Contribution to AEVUS-2 PT by RHM & Moscow State University: Key results and recent updates

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and all other contributing colleagues

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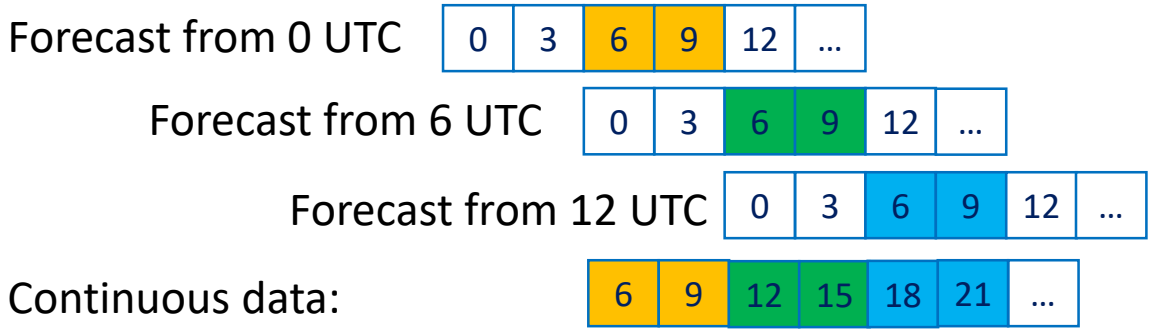
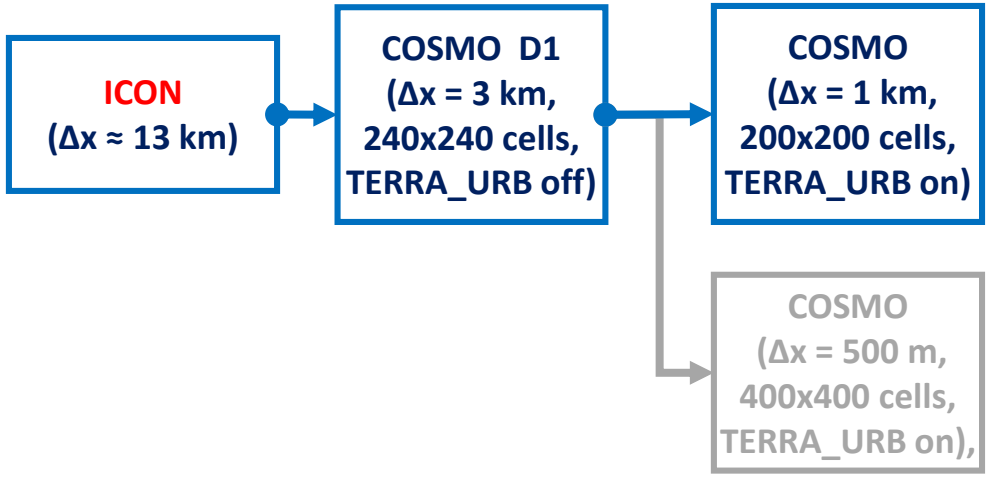
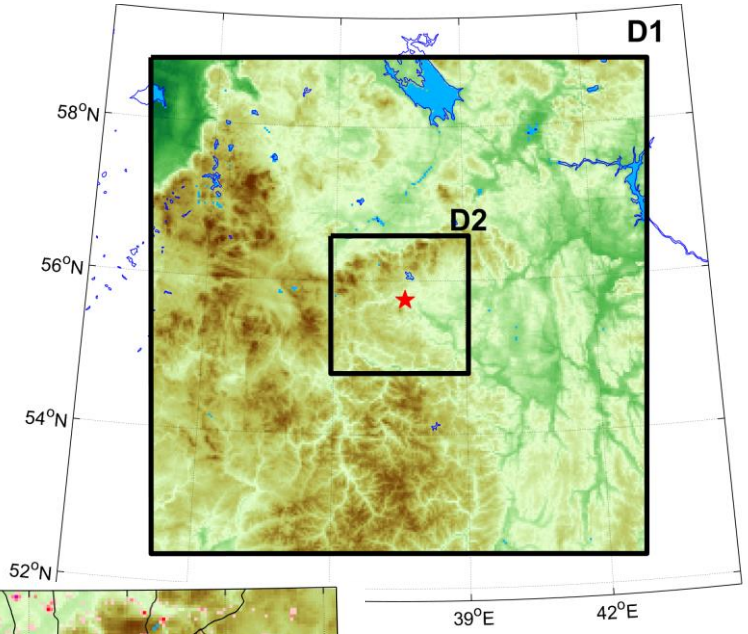
Set up of the recent simulations

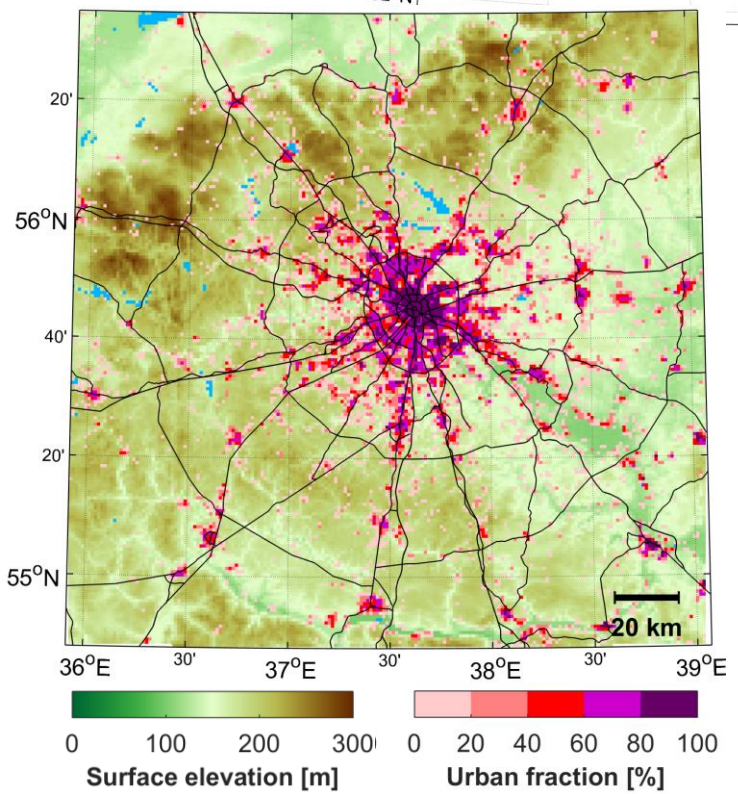
Initial and boundary conditions:
Continuous data set, constructed from ICON forecasts for 3 and 6 hours:



Scheme of dynamical downscaling:







Case studies:
1) 5-20 August 2017
2) 1-15 June 2019

Set up of the recent simulations

- ✓ TERRA_URB is always on
- ✓ Namelist settings generally similar to ARPAP's one, with exception for **itype_aerosol** (2 instead 1), **hcorr_*** parameters (model defaults are used), **llake** (TRUE instead FALSE) and some parameters for new turbulence

For common AEVUS paper?

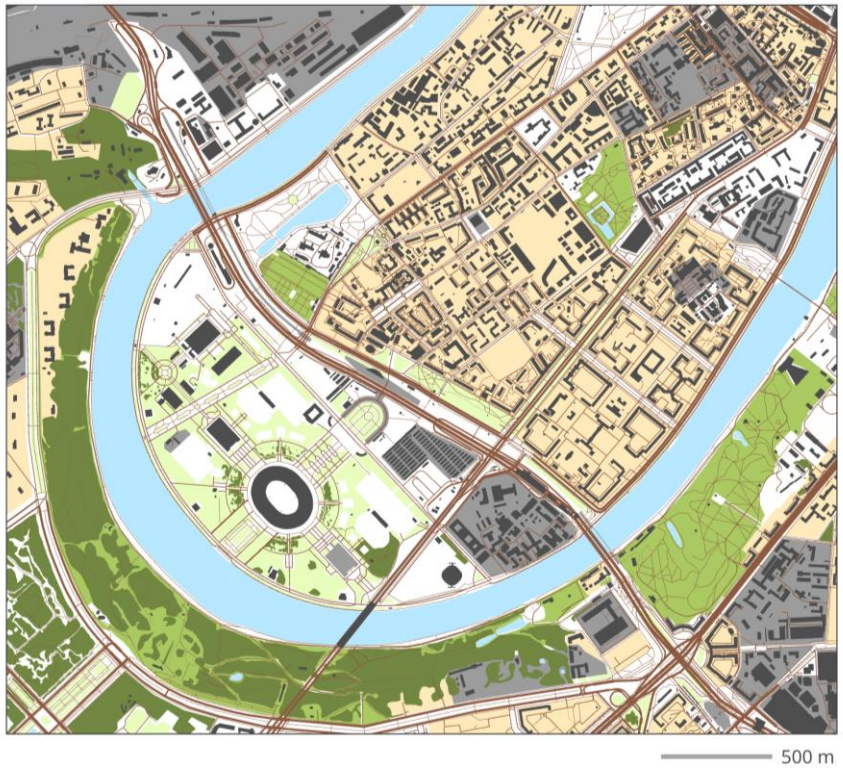
Simulation number	Turbulence	Itype_canopy	Itype_vdif	Urban canopy parameters	Urban thermal parameters
AEV1	Old	1	-1	Detailed "local" data set based on Opensteetmap, CGLC & Sentinel data	Defaults from (Wouters et al., 2016)
AEV2	Old	2	-1		
AEV3	New*	1	-1		
AEV4	New*	2	-1		
AEV5	New*	2	1		
AEV5a	New*	2	1		Modified values based on literature review
AEV5b	New*	2	1	LCZ-based data from Mathias	

*Settings for "new turbulence" include **pat_len**=100 (model default, instead of 750 from User Guide), **c_soil** = 1 (model default, instead of 1.75/1.25 from User Guide)

Urban canopy parameters: custom data set

Based on combined use of different data sets

- Built up fraction area from ***Copernicus Global Land Cover*** with 100 m resolution
- Data on buildings and roads from ***OpenStreetMap***
- Data on vegetation derived from ***Sentinel-2 satellite images*** with 10 m resolution



Trees and grass in 10 m resolution

Copernicus Global Land Service

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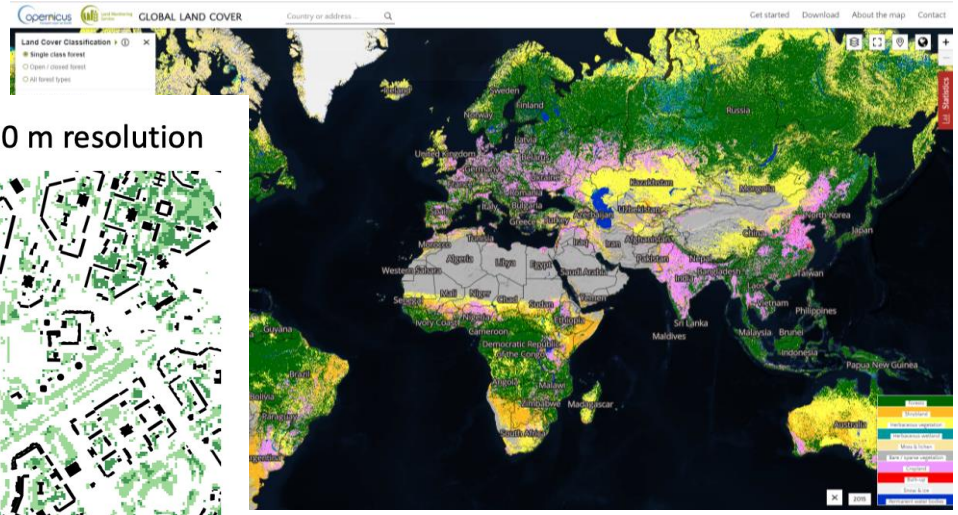
Release of Global 100m Land Cover maps for 2015

