



中央氣象局TWRP颱風數值預報系統對西北太平洋颱風預測能力之評估與改進研究

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¹中央氣象局

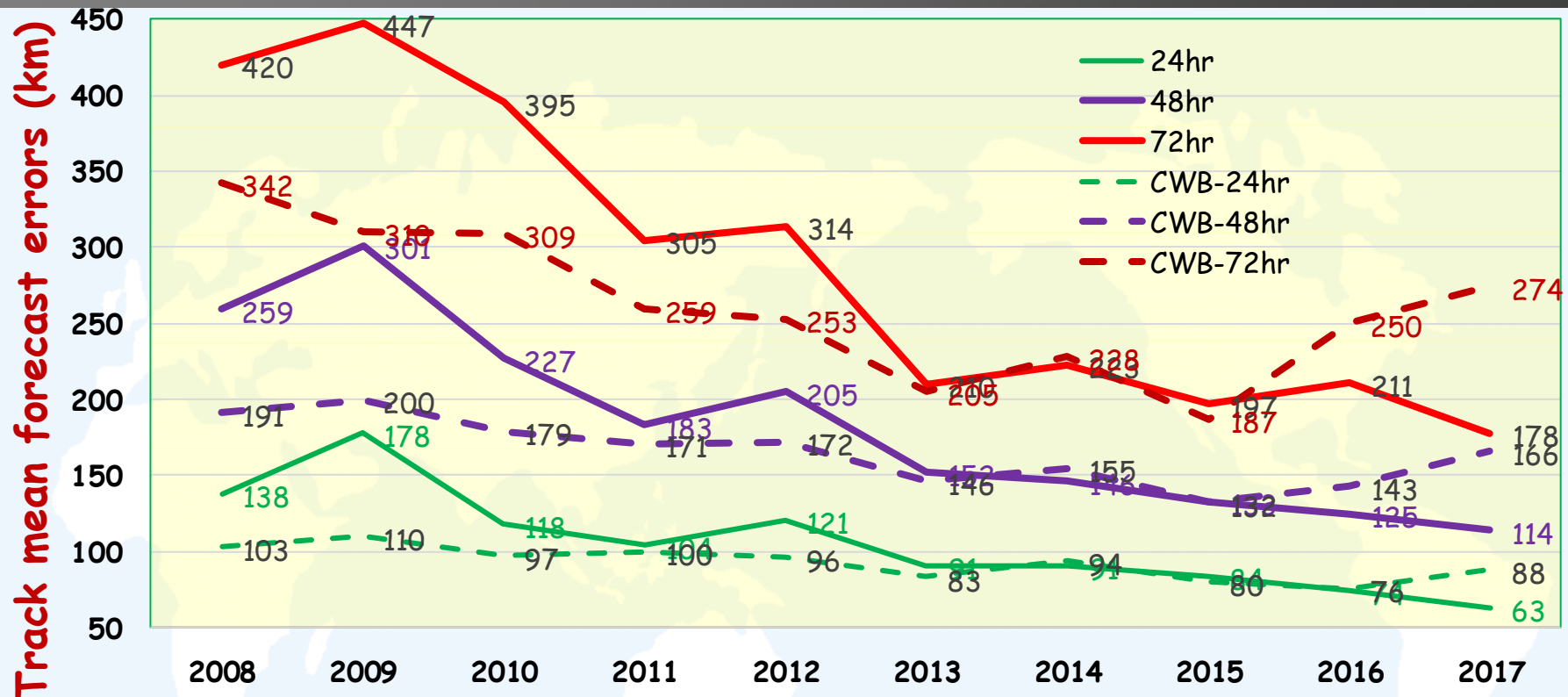
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中央氣象局
2018.09.12

Comparison between TWRF & CWB for the TC Track Forecast Errors

WRF(2008-2010)

TWRF(2011-2017)



Operation **TC Relocation** **New TC initialization** **Two-way interaction**

TC bogus **Partial cycling** **Blending** **TWRF2.0**

Outer loop **NCEPGFS & TWRF** **45/15km → 15/3km**

New trigger KF **45km → 15km** **Blending tuning**

TC track forecast skill of TWRF close to CWB official after 2013



TWRF2.2上線測試項目

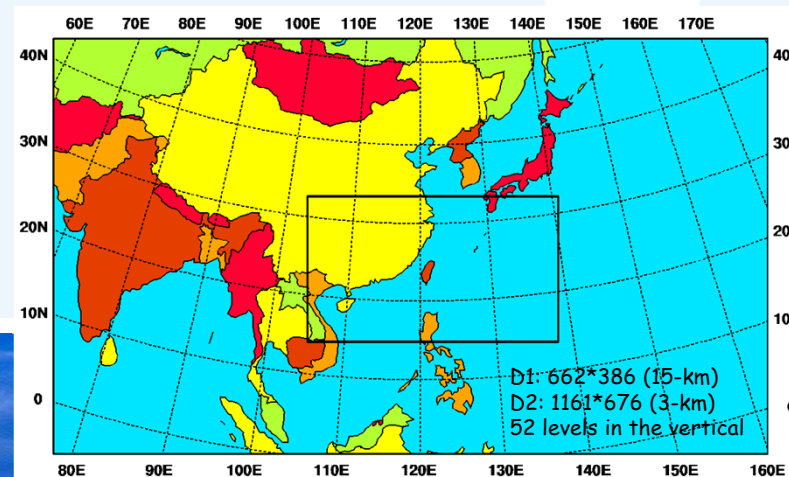


調整Relocation風速門檻值 (18m/s ↗ 21m/s)

評估模式版本升級 (WRF_V381)

評估資料同化策略 (Hybrid , 15km_EAKF; 3km_3DVAR)

側邊界網格點數 (15 ? 30 ?)



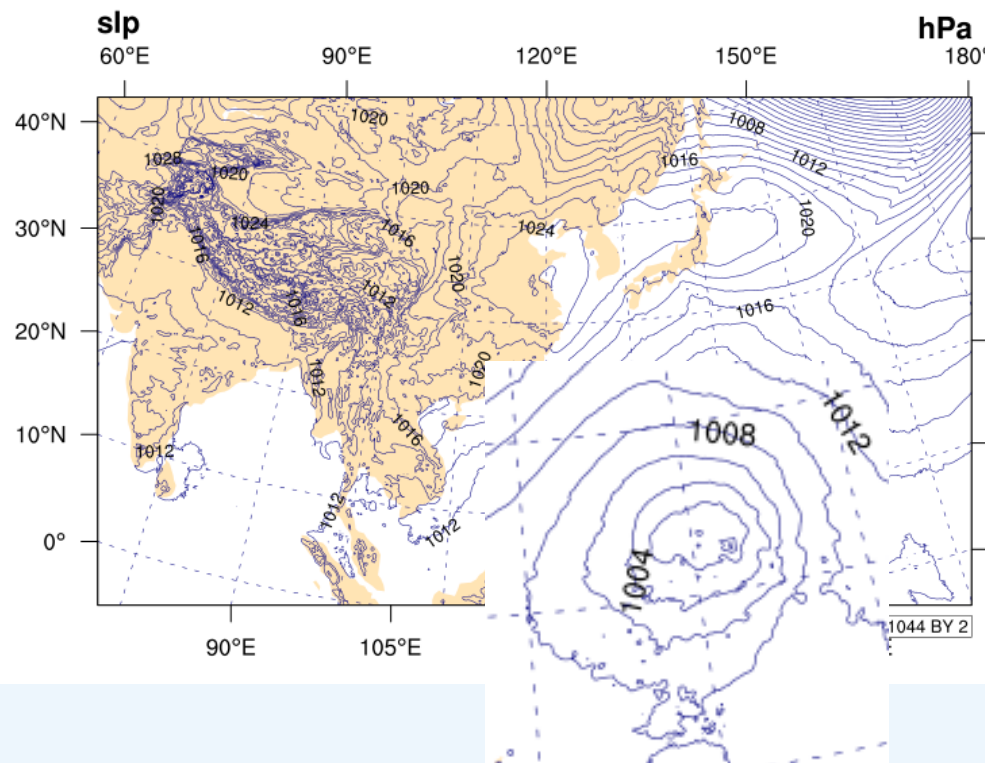
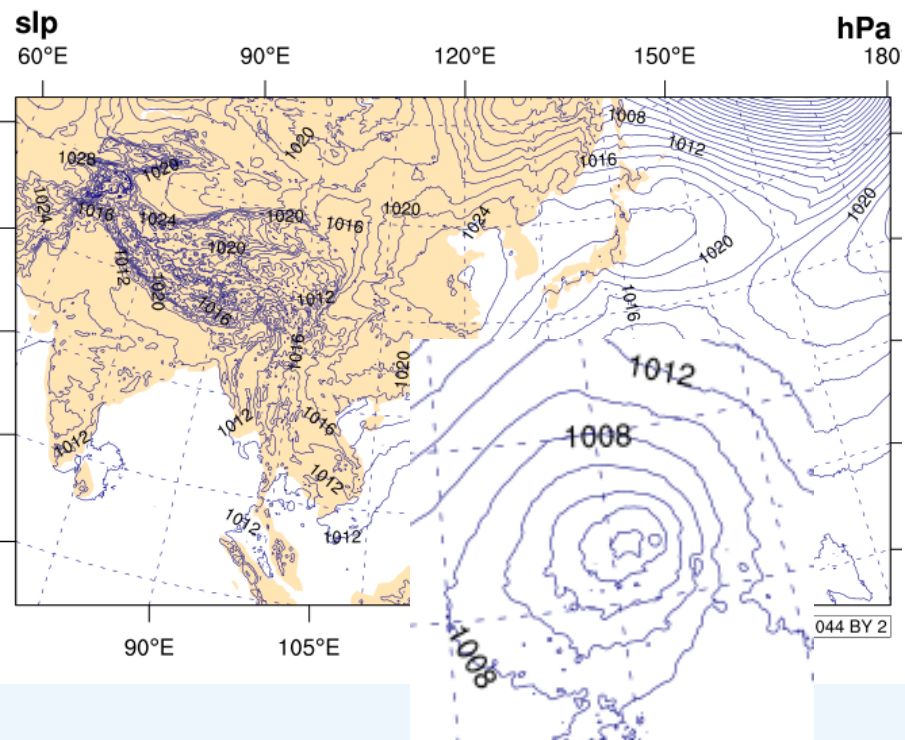


