

National Snow and Ice Data Center  
*Supporting Cryospheric Research Since 1976*

***Joint AMSR Science Team Meeting  
13-15 September, 2005  
Honolulu, HI***



**Current Research Activities at NSIDC**

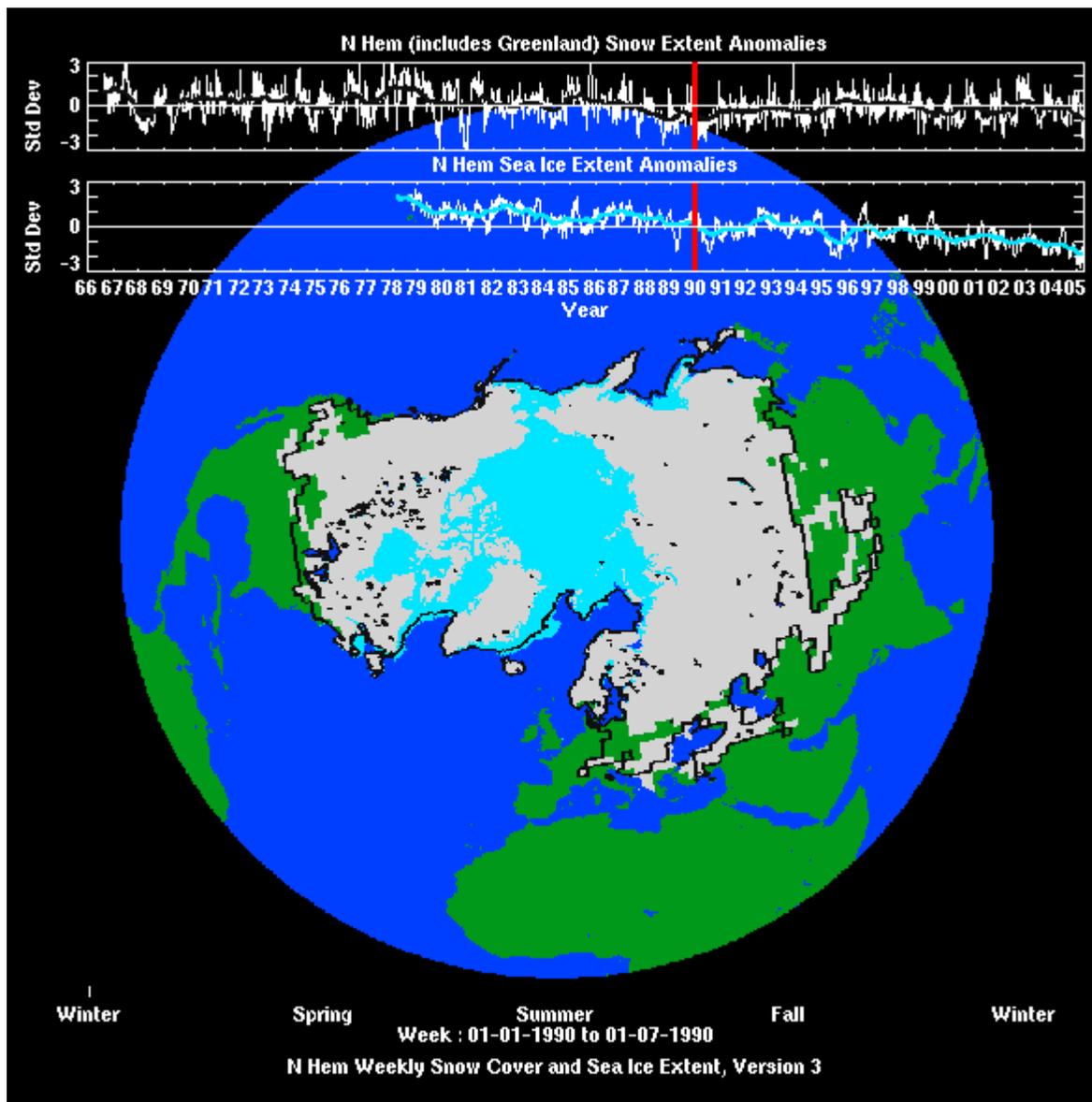
- 1. Legacy Snow Cover Time Series Data**
- 2. Combined AMSR-E and MODIS Snow Map**
- 3. Locating Stable Calibration Targets**
- 4. Validation in Tibet – Atmospheric Correction**

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***Mary Jo Brodzik, Matt Savoie, Ken Knowles***

# Northern Hemisphere Weekly Snow Cover and Sea Ice Extent, V. 3

Snow  
Extent



Browse images  
contain time line  
of anomalies with  
pointer for date  
being viewed.

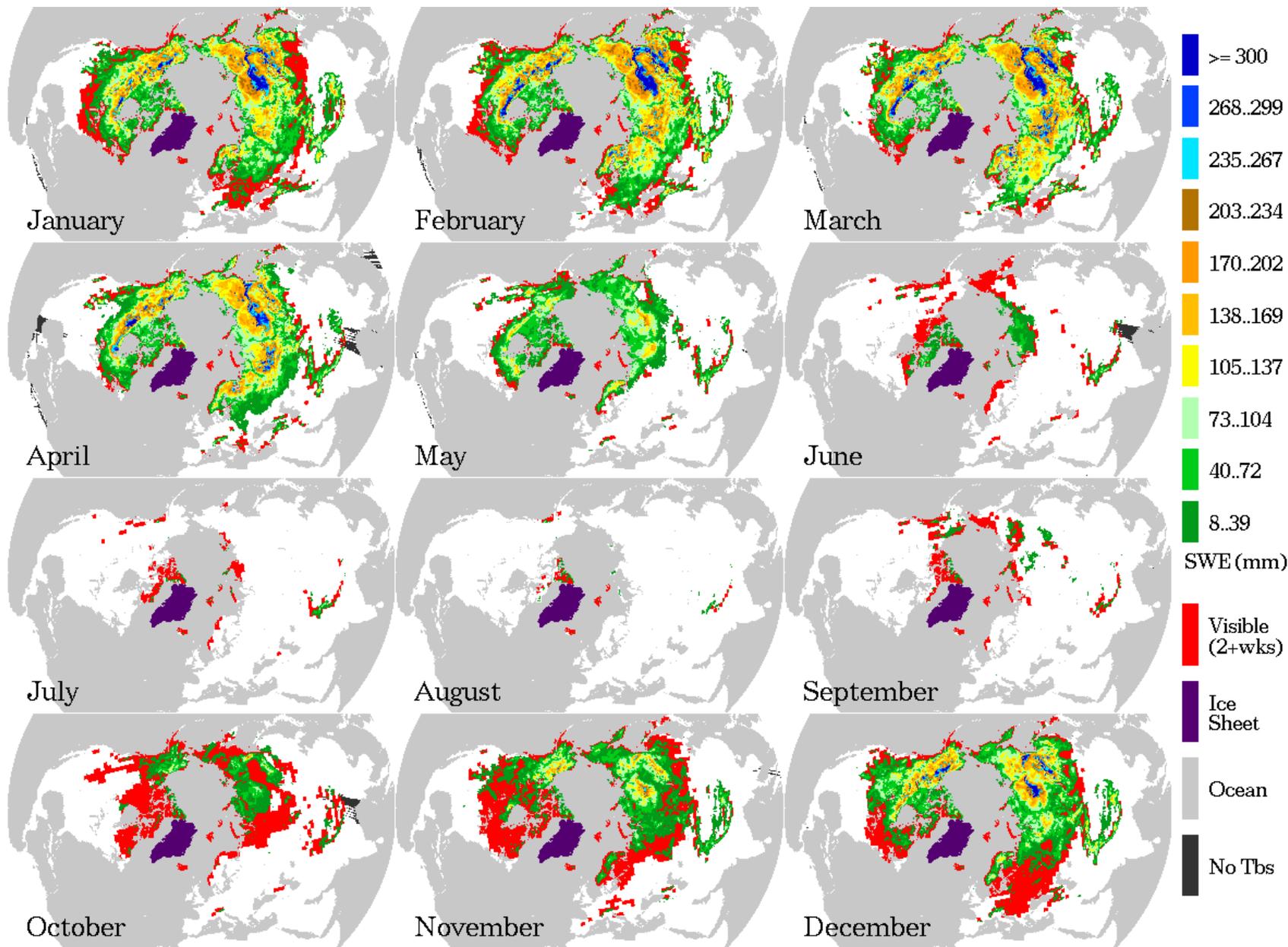
Snow extent (optical) begins 1966 and Sea Ice (microwave) 1978

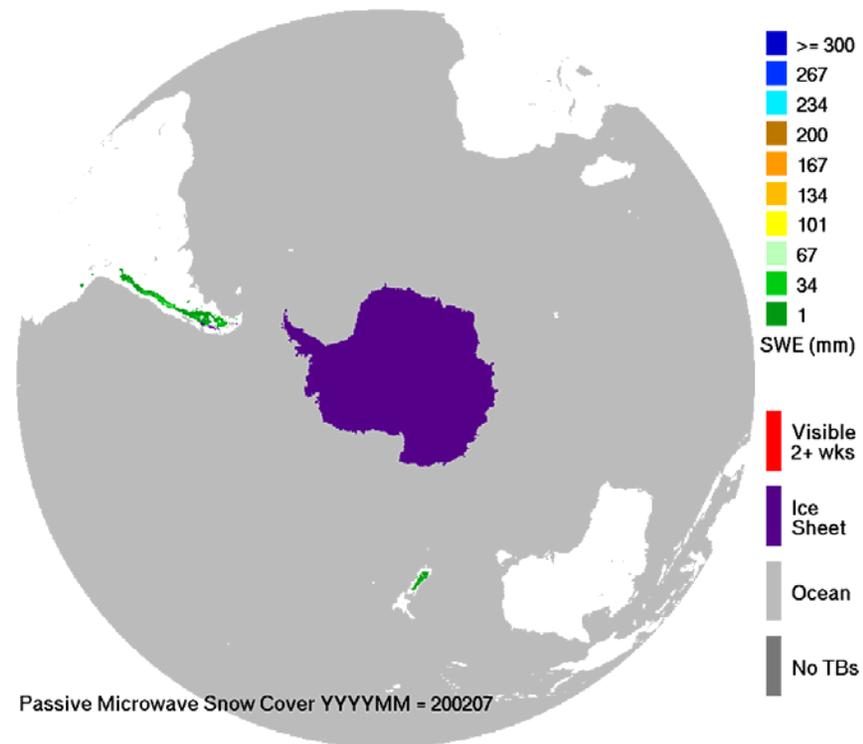
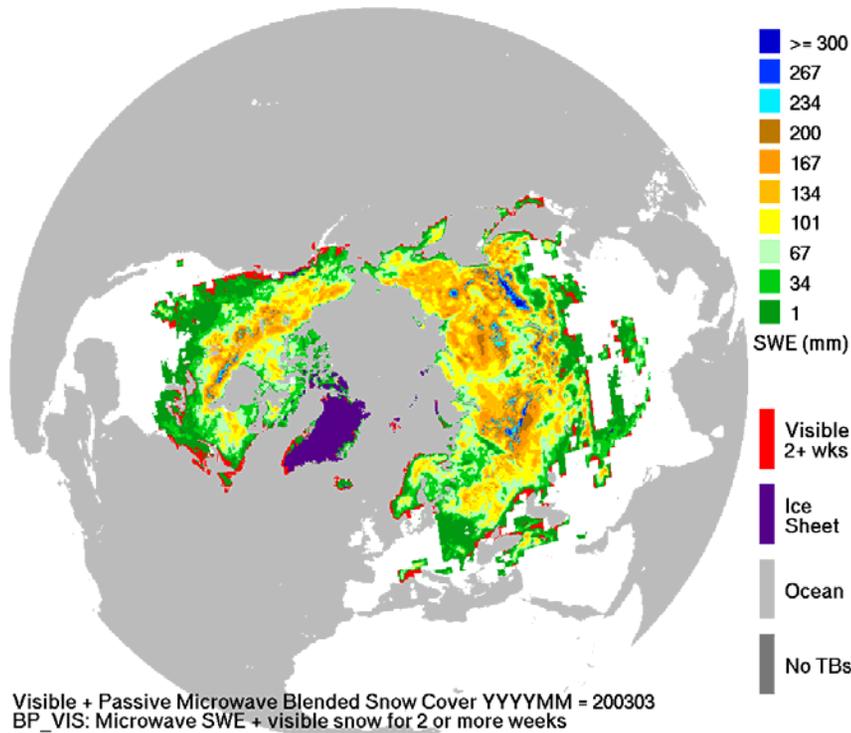


