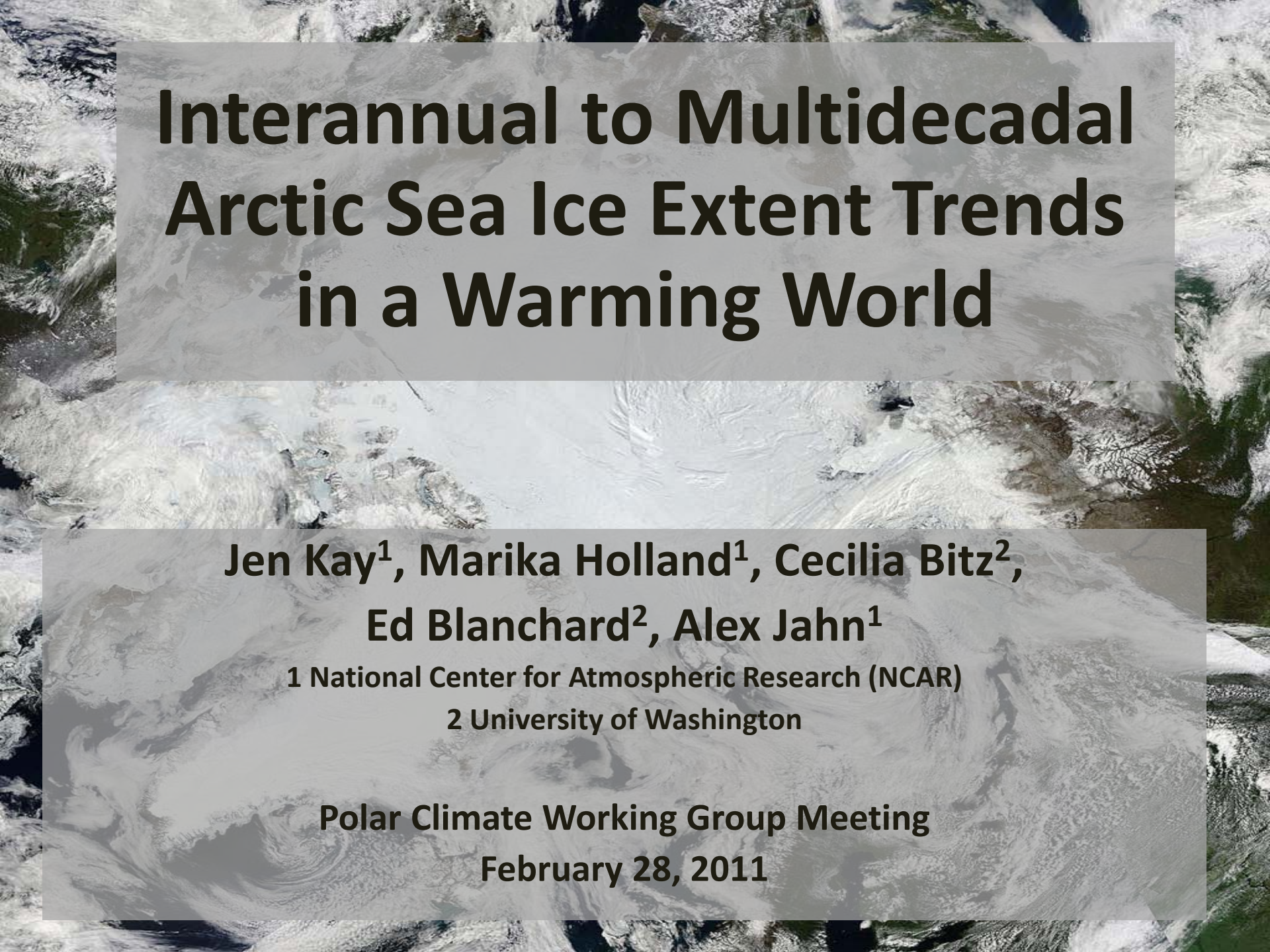


Interannual to Multidecadal Arctic Sea Ice Extent Trends in a Warming World

Jen Kay[1], Marika Holland[1], Cecilia Bitz[2], Ed Blanchard[2], Alex Jahn[1]

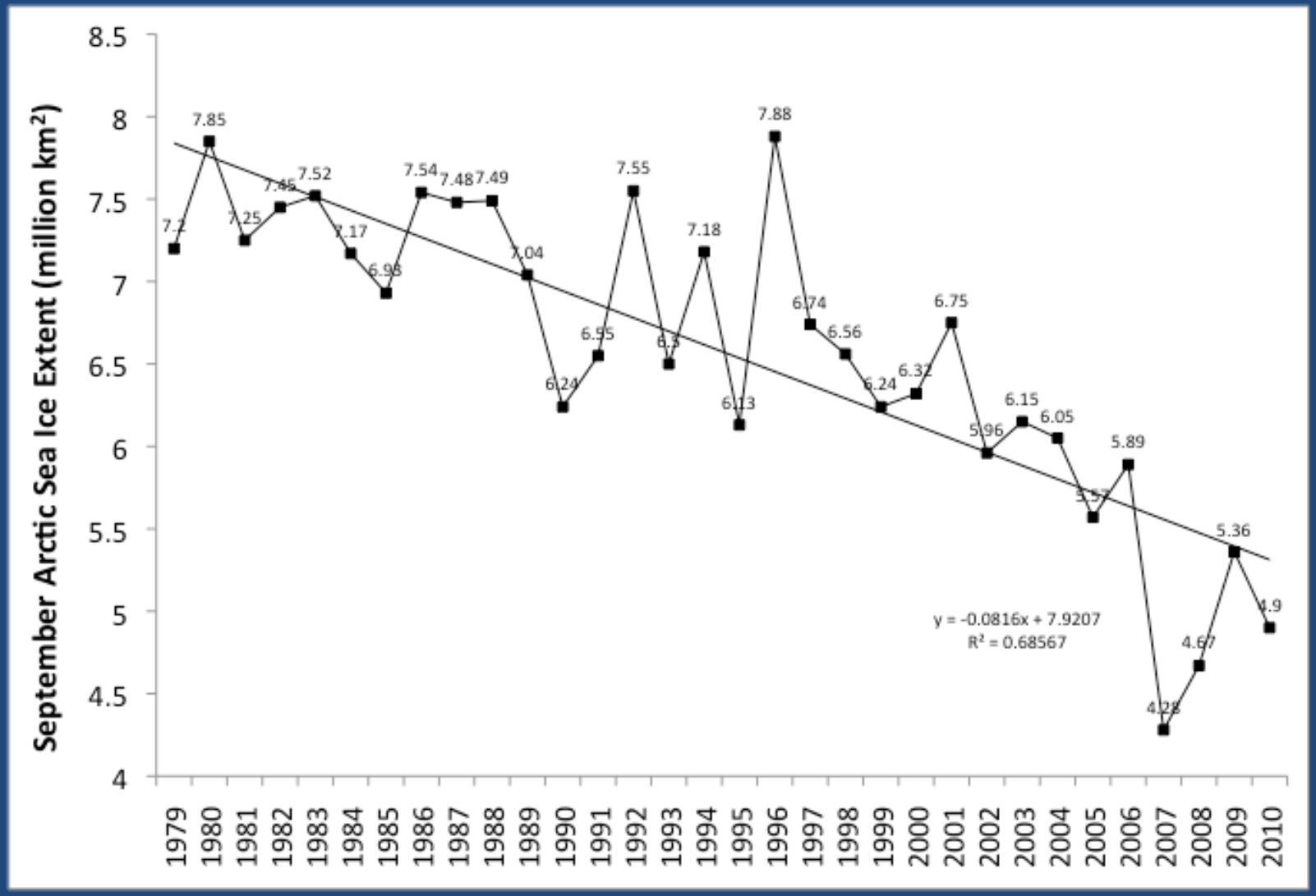
1 National Center for Atmospheric Research (NCAR)