SAOLA (17102406)

風速 = 20 m/s

new_relo 00 h

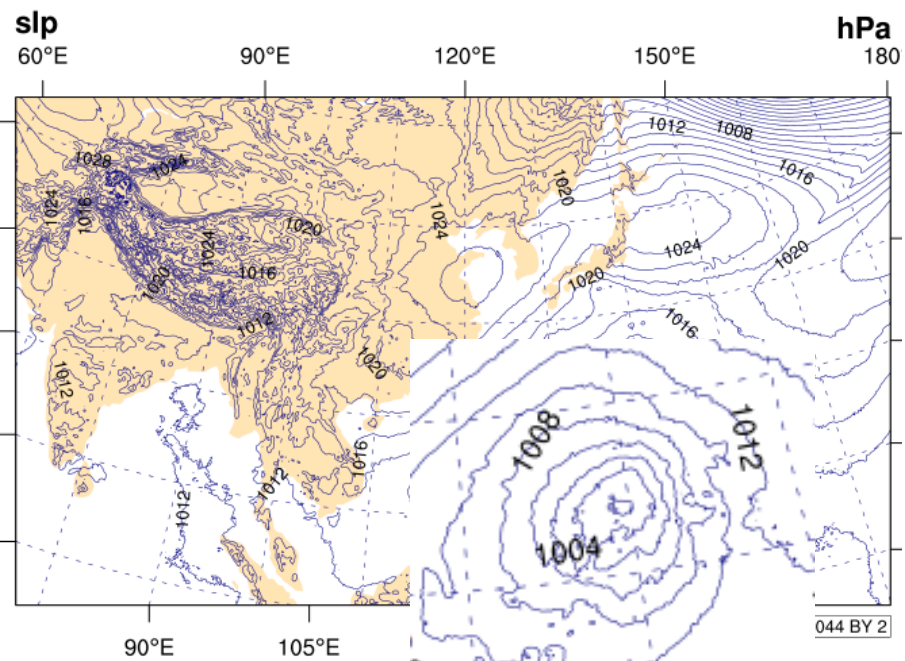
ori_relo 00 h



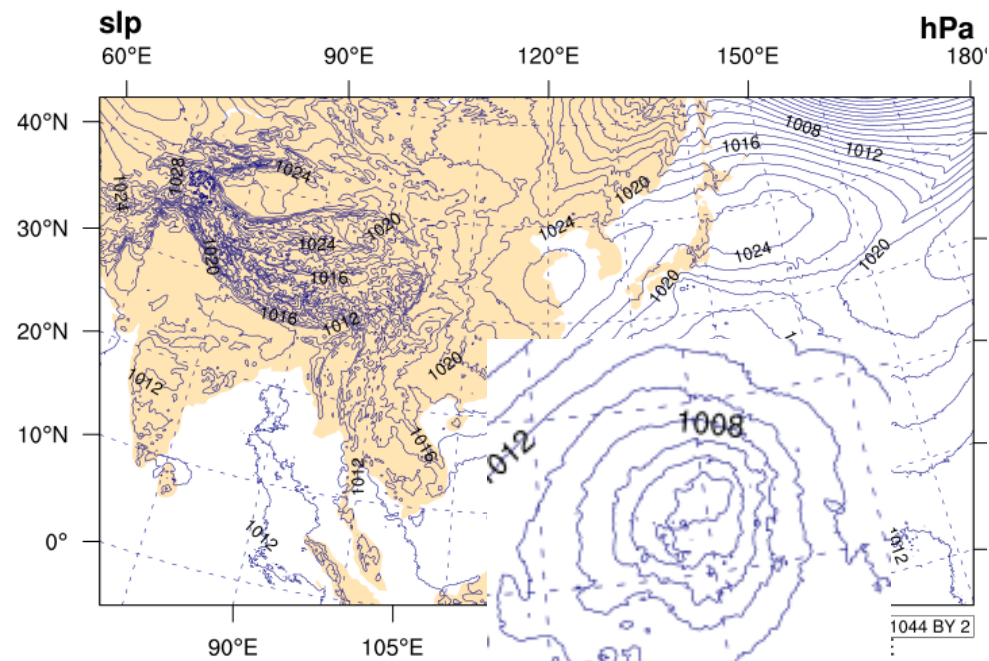


SAOLA (17102406)

