

Antarctic Sea Ice Data: the good, the bad and the ugly

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Is Antarctic sea ice *really* increasing?

The Washington Post

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As strange as it seems, scientists say increase in Antarctic ice may be sign of climate change

World environment on  NBCNEWS.com

Warming means more, not less, Antarctic sea ice, experts say

October 19, 2012

HUFF
POST

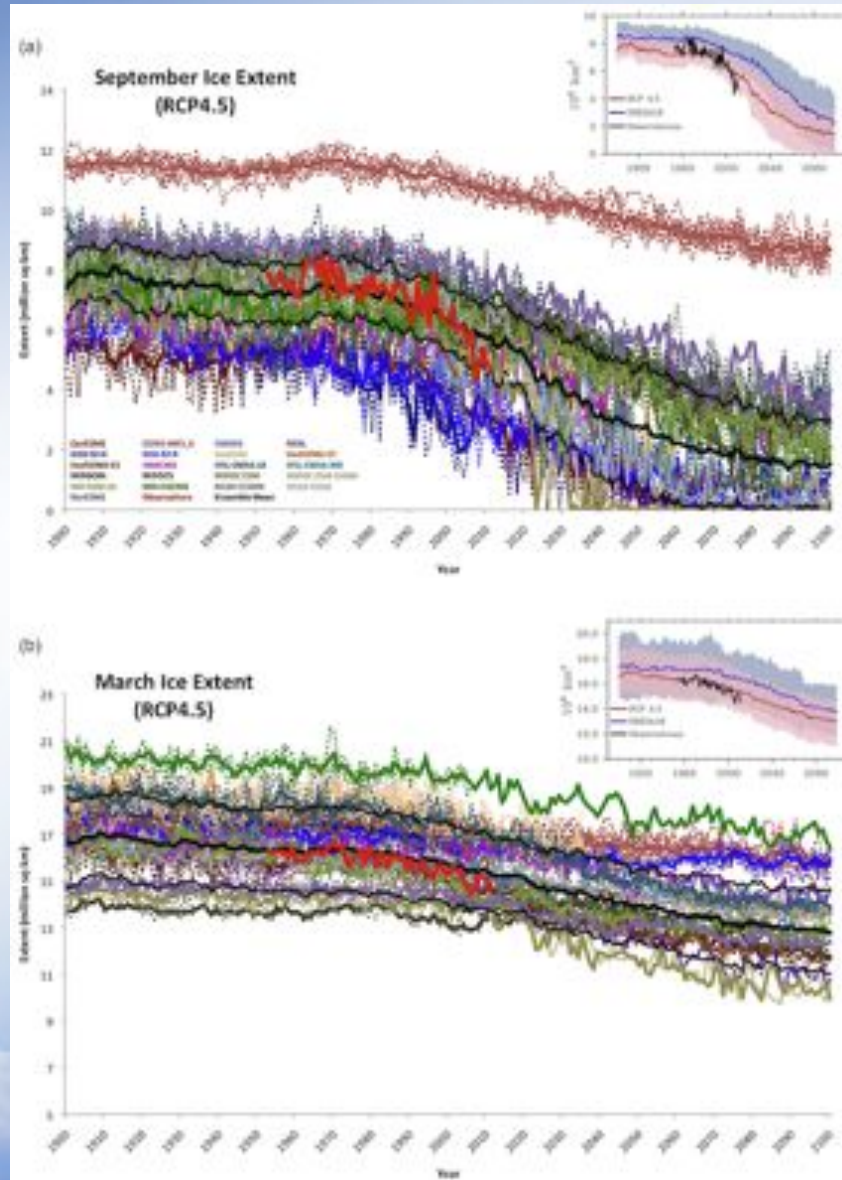
GREEN

Forget The Melting Arctic, Sea Ice In Antarctica Is Growing!!

Why might scientists say that the sea ice increase is a sign of warming?

- Wind trends (driven by ozone, CO₂ tropical teleconnections)
- Ocean freshening & stratification
- **The data are wrong!**

The Arctic makes sense (more or less)



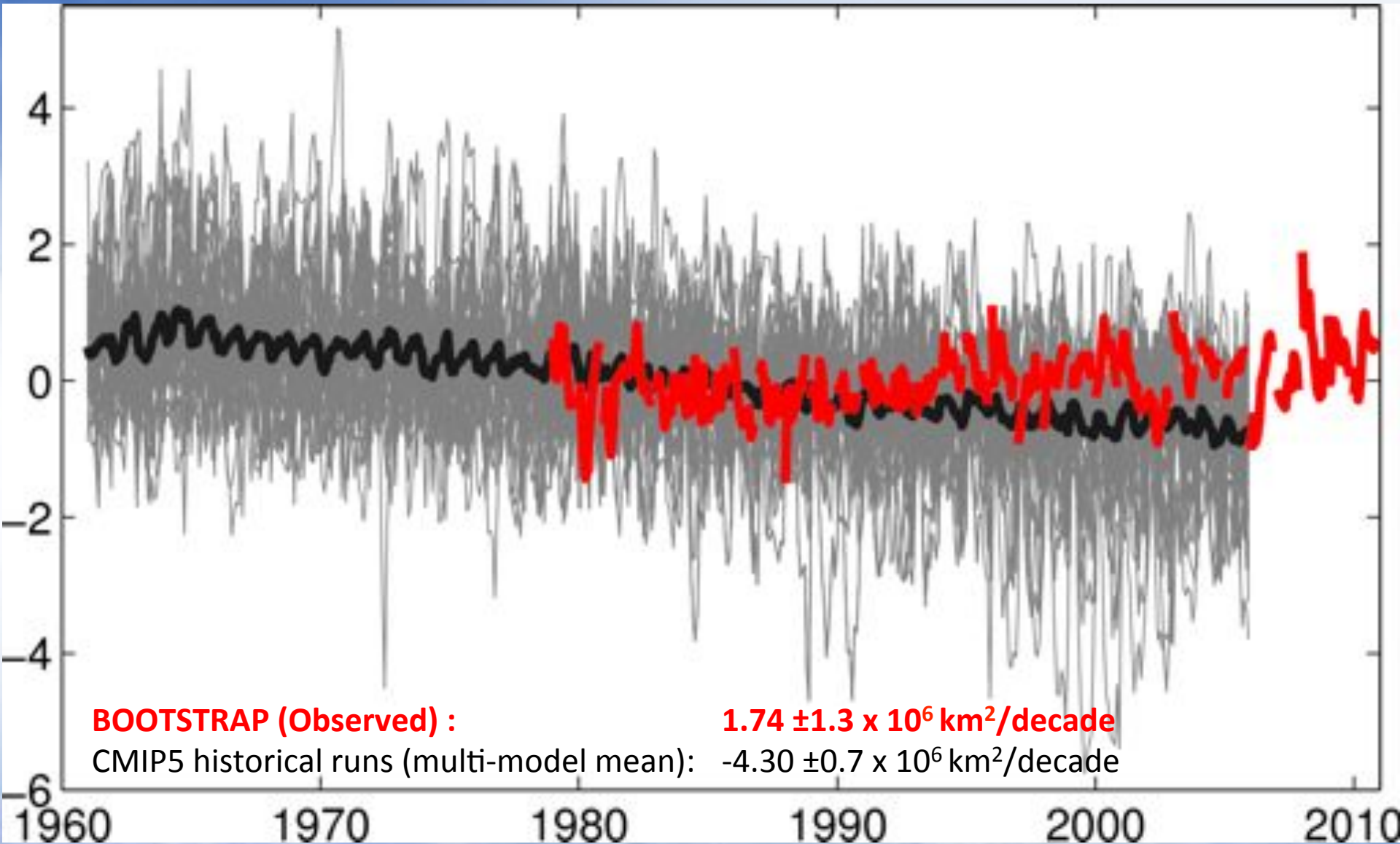
Stroeve et al., 2012

Geophysical Research Letters

Volume 39, Issue 16, pages n/a-n/a, 25 AUG 2012 DOI: 10.1029/2012GL052676

<http://onlinelibrary.wiley.com/doi/10.1029/2012GL052676/full#grl29477-fig-0002>

CMIP5: Antarctic Sea ice Extent (monthly anomalies)

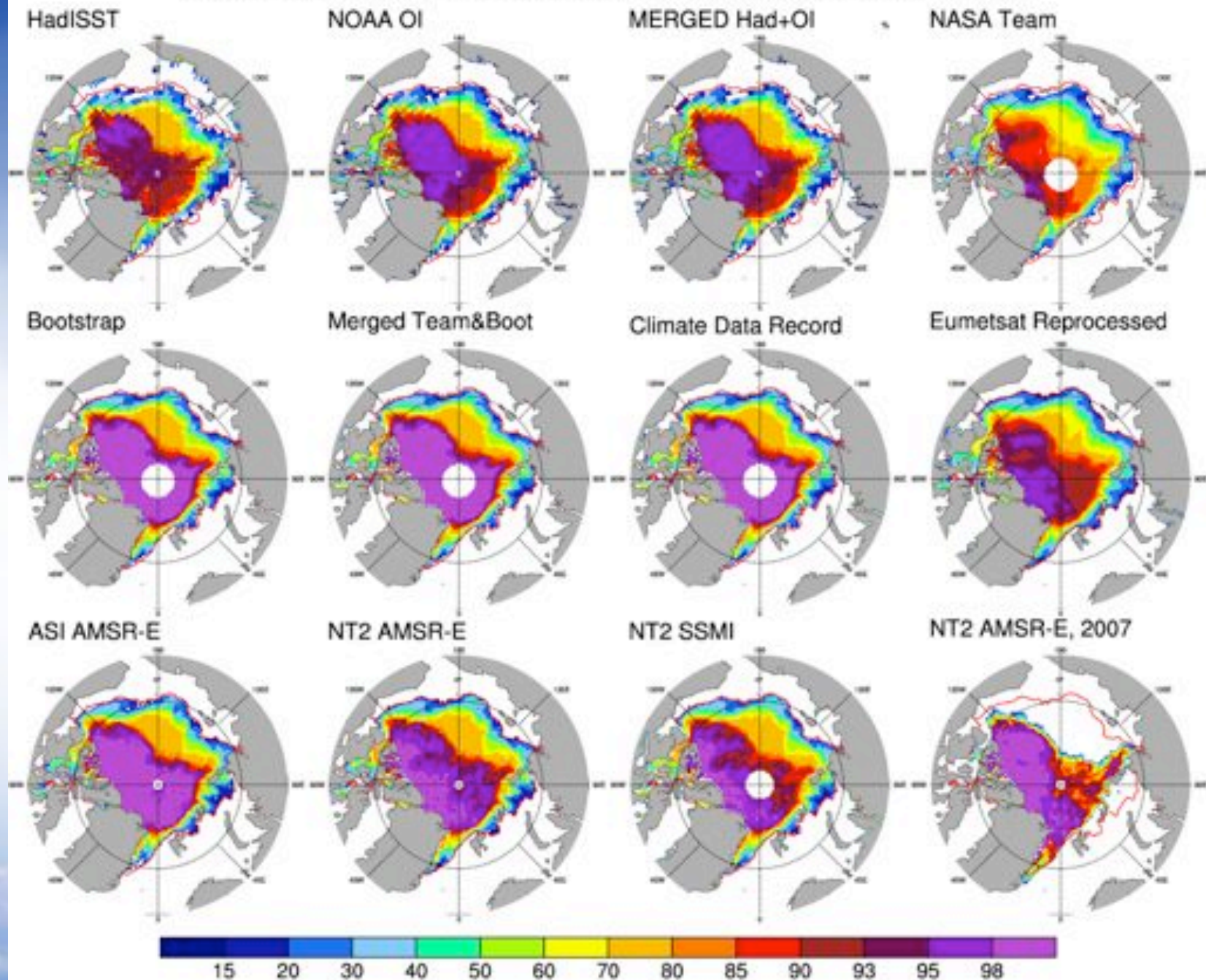


BOOTSTRAP (Observed) :

