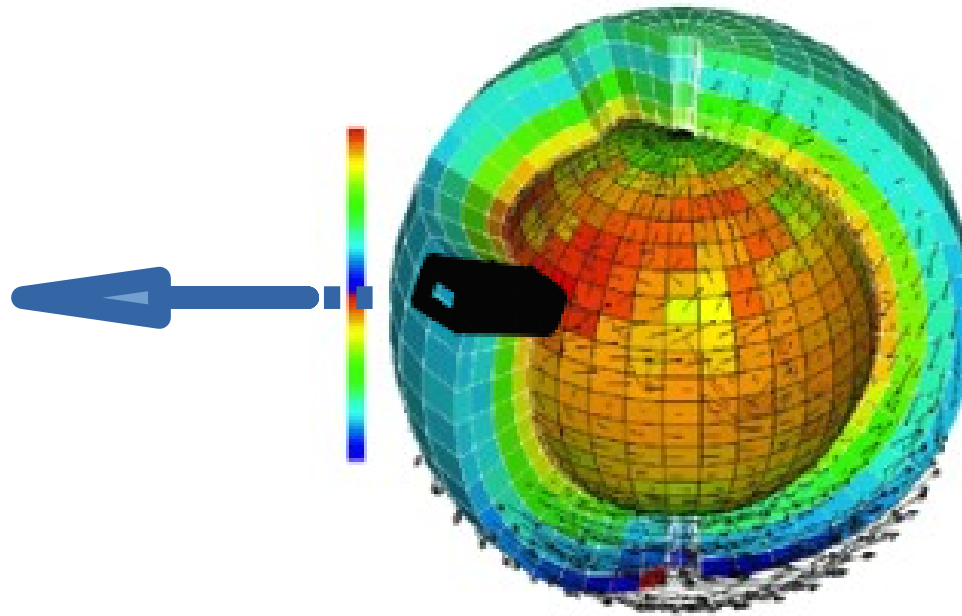


The LMDZ1D SCM (Single Column Model)

The LMDZ team
2026 Training Session

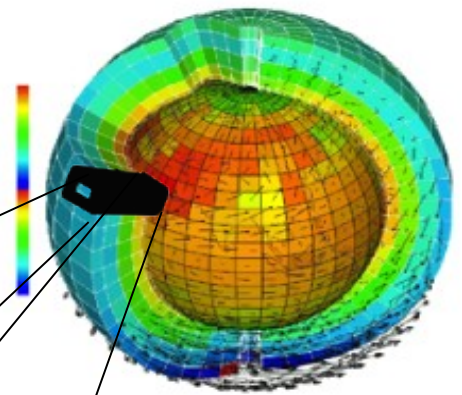


Why running LMDZ in a 1D (single column) mode ?

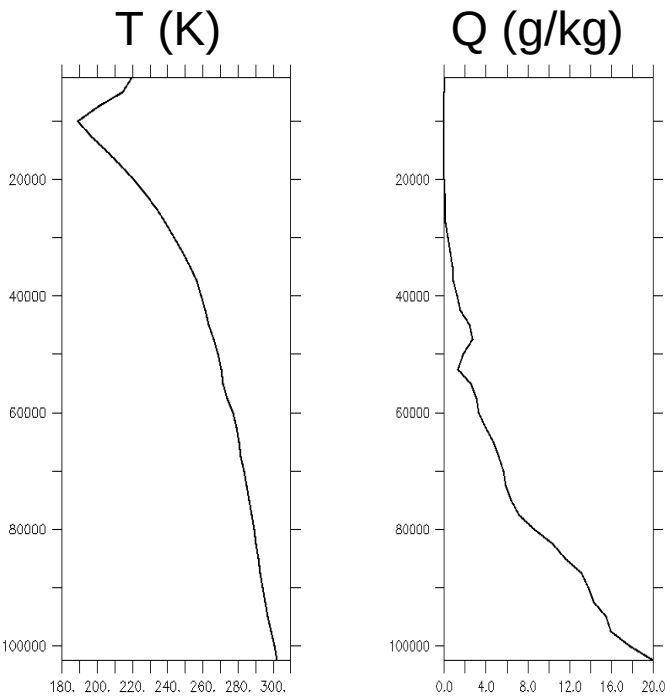
- To evaluate/develop the physical part of the model regardless of the dynamical part → central in the model development process
- To make quick sensitivity tests
- To carry out process-oriented studies
- To tune the model (see F. Hourdin's presentation)
- For teaching purposes

.....

