On the use of SURFEX for ALADIN/ALARO

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with input from ALADIN colleagues

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1. Evaluating the performance of SURFEXv5 as a new land surface scheme for the ALADINcy36 and ALARO-0 models

2. Testing the EKF data assimilation scheme

3. Evaluating the performance of SURFEXV7.2 within cycle CY38T1

4. Climate applications

5. Future work

Geosci. Model Dev., 7, 23–39, 2014
www.geosci-model-dev.net/7/23/2014/
doi:10.5194/gmd-7-23-2014

Geoscientific Model Development
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Evaluating the performance of SURFEXv5 as a new land surface scheme for the ALADINcy36 and ALARO-0 models

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ALADIN partners from Austria, Belgium, Morocco, Poland, Portugal, Tunisia, and Turkey participated to the SURFEX working week in Brussels 24-28 September 2012.

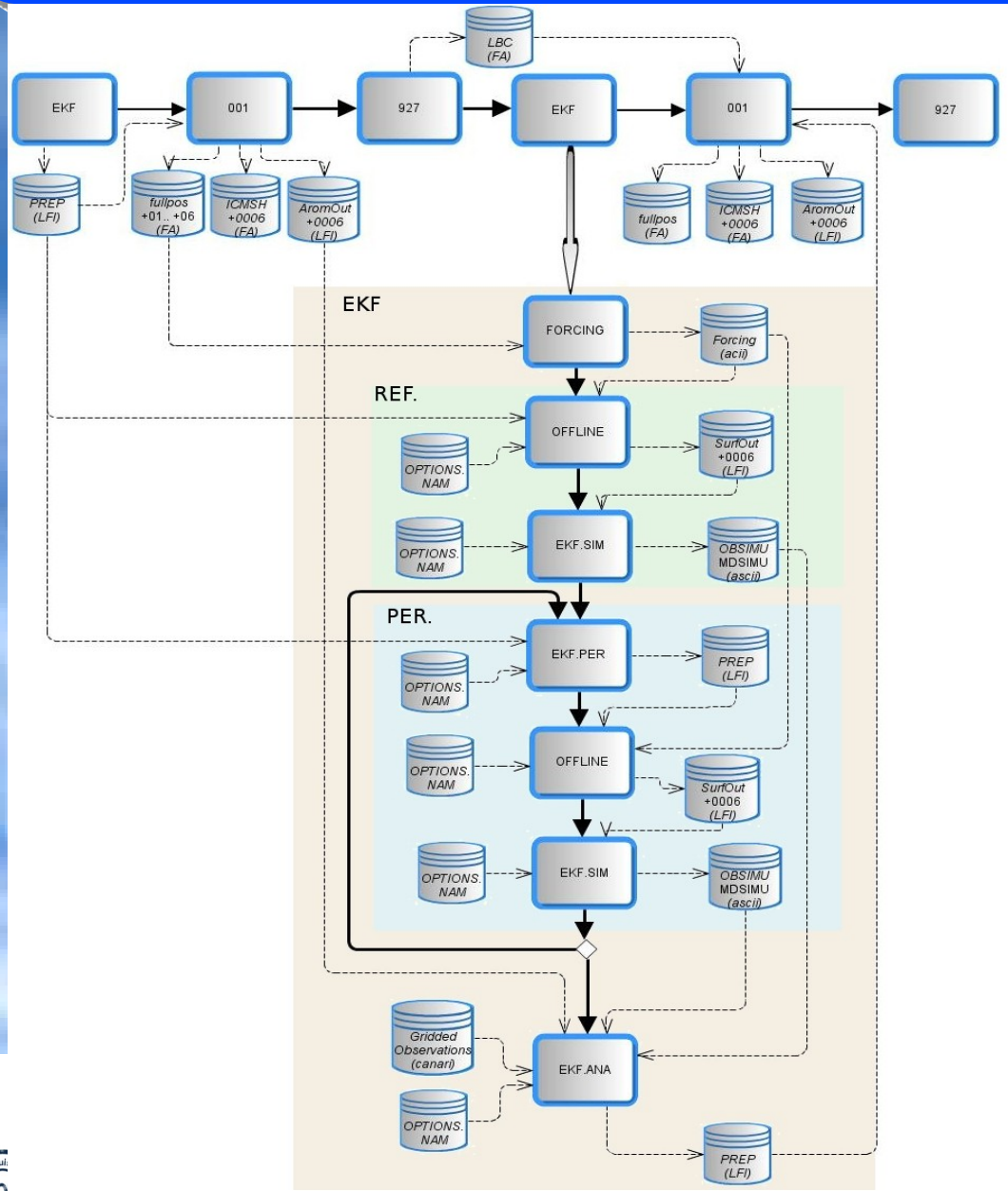
area numerical weather prediction model running operationally in a number of countries of the ALADIN and HIRLAM consortia. The primary question addressed is the ability of SURFEX to be used as a new land surface scheme and thus assessing its potential use in an operational configuration instead of the original ISBA (Interactions between Soil, Biosphere, and Atmosphere) scheme. The results show that the introduction of SURFEX either shows improvement for or has a neutral impact on the 2 m temperature, 2 m relative humidity and 10 m wind. However, it seems that SURFEX has a tendency to produce higher maximum temperatures at high-elevation stations during winter daytime, which degrades the 2 m temperature scores. In addition, surface radiative and energy fluxes improve compared to observations from the Cabauw tower. The results also show that promising improvements with a demonstrated positive impact on the forecast performance are achieved by introducing the town energy balance (TEB) scheme. It was found that the use of high-resolution run tends to cause rainfall to be locally concentrated, and the total accumulated precipitation obviously decreases during the summer. One of the novel features developed in SURFEX is the availability of a more advanced surface data assimilation using the extended Kalman filter. The results over Belgium show that the forecast scores are similar between the extended Kalman filter and the classical optimal interpolation scheme. Finally, concerning the vertical scores, the introduction of SURFEX either shows improvement for or has a neutral impact in the free atmosphere.

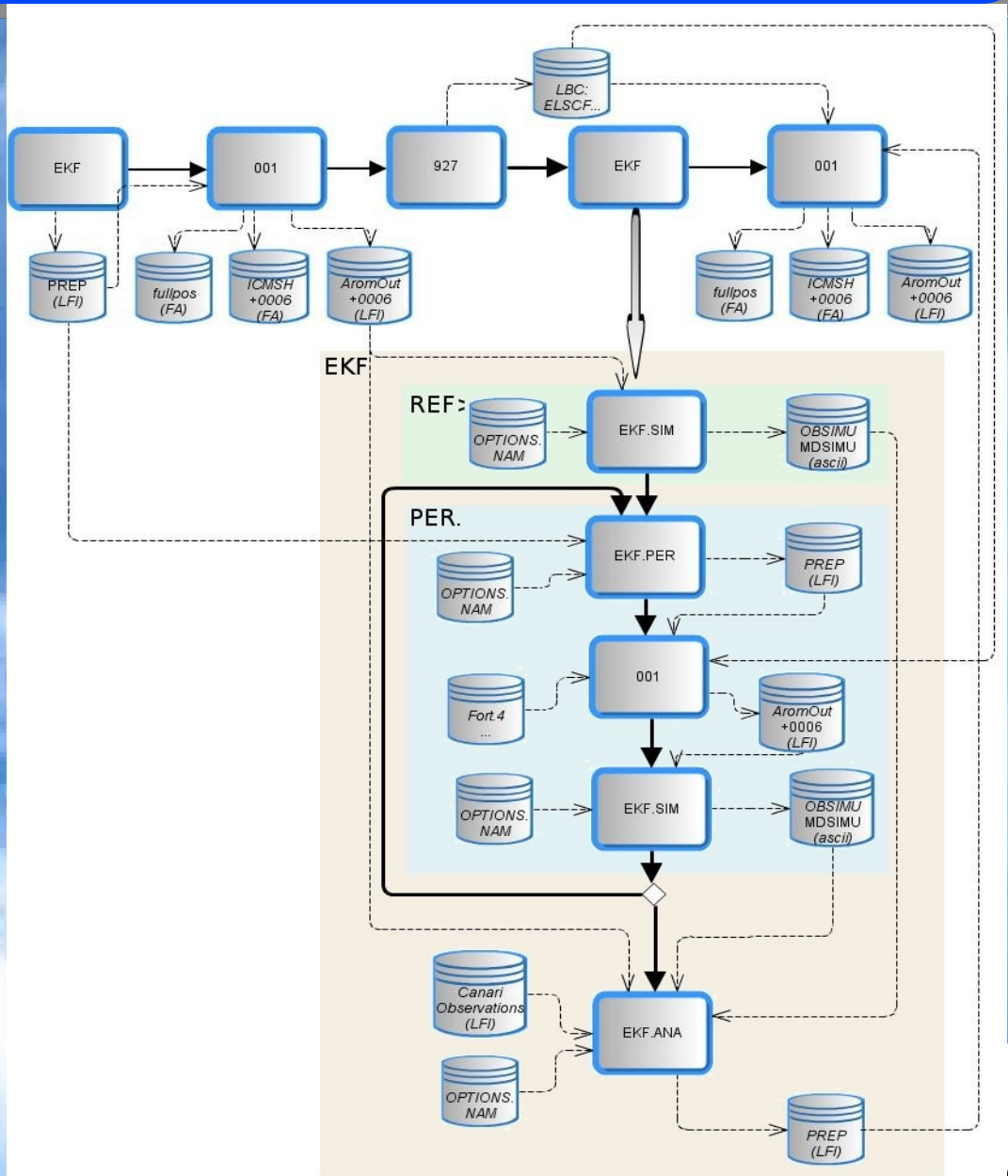
1 Introduction

Numerical weather prediction models need parameterizations of the surface processes to estimate the fluxes for physical budgets such as sensible heat, latent heat, momentum and radiation between the atmosphere and the surface features

