Impact of the Surface Data Assimilation on the Afternoon Thunderstorm Prediction in Taiwan

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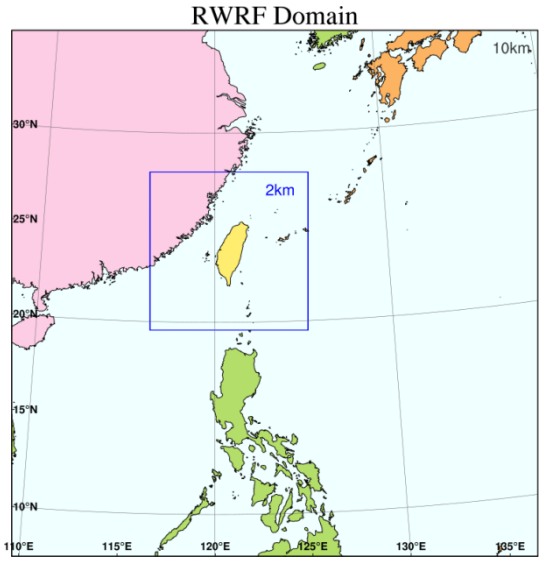
Central Weather Bureau

Overview

☐ Convective scale data assimilation system

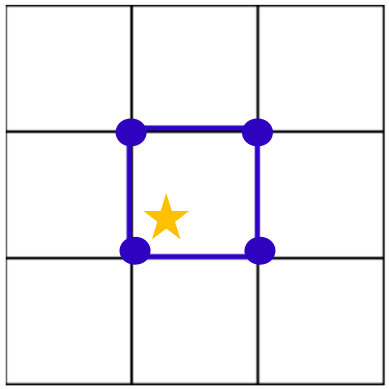


- First guess and boundary
  - ➢ 10 km : downscale run 6-hr updated from NCEP GFS
  - ➢ 2 km : from 10km forecast
- 2KM - Data assimilation strategy
  - ➢ WRFDA **3DVAR**
  - ➢ Hourly Update, 12hr forecast
  - ➢ **Full cycle** with **radar data assimilation**

- Afternoon thunderstorm case in Taiwan was significantly modulated by
  - ✓ Topography effect
  - ✓ local circulation

→ **Surface data assimilation**

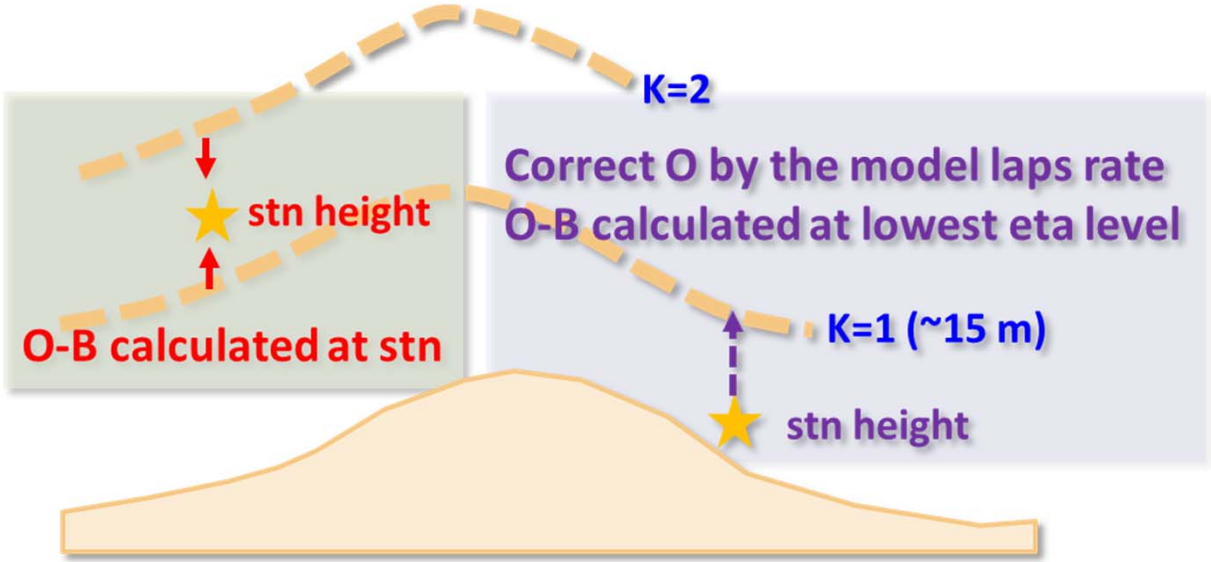
For surface DA : Calculation of the innovation



