

The LMDZORINCA configurations

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The LMDZORINCA configurations (LMDZORINCA and LMDZORINCA_v5) allow you to couple the LMDz atmospheric circulation model, the ORCHIDEE land model, and the INCA atmospheric chemistry model close to the CMIP6 coupled model.

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Description de la configuration Technical details

How to use it Computing performances Restart files Output level - gestion des outputs via XIOS paramètres gérables et conseillés depuis les card Lengths, fréquences conseillées Computing centres autres rubriques propres à chaque config.

1. Description of the configuration

1.1. LMDZORINCA_v6.1.10

LMDZORINCA_v6.1.10 is the **default configuration** for Inca forced model. It is compatible with the IPSLCM6.1.10_LR, LMDZOR_v6.1.10 models. It is constructed with the following models:

- LMDZ branches/IPSLCM6.0.15 rev 3483 for the gcm and the create_etat0_limit
- ORCHIDEE tag tags/ORCHIDEE_2_0/ORCHIDEE rev 5661
- INCA trunk/INCA6 rev 871

This configuration allows you to work with the INCA version tuned for 39 levels and old LMDZ physics scheme for NMHC, NMHC_AER, NMHC_AER_S, AER, GES and DUSS, and on 79 levels and new LMDZ physics scheme for AER.

The same version of INCA is used in IPSLCM5A2CHT.1 configuration.

1.1.1. LMDZORINCA_v6

LMDZORINCA_v6 is the same configuration than LMDZORINCA_v6.1.10 except for INCA version. We use the previous version of the model, (trunk/INCA5 rev 792). Results will be the same between these two versions.

1.2. LMDZORINCA_v6.2_work

LMDZORINCA_v6.2_work is a configuration close to LMDZORINCA_v6.1.10 with updated versions of components: LMDZ, ORCHIDEE, XIOS

- LMDZ6 trunk close to HEAD) for the gcm and the create_etat0_limit
- ORCHIDEE branches/ORCHIDEE_2_2/ORCHIDEE rev 6189
- INCA trunk/INCA6 rev 873

This configuration use the new way of compilation (with a script)

2. Technical details

2.1. How to use it

2.1.1. Compilation of LMDZORINCA_v6.1.10

To compile LMDZORINCA_v6.1.10 configuration you need to use the Makefile store in config/LMDZORINCA/ directory. You can choose between several target :

- VLR and Old LMDZ Physics scheme
 - NMHC_AERxLMD9695-L39 (default one)
 - NMHC_AER_SxLMD9695-L39
 - NMHCxLMD9695-L39
 - AERxLMD9695-L39

- DUSxLMD9695-L39
- GESxLMD9695-L39
- LR and New LMDZ Physics scheme
 - AERxLMD144142-L79
- no maintained anymore - ask to Anne COZIC if you want to use it
 - DUSxLMD144142-L39

2.1.2. Compilation LMDZORINCA_v6.2_work

To compile LMDZORINCA_v6.2_work configuration you need to use the script compile_lmdzorinca.sh. Options to use this script are :

- **-regular_latlon** : default is 96x95x39
- **-chimie** : default is NMHC_AER_S
- **-clean_inca** : active it if you want to recompile full inca model. This option will make a remove of mdoles/INCA/build/ directory.
- **-full** : active it if you want to recompile full configuration.
- **-debug, -dev, -prod**(default) : choose in which mode you want to compile your configuration.

```
./compile_lmdzorinca.sh -regular_latlon 144x142x79
./compile_lmdzorinca.sh -chimie DUS
./compile_lmdzorinca.sh -clean_inca
./compile_lmdzorinca.sh -full
./compile_lmdzorinca.sh -debug
./compile_lmdzorinca.sh -regular_latlon 144x142x79 -chimie AER -full
```

if you compile in debug or in dev mode you need to modify the parameter OptMode in config.card. If you change the resolution at the compilation you need to modify the parameter ResolAtm in config.card

Note : even if the script allow you to compile any resolution for any chemistry, support ones are the same than for LMDZORINCA_v6.1.10 (see above)

2.2. Computing performances

- for VLR resolution (96x95x39) we advice to work with 48MPI and 12OMP for the gcm executable (config.card)
- for LR resolution (144x142x79) we advice to work with 71MPI and 8 OMP for the gcm executable (config.card)

```
ATM= (gcm_${ResolAtm}_${OptMode}_${ConfChem}.e, lmdz.x, 48MPI, 12OMP)
```

2.3. Flags managing the INCA and ORCHIDEE activation

When you compile a model configuration which includes the INCA and ORCHIDEE models, those two models can be activated or deactivated in your simulation. In LMDZORINCA_v5 these activations are managed by the submission directory you chose (in EXPERIMENTS).

