Progress and Plans - CESM/MOM6

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In collaboration with: Cecile Hannay, Julio Bacmeister, Keith Lindsay, Frank Bryan, Gokhan Danabasoglu, Alper Altuntas, David Bailey, Adam Herrington, Rich Neale, Kieth Oleson, Will Wieder, Jim Edwards + many others

CESM OCEAN MODEL WINTER WORKING GROUP MEETING

February 9th, 2023

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Towards CESM3: preliminary evaluation of new components

Goal of Task Force 5

- Coupled simulations with CAM-dev/SE/L58 + MOM6 + CICE6 at ne30_T061
- Preliminary evaluation of coupled runs by the end of Summer 2022

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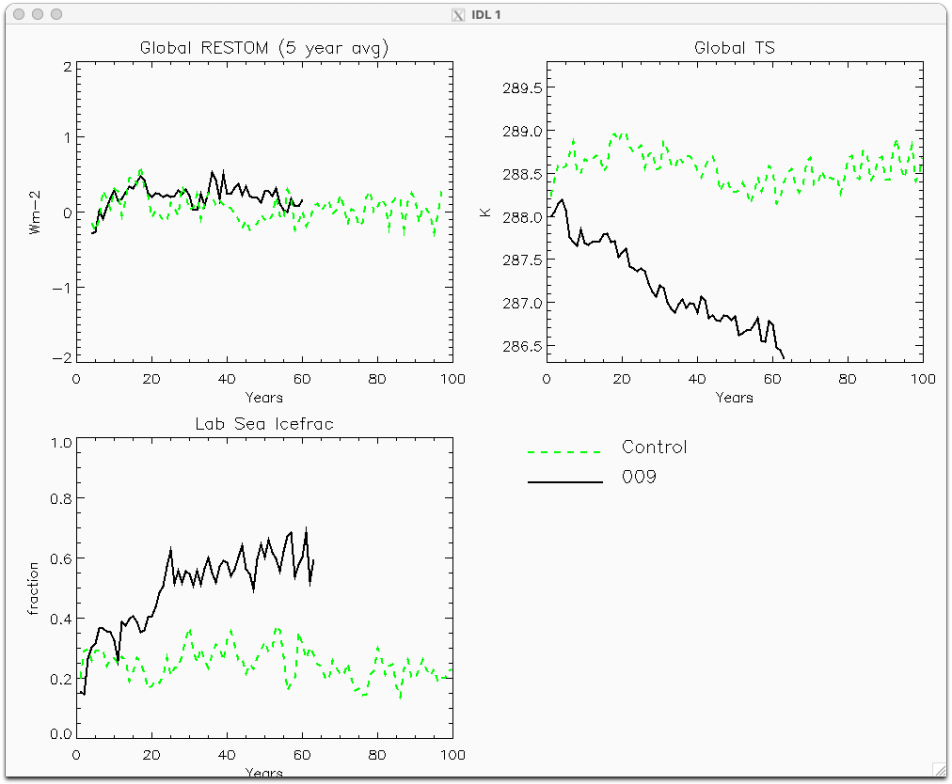

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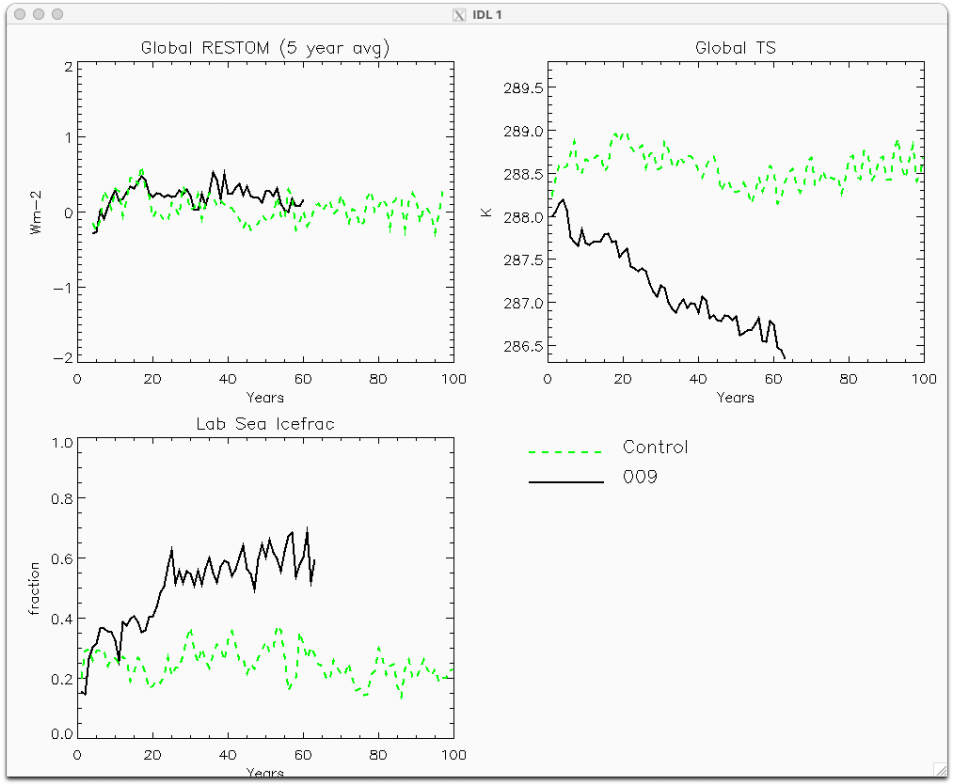

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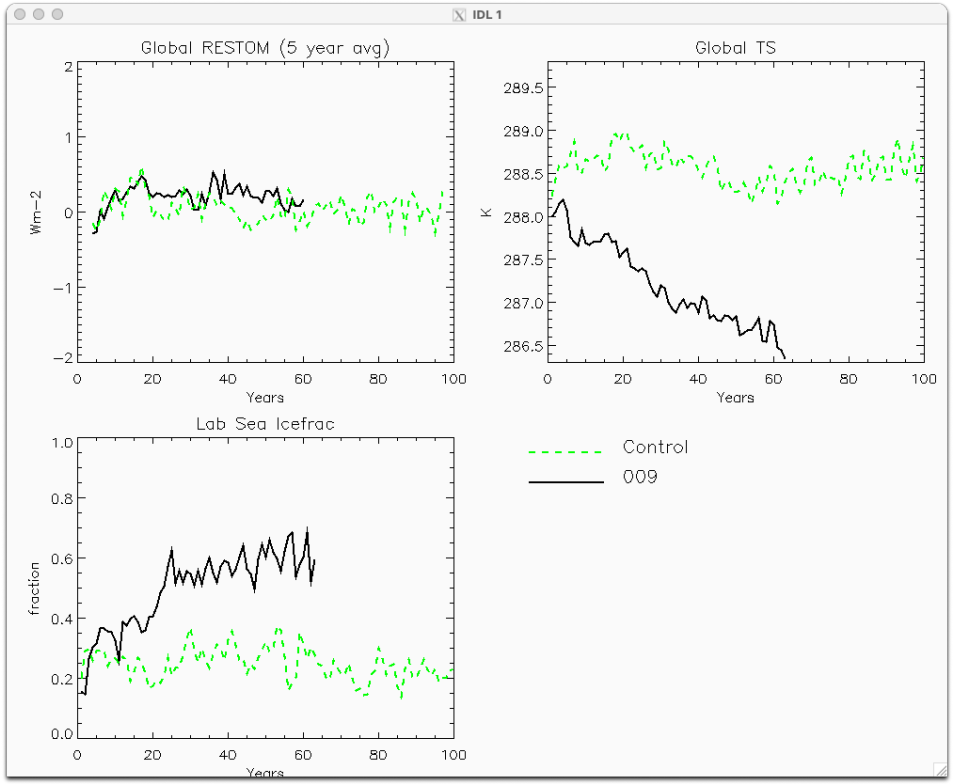

