

## **IS-ENES3 Milestone M8.3**

### **Final list of developments for OASIS3-MCT\_5.0**

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#### ABSTRACT

The list of developments that will be included in OASIS3-MCT\_5.0, which release is planned for December 2021, has been defined as part of the 2020 OASIS3-MCT Development Plan. This plan is an evolution of the 2019 Development Plan (Valcke et al. 2019) based on the experience of the OASIS developers and on a user survey realised in 2017. The 2020 OASIS3-MCT Development Plan (Valcke et al 2020) has been reviewed and approved by the OASIS [Advisory Board](#) . This approved lists of developments for OASIS3-MCT\_5.0 is presented here.



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### 1. Objectives

The objective of this milestone was to identify precisely the list of developments that will be included in OASIS3-MCT\_5.0, which release is planned for December 2021. OASIS developers established that list based on the IS-ENES3 and ESiWACE2 contractual engagements and on the user needs expressed in a user survey realised in 2017 and on users’ regular feedbacks.

### 2. Description of work: Methodology and Results

The list of developments that will be included in OASIS3-MCT\_5.0, which release is planned for December 2021, has been defined as part of the 2020 OASIS3-MCT Development Plan (Valcke et al. 2020). This plan is an evolution of the 2019 Development Plan (Valcke et al. 2019), based on the experience of the OASIS developers and on a user survey realised in 2017. The 2020 OASIS3-MCT Development Plan (Valcke et al 2020) has been reviewed and approved by the [OASIS Advisory Board](#) . This approved lists of developments for OASIS3-MCT\_5.0 is presented here.

As for the previous development plans, the developments are classified into 5 categories: Interpolation & transformations, Communication, Configuration, Other functionalities, Support & training. We don't list here bugs that are regularly reported and fixed. For each development, we also provide an estimate of the complexity to address it, C1 - being relatively easy- up to C4 - being very complex. For each development, we specify if it is funded by IS-ENES3 (IS3) or by ESiWACE2 (ES2). In most cases, the development is described in a ticket on the OASIS Redmine site (<https://inle.cerfacs.fr/projects/oasis3-mct>), and we provide the corresponding ticket number.

## Interpolations & transformations

- Interfacing with a high-quality parallel library for the calculation of the regridding/interpolation weight-and-address file, C4, IS3, tickets #[2349](#) & #[1011](#)

As written above, the SCRIP library was parallelized with OpenMP/MPI leading to great reduction in the calculation time of the remapping weights. But the SCRIP still shows specific problems near the pole for some grids (Jonville et al, 2018; Jonville & Valcke, 2019 ; Valcke & Piacentini, 2019) and some algorithms and this motivates the investigation of other parallel interpolation libraries of higher quality. ESMF, XIOS, ATLAS, YAC, MOAB/TempestRemap are considered. This is one of the main tasks funded in IS-ENES3 and the choice will be further discussed with the OASIS Advisory Board. In all cases, the idea is not to replace the SCRIP library but to extend the current mapping options in OASIS3-MCT. The SCRIP algorithms will still be available and remapping weights using the SCRIP format will still be supported.

- Conservative remapping for the runoffs, C3, IS3, ticket #[2556](#)

When coupling “traditional” fluxes, the basic idea is to provide data on each unmasked target grid point. In the case of river outflow, the rationale is reversed since not all ocean target grid points will receive a value but it is necessary that all source grid points find a target on the ocean grid. The method proposed by Aurore Voltaire at CNRM is based on the regular interpolation weights but taking the reverse interpolation links. This method allows to conserve the river outflow locally and globally and will be implemented in the next version of the coupler. The method supposes that, as for the SCRIPR/CONSERV and the global CONSERV, the runoff is expressed as an extensive property (e.g. in m/s).

- Improved and additional diagnostics, C2, IS3, ticket #[2356](#), #[1761](#) and #[1069](#)

Diagnostics, that are currently performed when the CHECKIN/CHECKOUT operations are specified in the *namcouple*, have to be revised as well as how their results are printed in the debug files. The diagnostics that should be performed on the source and target grids are the minimum, maximum, mean, integral and area-weighted integral value. Masks and fractional areas must be considered.

