

Preliminary tests of the CMC ALARO-1 coupled to SURFEX-8 using CY43T2 over Belgium

Rafiq Hamdi & Daan Degrauwe

**With inputs from:
Steven Caluwaerts, François Duchêne, Alex Deckmyn**

Royal Meteorological Institute, Brussels, Belgium

ALARO-1 Working days

September 2016, Brussels

*“It was decided that the current code in **cy43t2** is a base for further developments and tunings, also for the coupling with **SURFEXV8**.”*



Task: To develop a Canonical version of ALARO1 with SURFEXV8

Working on the interface: SURFEX <-> ALARO + TOUCANS

- ALARO with very high resolution (1~2km) requires new sophisticated turbulence/shallow convection scheme **TOUCANS**.
- TOUCANS calculates also third order moment terms (TOM), which interact strongly with surface fluxes (from SURFEX/ISBA), but since surface should stay externalised (Best et al.) → conflict
- Linking of the two schemes is needed without dramatic increase of complexity and numerical costs but keeping consistency

Working on the interface: SURFEX <-> ALARO + TOUCANS

- When increasing the horizontal resolution, it was found quite important to pay special attention to the way turbulence is triggered between the surface and lower model layer.
- Use tiling of the surface scheme in the turbulence scheme: some fraction of rough surfaces (urban areas) might start important turbulent behavior which would be escalated in the consecutive vertical development.
- Either do multiple solving for each tile (expensive) or to have an average lower boundary condition for a single solving.

aplpar

aro_ground_param

acptke

acdifus

acdifv1

vertical diffusion calling also soil routines

aro_ground_param

acdifv2

acdifv3

Correction of soil fluxes by TOM flux differences and update of upper air fluxes

SURFEX 3 times !!!

acdifv3a

aro_ground_param



aplpar

~~aro_ground_param~~

acptke

acdifus

vertical
diffusion calling
also soil routines

acdifv1

~~aro_ground_param~~

acdifv2

acdifv3

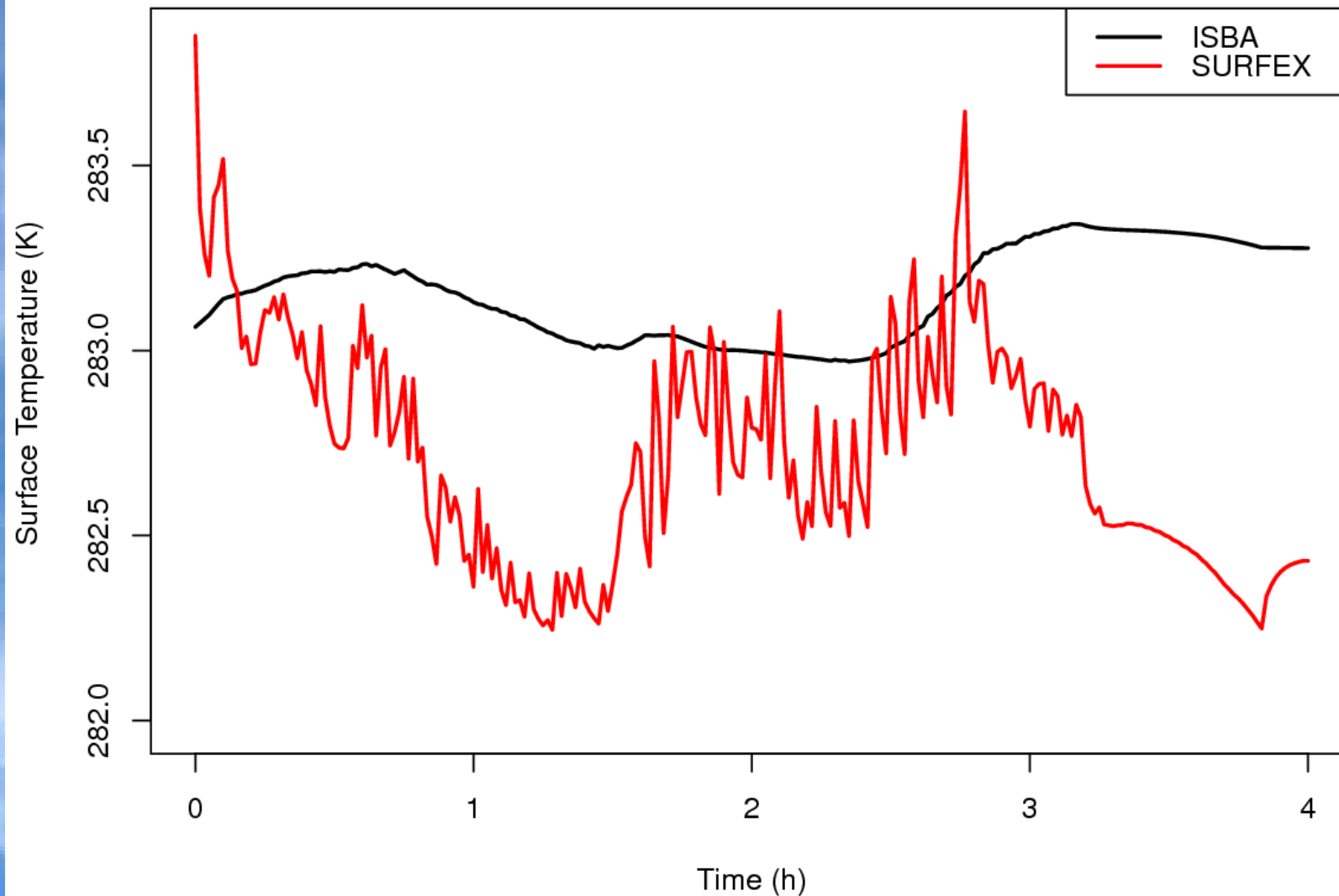
Correction of soil fluxes
by TOM flux differences
and update of upper air
fluxes

SURFEX 1 time + storage
of drag coefficient and
multipliers for
correction after TOMs
from previous time step

acdifv3a

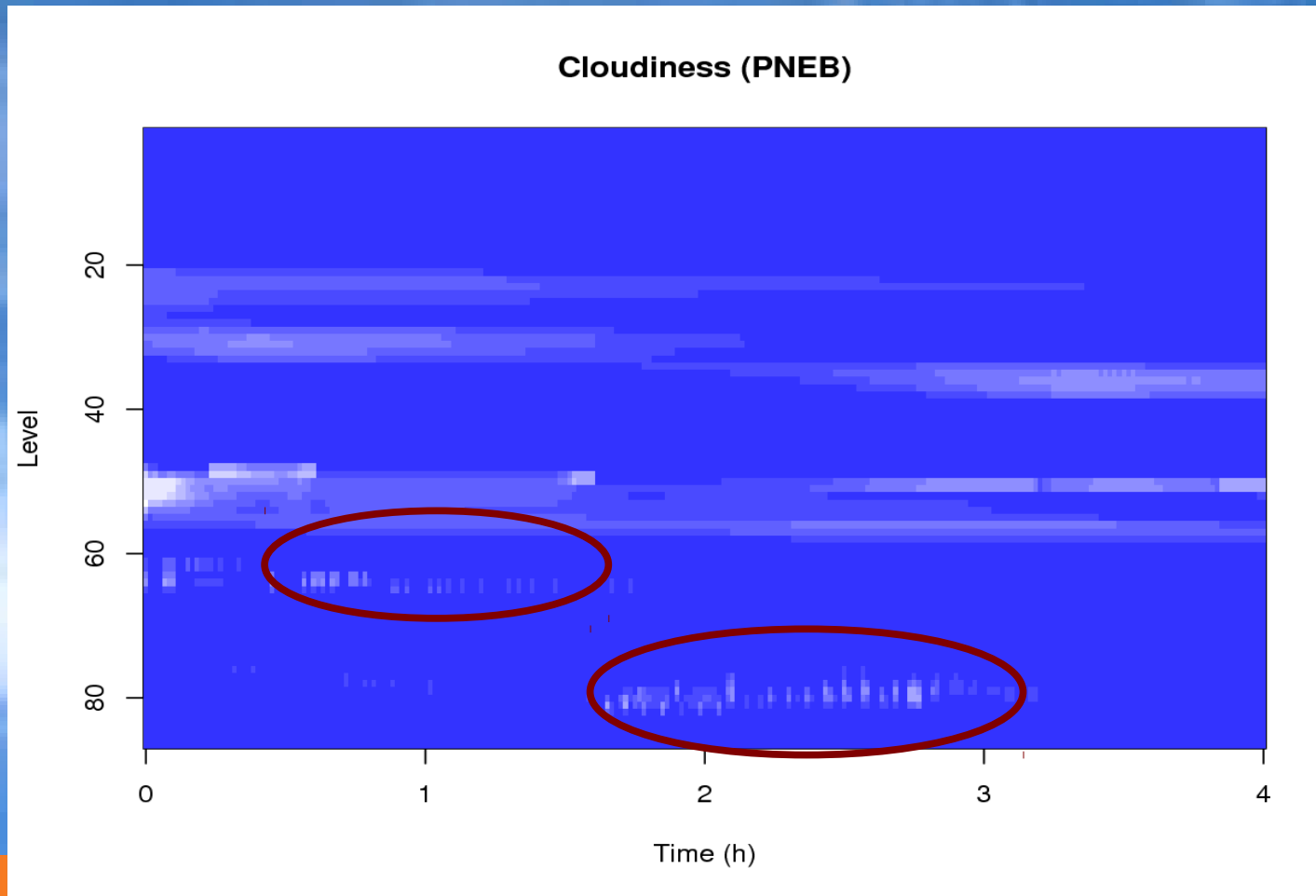
~~aro_ground_param~~

Surface temperature evolution in a single point



Surface temperature evolution in a single point

- Heavy oscillations in run with SURFEX !?
- Tracing the origin of these oscillations points at the shortwave radiative flux(input to SURFEX)
- The radiative flux oscillates due to on-off switching of cloudiness.



