

Running CESM+MOM6 with MARBL Tracers

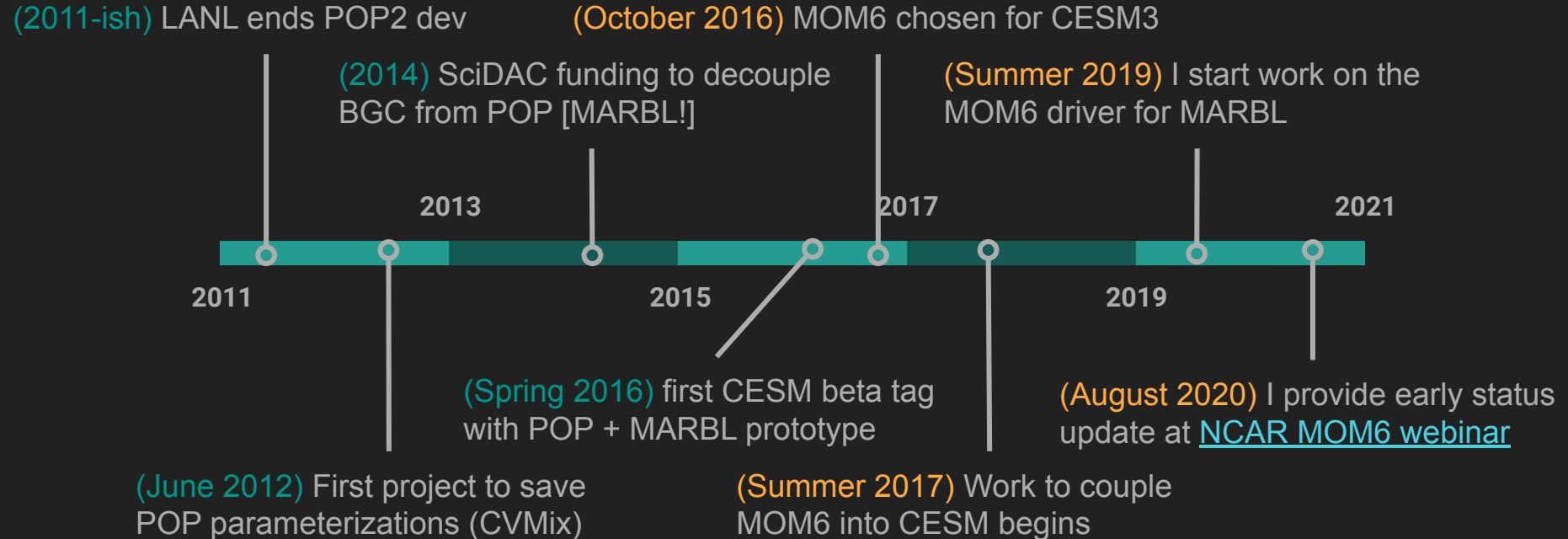
Mike Levy, Keith Lindsay, and Matt Long
CESM Workshop, June 2023

with help from Alper Altuntas, Gustavo Marques, and Andrew Shao

Outline

- Background / Current State of MARBL in CESM+MOM6
- CESM with MARBL (MOM6+MARBL vs POP2+MARBL)
- MOM6 solo driver with MARBL
- Summary

Background



Current Status

Since Aug 2020: **MARBL is fully functional*** in MOM6

1. Not just passively advecting tracers
2. MARBL diagnostics controlled via `diag_table`
3. MARBL parameters set via `user_nl_marbl`
4. Initial conditions provided on WOA 1 degree grid, MOM6 interpolates
5. Forcing fields available either via CESM mediator or netCDF file
 - Includes support for prognostic / diagnostic CO₂ from atmosphere & returning CO₂ flux

* *Fully functional on my branch, **not yet available in CESM***

Current Status

Remaining big tasks before MARBL will be available in CESM tag:

1. MARBL is in cgs; working to **support mks** (avoid confusion in diagnostics)
2. Test with **latest $\frac{2}{3}^\circ$ grid**

