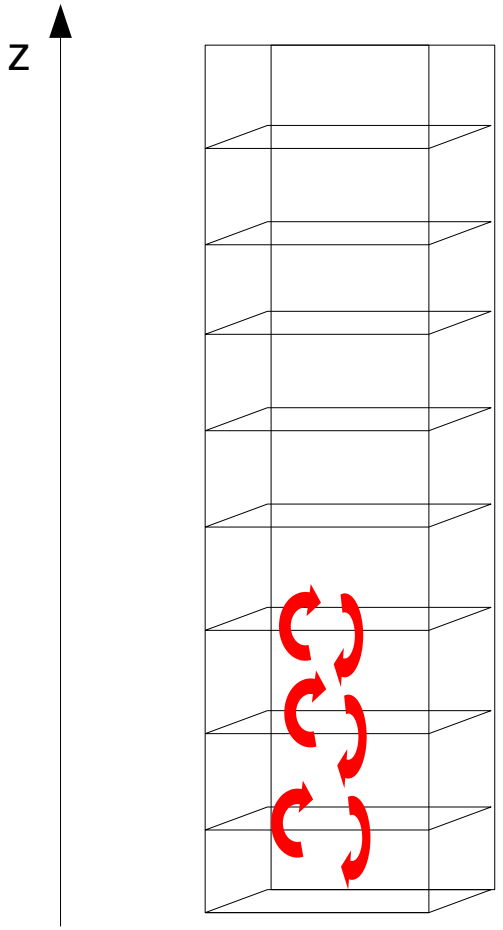
LMDZ Single Column Model



LMDZ team

LMDZ training session 2024

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

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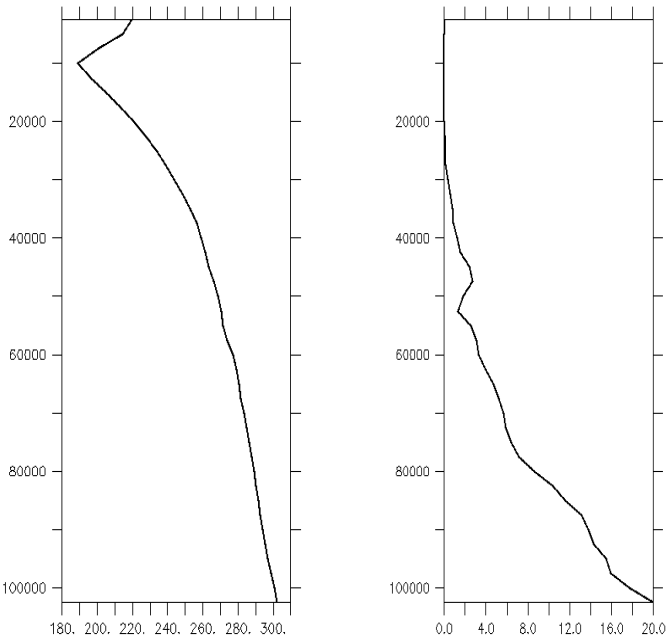
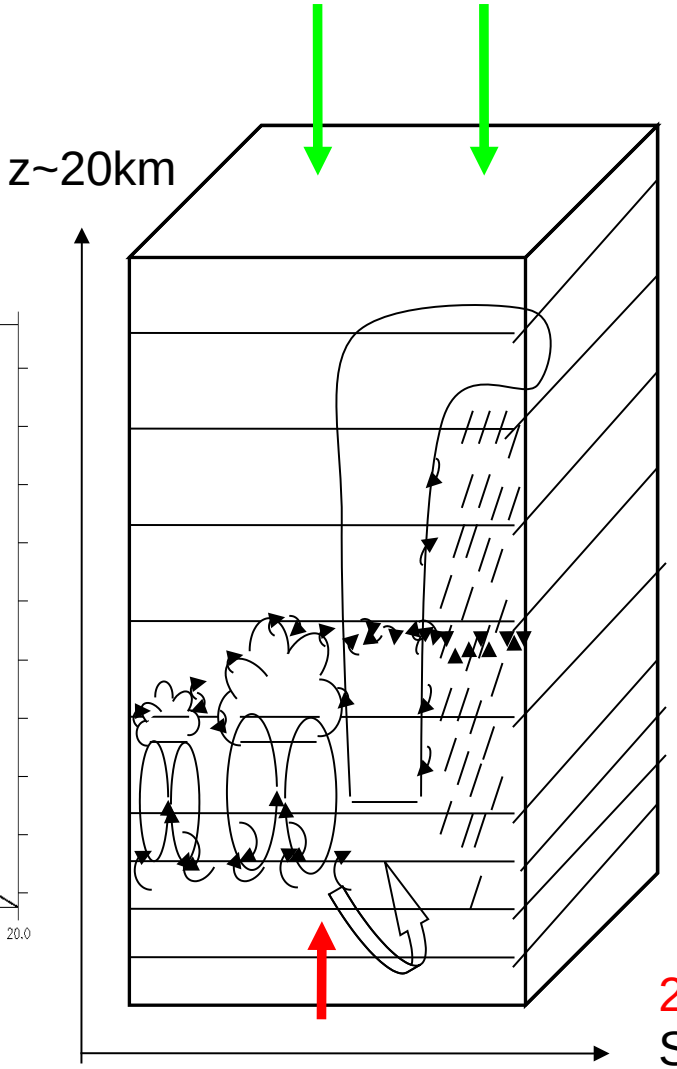
LMDZ in 1D (1 column) mode
physics only, no resolved dynamics

