BLLAST workshop 2013, Bergen

Sensitivity of LSM and PBL schemes in WRF simulations of the Atmospheric Boundary Layer during the BLLAST campaign

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Overview

- Study of variability and sensitivity of the model (WRF) to:
  - LSM schemes
  - PBL schemes

- Validation with observed data for days:
  24 and 25 June

- Comparison between V3.4.1 and V3.5

WRF settings

VERSION	WRF-ARW version 3.4.1
INITIAL AND BOUNDARY CONDITIONS	ECMWF data (pressure levels) 0.15° resolution; every 6 h
HORIZONTAL RESOLUTION	3 nested domains Grids of: 9 km, 3 km, 1 km
VERTICAL RESOLUTION	50 eta vertical levels (28 between ground and 1000 m)
TIME STEP	30 s
SPIN UP	12 h
PBL	YSU / MYJ / QNSE
LSM	5-layers / NOAH / RUC

Experiments

Two different exercises with:

a) Fixed **LSM**, varying **PBL**

b) Fixed **PBL**, varying **LSM**

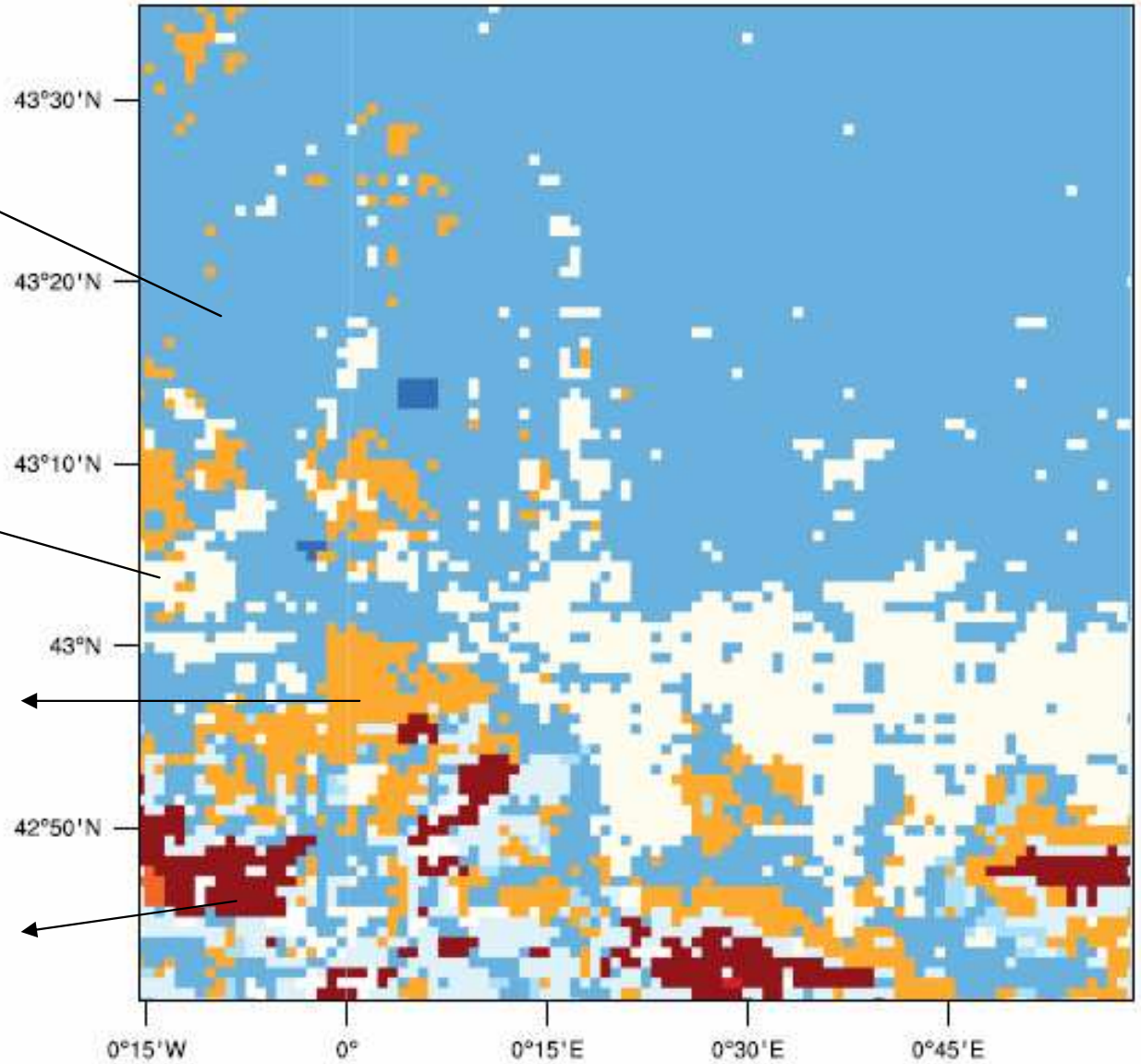
Surface energy balance: **LH, SH, R_N, G**

Surface variables: **T, q**

Turbulence parameter: **u_***

Vertical profiles: **wind, θ, q**

Land use (WRF)



