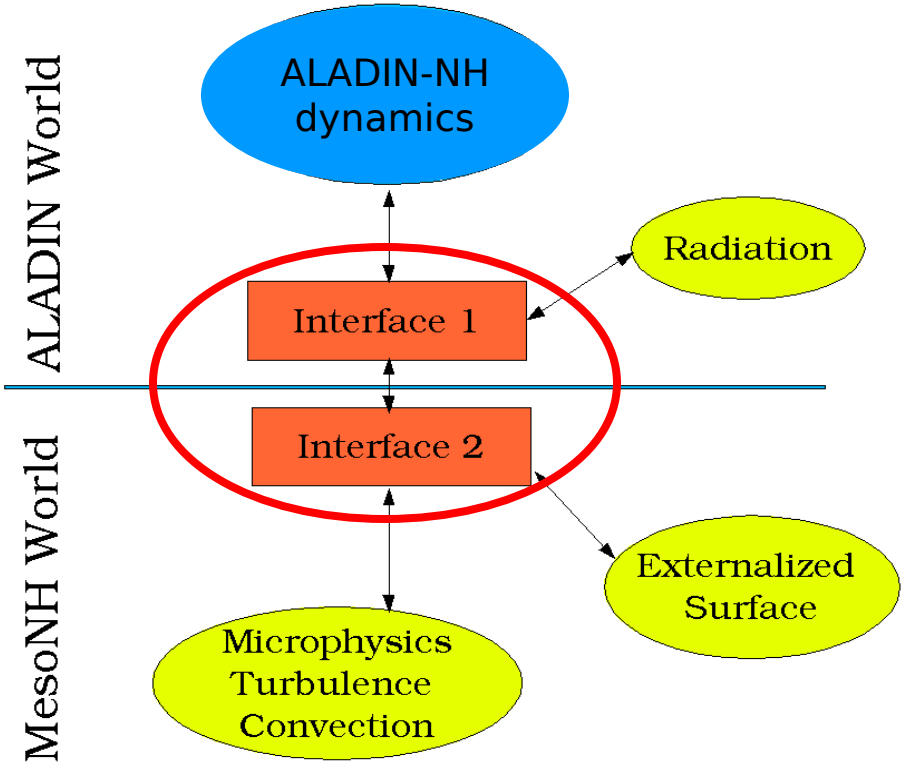
SURFEX use in AROME

Yann Seity (Météo-France CNRM/GMAP)

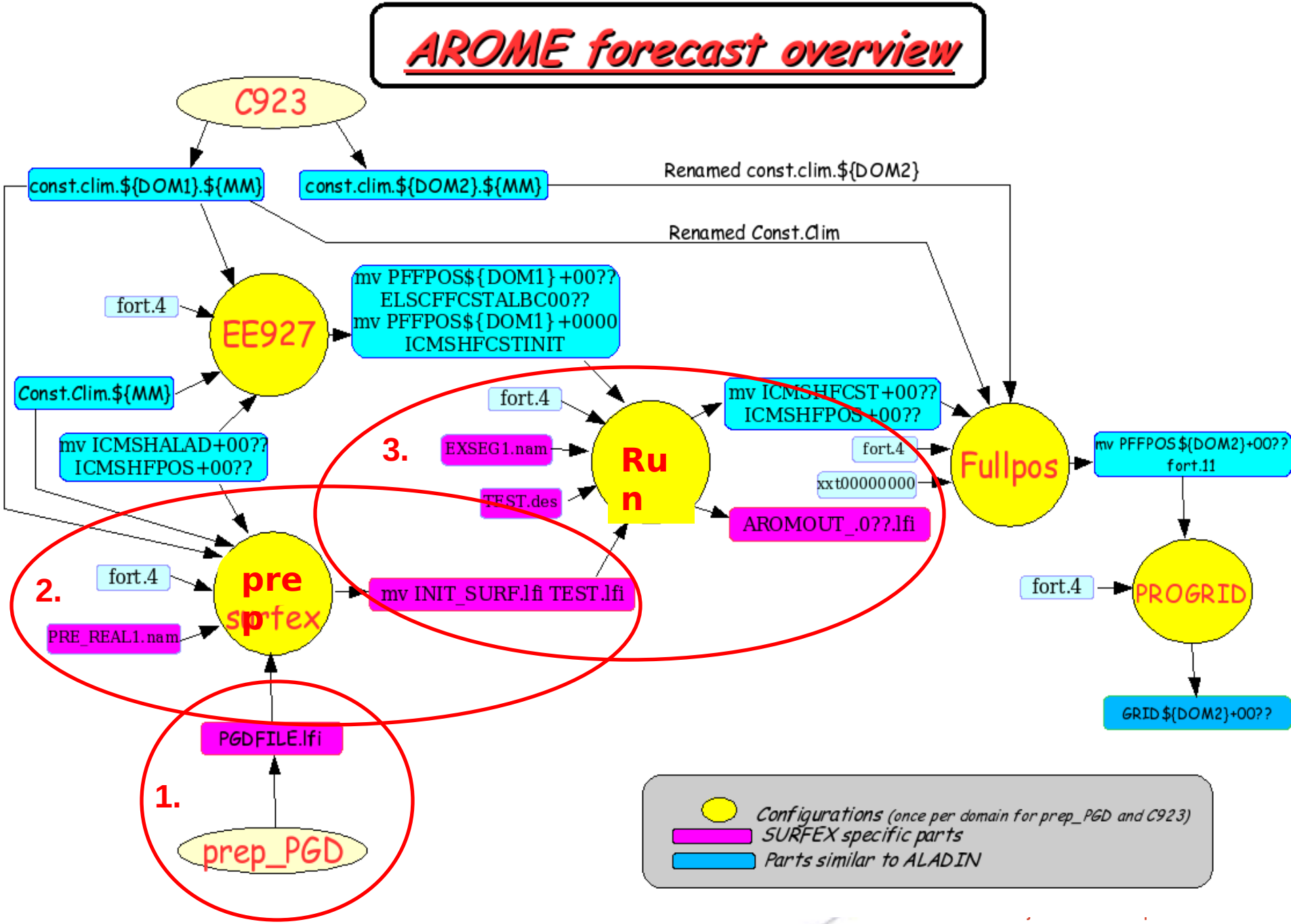
METEO FRANCE
Toujours un temps d'avance

AROME



Pieces of code written for AROME to be able to use SURFEX are interface routines

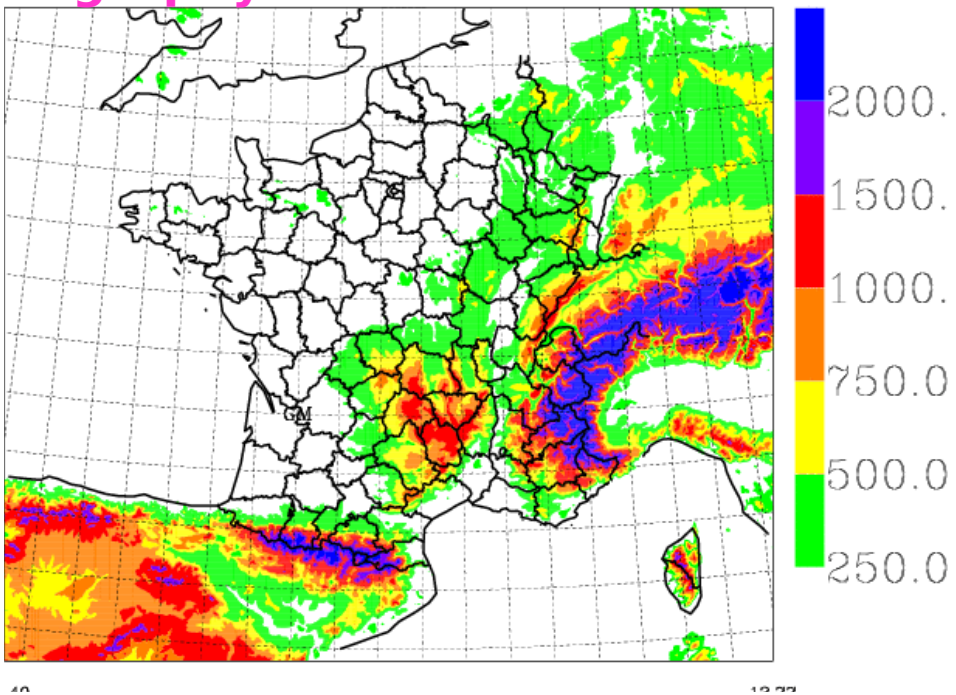
AROME forecast overview



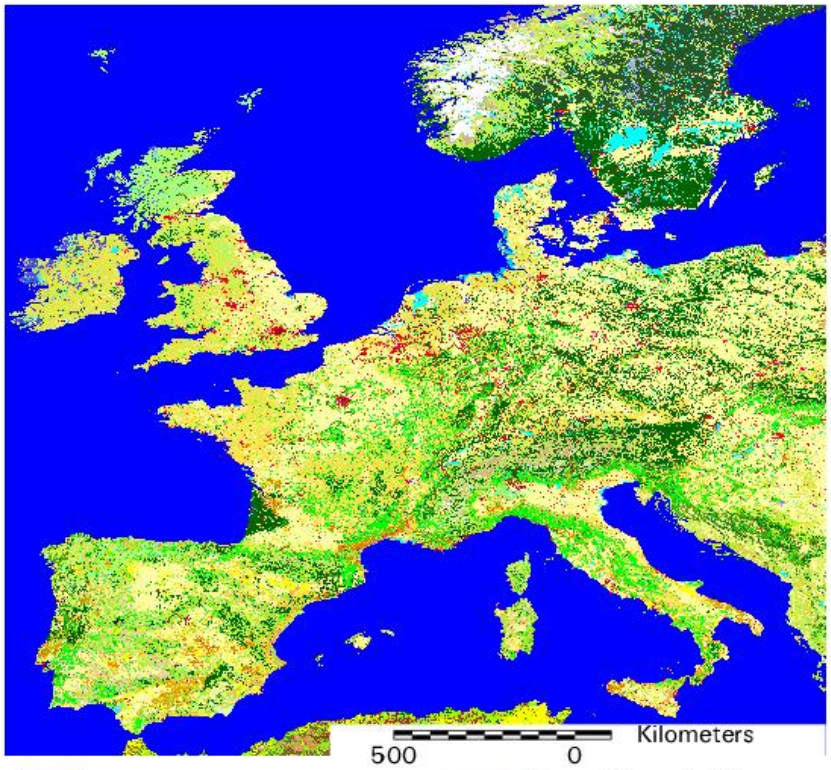
1. PREP_PGD

AROME-France Operational domain (588x500)

Orography from GTOPO30 :



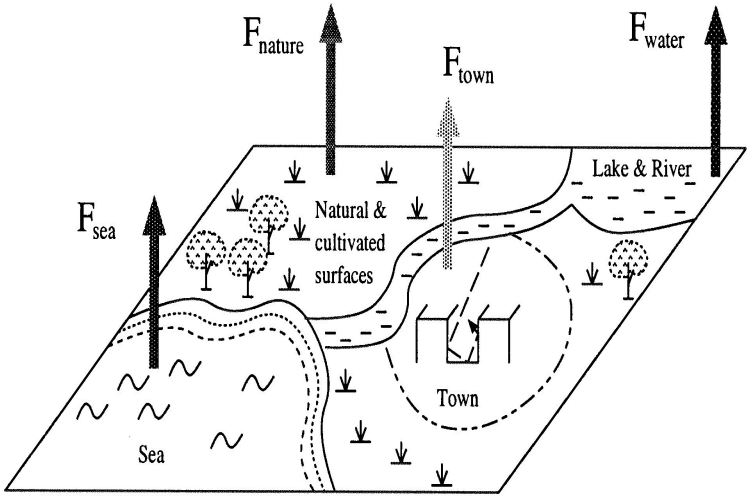
ECOCLIMAP (242 kinds of vegetation)



METEO FRANCE
Toujours un temps d'avance

1. PREP_PGD

- 4 tiles : Sea, Water, Towns and Nature. 2 levels inside the soil for T, 3 for hydrology.



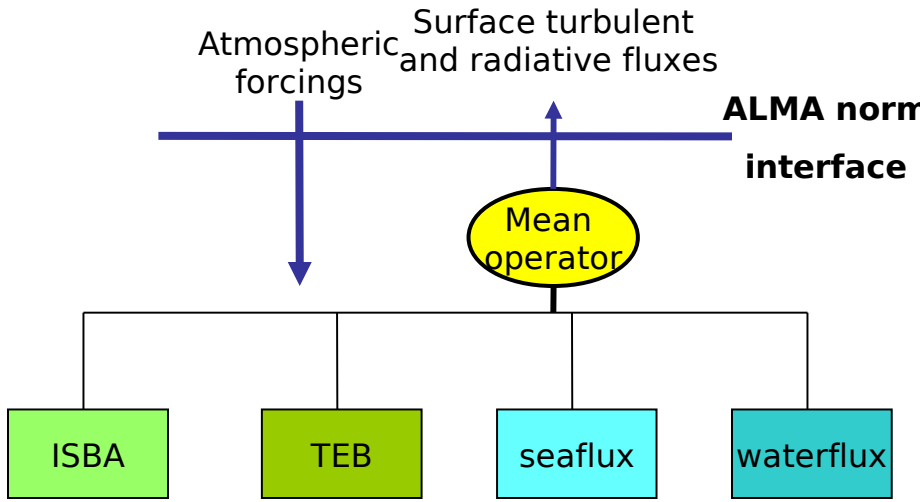
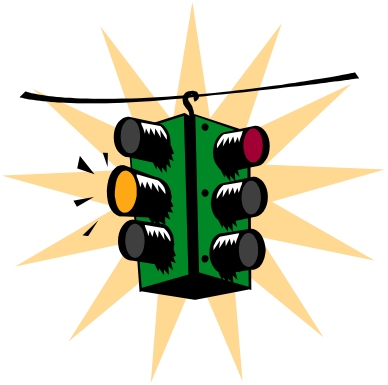
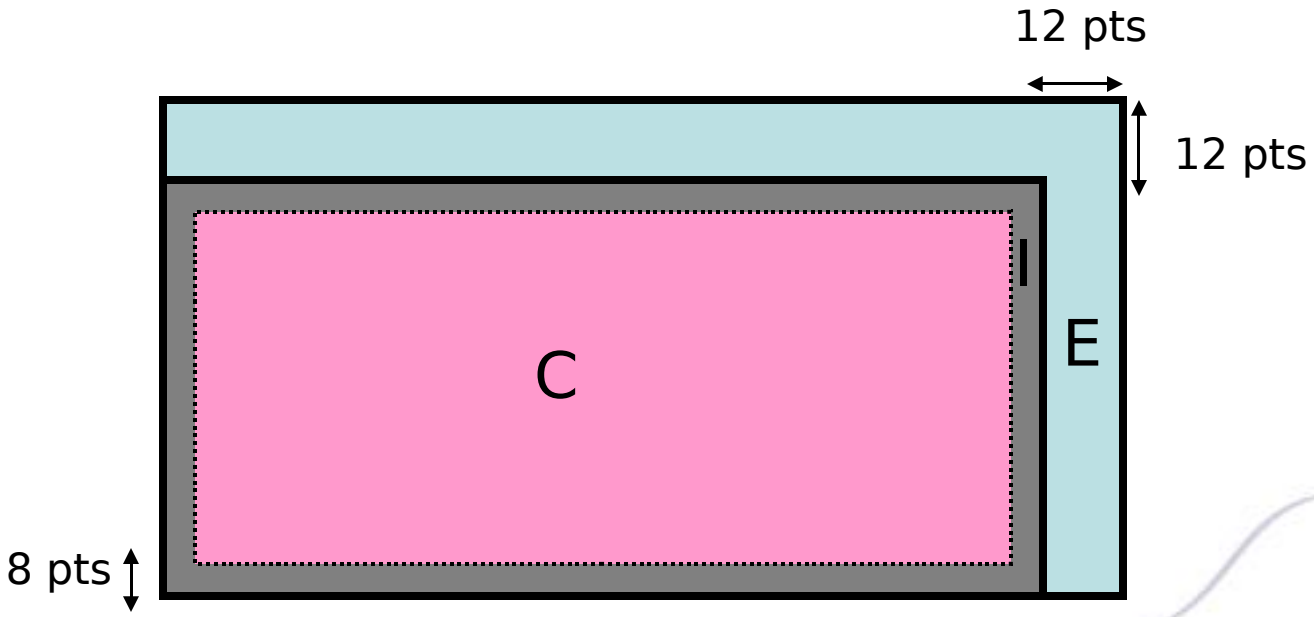


Figure 15.1: Partitioning of the MESO-NH grid box, and corresponding turbulent fluxes. F stands either for M (momentum flux), H (sensible heat flux), LE (latent heat flux), $S^{\uparrow}$ (the reflected solar radiation) or $L^{\uparrow}$ (the upward longwave radiation).

Limited area spectral model constraint



- Extension area (for biperiodicisation of fields before FFTs) present in atmospheric model, but not in surface.
- -> E zone surface fields needed by atmospheric model are initialized in AROME interface routines (Ts, albedo, emis for ex.).



Prep_PGD

PRE_PGD1.nam :

Domain dependant part :

```
&NAM_CONF_PROJ
     XLAT0=46.4, XLON0=2.20, XRPK=0.724189, XBETA=0.00 /
&NAM_CONF_PROJ_GRID
      XLATCEN=46.4,  XLONCEN=2.2,
     NIMAX=588, NJMAX=500,
     XDX=2500., XDY=2500. /
```

Prep_PGD

Domain independant part :

&NAM_PGDFILE CPGDFILE='PGD_FILE_NAME' /

where PGD_FILE_NAME.lfi will be the name of the created PGD file

&NAM_PGD_GRID CGRID='CONF PROJ' / (type of projection)

&NAM_PGD_SCHEMES

CNATURE='ISBA ', CSEA='SEAFLX', CWATER='WATFLX', CTOWN='TEB ' /

This namelist correspond to the activation of ISBA for the nature tiles, seaflux for the sea tiles, watflux for the lake tiles and teb for the town tiles.

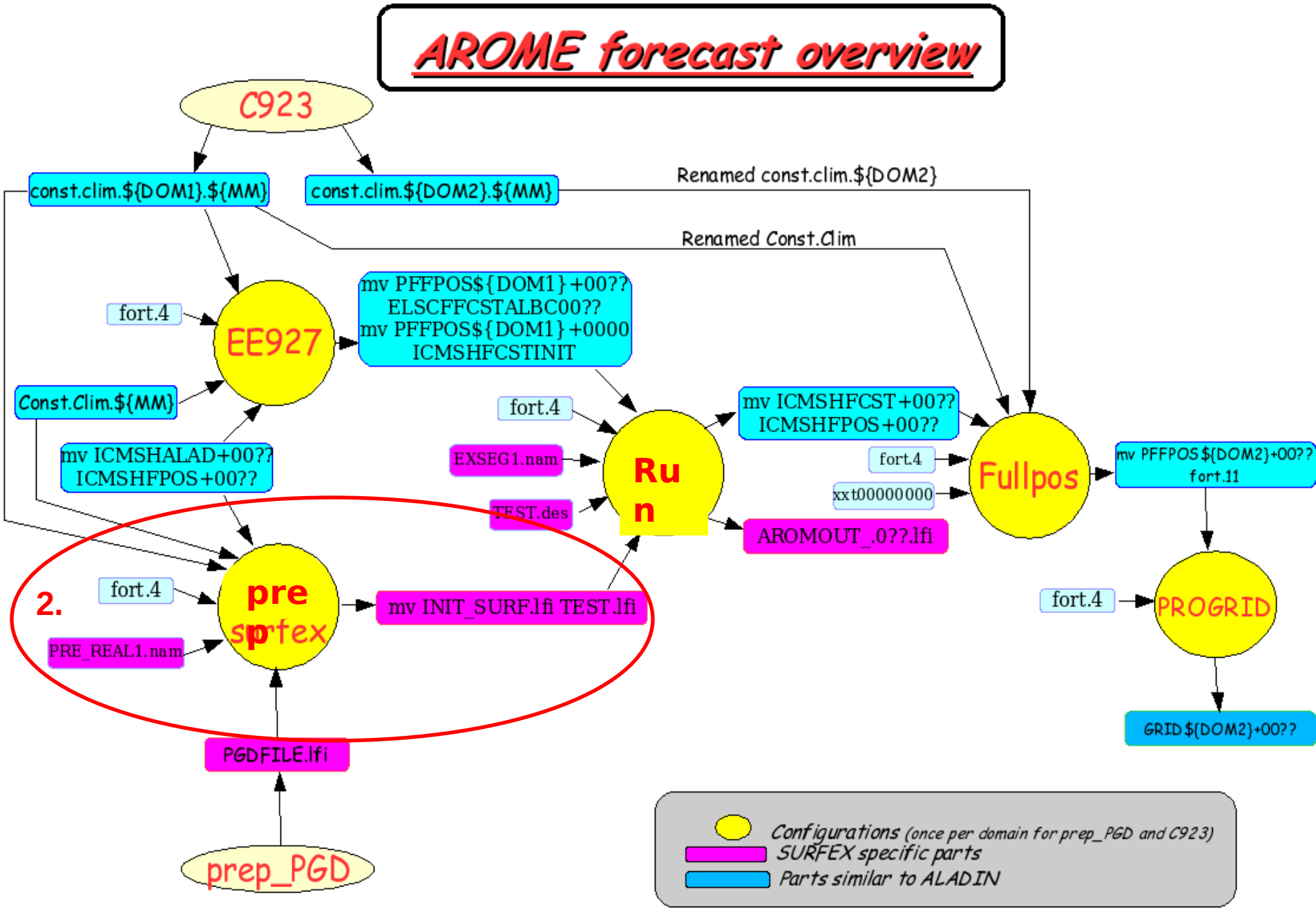
&NAM_COVER YCOVER='ecoclimats_v2', YFILETYPE='DIRECT' /

&NAM_ZS YZS='gtopo30', YFILETYPE='DIRECT' /

&NAM_ISBA YCLAY='clay_fao', YCLAYFILETYPE='DIRECT' ,

YSAND='sand_fao', YSANDFILETYPE='DIRECT' /

With such a namelist, you will use the physiographic data of ecoclimap, the orography from gtopo30 and the clay and sand data distributed by the fao.


AROME forecast overview
C923
const.clim.${DOM1}.${MM}
const.clim.${DOM2}.${MM}
Renamed const.clim.${DOM2}
Renamed Const.Clim
fort.4
EE927
Const.Clim.${MM}
mv ICMSHALAD+00??
ICMSHFPOS+00??
mv PFFPOS${DOM1}+00??
ELSCFFCSTALBC00??
mv PFFPOS${DOM1}+0000
ICMSHFCSTINIT
fort.4
EXSEG1.nam
TEST.des
Run
mv ICMSHFCST+00??
ICMSHFPOS+00??
AROMOUT_.0??.lfi
fort.4
xxt00000000
Fullpos
mv PFFPOS${DOM2}+00??
fort.11
fort.4
PROGRID
GRID${DOM2}+00??
2.
fort.4
PRE_REAL1.nam
pre
surfex
mv INIT_SURF.lfi TEST.lfi
PGDFILE.lfi
prep_PGD
Configurations (once per domain for prep_PGD and C923)
SURFEX specific parts
Parts similar to ALADIN

2 . Prepsurfex : preparation of initial file

The SURFEX PREP procedure has been adapted for AROME (prep_surf_aro).

Inside the atmospheric model, a buffer is filled with fields comming from coupling model (ALADIN or ARPEGE) surface analysis or AROME clim file :

SURFGEOPOTENTIEL (PHIS), SEASURFTEMPERATURE (SST), SURFTEMPERATURE(TG1), SURFRESERV.NEIGE(SNOW), SURFRESERV.EAU(WG1), SURFRESERV.GLACE(WGI1), PROFTEMPERATURE(TG2),SURFPROP.ARGILE(CLAY), SURFPROP.SABLE(SAND), SURFEPAIS.SOL(D2), PROFRESERV.EAU(WG2), PROFRESERV.GLACE(WGI2)

An interface routine has been built to read the buffer and give the requested fields to surfex (via prep_surf_atm, the driver for surface fields preparation)

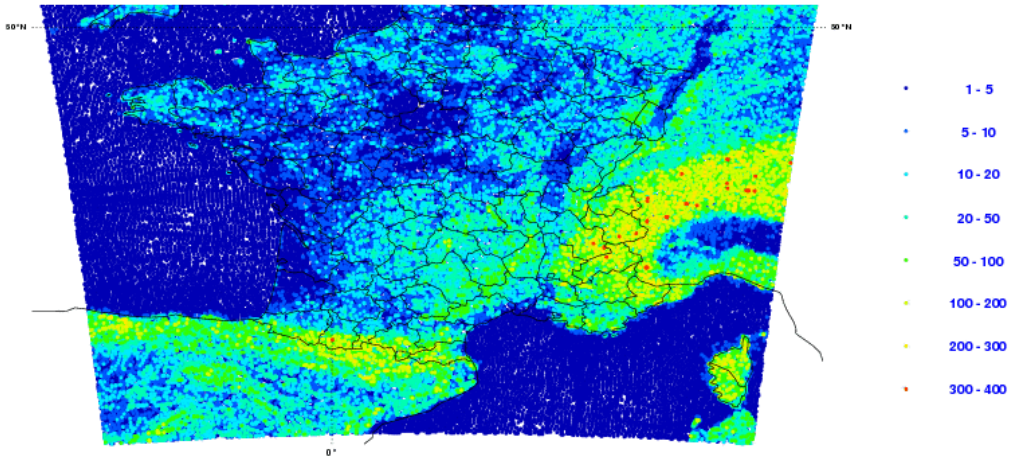
HPROGRAM='AROME' in the AROME specific interface routines for writing in lfi format

Atmospheric namelist:

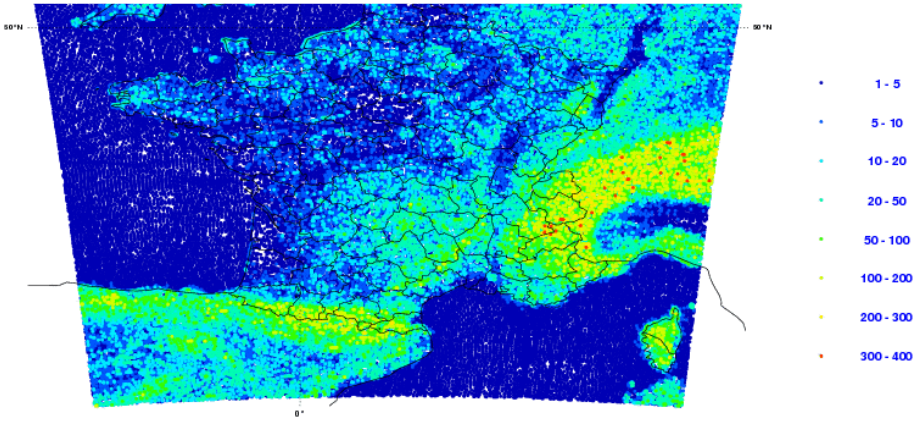
```
&NAMFPC
  NFPSURFEX=1,
/
...
```

2 . Prepsurfex : About orography

Model orography < PGD orography :



Model orography > PGD orography :

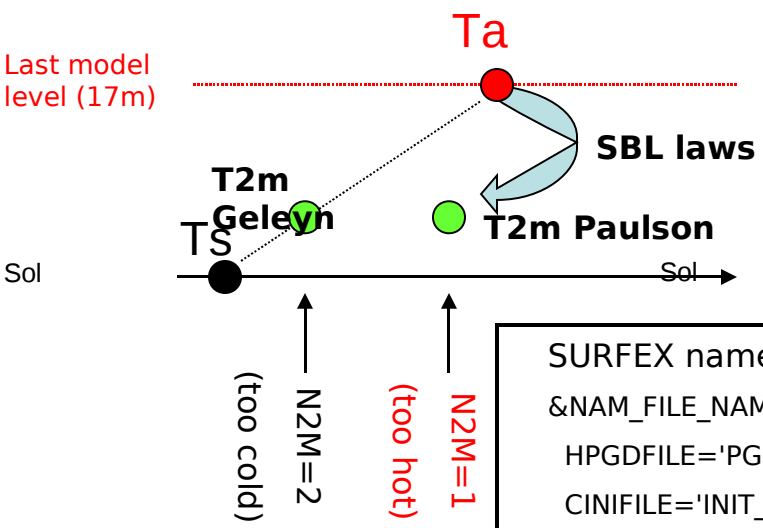


Option to force Surfex Orography with the one of atmospheric model (LPUTZS=.T. in atmospheric namelist NAMFPC (default))

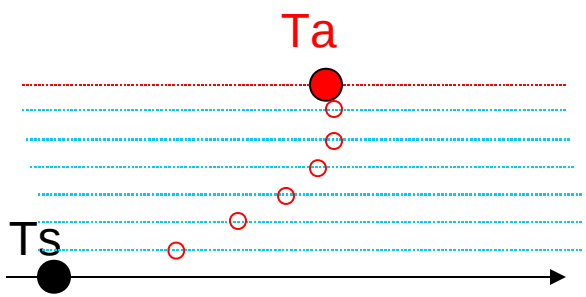
Neutral scores

2 . Prepsurfex : CANOPY scheme

Before :



Now : SBL CANOPY scheme

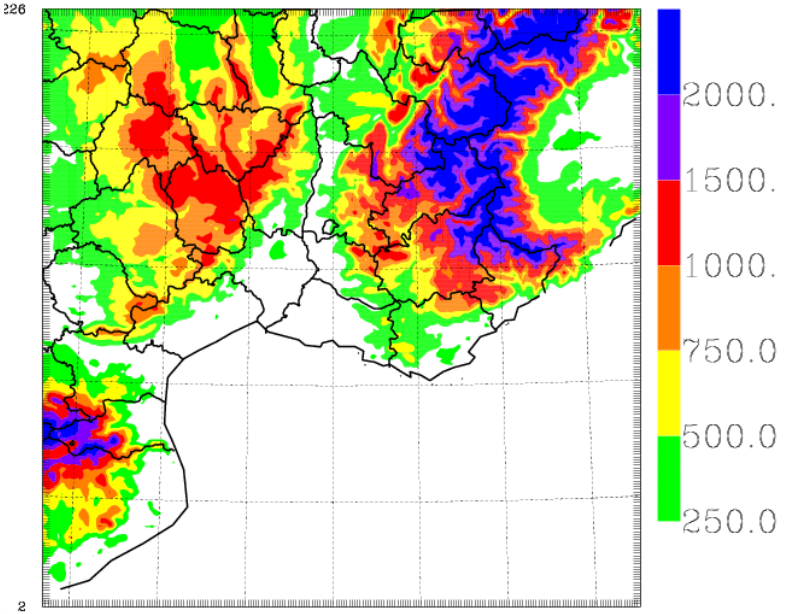


6 added levels and turb scheme in surfex

SURFEX namelist PRE_REAL1.nam

```
&NAM_FILE_NAMES
  HPGDFILE='PGDFILE',
  CINIFILE='INIT_SURF',
/
&NAM_PREP_ISBA
  LISBA_CANOPY=.TRUE.,
/
&NAM_PREP_SEAFLUX
  LSEA_SBL=.TRUE.,
/
&NAM_PREP_WATFLUX
  LWAT_SBL=.FALSE.,
/
```

Evaluation on July and January 2007 on South East France domai



Impact of Canopy scheme

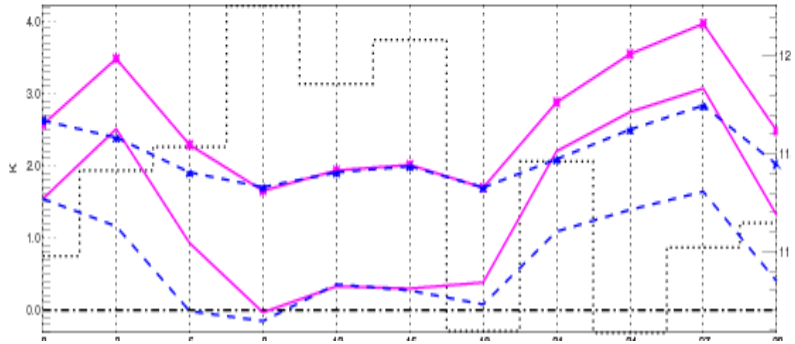
July 2007

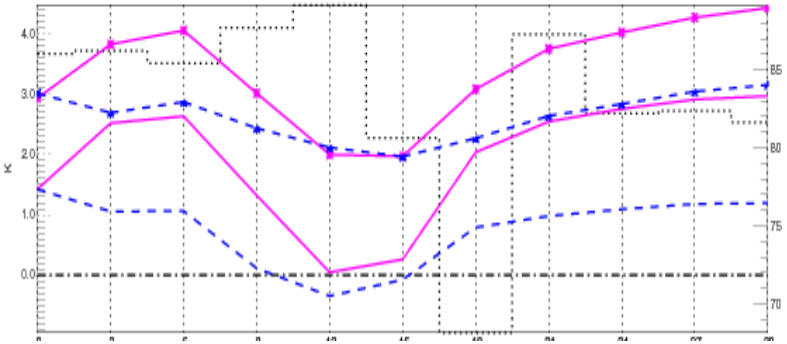
January 2007

Canopy (blue)

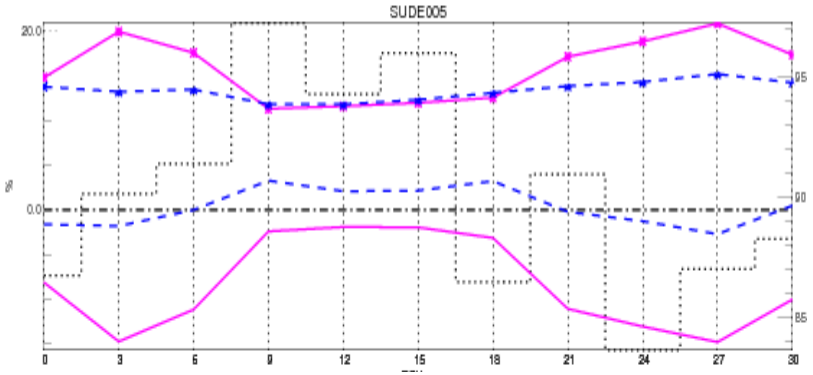
Ref (pink)

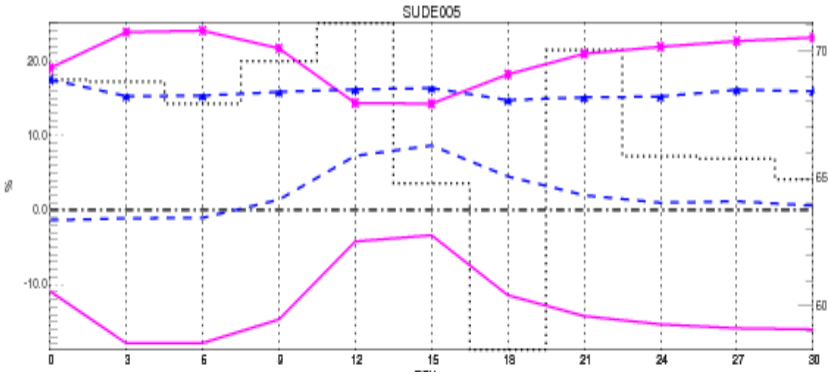
T2m



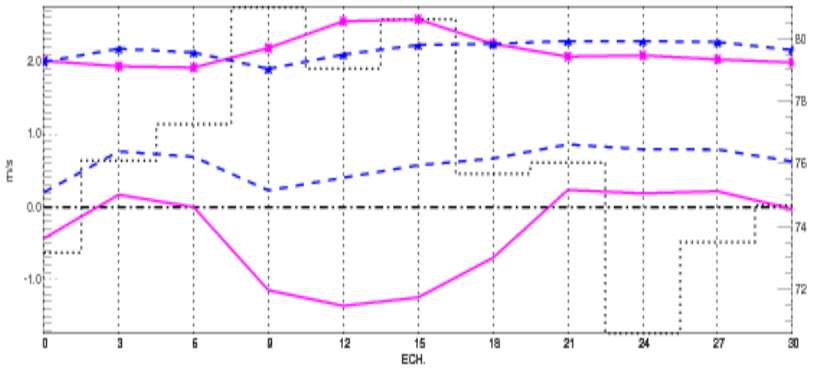


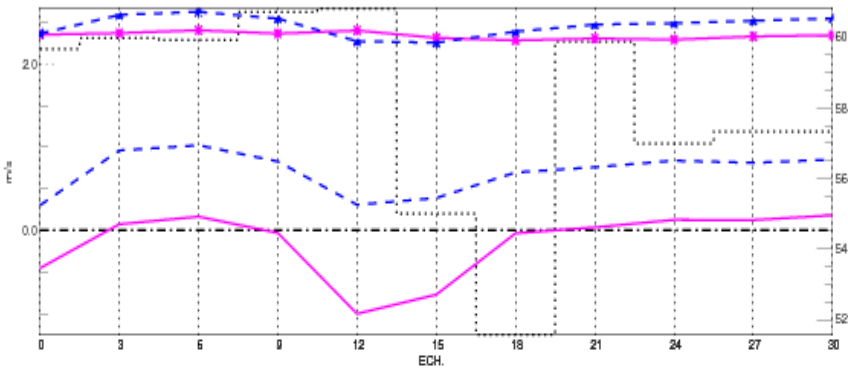
Hu2m

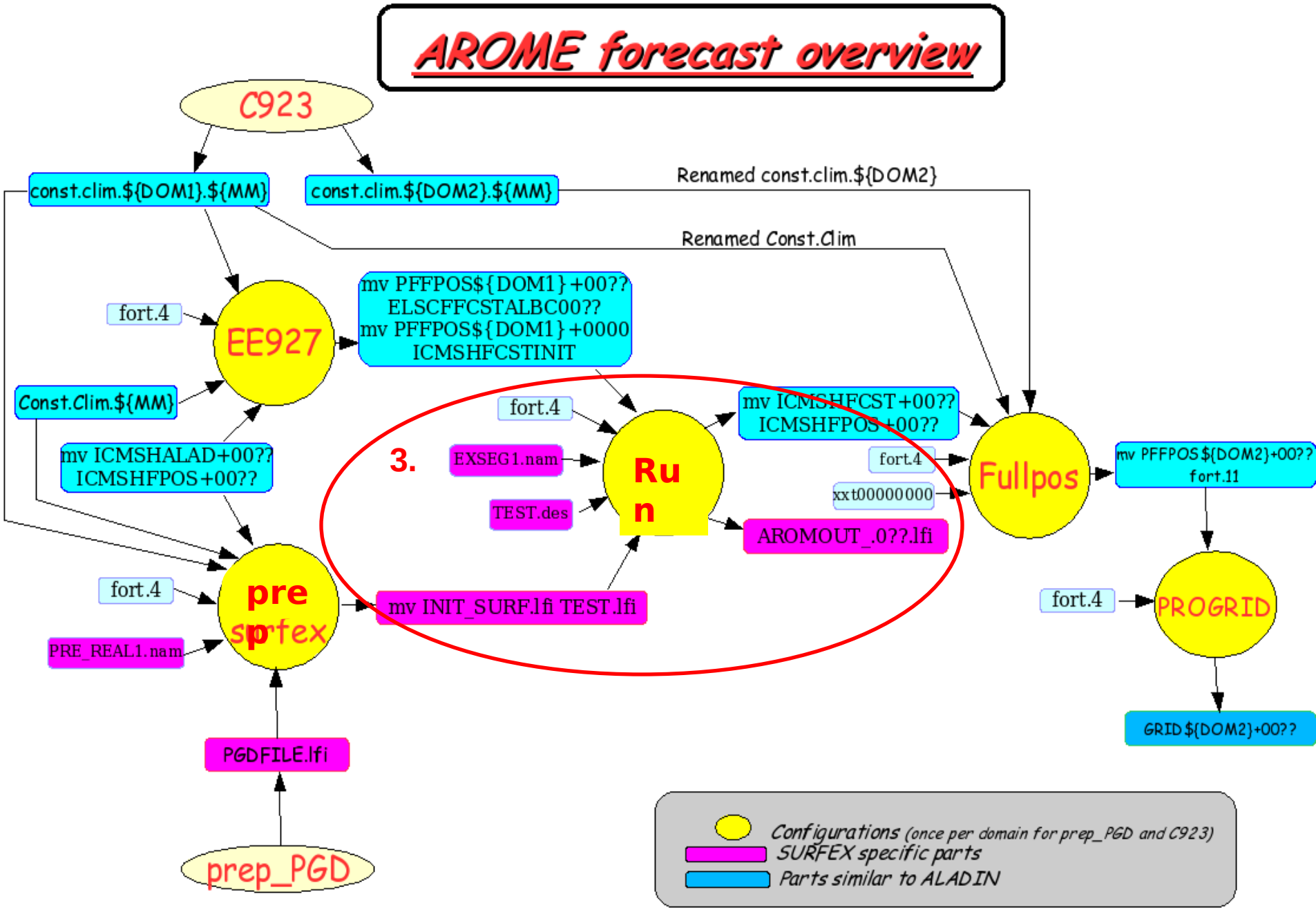




FF V10m





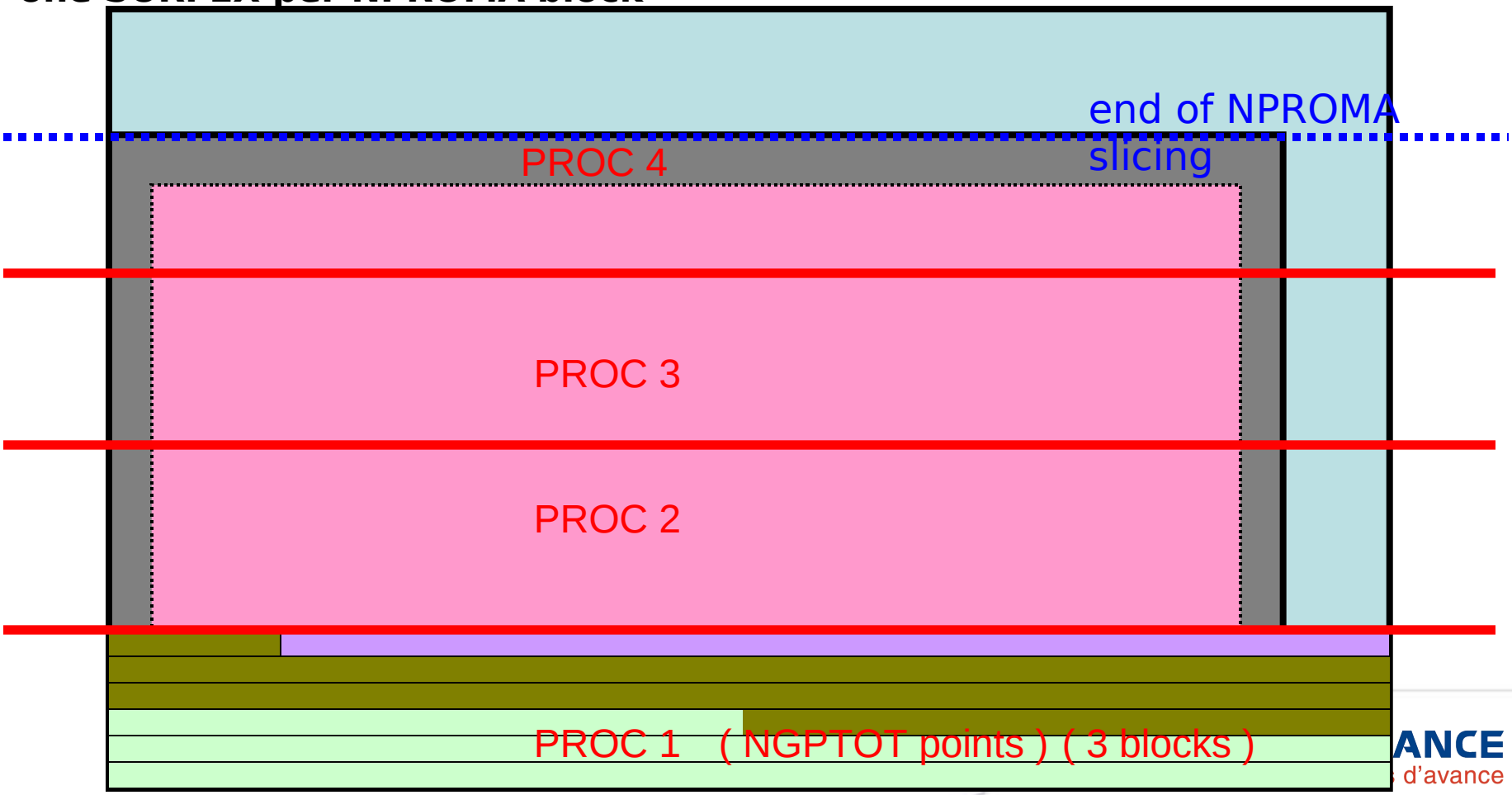

AROME forecast overview
C923
const.clim.${DOM1}.${MM}
const.clim.${DOM2}.${MM}
Renamed const.clim.${DOM2}
Renamed Const.Clim
fort.4
EE927
mv PFFPOS${DOM1}+00??
ELSCFFCSTALBC00??
mv PFFPOS${DOM1}+0000
ICMSHFCSTINIT
Const.Clim.${MM}
mv ICMSHALAD+00??
ICMSHFPOS+00??
3.
fort.4
EXSEG1.nam
TEST.des
Run
mv ICMSHFCST+00??
ICMSHFPOS+00??
AROMOUT_.0??.lfi
fort.4
xxt00000000
Fullpos
mv PFFPOS${DOM2}+00??
fort.11
fort.4
pre
surfex
mv INIT_SURF.lfi TEST.lfi
PRE_REAL1.nam
PGDFILE.lfi
prep_PGD
fort.4
PROGRID
GRID${DOM2}+00??
Configurations (once per domain for prep_PGD and C923)
SURFEX specific parts
Parts similar to ALADIN

3. Run

NPROMA Constraint : Secondary level of slicing not anticipated in SURFEX

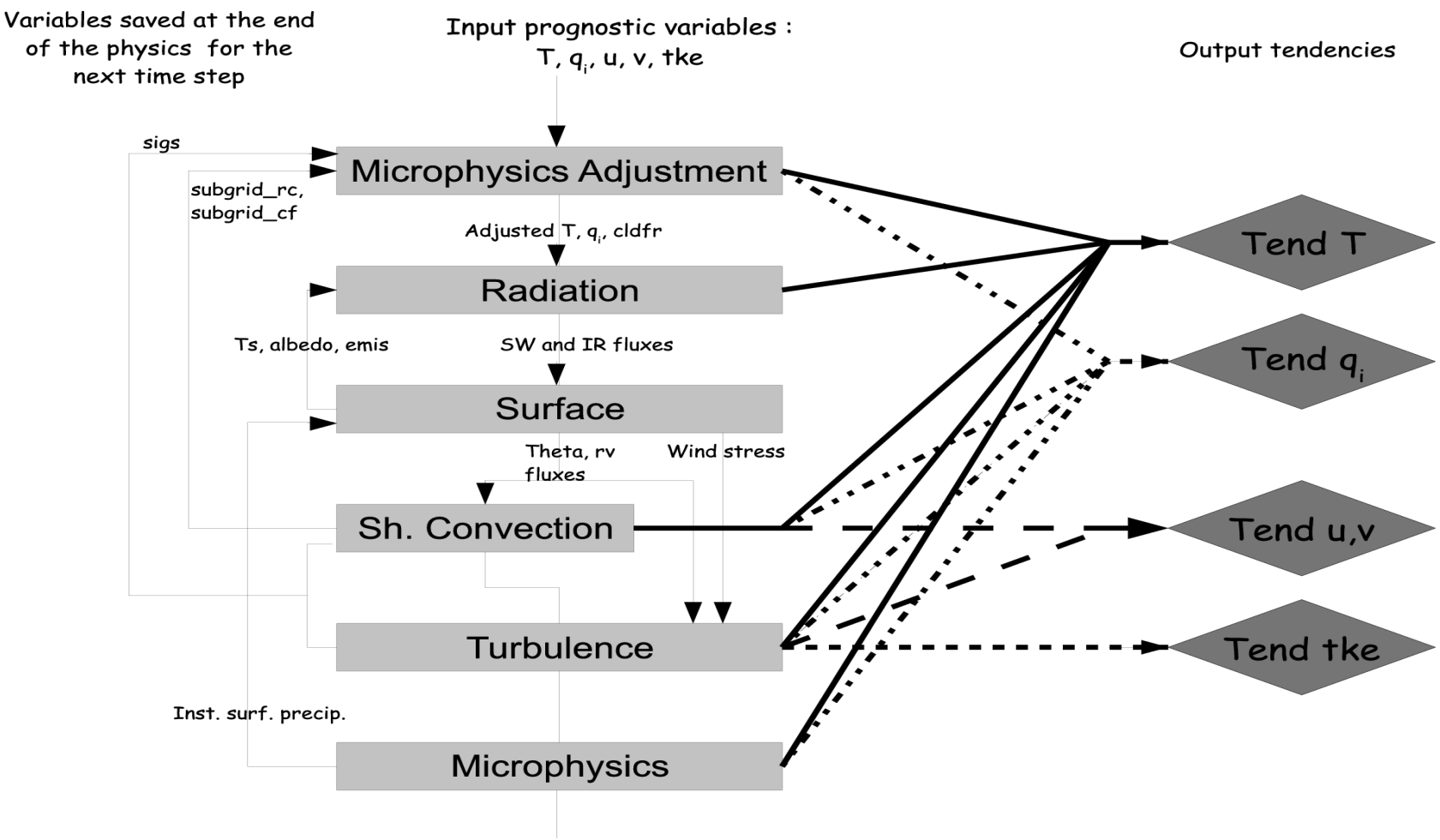
Example in AROME or ALADIN with 4 processors :

-> Modification in AROME reading/writing procedures to initialize and use one SURFEX per NPROMA block



3. Run : zoom on AROME physics (NPROMA sliced)

Surface is between radiation and shallow convection :



3. Run : ECUME

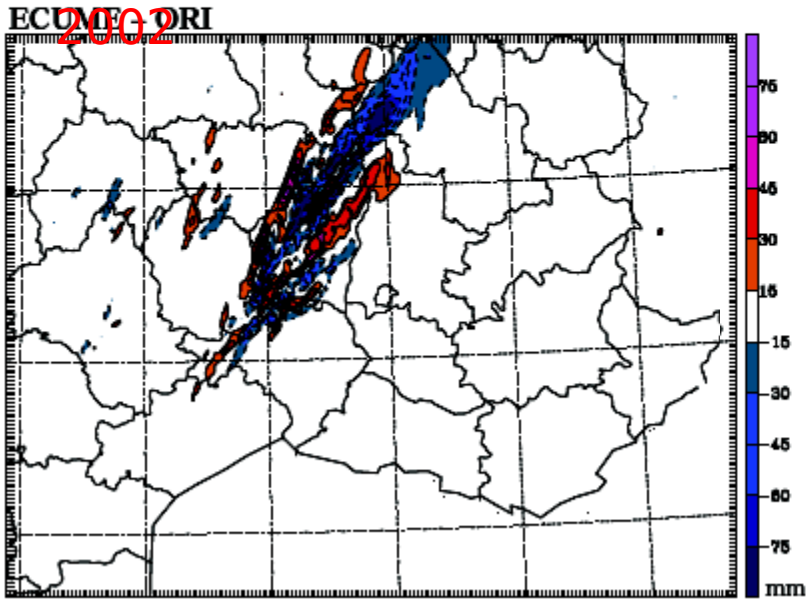
EXSEG1.nam :

&NAM_SEAFLUXn
CSEA_FLUX='ECUME'
LPWG=.TRUE.,
LPRECIP=.FALSE.,
LPWEBB=.FALSE.,
/

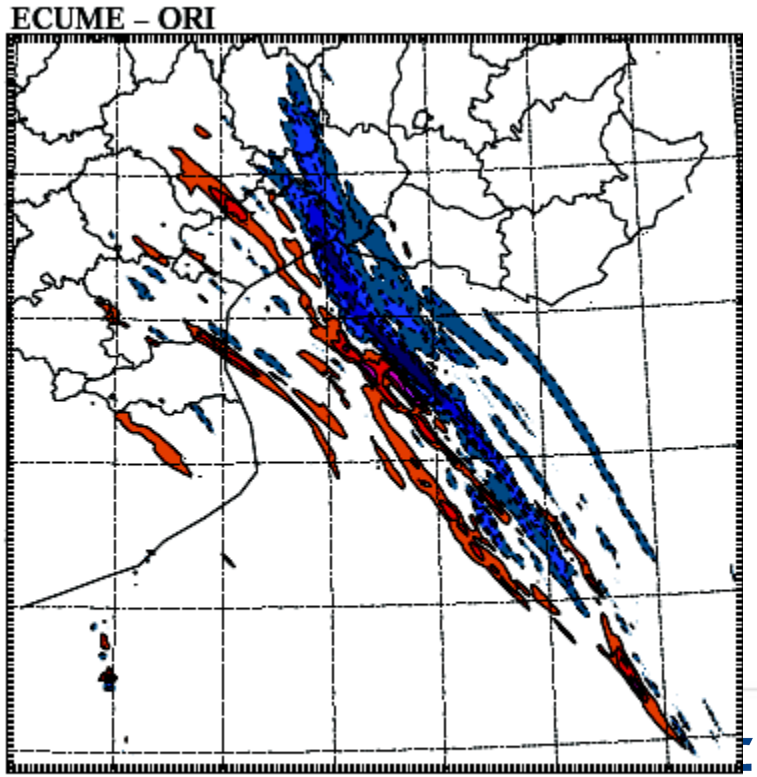
Validated in Meso-NH in ‘cevenol events’

Impact on cumulated rainfalls

Gard Case : 8-9 Sept 2002



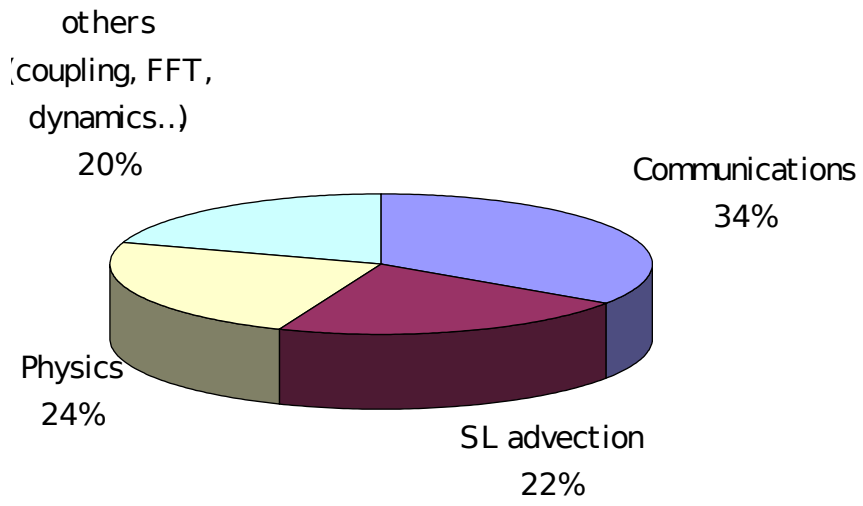
Herault Case : 3 Dec 2003



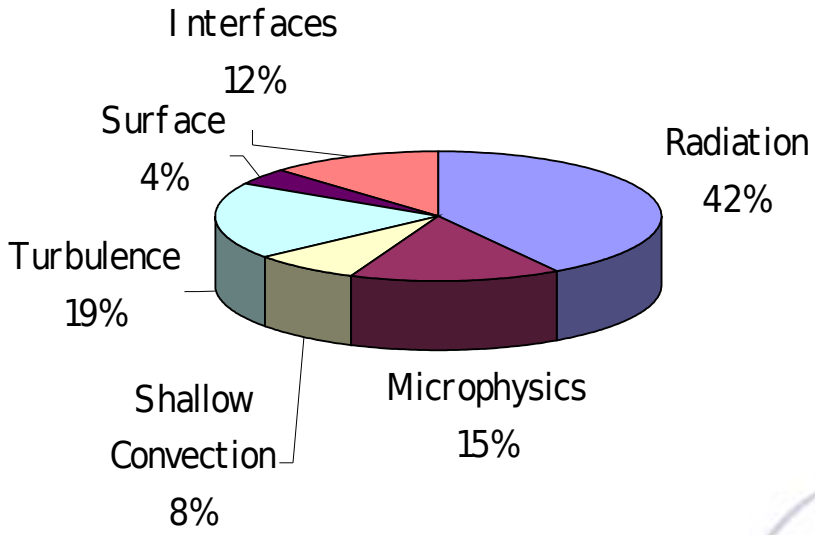
From C. Lebeaupin thesis

Numerical cost of Surfex

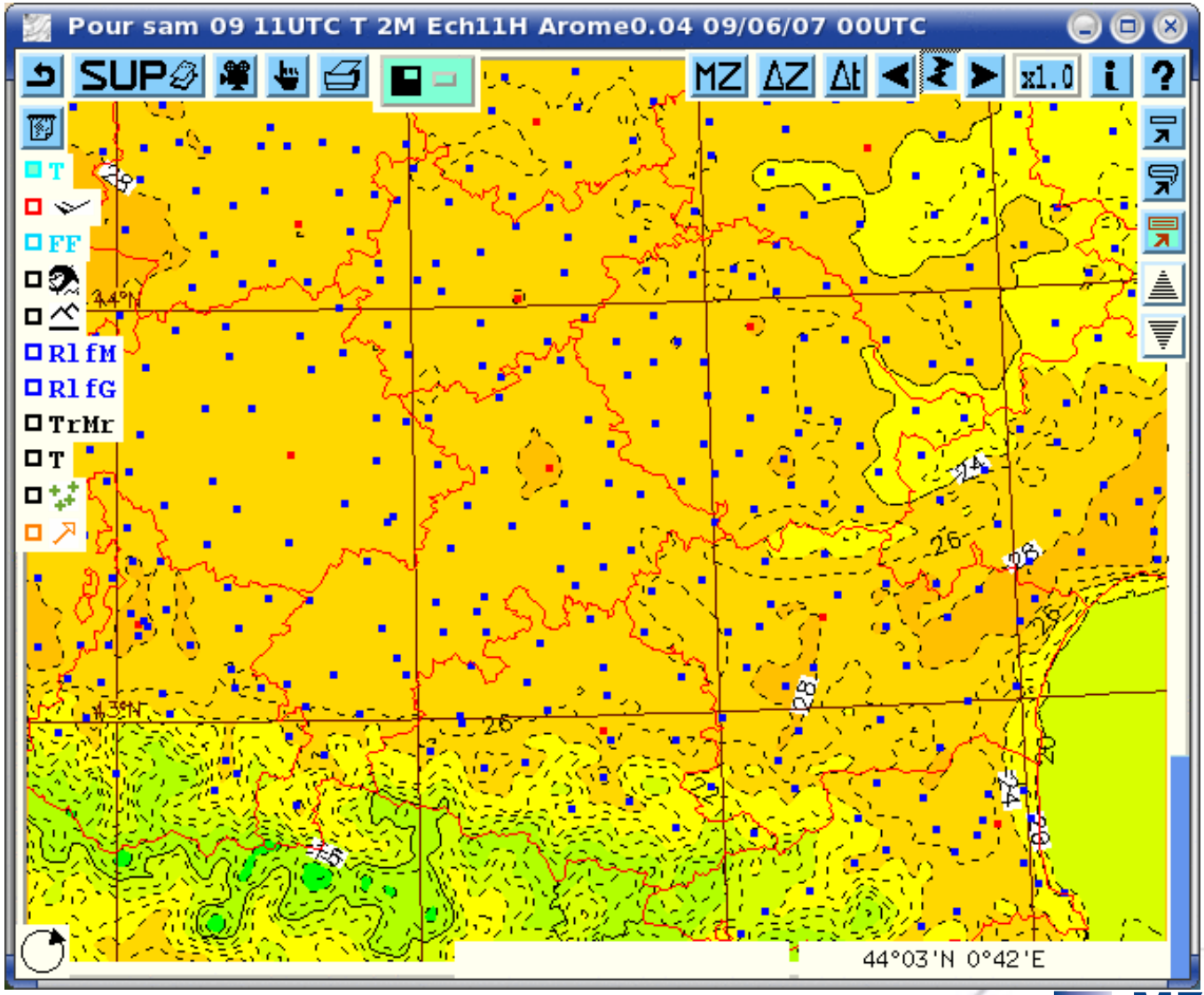
***AROME forecast* on 64 SX8 procs :**



AROME Physics :



Impact of TEB scheme in summer temperature



METEO FRANCE
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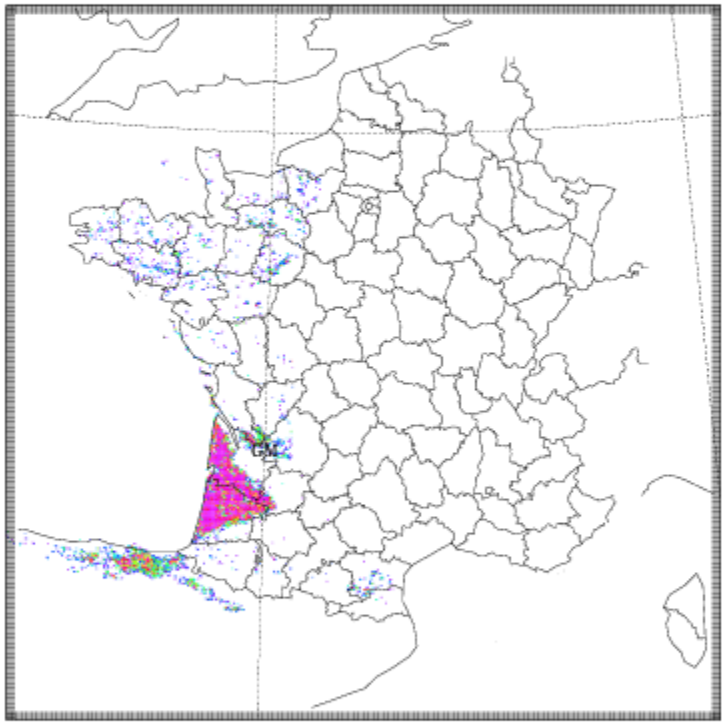
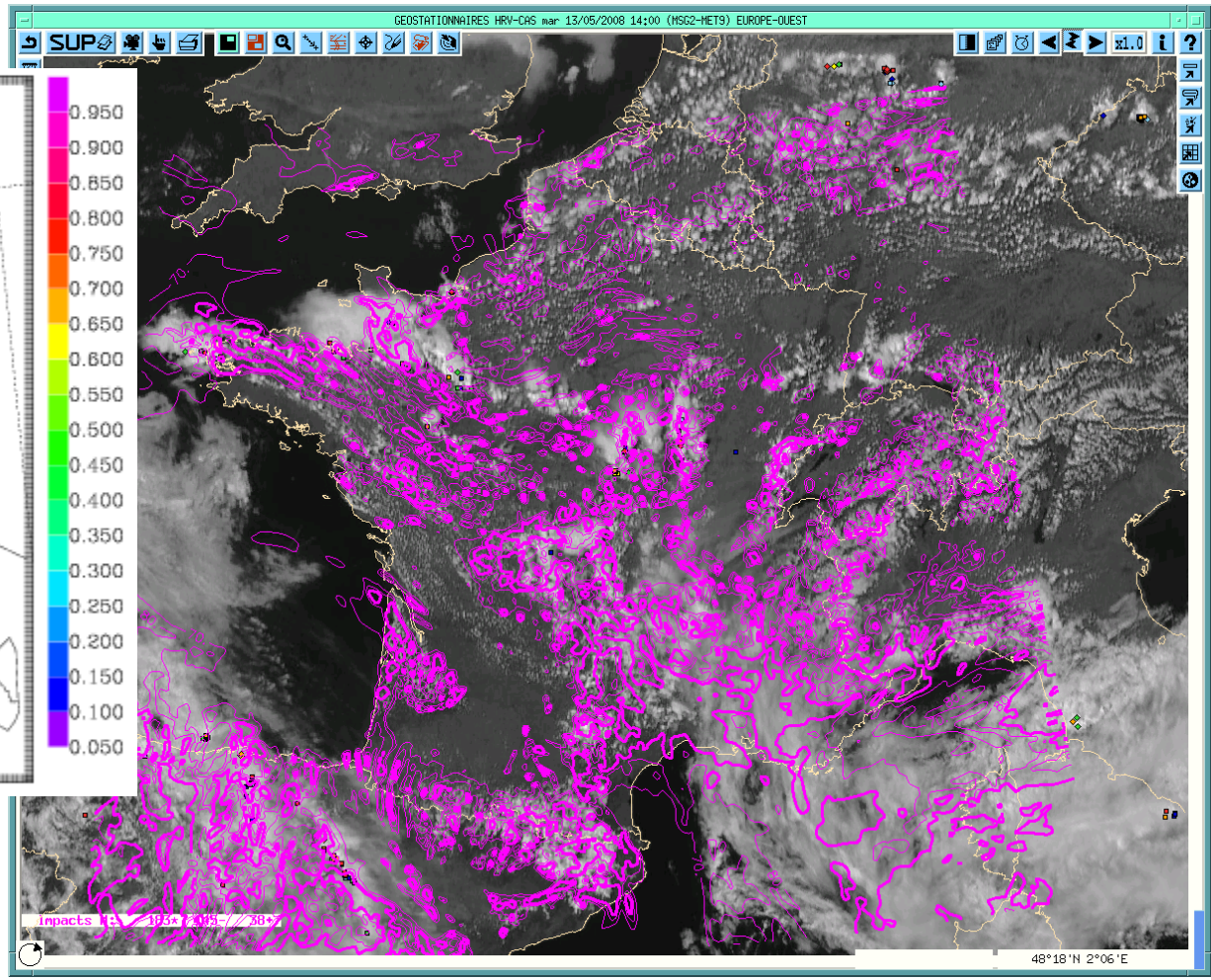
Impact of land cover





COVER 209 :
« forêt des Landes »

SURFEX use in AROME

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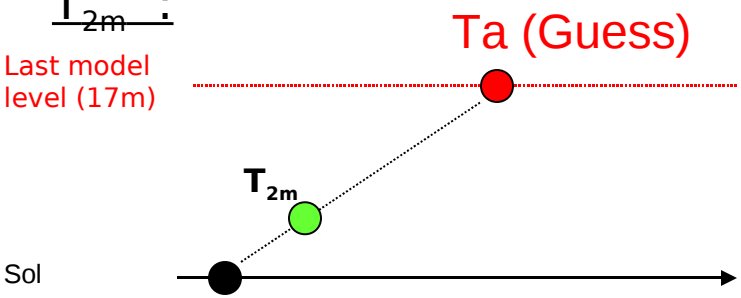
METEO FRANCE
Toujours un temps d'avance

Assimilation of T_{2m}, Hu_{2m} in AROME 3DVar

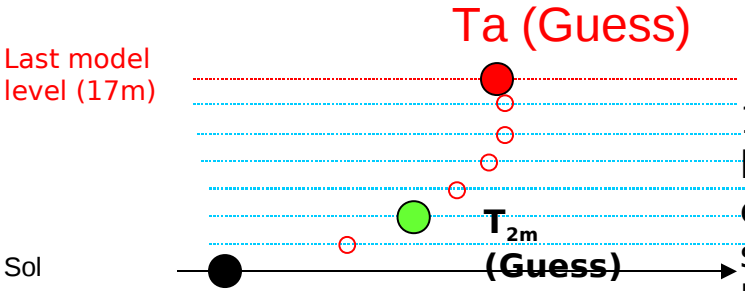
Before, observations were compared to re-computed T_{2m} :



Ts Canari (2D OI analysis based on T2m/HU2m obs)

- Strong differences in stable cases
- Allows assimilation in intermediate assimilation times (no more need of CANARI Ts)

Since november, 6th 2008 : observations are compared to CANOPY diagnostic from the guess



Ts (Guess)

1D lower boundary layer model embedded into surfex (6 vertical levels added + use a turbulence scheme)

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