Wikiprint Book

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IPSL-CM5A2-VLR configuration

Persons in charge: Sébastien Nguyen, Pierre Sepulchre

1. IPSL-CM5A2 model

IPSL-CM5A2 is an **IPSL coupled climate model** including atmosphere, land, ocean, sea ice and carbon cycle. The goal of this model is to reproduce IPSLCM5A-LR version, with reduced computing times to allow to run long simulations (i.e thousands of years) within reasonable time. Main characteritics of this model are **ORCA2-LIM2-PISCES x LMD 96x95x39, old LMDZ physics, ORCHIDEE with Choisnel hydrology (2 layers)**. This model uses both recent component versions and recent technical developments (hybrid parallelization MPI-OpenMP, XIOS 2.0 as input-output library, OASIS3-MCT parallel coupler) that allow to reach **80 simulated years per day** on about 300 computing cores. This model is available on Irene (TGCC) and JeanZay (IDRIS) supercomputers and benefits from last developments of libIGCM running environment.

IPSL-CM5A2 model includes :

- model components :
    - **LMDZ** as atmospheric model ;
    - **NEMO** as ocean model including sea ice (LIM2) and marine biogeochemistry (PISCES) ;
    - **ORCHIDEE** as land model ;
- tools :
    - **OASIS3-MCT** as parallel coupler ;
    - **XIOS 2.0** as I/O library ;
    - **libIGCM** as running environment (scripts) to run the model and to perform post processing ;
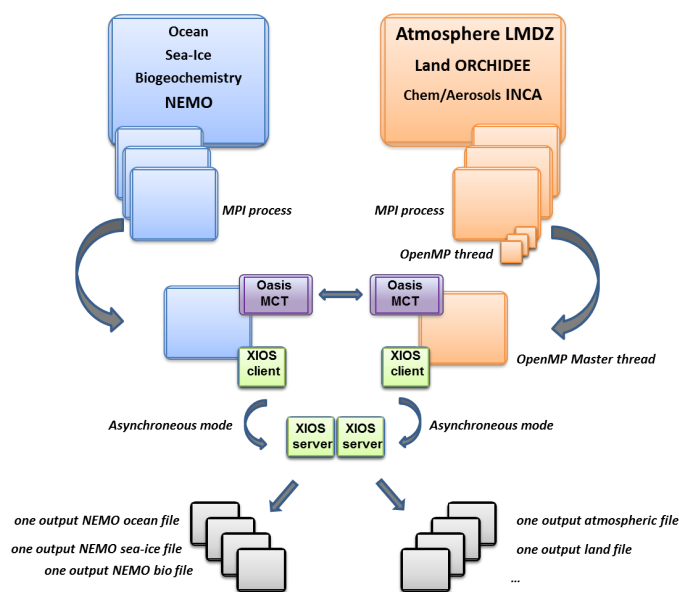
2. Technical details

IPSL-CM5A2 model is available at following resolutions/configurations :

- **IPSL-CM5A2-VLR**: LMDZ (Old Physics) 96x95x39-ORCHIDEE (Choisnel) - NEMO-LIM2-PISCES ORCA2

The resolution of LMDZ is 96x95 (3.75° in longitude and 1.875° in latitude) with 39 vertical levels. The ocean configuration is ORCA2 : global ocean with a tripolar grid with one South Pole, one North Pole above Siberia and one North Pole above northern America. The resolution is 2°. In the tropical region, the latitudinal resolution decreases to 1/2°. There are 31 vertical levels.