Surface temperature evolution in a single point

Heavy oscillations in run with SURFEX !?

Tracing the origin of these oscillations points at the shortwave radiative flux (input to SURFEX)

The radiative flux oscillates due to on-off switching of cloudiness.

... which in turn is due to the shallow convection scheme based on the 'modified Richardson number' in TOUCANS (LCOEFK_RIS=TRUE)

Note that the oscillations are not due to SURFEX itself, although it initially looked that way.

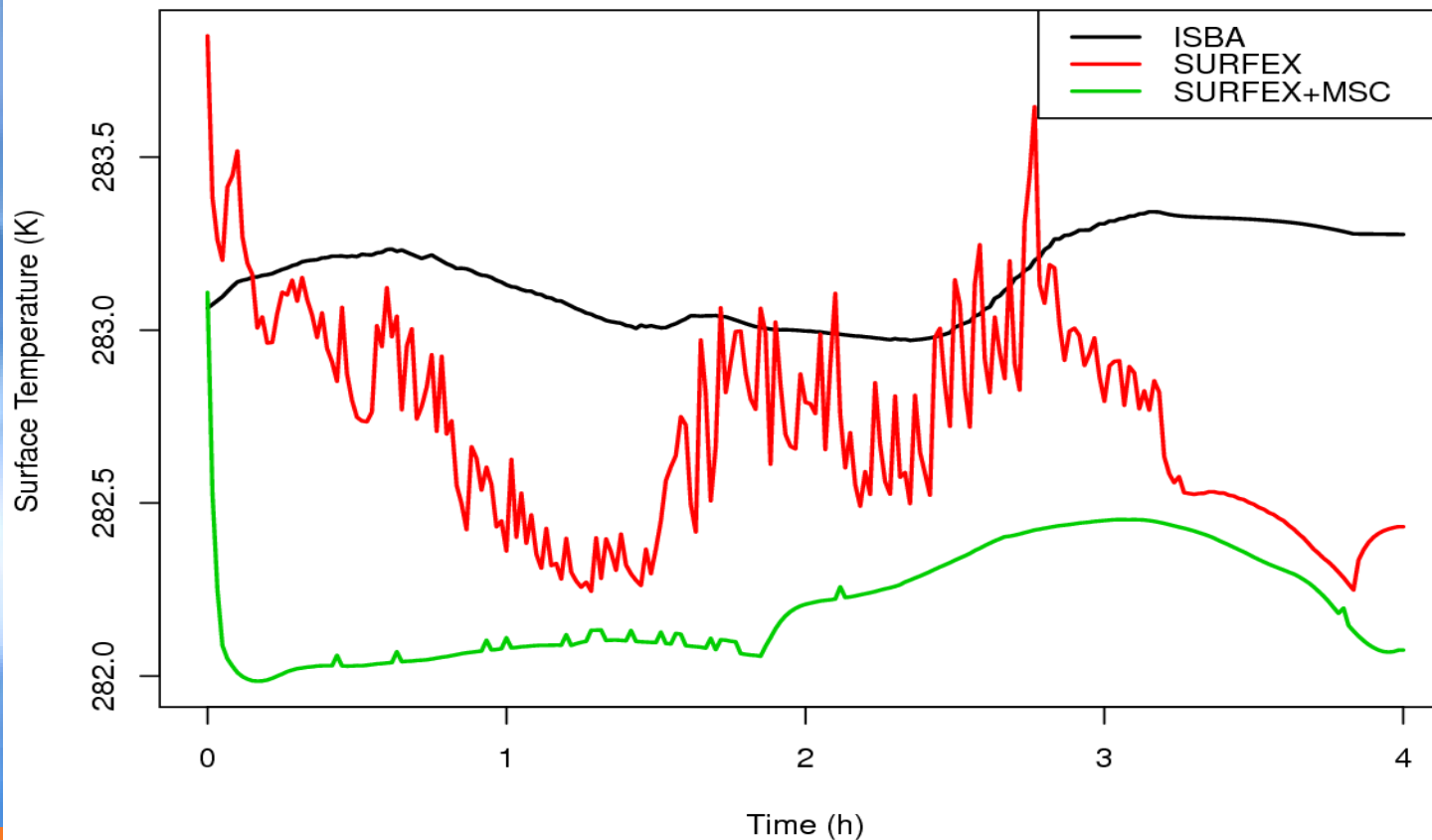
The reason the oscillations are more visible in a run with SURFEX (with TEB) is because the town tiles (not present in ISBA) respond very quickly on changing radiative fluxes.

The antifibrillation factors are not (yet) passed on to SURFEX, but this wouldn't change the unphysical radiative fluxes.

Surface temperature evolution in a single point

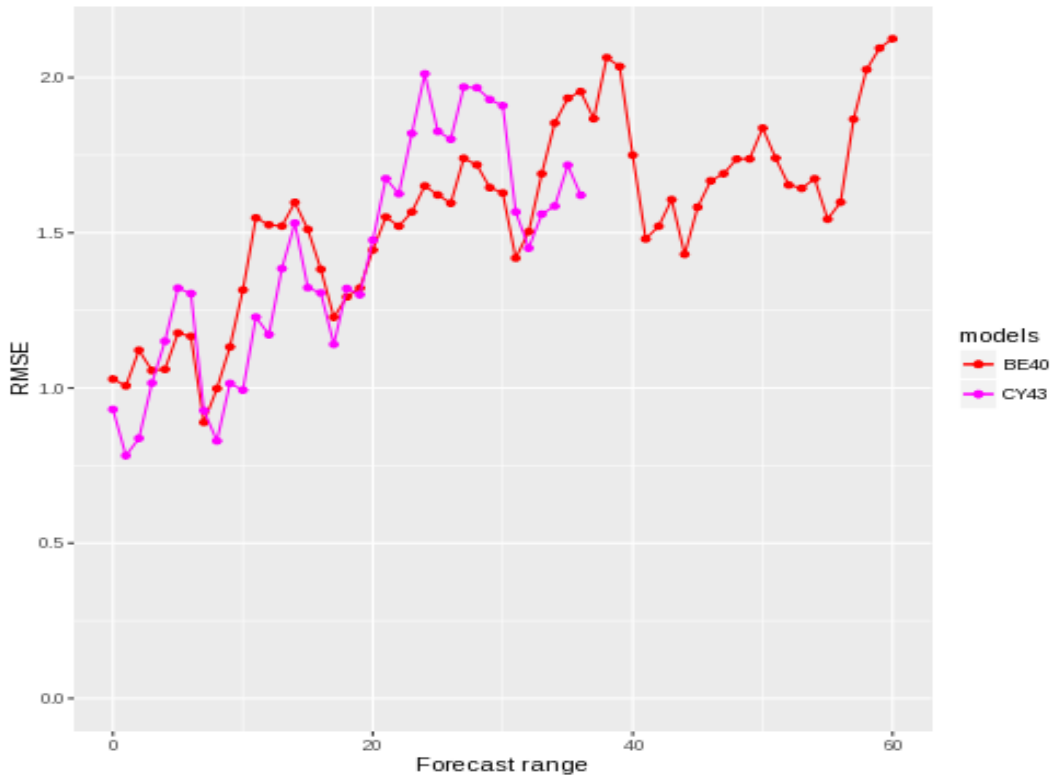
TOUCANS provides a novel way to diagnose shallow convection cloudiness: based on a mass-flux approach (LCOEFK_MSC=TRUE)

This setting indeed removes the oscillations

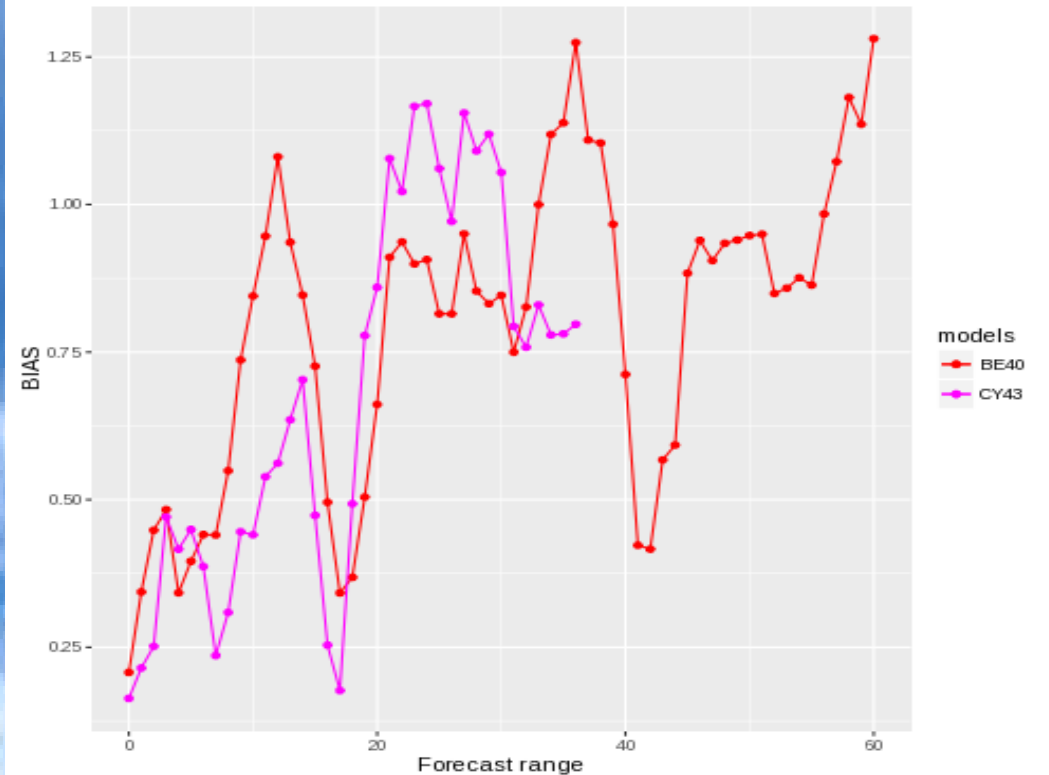


CY43T2 in e-suite set-up run 00 with 4km 15-25/07/2016 19-30/08/2016 09-20/09/2016

