Technical Reports

CENTRO EURO-MEDITERRANEO
PER I CAMBIAMENTI CLIMATICI

ANS – Numerical Applications and Scenarios Division

INGV-SXG: A Coupled Atmosphere Ocean Sea-Ice General Circulation Climate Model

Enrico Scoccimarro
Istituto Nazionale di Geofisica e Vulcanologia ((INGV) and Numerical Applications and Scenarios Division, CMCC

Silvio Gualdi
Istituto Nazionale di Geofisica e Vulcanologia ((INGV) and Numerical Applications and Scenarios Division, CMCC

Pier Giuseppe Fogli
Istituto Nazionale di Geofisica e Vulcanologia ((INGV) and Numerical Applications and Scenarios Division, CMCC

Elisa Manzini
Istituto Nazionale di Geofisica e Vulcanologia ((INGV) and Numerical Applications and Scenarios Division, CMCC

Anita Grezio
Istituto Nazionale di Geofisica e Vulcanologia ((INGV)

Antonio Navarra
Istituto Nazionale di Geofisica e Vulcanologia ((INGV) and Numerical Applications and Scenarios Division, CMCC

Centro Euro-Mediterraneo
per i Cambiamenti Climatici
www.cmcc.it

February 2007 ■ TR1

INGV-SXG:

A Coupled Atmosphere Ocean Sea-Ice General Circulation Climate Model

Summary

This technical report summarizes the SINTEX-G (INGV-SXG) model technical structure. INGV-SXG is an Atmosphere Ocean sea-ice General Circulation Model (AOGCM) developed at INGV with the aim of investigating the features and the mechanisms of the climate variability and change.

This model was used to produce the INGV-CMCC Intergovernmental Panel on Climate Change (IPCC) scenario simulations. INGV-SXG is an evolution of SINTEX and SINTEX-F and this report indicates the improvement with respect to these previous INGV AOCM model: the new model includes a thermodynamic-dynamic sea-ice model and the capabilities to use external radiative forcings (Ozone, Sulfate Aerosols, Greenhouse Gases) as specified in the protocol for the IPCC standard experiments.

The description of model components, coupling methods, compiling and running environments is a guideline for model users.

Keywords: Climate Variability, General Circulation Models, IPCC Scenario Simulations.

We *wish to thank all the other INGV-CMCC people who helped to assemble this model: Andrea Alessandri, Alessio Bellucci, Andrea F. Carril, Annalisa Cherchi, Simona Masina and Marcello Vichi.*

***Address for correspondence*:**

Enrico Scoccimarro, Istituto Nazionale di Geofisica e Vulcanologia

Via D. Creti, 12 - 40128 Bologna, Italy – E-mail: scoccimarro@bo.ingv.it

Index

Introduction

This report summarizes the technical structure and the characteristics of the new global coupled climate model developed at the Istituto Nazionale di Geofisica e Vulcanologia (INGV), with the aim of investigating the features and the mechanisms of the climate variability and change. The model, named SINTEX-G (INGV-SXG) (figure 1), is an evolution of the SINTEX and SINTEX-F models [Gualdi et al., 2003a, 2003b; Guilyardi et al., 2003, Luo et al. 2003].

With respect to the previous version of the model, INGV-SXG includes a model of the sea-ice, which allows the production of climate scenario experiments as defined by the Intergovernmental Panel on Climate Change (IPCC) (http://www.pcmdi.llnl.gov/ipcc/about_ipcc.php). This model includes calls that allow integrations with external forcing agents, which include greenhouse gases (CO_2, CH_4, N_2O and CFCs), ozone, sulfate aerosols, as specified in the protocol for the IPCC standard experiments.

1. INGV-SXG technical description

1.1 Model Components

The model is composed of four parts: Atmosphere, Ocean, Sea –Ice and Coupler. All the components are described in the following sections.

1.1.1 Atmosphere

The atmospheric component is ECHAM4 [Roeckner, 1996]. The release 4.6 used, is the MPI (Message Passing Interface) parallelized version.

- Resolution:

Horizontal res: Gaussian grid at triangular truncation T106 (about 1.125^{o}x1.125^{o}).

Vertical res: 19 hybrid sigma-pressure levels; top level at 10 hPa; 7 layers above 200

hPa, 5 layers below 850 hPa.

- Numerical scheme/grid:

  semi-implicit leap-frog time stepping.

- List of prognostic variables: vorticity, divergence, temperature, log surface pressure, water vapour, mixing ratio of total cloud water.

- Major parameterizations:

  a. clouds: Sundquist [Sundquist, 1978] type prognostic scheme for stratiform fractional clouds; optical cloud properties and cloud water determined by Mie theory [Rockel et al., 1991; Roeckner, 1995];

  b. tracer advection: transport of water vapour, cloud water, and (optionally) tracers by a semi-lagrangian scheme [Williamson and Rasch, 1994];.

  c. convection: shallow, mid-level, and deep cumulus convection with Tiedke [Tiedke, 1989] mass flux scheme and adjustment closure for deep convection as described by Nordeng [Nordeng, 1996];

  d. boundary layer and vertical diffusion: surface fluxes of momentum, heat, water vapour, and cloud water calculated with Monin-Obukhov theory [Luis, 1979], with eddy diffusivity coefficients depending on roughness length and Richardson No.; above the surface layer, the coefficients depend on wind shear, thermal stability, and mixing length;

  e. SW radiation: Fouquart and Bonnel[Fouquart and Bonnel, 1980], LW radiation: Morcrette et al. [Morcrette et al., 1986] including methane, nitrous oxide, and 16 CFC species, ozone (14.6 μm), and various types of aerosols (optional) effects; revised water vapor continuum [Giorgetta and Wild, 1995];

  f. Orographic Gravity Wave Drag.

1.1.2 Ocean

The ocean component is OPA 8.2 [Madec et al., 1999] in ORCA2 configuration: 2°x2° cos(latitude).

- Resolution:

  Horizontal res: quasi-isotrope tri-polar grid (2 poles in the northern hemisphere, one over Canada and the other over Siberia. 2° resolution Mercator grid with enhanced meridional resolution in the proximity of the equator and in Med and Red seas (1°);

  Vertical res: 31 vertical levels with 14 levels lying in the top 150 meters.

- Numerical scheme/grid:

  advection scheme : 2nd order Arakawa

  time-stepping: leap-frog except for lateral diffusion (forward) and vertical diffusion (backward)

  vertical coordinate : z-coordinate; free surface.

- List of prognostic variables and tracers: horizontal velocity components, temperature, salinity and kinetic energy.

- Major parameterizations:

  a. eddy parameterization;

  Isopycnal mixing on tracers (no horizontal background) with a constant coefficient of 2000 m^2/s. Eddy induced velocity with a coefficient varying in function of the growth rate of baroclinic instability (ranges 15 m^2/s to 2000 m^2/s). Note that the coefficient is set to 0 in the vicinity of the equator;

  b. bottom boundary layer treatment and/or sill overflow treatment diffusive bottom boundary layer [Beckmann and Dorscher 1997];

  c. mixed-layer treatment;

  TKE scheme [Blanke and Delecluse JPO, 1993 + modification in Madec et al. 1999];

  d. sunlight penetration with 2 master lengths [Blanke and Delecluse 1993];

e. no tidal mixing;

f. no river mouth mixing;

g. mixing isolated seas with the ocean: no mixing (Red and Med seas are explicitly connected to the remaining ocean) . For closed "seas" (Black Sea, Great lakes, Caspian Seas) the mean sea level remain constant, excess (deficit) of water been either redistributed over the world ocean (Caspian Sea) or in St Laurent river mouth (Great lakes) or Dardanel strait area (Black Sea);

h. treatment of North Pole "singularity": semi analytical tri-polar grid, no singular point in the ocean domain [Madec and Imbar,1996; Murray, 1996].

All the description of the model physics can be found in the OPA reference manual [Madec at al 1999] available on the web (http://www.lodyc.jussieu.fr/opa/).

1.1.3 Sea-ice

The evolution of the sea-ice is described by the LIM (Louvain-La-Neuve sea-ice model); [Fichefet and Morales Maqueda, 1997; Timmerman et al., 2005], which is a thermodynamic-dynamic snow sea-ice model. The ice momentum equation is solved on the ocean horizontal grid.

- Resolution:

Horizontal res: the same as the ocean model (2° in longitude and roughly 2° cos(phi) in latitude; equations for ice motion and transport written in curvilinear, orthogonal coordinates; staggered spatial grid of type B) (figure 5).

Vertical res: number of layers: 3 (1 in snow and 2 in ice).

Number of thickness categories: 2 (level ice and leads).

- Numerical scheme/grid:

Heat-diffusion equation: fully implicit scheme.

Momentum equation: semi-implicit scheme (combination of a modified Euler time step scheme and a point successive relaxation procedure).

Advection equations: forward time marching scheme which conserves the second-order moments of the spatial distribution of the advected quantities.

- List of prognostic variables: snow and ice thickness, ice concentration, ice velocity, internal temperature of snow and ice, heat content of brine reservoir.
- Major parameterizations:

a. effective thermal conductivity to account for the effect of the subgrid-scale snow- and ice-thickness distributions on sea-ice thermodynamics;

b. surface albedo dependent on the state of the surface (frozen or melting), the thickness of the snow and ice covers, and the cloudiness;

c. parameterization of leads;

d. snow-ice formation scheme;

e. viscous-plastic rheology;

f. treatment of salinity in ice;

g. constant ice salinity;

h. heat reservoir to account for the storage of latent heat inside the ice resulting from trapping of shortwave radiation by brine pockets;

i. brine rejection treatment;

l. salt rejected during ice accretion and snow-ice formation is put in the first oceanic layer.

1.1.4 Coupler

The software used to couple ocean and atmospheric components is OASIS 2.4 [Valke, 2000]. OASIS is a complete, self-consistent and portable set of Fortran 77, Fortran 90 and C routines divided into a main library, interpolation libraries and communication libraries. Its

main tasks are the synchronization of the models being coupled, and the treatment and interpolation of the fields exchanged between the models. All the coupling options of the simulation are defined using an input file *namecouple* (see appendix A) that uses free formatting.

1.2 Coupling method

The number of processes (in UNIX sense) involved in an INGV-SXG simulation is M=1+1+N: one process for the ocean model, one process for the coupler and N processes for the atmospheric model. N is equivalent to the number of boxes in which we decide to decompose the horizontal spatial domain in the atmospheric model: the parallelization of the ECHAM4.6 code is based on a domain decomposition approach. As shown in figure 2, every process (PE) only handles a limited domain of the full globe and only keeps the respective part of the data (Single Program Multiple Data paradigm).

All the simulation performed with INGV-SXG model were run using N = 4; it means that the number of processes M is typically equal to 6.

Only one process for each model component (i.e. 3 processes) is involved in the coupling: the master process of the atmospheric model gathers (scatters) all the domain subsets from (to) the other processes before (after) to communicate with the coupler process. We do not consider the sea-ice model as a process because it is an ocean model subroutine. The communication between models can be driven in different ways (in OASIS sense). In INGV-SXG the CLIM technique is applied: a MPI2 (Message Passing Interface 2) based synchronization and exchange method.

The models are integrated in parallel. The communication between models occurs, through the coupler, at each coupling time step (96 minutes) which correspond to 1 time step for the ocean model and 8 time steps for the atmospheric model. The ice model communicates with the ocean model at each ocean time step (figure 3).

The fields exchanged between ocean and atmosphere have to be insert in the *namcouple* coupler namelist, coherently with the model codes. The routines modified into each model involved in the coupling phase in INGV-SXG model are the following:

ocean model: stpcmo.F

flx.coupled.clio.h

tau.coupled.clio.h

atmospheric model: fromcpl.F

intocpl.F

During the coupling phase, a large number of operations can be made by the coupler on each field, as specified in the *namecouple* namelist (see appendix A), in order to optimize the interpolation at each coupling time step (figure 4), between the different grids of the two model. As mentioned before, the two grids are different both in type and resolution: figure 5 shows the horizontal grids of the two coupled models.

In order to peform the coupling operations, the following auxiliaries files have been built:

- grids: grid coordinates (latitude and longitude) of all the models.
- masks: land-sea masks of all the models.
- areas: surface area of the grid cells of all the models.
- mozaic_weights: weights needed by the mozaic interpolation technique (the one used to interpolate the fields sent from the ocean to the atmosphere).

For the interpolation from the ocean grid to the atmospheric grid, we use an area-averaging method (activated by the keyword 'MOZAIC' in the OASIS control file namecouple). The only field sent from the ocean model to the atmospheric model is the Sea Surface Temperature (SST) and the information about the Sea Ice Cover (SIC) is passed to the atmosphere through the SST field as values lower then -10 Celsius degrees in the grid

points where the SIC percentage is greather then 60%. The -10 degrees temperature value is interpreted as fully covered sea-ice area by the atmospheric model.

The fields sent from the atmospheric model to the ocean model are the following:

- Solar Heat flux
- Non Solar Heat Flux
- Water Flux
- Snow Fall
- Zonal Wind Stress
- Meridional Wind Stress

Figure 6 shows the operations performed by the coupler on each field (see OASIS 2.4 documentation, [Walke, 2000]) in the INGV-SXG model: preprocessing and interpolation flags. The coupling scheme do not use any flux adjustment.