new_relo 06 h



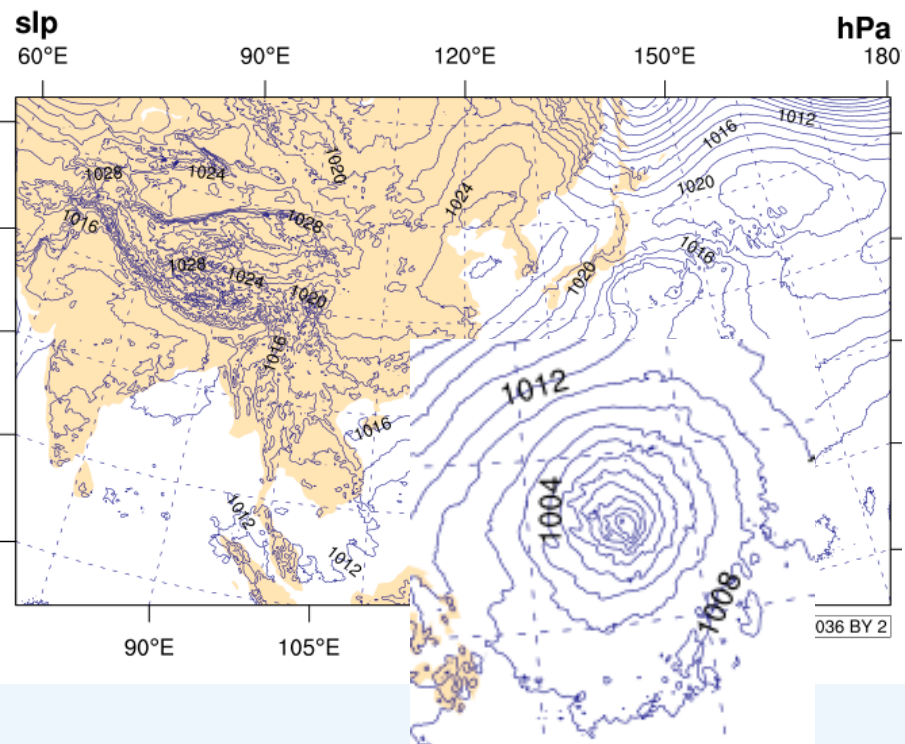
ori_relo 06 h



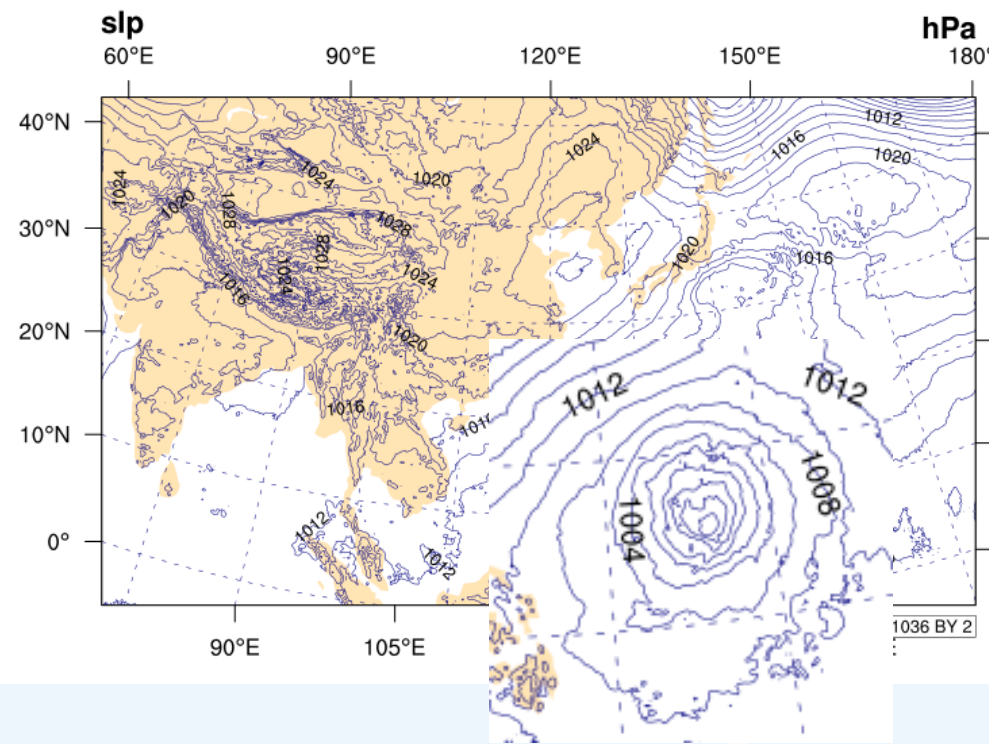


SAOLA (17102406)

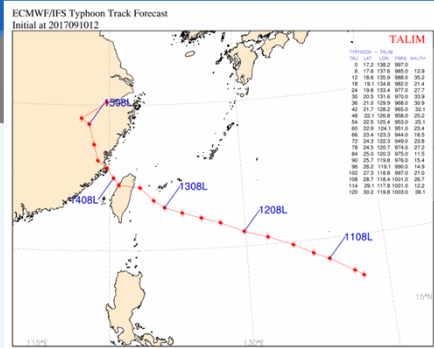
new_relo 24 h



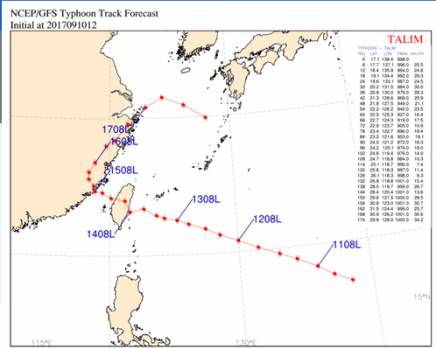
ori_relo 24 h



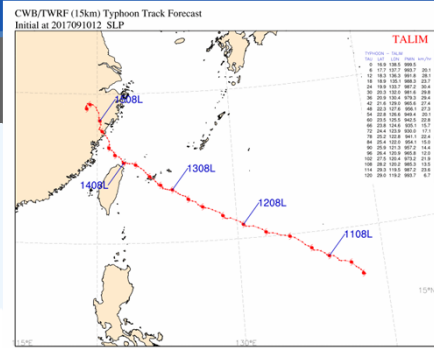
Talim (17091012)



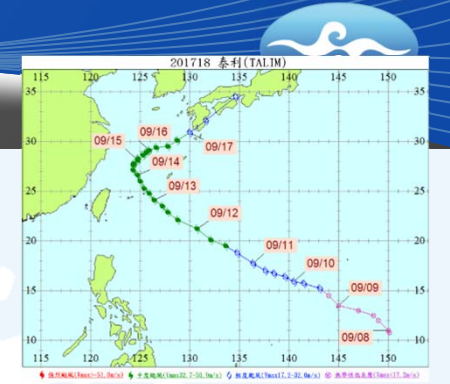
ECMWF



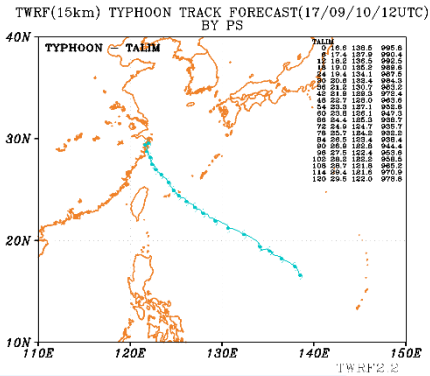
NCEP



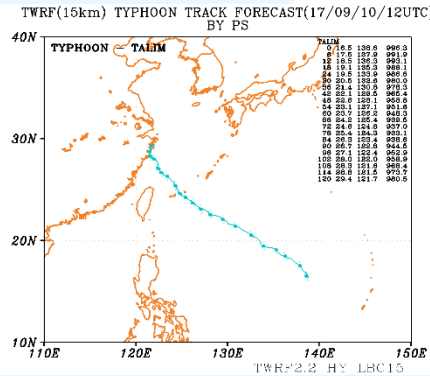
TWRF2.1 (V331)



TWRF2.2

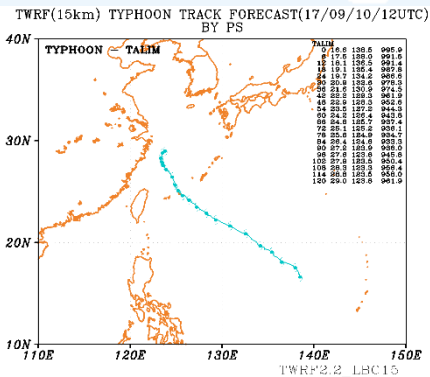


WRF_V381

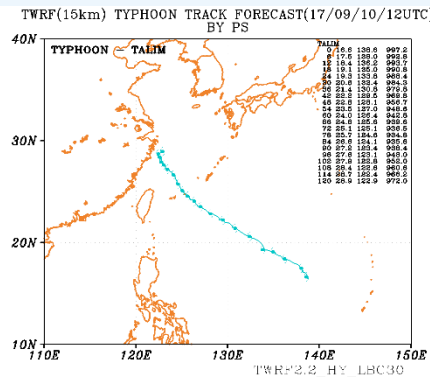


TWRF2.2_HY_LBC15

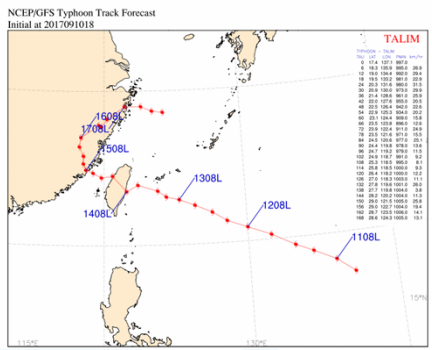
TWRF2.2_LBC15



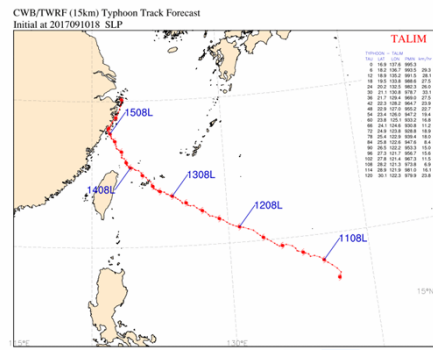
TWRF2.2_HY_LBC30



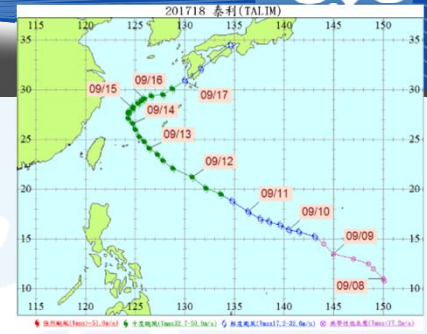
Talim 17091018



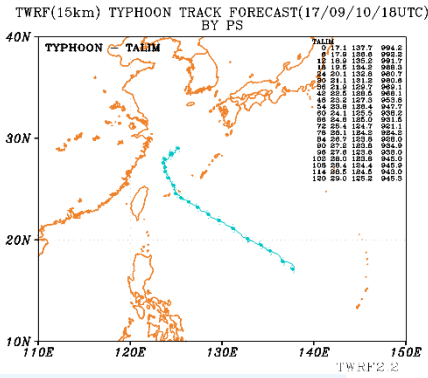
NCEP



TWRF2.1 (V331)

