Enhanced Bootstrap Algorithm and Comparative studies of AMSR 2, AMSR-E and SSM/I data

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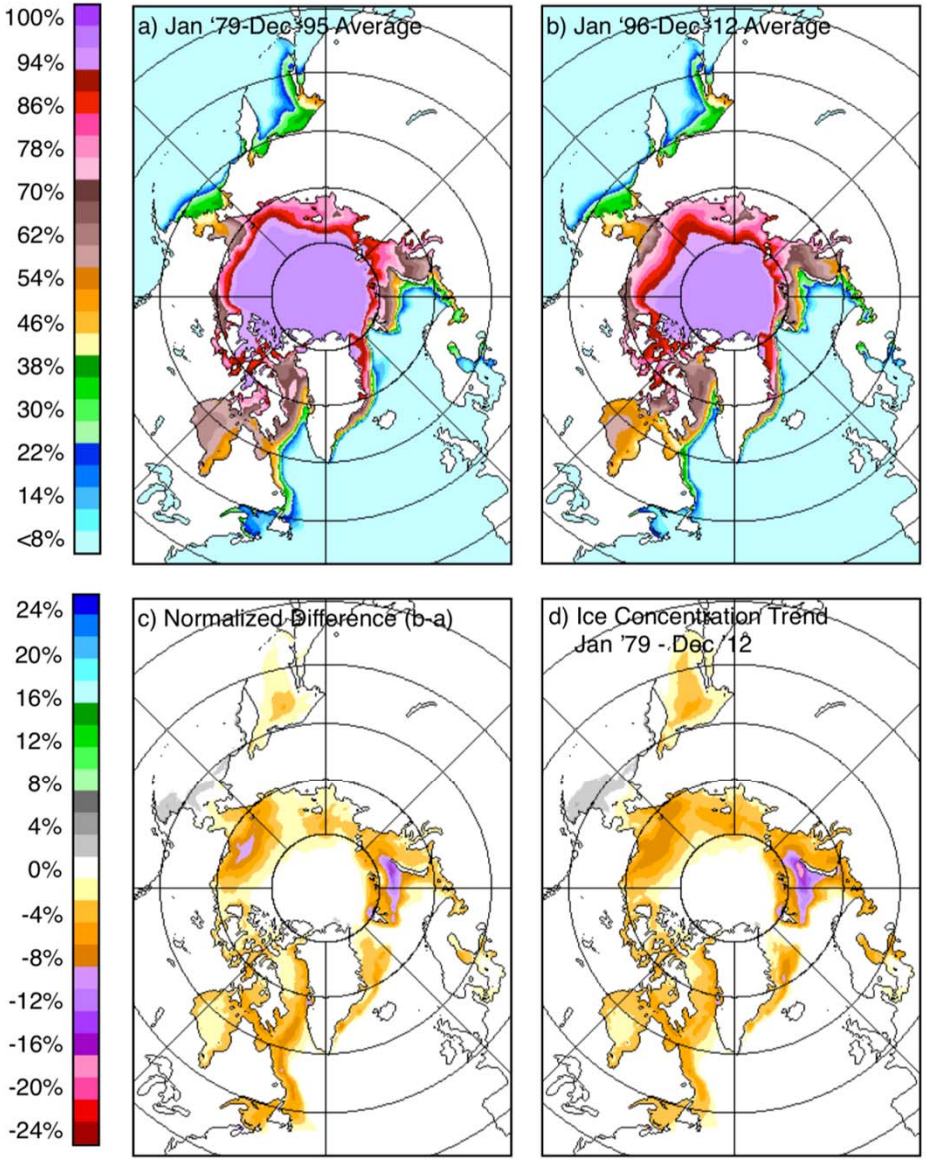
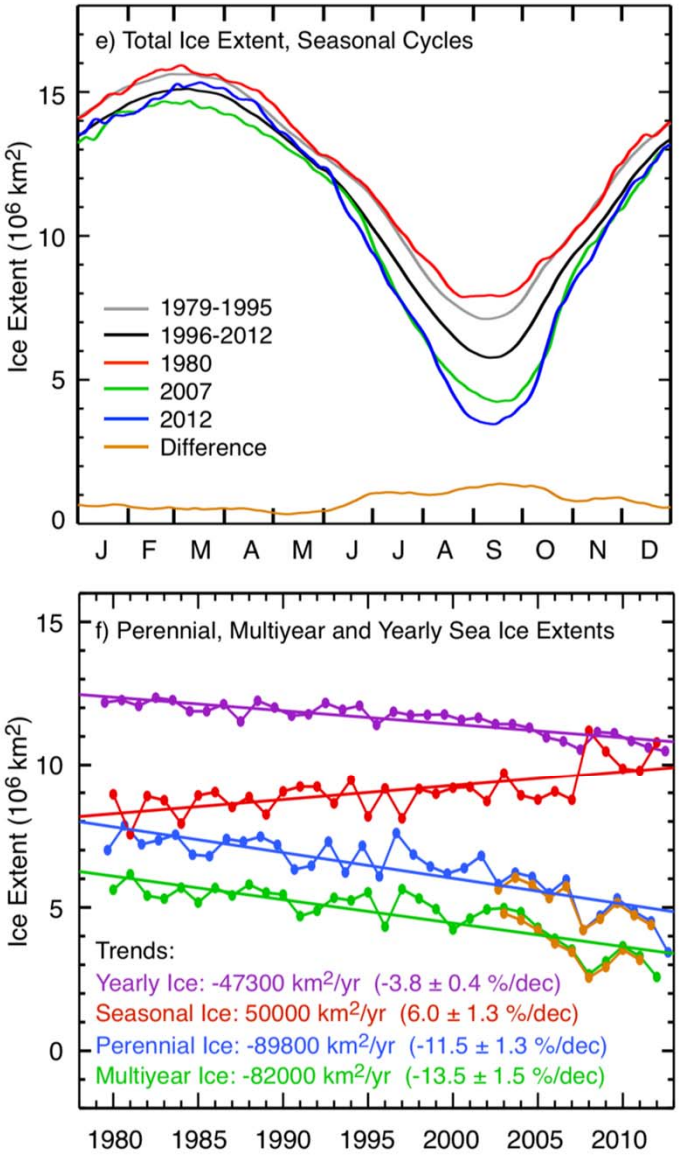
Motivation: The Changing Arctic Sea Ice Cover

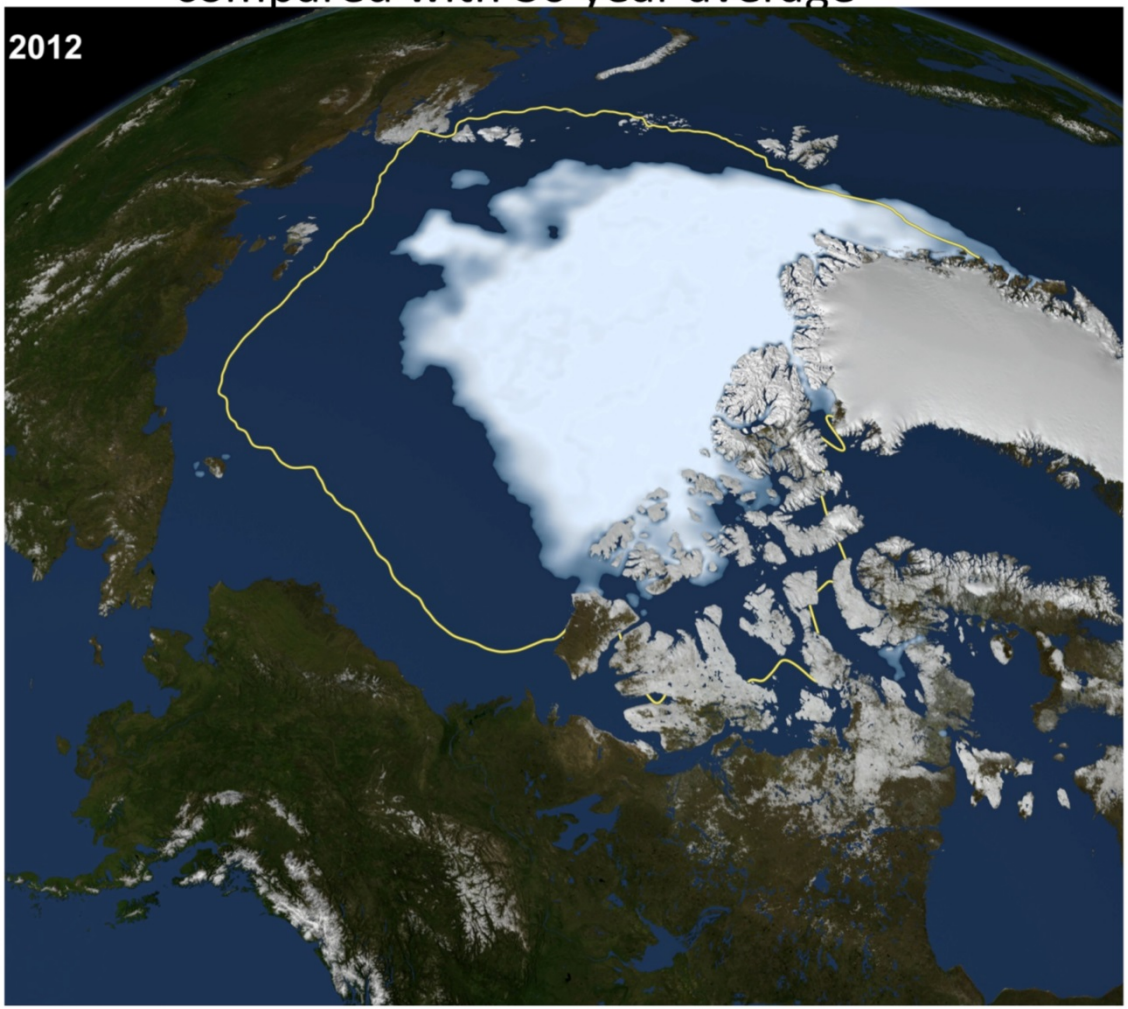




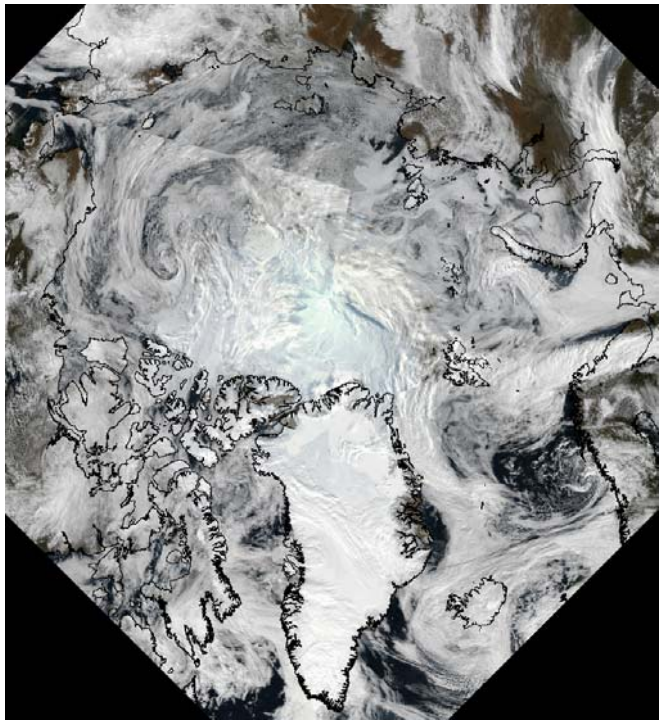
2012

The cryosphere and the Arctic perennial ice in 2012

Sea Ice cover during ice minimum in 2012
compared with 30 year average



MODIS on September 13, 2012



Outline of Talk:

- Comparison of AMSR2 and MODIS data
- Comparison of Ice Concentration Maps and Errors
- Comparison of Ice Extents and Ice Area and Biases

  AMSR-E vs AMSR2

  AMSR2 vs SSM/I

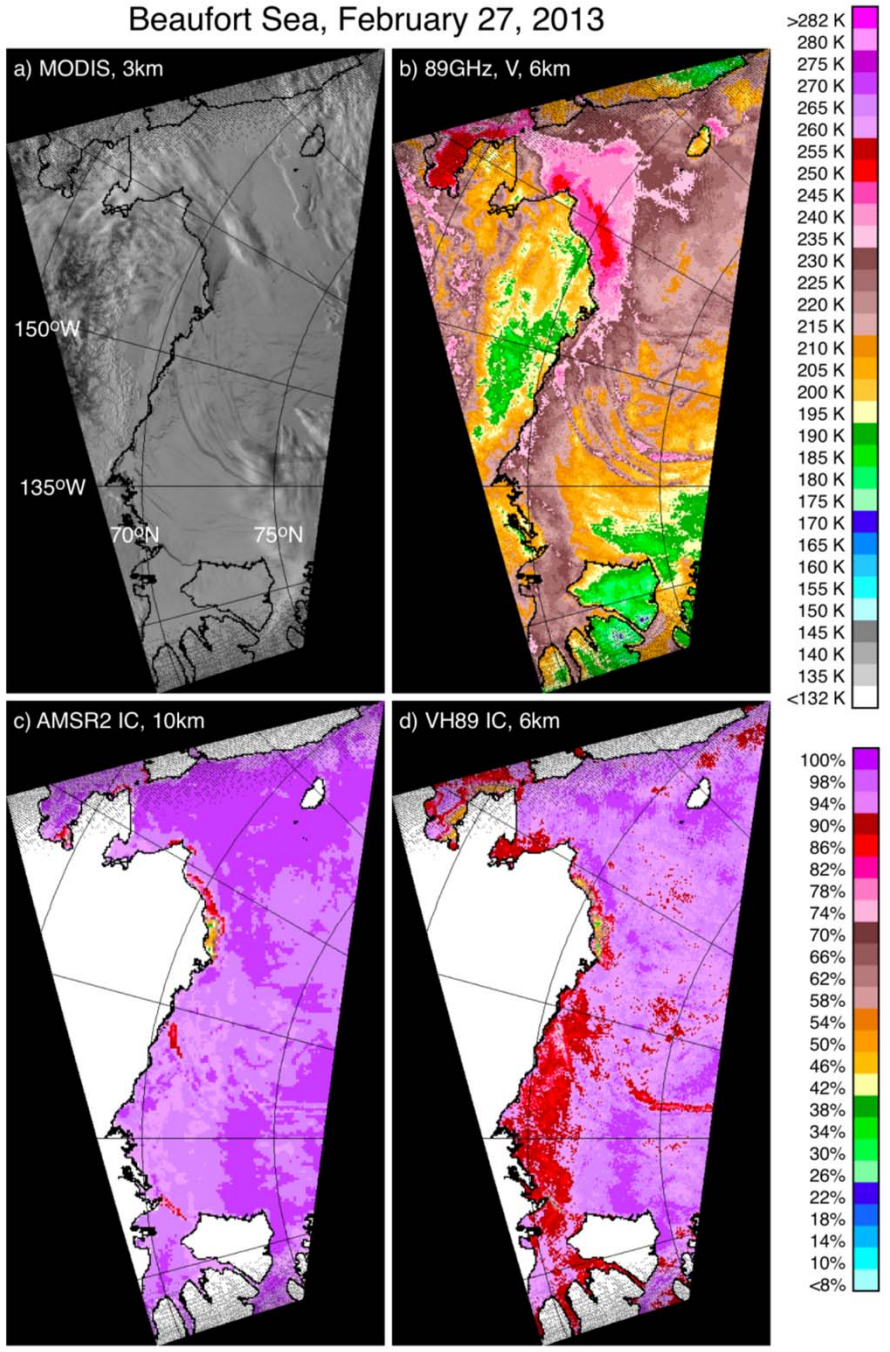
  AMSR-E vs SSM/I
- Assessment of Errors

  New Ice and Meltponding problem

Formation of leads in the Arctic

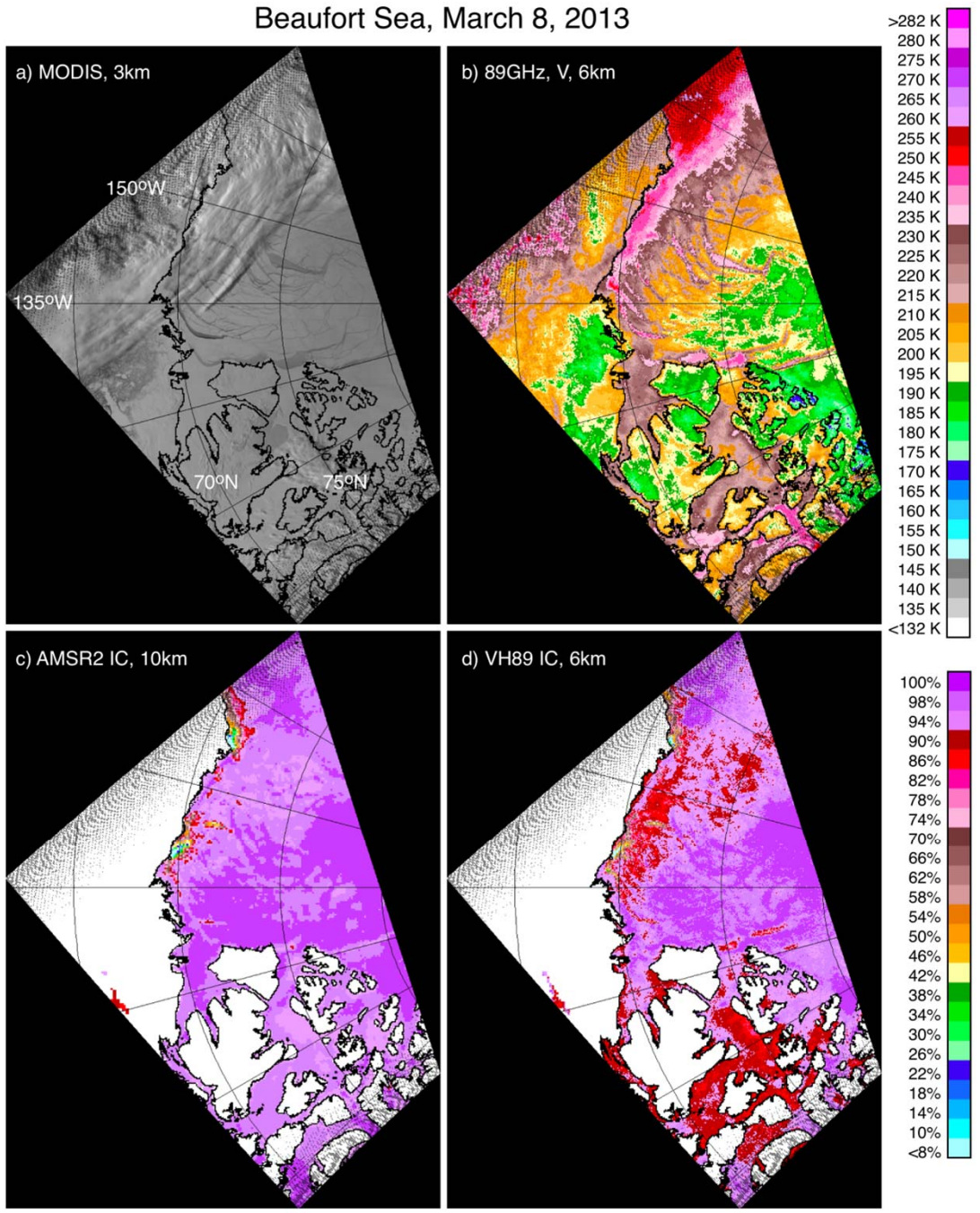
Heat Flux Effects

MODIS vs AMSR2 [TB, IC (standard) and IC (High Res)]

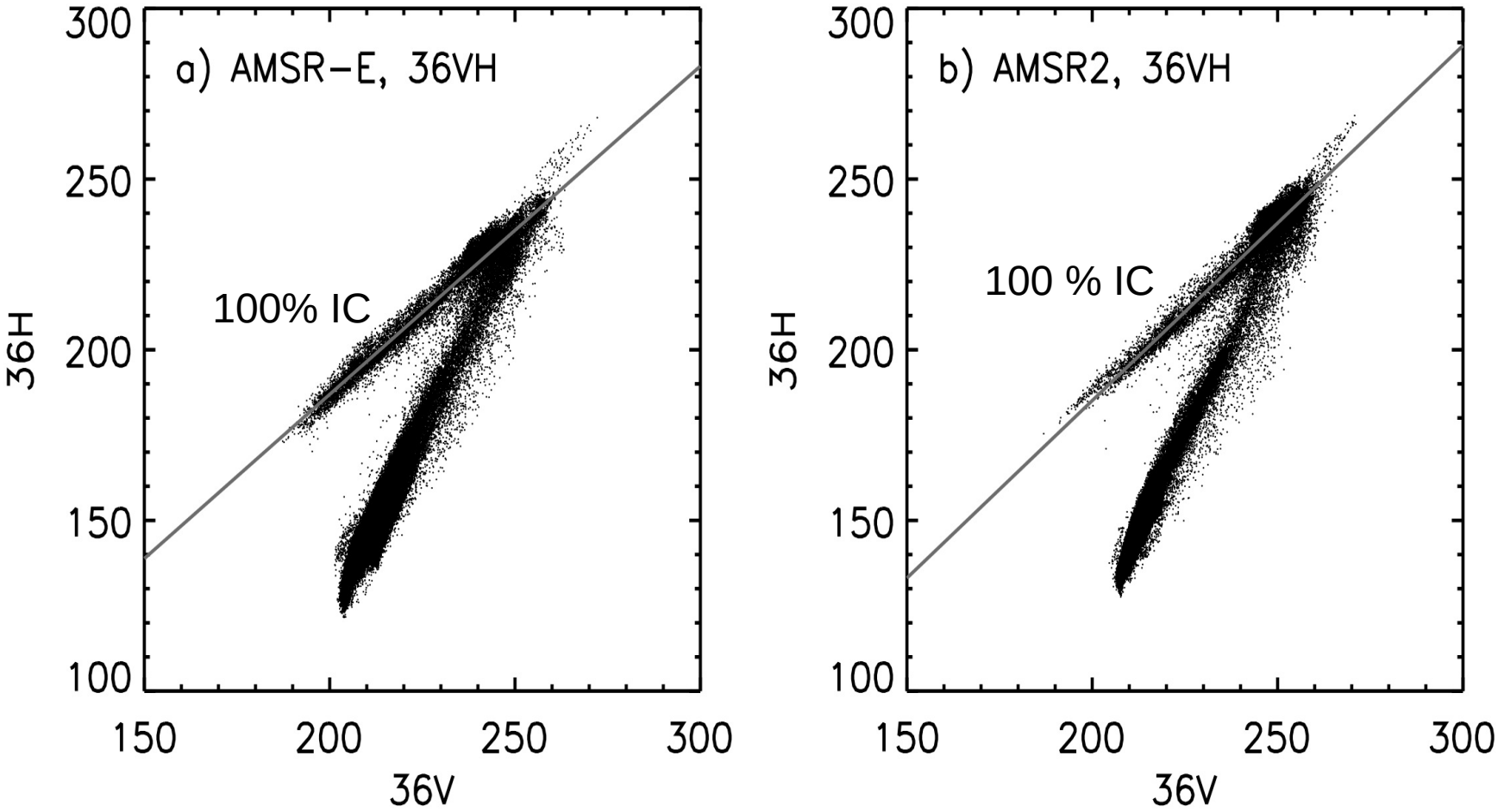


Large leads in the Arctic:

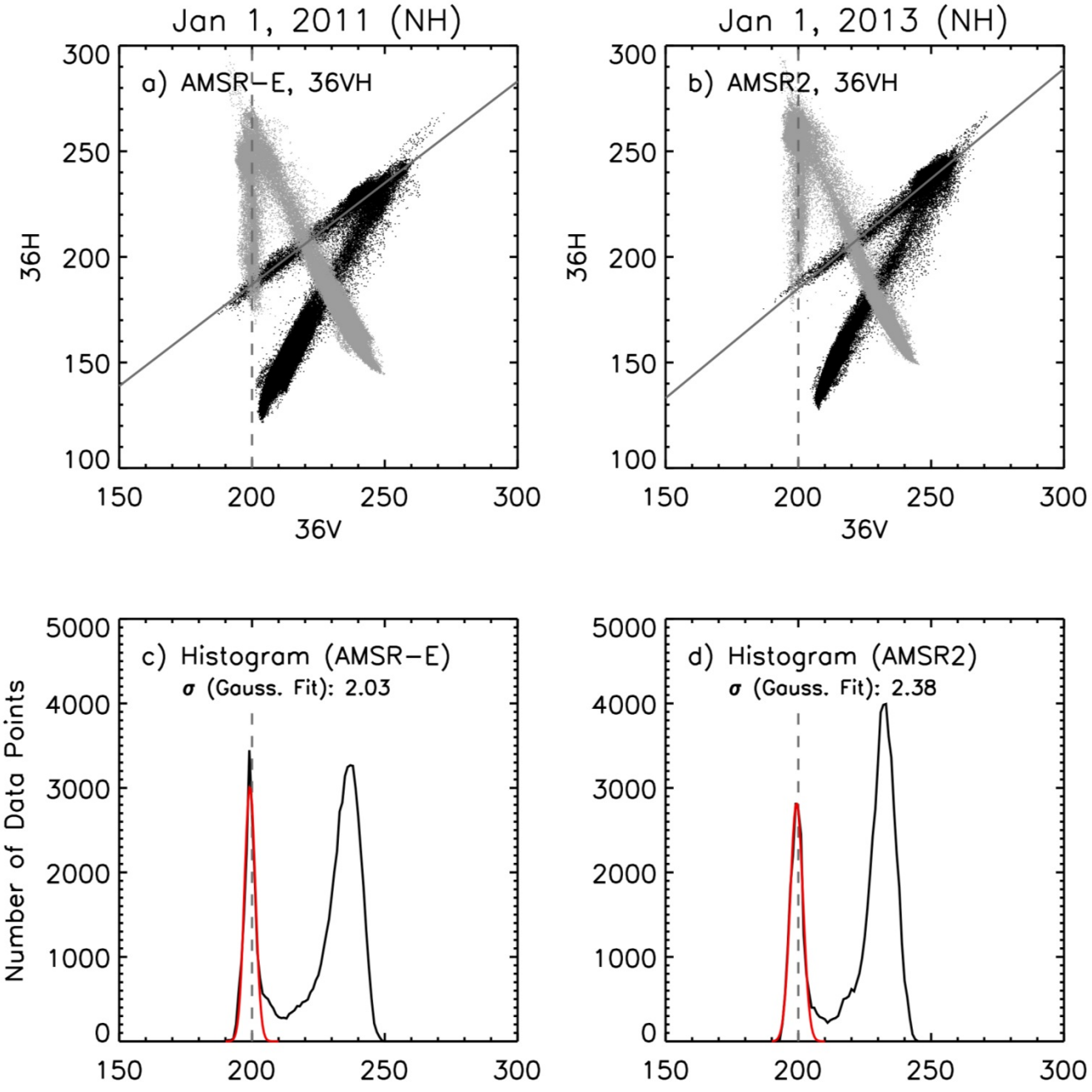
as detected in Winter of 2013



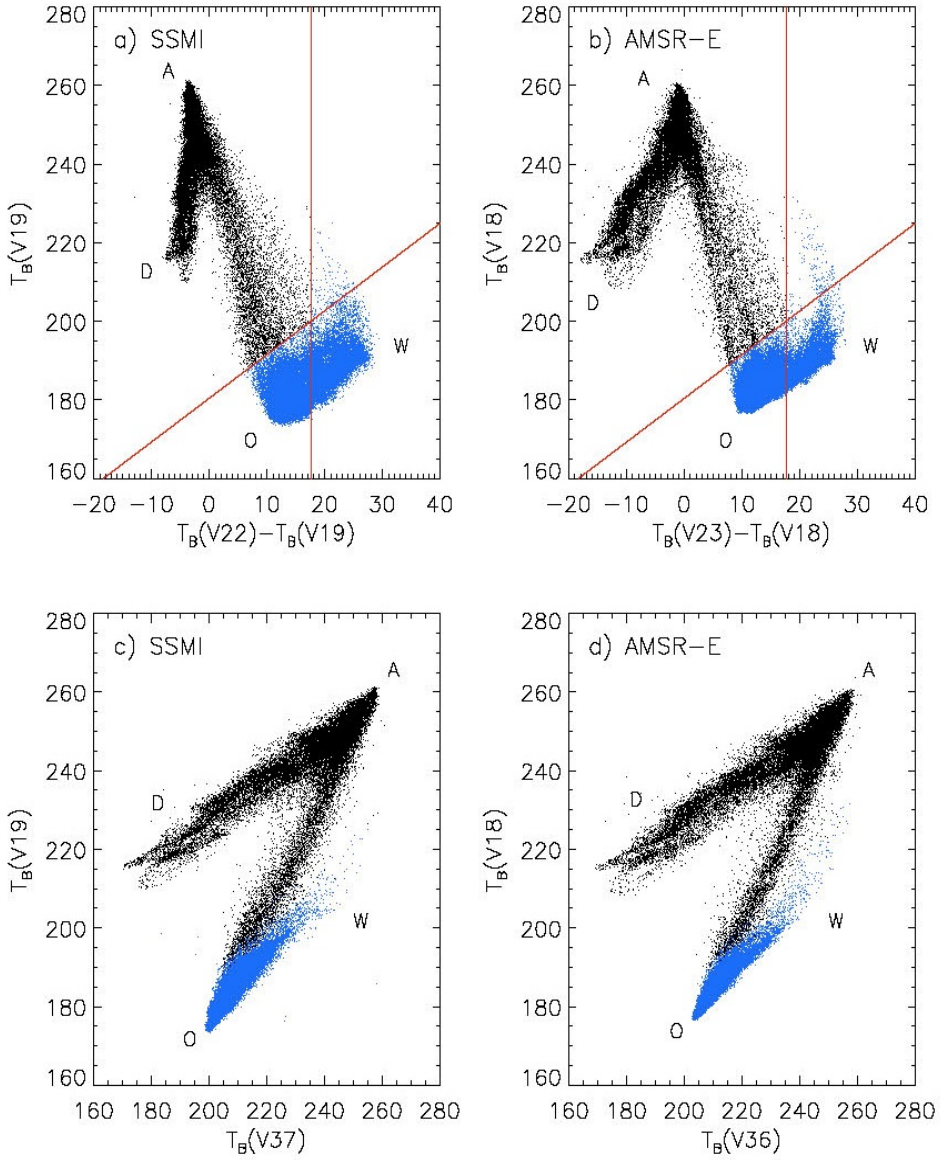
Sea Ice Winter Signature from AMSR-E and AMSR2



IC Accuracy Assessment



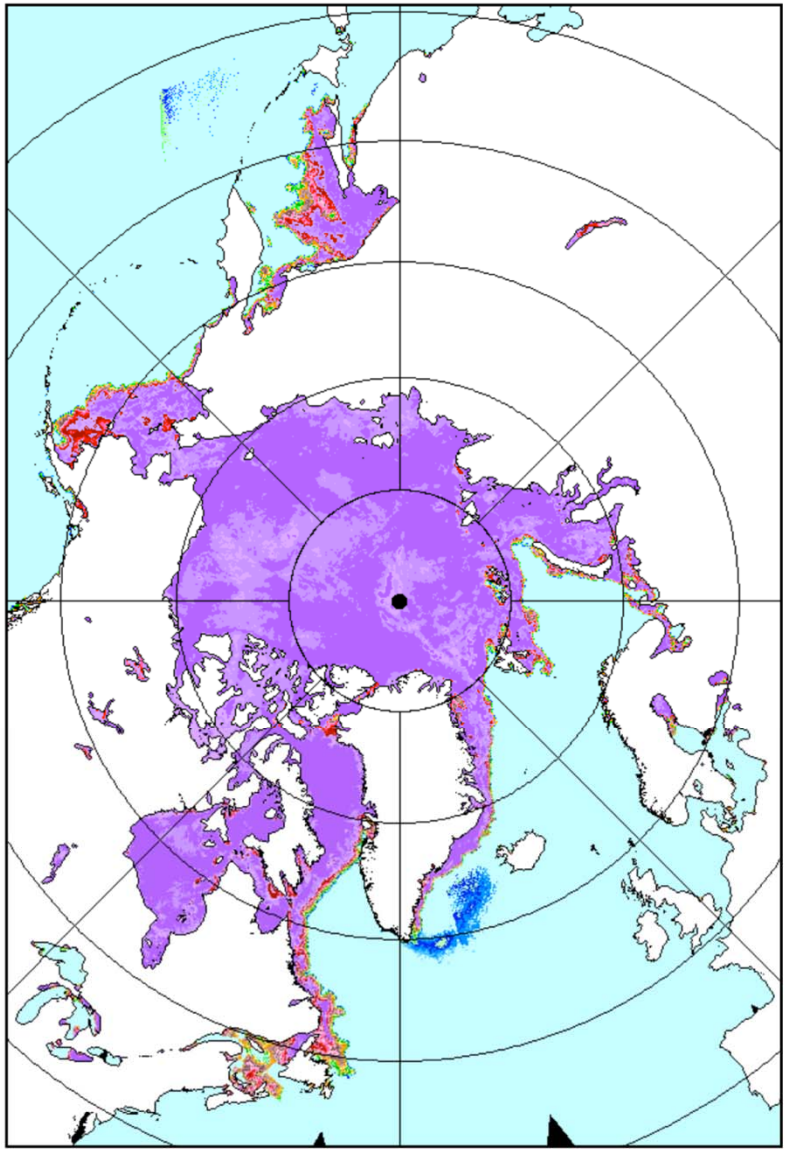
Open Ocean Mask with Bootstrap Algorithm