All the fields coming in to the ocean model from the coupler are interfaced through the sea-ice model, which is a physical interface between the atmosphere and the ocean; due to an underestimation of the albedo in the atmospheric model [Guilyardi & Madec, 1997], it has been necessary to reduce the solar heat flux, on the sea-ice covered regions, to 80% in the northern hemisphere and to 50% in the southern hemisphere.

1.3 Code structure

1.3.1 Compiling environment

The INGV-SXG code is divided in 7 main sections (directories):

1. Coupler component source (CPL)
2. Atmospheric component source (ECHAM4.6)
3. Compiling scripts (MAKE)
4. Ocean component source (OPA)

5. Namelists repository (Namelists)
6. Binaries repository (bin)
7. Experiments environment (exp)

The next paragraphs show the tree of the main directories in each section and the files modified in the INGV-SXG model with respect to the SINTEXF version of the components code; for the sea-ice code, included in section 4 under the UCL_SRC directory (not included in SINTEXF model) only the routines modified with respect to the original LIM code are indicated. Files are in italic.

The model is designed to run on NEC-SX6 vector super computer. The compilation can be done natively on the NEC-SX6 or using NEC cross-compiler on machines mounting the NEC-SX6 filesystems. To compile the code, login MAKE directory and tape gmake (or the cross-compiler command; $SXGMAKE is the environment variable to use on refosco SUN machine located in Bologna ingv CED). The Makefile will call sequentially the CPL, ECHAM4.6 and OPA Makefiles to obtain 3 executables (atmosx oceanx and oasis, collected in the bin directory).

Each Makefile will compile the component code: in case of the OPA model, both the ocean model code (.../OPA/modipsl/modeles/OPA/SRC_ORCA) and the sea-ice code (.../OPA/modipsl/modeles/OPA/SRC_UCL) will be included in the oceanx executable.

The common coupler routines (.../CPL/lib/clim/src_MPI2/*), needed by the other components, are included as libraries in case of OPA model (see .../OPA/modipsl/modeles/OPA/WORK/Makefile linking the .../CPL/MAKE/lib/liboasis2.4_mpi2.a library), and recompiled from local identical routines (.../ECHAM4.6/libclim/*) in case of ECHAM4.6.

1.3.1.1 Coupler component source

CPL

|-- include

parameter.h

|-- lib

| |-- clim

mpiclim.h

clim.h

| | |-- src_MPI2

| -- src

Makefile

1.3.1.2 Atmospheric component source

ECHAM4.6

|-- libclim

Makefile

fromcpl.F

inicma.F

intocpl.F

param_cou.h

|-- modules

Makefile

mo_aerosols.f90

mo_couple.f90

mo_ghgts.f90

mo_io.f90

mo_memory_g3a.f90

mo_memory_g3b.f90

mo_midatm.f90

mo_mpi.f90

mo_ozone.f90

mo_scenario.f90

|-- src

aerosol.f90

control.f90

ozone.f90

physc.f90

radint.f90

radlsw.f90

stepon.f90

Makefile

1.3.1.3 Compiling scripts

MAKE

|--lib

Makefile

1.3.1.4 Ocean and sea-ice component source

OPA

|-- modipsl

|-- modeles

| |-- CPLinclude

clim.h

comclim.h

mpiclim.h

| |-- IOIPSL

| |-- OPA

| | |-- SRC_ORCA

Fioopa.F

Fmpplib.F

common.coupled.h

common.h

common.ice.h

common.mpp.h

flx.coupled.clio.h

flxrnf.orca.r2.h

icelln.F

icelln.coupled.h

inicmo.F

parameter.coupled.h

parameter.h

parameter.ice.h

parctl.F

stpcmo.F

tau.F

tau.coupled.clio.h

| | |-- SRC_UCL

flxdump.F

flxdumpcent.F

fontbc.F

icetooce.F

thersf.F

| | |-- WORK

Makefile

Makefile

1.3.1.5 Namelists repository

Namelists

namcouple.base

namatmos.base

namelist

1.3.1.6 Binaries repository

bin

atmosx

oceanx

oasis

1.3.1.7 Experiments environment

exp

|-- SS26_T106

run.couple

SSXX_seco.trace

1.3.2 Running environment

The exp directory (section 1.3.1.7) contains the experiments directories where are located the scripts to run an INGV-SXG simulation.

In the .../exp/XX_seco experiment directory, the run.couple (Appendix B) script is the one used to run the INGV-SXG IPCC XX century simulation (20c3m). A restart procedure is applied to avoid too long jobs on the NEC queue. The model is designed to run 1 month of simulation for each subjob submission: a subjob is intended as a job subsample and a job as an entire simulation to perform.

The information regarding the period to integrate is stored in the text file named SSXX_seco.trace file which contains: year, month and day of the beginning of the subjob and number of months that have already been done in the job.The *run.couple* script, submitted to the NEC-SX6 nqs-queue system through the qsub command, executes the following steps:

- Set the environment variables related to:
  - input and output files path for all the components
  - MPI model name
  - experiment name
  - number of processes to use in ECHAM4.6 code
  - experiment date and duration (using as input the *SSXX_seco.trace* file) of subjob (here 1 month) and job (the entire simulation) for the entire job and for the single subjob
- Modify the namelists according to the job to run:

- *namelist* for the ocean component
- *namatmos* for the atmospheric component
- *namcouple* for the coupler
- *run.param.li* for the sea-ice

• Get the executables and input files in the scratch directory where the subjob will run, according to the information stored in the *SSXX_seco.trace* file

• Launch the model

• Save the output and restart files in the storage directories

• Update the *SSXX_seco.trace* file for the next subjob

• Resubmit the *run.couple* script to perform the next subjob (month) (until the end of the job).

The executable launched by the run.couple at launching time is *oasis,* the coupler executable; oasis will start the other 2 executables involved in the coupling: *oceanx* and *atmosx*. In case of parallel use of the ECHAM4.6 code, *atmosx* will start other N -1 *atmosx* executables (see 1.2 paragraph).

To run the ECHAM4.6 code with a number of processes not equal to 4 (the default in INGV-SXG), inicmo.F and inicma.F routines must be changed: mpi_totproc(2) must be equal to the new atmosx processes number; also the run.couple run script has to be modified indicating the new NPROCB number of processes.

2. Inputs

2.1 Restarts and auxiliary files

The input files needed to perform the first subjob of the XX century simulation are described in the next sections; the input files relative to other SRES scenario simulations are similar but with other time slices and names.

2.1.1 Atmospheric component input files

- *namatmos.base*: atmospheric model namelist
- *year106m.nc*: climate sea surface temperature field
- *SSXX_seco_01290130_unit.31*: restart unit.31 (ECHAM4.6 type) history file
- *SSXX_seco_01290130_unit.32*: restart unit.32 (ECHAM4.6 type) history file
- *SSXX_seco_01290130_unit.35*: restart unit.35 (ECHAM4.6 type) history file
- *SSXX_seco_01290130_unit.36*: restart unit.36 (ECHAM4.6 type) history file
- *SSXX_seco_01290130_unit.37*: restart unit.37 (ECHAM4.6 type) history file
- *XXghgtable_1870_2000.txt*: table of yearly values for greenhouse gases (CO_2, CH_4, N_2O, CFC-11, CFC-12)
- *T106_aerosolyrs_1870_1879nn.nc*: total sulphate aerosols 3d monthly fields for the 1870-1879 time slice file
- *T106_aerosolyrs_nat_nn.nc*: natural sulphate aerosols 3d monthly

fields for the *1870-1879* time slice file

- *T106_noaao3yrs1870_2100.nc*: ozone monthly 2d zonal monthly means fields for the 1870-2100 time slice file

The last 4 files are used by ECHAM4.6 to load the IPCC radiative forcing as explained in 2.2 paragraph.

2.1.2 Ocean component input files

- *namelist*: ocean model namelist
- *ahmcoef*: 2d integer array to define western bund increase in the equatorial strip at t-points
- *bathymetry*: ocean bathymetry file
- *coordinates.nc*: grid coordinates file
- *runoff_1m_nomask.nc*: climatologic river run-off file
- *LEVITUS_ 1m_Salinity_Ice_nomask.nc:* climatologic 3d monthly salinity file
- *LEVITUS_1m_Temperature_Pot_Ice_nomask.nc:* climatologic 3d monthly temperature file
- *REYNOLDS_1d_seasonnalcycle_82-89.interp.nc*: seasonal cycle sea surface Temperature 2d daily file
- *SSXX_seco_01290130_orcaini.nc* restart history file

2.1.3 Sea-ice component input files

- *run.param.li:* sea-ice model namelist
- *cpointj.dat:* list of local daily outputs file
- *geogra.param:* sea-ice model grid parameters
- *output.param:* output parameters file
- *thermo.param:* ice thermo-physical parameters file

- *dynami.param:* ice dynamic model parameters file
- *inice.param:* sea ice initial conditions file
- *SSXX_seco_01290130_restart_icemod:* restart history file

2.1.4 Coupler component input files

- *namcouple.base:* coupler namelist
- *areas_Orca2closea_T106_r8:* areas file (see 1.2 paragraph)
- *grids_Orca2closea_T106_r8 :* grids file (see 1.2 paragraph)
- *masks_Orca2closea_T106_r8:* masks file (see 1.2 paragraph)
- *mozaic_orca2closea_t106_4neig_r8:* mozaic ocean to atmosphere file (see 1.2 paragraph)
- *mozaic_t106_orca2closea_70neig_r8:* mozaic atmosphere to ocean file (see 1.2 paragraph)
- *SSXX_seco_02281130_flxatmos:* atmospheric fluxes restart history file
- *SSXX_seco_02281130_sstocean* sea surface temperature fluxes restart history file
- *julday* scripts to compute the date, called by
- *caldat* the script *run.couple*
- *SSXX_seco.trace* subjob date beginning file (see 1.3.2 paragraph)

2.2 Radiative forcings

In order to perform the IPCC scenarios simulations, according to the IPCC standard, input files for radiative forcings have been created (last 4 files in 2.1.1), according to the spatial resolution of the model. The ECHAM 4.6 code has been modified to load and use these input fields.

Greenhouse Gases (GHG) values are stored in a single text file, for the entire period of the simulation (i.e. 1870-2000). Only one global value for each year and ghg type (see 2.1.1 for the ghg list) is stored. Similar files are used to cover the XXI century period in SRES scenario simulations.

The ozone is stored in a NetCDF (Network Common Data Form) file [Rew et al., 2006], for the period 1870-2100 (also the SRES scenario post XX century ozone fields are included. The ozone don't change in different SRES scenarios) as monthly 2D zonal mean [Kihel et al., 1999]. The standard IPCC ozone fields have been interpolated on the atmospheric model grid.

Sulphate aerosols are stored in 2 NetCDF files, one with total (natural + anthropogenic) aerosols values and one with natural aerosol values only. This is the configuration used by the model to load and integrate the aerosols contribute in the radiative part of the code. The fields are 3D, stored monthly, and also in this case it has been necessary to interpolate the standard IPCC sulphate aerosols fields on the atmospheric model grid. Due to the large file dimension, aerosols input files have been splitted in 10 years files. The run.couple script is designed to select the right file, corresponding to the decade according to the date of the job. Several modification have been made in the ECHAM4.6 code in order to read and use sulphate aerosols; it is possible to highlight the modified code looking for *"!E+2005.9-aerosol"* comment lines.

3. Outputs

3.1 Atmospheric model output

- *atm_SSXX_seco_01290201_01290230.grib:* 12h grib variables output file,
- *SSX_seco_01290230_unit.31*: restart unit.31 (ECHAM4.6 type) history file
- *SSX_seco_01290230_unit.32*: restart unit.32 (ECHAM4.6 type) history file
- *SSX_seco_01290230_unit.35*: restart unit.35 (ECHAM4.6 type) history file
- *SSX_seco_01290230_unit.36*: restart unit.36 (ECHAM4.6 type) history file
- *SSX_seco_01290230_unit.37*: restart unit.37 (ECHAM4.6 type) history file
- *SSSXX_sec_00030101_00030130_atm.prt*: coupling information log file.

3.2 Ocean model output

- *SSXX_sec_5d_1290201_1290230_grid_T.nc*: 5 days NetCDF grid T variables output file
- *SSXX_sec_5d_1290201_1290230_grid_U.nc*: 5 days NetCDF grid U variables output file
- *SSXX_sec_5d_1290201_1290230_grid_V.nc*: 5 days NetCDF grid V variables output file
- *SSXX_sec_5d_1290201_1290230_grid_W.nc*: 5 days NetCDF grid W variables output file

- *SSXX_sec_1290201_1290230_oce.output*: ocean model log file (Includes sea-ice model log infos)
- *SSXX_sec_1290201_1290230_oce.prt* coupling information log file
- *SSXX_seco_01290230_orcaini.nc* NetCDF ocean restart file.

3.3 Sea-ice model output

- *SSXX_sec_5d_1290201_1290230_icemod.nc*: 5 days NetCDF sea-ice model variables output file
- *SSXX_seco_01290230_restart_icemod* NetCDF sea-ice restart file.

3.4 Coupler and standard output

- *SSXX_seco_01290201_01290230_cplout*: coupler log file
- *SSXX_seco_01290201_01290230_Oasis.prt* coupling information log file
- *SSXX_seco*.oXXXX running standard output (include run.couple stdout and atmospheric stdout)

All these files are stored coherently with the output path setting defined in *run.couple* script (see 1.3.2 paragraph). Only the standard output *SSXX_seco.oXXXX* (XXXX is a progressive queue job number) is stored in the exp directory, together with the updated *SSXX_seco.trace* file (see 1.3.2 paragraph).

