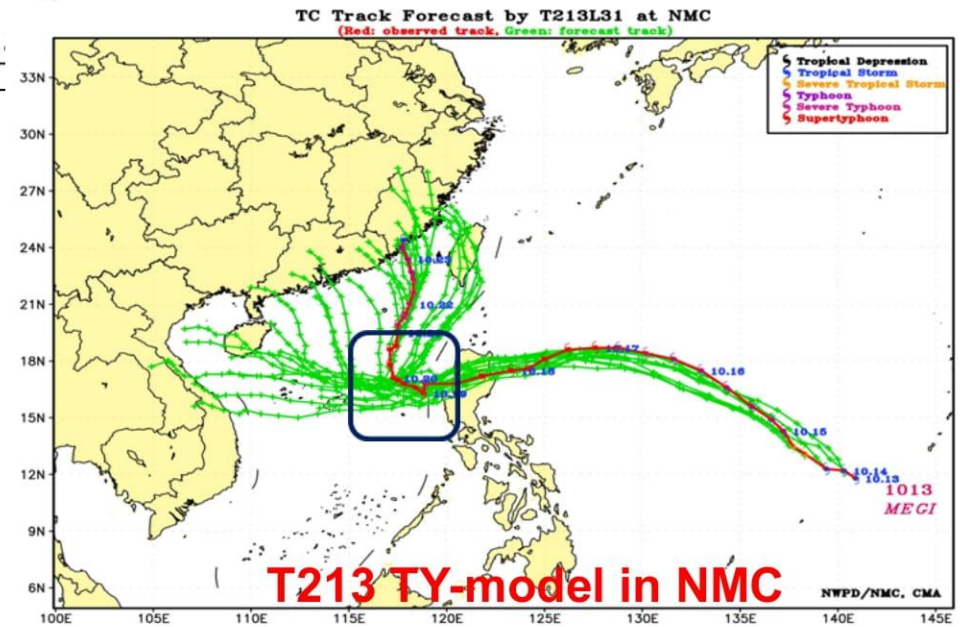
Case1: MEGI (1013)



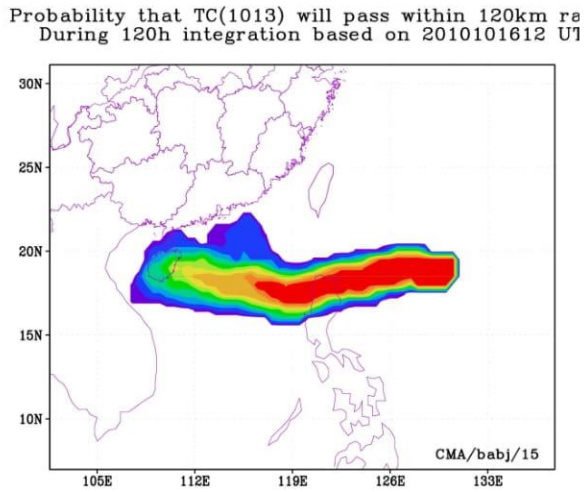
Red: best track from NMC

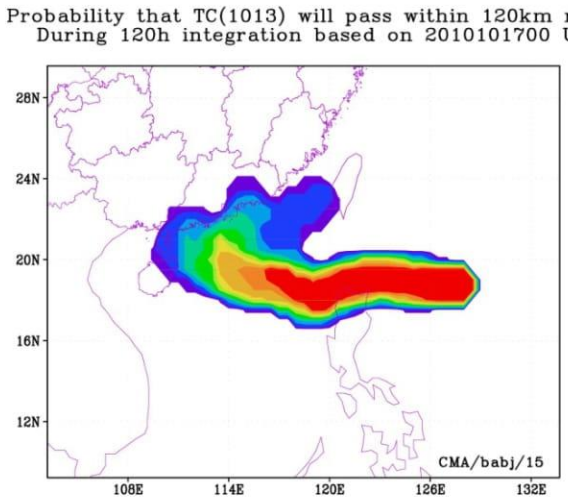
Green forecast tracks from NWP model in different initial time

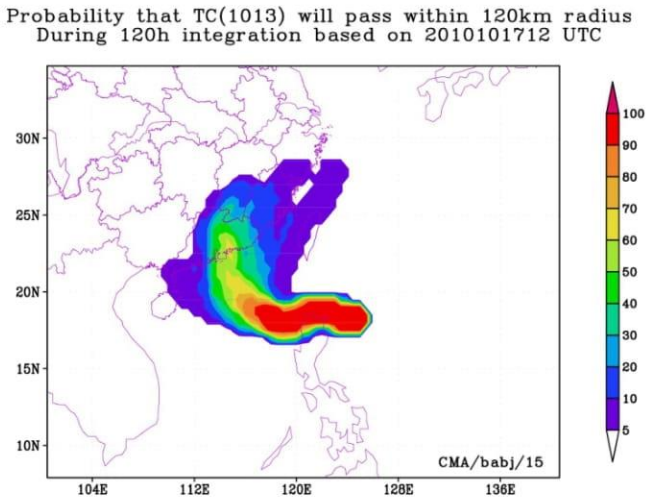
Numerical forecast tracks for Typhoon MEGI

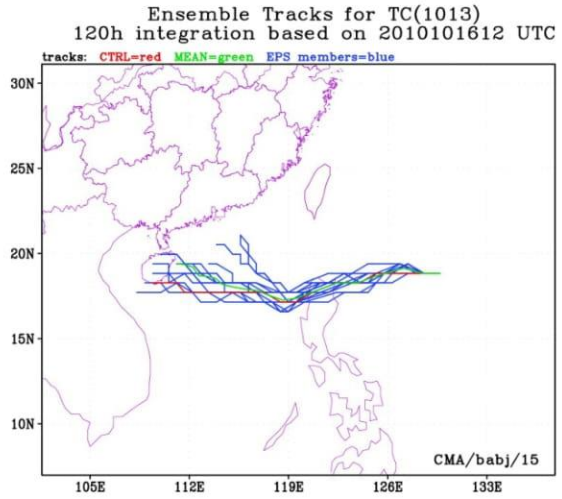


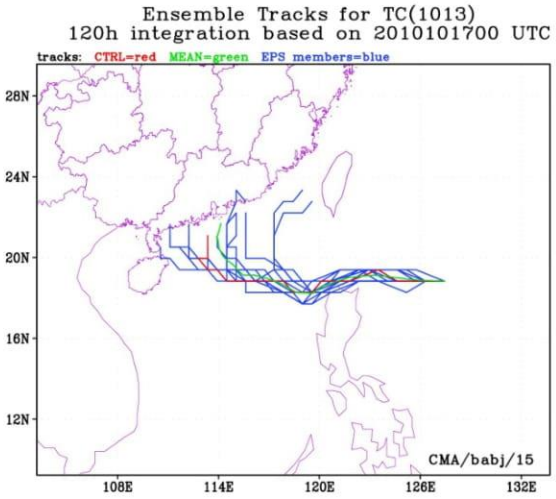
Strike probability and ensemble tracks for MEGI from 12UTC 16 -17 Oct. Int. 12h

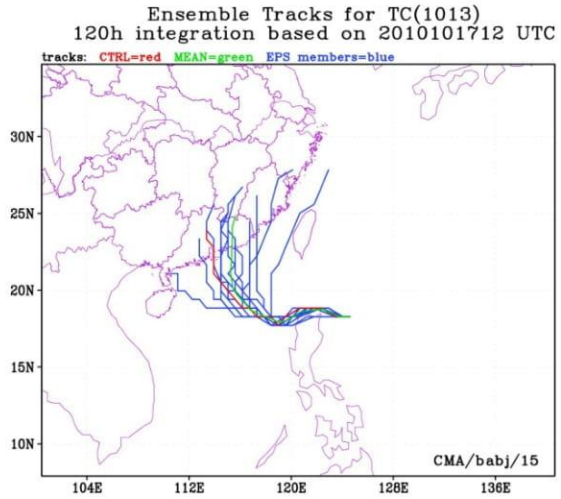




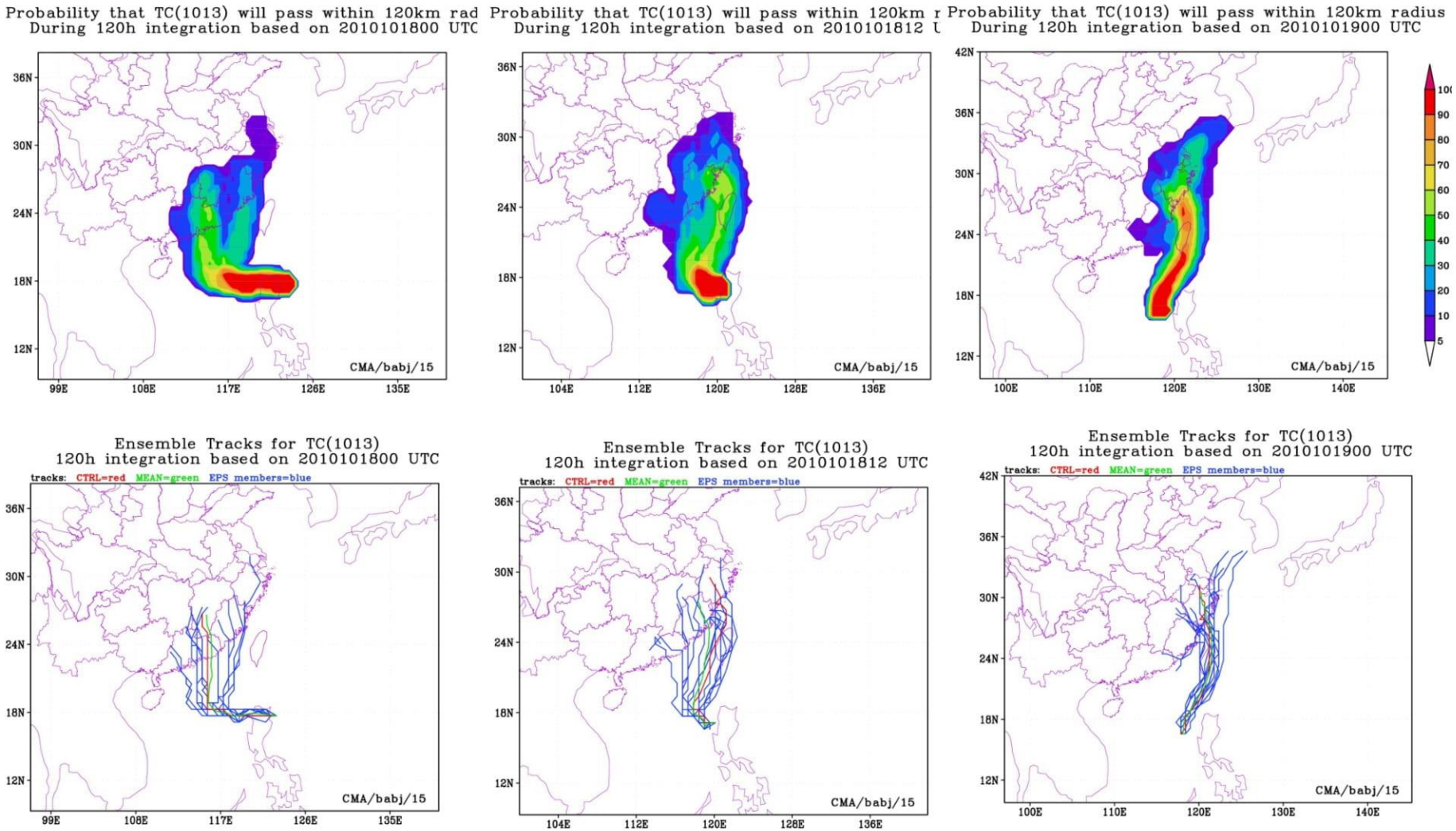






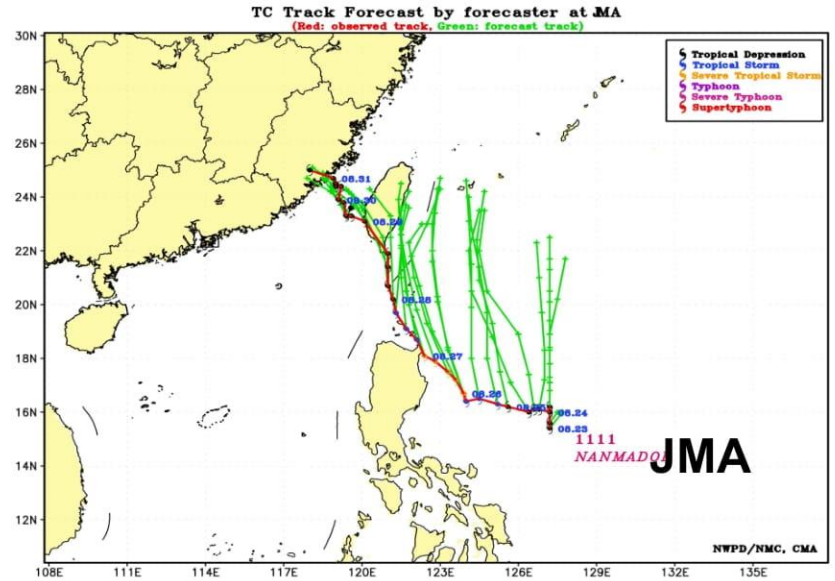


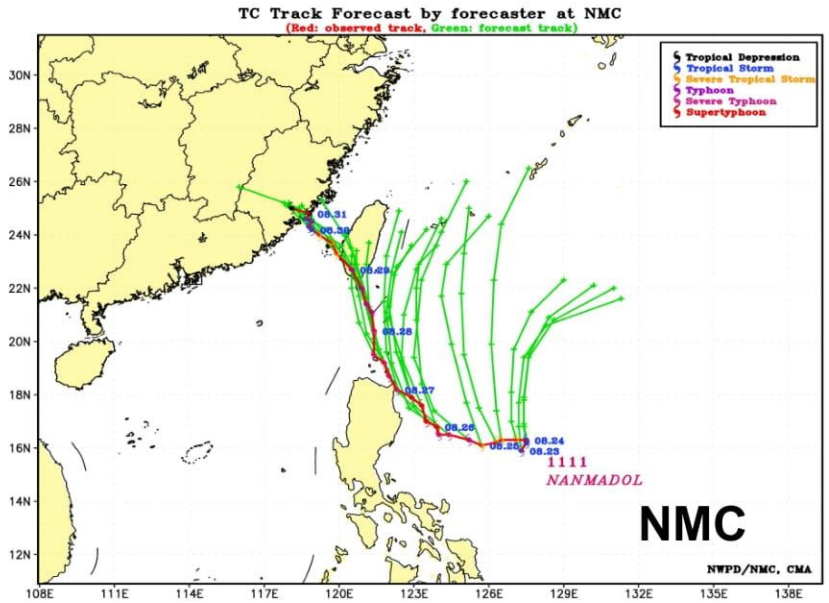
Strike probability and ensemble tracks for MEGI from 00UTC 18 -19 Oct. Int. 12h

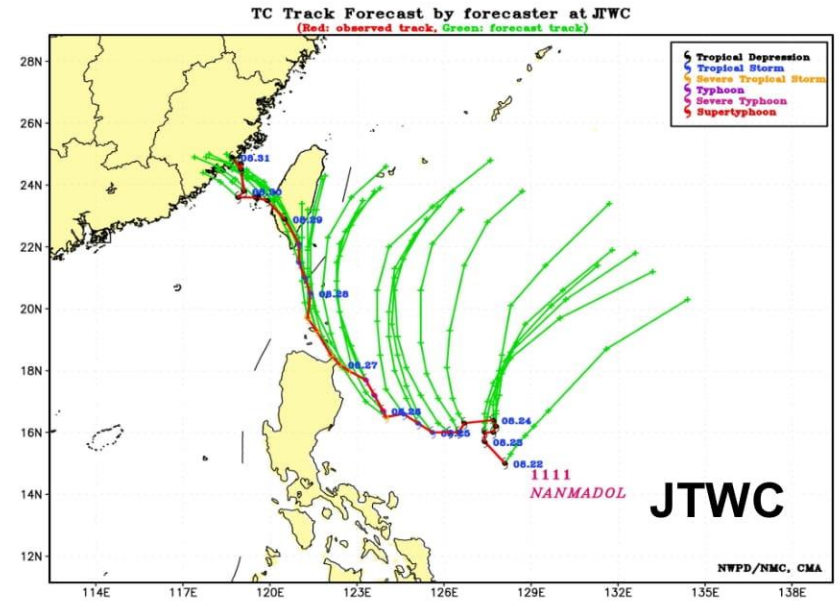


Case2 :NANMADOL in 2011

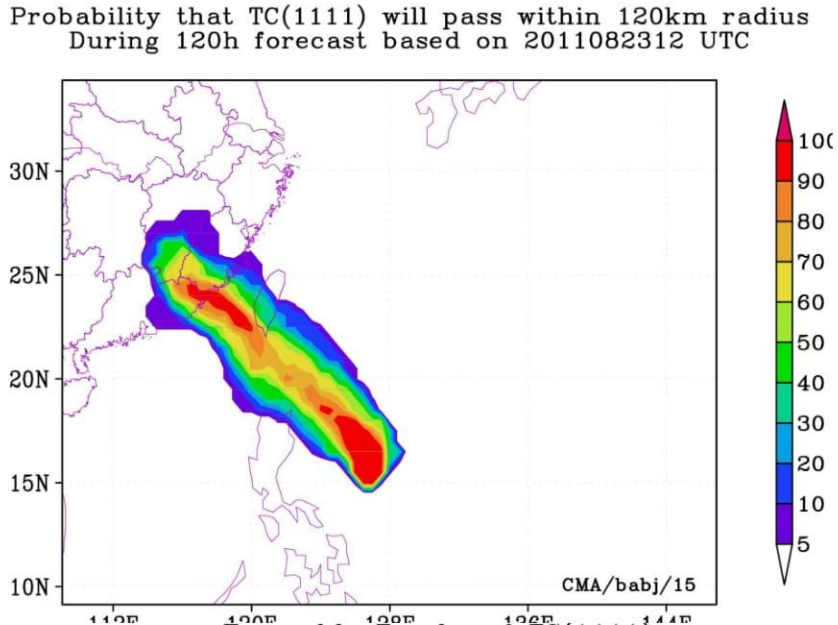
Official forecasts
from NMC,JTWC and JMA

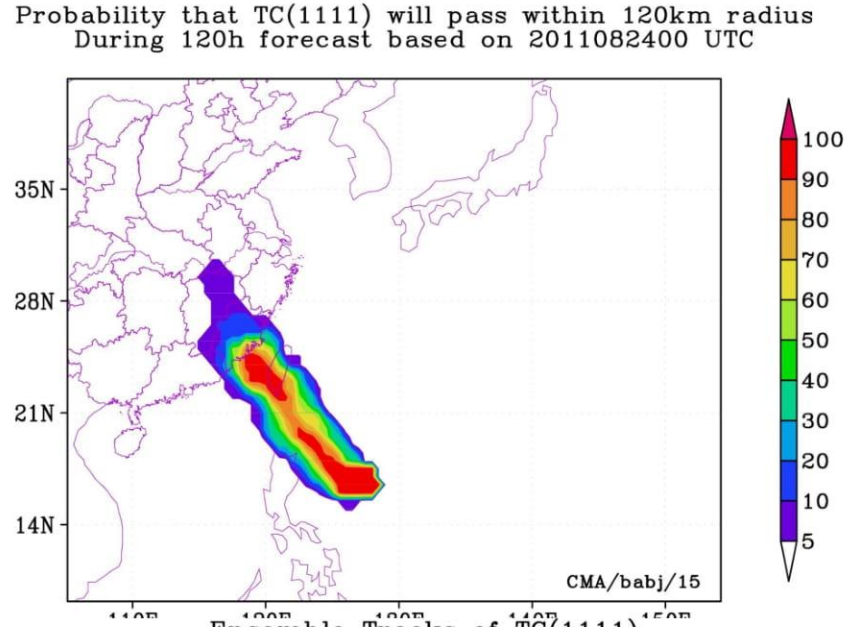


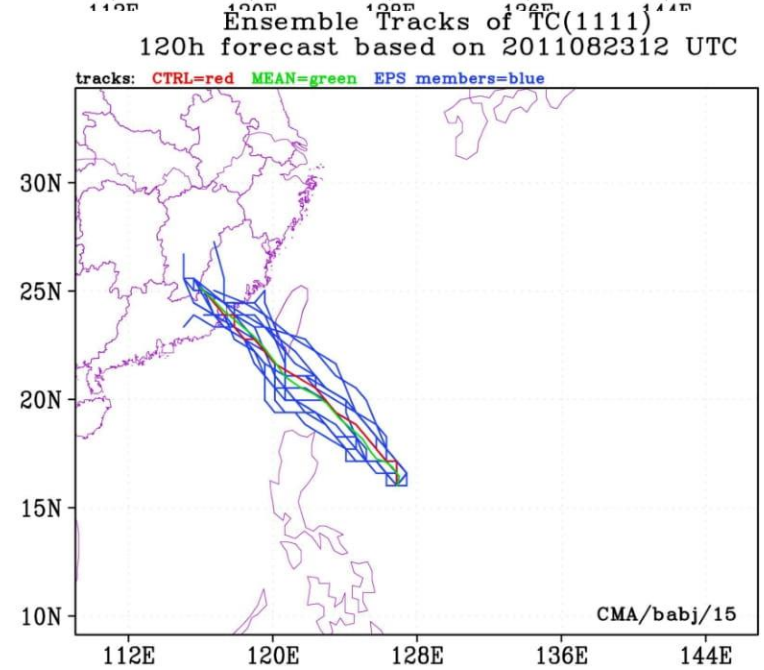


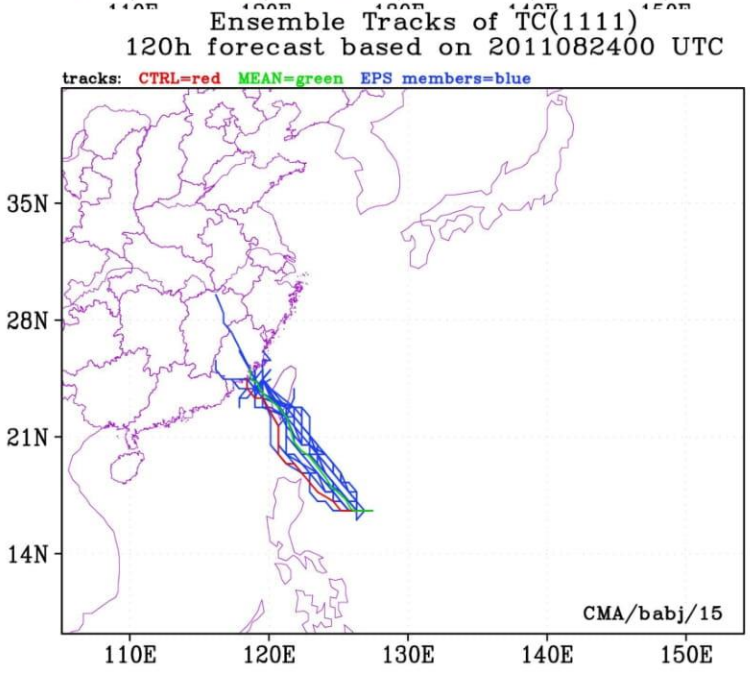


Strike probability and ensemble tracks for NANMADOL from 12UTC 23 -00UTC 24 Aug. Int. 12h







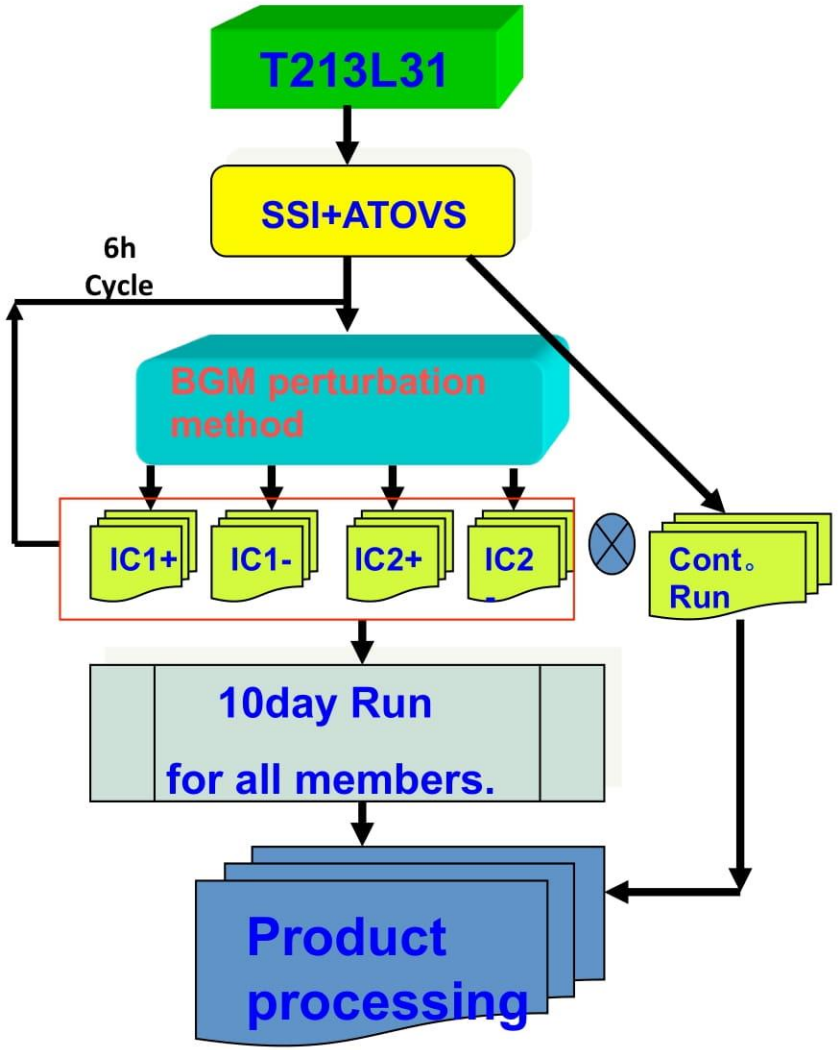


Summary

- **The mean track of TC-EPS system has smaller track errors than CTL**
- **The TC-EPS system have some skills in the unusual TC track prediction**
- **The spreads are much more smaller than the track errors**

NPC/CMA Ensemble Prediction System

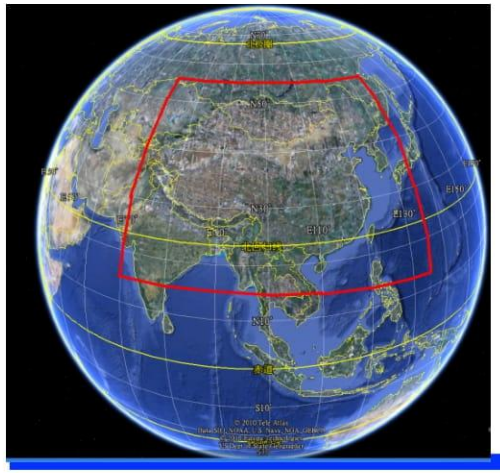
T213 GEPS



configurations	T213 GEPS System
model	T213L31
Horizontal Resolution	0.5625
Vertical Resolution	31
Analysis system	3D SSI+ATOVS
Perturbation method	BGM
Perturbation region	Global
EPS members	15
forecast	10 days
Typhoon	relocation and vortex perturbation

SYSNAME	CUT-OFF TIME (UTC)	RUNNING (UTC)	COMP
15 members （T213L31）	07:30(00Z_ASSIM+240HR_FCST)	07:30～09:15	IBM Cluster 1600
	12:30(06Z_ASSIM+6HR_FCST)	12:30～12:35	IBM Cluster 1600
	18:30(12Z_ASSIM+240HR_FCST)	18:30～20:15	IBM Cluster 1600
	23:30(18Z_ASSIM+6HR_FCST)	23:30～23:35	IBM Cluster 1600

Operational running for CMA REPS was implemented since 1 Jun 2011



working on REPS based on the WMO BO8RDP project.

working on REPS over China

Real time running.