- Pre- and post-processing transformations, C3, IS3, ticket #[2364](#)

This task is about extending the current pre- and post-processing transformations (BLASOLD/BLASNEW) with possibly user-defined transformations or combinations with other fields than the coupling fields. We still have to evaluate the cost/benefit of such developments. It would probably be very complex to develop in OASIS3-MCT some general treatment that would cover all possible use cases. Furthermore, we think that in most cases, those specific transformations can be easily coded in the models themselves. We also mention that we think that user needs with respect to this functionality are low, as nobody answered the mail and reminder that were recently sent on the OASIS user mailing list about their corresponding requirements.

- Normalisation by the “true” area for the conservative remapping, C2, IS3, ticket #[1010](#)  
 To be truly conservative the remapping weights have to be normalised by the “true” area of the grid cells i.e. the area of the cells as considered by the models themselves and not as calculated by the remapping library. This option is now available on the trunk version.
- Other issues requiring only minimal efforts, C1
  - Adding the number of neighbours used in the remapping file name so to avoid confusion when the same interpolation is used between the same grids but with different number of neighbours, IS3, ticket #[2350](#)
  - Easy detection of the target grid point that do not receive any value, IS3, ticket #[731](#)
  - Making OASIS3-MCT conformant with CMIP6 standard for weight file format, IS3, ticket #[2401](#)
  - Allow the definition of north\_thresh and south\_thresh values (Lambert projection) through the *namcouple*, IS3, ticket #[2459](#)

### **Communication**

- Extension of the oasis\_get\_intracomm API routine to support multiple components, C2, ES2, ticket #[2687](#)

The API routine oasis\_get\_intracomm merges two MPI communicators from two different components to form a new communicator. It is proposed to extend this to more than 2 components by overloading the interface. This is needed in coupled models involving both OASIS3-MCT and XIOS when XIOS manages ensemble simulations.

- Sending/receiving simple scalars, C2, IS3, ticket [1937](#)

This functionality, i.e. exchanging few scalar values once during the simulation, was asked by few users and is now available on the trunk version.

### **Other functionalities**

- Further development of LUCIA, the load balance analysis tool, C3, IS3, tickets #[2357](#) & #[1003](#)

LUCIA is the tool delivered with OASIS3-MCT to automatically evaluate the load balance of the coupled components. Currently the LUCIA analysis only provides information integrated during the whole simulation. A timeline will be made available to better identify load imbalance at every coupling time step. Fully integrating LUCIA analysis tool in the OASIS3-MCT finalisation step (instead of having to run it afterwards) and unifying LUCIA and the standard OASIS timer result presentation is also planned.

- Python bindings, C3, IS3, ticket #[2362](#) and #[2509](#)

This is included in the list of developments for IS-ENES3. Python bindings will allow the coupling of models written in Python. It will bring OASIS to a much wider ecosystem and be a good way to attract countries less advanced in HPC. It will be also of great interest when

using OASIS3-MCT as an offline interpolator. This will require an update of the compiling environment.

- Analyse and optimise the memory use in OASIS3-MCT, C2, ES2, ticket #[1104](#)

Even if there is currently no memory problem reported by the users, it is proposed to run some diagnostics to precisely evaluate the memory consumption in OASIS3-MCT.

- Develop, maintain, and systematically apply the buildbot test suite, C3, IS3, ticket #[232](#)

The buildbot suite is an automatic testing system composed of more than 20 toy models that are run automatically over three different platforms each time a source is committed in the GIT source manager. The results are automatically analysed and compared to a reference state to detect any bug that would be linked to the new development. We recently revised the suite to make sure that we are testing every important aspect of OASIS3-MCT functionalities. On the longer term, we could envisage switching to unit tests (instead of using toy models) but this would be a big step change. We consider with high priority the maintenance and further enhancement of the current test suite.

