



ESM-TOOLS: A common infrastructure for modular coupled Earth system modelling

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Earth system and climate modelling involves the simulation of processes on a large range of scales, and within very different components of the earth system. In practice, component models from different institutes are usually developed independently and then combined using a dedicated coupling software.

This procedure not only leads to a wildly growing number of available versions of model components and coupled setups, but also to model and system-dependent ways of obtaining and operating many of these. This can be challenging (and potentially a huge waste of time) especially for unexperienced researchers, or scientists aiming to change to a different model system, e.g. for intercomparisons.

In order to define a standard way of downloading, configuring, compiling and running modular ESMs on a variety of HPC systems, AWI and partner institutions developed and maintain the ESM-TOOLS software (<https://www.esm-tools.net>) within the framework of the Helmholtz Association-funded project Advanced Earth System Model Capacity (ESM). Our aim is to provide standard solutions to typical problems occurring within the workflow of model simulations, such as calendar operations, data post-processing and monitoring, sanity checks, sorting and archiving of output, and script-based coupling (e.g. ice sheet models, isostatic adjustment models). The user only needs to provide a short (40-50 lines) runscript of experiment specific definitions, while the ESM-TOOLS execute all the phases of a simulation in the correct order. A user-friendly API ensures that more experienced users have full control over each of these phases, and can easily add functionality. A GUI has been recently developed to provide a more intuitive approach to the modular system, and also to add a graphical overview of the available models and combinations.

The first version of the ESM-TOOLS has been released in September 2018 and with revision 2 (to be released on March 19th 2019), the ESM-TOOLS will support four ocean models, two atmosphere models, two biogeochemistry models, an ice sheet and an isostatic adjustment model as well as standard settings for five high performance computing systems. For the future we plan to add interfaces to the MESSy-framework (Joeckel et al., 2005), regional models and soil/hydrology models.