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# Snow Water Equivalent and Extent

Global mean monthly snow extent and SWE for 1978-2003 from a blend of passive microwave (SMMR & SSM/I) and visible (NOAA) data



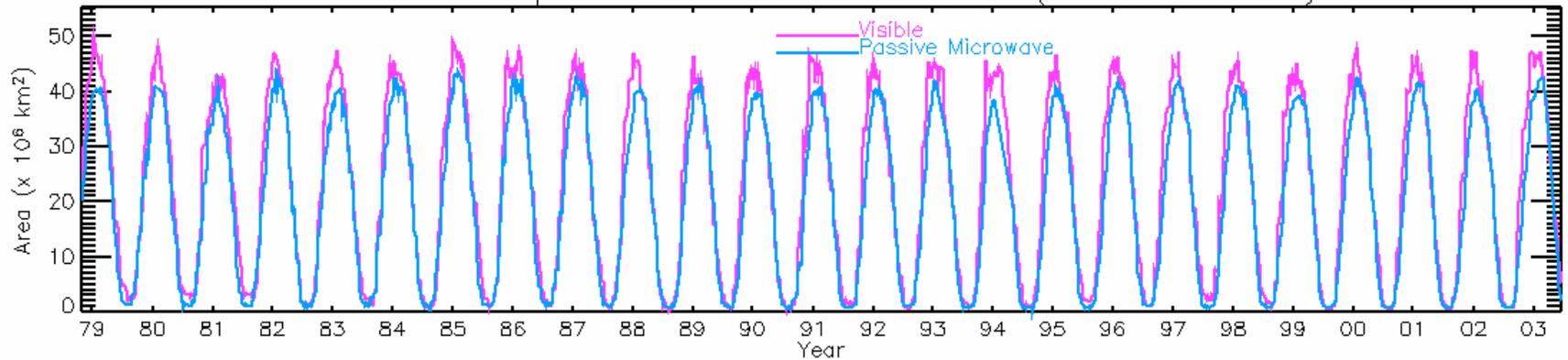


**Examples of Northern (Southern) Hemisphere monthly average snow water equivalent (mm) from passive microwave with additional area in red indicated as snow for 2 or more weeks in the month in the NOAA weekly snow maps (optical), March 2003 (July 2002)**

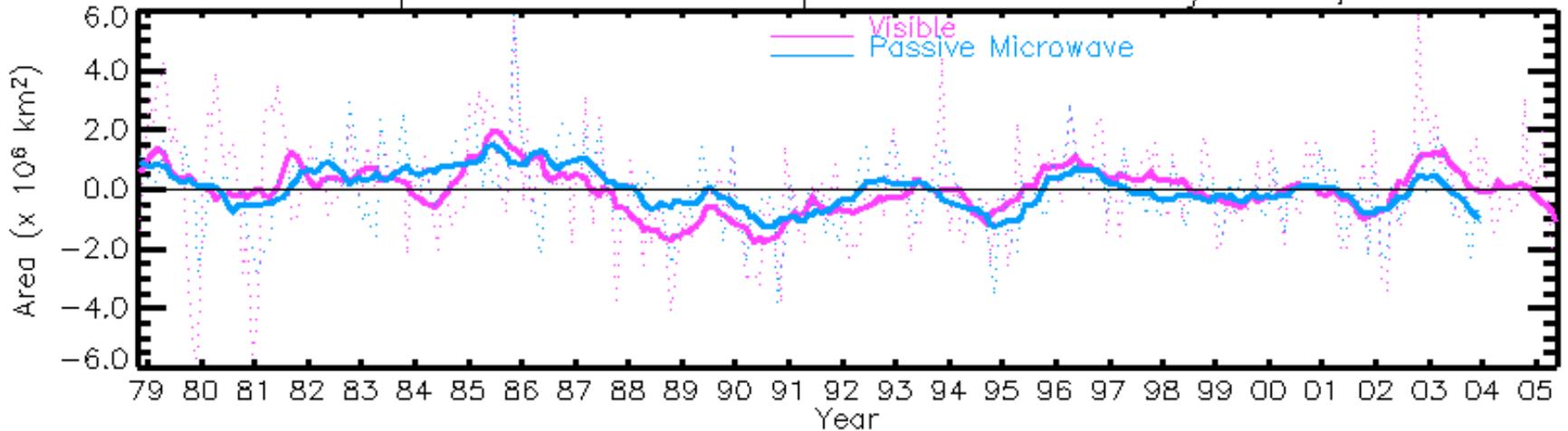
# Northern Hemisphere Satellite-Derived Total Snow Extent 1978 – 2005

Visible (NOAA) Passive Microwave (SMMR & SSM/I).

Northern Hemisphere Satellite-Derived Snow Extent (Excludes Greenland)