1/ Initial conditions:





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
- a time period (radiation)
- 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

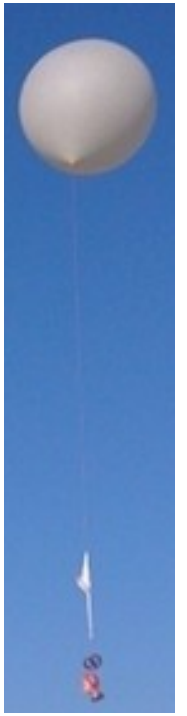
Different ‘cases ‘ have been built - with different degrees of idealisation -
to study various aspects of the physics (clouds, deep convection, boundary-layer dynamics ..)

Recent development of the so-called international standard ‘DEPHY’ format for 1D cases
https://github.com/GdR-DEPHY/DEPHY-SCM/

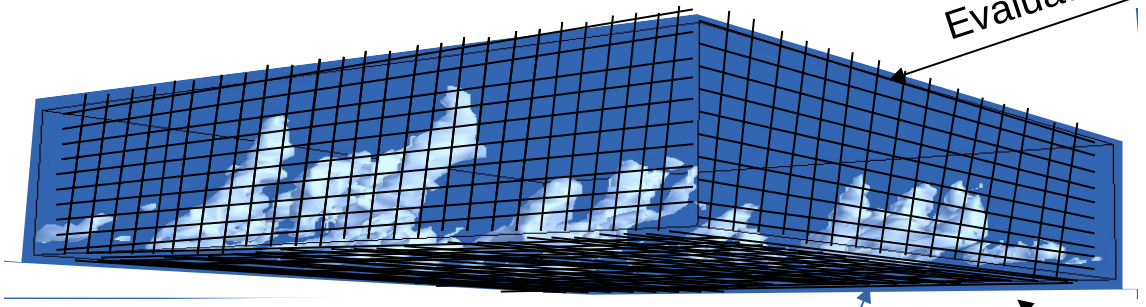
How 1D cases are built ?

Test case, field campaign experiment

Observation



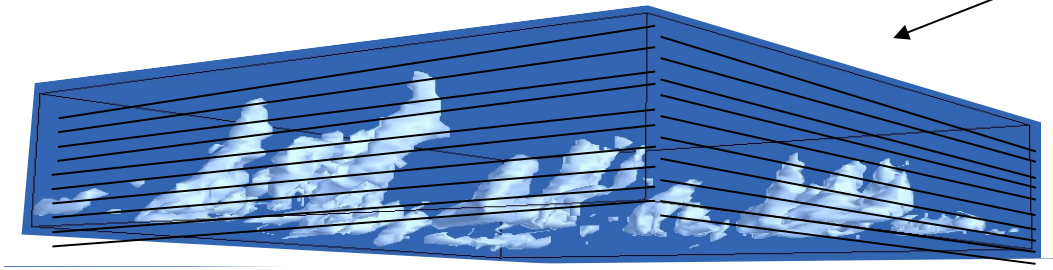
Evaluation



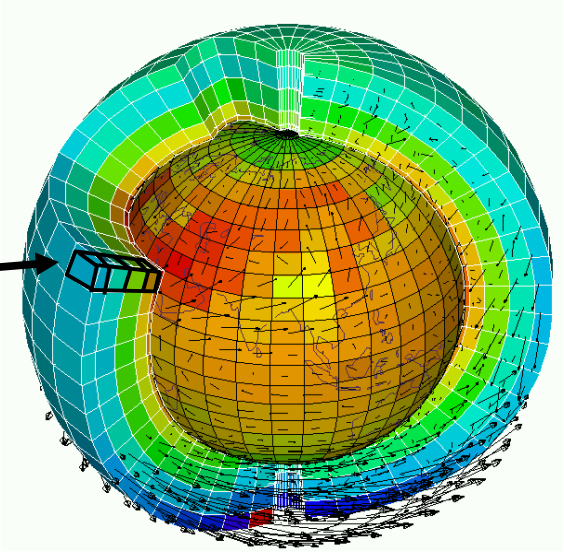
Explicit simulations (LES), Grid cell, 20-100 m

