Coupling SURFEX_V7.3 to ALARO within cycle CY38T1

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1. Compilation issues

This work is based on the reference (REF) cycle 38T1 from Radmila:
/home/mma/mma101/build/CY38T1

A copy is created under my account **/worklocal/mma202/CY38T1**

These are the issues that I encountered during the compilation:

1. Routine with small f920 under project **ifsaux** and **mpa**:
   ./ifsaux/sx-include/grib_f90.f90
   ./mpa/*
Solution: rename all these routines with .F90 instead of small .f90.

2. SURFEX routines should be compiled with a modified **Makefile.in** file, we should add some options for the **ifdef** statement inside some new routines in surfex version 7.3:

FFLAGS_surfex:=-DTHIS_IS_surfex -EP -dwW $(OPTIMIZATION) $(FTRACE) $(INLINE) $(PARALLEL) -V -Wf"-O nooverlap -pvctl noassume loopcnt=1000000 outerstrip -A dbl4 -Nesc" **-DARO -DOL -DASC -DTXT -DFA -DLFI** $(MODULE_DIRS)
FFLAGS77_surfex:=-DTHIS_IS_surfex -EP -dwW $(OPTIMIZATION) $(FTRACE) $(INLINE) $(PARALLEL) -V -Wf"-O nooverlap -pvctl noassume loopcnt=1000000 -A dbl4 -Nesc" **-DARO -DOL -DASC -DTXT -DFA -DLFI** $(MODULE_DIRS)

3. SURFEX routines with a closing apostrophe error during the compilation:
write_cover_tex_cover.F90
write_cover_tex_isba.F90
write_cover_tex_isba_par.F90
write_cover_tex_teb.F90
write_cover_tex_water.F90

4. We should run make more than one time due to dependencies at least until the message “no things to do at all” appear.

5. Finally you should run **/worklocal/mma202/CY38T1/link_38** and associated **/worklocal/mma202/CY38T1/ mysld.scr** in order to create the executable.

2. Running SURFEX

2.1 Create the PGD (surface physiographic parameters) file of the LACE

domain

You should use the script **/worklocal/mma202/CY38T1/link_38_pgd** and associated
/worklocal/mma202/CY38T1/mysld.scr.pgd

The executable is created in this directory: **/home/mma/mma202/CY38T1.bin/PGD.exe**
The script is under my account:
/home/mma/mma202/TOUCAN_SURFEX_CY38T1/scr/pgd.cz.job

The namelist is: **~/TOUCAN_SURFEX_CY38T1/namelist/morgane.namel.pgd**

This namelist will create a PGD file with:

* The ISBA scheme is run with three layers.
* The TEB scheme is turned off and city is replaced by rock.
* ECUME parametrization for sea.

The ECOCLIMAP database used is under my account:
/home/mma/mma202/TOUCAN_SURFEX_CY38T1/ecoclimap

With respect to SURFEX_v5 used in CY36T1 a new binary files should be linked together with the classical ecoclimap ones to create the PGD file:
ln -s $ECOCLIMAP/ecoclimapI_covers_param.bin ecoclimapI_covers_param.bin

ln -s $ECOCLIMAP/ecoclimapII_af_covers_param.bin ecoclimapII_af_covers_param.bin

ln -s $ECOCLIMAP/ecoclimapII_eu_covers_param.bin ecoclimapII_eu_covers_param.bin

Three PGD files are created for the LACE domain using ISBA-2L as in the old isba scheme and with and without TEB using the 3-L layer version of ISBA:
/home/mma/mma202/TOUCAN_SURFEX_CY38T1/pgd/PGDFILE.lfi.ISBA3L.TEB
/home/mma/mma202/TOUCAN_SURFEX_CY38T1/pgd/PGDFILE.lfi.ISBA3L
/home/mma/mma202/TOUCAN_SURFEX_CY38T1/pgd/PGDFILE.lfi.ISBA2L

2.2 Create the initial file for the prognostic variable of SURFEX

For the test case of 7/8/2011, we should create the initial file for SURFEX.
The script to prepare the initial file TEST.lfi for SURFEX is under my repository:
/home/mma/mma202/TOUCAN_SURFEX_CY38T1/scr/lancelot00.cz.job
Two namelists are used:
/home/mma/mma202/TOUCAN_SURFEX_CY38T1/namelist/lancelot.namel.sfx
/home/mma/mma202/TOUCAN_SURFEX_CY38T1/namelist/PRE_REAL1.nam

Three initial files are created corresponding to the three PGD files.

3 Run SURFEX coupled to ALARO (pTKE)

To run ALARO (pTKE) with SURFEX the issue of the exchange coefficient should be solved. The solution that I 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.

These are the modified routines where the original routines are now named with .ori:
aplpar.F90
aro_ground_diag.h
aro_ground_diag.F90
get_fluxn.F90
modi_get_fluxn.F90
driver_off_omp.F90
apl_arome.F90
get_surf_varn.F90

With respect to SURFEX_V5, some files should be put in the working directory as well:
1. The PGD file should be called PGD.lfi
2. The initial SURFEX file should be called TEST.lfi
3. ecoclimapI_covers_param.bin
4. ecoclimapII_af_covers_param.bin
5. ecoclimapII_eu_covers_param.bin

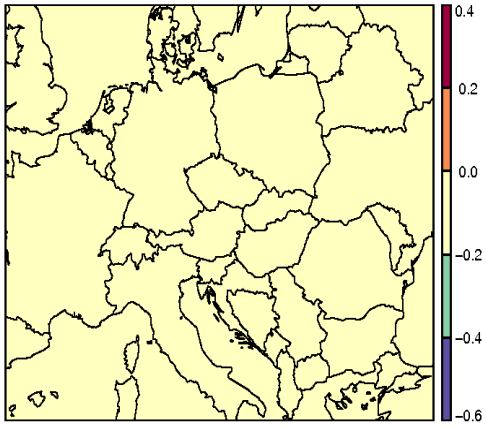
For the execution namelist of SURFEX we should have LCOEF=True:
&NAM_DIAG_SURFn
LCOEF=.TRUE.,

An abort line is added now to the code of diag_surf_atmn.F90:
IF (LPTKE.AND.(.NOT.LCOEF)) CALL ABOR1_SFX('ALARO+PTKE+SURFEX : PCD from surfex?, then LCOEF should be at true')

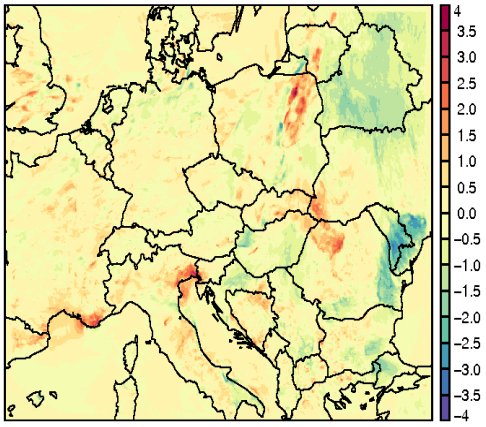
3.1 ALARO Versus ALARO+SURFEX (ISBA 2L)

The temperature differences at the lowest model level:

S087TEMPERATURE
2011/08/07 z12:00 Initialized



S087TEMPERATURE
2011/08/07 z12:00 +6h



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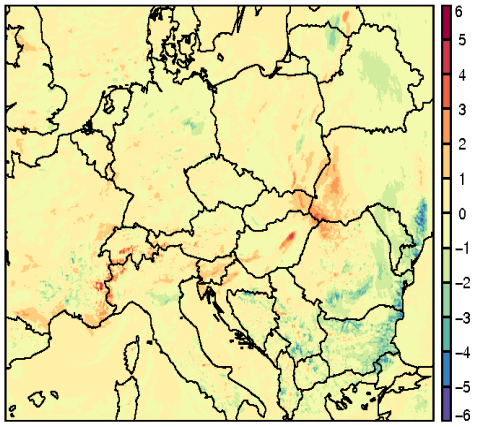
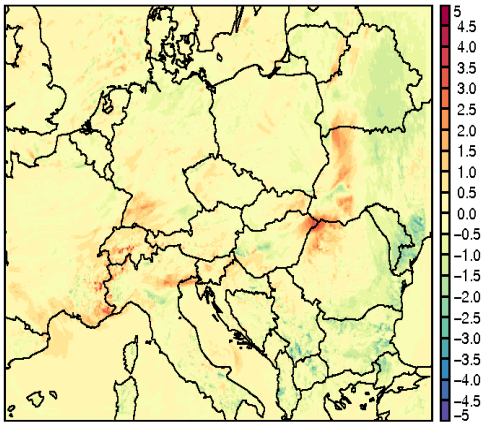
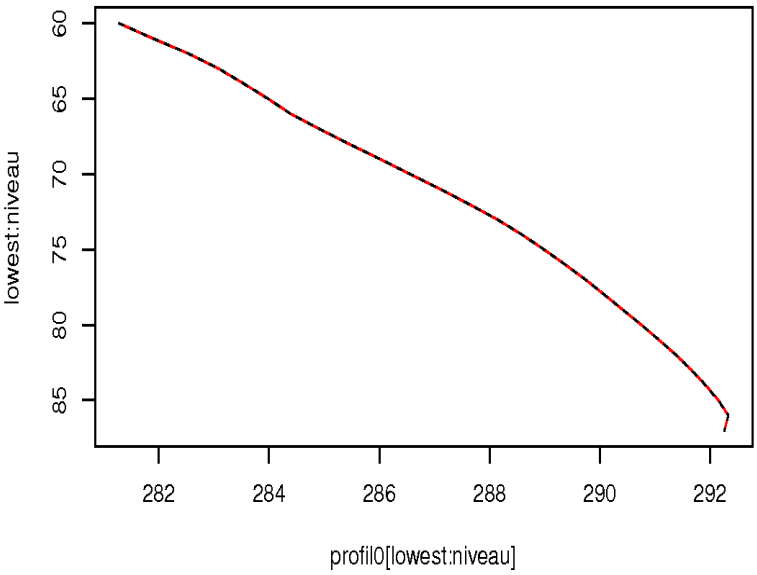
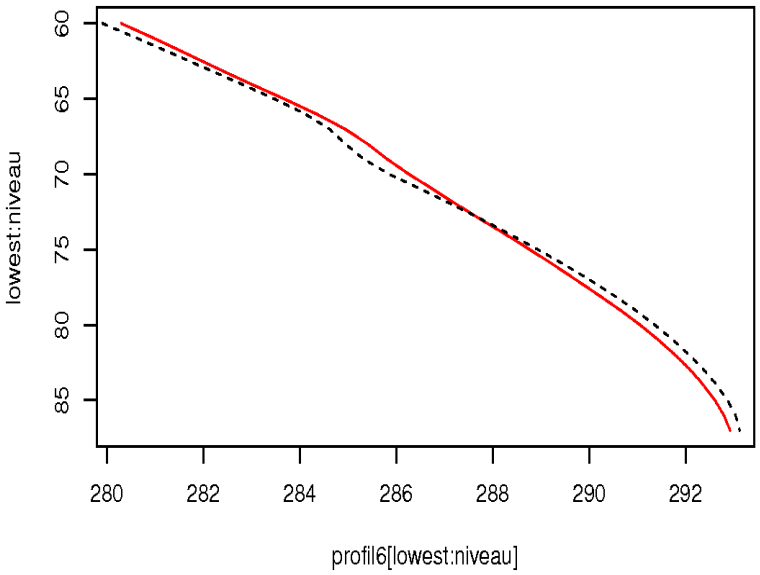


