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Introductory remarks for
joint AMWG/WAWG/CAWG/ESPWG/CVCWG winter meeting

AMWG = Atmosphere Model Working Group
WAWG = Whole Atmosphere Working Group
CAWG = Chemistry-Aerosol Working Group
ESPWG = Earth System Prediction Working Group
CVCWG = Climate Variability and Change Working Group

February 2, 2026

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Same procedure as last year: Joint 5 working group winter meeting

- Increase collaboration across working groups:

  model developers <-> model users

- Joint discussion on model performance

- Get community input to inform model development and experiment design in CESM3 and beyond (configurations, bias reduction, …)

- Reduce meeting load

Structure of joint sessions (Mon):

Today

- Overview from “model development” heavy working groups
- Coupled model evaluation
- High resolution modeling activities

	Overview	
1:00	Overview of CAM7 + Ocean developments	Peter Lauritzen/Ian Grooms/Gustavo Marques
1:20	Overview of chemistry/aerosols developments	Simone Tilmes
1:40	Overview of whole atmosphere modeling developments	Nick Pedatella
	CESM3 model evaluation	
2:00	The path towards CESM3 and status of coupled simulations	Cecile Hannay
2:20	Latest CESM3 development runs - how are they looking?	Isla Simpson
2:40	Tropical variability in CESM3	Rich Neale
3:00	BREAK	
	High to ultra-high resolution modeling	
3:30	Plans for and progress on the E3SMv4 Atmosphere Model	Christopher Terai
3:50	Tropical Cyclones in CAM7: Assessing the Impact of Prognostic Momentum Fluxes and Convective Parameterization at Global and Storm Scales	Ben Stephens
4:10	Analyses of stratospheric waves in high-resolution (1/8-degree) CAM	Julio Bacmeister
4:30	Incorporating CLUBB-MF in km-scale simulations with CESM	Adam Herrington
4:50	Discussion	
5:00	Adjourn	

Happy hour at Southern Sun.
Show of hands who is interested?

Structure of joint sessions (Tues):

- Specific talks from working groups we think are of interest to all working groups
- Overview talks from larger CESM projects
- New software developments
- Less "model development" centric working group updates

Wednesday: Individual working group meetings

Tuesday, February 3

** All times are MST; **Speakers**: please leave 5 min at the end of your slot for questions.*

	General cross working group session	
9:00	Deep Convective Transport in CAM-Chem is Sensitive to Nudging Analysis Choice	Ren Smith
9:20	Investigating the atmospheric response to radiation belt electron precipitation	Luisa Capannolo
9:40	Aerosol-Ice-Cloud Interactions in a Perturbed Parameter Ensemble	Brandon Duran
10:00	(Preliminary) Fast-track validation of ENSO performance using a comprehensive suite of GFDL models	Jiale Lou
10:20	Coupled development of systematic tropical ENSO-related seasonal forecast errors	Jonathan Beverley
10:40	BREAK	
11:10	QBO impacts on MJO through mesoscale convective systems in the observations and models	Kai Huang
11:30	Assessing the role of soil moisture and land-atmosphere coupling on CONUS temperature predictability	Meg Fowler
11:50	Implementation of the CMIP7 volcanic sulfur emissions in CESM and its impact in WACCM6 compared to CMIP6	Ilaria Quaglia
12:10	LUNCH	
	Overview talks	
1:10	Bridging the Gap Between Field Measurements and CESM: Updates from the INFORM Project	Ryan Patnaude
1:30	Practical lessons learned from CAM calibration using PPE (Perturbed Parameter Ensemble)-based methods	Qingyuan Yang
1:50	Towards a machine learning enhanced version of the Community Earth System Model (CESM3-MLe)	David Lawrence
2:10	Extending CAMulator to Subseasonal Prediction	Kirsten Mayer
2:30	CESM Unified Postprocessing and Diagnostics (CUPiD) package	Mike Levy
2:50	BREAK	
3:20	CAM4 Aquaplanet in CAM-SIMA (System for Integrated Modeling of the Atmosphere) code base and what is in the pipeline	Haipeng Lin & Jesse Nusbaumer
3:50	ESPWG update	
4:10	CVCWG update	
4:30	Discussion session	
5:00	Adjourn	