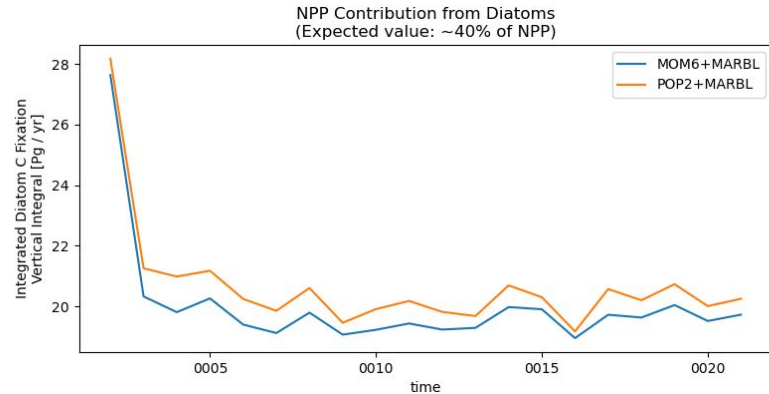
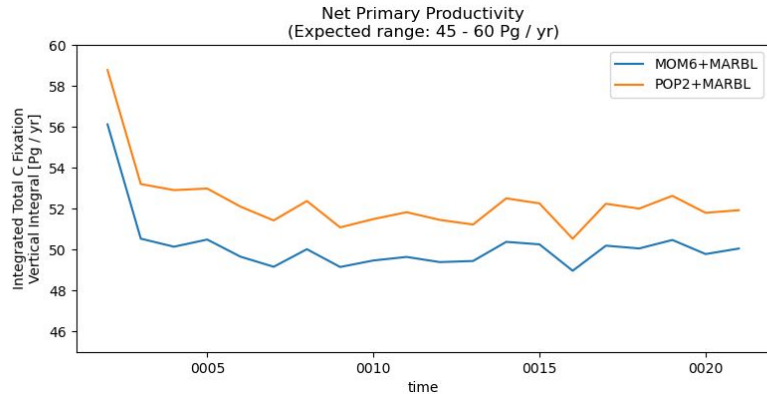
Known issues to resolve after MARBL is available:

1. Configure **default diagnostics** (which variables, frequency, vertical grid, etc)
2. Vectorize computation of surface fluxes
3. Support for **carbon isotopes**
4. Performance: **currently 6x the cost** of MOM6 without MARBL
 - hoping better I/O improves that
 - Need to add MOM6 timers to MARBL driver (measure then improve)

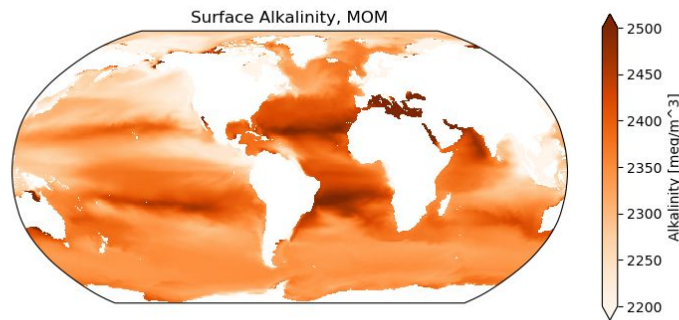
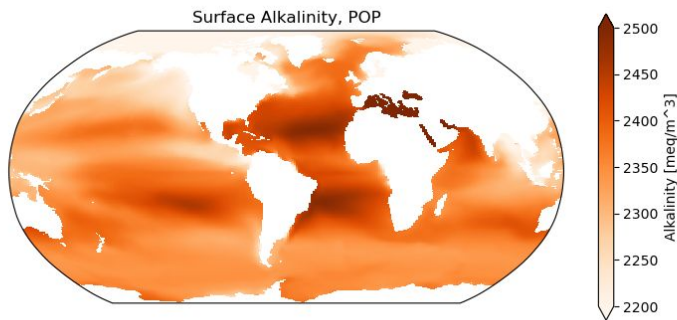
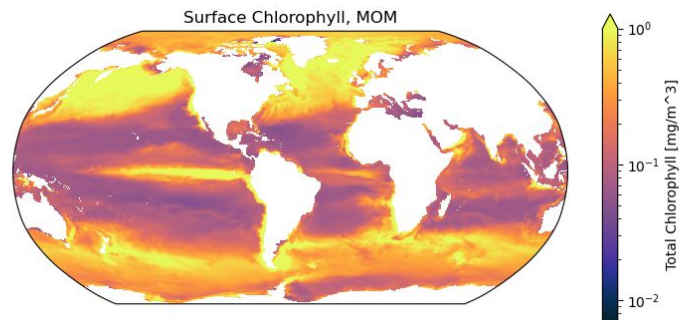
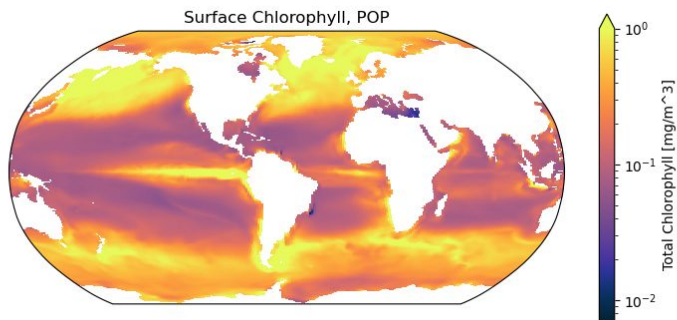
MOM6+MARBL vs POP2+MARBL (setup)

