

The LMDZ Code



Code structure : general principles, ...

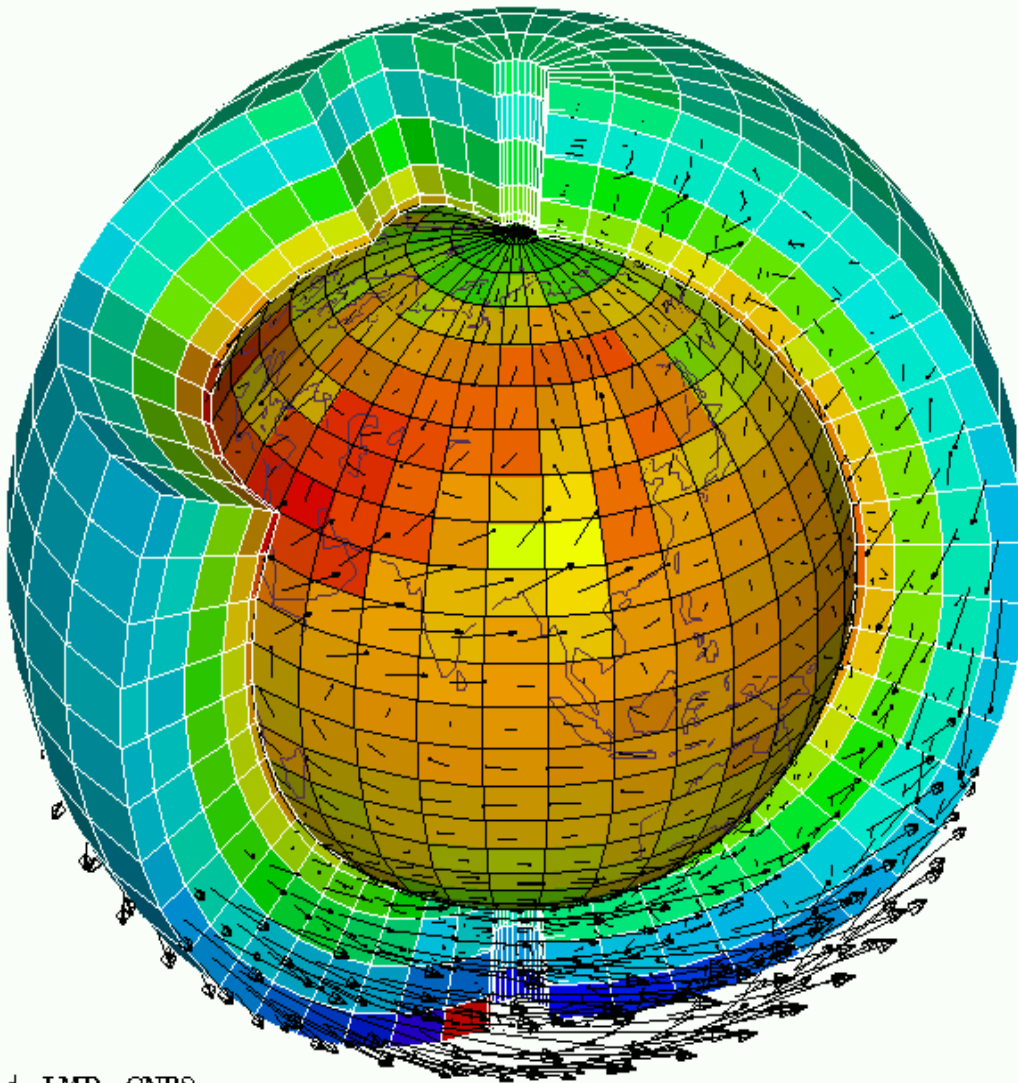


Code structure

Main principle : clear separation between the dynamical and physical modules

The dynamical module solves the general equations for atmospheric circulation

The physics module gathers all the physical parametrisations which compute the physical forcings of circulation and the details of the climate at each point of the grid
(radiation, precipitation, interfaces with surfaces, ...)