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- **New strategy**: start from control and work towards current configuration by making one modification per simulation, starting with what should matter the least

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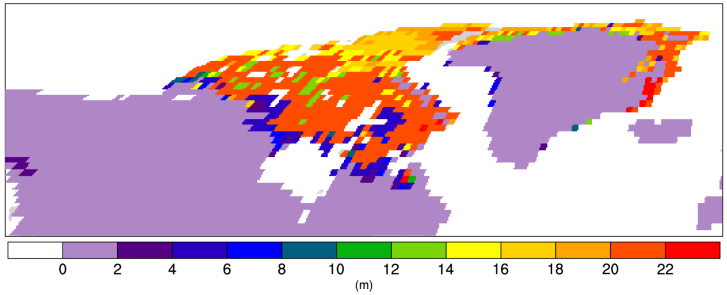
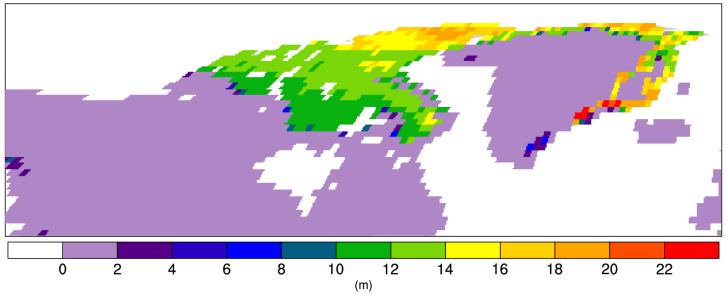


Year 58 of 016



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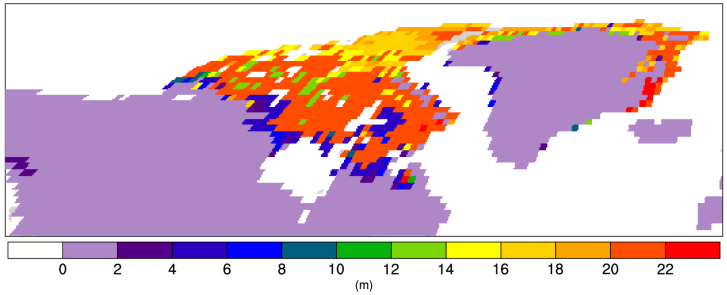

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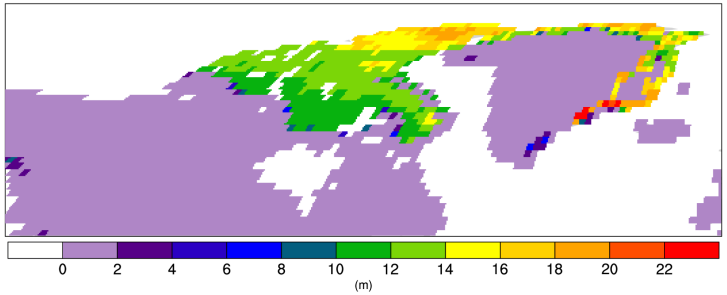

New approach is to use a “spun-up” initial file to reduce the initial surge in liquid runoff

Summary of the most recent simulations

	ATM	ICE	Purpose	Nyrs
Control	cam6/L32/FV	CICE5	control: MOM6+CAM6+CICE5	100
016	cam6/L32/FV	CICE5	Repeat control with recent sandbox	58
26c	cam_dev/L58/SE	CICE5	Same as 26a with spunup ice/land	199
26e	cam_dev/L58/SE	CICE6	Same as 26c + cice6	121
26f	cam_dev/L58/SE	CICE5	Same as 26c + **pertlim** = 1e-14	70
26g	cam_dev/L58/SE	CICE5	Same as 26c + **pertlim** = 2e-14	205
26h	cam_dev/L58/SE	CICE6	Same as 26c + cice6 + advanced snow physics	244
009	cam_dev/L58/SE	CICE6	Target simulation MOM6+CAM-dev+CICE6	63

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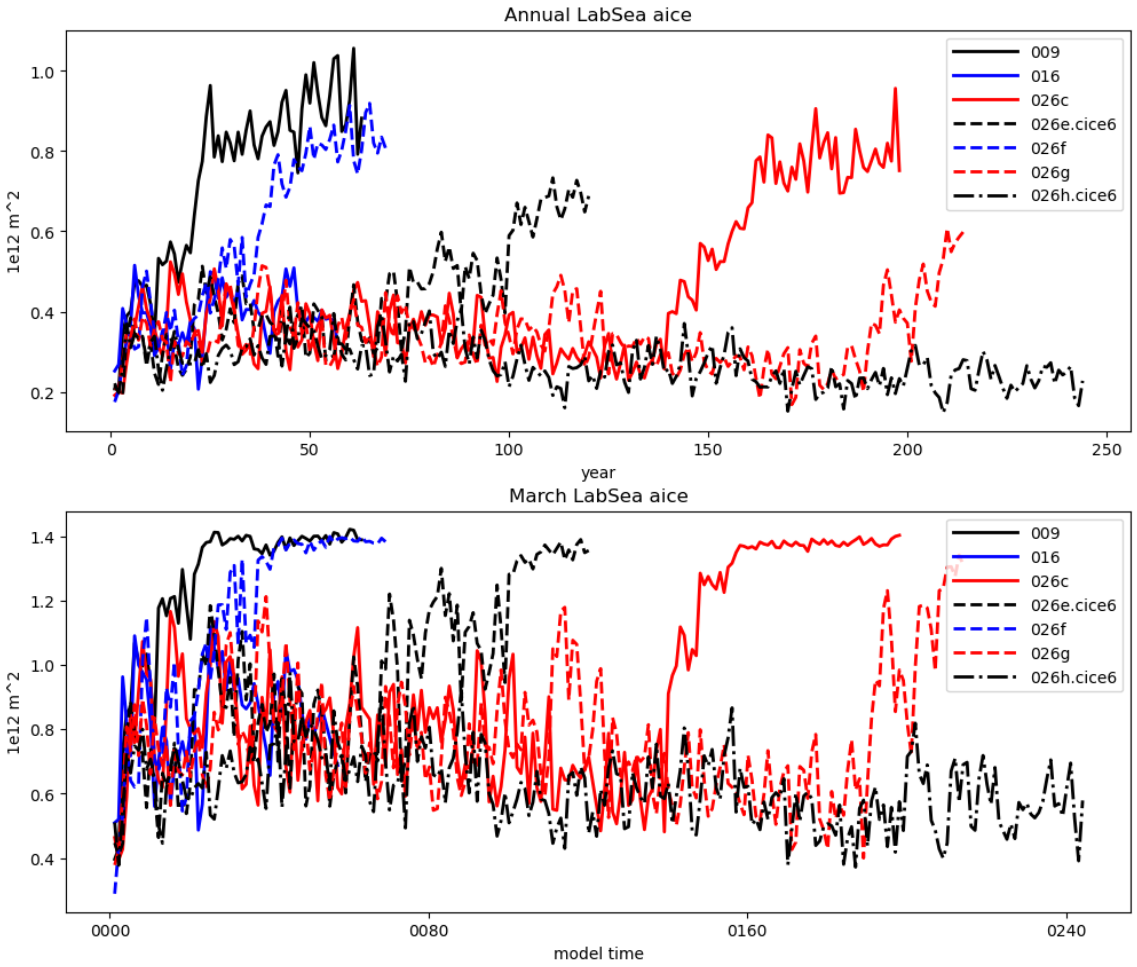
Annual & March Lab Sea Ice Area

