

# LMDZ - Planets

Some specificities about the planetary  
atmospheres GCMS

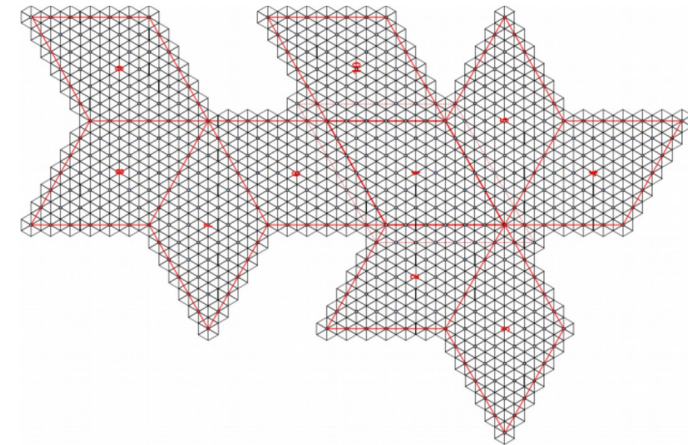
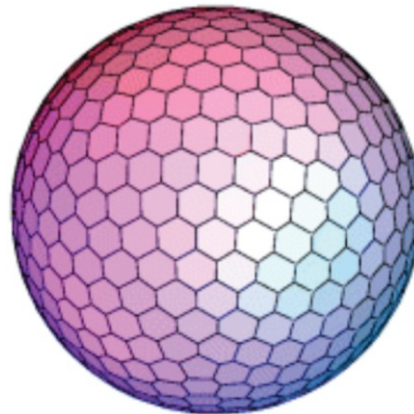
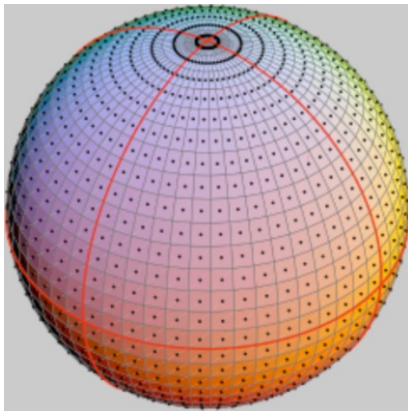
LMDZ courses, December 9, 2021

# Overview of available GCMs

- **Mars** => Derived from LMDZ3
- **Venus** => Derived from LMDZ4
- **Generic** => Derived from Mars GCM, for Exoplanets or Gas giants or early Mars, or even Earth
- **Titan** => First derived from Venus, but now from the Generic GCM
- **Pluto/Triton** (no really integrated with the rest) => derived from the Generic GCM

# Generalized planetary GCMs framework

- Share the same dynamics LMDZ.COMMON, and now also DYNAMICO (for Generic, Mars and Venus physics packages) and WRF.



- Importance of a **clean physics/dynamics** separation to handle switching from a dynamics (LMDZ/DYNAMICO/WRF) or physics package to another => see **libf**

# DYNAMICS

# DYNAMICS-PHYSICS INTERFACE

# PHYSICS

dyn3d  
dyn3dpar  
dyn3dmem  
filtrez  
grid

dynphy\_lonlat

phylmd  
phymars  
phyvenus  
phy...

misc

phy\_common  
  
phylmd  
phymars  
phyvenus  
phy...

dyn1d

UTILITIES  
(phy/dyn independent)

## 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

# DYNAMICS-PHYSICS INTERFACE

**dynphy\_\_lonlat**

**phylmd  
phymars  
phyvenus  
phy...**

**phy...** (subdir of `dynphy__lonlat`)

- 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`, ...

## **dynphy\_\_lonlat**

•Relies on both dynamics and physics:

`calfis[_p|_loc]`  
`gr_dyn_fi[_p]`  
`gr_fi_dyn[_p]`  
`inigeomphy_mod`  
`mod_interface_dyn_p`  
`hy`

# Planetary GCMs test cases (1)

- Download the install scripts from:  
<http://www.lmd.jussieu.fr/~lmdz/planets/>
- Like `install_lmdz.sh`, these scripts (`install_*.bash`) download the required NetCDF library, install it, download the model, compile it (as well as the IOIPSL library), download a testcase and run it.
- Look for the **documentation (Mars & Generic GCMs)** in `LMDZ.*/*` (a little bit also can be found in DOC), the trac <https://trac.lmd.jussieu.fr/Planeto> and also LMDZPedia: <https://lmdz-forge.lmd.jussieu.fr/LMDZPedia/Accueil>
- Check out the **.def (text) input files** distributed with the models in the `LMDZ.*/*deftank` directories
- Check out the NetCDF outputs (`diagfi.nc`, `stats.nc`, ...)

# Planetary GCMs test cases (2)

- Redo some extended simulations (change *nday* in run.def) and select outputs in `diagfi.nc` using a `diagfi.def` file (for Mars/Generic/Titan). Also check out the `stats.nc` output.
- Adapt the `arch files to compile in MPI` (see the LMDZ model tutorial, very straightforward to adapt to planetary GCMs) and learn to run using “mpirun”
- We are (slowly) moving on to `XIOS` for outputs; you might want to check out how to use it (mandatory with DYNAMICO!).
- Play with `start2archive` and `newstart` to change resolution (but it is easier to ask around for adequate initial conditions and def files).
- Also check out post-processing tools provided in LMDZ.\*\*\*/... of the models.
- If interested: Try to use the 1D version of the models.



# Mixed bag of comments & advice

- The scripts we provide are (mostly) for **illustrative examples**. You will most likely need to develop your own (no need to re-install the NetCDF, IOIPSL or XIOS library every time) and adapt to your machine's settings (e.g. **write your own "arch" files** to use "module load ..." and/or an existing installed MPI distribution... and/or...)
- Remember the "svn" (**subversion**) is your friend! Use it to regularly check for updates and check what you changed (if anything) with respect to the reference code.