

The performances of CWB NFS during SoWMEX

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Central Weather Bureau

- Purpose
- Analysis method
- CWB NFS model
- Results
- Conclusions



Purpose

- Re-executed the central weather bureau(CWB) non-hydrostatic forecast system(NFS)
- To evaluate the benefit of not routine observations during the period of SoWMEX



1. Cwb gfs, nfs rerun

→ Full data run of cwb gfs + full data run of nfs

→ operation data run of cwb gfs + operation data run of nfs

2. 2008/05/15/12 ~ 06/26/00

3. Ncep gfs, nfs rerun

→ Full data run of ncep gfs + full data run of nfs



CWB NFS

- 3 nested(45km/15km/5km), 30 vertical layers, $\Delta t = 120$ second.
- finite differencing spacing, leap frog timing, split-explicit scheme.
- Zhao (1997) cloud ice&water microphysics and kuo cumulus parameterization scheme.
- Harshvardhan et al.(1987) radiation scheme, TKE E- ε planetary boundary layer parameterization scheme.



CWB NFS

■Dynamics

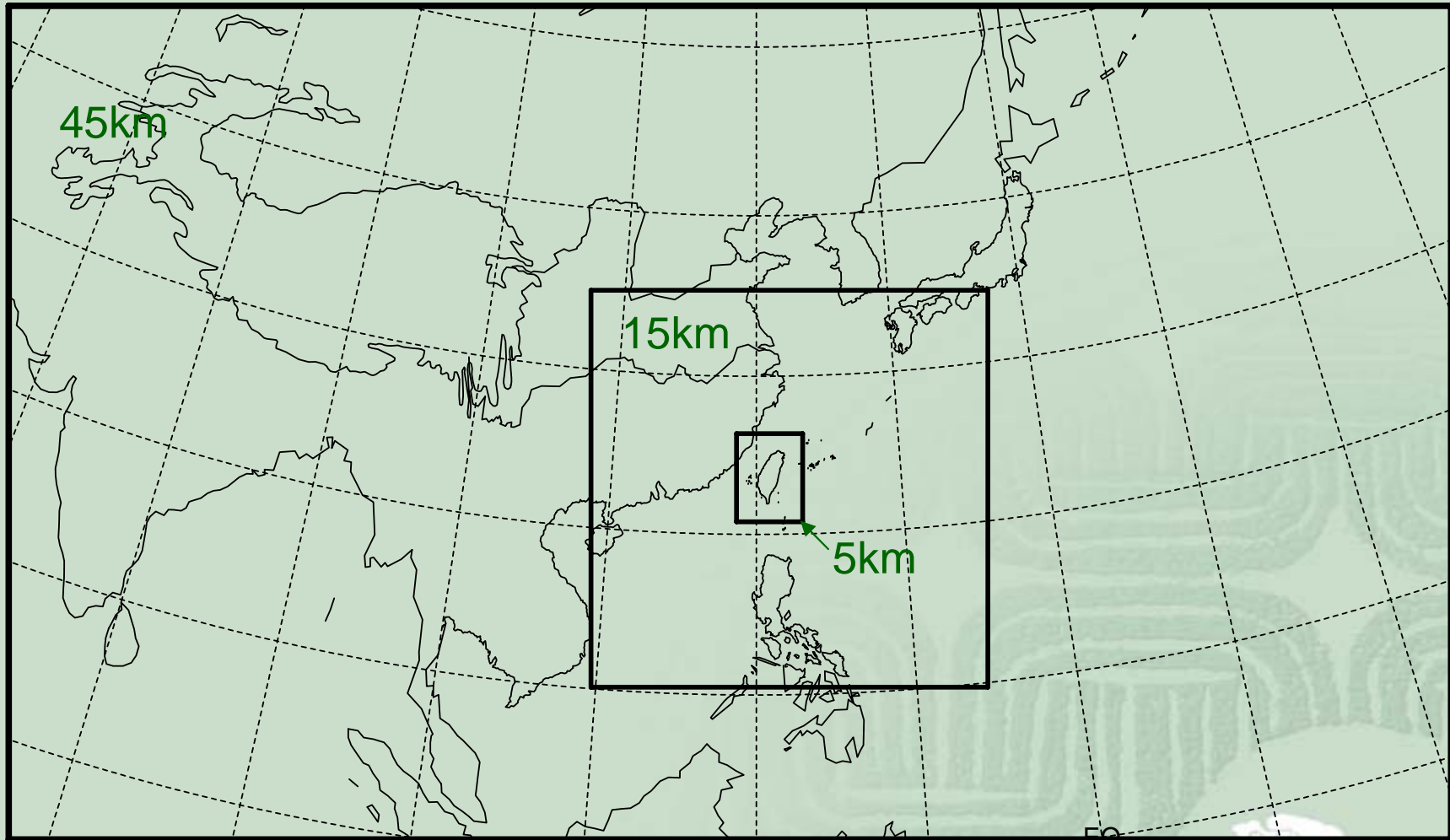
- grid resolution :
45km/15km/5km
- 30 vertical layers
- three days forecasts ,
 $\Delta t=120\text{sec}$.
- 06 h update cycle with Optimal Interpolation (OI).
- Use GFS forecast data(6h interval) for lateral boundary conditions.
- 4th order differencing advection scheme.
- Split explicit scheme suppress first 3 modes of gravity waves.
- Vertical normal modes initialization.

■Physics

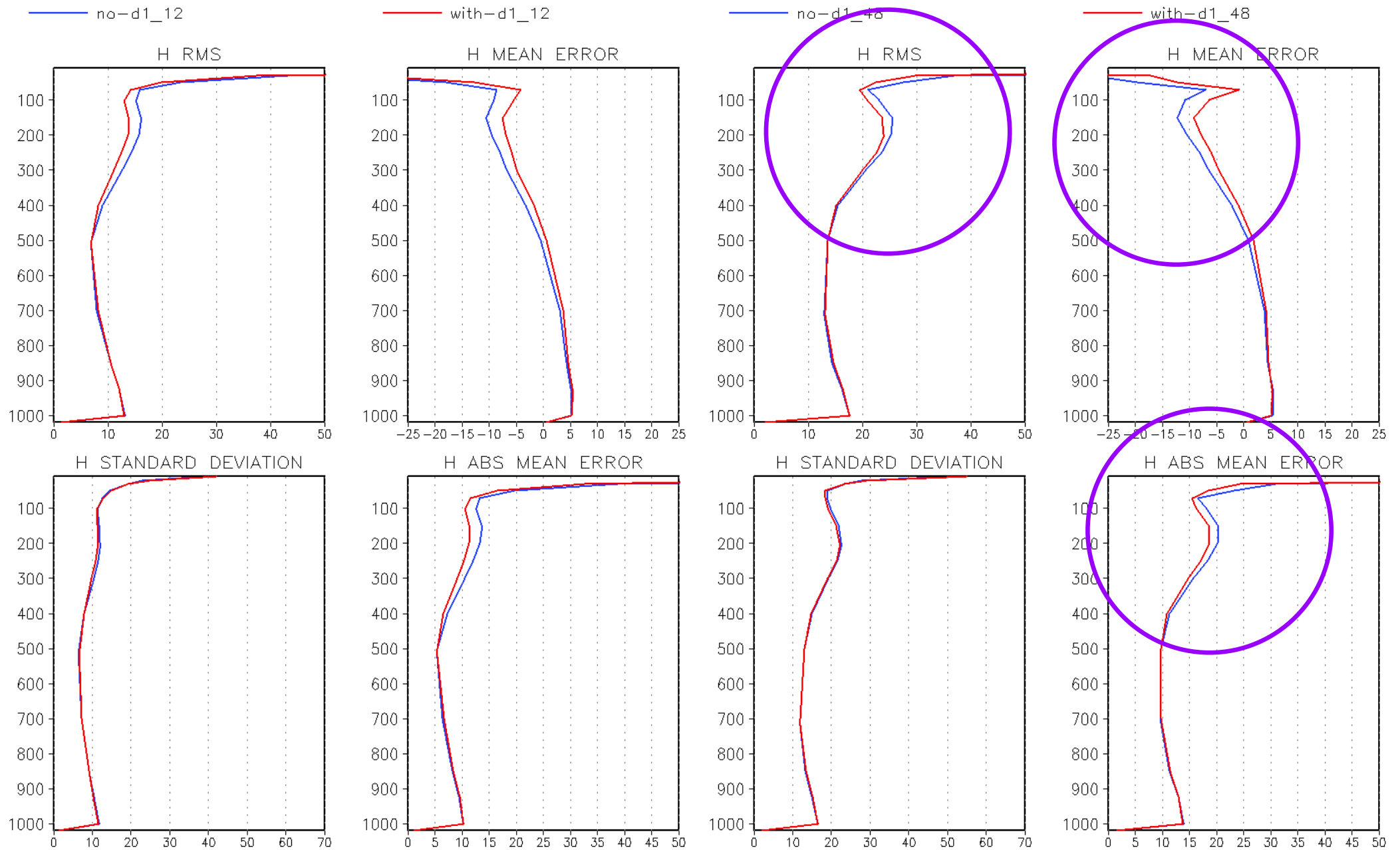
- TKE E- ε planetary boundary parameterization
- Kuo(1974),
- Arakawa and Schubert(1974) cumulus convective scheme
- Large scale precipitation
- Shallow convection scheme
- Radiation scheme :
- Harshvardhan et al. (1987)
- Zhao (1997) cloud ice&cloud water microphysics scheme.



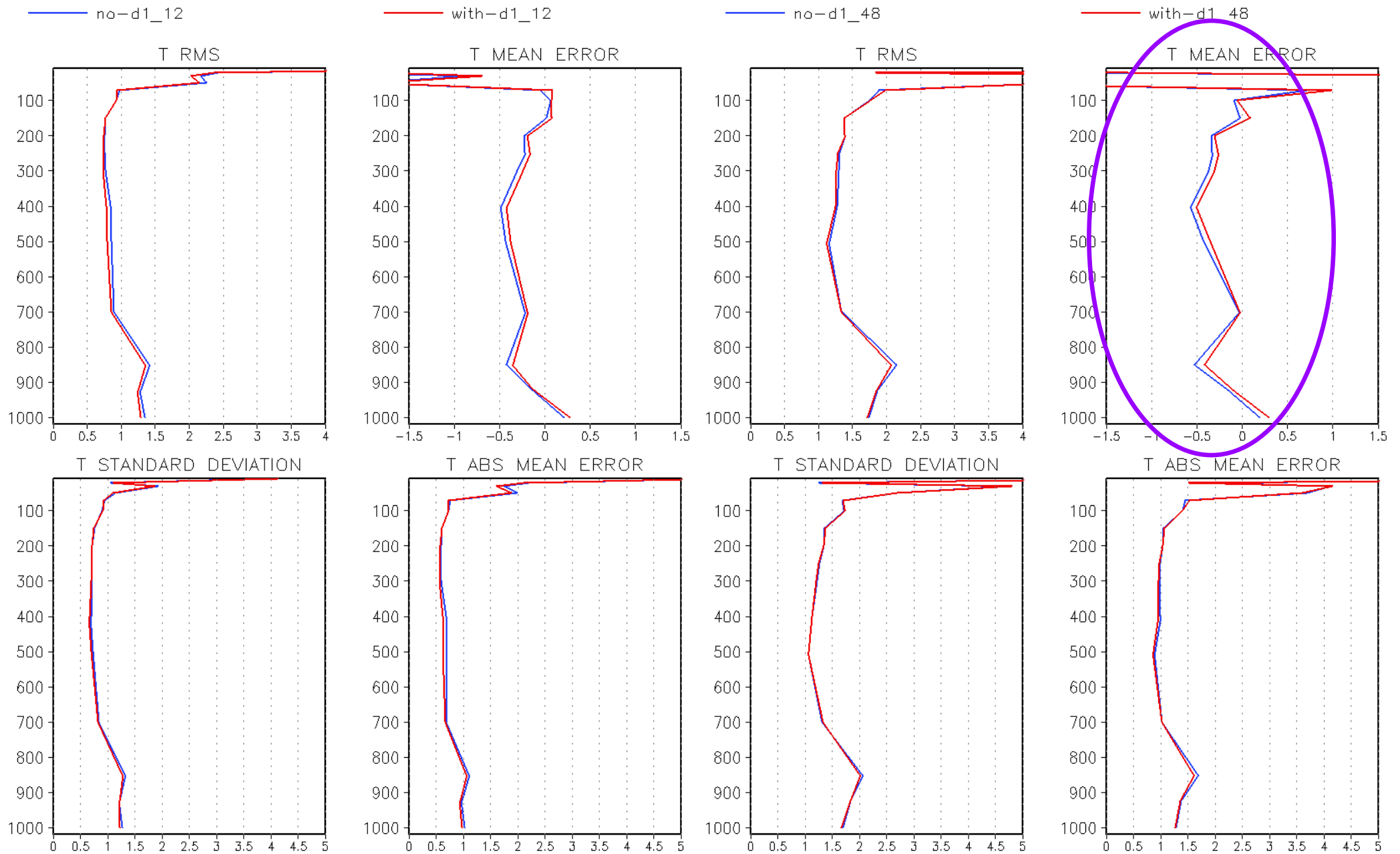
CWB NFS



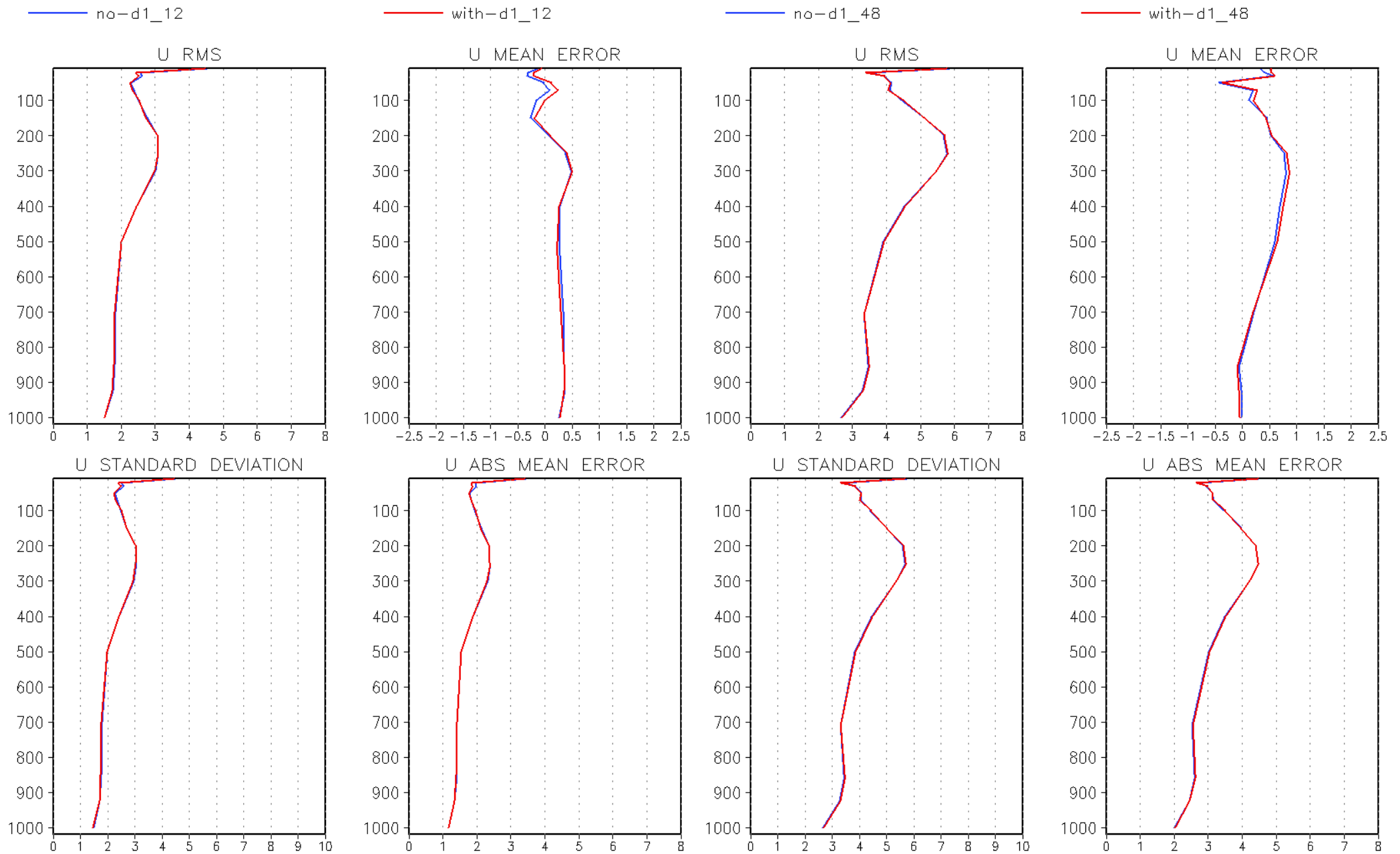
profiles of 45km, 12h&48h, height



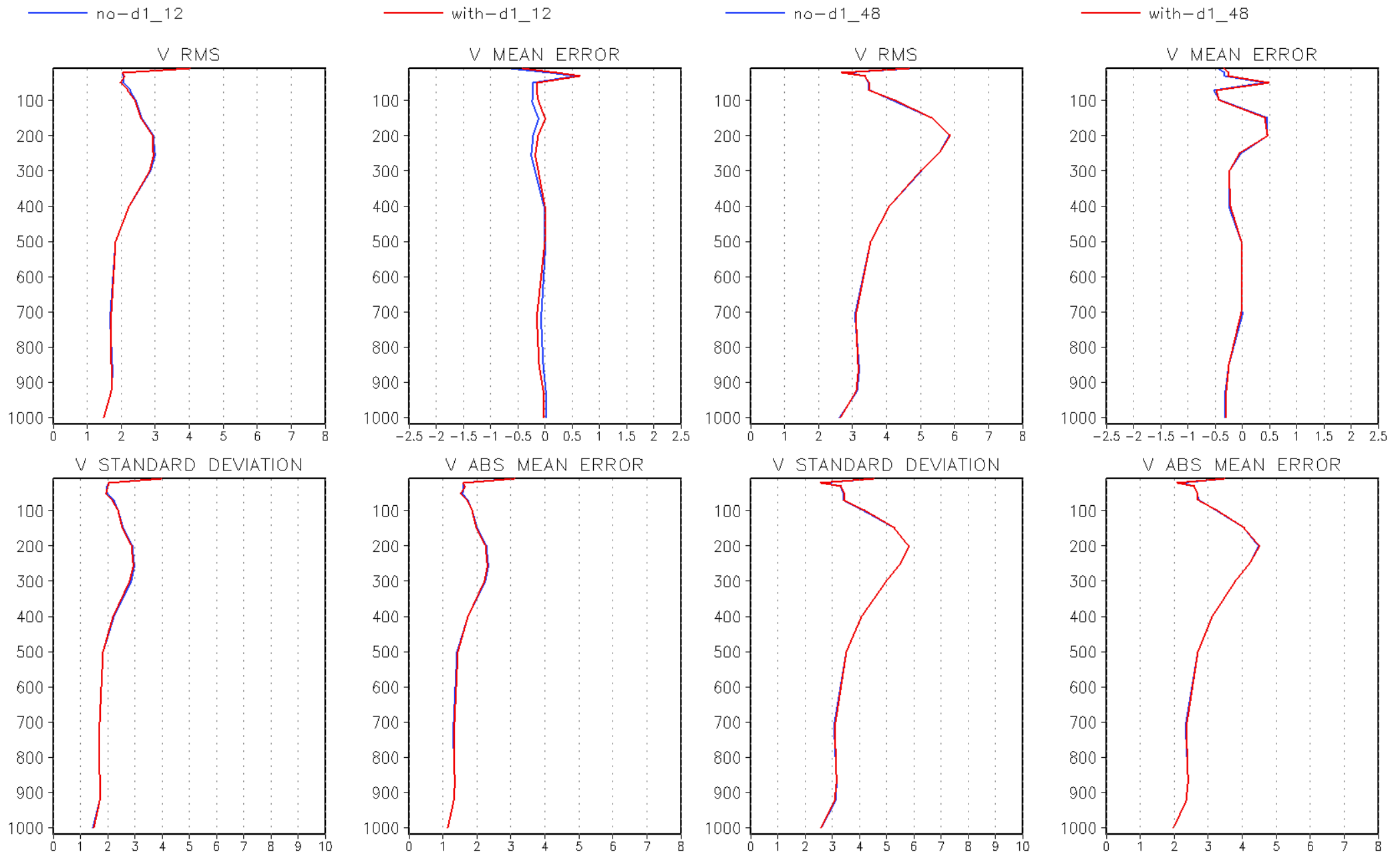
profiles of 45km, 12h&48h, temperature



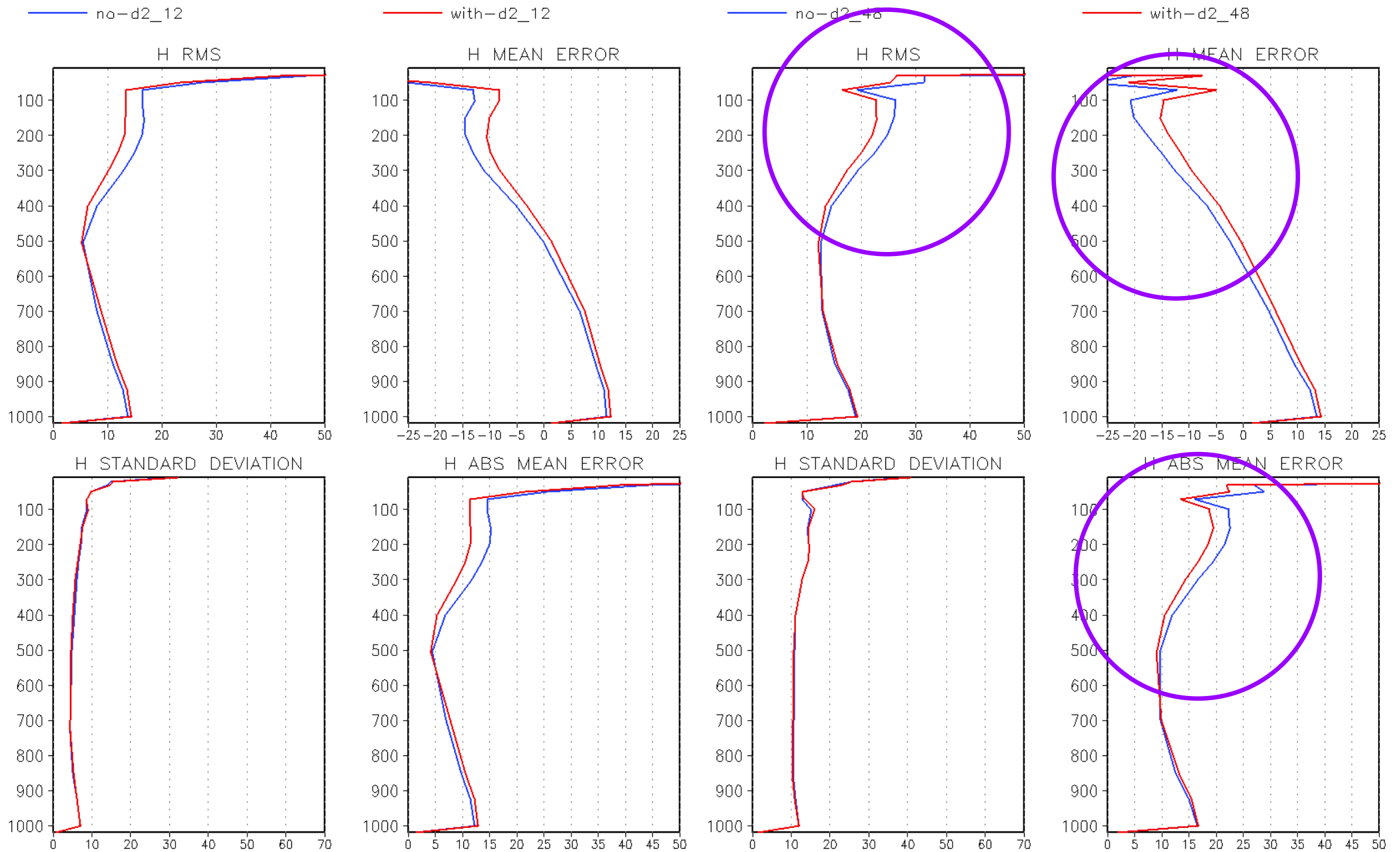
profiles of 45km, 12h&48h, u-comp.



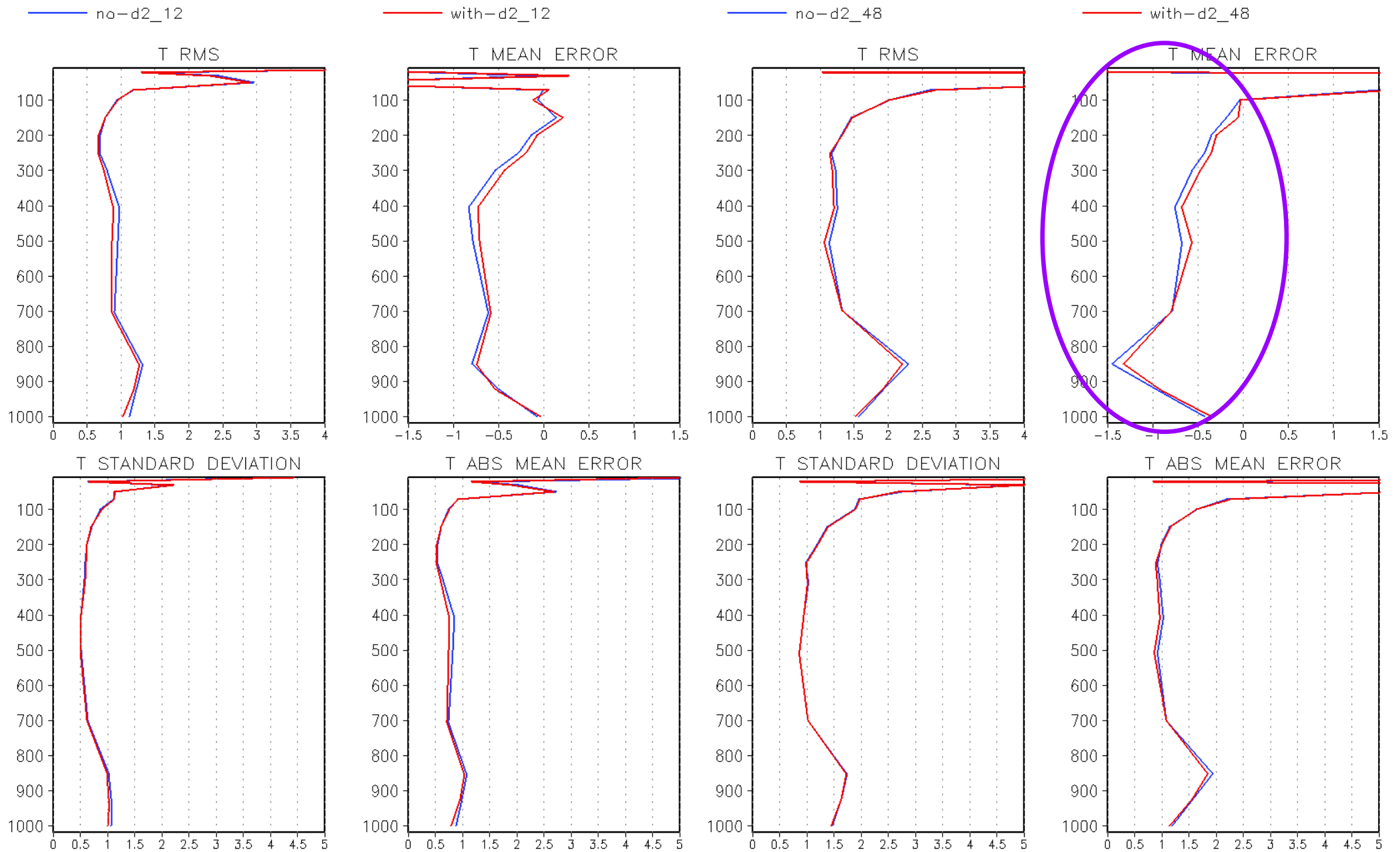
profiles of 45km, 12h&48h, v-comp.



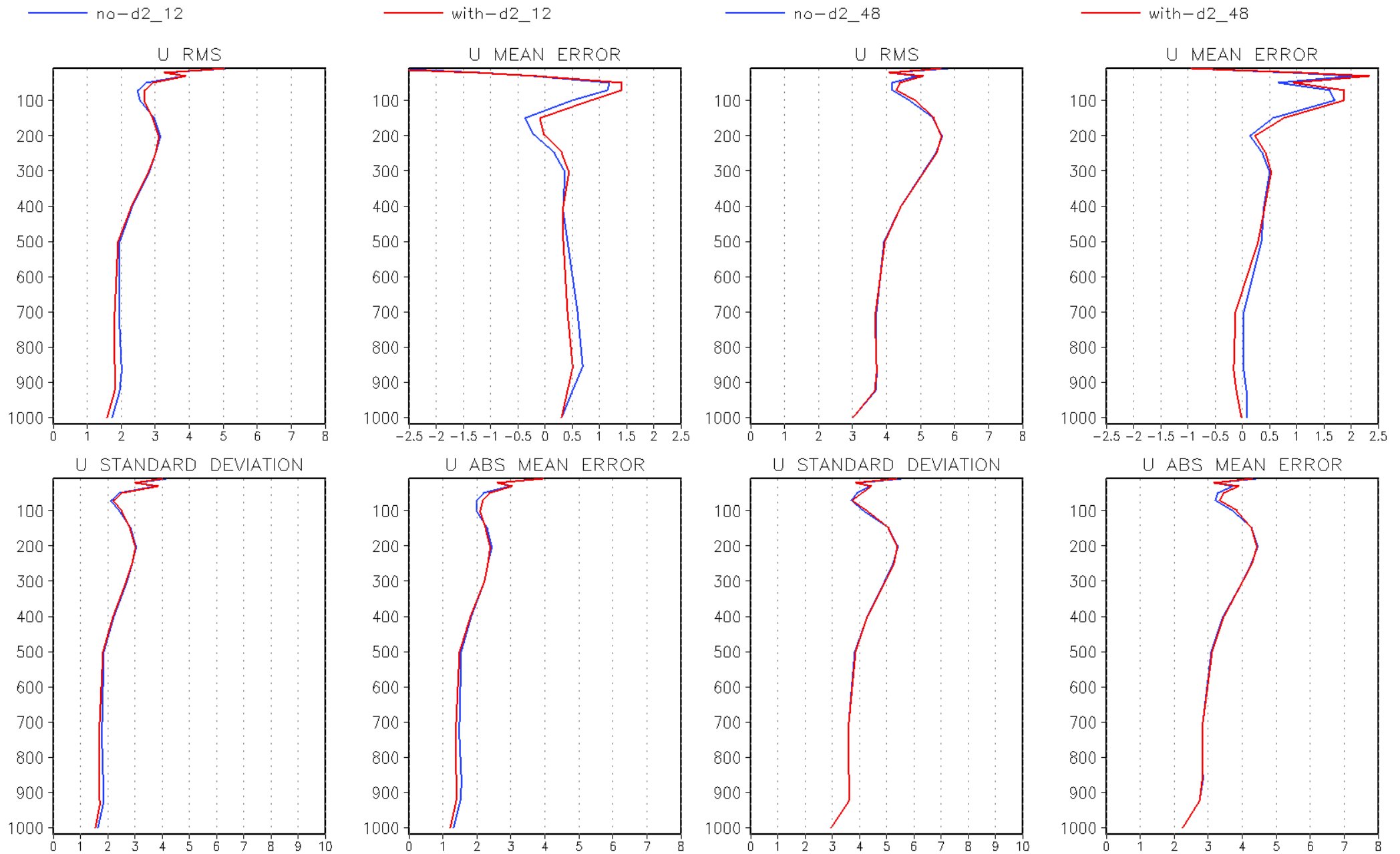
profiles of 15km, 12h&48h, height



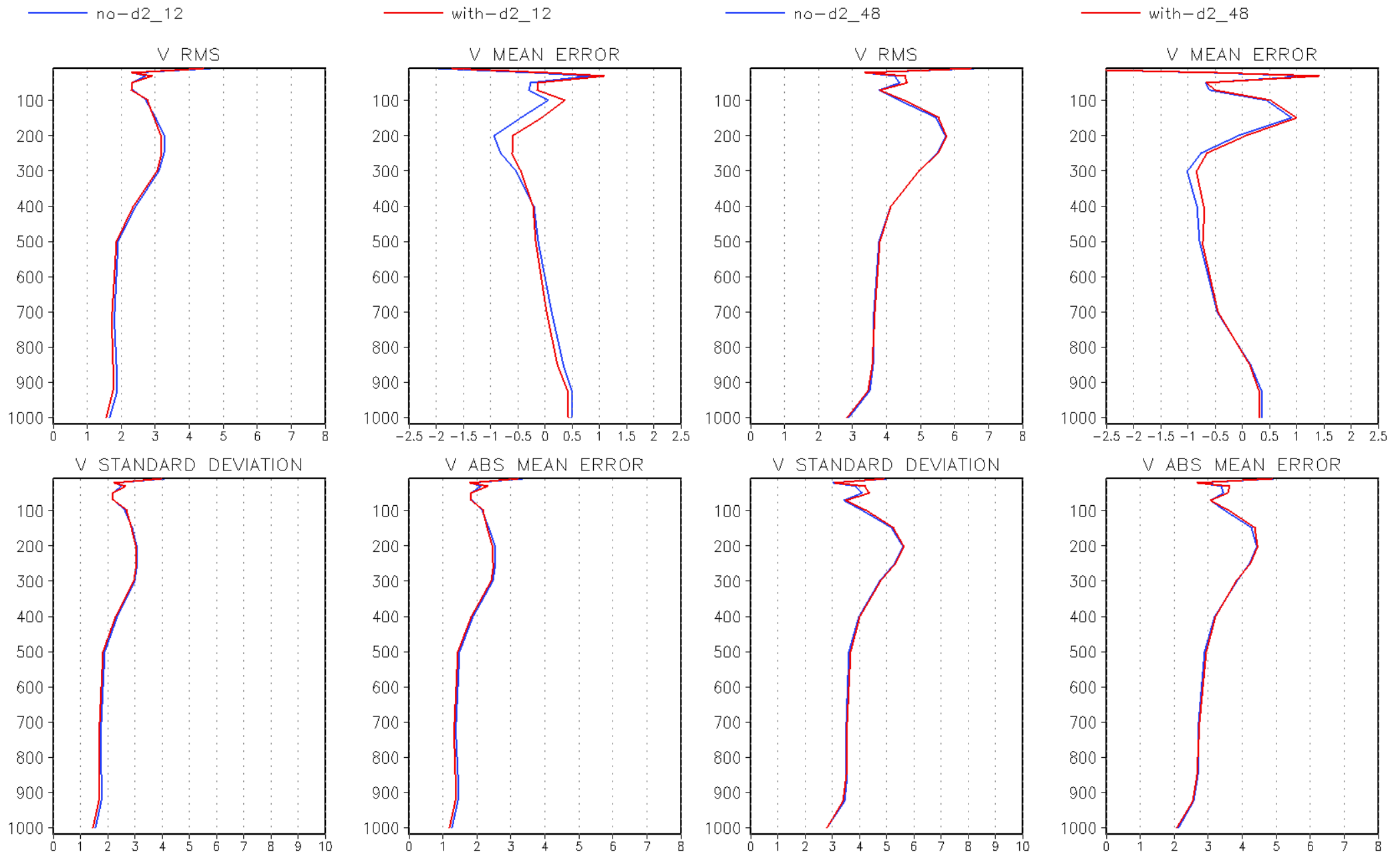
profiles of 15km, 12h&48h, temperature



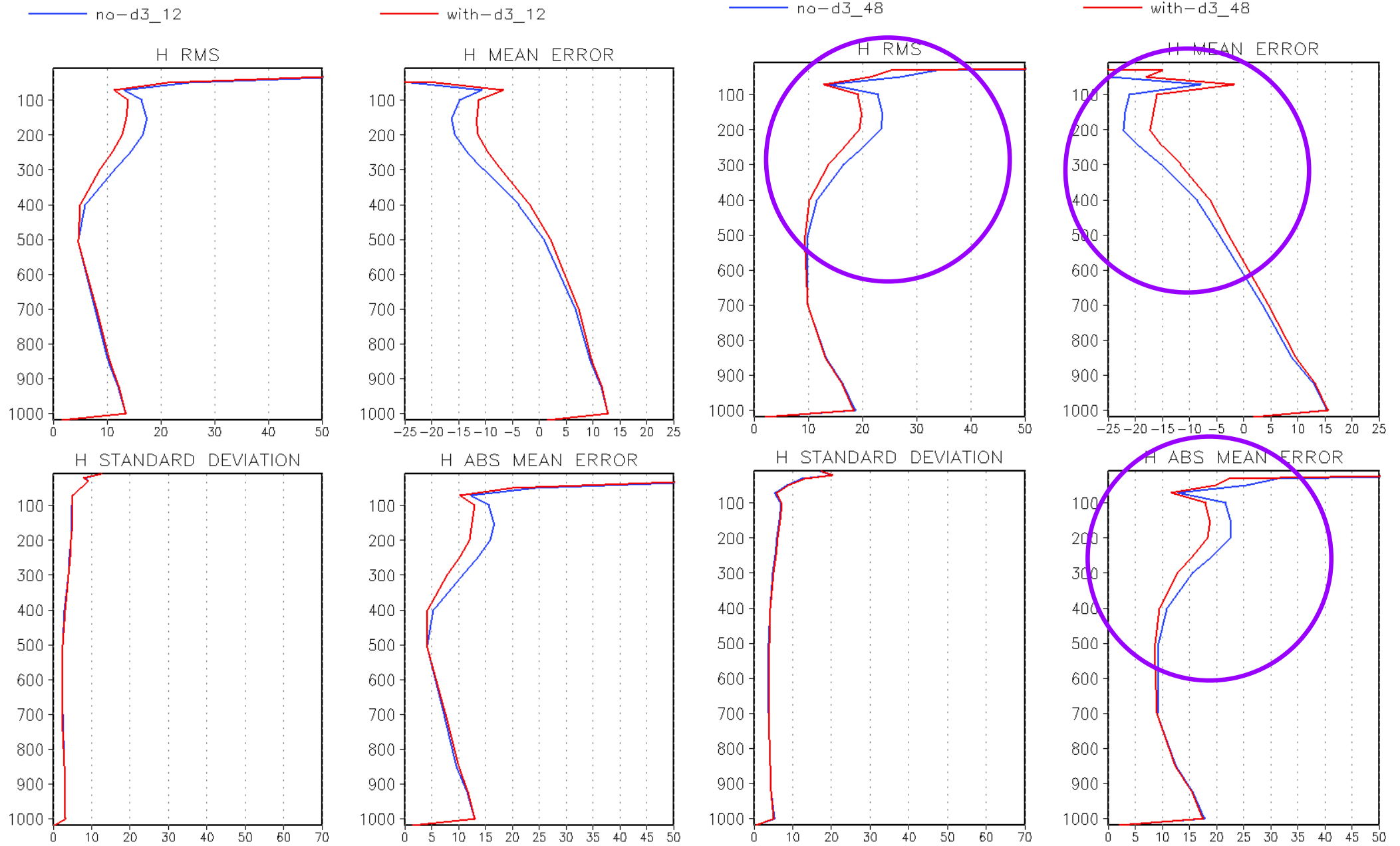
profiles of 15km, 12h&48h, u-comp.



