THE EXTERNALIZED SURFACE USER'S GUIDE

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Contents

Chapter 1

Overview of the externalized surface sequence

The externalized surface facilities do not contain only the program to run the physical surface schemes, but also those producing the initial surface fields (before the run) and the diagnostics (during or after the run). All these facilities are listed, below, and they separate in 4 main parts:

1.1 The sequence

1. **PGD** (routine pgd_surf_atm.f90): this program computes the physiographic data file (called PGD file below). At this step, you perform 3 main tasks:

    (a) You choose the surface schemes you will use.
    (b) You choose and define the grid for the surface
    (c) The physiographic fields are defined on this grid.

    Therefore, the PGD file contains the spatial characteristics of the surface and all the physiographic data necessary to run the interactive surface schemes for vegetation and town.

2. **PREP** (routine prep_surf_atm_n.f90): this program performs the initialization of the surface scheme prognostic variables, as temperatures profiles, water and ice soil contents, interception reservoirs, snow reservoirs.

3. **run of the schemes** (routine coupling_surf_atm_n.f90): this performs the physical evolution of the surface schemes. It is necessary that this part, contrary to the 2 previous ones, is to be coupled within an atmospheric forcing (provided either in off-line mode or via a coupling with an atmospheric model).

4. **DIAG** (routine diag_surf_atm_n.f90): this computes diagnostics linked to the surface (e.g. surface energy balance terms, variables at 2m of height, etc...). It can be used either during

the run (adding these diagnostics in the output file(s) of the run), or independantly from the run, for a given surface state (still, an instantaneous atmospheric forcing is necessary for this evaluation).

In addition, in order to read or write the prognostic variables or the diagnostics variables, respectively, in the surface files, the following subroutines are used: init_surf_atm_n.f90, write_surf_atm_n.f90 and write_diag_surf_atm_n.f90.

1.2 The atmospheric models using the externalized surface

The externalized surface can presently be used in:

1. in offline mode

2. MESONH

3. AROME

For each model, additionnal possibilities of the surface, especially the ability to read and write in files with particular formats, are added:

1.2.1 in offline mode

In this case, 2 types of files can be used:

- *ASCII files*, not efficient in term of storage, but completely portable.

- *netcdf files*, that can be used by the program code "OFFLIN".

currently, **PGD** and **PREP** steps are done using ASCII files, while the run produces time series of each variable (prognostic or diagnostic) in netcdf files and the output instant of the run again in an ASCII file.

The nameists are all included in the namelist file named OPTIONS.nam

1.2.2 in MESONH

In this case, MESONH FM files are used. The parallelization of the surface fields is done during the reading or writing of the fields by the FMREAD and FMWRIT routines.

Initialization of surface fields integrated in MESONH programs

In MESONH, there are usually 2 ways to produce initial files, depending if you want to use real or ideal atmospheric conditions. However, from the surface point of view, there is no difference between these 2 main possibilities of fields (real -e.g. from operationnal surface scheme in an operationnal model- or ideal -e.g. uniform-), whatever the treatment done for the atmospheric fields. This is allowed because the same externalized routines corresponding to **PGD** and **PREP** are used:

In the case of realistic atmospheric fields, the MESONH programs calling the surface are:

1. PREP_PGD : it uses the **PGD** facility of the surface

2. PREP_NEST_PGD : surface fields are only read and rewritten, except the orography that is modified (the modification of the orography itself is considered as an atmospheric model routine, as orography is also a field of the atmospheric model).

3. PREP_REAL_CASE : it uses the **PREP** facility of the surface, that can produce either ideal or realistic surface fields.

4. SPAWNING : it does not produce surface fields any more. The surface fields will be recreated during the PREP_REAL_CASE step following the SPAWNING.

In the case of ideal atmospheric fields, the MESONH program calling the surface is:

1. PREP_IDEAL_CASE : it uses both the **PGD** and **PREP** facilities of the surface. Ideal or realistic (the latter only in conformal projection) physiographic fields can be either produced or read from a file. Then the prognostic surface variables, either ideal or realistic, can be computed by **PREP**.

If you use MESONH atmospheric model, the input and output surface files are the same as the atmospheric ones, so there is no need to specify via surface namelists any information about the input or output file names.

Namelist NAM_PGDFILE

Note however that, in PREP_PGD (just before the call to the surface physiographic computation in **PGD**, for which the namelists are described in the next chapter), there is a namelist to define the output physiographic file:

Fortran name	Fortran type
CPGDFILE	string of 28 characters

MESONH run and diagnostics

Then, the MESONH run can be done. During this one, the diagnostics can be, or not, be computed.

In DIAG, the surface diagnostics can also be recomputed.

1.2.3   in AROME

In this case, MESONH FM files are also used, for the surface only. The parallelization of the surface fields is done during the reading or writing of the fields by parallelization routines of ALADIN atmospheric model.

Chapter 2

The physiographic fields

2.1 Overview of physiographic fields computation: PGD

The physiographic fields are averaged or interpolated on the specified grid by the program **PGD**. They are stored in a file, called PGD file, but only with the physiographic 2D fields, the geographic and grid data written in it.

During the **PGD** facility :

1. You choose the surface schemes you will use.

2. You choose and define the grid for the surface.

3. The physiographic fields are defined on this grid.

2.1.1 Choice of the grid

There are 3 possibilities. 2 are always possible, one is available only if the **PGD** routine is integrated into an atmospheric model initialization facility.

1. The grid is chosen via namelists options (see below)

2. The grid is defined as a part of the grid of an already existing surface file, indicated via namelists (see below)

3. The grid is defined as being identical to the one of an atmospheric model, which is given as fortran argument in the coupling of the **PGD** surface facilities (routine PGD_SURF_ATM) into an atmospheric model initialization procedures. In this case, **all namelists that are usually used to define the surface grid are ignored**. Note that, in addition to the grid, the orography can also be given from the atmospheric file.

2.1.2 Choice of the physiographic fields

There are 2 main possibilities:

ideal physiographic fields:

These fields are either uniform (fraction of each 215 ecoclimap ecosystem, orography, or any field needed by the surface schemes). As mentionned above, orography can be, in the case of the coupling with an atmospheric model, imposed as the atmospheric model (non-uniform) field.

realistic physiographic fields:

PGD can use files to build accurate physiographic fields from geographical information. This is possible only if the grid chosen can be linked to geographical coordinates (latitude and longitude), i.e. if the grid type is "LATLONREG " or "CONF PROJ ".

The files that can be used are :

- A file describing the type of cover of the surface. This describes where are located the different cover types (forests, towns, seas, etc...). At the time being, the file provided contains the ecoclimap data (215 land covers) on the world, with a resolution of 30". **PGD** computes the fraction of surface coverage occupied by each type in the grid mesh. From this information, the surface parameter convenient for the surface schemes (such as building fraction, leaf area index, etc..) are deduced, using correspondance arrays: **a parameter has always the same value for a given cover type, anywhere in the world**.

