CESM2 PCWG Update

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Sea Ice Component

- CESM2 will contain version 5.1.2 of the Los Alamos Sea Ice Model (CICE).
- New physics including the mushy-layer physics of Turner and Hunke 2015.
- Level ice melt pond scheme of Hunke et al. 2013.
- The vertical levels in the sea ice have been increased from 4 to 8 and in the snow from 1 to 3.
- We have also moved to a salinity dependent freezing point of Assur, 1958.

Land Component

CLM4 → CLM4.5

- Vertically-resolved soil carbon and nitrogen model --> permafrost carbon
- Cold region soil hydrology updates
- Methane emissions
- Revised snow cover fraction parameterization reflecting hysteresis between accumulation and melt phases
- Improved treatment of snow-covered versus snow-free energy budget
- Surface water store and prognostic wetlands

CLM4.5 → CLM5

- Snow density parameterization updated to include wind impacts and better temperature --> denser and more realistic snow densities
- Max snow depth 10m SWE, up to 10 snow layers --> firn model for ice sheets
- Increased vertical soil resolution --> resolve permafrost active layer thickness
- Snow on vegetation --> improved snow albedo feedback
- Revised plant functional type distributions (shrub fraction reduced)
- Vegetation processes completely revamped, especially plant-nitrogen interactions

Atmosphere Component

- A new parameterization has been introduced (CLUBB) to unify the moist turbulence in CAM6: boundary layer, large scale condensation (cloud fraction) and shallow convection are handled by CLUBB. CLUBB does not operate or close it's equations on ice, only liquid
- The 2-moment microphysics in CAM6 now includes rain and snow as prognostic species. That means snow and rain need not hit the ground in a single time step, and are advected.
- A new parameterization for ice nucleation in the mixed phase regime (-30>T>0˚C) has been introduced that links to aerosols (the old scheme was a function of temperature). This tends to reduce ice nucleation in this regime, and result in more supercooled liquid.

Ocean Component

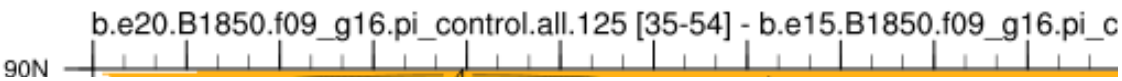
Estuary box model

- Premixes river water with surrounding ocean using local salinity, temperature, etc. No longer uses reference salinity.
- Resulting water spread vertically in a single grid cell.
- Does not impact frozen runoff.

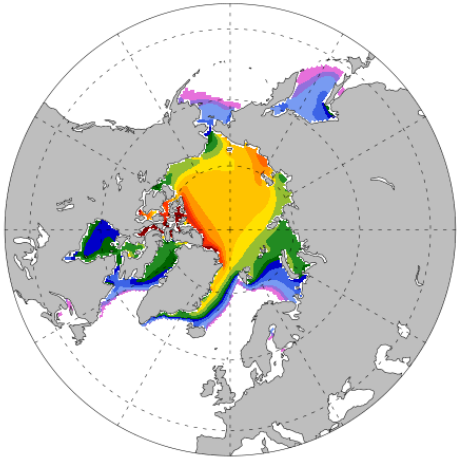
Land Ice Component

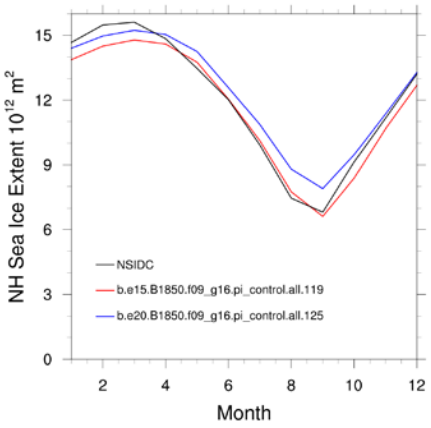
- Two-way coupling
- Parallel, higher-order
- TG compset for running standalone CISM
- 10 m snow pack in CLM
- All land/atmosphere resolutions supported
- Surface Mass Balance computed in all runs standard

