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

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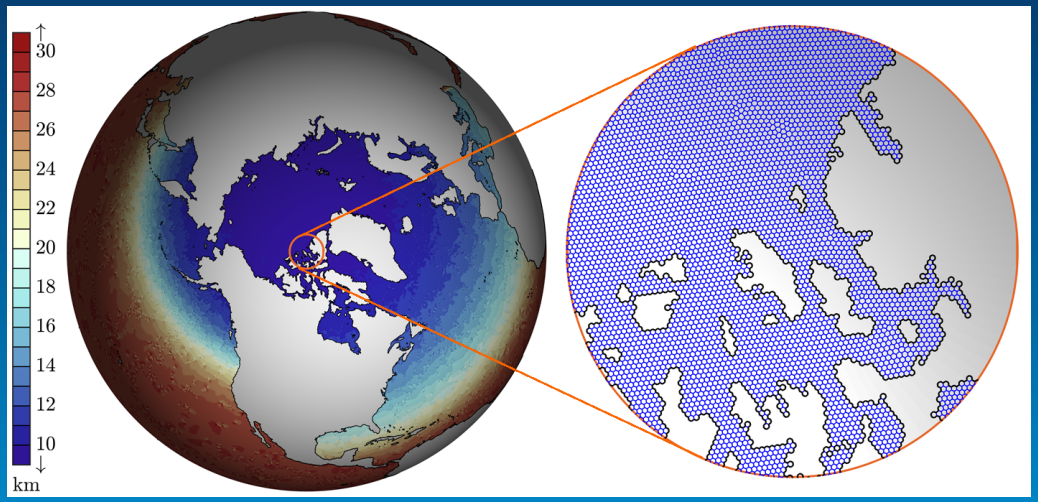
[(1)]LANL, [(2)]Institute of Oceanology Polish Academy of Sciences, [(3)]Naval Postgraduate School



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

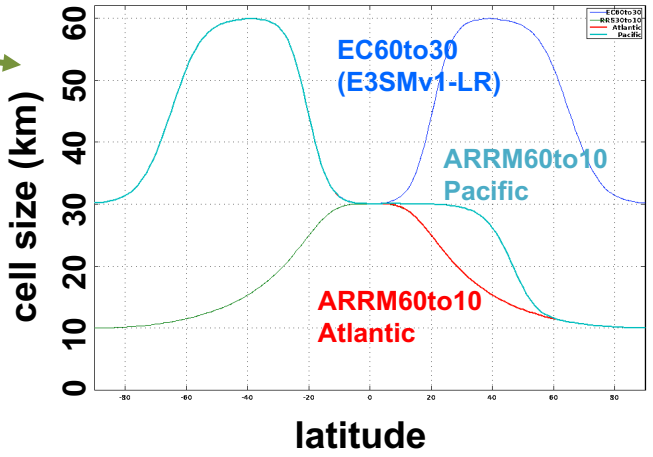
- HiLAT-RASM main charge is to investigate exchange processes between the high- and mid-latitudes that are *critical* for the high-latitudes roles in the global system