RMSE T2m
20160715 - 20160920 00h
station Ukkel (6447)



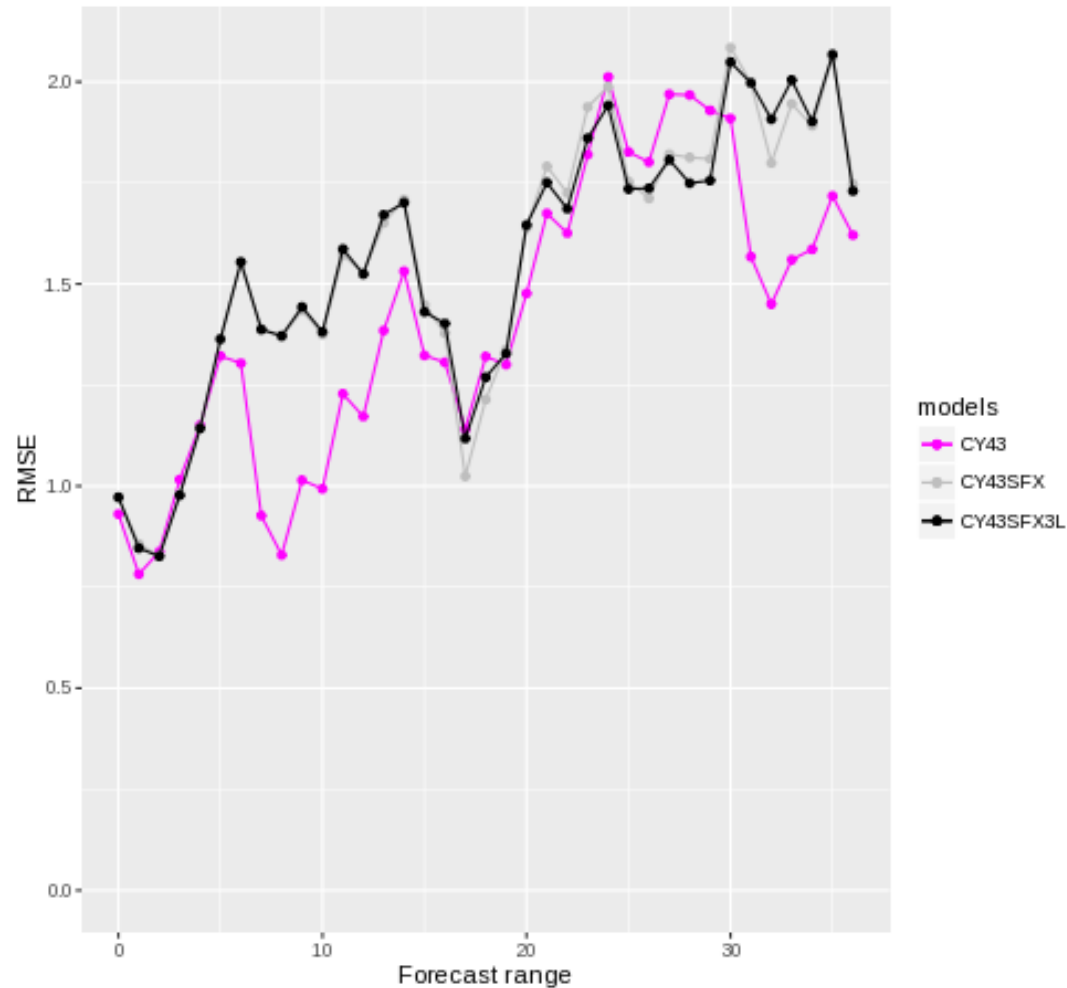
BIAS T2m
20160715 - 20160920 00h
station Ukkel (6447)



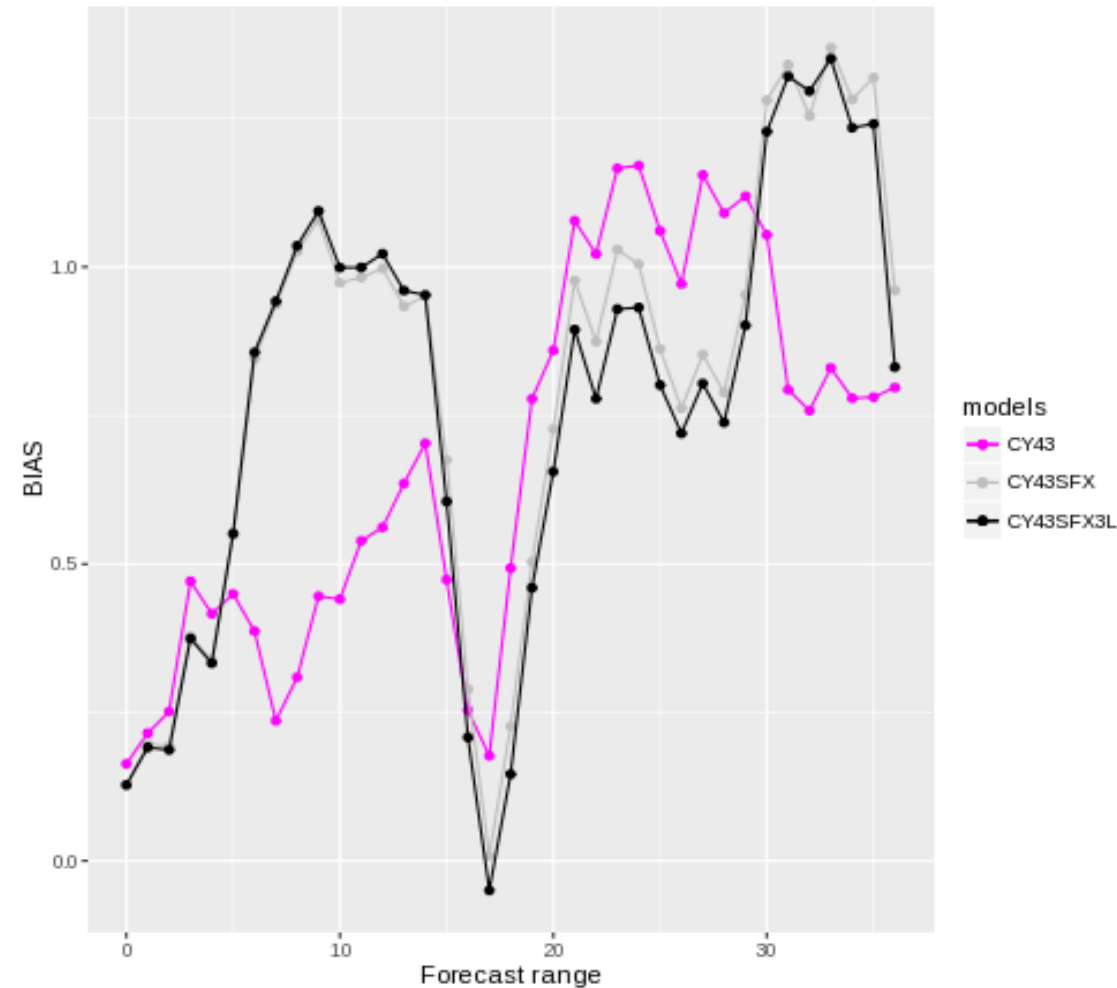
CY43T2 in e-suite set-up run 00 with 4km

15-25/07/2016 19-30/08/2016 09-20/09/2016

RMSE T2m
20160715 - 20160920 00h
station Ukkel (6447)