IPSL-CM5A2 is composed of following components and tools and available within **IPSLCM5A2.1** release:

```
#-H- IPSLCM5A2.1  IPSLCM5A2.1 coupled configuration
#-H- IPSLCM5A2.1  2nd frozen IPSLCM5A2 version
#-H- IPSLCM5A2.1  NEMOGCM branch nemo_v3_6_STABLE revision 6665
#-H- IPSLCM5A2.1  XIOS2 trunk revision 1551
#-H- IPSLCM5A2.1  IOIPSL/src svn tags/v2_2_2
#-H- IPSLCM5A2.1  LMDZ5 branches/IPSLCM5A2.1 rev 3342
#-H- IPSLCM5A2.1  ORCHIDEE  branches/ORCHIDEE-IPSLCM5A2.1 rev 5307
#-H- IPSLCM5A2.1  OASIS3-MCT 2.0_branch rev 1818
#-H- IPSLCM5A2.1  IPSLCM5A2 svn
#-H- IPSLCM5A2.1  libIGCM trunk rev 1477
#-M- IPSLCM5A2.1  arnaud.caubel@lsce.ipsl.fr
#-C- IPSLCM5A2.1  IOIPSL/tags/v2_2_2/src                          HEAD      8  IOIPSL/src   modeles
#-C- IPSLCM5A2.1  branches/ORCHIDEE-IPSLCM5A2.1/ORCHIDEE          5307     14  ORCHIDEE     modeles
#-C- IPSLCM5A2.1  branches/OASIS3-MCT_2.0_branch/oasis3-mct 1818          15  oasis3-mct   .
#-C- IPSLCM5A2.1  LMDZ5/branches/IPSLCM5A2.1                      3342     11  LMDZ         modeles
#-C- IPSLCM5A2.1  CONFIG/UNIFORM/v6/IPSLCM5A2                     4041      8  IPSLCM5A2     config
#-C- IPSLCM5A2.1  trunk/libIGCM                                   1477     10  libIGCM      .
#-C- IPSLCM5A2.1  branches/2015/nemo_v3_6_STABLE/NEMOGCM          6665      7  .            modeles
#-C- IPSLCM5A2.1  XIOS/trunk                                      1551     12  XIOS         modeles
```

Note that previous IPSLCM5A2.0 release (with bug in runoff conservation) is still available.

Newer version **IPSLCM5A2.2** has been released. It uses the following components:

```
#-H- IPSLCM5A2.2  IPSLCM5A2.2 coupled configuration
#-H- IPSLCM5A2.2  Working IPSLCM5A2 version
#-H- IPSLCM5A2.2  NEMOGCM branch nemo_v3_6_STABLE revision 6665
#-H- IPSLCM5A2.2  XIOS2 branchs/xios-2.5 revision 1903
#-H- IPSLCM5A2.2  IOIPSL/src svn tags/v2_2_2
#-H- IPSLCM5A2.2  LMDZ5 branches/IPSLCM5A2.1 rev 3907
#-H- IPSLCM5A2.2  ORCHIDEE  branches/ORCHIDEE-IPSLCM5A2.1 rev 7376
#-H- IPSLCM5A2.2  OASIS3-MCT 2.0_branch (rev 1818 Cerfacs server, rev 4775 IPSL server)
#-H- IPSLCM5A2.2  IPSLCM5A2 svn 6056
#-H- IPSLCM5A2.2  libIGCM trunk rev 1534
#-M- IPSLCM5A2.2  platform-extract@listes.ipsl.fr
#-C- IPSLCM5A2.2  IOIPSL/tags/v2_2_2/src                              HEAD      8  IOIPSL/src   modeles
#-C- IPSLCM5A2.2  branches/ORCHIDEE-IPSLCM5A2.1/ORCHIDEE              7376     14  ORCHIDEE     modeles
#-C- IPSLCM5A2.2  CPL/oasis3-mct/branches/OASIS3-MCT_2.0_branch 4775           8  oasis3-mct   .
#-C- IPSLCM5A2.2  LMDZ5/branches/IPSLCM5A2.1                          3907     20  LMDZ         modeles
#-C- IPSLCM5A2.2  CONFIG/UNIFORM/v6/IPSLCM5A2                         6056      8  IPSLCM5A2     config
#-C- IPSLCM5A2.2  trunk/libIGCM                                       1534     10  libIGCM      .
#-C- IPSLCM5A2.2  branches/2015/nemo_v3_6_STABLE/NEMOGCM              6665      7  .            modeles
#-C- IPSLCM5A2.2  XIOS/branchs/xios-2.5                               1903     12  XIOS         modeles
```