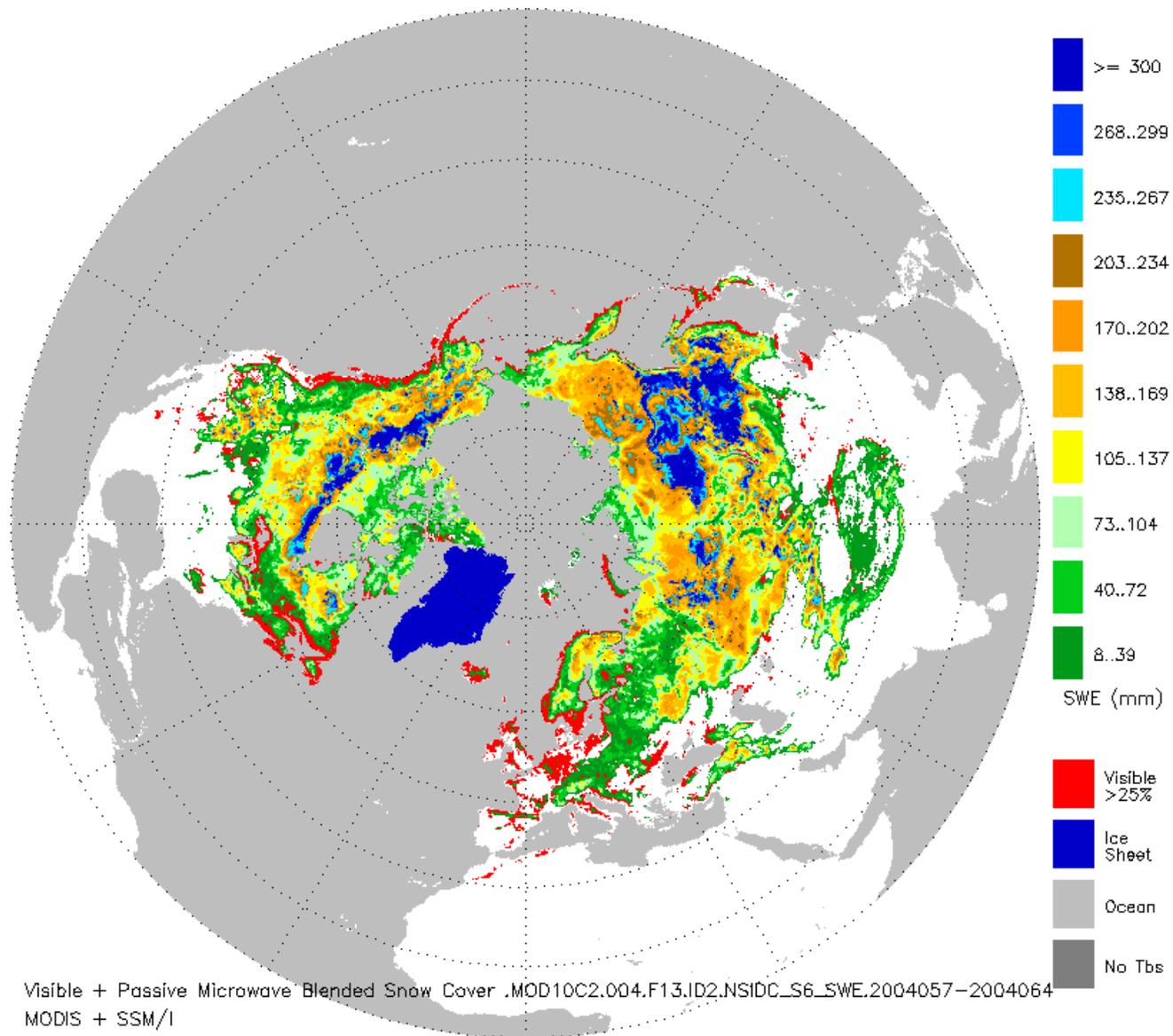


Northern Hemisphere Snow Extent Departures from Monthly Means, 1978–2005



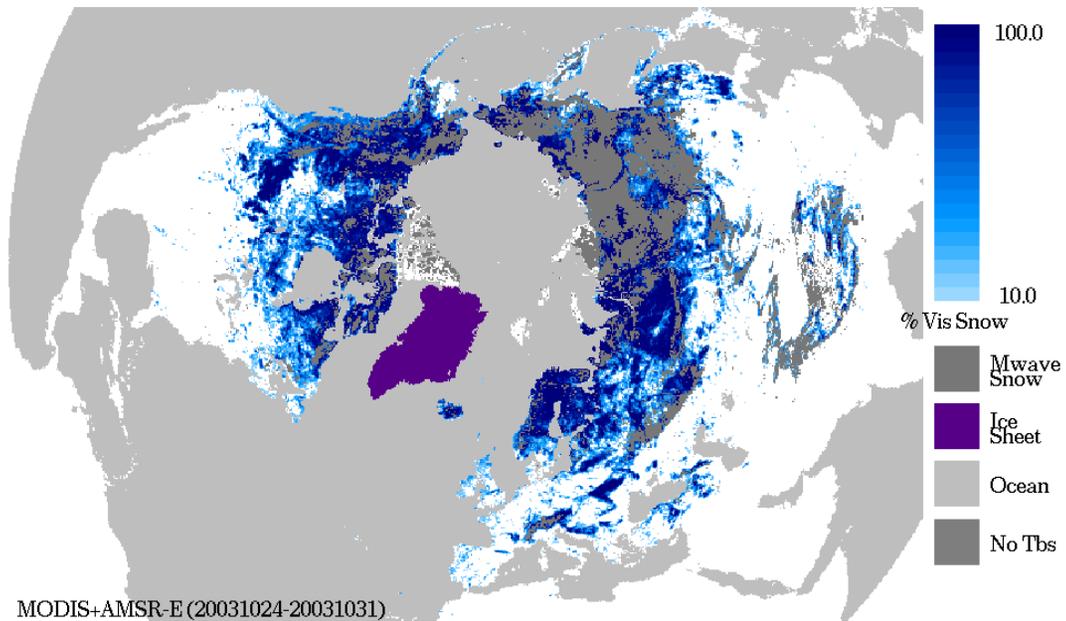
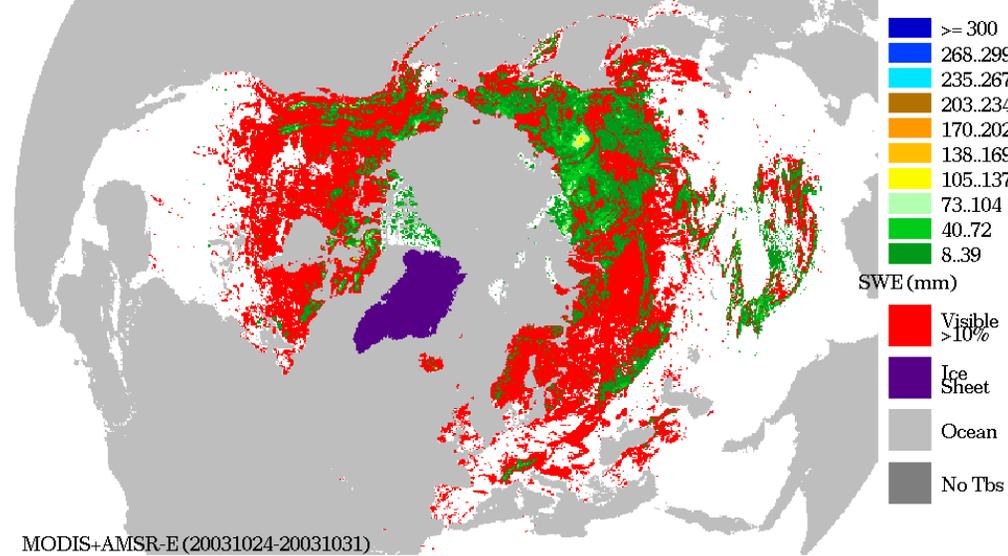
**Northern Hemisphere visible and passive microwave snow-covered area (x 106 km<sup>2</sup>) departures from monthly means (12 – month smoothed).**

# Blended AMSR-E & MODIS Snow Product



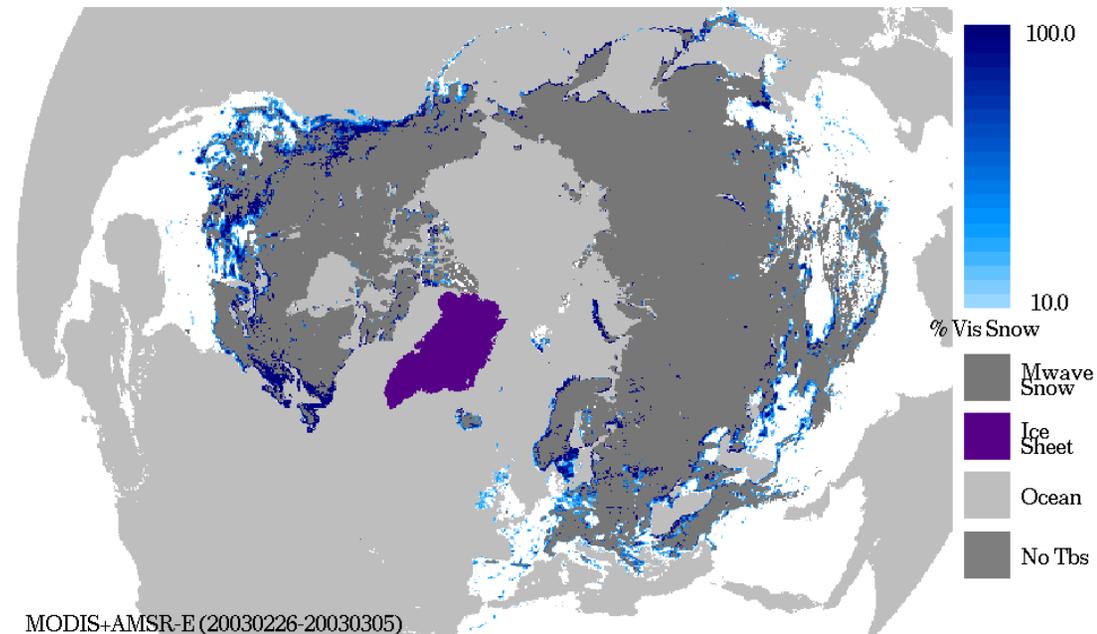
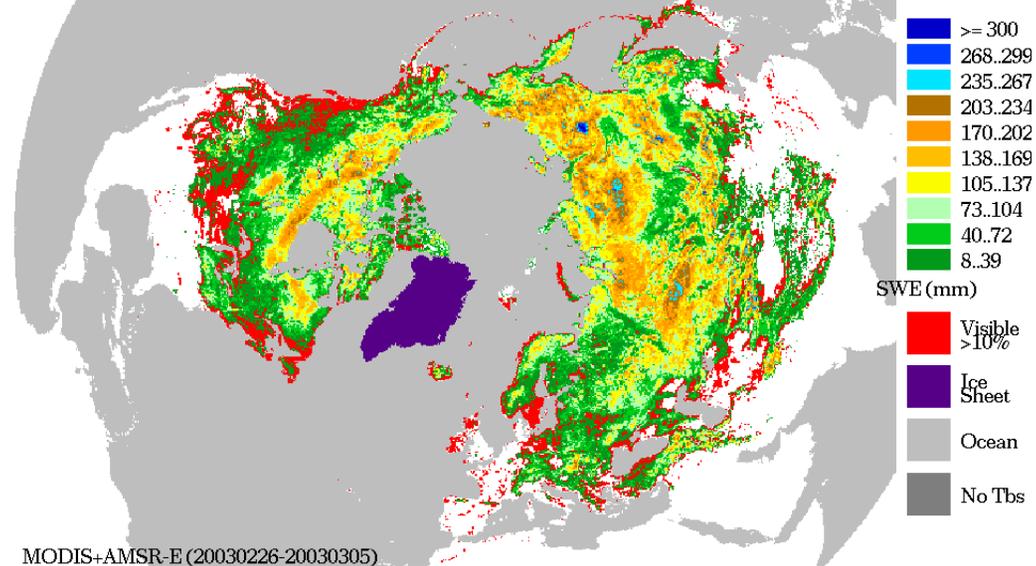
Ongoing processing at NSIDC since AMSR-E launch, product available fall 2005

# Fall Season Example



**Blended snow product prototypes, SWE (mm) from AMSR-E with additional snow extent from MODIS in red (October 24-31, 2003, max). Lower image represents AMSR-E snow extent in grey, with percent area of additional pixels that MODIS classifies as snow in blues. (AMSR-E @ 25 km, MODIS CMG @ 5 km)**

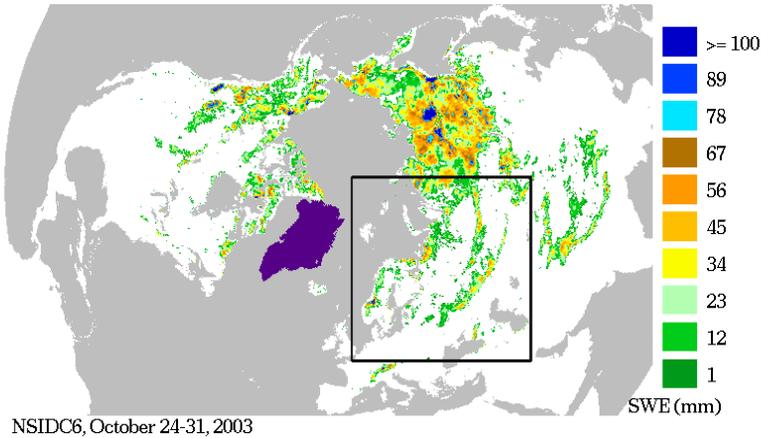
# Winter Season Example



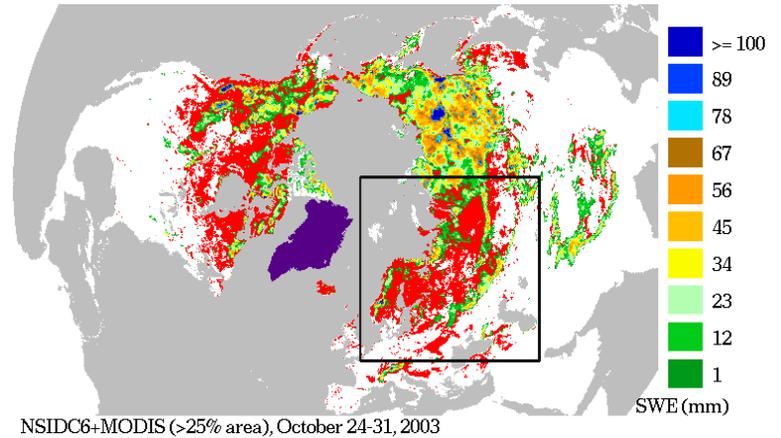
**Blended snow product prototypes, SWE (mm) from AMSR-E with additional snow extent from MODIS in red (Feb 26 – Mar 5, 2003, max). Lower image represents AMSR-E snow extent in grey, with percent area of additional pixels that MODIS classifies as snow in blues. (AMSR-E @ 25 km, MODIS CMG @ 5 km)**

