esiwace
CENTRE OF EXCELLENCE IN SIMULATION OF WEATHER AND CLIMATE IN EUROPE

Reports on user support, training, and integration of NEMO and EC-Earth community models

Milestone MS6

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Report on user support, training, and integration of NEMO and EC-Earth community models

Introduction

Computational models are at the foundation of climate research, providing the main tools for simulations of the climate system. However, given the complexity of modern climate models, the development has to be accompanied with services that allow for effective and efficient use of the models by the research community. These services form an interface between model developers and users, providing easy access to information, and defining formal processes for the feedback loop between model development and usage.

This report covers user support and training provided for NEMO and EC-Earth within the ESiWACE project. It summarises support activities qualitatively and gives some quantitative measure about the effort undertaken to support the community.

Moreover, a summary is given about the activities and results of the integration of OpenIFS into EC-Earth. This development (described in WP2/task 2.1.1) will bring a new atmospheric component into EC-Earth and, at the same time, ensure faster upgrade cycles and more rapid benefit from on-going scientific developments to the user community.

The milestone report covers the time period from September 2015 until February 2018 (months 1 – 30 of the ESiWACE project).

This milestone report is available on ESiWACE website https://www.esiwace.eu/results/milestones

1. EC-Earth user support

The EC-Earth earth system model is developed and used by a European consortium of 22 research institutes in ten countries. The model is used in a wide range of configurations (from climate prediction experiments to centennial simulations) and on many different computing platforms. The diversity of the user community and use-cases demands high-quality user support to allow for an effective and efficient use of the model in different contexts. During the reporting period, user support through the EC-Earth Development Portal has ensured community-wide access to the model code and data, documentation, and feedback to model developers.

1.1 Releases

Regular releases are a fundamental service to the user community, as they provide access to recent developments and reliable references to the state of the model in regular intervals.

During the reporting period, the EC-Earth release roadmap has been dominated by the model development targeting the CMIP6 version of EC-Earth. Hence, releases have been defined at regular intervals and with defined feature sets to allow early testing of model configurations relevant for planned CMIP6 experiments.

Issue tracking has been used to define feature sets for the EC-Earth 3.2 series of releases and to track release progress. The following EC-Earth releases have been published in the reporting period:

Released version	Release date	Revision
EC-Earth 3.2beta	2015-12-08	2700
EC-Earth 3.2.0	2016-05-04	3051
EC-Earth 3.2.1	2016-12-15	3798
EC-Earth 3.2.2	2017-03-15	4062
EC-Earth 3.2.3	2018-02	t.b.d.

1.2 EC-Earth Development Portal

The main platform and central interface for EC-Earth user support is the *EC-Earth Development Portal*. This is a web service provided to the EC-Earth user and developer community and comprises a web site (www.ec-earth.org), a collaboration platform (dev.ec-earth.org), and a version control repository (svn.ec-earth.org). The web site targets the general public, whilst the collaboration platform and version control repository are for the particular needs of the EC-Earth user and developer community. Technically, the collaboration platform is based on a Redmine web services and Subversion is used for version control. The Redmine and Subversion sites are technically interconnected to allow for an integrated interface for user support.

The user base of the Development Portal has been significantly broadened during the ESiWACE project. Of the 239 individual users in total, 86 new user accounts have been added over the reporting period.

The main means of communication among users and between users and model developers are issue tracking and forum discussions. Furthermore, Wiki pages provide up-to-date documentation about many aspects of the EC-Earth model (beside the user manuals provided with the source code).

Issue tracking is used by many users to report bugs or other problems and to feedback user experience to the development process. During the reporting period, a total of 239 issues have been reported and 183 issue could be closed. Overall 139 issues have been resolved within the reporting period (i.e. have been both reported and closed in this time period).

In the Development Portal discussion forums, 49 new topics have been discussed during the reporting period, receiving a total of 296 response messages. The EC-Earth documentation has been enlarged by 37 new Wiki pages and 542 individual updates have been provided by the user community.

A major aspect of user support is the provision of the revision control repository to the EC-Earth community, allowing instant access to ongoing development activities. Beside official releases, this mode of access is heavily used, and particularly useful to support a user-driven development strategy. During the period covered in this report, a total of 2411 individual code changes where published by 56 contributors.

