Tutorial N°2

Setting up a simulation
with a regular or zoomed grid

and options :
nudging, tracers, Orchidee, 1D, different physics,
XIOS, parallelism

LMDZ team

Practical guide :

Tutorial_2.pdf

Working directory (to be downloaded and unpacked) :

LMDZ/LMDZ20171119.trunk/modipsl/modeles/LMDZ/**TUTORIAL**

imposed

user's choice : *./install_lmdz.sh -name XXX*

user's choice : *mkdir XXX*

```
[asima@ciclad-ng TUTORIAL]$ tree
.
├── DEF
│   ├── config.def
│   ├── gcm.def
│   ├── gcm.def_96x95x39_NPv3.1
│   ├── gcm_zoom_tuto.def
│   ├── guide.def
│   ├── L39.def
│   ├── L47.def
│   ├── L79.def
│   ├── orchidee.def
│   ├── PHYS
│   │   ├── physiq.def_AR4
│   │   ├── physiq.def_NPv0.0
│   │   ├── physiq.def_NPv1.0
│   │   ├── physiq.def_NPv2.0
│   │   ├── physiq.def_NPv3.0
│   │   ├── physiq.def_NPv3.1
│   │   ├── physiq.def_NPv3.2
│   │   ├── physiq.def_NPv4.12
│   │   ├── physiq.def_NPv5.17h
│   │   ├── physiq.def_NPv5.4
│   │   ├── physiq.def_NPv5.5
│   │   ├── physiq.def_NPv5.65
│   │   ├── physiq.def_NPv5.67
│   │   ├── physiq.def_NPv5.70
│   │   ├── physiq.def_NPv5.80b
│   │   ├── physiq.def_NPv5.80bz0
│   │   ├── physiq.def_NPv6.0.10
│   │   ├── physiq.def_NPv6.0.10fallv
│   │   ├── physiq.def_NPv6.0.11trigB
│   │   ├── physiq.def_NPv6.0.12
│   │   ├── physiq.def_NPv6.0.12split
│   │   ├── physiq.def_NPv6.0.12ttop
│   │   ├── physiq.def_NPv6.0.7
│   │   ├── physiq.def_NPv6.0.8
│   │   └── physiq.def_NPv6.0.9
│   ├── physiq.def
│   ├── Readme
│   ├── run.def
│   └── traceur.def
├── get_era.sh
├── init.sh
├── Readme
├── reb.sh
├── run_local.sh
└── run_X64_ADA.sh
```

Content of working directory TUTORIAL (1/3)

Readme

```
In the current directory, you may
 1/ compile the model
 2/ create initial and boundary conditions on a zoomed (or regular)
      grid
 3/ run the model

Contains :
==========

init.sh : main script that
 1/ creates initial state and boundary conditions -> INITIAL
 2/ prepares a first simulation -> SIMU1

DEF : contains default files .def for setup parameters

get_era.sh : interpollation of ERA reanalysis on the model grid
reb.sh : to "rebuild" outputfile for parallel computation with IOPSL
run_local.sh : a script to run the model (important for parallel
computers)
run_X64_ADA.sh : the same for the ada supercomputer at idris.

NB: If you modify the horizontal resolution of LMDZ you should
    modify parameters like day_step and iphysiq in order to satisfy
    the CFL criteria.
    Also you need to change the tetagdiv, tetagrot,tetatemp
    parameters.
```

```
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│   │   ├── physiq.def_NPv3.2
│   │   ├── physiq.def_NPv4.12
│   │   ├── physiq.def_NPv5.17h
│   │   ├── physiq.def_NPv5.4
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│   ├── physiq.def
│   ├── Readme
│   ├── run.def
│   └── traceur.def
├── get_era.sh
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├── run_local.sh
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```

Content of working directory TUTORIAL (2/3)

DEF directory : Parameter files *.def for 3D simulations

run.def : general configuration file :
**.def* files to use, calendar type (*earth_360d,365d,366d*), restart year, number of days to run *nday* etc

config.def : output, coupling, RRTM, orb. par.,GHG, aerosol eff, O_3 etc
gcm.def : grid-dependent param. (day_step, iphysiq, zoom, dissipation) etc.
physic.def : version-specific set of param. (here the 'NPv6.0.12split')
PHYS/physic.def_XXX : available versions of physic.def

guide.def : nudging param.
traceur.def : tracer nb., transport processes, name
orchidee.def : parameters for land model Orchidee
L39, L47, L79.def : vertical discretization etc.

Also seen in run.def : ../DefLists/output.def : output configuration (variables)

See DEF/Readme for details on physic.def_XXX files and references **!**
Hourdin et al., Clim. Dyn (2006, 2013a, 2013b)

```
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```

Content of working directory TUTORIAL (3/3)

