

LA-UR-19-29683

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Title:	An Arctic regionally refined E3SM configuration: first results from a forced ocean-sea ice (E3SM-Arctic-OSI) simulation
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Intended for:	IMUM 2019, 2019-09-24/2019-09-27 (Santa Fe, New Mexico, United States)
Issued:	2019-09-25

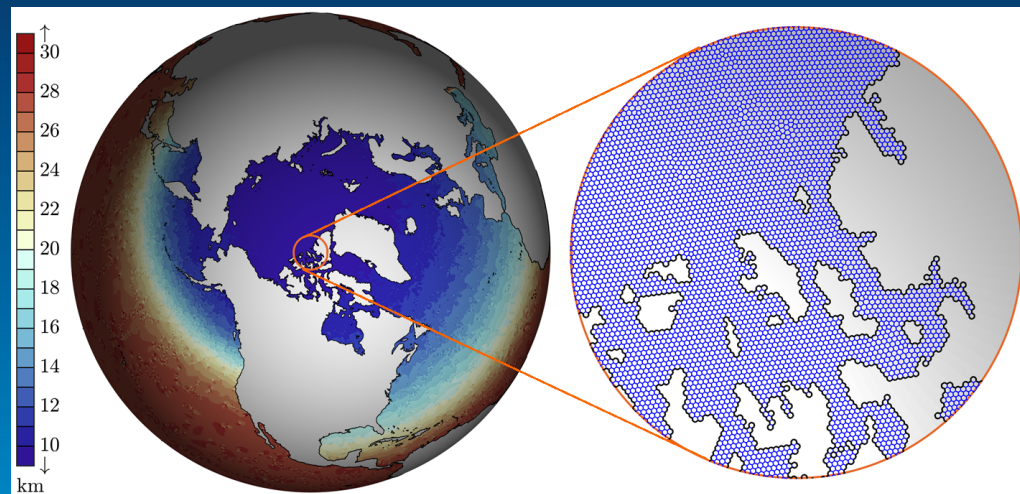
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An Arctic regionally refined E3SM configuration: first results from a forced ocean-sea ice (E3SM-Arctic-OSI) simulation

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IMUM, Santa Fe, 25 September 2019

The What and Why

- Arctic-focused E3SM configuration developed under the High Latitude Application & Testing (HiLAT) science focus area, which, in its phase 2, is partnering with the Regional Arctic System Model (RASM) group
- HiLAT-RASM main charge is to investigate **exchange processes** between the high- and mid-latitudes that are **critical for the high-latitudes roles in the global system**

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The What and Why

- Specific science questions include:
 - ✱ Variability of the **Arctic freshwater budget**, and how the export of fresh water into the North Atlantic subpolar ocean affects the formation and variability of the global Meridional Overturning Circulation (MOC)
 - ✱ Partitioning of **meridional heat transport** into/out of the Arctic between the ocean and atmosphere, and how that is modulated by sea-ice variability
- We develop the **E3SM-Arctic** configuration with the goal to eventually investigate these questions

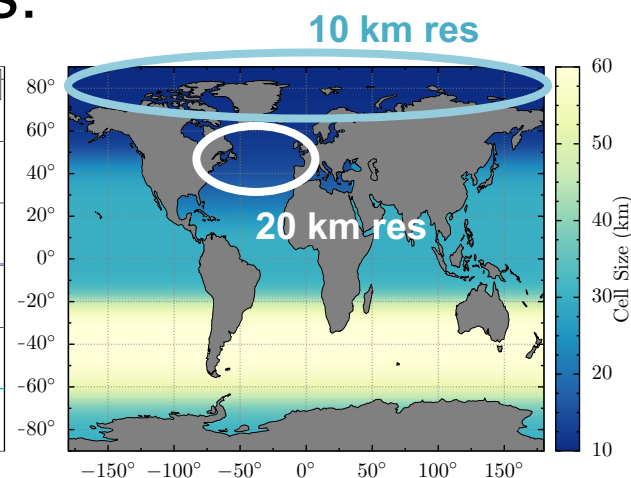
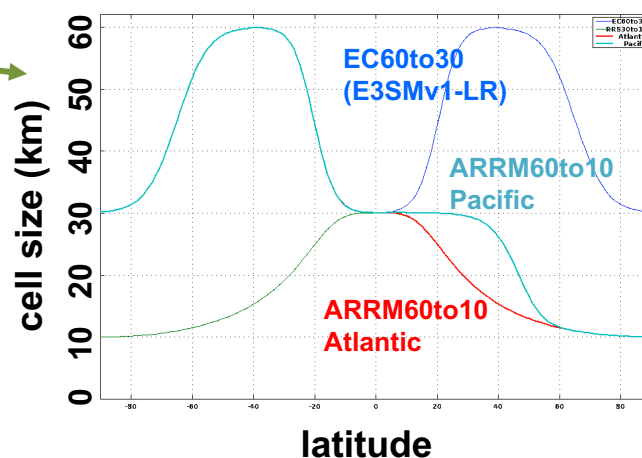
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E3SM-Arctic-OSI configuration

- OSI stands for ocean-sea-ice (no active atmosphere and land components)
- We are currently running two meshes:

* 60to10
620K # of cells

* 60to6
1.2M # of cells



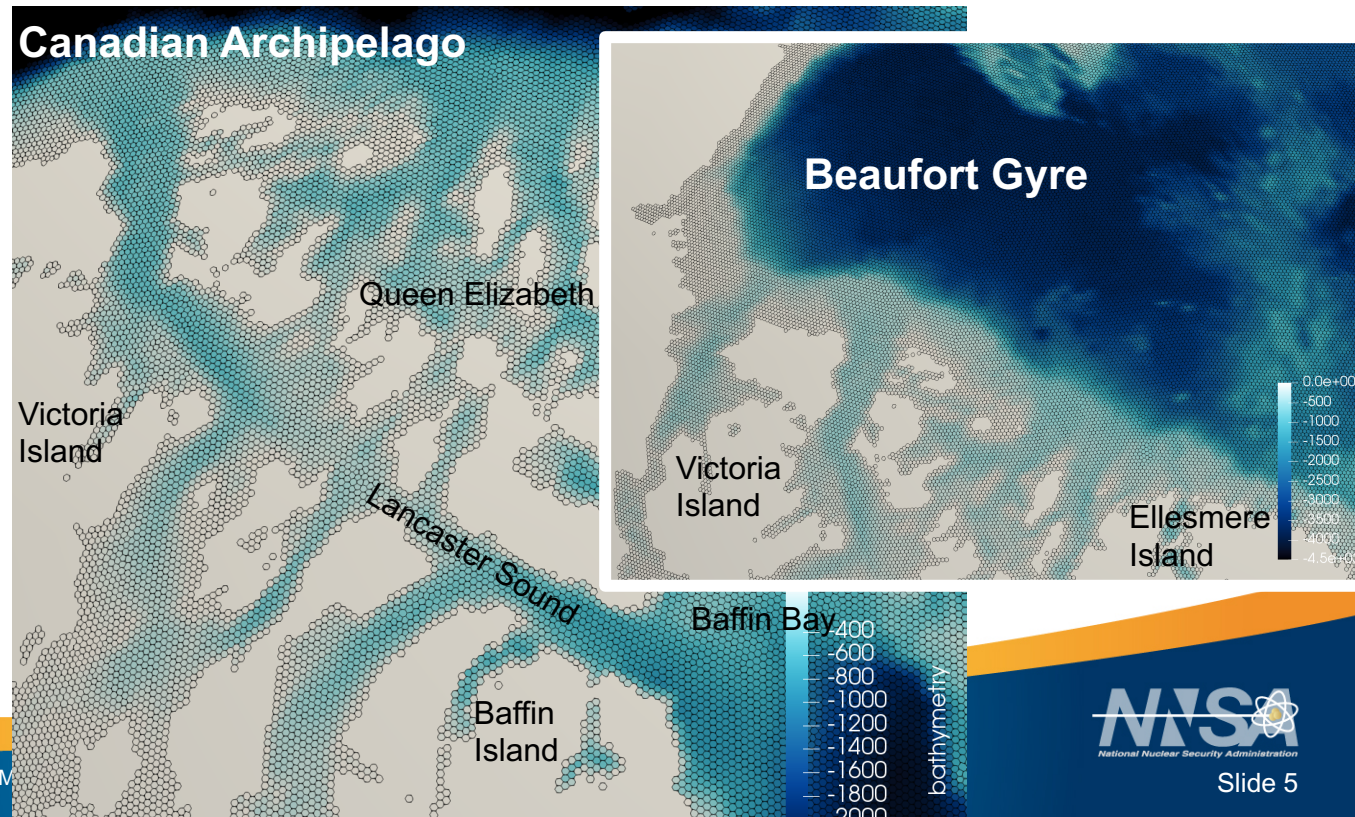
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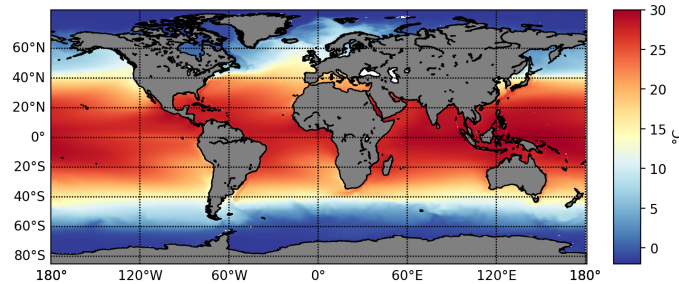
E3SM-Arctic-OSI simulations

- Variable Gent-McWilliams eddy parameterization (GM parameter transitions from 0 at $\text{cellSize} < 20$ km to its maximum value at $\text{cellSize} > 30$ km)
- Forcing is the JRA55-do product (1958-2016 cycle)
- Simulations underway:
 - two JRA55 cycles for the 60to10 configuration (LANL), starting our third and likely last cycle now
 - one JRA55 cycle for the 60to6 configurations (NPS), hopefully also completing 3 cycles soon

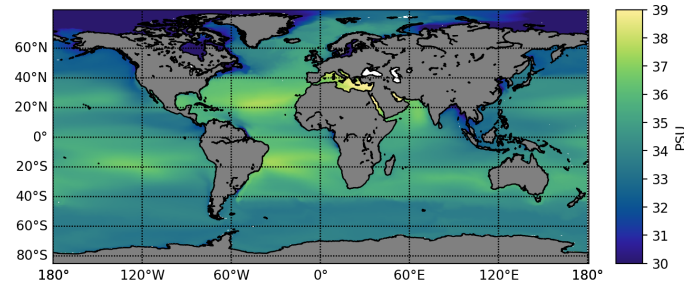
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Results from the 60to10: Global perspective SST, SSS compared with ARGO observations

