

LA-UR-19-29683

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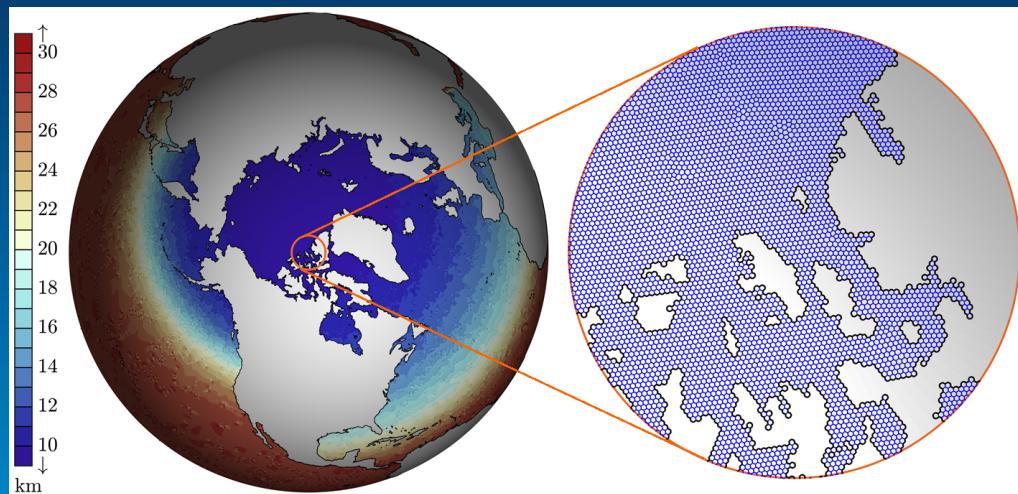
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An Arctic regionally refined E3SM configuration: first results from a forced ocean-sea ice (E3SM-Arctic-OSI) simulation

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IMUM, Santa Fe, 25 September 2019



Office of
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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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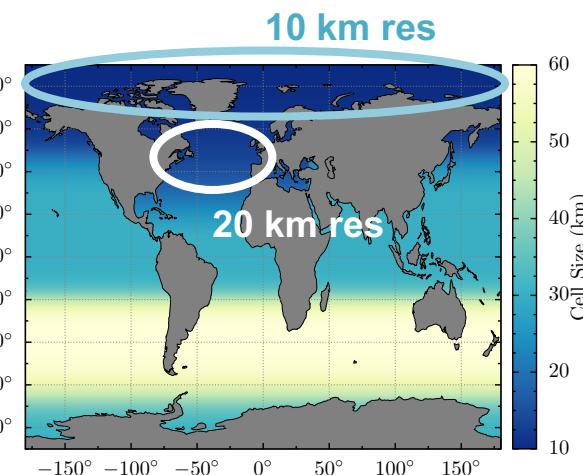
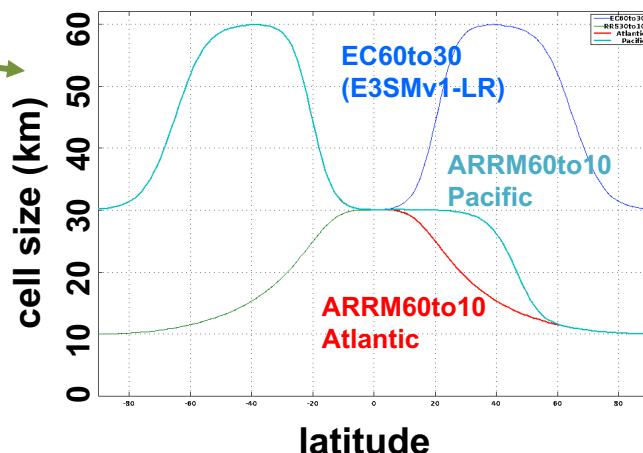
The What and Why