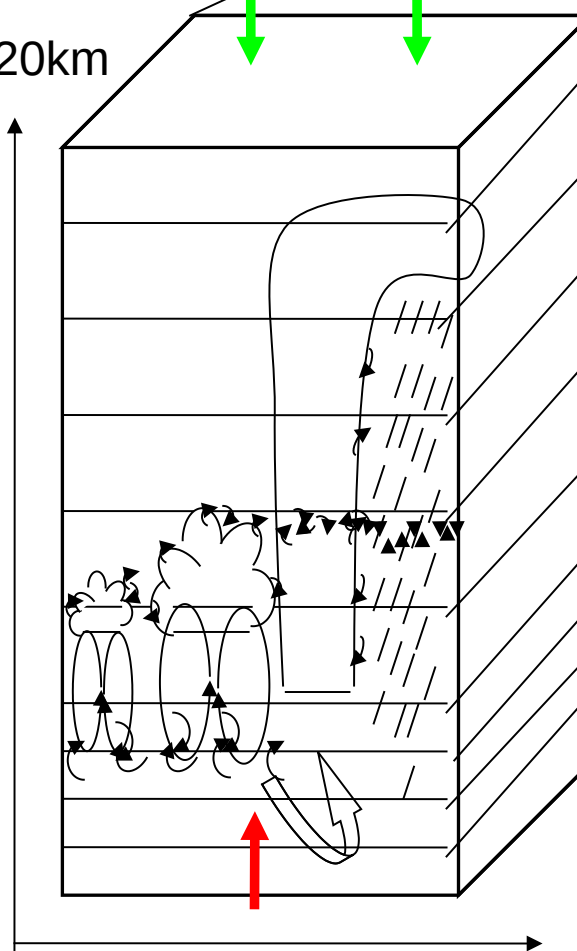
LMDZ in 1D (1 column) mode



1/ Initial conditions:



$z \sim 20\text{km}$



$\Delta x =$
20-300 km

3/ Large scale forcings

Temperature, humidity,
Wind advection

2/ Surface conditions:
Surface fluxes or
Surface temperature

The 1D 'case' concept

A 'case' is :

- a set of initial conditions
- a set of lateral (and sometimes surface) forcings
- surface properties

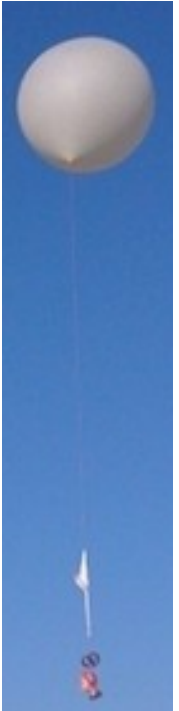
Note that, as the large scale dynamics is prescribed through forcings, 1D 'cases' make it possible to thoroughly explore and assess the 'physics' of the model

Different 'cases ' have been built - with different degrees of idealisation - to study various aspects of the physics (clouds, deep convection, boundary-layer dynamics ..)

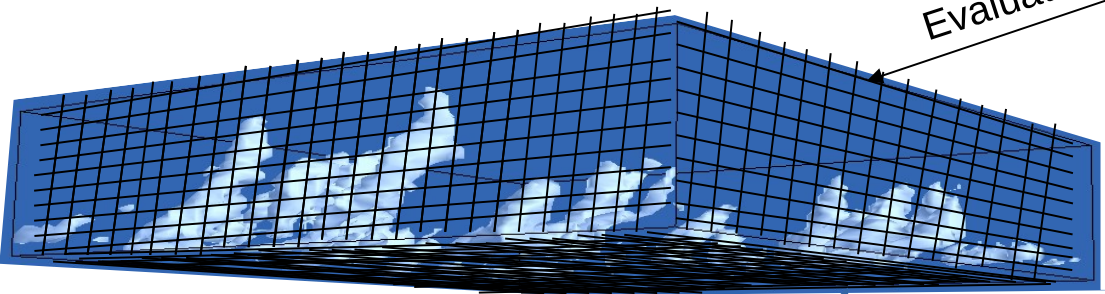
How 1D cases are built ?



