Tutorial I. Installing the LMDZ model

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https://lmdz.lmd.jussieu.fr/pub/Training/Tutorials/Tutorial_1.pdf

Tutorial I. Installing the LMDZ model

To install and run the LMDZ model you need to:

1/ get source codes: netcdf, IOIPSL, (XIOS*), ORCHIDEE, LMDZ
2/ compile the codes
3/ run a bench test of 3 days

We have developped a script that does all three things:

install_lmdz.sh

but there are 2 other ways

Tutorial I. Installing the LMDZ model

There are 3 ways to install LMDZ.

Right choice depends on the machine you are using, the type of simulation (long for research projects or short for development) you run and the LMDZ vesion you need.

1) using the install_lmdz.sh script (⇒ this Tutorial)

- recommended method for Linux PC or IDRIS
- development or short test run
- new LMDZ version available every 1-2 months

2) using modipsl and libIGCM ⇒ see IPSL Training course, 30-31 January or 6-7 February 2025)

- will install one of the configurations pre-defined by modipsl, for example LMDZOR_v6
- recommended for IDRIS, TGCC, CINES and for long simulations, as it provides tested reference versions and scripts for launching and monitor long simulations.
- new LMDZOR configuration available every 6-12 months

3) *by hand*

- recommended for people aiming **challenges (!)**
- you need to develop own scripts to get source codes for each component you need (IOIPSL, ORCHIDEE, LMDZ) and link them with the netcdf library installed on your machine.

Tutorial I. Using install_lmdz.sh – Contents

install_lmdz.sh is using standard shell tools and commands (wget, gunzip, tar, gcc,...) :

- Download the required codes archives
  - ancillary libraries (netcdf, modipsl, IOIPSL, XIOS*)
  - land surface model ORCHIDEE* (if requested)
  - LMDZ using makelmdz_fcm (or makelmdz) script
- Choose adequate compiler options and build a Makefile
- Run a test bench

Further details on LMDZ version (in French), in particular the main modifications between versions:

`http://lmdz.lmd.jussieu.fr/pub/LISMOI.trunk`

Tutorial I. install_lmdz.sh options

./install_lmdz.sh -h

-v version	LMDZ version **YYMMDD.trunk**	20231022.trunk
-r release_nb	LMDZ' svn release : **release_nb/last**	----
-compiler compiler	**gfortran / ifort/ pgf90/ mpif90**	gfortran
-parallel mode	parallelism type : **none/mpi_omp**	none
-d grid_resolution	grid resolution : **nlon x nlat x nlev**	32x32x39
-bench	launch or not a test bench : **1/0**	1
-testing/unstable	LMDZ' svn branch : **testing/unstable**	testing
-name MODEL	model folder **LMDZ$version$svn$optim**	LMDZ20241121.trunk
-netcdf PATH	**0, 1 or PATH** to an existing netcdf	1
-xios	**with_xios="y"**; need **parallel=mpi_omp**	----
-gprof	compile with **-pg** to enable profiling	----
-cosp	run without, with COSP v1 or COSP v2: **NONE/v1 /v2**	NONE
-rad	RADIATIVE code : **oldrad/rrtm/ecrad**	oldrad
-nofcm	compile_with_fcm : **0/1**	1
-SCM	install **1D** version automatically : **0/1**	0
-debug	compile everything in debug mode	none
-opt_makelmdz	call **makelmdz_fcm**/makelmdz with additional option	none
-physiq	physics' package to use : **physiq.def_${physiq}**	physiq.def_NPv6.1
-env_file	**arch.env** environment file to overwrite the existing one	----
-veget	surface model to run : **NONE/CMIP6/xxxx**	NONE

Tutorial I. install_lmdz.sh script

Download the script :

```
wget http://lmdz.lmd.jussieu.fr/pub/install_lmdz.sh
```

Make it executable :

```
chmod +x install_lmdz.sh
```

Execute the script, i.e. compile the model and run a 5-days test simulation

```
./install_lmdz.sh -d 32x32x39 -name LMDZseq
```

=> modipsl.**20241121.trunk**.tar.gz => code sources

=> bench_lmdz_**32x32x39**.tar.gz => input files

Tutorial I. Code compilation

Principles:

Based on makefiles and pre-processor directives.

A unique procedure to compile the different executables (gcm, ce0l, 1d, …)

An environment which allows the compilation of different configurations (zoom, resolution, physics, …) from the same directory and source code.

An executable compiled with ORCHIDEE does not need to be recompiled to run without ORCHIDEE.

Pre-processor directives allow you to include specific parts of code in your main code. They are governed by what are called CPP keys (such as CPP_MPI, CPP_COUPLE, CPP_VEGET, INCA) that are set by the installation script.