CESM2 Development Runs



grid cell mean ice thickness m





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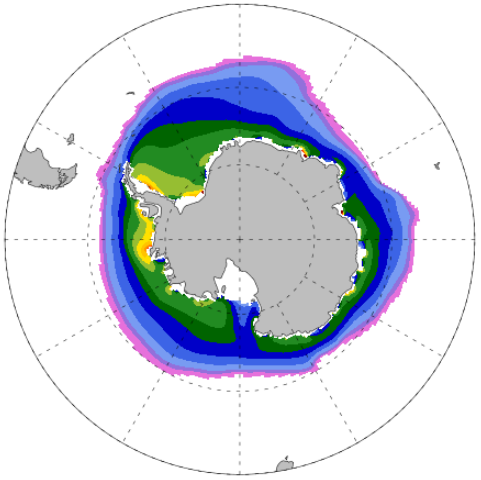

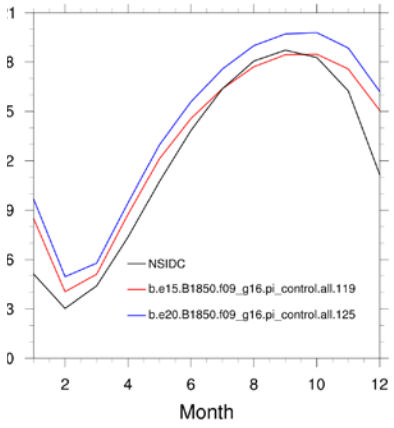

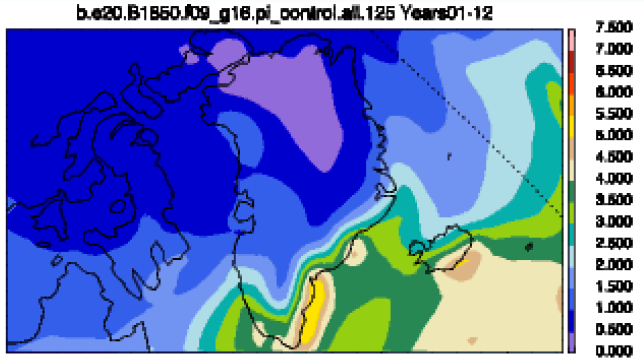

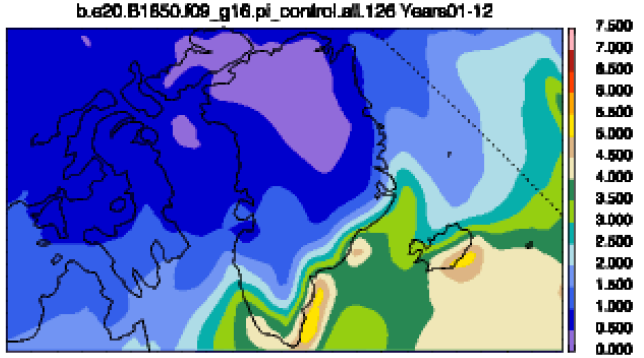

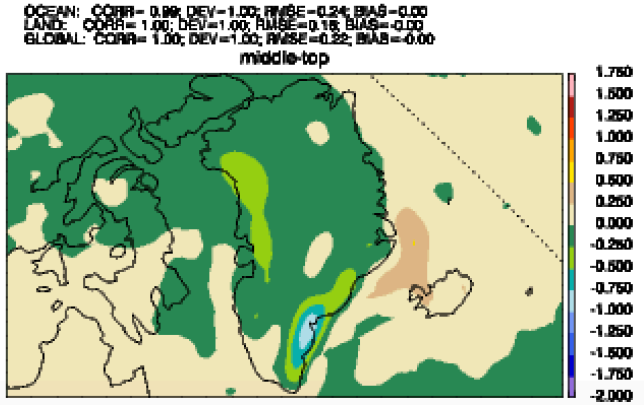

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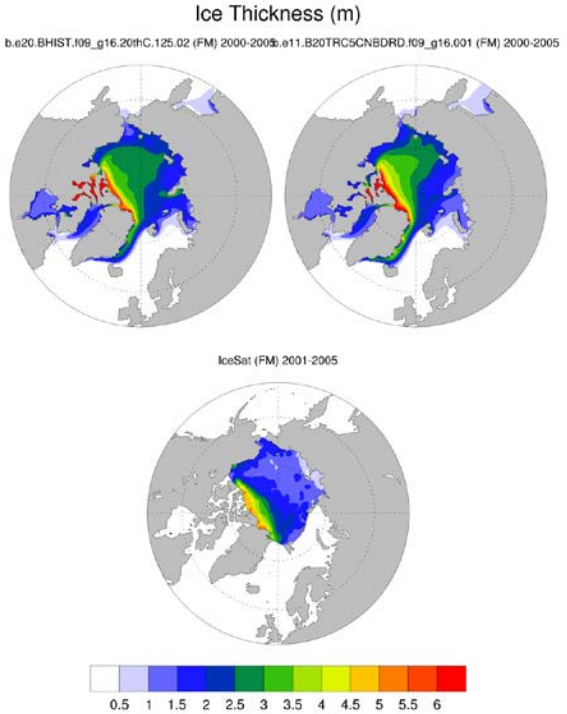