Evaluation

« Large scale » conditions imposed



Climate model, parameterizations, « single-column » mode



Courtesy F.Hourdin

Avalaible 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

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

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

MPACE case : mixte phase in Arctica. Shallow convection with Stratocumulus developing at the top of boundary layer

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How to install 1D model ?

cd LMDZ******

wget
http://www.lmd.jussieu.fr/~lmdz/Distrib/1D/1D.tar.gz

tar xvzf 1D.tar.gz

cd 1D

CAS folder

An international common format for forcings and output files has been defined.

→ https://github.com/GdR-DEPHY/DEPHY-SCM/

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

+ common forcings file is **cas.nc**
+ common output file is **hourly_std.nc**
+ there is also histhf.nc or hourly.nc

Other cases are in OLDCASES :

+ forcings file is case_name.nc or prof.inp.001
+ output file is histhf.nc or hourly.nc

Have a look at run.sh

Script that COMPILES the model and RUN cases

Which case(s) ?

listecas="ARMCU/REF"

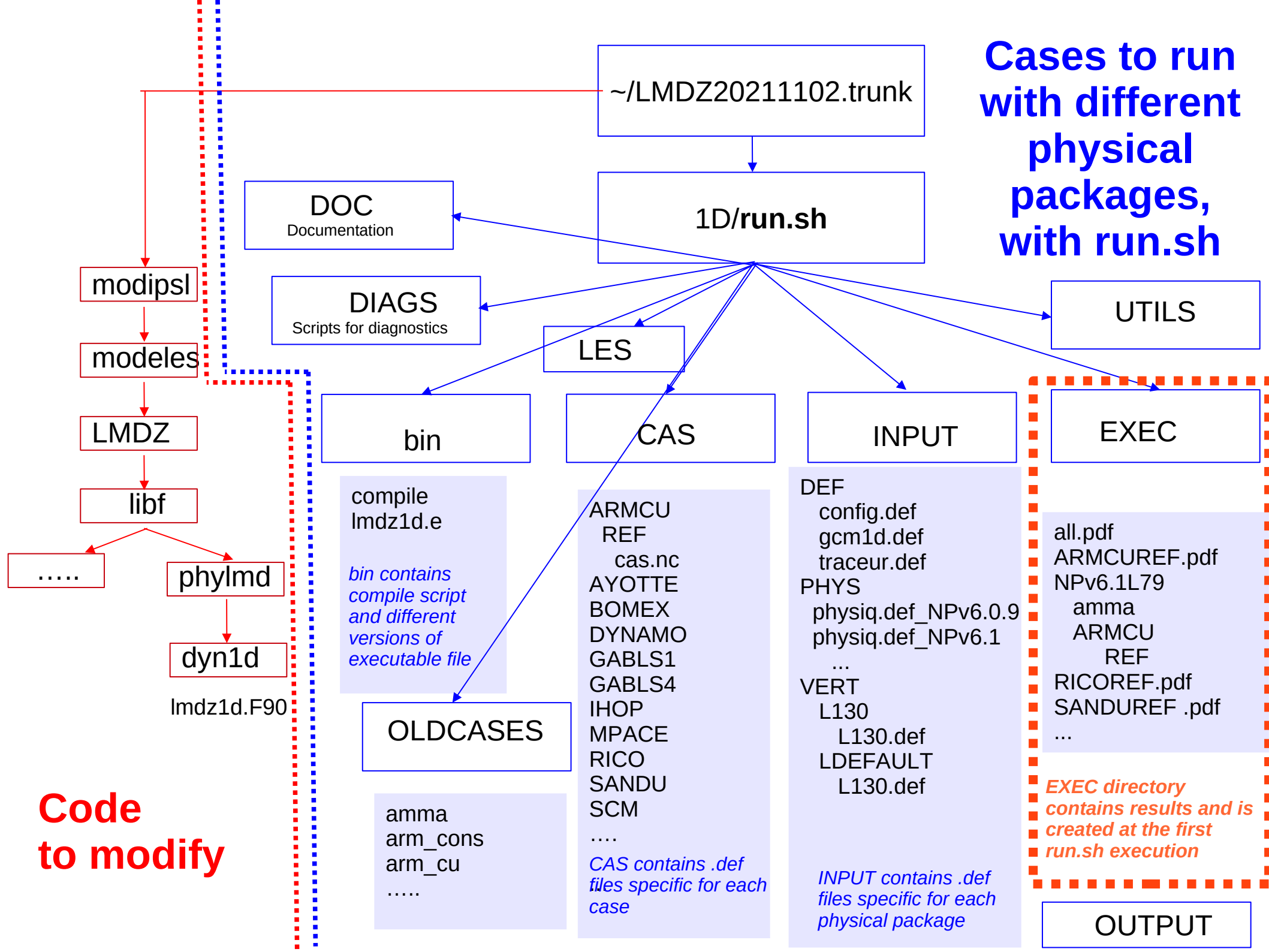
Which physics ?