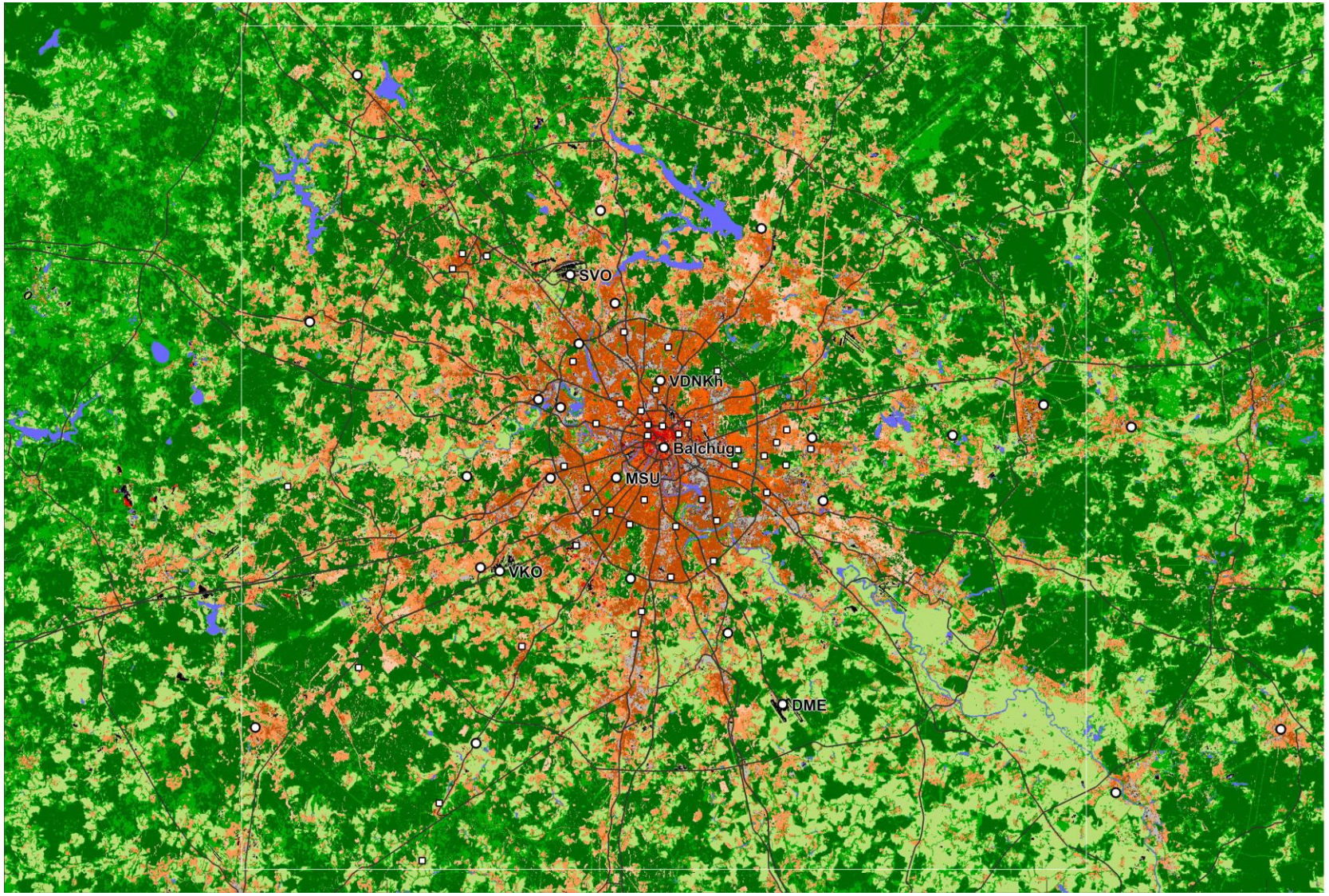
Today, at the occasion of ESA's biggest Earth observation conference, the 'Living Planet Symposium 2019' (Milan, Italy), the Global Land Service team is thrilled to **release** a new set of **Global Land Cover** layers, with an **overall 80% accuracy**:

- a complete, **discrete classification with 23 classes**
- **fractional cover layers** for the **ten** base land cover classes: forest, shrub, grass, moss & lichen, bare & sparse vegetation, cropland, built-up / urban, snow & ice, seasonal & permanent inland water bodies.
- a **forest type layer** offering twelve types of forest
- **quality indicators** for input data (data density indicator), for the discrete map (probability) and for six of the fractional cover layers.



(Samsonov, Varentsov, 2020, submitted)

Urban canopy parameters: LCZ-based data set



LCZ type

1	Compact high-rise
2	Compact midrise
3	Compact low-rise
4	Open high-rise
5	Open midrise
6	Open low-rise
7	Lightweight low-rise
8	Large low-rise
9	Sparsely Built
10	Heavy Industry
A	Dense trees
B	Scattered trees
D	Low plants
E	Bare rock or paved
G	Water
	Major highways and streets

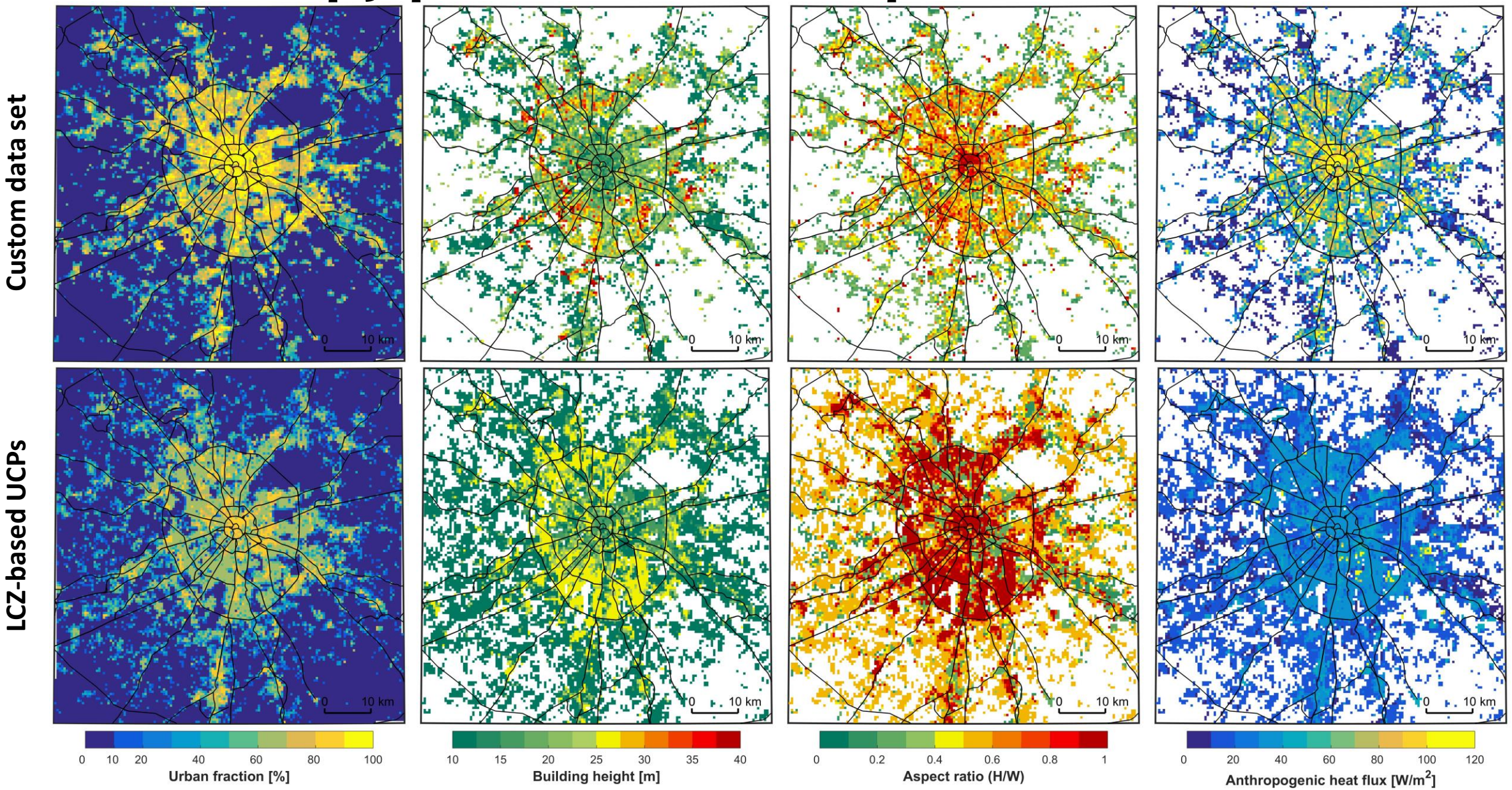

Open high-rise


Sparsely built


Low plants

LCZ map for Moscow region from (Samsonov, Trigub, 2017) was recently re-classified and extended for a wider area by Matthias Demuzere (Ruhr University Bochum)

Urban canopy parameters: comparison

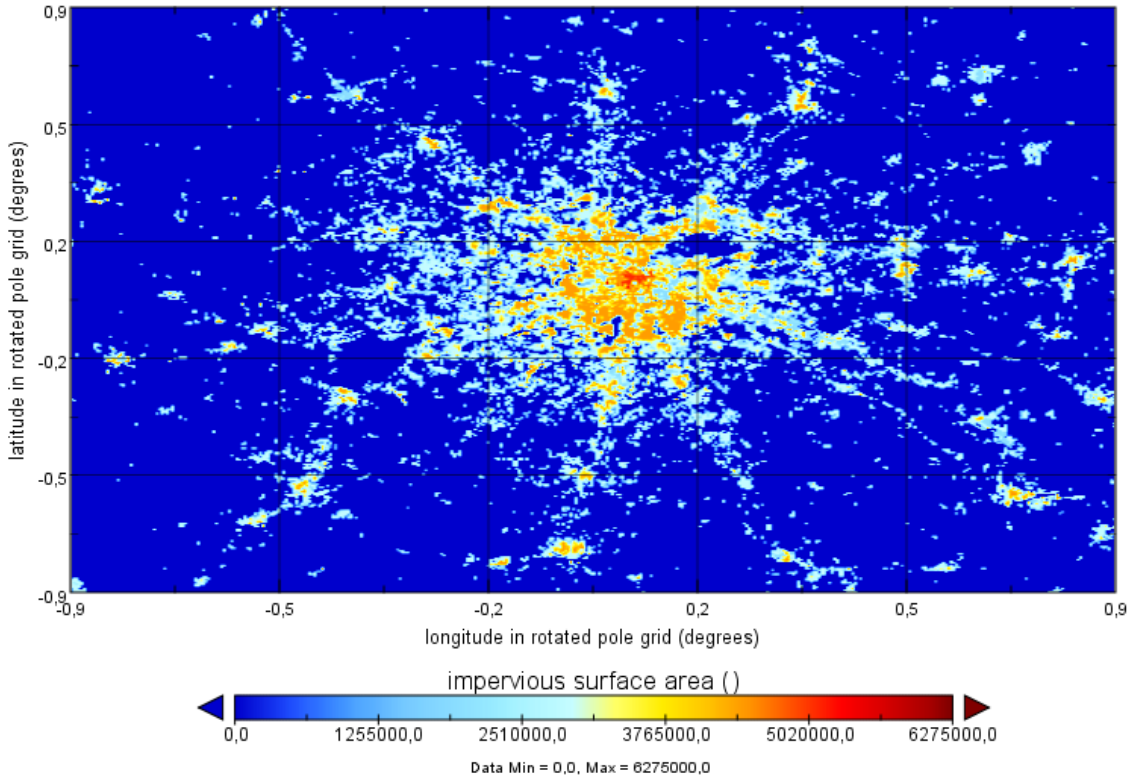


What about urban thermal parameters?

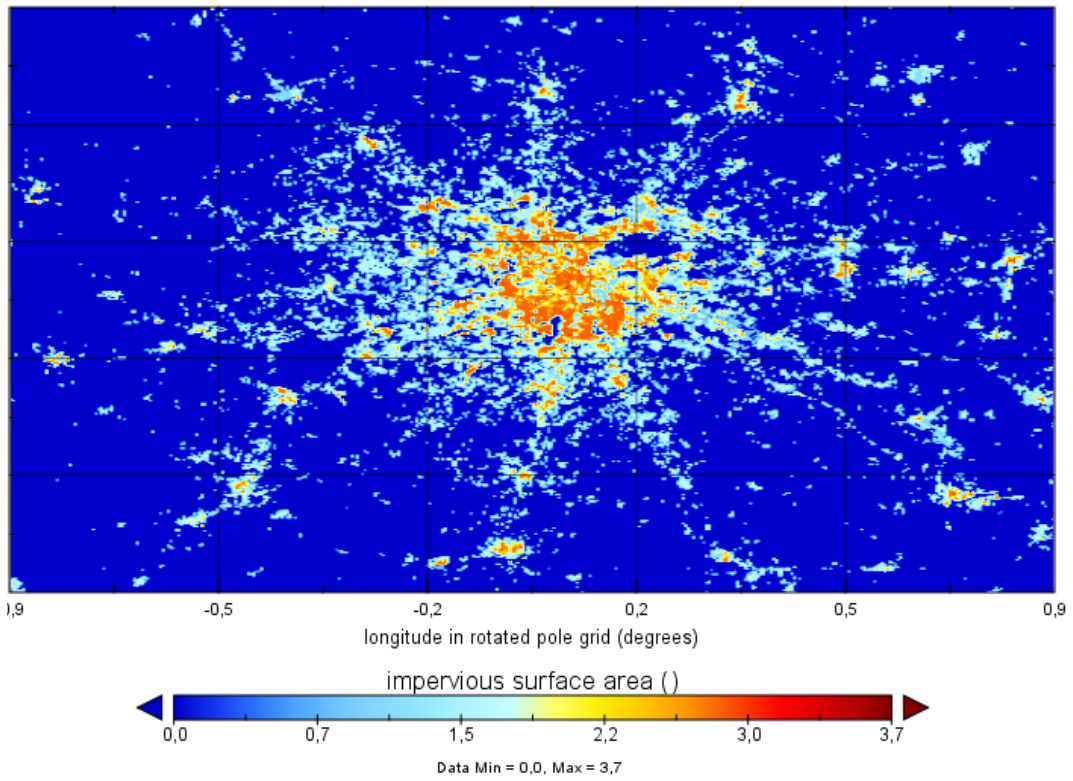
LCZ-based values looks strange, additional check is needed, so not used yet

	default values from (Wouters et al., 2016)	Probably more reasonable values obtained based on literature review for AEV5a run
curb_hcap	1.25*10^6	1.8*10^6
curb_hcon	0.77	0.77
curb_salb	0.1	0.2
curb_tabl	0.14	0.14