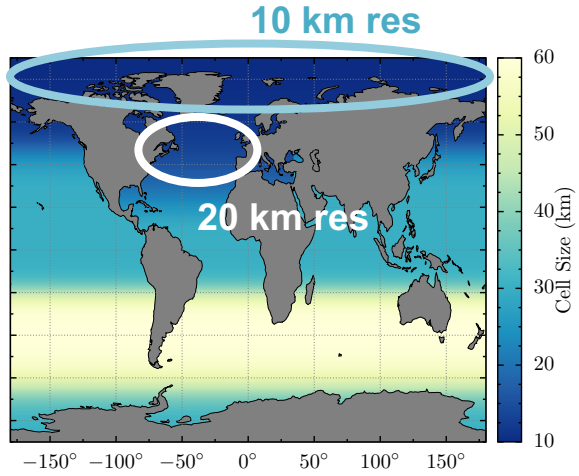
The What and Why

- 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

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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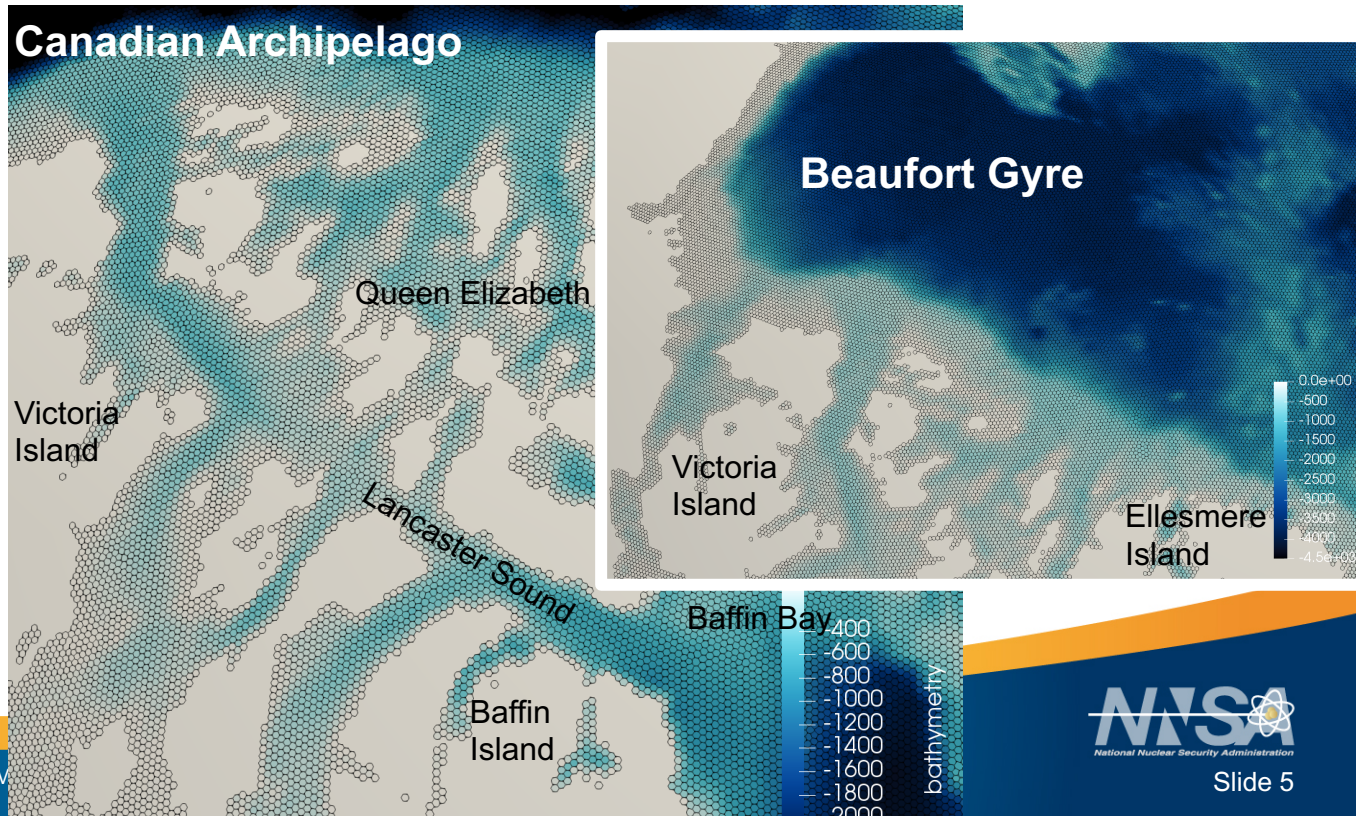
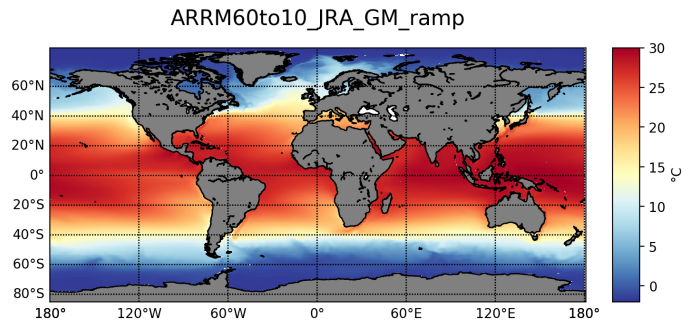
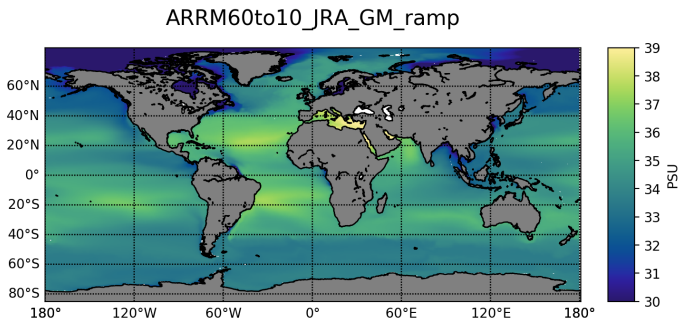


E3SM-Arctic-OSI simulations

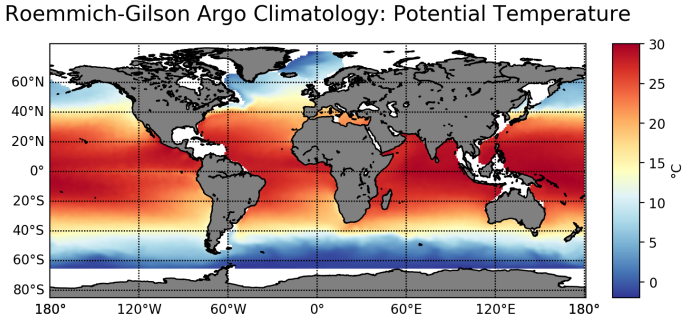
- Variable Gent-McWilliams eddy parameterization (GM parameter transitions from 0 at cellSize<20 km to its maximum value at cellSize>30 km)
- Forcing is the JRA55-do product (1958-2016 cycle)
- Simulations underway:
  - two JRA55 cycles for the 60to10 configuration (LANL), starting our third and likely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

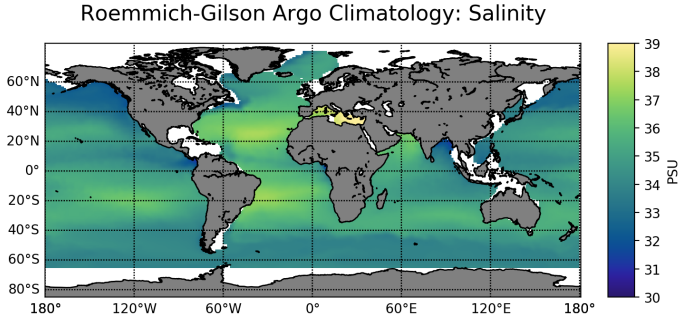
Results from the 60to10: Global perspective SST, SSS compared with ARGO observations