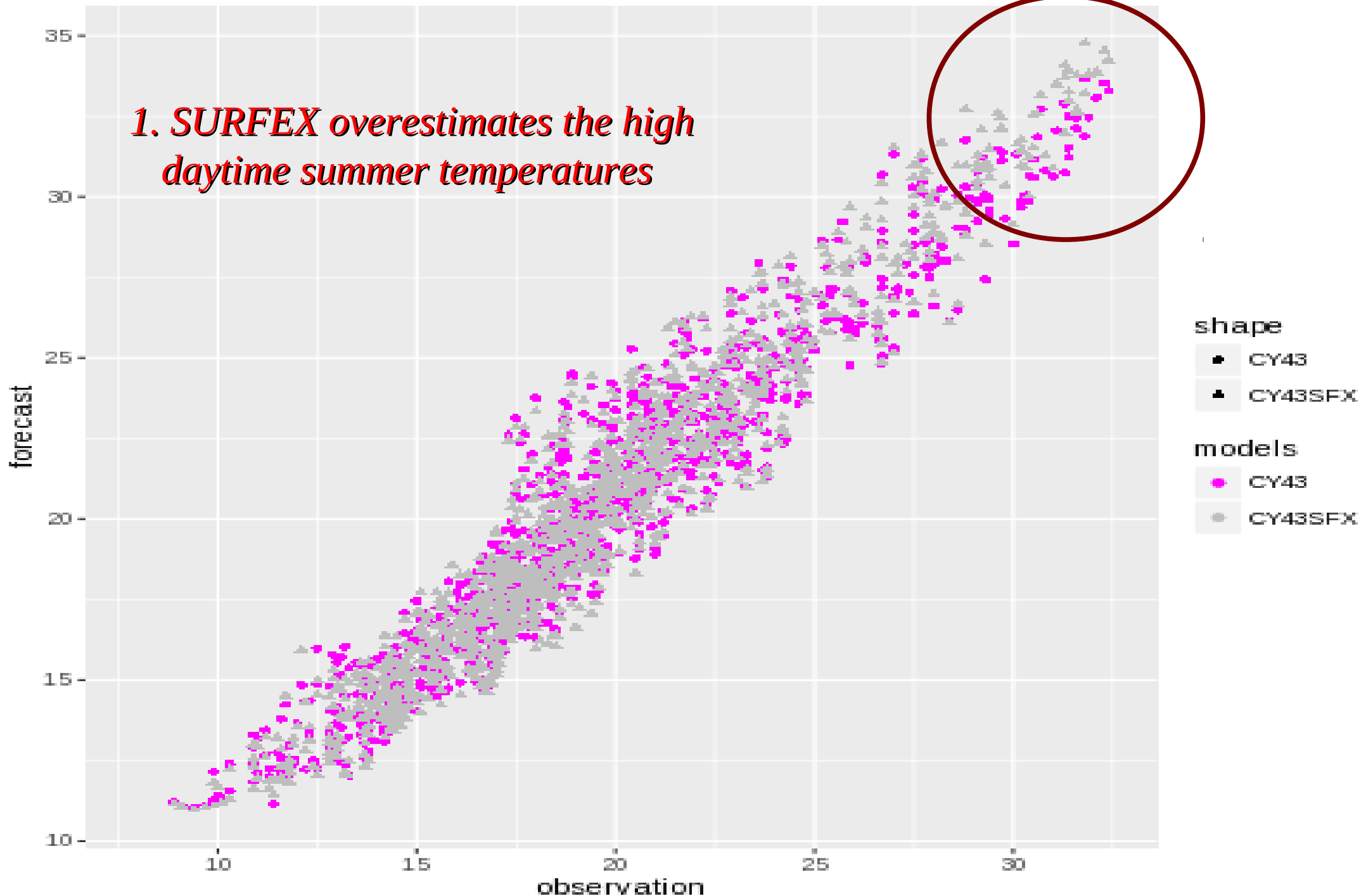


BIAS T2m
20160715 - 20160920 00h
station Ukkel (6447)



Scatterplot T2m
20160715 - 20160920 00h
station Ukkel (6447)

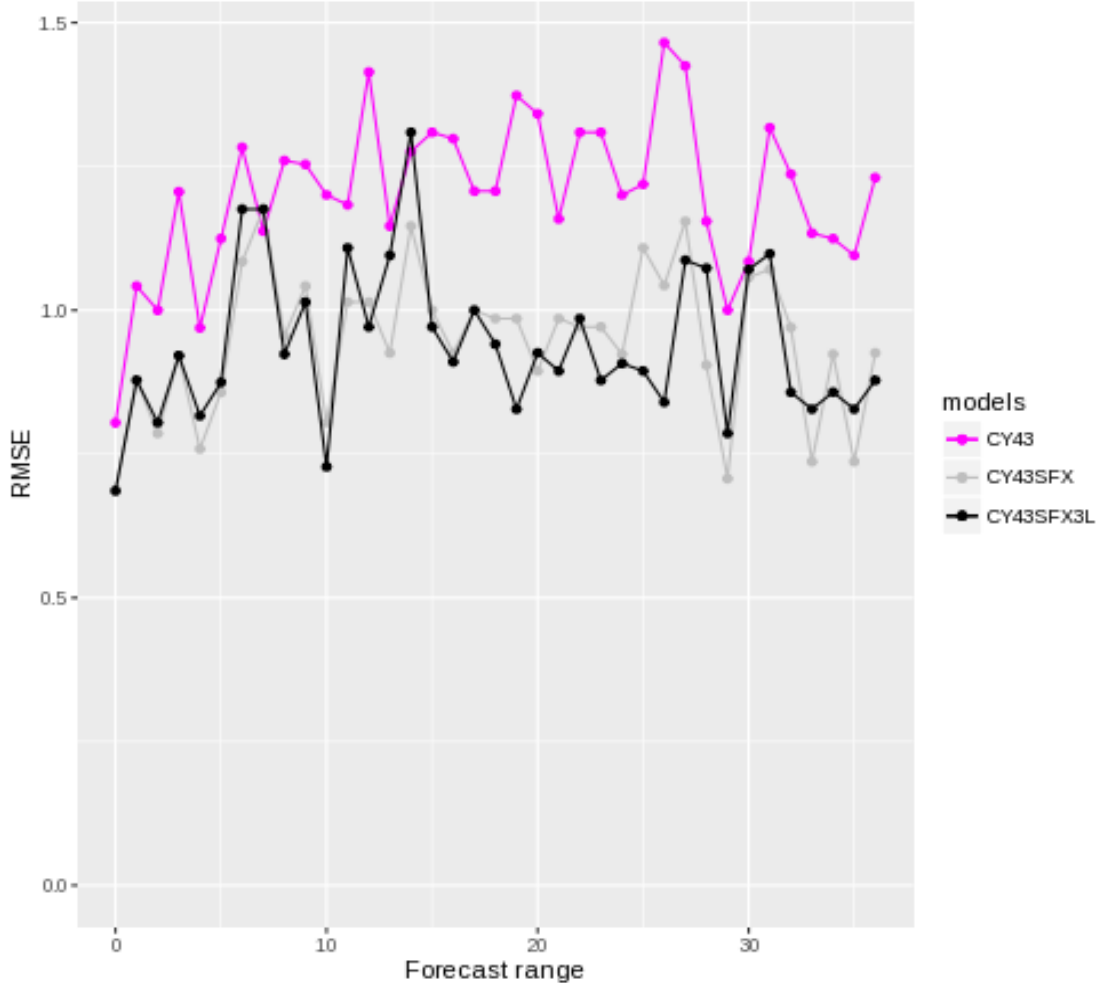
1. SURFEX overestimates the high daytime summer temperatures



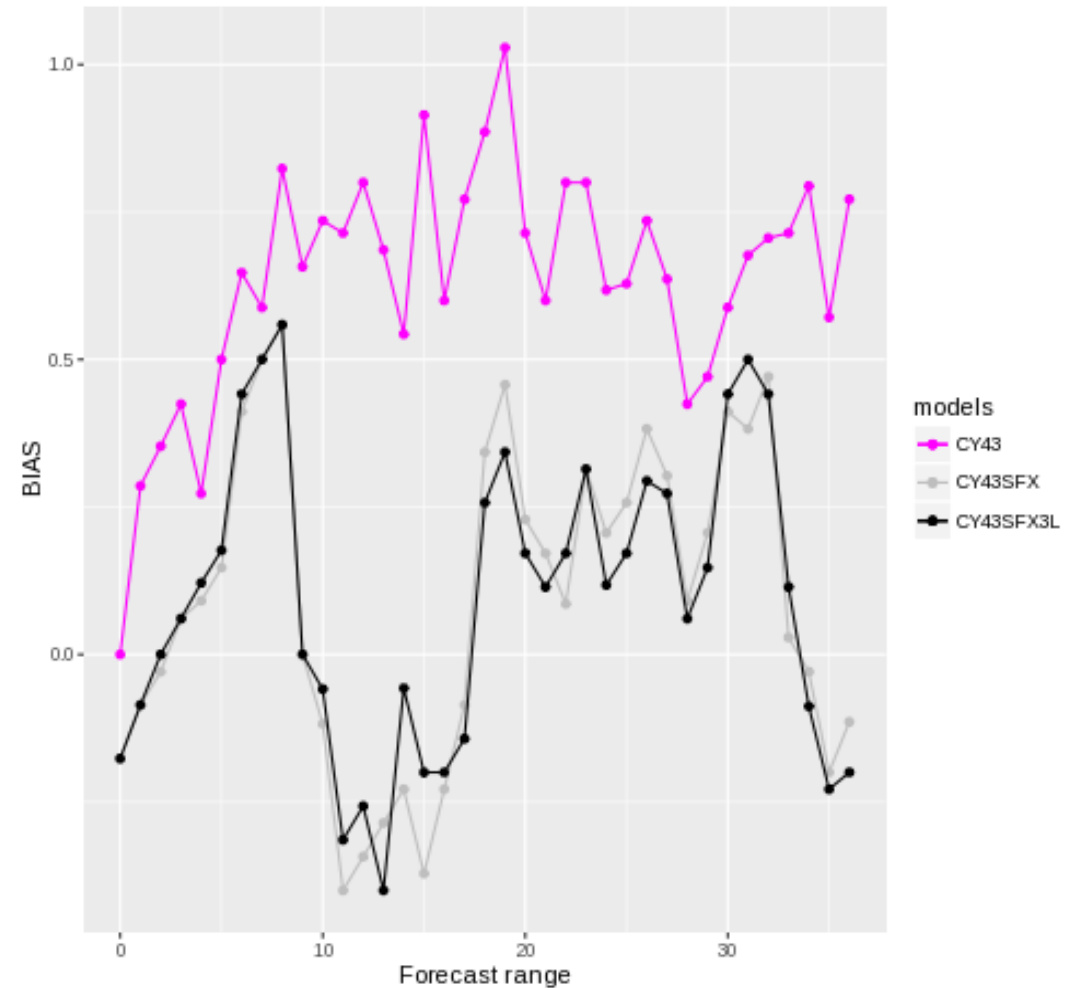
CY43T2 in e-suite set-up run 00 with 4km