- A file containing the orography: GTOPO30. The resolution of the file is 30" on the world. This allows to compute the model orography, and the following subgrid-scale orographic characteristics:

  - the surface of frontal obstacle (A) over the surface of the grid mesh (S) in each direction ($\sum A_{i+}/S$, $\sum A_{i-}/S$, $\sum A_{j+}/S$, $\sum A_{j-}/S$, used to compute the directional z_{0eff}),

  - the half height of these obstacles ($h_i^+/2$, $h_i^-/2$, $h_j^+/2$, $h_j^-/2$, used to compute the directional z_{0eff}),

  - These 8 parameters are used to compute the total roughness length in the four directions given by the model axis ($z_{0eff_{i+}}$, $z_{0eff_{i-}}$, $z_{0eff_{j+}}$, $z_{0eff_{j-}}$),

– the Subgrid-Scale Orography (SSO) parameters (standard deviation μ_{z_s}, anisotropy γ_{z_s}, direction of the small main axis θ_{z_s} and slope σ_{z_s}).

- For ISBA scheme, a file with the clay fraction of the (near-surface) soil. The resolution of the file provided is 5' on the world.

- For ISBA scheme, a file with the sand fraction of the (near-surface) soil. The resolution of the file provided is 5' on the world.

2.2   Choice of the surface schemes

You must first choose the surface schemes you will use. It is not possible, once chosen, to modify the surface schemes in the later steps (**PREP**, **running of the schemes**, **DIAG**).

Depending on the schemes you use, some additional physiographic fields will be computed if they are needed for the surface scheme chosen. For example, the ISBA scheme (used for vegetation and soil) needs the fractions of clay and sand.

Namelist NAM_PGD_SCHEMES

This namelist defines the four schemes that will be used, one for each type of surface (sea, inland water, town, vegetation).

Fortran name	Fortran type	values	default value
CNATURE	string of 6 characters	"NONE ", "FLUX ", "TSZ0 ", "ISBA "	"ISBA "
CSEA	string of 6 characters	"NONE ", "FLUX ", "SEAFLX"	"SEAFLX"
CWATER	string of 6 characters	"NONE ", "FLUX ", "WATFLX"	"WATFLX"
CTOWN	string of 6 characters	"NONE ", "FLUX ", "TEB "	"TEB "

- CNATURE: scheme used for vegegation and natural soil covers . The different possibilities are:

  1. "NONE " : no scheme used. No fluxes will be cmputed at the surface.
  2. "FLUX " : ideal fluxes are prescribed. The have to be set in the fortran routine *init_ideal_flux.f90*.
  3. "TSZ0 " : In this cheme, the fluxes are computed according to the ISBA physics, but the surface characteristics (temperature, humidity, etc...) remain constant with time.
  4. "ISBA " : this is the full ISBA scheme (Noilhan and Planton 1989), with all options developped since this initial paper.

- CSEA : scheme used for sea and ocean . The different possibilities are:

  1. "NONE " : no scheme used. No fluxes will be cmputed at the surface.

  2. "FLUX " : ideal fluxes are prescribed. The have to be set in the fortran routine *init_ideal_flux.f90.*

  3. "SEAFLX" : this is a relatively simple scheme, using the Charnock formula.

- CWATER : scheme used for inland water . The different possibilities are:

  1. "NONE " : no scheme used. No fluxes will be cmputed at the surface.

  2. "FLUX " : ideal fluxes are prescribed. The have to be set in the fortran routine *init_ideal_flux.f90.*

  3. "WATFLX" : this is a relatively simple scheme, using the Charnock formula.

- CTOWN : scheme used for towns . The different possibilities are:

  1. "NONE " : no scheme used. No fluxes will be cmputed at the surface.

  2. "FLUX " : ideal fluxes are prescribed. The have to be set in the fortran routine *init_ideal_flux.f90.*

  3. "TEB " : this is the Town Energy Balance scheme (Masson 2000), with all the susequent ameliorations of the scheme.

2.3   Definition of the grid

Note that all the namelists presented in this section are ignored if the grid is imposed, in the fortran code, from an atmospheric model. This is the case when one already have defined the atmospheric grid and one want to be sure that the surface has the same grid. For example, this is what happens in the MESONH program PREP_IDEAL_CASE (when no physiographic surface file is used).

   If you are in this case, ignore all the namelists presented in this section, and only the namelists for cover and the following ones, have to be used.

2.3.1   Choice of the grid type

__Namelist NAM_PGD_GRID__

This namelist defines the grid type, either specified or from an existing surface file

Fortran name	Fortran type	default value
CGRID	string of 10 characters	"CONF PROJ "
YINIFILE	string of 28 characters	none
YFILETYPE	string of 6 characters	none

- CGRID: type of grid and projection . It is used **only** if a file is not prescribed (see below). The different grid possibilities are:

   1. "CONF PROJ " : this grid is a regular grid (in meters in x and y perpendicular directions) on conformal projection plan (Mercator, Lambert or polar stereographic).

   2. "CARTESIAN " : this grid is a regular grid (in meters in x and y perpendicular directions), with no reference to real geographical coordinates.

   3. "LONLAT REG" : this grid is defined as a regular latitude - longitude grid.

   4. "NONE " : this grid is not regular. Only the number of points and the size of each grid mesh is prescribed. There is no positioning of each point compared to any other.

- YINIFILE: name of the file used to define the grid. It is possible to define the grid as a subgrid of a previously created file. This is currently possible only for files that have a "CONF PROJ " or "CARTESIAN " grid type. The exact definition of the subgrid grid chosen is prescribed in a namelist (described below), depending on the type of grid available in the file chosen. The use of a file has priority on the CGRID type.

- YFILETYPE: type of the YINIFILE file, if the latter is provided. YFILETYPE must be given. The following values are currently usable:

– "MESONH" : the file type is a MESONH file.

2.3.2 Conformal projection grids (Mercator, Lambert, Polar stereographic)

<u>Namelist **NAM_CONF_PROJ**</u>

This namelist defines the projection in case CGRID="CONF PROJ "

Fortran name	Fortran type	default value
XLAT0	real	none
XLON0	real	none
XRPK	real	none
XBETA	real	none

- XLAT0: reference latitude for conformal projection (real, decimal degrees)

- XLON0: reference longitude for conformal projection (real, decimal degrees)

- XRPK: cone factor for the projection (real):

  - XRPK=1: polar stereographic projection from south pole

  - 1>XRPK>0: Lambert projection from south pole

  - XRPK=0: Mercator projection from earth center

  - -1<XRPK<0: Lambert projection from north pole

  - XRPK=-1: polar stereographic projection from north pole

- XBETA: rotation angle of the simulation domain around the reference longitude (real)

<u>Namelist **NAM_CONF_PROJ_GRID**</u>

This namelists defines the horizontal domain in case CGRID="CONF PROJ ".

Fortran name	Fortran type
XLATCEN	real
XLONCEN	real
NIMAX	integer
NJMAX	integer
XDX	real
XDY	real

- XLATCEN: latitude of the point of the center of the domain (real, decimal degrees)

- XLONCEN: longitude of the point of the center of the domain (real, decimal degrees)

- NIMAX: number of surface points of the grid in direction x.

- NJMAX: number of surface points of the grid in direction y.

- XDX: grid mesh size on the conformal plane in x direction (real, meters).

- XDY: grid mesh size on the conformal plane in y direction (real, meters).

Namelist NAM_INIFILE_CONF_PROJ

This namelists defines the horizontal domain from an existing surface file in which grid type is "CONF PROJ". If nothing is set in the namelist, a grid identical as the one in the file is chosen.