Operational implementation

May 2009

Jun 2010

Jun 2011

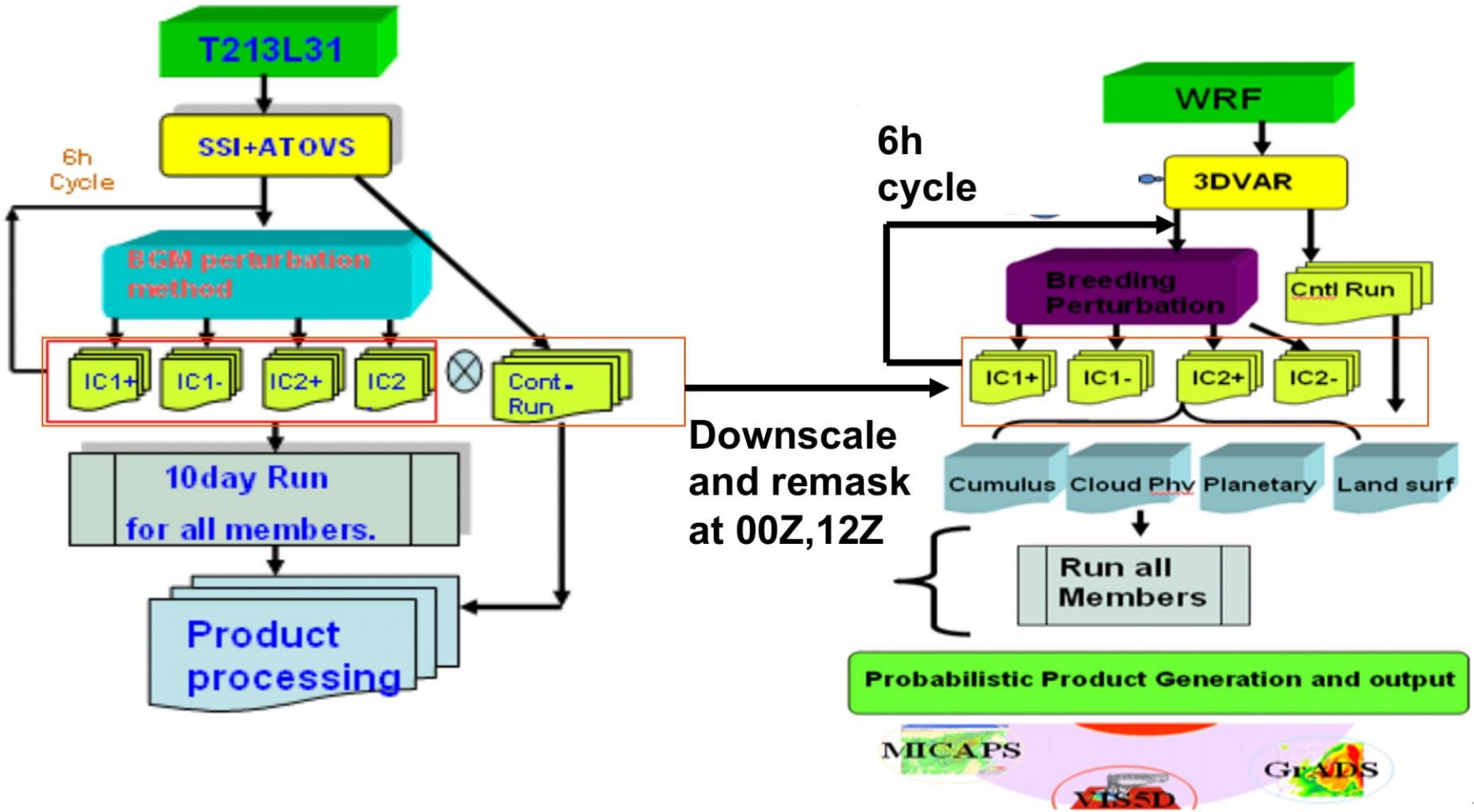
Configuration of REPS

- Model(WRF-ARW dynamical core)
- 15km grid space, 31 vertical levels
- 72h forecast
- 15 members
- BGM initial perturbation method
- multi- physics

Forecast data was put into CMA TIGGE archive center every day

Ens. mem	Microphysics scheme	Convective scheme	PBL scheme
Ctrl.	Lin scheme	Betts	MYJ
Pair 1	Lin scheme	KF	YSU
Pair 2	Lin scheme	Betts-Miller	YSU
Pair 3	Lin scheme	Betts-Miller-Janjic	YSU
Pair 4	Lin scheme	KF	MJY
Pair 5	WSM6	Betts-Miller	MJY
Pair 6	WSM3	Betts	MJY
Pair 7	WSM3	Betts	YSU

The Flow chart of REPS



SYSNAME	CUT-OFF TIME (UTC)	RUNNING (UTC)	COMP
15 members （WRF） Ensemble	03:00(00Z_72HR_FCST)	03:00～05:45	IBM Cluster 1600
	12:00(00Z_ASSIM+6HR_FCST)	12:00～12:30	IBM Cluster 1600
	12:30(06Z_ASSIM+6HR_FCST)	12:30～13:00	IBM Cluster 1600
	15:00(12Z_72HR_FCST)	15:00～17:45	IBM Cluster 1600
	00:00(12Z_ASSIM+6HR_FCST)	00:00～00:30	IBM Cluster 1600
	00:30(18Z_ASSIM+6HR_FCST))	00:30～01:00	IBM Cluster 1600

Ensemble Products

GEPS Products

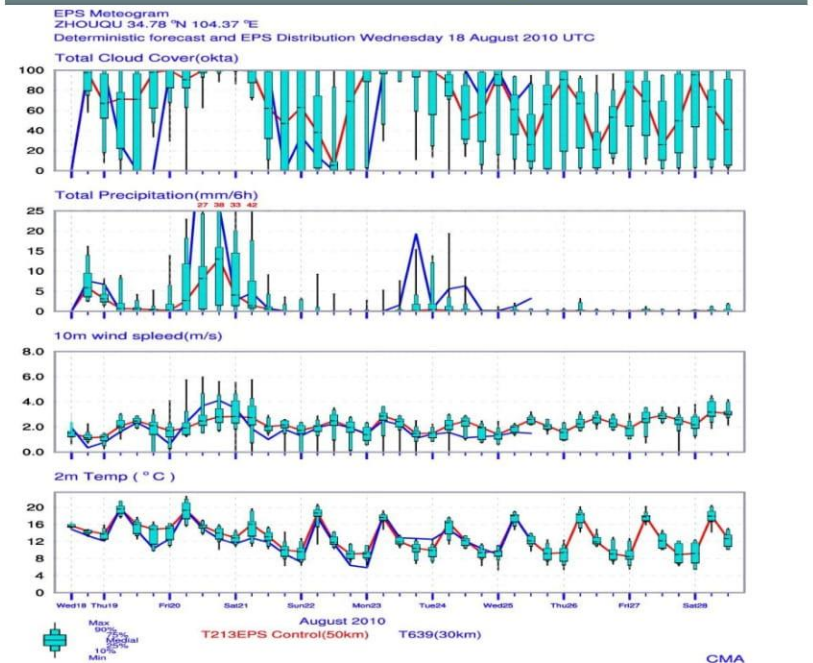
Ensemble mean、 spread and spaghetti

parameter	level	Line interval	units	region
Accumulent precipitation	surface	1,5,10,25,50,100,250	mm	10°-55°N 70°-150°E
10m wind speed	10m	4	m/s	
2m temp.	2m	4	°C	
MSLP		4	hPa	NH
Geop. height	700; 500;200	4	gpm	
temperature	850	4	°C	
Wind field	850;700; 500;200	*Wind vane*		
divergence	850;700; 200	4	10-5s-1	5°-80°N 0°-160°E
vorticity	500	4		
relative humidity	850;700	10	%	
vertical velocity	700;500	2 (|w|<20) 10(|w|≥20)	m/s	

probability

parameter	Probability
12h ccumulated precipitation	>0.1, >10, >25, 50,>100(mm)
24h ccumulated precipitation	
12 ccumulated snow	
24h ccumulated snow	
2m Temperature	>33,>35 >38,>40 （J/kg） <-30,<-25 <-20,<-10,<0,<5（J/kg）
10m Wind	>5.5m/s, >8.0m/s, >10.8 (m/s), >17.2m/s, >24.5m/s, >32.7 (m/s

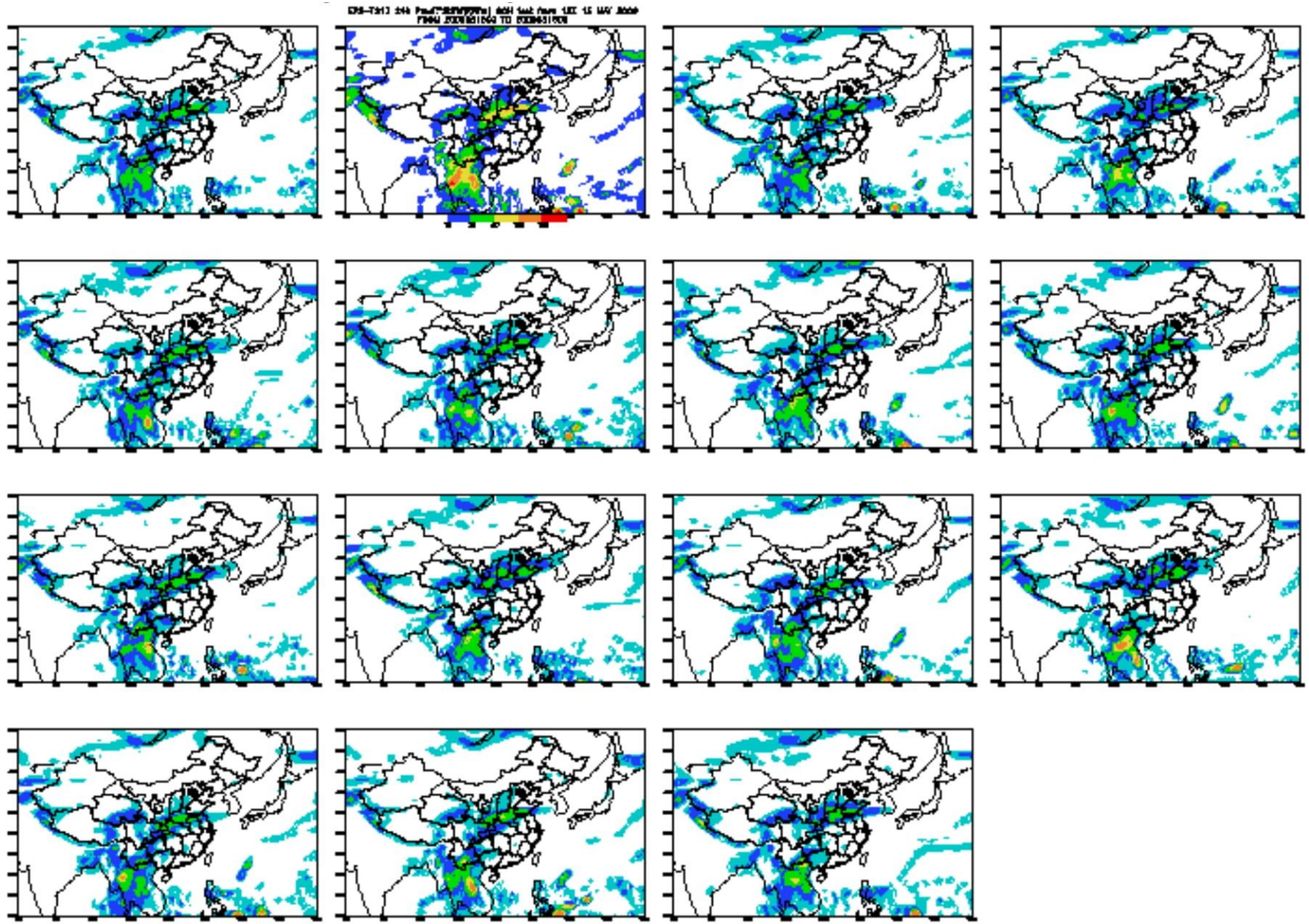
Station Whisker-Box diagram



Spatial graphs

Postage stamps

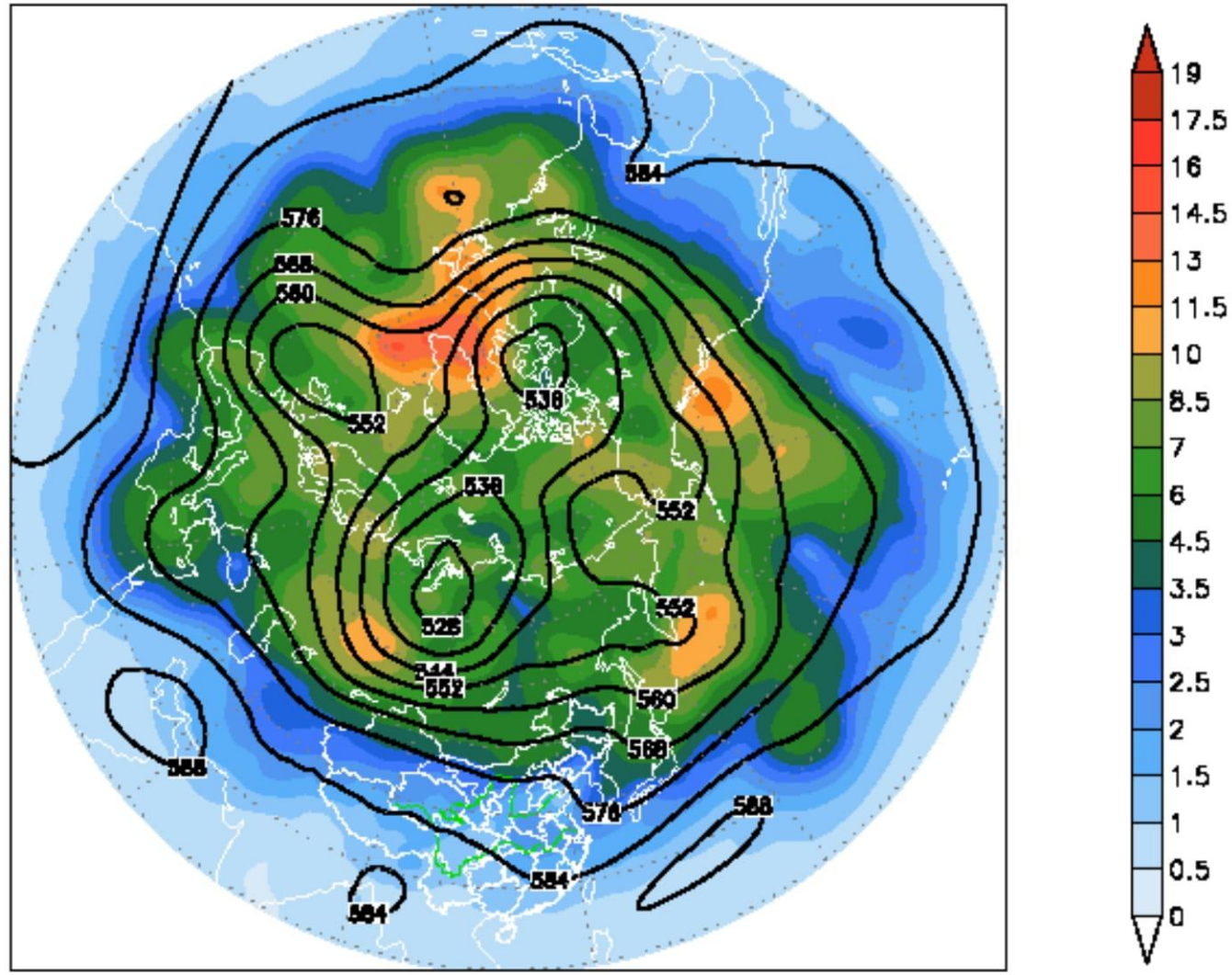
- For a given variable and lead time all ensemble members are presented
- Advantages: All ensemble members are presented
- Disadvantages: Too much information



Spatial graphs

Spatial graphs: Mean and spread

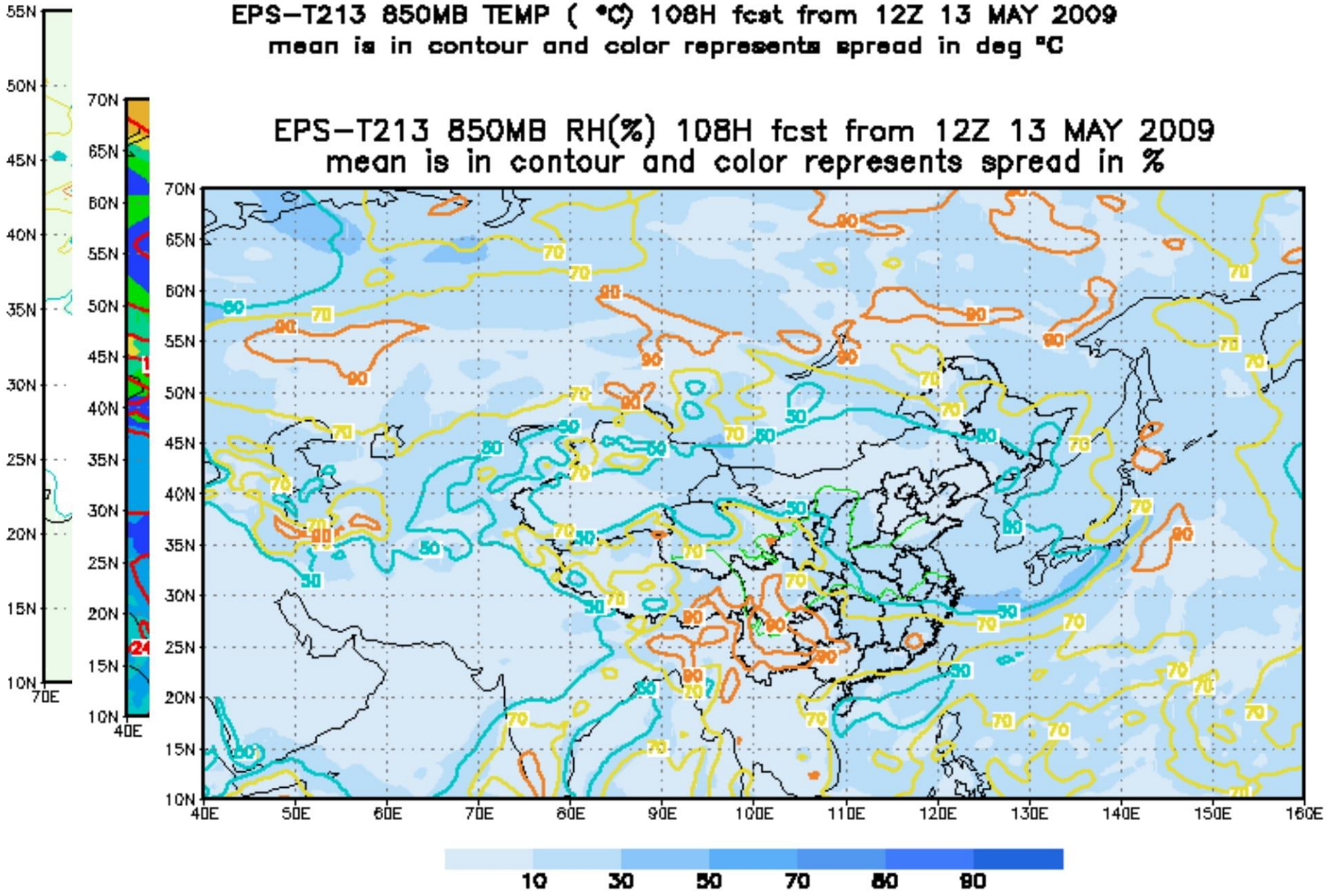
EPS-T213 500MB Height(dm) 204H fcst from 12Z 13 MAY 2009
mean is in contour and color represents spread



EPS-T213 24h apcp (mm) 60H fcst from 12Z 13 MAY 2009
FROM 2009051500 TO 2009051600

EPS-T213 850MB TEMP (°C) 108H fcst from 12Z 13 MAY 2009
mean is in contour and color represents spread in deg °C

EPS-T213 850MB RH(%) 108H fcst from 12Z 13 MAY 2009
mean is in contour and color represents spread in %



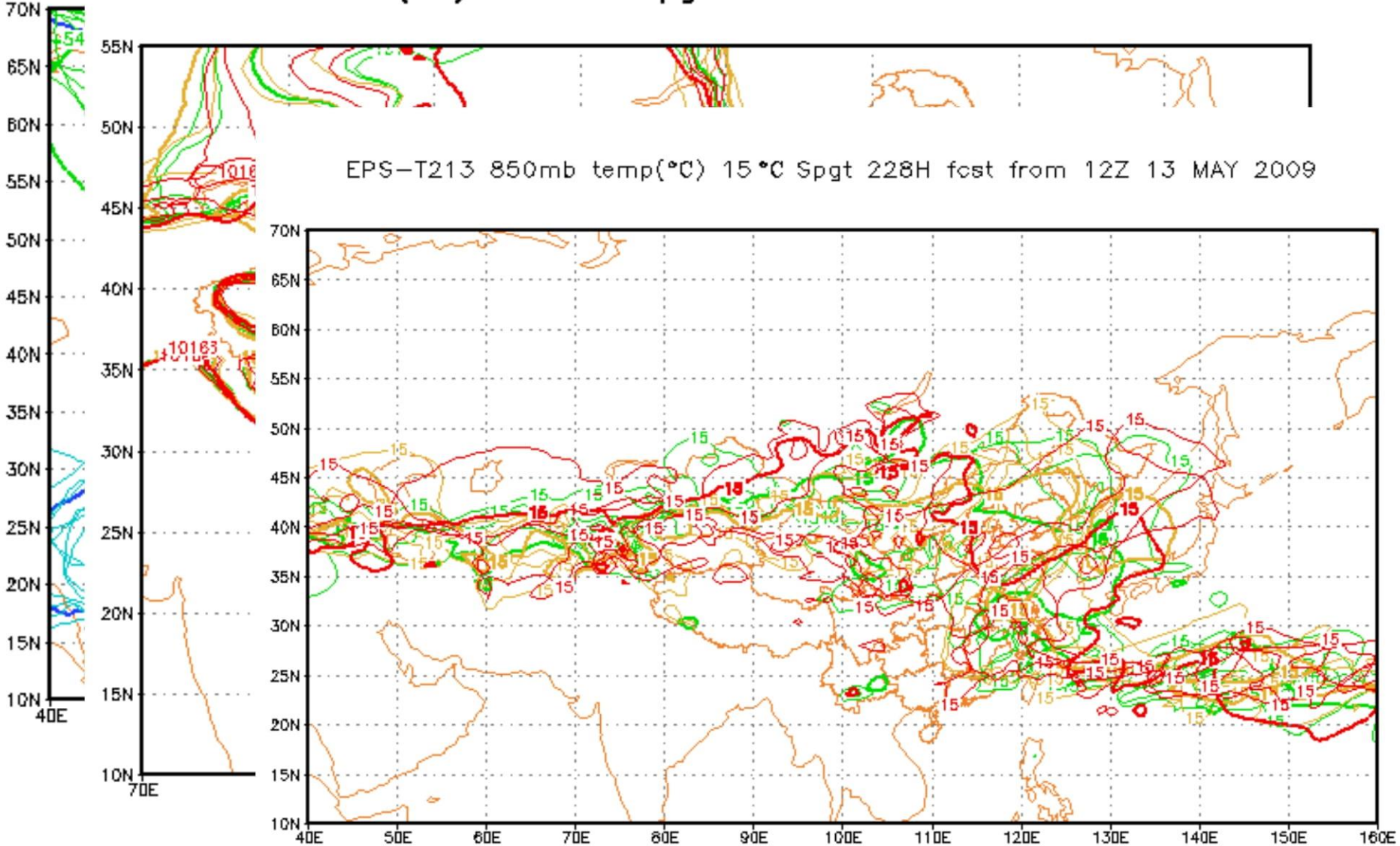
Spatial graphs

Spatial graphs: Spaghetti plots

EPS-T213 500mb Height(dm) 544 and 588 Spgt 168H fcst from 12Z 13 MAY 2009

EPS-T213 SLP(MB) 1016mb Spgt 48H fcst from 12Z 13 MAY 2009

EPS-T213 850mb temp(°C) 15 °C Spgt 228H fcst from 12Z 13 MAY 2009



GrADS: COLA/IGES

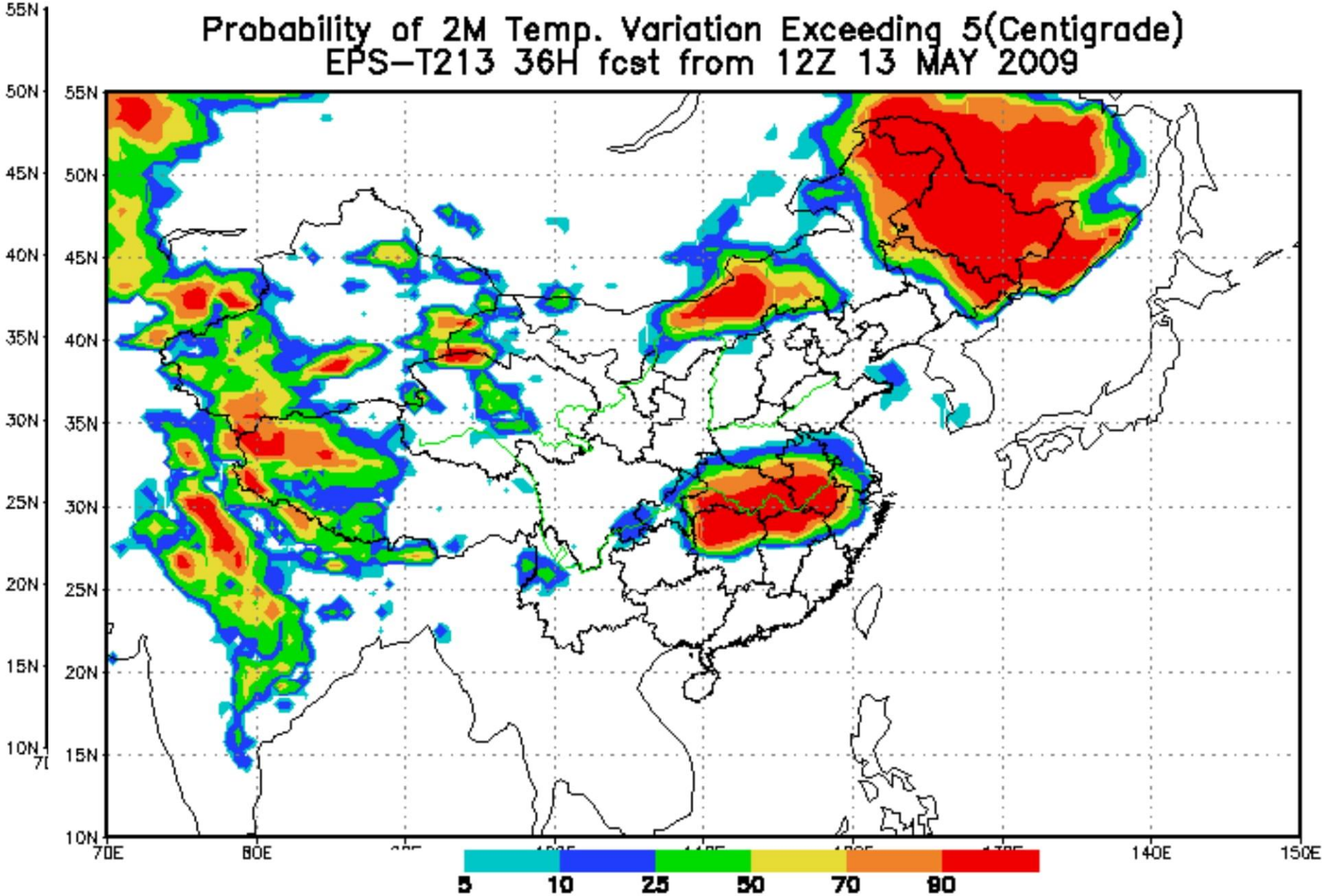
Spatial graphs

Probabilities of exceeding a threshold

- Very useful for extreme events
- The probability is calculated by counting the number of ensemble members that exceed a chosen threshold, and then dividing by the total number of members in the ensemble (democratic counting)

