Sea Ice Cover Studies Using AMSR-E and MODIS

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AMSR-E Science Team Meeting
La Jolla, California, 6-8 September 2006

Scientific Motivations

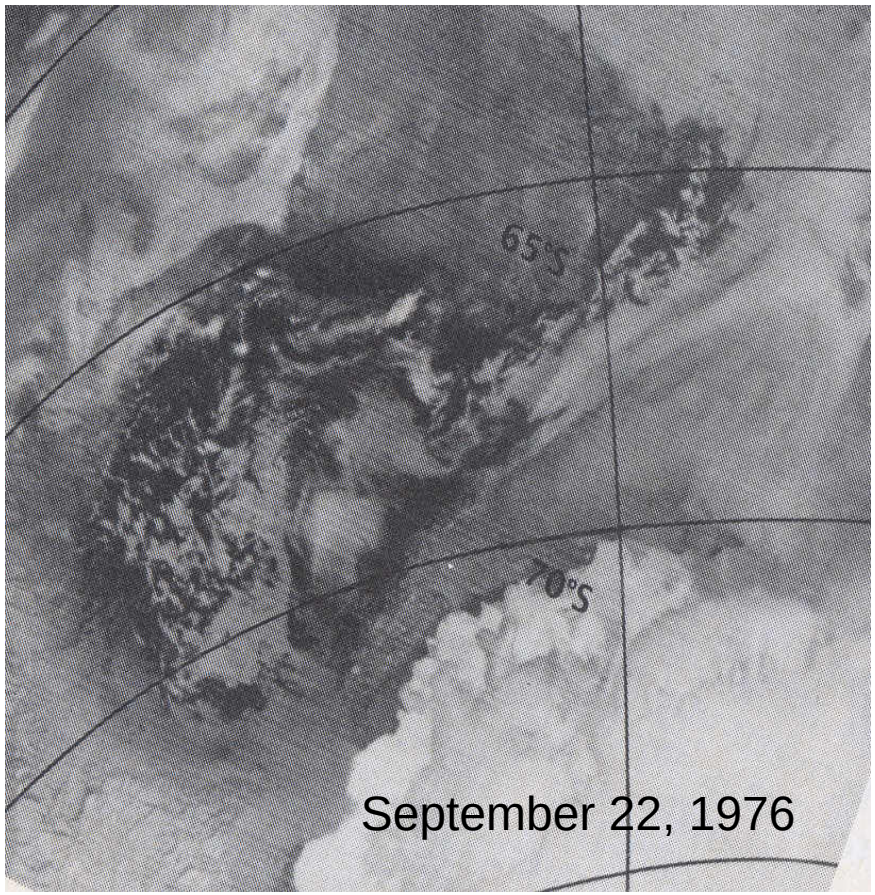
- The sea ice cover is a complex distribution of ice surfaces with different growth stages, history, surface characteristics and radiative property.
- Passive microwave sensors can capture only so much of this information because of coarse resolution, unpredictable emissivity of the material and too many ice types.
- MODIS data with all its shortcomings due to cloud cover can provide much needed complementary information to understand composition and overall state of the ice cover.
- Many scientific studies can benefit from a combined AMSR-E and MODIS data set.

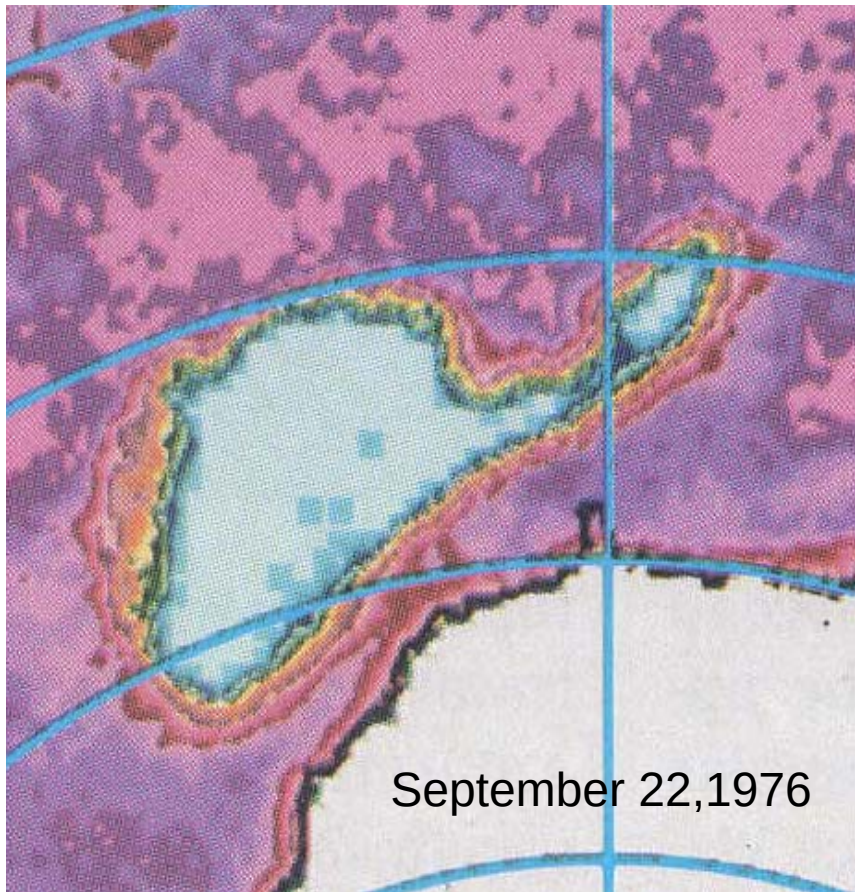
Why use MODIS?

- Near coincident coverage
- Lots of visible and infrared channels
- Relatively high resolution
- Ability to study new/young ice distribution
- Ability to assess presence of snow or no snow cover or meltponding
- Ability to detect small polynyas and leads and assess their physical characteristics