ARRM60to10_JRA_GM_ramp

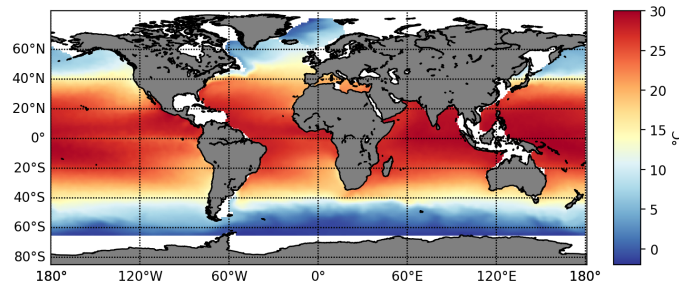


ARRM60to10_JRA_GM_ramp

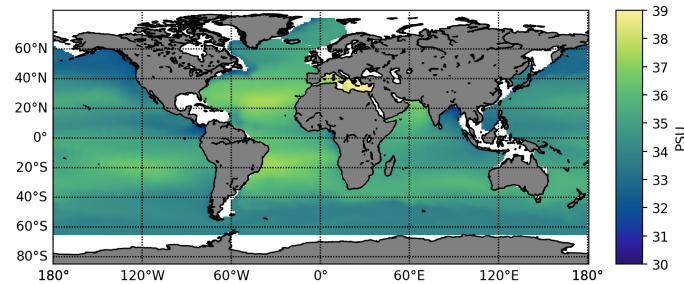


Model climatologies over last 10 years of 2nd JRA55 cycle

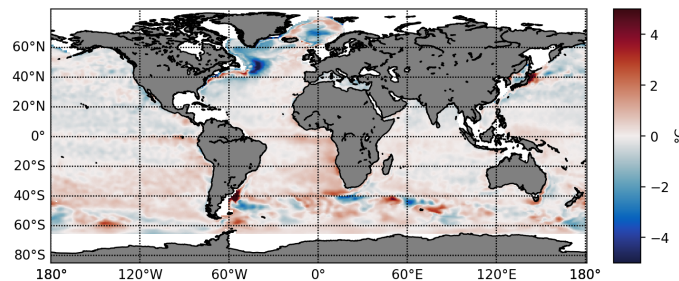
Roemmich-Gilson Argo Climatology: Potential Temperature



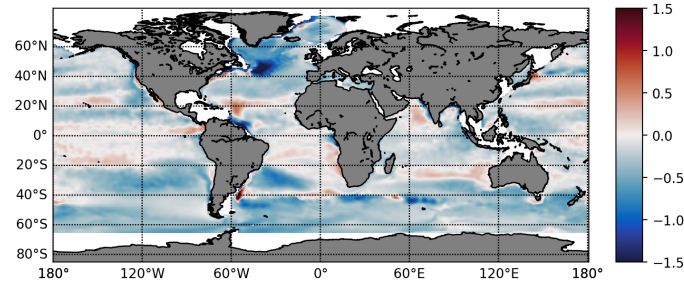
Roemmich-Gilson Argo Climatology: Salinity



Model - Argo

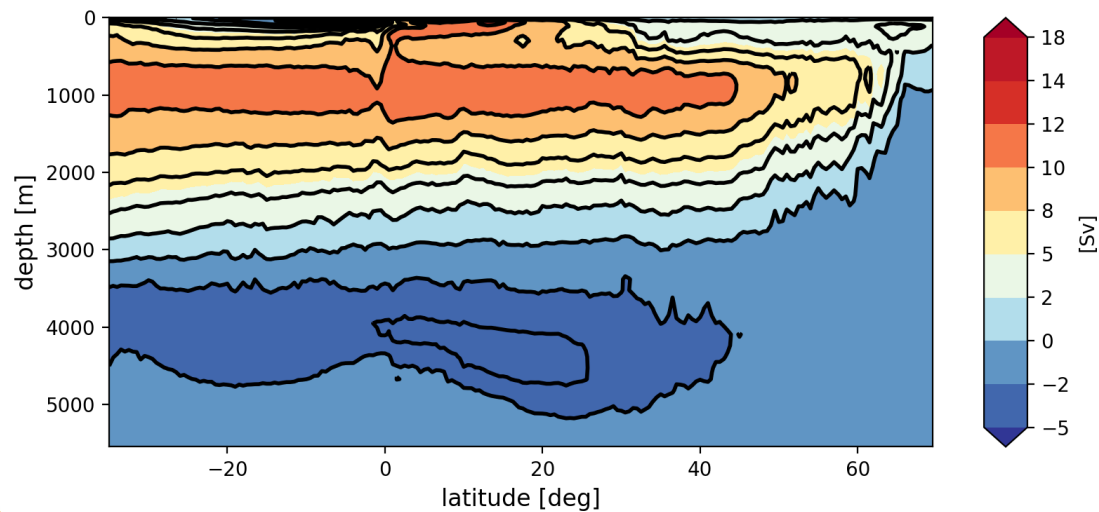
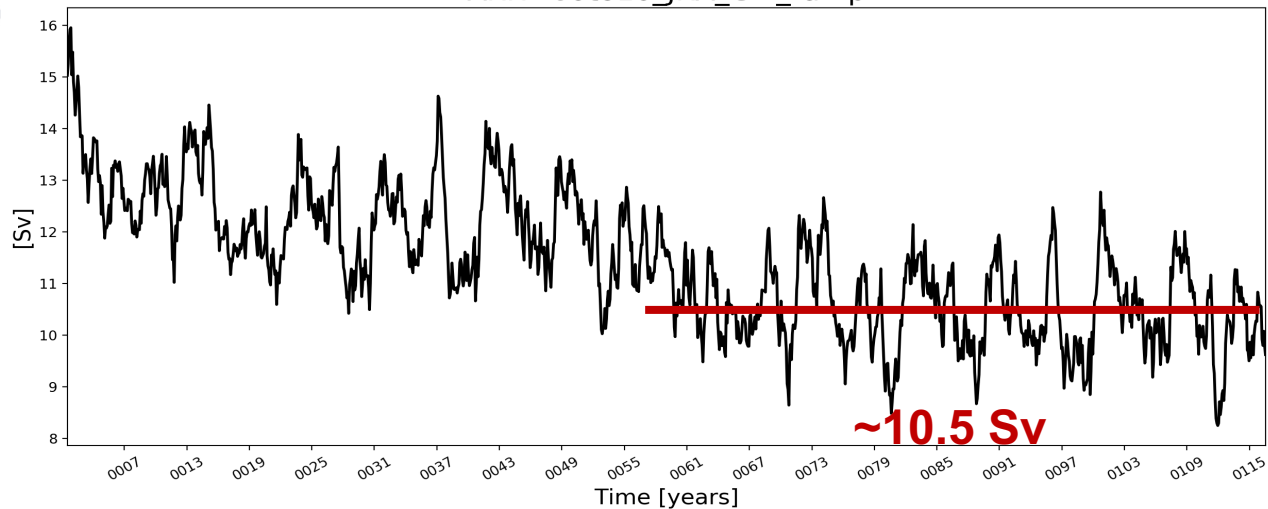