15-25/07/2016 19-30/08/2016 09-20/09/2016

RMSE S10m
20160715 - 20160920 00h
station Elsenborn (6496)

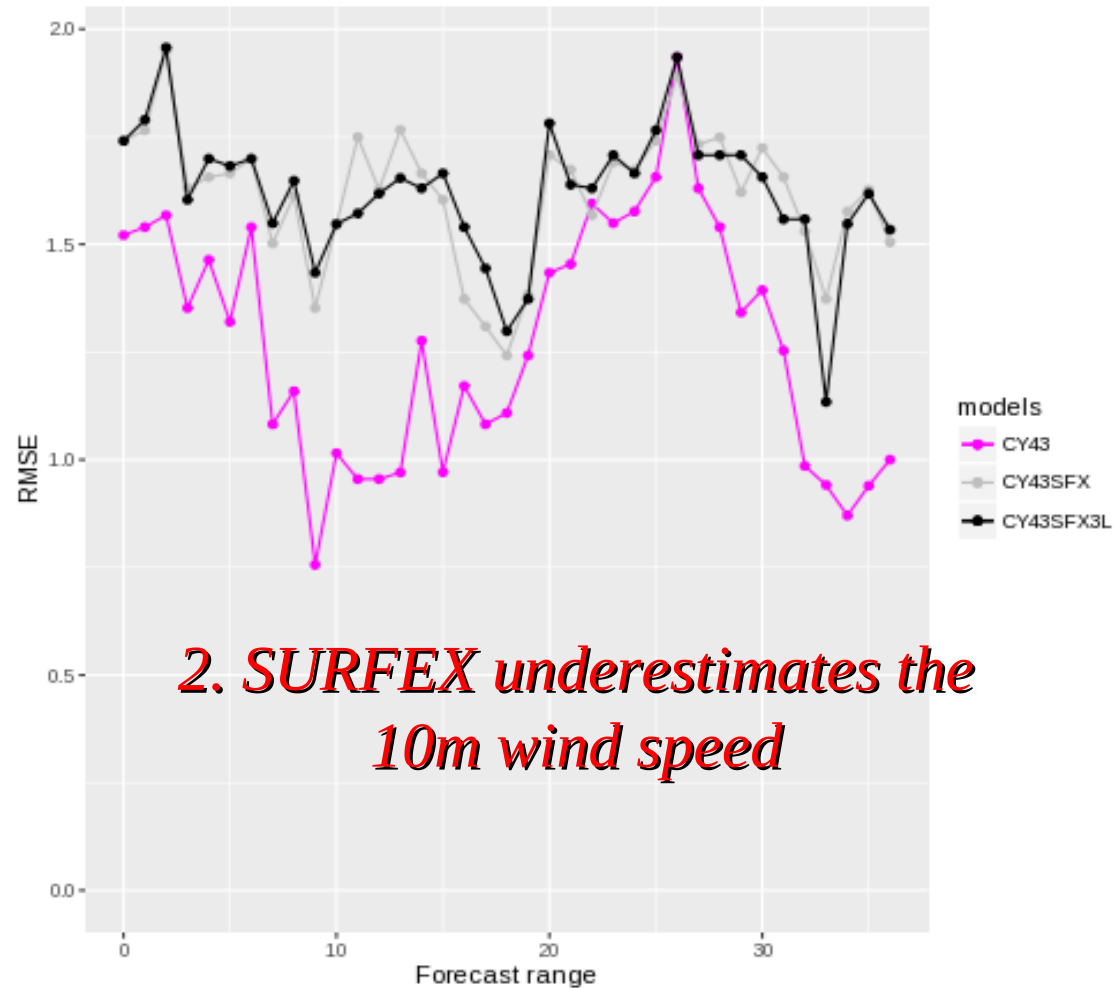


BIAS S10m
20160715 - 20160920 00h
station Elsenborn (6496)

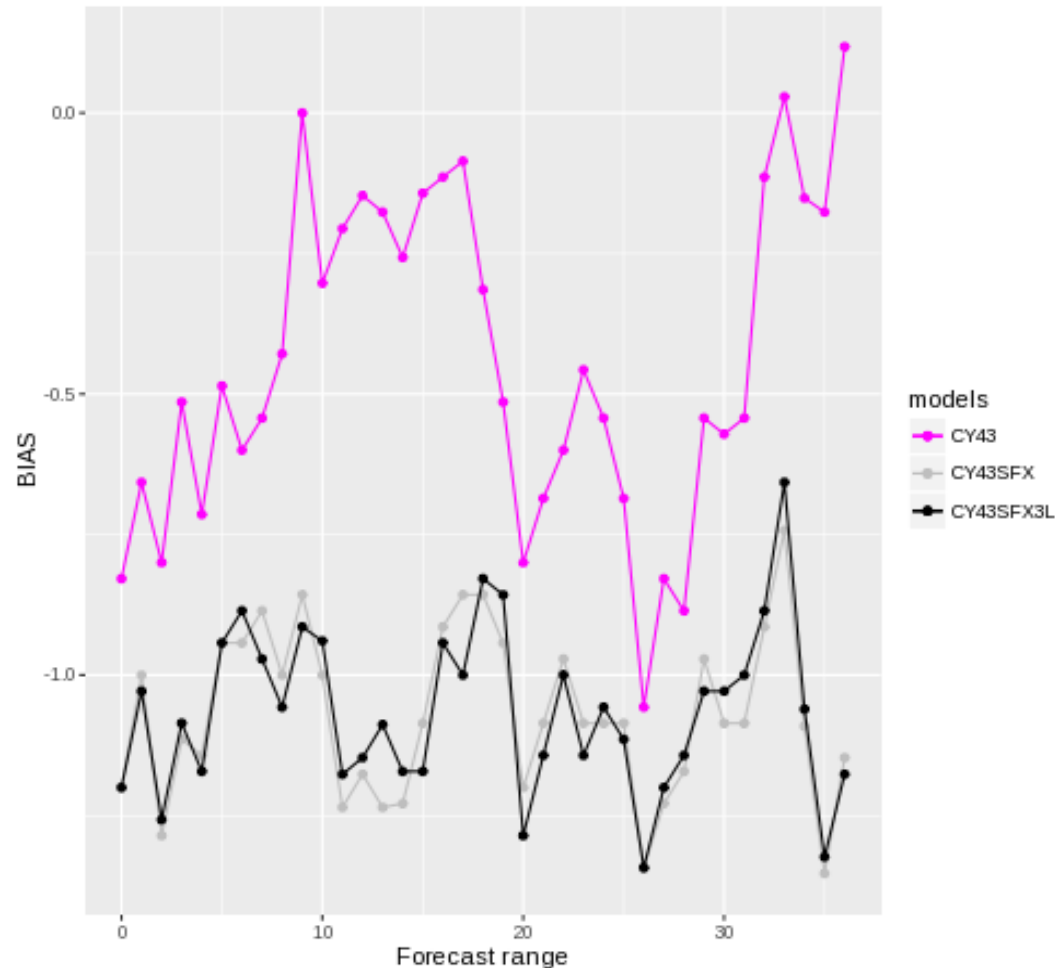


CY43T2 in e-suite set-up run 00 with 4km 15-25/07/2016 19-30/08/2016 09-20/09/2016

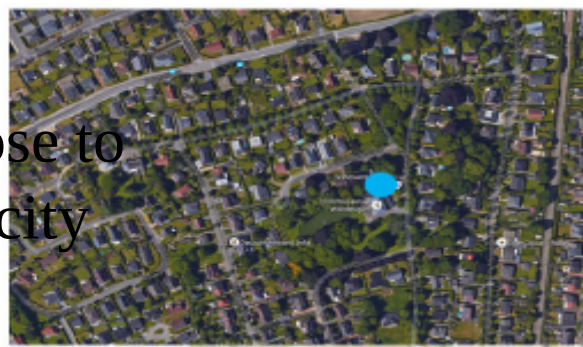
RMSE S10m
20160715 - 20160920 00h
station Saint-Hubert (6476)



