HWRF模式2012年於西北太平洋之建置與預報表現評估

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報告大綱

- HWRF 系統簡介
- HWRF 2012 05-06月初步測試研究
- HWRF 2012 07-12月預報表現
- 總結

HWRF 系統簡介

- The Weather Research and Forecast (WRF) system for hurricane prediction (HWRF) is an operational model implemented at the National Weather Service (NWS)/National Centers for Environmental Prediction (NCEP) to provide numerical guidance to the National Hurricane Center for the forecasting of tropical cyclones' track, intensity, and structure.
- Differences between ARW-WRF and WRF-NMM
  1) Vertical level
     – Sigma & Sigma – pressure Hybrid level(~400hPa)
  2) Projection
     – Lambert & rotated
  3) Grid staggering
     – Arakawa C-grid & Arakawa E-grid
  4) Prognostic Variables
     – (U,V,W,Θ,ø',μ',Qm)&(PD,PINT,T,Q,CWM,Q2,U,V)
- HWRF
  1) Vortex following moving nest
  2) Horizontal diffusion related to turbulent kinetic energy
  3) Ocean coupler related changes
  4) Momentum tendency added by SAS convection scheme

HWRF 系統簡介(續)

Operational HWRF Domains and Initialization

d01: 216x432 with resolution 0.18 deg.
Covers about 80x80 deg

4x: 748x1504 with resolution of 0.02 deg.
Covers about 40x40 deg

Ghost: 529x988 with resolution of 0.02 deg.
Covers about 20x20 deg

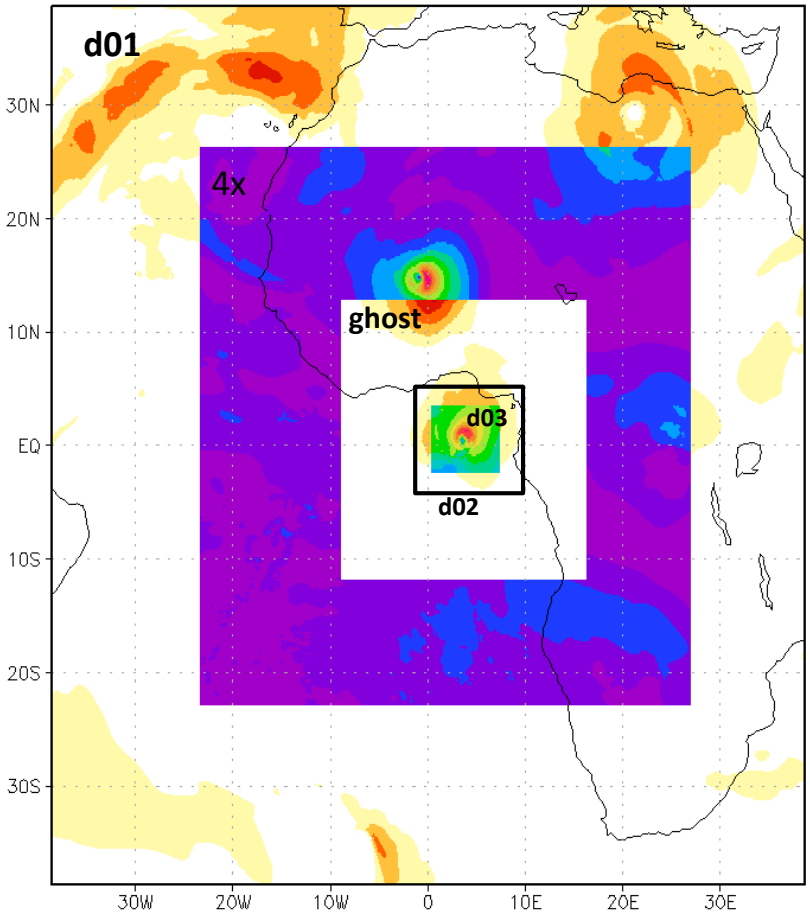
d02: 88x170 with resolution of 0.06 deg.
Covers about 10x10 degree

d03: 154x272 with resolution of 0.02 deg.
Covers about 6x6 degree

Model domains: d01 , d02 and d03

HWRF vortex initialization domain: 4x

GSI analysis domain: d01 and ghost



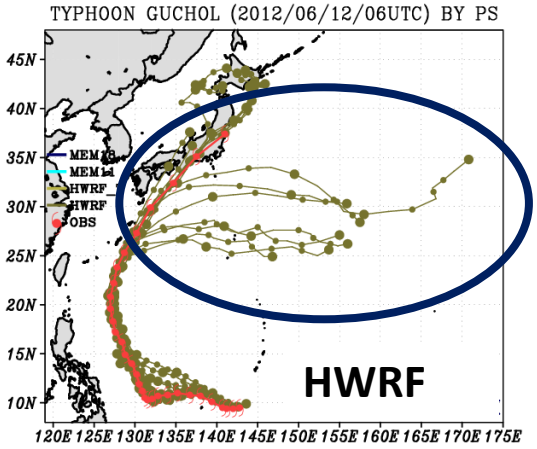
Four HWRF domains in rotated grid

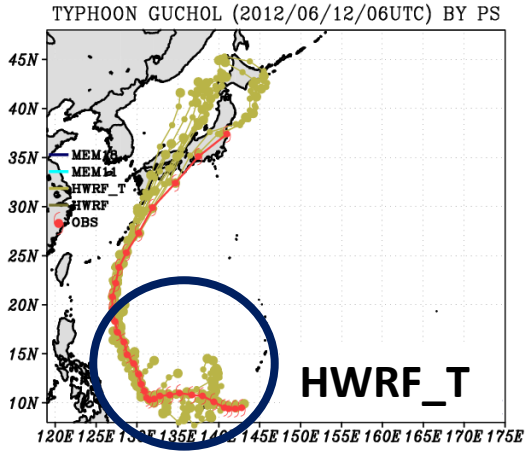
HWRF 2012 05-06月
初步測試研究

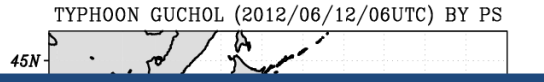
HWRF模式設計

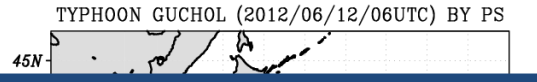
Experiment	cold/warm	analysis	bogus	Cumulus scheme	Microphysics scheme	Boundary Layer	Note
HWRF	cold start	NODA	HWRF bogus	SAS	Ferrier	NCEP GFS	43levels ;model top 50hPa; 2 way; 27/9/3km; moving; no ocean couple & no GSI; BC from NCEP T574
HWRF_T	cold start	NODA	no bogus	SAS	Ferrier	NCEP GFS	43levels; model top 50hPa; 2 way; 45/15/5km; no ocean couple & no GSI; IC&BC from NCEP 0.5deg.