Tutorial I. Code Compilation – the makefiles

Two different but similar scripts can be used to compile LMDZ :

- *makelmdz* : using the basic shell and our own scripts.
  - create the *dimensions.h* file using script *makdim* for the required resolution (this allows us to manage multiple resolution from the same directory)
  - create code dependencies with script *create_make_gcm*
  - create the *makefile*
  - define compilation and optimisation options
  - compile and creates the executable *gcm.e*

- *makelmdz_fcm* : used by ***MODIPSL***
  - creates the *dimensions.h file*
  - the *-arch* (needed) option determines the architecture of the target machine. Needed so as to read the right configuration file in the *LMDZ/arch* repertory
  - calls script *fcm* to generate dependencies and compile the code, creates an executable *gcm_RESOLUTION_PAR_....e*

Simple example : ./makelmdz -d 48x32x11 -v false gcm
./makelmdz_fcm -d 48x32x11 -v false gcm

Tutorial I. Compilation : main options

makelmdz main options :

[-h] :	help
[-d [[Imx]JMx]LM]:	IM, JM, LM are the x, y, z dimensions (def: 96x72x19)
[-p PHYS]:	to compile with libf/phyPHYS physics module, (def: lmd)
[-prod / -dev / -debug] :	to compile in production (default) / developpement / debug mode.
[-c false/MPI1/MPI2] :	ocean coupling : MPI1/MPI2/false (def: false)
[-v false/true] :	with or without vegetation (def: false)
[-chimie INCA/false] :	with or without INCA (def: false)
[-parallel none/mpi/omp/mpi_omp] :	parallelisation (default: none) : mpi, openmp or mix mpi_openmp
[-g GRI] :	grid definition in dyn3d/GRI_xy.h (def: regular)
[-io IO] :	choice of I/O library, left to the experts (def: ioipsl)
[-include INCLUDES] :	supplementary variables for includes
[-cpp CPP_KEY] :	supplementary CPP keys definition
[-filtre NOMFILTRE] :	use the filter in libf/NOMFILTRE (def: filtrez)
[-link LINKS] :	optional library links

makelmdz_fcm option:

-arch nom_arch : name of target architecture

Tutorial I. Choosing which LMDZ version to work with

Choose between the different available versions on the LMDZ web site:

`http://lmdz.lmd.jussieu.fr/pub/LISMOI.trunk`

Ask the LMDZ team for more information on which versions are actually used :