Model - Argo



Global perspective: Atlantic MOC

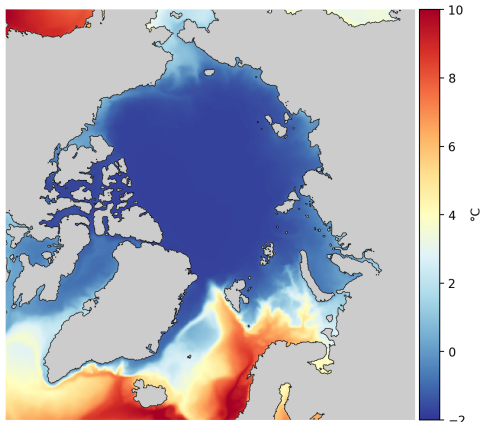
Max Atlantic MOC at 26.5°N
ARRM60to10_JRA_GM_ramp



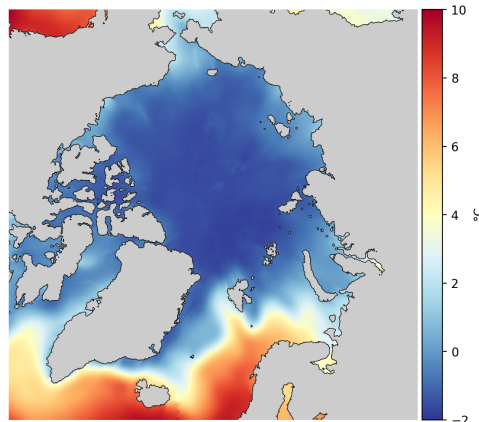
Arctic Ocean: SST, SSS compared with WOA18

Sea Surface Potential Temperature (ANN, years 0097-0116)

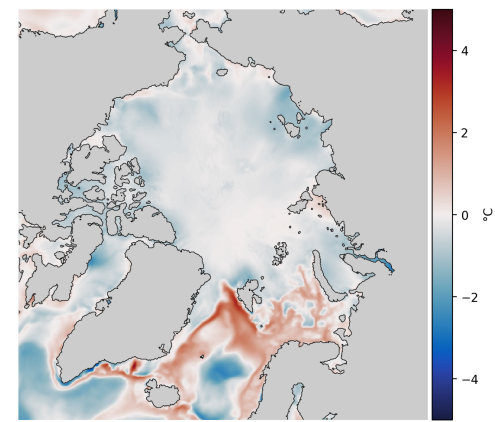
ARRM60to10_JRA_GM_ramp



WOA18 Climatology

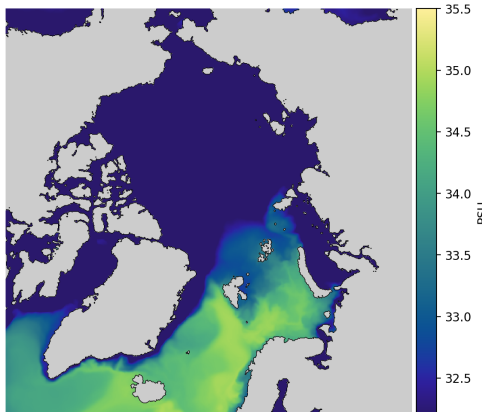


Model - Climatology

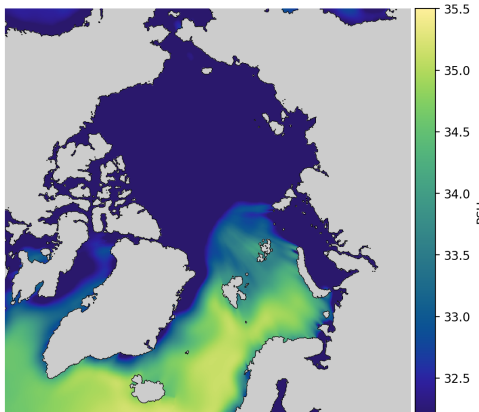


Sea Surface Salinity (ANN, years 0097-0116)

