

Sea ice variability across timescales in CESMx and observations

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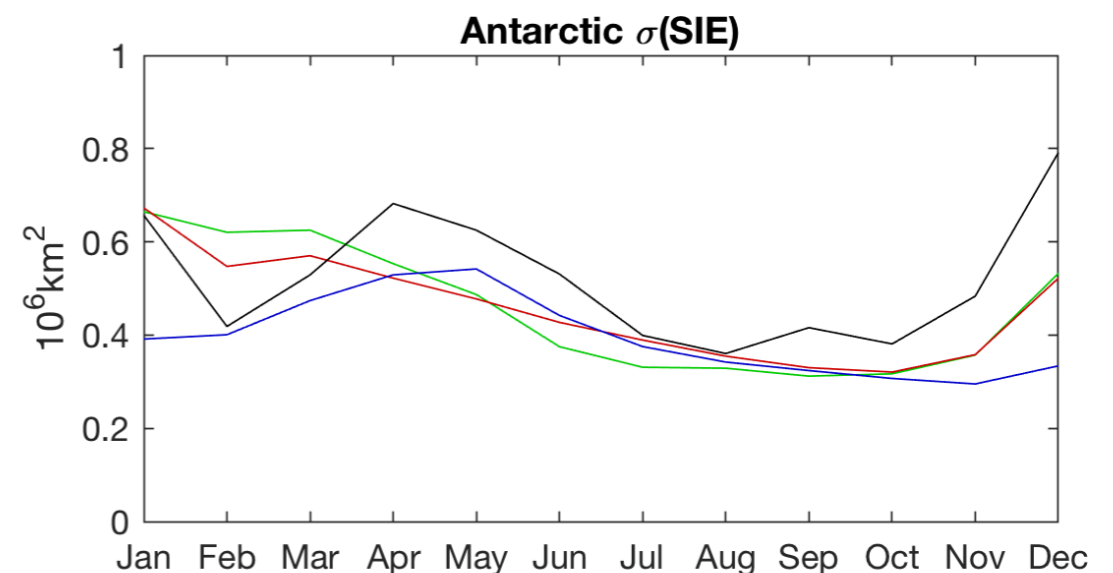
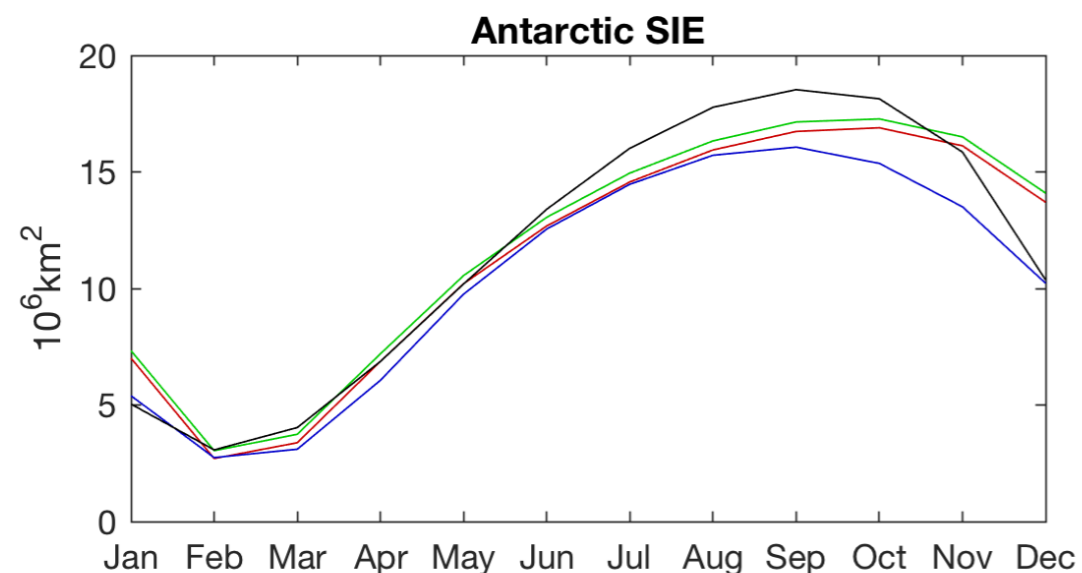
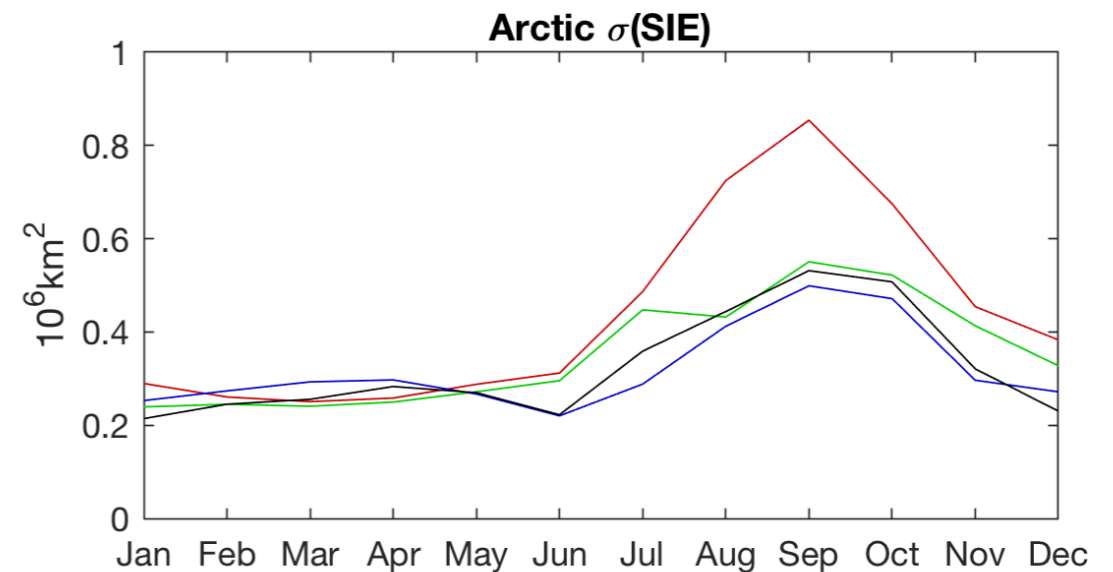
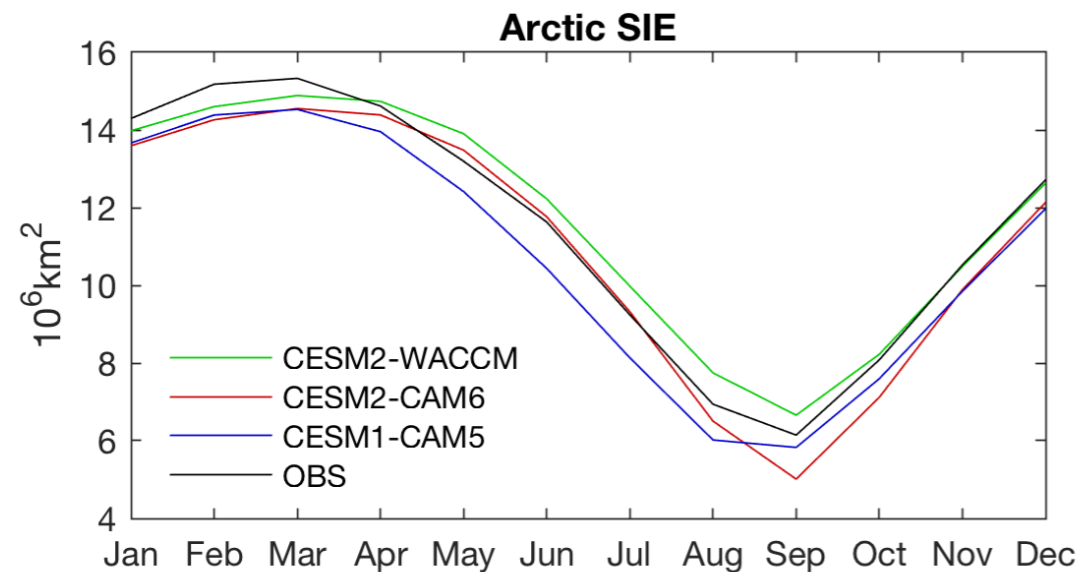


Investigate coupling of sea ice/atmos at 'short' timescales (sub-monthly)