2.0.1. How to use it

Here are the commands you need to know if you want to retrieve and compile the IPSL-CM5A2 model and if you want to setup and run a piControl experiment (pdControl is also available):

```
mkdir YOUR_DIRECTORY ; cd YOUR_DIRECTORY
svn_ano # svn co http://forge.ipsl.jussieu.fr/igcmg/svn/modipsl/trunk modipsl
cd modipsl/util
./model IPSLCM5A2.1
cd ../config/IPSLCM5A2
gmake # by default ORCA2xLMD9695-L39
cp EXPERIMENTS/IPSLCM/piControl/config.card .
vi config.card # modify JobName (at least) : MYJOBNAME, restarts
../../libIGCM/ins_job # Check and complete job's header
cd MYJOBNAME
vi Job_MYJOBNAME # modify PeriodNb, adjust the time, headers ...
```

```
llsubmit Job_MYJOBNAME # IDRIS
ccc_msub  Job_MYJOBNAME # TGCC
```

2.0.2. IPSLCM5A2.2 specifics

It retains all the standard functionalities of **IPSLCM5A2.1**. It's usage is transparent for "non-paleo" simulations.

It restores the possibility to compile the create_etatlimite executable that was broken in preceding versions.

Some new functionalities have been added for "paleo" runs:

- you can compile a paleo version of the model including sources suitable for paleo simulations that are aware of paleorca grids. Use `gmake PALEOIPSLCM5A2-VLR`.
- the model now accepts configurations with no land ice (a bug has been corrected in Orchidee in rev 7376).
- you can use MOSAIX interpolation weights instead of MOSAIC if you wish. You need to set `cpl_old_calving = n` in **run.def** if you use MOSAIX. Also you need to recompute the initial state of your atmosphere with create etat limit. Do not use a restart from MOSAIC with LMDZ.

```
Note that
```

- some problem has been found by Delphine Tardif regarding plant phenologies in dynamical vegetation within orchidee. You need to replace 0% by 1% in your PFT map file and deactivate the restart for species to grow properly.
- you can't use the paleo version alongside the standard version of the model within the same installation directory (modipsl/config/IPSLCM5A2).

2.0.3. Computing performances

The basic configuration (default configuration) ran smoothly on Irene TGCC (and very soon on JeanZay IDRIS) machine and uses **302 computing cores** : 1 process for XIOS, 45 processes for NEMO, and 32 MPI processes and 8 OpenMP threads for LMDZ. This configuration allows you to run **80 simulated years per day** on Irene TGCC.

2.0.3.1. How to run more efficiently (using less resources)

In order to use less computing resources, it is possible to run on 160 cores (56 simulated years per day) as follows : 1 process for XIOS, 31 processes for NEMO, and 32 MPI processes and 4 OpenMP thread for LMDZ. To do that, you have to :

- Modify config.card as follows :

```
#=======================================================================
#D-- Executable -
[Executable]
#D- For each component, Real name of executable, Name of executable for oasis
ATM= (gcm.e, lmdz.x, 32MPI, 4OMP)
SRF= ("" ,"" )
SBG= ("" ,"" )
OCE= (opa, opa.xx, 31MPI)
ICE= ("" ,"" )
MBG= ("" ,"" )
CPL= ("", "" )
IOS= (xios_server.exe, xios.x, 1MPI)
```

- create the new job :

```
../../libIGCM/ins_job
```

- Modify PARAM/namelist_ORCA2_cfg

```
   jpni        =   1      !  jpni   number of processors following i (set automatically if < 1)
   jpnj        =  31      !  jpnj   number of processors following j (set automatically if < 1)
   jpnij       =  31      !  jpnij  number of local domains (set automatically if < 1)
```

- submit the job : ccc_msub (or sbatch) Job_MYJOBNAME

2.0.3.2. How to run faster (using more resources)

In order to run faster (using more computing resources), it is possible to run on 437 cores (95 simulated years per day) as follows : 1 process for XIOS, 60 processes for NEMO, and 47 MPI processes and 8 OpenMP thread for LMDZ. To do that, you have to :

Modify `config.card` as follows :

```
#========================================================================
#D-- Executable -
[Executable]
#D- For each component, Real name of executable, Name of executable for oasis
ATM= (gcm.e, lmdz.x, 47MPI, 8OMP)
SRF= ("" ,"" )
SBG= ("" ,"" )
OCE= (opa, opa.xx, 60MPI)
ICE= ("" ,"" )
MBG= ("" ,"" )
CPL= ("", "" )
IOS= (xios_server.exe, xios.x, 1MPI)
```

- create the new job :

```
../../libIGCM/ins_job
```

Modify `PARAM/namelist_ORCA2_cfg`

```
   jpni       =   4      !  jpni   number of processors following i (set automatically if < 1)
   jpnj       =  15      !  jpnj   number of processors following j (set automatically if < 1)
   jpnij      =  60      !  jpnij  number of local domains (set automatically if < 1)
```

- submit the job : ccc_msub (or sbatch) Job_MYJOBNAME

2.0.3.3. Load balancing

Because of load-balancing (difference between ocean computing time and atmosphere computing time), not all of the configurations (in terms of number of process/threads) are efficient. If you want to run a configuration with fewer cores, ask Arnaud Caubel what would be the optimum configuration.