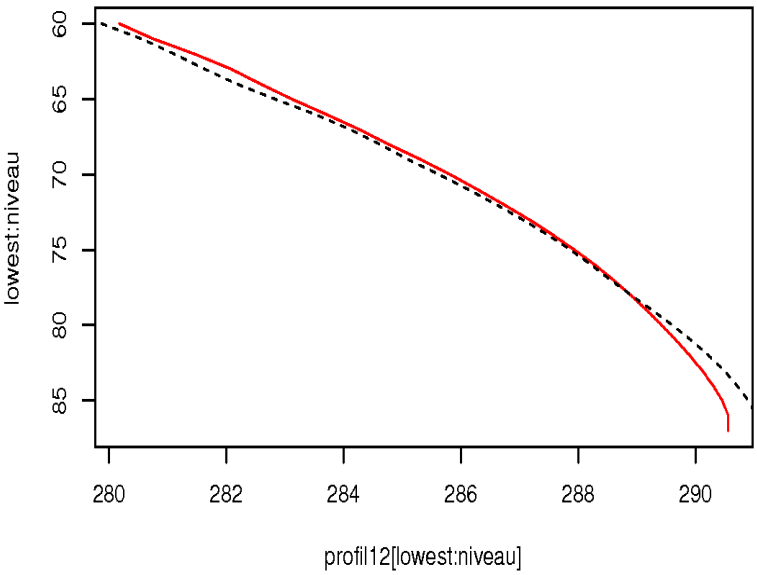
S087TEMPERATURE
2011/08/07 z12:00 +18h

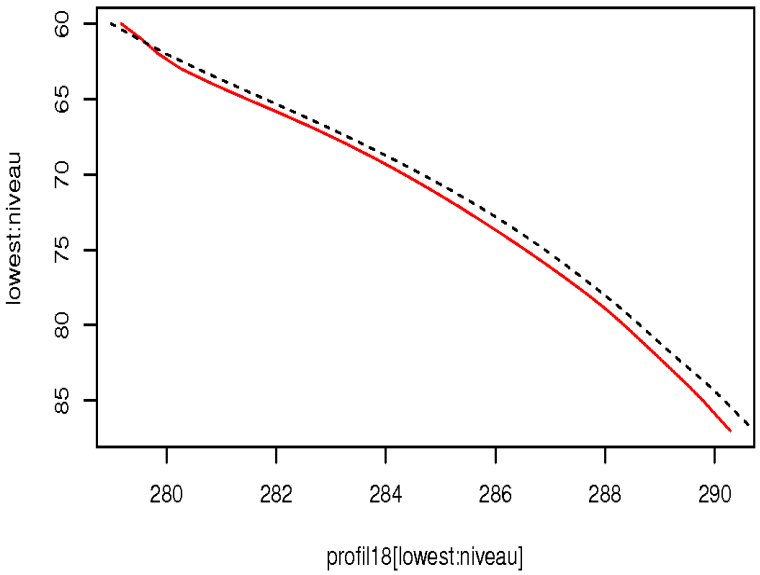


And the temperature profile at the grid point closest to Prague (red is without surfex):



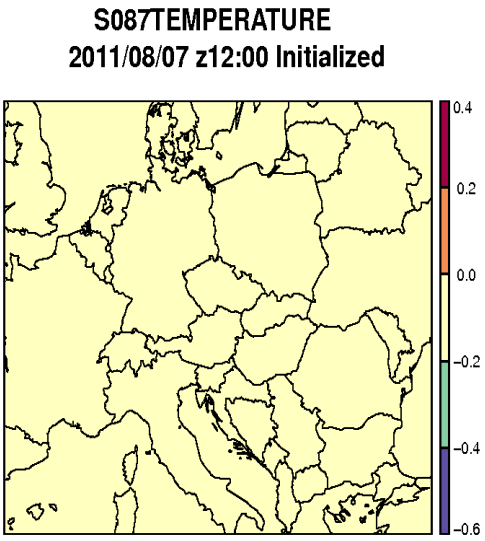


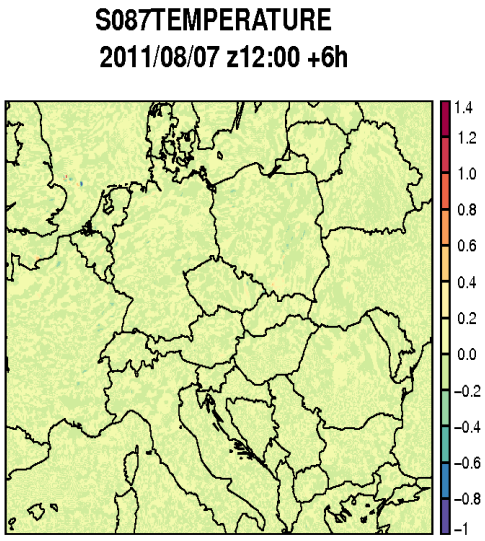


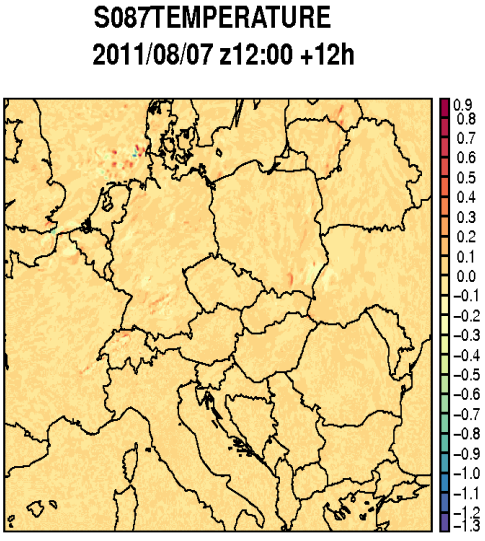


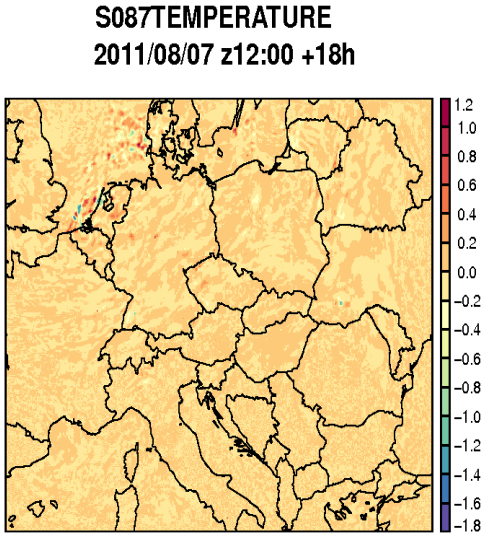
3.2 ALARO+SURFEX (ISBA 2L) Versus ISBA 3L

The temperature differences at the lowest model level:

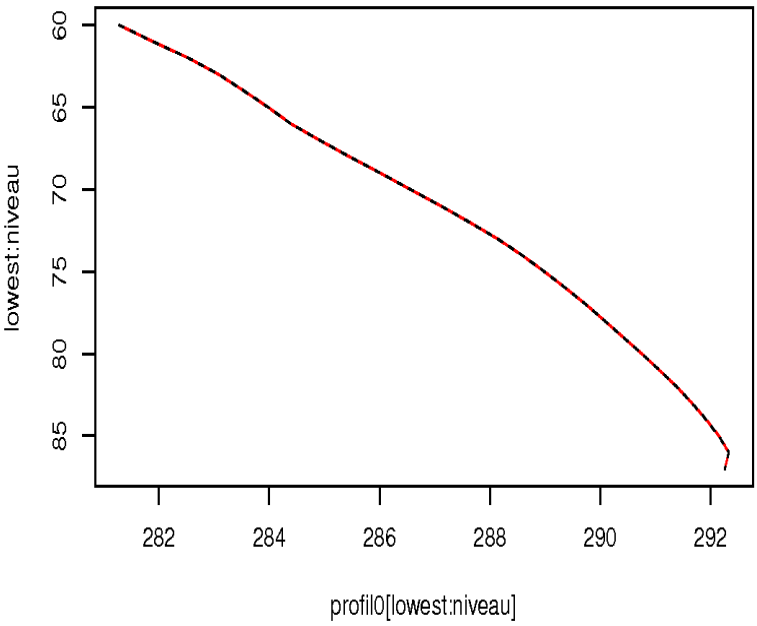


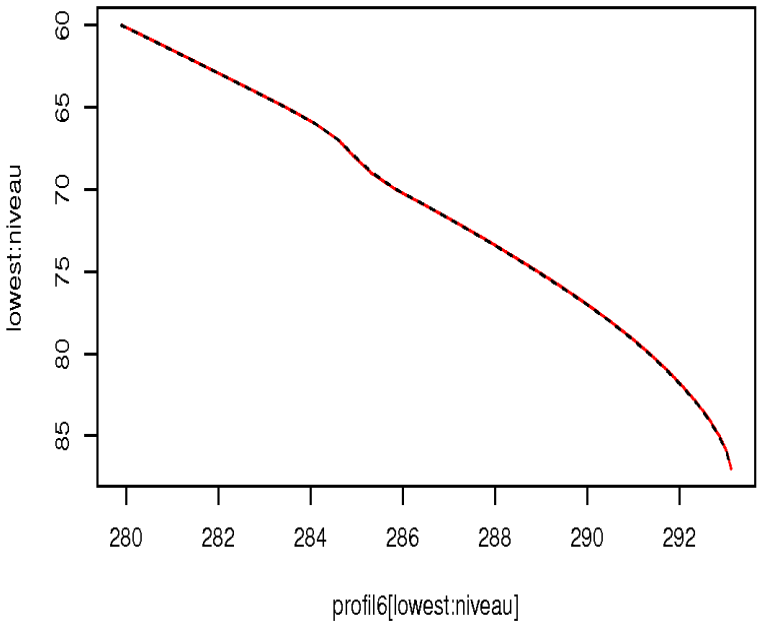


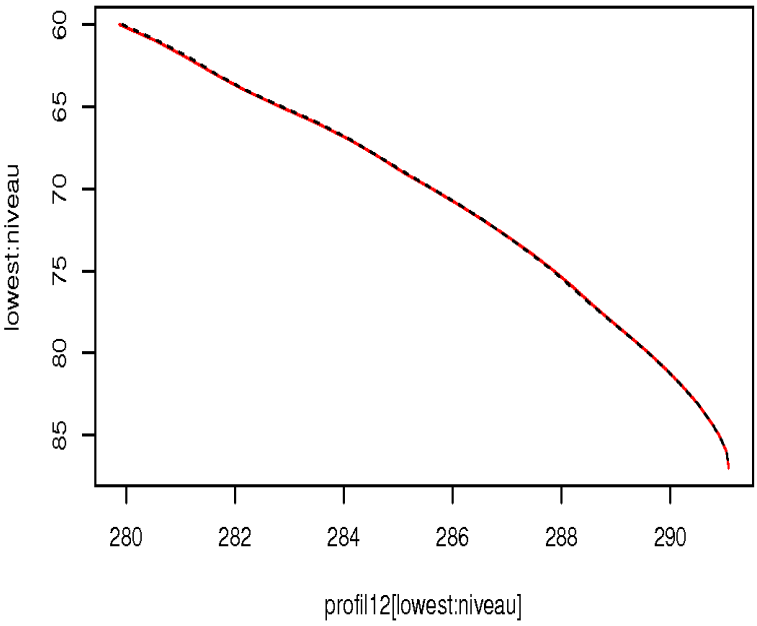


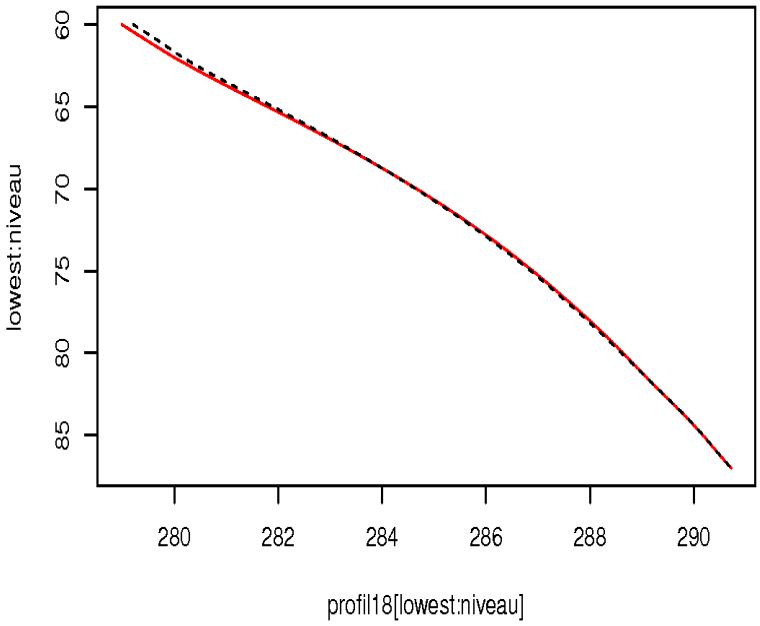


And the temperature profile at the grid point closest to Prague (red is ISBA2L):