The most notable Antarctic feature

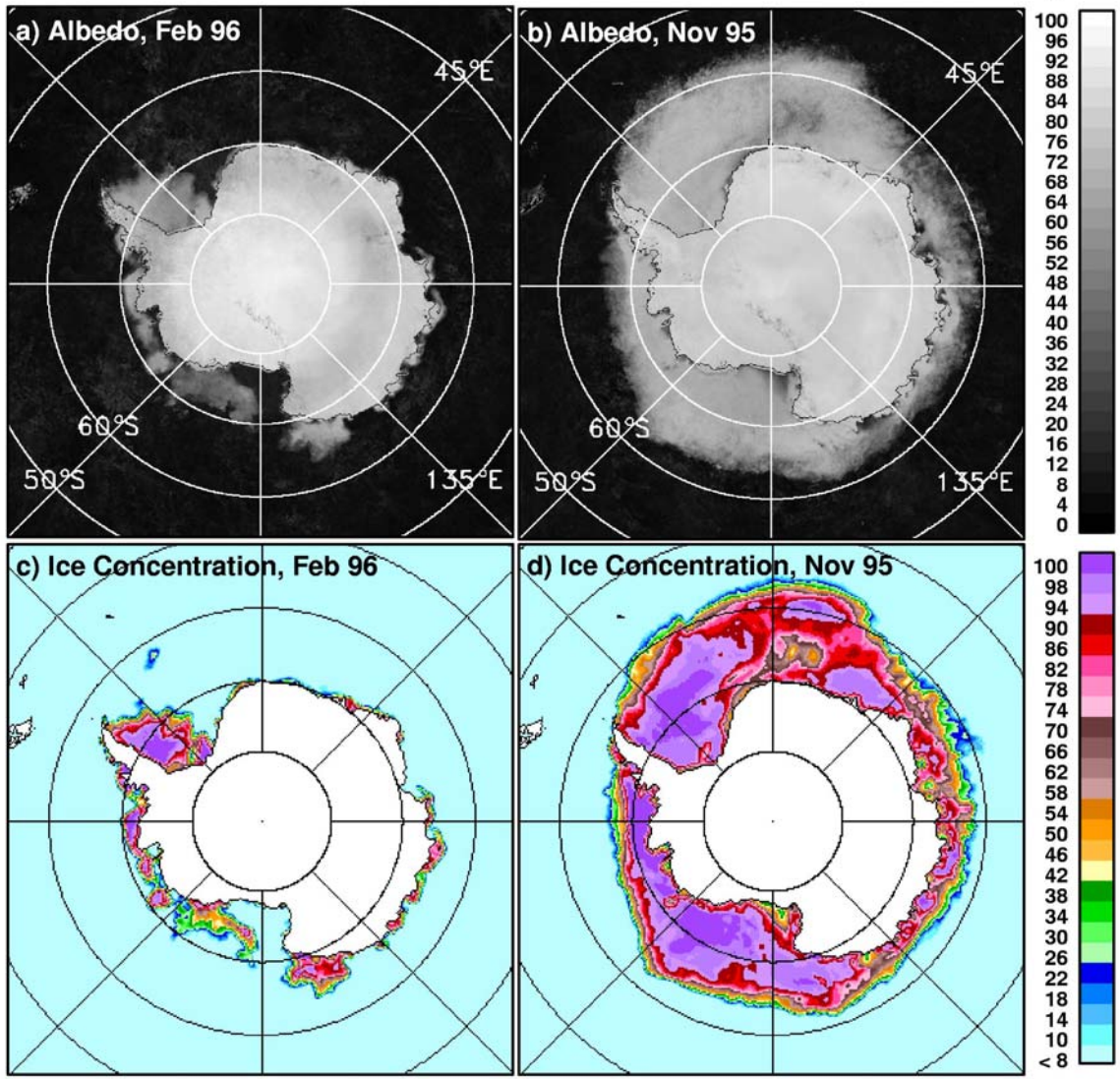
The large Weddell Polynya of 1974-1976

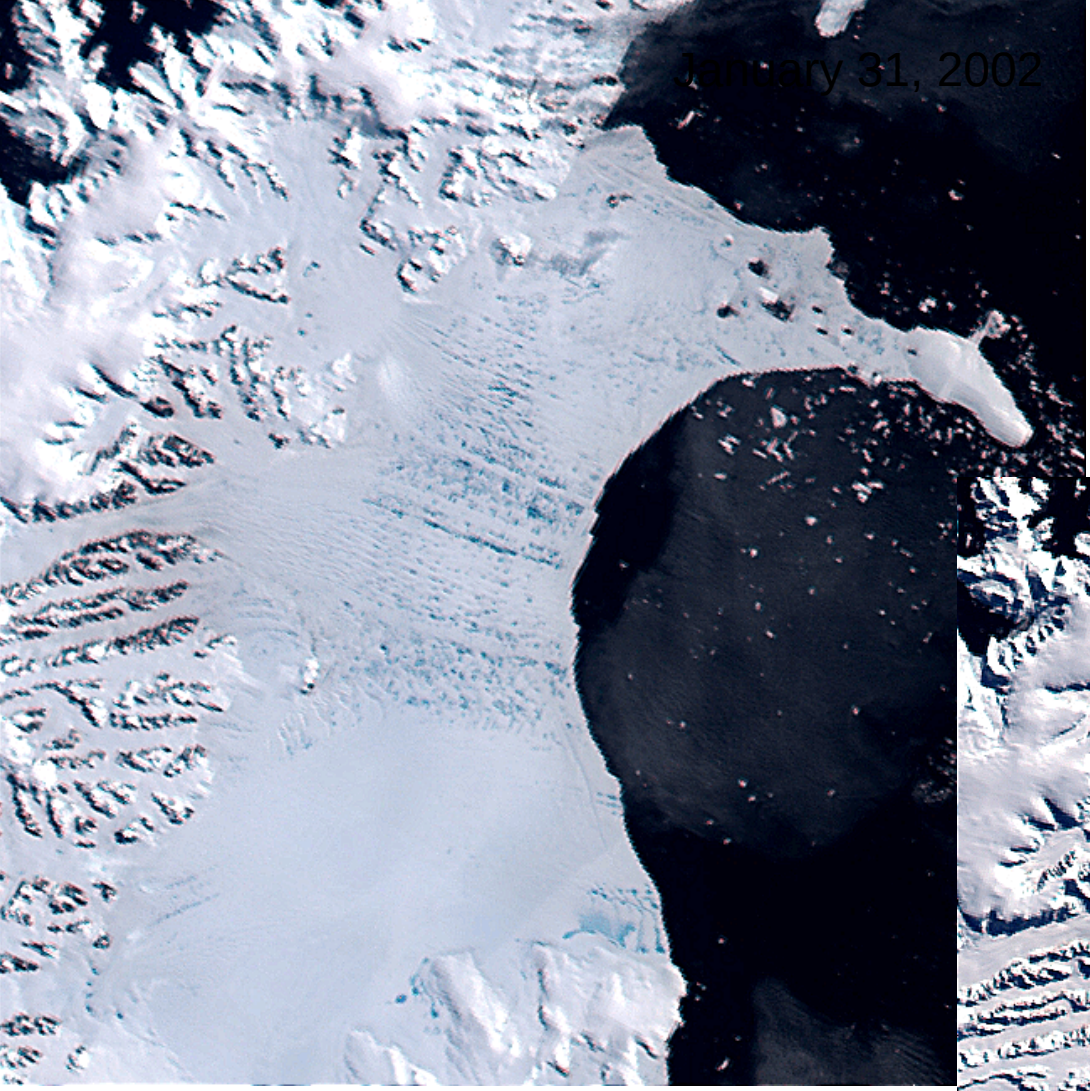




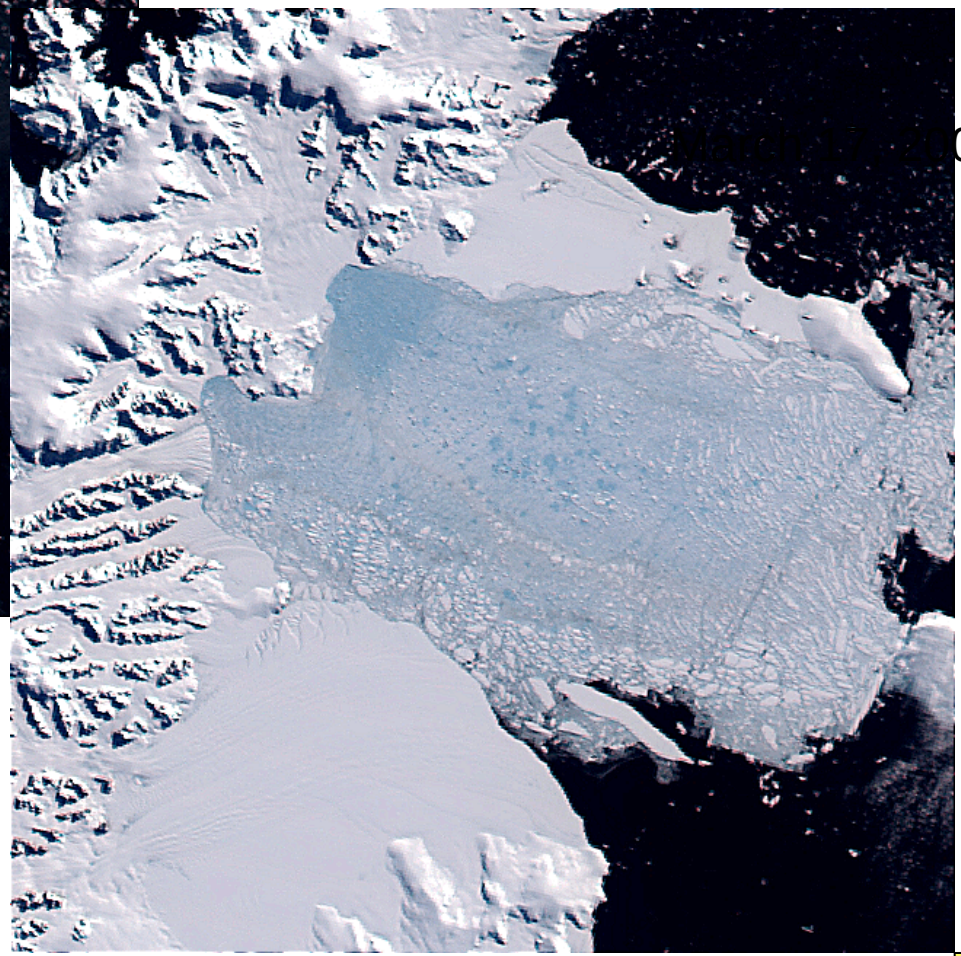
Sea Ice Cover in the SH using visible and passive microwave data

- Antarctic sea ice is more seasonal than the Arctic sea ice and has asymmetric seasonal distribution.
- Antarctic sea ice is surrounded by oceans while Arctic sea ice is surrounded by land.
- Coastal polynyas are prime sources of bottom water.

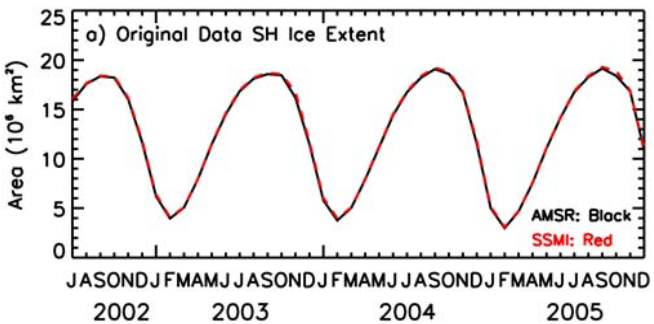


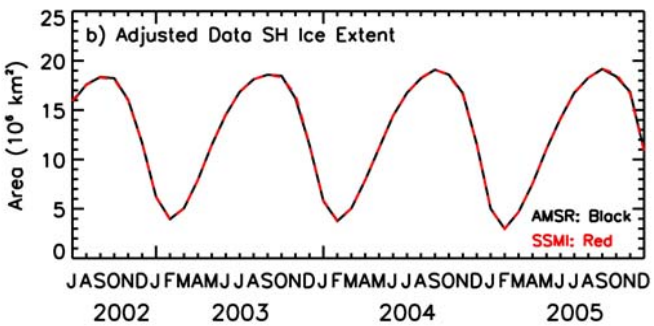


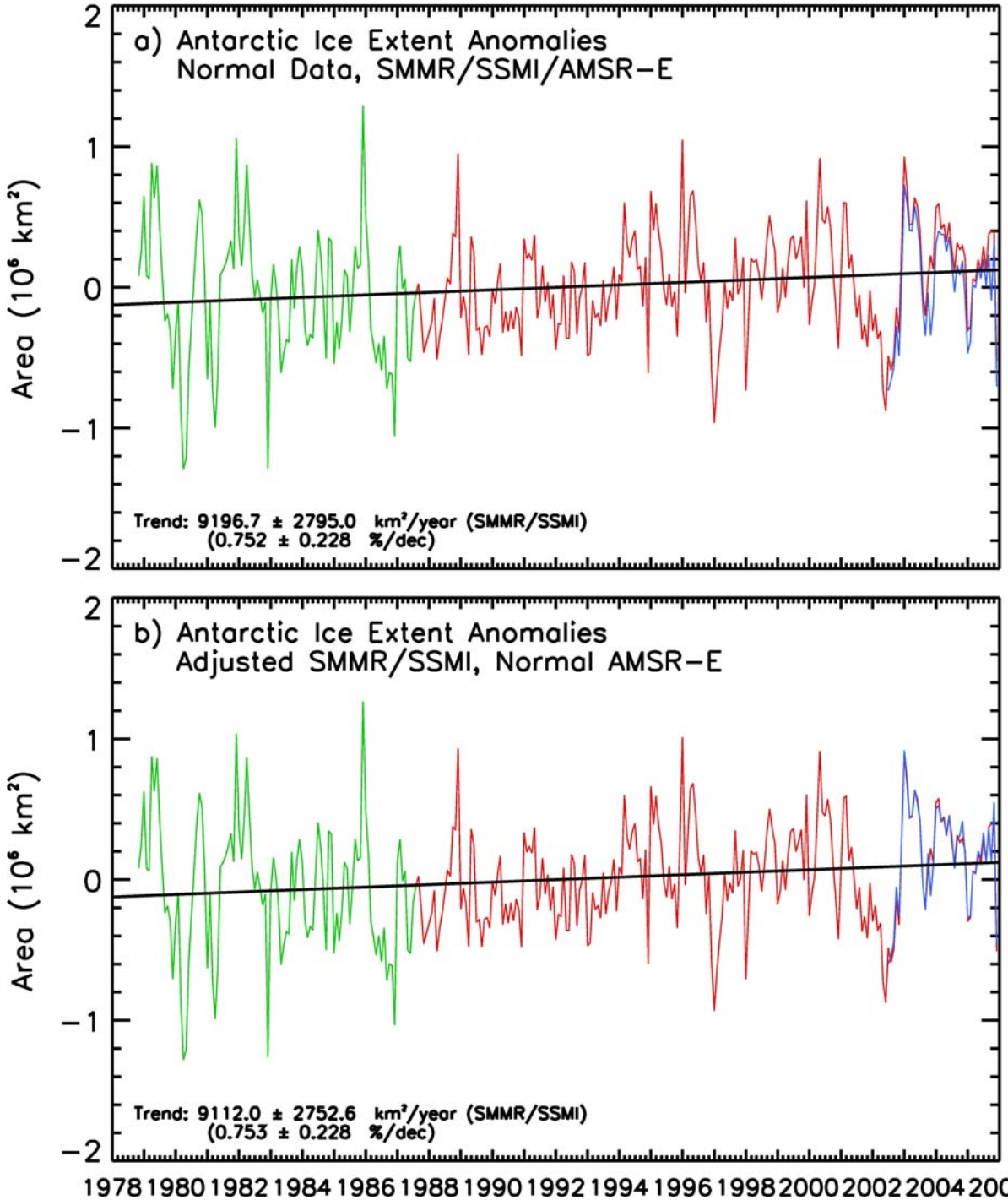
Sea Ice Boundaries
Are not Fix
Example: collapse of the
Larsen Ice Shelf