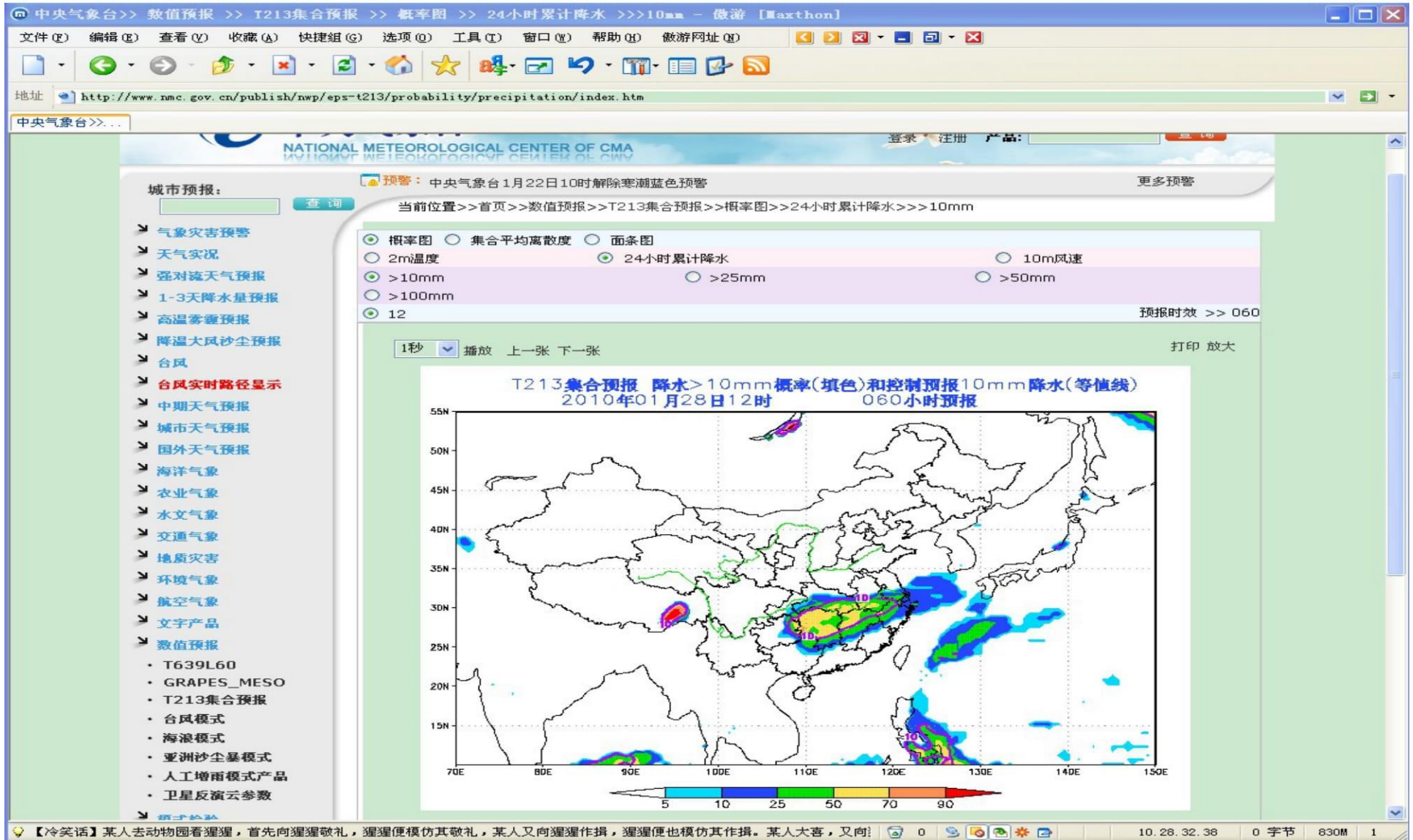
$$prob = \frac{n_{>threshold}}{N_{total}}$$

EPS–T213 Probability of precip.>25mm (shaded) and



The ensemble products on the NMC's web

http://www.nmc.gov.cn/publish/nwp/eps-t213/probability/precipitation/index.htm

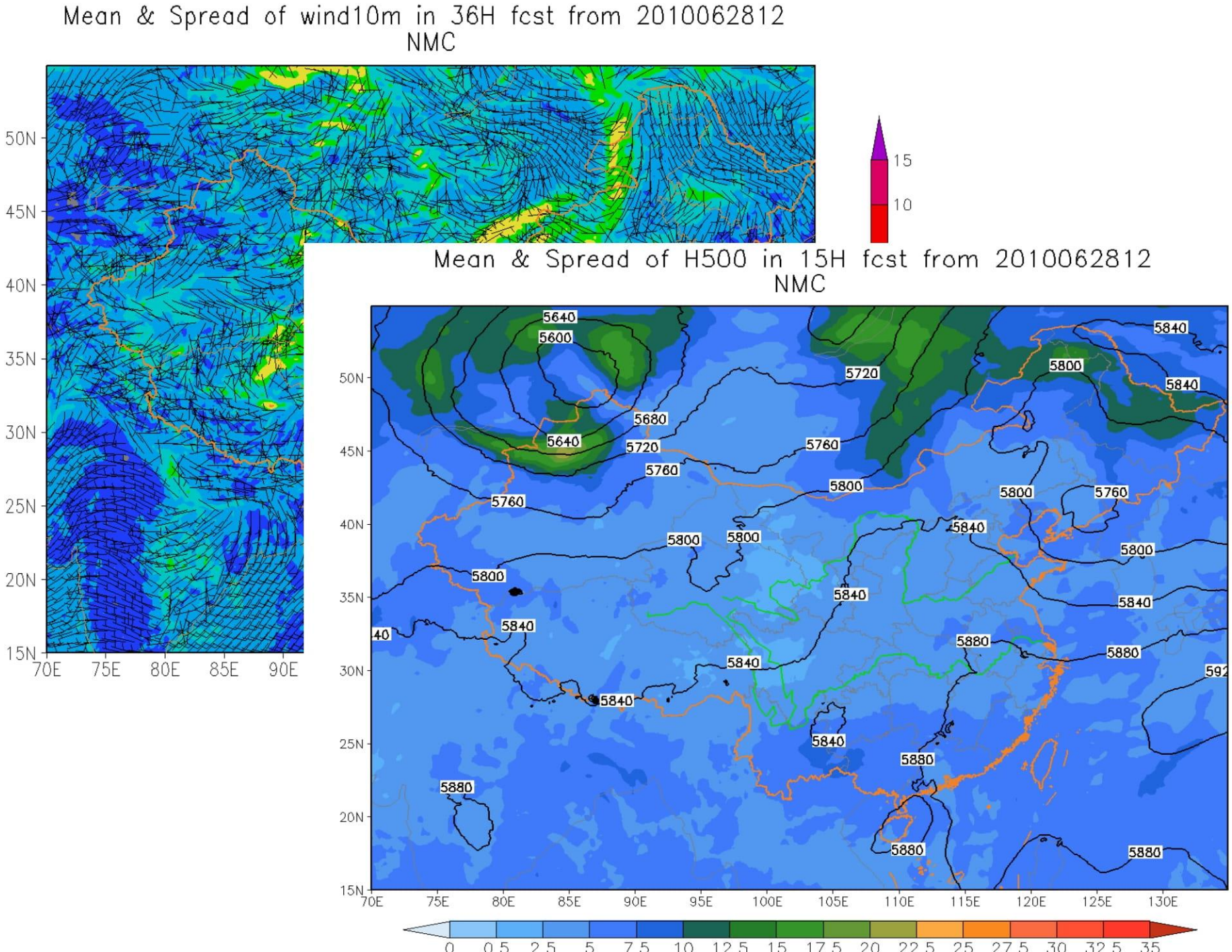


Products for REPS

Name	Variables	Products	Probability
3D variables			
HGT	Height	Layers：200 ,250,500,700,850,925, 1000hPa Mean,Spread	Forecast hours： 000,003,006,012,018,021,024， 027,030,036，039，42，045，048，051，054，057，060
QVAPOR	Specific humidity		
RH	Relative humidity		
UV	U and V component Wind		
TCTD	Temperature and Dew-point temperature		
THETASE	Pseudo-wet-bulb potential temperature		
DBZ	Radar reflection	Mean, Spread, Probability	>10,>30,>50
SOIL	4 level Soil humidity	Mean, Spread	
2D variables			
RAIN_3HR	3h accumulated precipitation	Mean, Spread, Probability	>0.25, >5, >15, >25, >50(mm)
RAIN_6HR	6h accumulated precipitation		
RAIN_12HR	12h accumulated precipitation		
RAIN_24HR	24h accumulated precipitation		
RAINC_3HR	3h accumulated convective precipitation		
RH2M	2m Relative humidity	Mean, Spread, Probability	
SAUN	Sangla Index		
CIN	Convective inhibition		
SLP	Sea Level Pressure		
T2M	2m Temperature	Mean, Spread, Probability	>35,>38（J/kg）
CAPE	Convective Available Potential Energy	Mean, Spread, Probability	>500,>1000，>1500,>2000（J/kg）
UV10M	10m Wind	Mean, Spread, Probability	>8m/s, >12m/s, >16 (m/s)
Convective Risk Index			
RISK_PRB1	Convective Risk Index	Probability	
RISK_PRB2	Convective Risk Index	Probability	

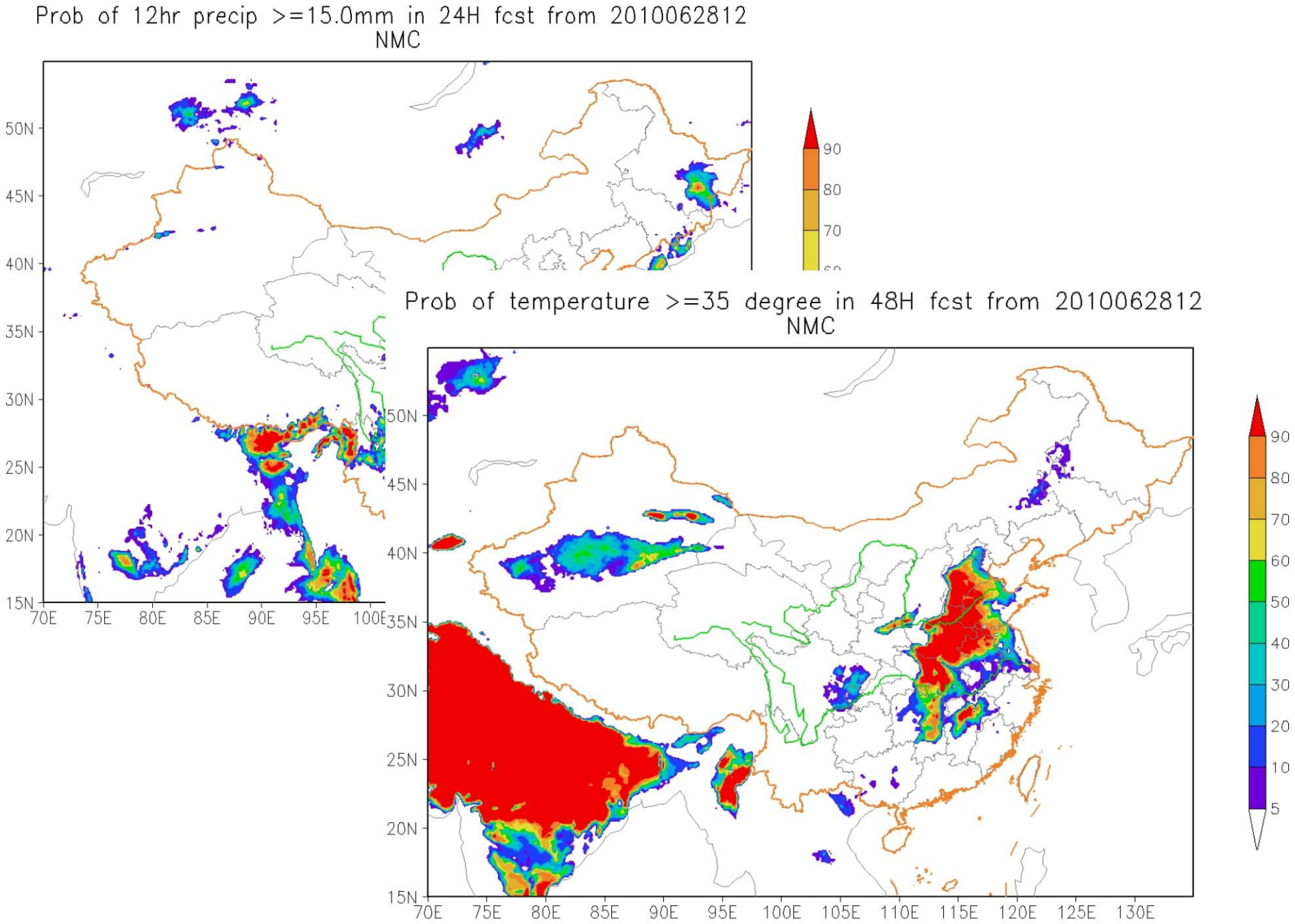
Mean and Spread
Forecast lead time:0-60hr

variable	level	INTERVALS	UNITS
precipitation	SURFACE	0.1,5,10,25,50	mm*
Wind	10m,200,850hPa	4	m/s
T2m	2m	2	°C
RH2m	2m	10	%
SLP	Sea level	1	hpa
MCAPE	Single level	200	m^2/s^2
CIN	Single level	10	J/kg
Sauna Index	Single level	2	°C
GH	500hpa,	10	GH


Mean & Spread of wind10m in 36H fcst from 2010062812
NMC
50N
45N
40N
35N
30N
25N
20N
15N
70E
75E
80E
85E
90E
15
10
Mean & Spread of H500 in 15H fcst from 2010062812
NMC
5640
5600
5720
5840
5800
5680
5760
5880
95E
100E
105E
110E
115E
120E
125E
130E
0
0.5
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
27.5
30
32.5
35

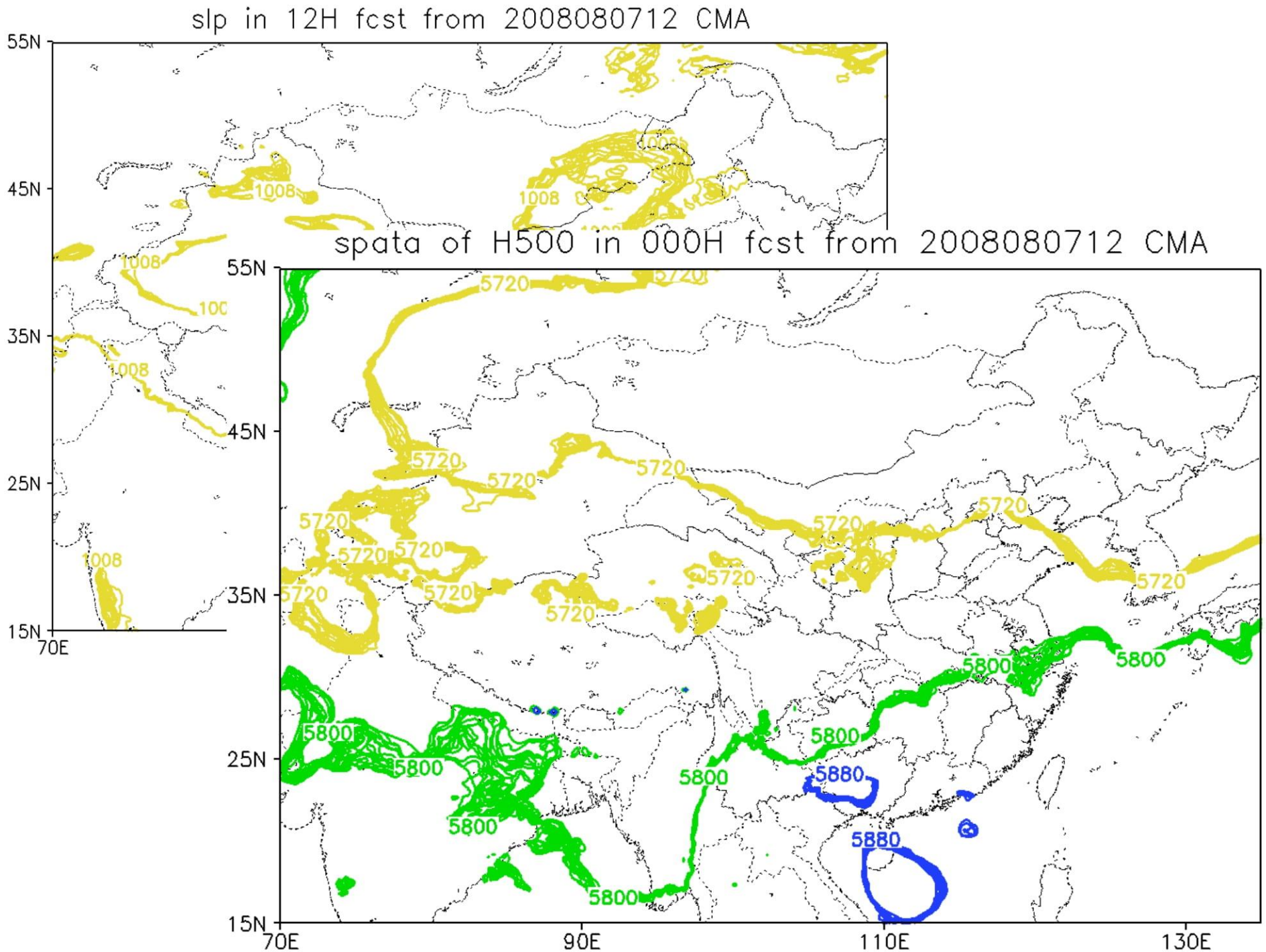
probability
Forecast lead time:0-60hr

variable	THRESHOLDS	units
precip	0.1; 10; 25; 50	mm*
wind	4J(5.5); 5J(8.0); 6J(10.8); 8J(17.2); 10J(24.5); 12J(32.7)	m/s
T2M	35; 38	°C


Prob of 12hr precip >=15.0mm in 24H fcst from 2010062812
NMC
50N
45N
40N
35N
30N
25N
20N
15N
70E
75E
80E
85E
90E
95E
100E
90
80
70
Prob of temperature >=35 degree in 48H fcst from 2010062812
NMC
50N
45N
40N
35N
30N
25N
20N
15N
70E
75E
80E
85E
90E
95E
100E
105E
110E
115E
120E
125E
130E
90
80
70
60
50
40
30
20
10
5

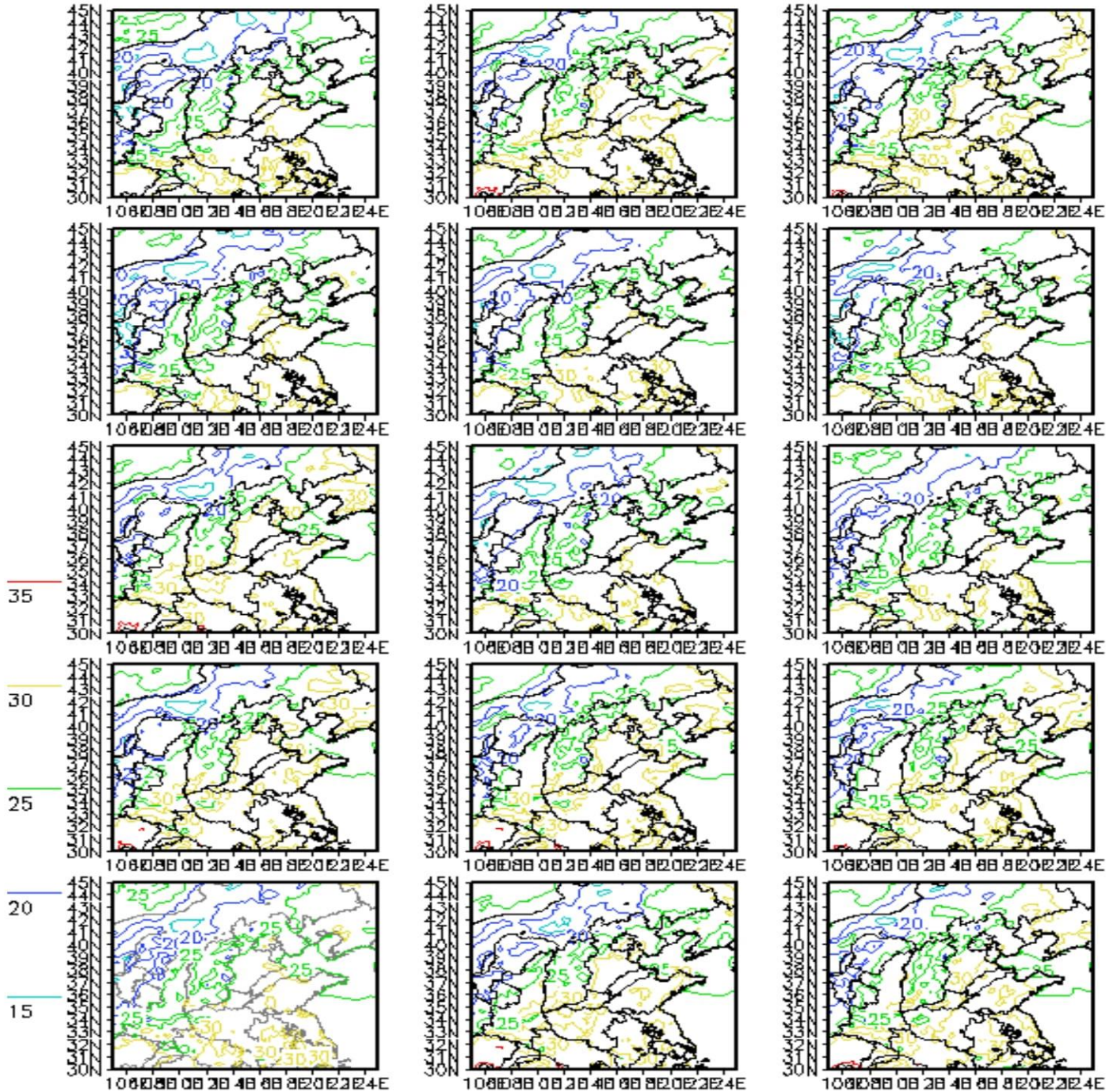
Spaghetti
Forecast lead time:0-60hr

VARIABLE	thresholds	units
PRECIP	0.1; 10; 25; 50	mm*
T2M	0，30	m/s
SLP	1008，1000，992	hPa
GH	5880,5800,5720	m


slp in 12H fcst from 2008080712 CMA
spata of H500 in 000H fcst from 2008080712 CMA
55N
45N
35N
25N
15N
70E
90E
110E
130E
1008
5720
5800
5880