grassland

forest

mixed forest

bare ground

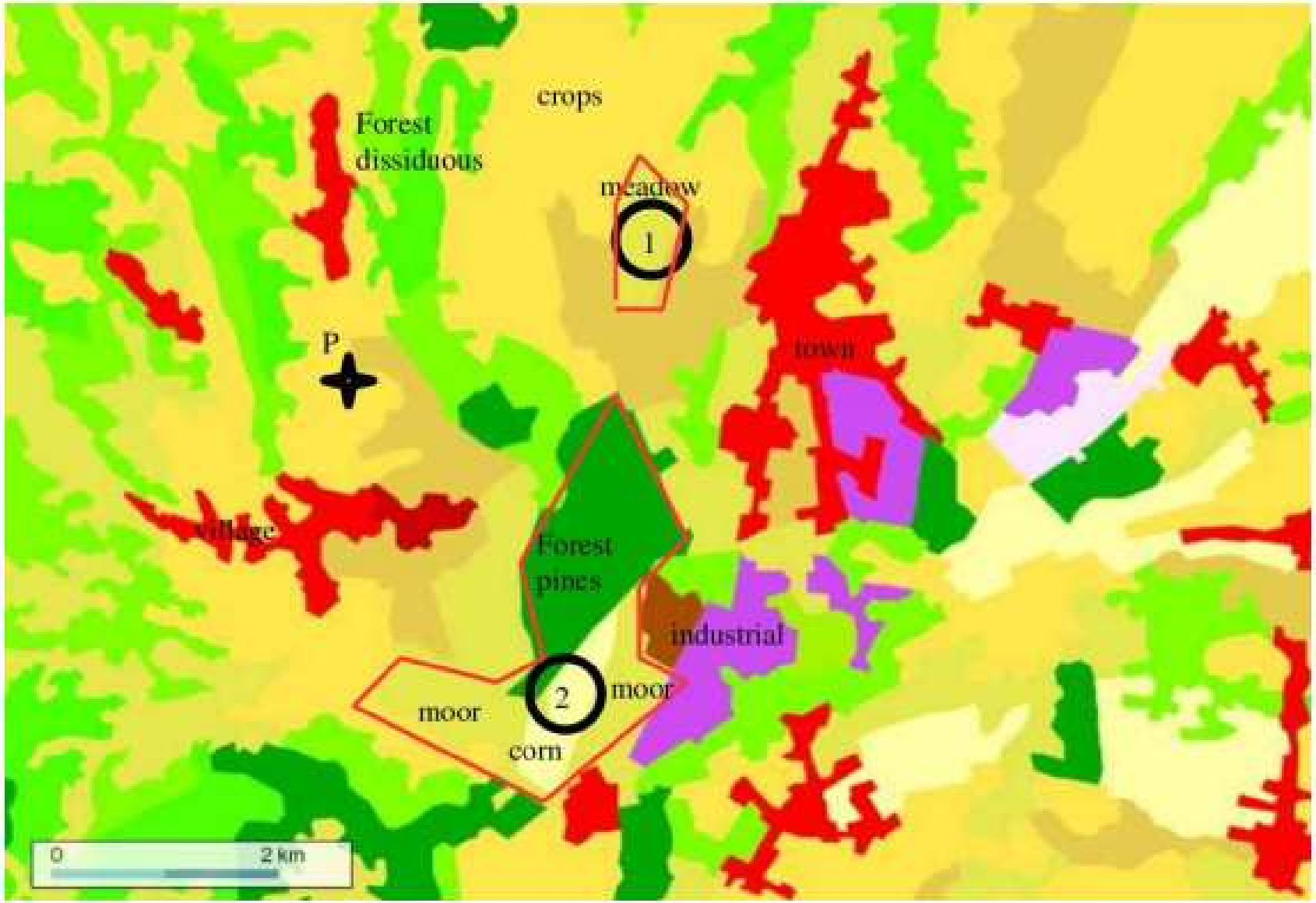
100 km

100 km

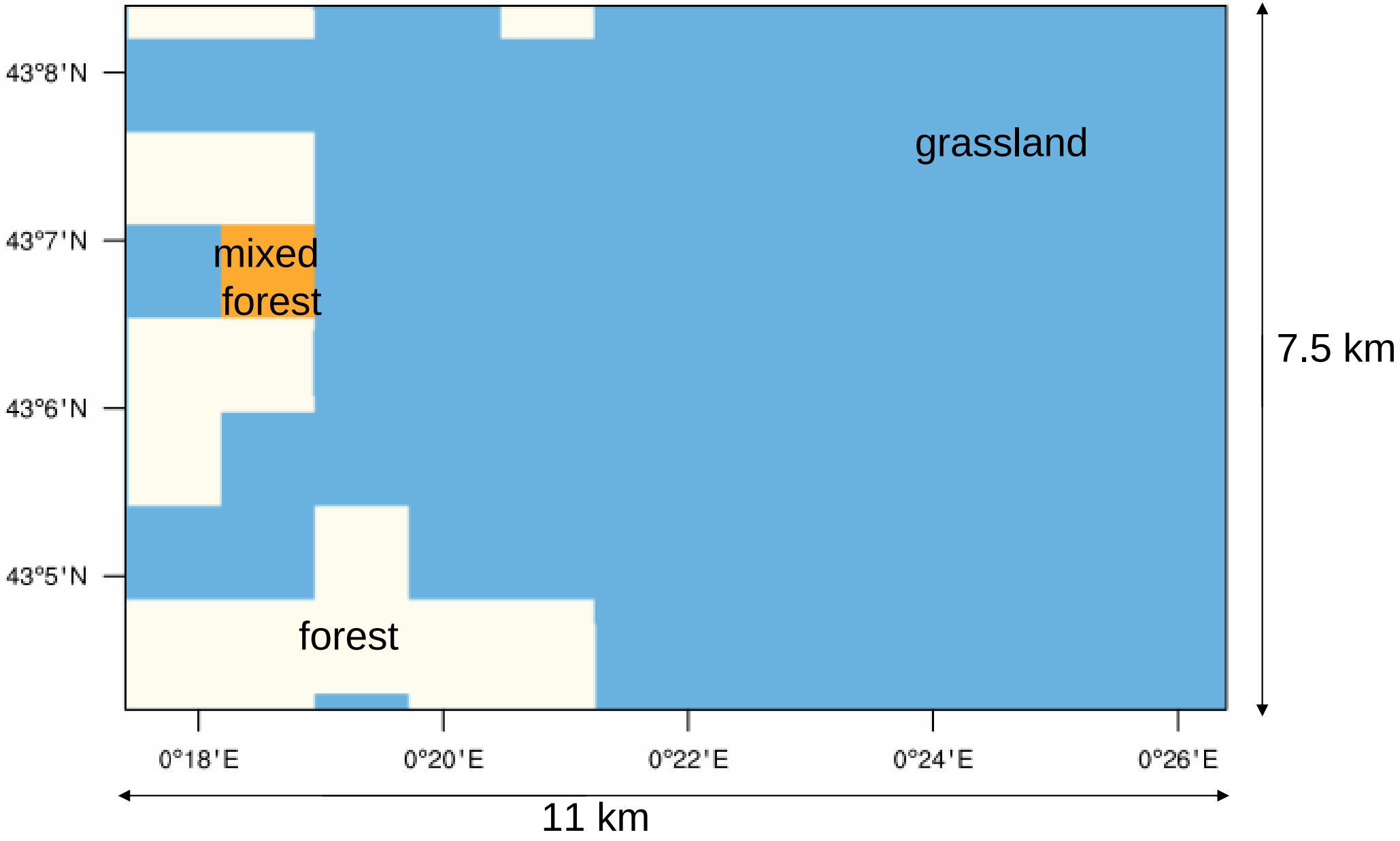
USGS database

Satellite (Google Earth)

Land cover (CORINE)



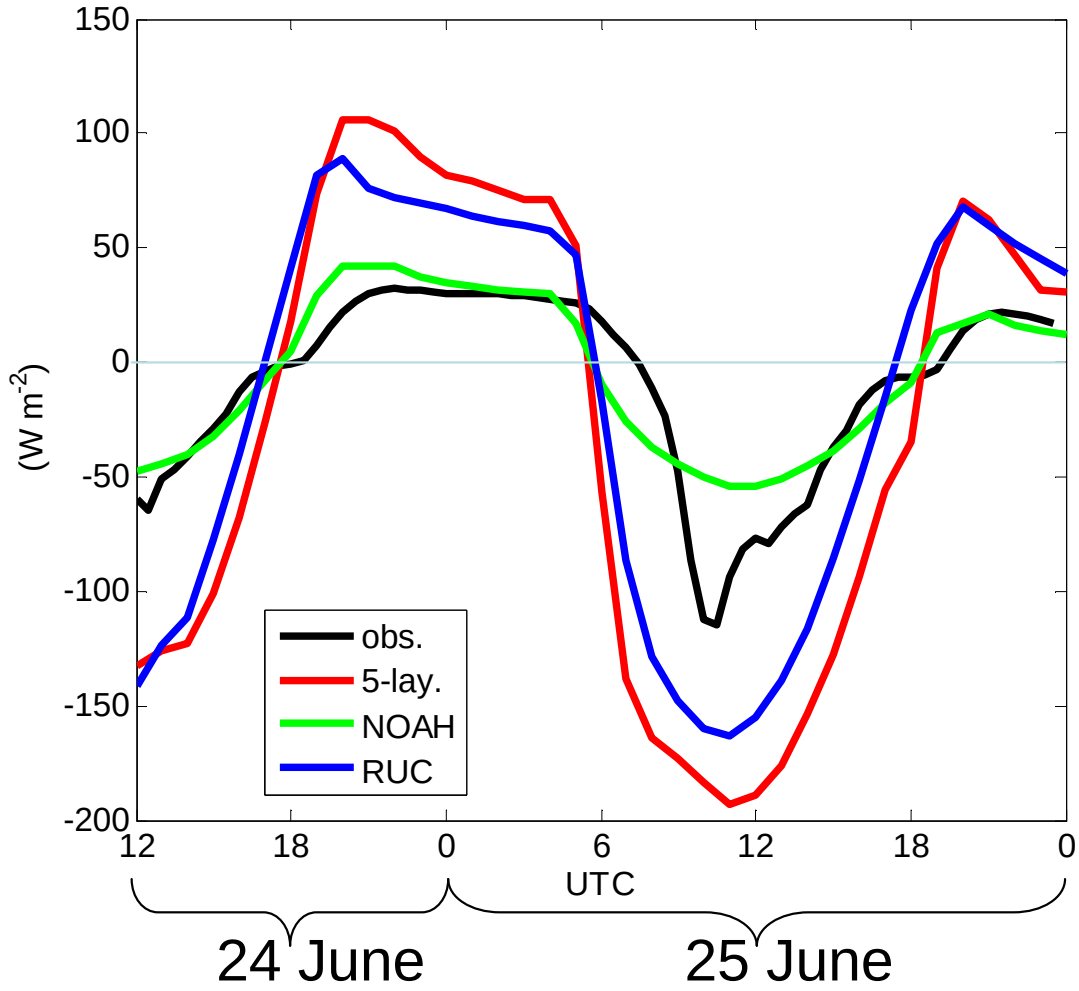
Land use zoom (WRF)



