The influence of new sea ice physics in CESM2

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May 23, 2019

This material is based upon work supported by the National Center for Atmospheric Research, which is a major facility sponsored by the National Science Foundation under Cooperative Agreement No. 1852977.

Sea Ice Model Intercomparison Project (SIMIP)
Notz, D., A. Jahn, M Holland, E. Hunke, F. Massonnet, J. Stroeve, B. Tremblay, and M. Vancoppenolle, 2016: The CMIP6 Sea-Ice Model Intercomparison Project (SIMIP): understanding sea ice through climate-model simulations. Geosci. Model Dev., 9, 3427–3446. doi:10.5194/gmd-9-3427-2016

- This MIP specifies the sea ice variables available for CMIP6 runs.

- Not included from CESM2: sidragbot, siitdsnconc, simpconc, simpmass, simprefrozen, sisali, sisnconc, sisnmass, sndmassdyn, sndmasssi, sndmasswindrif, snmassacrossline

- These can easily be computed from other variables using constants, or we don't simulate them.

http://www.cesm.ucar.edu/models/cmip6.html

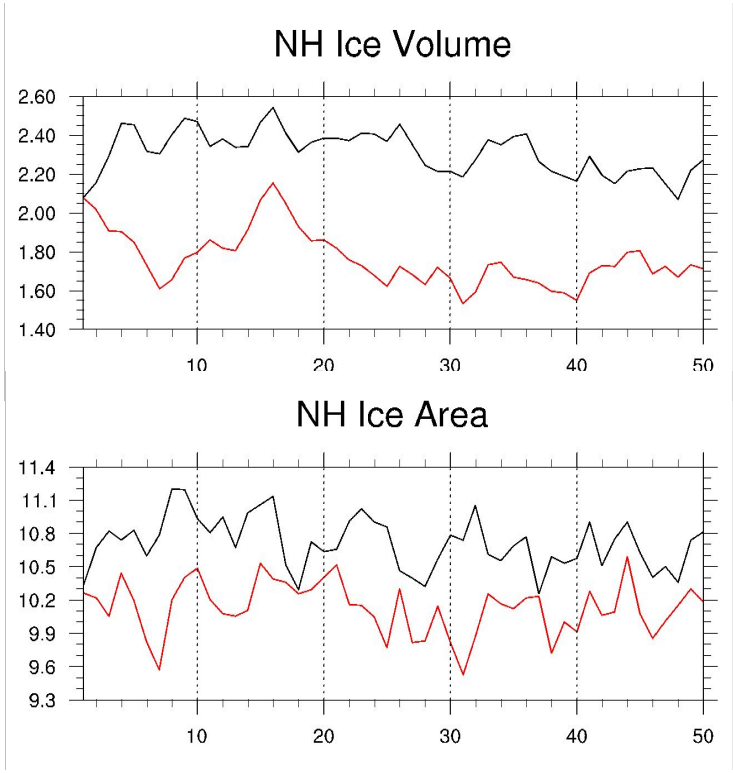
CESM2 CICE

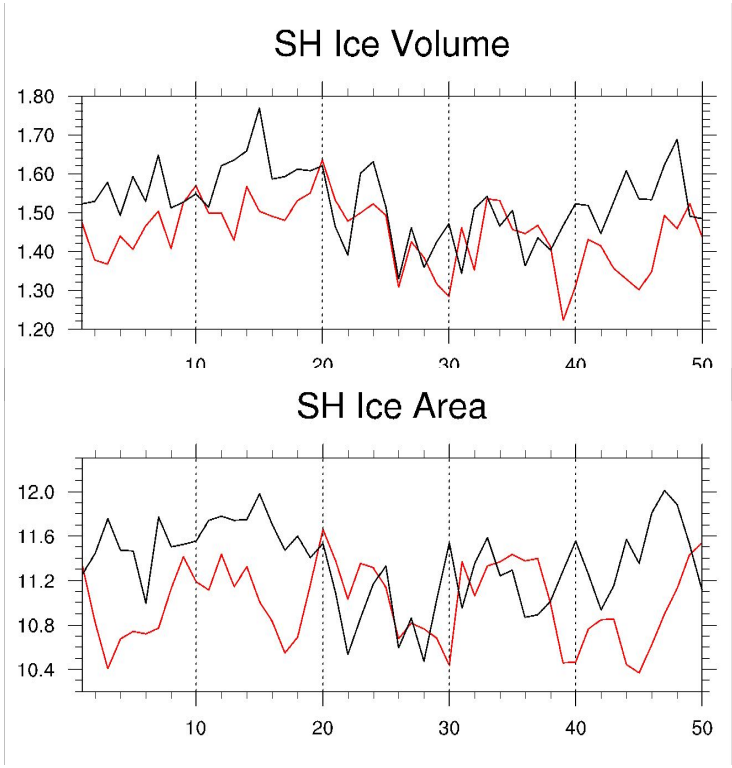
- CESM2 contains version 5.1.2 of the Los Alamos Sea Ice Model (CICE).
- New thermodynamics including the mushy-layer (ML) physics of Turner et al. 2013. Used instead of the Bitz and Lipscomb 1999 (BL99) thermodynamics as in CESM1.
- Level ice melt pond scheme of Hunke et al. 2013.
- The vertical levels 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.