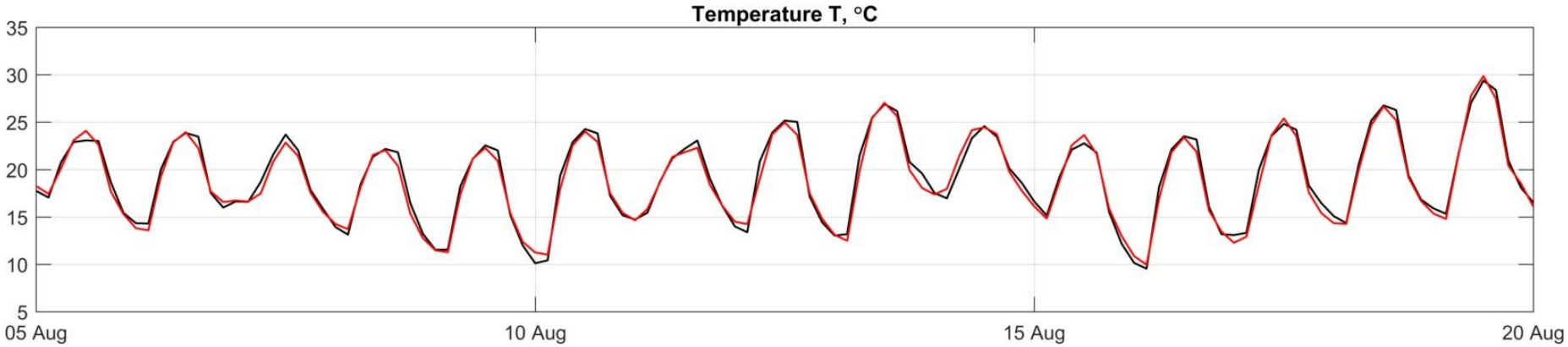
URB_HCAP

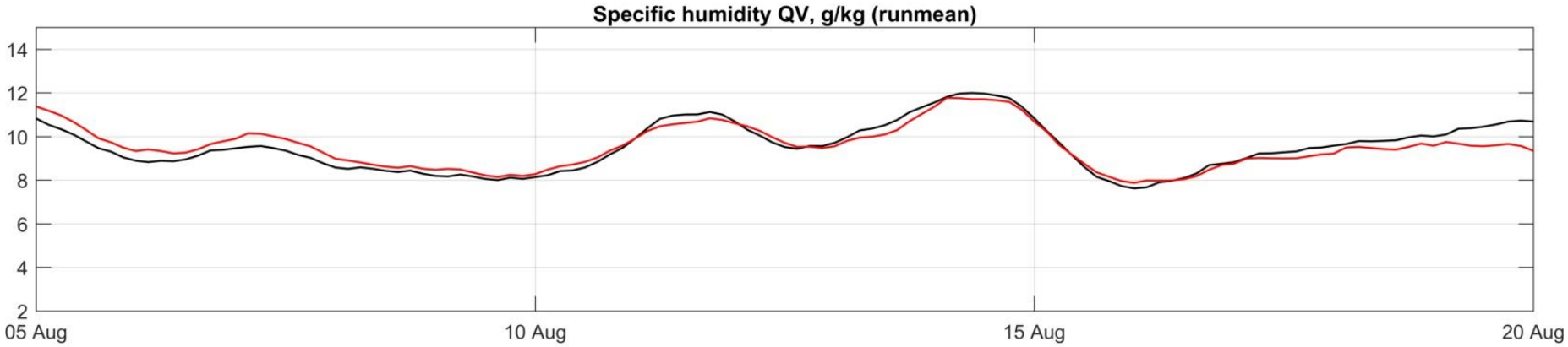


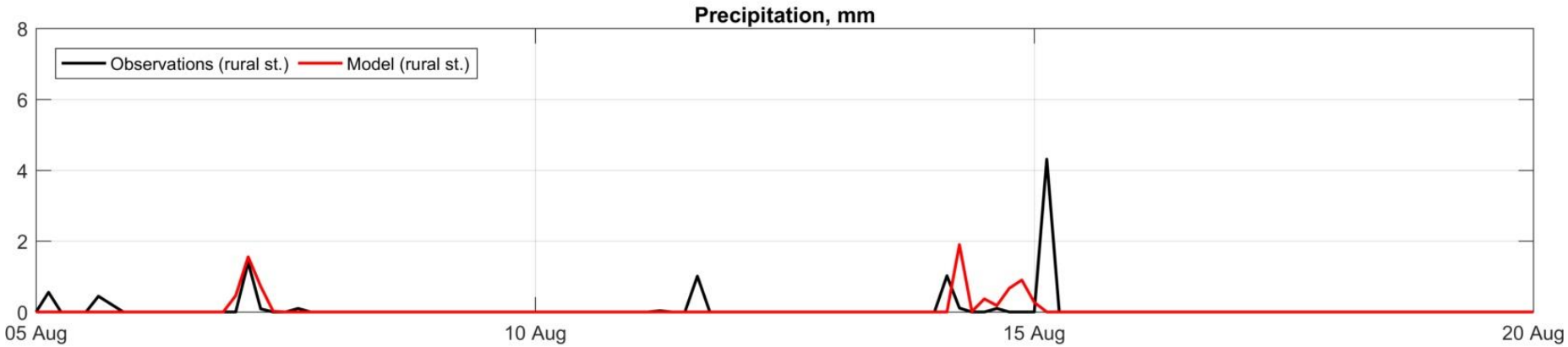
URB_HCON



Basic verification: case 1 (05.08.2017-20.08.2017)

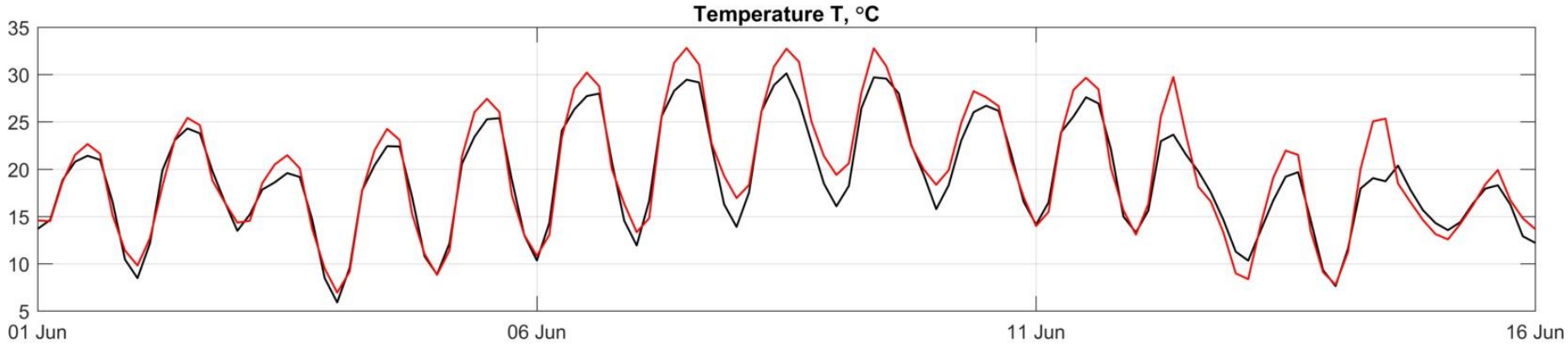


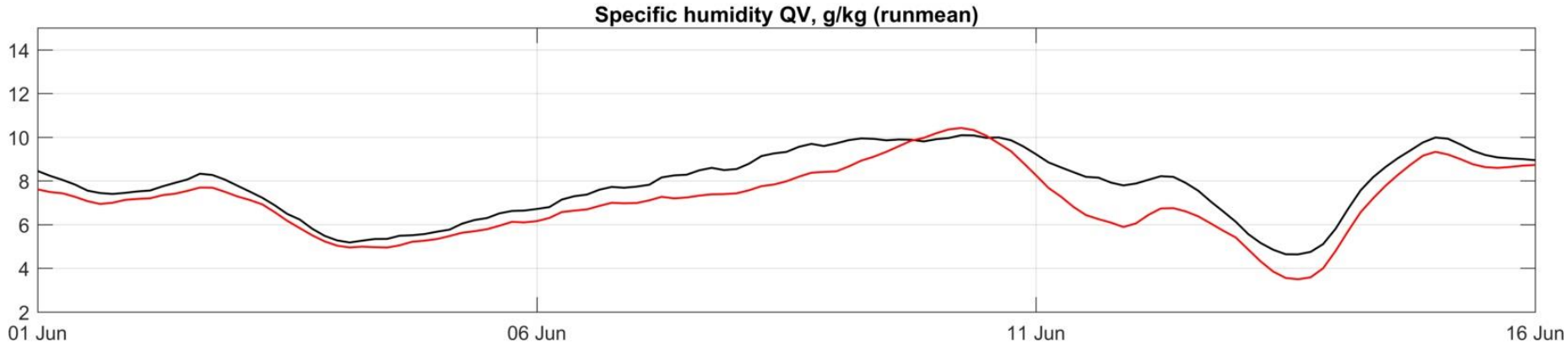


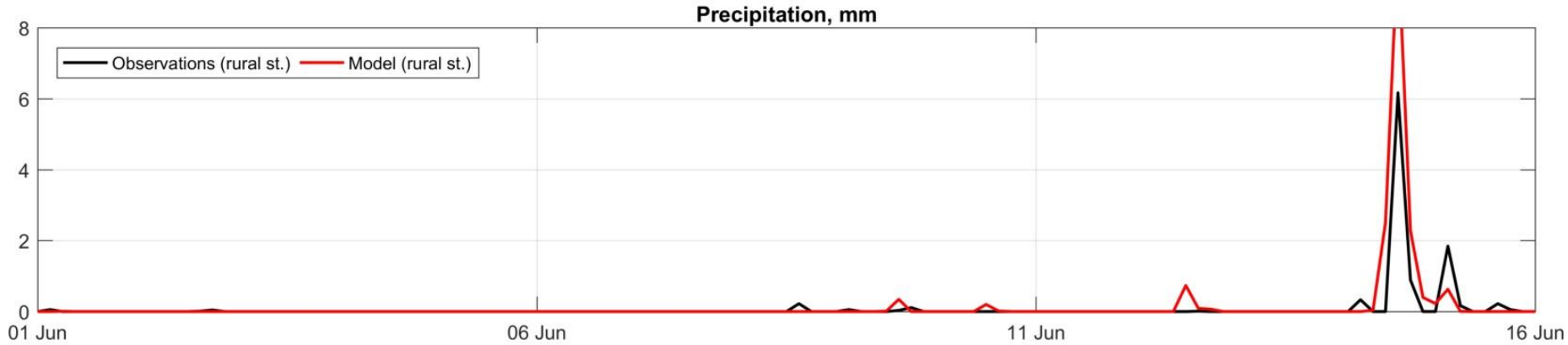


Results for D1 domain (no TERRA_URB), mean values for 9 rural stations, AEV5 simulation

Basic verification: case 2 (01.06.2019-15.06.2019)