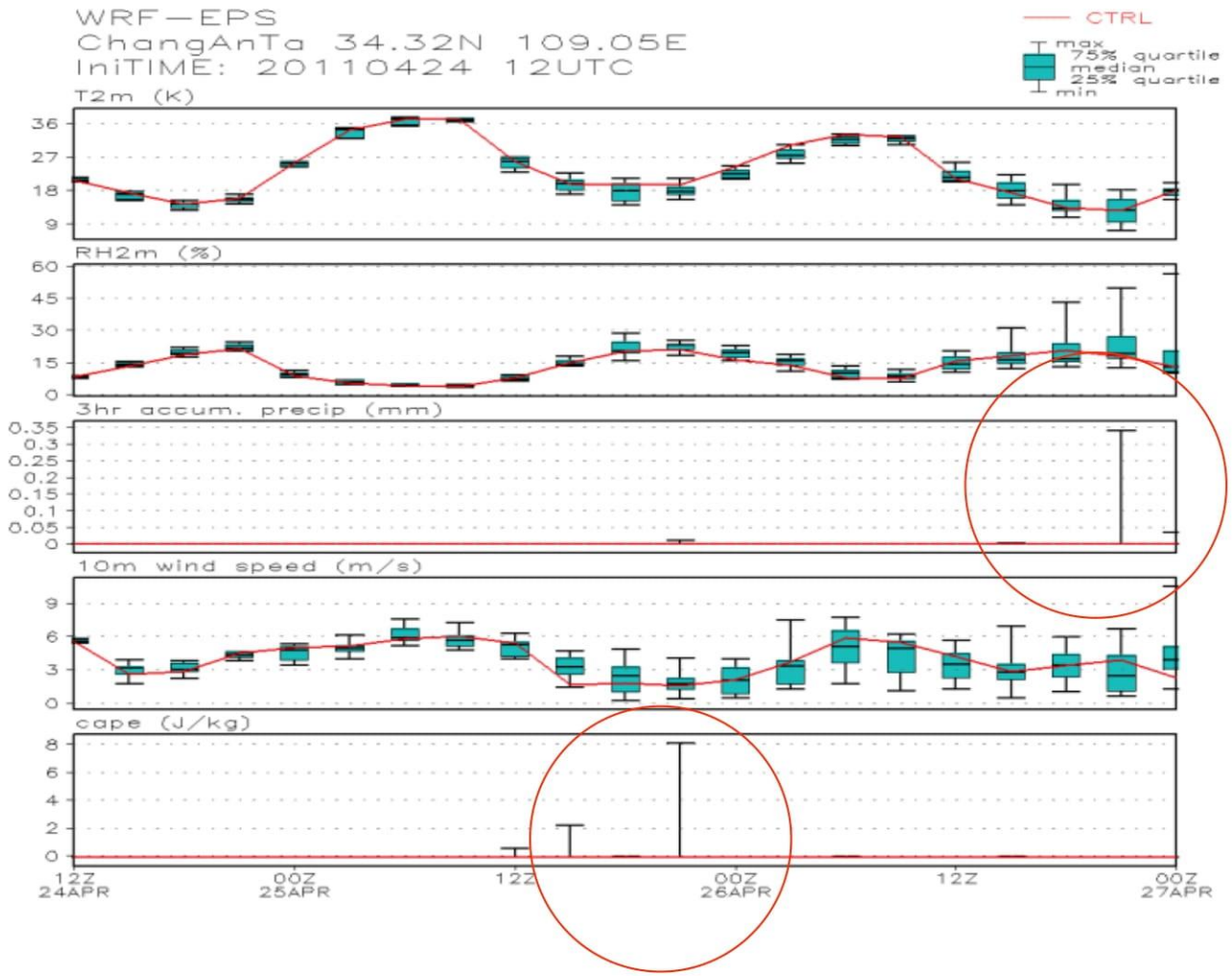
STAMP
Forecast lead time:0-60hr

Precip	Surface	0.1,5,10,25,50	mm
T 850h	850hPa	2	℃
T2m	2m	2	℃
2m RH	2m	10	%
Wind 10m	Sea Level		hPa
GH	500hpa	10	GH
2m delT	2m	0.5	℃


Stamp of t2 in 015H fcst from 2008073012 nmc
35
30
25
20
15

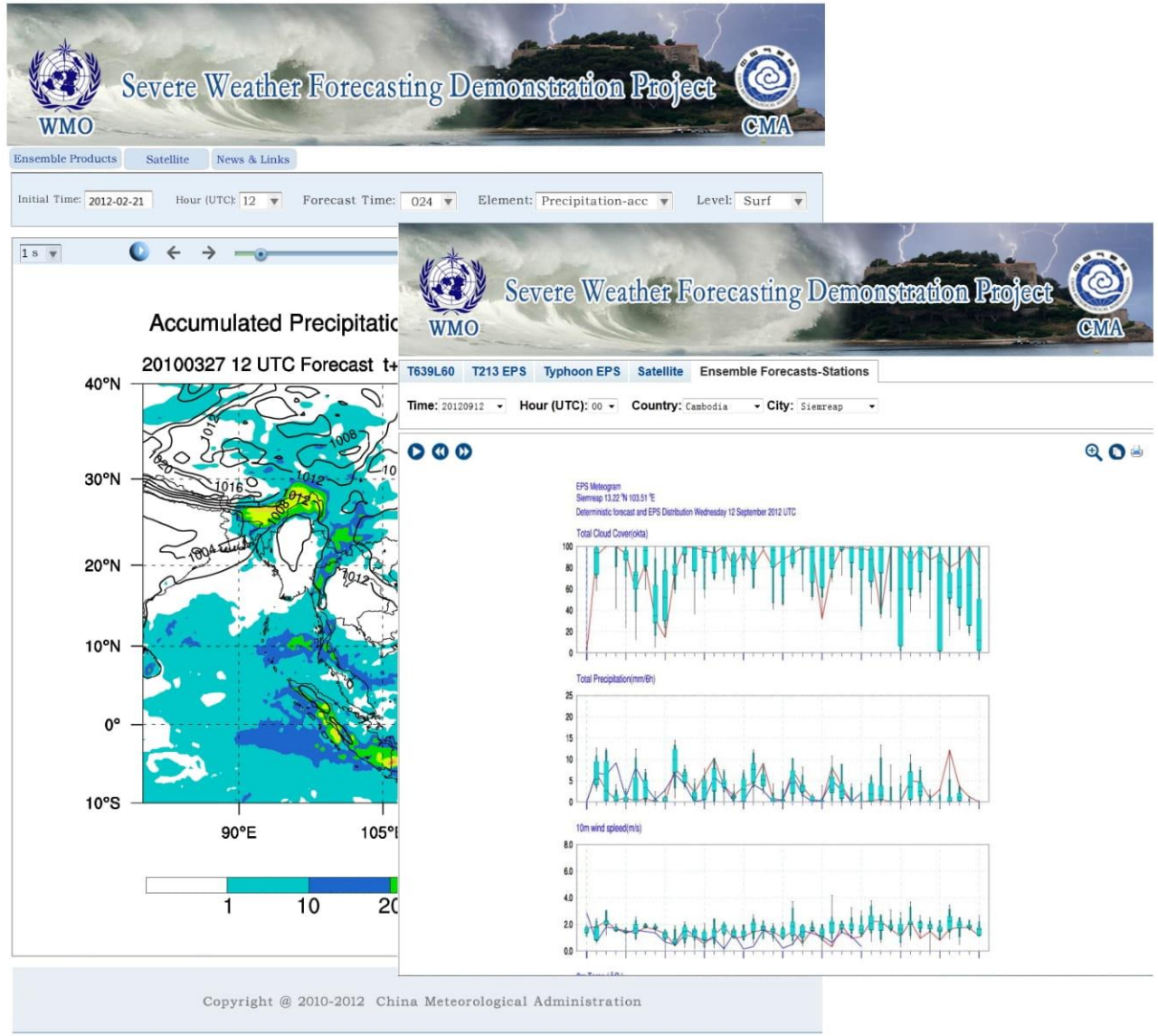
Time Series and Plumes

- Cape
- Cin
- T2m
- RH2m
- Precip
- …



http://eng.weather.gov.cn/swfdp/

The guide website of English version includes the demonstration program of Southeast Asian hazard/severe weather



Providing the real-time NWP products to Southeast Asia countries, including T639 products, T213 ensemble products, typhoon ensemble products, station ensemble products et al.

Specialized atmospheric dispersion model (RSMC Beijing)

History of RSMC Beijing

- Regional Specialized Meteorological Centre (RSMC Beijing) Beijing for Environmental Emergency Response (EER) was established in 1996. RSMC Beijing is one of the eight RSMCs designated by the WMO in the world and locates in the National Meteorological Centre of CMA.

Locations of Eight RSMCs Designated by the WMO and IAEA

Responsibilities and Tasks

- **International nuclear emergency response organized by IAEA and WMO, providing the standard products to other Asian nations in the Region, other WMO RSMCs, IAEA and WMO.**
- **Backtracking calculation organized by CTBTO and WMO and provide the corresponding products.**
- **Participate in the nuclear emergency exercises and operations organized by Chinese Nuclear Emergency Office and other departments and provide the forecast products to the national decision-making departments.**

The developing history of atmospheric transport model in RSMC Beijing

✓ First Generation (1997-2001)

- Atmospheric Transport model： LMTTP (Lagrange Model for Trajectory and Transport Prediction) by CMA；
- Atmospheric model：T106L19, providing the meteorological forcing data

✓ Second Generation: HYSPLIT4 global (2002-now)

- Atmospheric Transport Model: HYSPLIT4（Hybrid Single-Particle Lagrangian Integrated Trajectories, Version 4.0) ;
- Atmospheric model: T213L31

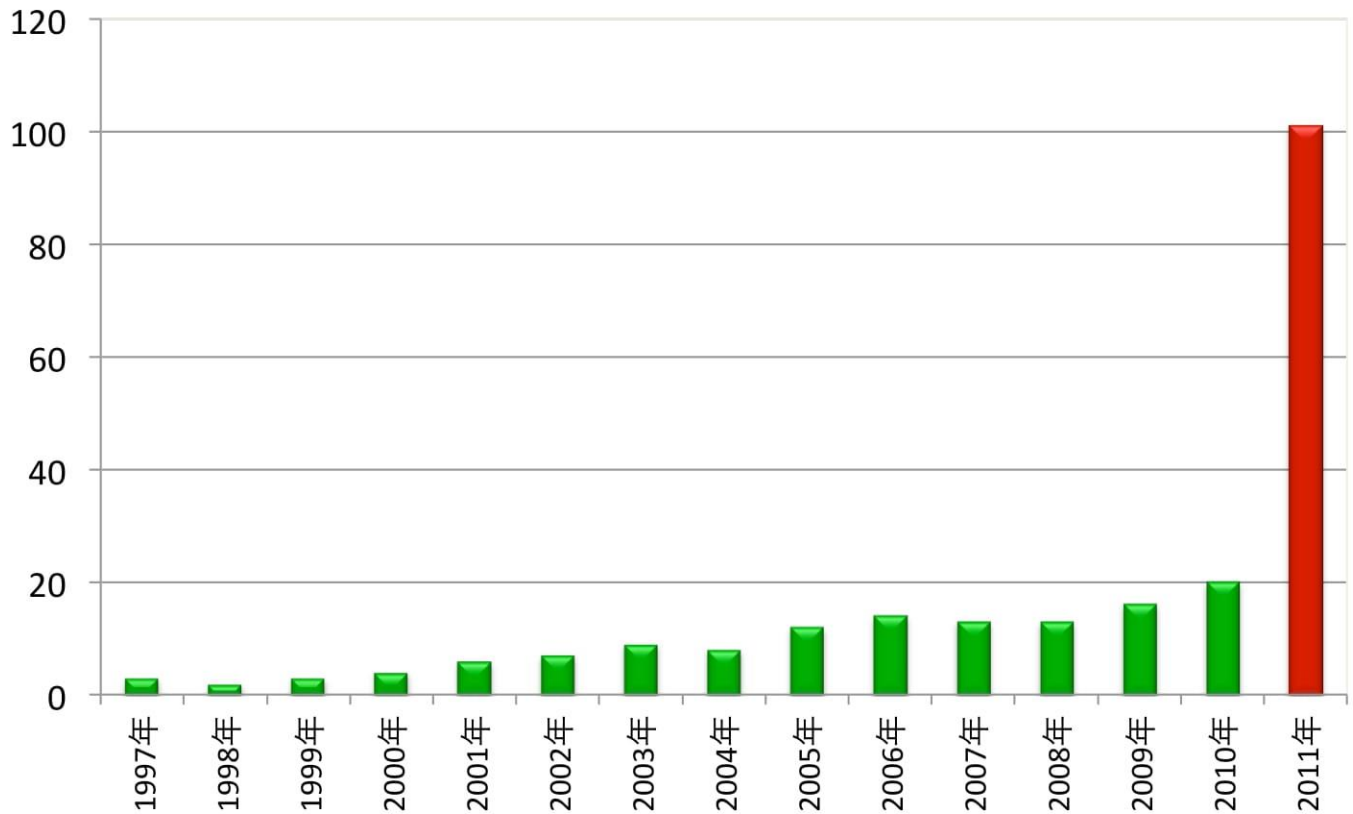
✓ The latest generation: HYSPLIT4 fine grid(2007-now)

- Atmospheric Transport Model: HYSPLIT4.9
- Atmospheric model: WRF

Brief introduction of HYSPLIT4

- HYSPLIT: Hybrid Single-Particle Lagrangian Integrated Trajectory.
- It is developed by **NOAA Air Resources Laboratory**.
- HYSPLIT model is a complete system for computing simple air parcel trajectories, complex dispersion and deposition.
- The dispersion in HYSPLIT is calculated by assuming either **puff** or **particle dispersion**.

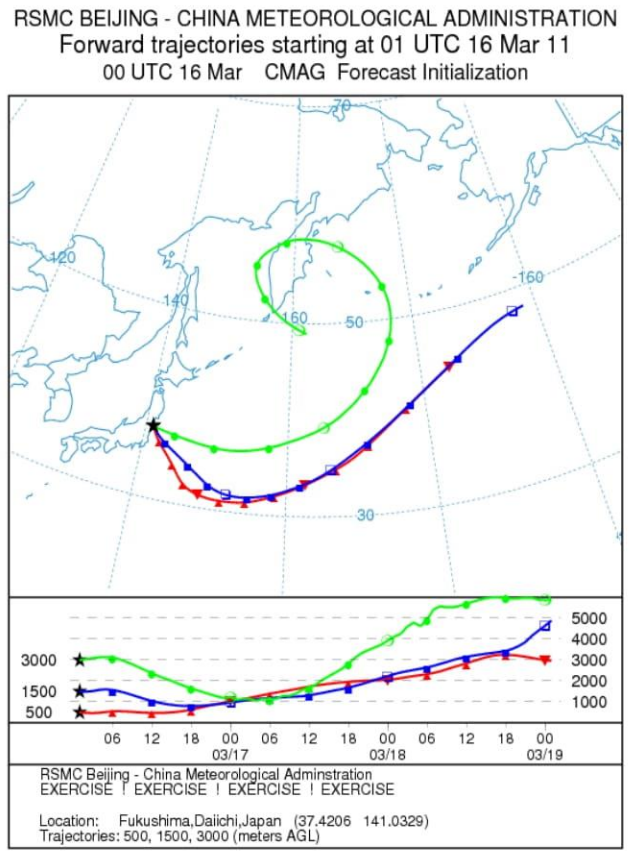
Participated International Nuclear Emergency Exercises

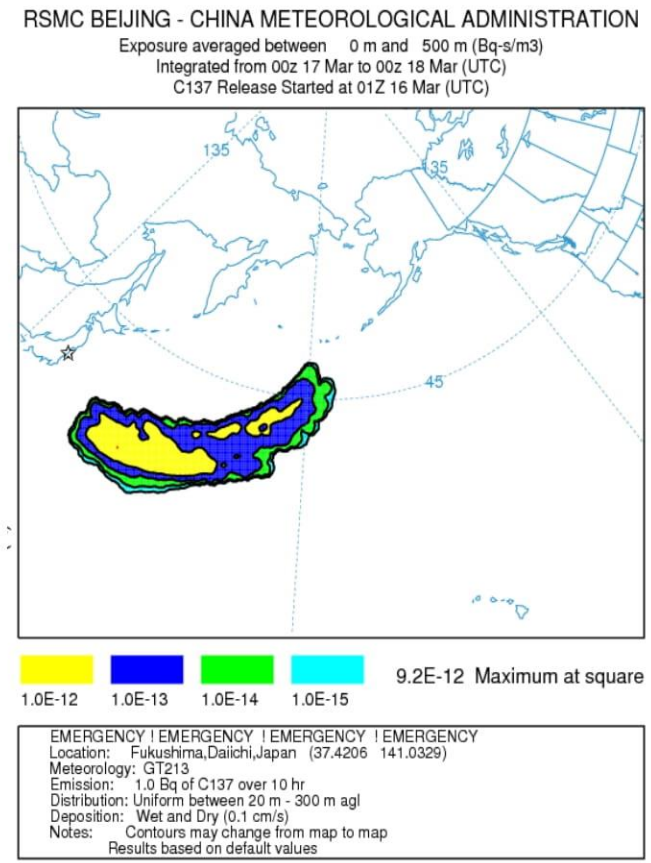


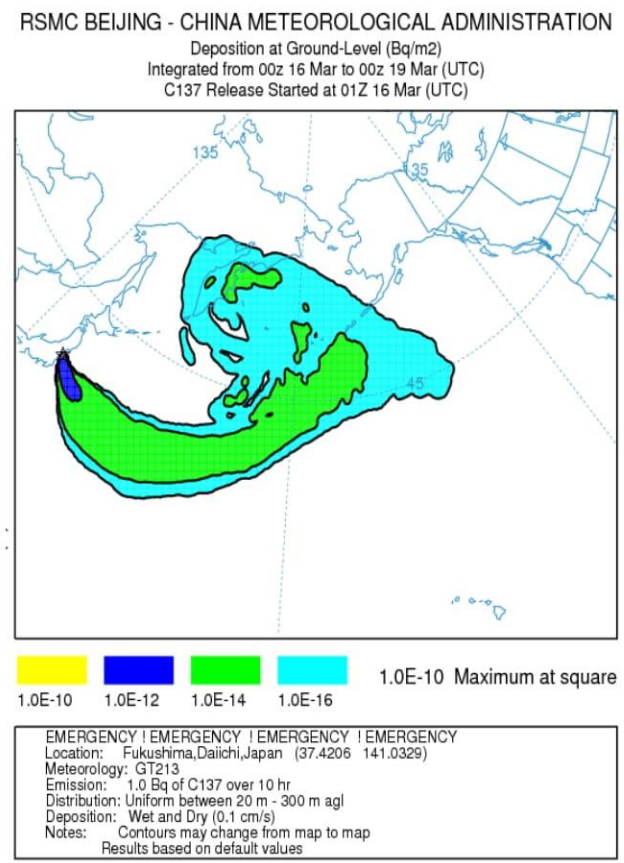
From 1997 to 2011

International Standard Products of RSMC Beijing

- Three-dimensional trajectories starting at 500, 1500 and 3000 m above the ground, at 6h interval, for 72-hour;
- Time-integrated air concentrations in Bq.s m^{-3} between 500 m and ground, (24-hour, 48-hour, and 72-hour);
- Total deposition (wet + dry) in Bq m^{-2} from the release time to the end of the dispersion model forecast (72-hour).







Backtracking of CTBTO-WMO

(Comprehensive nuclear-test-ban treaty organization)

Source-Receptor Sensitivity fields from the RSMC

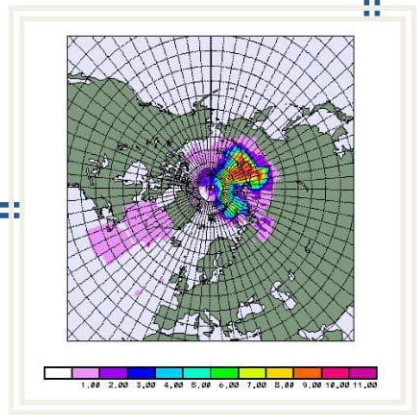
CTBTO post-processing computations

Fields of Regard

Possible Source Region estimation

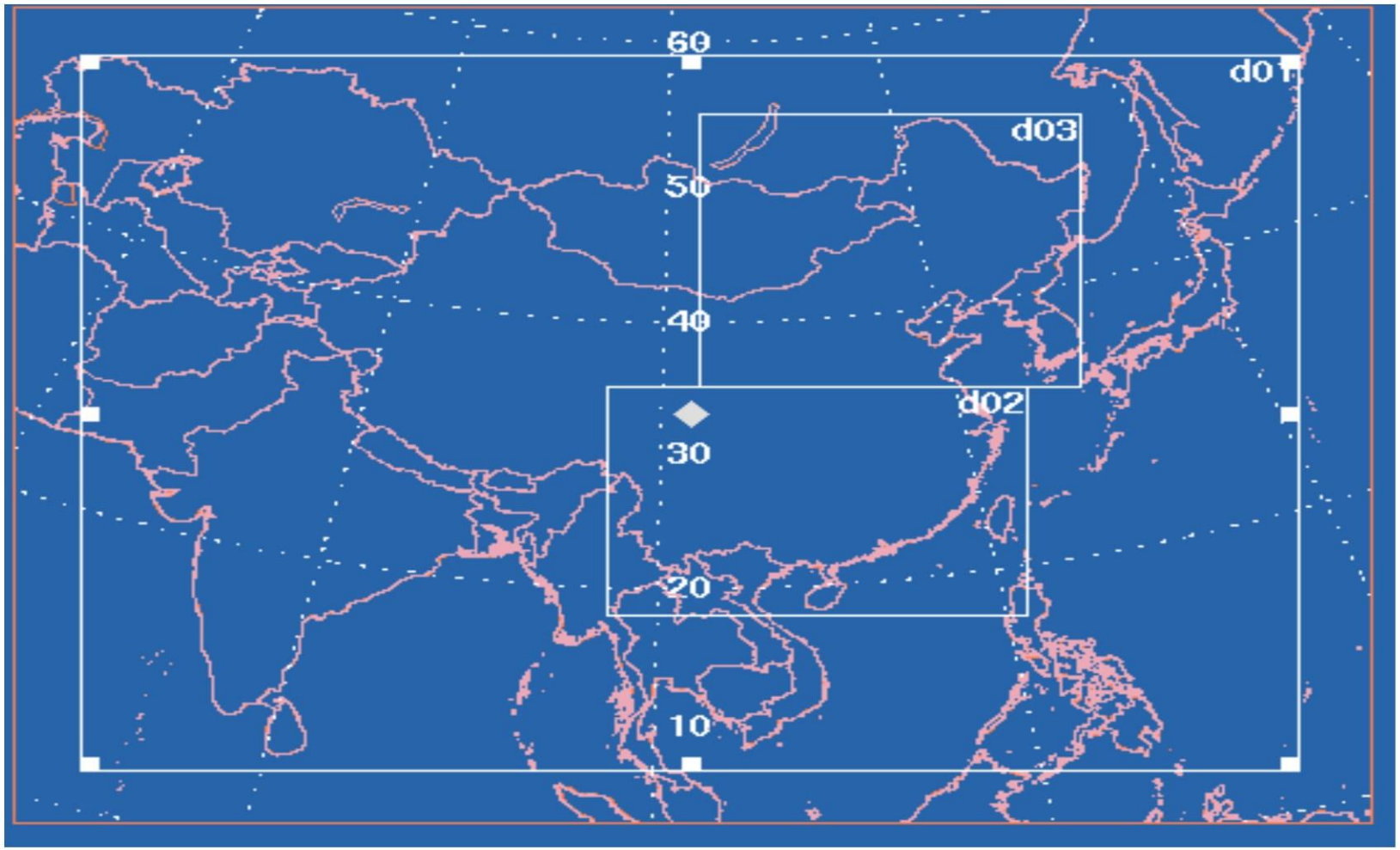
The region of the globe where a source could potentially influence a RN measurement is called Field of Regard (FOR):

- **Binary FOR**
- **Quantitative FOR**
- **Multiple model FOR**



To each potential release point a number can be associated; the square of the correlation coefficients between the measured concentration pattern that would result from a hypothetical point release at that point

Domestic Emergency Response



Horizontal Resolution:

15 kilometers/5 kilometers

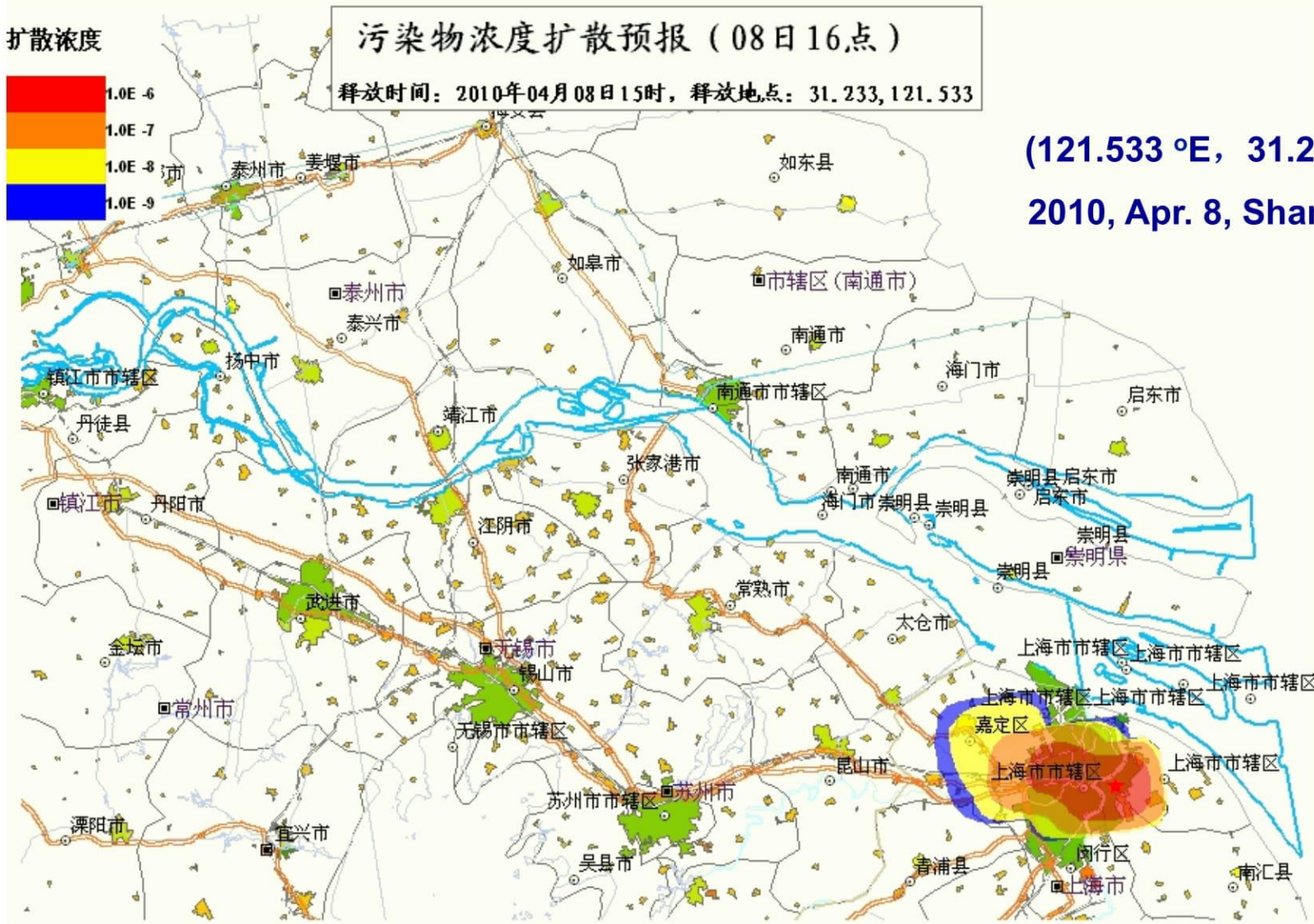
The 12-hour Trajectories released at different heights

