MODIS植物分布率對WRF模式預報之影響

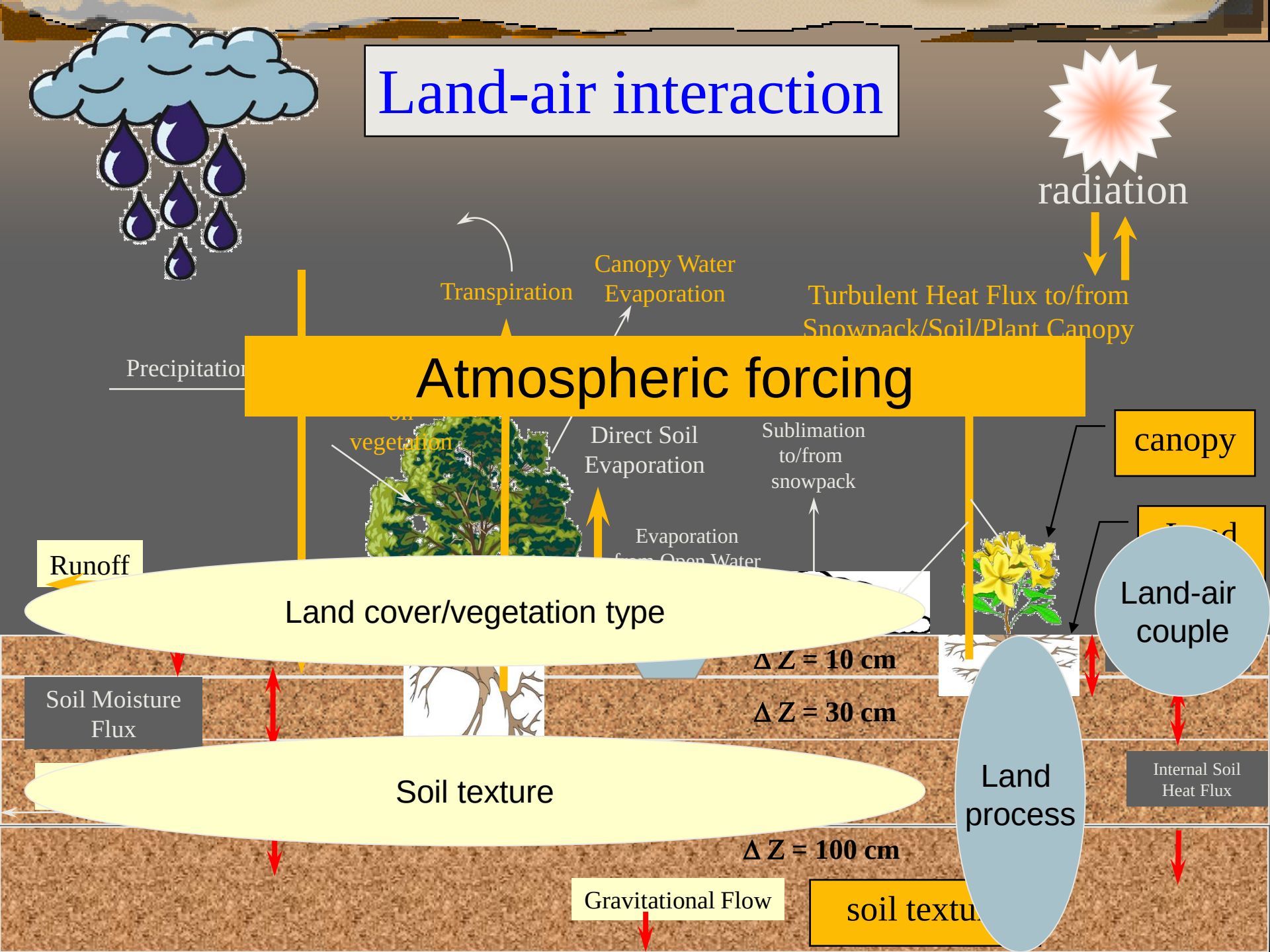
洪于珺[1]
Michael Barlage[2]
洪景山[1]

[1]中央氣象局資訊中心
[2]National Center for Atmospheric Research

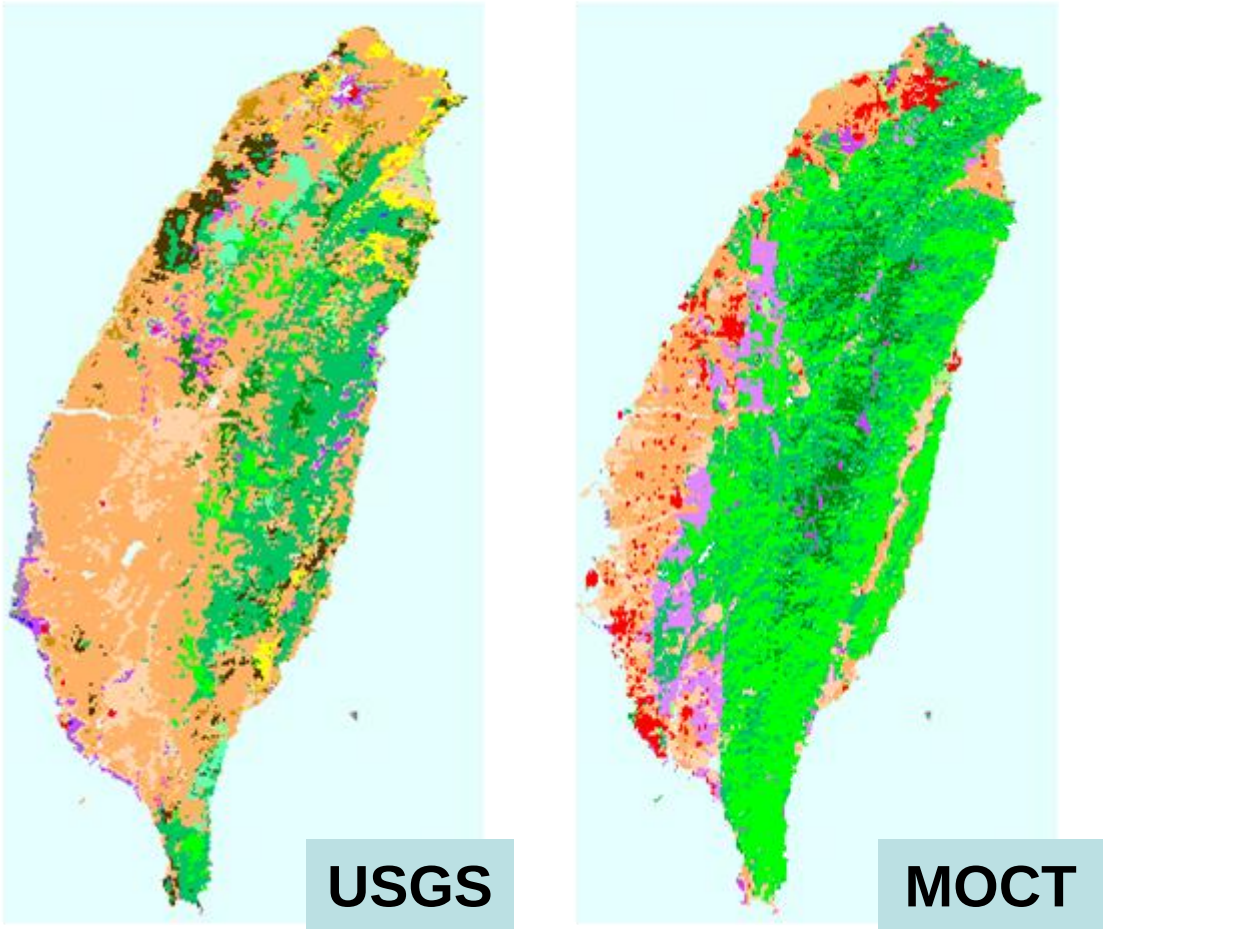
Outline

- Introduction
- Experiment Design
- Analysis and Discussion
- Summary and Future Work

INTRODUCTION


Land-air interaction
radiation
Transpiration
Canopy Water Evaporation
Turbulent Heat Flux to/from Snowpack/Soil/Plant Canopy
Precipitation
Atmospheric forcing
vegetation
Direct Soil Evaporation
Sublimation to/from snowpack
canopy
Evaporation
Runoff
Land cover/vegetation type
Land-air couple
Δ Z = 10 cm
Soil Moisture Flux
Δ Z = 30 cm
Soil texture
Land process
Internal Soil Heat Flux
Δ Z = 100 cm
Gravitational Flow
soil textu