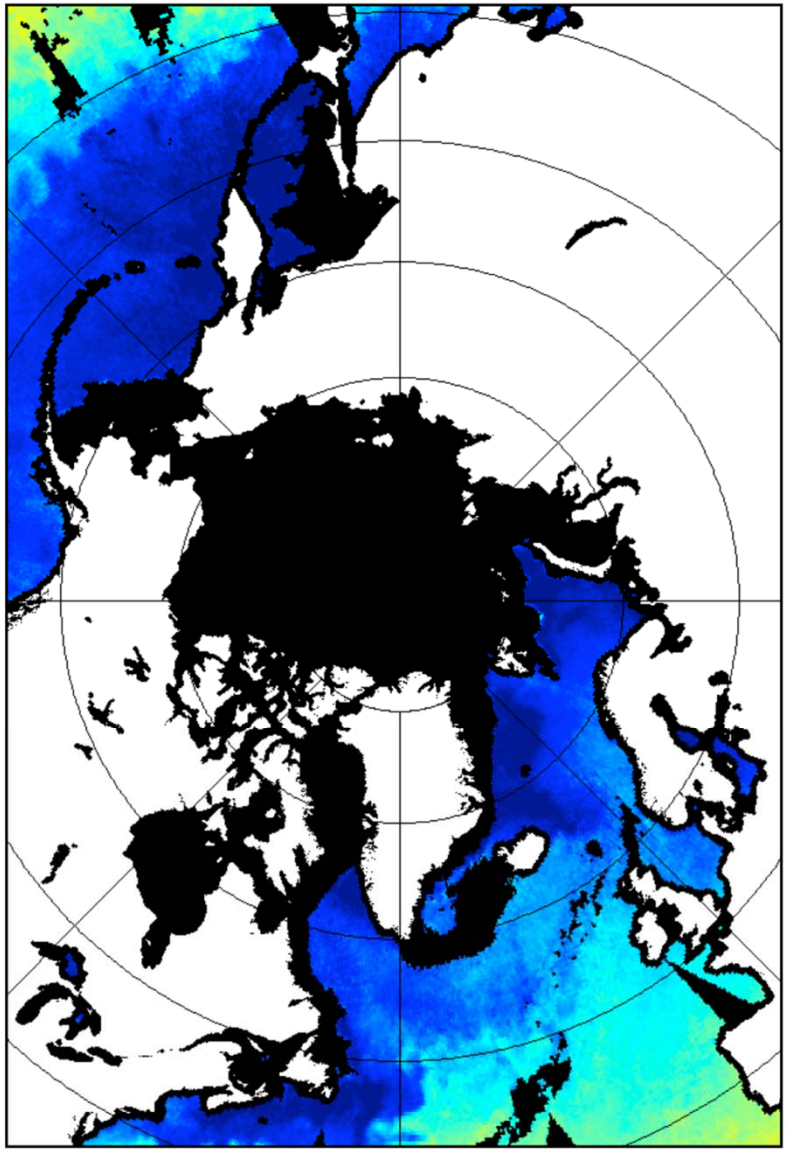
Residual ice in open ocean and SST

March 14, 2007

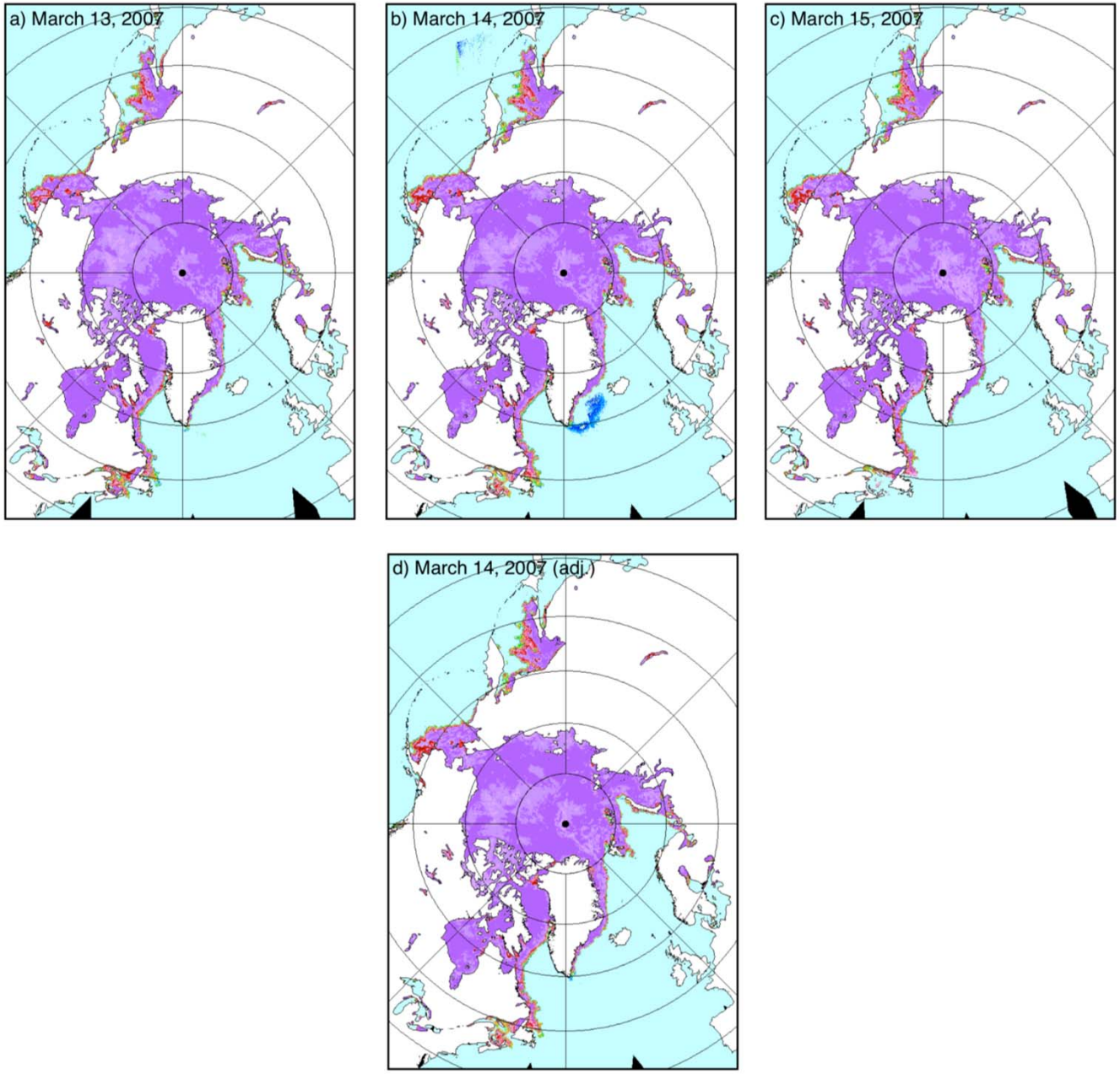
AMSR-E IC (ABA)



AMSR-E SST

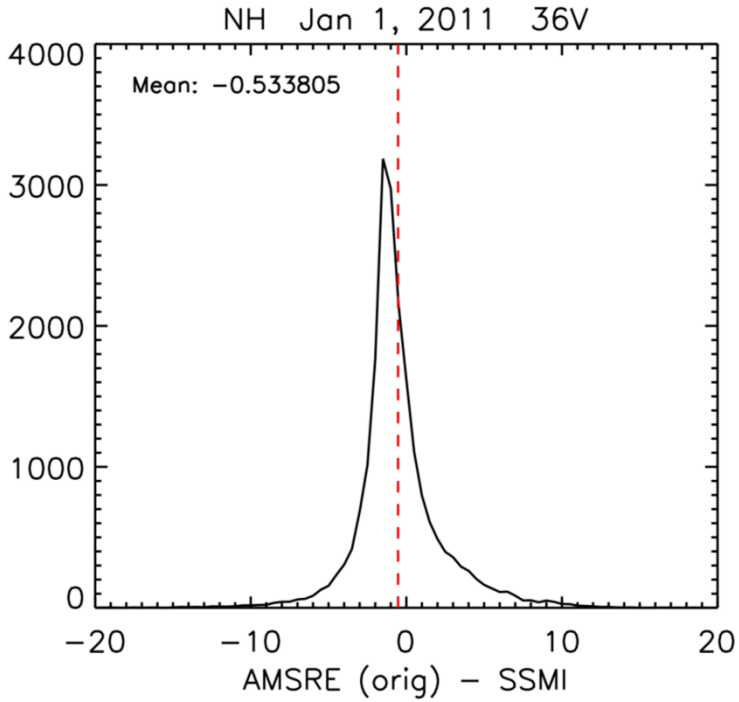


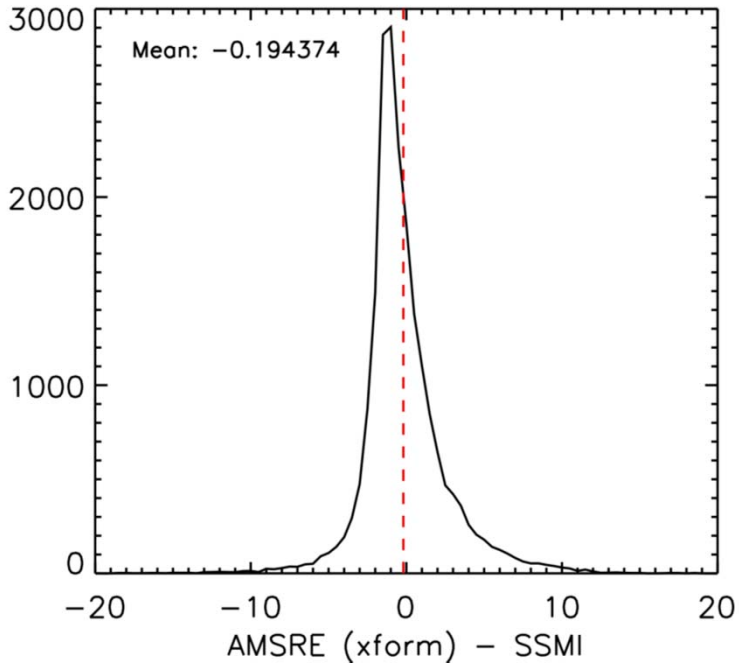
Time Series Solution for Time Series Studies