2.3.1. Activating or deactivating INCA

Flag	Value	Meaning
config_inca	none	run without INCA
config_inca	aero	coupling with INCA AER/NMHC_AER
config_inca	chem	coupling with INCA NMHC/GES

2.3.2. Activating or deactivating ORCHIDEE

Flag	Value	Meaning
veget	y	run with Orchidee
veget	n	run without Orchidee

3. Available resolutions

When you compile the model you must choose the chemistry component and its resolution:

- AERxLMD9695-L39
- NMHC_AERxLMD9695-L39
- GESxLMD9695-L39
- AERxLMD144x142-L39
- AERxLMD9695-L19
- NMHC_AERxLMD9695-L19
- GESxLMD9695-L19
- AERxLMDZ144142-L19

With LDMZORINCA_v5 we recommend to use the 39 vertical level resolution. With LMDZORINCA we recommend to use the 19 vertical levels resolution.

3.1. Changing the resolution

You can add the compilation of another resolution by copying the syntax of an existing resolution. If you do so, you will need to regrid all input files for the chosen chemistry model. [documentation To regrid the inca files](#)

4. Initial states

With the LMDZ model you can create initial files (start.nc, startphy.nc and limit.nc) for each simulation (for this, use the experiments : EXPERIMENTS/LMDZORINCA/CREATE/). However, start.nc file only contain zero-values for tracers when the model is coupled to INCA. You must therefore work on those values or use output files from existing simulations. By default, we provide one initial state per configuration.

- `$(R_INIT)/CHM/LMDZORINCA/INCA${RESOL_CHM}/start.nc --> start.nc`
- `$(R_INIT)/CHM/LMDZORINCA/INCA${RESOL_CHM}/startphy.nc --> startphy.nc`

With

- `$(R_INIT) = /ccc/work/cont003/p86ips/IGCM/INIT at TGCC`
- `$(RESOL_CHM) = 9695-L39 / 9695-L19 / 144142-L19 / 144142-L39`

They are defined in the [InitialStateFiles] section of lmdz.card

```
[InitialStateFiles]
List= ( $(R_INIT)/CHM/LMDZORINCA/INCA${RESOL_CHM}/start.nc , start.nc ) \
      ( $(R_INIT)/CHM/LMDZORINCA/INCA${RESOL_CHM}/startphy.nc , startphy.nc )
```

5. Experiments

In the EXPERIMENTS directory the available configurations are LMDZORINCA, LMDZOR, LMDZ. In LMDZORINCA you can choose among three kind of experiments:

- NMHC_AER
- AER
- GES

5.1. inca.card

5.1.1. UserChoices Parameters

You can manage some parameter since the inca.card file

- `climatological=[n/y] --> set climatological to choose if the simulation will use online 10m wind (y) or offline (no)`
- `freq_write_chem=[time in second] --> set freq_write_chem to choose the write frequency in second for inca output (inca_avgr, forcate)`

- `feedb=[0/1]` --> heat fluxes computed with feedback corresponding to 0 = no aerosol effects, 1 = aerosol effects selected by `ok_ade`, `ok_aie`

5.1.2. 10-m winds

- There is an experiment directory for each configuration of the chemistry component:
 - `EXPERIMENT/LMDZORINCA/NMHC_AER/`
 - `EXPERIMENT/LMDZORINCA/AER/`
 - `EXPERIMENT/IMDZORINCA/GES/`

Each of those directories contain a `config.card`

- If you work with an aerosol configuration (AER or NMHC_AER) you can chose to work with 10-m winds computed by the LMDZ model or read in forcing files. By default the second option is chosen. On the other hand, if you want to use the values computed by LMDZ, you must change the model by hand by setting the climatological variable to true in `INCA/src/INCA_SRC/aerosol_meteo_calc.F90`.

