BLLAST workshop 2016 - Wageningen

WRF evaluation on atmospheric boundary-layer transitions and diurnal cycles

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Overview

Modelling the late-afternoon and evening transition: WRF
Two BLLAST days for validation: 24 and 25 June 2011

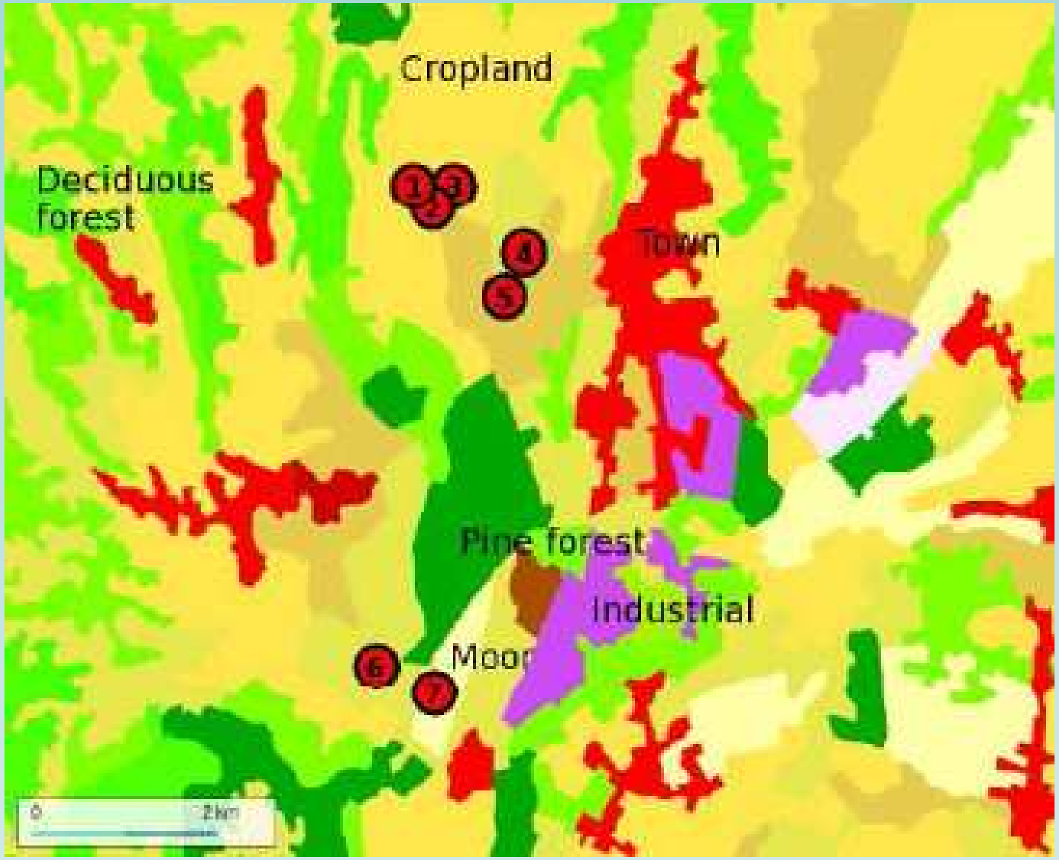
- Experiments on WRF sensitivity to LSM and PBL during the transition.
- Study the influence of varying the number of domains and the domain size.
- Study the effect of initializing soil variables temperature and moisture using self-spinup.

[Angevine et al., 2014]

Model settings

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

Observations

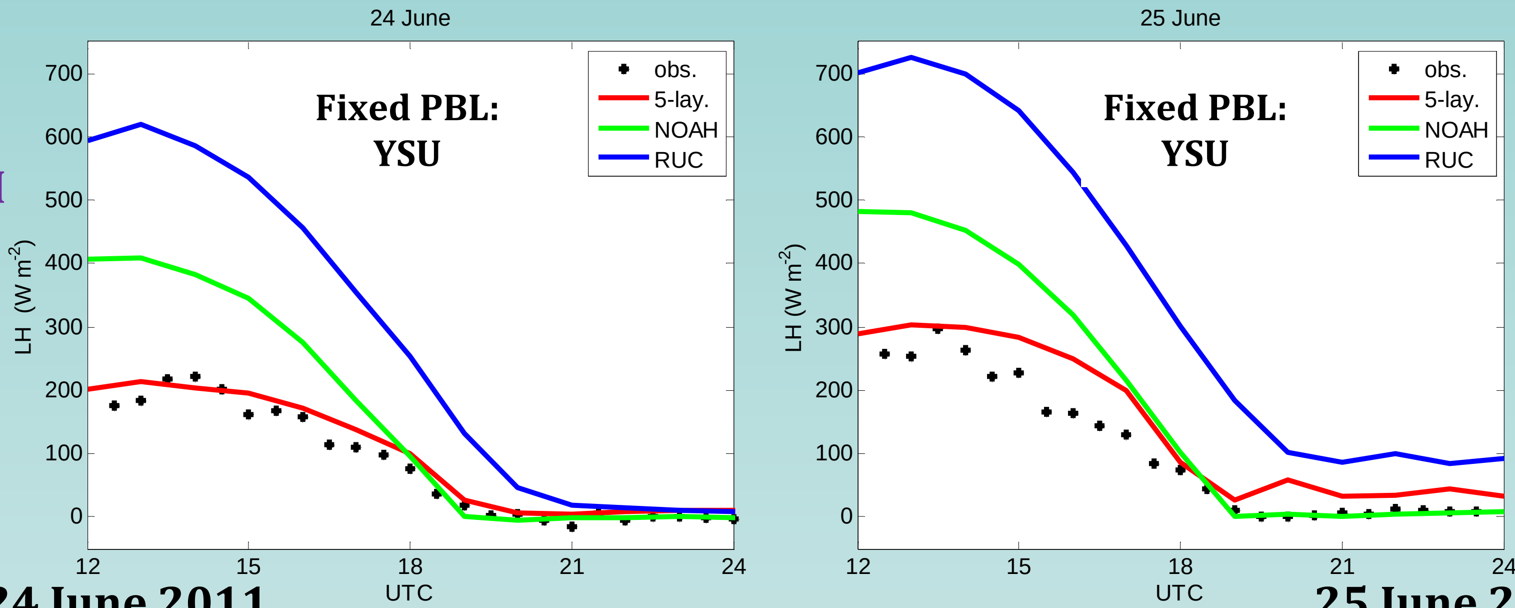

Cropland
Deciduous forest
1
2
3
4
5
Town
Pine forest
Industrial
Moor
6
7
0
2km

[Pietersen et al., 2015]