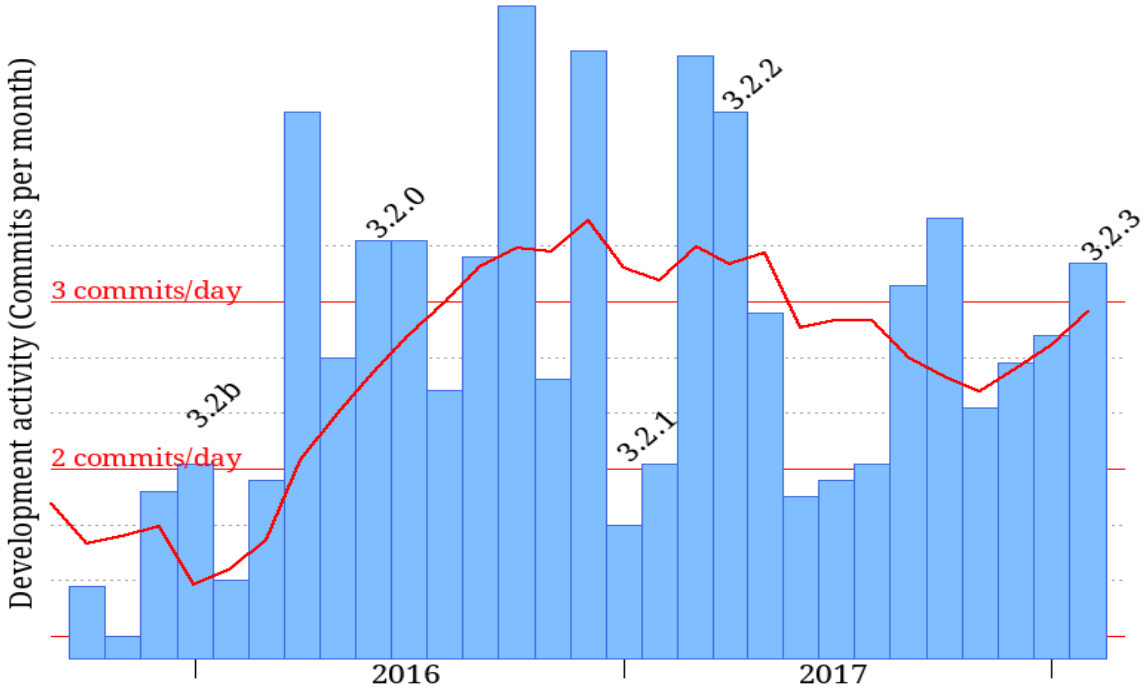

Figure 1 illustrates the volume of model development effort that was fed back to the user community over the course of ESiWACE. The number of individual contributions (as well as the number of contributors) has been increasing during the reporting period.

2. OpenIFS Integration in EC-Earth

The EC-Earth development roadmap defines a transition for the atmospheric component from IFS cycle 36r4 to an up-to-date version of OpenIFS. This introduces not only a much more recent state of the scientific development, but also a fundamental change in the accessibility of the model (due to a more permissive ECMWF license, which allows free access to source code, data files and tools for academic and research institutions) and a more dynamic and reliable upgrade path for future releases.

Within the reporting period, an initial version of EC-Earth/OpenIFS was developed, based on OpenIFS cycle 40r1. This development included a number of transitional changes to allow the integration of OpenIFS in the EC-Earth software infrastructure and introduce OpenIFS coupling to the other ESM components. In particular, the following tasks have been completed:

- setting up an OpenIFS vendor branch in the EC-Earth version control repository, in order to allow tracking the OpenIFS development;
- integration of the OpenIFS build environment with the EC-Earth build configuration system, to allow for a consistent user experience;
- integration of OpenIFS into the EC-Earth run-time environment for atmosphere-only and GCM (atmosphere-ocean) experiment types;
- provision of initial data for OpenIFS via the EC-Earth data distribution infrastructure and integration in the run-time environment;
- further development of the EC-Earth coupling interface for the atmosphere and introduction in OpenIFS (this has been fed back to ECMWF and will be integrated in future IFS/OpenIFS releases);
- integration of EC-Earth's so-called long-run changes into OpenIFS, which allows long integrations typical for climate-type experiments (this development has also been fed back to ECMWF).

The implementation of these points has been the basis for and experimental version of EC-Earth/OpenIFS, which has been published for testing to the EC-Earth community. Discussions between EC-Earth developers and the OpenIFS team at ECMWF are currently ongoing about the upgrade to the next OpenIFS release, based on a more recent cycle of IFS.

3. NEMO user support

1.1 Context of NEMO Services

NEMO (Nucleus for European Modelling of the Ocean) is a state-of-the-art modelling framework for oceanographic research, operational oceanography, seasonal to decadal forecasting and climate studies. It is a shared, reliable, and evolving system, developed by a "NEMO System Team" of experts. NEMO includes:

- **five major components:**
  - ↘ the blue ocean (ocean dynamics, NEMO-OPA),
  - ↘ the white ocean (sea-ice, NEMO-LIM),
  - ↘ the green ocean (biogeochemistry, NEMO-TOP),
  - ↘ the adaptive mesh refinement software (AGRIF), and
  - ↘ the assimilation component NEMO-OBS, NEMO-ASM and NEMO-TAM, including observational operators and the linear tangent and adjoint models;
- **an OASIS3-MCT interface for coupling,**
- **some "reference configurations"** allowing the user to easily set-up and validate the model and it's applications (see http://www.nemo-ocean.eu/Using-NEMO/Configurations), and
- **a set of scripts and tools** (including pre- and post-processing).

