

ACME Collaboration Agreement CICE Community of Users/Developers

This collaboration agreement describes ACME's interaction with the broader CICE user and development communities during ACME development of the new MPAS-based sea-ice model.

Background:

A very large community, including many climate modeling and forecast centers, uses the CICE model. Several of these centers and collaborators have been active in the development of CICE, particularly in the column physics. As part of the ACME proposal, we specifically outlined an approach for continued support of this CICE community during the transition to the new MPAS-based sea-ice model. In the proposal, we describe the development of a standalone CICE column physics package as a set of modules that are completely independent of grid and other infrastructural CICE elements (e.g. MPI tasks, calendar). It also includes an interface of subroutine calls that translate from model-specific arrays and other variables to the model-independent column physics calculations. This package will be callable by both the older CICE model and the new MPAS model to enable continued development of the CICE column physics during the transition.

Duration:

This collaboration would begin on approval and exist for the duration of ACME.

Personnel:

As described above, the CICE user community is very large and this collaboration agreement would be best served by separate releases of the column physics package as noted below. The most important collaborations are with significant users and with those involved in joint development of the CICE model. This "CICE developers group" includes the following research groups and institutions:

- The US Navy uses CICE in its operational Arctic forecast model. The current operational version is CICE v4.0. They are currently testing CICE v5.1 as part of their plans to upgrade the forecast model for future operational use.
- The UK Met Office uses CICE in its forecasting suite at all time scales (numerical weather prediction to climate projection). Like the Navy, they currently use an older version operationally while testing CICE v5.1 as part of a lengthy validation and evaluation cycle.
- Daniel Feltham's group at the University of Reading is responsible for a number of CICE developments and is funded to supply new developments to the UK Met Office. Feltham's group has made sustained contributions to CICE, most notably contributing new form drag, melt pond and anisotropic rheology parameterizations for CICE v5. They have a number of other developments in the pipeline, including refreezing of melt water on top of and underneath the ice, frazil ice physics, and inclusion of ocean stability effects on ice-ocean drag. Their funding hinges on the contingency that their

- parameterizations be adopted in CICE and used by UK Met Office.
- GFDL has requested the column package to test in their modeling framework, for evaluation purposes. They would not adopt it into GFDL-released code until after their CMIP6 code is frozen, which likely would be after the column package has been released by us. (They do not adopt the entire CICE model).
 - The Regional Arctic System Model (RASM) based at the Naval Postgraduate School, funded by DOE (RGCM), the Office of Naval Research and NSF, has been a long-term user and developer of CICE capabilities. Recently, they were responsible for diagnosing and fixing high-frequency ocean-ice coupling instabilities and for incorporating CICE v5 into the CESM model. Current collaborative research includes developing a more physically defensible, unified sea ice form-drag and ridging parameterization. In addition, RASM is conditionally accepted for DOE funding to implement a satellite emulator for the NASA ICESat-2 mission to be launched in 2017 for evaluating sea ice volume in CICE, which will directly benefit ACME. This work addresses issues with the sea ice thickness distribution that are not scheduled for improvement as part of ACME development. All of this work needs to be done in the column physics package to enable its timely adoption into MPAS-CICE. The RASM project is required by DOE to collaborate closely with the HiLAT project below.
 - The undeniable success of CICE is a direct result of our decades-long collaboration with CESM researchers. This collaboration continues through RASM, with a particular focus on biogeochemical cycles.
 - The DOE High-Latitude Application and Testing of Regional and Global Climate Models (HiLAT) project plans to use CICE v5 in coupled simulations and specific studies exploring model sensitivity to new CICE physics such as melt ponds (HiLAT will be the subject of its own collaboration agreement).

Process for collaboration:

In the short term, we have created the column physics package and are manually synchronizing the CICE and MPAS models while we test the interfaces. We would like to distribute an early version of the column physics from the existing CICE repository, to be used with CICE. In the longer term, we will work toward an independent repository from which we can distribute the column physics as a standalone package and where community developments will continue to be merged. This collaboration agreement, then, specifically requests:

- An initial, limited release of the column physics package to the CICE developers group, including physics that was already released as part of CICE5, v5.1. This release is necessary to support existing collaborations and speed integration into the ACME model. It will also include the full 3-D sea-ice biogeochemistry that has been published (N. Jeffery and E. C. Hunke, 2014. JGR, DOI: 10.1002/2013JC009634), but was not quite ready for the v5 release due to inadequate documentation and final testing that were continued under the ACME project.

- The move of the column physics package to an external repository where new community developments will be integrated. Further ACME development will continue on a private branch.

To be incorporated into the column package, community development code must be accompanied with a complete description of the changes necessary to the column package interface. A form detailing the information needed will be provided to developers (a draft version is available at <https://acme-climate.atlassian.net/wiki/display/OCNICE/Sea+Ice+-+Documentation+Required+for+Changes+to+the+Column+Package>).

Developers of the column package (E. Hunke, A. Turner, and for BGC, N. Jeffery and S. Elliott) will be invited as co-authors on all publications utilizing the column package software until such time as it is publicly released, and publications will acknowledge support from DOE as the funding source of the column package refactorization.

Collaborators will not require access to ACME repositories. Further ACME development will occur on a private branch with ACME developers (Hunke, Jeffery, Turner) responsible for ensuring all ACME collaboration policies are followed for any release from that private branch into public or collaborative spaces in the repository. In particular, all proposed research using ACME development code in the private branch and associated simulations must be coordinated with the related developers and subsequently approved by the Council or its designee prior to starting the research. The research plan should include an upfront discussion of publications and authorship. All developers must be given an offer to participate in both the design and performance of the research.

Benefits to ACME:

As noted above, CICE has strongly benefitted from community development efforts and this agreement would allow us to continue integrating and rapidly adopting these new developments in the new MPAS sea ice model.

Benefits to community:

This benefits the CICE user community by enabling them to continue development and testing of new physics while ACME transitions to the new MPAS model. Familiarity with the column package may ease their future transition to MPAS-CICE.