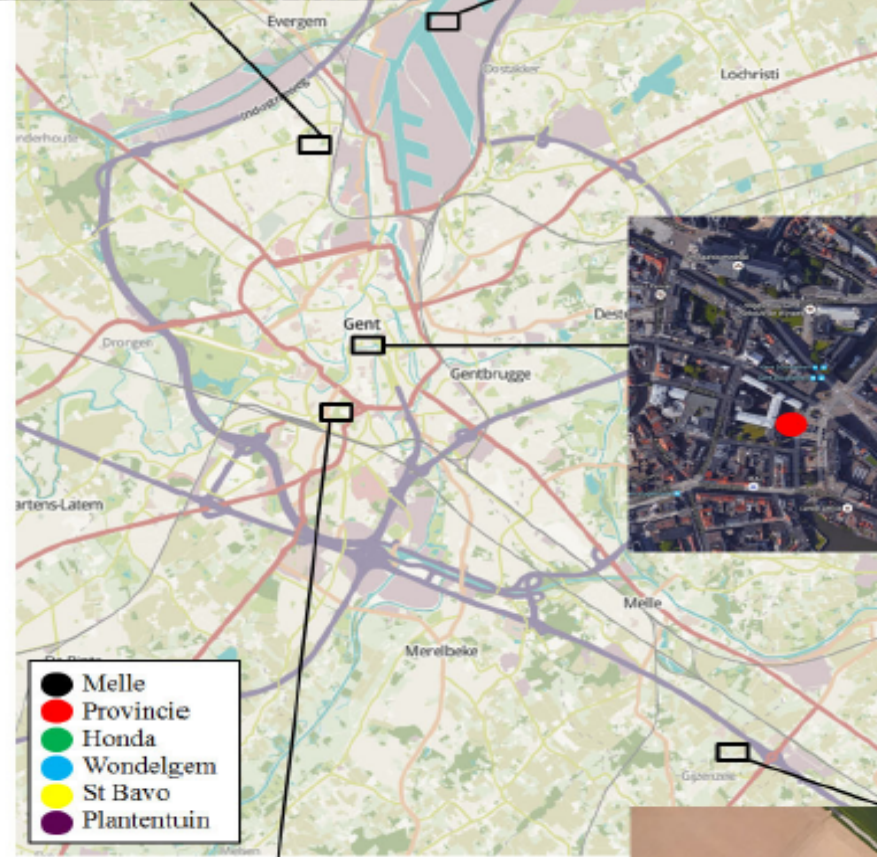
BIAS S10m
20160715 - 20160920 00h
station Saint-Hubert (6476)



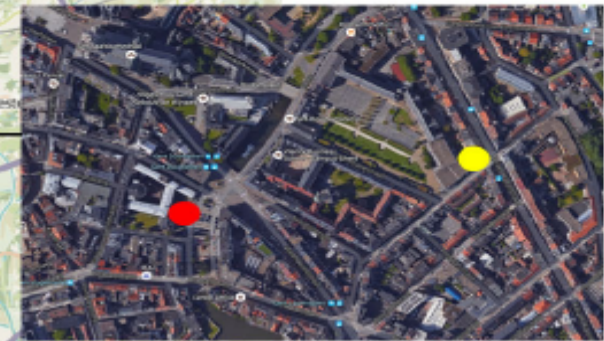
- Provincie and St Bavo are close to each other in the densely built city centre of Ghent



- Plantentuin is situated in a small park



- Honda is situated in the port, north of the city center



- Wondelgem represents a typical suburban neighborhood (detached housing with large green spaces in between) at the northwestern border of the city



- Melle is located southeast of Ghent in a rural environment



Figure 4. Detailed view of the sensors at one of the weather stations: actively ventilated radiation shield (1) with temperature sensor, rain gauge (2), passively ventilated shield (3) with temperature and relative humidity measurement, and sonic anemometer (4).

6.6.1. Namelist NAM_TEBn

Fortran name	Fortran type	values	default value
CZ0H	character(LEN=6)	'MASC95','BRUT82','KAND07'	'KAND07'
CCH_BEM	character(LEN=5)	','DOE-2'	'DOE-2'
XDT_RES	real		0.
XDT_OFF	real		0.

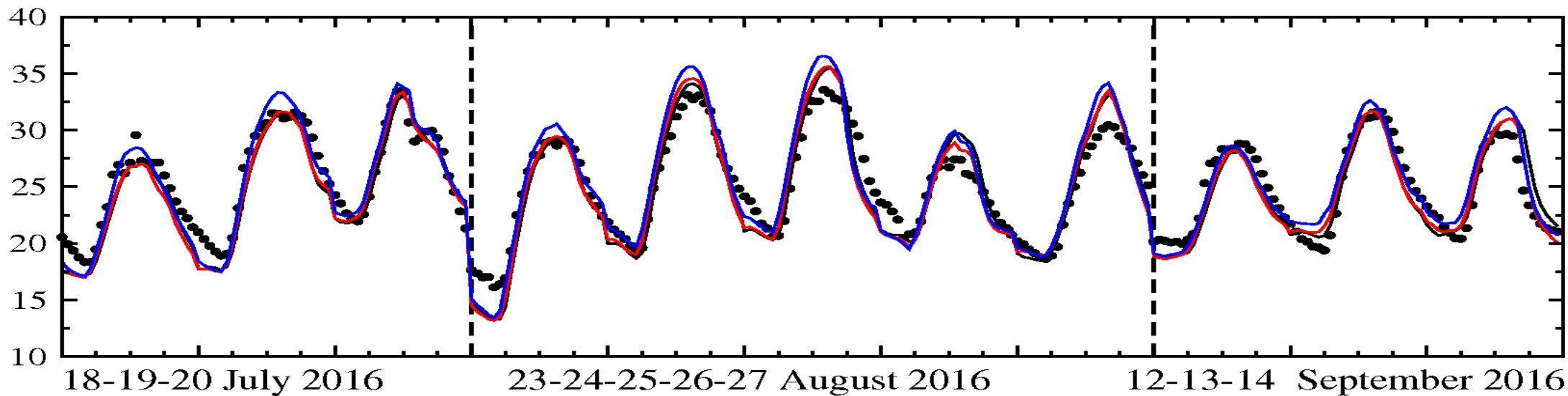
- CZ0H: TEB option for z0h roof & road:
 - ◆ 'MASC95' : Mascart et al 1995
 - ◆ 'BRUT82' : Brusttaert 1982
 - ◆ 'KAND07' : Kanda 2007

