



OASIS3-MCT test_interpolation

All the documentation about the coupler OASIS3-MCT can be found on the OASIS web site at <http://oasis.enes.org> and in the OASIS3-MCT sources in the oasis3-mct/doc directory.

The current OASIS3-MCT coupler uses internally the Model Coupling Toolkit (MCT) developed by the Argonne National Laboratory (<http://www.mcs.anl.gov/mct>) to perform parallel regridding and parallel exchanges of the coupling fields.

III – Test interpolation

This toy tests the quality of the interpolation between a source grid and a target grid by calculating the error of interpolation on the target grid. There is only one time step and the coupling is performed at $t=0$. At $t=0$, model1 sends its coupling field "FSENDANA" to model2.

A. Quality of the conservative interpolation from “torc” to “lmdz”

The namcouple was created with the GUI and the corresponding xml data file is the file *data_oasis3/namcouple_map_conserv_torc_lmdz.xml*.

As specified in the OASIS3-MCT configuration file "data_oasis3/namcouple" and in the toy namelist file "data_oasis3/name_grids.dat", the toy performs a conservative interpolation between “torc” and “lmdz” using the predefined remapping file myfile_torc_to_lmdz_CONSERV_FRACNNEI.nc. The “torc” and “lmdz” grids are defined in the “grids.nc”, “masks.nc” and “areas.nc” OASIS3-MCT grid data files.

To evaluate the quality of the interpolation between the source grid and the target grid an analytical field is defined by model1 on the source grid and then interpolated on the target grid and sent to model2 (or sent to model2 and then interpolated on the target grid) where the error of interpolation is calculated. The error is defined as the absolute value of the difference between the interpolated field and the analytical field calculated on the target grid, divided by the interpolated field (multiplied by 100 to have it in %).

1. Compiling and running test_interpolation

- Go to the directory "oasis3-mct/examples/test_interpolation"
- Compile the toy using : "make clean ; make"
- Adapt to your platform and execute the script run_test_interpolation: `./run_test_interpolation`. The results of the component models are now in the \$rundir directory (as defined in the script run_test_interpolation).

2. Analysis of the results

- After running the test_interpolation toy model, the analytical field on the source grid "torc" is available in file \$rundir/FSENDANA_model1_01.nc, the interpolated field on the target grid "lmdz" in file \$rundir/FRECVANA_model2_01.nc and the error field, as defined above, in file "\$rundir/error.nc". You can find the minimum and maximum of the error in the output file \$rundir/model2.out_101.
- You can visualize the results with ferret and the scripts script_ferret_*.jnl. Type "ferret" and then "go xxx.jnl" where xxx.jnl is the name of the ferret script you want to run. (Note that to run another ferret script, you have to restart ferret.). Why is the error more important at the North pole and near the coasts ?
- Keep your results by renaming /work_test_interpolation into /work_test_interpolation_A2_mono

B. Quality of other interpolations

In the tests below, the SCRIP library is used to calculate the weights and addresses remapping file.

1. Bilinear interpolation between "torc" and "lmdz" using the SCRIP library

- Open the GUI again using oasisgui if you closed the interface. Download the xml file *data_oasis3/namcouple_map_conserv_torc_lmdz.xml*
- Save a new xml file in *data_oasis3/namcouple_scrip_bili_torc_lmdz.xml* to avoid to overwrite the namcouple used in III-A.
- Modify the GUI to perform a bilinear interpolation using explicitly the SCRIP library available in OASIS-MCT to calculate the interpolation weights and addresses (see the section 4.3 of the User Guide for more details).
- Copy the namcouple file created in *data_oasis3/namcouple_scrip_bili_torc_lmdz* in data_oasis3.
- Run again the toy test_interpolation executing the script `./run_test_interpolation`.
- Keep your results by renaming /work_test_interpolation into /work_test_interpolation_B1_mono. You can see that a new remapping file has been created rmp_torc_to_lmdz_BILINEAR.nc.
- Visually compare the results with the case A2_mono.

