SURFEX use in AROME

Yann Seity (Météo-France CNRM/GMAP)
Pieces of code written for AROME to be able to use SURFEX are interface routines
1. PREP_PGD

AROME-France Operational domain (588x500)

Orography from GTOPO30:

ECOCLIMAP (242 kinds of vegetation)
1. PREP_PGD

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

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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), $S^\dagger$ (the reflected solar radiation) or $L^\dagger$ (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.).
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. /
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.
The SURFEX PREP procedure has been adapted for AROME (prep_surf_aro).

Inside the atmospheric model, a buffer is filled with fields coming 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), SURFPAIS.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:

```
&NAMFPC
NFPSURFEX=1,
/
...
```
2. Prepsurfex: About orography

Model orography < PGD

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

Model orography > PGD

- 1 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
2. Prepsurfex: CANOPY scheme

Before:

- Last model level (17m)
- T2m Paulson
- SBL laws
- Ta
- Ts
- Geleyn

Now: SBL CANOPY scheme

- 6 added levels and turb scheme in surfex

Evaluation on July and January 2007 on South East France domain:

Prepsurfex: CANOPY scheme
Impact of Canopy scheme

July 2007

January 2007

Canopy (blue)
Ref (pink)
T2m
Hu2m
FF V10m
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

PROC 1 (NGPTOT points) (3 blocks)
PROC 2
PROC 3
PROC 4

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

Surface is between radiation and shallow convection:

Variables saved at the end of the physics for the next time step

Microphysics Adjustment

Input prognostic variables:
T, q, u, v, tke

Adjusted T, q, cldfr

Tend T

Tend q_i

Tend u,v

Tend tke

Output tendencies

Radiation

Ts, albedo, emis

SW and IR fluxes

Surface

Theta, rv fluxes

Wind stress

Sh. Convection

Microphysics

Turbulence

Inst. surf. precip.
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

Herault Case : 3 Dec 2003

From C. Lebeaupin thesis
AROME forecast on 64 SX8 procs:

AROME Physics:

- Turbulence: 19%
- Shallow Convection: 8%
- Surface: 4%
- Microphysics: 15%
- Radiation: 42%
- Interf aces: 12%

Other (coupling, FFT, dynamics...): 20%

Communications: 34%

SL advection: 22%

Radiation: 42%

Microphysics: 15%

Shallow Convection: 8%

Surface: 4%

Interf aces: 12%
Impact of TEB scheme in summer temperature
Impact of land cover

COVER 209 : « forêt des Landes »
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Assimilation of $T_{2m}$, $Hu_{2m}$ in AROME 3DVar

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

- 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.