Time Series from AMSR and Historical Data

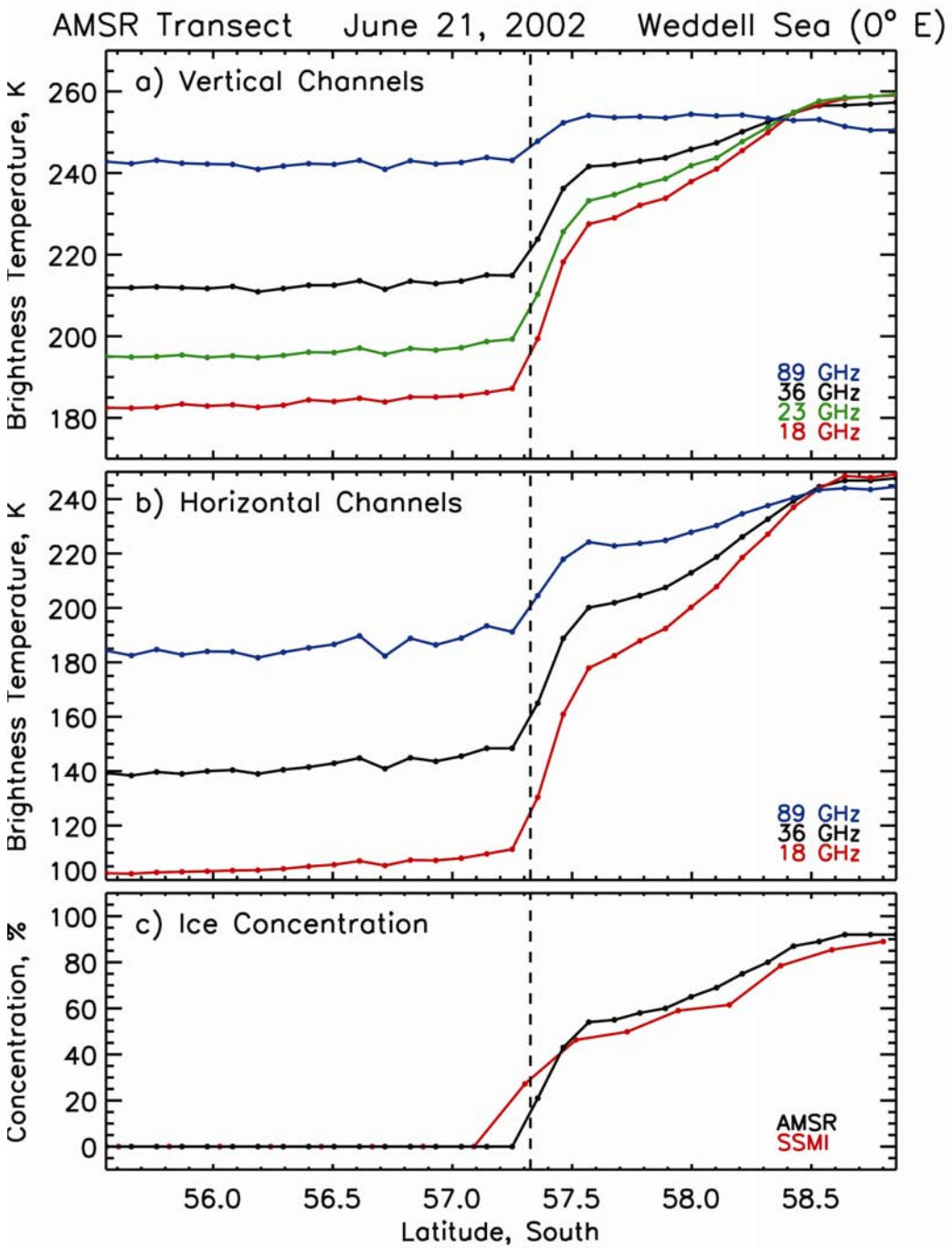






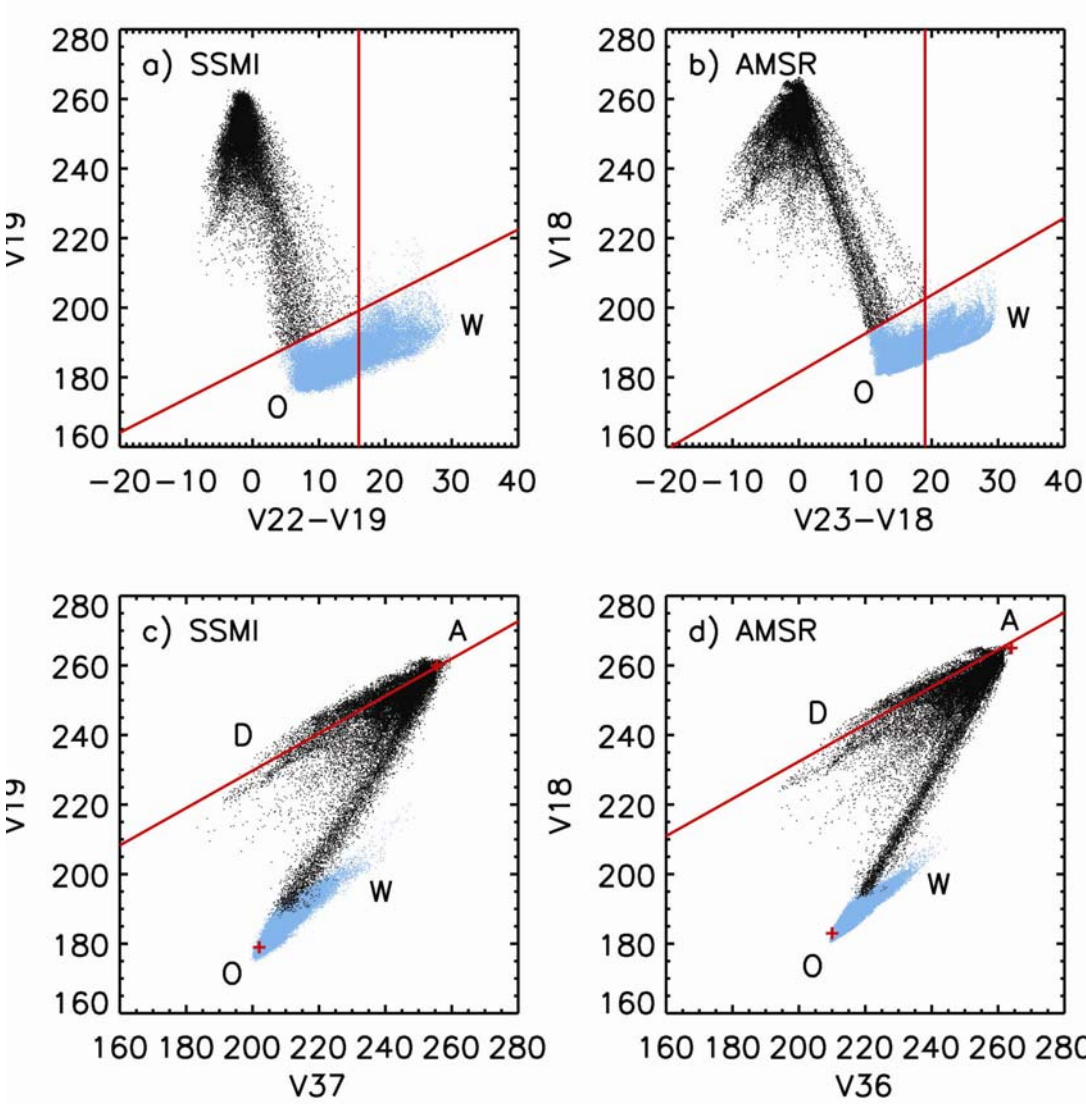
AMSR Ice edge
12.5 km resolution

- High resolution data provide a better definition of the ice edge.
- With AMSR data, all channels provide consistent ice edge information.
- Some discrepancies between AMSR and SSM/I IC ice edge location is observed.

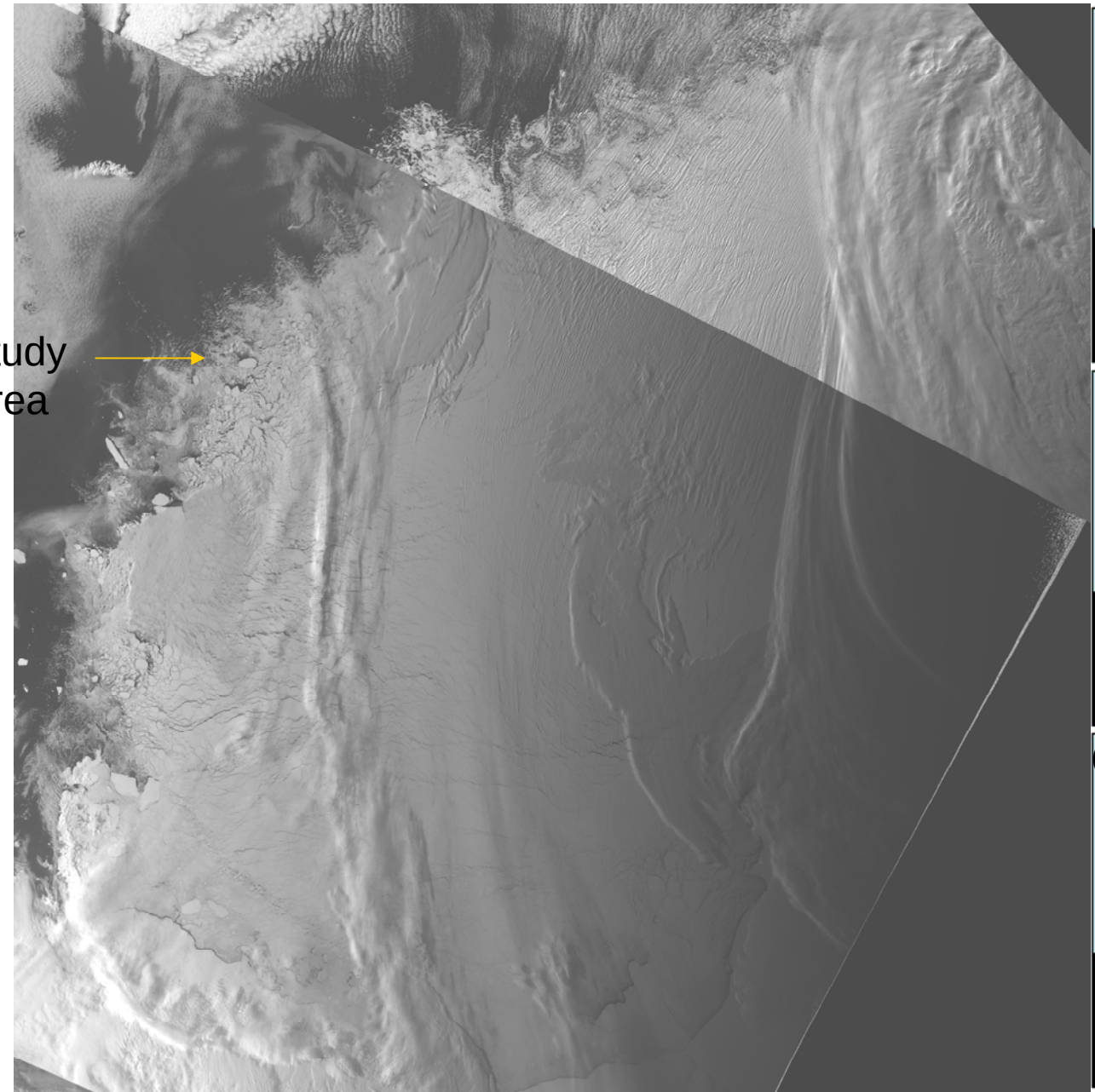


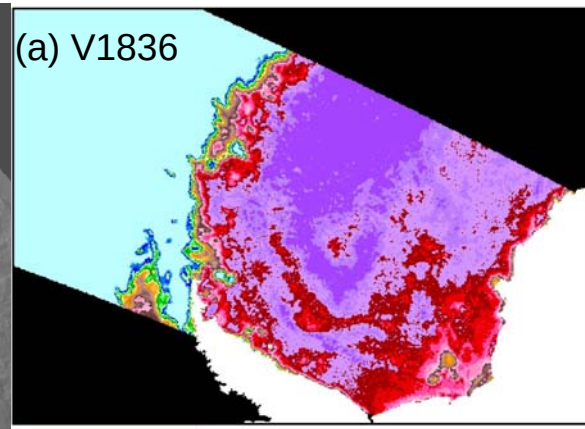
Ocean Mask with SSM/I and AMSR

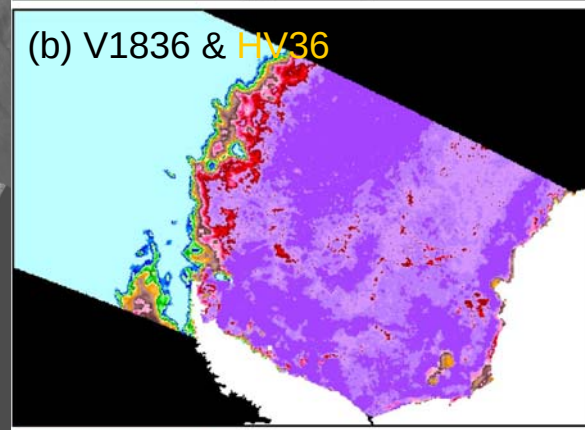
- Patterns for open ocean data are similar but are more defined with AMSR.
- With AMSR, a 10% ice edge is much easier to consistently obtain despite varying weather conditions than with SSM/I data.
- With NT2, location of O is shifted up and produces a bias