Red:10m
Blue:500m
Green:1000m

(121.533 °E，31.233 °N)

2010, Apr. 8, Shanghai

1 to 6-hour Forecast of the Pollutant Concentration Distribution at 100m（1 slide/h）



(121.533 °E，31.233 °N）

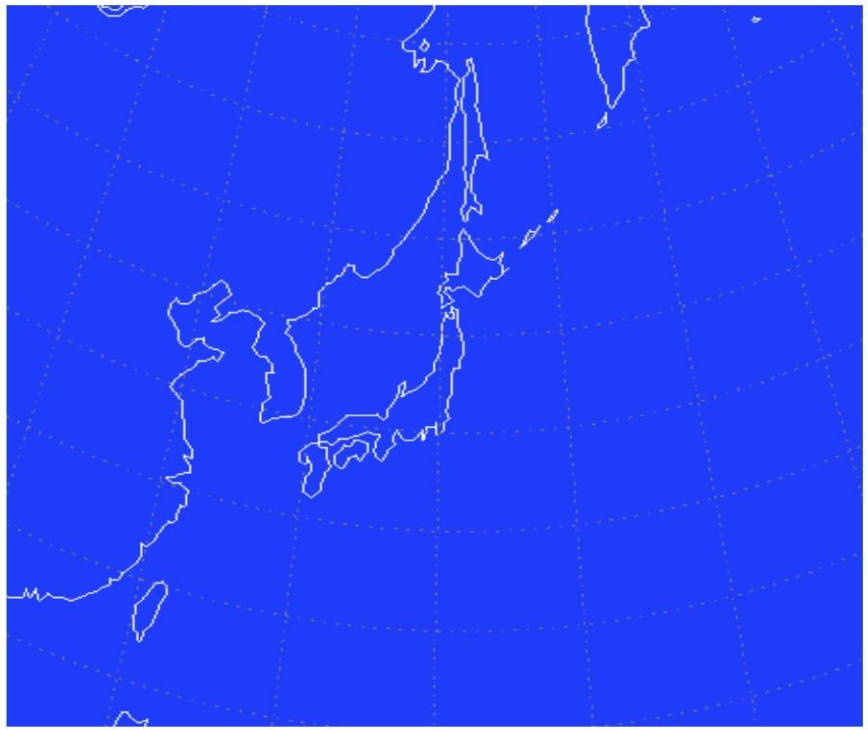
2010, Apr. 8, Shanghai

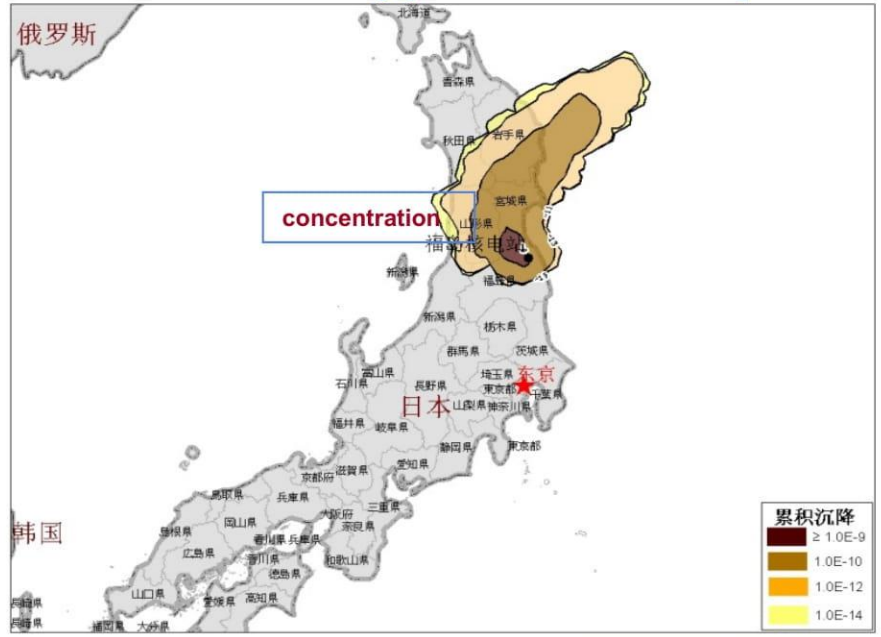
1 to 6-hour Forecast of the Pollutant Deposition（1 slide/h）

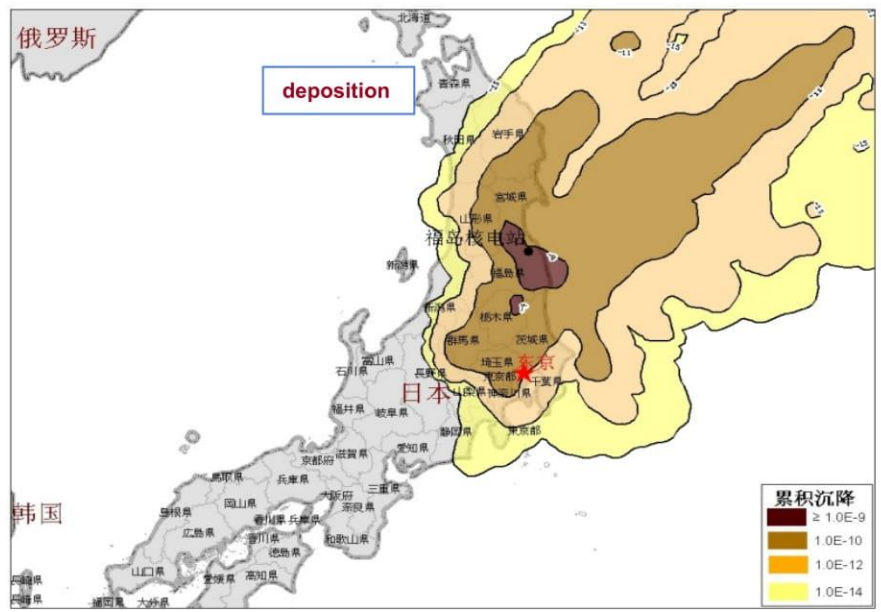
What have we done

- 64 copies of special reports for domestic decision-making until May 16;
- 42 copies of products and joint statements according to IAEA requests
- 20 copies of CTBTO backtracking products.
- Developed the Fine-Grid EER System for the region of Japan, numerous simulations of extreme weather cases, the GIS plots and long-time assessment of Japan nuclear dispersion;

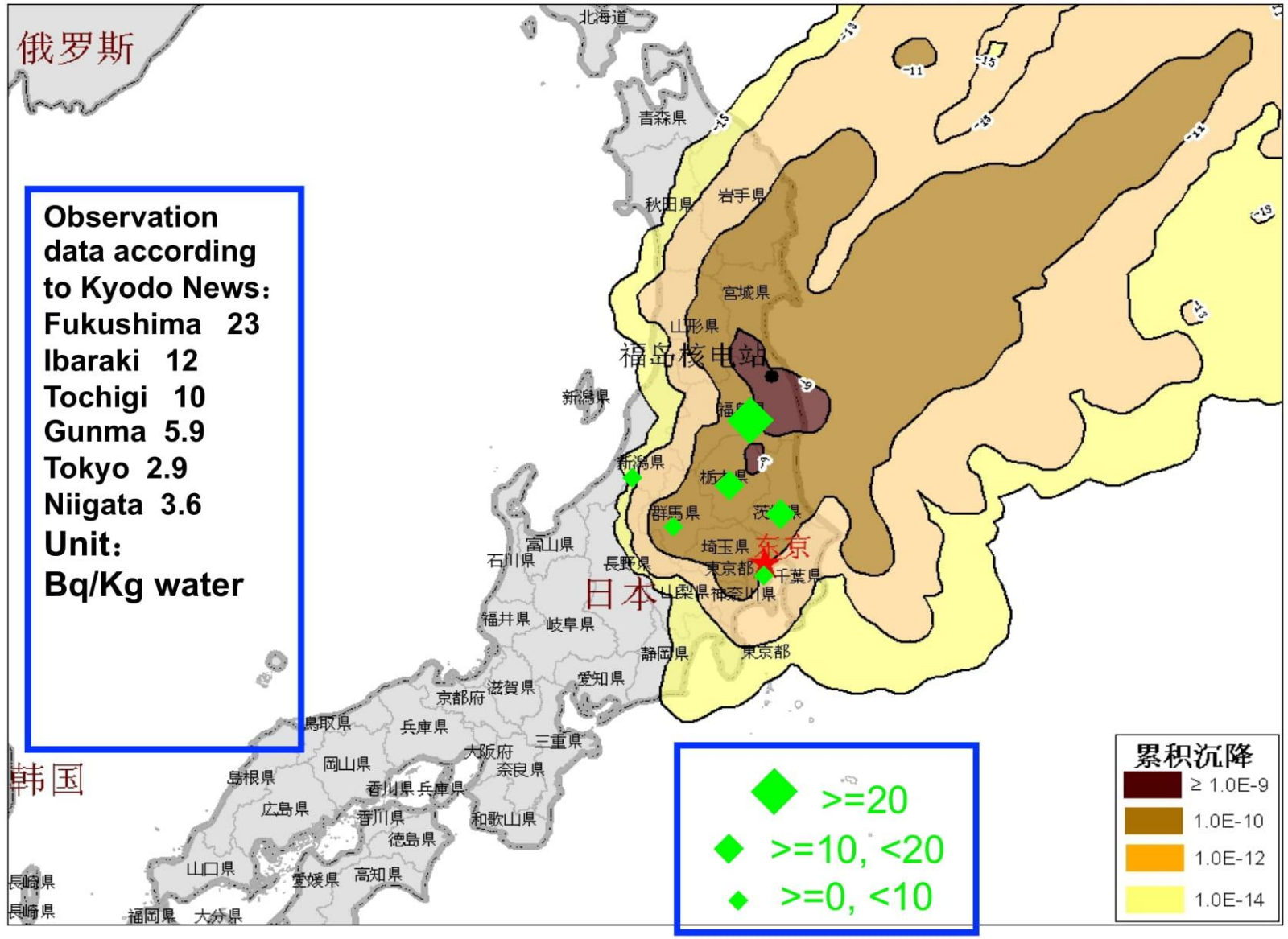
Fine-Grid EER System for the Region of Japan



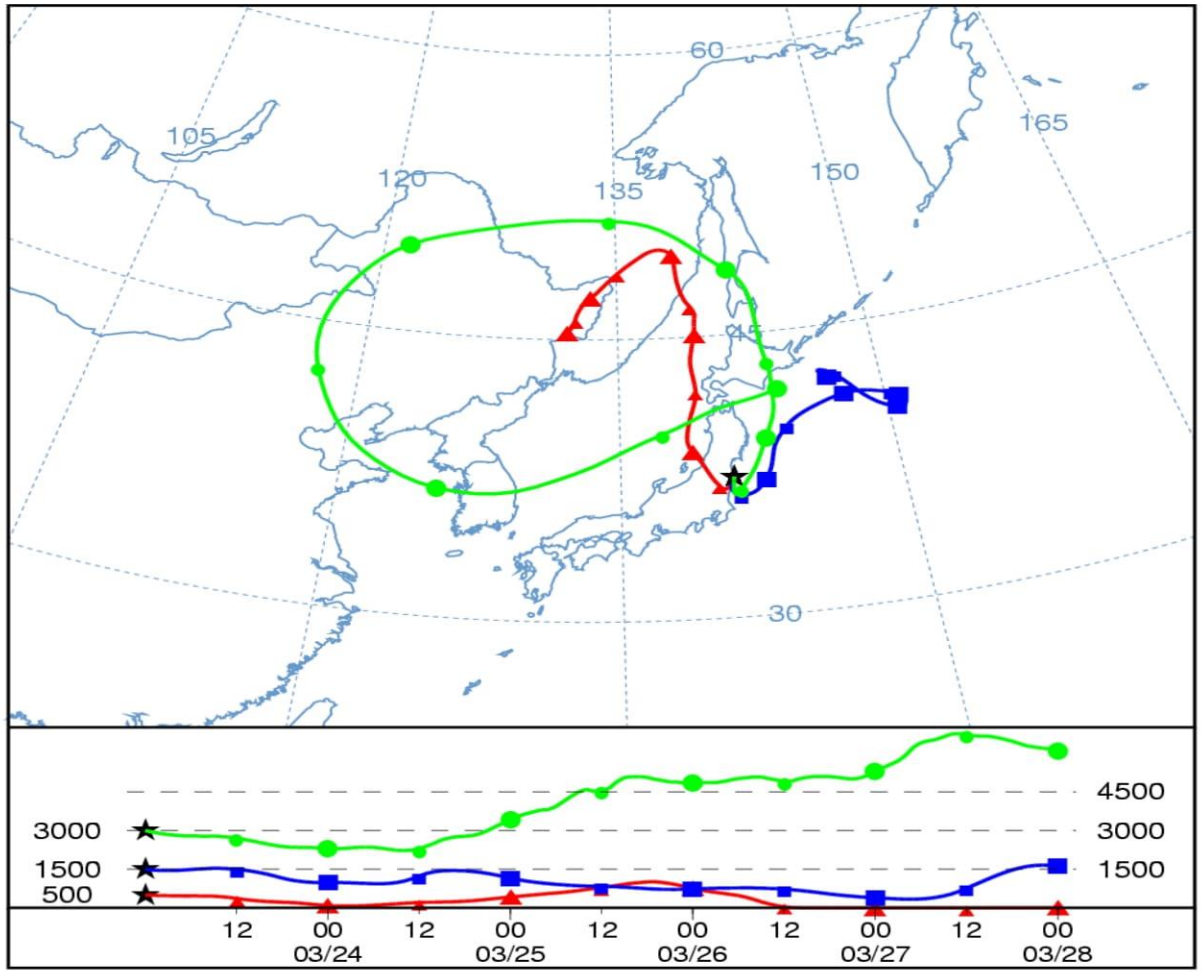




The Deposition of Cs for Fukushima Daiichi
Mar.20,00UTC～Mar.23,00UTC



The case of extreme weather: East Wind

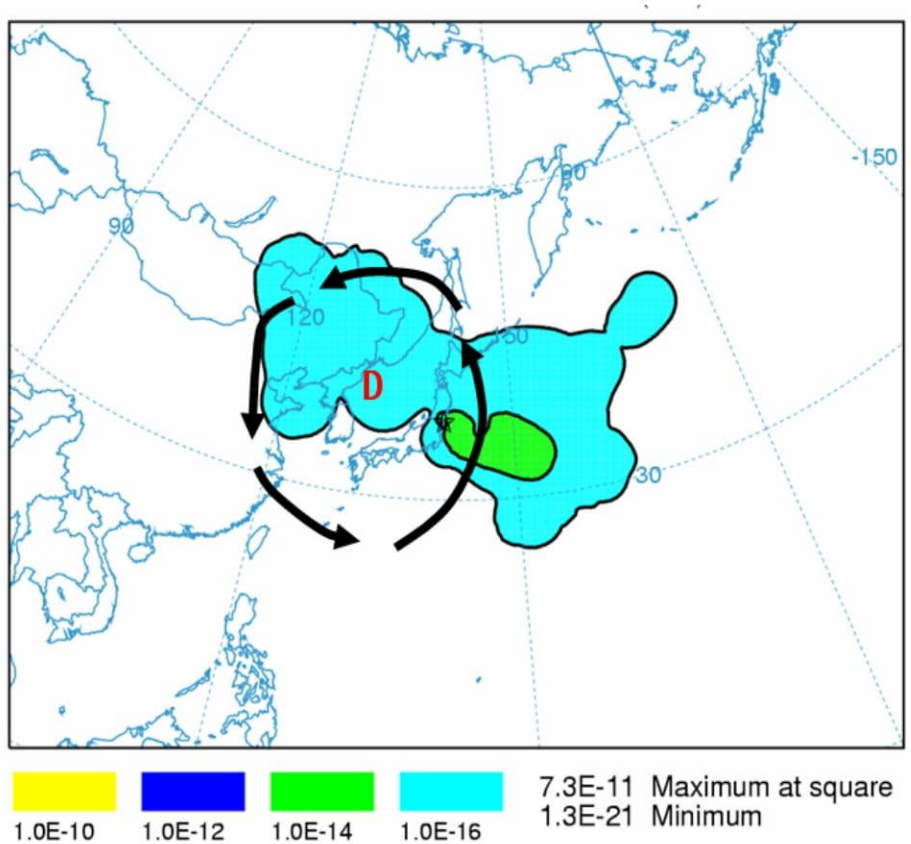


The trajectories released at different heights: 500m, 1500m, and 3000m

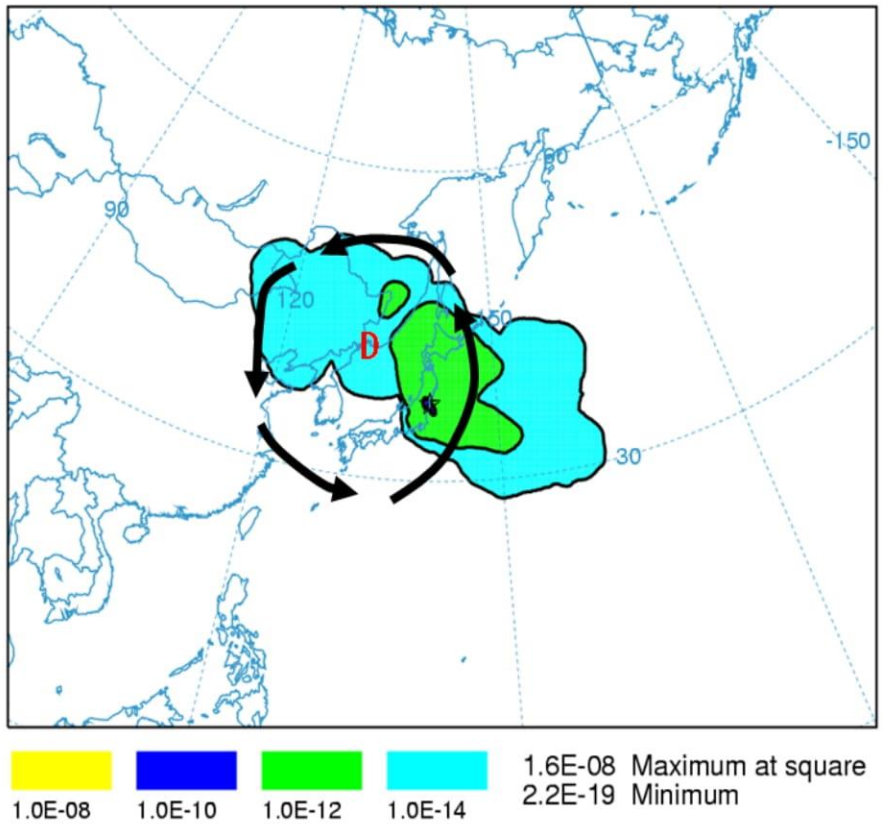
The case under extreme weather: East Wind

From: Mar 23 to Mar 27
Duration: Mar 23 to Mar 27

Total quantity: 1Bq Cs137
Height: 20m to 500m



The distribution of concentration, mBq/m^3
Mar 27, 00:00 – Mar 28, 00:00
The arrows show the wind

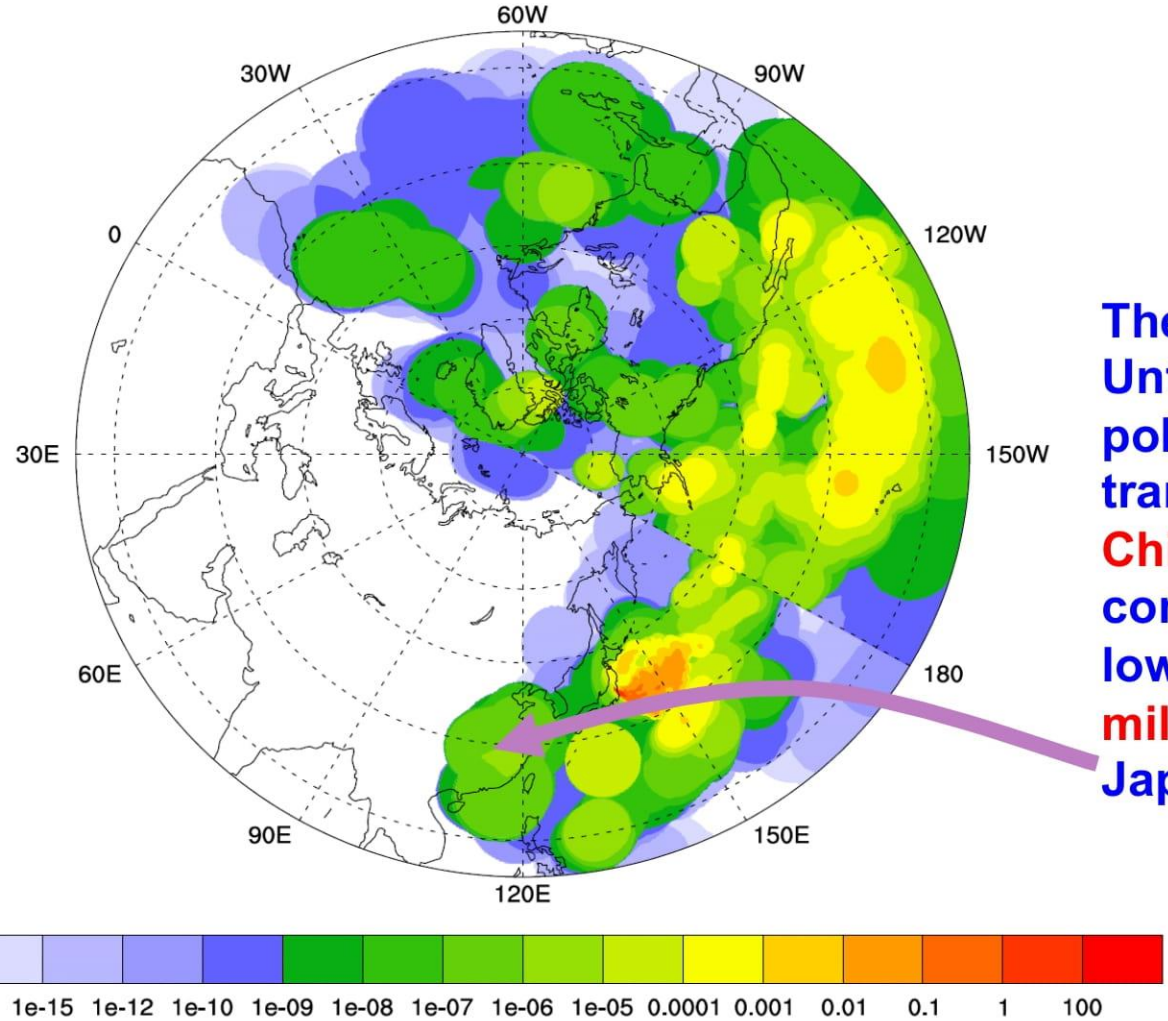


The distribution of deposition, mBq/m^2
Mar 23, 00:00 – Mar 28, 00:00
The arrows show the wind

The Integrated Result of the Environmental Emergency Response Model

The global averaged concentration from 0-500m of the nuclear pollutants released by Japan Fukushima Nuclear Accidents at 00UTC,Mar.28

（Start of the Release：00UTC,Mar.12;Total Release Quantity：3.7×10^{16}Bq）



The result shows：Until Mar.28,nuclear pollutants have transported to East China, but the concentration is lower than 1 of 1 millionth that in Japan (Fukushima).

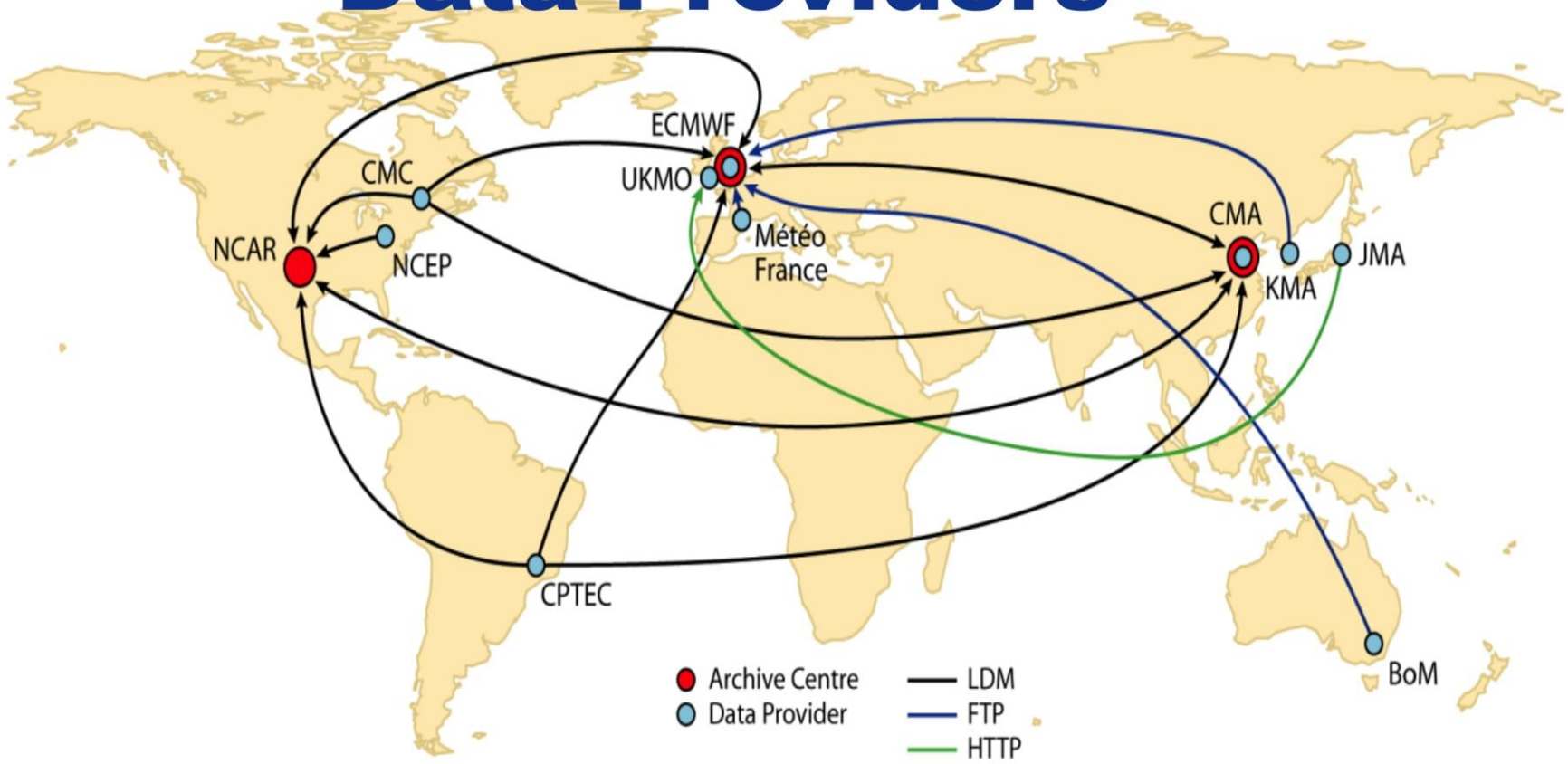
TIGGE - the THORPEX Interactive Grand Global Ensemble

TIGGE, the THORPEX Interactive Grand Global Ensemble, is a key component of THORPEX: a World Weather Research Programme to accelerate the improvements in the accuracy of 1-day to 2 week high-impact weather forecasts for the benefit of humanity

The TIGGE archive consists of ensemble forecast data from ten global NWP centres, starting from October 2006, which has been made available for scientific research. TIGGE has become a focal point for a range of research projects, including research on ensemble forecasting, predictability and the development of products to improve the prediction of severe weather. The TIGGE project is overseen by the GIFS-TIGGE working group, which includes representative of the TIGGE data providers and the TIGGE archive centres.