Horizontal

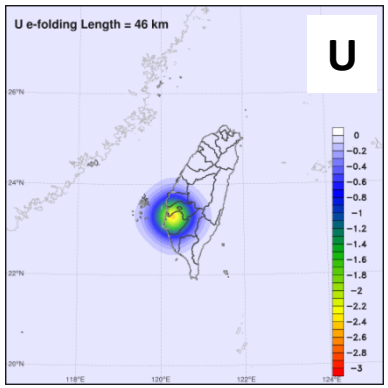
- Choose the grid point with the smallest height difference
- Check the matching land type

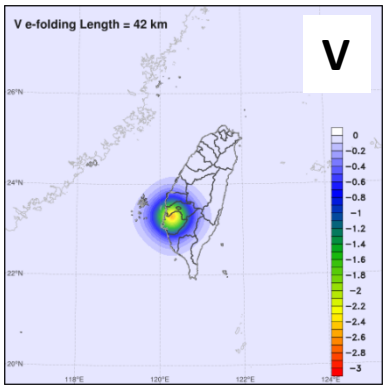
Vertical

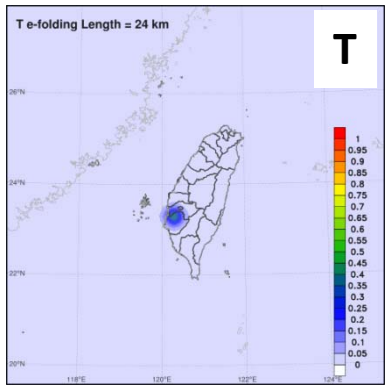


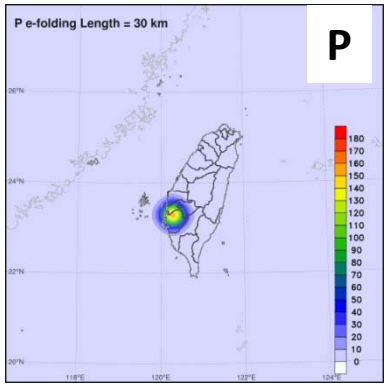
Single Observation Test

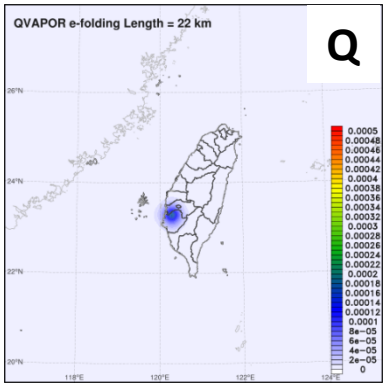
Innovation	-3.0 m/s	-3.0 m/s	4 K
Obs_error	1.1 m/s	1.1 m/s	2 K
E-folding L	46 km	42 km	24 km











Innovation	300 Pa	8 g
Obs_error	100 Pa	2 g
E-folding L	30 km	22 km

Obs at lowest model level

Single Observation Test

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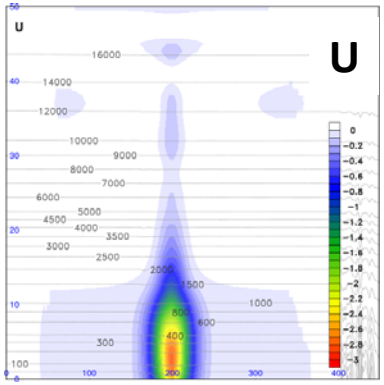