- 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

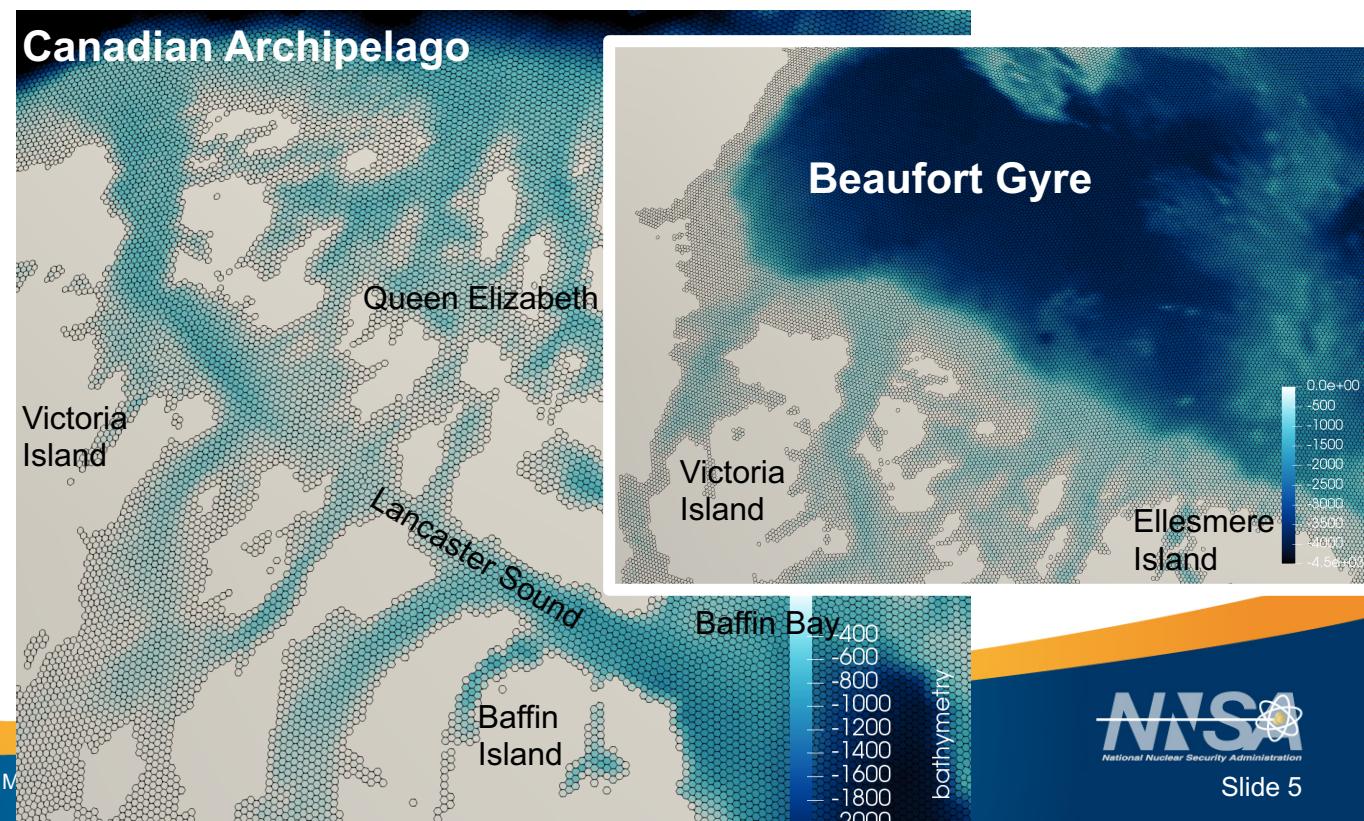


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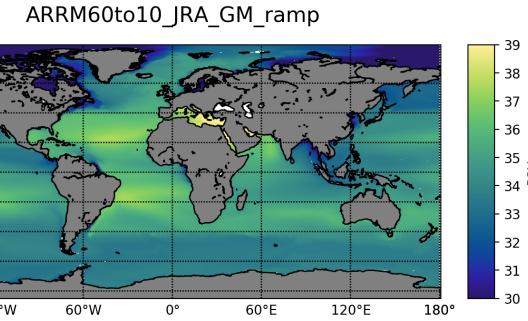
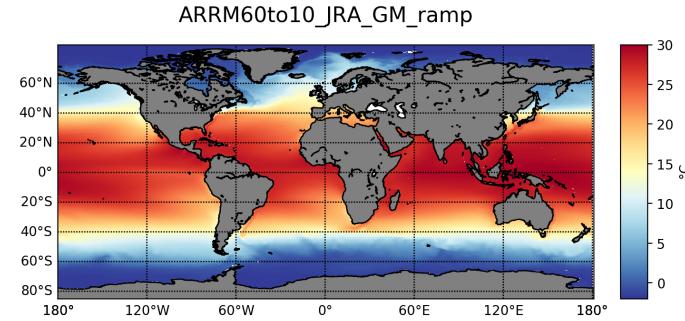


E3SM-Arctic-OSI simulations

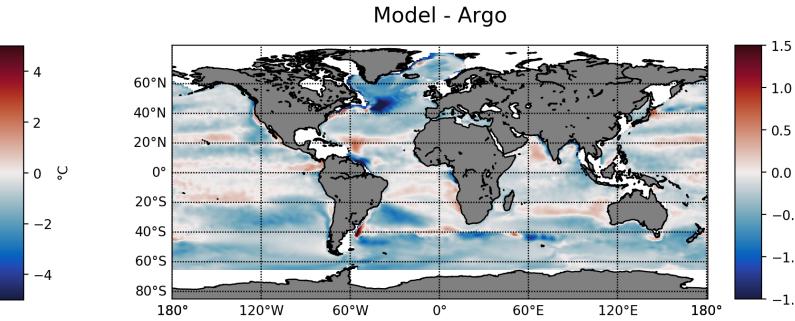
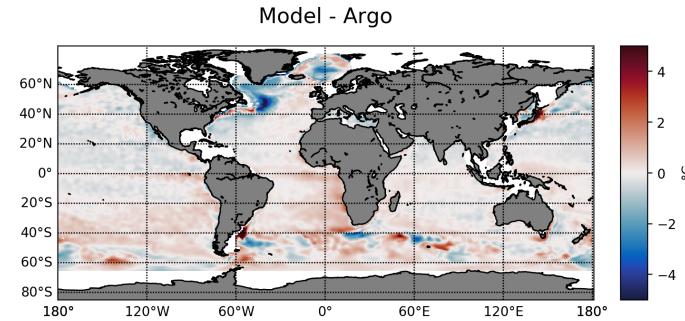
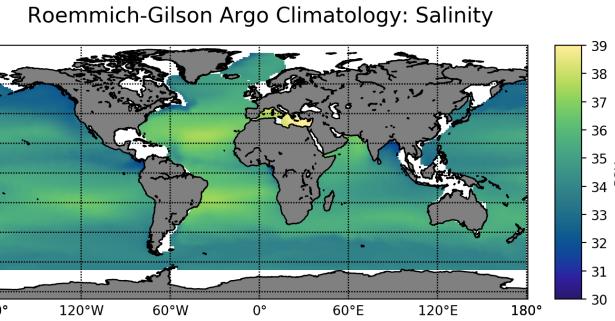
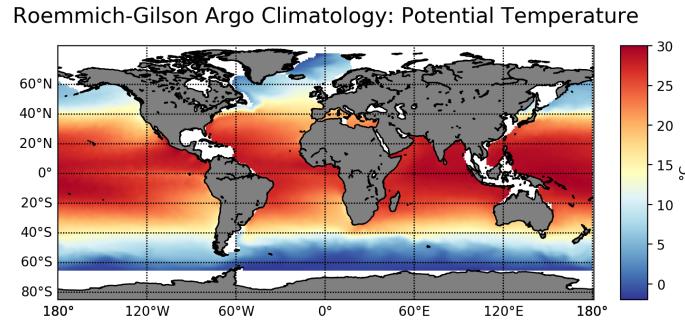
- Variable Gent-McWilliams eddy parameterization (GM parameter transitions from 0 at $\text{cellSize} < 20$ km to its maximum value at $\text{cellSize} > 30$ km)
- Forcing is the JRA55-do product (1958-2016 cycle)
- Simulations underway:
 - two JRA55 cycles for the 60to10 configuration (LANL), starting 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

