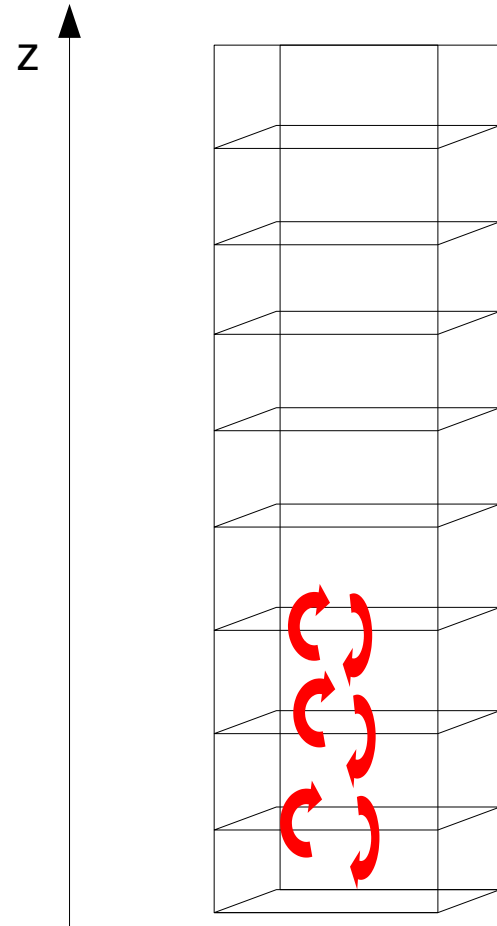


LMDZ Single Column Model



LMDZ team

LMDZ training session 2024

