The LMDZ Code

Code structure : general principles, ...

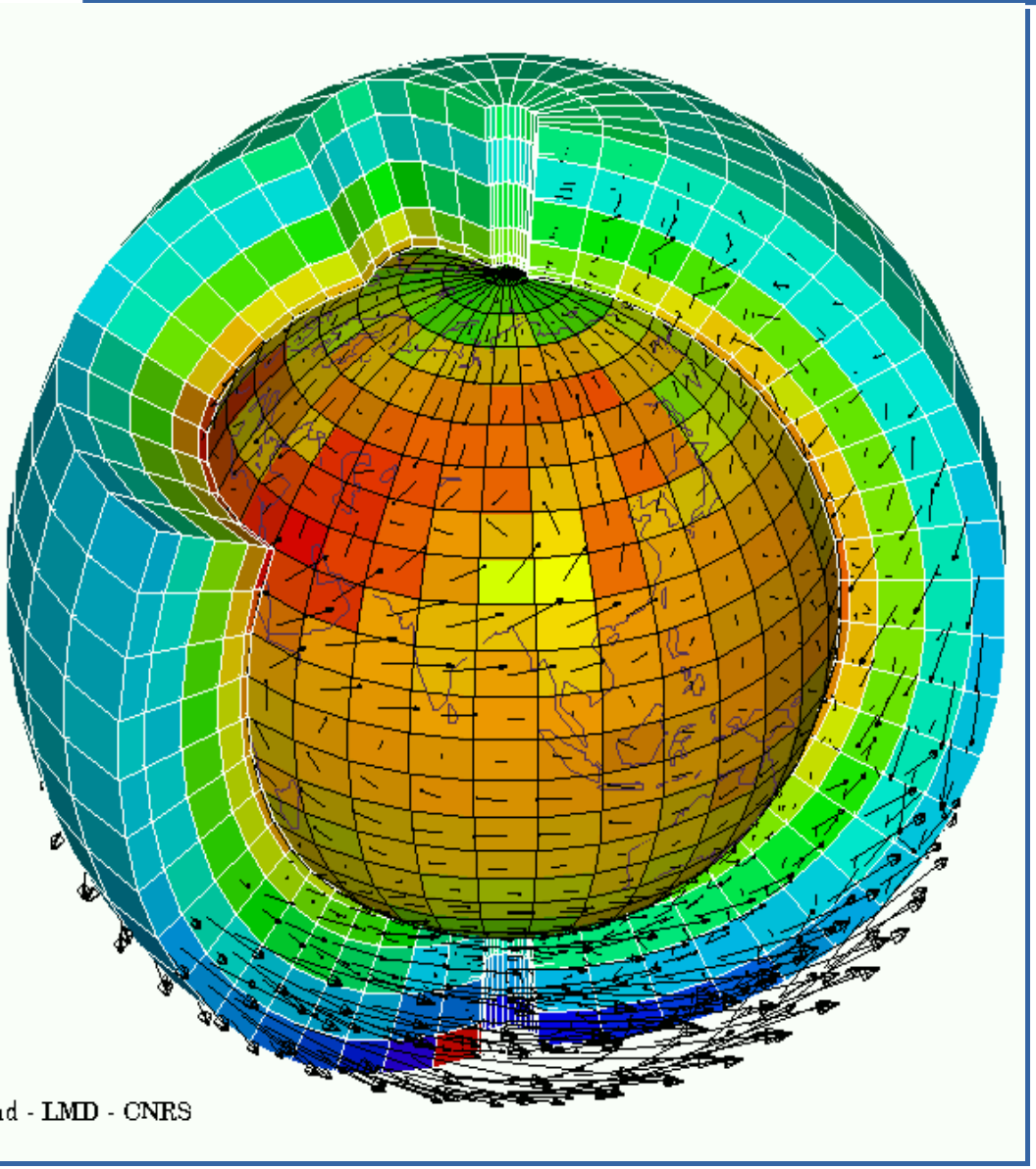
Code structure

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, …)

The LMDZ Code



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 accomplishe in a specific routine :

- « calfis.F/calfis_loc.F » in LonLat dynamical core
- « phylmd/interface_icosa_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 package : 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 a there has been a push to « rejuvenate » the code with modern syntax. A F90 compiler is used and all recent developpements 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.