From http://tigge.ecmwf.int/

TIGGE Archive Centres and Data Providers



Three archive center: ECMWF, NCAR, CMA

Ten data providers: ECMWF, JMA (Japan), UK Met Office (UK), CMA (China), NCEP (USA), CMC (Canada), Météo-France (France), BOM (Australia), KMA (Korea), CPTEC (Brazil)

TIGGE Data day reception

Product Center	Prediction Time (Hour, Day)	Mem bers	Level type	Times	Start Time	the Daily Incremental Data (GB)	Total Data（TB）（to 2012.8.31）
egrr(UKMO)	0000-0360, 15	24	pl, pt, pv, sl	2(00,12)	11/2006 03/2010	24 54	68
babj(CM			pl, sl	2(00,12)	02/2007	28	57
ecmf(ECMWF)	0000-0360, 15	51	pl, pt, pv, sl	2(00,12)	03/2007 01/2010 07/2012	150 332 338	423
kwbc(NCE)			l, pt, pv	4			
rjtd(JMA)	0000-0216, 9	51	pl, sl				
ammc(BoM)			sl				
cwao(CMC)	0000-0384,16	21	pl, sl				
lfpw(Meteo France)	0000-0060, 2.5			1(18)	10/2007 12/2009	0.2 2	2
rksl(KMA)				,12)	01/2008 03/2011	5 60	19
sbsj(CPTEC)	0000-0360, 15	15	pl, sl	2(00,12)	02/2008	12	20
合计					12/2006 01/2010	253.2 437	656

Add a new parameter , Convective Inhibition (CIN) from 28 July,2012

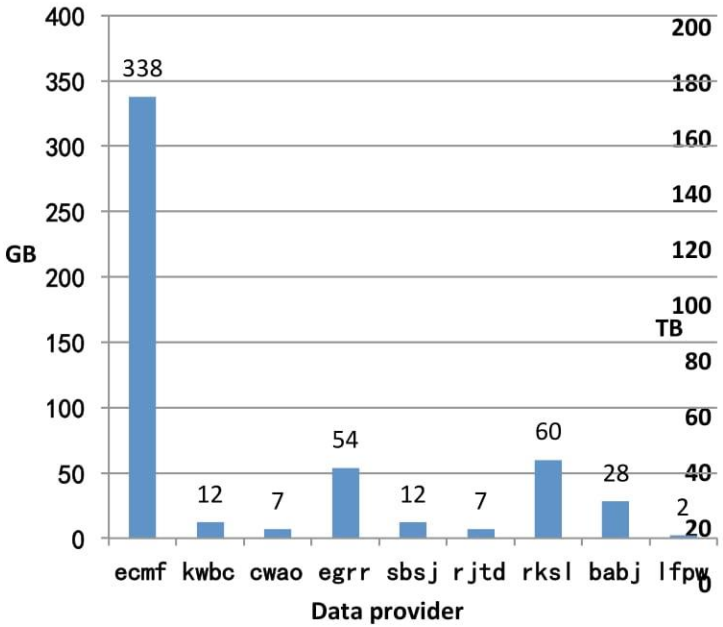
Add 00Z data since Aug.2011

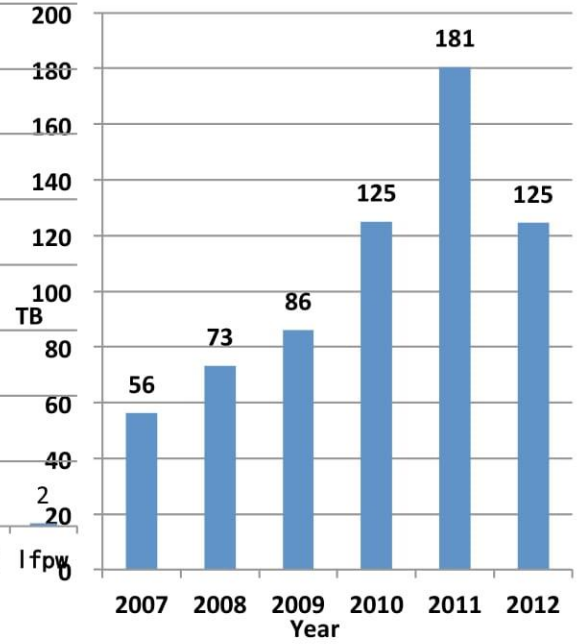
Stop in Aug.2010

Stop in Dec.2010 then begin to transfer the data of upgrade model since Mar.2011,the data size is 60GB/day.

We have received data from other centers since 1th,nov, 2006. It is reported that 656TB data exchange has been achieved totally until Aug.2012.
57TB data of the products of CMA Ensemble Prediction System has been sent.
According to the received data volume, ECMWF takes the lead with the total number 423TB， followed by UK Met Office with 68TB.

Number of exchange TIGGE data in CMA





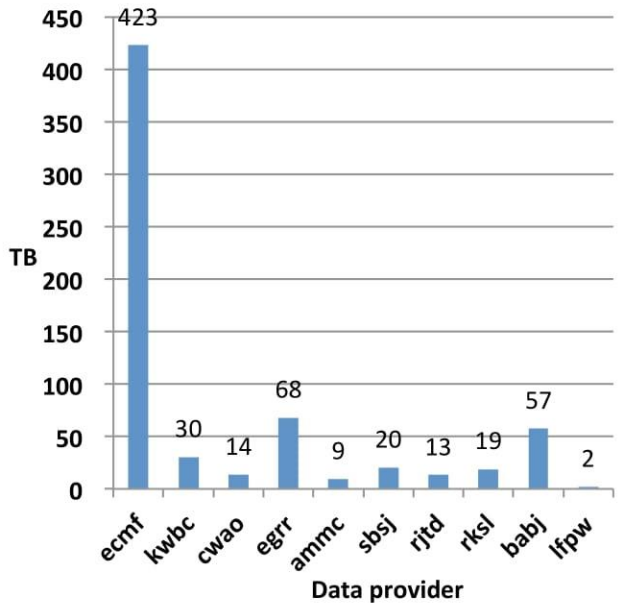
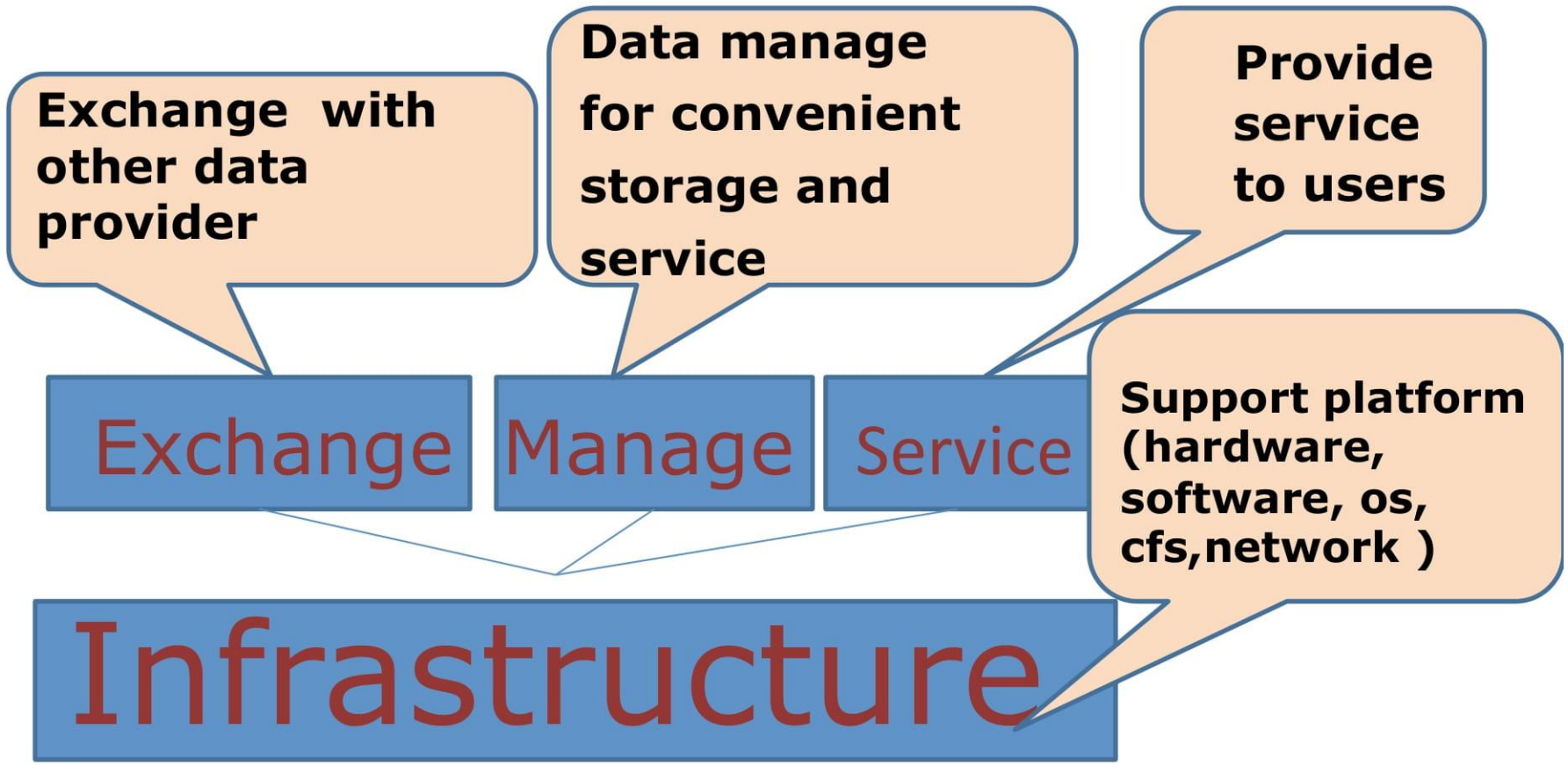


CHART 1:
The Daily Incremental Data In CMA

CHART 2:
The annual number from 2007 to Aug 2012.

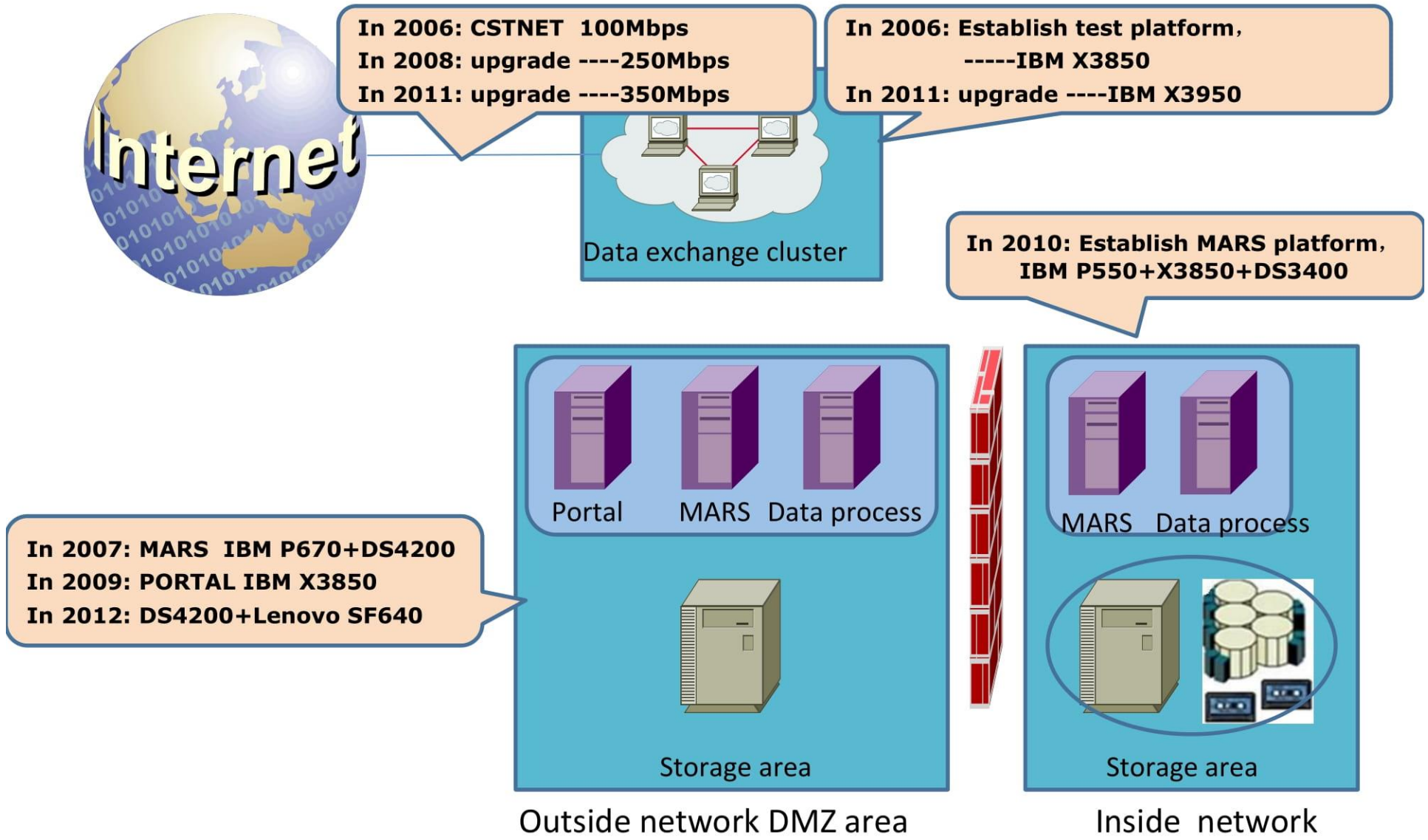
CHART 3:
From 2007 to Aug 2012.total number each provider,
Total 656 TB.

Logical structure in CMA TIGGE



Progress overview

Infrastructure hardware overview



Progress overview

•Infrastructure — Internet

- **CMA TIGGE access：**
  - CSTNET(China Science and Tech network)
  - Network bandwidth
- **In 2006**

  - Connect to CSTnet access rate 100Mbps
- **In 2008:**

  - upgrade ----250Mbps
- **In 2011**

  - Optimal network performance, Internet access rate upgraded to 350Mbps

Progress overview

- Infrastructure

  ----software

1	Os platform	Linux
2	Cfs	IBM GPFS
3	Transfer	UNIDATA LDM
4	Monitor	SMS
5	Manage	MARS

Progress overview

- Data exchange system
- **In 2006**
  - July: Establish test platform
  - Nov: Continuous data receiving test
- **In 2008**

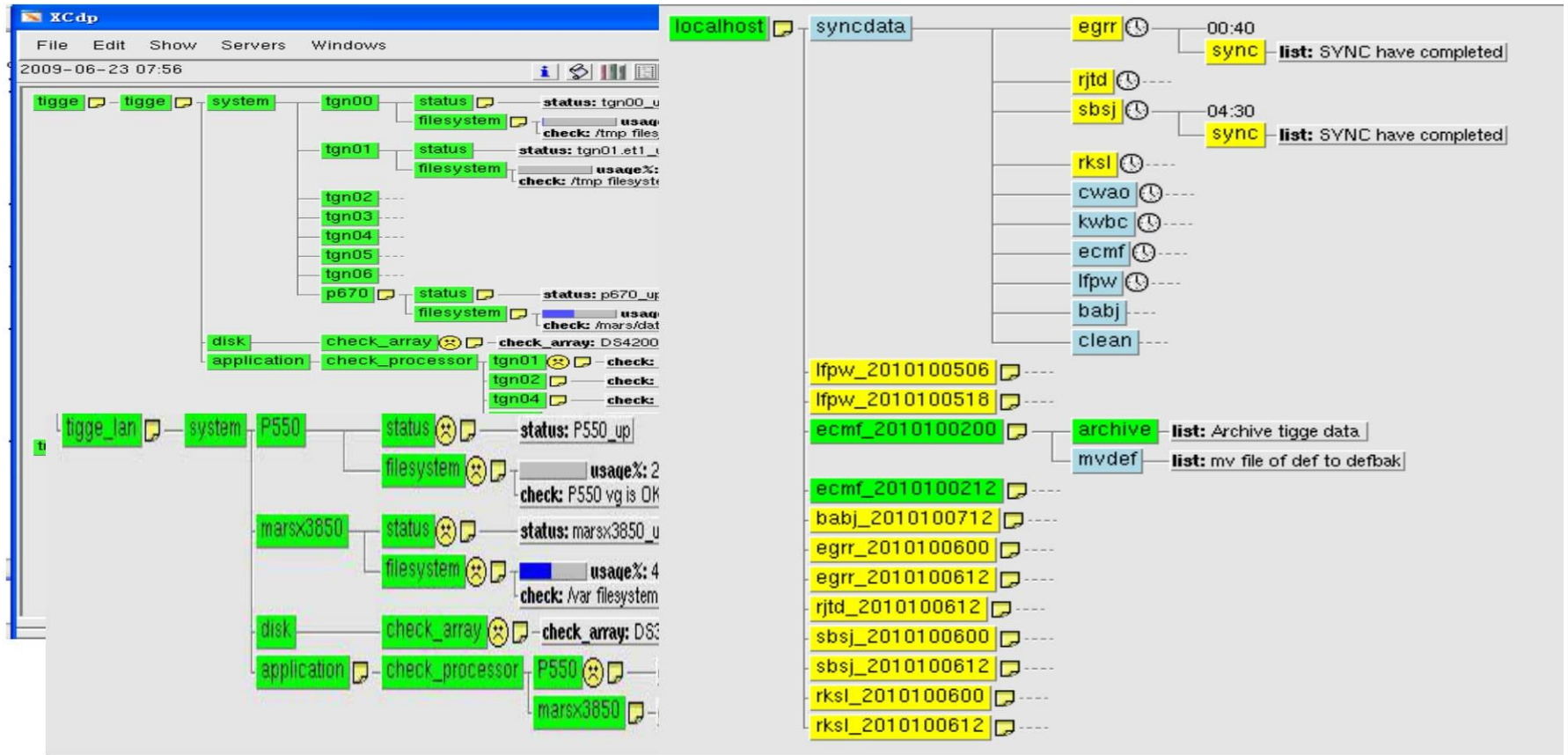
  Oct：Update LDM performance
  - upgrade high performance LDM data receive cache
  - Update single LDM receive to multi LDM receive
  - Enlarge LDM server internal memory
- **In 2011**

  Oct：Update LDM performance
  - upgrade high performance LDM data receive server (IBM X3950)
  - Upgrade high-performance FC RAID
- **In 2012**

  MAR：enlarge LDM receive cache filesystem.

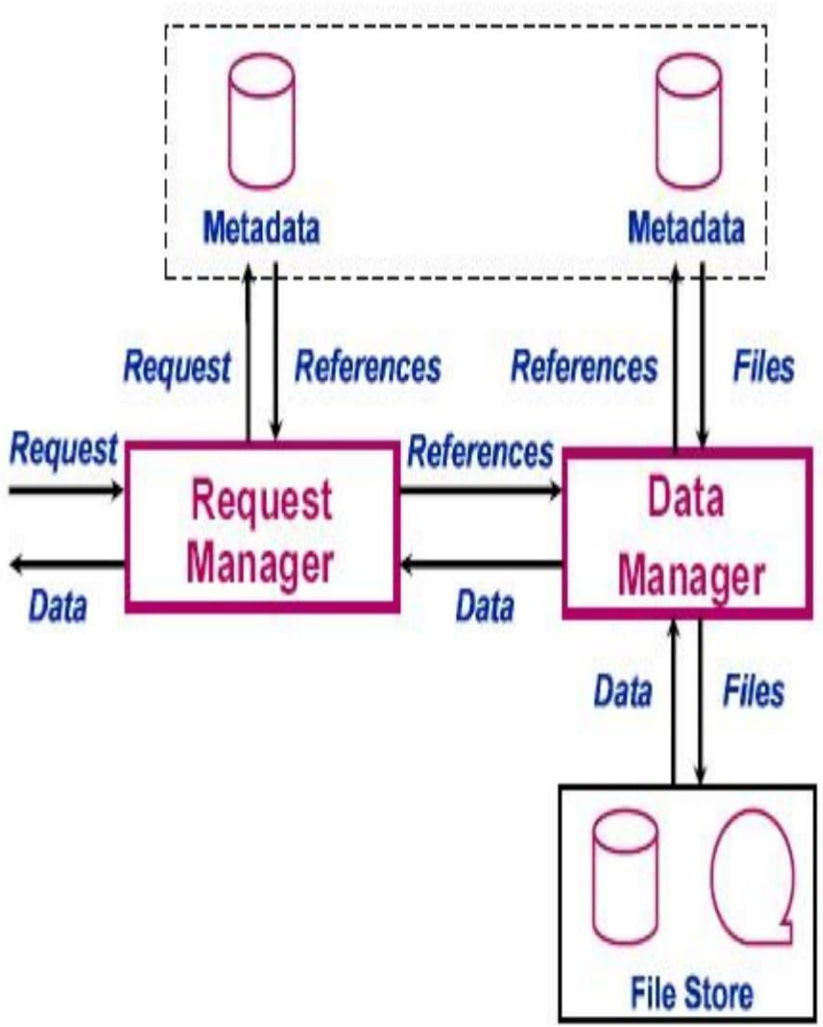
Progress overview

- Data manager system
- **In 2009**
- **May：Using SMS to monitoring TIGGE data exchange and archive flow in DMZ area and inside network.**



Progress overview

- Data manager system
- **In 2007**
  - Using MARS system,Localize and test MARS system, Establish MARS environment
- **In 2008,2009**
  - Develop Data cutting and interpolation function based on user requirement
  - All TIGGE data use MARS to archive
  - Link MARS to CMA TIGGE portal



Progress overview

- Data manager system
- **In 2010**
  - In inside network, established a TIGGE Data Management System to provide data retrieval services directly for users.
- **In 2012**
  - Modify data process flow, archive from outside network to inside network,raise the efficiency,

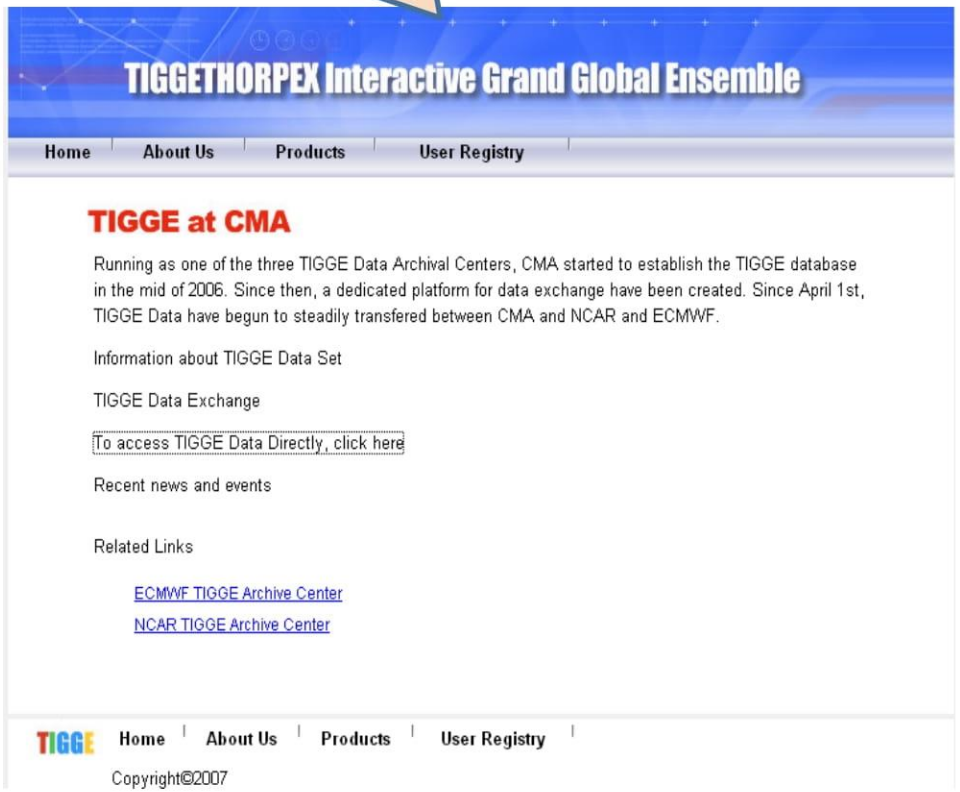
Progress overview

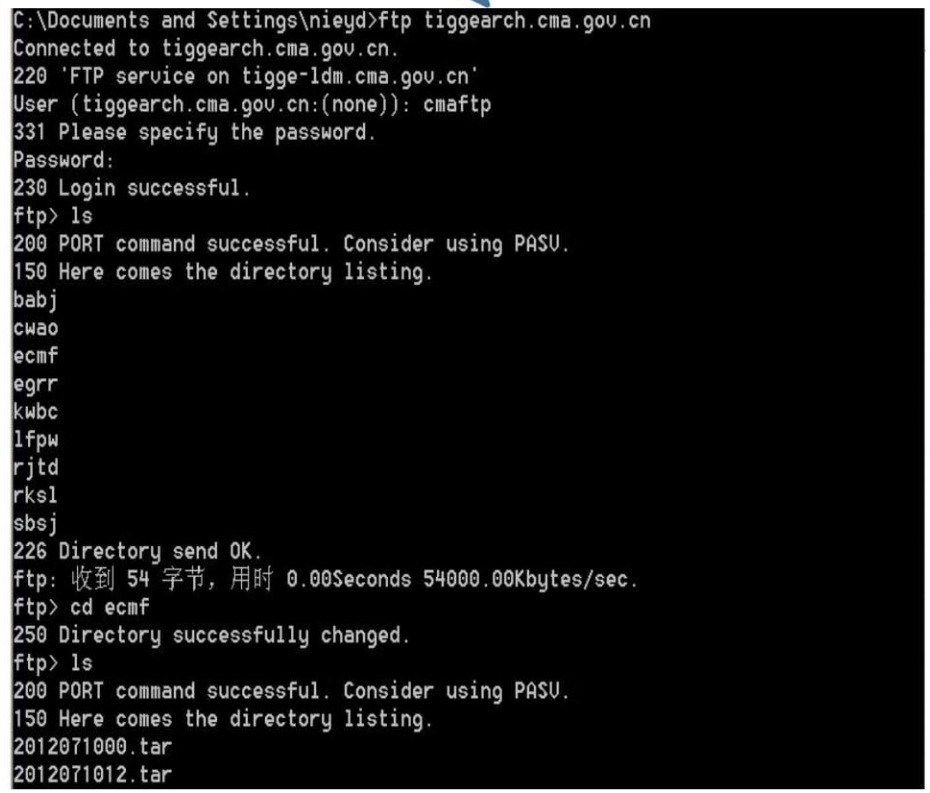
• Data service system

- In 2009
- July:TIGGE portal online, http://wisportal.cma.gov.cn/tigge/
- Register Users from ECMWF, JMA, CPTEC, etc