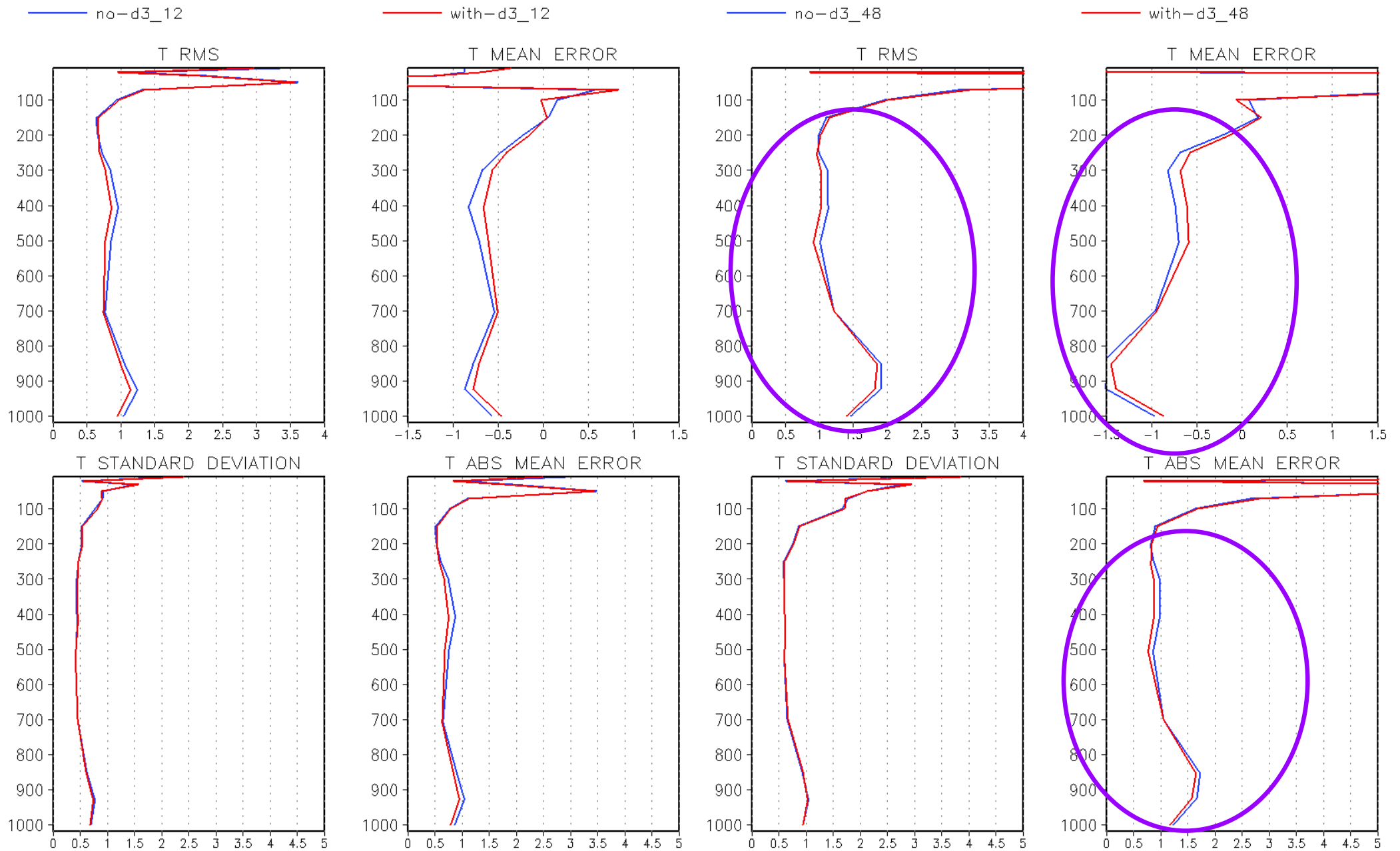
profiles of 15km, 12h&48h, v-comp.



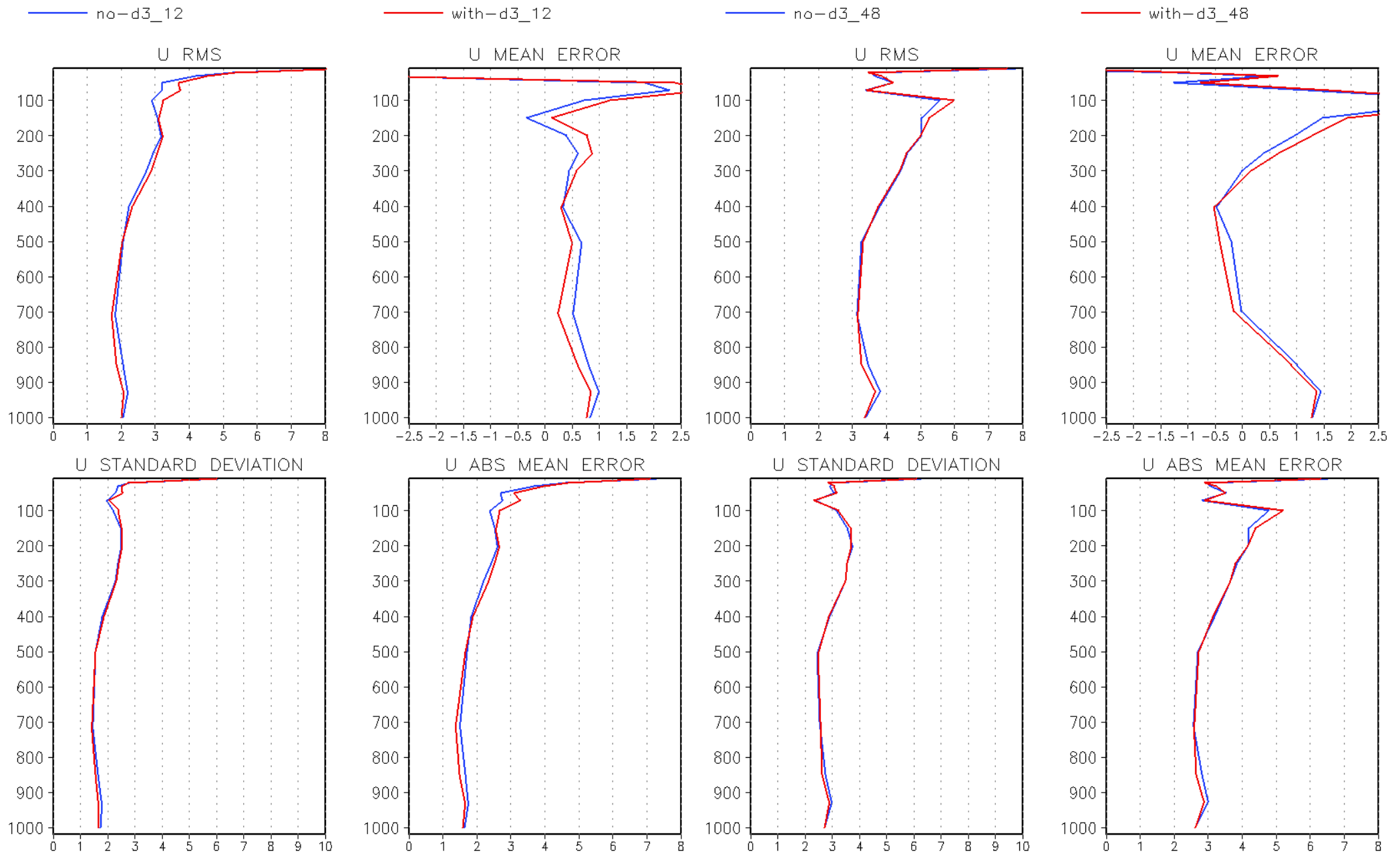
profiles of 5km, 12h&48h, height



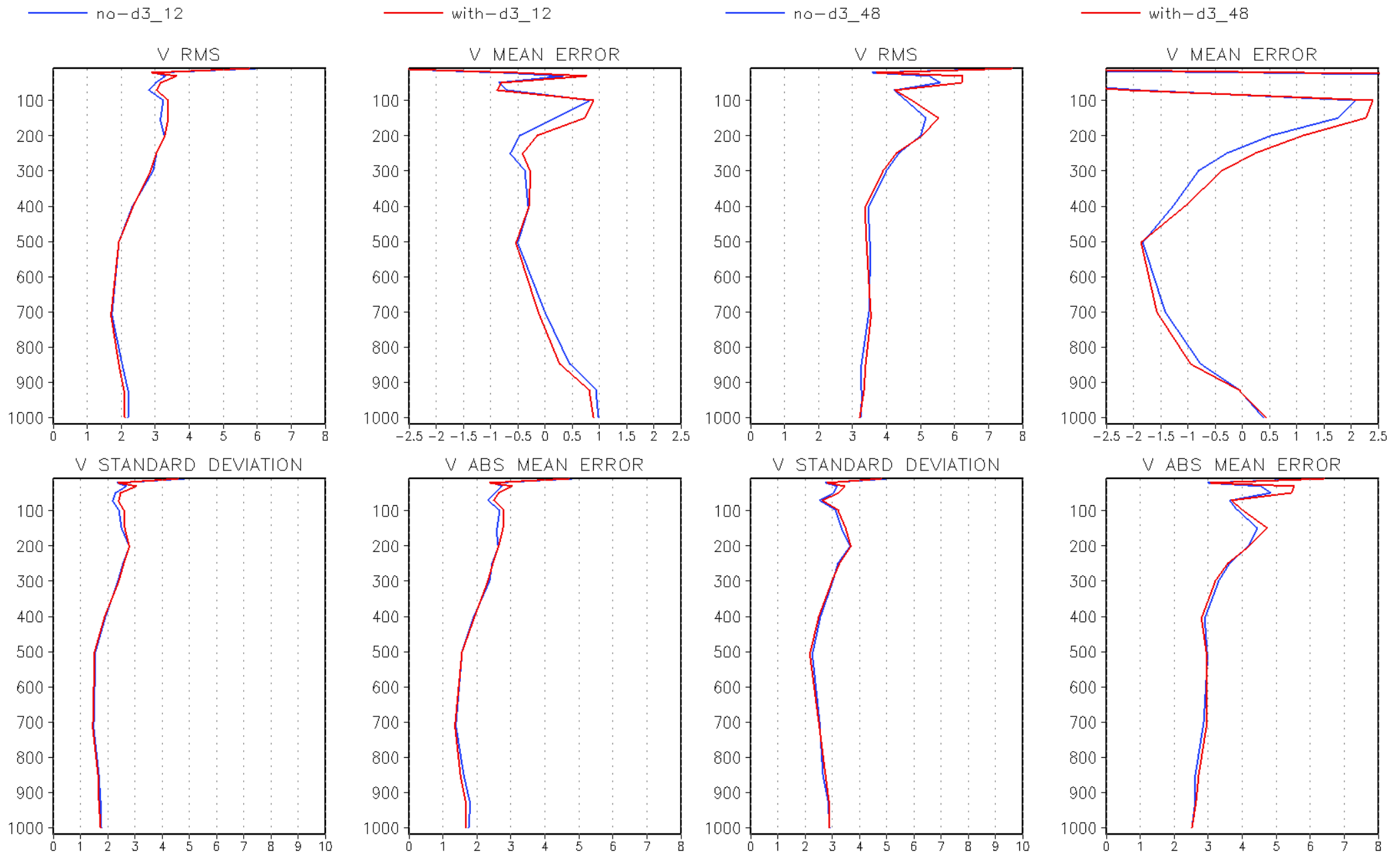
profiles of 5km, 12h&48h, temperature



profiles of 5km, 12h&48h, u-comp.



profiles of 5km, 12h&48h, v-comp.

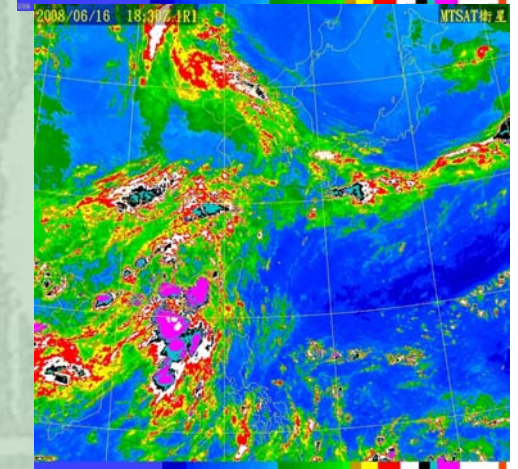
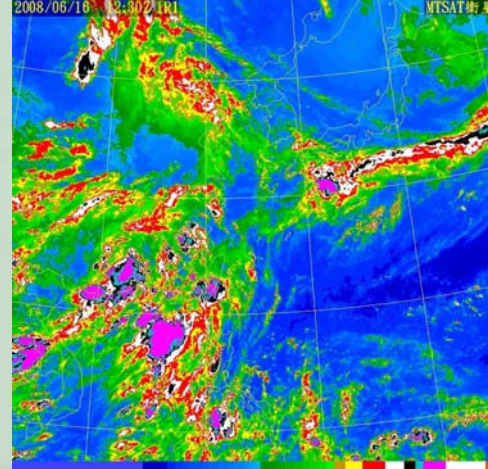
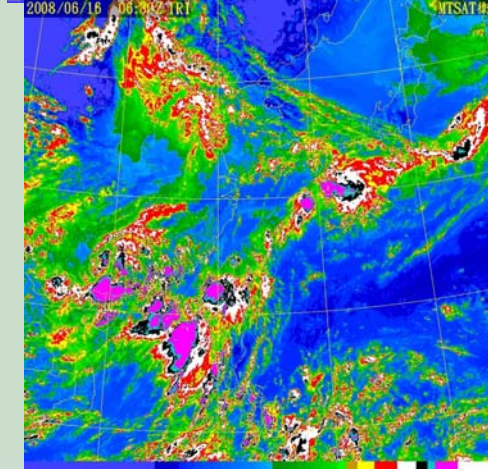
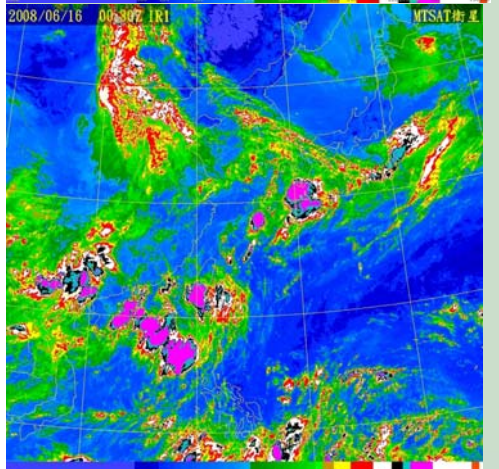
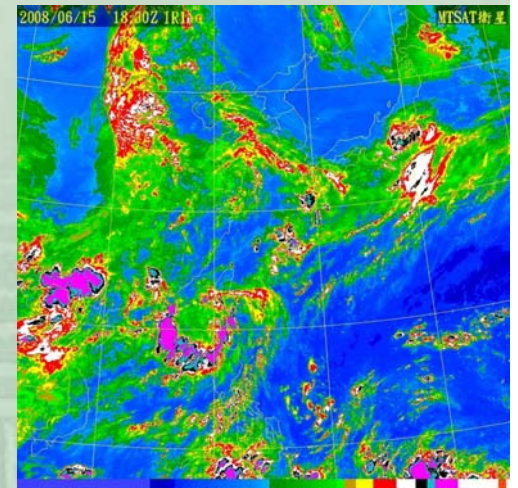
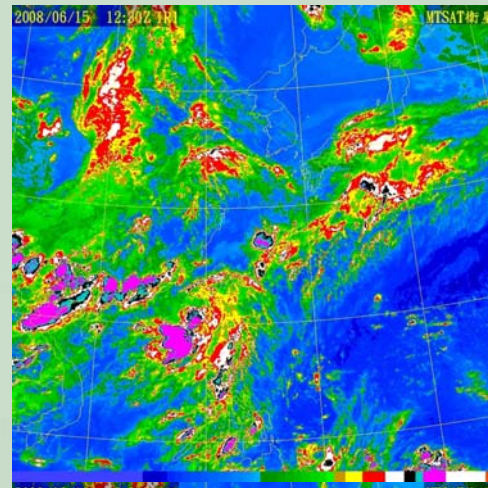
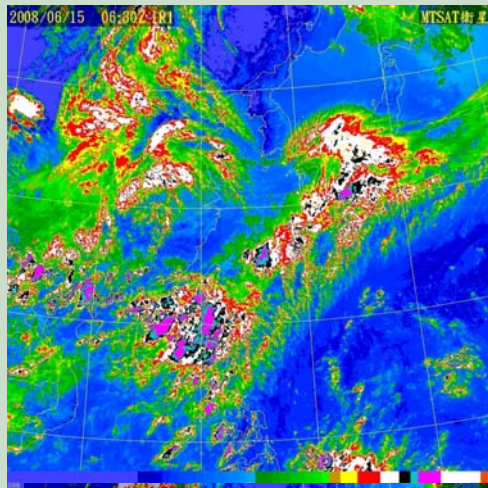
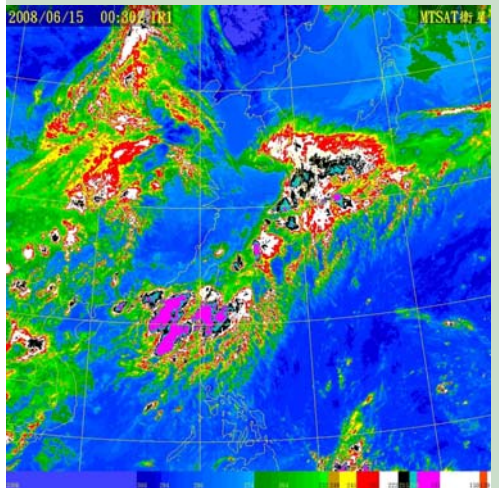
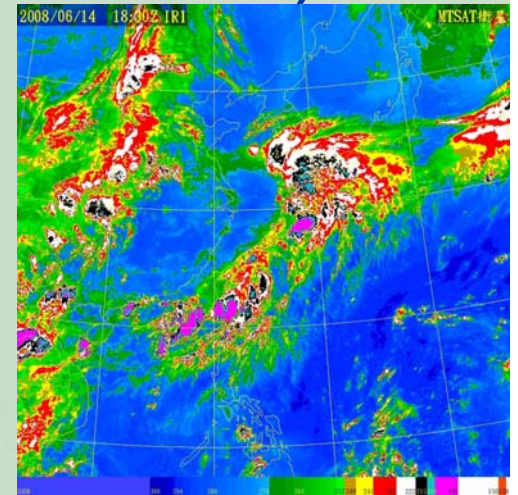
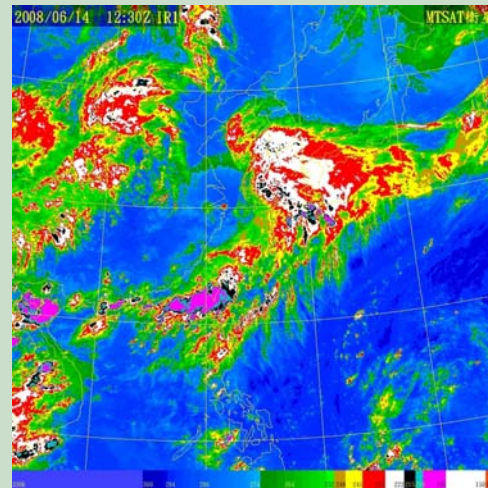
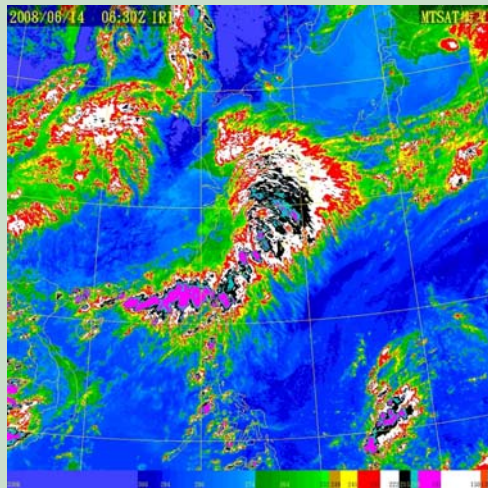
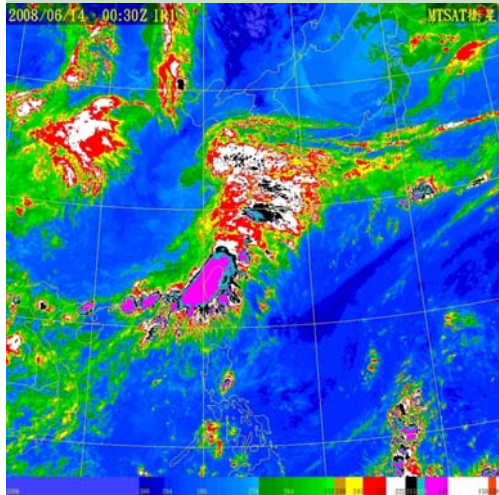


Summary of profiles of nfs 45/15/5km

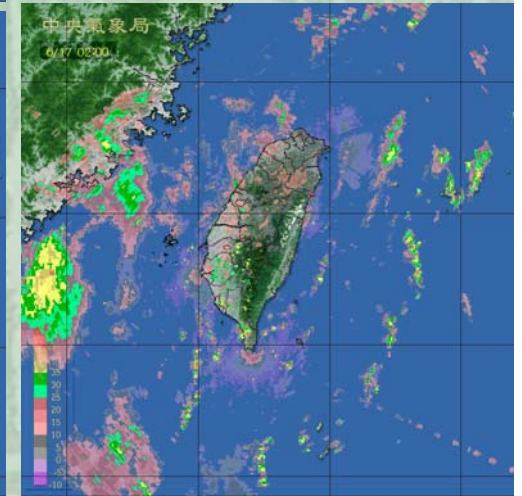
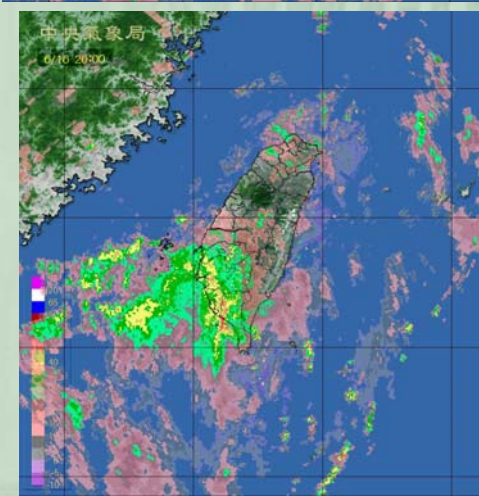
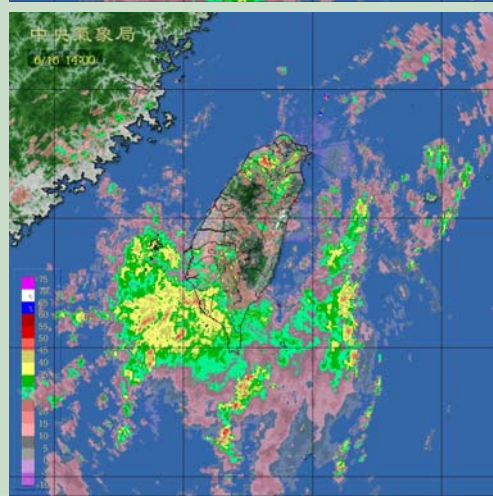
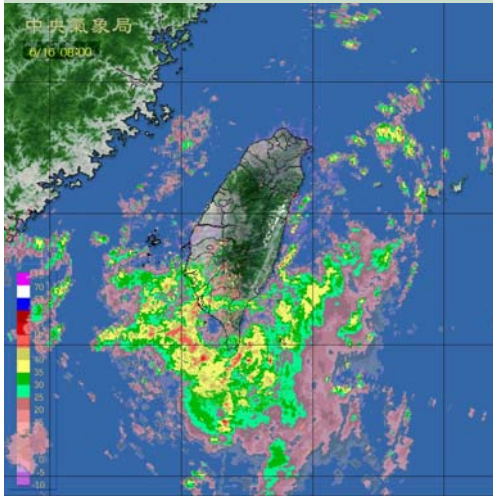
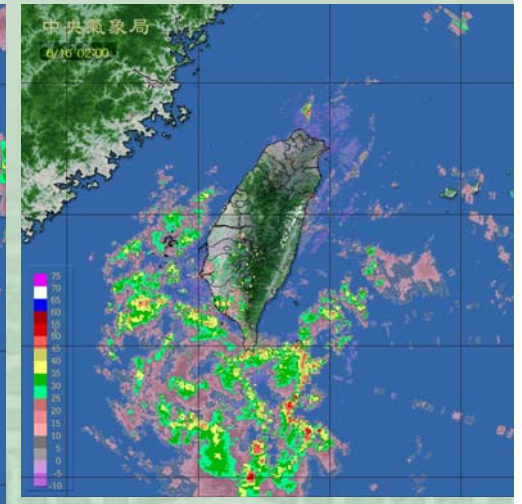
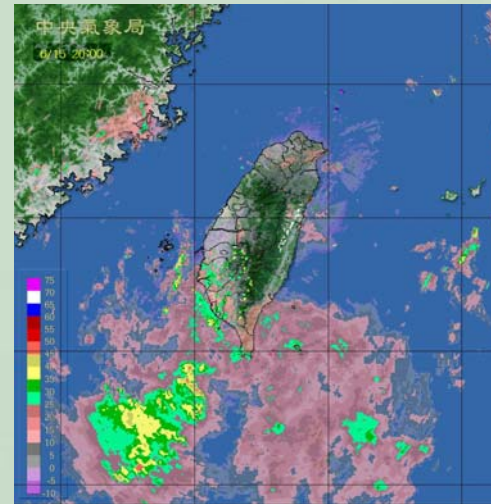
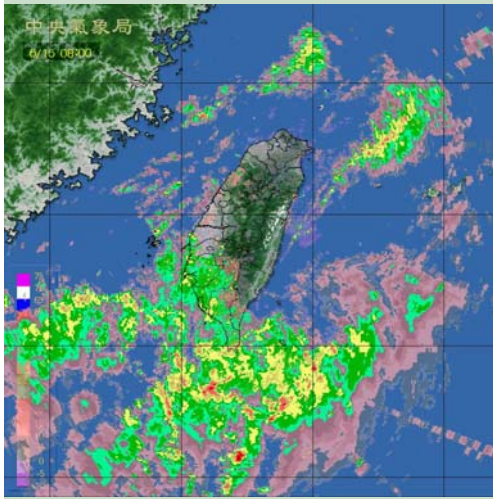
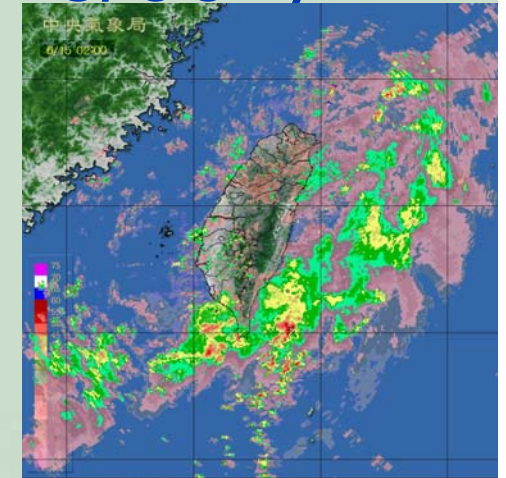
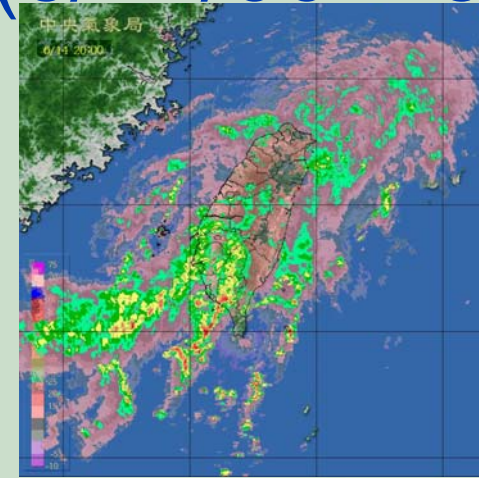
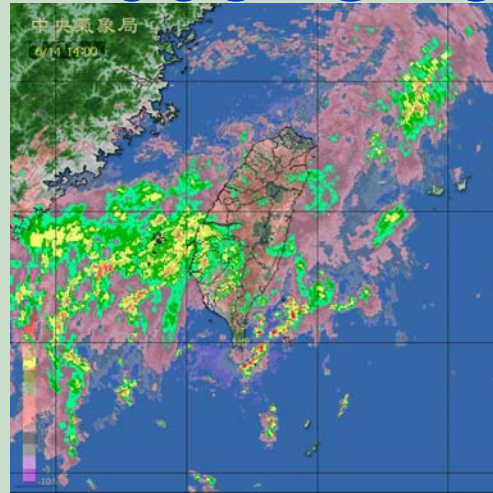
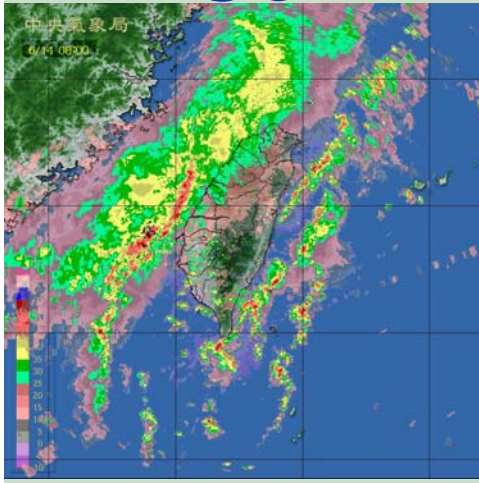
- same as std&mean error scores results.



