



IS-ENES2 MILESTONE (M -N^o: 9.8) *New I/O server release*

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Abstract

XIOS 2 has now more than one year development and is now suitable to be used into models. Development has been focused on new internal design, enabling more easily the implementation of new functionalities. We think that XIOS 2 is now ready to be used, and although syntax is no strictly retro-compatible with XIOS 1, changes are minor, so we think it must be easy to manage the 2 versions in the same model for an overlapping time.

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants including the Commission Services	
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CO	Confidential, only for partners of the IS-ENES2 project	

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Executive Summary

- *Objectives:* new release of XIOS I/O server
- *Results:* XIOS 2 has now more than one year development and is now suitable to be used into models. Development has been focused on new internal design, enabling more easily the implementation of new functionalities. We think that XIOS 2 is now ready to be used, and although syntax is not strictly retro-compatible with XIOS 1, changes are minor, so we think it must be easy to manage the 2 versions in the same model for an overlapping time.
- *Perspectives:* Implementation on NEMO (in parallel of XIOS 1.0) and ARPEGE models

1. XIOS 2.0 release

XIOS 2 has now more than one year development and is now suitable to be used into models. Development has been focused on new internal design, enabling more easily the implementation of new functionalities. We think that XIOS 2 is now ready to be used, and although syntax is no strictly retro-compatible with XIOS 1, changes are minor, so we think it must be easy to manage the 2 versions in the same model for an overlapping time. We made a (non- exhaustive) list of functionalities provided by the new version of XIOS.

- New management of memory buffer for client-server : buffer size is evaluated at context definition closing and has not to be specified any more. Just specify if you want optimization for memory or performance. Depending of the case, huge memory size can be saved (factor 2-5 or more).
- Enhanced calendar functionality : User defined calendar can be specified (useful for planetology and paleo-climate studies), time operation (duration and date manipulation : ex : date +duration-> new date, or duration-duration-> new duration) are available from FORTRAN API.
- Management of netcdf4-HDF5 format or netcdf4 classical format using PNETCDF in parallel.
- Management of time-series : each variable can be output automatically in a single file with a defined splitting independently of the chunk of simulation, i.e. a written file can be reopened and appended.
- Field of any dimension are managed, the constraint of 2D or 3d field has been released, i.e. you can output scalar, 1D, as well as 4D, and up, with time records.
- File reading is now manage: it is now possible to received data in the model using `xios_rcv_field("field_id",field)`. Data are read and sent asynchronously by the server. In case of periodic read (for example forcing file), the server will do pre-fetching, i.e. data will be sent and stored in the client in advance to be available when the model will request the data, avoid the reading latency.

- We have introduced grid transformation, i.e to transform field providing from the model or input file into a new field changing dimension, parallel distribution and data. A large variety of transformation will be implemented in the future. Actually, we have implemented interpolation of vertical axis and horizontal domain, axis inversion and we are working to implement parallel global or partial reduction like global mean, zonal mean, etc.... All implemented transformation filters are (or must be) fully parallel and scalable. Many more transformation filter will follow, like gradient computation, vorticity, neighbouring discovery, halo transferring management, etc...
- Internally XIOS has been rewritten in term of parallel workflow and data flow. Data providing from model or input file are expressed in term of flow assigned to a timestamp. A Flow can be connected to filters, creating a new modified flow in output. There are time filter (which cumulate and manipulate data for an amount of time), arithmetic filters which perform and combine any point to point arithmetic operations between several incoming flows, and grid transformation which change the shape of the flow. All filters can be chained to perform complex operations. The idea is to provide a way to simply implement "in situ" parallel pre and post-treatment chain on allocated computing nodes. We believe that the most costly part of post-treatment could be done by this way very quickly and all along the running simulation.

What are incompatibility between XIOS-1 and XIOS-2, using only XIOS-1 functionalities?

- To be more consistent we decide to adopt C-convention for array index, that's mean all array index will now begin to 0 instead of 1 (like fortran convention). The array row order storage convention is unchanged and follows the Fortran convention.
- Calendar definition has changed, like described in the XIOS web-page: <http://forge.ipsl.jussieu.fr/ioserver/wiki/BackwardIncompatibleChanges>.
- Grid definition (in XML) has changed to enable any-dimensional grid. Using actual functionalities:

XIOS 1 :

```
<grid id="a_grid" domain_ref="a_domain"
axis_ref="an_axis" />
```

XIOS 2 :

```
<grid id="a_grid" >
```

```
<domain domain_ref="a_domain" />  
<axis axis_ref="an_axis" />  
</grid>
```

- Zoom are now expressed as a grid transformation. There are many advantage to that : unnecessary to re-declare new domains attributes when using multiple zoom from a same global domain, and better integration into the workflow:

XIOS 1 :

```
<domain id= "a_domain" ni_glo="100" nj_glo="50"  
zoom_ibegin="10  
zoom_ni="20" zoom_jbegin="10" zoom_nj="20" />
```

XIOS 2 :

```
<domain id="zoom_domain" domain_ref="a_domain">  
<zoom_domain zoom_ibegin="10" zoom_ni="20"  
zoom_jbegin="10"  
zoom_nj="20" />  
</domain>
```