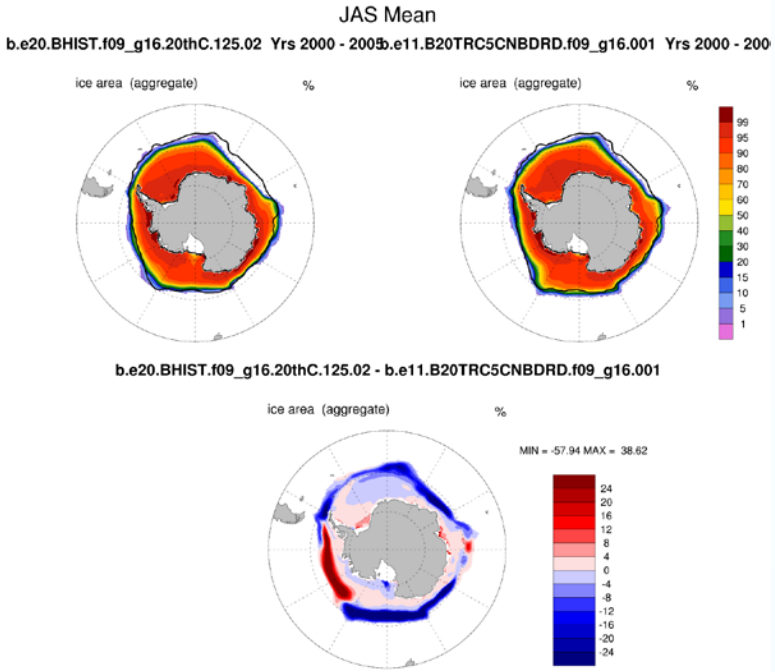

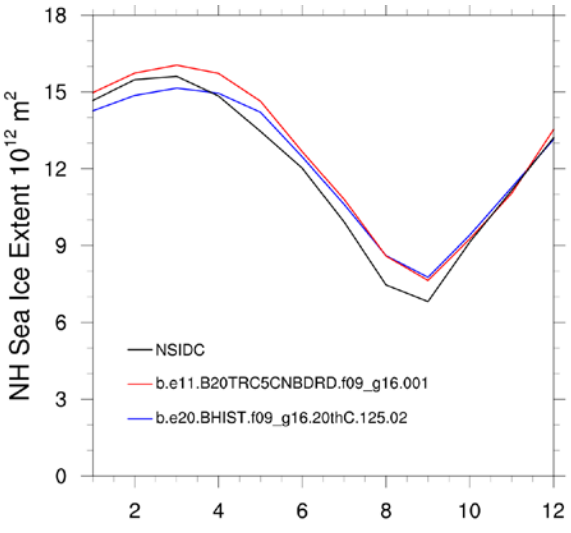

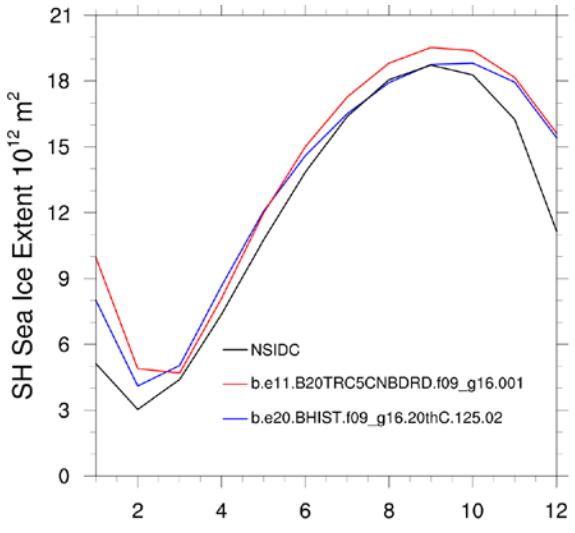