2012 05-06月初步測試研究





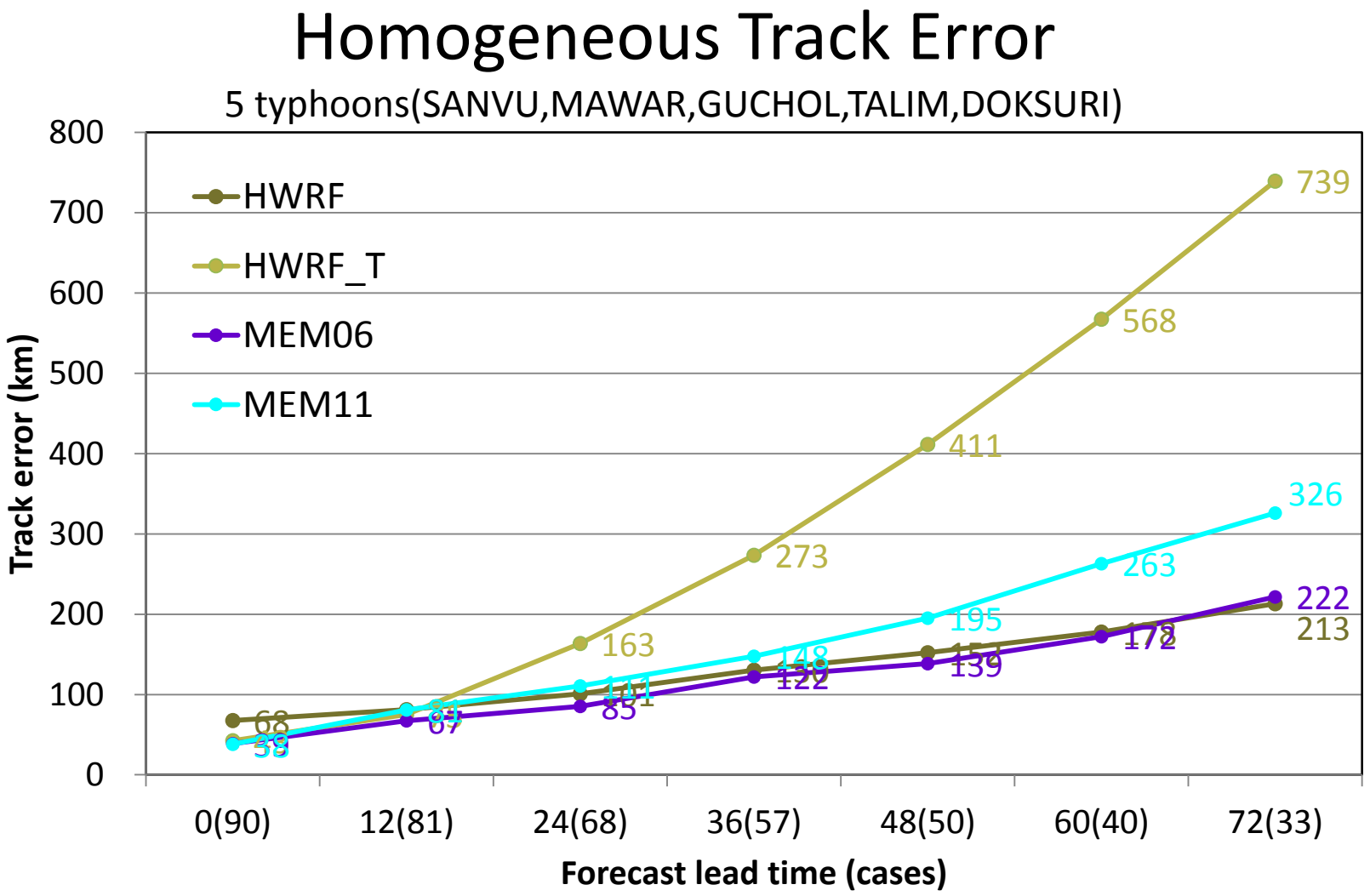




- 最細網格使用積雲參數化，將造成HWRF(moving)預報強烈颱風出現超級颱風(<800hPa) 。
- HWRF_T(static)若使用2way feedback，颱風將被最粗網格與細網格邊界之異常梯度阻擋。此外，模式颱風路徑預報表現對於積分時間步階較為敏感，目前HWRF_T使用54s設定。

Experiment	0 fhr(31)*	24fhr	48fhr	72fhr
HWRF	52	114	332	378
HWRF_T	20	153	462	953
MEM06	21	73	125	170
MEM11	47	100	174	260

2012 05-06月初步測試研究(續)