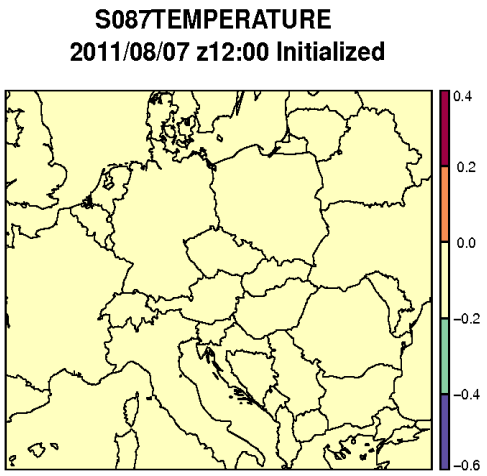


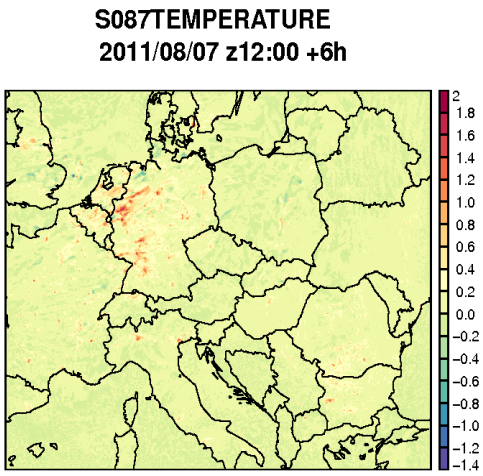


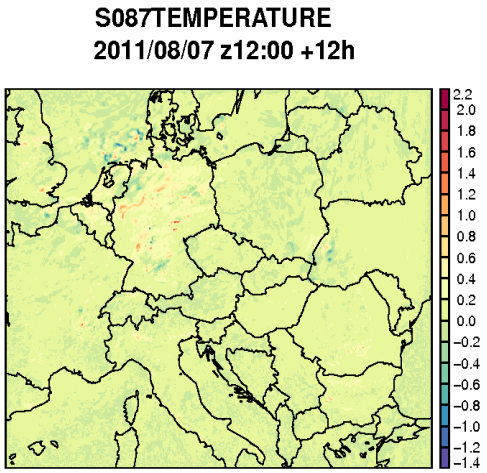


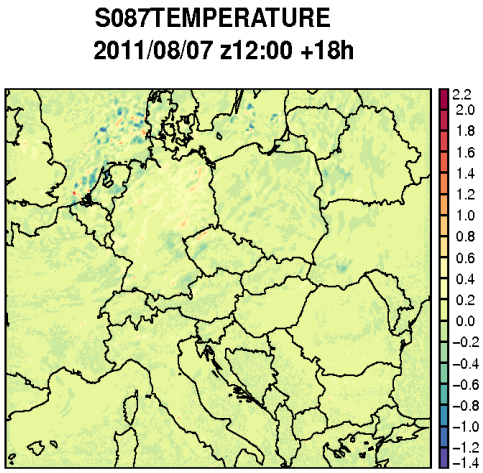
3.3 ALARO+SURFEX (ISBA 3L) Versus ISBA 3L+TEB

The temperature differences at the lowest model level:



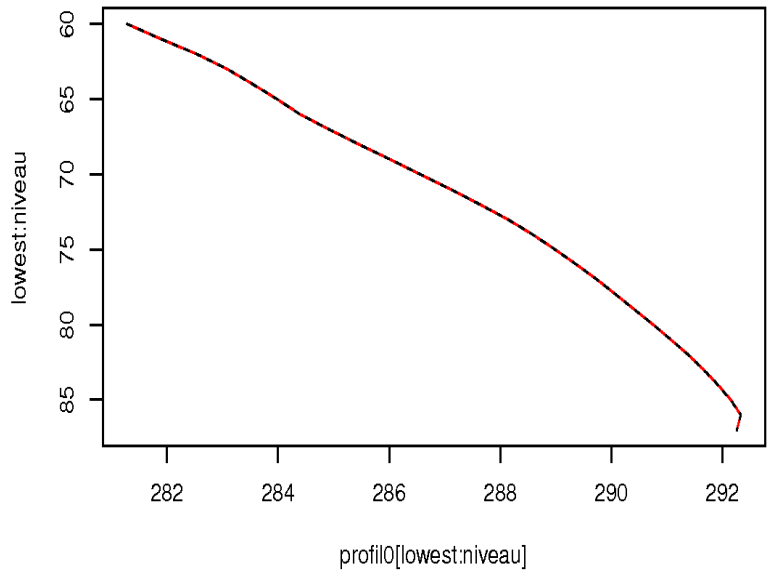


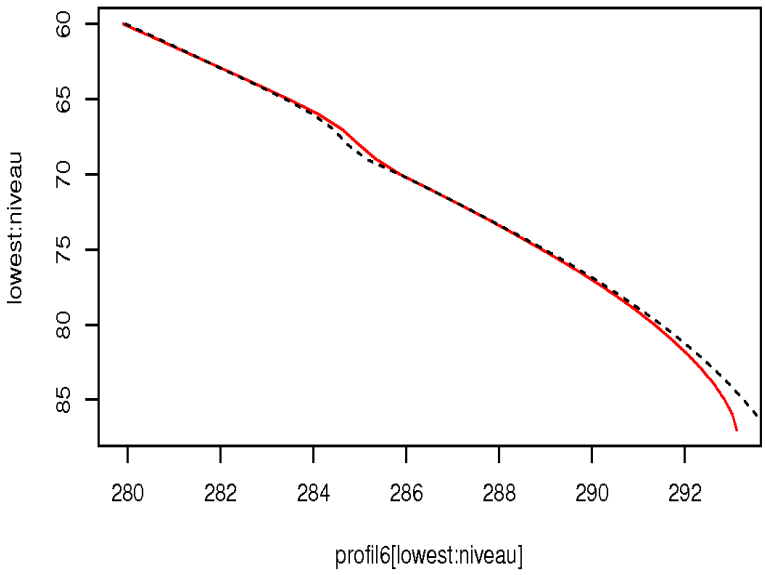


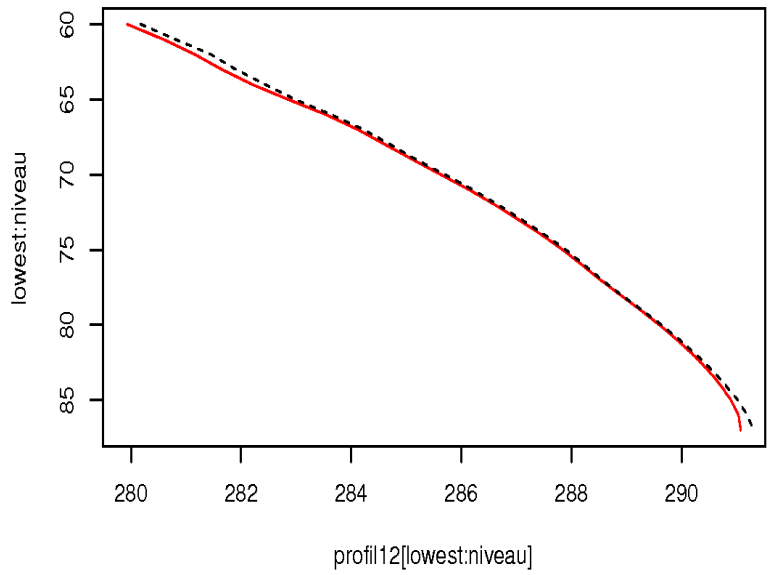


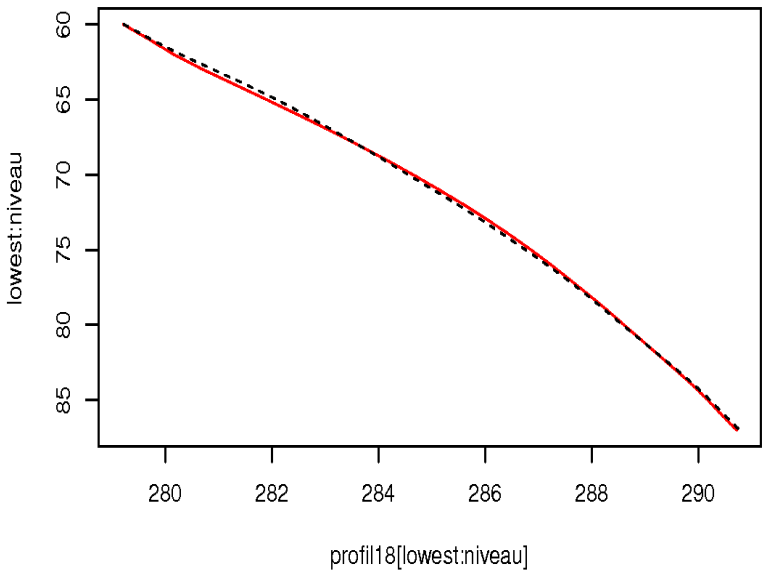
We could see some urban heat island effect during the night over Germany, Belgium and the Netherlands.

And the temperature profile at the grid point closest to Prague (red is ISBA3L):

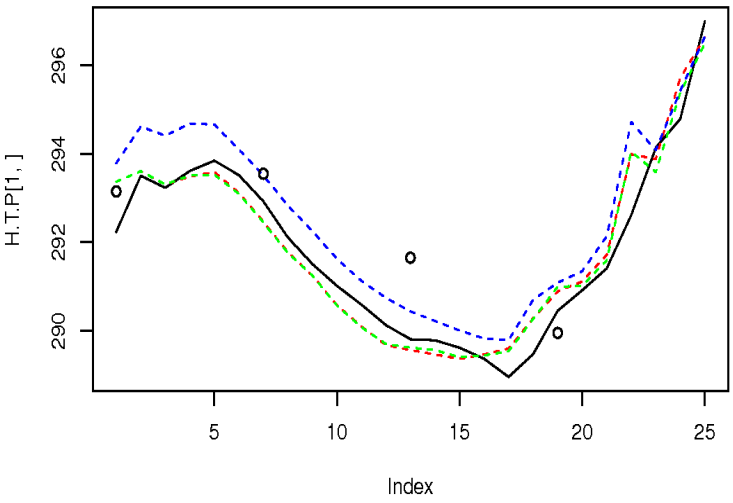


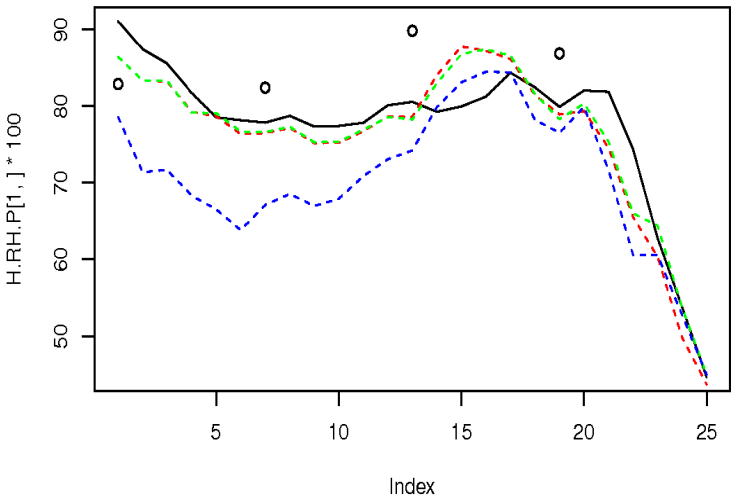


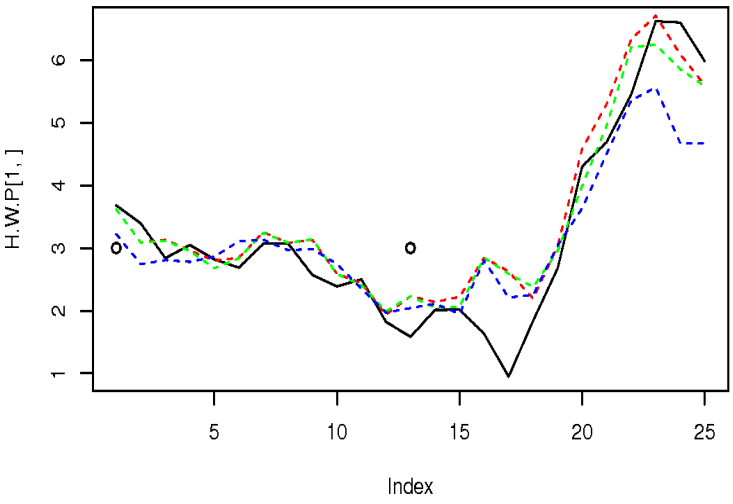




3.4 Comparison with observation at Prague station







Black is ALARO without SURFEX
Red is ALARO with SURFEX+ISBA2L
Green is ALARO with SURFEX+ISBA3L
Blue is ALARO with SURFEX+ISBA3L+TEB

