MUSC EXPERIENCES AT AEMET

Hirlam-B working days on HARMONIE-MUSC
29.11 - 2.12.2011, Helsinki

Daniel Martín
Javier Calvo

1. INSTALLATION

- **MUSC 35T2** version provided by Eric Bazile

  Main version of HARMONIE and test version with MUSC routines.

  ascii2fa and surfex code to generate initial conditions file and surface(.lfi,.des) files.

- Installed in Linux BladeFrame server
- Compilation utility **gmkpack** of Harmonie 36h13
- GMKFILE=**GFORTRAN.LINUX** (Harmonie config: LINUX)
- MPL (Message Passing Library) library was used instead of MPI (Message Passing Interface)

Compilation problems (local prolems)

* The file *lex.l* was substituted by the one of version 33h1
* Segmentation fault problem in *bator_init_mod.F90* (a loop is changed)
* Minor problems in *fltbgvarens.F90*, *suphy2.F90*, *new_thin_radar.F90*

As MPL library was used instead of MPI.

* Error message: **`ABORT called by mpi_init_thread_()@mpi_serial.c`** due to MPI routines being called when they are not going to be used.
* Changes in *mpl_init_mod.F90* (xrd/module) and *sumpini.F90* (arp/setup) are needed.
* Variable **`LMPOFF = TRUE`** in namelist NAMPAR0 when running an experiment

MUSC version 37t1 was sucessful installed in the same server with mpi libraries.

2. NOTES on CONFIGURATION and EXECUTION

The Initial state is obtained from an ascii file

* ascii_$CASE → FA_$CASE
* ascii2fa code was used.

* Error message:

SURFAEROS.SEA MISSING FROM ARPEGE FILE

A new variable was added to the ascii file:

AEROS.SEA

```
6.200E-3
```

The routine *acadfa1D_main.F90* needed to be modified in order to read the new variable and to be added to the fa file.

```
&NAM1D
 IFLEV=79,
 ZDELY=250000.,
 LNHDYN=.FALSE.,
 LALAPHYS=.T.,
 LREASUR=.T.,
 NFORC=14
 LQCGRP    = .T.
 LQIGRP    = .F.
 LQRGRP    = .F.
 LQSGRP    = .F.
 LQGGRP    = .F.
 LCFGRP    = .F.
 LSRCGRP   = .F.
 LTKEGRP   = .T.
 IYEAR=1992
 IMONTH=6
 IDAY=13
 IHH=00
 IMIN=00
/
```

```
ETA
vah
   0.000000
   0.000000
...
vbh
   0.000000
   1.9999999E-04
...
ATMOSPHERE
zorog
   0.000000
ps (hPa)
    97000.00
```

Surface files

To create the surface files, two programs were needed.

The code is in two folders:

PREP_PGD_AROME (pgd_exe or PGDmusc).

Libmse.new.a is built. (Folder: updatelibs)

PRE_SURF_AROME (prepsurf_exe, PREPsurfex)

Makefile files needed to be modified in order to link libraries of the main HARMONIE

The exe files read the surface namelist and generate the surface files (.lfi,.des)

Surface files Namelist:

PRE_REAL1_$CASE:

&NAM_FILE_NAMES HPGDFILE ='AROME_PGD' , CINIFILE='AROME_PREPSURF' /

&NAM_PREP_SURF_ATM NYEAR=1997 , NMONTH=6 , NDAY=21, XTIME=41400. /

&NAM_PGDFILE CPGDFILE='pgd_ideal' /

PRE_PGD1_$CASE:

&NAM_PGD_SCHEMES CNATURE='FLUX' , CSEA='NONE' , CWATER='NONE' , CTOWN='NONE' /
&NAM_PGD_GRID CGRID='CARTESIAN' /
&NAM_CARTESIAN XLAT0=36.605 , XLON0=-97.485 , NIMAX=1 , NJMAX=4 , XDX=250000. ,
XDY=250000. /
&NAM_COVER XUNIF_COVER(4)=1. /
&NAM_ZS XUNIF_ZS=0. /
&NAM_FRAC LECOCLIMAP=.TRUE., XUNIF_SEA=0., XUNIF_WATER=0.,
XUNIF_TOWN=0.,XUNIF_NATURE=1/

EXEG.nam

&NAM_SURF_ATMn /

&NAM_ISBAn /

&NAM_DIAG_SURFn LSURF_BUDGET=.TRUE., N2M=2 /

&NAM_DIAG_ISBAn LSURF_EVAP_BUDGET=.TRUE., LSURF_MISC_BUDGET=.TRUE.,
LPGD=.TRUE. /

Namelist

* Mainly **convection cases** have been studied. The different configurarions used have been obtained by giving different values to switches and variables:
  * NAMARPHY: **LKFBCONV, LKFBD, LKFBS, LMFSHAL**
  * NAMPARAR: **CMF_UPDRAFT** (*EDKF, DUAL*), **CMF_CLOUD** (*DIRE,STAT*)
  * NAMCVMNH: **OTADJS, OTADJD** (user specified time step to call shallow and deep convection)
* Convective variables contained in routine **ini_convpar.mnh** were not modified.

Outputs

* In order to get ascii files from the outputs, "gl -scum" was used (gl from Harmonie 33h1) on the "ICMSHAROM+" files

* Surface fluxes. Temperature and humidity surface fluxes are included in the routine **`mse/internals/init_ideal_flux.mnh`**

IS THERE ANY OTHER WAY TO CHANGE THE SURFACE FLUXES?

* Large scale forcing are added in the ascii file containing the initial profiles and the namelist nam1D.

Modifications in namelist:

NAMGFL: `NGFL_FORC=24, YFORC_NL(1)%CNAME='FORC001',...`

NAMLSFORC: time and type of the tendency.

3. CUMULUS CASE: ARM(21/06/1997) - ARMCu_L79

* The ascii file with initial conditions and large scale forcing was already prepared. And no chages were needed as the surface flux included in the model corresponded with the one of this case.

* The main purpose of running this experiment was to get some experience with the model.

* Shallow Convection case of 21st June 1997 from observations of the 1997 Single Column Model Summer IOP and studied for the project EUROCS (2002).

* Description of the case and results of the LES model: http://www.knmi.nl/samenw/eurocs/ARM/index.html

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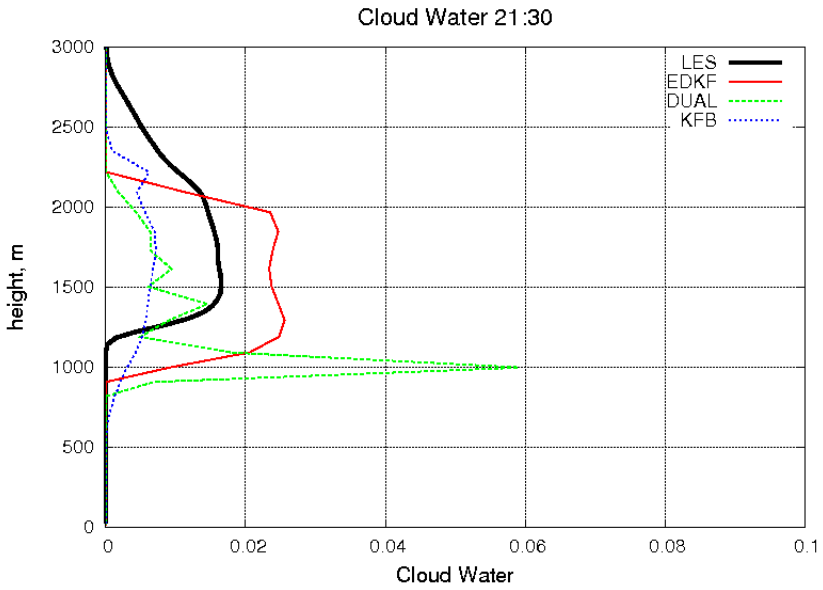
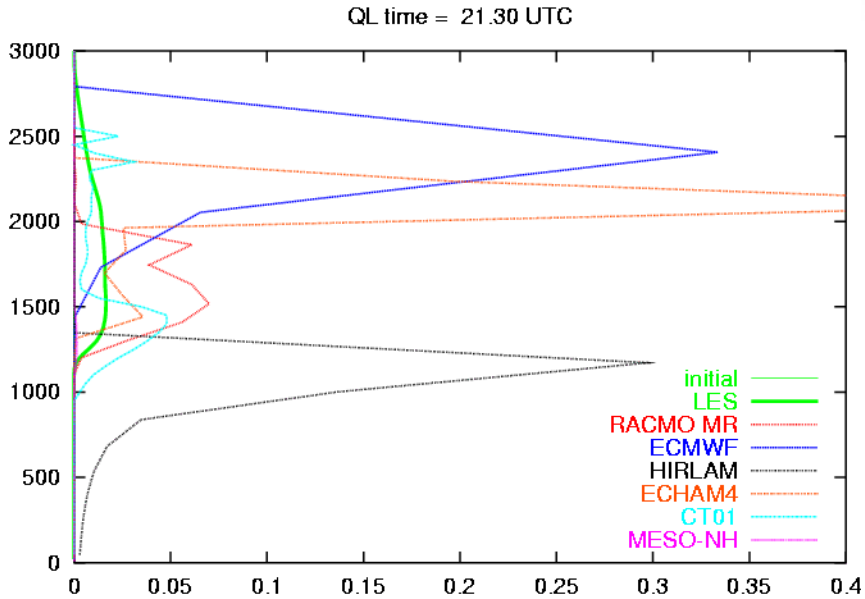
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO
AEMet Agencia Estatal de Meteorología

At AEMET:

- MUSC35t2 has been run for the test case with AROME physics (LAROME)
- Three different configurations have been used: EDKF, KFBS, DUAL.
- Time step: 60 seconds.
- 79 levels.
- The results have been compared with the ones obtained with the LES model.

	LKFBCONV	LKFBD	LKFBS	LMFSHAL	CMF_UPDRAFT
EDKF	F	F	F	T	EDKF
DUAL	F	F	F	T	DUAL
KFB	T	F	T	F	EDKF





Comparison of cloud water at 21:30 UTC 21/06/1997.

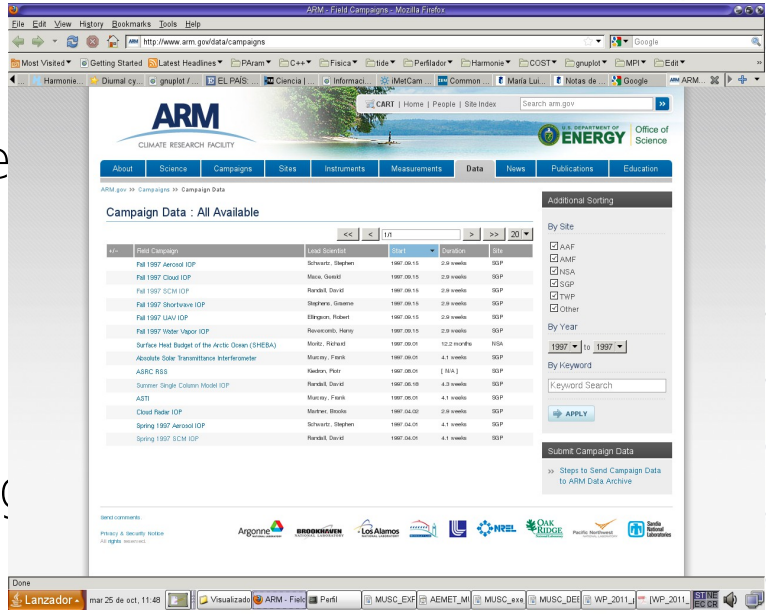
* MUSC35t2: Three configurarions (EDKF, EDMF, KFBS) and LES

* Models and LES used for EUROCS project.

4. CONTINENTAL DEEP CONVECTION CASE: ARM (27-28/06/1997)

* A case study based on the GCSS WG4 Case 3 intercomparison project, Diurnal Cycle of Precipitating Deep Convection Over Land. (EUROCS Project)
* link: http://www.cnrm.meteo.fr/gcss/EUROCS/deepdiurnland.html

* The data has been collected from webpage /data/campaigns
* Summer Single Colum Model IOP (Intensive operation period) documentation downloaded from the webpag
*Files: *layer_9706.dat*, *surface_9706.dat*, Info files and fortran programs.



The file (layer_9706.dat) contains data every 3h, 35 levels and the variables:

Length of each field

Number of pressure levels (35)

Pressure levels (mb)

Time (Calendar day)

Year

Month

Day

Hour

Minutes

Number of multilevel fields (19)

Temp_(K)

H2O_Mixing_Ratio_(g/kg)

u_wind_(m/s)

v_wind_(m/s)

omega_(mb/hour)

Wind_Div_(1/s)

Horizontal_Temp__Advec_(K/hour)

Vertical_T_Advec(K/hour)

Horizontal_q_Advec_(g/kg/hour)

Vertical_q_Advec(g/kg/hour)

s(Dry_Static_Energy)(K)

Horizontal_s_Advec_(K/hour)

Vertical_s_Advec(K/hour)

ds/dt(K/hour)

DT/dt(K/hour)

dq/dt_(g/kg/hour)

Q1_(k/hour)

Q2_(g/kg/hour)

ARSCL_Cld

Observations contained in surface file (*surface_9706.dat*):

Number of single level fields (43)

Length of each field (233)

Time (Calendar day)

Year

Month

Day

Hour

Minute

Precipitation (mm/h)

LH_(upward_W/m2)

SH_(upward_W/m2)

Area_mean_pressure (mb)

Central facility pressure (mb)

Ts_Air (ºC)

Tg_Soil (ºC)

Surface air RH(%)

Surface wind speed (m/s)

u_wind (m/s)

v_wind (m/s)

Sfc_Net_Dn_Rad (W/m2)

TOA_LW_Up (W/m2)

TOA_SW_Down (W/m2)

TOA_Ins (W/m2)

GOES_Lowcld (%)

GOES_Midcld (%)

GOES_HgHcld (%)

GOES_Totcld (%)

Cld_Thickness (Km)

Cld_Topheight (Km)

MWR_Cld_liquid (cm)

d(Column_H20)/dt (mm/hour)

Column_H2O advection (mm/hour)

Srf_Evaporation (mm/hour)

d(Column_Dry_Static_Energy)dt (W/m2)

Column_Dry_Static_Energy_Advection _(W/m2)

Column_Radiative_Heating_(W/m2)

Column_Latent_heating_(W/m2)

omega_surface_(mb/hr)

qs_surface_(kg/kg)

s_surface_(K)

MWR_precip_water_(cm)

Siros_Srf_LWUP_(W/m2)

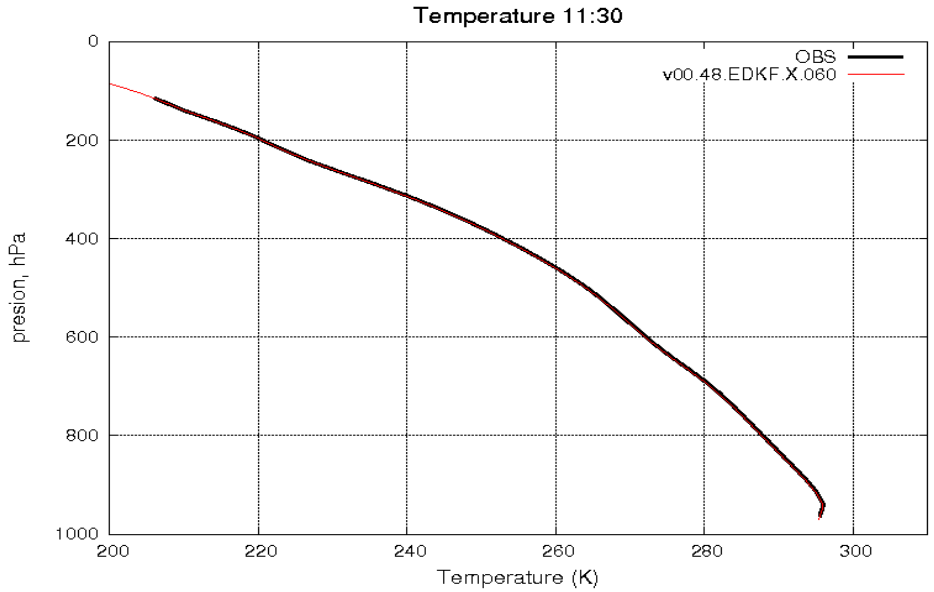
Siros_Srf_LWDN_(W/m2)

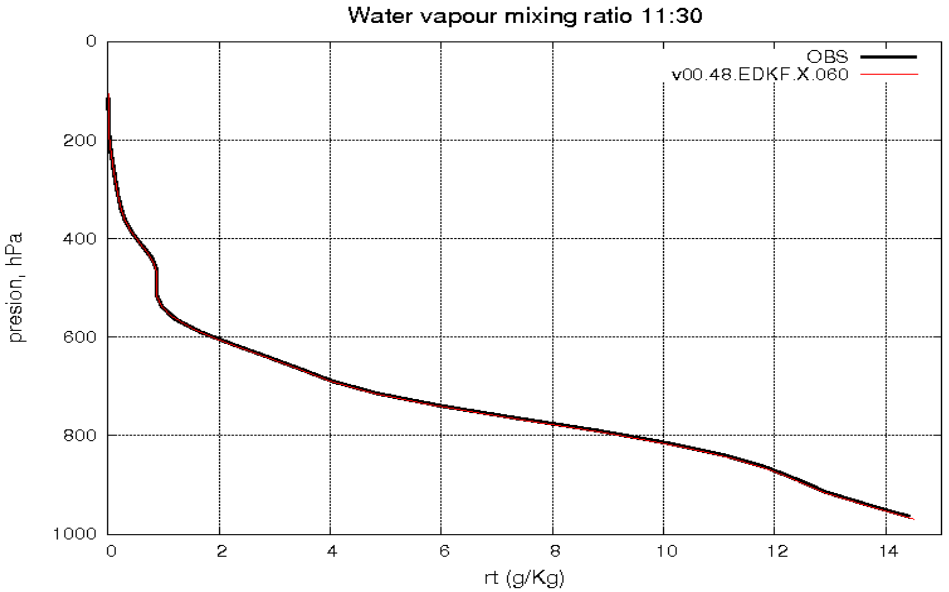
Siros_Srf_SWUP_(W/m2)

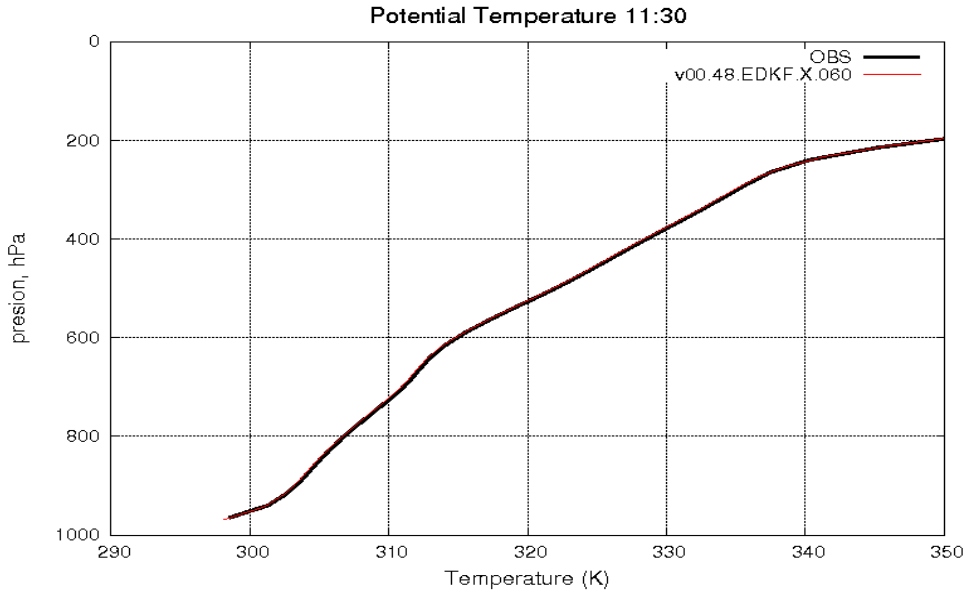
Siros_Srf_SWDN _(W/m2)

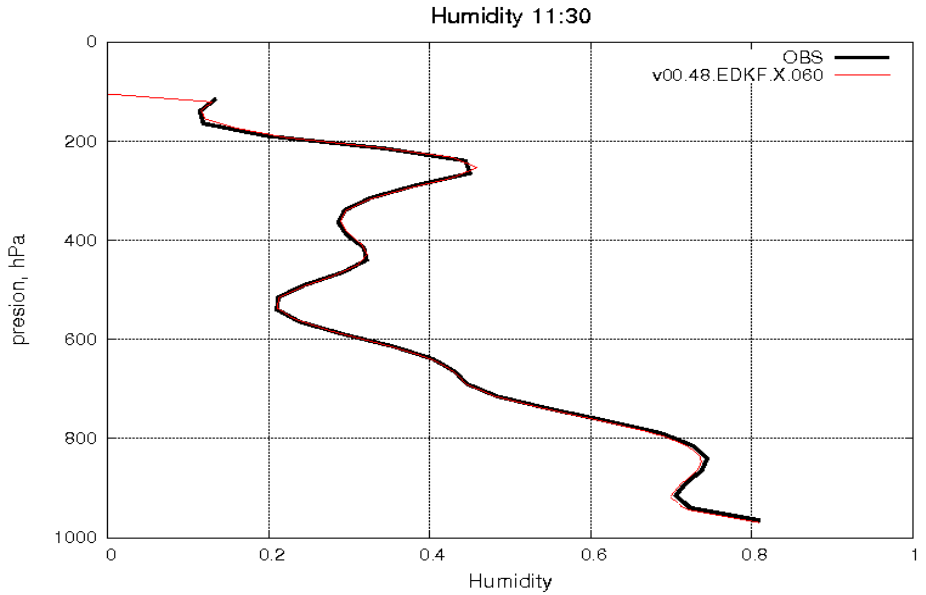
Execution of the model.

* 79 levels, it's been also run for 65 levels.
* Initial conditions (T, rt, u, v) have been interpolated to the 79 levels used in the model from the 35 levels of the observations.
* Time steps of 60 seconds
* And a ideal surface flux has been used.
* Differenct configurations combining EDKF and EDMF mass flux schemes with DEEP convection schem activated or deactivated.


Temperature 11:30
OBS
v00.48.EDKF.X.060
presion, hPa
Temperature (K)
0
200
400
600
800
1000
200
220
240
260
280
300


Water vapour mixing ratio 11:30
OBS
v00.48.EDKF.X.060
presion, hPa
rt (g/Kg)
0
200
400
600
800
1000
0
2
4
6
8
10
12
14


Potential Temperature 11:30
OBS
v00.48.EDKF.X.060
presion, hPa
Temperature (K)
0
200
400
600
800
1000
290
300
310
320
330
340
350


Humidity 11:30
OBS
v00.48.EDKF.X.060
presion, hPa
Humidity
0
200
400
600
800
1000
0
0.2
0.4
0.6
0.8
1

4.2. Surface fluxes

* Idealized surface temperature and vapour mixing ratio fluxes have been used instead of those calculated from observations.

* The fluxes have been collected from the webpage:

http://www.cnrm.meteo.fr/gcss/EUROCS/deepdiurnland/idea_index.html

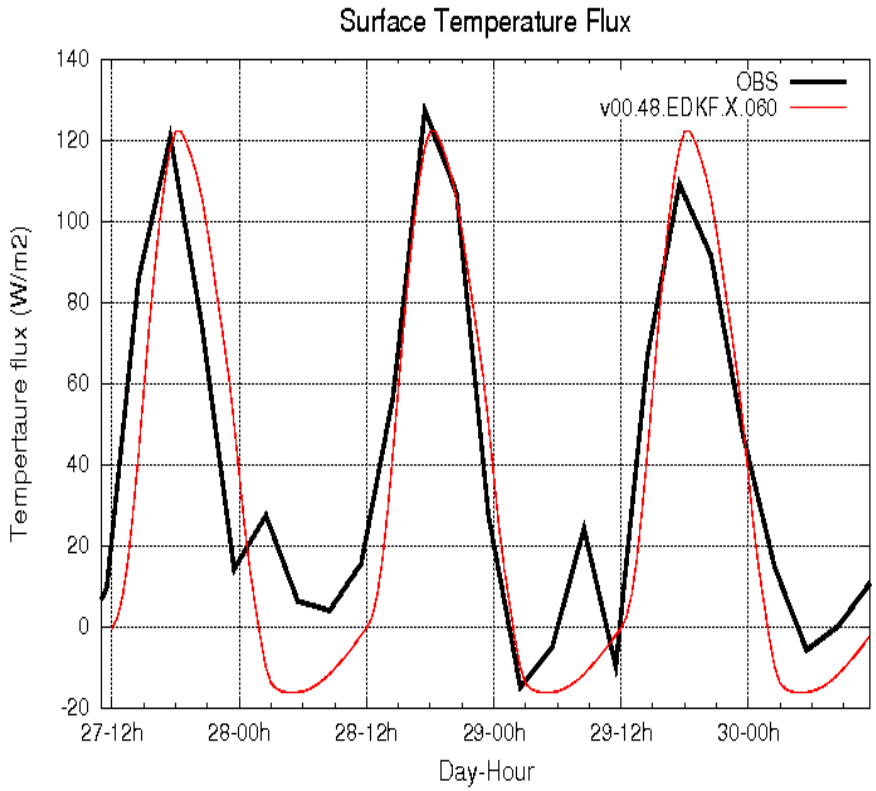
* Surface schemes are defined in namelist:

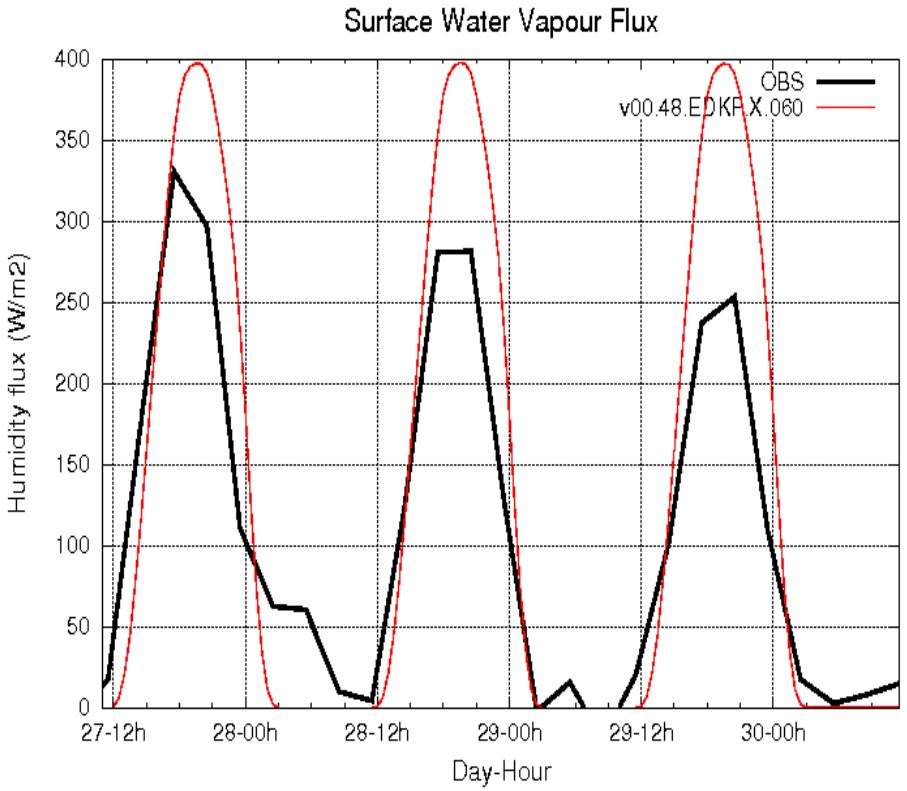
```
&NAM_PGD_SCHEMES CNATURE='FLUX' , CSEA='NONE' , CWATER='NONE' ,
   CTOWN='NONE' /
```

* The surface fluxes are written in the routine:

```
mse/internals/init_ideal_flux.mnh
```

```
!*       1.    HOURLY surface theta flux (NFORC+1 values from 00UTC to 24UTC)
!              -------------------------
IF(.NOT. ALLOCATED (XSFTH) )ALLOCATE(XSFTH(0:NFORC))
!
!* unit: W/m2
!
XSFTH(:) = 0.
!
XSFTH( 0)=    30.60
XSFTH( 1)=    18.59
XSFTH( 2)=     9.67
…
XSFTH(46)=    56.39
XSFTH(47)=    44.05
!
XSFTH(48) = XSFTH(0)
!-------------------------------------------------------------------------
!
!* 2. HOURLY surface vapor mixing ratio flux (NFORC+1 values from 00UTC to 24UTC)
!              ------------------------------------
!
IF(.NOT. ALLOCATED (XSFTQ) )ALLOCATE(XSFTQ(0:NFORC))
!
!* unit: kg/m2/s
!
XSFTQ(:) = 0.
!
XSFTQ( 0)=   156.55/XLVTT
XSFTQ( 1)=    98.57/XLVTT
…
```


Surface Temperature Flux
OBS
v00.48.EDKF.X.060
Tempertaure flux (W/m2)
140
120
100
80
60
40
20
0
-20
27-12h
28-00h
28-12h
29-00h
29-12h
30-00h
Day-Hour

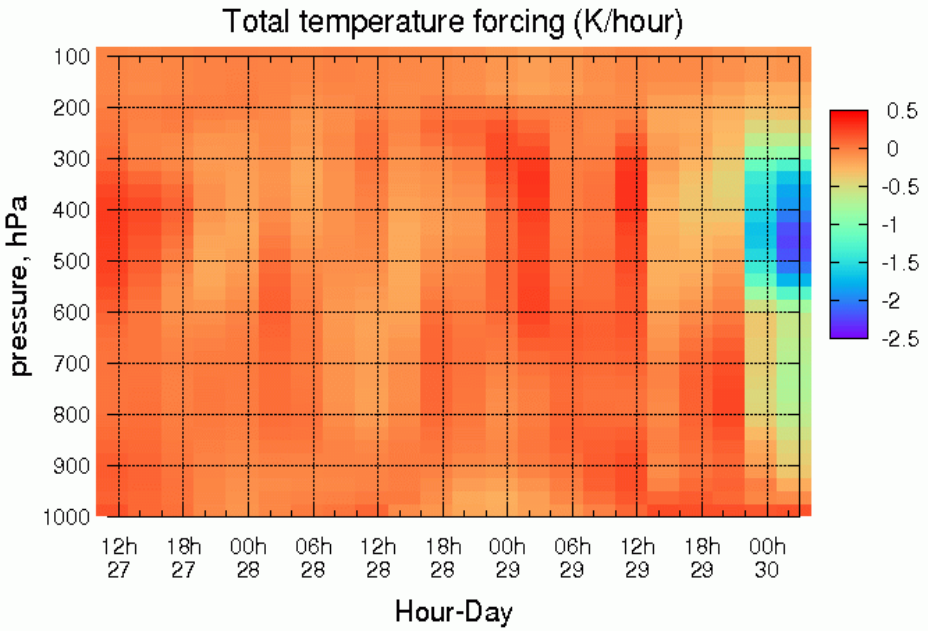

Surface Water Vapour Flux
OBS
v00.48.EDKF.X.060
Humidity flux (W/m2)
400
350
300
250
200
150
100
50
0
27-12h
28-00h
28-12h
29-00h
29-12h
30-00h
Day-Hour

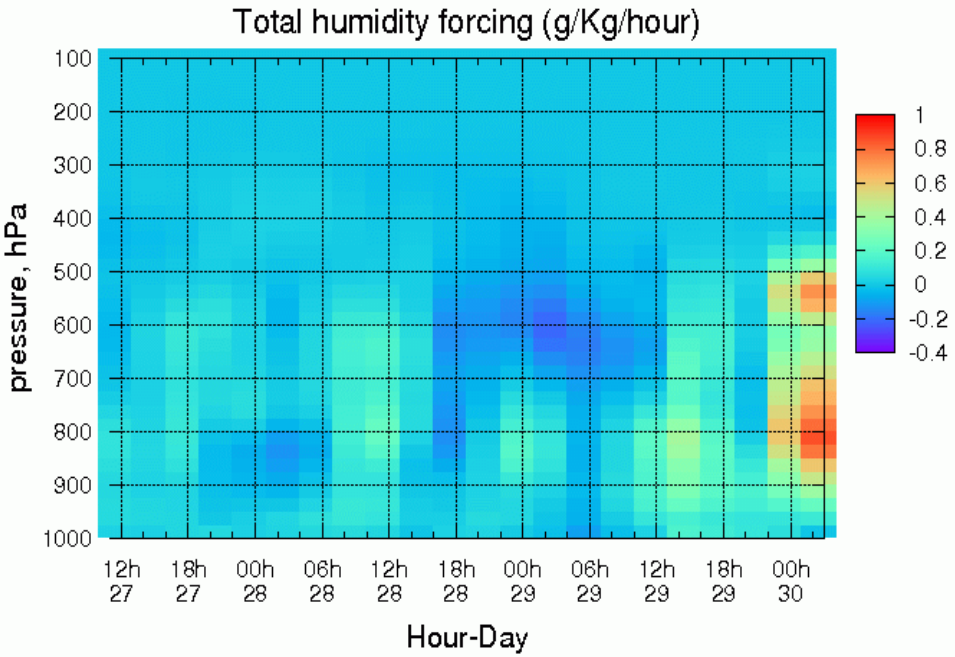
4.3. Large Scale forcing

Total temperature forcing = Horizontal_temp_Advec + Vertical_s_Advec

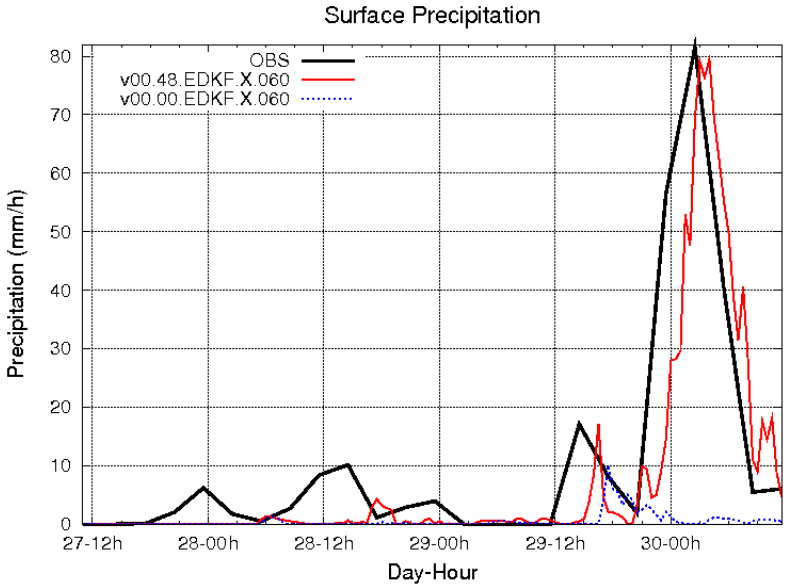
Total moisture forcing = Horizontal_q_Advec + Vertical_q_Advec

* The large scale forcing must be included in the FA initial conditions file.
* The forcing in ascii format is written together with the namelist nam1D.
* The number of forcings used and the names are specified in namelist:

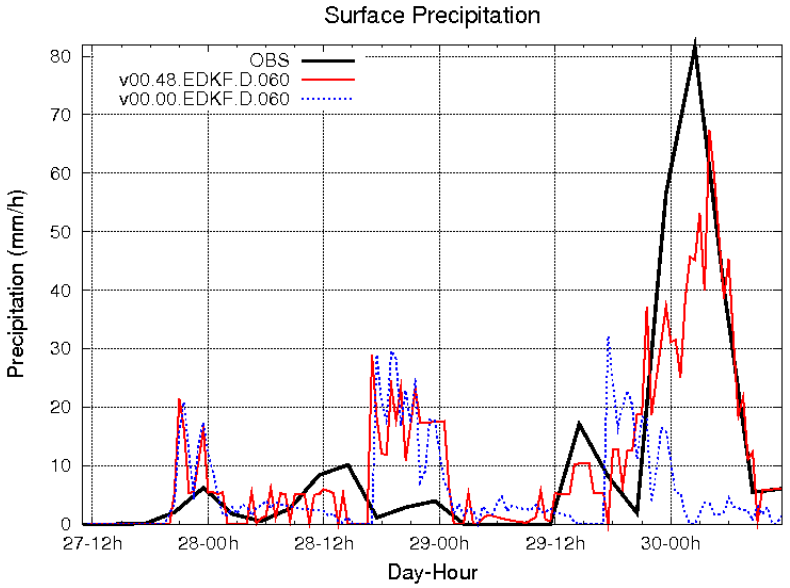

Total temperature forcing (K/hour)
pressure, hPa
100
200
300
400
500
600
700
800
900
1000
12h 27
18h 27
00h 28
06h 28
12h 28
18h 28
00h 29
06h 29
12h 29
18h 29
00h 30
Hour-Day
0.5
0
-0.5
-1
-1.5
-2
-2.5


Total humidity forcing (g/Kg/hour)
pressure, hPa
100
200
300
400
500
600
700
800
900
1000
12h 27
18h 27
00h 28
06h 28
12h 28
18h 28
00h 29
06h 29
12h 29
18h 29
00h 30
Hour-Day
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4

- Comparison of the precipitation for de EDKF configuration and no DEEP convection activated.
  - Red → LS forcing
  - Blue → no LS forcing.
- Only when LS forcing is used, similar values of precipitation are obtained.



- Comparison of precipitation with observations.
- EDKF configuration with DEEP convection activated.
- No big differences in DEEP convection precipitation whenever LSF is consedered or not. (Dependence mainly on the surface fluxes)
- Differences in time precipitation distribution and intensity

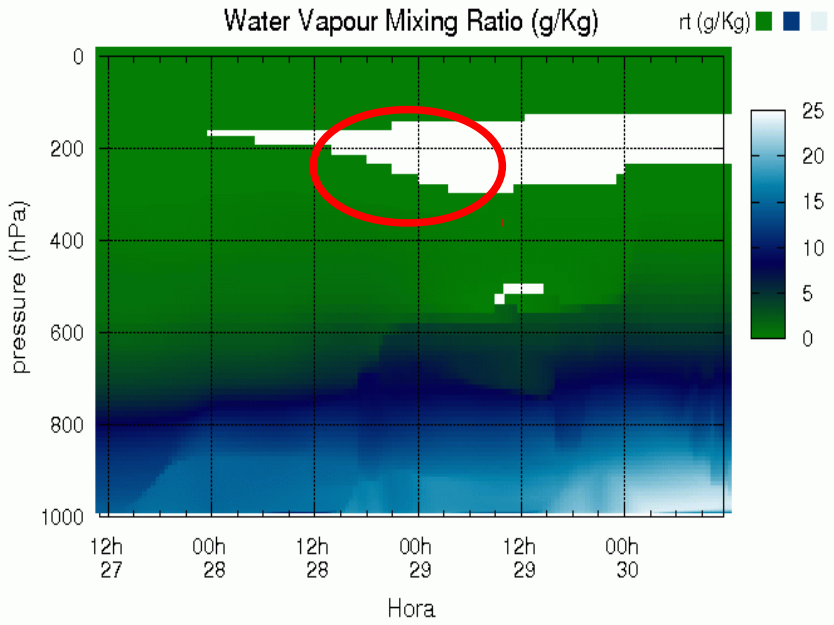


4.4. Problems

- Negative values of rt have been found when large scale forcing are used.

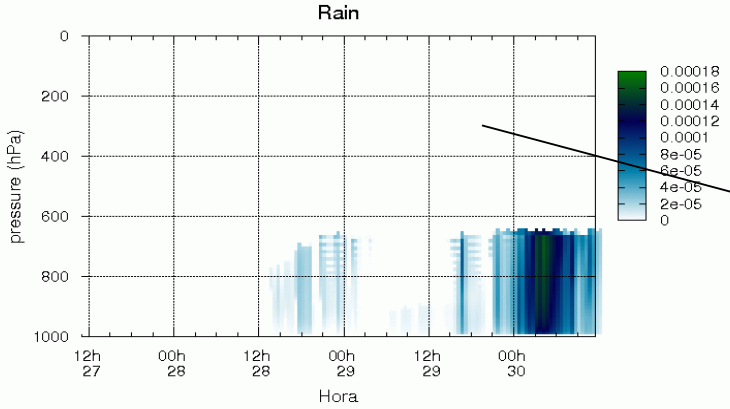
- CPG
  - CPG_GP
    - CPCTY_FORC (LSFORC,LSW_FRC)
  - MF_PHYS (LMPHYS)
  - CPG_DYN
    - CP_FORCING (LSFORC)

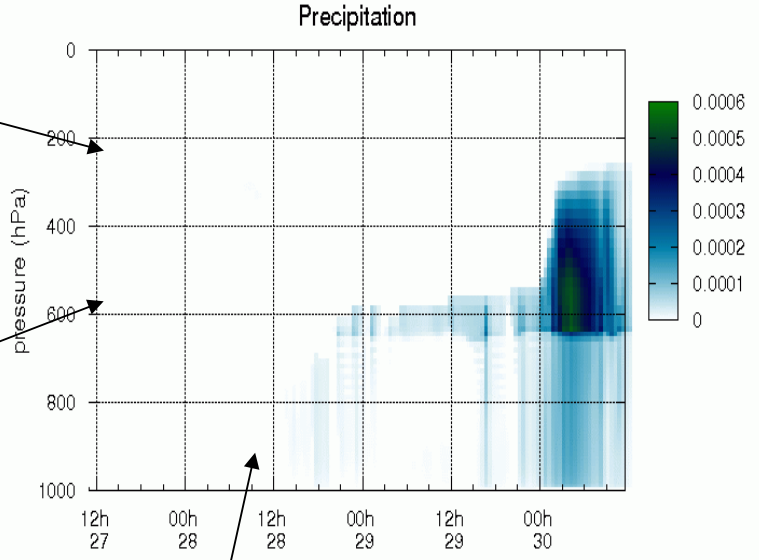
In routine CP_FORCING, LSF are interpolated to every timestep and added to the variables. Eventhough is changed to prevent from getting

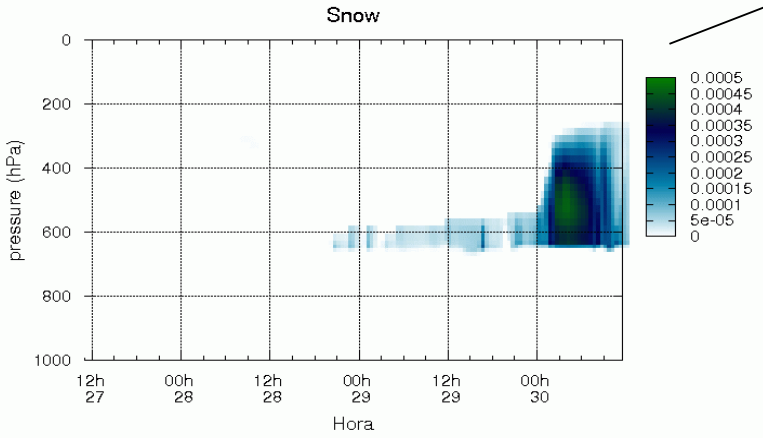


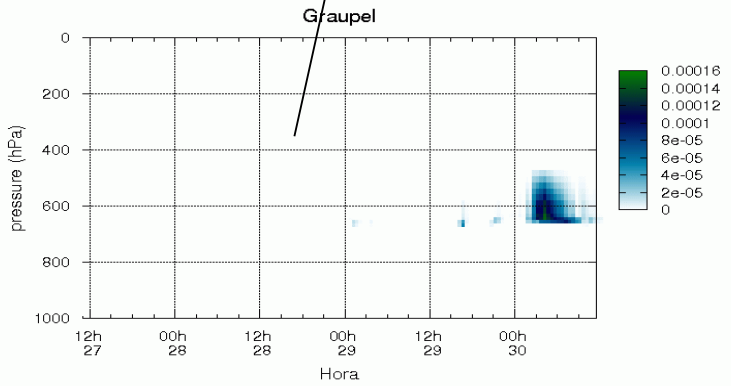
*EDKF and **no** DEEP Conv. Activated*

Negative values of water mixing ratio









*EDKF and **no** DEEP Conv. Activated*

Graupel and snow melting too fast?

Conclusions

* MUSC35t2 succesfully installed.
* Model gives good result for the test case ARMCu_L79.
* Problems with humidity in high levels need to be solved.

Future aims:

* Study of deep convection parametrization.
* Application operationally at barajas airport (study of fog)

Thank you for your attention !

Questions ?