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
i_diag=1 # run automated post-processing scripts → plots


Cases to run with different physical packages, with run.sh
~/LMDZ20211102.trunk
1D/run.sh
DOC
Documentation
DIAGS
Scripts for diagnostics
LES
UTILS
modipsl
modeles
LMDZ
libf
.....
phylmd
dyn1d
lmdz1d.F90
bin
compile
lmdz1d.e
bin contains compile script and different versions of executable file
CAS
ARMCU
REF
cas.nc
AYOTTE
BOMEX
DYNAMO
GABLS1
GABLS4
IHOP
MPACE
RICO
SANDU
SCM
....
CAS contains .def files specific for each case
INPUT
DEF
config.def
gcm1d.def
traceur.def
PHYS
physiq.def_NPv6.0.9
physiq.def_NPv6.1
...
VERT
L130
L130.def
LDEFAULT
L130.def
INPUT contains .def files specific for each physical package
EXEC
all.pdf
ARMCUREF.pdf
NPv6.1L79
amma
ARMCU
REF
RICOREF.pdf
SANDUREF .pdf
...
EXEC directory contains results and is created at the first run.sh execution
OUTPUT
OLDCASES
amma
arm_cons
arm_cu
.....
Code to modify

Results : in ~/1D/OUTPUT

all.pdf

ARMCUREF.pdf

NPv6.1L79/

RICOREF.pdf

SANDUREF.pdf

SAVE41389/

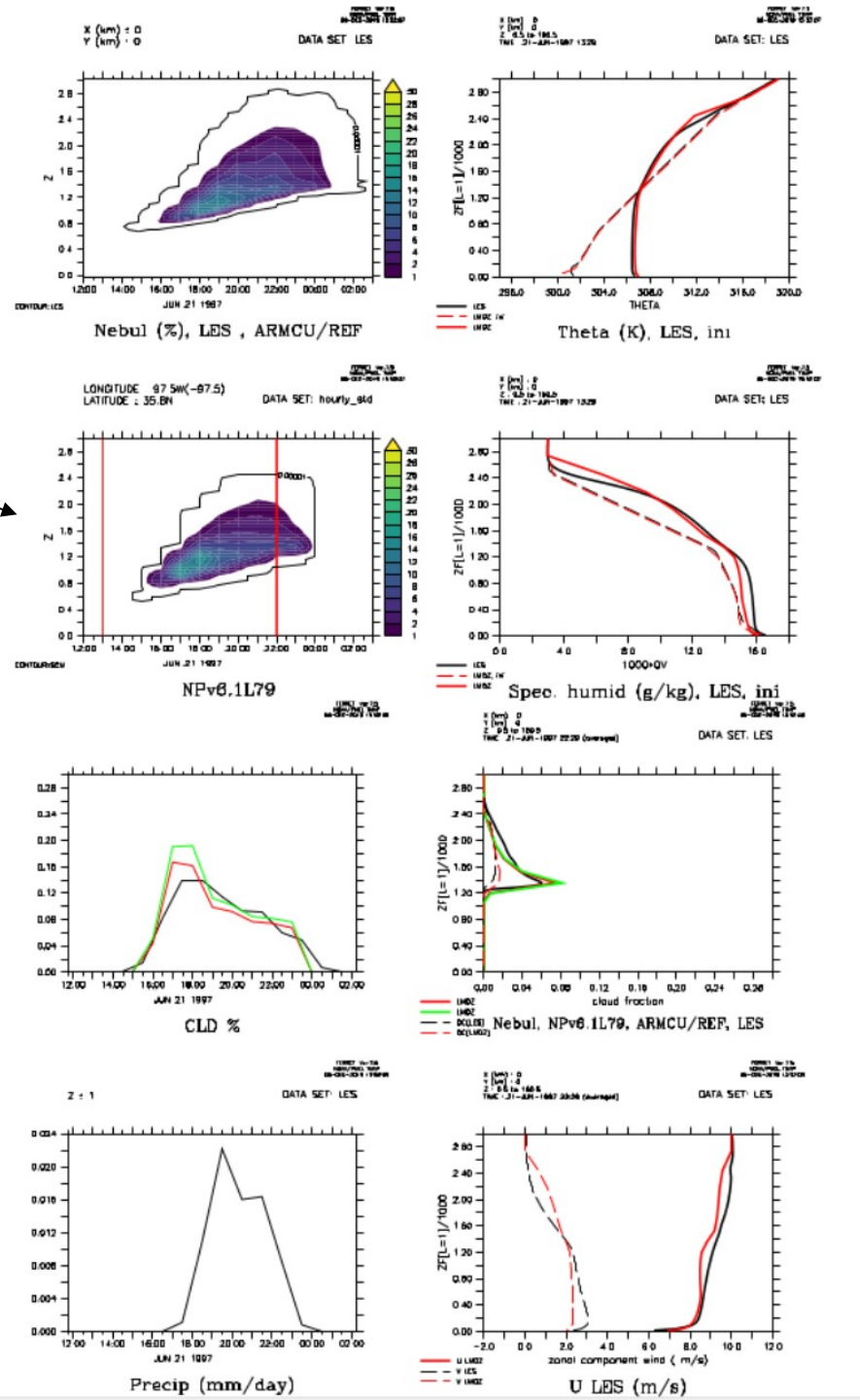
~/1D/OUTPUT/6AL79/ARMCU/REF

histhf.nc
hourly.nc
hourly_std.nc
LES.nc