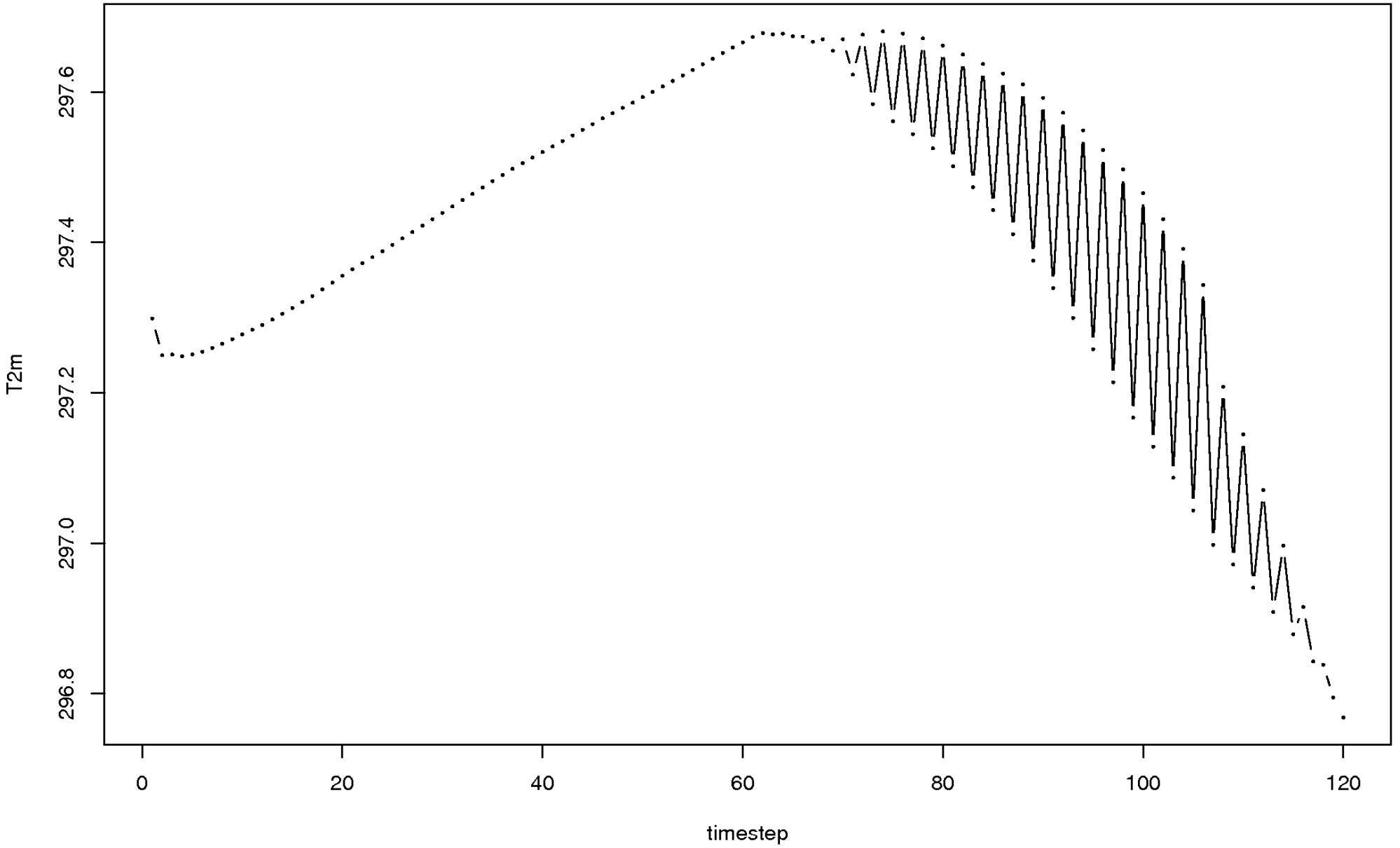
Published by Copernicus Publications on behalf of the European Geosciences Union.

Development of a SURFEX EKF for ALARO and comparison of the offline and coupled version with the OI analysis.