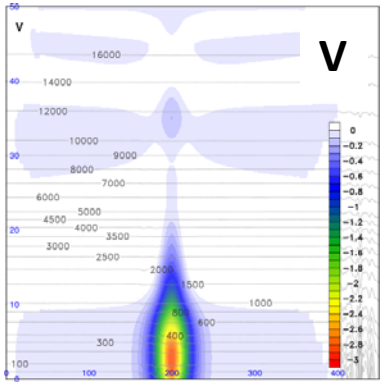

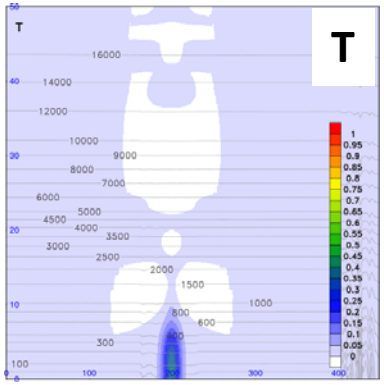

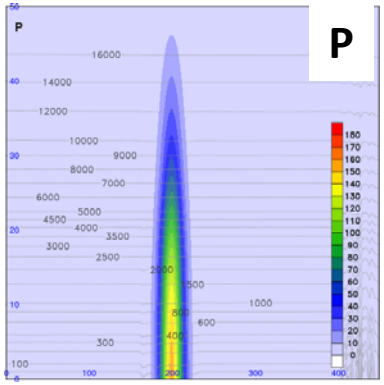

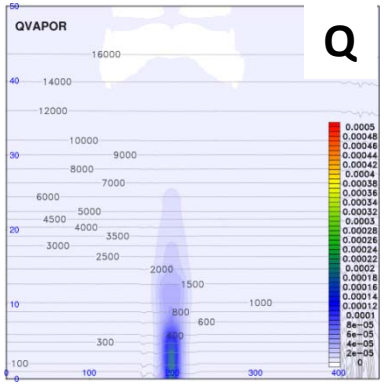

Innovation	**300 Pa**	**8 g**
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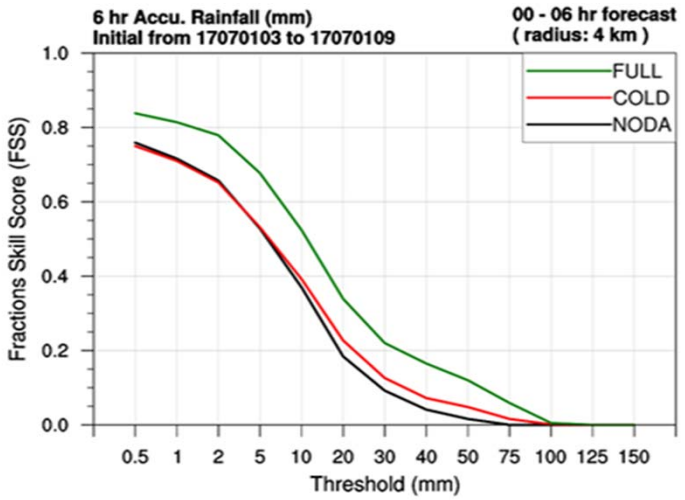
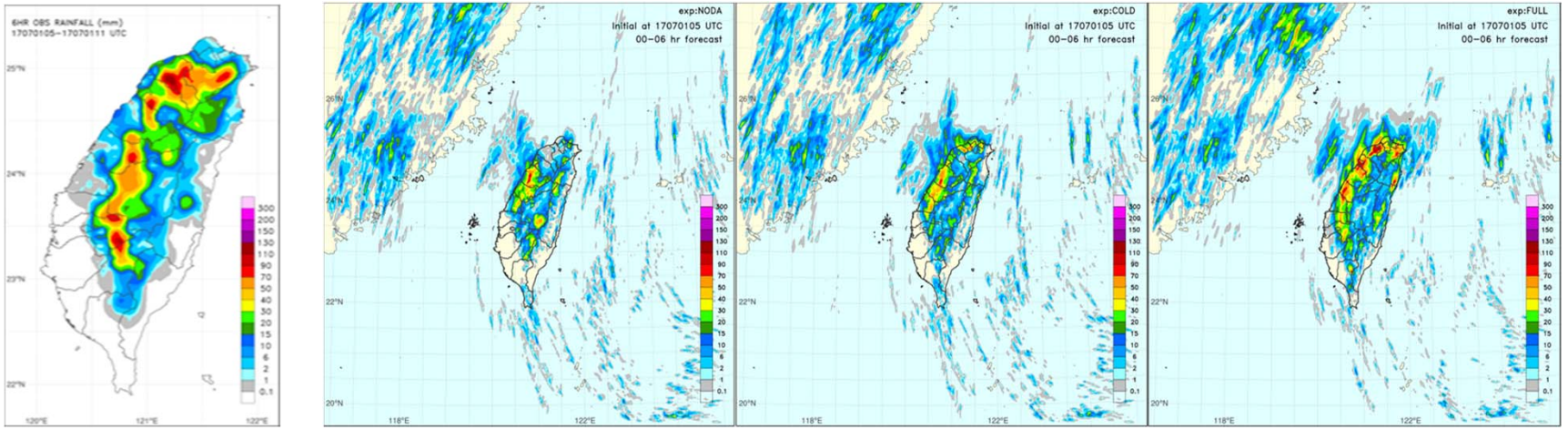
Impact of DA strategy

- Initial time : 17070103-17070109 UTC

	FG	BDY	SFCDA
NODA	10 km fcst	10 km fcst	X
COLD START	10 km fcst	10 km fcst	O
FULL CYCLE	2 km fcst	10 km fcst	O



- 6HR accumulated rainfall (17070105)