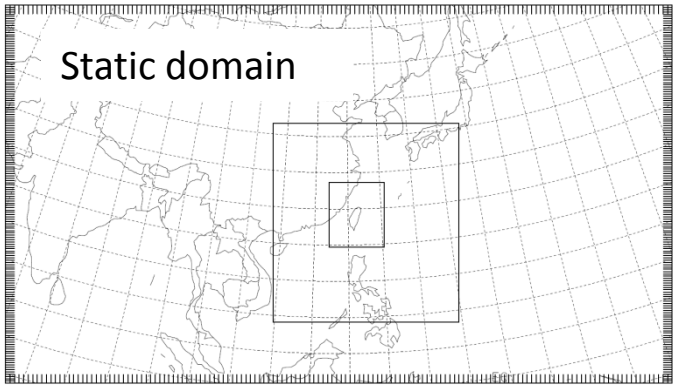


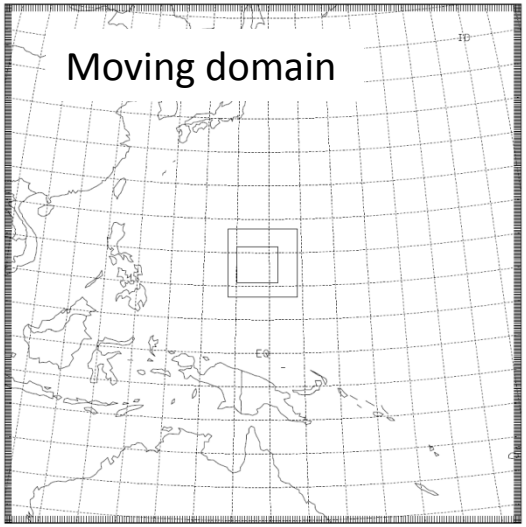
HWRF 2012 07-12月預報表現

HWRF模式設計與對照組實驗

Experiment	cold/warm	analysis	bogus	Cumulus scheme	Microphysics scheme	Boundary Layer	Note
HWRF	cold start	NODA	HWRF bogus	SAS	Ferrier	NCEP GFS	43levels ;model top 50hPa; 2 way; 27/9/3km; moving; no ocean couple & no GSI; BC from NCEP T574; d03 w/o Cu
HWRF_T	cold start	NODA	no bogus	SAS	Ferrier	NCEP GFS	43levels; model top 50hPa; 1 way; 45/15/5km; no ocean couple & no GSI; IC&BC from NCEP 0.5deg; t=54s
MEM06	cold start	WRF3DVAR (CV5+OL3)	CWB bogus	new KF	Goddard	YSU	45levels; model top 30hPa; 1way; 45/15/5km; IC&BC from NCEP 0.5deg.
MEM18	cold start	NODA	no bogus	KF	WSM5	YSU	28levels; 2 way; 45/15/5km; d03 with Cu. ; IC&BC from NCEP 0.5deg.

Model domain and Cases

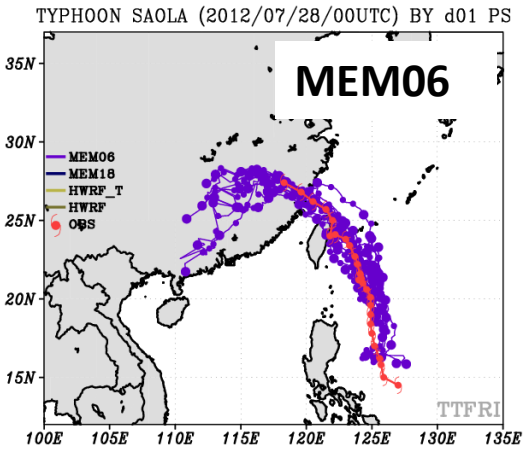


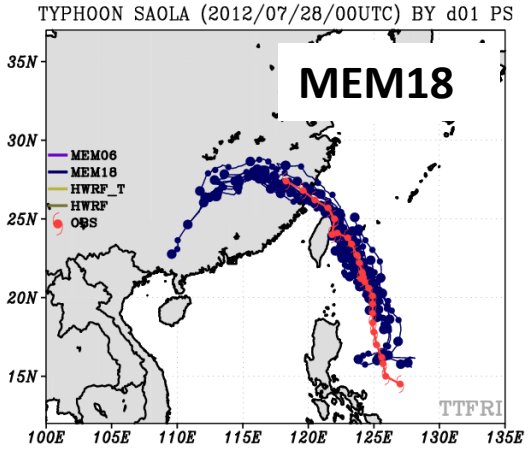


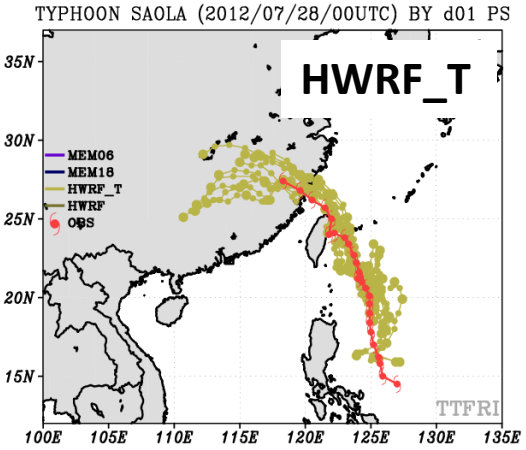
17 Cases :

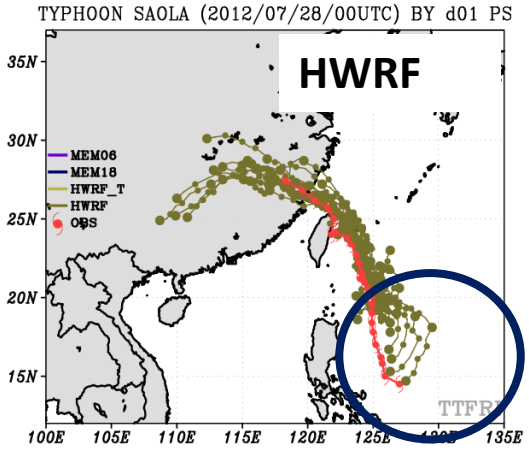
- SAOLA(10W) : 072800-080306Z
- DAMREY(11W) : 072818-080300Z
- HAIKUI(12W) : 080300-080906Z
- KIROGI(13W) : 080800-081000Z
- KAI-TAK(14W) : 081300-081800Z
- TEMBIN(15W) : 081900-083006Z
- BOLAVEN(16W) : 082006-082812Z
- SANBA(17W) : 091100-091800Z
- JELAWAT(18W) : 092018-100106Z
- EWINIAR(19W) : 092412-092918Z
- MALIKSI(20W) : 100106-100400Z
- GAEMI(21W) : 100112-100606Z
- PRAPIROON(22W): 100712-101906Z
- MARIA(23W) : 101412-101812Z
- SON-TINH(24W) : 102318-102906Z
- BOPHA(26W) : 112700-120818Z
- WUKONG(27W) : 122500-122800Z