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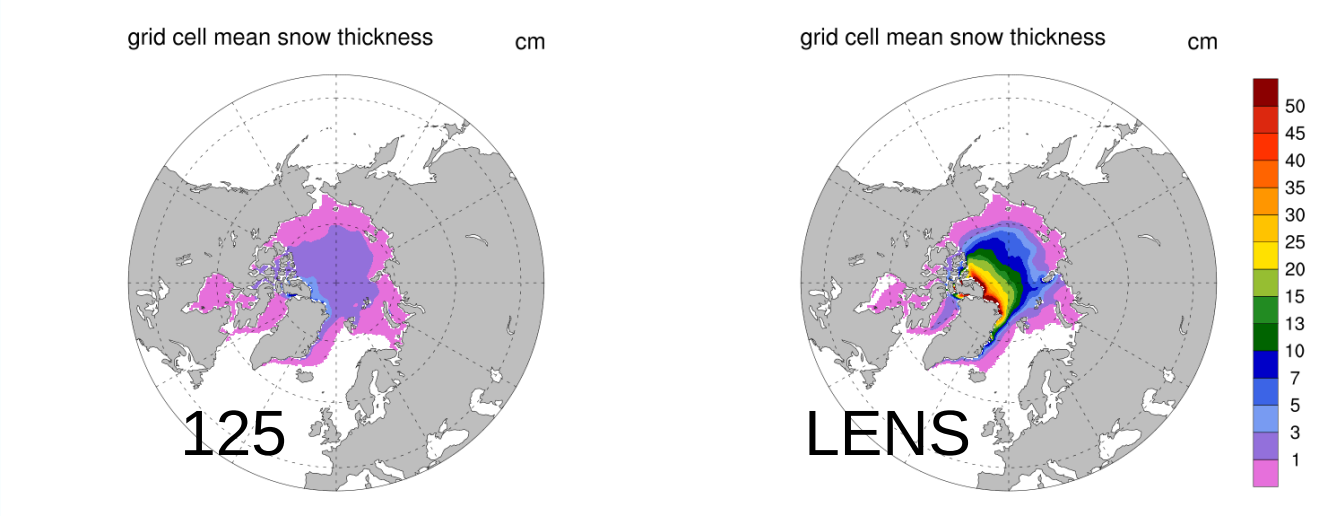
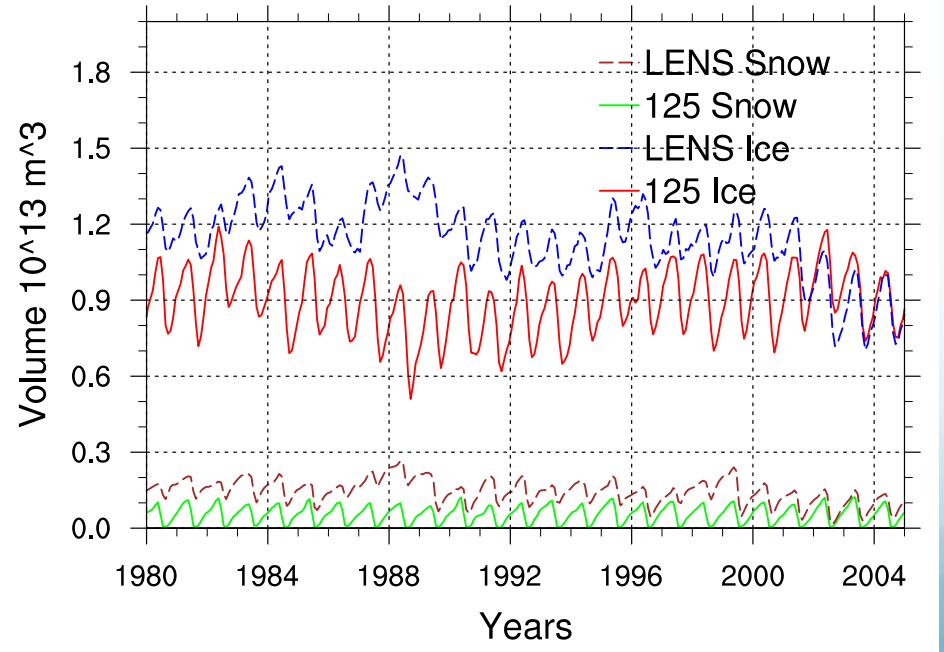