Fortran name	Fortran type	default value
IXOR	integer	1
IYOR	integer	1
IXSIZE	integer	YINIFILE size
IYSIZE	integer	YINIFILE size
IDXRATIO	integer	1
IDYRATIO	integer	1

- IXOR: first point I index, according to the YINIFILE grid, left to and out of the new physical domain.

- IYOR: first point J index, according to the YINIFILE grid, under and out of the new physical domain.

- IXSIZE: number of grid points in I direction, according to YINIFILE grid, recovered by the new domain. If to be used in MESONH, it must only be factor of 2,3 or 5.

- IYSIZE: number of grid points in J direction, according to YINIFILE grid, recovered by the new domain. If to be used in MESONH, it must only be factor of 2,3 or 5.

- IDXRATIO: resolution factor in I direction between the YINIFILE grid and the new grid. If to be used in MESONH, it must only be factor of 2,3 or 5.

- IDYRATIO: resolution factor in J direction between the YINIFILE grid and the new grid. If to be used in MESONH, it must only be factor of 2,3 or 5.

2.3.3 Cartesian grids

<u>Namelist **NAM_CARTESIAN**</u>

This namelist defines the projection in case CGRID="CARTESIAN "

Fortran name	Fortran type	default value
XLAT0	real	none
XLON0	real	none
NIMAX	integer	none
NJMAX	integer	none
XDX	real	none
XDY	real	none

- XLAT0: reference latitude (real, decimal degrees)

- XLON0: reference longitude (real, decimal degrees)

- NIMAX: number of surface points of the grid in direction x.

- NJMAX: number of surface points of the grid in direction y.

- XDX: grid mesh size on the conformal plane in x direction (real, meters).

- XDY: grid mesh size on the conformal plane in y direction (real, meters).

<u>Namelist **NAM_INIFILE_CARTESIAN**</u>

This namelists defines the horizontal domain from an existing surface file in which grid type is "CARTESIAN ". If nothing is set in the namelist, a grid identical as the one in the file is chosen.

Fortran name	Fortran type	default value
IXOR	integer	1
IYOR	integer	1
IXSIZE	integer	YINIFILE size
IYSIZE	integer	YINIFILE size
IDXRATIO	integer	1
IDYRATIO	integer	1

- IXOR: first point I index, according to the YINIFILE grid, left to and out of the new physical domain.

- IYOR: first point J index, according to the YINIFILE grid, under and out of the new physical domain.

- IXSIZE: number of grid points in I direction, according to YINIFILE grid, recovered by the new domain. If to be used in MESONH, it must only be factor of 2,3 or 5.

- IYSIZE: number of grid points in J direction, according to YINIFILE grid, recovered by the new domain. If to be used in MESONH, it must only be factor of 2,3 or 5.

- IDXRATIO: resolution factor in I direction between the YINIFILE grid and the new grid. If to be used in MESONH, it must only be factor of 2,3 or 5.

- IDYRATIO: resolution factor in J direction between the YINIFILE grid and the new grid. If to be used in MESONH, it must only be factor of 2,3 or 5.

2.3.4 Regular longitude-latitude grids

Namelist NAM_LONLAT_REG

This namelist defines the projection in case CGRID="LONLAT REG"

Fortran name	Fortran type	default value
XLONMIN	real	none
XLONMAX	real	none
XLATMIN	real	none
XLATMAX	real	none
NLON	integer	none
NLAT	integer	none

- XLONMIN: minimum longitude covered by the grid, i.e. corresponding to the west border of the domain (real, decimal degrees). XLONMIN must be smaller than XLONMAX, but no more than 360 smaller.

- XLONMAX: maximum longitude covered by the grid, i.e. corresponding to the east border of the domain (real, decimal degrees). XLONMAX must be larger than XLONMIN, but no more than 360 larger.

- XLATMIN: minimum latitude covered by the grid, i.e. corresponding to the south border of the domain (real, decimal degrees). XLATMIN must be between -90 and +90, and smaller than XLATMAX.

- XLATMAX: maximum longitude covered by the grid, i.e. corresponding to the 'right' border of the domain (real, decimal degrees). XLATMAX must be between -90 and +90, and larger than XLATMIN.

- NLON: number of surface points in the longitude direction.

- NLAT: number of surface points in the latitude direction.

2.4 Land cover fractions

Namelist NAM_COVER

This namelist gives the information to compute the surface cover fractions.

Fortran name	Fortran type	values	default value
XUNIF_COVER	array of 255 reals	≥ 0 and $\sum_{i=1}^{255}$ XUNIF_COVER$(i) = 1$	none
YCOVER	character (LEN=28)		' '
YFILETYPE	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none
XRM_COVER	real	≥ 0	10^{-6}
LRM_TOWN	logical		.FALSE.

- XUNIF_COVER : specified values for uniform cover fractions. For each index i between 1 and 255, XUNIF_COVER(i) is the fraction of the ith ecosystem of ecoclimap. The same fraction of each ecosystem is set to all points of the grid. The sum of all ecosystem fractions must be equal to one : $\sum_{i=1}^{255}$ XUNIF_COVER$(i) = 1$.
  If XUNIF_COVER is set, it has priority on the use of an ecosystem file (see next item: YCOVER). In the case of grid without any reference to geographical coordinates ("CARTESIAN " or "NONE "), XUNIF_COVER **must** be set.

- YCOVER: ecoclimap data file name. It is used only if XUNIF_COVER is not set.

- YFILETYPE: type of YCOVER file ('DIRECT', 'BINLLV', 'BINLLF', 'ASCLLV').

- XRM_COVER: for each point, all fractions of ecosystems that are below XRM_COVER are removed (i.e. set to zero), and the corresponding area fractions are distributed among the remaining ecosystem fractions. Whatever the value of XRM_COVER, at least one ecosystem remains for each grid point.

- LRM_TOWN: if .TRUE., all ecosystems containing town fractions are removed and replaced by the ecosystem corresponding to rocks.

2.5 Orography and subgrid orography

Namelist NAM_ZS

This namelist defines the orography file and orographic treatment to be done.

Fortran name	Fortran type	values	default value
XUNIF_ZS	real		none
YZS	character (LEN=28)		' ' (default orography is 0.)
YFILETYPE	character (LEN=6)	'DIRECT', 'BINLLF' 'BINLLV', 'ASCLLV'	none
COROGTYPE	character (LEN=3)	'AVG', 'ENV', 'SIL '	'ENV'
XENV	real		0.
NZSFILTER	integer		1

- XUNIF_ZS : uniform value of orography imposed on all points (real,meters). If XUNIF_ZS is set, file YZS is not used.

- YZS: data file name. If XUNIF_ZS is set, file YZS is not used. If neither XUNIF_ZS and YZS is set, then orography is set to zero.

- YFILETYPE: type of data file ('DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV')

- COROGTYPE: type of orography (string of 3 characters):

  - 'AVG': mean orography $\overline{z_s}$.

  - 'ENV': envelope relief, defined from mean orography and the subgrid orography standard deviation as $\overline{z_s} + XENV * \sigma_{z_s}$.

  - 'SIL': silhouette relief, defined as the mean of the two subgrid silhouettes in directions x and y (if two main directions can be defined for the grid chosen).