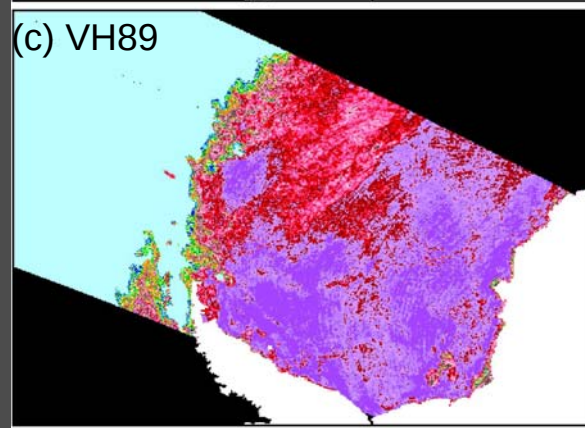


9 September 2002 MODIS and AMSR-E IC

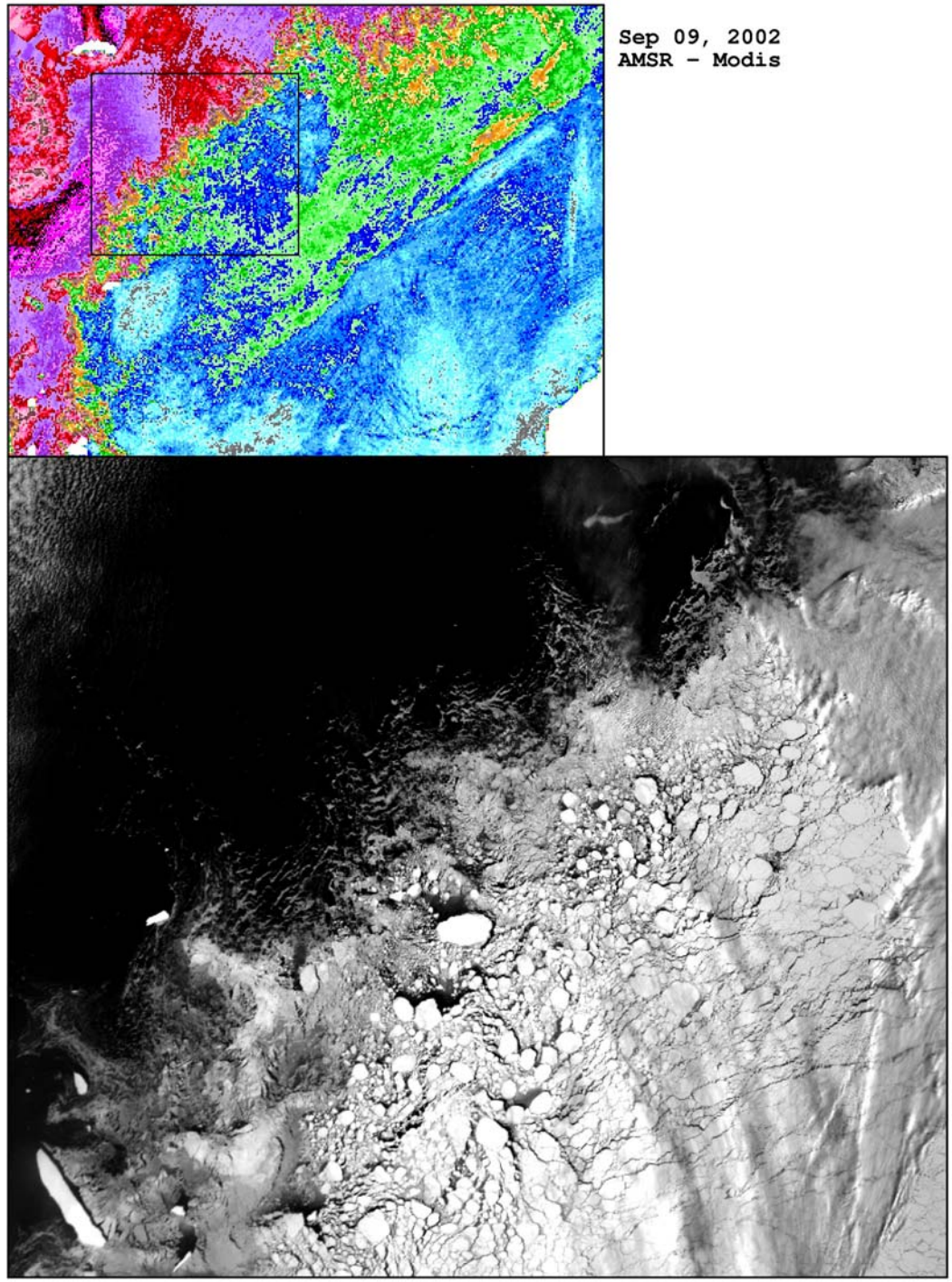




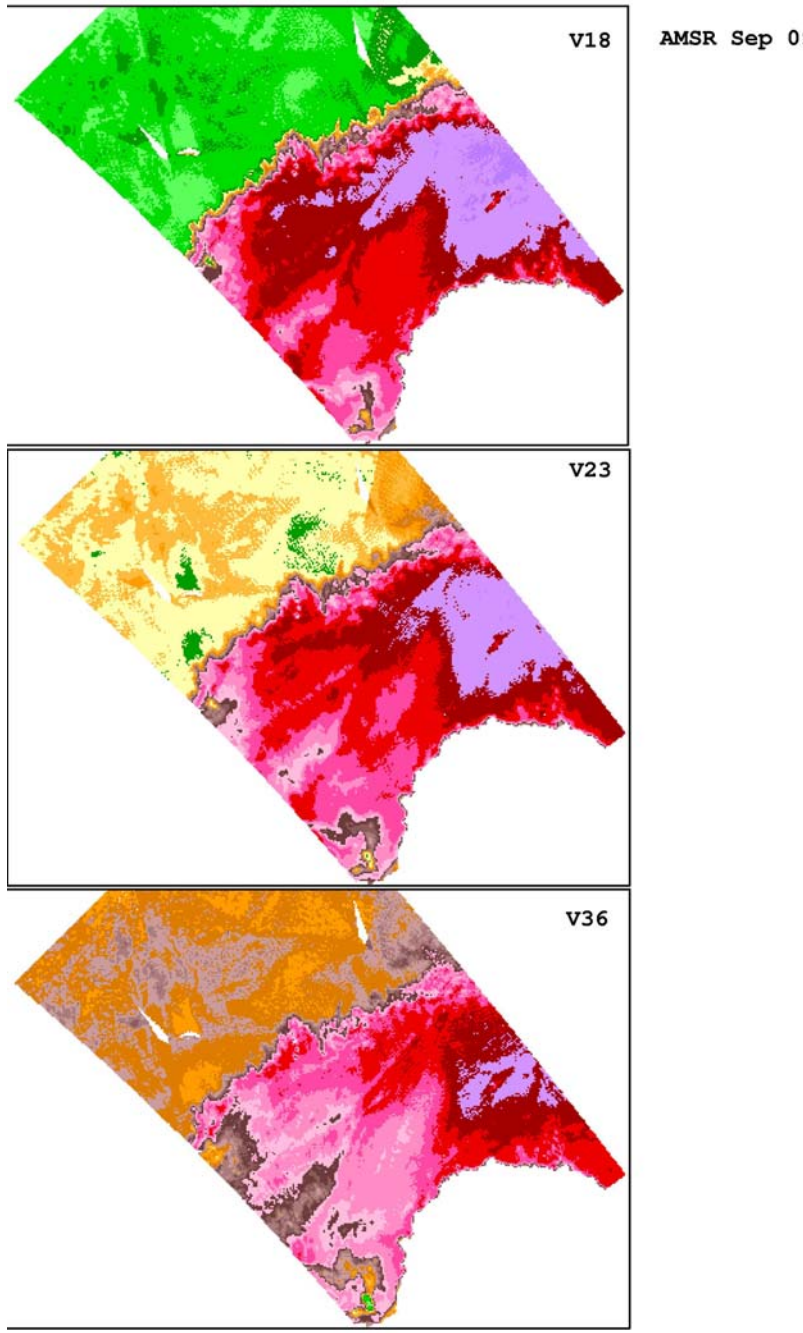




Take advantage of rich information available from PM and visible data

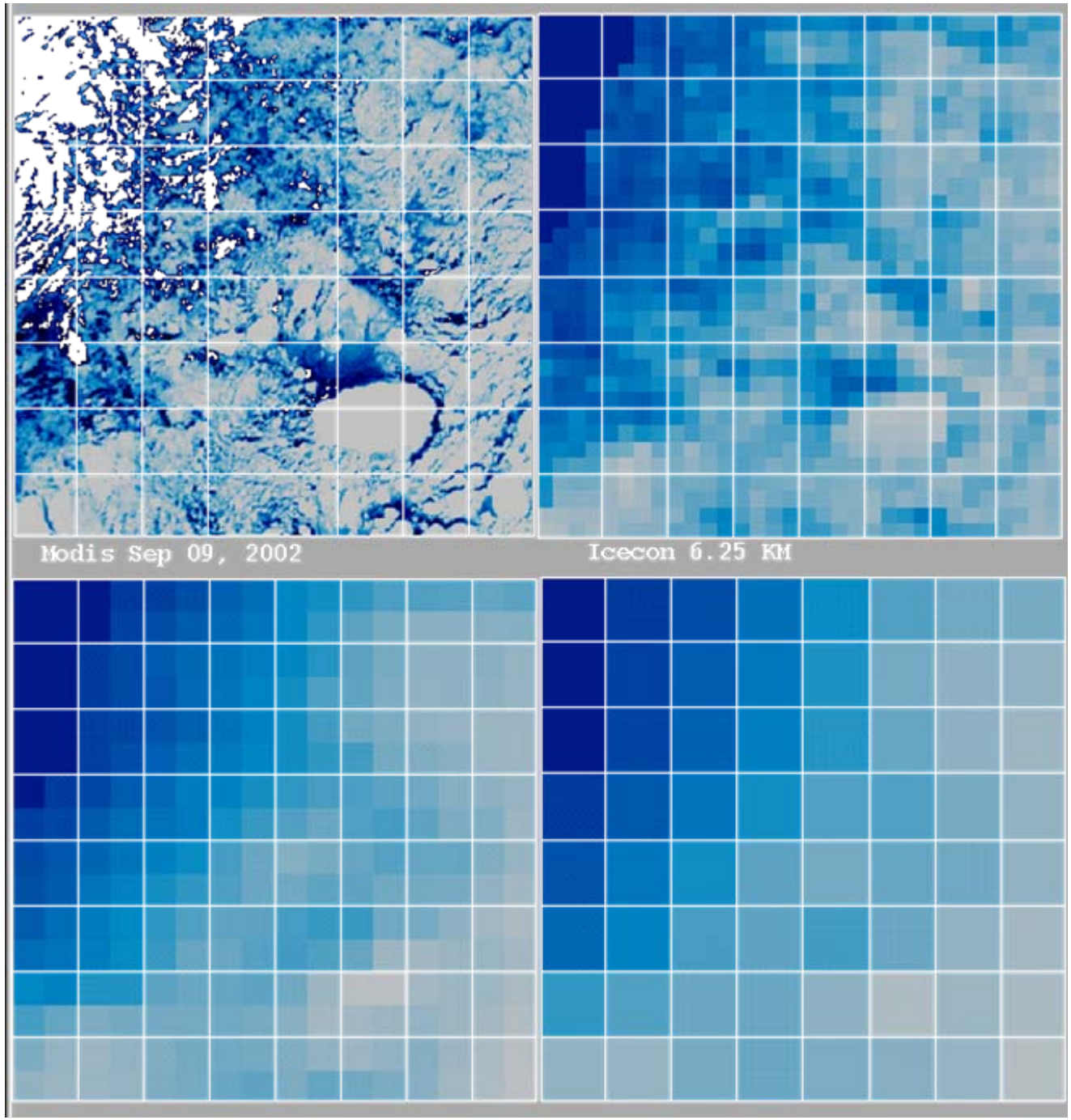


Low resolution channels are consistent and coherent but we do not know very well what they mean