- 26c, and “pertlims” of it, have all frozen. Date of freeze onset varies widely
- 26e, using cice6, also froze
- 26h, using cice6, not frozen through 245 years



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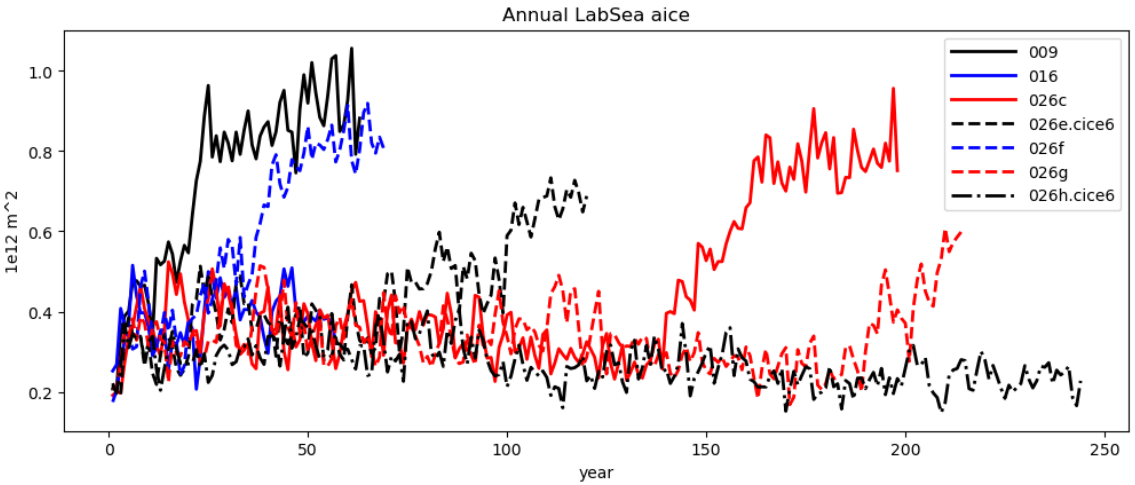
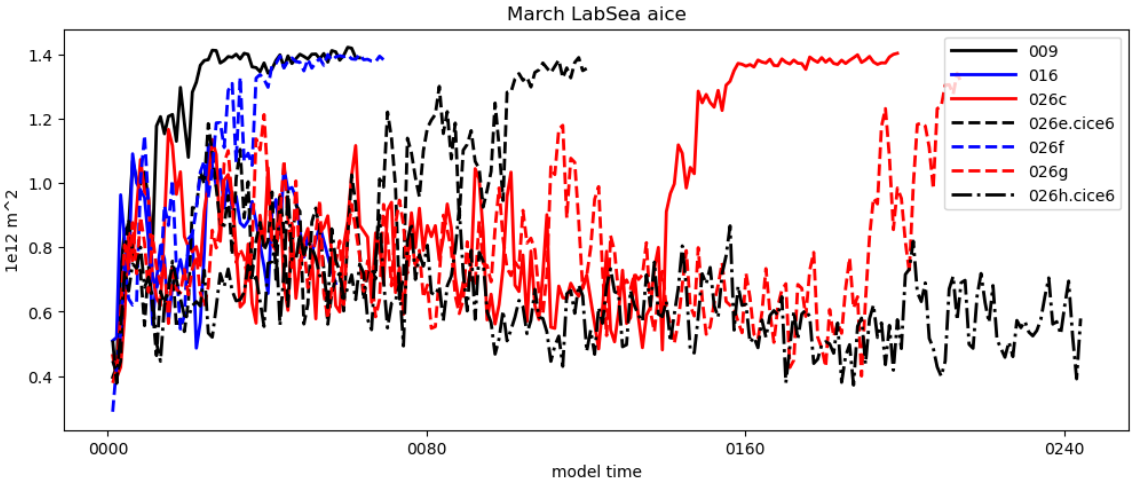


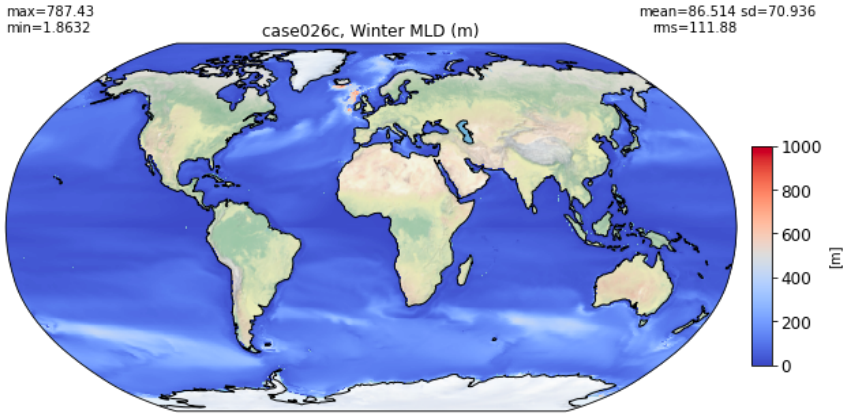


The winner is:

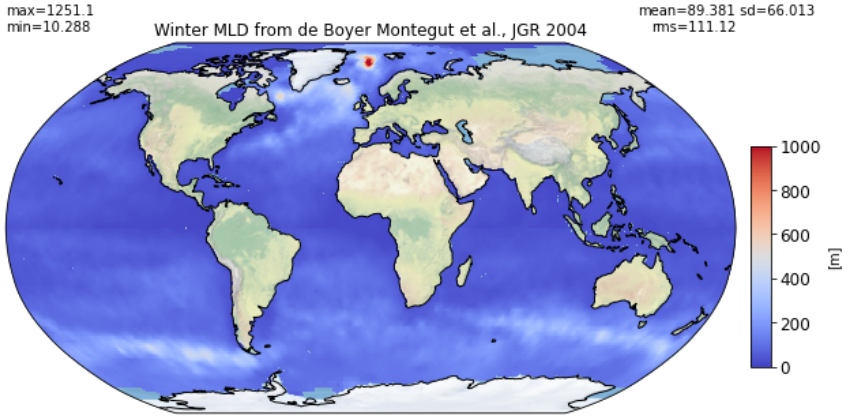
climate model trophy for best fully-coupled simulation

Winter mixed layer depth [m], 0.03 kg/m³ density criteria

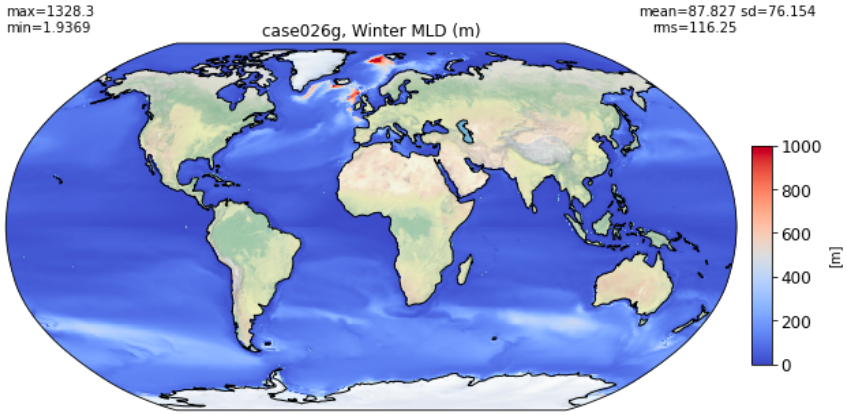
026c: 26a + spunup ice/land (178-198)