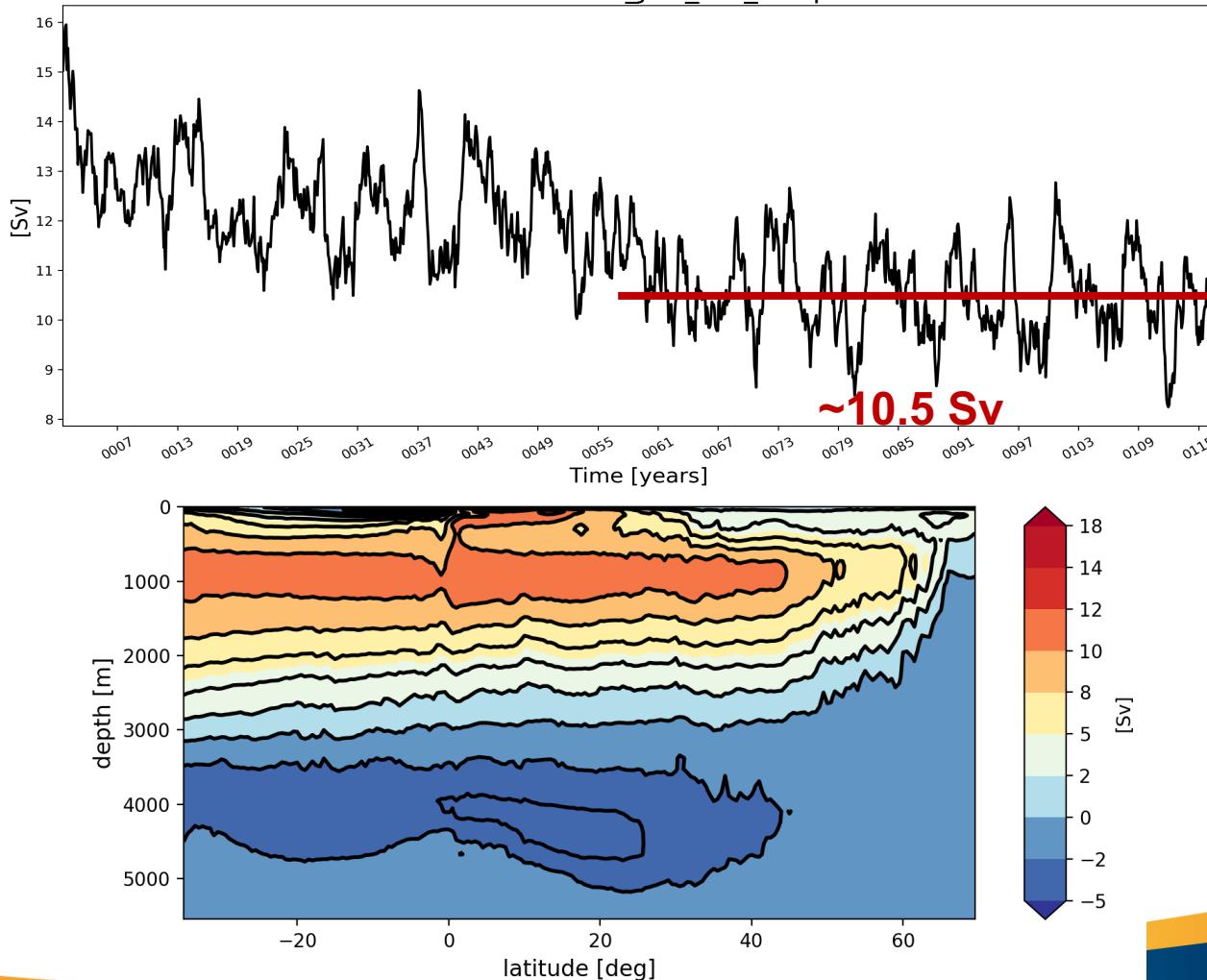


**Model
climatologies
over last 10
years of 2nd