The atmospheric output file is in GRIB (GRIdded Binary) format [WMO, 1994]. In order to obtain selected variables in NetCDF format, it is necessary to postprocess these .grib files with the AFTERBURNER (http://www.mpimet.mpg.de/fileadmin/software/afterburner/) software. The total amount of data produced for each subjob is about 1GB, dependent on the number of variable saved. A typical century climate simulation needs 1.2 TB of disk space.

To create the standard output format (network Common Data Form Climate and Forecast Metadata Conventions, netCDF-CF, see http://www.cgd.ucar.edu/cms/eaton/cf-metadata) required to store the data in the PCMDI IPCC database (http://www-pcmdi.llnl.gov/ipcc/about_ipcc.php), several operation have to be made on all the data, through shell scripting and CMOR software (Climate Model Output Rewriter, CMOR, see http://www-pcmdi.llnl.gov/software/cmor/cmor_users_guide.pdf). In this report the postprocessing is not explained.

Bibliography

Beckmann, A. and Dorscher, (1997): A method for improved representation of dense water spreading over topography in geopotential-coordinate models. J. Phys. Oceanogr., 27,581-591

Bower, A.S., Armi, L. and Ambar, I., (1995): Direct evidence of meddy formation off the southwest coast of Portugal. Deep-Sea Research, 42, 1621-1630.

Blanke, B. and Delecluse, P., (1993): Variability of the tropical Atlantic Ocean simulated by a general circulation model with two different mixed-layer physics. J. Phys. Oceanogr., 23, 1363–1388.

Boucher, O. and M. Pham, (2002): History of sulphate aerosol radiative forcings. Geophysical Research Letters, 29(9), 1308.

Fichefet ,T and Morales Maqueda MA (1997): Sensitivity of a global sea ice model to the treatment of ice thermodynamics and dynamics. J Geophys Res 102 : 12,609 - 12,646

Fouquart, Y. and B. Bonnell, (1980): Computations of solar heating of the Earth's atmosphere. Beitr. Phys. Atmos., 53, 35-62.

Giorgetta, M. and M. Wild, (1995): The water vapor continuum and its representation in ECHAM4. MPI for Meterolo., Report No. 162, Hamburg, 38 pp.

Gualdi, S., Guilyardi, E., Navarra, A., Masina, S. and Delecluse, P., (2003a): The interannual variability in the tropical Indian Ocean as simulated by a CGCM, Clim. Dyn., 20, 567–582.

Gualdi, S., Navarra, A., Guilyardi, E., and Delecluse, P., (2003b): Assessment of the tropical Indo-Pacific climate in the SINTEX CGCM, Ann. Geophys., 46, 1 – 26.

Gualdi, S., Scoccimarro, E., Bellucci, A., Grezio, A., Manzini, E. and Navarra, A., (2006): The main features of the 20th Century climate as simulated with the SXG coupled GCM. Claris Newsletter issue 4.

Guilyardi, E., and Madec, G, (1997): Performance of the OPA/ARPEGE-T21 global ocean-atmosphere coupled model. Clim. Dyn., 13, 149-165.

Guilyardi, E., Delecluse, P., Gualdi, S. and Navarra, A., (2003): Mechanisms for ENSO phase change in a coupled GCM, J. Clim., 16, 1141–1158.

Kiehl, J. T., Schneider, T.L., Portmann, R.W., Solomon, S, (1999): Climate forcing due to tropospheric and stratospheric ozone. Journal of Geophysical Research, 104, 31,239 – 31,254.

Levitus, S., (1982): Climatological atlas of the World Ocean, NOAA Prof. Paper 13, US Government Printing Office, Washington DC, USA.

Luis, J. F., (1979): A parametric model of vertical eddy fluxes in the atmosphere. Boundary Layer Meteorology, 17, 187-202.

Luo, J.-J., Masson, S., Becera, S., Delecluse, P., Gualdi, S., Navarra, A., and Yamagata, T., (2003): South Pacific origin of the decadal ENSO-like variation as simulated by a coupled GCM. Geophys. Res. Lett., 30(24), 2250.

Madec, G., and Imbard, I., (1996): A global ocean mesh to overcome the North Pole singularity. Climate Dyn, 12, 381–388.

Madec, G., Delecluse, P., Imbard, I. and Levy, C., (1999), OPA 8.1 Ocean General Circulation Model reference manual, Note du Pôle de modélisation,, Inst. Pierre-Simon Laplace (IPSL), France, No. 11, 91 pp.

Morcrette, J.-J., Smith, L. and Fouquart, Y., (1986): Pressure and temperature dependence of the absorption in longwave radiation parameterizations. Beitr. Physic Atmos., 59, 691-708.

Murray, R. J., (1996): Explicit generation of orthogonal grids for ocean models. J. Comput. Phys, 126, 251–273.

Nordeng, T.E., (1996): Extended versions of the convective parameterization scheme a ECMWF and their impact on the mean and transient activity of the model in the tropics. Technical Memorandum 206, ECMWF, Reading, UK.

Rew, R., Davis, G., Emmerson, S., Davies, H. and Hartnett, E., (2006): The NetCDF User's Guide, Version 3.6.1, Unidata Program Center, 62.p.

Rockel, B., Raschke, E. and Weyres, B., (1991): A parameterization of broad-band radiative transfer properties of water, ice and mixed clouds. Beitr. Physik Atmos., 64, 1-12.

Roeckner, E., (1995): Parameterization of cloud radiative properties in the ECHAM4 model. In: Proc. of the WCRP Workshop on "Cloud Mikrophysics Parameterizations in Global Atmospheric Circulation Models", May 23-25, Ananaskis, Alberta, Canada, WCRP-Report No. 90, 105-116, WMO/TD-No. 713.

Roeckner, E., Arpe, K., Bengtsson, L., Christoph, M., Claussen, M., Dümenil, L., Esch, E., Giorgetta, M., Schlese, U. and Schulzweida, U., (1996): The atmospheric general circulation model ECHAM-4: Model description and simulation of present-day climate. Reports 218, Max-Planck-Institute for Meteorology, Hamburg, 90 pp.

Sundqvist, H. (1978): A parameterization scheme for non-convective condensation including prediction of cloud water content, Quart. J. Roy. Meteor. Soc., 104, 677–690.

Tiedtke, M., (1989): A comprehensive mass flux scheme for cumulus parameterization in large-scale models. Mon. Wea. Rev., 117, 1779-1800.

Timmermann, R., Goosse, H., Madec, G., Fichefet, T., Etheb, C. and Dulière, V. , (2005): On the representation of high latitude processes in the ORCA-LIM global coupled sea ice–ocean model. Ocean Modell., 8, 175-201.

Valke, S, Terray, L, Piacentini, A (2000): The OASIS coupled user guide version 2.4, Technical Report TR/ CMGC/00-10, CERFACS

Williamsen, D. L. and Rasch, P.R., (1994): Water vapor transport in the NCAR CCM2. Tellus 46A, 34-51.

WMO, (1994): Guide to WMO binary code forms. World Meteorological Organization, Geneva, 117p.

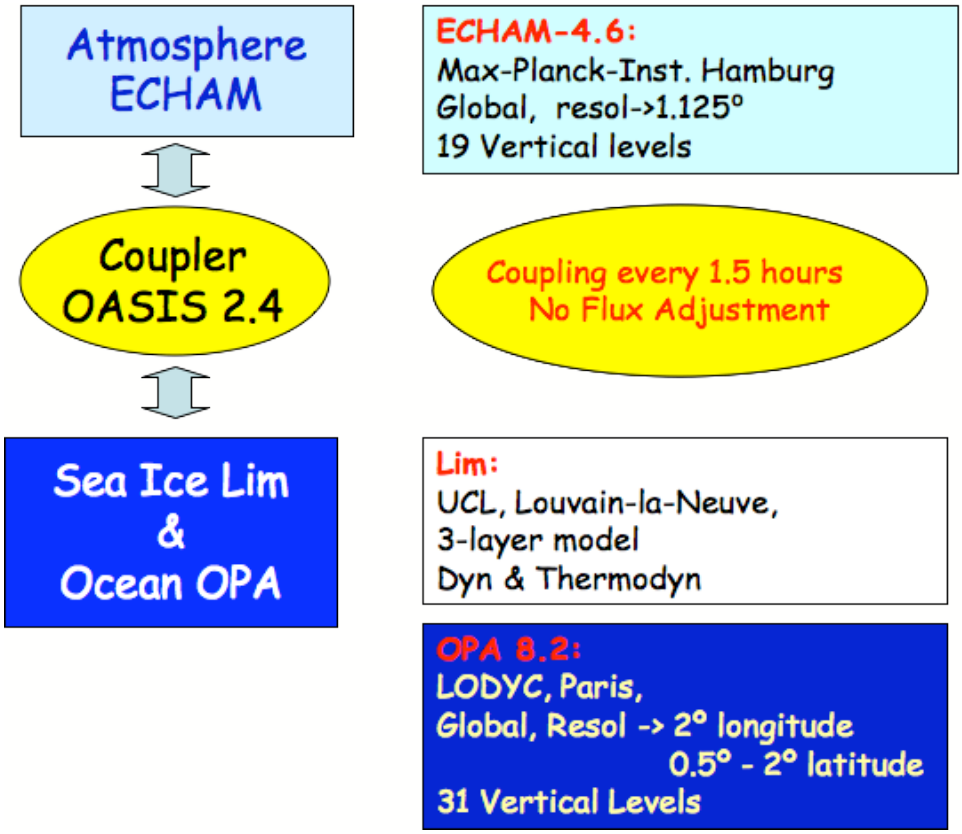

Figure 1: INGV-SXG components.

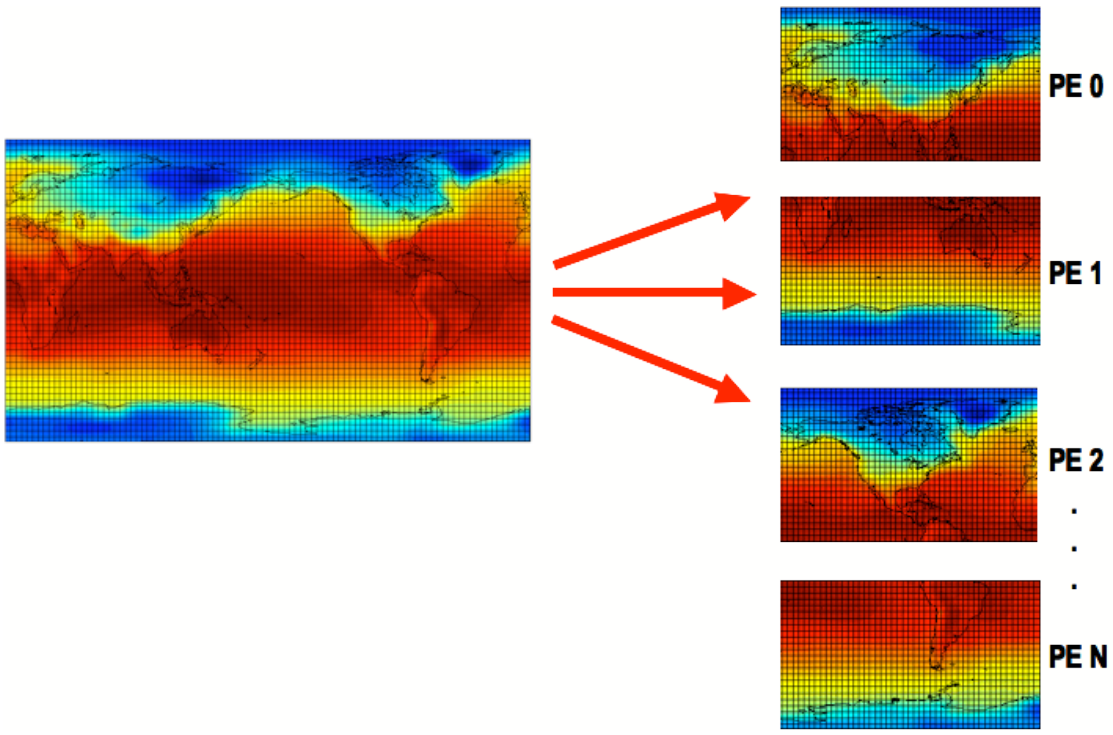

Figure 2: Global domain decomposition in the atmospheric model.