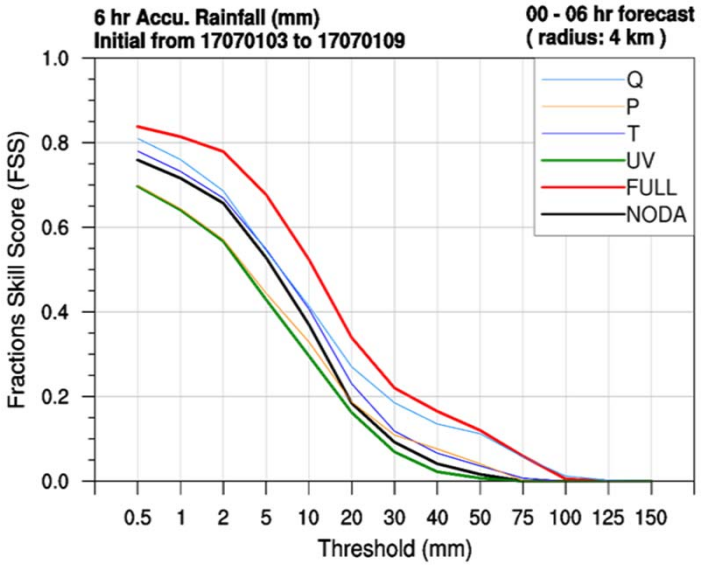


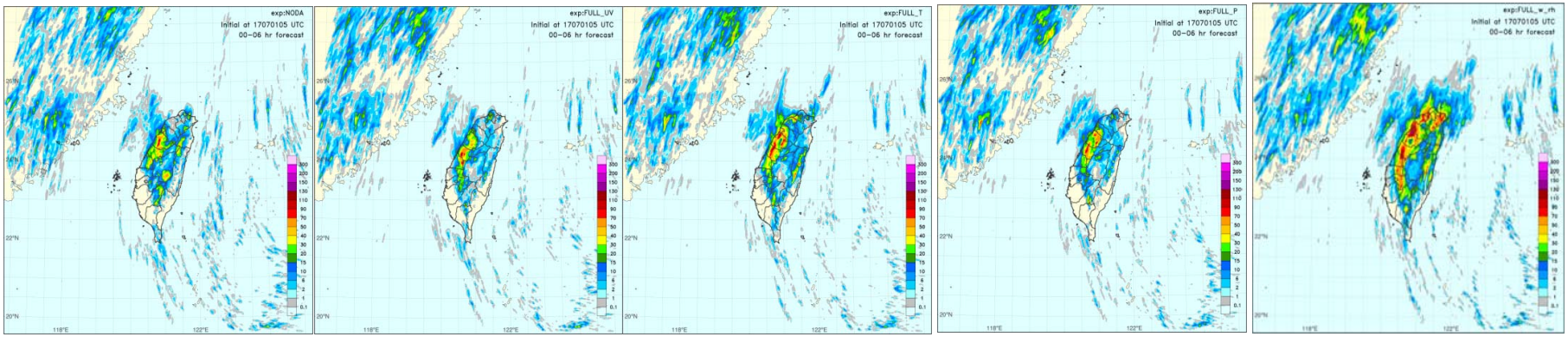
OBS **NODA** **COLD START** **FULL CYCLE**

Sensitivity of each variable

- Initial time : 17070103-17070109 UTC

	DA strategy	SFCDA
NODA	X	X
FULL CYCLE	FULL CYCLE	all variable
UV		uv
T		temperature
P		pres
Q		qv

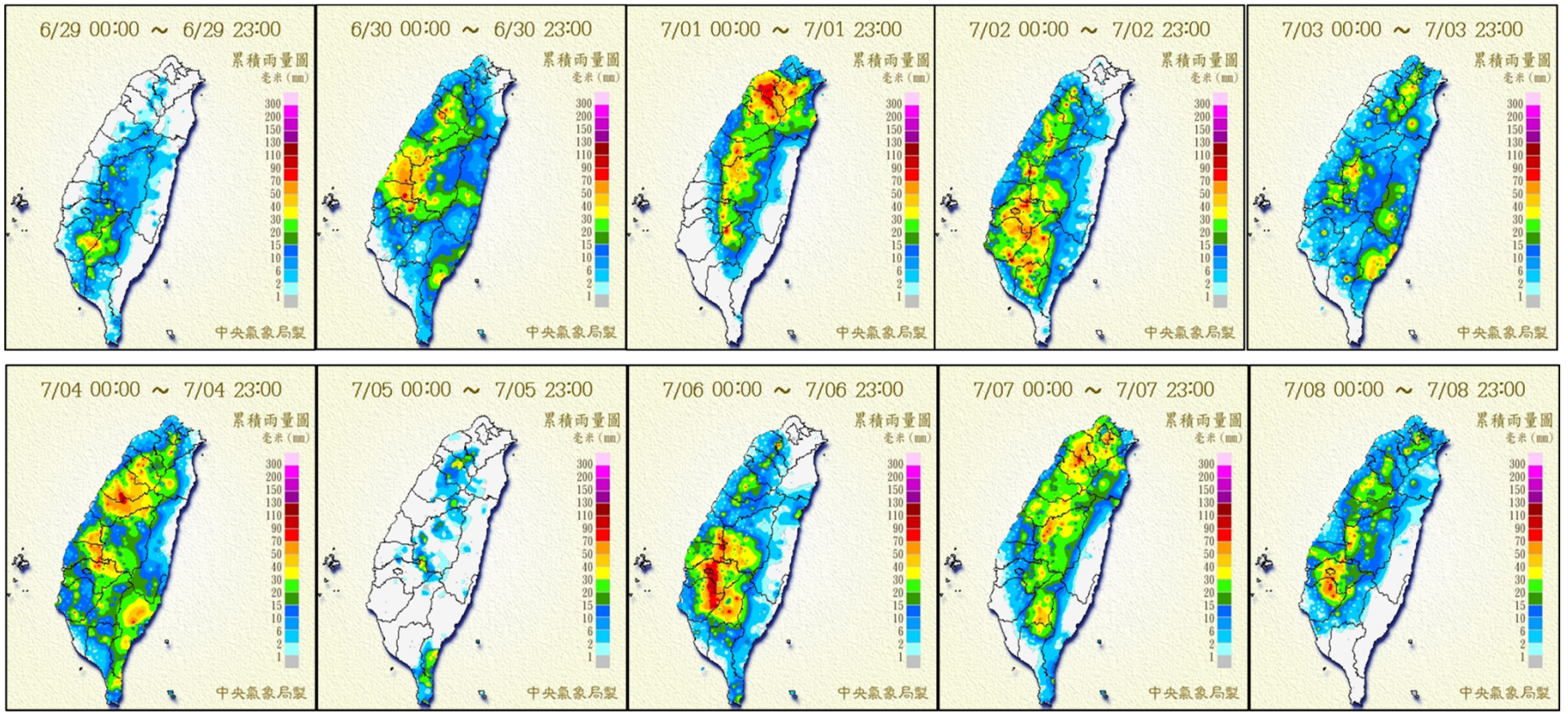




NODA **UV** **T** **P** **Q**

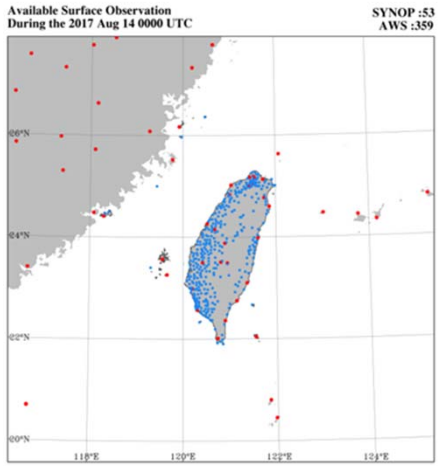
2017 Afternoon Thunderstorm Cases

Select 10 afternoon thunderstorm cases during 2017 Jun 29 – Jul 08



Experimental design

DA strategy for 2-km mesh:



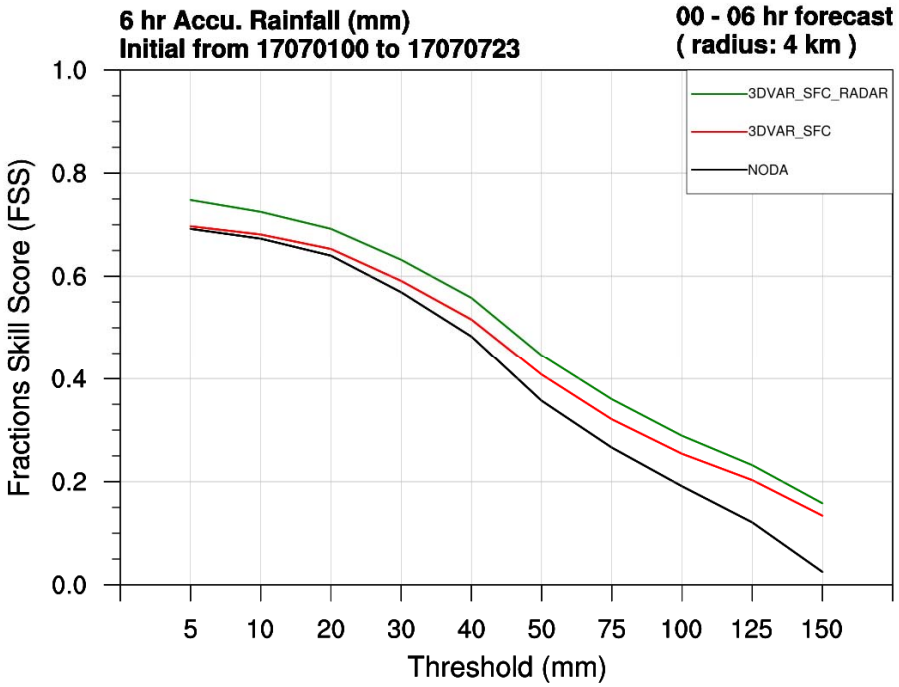
- Full cycle for 10 days from **29 Jun to 8 July** 2017
- Cold start at 0000 UTC 29 June, 2017
- **Hourly update cycle** using the WRF 3DVAR, a total of 240 cases
- Using the Blending scheme to Re-Center the 3DVAR full cycle run (Hsiao et al. 2015)
- Blended the 10-km and 2-km analysis at **00/06/12/18 UTC**

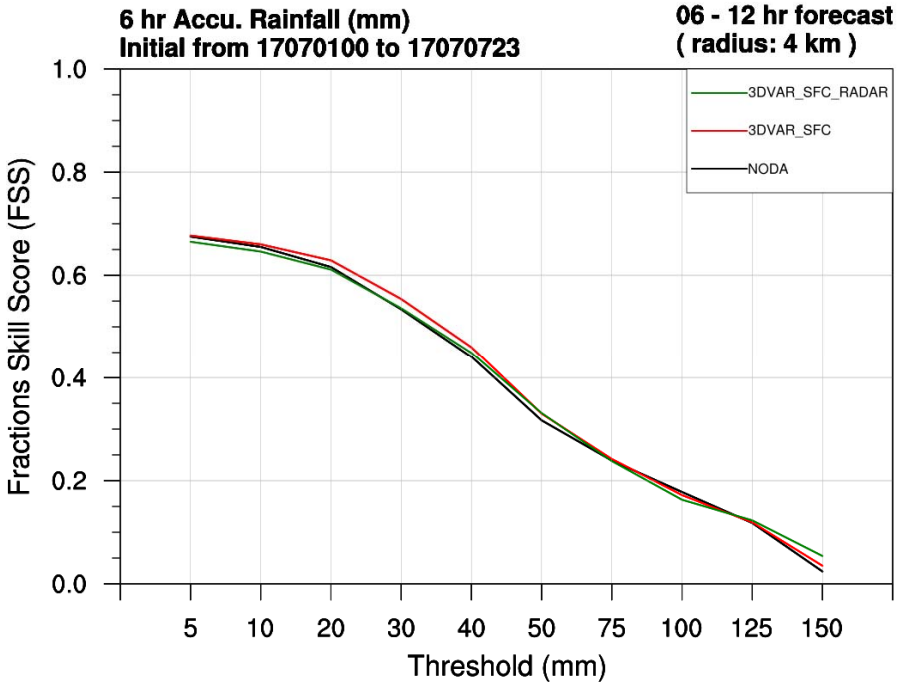
10-/2-km resolution domains
RRTMG radiation/Goddard MPS/YSU PBL/NOAH

Impact of surface da	DA strategy	LBDY	DA scheme	Radar OBS	Sfc OBS
CNTL	Full cycle	10 km fcst	NoDA	x	x
3DVAR_SFC			3DVAR	x	o
3DVAR_SFC_RADAR			3DVAR	o	o