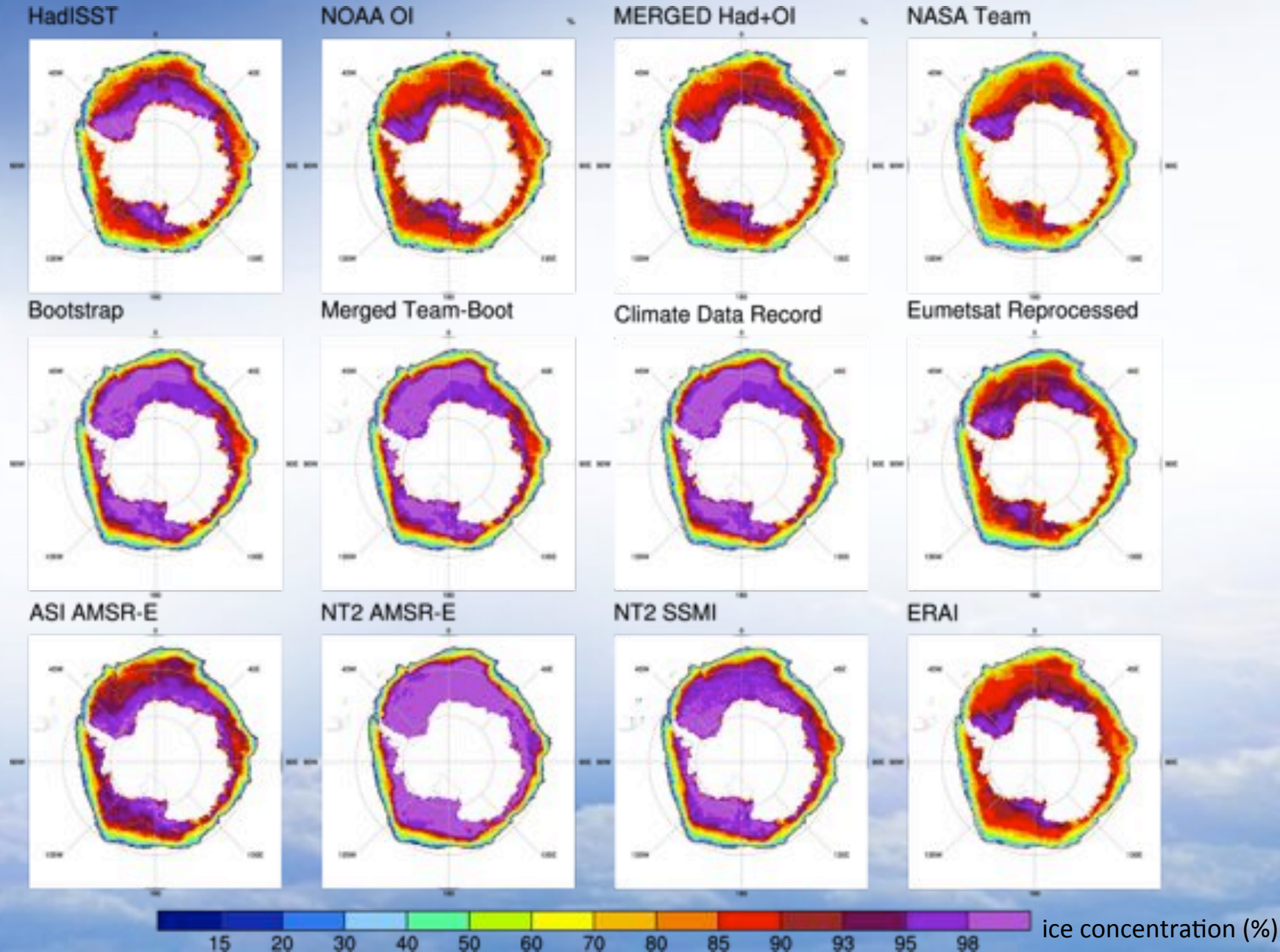
$1.74 \pm 1.3 \times 10^6 \text{ km}^2/\text{decade}$

CMIP5 historical runs (multi-model mean): $-4.30 \pm 0.7 \times 10^6 \text{ km}^2/\text{decade}$

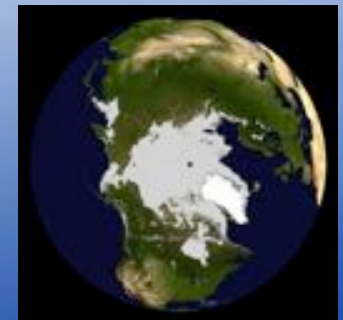
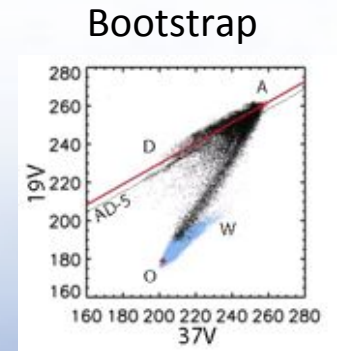
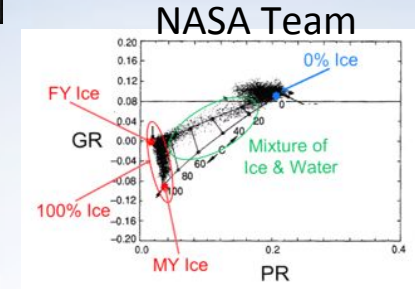
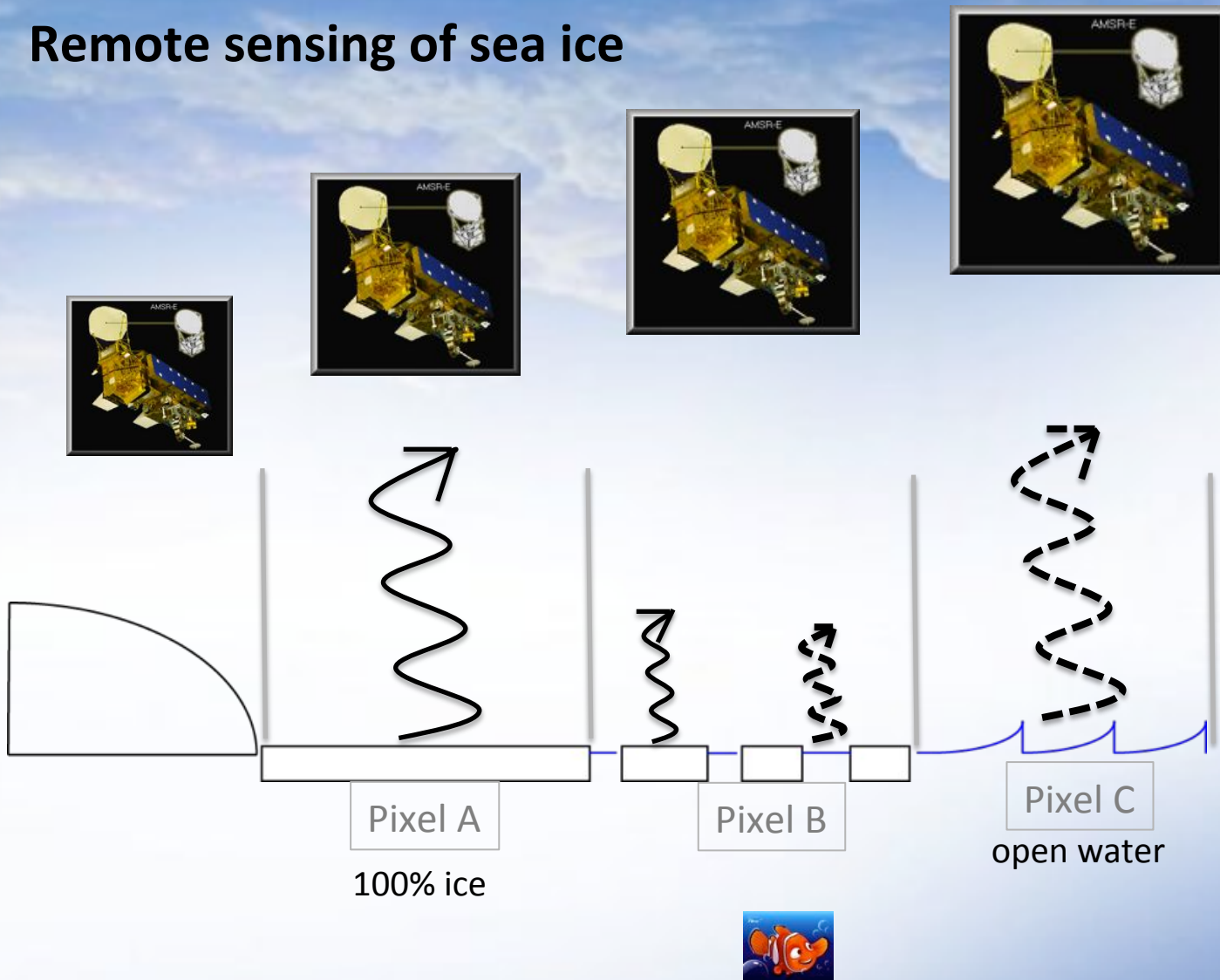
Sept. 2003:2007 climatology of Arctic Sea Ice Concentration



Sea Ice Concentration, September 2003:2007



Remote sensing of sea ice



Only 100% sea ice and 0% sea ice are obvious. All else is interpolation.