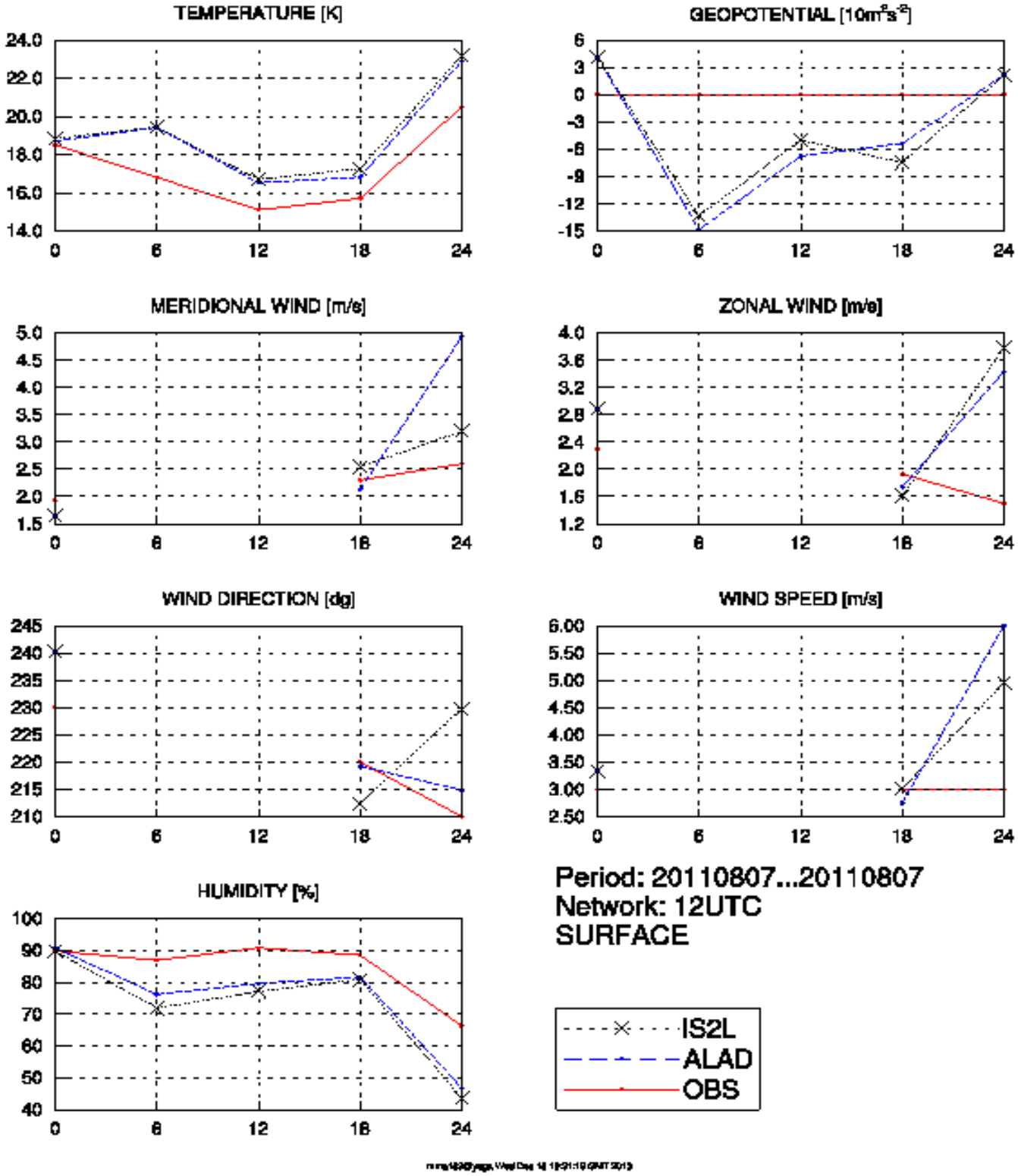
3.4 Verification using VERAL application at Prague station for ALARO Versus ALARO+SURFEX (ISBA 2L)

Just a remark that if you want to use VERAL for FA files from a run with SURFEX this list of field should be added to the original FA files:

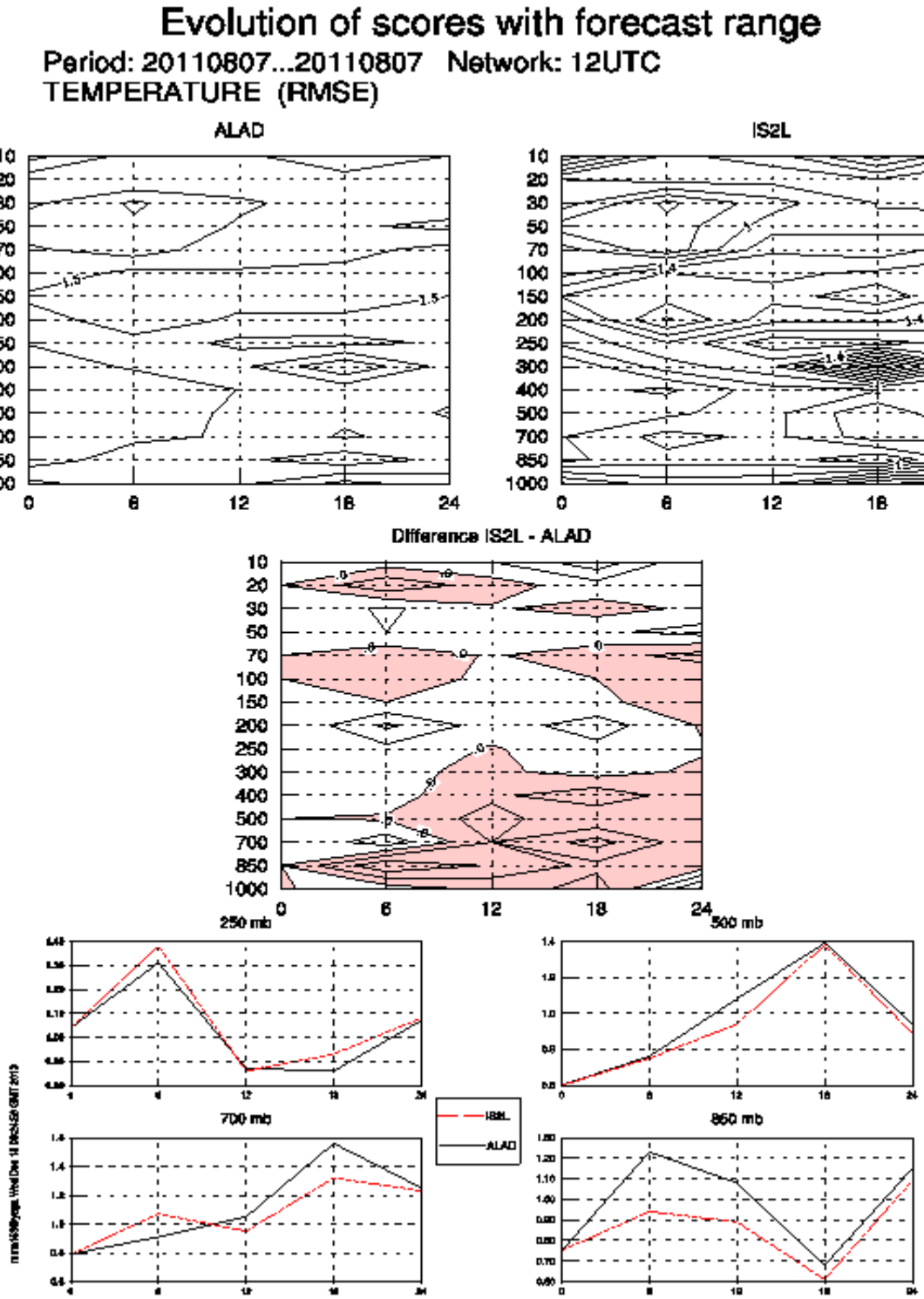
CVARFAI='ALBEDO NEIGE'
CVARFAI='DENSIT.NEIGE'
CVARFAI='RESERV.INTER'
CVARFAI='Z0.FOIS.G'
CVARFAI='ALBEDO'
CVARFAI='EMISSIVITE'
CVARFAI='IND.VEG.DOMI'
CVARFAI='RESI.STO.MIN'
CVARFAI='IND.FOLIAIRE'
CVARFAI='RES.EVAPOTRA'
CVARFAI='GZ0.THERM'
CVARFAI='ALBEDO.SOLNU'
CVARFAI='ALBEDO.VEG'

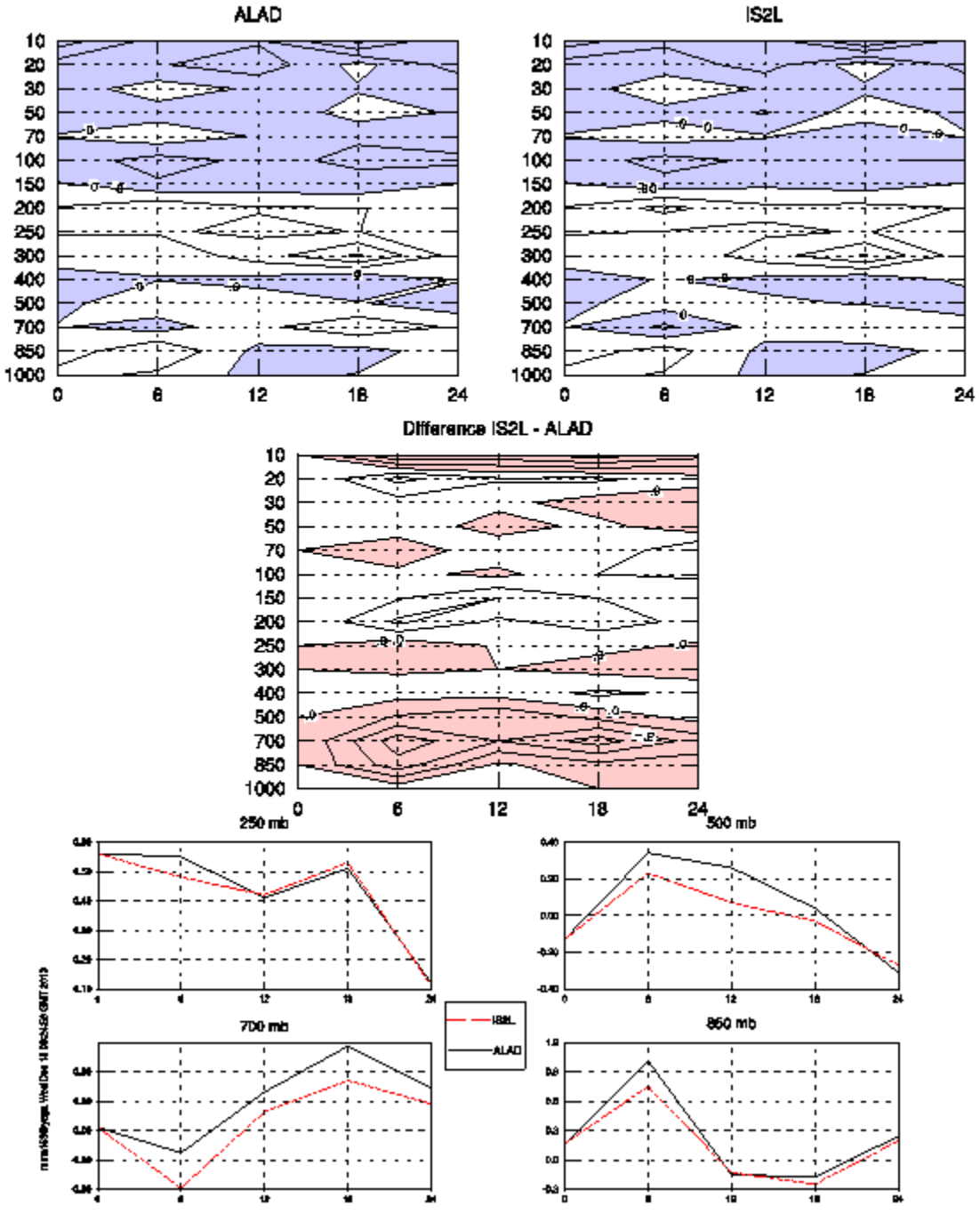
Some sensitivity tests should be done to examine the impact of adding these fields to the scores.