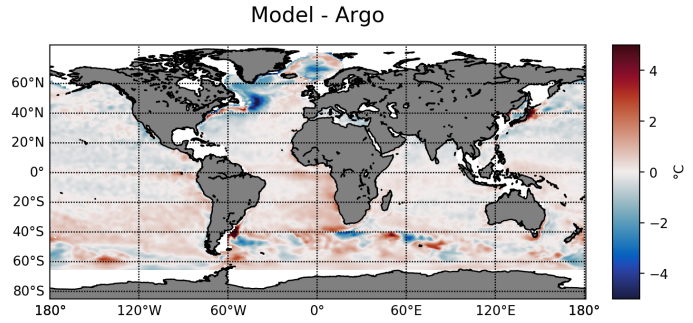


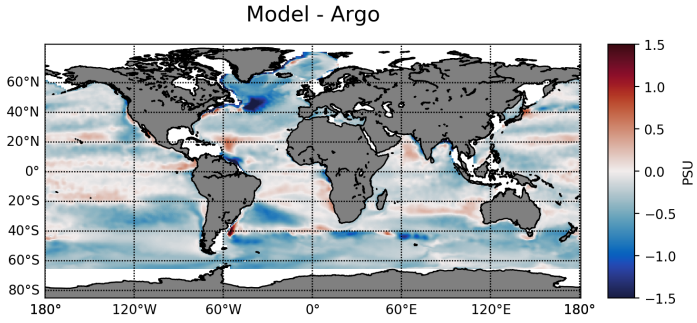


Model climatologies over last 10 years of 2nd JRA55 cycle

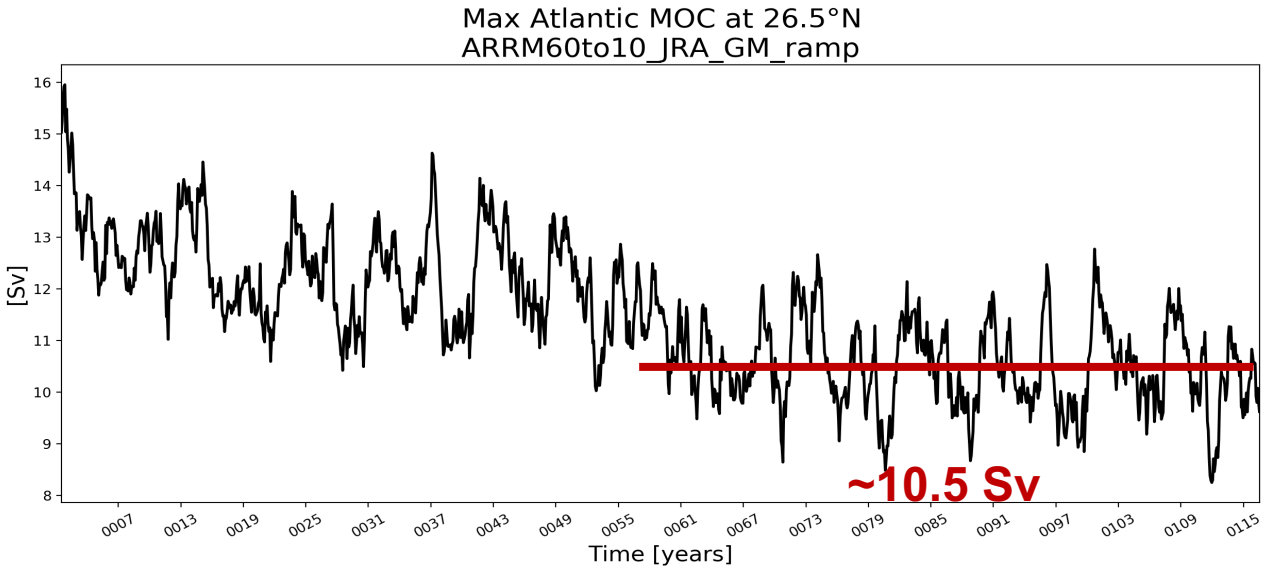


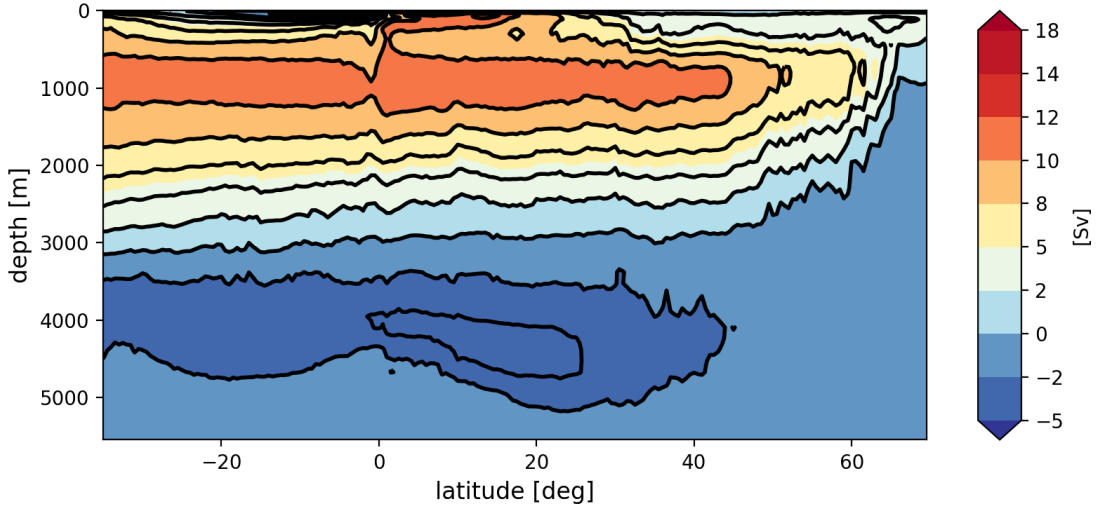






Global perspective: Atlantic MOC

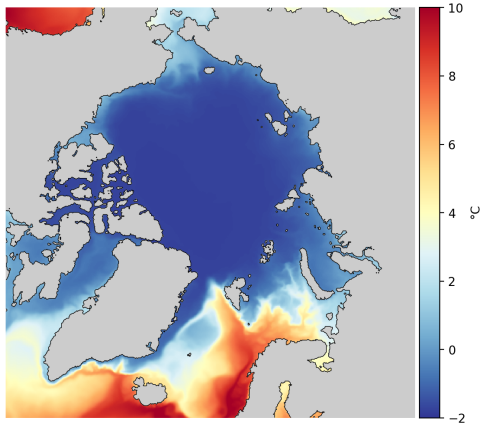




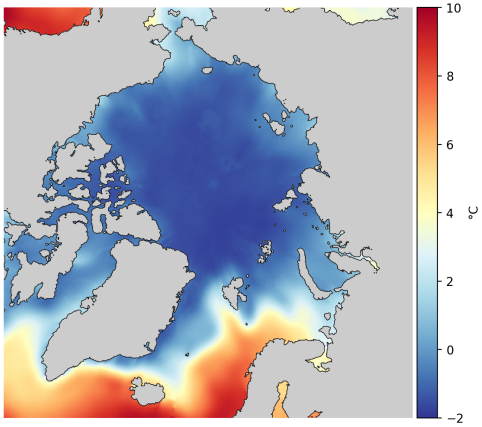
