DEPHY – Common format for SCM simulations
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For each case, 2 netCDF files will be made available:

- A file “REF”, which defines the case as close to its reference definition (literature, intercomparison project) as possible;
- A file “SCM” similar to the file “REF”, but with a common vertical axis common to all variables (high vertical resolution, e.g., 10 m, in order to ensure a quasi convergence of profiles applied to any SCM), a time axis common to all forcing variables. The file will also contain anything required to initialize and force a model which uses T or θ, q_v, q_t, r_v, or r_t. as state variables. Therefore interpolation/extrapolation and variable conversion will be handled by shared tools when creating the “SCM” file from the “REF” file.

1. <u>Formatting common to both files:</u>

All netCDF files should have NETCDF3 format.
All netCDF variables are of type *double*. Name and unit conventions are defined in Appendix 1.
Each file contains a series of global attributes which define the forcing type of the case. This series of attributes is defined in Appendix 2.

Each variable should have, at least, the following attributes, consistently with Appendix 1:

- `long_name`: name of the variable
- `units`: unit of the variable

Time axes should have the following attributes:

- `long_name`: name of the axis
- `units`: unit of the axis, of the form “`seconds since YYYY-MM-DD HH:MM:SS`” where `YYYY-MM-DD HH:MM:SS` is the initial date of the simulation
- `calendar`: calendar to be used to interpret the date in the time axis (generally `gregorian`)

The latitude axis is of length 1, is named `lat`, and has the following attributes:

- `units` = “`degrees_north`”
- `long_name` = “`latitude`”

The longitude axis is of length 1, is named `lon` and has the following attributes:

- `units` = “`degrees_east`”
- `long_name` = “`longitude`”
- Note that a longitude between -180 and +180 is preferred.

Vertical axes should have the following attributes:

- `long_name`: name of the axis
- `units`: usually “`m`”, “`Pa`”.

2. File “DEF”

This file is named `$CASE$_$SUBCASE$_DEF_driver.nc`. It contains the initial conditions and forcings of the case `$CASE$/$SUBCASE$`, in a way as close to its original definition as possible (e.g., as in the reference paper or the intercomparison documentation). `$SUBCASE$` is by default `REF` if the case has no subcase. Each field is defined with its own spatial and temporal grid, except the initial conditions which share the same time axis `t0`. For instance, the vertical axis `lev_temp` is associated to the initial temperature profile `temp(t0,lev_temp,lat,lon)` and contains the vertical level (altitude above the ground or pressure).

Initial profiles:

Expected v*ariables:*

- only the variables defined in the reference paper/document of the case.

Axes:

- `t0`: time axis of length 1, which contains the initial date of the case, consistently with the global attribute `startDate`. See section 1 for its attributes. The attribute `long_name` should be equal to ”`Initial time`”.
- `lev_$X$`: vertical axis of the variable `$X$` which contains either the altitude above the ground (`long_name=”altitude for variable $X$”`, `units=”m”`), or the pressure (`long_name=”pressure for variable $X$”`, `units=”Pa”`). Altitude is preferred, except if the case was defined directly on pressure levels.
- `lat`: see section 1
- `lon`: see section 1

Forcing variables:

Expected v*ariables:*

- variables defined in the reference paper/document of the case

Axes :

- `time_$X$`: time axis defining the date of the forcing `$X$` (from `startDate` to `endDate`): `long_name=”Forcing time for variable X”`, same `units` attribute as `t0`
- `lev_$X$`: see above, subsection Initial profiles
- `lat`: see section 1
- `lon`: see section 1

3. File “SCM”

The objective is to have a netCDF file in which all variables (initial profiles and forcing variable profiles) share the same axes. The use of a high-resolution vertical axis should allow to deal with the interpolation problem ahead from the simulation, in a consistent way for each model. Besides, a consistent computation of the various state variables that can be used in a wide variety of SCM (and LEM) should allow a more rigorous comparison of simulations coming from different models.