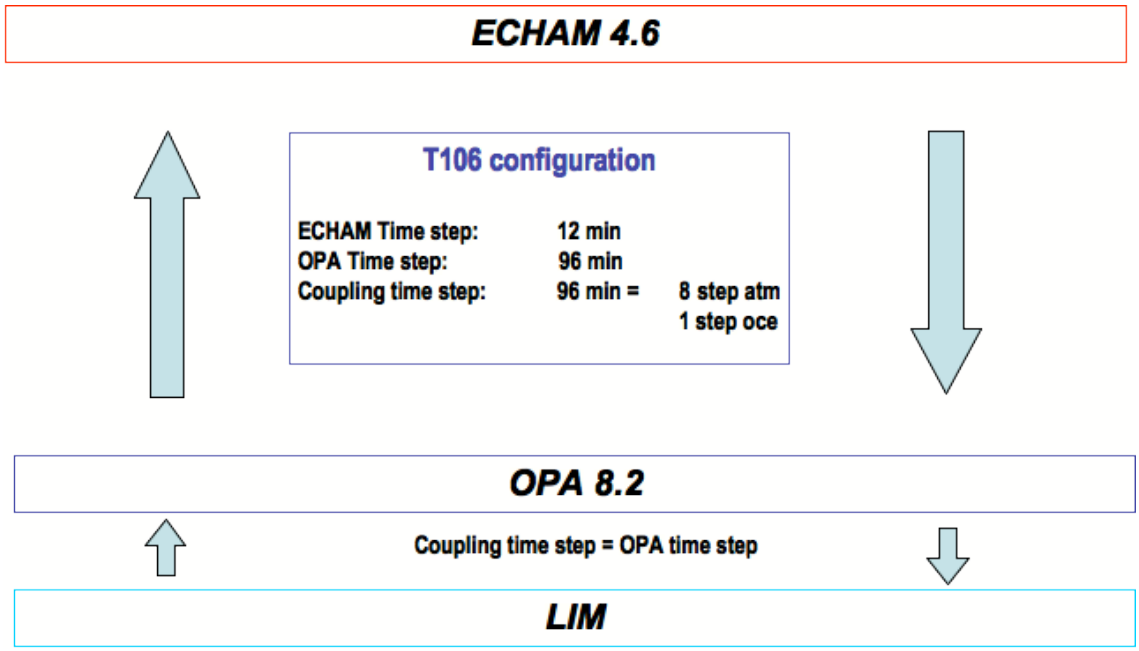

Figure 3: Time stepping.

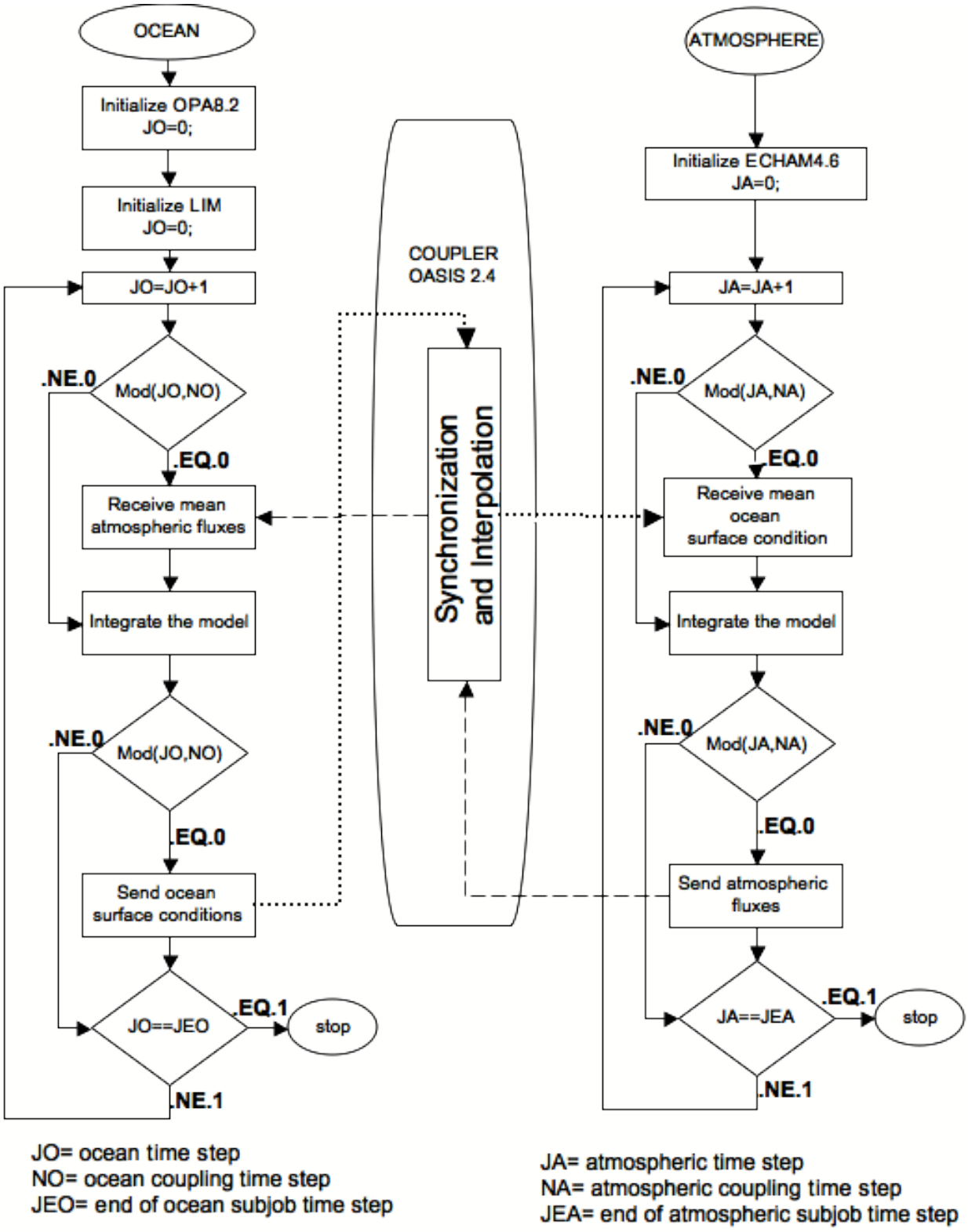

Figure 4: Scheme of time integration.

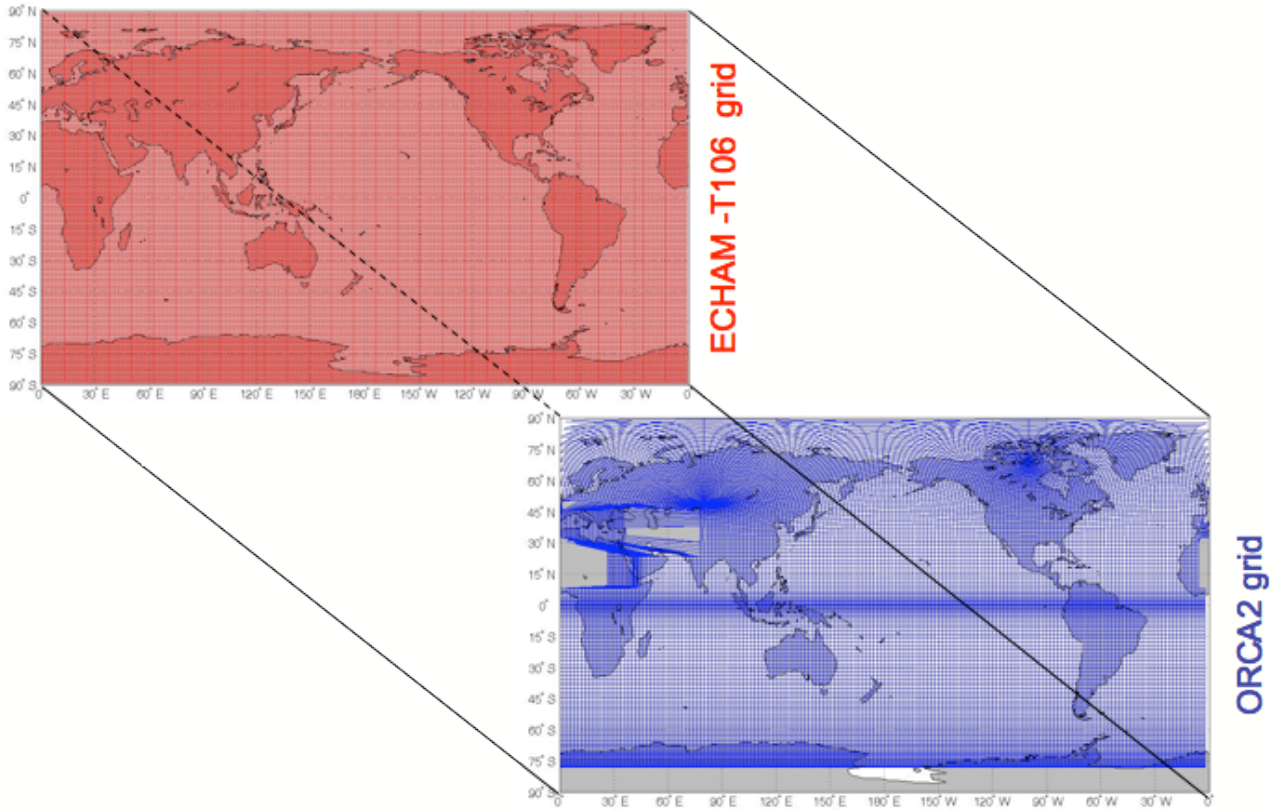

Figure 5: Atmospheric and ocean model grids.

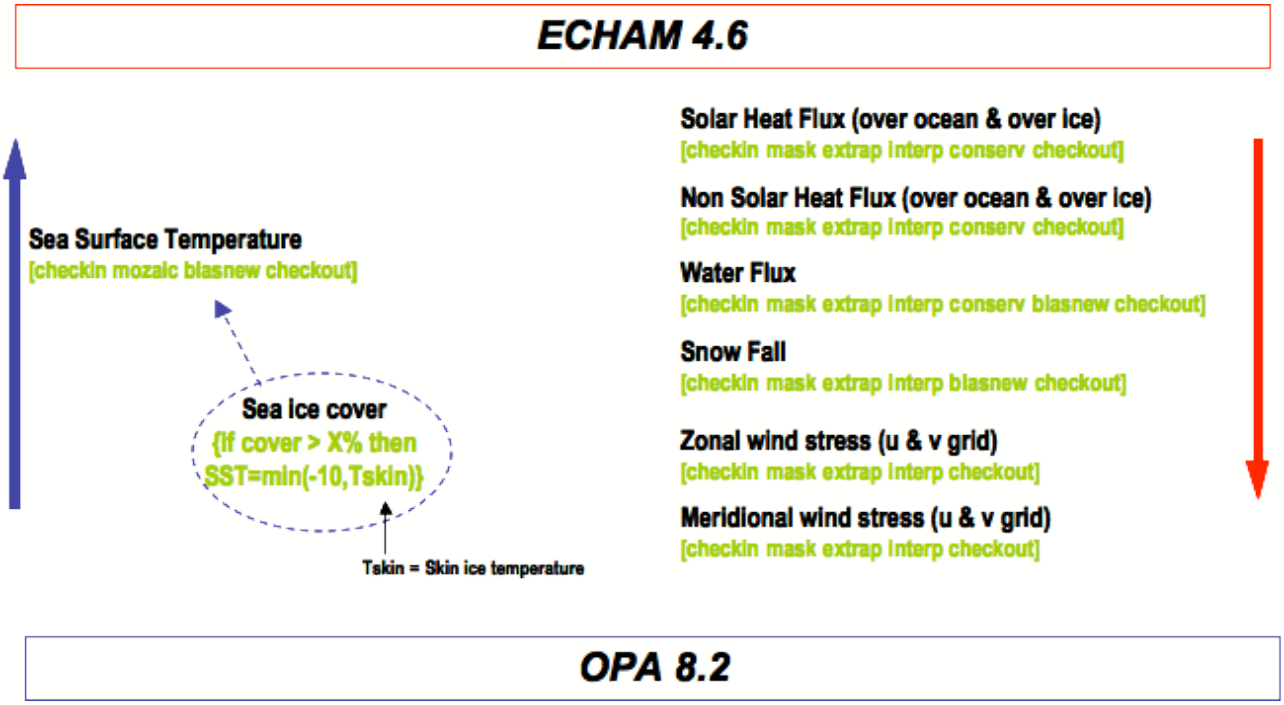

Figure 6: Coupling involved fields.