Arctic Ocean: SST, SSS compared with WOA18

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

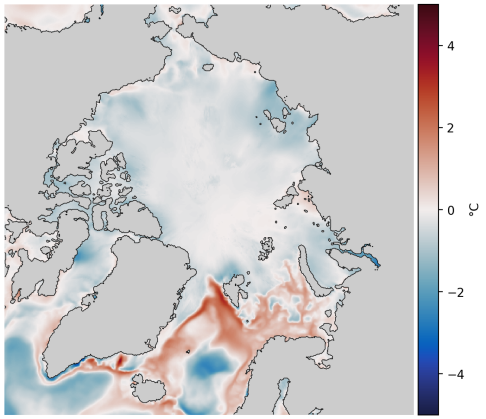
ARRM60to10_JRA_GM_ramp



WOA18 Climatology

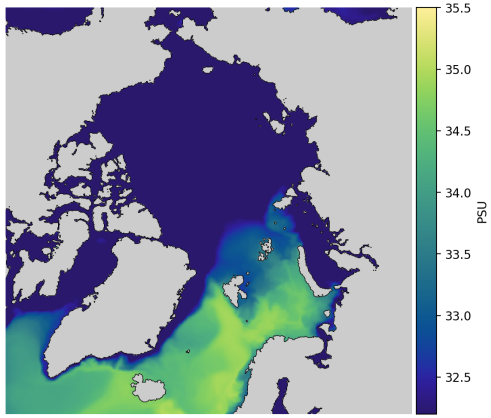


Model - Climatology

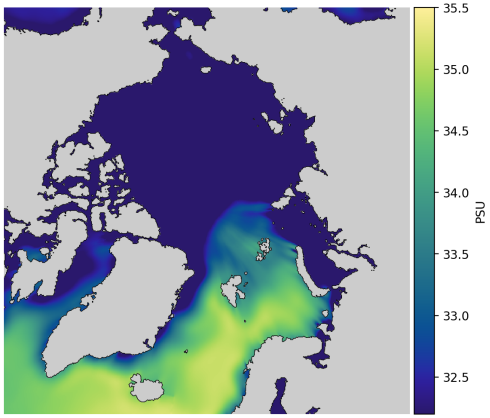


Sea Surface Salinity (ANN, years 0097-0116)