Sensitivity to PBL and LSM

Latent heat flux

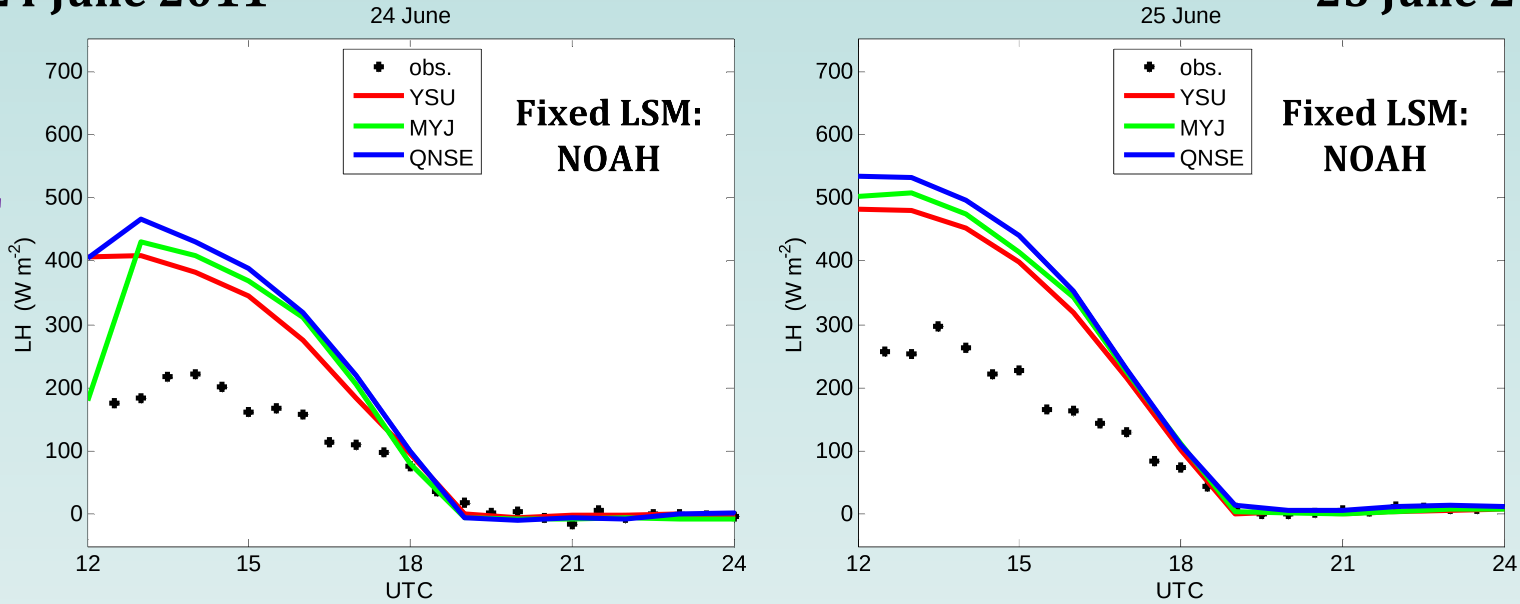
Fixing PBL, varying LSM



24 June 2011

25 June 2011

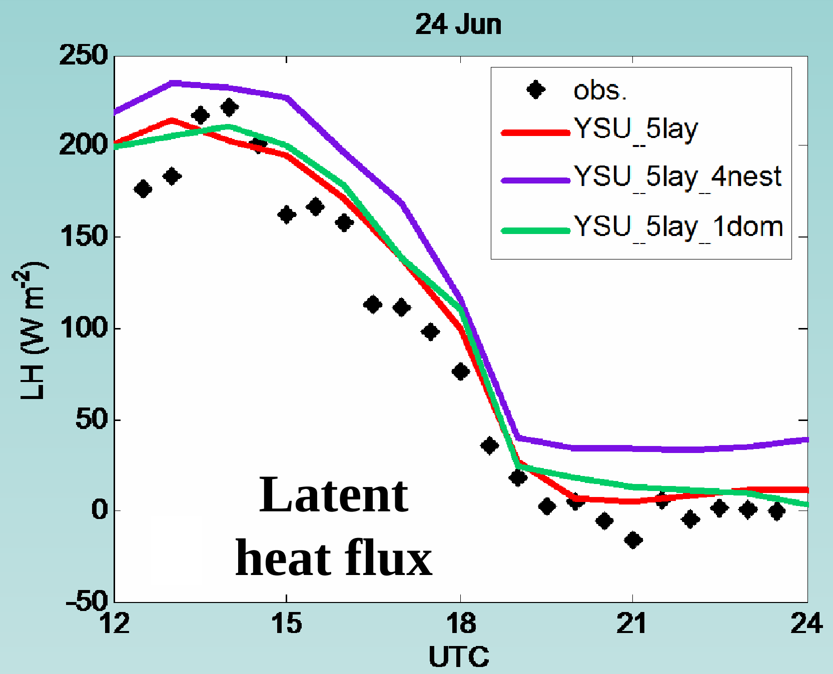
Fixing LSM, varying PBL

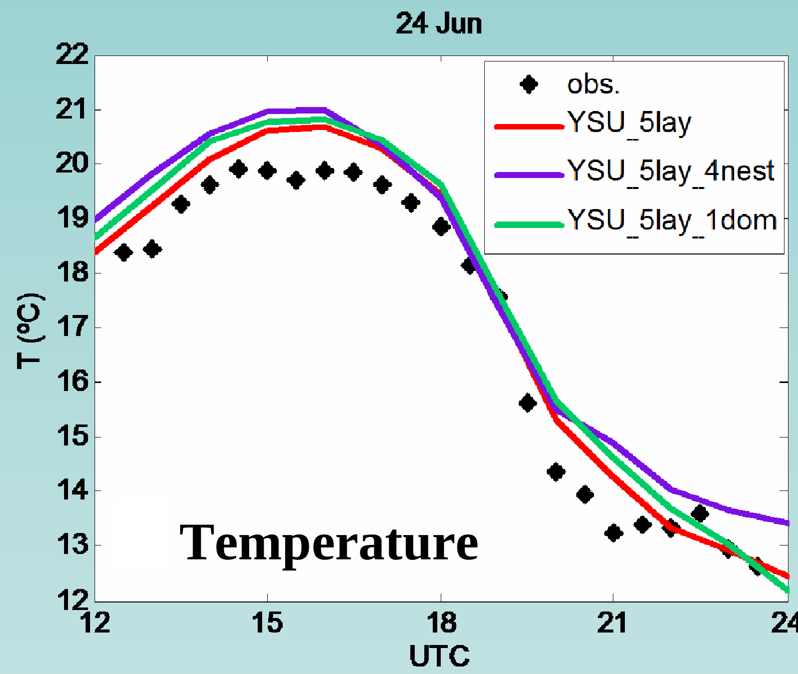


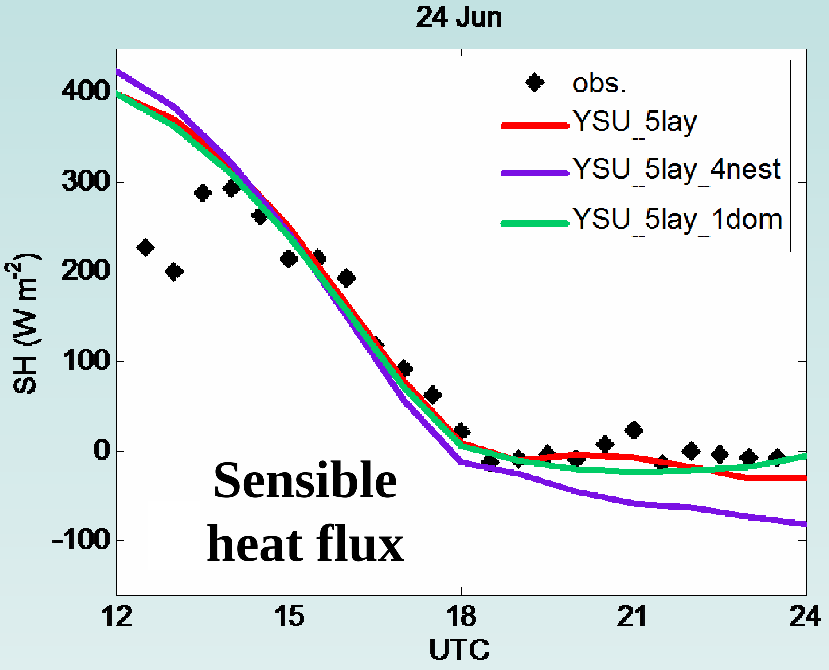
Model settings

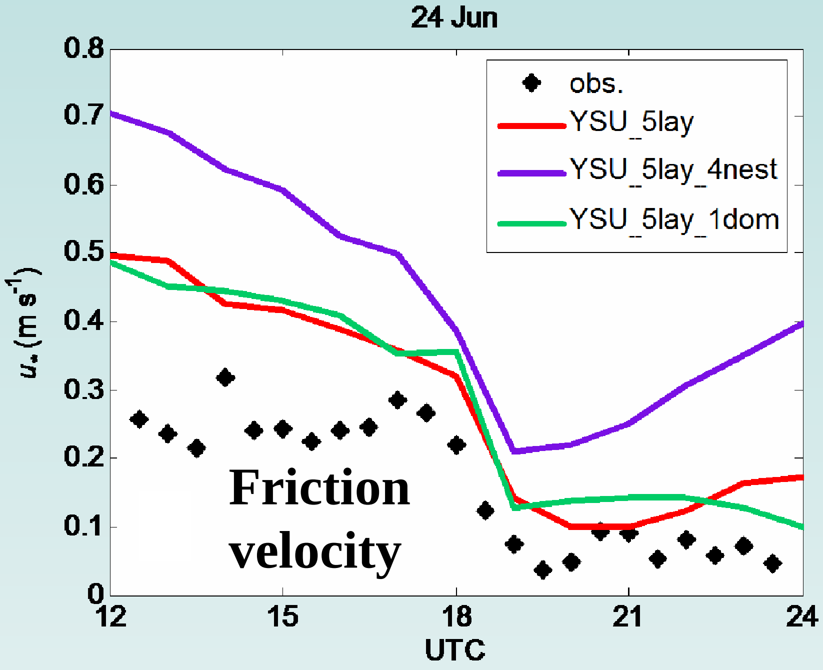
	YSU_5lay	YSU_5lay _4nest	YSU_5lay _1dom	YSU_5lay _SS
Spinup	12 h	12 h	12 h	Self spinup
Number of domains	3 (nested)	4 (nested)	1	3 (nested)
Horizontal resolution	1 – 3 – 9 km	1 – 3 – 9 – 27 km	2.5 km	1 – 3 – 9 km
Number of grid points per domain	100×100	100×100 60×60 (larger domain)	300×300	100×100
Vertical resolution	50 vertical levels (eta)			
SW radiation	Dudhia			
LW radiation	RRTM			
Microphysics	WSM3			