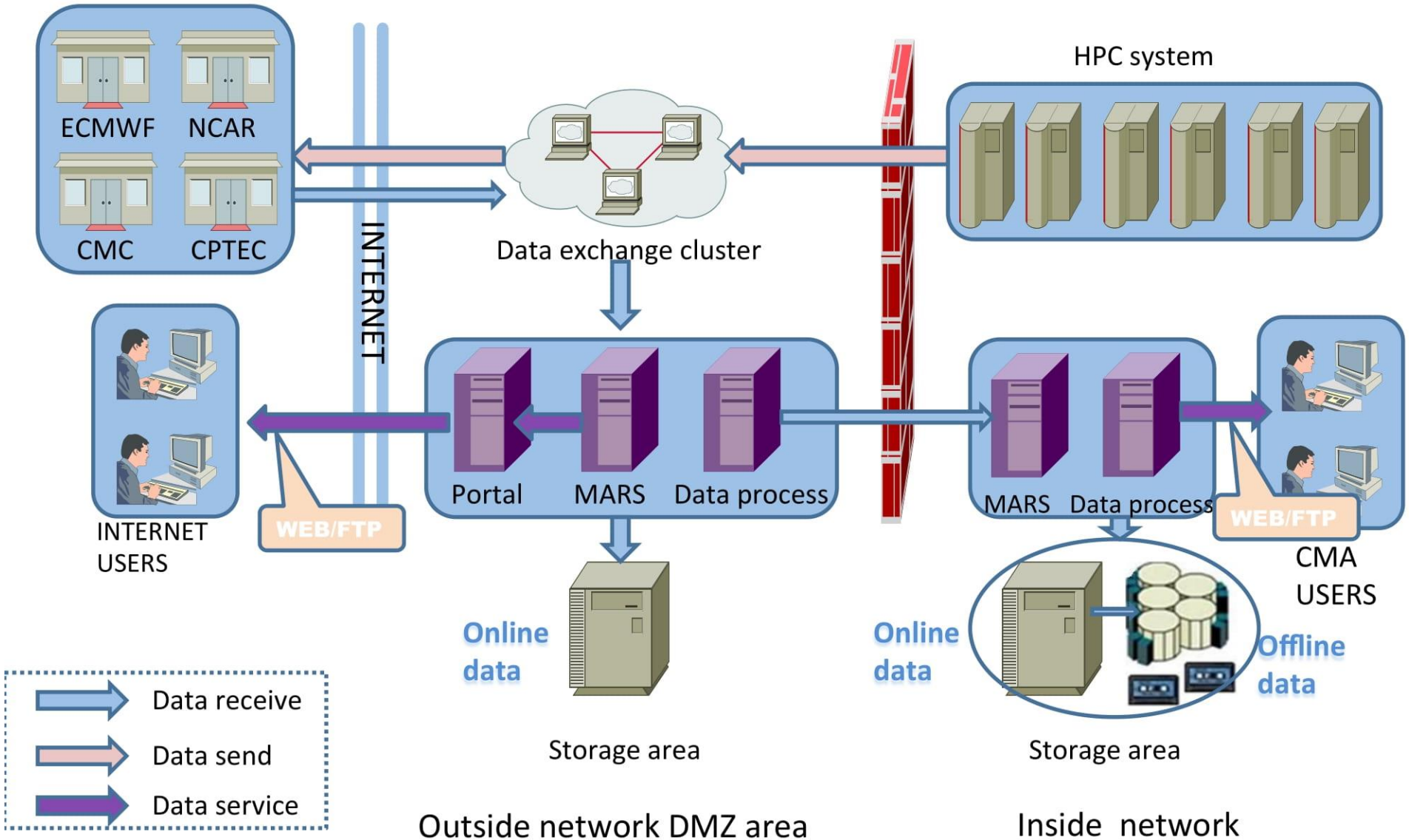
- In 2012

NCL, precipitation download platform FTP site ftp://tiggearch.cma.gov.cn

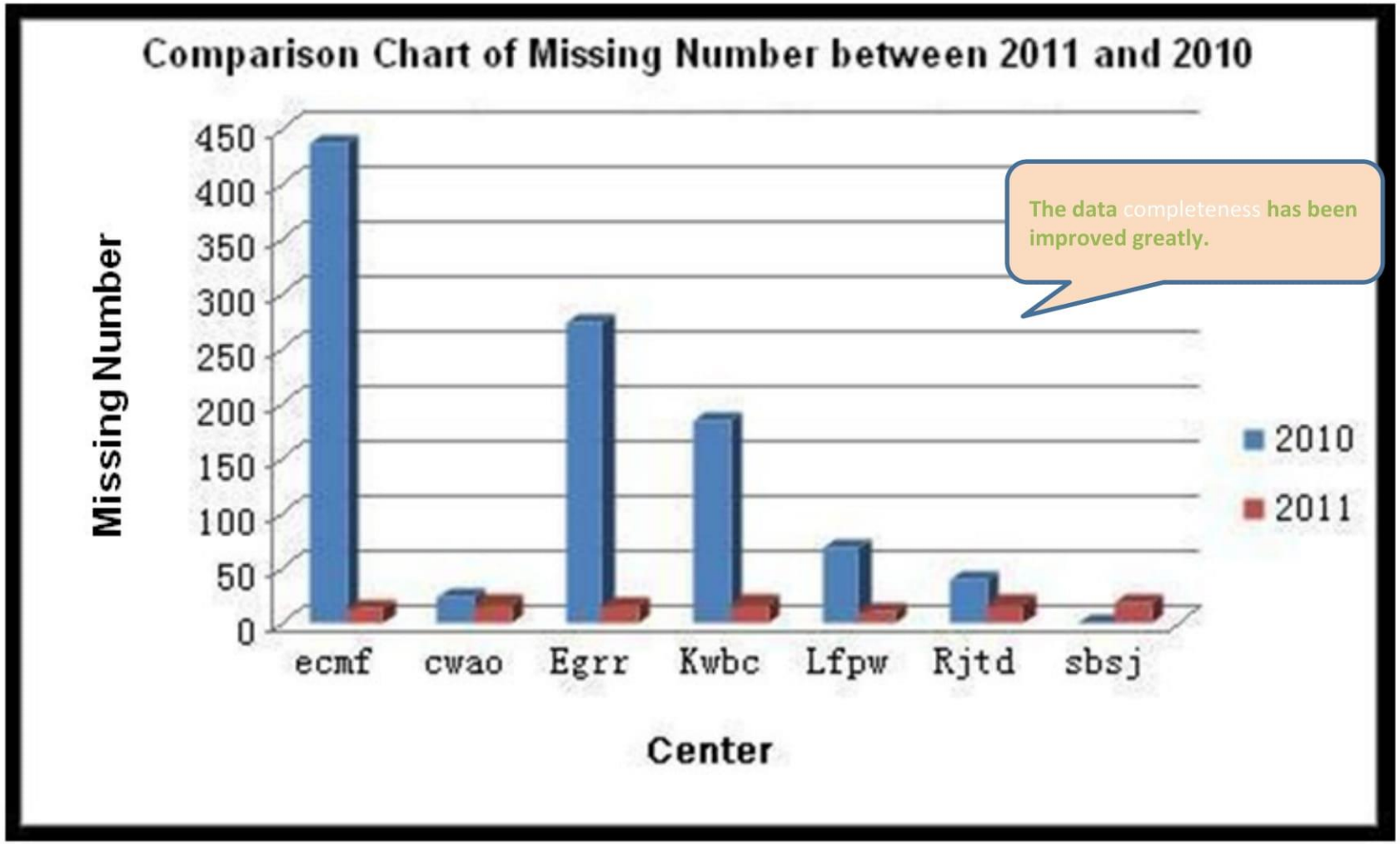




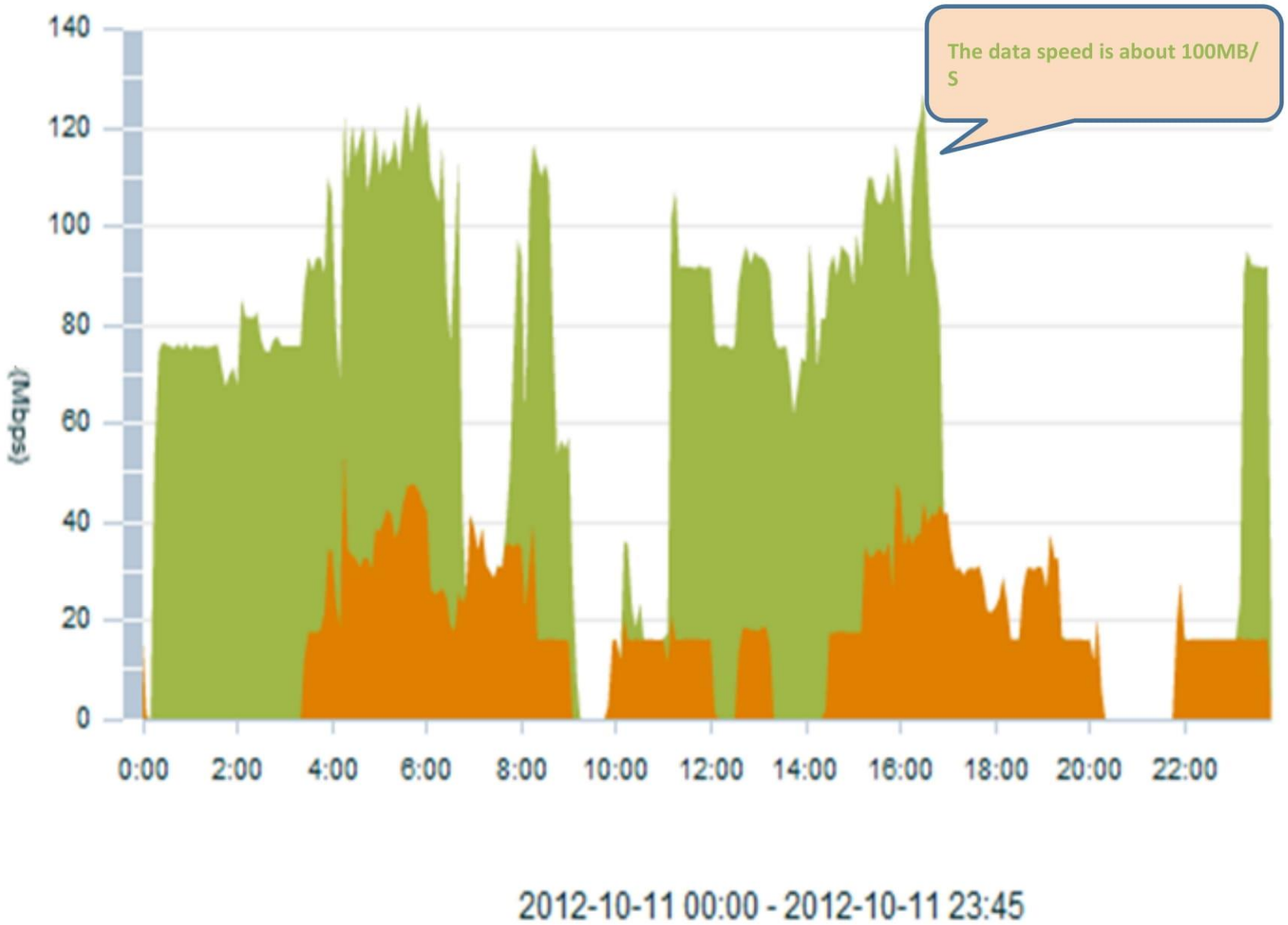
TIGGE data flow in CMA



Comparison Chart of Missing Number between 2011 and 2010



CSTNetwork throughout in CMA



Data service

2008, BEIJING Olympic Games.

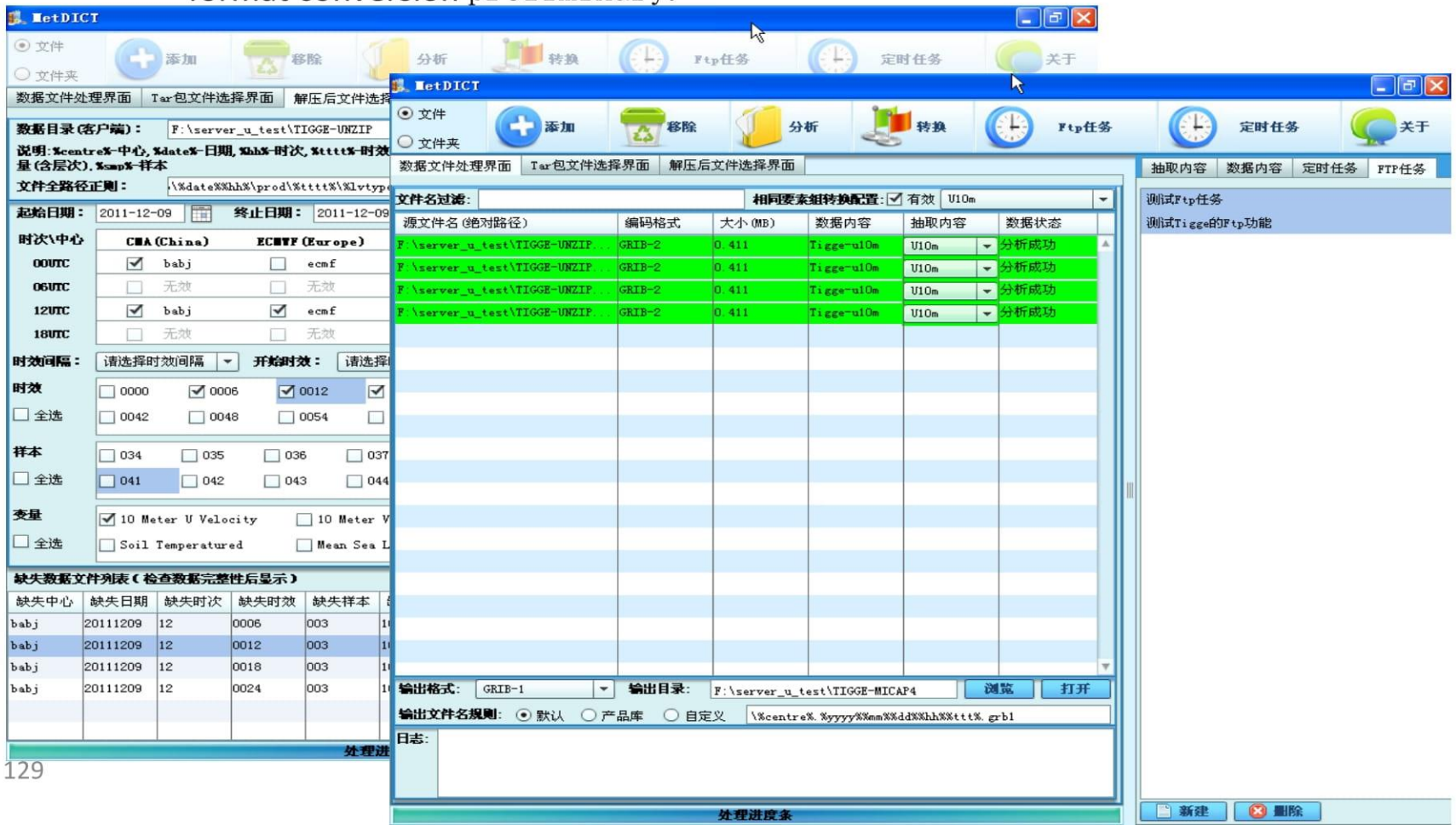
CMA、ECMWF、NCEP、UKMO、JMA、KMA、CMC tropical-cyclone data exchange support.

2010 Xi'an World Horticultural Exposition.
Pressure Level and Single Level data download support.

Data service

TIGGE data-processing software

- We have developed “TIGGE data processing software” for the user’s convenience.
- The system has the functions of ftp download, unzip, selecting the data elements, missing data checks, Area cut interpolation and format conversion preliminary.



Future plan

- Raise and upgrade the hardware process and storage ability, Optimize the data process flow, Enhance the process ability
- Perfect service function and ability

  - TIGGE data transfer statistics

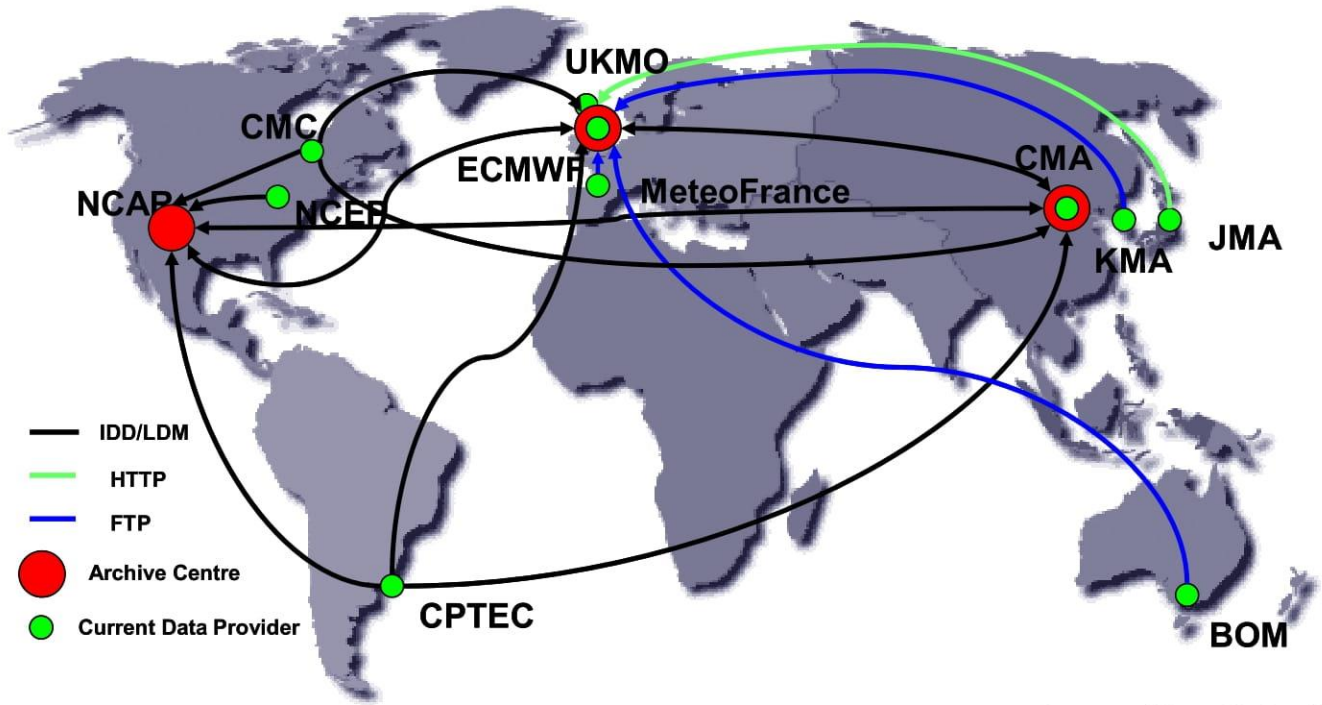
    - Data flow control, Webpage method
- Distribution data storage and service technology research, test, application.
- More cooperation ,more opportunity, more experience, more knowledge

What's CXML Data

CXML (Cyclone eXtensible Markup Language):

http://cawcr.gov.au/bmrc/projects/THORPEX/CXML/index.html

TIGGE Archive Centers and Data Providers



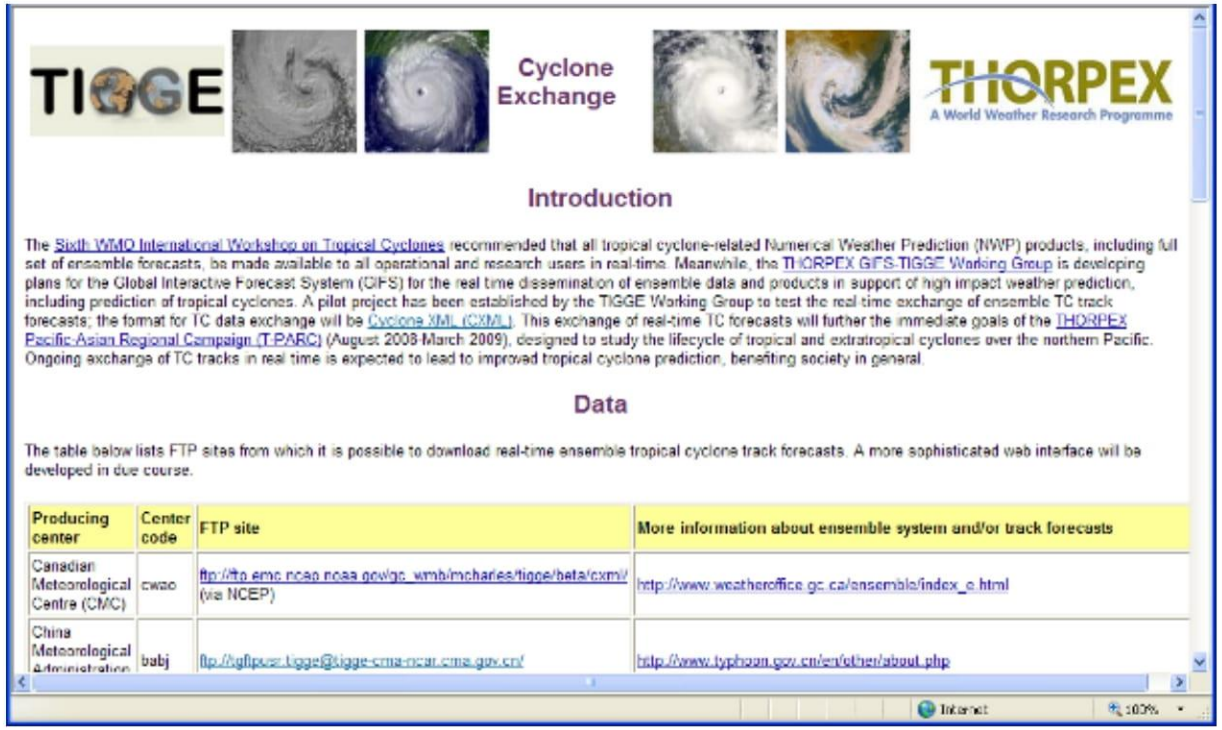
Courtesy of Steve Worley, NCAR

CXML Providers

- CMA - yes
- ECMWF - yes
- Met Office - yes
- JMA - yes
- NCEP - yes
- CMC - yes (via NCEP)
- KMA - yes

Near real time cyclone data exchange

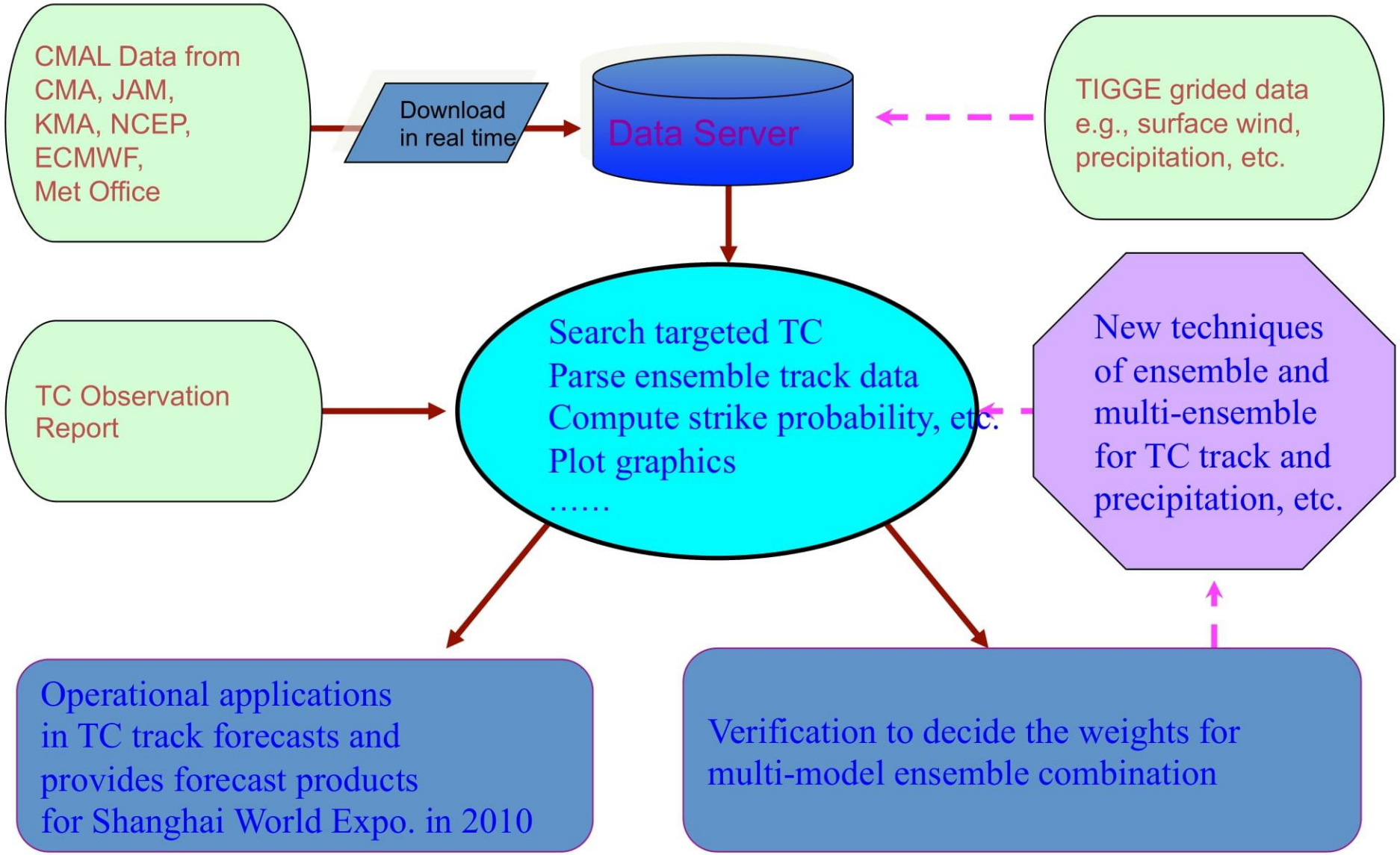
- Data exchanged via FTP (some sites require registration)
- TC data archived at NCAR at http://dss.ucar.edu/datasets/ds330.3/ under 'Data Access' and 'Internet Download'
- Data format is CXML (Cyclone XML), designed to exchange TC analyses, deterministic forecasts, and ensemble forecasts,