As in CY36 with SFX-v5

Oscillations

— ALARO1.BE40km
— ALARO1.BE40km.SFX
— ALARO1.BE40km.SFX.TEB

Provinciehuis

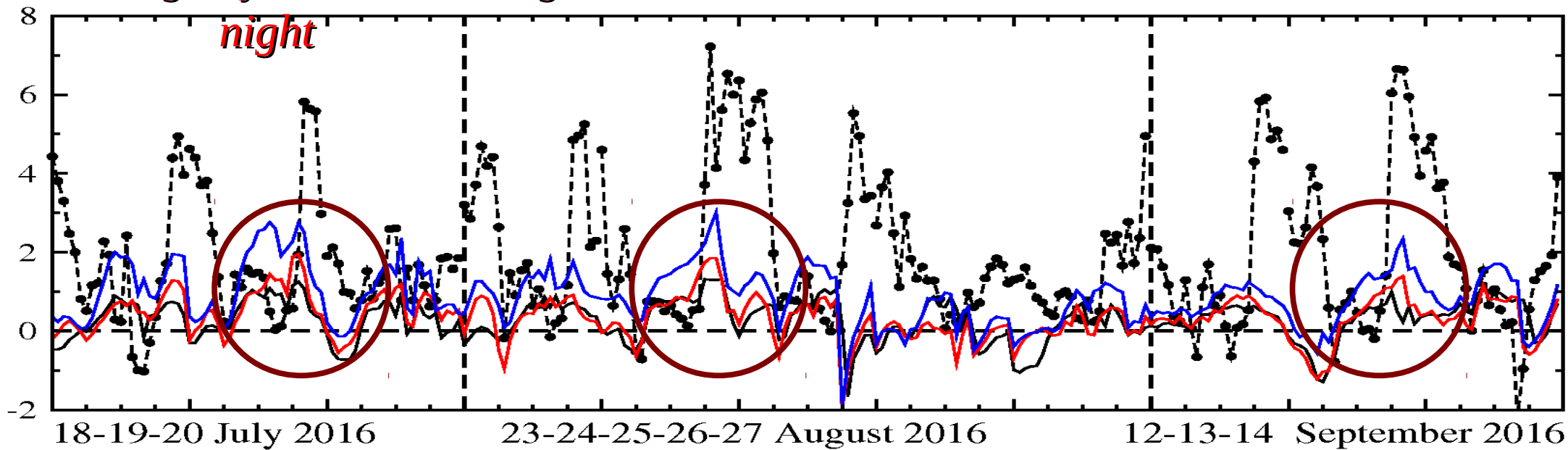


3. SURFEX/TEB shifts the diurnal cycle of the UHI,

max during day and min during

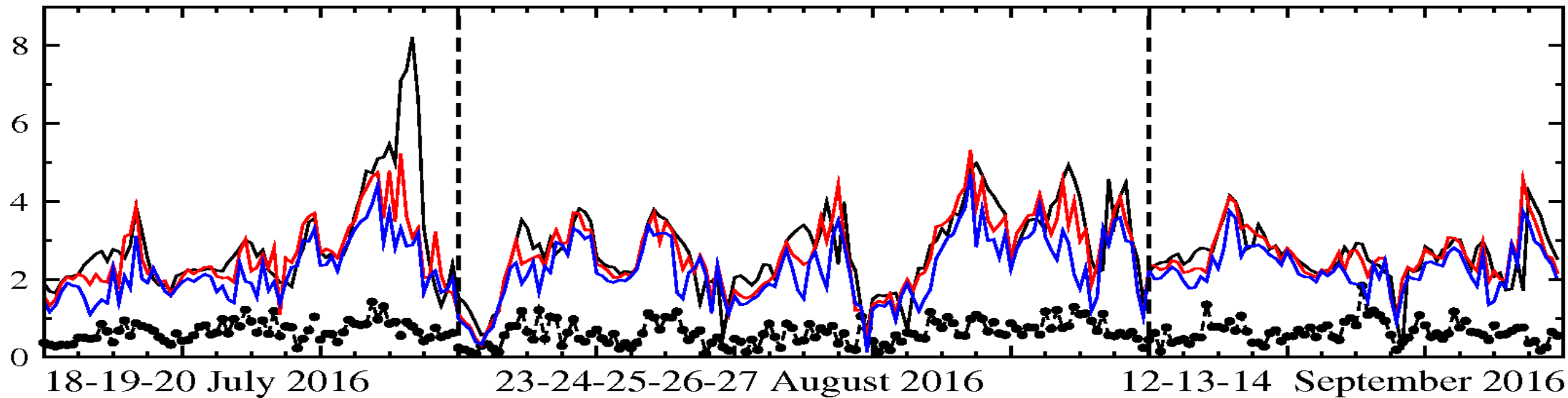
Provinciehuis - Melle

night

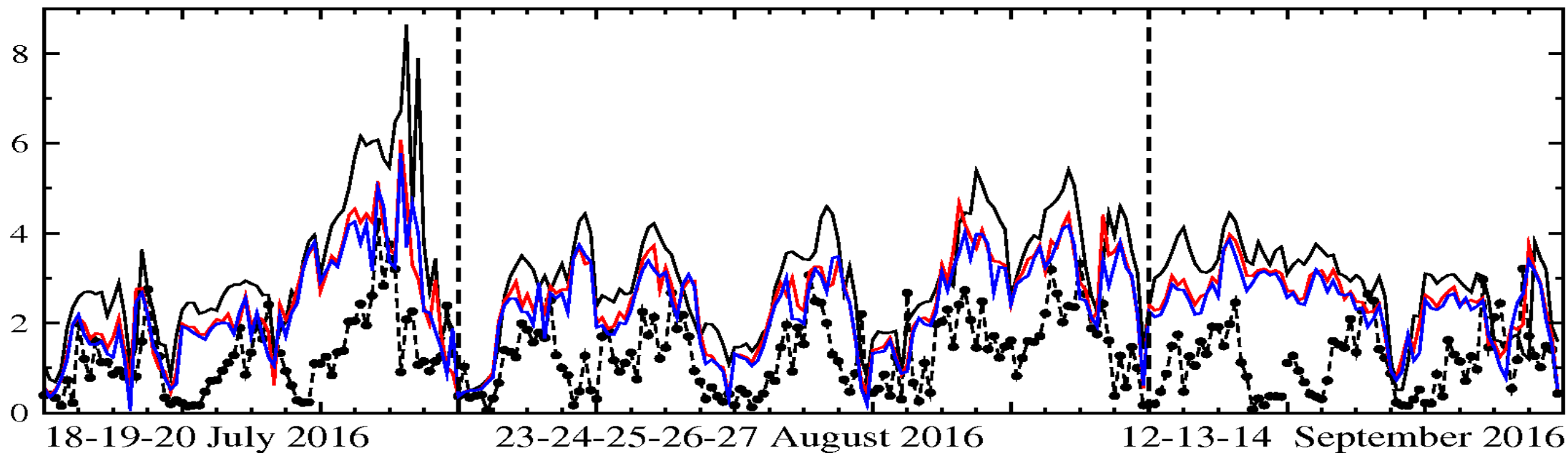


— ALARO1.BE40km
— ALARO1.BE40km.SFX
— ALARO1.BE40km.SFX.TEB

Provinciehuis



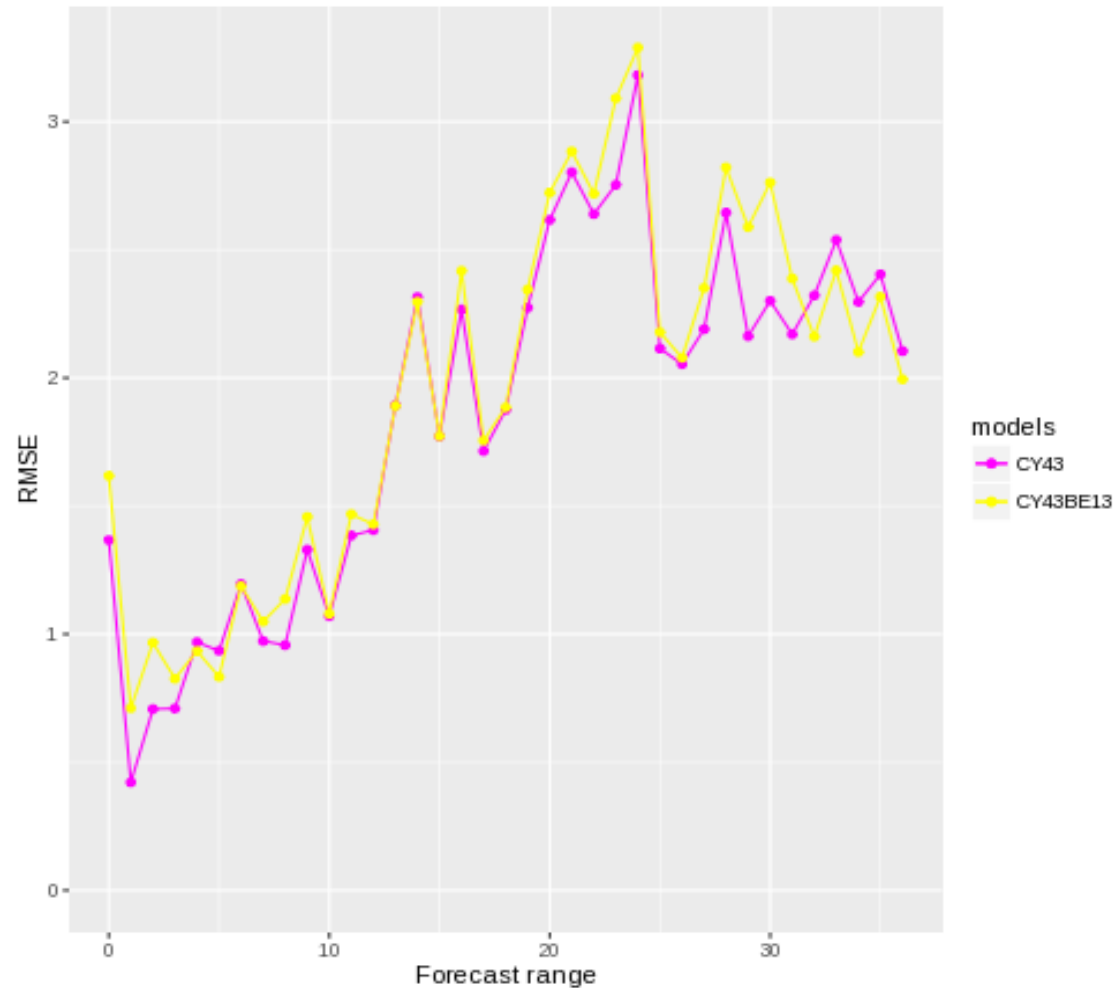
Melle



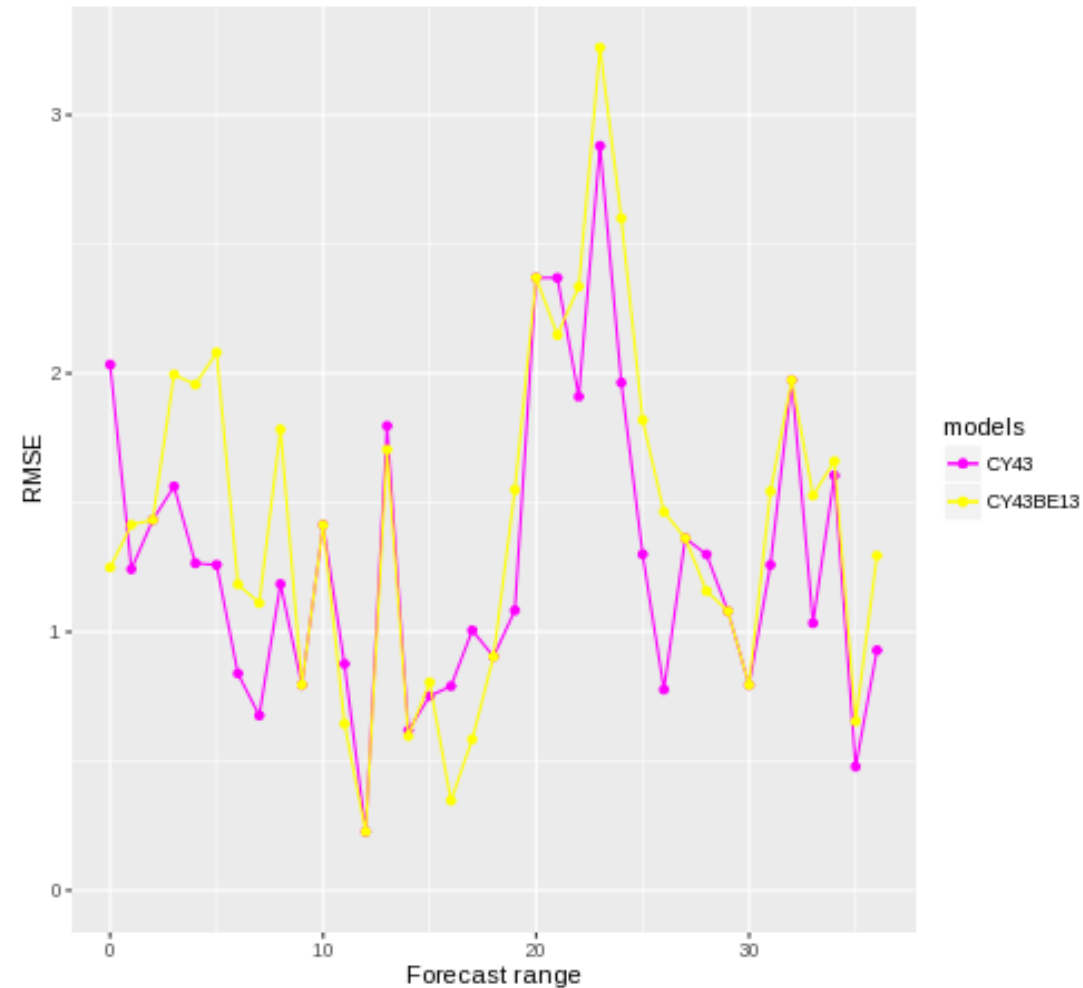
CY43T2 in e-suite set-up run 00 with 1.3km