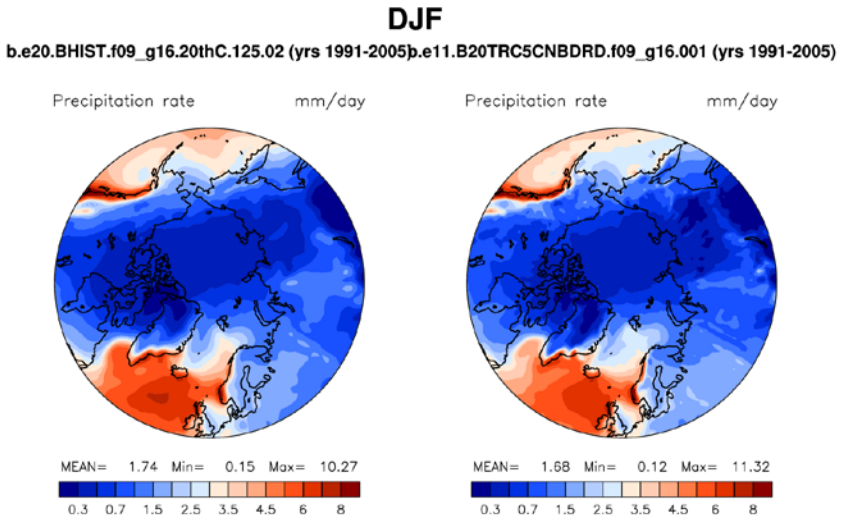
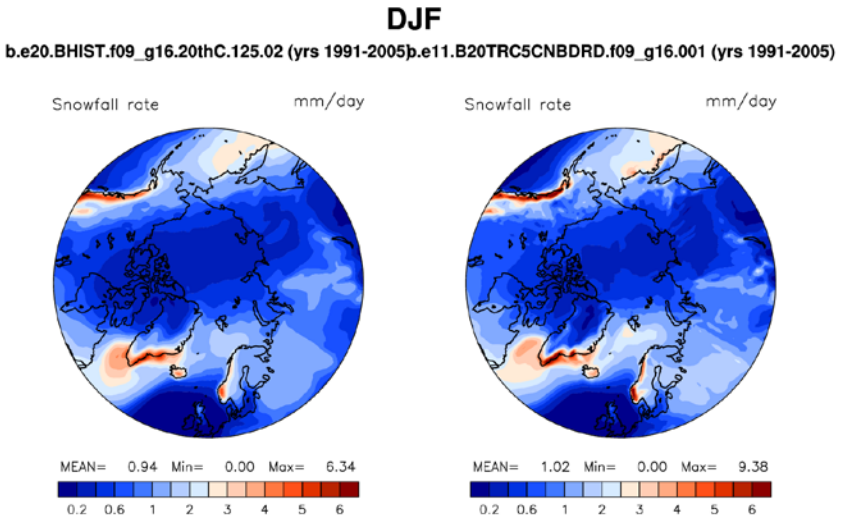
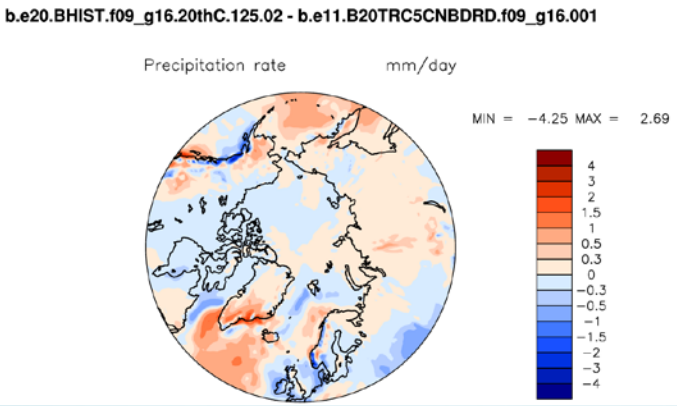