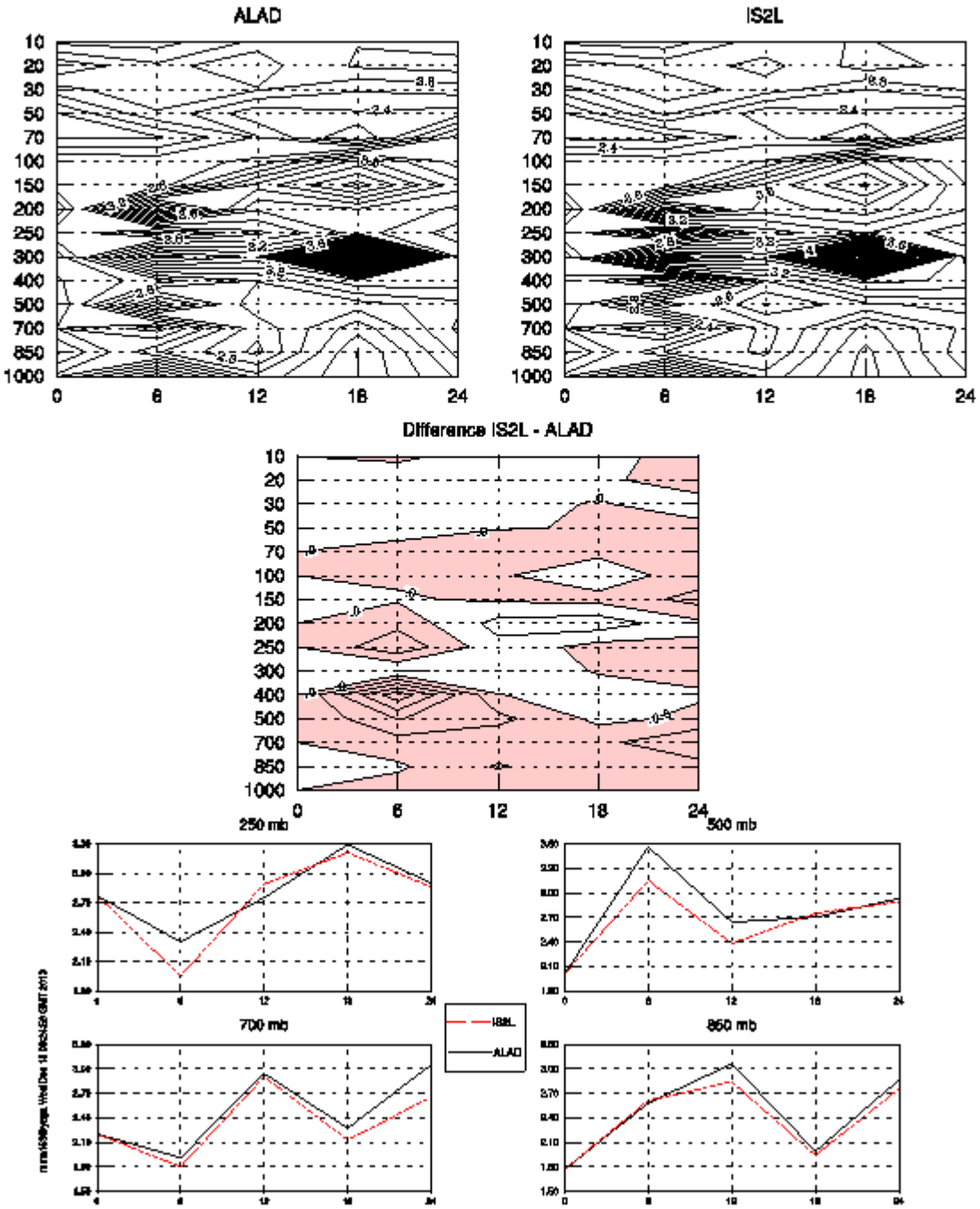
Evolution with forecast range [station 11520]

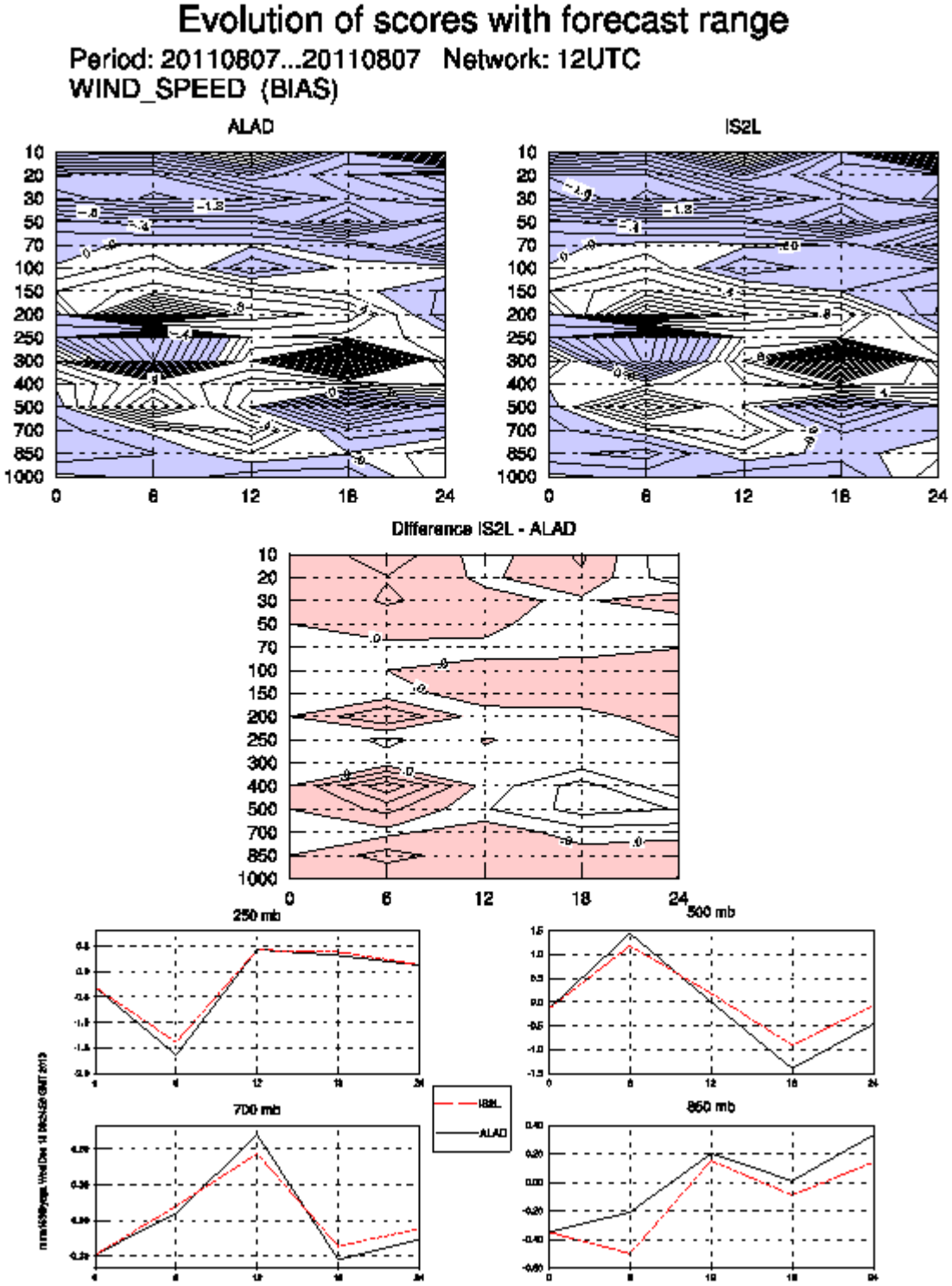


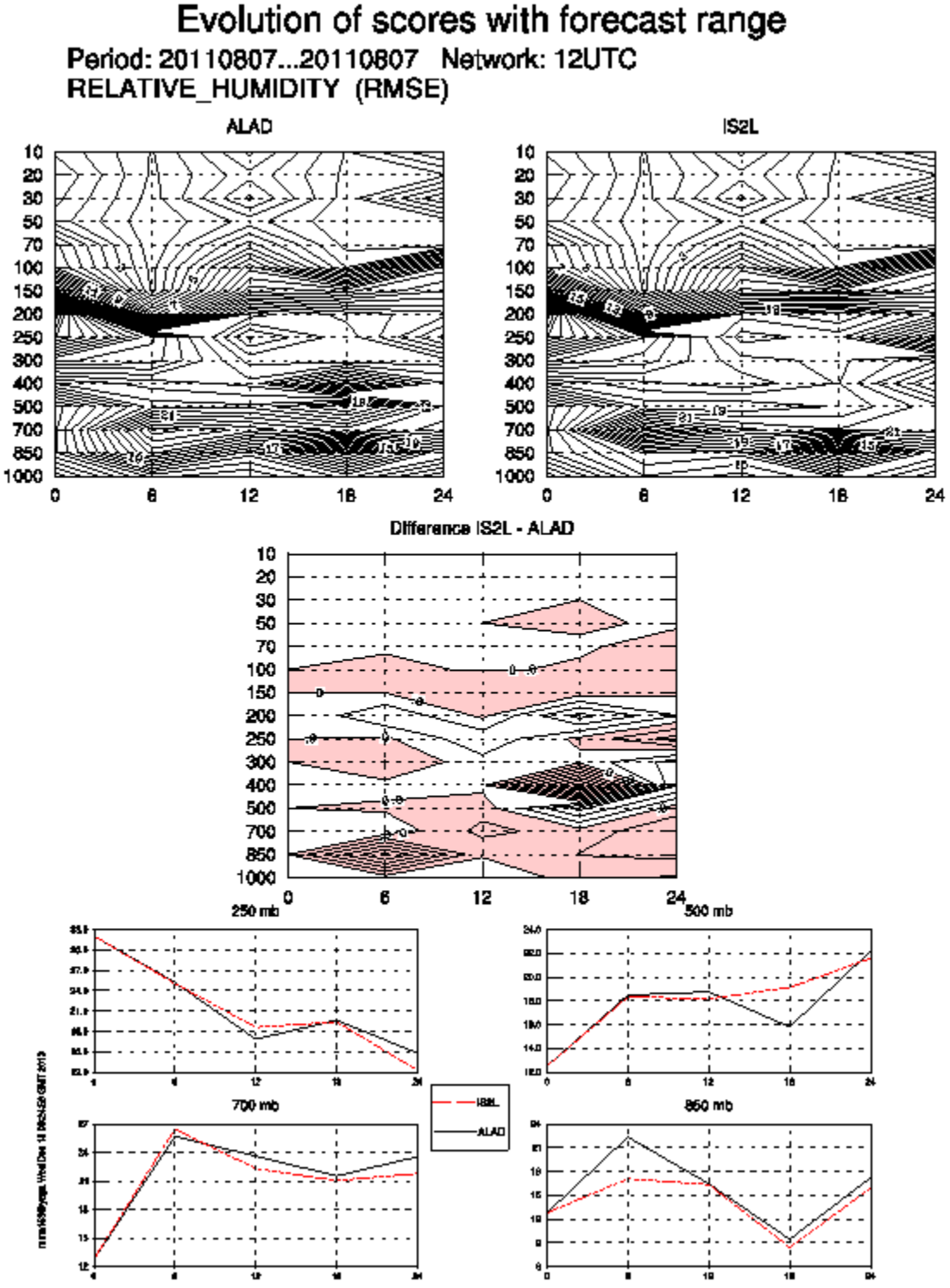
3.5 Verification using VERAL application for LACE domain for ALARO Versus ALARO+SURFEX (ISBA 2L)