Brief History of Satellite Instruments, Channels, & Sea Ice Algorithms applied

1978- 1987 SMMR: 18.0H, 18.0V, 21.0V*; 37.0H, 37.0V
Bootstrap; NASA Team; both

1987-current SSMI: 19.4H 19.4V; 22.2 V*; 37.0H 37.0V; 85.5H 85.4V
Bootstrap, NASA Team +NT2

2003-current SSMIS: 19.4; 22.2V; 37.0; 91.7

2002-2011 AMSR-E: 18.7H 18.7V, 23.8V*, 36.5H 36.5 V, 89.0H 89.0V
Bootstrap; NT2; Boot & NT2; NT2 & ASI

2012-current AMSR2: 18.7, 23.8, 36.5, 89.0 *used for weather filter

Channels in GHz
H = horizontal polarization
V = vertical polarization

Low frequencies (37GHz & lower)

PROS
Less affected by weather
Long record length

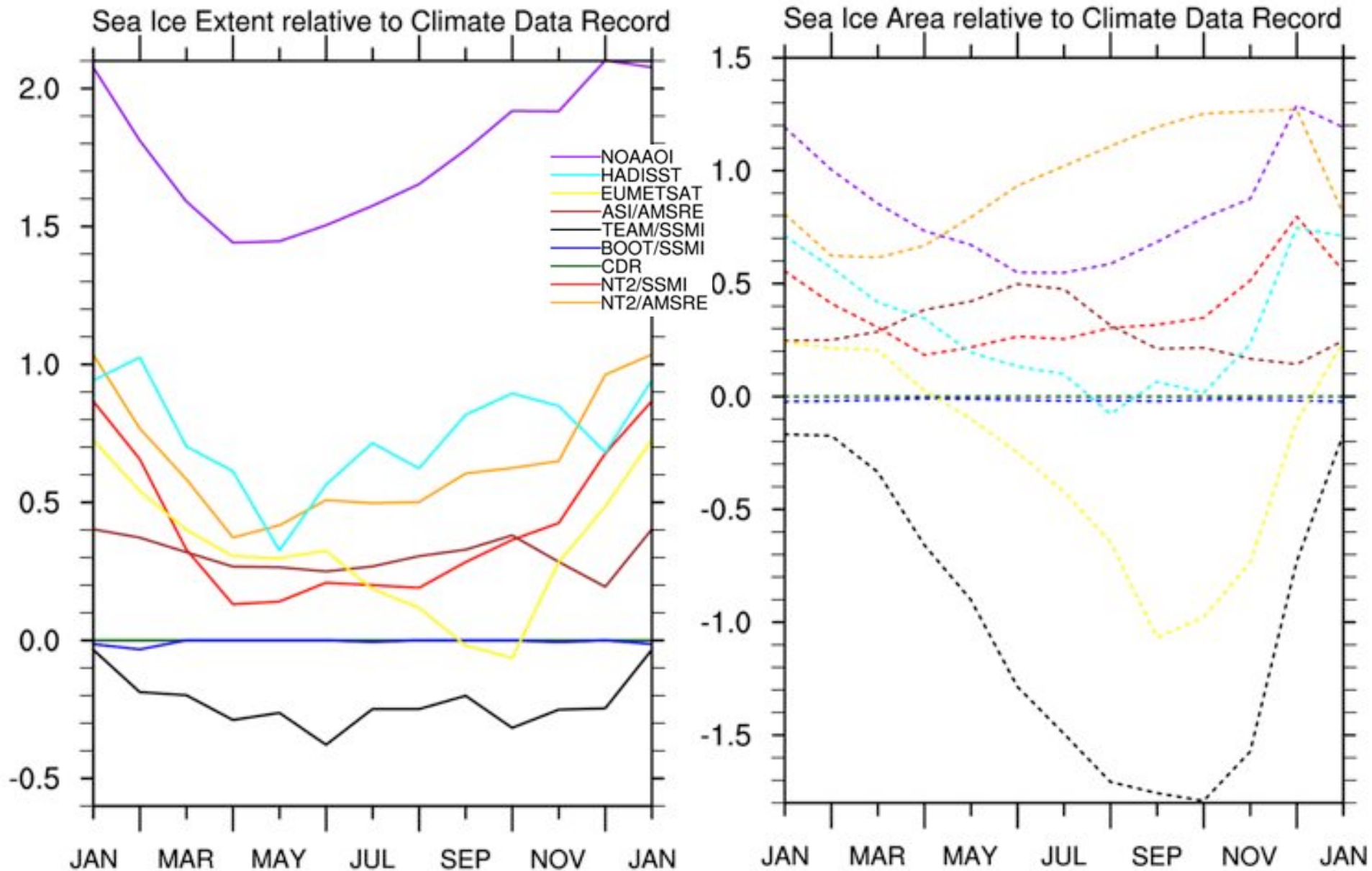
CONS
More affected by layering
Larger spatial footprint

High frequencies

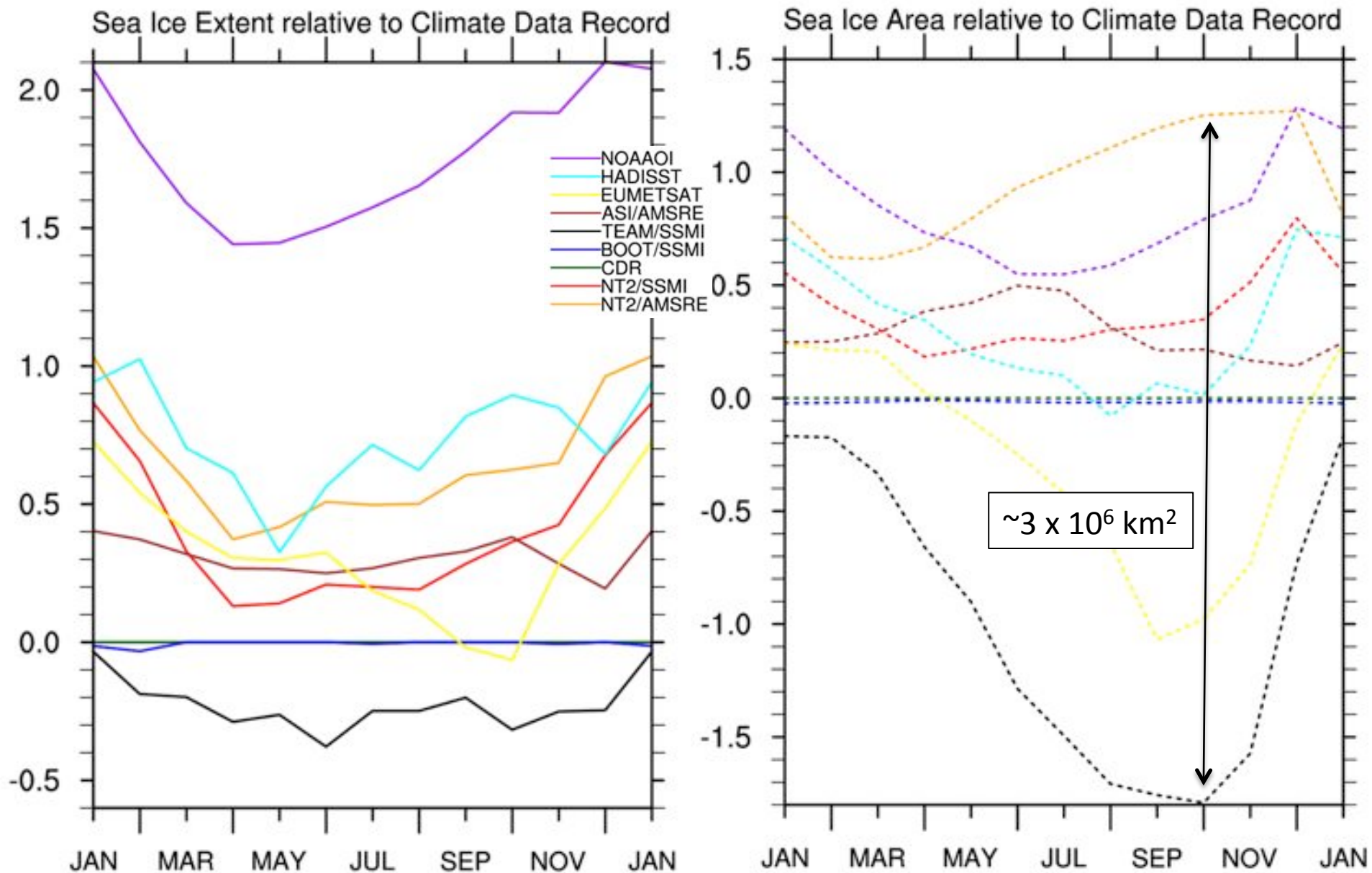
PROS
Smaller spatial footprint
Less sensitive to layering