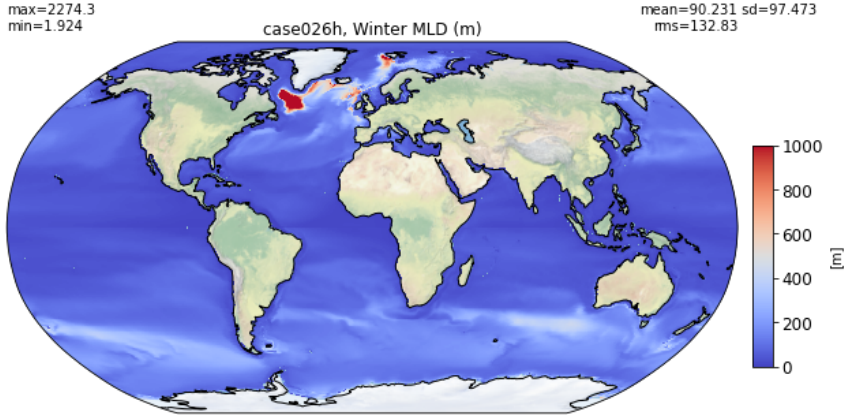
Observation-based



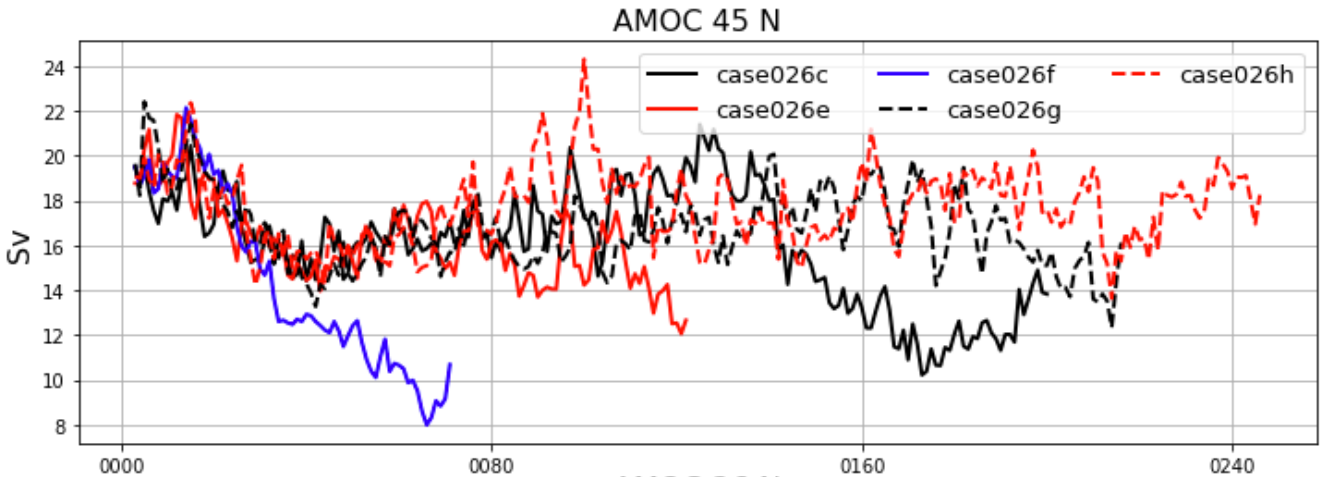
026g: same as 26c + pertlim (185-205)



026h: (224-244)