JRA55 cycle**

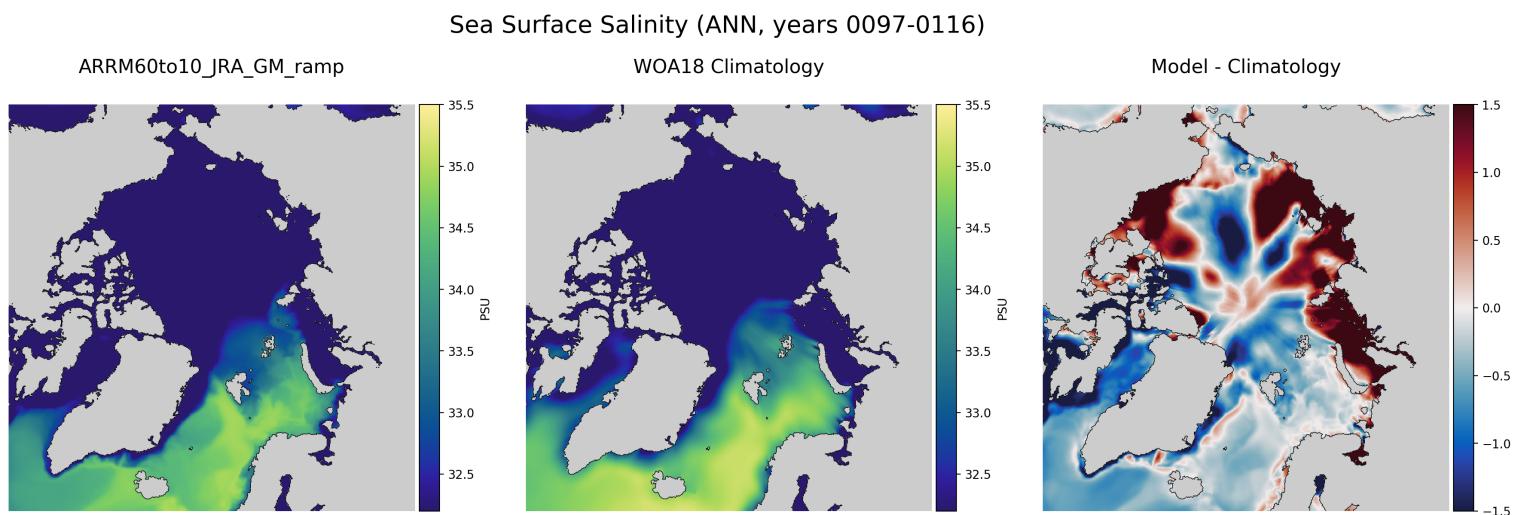
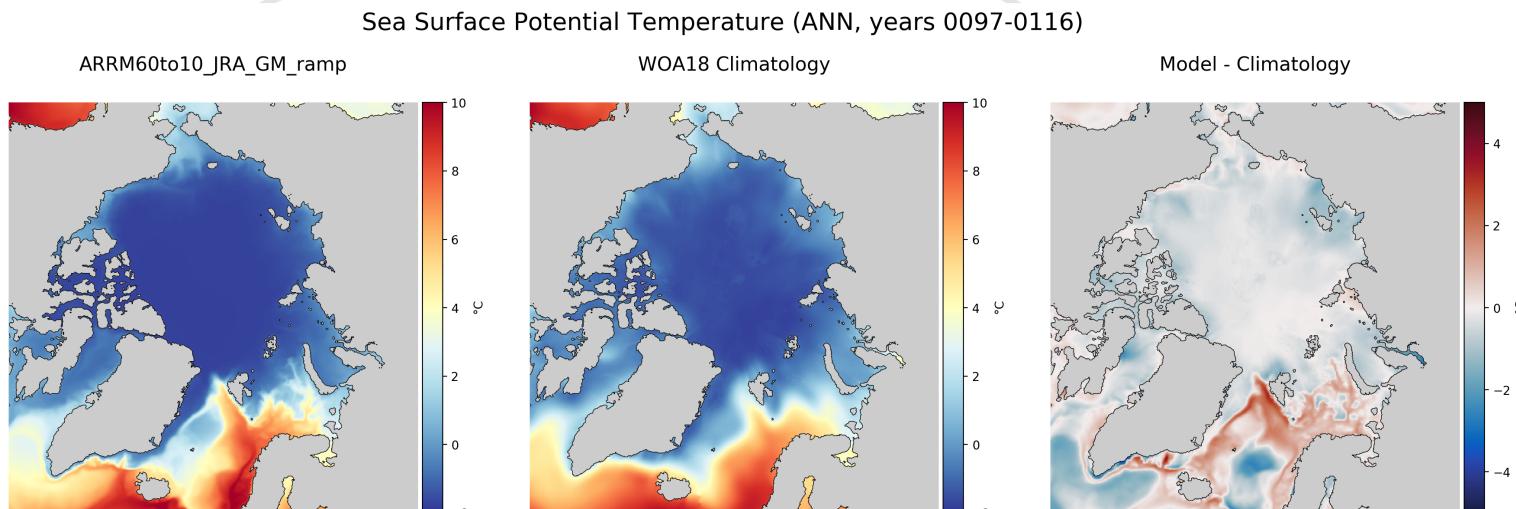