蘇拉颱風



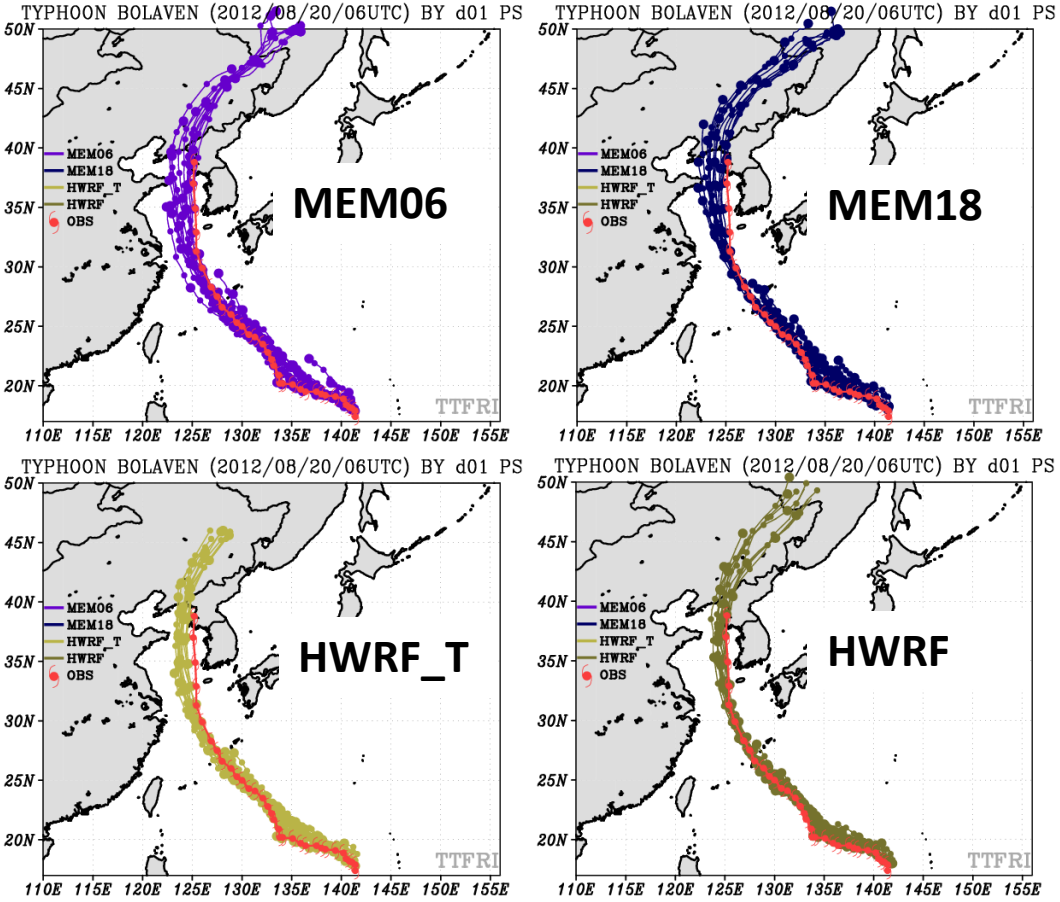






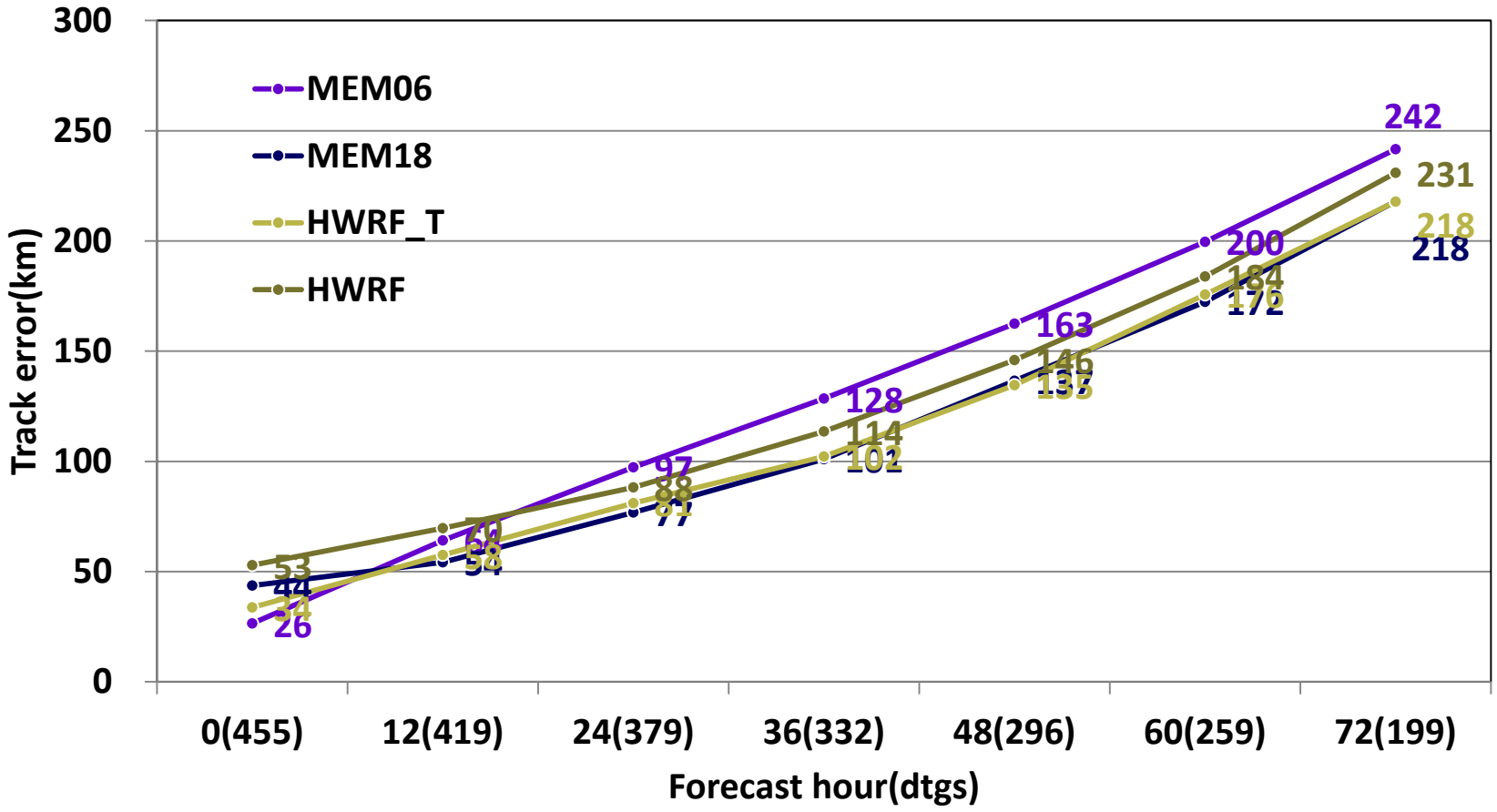
	0(26)	12(24)	24(22)	36(20)	48(18)	60(16)	72(14)
MEM06	51	63	78	96	115	128	154
MEM18	61	60	79	89	95	116	154
HWRF_T	45	63	76	117	143	152	179
HWRF	67	107	118	120	139	184	246

布拉萬颱風



	0(34)	12(32)	24(30)	36(28)	48(26)	60(24)	72(19)
MEM06	20	50	66	89	115	162	184
MEM18	31	48	68	87	122	167	209
HWRF_T	27	50	73	94	113	140	141
HWRF	37	46	58	76	92	114	124