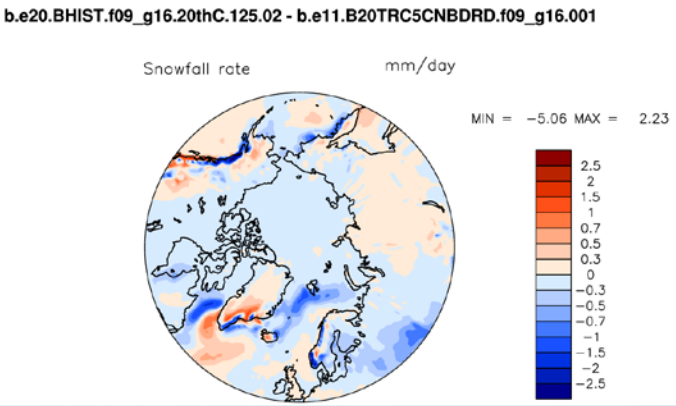


Snowfall


DJF
b.e20.BHIST.f09_g16.20thC.125.02 (yrs 1991-2005)þ.e11.B20TRC5CNBDRD.f09_g16.001 (yrs 1991-2005)
Precipitation rate mm/day
MEAN= 1.74 Min= 0.15 Max= 10.27
0.3 0.7 1.5 2.5 3.5 4.5 6 8
Precipitation rate mm/day
MEAN= 1.68 Min= 0.12 Max= 11.32
0.3 0.7 1.5 2.5 3.5 4.5 6 8


DJF
b.e20.BHIST.f09_g16.20thC.125.02 (yrs 1991-2005)þ.e11.B20TRC5CNBDRD.f09_g16.001 (yrs 1991-2005)
Snowfall rate mm/day
MEAN= 0.94 Min= 0.00 Max= 6.34
0.2 0.6 1 2 3 4 5 6
Snowfall rate mm/day
MEAN= 1.02 Min= 0.00 Max= 9.38
0.2 0.6 1 2 3 4 5 6


b.e20.BHIST.f09_g16.20thC.125.02 - b.e11.B20TRC5CNBDRD.f09_g16.001
Precipitation rate mm/day
MIN = −4.25 MAX = 2.69
4
3
2
1.5
1
0.5
0.3
0
−0.3
−0.5
−1
−1.5
−2
−3
−4


b.e20.BHIST.f09_g16.20thC.125.02 - b.e11.B20TRC5CNBDRD.f09_g16.001
Snowfall rate mm/day
MIN = −5.06 MAX = 2.23
2.5
2
1.5
1
0.7
0.5
0.3
0
−0.3
−0.5
−0.7
−1
−1.5
−2
−2.5