Coding conventions :

https://lmdz-forge.lmd.jussieu.fr/mediawiki/LMDZPedia/index.php/LMDZ_Coding_conventions_and_guidelines

For clear and manageable code, porting and optimising purposes

The LMDZ Code

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The LMDZ Code

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

or look here

`.../LMDZseq/modipsl/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

phy_common
phylmd
phylmdiso
phymars
phyvenus
phy…

dyn1d

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)

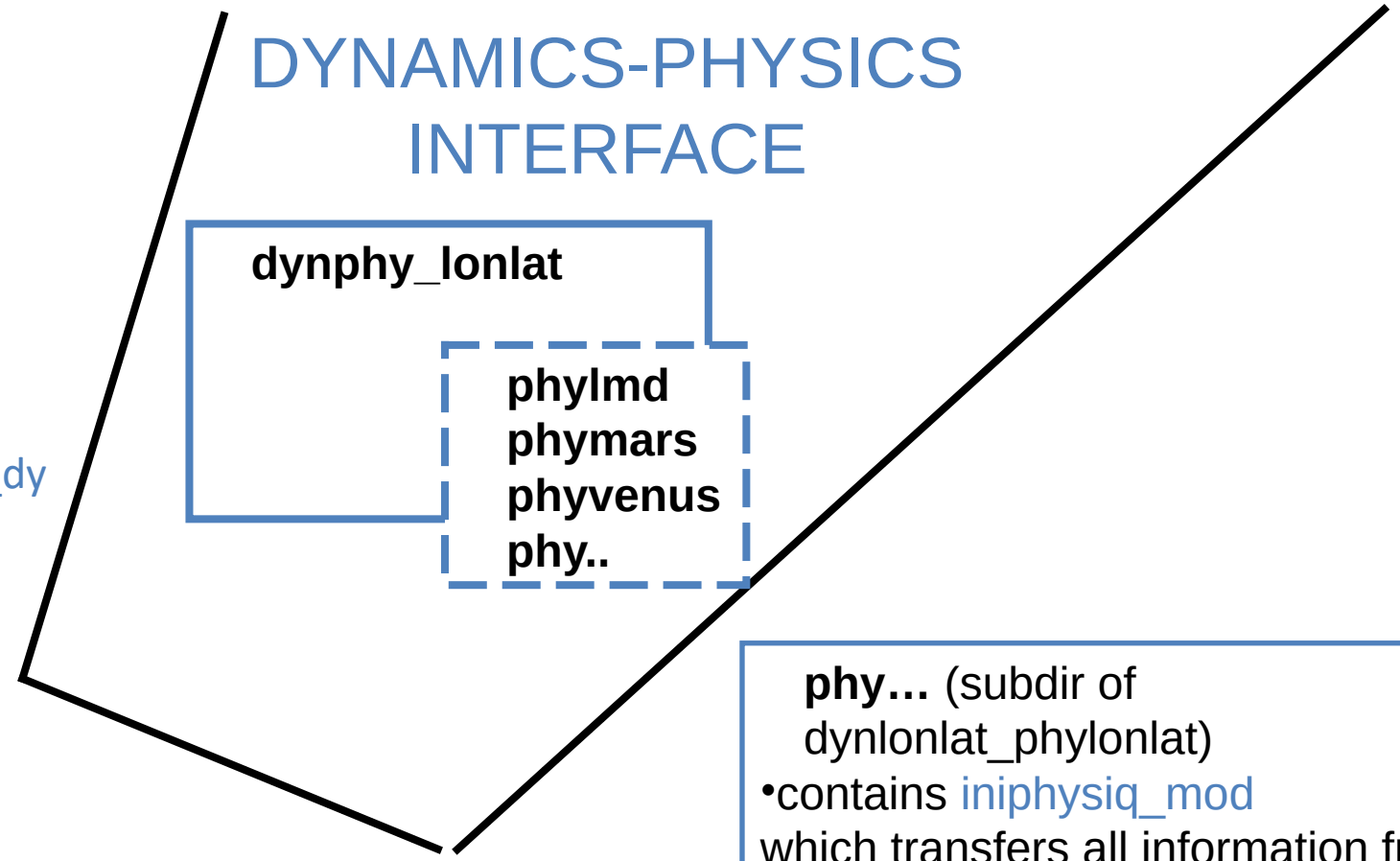
•Uses physics routines from ../phy…

The LMDZ Code : LonLat

dynphy_lonlat

•Relies on both dynamics and physics:

calfis[_p|_loc]
gr_dyn_fi[_p]
gr_fi_dyn[_p]
mod_interface_dyn_phy

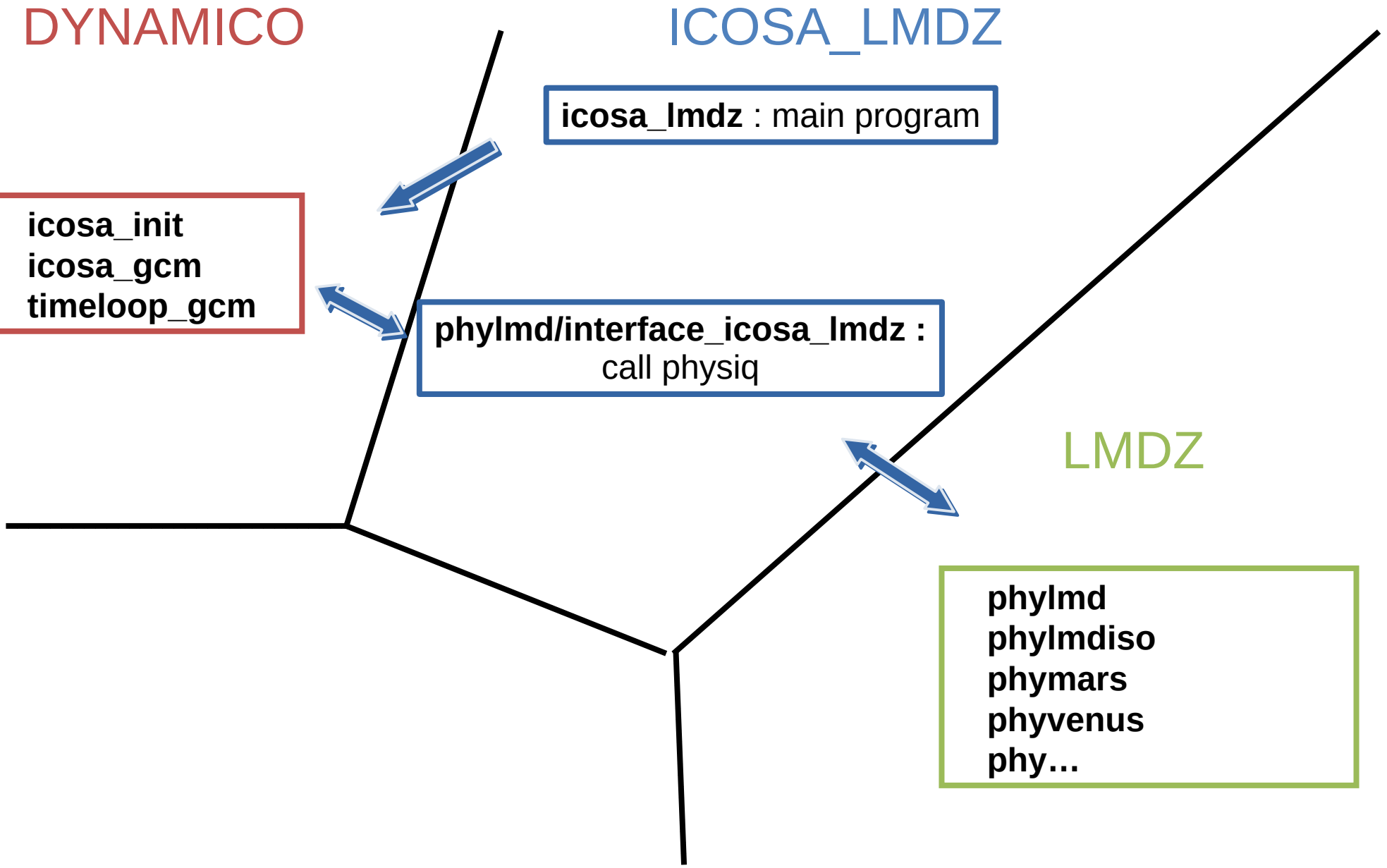


phy… (subdir of dynlonlat_phylonlat)

•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.)

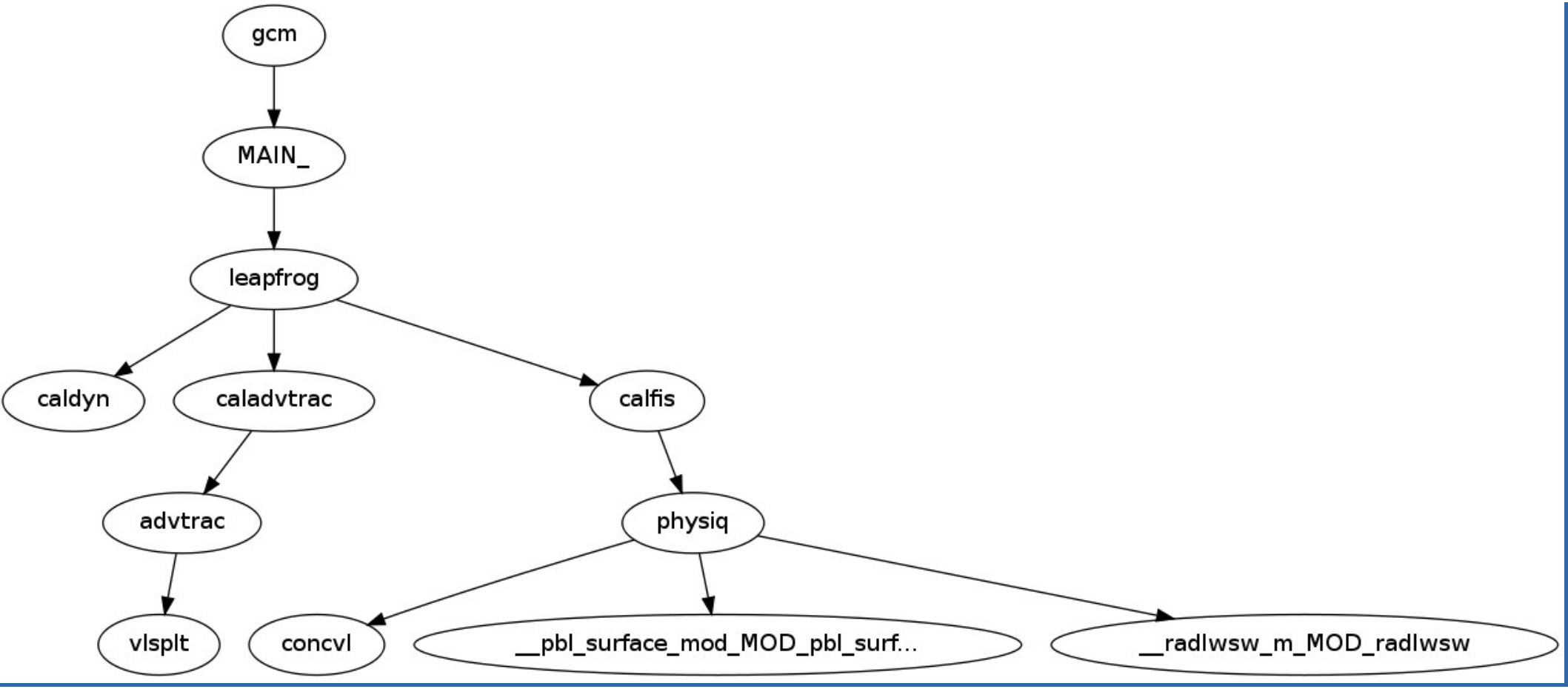
•contains utility programs to generate/modify/process initial conditions, e.g. ce0l newstart

The LMDZ Code : ICOLMDZ



The LMDZ Code

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



or https://web.lmd.jussieu.fr/~fairhead/LMDZ6_doc_FORD/lists/programs.html

The LMDZ Code

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