Ocean Model Working Group Update

THE 27th CESM ANNUAL WORKSHOP

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CESM Ocean Component "Workhorse" Configurations

	POP →	MOM6
Horizontal Grid	**1.125° dipole** w/ equatorial refinement	**0.66° tripole** w/ equatorial refinement
Vertical Grid	Z-coord. 10m at surface, 60 levels	Z*-coord *or* Hycom-like *or* Vert. Mode Optimized ~2.5m at surface, 65-85 levels
Freshwater b.c.	Constant volume, **virtual salt flux**	Variable mass, **natural b.c.**, enthalpy conserving
Vertical Mixing	CVMIX-KPP + param. Langmuir mixing	CVMIX-KPP + wave processes
GM+Redi	N^2 scaling	MEKE+GEOMETRIC scaling + GME backscatter
H. Viscosity	Anisotropic Laplacian	Isotropic Laplacian + Biharmonic via MEKE
Solar penetration	Ohlmann (2003)	Manizza (2005)
Advection	3rd order upwind	Horiz. PPM, Vert. ALE w/ 2nd or 4th order remap
Other params	Overflow, Estuary box model	Nonlinear EOS correction
Coupling API	MCT, NUOPC	NUOPC
Cost	1	5-8

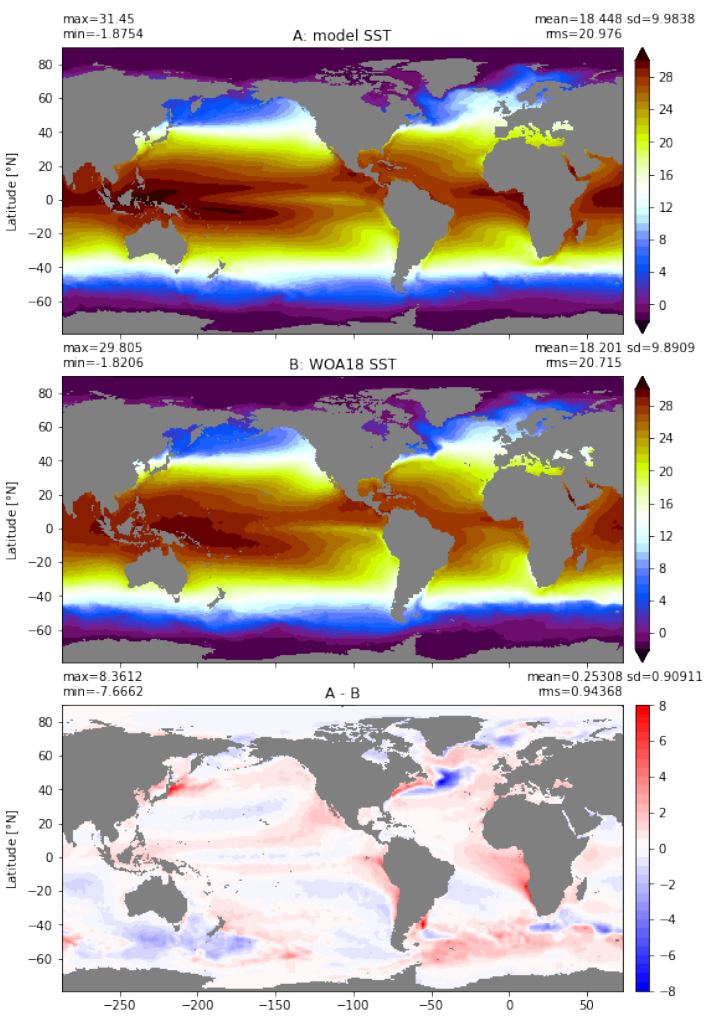
CESM-MOM6 “Workhorse” Configuration

Mean SST

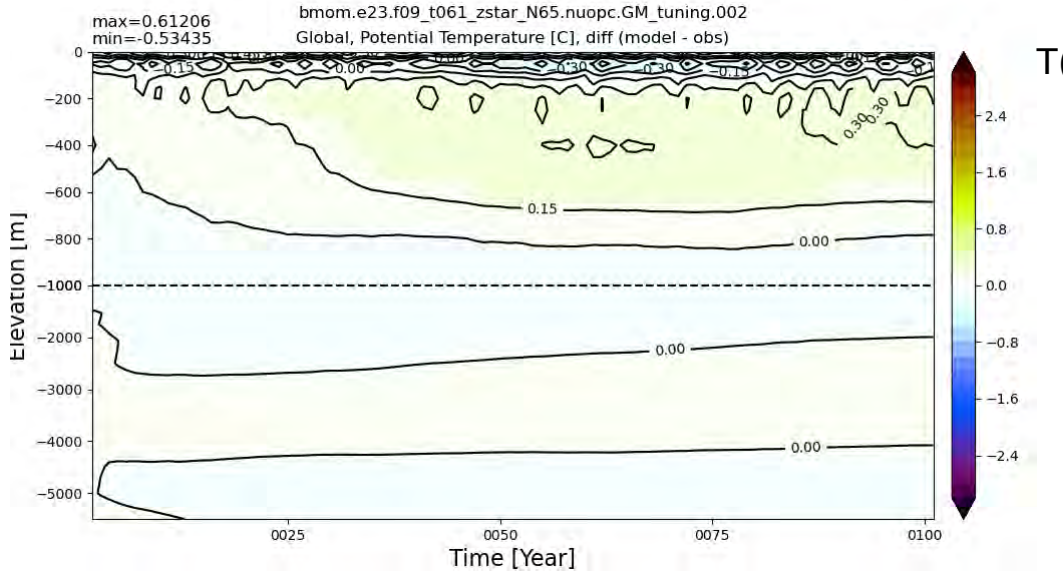
MOM6

OBS

MOM6-OBS



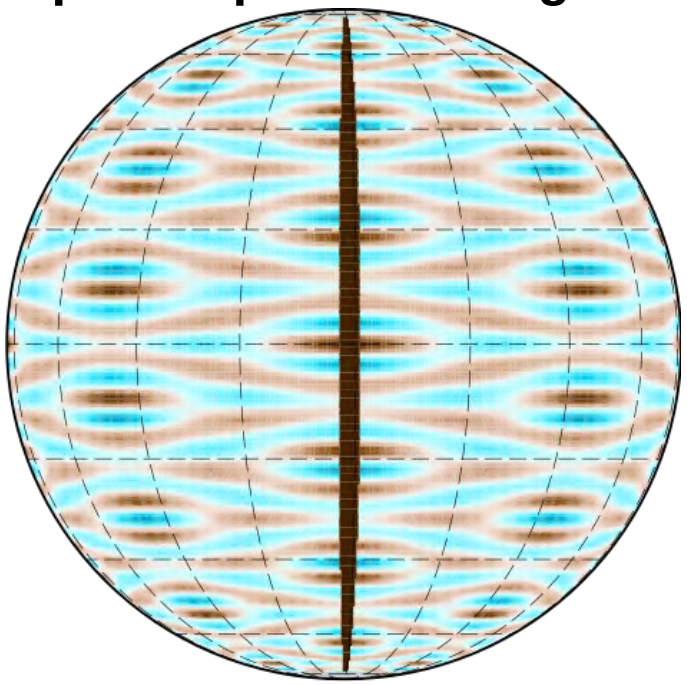
Century length integrations of CESM with MOM6 producing stable climate with bias and drift less than or equal to POP.