2. Bilinear interpolation from "lmdz" to "torc" using the SCRIP library

- Download the xml file *data_oasis3/namcouple_scrip_bili_torc_lmdz.xml* in the GUI.
- Save a new xml file in *data_oasis3/namcouple_scrip_bili_lmdz_torc.xml* to avoid to overwrite the namcouple used in III-B1.
- Modify the GUI to perform a bilinear interpolation between "lmdz" and "torc" using the SCRIP library.

- Copy the namcouple file created in *data_oasis3/namcouple_scrip_bili_lmdztorcz* in *data_oasis3*.
- Exchange the names of the source grid and the target grid in the namelist file "data_oasis3/name_grids.dat".
- Run again the toy test_interpolation executing the script `./run_test_interpolation`.
- Keep your results by renaming `/work_test_interpolation` into `/work_test_interpolation_B2_mono`.
- Analyse the error of interpolation (adapt the scale in the file `script_ferret_error.jnl` to better visualise the error if necessary).

C. Time statistics: comparison of time using src or dst options of the "MAPPING" transformation

It is possible to get time performance information with OASIS3-MCT thanks to the value of variable "TIMER_Debug" defined in the namcouple (see also the section 6.4.2 of the User Guide for more details).

1. Time performance for the "MAPPING" transformation using the "src" option (see section 4.3 of the User Guide):

- Copy the `rpm_lmdz_to_torc_BILINEAR.nc` from the previous working directory `/work_test_interpolation_B2_mono` to the *data_oasis3* directory.
- Download the xml file *data_oasis3/namcouple_scrip_bili_lmdz_torc.xml* in the GUI.
- Save a new xml file in *data_oasis3/namcouple_map_bili_lmdz_torc.xml* to avoid to overwrite the namcouple used in III-B2.
- Modify the GUI to assign 1 to the `TIMER_debug` variable and to test the performance of the bilinear interpolation from "lmdz" to "torc" with the pre-existing remapping file `rpm_lmdz_to_torc_BILINEAR.nc` just created, using the "src" option (in this case, the interpolated field is interpolated from the source grid to the target grid on the source model process(es) and then sent to the target model process(es)). Do not forget also to copy the namcouple in *data_oasis3*.
- Run the test_interpolation toy model with for example 4 processes per model and keep your results in `/work_test_interpolation_C2_para_src`.
- Look into the files "model1.timers_0000" and "model2.timers_0000". The information given in these files are explained in the section 6.4.2 of the User Guide.

2. Time performance for the "MAPPING" transformation using the "dst" option:

- Download the xml file *data_oasis3/namcouple_map_bili_lmdz_torc.xml* in the GUI.
- Modify the GUI to test the performance of the bilinear interpolation from "lmdz" to "torc" with the pre-existing remapping file `rpm_lmdz_to_torc_BILINEAR.nc` using the "dst" option.
- Test again the "MAPPING" transformation between "lmdz" and "torc" with the remapping file `rpm_lmdz_to_torc_BILINEAR.nc` in parallel with 4 processes per model using the "dst" option. In this case, the field is interpolated from the source to the target grid on the target processes.

- Keep your results respectively in /work_test_interpolation_C3_para_dst.
- Compare the time statistics to the results obtained with the "src" option. In which case and in which file is there a "pmap_001" or a "gmap_001" timer?

D. Other optimization options for the "MAPPING" transformation : bfb and sum

By default, the "bfb" option is activated (see the section 4.3 of the User Guide for more details). It forces the mapping to be done in a bit for bit manner and the results are independent of the domain decomposition. The "sum" option forces the mapping to be done using partial sums. The source values belonging to one particular process and used in the calculation of one target point is locally partially summed before the global sum, involving possible other source values from other processes, is done. The partial sums will result in non bit reproducible results between simulations done with different number of processes. Finally, the "opt" option allows the code to choose either "bfb" or "sum" based on which might be faster.

If the models run on one process the results are of course independent of the option "bfb" and "sum" (or "opt").