Maximum AMOC time series



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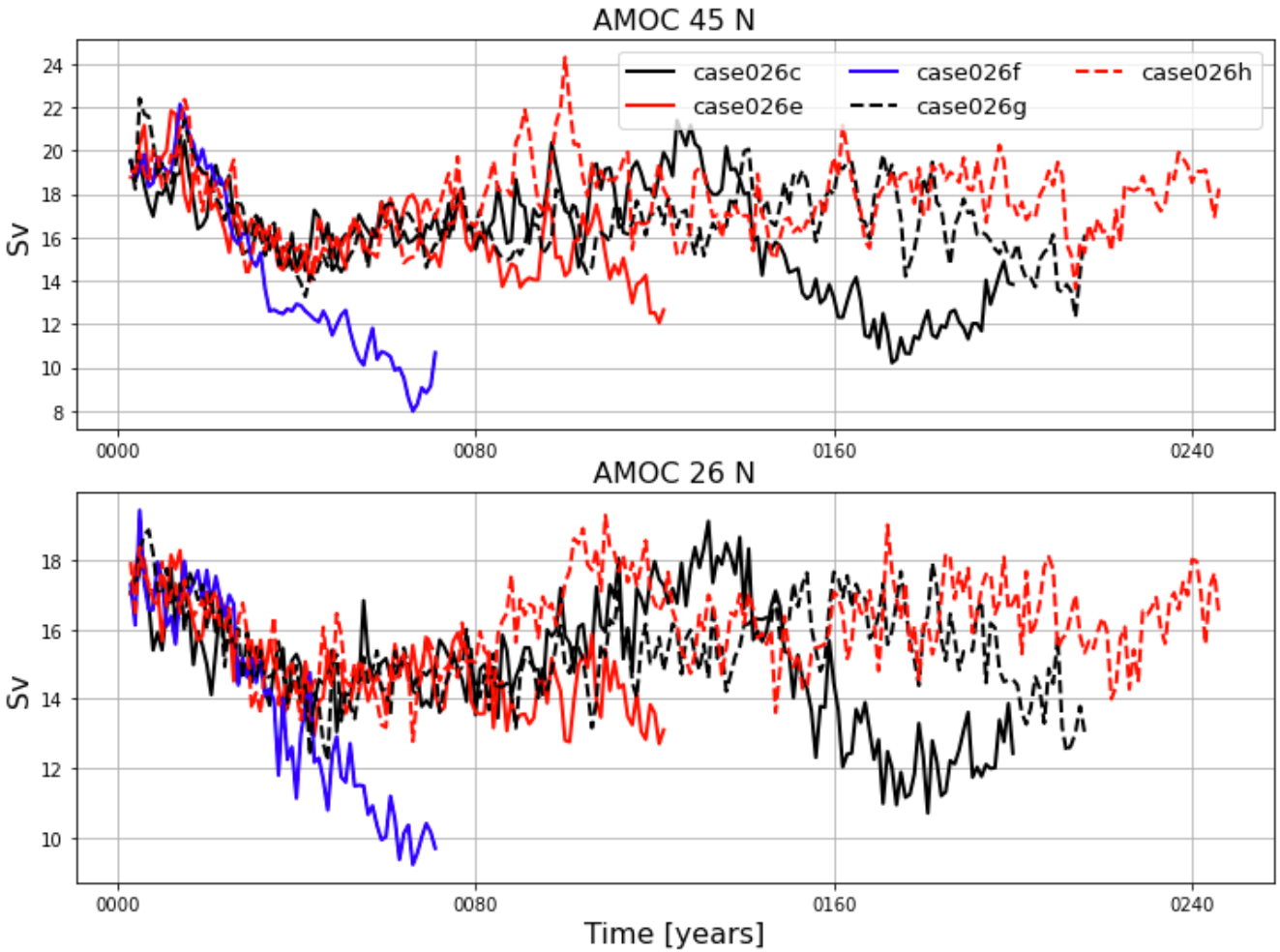
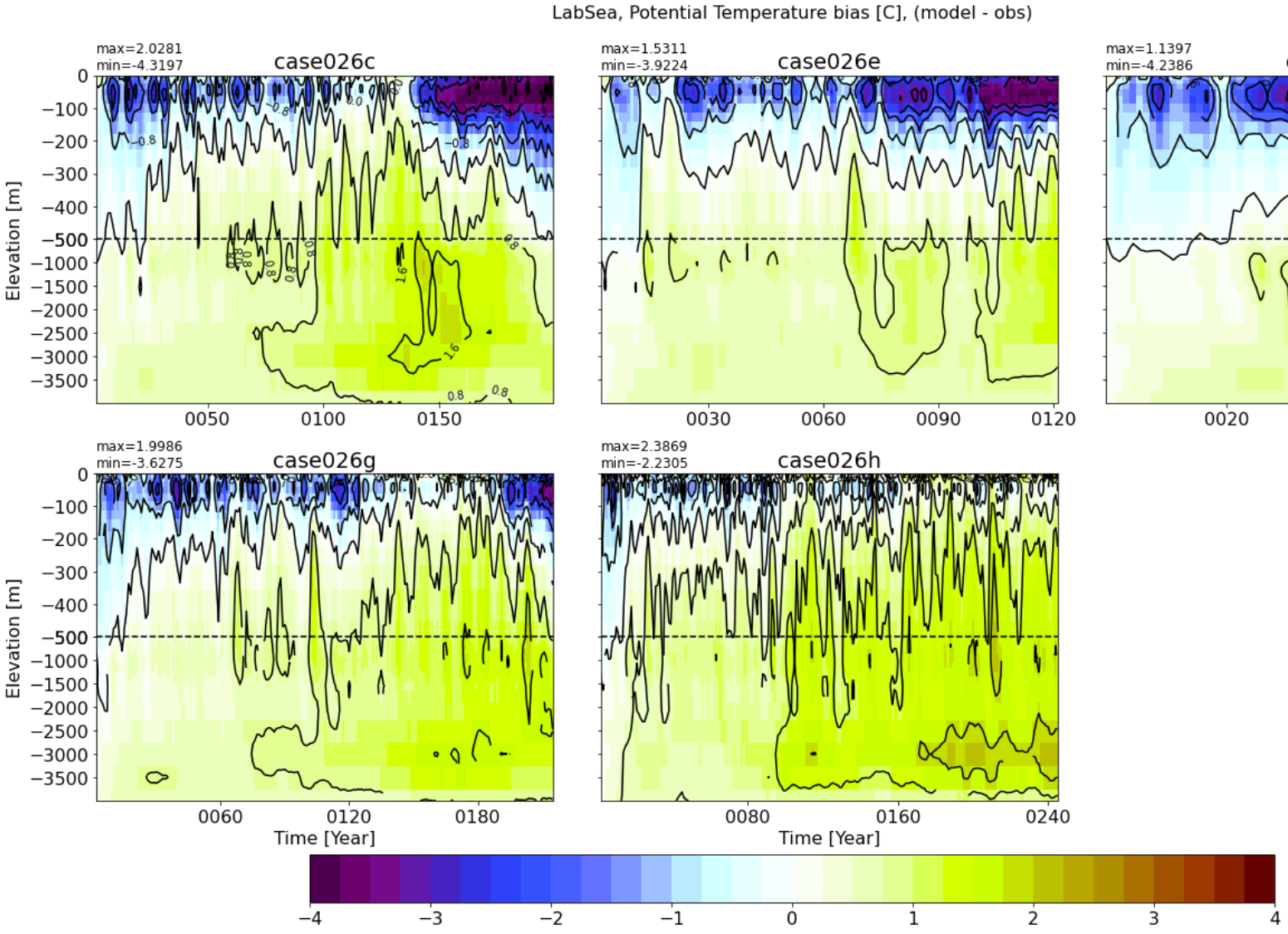
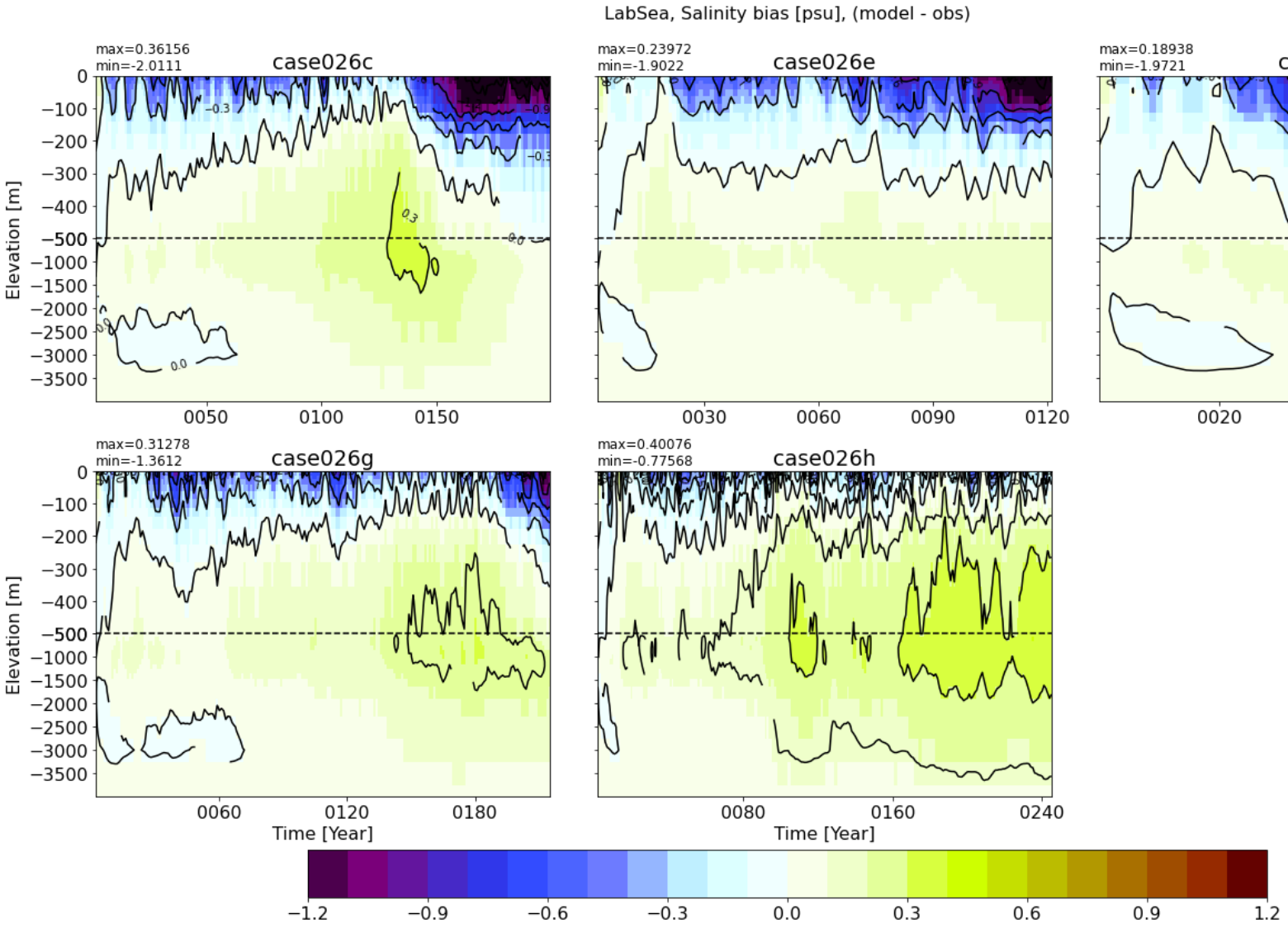