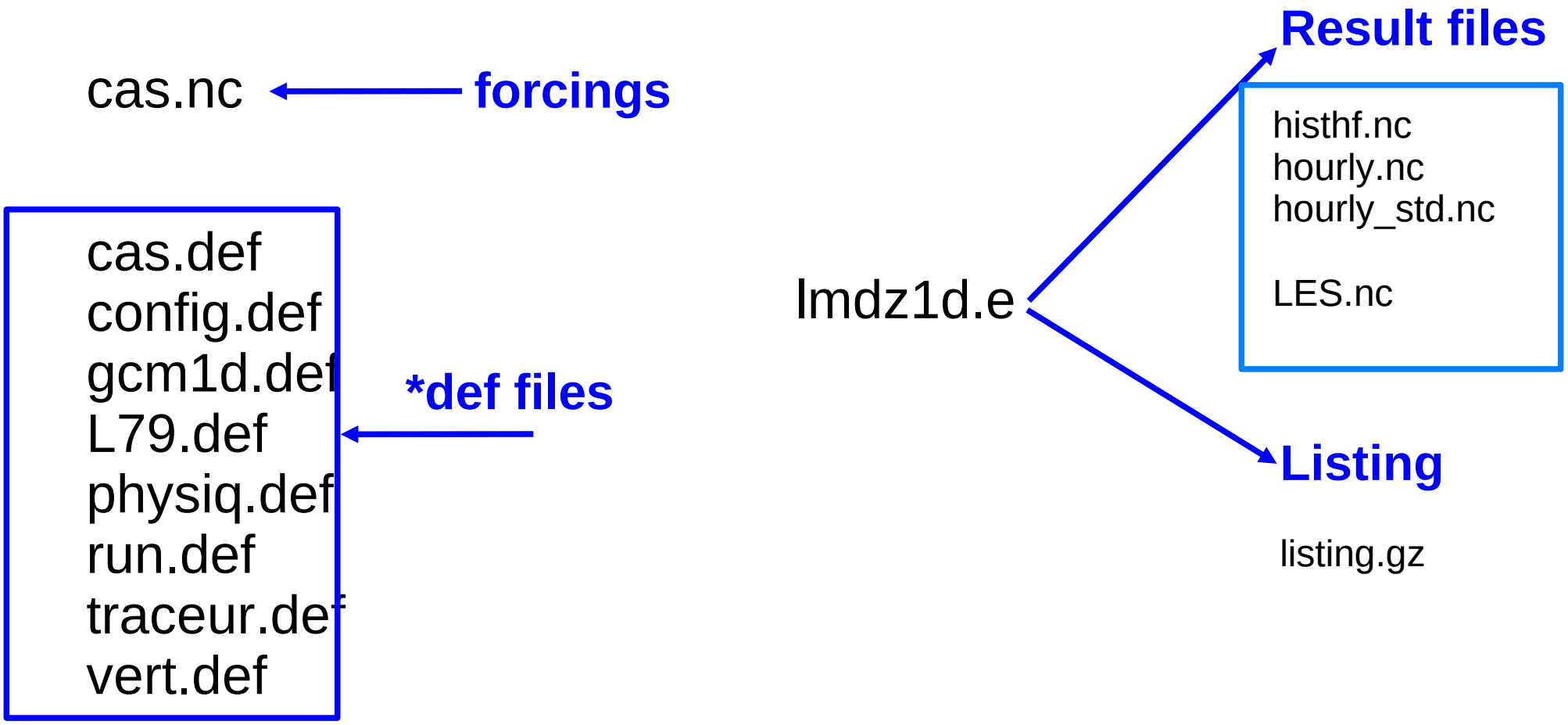
+ some pdf files

~/1D/EXEC

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



Where are the results ?
In 1D/EXEC/6AL79/ARMCU/REF



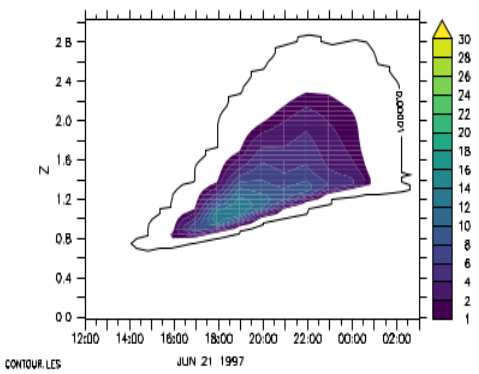
CAUTION !

You can modify *def files in ~LMDZ20211102.trunk/1D/EXEC/NPv6.1/ARMCU/REF and quickly rerun the model because lmdz1d.e is in this directory.

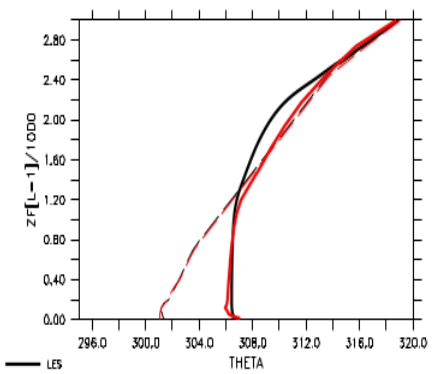
BUT BE CAREFULL

The « original » files are either under ~/CAS or ~/INPUT

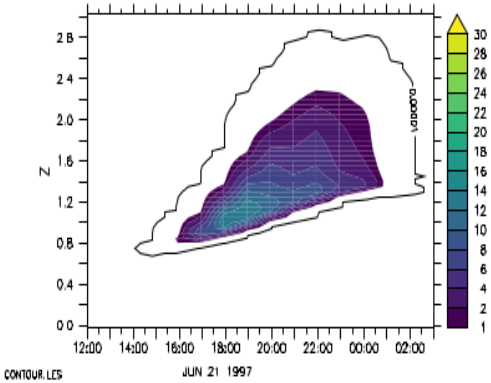
And will be replaced at each run of run.sh