2 University of Washington

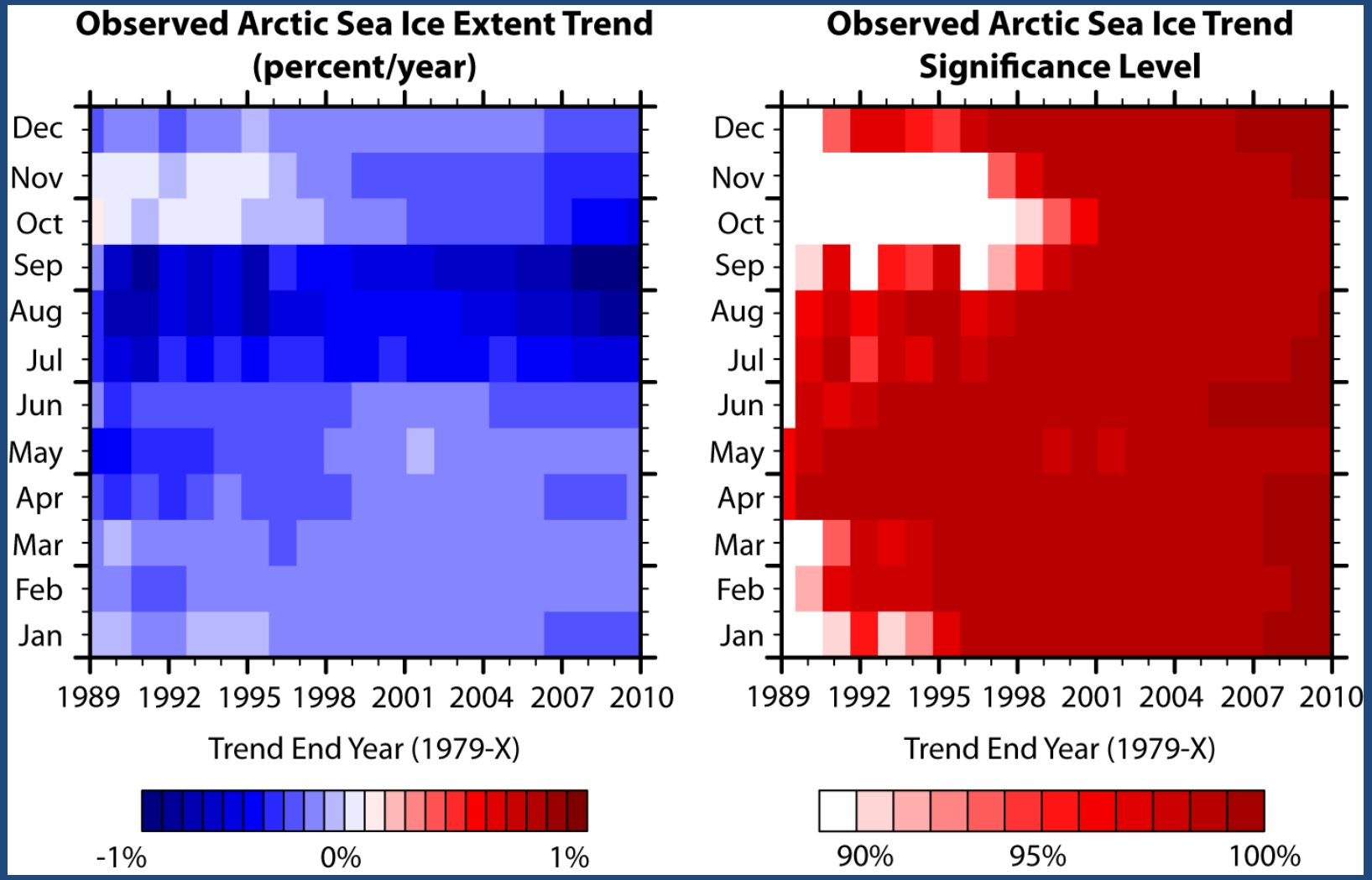
Polar Climate Working Group Meeting

February 28, 2011

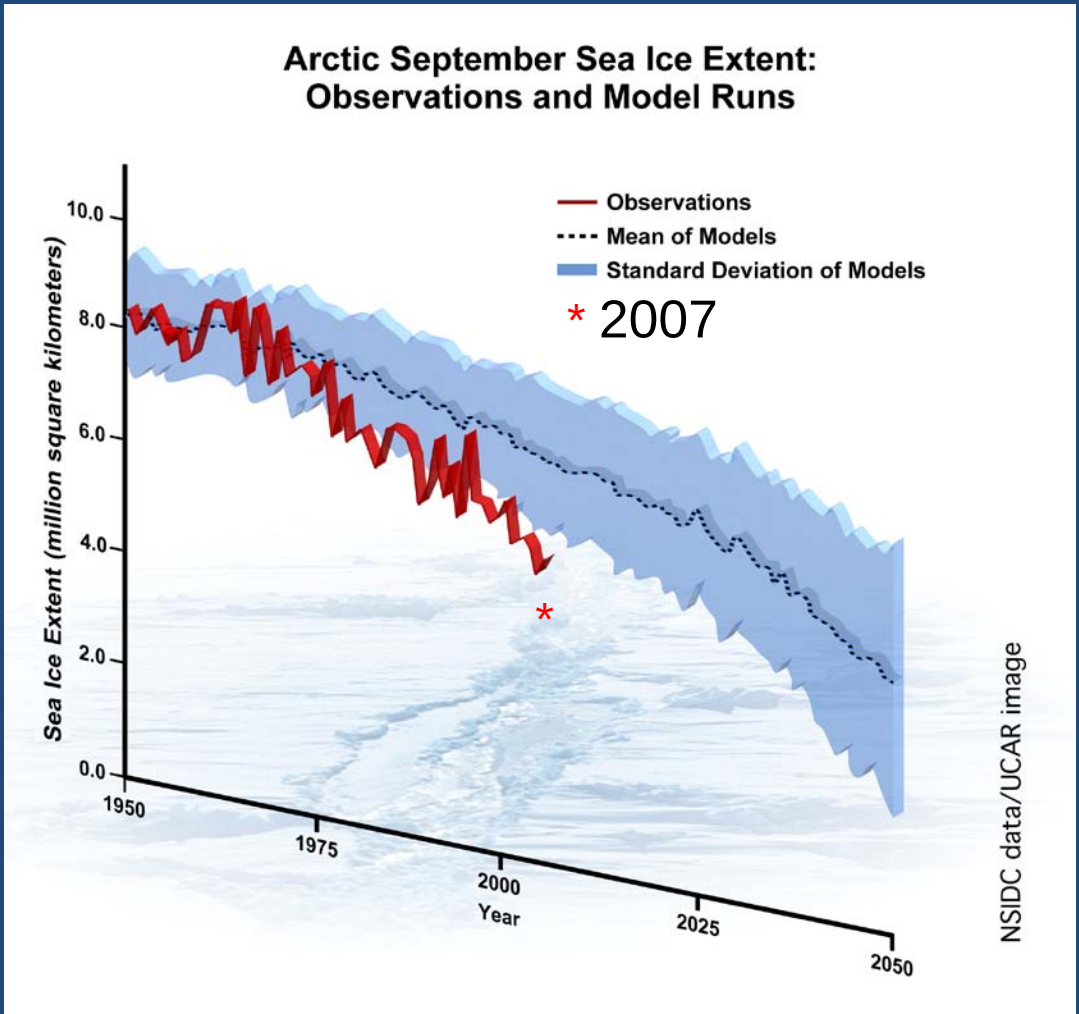
Observed September Arctic Sea Ice Extent (1979-2010)



Observed Arctic Sea Ice Extent Trends and Trend Significance (1979-variable end year)

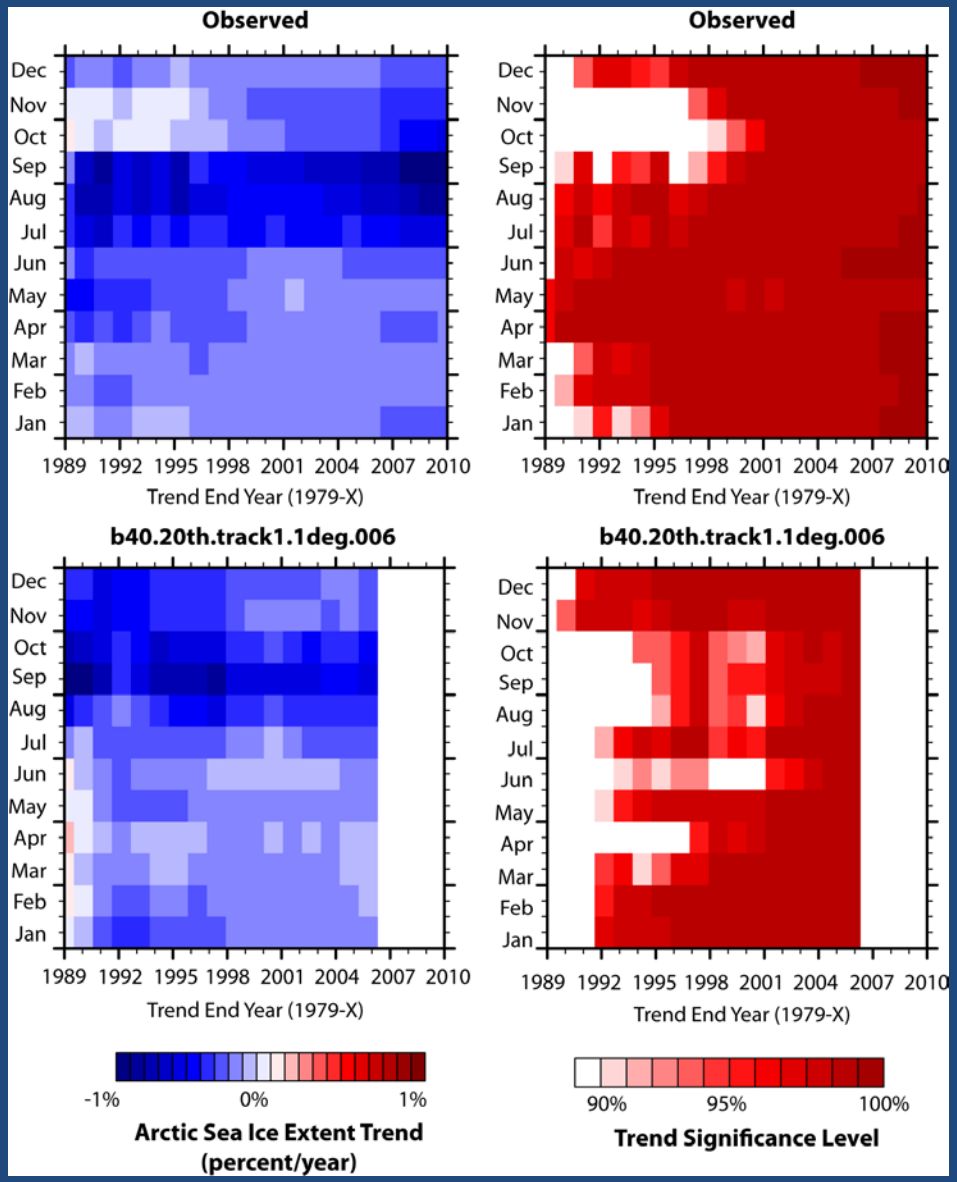


Observed Arctic sea ice loss has been "faster than forecasted" by IPCC climate models

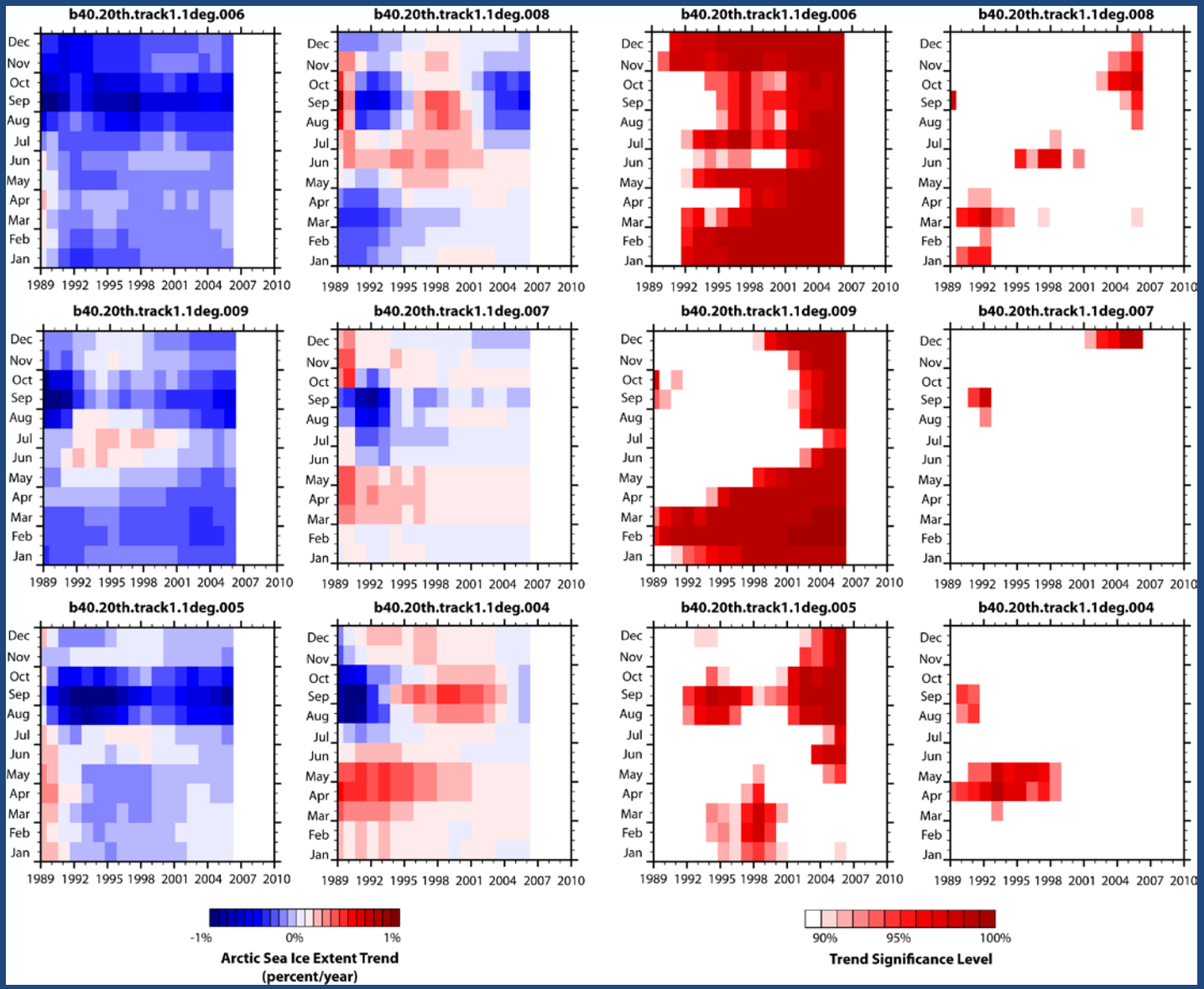


Stroeve et al. (2007)

Observed September loss not “faster than forecasted” by CCSM4 (if you cherry pick)



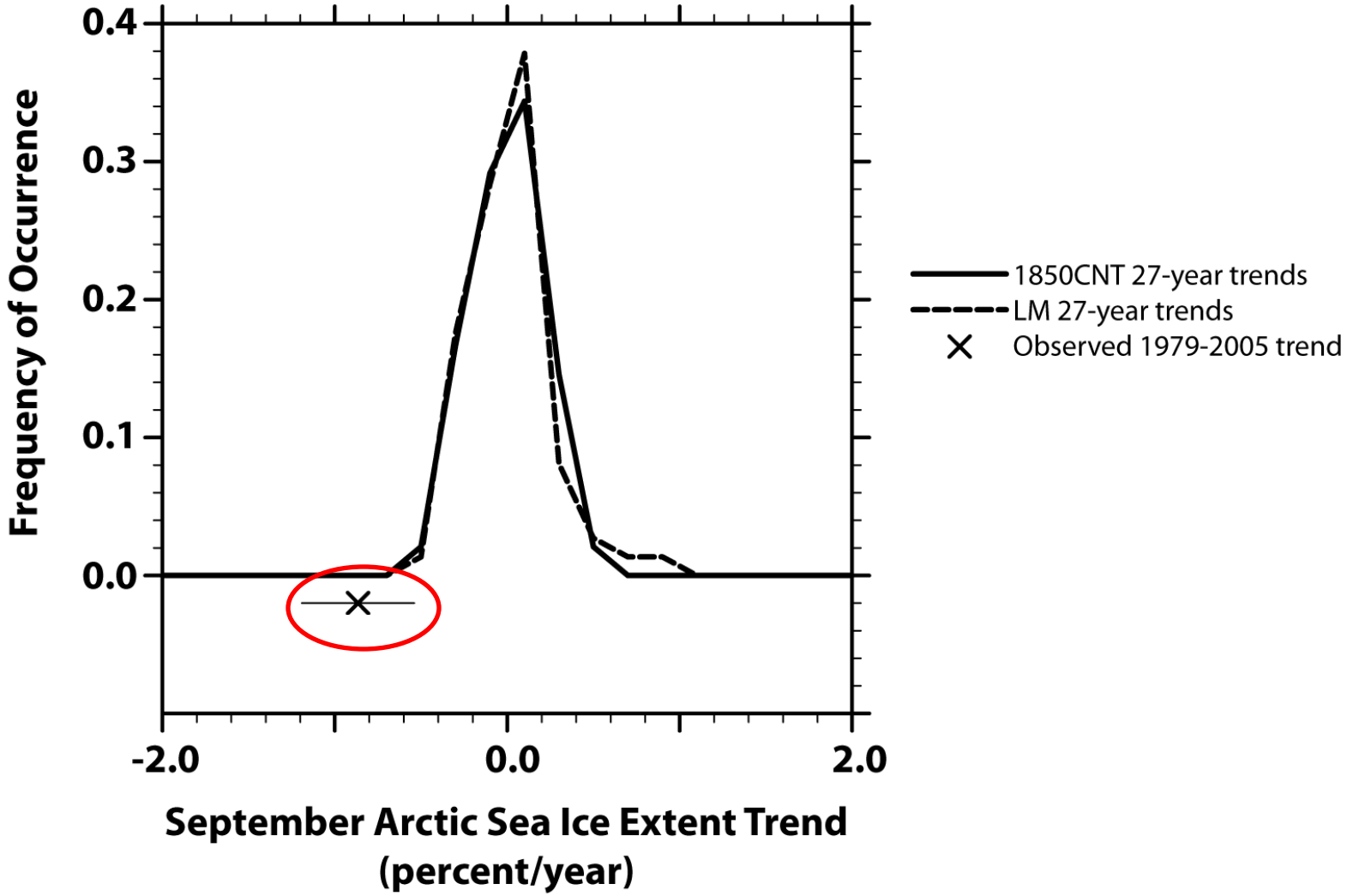
Natural variability influence on trends = CCSM4 says it's significant!



Is it possible to reproduce late 20th century observed Arctic sea ice trends with natural forcing or variability alone?

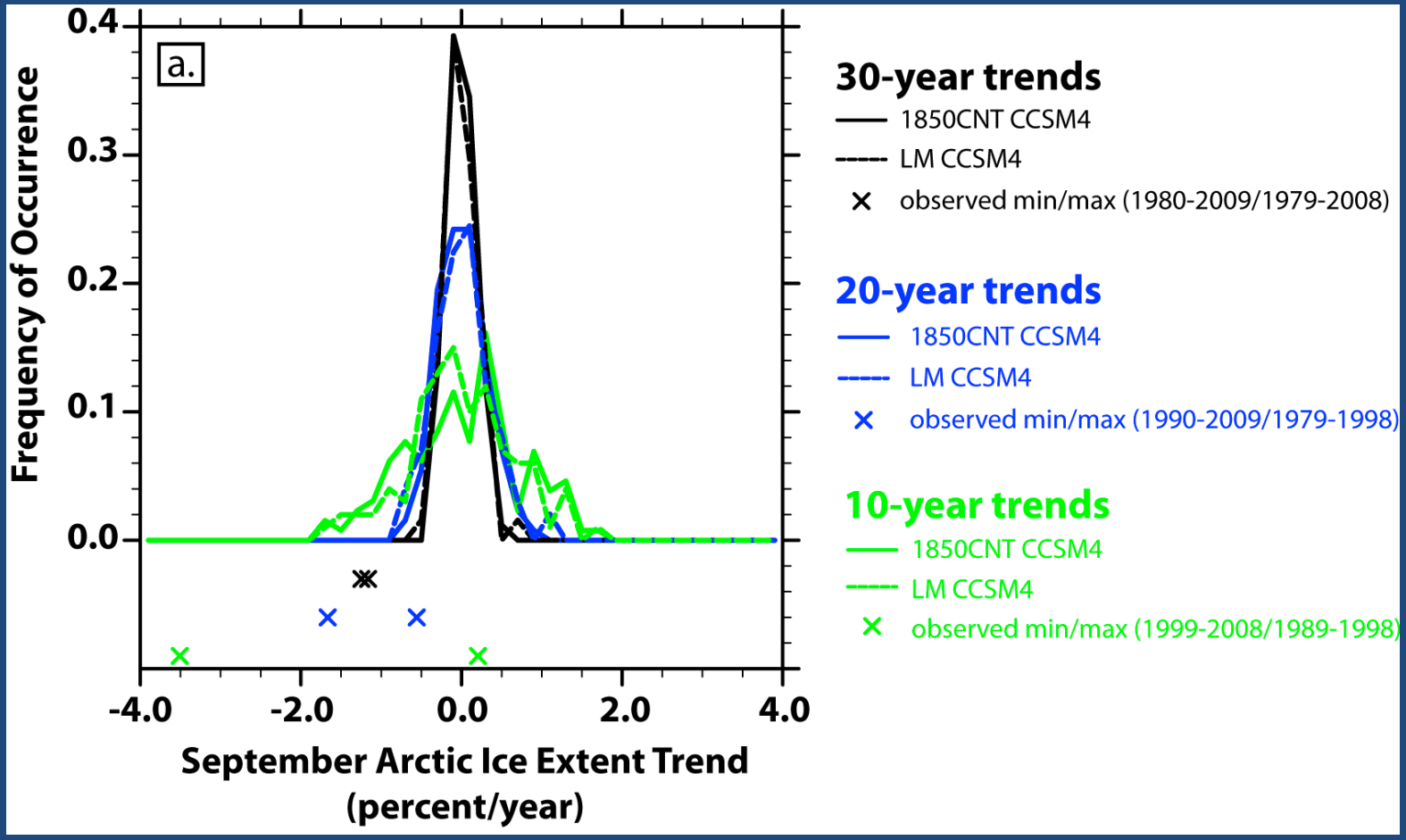
(let's use CCSM4, and assume it is doing a reasonable job of capturing processes influencing trend variability)

Observed and Modeled 27-year Trends



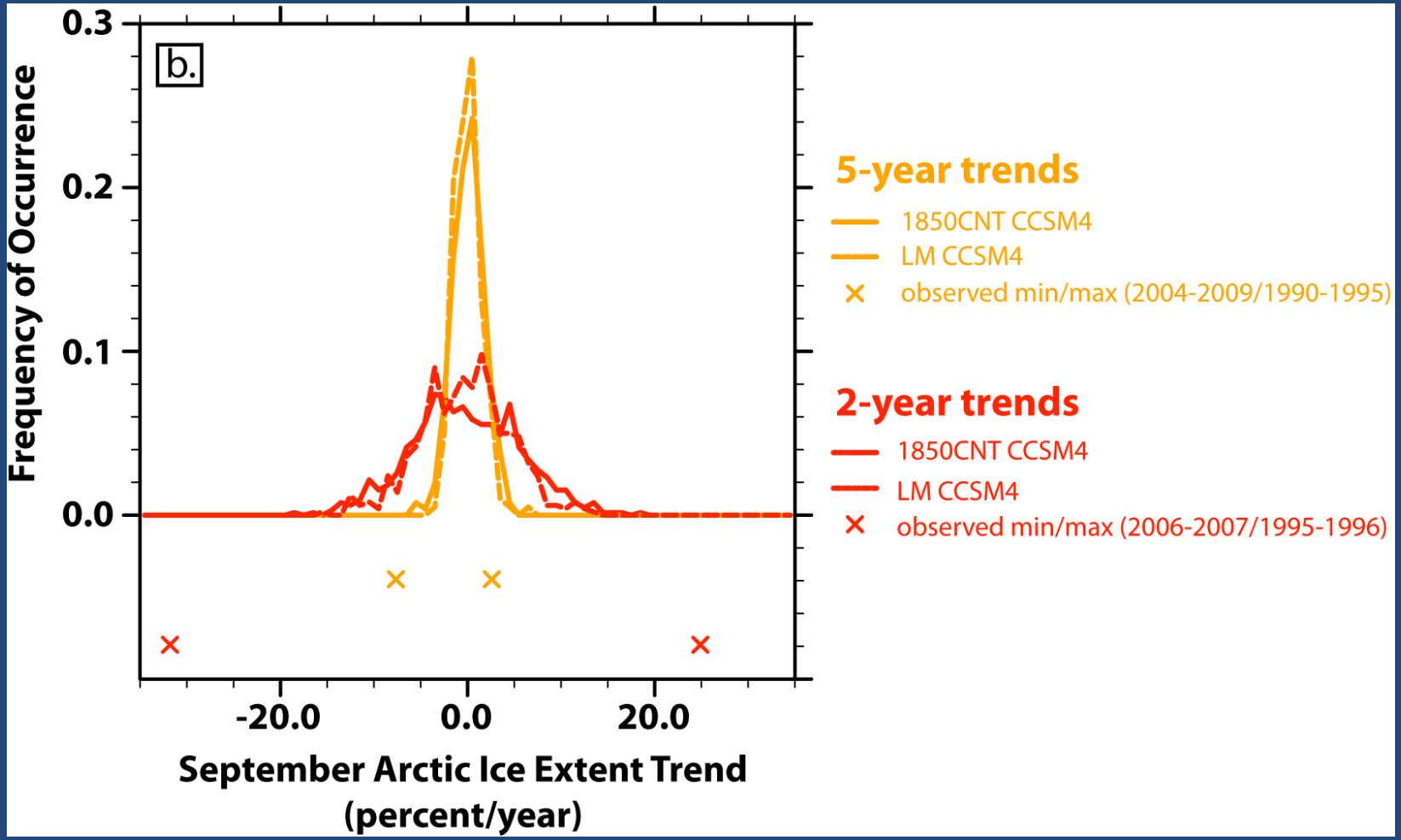
From Kay et al. (in prep)

Observed 10-30 year Arctic sea ice trends cannot be produced in CCSM4 with natural variability or natural forcing alone



From Kay et al. (in prep)

Both increasing inter-annual variability and negative 5-year trends not “natural”.



From Kay et al. (in prep)

Summary

1. Natural variability complicates efforts to understand why observed Arctic sea ice extent loss is “faster than predicted”. CCSM4 ensemble suggests we live in a “faster than average” Arctic sea ice loss realization.

2. In a warming world, positive trends happen. From 1979-2010, 2-10 year positive trends have been observed. From 1979-2005, 2-20+ year positive trends present in the CCSM4 20th C ensemble.

3. Observed large declining trends (length = 2-30 years) and large inter-annual variability cannot be explained by CCSM4 natural variability or natural forcings alone. The extreme loss in recent years (2007-present) made a human influence detectable on 2-10 year declining trends.

Kay, J. E., Holland, M. M., Blanchard-Wrigglesworth, E., Bitz, C., Gettelman, A., Conley, A., and D. Bailey (in prep for J. Climate): **The influence of local feedbacks and northward heat transport on the equilibrium Arctic climate response to greenhouse gas forcing in coupled climate models using the Community Atmosphere Model (CAM) versions 4 and 5**.

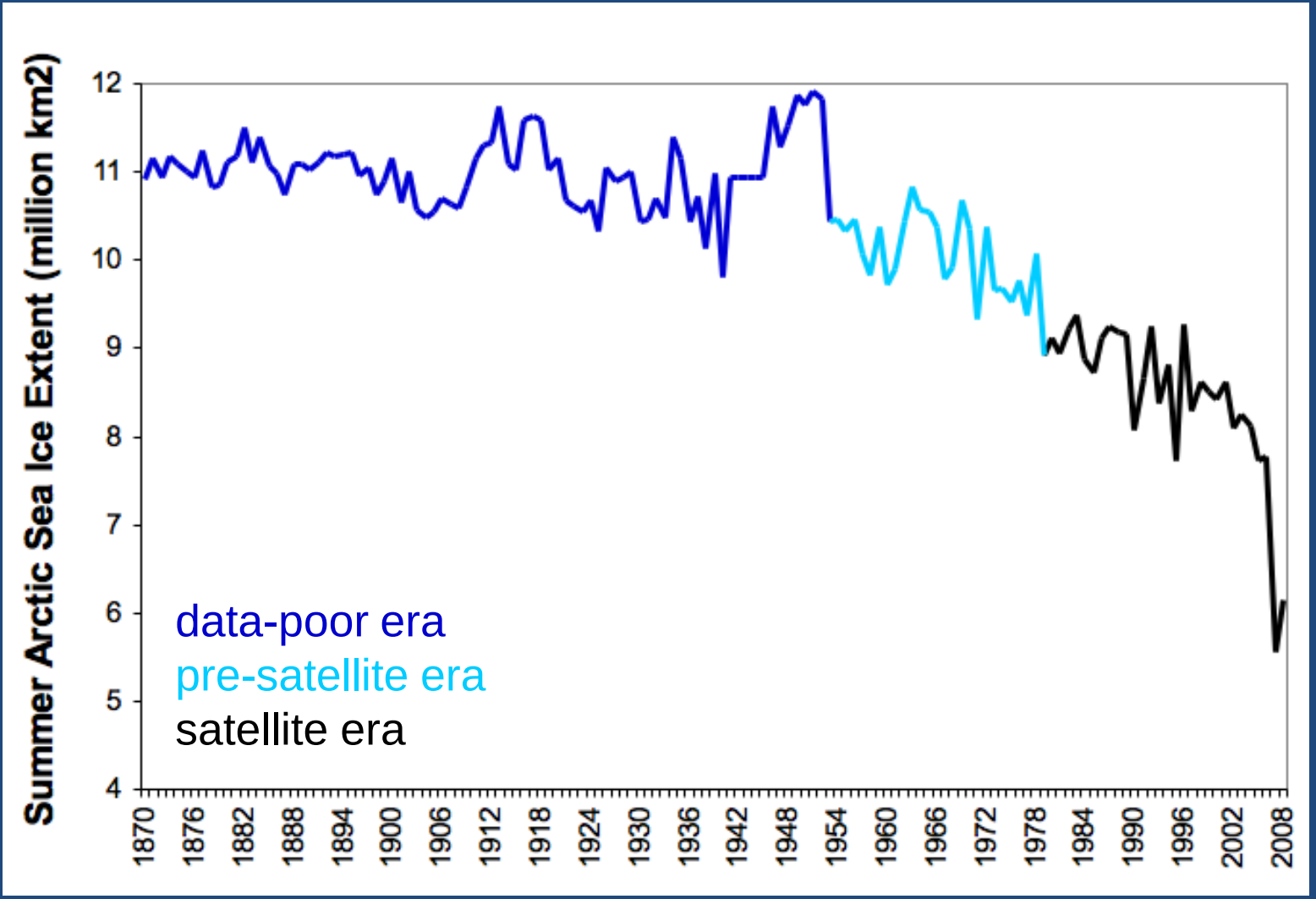
summary

1. We explain the equilibrium Arctic climate response to $2xCO_2$ in slab ocean models using CAM4 and CAM5. (differences from local shortwave feedbacks, not atmospheric heat transport)

2. We examine the influence of coupling with the deep ocean.
(ocean heat transport increases with $2xCO_2$, but is a small influence on the Arctic climate response to when compared to the atmospheric model)


Questions?

Some Historical Perspective



Data from University of Illinois Cryosphere Today