The Arctic climate response to 2xCO_2 and present day aerosol forcing in CAM4 and CAM5 slab ocean model experiments

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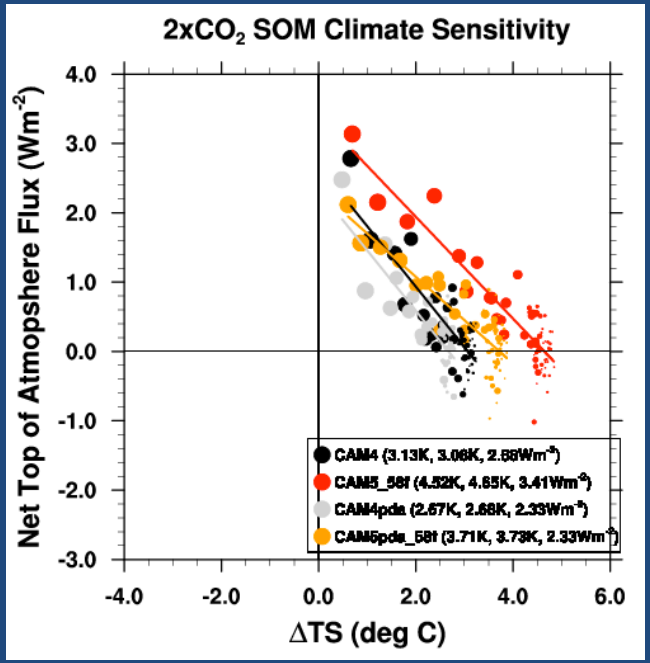
Which Slab Ocean Model (SOM) Experiments?

	Experiments	Global dT	Arctic (70-90 N) dT
CAM4	1850 control		
	..+2xCO_2	+3.1 K	+6.7 K
	..+2xCO_2+2000 aerosols	+2.7 K	+5.2 K
CAM5 -dev (58f)	1850 control		
	..+2xCO_2	+4.7 K	+11.0 K
	..+2xCO_2+2000 aerosols	+3.7 K	+8.1 K



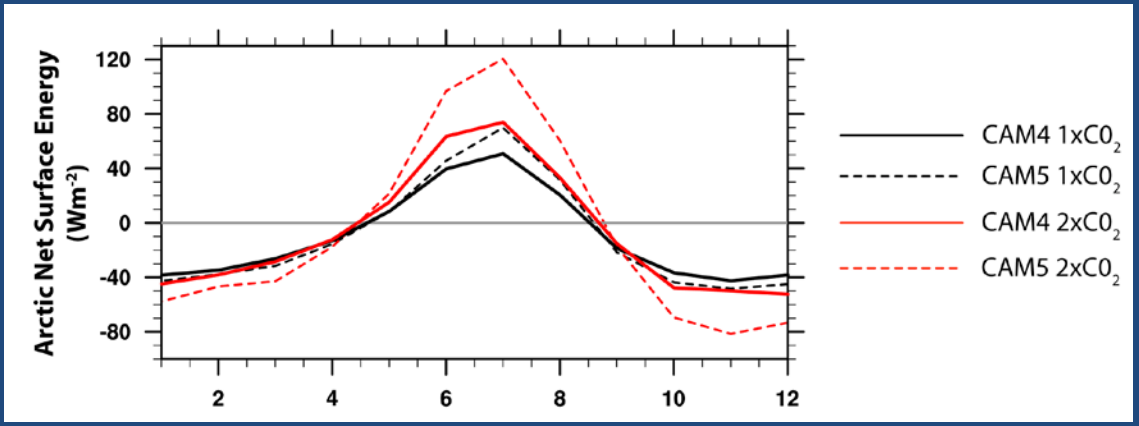
What controls the Arctic climate response to $2xCO_2$ forcing in slab ocean models?

1. Poleward heat transport
   - Atmosphere
   - Sea ice
   - Ocean (fixed)
2. **Local feedback strength**
   - **temperature (lapse rate, Planck)**
   - **water vapor**
   - **surface albedo**
   - **clouds**

Why is the SOM Arctic climate response to $2xCO_2$ greater in CAM5 than in CAM4?

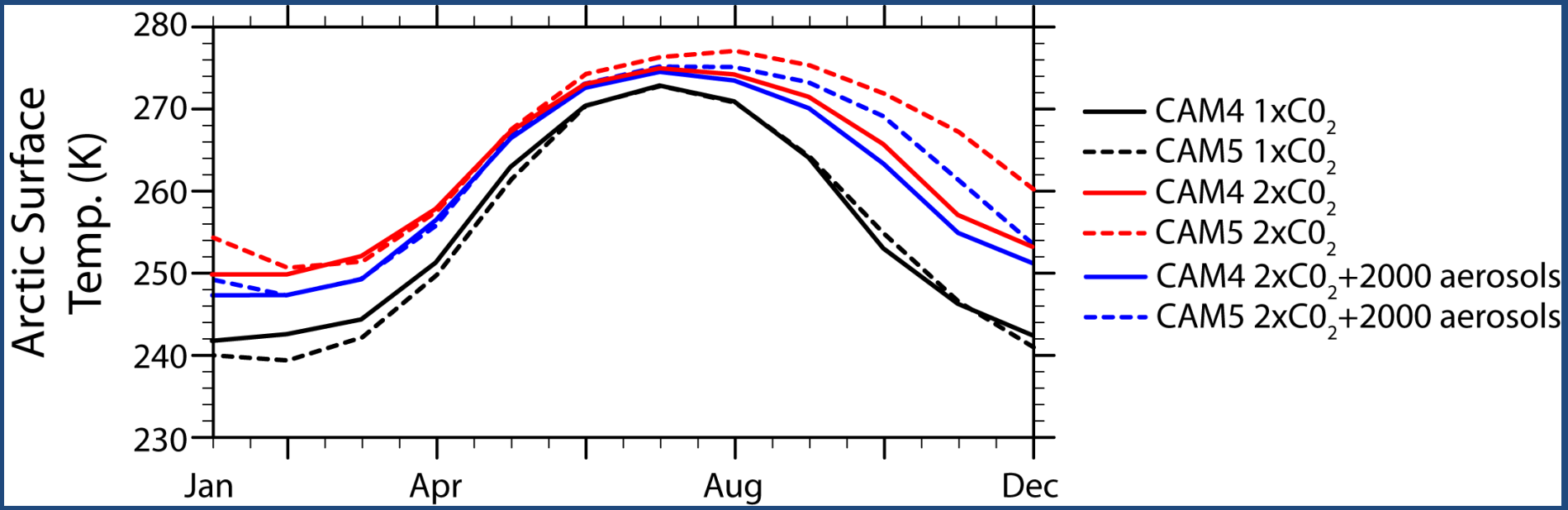
not advection!

Local Arctic shortwave feedbacks are stronger in CAM4 than in CAM5.



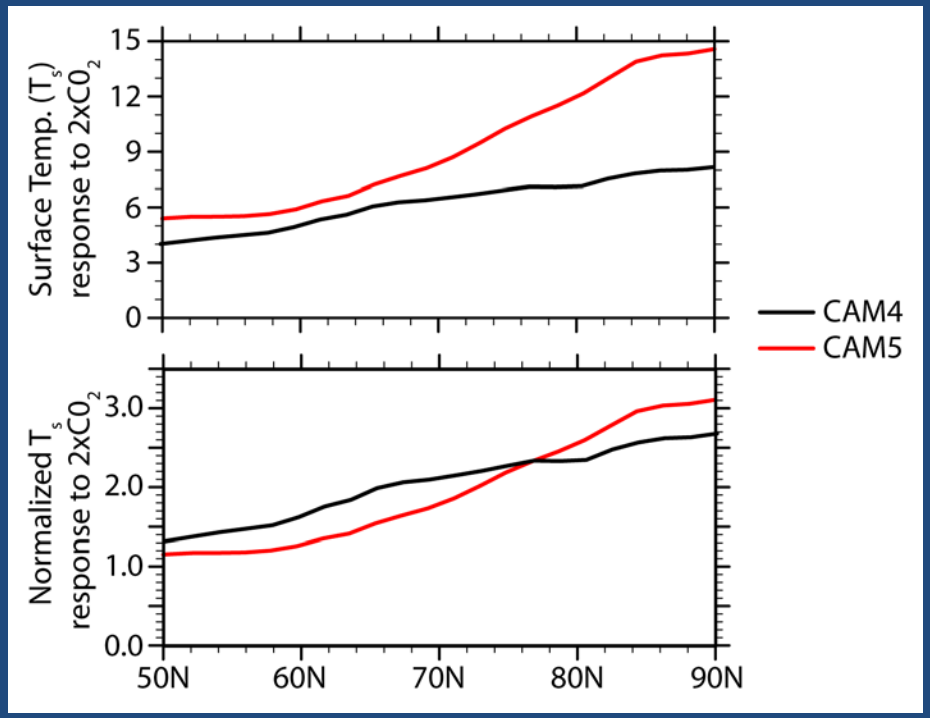
EXTRA

Seasonal variations in the Arctic surface temperature response to $2xCO_2$



For the rest of the talk,
I will focus on the Arctic response to $2xCO_2$ forcing.

What controls the Arctic climate response to 2xCO_2 forcing in slab ocean models?



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Holland and Bitz (2003), Winton (2006), Bitz (2008), Boe et al. (2009), Graverson and Wang (2009)

Does poleward heat transport (PWHT) @70 N *change* with 2xCO_2 forcing? Answer: not much!

	CAM4 SOM	CAM5 SOM
PWHT @70N (1xCO_2)	**117**	**113**
PWHT-atmosphere @70N (1xCO_2)	**108 (92%)**	**104 (92%)**
ΔTOA Energy Budget 70-90 N	*-0.6*	*-0.1*
ΔPWHT @70N	**+0.6**	**+0.1**
ΔSurface Energy Budget 70-90 N	*+2.3*	*+1.4*
ΔPWHT-atmosphere @70N	**+3.0**	**+1.5**
ΔPWHT-residual (ice export) @70N	**-2.4**	**-1.4**

All values in Wm^{-2}.

Δ = Equilibrium response to 2xCO_2 forcing.