T(z,t)

Alternative CESM Ocean Configurations with MOM6

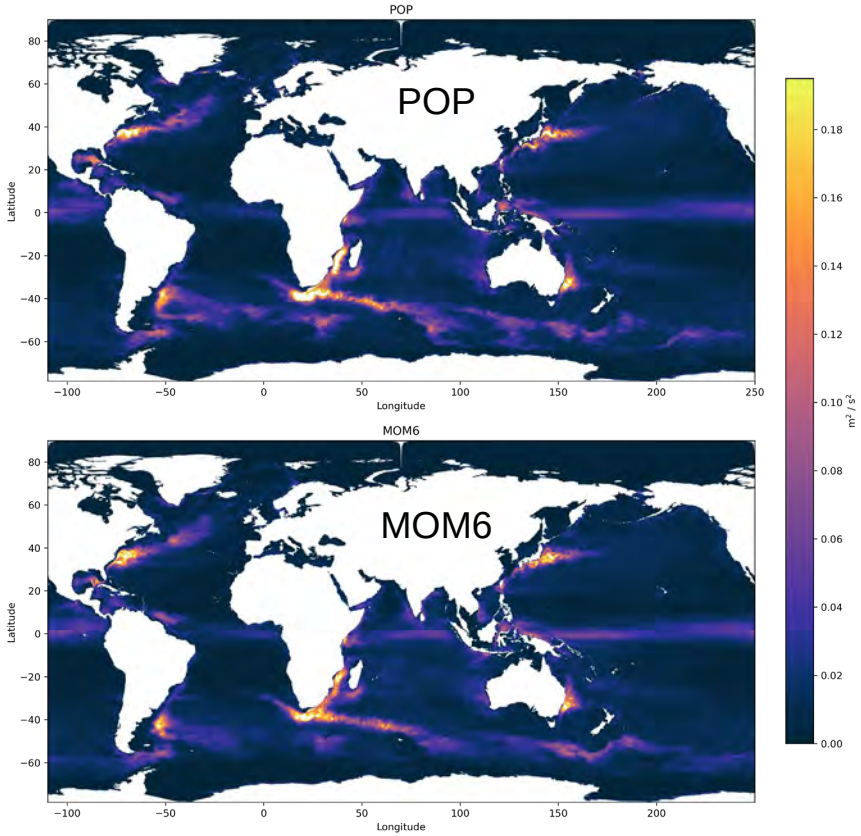
Coupled Aqua- and Ridge-Planets



Ocean Depth (m)

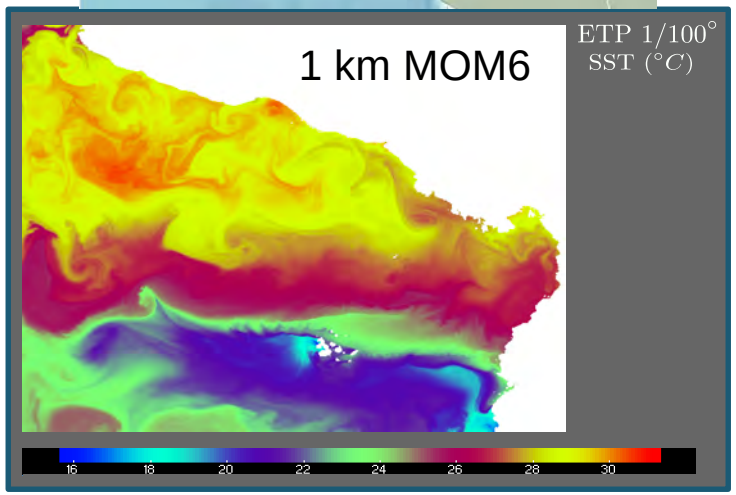
Wu et al (2021)

