Updates on the CESM2 Large Ensemble and Polar Amplification MIP

CESM2 Large Ensemble is underway!

- In partnership with IBS Center for Climate Physics, South Korea
- 1 degree spatial resolution
- 1850-2100 (historical and SSP370)
- 100 members
- Completion in ~ 7 months (Sep 2020)
- First 10 members by end of February

Initialization protocol to create ensemble spread

- CESM1 used a single ocean initial state, with tiny (10^{-14} K) perturbations to the initial atmospheric temperatures ("pertlim").

- CESM2 will use a combination of different ocean initial states ("macro perturbations") and pertlim ("micro perturbations").

CESM2 Large Ensemble Initialization Protocol

- 20 random ocean initial states (taken from restart files every 10 years of the long 1850 control simulation during model years 1001-1200 to avoid drift issues).
- 4 pre-selected ocean initial states based on AMOC phase (model years 1230-1301), with 20 “pertlim” members each.

CESM2 Large Ensemble Initialization Protocol

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- 4 pre-selected ocean initial states based on AMOC phase (model years 1230-1301), with 20 "pertlim" members each.

Allows assessment of AMOC initial condition memory, and ocean vs. atmosphere contributions to ensemble spread.


Updates on the
CESM2 Large Ensemble
and Polar Amplification MIP

www.cesm.ucar.edu/ projects/CMIP6/PAMIP/

POLAR AMPLIFICATION MODEL INTERCOMPARISON PROJECT

Polar amplification, the phenomenon that external radiative forcing produces a larger change in surface temperature at high latitudes than the global average, is a key aspect of anthropogenic climate change but its causes and consequences are not fully understood.

The Polar Amplification Model Intercomparison Project (**PAMIP**), co-led by Dr. Doug Smith, Dr. James Screen, and Dr. Clara Deser seeks to improve our understanding of this phenomenon through a coordinated set of numerical model experiments. As one of the Coupled Model Intercomparison Project Phase 6 (CMIP6) endorsed MIPs, PAMIP will address the following primary questions:

1. What are the relative roles of local sea ice and remote sea surface temperature changes in driving polar amplification?
2. How does the global climate system respond to changes in Arctic and Antarctic sea ice?

Click here to read the full background...

The following article provides an overview of the PAMIP including the protocols:
https://www.geosci-model-dev.net/12/1139/2019/

Article Reference

> *Smith, D. M., J. A. Screen, C. Deser, J. Cohen, J. C. Fyfe, J. García-Serrano, T. Jung, V. Kattsov, D. Matei, R. Msadek, Y. Peings, M. Sigmond, J. Ukita, J.-H. Yoon and X. Zhang, The Polar Amplification Model Intercomparison Project (PAMIP) contribution to CMIP6: investigating the causes and consequences of polar amplification, Geosci. Model Dev., 12, 1139–1164, 2019*

For any suggestions or comments, please email Lantao Sun
[lantao.sun@colostate.edu]

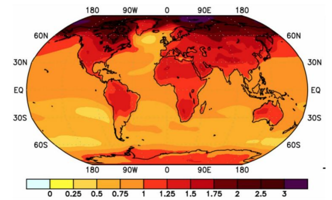
PAMIP Links

- Click on Background and Experiment Protocol to understand the PAMIP experiments. The SST and SIC forcing files used in PAMIP experiments can be downloaded there.
- Click on Data Status to track the PAMIP data information from each modeling center, including the contact information.
- Click on PAMIP Workshop for the June 2019 PAMIP workshop agenda and presentations.
- To see a list of PAMIP papers or projects click on Publications or On-going Projects.
- Click on Known issues for information regarding problems discovered.
- Sign up for the official PAMIP Mailing list. Discussion on PAMIP can be also posted on Slack Workspace.

CESM PROJECT

The CESM project is supported primarily by the National Science Foundation (NSF). Administration of the CESM is maintained by the Climate and Global Dynamics Laboratory (CGD) at the National Center for Atmospheric Research (NCAR).

CESM is a fully-coupled, community, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states.



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colostate.edu

www.cesm.ucar.edu/ projects/CMIP6/PAMIP/

PAMIP EXPERIMENT PROTOCOL

Coordinated model experiments in PAMIP are listed in the following tables:

1. Atmosphere-only time slice experiments
2. Coupled ocean-atmosphere time slice experiments
3. Atmosphere-only time slice experiments to investigate regional forcing
4. Atmosphere-only time slice experiments to investigate the role of the background state
5. Atmosphere-only transient experiments
6. Coupled ocean-atmosphere transient experiments

www.cesm.ucar.edu/ projects/CMIP6/PAMIP/

/ CESM Models / CESM Projects / CESM - CMIP6 / PAMIP / Experiment Protocol

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PAMIP WORKSHOP

2019 PAMIP Workshop Agenda & Presentations

June 2019 Exeter, UK

DATA STATUS

Institute	Model	Planned Experiments	Completed Experiments	Data Delivery	Contact Information
AWI	OpenIFS LR	-	1.1-1.3, 1.5-1.6, 3.2	email with data request	jan.streffing@awi.de
AWI	OpenIFS MR	-	1.1-1.3, 1.6	email with data request	jan.streffing@awi.de
AWI	OpenIFS HR	-	1.1, 1.6	email with data request	jan.streffing@awi.de
AWI/MPI	AWI-CM, MPI-ESM	1.1-1.10, 2.1-2.3, 3.1-3.2, 4.1-4.2, 6.1-6.2	ECHAM6 T127L95(1.1-1.6, 3.1, 3.2); ECHAM6-SWIFT T127L95 (1.1, 1.5-1.6, 3.1-3.2)	2020	tido.semmler@awi.de
BSC	EC-Earth3	1.1, 1.6, 2.1, 2.3	-	-	-
CCCma	CanESM5	1.1-1.8, 3.1-3.2	1.1-1.8, 3.1-3.2	September 2019; available on ESG	michael.sigmond@canada.ca john.fyfe@canada.ca
Cerfacs	CNRM-CM6	1.1-1.6, 1.8, 2.1-2.3, 3.1-3.2, 4.1-4.2, 6.1-6.2	1.1-1.6, 3.1-3.2	Oct 2019	rym.msadek@cerfacs.fr
DMI	EC-Earth3	1.1, 1.3, 1.5-1.6, 6.1-6.2	-	Late 2019	shuting@dmi.dk
IPSL	IPSL-CAM6A-LR	1.1-1.8, 2.1-2.3, 3.1-3.2, 6.1-6.2	1.1-1.8, 3.1,3.2	email with data request	guillaume.gastineau@upmc.fr
Met Office	HadGEM3 N216O025	1.1-1.8, 2.1-2.3, 3.1-3.2, 4.1-4.2	1.1-1.8, 2.1, 2.3, 3.1-3.2	email with data request	rosie.eade@metoffice.gov.uk doug.smith@metoffice.gov.uk
METEO-UB	SPEEDY	-	1.1, 1.5, 1.6, 3.2	email with data request	j.garcia-serrano@meteo.ub.edu
NCAR/CSU	CESM2	1.1-1.8, 3.1-3.2, 6.1-6.3	1.1-1.8	Tier 1 available on ESG	lantao.sun@colostate.edu cdeser@ucar.edu
NCC/MET Norway/NORCE	NorESM2-LM	1.1, 1.3, 1.5-1.8, 2.1, 2.3, 4.1-4.2, 6.1-6.2	1.1, 1.3, 1.5-1.8	Tier 1 available on ESG	lise.s.graff@met.no
Niigata U	AFES	1.1-1.8, 3.1-3.2	-	Spring/Summer 2019	jukita@env.sc.niigata-u.ac.jp f16n003j@mail.cc.niigata-u.ac.jp
UC Irvine	E3SMv1	1.1-1.10, 2.1-2.5, 3.1-3.2, 4.1-4.2, 5.1-5.2	1.1, 1.4-1.6,1.9-1.10	Fall 2019	ypeings@uci.edu gudrun@uci.edu
UC Irvine	SC-WACCM	1.1-1.10, 2.1-2.5, 3.1-3.2, 4.1-4.2, 5.1-5.2	1.1-1.10, 3.1-3.2, 5.1-5.2	Fall 2019	ypeings@uci.edu gudrun@uci.edu
U of Exeter	HadGEM3 N96O1	1.1, 1.3, 1.5-1.8, 2.2, 6.3	-	Late 2019	j.screen@exeter.ac.uk
U of Tokyo	MIROC6	1.1, 1.5-1.8, 3.1-3.2	1.1, 1.5-1.8, 3.1-3.2	Summer 2019 for monthly data	masato@atmos.rcast.u-tokyo.ac.jp

Institute	Model	Planned Experiments	Completed Experiments	Data Delivery	Contact Information
U of Tokyo	MIROC6	1.1, 1.5–1.8, 3.1–3.2	1.1, 1.5–1.8, 3.1–3.2	Summer 2019 for monthly data	masato@atmos.rcast.u-tokyo.ac.jp

PAMIP PUBLICATIONS

Smith, D. M., J. A. Screen, C. Deser, J. Cohen, J. C. Fyfe, J. García-Serrano, T. Jung, V. Kattsov, D. Matei, R. Msadek, Y. Peings, M. Sigmond, J. Ukita, J.-H. Yoon and X. Zhang, The Polar Amplification Model Intercomparison Project (PAMIP) contribution to CMIP6: investigating the causes and consequences of polar amplification, Geosci. Model Dev., 12, 1139–1164, 2019.

Link to article:
https://www.geosci-model-dev.net/12/1139/2019/

Liang, Y.-C., Kwon, Y.-O., Frankignoul, C., Danabasoglu, G., Yeager, S., Cherchi, A., et al. (2020). Quantification of the Arctic sea ice-driven atmospheric circulation variability in coordinated large ensemble simulations. Geophysical Research Letters, 47, e2019GL085397. https://doi.org/10.1029/2019GL085397

Sun, L., Deser, C., Tomas, R., & Alexander, M. (2020). Global coupled climate response to polar sea ice loss: Evaluating the effectiveness of different ice-constraining approaches. Geophysical Research Letters, 47, e2019GL085788. https://doi.org/ 10.1029/2019GL085788

To add your publications to the list, please email Lantao Sun
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PAMIP PUBLICATIONS

Smith, D. M., J. A. Screen, C. Deser, J. Cohen, J. C. Fyfe, J. García-Serrano, T. Jung, V. Kattsov, D. Matei, R.

PAMIP FORUMS

Mailing list: you can sign up to the official PAMIP mailing list: https://www.wcrp-climate.org/modelling-wgcm-mip-catalogue/cmip6-endorsed-mips-article/1303-modelling-cmip6-pamip.

PAMIP slack space: discussion on PAMIP can be posted on slack workspace: https://app.slack.com/client/TM6T18TCG/DM17UBLL9/thread/CM6TD0LP2-1567514535.001700. If you want to join, please email Lantao Sun [lantao.sun@colostate.edu] for the invitation.

To add your publications to the list, please email Lantao Sun [lantao.sun@colostate.edu]

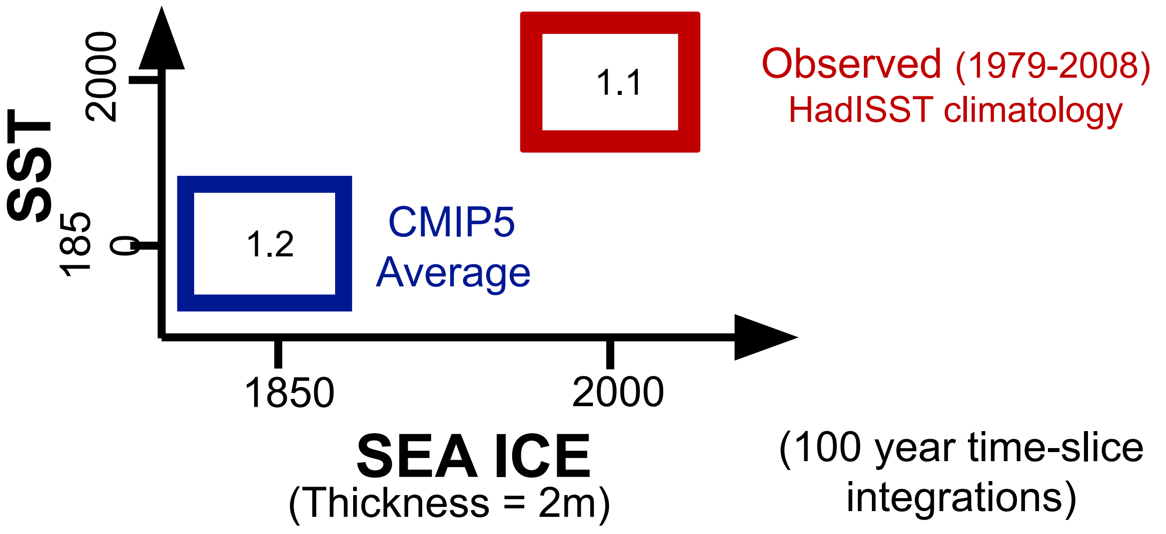
Institute	Model	Planned Experiments	Completed Experiments	Data Delivery	Contact Information
U of Tokyo	MIROC6	1.1, 1.5-1.8, 3.1-3.2	1.1, 1.5-1.8, 3.1-3.2	Summer 2019 for monthly data	masato@atmos.rcast.u-tokyo.ac.jp

Atmospheric circulation response to Arctic sea ice loss: Sensitivity to background SSTs

Clara Deser (NCAR) and Lantao Sun (CSU)

A51A AGU Dec 2019

Polar Amplification Model Intercomparison Project (PA-MIP) Tier 1 Experiments with CAM6 (1°)



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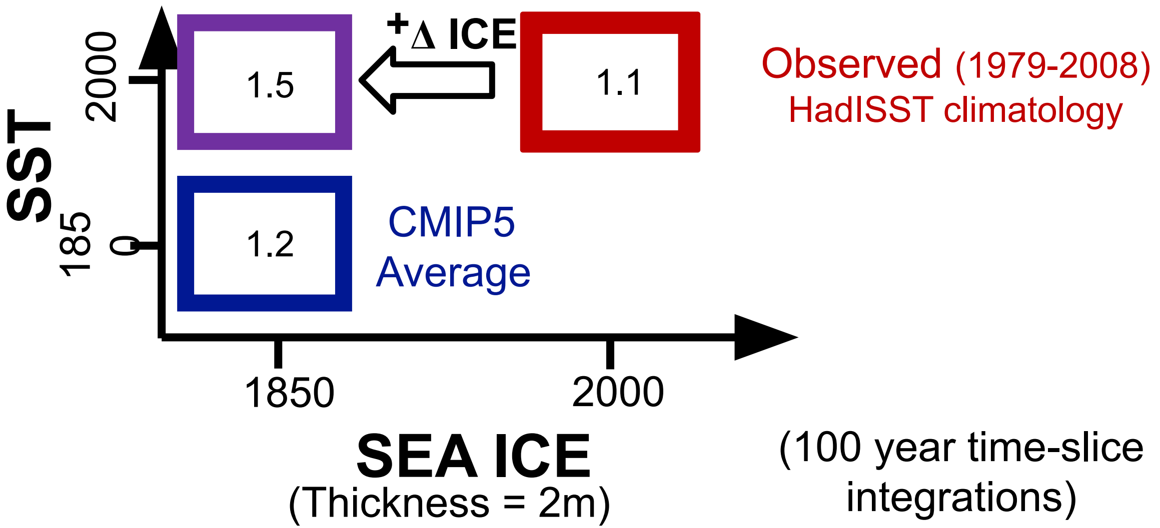

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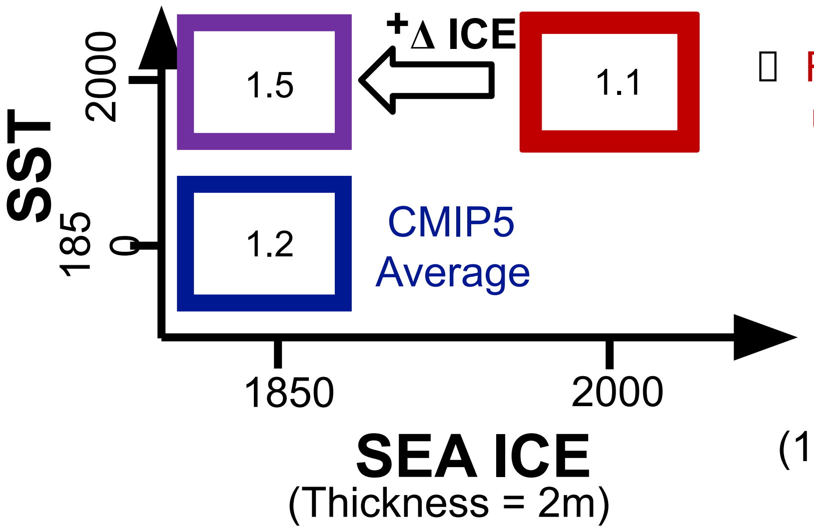

- Response to ice gain under present SSTs

(100 year time-slice integrations)

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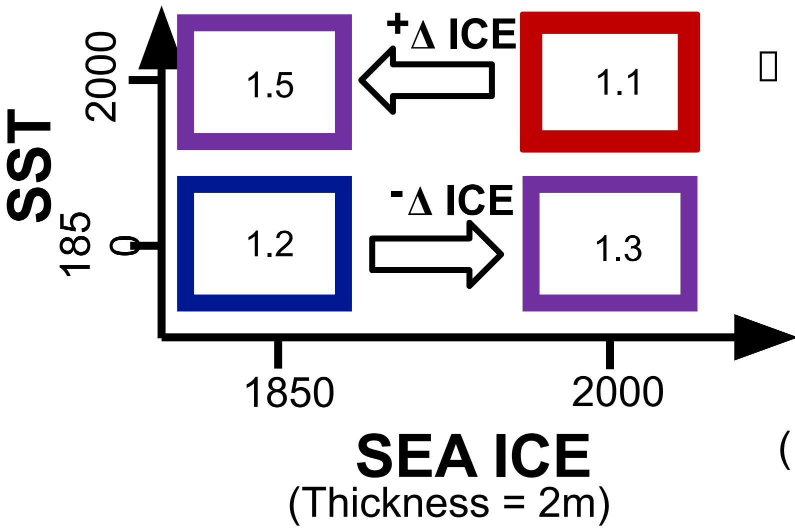

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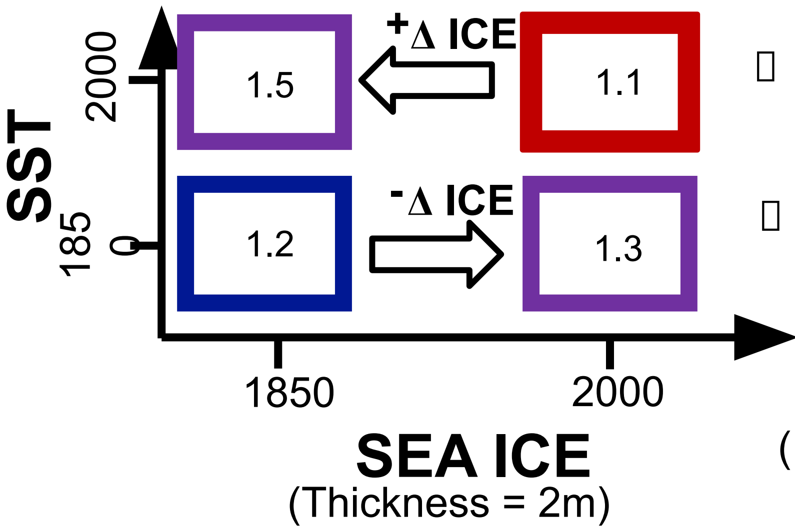


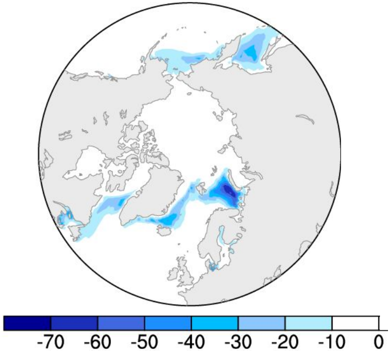
- Response to ice gain under present SSTs
- Response to ice loss under past SSTs

(100 year time-slice integrations)

Response to Arctic Sea Ice loss (DJFMA)

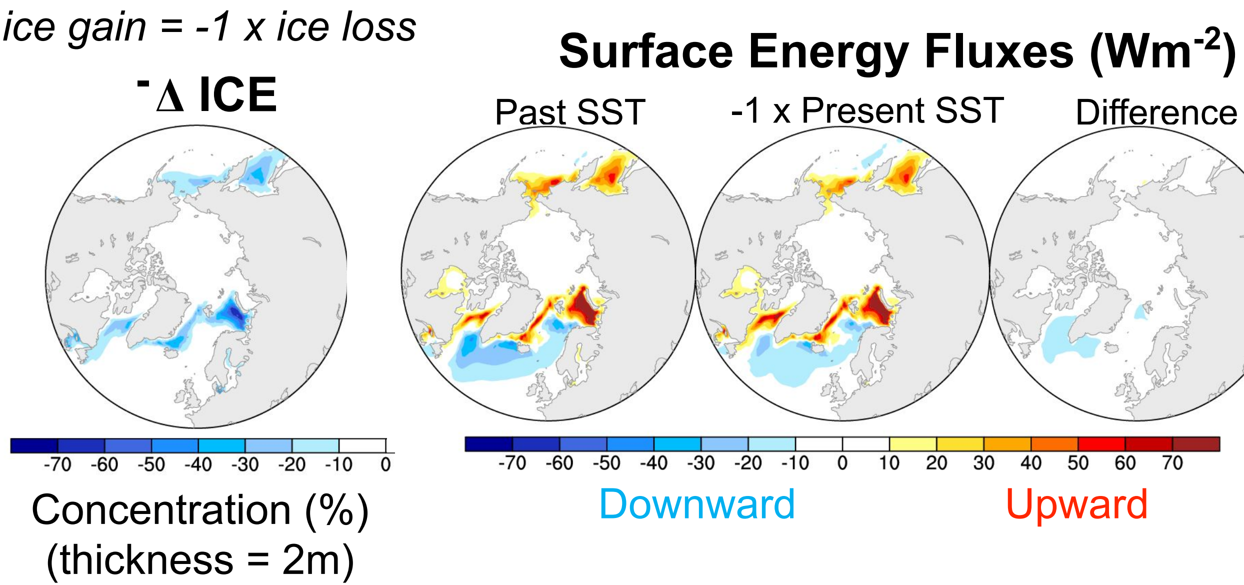
ice gain = -1 x ice loss

- Δ ICE



Concentration (%)
(thickness = 2m)

Response to Arctic Sea Ice loss (DJFMA)



Response to Arctic Sea Ice loss (DJFMA)

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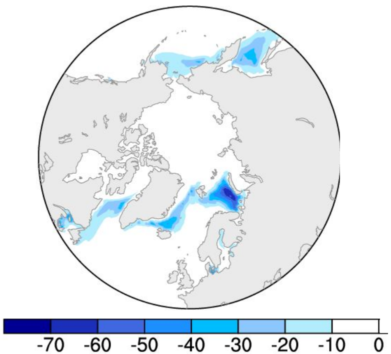
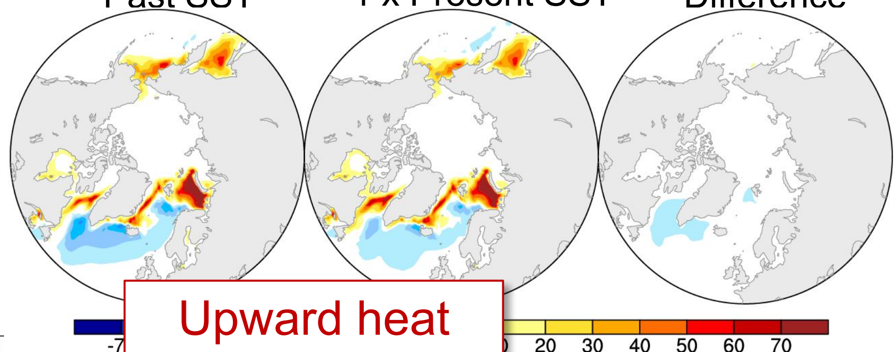
Surface Energy Fluxes (Wm^{-2})

-Δ ICE



Concentration (%)
(thickness = 2m)

Past SST | -1 x Present SST | Difference



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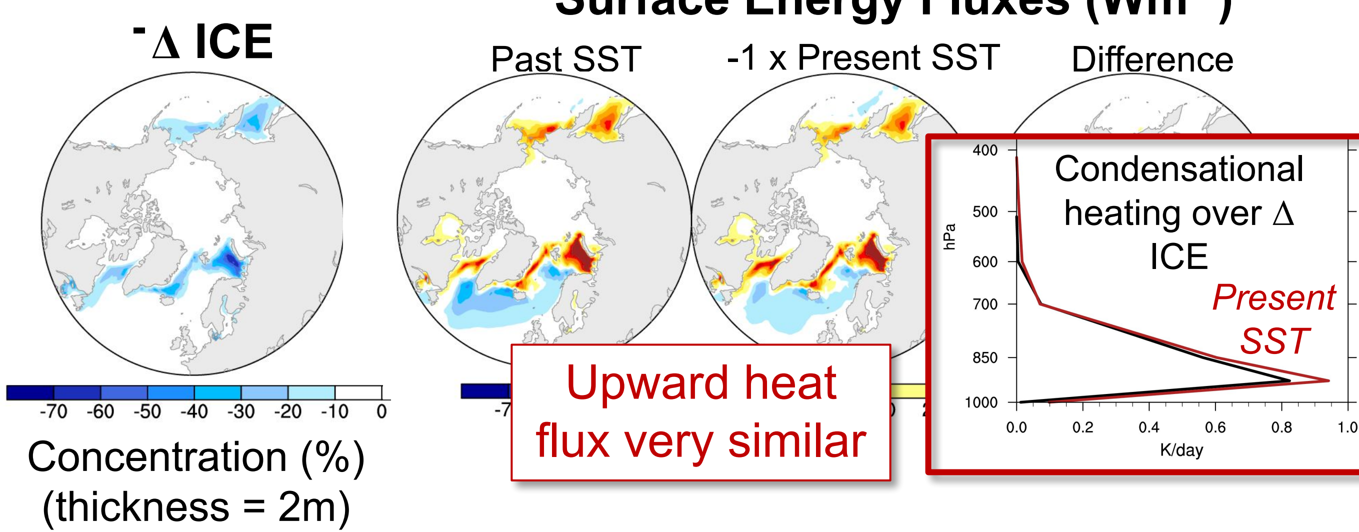

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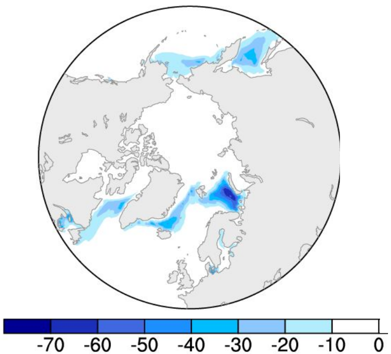

Concentration (%)
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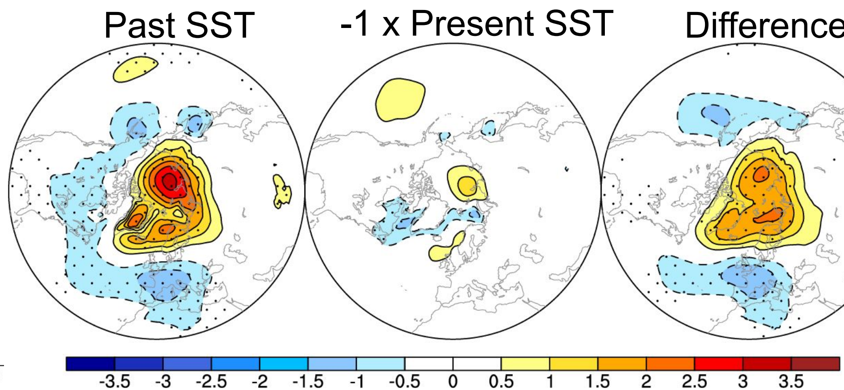
Sea Level Pressure (hPa)



Decrease Increase

Stippled areas are significant at 5% confidence level

Response to Arctic Sea Ice loss (DJFMA)

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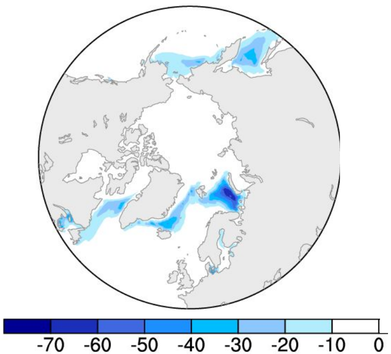

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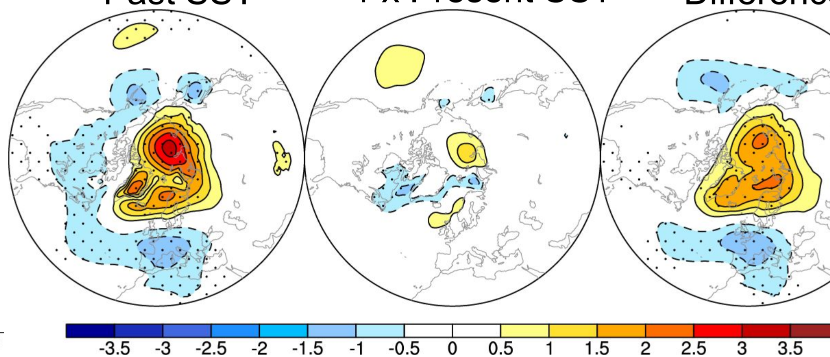
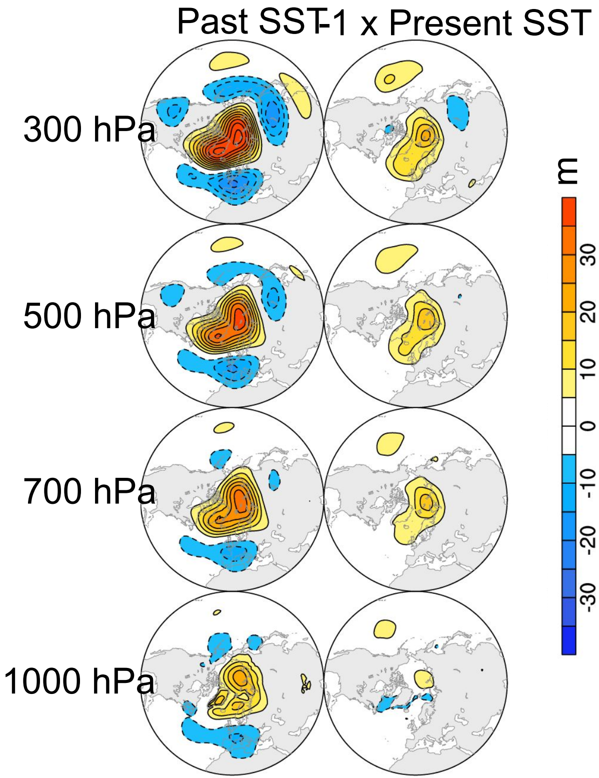
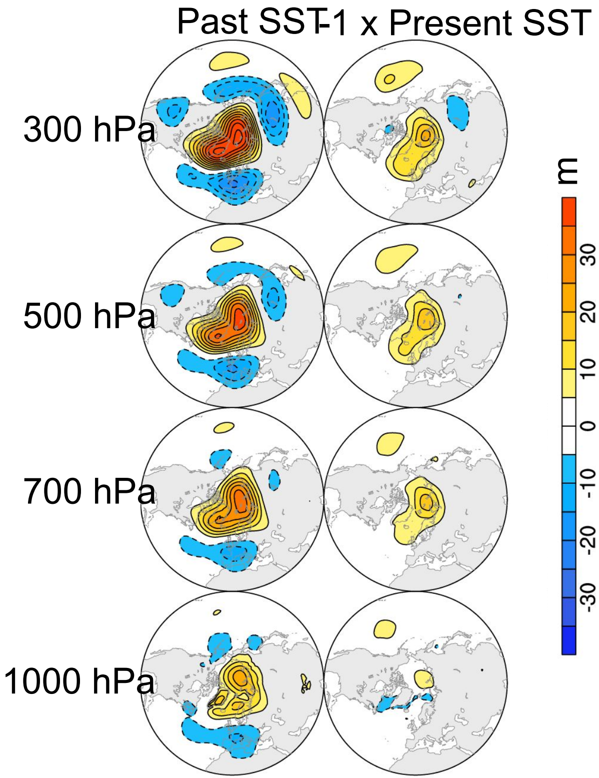


Decrease | Increase

 Implications for surface climate response

Geopotential Height Response to Arctic Sea Ice Loss (DJFMA)



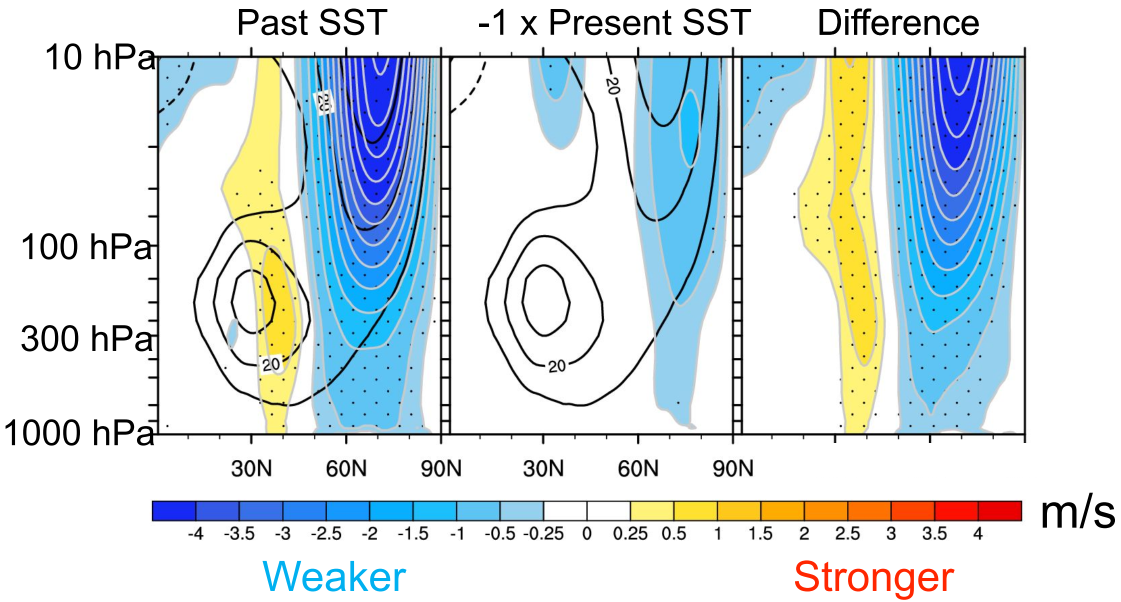


Geopotential Height Response to Arctic Sea Ice Loss (DJFMA)

Reminiscent of the non-linear response to warm *vs*. cold North Atlantic SST anomalies: “indirect” equivalent barotropic *vs*. “direct” baroclinic.
Deser et al. 2004 & 2007

Response to Arctic Sea Ice loss (DJFMA)

Zonal Mean Zonal Wind (Latitude, Height)



Response to Arctic Sea Ice loss (DJFMA)

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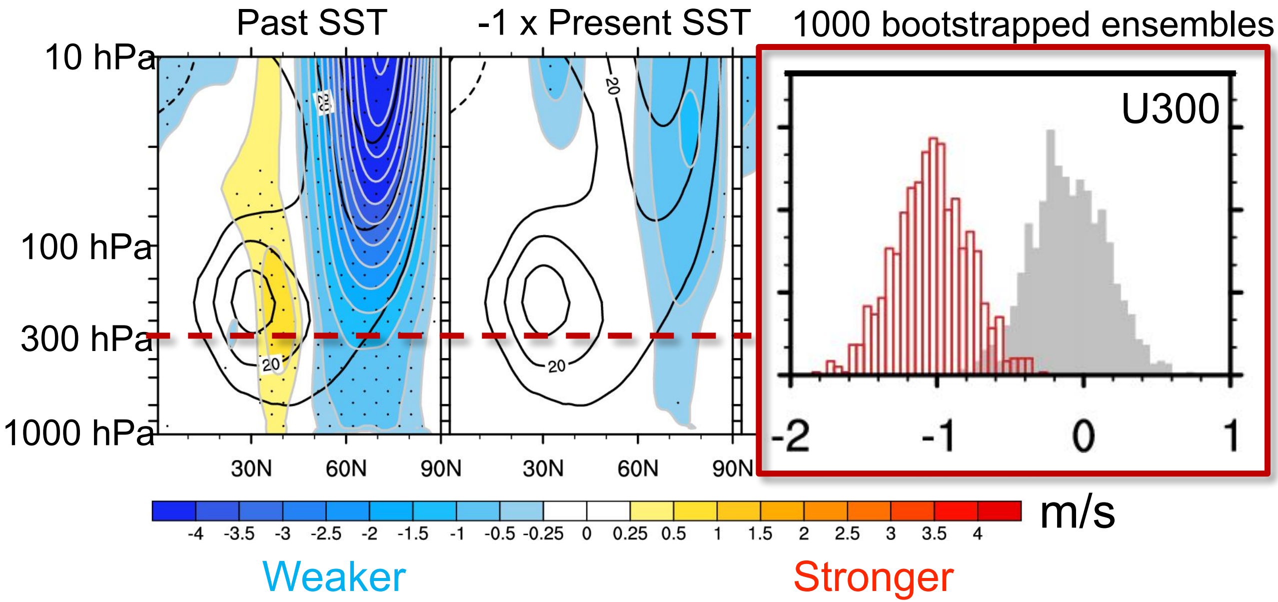

Mechanisms for the Sensitivity to Background SSTs

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Candidates:

- Statistical sampling

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