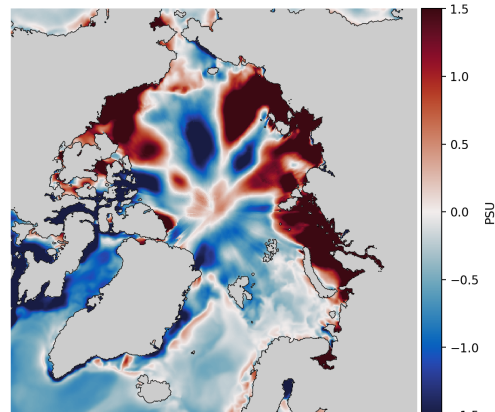
ARRM60to10_JRA_GM_ramp



WOA18 Climatology



Model - Climatology



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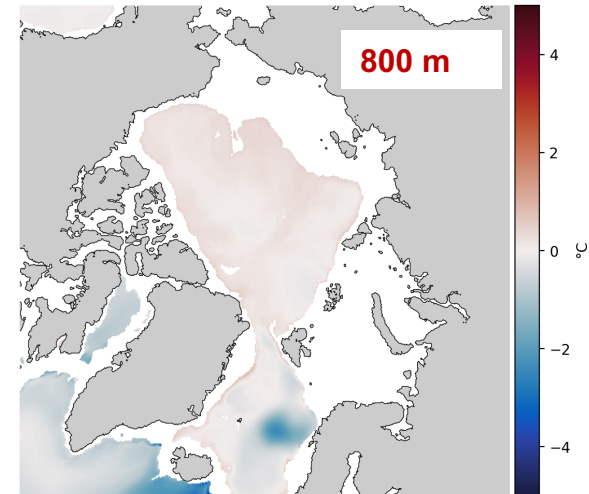
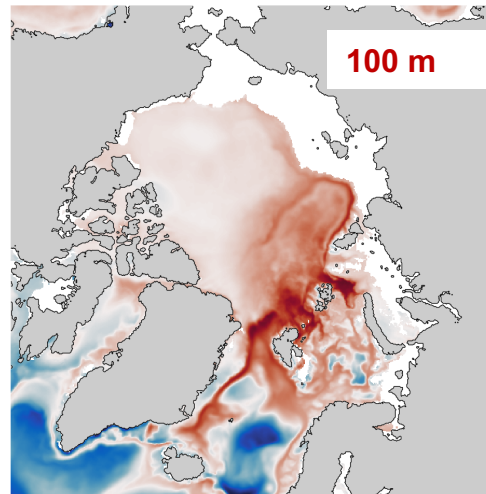
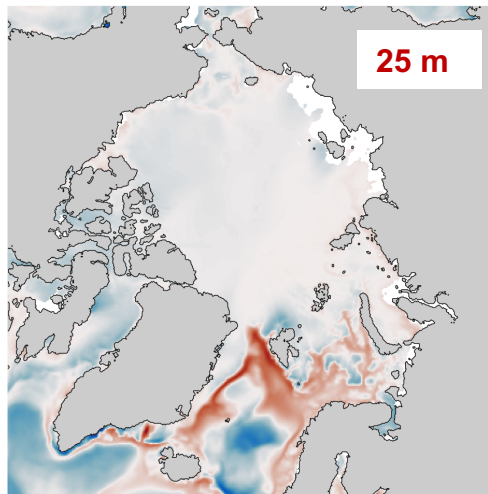
Arctic Ocean: subsurface T,S biases with respect to WOA18

Model - Climatology

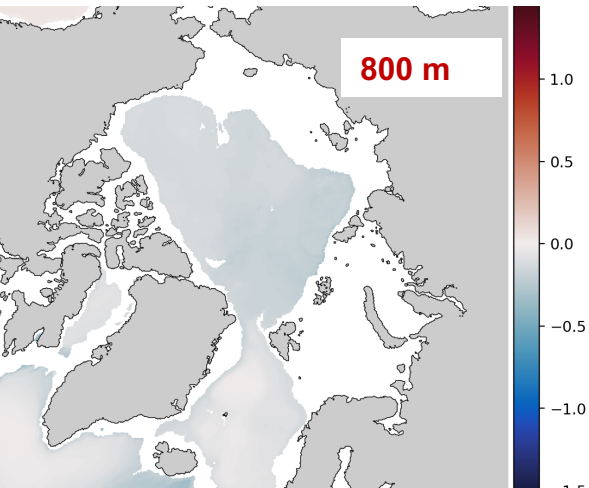
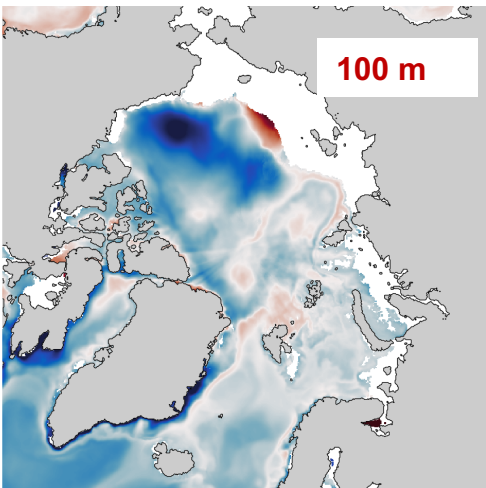
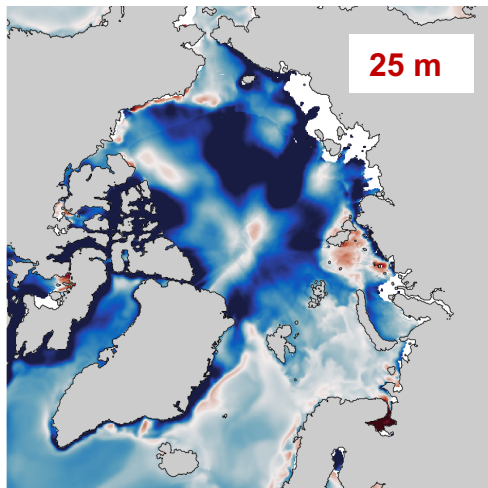
Model - Climatology