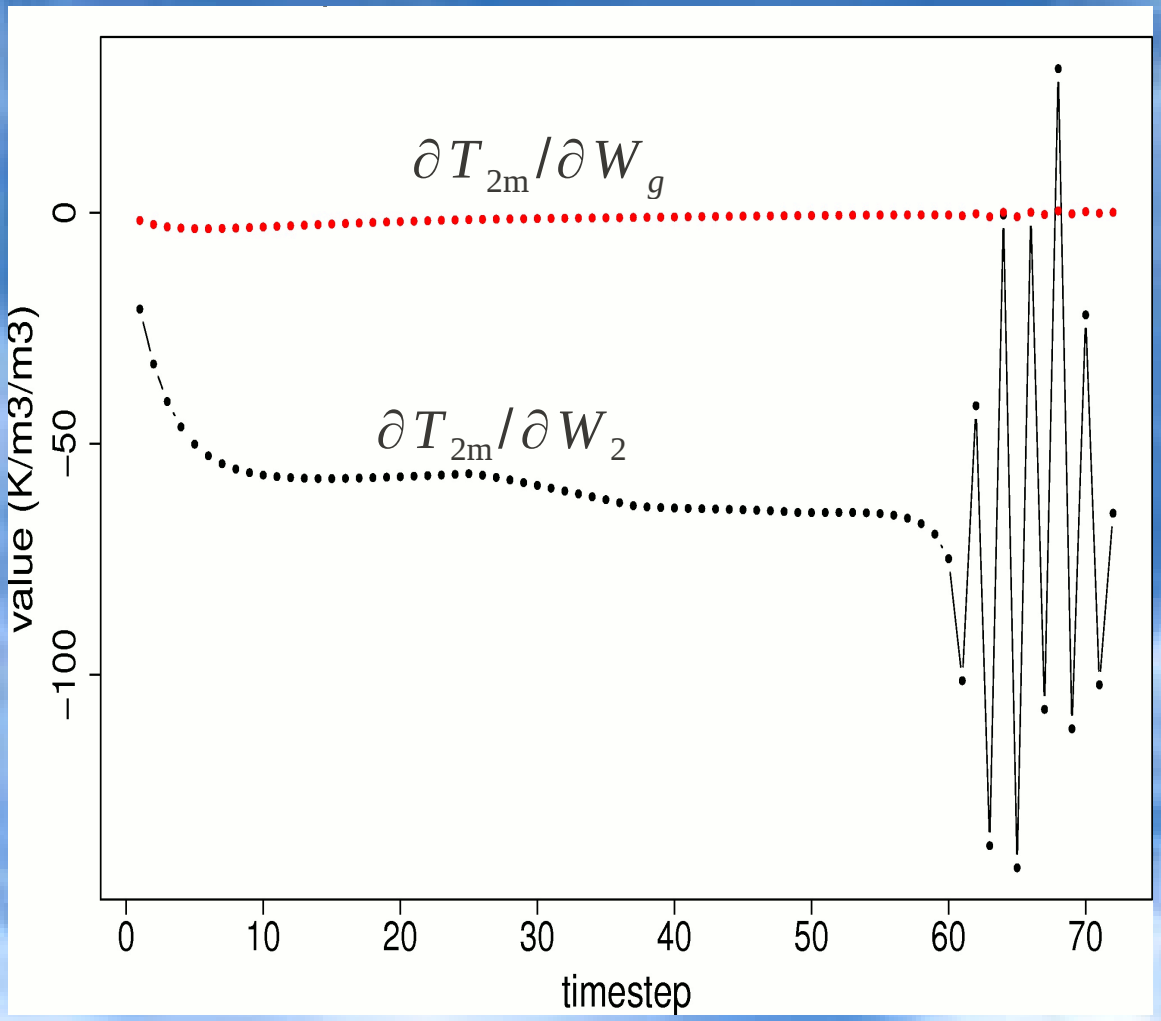


2m Temperature, 2 July 2010, 12-->18UTC assimilation window

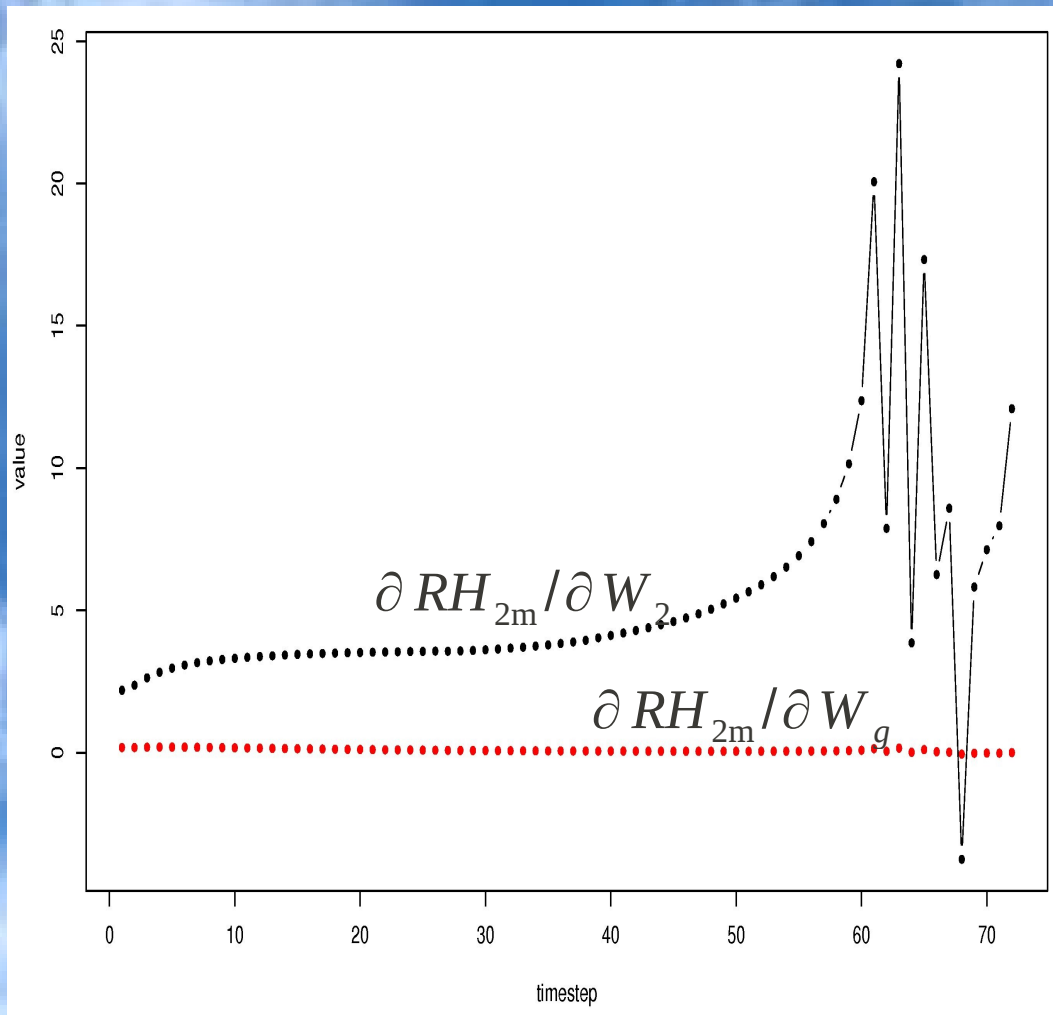


oscillations

Jacobian of 2m T



Jacobian of 2m RH



Duerinckx et al., in preparation for GMD

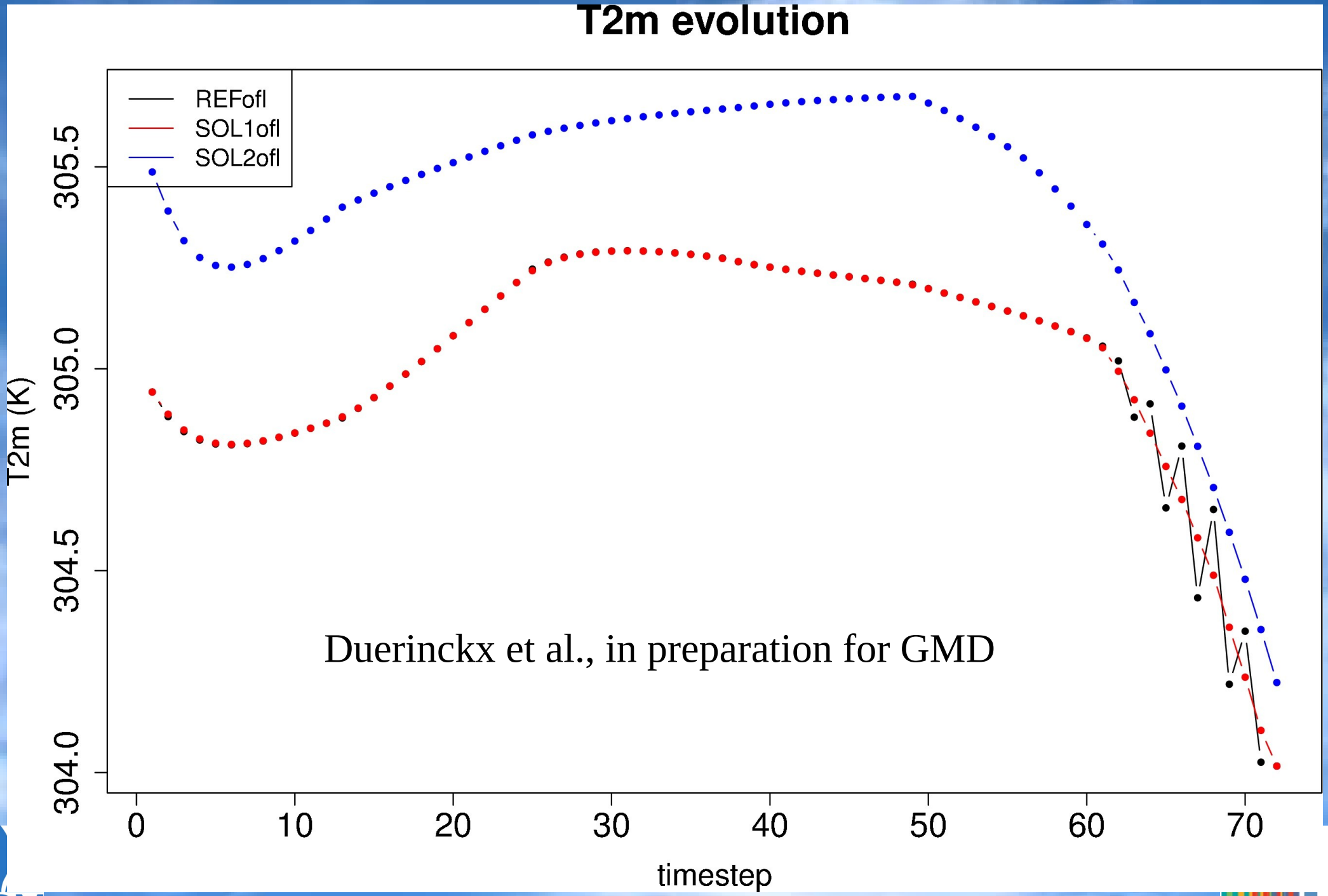
- **Oscillations are in the lowest model level and at the surface as soon as Ri > 0, with opposite movements of the oscillations in the lowest level and at the surface.**
- **Oscillations are found for the reference run and the perturbed one.**
- **Oscillations are found for small and big perturbation sizes.**
- **Oscillations are found for 300s and 60s time step of SURFEX.**
- **Oscillations are found for implicit (worse) and explicit coupling for SURFEX.**
- **Oscillations are also found when a run is initialized from ARPEGE analysis instead of the EKF analysis.**

Problem:

- Decoupling of the surface and the atmosphere during sunset
- Creates very small oscillations in the fluxes BUT big oscillations in the Jacobian values

Solution:

- Filter the oscillation
- Use forcing files from an earlier run so the atmosphere has more time to adjust to the surface.
- Use Canopy