APPENDIX A

namcouple – namelist containing INGV-SXG coupling settings.

```
$SEQMODE
# This has to do with the time strategy. If you have all the models
# running simultaneously, you must put 1.
# Otherwise, if you have n models running sequentially, you put n
#
          1
 $END
#############################################################################
######
 $MACHINE
# This describes the type of machine you run OASIS on.
# - if it is a cray, put CRAY; otherwise put IEEE
#
            IEEE
 $END
#############################################################################
######
 $CHANNEL
# This describes the kind of message passing you want to use.
# - if you use named pipes + binary files (for synchro and data respectively)
#   you must write PIPE
# - if you use sockets for both synchro. and data (use of the Cerfacs library
#   CLIM based on PVM3.3), you must write CLIM
# - If you use system V shared memory segments and semaphores (for data and
#   synchro respectively), you must write SIPC
# - If you use OASIS as just an interpolator (i.e no models), you
#   must write NONE (furthermore you need to set NBMODEL to 0)
            CLIM
 $END
#############################################################################
######
 $CHATYPE
# This describes the type of message passing you want to use.
# - if you use PVM 3.3 version library :
#   you must write PVM3
# - if you use MPI-2 library of message passing,
#   you must write MPI2, the number of procs on which you want
#   to distribute each model, and the number of procs involved in
#   the coupling for each model.
# - Only these two types of libraries are allowed
            MPI2  1   1   1   1
#############################################################################
######
 $NFIELDS
# This is the total number of fields being exchanged.
# 2 fields  Ocean -> Atm + 11 fields Atm. -> Ocean
#
```

```
#
# For the definition of the fields, see under $STRINGS keyword
#
          13
 $END
##############################################################################
######
 $JOBNAME
# This is an acronym for this given simulation
# (3 characters)
   CLI
 $END
##############################################################################
#######
 $NBMODEL
# This gives you the number of models running in this experiment +
# their names (6 characters).
#
  2 oceanx atmosx
 $END
##############################################################################
########
 $RUNTIME
# This gives you the total simulated time for this run in seconds (here 1 month)
#
   2592000
 $END
##############################################################################
########
 $INIDATE
# This is the initial date of the run. It is regularly updated by the
# program. This is important if, for example, the SST field coming from
# a Pacific OGCM needs to be completed with climatological data
# of the right date.
#
  010101
 $END
##############################################################################
########
 $MODINFO
# Indicates if a header must be encapsulated within the field brick
# (YES or NOT)
  NOT
 $END
##############################################################################
########
 $NLOGPRT
# Index of printing level in output file cplout: 0 = no printing
#  1 = main routines and field names when treated, 2 = complete output
 2
 $END
```

```
#############################################################################
########
 $STRINGS
#
# The above variables are the general parameters for the experiment.
# Everything below has to do with the fields being exchanged
# For each field, the first 2 lines are descriptors of the field, the
# related grid, the related model and data files.
# The third line gives the list of analysis to be performed  and the
# following lines give specific parameters  for each analysis.
# See the documentation for the analyses available in Oasis and for the
# relevant lines.
#
#############################################################################
#########
#                 OCEAN  --->>>  ATMOS
#                 --------------------
# Field 1 : sea surface temperature
#
#   First line:
# 1) and 2) Symbolic names for the field before and after interpolation
#          (8 characters maximum)
# 3) Label number for internal oasis output (cf blkdata.f)
# 4) Exchange frequency for the field in seconds (here 1 day)
# 5) Number of analysis to be performed
# 6) 7) 8) and 9) restart input binary file names + related unit numbers
# 10) Field status (EXPORTED or AUXILARY)
#
SOSSTSST SISUTESU 1 5760  4  sstocean   sstatmos  85   96  EXPORTED
#
#   Second line:
# 1) 2) 3) and 4) Number of long. and lat. on initial and final grids
# 5) and 6) locator prefix (4 characters) used to read the parameters
#          of the source and target grid
# 7) Index of the sequential position of the model generating the field
#    Meaningfull only if the SEQMODE input is > 1.
# 8) Flag used to delay the exchange of the given field in the case of models
#    running simultaneously (n = number of coupling timestep delay).
# 9) Flag to compute an extra timestep at the end (1 yes, 0 no)
# 10) Flag to compute the field integral in analyses CHECKIN and CHECKOUT
#     (1 yes, 0 no)
#
182  149    320  160    or1t  a106     1     0      0      1
P  2  P  0
SERIAL
#
# List of analyses
#
 CHECKIN  MOZAIC  BLASNEW   CHECKOUT
#
# Specific parameters for each analysis
#
```

```
# Mozaic: 1) mapping filename 2) connected unit 3) dataset rank 4) Maximum
#         number of neighbors used
#
orcat106      91      2     4
#
# Blasnew: go from Celsius to Kelvin
# 1) mult. coeff for initial field 2) nb of additional fields
# 3) names of additional field, 4) value of multiplicative coefficient
#
  1.   1
  CONSTANT     273.15
#  CONSTANT     0
#
# Reverse: 1) and 2) describes the ordering of the target model
#
#  NORSUD   WSTEST
#
# Glored: Since version 2.3, the information on the reduced grid
# has to be NOxx WHERE xx is half the number of latitude lines
#
# NO24 2 1 2
#
#####################################################################
#########
# Field 2 : Sea ice extent
#
SOICECOV SIICECOV 2 5760  3  sstocean   sstatmos  85   96  EXPORTED
182  149    320  160    or1t  a106     1    0     0    1
P  2  P  0
SERIAL
#
CHECKIN  MOZAIC  CHECKOUT
#
orcat106   91    2    4
#####################################################################
#########
#
#####################################################################
#########
#
#
#####################################################################
#########
#                 ATMOSPHERE  --->>>  OCEAN
#                 ------------------------
#####################################################################
#########
#####################################################################
#########
#
# Field 3 : Non solar heat flux over ice
#
```

```
CONSFLIC SONSFLIC 6 5760  6   flxatmos  flxocean  87   89   EXPORTED
320   160  182   149  a106   or1t    1     0     0     1
P  0  P  2
SERIAL
#
CHECKIN  MASK EXTRAP   INTERP CONSERV  CHECKOUT
#
# NO24     SEALAND
#
# NORSUD    WSTEST
#
999999.9
NINENN  2 1 1
BICUBIC  G  SCALAR
GLOBAL
#
##########################################################################
##########
##
##########################################################################
##########
#
# Field 4 : Non solar heat flux over open ocean
#
CONSFLWA SONSFLWA 6 5760  6   flxatmos  flxocean  87   89   EXPORTED
320   160  182   149  a106   or1t    1     0     0     1
P  0  P  2
SERIAL
#
CHECKIN  MASK EXTRAP   INTERP CONSERV  CHECKOUT
#
# NO24     SEALAND
#
# NORSUD    WSTEST
#
999999.9
NINENN  2 0 1
BICUBIC  G  SCALAR
GLOBAL
#
##########################################################################
##########
##
##
##########################################################################
##########
# Field 5 : Solar heat flux over ice
#
COSHFTIC  SOSHFLIC   7   5760  6   flxatmos  flxocean  87   89  EXPORTED
320   160  182   149  a106   or1t  1  0   0   1
P  0  P  2
SERIAL
```

```
#
CHECKIN  MASK EXTRAP   INTERP CONSERV  CHECKOUT
#
# NO24     SEALAND
#
# NORSUD    WSTEST
#
999999.9
NINENN  2 0 1
BICUBIC  G  SCALAR
GLOBAL
#
##########################################################################
##########
##
##########################################################################
##########
#
# Field 6 : Solar heat flux over open ocean
#
COSHFTWA  SOSHFLWA   7   5760  6   flxatmos  flxocean  87   89  EXPORTED
320   160  182   149  a106   or1t  1  0   0   1
P  0  P  2
SERIAL
#
CHECKIN  MASK EXTRAP   INTERP CONSERV  CHECKOUT
#
# NO24     SEALAND
#
# NORSUD    WSTEST
#
999999.9
NINENN  2 0 1
BICUBIC  G  SCALAR
GLOBAL
#
##########################################################################
##########
##
##########################################################################
##########
#
# Field 7 : water flux
#
COWATFLU SOWAFLDO 30 5760  7   flxatmos  flxocean  87   89  EXPORTED
320   160   182   149    a106    or1t    1    0     0     1
P  0  P  2
SERIAL
#
CHECKIN  MASK EXTRAP   INTERP CONSERV  BLASNEW CHECKOUT
#
# NO24     SEALAND
```

```
#
# NORSUD    WSTEST
#
999999.9
NINENN  2 0 1
BICUBIC  G  SCALAR
GLOBAL
-1000. 0
##########################################################################
##########
##
##########################################################################
##########
##
## Field 8 : snow fall
###
COSNOWFA  SOSNOWFA   28  5760    6   flxatmos  flxocean  87   89  EXPORTED
320  160   182 149  a106   or1t   1     0     0    1
P  0  P  2
SERIAL
###
CHECKIN  MASK EXTRAP   INTERP  BLASNEW CHECKOUT
#
# NO24     SEALAND
#
# NORSUD    WSTEST
#
999999.9
NINENN  2 0 1
BICUBIC  G  SCALAR
-1000. 0
#
##########################################################################
##########
##
##########################################################################
##########
##
### Field 9 : Runoff
###
CORUNOFF  SORIVOFF   32  5760    5   flxatmos  flxocean  87   89  EXPORTED
320  160   182 149  a106   or1t   1     0     0    1
P  0  P  2
SERIAL
###
CHECKIN MASK EXTRAP INTERP  CHECKOUT
999999.9
#999.999
#9
NINENN  2 0 1
BICUBIC  G  SCALAR
#0. 0
```

```
##runoff31   93   1    41
##1.157407e-05  0
#########################################################################
#######
##
#########################################################################
#######
#
# Field 10 : zonal wind stress -> ugrid
#
COZOTAUX  SOZOTAUX   23  5760  5   flxatmos  flxocean   87  89  EXPORTED
320  160   182 149  a106     or1u  1  0    0    1
P  0  P  2
SERIAL
#
CHECKIN  MASK EXTRAP INTERP CHECKOUT
#
# NO24     SEALAND
#
# NORSUD    WSTEST
#
999.999
NINENN  2 0 1
BICUBIC  G   VECTOR
#
#########################################################################
#######
#
## Field 11 : zonal wind stress -> ugrid
#
COMETAUY  SOMETAUY   24  5760  5   flxatmos  flxocean   87  89  EXPORTED
320  160   182 149  a106     or1v  1  0    0    1
P  0  P  2
SERIAL
#
CHECKIN  MASK EXTRAP INTERP CHECKOUT
#
# NO24     SEALAND
#
# NORSUD    WSTEST
#
999.999
NINENN  2 0 1
BICUBIC  G   VECTOR
##
#########################################################################
#######
#
# Field 12 : zonal wind stress -> vgrid
#
COZOTAUV  SOZOTAUV   23  5760  5   flxatmos  flxocean   87  89  EXPORTED
320  160   182 149  a106     or1v  1  0    0    1
```

```
P  0  P  2
SERIAL
#
CHECKIN  MASK EXTRAP INTERP CHECKOUT
#
# NO24     SEALAND
#
# NORSUD    WSTEST
#
999.999
NINENN  2 0 1
BICUBIC  G    VECTOR
#
#########################################################################
#######
##
# Field 13 : meridional wind stress -> ugrid
#
COMETAUU  SOMETAUU   24  5760  5   flxatmos  flxocean 87   89  EXPORTED
320   160  182 149  a106     or1u    1    0     0     1
P  0  P  2
SERIAL
#
CHECKIN  MASK EXTRAP   INTERP  CHECKOUT
#
999.999
NINENN  2 0 1
BICUBIC  G  VECTOR
#
#########################################################################
########
 $END
```