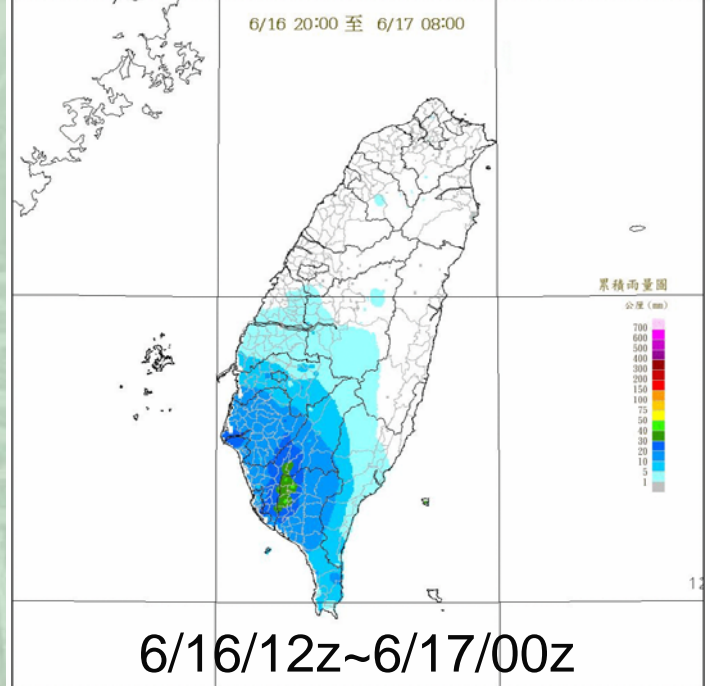
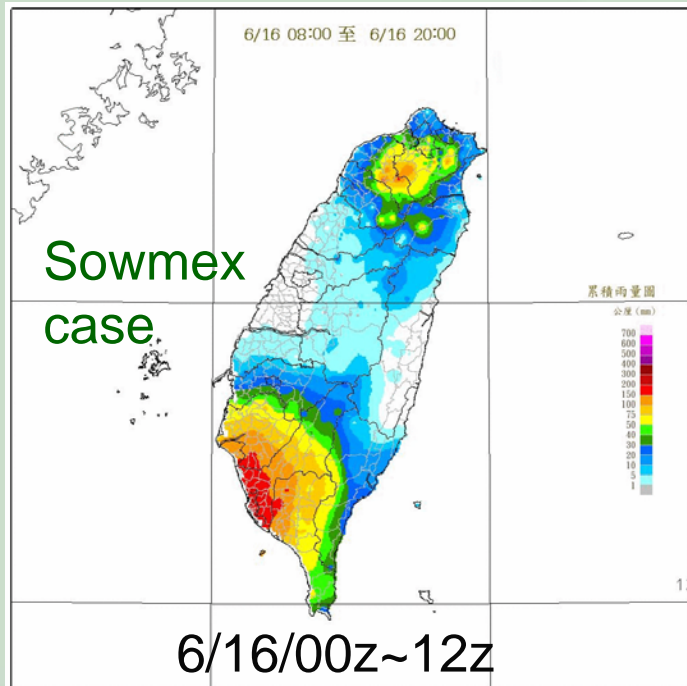
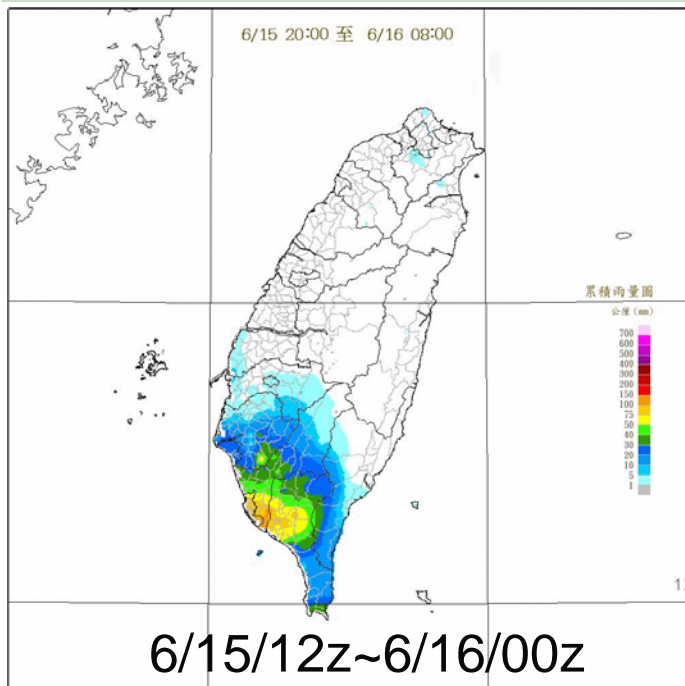
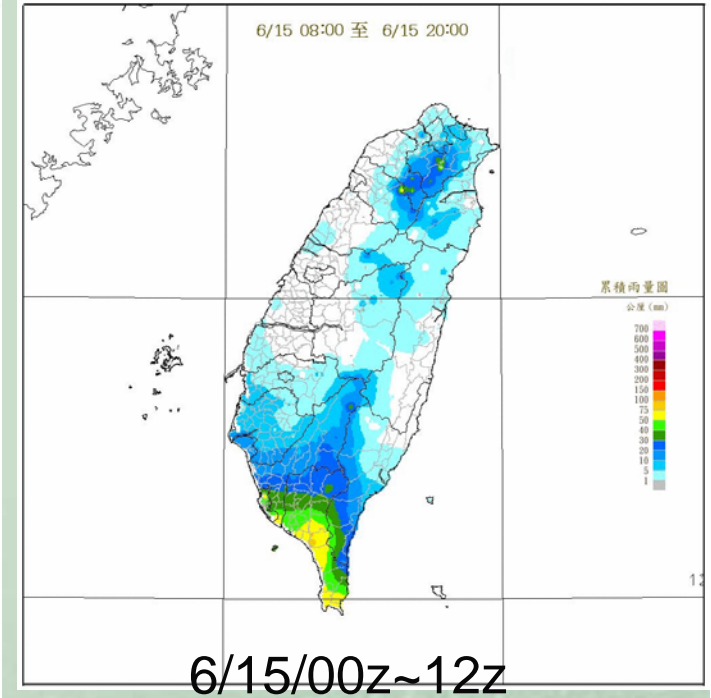
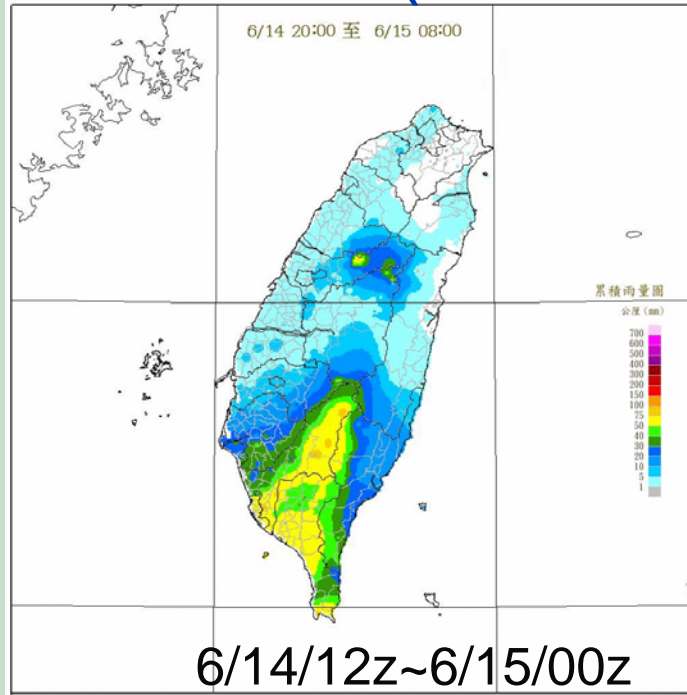
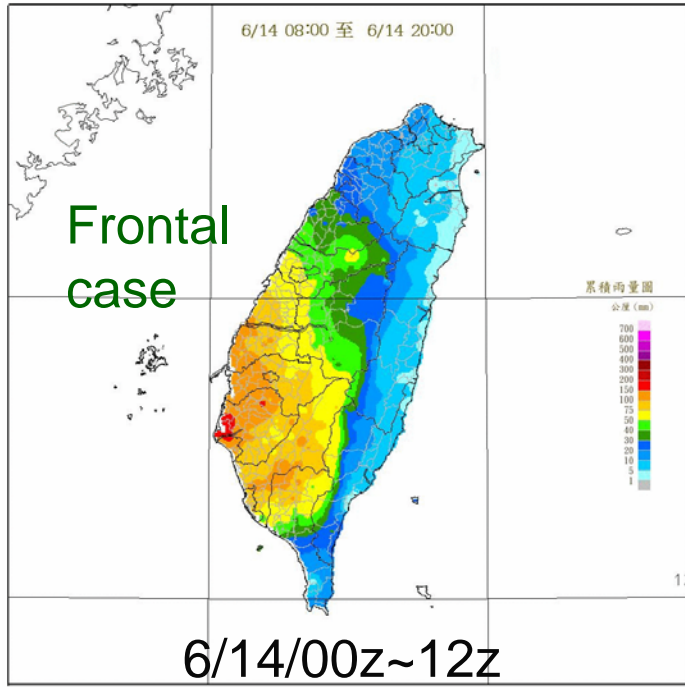
SoWMEX 2008 IOP8 (6/14/00z~6/16/00z)



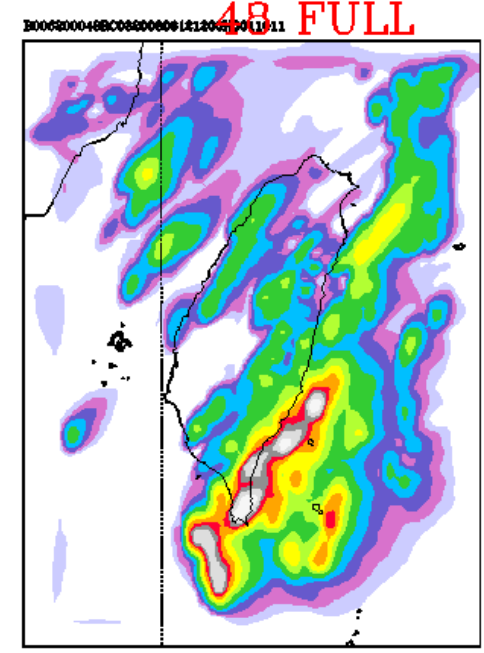
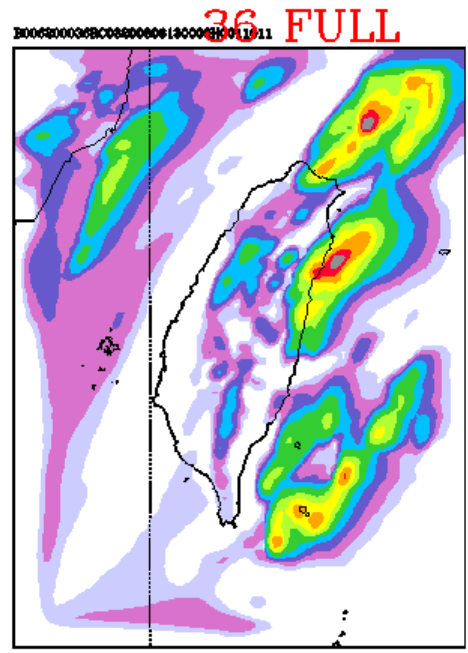
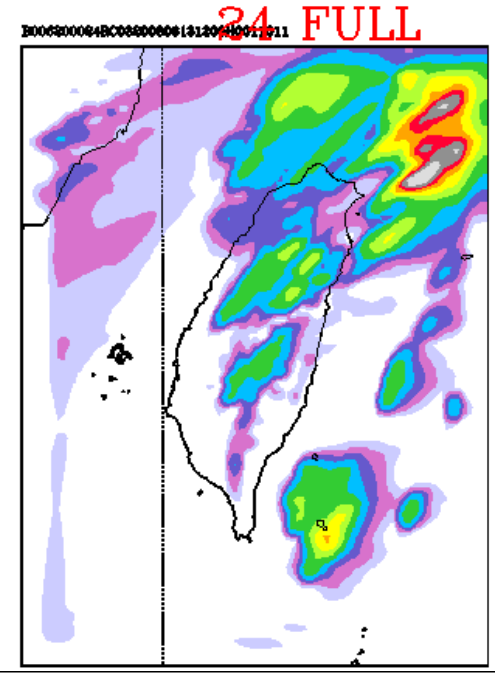
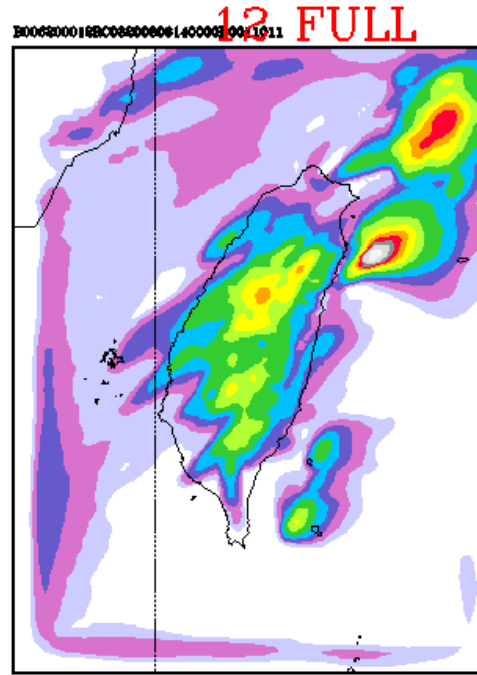
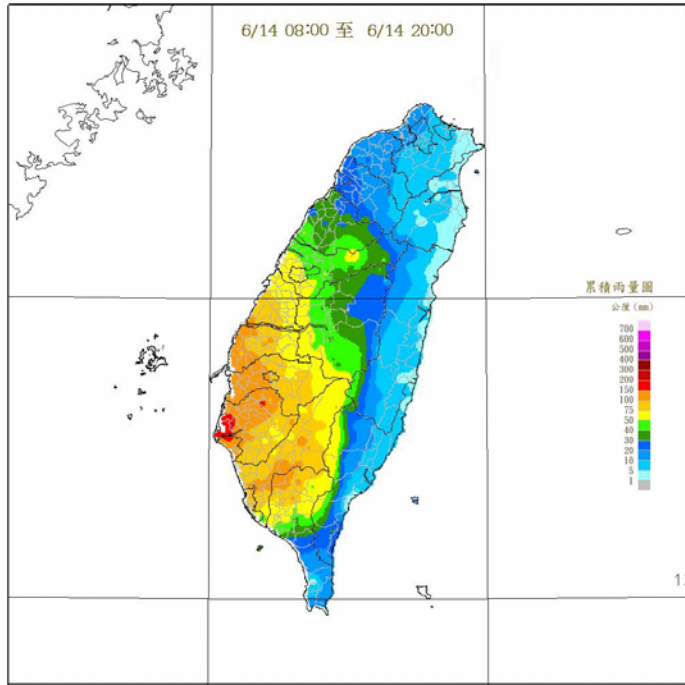
SoWMEX 2008 IOP8 (6/14/00z~6/16/00z)



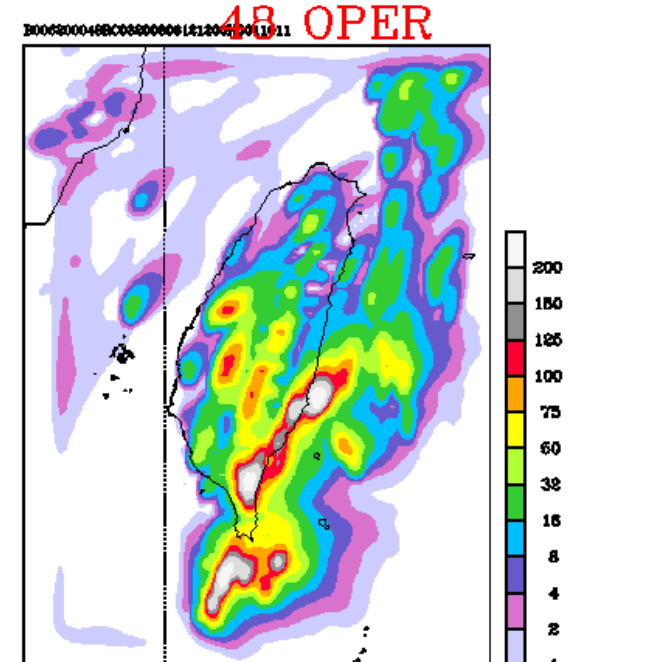
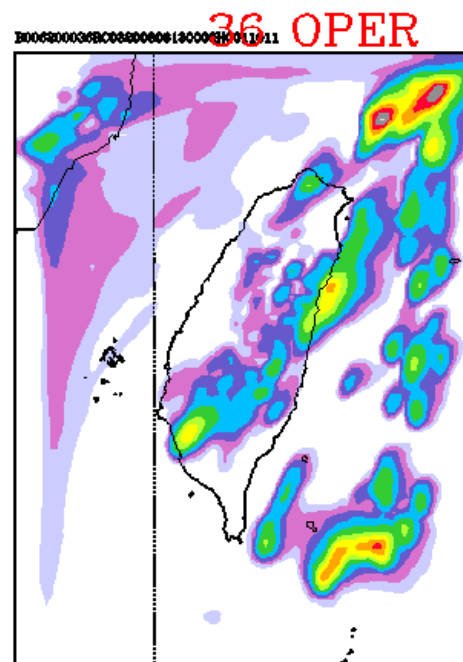
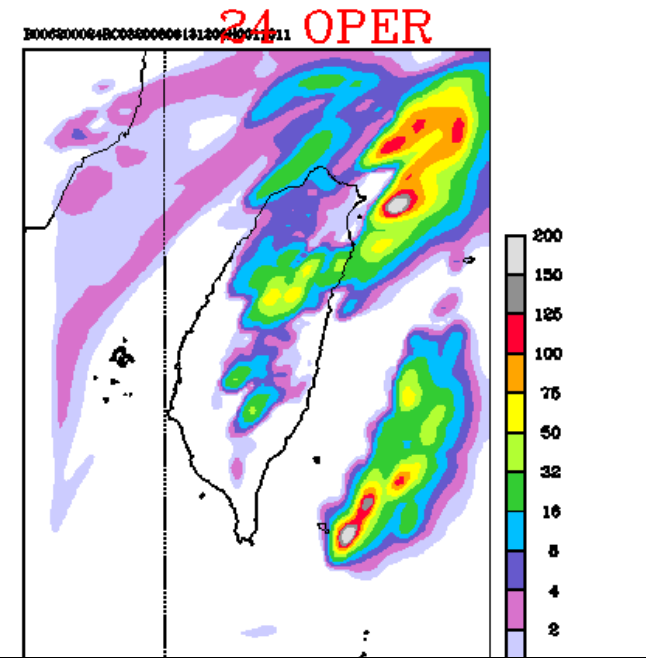
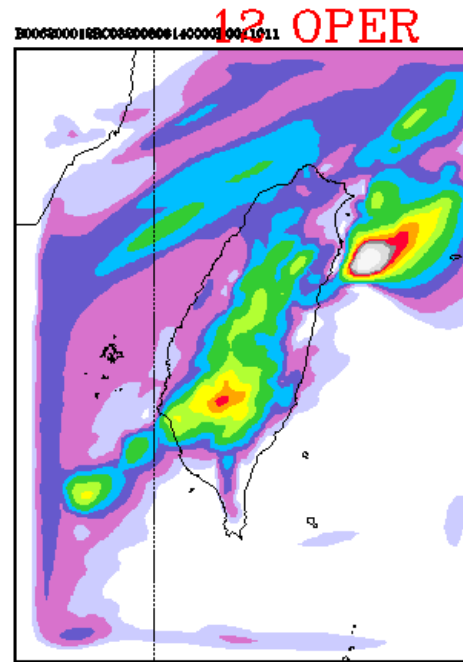
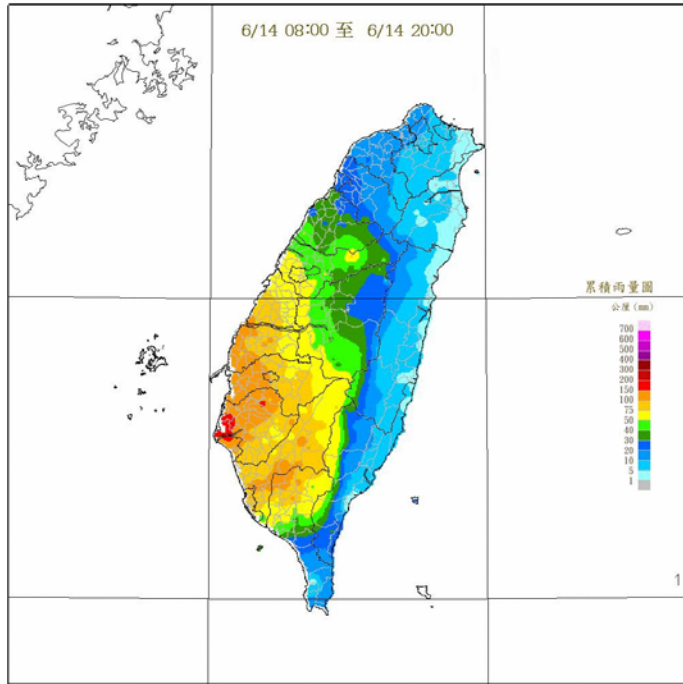
SoWMEX 2008 IOP8 (6/14/00z~6/16/00z)



nfs SoWMEX 2008 IOP8 (6/14/00z~12z) FULL

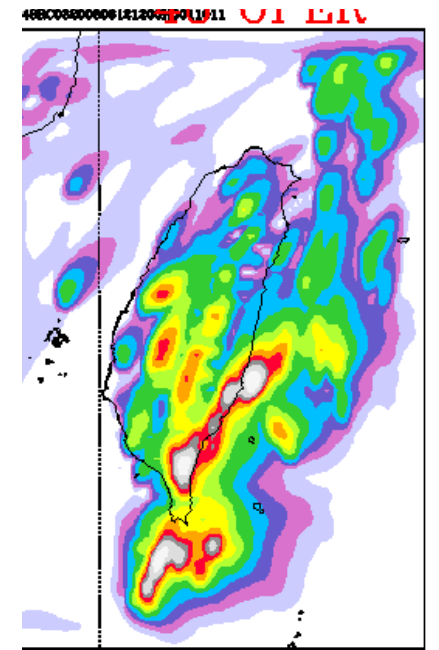
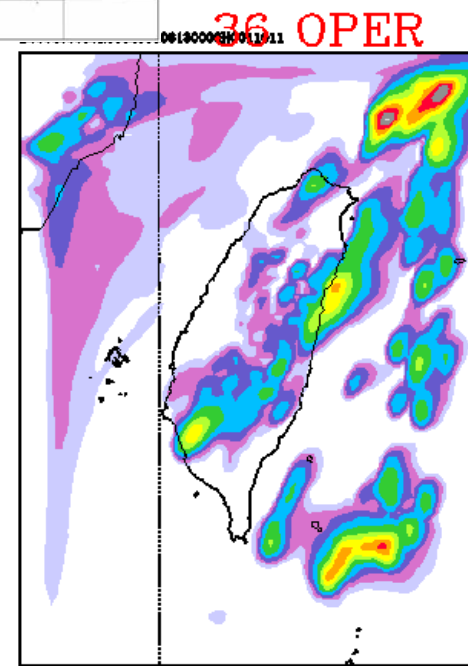
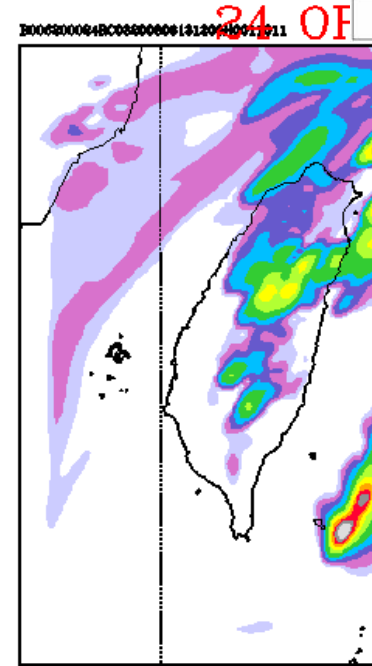
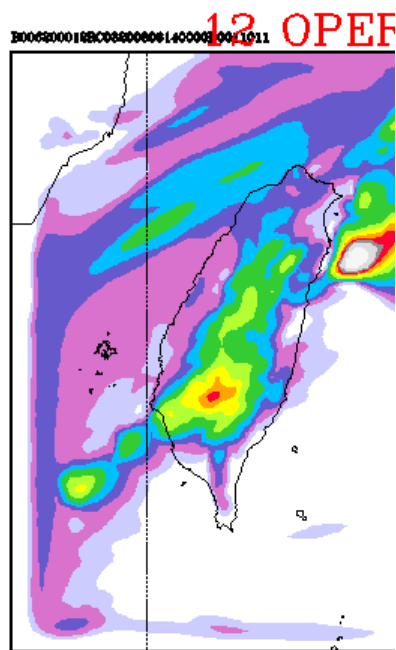
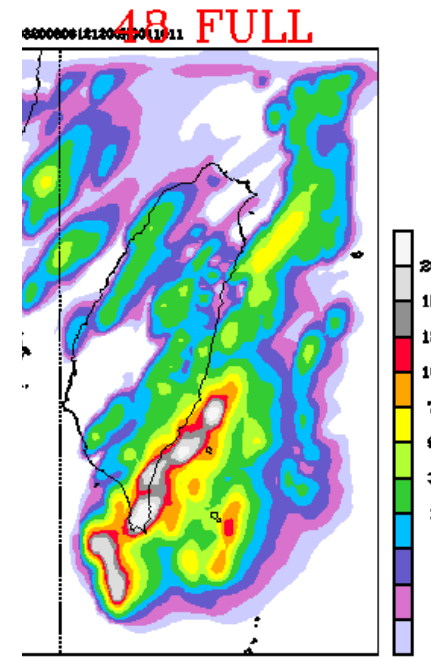
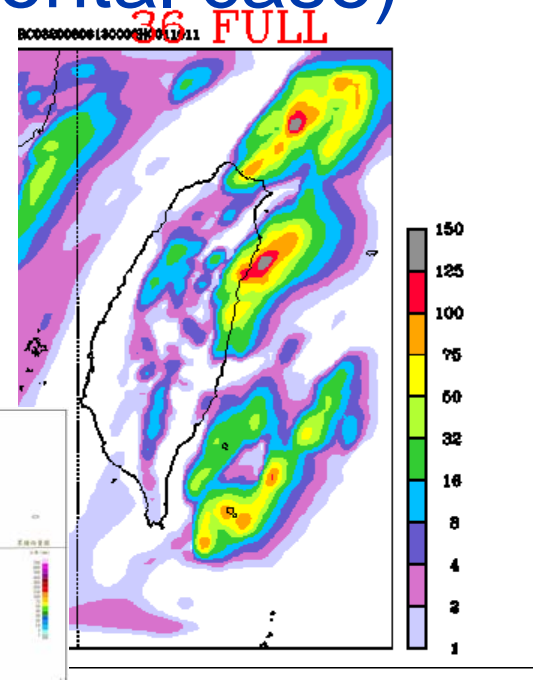
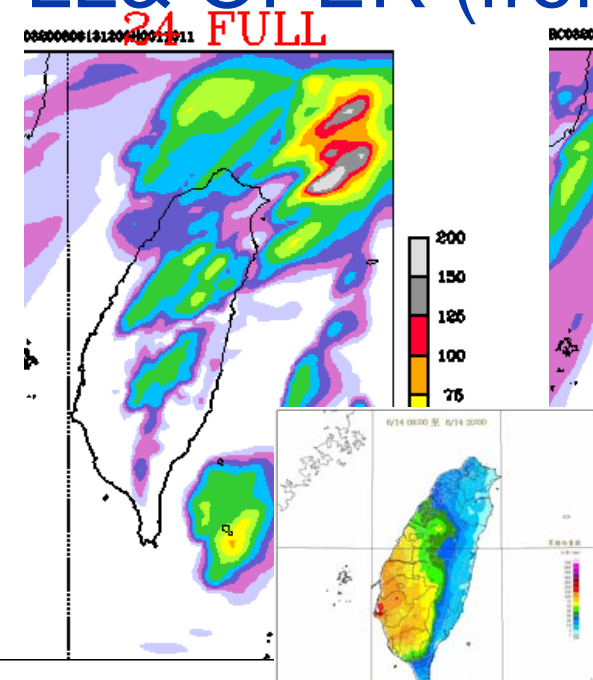
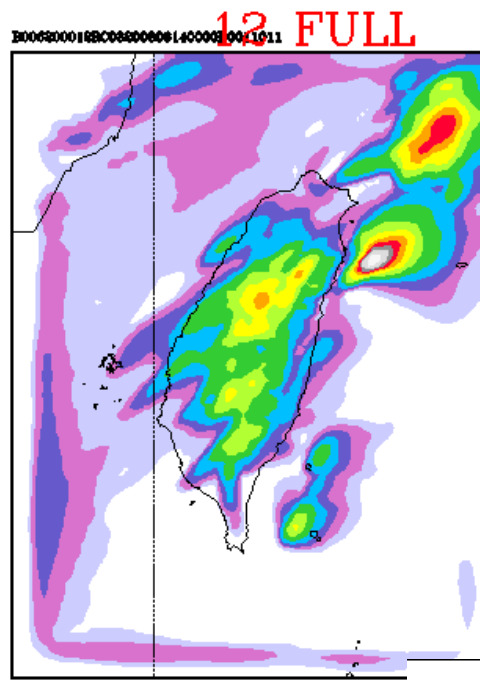


nfs SoWMEX 2008 IOP8 (6/14/00z~12z) NO

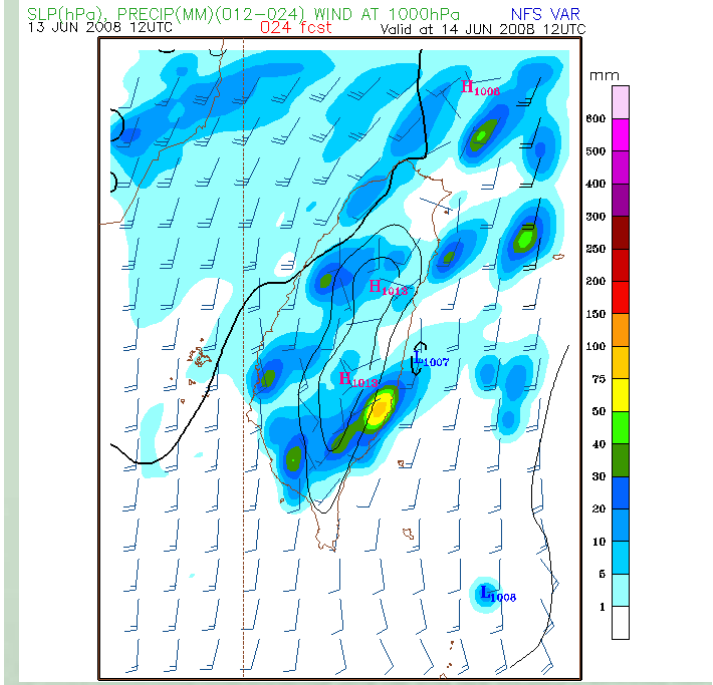
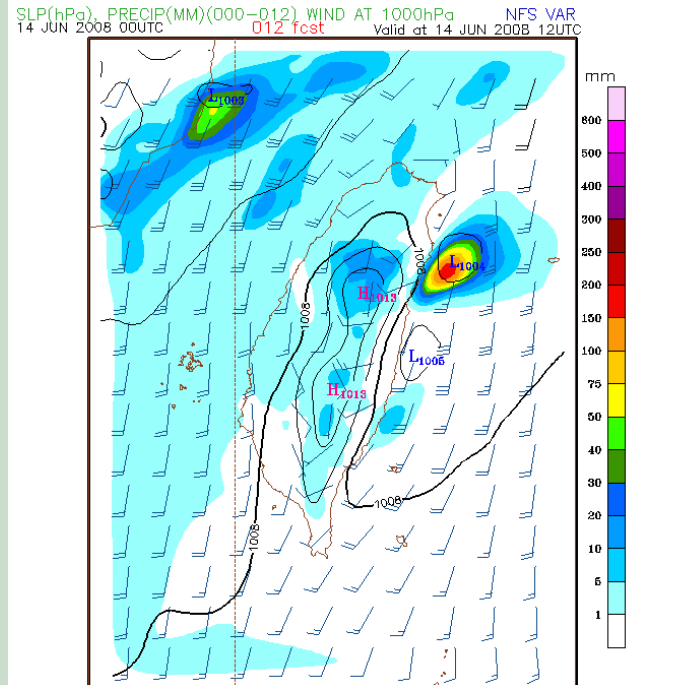
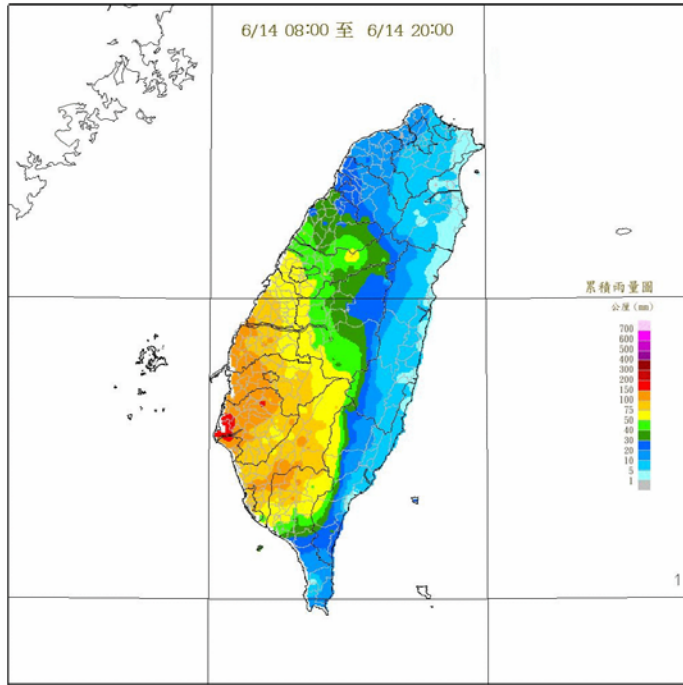


NFS SoWMEX 2008 IOP8 (6/14/00z~12z)

FULL & OPER (frontal case)