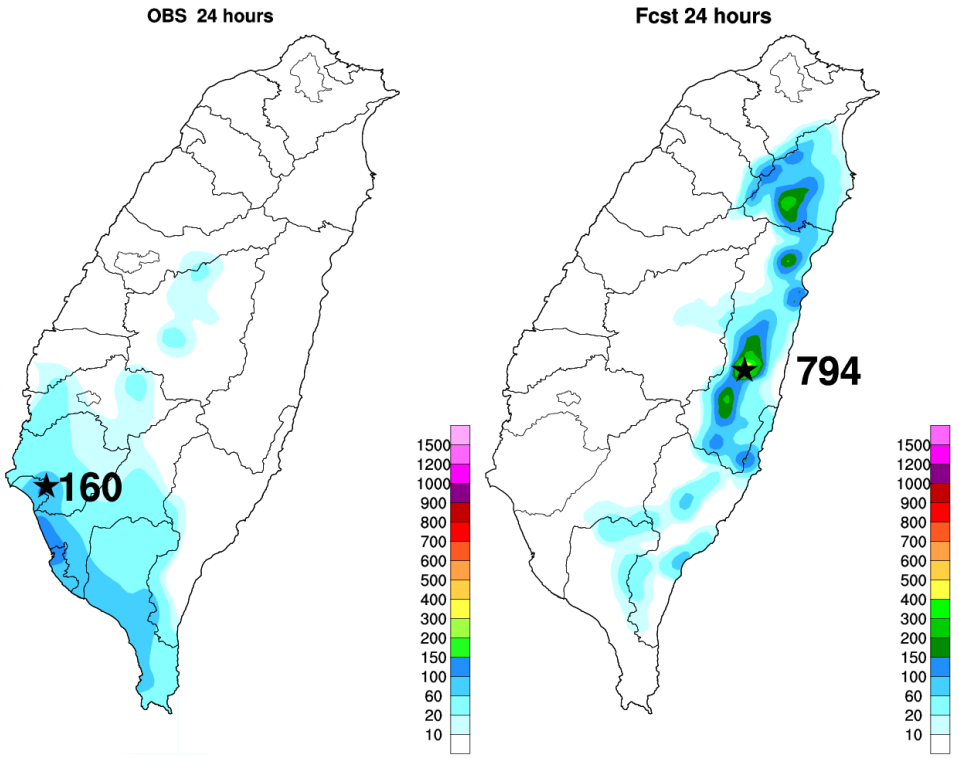
2012年 蘇拉-悟空颱風
（17個颱風, 455dtgs, homogeneous）