BL99 versus ML Variability (Preindustrial)

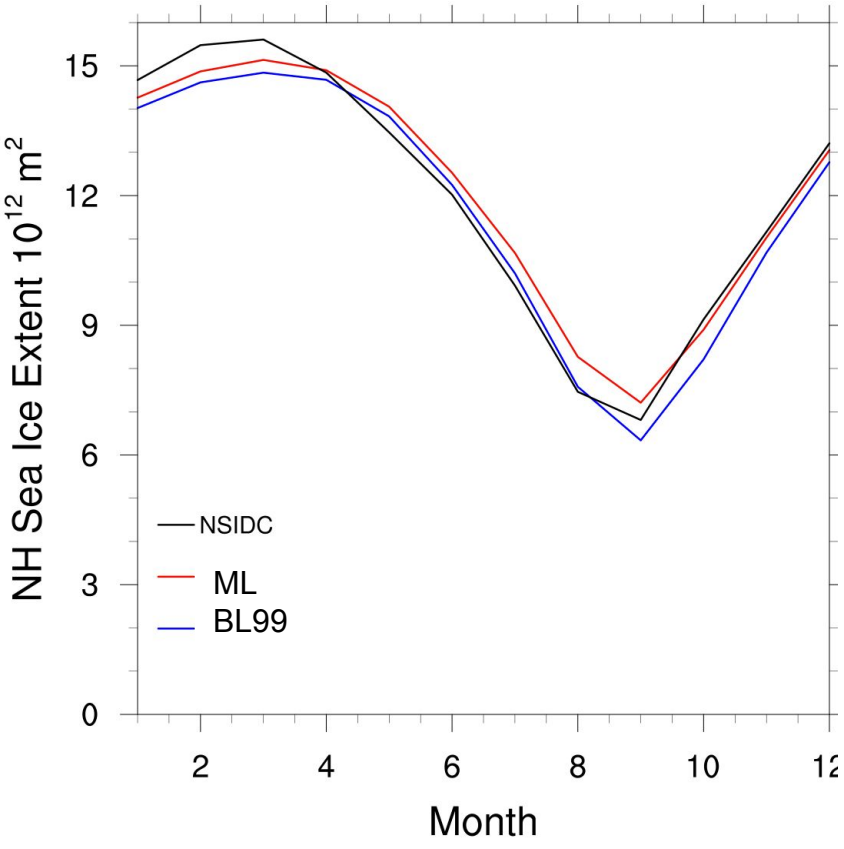
ML

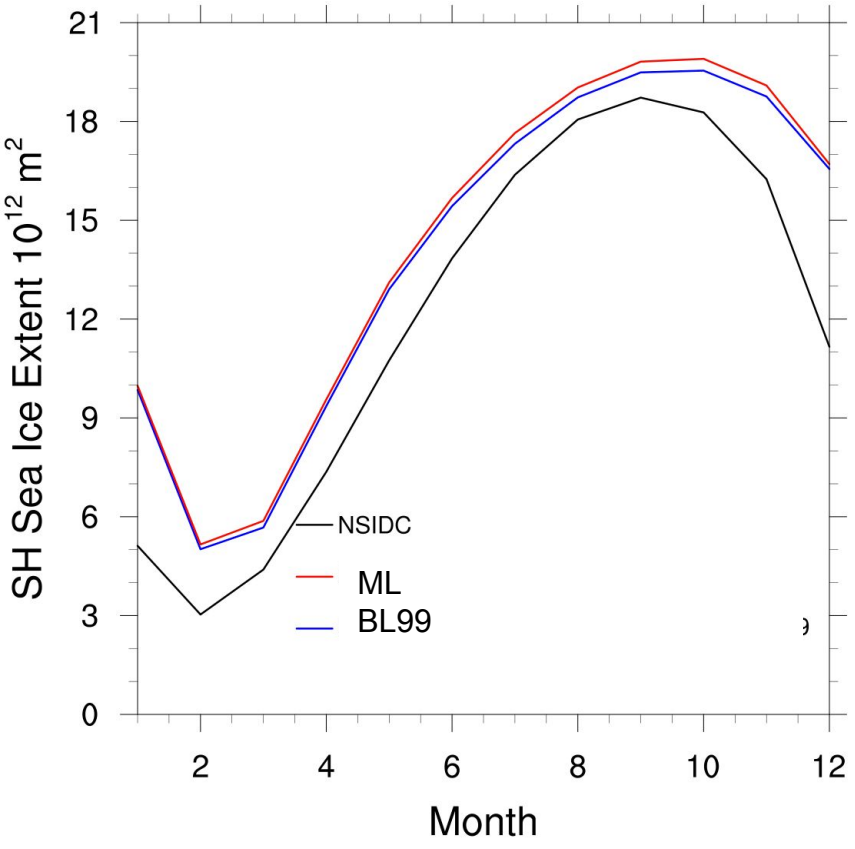
BL99



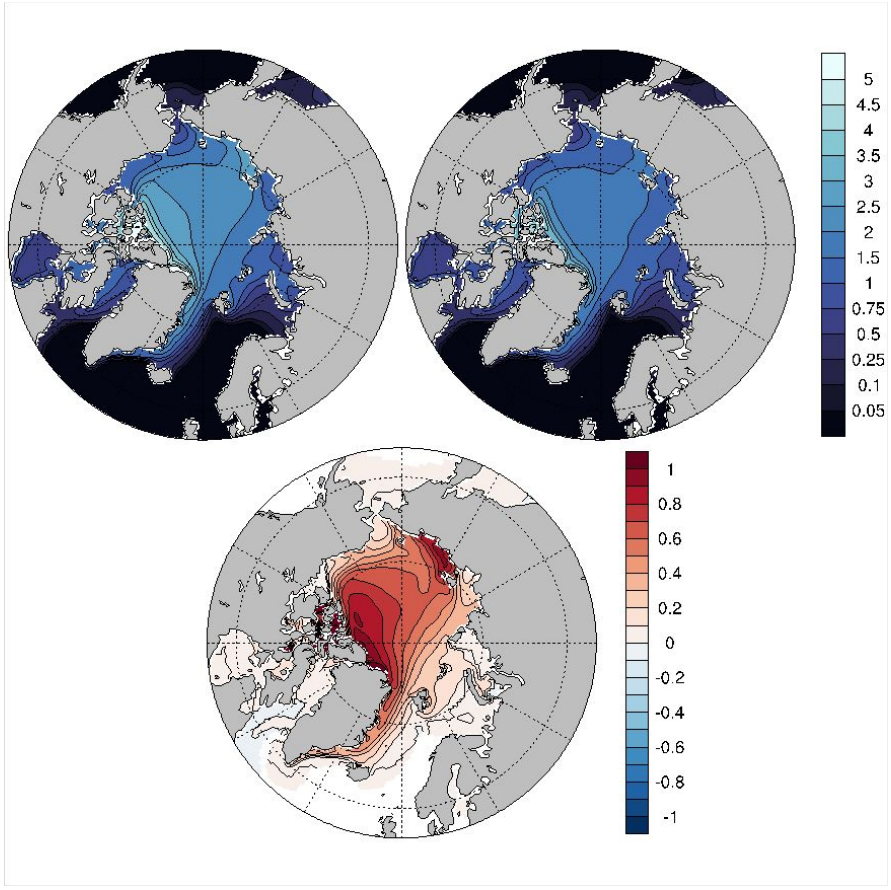