Model - Climatology

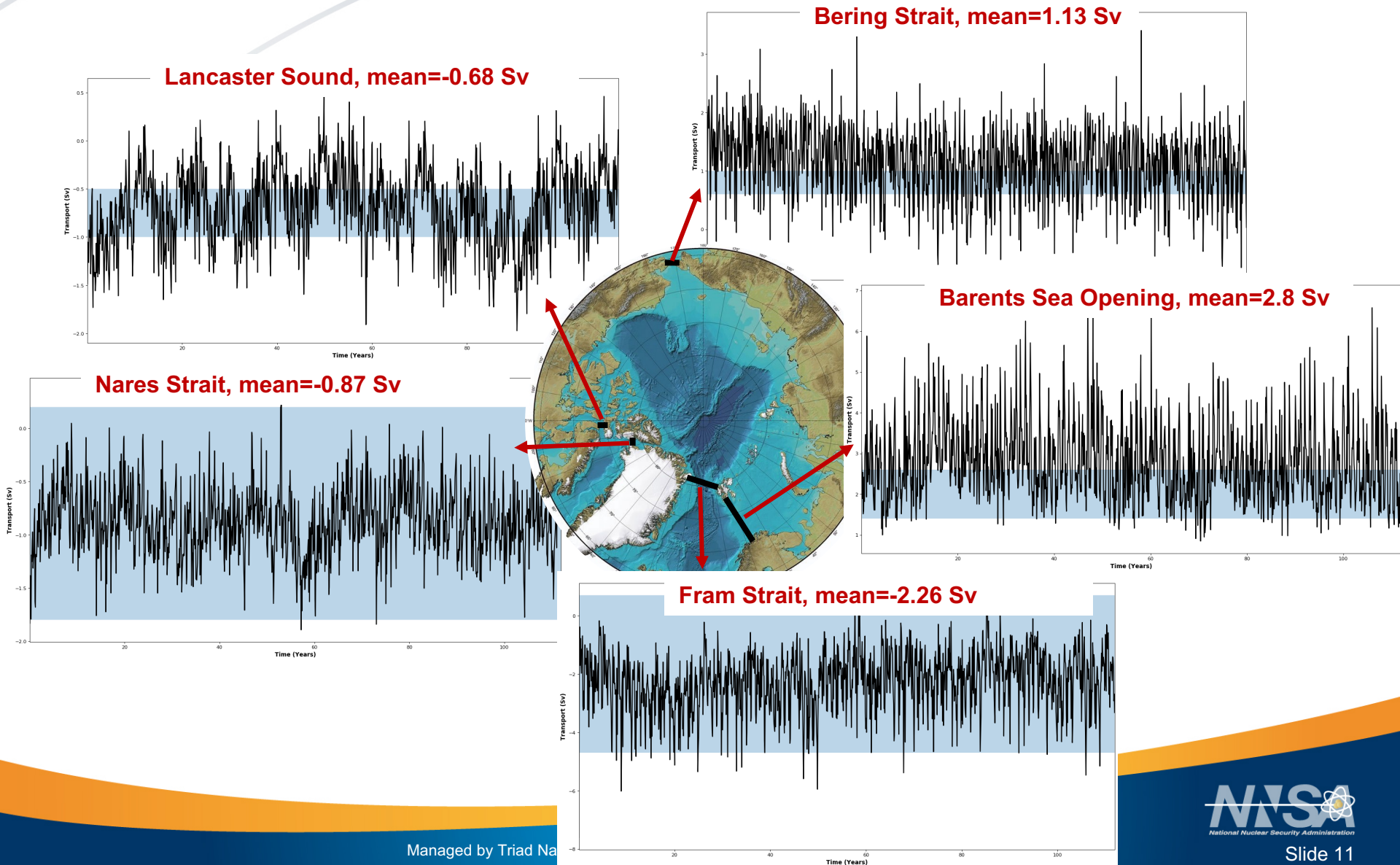
Temperature bias



Salinity bias



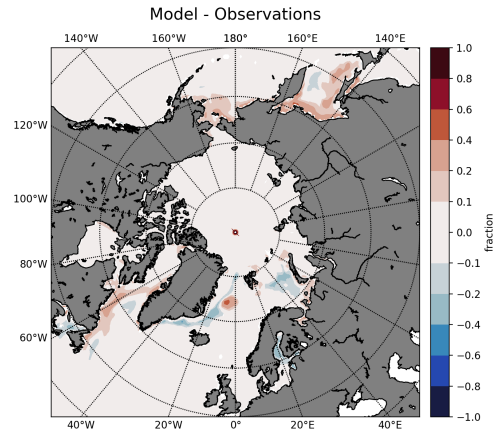
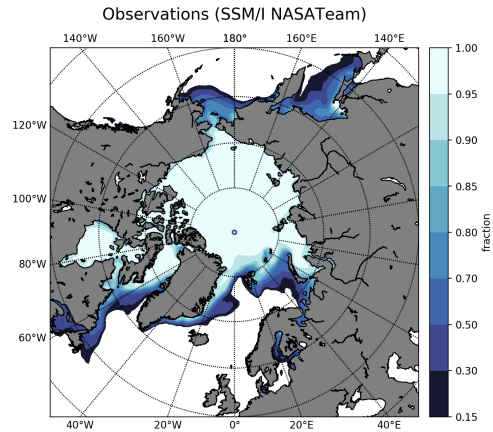
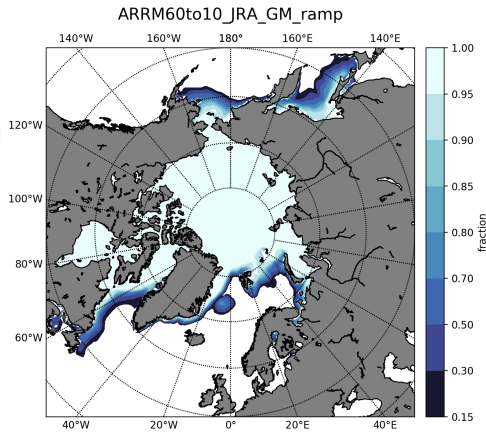
Arctic Ocean: mass transport across critical passages



Arctic sea-ice concentration

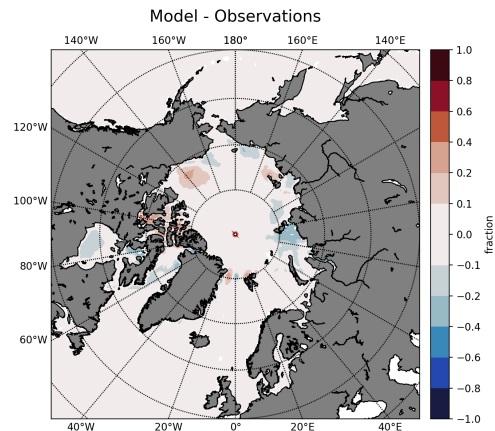
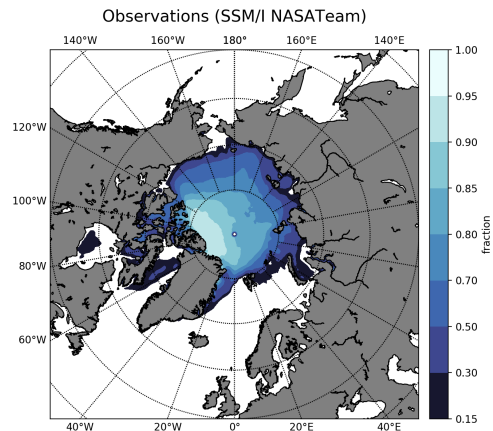
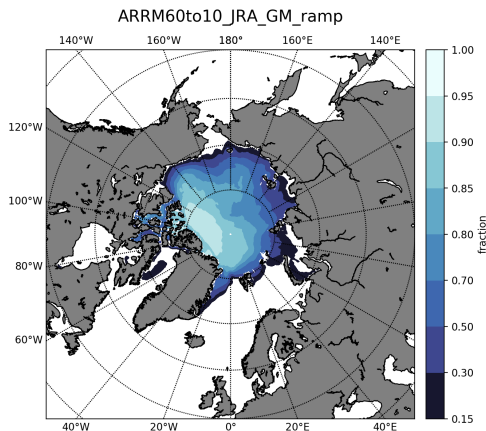
Sea ice concentration (JFM, years 0097-0116)