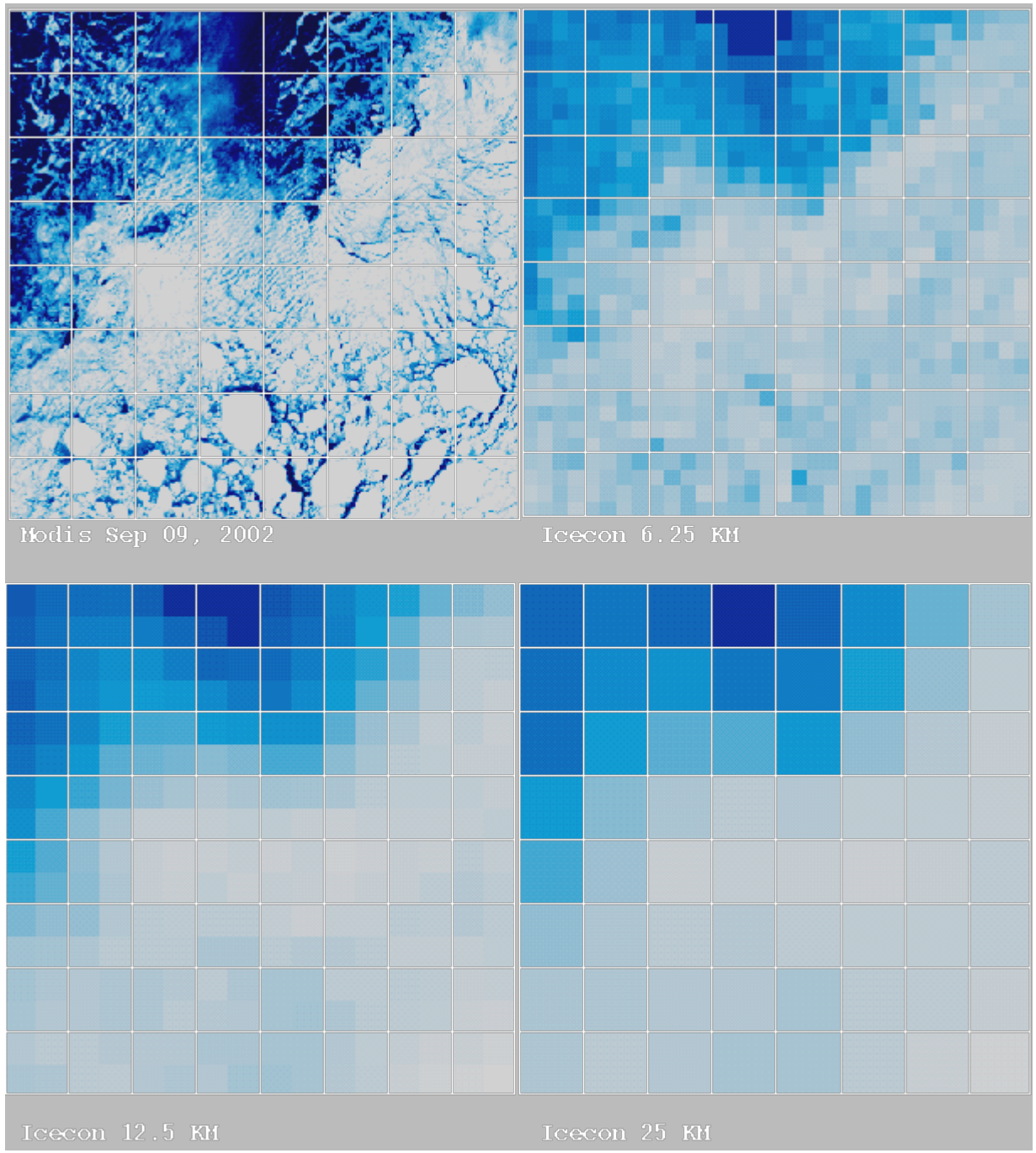
Does the passive microwave and visible channels see the same thing?

Weddell
9 September
2002 image



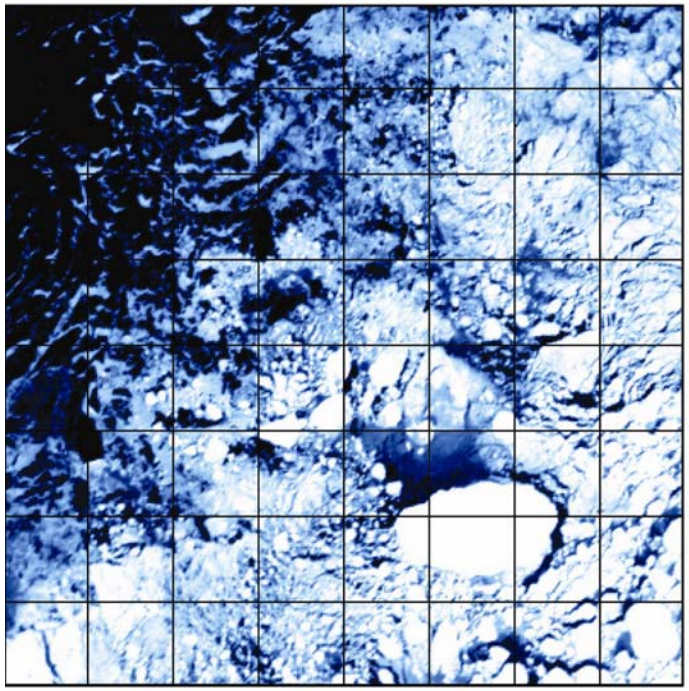
One to one signal apparent but not always. Can use the visible to assess and understand the limitations of passive microwave data.

