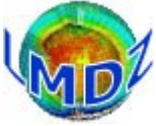


# *The LMDZ Code*

Code structure : general principles, ...



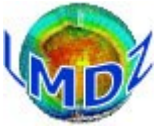
# *The LMDZ Code*

## Code structure

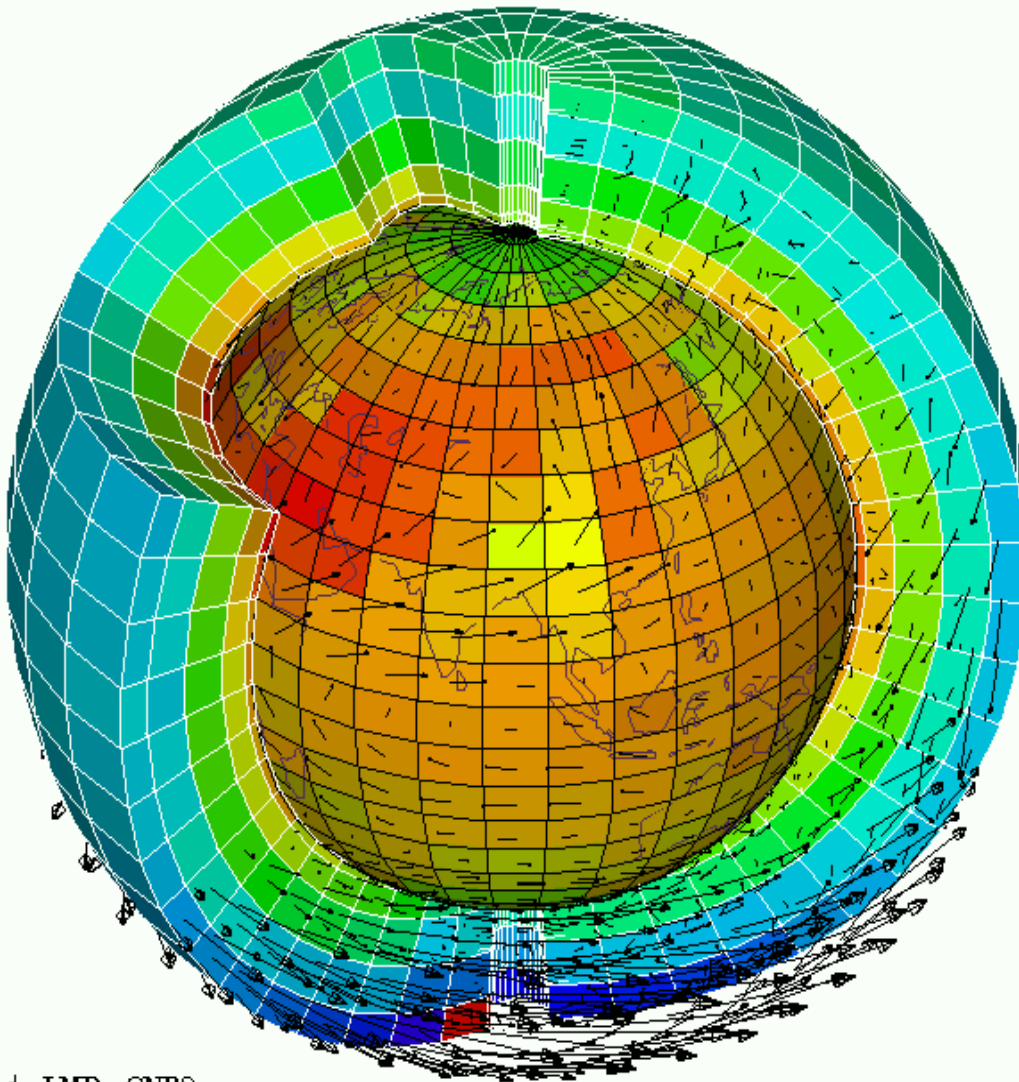
Main principle : clear separation between the dynamical and physical modules

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, ...)



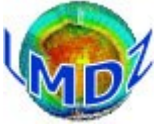
# The LMDZ Code



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 accomplished in a specific routine :  
« calfis.F/calfis\_loc.F »



# *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 :

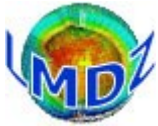
- physics describing other planetary atmospheres
- other terrestrial physics packages (WRF/MAR/simplified/parametrised/idealised, ...)

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

The layout 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, some major parts are still in « F77 » Fortran but a Fortran 90 compiler is used and all present developments are coded in Fortran 90 (at the least). In all, it represents some 760000 lines of code in some 2100 routines.

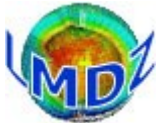


# The LMDZ Code

▶ arch	←	compilation configuration files
▶ DefLists	←	execution configuration files
▼ libf	←	Source code
▶ dyn3d	←	dynamical module (sequential)
▶ dyn3d_common	←	dynamical module (common routines)
▶ dyn3dmem	←	dynamical module (parallelised localised)
▶ <del>dyn3dpar</del>	←	dynamical module (parallelised) OBSOLETE
▶ dynlonlat_phylonlat	←	interface
▶ filtrez	←	filter
▶ grid	←	grid definition
▶ misc	←	miscellaneous utilities
▶ obsolete	←	obsolete routines for historical purposes
▶ phy_common	←	physics common modules
▶ phydev	←	physics module devt
▶ phylmd	←	physics module 3D terrestrial
▶ phymar	←	physics module MAR
▶ tools	←	utilities
000-README		
beta_crf.data		
bld.cfg		
build_gcm		
create_make_gcm		
Licence_CeCILL_V2-en.txt		
Licence_CeCILL_V2-fr.txt		
<del>makegcm</del>		
makelmdz		
makelmdz_fcm		

} → scripts needed for the compilation of the model

} → Formation LMDZ



# The LMDZ Code

## DYNAMICS

dyn3d  
dyn3dpar  
dyn3dmem  
filtrez  
grid

## DYNAMICS-PHYSICS INTERFACE

dynphy\_1onlat

phylmd  
phymars  
phyvenus  
phy...

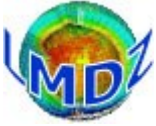
## PHYSICS

phy\_common  
phylmd  
phymars  
phyvenus  
phy...  
dyn1d

misc

## UTILITIES (phy/dyn independent)

Formation LMDZ



# The LMDZ Code

## 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

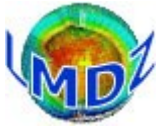
phylmd

phymars

phyvenus

phy...

dyn1d



# The LMDZ Code

## **dynlonlat\_phylonlat**

•Relies on both dynamics and physics:

calfis[\_p|\_loc]  
gr\_dyn\_fi[\_p]  
gr\_fi\_dyn[\_p]  
mod\_interface\_dy  
n\_phy

## DYNAMICS-PHYSICS INTERFACE

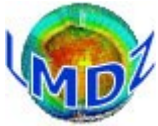
**dynphy\_lonlat**

phylmd  
phymars  
phyvenus  
phy...

**phy...** (subdir of dynlonlat\_phylonlat)  
•contains **iniphysiq\_mod**, the routine 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**, ...

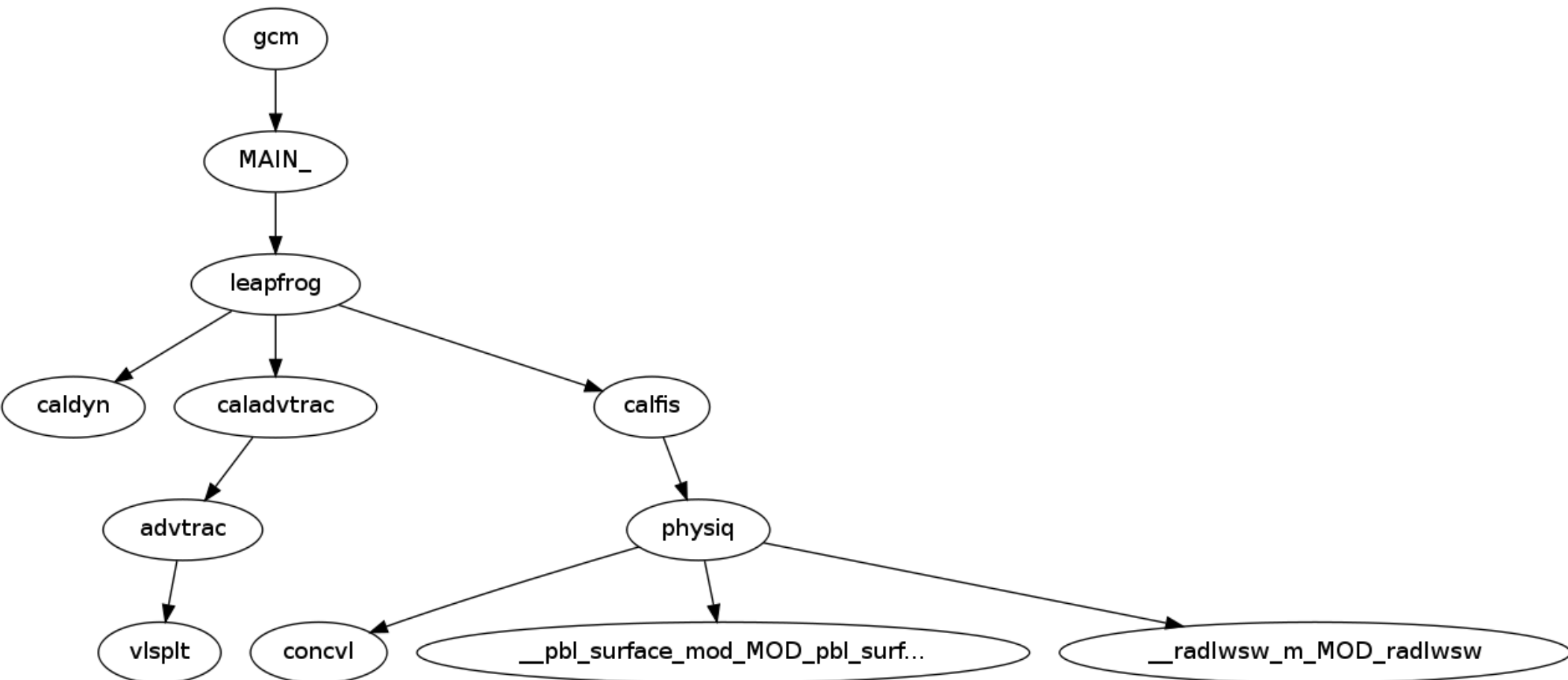
Formation LMDZ



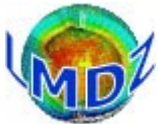


# The LMDZ Code

Also see [http://www.lmd.jussieu.fr/~lmdz/LMDZ5/doxy\\_201512/html/em\\_2gcm\\_8\\_f90.html](http://www.lmd.jussieu.fr/~lmdz/LMDZ5/doxy_201512/html/em_2gcm_8_f90.html)

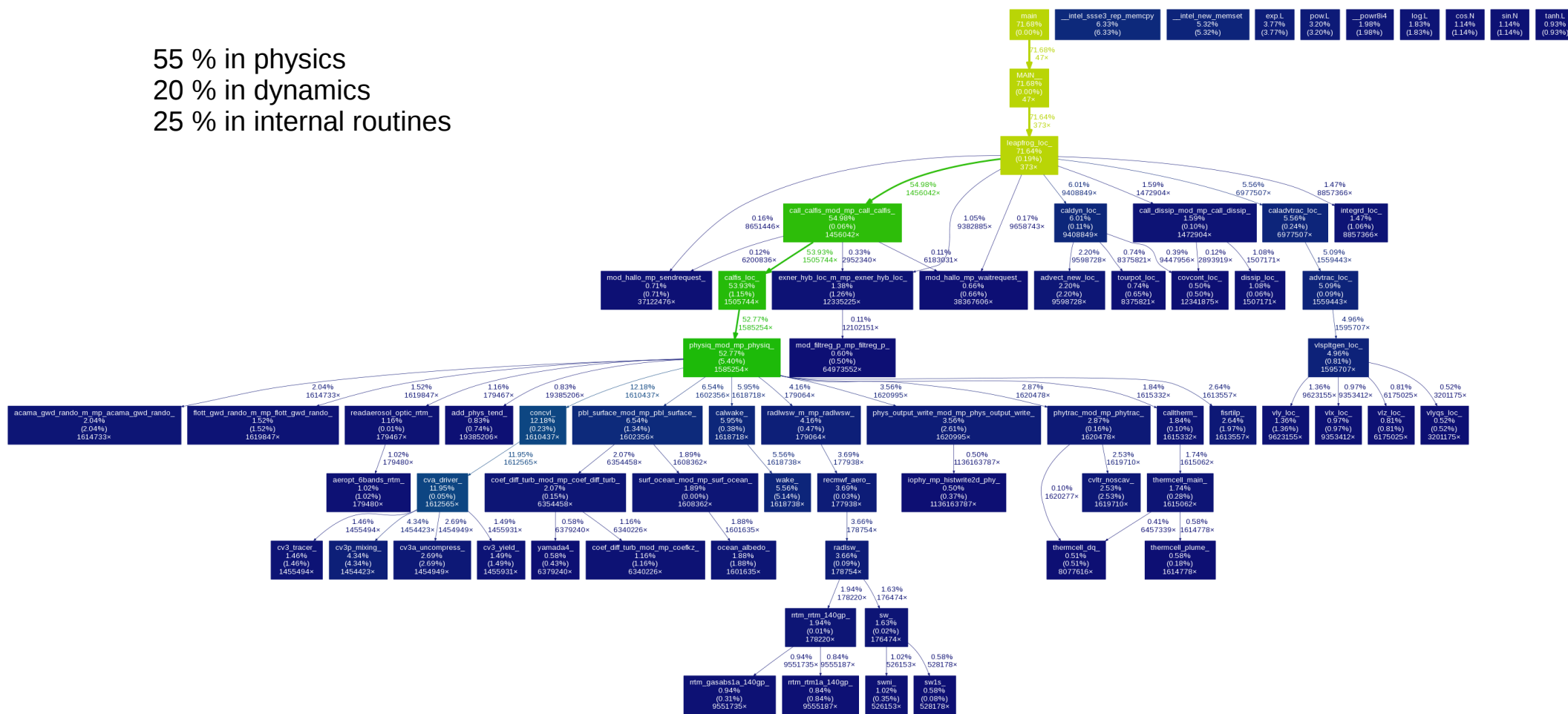


Formation LMDZ



# The LMDZ Code

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



Formation LMDZ