

# Coupling SURFEX with pTKE, TOUCANS, and TOM's

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Abstract: This note is about the coupling of surfex with pTKE, TOUCANS, and TOM's correction at the CHMI. Firstly, the used version of SURFEX was not up to date with respect to the one used operationally at Meteo-France and tested for research purpose at the RMI. So, I first make a phasing exercise to have the correct version of surfex. The initialization of SURFEX is done correctly and the TEST.lfi file is correctly produced. However, during the run the writing of the initial file ICMSHALAD+0000 takes a very long time for the LACE domain due probably to some memory problem (this bug was not corrected during this stay). The coupling between SURFEX and the pTKE, TOUCANS, and TOM's correction was done successively and a solution of the interface was proposed, respectively. This solution is working technically, but more scientific validation must start now in order to investigate more in detail the effect of the tiling approach inside SURFEX on the boundary layer when switching on the TOUCANS scheme. This could be investigated for example with the TEB scheme later since more drag will be introduced in the surface boundary layer.

# 1. Technical description

## 1.1 Code repository

SURFEX\_5.1 is installed on cycle 36t1, the cycle is under my account:

yaga:/home/mma/mma202/build\_cy36t1\_sfx/

The surfex repository are **Sfx** where you have the code of surfex itself and **Mse** where you have the external function which make the link with the upper air routine like apalpar.F90.

All modified routine are copied in name\_routine.F90.ori

To compile surfex you need to run make.

The upper air cycle on which I build surfex is under my account:

yaga:/home/mma/mma202/CY36T1OPE\_TOUCANS

This is the latest version where we have also the correction from TOM's.

All modified routine are copied in name\_routine.F90.ori

The interface with surfex is under /home/mma/mma202/CY36T1OPE\_TOUCANS/Mse/interface

When you modify the externals routine of surfex (yaga:/home/mma/mma202/build\_cy36t1\_sfx/Mse) you must correct also the interface.

To compile the upper air cycle you run make.

To make the link between the upper air cycle and surfex you run the script:

/home/mma/mma202/CY36T1OPE\_TOUCANS/link\_36t1

## 1.2 Running surfex

### 1.2.1 Create the pdg file for the domain

To run surfex you need first to create the PGD file for the domain. For the LACE domain the pdg file is created under this repository:

/home/mma/mma202/TOUCAN\_SURFEX/pgd/PGD\_ALD\_TCH.lfi

Within this file:

- The ISBA scheme is run with three layers.
- The TEB scheme is turned off and city is replace by rock.
- ECUME parameterization is used for sea.

All this set up can be changed when creating the pdg file. The pdg file was created in Toulouse.

### 1.2.2 Create the initial file for the prognostic variable of surfex

This script to prepare the initial file for surfex (TEST.lfi) is under my repository:

/home/mma/mma202/TOUCAN\_SURFEX/scr/lancelot00.job

To create the TEST.lfi, I am not using the offline prep tools but the master executable.

The initial file are created correctly for the LACE domain.

### 1.2.3 Create the classical LBC file

The script is under my repository:

/home/mma/mma202/TOUCAN\_SURFEX/scr/lancelot.job

### 1.2.4 Run surfex for the LACE domain coupled to alaro

The script is under my repository:

/home/mma/mma202/TOUCAN\_SURFEX/scr/job\_rafiq\_cz.ptke

### 1.3 Test of surfex for the LACE domain

I noticed that there is a problem of creating the first +0000 file when running surfex at the CHMI. Below is the output for a simulation without surfex, the creation of the ICMSHALAD+0000 takes 5 minutes.

```
2012-12-19 18:47 ICMSHALADINIT
2012-12-19 18:51 ALADIN
2012-12-19 18:52 ICMSHALAD+0000
```