Observation



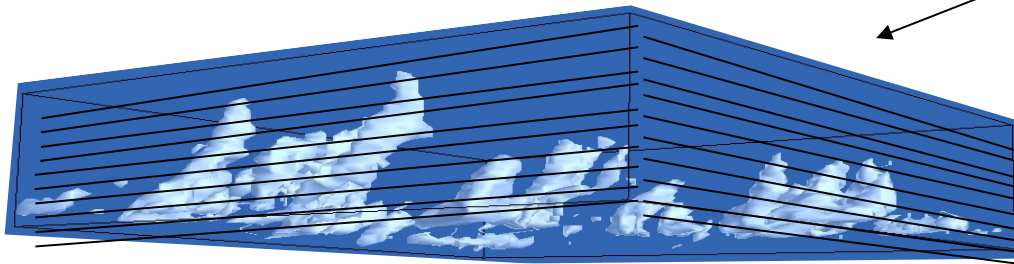
Evaluation



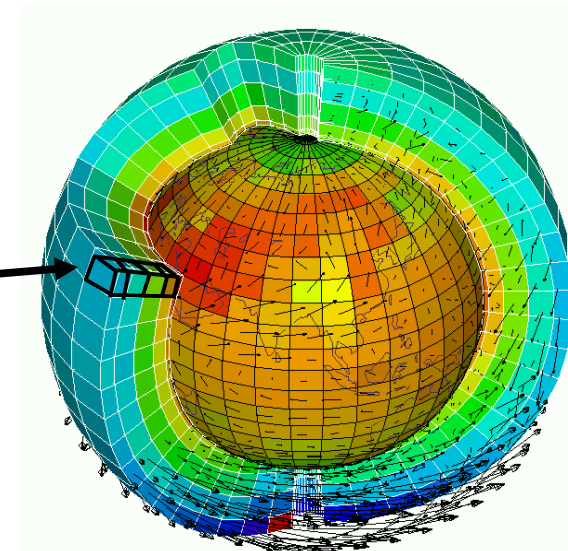
Explicit simulations, Grid cell, 20-100 m

Evaluation

« Large scale »
conditions
imposed



Climate model, parameterizations, « single-column » mode



Courtesy F.Hourdin

Available cases correspond to different meteorological situations

Dry and shallow convection

ARMCU (diurnal cycle of shallow cumulus over land)

RICO (Rain In Cumulus over Ocean,
shallow precipitating cumulus over sea)

AYOTTE (convective boundary layer, sky clear)



Stratocumulus and transition to cumulus

SANDU (transition case with 3 options : variation of SST)

FIRE (diurnal cycle of stratocumulus)



Deep convection over ocean:

Toga

case_e (part of Toga)

TWPICE : off the coast of Darwin



Deep convection over land:

Hapex : african monsoon

AMMA : african monsoon

Idealized case:

eq_rad_conv (RCE) : radiative
and convection scheme active

DICE case : characterize boundary layer
In the site of SGP during 3 days/nights
May be coupled with soil model



Cindy Dynamo case (Madden Julian
Oscillation study, intraseasonal
variability in the tropical atmosphere)

.....



GABLS4 case : interaction of a
very stable boundary layer with a
snow surface

**MPACE, ISDAC and
COMBLE** cases : mixte phase in
Arctic. Shallow convection with
Stratocumulus developing at the
top of boundary layer

How to install 1D model ?

```
cd LMDZ*****
```

```
git clone https://gitlab.in2p3.fr/ipsl/projets/lmdz/1D 1D
```

```
cd 1D
```

```
./run.sh (COMPILE the model and run the cases)
```

Have a look in run.sh

Which case(s) ?

```
listecas="ARMCU/REF bomex "
```

Which physics ?

```
listedef="6A"
```

Number of levels ?

```
LLM="79" # imposing the number of vertical level (default 79)  
# default values for various cases are defined bellow
```

```
day_step="" # number of physical steps per day  
flag_output_commun="1"
```

Common input and output format

We've defined an international common format for forcings and output files.