AMSR-E TB averages over the Arctic with and without bias

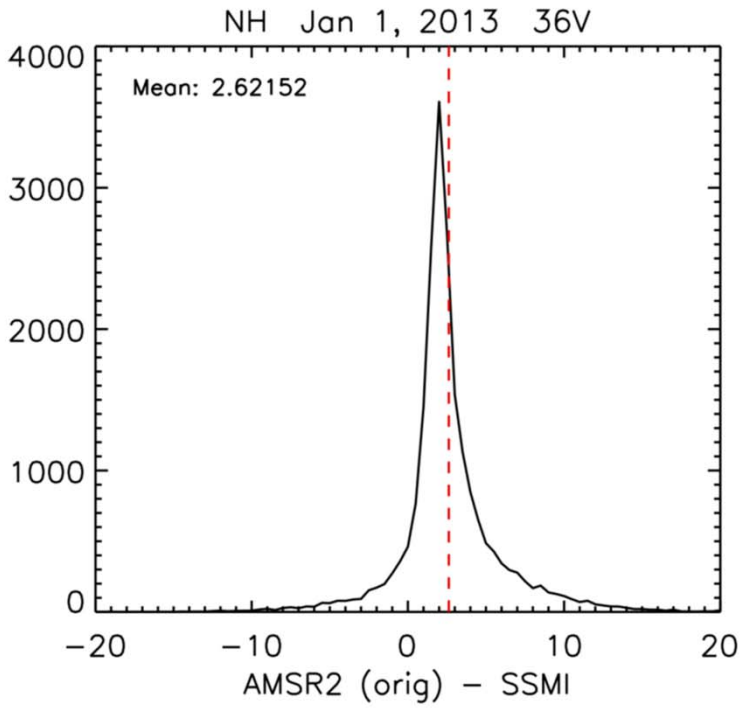
- bias, relatively minor compared to SSM/I

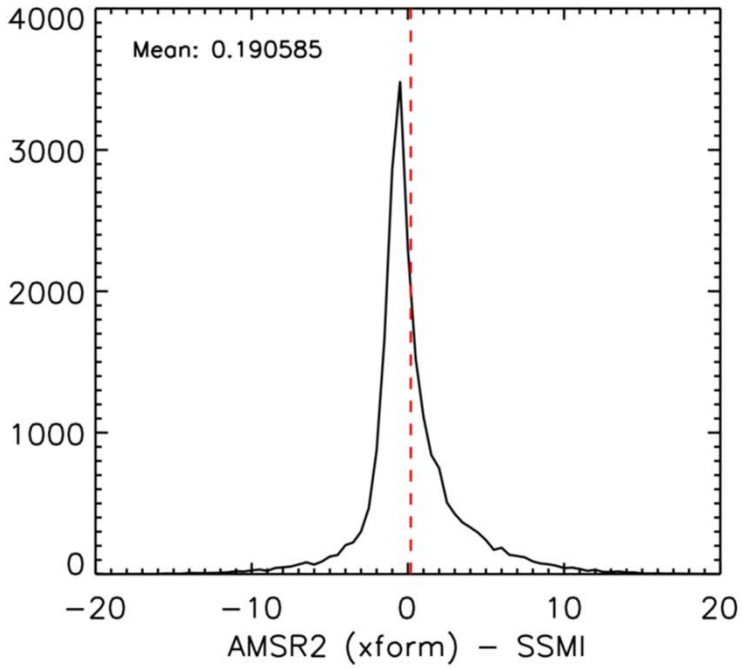




AMSR-2 averages over the Arctic, with and without bias

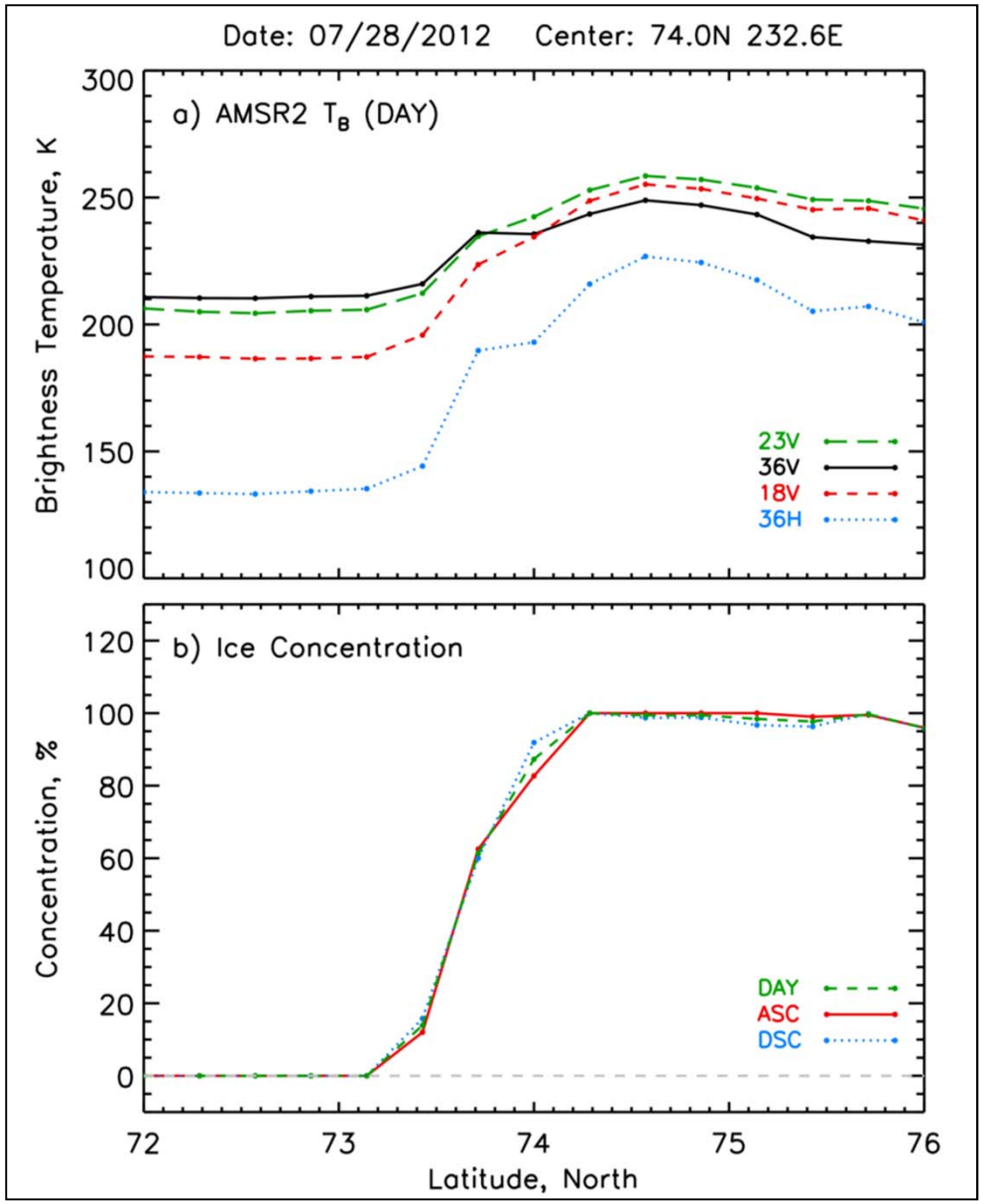
- bias around 3K.



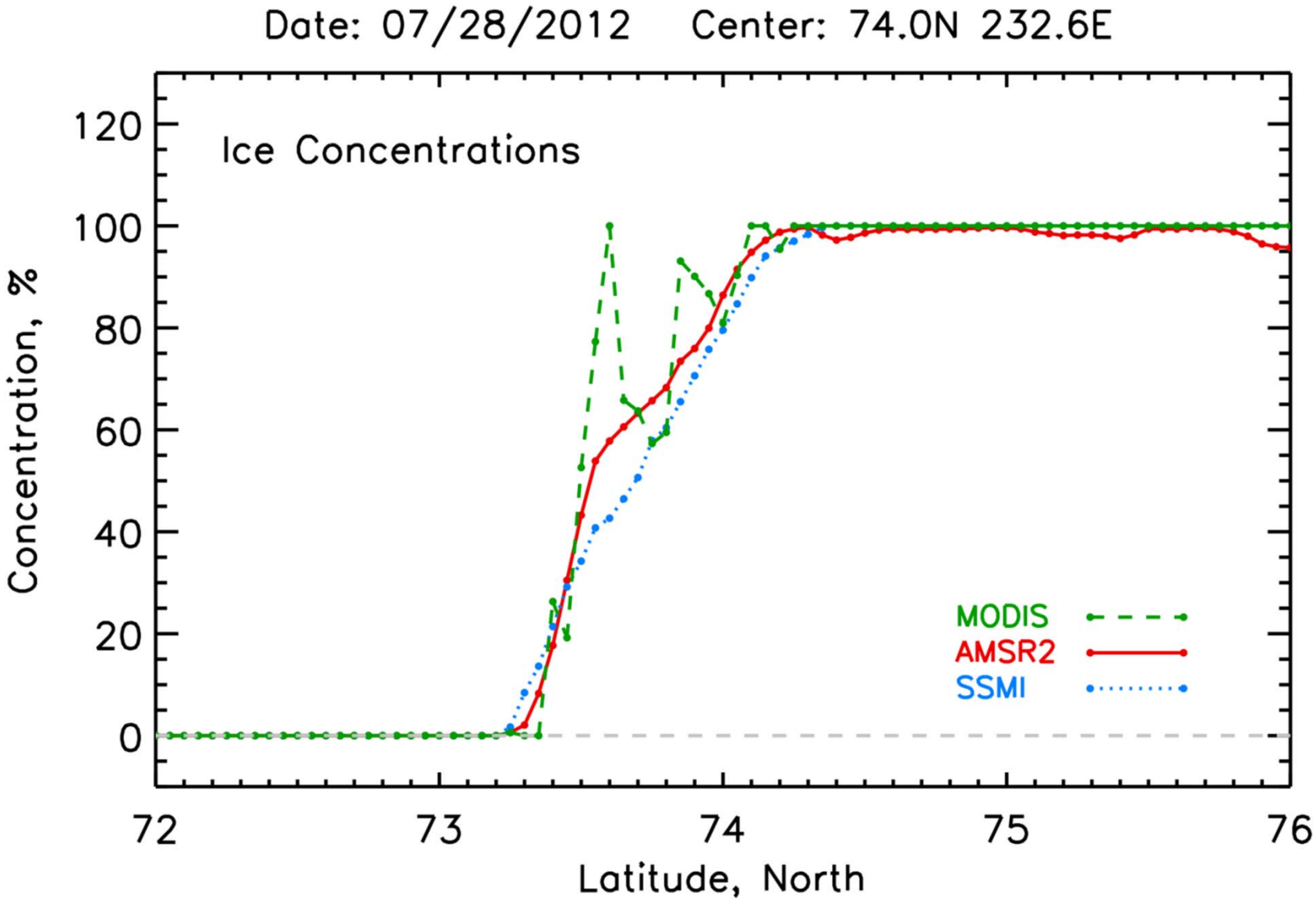


AMSR2 Tbs and Ics across the Ice Edge

The 15% ice edge needs to be estimated as accurately as possible.