When using surfex, the creation of the ICMSHALAD+0000 takes **1h30 min.**

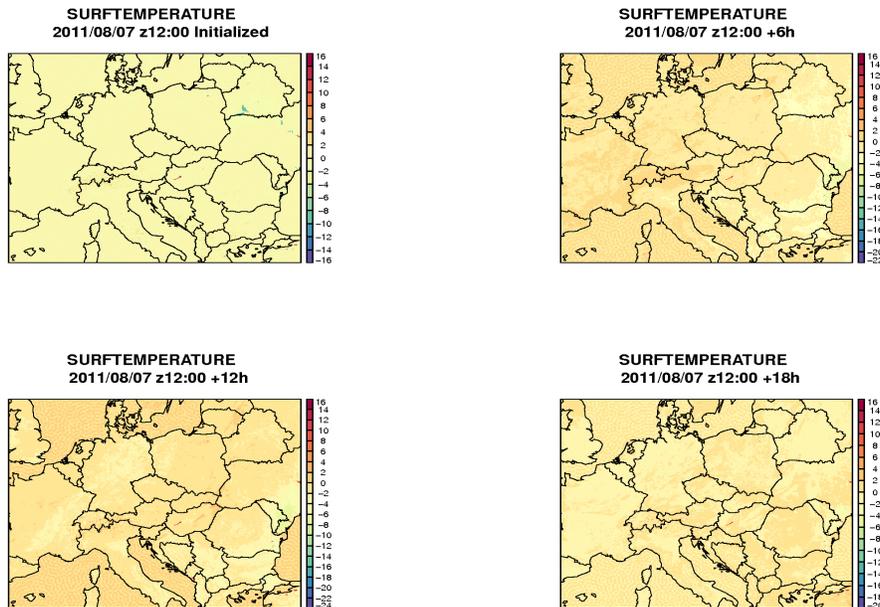
```
2012-12-19 18:53 ICMSHALADINIT
2012-12-19 18:59 ALADIN
2012-12-19 20:25 ICMSHALAD+0000
2012-12-19 20:25 AROMOUT_.0000.des
2012-12-19 20:26 AROMOUT_.0000.lfi
```

For a the smaller operational domain of Belgium this problem is not found. Perhaps a problem of memory... I did not try to solve this problem.

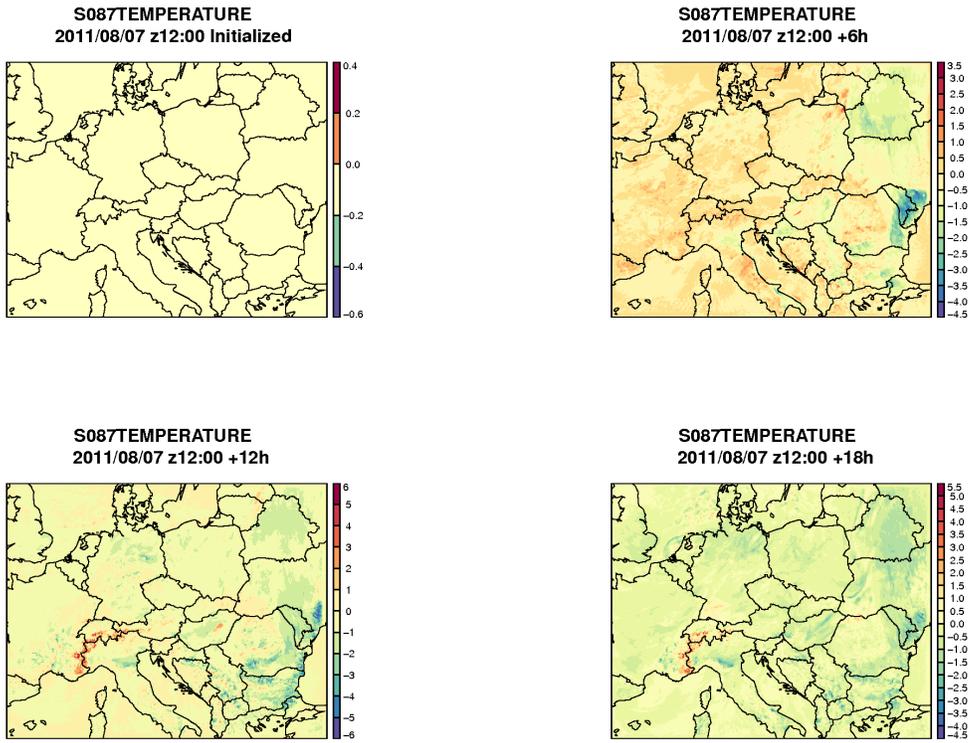
So as a fast solution, all my test runs for the coupling with surfex were done for the smaller domain of Belgium but I also run some final runs over LACE domain.