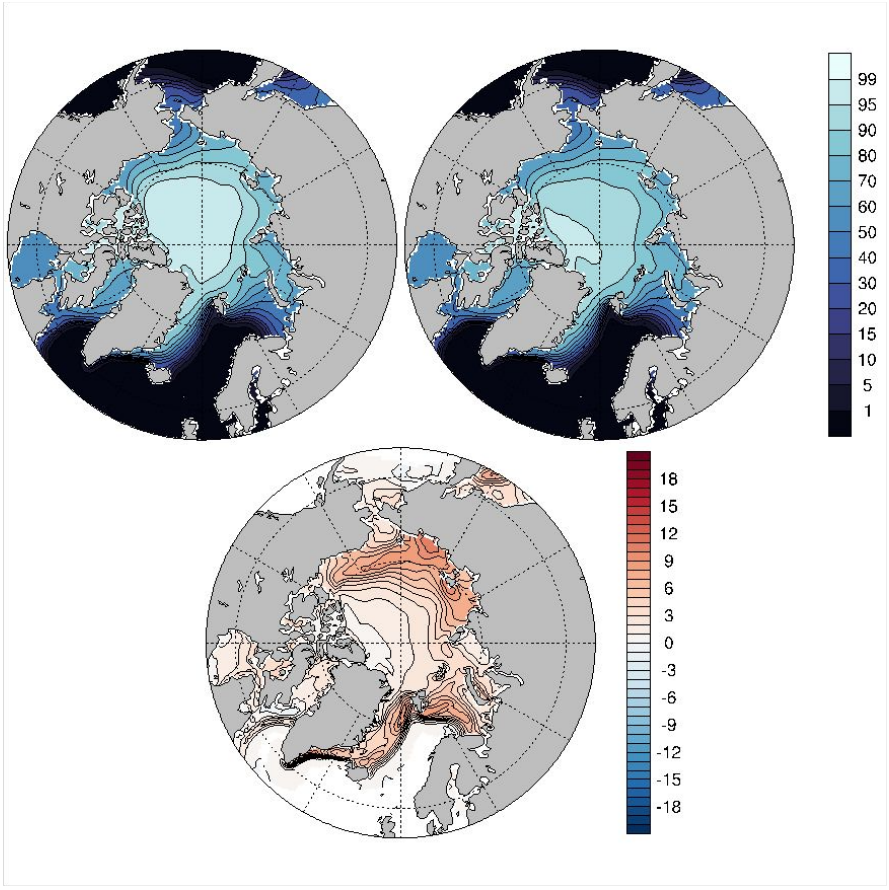
BL99 versus ML Sea Ice Extent



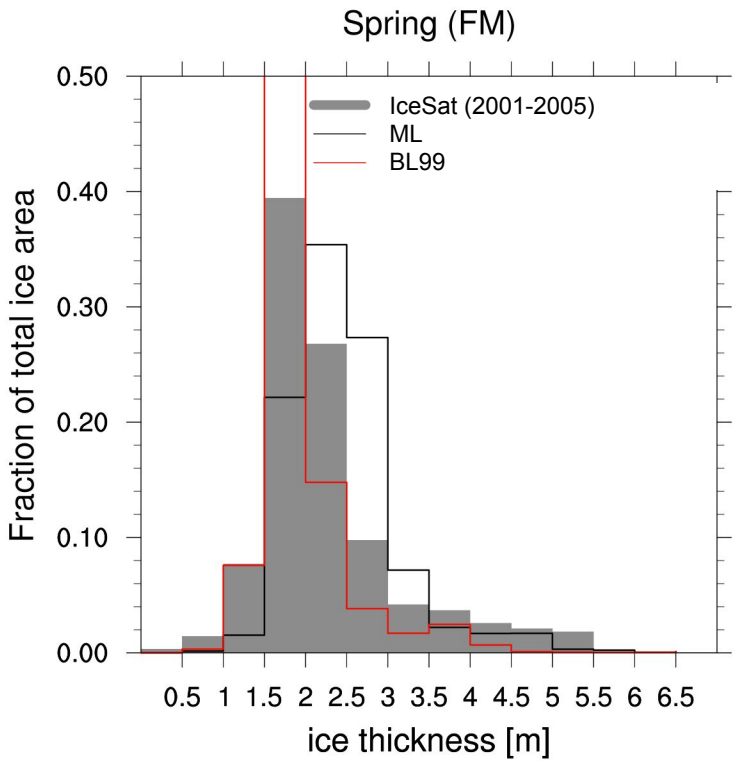


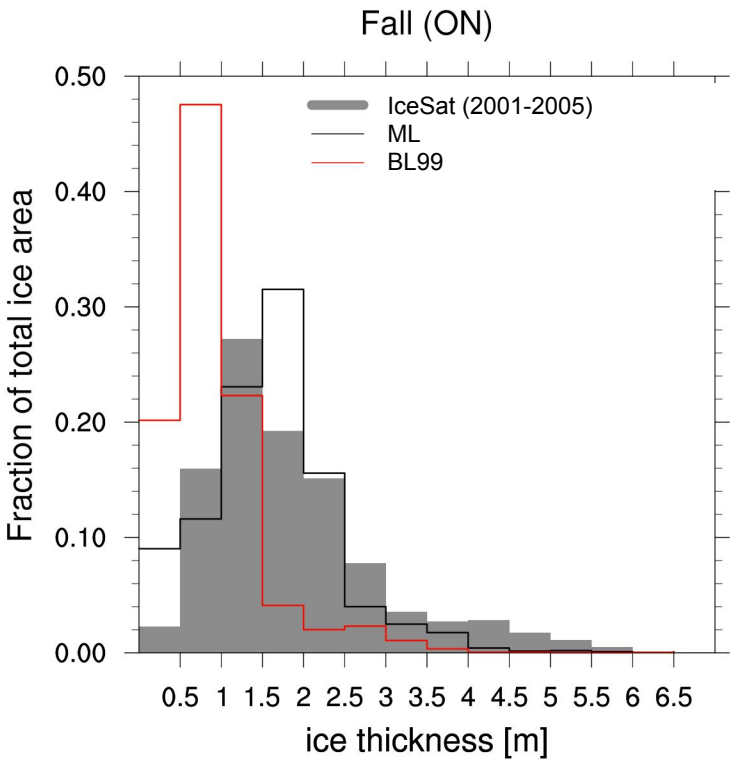
Mean Thickness and Ice Area



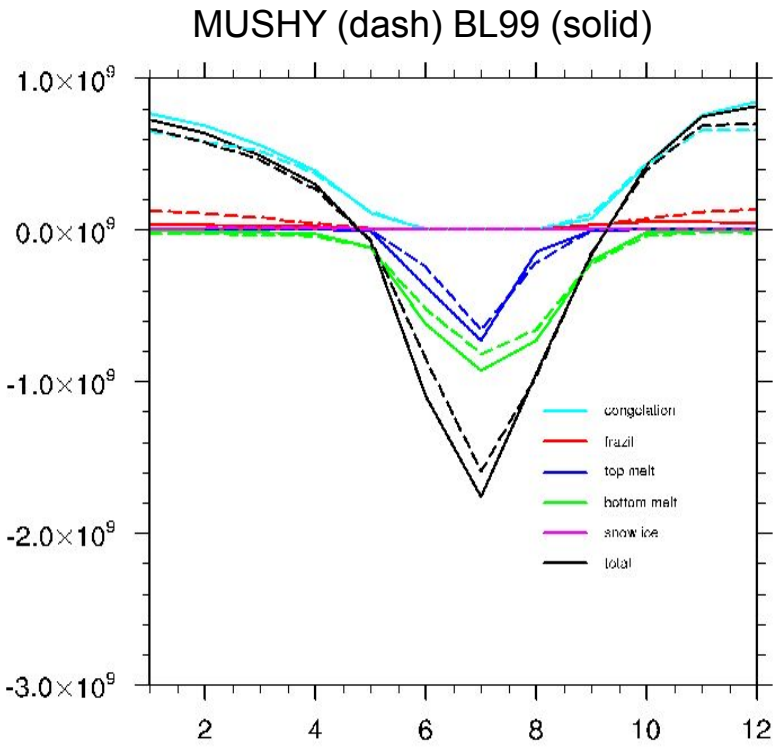