Global perspective: Atlantic MOC

Max Atlantic MOC at 26.5°N
ARRM60to10_JRA_GM_ramp



Arctic Ocean: SST, SSS compared with WOA18

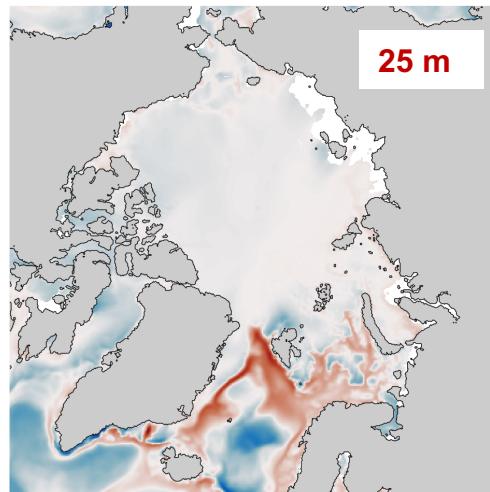


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Arctic Ocean: subsurface T,S biases with respect to WOA18

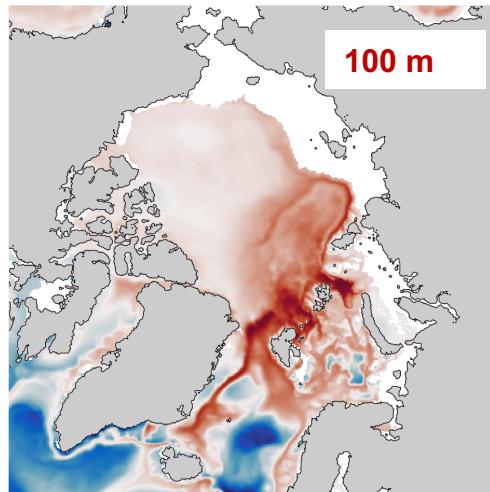
Temperature bias

Model - Climatology



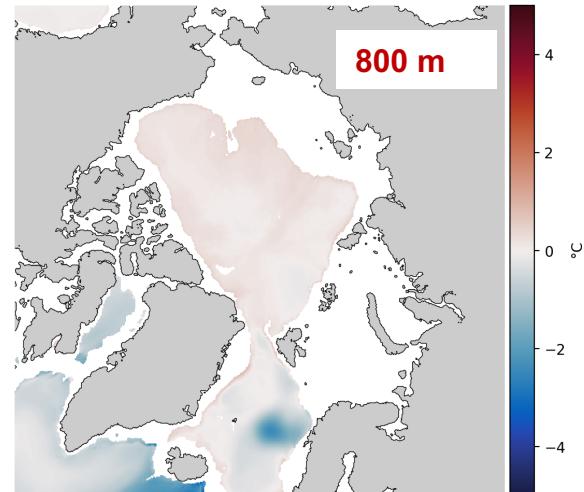
25 m

Model - Climatology



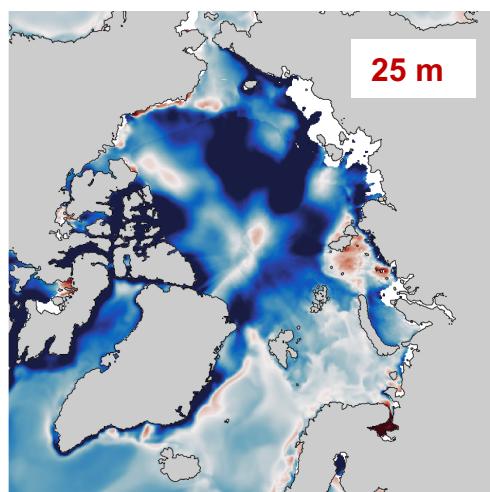