# Fall Season Example

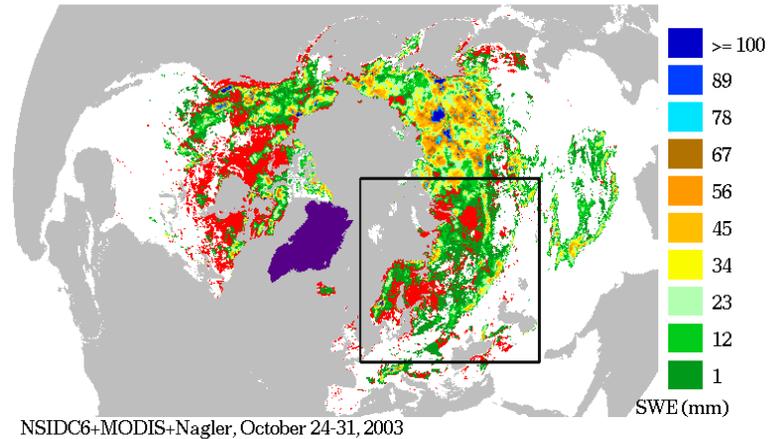
## AMSR-E Only



## AMSR-E + MODIS



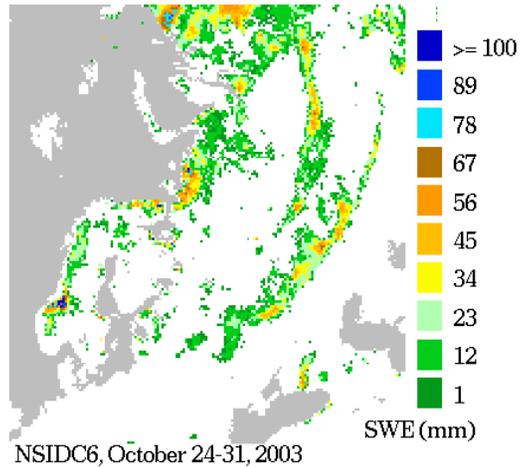
October 24-31, 2003



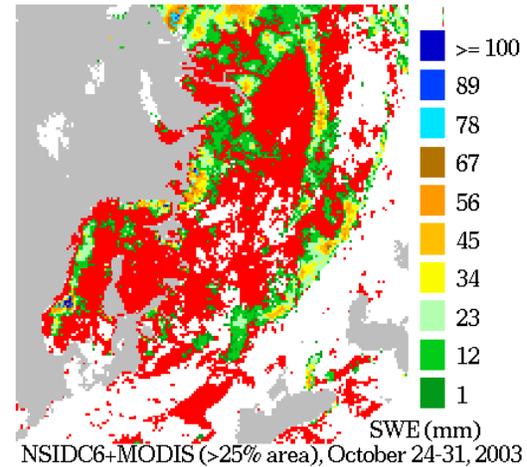
## AMSR-E+MODIS+89 GHz (Nagler)

# Fall Season Example

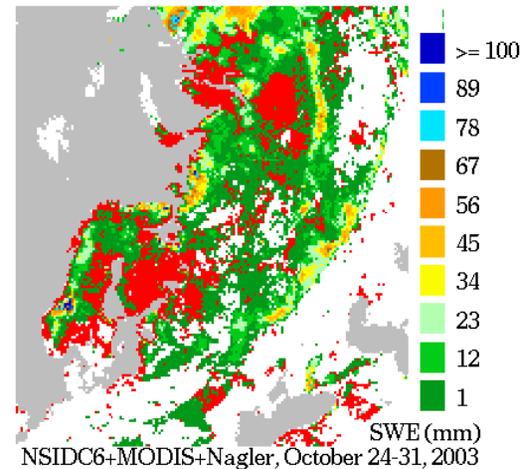
AMSR-E Only



AMSR-E + MODIS

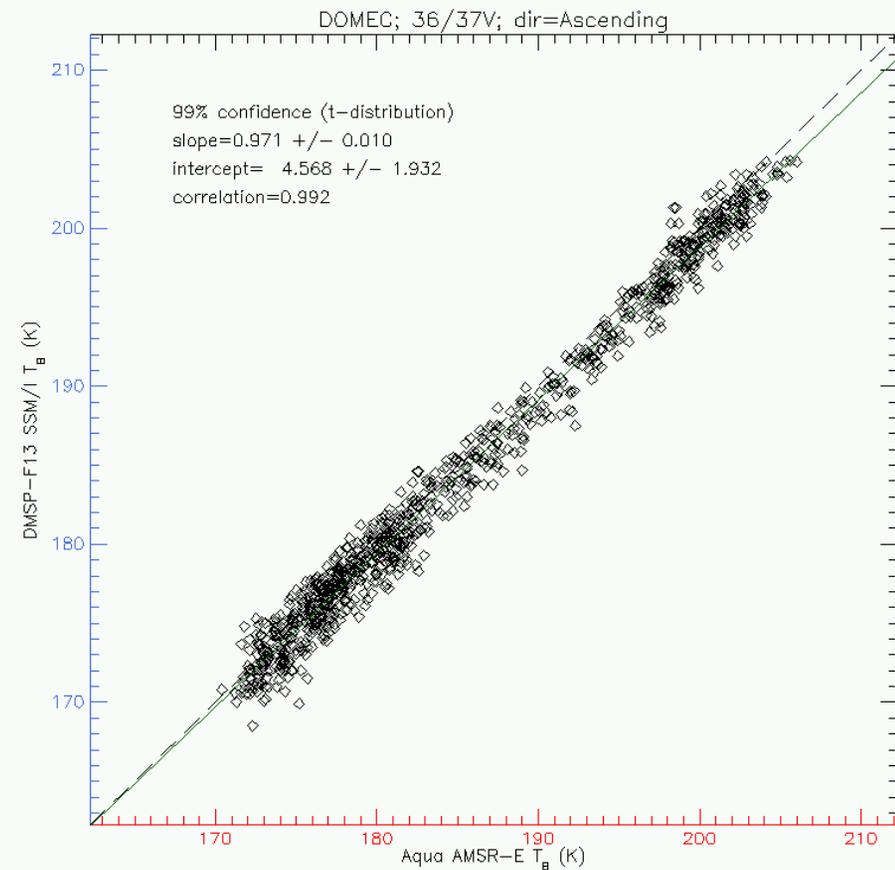
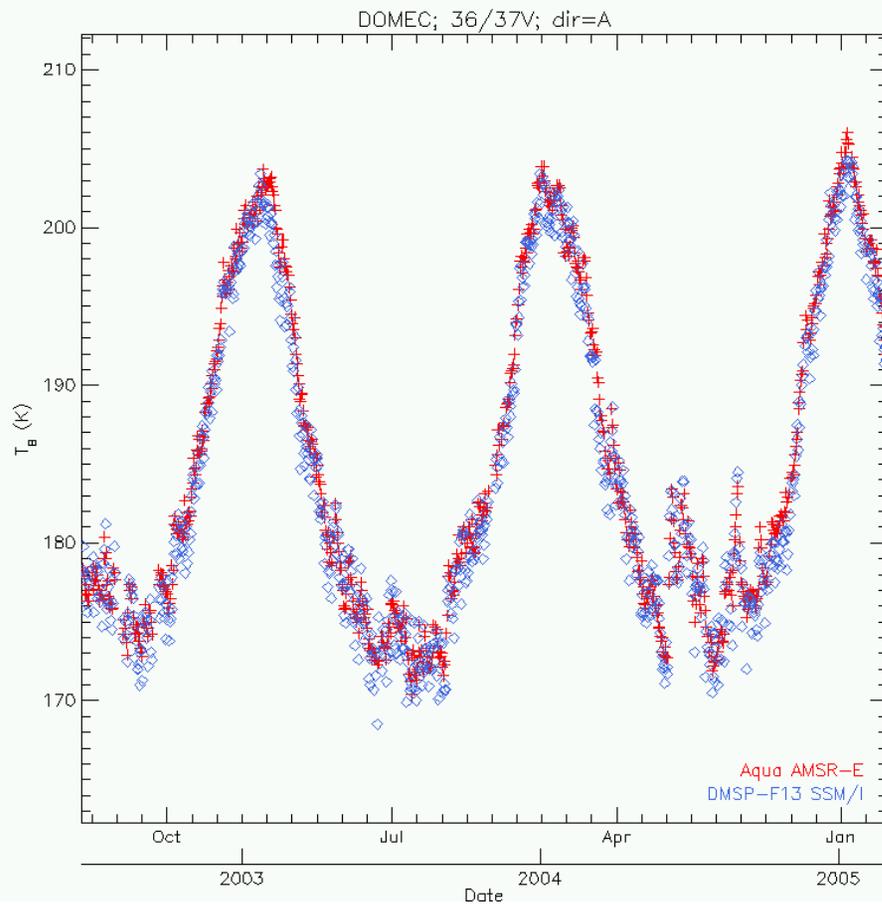


October 24-31, 2003

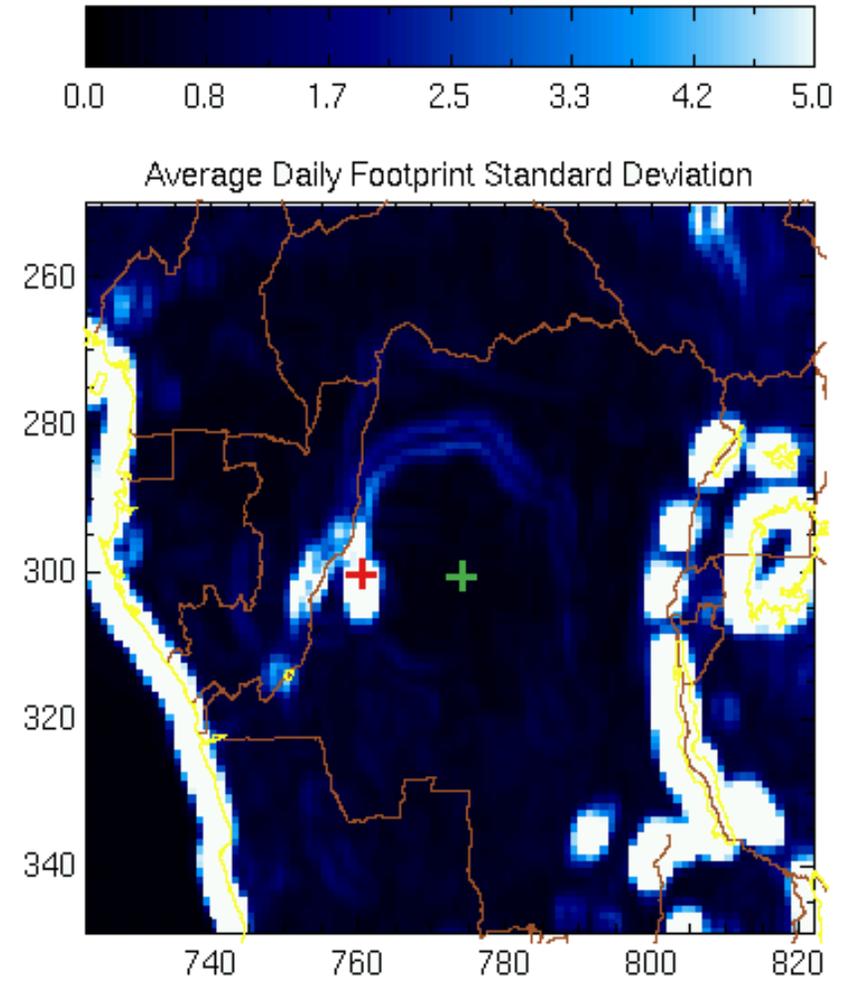
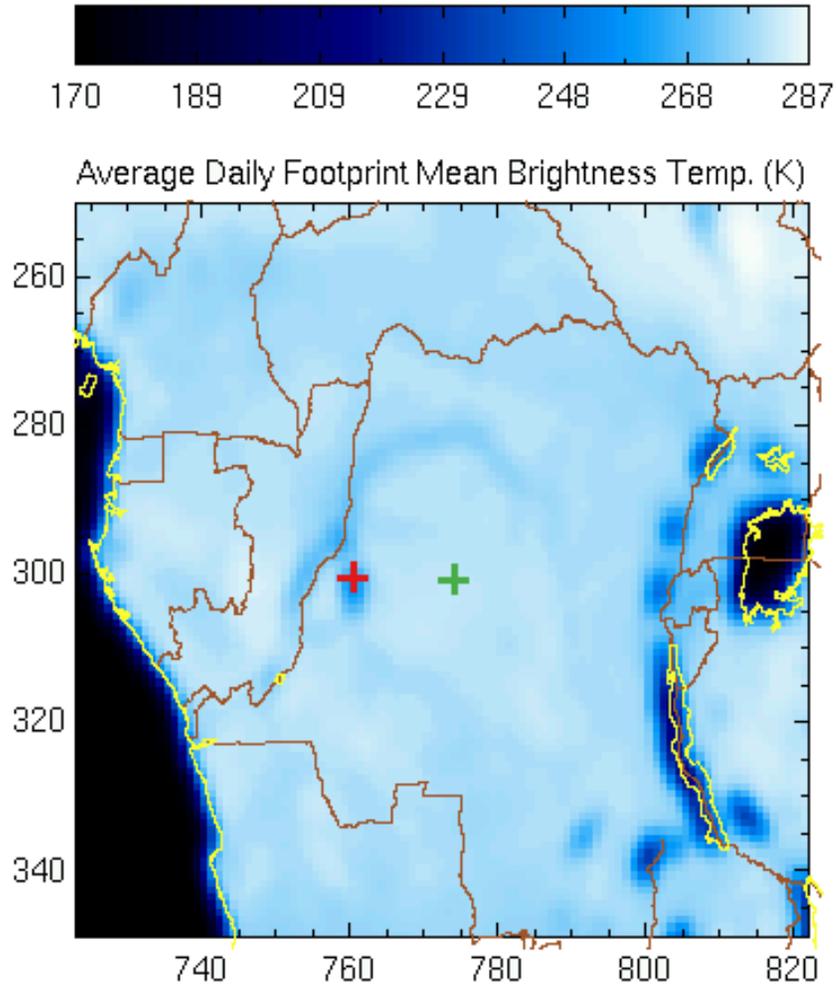