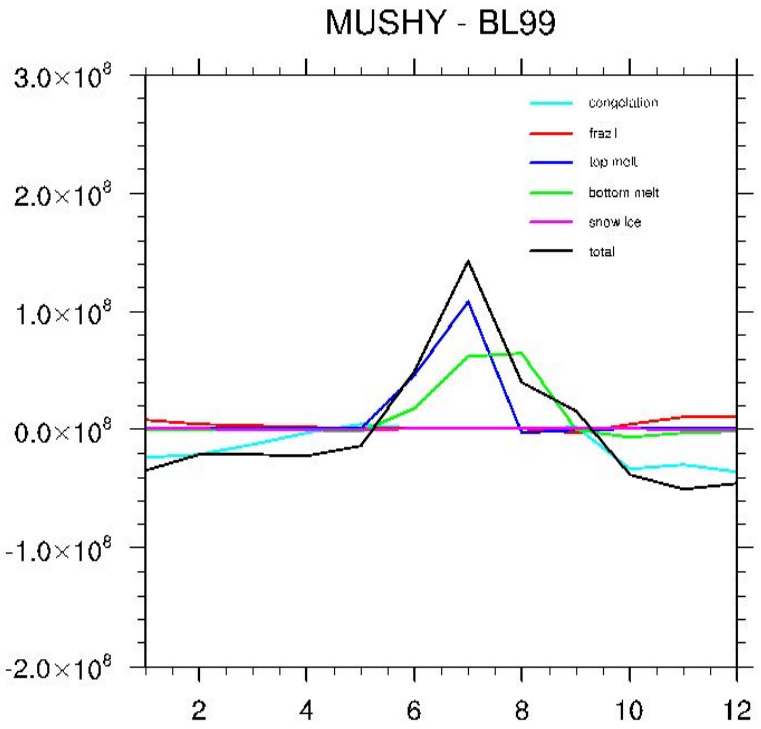
BL99 versus ML Arctic Ice Thickness





Ice Mass Budgets (BL99-ML)

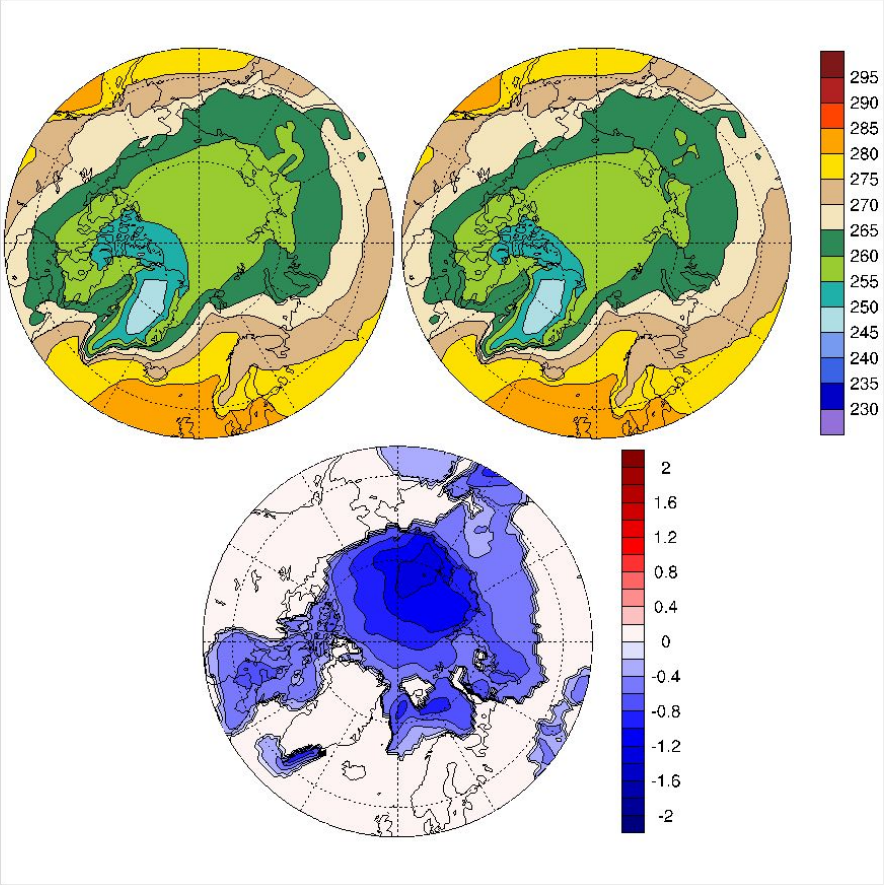




total top melt
frazil growth bottom melt
congelation growth

Thanks to Ed Blockley for the python scripts.

Surface Air Temperature



Summary

- Change in sea ice thermodynamics leads to thicker and more extensive ice in the Arctic.
- Partly due to melt pond drainage impacting surface albedo and top melt as in Turner and Hunke 2015.
- Role of frazil and congelation growth.
- Leads to colder Arctic temperatures.