SCI-SWIM

Sustainable Community Infrastructure *for* Stable Water Isotope Modeling

Enabling Earth System Research

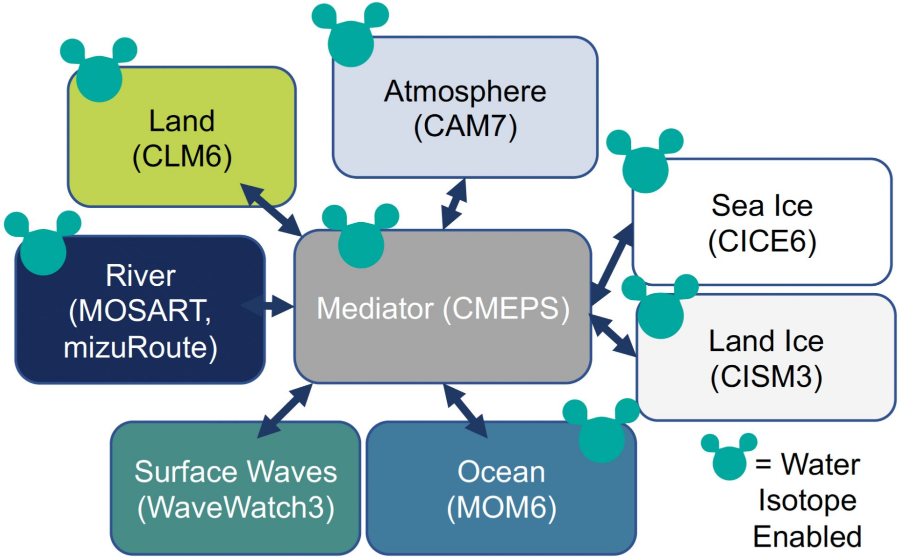
[NSF-CSSI Funded Project]

PI: *Sylvia Dee (Rice U.) & Jiang Zhu (NSF NCAR)*

Co-PI: *Peter Lauritzen & Will Wieder (NSF NCAR)*

Other Personnel: *Bill Sacks & Jesse Nusbaumer (NSF NCAR)*

- Develop the next-generation water-isotope-enabled CESM using modern software design.
- Sustain long-term community use and co-development through open-source tools, clear documentation, and training.
- Replace the legacy iCESM1, which relies on physics more than a decade old.

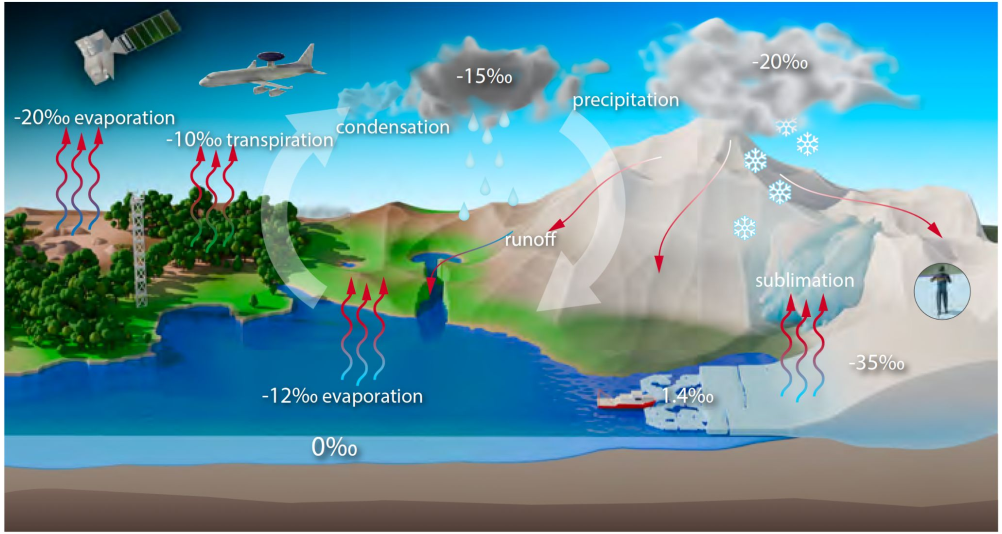


Please participate in this survey to help guide ***iCESM development***, ***validation***, and ***user support***.