High-Res Global



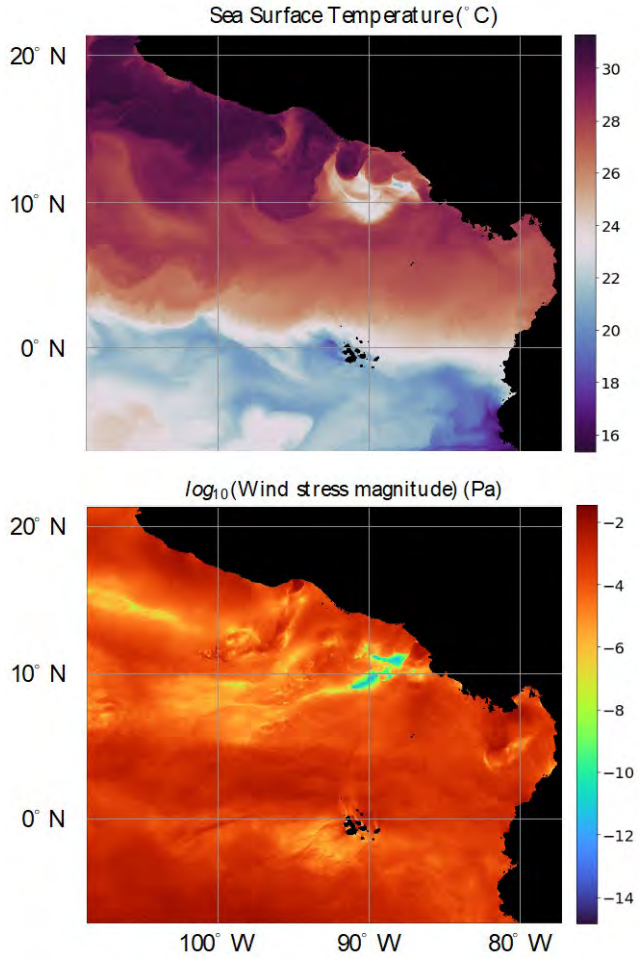
Partee et al (2021)

Regional Downscaling



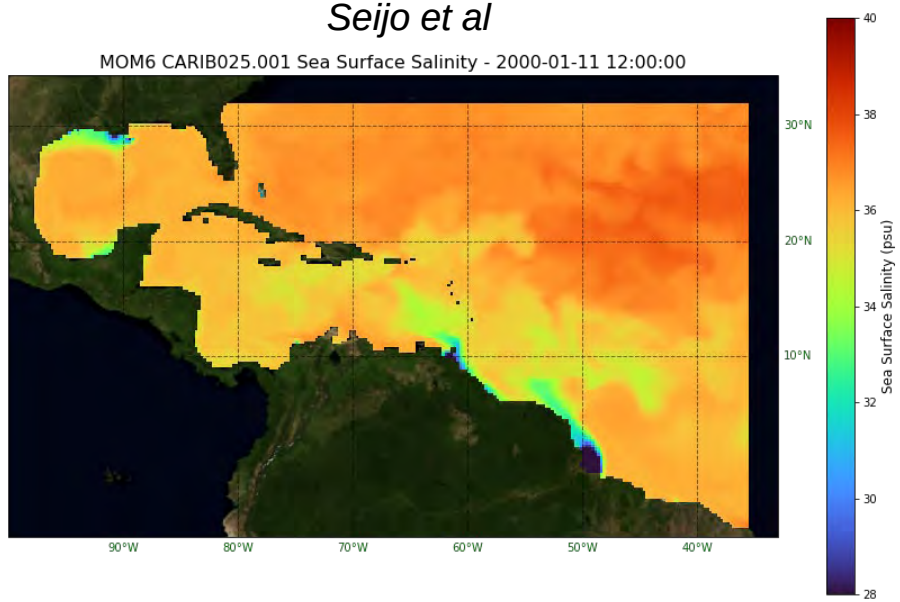
Regional Ocean Modeling Using CESM -MOM6

Eastern Tropical Pacific
CESM-MOM6 (1 km) Driven by MPAS-A (3 km)
Bachman et al



Working towards support for easily configurable/re-locatable regional ocean model in CESM framework ***using CESM-MOM6 codebase and CESM/CIME infrastructure.***