The complete descriptions of NEMO's components are available in the Reference Manuals on line: https://forge.ipsl.jussieu.fr/nemo/wiki/Documentation.

NEMO is a shared reliable and evolving system. These objectives rely on the work of the NEMO System Team. The NEMO system team is a team of developers mostly employed by the various NEMO Consortium members (CMCC, CNRS, INGV, Mercator-Océan, Met-Office and NOC, see www.nemo-ocean.eu). Its work is focused on NEMO platform development with the following remit:

- to adopt changes and improvements in natural (ocean) and computer sciences,
- to prepare for future changes by the simplification and redesign of key modules and algorithms,
- to use sustainable development methodologies which ensure quality control and traceability, and
- to fix reported bugs and keep documentation (reference manual, Wiki pages, code comments) up to date.

The main service around NEMO is its sustainable development. The NEMO System Team also ensures the distribution and support of the NEMO reference software under free licence.

The resources allocated to these tasks are coming from the NEMO consortium members for a sustainable total of 9 FTE.

1.2 Distribution and support of the NEMO reference software

The NEMO Collaborative Development Environment (CDE) including the public access, the User and Developer's access to NEMO reference code, documentation, and communication tools has been completely redesigned. The new services opened mid 2017 including:

- the new public website www.nemo-ocean.eu hosted at Mercator-Océan IT facilities,
- the re-factored Forge/Trac project hosted at IPSL including:
    - ↘ the NEMO reference svn repository,
    - ↘ the users forums,
    - ↘ the Trac Wiki,
    - ↘ the Trac ticketing system.

For 2017, the main indicators of activity are:

- total number of registered users (active at least once during last 3 years): **1660,**
- number of new users registrations in 2017

(as indicator of NEMO community growth): **~260**,

- distribution of NEMO: number of downloads in 2017 (from svn logs):

↘ downloads of NEMO sources:

1276 for the 3_6_STABLE reference, **868** for the trunk (shared version in development)

↘ NEMO updates downloaded by users:

10357 for the 3_6_STABLE reference,

15198 for the trunk (shared version in development)

- number of emails (user support): **~100**
- Number of publications in 2017:

↘ registered on NEMO web site: 36

(https://www.nemo-ocean.eu/bibliography/publications/)

↘ **on the newly created topic page on Research Gate: https://www.researchgate.net/topic/NEMO-Ocean**

- sustainable code development (Trac tickets):

Around the NEMO reference repository, the Forge/Trac software allows to open/close

tickets to identify and follow the work. These tickets have different types: bug (their fix allowing the close of the ticket), defect, development branches, and enhancement. The table below shows the amount of work in 2017, and especially the distribution between developments and bug fixes:

Ticket type	Opened in 2017	Closed in 2017
Bug	70	126
Task	38	93
Defect	26	29
Enhancement	31	52
TOTAL	**165**	**300**

The numbers of closed tickets this year indicates both the amount of work done for the 3_6_STABLE release in order for it to be ready for CMIP6 experiments, and the drastic cleaning of the ticketing database done by the System team, including a major reorganisation between ticket type and assignment process. The ticketing database is now clean and up to date, ready for the 2018 stage, building the 4.0 release.

- number of edits on the Wiki pages (as indicator of documentation of developments): **~2055** for a total number of **800** Wiki pages: This number has widely increased compared to previous years because of the changes in Collaborative Development environment, and especially the fact that all users documentation has moved from the web site to the Forge Wiki.
- number of source files changed in the NEMO repository (indicator of development activity): **~1500**
- Update of the NEMO Development Strategy document: The NEMO Consortium defines the mid-term strategy through its NEMO Development Strategy document. This document is regularly updated and Version 2 is now published (https://www.nemo-ocean.eu/wp-content/uploads/NEMO_Development_Strategy_Version2_2018-2022.pdf). This update has been built through discussion between NEMO consortium members and also a 3 days meeting of the NEMO Enlarged Developer's Committee at BSC in Barcelona 3-5 April 2017. ESiWACE funding contributed to the organisation and travel expenses for this meeting.

4. Training

The EC-Earth model, including the NEMO ocean component, has been part of the set-up for the "Third European Earth System and Climate Modelling School (3rd E2SCMS)", which was held in Helsinki, Finland, 9 – 21 June 2016. This school is initiated by ENES and open to early career scientists (advanced PhD candidates, postdoctoral scientists, and scientific programmers) who are affiliated with research institutions. The students attending the school were learning how to set up, run, monitor, and analyse ESM experiments with given objectives. Of the 40 applicants that answered the call, 28 were accepted and able to attend the school. A detailed report was produced as a deliverable in IS-ENES2 (D2.4).