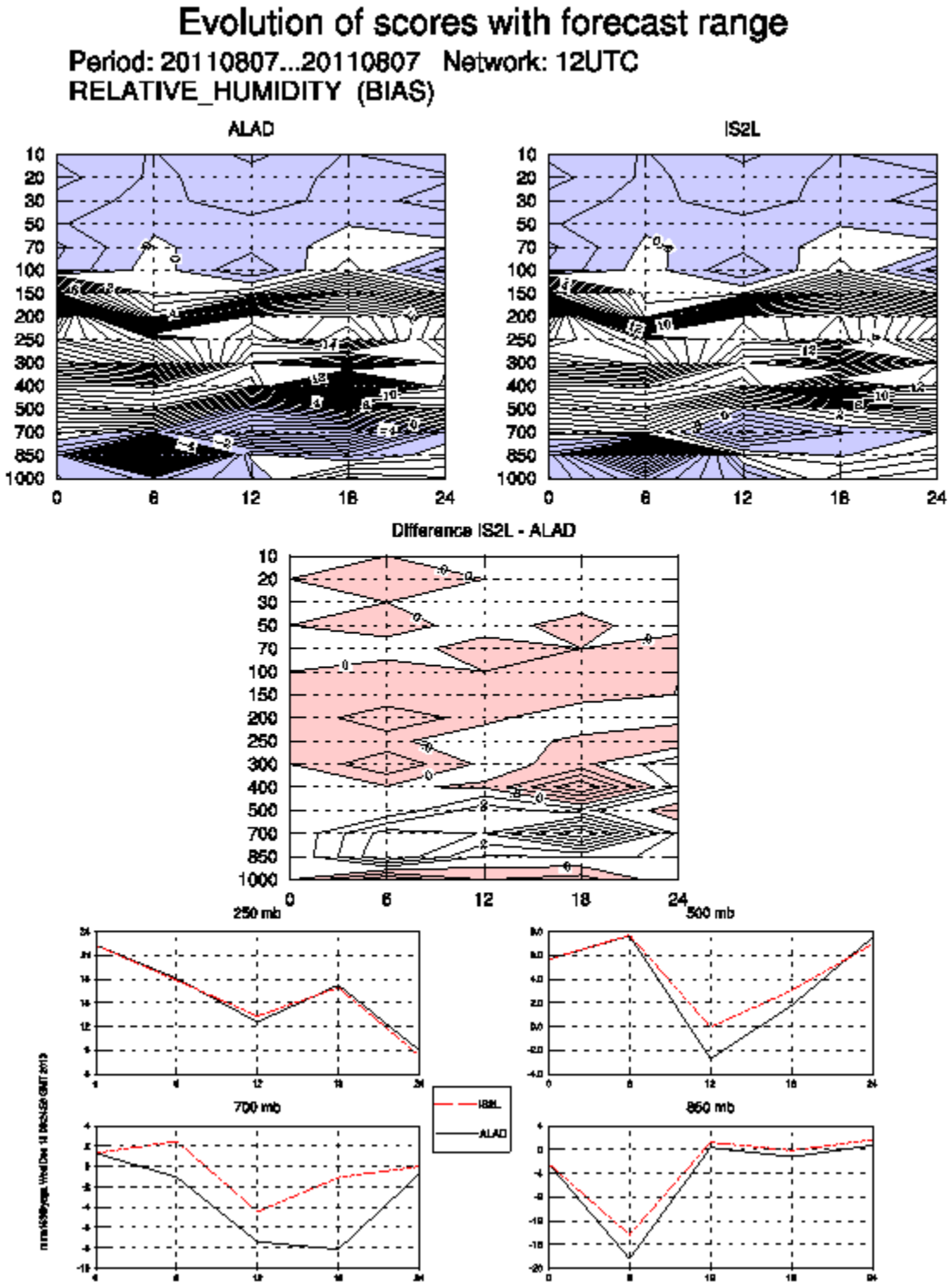



Evolution of scores with forecast range
Period: 20110807...20110807 Network: 12UTC
TEMPERATURE (BIAS)
ALAD
IS2L
Difference IS2L - ALAD
250 mb
500 mb
700 mb
850 mb
IS2L
ALAD


Evolution of scores with forecast range
Period: 20110807...20110807 Network: 12UTC
WIND_SPEED (RMSE)
ALAD
IS2L
Difference IS2L - ALAD
250 mb
500 mb
700 mb
850 mb
IS2L
ALAD


Evolution of scores with forecast range
Period: 20110807...20110807 Network: 12UTC
WIND_SPEED (BIAS)
ALAD
IS2L
Difference IS2L - ALAD
250 mb
500 mb
700 mb
850 mb
IS2L
ALAD


Evolution of scores with forecast range
Period: 20110807...20110807 Network: 12UTC
RELATIVE_HUMIDITY (RMSE)
ALAD
IS2L
Difference IS2L - ALAD
250 mb
500 mb
700 mb
850 mb
IS2L
ALAD


Evolution of scores with forecast range
Period: 20110807...20110807 Network: 12UTC
RELATIVE_HUMIDITY (BIAS)
ALAD
IS2L
Difference IS2L - ALAD
250 mb
500 mb
700 mb
850 mb
IS2L
ALAD

4. Run SURFEX coupled to ALARO (TOUCANS)

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. Therefore, 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.

The routines that are modified are 6 for the upper air physics:
actkehmtls.F90
aplpar.F90
aro_ground_diag.h
aro_ground_diag.F90
driver_off_omp.F90
apl_arome.F90

and 46! SURFEX routines to be able to interface the neutral drag coefficient:
get_fluxn.F90
modi_get_fluxn.F90
get_surf_varn.F90
diag_inline_seafluxn.F90
diag_seafluxn.F90
diag_inline_tebn.F90
diag_tebn.F90
modi_diag_tebn.F90
diag_inline_watfluxn.F90
diag_watfluxn.F90
modi_diag_watfluxn.F90
modd_diag_idealn.F90
diag_isba_initn.F90
modd_diag_isban.F90
average_diag_isban.F90
unpack_diag_patchn.F90
modd_diag_seafluxn.F90
modd_diag_surf_atmn.F90
alloc_diag_surf_atmn.F90
dealloc_diag_surf_atmn.F90
diag_surf_atmn.F90
modd_diag_tebn.F90
modd_diag_watfluxn.F90
modd_diag_flaken.F90
diag_inline_flaken.F90
diag_inline_isban.F90
diag_naturen.F90
diag_isban.F90
diag_sean.F90

average_diag.F90
diag_townn.F90
diag_inland_watern.F90
diag_flaken.F90
modi_diag_flaken.F90
modi_diag_naturen.F90
modi_diag_isban.F90
modi_diag_sean.F90
modi_diag_seafluxn.F90
modi_average_diag.F90
modi_diag_townn.F90
modi_diag_inland_watern.F90

and very important routine to initialize the new argument because the model stops during the run:
diag_ideal_initn.F90
diag_flake_initn.F90
diag_seaflux_initn.F90
diag_teb_initn.F90
diag_watflux_initn.F90

In the SURFEX execution namelist **EXSEG1.nam** the **LRRGUST_ARP** should be false because this correction will be done in the **actkehmtls.F90** routine.

&NAM_SURF_ATMn
LRRGUST_ARP=.FALSE.

And

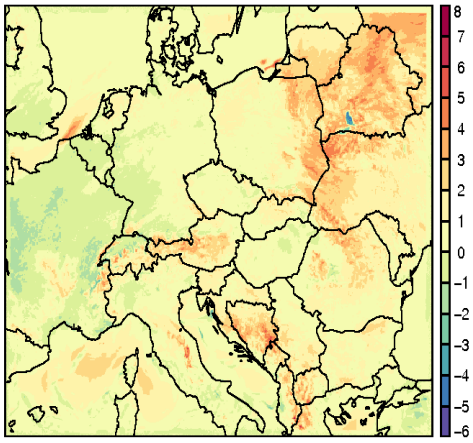
&NAM_SSOn
CROUGH="Z01D",
XFRACZ0=15.,
/

An abort line is added now to the code of diag_surf_atmn.F90:
IF (LCOEFKTKE.AND.(.NOT.LCOEF)) CALL ABOR1_SFX('ALARO+TOUCANS+SURFEX : PCDN from surfex?, then LCOEF should &
& be at true and LRRGUSTARP at false')

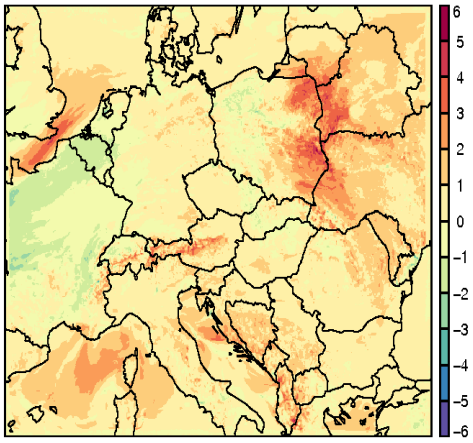
4.1 ALARO Versus ALARO+SURFEX (ISBA 2L) 03/03/2011

The temperature differences at the lowest model level:

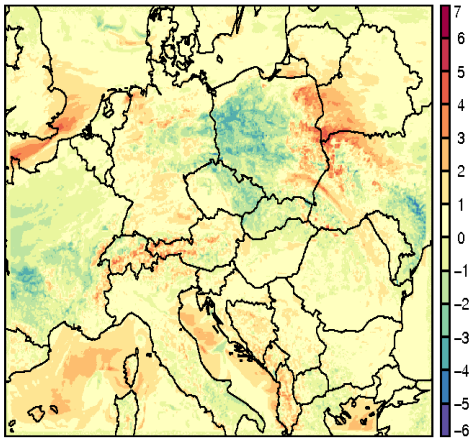
S087TEMPERATURE
2011/03/03 z06:00 +6h



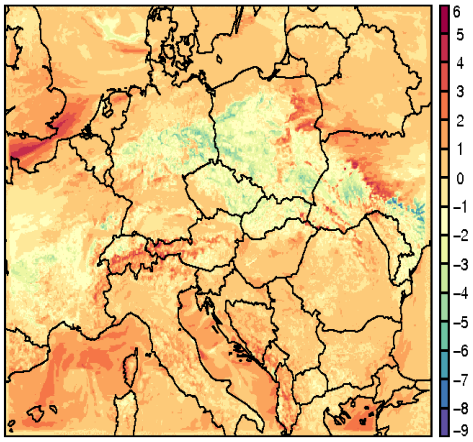
S087TEMPERATURE
2011/03/03 z06:00 +12h



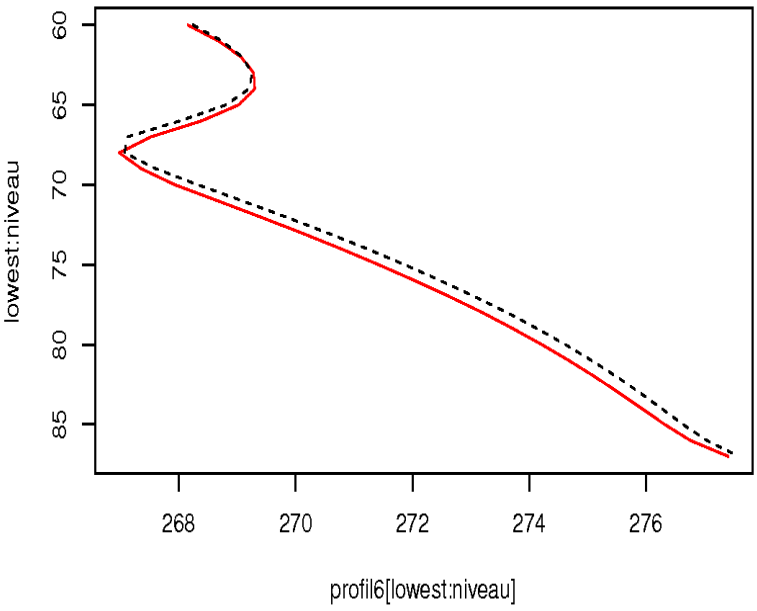
S087TEMPERATURE
2011/03/03 z06:00 +18h

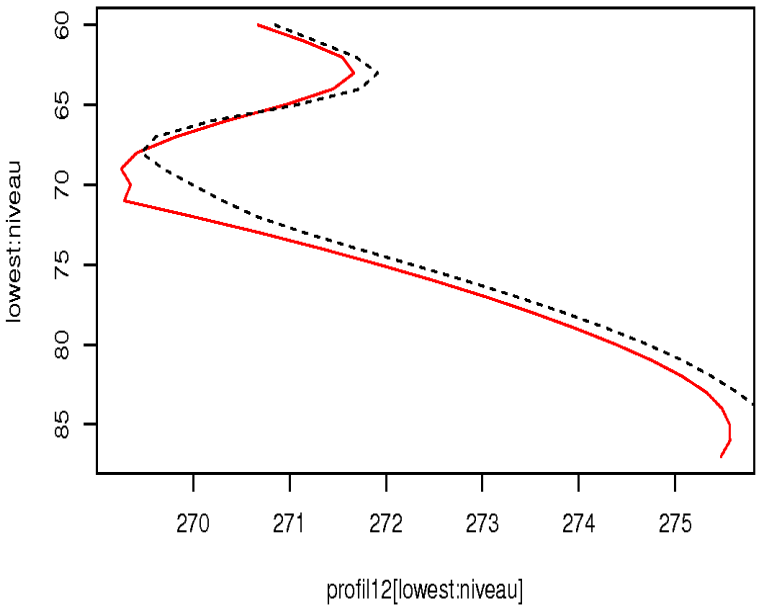


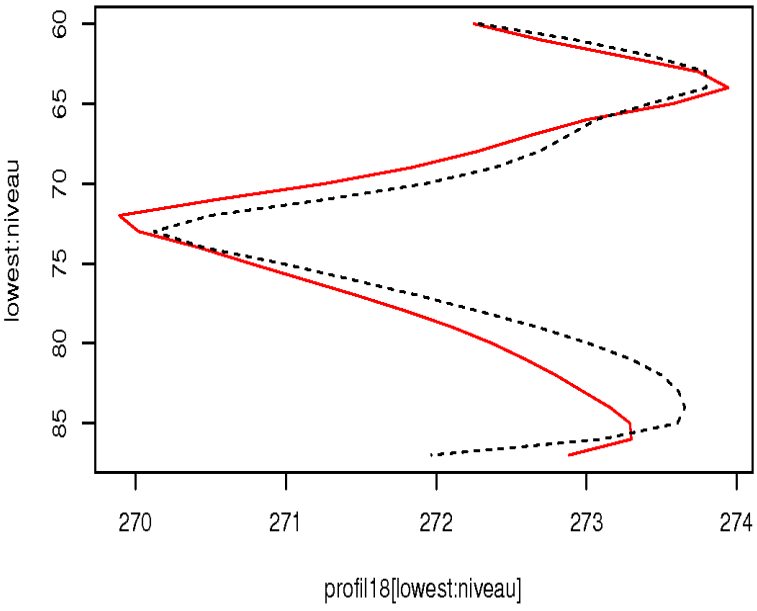
S087TEMPERATURE
2011/03/03 z06:00 +24h

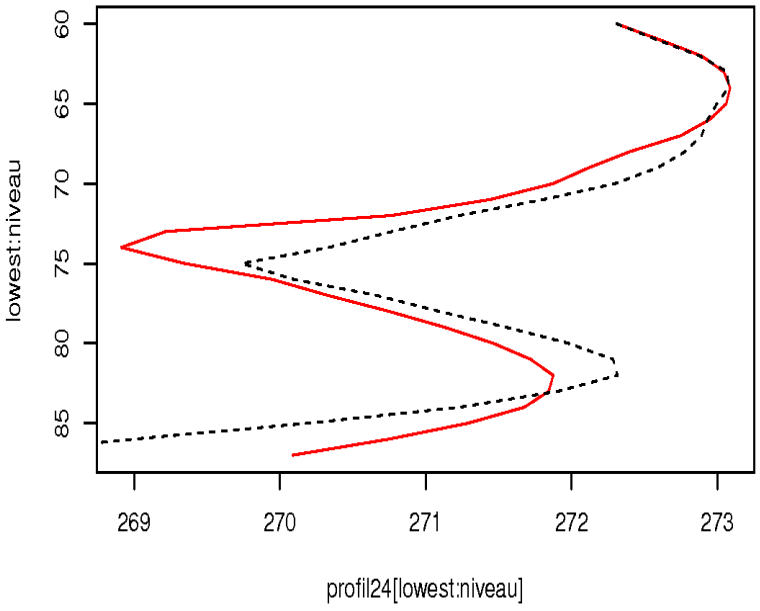


And the temperature profile at the grid point closest to Prague (red is without surfex):



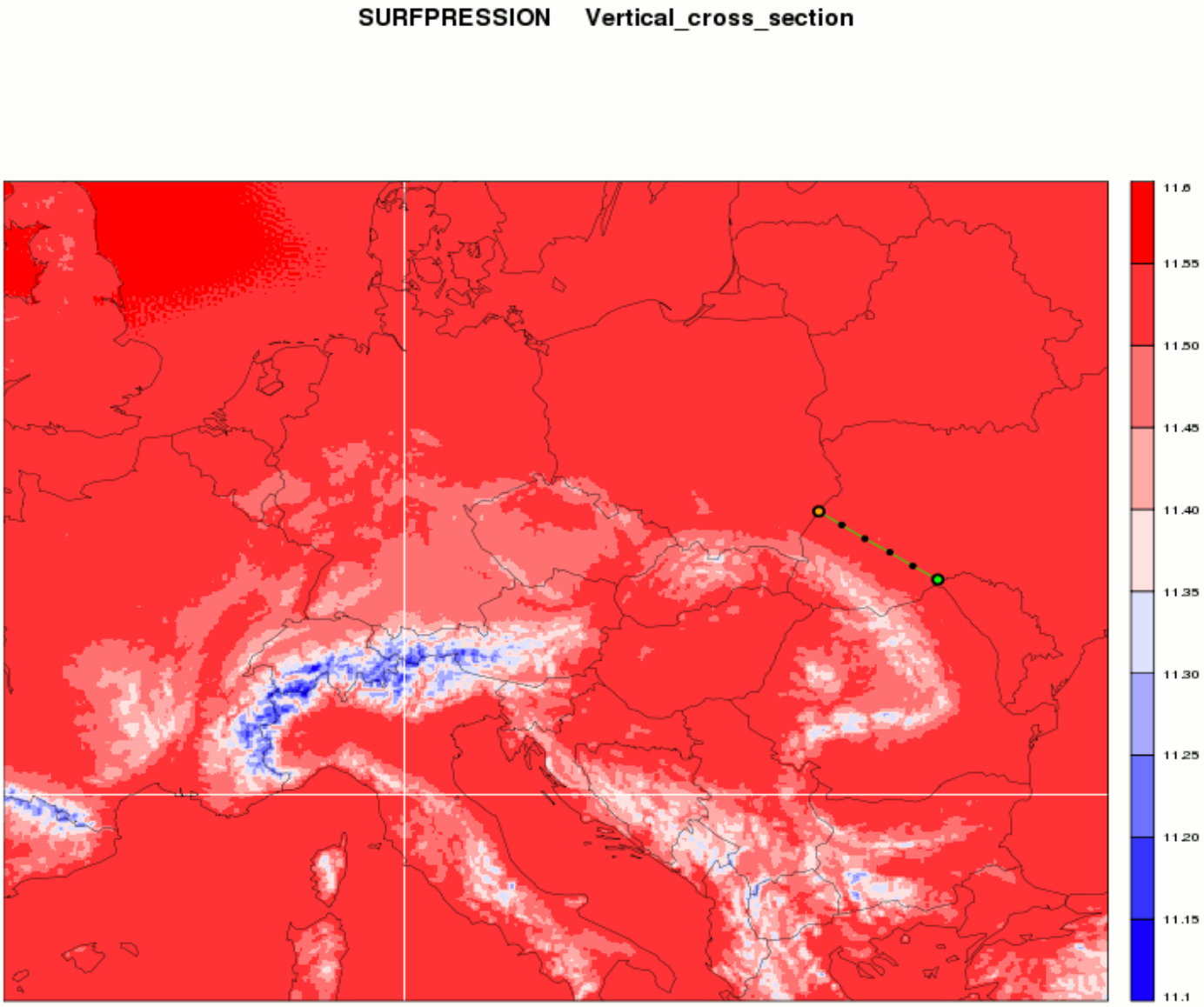




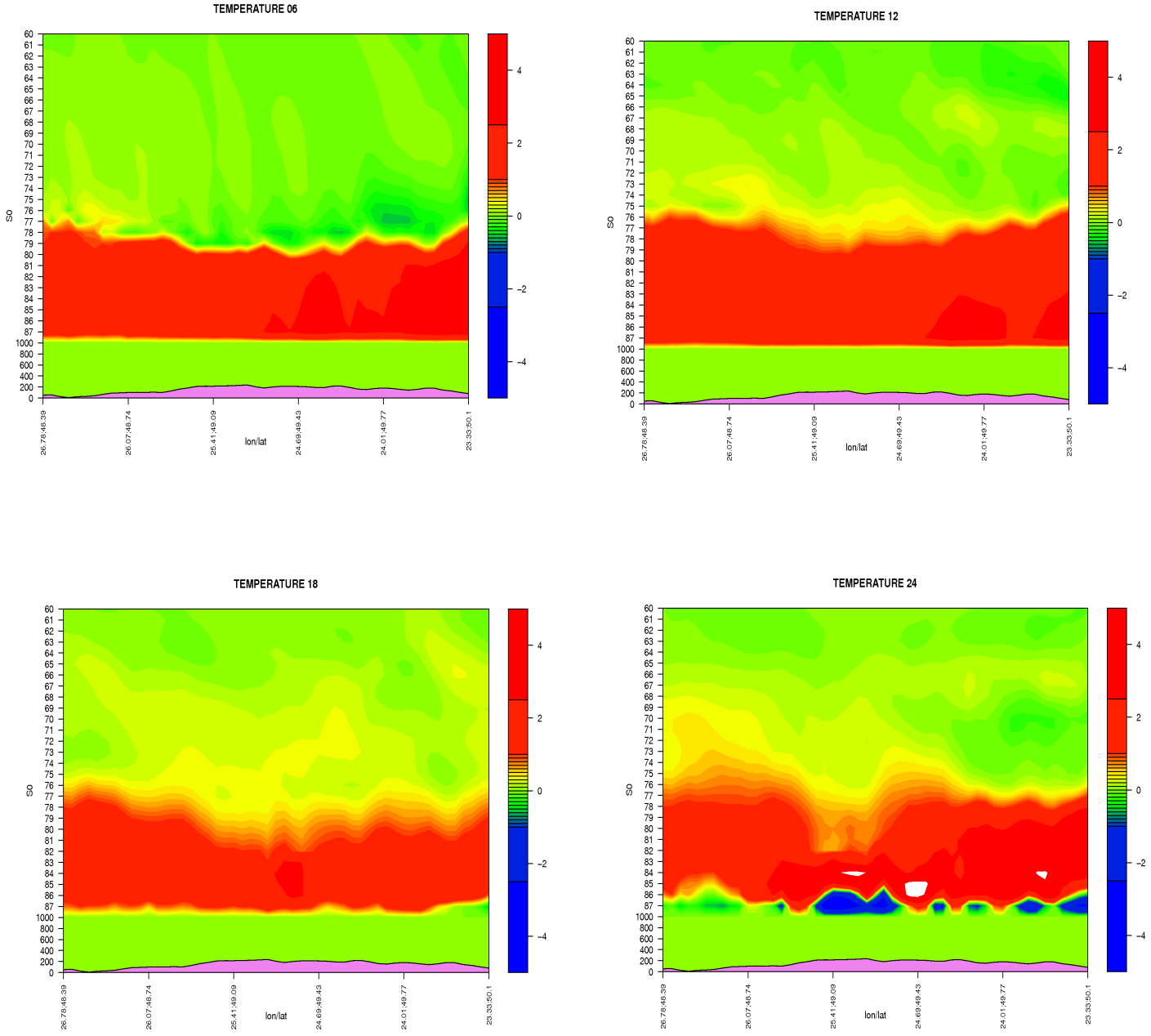


As we can see TOUCANS seems more sensitive to the new SURFEX land surface scheme than the pTKE.

A cross section plot is then done for this interesting case study:



The temperature difference with and without SURFEX

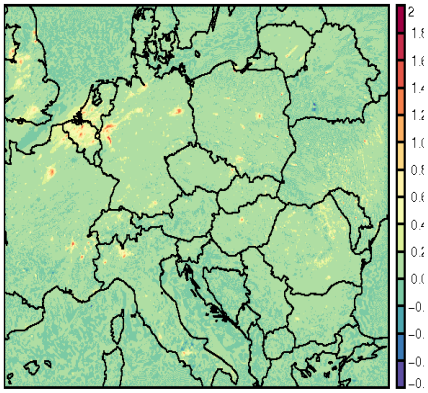


Note that the solution using neutral drag coefficient and roughness length from SURFEX give the same results.