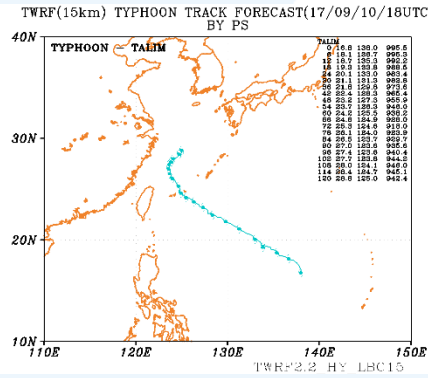


TWRF2.2

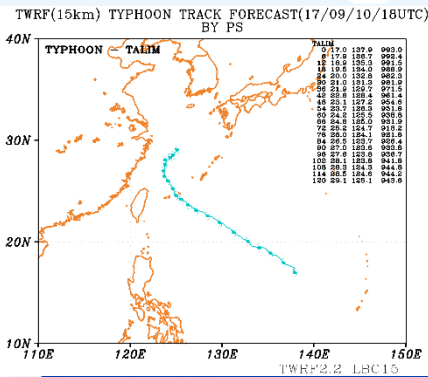


WRF_V381

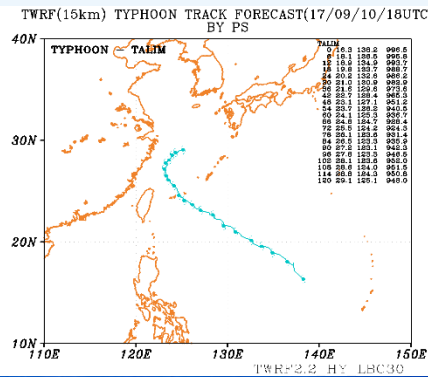
TWRF2.2_HY_LBC15



TWRF2.2_LBC15



TWRF2.2_HY_LBC30



小結



- 風速較弱的颱風進行渦漩移置(relocation)，會破壞其初始場的颱風環流結構
- 模式版本更新(V331 -> V381)，颱風強度及路徑預報明顯改善
- 側邊界網格點數增加為15或30點，較差的NCEP預報，不會透過側邊界影響TWRF的預報表現



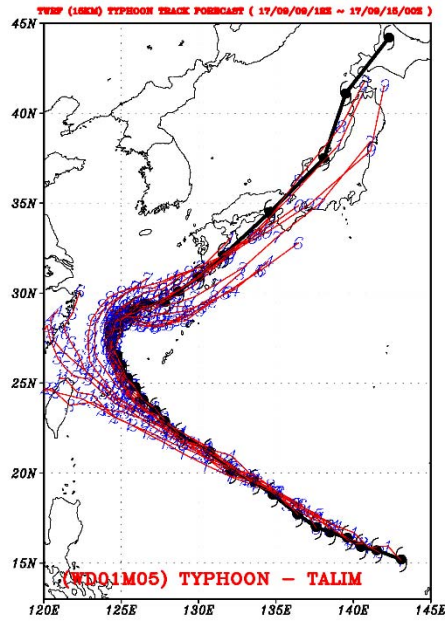
Cases & DOE of TWRf2.2

實驗名稱	實驗設定	模式版本	資料同化	側邊界網格點數
TWRf2.1		WRF_V331	3DVAR	5
TWRf2.2		WRF_V381	3DVAR	5
TWRf2.2_LBC15		WRF_V381	3DVAR	15
TWRf2.2_HY_LBC15		WRF_V381	Hybrid	15
TWRf2.2_HY_LBC30		WRF_V381	Hybrid	30

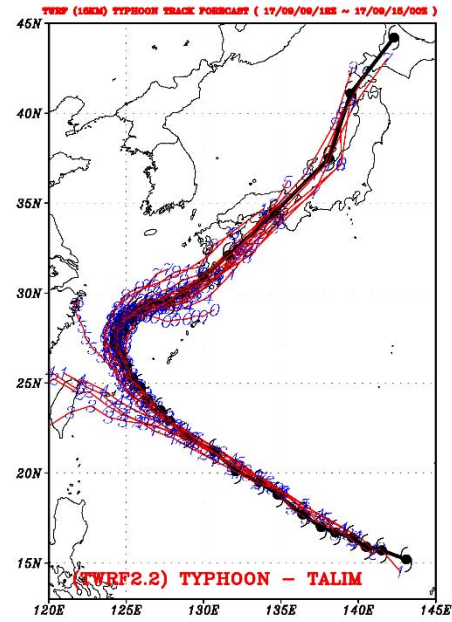
	Date	Intensity	Movement	Cases no.
Nesat*	2017/07/26/18~2017/07/30/00	Medium-strength	Westward	14
Haitang*	2017/07/29/12~2017/07/30/00	Weak	Recurved	3
Hato*	2017/08/20/06~2017/08/22/06	Medium-strength	Westward	7
Talim*	2017/09/09/12~2017/09/15/00	Medium-strength	Recurved	23
Doksuri	2017/09/12/12~2017/09/15/00	Medium-strength	Westward	9
Lan	2017/10/15/18~2017/10/18/00	Strong	Recurved	10
Saola	2017/10/24/06~2017/10/27/18	Weak	Recurved	15
Total cases				81