AMSR-E+MODIS+ 89 GHz  
(Nagler)

# Locating Stable Calibration Targets (150-250 K) Comparison of NASA AMSR-E (36 GHz V) and DMSP SSM/I (37 GHz V) Dome-C Antarctica, July 2002 to March 2005.

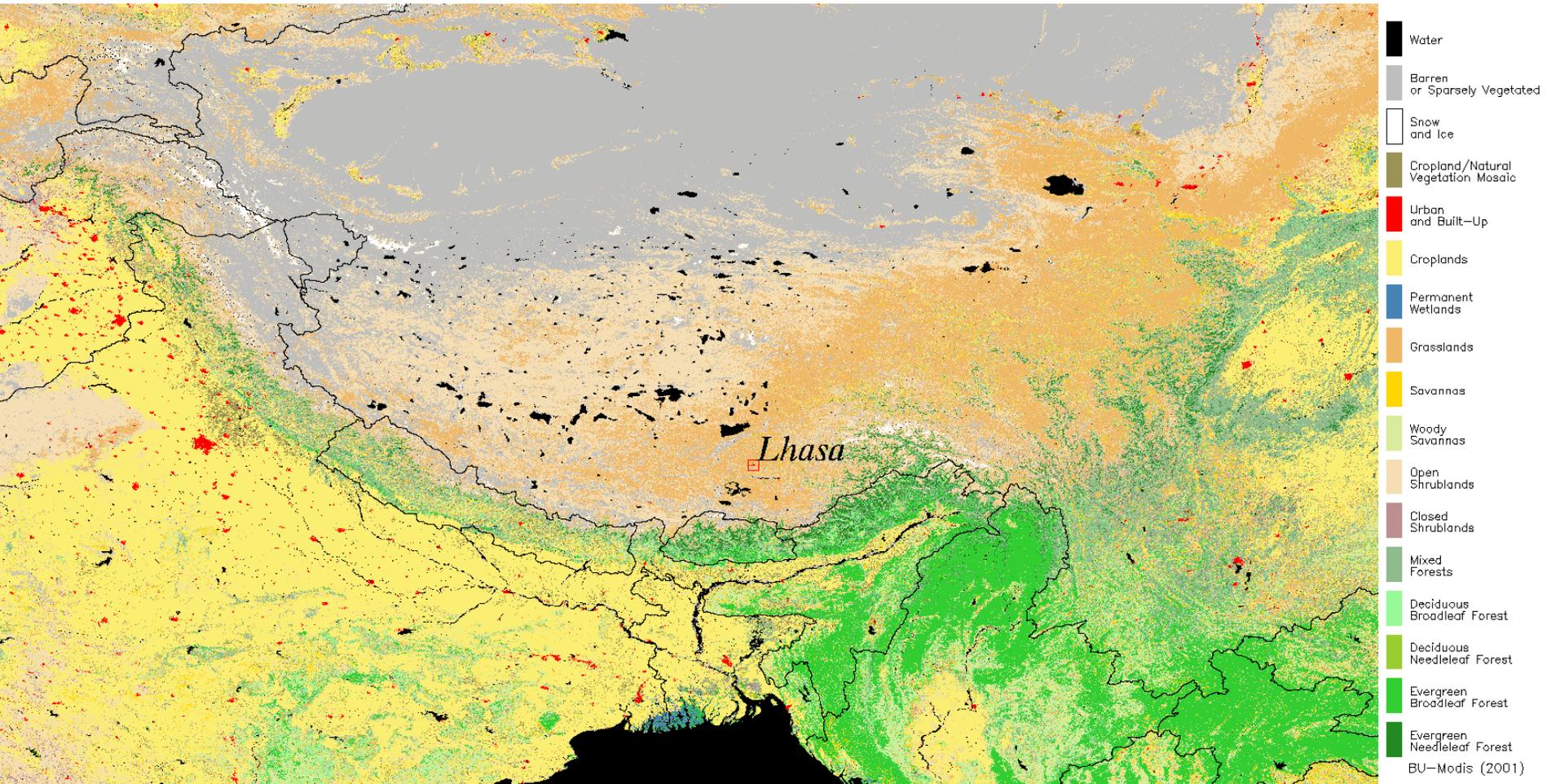


# Locating Stable Calibration Targets (250 – 300 K) Central Africa Experimental Area



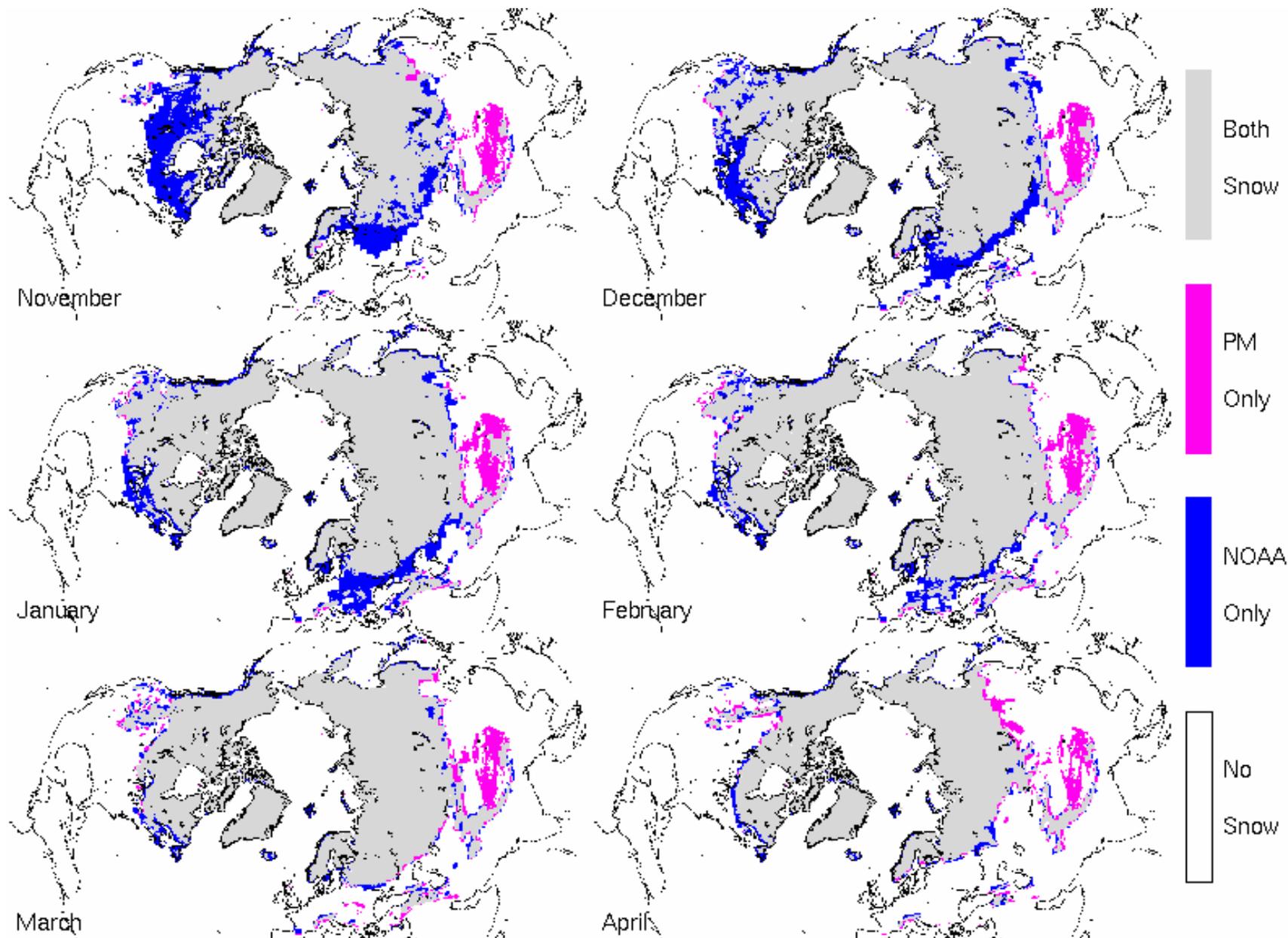
**AMSRE 6.9 GHz V, descending – footprint (3x3) mean and standard deviation for annual cycle**

# Tibet



## *Land Classification MODIS*

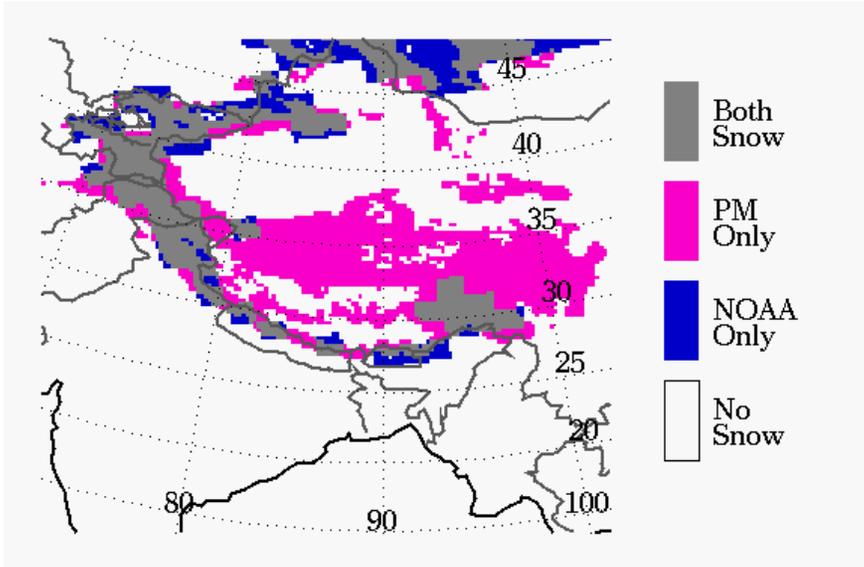
Grasslands in the south-east changing to drier shrublands in the north-west. Pastoralism is found at elevations of 3,500 to 5,400m, 42% of China's total Rangeland.