CONS
Affected by water vapor & clouds
Shorter record lengths

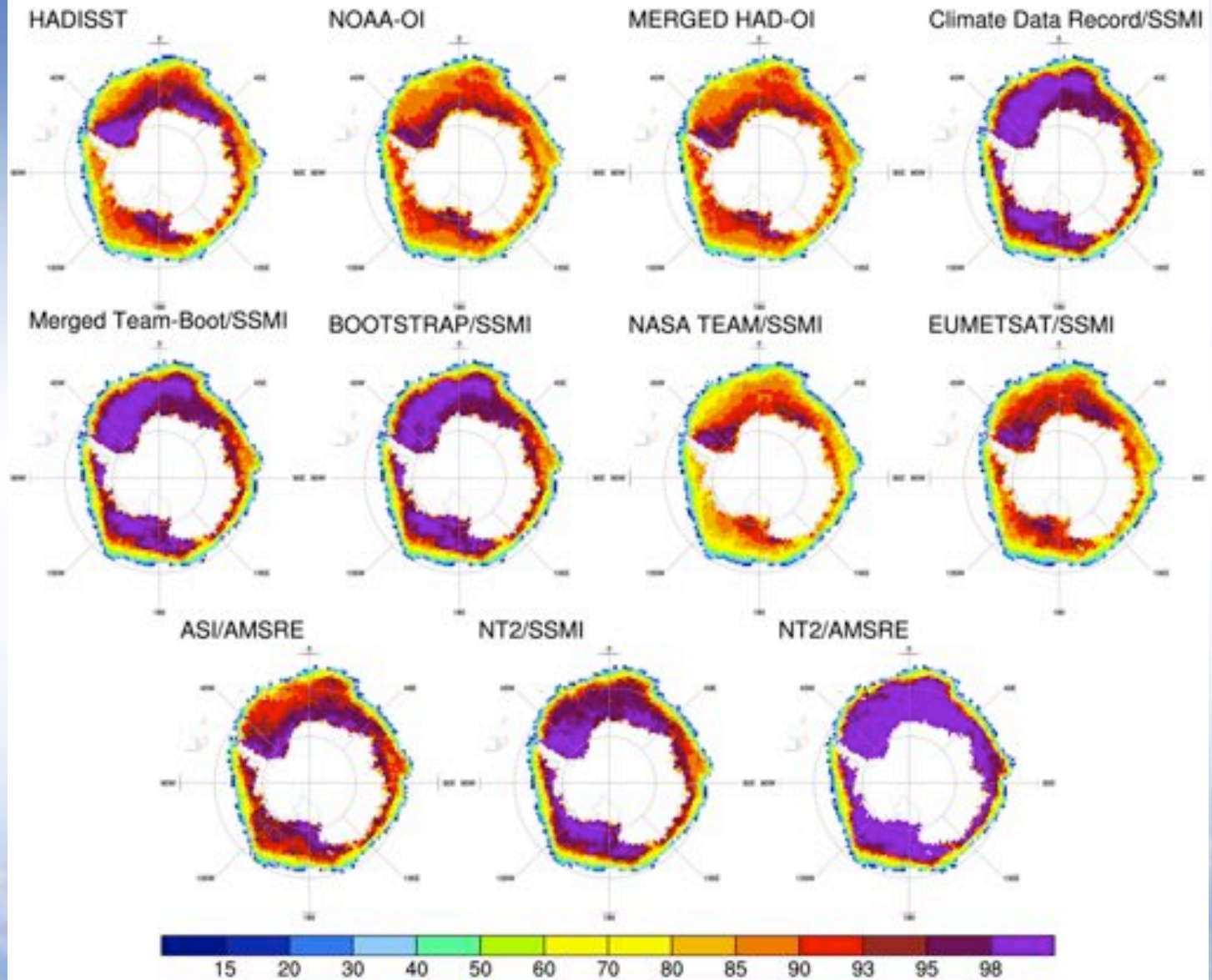
Relative Differences by month, 2003:2007



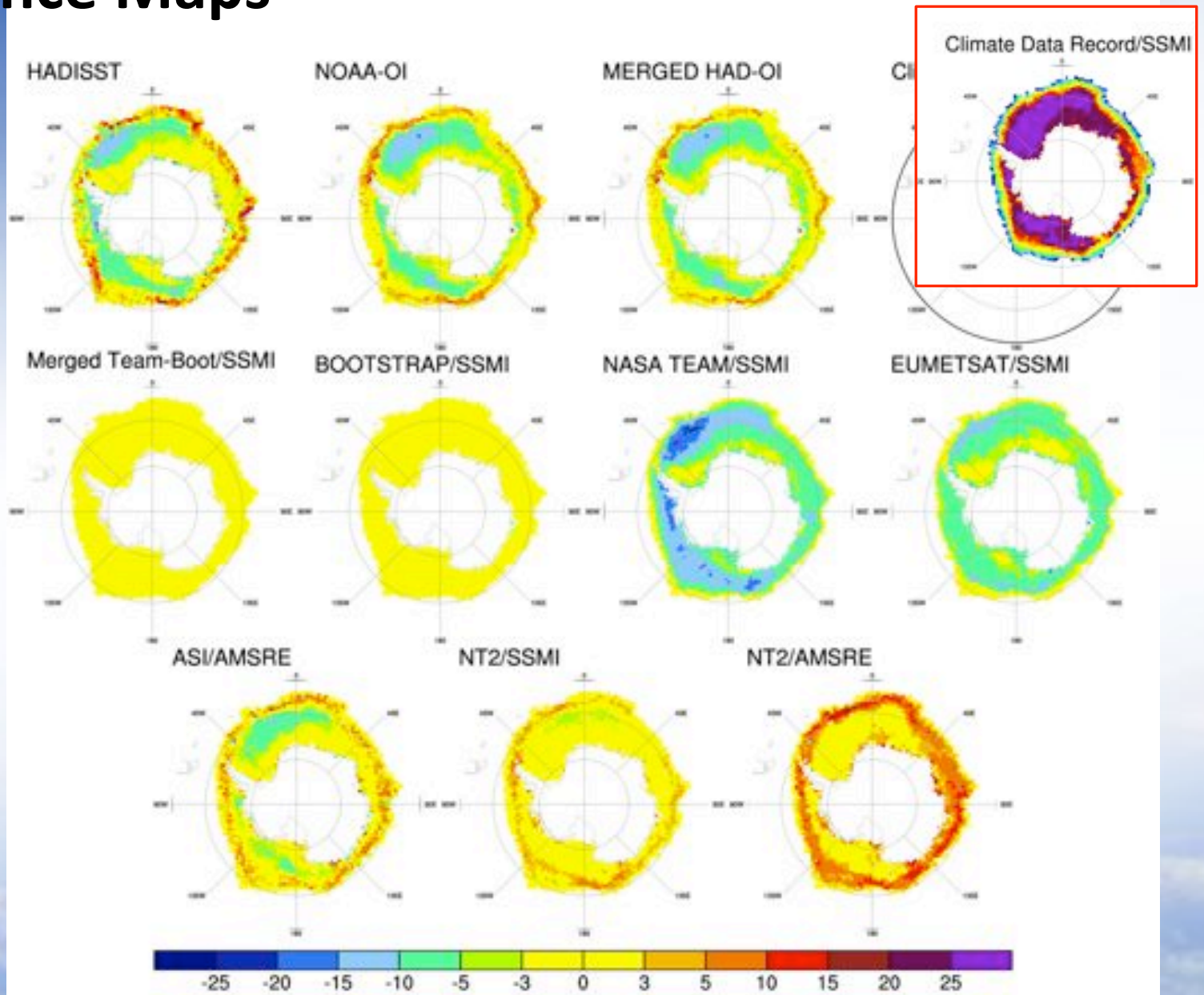
Relative Differences by month, 2003:2007