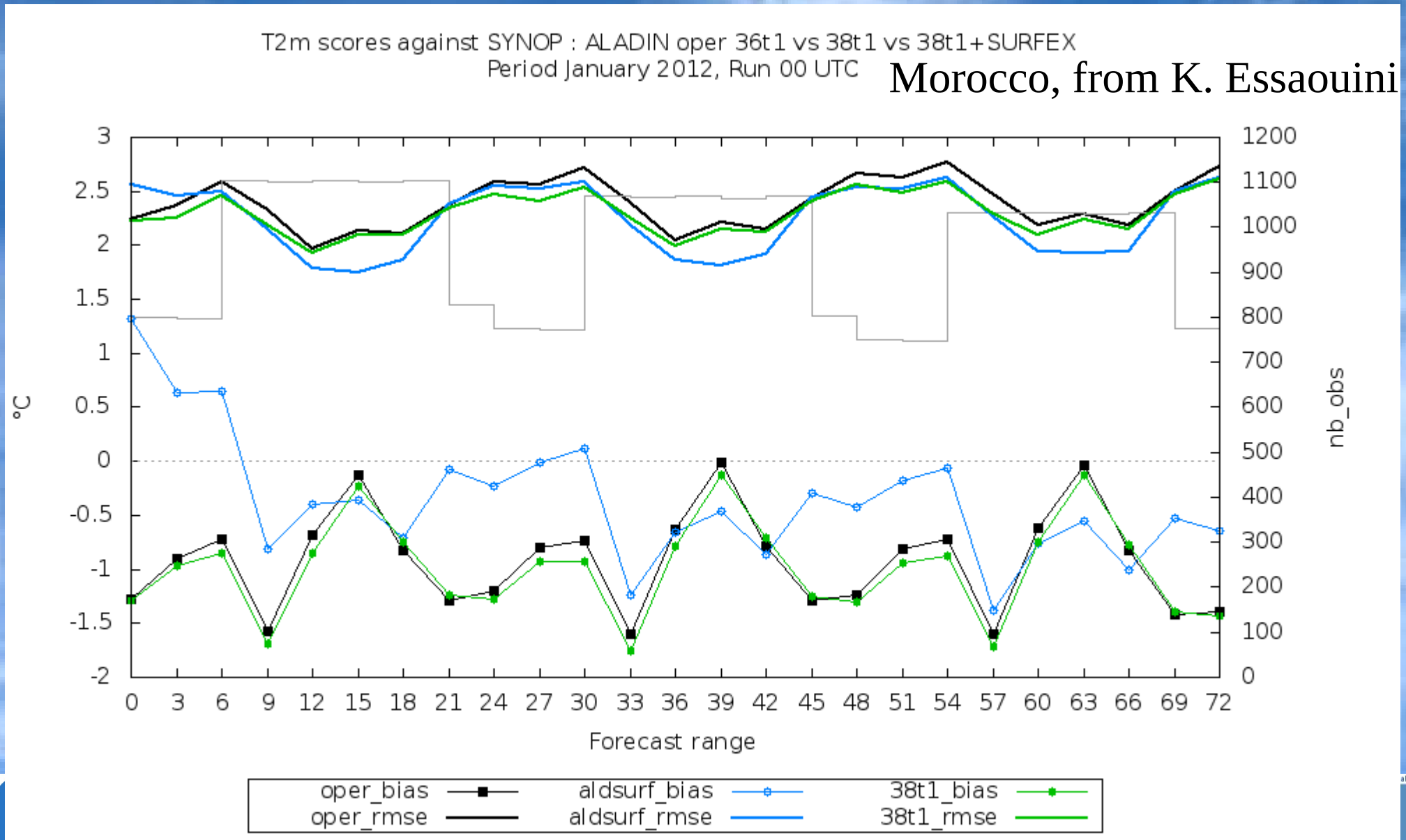

T2m evolution
REFofl
SOL1ofl
SOL2ofl
T2m (K)
304.0
304.5
305.0
305.5
0
10
20
30
40
50
60
70
timestep
Duerinckx et al., in preparation for GMD

- **Combining SURFEX EKF with 3dVar atmospheric assimilation.**

- **STAEKF scheme is introduced in the code but still to solve some final technical difficulties due to the new derivative computation of the B matrix. Some surface parameters are not initialized correctly.**

- **Testing SODA within Cy38 but still some compilation issues to be solved.**

3. Evaluating the performance of SURFEXV7.2 within ALADIN cycle CY38T1



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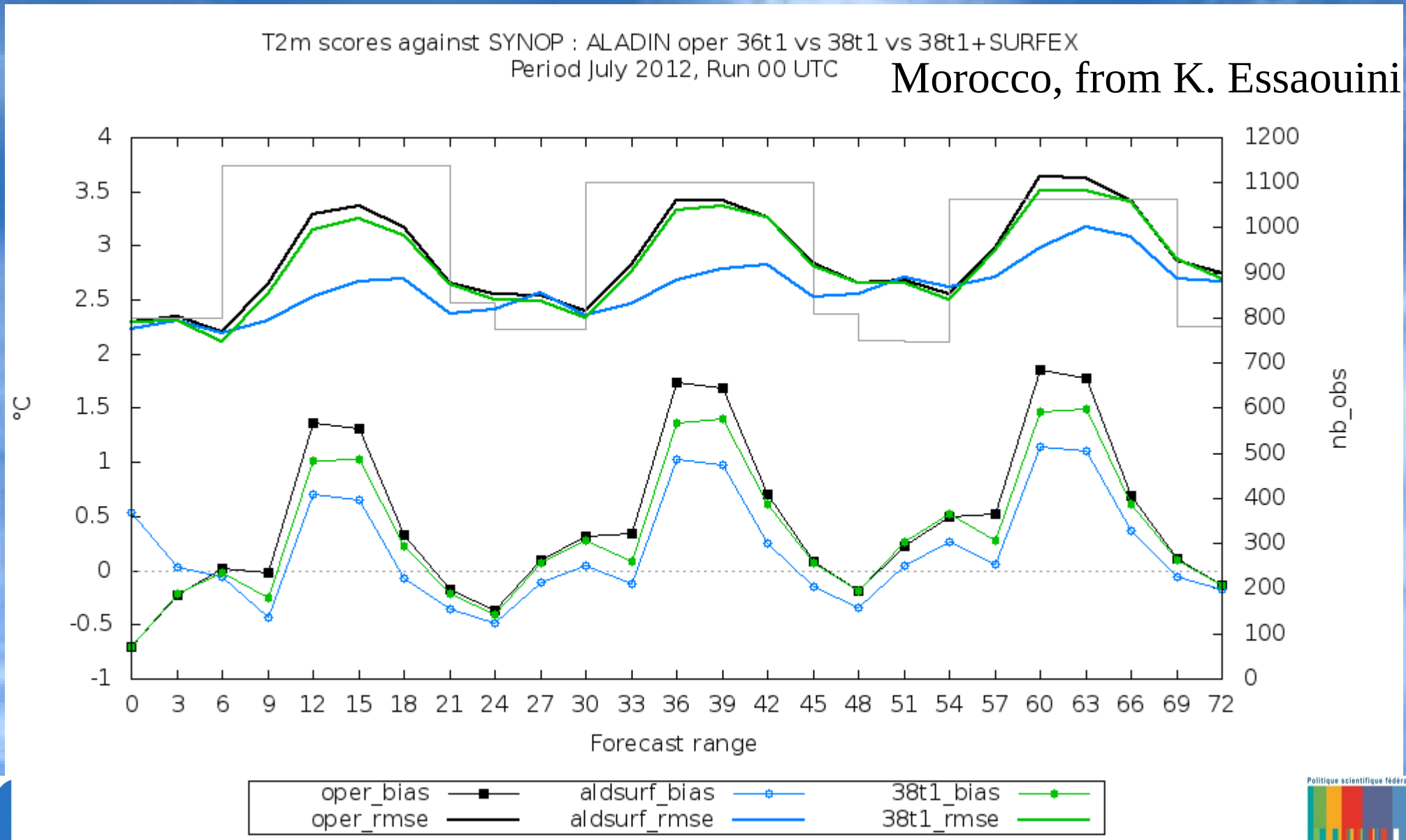