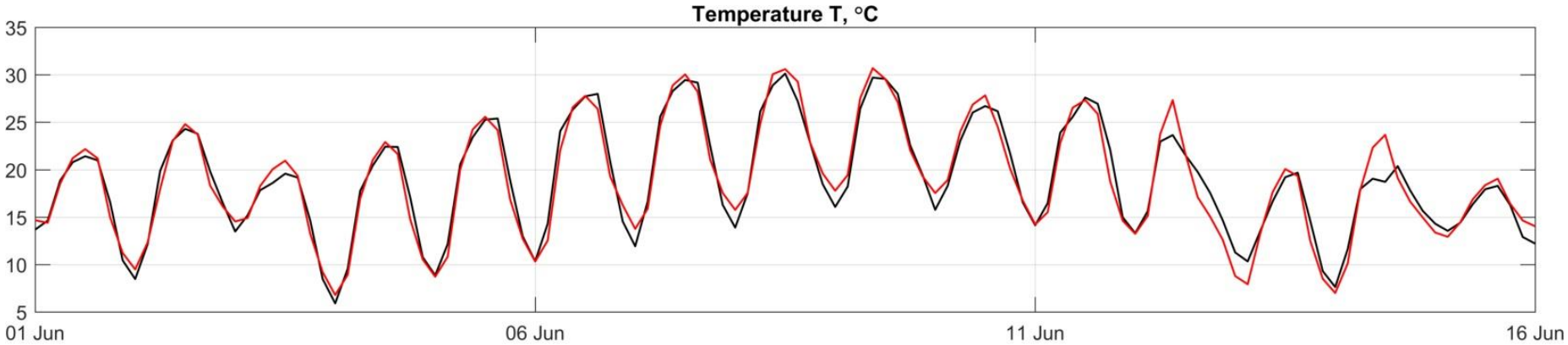


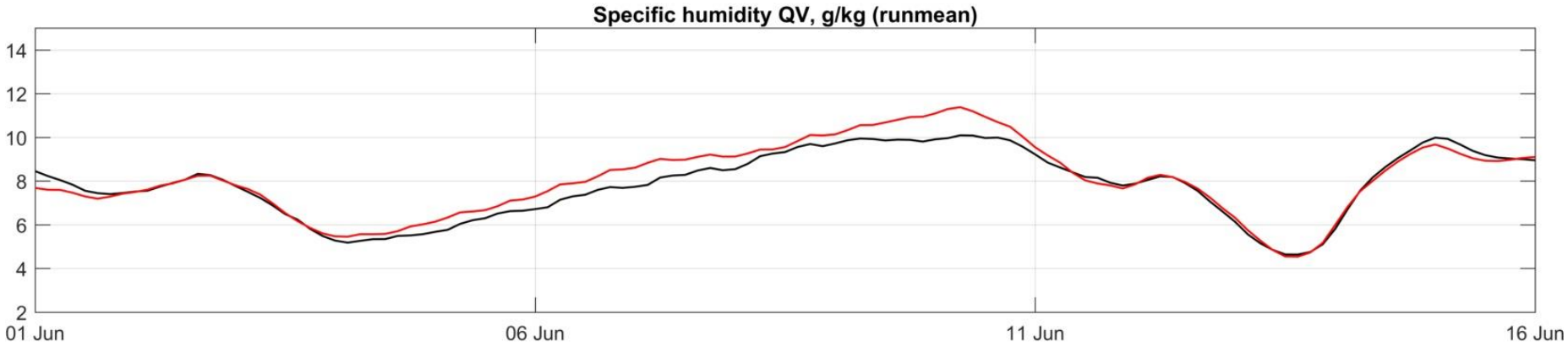


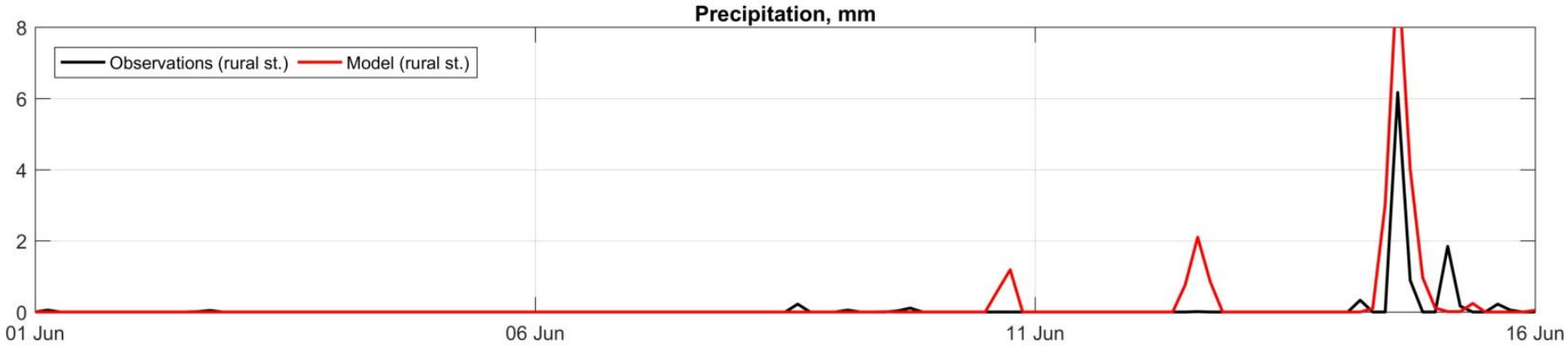
Results for D1 domain (no TERRA_URB), mean values for 9 rural stations, AEV5 simulation

Problem: warn & dry bias over whole domain

Basic verification: case 2 (01.06.2019-15.06.2019)





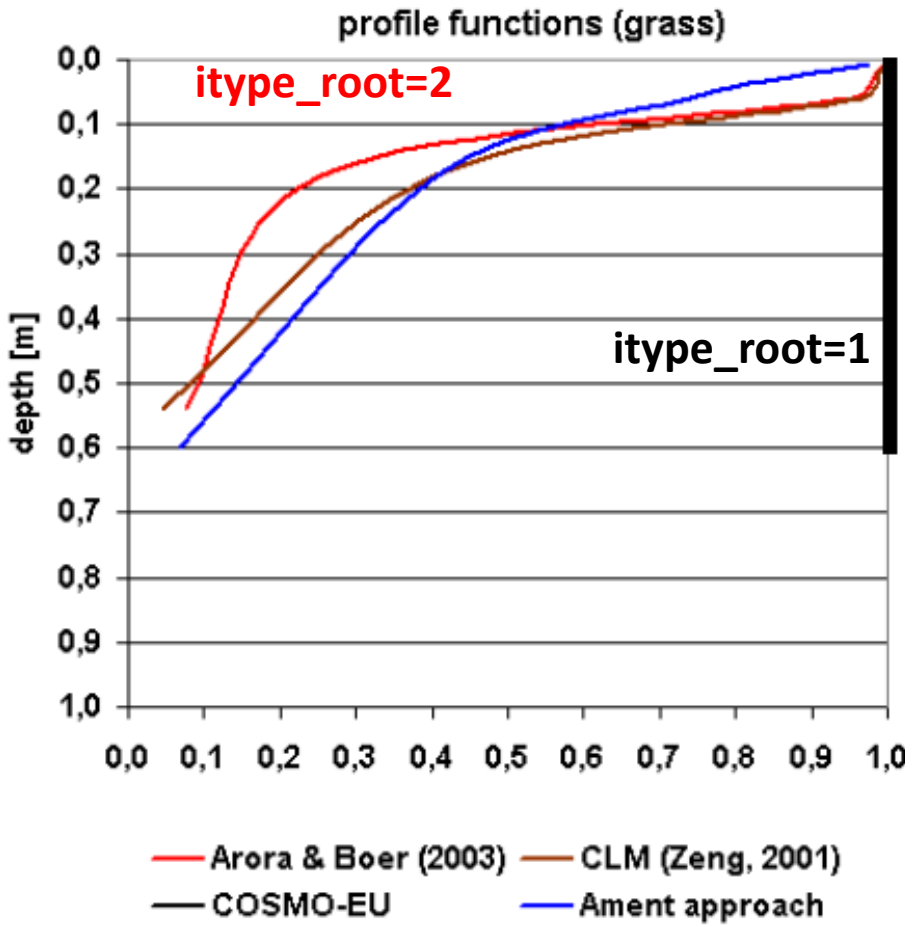


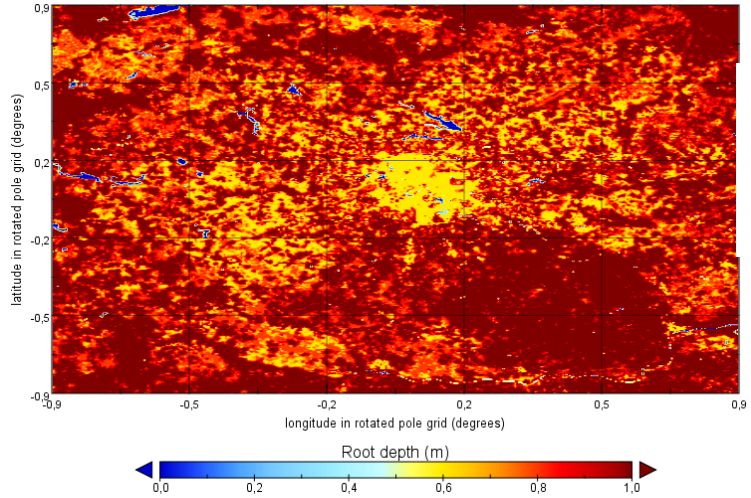
Results for D1 domain (no TERRA_URB), mean values for 9 rural stations, AEV5 simulation

Problem: warn & dry bias over whole domain

Solution: increased rooting depth by 2.5 times (crootdp = 2.5) in all simulations for this case

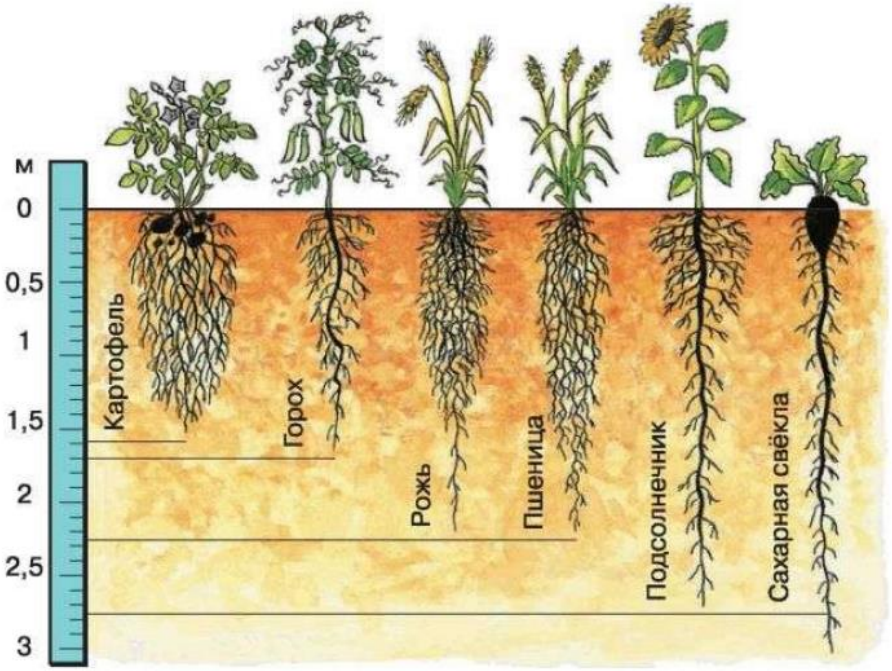
Why rooting depth?





Rooting depth from Extpar:

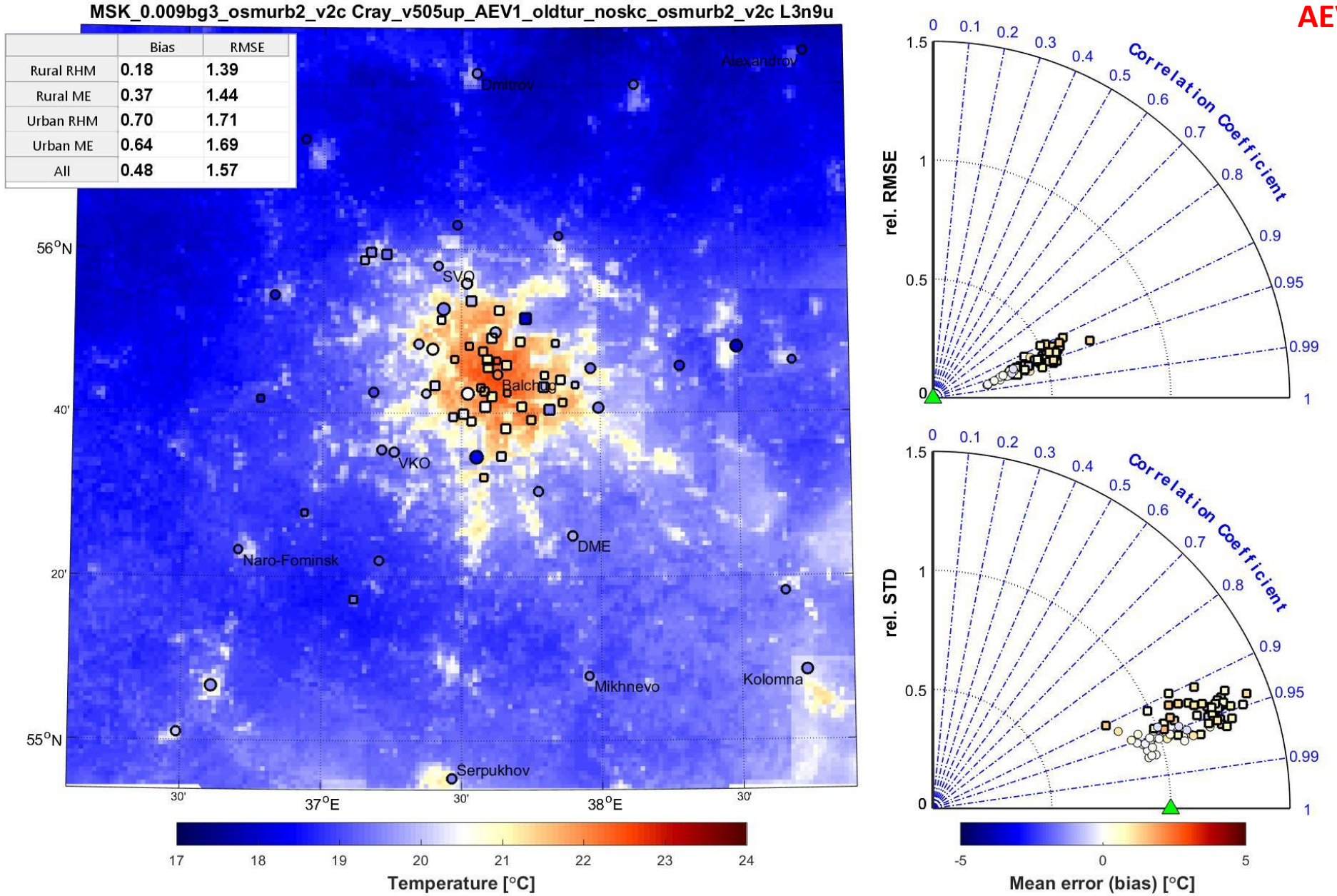
No higher than 1 m



Rooting depth in real world:

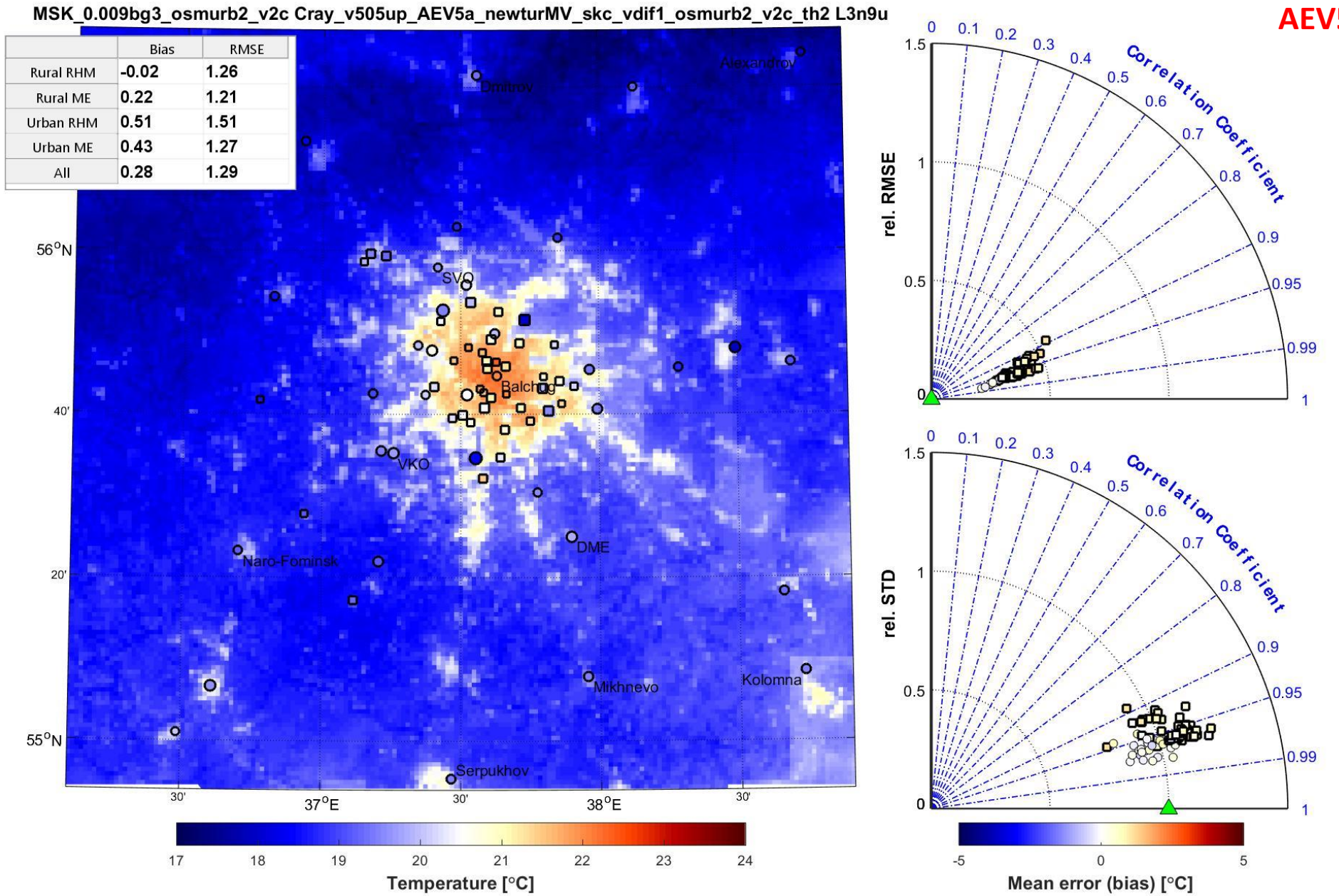
1.5 m even for potatoes (and what about trees?)

