Tutorial #2 – Orchidee

LMDZ team

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Contents

This tutorial makes use of zoomed configurations of LMDZ. It includes 1) an initialization phase, 2) an example of use of the model (three versions of the tutorial exist for this part), and 3) a last optional phase in which the model can be nudged toward analyzed wind fields.

If you work on a station of the local LMD network, start by creating a directory at your name, then enter this directory. Install the model with the script `install.sh`, if you have not already done so in tutorial #1.

1 Setting up a case with a zoomed grid

- Go to the directory `LMDZtesting/modipsl/modeles/LMDZ5`, which contains files `makegcm`, `libf` ... In this directory, download the following tar file :

  ```
  wget http://www.lmd.jussieu.fr/~lmdz/Distrib/tutorial.tar
  tar -xf tutorial.tar
  cd TUTORIAL
  ```

- In the directory `TUTORIAL`, take a look at the extracted files. You should edit file `gcm.def` if you want to place the center of the zoom at your preferred location. For that you just have to change the longitude and latitude of the zoom center, `clon` and `clat`.

- If you are interested in coupling LMDZ with the surface scheme Orchidee, edit the `init.sh` file and set option `veget=1`. If not (`veget=0`), the model will be run with a simplified bucket scheme for surface hydrology.

- Run the script :

  ```
  ./init.sh
  ```

  The script first compiles the model (`gcm.e`) again because it uses a different resolution, $48 \times 36 - L39$, than the one used in `install.sh`. `init.sh` also compiles the program `ce0l.e`, which creates initial state and boundary conditions. `init.sh` then downloads new NetCDF files which contain the surface orography, sea-surface temperature, and so on, as well as 3D meteorological files taken from ECMWF analyses at a particular date.

`init.sh` then runs `ce0l.e` which creates files `start.nc`, `startphy.nc` and `limit.nc`. Check that these files have been actually created. If not, please ask for our help. If you set `veget=1`, the model will also be run automatically for one day in order to create also a start file for Orchidee, which will be called `sechiba_rest_in.nc`.

- If you now have the files `start.nc`, `startphy.nc` and `limit.nc` (and optionally `sechiba_rest_in.nc` for `veget=1`), you can run the model by executing the command `./gcm.e`.

Note that the run can fail due to a lack of memory. In this case (usually ending up with a segmentation fault), you can increase available memory this way:

```
ulimit -Ss unlimited
```

For further runs, the length of the simulation can be adjusted using keyword `nday=n` in `run.def`, wheren is a number of days.

2 Sensitivity to the soil scheme

Running with ORCHIDEE 2-layers

After having run **init.sh** with **veget=1** you can do a first run with orchidee activated.

In the running directory you need to proceed as without ORCHIDEE but you need to have the file **sechiba_rest_in.nc** in addition to **start.nc** and **startphy.nc** as explained in the previous section.

To get **sechiba** outputs (**sechiba** being the hydrological part of the soil/vegetation model Orchidee), you need to modify variable **WRITE_STEP** in **orchidee.def** in order to set it to the frequency for storage expressed in sec (for instance for a **N**-day run, you may set **WRITE_STEP** to **N*86400** or **86400**). If you do not want the history file you may set **WRITE_STEP** to **0**, If you want to have a 1-month lenght output you may set **WRITE_STEP** to **-1**, You can increase the level of outputs playing with the **SECHIBA_histlevel** variable. Increasing sechiba_histlevel leads to more detailed outputs. The variable corresponding to the various levels are coded in

```
modipsl/modeles/ORCHIDEE/src_sechiba/intersurf.f90
```

Running with ORCHIDEE 11-layers

You need to follow the same procedure as for ORCHIDEE 2-layers but you need to set **HYDROL_CWRR** to **y** in orchidee.def. If you already have done a run with ORCHIDEE -2 layers, you need to re-create an initial state file which is adapted to the multi-layer hydrology. This means remove the file **sechiba_rest_in.nc** in your working directory and set **SECHIBA_restart_in.nc** to **NONE** in orchidee.def and relaunch the gcm.

Running with the simple bucket

If **VEGET=n** (meaning that vegetation is not activated) instead of **y** in file **config.def**, the soil scheme is a simple bucket (even if you compiled with **makegcm -v true** as done by **install.sh** when ran with **veget=1**).

Running with bucket scheme with imposed soil water content

In this case you should run with **VEGET** in **config.def** and add the line **qsol0=qsol0_val** in **physiq.def**, **qsol0** being the soil water content in mm. In this case, the aridity coefficient, **vbeta**, which enables to compute the evaporation as the product of **vbeta** by the potential evaporation is constant: **vbeta(i) = MIN(2.0*qsol/mx_eau_sol, 1.0)**. **mx_eau_sol=150mm** here. You can choose **vbeta** values typical of summer time (which corresponds typically to **qsol0_val=5** or **10**).

The values of the turbulent fluxes for the austral summer (flat and sens in the LMZ output files) can be compared when using the 3 options.

3 Nudging

- You first have to create the file `grilles_gcm.nc` wich contains the longitudes and latitudes of the model grid. To do this, add the line:

  ```
  grilles_gcm_netcdf = TRUE
  ```

  in `run.def` and run again `ce0l.e`. You can then plot the orography map as seen by the zoomed grid, by opening file `grilles_gcm.nc` with `ferret` or `grads` and plotting the surface geopotential `phis`. You can also easily plot the horizontal resolution of the model as the square root of the grid mesh area (`aire`).

- Then you have to get the reanalysis files for nudging. You will find the script `get_era.sh` in the directory `TUTORIAL`. Run the script. It will interpolate the winds on the model grid (by reading the model grid from file `grilles_gcm.nc`). You should end up with files `u.nc` and `v.nc` in your current directory. Note that for this tutorial we have given open access to a subset of the ERA-interim wind fields. ERA-interim files are stored at IDRIS, CCRT and Climserv, with restricted access. To access these files at IDRIS or on Climserv, you should contact Sophie Bouffies-ClochÃ© (IPSL). For access at CCRT, contact Anne Cozic (LSCE). `get_era.sh` is a very simplified script for the tutorial, but more general scrips are available on `http://forge.ipsl.jussieu.fr/igcmg/svn/CONFIG/LMDZOR/branches/LMDZOR_v4/CREATE/SCRIPT`.

- You can then modify file `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
  ```

Here, in `guide.def`, nudging is activated for variables u and v only (as is often the case). The relaxation time is set to 3 hours inside the zoomed area (`tau_max=0.125` days) and half an hour outside (`tau_min`=0.0208333 days). The smaller the relaxation, the stronger the nudging.

- Add the line:

  ```
  INCLUDEDEF=guide.def
  ```

  in `run.def`.

- Without overwriting the old `hist*` files, run the model again with nudging:

  ```
  ./gcm.e
  ```

- Compare the results of the simulations with and without nudging.