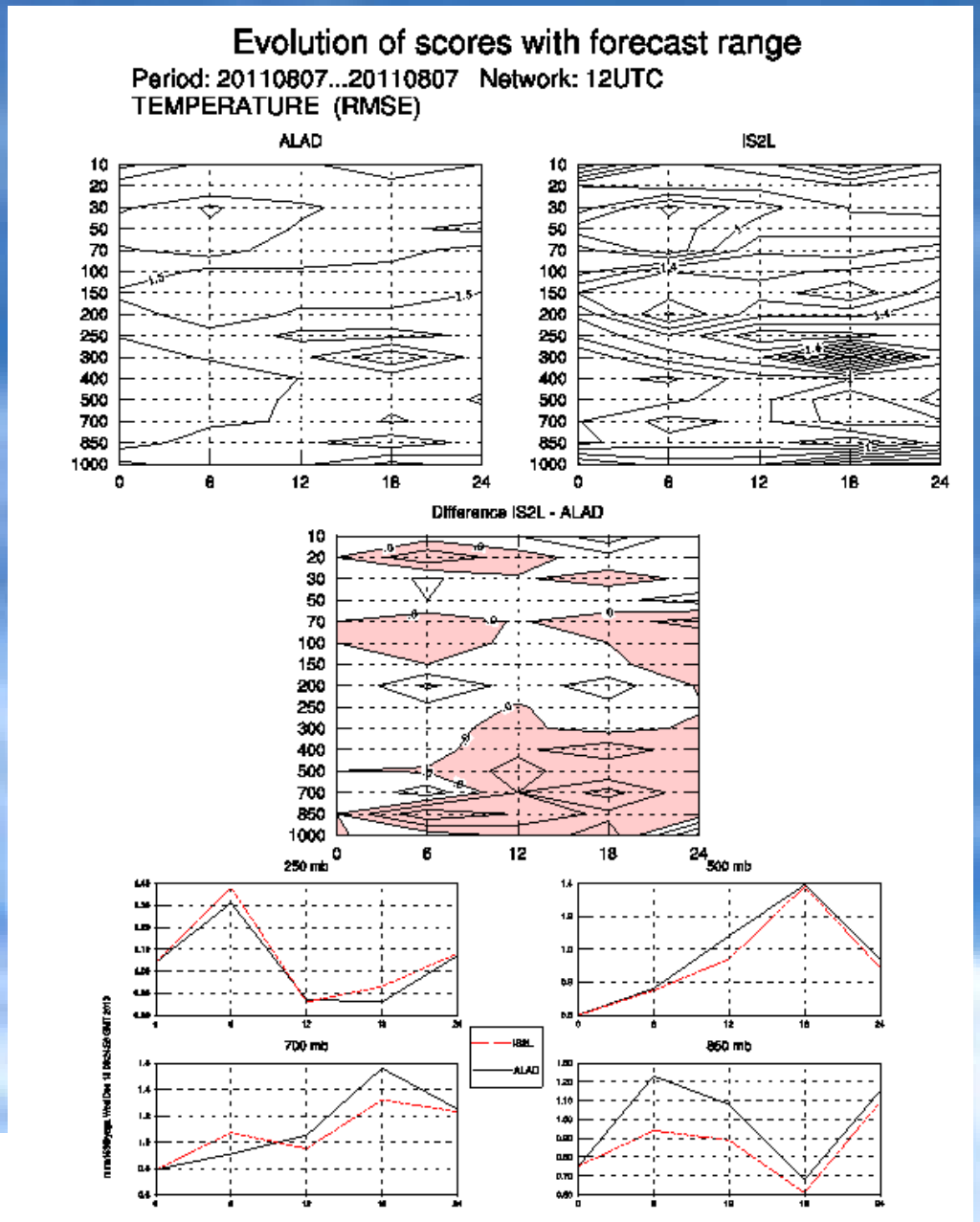
3. Evaluating the performance of SURFEXV7.2 within ALARO cycle CY38T1

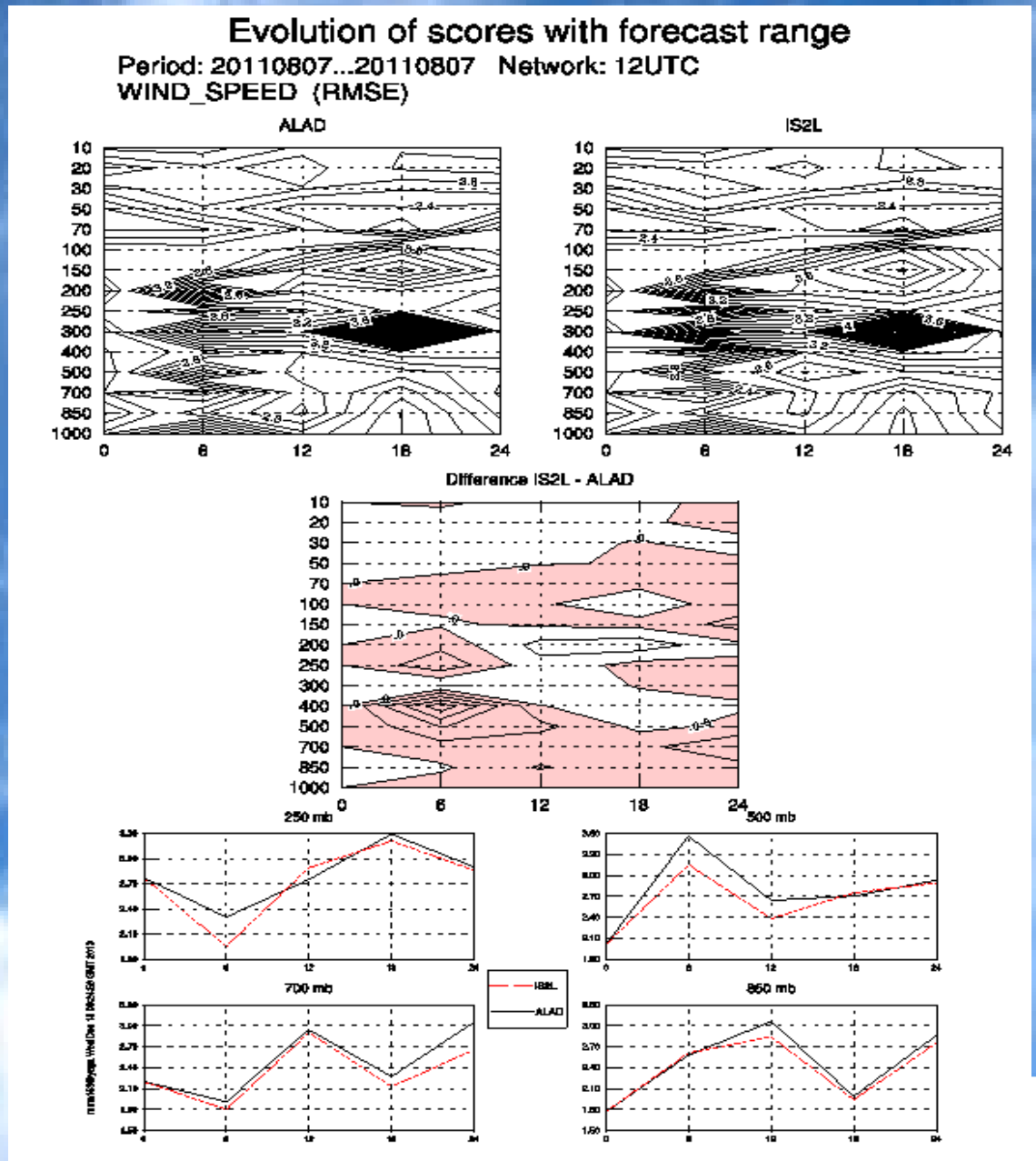
- To run ALARO (using the pTKE scheme) with SURFEX the issue of the exchange coefficient should be solved.

- The solution that was proposed for CY36T1 is now introduced in this new cycle interfacing the average drag coefficient PCD calculated from SURFEX and to initialize its value for the first time step.

- This solution will be available for the next version of SURFEX V8.

3. Evaluating the performance of SURFEXV7.2 within ALARO cycle CY38T1





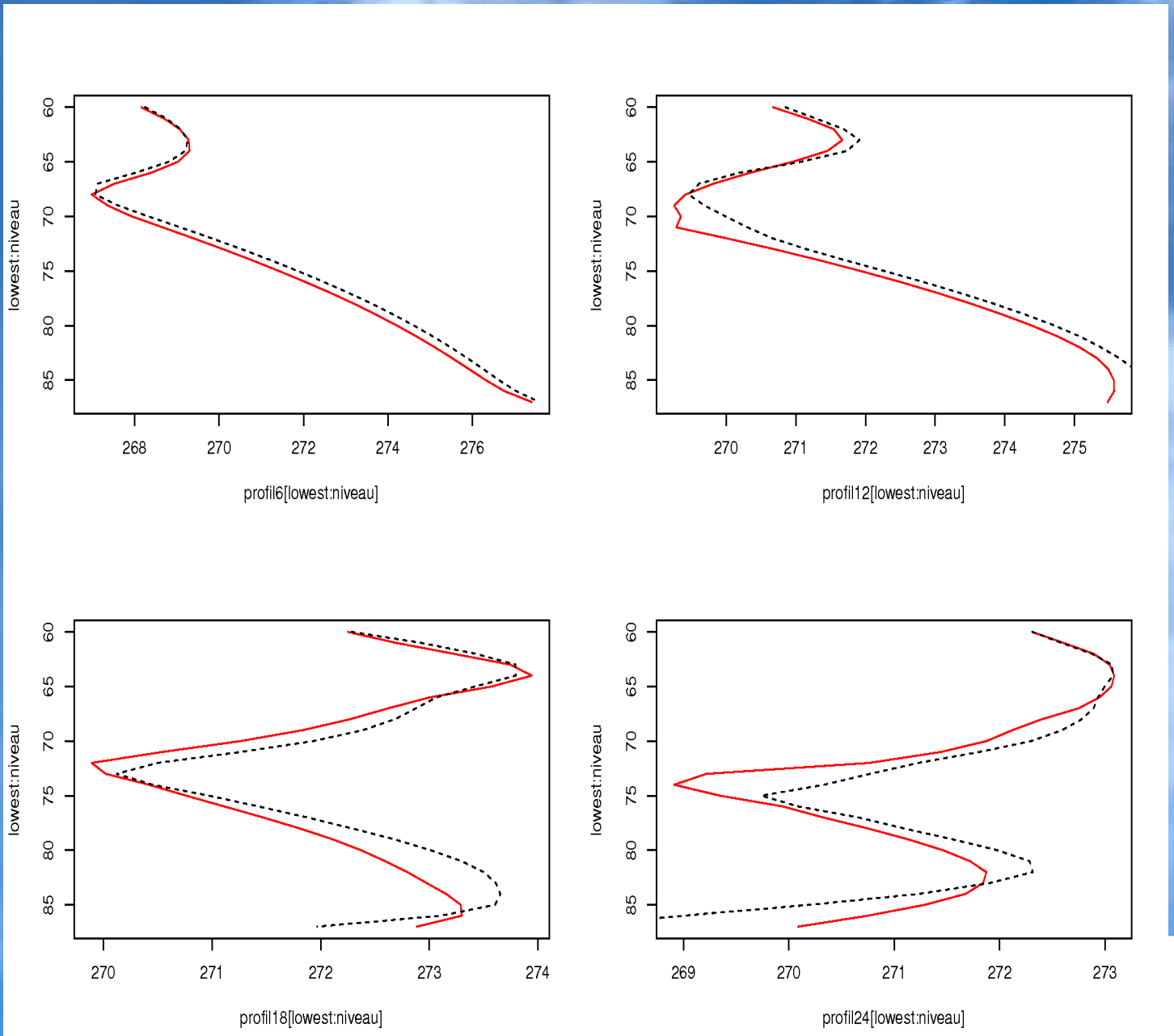
3. Evaluating the performance of SURFEXV7.2 within ALARO cycle CY38T1