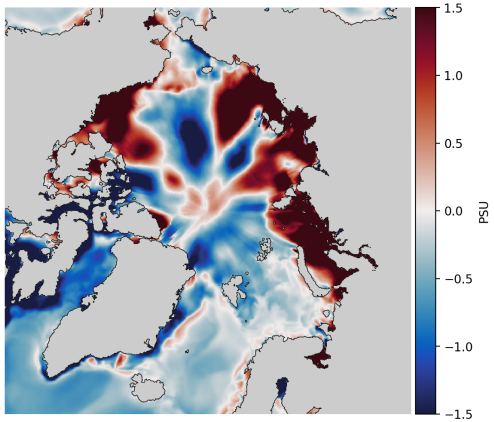
ARRM60to10_JRA_GM_ramp



WOA18 Climatology



Model - Climatology



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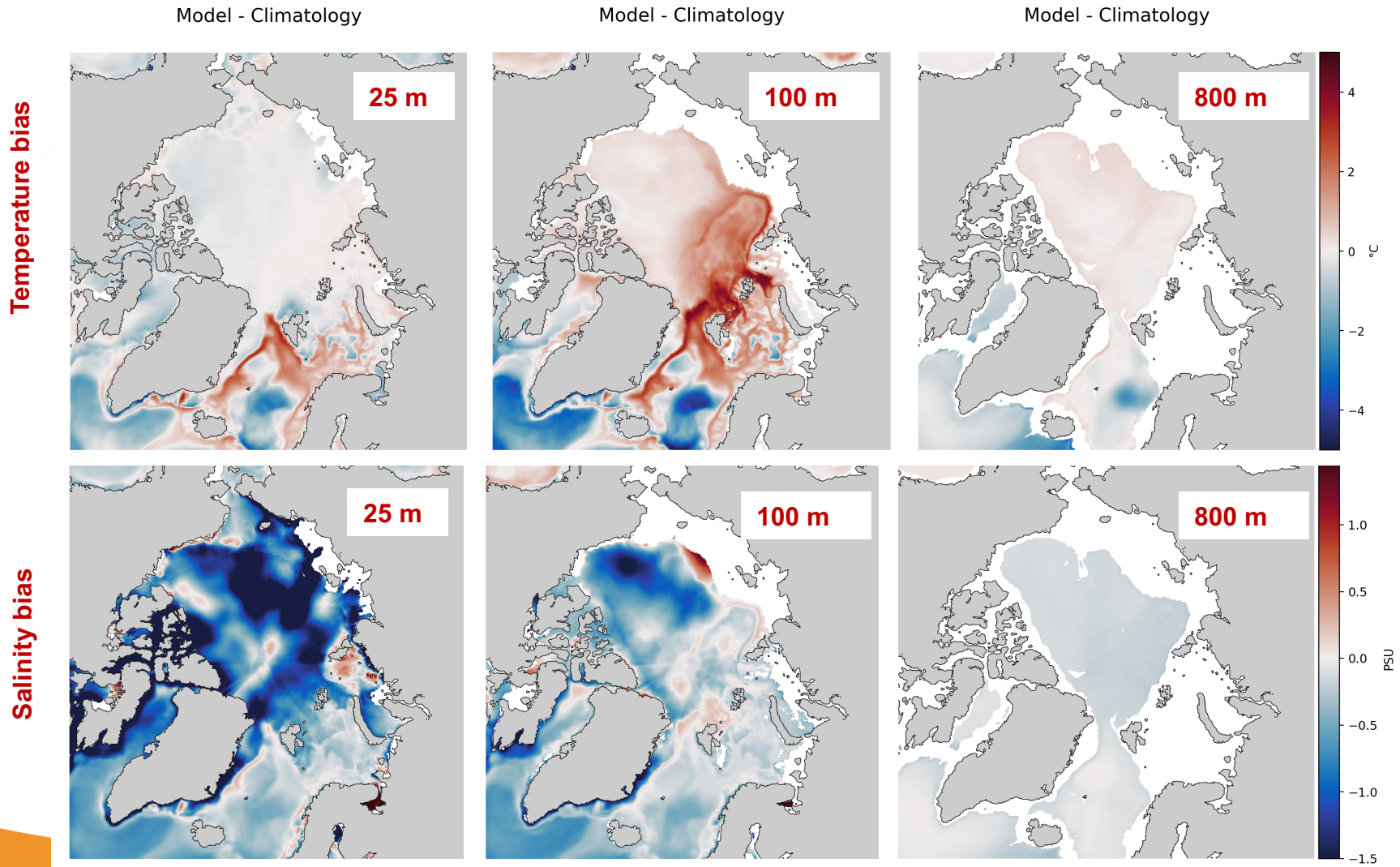
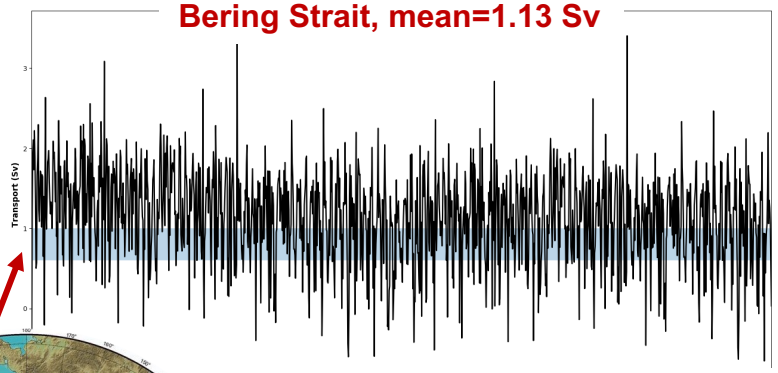
Arctic Ocean: subsurface T,S biases with respect to WOA18

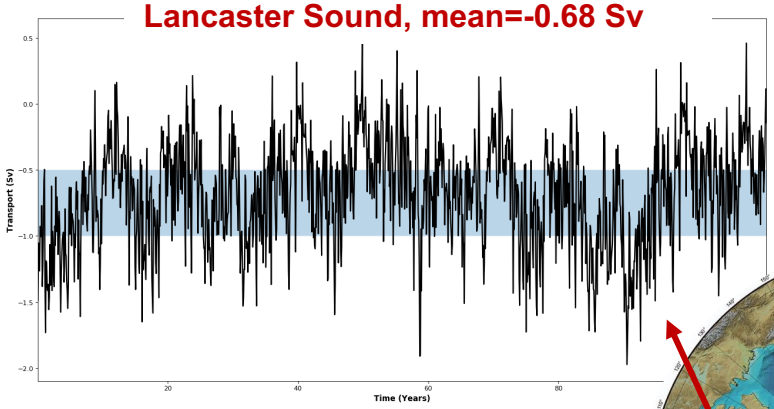


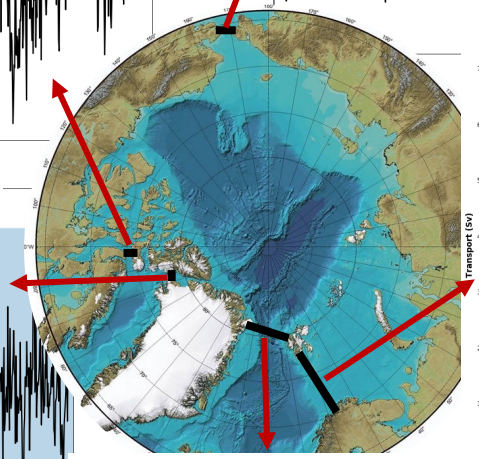
Arctic Ocean: mass transport across critical passages