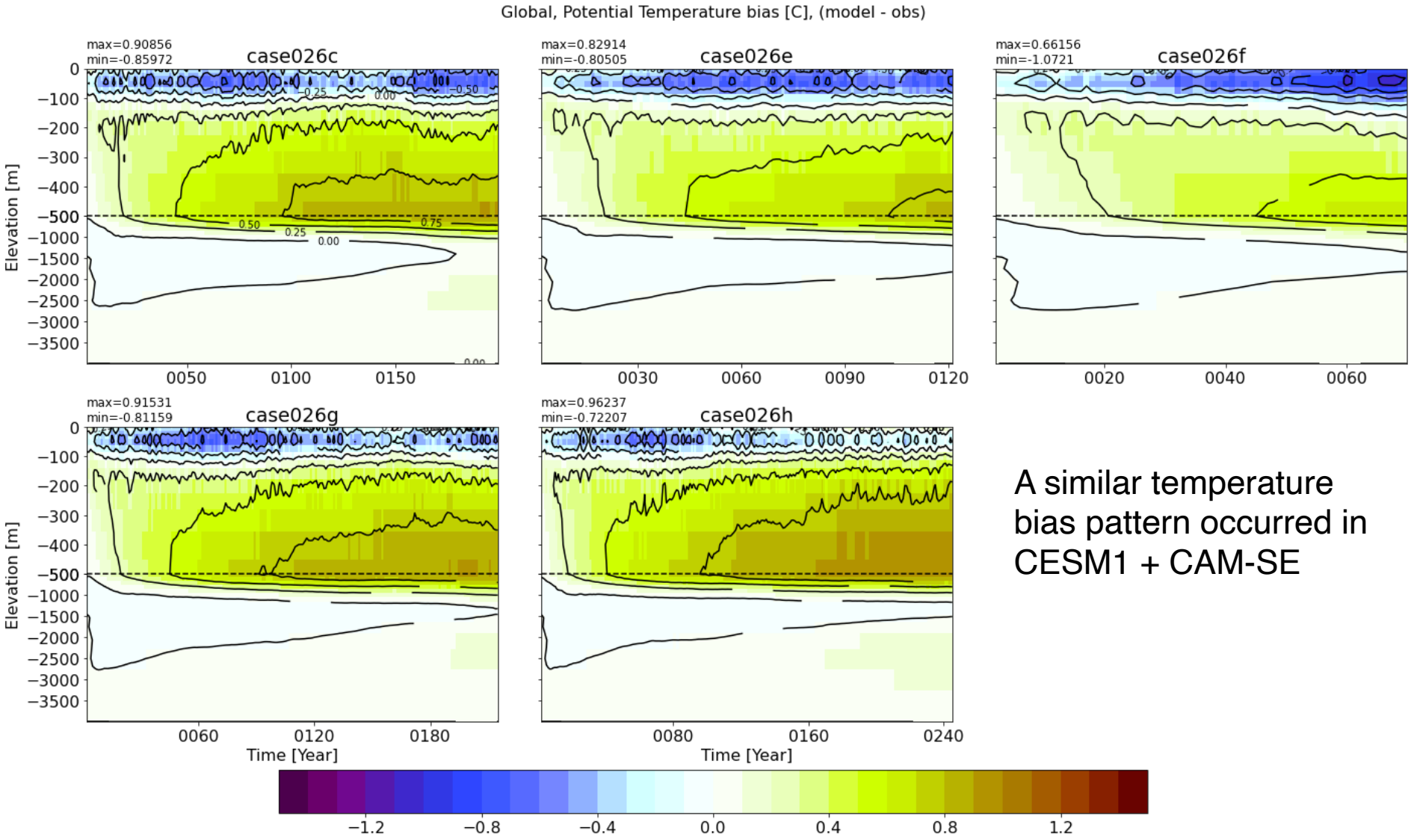
Temperature drift (Lab Sea)



Salinity drift (Lab Sea)



Temperature drift (Global)



A similar temperature bias pattern occurred in CESM1 + CAM-SE

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- Re-tune mixing coefficients and implement option to apply depth-dependent isopycnal diffusion (Redi)

New and revised configurations

Revised workhorse configuration;
2/3^{o} resolution (tx2_3):

Many thanks to Frank Bryan and Fred Castruccio!

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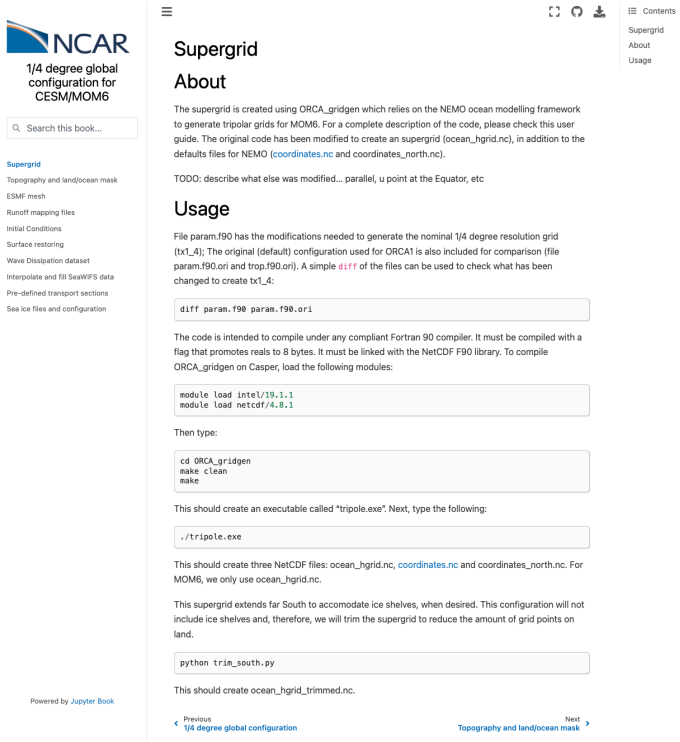
Configurations will be fully documented on GitHub



ncar.github.io/tx1_4/

MOM6-DART development

In progress: Global 2/3° MOM6-DART (Alper Altunas, Helen Kershaw, Dan Amrhein, Jeff Anderson)

We anticipate functional capabilities with the DART suite of algorithms for ensemble adaptive inflation, etc. by the **end of 2023**.