Number of domains and domain size



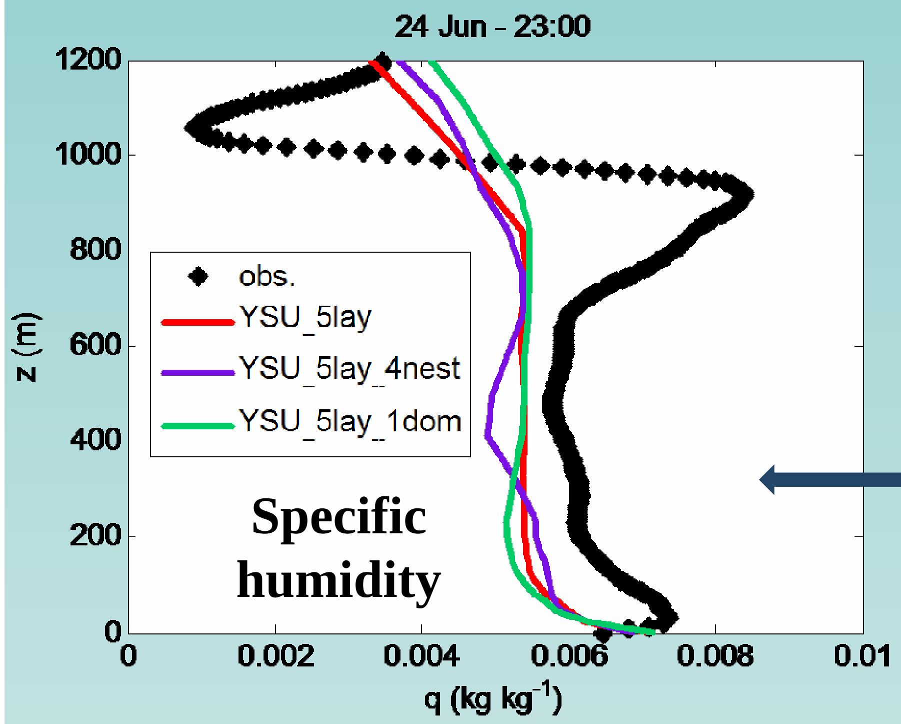


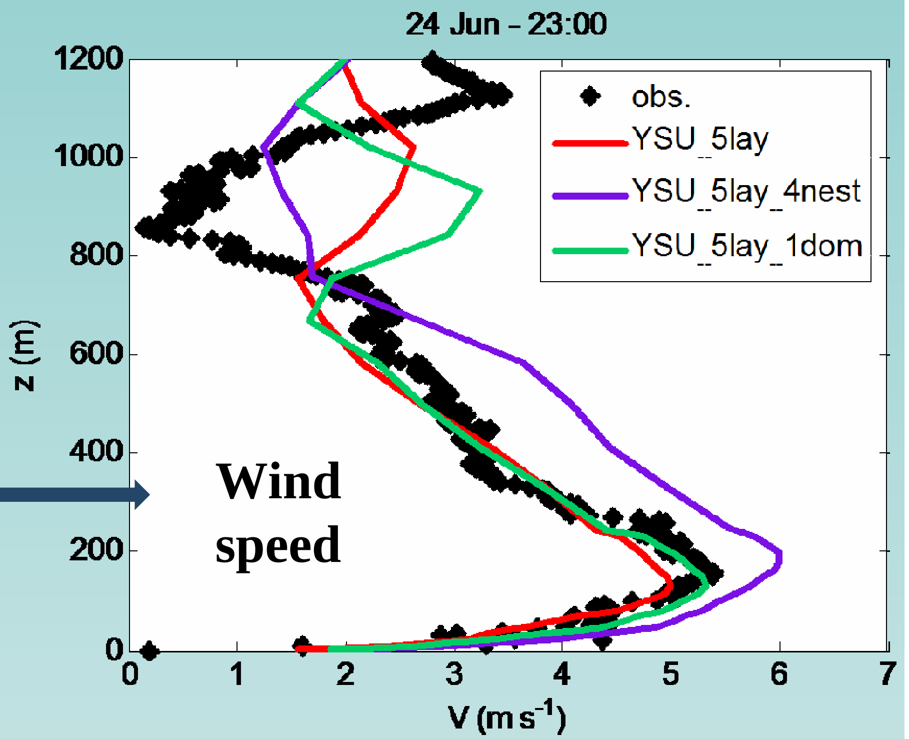


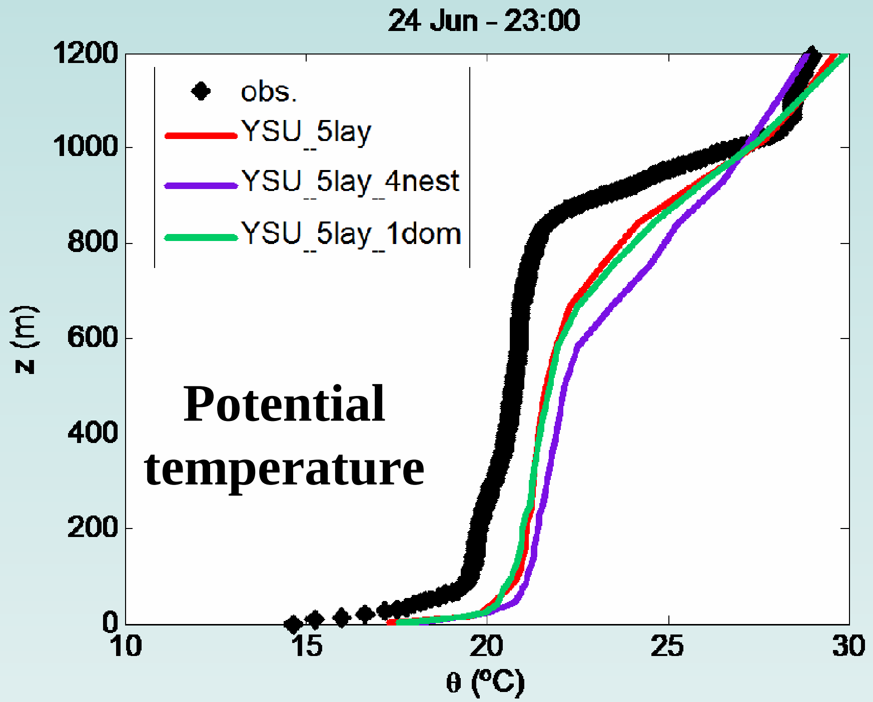


Number of domains and domain size

Vertical profiles 23:00 UTC