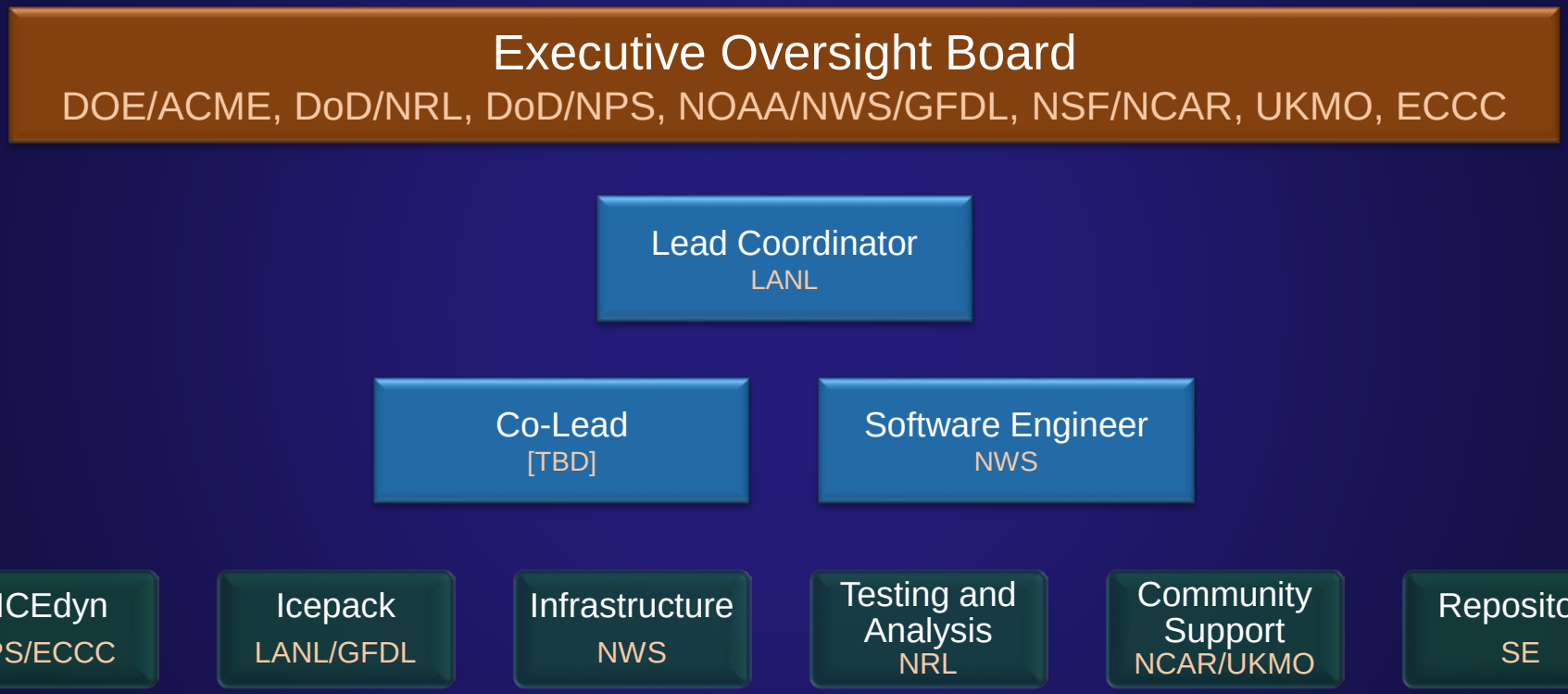
CESM Tutorial

There is also an annual CESM tutorial held in July/August and pieces of this are focused on the sea ice component.

Targeted at 2-3 year graduate students.

The next one is August 14-18, 2017 at the NCAR Mesa Lab in Boulder.

The course materials (lectures and exercises) are also available online at:

http://www.cesm.ucar.edu/events/tutorials/

CICE Consortium Organization