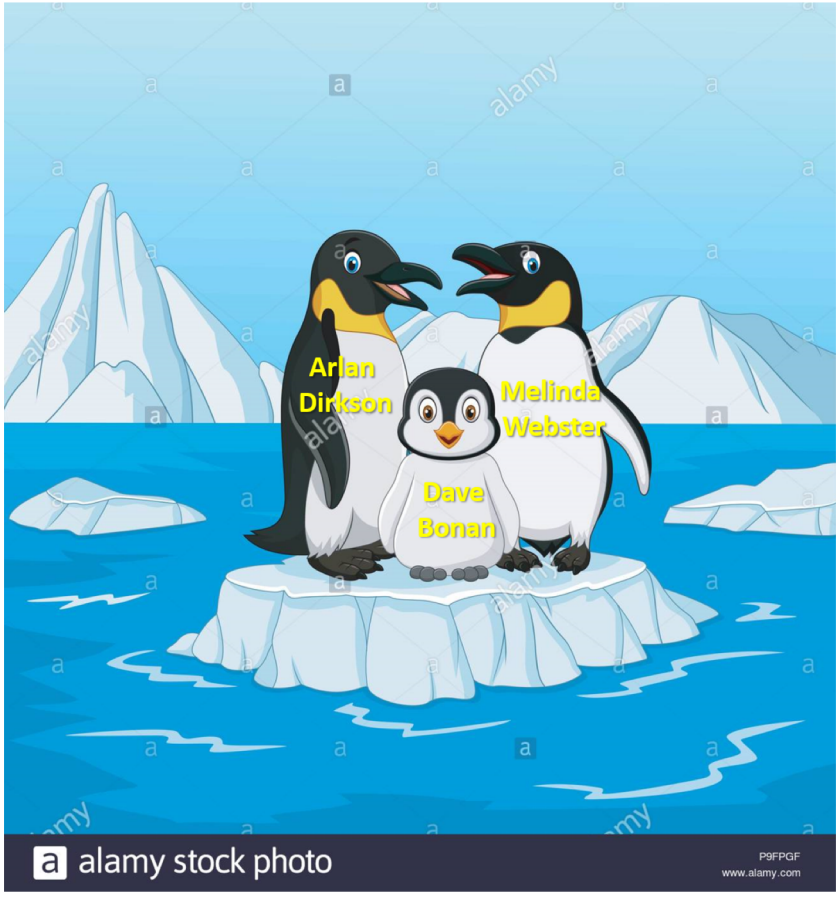
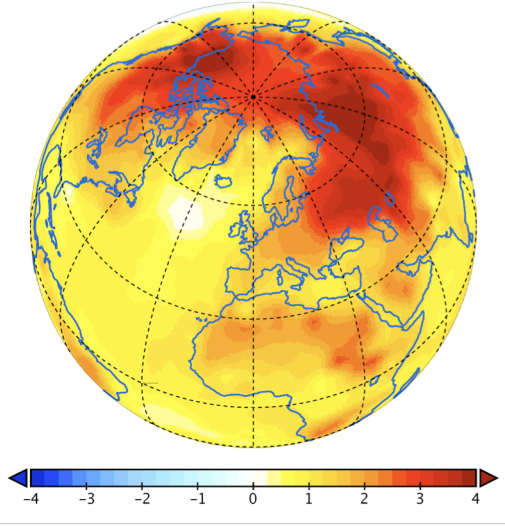


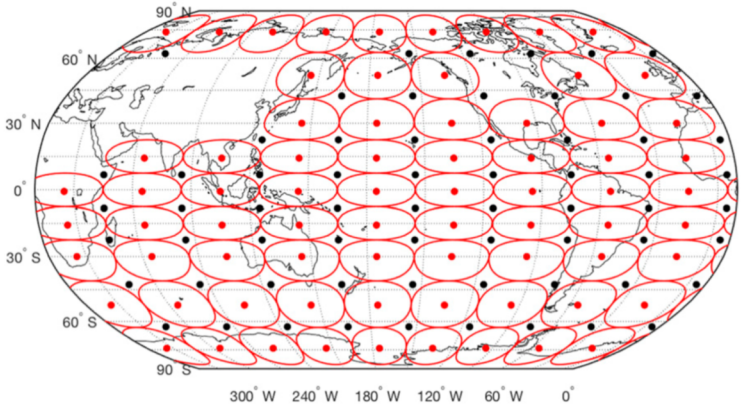
Does the western Pacific Ocean contribute to Arctic amplification?

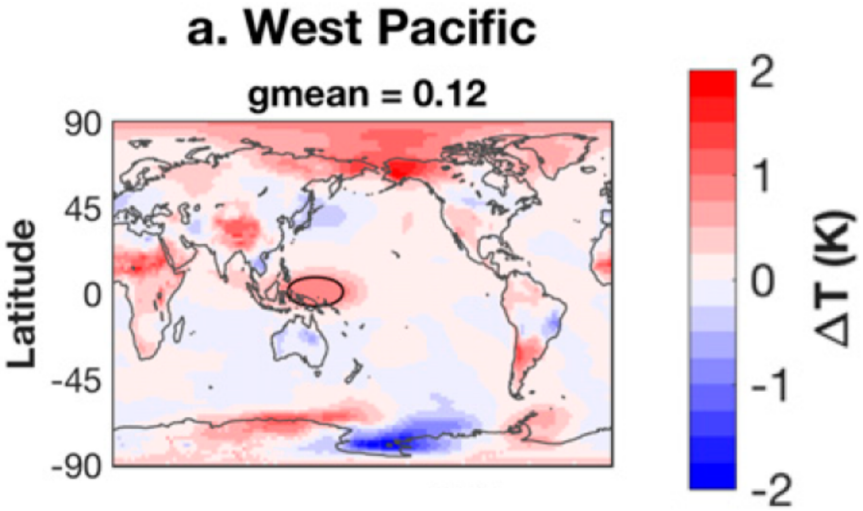
Dave Bonan
Arlan Dirkson
Melinda Webster