18-20/07/2016 23-27/08/2016 12-14/09/2016

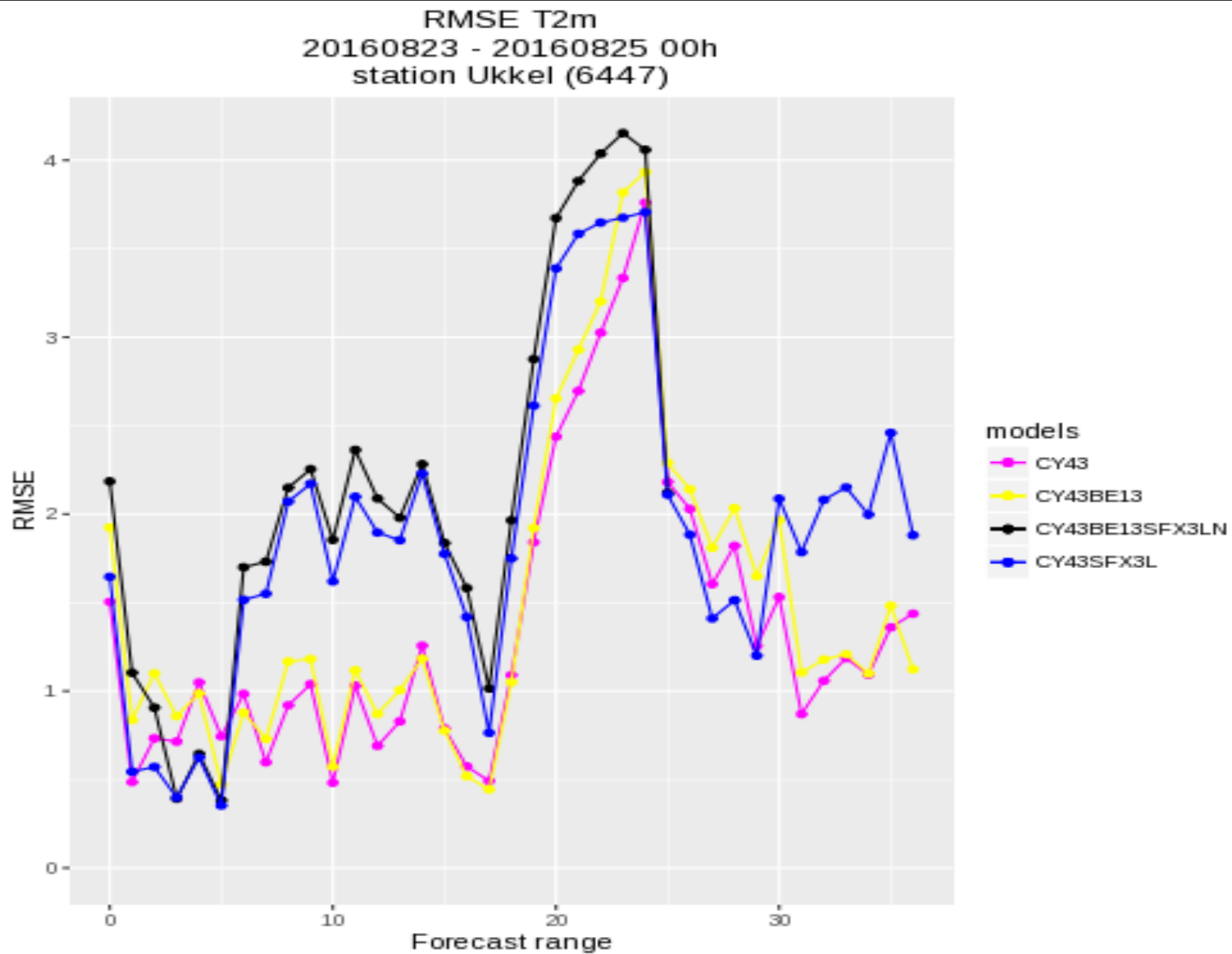
RMSE T2m
20160823 - 20160827 00h
station Ukkel (6447)



RMSE S10m
20160823 - 20160827 00h
station Ukkel (6447)

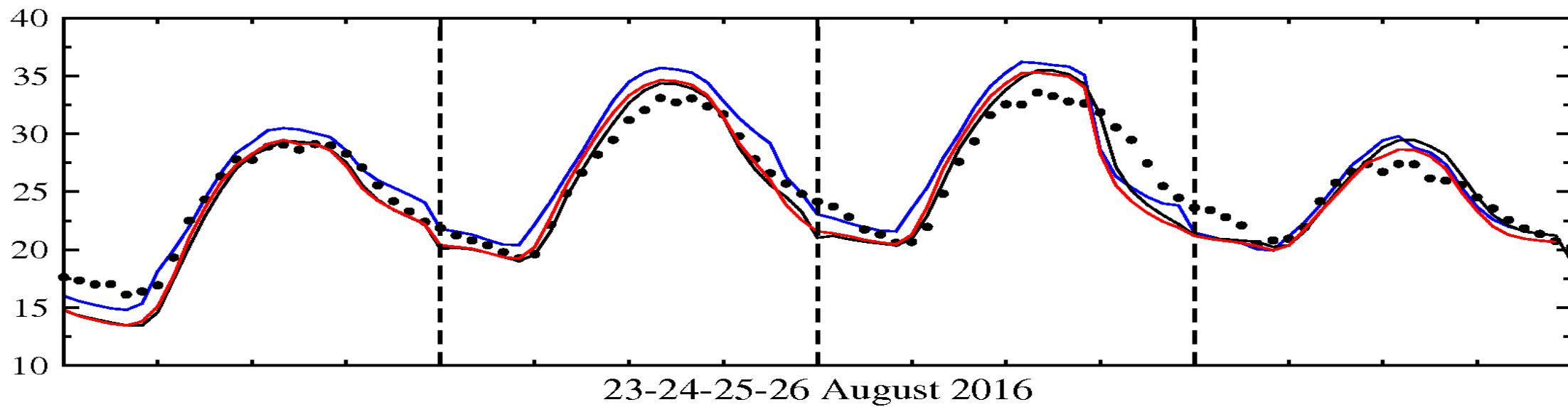


CY43T2 in e-suite set-up run 00 with 1.3km 23-24-25-26/08/2016

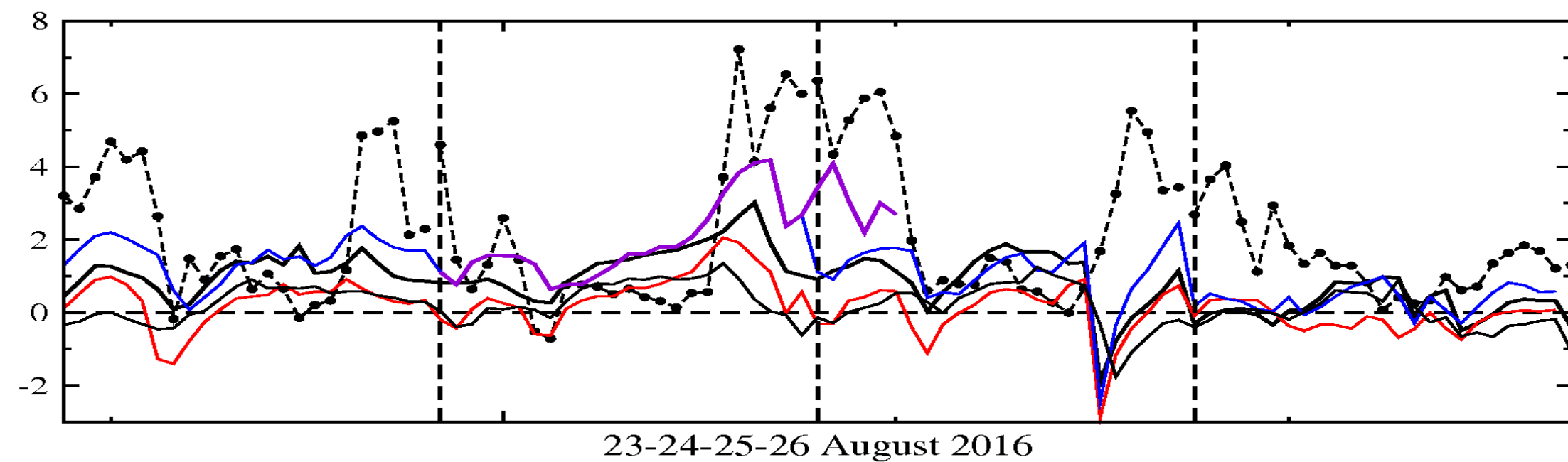


- ALARO1.BE13km.SFX.TEB
- ALARO1.BE13km
- ALARO1.BE13km.SFX

Provinciehuis



Provinciehuis - Melle



The coupling of SURFEX to TOUCANS seems to work, but...

1. SURFEX overestimates the high daytime summer temperatures
 - > test namelist parameters in options.nam
2. SURFEX underestimates the 10m wind speed
 - > tuning of TOUCANS 5 free parameters
3. TEB shifts the diurnal cycle of the UHI, max during day and min during night
 - > test TOUCANS stability functions with other CZOH formulations
4. Couple a run with SFX to another run with SFX
 - > test the solution of Météo-France