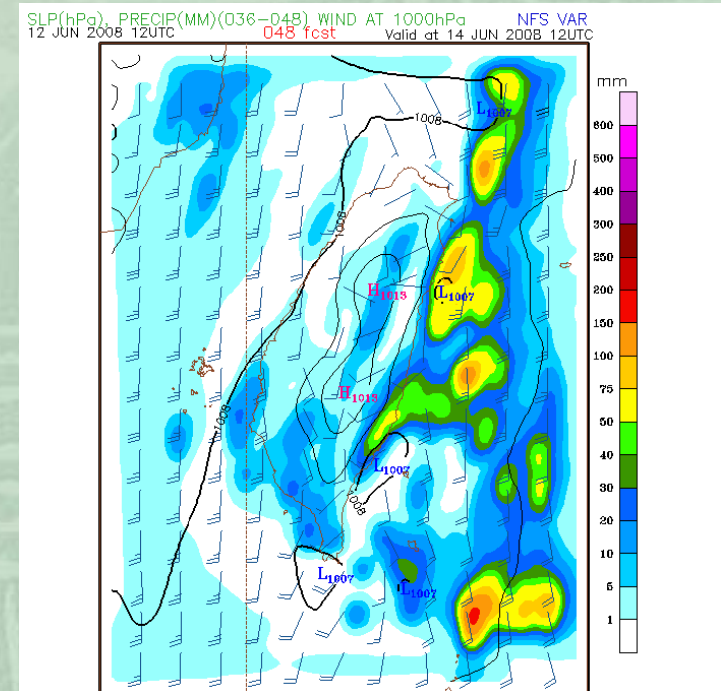


nfsvar_Sowmex 2008 IOP8 (6/14/00z~12z)

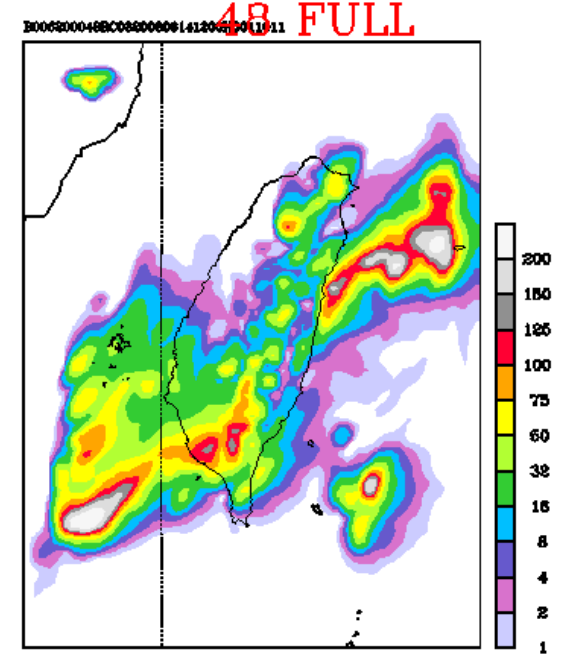
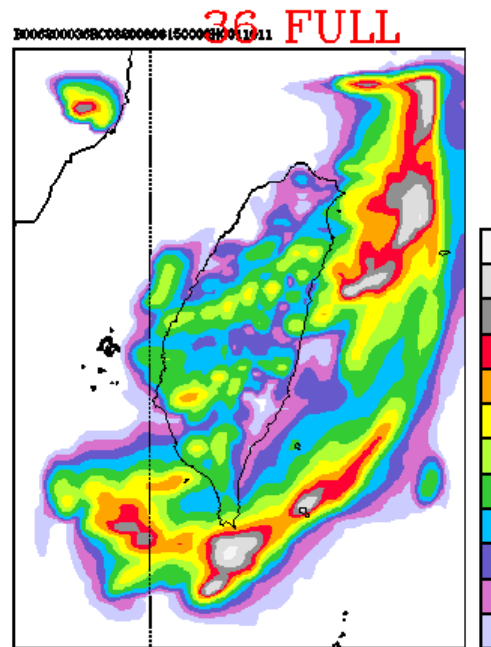
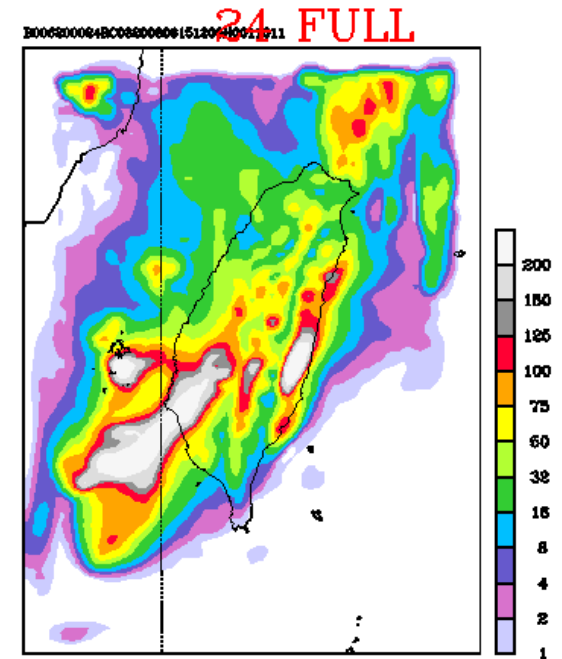
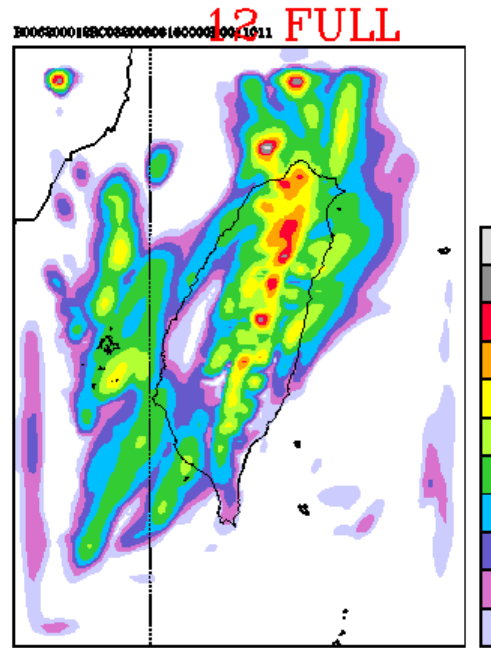
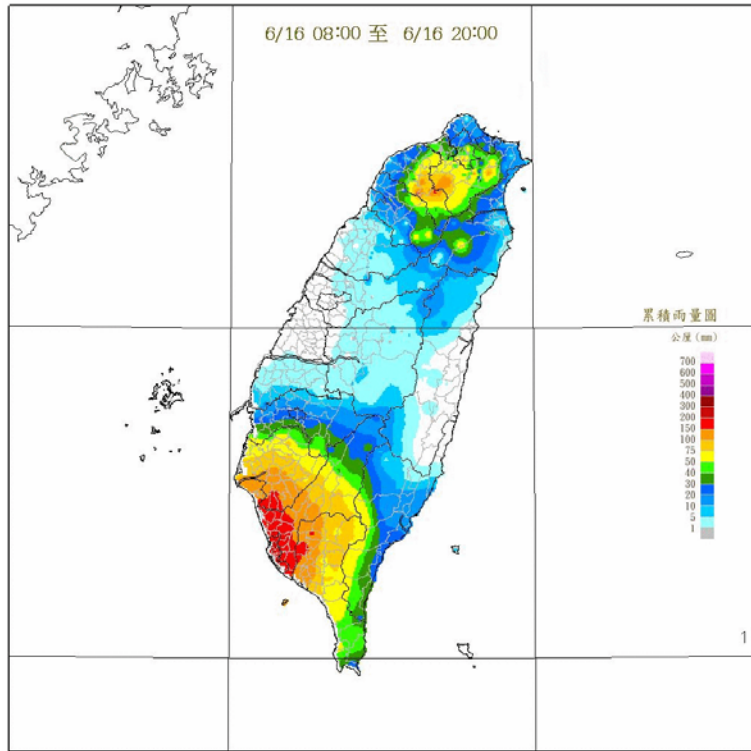


CWB NFS
real time products

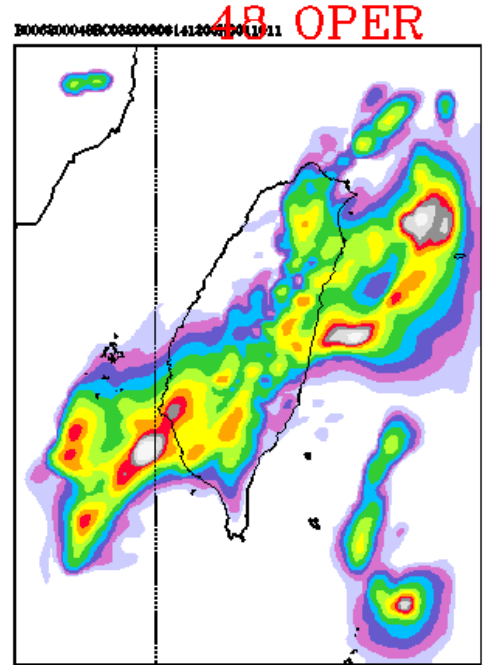
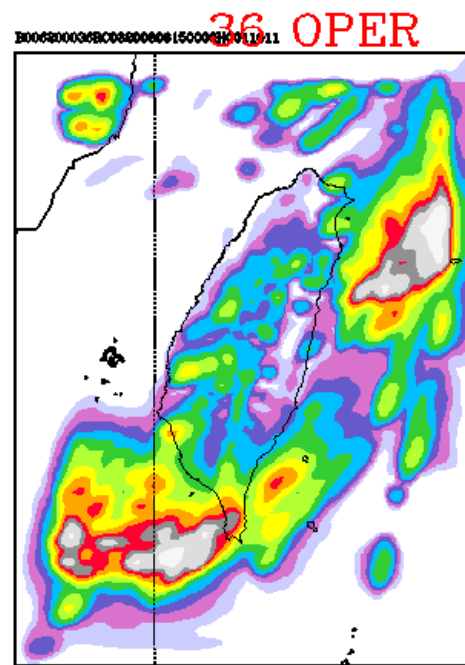
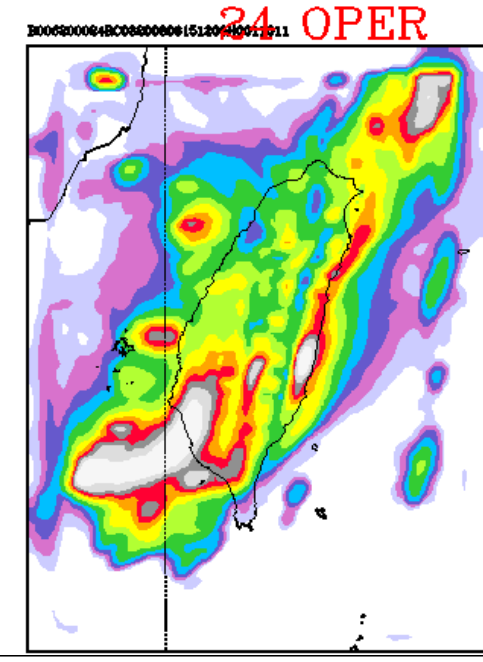
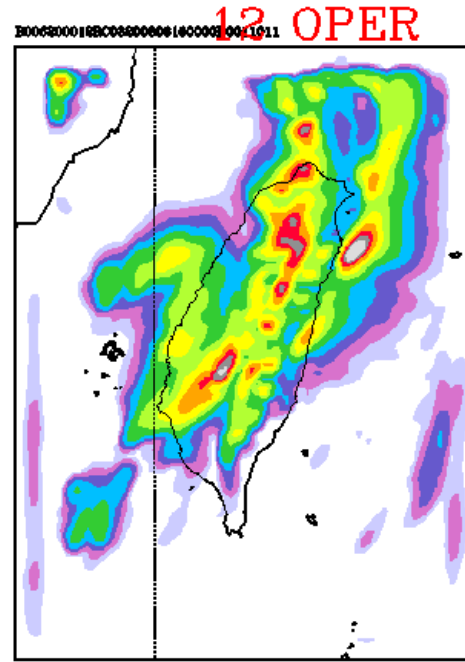
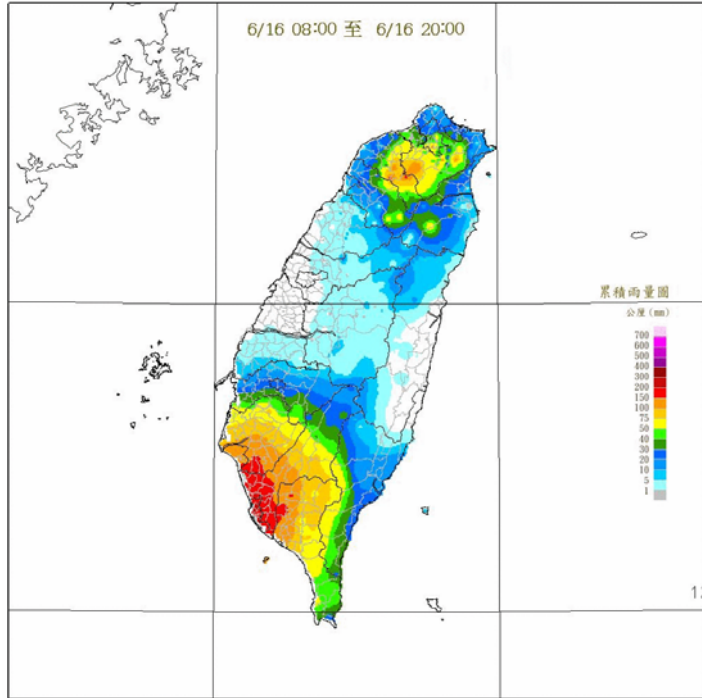
quite different from
re-executed



nfs SoWMEX 2008 IOP8 (6/16/00z~12z) FULL

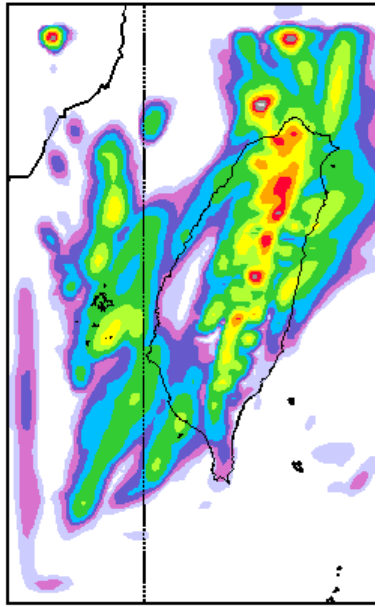


nfs SoWMEX 2008 IOP8 (6/16/00z~12z) NO

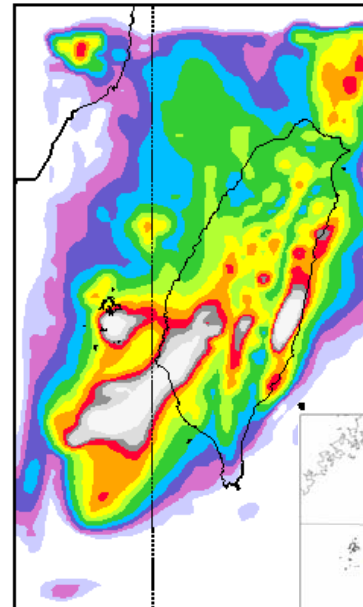


FULL&OPER (sowmex case)

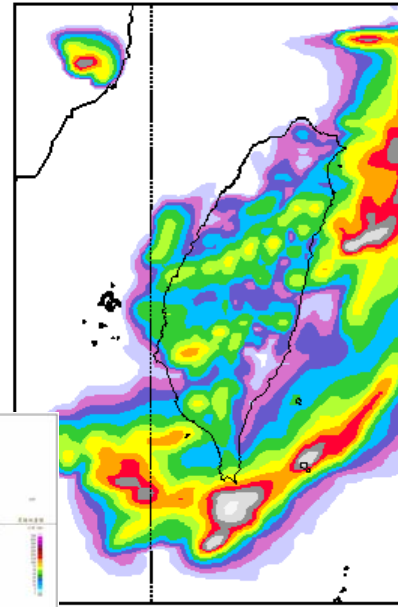
12 FUL



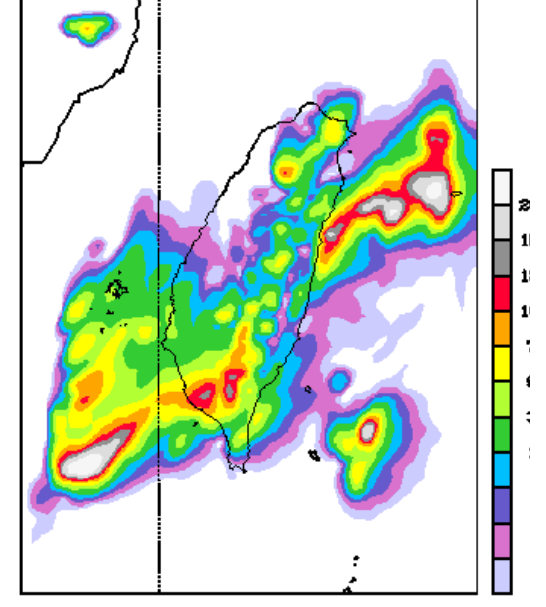
24 FUL



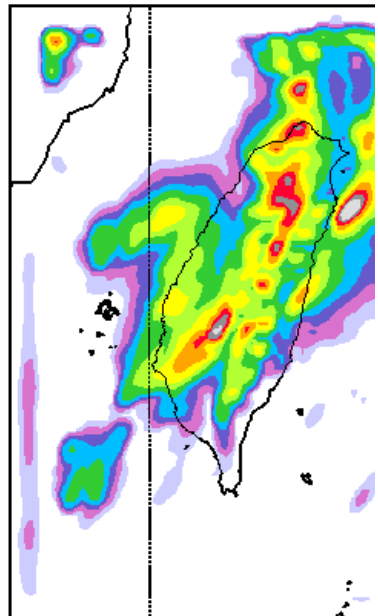
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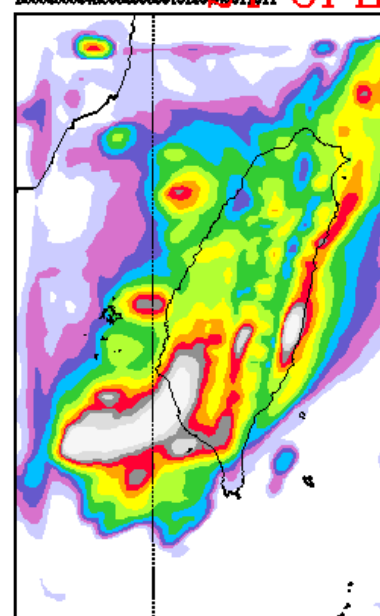
48 FUL



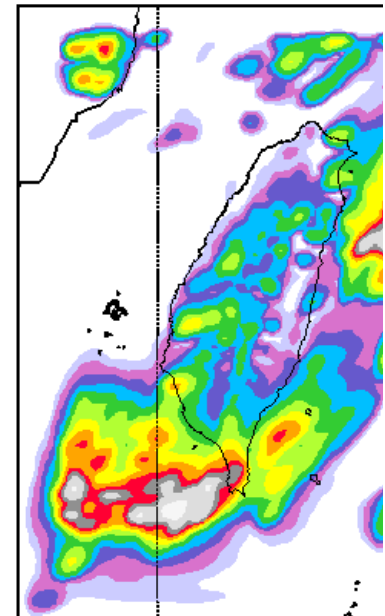
12 OPE



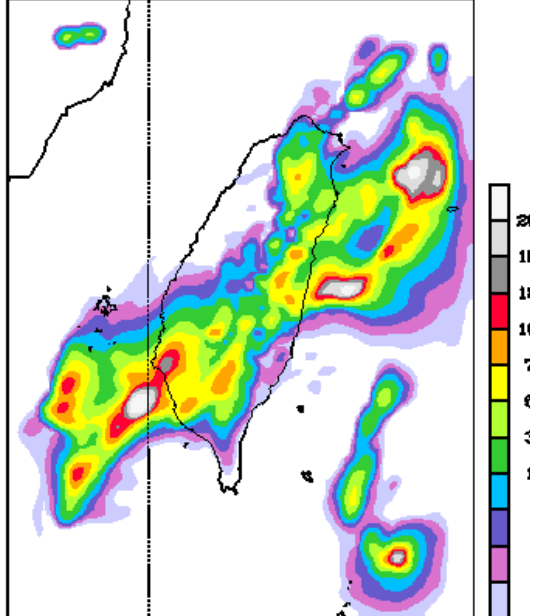
24 OPE



36 OPE

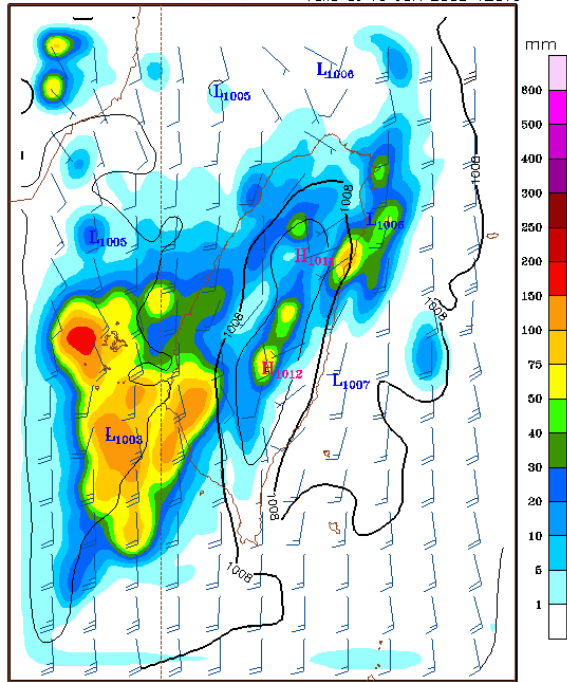


48 OPER

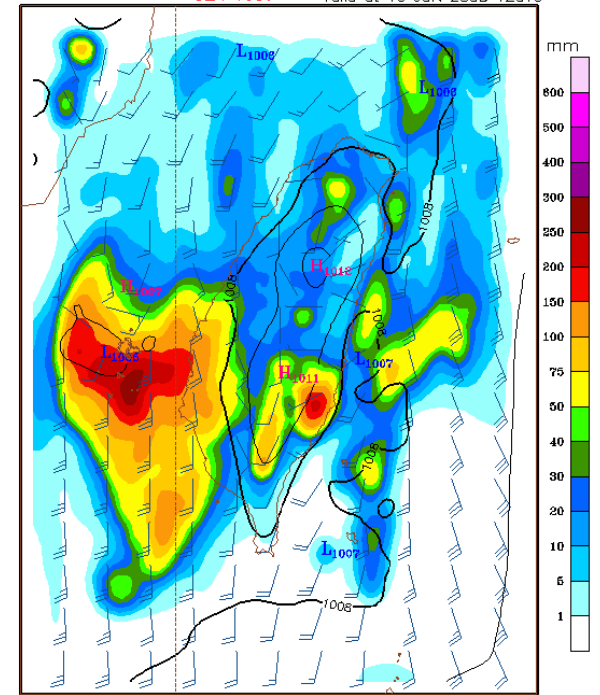


nfsvar_Sowmex 2008 IOP8 (6/16/00z~12z)

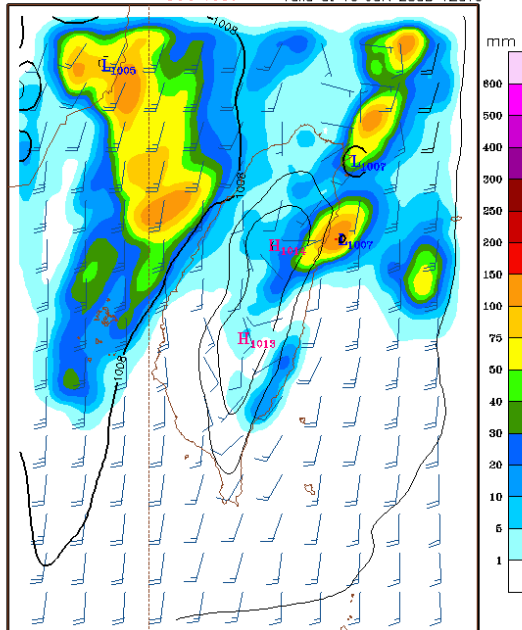
SLP(hPa), PRECIP(MM)(000-012) WIND AT 1000hPa NFS VAR
 16 JUN 2008 00UTC 012 fcst Valid at 16 JUN 2008 12UTC



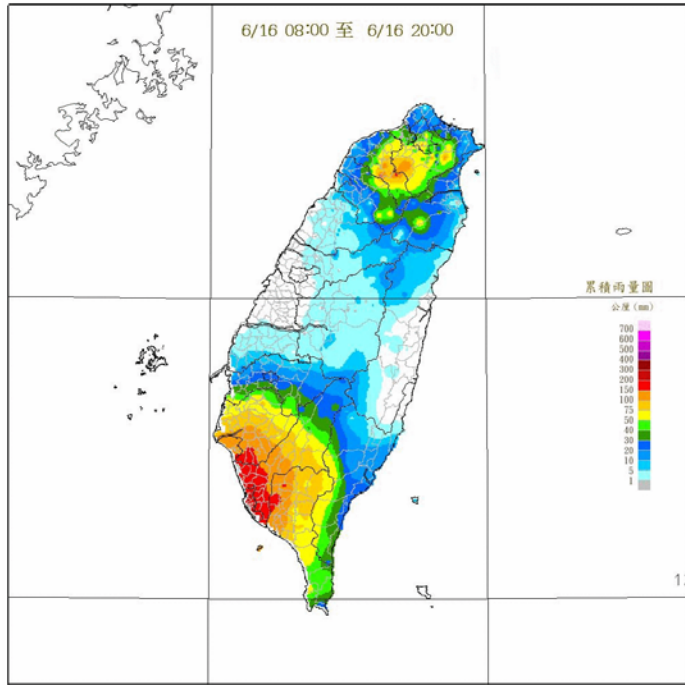
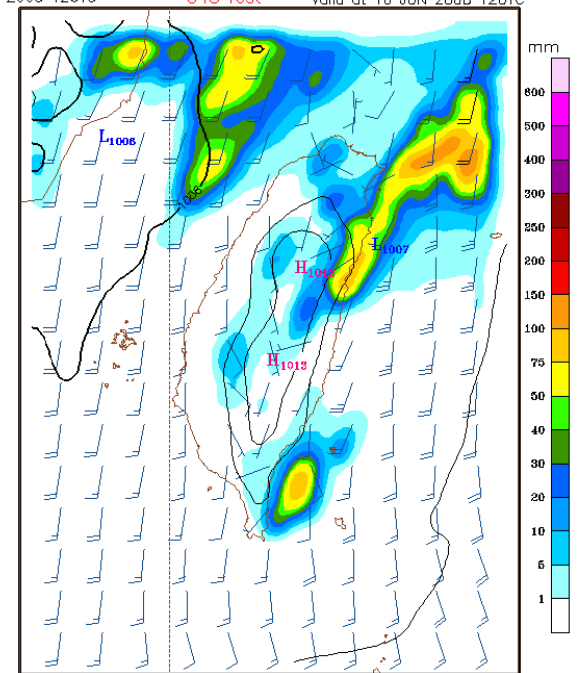
SLP(hPa), PRECIP(MM)(012-024) WIND AT 1000hPa NFS VAR
 15 JUN 2008 12UTC 024 fcst Valid at 16 JUN 2008 12UTC



SLP(hPa), PRECIP(MM)(024-036) WIND AT 1000hPa NFS VAR
 15 JUN 2008 00UTC 036 fcst Valid at 16 JUN 2008 12UTC



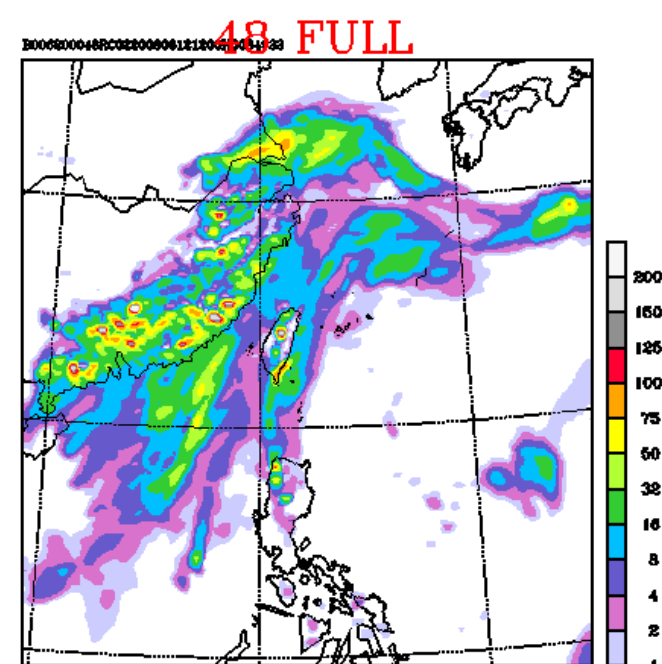
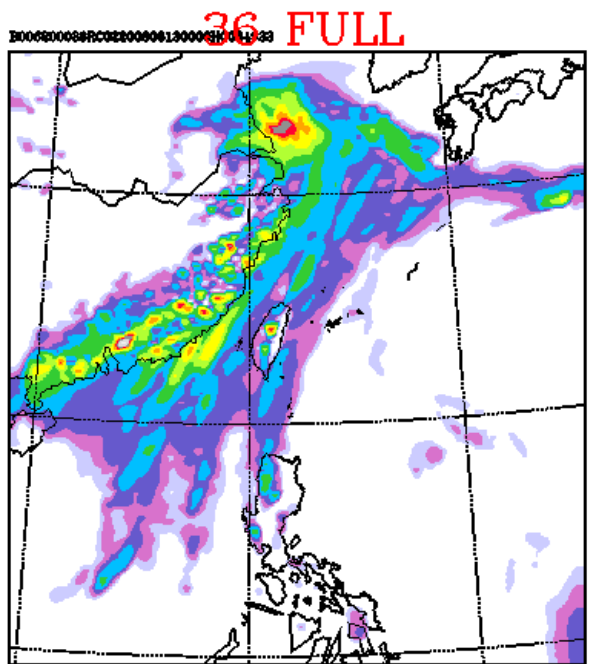
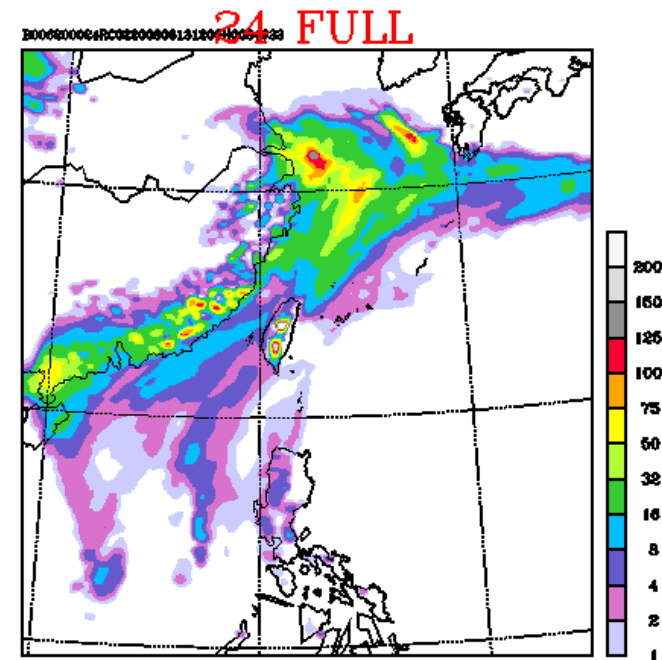
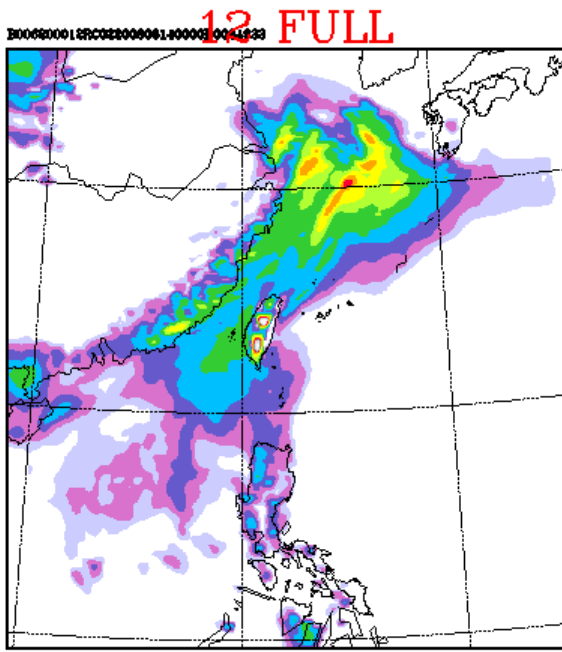
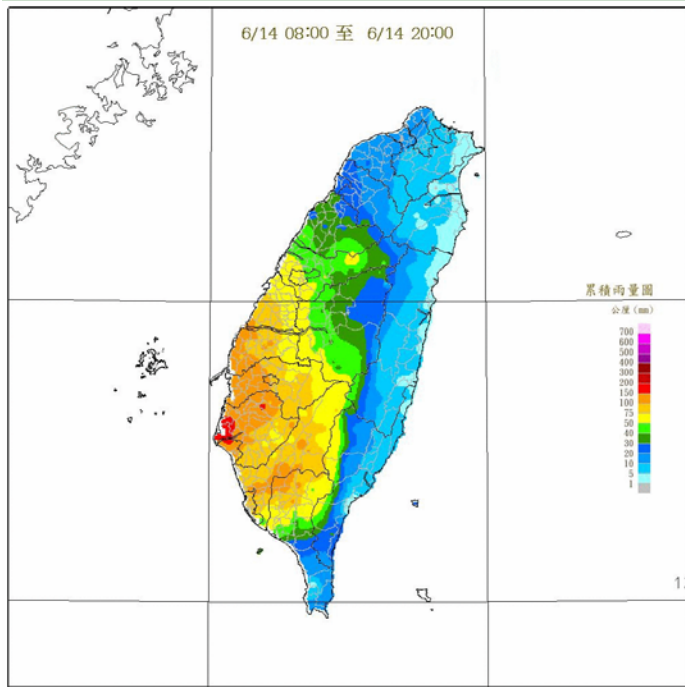
SLP(hPa), PRECIP(MM)(036-048) WIND AT 1000hPa NFS VAR
 14 JUN 2008 12UTC 048 fcst Valid at 16 JUN 2008 12UTC