Verification for urban areas: example for case 1



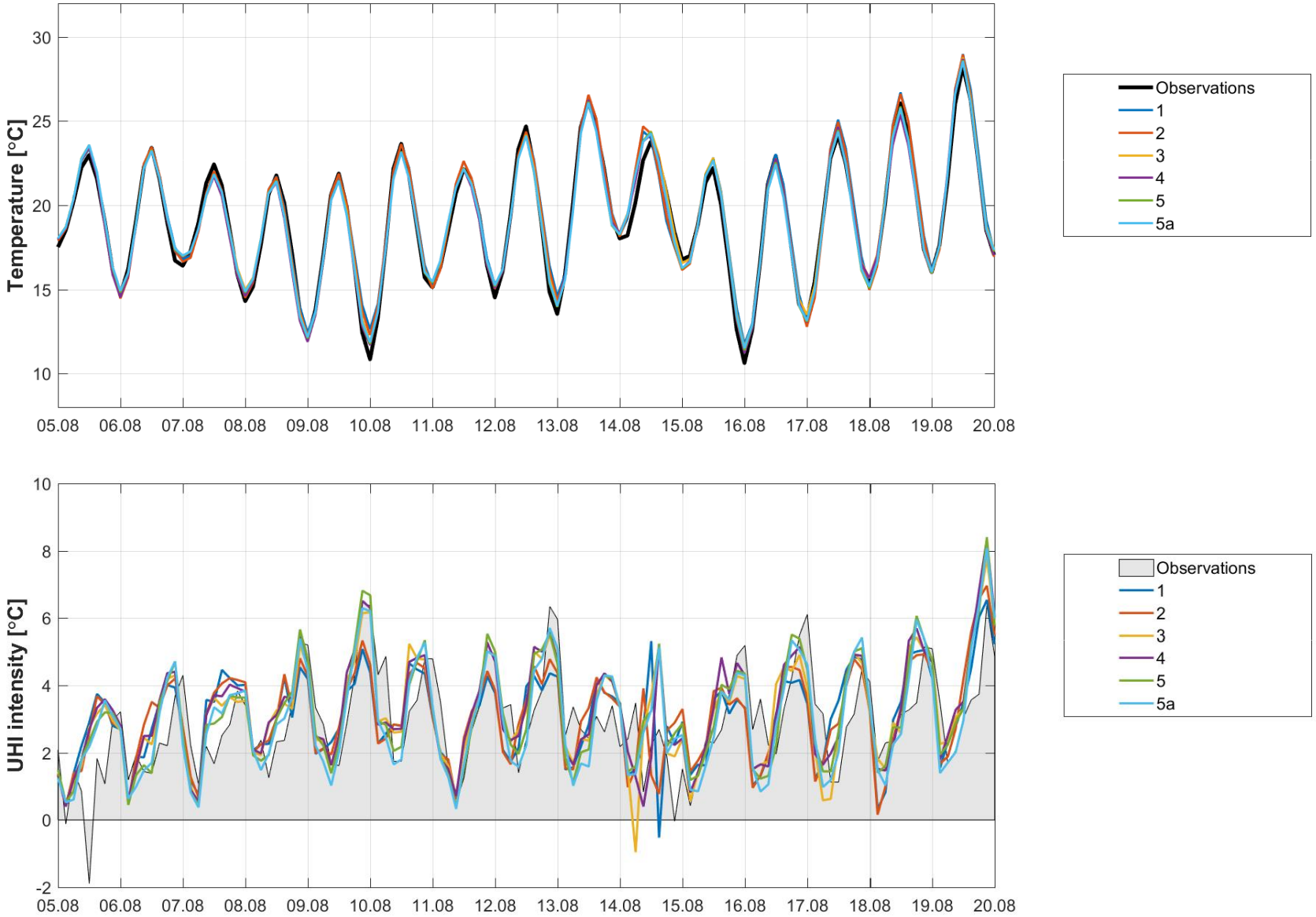
AEV1

Verification for urban areas: example for case 1

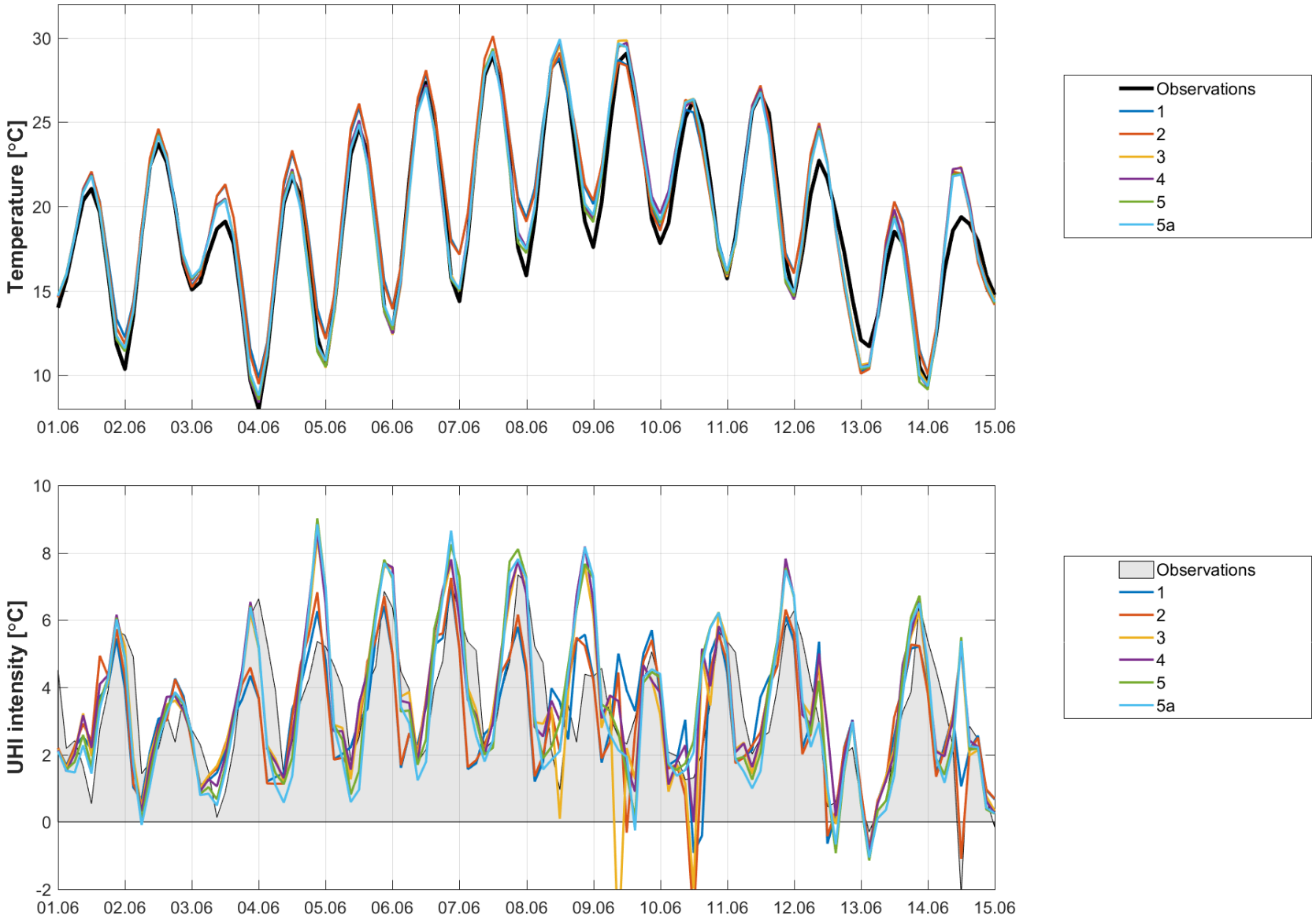


AEV5a

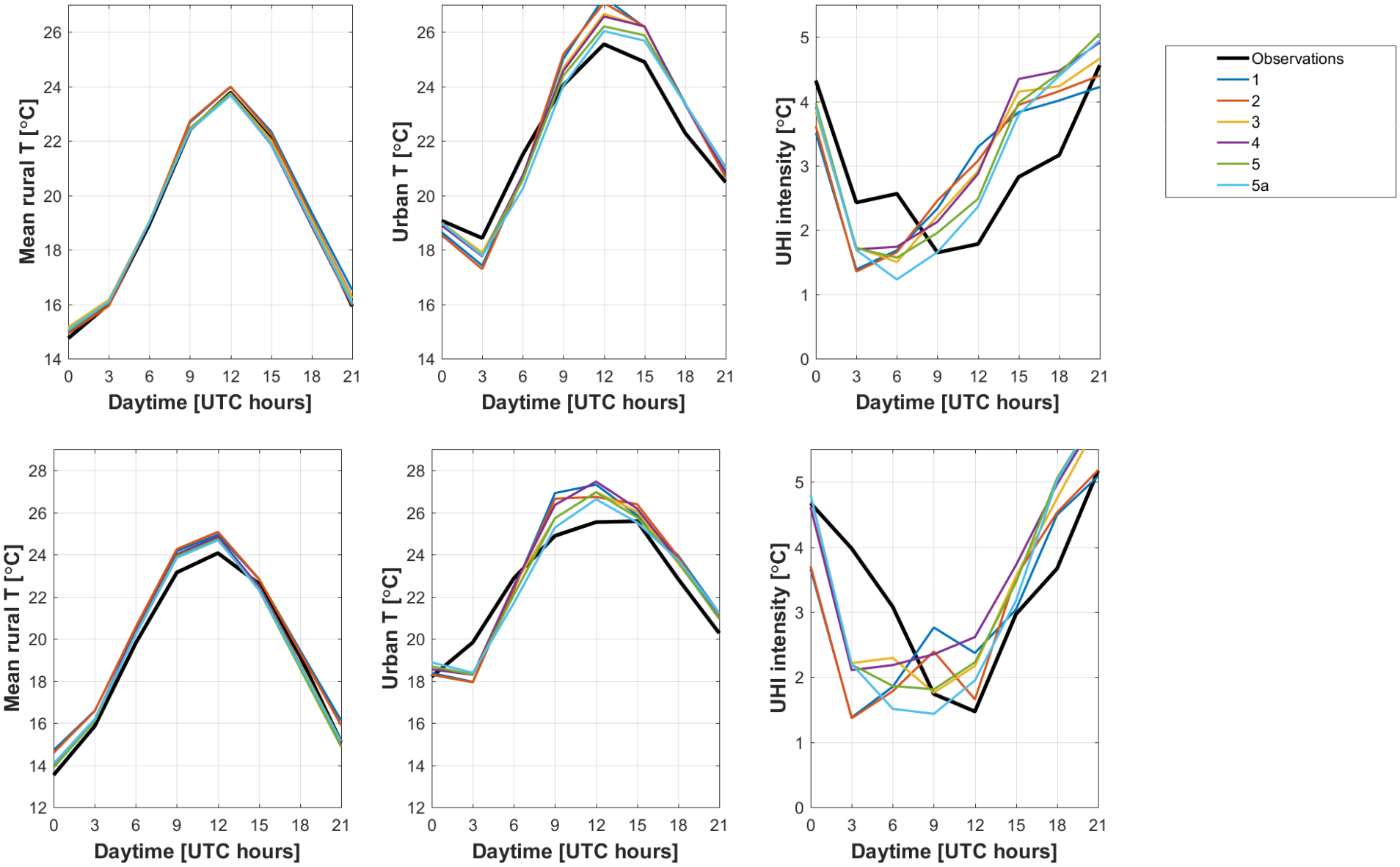
An attempt to compare all runs: case 1



An attempt to compare all runs: case 2



An attempt to compare all runs: case 1 & 2

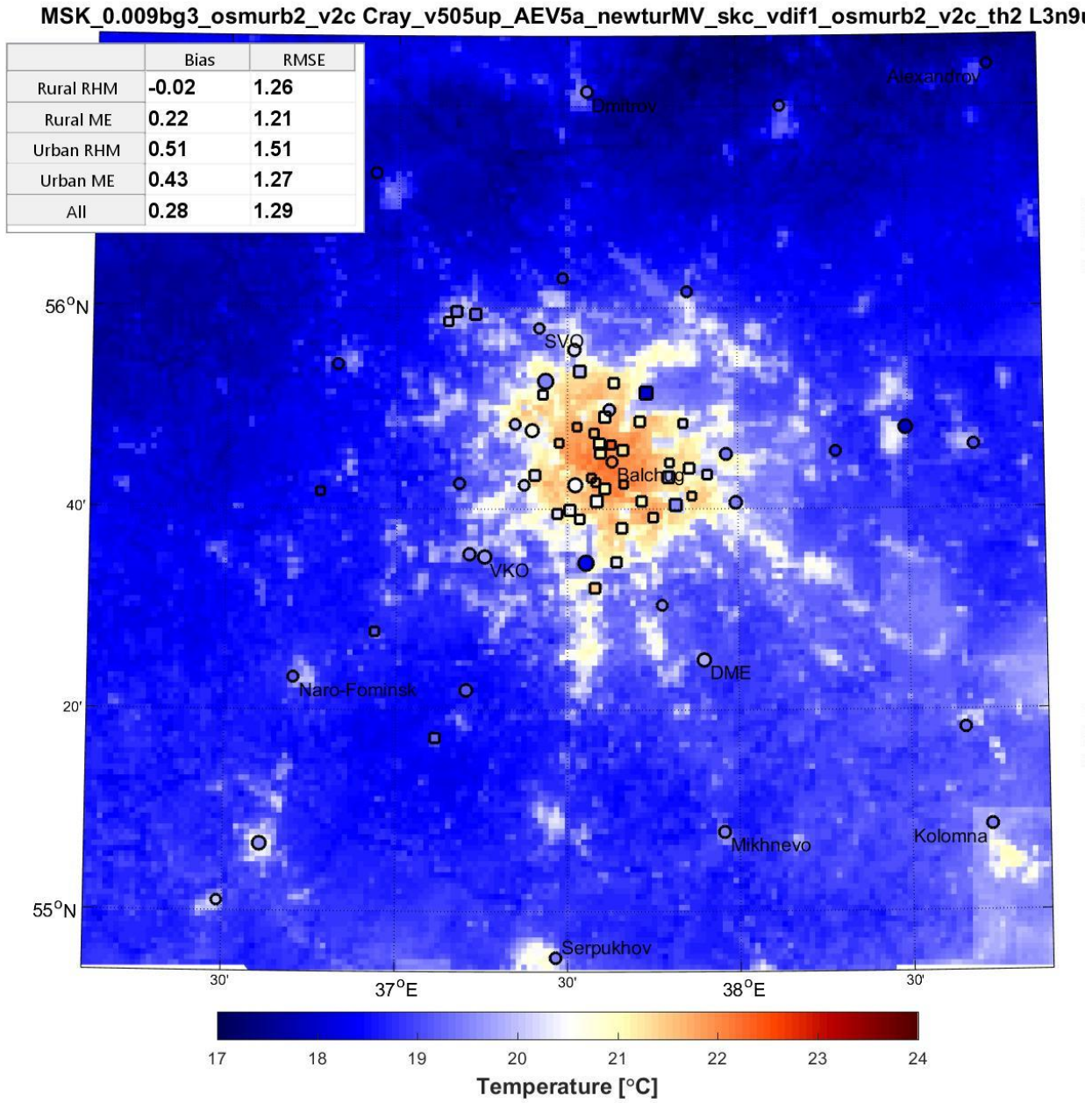


Verification scores

	Case 20170805		Case 20190601	
	bias (all)	rmse (all)	bias (all)	rmse (all)
AEV1	0.48	1.57	0.38	2.09
AEV2	0.45	1.6	0.36	2.09
AEV3	0.4	1.36	0.19	1.96
AEV4	0.35	1.35	0.2	1.97
AEV5	0.3	1.31	0.07	1.95
AEV5a	0.28	1.29	0.02	1.96
AEV5b	0.06	1.22	-0.17	1.95

Surprisingly good results for AEV5b with LCZ-based urban canopy parameters!

AEV5a, case 1



Verification scores

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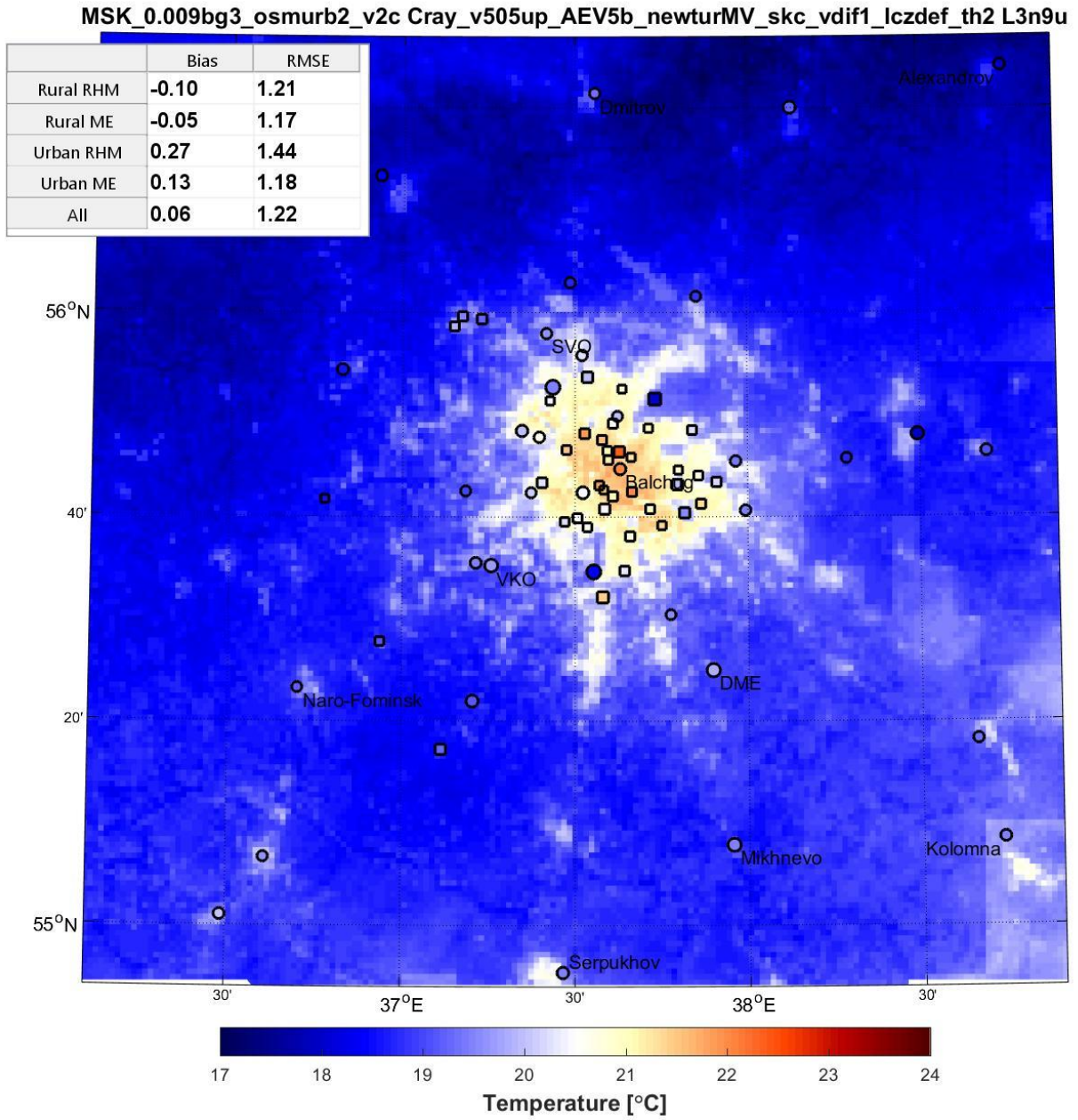
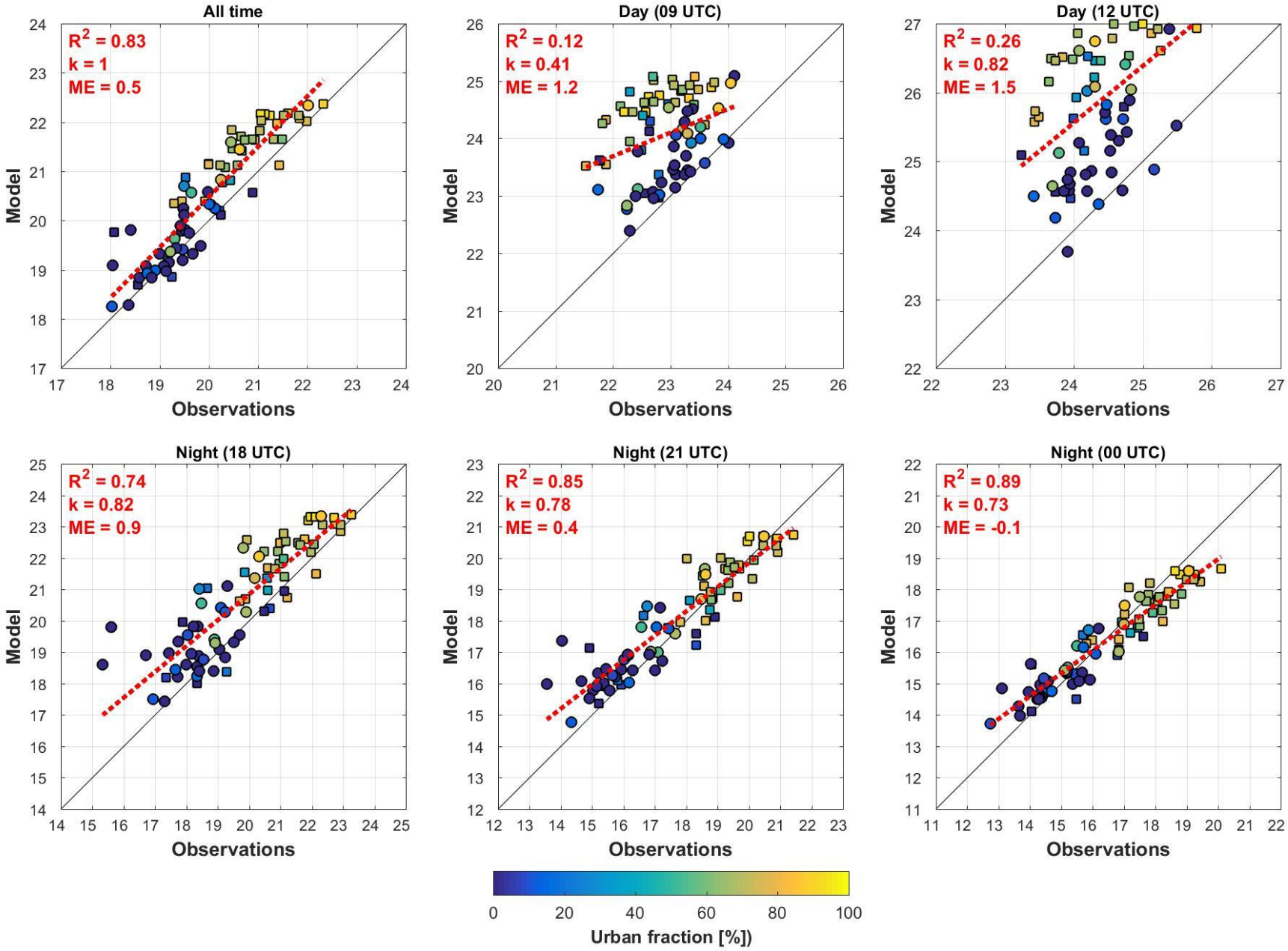
AEV5b	0.06	1.22	-0.17	1.95