JFM



Sea ice concentration (JAS, years 0097-0116)

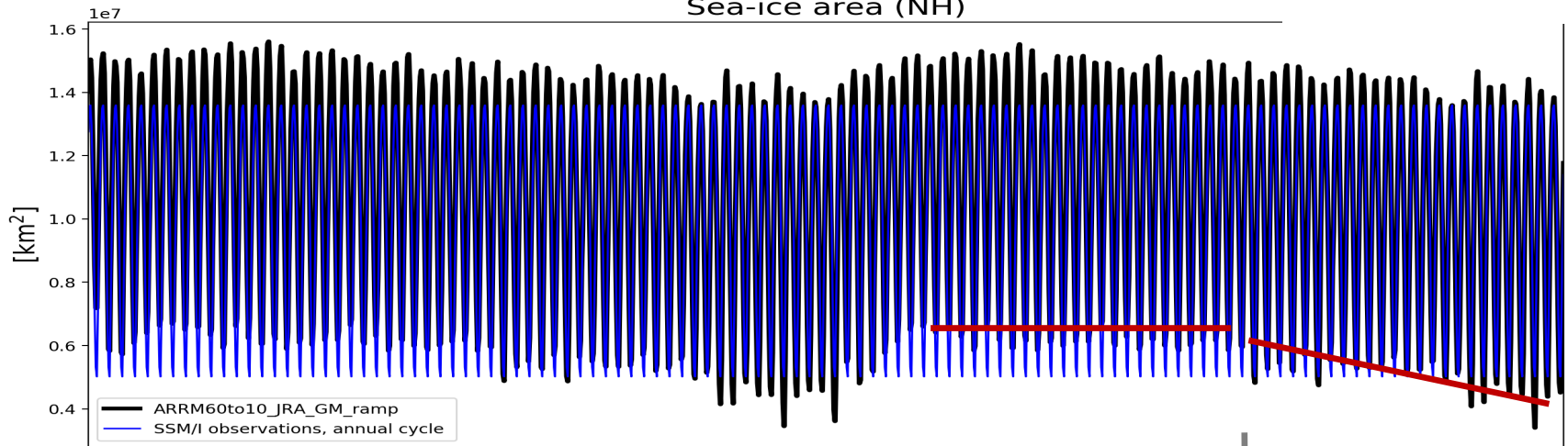
JAS



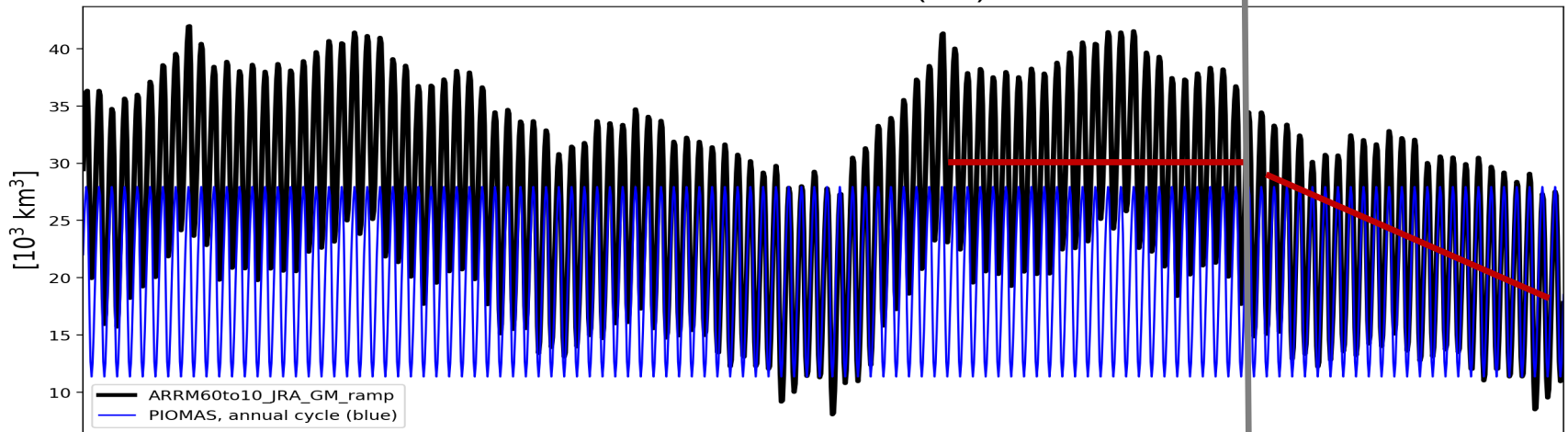
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Arctic sea-ice trends

Sea-ice area (NH)



Sea-ice volume (NH)