Caribbean Sea/Gulf of Mexico
MOM6 (25 km) Driven by CESM-LE (100 km)
Seijo et al



Wind Waves in CESM

Wave Watch 3

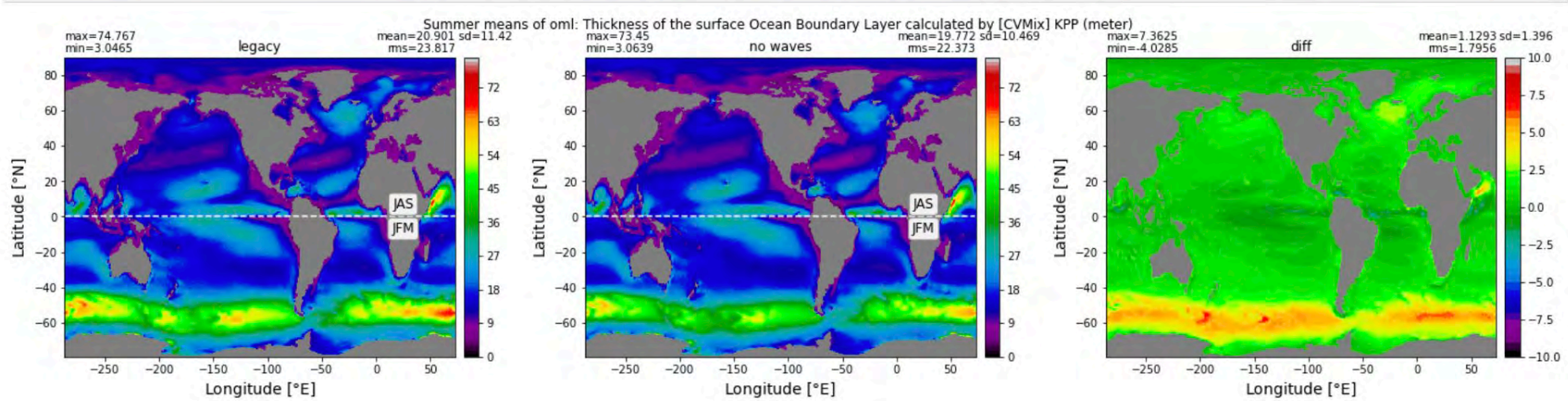
- Close Collaboration with NOAA/EMC
- CESM directly forking from main EMC WW3 repo
  - Facilitate closer coordination with EMC and broader WW3 community
- Unified NUOPC cap being adopted by EMC and CESM
- CESM specific code isolated in CESM interface repo (similar to MOM6)

MOM6

- Close Collaboration with NOAA/GFDL (B. Riechel)
- Vertical profile of Stokes drift

$$\overrightarrow{U_s}(z) = \sum_{i=1}^{N\approx 6} \overrightarrow{U_i} e^{\eta_i z}$$

- Wave-averaged Boussinesq Lagrangian equations of motion ($\vec{U} + \overrightarrow{U_s}$)
- Robust integration of non-local momentum flux (non-aligned shear and stress)
- Ongoing research on wave-driven mixing



Some Resources

- MOM6 is an *optional component* beginning with CESM2.2

  https://github.com/ESCOMP/MOM_interface/wiki/Detailed-Instructions

- Expanding MOM6 documentation with community contributions

  https://mom6.readthedocs.io/en/main/

- CESM Forums

  https://bb.cgd.ucar.edu/cesm/forums/

- 8 part webinar tutorial series on MOM6 design and use

  https://www.cesm.ucar.edu/events/2020/MOM6/

- Ocean Model Working Group Meeting

  Tuesday 6/14 : 0830 - 1200

OMWG Session Tuesday 0830 to 1200

- Ocean Science Talks
- Updates on:
  - Coupled integrations with CESM-MOM6
  - Regional modeling with CESM-MOM6
- Focused Discussions on:
  - Directions and priorities for mesoscale and sub-mesoscale parameterization
  - Directions and priorities for diapycnal mixing parameterization