Initial results

a) **Fixed PBL, varying LSM**

G



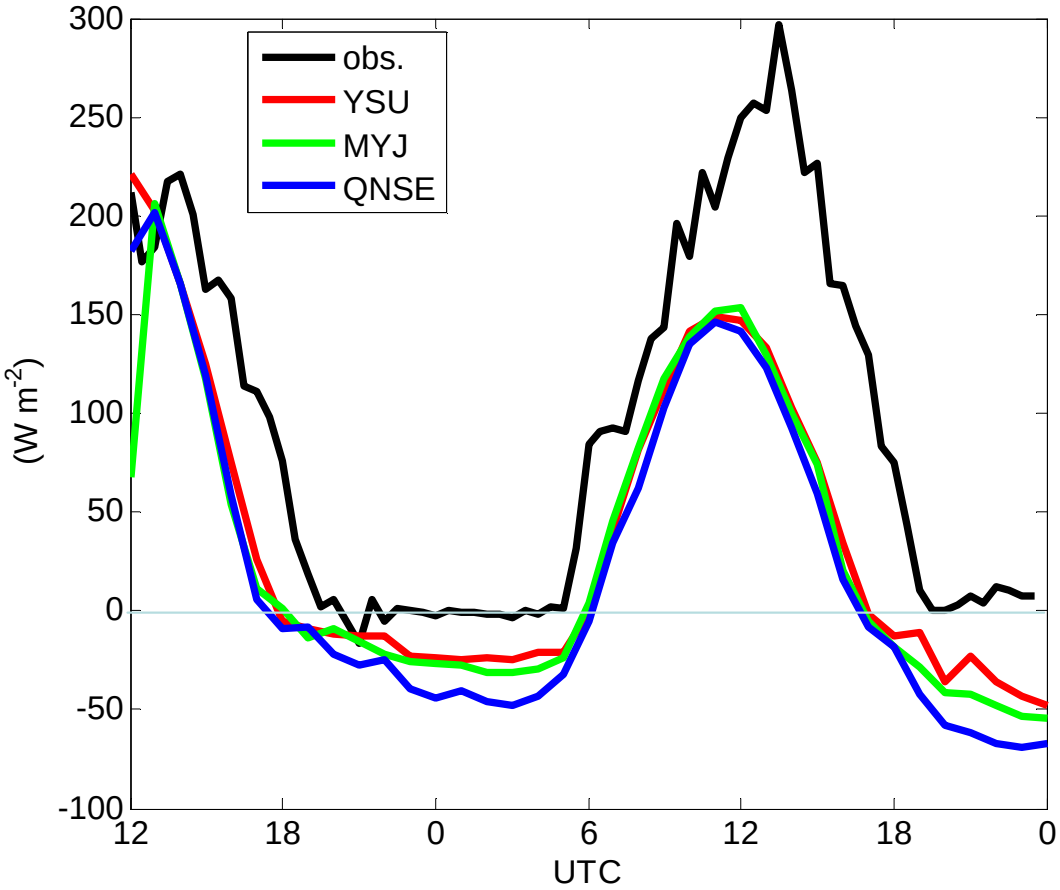
PBL: **YSU**

Great discrepancies among LSM in some terms

Initial results

b) **Fixed LSM, varying PBL**

SH

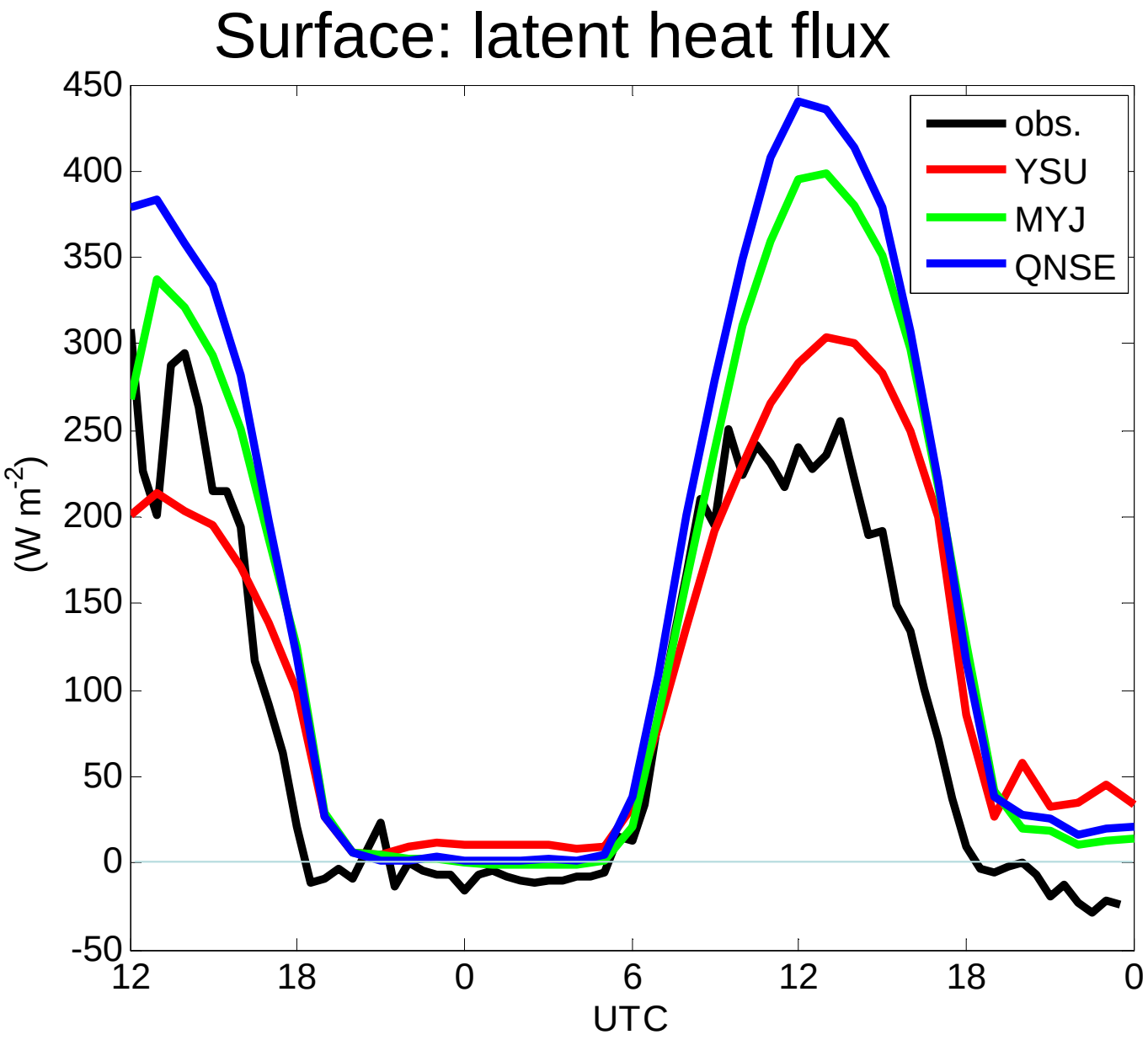


LSM: **NOAH**

Some differences, but smaller than before

5-layer scheme

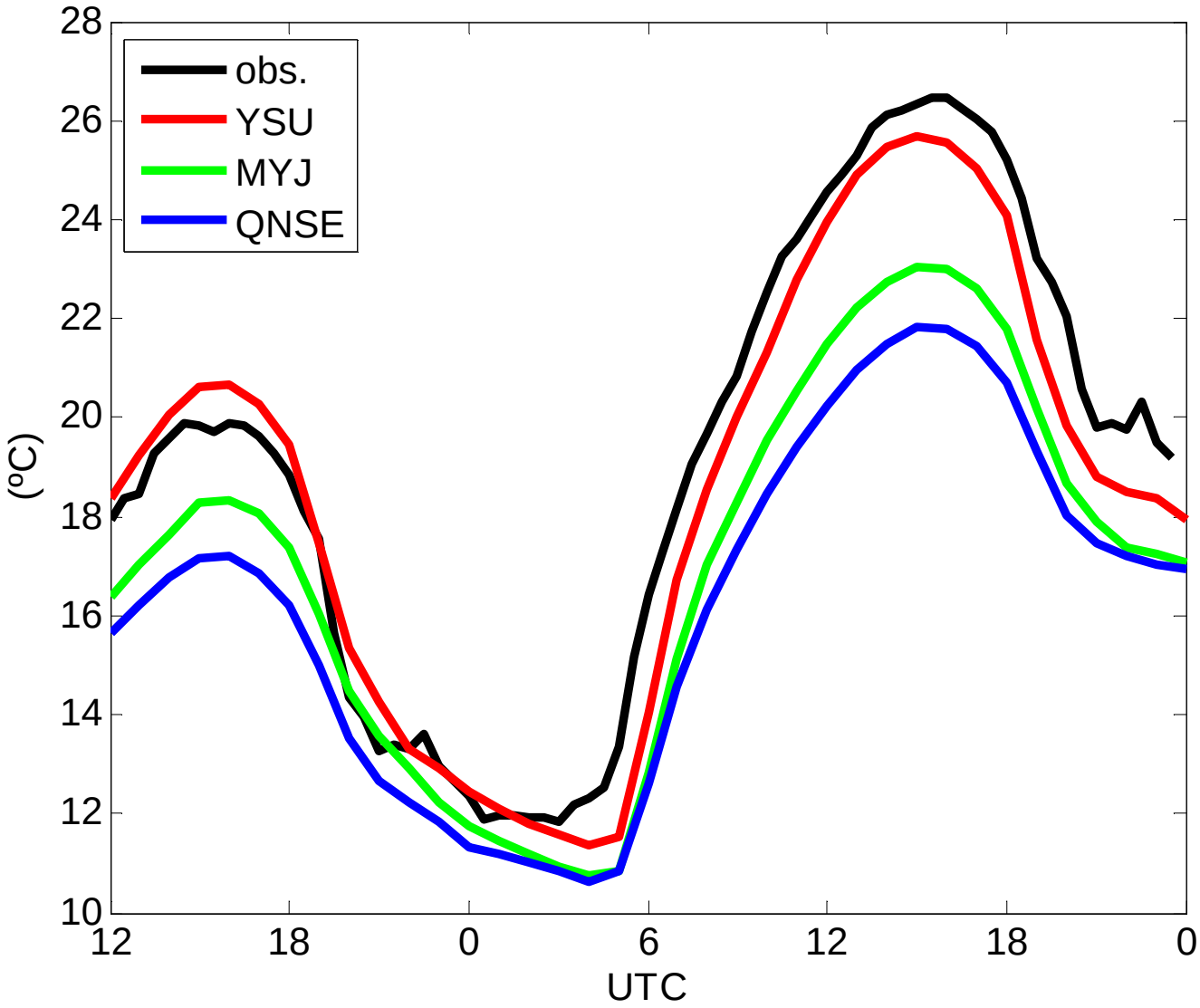
LH



5-layer scheme

Surface: temperature

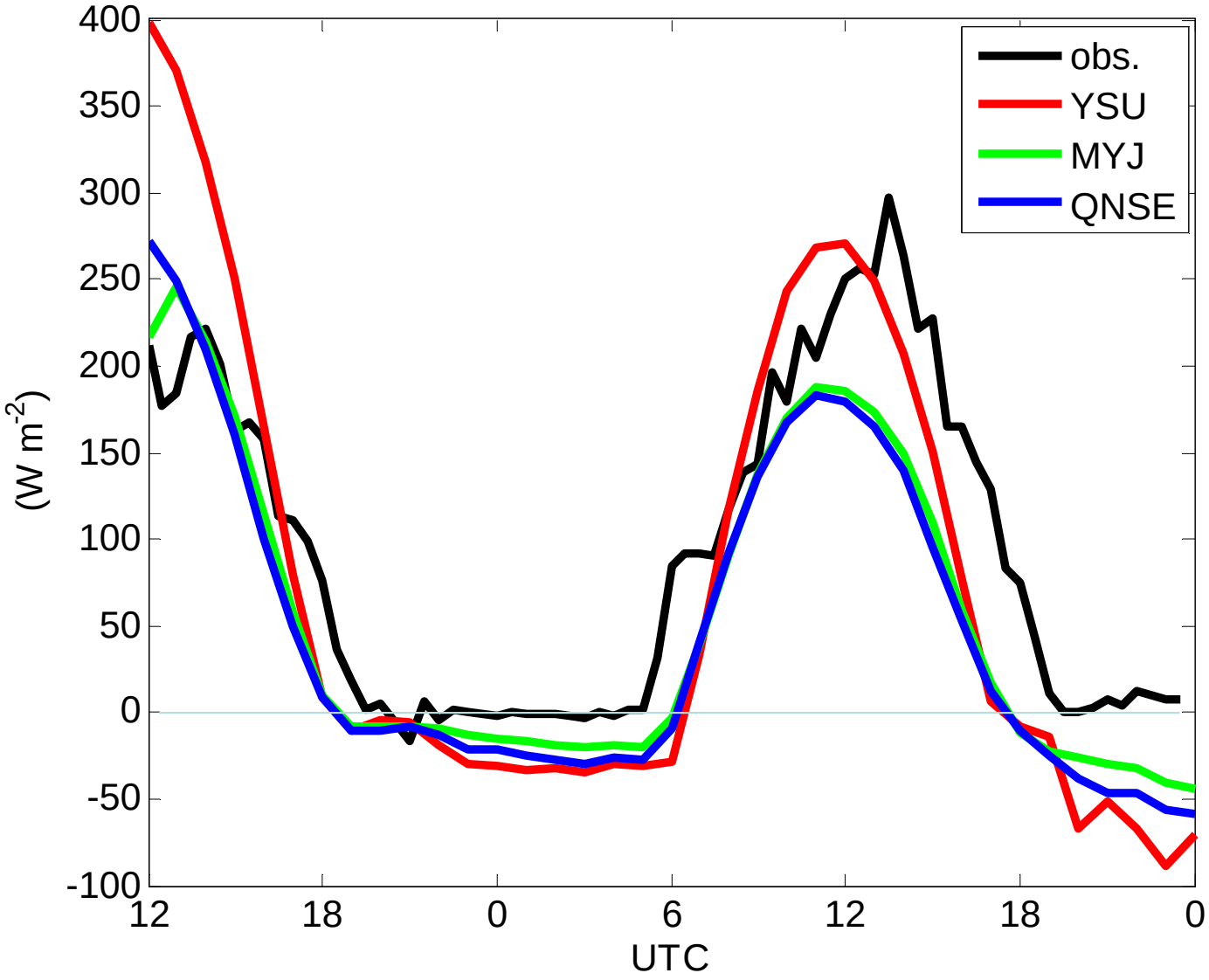
T_{2m}



5-layer scheme

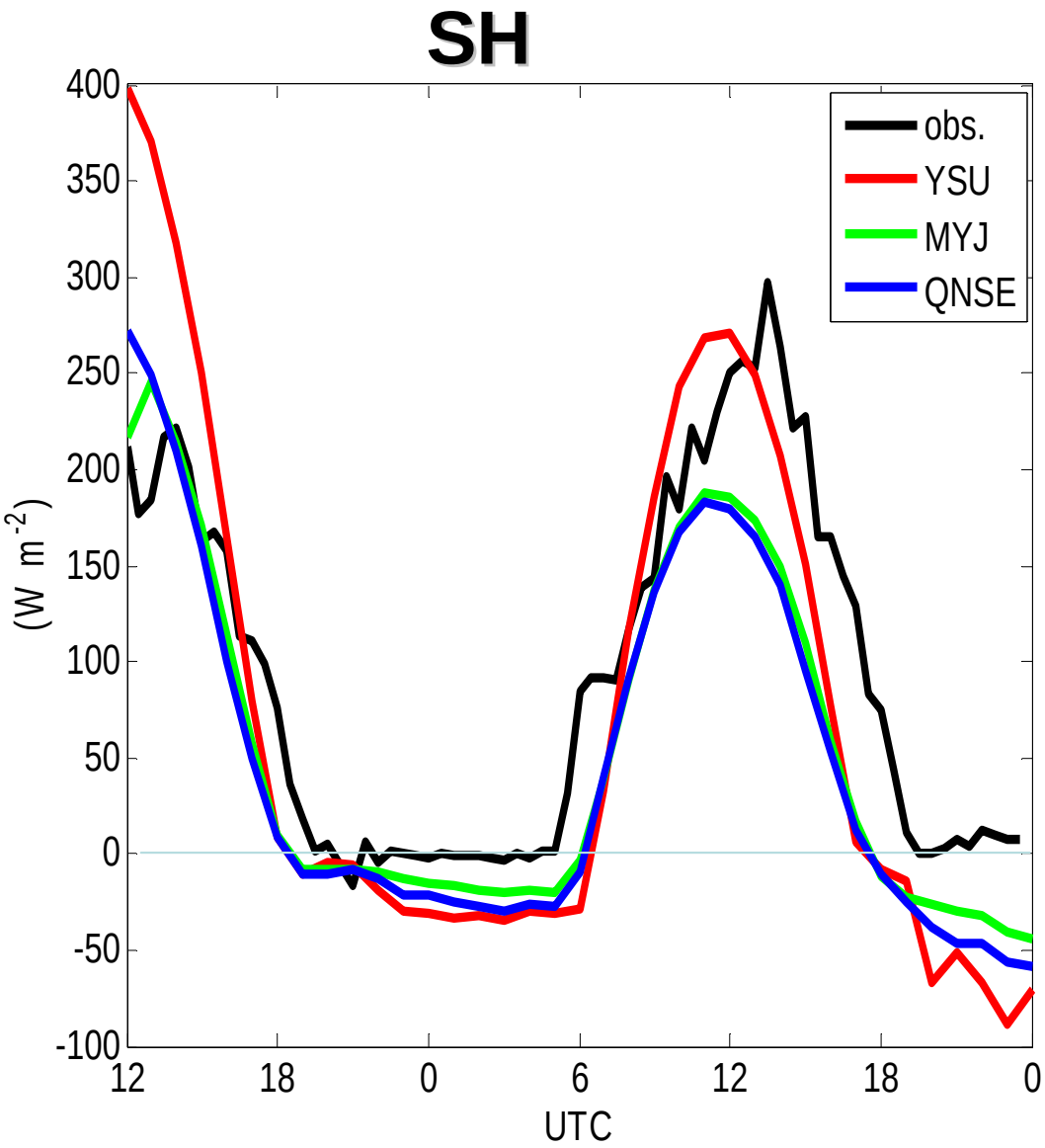
Surface: sensible heat flux

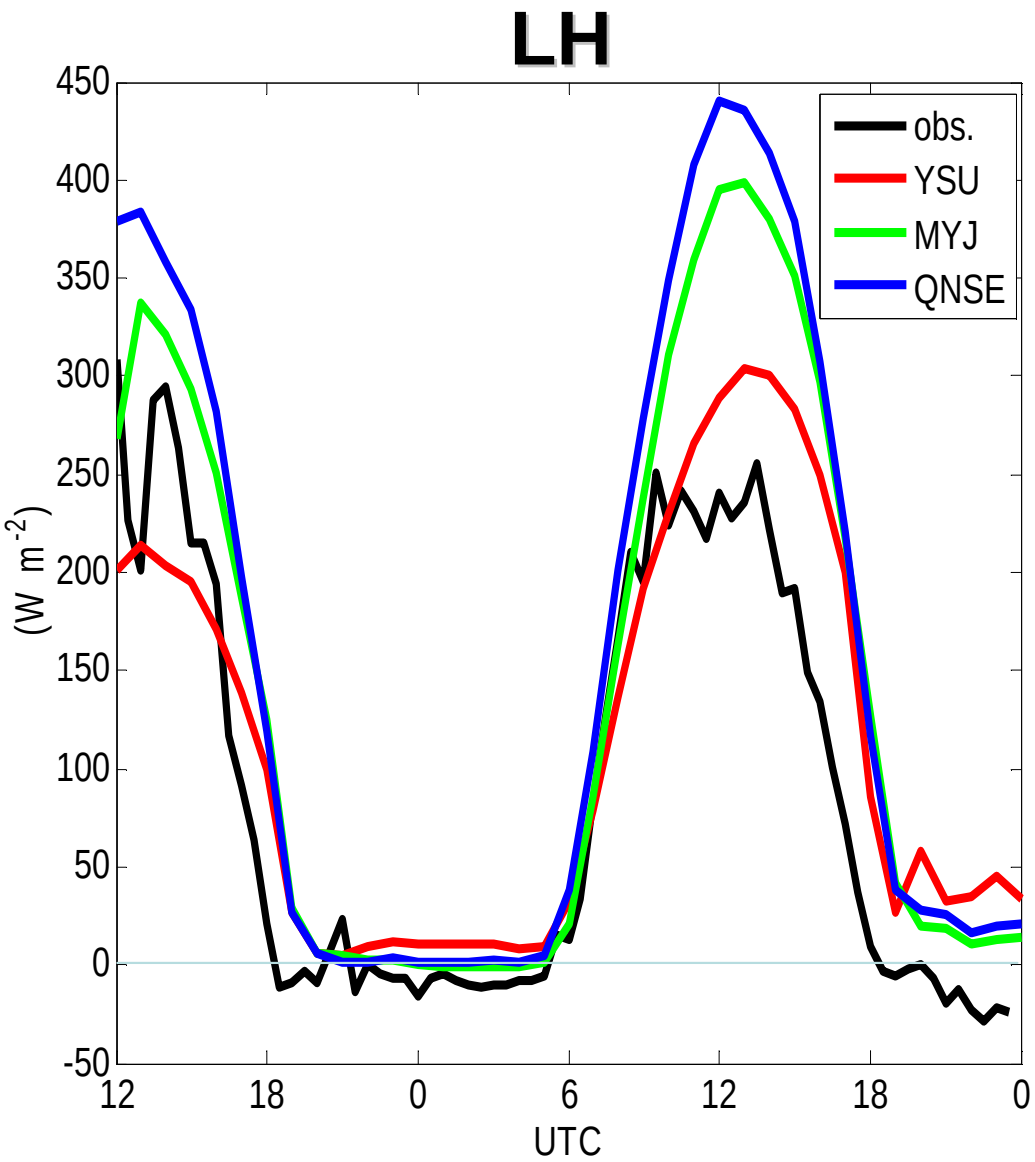
SH



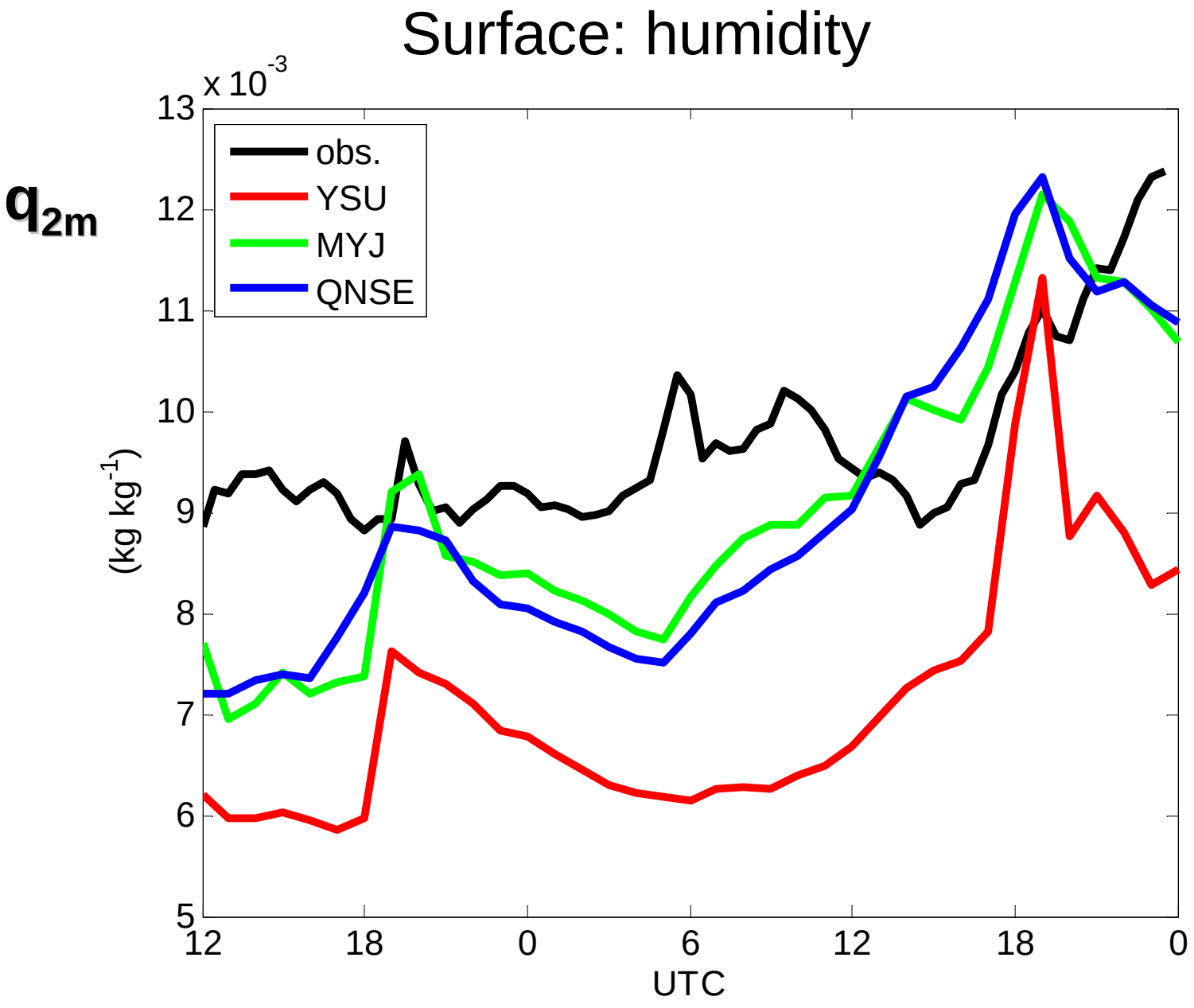
5-layer scheme

Surface





WRF tests: 5-layer scheme

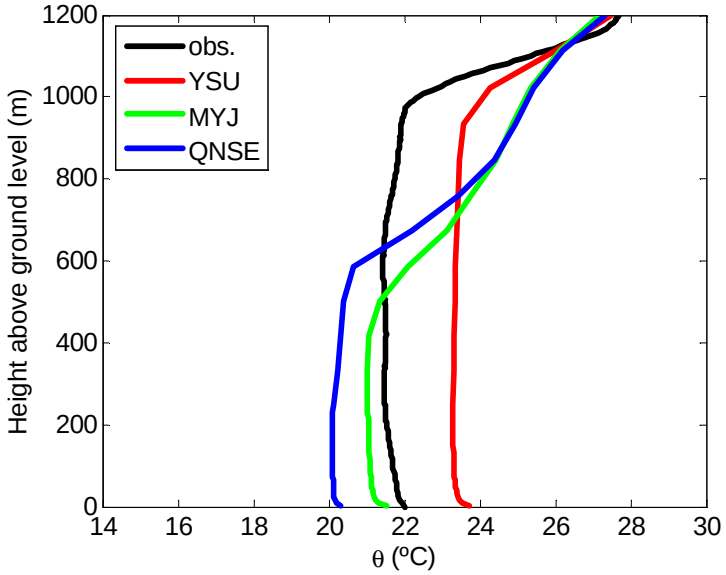


5-layer scheme

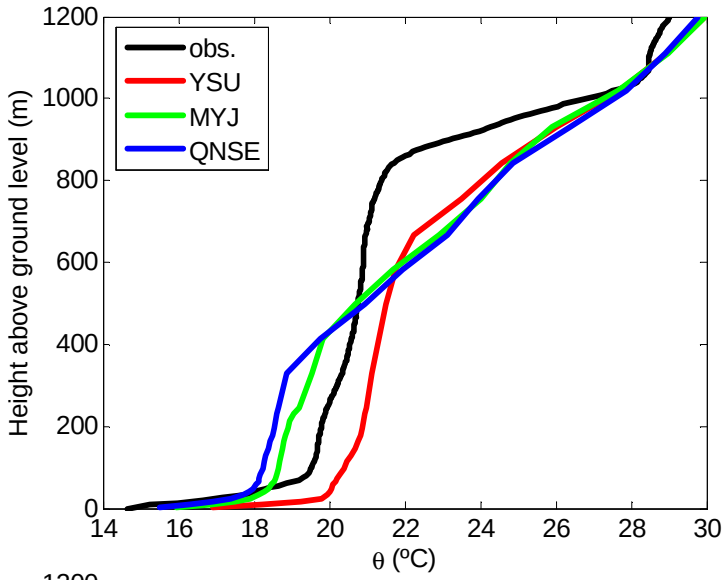
Vertical profiles

θ

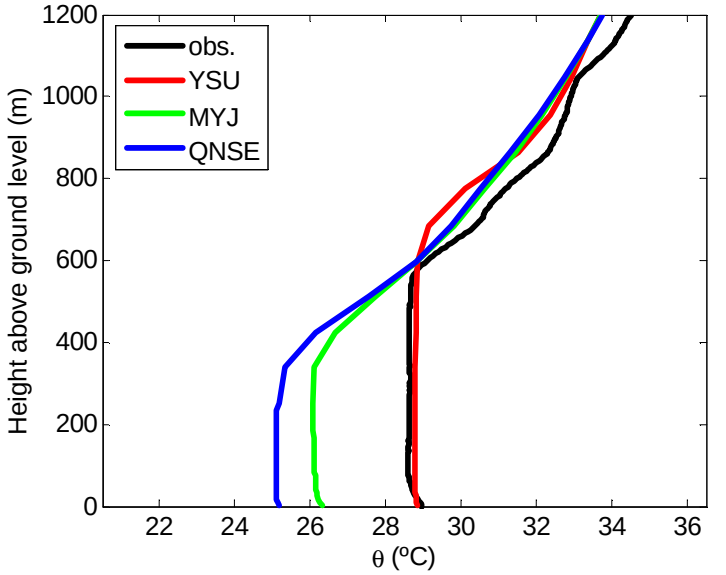
17 UTC

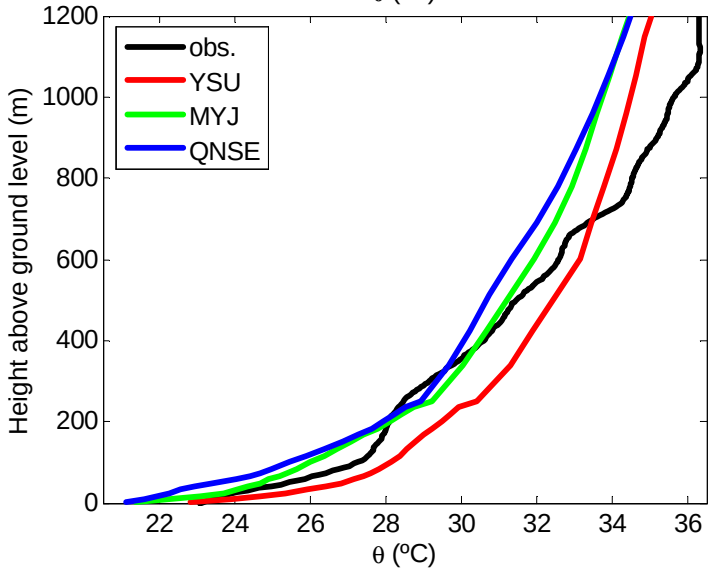


23 UTC



24 June





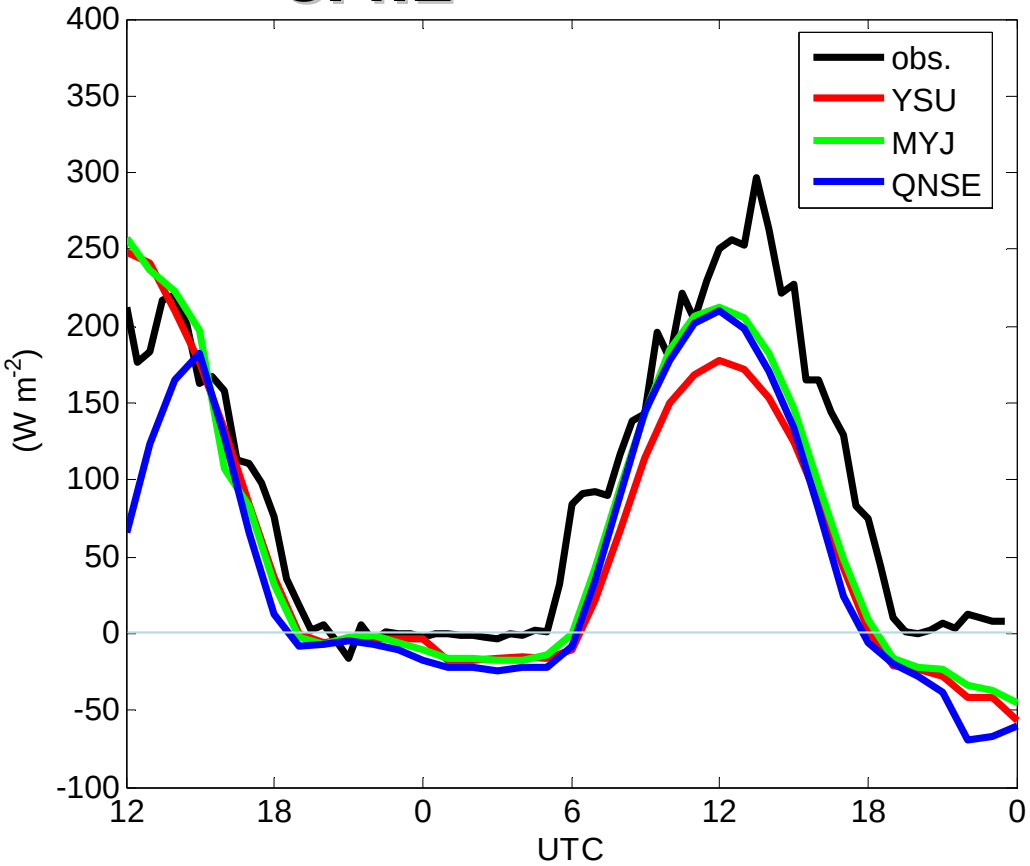
25 June

3.4.1 vs. 3.5 version

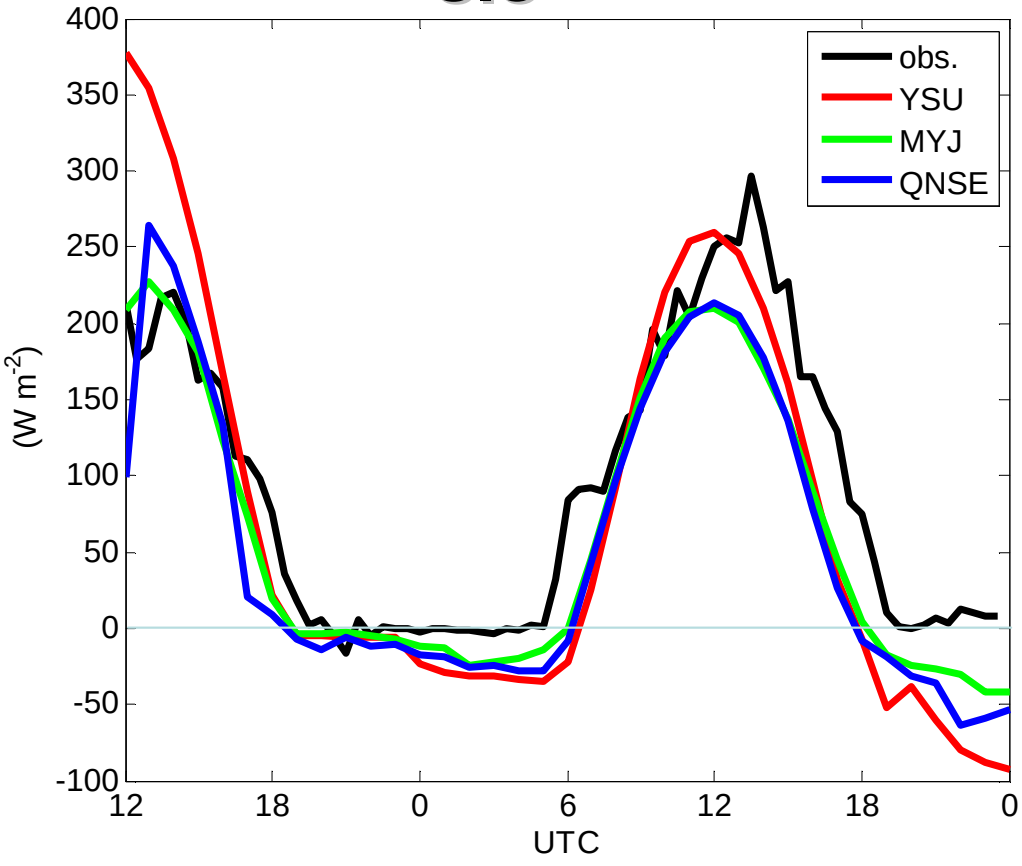
SURFACE: **SH**

Fixed LSM: ***RUC***

3.4.1



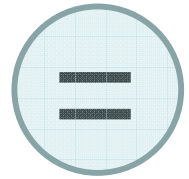
3.5



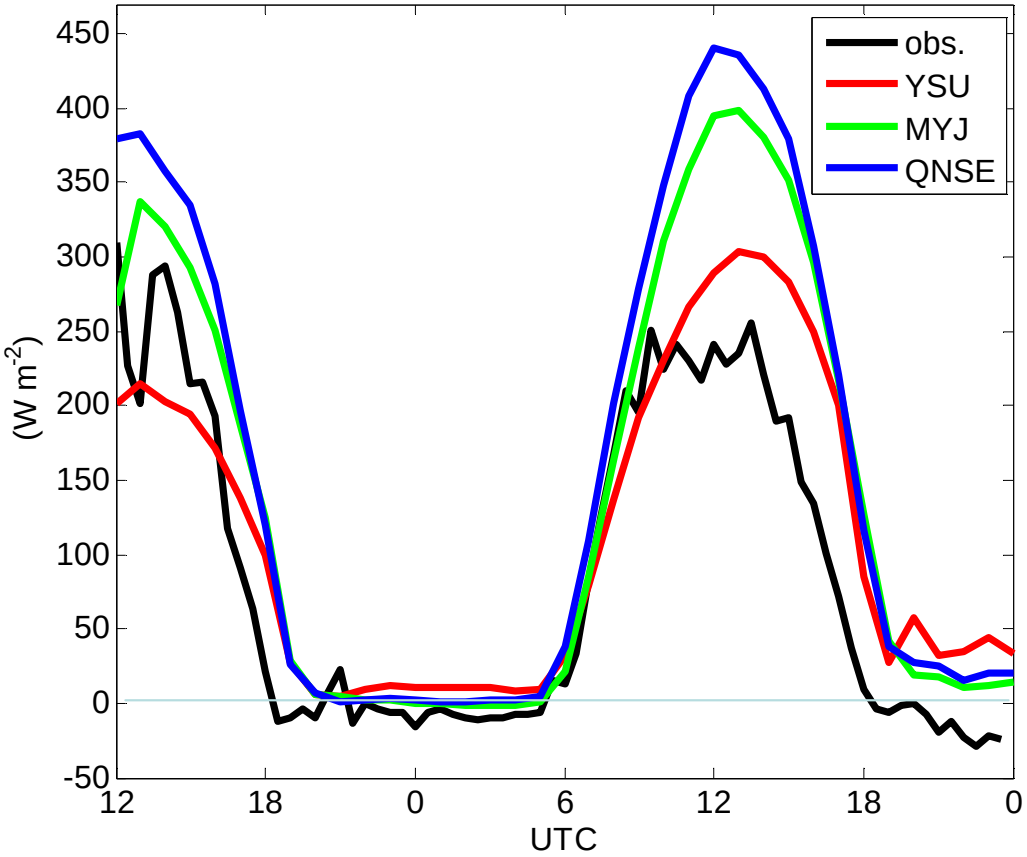
3.4.1 vs. 3.5 version

SURFACE: **LH**

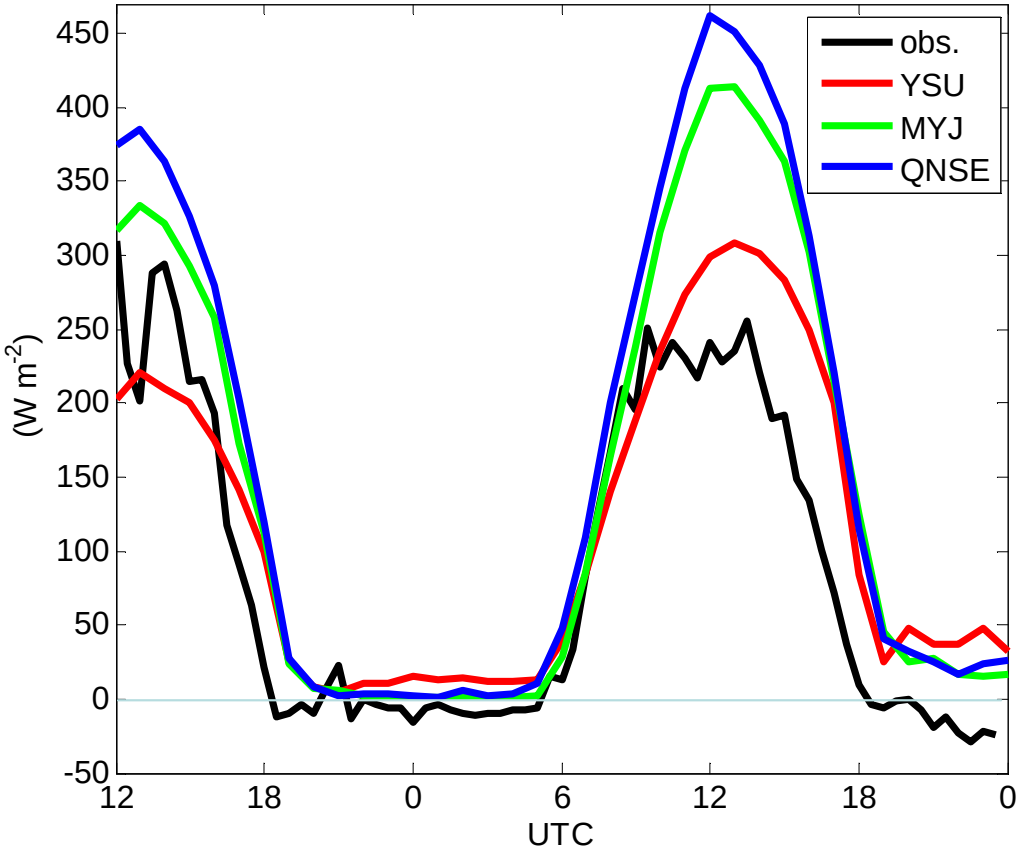
Fixed LSM: ***5-lay***



3.4.1



3.5

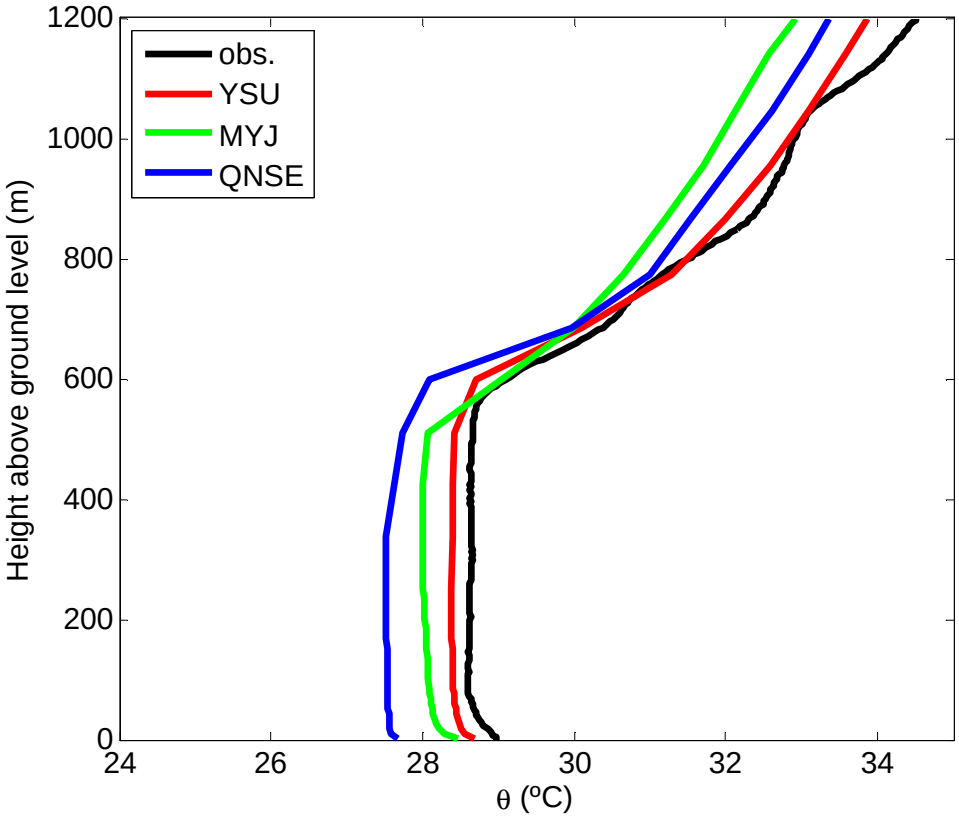


3.4.1 vs. 3.5 version

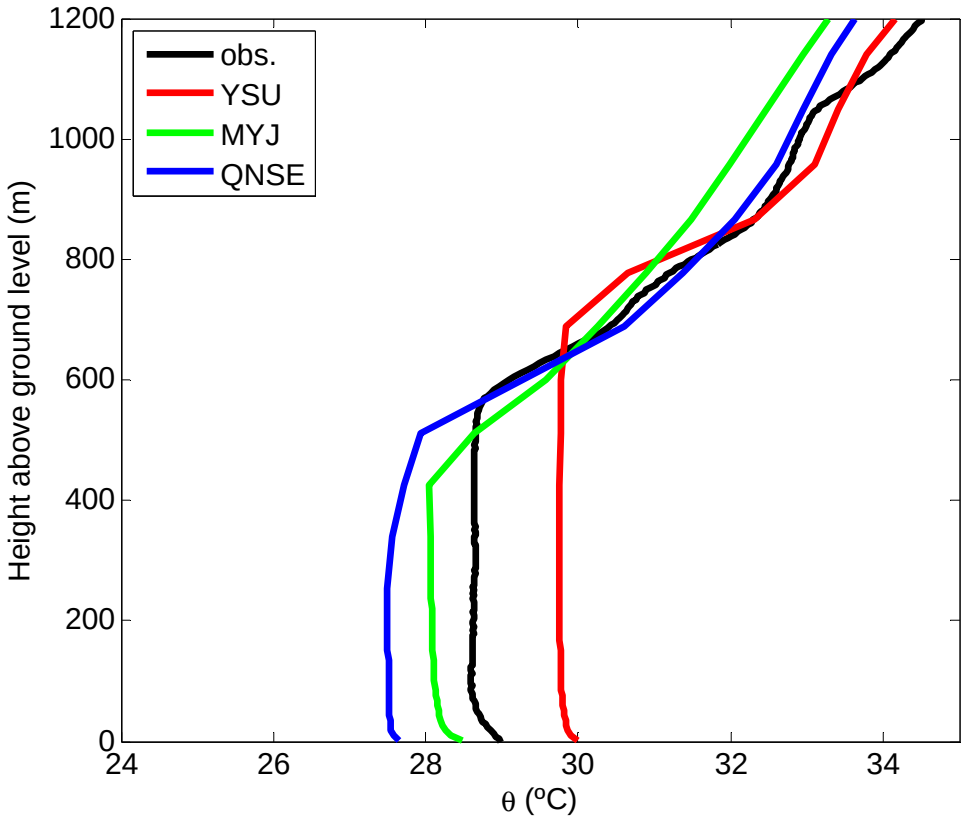
VERTICAL PROFILES: θ

Fixed LSM: ***RUC***

3.4.1



3.5

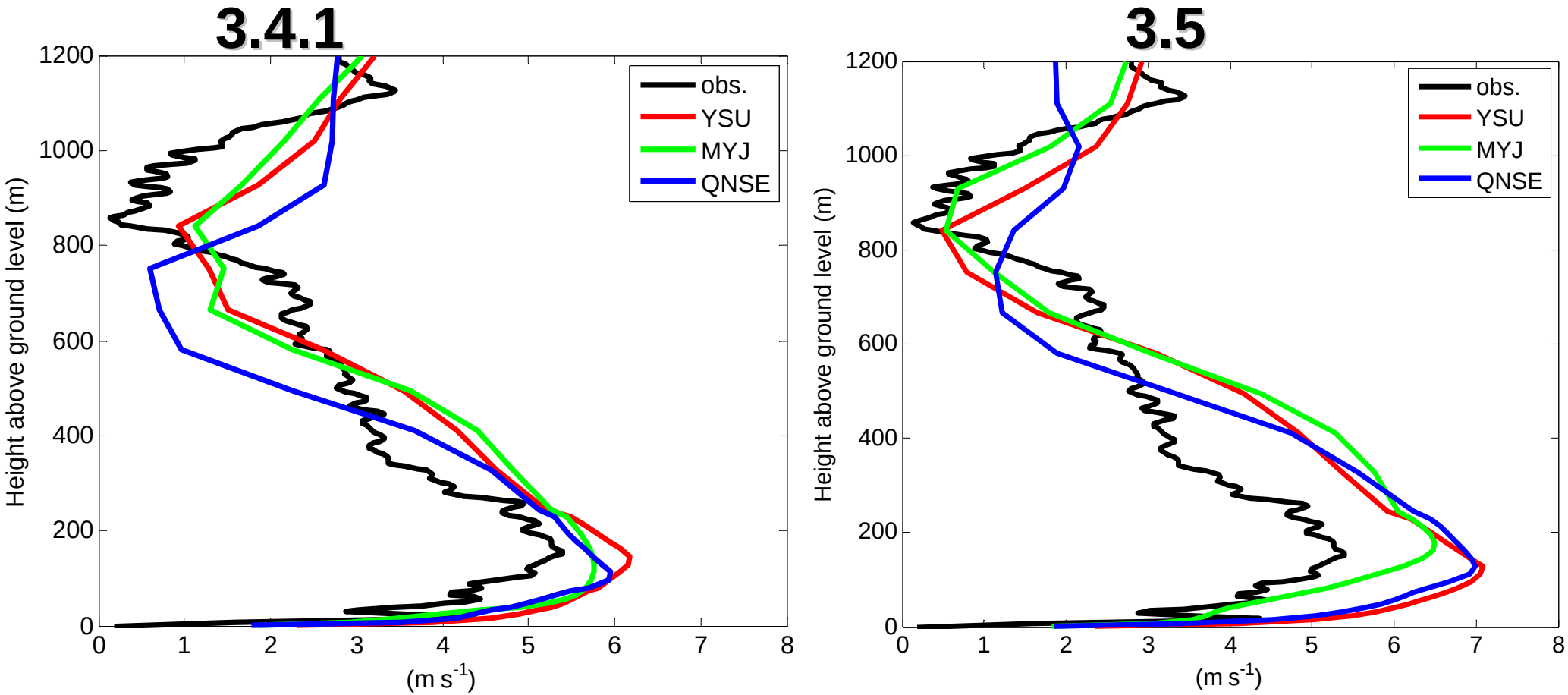


25-Jun, 17 UTC

3.4.1 vs. 3.5 version

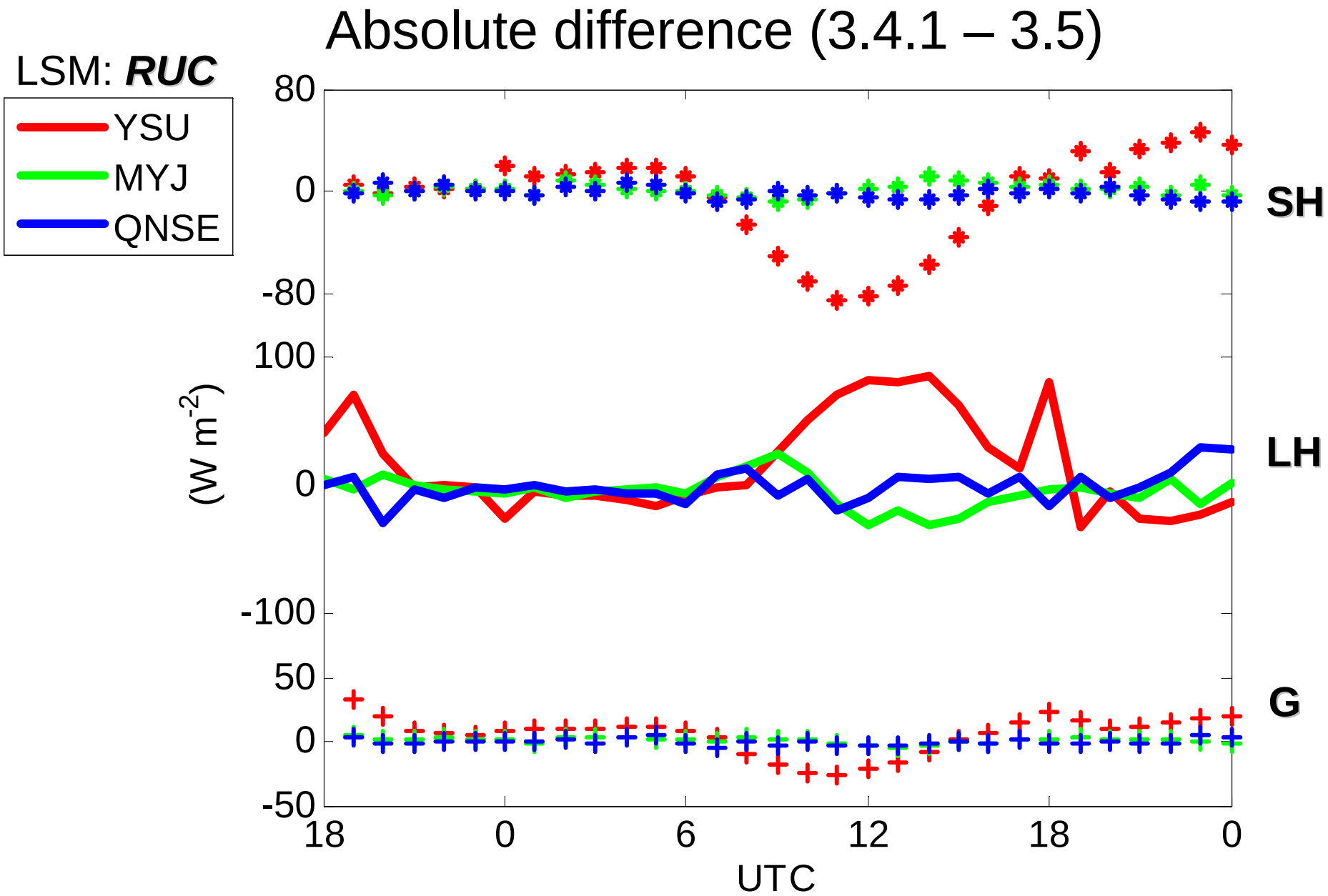
VERTICAL PROFILES: **WIND MODULE**

Fixed LSM: ***NOAH***



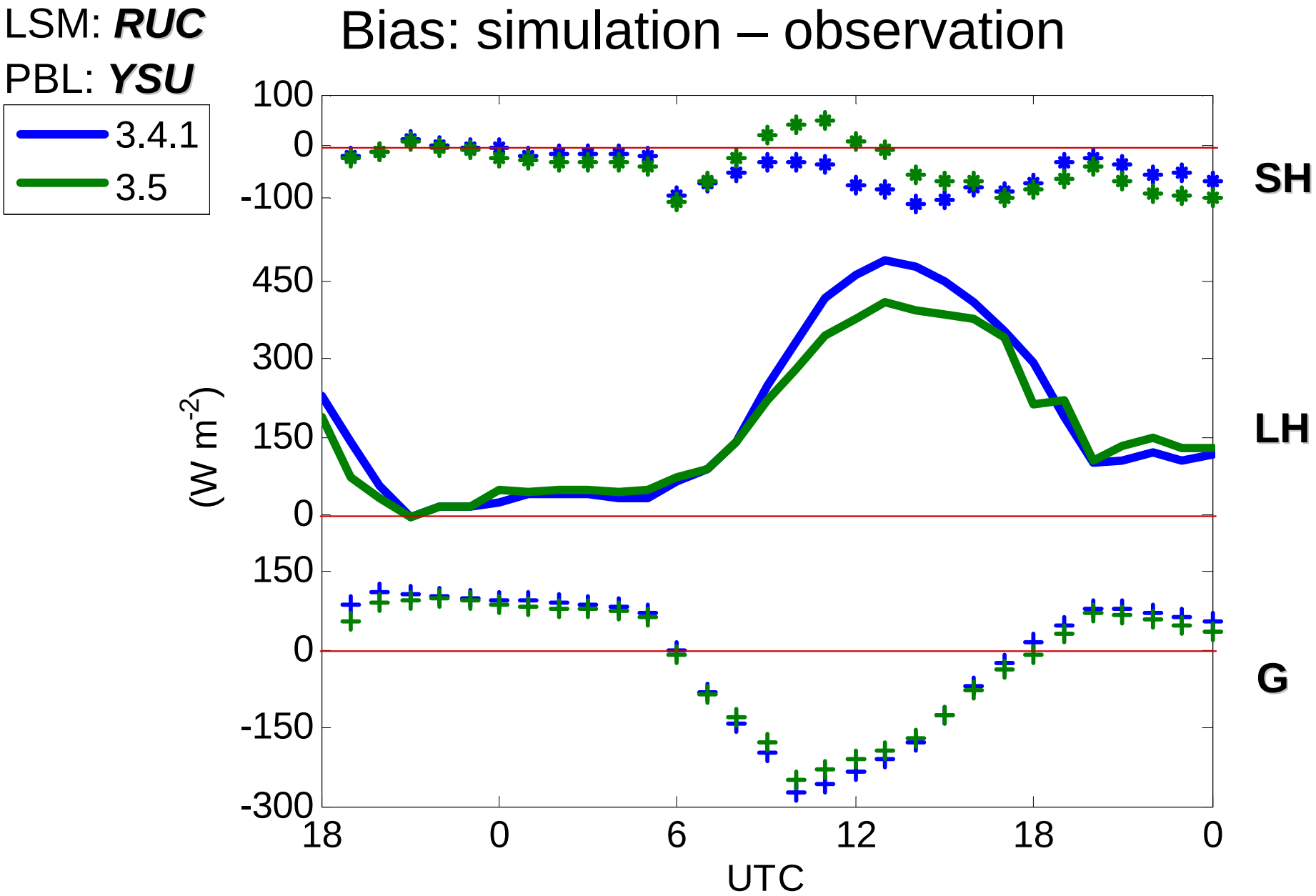
24-Jun, 23 UTC

3.4.1 vs. 3.5 version



3.4.1 vs. 3.5 version

LSM: ***RUC***
PBL: ***YSU***



Conclusions

- Combined simplest schemes of PBL (**YSU**) and LSM (simple **5-layers**) provide as a whole better results.
- There is more **sensitivity** to changes in LSM for a fixed PBL than the opposite.
- A **larger spin-up** might be advisable for some combinations of LSM and PBL.
- Version **3.5** is found to perform similarly to **3.4.1** (or slightly better) for the cases studied.

Future work

- Understand latent heat disagreement
- Compare with 60-m tower data (larger footprint?)
- Test other case studies
- Simulate gravity wave events
- Other suggestions?