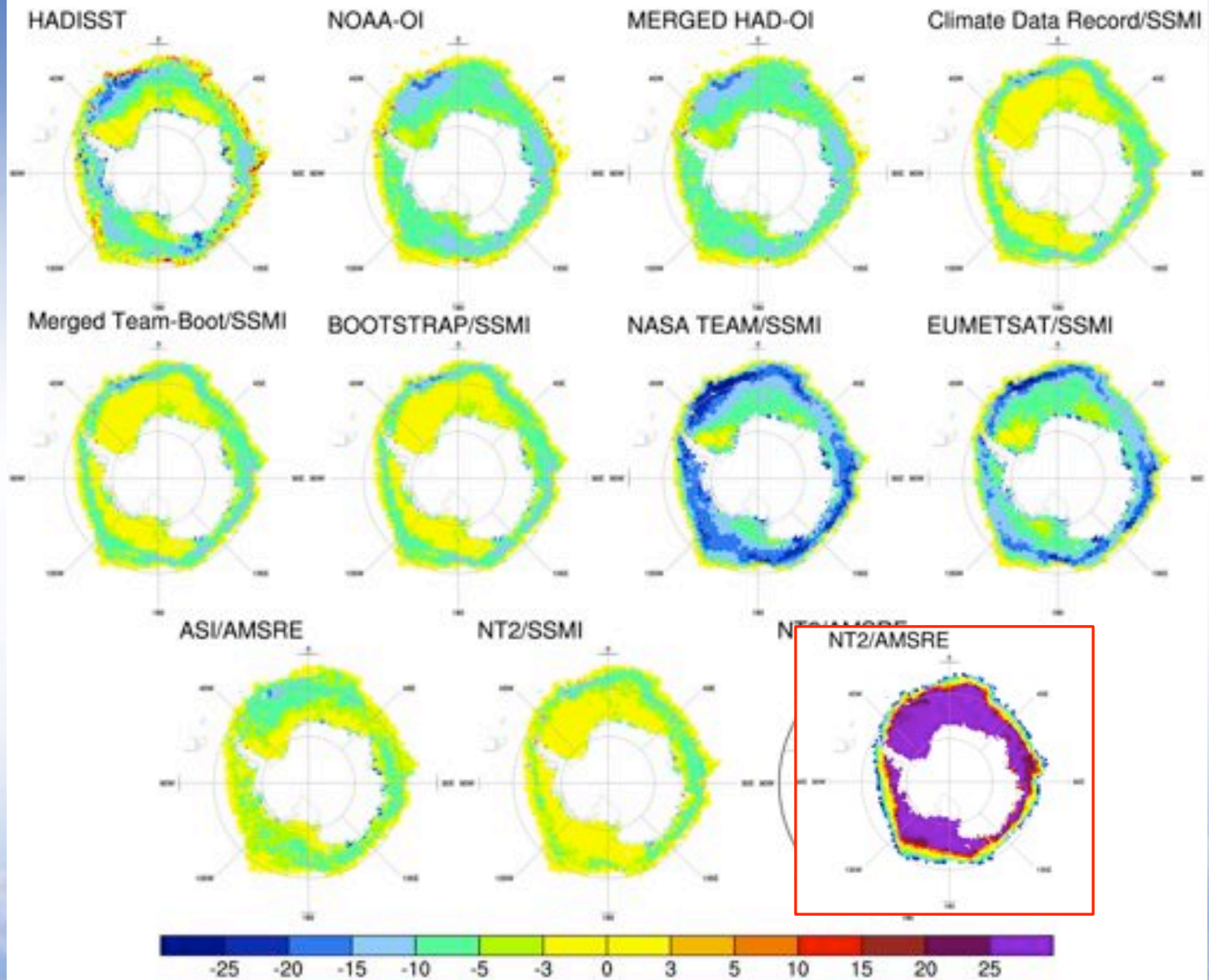
Regridded to 1°x1°; September 2003:2007



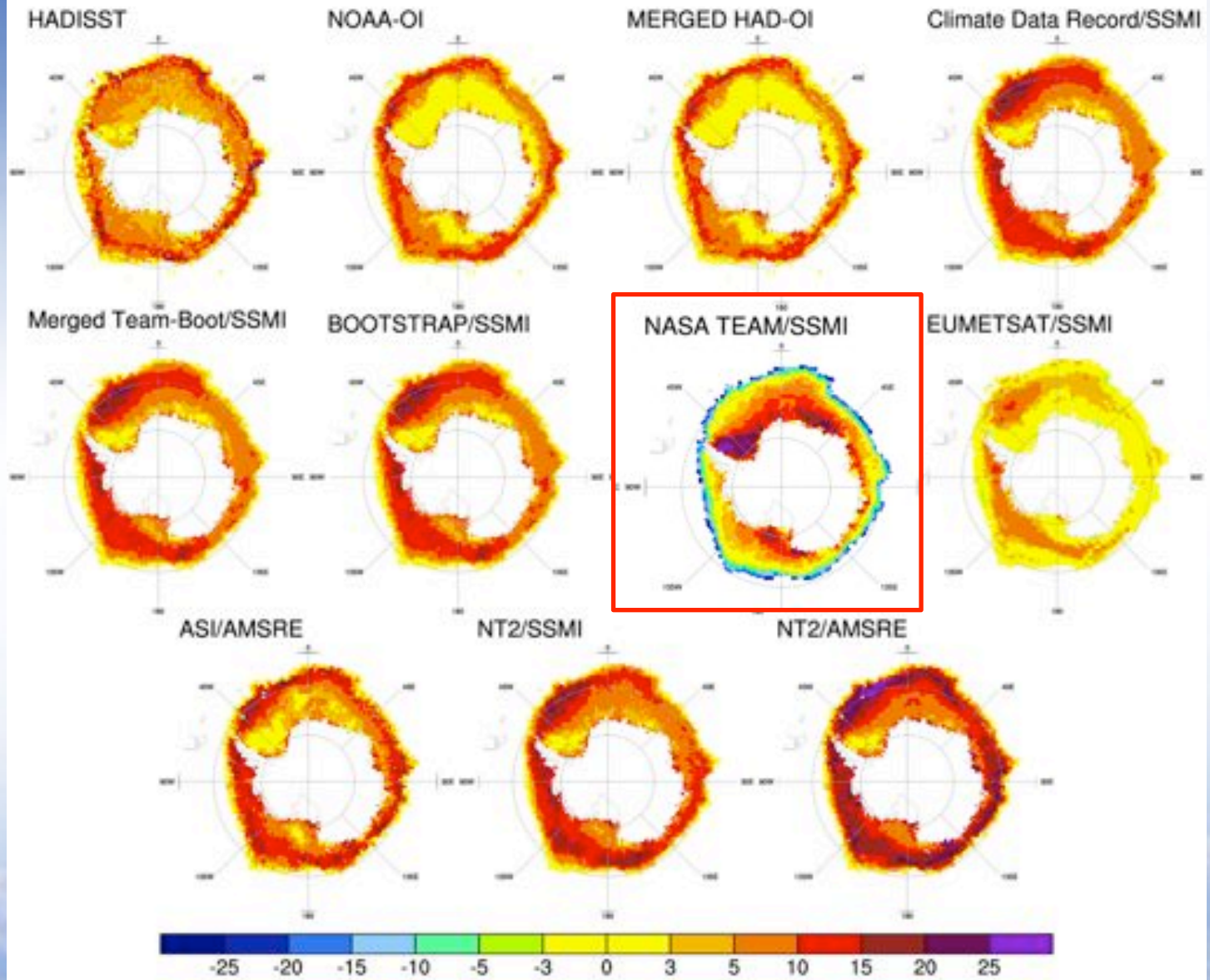
Difference Maps



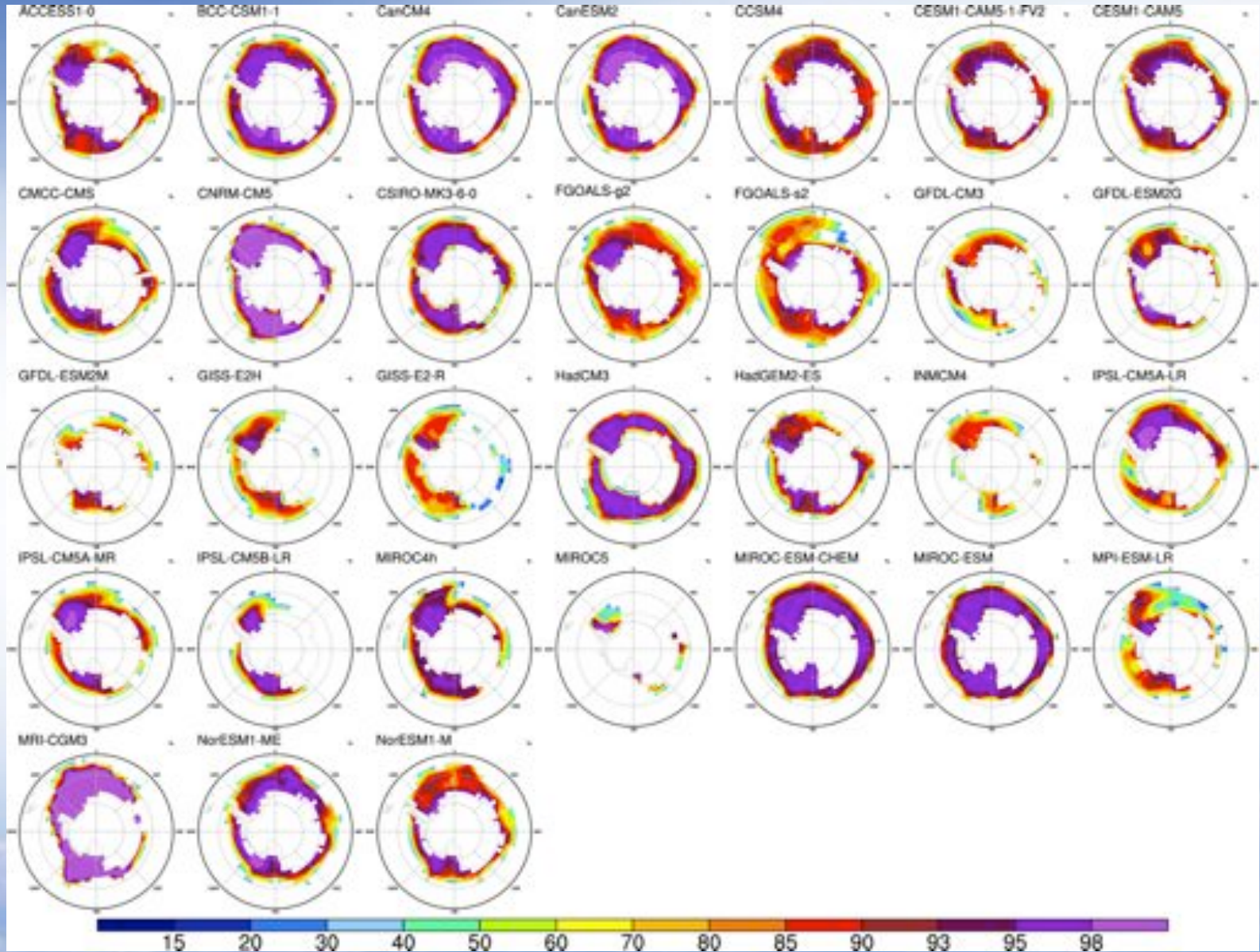
Difference Maps



Difference Maps



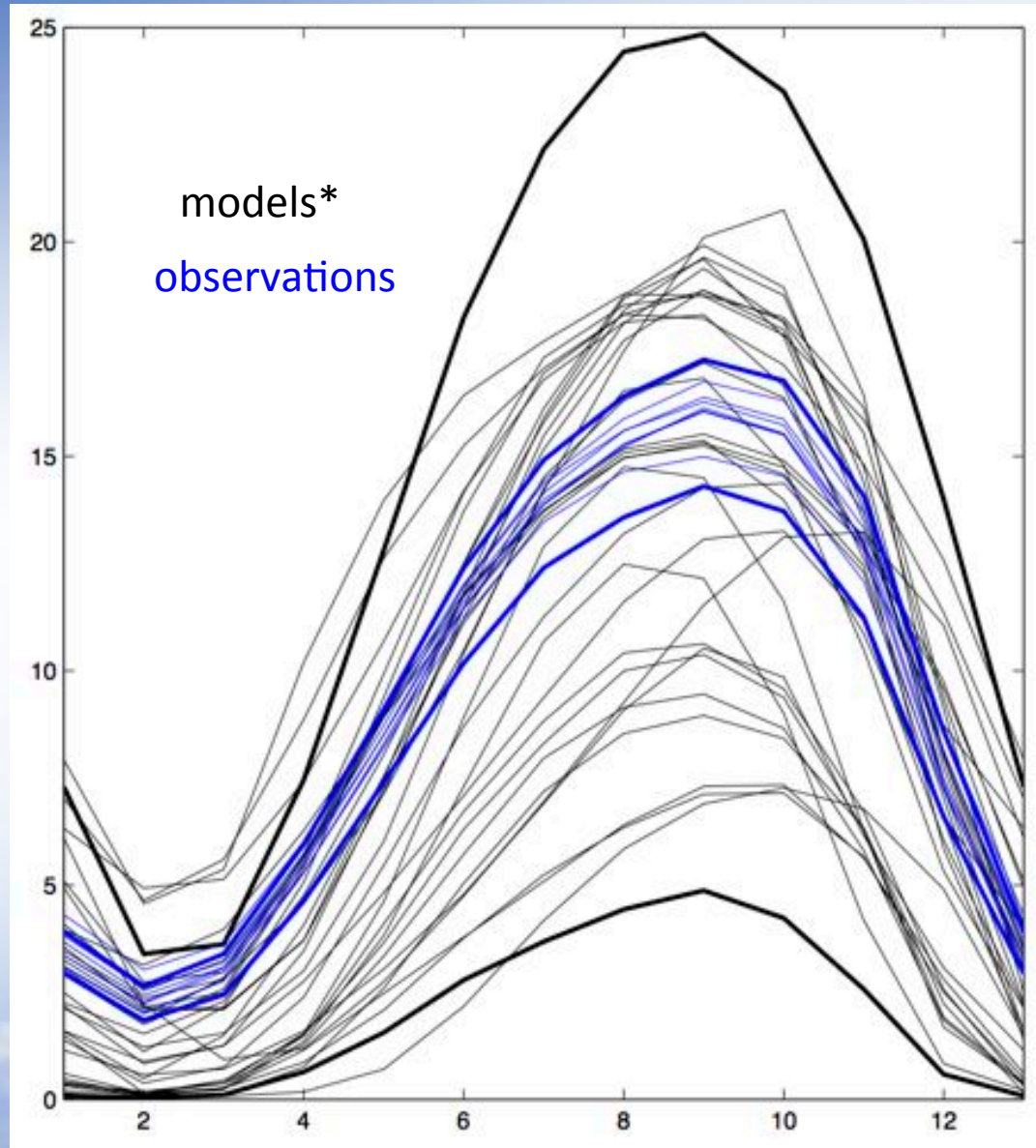
CMIP5 Models' September sea ice concentration