From a numerical standpoint : equations are solved on two types of grid

- a 3D grid for the dynamics
- a 2D grid for the physics

The interface between the two modules (and the two types of grids) is accomplished in a specific routine :

- « calfis.F/calfis_loc.F » in LonLat dynamical core
- « phylmd/interface_icoso_lmdz.F90 » in ICOSA_LMDZ

The LMDZ Code



The clear partition between two modules (the dynamics and the physics of the model) enables us to use the same dynamical package with different physics packages :
physics describing other planetary atmospheres
other terrestrial physics package (WRF/MAR/simplified/parametrised/idealised, ...)

This partition also allows the use of other dynamical packages (DYNAMICO, WRF, parallelised, ...) with a common physics package, the 1D LMDz model being a special case of this substitution.

The outlay of the source code reflects this partition between modules and facilitates the use of the LMDZ code in different configurations.

Switching between different dynamical cores and physics packages is facilitated by a clearly defined interface.

The code is written in Fortran. It started life as Fortran IV code but there has been a push to « rejuvenate » the code with modern syntax. A F90 compiler is used and all recent developments use F90 (at least) syntax.

In all, it represents some 1.1 million lines of code (not counting ECRAD, the external radiation code that is being tested, that will add some 200000 lines of code) in some 2900 routines .

The LMDZ Code



<https://trac.lmd.jussieu.fr/LMDZ/browser/LMDZ6/trunk#libf>

or look here

`.../LMDZseq/modips1/modeles/LMDZ`

The LMDZ Code : LonLat



DYNAMICS

dyn3d
dyn3d_common
dyn3dmem
filtrez
grid

DYNAMICS-PHYSICS INTERFACE

dynphy_lonlat

phylmd
phymars
phyvenus
phy...

PHYSICS

phy_common
phylmd
phylmdiso
phymars
phyvenus
phy...

dyn1d

misc

UTILITIES

(phy/dyn independent)

The LMDZ Code : LonLat



phy_common

- contains routines common to all physics packages phy... , e.g.:

`mod_phys_lmdz_[mpi|omp]*` (MPI/OpenMP organization)

`ioipsl_getin_p_mod` (getin_p)

`abort_physic`

`print_control` (lunout, prt_level)

`geometry_mod` (lon,lat,cell_area)

`regular_lon_lat_mod` (info on global lon-lat grid for outputs)

`mod_grid_phy_lmdz` (nbp_lon, nbp_lat, nbp_lev,
klon_glo, grid_type, nvertex)

PHYSICS

dyn1d (subdir of phy...)

- contains 1d main program (lmdz1d.F90 or testphys1d.F or rcm1d.F...) and a couple of relevant dynamical routines (links from dyn3d)

- Uses physics routines from ../phy...

phy_common

phylmd

phylmdiso

phymars

phyvenus

phy...

dyn1d

The LMDZ Code : LonLat



DYNAMICS-PHYSICS INTERFACE

dynphy_lonlat

**phylmd
phymars
phyvenus
phy..**

dynphy_lonlat

•Relies on both
dynamics and
physics:

calfis[_p|_loc]
gr_dyn_fi[_p]
gr_fi_dyn[_p]
mod_interface_dy
n_phy

phy... (subdir of
dynlonlat_phylonlat)
•contains **iniphysiq_mod**
which transfers all information from
the dynamics to the physics required
to initialize the physics (r, g, tracer
names, global grid layout, etc.)
•contains utility programs to
generate/modify/process initial
conditions, e.g. **ce0l newstart**