APPENDIX B

run.couple – Script to submit an INGV-SXG simulation on NEC-SX6 vector machine.

```
#@$-q large
#@$-s /usr/bin/ksh -x
#@$-c 4
#@$-eo
#@$-r SSXX_seco
#
##############################################################################
#####
##
##      Based on
##      Script for coupled model LMDZ 72x45 / ORCA 4 degres
##      $Header: /home/ioipsl/CVSROOT/IPSLCM4/scripts/AA_job,v 1.11 2002/05/10
14:19:19 adm Exp $
#####
##      Modified for NEC SX-6 barolo.bo.ingv.it by Annalisa Cherchi Ottobre 2003
##      Revised on April 2004 Enrico Scoccimarro
##
##      Eric MAISONNAVE / Marie-Alice FOUJOLS
##      Sources d'origine:
##                      Lancement Coupleur : Oasis team
##                      Lancement ORCA : Olivier Marti
##                      Lancement LMDZ : Laurent Fairhead
##                      Systeme de relances :  Olivier Marti
##
##
##############################################################################
#####
ORCA2=/scratch/users/enrico/data/ORCA2
DATAB=/scratch/users/enrico
SCRATCHB=/scratch/users/enrico
HOMEB=/home/enrico

################ ENVIRONMENT VARIABLES TO CHANGE ###############
F_PROGINF=detail
export F_PROGINF
######################### MPI ENVIRONMENT VARIABLES
MPISUSPEND=on
export MPISUSPEND
MPIPROGINF=all_detail
export MPIPROGINF
##-- print the date
date
##-- print the "echo" of the commands before and after execution
set -vx
##############################################################################
######
```

```
##
##    I. Definitions
##
#########################################################################
######
##=======================================================================
========
##-----------------------------------------------------------------------
##    I.1 General definitions
##-----------------------------------------------------------------------
##=======================================================================
========
#
##-- Model Name
MODNAME=SINTEXS
##-- Experience Name: to change
CEXPER=SSXX_seco
##-- Directory where modipsl is located
## Number of cpu used in ECHAM 4.6: to change (according to -c and NCPUS)
NPROCA=4
NPROCB=1
#
##=======================================================================
========
##-----------------------------------------------------------------------
##    I.2 definitions of experiment and restart lengths
##-----------------------------------------------------------------------
##=======================================================================
========
##
##-- The experimement is divided into jobs (called with "qsub" command)
##    that are themselves divided into subjob (directly called by ./Job.
##    as a shell script without qsub )
##
##-- Eg: an 11 years experiment contains A) 1 year of echam spin up (not
##       managed by this script) and then B) 10 years of coupled
##       experiment that is divided into
##--        20 jobs of 6 months duration that are themselves divided into
##--        6 subjobs of 1 month duration.
##
##-- Calendar type, 2 cases are possible: 30d (for 30 days/month calendar)
##   or greg (for using the real gregorian calendar)
#
CALTYPE=30d
#
##-- First day of the experiment (including the spin-up of ECHAM)
##   As the calendar is included in ECHAM restarts files, if we want
##   that ORCA and ECHAM use the same calendar (necessary in the case
##   of the true calendar), we must consider the number of years of
##   ECHAM spin-up to define the calendar origin of the experiment.
#
DAY_BEGIN_EXP=1  ; MONTH_BEGIN_EXP=1  ; YEAR_BEGIN_EXP=1
```

```
#
##  Number of years already done in the echam spin-up:
#
NYSPIN=1
##--
##-- duration of the experiment (in months), only the coupled part,
##   without ECHAM spin-up
# to Change
CPEXP_DUR=$(( 2000 ))
##--
##-- duration of one job (in months)
JOB_DUR=2000
##--
##-- maximum duration of one subjob (in months)
MAXSUBJOB_DUR=1
##--
##
##================================================================
========
##----------------------------------------------------------------
##    I.3 Definition of the IO directories
##----------------------------------------------------------------
##================================================================
========
##
## Only $STOREIN directory must exist before running the experiment.
## All the other directories will be automatically created if they
## are not existing.
##
## You have to define only: $STOREIN, $LOCAL and $STOREOUT directories.
## The name of the other directories will be automatically defined.
## WARNING: Check the definition of $TOWORK. If the directory where
## the model is running is a temporary directory automatically defined
## by a enironment variable, use it to define TOWORK.
##   e.g.: TOWORK=$TMPDIR
##
# General purpose directories
#-------
HOMEDIR=${HOMEB}/$MODNAME/exp/$CEXPER
cd $HOMEDIR
#
LOCAL=${SCRATCHB}/$MODNAME/$CEXPER
if [ ! -f ${SCRATCHB}/$MODNAME/$CEXPER ]; then
   mkdir -p ${SCRATCHB}/$MODNAME/$CEXPER
fi
# Remote Storage of Input data
#-------
STOREIN=${DATAB}/data
#-------
# Remote Storage of model outputs
#-------
STOREOUT=$LOCAL
```

```
#-------
# Remote storage for models diagnostics
#-------
STOREDIAG=${DATAB}/${MODNAME}/${CEXPER}/Diag
if [ ! -d $STOREDIAG ]; then
        mkdir -p $STOREDIAG
fi
#
# ----------------- ECHAM4 ---------------------
#
# local input from the atmosphere
LOCAL_INATM=$STOREIN/In/Atm
STOUT_AFILES=${STOREOUT}/Atm/Results
if [ ! -f $STOUT_AFILES ]; then
  mkdir -p $STOUT_AFILES
fi
STOREOUT_ARES=${STOREOUT}/Atm/Restarts
if [ ! -f $STOREOUT_ARES ]; then
  mkdir -p $STOREOUT_ARES
fi
STOUT_AFILES_D=${DATAB}/${MODNAME}/${CEXPER}/Atm/Results
if [ ! -f $STOUT_AFILES_D ]; then
  mkdir -p $STOUT_AFILES_D
fi
STOREOUT_ARES_D=${DATAB}/${MODNAME}/${CEXPER}/Atm/Restarts
if [ ! -f $STOREOUT_ARES_D ]; then
  mkdir -p $STOREOUT_ARES_D
fi
# for IPCC scenarios
SCENARIO=/home/enrico/SINTEXS/ghg
PAST=/home/enrico/SINTEXS/ghg
# RES T30 or T106
RES=106
#
# ----------------- ORCA ----------------------
#
LOCAL_INICE=${STOREIN}/In/Lim
STOUT_OFILES=${DATAB}/${MODNAME}/${CEXPER}/Oce/Results
if [ ! -f $STOUT_OFILES ]; then
  mkdir -p $STOUT_OFILES
fi
STOREOUT_ORES=${STOREOUT}/Oce/Restarts
if [ ! -f $STOREOUT_ORES ]; then
  mkdir -p  $STOREOUT_ORES
fi
#
STOREOUT_ORES_D=${DATAB}/${MODNAME}/${CEXPER}/Oce/Restarts
if [ ! -f $STOREOUT_ORES_D ]; then
  mkdir -p  $STOREOUT_ORES_D
fi
#
# ----------------- OASIS ----------------------
```

```
#
LOCAL_INCPL=${STOREIN}/In/Cpl
STOREOUT_CRES=${STOREOUT}/Cpl/Restarts
if [ ! -f $STOREOUT_CRES ]; then
  mkdir -p $STOREOUT_CRES
fi
STOREOUT_CRES_D=${DATAB}/${MODNAME}/${CEXPER}/Cpl/Restarts
if [ ! -f $STOREOUT_CRES_D ]; then
  mkdir -p $STOREOUT_CRES_D
fi
#
# ----------------- OTHERS ----------------------
#
# remote storage of Namelists of each models
STOUT_OUT=$HOMEDIR/Out
if [ ! -f $STOUT_OUT ]; then
  mkdir -p $STOUT_OUT
fi
# remote storage of other outputs files!
STOUT_MORE=$HOMEDIR/More
if [ ! -f $STOUT_MORE ]; then
  mkdir -p $STOUT_MORE
fi
#
# ----------- directory where the model is running -----------
#
TOWORK=$LOCAL/Towork
if [ ! -f $TOWORK ]; then
  mkdir -p $TOWORK
fi
cd ${TOWORK} || exit
#- cleanning
\rm -f *
##
if [ ! -f ${LOCAL}/Res/Cpl ]; then
  mkdir -p ${LOCAL}/Res/Cpl
fi
#
if [ ! -f ${LOCAL}/Res/Atm ]; then
  mkdir -p ${LOCAL}/Res/Atm
fi
#
if [ ! -f ${LOCAL}/Res/Oce ]; then
  mkdir -p ${LOCAL}/Res/Oce
fi

#########################################################################
######
##
##    II. General check/definition of Calendar and dates
##
```

```
#####################################################################
######
##
SCRIPTDIR=${HOMEB}/$MODNAME/scripts
#
# Get calendar computation tools
#
cp $SCRIPTDIR/julday .
cp $SCRIPTDIR/caldat .
#
# somme additional calendar computation tools...
#
valid_date () { ./caldat `./julday $1 $2 $3 $CALTYPE` $CALTYPE ; }
yyyymmdd_fmt () { valid_date $1 $2 $3 | read m d y ; echo $( printf "%04s\n" $y)$(
printf "%02s\n" $m)$( printf "%02s\n" $d) ; }
#
##=================================================================
========
##-----------------------------------------------------------------
##    II.1 Calendar computation linked to the experiment
##-----------------------------------------------------------------
##=================================================================
========
#
# first date of the experiment in format yyyymmdd
DATE_BEGIN_EXP=`yyyymmdd_fmt $MONTH_BEGIN_EXP $DAY_BEGIN_EXP
$YEAR_BEGIN_EXP`
#
# first date of the coupled experiment
valid_date $(( $MONTH_BEGIN_EXP + $NYSPIN*12 )) $DAY_BEGIN_EXP
$YEAR_BEGIN_EXP | read MONTH_BEGIN_CPEXP DAY_BEGIN_CPEXP
YEAR_BEGIN_CPEXP
# first date of the coupled experiment in format yyyymmdd
DATE_BEGIN_CPEXP=`yyyymmdd_fmt $MONTH_BEGIN_CPEXP
$DAY_BEGIN_CPEXP $YEAR_BEGIN_CPEXP`
#
# last date of the experiment
valid_date $(( $MONTH_BEGIN_EXP + $CPEXP_DUR + $NYSPIN*12 )) $((
$DAY_BEGIN_EXP-1 )) $YEAR_BEGIN_EXP | read MONTH_END_EXP
DAY_END_EXP YEAR_END_EXP
# last date of the experiment in format yyyymmdd
DATE_END_EXP=`yyyymmdd_fmt $MONTH_END_EXP $DAY_END_EXP
$YEAR_END_EXP`
##
##=================================================================
========
##-----------------------------------------------------------------
##    II.2 definition of the auxiliary file used in the restart procedure
##-----------------------------------------------------------------
##=================================================================
========
##
```

```
##  Creation of ${CEXPER}.trace if it doesn't exist.
##  This file is used for the restart proceddure.
##  It contains:
##    1) Year Month Day of the beginning of the subjob.
##    2) The number of months that have already been done in the job
##
##
#
if [ ! -f ${HOMEDIR}/${CEXPER}.trace ]
then
## if ${CEXPER}.trace doesn't exist
## this is the beginning of the coupled experiment.
## start from the beginnig of the coupled experiment
   YEAR_BEGIN_SUBJOB=${YEAR_BEGIN_CPEXP}
   MONTH_BEGIN_SUBJOB=${MONTH_BEGIN_CPEXP}
   DAY_BEGIN_SUBJOB=${DAY_BEGIN_CPEXP}
## 0 days have been done in the job
   MONTHS_DONE=0
## store the informations in ${CEXPER}.trace
   cat <<EOF >${CEXPER}.trace
$YEAR_BEGIN_SUBJOB $MONTH_BEGIN_SUBJOB $DAY_BEGIN_SUBJOB
$MONTHS_DONE
EOF
## define the file ${CEXPER}.log that contains jobs history
   echo `date` " Begining of The Coupled Experience : " ${CEXPER} " in directory :"
${R_EXPER} > ${CEXPER}.log
else
  cp ${HOMEDIR}/${CEXPER}.trace .
fi
##
##================================================================
========
##----------------------------------------------------------------
##    II.3 Calendar computation linked to the subjob
##----------------------------------------------------------------
##================================================================
========
##-------
## get, via ${CEXPER}.trace, year month day of subjob beginning and the number
## of days already done in the Job
##-------
cat ${CEXPER}.trace | read YEAR_BEGIN_SUBJOB MONTH_BEGIN_SUBJOB
DAY_BEGIN_SUBJOB MONTHS_DONE
echo In ${CEXPER}.trace:
echo $YEAR_BEGIN_SUBJOB $MONTH_BEGIN_SUBJOB $DAY_BEGIN_SUBJOB
$MONTHS_DONE
##!E+2005.9-aerosol
if [ ${YEAR_BEGIN_SUBJOB} -ge 129 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1870_1879nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 139 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1880_1889nn.nc
```

```
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 149 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1890_1899nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 159 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1900_1909nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 169 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1910_1919nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 179 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1920_1929nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 189 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1930_1939nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 199 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1940_1949nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 209 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1950_1959nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 219 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1960_1969nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 229 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1970_1979nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 239 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1980_1989nn.nc