<https://github.com/GdR-DEPHY/DEPHY-SCM>

For cases which are up to date in CAS: ARMCU, AYOTTE, BOMEX, COMBLE, DYNAMO, GABLS1, GABLS4, IHOP, ISDAC, MPACE, RICO, SANDU, SCMS

Each forcing file (netcdf file) can be regenerated with python scripts and the dephycf library (see howto on the webpage)

- forcing file is cas.nc (standardized format)

- output files are histhf.nc, hourly.nc (LMDZ format)

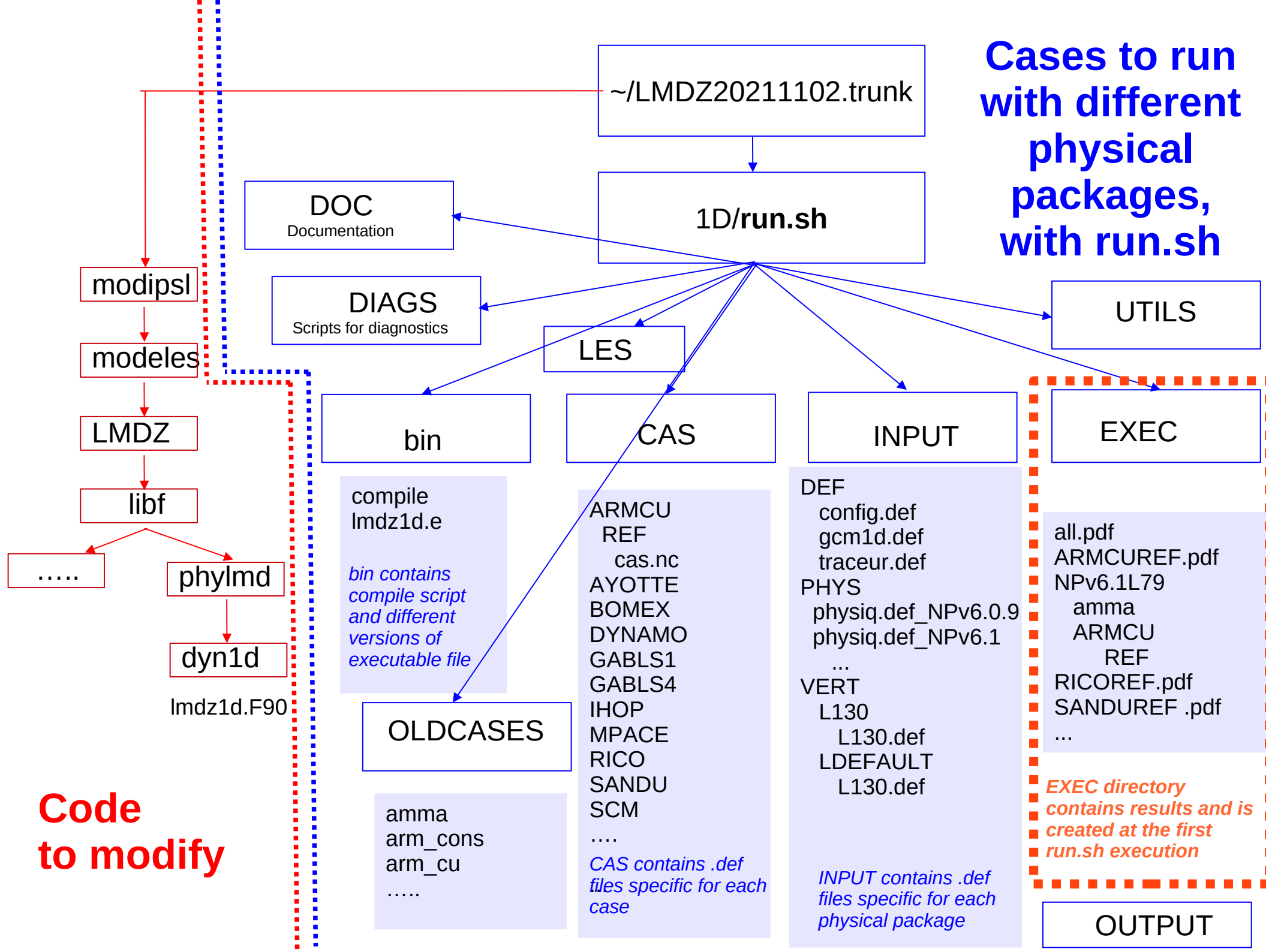
AND hourly_std.nc (standardized format)

For the other and older cases in OLDCASES :