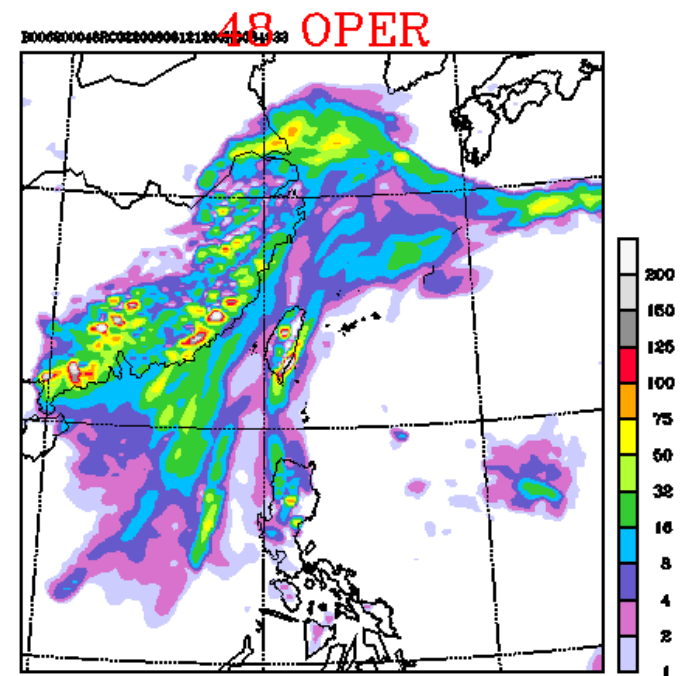
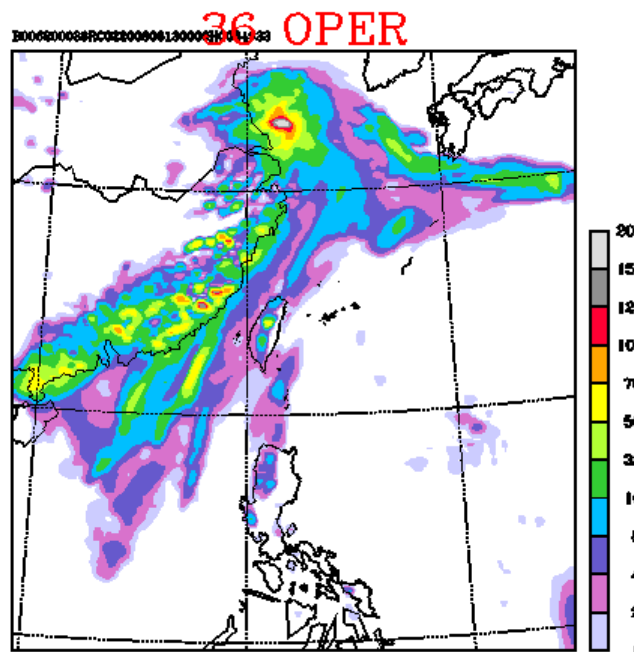
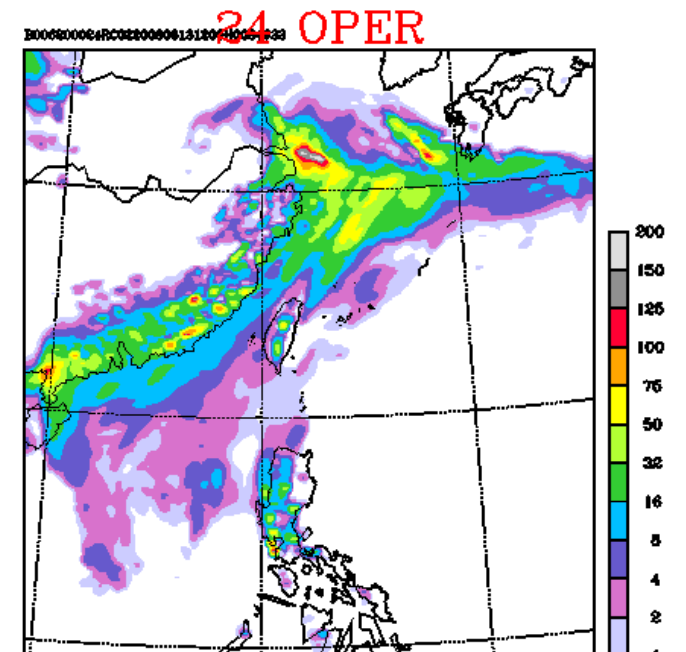
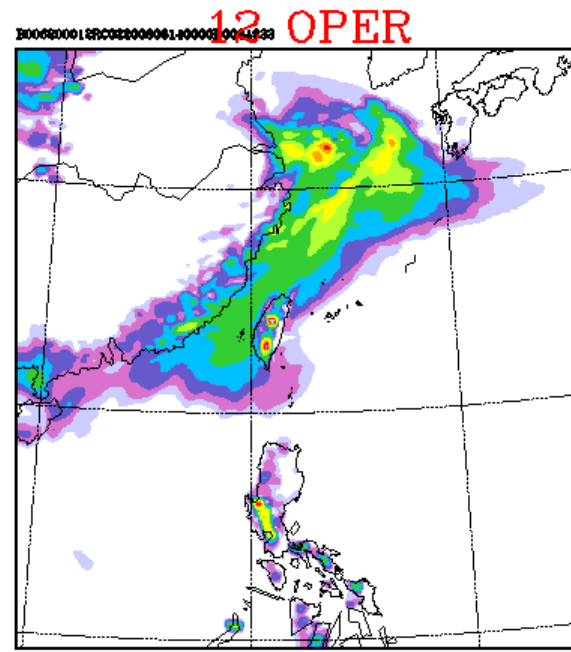
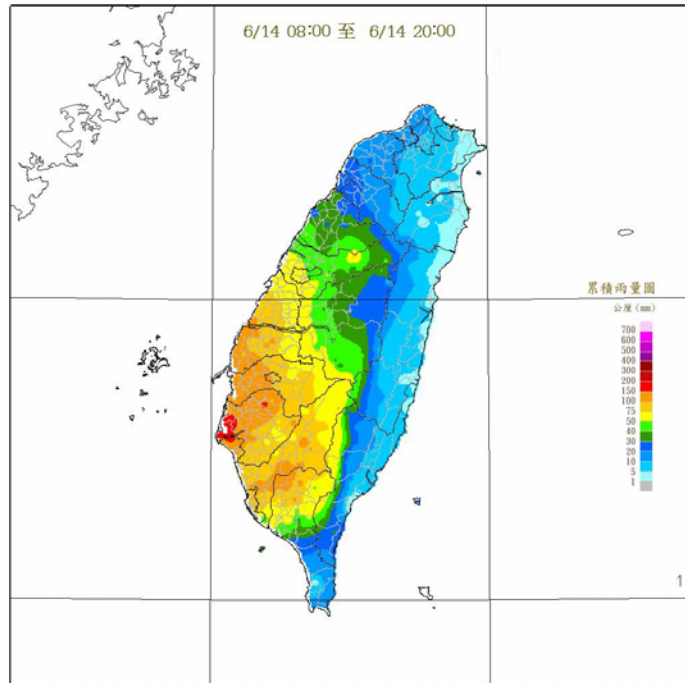
CWB NFS
 real time products

quite different from
 re-executed

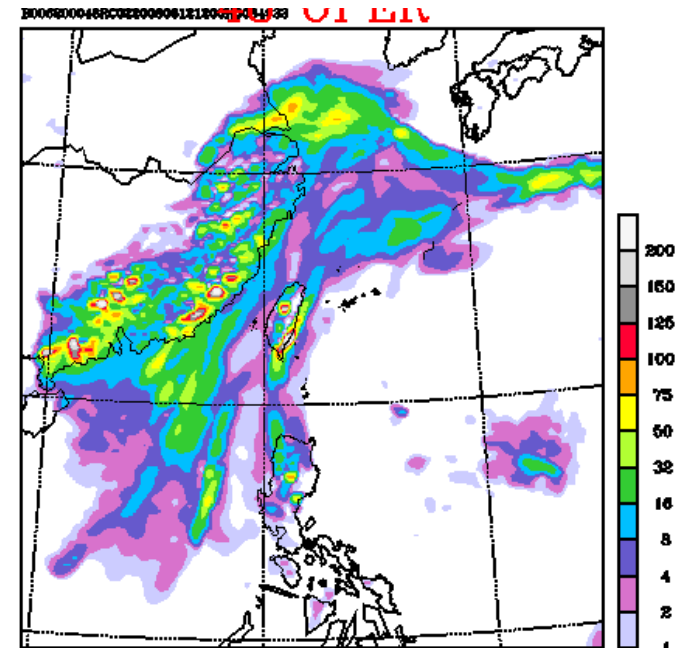
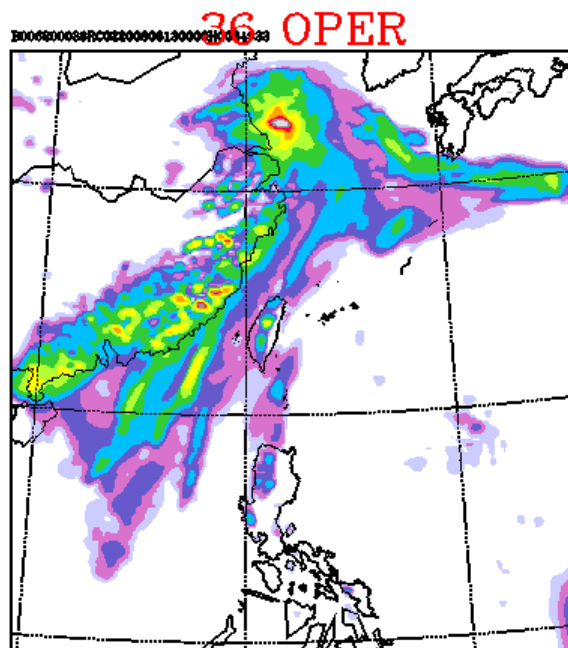
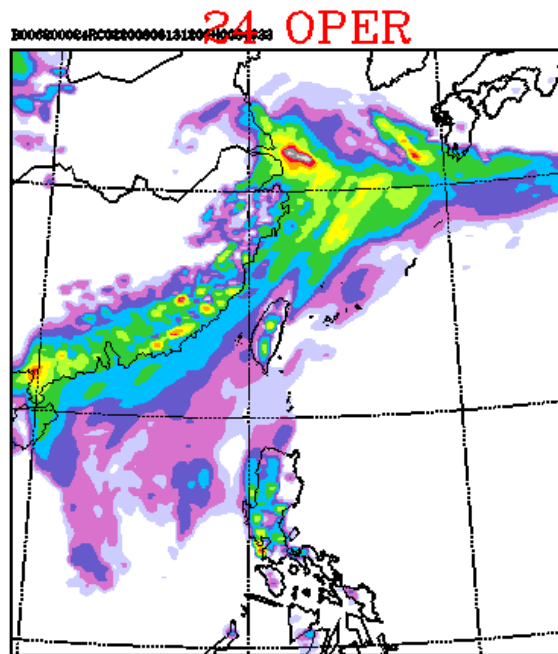
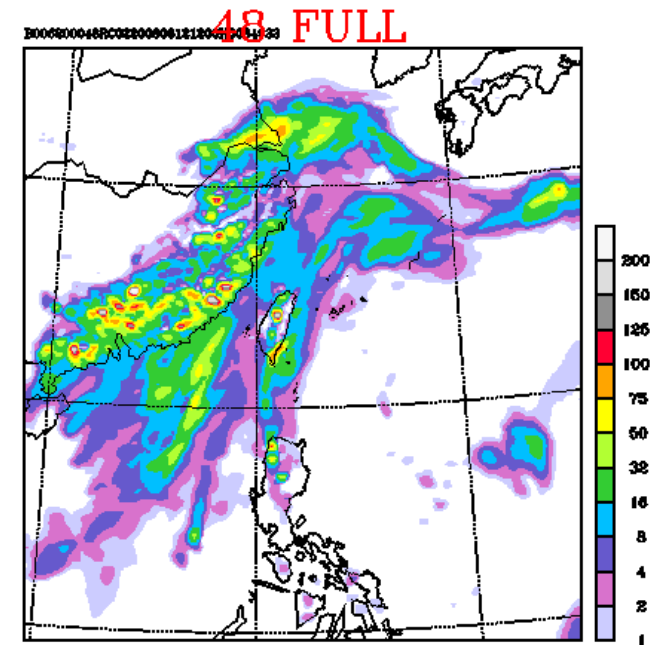
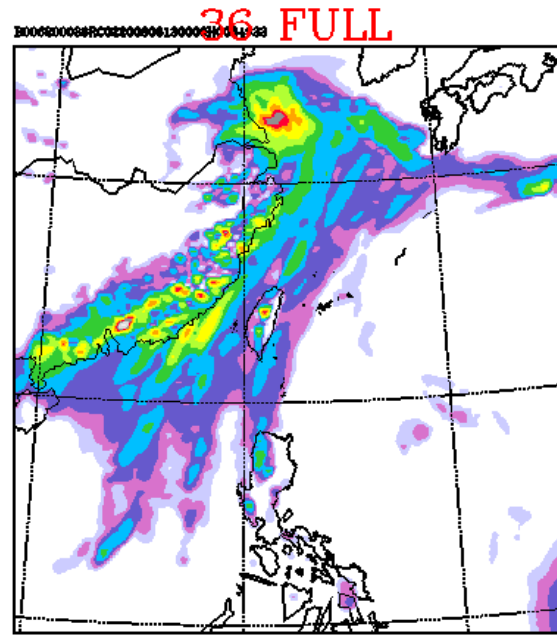
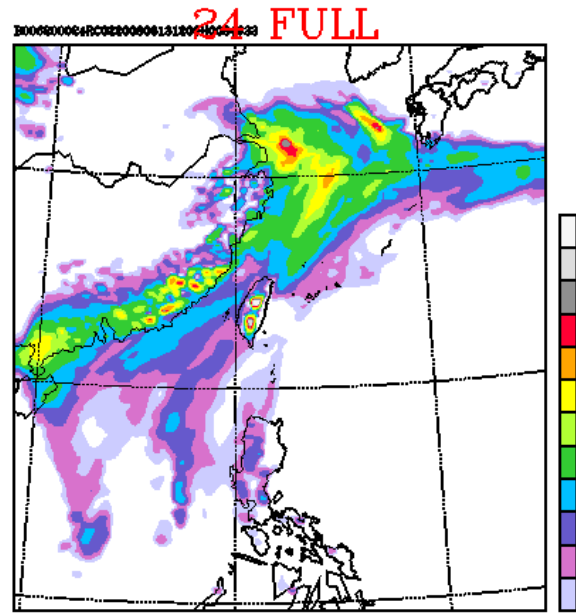
nfs Sowmex 2008 IOP8 (6/14/00z~12z) FULL



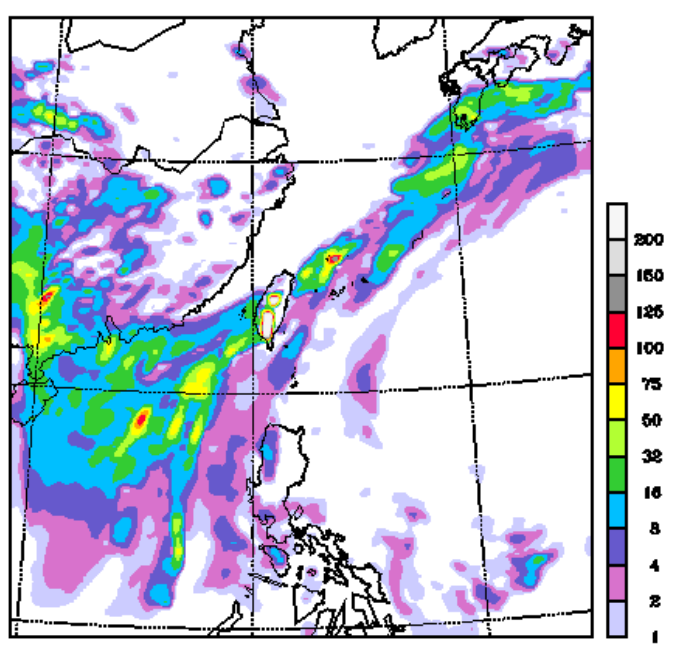
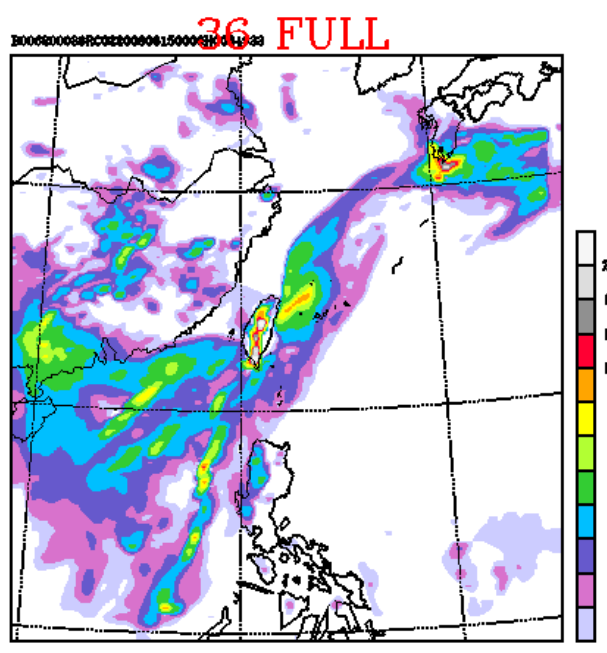
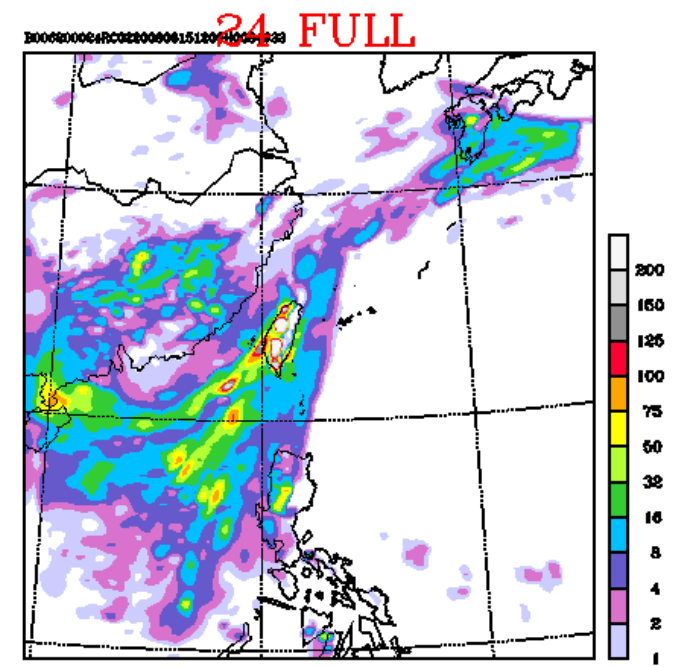
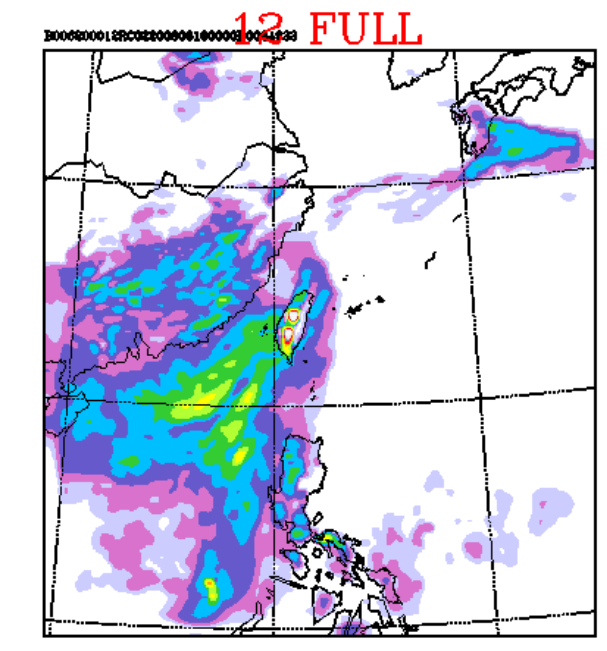
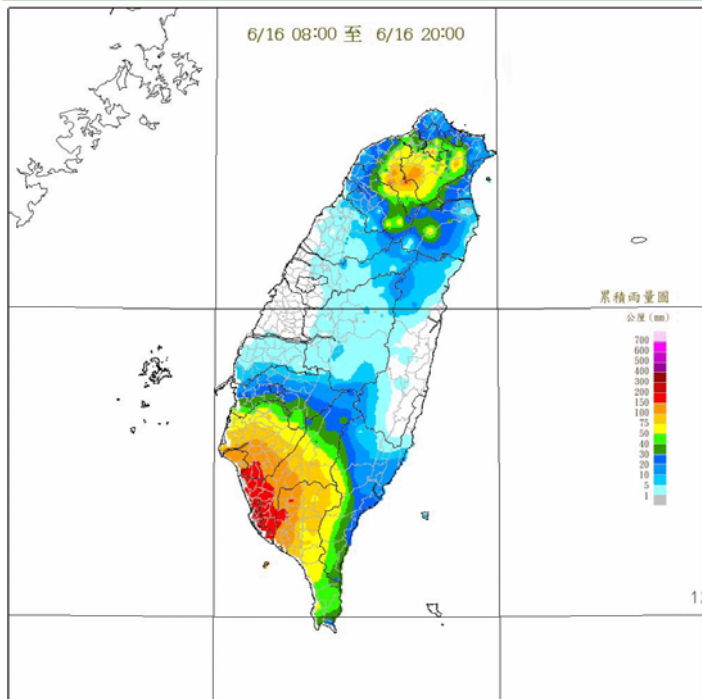
nfs Sowmex 2008 IOP8 (6/14/00z~12z) NO



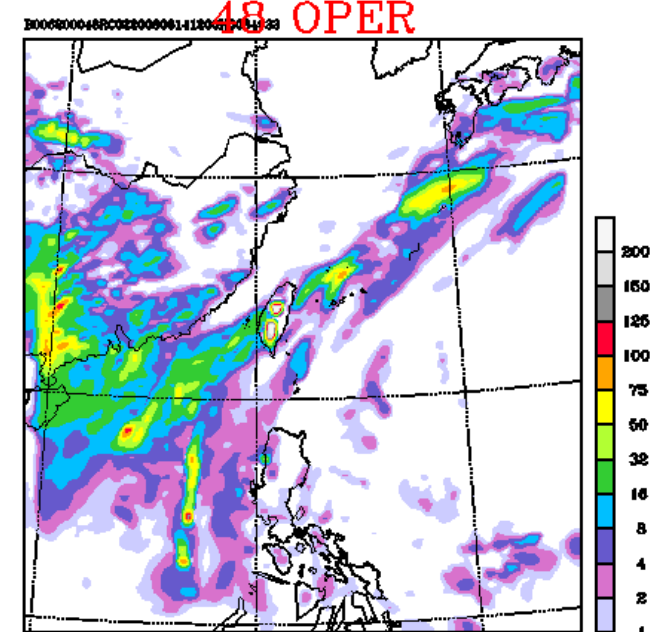
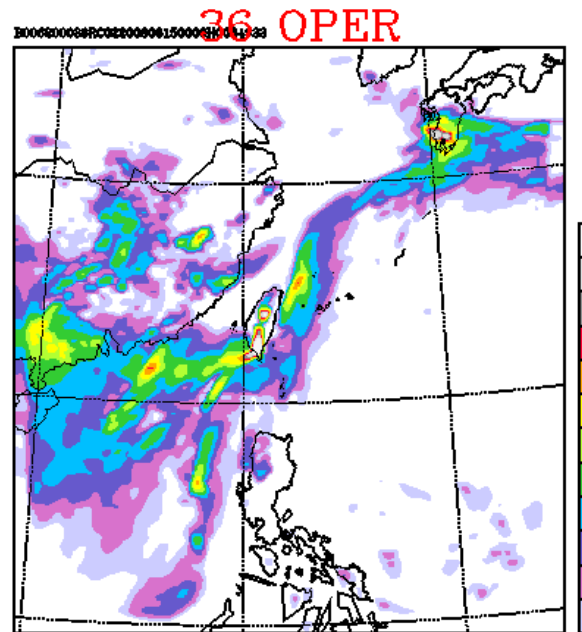
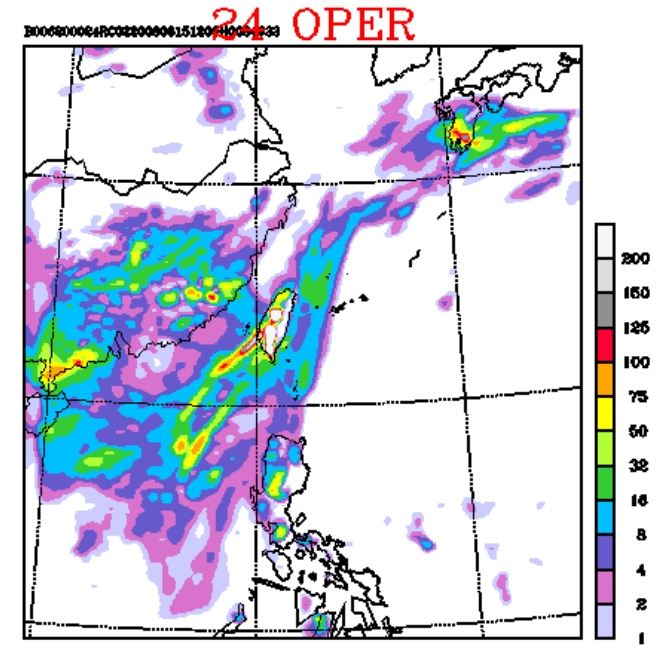
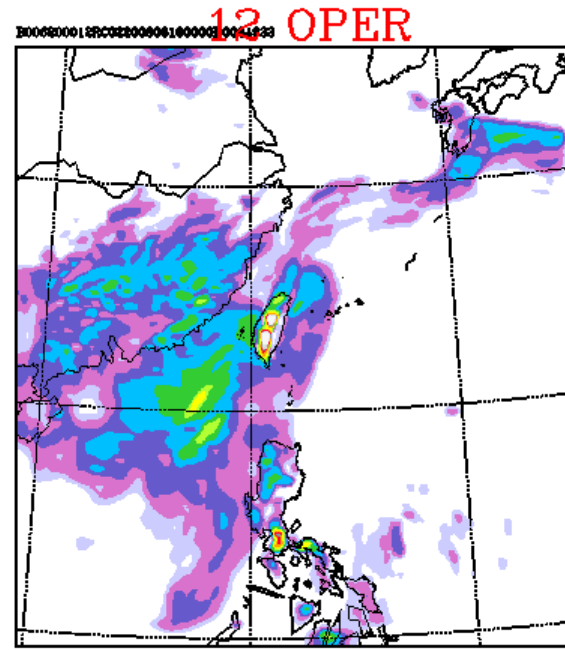
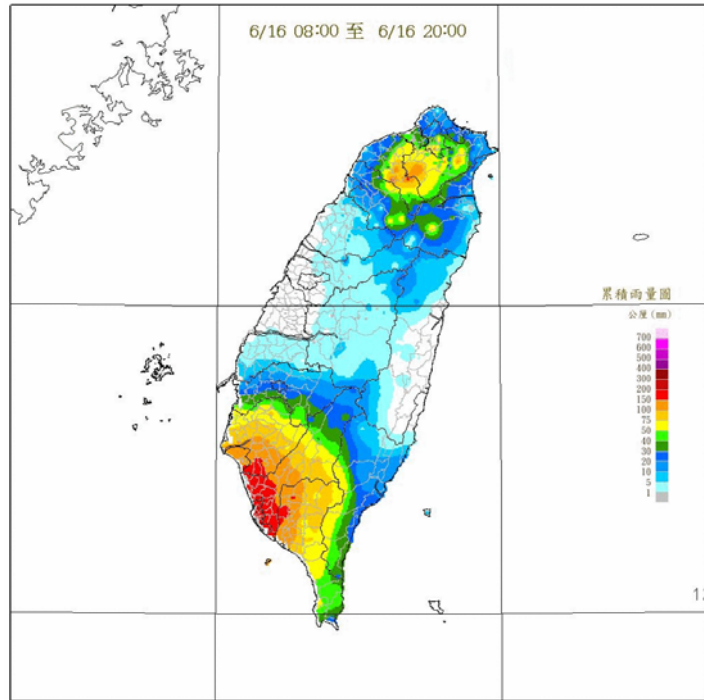
nfs 15km Sowmex 2008 IOP8 (6/14/00z~12z) Full&NO



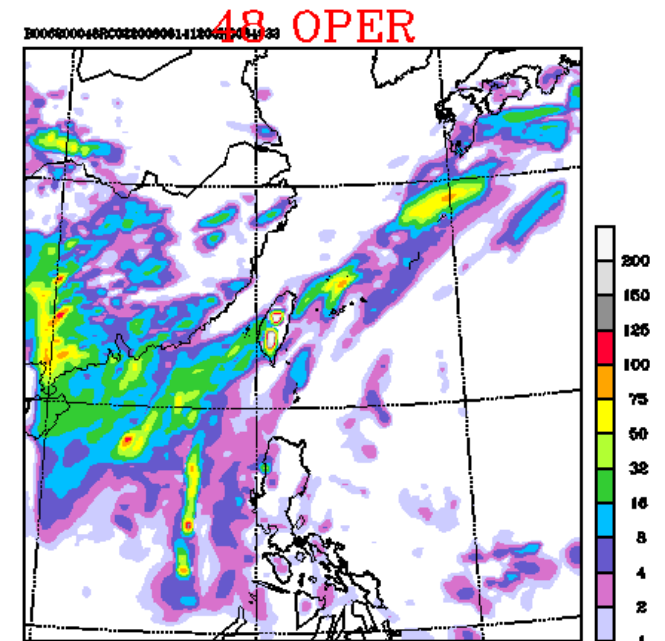
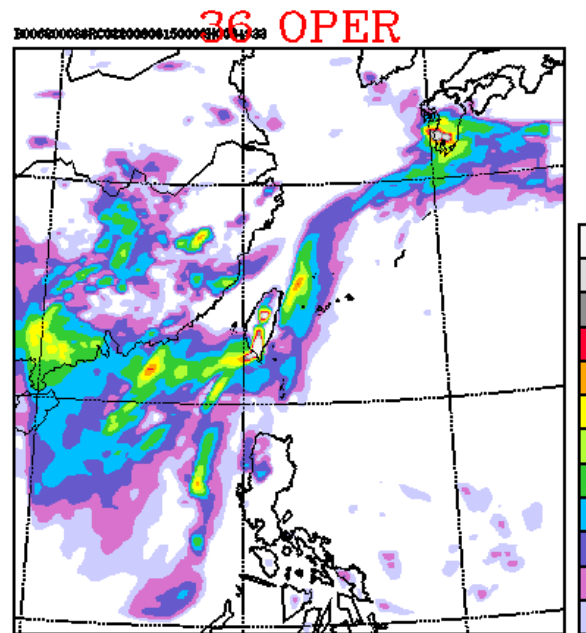
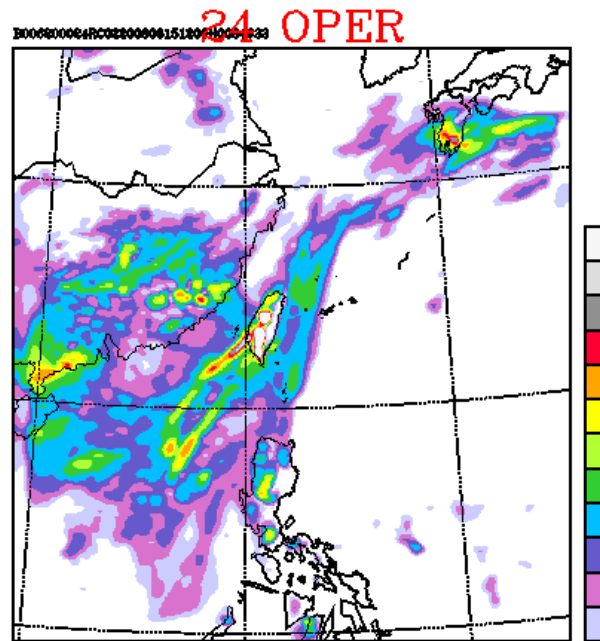
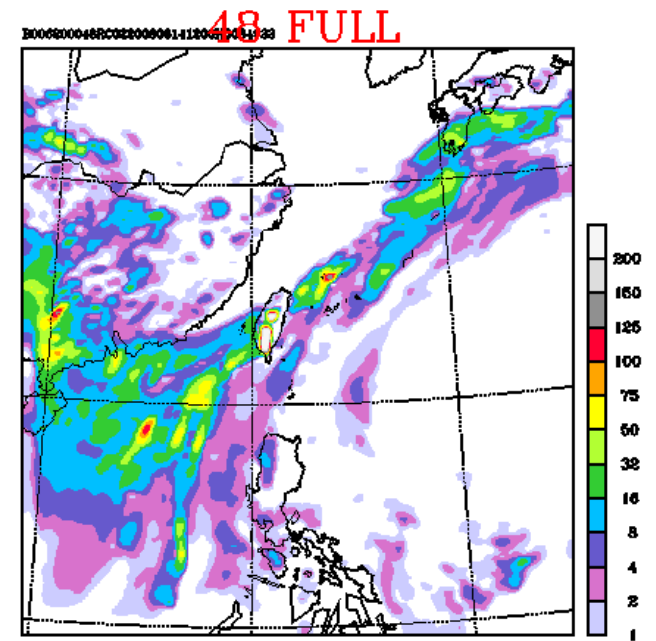
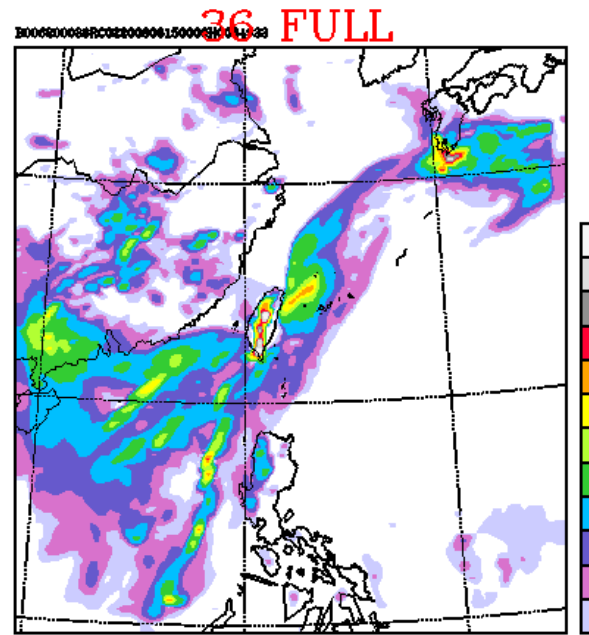
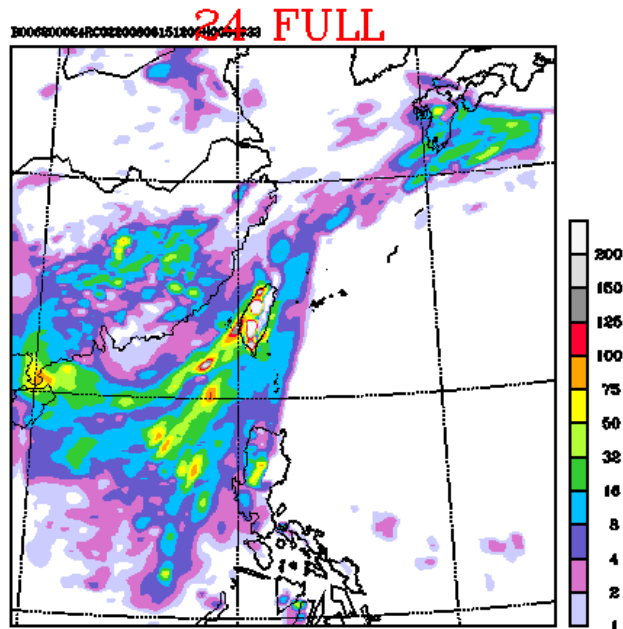
nfs Sowmex 2008 IOP8 (6/16/00z~12z) FULL



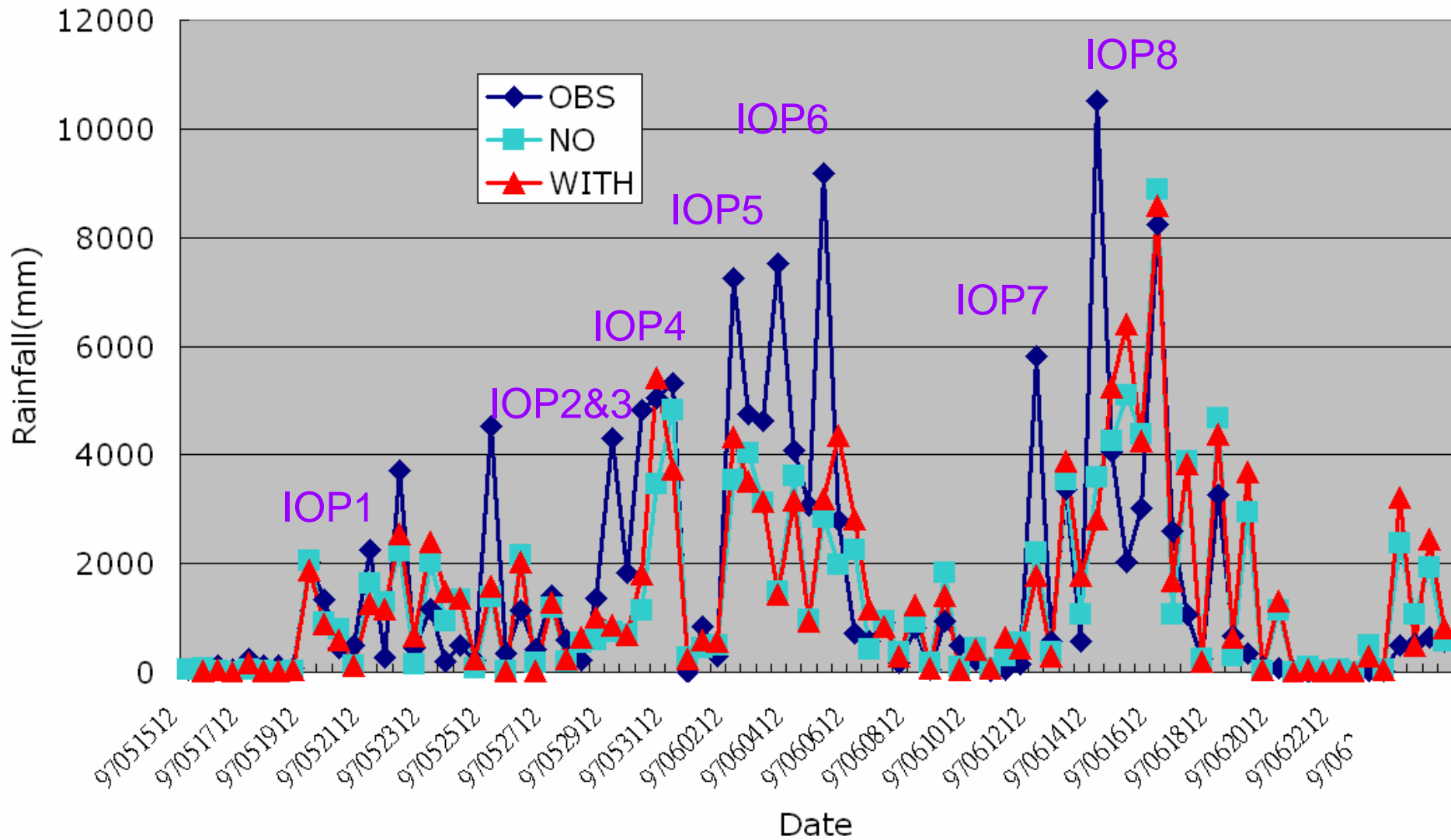
nfs Sowmex 2008 IOP8 (6/16/00z~12z) NO



nfs 15km Sowmex 2008 IOP8 (6/16/00z~12z) Full&NO




Sowmex 2008/05/15/12~06/26/00 total rainfall nfs 5km



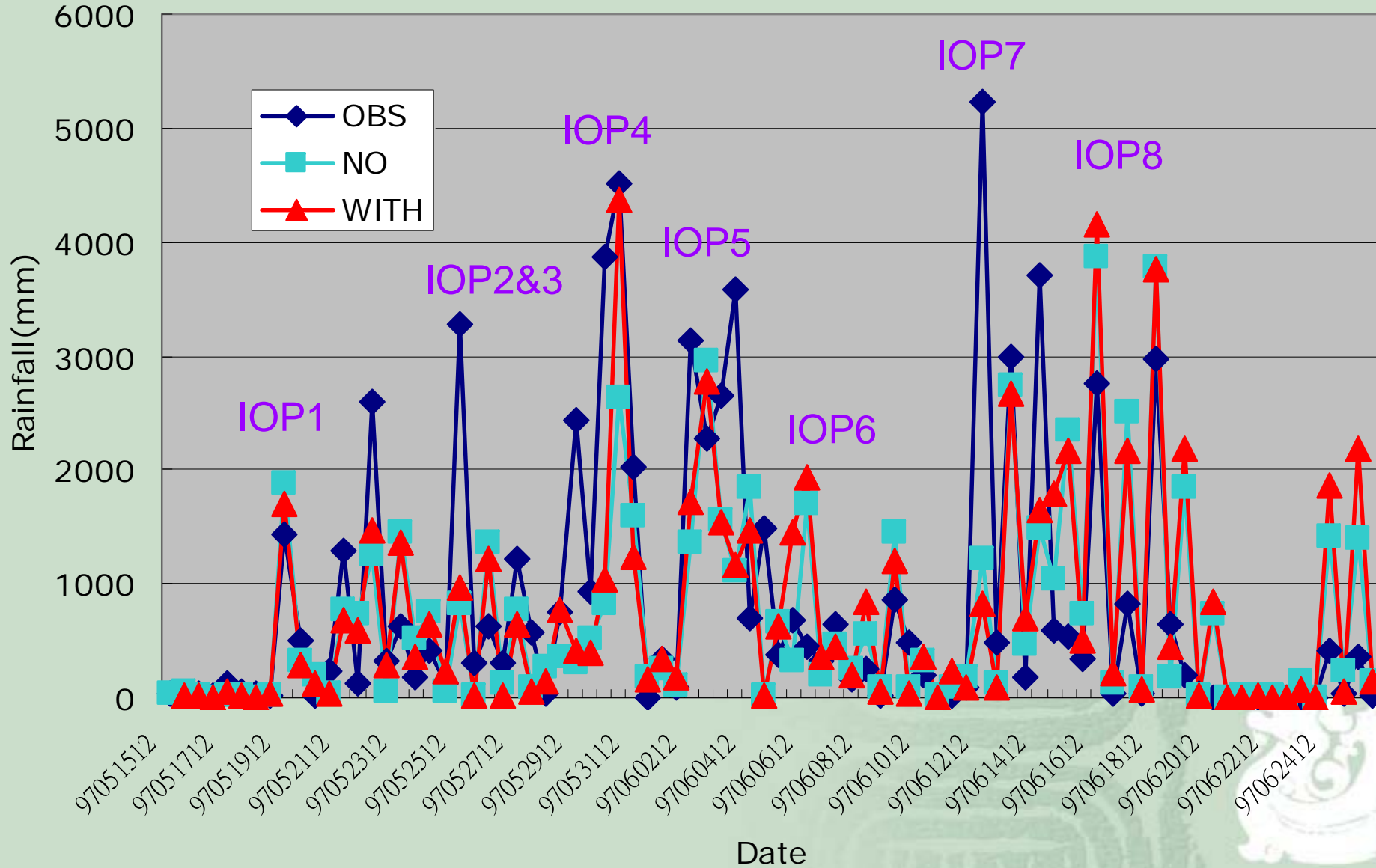
From
CHANG HWA-YUN LIN intercept,
cross to center of HUA LIEN



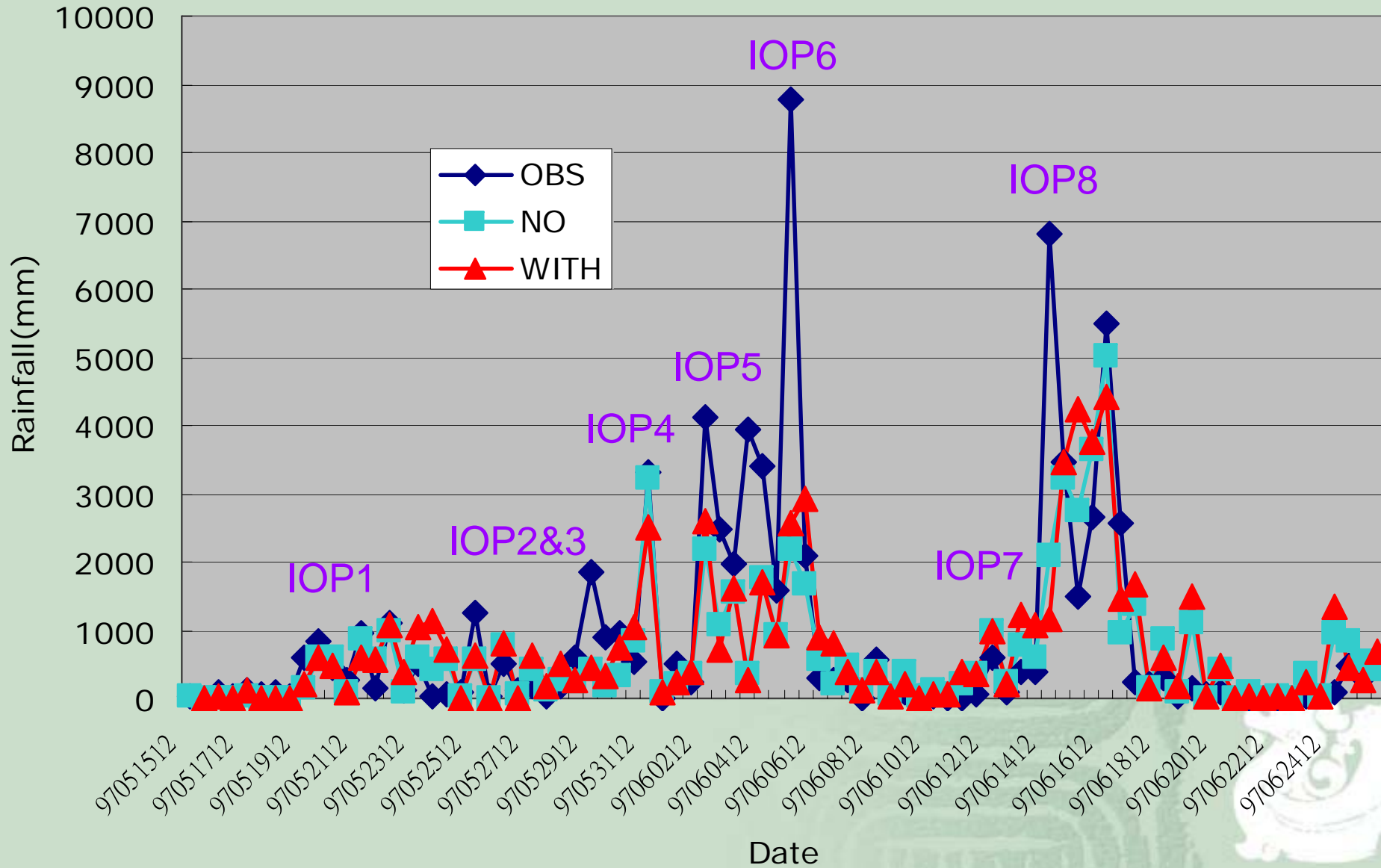


彰化-雲林交界, 花蓮中部

Sowmex 2008/05/15/12~06/26/00 total rainfall nfs 5km, north-half of Taiwan



Sowmex 2008/05/15/12~06/26/00 total rainfall nfs 5km, south-half of Taiwan

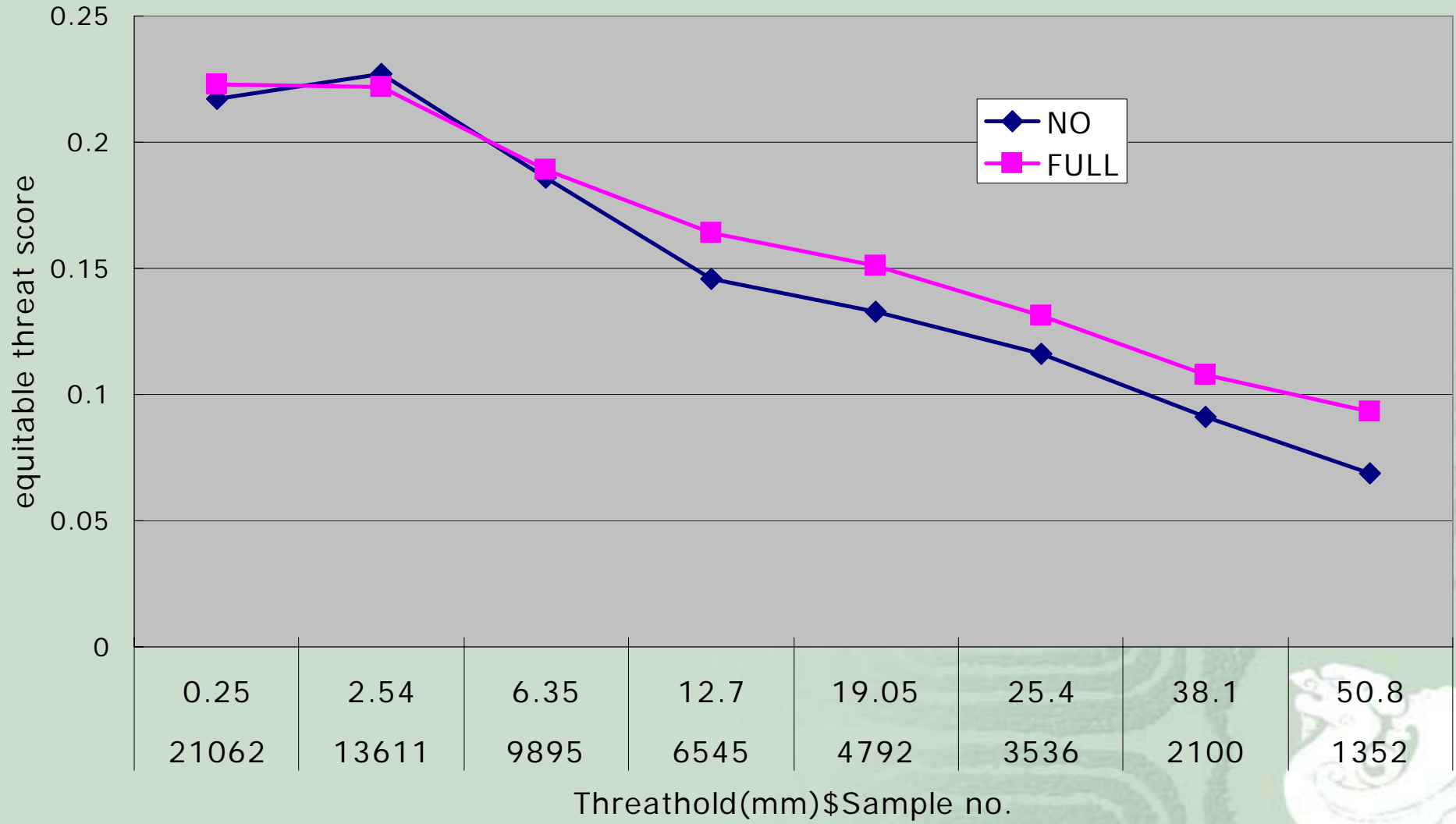


Summary of Taiwan total rainfall

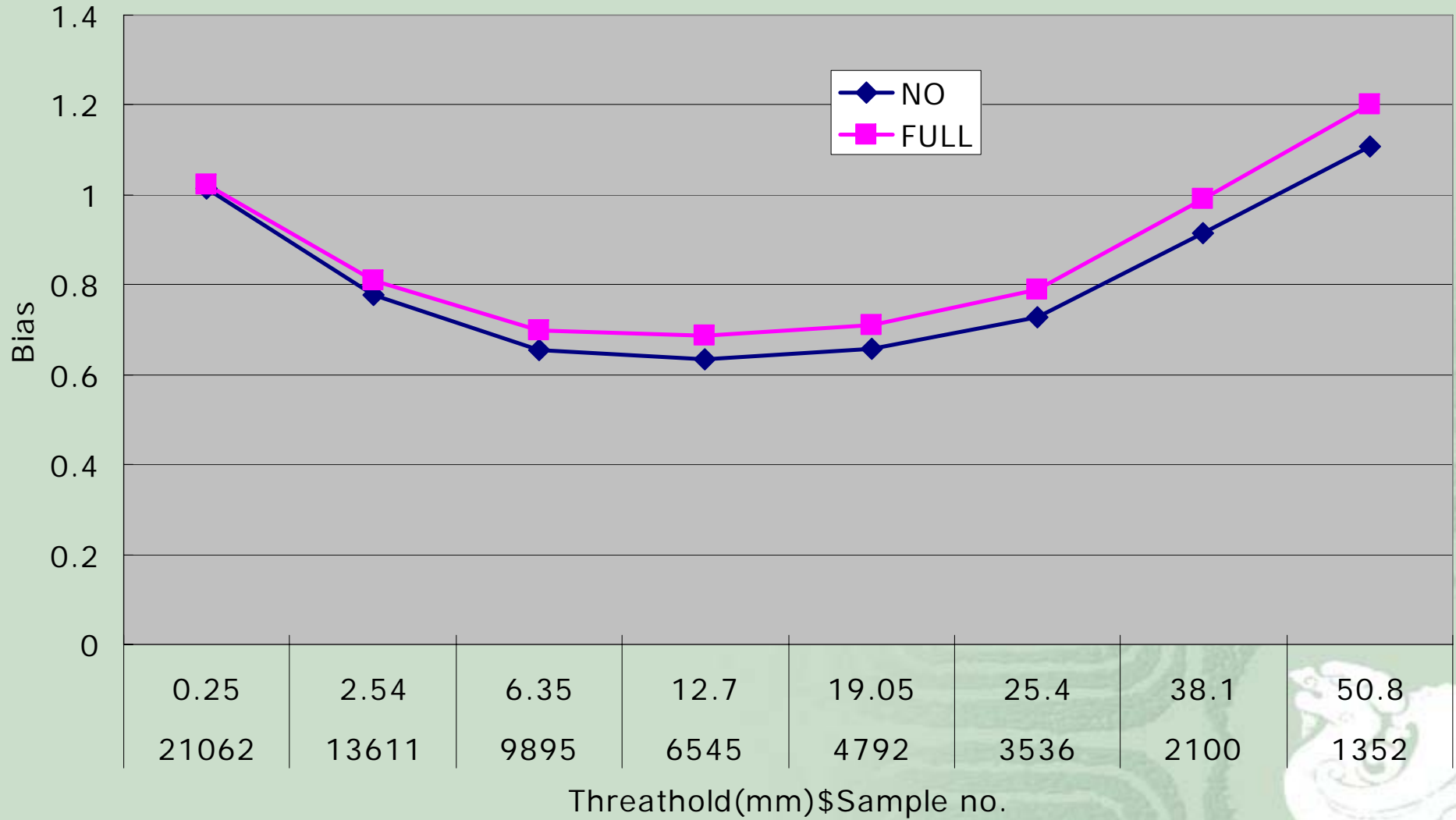
- About total rainfall : **under-estimated**, but **IOP4** and end of **IOP8(6/16)** have good rainfall estimated
- About north half of Taiwan : better estimated on **IOP4~6(early of June)**
- About south half of Taiwan : better estimated on **May**



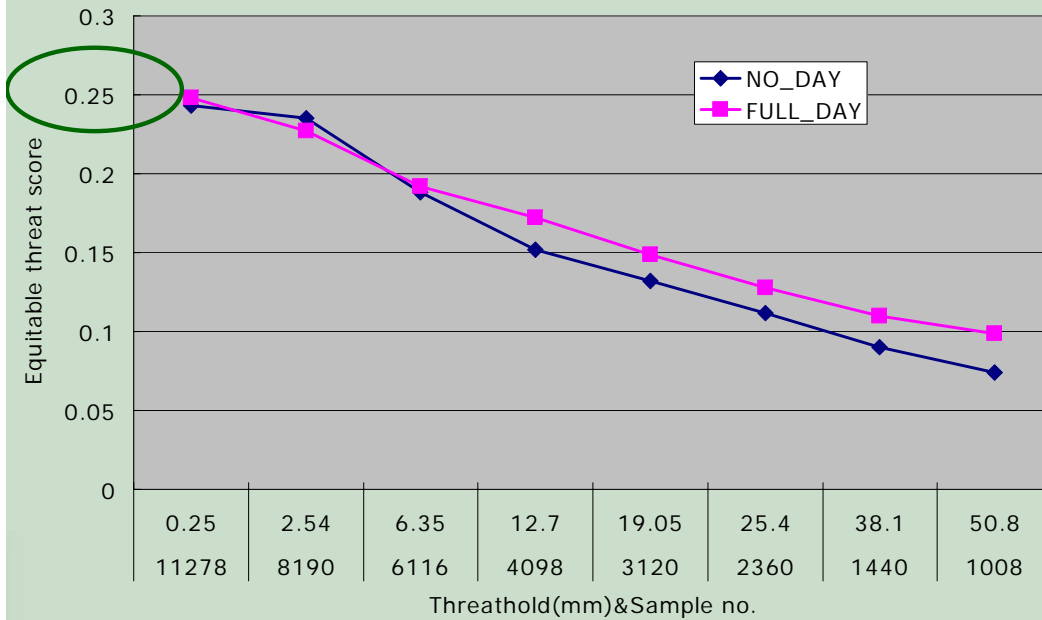
Sowmex(2008/05/15/12~06/26/00) NFS/15km



Sowmex(2008/05/15/12~06/26/00) NFS/15km

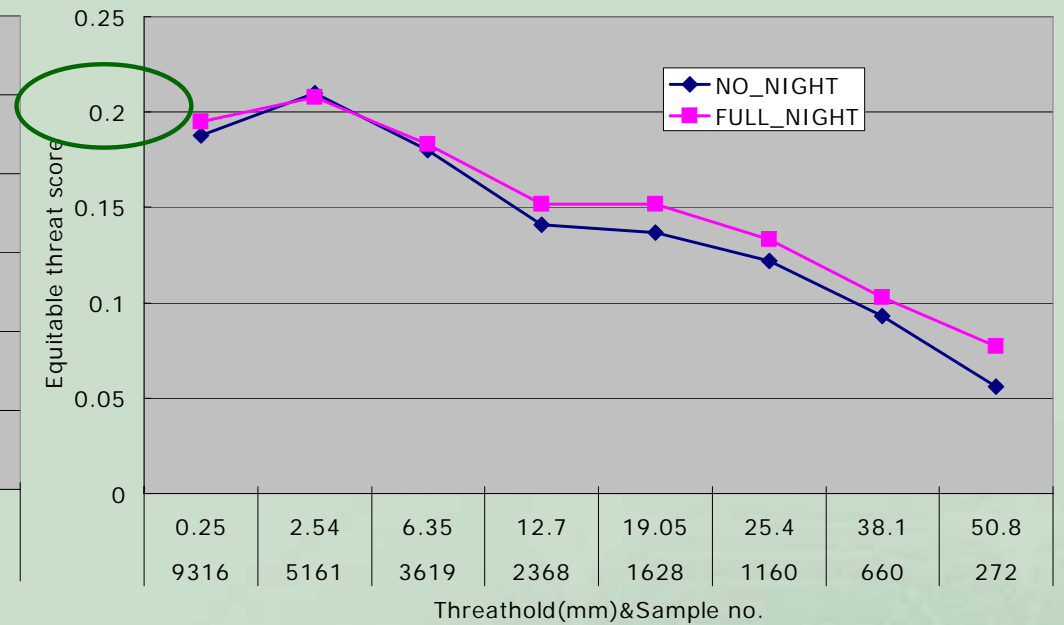


Sowmex(2008/05/15/12~06/26/00) nfs/15km daytime



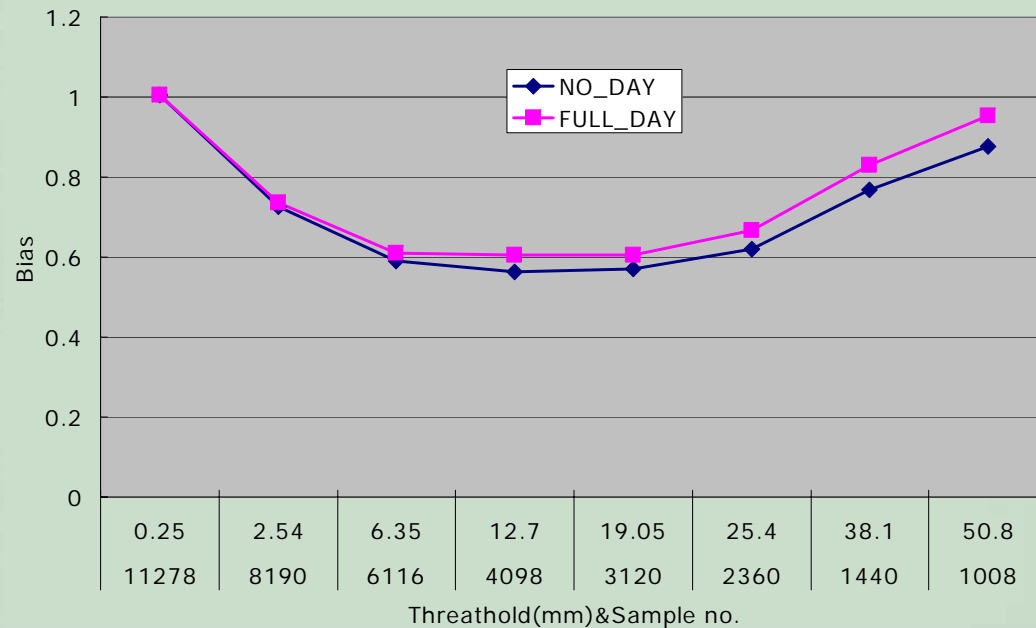
daytime

Sowmex(2008/05/15/12~06/26/00) nfs/15km nighttime

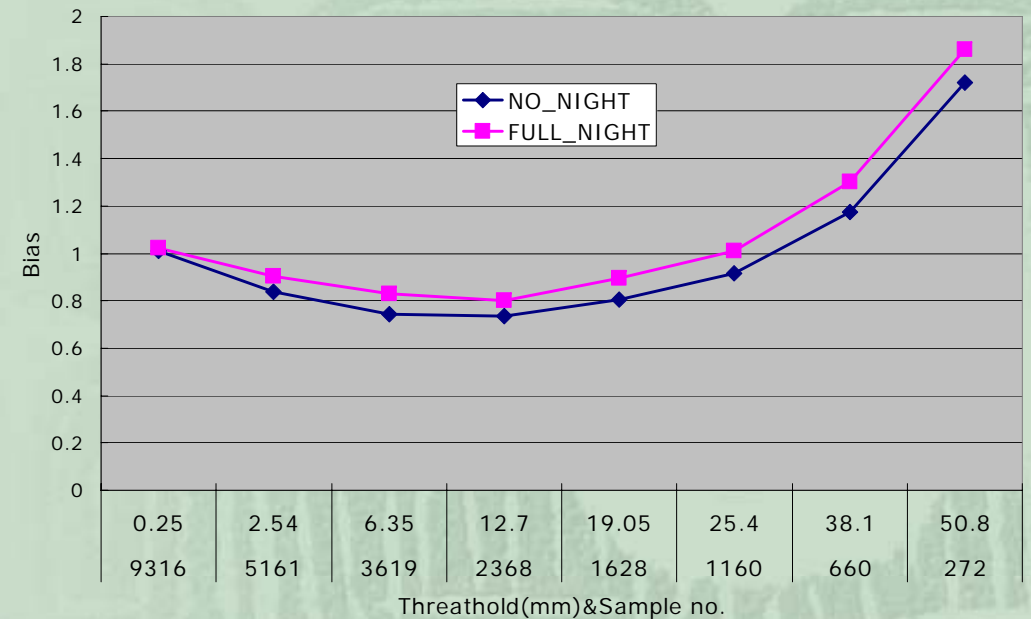


nighttime

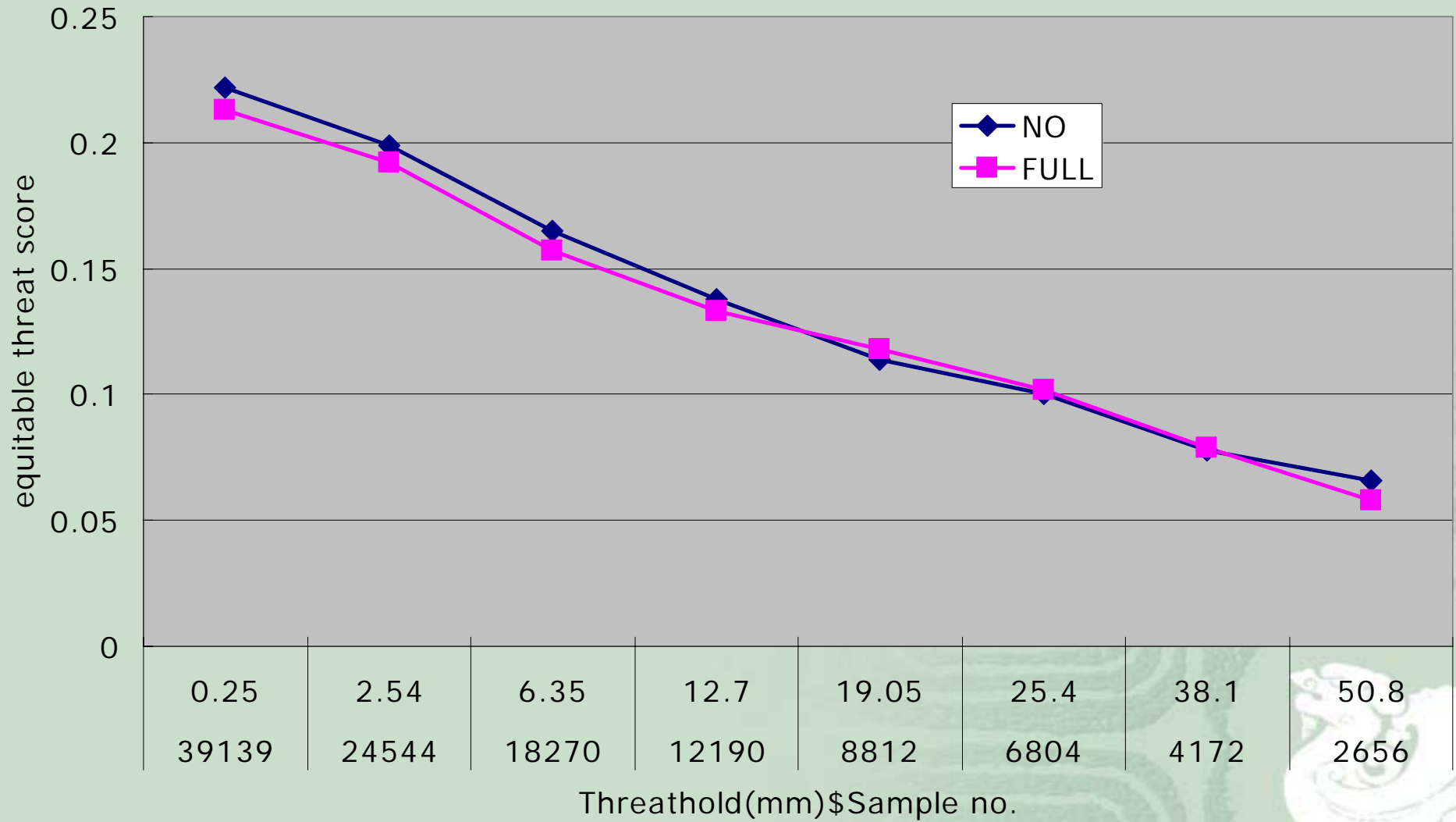
Sowmex(2008/05/15/12~06/26/00) nfs/15km daytime



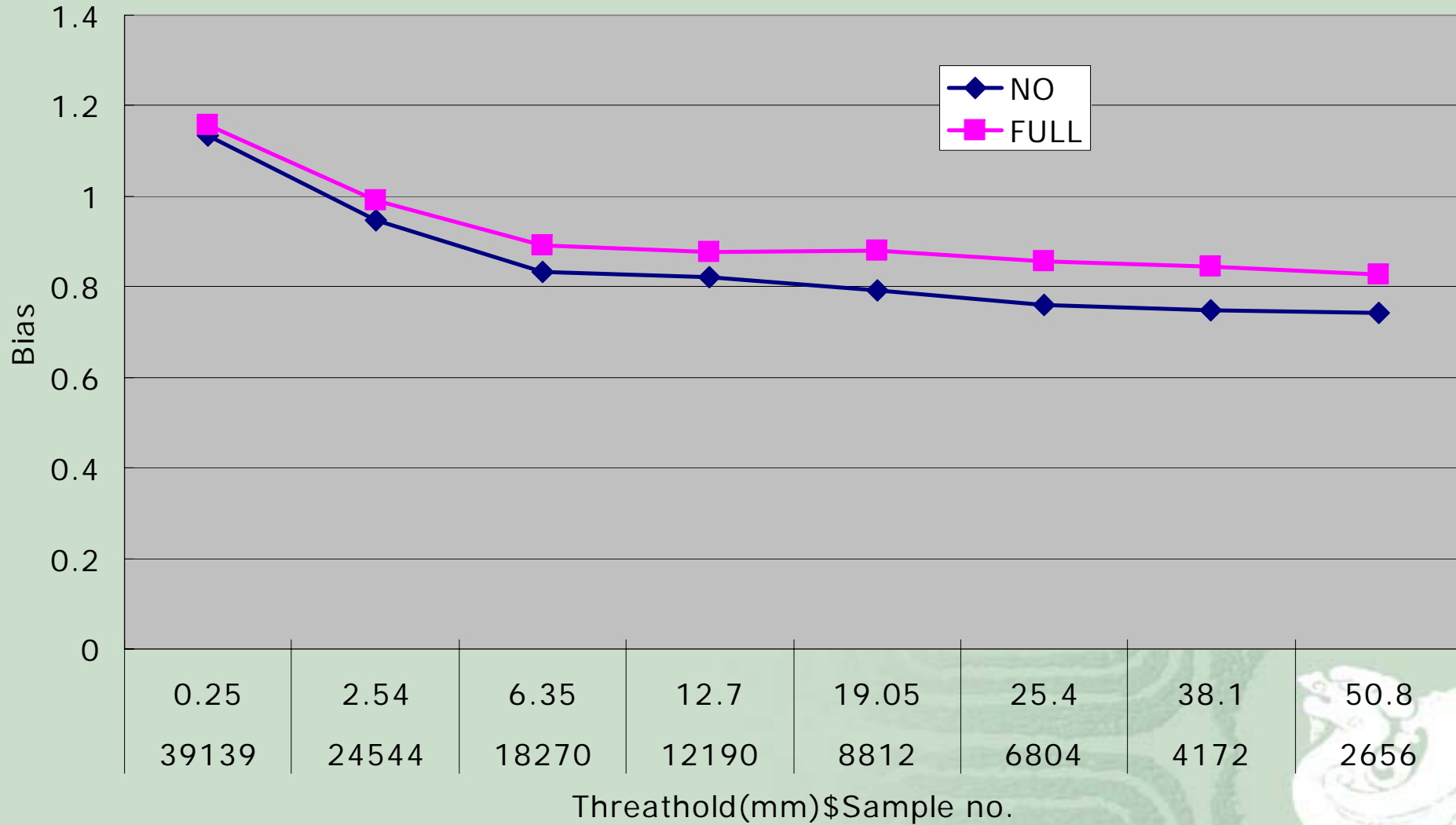
Sowmex(2008/05/15/12~06/26/00) nfs/15km nighttime



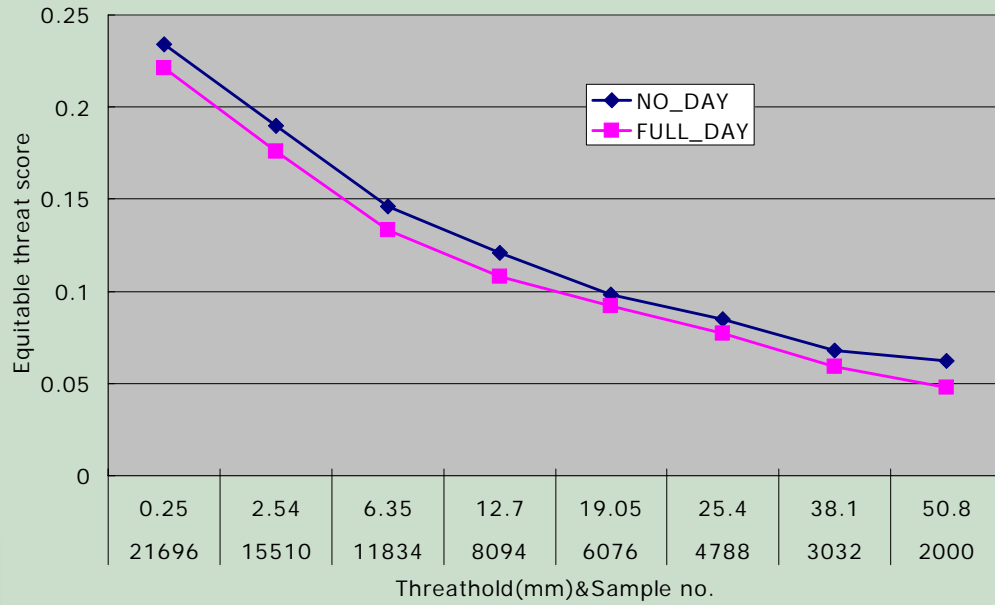
Sowmex(2008/05/15/12~06/26/00) NFS/5km



Sowmex(2008/05/15/12~06/26/00) NFS/5km

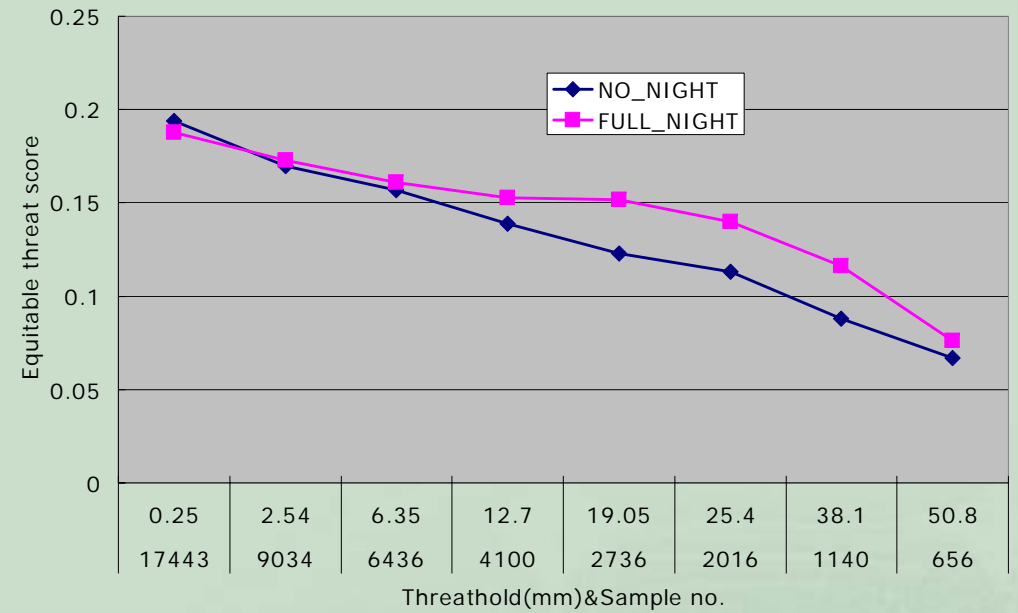


Sowmex(2008/05/15/12~06/26/00) nfs/5km daytime



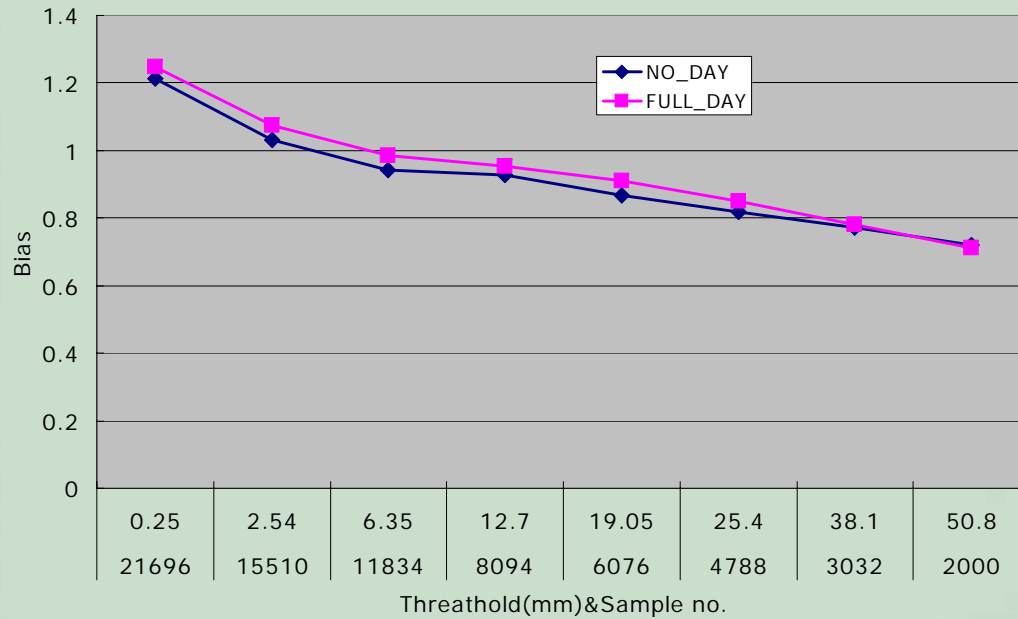
daytime

Sowmex(2008/05/15/12~06/26/00) nfs/5km nighttime

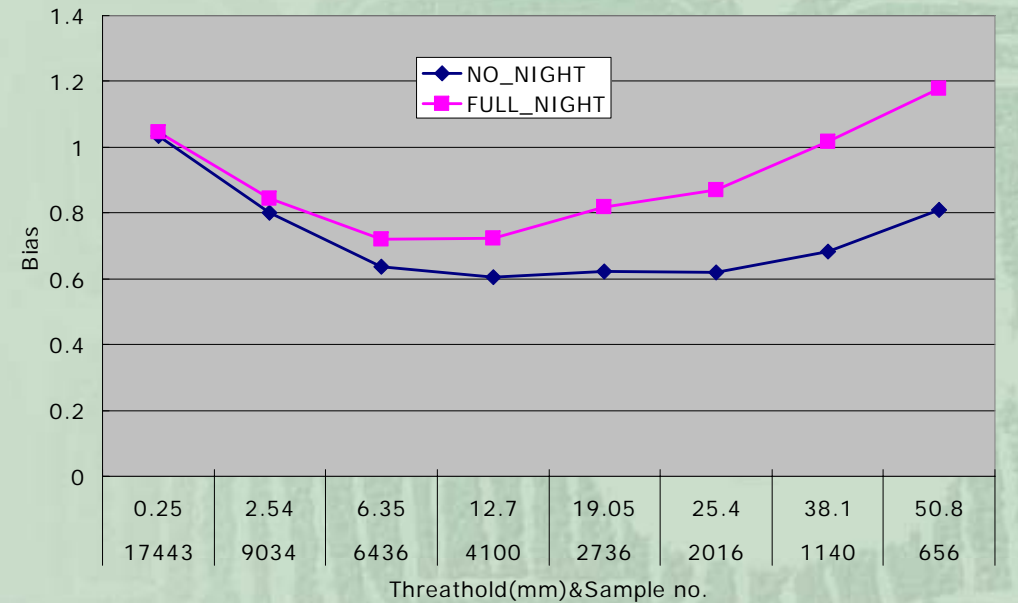


nighttime

Sowmex(2008/05/15/12~06/26/00) nfs/5km daytime



Sowmex(2008/05/15/12~06/26/00) nfs/5km nighttime



Summary of qpf

NFS 15km

- Full data run have better ets score and bias than operational data run on both day and night.
- Daytime have higher ets score than nighttime. (dropsondes daytime only?)
- daytime have low bias, nighttime have high bias above 25mm threathold. (the characteristics of rainfall to nfs is low bias)



Summary of qpf(continue)

NFS 5km

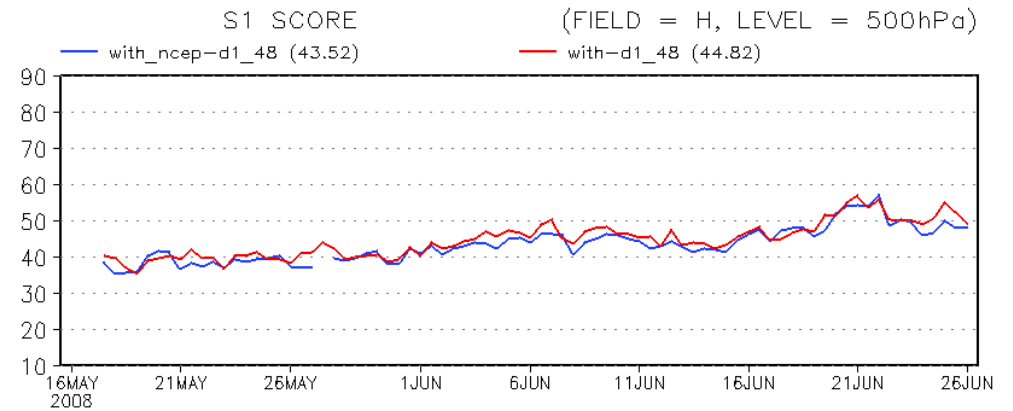
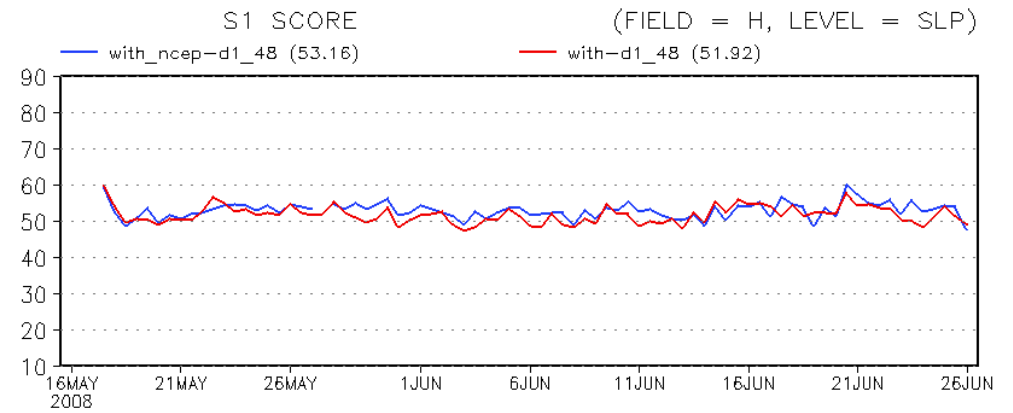
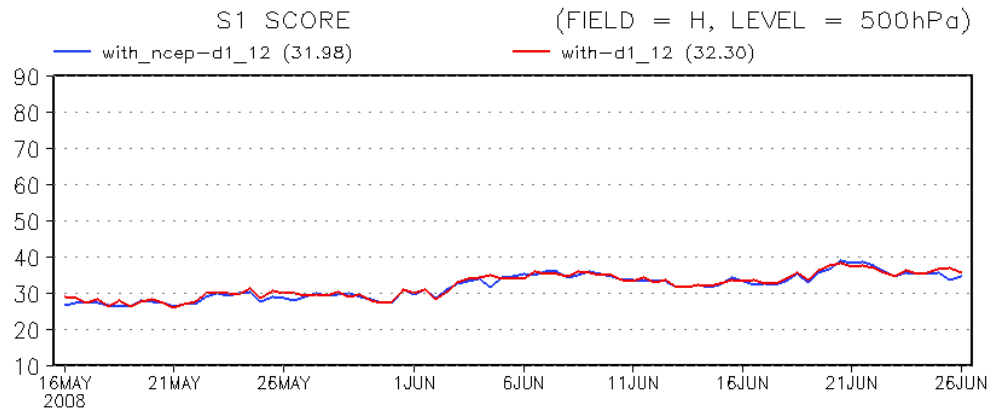
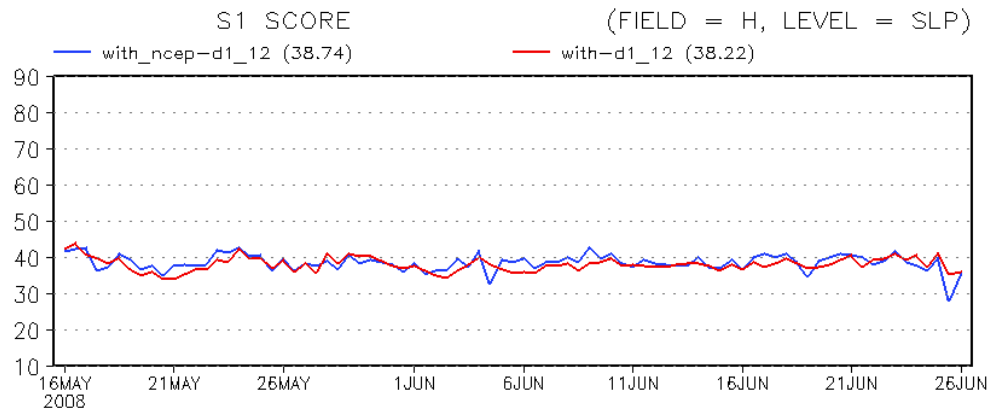
- The ets score of operational data run is slight better than full data run.
 - Full data run have better ets score on nighttime, but operational data run have better ets score on daytime.
 - The bias of full data run is slight better than operational data run on both day and night.
- ➔ Positive impacts of full data run on qpf studies, especially at nfs 15km, slightly at nfs 5km.

3. Ncep gfs, nfs rerun

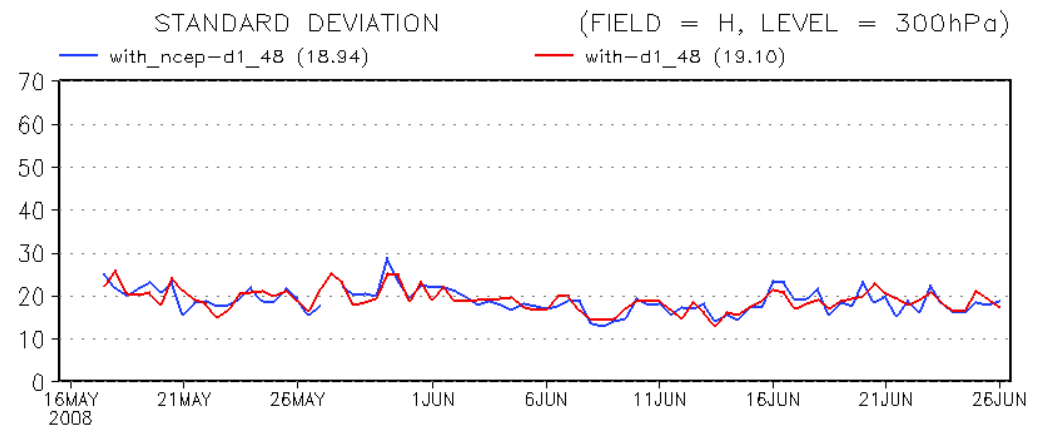
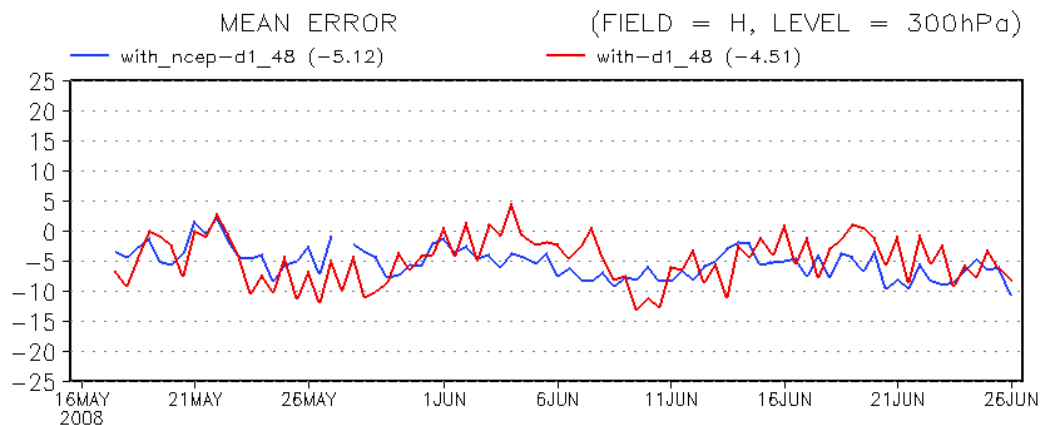
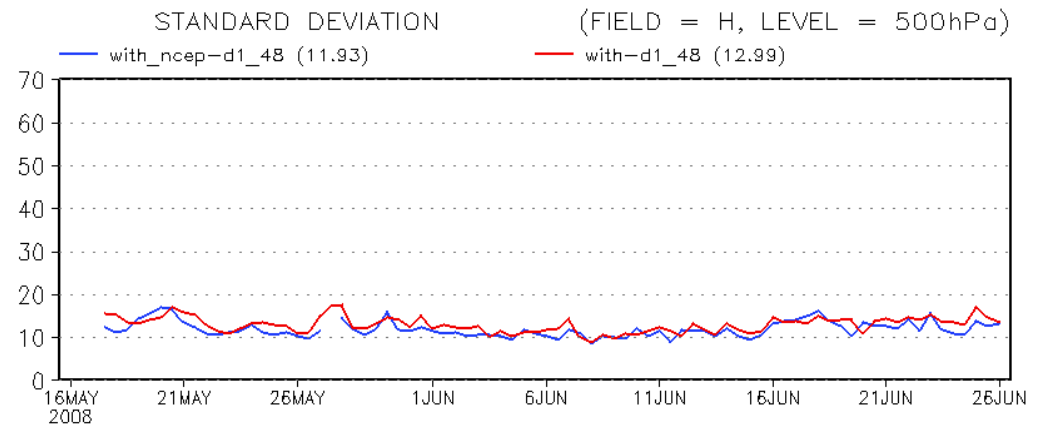
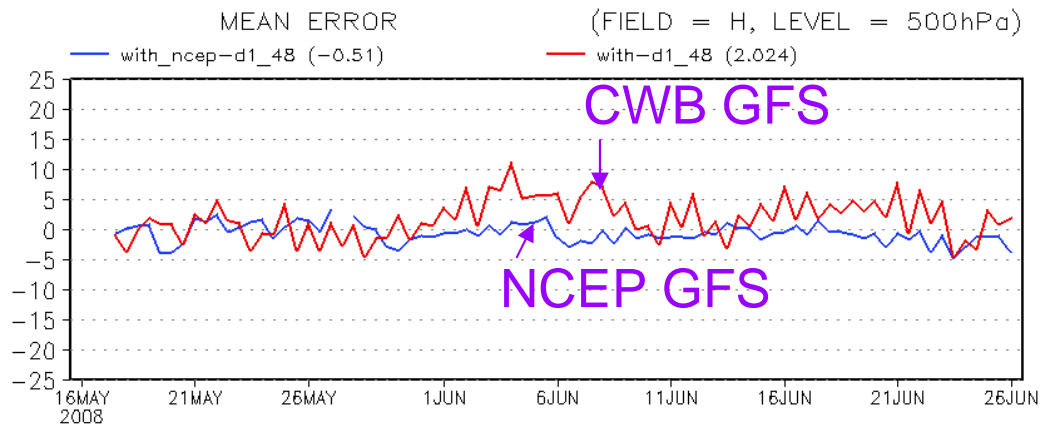
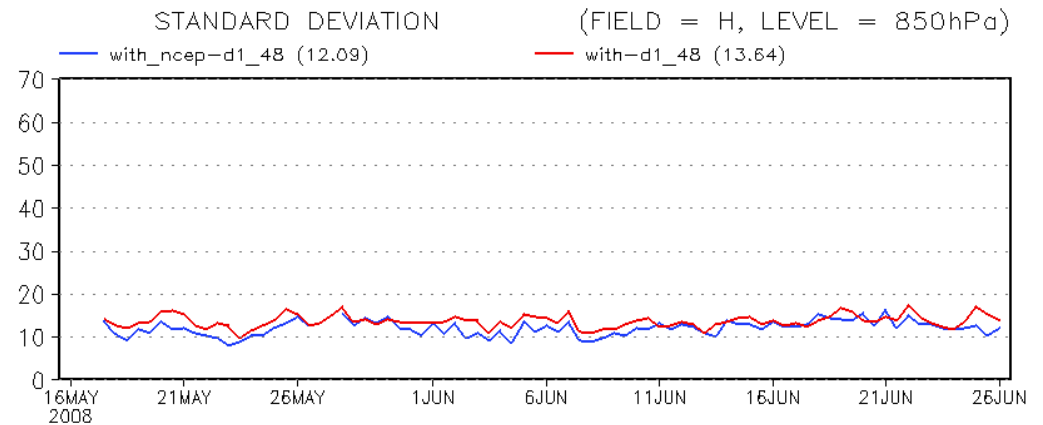
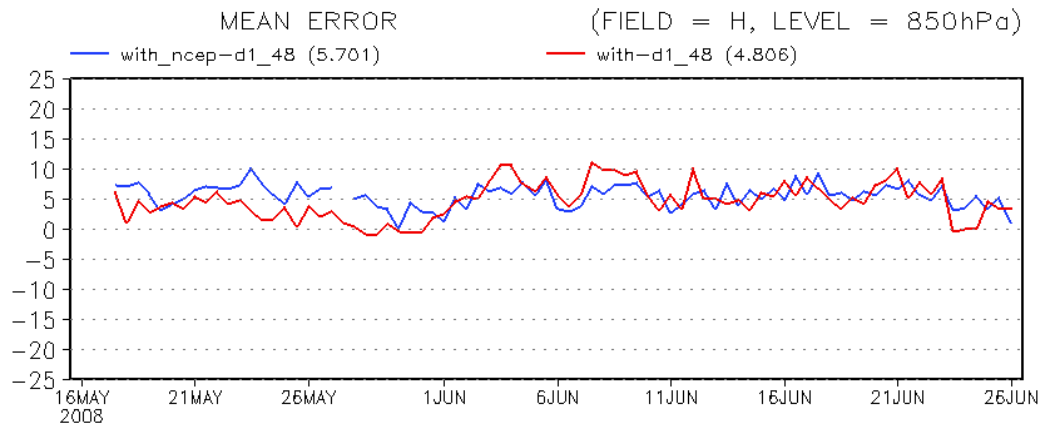
→ Full data run of ncep gfs +
full data run of nfs



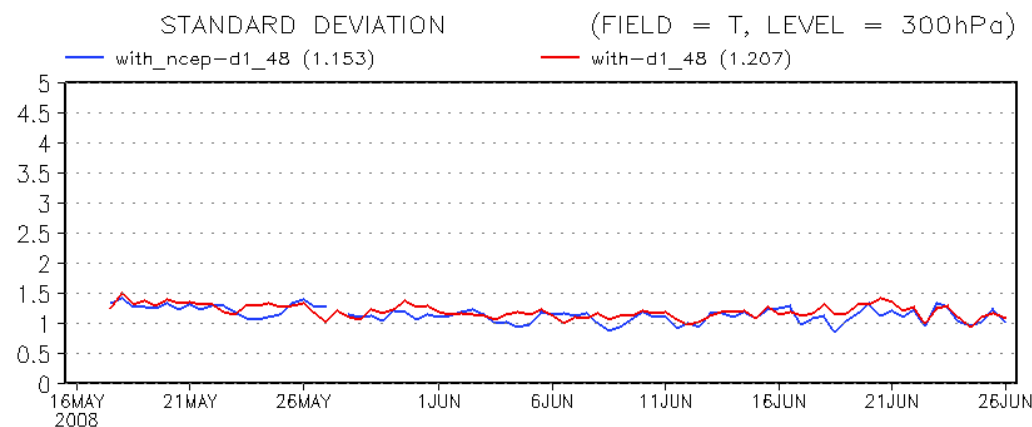
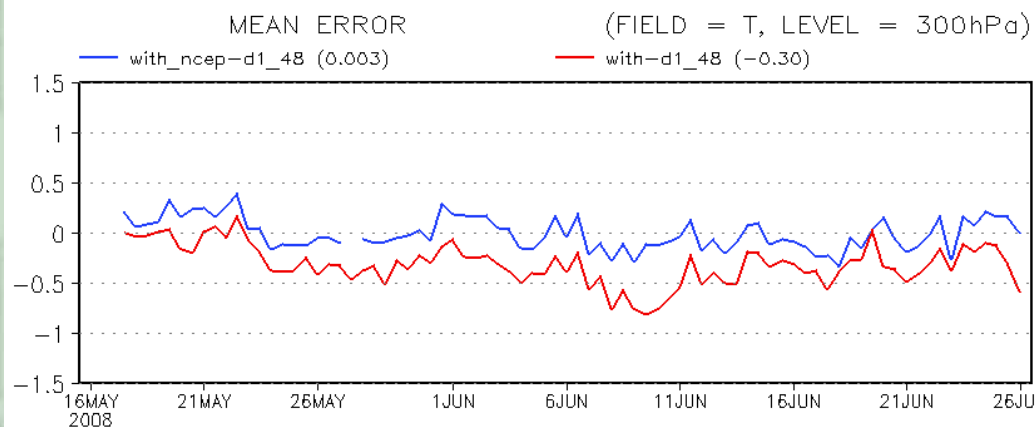
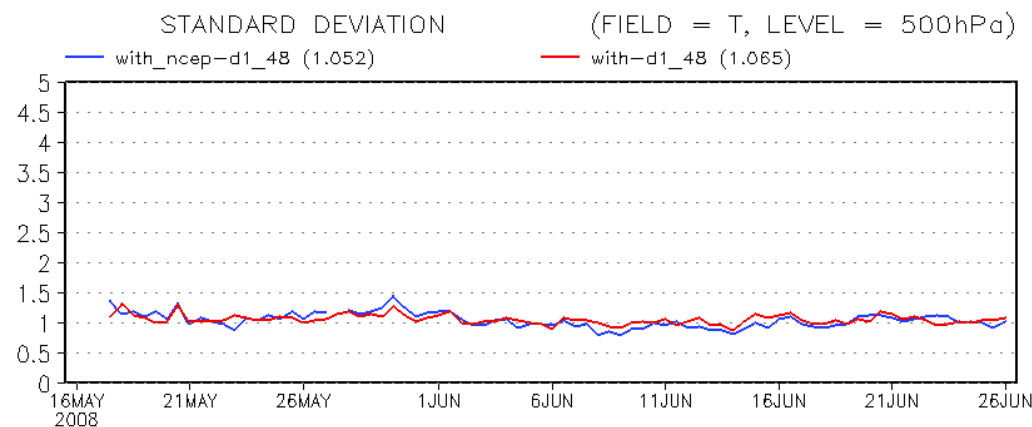
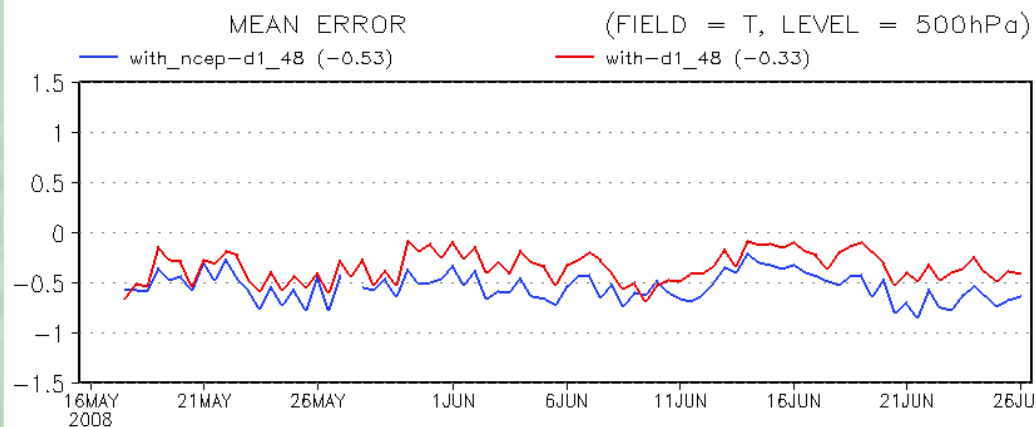
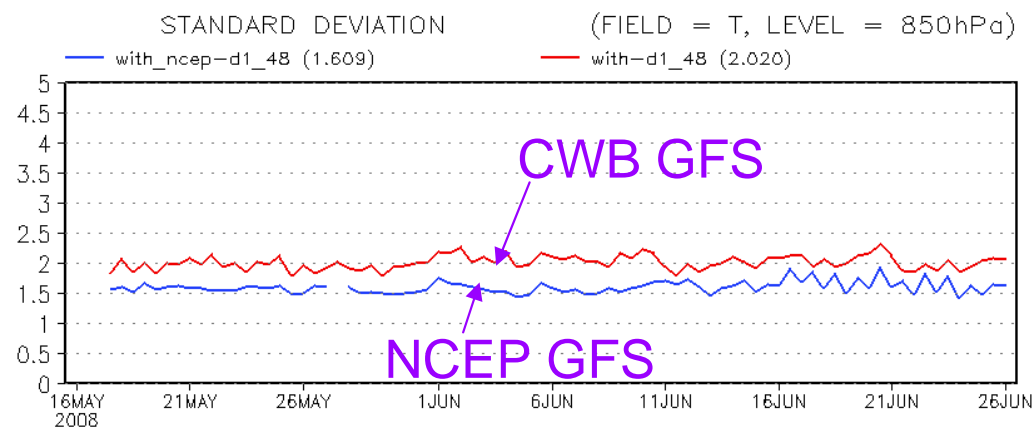
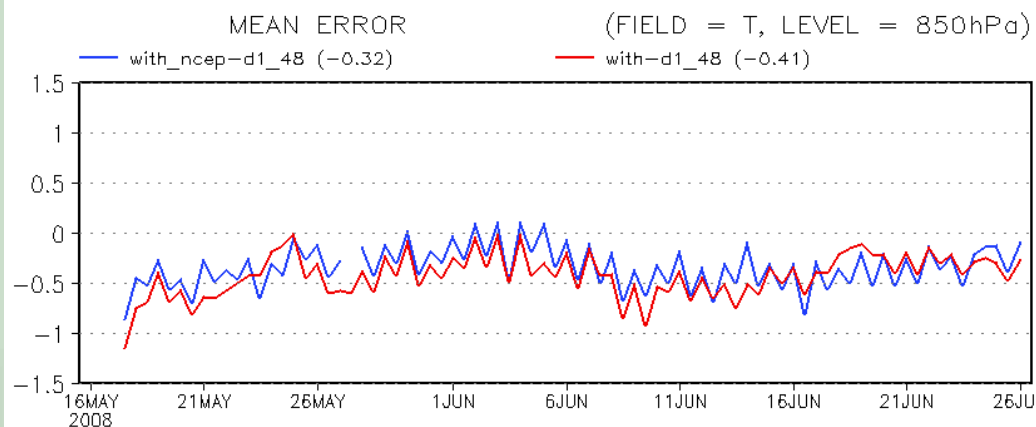
S1 score of 45km, 12h&48h



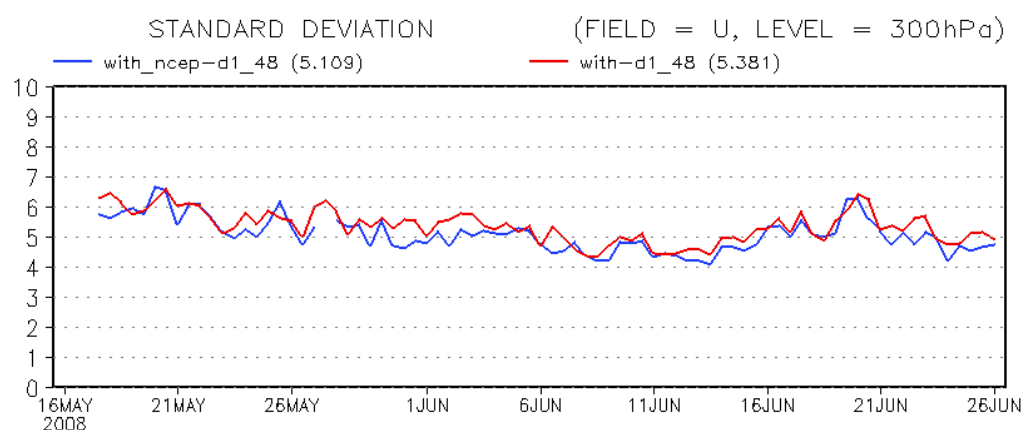
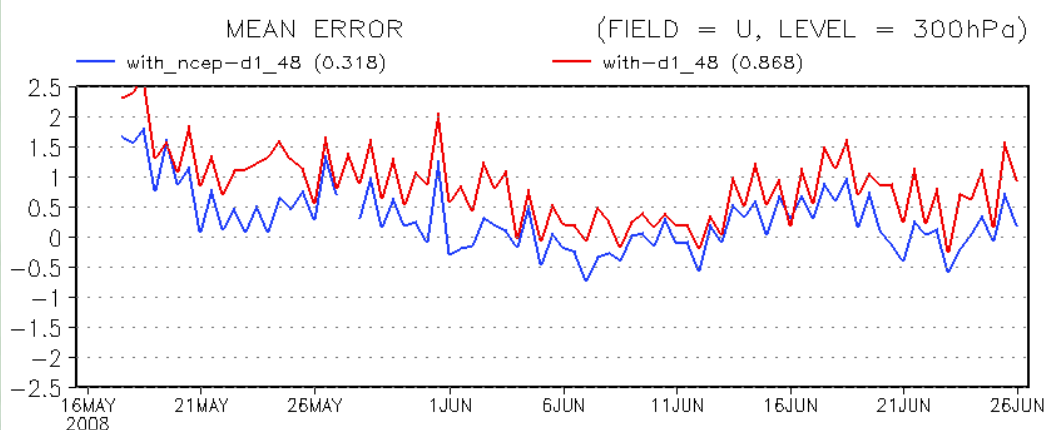
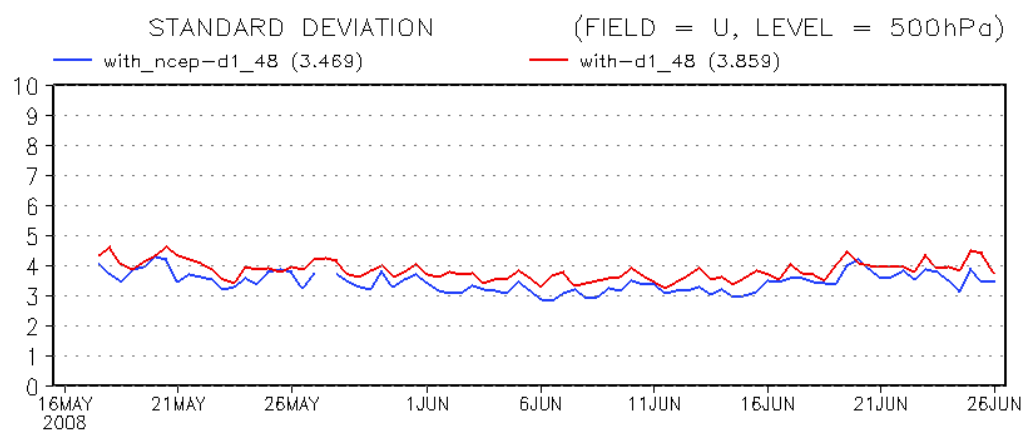
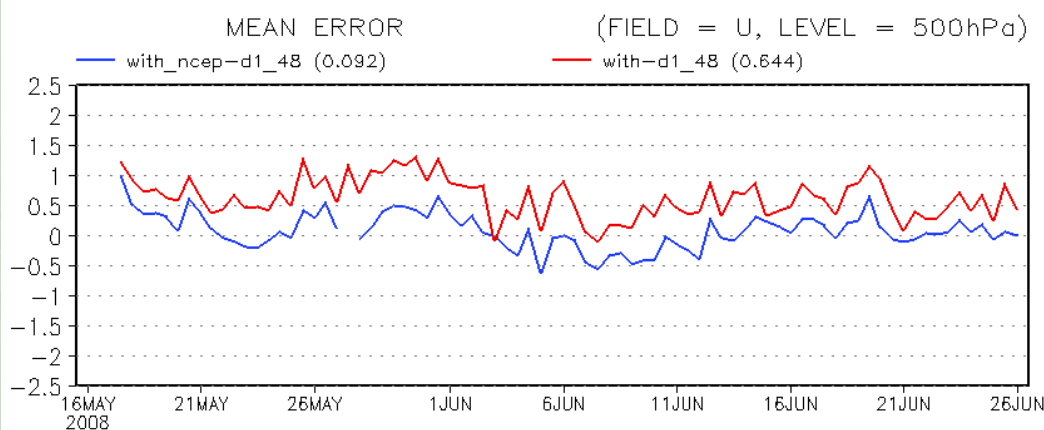
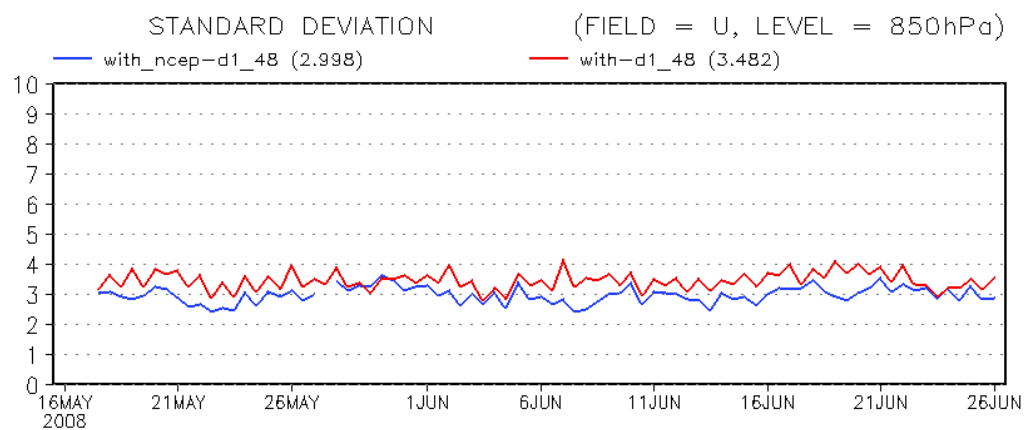
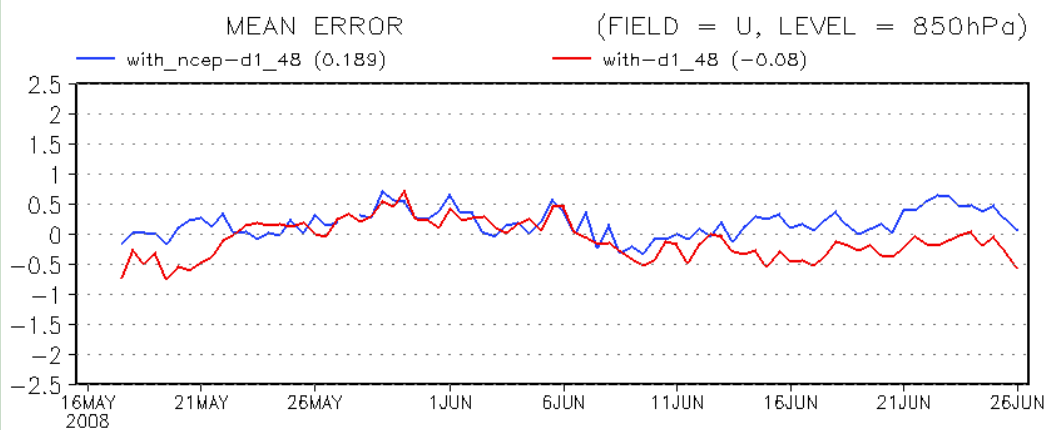
mean error&std of 45km, 48h height



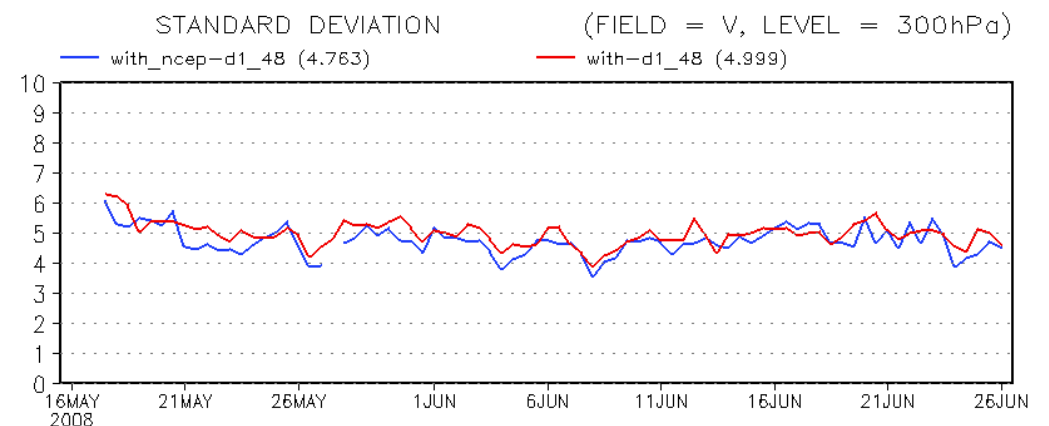
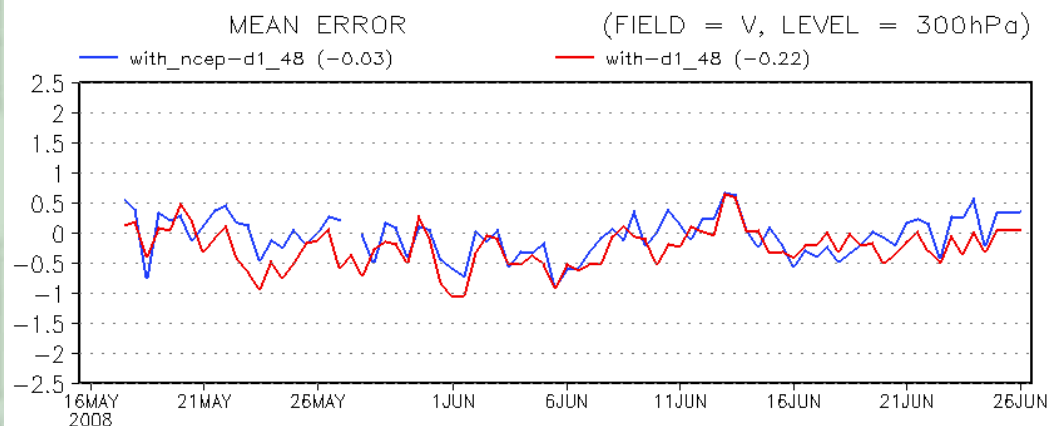
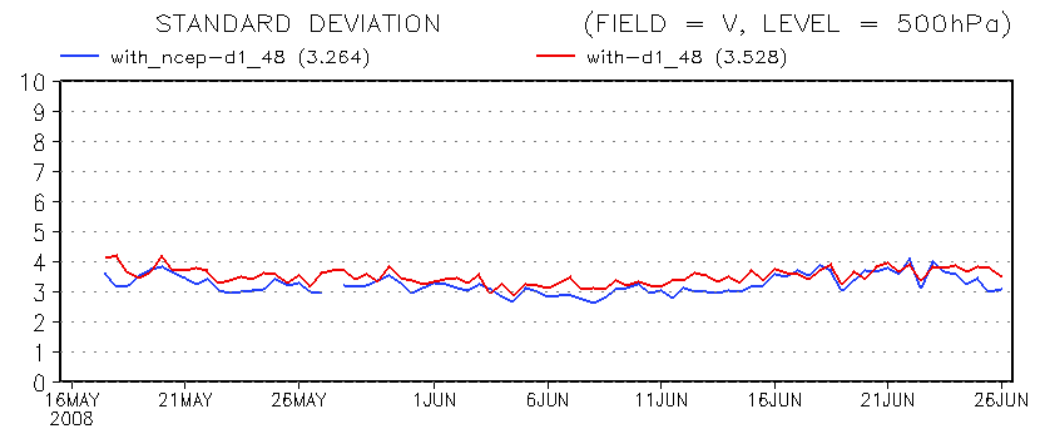
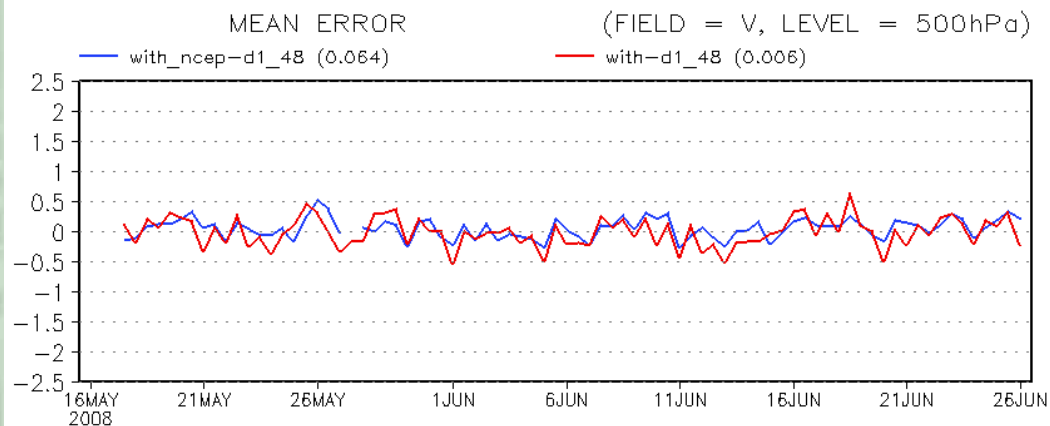
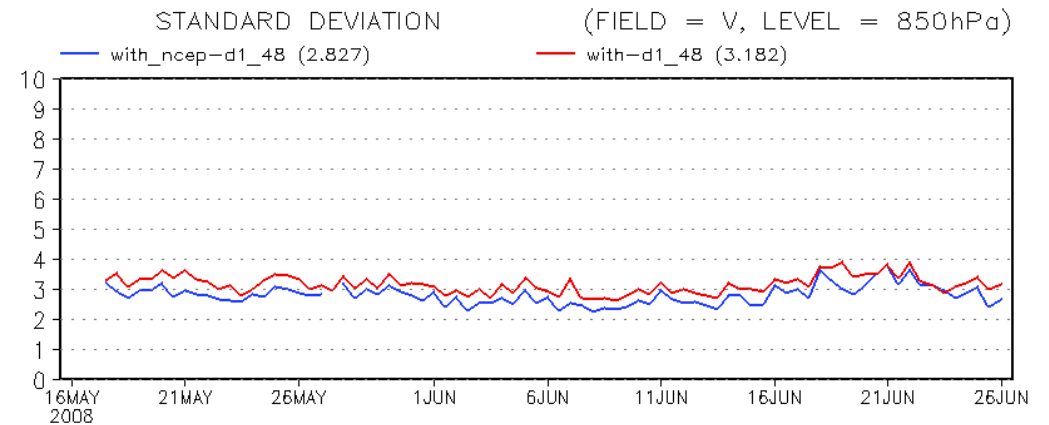
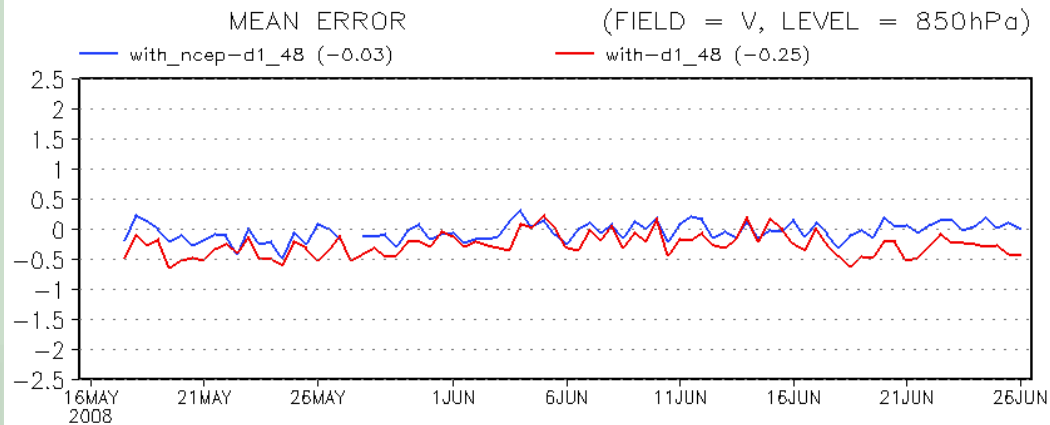
mean error&std of 45km, 48h temperature



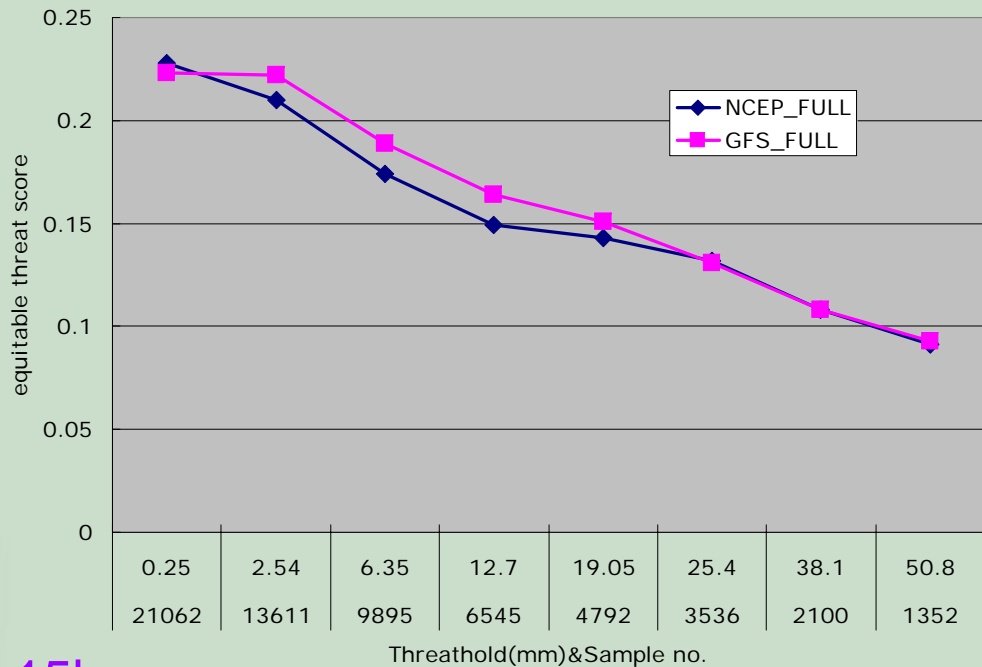
mean error&std of 45km, 48h U-comp.



mean error&std of 45km, 48h V-comp.

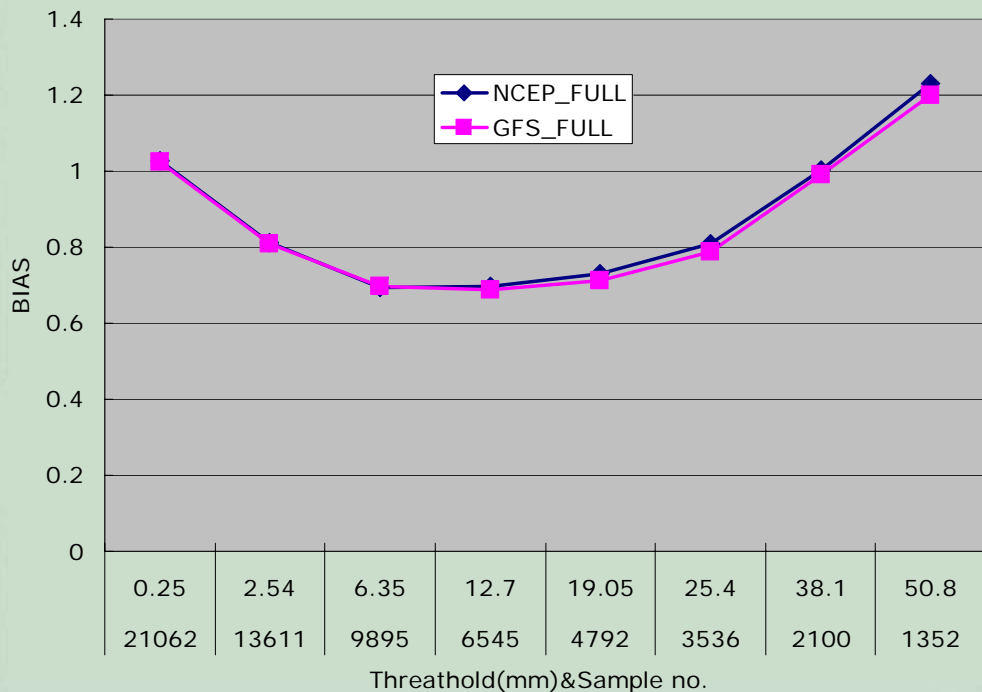


Sowmex(2008/05/15/12~06/26/00) NFS/15km

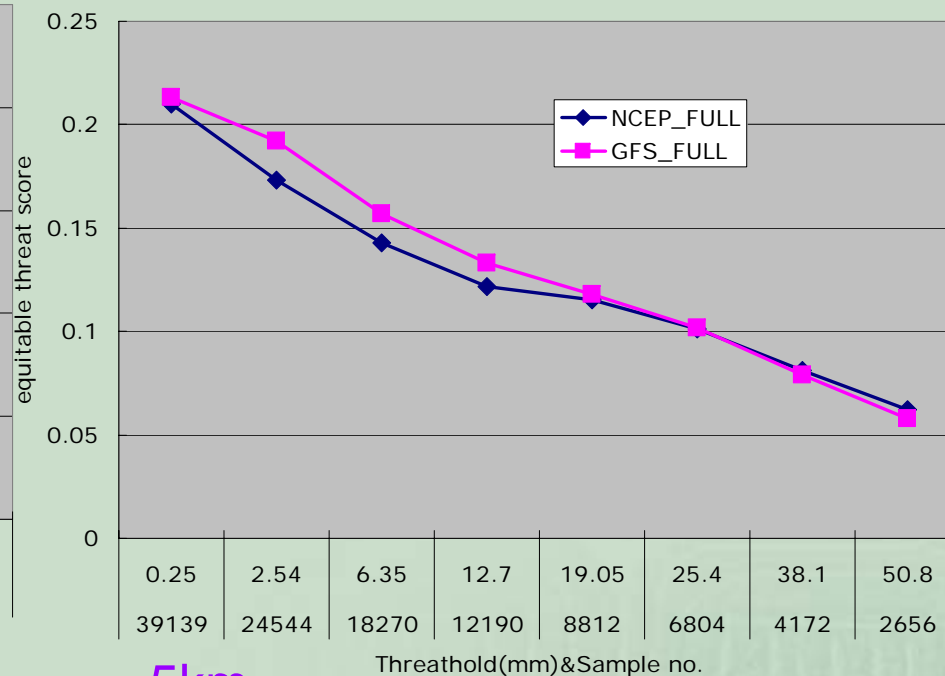


15km

Sowmex(2008/05/15/12~06/26/00) NFS/15km

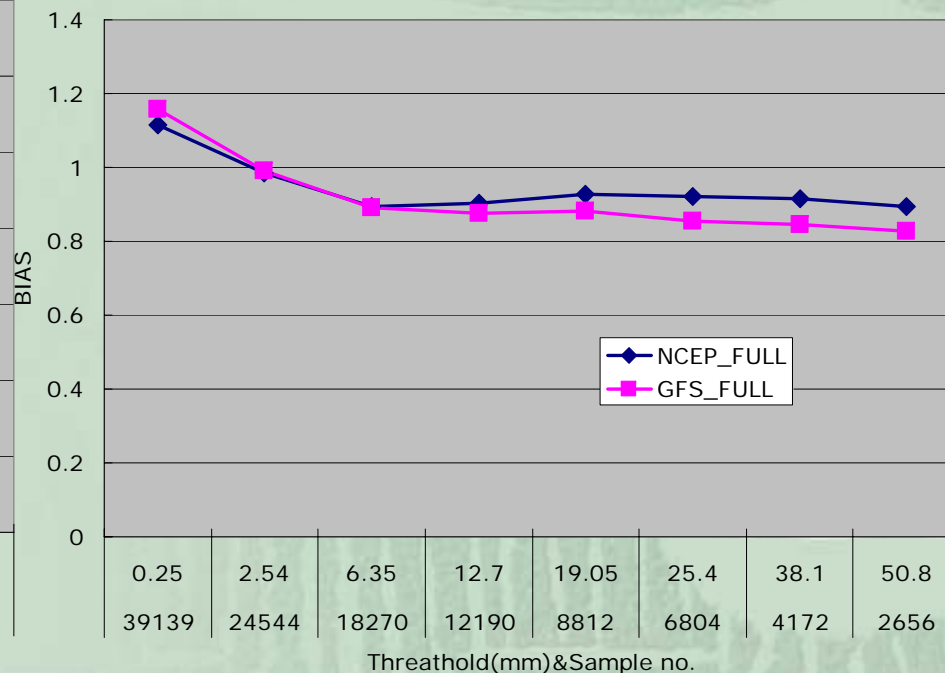


Sowmex(2008/05/15/12~06/26/00) NFS/5km



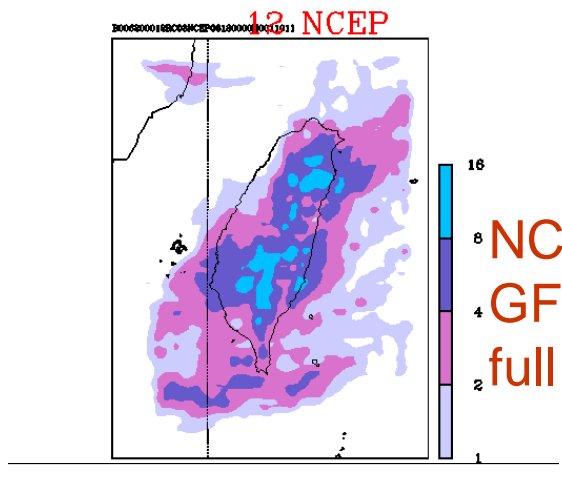
5km

Sowmex(2008/05/15/12~06/26/00) NFS/5km

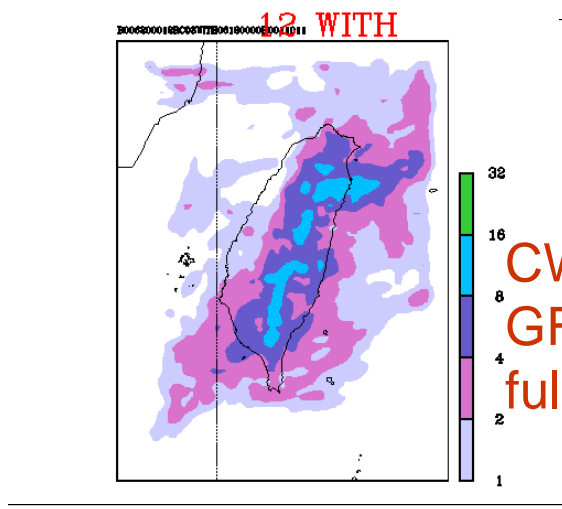
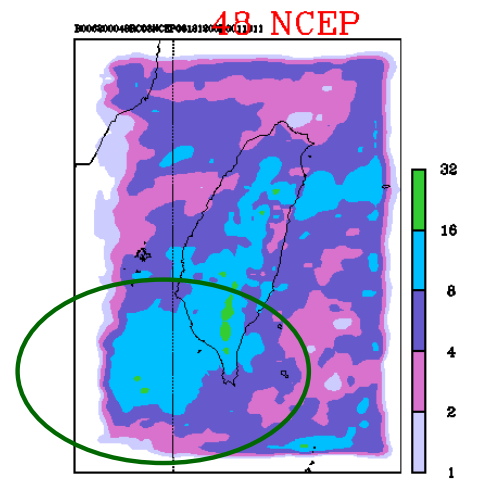
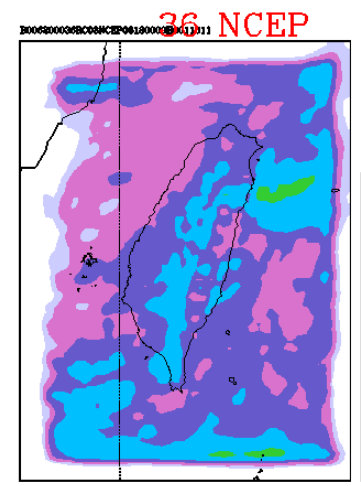
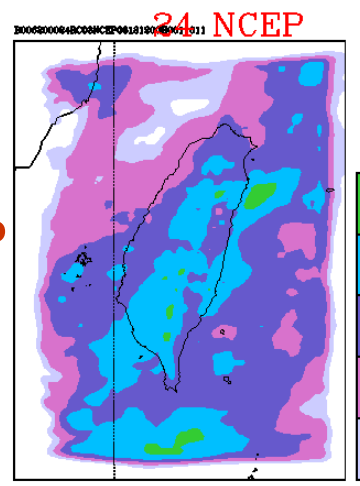


ETS

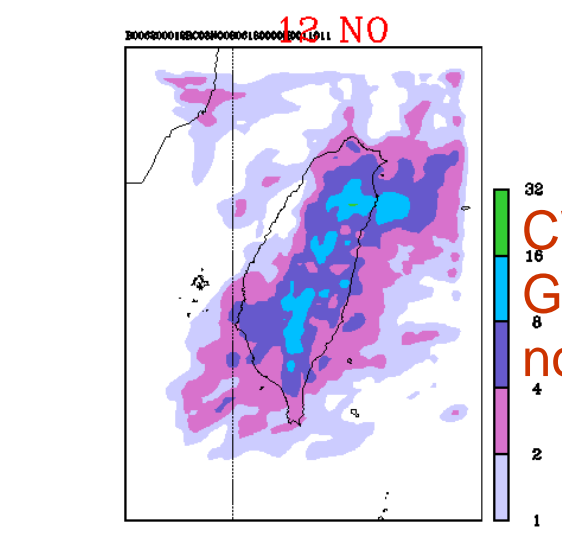
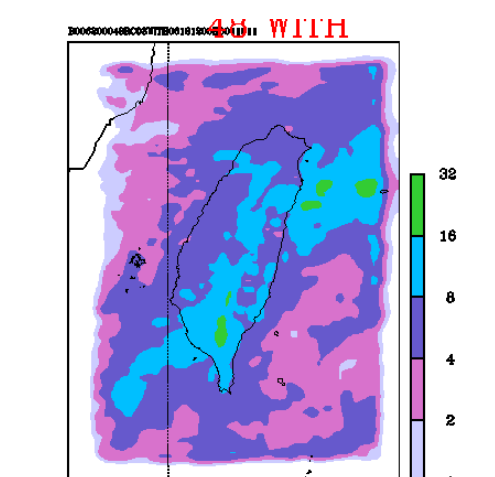
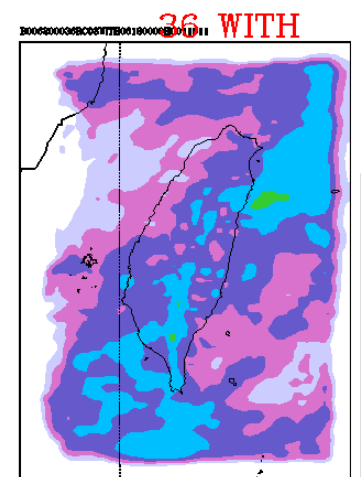
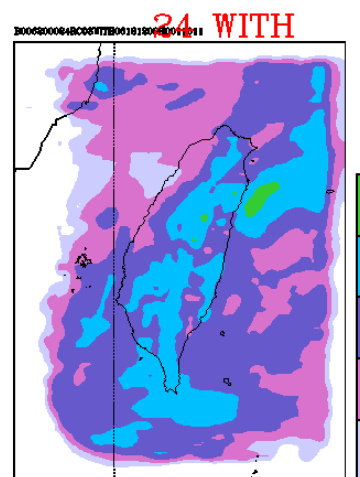
BIAS



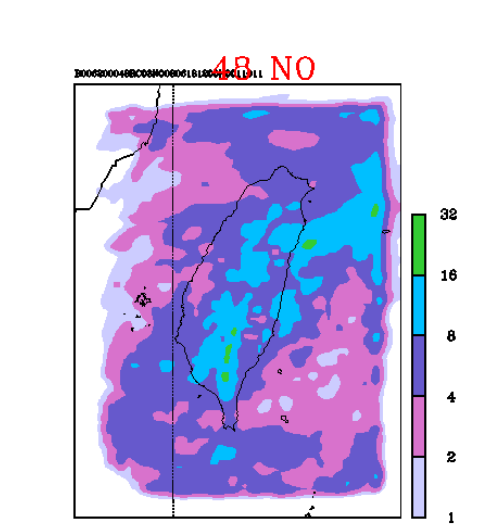
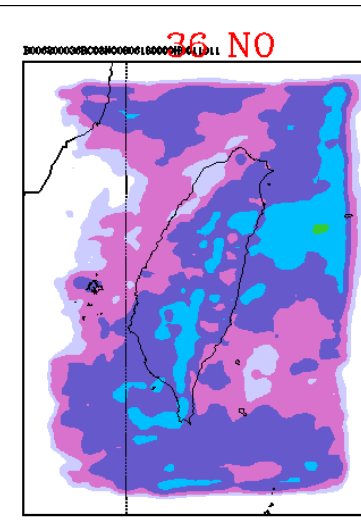
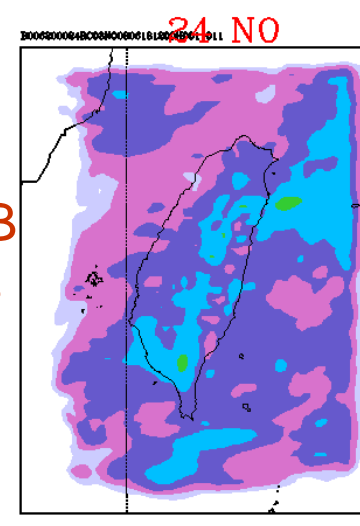
NCEP
GFS
full



CWB
GFS
full



CWB
GFS
no



Summary

- Positive impacts of full data run on **qpf** studies, especially at **nfs 15km**, slightly at **nfs 5km**.
 - Full data run have slightly better **mean error** than original data run around **high level height field** and **middle&high level temperature field**.
- ➔ SoWMEX addition (not routine) observations have positive impacts to **cwb nfs forecasts**



Thanks listening
Welcome to Taiwan