- For TOUCANS the interface with SURFEX is done via the neutral drag coefficient Cdn.
- The PCDN is now extracted from SURFEX and given as input to the routine ACTKEHMTLS.F90.
- The new stability function are valid at the surface and in the boundary layer and the drag coefficient for momentum PCD and heat PCH are calculated using TOUCANS stability functions.
- 46! SURFEX routines to be able to interface the neutral drag coefficient.

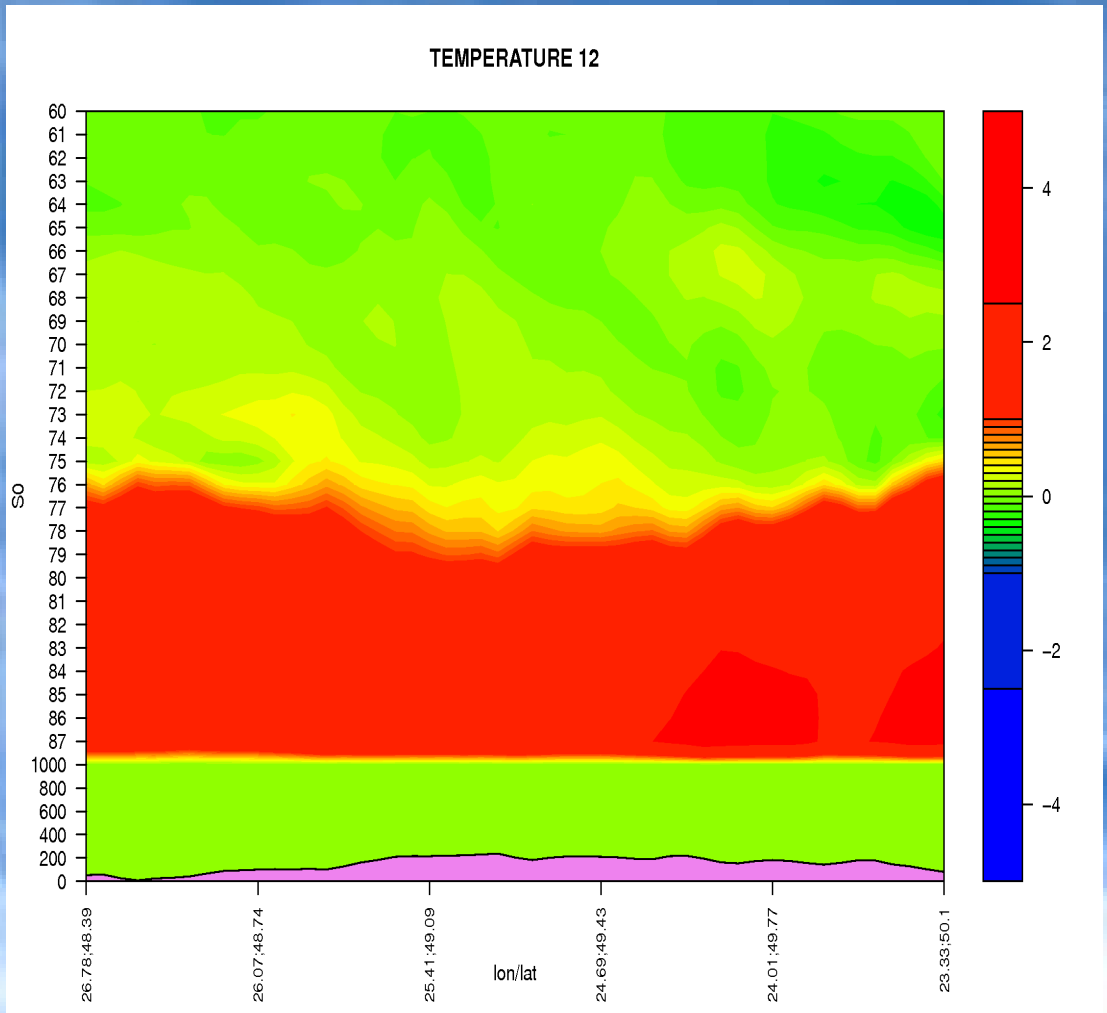
3. Evaluating the performance of SURFEXV7.2 within ALARO cycle CY38T1

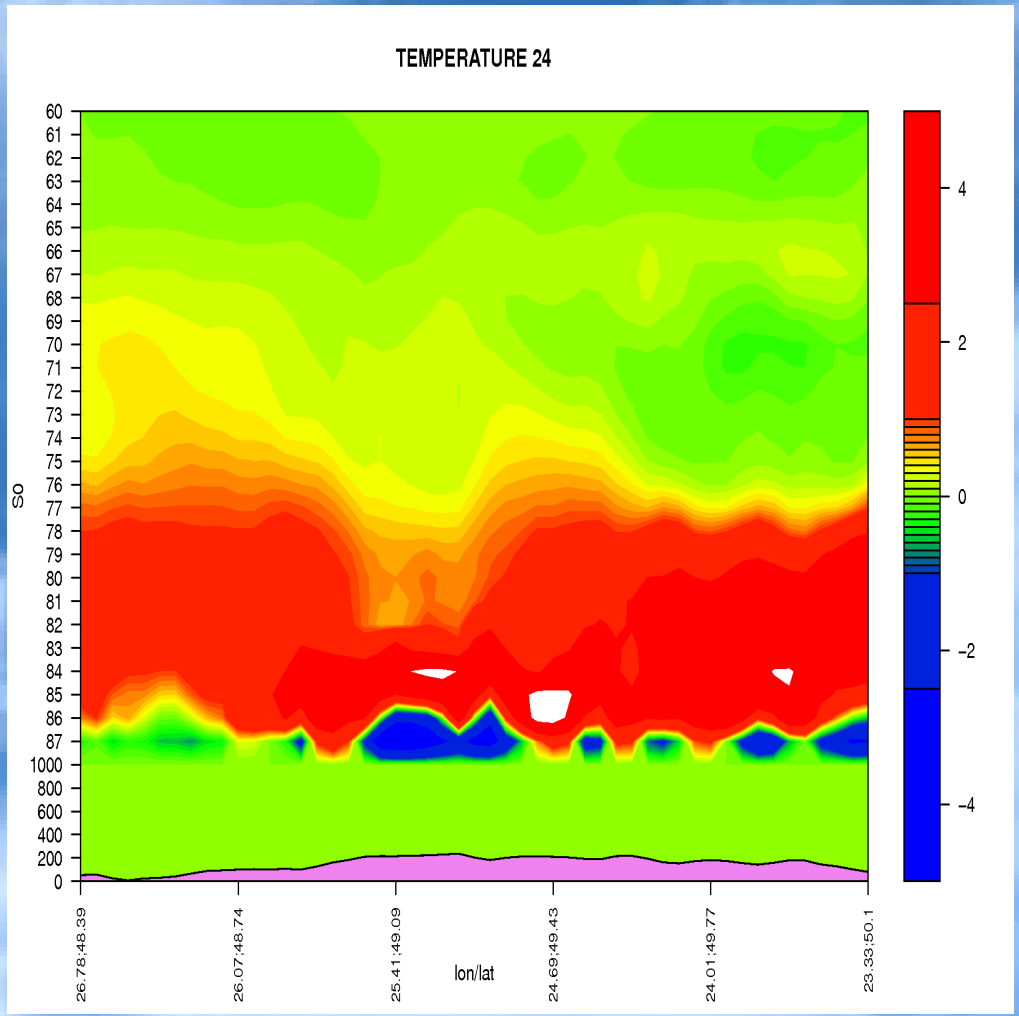
TOUCANS seems more sensitive to the new SURFEX land surface scheme than the pTKE.

Tests are still under investigation.