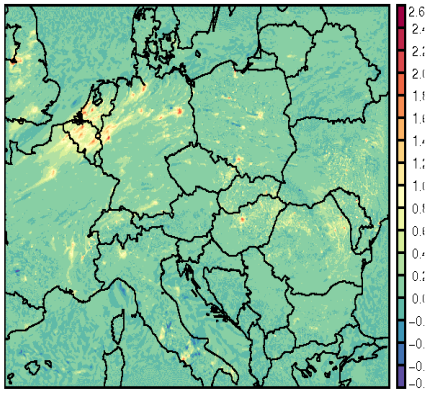
4.2 ALARO+SURFEX (ISBA 3L) Versus ISBA 3L+TEB

The temperature differences at the lowest model level:

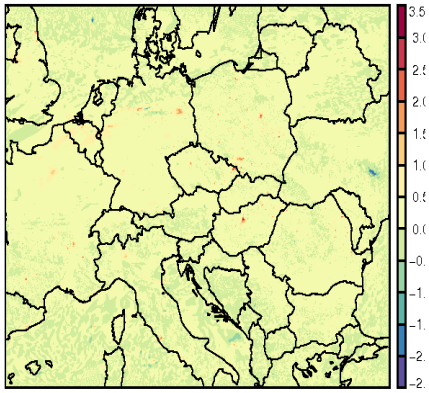
S087TEMPERATURE
2011/03/03 z06:00 +6h



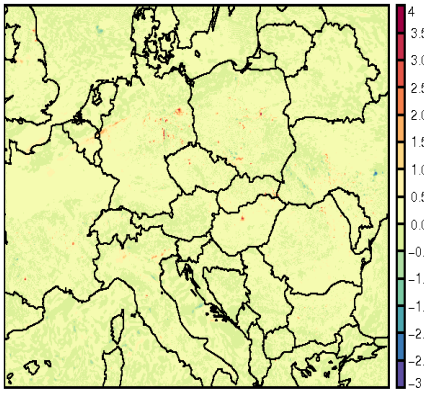
S087TEMPERATURE
2011/03/03 z06:00 +12h



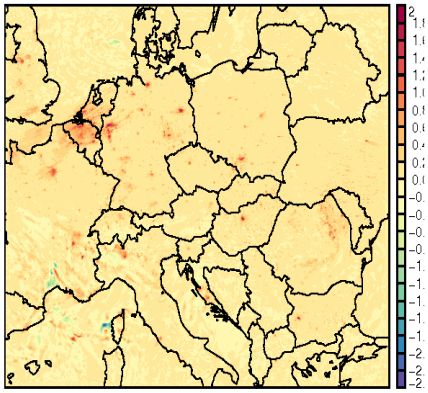
S087TEMPERATURE
2011/03/03 z06:00 +18h



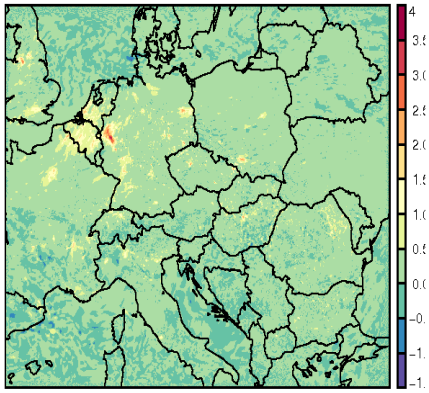
S087TEMPERATURE
2011/03/03 z06:00 +24h



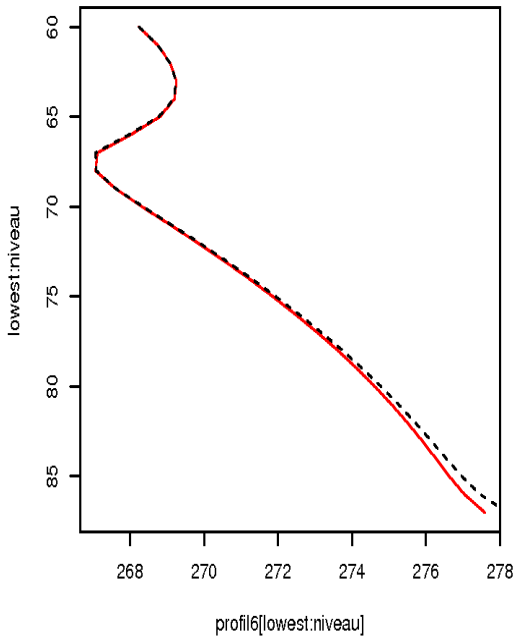
S087TEMPERATURE
2011/03/03 z06:00 +30h

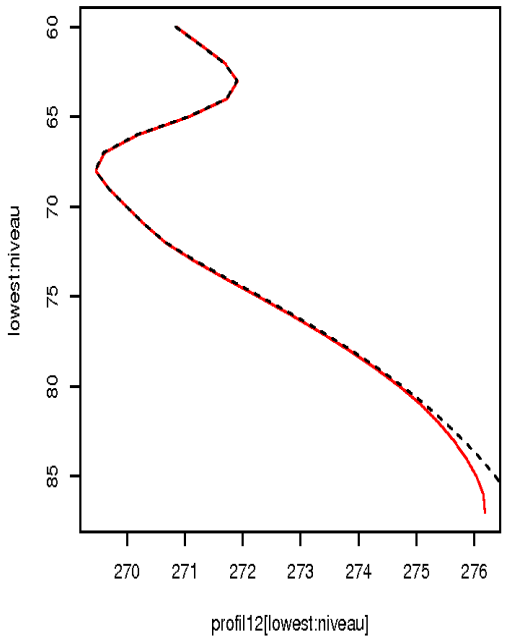


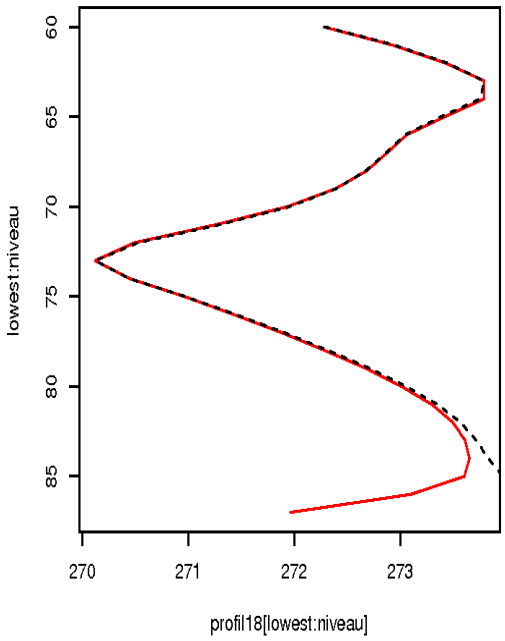
S087TEMPERATURE
2011/03/03 z06:00 +36h

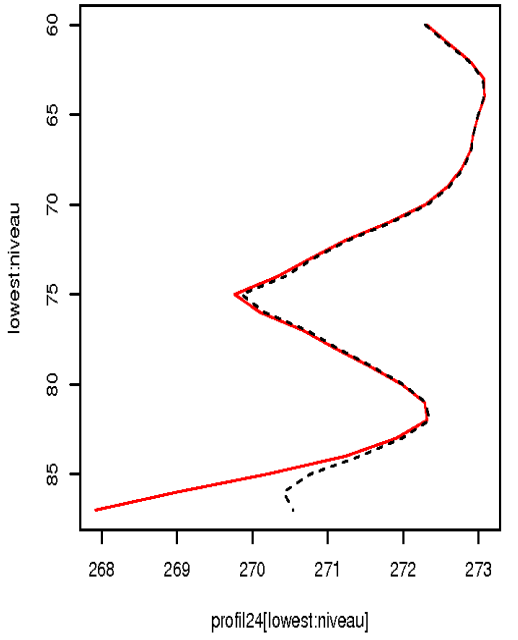


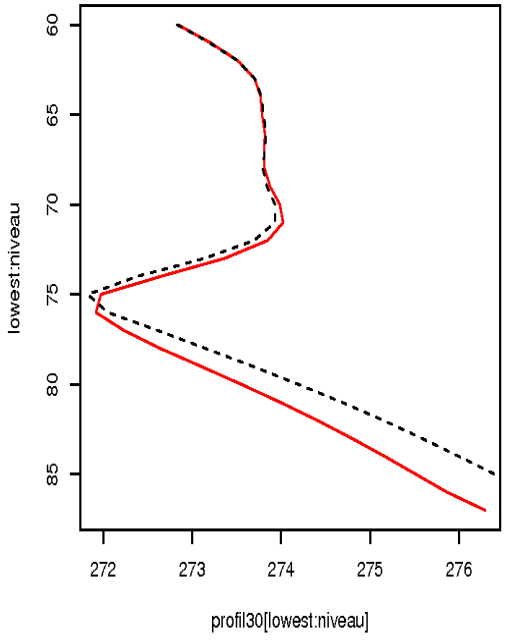
And the temperature profile at the grid point closest to Prague (red is without TEB):

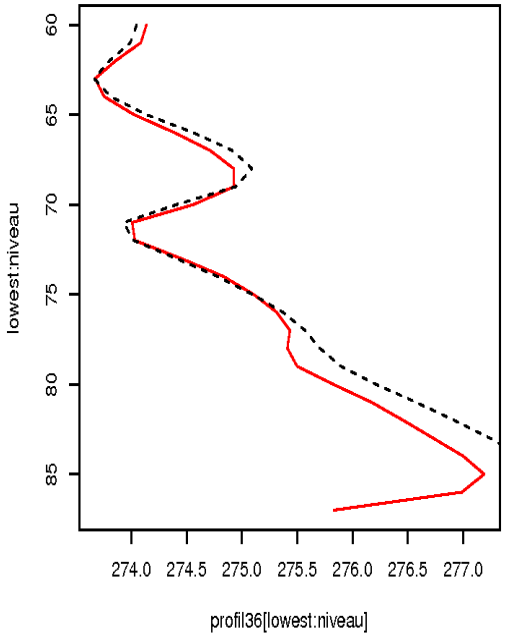




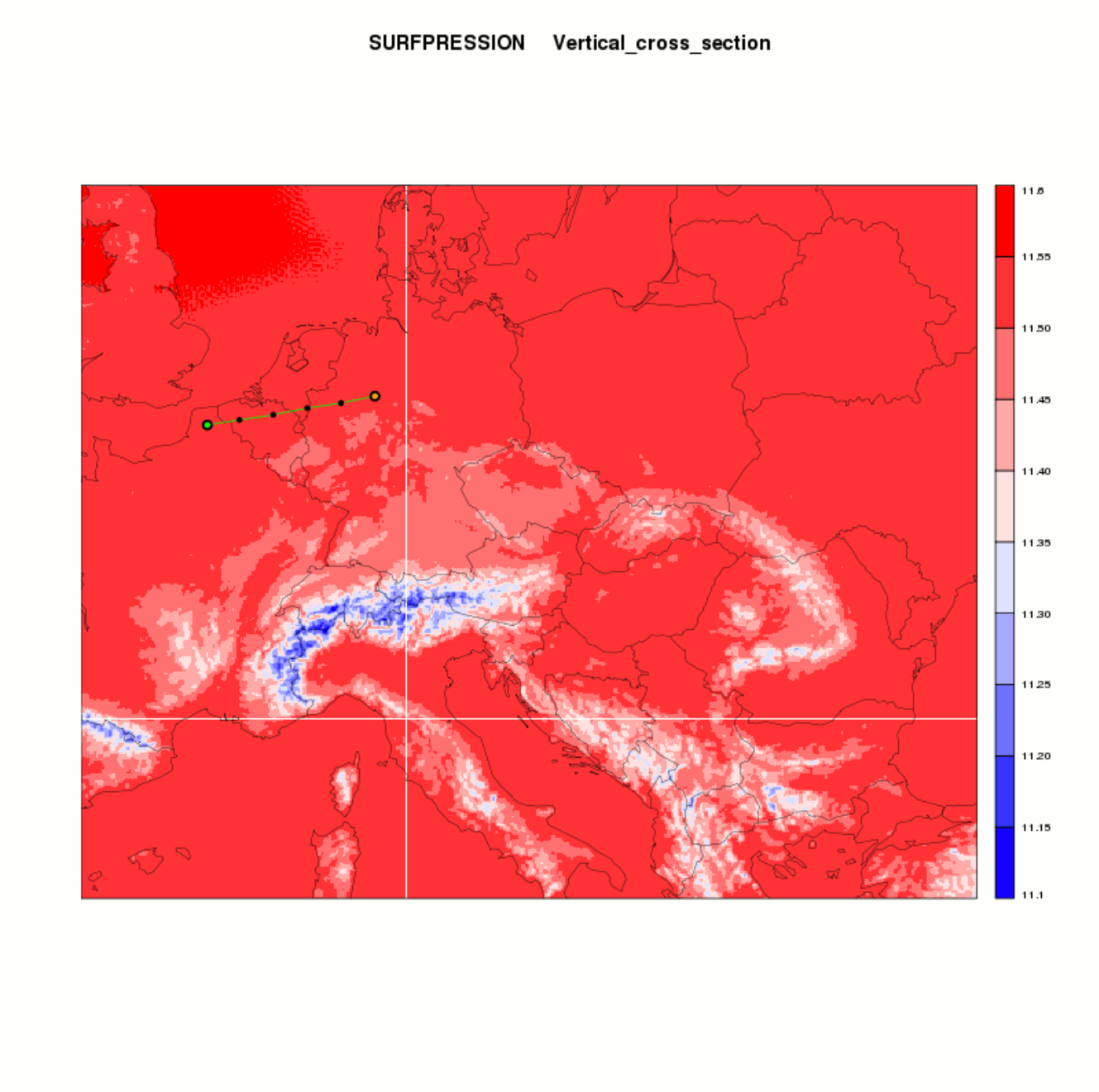








A cross section plot is then done for this interesting urbanized place over Belgium and Germany:



The temperature difference with and without TEB: