Arctic Regionally Refined E3SM Configurations: Initial Results from Forced Ocean-Sea Ice (E3SM-Arctic-OSI) Simulations

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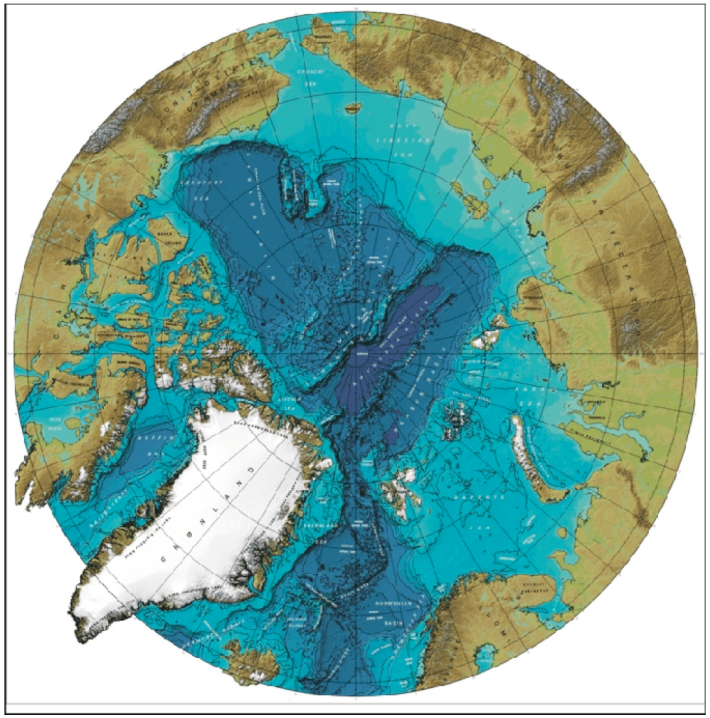
DOE RGMA HiLAT SFA Objectives

To reduce uncertainties and enhance predictive understanding of:

(i) The amplified environmental changes taking place in high latitudes
(ii) Their global effects
(iii) Their seasonal to decadal predictability



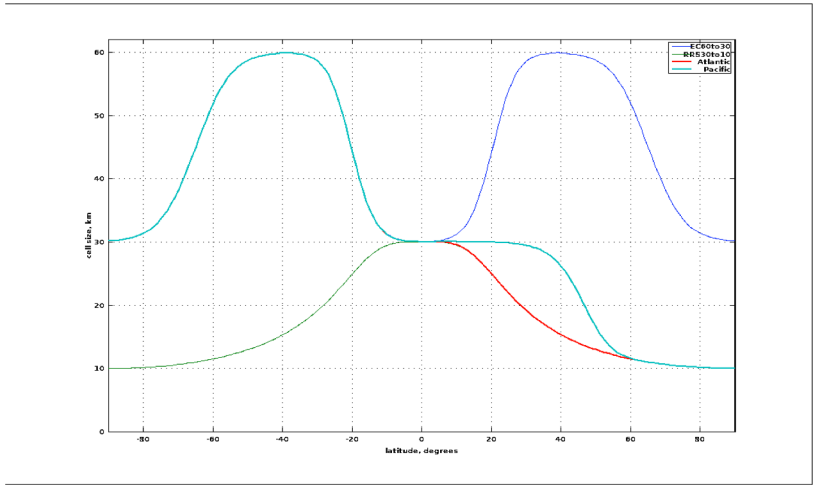
IBCAO v.3 bathymetry map of the Arctic

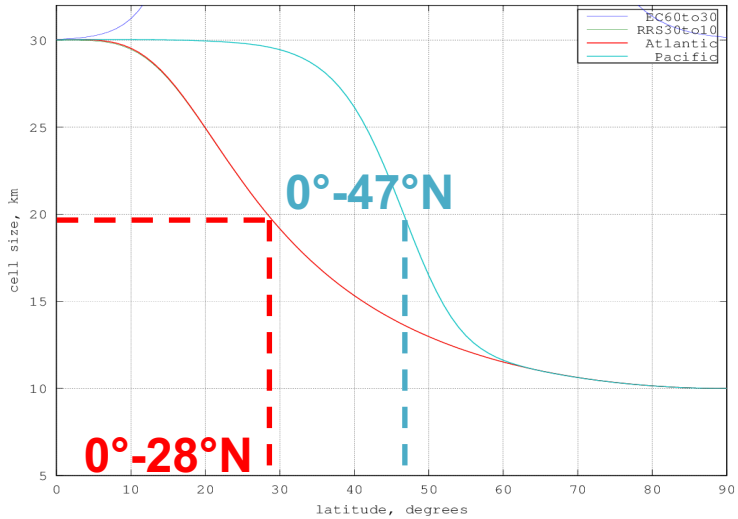
Rationale: Arctic is the most rapidly changing region

Key Arctic Modeling Challenges:

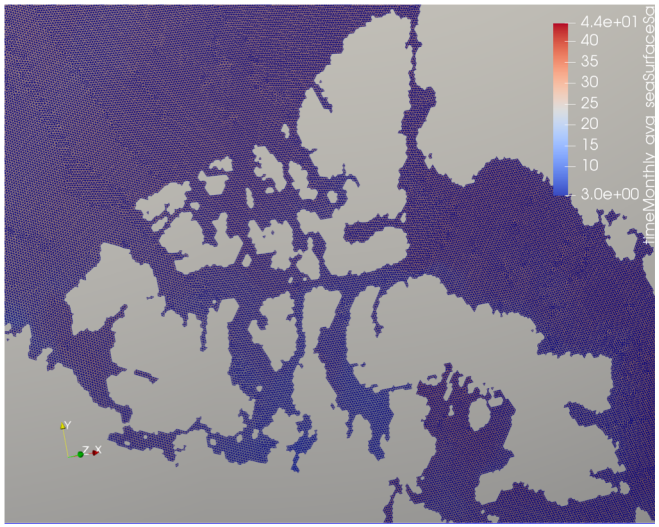
- a land-locked ocean
- narrow oceanic gates
- radius of deformation (1-10km)
- rea ice
- mixed phase clouds

JRA55 (1958-2017) forced E3SM-Arctic-OSI simulations

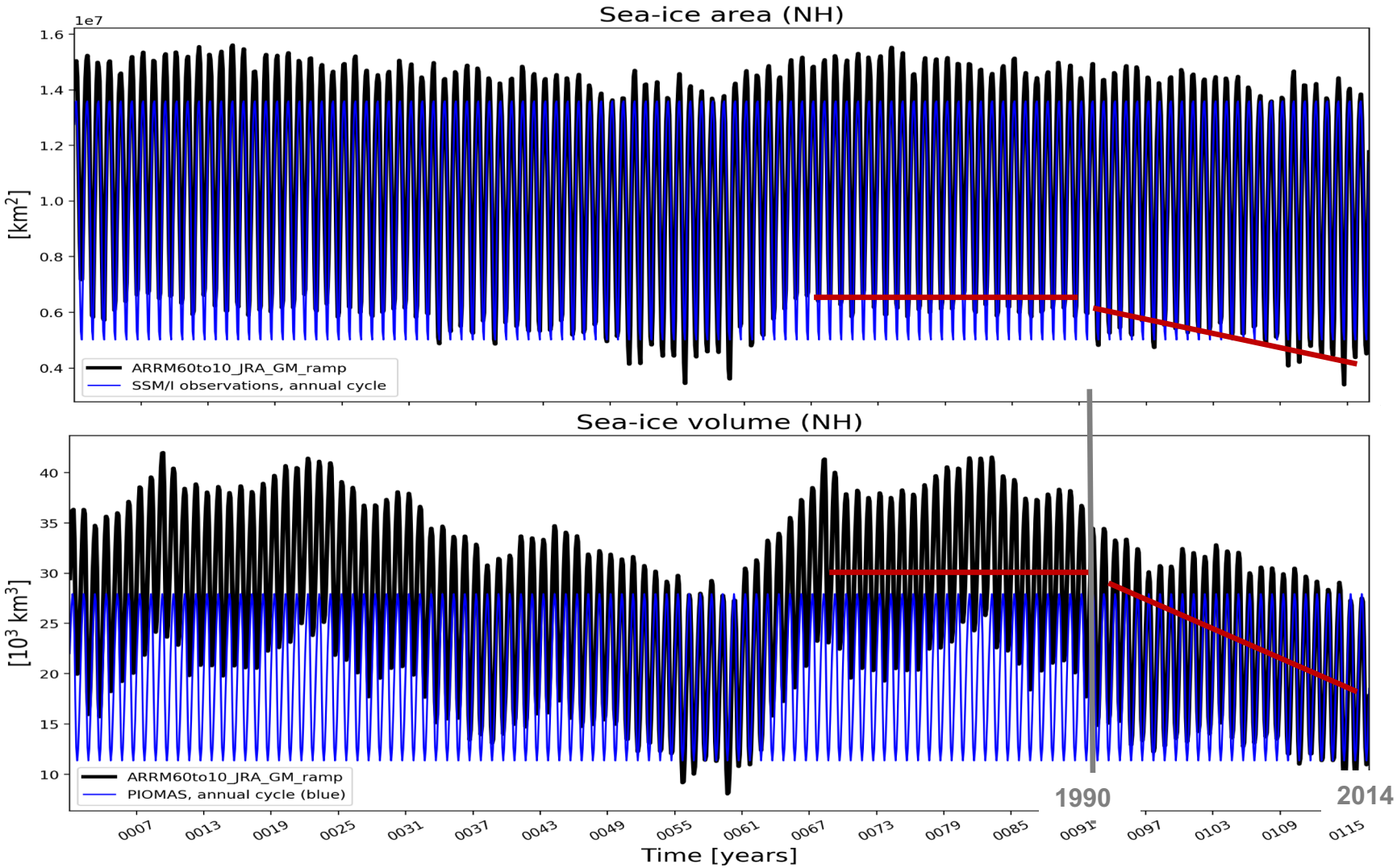




- 60to10 – DOE/cori
  - 3rd cycle by end of Nov'19
- 60to6 - DoD/onyx
  - completed 3 cycles
- 60to10 - DoD/onyx
  - compressive sea-ice strength C_f=34
  - completed 3 cycles (DoD/onyx)

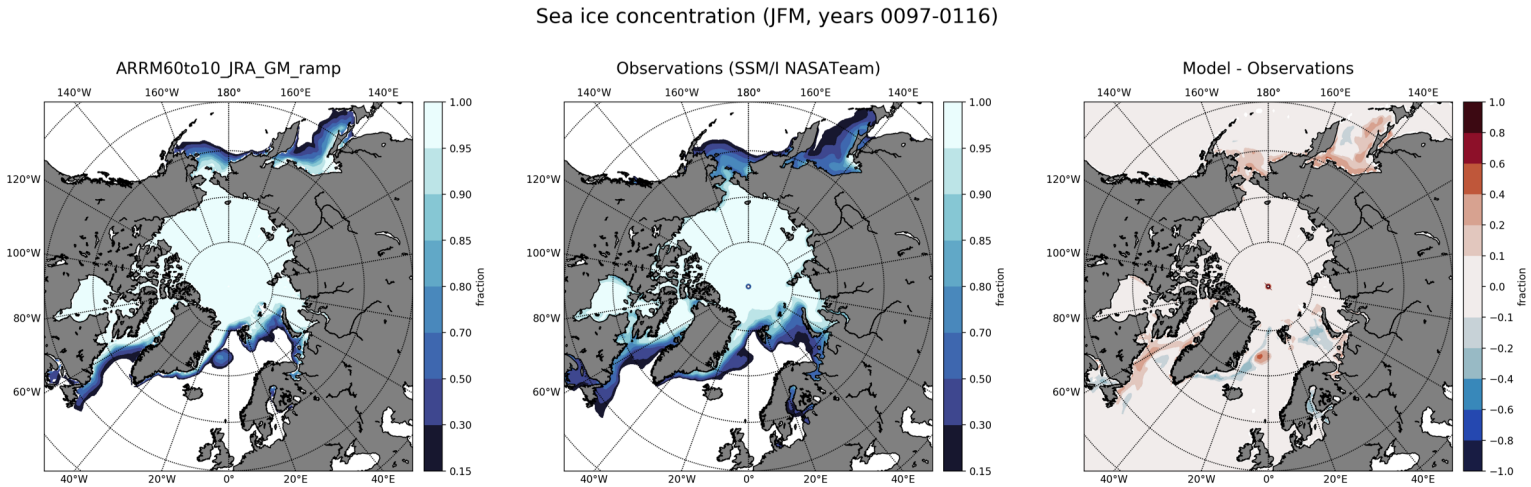


Arctic sea-ice trends – 60to10

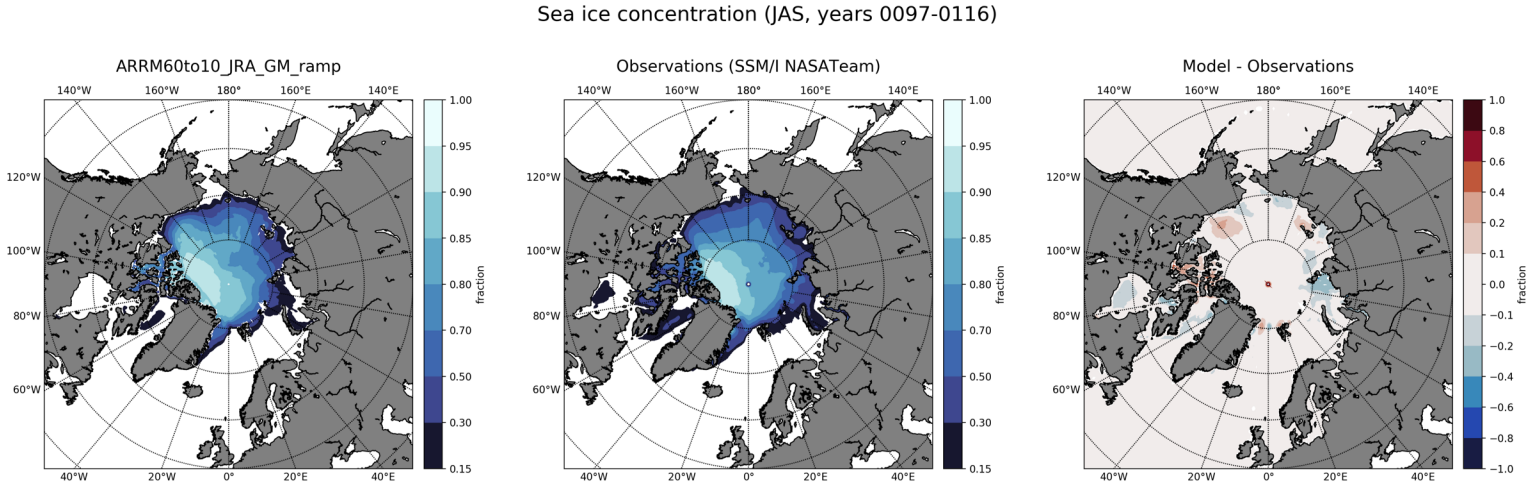


Arctic sea-ice concentration - 60to10

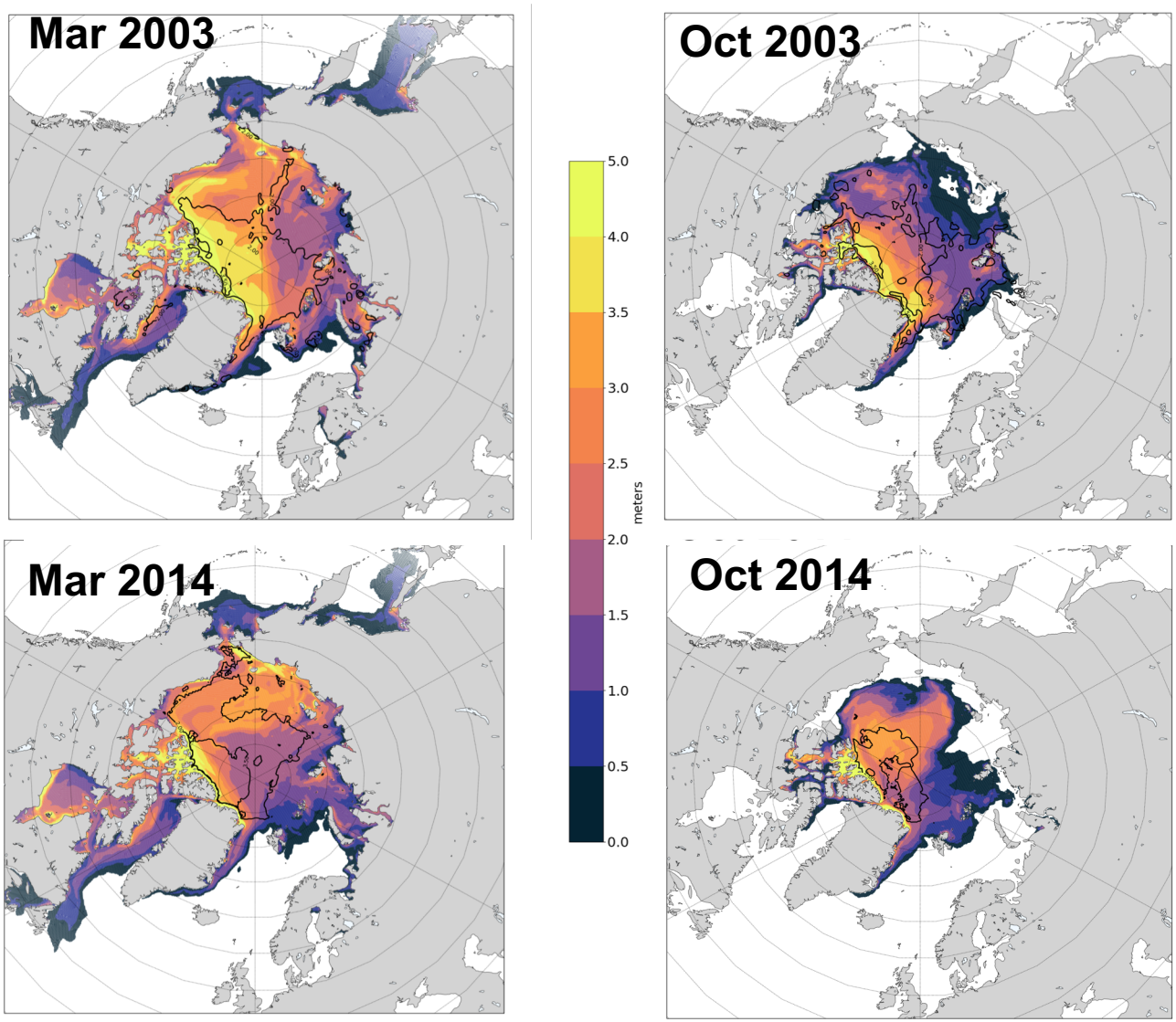
JFM



JAS



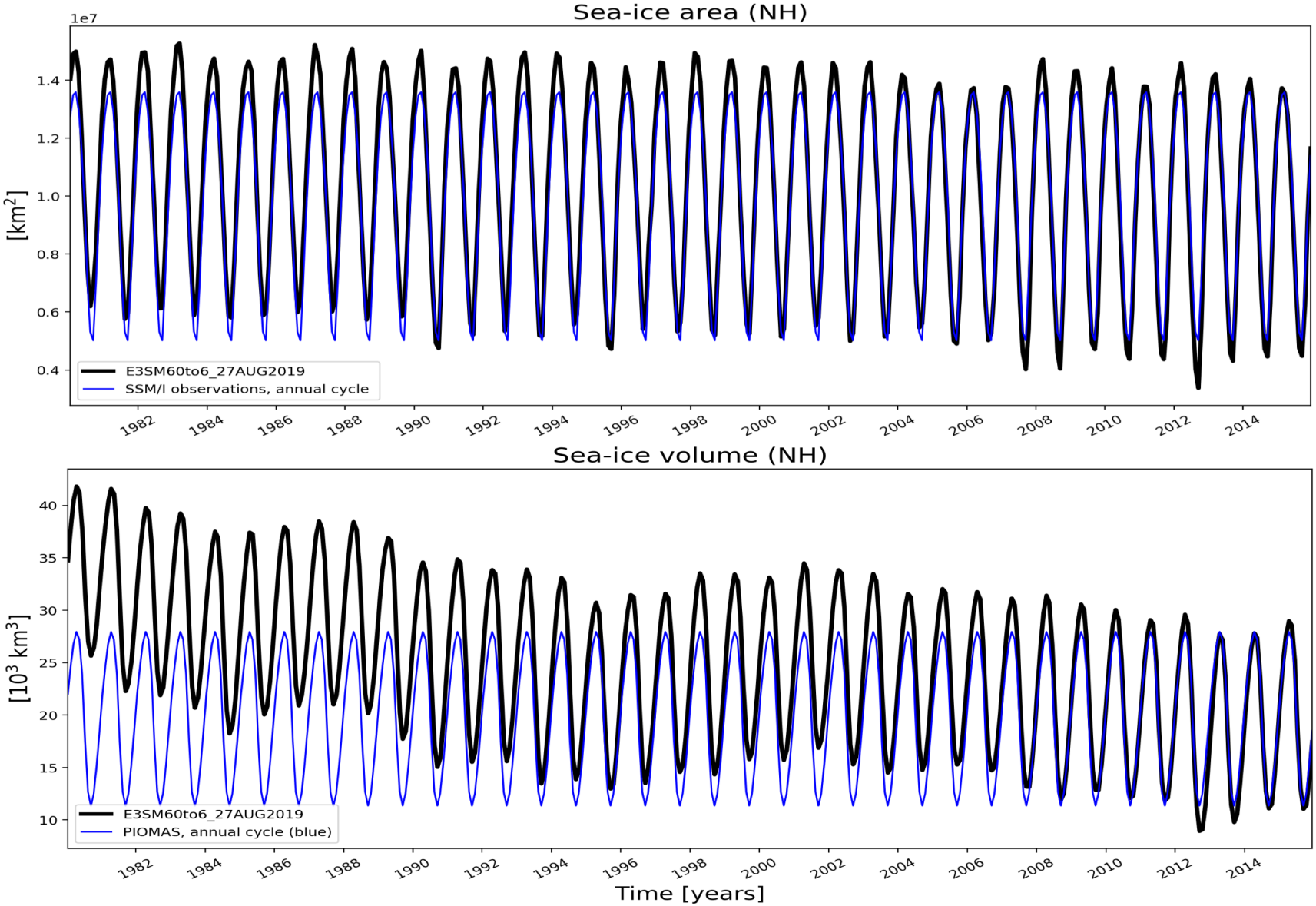
Arctic sea-ice thickness - 60to10



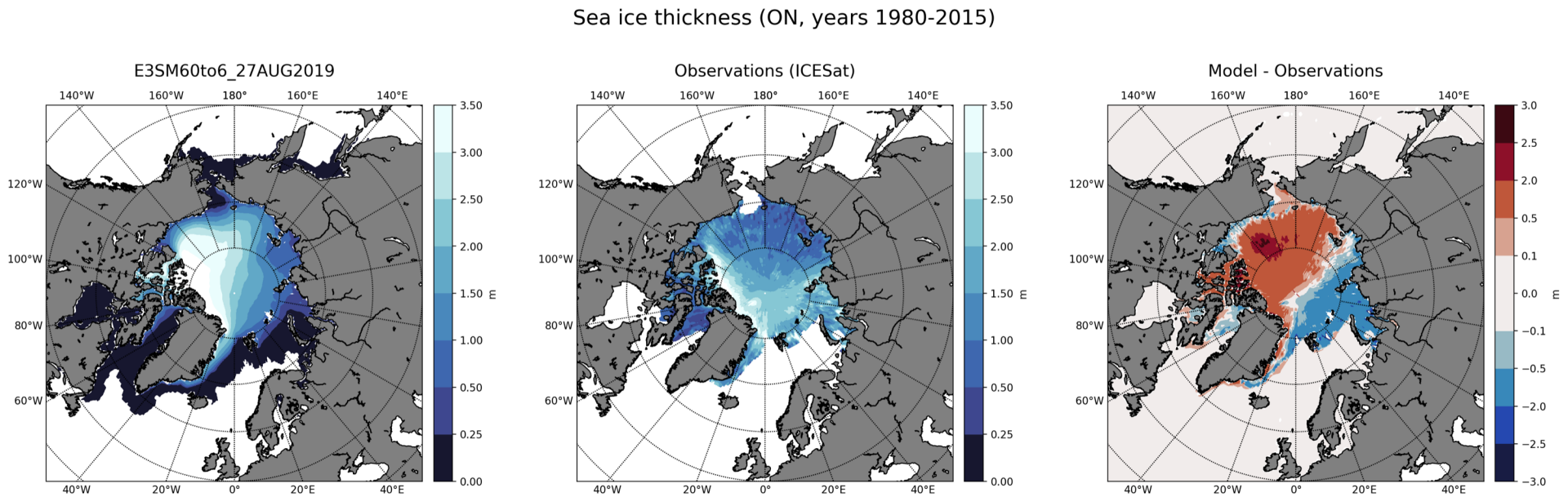
color=model (native grid)

contours=IceSat/CryoSat-2 obs (2m and 3.5m contours)

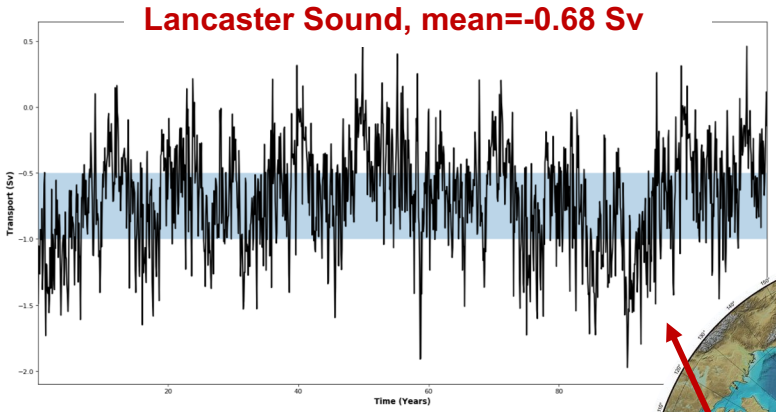
Arctic sea-ice timeseries – 60to6

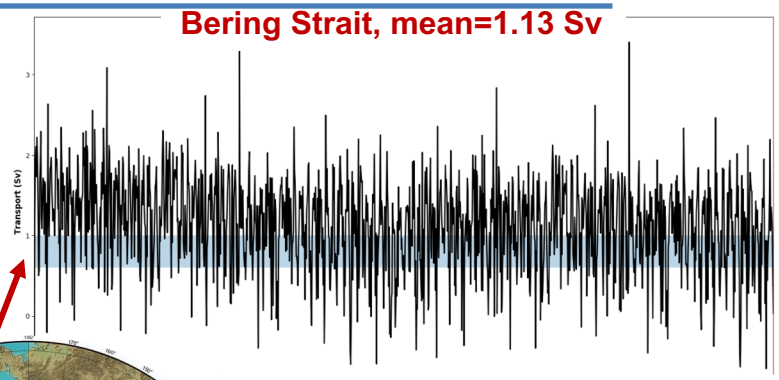


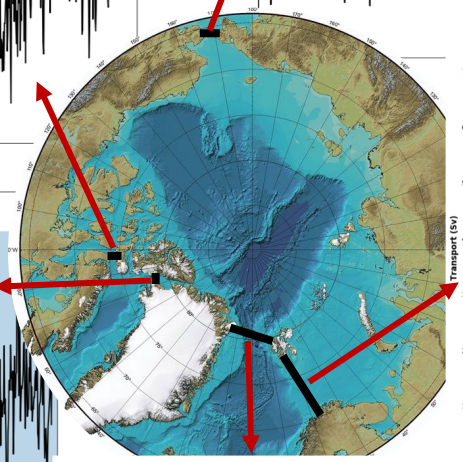
Arctic sea-ice thickness – 60to6

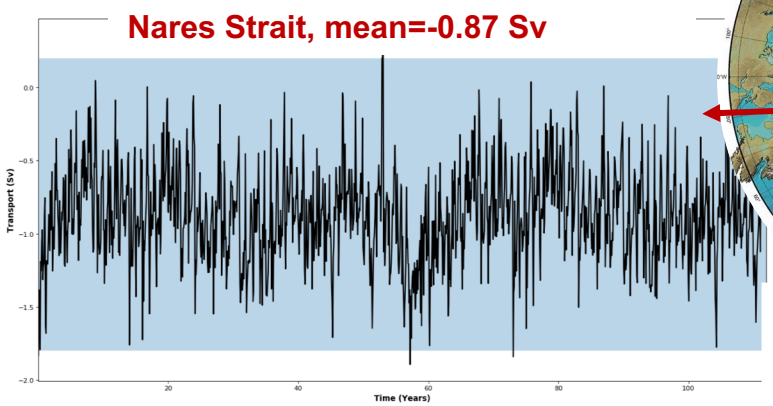


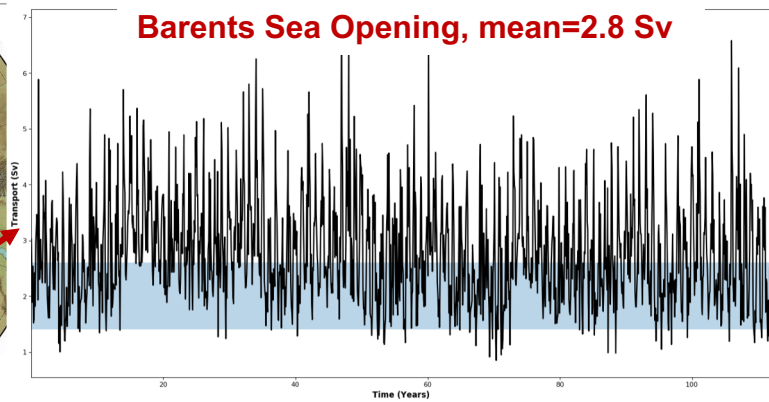
Arctic Ocean @60to10: mass transport across critical passages

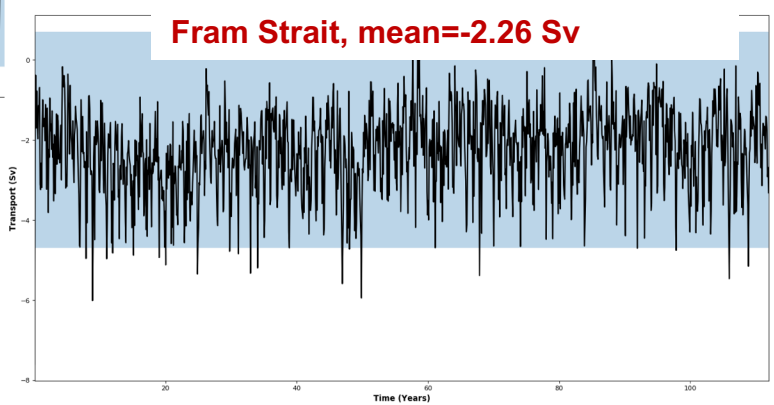




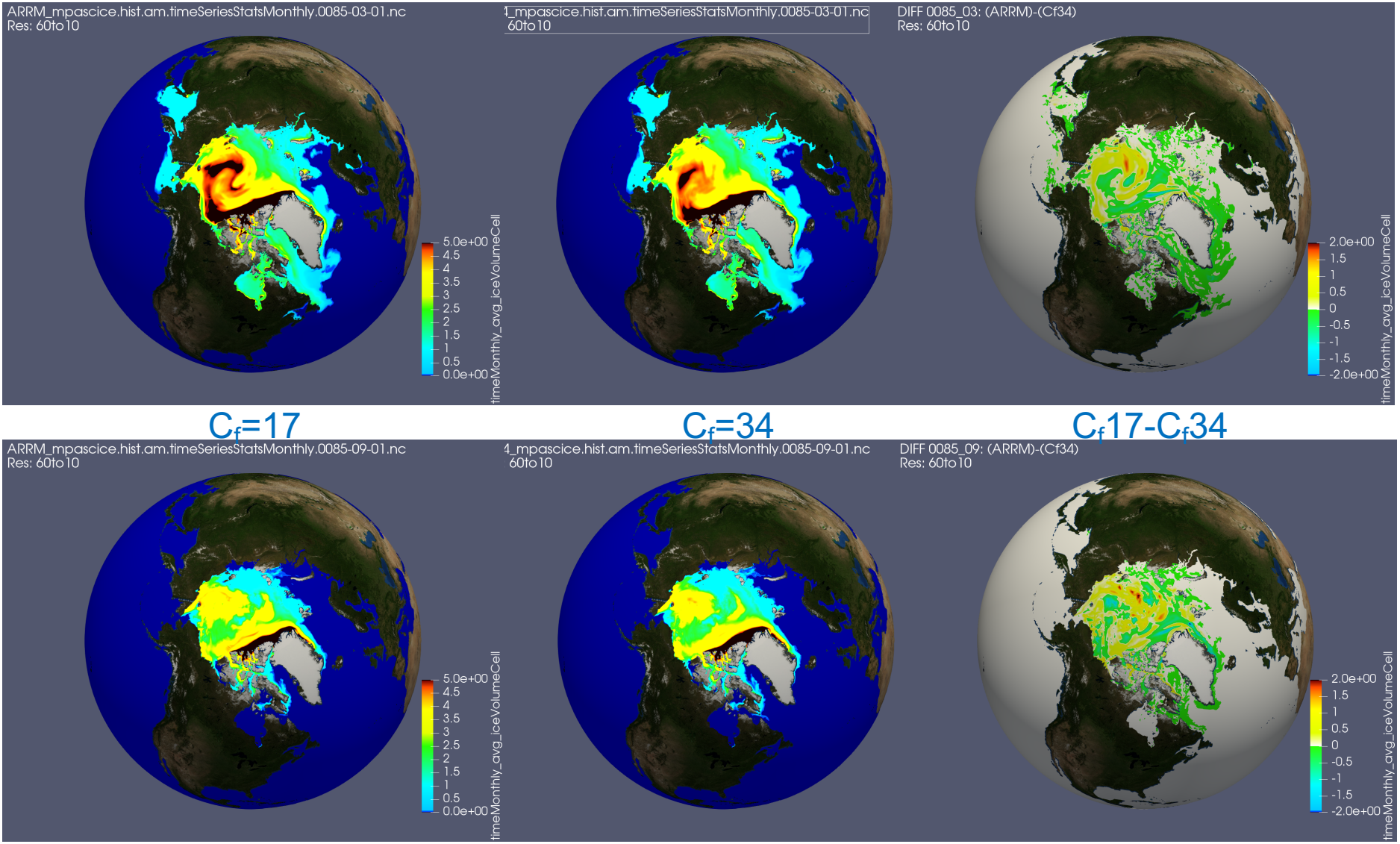






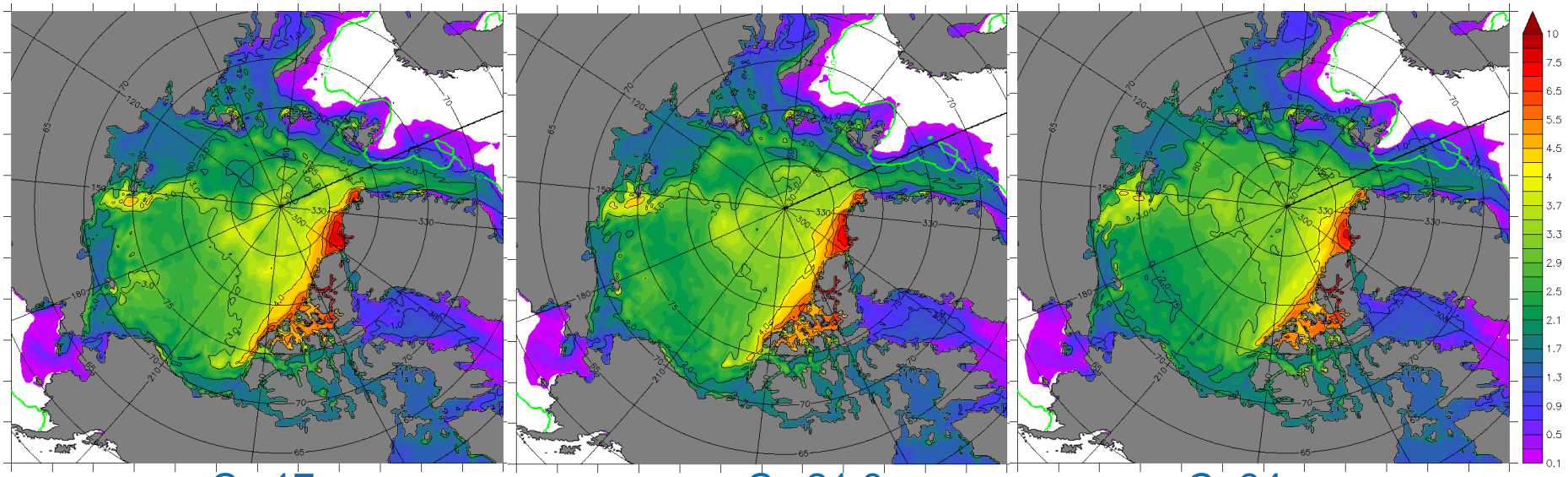


Arctic sea-ice thickness 1983 Mar & Sep: 60to10(C_f17-C_f34)

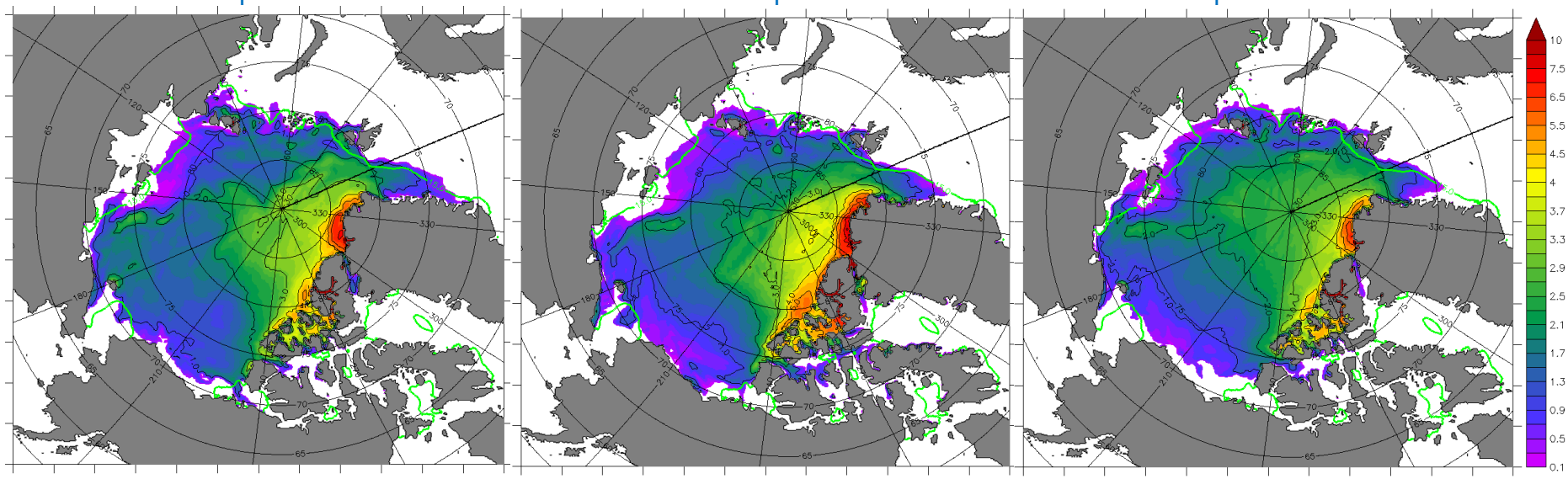


C_f=17 C_f=34 C_f17-C_f34

Coupled RASM@9km sea ice thickness 1983 Mar & Sep: C_f=17, 21.3, 34



C_f=17 C_f=21.3 C_f=34



Summary

- E3SM-Arctic-SIO simulates reasonable sea ice cover, including area, variability and trends as well as oceanic exchanges but …
- Sea ice thickness distribution is not realistic and overestimated
- Fine (60to6) Arctic mesh refinement does not help much
- Tuning might yield some improvements but more tests needed
- Comparisons with RASM results to diagnose bias causality

Plan for coupled simulations

- Parameter space sensitivity with E3SM-Arctic-SIO@60to10
- Coordination of efforts between HiLAT-RASM and InteRFACE (Andrew Roberts/Joel Rowland at LANL). Although projects are different, we have similar investments in Arctic mesh configuration(s) and first baseline coupled simulation(s).
- First, coupled atmosphere with standard low-resolution mesh
- Next, atmosphere with Arctic refined mesh