iCESM User Survey

https://forms.gle/gBftvVGEQeMWG2NGA

(Link also available in upcoming CESM Newsletter)



Community Atmosphere Model version 7 (CAM7)

Peter Lauritzen on behalf of all CAM developers (Adam Herrington, Addisu Semie, Ben Stephens, Brian Eaton, Brian Medeiros, Cecile Hannay, Cheryl Craig, Christina McCluskey, Colin Zarzycki, Courtney Peverley, Dan Marsh, Douglas Kinnison, Francis Vitt, Haipeng Lin, Hanli Liu, Isla Simpson, Jack Chen, Jesse Nusbaumer, Jian Sun, Jiang Zhu, Jim Edwards, John Truesdale, Julio Bacmeister, Katherine Thayer-Calder, Keith Lindsay, Martina Bramberger, Meg Fowler, Mijeong Park, Patrick Callaghan, Qingyuan Yang, Rich Neale, Rolando Garcia, Simone Tilmes, Thomas Toniazzo, Trude Eidhammer, Vince Larson, Yuanpu Li…)

AMWG co-chairs: Hui Wan (PNNL), Kevin Reed (Stony Brook) and Peter Lauritzen (NCAR)

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Version (release date) Coupled Model version	CAM4 (April 2010) CCSM4	CAM5 (June 2011) CESM1	CAM6 (June 2017) CESM2	CAM7 CESM3
PBL Scheme	HB	UW	CLUBB	**CLUBB+ (progn. momentum fluxes)**
Shallow convection	Hack	UW	CLUBB	**CLUBB+ (progn. momentum fluxes)**
Deep convection Scheme	ZM_mod1	ZM_mod1	ZM_mod2	**ZM_mod3** / CLUBB-MF (ultra high res; ~3km)
Microphysics Scheme	RK	MG1	MG2	**PUMAS**
Macrophysics Scheme	Zhang	Park	CLUBB	**CLUBB+ (prognostic momentum fluxes)**
Radiation Model	CAMRT	RRTMG	RRTMG	**RRTMGP**
Drag/Gravity wave source	McFarlane orographic GW scheme	NOGW/TMS oro	Beljaars/NOGW/AnisoOGW	**Beljaars/NOGW(+moving mountains source)/ AnisoOGW**
Chemistry Package	-	MOZART	MOZART T1MA (air quality chemistry)	**MOZART T4S (climate chemistry)**
Aerosols Model	BAM	MAM3/CI	MAM4/CI	**MAM (if using strat. chem. then MAM5)/CI**
Dynamical cores	**FV** / EUL / SLD	**FV** / EUL / SLD / SE	**FV** / EUL / SE / FV3	**SE-CSLAM** / MPAS / (SE-NH) / FV/FV3
Model top / #levels	~42km /26	~42km / 30	~42km / 32	~80km/93 (Mid Top: **MT**) & ~42km/58 (Low Top: **LT**)
Land/Ocean Model	CLM4/POP2	CLM4/POP2	CLM5/POP2	**CLM6/MOM6**

HB - Holtslag-Boville **TMS** – Turbulent Mtn Stress
NOGW – non-orographic gravity wave (**GW**);
Sources: frontal and convective
{Iso/Aniso}OGW – isotropic/anisotropic orog. GW
CI - cloud droplet activation and ice nucleation
FV/FV3 - finite-volume dycore lat-lon/cubed-sphere

MG – Morrison Gettelman **UW** – U.Washington
ZM - Zhang-McFarlane
CLUBB - Cloud Layers Unified By Binormals
CLUBB-MF - Unified deep-shallow convection
SE - spectral-element dynamical core on GLL grid
SE-CSLAM - SE with CSLAM and physics grid

RT - Radiative Transfer
RRTMGP – Rapid Radiative Transfer Model
MAM – Model Aerosol Model
RK – Rasch-Kristjánsson
EUL/SLD - spectral-transform dycore
MPAS - Model for Precition Across Scales

Since last winter working group meetings a year ago …

… we have been focusing on coupled model tuning!