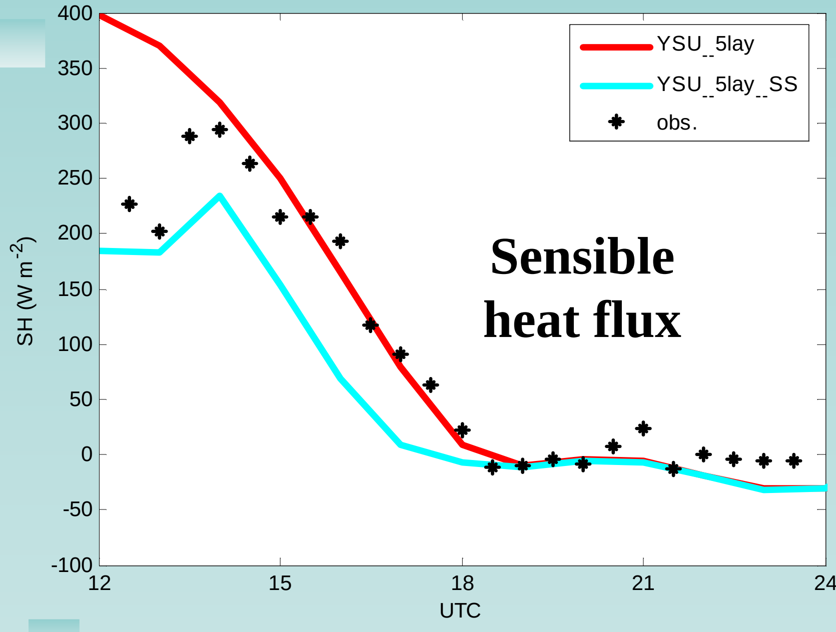


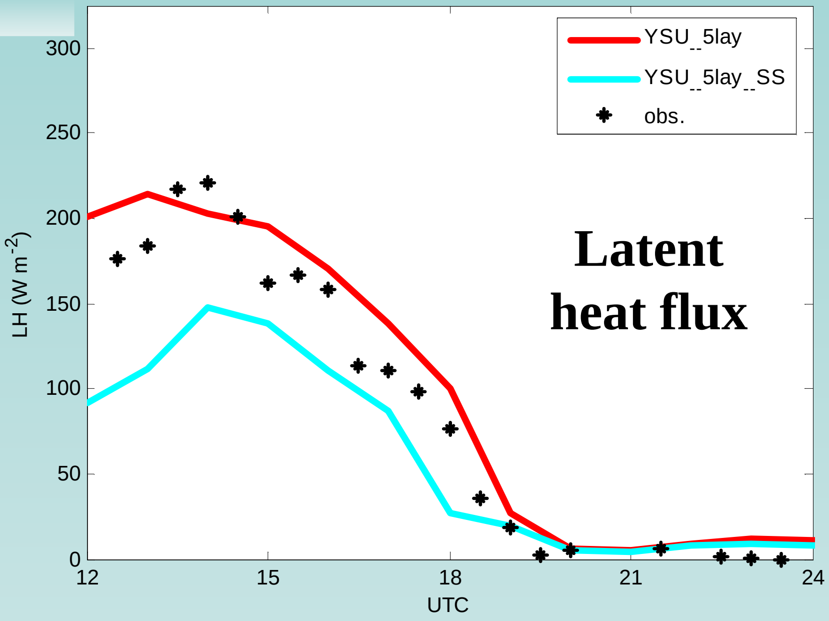


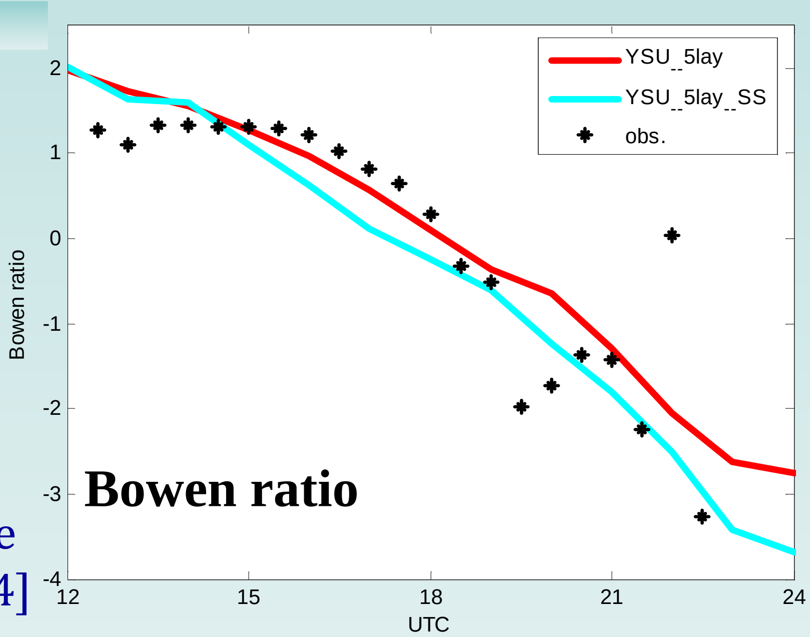


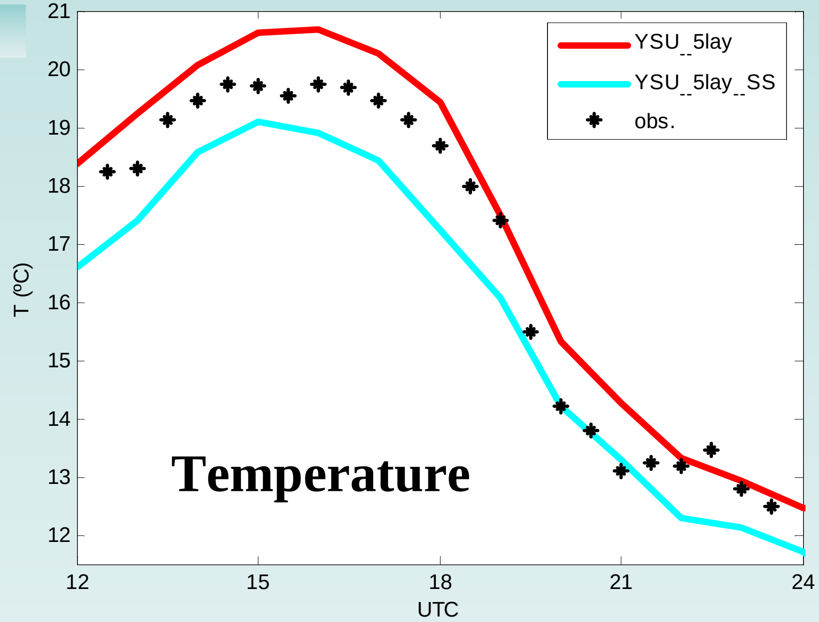
Soil moisture and temperature self spinup