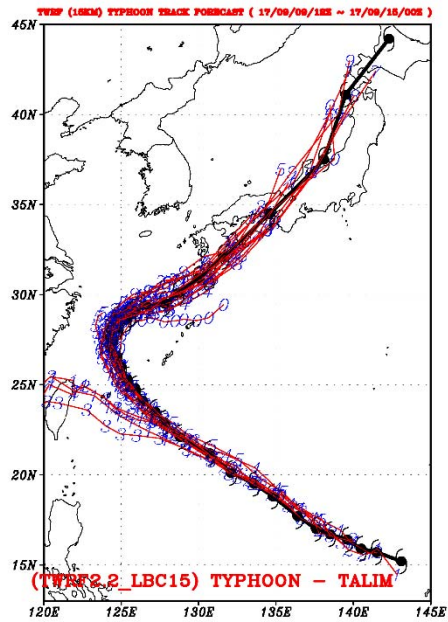
TWRf2.1



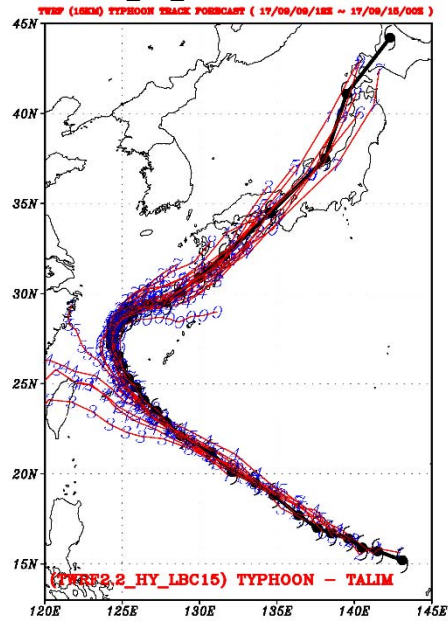
TWRf2.2



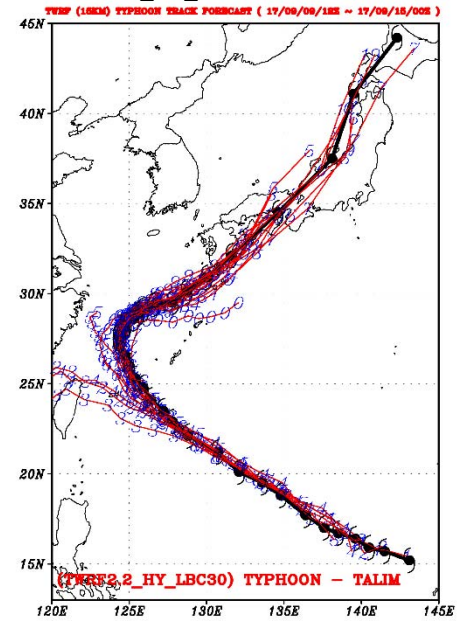
TWRf2.2_LBC15



TWRf2.2_HY_LBC15



TWRf2.2_HY_LBC30



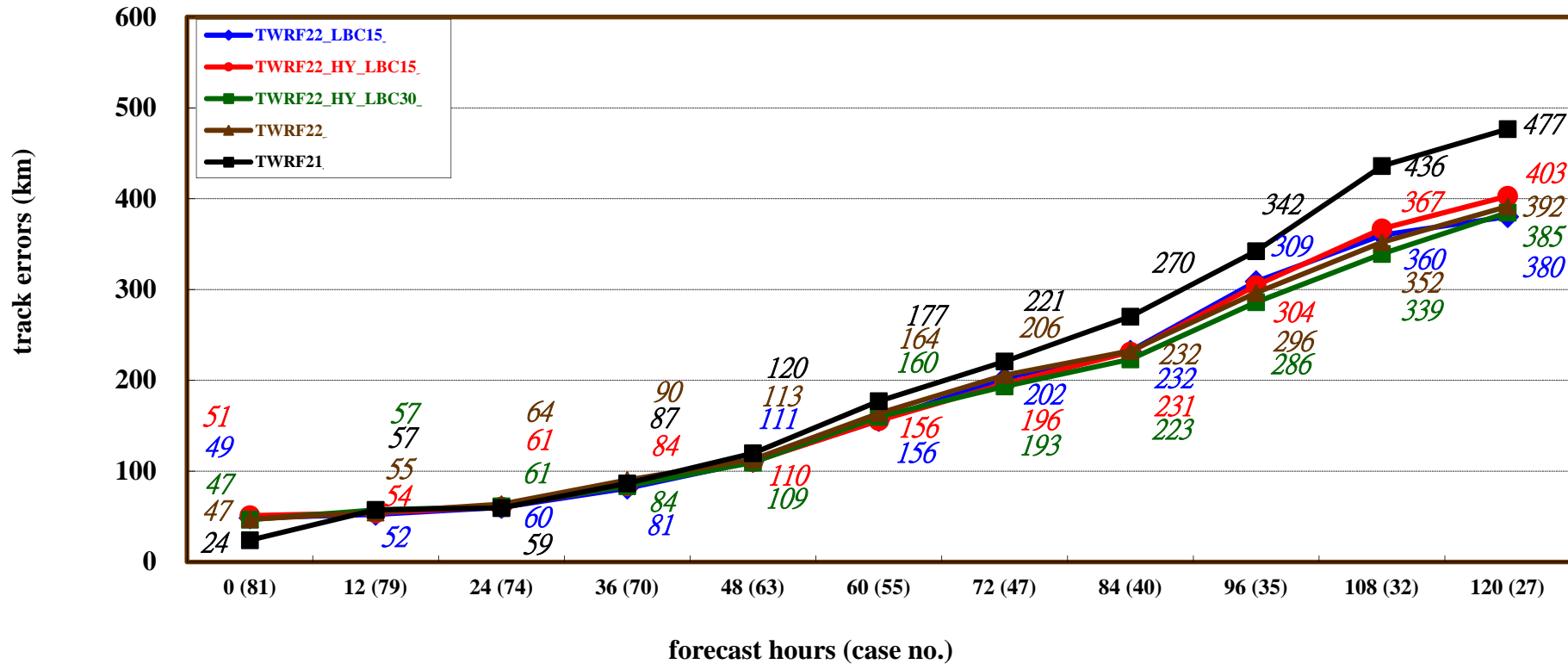
Typhoon track mean error of Talim @15 km



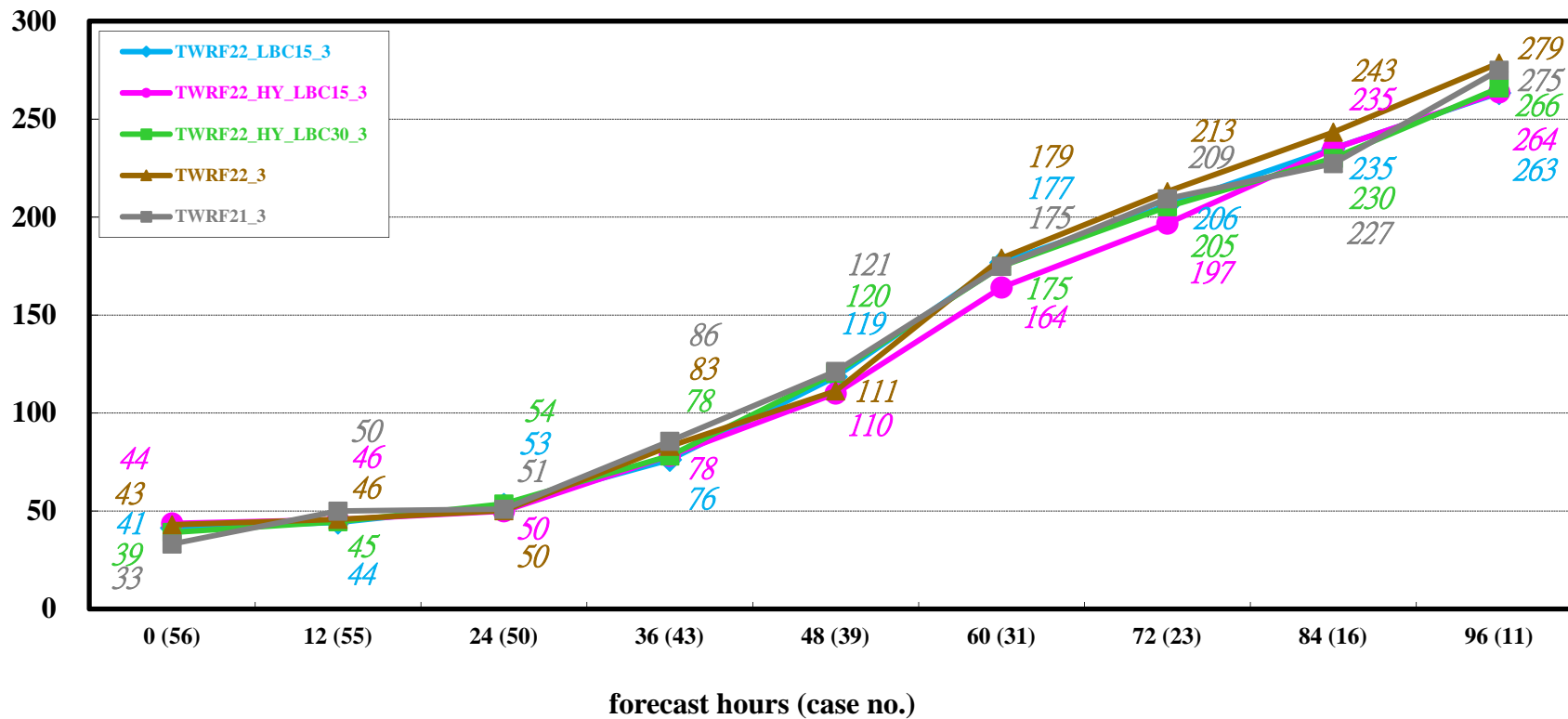
TALIM 2017/09/09/12~2017/09/15/00	0hr	12hr	24hr	36hr	48hr	60hr	72hr	84hr	96hr	108hr	120hr
TWRF22_LBC15_15	25	33	46	58	64	88	111	140	216	306	416
TWRF22_HY_LBC15_15	30	36	45	53	64	85	113	138	215	316	436
TWRF22_HY_LBC30_15	30	34	43	51	57	76	102	130	204	290	393
TWRF22_15	24	34	44	54	58	85	117	151	235	328	437
TWRF21_15	14	30	44	53	67	99	135	193	271	400	536
case no.	23	23	23	23	23	23	22	21	19	18	16



Experiments result for TWR2.2 (15km) to 2017 7 TCs 81 cases



Experiments result for TWRF2.2 (3km) to 2017 6 TCs 56 cases



TWRF2.2 上線版本

1. 調整relocation策略 (風速門檻值18m/s ↗ 21m/s)

2. 升級模式版本 (WRF_V331 ↗ WRF_V381)

3. 改變資料同化策略(3DVAR → Hybrid 15km_EAKF; 3km_3DVAR)