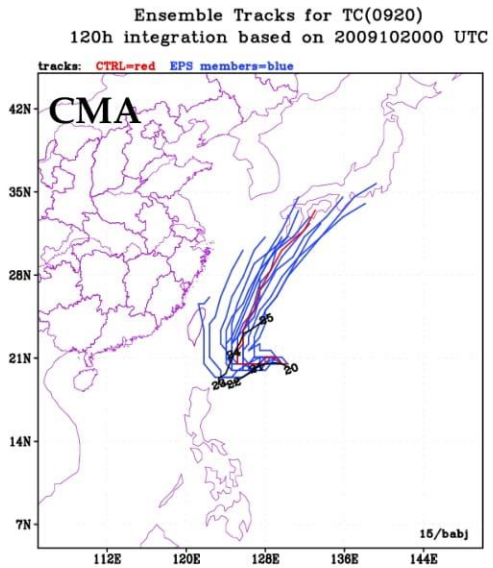
Courtesy of Beth Ebert, CAWCR

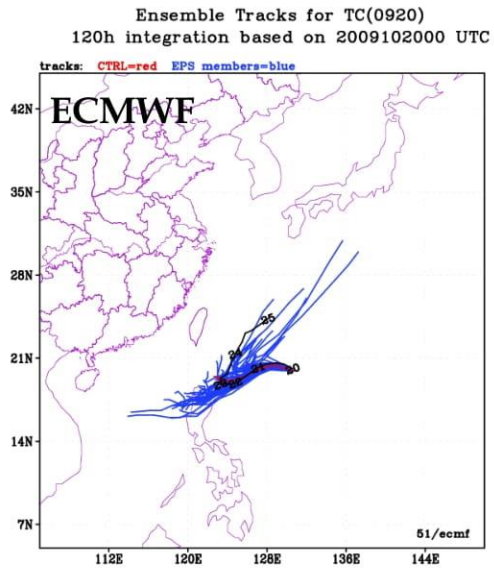
http://www.bom.gov.au/bmrc/projects/THORPEX/TC/index.html

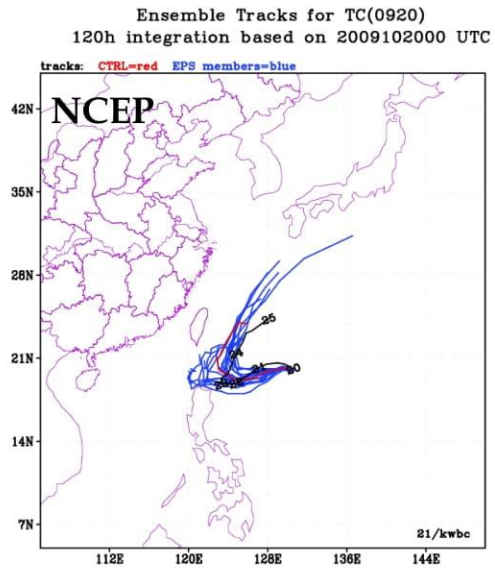
Operational Applications of CXML data in NMC/CMA

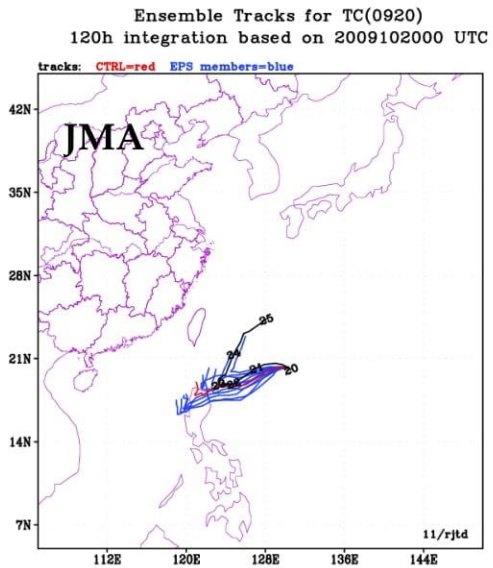


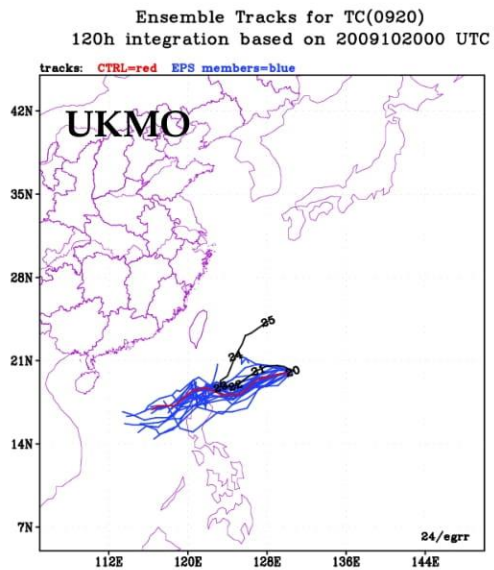
Ensemble tracks for LUPIT(0920)

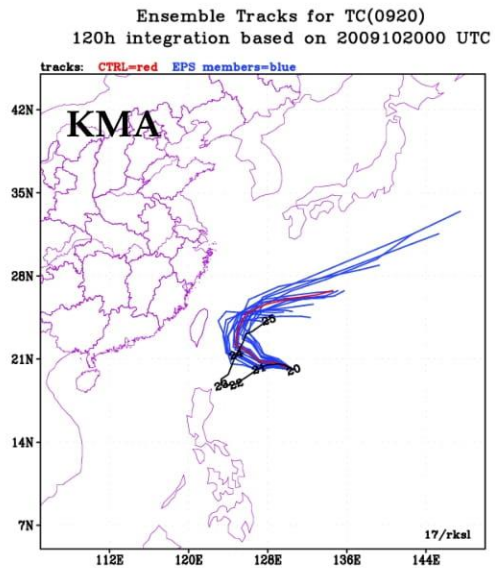






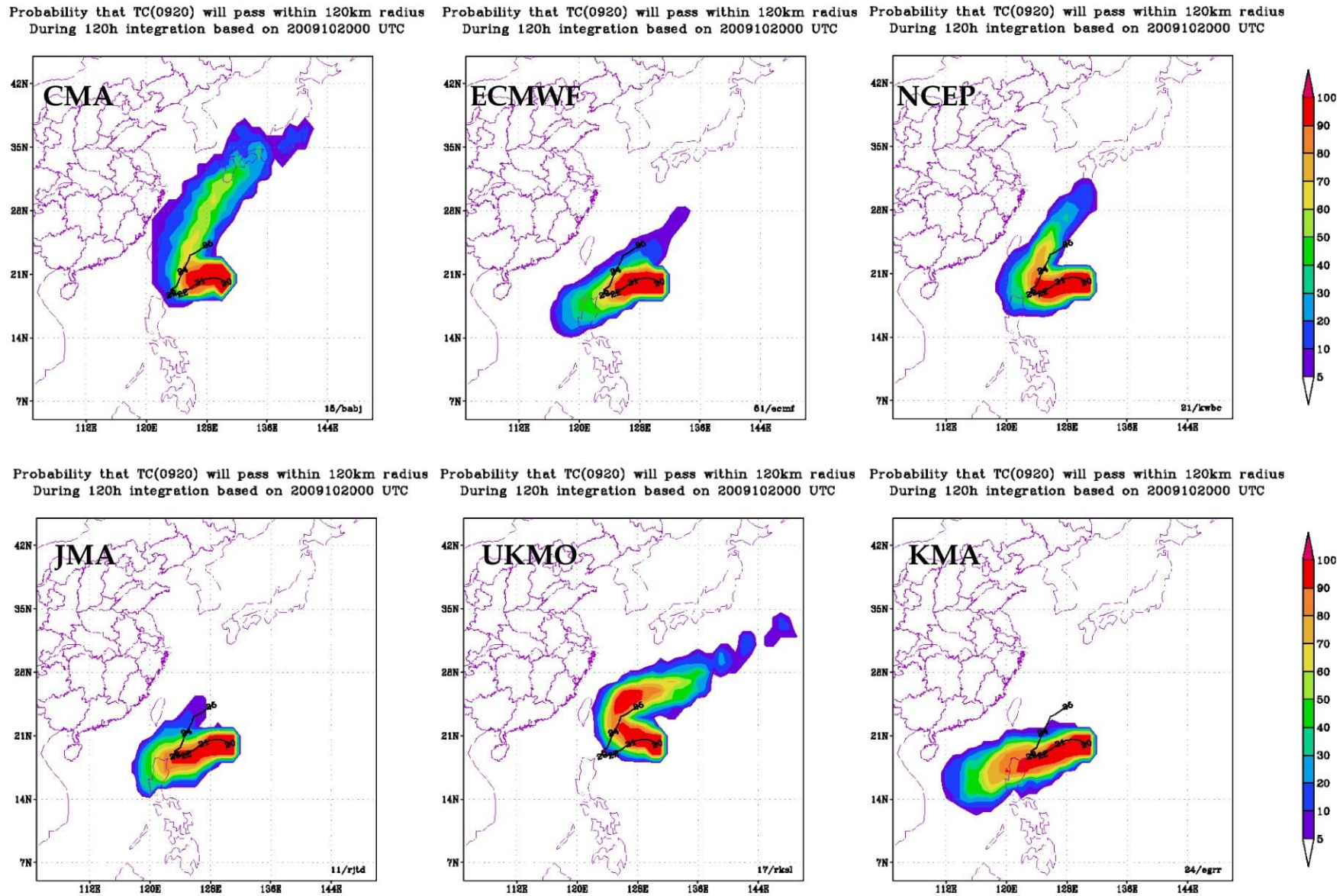






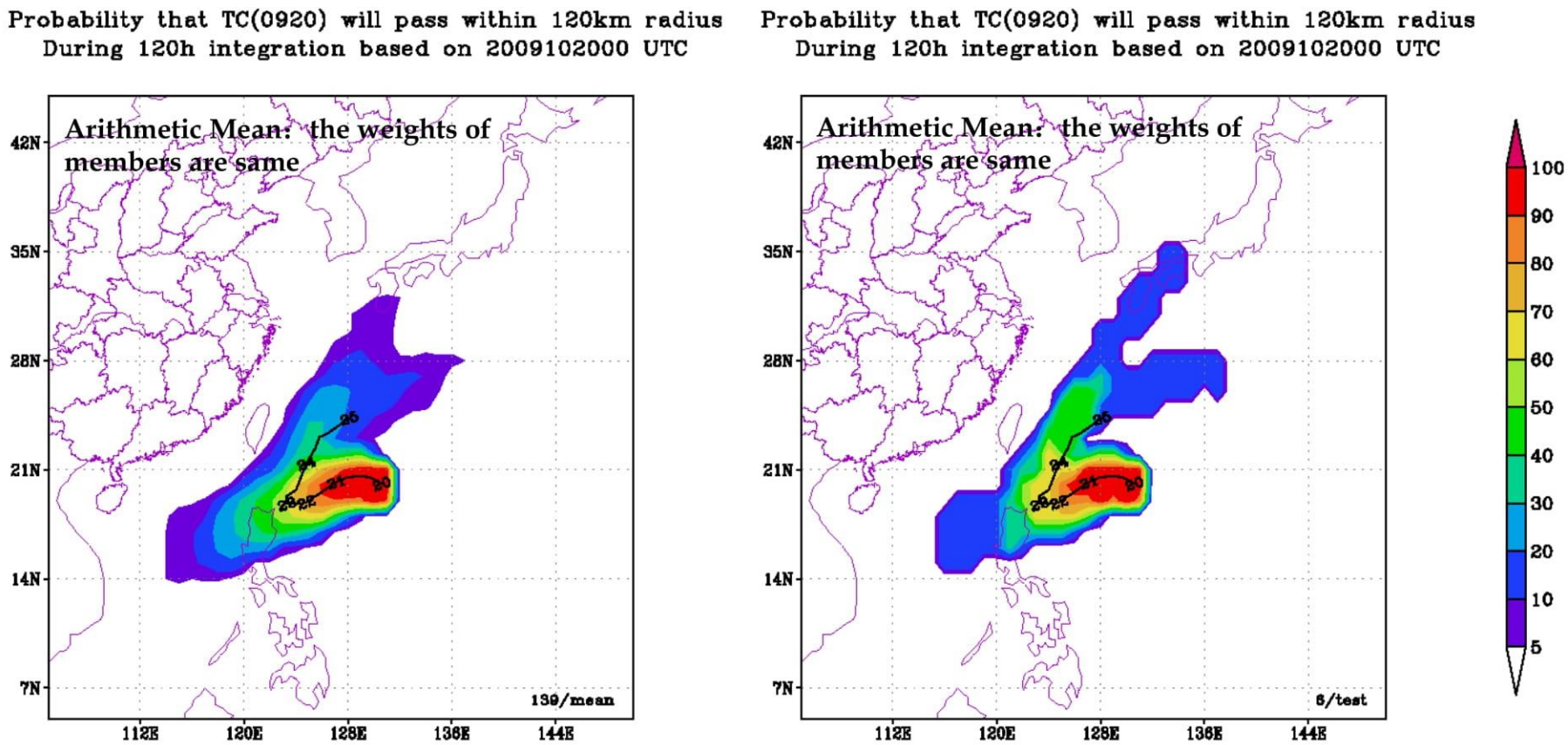
Initial time：2009-10-20_00

120-h strike probability for LUPIT(0920)

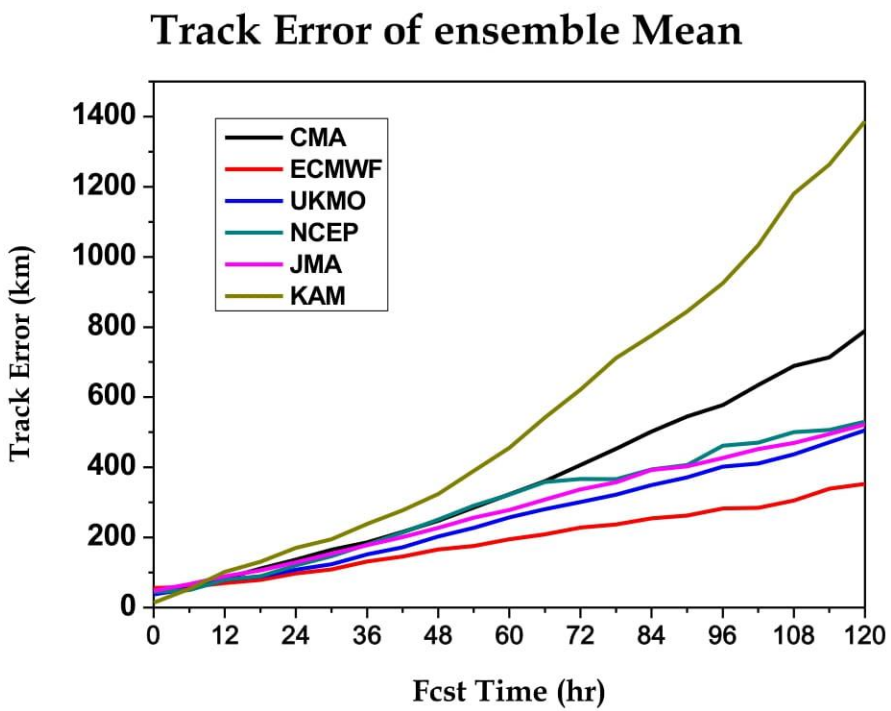


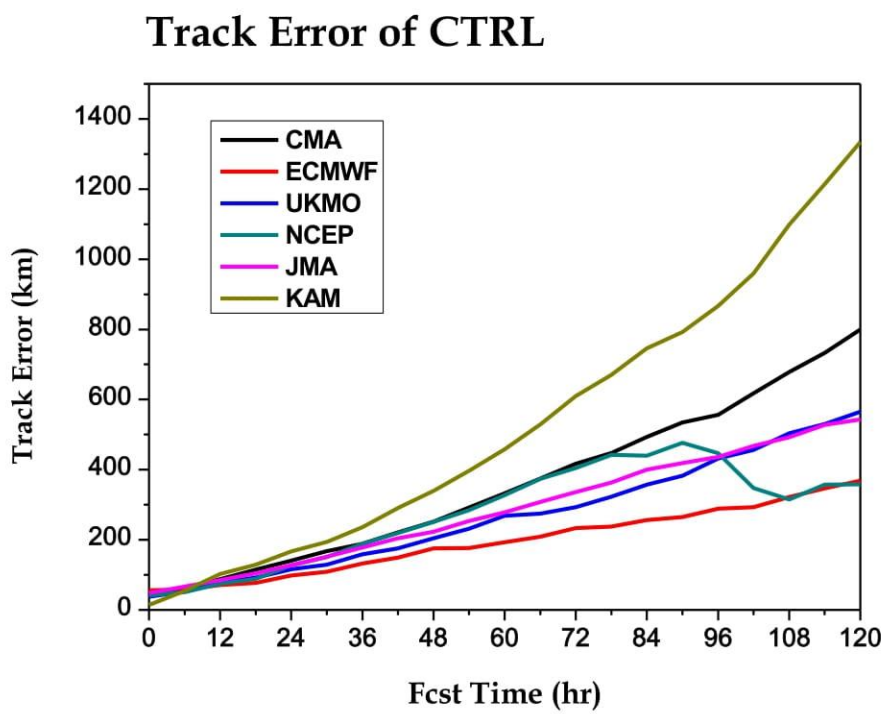
Initial time：2009-10-20_00

120-h strike probability: ensemble of mutli-ensemble



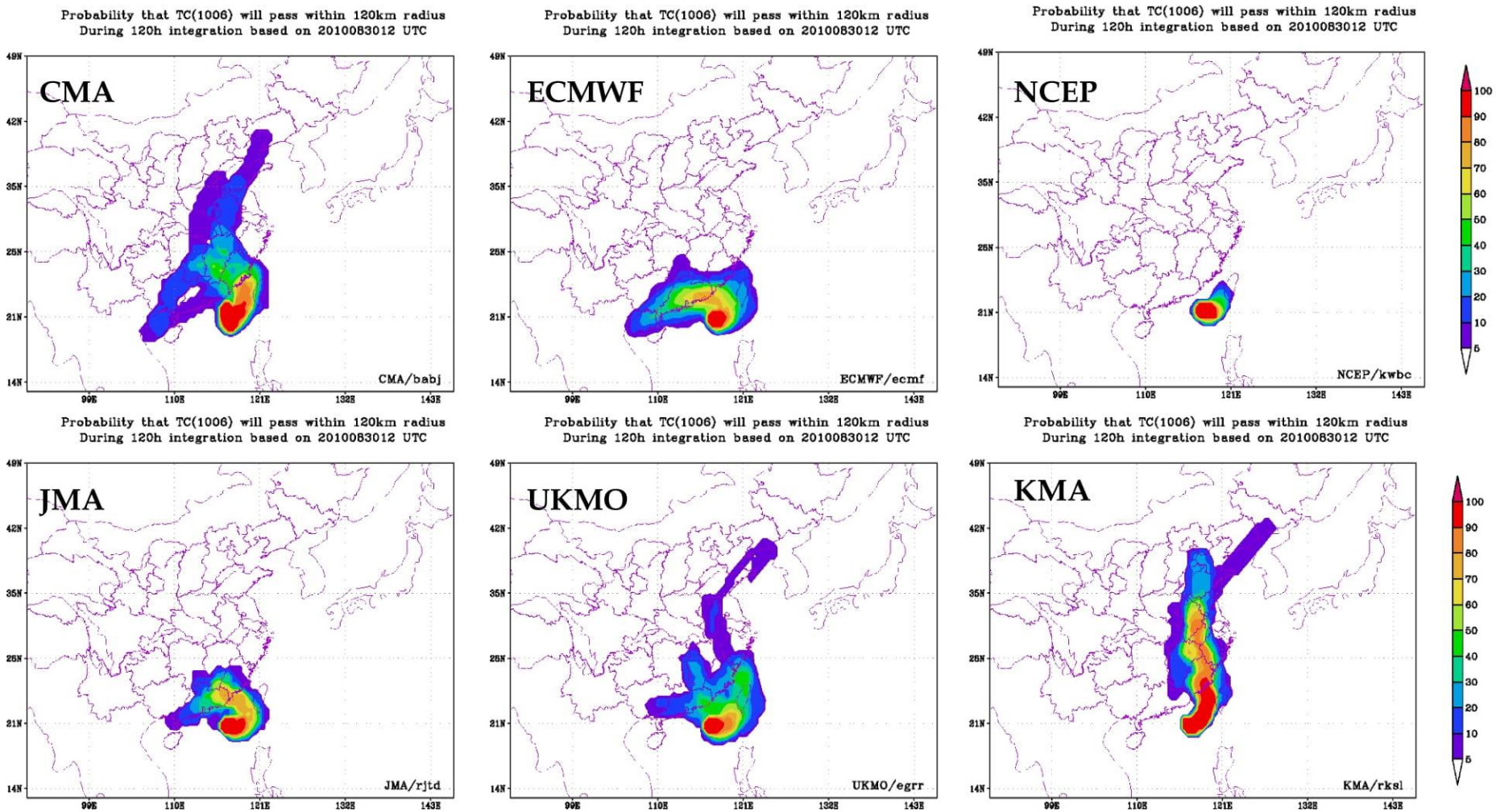
Track error for each forecast center in 2009





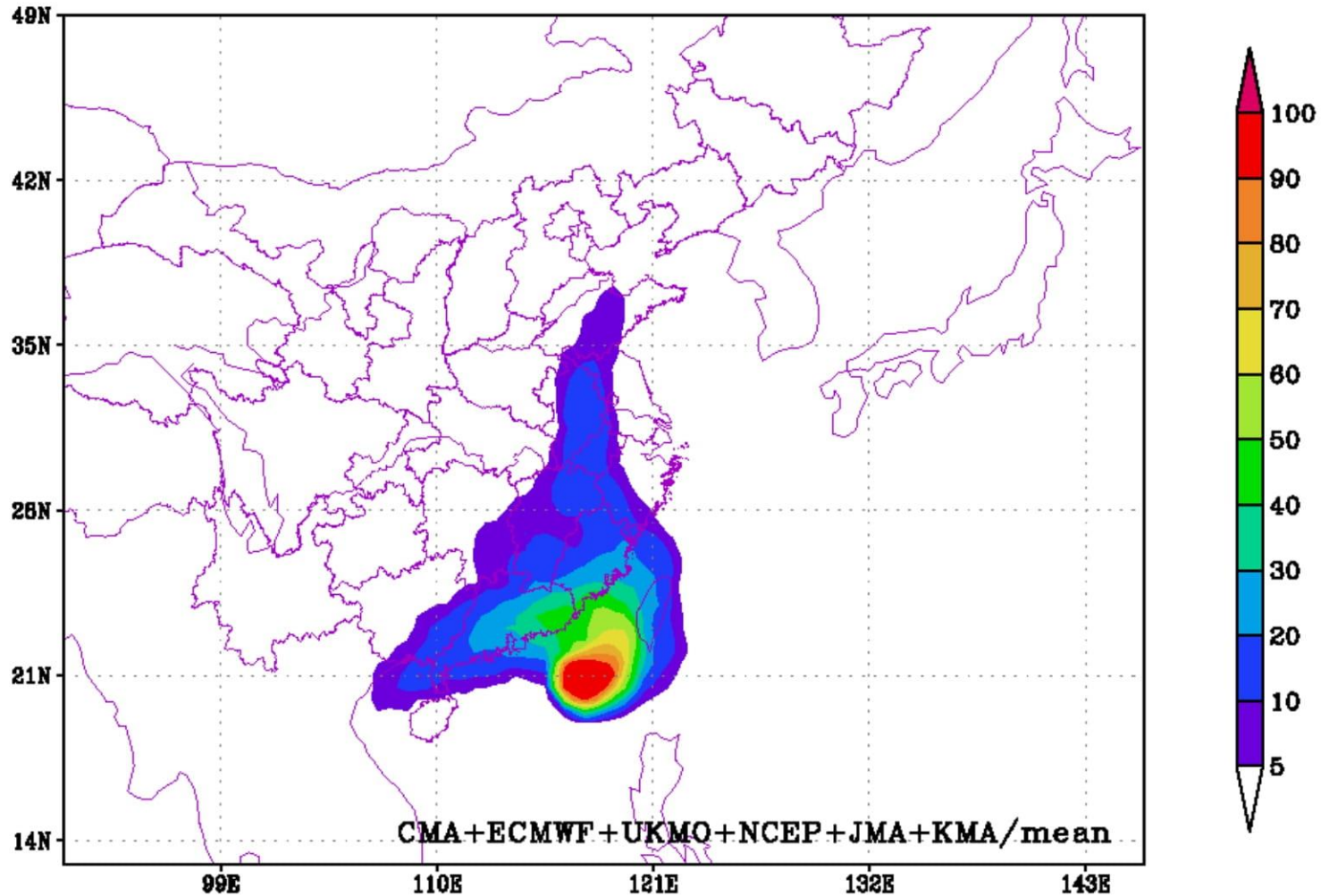
Near real time forecast products for Shanghai World Expo.

120-h strike probability for LIONROCK(1006)



Initial time：2010-08-30_12

Probability that TC(1006) will pass within 120km radius
During 120h integration based on 2010083012 UTC



Thanks!

- The End -