HWRF_T(static domain) 雨量

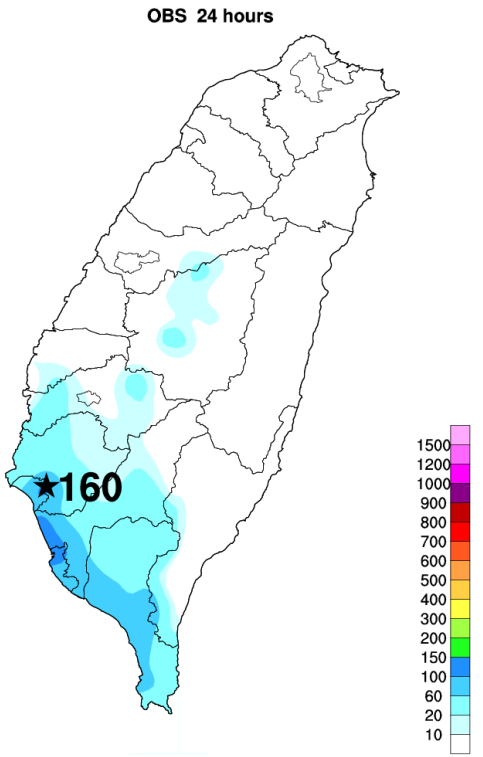
2012/08/08 00Z

- 水平擴散
- 地形
- 微物理參數法
- 版本差異

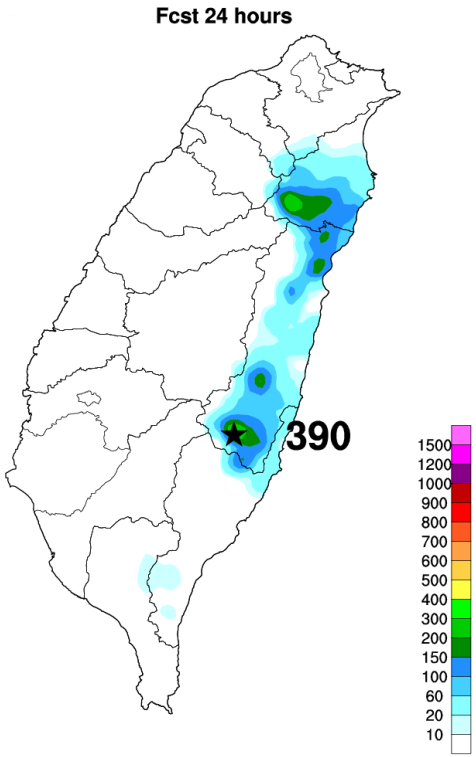


HWRF_T(static domain) 雨量
-不同微物理參數法

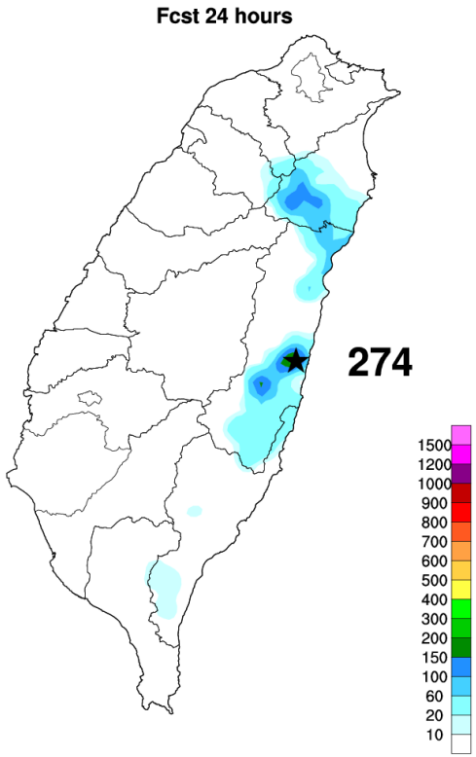
OBS



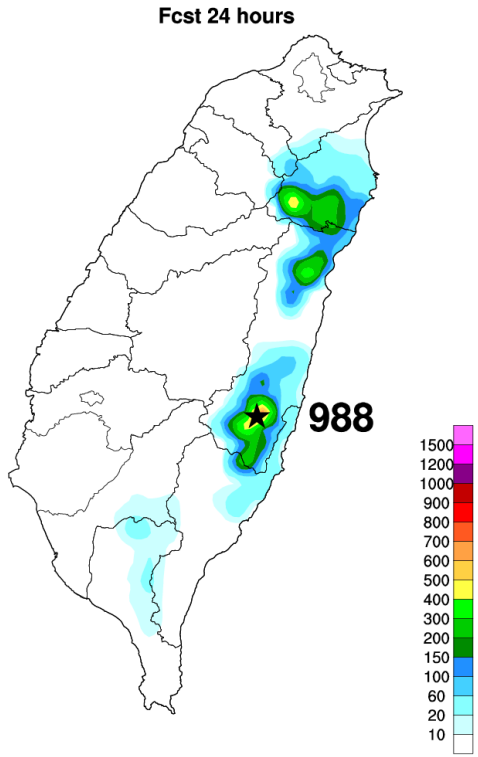
Ferrier_ HWRF



Ferrier_ NEW



WSM5

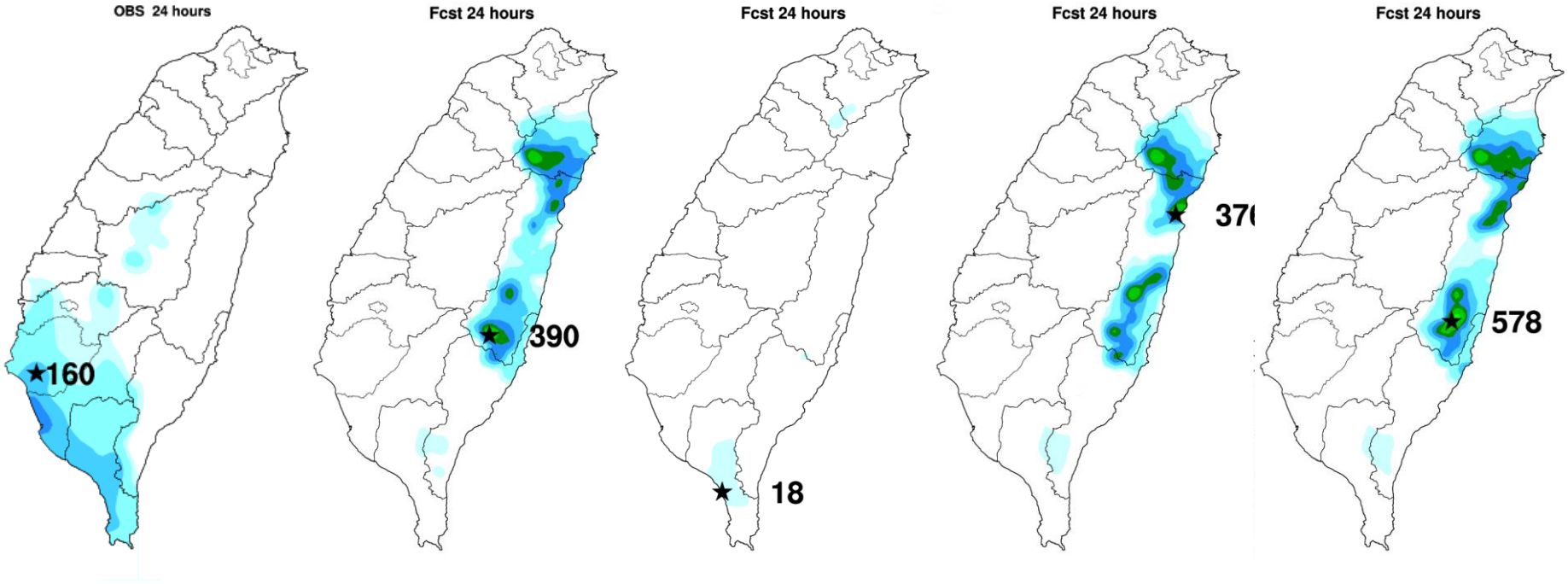


HWRF_T(static domain) 雨量 -Ferrier_HWRF

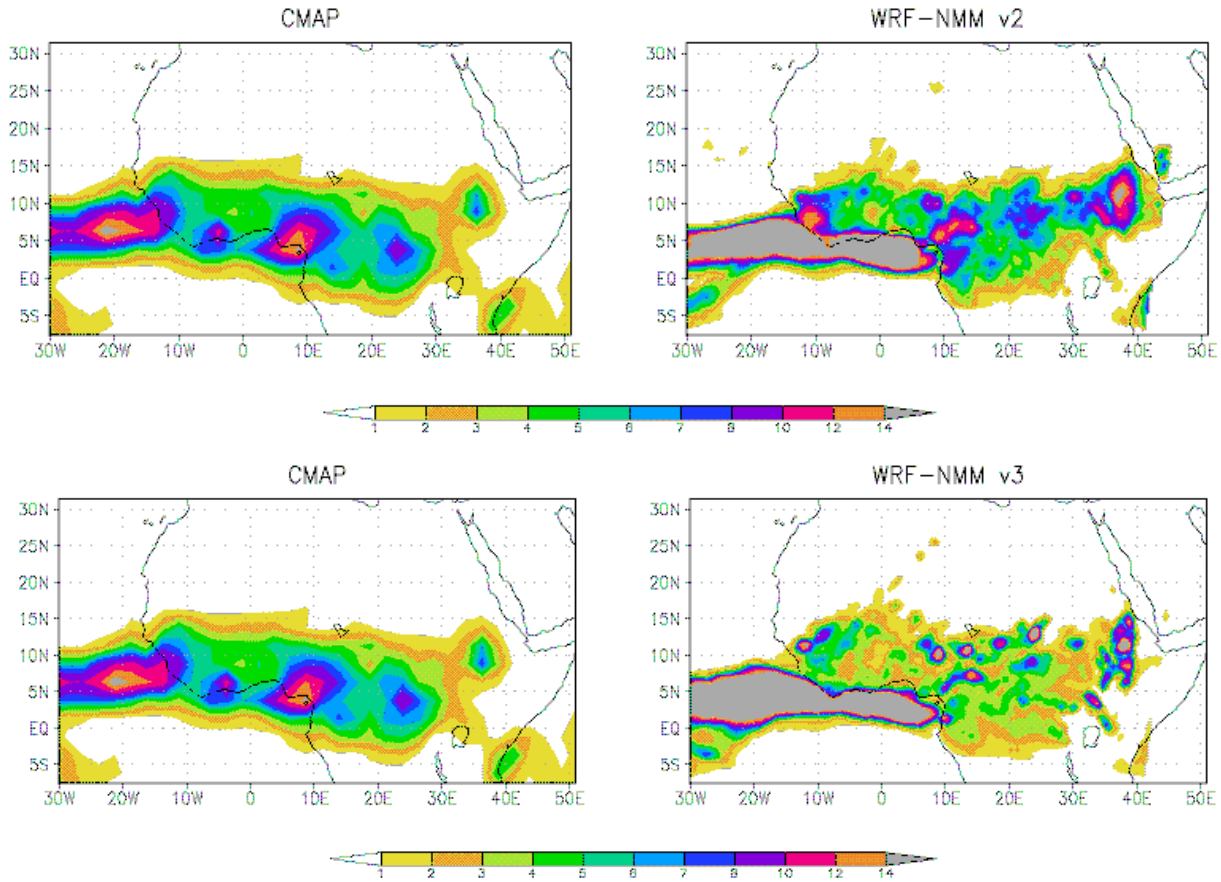
G0:CTL with all terms
G1:term1 off
G2:term2 off
G3:term3 off

```
DELT in M.P.
DELT= XLV1*(PCOND+PIEVP+PICND+PREVP)  … term 1
&     +XLS1*PIDEP                     … term 2
&     +XLF1*(PIACWI+PIACR-PIMLT)      … term 3
```