1. Run **20 years** of G compset (active ocean & ice, data atmosphere; aka **FOSI**)
2. MARBL is configured to run “**4p2z**” (4 phytoplankton and 2 zooplankton)
3. Keith Lindsay put together diagnostic package to **look at time-series** of global and regional means / integrals
 - Diagnostics have uncovered several issues which we have fixed
4. **Next step** is to take a closer **look at spatial distributions**

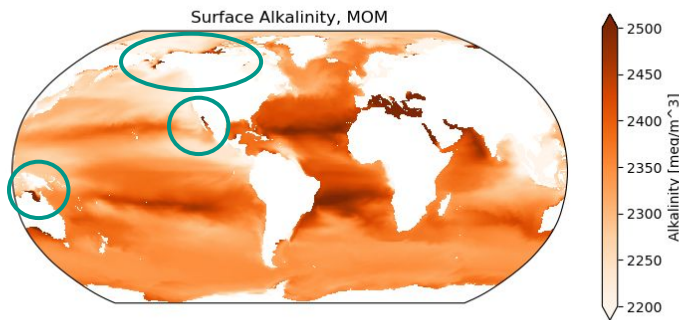
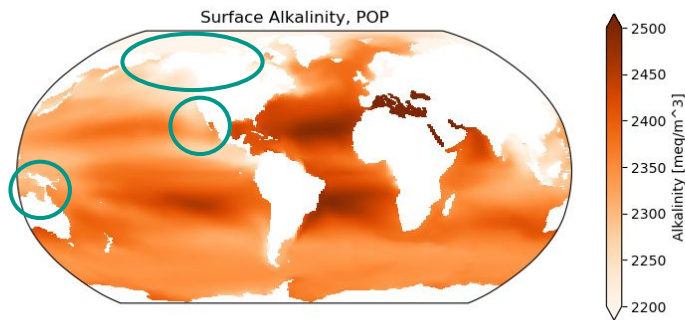
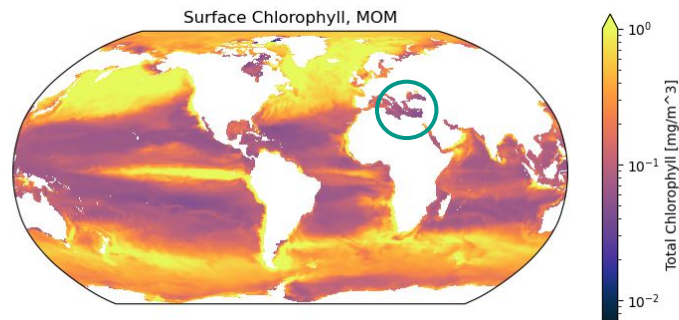
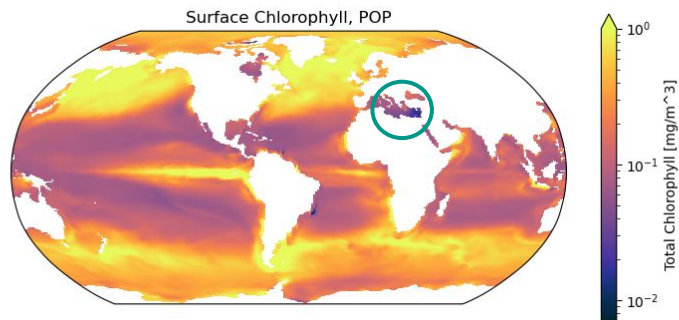
MOM6+MARBL vs POP2+MARBL (NPP time series)



MOM6+MARBL vs POP2+MARBL (maps)



MOM6+MARBL vs POP2+MARBL (maps)



Single Column Configuration

Purpose: run stand-alone MOM6 from CESM checkout

1. Setup

- Subset of **ocean-only configurations** (from [MOM6-examples](#)) available in [MOM_interface](#) layer
- MARBL dev branch adds **single_column_MARBL** directory
- Forcing comes from docn (**5 year A compset** run, output on MOM6 global grid)

2. Remaining tasks

- Support for **restoring MARBL tracers** (not needed for MARBL in CESM+MOM6)
- **Improve user interface** (build via CIME tools? better machine support? Other improvements?)