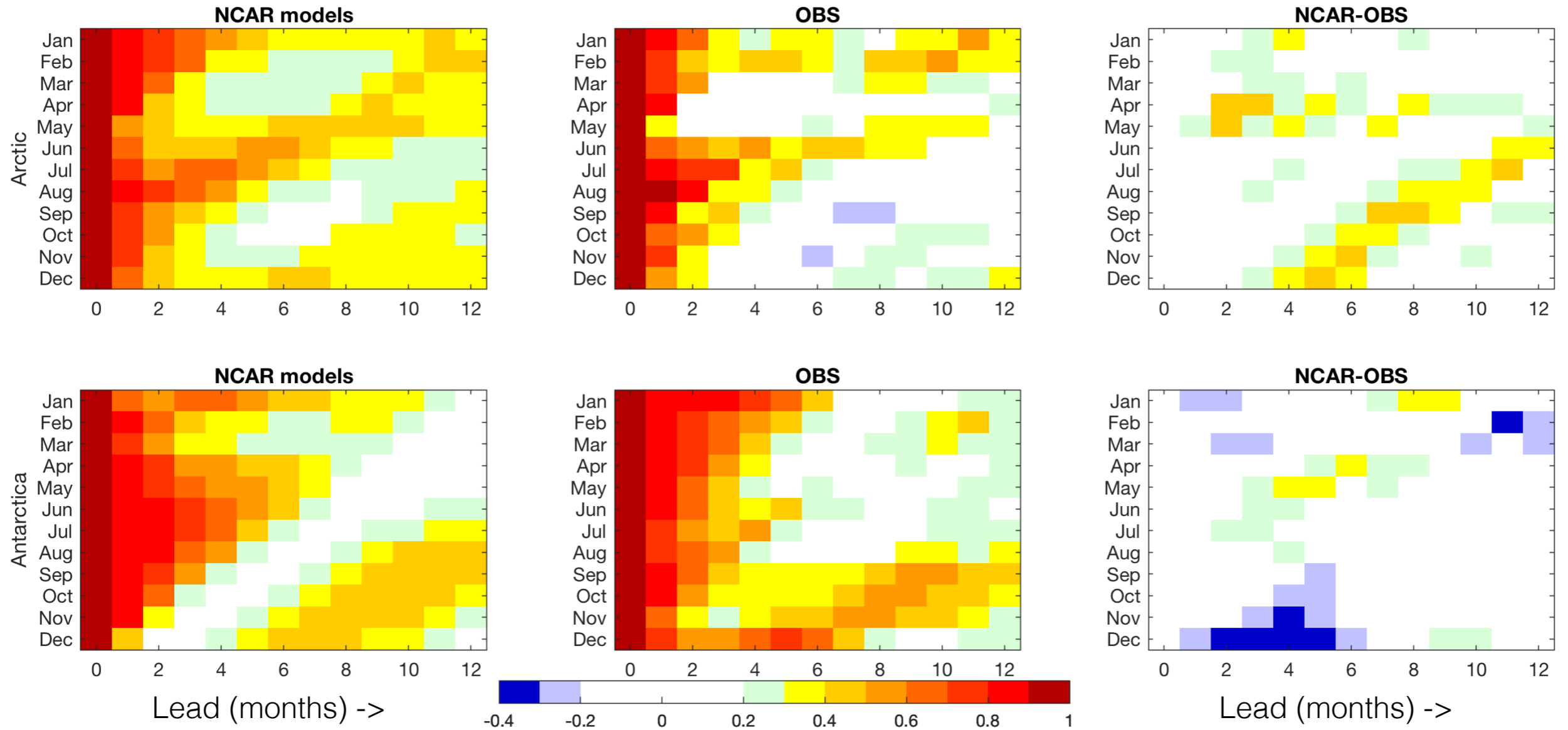
These timescales have been less studied than seasonal/annual/decadal

But important to stakeholders, likely can have high forecast skill of atmos/sea ice

Can be a 'clean' timescale to study sea ice/atmos coupling (can ignore ocean),
also more degrees of freedom in observations



Persistence of monthly SIA anomalies

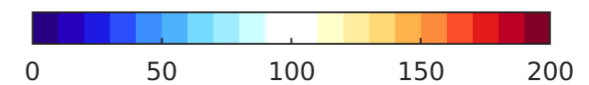
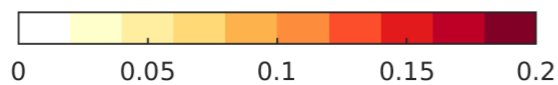
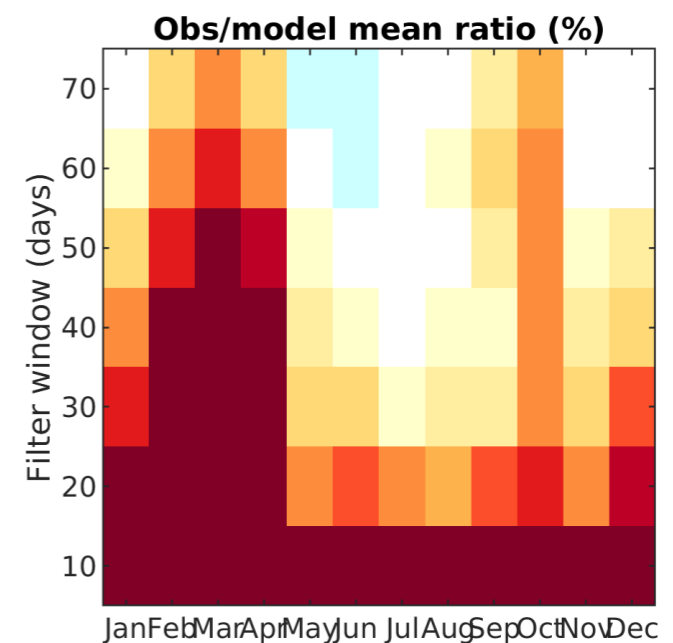
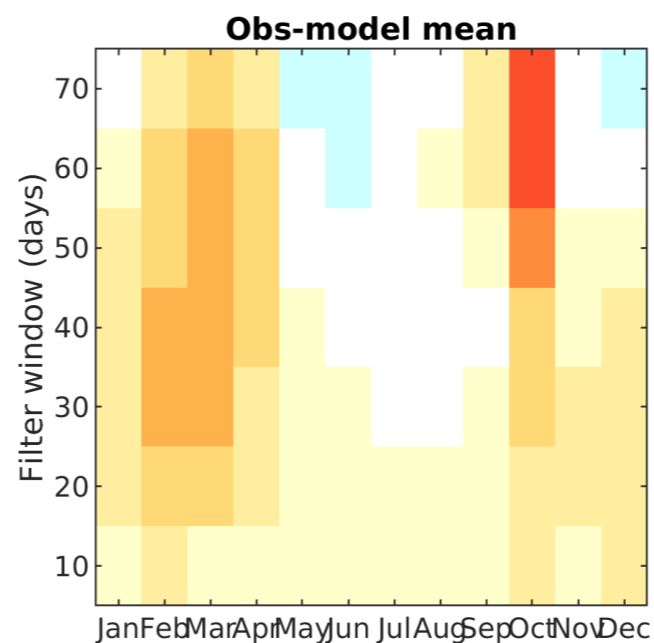
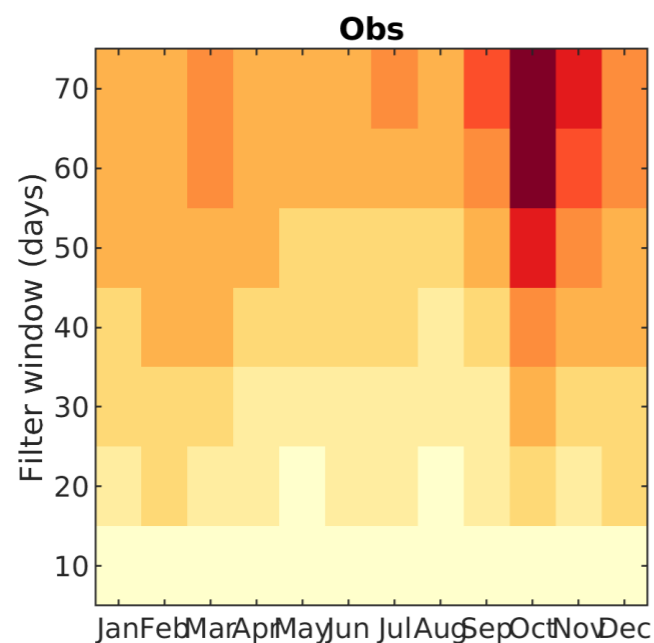
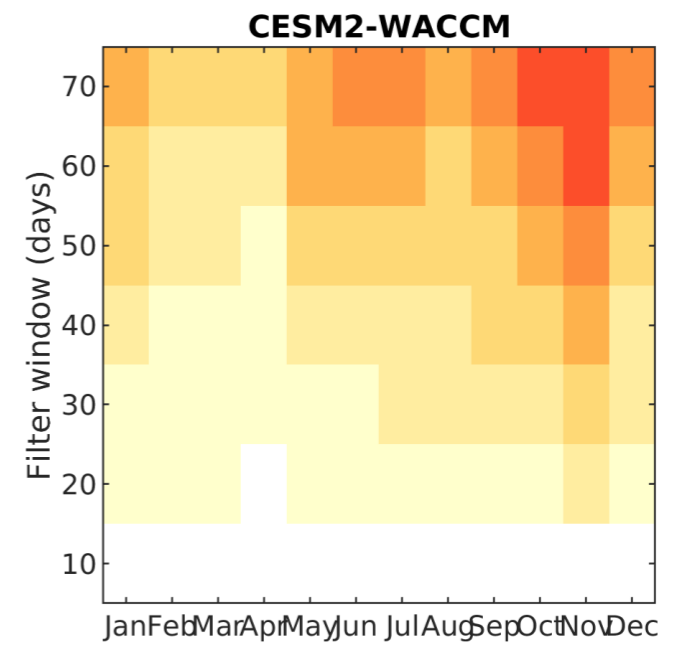
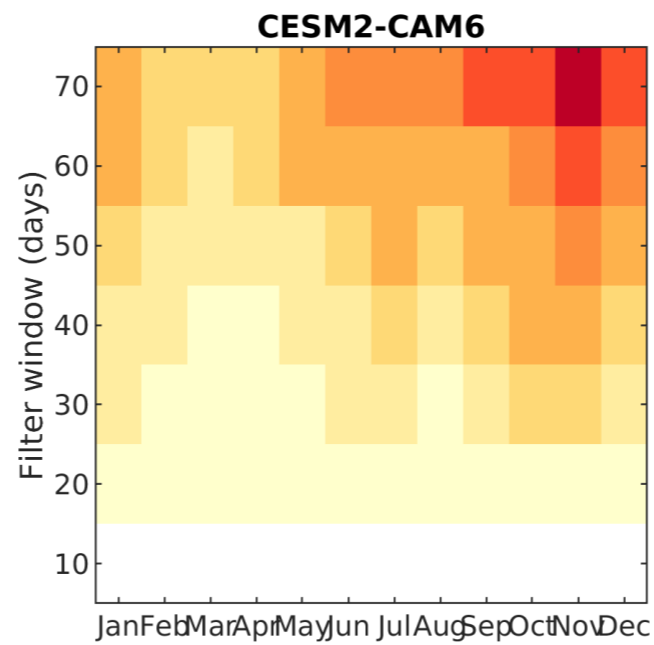
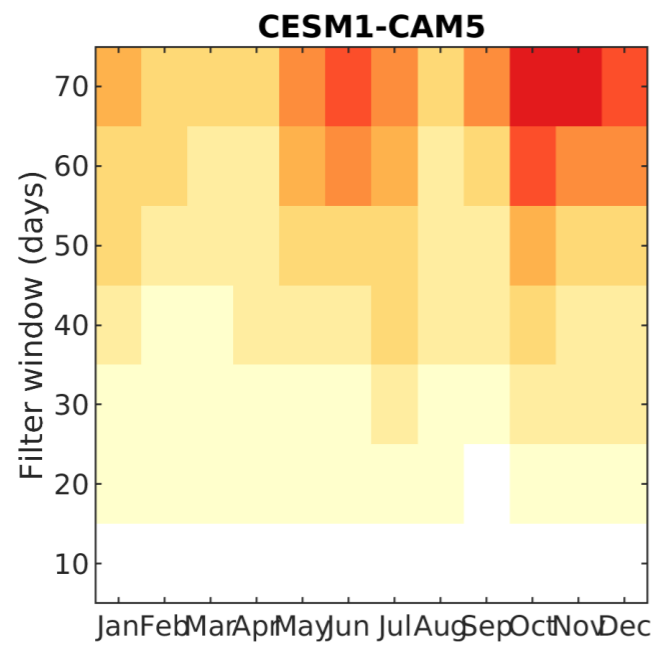


Models too persistent in Arctic (especially winter)
mixed in Antarctica

High frequency variability of sea ice

Standard deviation of high-filtered SIE timeseries (3 to Y-axis days)

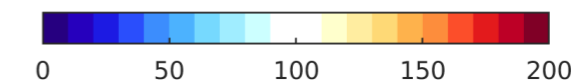
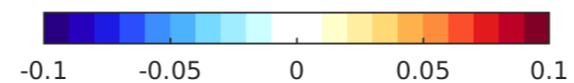
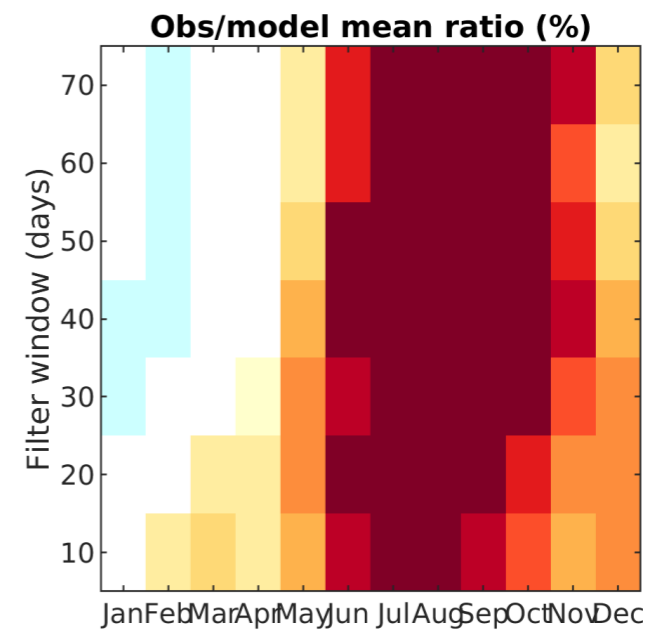
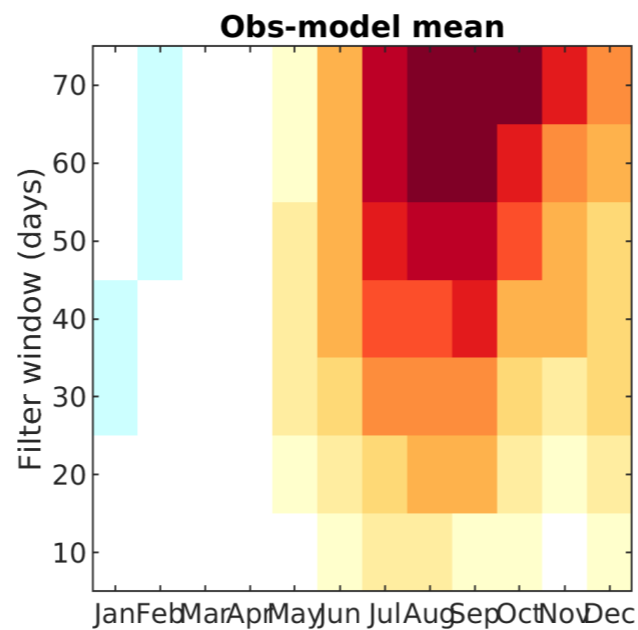
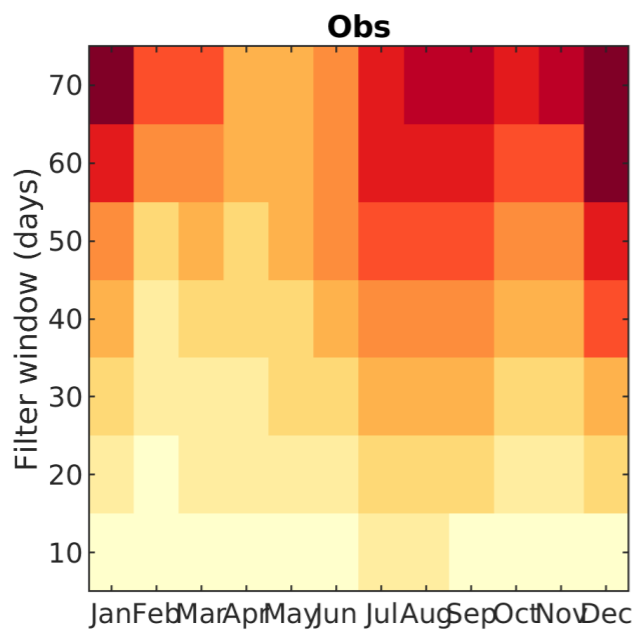
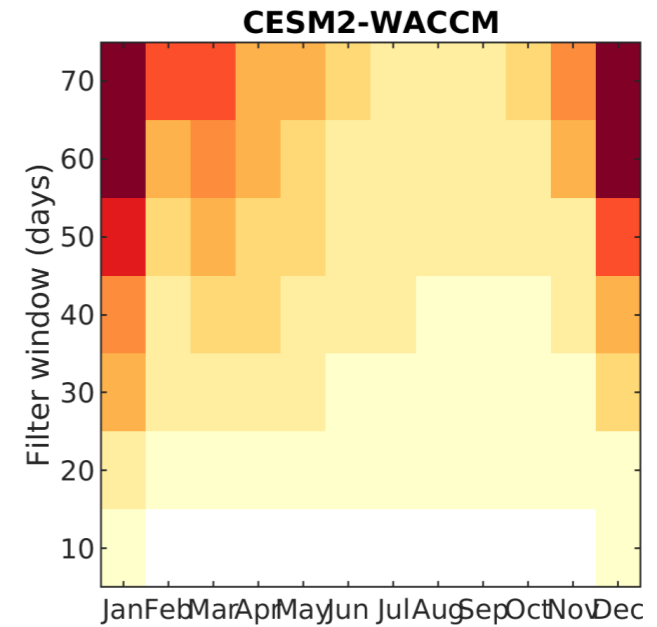
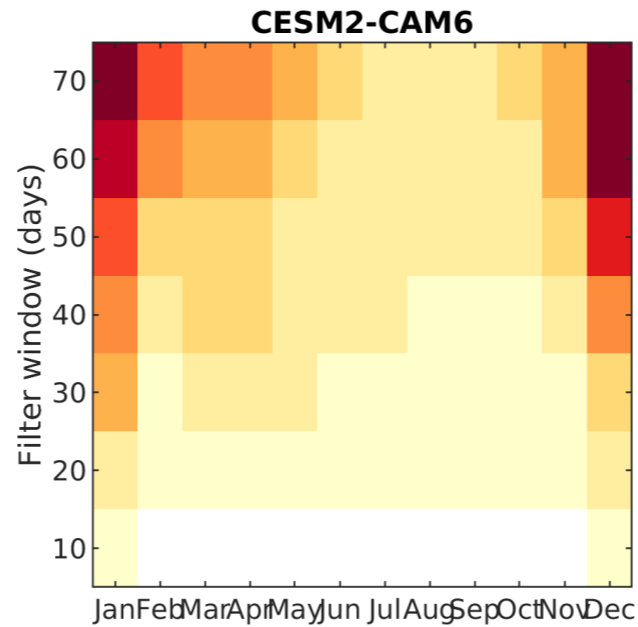
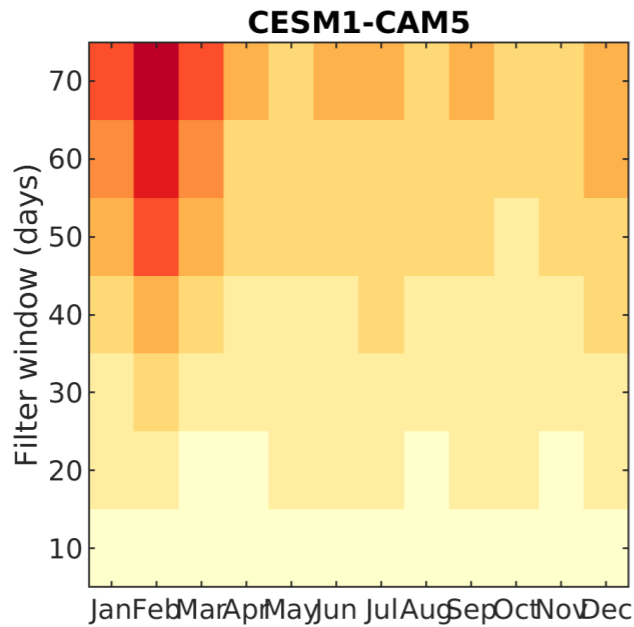
Arctic