Focusing on **2/3°**: Moving towards a "DA workhorse" release of CESM3 + DART enabled for ocean, atmosphere, sea ice, and land

NSF CSSI proposal: Regional high-res MOM6-DART + MARBL with rapid prototyping of model grids, forcing files, and observations for DA with a Python front end and multiple post-processing options

Community input on priorities for CESM DA capabilities is highly welcome!
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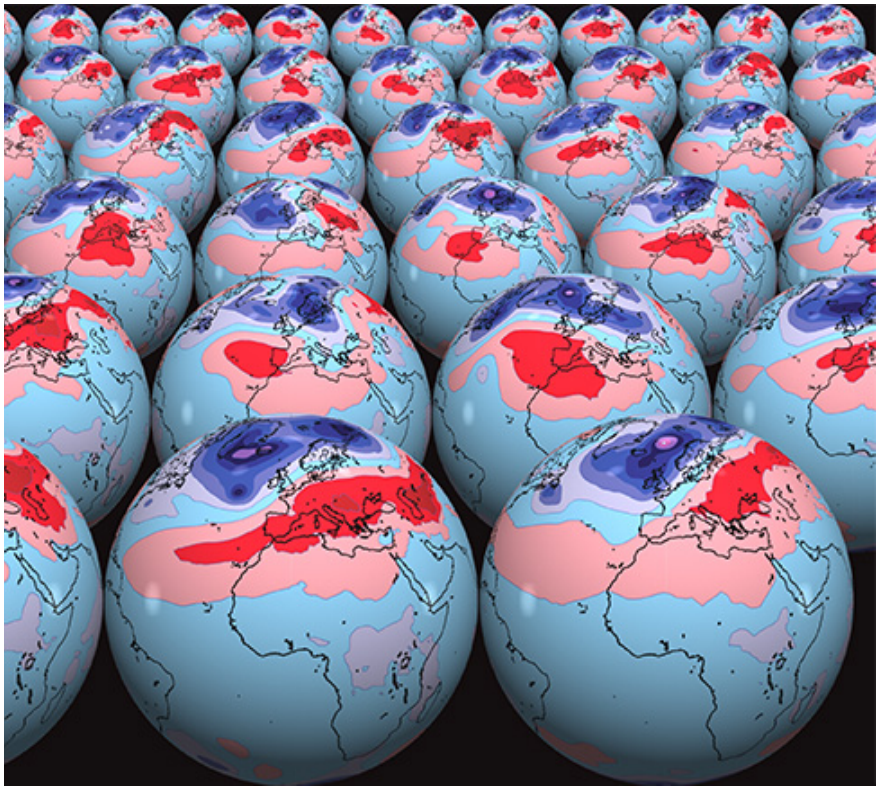

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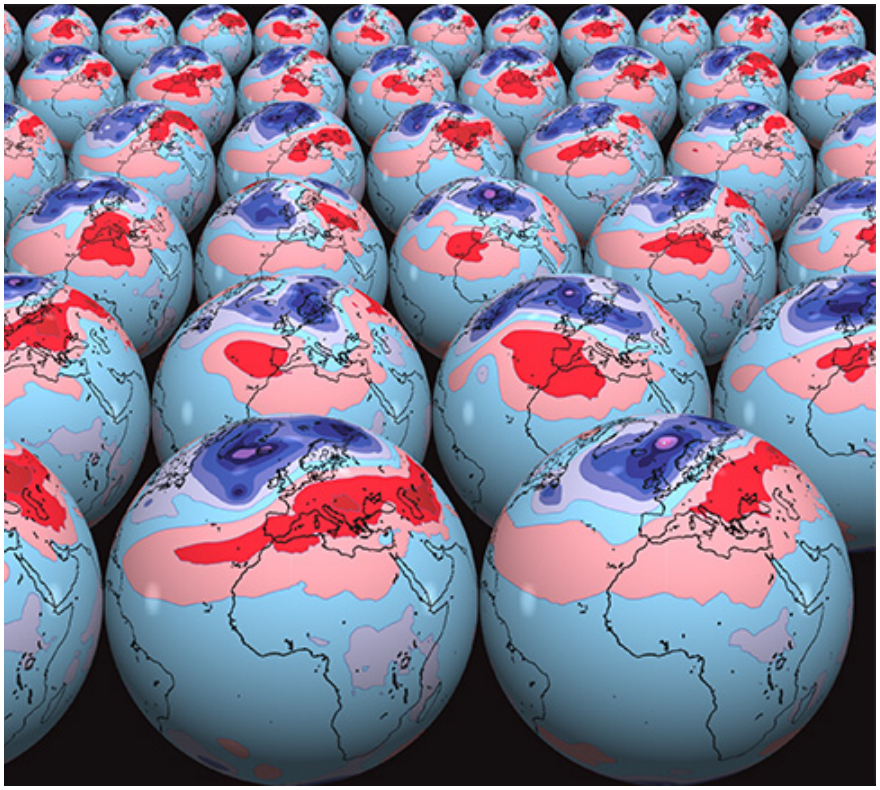
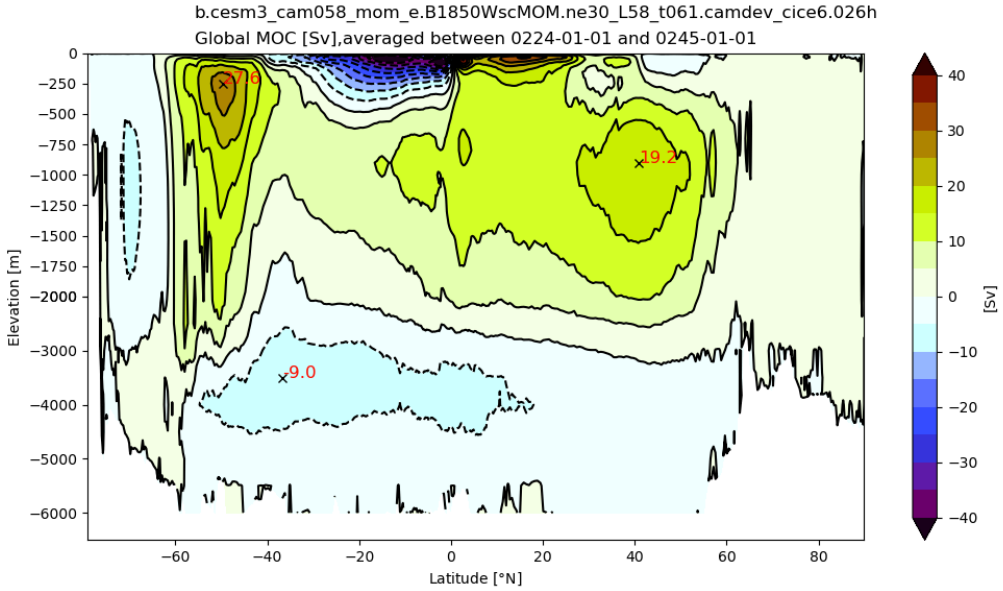
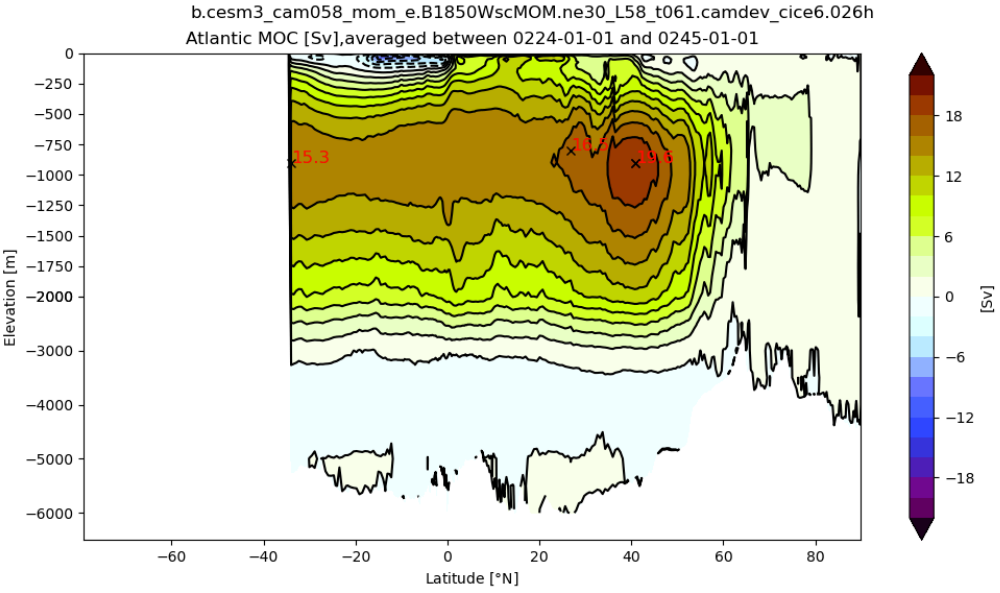
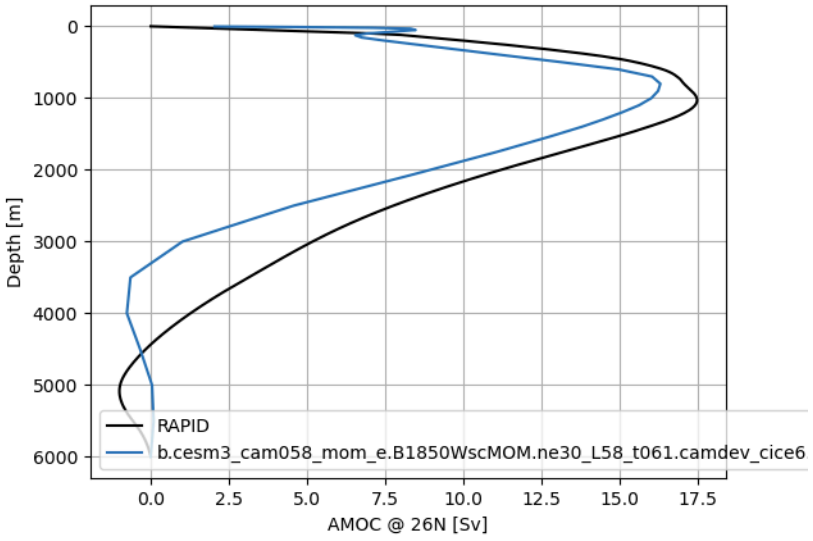