“The Floe Survivors”



Background and motivation





- Investigated warming responses from SST perturbations in distinct geographical regions
- Showed that SST forcing in the west Pacific Ocean causes strong warming in the Arctic

Dong et al., (2019)

Background and motivation

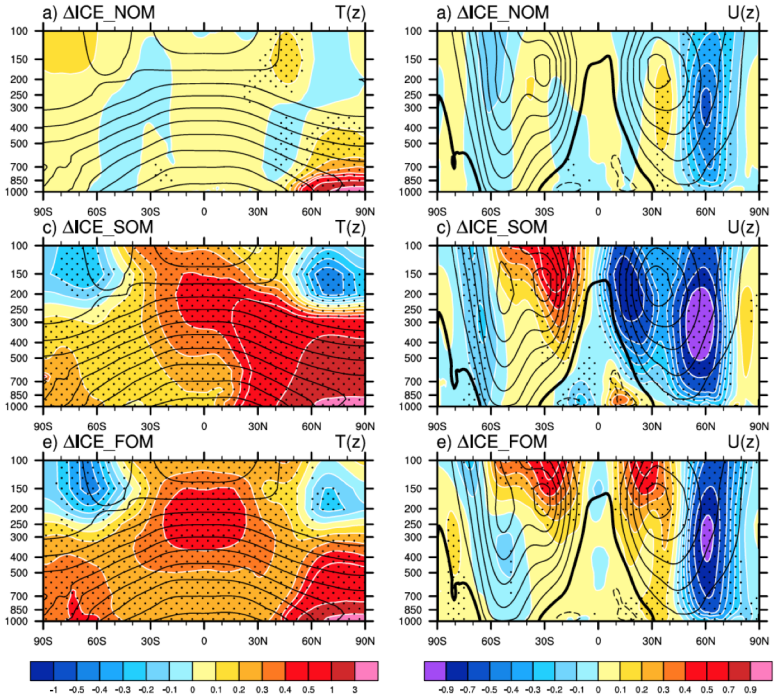


Figure 1. Annual zonal mean (a, c, e) temperature (°C) and (b, d, f) zonal wind ($m\,s^{-1}$) responses to Arctic sea ice loss in the in ΔICE_NOM (Figures 1a and 1b), ΔICE_SOM (Figures 1c and 1d), and ΔICE_FOM (Figures 1e and 1f) model configurations (color shading: color bars at the bottom of each column; note the nonlinear color scales). Stippling indicates where the response is statistically significant at the 95% confidence level. Contours indicate the twentieth century climatology (contour interval of 10°C for temperature and 5 $m\,s^{-1}$ for zonal wind with the zero contour thickened).

But…

Deser et al., (2016) show that you can get large differences in temperature responses to perturbations using a climate model with fixed SSTs, a slab ocean, and a fully-interactive ocean.

Research questions

1. Does warming in the western Pacific Ocean contribute to Arctic amplification?
2. How does this occur?
3. How sensitive is this result to internal variability?

CESM experimental design: overview

Control (already exist!)

1. DOM (1)
2. SOM (1)
3. fixedSST (1)

Experiment (need to run!)

1. DOM (1) : 150 year simulation
2. SOM (1) : 100 year simulation
3. fixedSST (40*): 35 year simulation

CESM Experiment Design

- f09_g17 resolution
- Branched from 1850 control run
- Source Code Modification: src.pop — add a 1.5K SST relative to climatology
- Pacemaker-esque — fix SST in western Pacific in SOM and DOM
- ***SOM*** -- Investigates the role of an ocean that can exchange local heat fluxes
  - Compset: E1850
  - 100-yr simulation [70 yrs for spin-up (1) + 30 yrs for experiment (1)]
- ***DOM*** -- Tests the sensitivity to a fully dynamical ocean
  - Compset: B1850
  - 150-yr simulation [120 yrs for spin-up (1) + 30 yrs for experiment (1)]
- ***FixedSST*** -- Mimics earlier study but includes role of internal variability
  - Compset: F1850
  - 35-yr simulation [5 yrs for spin-up (1) + 30 yrs for round-off error experiments (40)]

Computational Expenses

Experiment	*Resolution*	*Total PE*	*Cost PE-hours/year*	*Thru-put years/day*	*Total Year Run*	*Total PE hours*	*Total Years Stored*	*Storage Needs*
(B) DOM	f09_g17	720	2200	8	100	220,000	30	330 GB
(E) SOM	f09_g17	720	2200	8	150	220,000	30	330 GB
(F) FixedSST	f09_g17	360	1100	4	1205	1,325,500	1200	13.2 TB
Testing SOM/DOM	f09_g17	720	2200	8	40	88,000	-	-
Total:						***1,853,500***		***14 TB***