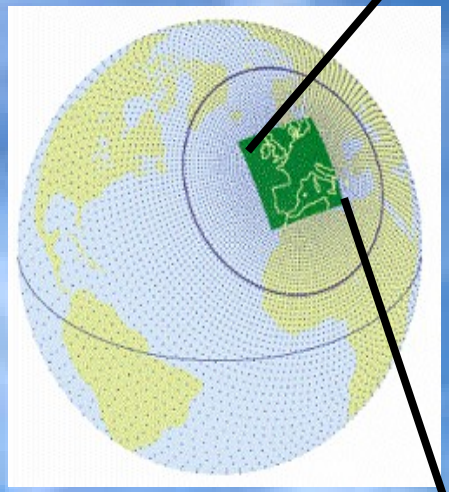
3. Evaluating the performance of SURFEXV7.2 within ALARO cycle CY38T1



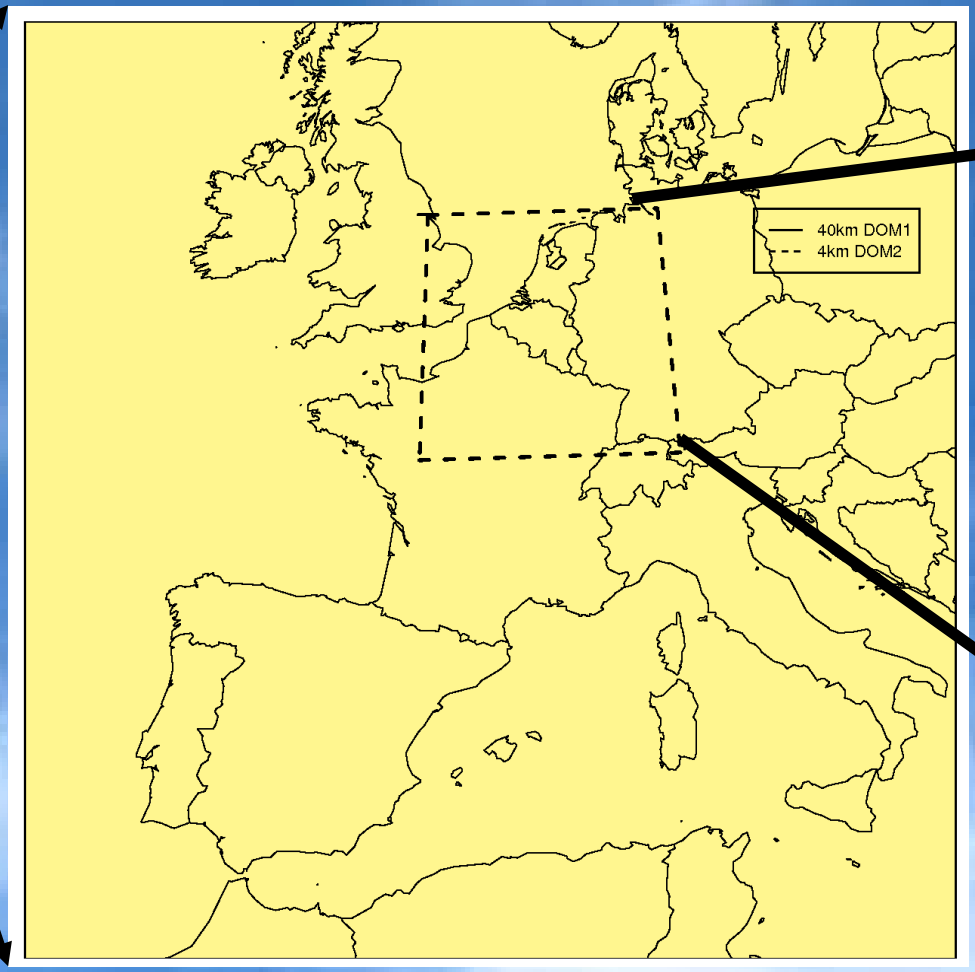


Regional climate simulations using ALARO+SURFEX+TEB

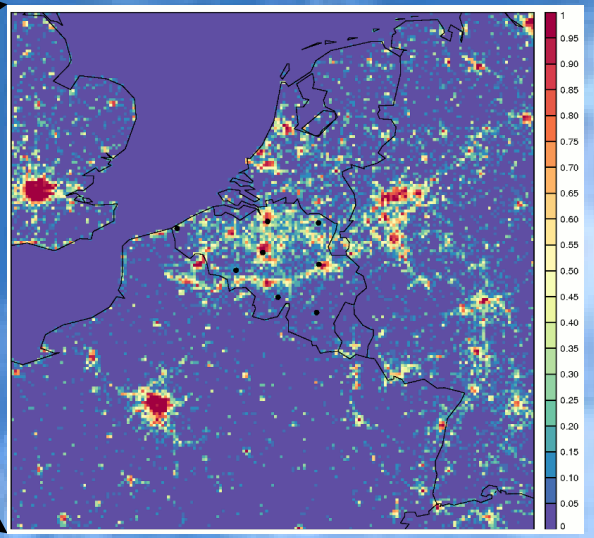
GLOBAL



40/20 km

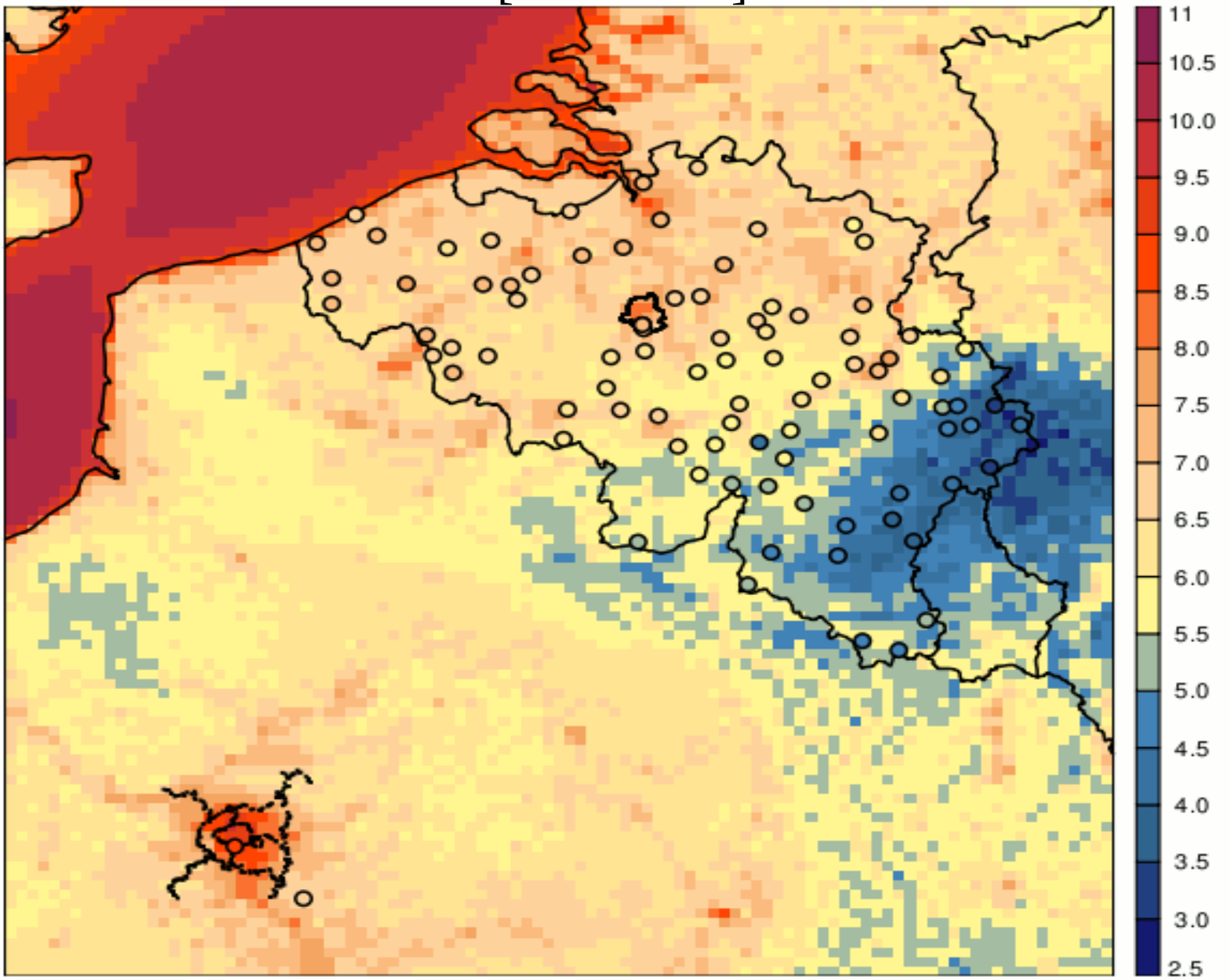


4km



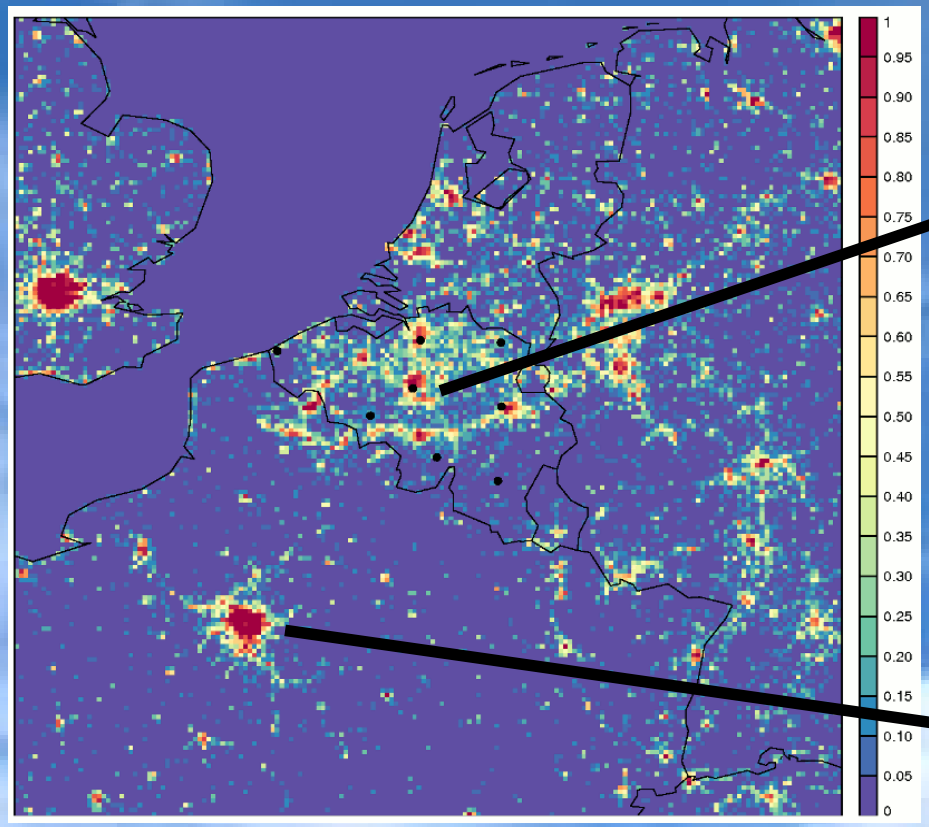
mean minimum temperature [°C]

ERA-int [2001-2010]

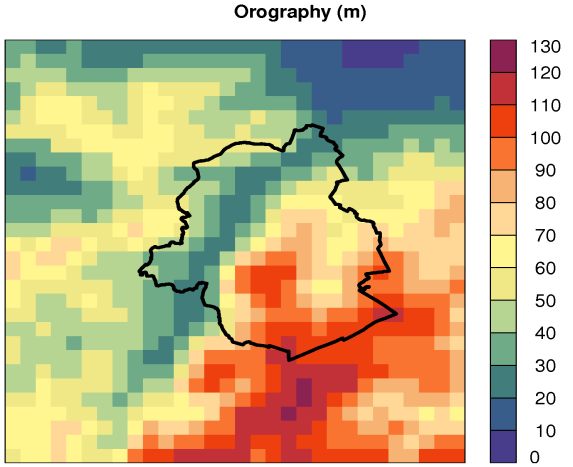


Urban climate simulations using SURFEX+TEB+SBL

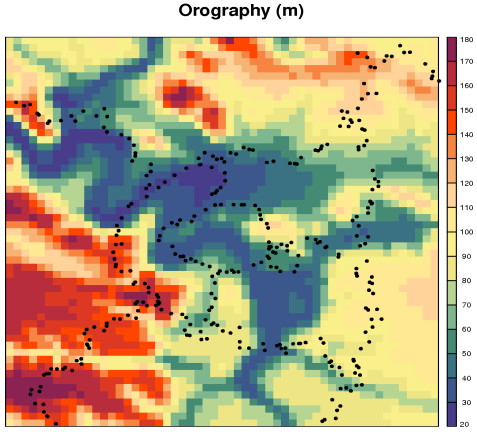
ALARO+SURFEX INLINE 4km



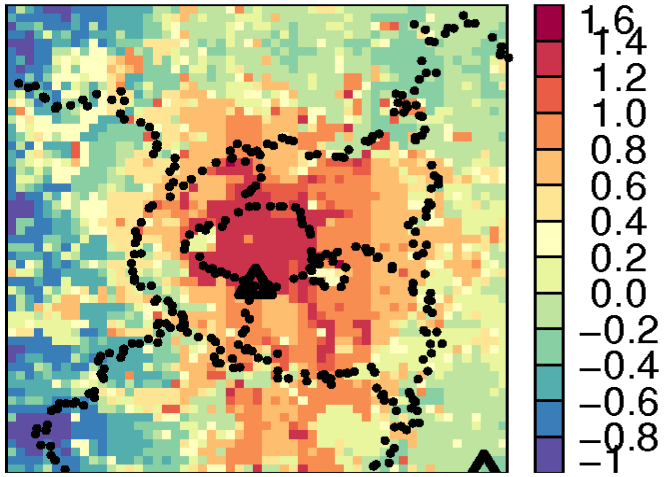
SURFEX OFFLINE 1 km, Brussels, 30x30



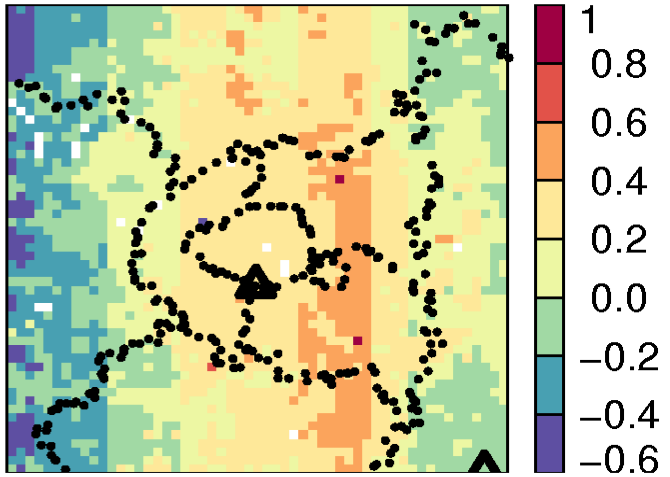
SURFEX OFFLINE 1 km, Paris, 55x55