fi
if [ ${YEAR_BEGIN_SUBJOB} -ge 249 ] ; then
TEN_YEARS_AEROSOL_FILE=T106_aerosolyrs1990_1999nn.nc
fi
echo "Total aerosol file choosen: " ${TEN_YEARS_AEROSOL_FILE}
##!E-2005.9-aerosol
##--------
## beginning date of subjob in format yyyymmdd
##--------
DATE_BEGIN_SUBJOB=`yyyymmdd_fmt $MONTH_BEGIN_SUBJOB
$DAY_BEGIN_SUBJOB $YEAR_BEGIN_SUBJOB`
##--------
## Duration of the subjob in months
##--------
SUBJOB_DUR=$(( $JOB_DUR - $MONTHS_DONE ))
[ ${SUBJOB_DUR} -gt ${MAXSUBJOB_DUR} ] &&
SUBJOB_DUR=${MAXSUBJOB_DUR}
##-------
## year month day of the end of subjob
##-------
```

```
valid_date $(( $MONTH_BEGIN_SUBJOB+$SUBJOB_DUR )) $((
$DAY_BEGIN_SUBJOB-1 )) $YEAR_BEGIN_SUBJOB | read
MONTH_END_SUBJOB DAY_END_SUBJOB YEAR_END_SUBJOB
##-------
## last date of subjob in format yyyymmdd
##-------
DATE_END_SUBJOB=`yyyymmdd_fmt $MONTH_END_SUBJOB
$DAY_END_SUBJOB $YEAR_END_SUBJOB`
##-------
## dates interval of the subjob
##-------
DATES=${DATE_BEGIN_SUBJOB}_${DATE_END_SUBJOB}
##-------
## beginning of the experiment in julian calendar (in days):
##-------
JDAY_FIRST_EXP=`julday ${MONTH_BEGIN_EXP} ${DAY_BEGIN_EXP}
${YEAR_BEGIN_EXP} $CALTYPE`
##-------
## beginning of the coupled experiment in julian calendar (in days):
##-------
JDAY_FIRST_CPEXP=`julday ${MONTH_BEGIN_CPEXP} ${DAY_BEGIN_CPEXP}
${YEAR_BEGIN_CPEXP} $CALTYPE`
##-------
## beginning and end of subjob in julian calendar (in days):
##-------
JDAY_FIRST_SUBJOB=`julday ${MONTH_BEGIN_SUBJOB}
${DAY_BEGIN_SUBJOB} ${YEAR_BEGIN_SUBJOB} $CALTYPE`
JDAY_LAST_SUBJOB=`julday ${MONTH_END_SUBJOB} ${DAY_END_SUBJOB}
${YEAR_END_SUBJOB} $CALTYPE`
##-------
## Subjob length (in days)
##-------
(( NB_DAY_SUBJOB = ${JDAY_LAST_SUBJOB} - ${JDAY_FIRST_SUBJOB} + 1 ))
##
##
##============================================================
========
##------------------------------------------------------------
##    II.4 calendar computations for restart procedure
##------------------------------------------------------------
##============================================================
========
##
##-------
## year month day of the restart
##-------
valid_date $MONTH_BEGIN_SUBJOB $(( $DAY_BEGIN_SUBJOB-1 ))
$YEAR_BEGIN_SUBJOB | read MONTH_RESTART DAY_RESTART
YEAR_RESTART
##-------
## restart date in format yyyymmdd
##-------
```

```
DATE_RESTART=`yyyymmdd_fmt $MONTH_RESTART $DAY_RESTART
$YEAR_RESTART`
#
##
##================================================================
========
##----------------------------------------------------------------
##    II.5 calendar computations  for ORCA (to redefine ORCA namelist)
##----------------------------------------------------------------
##================================================================
========
##
#-------
## Number of time step per day in ORCA
#-------
ORCA_NTS_DAY=15
#-------
## frequency of the outputs write
#-------
(( ORCA_NWRITE = ORCA_NTS_DAY*5 )) # 5 days
#-------
## computation of fist/last time step and number of time steps in subjob
#-------
(( ORCA_NIT000 = ( ${JDAY_FIRST_SUBJOB} - ${JDAY_FIRST_CPEXP} ) *
${ORCA_NTS_DAY} + 1 ))
(( ORCA_NITEND = ( ${JDAY_LAST_SUBJOB} - ${JDAY_FIRST_CPEXP} + 1 ) *
${ORCA_NTS_DAY}     ))
(( ORCA_NTS = ORCA_NITEND - ORCA_NIT000 + 1 ))
#-------
## length of subjob (in seconds)
#-------
(( L_SUBJOB_SEC = 3600 * 24 * $NB_DAY_SUBJOB ))
#
##
##================================================================
========
##----------------------------------------------------------------
##    II.6 calendar computations  for ECHAM (to redefine ECHAM namelist)
##----------------------------------------------------------------
##================================================================
========
##
#-------
## Number of time step per day in ECHAM
#-------
ECHAM_NTS_DAY=120
# ECHAM_NTS_DAY=240 used to run with atm tstep=360 instead of 720
#ECHAM_NTS_DAY=240
#-------
## frequency of the outputs write (in timesteps)
#-------
#NPTIME=$(( 5 * $ECHAM_NTS_DAY )) # 5 days
```

```
#NPTIME=120 used to run with atm tstep=360 instead of 720
NPTIME=60 # 0.5 days
# To save 6 hours for claris project from 1960 to 1990 NPTIME=30
#if  [ ${YEAR_BEGIN_SUBJOB} -ge 219 ] ; then
# if  [ ${YEAR_BEGIN_SUBJOB} -lt 260 ] ; then
#  NPTIME=30
# fi
#fi
#-------
## When shall we stop echam (in timesteps) ?
#-------
NSTOP=$(( ( ( ${YEAR_BEGIN_SUBJOB} - 1 ) * 12 + ${MONTH_BEGIN_SUBJOB}
) * $ECHAM_NTS_DAY * 30 ))
NSTOP=$(( $NSTOP - 1 ))
##
##
##================================================================
========
##----------------------------------------------------------------
##    II.7 General echo
##----------------------------------------------------------------
##================================================================
========
##
##-------
## store date into ${CEXPER}.log
##-------
echo "`date` $YEAR_BEGIN_SUBJOB $MONTH_BEGIN_SUBJOB
$DAY_BEGIN_SUBJOB begin" >> ${CEXPER}.log
##-------
##-------
echo $YEAR_BEGIN_EXP $MONTH_BEGIN_EXP $DAY_BEGIN_EXP
echo $YEAR_BEGIN_CPEXP $MONTH_BEGIN_CPEXP $DAY_BEGIN_CPEXP
echo $YEAR_END_EXP $MONTH_END_EXP $DAY_END_EXP
echo $DATE_BEGIN_EXP $DATE_BEGIN_CPEXP $DATE_END_EXP
#
echo $YEAR_BEGIN_SUBJOB $MONTH_BEGIN_SUBJOB $DAY_BEGIN_SUBJOB
echo $YEAR_END_SUBJOB $MONTH_END_SUBJOB $DAY_END_SUBJOB
echo $DATE_BEGIN_SUBJOB $DATE_END_SUBJOB
#
echo $JDAY_FIRST_EXP $JDAY_FIRST_CPEXP
echo $JDAY_FIRST_SUBJOB $JDAY_LAST_SUBJOB $NB_DAY_SUBJOB
#
echo $DATE_RESTART
#
echo $ORCA_NTS_DAY $ORCA_NWRITE
echo $ORCA_NIT000 $ORCA_NITEND $ORCA_NTS
#
echo $ECHAM_NTS_DAY $NPTIME
echo $NSTOP
##
##
```

```
#######################################################################
######
#######################################################################
######
##
##    III. executables
##
#######################################################################
######
#######################################################################
######
##
##
##===================================================================
========
##-------------------------------------------------------------------
##    III.1 get the executables files
##-------------------------------------------------------------------
##===================================================================
========
##
#
DIREXE=${HOMEB}/$MODNAME/bin
# --- ECHAM ------
cp $DIREXE/atmosx.720.133.4cpu atmosx
#cp $DIREXE/old/atmosx.SSXX.720 atmosx
# --- ORCA -------
cp $DIREXE/oceanx.4cpu oceanx
#cp $DIREXE/oceanx.8cpu oceanx
# --- OASIS ------
cp $DIREXE/oasis oasis
#
##
##===================================================================
========
##-------------------------------------------------------------------
##    III.2 Number of Cpu used in ECHAM 4.6
##          => verification of the "oasis part" of ECHAM and ORCA...
##-------------------------------------------------------------------
##===================================================================
========
##
#
NCPUSECHAM=$(( $NPROCA * $NPROCB ))
#INORCA=$MODIPSL/modeles/OPA/SRC_ORCA/inicmo.F
#INECHAM=$MODIPSL/modeles/ECHAM4.6/libclim/inicma.F
## atmosx has the same number in ORCA and ECHAM?
#grep cmpi_modnam.*atmosx $INORCA | cut -f2 -d"(" | cut -f1 -d")" | read
numatmosx_orca
#grep cmpi_modnam.*atmosx $INECHAM | cut -f2 -d"(" | cut -f1 -d")" | read
numatmosx_echam
#echo numatmosx_orca $numatmosx_orca numatmosx_echam $numatmosx_echam
```

```
#[ $numatmosx_orca -ne $numatmosx_echam ] && echo "atmosx has not the same
number in ORCA and ECHAM, we stop, check the files "$INORCA and $INECHAM
&& exit
##
## number of CPU defined for ECHAM in the Oasis part or ORCA
#grep mpi_totproc\($numatmosx_orca $INORCA | cut -f2 -d"=" | read procsnum_orca
#echo procsnum_orca $procsnum_orca
#[ $procsnum_orca -ne $NCPUSECHAM ] && echo "The number of CPU defined for
ECHAM in the Oasis part or ORCA is not equal to NPROCA*NPROCB, we stop,
check the file "$INORCA  && exit
##
## number of CPU defined for ECHAM in the Oasis part or ECHAM
#grep mpi_totproc\($numatmosx_echam $INECHAM | cut -f2 -d"=" | read
procsnum_echam
#echo procsnum_echam $procsnum_echam
#[ $procsnum_echam -ne $NCPUSECHAM ] && echo "The number of CPU defined
for ECHAM in the Oasis part or ECHAM is not equal to NPROCA*NPROCB, we stop,
check the file "$$INORCA && exit
##
##
##================================================================
========
##----------------------------------------------------------------
##    III.3 ORCA Verifications
##----------------------------------------------------------------
##================================================================
========
##
#-------
# Check ORCA Resolution (must be 2)
#-------
#grep key_orca $MODIPSL/modeles/OPA/WORK/KEY_CPP | sed s/.*key_orca_r// |
sed s/-Wp.*// | read RESOL_ORCA
#echo RESOL_ORCA ${RESOL_ORCA}
#if [ ${RESOL_ORCA} -ne "2" ] ; then
#    echo " Bad resolution of ORCA : " ${RESOL_ORCA}
#   exit
#fi
#
#-------
#
#####################################################################
######
##
##    IV. namatmos/namelists/namcouple/
##
#####################################################################
######
##
#
NAMBASEDIR=${HOMEB}/$MODNAME/Namelists
#
```

```
##
##============================================================
========
##------------------------------------------------------------
##    IV.1 ECHAM4.6: namatmos
##------------------------------------------------------------
##============================================================
========
##
#-------
# get
#-------
cp $NAMBASEDIR/namatmos.base namatmos
#-------
# extract some values from namatmos...
#-------
LY365OLD=$( grep 'LY365'  namatmos)
NDSTARTOLD=$( grep 'NDSTART'  namatmos)
NSTOPOLD=$( grep 'NSTOP'  namatmos)
NWTIMEOLD=$( grep 'NWTIME'  namatmos)
NPROCAOLD=$( grep 'NPROCA'  namatmos)
NPROCBOLD=$( grep 'NPROCB'  namatmos)
NPTIMEOLD=$( grep 'NPTIME'  namatmos)
#-------
# define the new values
#-------
[ $CALTYPE = 30d ] && LY365=.false. || LY365=.true.
#-------
# change some namelist values
#-------
sed -e "s/$LY365OLD/  LY365=$LY365,/" \
    -e "s/$NDSTARTOLD/  NDSTART=$DATE_BEGIN_EXP,/" \
    -e "s/$NSTOPOLD/  NSTOP=$NSTOP,/" \
    -e "s/$NPROCAOLD/  NPROCA=$NPROCA,/" \
    -e "s/$NPROCBOLD/  NPROCB=$NPROCB,/" \
    -e "/$NWTIMEOLD/d" \
    -e "s/$NPTIMEOLD/   NPTIME=$NPTIME,/" \
    namatmos > namtmp || exit
mv namtmp namatmos
#
##
##============================================================
========
##------------------------------------------------------------
##    IV.2 ORCA: namelist & run.param.li
##------------------------------------------------------------
##============================================================
========
##
# ---------------- ORCA --------------------
#
#-------
```

```
# get
#-------
cp $NAMBASEDIR/namelist namelist
#-------
# transformation namelist: fortran 77 --> fortran 90
#-------
sed -e /:/d -e s/" \&END"/"\/"/ -e s/" \&"/"\&"/ namelist > namtmp || exit
mv namtmp namelist
#-------
# extract some namelist values
#-------
PAT_CEXPER=$( grep 'cexper' namelist )
PAT_NIT000=$( grep 'nit000' namelist )
PAT_NITEND=$( grep 'nitend' namelist )
PAT_NWRITE=$( grep 'nwrite' namelist )
PAT_RESTAR=$( grep 'lrstar' namelist )
PAT_NSTOCK=$( grep 'nstock' namelist )
PAT_NRSTAR=$( grep 'nrstdt' namelist )
PAT_NMSH=$( grep 'nmsh' namelist )
PAT_NDATE0=$( grep 'ndate0' namelist )
PAT_NCLOSEA=$( grep 'nclosea' namelist )
PAT_NBISEX=$( grep 'nbisex' namelist )
#-------
# define the new values
#-------
[ $CALTYPE = 30d ] && nbisex=30 || nbisex=1
#-- check of the number of time step per day
ORCA_NSTOCK=$(echo $PAT_NSTOCK | sed "s/[a-z,A-Z,=]//g" )
echo ORCA_NSTOCK $ORCA_NSTOCK
ORCA_RDT=$( egrep 'rdt *=' namelist | sed 's/ *rdt *=//' | sed 's/\. *,//' )
ORCA_NSTOCK="$ORCA_NTS"
echo ORCA_RDT $NORCA_RDT
echo ORCA_NSTOCK $ORCA_NSTOCK
(( NB_SEC_DAY_MODEL = ORCA_NTS_DAY * ORCA_RDT ))
echo NB_SEC_DAY_MODEL $NB_SEC_DAY_MODEL
(( NB_SEC_DAY = 60 * 60 * 24 ))
if [ ${NB_SEC_DAY_MODEL} -ne ${NB_SEC_DAY} ]
then
        echo " Check ORCA_NTS_DAY ... "
        exit
fi
#-------
# change some namelist values
#-------