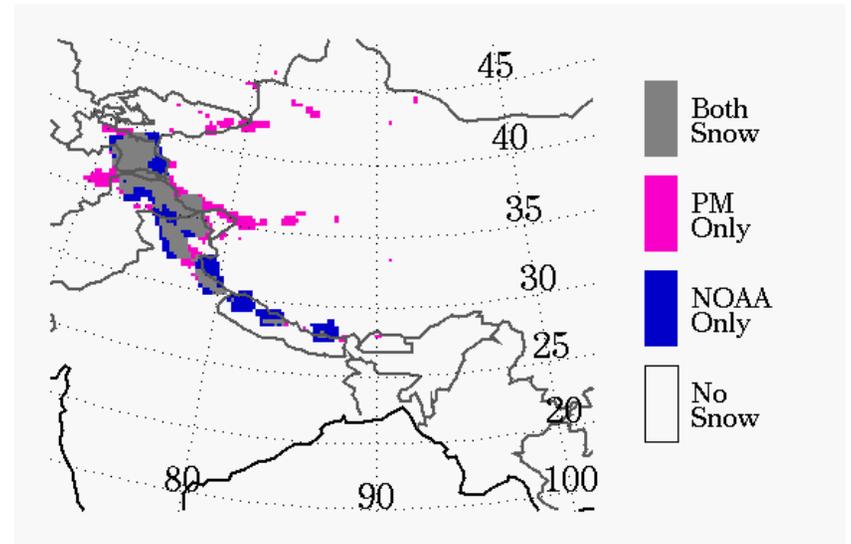
Monthly snow extent climatology for NOAA and passive microwave data for the period 1978 to 1999 (50% or more of the weeks in the particular month over the total time period classified as snow covered).

# Tibetan Plateau - Winter vs. Summer

November



July

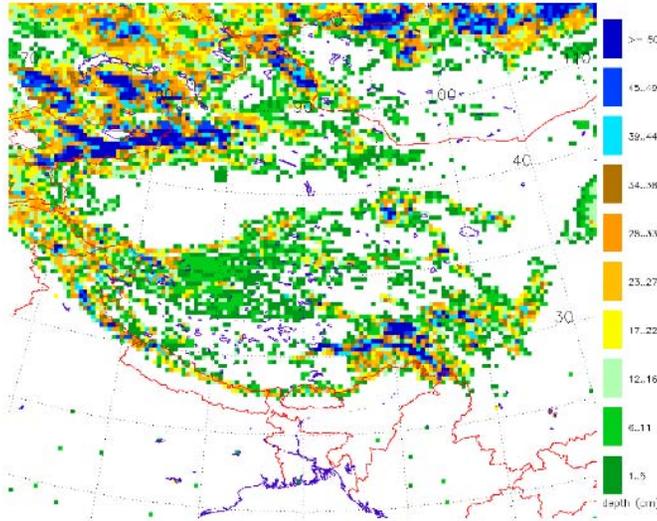


\Climatology differences, November and July, showing the anomalous snow cover to be a cold-season phenomenon.