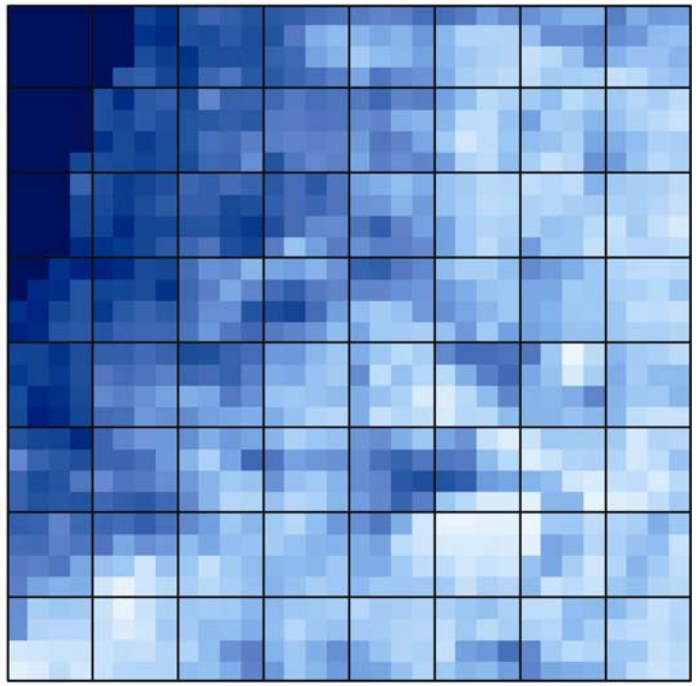
September 9, 2002

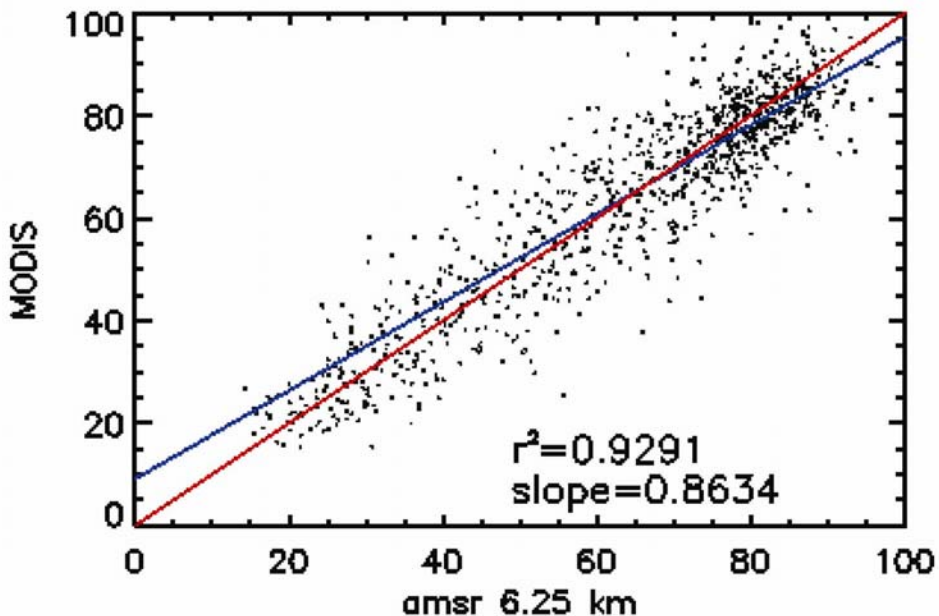


MODIS Sep 09, 2002

AMSR 6.25 km Icecon

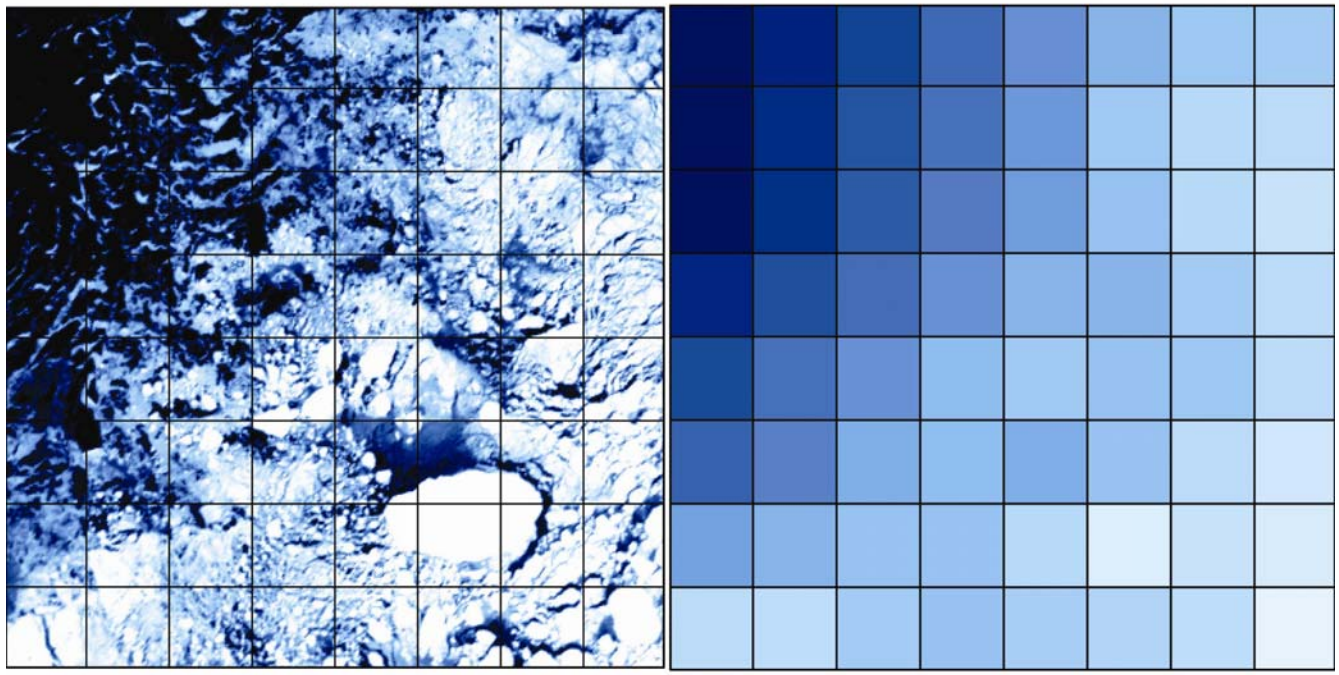


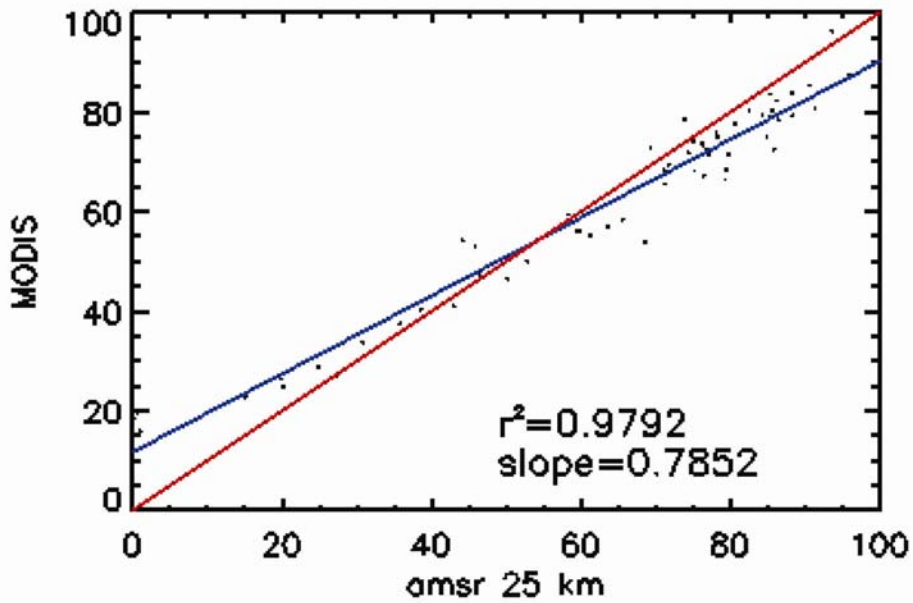




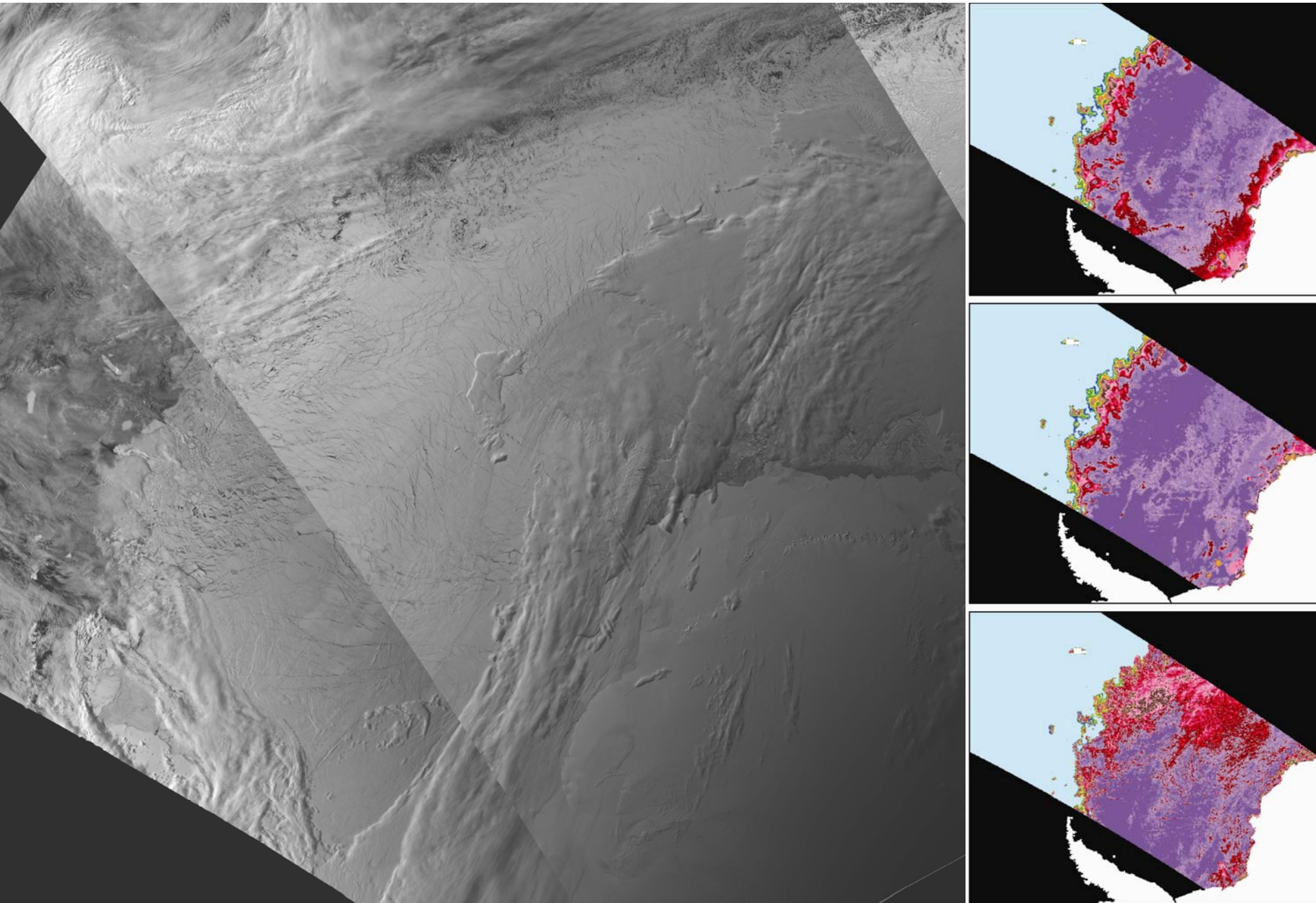
MODIS Sep 09, 2002

AMSR 25KM Icecon

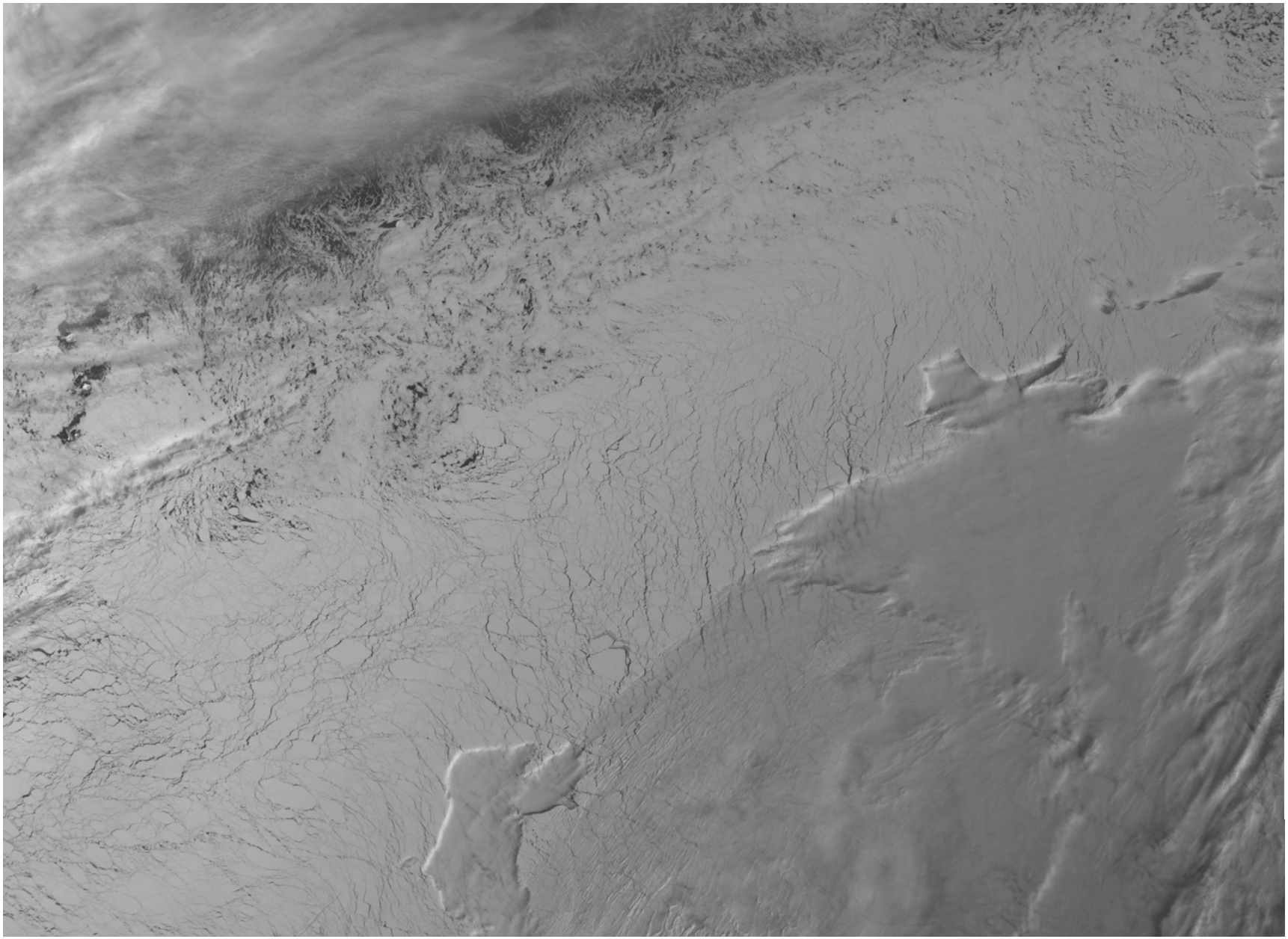




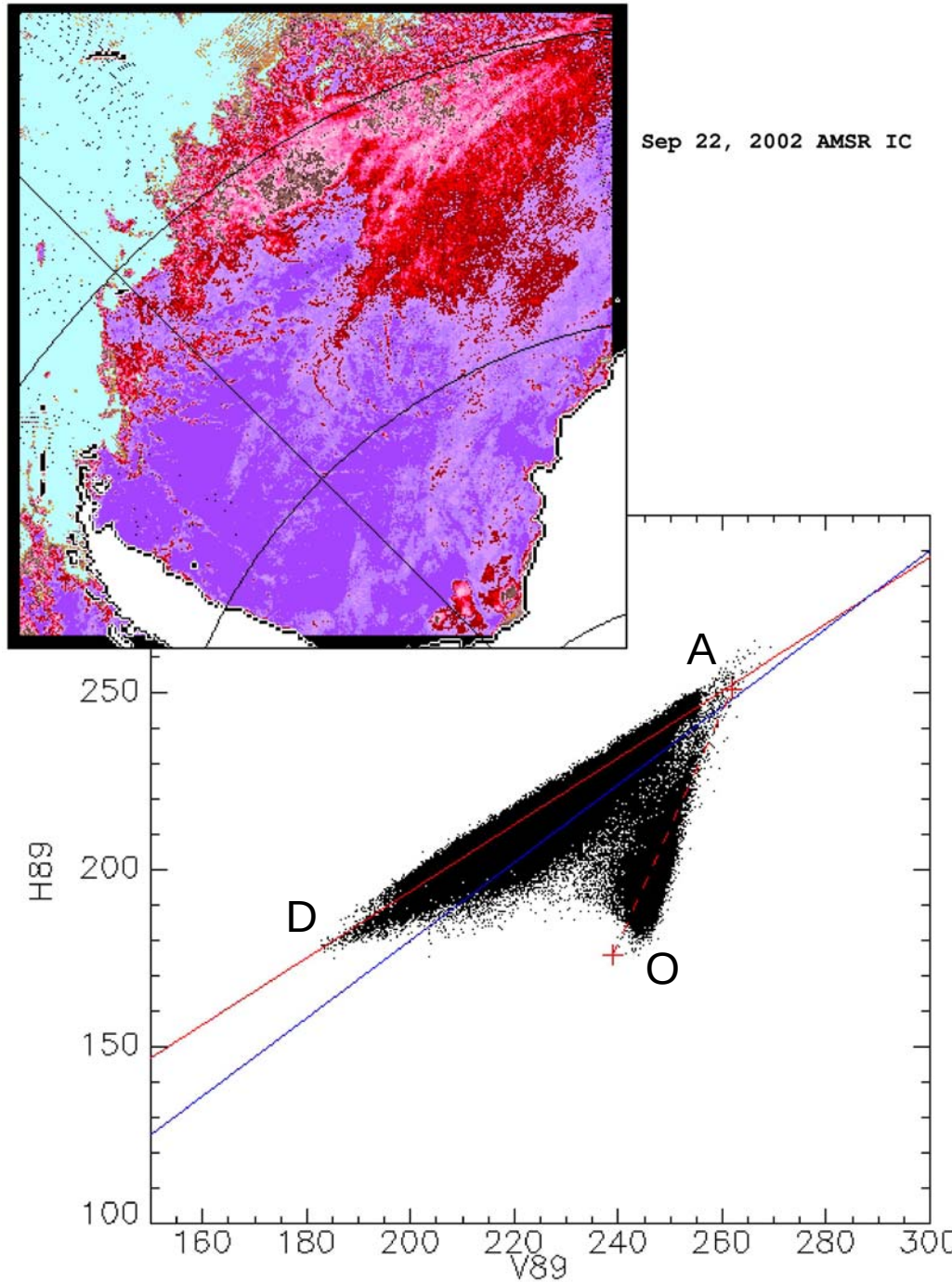
22 September 2002 MODIS and AMSR-E IC



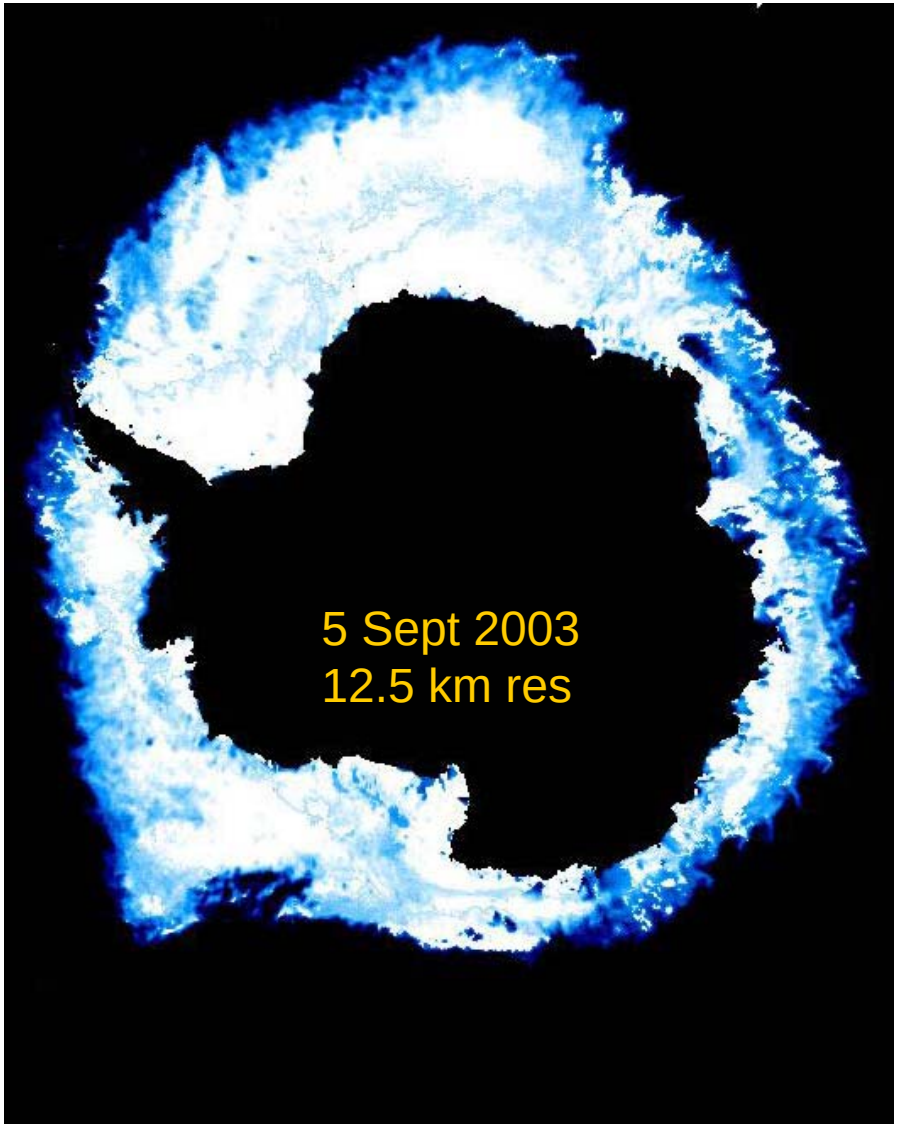
22 September 2002 MODIS and AMSR-E IC

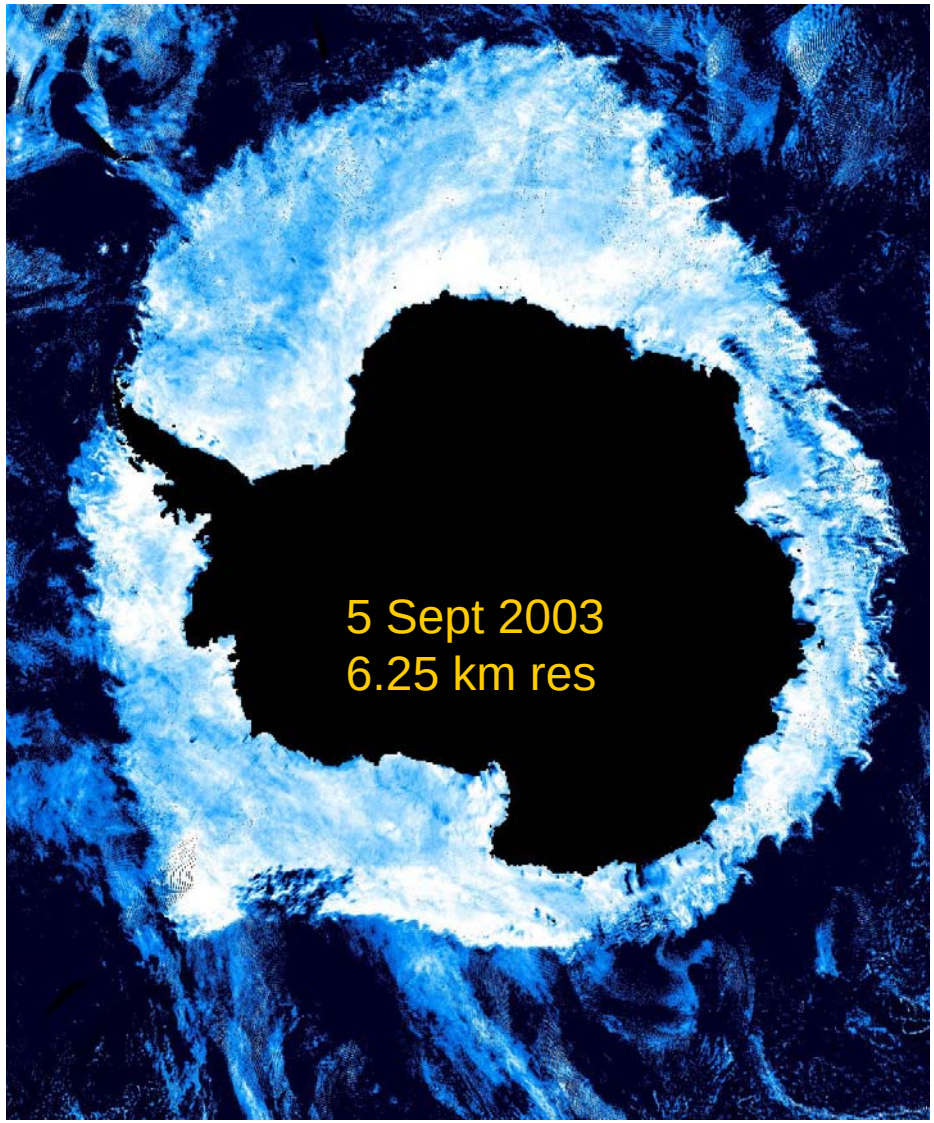


The 89 GHz channel provides intriguingly good data set which when interpreted properly can become a valuable tool for polar process studies.



AMSR IC: 12.5 km vs 6.25 km



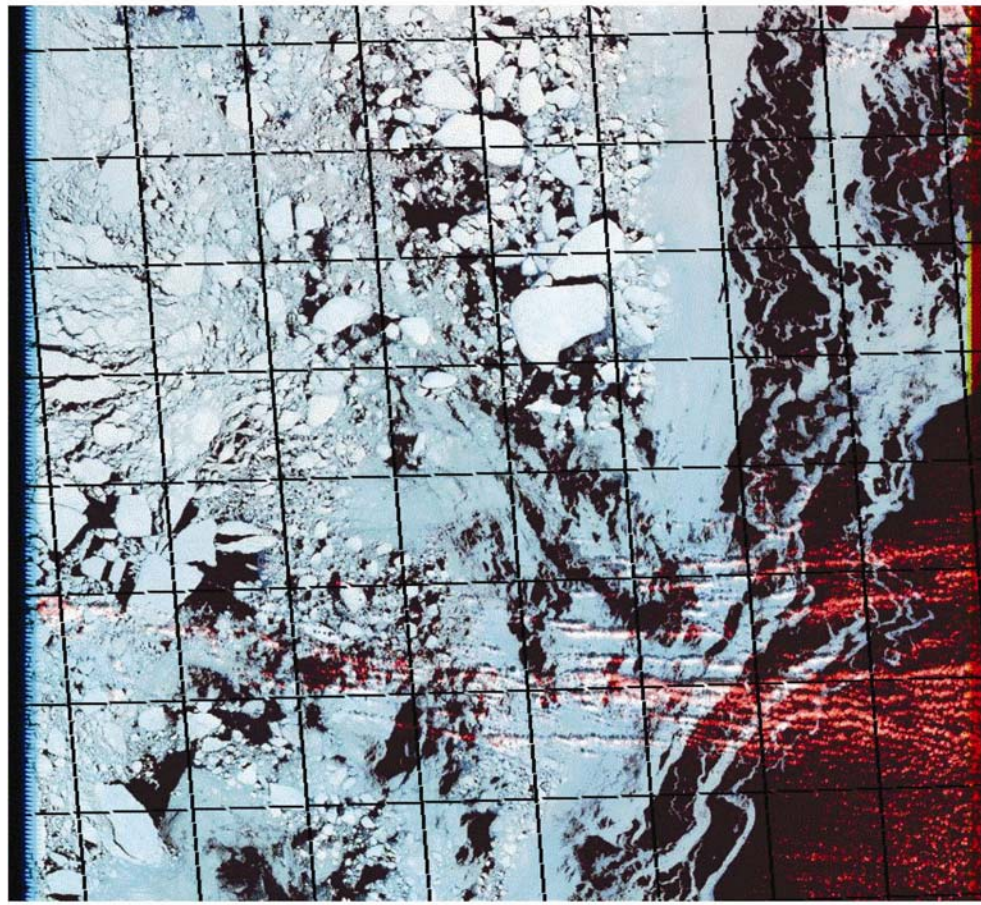


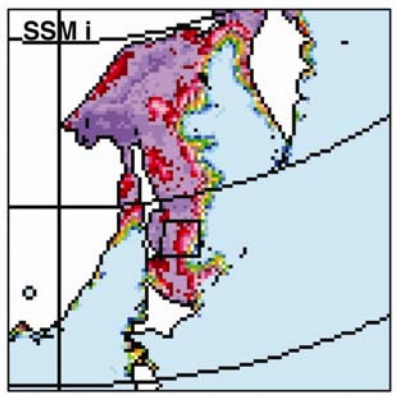
Note: NT1 retrieval is similar to the 89 GHz channel retrieval

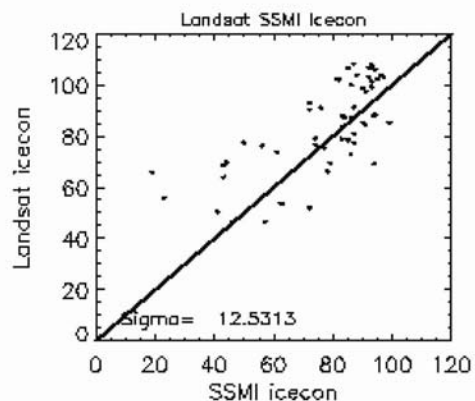
Landsat image of the Sea of Okhotsk

- Landsat scenes provide the means to study large areas at a high resolution.
- On February 11, the ice cover in the southern area was very active with a large fraction being covered by shuga, pancakes, nilas and grease ice.