Bering Strait, mean=1.13 Sv

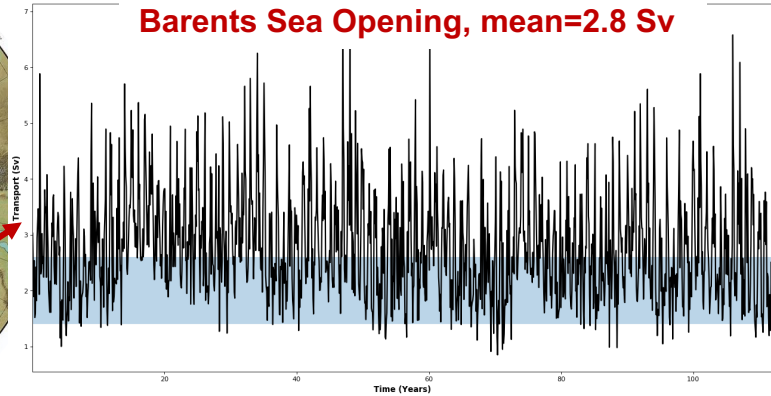


Lancaster Sound, mean=-0.68 Sv

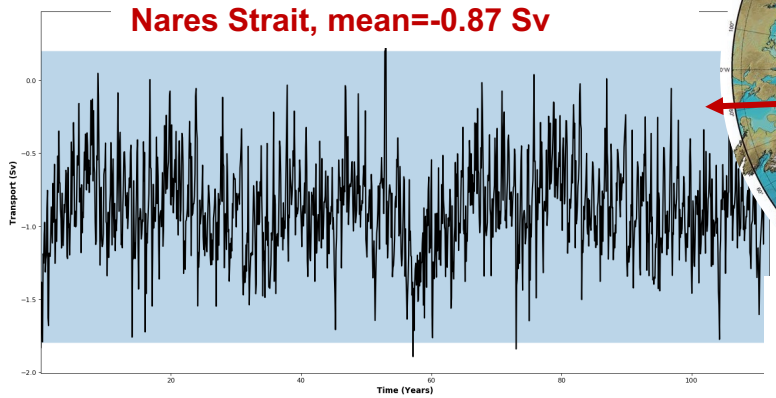




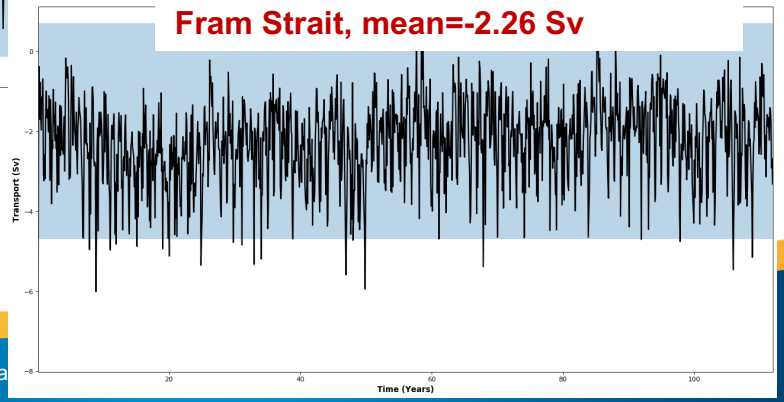
Barents Sea Opening, mean=2.8 Sv



Nares Strait, mean=-0.87 Sv



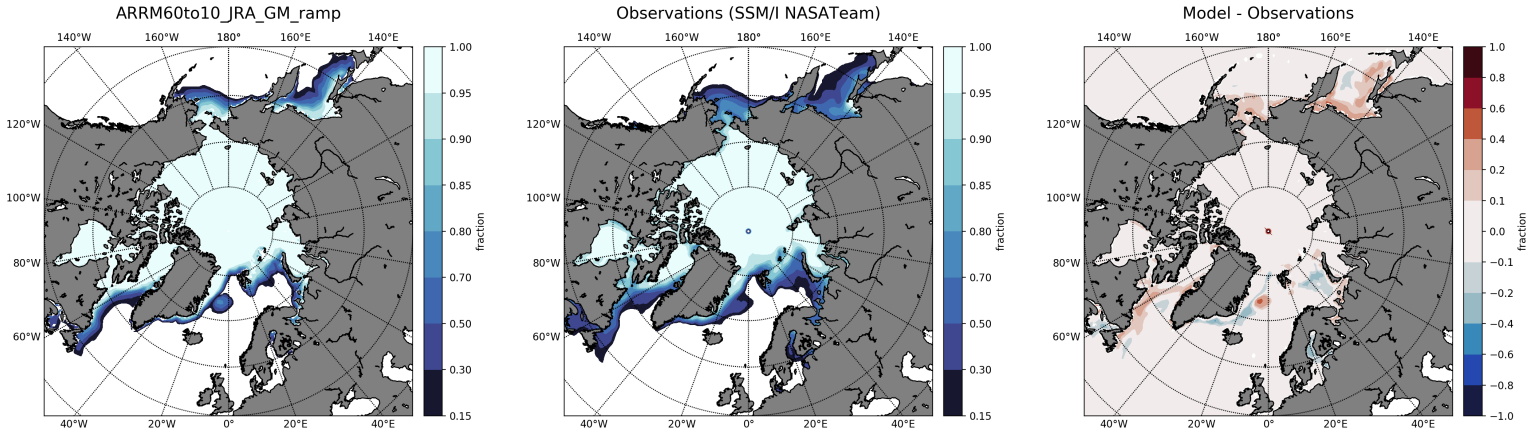
Fram Strait, mean=-2.26 Sv



Arctic sea-ice concentration

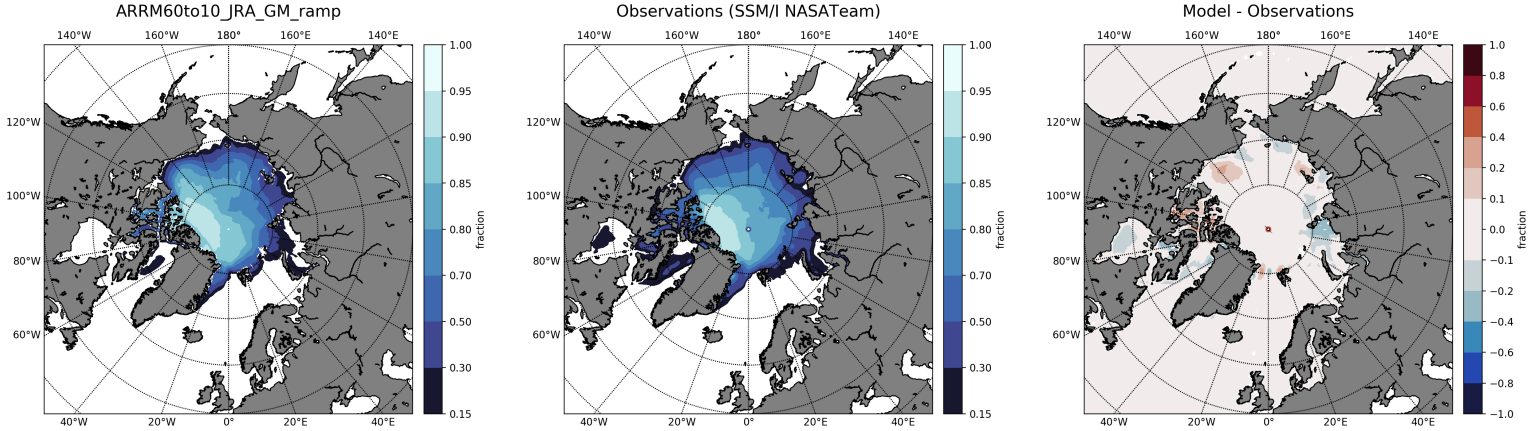
Sea ice concentration (JFM, years 0097-0116)