High frequency variability of sea ice

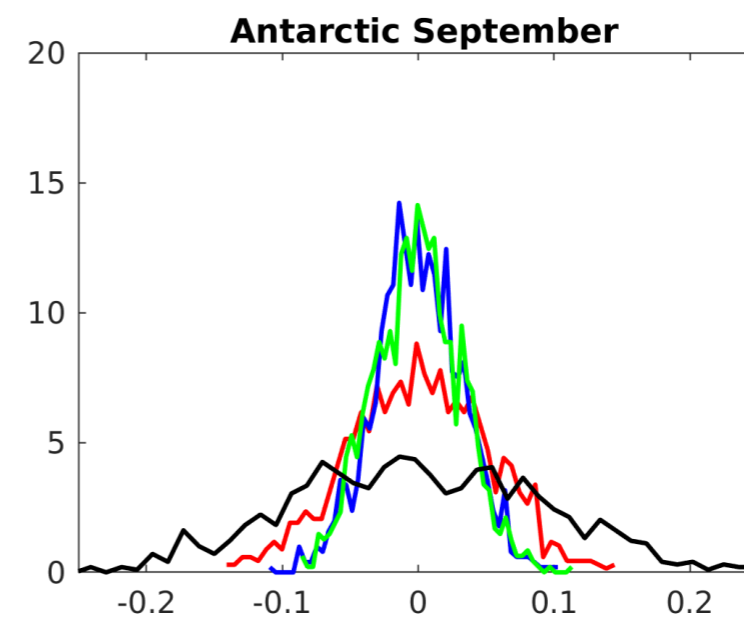
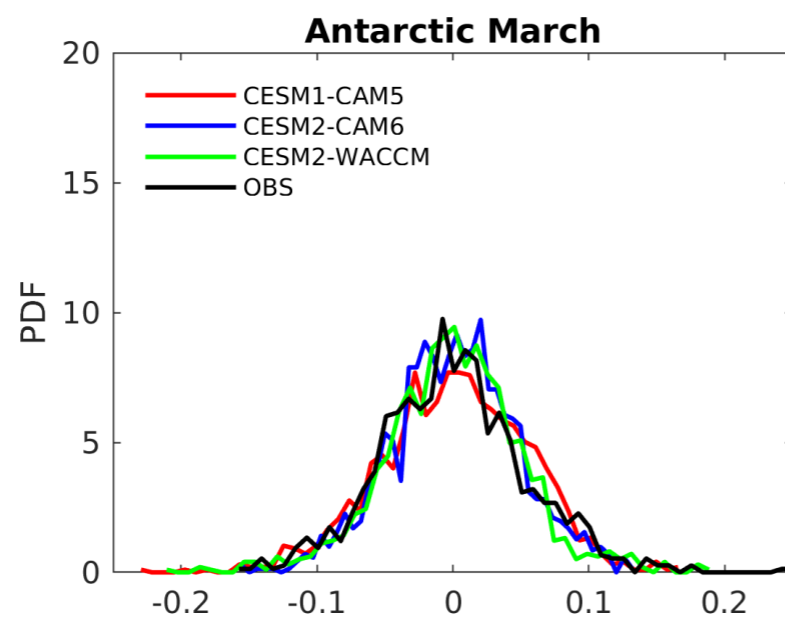
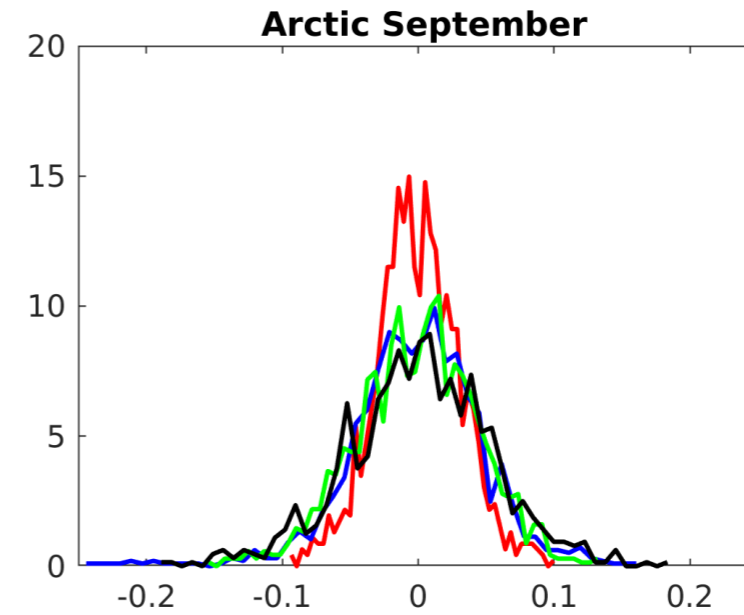
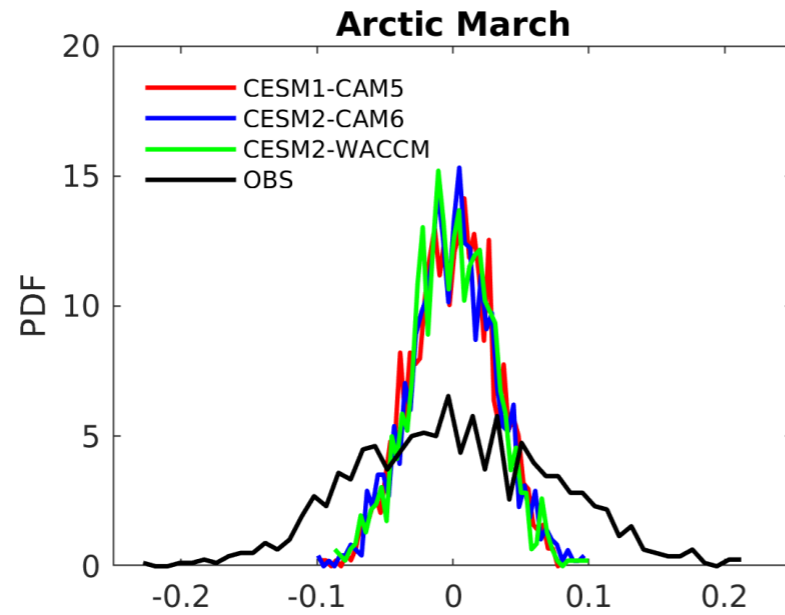
Standard deviation of high-filtered SIE timeseries

Antarctica



High frequency variability of sea ice

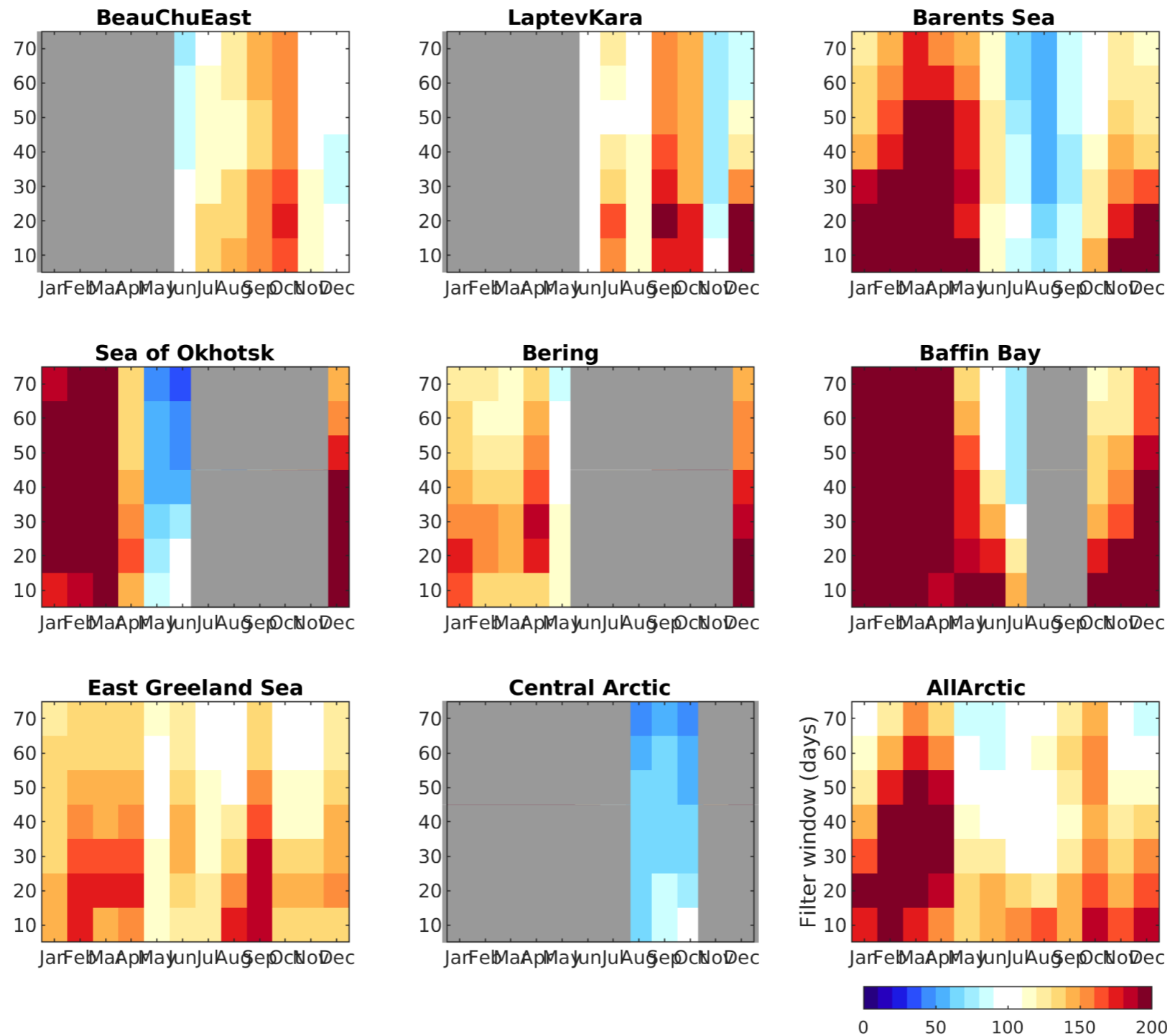
Distributions of standard deviation of high-filtered SIE timeseries for 3-30day variability



