Auto-EC-Earth: An automatic workflow to manage climate modelling experiments using Autosubmit <u>Eric Ferrer</u>¹ (eric.ferrer@bsc.es), Gilbert Montane ¹, Miguel Castrillo¹, Alejandro García¹

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Introduction: Earth System Models

Earth System Models (ESMs) are complex systems that try to represent the physical, chemical, and biological processes that drive Earth climate to be able to run simulations to understand its behavior and to predict its evolution in the future. In order to do so, they perform different tasks that conform the workflow, with very clear steps required in order to perform and analyze the simulations.



EC-Earth

EC-Earth is one of those ESMs, formed by different components that represent different processes of the Earth, like NEMO for the ocean, or IFS/OIFS for the atmosphere. They are integrated together via the OASIS coupler to simulate the interactions between all of them representing the Earth dynamics.



EC-Earth3 is the ESM model from the EC-Earth consortium that contributed to CMIP6, while EC-Earth4 is in development and it's expected to contribute to CMIP7.

Motivation

The EC-Earth Consortium is an entity composed of different European national meteorological services and research institutes. Its main goal is to develop and maintain the EC-Earth model and the necessary scripts to execute it in a collaborative environment. The code from the Consortium covers only the compilation and simulation steps, but a full workflow as seen in the image below requires some extra steps.



helping scientists to perform the other required tasks to run EC-Earth. It is based on Autosubmit, a lightweight workflow manager designed to meet climate research necessities.

Autosubmit Workflow Manager

Its development here allows for an agile co-design approach where Auto-EC-Earth workflow needs are quickly taken into account for new improvements on the tool. This implies that it has been

Autosubmit allows to split the tasks into smaller ones that can be performed independently. This may increment the complexity of the workflow management, but the granularity allows easier error detection and bug solving without adding complexity since Autosubmit generates the tasks dynamically. In the image below we can see a splice of a 50 year long experiment, visualized with



The upgrade from EC-Earth 3 to EC-Earth 4 provides a significant upgrade in most of the model components of EC-Earth.

In addition, EC-Earth 4 has a new scripting system (Script Engine) which has been seamlessly integrated with Autosubmit in Auto-EC-Earth 4, allowing experiments to be run with all the management advantages provided by the Workflow Manager.

In turn, Auto-EC-Earth4 uses Autosubmit 4, which offers more flexibility in experiment configuration than the previous version, making it easier to develop, maintain and share.

The Auto-EC-Earth 4 workflow, like the EC-Earth 4 model, is still in its early stages of development and will continue to grow, adding new features and enhancements as needed by users with the CMIP7 contribution in mind.

Setting up an experiment is done by modifying the experiment files, similar to Auto-EC-Earth 3. The upgrade hasn't changed this approach, and the workflow has been developed designed with simplicity in mind, so that users don't have to modify a lot of things to run.

References

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- Script Engine: https://github.com/uwefladrich/scriptengine

Conclusions

ESM and climate workflows are very complex. Due to that, we need automatic tools to easily manage them in a high productivity environment. We selected Autosubmit, as it is a very powerful tool that helps us with that automation requirement.

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