JFM

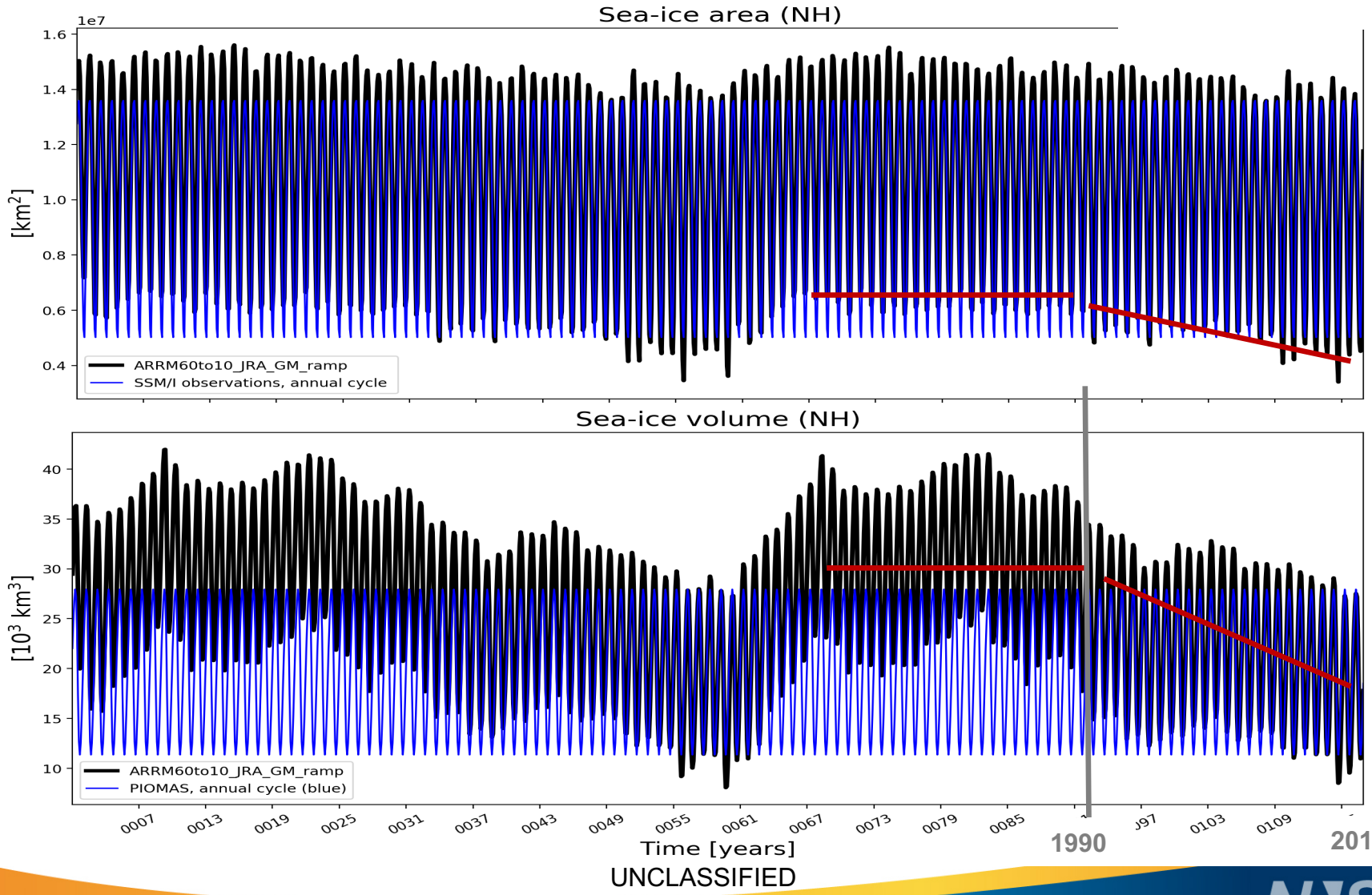


Sea ice concentration (JAS, years 0097-0116)

JAS



Arctic sea-ice trends



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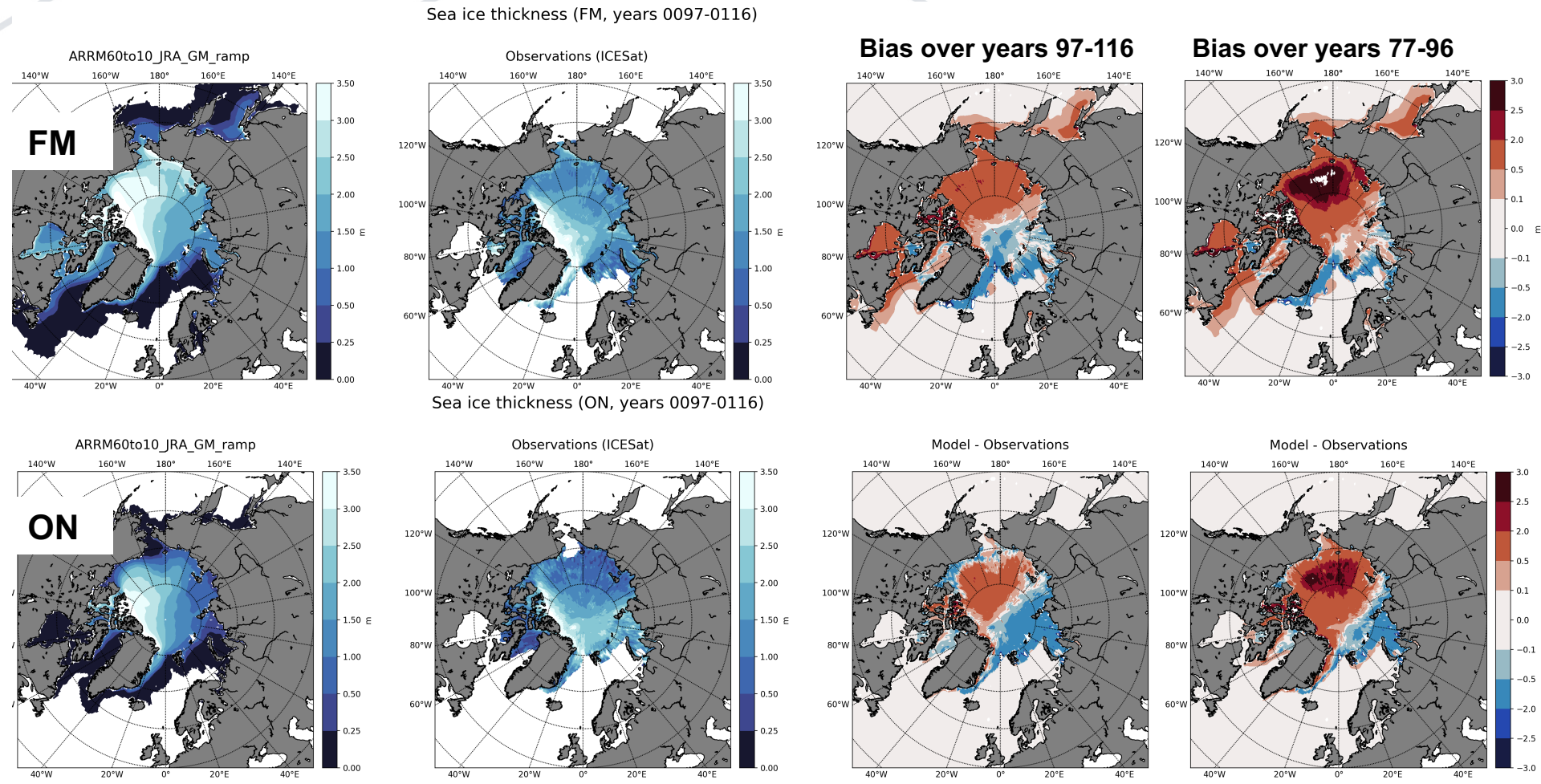
Arctic sea-ice thickness



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

Thanks!