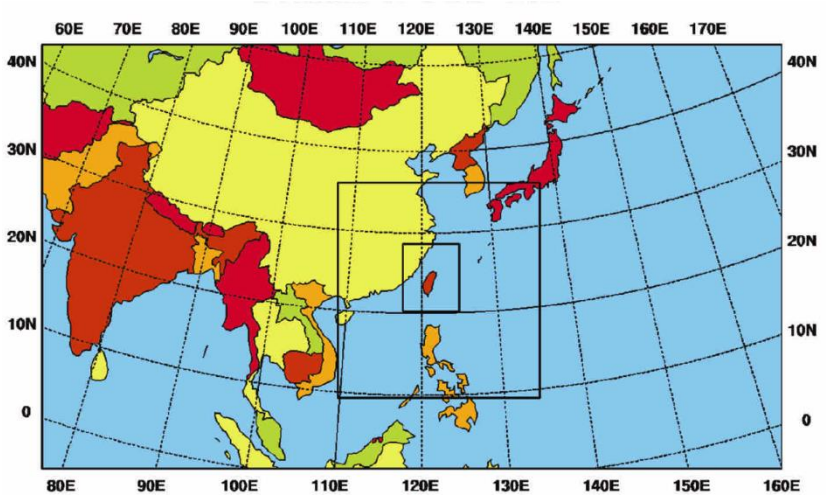
Landuse of Taiwan



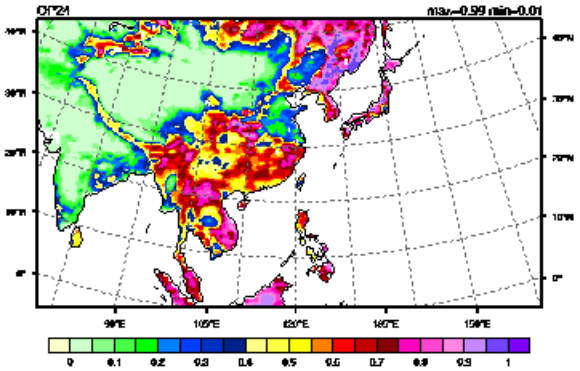
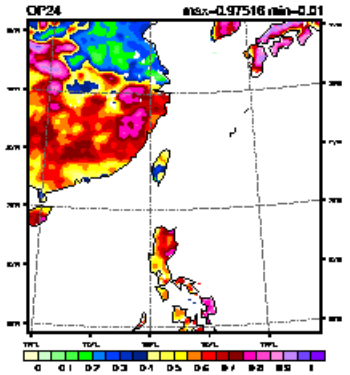
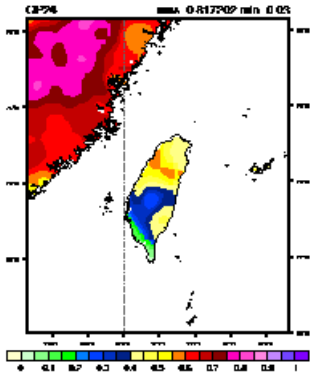
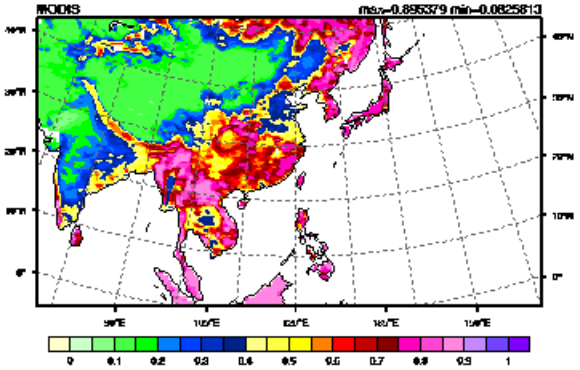
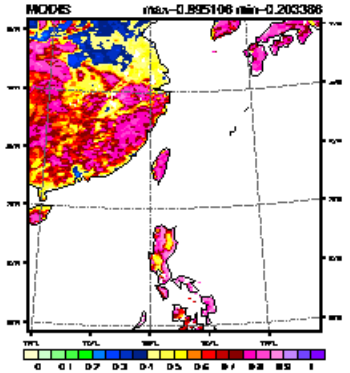
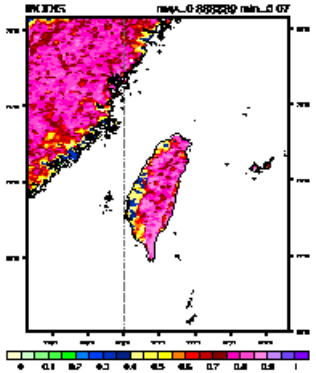
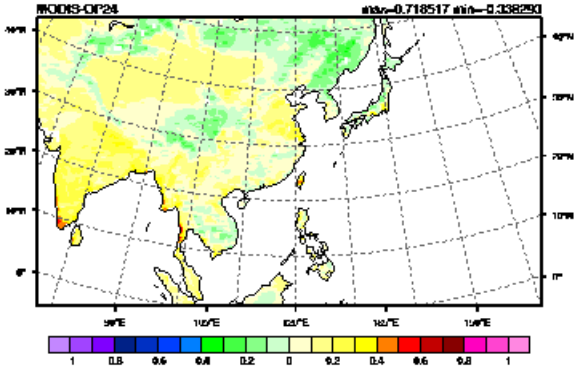
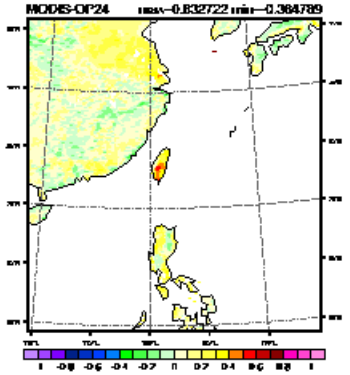
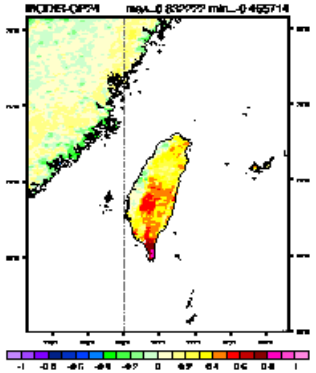
EXPERIMENT DESIGN

Experiment Design

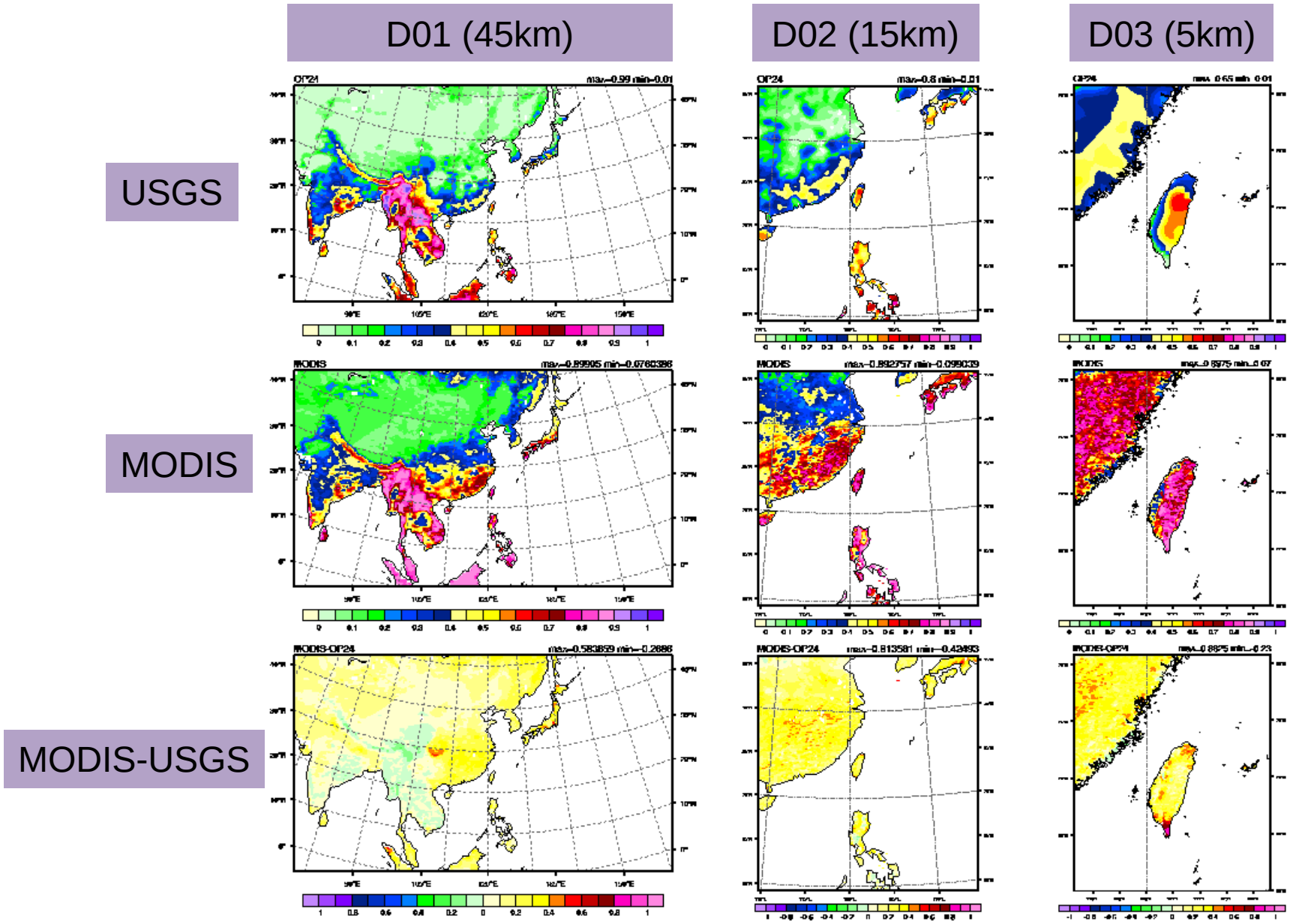
Experiment	OP24	MODIS
Model	WRF v3.3.1	
I.C. & B.C.	NCEP GFS Forecast	
Resolution	Horizontal: 45 / 15 / 5 km, Vertical: 45 Layers	
Vegetation Fraction	USGS	MODIS
Land Model	NOAH LSM	
Radiation	RRTM (LW) / Goddard (SW)	
PBL	YSU v3.1.1	
Time	Summer：2012/06/01 00Z – 2012/06/15 12Z, noDA Winter：2012/12/01 00Z – 2012/12/15 12Z, noDA	