2.0.4. Restart files

Default IPSL-CM5A2-VLR configuration starts from **CM5A2.1.pi.debug** simulation at the date of **5009-12-31**. The monitoring of this simulation is available here :
■https://vesg.ipsl.upmc.fr/thredds/fileServer/work_thredds/p25sepul/IPSLCM5A2/PROD/piControl/CM5A2.1.pi.debug/MONITORING/index.html

2.0.5. Output level

By default, **low output levels** are activated : monthly and daily outputs for atmospheric component, monthly and/or yearly outputs for other components. Remind that you have to think of the output you need before launching a long simulation.

2.0.6. Lengths, frequencies

2.0.6.1. Period length

Default period length is 1Y, i.e in config.card :

```
PeriodLength=1Y
```

Note that clean_PeriodLength.job will remove last period files, i.e last simulated year files.

2.0.6.2. Pack Frequency

Default pack frequency is 10Y, i.e in config.card :

```
PackFrequency=10Y
```

Note that since clean_latestPackperiod.job works on the latest pack period, clean_latestPackperiod.job will remove files from latest 10Y pack period. clean_latestPackperiod.job can also be used several time in a row to delete several 10Y pack periods. In order to optimize the use of inodes (beware of quotas !), we advice you to use 100Y as PackFrequency for very long simulations.

2.0.6.3. Rebuild frequency

Since we run with XIOS (server mode) as output library, **the rebuild step is not needed anymore**.

2.0.7. Computing centres

This configuration runs on TGCC-Irene-SKL and at IDRIS-JeanZay.

2.0.7.1. IDRIS-JeanZay

Because of JeanZay architecture (computing nodes based on sockets of 20 cores), we advice you to use 2, 4, 5, 10 or 20 OpenMP threads for LMDZ-ORCHIDEE component. By default, the number of OpenMP threads defined in config.card is 8. To change that, you have to :

- edit and modify config.card as follows :

```
#========================================================================
#D-- Executable -
[Executable]
#D- For each component, Real name of executable, Name of executable for oasis
ATM= (gcm.e, lmdz.x, 35MPI, 10OMP)
SRF= ("" ,"" )
SBG= ("" ,"" )
OCE= (opa, opa.xx, 48MPI)
ICE= ("" ,"" )
MBG= ("" ,"" )
CPL= ("", "" )
IOS= (xios_server.exe, xios.x, 1MPI)
```

- create the new job :

```
../../libIGCM/ins_job
```

Modify `PARAM/namelist_ORCA2_cfg`

```
   jpni        =   4     !  jpni   number of processors following i (set automatically if < 1)
   jpnj        =  12     !  jpnj   number of processors following j (set automatically if < 1)
   jpnij       =  48     !  jpnij  number of local domains (set automatically if < 1)
```

- submit the job : sbatch Job_MYJOBNAME

The above configuration allows you to run **93 SYPD**.

3. Tuning and evaluation of the model

Tuning and evaluation of the model are described in a paper in open-discussion at Geoscientific Model Development :

■**https://www.geosci-model-dev-discuss.net/gmd-2019-332/**

Most of the scripts used to evaluate the model can be retrieved and run interactively here :

■**https://zenodo.org/record/3549652**

4. Modifications since frozen release

4.1. January, 24th 2018

File bathy.orca.nc changed into bathy.orca_v1.nc (see ■https://forge.ipsl.jussieu.fr/igcmg/changeset/3545/CONFIG/UNIFORM/v6/IPSLCM5A2). No change in results except for MBG component. The corrupted file (it was not defined on the right grid) was here : `$(ccc_home --cccwork -u igcmg)/IGCM/OCE/IPSLCM6/ORCA2.3/bathy.orca_orca1l46.nc.`