Landsat Feb 11, 2003 Path 106 Row 27

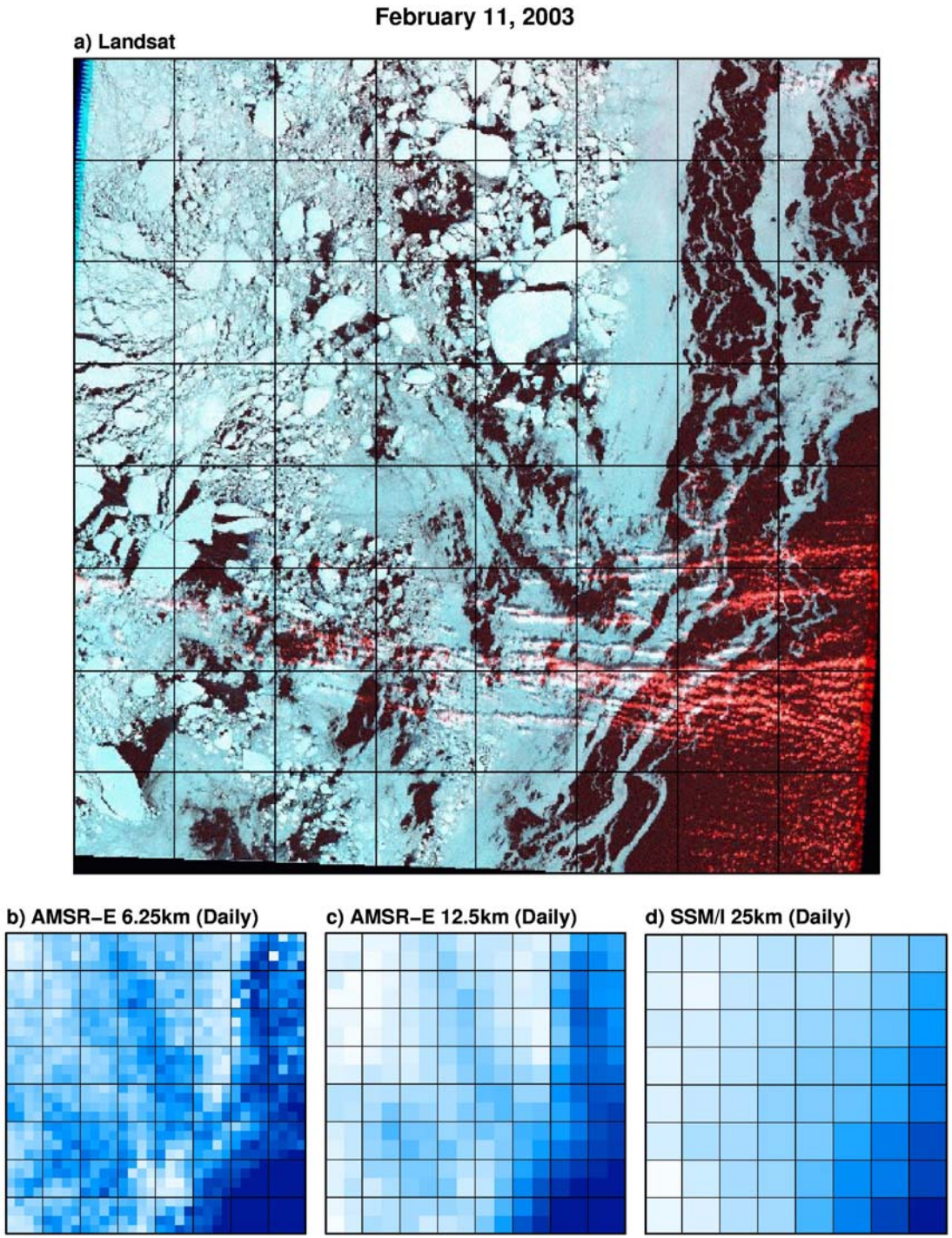




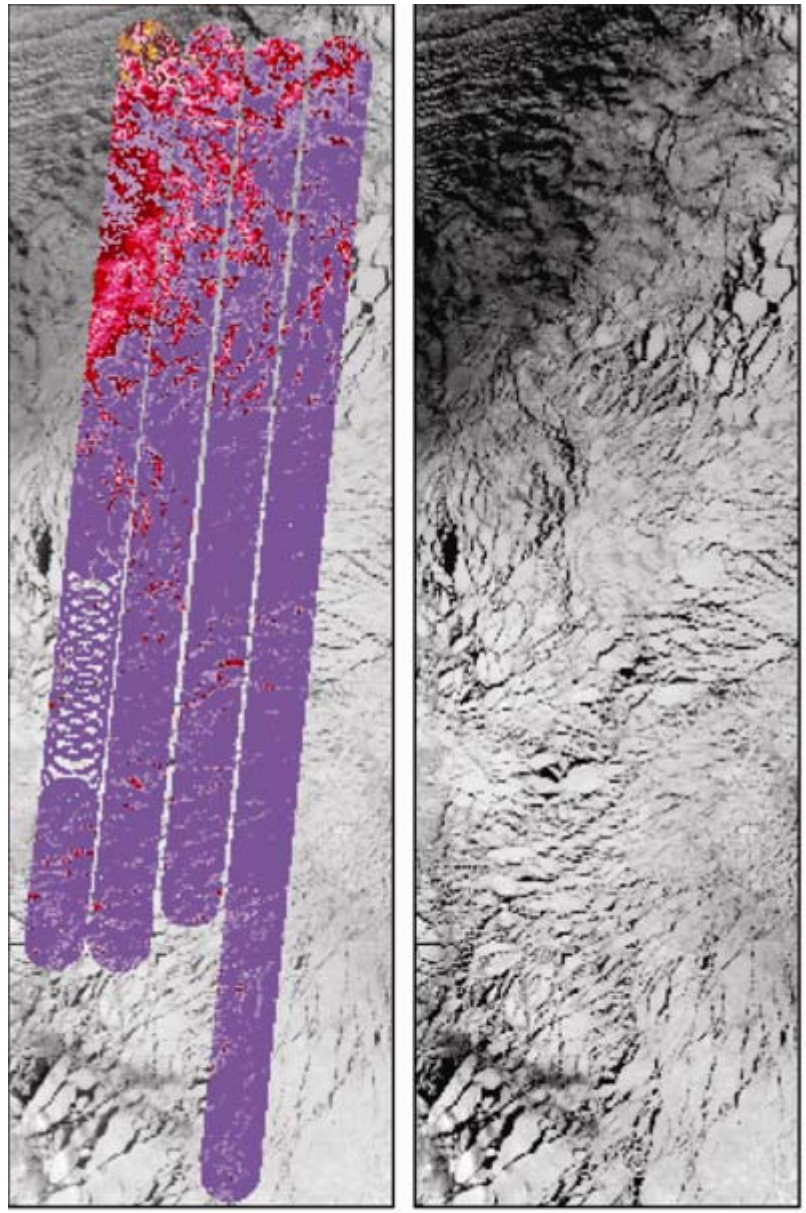


High Resolution AMSR vs Landsat

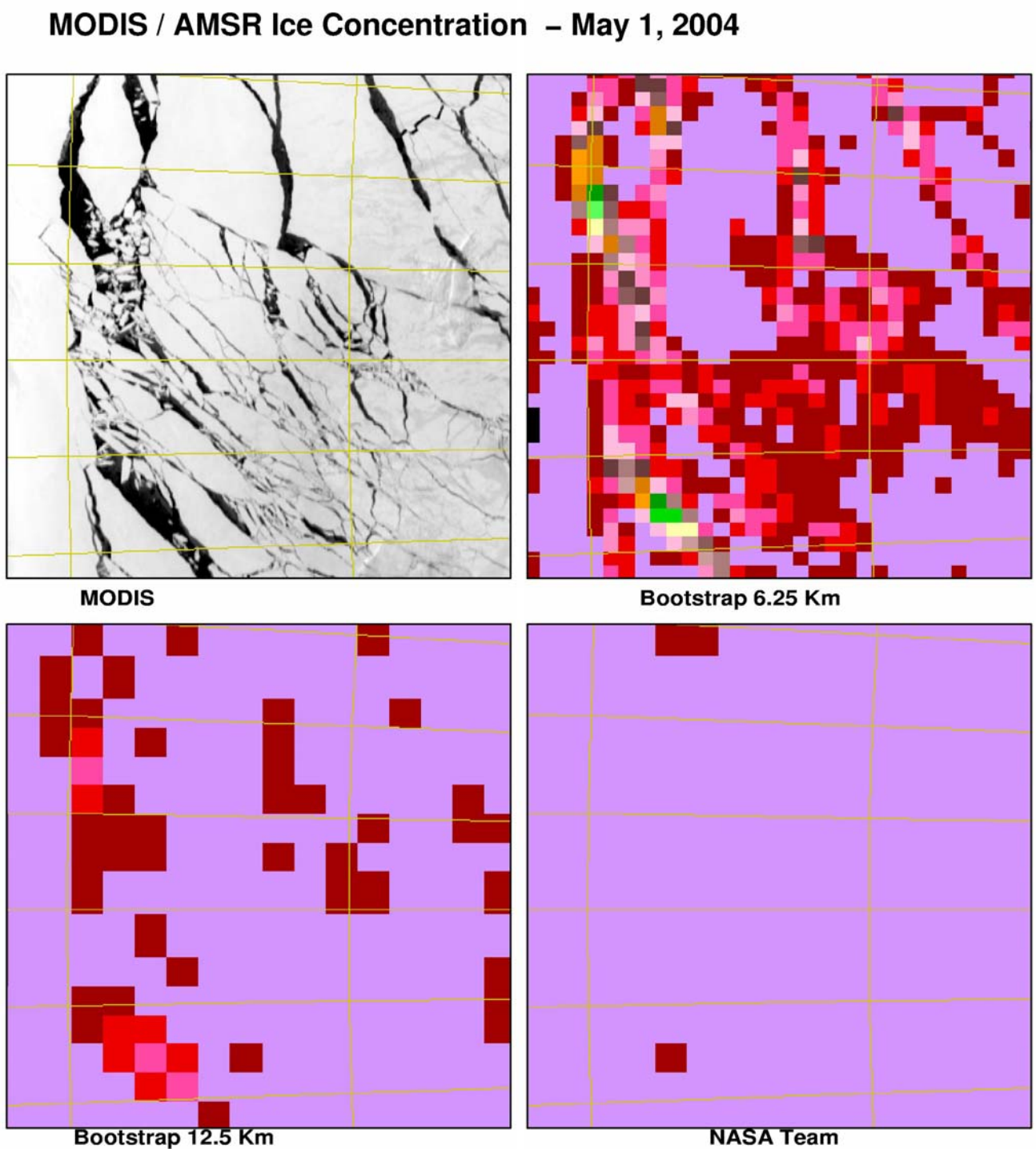
- Higher spatial details can be inferred from AMSR-E data, especially at 89 GHz
- AMSR-E data at 6.25 km resolution captures many of the spatial features from a high resolution visible channel
- The 12.5 km data show some details but the 25 km data smear out much of the features.



PSR shows that the retrieved passive microwave data exhibit good sensitivity to the presence of leads and new ice.



Large leads in Alaska



Summary

- MODIS and AMSR-E provides consistent information about the ice cover.
- MODIS provides useful information needed to interpret AMSR-E data
- MODIS also provides complementary information to AMSR-E data about the state of the ice edge and snow cover and detailed characteristics of lead distribution and polynyas.
- Joint data set should be used in the studies of the ice edge, latent and sensible heat polynya, icebergs, meltponding, Odden, and MIZs