The LMDZ Code : ICOLMDZ



DYNAMICO

ICOSA_LMDZ

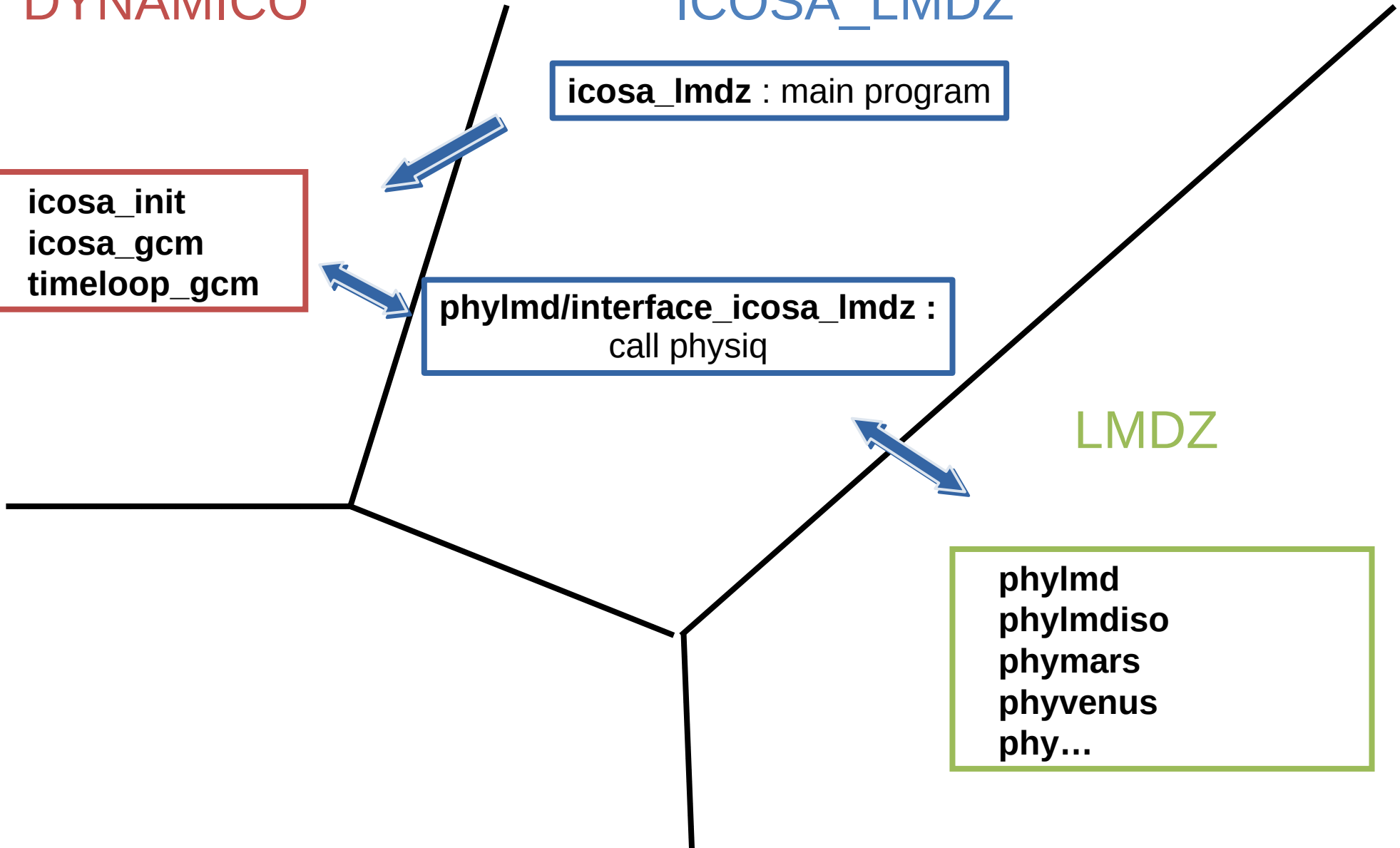
icoso_lmdz : main program

icoso_init
icoso_gcm
timeloop_gcm

phylmd/interface_icoso_lmdz :
call physiq

LMDZ

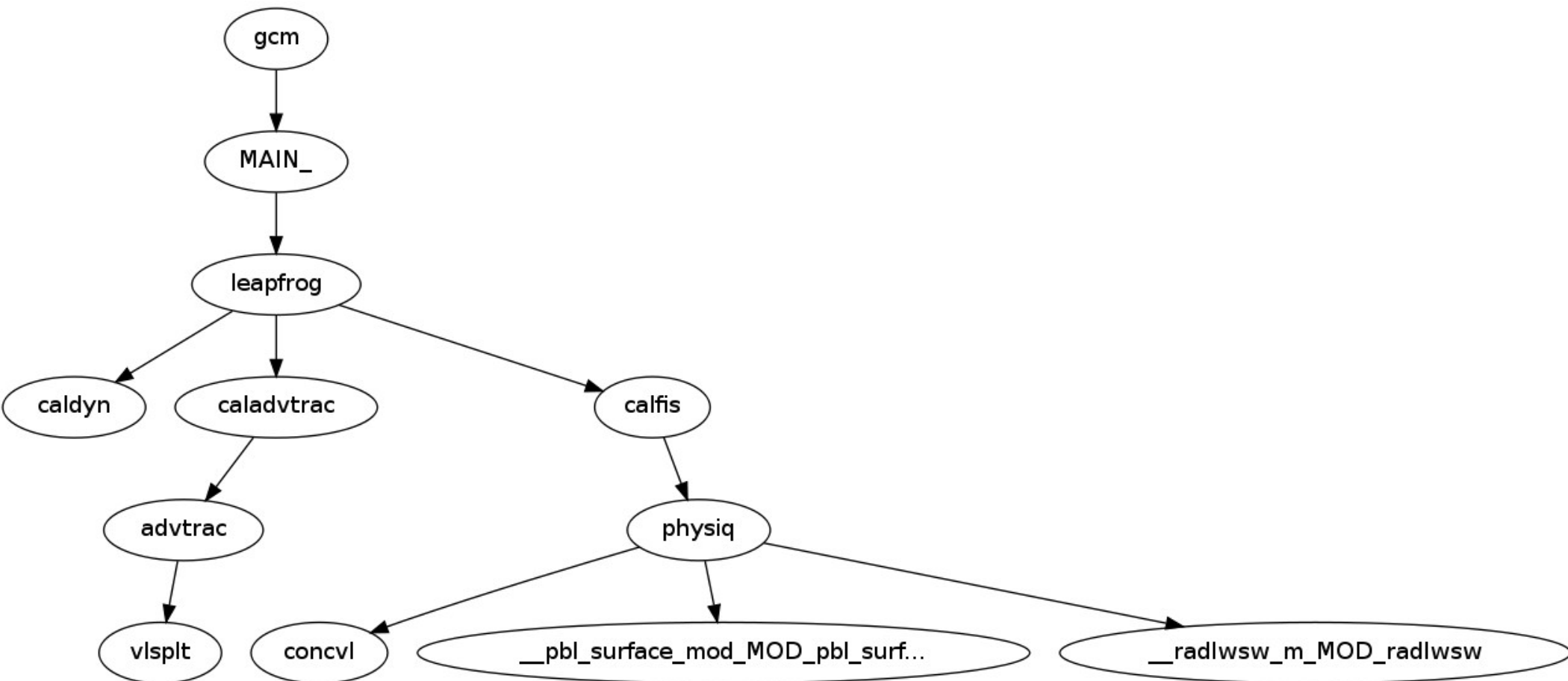
phylmd
phylmdiso
phymars
phyvenus
phy...



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Also see http://www.lmd.jussieu.fr/~lmdz/LMDZ5/doxy_201512/html/em_2gcm_8_f90.html



The LMDZ Code



55 % in physics
 20 % in dynamics
 25 % in internal routines