Files definition to read the 10-m winds

```
[BoundaryFiles]
List=      ( /ccc/work/cont003/subips1/subips1/ECMWF320x160/AN${year}/165_${year}${month}.nc      , u10mec.nc)\
          ( /ccc/work/cont003/subips1/subips1/ECMWF320x160/AN${year}/166_${year}${month}.nc      , v10mec.nc)\
          ( ${R_BC}/ATM/LMDZORINCA/${RESOL_ATM}/NUDGE_FILES/ERA1/AN${year}/u10m_ecmwf_${year}${month}.nc , u10m.nc )\
          ( ${R_BC}/ATM/LMDZORINCA/${RESOL_ATM}/NUDGE_FILES/ERA1/AN${year}/v10m_ecmwf_${year}${month}.nc , v10m.nc )
```

5.1.3. Text outputs

In the INCA4 model version, the text outputs are not in the standard output files. They are redirected to a text file per processor. These files are concatenated at the end of the simulation to create only one `inca.out` file. This file is saved in the `DEBUG/` archive. If the simulation fails, the file is saved in the `Debug/` directory which is available in the experiment directory.

5.2. lmdz.card

You will find all the information needed to understand the `lmdz.card` file [here](#).

5.2.1. The nudged mode

You can work in nudged mode (by forcing the winds using files read by the LMDZ model) or in climatological mode (by using the wind values computed by LMDZ). If you work in nudged mode, several forcing files are available on the subips1 shared account at TGCC : `/ccc/work/cont003/subips1/subips1` (only on Curie)

- `ECMWF96x95` : regrided winds in 96x95 from OPERA of `ecmwf`
- `ECMWF144x142` : regrided winds in 144x142 from OPERA of `ecmwf`
- `ECMWF320x160` : winds distributed by `ecmwf` (1979 to 2013)
- `ERA196x95` : regrided winds in 96x95 from ERA1 of `ecmwf`
- `ERA1` : winds distributed by `ecmwf` (store on `/ccc/store/cont003/subips1/subips1/dmf_import/ERA1/NETCDF/GLOBAL_075/4xdaily/AN_PL` for year 1979 to 2011)

5.2.2. adjust

If you have a simulation which includes the INCA model, you must not use the `adjust` option which creates biases at the beginning of the simulation in particular for configurations with aerosols. If you didn't change the models you can use `Bands` files which are defined by default in the `lmdz.card` files.

```
AER
#LMDZ_Bands_file_name=/ccc/store/cont003/dsm/p86cozic/IGCM_OUT/LMDZORINCA/AER/L5OI4_Bands/ATM/Debug/L5OI4_Bands_Bands_96x95

NMHC_AER
#LMDZ_Bands_file_name=/ccc/store/cont003/dsm/p86cozic/IGCM_OUT/LMDZORINCA/NMHC_AER/L4OI3NA_39_Bands/ATM/Debug/L4OI3NA_39_B

GES
not provided
```

If you added computations in the model, we recommend to regenerate this file by performing a 3-month pre-simulation.

6. The aerosol coupling and the radiative effect in LMDZORINCA

LMDZORINCA allows you to activate the aerosol impact on climate. To this end, we have used Céline Déandreis' PhD results.

This coupling can be made in two different modes:

- offline (reading the aerosols in files)
- online (computing the aerosols using INCA)

Different flags were introduced to manage these new options: **aerosol_couple** and **flag_aerosol** (in physiq.def).

The aerosols you can use with offline or online coupling are : SO4, BC, POM, SS and DUST. If your coupling is offline, refer to the [next](#) chapter.

6.1. Flag definitions

Flag	Value	Meaning
aerosol_couple	n	offline coupling
aerosol_couple	y	online coupling

LMDZ offers two flags to activate the radiative forcings: **ok_ade**, **ok_aie**

Flag	Value	Meaning
ok_ade	y/n	computing (or not) the aerosol direct effect
ok_aie	y/n	computing (or not) the aerosol indirect effect

The ok_ade and ok_aie flags are managed from lmdz.card :

- AER --> aerosol_couple = y, ok_ade = y and ok_aie = n
- NMHC_AER --> aerosol_couple = y, ok_ade = y and ok_aie = n
- GES --> aerosol_couple = n, ok_ade = n and ok_aie = n

6.2. Variable definitions

You can also choose to compute the radiative forcing without their climatic impacts. In this case, you must use the **feedb** variable in the src/INCA_SRC/radlsw_inca.F90 routine. If the variable equals 0 the climatic impact is not activated, if the variable equals 1 the climatic impact is activated.