High frequency variability of sea ice

Standard deviation of regional high-filtered SIE timeseries

Arctic: $(\text{obs} - \text{model mean}) / \text{obs} * 100\%$

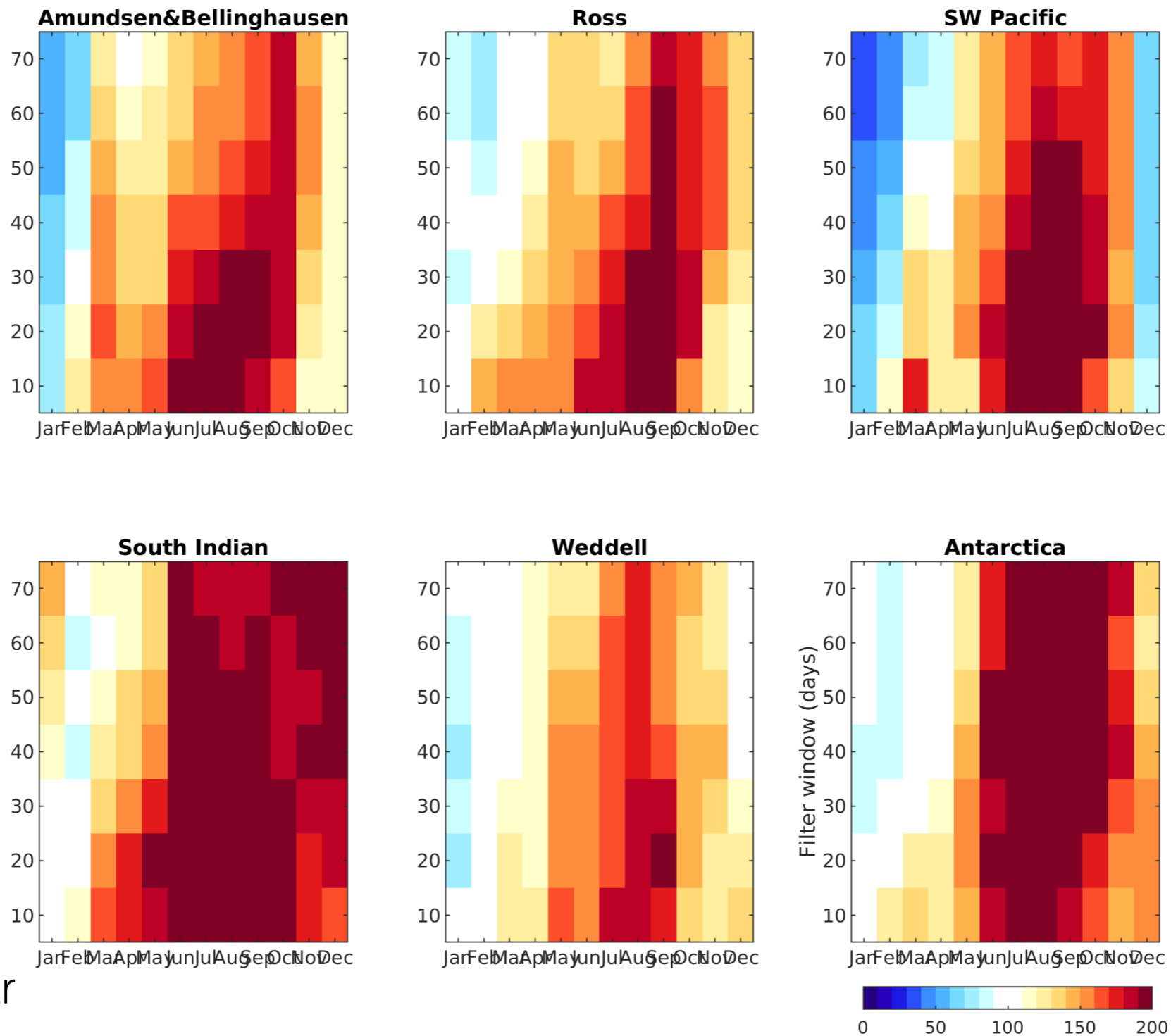


=no sea ice var

High frequency variability of sea ice

Standard deviation of regional high-filtered SIE timeseries

Antarctic: $(\text{obs} - \text{model mean}) / \text{obs} * 100\%$



=no sea ice var

Results part I

CESM models capture inter annual variability and mean state reasonably well, but show too little variability in winter at sub-monthly timescales both in the Arctic and Antarctica

This bias is seen at the regional level

Is the bias originating in the atmosphere?
in atmosphere/sea ice coupling?
or in sea ice model? (missing mechanisms)

Part II

Nudge CESM1-CAM5 to observed winds, see what happens

Part II

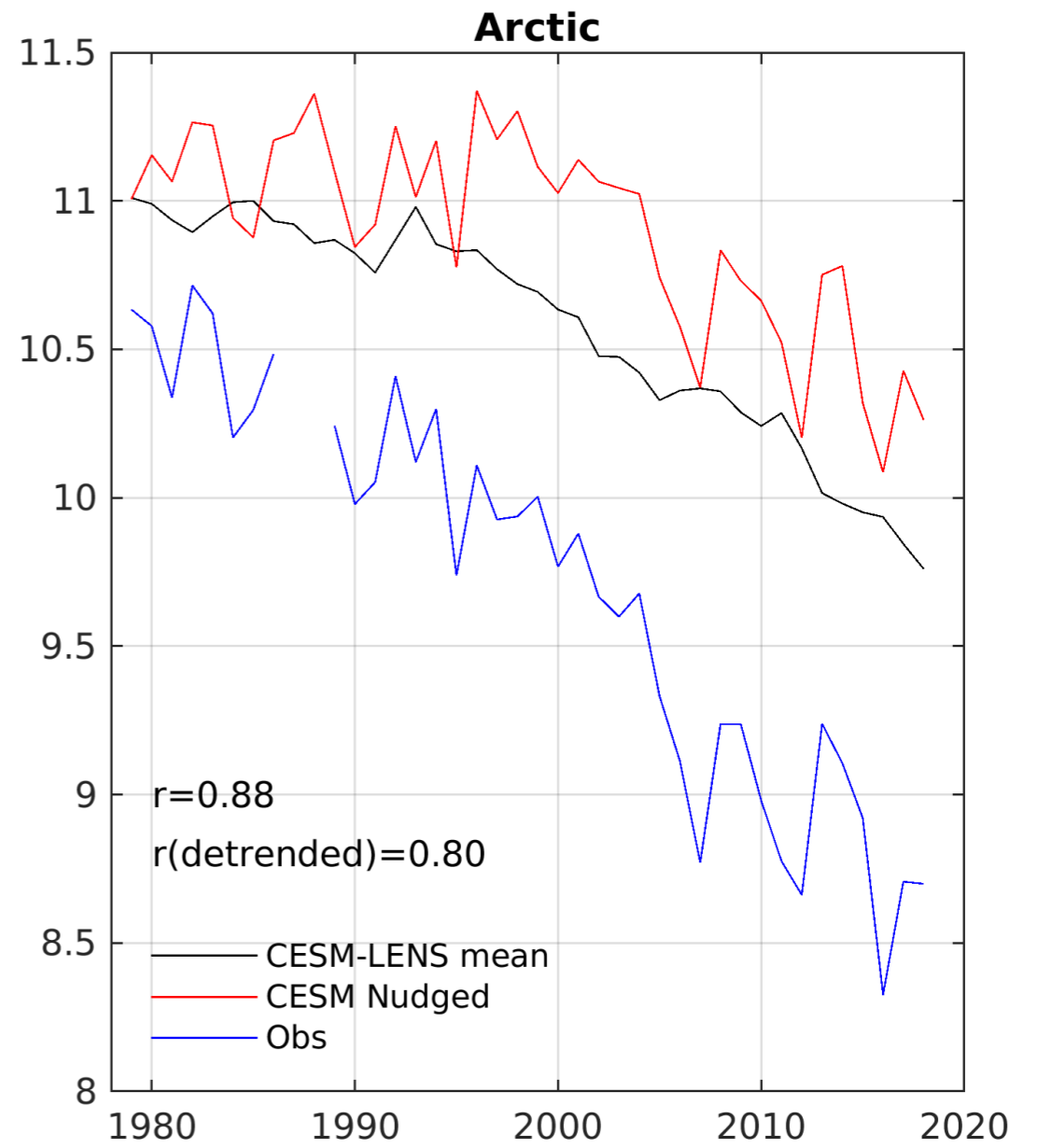
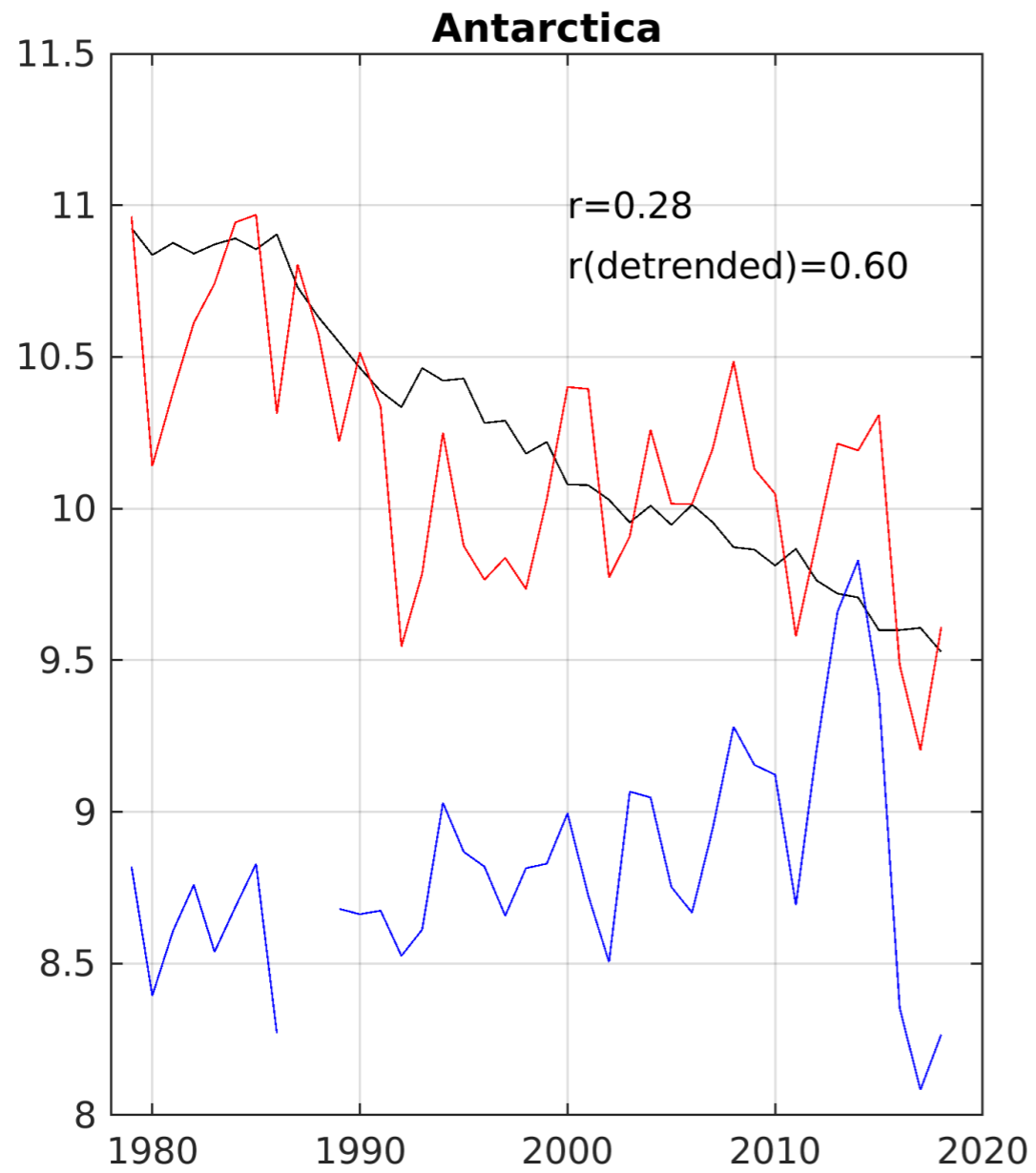
Nudge CESM1-CAM5 to observed winds, see what happens

Nudge U and V winds to 6-hr ERA Interim, 1979-2018

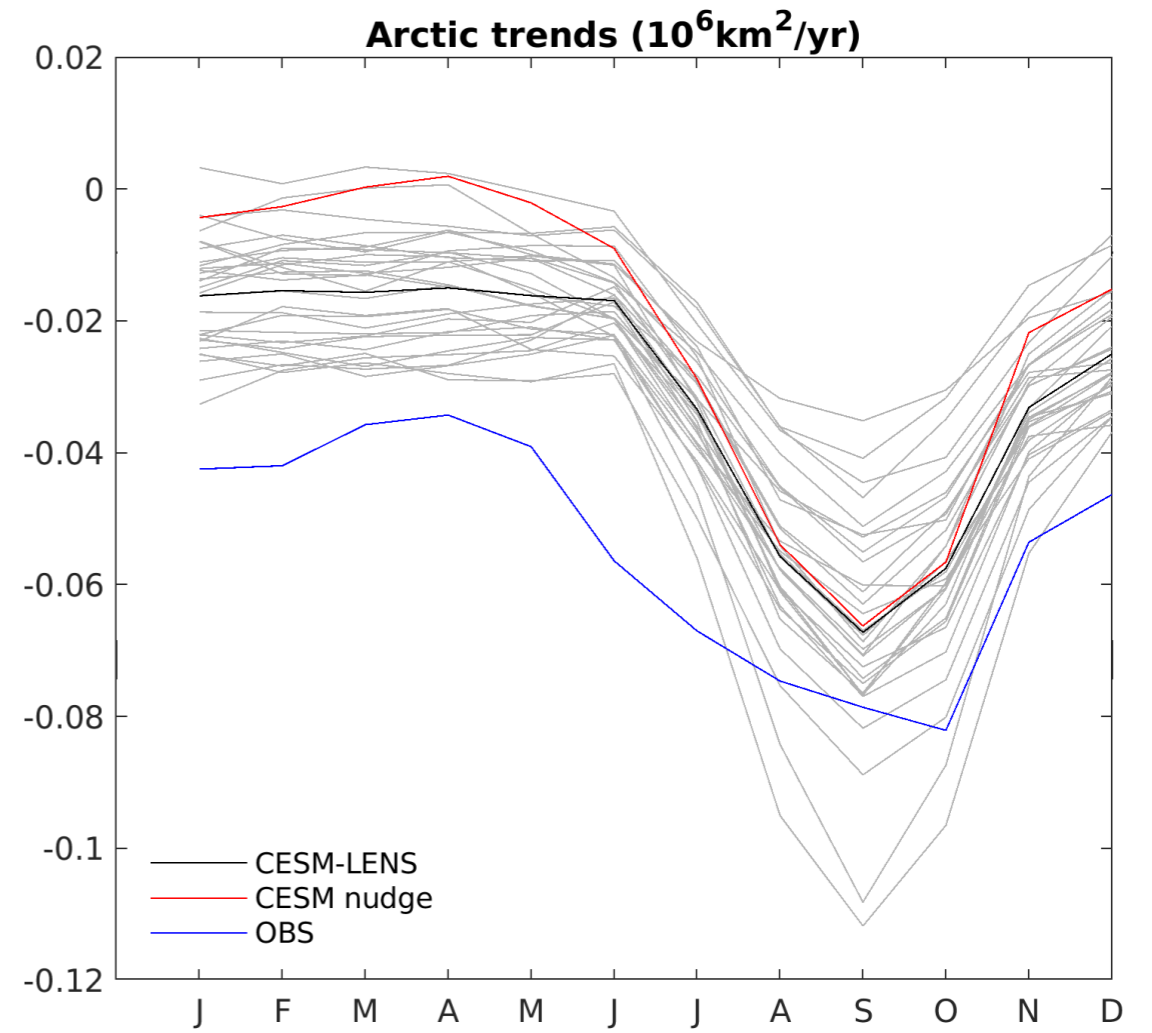
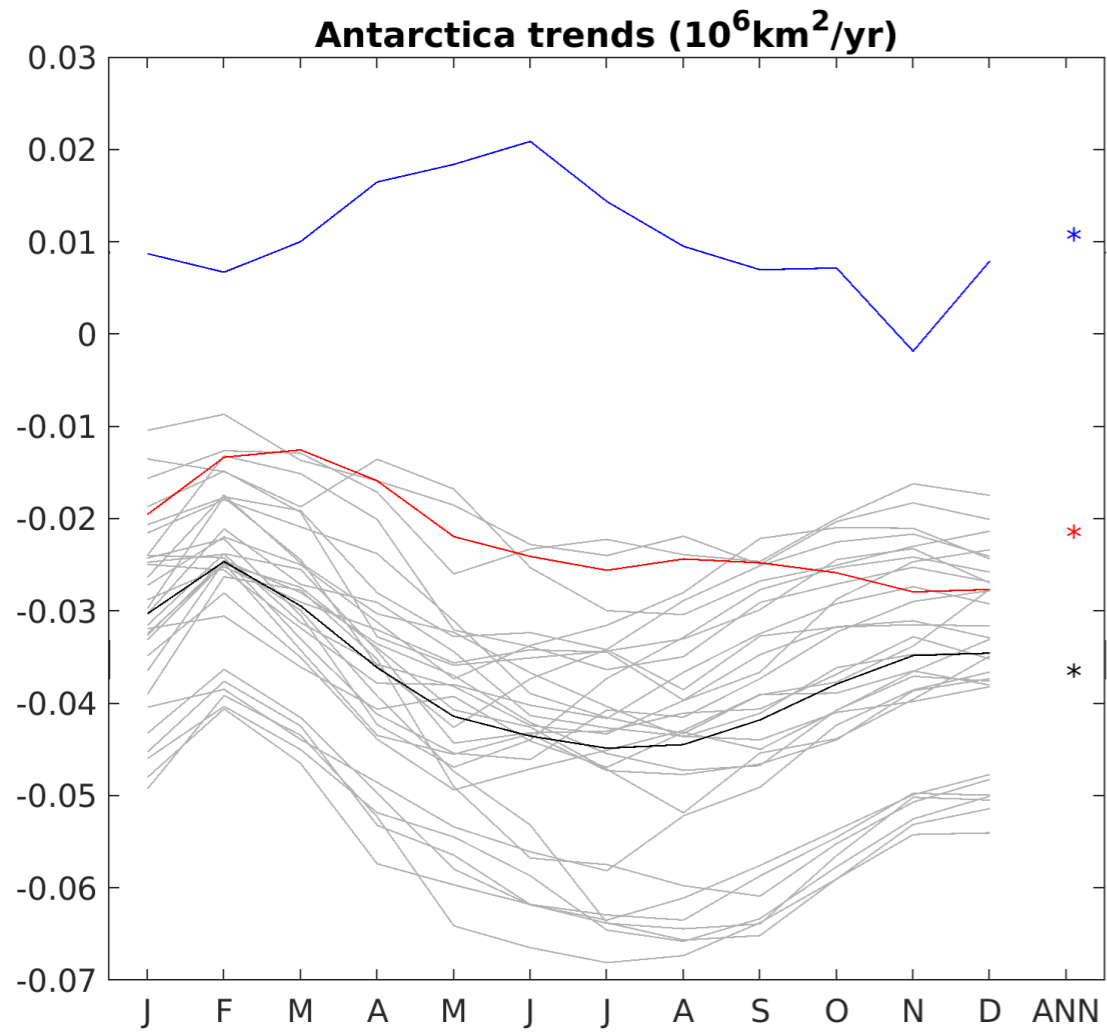
Over 45N-90N and 45S-90S (in same run)

