# An assessment of Pan-Arctic sea ice and regional limitations in CMIP6 historical simulations

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## Overview:

- Objective: Assess progress and outstanding limitations in the CMIP6 historical sea ice simulations

- Models: 12 CMIP6 models (129 ensembles), Regional Arctic System Model (RASM)

- Observational references: Data on sea ice extent (SIE), thickness (SIT) and volume[*] (SIV)

- Part 1: Standard analysis of SIE, SIT, SIV variability and trends

- Part 2: New contribution – Analysis of Pan-Arctic and regional **Integrated Ice-Edge Error (IIEE)**
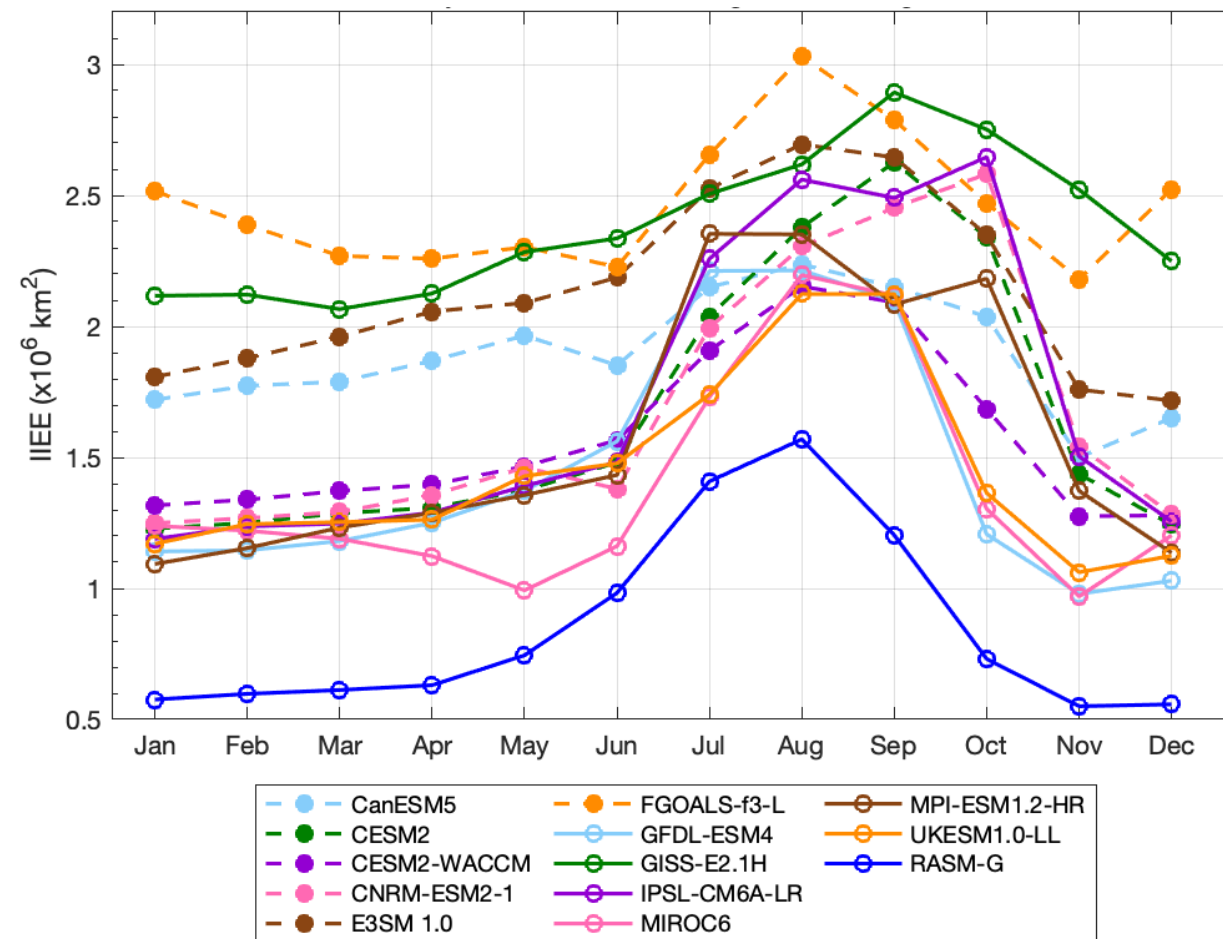
[*]PIOMAS Reanalysis

# Integrated ice-edge error (IIEE)



Goessling et al 2018

$$IIEE = O + U$$

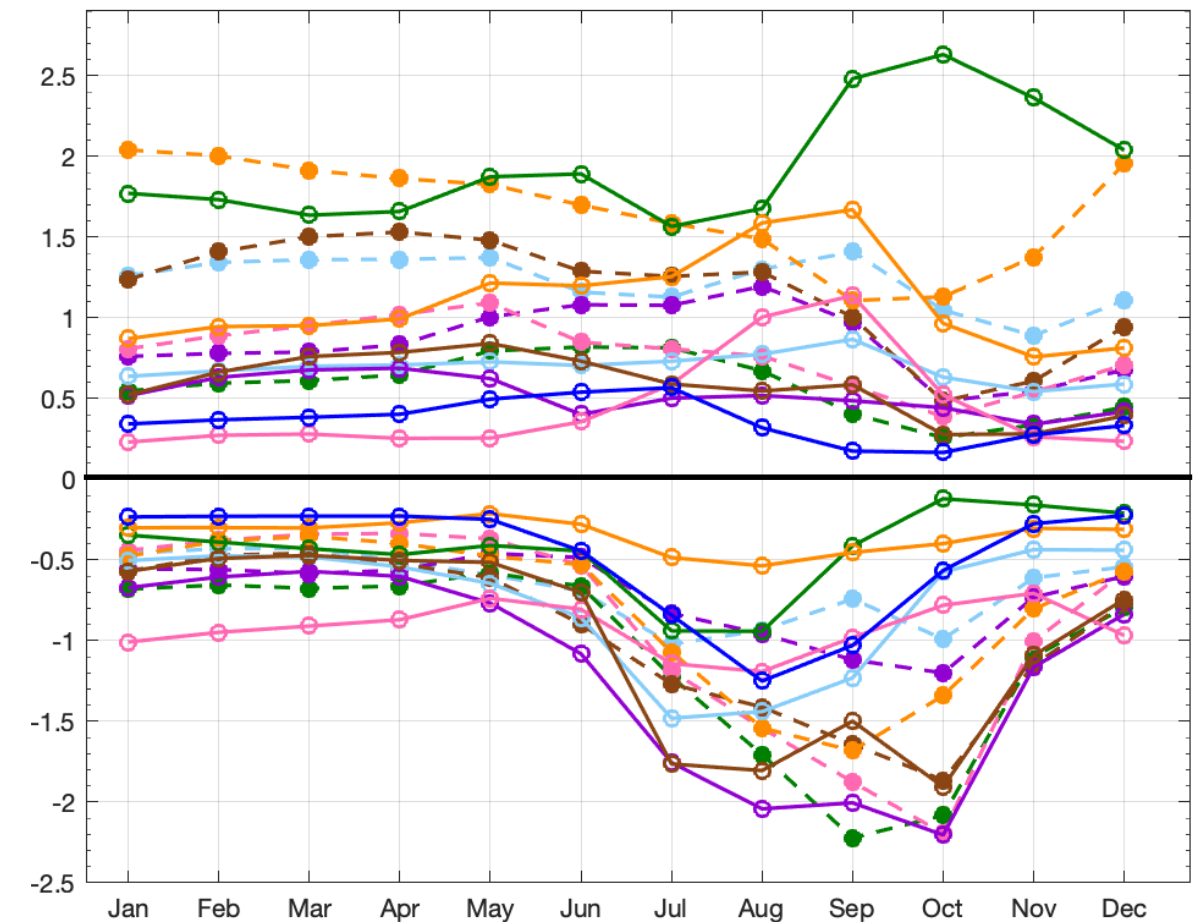Absolute error between observed SIC area (≥15%) and the model-simulated SIC area (≥15%)
-Red is observed sea ice-edge
-Blue is model sea ice-edge

# Pan-Arctic IIEE



Total IIEE analysis of the CMIP6 long-term error means, avoiding interannual comparisons, of which no CMIP6 models show predictive SIE skill
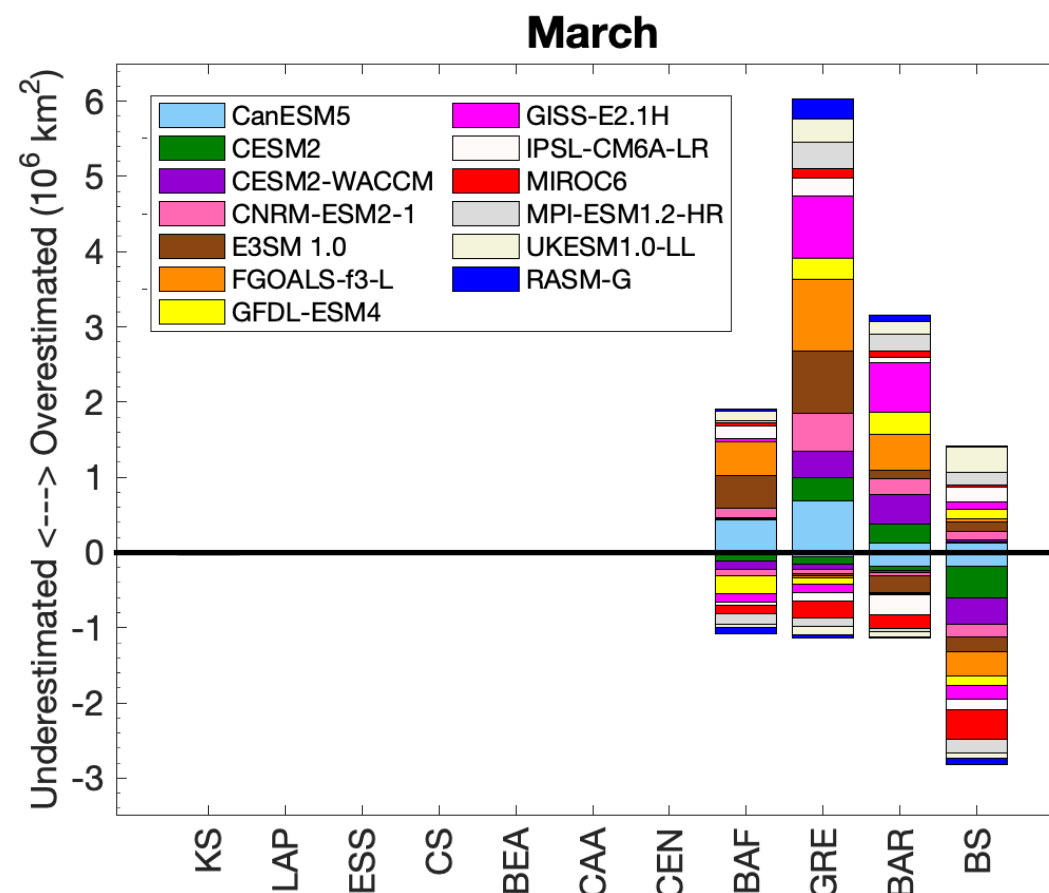
# IIEE Overestimation / Underestimation



Components of IIEE analysis
-Positive values are IIEE Overestimation
-Negative values are IIEE Underestimation

# Regional IIEE

35-year mean IIEE-O / IIEE-U ($10^6$ km$^2$) contribution per region (x-axis), per model (colorbar)
- Individual colors represent model IIEE contribution
- Larger bars indicates large cumulative IIEE



Winter / Spring:
IIEE predominantly limited to Arctic gateways (e.g. Nordic Seas (GRE, BAR), Bering Sea (BS), Baffin Bay (BAF))