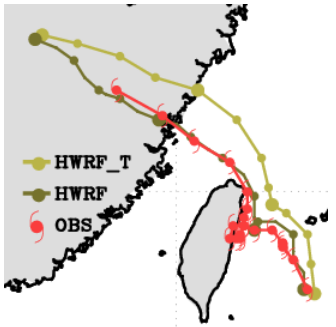
OBS G0 G1 G2 G3

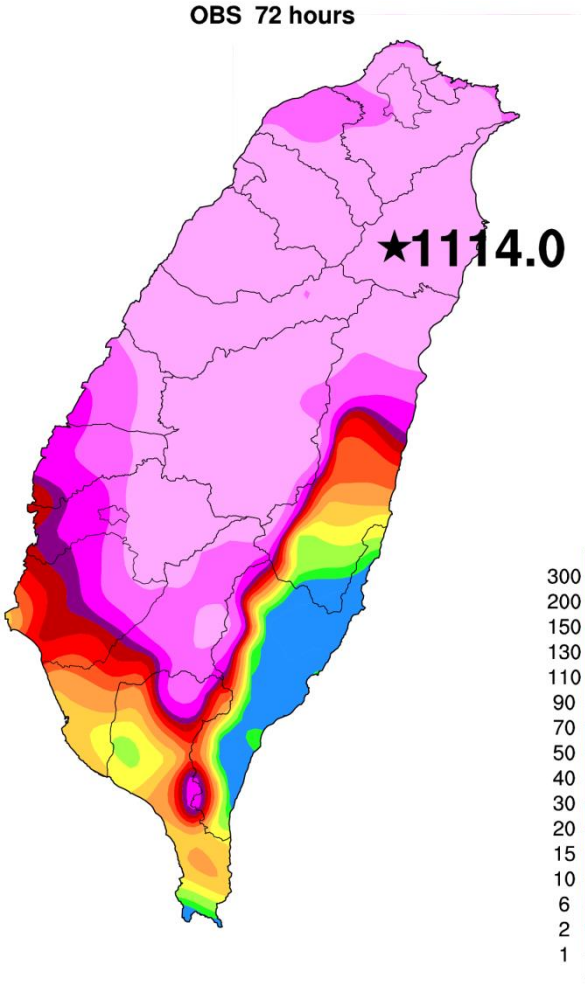


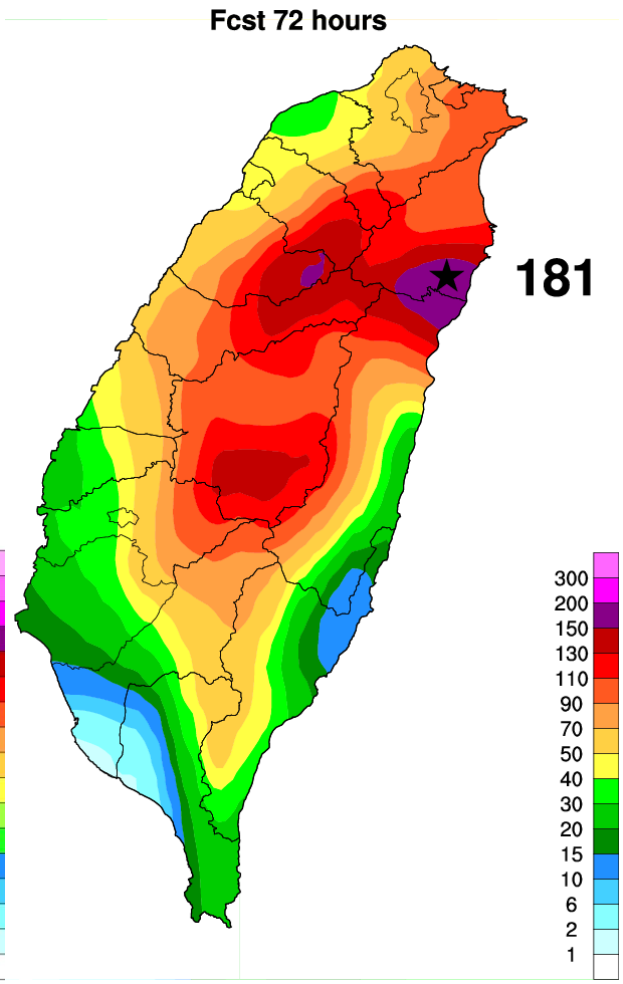
HWRF_T(static domain) 雨量 -版本差異

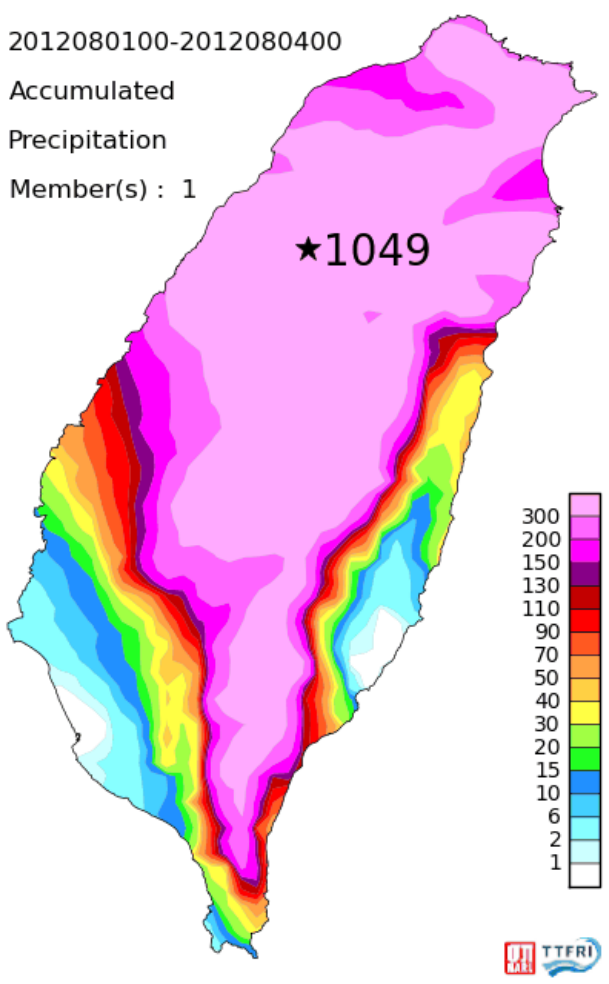


颱風降雨 2012/08/01 00Z
OBS & HWRF & HWRF_T









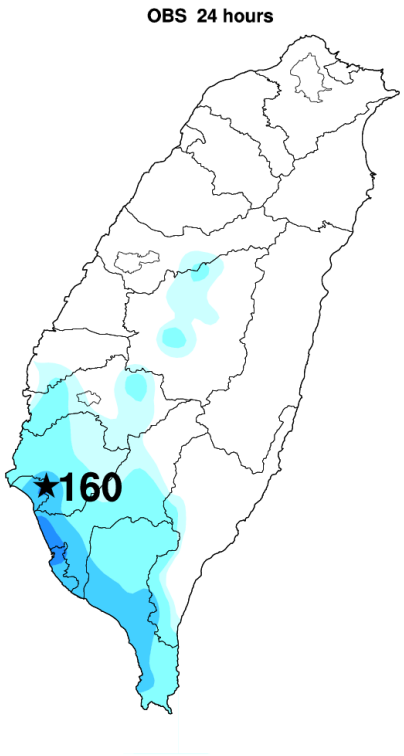
總結

- 最細網格不使用積雲參數法可解決HWRF(moving)出現超級颱風(<800hPa)的問題，並調整HWRF_T(static)為1 way且模式時間步階為54s，改進HWRF_T對颱風路徑預報之表現。