100 m

Model - Climatology

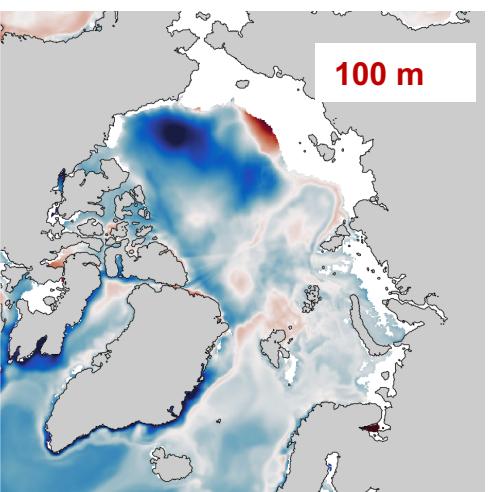


800 m

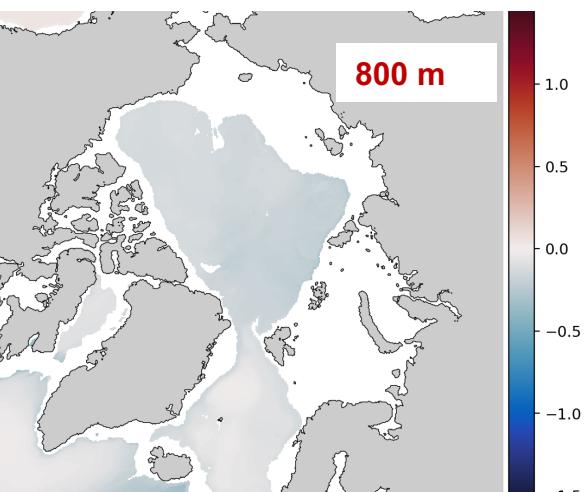
Salinity bias



25 m

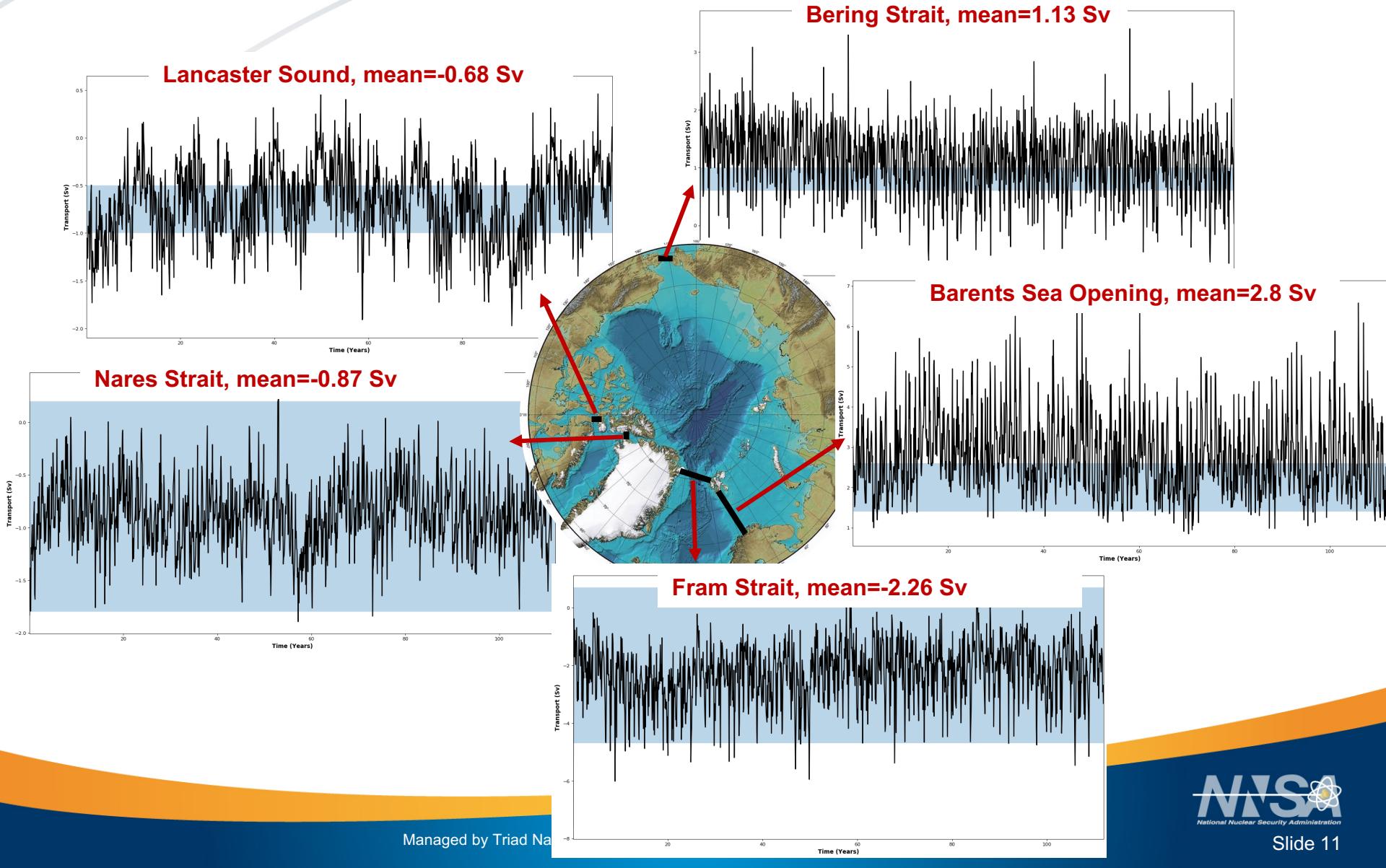


100 m



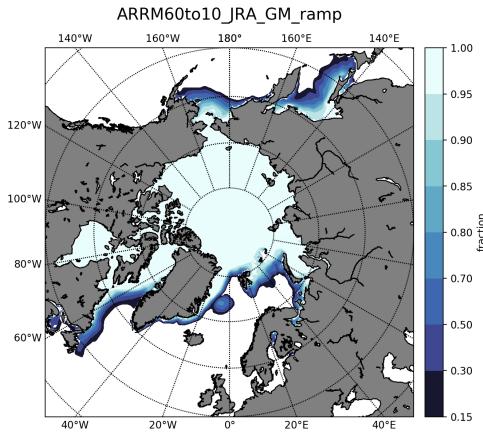
800 m

Arctic Ocean: mass transport across critical passages

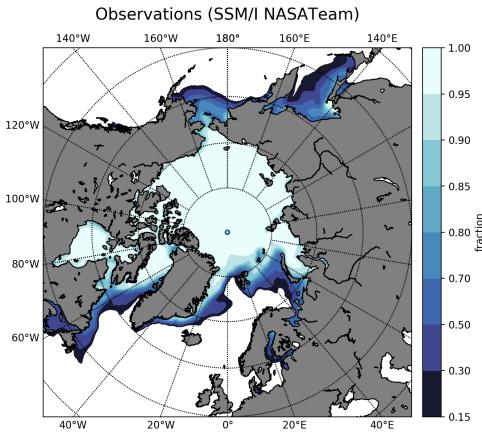


Arctic sea-ice concentration

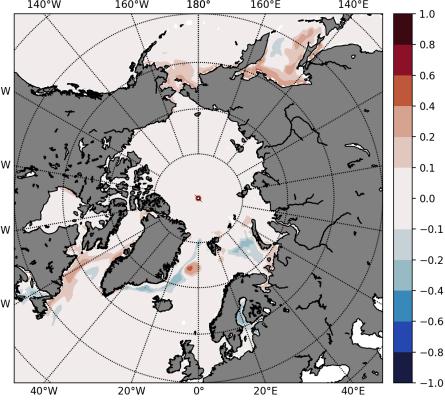
JFM



Sea ice concentration (JFM, years 0097-0116)