Summer:
As sea ice retreats poleward, regions over which IIEE is determined increases and evolves in time over the Arctic interior
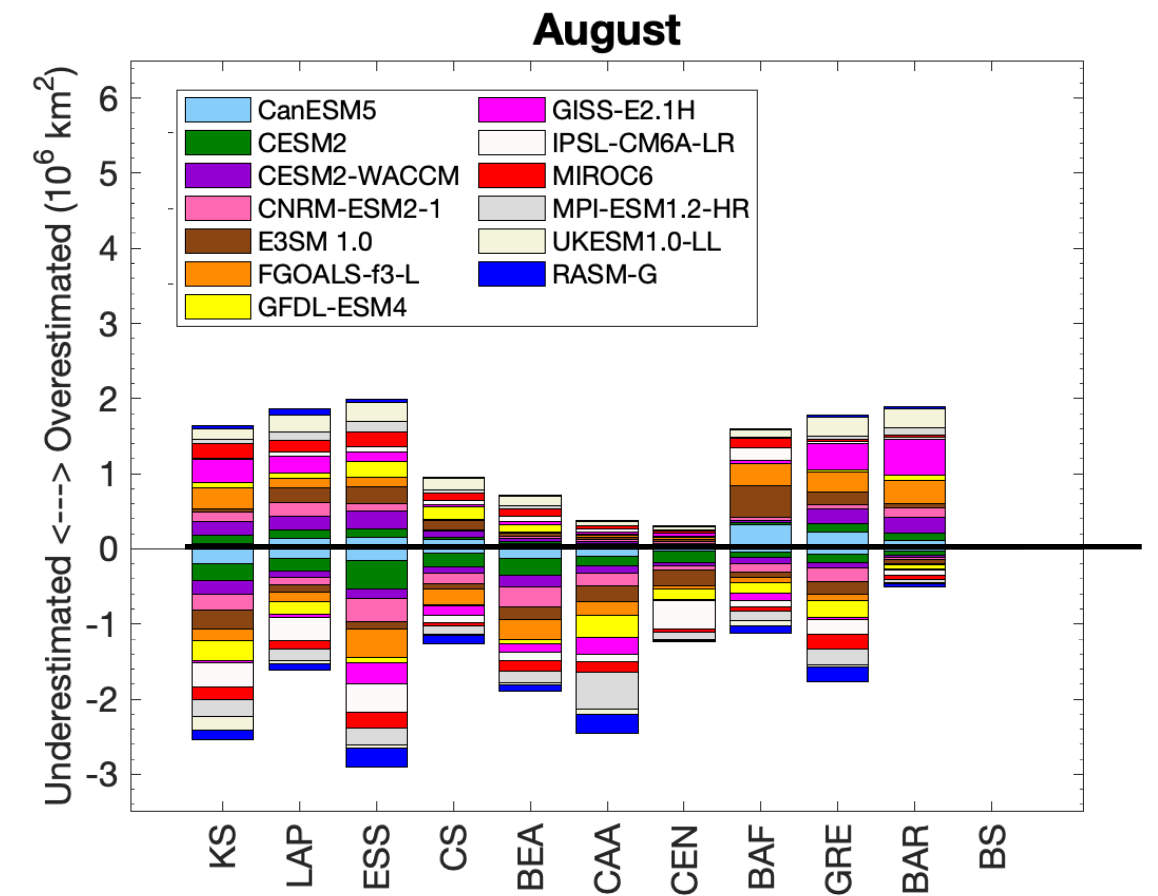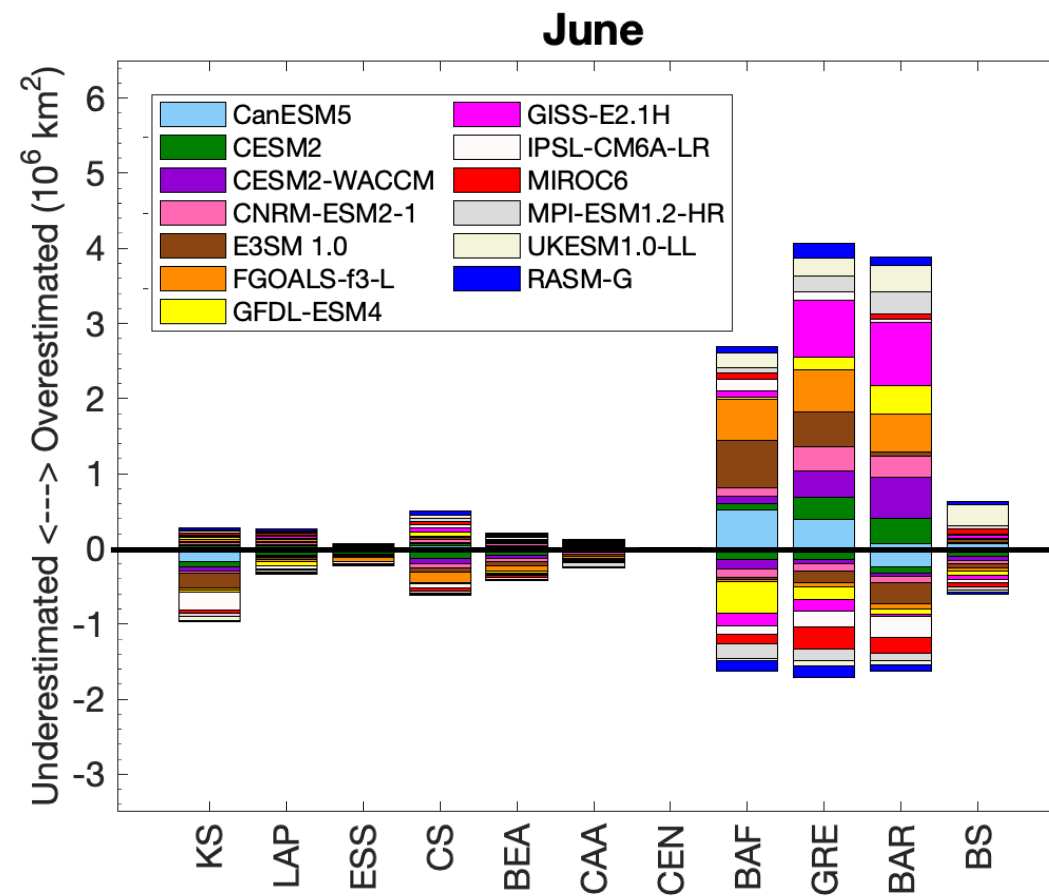
# Summary

- CMIP6 models have collective skill in representing sea ice mean and long-term declining trends; individual models and their ensemble members have large spread

- IIEE may prove useful as a diagnostic, and lead to potential improvement of specific model regional/local biases

- Future work: examine the role of oceanic forcing on sea ice biases