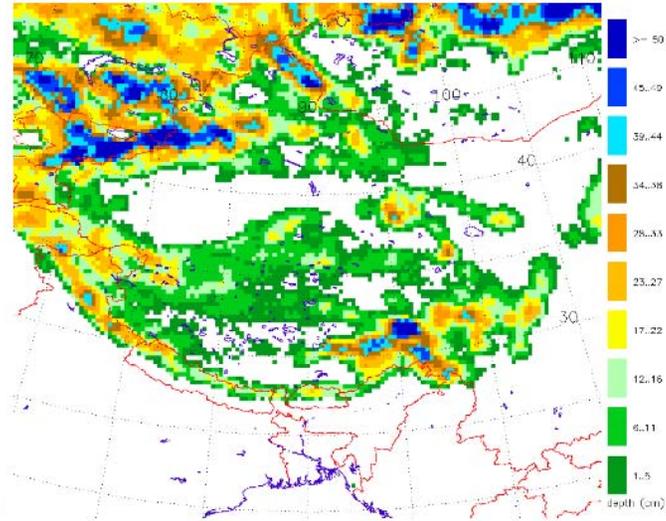


# Tibet Plateau Region Snow Cover Jan 9-16, 2003

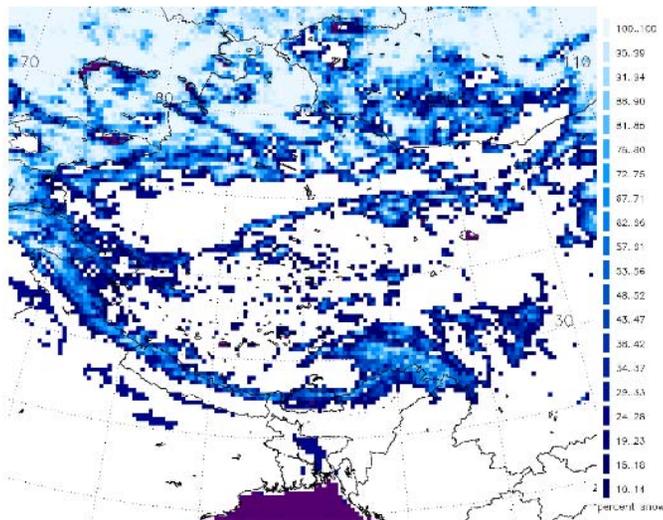
AMSR-E



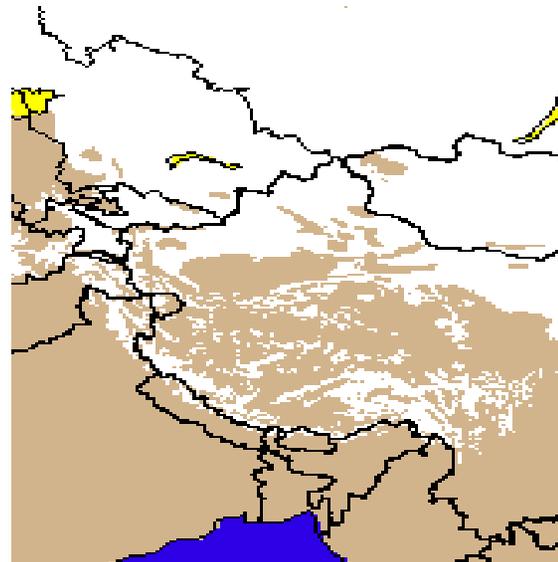
SSM/I



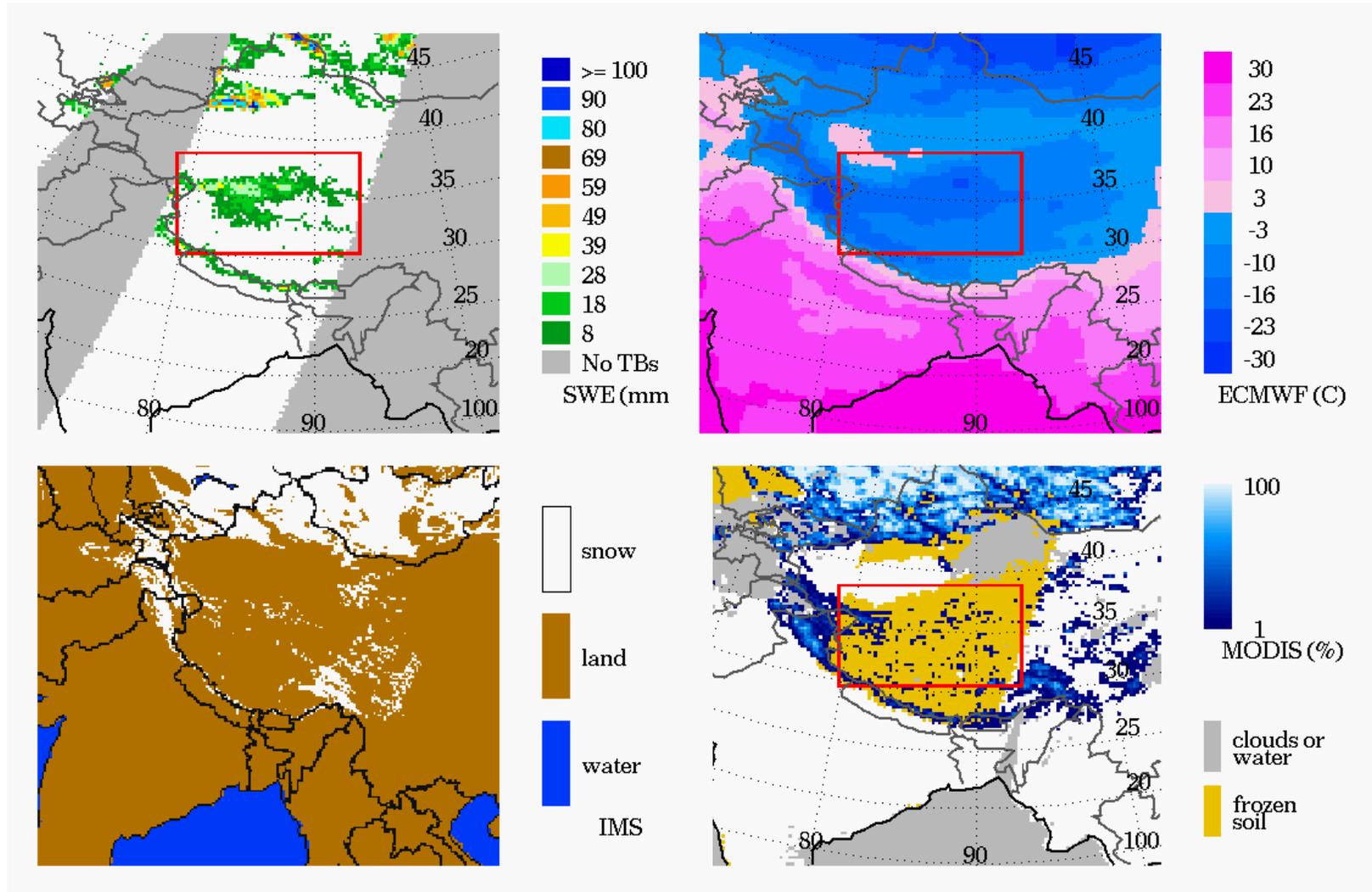
MODIS



NOAA  
IMS

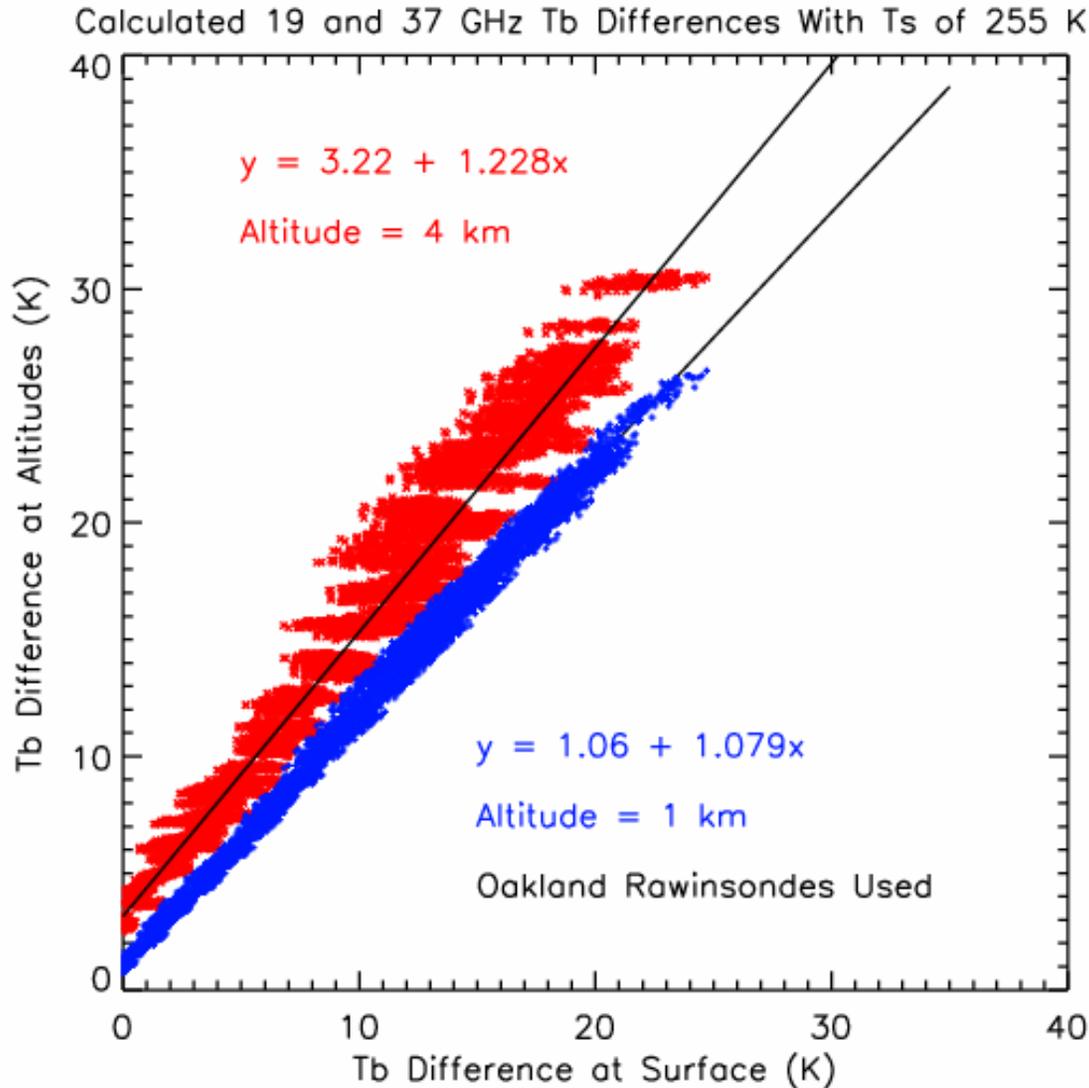


# Tibetan Plateau - Air Temperature and Frozen Soil



Clockwise from upper left: SWE derived from SSM/I, ECMWF average daily surface temperatures, MODIS snow cover with frozen soil derived from SSM/I, and NOAA IMS product.

# Possible Solution: Atmospheric Correction

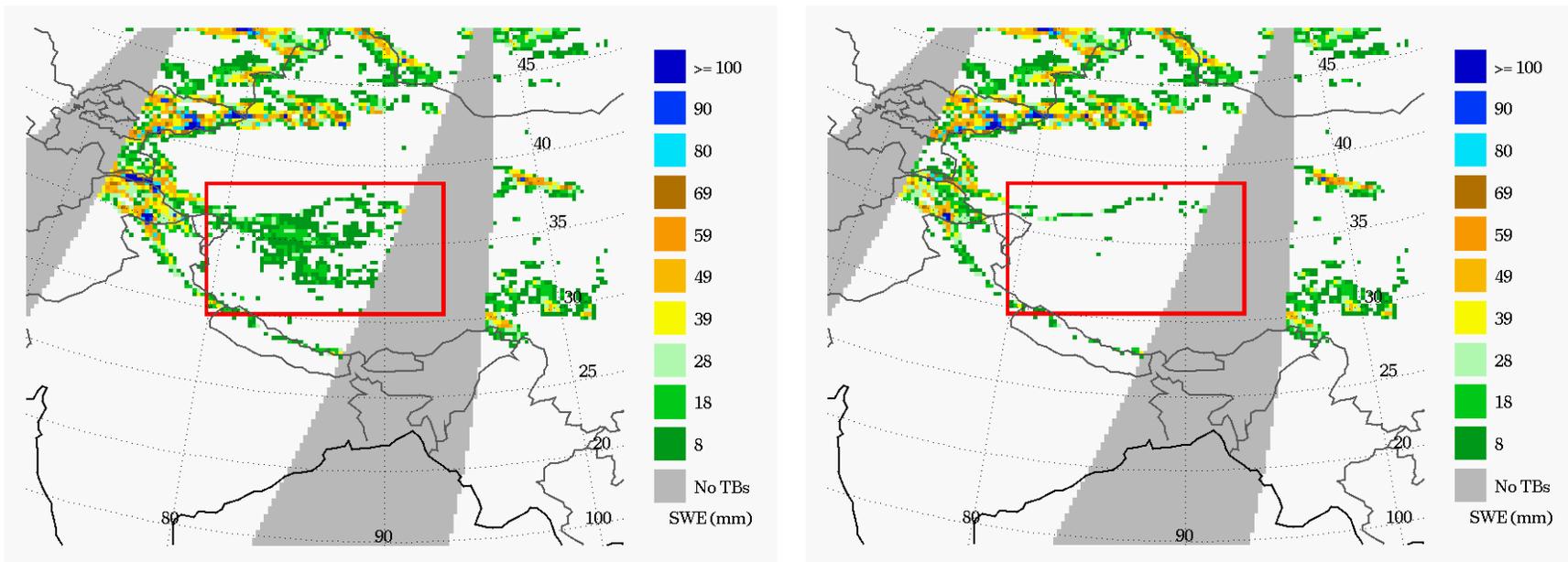


**Atmosphere should be considered when validating satellite retrieval algorithms based on surface and low-alt. aircraft Measurements (Wang & Manning, 2003)**

**Atmospheric correction to microwave spectral gradient, modelled at altitudes of 1 km and 4 km. James Wang, GSFC**

**Decreased atmospheric thickness leads to increased spectral gradient.**

# AMSR-E SWE, Before & After Atmospheric Correction



**Result of atmospheric correction, November 29, 2003. SWE derived from uncorrected AMSR-E (left) and corrected AMSR-E (right).**

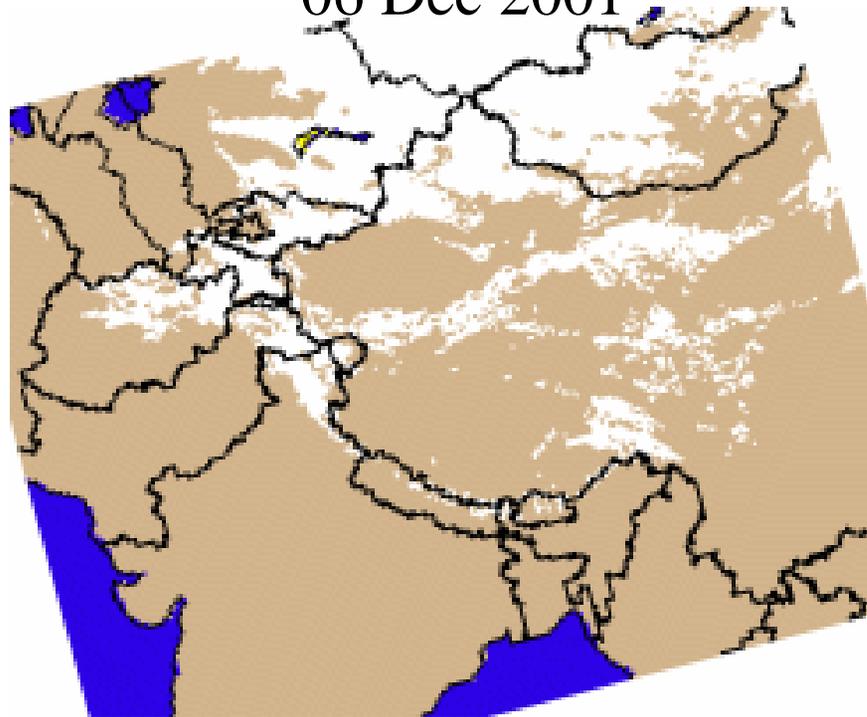
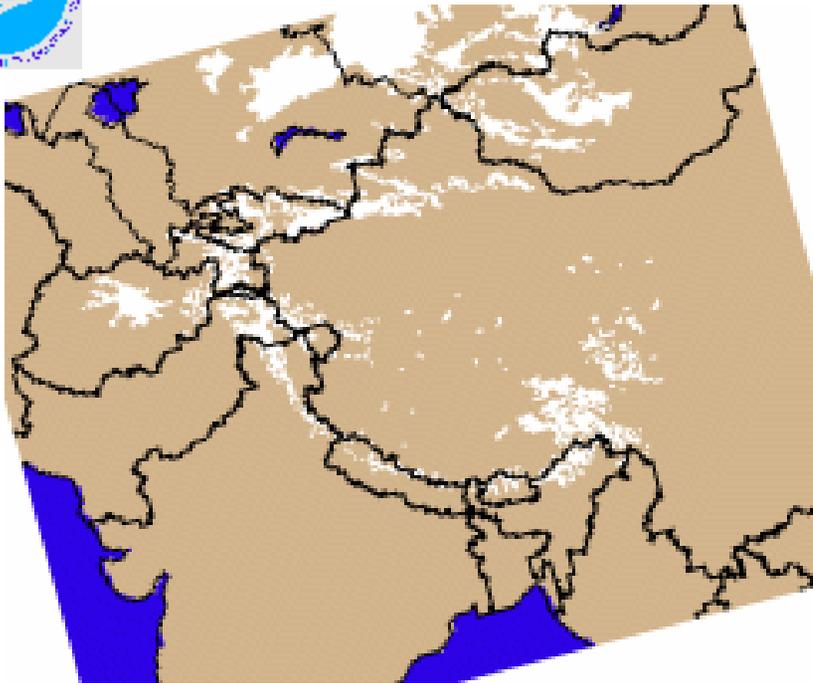