- XENV: enhance factor in envelope orography definition (real).

- NZSFILTER: number of iterations of the spatial filter applied to smooth the orography (integer, 1 iteration removes the $2\Delta x$ signal, 50% of the $4\Delta x$ signal, 25% of the $6\Delta x$ signal, etc[1]...).

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[1] The amplitude of the filtered signal for each wavelength $\lambda \Delta x$ is $\frac{1}{2}\left(cos(2\pi/\lambda) + 1\right)$.

2.6 Namelist for ISBA scheme

Namelist NAM_ISBA

Fortran name	Fortran type	values	default value
NPATCH	integer	between 1 and 12	1
CISBA	character (LEN=3)	'2-L', '3-L', 'DIF'	'3-L'
CPHOTO	string of 3 characters	'NON', 'AGS', 'LAI', 'AST', 'LST', 'NIT'	'NON'
NGROUND_LAYER	integer	> 0	3
XUNIF_CLAY	real	between 0 and 1	none
YCLAY	character (LEN=28)		' '
YCLAYFILETYPE	character (LEN=6)	'DIRECT', 'BINLLF' 'BINLLV', 'ASCLLV'	none
XUNIF_SAND	real	between 0 and 1	none
YSAND	character (LEN=28)		' '
YSANDFILETYPE	character (LEN=6)	'DIRECT', 'BINLLF' 'BINLLV', 'ASCLLV'	none
XUNIF_RUNOFFB	real	between 0 and 1	0.5

- NPATCH : number of patches used in ISBA. One patch corresponds to aggregated parameters. 12 patches correspond to separate energy budgets for all vegetation types present in ISBA (bare soil, rocks, permanent snow and ice, C3 crops, C4 crops, irrigated crops, C3 grass, C4 grass, marsh and gardens, coniferous trees, evergreen broadleaf trees, deciduous broadleaf trees). 3 patches correspond to bare soil types, low vegetation, trees. Any number of patches between 1 and 12 is possible.

- CISBA : type of soil discretization and physics in ISBA:

  - '2-L' : force-restore method with 2 layers for hydrology

  - '3-L' : force-restore method with 3 layers for hydrology

  - 'DIF' : diffusion layer, with any number of layers

- CPHOTO: type of photosynthesis physics. The following options are currently available:

  - "NON" : none is used. Jarvis formula is used for plant transpiration.

  - "AGS" : ISBA-AGS, without evolving Leaf Area Index

  - "LAI" : ISBA-AGS, with evolving Leaf Area Index

  - "AST" : ISBA-AGS with offensive/defensive stress, without evolving Leaf Area Index

  - "LST" : ISBA-AGS with offensive/defensive stress, with evolving Leaf Area Index

  - "NIT" : ISBA-AGS with nitrogen, with evolving Leaf Area Index

- NGROUND_LAYER : number of soil layer used in case of diffusion physics in the soil (CISBA = 'DIF').

- XUNIF_CLAY : uniform prescribed value of clay fraction. If XUNIF_CLAY is set, file YCLAY is not used.

- YCLAY: clay fraction data file name. If XUNIF_CLAY is set, file YCLAY is not used.

- YCLAYFILETYPE: type of clay data file ('DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV')

- XUNIF_SAND : uniform prescribed value of sand fraction. If XUNIF_SAND is set, file YSAND is not used.

- YSAND: sand fraction data file name. If XUNIF_SAND is set, file YSAND is not used.

- YSANDFILETYPE: type of sand data file ('DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV')

- XUNIF_RUNOFFB : uniform prescribed value of subgrid runoff coefficient.

2.7 Namelist to add user's own fields

Namelist NAM_DUMMY_PGD

This namelist allows to incorporate into the physiographic file any surface field.

You can treat up to 999 such fields. These fields will be written on all the files you will use later(after prognostic fields initialization, or during and after run, etc...). Their name in the files are 'DUMMY_GRnnn', where nnn goes from 001 to 999.

During the execution of the programs, these fields are stored in the XDUMMY_FIELDS(:,:) (first dimension: spatial dimension, second dimension: total number of fields), in the module MODD_DUMMY_SURF_FIELD$n. You must modify the fortran source, where you want to use them.

Fortran name	Fortran type	default value
NDUMMY_PGD_NBR	integer	0
CDUMMY_PGD_NAME(:)	1000 * character (LEN=20)	1000 * ' '
CDUMMY_PGD_FILE(:)	1000 * character (LEN=28)	1000 * ' '
CDUMMY_PGD_COMMENT(:)	1000 * character (LEN=40)	1000 * ' '
CDUMMY_PGD_FILETYPE(:)	1000 * character (LEN=6)	1000 *' '
CDUMMY_PGD_AREA(:)	1000 * character (LEN=3)	1000 *'ALL'
CDUMMY_PGD_ATYPE(:)	1000 * character (LEN=3)	1000 *'ARI'

Only the first NDUMMY_PGD_NBR values in these arrays are meaningfull.

- NDUMMY_PGD_NBR: number of dummy fields.

- CDUMMY_PGD_NAME(:) : list of the dummy fields you want to initialize with your own data. You can give any name you want. This is a way to describe what is the field. This information is not used by the program. It is just written in the FM files.

- CDUMMY_PGD_FILE(:) : list of the names of the files containing the data for the fields you have specified in CDUMMY_PGD_NAME(:).

- CDUMMY_PGD_FILETYPE(:) : list of the types of the files containing the data for the fields you have specified in CDUMMY_PGD_NAME(:) ('DIRECT', 'LATLON', 'BINLLF', 'BINLLV', 'ASCLLV').

- CDUMMY_PGD_AREA(:) : area of meaningfullness of the fields you have specified in CDUMMY_PGD_NAME(:) ('ALL', 'NAT', 'TWN', 'SEA', 'WAT', 'LAN', respectively for everywhere, natural areas, town areas, sea, inland waters, land = natural cover + town). For example, oceanic emission of DNS is relevant on 'SEA'.

- CDUMMY_PGD_ATYPE(:) : type of averaging (during **PGD** for the fields you have specified in CDUMMY_PGD_NAME(:) ('ARI', 'INV', 'LOG', respectively for arithmetic, inverse and logarithmic averaging).

2.8   Namelist for chemistry anthropogenic emissions

Namelist NAM_CH_EMIS_PGD

This namelist is used to initialize chemistry components emissions.

You can treat up to 999 such fields. These fields will be written on all the files you will use later (after prognostic fields initialization, or during and after run, etc...). Their name in the files are 'EMIS_GRnnn', where nnn goes from 001 to 999.

During the execution of the programs, these fields are stored in the XEMIS_GR_FIELDS(:,:) (first dimension: spatial dimension, second dimension: total number of fields), in the module MODD_EMIS_GR_FIELD$n. The temporal evolution, the aggregation of prescribed emissions and the link with the corresponding chemical prognostic variables are handled by the subroutine CH_EMISSION_FLUXn.f90

Fortran name	Fortran type	default value
NEMIS_PGD_NBR	integer	0
CEMIS_PGD_NAME(:)	1000 * character (LEN=20)	1000 * ' '
CEMIS_PGD_FILE(:)	1000 * character (LEN=28)	1000 * ' '
CEMIS_PGD_COMMENT(:)	1000 * character (LEN=40)	1000 * ' '
NEMIS_PGD_TIME	integer	0
CEMIS_PGD_FILETYPE(:)	1000 * character (LEN=6)	1000 *'DIRECT'
CEMIS_PGD_AREA(:)	1000 * character (LEN=3)	1000 *'ALL'
CEMIS_PGD_ATYPE(:)	1000 * character (LEN=3)	1000 *'ARI'

Only the first NEMIS_PGD_NBR values in these arrays are meaningfull.