The file is named `$CASE$_$SUBCASE$_SCM_driver.nc` and contains the initial profiles and the forcing to used to setup SCM simulation (or possibly LES), on a unique high-resolution vertical grid (generally 10 m, possibly to be adapted when arriving at higher resolution for specific cases).

If any extrapolation, … to be done using conservative variable? Or complete with reanalysis or other data.

The temporal grid is also common to all forcing. It can correspond to the highest frequent forcing.

initial profiles:

Expected variables:

- `temp, theta, qv, qt, rv, rt, u, v, pressure, height` of dimension `(t0, lev, lat, lon);`
- `ps (t0, lat, lon);`
- `ql, qi, rl, ri, tke` set to 0 if not defined in the case

Axes:

- `t0`: see section 2
- `lev`: vertical axis with either altitude above the ground (`long_name="altitude", units="m"`), or the pressure (`long_name="pressure", units="Pa"`). Altitude is preferred, except if the case was defined directly on pressure levels.
- `lat`: see section 1
- `lon`: see section 1

Forcing :

Expected variables:

- Forcing fields consistent with the global attribute of the "REF" file (Appendix 2) and allowing to force the SCM in T or θ, q_v, q_t, r_v, or r_t.
- Altitude of the forcing : `pressure_forc` and `height_forc` of dimension `(time, lev, lat, lon)`
- Forcing fields at the surface, consistently with the global attribute of the "REF" file (cf. Appendix 2).
- `ps_forc` of dimension `(time, lat, lon)`

Axes:

- `time` : axis with the forcing dates, from `startDate` to `endDate`, following section 1: `long_name="Forcing time"`
- `lev` : see previous subsection
- `lat` : see section 1
- `lon` : see section 1

Appendix 1: Conventions for variables

id	*long_name*	units
height	*Height above ground*	m
pressure	*Pressure*	Pa
height_forc	*Height above the ground for forcing*	m
pressure_forc	*Pressure for forcing*	Pa
temp	*Temperature*	K
theta	*Potential temperature*	K
thetal	*Liquid potential temperature*	K
rv	*Water vapor mixing ratio*	kg kg-1
rl	*Liquid water mixing ratio*	kg kg-1
ri	*Ice water mixing ratio*	kg kg-1
rt	*Total water mixing ratio*	kg kg-1
qv	*Specific humidity*	kg kg-1
ql	*Liquid water content*	kg kg-1
qi	*Ice water content*	kg kg-1
qt	*Total water content*	kg kg-1
rh	*Relative humidity*	%
tke	*Turbulent kinetic energy*	m2 s-2
u	*Zonal wind*	m s-1
v	*Meridional wind*	m s-1
w	*Vertical velocity*	m s-1
omega	*Vertical pressure velocity*	Pa s-1
ug	*Geostrophic zonal wind*	m s-1
vg	*Geostrophic meridional wind*	m s-1
u_adv	*Zonal wind large-scale advection*	m s-2
v_adv	*Meridional wind large-scale advection*	m s-2
temp_adv	*Temperature large-scale advection*	K s-1
theta_adv	*Potential temperature large-scale advection*	K s-1