Scripts

init.sh : main script

run_local.sh :
run in parallel & rebuild output on local machine

run_X64_ADA.sh :
same thing on “ADA” supercomputer at IDRIS

reb.sh : rebuild output, if running in parallel mode

get_era.sh : for nudging :
retrieve and interpolate ERAI reanalysis files

Content of main script init.sh

Remember from TUTORIAL/Readme :

```
init.sh : main script that
 1/ creates initial state and boundary conditions -> INITIAL
 2/ prepares a first simulation -> SIMU1
```

init.sh (1/2)

```
############################################################
0. Setup
############################################################
# standards : 96x95x39, 144x142x79
grid_resolution=48x36x39
an=clim
veget=0
parallel=0
mpi=4
omp=2
machine=local
rrtm=1

############################################################
1. Model Compilation (parallel/sequential; consistent with install)
############################################################
```

init.sh (2/2)

```
2.Creating initial state and boundary conditions : start.nc, startphy.nc, limit.nc
#############################################################################
        2.1  Getting input files from the web
        ..................................................
   In TUTORIAL, it creates the directory INITIAL
   It copies in it the necessary files
 ECDYN.nc
 Albedo.nc,Relief.nc,Rugos.nc,landiceref.nc,amipbc_sic_YYYY.nc,amipbc_sst_YYYY.nc
        ..................................................
        2.2 Running ce0l.e  (output listing in ce0l.out)  :
It produces initial files start.nc, startphy.nc, and boundary cond. limit.nc
        ..................................................
        2.3 Creating a figure for the grid : grid.pdf
#####################################################
3. Creating a simulation directory (for the case without Orchidee : veget=0)
#####################################################
   In TUTORIAL, it creates the directory SIMU1
   It copies in it the DEF/*def files, and creates links to other necessary files
        (TUTORIAL/gcm.e, TUTORIAL/INITIAL :start.nc, startphy.nc and limit.nc )

NB : In the case veget=1, a preliminary simulation SIMU0 is created and run
to produce the initial files start, startphy and sechiba_rest_in
#####################################################
4. Printing instructions for running the simulation (ex: cd SIMU1 ; ./gcm.e )
   Wishing you to « enjoy it »
```

Steps for setting up a simulation

0) Download and unpack tutorial.tar

1) Check *.def files, set your desired parameters
Here in particular : the zoom parameters in gcm.def

2) Check/modify setup parameters in init.sh script : grid_resolution, veget, parallel

3) run : ./init.sh ; pay attention at its final instructions about how to run the model

4) check the results :
- visualize grid.pdf , or plot "grille_s" variable from INITIAL/grilles_gcm.nc
- verify that start.nc, startphy.nc and limit.nc files were created in TUTORIAL/INITIAL
and the links to those files in TUTORIAL/SIMU1 are OK
IF NOT : Ask for Help

(*Possible Solution :* ulimit -s unlimited , and in TUTORIAL/INITIAL run : ./ce0l)

Now you can run the model : in SIMU1, run : ./gcm.e
and visualize the results : output files in SIMU1: histhf.nc and histday.nc

Proposed exercises :

Nudging

Tracers

Orchidee

1D

Different physics

Parallelism

XIOS

Optional exercise : Nudging (1/2)

In TUTORIAL :

1) run the script get_era.sh, that :

-> creates the directory GUIDAGE (i.e. “nugding” in French)
-> retrieves in it the ERAI files for wind components u& v
-> interpolates them on the LMDZ grid => files u.nc and v.nc
(in ferret, using the INITIAL/grilles_gcm.nc file)

NB : Tutorial_2.def contains info about :
-> accessing ERAI files at computing centers IDRIS, CCRT and Climserv
-> getting more complex scripts for dealing with multiple months&years

2) create a new simulation directory : SIMU1_nudged ;
copy in it, or establish links to the needed files : *def, initial, limit, u&v

Optional exercise : Nudging (2/2)

In TUTORIAL/SIMU1_nudged :

1) Have a look at guide.def :

```
ok_guide=y
guide_u= y
guide_v= y
guide_T= n
guide_P= n
guide_Q= n
tau_min_u=0.0208333
tau_max_u=0.125
tau_min_v=0.0208333
tau_max_v=0.125
```

Relaxation time :

tau_max=0.125 days = 3h inside the zoomed area
tau_min=0.0208333 days= 30 min outside zoom

2) In run.def, add line : `INCLUDEDEF=guide.def`

3) Run the model : ../gcm.e > listing

4) Check nudging effect : compare output winds with nudging winds u.nc and v.nc, and with non-nudged run SIMU1

Optional exercise : LMDZ coupled with ORCHIDEE

Follow instructions in Tutorial_ORCHIDEE.pdf to :

-> Prepare a simulation with ORCHIDEE using init.sh

-> Perform some exercises :

Run with ORCHIDEE 2-layers
Run with ORCHIDEE 11-layers
Run with ORCHIDEE 11-layers newer version (~CMIP6)

Disable ORCHIDEE even if you compiled with it,
to run with « bucket » scheme as done in SIMU1 :
change parameter VEGET=y --> VEGET=n in config.def

Run with bucket scheme and imposed soil water content