- NEMIS_PGD_NBR: number of dummy fields.

- CEMIS_PGD_NAME(:) : list of the dummy fields you want to initialize with your own data. You can give any name you want. This is a way to describe what is the field. This information is not used by the program. It is just written in the FM files.

- CEMIS_PGD_FILE(:) : list of the names of the files containing the data for the fields you have specified in CEMIS_PGD_NAME(:).

- CEMIS_PGD_COMMENT(:) : list of the comments associated to each emission field.

- NEMIS_PGD_TIME(:) : list of the time of the files containing the data for the fields you have specified in CEMIS_PGD_NAME(:).

- CEMIS_PGD_FILETYPE(:) : list of the types of the files containing the data for the fields you have specified in CEMIS_PGD_NAME(:) ('DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV').

- CEMIS_PGD_AREA(:) : area of meaningfullness of the fields you have specified in CEMIS_PGD_NA
  ('ALL', 'NAT', 'TWN', 'SEA', 'WAT', 'LAN', respectively for everywhere, natural areas, town areas, sea, inland waters, land = natural cover + town). For example, oceanic emission of DNS is relevant on 'SEA'.

- CEMIS_PGD_ATYPE(:) : type of averaging (during **PGD** for the fields you have specified in CEMIS_PGD_NAME(:) ('ARI', 'INV', 'LOG', respectively for arithmetic, inverse and logarithmic averaging).

Example:

```
&NAM_CH_EMIS_PGD NEMIS_PGD_NBR  = 2,
           CEMIS_PGD_NAME(1)='COE',
    NEMIS_PGD_TIME(1)=0,
    CEMIS_PGD_COMMENT(1)='CO_00h00',
    CEMIS_PGD_AREA(1)='LAN',
           CEMIS_PGD_ATYPE(1)='ARI',
           CEMIS_PGD_FILE(1)='co_00.asc',
    CEMIS_PGD_FILETYPE(1)='ASCLLV',
    CEMIS_PGD_NAME(2)='COE',
    NEMIS_PGD_TIME(2)=43200,
    CEMIS_PGD_COMMENT(2)='CO_12h00',
    CEMIS_PGD_AREA(2)='LAN',
    CEMIS_PGD_ATYPE(2)='ARI',
    CEMIS_PGD_FILE(2)='co_12.asc',
    CEMIS_PGD_FILETYPE(2)='ASCLLV',
    CEMIS_PGD_NAME(3)='DMSE',
    NEMIS_PGD_TIME(3)=0,
    CEMIS_PGD_COMMENT(3)='dms_cte',
    CEMIS_PGD_AREA(3)='SEA',
    CEMIS_PGD_ATYPE(3)='ARI',
    CEMIS_PGD_FILE(3)='dms.asc',
    CEMIS_PGD_FILETYPE(3)='ASCLLV' /
```

Chapter 3

Initialization of the prognostic fields

3.1   Overview of fields computation: PREP

The prognostic fields (temperature, humidity, ice, snow, etc...) are averaged or interpolated on the specified grid by the program **PREP**. They are stored in the surface file. The computation is done separately for each surface scheme.

During the **PREP** facility :

1. You initializes the date of the surface

2. You initializes the prognostic variables of the chosen sea scheme

3. You initializes the prognostic variables of the chosen lake scheme

4. You initializes the prognostic variables of the chosen vegetation scheme

5. You initializes the prognostic variables of the chosen town scheme

Here are presented the initialization procedures for the schemes that need such information (for example, scheme "IDEAL " does not need any information here, but modificaton of the code source *init_ideal_flux.f90*).

Note that for each scheme, and for some for each variable of the scheme, it is possible to initialize the prognostic fields either form an operationnal or research model, or using prescribed (usually uniform) fields.

3.2 Date initialization and default input data file for all schemes

Namelist NAM_PREP_SURF_ATM

This namelist information is used to (possibly):

- initialize the date of all surface schemes. The namelist information is used only if no input data file is used, either from namelist or by fortran code (as in MESONH programs). If a file is used, the date is read in it.

- define the default file in which each scheme can read the needed data (e.g. temperature).

Note that, all the information given in this namelist can be erased for each scheme by the namelist corresponding to this scheme, as the information in the shceme namelists have priority on namelist NAM_PREP_SURF_ATM.

Fortran name	Fortran type	values	default value
CFILE	string of 28 characters		- atmospheric file used in the program calling the surface facilities, if any - none otherwise
CFILETYPE	string of 6 characters	'MESONH', 'GRIB '	- type of the atmospheric file, if any - none otherwise
NYEAR	integer		none
NMONTH	integer		none
NDAY	integer		none
XTIME	real		none

- CFILE: name of the file used to define

    1. the date.
    2. the file in which to read the needed data (e.g. temperature).

    The use of a file or prescribed value in each scheme namelist has priority on the data in CFILE file of namelist NAM_PREP_SURF_ATM.

- CFILETYPE: type of the CFILE file, if the latter is provided. CTYPE must then be given. The following values are currently usable:

    - "MESONH" : the file type is a MESONH file.

    - "GRIB " : the file type is a GRIB file, coming from any of these models:

        1. "ECMWF " : european center forecast model

2. "ARPEGE" : Arpege french forecast model

3. "ALADIN" : Aladin french forecast local model

4. "MOCAGE" : Mocage french research chemistry model

- NYEAR : year of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NMONTH : month of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NDAY : day of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- XTIME : time from midnight of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read). (seconds).

3.3 Sea scheme "SEAFLX"

Namelist NAM_PREP_SEAFLUX

This namelist information is used to initialize the "SEAFLX" sea scheme temperature.

Fortran name	Fortran type	values	default value
XSST_UNIF	real		none
CFILE_SEAFLX	string of 28 characters		CFILE in NAM_PREP_SURF_ATM
CTYPE	string of 6 characters	'MESONH', 'GRIB '	CFILETYPE in NAM_PREP_SURF_ATM
NYEAR	integer		none
NMONTH	integer		none
NDAY	integer		none
XTIME	real		none

- XSST_UNIF : uniform prescribed value of Sea Surface Temperature. This prescribed value, if defined, has priority on the use of CFILE_SEAFLX data.

- CFILE_SEAFLX: name of the file used to define the Sea surface Temperature. **The use of a file or prescribed value XSST_UNIF has priority on the data in CFILE_SEAFLX file**.

- CTYPE: type of the CFILE_SEAFLX file, if the latter is provided. CTYPE must then be given. The following values are currently usable:

    - "MESONH" : the file type is a MESONH file.
    - "GRIB " : the file type is a GRIB file, coming from any of these models:
        1. "ECMWF " : european center forecast model
        2. "ARPEGE" : Arpege french forecast model
        3. "ALADIN" : Aladin french forecast local model
        4. "MOCAGE" : Mocage french research chemistry model

- NYEAR : year of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NMONTH : month of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NDAY : day of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- XTIME : time from midnight of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read). (seconds).

3.4 Lake scheme "WATFLX"

Namelist NAM_PREP_WATFLUX

This namelist information is used to initialize the "WATFLX" sea scheme temperature.

Fortran name	Fortran type	values	default value
XTS_WATER_UNIF	real		none
CFILE_WATFLX	string of 28 characters		CFILE in NAM_PREP_SURF_ATM
CTYPE	string of 6 characters	'MESONH', 'GRIB '	CFILETYPE in NAM_PREP_SURF_ATM
NYEAR	integer		none
NMONTH	integer		none
NDAY	integer		none
XTIME	real		none

- XTS_WATER_UNIF : uniform prescribed value of water surface temperature supposed at an **altitude of 0m** (mean sea level altitude). The temperature is then modified for each point depending on its altitude, following a uniform vertical gradient of -6.5 Kkm^{-1}. This prescribed value, if defined, has priority on the use of CFILE_WATFLX data.

- CFILE_WATFLX: name of the file used to define the Sea surface Temperature. **The use of a file or prescribed value XTS_WATER_UNIF has priority on the data in CFILE_WATFLX file**.

- CTYPE: type of the CFILE_WATFLX file, if the latter is provided. CTYPE must then be given. The following values are currently usable:

  - "MESONH" : the file type is a MESONH file.

  - "GRIB " : the file type is a GRIB file, coming from any of these models:

    1. "ECMWF " : european center forecast model
    2. "ARPEGE" : Arpege french forecast model
    3. "ALADIN" : Aladin french forecast local model
    4. "MOCAGE" : Mocage french research chemistry model

- NYEAR : year of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NMONTH : month of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NDAY : day of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- XTIME : time from midnight of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read). (seconds).

3.5 Vegetation scheme "ISBA "

Namelist NAM_PREP_ISBA

This namelist information is used to initialize the "ISBA " vegetation scheme variables: soil temperature profile, soil water and ice profiles, water intercepted by leaves, snow.

Fortran name	Fortran type	values	default value
XHUG_SURF	real		none
XHUG_ROOT	real		none
XHUG_DEEP	real		none
CFILE_WG	string of 28 characters		CFILE_ISBA in this namelist
CTYPE_WG	string of 6 characters	'MESONH', 'GRIB '	CTYPE in this namelist
XTG_SURF	real		none
XTG_ROOT	real		none
XTG_DEEP	real		none
CFILE_TG	string of 28 characters		CFILE_ISBA in this namelist
CTYPE_TG	string of 6 characters	'MESONH', 'GRIB '	CTYPE in this namelist
CFILE_ISBA	string of 28 characters		CFILE in NAM_PREP_SURF_ATM
CTYPE	string of 6 characters	'MESONH', 'GRIB '	CFILETYPE in NAM_PREP_SURF_ATM
NYEAR	integer		none
NMONTH	integer		none
NDAY	integer		none
XTIME	real		none

- XHUG_SURF : uniform prescribed value of soil water index (SWI) for the surface soil layer. This prescribed value, if defined, has priority on the use of CFILE_WG and CFILE_ISBA data.

- XHUG_ROOT : uniform prescribed value of soil water index (SWI) for the root zone soil layer(s). This prescribed value, if defined, has priority on the use of CFILE_WG and CFILE_ISBA data.

- XHUG_DEEP : uniform prescribed value of soil water index (SWI) for the deep soil layer(s). This prescribed value, if defined, has priority on the use of CFILE_WG and CFILE_ISBA data.

- CFILE_WG: name of the file used to define the soil water profiles. **The use of a file or prescribed value of XHUG_SURF, XHUG_ROOT and XHUG_DEEP has priority on the data in CFILE_WG file**.

- CTYPE_WG: type of the CFILE_WG file, if the latter is provided. CTYPE_WG must then be given. The following values are currently usable:

  - "MESONH" : the file type is a MESONH file.
  - "GRIB " : the file type is a GRIB file, coming from any of these models:
    1. "ECMWF " : european center forecast model
    2. "ARPEGE" : Arpege french forecast model
    3. "ALADIN" : Aladin french forecast local model
    4. "MOCAGE" : Mocage french research chemistry model

- XTG_SURF : uniform prescribed value of temperature for the surface soil layer, supposed at an **altitude of 0m** (mean sea level altitude). The temperature is then modified for each point depending on its altitude, following a uniform vertical gradient of -6.5 Kkm^{-1}. This prescribed value, if defined, has priority on the use of CFILE_TG and CFILE_ISBA data.

- XTG_ROOT : uniform prescribed value of temperature for the root zone soil layer(s), supposed at an **altitude of 0m** (mean sea level altitude). The temperature is then modified for each point depending on its altitude, following a uniform vertical gradient of -6.5 Kkm^{-1}. This prescribed value, if defined, has priority on the use of CFILE_TG and CFILE_ISBA data.

- XTG_DEEP : uniform prescribed value of temperature for the deep soil layer(s), supposed at an **altitude of 0m** (mean sea level altitude). The temperature is then modified for each point depending on its altitude, following a uniform vertical gradient of -6.5 Kkm^{-1}. This prescribed value, if defined, has priority on the use of CFILE_TG and CFILE_ISBA data.

- CFILE_TG: name of the file used to define the soil temperature profile. **The use of a file or prescribed value of XTG_SURF, XTG_ROOT and XTG_DEEP has priority on the data in CFILE_TG file**.

- CTYPE_TG: type of the CFILE_TG file, if the latter is provided. CTYPE_TG must then be given. The following values are currently usable:

  - "MESONH" : the file type is a MESONH file.
  - "GRIB " : the file type is a GRIB file, coming from any of these models:
    1. "ECMWF " : european center forecast model
    2. "ARPEGE" : Arpege french forecast model

3. "ALADIN" : Aladin french forecast local model

4. "MOCAGE" : Mocage french research chemistry model

- CFILE_ISBA: name of the file used to define any ISBA variable. **The use of a file or prescribed value XHUG_SURF, XHUG_ROOT, XHUG_DEEP, XTG_SURF, XTG_ROOT, XTG_DEEP, CFILE_WG and CFILE_TG has priority on the data in CFILE_ISBA file**.

- CTYPE: type of the CFILE_ISBA file, if the latter is provided. CTYPE must then be given. The following values are currently usable:

  - "MESONH" : the file type is a MESONH file.

  - "GRIB " : the file type is a GRIB file, coming from any of these models:

    1. "ECMWF " : european center forecast model

    2. "ARPEGE" : Arpege french forecast model

    3. "ALADIN" : Aladin french forecast local model

    4. "MOCAGE" : Mocage french research chemistry model

- NYEAR : year of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NMONTH : month of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NDAY : day of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- XTIME : time from midnight of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read). (seconds).

Namelist NAM_PREP_ISBA_SNOW

This namelist defines the type of snow scheme used in ISBA scheme.

Fortran name	Fortran type	values	default value
CSNOW	string of 3 characters	'D95', '3-L'	'D95'

- CSNOW : type of snow scheme. Possible snow schemes are:

  1. 'D95' : Douville et al (1995) snow scheme.

  2. '3-L' : Boone and Etchevers (2000) three layers snow scheme.

3.6   Town scheme "TEB "

Namelist NAM_PREP_TEB

This namelist information is used to initialize the "TEB " urban scheme variables: road, roof and wall temperature profiles, water intercepted by roofs and roads, snow, building internal temperature.

Fortran name	Fortran type	values	default value
XWS_ROAD	real		none
XWS_ROOF	real		none
CFILE_WS	string of 28 characters		CFILE_TEB in this namelist
CTYPE_WS	string of 6 characters	'MESONH', 'GRIB '	CTYPE in this namelist
XTS_ROAD	real		none
XTS_ROOF	real		none
XTS_WALL	real		none
XTI_BLD	real		none
XTI_ROAD	real		none
CFILE_TS	string of 28 characters		CFILE_TEB in this namelist
CTYPE_TS	string of 6 characters	'MESONH', 'GRIB '	CTYPE in this namelist
CFILE_TEB	string of 28 characters		CFILE in NAM_PREP_SURF_ATM
CTYPE	string of 6 characters	'MESONH', 'GRIB '	CFILETYPE in NAM_PREP_SURF_ATM
NYEAR	integer		none
NMONTH	integer		none
NDAY	integer		none
XTIME	real		none

- XWS_ROAD : uniform prescribed value of soil water interception for the road reservoir. This prescribed value, if defined, has priority on the use of CFILE_WS and CFILE_TEB data.

- XWS_ROOF : uniform prescribed value of soil water interception for the roof reservoir. This prescribed value, if defined, has priority on the use of CFILE_WS and CFILE_TEB data.

- CFILE_WS: name of the file used to define the soil water reservoirs. **The use of a file or prescribed value of XWS_ROAD and XWS_ROOF has priority on the data in CFILE_WS file**.

- CTYPE_WS: type of the CFILE_WS file, if the latter is provided. CTYPE_WS must then be given. The following values are currently usable:

  - "MESONH" : the file type is a MESONH file.
  - "GRIB " : the file type is a GRIB file, coming from any of these models:
    1. "ECMWF " : european center forecast model
    2. "ARPEGE" : Arpege french forecast model
    3. "ALADIN" : Aladin french forecast local model
    4. "MOCAGE" : Mocage french research chemistry model

- XTS_ROAD : uniform prescribed value of surface temperature for road, supposed at an **altitude of 0m** (mean sea level altitude). The temperature is then modified for each point depending on its altitude, following a uniform vertical gradient of -6.5 Kkm^{-1}. This prescribed value, if defined, has priority on the use of CFILE_TS and CFILE_TEB data.

- XTS_ROOF : uniform prescribed value of surface temperature for roof, supposed at an **altitude of 0m** (mean sea level altitude). The temperature is then modified for each point depending on its altitude, following a uniform vertical gradient of -6.5 Kkm^{-1}. This prescribed value, if defined, has priority on the use of CFILE_TS and CFILE_TEB data.

- XTS_WALL : uniform prescribed value of surface temperature for wall, supposed at an **altitude of 0m** (mean sea level altitude). The temperature is then modified for each point depending on its altitude, following a uniform vertical gradient of -6.5 Kkm^{-1}. This prescribed value, if defined, has priority on the use of CFILE_TS and CFILE_TEB data.

- XTI_BLD : uniform prescribed value of internal building temperature. This temperature is not dependent on altitude. This prescribed value, if defined, has priority on the use of CFILE_TS and CFILE_TEB data.

- XTI_ROAD : uniform prescribed value of deep road temperature, supposed at an **altitude of 0m** (mean sea level altitude). The temperature is then modified for each point depending on its altitude, following a uniform vertical gradient of -6.5 Kkm^{-1}. This prescribed value, if defined, has priority on the use of CFILE_TS and CFILE_TEB data.

- CFILE_TS: name of the file used to define the soil temperature profile. **The use of a file or prescribed value of XTS_ROAD, XTS_ROOF, XTS_WALL, XTI_BLD or XTI_ROAD has priority on the data in CFILE_TS file**.

- CTYPE_TS: type of the CFILE_TS file, if the latter is provided. CTYPE_TS must then be given. The following values are currently usable:

- "MESONH" : the file type is a MESONH file.

- "GRIB " : the file type is a GRIB file, coming from any of these models:

  1. "ECMWF " : european center forecast model
  2. "ARPEGE" : Arpege french forecast model
  3. "ALADIN" : Aladin french forecast local model
  4. "MOCAGE" : Mocage french research chemistry model

- CFILE_TEB: name of the file used to define any TEB variable. **The use of a file or prescribed value XWS_ROAD, XWS_ROOF, XTS_ROAD, XTS_ROOF, XTS_WALL, XTI_BLD, XTI_ROAD, CFILE_WS or CFILE_TS has priority on the data in CFILE_TEB file.**

- CTYPE: type of the CFILE_TEB file, if the latter is provided. CTYPE must then be given. The following values are currently usable:

  - "MESONH" : the file type is a MESONH file.

  - "GRIB " : the file type is a GRIB file, coming from any of these models:

    1. "ECMWF " : european center forecast model
    2. "ARPEGE" : Arpege french forecast model
    3. "ALADIN" : Aladin french forecast local model
    4. "MOCAGE" : Mocage french research chemistry model

- NYEAR : year of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NMONTH : month of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- NDAY : day of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read).

- XTIME : time from midnight of surface UTC time. It is used only if no atmospheric file or no surface file is given (in those the date can be read). (seconds).

Chapter 4

How to run the externalized surface physical schemes

Here are described the options available during the run of the several surface schemes.

4.1 "SEAFLX" sea scheme options

Namelist NAM_SEAFLUXn

Fortran name	Fortran type	values	default value
CSEA_FLUX	string of 6 characters	'DIRECT'	'DIRECT'
CSEA_ALB	string of 4 characters	'UNIF', 'TA96'	'TA96'

- CSEA_FLUX: type of flux computation physics. The following option is currently available:

  - "DIRECT" : direct Charnock computation. No effect of convection in the the boundary layer on the fluxes formulae.

- CSEA_ALB: type of albedo formula. The following options are currently available:

  - "UNIF" : a uniform value of 0.135 is used for water albedo

  - "TA96" : Taylor et al (1996) formula for water direct albedo, depending on solar zenith angle θ: $\quad \alpha_{dir} = 0.037/\left(1.1\cos(\theta)^{1.4} + 0.15\right)$

4.2 "ISBA " vegetation scheme options

Namelist NAM_ISBAn

Fortran name	Fortran type	values	default value
CRUNOFF	string of 4 characters	'WSAT', 'DT92'	'WSAT'
CC1DRY	string of 4 characters	'DEF ', 'GB93'	'DEF '
CSCOND	string of 4 characters	'NP89', 'PL98'	'NP89'
CSOILFRZ	string of 3 characters	'DEF', 'LWT'	'DEF'
CDIFSFCOND	string of 4 characters	'DEF ', 'MLCH'	'DEF '
CSNOWRES	string of 3 characters	'DEF', 'CRO'	'DEF'
CALBEDO	string of 4 characters	'MEAN', 'DRY ', 'WET ', 'EVOL'	'DRY '
CROUGH	string of 4 characters	'Z01D', 'Z04D'	'Z04D'
XTSTEP	real		none

- CRUNOFF: type of subgrid runoff. The following options are currently available:

  - "WSAT" : runoff occurs only when saturation is reached

  - "DT92" : Dumenill and Todini (1992) subgrid runoff formula

- CC1DRY: type of C1 formulation for dry soils. The following options are currently available:

  - "DEF " : Giard-Bazile formulation

  - "GB93" : Giordani 1993, Braud 1993

- CSCOND: type of thermal conductivity. The following options are currently available:

  - "NP89" : Noilhan and Planton (1989) formula

  - "PL98" : Peters-Lidard et al. (1998) formula

- CSOILFRZ: type of soil freezing-physics option. The following options are currently available:

  - "DEF" : Boone et al. 2000; Giard and Bazile 2000

  - "LWT" : Phase changes as above, but relation between unfrozen water and temperature considered

- CDIFSFCOND: type of Mulch effects. The following options are currently available:

  - "DEF " : no mulch effect

  - "MLCH" : include the insulating effect of leaf litter/mulch on the surf. thermal cond.