Data courtesy Irina Mahlstein

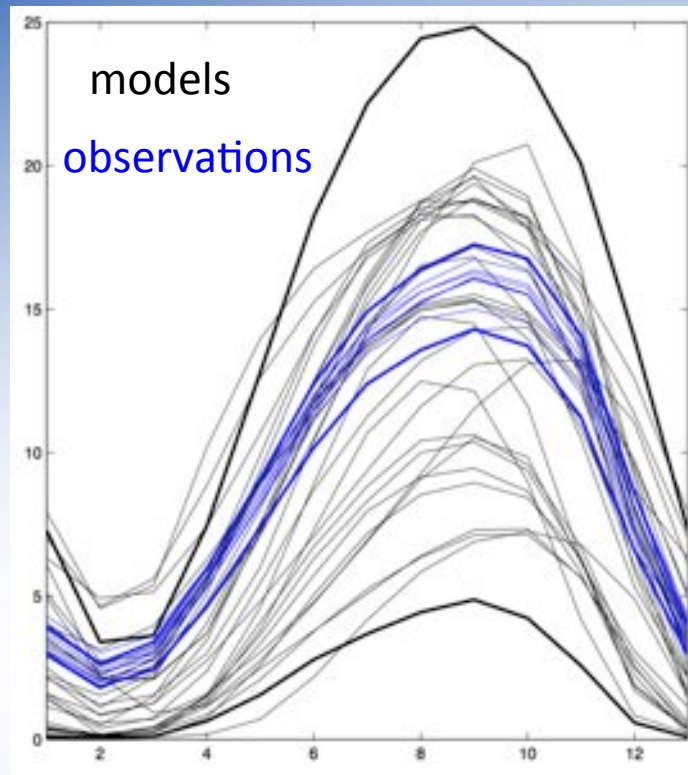
Models

Sea Ice Area climatology



*caveat: preliminary data; regridding method not checked

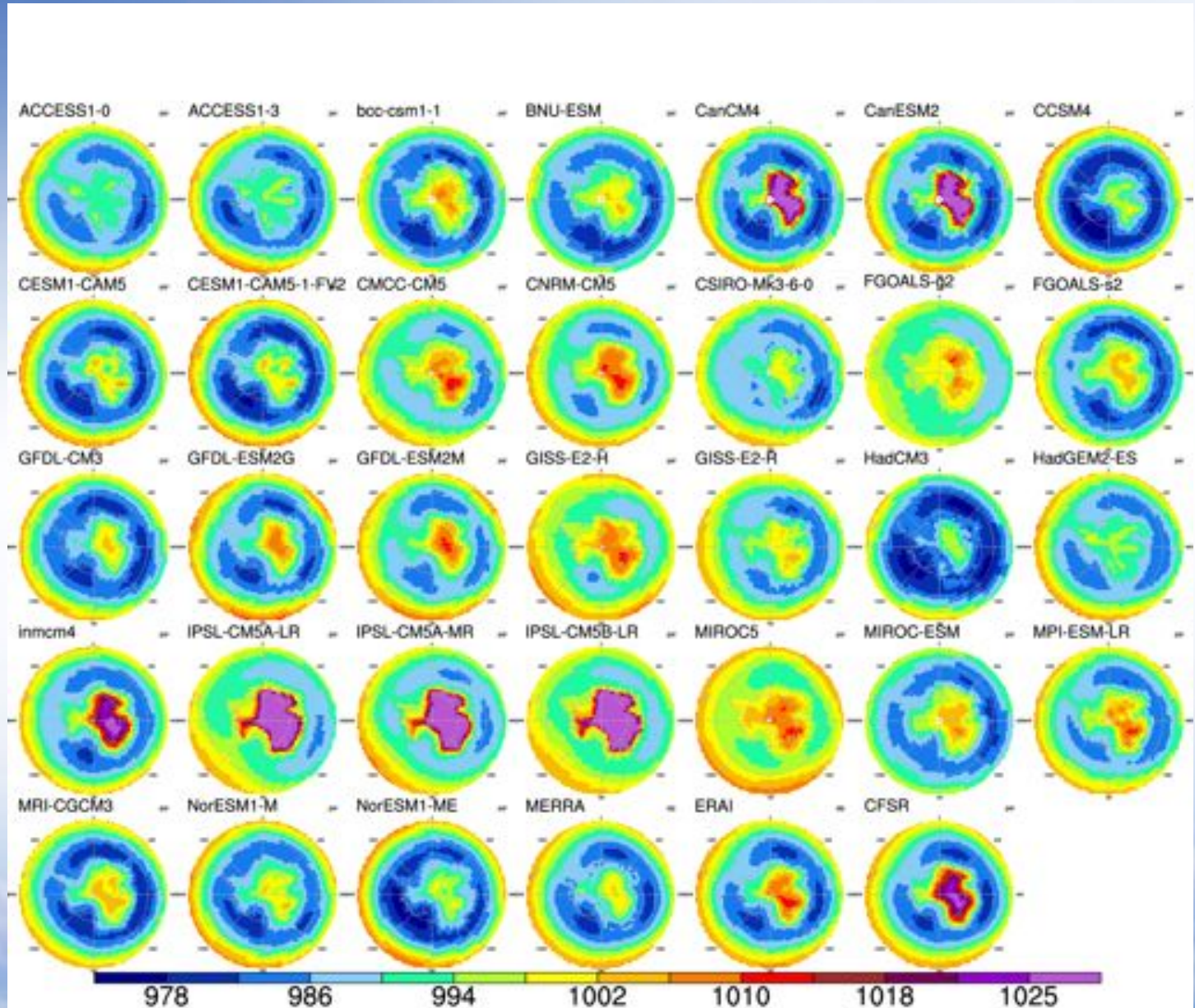
Models



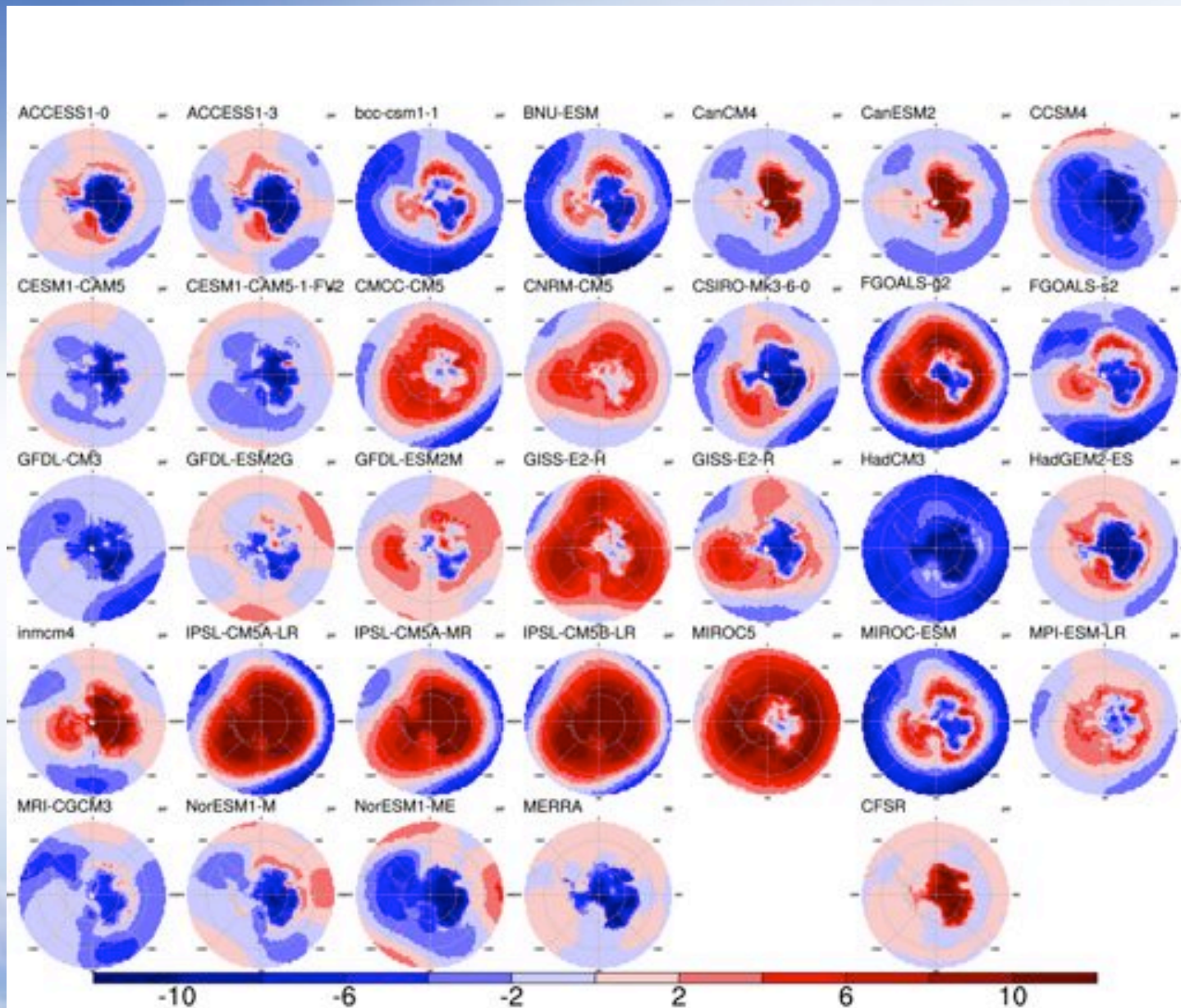
Models with least average monthly deviation from observed sea ice area