## 2. Coupling SURFEX with pTKE

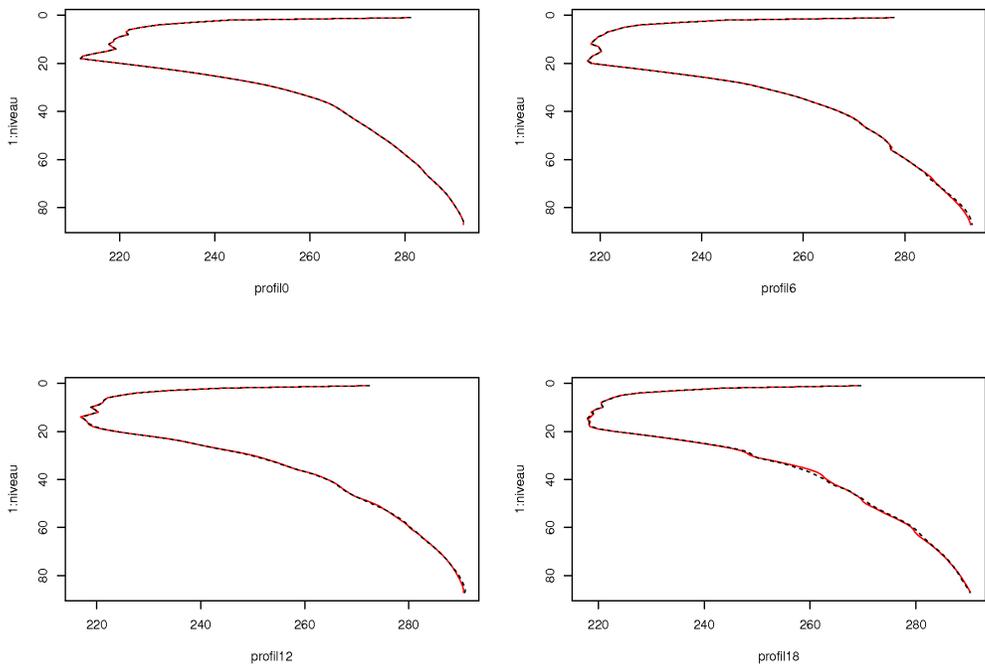
The interface between surfex and the pTKE is done via the drag coefficient  $C_d$ , this is how it is done currently at the RMI. Two runs with and without surfex are performed for the 7 August 2011 starting at 1200 UTC. The figure below presents the difference in the surface temperature  $T_s$  of the first layer of the soil. At the initialization, we can see that some lakes are initialized by surfex differently either warmer or colder than the old isba version.



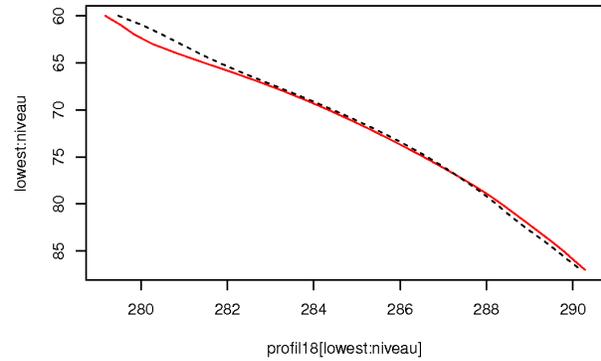
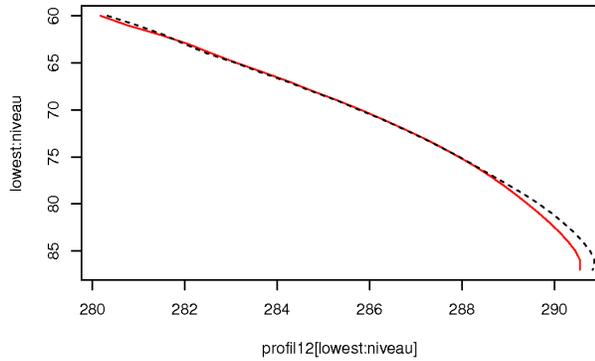
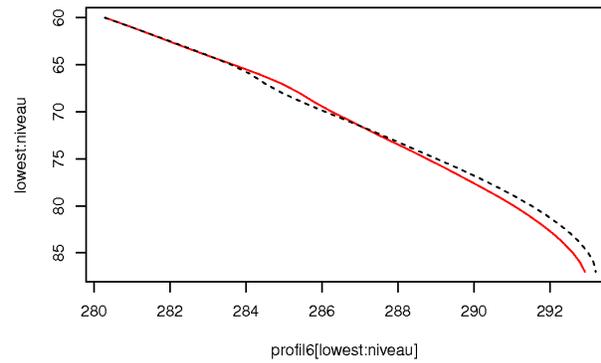
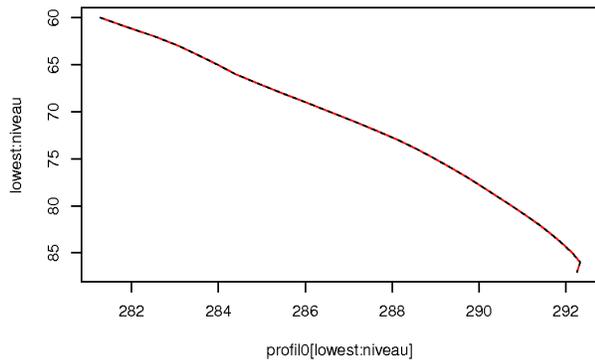
The coupling could be done also via the neutral drag coefficient  $C_{dn}$ , this solution has not been tested during this stay. Below is the difference of the temperature at the lowest model level:



And the temperature profile at the grid point closest to Prague (Red is without SURFEX):



At the lowest model levels:



### 3. Coupling SURFEX with TOUCANS

For TOUCANS the interface with surfex is done via the neutral drag coefficient  $C_{dn}$ . In routine ACTKEZOTLS.F90 the PCDN and the PGZ0H are now taken from surfex and we calculate only the PCDNH in this routine using the new stability function of TOUCANS. Therefore, the new stability function are valid at the surface and in the boundary layer. One solution could be to introduce the new stability function inside surfex via the key LDRAG\_COEF\_ARP in routine drag.F90, therefore, we can interface the fluxes, this solution is coded but not yet tested.

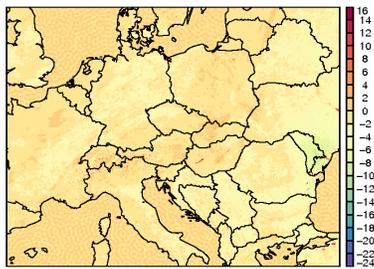
**SURFTEMPERATURE**  
2011/08/07 z12:00 Initialized



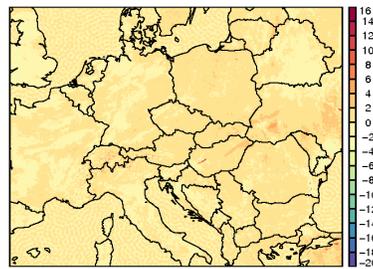
**SURFTEMPERATURE**  
2011/08/07 z12:00 +6h



**SURFTEMPERATURE**  
2011/08/07 z12:00 +12h



**SURFTEMPERATURE**  
2011/08/07 z12:00 +18h

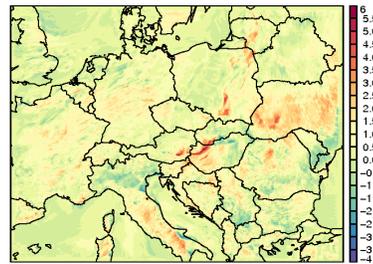


Below is the difference of the temperature at the lowest model level:

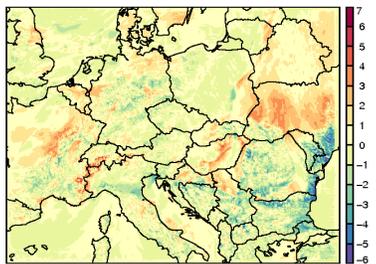
**S087TEMPERATURE**  
2011/08/07 z12:00 Initialized



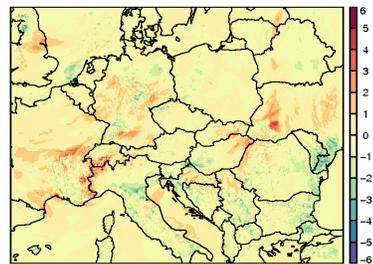
**S087TEMPERATURE**  
2011/08/07 z12:00 +6h



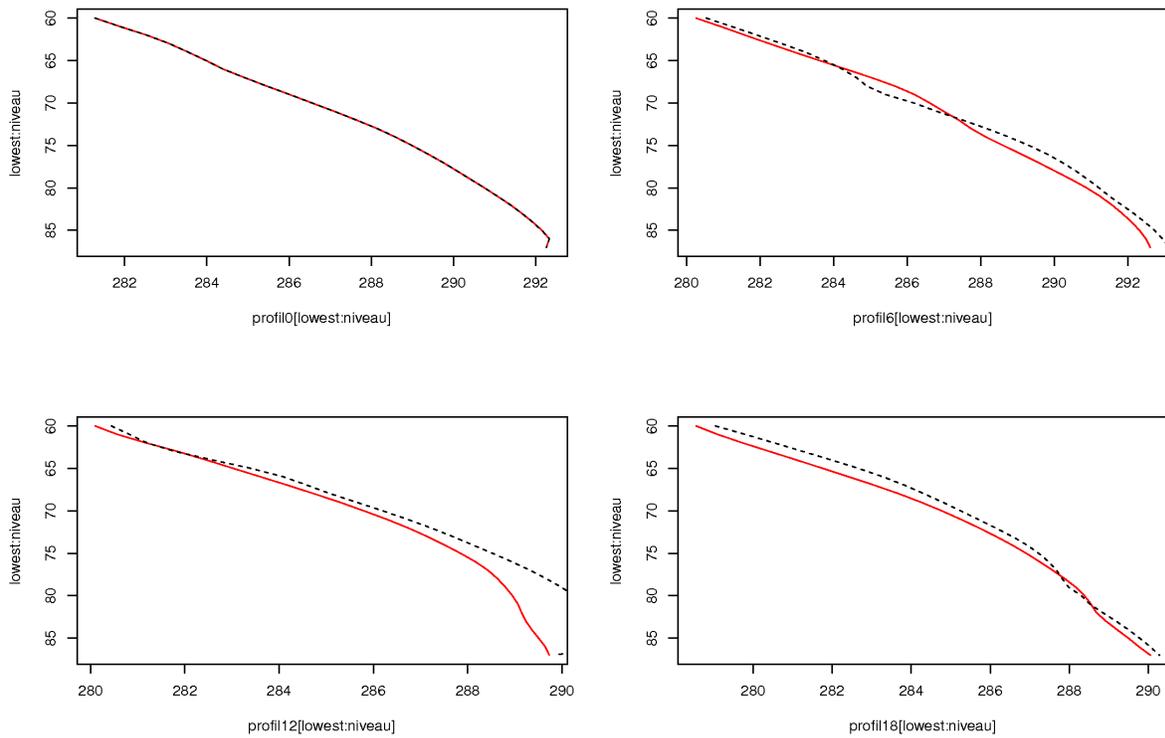
**S087TEMPERATURE**  
2011/08/07 z12:00 +12h



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



And the vertical profile:



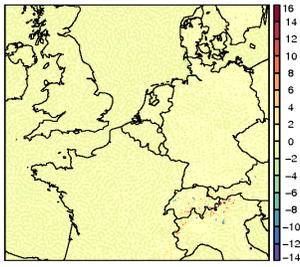
#### 4. Coupling SURFEX with TOUCANS and TOM's correction

Three arguments are added to the routine ARO\_GROUND\_DIAG.F90: ZPCDN (neutral drag coefficient), ZPSNG (snow fraction at the ground), ZPFROZEN1 (fraction of frozen soil from isba only! For TEB, sea and water this is considered as 0.). The TOM's correction are added just after the call of ARO\_GROUND\_DIAG inside APLPAR.F90. I made a test with the configuration of:

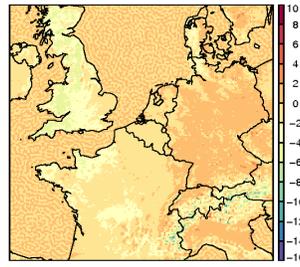
```
model="QNSEA"  
mRi="Ris"  
par_mixl="AY"  
par_TOMs="T"
```

For the Belgian domain (faster run).

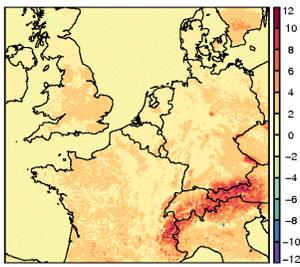
**SURFTEMPERATURE**  
2012/01/25 z00:00 Initialized



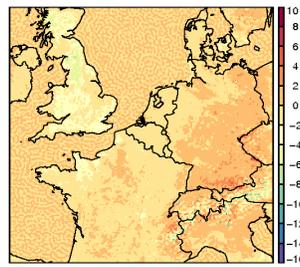
**SURFTEMPERATURE**  
2012/01/25 z00:00 +6h



**SURFTEMPERATURE**  
2012/01/25 z00:00 +12h

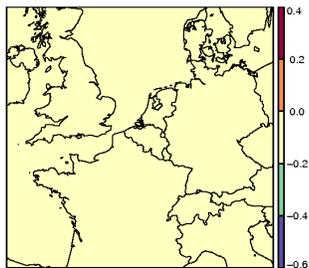


**SURFTEMPERATURE**  
2012/01/25 z00:00 +18h

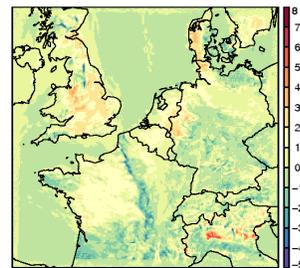


Below is the difference of the temperature at the lowest model level:

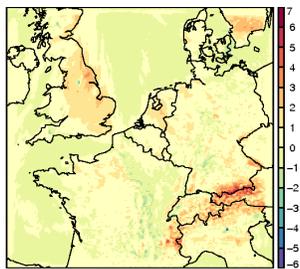
**S046TEMPERATURE**  
2012/01/25 z00:00 Initialized



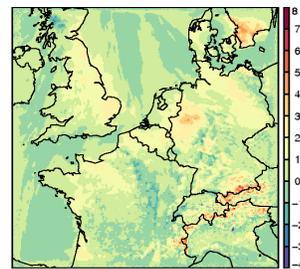
**S046TEMPERATURE**  
2012/01/25 z00:00 +6h



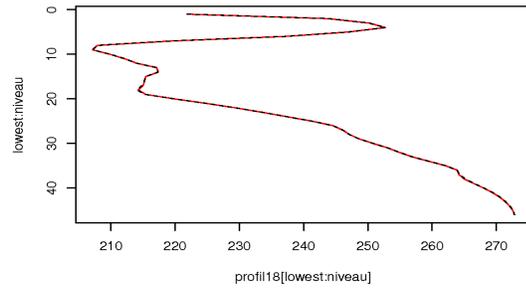
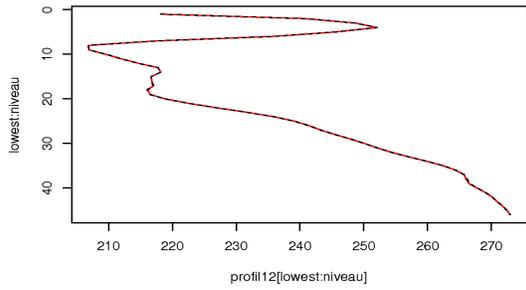
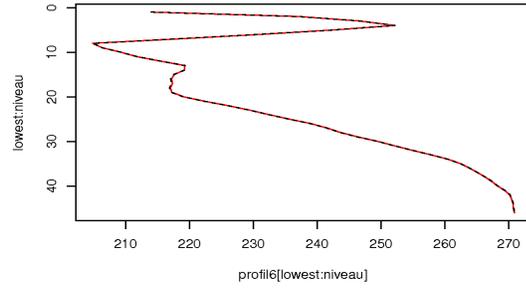
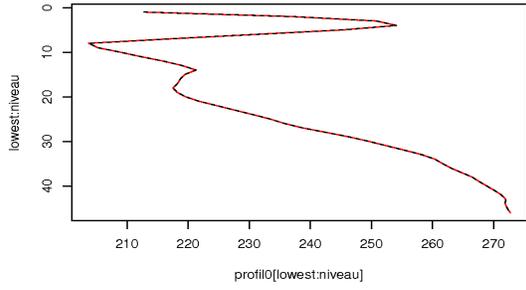
**S046TEMPERATURE**  
2012/01/25 z00:00 +12h



**S046TEMPERATURE**  
2012/01/25 z00:00 +18h



and the profile:



At the lowest model level:

