LMDZ Single Column Model

+ what is it ?
+ why is it interesting ?
+ List of 1D cases
+ how to install and run it ?

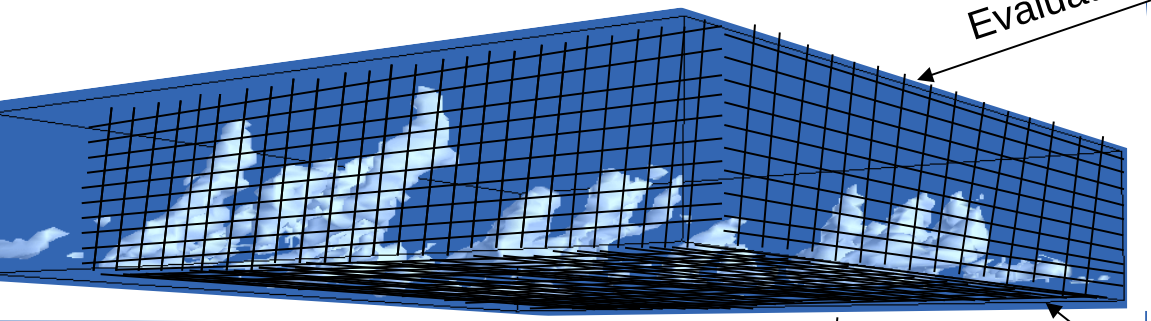
M-P Lefebvre and LMDZ team

Use of 1D cases

Test case, field campaign experiment

Observation

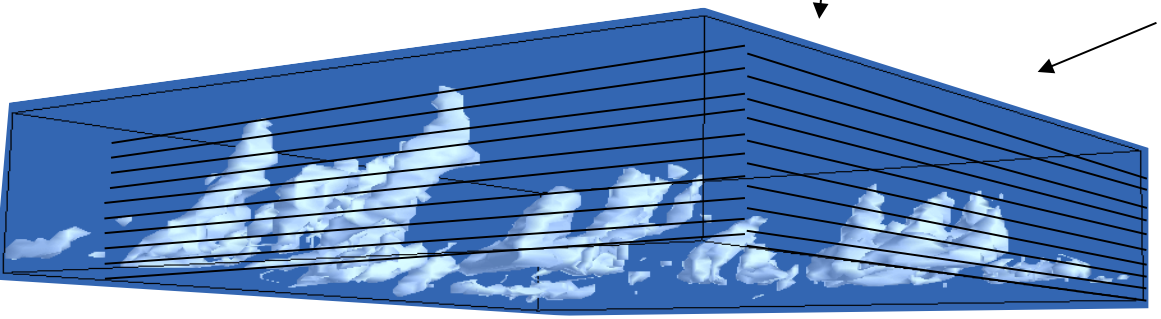
Evaluation



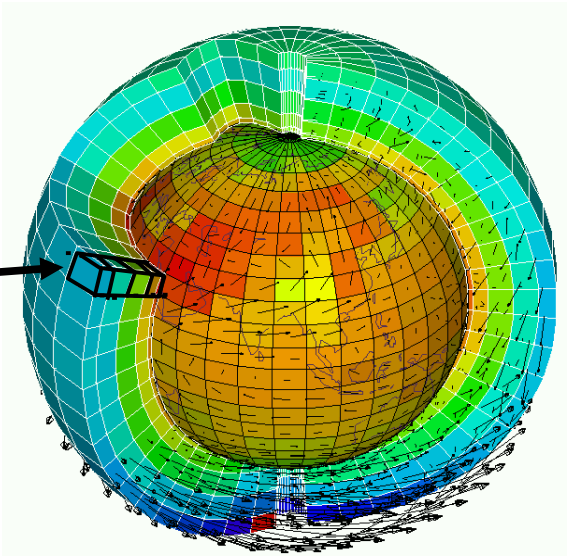
Explicit simulations, Grid cell, 20-100 m

Evaluation

« Large scale » conditions imposed



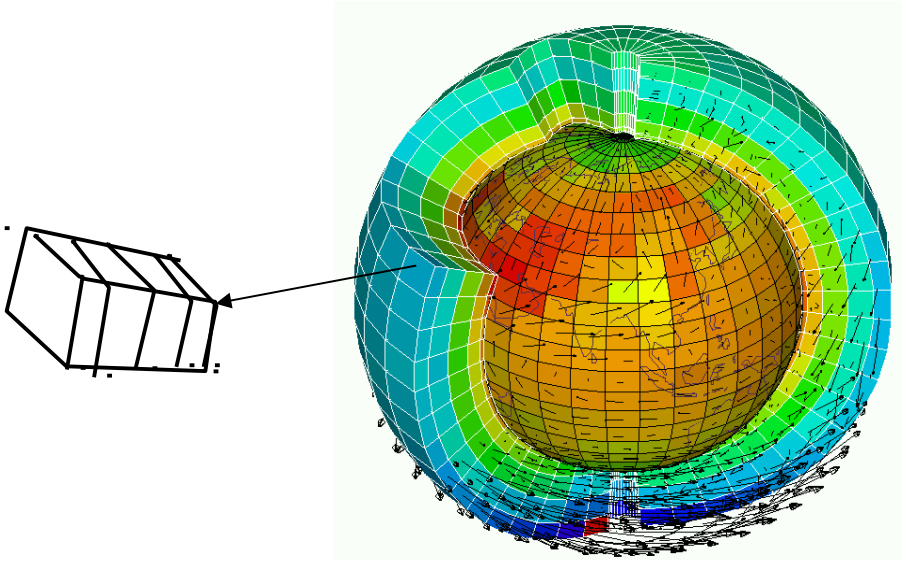
Climate model, parameterizations, « single-column » mode



Courtesy F.Hourdin

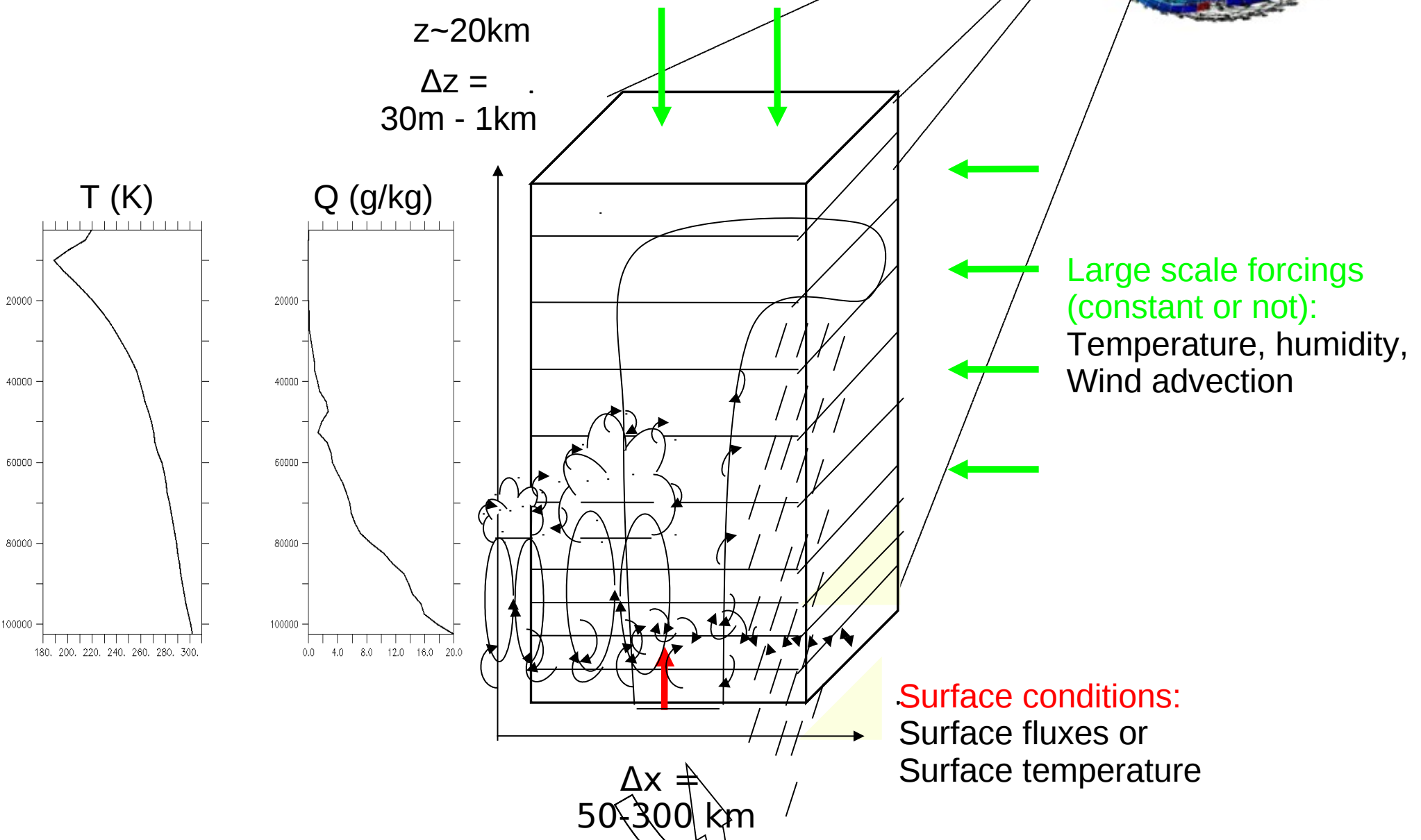
3D is a collection of many “single column models”, covering earth and interaction with each other through a set of rules known as “large scale dynamics”.

In a 1D model, there is no dynamics. We use observations or model output or idealized forcing to impose forcing at the boundaries of the column.



LMDZ model in 1D mode

- We impose large scale conditions.
- Duration of the case varies from few hours to few months
- We study parameterizations in a given environment.



Why use SCMs ?

+ **simplicity**: technical and understanding, usable on any labtop

+ it's a useful tool for **parameterization development**: shallow convection, deep convection, transition from stratocumulus to cumulus, stable boundary layer, radiation...

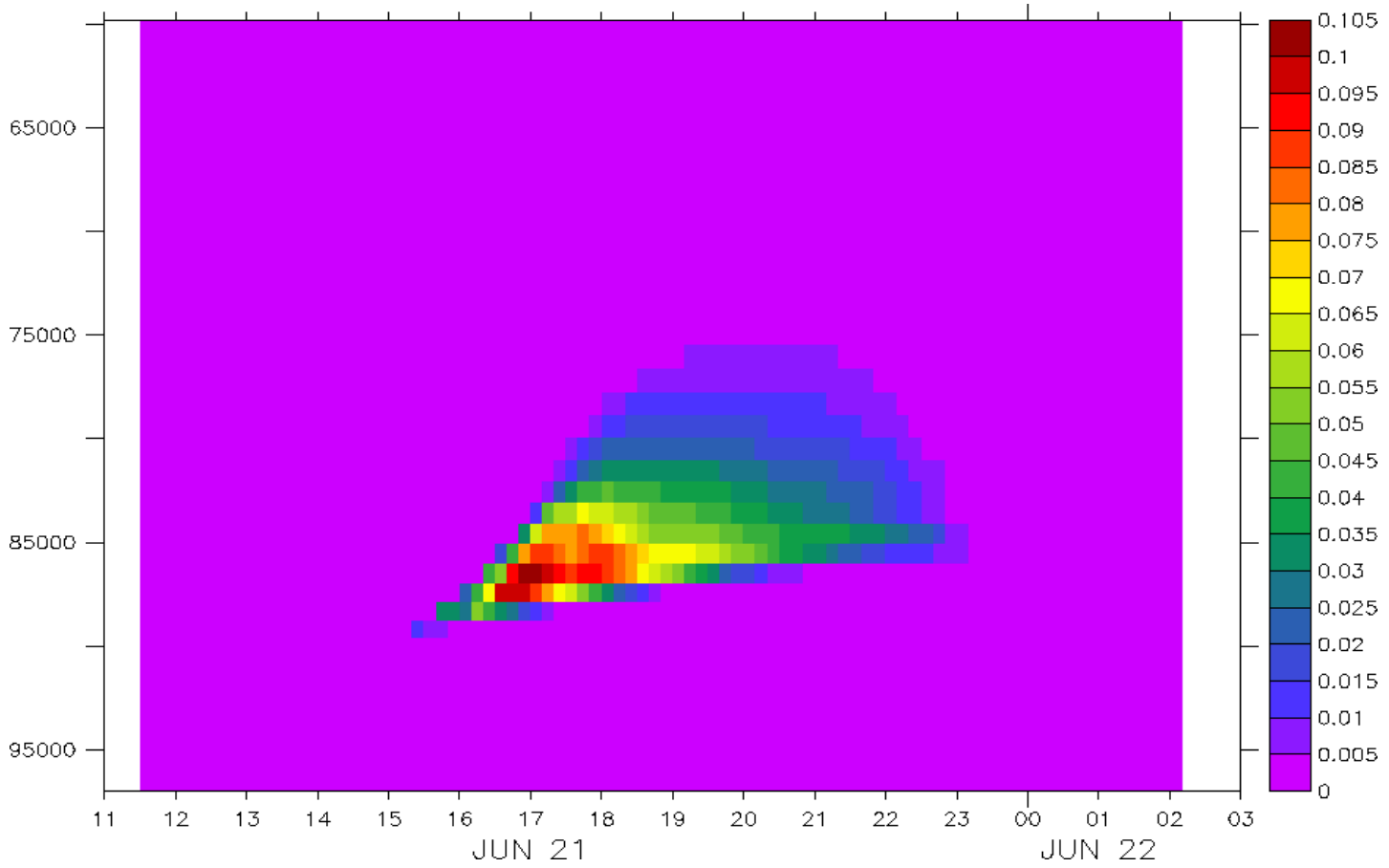
+ we can **compare results to observations or to explicit simulations** (CRM, LES)

+ then we go back to GCM and test new parameterizations ...

+ hierarchy of models: SCM, LAM, AGCM, GCM ...

l shallow convection

cu (diurnal cycle of shallow cumulus over land)
Rain In Cumulus over Ocean, shallow precipitating cumulus over sea)
e (convective boundary layer, sky clear)



Arm_cu case - Cloud fraction

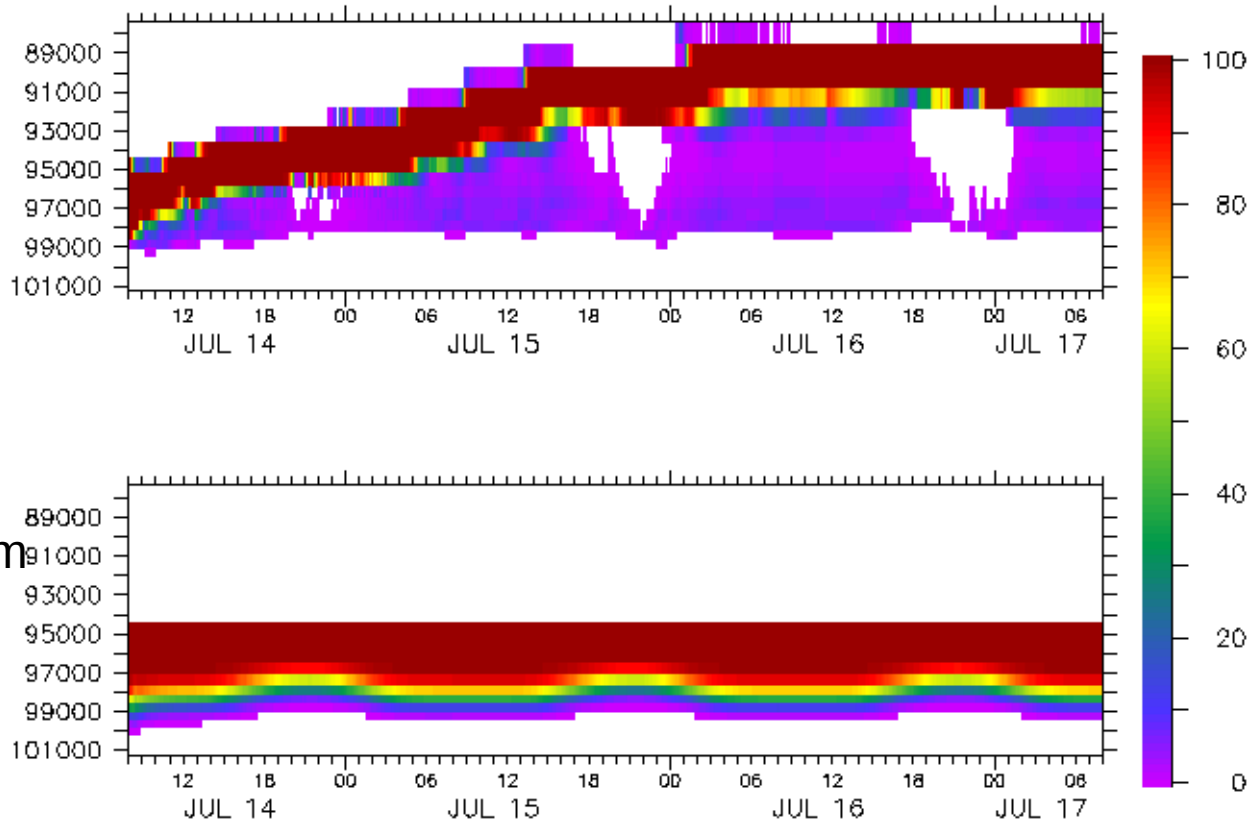
Stratocumulus and transition to cumulus

- **Sandu** (transition case with 3 options according to variation of SST)
- **Fire** (diurnal cycle of stratocumulus)

Fire case:
Cloud fraction (%)

Top: standard version
Bad representation because not
Enough entrainment at the cloud top

Bottom: version developped by A.Jam

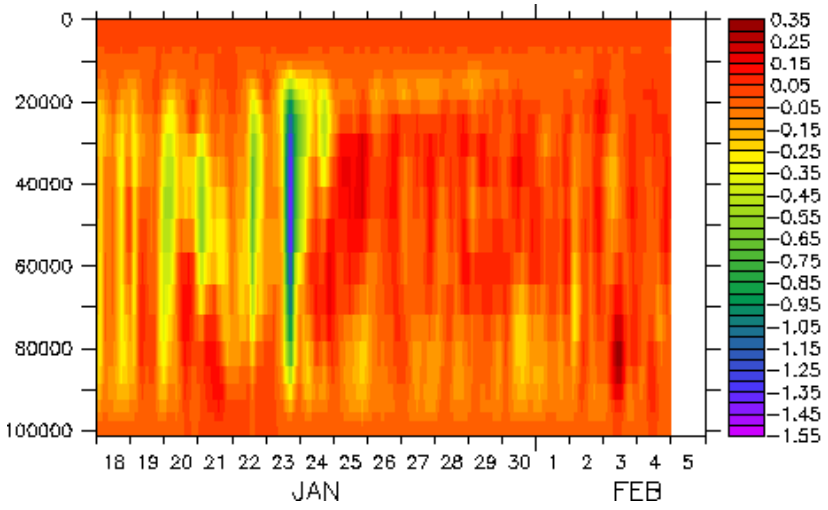


Deep convection:

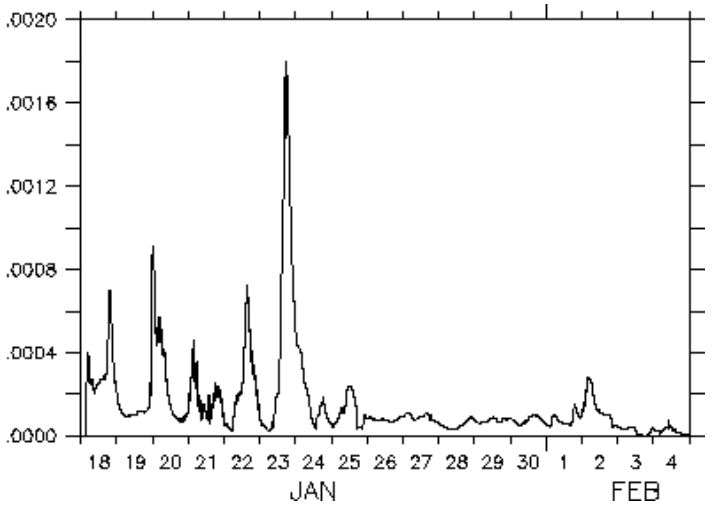
Over ocean:

- **Toga**
- **case_e** (part of Toga)
- **TWPICE** : off the coast of Darwin

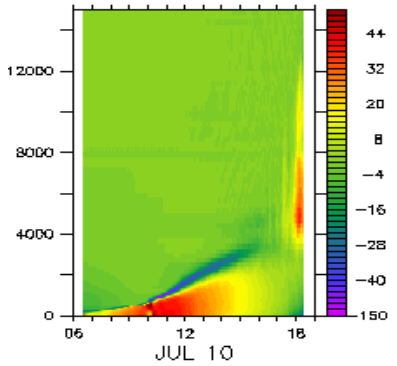
TWPICE Case (2 weeks)



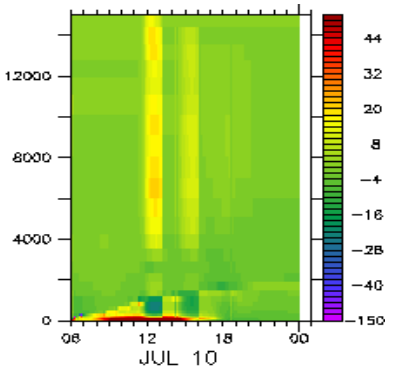
Vertical speed (m/s)



Precipitation (mm/j)



LES from 6h **to 18h**



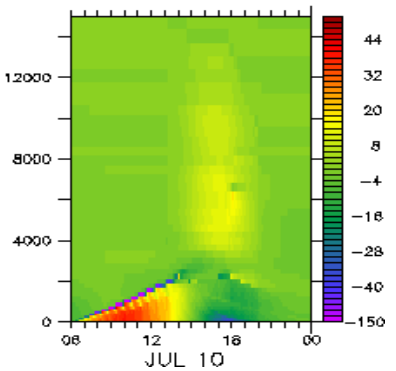
LMDZ_AR4_L39
From 6h **to 00h**

AMMA case (10h july 2006):
Thetal tendencies due to all schemes (K/j)

<u>Deep convection:</u>

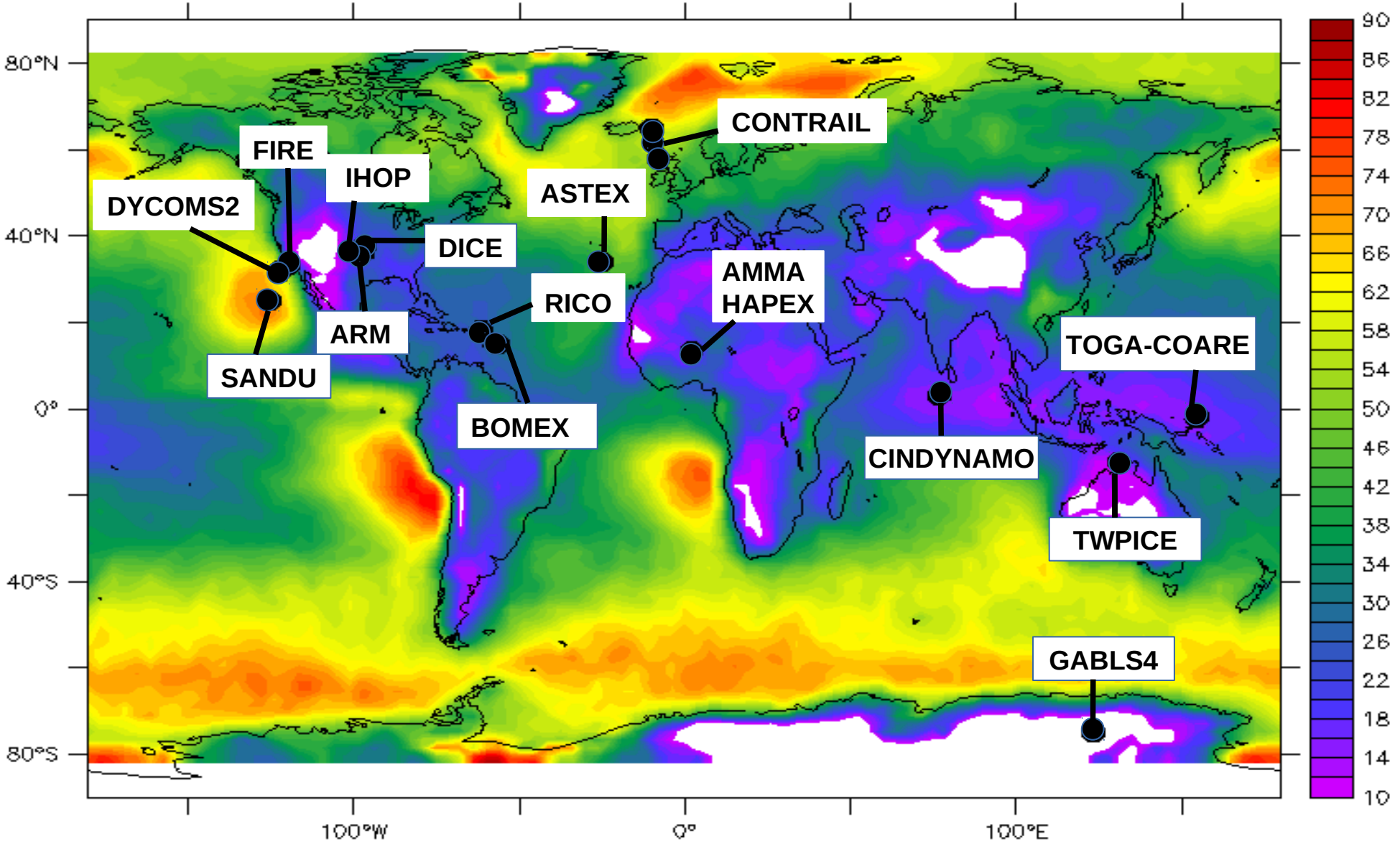
<u>Over land:</u>
- **Hapex**
- **AMMA**

<u>Idealized case</u>:
- **eq_rad_conv** (RCE) : radiative and convection scheme active



LMDZ_NP_L70 from 6h **to 00h**

Where are located all these cases ?



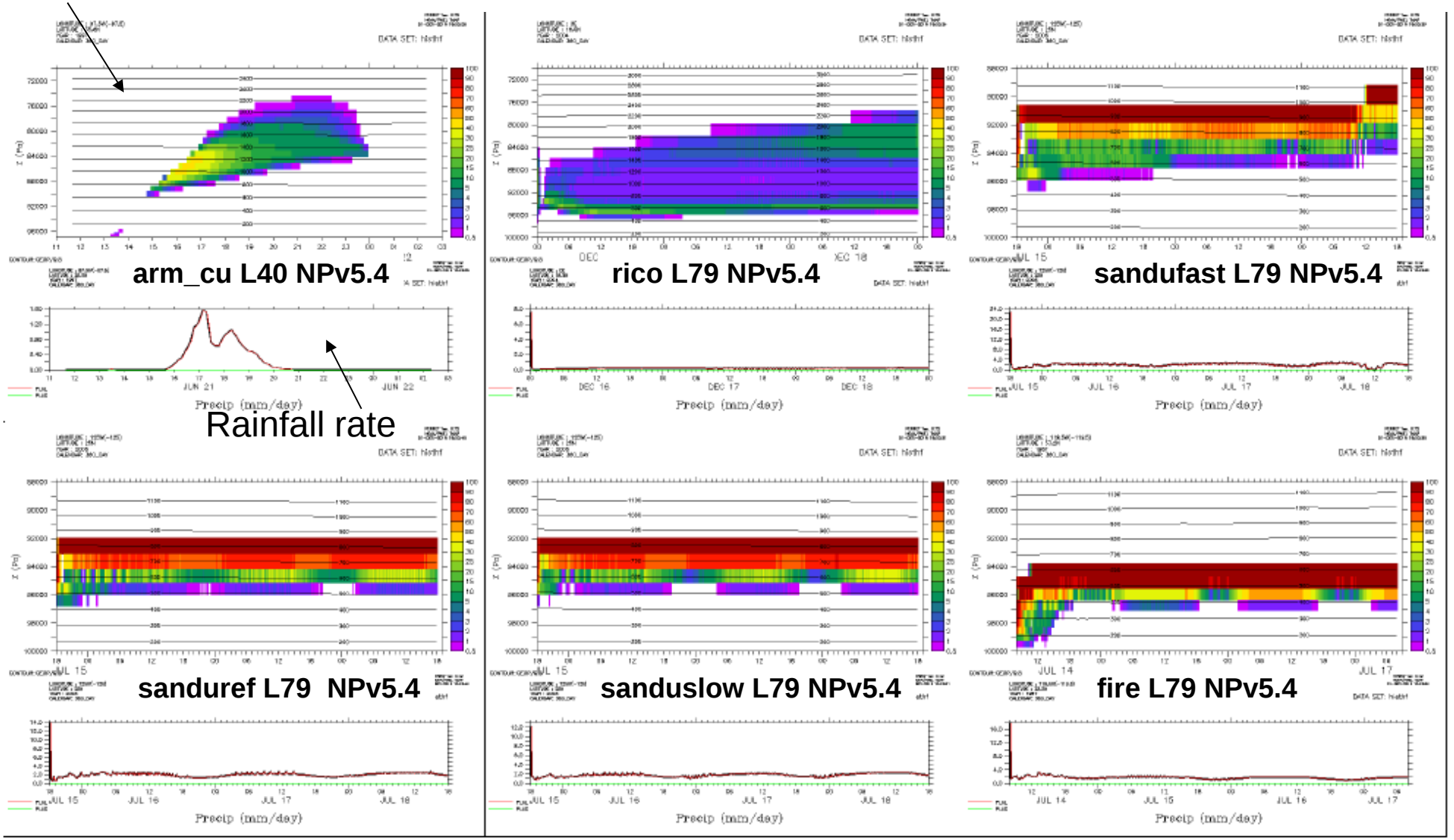
Background : low cloud cover from Calipso (Chepfer et al. 2008)

How to proceed ?

+ install LMDZ 3D with **install.sh**

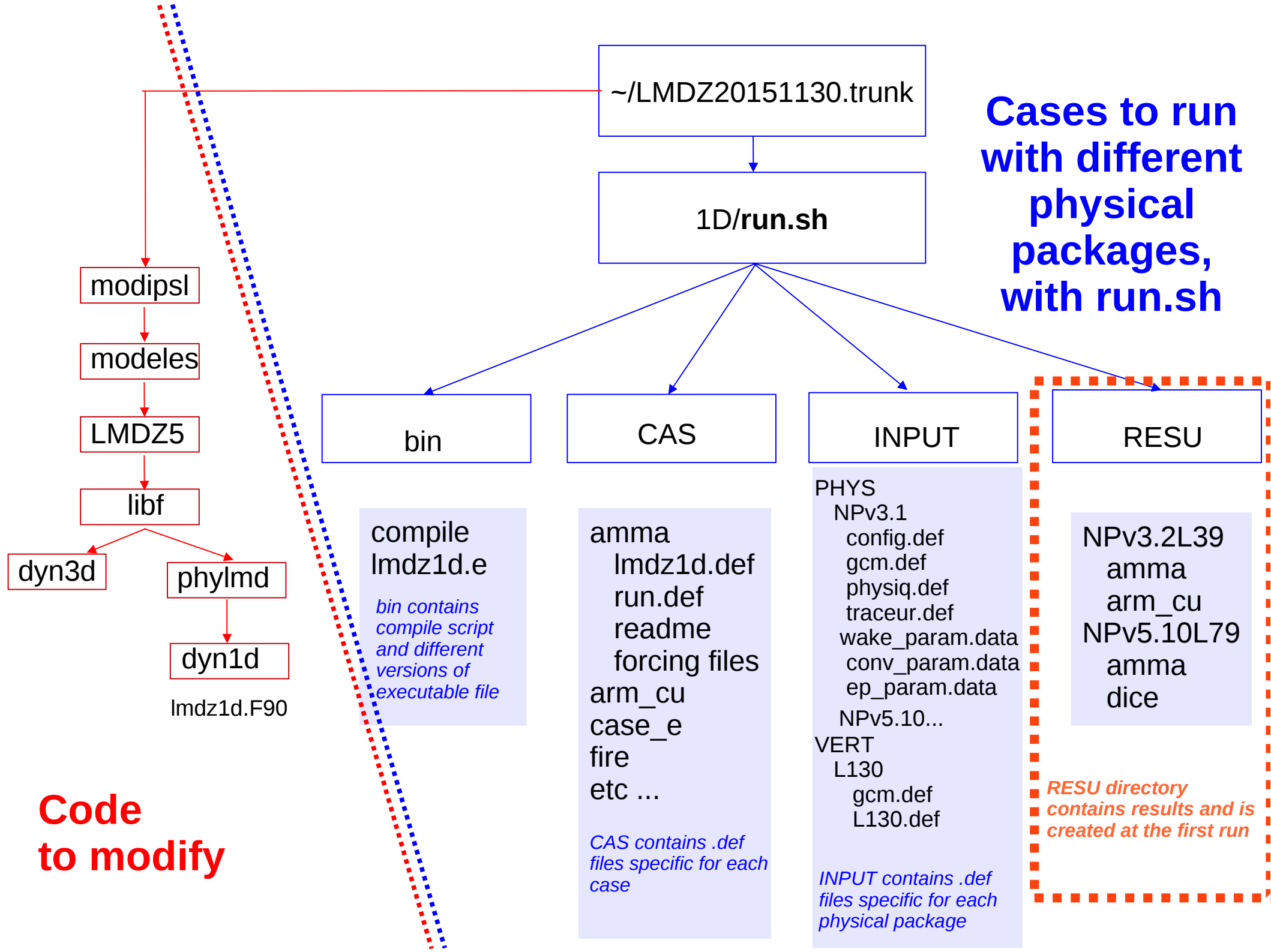
+ install LMDZ 1D with **instal1d.sh**.
    * creates 1D directory
    * compiles
    * runs 6 cases (arm_cu, rico, sandufast, sanduref, sanduslow, fire) with 1 physical package and show cloud cover + precipitation plot

Cloud cover


arm_cu L40 NPv5.4
rico L79 NPv5.4
sandufast L79 NPv5.4
Rainfall rate
sanduref L79 NPv5.4
sanduslow L79 NPv5.4
fire L79 NPv5.4
Precip (mm/day)

What can you do in each case directory ?

+ **compile & run** with run.sh: choose case, physical package and level number
+ Look at **initial profils and forcings** (ascii files or netcdf files)
+ Modify *def files
+ Read readme file
+ **get results** in netcdf files (hist*.nc)
+ **compare** to LES results if avalaible


~/LMDZ20151130.trunk
1D/run.sh
Cases to run with different physical packages, with run.sh
modipsl
modeles
LMDZ5
libf
dyn3d
phylmd
dyn1d
lmdz1d.F90
bin
CAS
INPUT
RESU
compile
lmdz1d.e
bin contains compile script and different versions of executable file
amma
lmdz1d.def
run.def
readme
forcing files
arm_cu
case_e
fire
etc ...
CAS contains .def files specific for each case
PHYS
NPv3.1
config.def
gcm.def
physiq.def
traceur.def
wake_param.data
conv_param.data
ep_param.data
NPv5.10...
VERT
L130
gcm.def
L130.def
INPUT contains .def files specific for each physical package
NPv3.2L39
amma
arm_cu
NPv5.10L79
amma
dice
RESU directory contains results and is created at the first run
Code to modify

There are two ways to run the model :

- Either in « **operationnal mode** » with run.sh (several cases and physical packages)
- Or « **by hand** » with ~bin/compile then lmdz1d.e

How to run a case or compile after modifications : With run.sh

Which case(s) ?

```
listecas="dice ihop arm_cu rico sandufast sanduref sanduslow fire
          toga ayotte twpice case_e amma " # testes
listecas="arm_cu rico sandufast fire twpice amma"
listecas="amma"
```

Which physics ?

```
listedef="SP NPv3.1 NPv3.2 NPv4.12 NPv5.00 NPv5.10"
listedef="NPv5.00 "
listedef="NPv3.2 NPv5.00 "
```

Number of levels ?

```
case $DEF in
   SP|NPV3.1|NPv3.2) L=39 ;;
   NPv4.12) L=59 ;;
   *) L=79
esac
```

Where are the results ?
In LMDZtesting/1D/RESU/NPv3.2L39/amma

```
lrwxrwxrwx 1 ...     36  3 déc.  11:38 amma.nc
-rw-r--r-- 1 ... 285452  3 déc.  11:38 histhf.nc
-rw-r--r-- 1 ... 279088  3 déc.  11:38 hourly.nc
-rw-r--r-- 1 ...  15292  3 déc.  11:38 limit.nc
-rw-r--r-- 1 ...    652  3 déc.  11:38 lmdz1d.def
-rw-r--r-- 1 ...   4247  3 déc.  11:38 config.def
-rw-r--r-- 1 ...     85  3 déc.  11:38 gcm.def
-rw-r----- 1 ...   3765  3 déc.  11:38 physiq.def
-rwxr-xr-- 1 ...    692  3 déc.  11:38 run.def
-rw-r--r-- 1 ...     42  3 déc.  11:38 traceur.def
-rw-r--r-- 1 ...   7728  3 déc.  11:38 paramLMDZ_phy.nc
-rw-r--r-- 1 ...  16532  3 déc.  11:38 startphy.nc
```

forcings

Result files

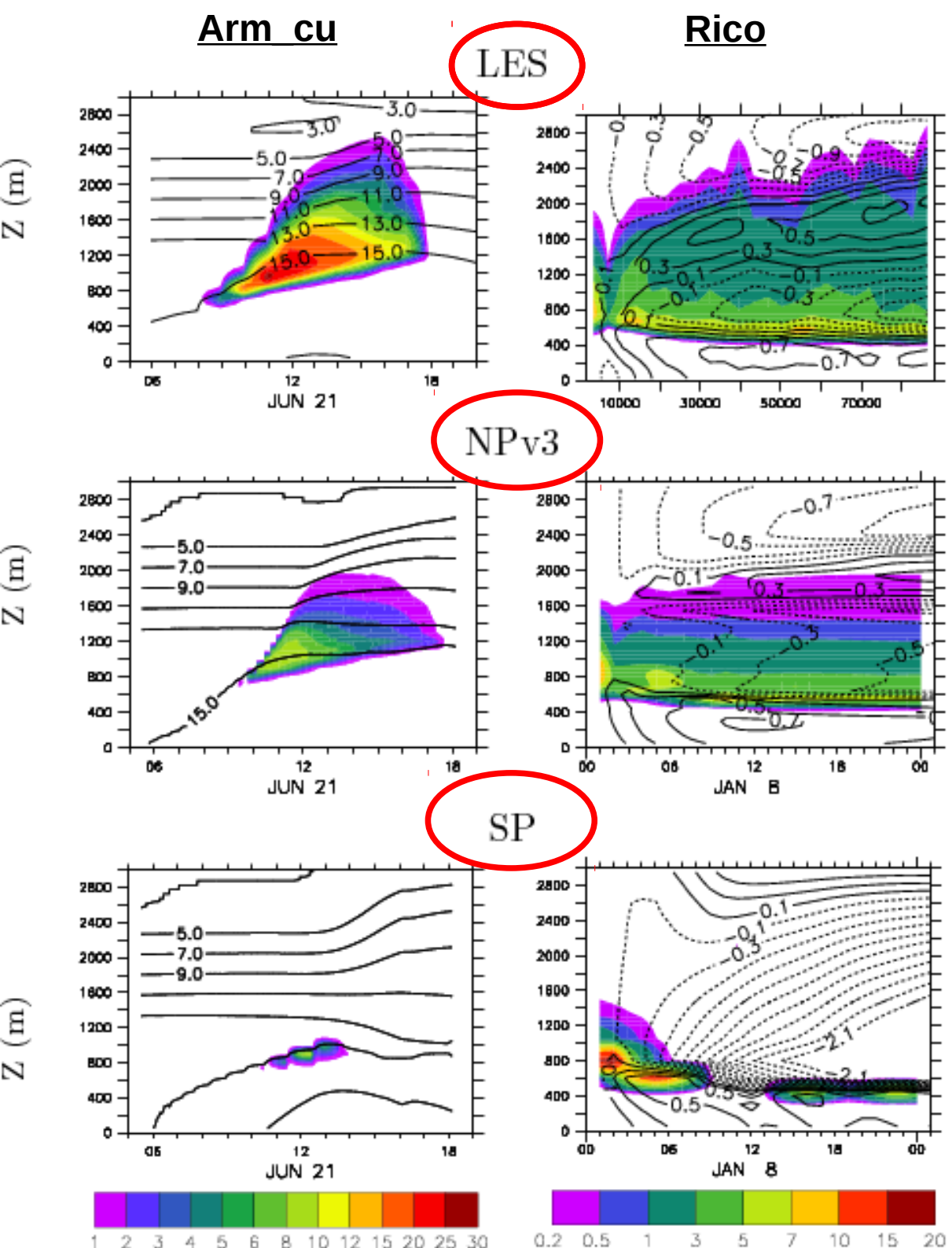
***def files**

CAUTION !

You can modify *def files in ~LMDZtesting/1D/RESU and quickly rerun the model because lmdz1d.e is in this directory. **BUT BE CAREFULL**

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

And will be replaced at each run of run.sh



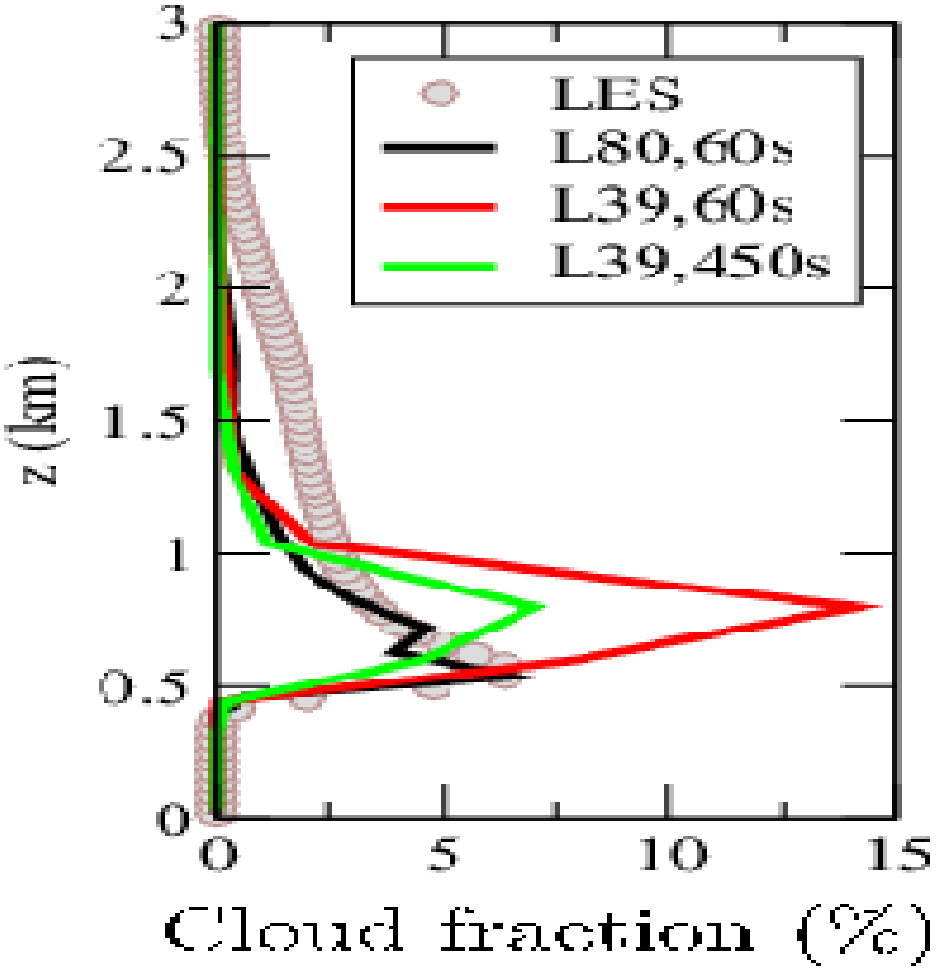
In LMD, we used these cases to develop New Physics version.

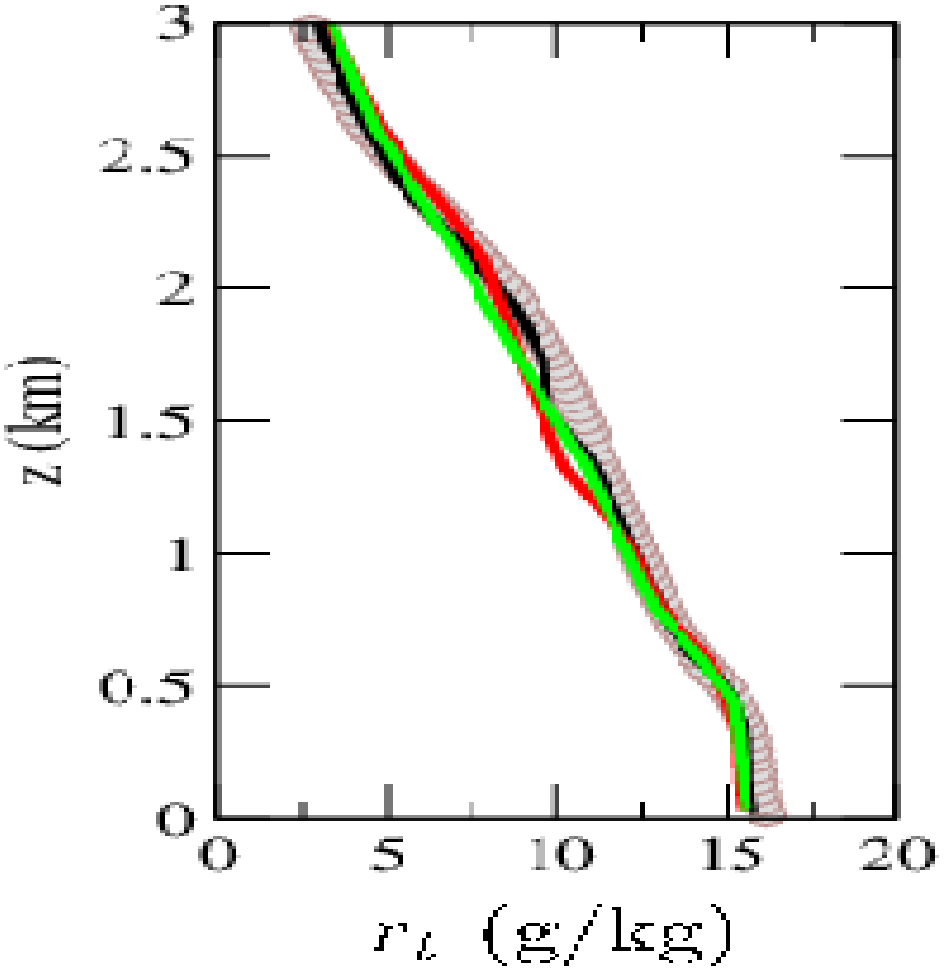
For 2 cases, Arm_cu and Rico, we compare results of « standard physics » (CMIP3), « new physics » (CMIP5) and LES model.

Shade= cloud cover
Contour= specific humidity (g/kg)

Rico case :

Sensitivity Tests to vertical discretization and time step





Recent improvements:

+ 1D with tracers

+ 1D coupled with soil model Orchidee:

DICE case : characterize boundary layer
In the site of SGP during 3 days/night

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

+ Cindy Dynamo case (MJO study)