- + forcings file is case_name.nc or prof.inp.001

- + output files are histhf.nc or hourly.nc

**Cases to run
with different
physical
packages,
with run.sh**



Results : in ~/1D/OUTPUT

all.pdf

ARMCUREF.pdf

NPv6.1L79/

RICOREF.pdf

SANDUREF.pdf

SAVE41389/

~/1D/OUTPUT/NPv6.1L79/ARMCU/REF

histhf.nc

hourly.nc

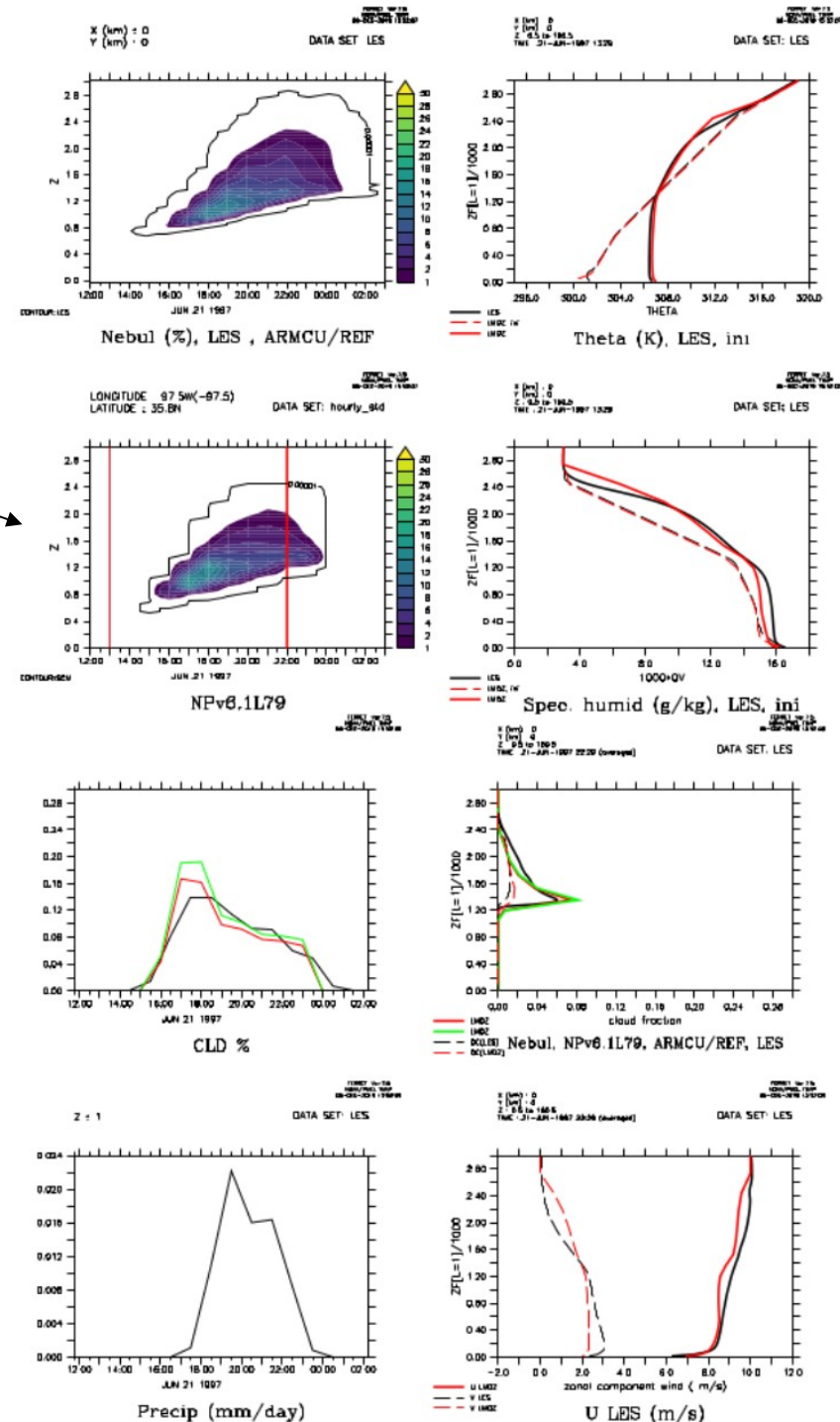
hourly_std.nc

LES.nc

+ some pdf files

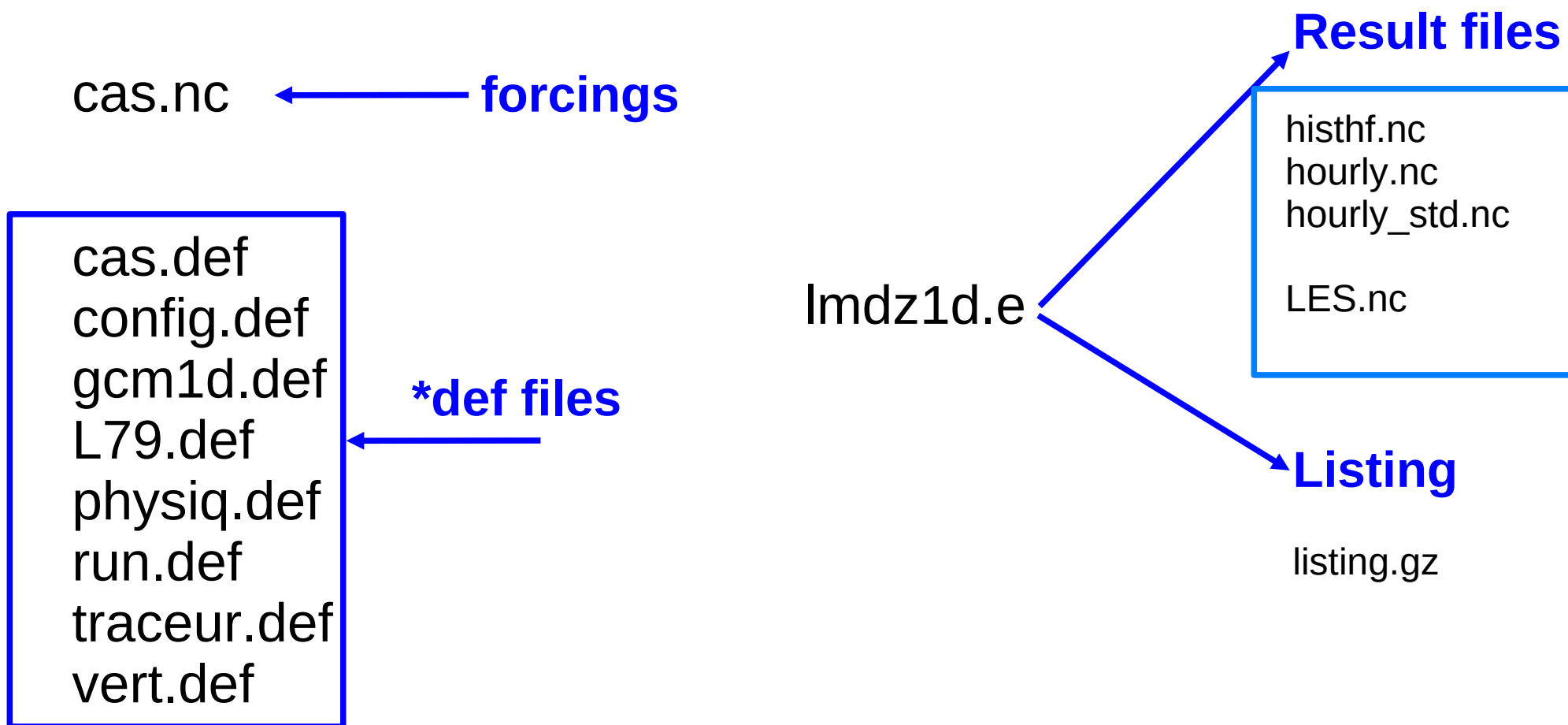
~/1D/EXEC

Same than OUTPUT + All the files used to run the case : forcings, .def files, listing ...



Where are the results ?