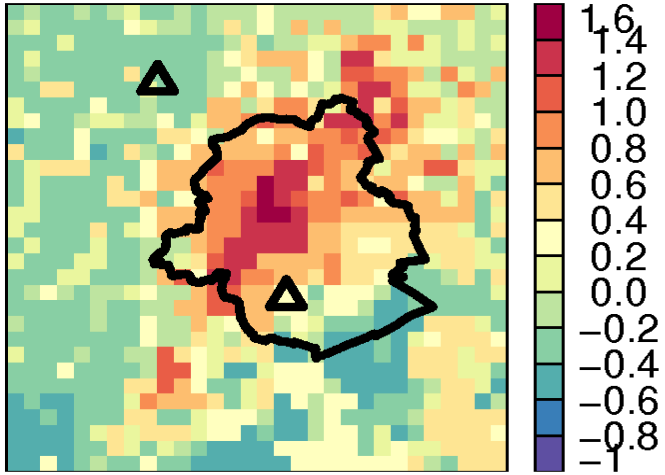
UHI_N, Center = 1.35 °C



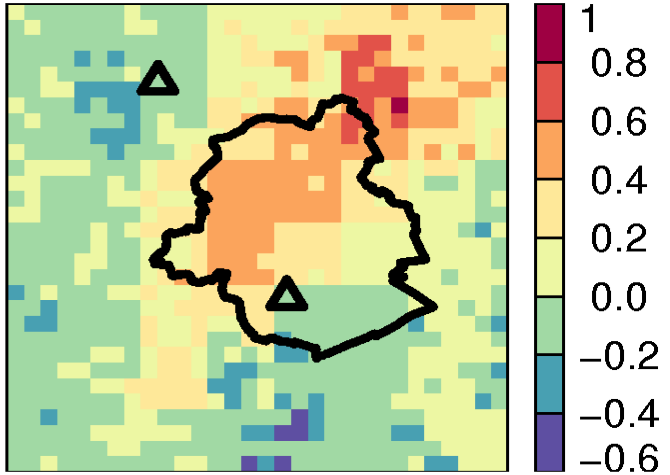
UHI_D, Center = 0.32 °C



UHI_N, Center = 1.37 °C



UHI_D, Center = 0.47 °C



- **Investigate deeply the oscillation problem, a scientific paper is in preparation (PhD of Annelies).**

- **A scientific paper about the coupling 3DVAR + EKF for ALARO is in preparation (PhD of Annelies).**

- **Introduce the STAEKF within SODA and test it with 3-DVAR for ALARO.**

- **Continue the work of the interface between TOUCANS and SURFEX.**

- **Evaluate ECOCLIMAP for Belgium, a new project MASC (funded by the Belgian Science Policy) will start in collaboration with the team of J-L Roujean.**