Surprisingly good results for AEV5b with LCZ-based urban canopy parameters!

AEV5b, case 1



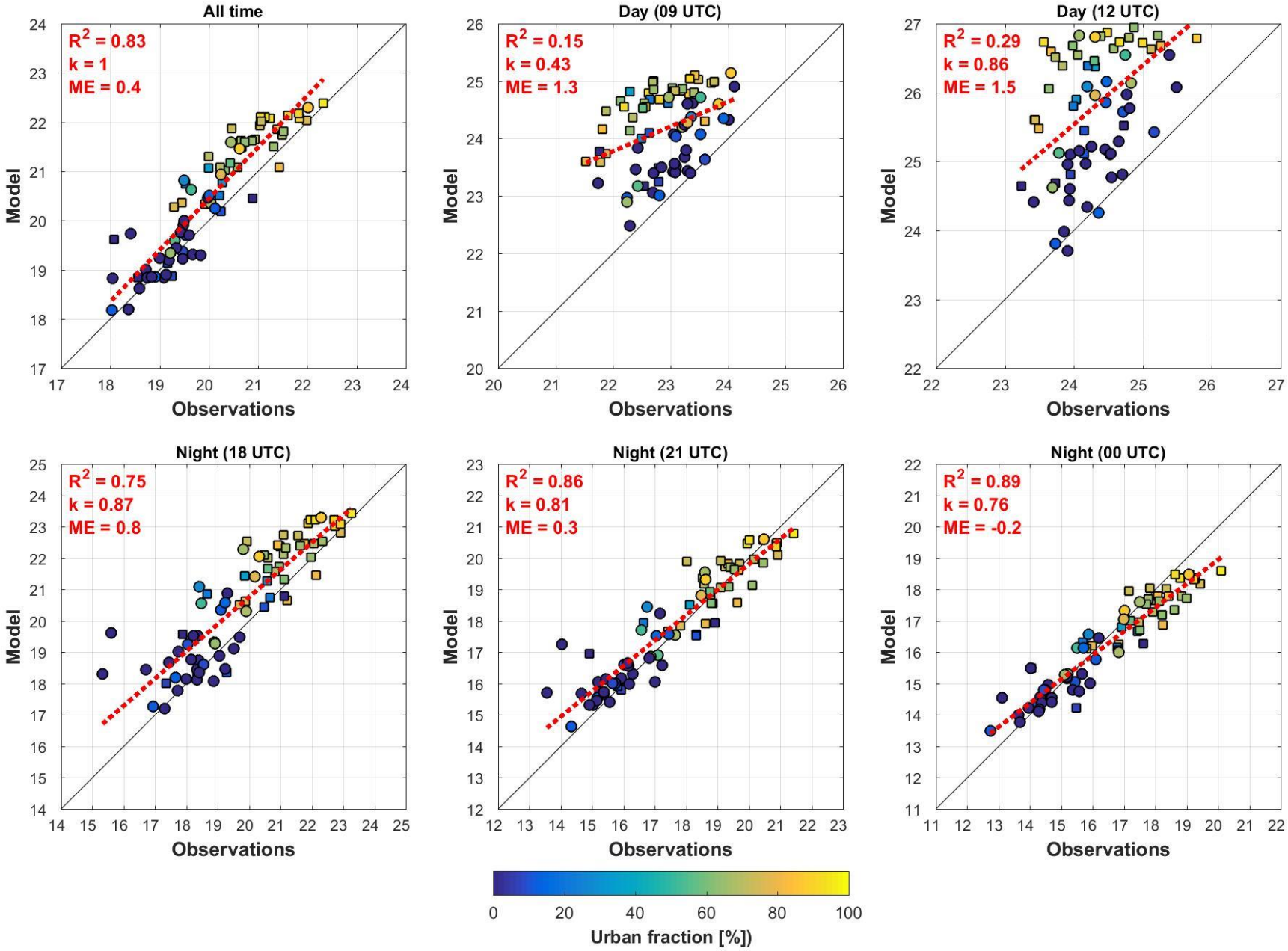
Some more insights



Case 1, AEV1

- ltype_canopy = 1
- Old turbulence

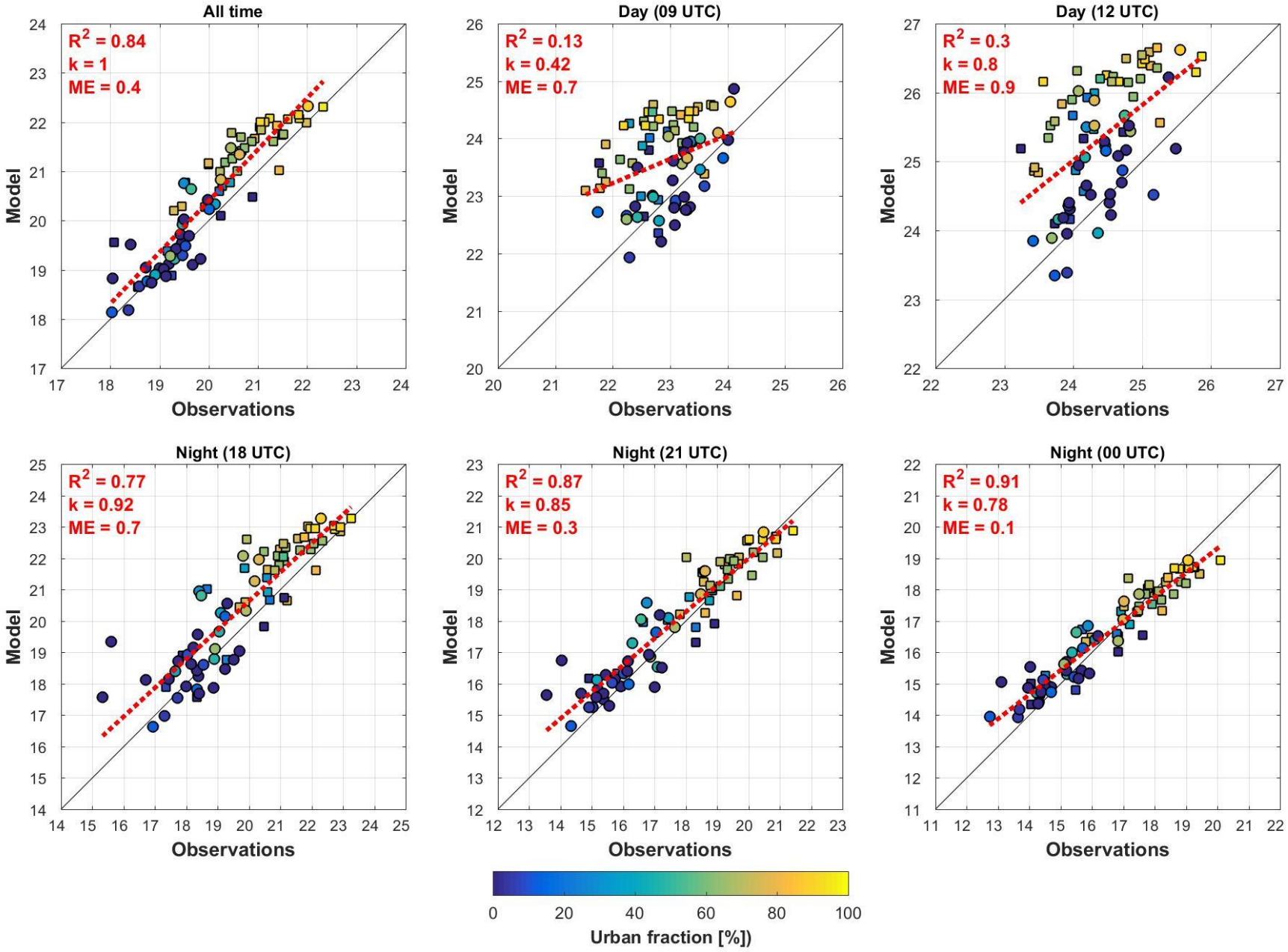
Some more insights



Case 1, AEV2

- ltype_canopy = 2
- Old turbulence

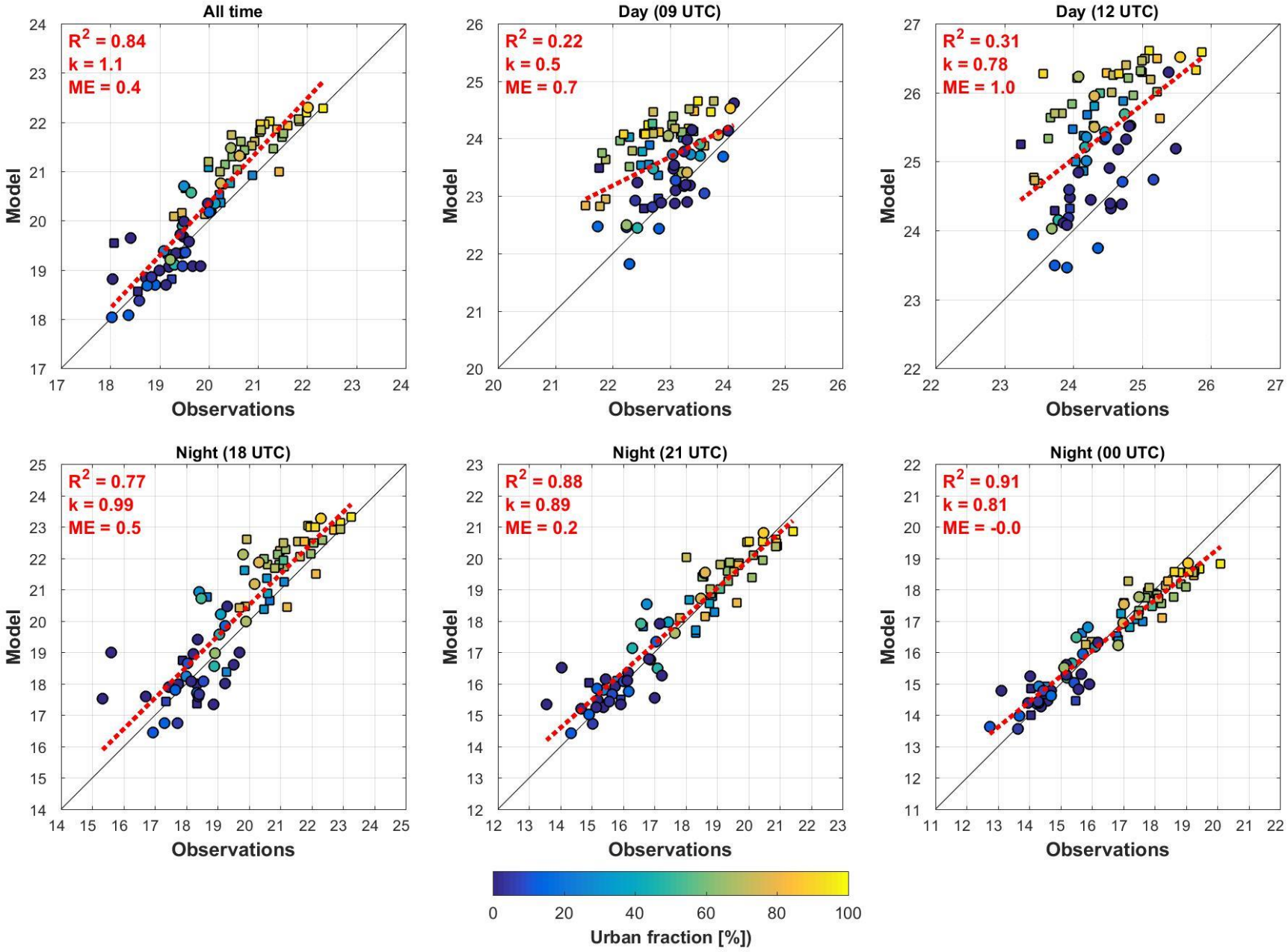
Some more insights



Case 1, AEV3

- ltype_canopy = 1
- New turbulence

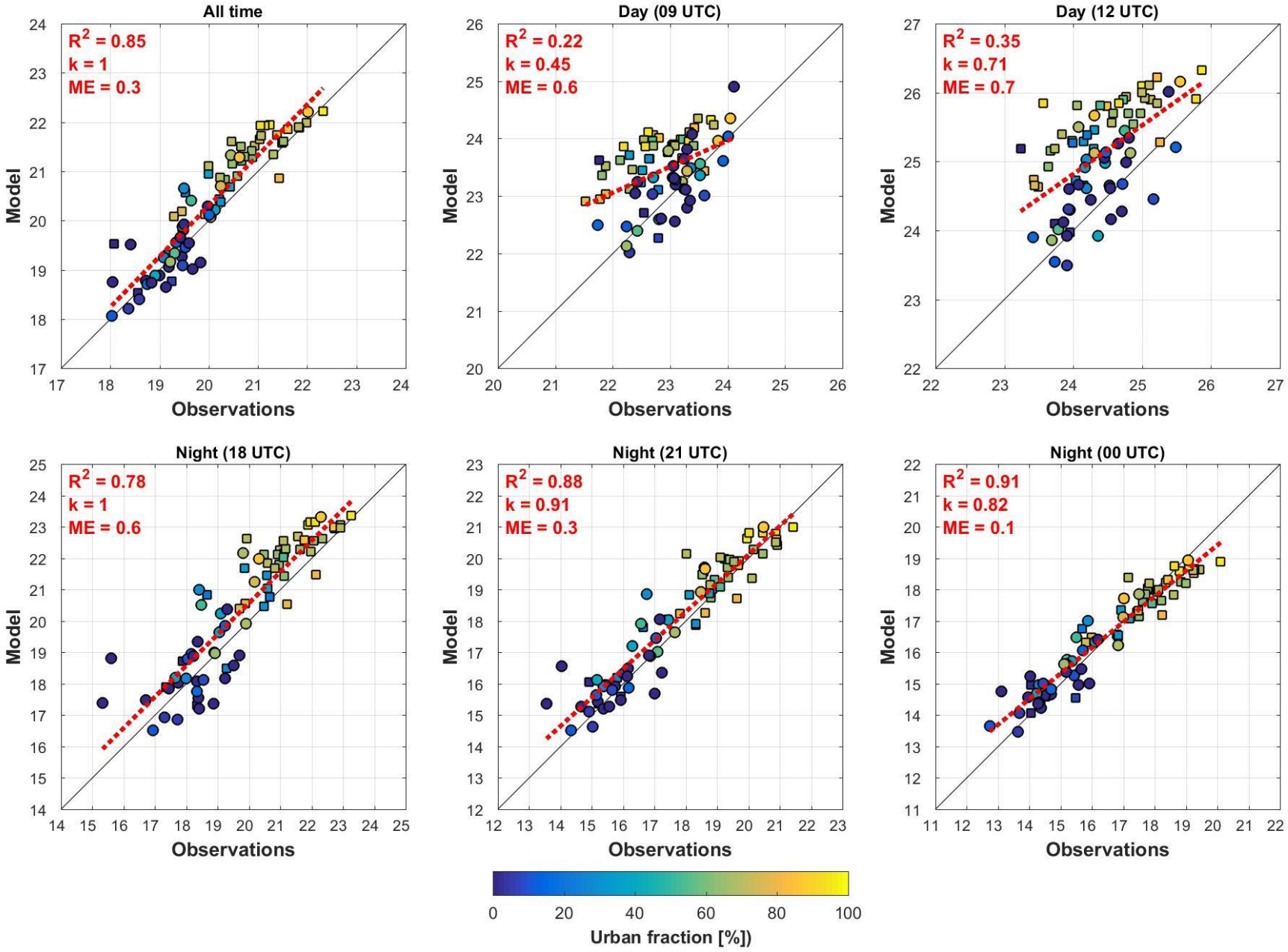
Some more insights



Case 1, AEV4

- ltype_canopy = 2
- New turbulence

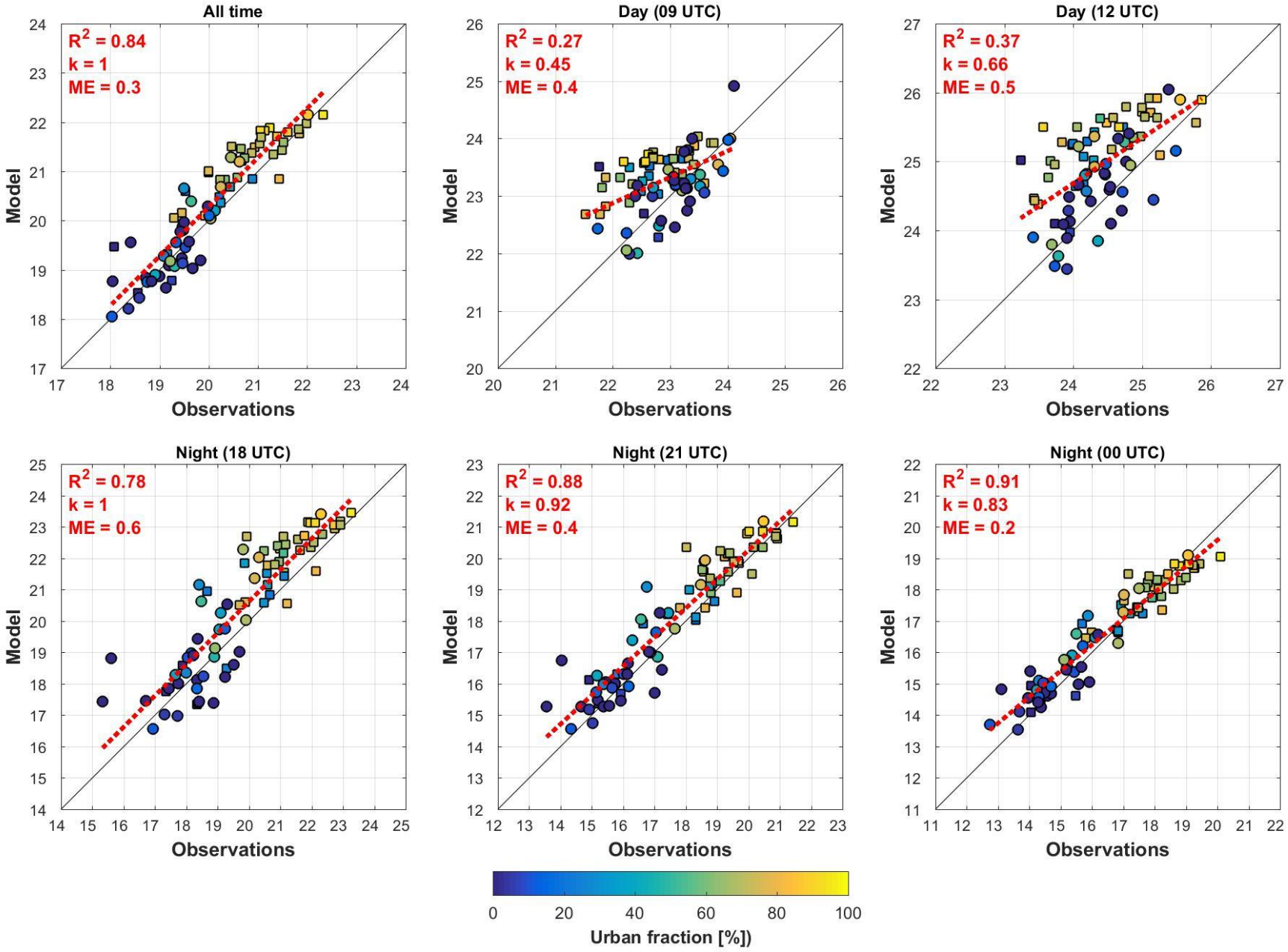
Some more insights



Case 1, AEV5

- Itype_canopy = 2
- New turbulence
- Itype_vdif=1,

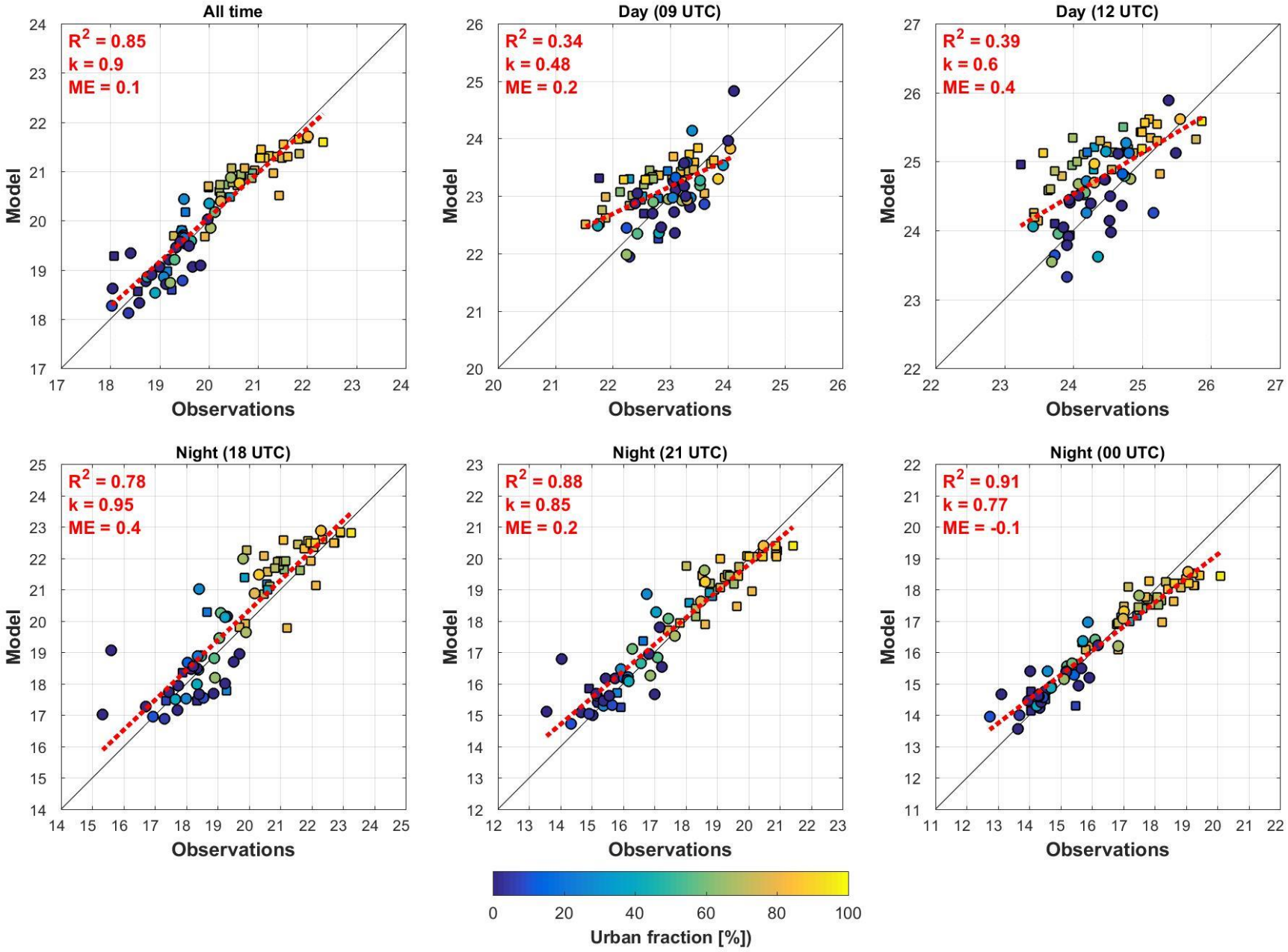
Some more insights



Case 1, AEV5a

- Itype_canopy = 2
- New turbulence
- Itype_vdif=1,
- Alternative urban thermal parameters

Some more insights



Case 1, AEV5b

- Itype_canopy = 2
- New turbulence
- Itype_vdif=1,
- Alternative urban thermal parameters
- LCZ- based urban canopy parameters

Key conclusions and questions for discussion

- Skin-layer temperature scheme and new turbulence improves modelling results both for rural and urban areas
- Itype_vdif=1 improves reduces the daytime overheating in the city. Should we include such simulations to the paper?
- Urban thermal parameters needs better calibration. Default values should be discussed with Matthias and Hendrik.
- LCZ-based approach works nice for summer conditions. But what about winter?