NASA Team (SSM/I)	Bootstrap (SSM/I)	NASA Team 2 (AMSRE)
1. MIROC-ESM1; 19%	CESM1-CAM5; 11%	MRI-GCM3; 9%
2. BCC-CSM-1-1; 19%	MIRCOE-ESM-CHEM; 12%	CESM1-CAM5-FV2; 10%
3. CAN-ESM2; 20%	MIROC-ESM; 13%	MIROC-ESM-CHEM; 11%
4. CMCC-CM5; 20%	CAN-ESM2; 13%	NOR-ESM1; 12%
5. CESM1-CAM5; 20%	CESM1-CEM5-FV2; 15%	CESM1-CAM5; 12%

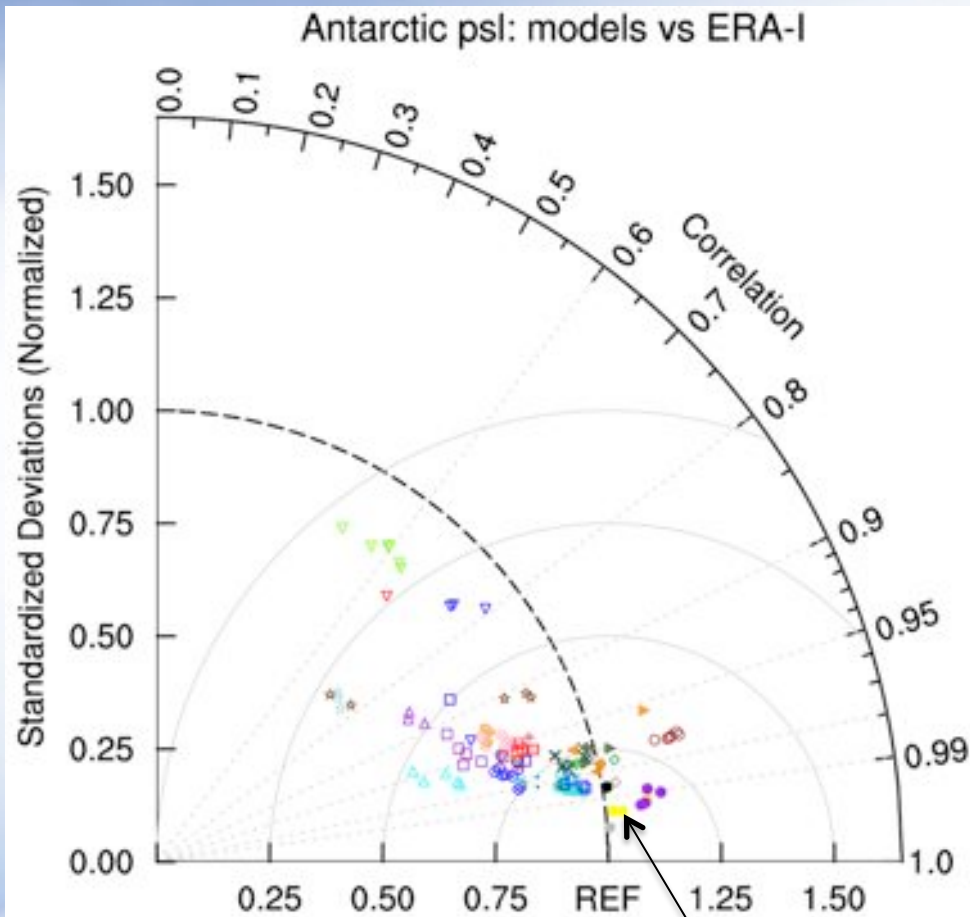
Other metrics: Ann climatology of slp 1991-2000



Bias in annual slp (relative to ERA-Interim)

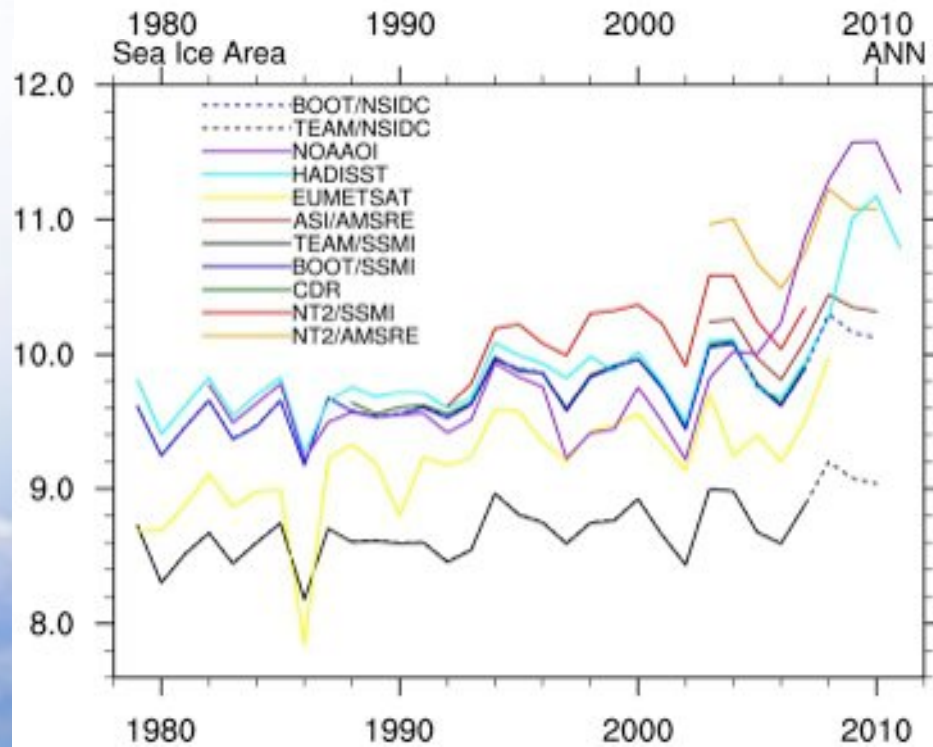
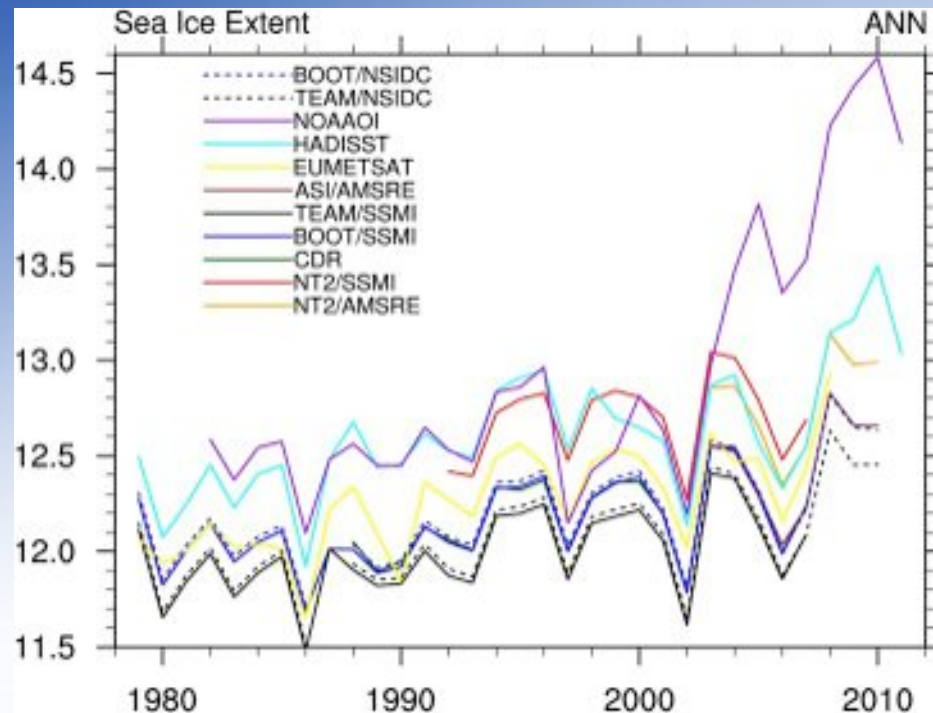


Other metrics: Bias in SLP

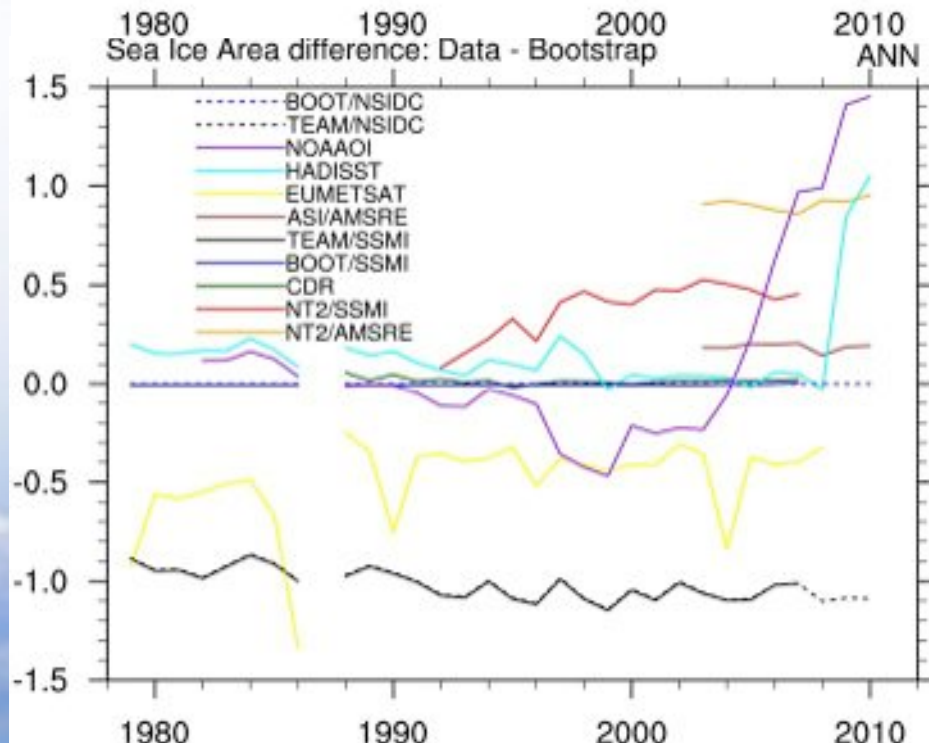
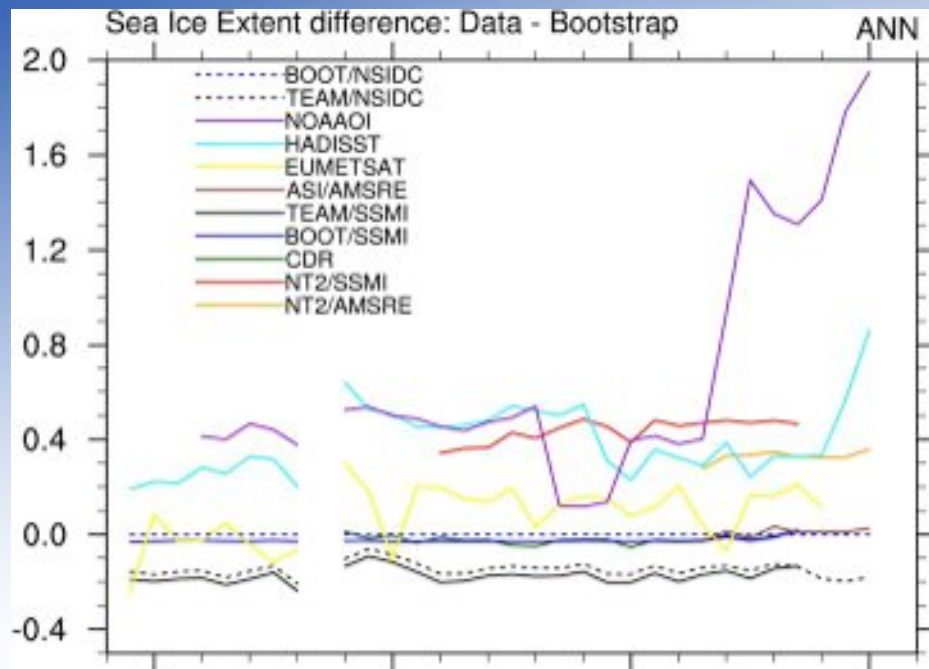