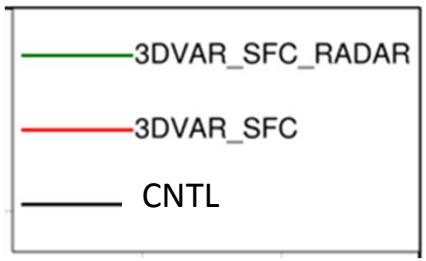
Impact of radar da

Rainfall verification

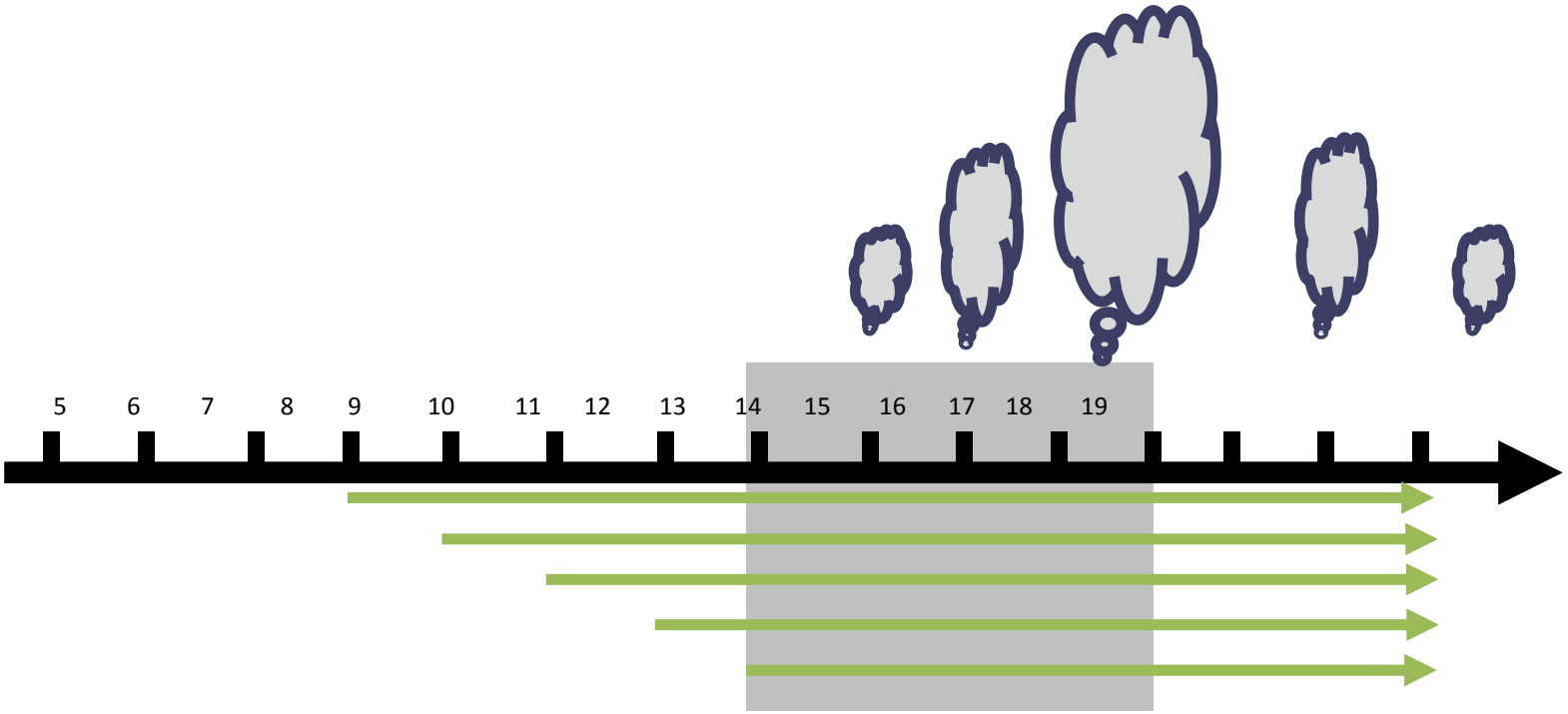




FSS scores for the 10-days DA experiment show that the 3DVAR_SFC_RADAR outperforms to the others .



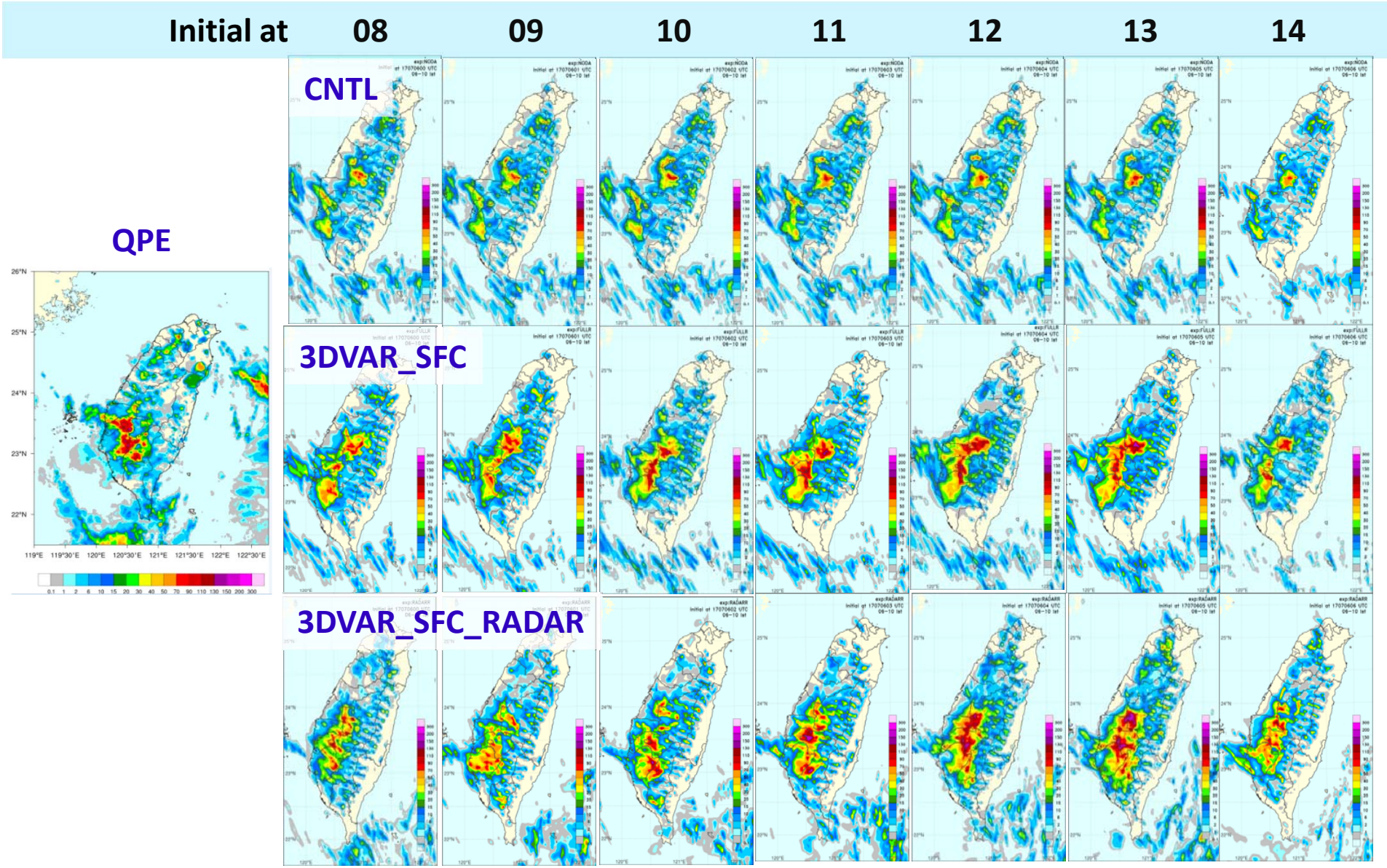
Concept of event based verification



- Afternoon thunderstorm case occurs mainly during 12-18 pm
- Goal : The best initial time toward rainfall prediction ?

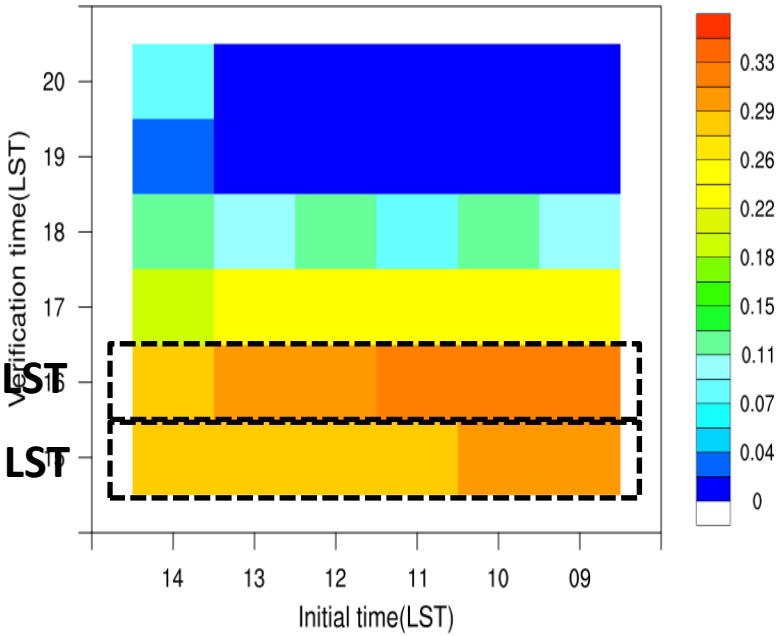
6-hr accumulated rainfall from 14-18 LST 6 July, 2017

(LST)

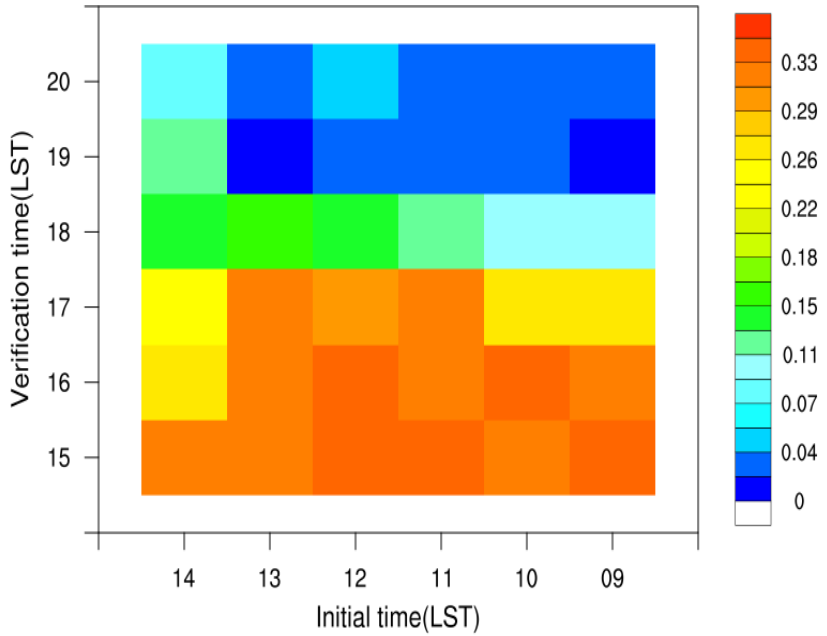


Lead time based FSS

CNTL



3DVAR_SFC



threshold: 5mm/hr
10 days average

Summary and Future work

- Assimilating surface observations has positive impact on model rainfall forecast, especially in Full cycle run.

- The model initiated at 11 and 12 LST has the best QPF performance, the longer lead time, the less skill due to the degrade of the predictability.

- The Hybrid 3DEnVAR, which has flow dependent background error, is expected further improve the QPF.

Thanks for your attention !