Take CESM-LENS initial conditions from 1980, run with same forcing as CESM-LENS

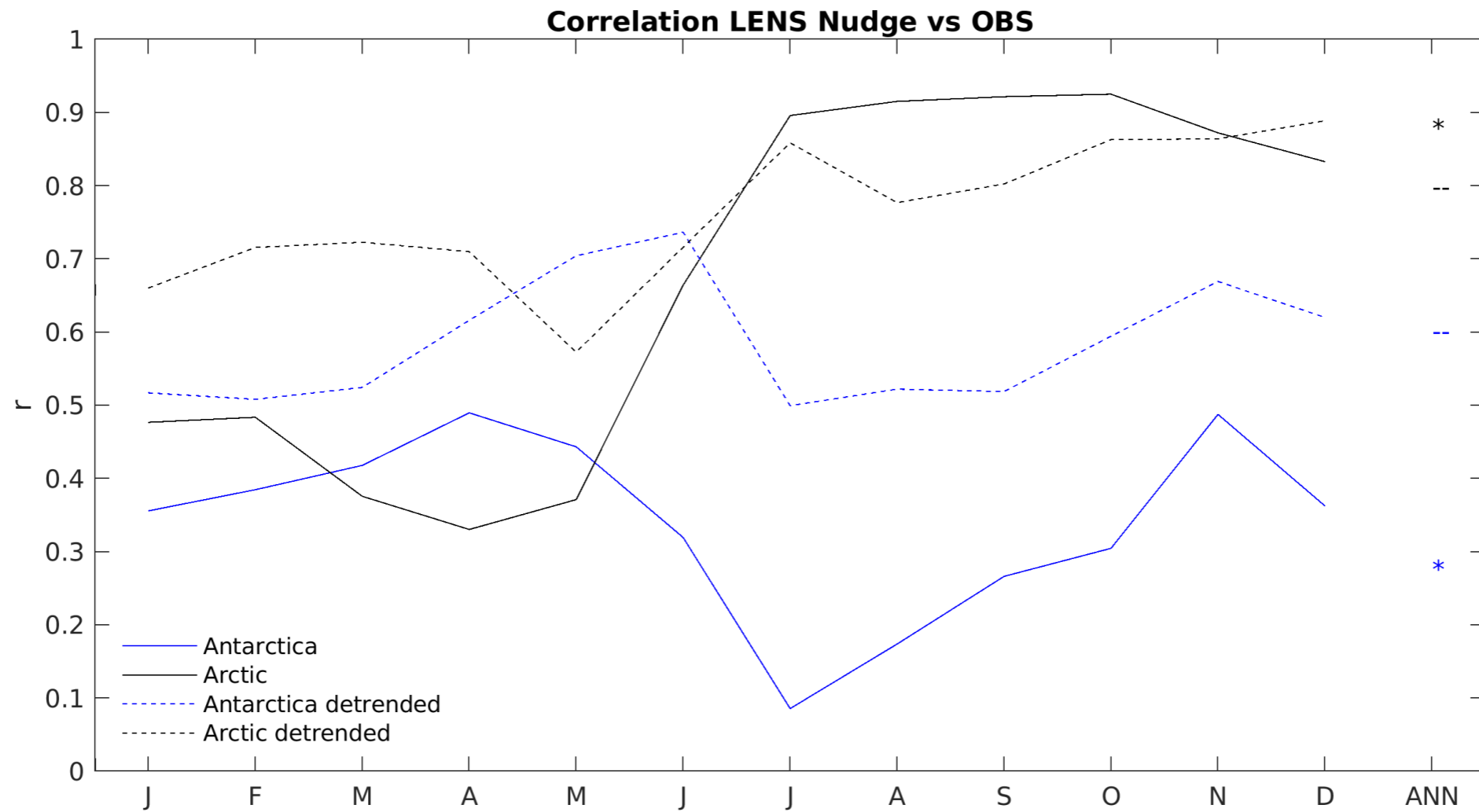
Annual SIA



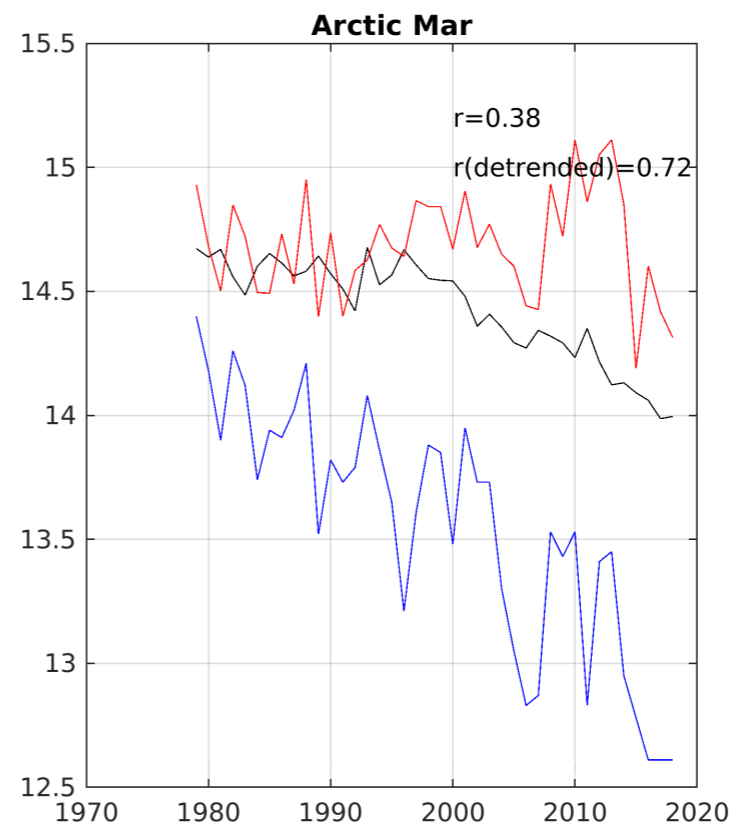
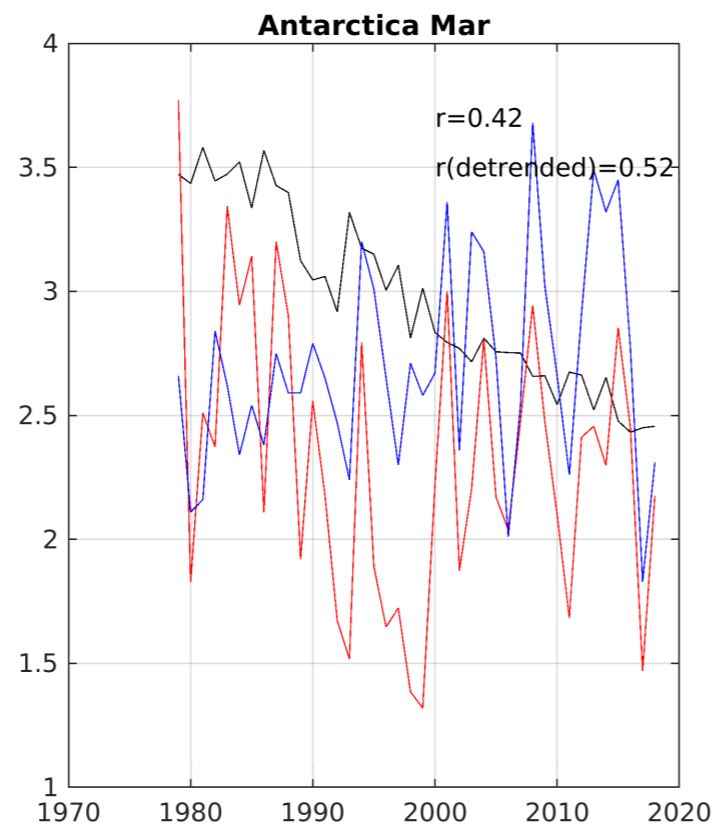
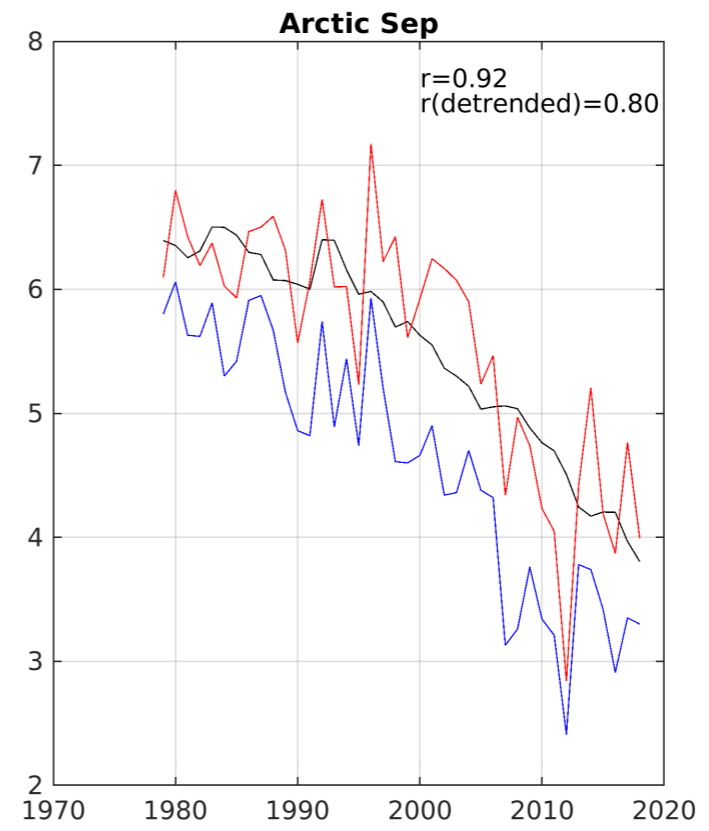
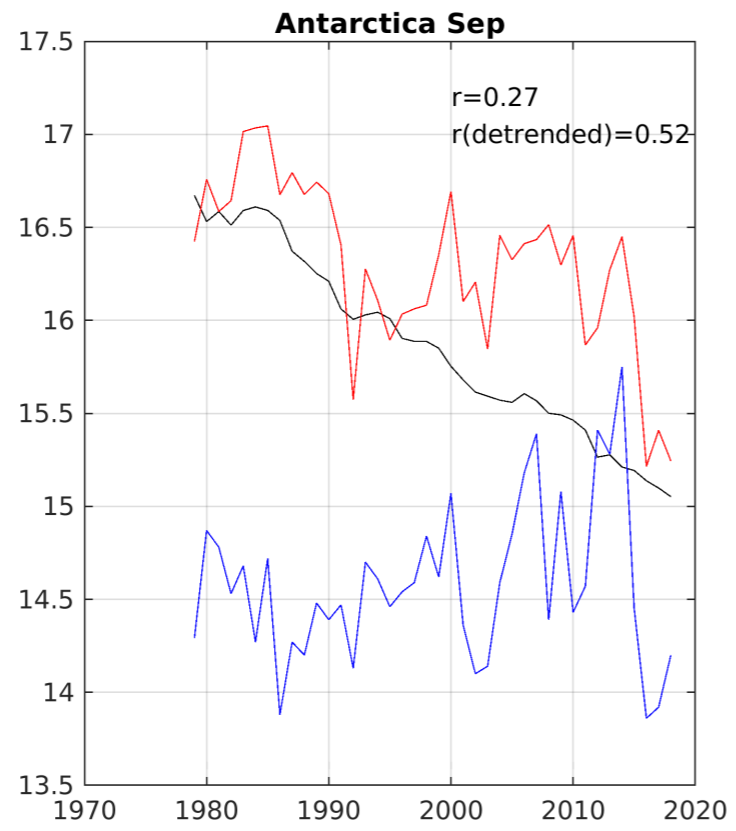
Trends