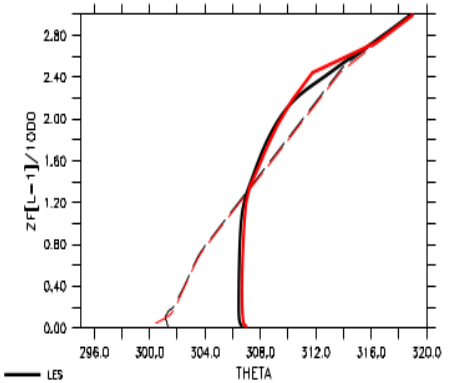
Nebul (%), LES , arm_cu



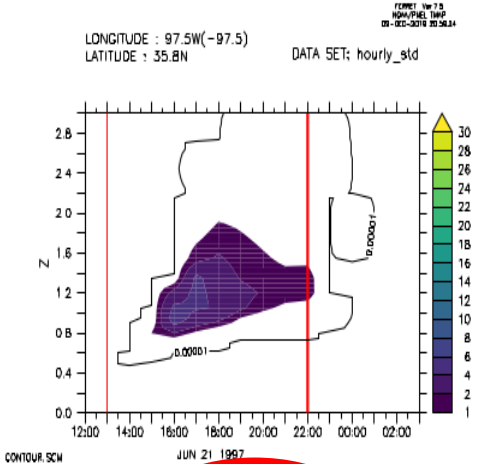
Theta (K), LES, ini



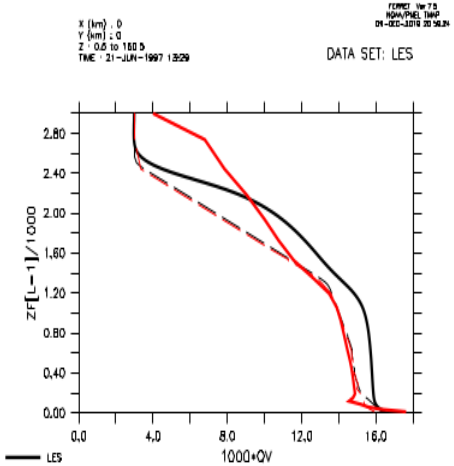
Nebul (%), LES , arm_cu



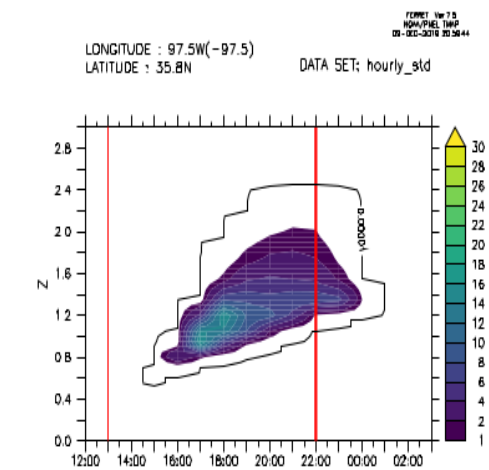
Theta (K), LES, ini



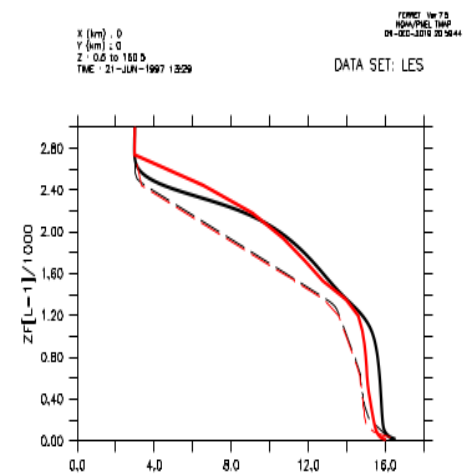
NPv3.0L79



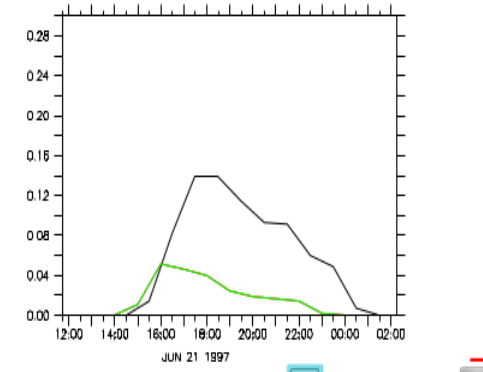
Spec. humid (g/kg), LES, ini



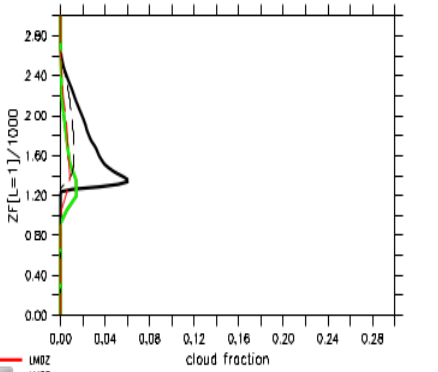
NPv6.1L79



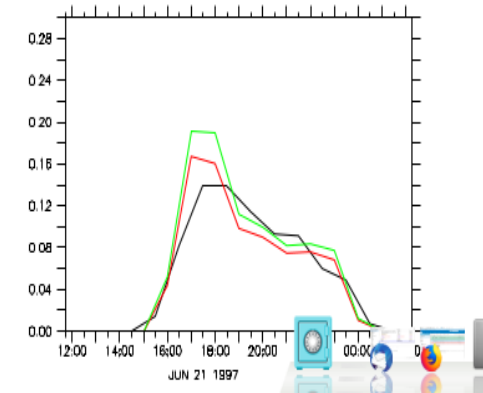
Spec. humid (g/kg), LES, ini

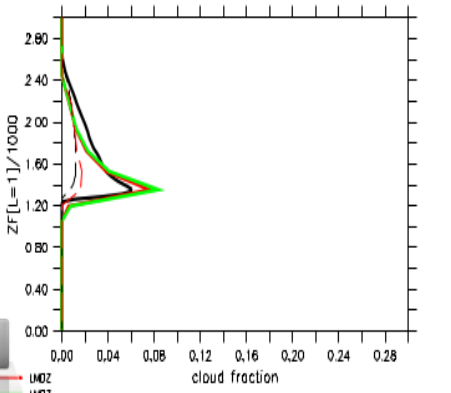


CLD %



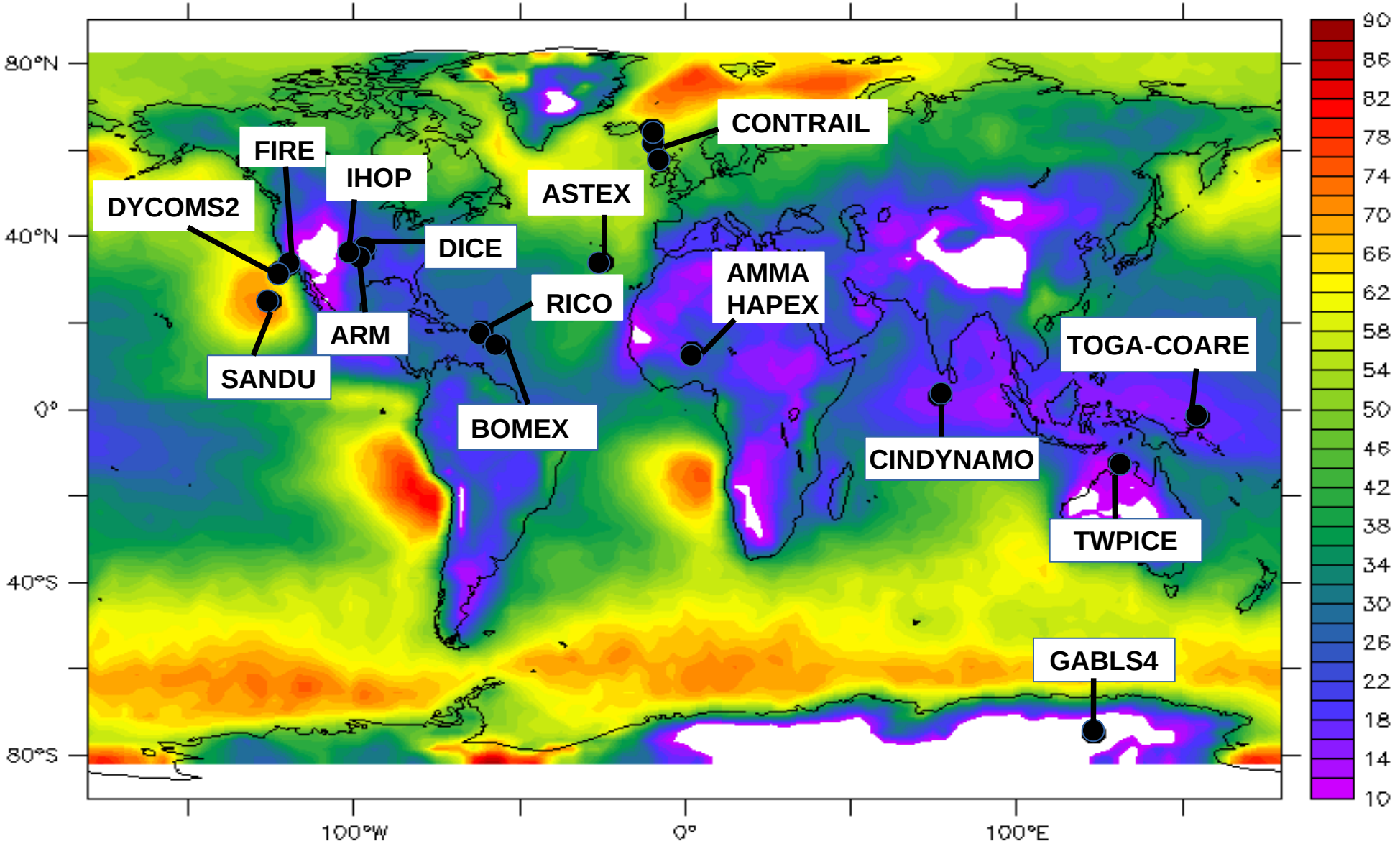
Nebul, NPv3.0L79, arm_cu, LES





Thank you for your attention !

Where are located all these cases ?



Background : low cloud cover from Calipso (Chepfer et al. 2008)