CSM1-CAM5

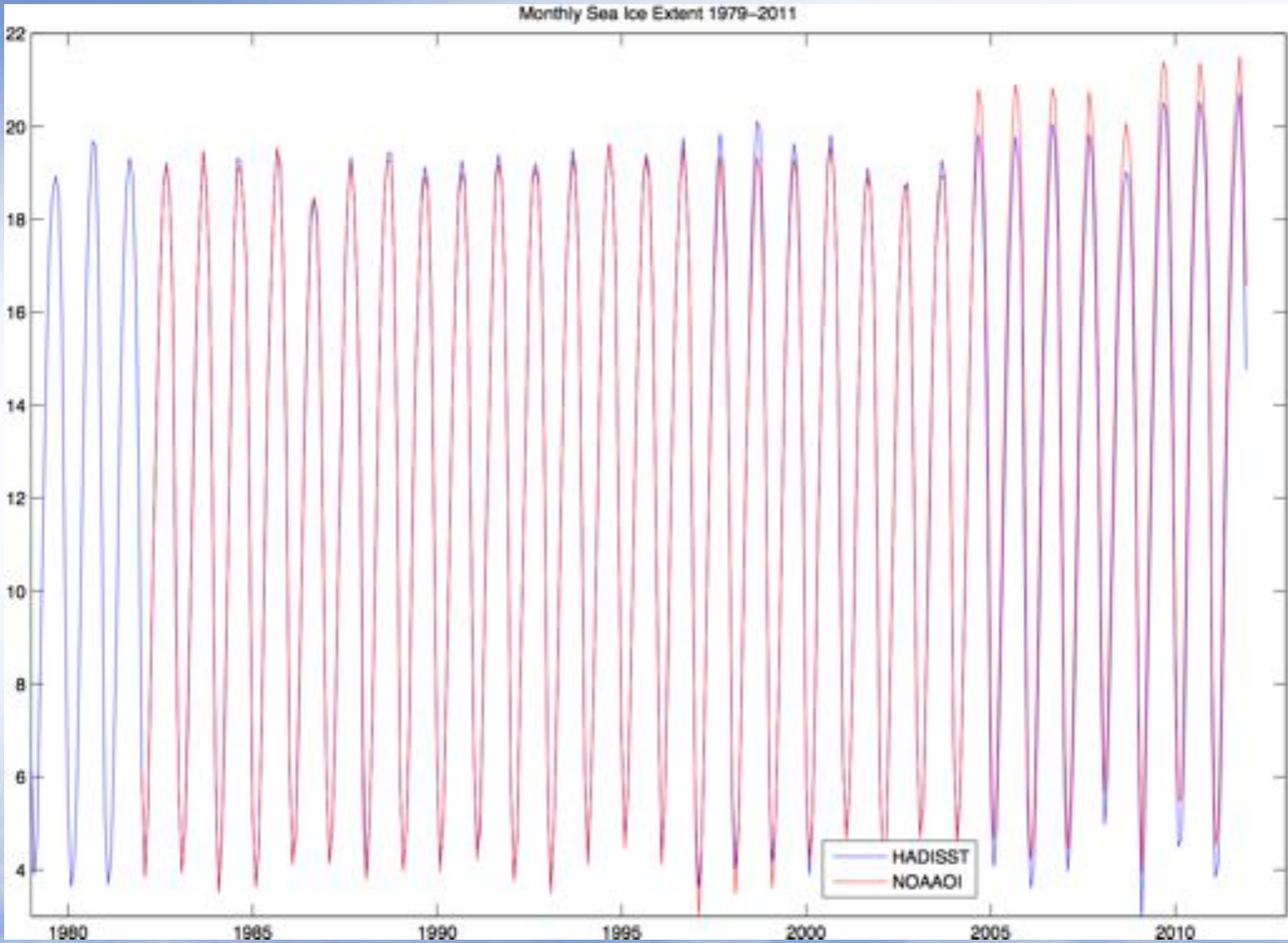
trends



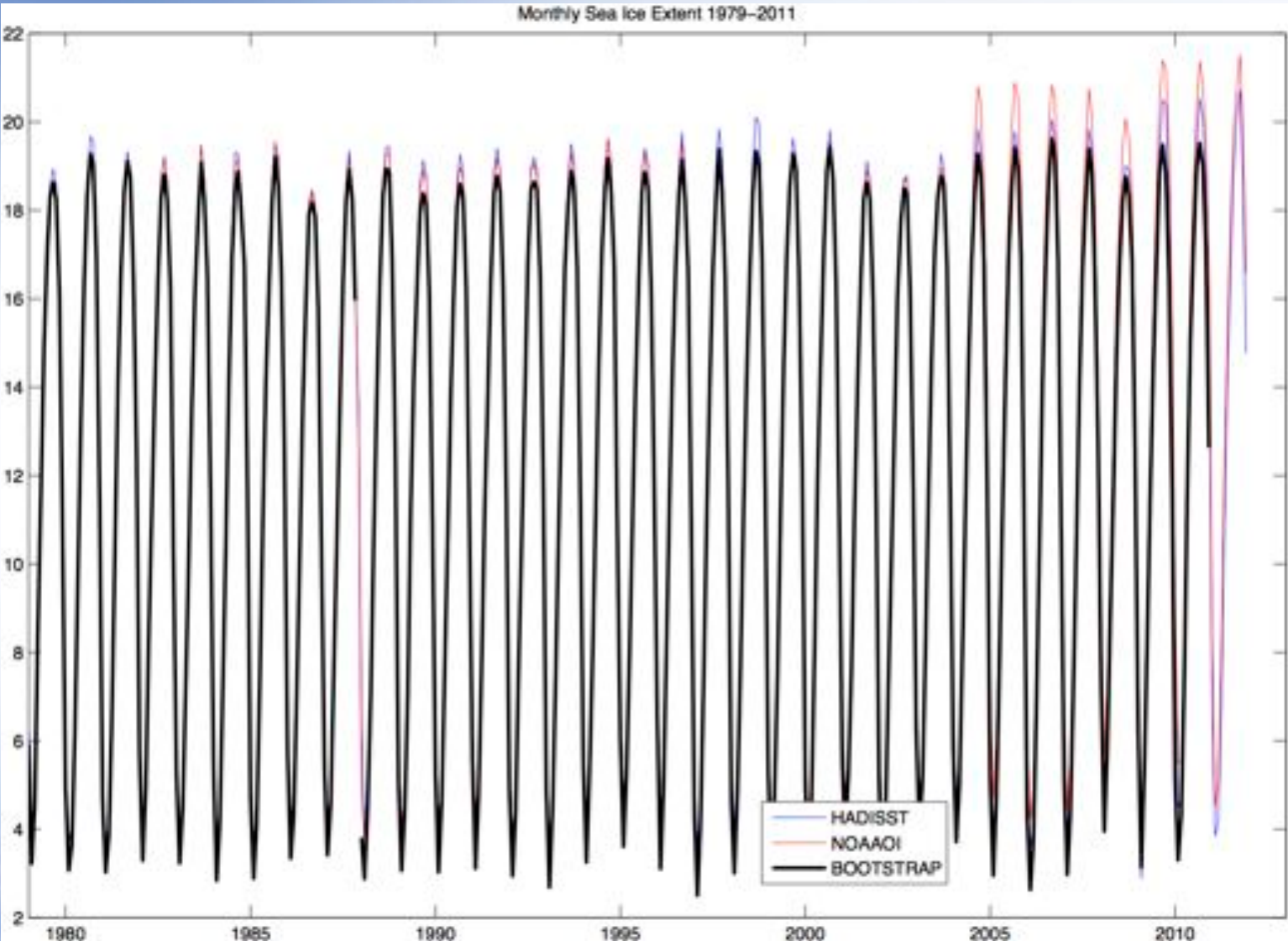
trends



trends



trends



Sea Ice trends (annual)

		EXTENT Trend x 10 ⁶ km ² 10yr ⁻¹	AREA Trend x 10 ⁶ km ² 10yr ⁻¹
Bootstrap (NSIDC 192)	1979-2010	0.17±0.10	0.21±0.10
NASA Team (NSIDC 192)	1979-2010	0.17±0.10	0.16±0.10
EUMETSAT	1979-2009	0.21±0.12	0.29±0.16
HADISST	1979-2011	0.22±0.12	0.27±0.14
NOAA OI	1982-2011	0.73±0.24	0.65±0.37
Climate Data Record	1988-2007	0.13±0.14	0.12±0.15

Conclusions / Discussion points

Yes, Antarctic sea ice extent and area is increasing!

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The sea ice concentration data sets are different. Does it matter?

What are the appropriate set of 4-6 metrics/benchmarks for the Antarctic & Southern Ocean surface climate? Should be adopt a standard set of obs for sea ice concentration, air temperature, winds, SLP, etc.?

Would it be useful to have a more physically based sea ice & compatible SSTs boundary conditions data set for the polar regions?