USGS v.s. MODIS @ Summer

	D01 (45km)	D02 (15km)	D03 (5km)
USGS			
MODIS			
MODIS-USGS			

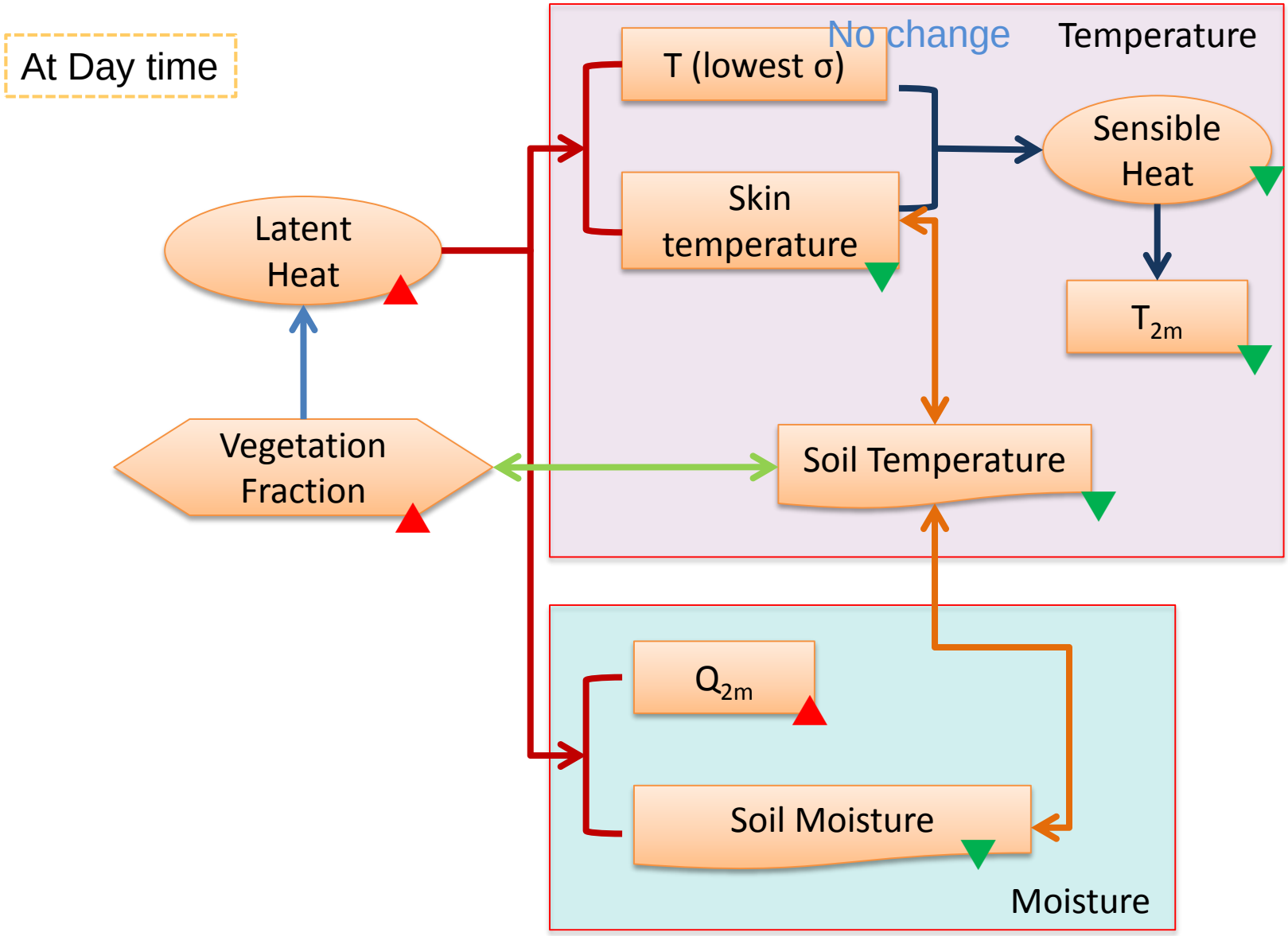
USGS v.s. MODIS @ Winter



ANALYSIS & DISCUSSION

1. Expectation
2. Forecast results
3. Monthly averaged diurnal cycle
4. Rainfall verification

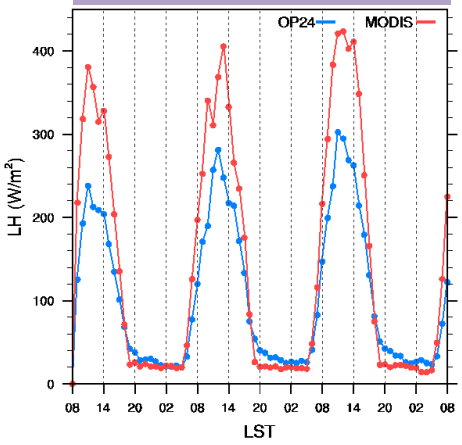
Expectation



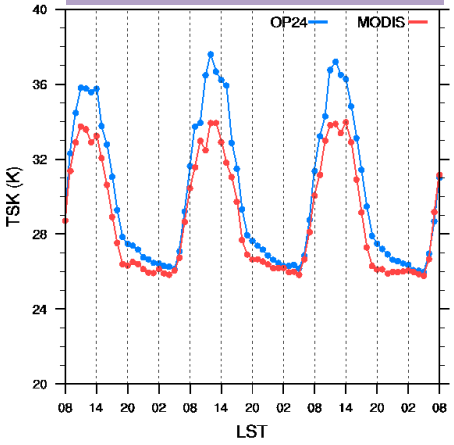
Forecast results @ summer, point @ Hengchun (0.05 → 0.62)

Landuse: 2 (Dryland Cropland and Pasture)
Soil type: 12 (Clay)

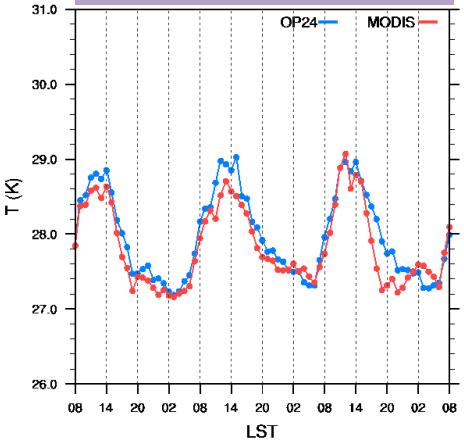
Latent Heat



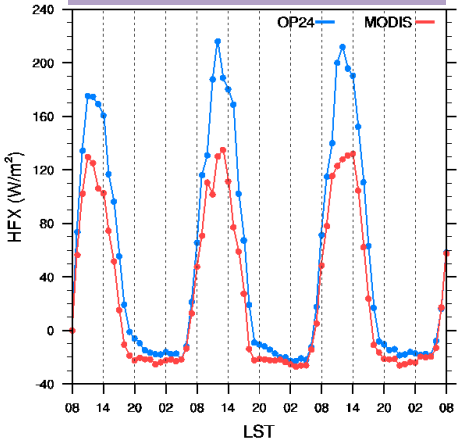
Skin Temp



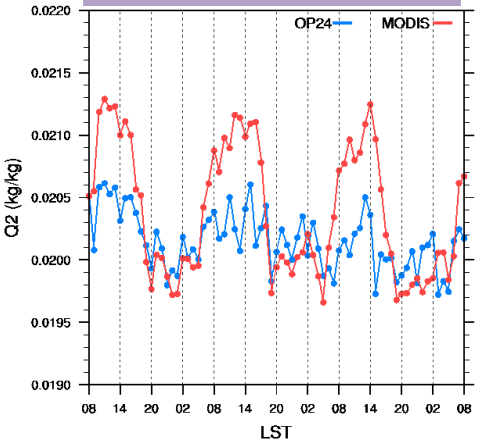
T (lowest σ)