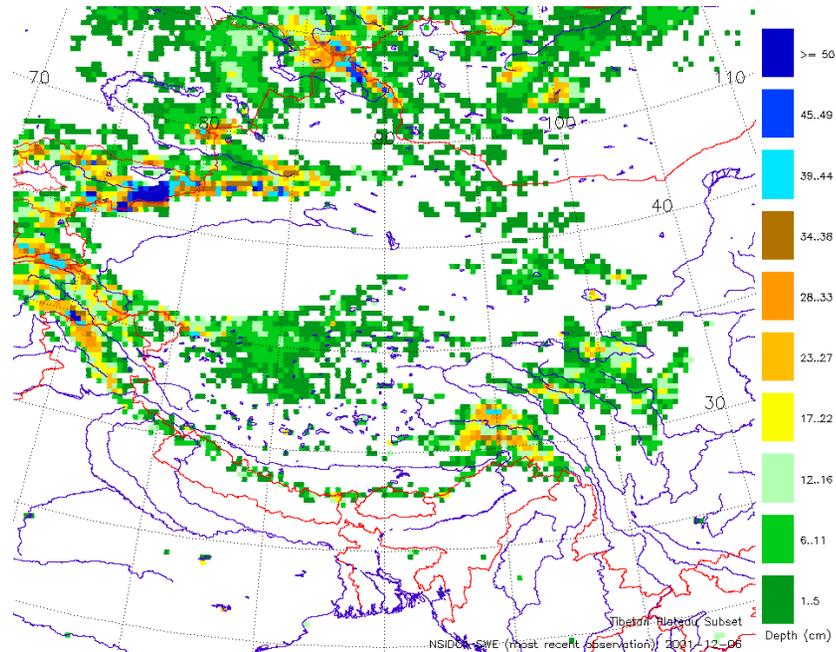
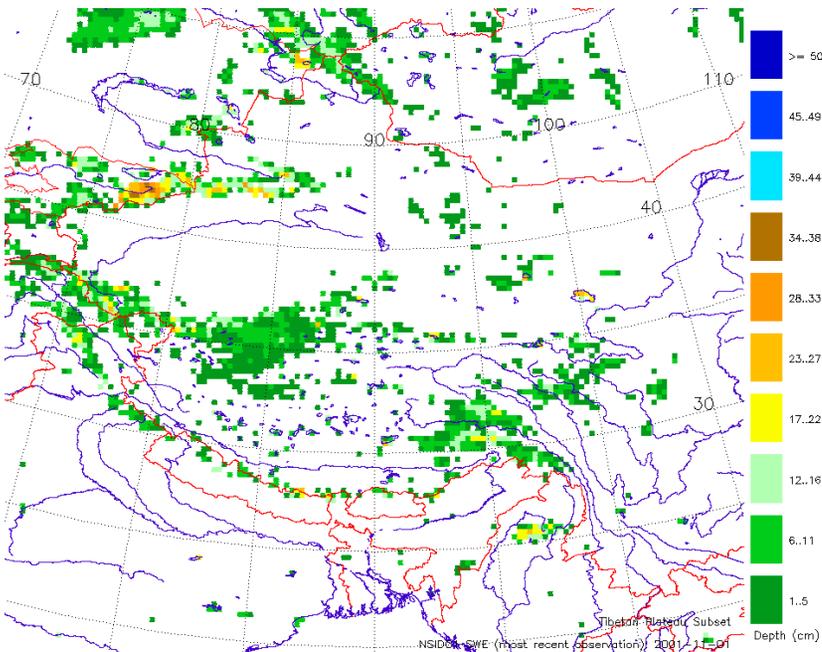
01 Nov 2001

06 Dec 2001

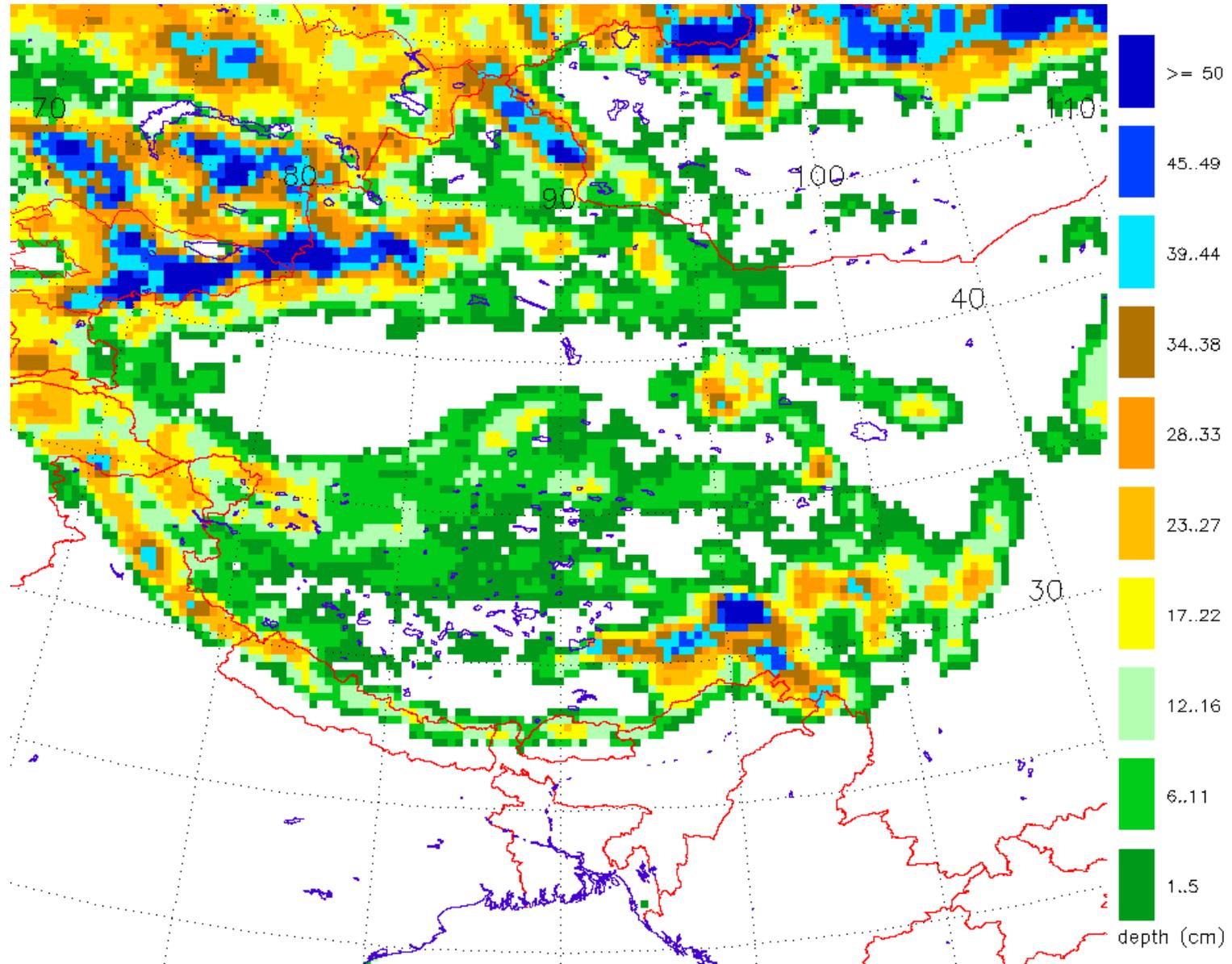
Visible



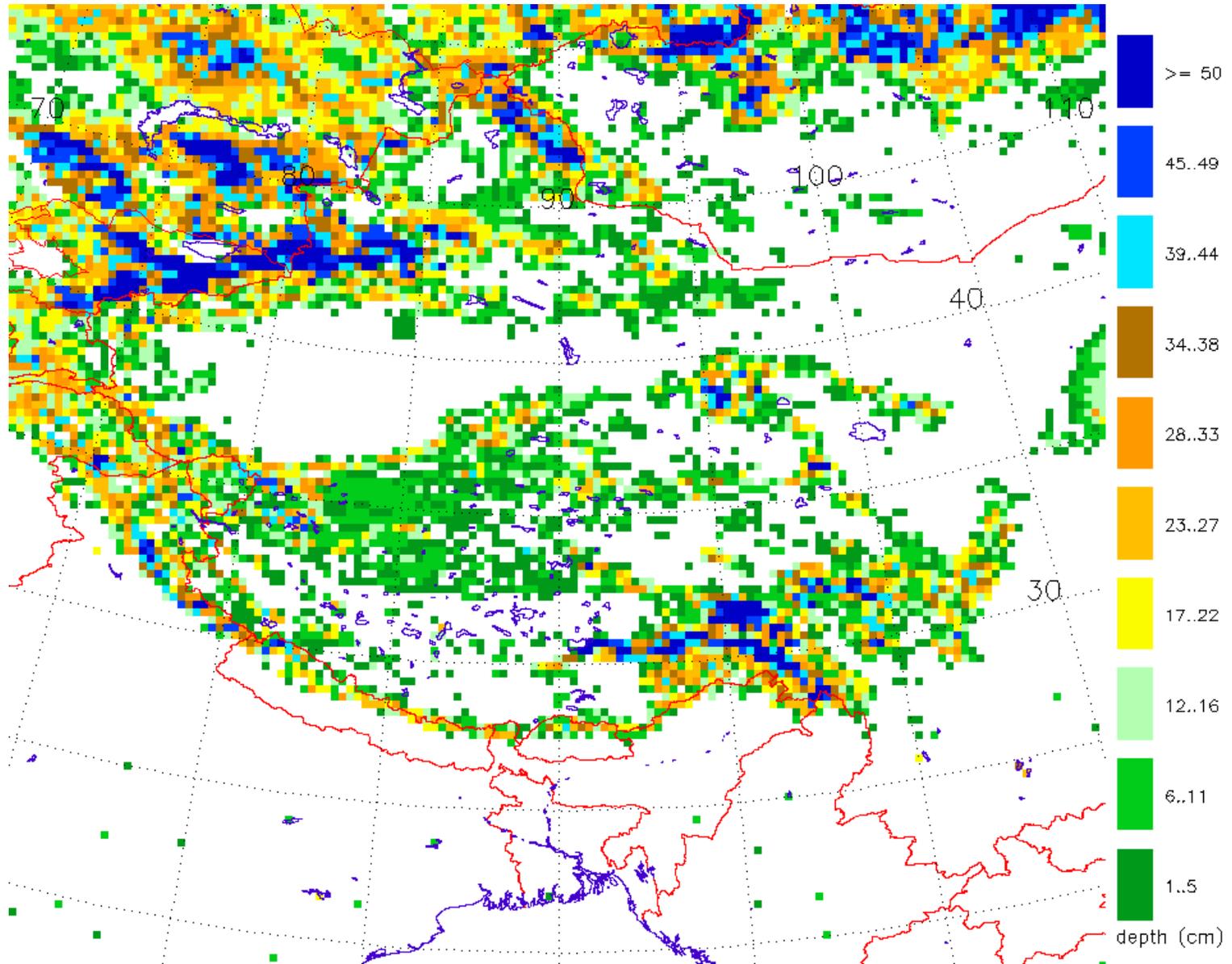
Microwave



# Snow Cover Derived from SSM/I January 9-16 2003



# Snow Cover Derived from AMSR-E January 9-16 2003



# Definitions

- **Footprint mean** = the mean of the brightness temperatures of each grid cell in a footprint.
- **Footprint standard deviation** = spatial variance at an instant in time or how the grid cells change in brightness temperature over the footprint. Needs to be small to have a homogeneous target.
- **Average daily footprint mean** = time average of the footprint mean, e.g. over one year.
- **Standard deviation of the daily footprint mean** = standard deviation of the footprint mean over time. Sites with a low SDDFM when the time period is long are sites that generally have low seasonal brightness temperature variation.
- **Average daily footprint standard deviation** = the average of each footprint standard deviation over some time series. Sites that are spatially homogeneous or have low brightness temperature gradients across a footprint will have low values of ADFSD. An area with a large ADFSD would not be a suitable calibration target, such as locations near land/water boundaries.