24 June 2011


Sensible heat flux


Latent heat flux

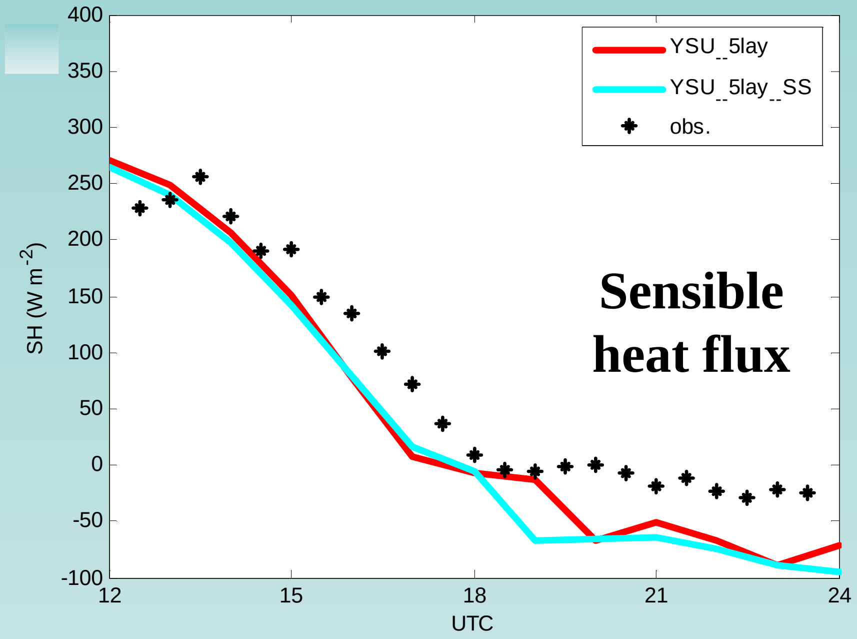

Bowen ratio

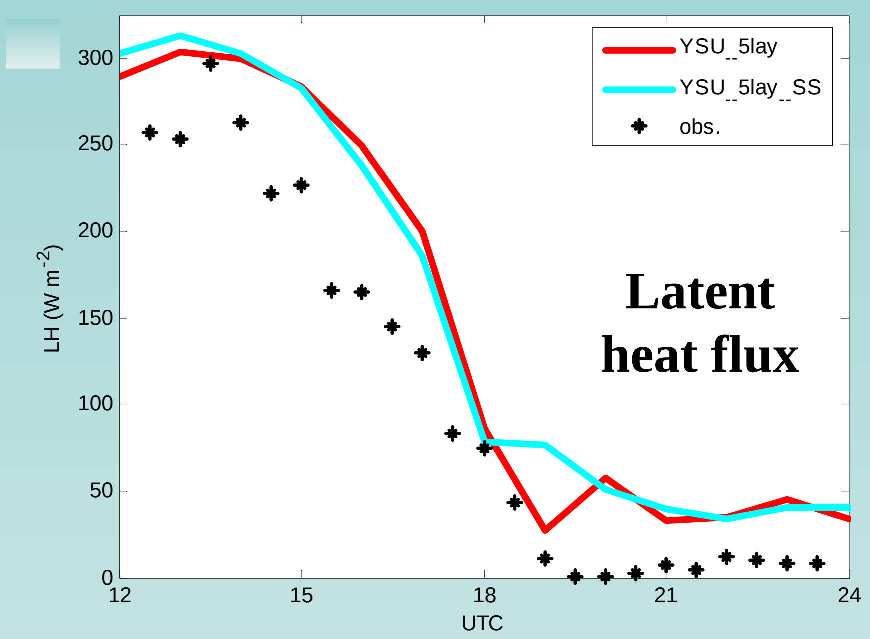

Temperature

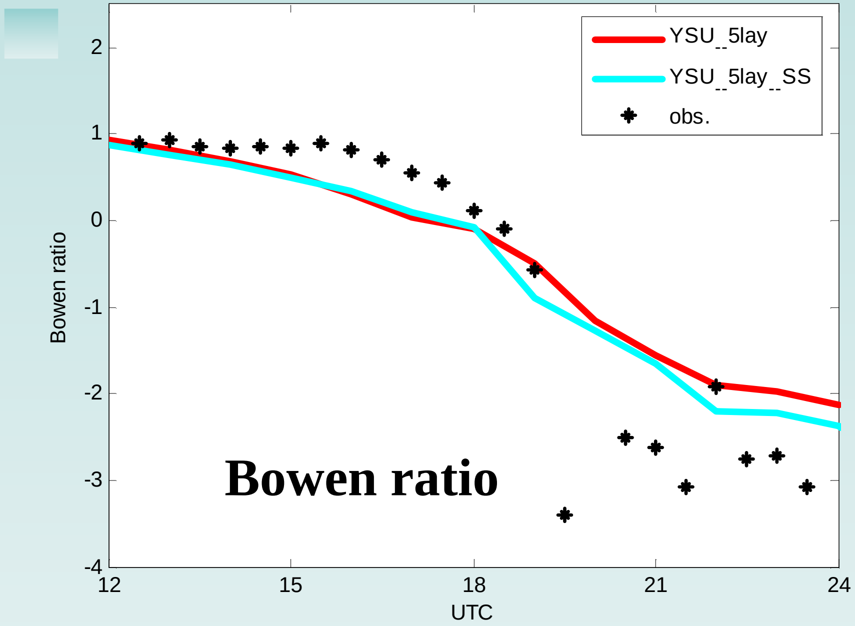
[Angevine et al., 2014]