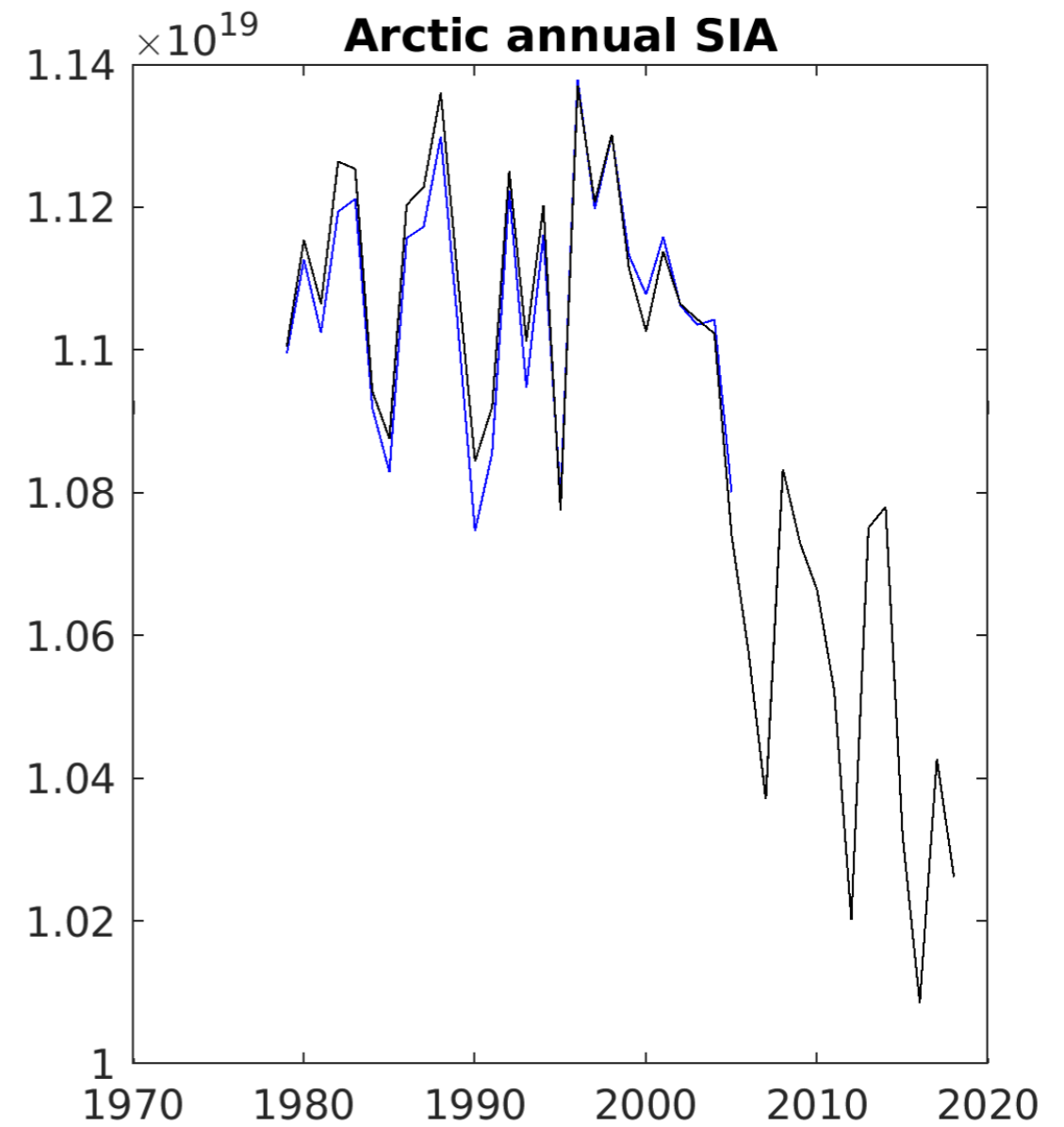
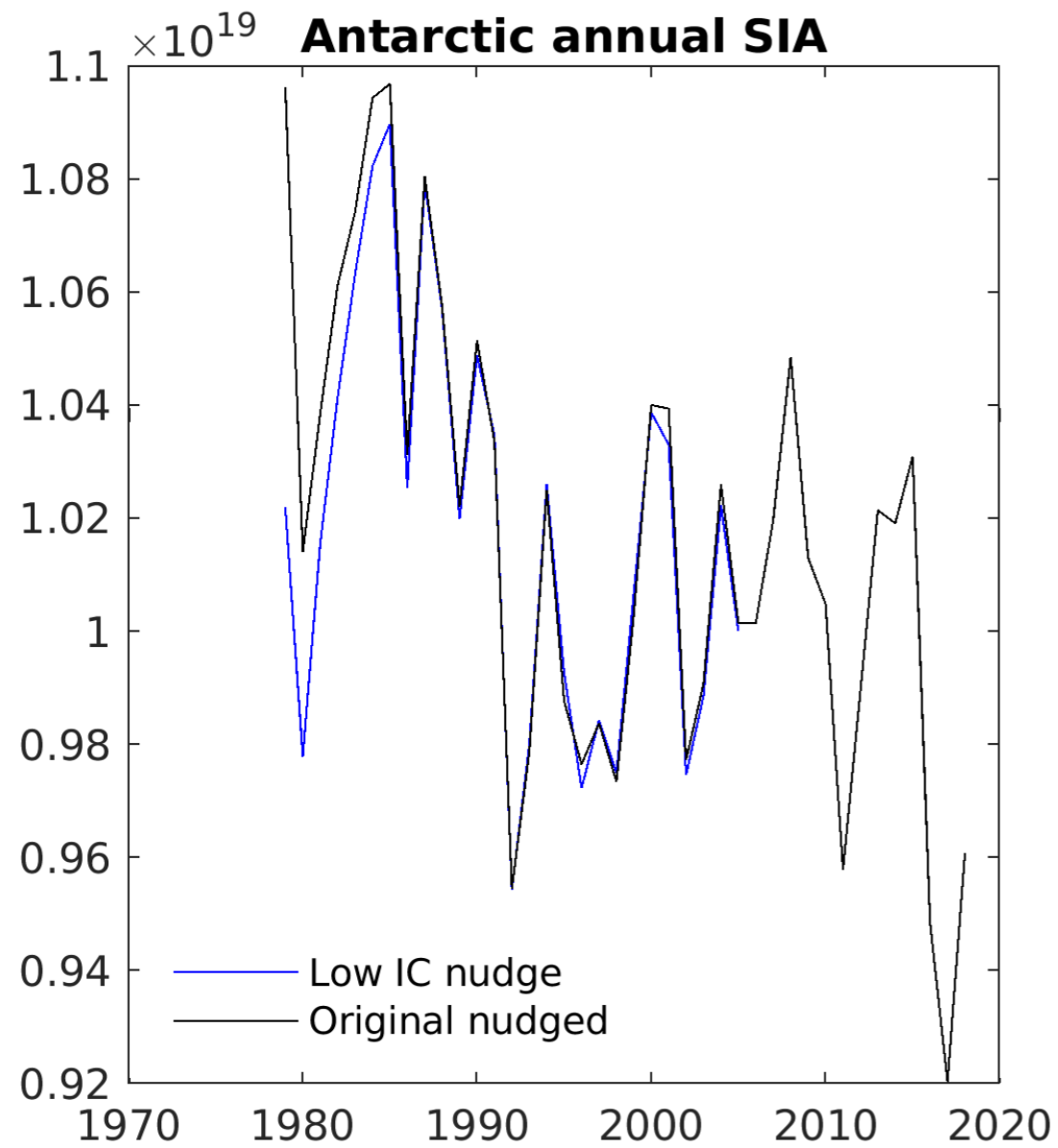
Interannual variability



Interannual variability



Influence of initial conditions on trends



Minimal influence of 1979 ICs

Results part II

Observed winds help explain interannual variability, but not trends

Arctic better explained than Antarctica

(why? reanalysis winds too uncertain in Antarctica, or Antarctic sea ice inherently less constrained by winds? Or model physics better in Arctic than Antarctica?)

40-year Trends not influenced by ICs (can't explain positive Antarctic trend)