- HWRF_T(static)對於非颱風期間的降雨預報易出現local storm現象，初步研究發現微物理過程中水氣相位變化造成之溫度增量為主因，但仍需持續投入研究。
- 2013年將持續評估HWRF與HWRF_T在西北太平洋的路徑與降雨之預報表現；測試高解析度HWRF(9/3/1km)。

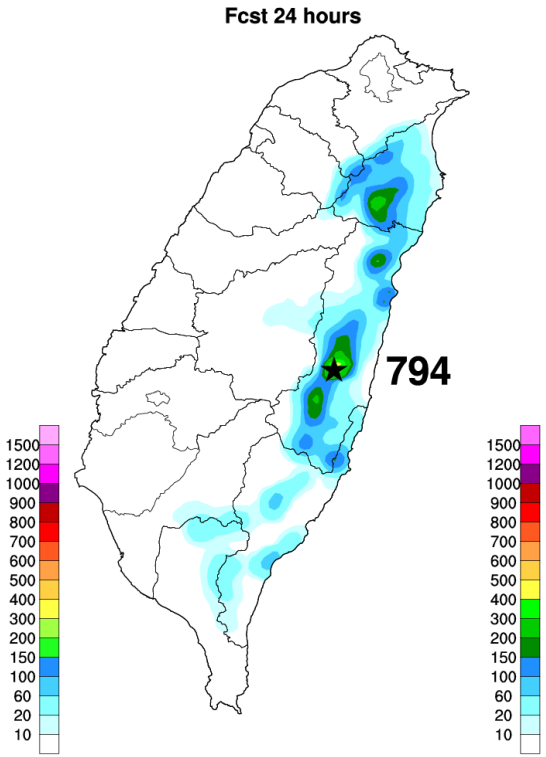
Q & A

HWRF_T(static domain) 雨量 -地形影響

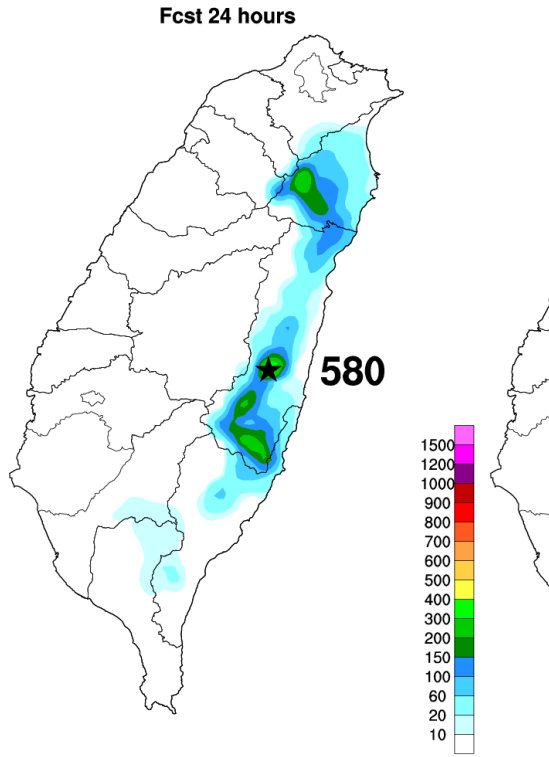
OBS



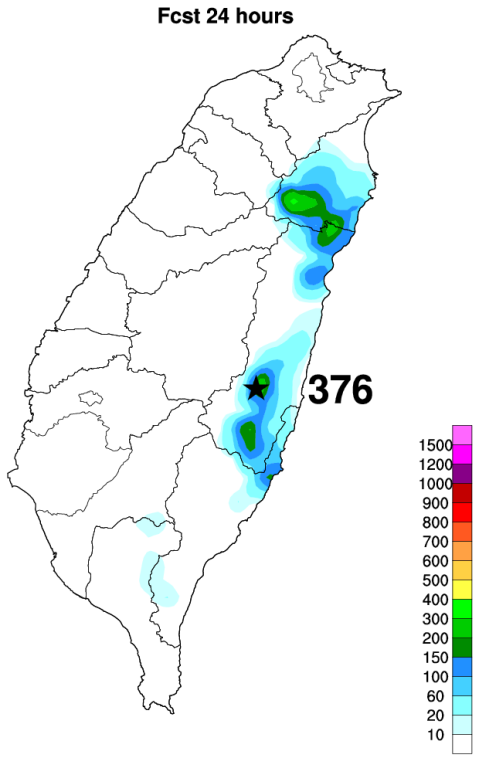
2m



5m



10m



颱風降雨 2012/07/31 06Z
OBS & HWRF & HWRF_T