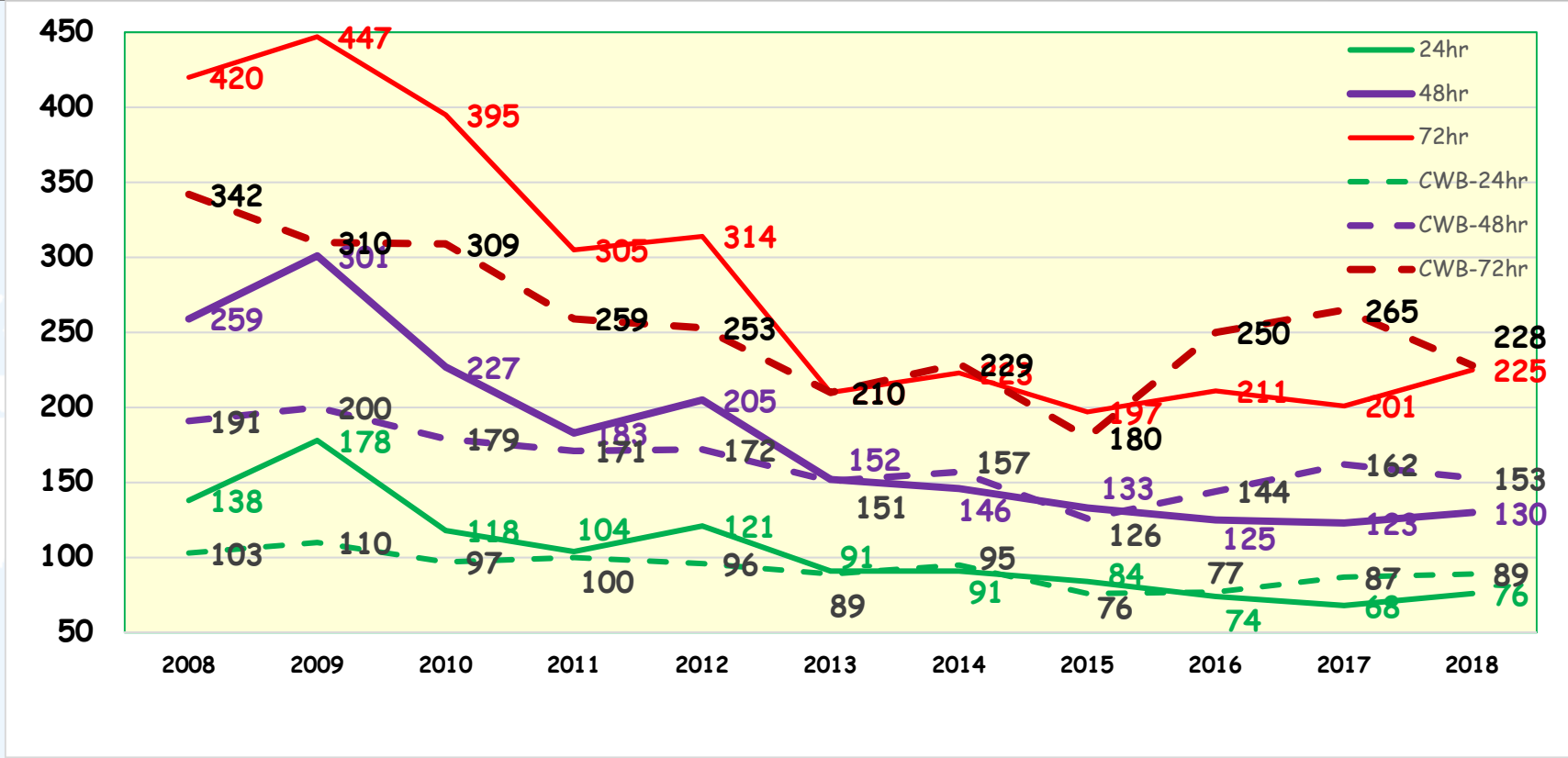
~~4. 增加側邊界網格點數 (5 ↗ 30)~~

Comparison between TWRP & CWB for the TC Track Forecast Errors

WRF(2008-2010)

TWRP(2011-2018)

Track mean forecast errors (km)

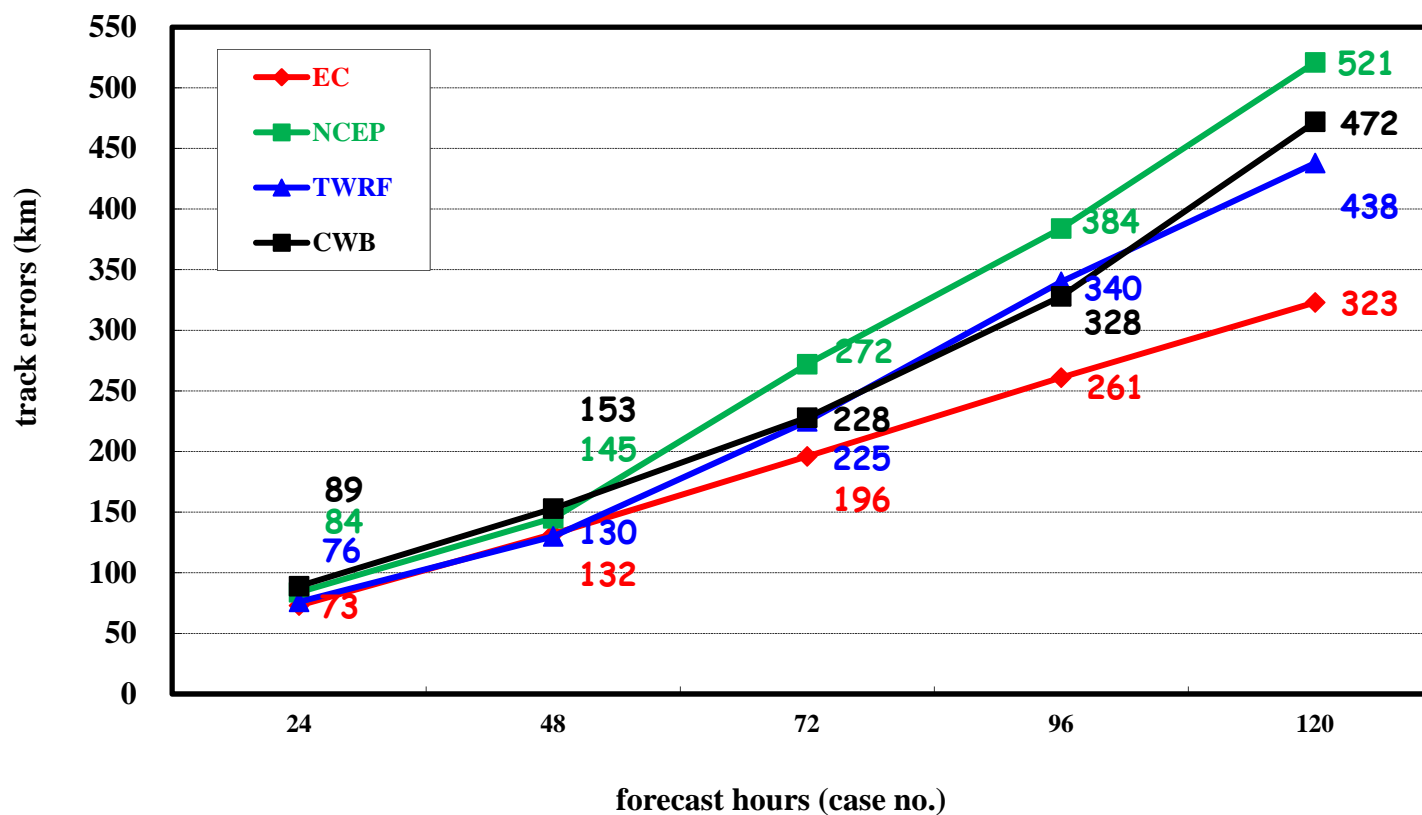


- Operation
- TC Relocation
- New TC initialization
- Two-way interaction
- WRF_V331 → WRF_V381 Hybrid
- TC bogus
- Partial cycling
Outer loop
New trigger KF
- Blending
NCEPGFS & TWRP
45km → 15km
- TWRP2.0
45/15km → 15/3km
Blending tuning

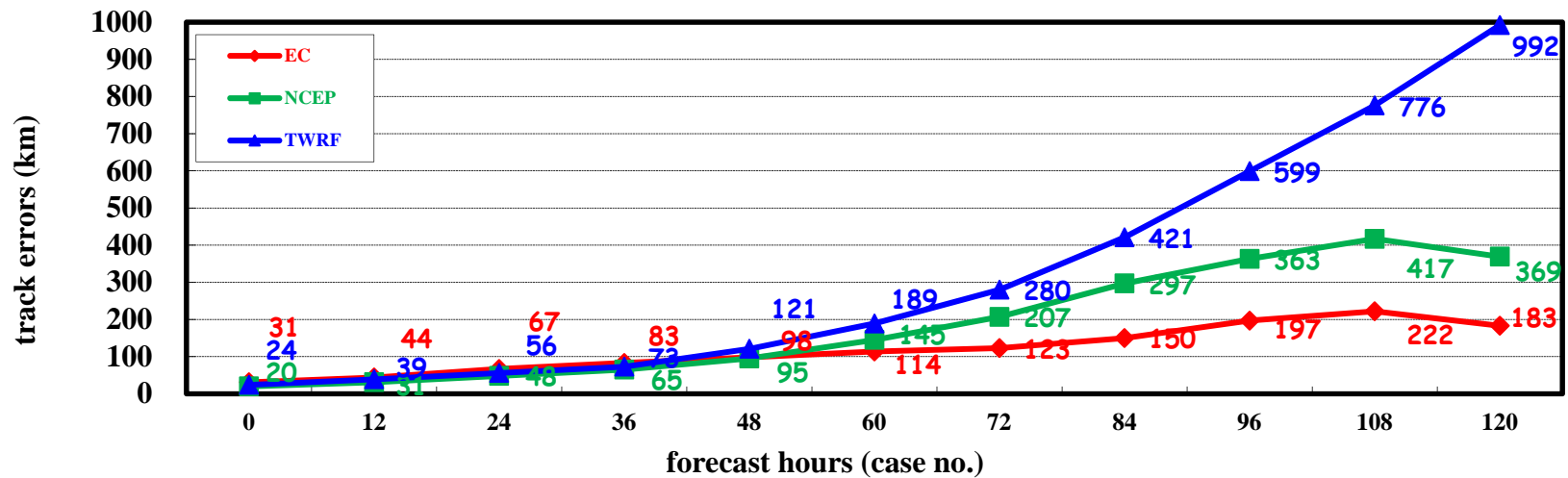
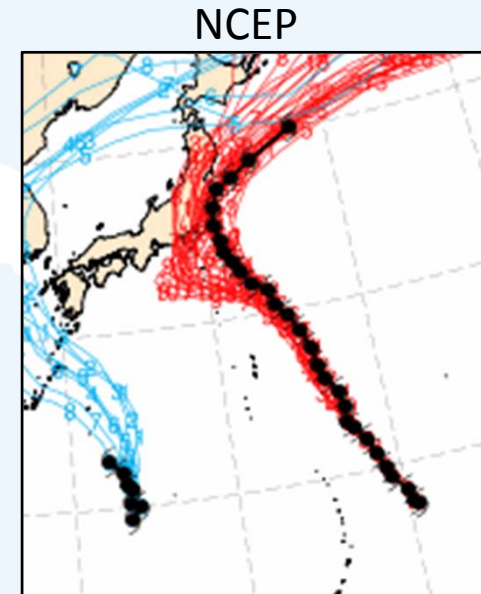
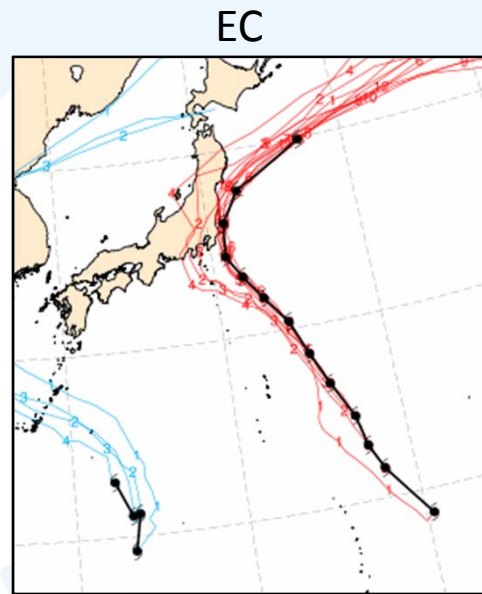
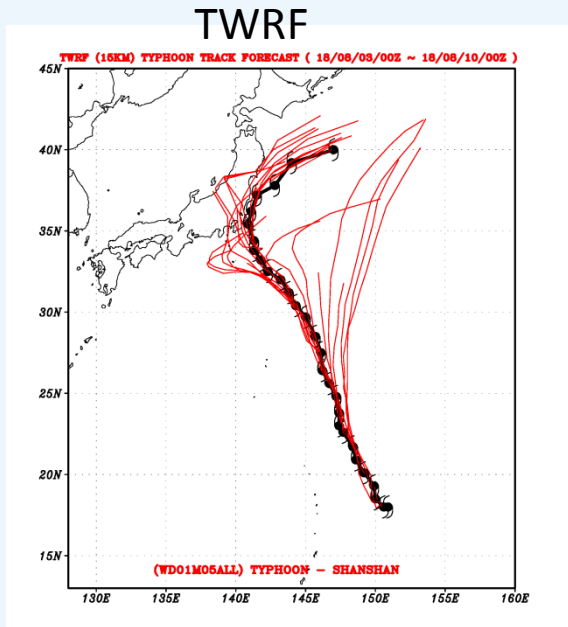