Thank you!

Meridional overturning circulation (MOC) in 26h

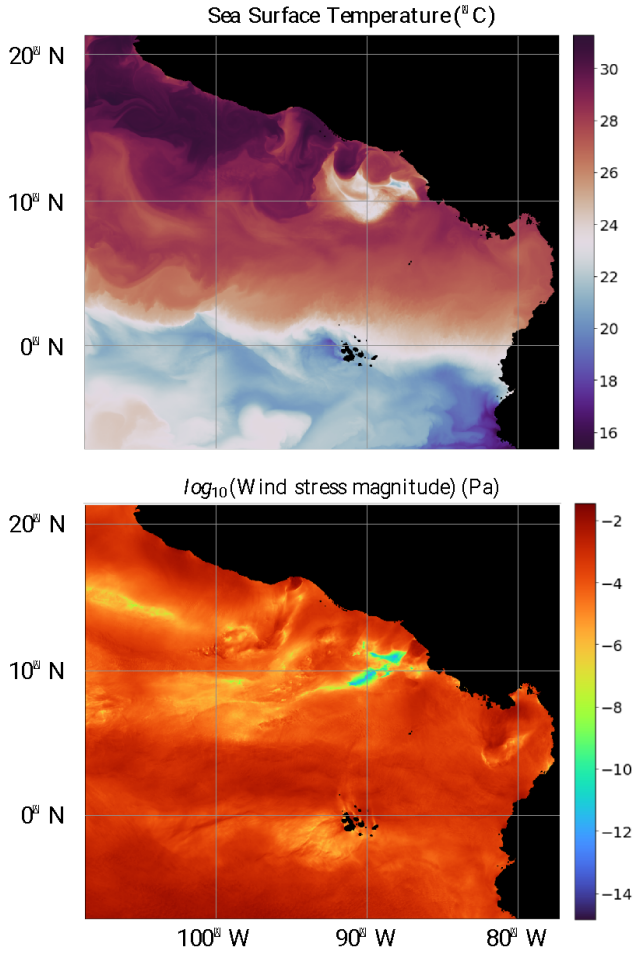




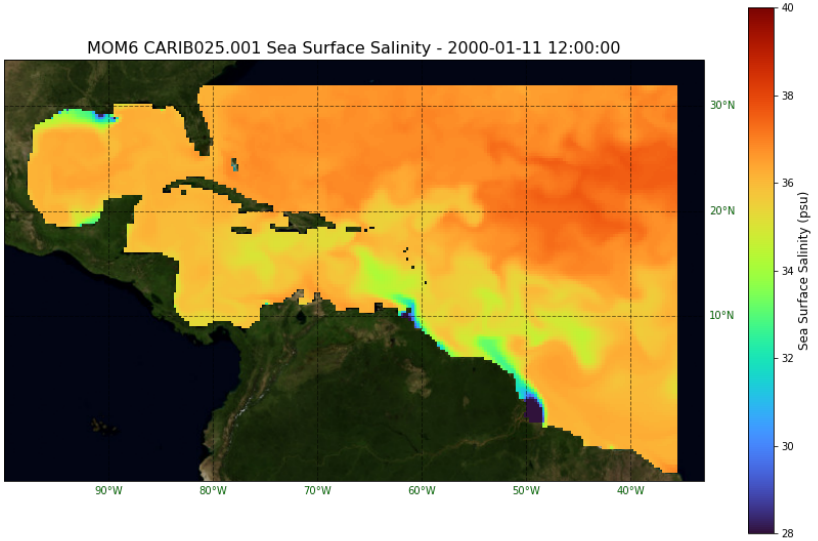


Regional Ocean Modeling Using CESM-MOM6

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



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



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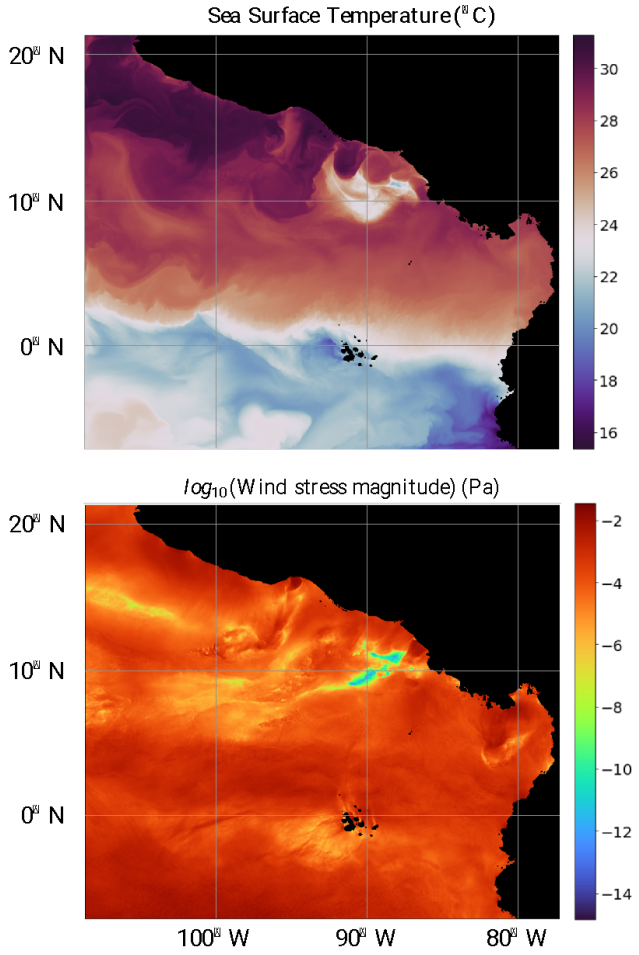

Working towards **support** for easily configurable/re-locatable **regional ocean model in CESM** framework using CESM-MOM6 codebase and CESM/CIME infrastructure.

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