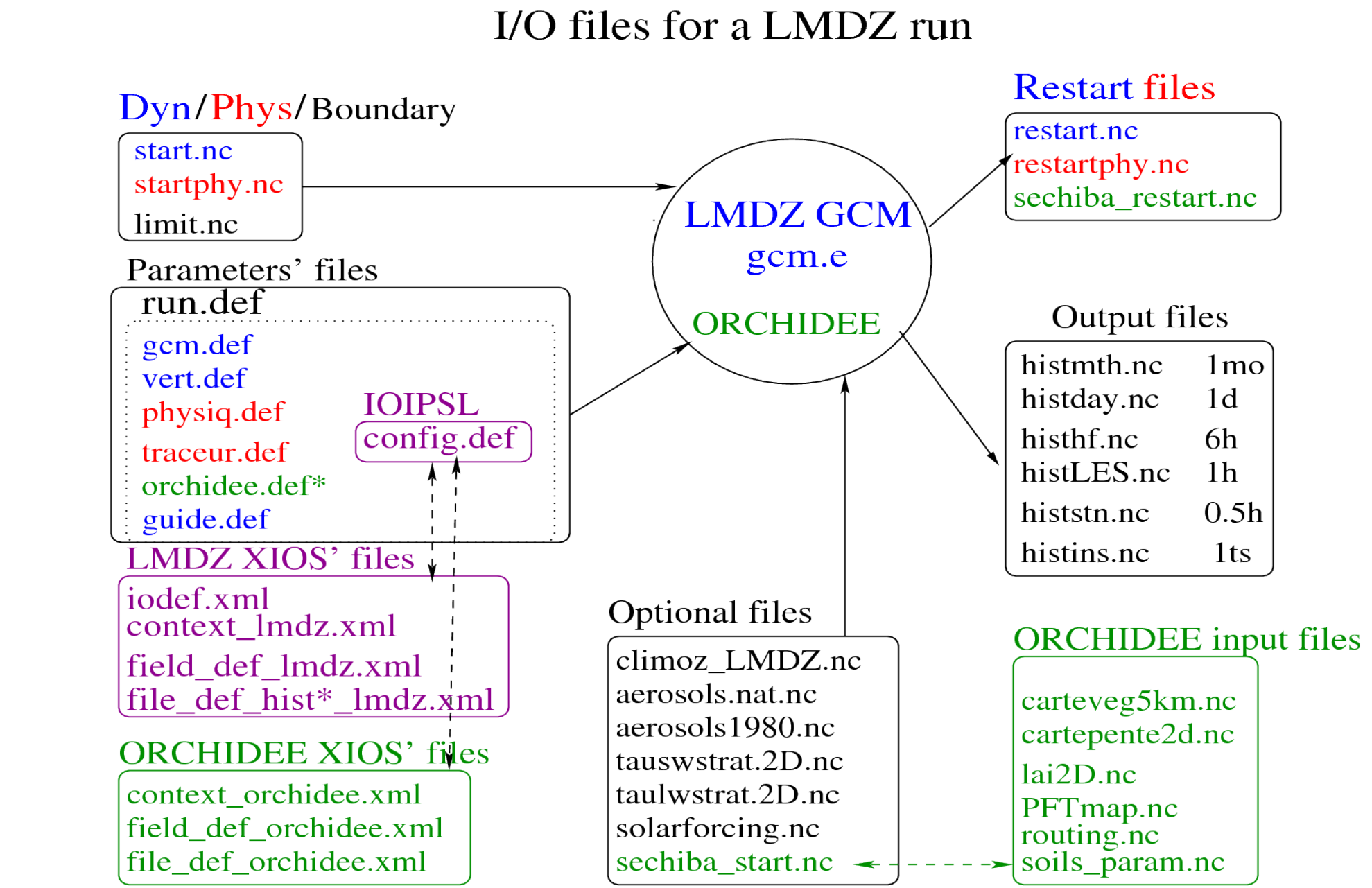
lmdz-users@listes.ipsl.fr

Tutorial I. What you need to run the LMDZ GCM (1)

- Executable (LMDZ) file :
  - gcm.e
- Parameters files
  - run.def, gcm.def, vert.def, physiq.def, traceur.def, config.def, etc
- Start files
  - start.nc, startphy.nc
    These files are created by the ce0l.e program or may be the result of previous runs
- Boundary conditions file
  - limit.nc
    Created by ce0l.e
- Some optional input files v (depending on the simulation)
  - aerosols.nc, climoz_LMDZ.nc, nudging input files (u.nc, v.nc,..), etc

v : these files have to be interpolated on the horizontal grid of the model

Tutorial I. What you need to run the LMDZ GCM (2)



Tutorial I. Running the model

```
$> cd ~/LMDZseq/modipsl/modeles/LMDZ/BENCH32x32x39
$> ls
```

gcm.e start.nc startphy.nc limit.nc config.def gcm.def orchidee.def physiq.def run.def traceur.def vert.def

```
$> ./gcm.e
```

or

```
$> ./gcm.e > listing 2>&1
```

To carry on a simulation that has been run, you have to copy the restart files obtained at the end of the previous run as new initial start files:

```
>$ mv restart.nc start.nc
>$ mv restartphy.nc startphy.nc

>$ ./gcm.e
```

Tutorial I. Has your run completed successfully ?

YES

► you will then have a message saying ***Everything is cool*** on the standard output or in the output text file.

► The code will have created 2 restart files

restart.nc and restartphy.nc

needed to carry on your run

► and some output diagnostic files

histhf.nc, histday.nc, histmth.nc, etc

to explore/view using ferret, grads, python...

Tutorial I. Has your run completed successfully ?

NO

You must find out what the problem is.
Look for an error message in the output text file (called listing here), i.e. search for one of the following keywords/phrase:

STOP, Houston, we have a problem, hgardfou, negative surface pressure, ...

Different typical errors :

- **Technical problem** : a missing input file, an error in one of the *.def or .xml file

- **Problem with the model's stability.**
  - instability in the physics are likely to be detected by **hgardfou,** which checks the model temperature has realistic values.
  - instability in the dynamics most often end up the run with a ***negative surface pressure*** (integrd routine) error message.

  ► **In any of these cases you will most probably have to adjust some flags in the .def files (modify dynamic' timestep and teta* flags for a new resolution, for example)**.

- **Otherwise you may have made some source code modifications that might not have been thoroughly tested or validated.**

Tutorial I. Installing the LMDZ model: Take-off infos

- **Install LMDZ** using **install_lmdz.sh**

wget http://lmdz.lmd.jussieu.fr/pub/install_lmdz.sh
chmod +x install_lmdz.sh
./install_lmdz.sh -d 32x32x39 -name LMDZseq

- **Re-compile** and **re-run** an LMDZ simulation : **compile.sh** and **bench.sh**

cd ~/LMDZseq/modipsl/modeles/LMDZ
./compile.sh
cd BENCH32x32x39
./bench.sh

- **LMDZ releases** : ask to lmdz-users@listes.ipsl.fr or look here

http://lmdz.lmd.jussieu.fr/pub/LISMOI.trunk