In LMDZ20211102.trunk/1D/EXEC/NPv6.1/ARMCU/REF

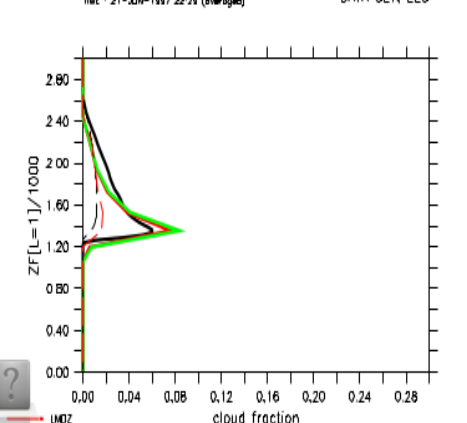
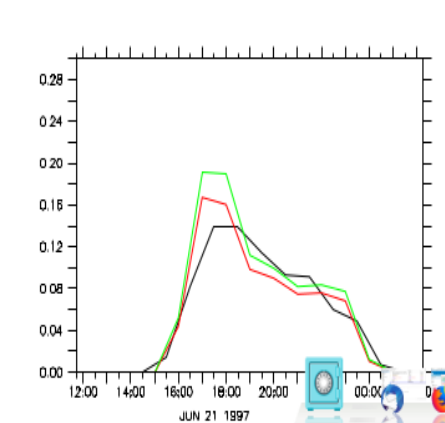
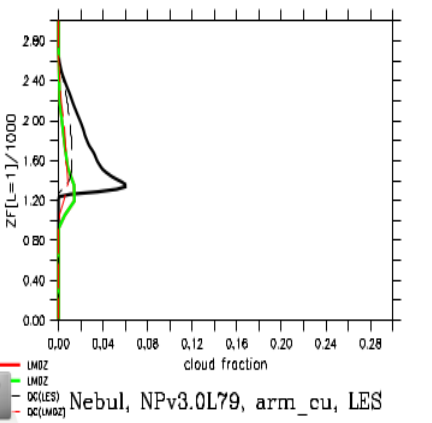
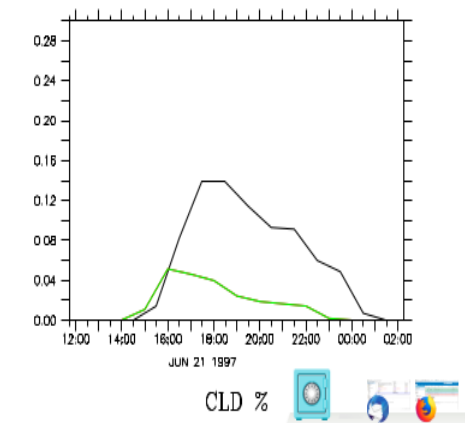
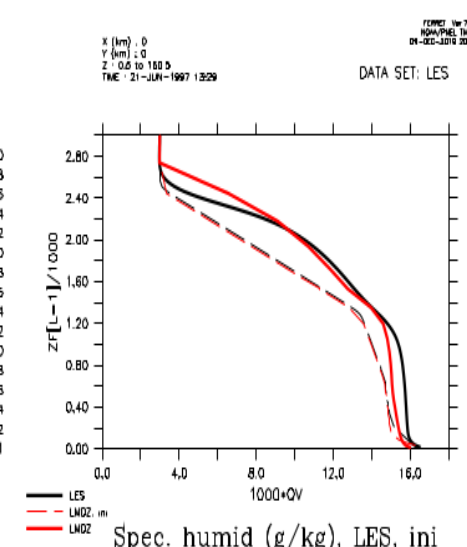
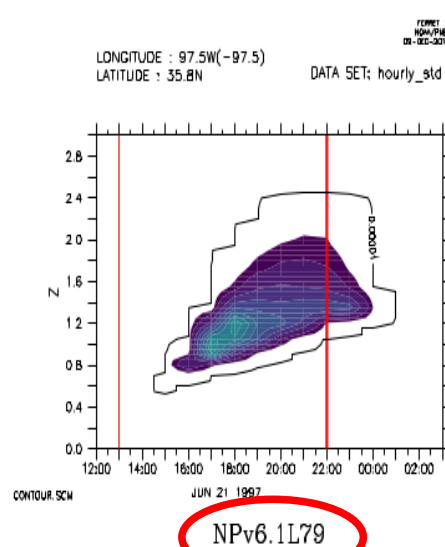
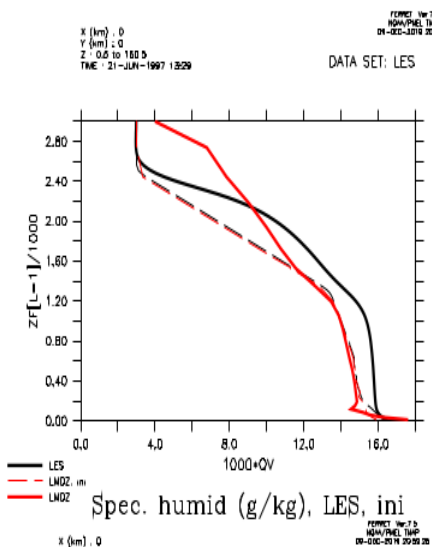
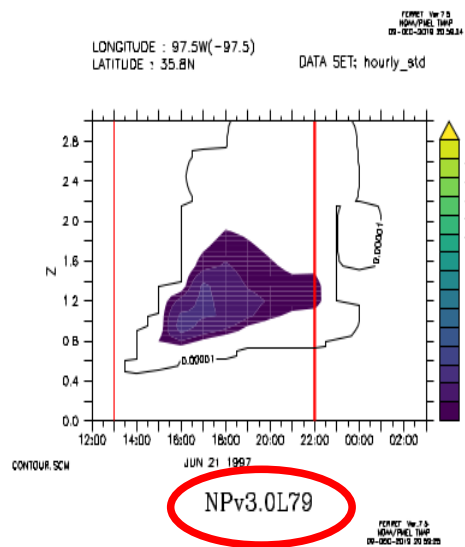
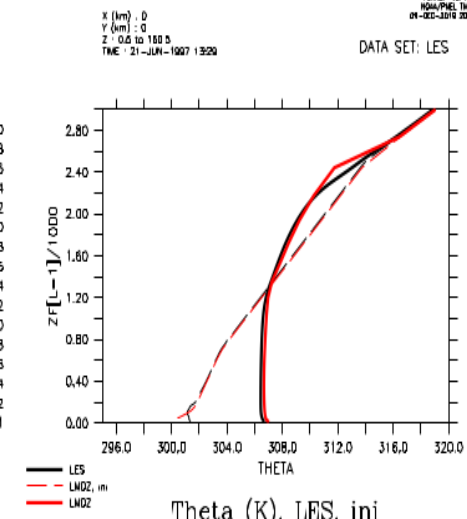