Single Column Configuration

Currently provide forcing / IC files for 7 of 9 [JGOFS](#) locations in [Moore et al. \(2002\)](#)

An intermediate complexity marine ecosystem model
for the global domain

J. Keith Moore^{a,*}, Scott C. Doney^a, Joanie A. Kleypas^a, David M. Glover^b,
Inez Y. Fung^c

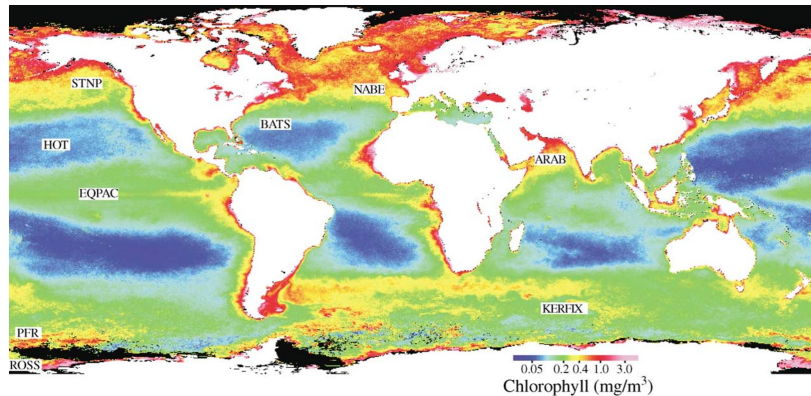
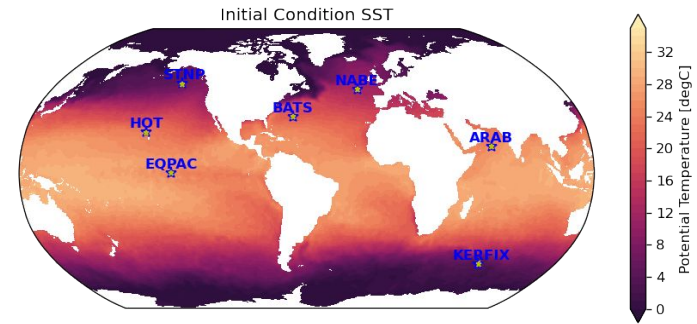


Fig. 2. The location of the nine JGOFS sites used in this study is shown over annual mean chlorophyll concentrations from SeaWiFS (October 1998–September 1999).



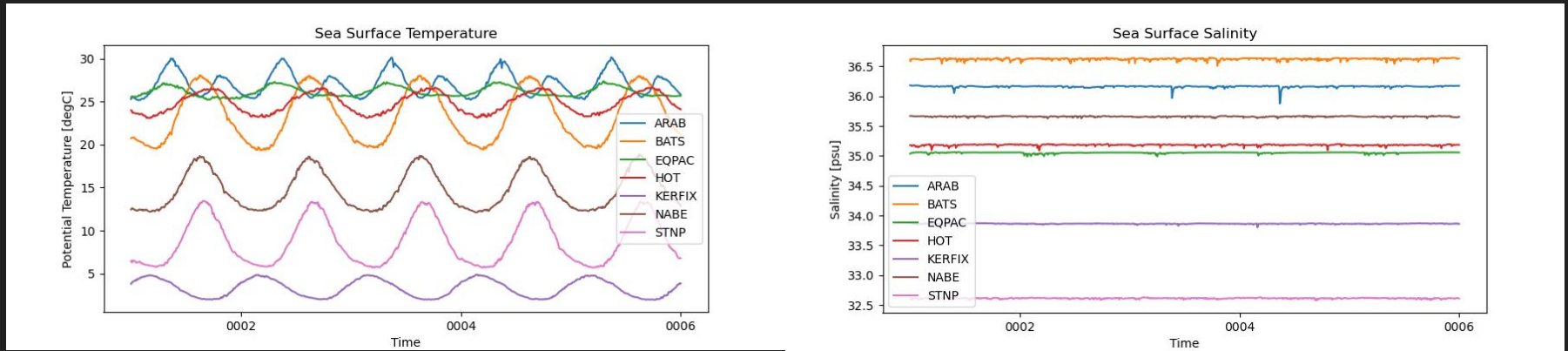
ARAB depth: 4043.0m
BATS depth: 4549.0m
HOT depth: 4695.0m
EQPAC depth: 4328.5m
HOT depth: 4695.0m
KERFIX depth: 2059.0m
NABE depth: 4581.0m
STNP depth: 4230.0m

Single Column Configuration

Collaborators are using single column MOM6+MARBL for:

- Diurnal vertical migration (DVM)
- Macroalgae (non-advected biomass pool)
- Faster turnaround for tuning MARBL parameters
- Provide output for tuning FEISTY (fishery model)

Single Column Configuration (SST and SSS plots)



Note: we restore SST (to values used to compute heat flux) and SSS (to initial value)

MARBL is enabled in this run, but I don't want to include plots until restoring is available

Summary

- Branch of **MOM6** exists that **can run with MARBL tracers**
 - Supports science features wanted in CESM3, but a few SE tasks remain
 - Coming to CESM this fall?
- **CESM checkout** can run **subset MOM6-examples**
 - Very kludgy, but I'll work on improving that when we are happy with setup
 - Will provide some **single column examples with MARBL** enabled