- cam6_4_057 -> cam6_4_148 **Almost 100 new CAM tags!**
- Coupled simulations: 121 -> 302 **182 B-cases!**
  (which excludes simulations that were tracked outside of GitHub)
- ~86 F-case simulations
  (which excludes the many simulations that were tracked outside of GitHub)

Ocean and Sea Ice model tuning/changes have had significant impact on the atmosphere … hence these groups have been invited to give brief updates on model changes to provide context for the CESM3 tuning talks later in this session …

Since last working group meetings …

Major updates to the Ocean Model:

- Mixed Layer Eddy: Update the old FFH scheme (Fox-Kemper, Ferrari, and Hallberg 2008) scheme to the new Bodner (Bodner et al. 2023) scheme.
- Add new stochastic GM+E backscatter (Grooms et al. 2025).
- Add new Leith+E backscatter (Grooms, 2023).

Many minor updates, including

- New eqn of state accurate over a wider range of salinities
- New vertical grid (still hybrid coordinate)
- Many updates to vertical mixing parameters

Major updates to the Sea Ice Model:

- Prognostic Sea ice floe size distribution, including interactions with surface gravity waves

Bodner MLE scheme:

FFH and Bodner restratify the ocean mixed layer by an overturning streamfunction that flattens sloping isopycnals.

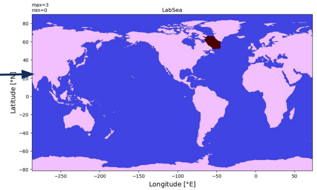
$$\mathbf{\Psi} = C_e \frac{\Delta s}{L_f} \frac{H^2 \nabla \bar{b}^z \times \mathbf{z}}{\sqrt{f^2 + \tau^{-2}}} \mu(z) \Rightarrow C_r \frac{\Delta s |f| h H^2 \nabla \bar{b}^z \times \mathbf{z}}{(m_* u_*^3 + n_* w_*^3)^{2/3}} \mu(z)$$

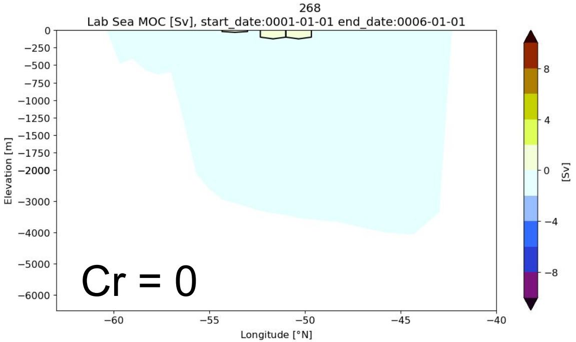
The new scheme has a prognostic latitudinal depend frontal length scale (L_f). It leads to improved mixed layer depths from the tropics to high latitudes.

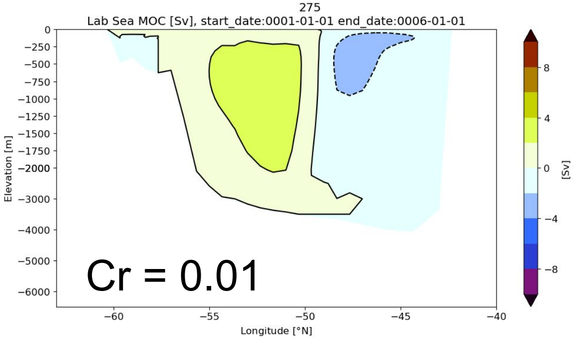
The strength of overturning increases rapidly with the boundary layer depth *h*, the mixed layer depth H, and lateral buoyancy gradients $\nabla \bar{b}^z$. Deep mixed layers and strong $\nabla \bar{b}^z$ in the Labrador Sea lead to excessive restratification, shutting off convection and leading to freeze.

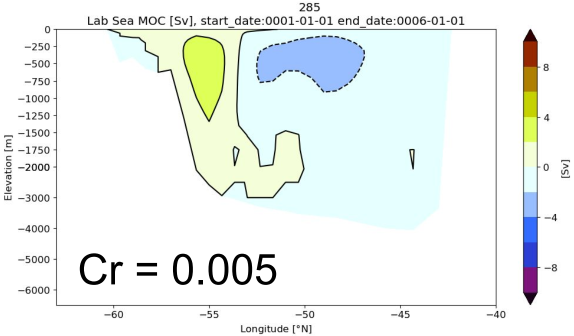
MLE overturning streamfunction in the Lab Sea:

Lab Sea Mask

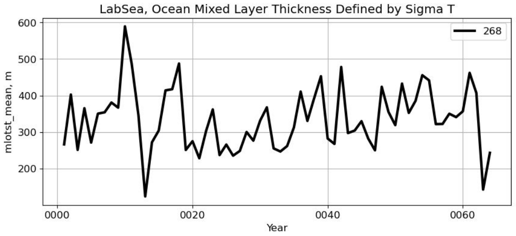


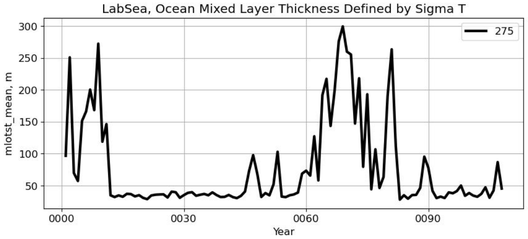


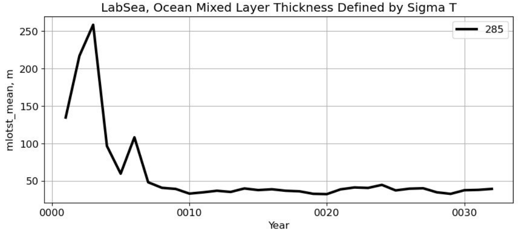




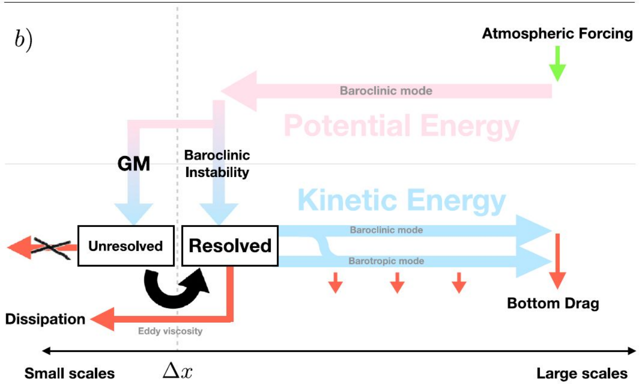
$$\mathbf{\Psi} = C_e \frac{\Delta s}{L_f} \frac{H^2 \nabla \bar{b}^z \times \mathbf{z}}{\sqrt{f^2 + \tau^{-2}}} \mu(z) \Rightarrow C_r \frac{\Delta s |f| h H^2 \nabla \bar{b}^z \times \mathbf{z}}{(m_* u_*^3 + n_* w_*^3)^{2/3}} \mu(z)$$



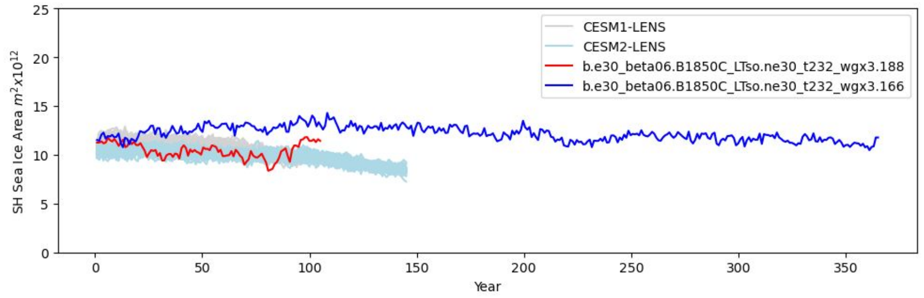




Stochastic GM+E backscatter:



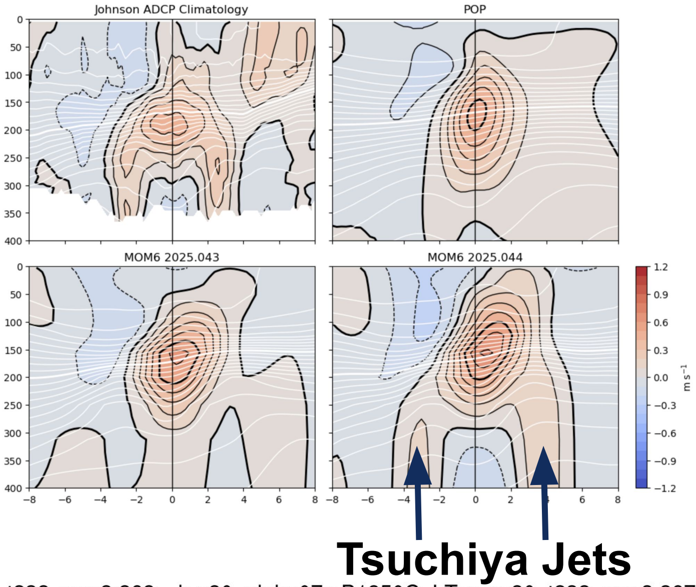
GM removes potential energy, which goes into A SGS 'MEKE' energy budget. Some of this should be recycled as KE. Stochastic GM+E uses stochastic backscatter to send some of the energy removed by GM back into KE. Since GM primarily acts in the Southern Ocean and western boundary current extensions (Gulf Stream, Kuroshio) this backscatter also acts there. It increases/improves SST variability in the extratropics and also reduces excessive southern hemisphere sea ice extent.

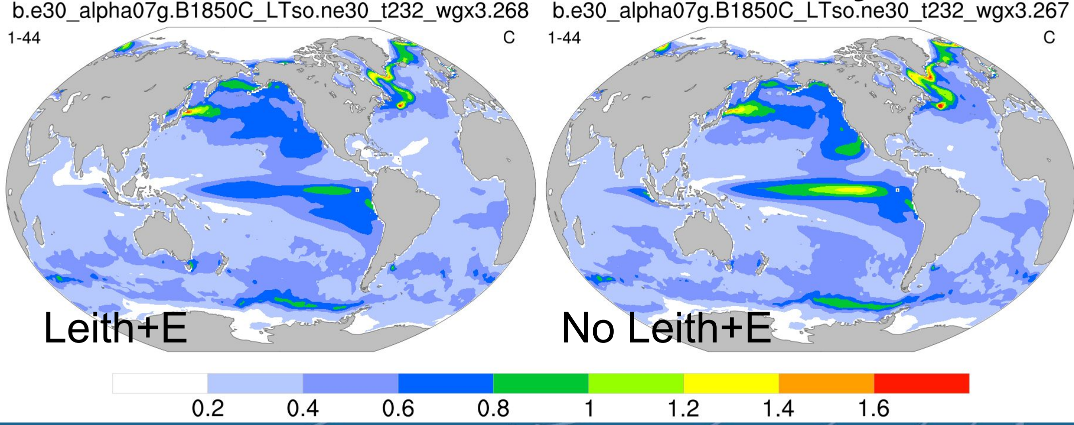


Leith+E backscatter:

The biharmonic lateral viscous closure removes too much KE. Leith+E recycles some of this using deterministic (negative-Laplacian-viscosity) backscatter. Backscatter turns on when a biharmonic coefficient rises above a minimum threshold. The coefficient scales as grid scale to the **sixth** power. In the ⅔ degree model, *this* backscatter turns on primarily in the tropics. (Leith+E and Stochastic GM+E act at different latitudes.)

Leith+E improves zonal flow at ~400m In the equatorial Pacific, leading to Improvements in BGC. It also improves (reduces) monthly SST variance in the Tropical Pacific.

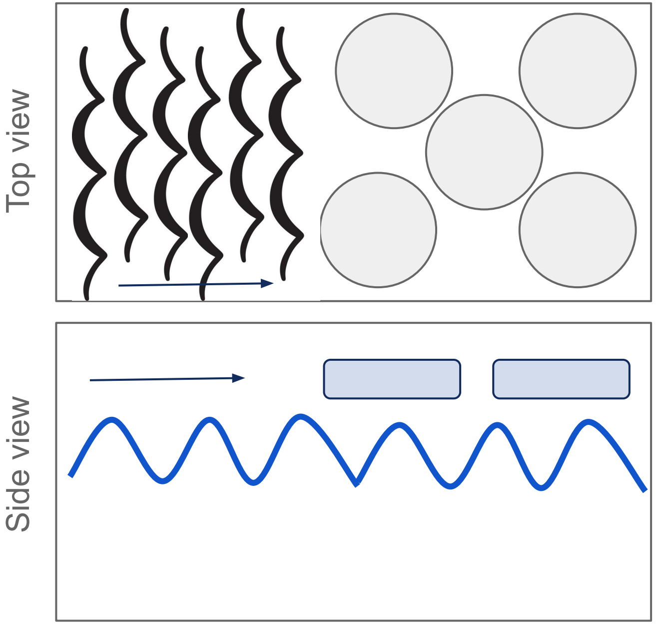




CESM3: Ocean wave - sea ice interactions with prognostic floe size distribution (FSD)