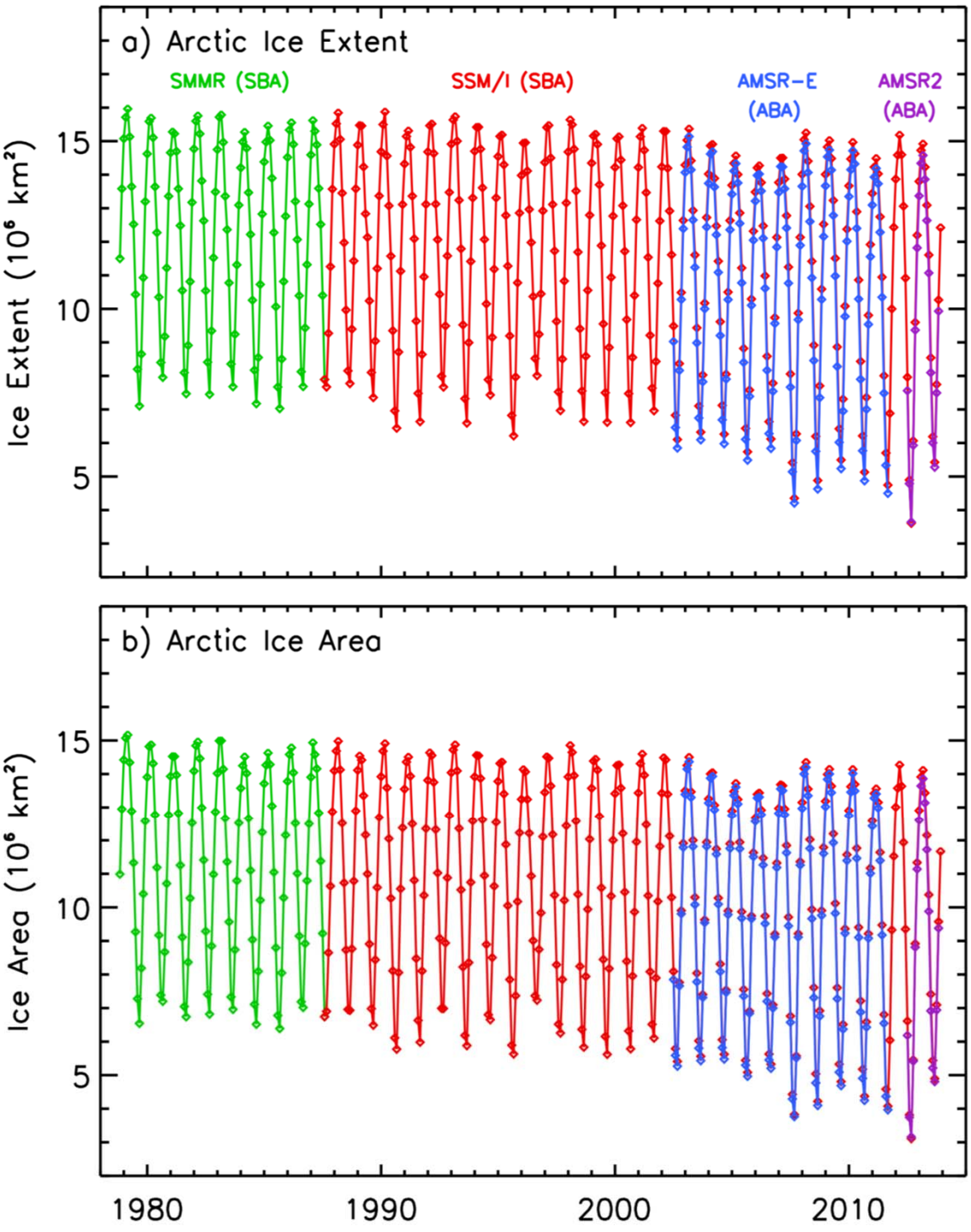


MODIS, AMSR2 and SSM/I across the ice edge



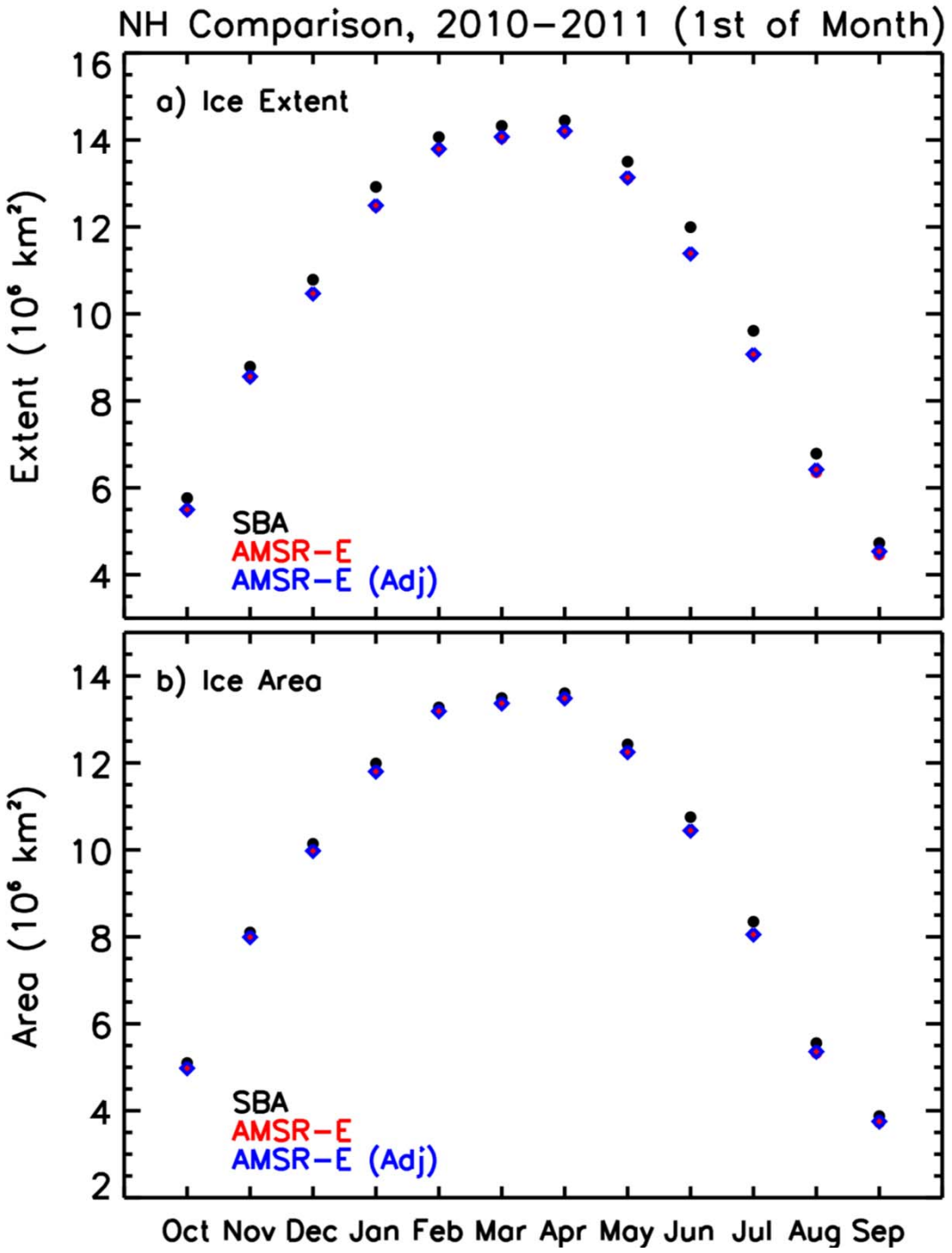
Arctic Ice Extent and Ice Area Using SMMR, SSM/I, AMSR-E and AMSR2 ice extent and ice area data.

Overlapping periods:
SMMR and SSM/I – 1year
SSM/I and AMSR-E – 9 yrs
SSM/I and AMSR2 – more than 1 year
AMSR-E and AMSR2 - 0

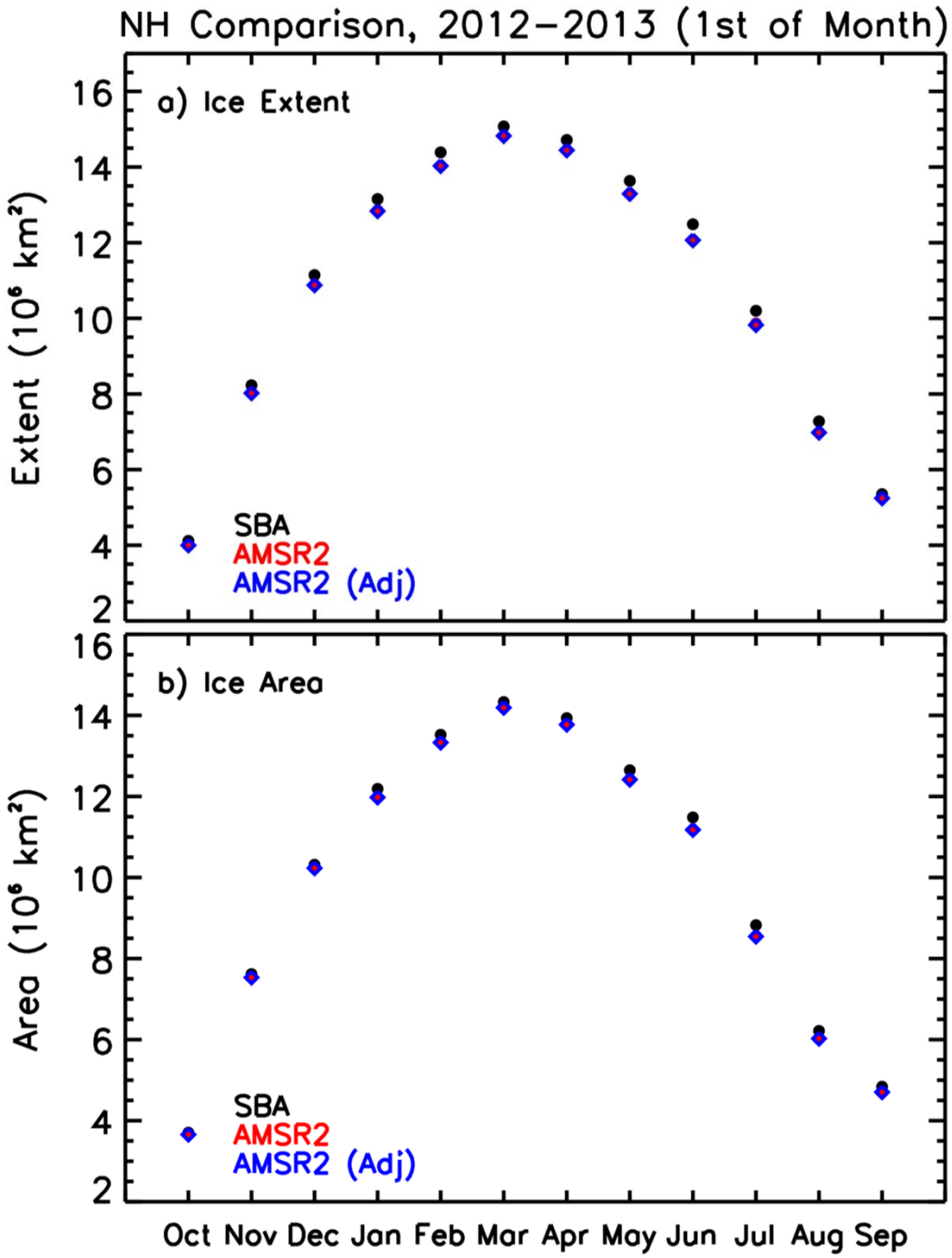


Comparison of Extent and Area:

AMSR-E versus SSM/I



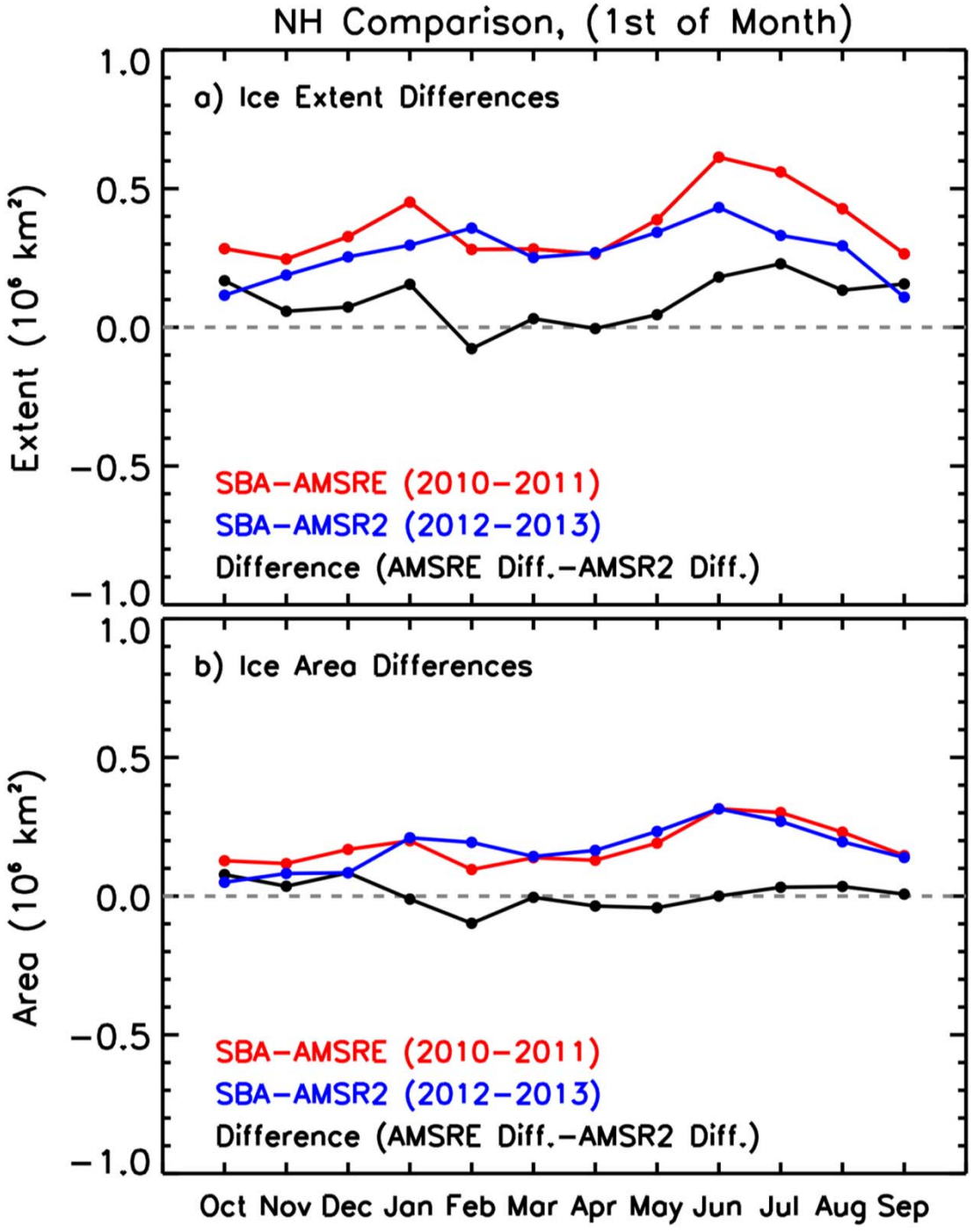
Comparison of ice extent and ice area: AMSR2 versus SSMI



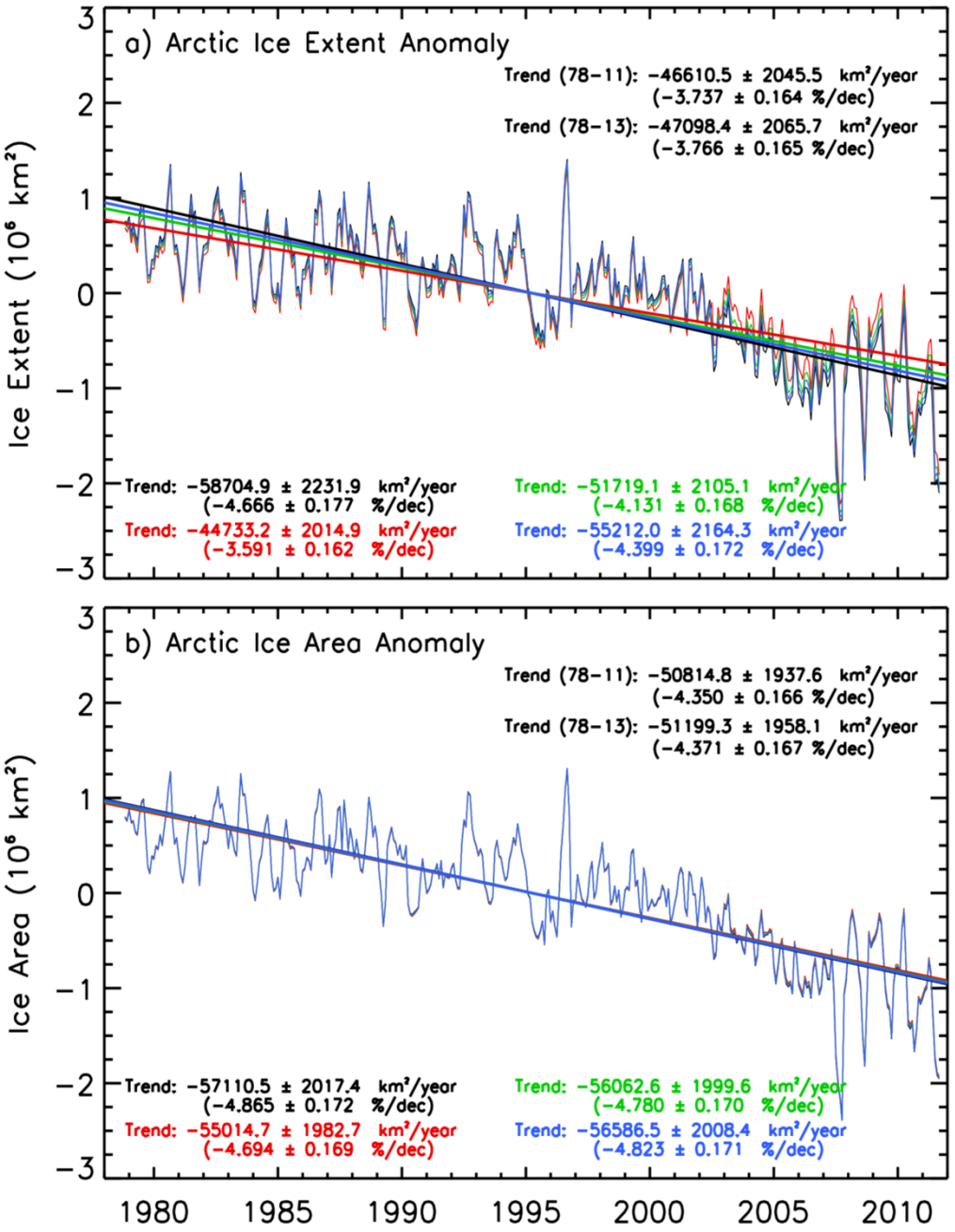
Possible Bias in ice extent and ice area:

between AMSR-E and AMSR2

- extent can be issue but data can be real interannual diff.



Monthly Anomalies and Trends in the Arctic



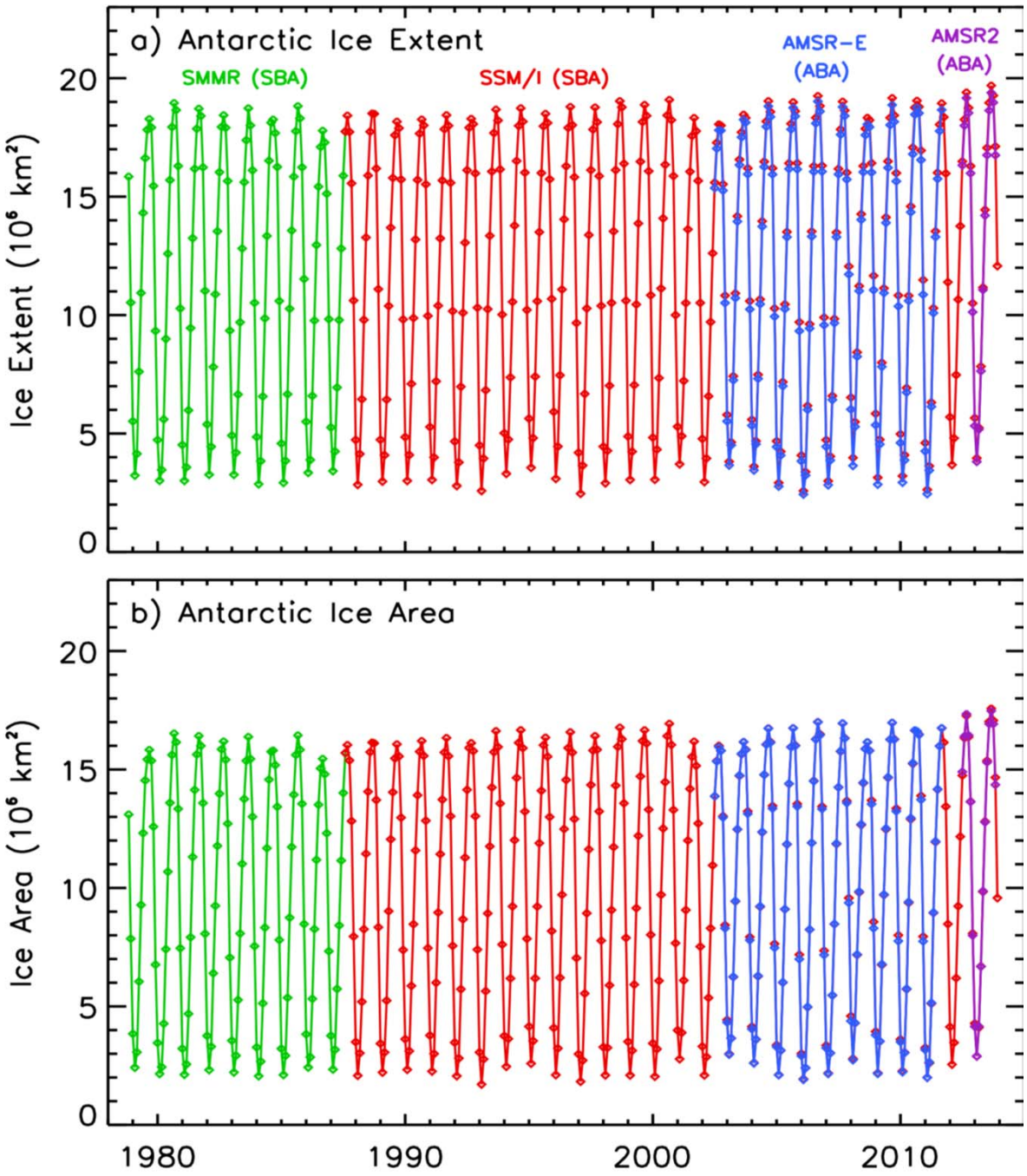
Top right numbers are trends for SMMR + SSMI only

Trends in plots: SMMR+SSMI+AMSR with 15% ice edge varied as follows:
Red – a whole pixel (1%)
Green – half a pixel (.5%)
Blue – quarter of a pixel (.2%)

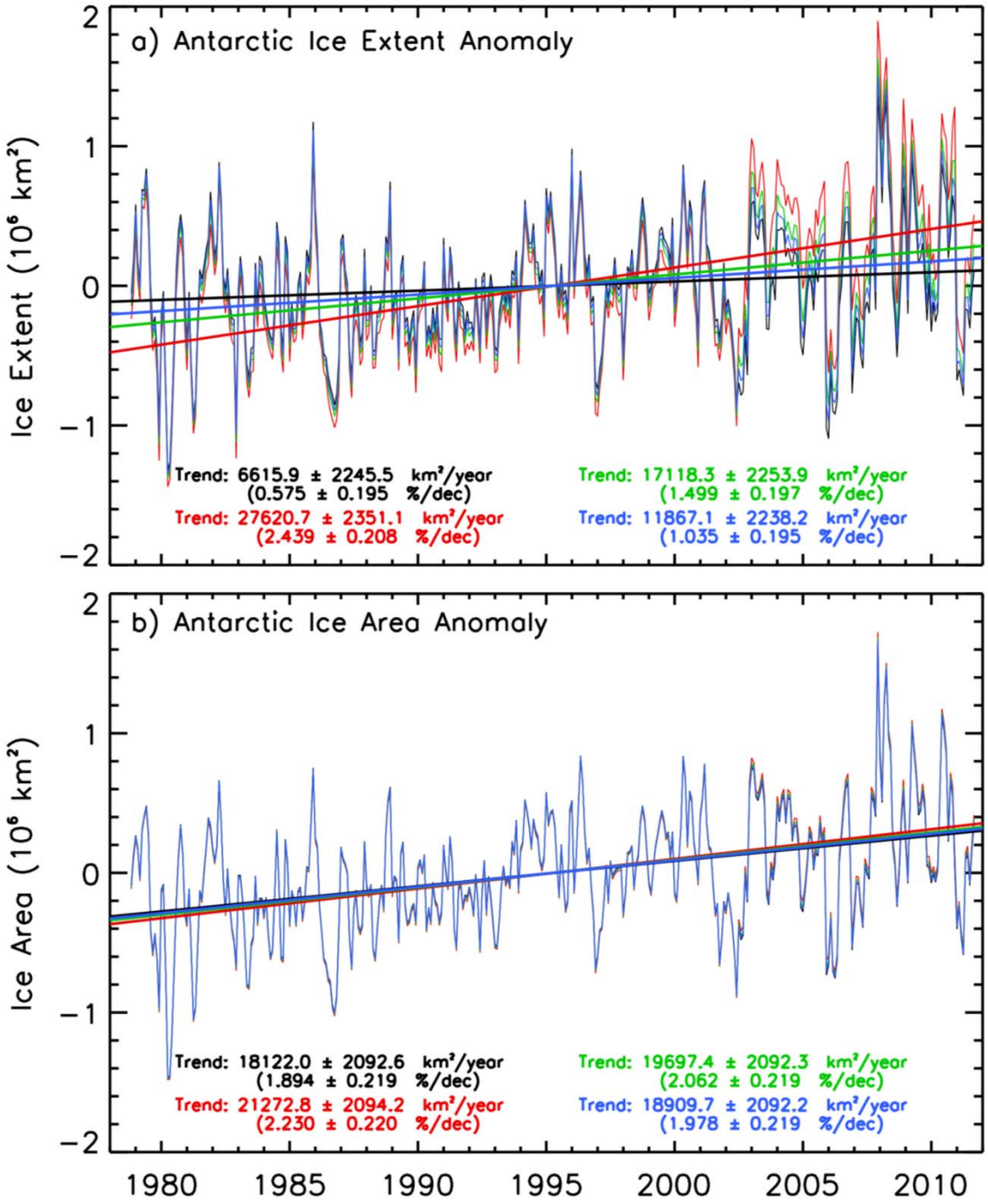
A bias of 12.5 (half a pixel) for ice extent is apparent if AMSR data is used.

With ice area, the bias is minimal.

Antarctic Extent and Area



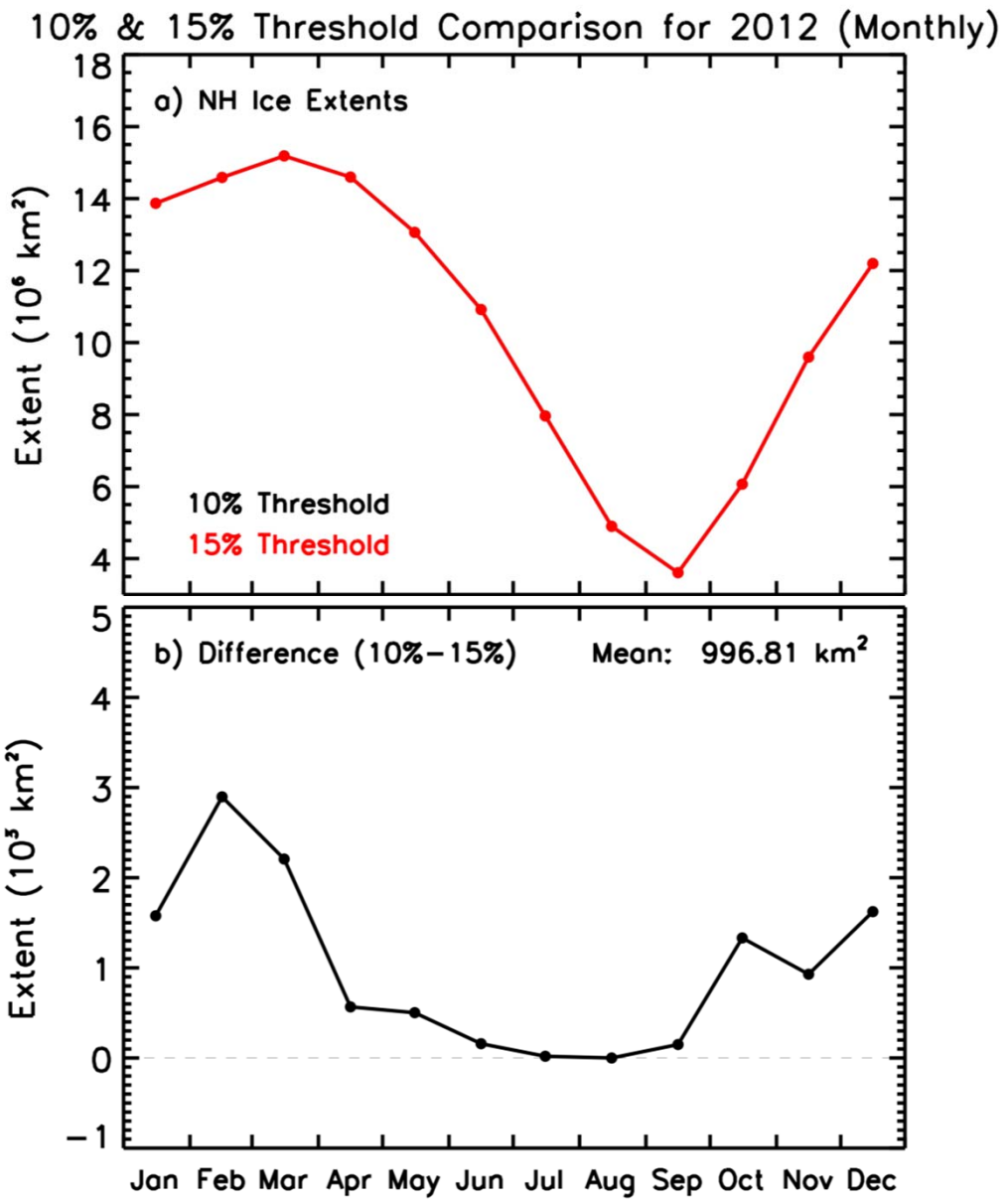
Antarctic Monthly Anomalies and Trends in the Antarctic



Error in Extent due to 10 or 15% error in IC

Northern Hemisphere Ice Extents (km^2)

	10% Thresh	15% Thresh	Difference	% diff
Jan	13870034.815	13868457.590	1577.225	0.012
Feb	14588963.869	14586066.834	2897.034	0.020
Mar	15186517.408	15184310.407	2207.000	0.015
Apr	14596996.801	14596430.216	566.585	0.004
May	13061394.000	13060891.471	502.528	
Jun	10917731.338	10917572.663	158.675	
Jul	7962275.073	7962255.910	19.163	
Aug	4896144.216	4896144.216	0.000	
Sep	3607694.289	3607544.705	149.584	
Oct	6067326.069	6065994.394	1331.675	
Nov	9597434.883	9596505.968	928.916	
Dec	12196507.777	12194884.445	1623.333	



Summary

- Some biases in AMSR-E and AMSR2 brightness temperatures are apparent. But spatial distribution over the sea ice cover are very similar.
- Absolute calibration is not needed for sea ice retrieval. IC depends more on the accuracy in the estimates for tie points of sea ice and open water
- There is a general agreement in IC, ice extent, and ice area estimates but biases have to be removed when SSM/I and AMSR data are combined.

Arigato

Meltponding Issue