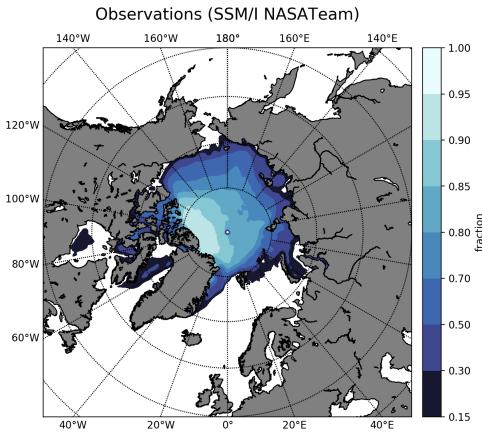
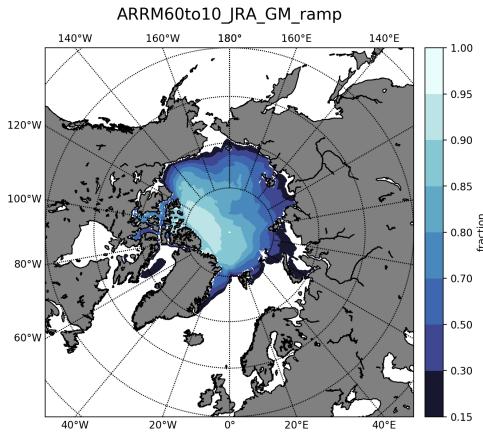


Model - Observations

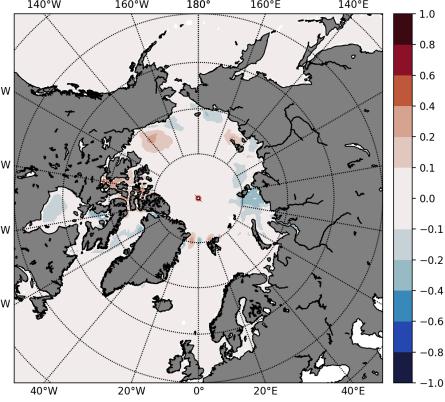


Sea ice concentration (JAS, years 0097-0116)

