Putting the salt back in CICE: Progress on CICE5 in CESM.

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CICE5

* Same infrastructure as CICE4
* New thermodynamics, dynamics, melt ponds, and BGC.
* Initial configuration is the same as CICE4 and CICE5 in CESM as of cesm1_4_beta01.
  (Many thanks to Tony Craig!)
* Back-ported to CESM-LENS tag.
PCWG Priorities

* New mushy-layer (ML) thermodynamics (Turner and Hunke 2015)
* Elastic-Anisotropic (EAP) dynamics (Tsamados et al. 2012)
* Form drag at atmosphere-ice interface (Hunke et al.)
* Snow on sea ice processes
* Ponds
* Vertical levels and subgridscale categories.
Experiments

* CAM5.3 + CICE4/5 + SOM (Slab Ocean Model)
* SOM Forcing derived from years 402-1510 of LENS 1850 control run.
* Simulations are 50-60 years long (equilibrates in about 30 years).
* CICE5 runs have ML thermo and level ponds.
* CVCWG running SOM 1850 control run out 1000 years!
Mushy-Layer Thermodynamics (Turner and Hunke 2015)

\[ \rho c \frac{\partial T}{\partial t} = \frac{\partial}{\partial z} \left( K \frac{\partial T}{\partial z} \right) + F, \]  

(1)

where \( z \) is the vertical coordinate, defined to be positive downward with \( z = 0 \) at the top surface, \( \rho \) is a fixed sea-ice density, \( c \) is the specific heat of sea ice, \( K \) is the thermal conductivity of sea ice, \( F \) is the absorbed shortwave radiation. The specific heat, \( c \), is given by the approximation of Ono [1967]

\[ c(T, S) = c_0 + \frac{L_0 \mu S}{T^2}, \]  

(2)
Salinity
ML and Level Ponds
ML and Level Ponds

ANN Mean

Ice area (aggregate) %

MIN = -20.98 MAX = 46.07

ANN Mean

Ice area (aggregate) %

MIN = -14.69 MAX = 22.35
Seasonal Cycle of Extent
Mushy-layer and level ponds still produce thicker ice and larger extent overall, but more reasonable than earlier simulations.

Appears to be a different albedo response.

Salinity is prognostic in ML thermo. More work needed to assess this.

Need to assess sensitivity to different settings before October 1\textsuperscript{st}.

Reassess with CAM5.4+ after October 1\textsuperscript{st}.

Summary
Albedo Response