# General changes
sed    -e "s/$PAT_CEXPER/       cexper=\"$CEXPER\",/" \
   -e "s/$PAT_NIT000/       nit000=$ORCA_NIT000,/" \
   -e "s/$PAT_NITEND/       nitend=$ORCA_NITEND,/" \
   -e "s/$PAT_NWRITE/       nwrite=$ORCA_NWRITE,/" \
   -e "s/$PAT_NSTOCK/       nstock=$ORCA_NSTOCK,/" \
   -e "s/$PAT_NDATE0/       ndate0=$DATE_BEGIN_SUBJOB,/" \
   -e "s/$PAT_NCLOSEA/      nclosea=1,/" \
```

```
   -e "s/$PAT_NBISEX/       nbisex=$nbisex,/" \
   namelist > nam.tmp
# Changes only if it is the fist subjob of the experiment
if [ ${DATE_BEGIN_SUBJOB} -eq ${DATE_BEGIN_CPEXP} ]
then
  sed    -e "s/$PAT_RESTAR/       lrstar=.FALSE.,/" \
    -e "s/$PAT_NMSH/       nmsh=1,/" \
    -e "s/$PAT_NRSTAR/       nrstdt=0,/" \
    nam.tmp > namelist
else
# Changes only if we use restart
  sed    -e "s/$PAT_RESTAR/       lrstar=.TRUE.,/" \
    -e "s/$PAT_NMSH/       nmsh=1,/" \
    -e "s/$PAT_NRSTAR/       nrstdt=1,/" \
    nam.tmp > namelist
fi
\rm -f nam.tmp
#
# ---ICE---
#
#GETNAM run.param.li
cp ${LOCAL_INICE}/run.param.li .
if [ ${DATE_BEGIN_SUBJOB} -eq ${DATE_BEGIN_CPEXP} ]
then
  sed -e "s/KKKKKKK/2/" run.param.li >run.param.tmp
#  sed -e "s/KKKKKKK/0/" run.param.li >run.param.tmp
else
  sed -e "s/KKKKKKK/1/" run.param.li >run.param.tmp
fi
#- take care about ice result storage
(( ICE_NSTOCK = ORCA_NSTOCK ))
sed -e "s/SSSSSSS/${ICE_NSTOCK}/" run.param.tmp >run.param.li
cp run.param.tmp run.param.li
cat run.param.li
##
##============================================================
========
##------------------------------------------------------------
##    IV.3 OASIS: namcouple
##------------------------------------------------------------
##============================================================
========
##
#
#-------
# get
#-------
cp $NAMBASEDIR/namcouple.base namcouple
#-------
# change some values
#  - Index of printing level in output file cplout
#  - Initial date of the run.
```

```
#  - Total simulated time for this run in seconds
#-------
sed -e "s/^ *2 *$/0/" \
   -e "s/^ *0*10101 *$/${DATE_BEGIN_SUBJOB}/" \
   -e "s/^ *2592000 *$/${L_SUBJOB_SEC}/" \
   -e "s/^ *MPI2  *1  *1  *1  *1/MPI2 1 $NCPUSECHAM 1 1/" \
   namcouple > nam.tmp
mv nam.tmp namcouple
#
##
##
#########################################################################
######
#########################################################################
######
##
##    V. Inputs files and restarts
##
#########################################################################
######
#########################################################################
######
##
##=======================================================================
========
##-----------------------------------------------------------------------
##  V.1 ECHAM4.6
##-----------------------------------------------------------------------
##=======================================================================
========
#
#-------
# input files
#-------
cp ${LOCAL_INATM}/year106m.nc unit.20
#############cp ${SCENARIO}/scenario4.table .
cp ${SCENARIO}/XXghgtable_1870_2000.txt .
#
cp ${PAST}/T${RES}_noaao3yrs1870_2100.nc unit.21
##!E+2005.9-aerosol
cp /scratch/users/enrico/SINTEXS/Aero_inputs/${TEN_YEARS_AEROSOL_FILE}
unit.22
cp /scratch/users/enrico/SINTEXS/Aero_inputs/T106_aerosol_nat_nn.nc unit.23
##!E-2005.9-aerosol

#-------
# restart files
#-------
if [ ${DATE_BEGIN_SUBJOB} -eq ${DATE_BEGIN_CPEXP} ]
   then
   for unit in 31 32 35 36 37 ; do
        cp ${STOREIN}/Res/Atm/atm_restart0_unit.$unit unit.$unit
```

```
   done
else
   for unit in 31 32 35 36 37 ; do
        cp ${LOCAL}/Res/Atm/${CEXPER}_${DATE_RESTART}_unit.$unit unit.$unit
   done
fi
F_FF99=namatmos
export F_FF99
#
##================================================================
========
##----------------------------------------------------------------
##  V.2 ORCA & Ice
##----------------------------------------------------------------
##================================================================
========
#
#-------
# -  Inputs files for ORCA
#-------
# levitus data -> feeback in closed seas and mediterranean sea.
cp ${ORCA2}/INDATA_STD/LEVITUS_1m_Salinity_Ice_nomask.nc .
cp ${ORCA2}/INDATA_STD/LEVITUS_1m_Temperature_Pot_Ice_nomask.nc .
# for the ice IF
cp ${ORCA2}/INDATA_STD/REYNOLDS_1d_seasonnalcycle_82-89.interp.nc
sst_1d.nc
# eddy viscosity coef
cp ${ORCA2}/INDATA/ahmcoef .
cp ${ORCA2}/INDATA/bathymetry .
# for the atlantic overturning (key_diaznl)
cp ${LOCAL_INICE}/bathymetry.atlantic .
cp ${ORCA2}/INDATA/coordinates.nc .
# new runoff parametrisation
cp ${ORCA2}/INDATA/runoff_1m_nomask.nc .
#
#-------
# - Inputs files for Ice
#-------
#
cp ${LOCAL_INICE}/cpointj.dat . || exit
cp ${LOCAL_INICE}/geogra.param . || exit
cp ${LOCAL_INICE}/output.param . || exit
cp ${LOCAL_INICE}/thermo.param . || exit
cp ${LOCAL_INICE}/dynami.param . || exit
cp ${LOCAL_INICE}/inice.param . || exit
#
#-------
# - restarts ORCA et Ice
#-------
#
if [ ${DATE_BEGIN_SUBJOB} -eq ${DATE_BEGIN_CPEXP} ]
then
```

```
  echo "NO RESTARTS FOR ORCA and UCL"
else
  echo "RESTART ORCA and UCL"
  cp ${LOCAL}/Res/Oce/${CEXPER}_${DATE_RESTART}_orcaini.nc orcaini.nc
  cp ${LOCAL}/Res/Oce/${CEXPER}_${DATE_RESTART}_restart_icemod rest.nc
#
fi
#
##============================================================
========
##------------------------------------------------------------
##  V.3 OASIS
##------------------------------------------------------------
##============================================================
========
#
#-------
# -  Inputs files
#-------
#

cp ${LOCAL_INCPL}/areas_Orca2closea_T106_r8 areas
cp ${LOCAL_INCPL}/grids_Orca2closea_T106_r8 grids
cp ${LOCAL_INCPL}/masks_Orca2closea_T106_i8 masks
# for mozaic interpolation
cp ${LOCAL_INCPL}/mozaic_orca2closea_t106_4neig_r8 orcat106
cp ${LOCAL_INCPL}/mozaic_t106_orca2closea_70neig_r8 t106orca
#-------
# -  restart
#-------
if [ ${DATE_BEGIN_SUBJOB} -eq ${DATE_BEGIN_CPEXP} ]
then
   cp ${STOREIN}/Res/Cpl/cpl_restart0_flxatmos flxatmos
   cp ${STOREIN}/Res/Cpl/cpl_restart0_sstocean sstocean
#    cp ${STOREIN}/Res/Cpl/cpl_restart0_sstocean sstocean
else
   cp ${LOCAL}/Res/Cpl/${CEXPER}_${DATE_RESTART}_flxatmos flxatmos
   cp ${LOCAL}/Res/Cpl/${CEXPER}_${DATE_RESTART}_sstocean sstocean
fi
#
##
#######################################################################
######
##
##    VI. Run the model!
##
#######################################################################
######
# Direct Acess files record length in bytes
export F_RECLUNIT=BYTE
# set line size for standard output
export F_SYSLEN=1000
```

```
# number of runtime errors before aborting
# if oasis stops
###export F_ERRCNT=999999
export F_ERRCNT=0
export F_ABORT=YES
export F_ERRHALT=YES
#
export ASSCOM="echo "
export MACH=IEEE
echo "$MACHINE OK"
#
#
# test sizes of executables
size oceanx oasis atmosx
# Oasis and model launching
mpiexec -v -np 1 -max_np $(( 2+$NCPUSECHAM )) oasis
stat=$?
if [ $stat -ne 0 ] ; then
exit
fi
#ls -alF $LOCAL/*
#
NIT_END=$( cat time.step )
echo Last time step of ORCA: $NIT_END
#
##########################################################################
######
##
##    VII. post-processing
##
##########################################################################
######
#
(( MONTHS_DONE = ${MONTHS_DONE} + ${SUBJOB_DUR} ))
[ ${MONTHS_DONE} -eq ${JOB_DUR} ] && JOB_FINISHED=1 || JOB_FINISHED=0
##-----------------------------------------------------------------
##    VII.1  ECHAM4
##-----------------------------------------------------------------
##=================================================================
========
#
# model outputs
#cp atmosx.prt $STOUT_OUT/${CEXPER}_${DATES}_atm.prt || exit
# Results
cp atm*__* $STOUT_AFILES_D/atm_${CEXPER}_${DATES}.grib || exit
${YEAR_END_SUBJOB} ${MONTH_END_SUBJOB}
atm_${CEXPER}_${DATES}.grib ">&"
outpostproc${YEAR_END_SUBJOB}${MONTH_END_SUBJOB}
# restarts
if [ ${JOB_FINISHED} -eq 1 ]
then
   for unit in 31 32 35 36 37 ; do
```

```
        cp unit.$unit
${STOREOUT_ARES}/${CEXPER}_${DATE_END_SUBJOB}_unit.$unit
   done
fi
for unit in 31 32 35 36 37 ; do
mv unit.$unit ${LOCAL}/Res/Atm/${CEXPER}_${DATE_END_SUBJOB}_unit.$unit
done
#
##================================================================
========
##----------------------------------------------------------------
##  VII.2 ORCA
##----------------------------------------------------------------
##================================================================
========
#
#  outputs
cp oceanx.prt $STOUT_OUT/${CEXPER}_${DATES}_oce.prt || exit
cp ocean.output $STOUT_OUT/${CEXPER}_${DATES}_oce.output || exit
# more
# Results
for file in *_grid_* *_diagap* *_diaznl* *icemod* *trend*
  do
    [ -f $file ] && cp $file ${STOUT_OFILES}/${file}
  done
[ -f output.abort.nc ] && cp output.abort.nc ${STOUT_OFILES}/output.abort.nc
# remote storage of restarts
mv ${CEXPER}_*_restart.nc orcaini.nc
if [ ${JOB_FINISHED} -eq 1 ]
then
   cp orcaini.nc
${STOREOUT_ORES}/${CEXPER}_${DATE_END_SUBJOB}_orcaini.nc
   cp rest_ice.nc
${STOREOUT_ORES}/${CEXPER}_${DATE_END_SUBJOB}_restart_icemod
fi
# local storage of restarts
mv orcaini.nc ${LOCAL}/Res/Oce/${CEXPER}_${DATE_END_SUBJOB}_orcaini.nc
#
mv rest_ice.nc
${LOCAL}/Res/Oce/${CEXPER}_${DATE_END_SUBJOB}_restart_icemod
#
##================================================================
========
##----------------------------------------------------------------
##    VII.3  OASIS
##----------------------------------------------------------------
##================================================================
========
#
#  outputs
cp Oasis.prt $STOUT_OUT/${CEXPER}_${DATES}_Oasis.prt
cp cplout $STOUT_OUT/${CEXPER}_${DATES}_cplout
```

```
 mv ocesst sstocean
 cat oceice >> sstocean
#
if [ ${JOB_FINISHED} -eq 1 ]
then
   cp sstocean
${STOREOUT_CRES}/${CEXPER}_${DATE_END_SUBJOB}_sstocean
   cp flxatmos
${STOREOUT_CRES}/${CEXPER}_${DATE_END_SUBJOB}_flxatmos
fi
mv sstocean ${LOCAL}/Res/Cpl/${CEXPER}_${DATE_END_SUBJOB}_sstocean
mv flxatmos ${LOCAL}/Res/Cpl/${CEXPER}_${DATE_END_SUBJOB}_flxatmos
#
##
##================================
##  Diagnostics
DIAGFILES=`ls *.dat *.ascii *.bin`
for i in $DIAGFILES; do
        if [ -f $i ]; then
                inew=`echo $i | cut -d'.' -f1`
                iext=`echo $i | cut -d'.' -f2`
                cp $i ${STOREDIAG}/${inew}_${DATE_END_SUBJOB}.${iext}
        fi
done
##================================
#########################################################################
######
##
##    VIII call of the next subjob
##
#########################################################################
######
##
#-------
# year month day of the beginning of next subjob
#-------
valid_date $MONTH_END_SUBJOB $(( $DAY_END_SUBJOB + 1 ))
$YEAR_END_SUBJOB | read MONTH_NEXT_SUBJOB DAY_NEXT_SUBJOB
YEAR_NEXT_SUBJOB
#-------
# update the log file
#-------
echo "`date` $YEAR_END_SUBJOB $MONTH_END_SUBJOB
$DAY_END_SUBJOB done" >> ${CEXPER}.log
cp ${CEXPER}.log $SCRIPTDIR/
#-------
# save the previous output file
#-------
# CMDFRONT "mv $SCRIPTDIR/output_LO1.1
$SCRIPTDIR/${CEXPER}_${DATE_RESTART}_JobOutput"
[ -f $SCRIPTDIR/output_LO1.1 ] && mv $SCRIPTDIR/output_LO1.1
$SCRIPTDIR/${CEXPER}_${DATE_RESTART}_JobOutput
```

```
[ -f $SCRIPTDIR/stderr_LO1.1 ] && mv $SCRIPTDIR/stderr_LO1.1
$SCRIPTDIR/${CEXPER}_${DATE_RESTART}_JobStderr
#
if [ ${JOB_FINISHED} -eq 0 ]
#-------
# The Job is not finished, we must call Job for to perform a new subjob
#-------
then
# update the trace file
#-------rm -f ${CEXPER}.trace
cat <<EOF >${CEXPER}.trace
$YEAR_NEXT_SUBJOB $MONTH_NEXT_SUBJOB $DAY_NEXT_SUBJOB
$MONTHS_DONE
EOF
cp ${CEXPER}.trace $HOMEDIR/
#
   echo ""
   echo ""
   echo
"%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%"
   echo "%%%%%%%%%%%%%%   NEW SUBJOB   %%%%%%%%%%%%%%"
   echo
"%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%"
   echo ""
   echo ""
#
# call again Job to perform a subjob
cd $HOMEDIR
qsub run.couple
else
#-------
# The Job is finished
#-------
   if [ ${DATE_END_SUBJOB} -ne ${DATE_END_EXP} ]
#-------
# The experiment is not finished, we must resubmit a new Job
#-------
   then
# Redefine the trace file; 0 days are done in this new Job
        cat <<EOF >${CEXPER}.trace
$YEAR_NEXT_SUBJOB $MONTH_NEXT_SUBJOB $DAY_NEXT_SUBJOB 0
EOF
        cp ${CEXPER}.trace $HOMEDIR/
   fi
fi
```