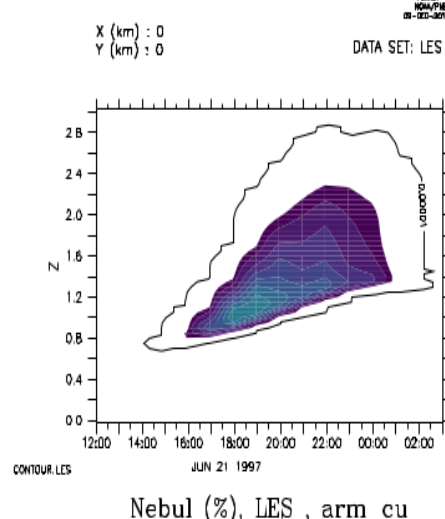
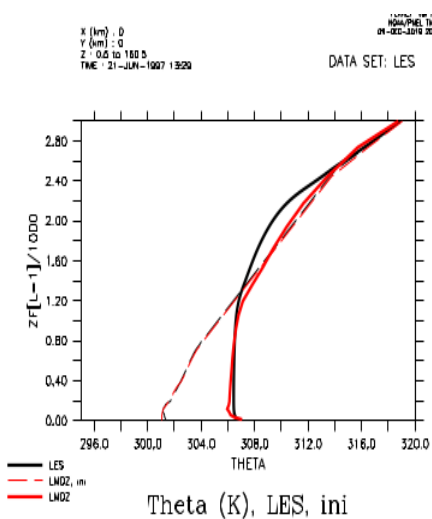
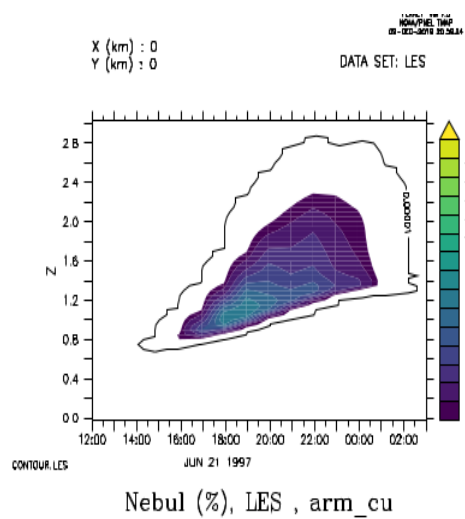


CAUTION !

You can modify *def files in 1D/EXEC/NPv6.1/ARMCU/REF and quickly rerun the model because lmdz1d.e is in this directory.

BUT BE CAREFULL

The « original » files are either under ~/CAS or ~/INPUT
And will be replaced at each run of run.sh



Thank you for your attention !