JAS

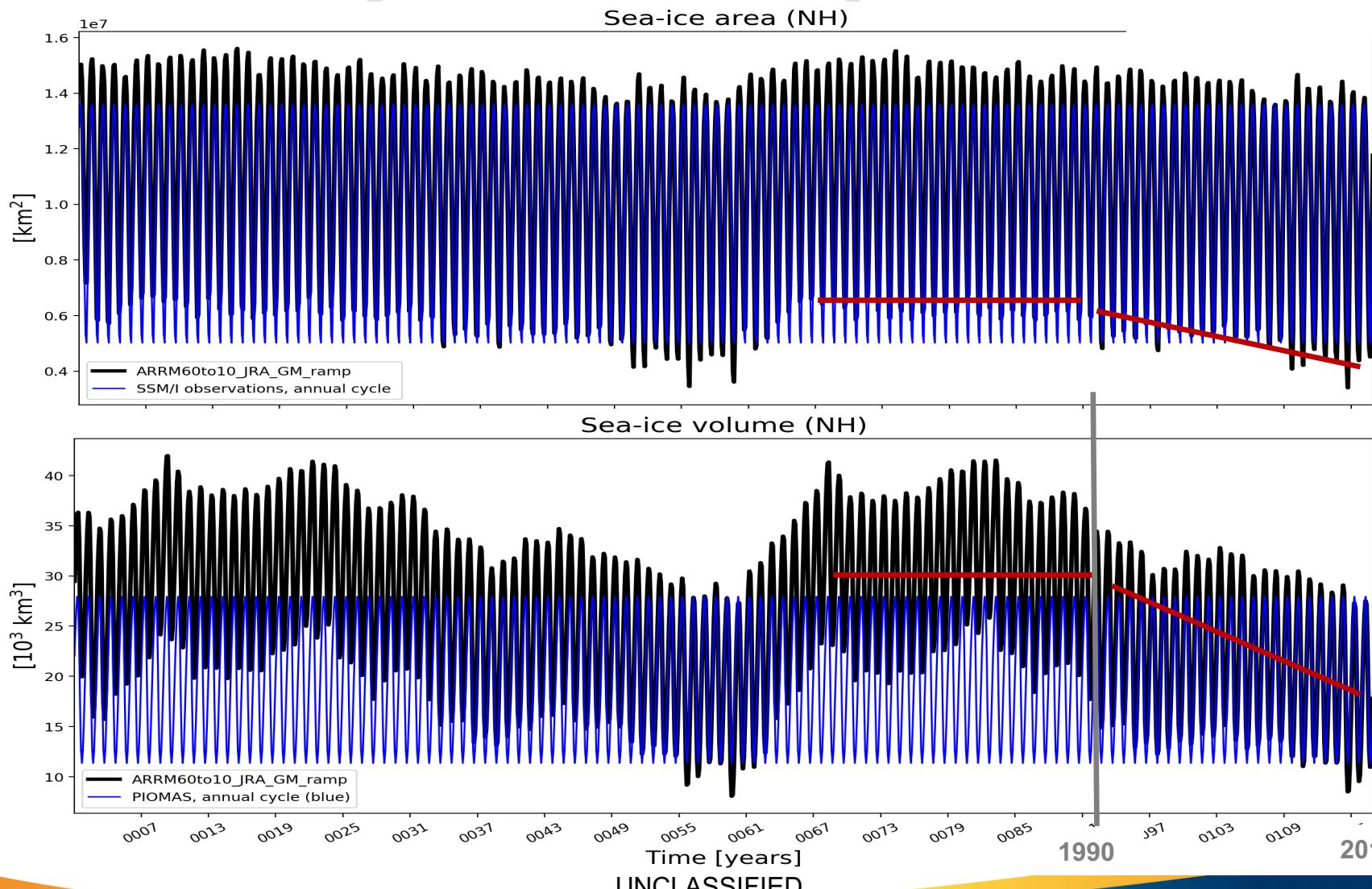


Model - Observations

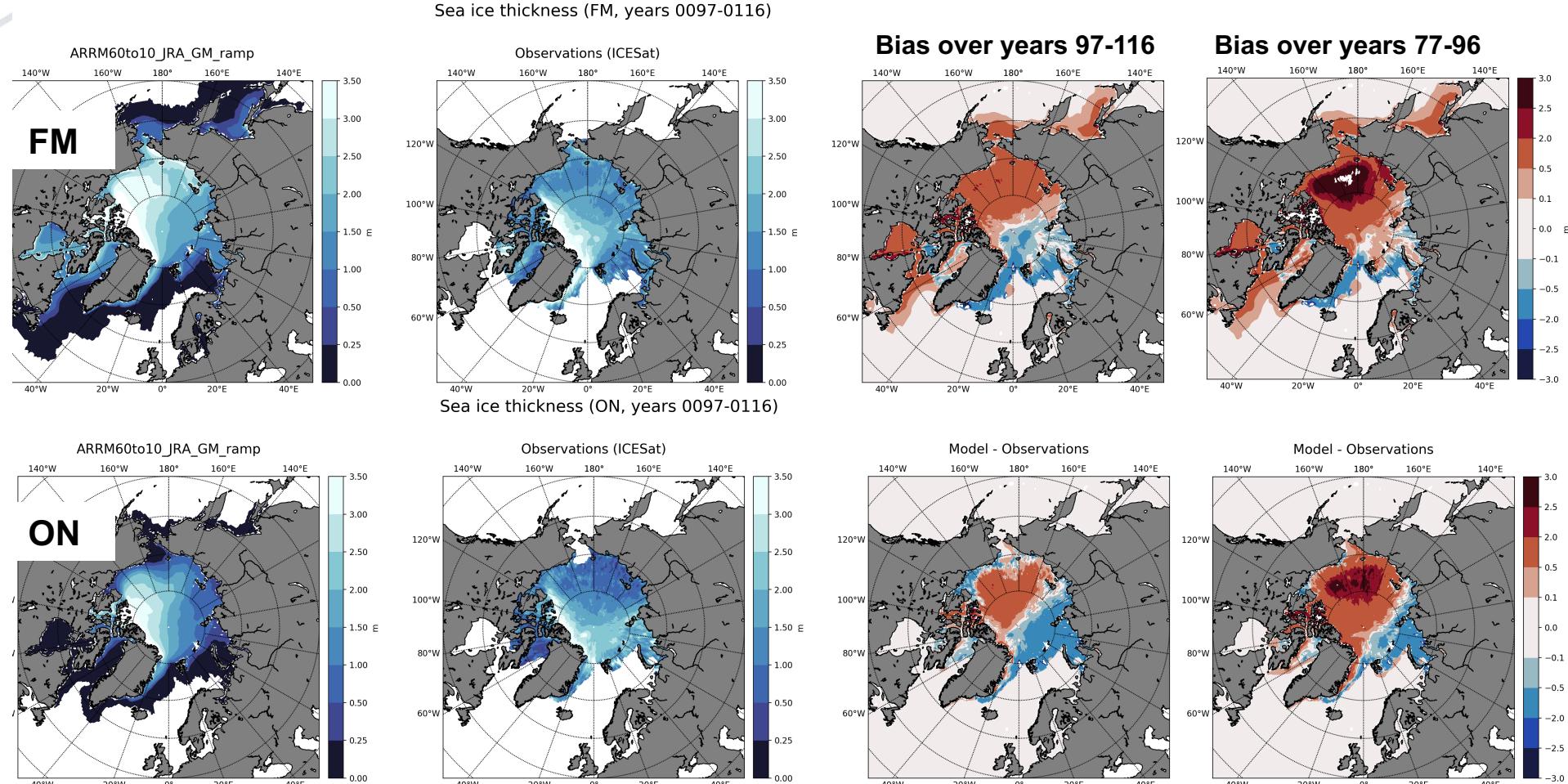


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Arctic sea-ice trends



Arctic sea-ice thickness



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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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