thetal_adv	*Liquid potential temperature large-scale advection*	K s-1
qv_adv	*Specific humidity large-scale advection*	kg kg-1/s-1
qt_adv	*Total water content large-scale advection*	kg kg-1 s-1
rv_adv	*Water vapor mixing ratio large-scale advection*	kg kg-1 s-1
rt_adv	*Total water mixing ratio large-scale advection*	kg/kg/s
temp_rad	*Radiative temperature tendency*	K s-1
theta_rad	*Radiative potential temperature tendency*	K s-1
thetal_rad	*Radiative liquid potential temperature tendency*	K s-1
temp_nudging	*Temperature profile for nudging*	K
theta_nudging	*Potential temperature profile for nudging*	K
thetal_nudging	*Liquid potential temperature profile for nudging*	K
qv_nudging	*Specific humidity profile for nudging*	kg kg-1
qt_nudging	*Total water content profile for nudging*	kg kg-1
rv_nudging	*Water vapor mixing ratio profile for nudging*	kg kg-1
rt_nudging	*Total water mixing ratio profile for nudging*	kg kg-1
u_nudging	*Zonal wind profile for nudging*	m s-1
v_nudging	*Meridional wind profile for nudging*	m s-1
sfc_sens_flx	*Surface sensible heat flux (positive upward)*	W m-2
sfc_lat_flx	*Surface latent heat flux (positive upward)*	W m-2
wpthetap	*Surface flux of potential temperature* ($w'\theta'$)	K m s-1
wpqvp	*Surface flux of water vapor specific humidity* ($w'q_v'$)	m s-1
wpqtp	*Surface flux of total water specific humidity* ($w'q_t'$)	m s-1
wprvp	*Surface flux of water vapor mixing ratio* ($w'r_v'$)	m s-1
wprtp	*Surface flux of total wate mixing ratio* ($w'r_t'$)	m s-1
ts	*Surface temperature*	K
ps	*Surface pressure*	Pa
ps_forc	*Surface pressure for forcing*	Pa
ustar	*Surface friction velocity*	m s-1

Appendix 2: Global attributes

case = “$CASE$/$SUBCASE$”
title = "Forcing and initial conditions for $CASE$/$SUBCASE$ case"

reference = Reference, website... where the case description is available
author = Name of the person who created these driver file ; possibly name of the persons who modified the original version
version = “Created on $DATE$”
format_version = Version number of the format used for the present file
modifications = Describe modifications done with respects to initial file
script = script that generated the present file
comment = Anything useful

startDate = "yyyymmddhhmmss"
endDate = "yyyymmddhhmmss"

adv_X = `0` unactivated / `1` activated (X_adv should a variable in the file)

rad_temp = 0/1/”adv”

- `0`: radiation scheme should be activated
- `1`: radiative temperature tendency is prescribed with variable `temp_rad`
- `adv`: radiative temperature tendency is prescribed and included in temperature advection

rad_theta = 0/1/”adv”: similar to `rad_temp`
rad_thetal = 0/1/”adv”: similar to `rad_thetal`

forc_omega = 0/1

- `0`: no vertical pressure velocity is given
- `1`: vertical pressure velocity is prescribed and should be used to compute vertical advection (`omega` should be a variable in the file)

forc_w = 0/1

- `0`: no vertical velocity is given
- `1`: vertical velocity is prescribed and should be used to compute vertical advection (`w` should be a variable in the file)

forc_geo = 0/1

- `0`: No geostrophic forcing of the wind
- `1`: geostrophic forcing of the wind is activated, using latitude in `lat` axis to compute the coriolis parameter (`ug` and `vg` should be variables in the file).

nudging_X = `0`/positive integer

- `0`: no nudging
- positive integer: nudging is activated for variable `$X$` and the positive integer defines the nudging time in seconds. `$X$` is in `{temp, theta, thetal, qv, qt, rv, rt, u, v}`. `$X$_nudging` is a variable of the file.

z_nudging_X = height (in m) above which variable X should be nudged
p_nudging_X = pressure (in Pa) above which variable X should be nudged

zorog = surface altitude above sea level (in m)
z0 = roughness length (in m). Provided only if necessary
surfaceType = "ocean"/"land"
surfaceForcing = "Flux"/"surfaceFlux"/"ts"

- Flux: surface forcing with wpthetap, wpqtp,... provided
- surfaceFlux: surface forcing with sensible and latent heat fluxes provided (sfc_sens_flx and sfc_lat_flx)
- ts: prescribed surface temperature (ts is a variable of the file)

surfaceForcingWind = "z0/ustar": to be used in case surfaceForcing is Flux or surfaceFlux

- z0: constant roughness length to be used to compute ustar. z0 is provided as a global attribute
- ustar: ustar is a time-varying variable present in the file