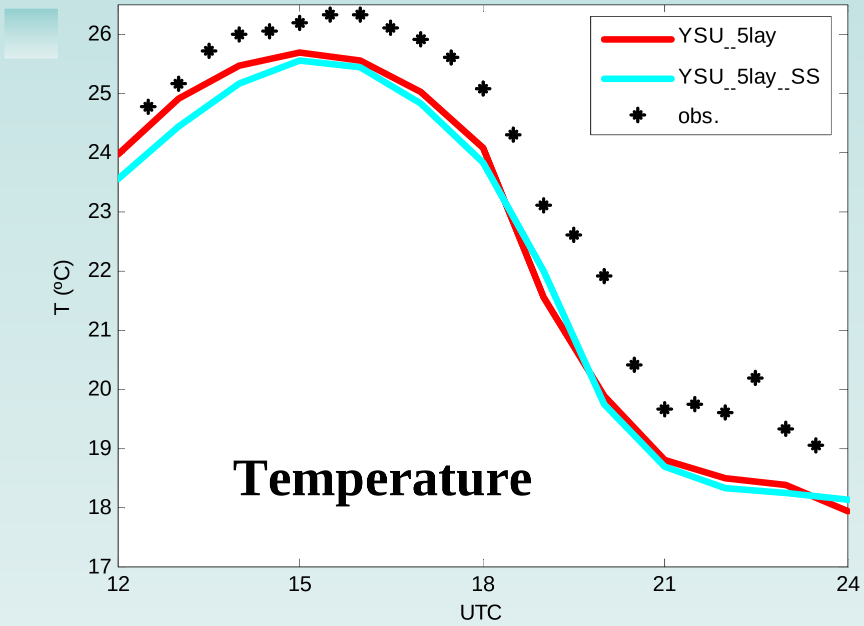
Soil moisture and temperature self spinup

25 June 2011









Ensemble of simulations?

1 obs. vs. all 12 simulations

Sensitivity to PBL and LSM	
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9 SIMULATIONS

Other experiments

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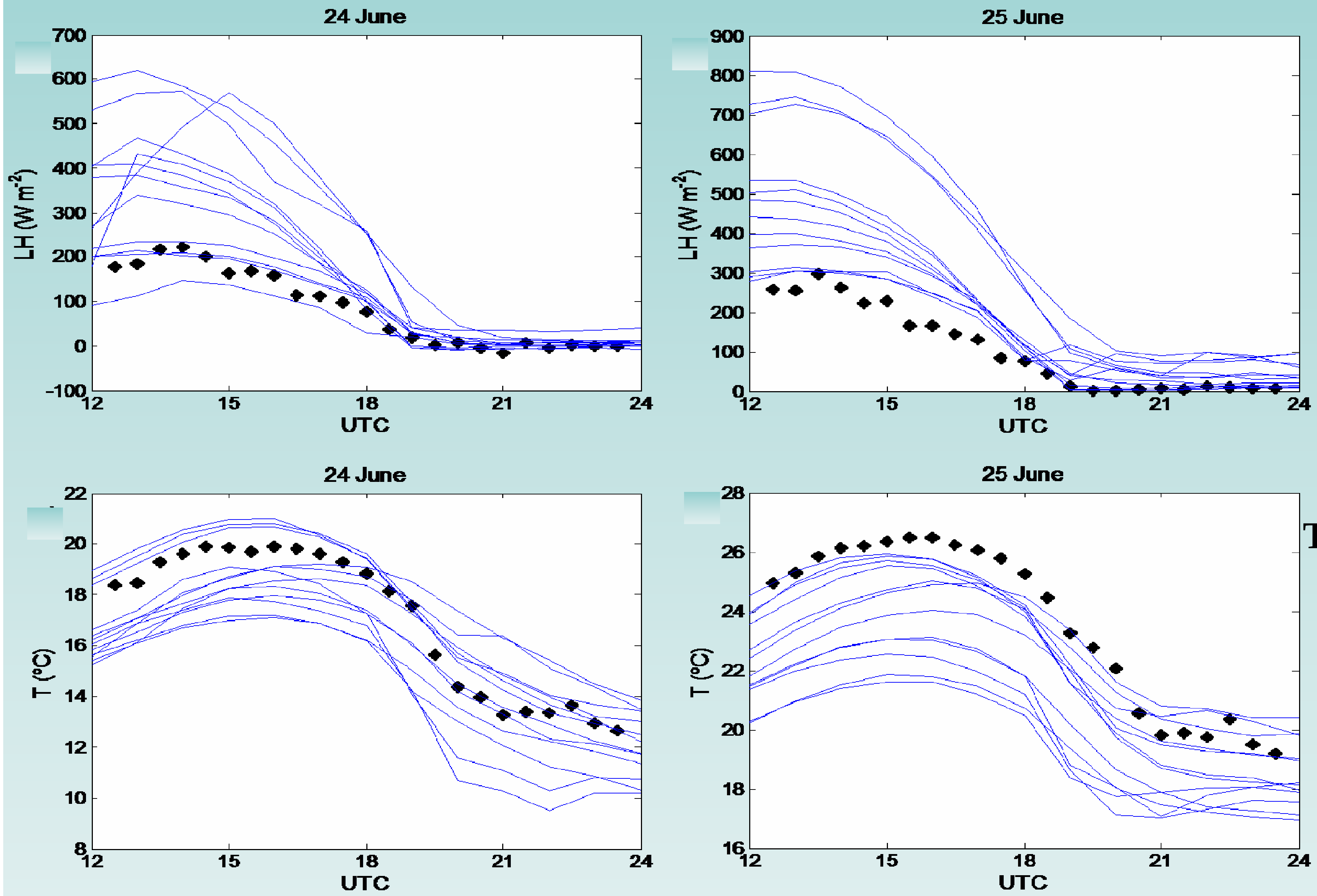
3 SIMULATIONS

Ensemble of simulations?