- Format of files for EXPOUT coupling field, C2, IS3, ticket #[2365](#)

When written out for debug, each bundle member appears in a different file. Some users have reported that they would find it more practical to have all bundle members into one file. Other users would like to have the field grid written out in debug file for easier plotting.

- New API interface for oasis\_def\_var, C2, IS3, ticket #[2273](#)

One argument of oasis\_def\_var is not used anymore but is mandatory for backward compatibility. A new interface has been defined without the unused argument and both the old and new API are supported. This feature is now available on the trunk version.

- Systematic tests of NetCDF returned error code, C2, IS3, ticket #550

### **Support and training**

It is also very important for us to keep on offering high quality user support and training, in particular (in order of priority from the highest to the lowest):

- Regular user support through the forum, by mail or by phone, C2, IS3
- Training, C3, ES2

Training on OASIS3-MCT will continue to be offered on a regular basis. In the current sanitary context, on-line training will be preferred until face-to-face training can resume. A SPOC (Small Private Online Course) has been recently developed in the framework of ESiWACE2(see [https://cerfacs.fr/code\\_coupling\\_with\\_oasis3-mct/](https://cerfacs.fr/code_coupling_with_oasis3-mct/)). This SPOC will be enhanced with additional exercises and will be officially delivered at least twice a year. The next session is planned April 19th-25th 2021.

- Dedicated User Support, C3, IS3 & ES2

Dedicated User Support, i.e. organising the visit of an OASIS developer to a chosen institute to help setting up or optimising a coupled system, is provided in the IS-ENES3 and ESiWACE2 contexts with respectively 9 pms and 4 pms. In 2019, the support was provided as planned. In 2020, the support has suffered some delay due to covid-19 but we are still planning to provide the total level of services planned before the end of those two projects.

- Toy coupled models, C2, IS3, ticket #[2555](#) and #[2175](#)

A toy coupled model coupling a fake atmosphere model and a fake ocean model is delivered with the coupler sources so that users can get familiar with compiling and running with OASIS3\_MCT. This toy coupled model has been revised while developing the SPOC and will be made available to the users with the next official release.

Another toy model showing how a vector field should be coupled will be developed. In that case, the source component of the toy must project the original vector field on a cartesian space and send the 3 projected components. The target component receives the 3 components (on the cartesian grid) and must project them on its grid and verify that the resulting vertical component is null.

- Environment to create fractional areas for truly conservative remapping, C2, ES2, ticket #[2460](#)

In an ocean-atmosphere coupling, the binary (i.e. not fractional) ocean mask should be taken as it is from the model. For the atmospheric model, coupling cell fractions should be defined by the conservative remapping of the ocean mask on the atmospheric grid, retaining fractions above a certain threshold. These coupling cell fractions should be used in the atmospheric model to define the % of ocean subsurface to be considered. Then the atmospheric coupling mask should be adapted associating a non-masked index to all cells with an ocean fraction above the chosen threshold. An environment reproducing all these steps will be developed and made available to the users.

- Migration from SVN to GIT for source management, C3, IS3, ticket #[2352](#)

Using GIT for source management is of great benefit for the OASIS3-MCT users, in particular, given its distributed method for version control, which means that each user clones a full version of the repository to her local machine. GIT branching and merging features are also more evolved than in SVN.

### 3. Next steps

Work is going on to include the above developments in OASIS3-MCT\_5.0. We do not foresee any specific problem or delay in releasing OASIS3-MCT\_5.0 in December 2021, given that the work has actively started since the release of the latest OASIS3-MCT version in June 2018 and that the developers form a well-coordinated group.

## 4. References

Valcke, S., Craig, A. and Coquart, L. (2020), 2020 OASIS3-MCT Development Plan, CECI, Université de Toulouse, CNRS, CERFACS, Toulouse, France - TR-CMGC-20-164, Technical report, [https://cerfacs.fr/wp-content/uploads/2020/11/GlobC-TR-164-202011\\_OASIS3-MCT\\_development\\_plan\\_final.pdf](https://cerfacs.fr/wp-content/uploads/2020/11/GlobC-TR-164-202011_OASIS3-MCT_development_plan_final.pdf)

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