1. "MAPPING" transformation using the "sum" option :

- Download the xml file *data_oasis3/namcouple_map_bili_lmdz_torc.xml* in the GUI.
- Modify the configuration file in order to perform a bilinear interpolation from "lmdz" to "torc" with the pre-existing remapping file rmp_lmdz_to_torc_BILINEAR.nc using the ("src" + "sum") options. Do not forget to copy the new namcouple in *data_oasis3*.
- Run the toy in parallel, always on 4 processes for each model. Keep your results in /work_test_interpolation_D1_para_src_sum.
- Compare the interpolated field, the error and the time statistics results with the case in /work_test_interpolation_C2_para_src, corresponding to the case with only "src" option i.e. with "bfb" by default). Verify that the latter gives indeed bit reproducible results compared to the mono case and that this is not the case with "sum" option. Do you see any performance differences between the two cases?

2. "MAPPING" transformation using the "opt" option :

- Download the xml file *data_oasis3/namcouple_map_bili_lmdz_torc.xml* in the GUI if you closed it.
- Modify the configuration file in order to perform a bilinear interpolation from "lmdz" to "torc" with the pre-existing remapping file rmp_lmdz_to_torc_BILINEAR.nc using the "src" + "opt" options. Do not forget to copy the new namcouple in *data_oasis3*.
- Run the toy model in parallel and keep your results in /work_test_interpolation_D2_para_src_opt
- Compare the interpolated field, the error and the time statistics results with the case C2_para_src and D1_para_src_sum. Which strategy was chosen in this case ("sum" or "bfb") ?

E. Test of the quality of the bilinear interpolation between the participant's grids.

1. Creation of the grids.nc, masks.nc and areas.nc files, needed to calculate the weights and addresses mapping files, with the grid definitions of the participant's models.
The NCL program "create_aux_files.ncl" located in oasis3-mct/examples/test_interpolation gives an example of how one would create files grids.nc, masks.nc and areas.nc from the two files "data_oasis3/grid_model1.nc" and "data_oasis3/grid_model2.nc" containing respectively the ORCA2T and the LMDz grids. This program can be used as a base to build your own grids.nc, masks.nc and areas.nc files starting from your model grid files. All the documentation about NCL can be found on the NCAR web site: <http://www.ncl.ucar.edu/>
2. Quality of the bilinear interpolation between "grd1" and "grd2" of the participants:
 - Put the name of your source "grd1" and target "grd2" grids in the namelist data file "data_oasis3/name_grids.dat"
 - Download the xml file *data_oasis3/namcouple_map_bili_lmdz_torc.xml* in the GUI.
 - Save a new xml file in *data_oasis3/namcouple_scrip_bili_grd1_grd2.xml* to avoid to overwrite the namcouple used in III-C. Do not forget to copy the namcouple in *data_oasis3*.
 - Modify the configuration file in order to perform a bilinear interpolation from the source "grid1" to the target "grid2" using the SCRIP library.
 - Specify "nproc_exe1=1", "nproc_exe2=1" in the script run_test_interpolation. Execute `./run_test_interpolation`.
 - Keep your results in /work_test_interpolation_E2_mono
 - Analyse the quality of the interpolation by plotting the interpolated field and the error of interpolation.
3. Quality of the bilinear interpolation between "grd2" and "grd1" of the participants:
 - Modify the name of your source and target grid in the namelist data file "data_oasis3/name_grids.dat"
 - Download the xml file *data_oasis3/namcouple_scrip_bili_grd1_grd2.xml* in the GUI.
 - Save a new xml file in *data_oasis3/namcouple_scrip_bili_grd2_grd1.xml* to avoid to overwrite the namcouple used in III-E2.
 - Modify the configuration file in order to perform a bilinear interpolation from the source "grid2" to the target "grid1" using the SCRIP library. Do not forget to copy the namcouple in *data_oasis3*.
 - Execute `./run_test_interpolation`.
 - Keep your results in /work_test_interpolation_E3_mono
 - Analyse the quality of the interpolation by plotting the interpolated field and the error of interpolation.