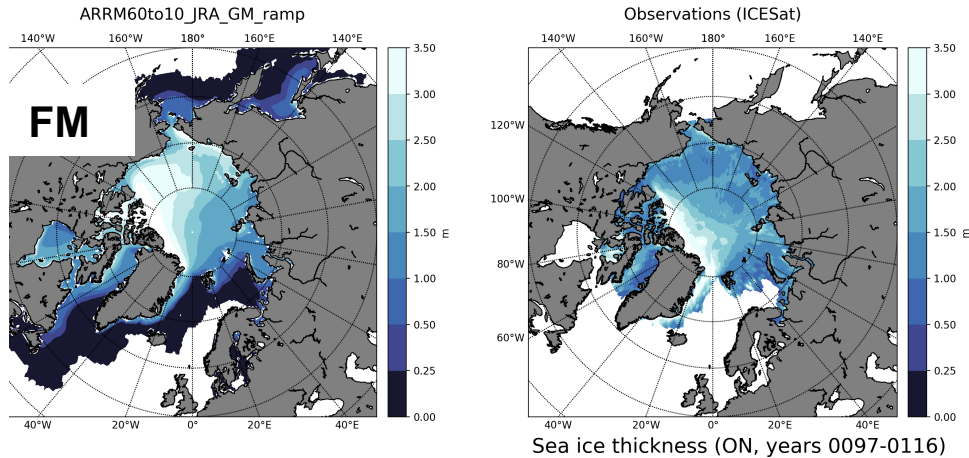
Time [years]
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1990

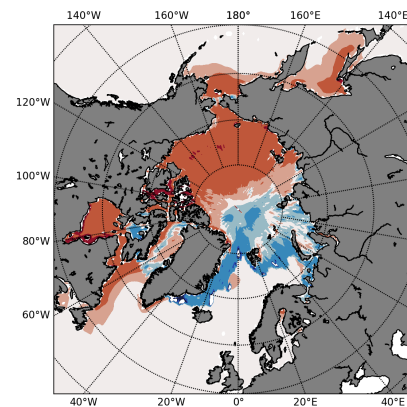
2014

Arctic sea-ice thickness

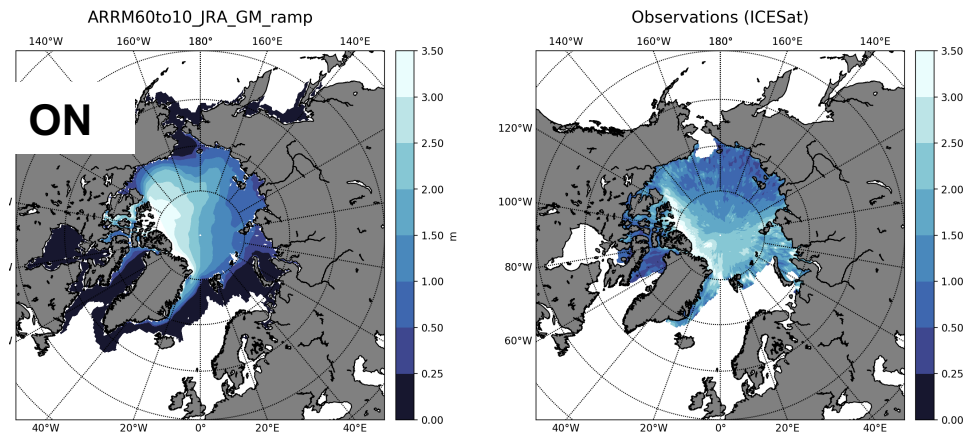
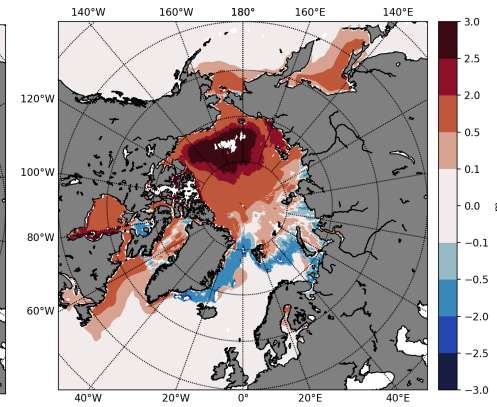
Sea ice thickness (FM, years 0097-0116)



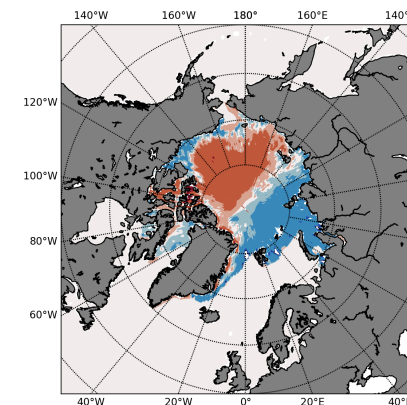
Bias over years 97-116



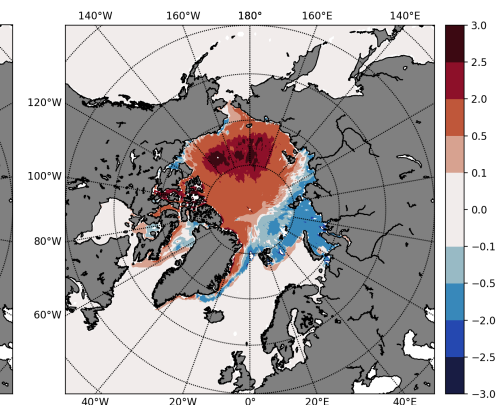
Bias over years 77-96



Model - Observations



Model - Observations



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Summary

- Considering how young E3SMv1 is, we are quite satisfied with the results from this first E3SM-Arctic configuration
- Arctic sea-ice concentration is very well represented in both winter and summer. Ice thickness is overestimated, especially in the Beaufort gyre. Present-day trends are well reproduced
- Things to investigate: low AMOC and upper ocean salinity biases (possibly related to sea-ice thickness biases). Common to other E3SMv1 simulations
- Next step: couple to atmosphere and land models

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Thanks!

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