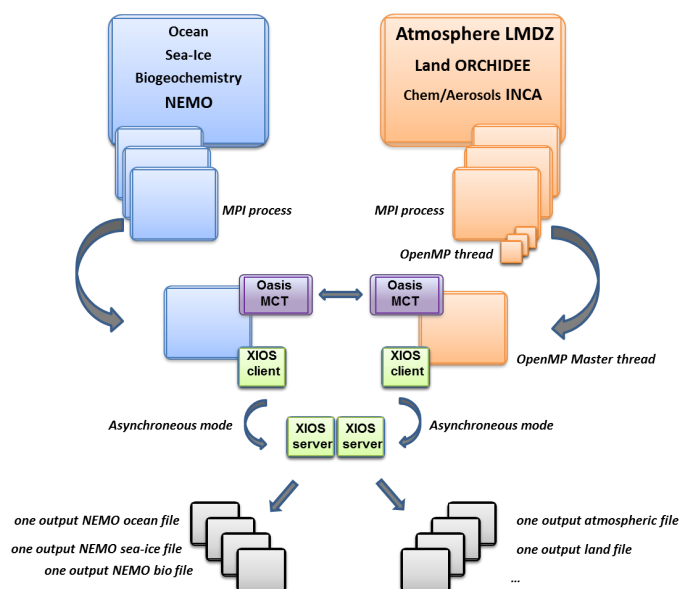# IPSL-CM5A2-VLR configuration

Table of Content

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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 reasonnable time. Main caracteritics 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 **56 simulated years per day** on about 300 computing cores. This model is available on Ada (IDRIS) and Curie (TGCC) supercomputers and benefits from last developments of libIGCM runnning 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 965
```

```
#-H- IPSLCM5A2.1  IOIPSL/src svn tags/v2_2_2
#-H- IPSLCM5A2.1  LMDZ5 trunk rev 2621
#-H- IPSLCM5A2.1  ORCHIDEE version trunk rev 3930
#-H- IPSLCM5A2.1  OASIS3-MCT 2.0_branch rev 1818
#-H- IPSLCM5A2.1  IPSLCM5A2 svn
#-H- IPSLCM5A2.1  libIGCM trunk rev 1373
#-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  trunk/ORCHIDEE                            3930     14  ORCHIDEE      modeles
#-C- IPSLCM5A2.1  branches/OASIS3-MCT_2.0_branch/oasis-mct 1818     15  oasis3-mct    .
#-C- IPSLCM5A2.1  LMDZ5/trunk                               2621     11  LMDZ          modeles
#-C- IPSLCM5A2.1  CONFIG/UNIFORM/v6/IPSLCM5A2               HEAD      8  IPSLCM5A2      config
#-C- IPSLCM5A2.1  trunk/libIGCM                             1373     10  libIGCM       .
#-C- IPSLCM5A2.1  branches/2015/nemo_v3_6_STABLE/NEMOGCM    6665      7  .             modeles
#-C- IPSLCM5A2.1  XIOS/trunk                                 965     12  XIOS          modeles
```

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

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. Computing performances

The basic configuration (default configuration) runs on Curie TGCC and Ada IDRIS machine and uses 302 computing cores : 1 process for XIOS, 45 processes for NEMO, and 32 MPI processes and 8 OpenMP thread for LMDZ. This configuration allows you to run 56 simulated years per day.

2.0.2.1. How to run more efficiently (using less ressources)

In order to use less computing ressources, it is possible to run on 160 cores (38 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 llsubmit) Job_MYJOBNAME

2.0.2.2. How to run faster (using more ressources)

In order to run faster (using more computing ressources), it is possible to run on 437 cores (66 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 llsubmit) Job_MYJOBNAME

2.0.2.3. 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 less cores, ask Arnaud Caubel what would be the optimum configuration.

2.0.3. Restart files

Default IPSL-CM5A2-VLR configuration starts from **CM5A2.1.pi.debug** simulation at the date of **4959-12-31**. The monitoring of this simulation is available here : ■http://esgf.extra.cea.fr/thredds/fileServer/work/p25sepul/IPSLCM5A2/PROD/piControl/CM5A2.1.pi.debug/MONITORING/index.html

2.0.4. 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.

2.0.5. Lengths, frequencies

2.0.5.1. Period length

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

```
PeriodLength=1Y
```

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

2.0.5.2. 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.

2.0.5.3. Rebuild frequency

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

2.0.6. Computing centres

2.0.6.1. IDRIS Ada features

The basic configuration (default configuration) runs on Ada (IDRIS). In order to use efficiently computing ressources, you have to use Intel environment. To do that you have to :

- ask IDRIS assistance (mail to assist@…) to be authorized to use Ada full node and (# @ node = N) option.
- specify the environment you want to use when you do the ../../libIGCM/ins_job command as follows :

```
Hit Enter or give MPI Environement (default is IBM), possible MPI environments are IBM (MPI IBM) and Intel (MPI Intel)
Intel
MPIEnvironment is Intel
```

3. Tuning and evaluation of the model

A note is being written on the tuning strategy of IPSL-CM5A2. The following pdf document is updated very frequently: IPSL-CM5A2 : Set-up, tuning strategy and evaluation

CliMAF atlases comparing IPSL-CM5A2 and IPSL-CM5A pre-industrial climatologies will soon be available here : [■http://esgf.extra.cea.fr/thredds/fileServer/work/p25sepul/C-ESM-EP_CM5A2.1_vs_CM5A_vs_data.html]

Intermonitoring (i.e. evolution in time of the main variables of model components) between IPSL-CM5A2.1 and IPSL-CM5A :

■http://esgf.extra.cea.fr/thredds/fileServer/work/p25sepul/intermonito_CM5A2_CM5A/index.html

Legend to read this intermonitoring :

Blue curve : IPSL-CM5A-LR

Red Curve : IPSL-CM5A2.1 initial run, before tuning, starting from climatologies

Green+Yellow curves : IPSLCM5A2.1 after tuning, branched at year 620 of CM5A2.1 initial run.

Total run length after tuning: 1600 years.

Total run length from climatologies : 2220 years.