

Impact of Biomass Burning Emissions on Arctic Sea Ice Loss

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DeRepentigny, P. et al., to be submitted shortly.



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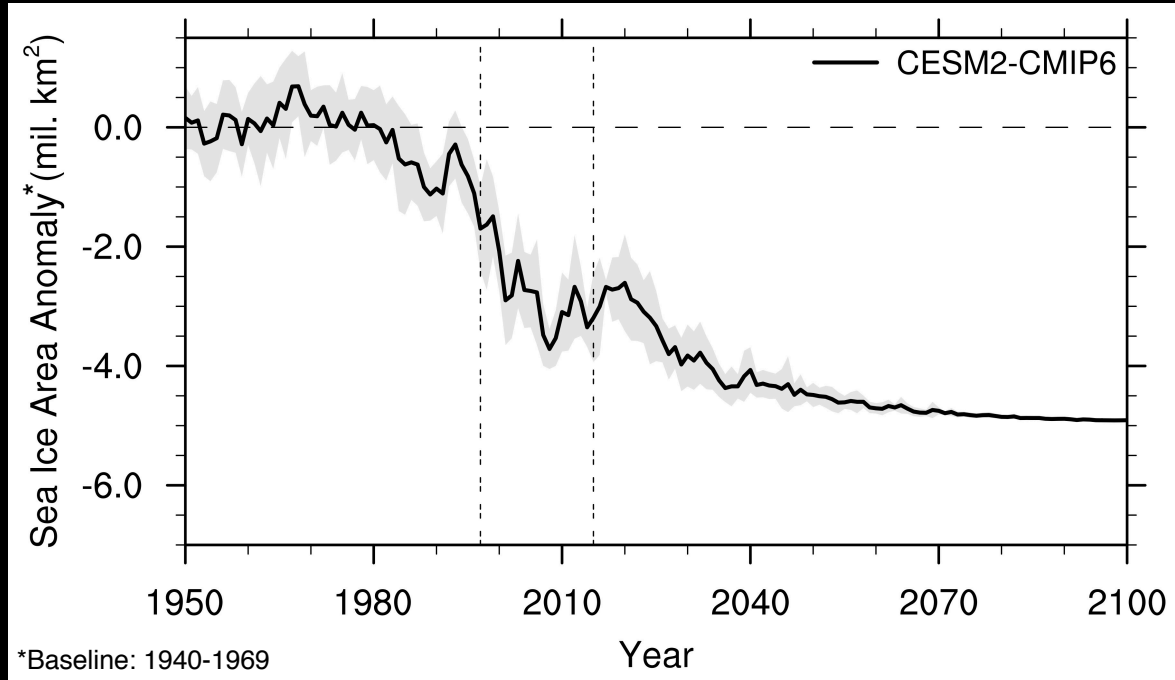


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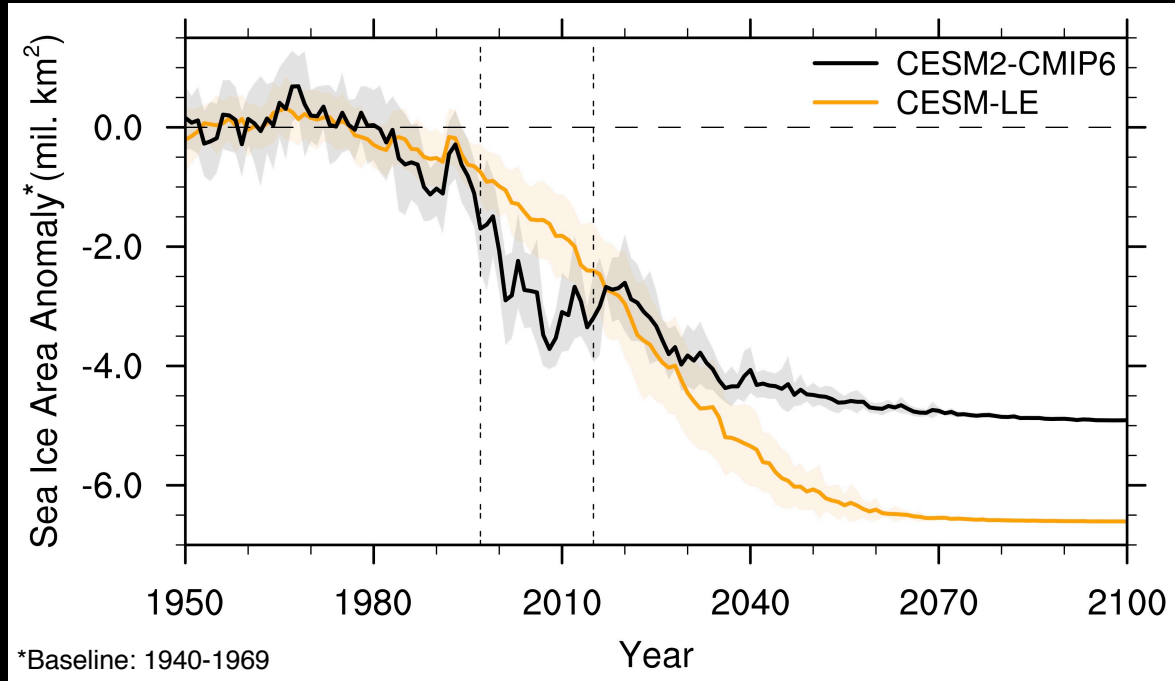
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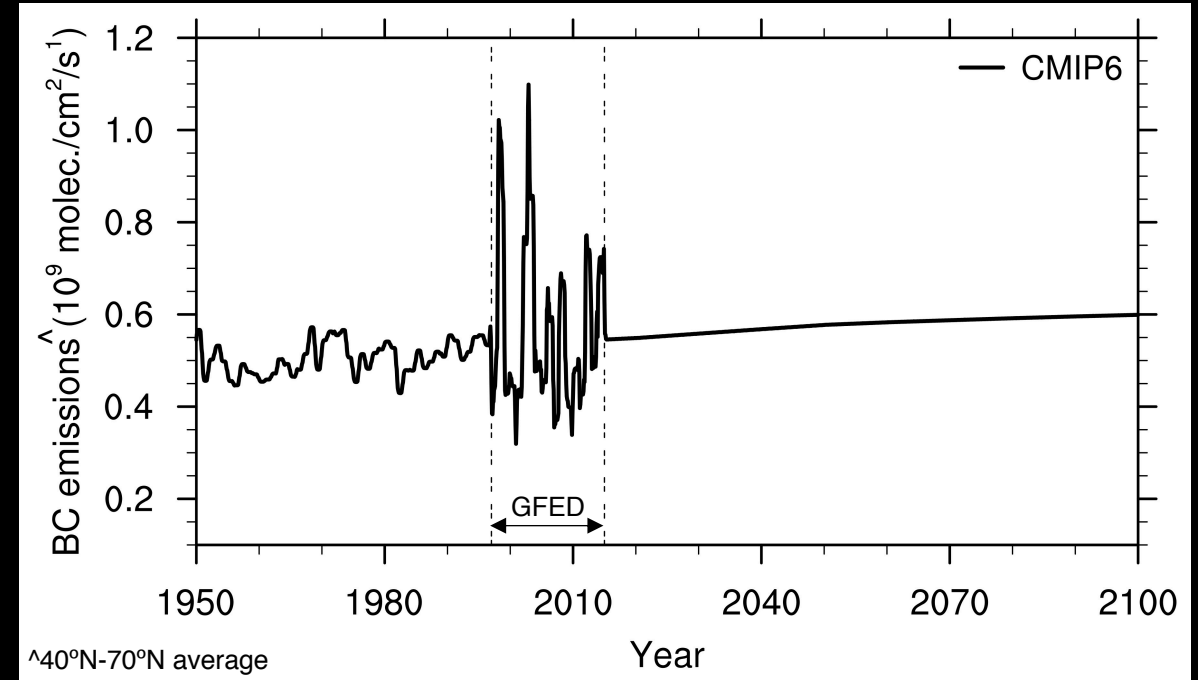
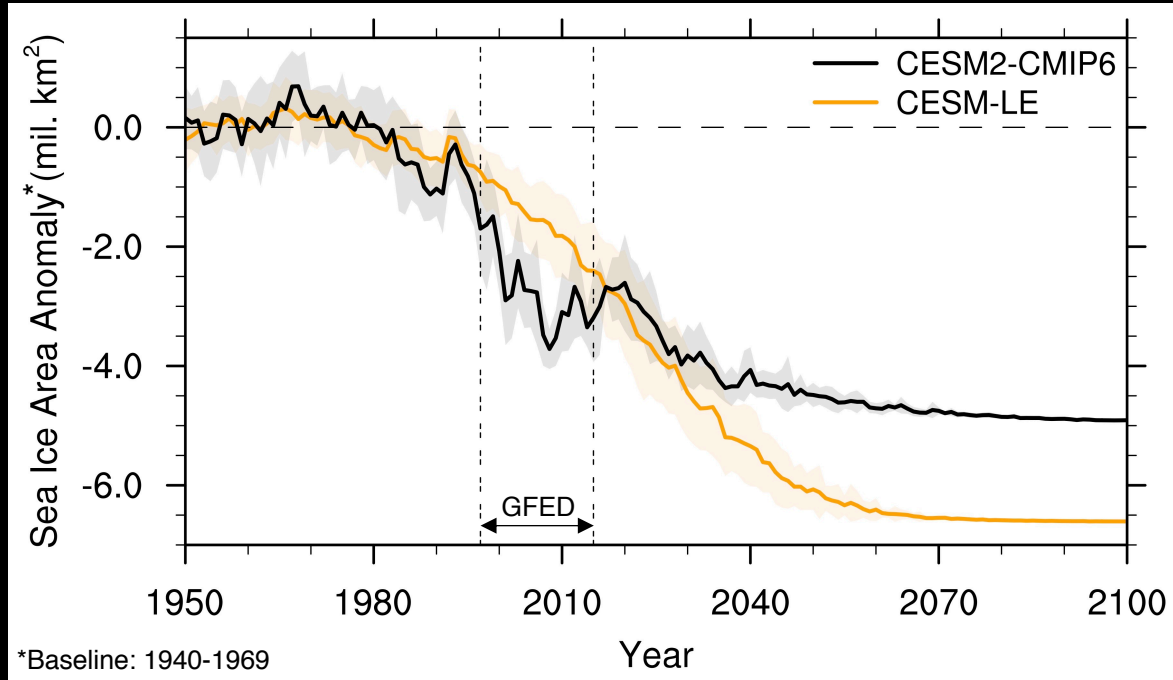
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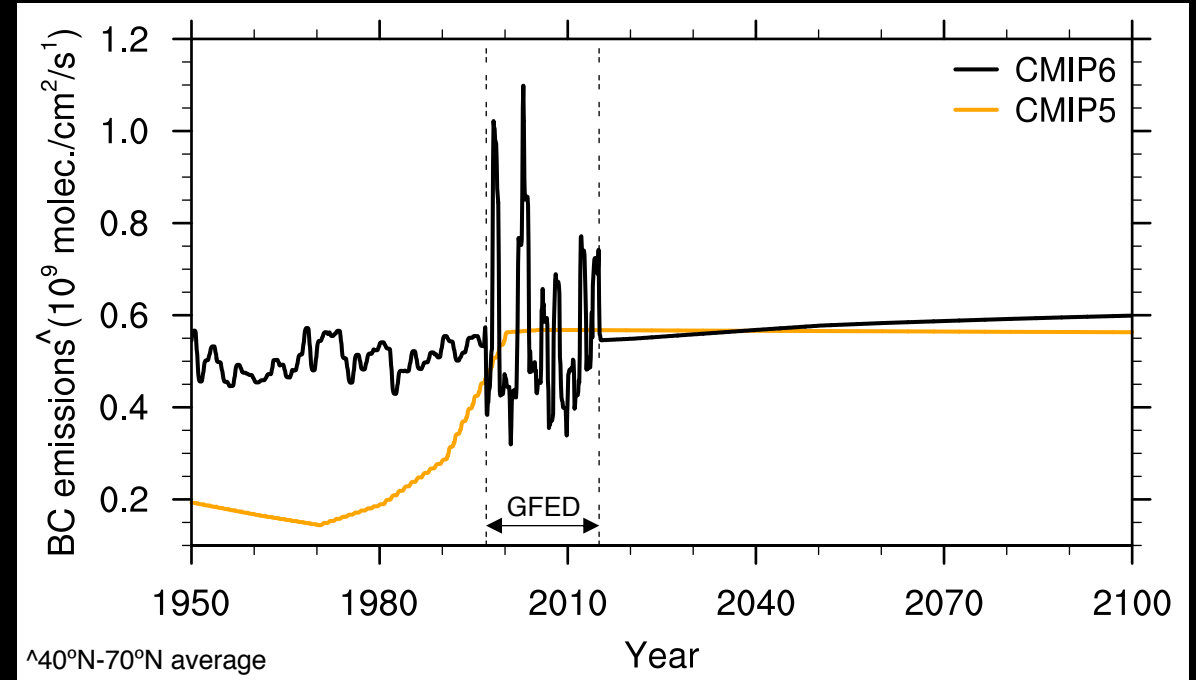
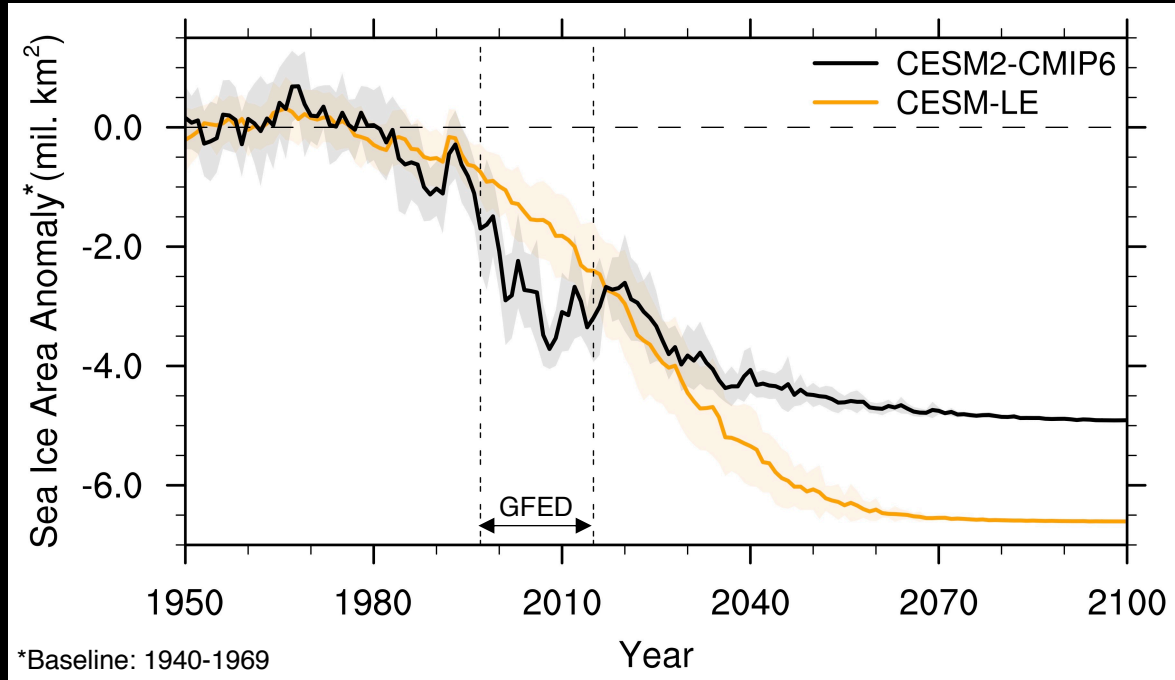


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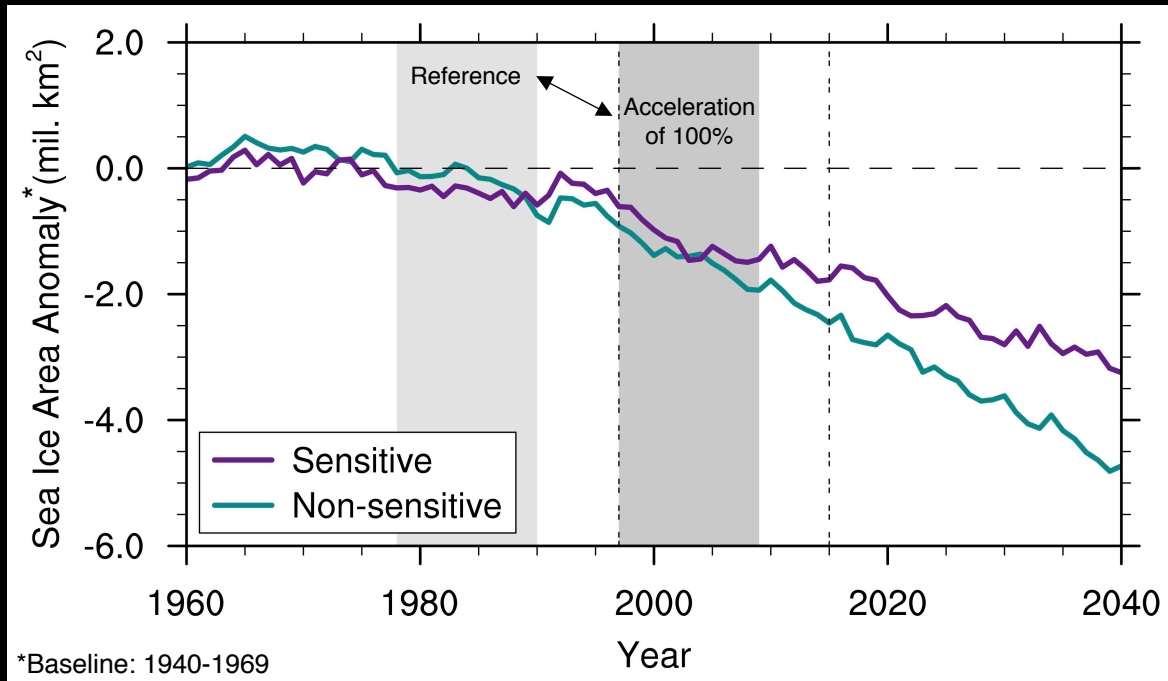
- The Global Fire Emissions Database (GFED) from 1997-2014 was used to produce estimates of **biomass burning (BB)** emissions prescribed in the Coupled Model Intercomparison Project Version 6 (CMIP6).
- It is characterized by increased inter-annual variability in BB emissions, more inline with observations.

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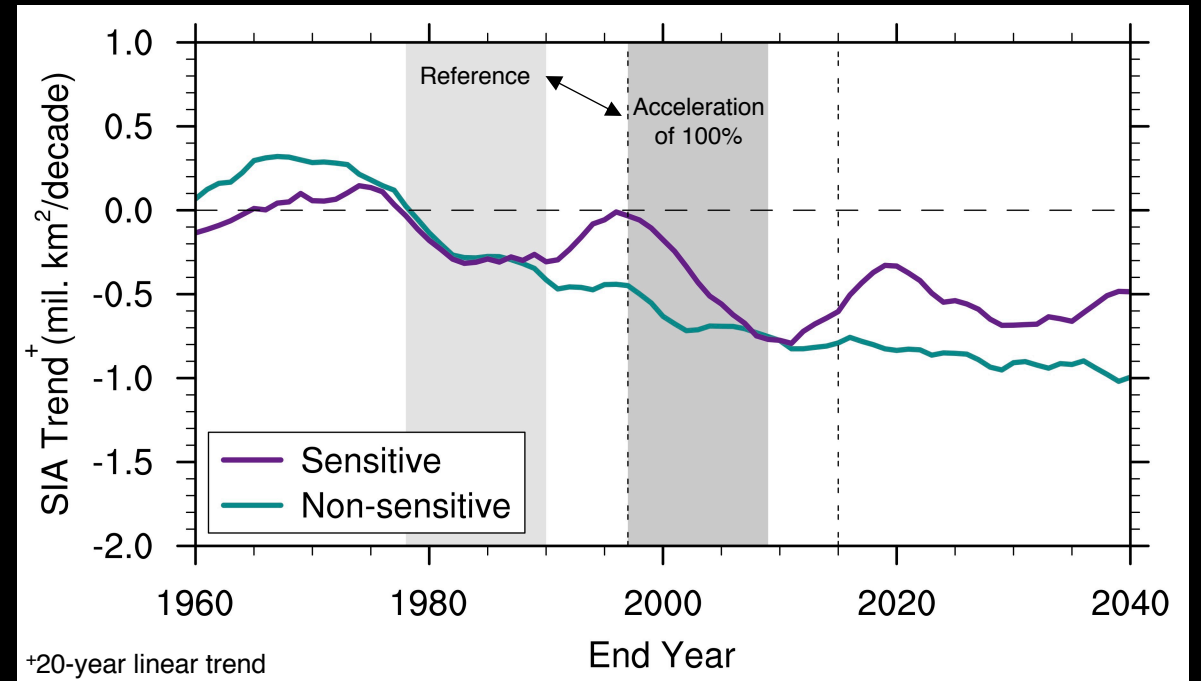
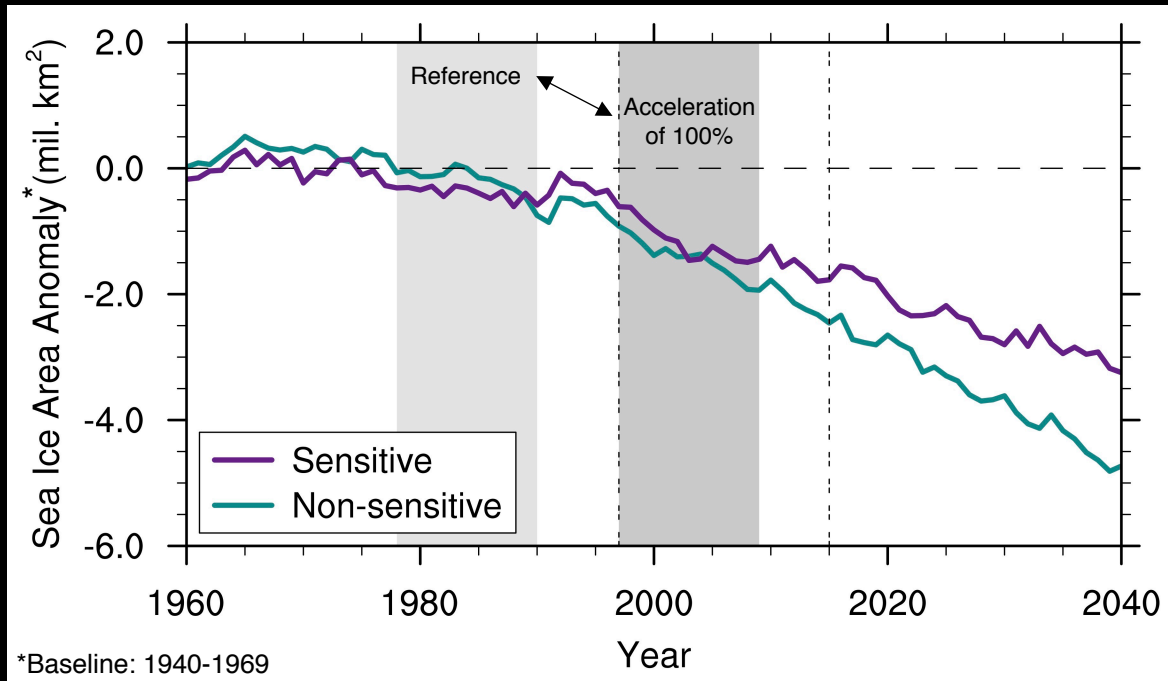
This sea ice loss and recovery is also simulated by other CMIP6 models, although not all



12 CMIP6 models (first 3 ensemble members only) from 1850 to 2100 have been separated into a Sensitive or Non-sensitive category depending on if they exhibit an acceleration in sea ice decline from 1997-2009 that is 100% larger compared to 1978-1990.

- We exclude the period 1991-1996 because of the Pinatubo volcanic eruption and its effect on global climate

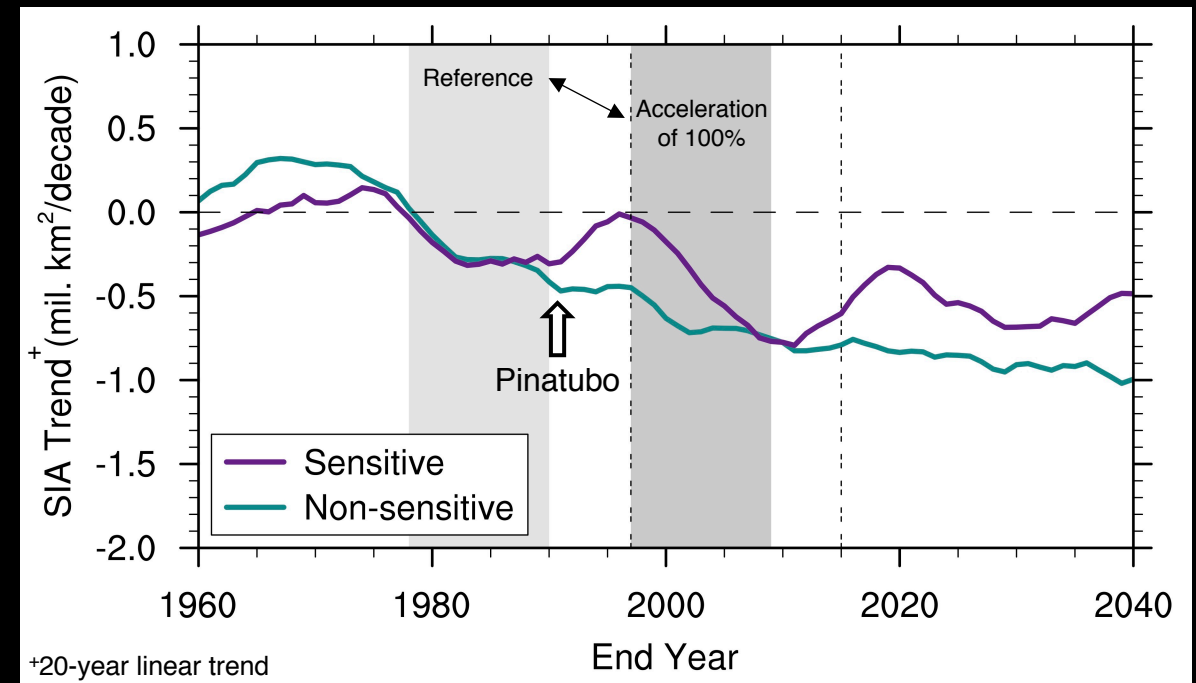
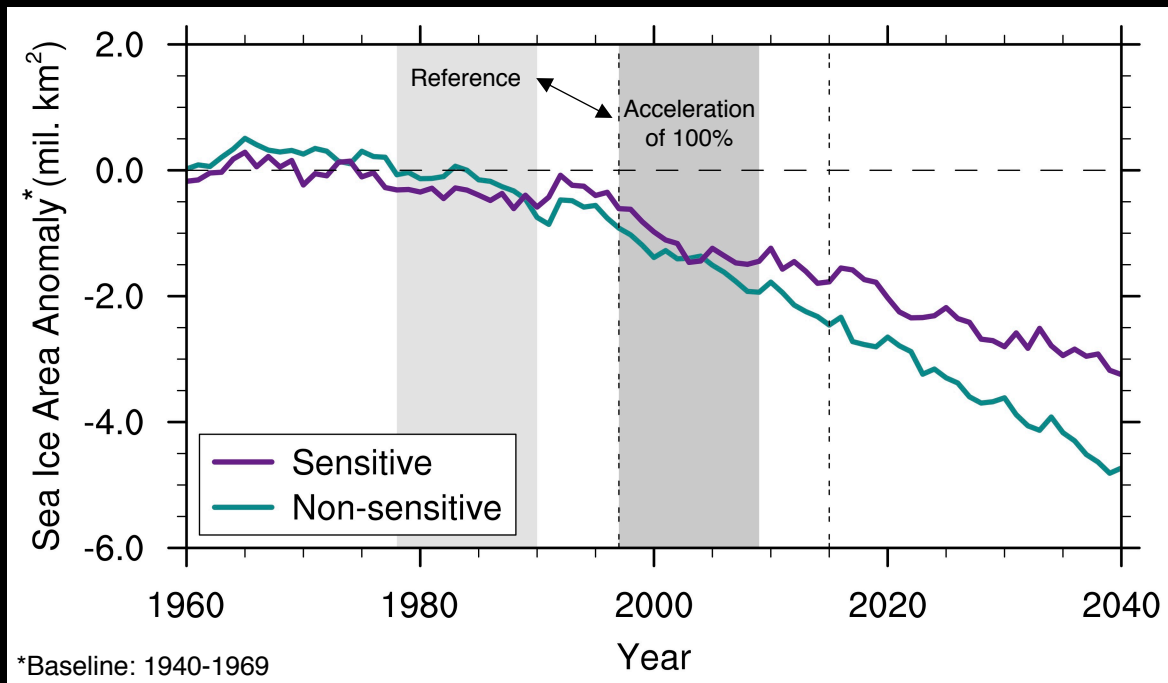
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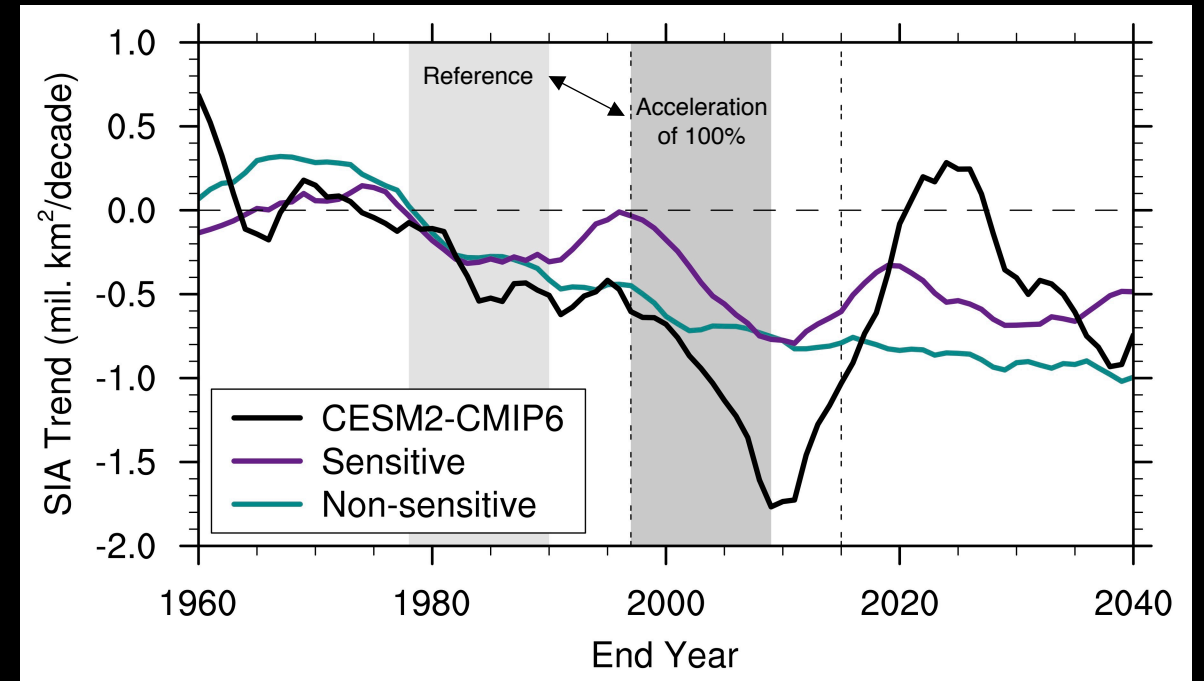
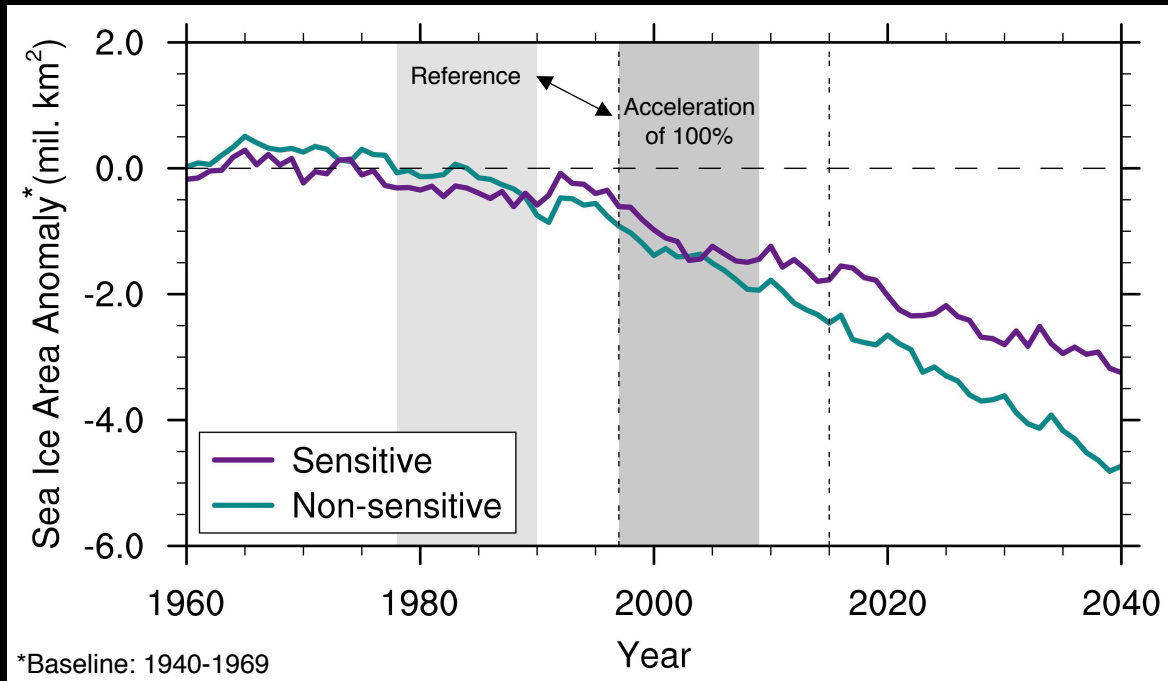
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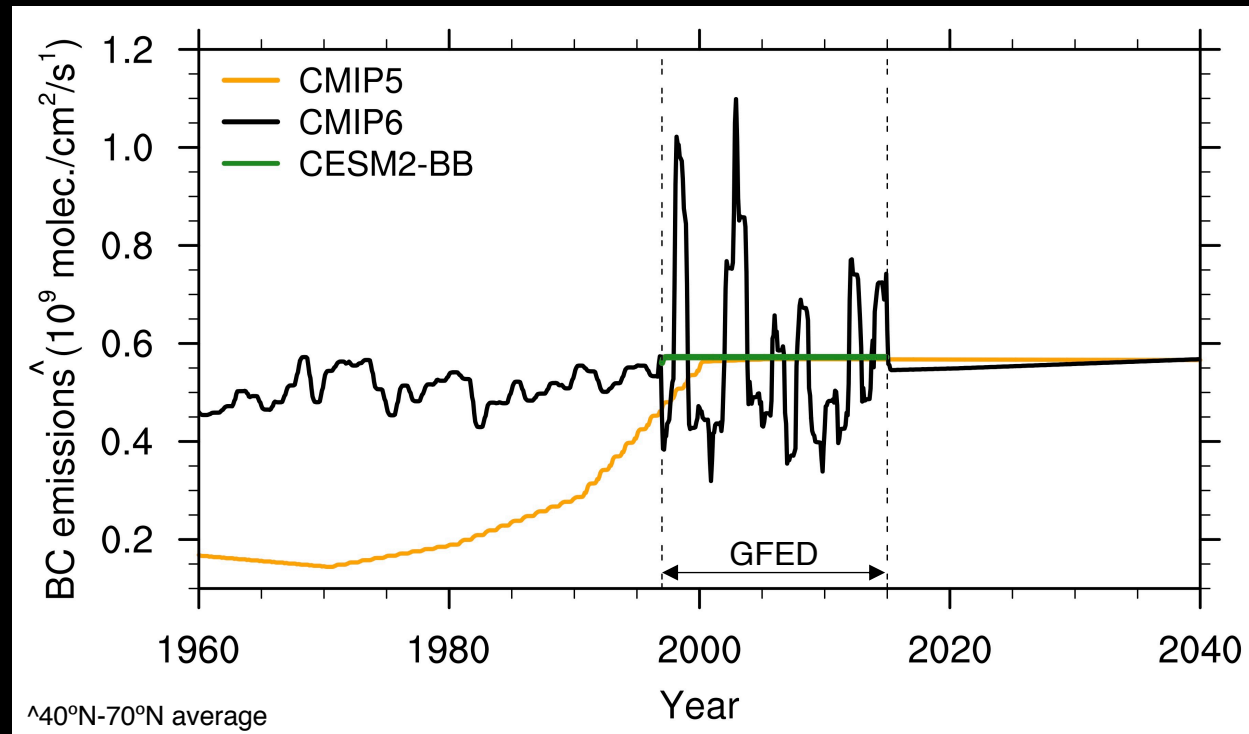
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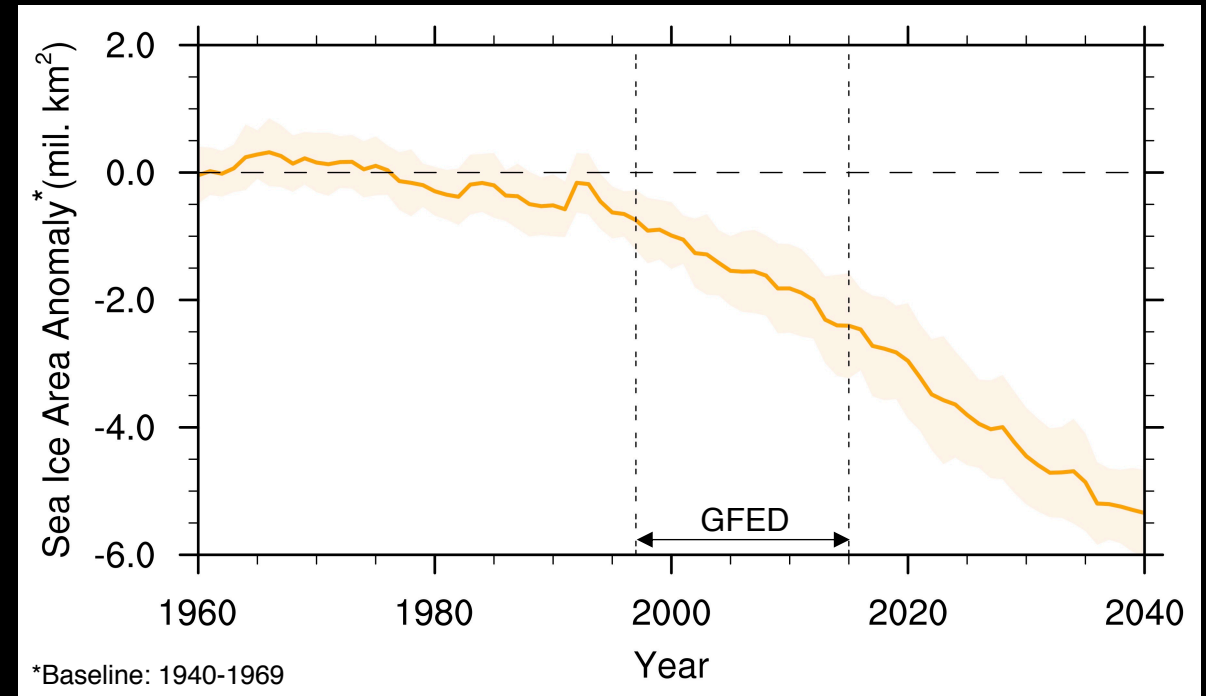
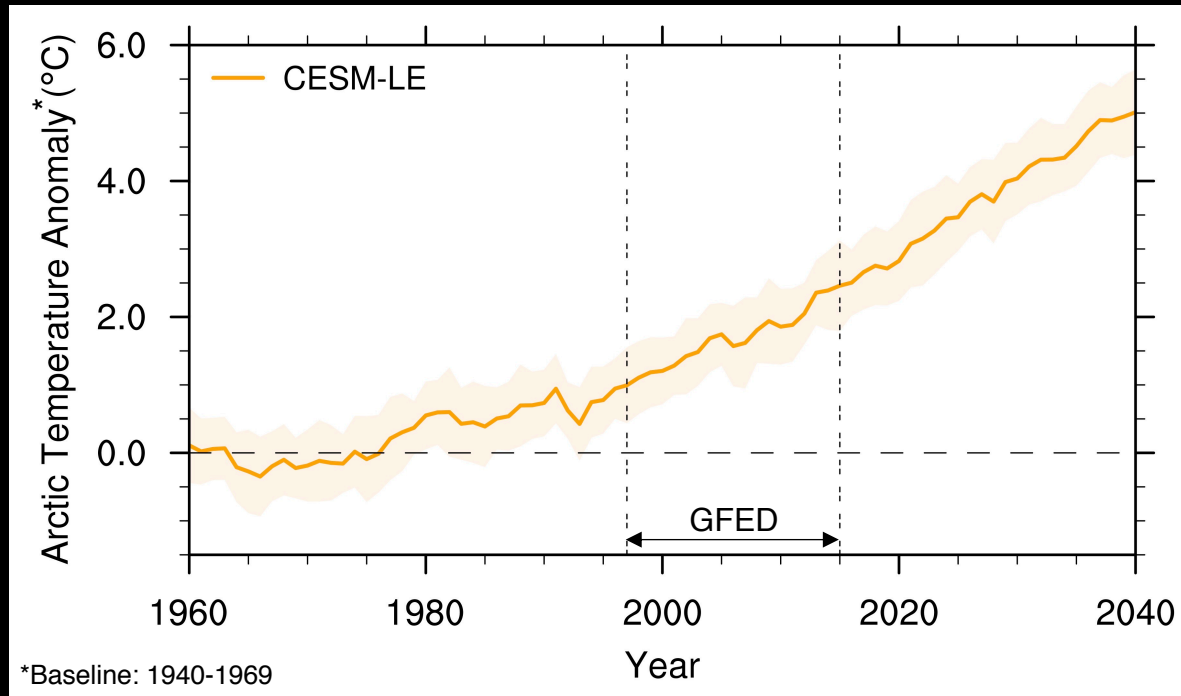
Sensitivity Experiment – Removing the variability in BB emissions over the GFED era



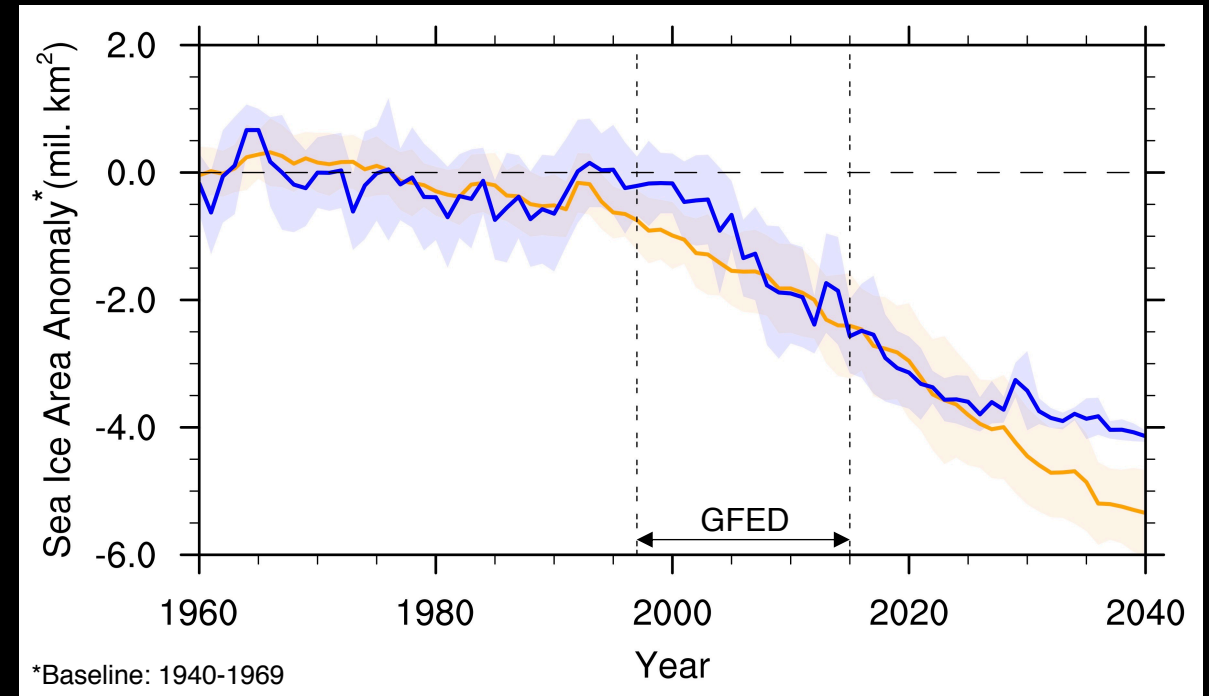
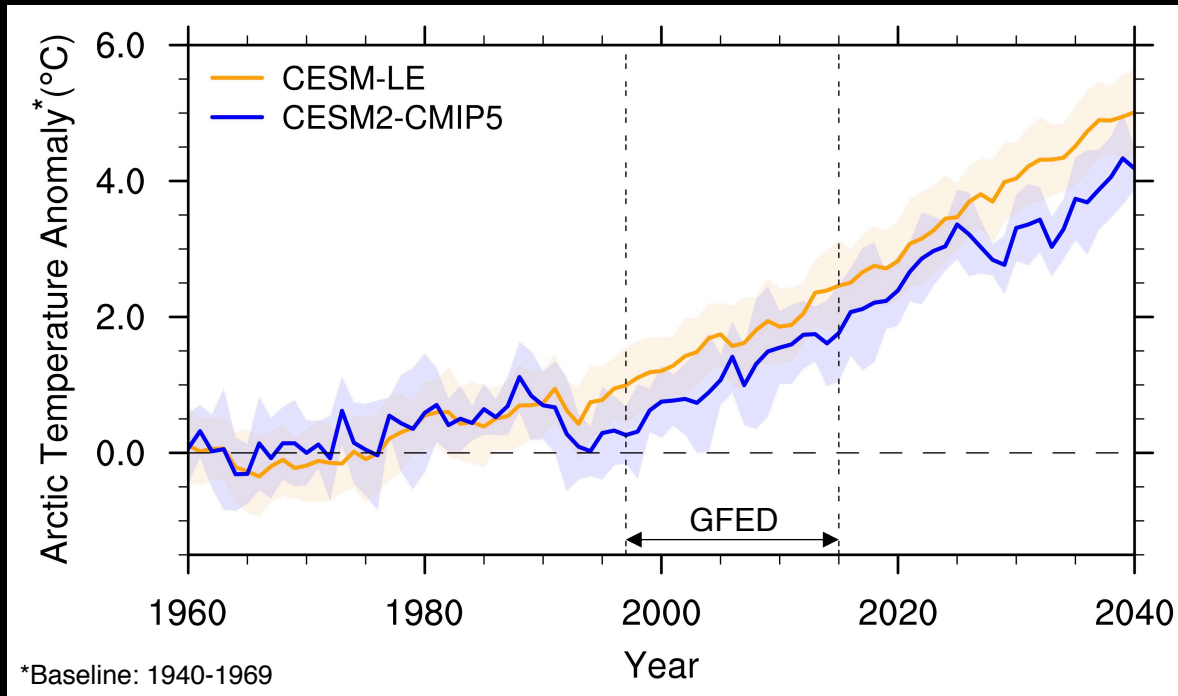
Model Experiments

	Model Version	Forcing	# of Ensemble Members
CESM-LE	CESM1	CMIP5	40
CESM2-CMIP5	CESM2	CMIP5	7
CESM2-CMIP6	CESM2	CMIP6	11
CESM2-BB	CESM2	CMIP6 except for BB emissions from 1997-2014	10

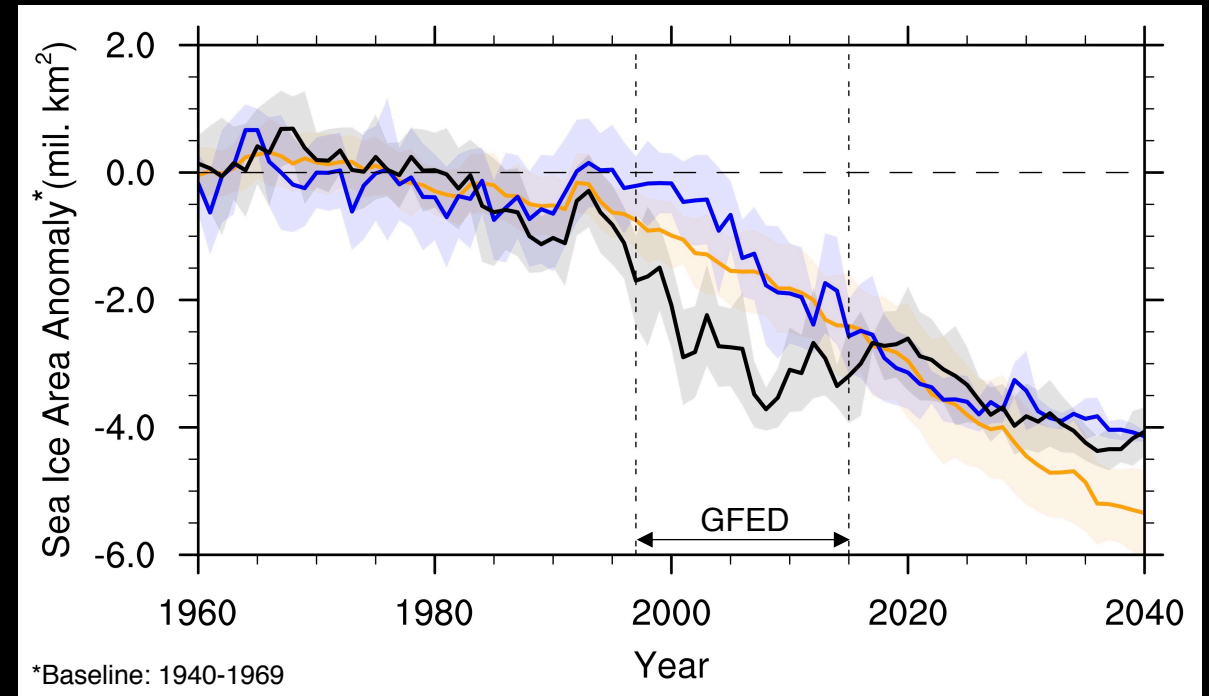
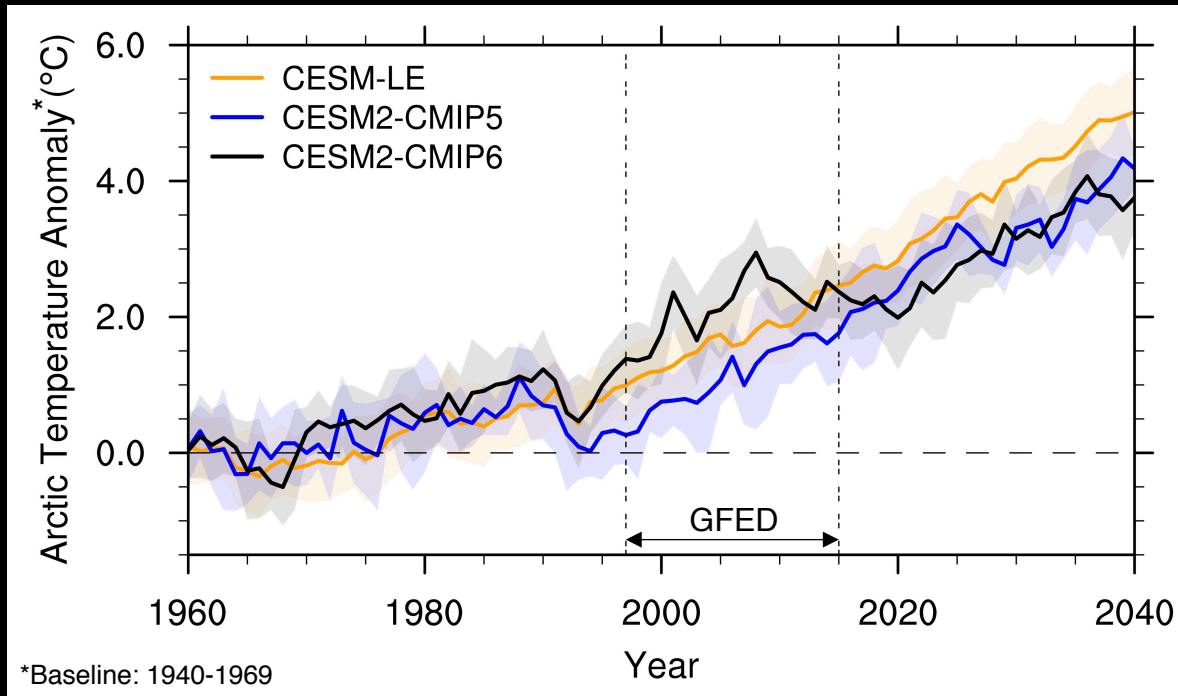
Removing the variability in BB emissions leads to reduced Arctic warming and sea ice loss



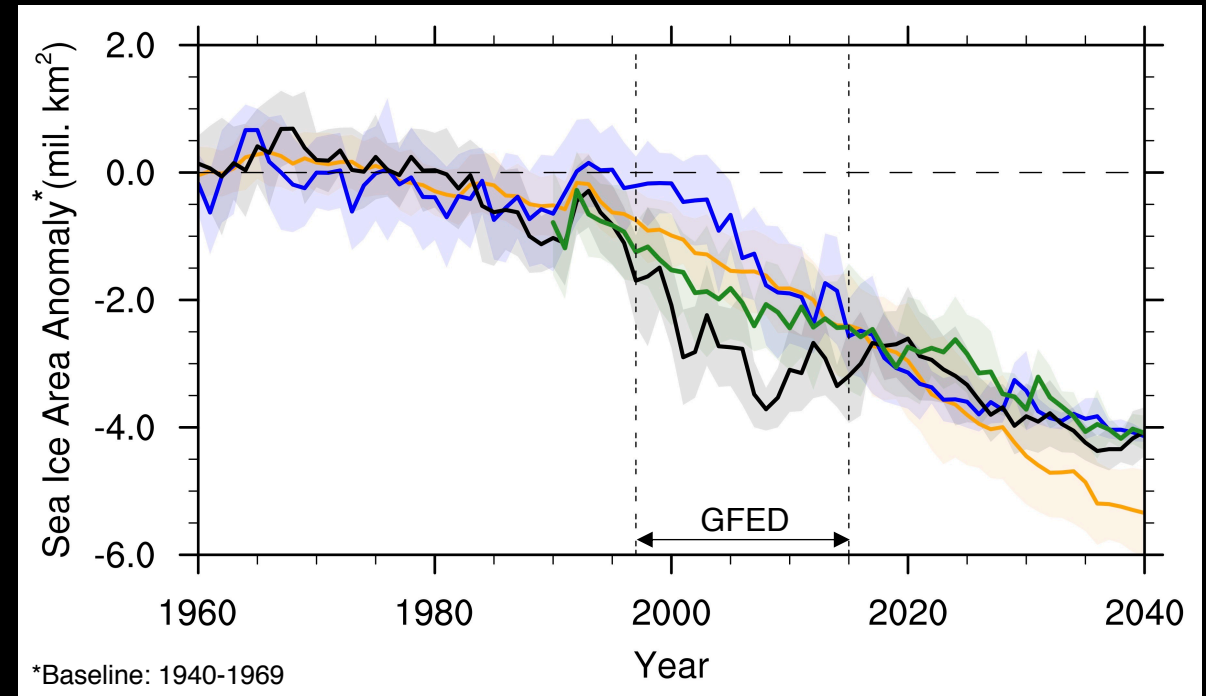
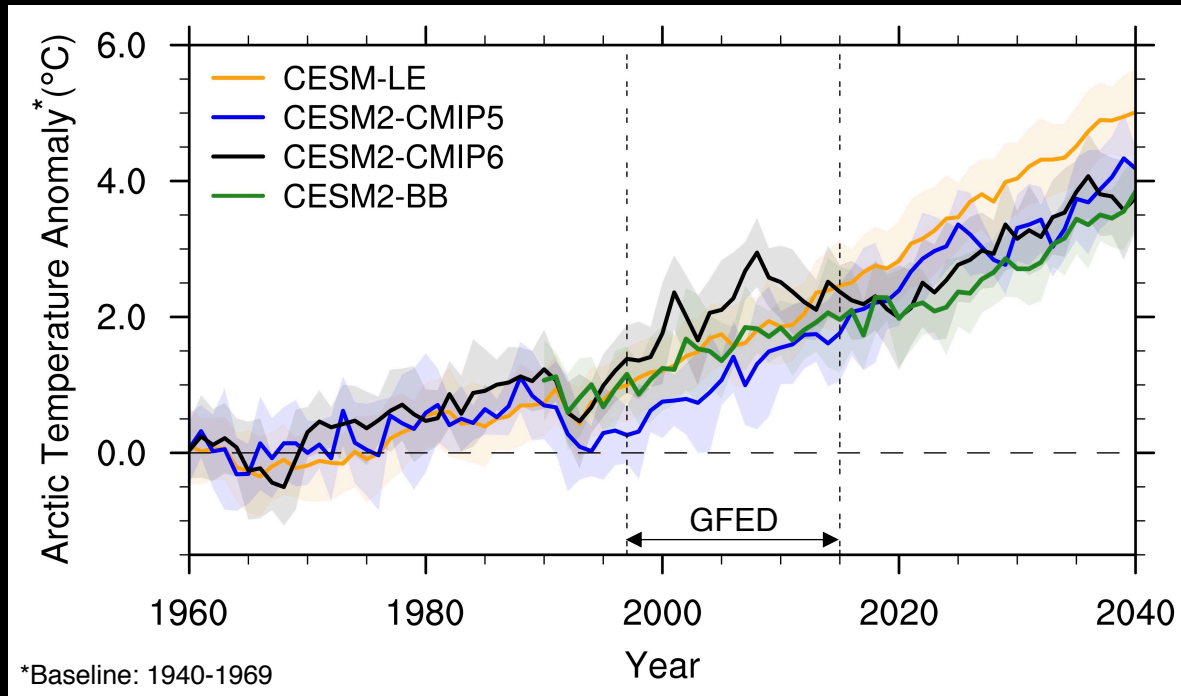
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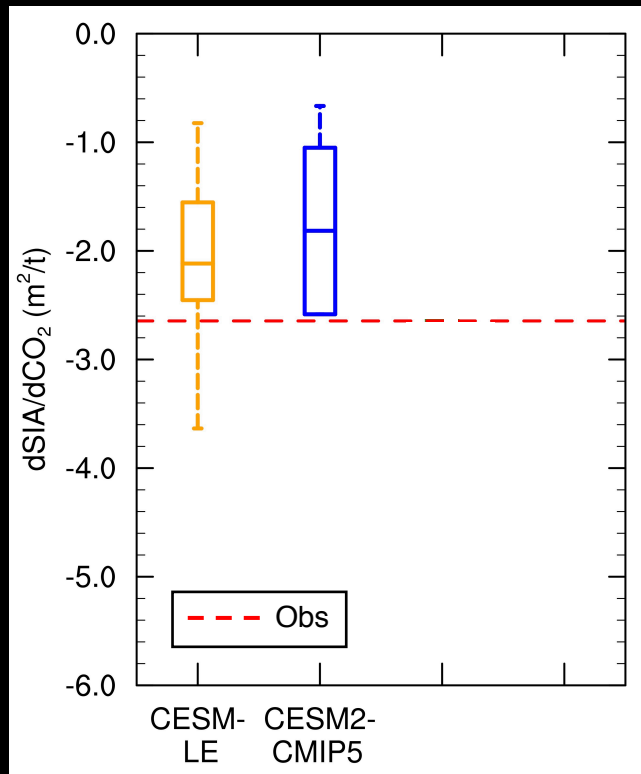


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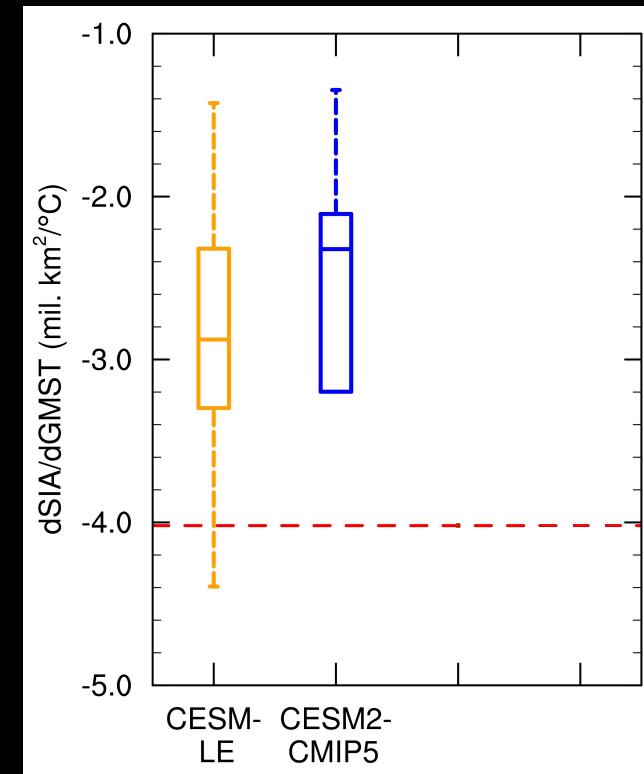


Half of the increased sea ice sensitivity from CMIP5 to CMIP6 in the CESM2 is due to improved BB emissions

Sea ice sensitivity to anthropogenic CO₂ emissions (1979-2014)

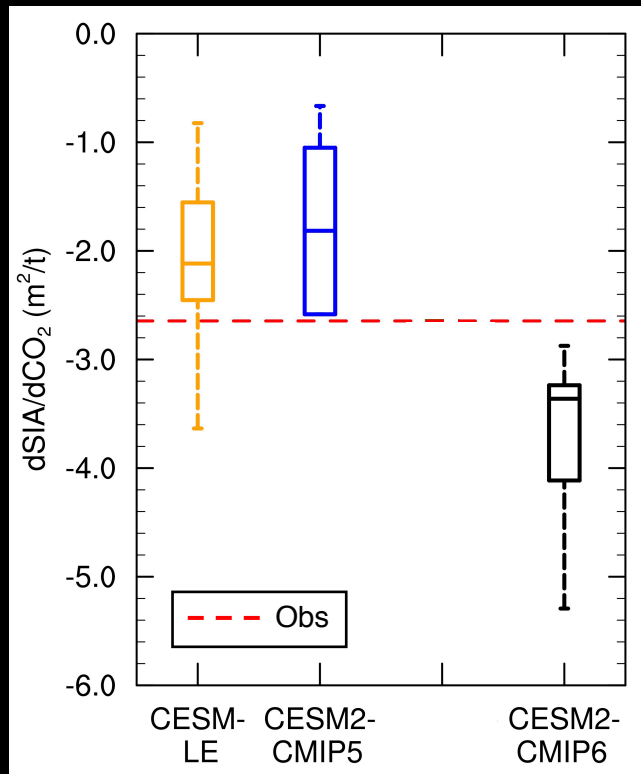


Sea ice sensitivity to global mean surface temperature (1979-2014)

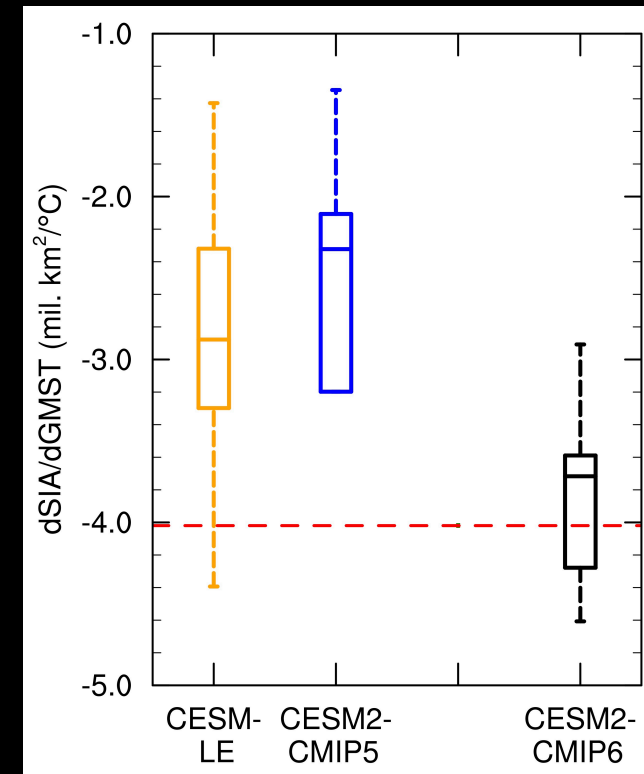


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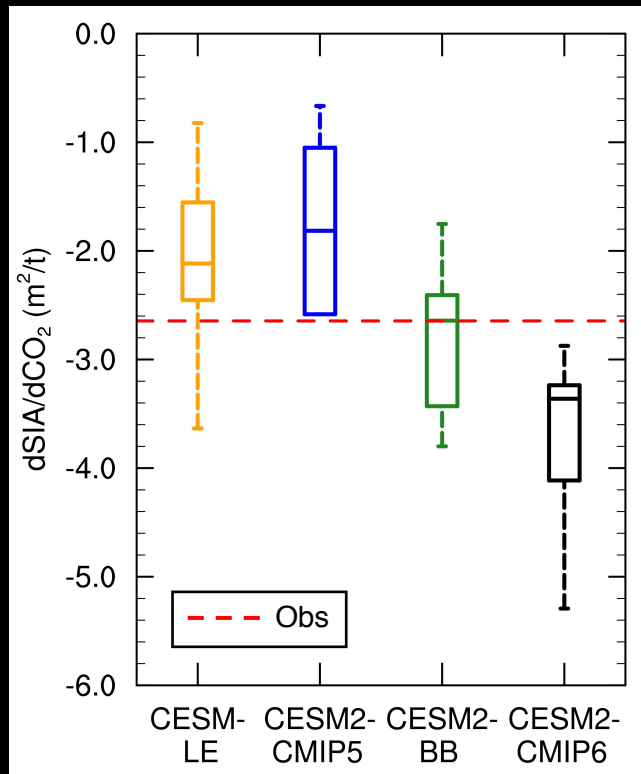


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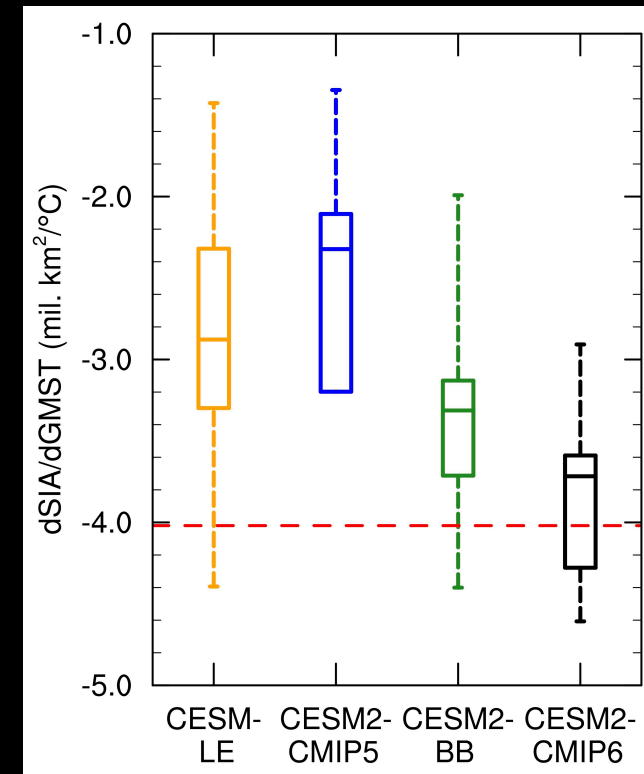


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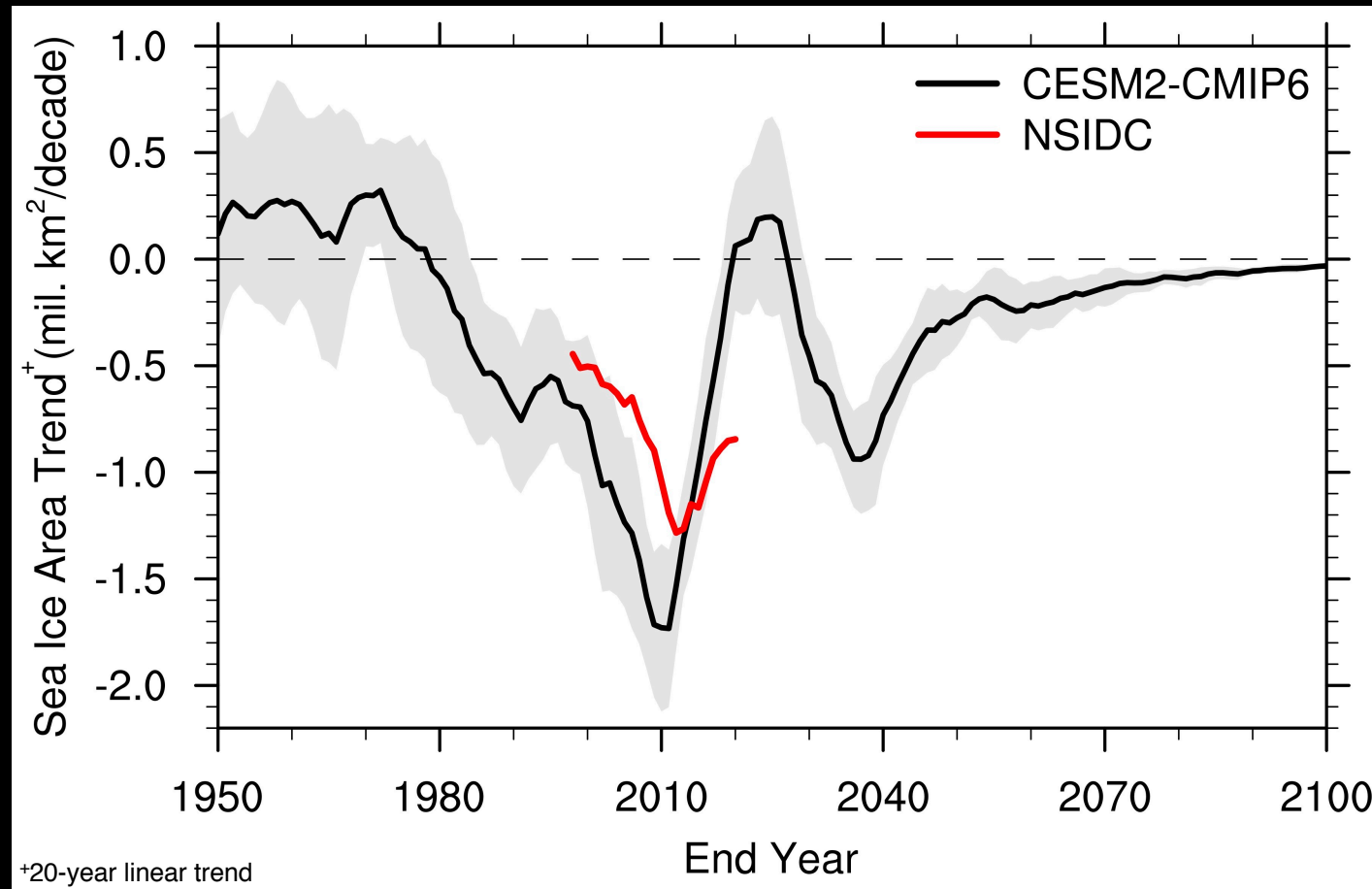
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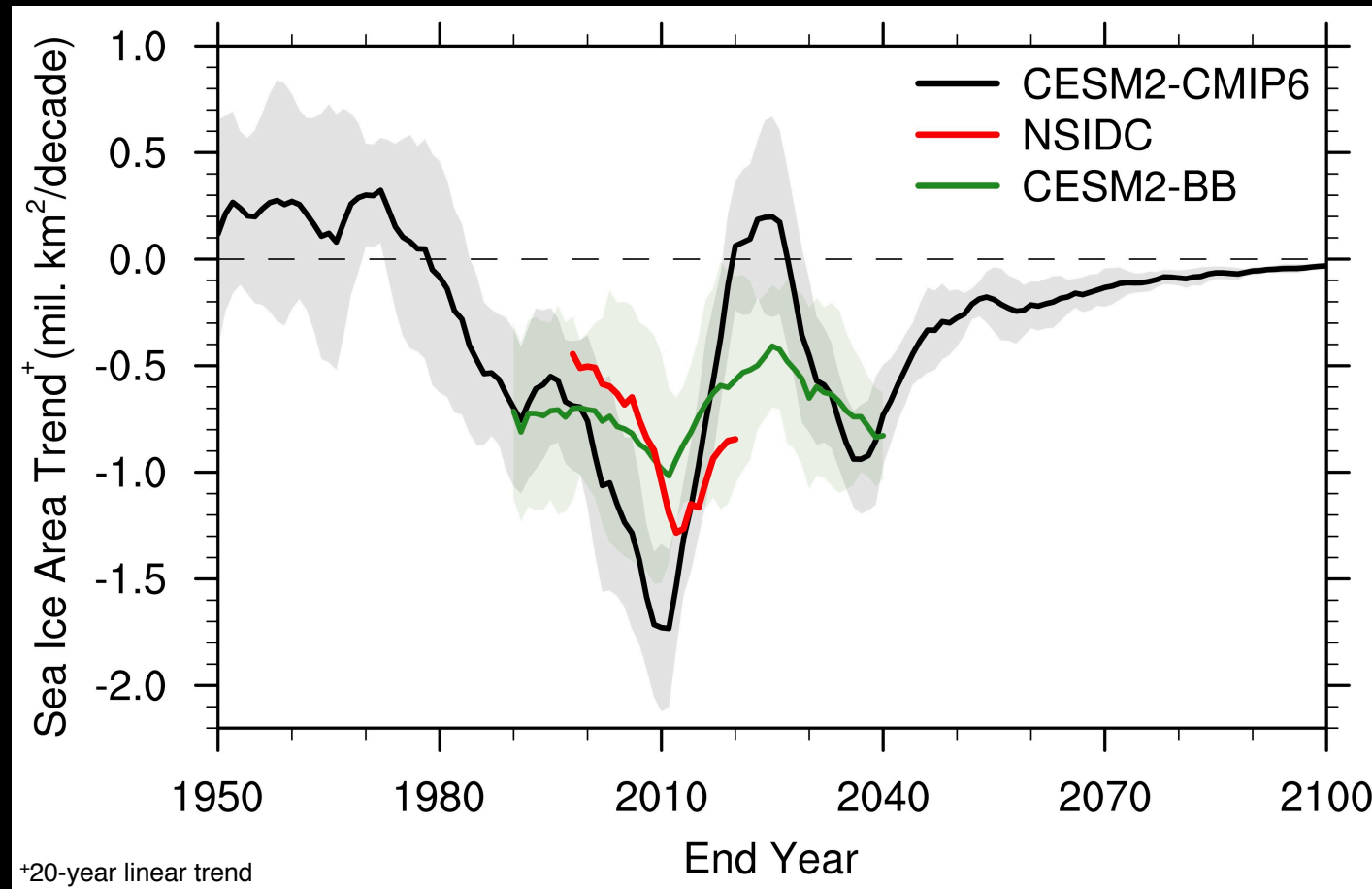
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Is there a forced signal in the recent reduced rate of Arctic sea ice loss?



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Summary

- The CESM2-CMIP6, as well as a few other CMIP6 models, simulate **an acceleration in sea ice decline** that coincides with the start of the GFED era, **followed by a recovery** until the start of the 2020s.
- We conducted a sensitivity experiment in which **we removed the inter-annual variability in biomass burning emissions** over the GFED period.
- The sensitivity runs show **reduced Arctic warming and sea ice decline** compared to the CESM2-CMIP6 when the biomass burning variability is removed.
- **Half of the increase in sea ice sensitivity** from CMIP5 to CMIP6 in the CESM can be attributed to the increased variability in BB emissions during the GFED era.
- There is **indication of a forced signal** in the recent reduced rate of Arctic sea ice loss.

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