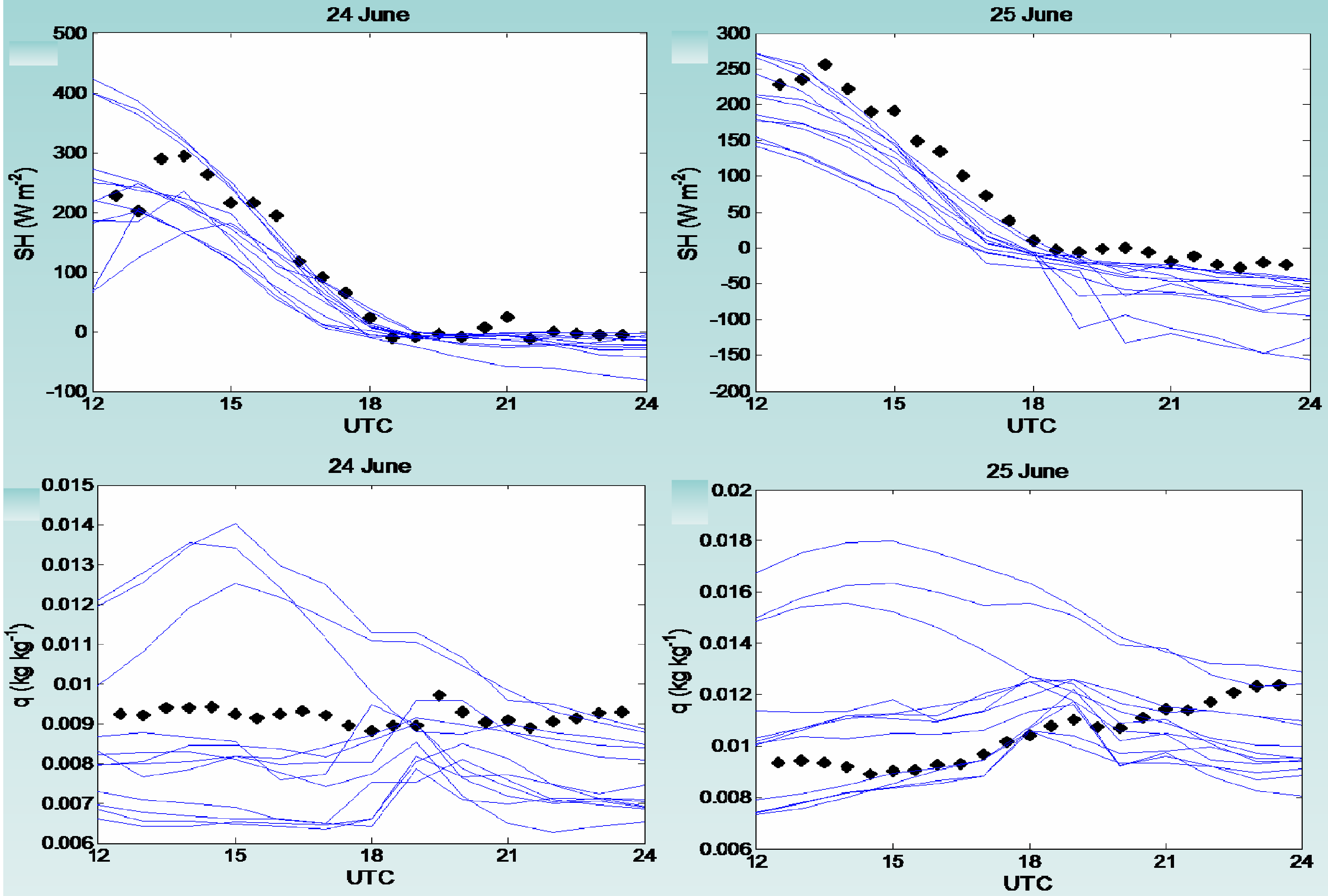
1 obs. vs. all 12 simulations



Latent heat flux

Temperature

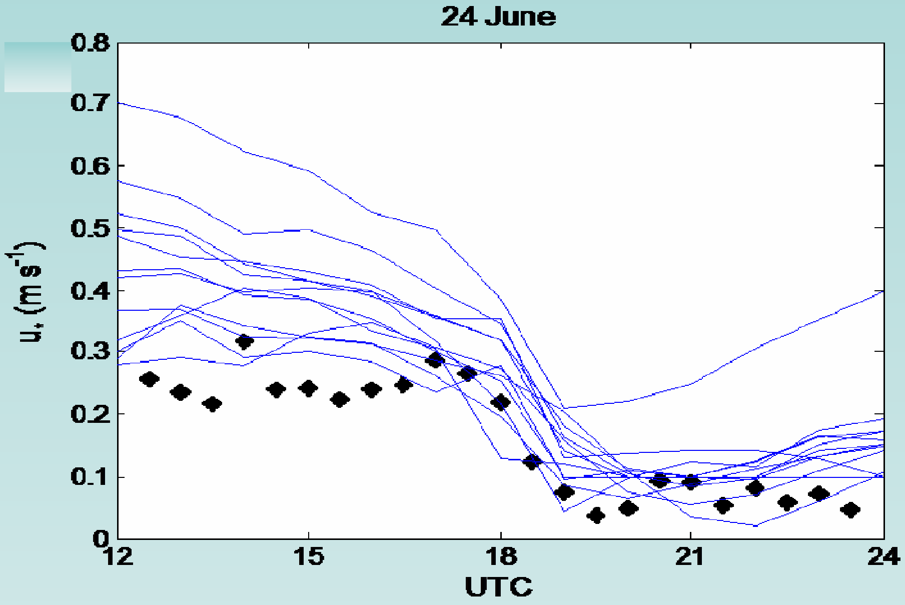
1 obs. vs. all 12 simulations

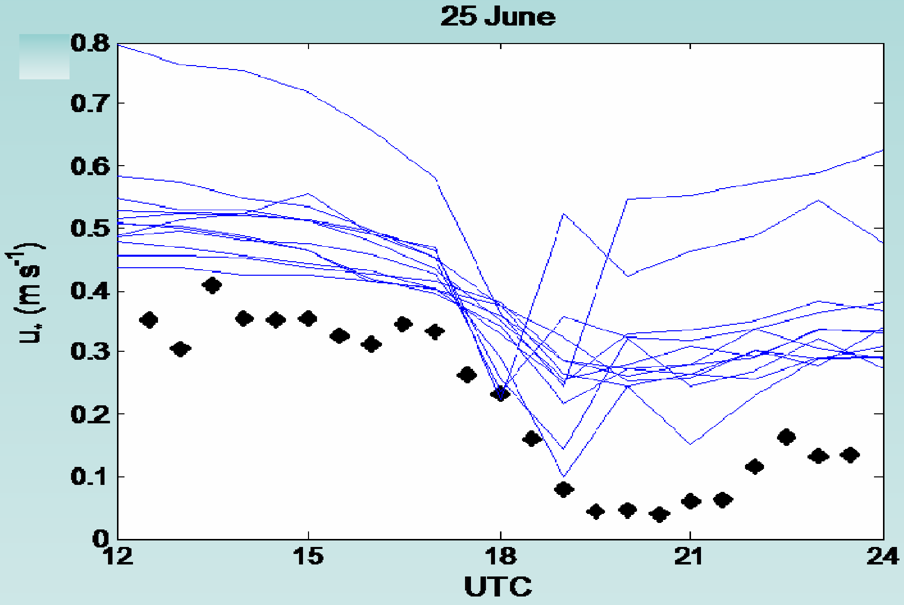


Sensible heat flux

Specific humidity

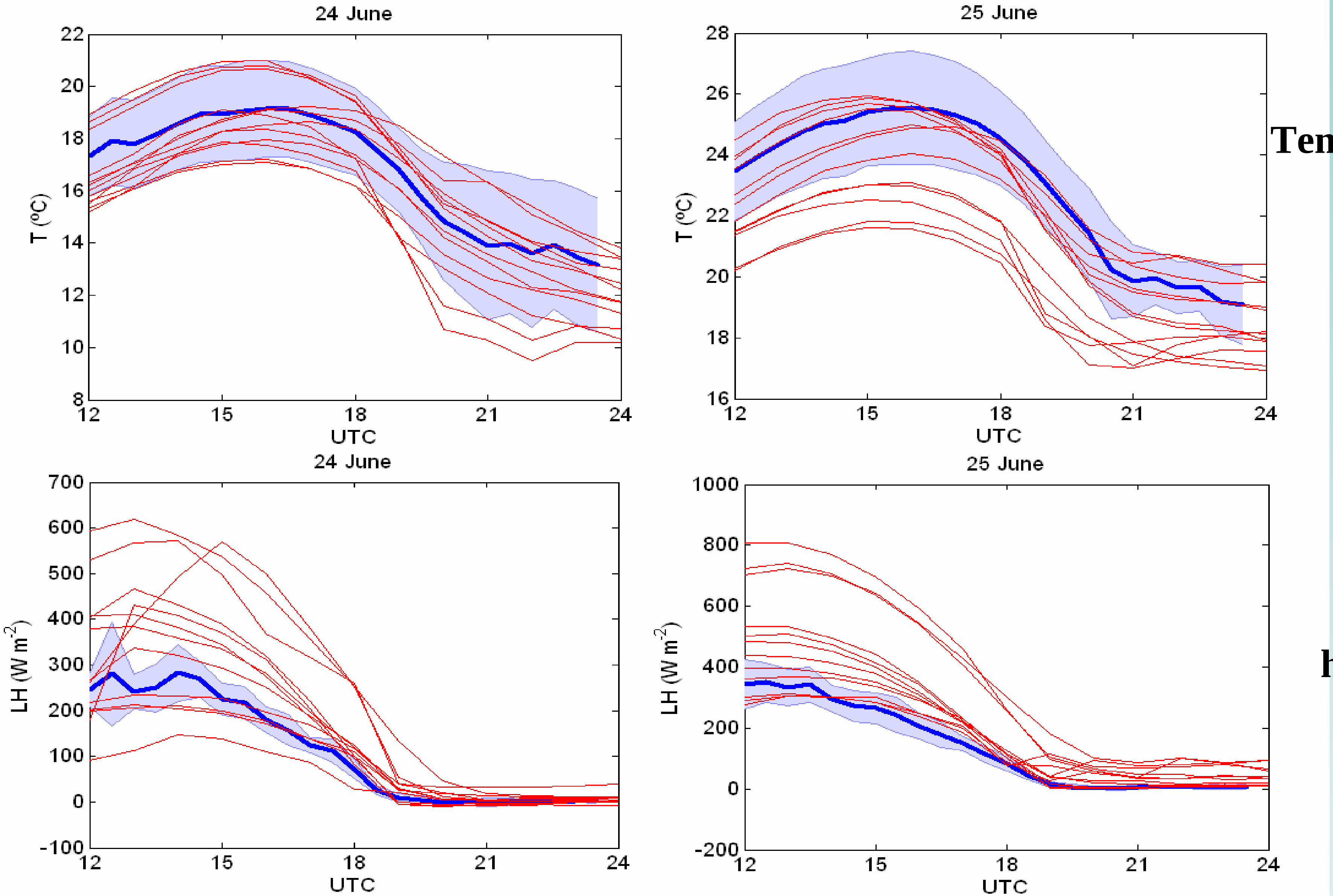
1 obs. vs. all 12 simulations





Friction velocity

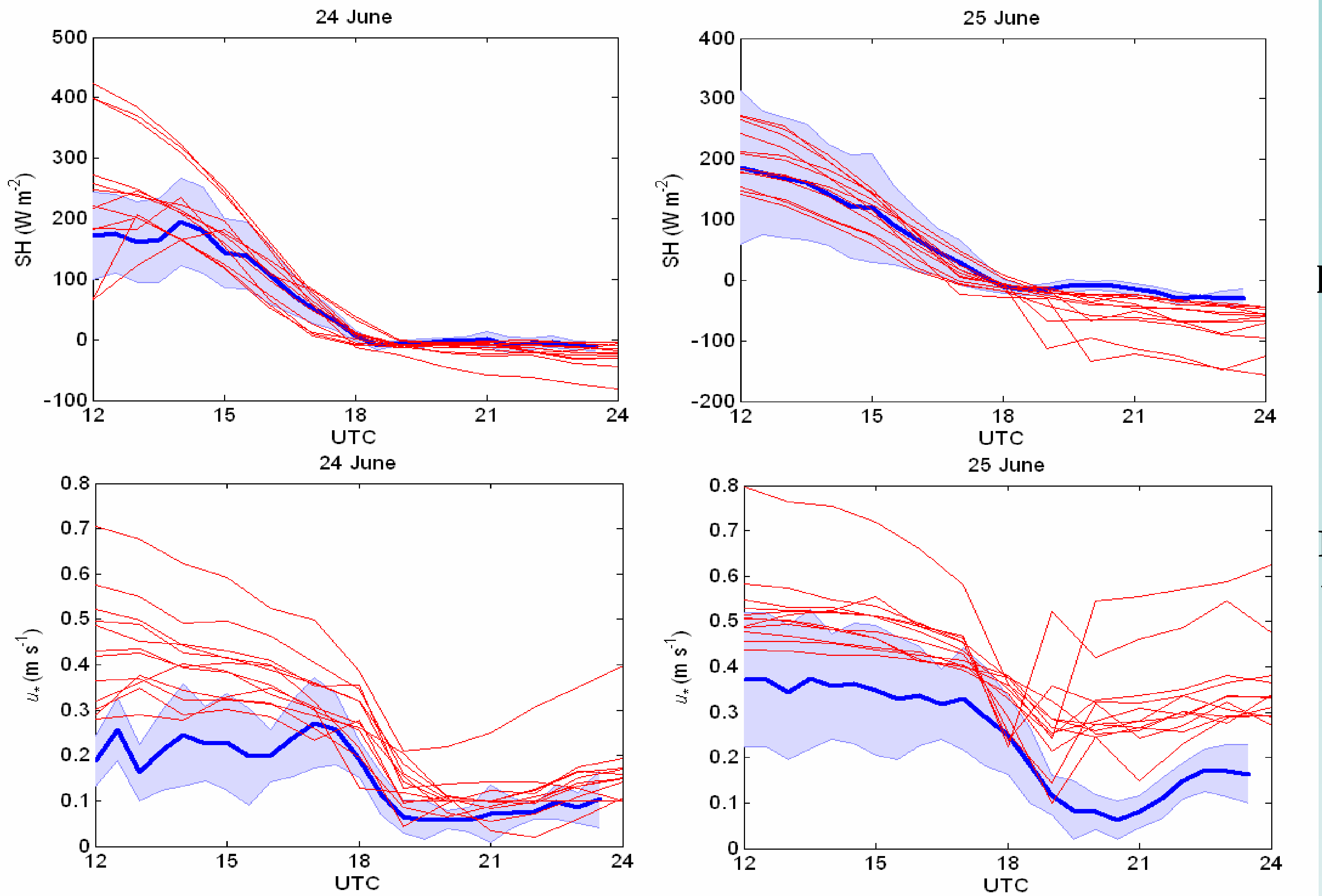
Average of observations vs. all 12 simulations



Temperature

Latent heat flux

Average of observations vs. all 12 simulations



Sensible heat flux

Friction velocity

Summary and conclusions

- WRF simulations show more sensitivity to changes in the LSM scheme for a fixed PBL than opposite, making a convenient LSM election very relevant to obtain appropriate simulation results.

- A combination of relatively simple PBL (YSU) and LSM (5lay) globally provide good results, often closer to observations than other more sophisticated (and computationally expensive) setups.

- Using one-domain simulations result in finer agreement rather than increasing the number of nested domains.

Sastre et al., ACP (BLLAST special issue), submitted

THANK YOU FOR YOUR ATTENTION

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