Typhoon track forecast error over NW Pacific in 2018

CWB, TWRF, EC, NCEP



Shanshan (18080300 ~ 18081000)



Shanshan (18080300 ~ 18080400)



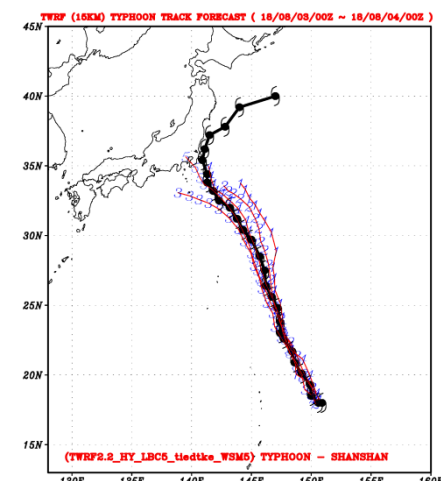
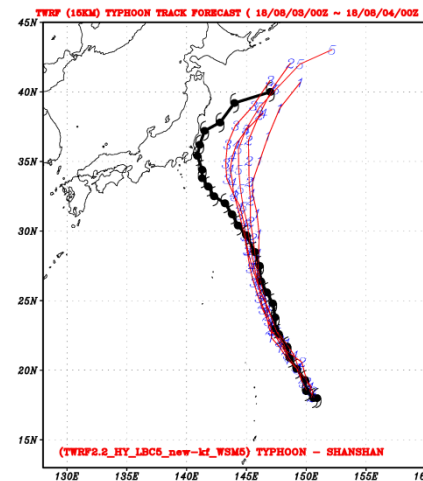
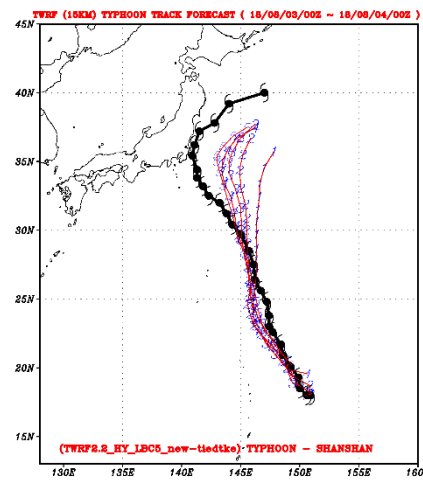
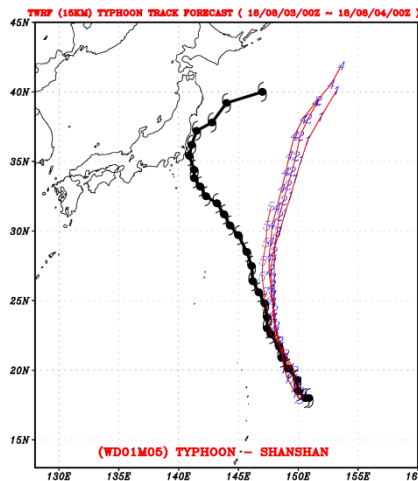
	TWRF_OP	New Tiedtke	New KF+WSM5	Tiedtke+WSM5
Microphysics	Goddard	Goddard	WSM5	WSM5
PBL	YSU	YSU	YSU	YSU
Cumulus	New KF	New Tiedtke	New KF	Tiedtke

TWRF_OP

New Tiedtke

New KF + WSM5

Tiedtke + WSM5

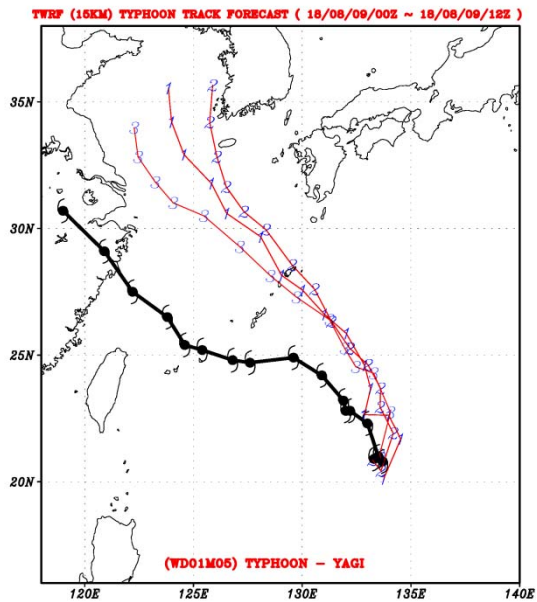


Yagi (18080900 ~ 18080912)

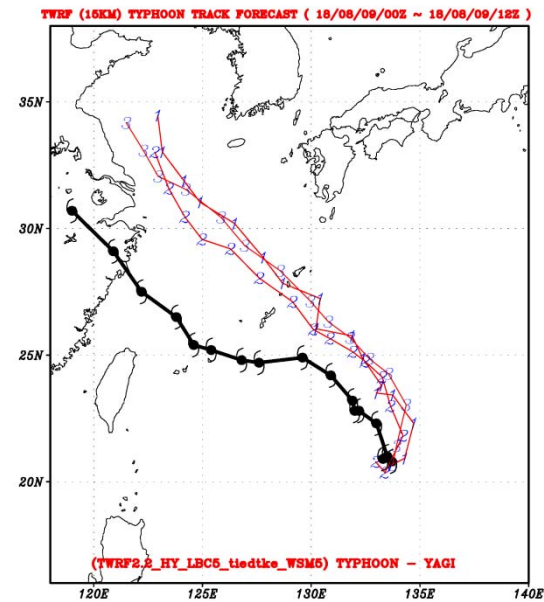


	TWRF_OP	Tiedtke+WSM5
Microphysics	Goddard	WSM5
PBL	YSU	YSU
Cumulus	New KF	Tiedtke

TWRF_OP



Tiedtke + WSM5



Dropsonde Experiments in TWRF 2008-2018



	Date	Intensity	Movement	Cases no.
Fengsen	08062312	Medium-strength	Westward	1
Kalmaegi	08071612	Medium-strength	Northward	1
Fungwong	08072612	Medium-strength	Recurved	1
Nuri	08082012	Medium-strength	Westward	1
Sinlaku	08091000, 08091100, 08091600	Strong	Recurved	3
Hagupit	08092200	Medium-strength	Westward	1
Jangmi	08092700, 08092800	Strong	Recurved	2
Linfa	09062000	Weak	Northward	1
Morakot	09080600	Medium-strength	Recurved	1
Parma	09100300, 09100312	Medium-strength	Westward	2
Lupit	09102000, 09102100, 09102200	Strong	Recurved	3
Kompasu	10083112	Medium-strength	Recurved	1
Lionrock	10090100	Weak	Recurved	1
Fanapi	10091600, 10091700, 10091800	Medium-strength	Westward	3
Megi	10101700	Medium-strength	Northward	1
Meari	11062300	Weak	Northward	1
Muifa	11080300, 11080400	Medium-strength	Recurved	2
Roke	11091800	Medium-strength	Recurved	1

Dropsonde Experiments in TWRP 2008-2018



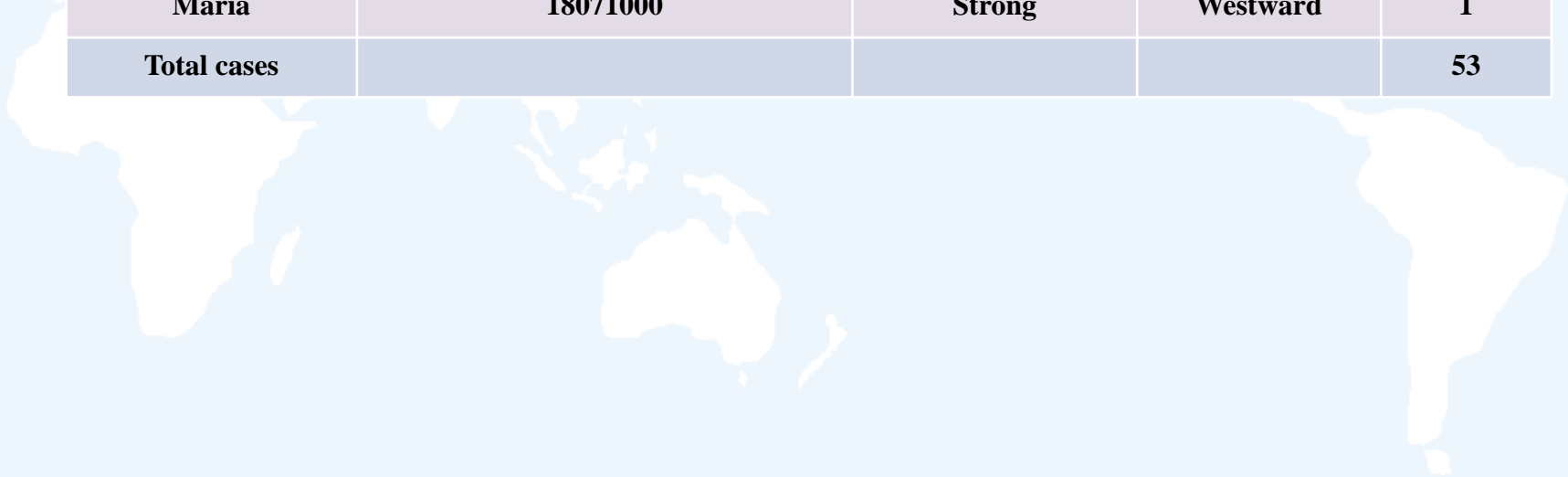
	Date	Intensity	Movement	Cases no.
Talim	12061912	Weak	Northward	1
Doksuri	12062712	Weak	Westward	1
Saola	12073012	Medium-strength	Northward	1
Kaitak	12081500	Weak	Westward	1
Tembin	12082100, 12082200, 12082700	Medium-strength	Recurved	3
Bolaven	12082500	Strong	Recurved	1
Jelawat	12092700	Strong	Recurved	1
Soulik	13071112	Strong	Westward	1
Trami	13081912	Weak	Recurved	1
Kong-Rey	13082800	Weak	Recurved	1
Usagi	13091912	Strong	Westward	1
Fitow	13100500	Medium-strength	Recurved	1
Matmo	14072112	Medium-strength	Recurved	1
Fung-Wong	14091900	Weak	Recurved	1
Soudelor	15080600, 15080612	Medium-strength	Westward	2
Goni	15082000	Strong	Recurved	1
Dujuan	15092700	Strong	Westward	1



Dropsonde Experiments in TWRF 2008-2018

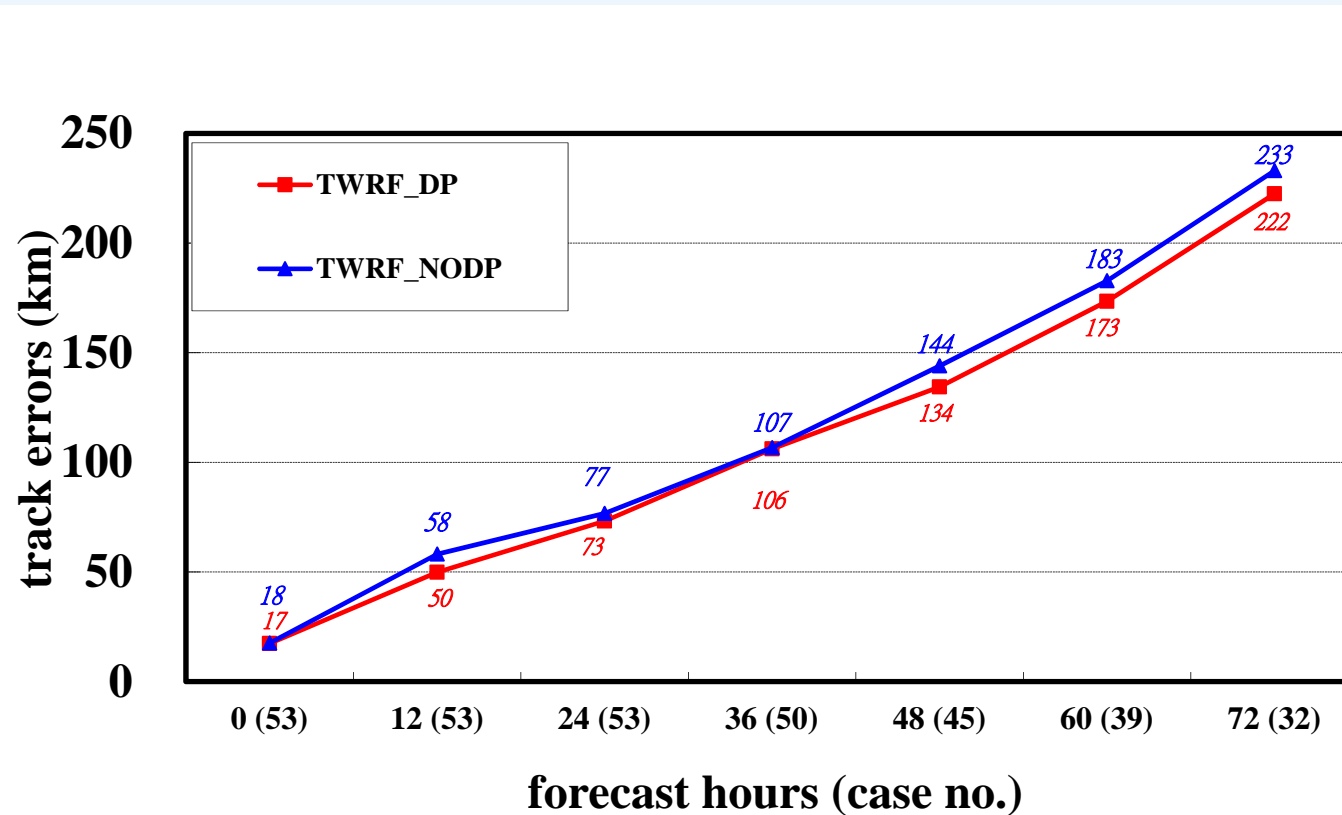


	Date	Intensity	Movement	Cases no.
Nepartpak	16070612	Strong	Westward	1
Megi	16092600	Medium-strength	Westward	1
Talim	17091212	Medium-strength	Recurved	1
Lan	17102112	Strong	Recurved	1
Saola	17102712	Weak	Recurved	1
Maria	18071000	Strong	Westward	1
Total cases				53



Experiment result for 2008-2018

41 TCs 53 cases



加入dropsonde資料，TWRF平均誤差改進幅度為 **6.14%**。





謝謝聆聽
敬請指教



模式更新項目



- WRF_V331 升級至WRF_V381
- 更新地形檔：15弧秒MODIS土地利用類型以及2010年全球多重解析度地形高度資料場(使用USGS之2010 GMTED資料)更新地形檔
- 耦合3公里土壤資料同化(HRLDAS)
- Domain 1使用 Hybrid，Domain 2維持使用3DVar
- 地面觀測資料同化: 改為在模式最低層計算觀測增量，調整水氣場的觀測誤差
- 重力波拖曳力更新：增強重力波拖曳力的效應至原來的3倍
- sf_sfclay_physics：使用之參數法中，對海面上溫濕通量的計算使用隨月份之權重調整
- 平流層中同溫層溫度(iso_temp)：調整為200K
- 考慮積雲溢出之雲量對輻射的貢獻(cu_rad=true.)
- 考慮邊界層頂雲之輻射冷卻效應的混合作用(topdown_mixing=1)