- CSNOWRES: type of turbulent exchanges over snow. The following options are currently available:

  - "DEF" : Louis
  - "CRO" : Maximum Richardson number limit for stable conditions ISBA-SNOW3L turbulent exchange option

- CALBEDO: type of bare soil albedo. The following options are currently available:

  - "DRY " : dry bare soil albedo
  - "WET " : wet bare soil albedo
  - "MEAN" : albedo for bare soil half wet, half dry
  - "EVOL" : albedo of bare soil evolving with soil humidity

- CROUGH: type of orographic roughness length. The following options are currently available:

  - "Z01D" : orographic roughness length does not depend on wind direction
  - "Z04D" : orographic roughness length depends on wind direction

- XTSTEP: time step for ISBA. Default is to use the time-step given by the atmospheric coupling (seconds).

Chapter 5

How to run the externalized surface chemical schemes

Here are described the options available during the run of the several schemes for emission and deposition of chemical species. Note that all the schemes for deposition and emission of chemical species do activate only if chemical species are present (i.e. if the coupling between atmosphere and surface include the chemical species concentrations and fluxes).

5.1 Chemical settings control

Namelist NAM_CH_CONTROLn

Fortran name	Fortran type	values	default value
CCHEM_SURF_FILE	string of 28 characters	'DIRECT'	'DIRECT'

- CCHEM_SURF_FILE: name of general (chemical) purpose ASCII input file.

5.2 Chemical anthropogenic emissions

Namelist NAM_CH_SURFn

Fortran name	Fortran type	values	default value
LCH_SURF_EMIS	logical		.FALSE.

- LCH_SURF_EMIS: flag to use anthropogenic emissions or not.

5.3   Chemical deposition over ocean

Namelist NAM_CH_SEAFLUXn

Fortran name	Fortran type	values	default value
CCH_DRY_DEP	string of 6 characters	'NONE ', 'WES89 '	'WES89 '

- CCH_DRY_DEP: type of deposition scheme.

  - "NONE " : no chemical deposition scheme.

  - "WES89 " : Wesley (1989) deposition scheme.

5.4   Chemical deposition over lakes

Namelist NAM_CH_WATFLUXn

Fortran name	Fortran type	values	default value
CCH_DRY_DEP	string of 6 characters	'NONE ', 'WES89 '	'WES89 '

- CCH_DRY_DEP: type of deposition scheme.

  - "NONE " : no chemical deposition scheme.

  - "WES89 " : Wesley (1989) deposition scheme.

5.5   Chemical deposition over towns

Namelist NAM_CH_TEBn

Fortran name	Fortran type	values	default value
CCH_DRY_DEP	string of 6 characters	'NONE ', 'WES89 '	'WES89 '

- CCH_DRY_DEP: type of deposition scheme.

  - "NONE " : no chemical deposition scheme.

  - "WES89 " : Wesley (1989) deposition scheme.

5.6 Chemical deposition and biogenic emissions over vegetation

Namelist NAM_CH_ISBAn

Fortran name	Fortran type	values	default value
CCH_DRY_DEP	string of 6 characters	'NONE ', 'WES89 '	'WES89 '
LCH_BIO_FLUX	logical		.FALSE.

- CCH_DRY_DEP: type of deposition scheme.

  - "NONE " : no chemical deposition scheme.

  - "WES89 " : Wesley (1989) deposition scheme.

- LCH_BIO_FLUX : flag to activate the biogenic emissions.

Chapter 6

Externalized surface diagnostics

The diagnostics for the surface require the call to the complete physics of the surface. Therefore, they can be computed either during the run of the schemes (in order to have for example continuous time series of these diagnostics), or can be computed at a given instant only, if atmospheric forcing is given at this instant for the surface scheme to do one time step. The cumulated diagnostics are of course significant only when computed during a run.

6.1 Diagnostics relative to the general surface monitor

Namelist NAM_DIAG_SURF_ATMn

Fortran name	Fortran type	default value
LFRAC	logical	.FALSE.

- LFRAC: flag to save in the output file the sea, inland water, natural covers and town fractions.

6.2 Diagnostics relative to the general surface monitor and to each surface scheme

Namelist NAM_DIAG_SURFn

Fortran name	Fortran type	values	default value
N2M	integer	0, 1	0
LSURF_BUDGET	logical		.FALSE.

- N2M : flag to compute surface boundary layer characteristics:

  - N2M=1 : computes temperature at 2 m, specific humidity at 2 m, zonal and meridian wind at 10 m, and Richardson number.

- LSURF_BUDGET: flag to save in the output file the terms of the surface energy balance (net radiation, sensible heat flux, latent heat flux, ground flux), for each scheme (on the four separate tiles), on each patch of the vegetation scheme if existing, and aggregated for the whole surface. The diagnosed fields are ($*$ stands for the scheme considered ($*$=nothing : field aggregated on the whole surface; $*$=name of a scheme : field for this scheme):

  - RN_$*$: net radiation

  - H_$*$: turbulent sensible heat flux

  - LE_$*$: turbulent latent heat flux

  - GFLUX_$*$: ground or storage heat flux

6.3   Diagnostics relative to the ISBA vegetation scheme

Namelist NAM_DIAG_ISBAn

Fortran name	Fortran type	default value
LPGD	logical	.FALSE.
LSURF_EVAP_BUDGET	logical	.FALSE.
LSURF_BUDGETC	logical	.FALSE.

- LPGD : flag to save in the output file the physiographic fields of ISBA scheme that are computed from ecoclimap data from the ecosystem fractions.

- LSURF_EVAP_BUDGET: flag to save in the output file the detailled terms of the water vapor fluxes, on each patch of the vegetation scheme if existing, and aggregated for the natural surface. The diagnosed fields are:

    - LEG : ground evaporation

    - LEGI : ground sublimation

    - LEV : evaporation of intercepted water on leaves

    - LES : snow sublimation

    - LER : plant evaporation

    - LETR : transpiration

    - EVAP : total evaporation

    - DRAIN : drainage

    - RUNOFF : runoff

- LSURF_BUDGETC: flag to save in the output file the time integrated values of all budget terms that have been activated (either with :LSURF_BUDGET flag in NAM_DIAG_SURFn or LSURF_EVAP_BUDGET in the present namelist).