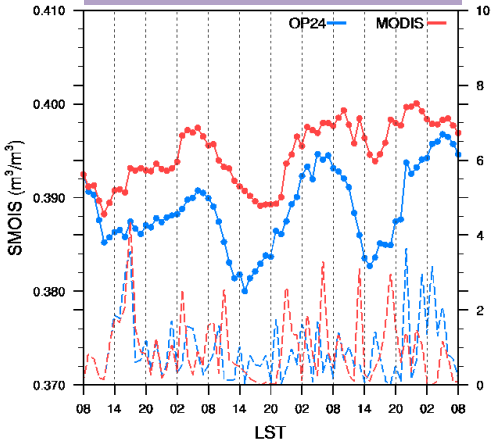
Sensible Heat



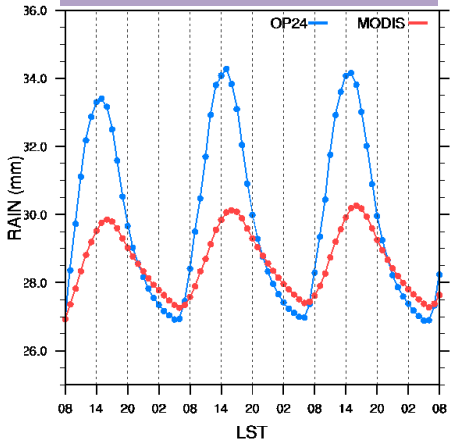
Q_{2m}



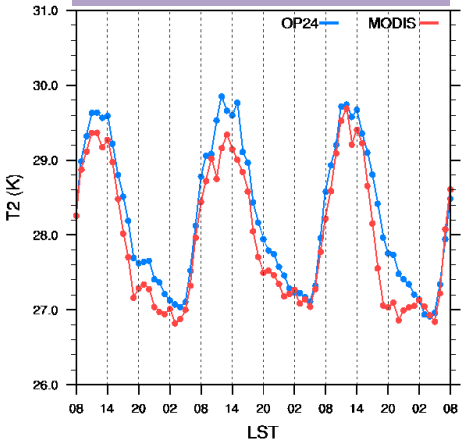
SMOIS (Layer1)



STEMP(Layer1)



T_{2m}

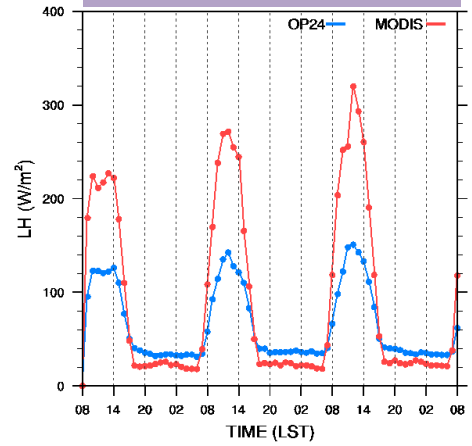


VEGFRA	LH	TSK	T	SH	T2m	Q2m	SMOIS	STEMP
▲	▲	▼	equal	▼	▼	▲	▼	▼

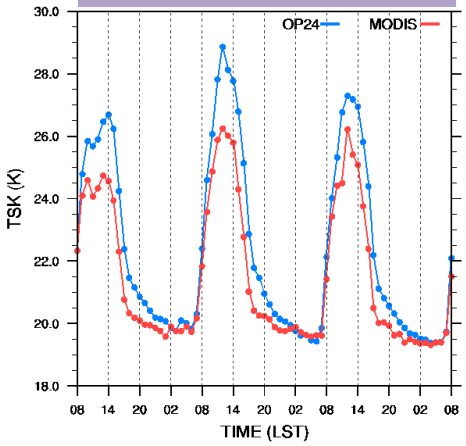
Forecast results @ winter, point @ Hengchun (0.01 → 0.66)

Landuse: 2 (Dryland Cropland and Pasture)
Soil type: 12 (Clay)

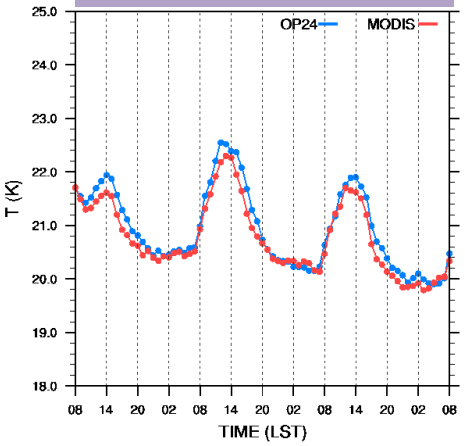
Latent Heat



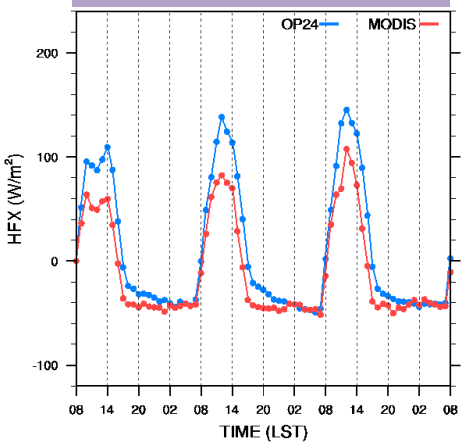
Skin Temp



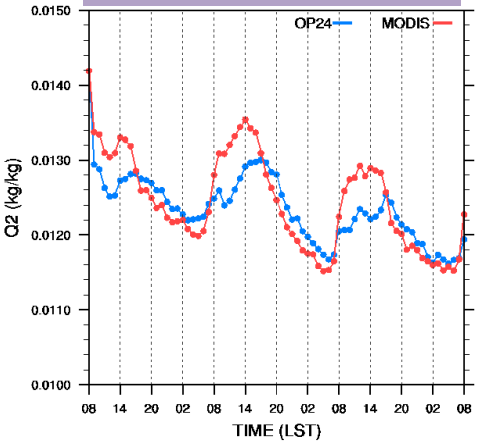
T (lowest σ)



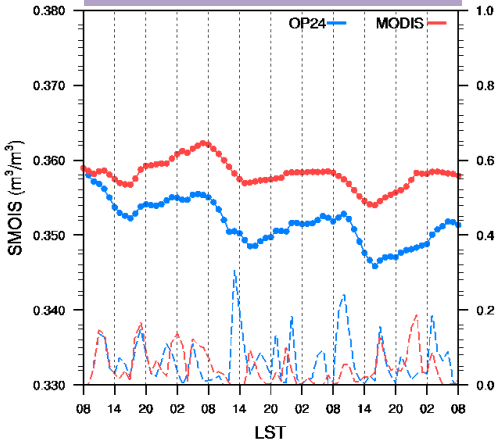
Sensible Heat



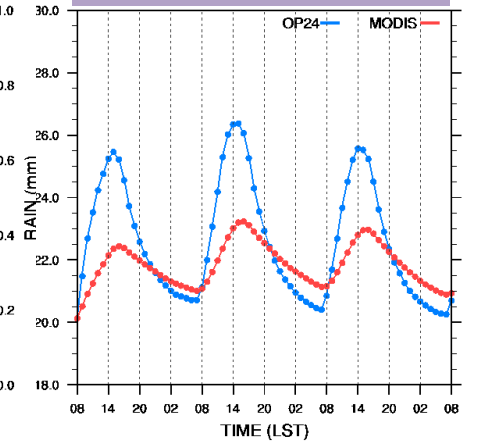
Q_{2m}



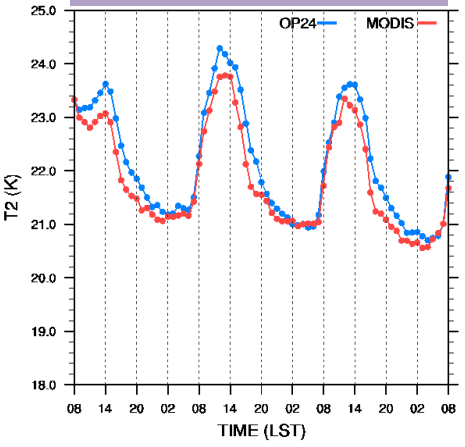
SMOIS(Layer1)



STEMP(Layer1)



T_{2m}



VEGFRA	LH	TSK	T	SH	T2m	Q2m	SMOIS	STEMP
▲	▲	▼	equal	▼	▼	▲	▼	▼

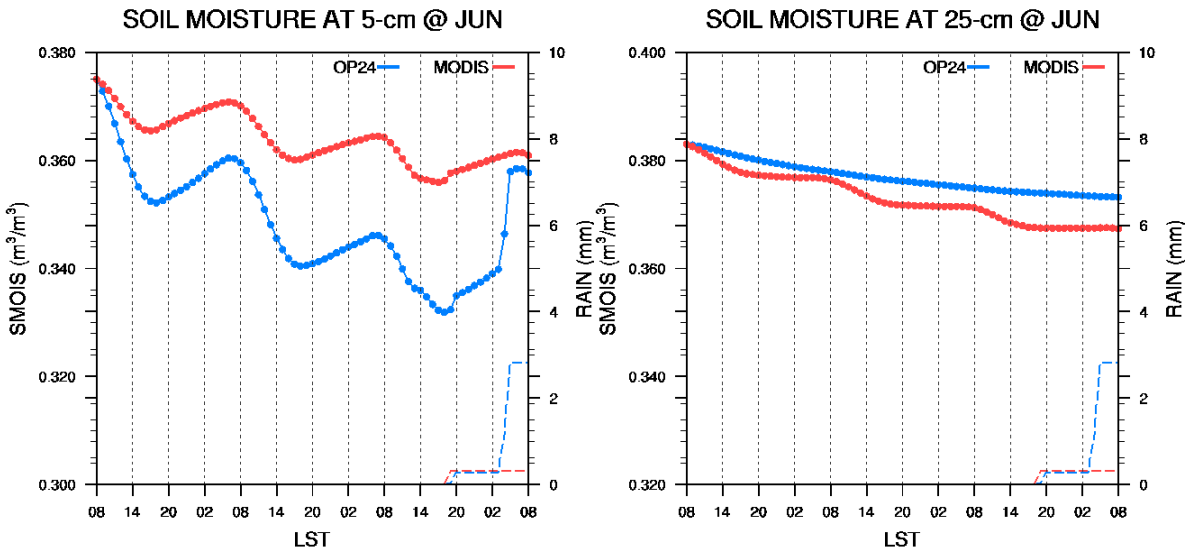
More discussion: soil moisture

Evaporation = $E_{dir} + E_t + E_c$

E_{dir} : Direct

E_t : Roots

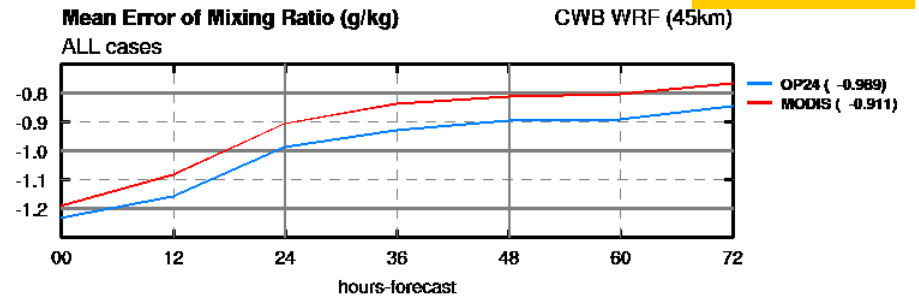
E_c : leaf cut off

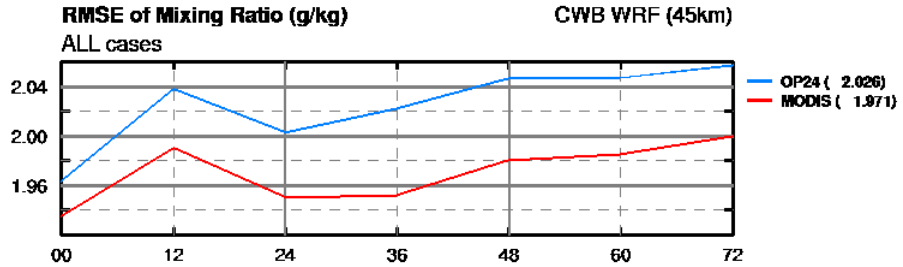


[At Layer 1]

Edir > Et → Layer 1 wetter, Layer 2 drier

JUN_Q2





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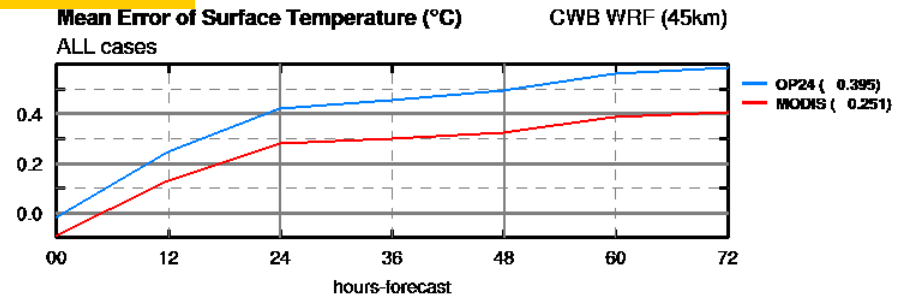

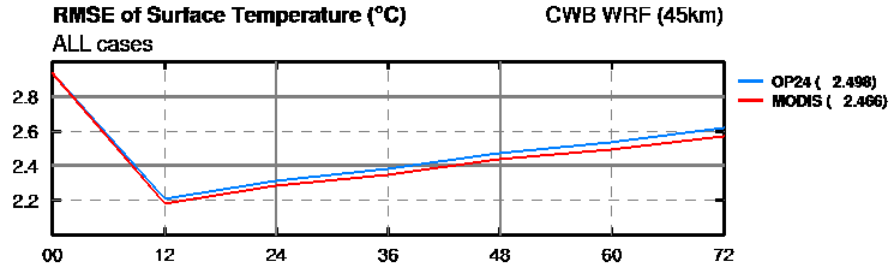

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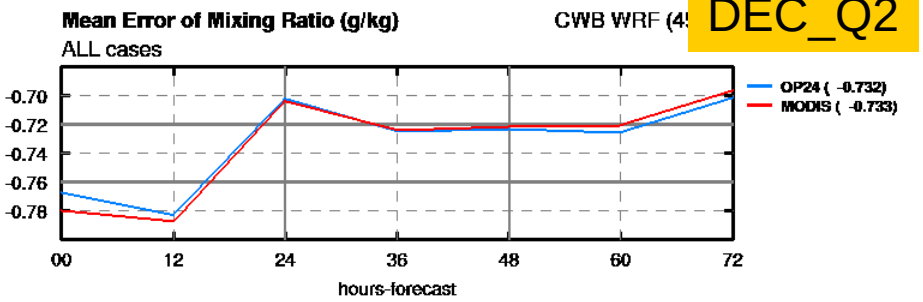

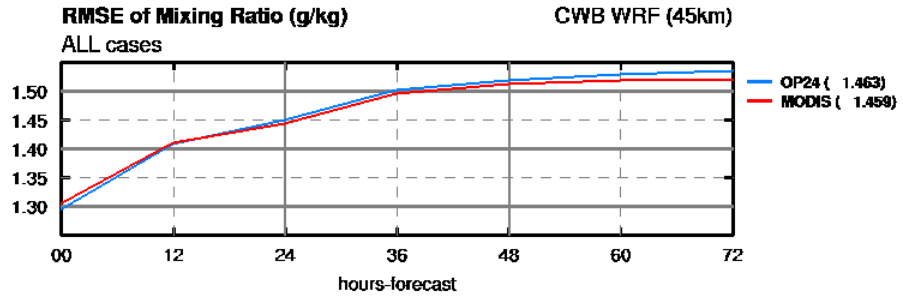

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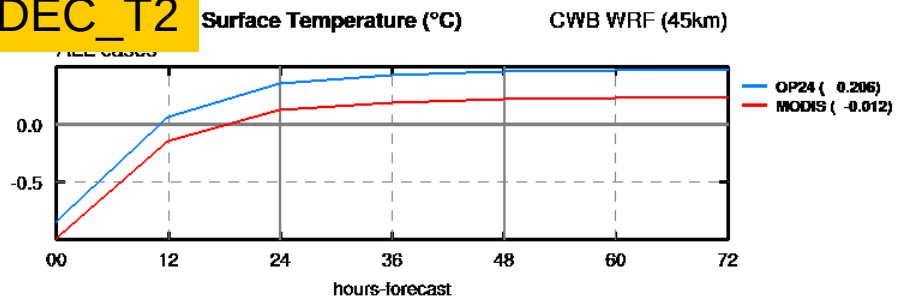

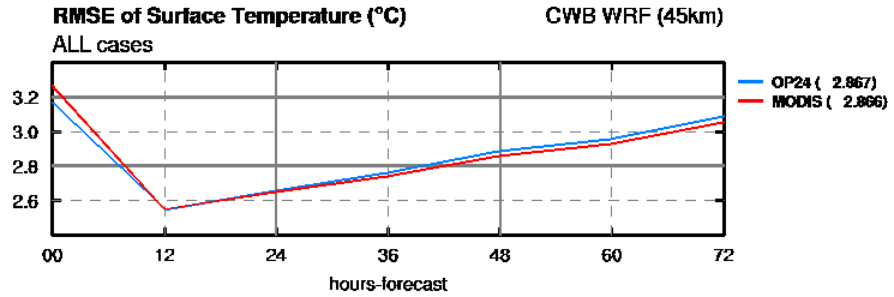

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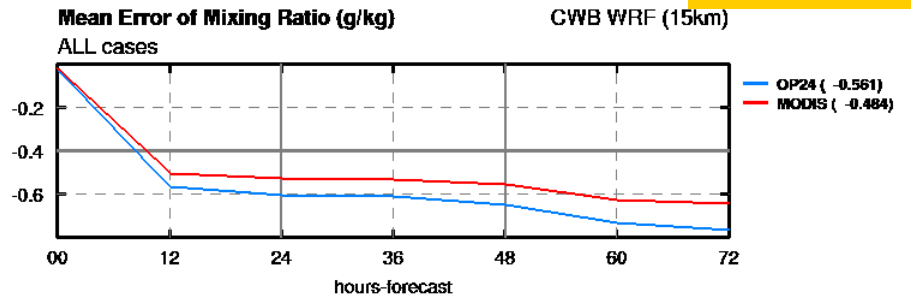

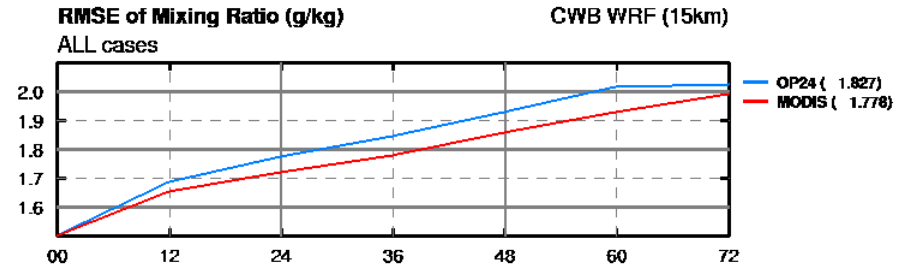

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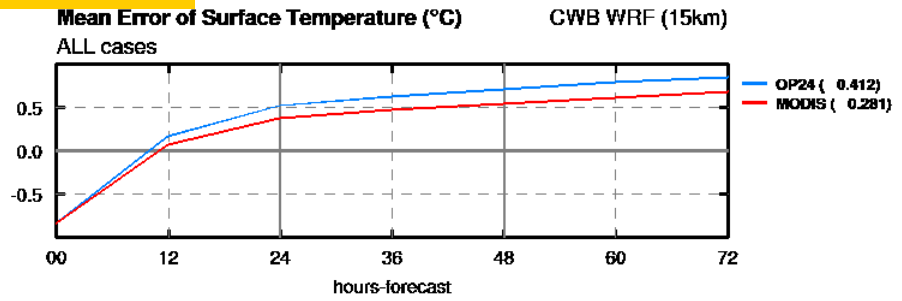

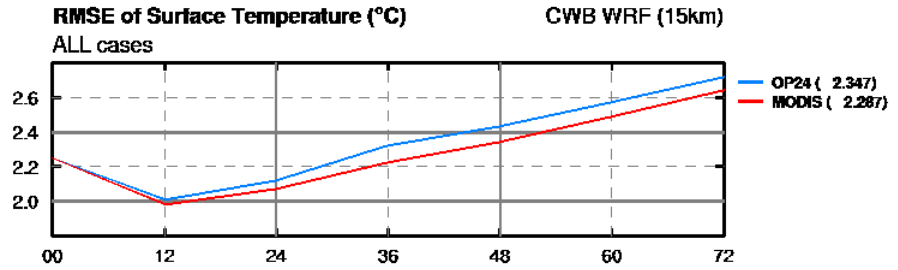

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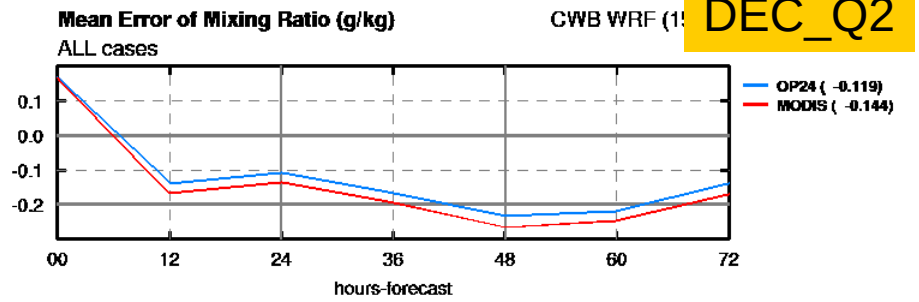

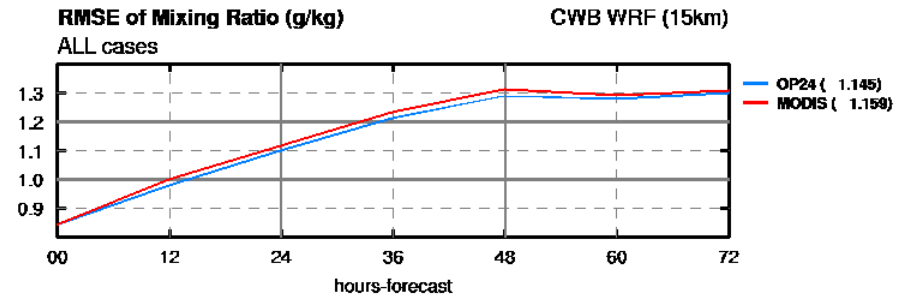

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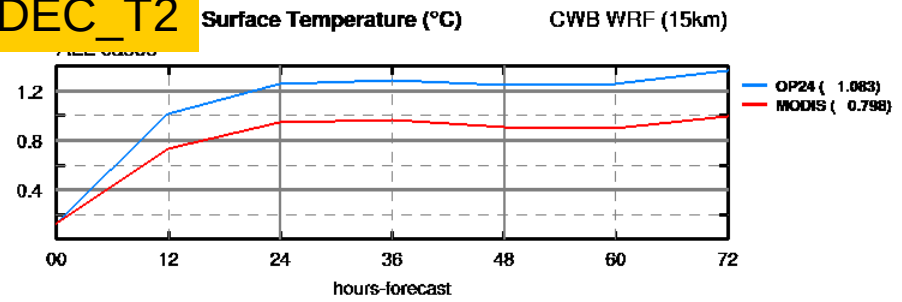

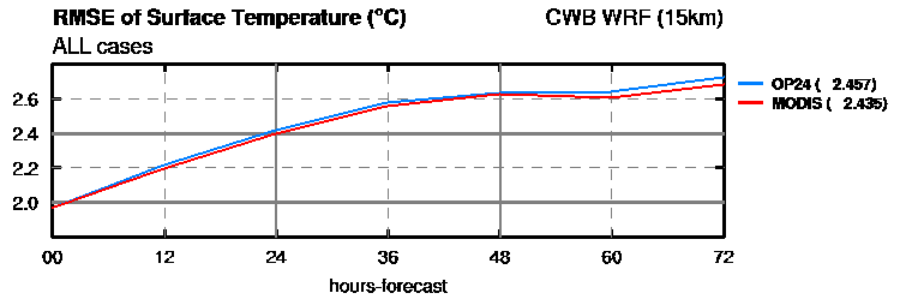

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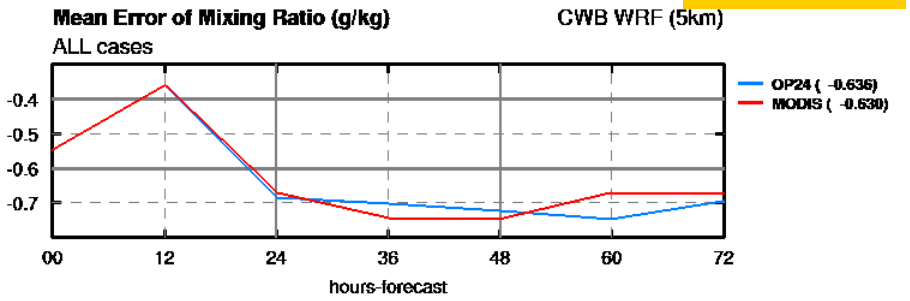

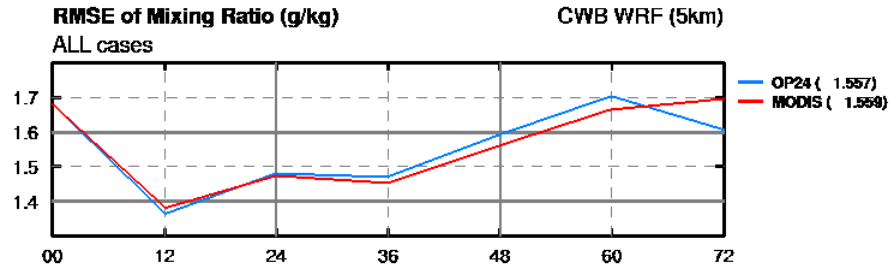

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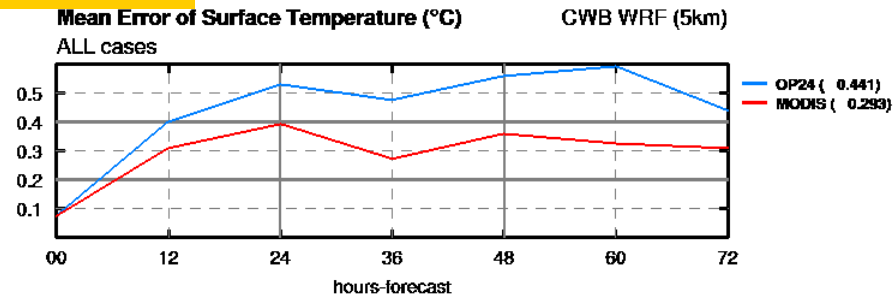

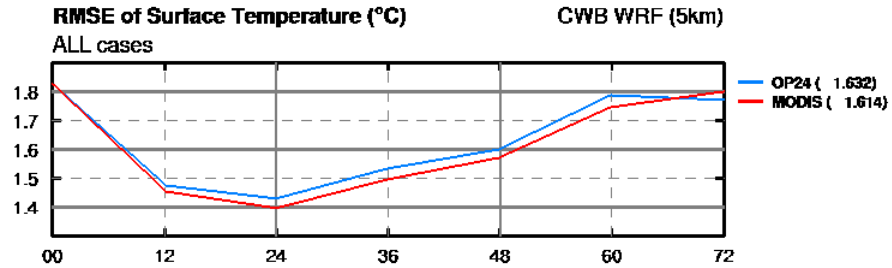

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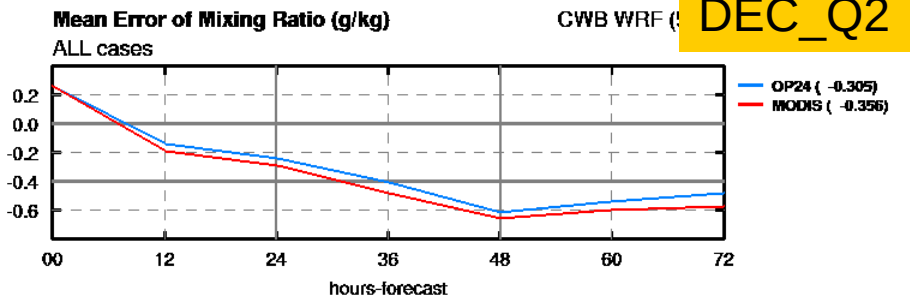

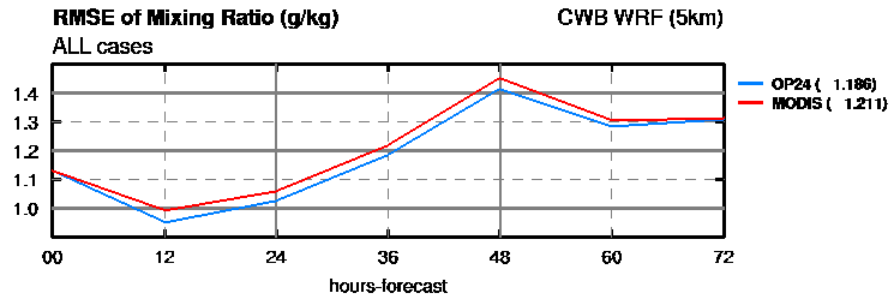

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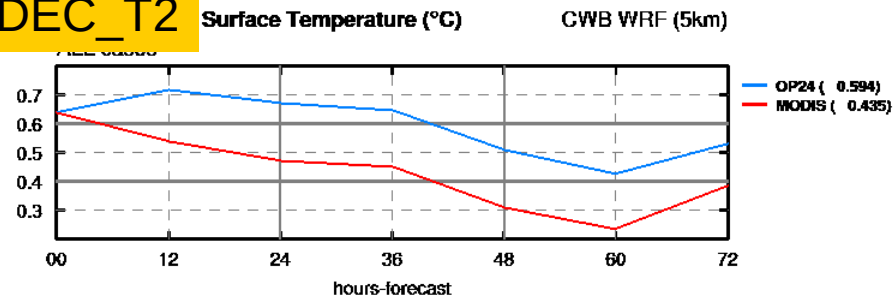
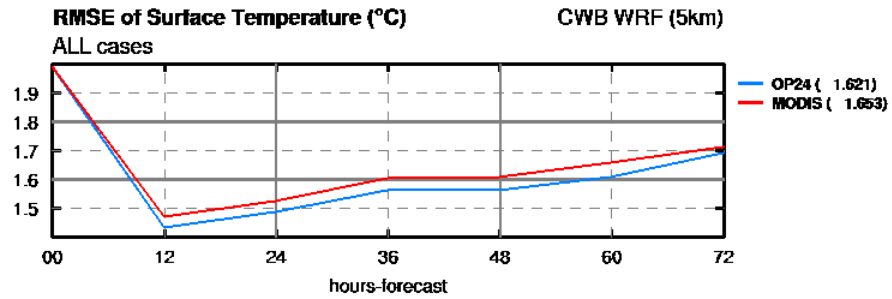
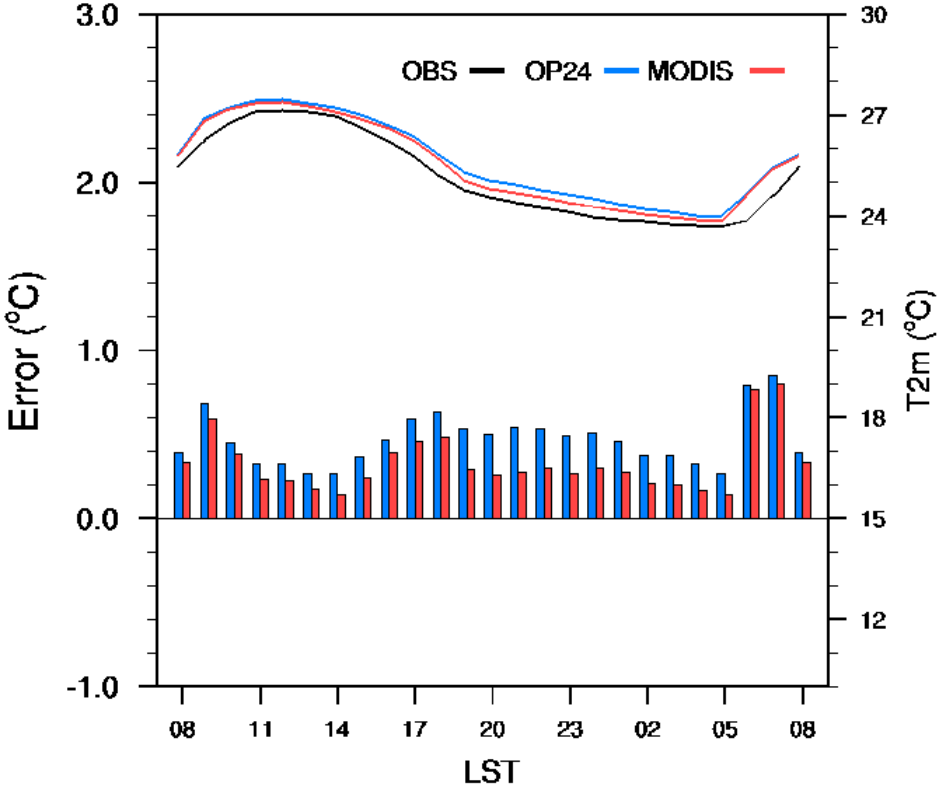




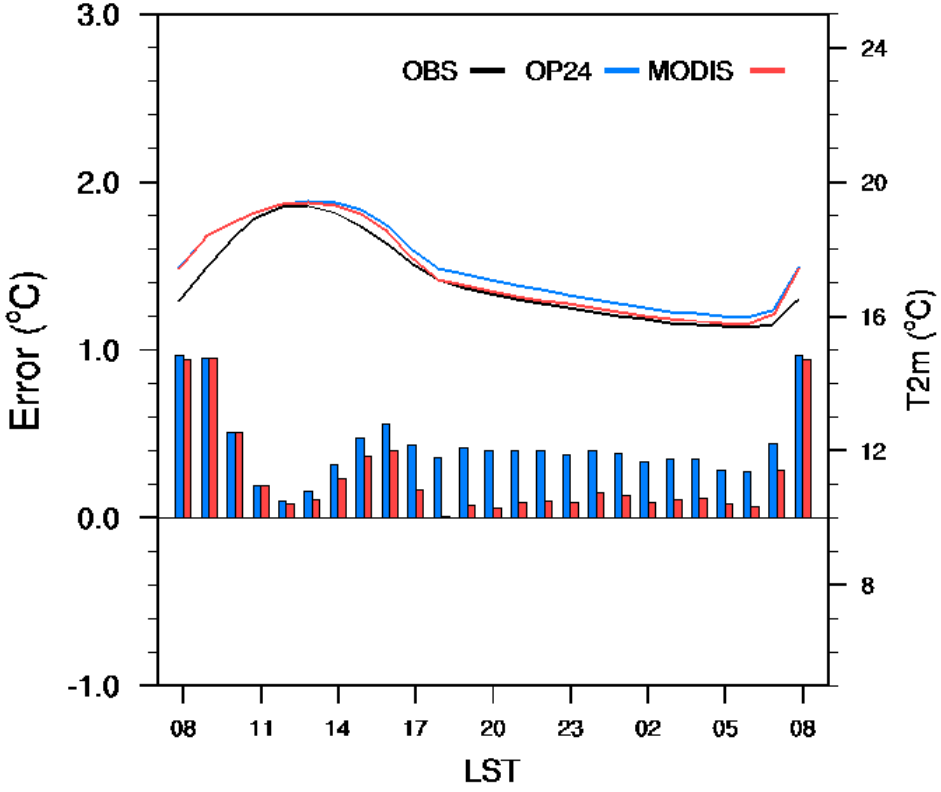
Monthly averaged diurnal cycle

T_{2m} (5 km)

Summer



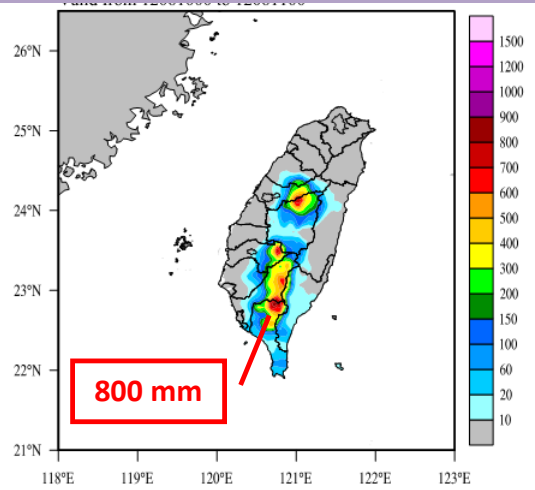
Winter



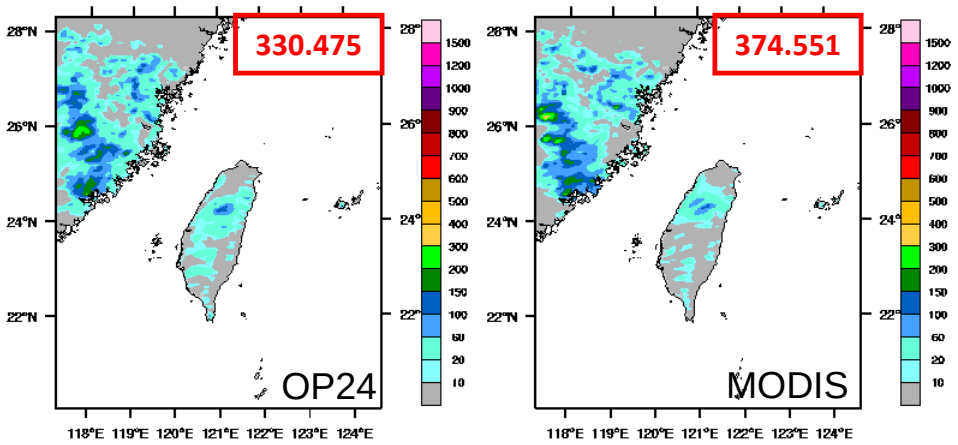
Improved about 50% on T_{2m}.

24-hr Accumulate Rainfall

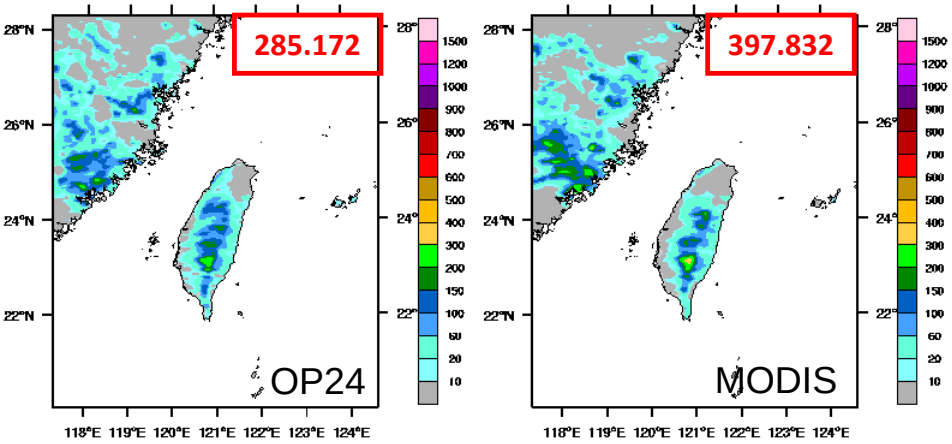
OBS
2012/06/10~2012/06/11



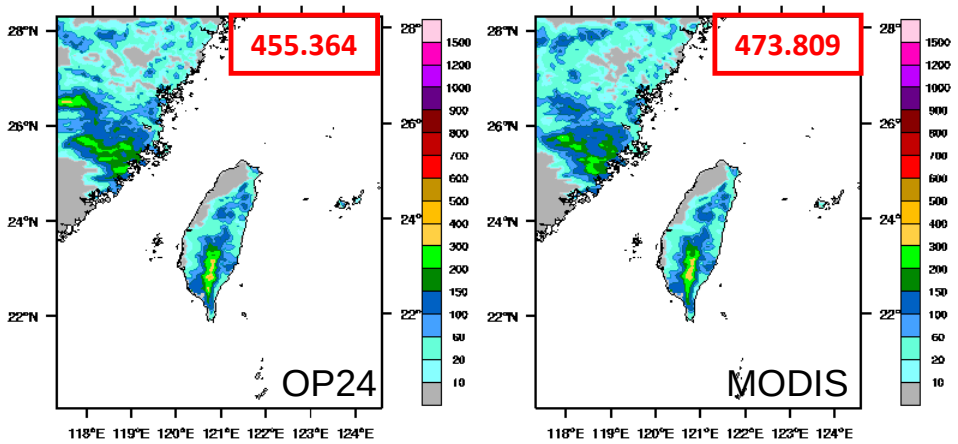
Initial @ 2012/06/08 00Z
Valid @ 2012/06/11 00Z



Initial @ 2012/06/09 00Z
Valid @ 2012/06/11 00Z



Initial @ 2012/06/10 00Z
Valid @ 2012/06/11 00Z



Summary & Future Work

- MODIS vegetation fraction dataset was implemented to WRF v3.5, which was contributed by CWB and NCAR.

- Characteristic of MODIS vegetation fraction data:
  1. Increase the vegetation fraction value about 0.5 over Taiwan area.
  2. Horizontal resolution is better than USGS data.

- The impact on WRF forecast:
  1. latent heat(↑), skin temperature(↓),
     sensible heat(↓), T_{2m}(↓), Q_{2m}(↑).
  2. Improve T_{2m} forecast about 50%.
  3. Smaller Diurnal cycle on soil temperature.
     Wetter soil moisture at layer 1, drier soil moisture at layer 2.
  4. Better rainfall prediction.

- Future work:
  1. Implementation about MODIS albedo and LAI data.
  2. More analysis about the evaporation issue.
  3. Study on afternoon thunderstorm cases.

THANKS FOR YOUR ATTENTION.