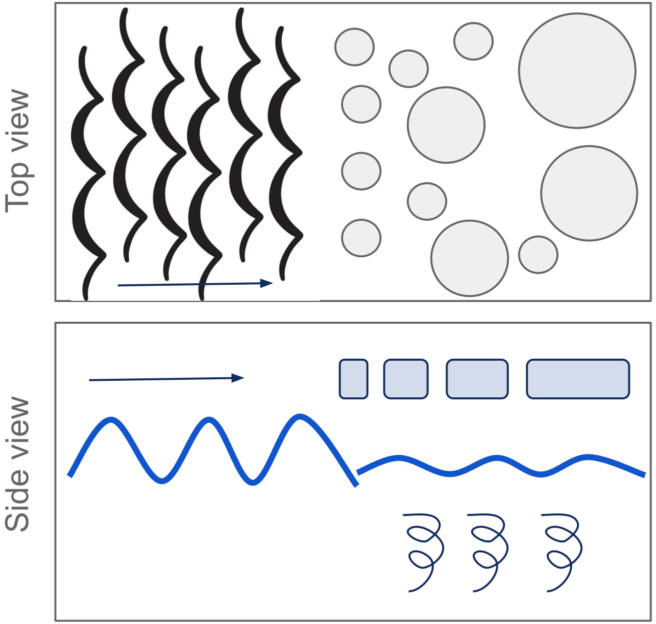
CESM2

Constant floe diameter: 300m
Ocean waves **not** damped by sea ice
Ocean mixing **not** impacted



CESM3

Prognostic joint floe size and ice thickness distribution
Ocean waves **are** damped by sea ice
Ocean mixing **is** impacted by waves



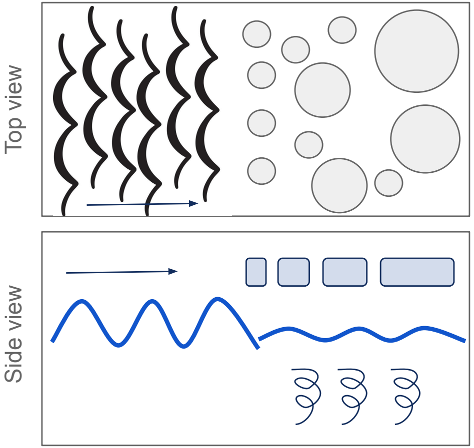
Coupled impacts

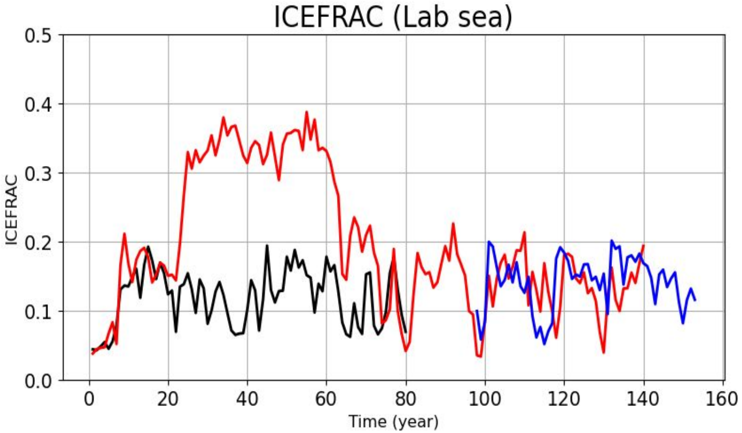
← Ice lateral melt calculated using floe size categories

← Wave attenuation depends on average floe size

← Ocean waves impact ocean mixing, feedbacks to ocean heat to ice.

FSD helps resolve the Labrador Sea freeze issue





With FSD, multiple simulations show the Labrador Sea de-freezes after ~40 years (red time series above)