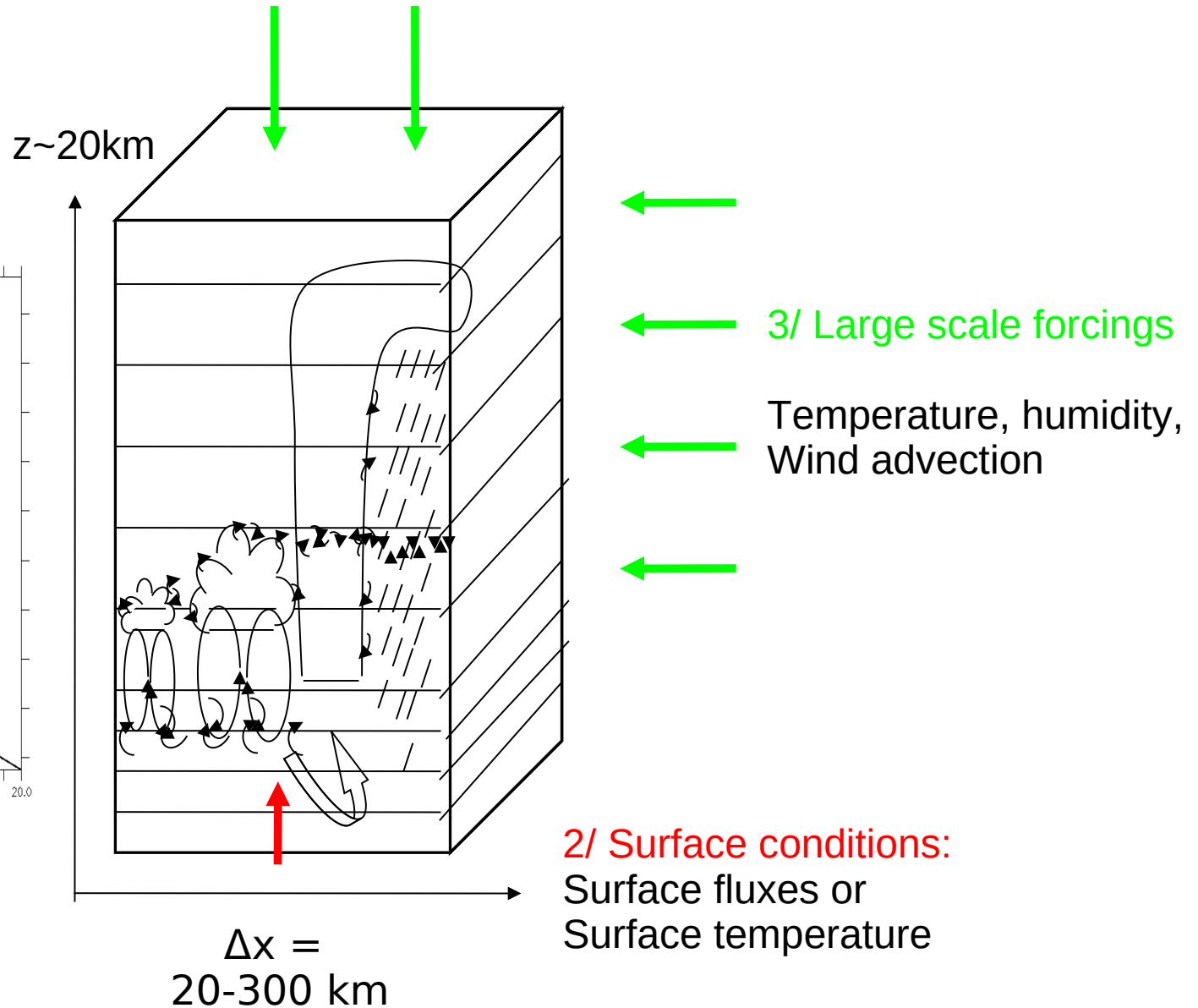
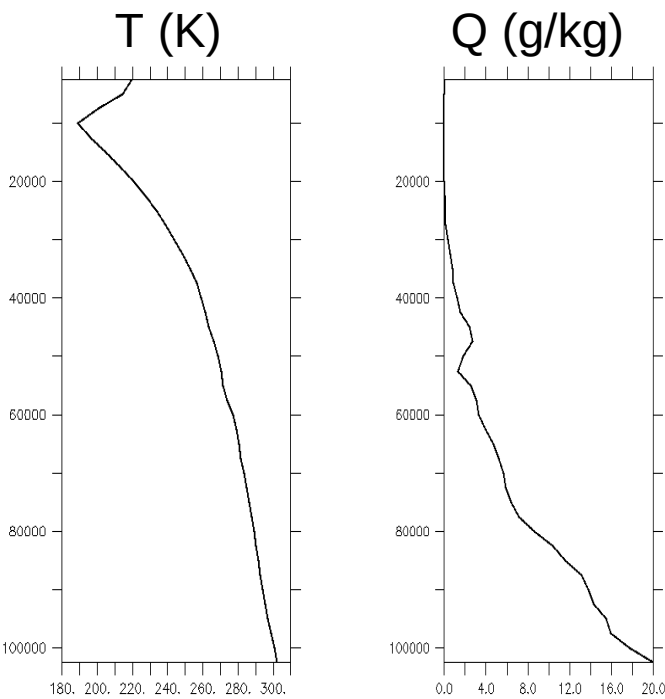
Why running LMDZ in 1D (single column) mode ?

- 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

.....

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

1/ Initial conditions:



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/>

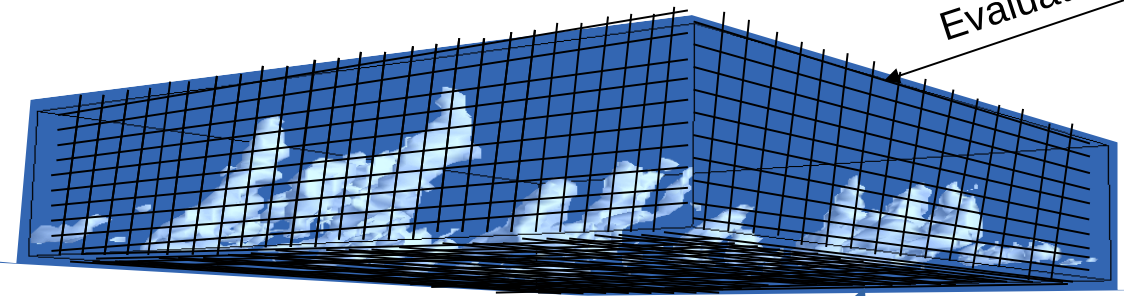
How 1D cases are built ?



Test case, field campaign experiment

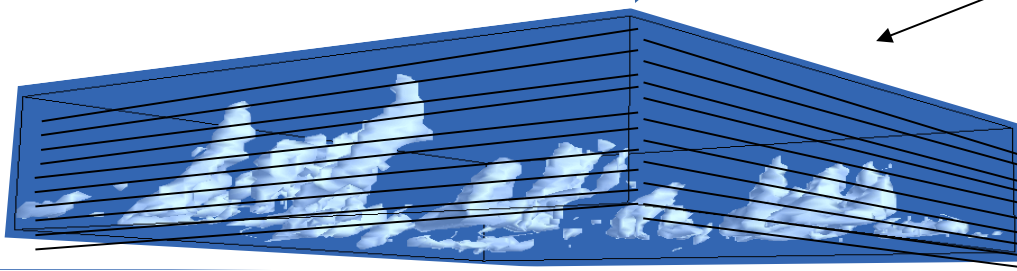


Observation



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

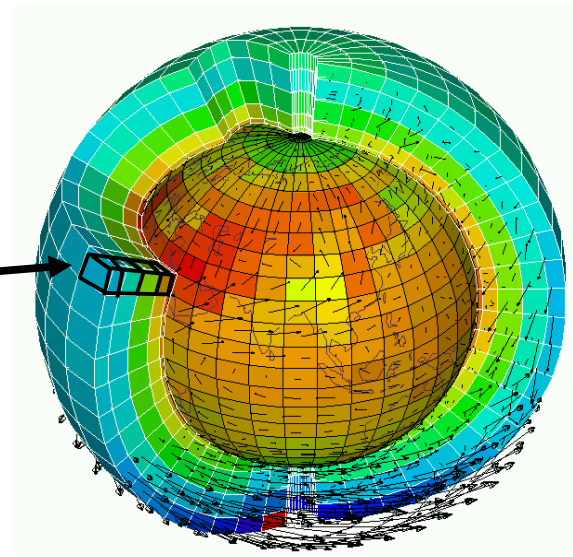
Evaluation



Climate model, parameterizations, « single-column » mode

Evaluation

« Large scale »
conditions
imposed



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



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

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

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

.....

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 ?

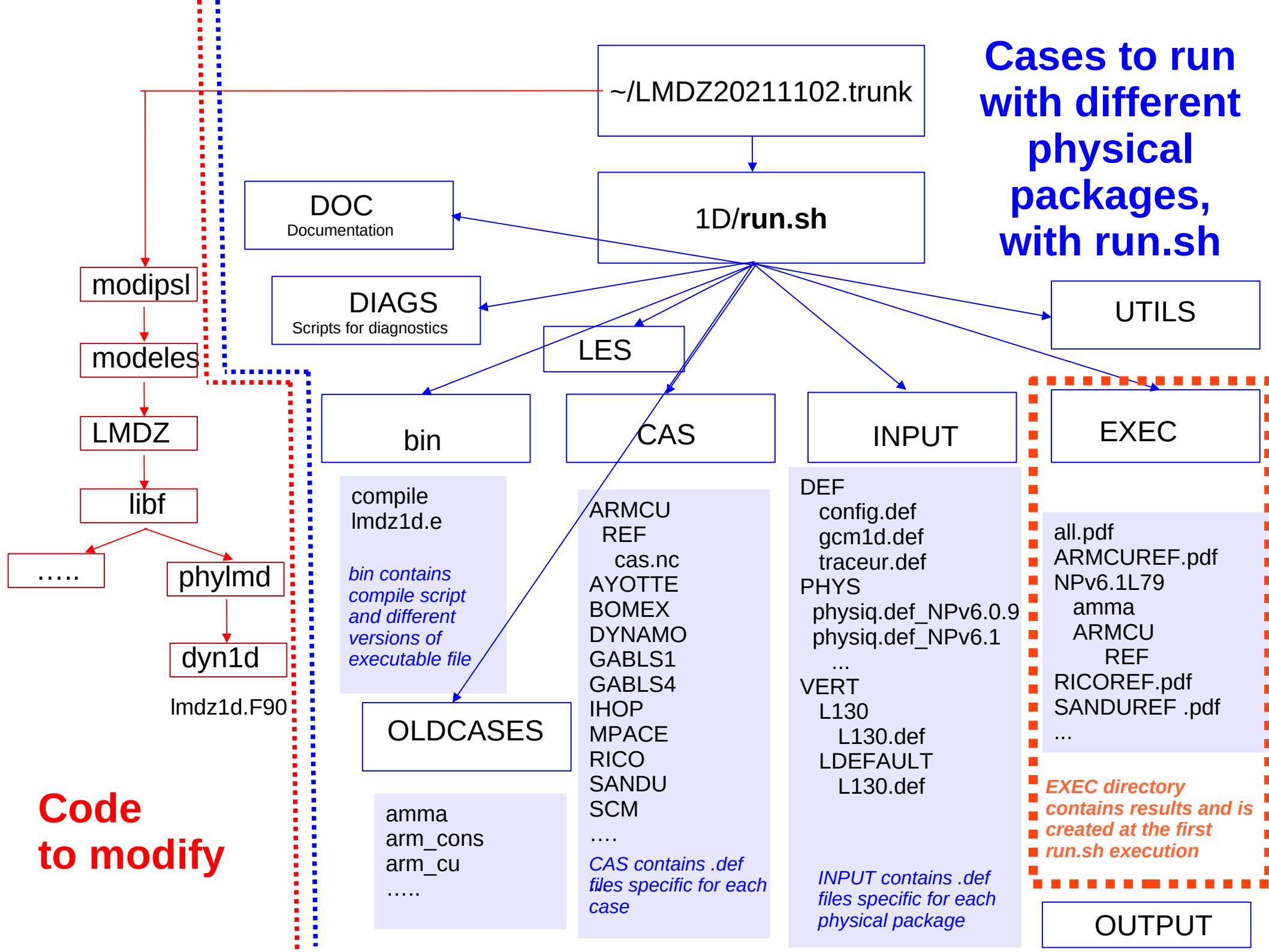
```
listedef="6A"
```

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



Code to modify

EXEC directory contains results and is created at the first run.sh execution

Results : in ~/1D/OUTPUT

all.pdf

ARMCUREF.pdf

NPv6.1L79/

RICOREF.pdf

SANDUREF.pdf

SAVE41389/

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

histhf.nc

hourly.nc

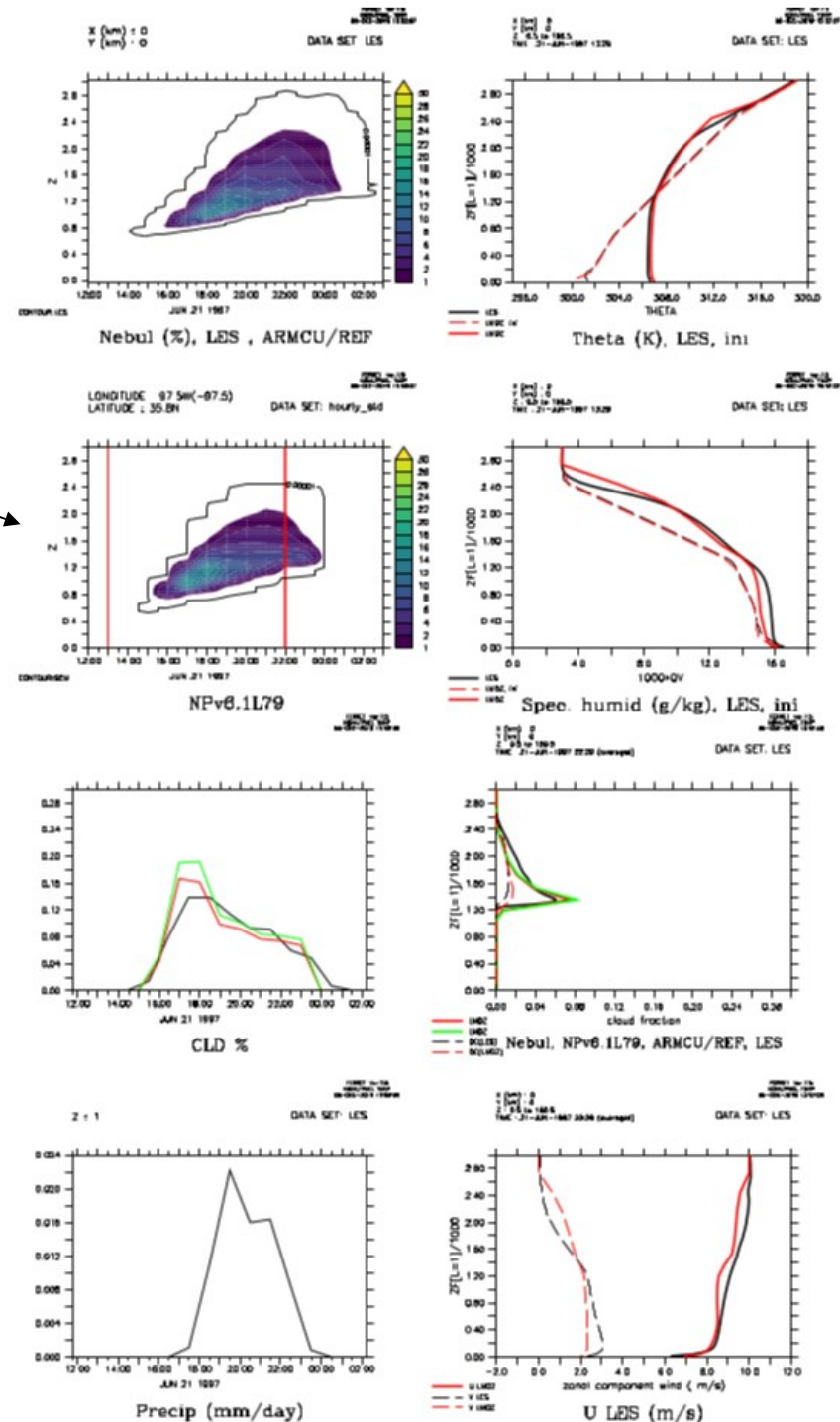
hourly_std.nc

LES.nc

+ some pdf files

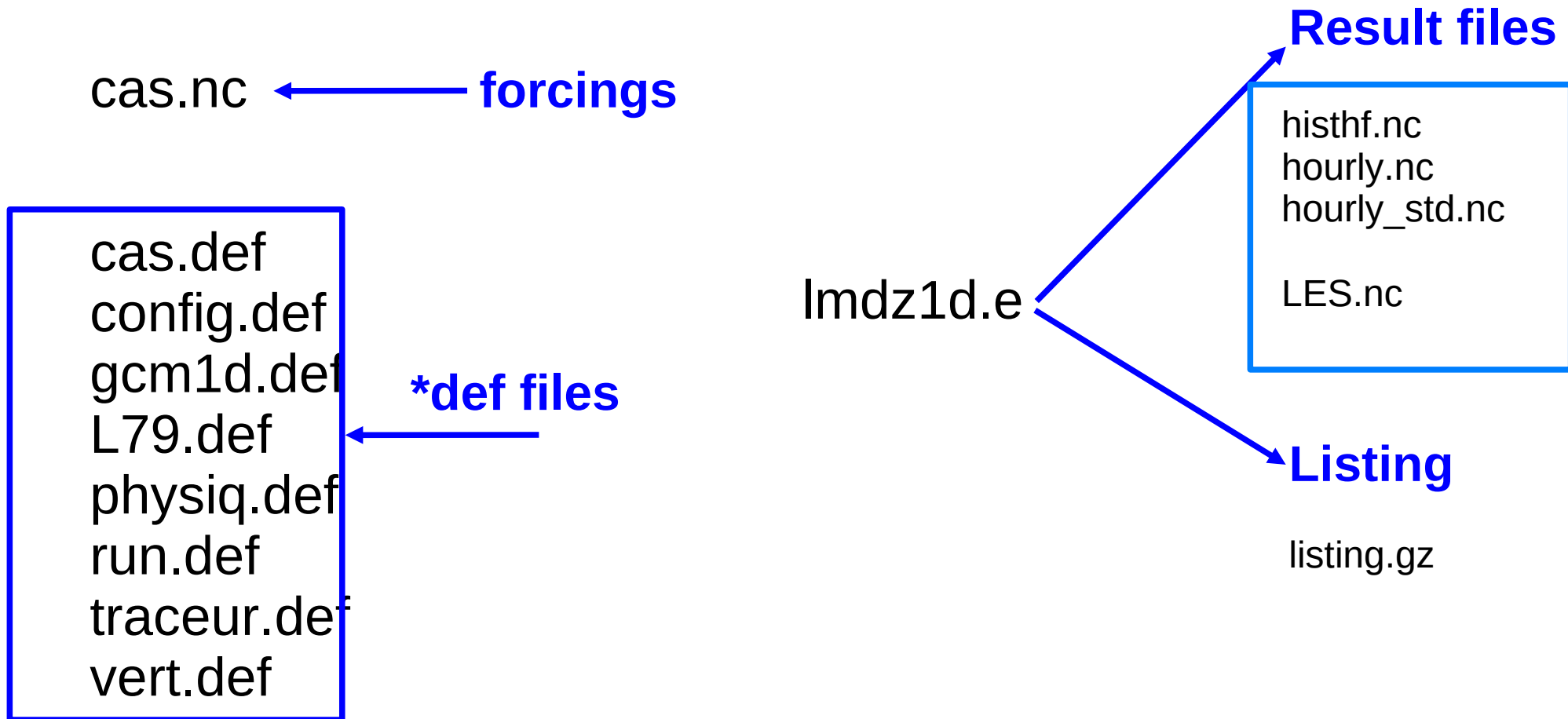
~/1D/EXEC

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

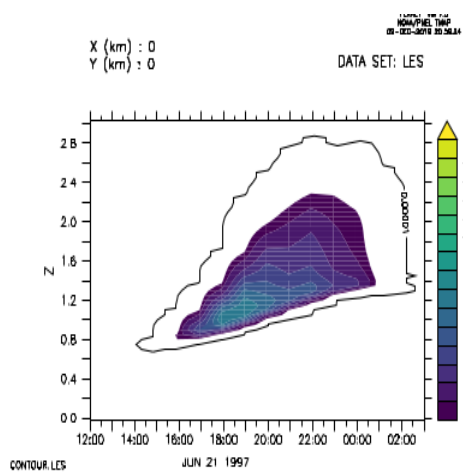


CAUTION !

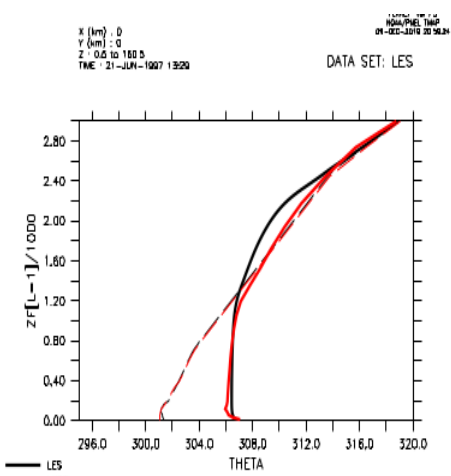
You can modify *def files in ~LMDZ20211102.trunk/1D/EXEC/NPv6.1/ARMCU/REF and quickly rerun the model because lmdz1d.e is in this directory.

BUT BE CAREFULL

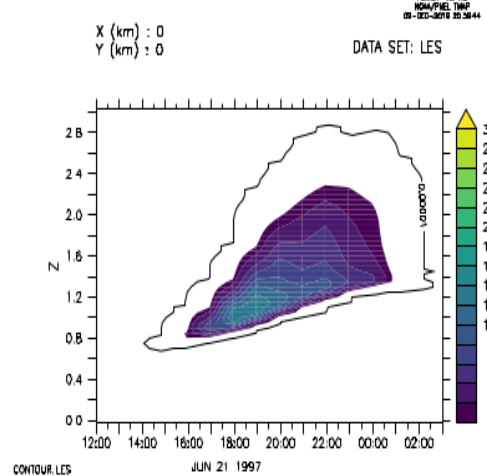
The « original » files are either under ~/CAS or ~/INPUT
And will be replaced at each run of run.sh



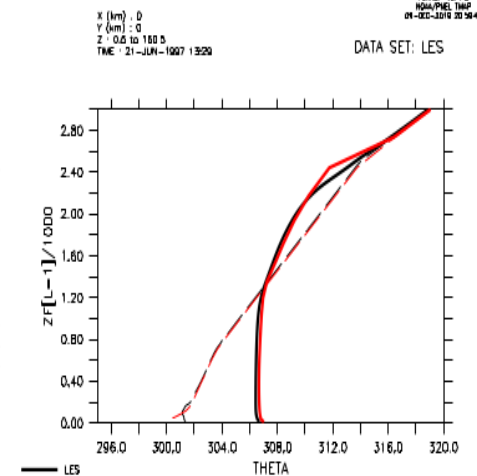
Nebul (%), LES, arm_cu



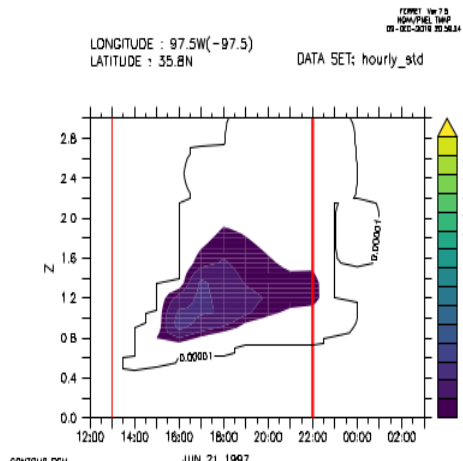
Theta (K), LES, ini



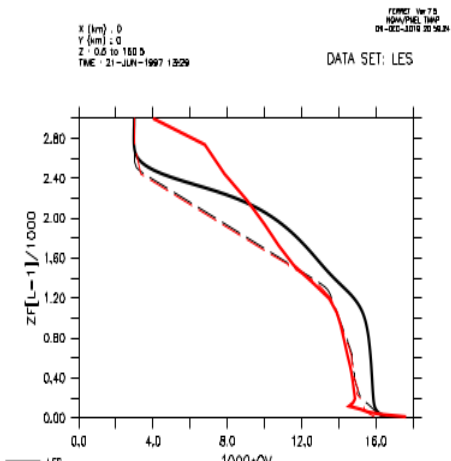
Nebul (%), LES, arm_cu



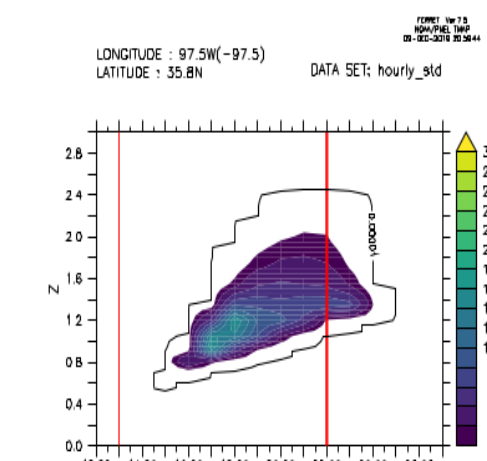
Theta (K), LES, ini



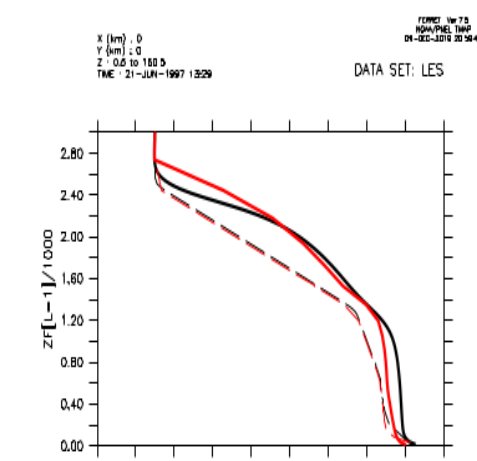
NPv3.0L79



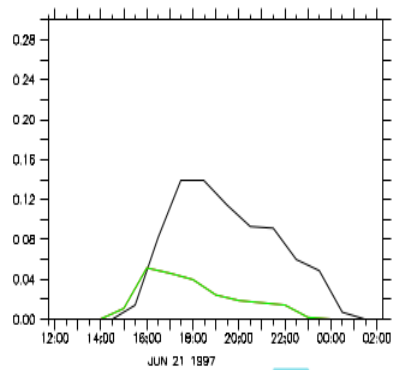
Spec. humid (g/kg), LES, ini



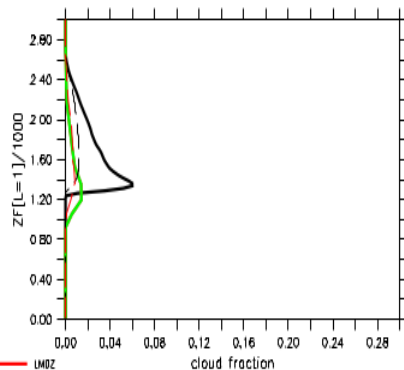
NPv6.1L79



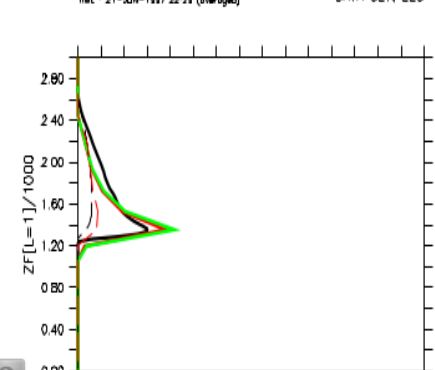
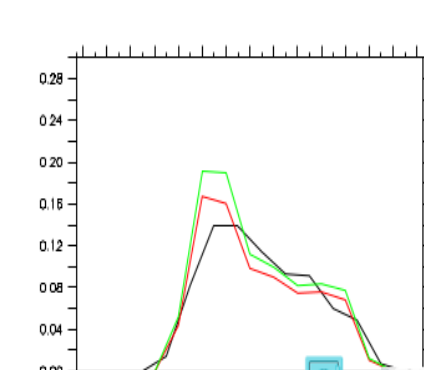
Spec. humid (g/kg), LES, ini



CLD %



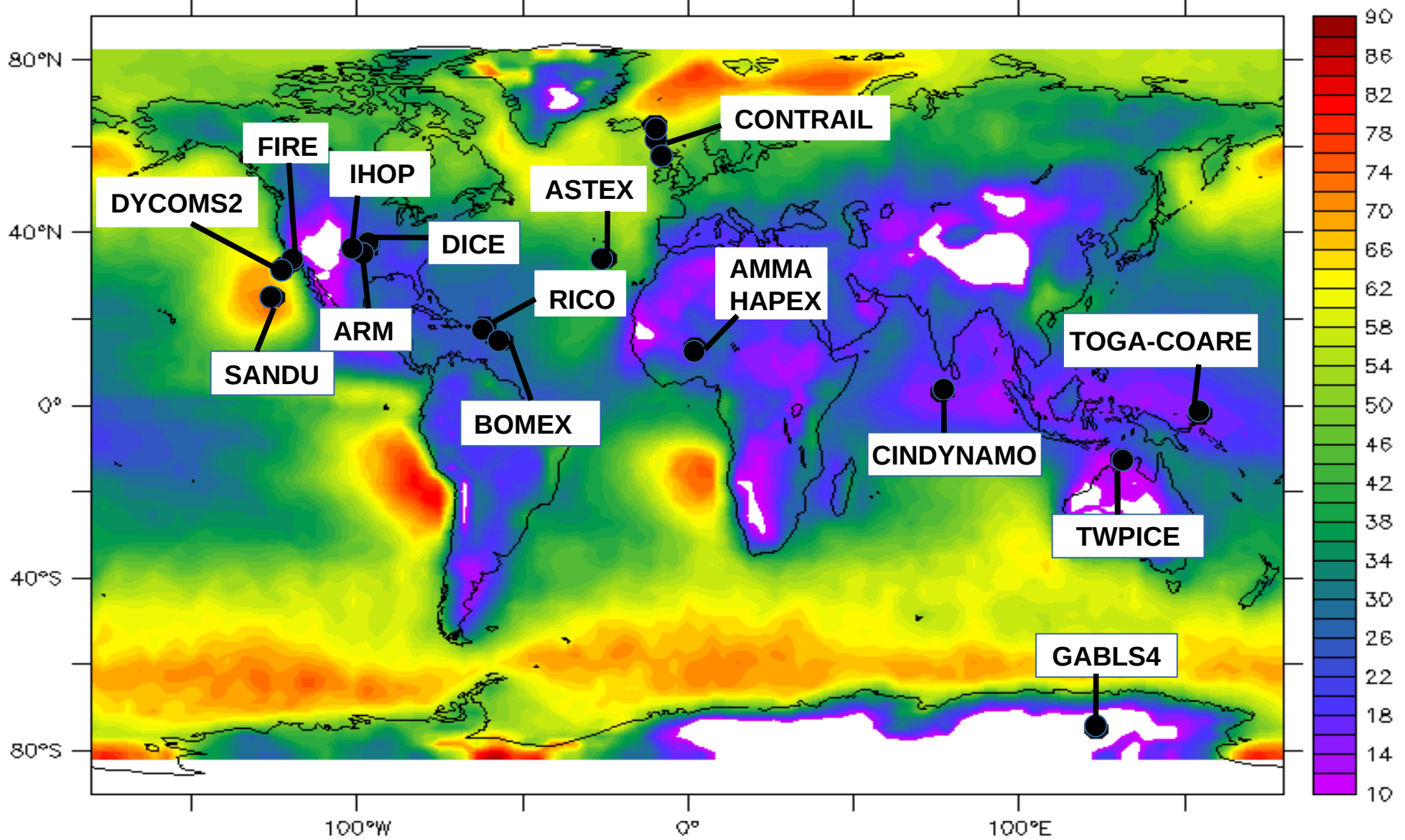
Nebul, NPv3.0L79, arm_cu, LES



cloud fraction

Thank you for your attention !

Where are located all these cases ?



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