MODIS Snow and Sea Ice Cover using Moderate Resolution Imaging Spectroradiometer (MODIS) data

Dorothy K. Hall

Hydrological Sciences Branch

NASA/GSFC

dhall@glacier.gsfc.nasa.gov

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http://snowmelt.gsfc.nasa.gov/MODIS_Snow/modis.html

Others Involved in the Project

Vincent V. Salomonson/NASA/GSFC, Team Member

George A. Riggs/SSAI Team Leader (algorithm development, science, programming)

Igor Appel/SSAI (works with Vince on FSC for 500-m product)

Kimberly A. Casey/SSAI (Web site, sea ice)

Janet Y. L. Chien/GSC (image processing, validation)

Nicolo E. DiGirolamo/SSAI (programming)

Andrew G. Klein/Texas A&M (snow albedo)

Hugh W. Powell/GSC (programming)

Outline

- Snow Products
  - Recent and future enhancements
  - Validation activities & status
- Sea Ice Products
  - Validation activities & status
  - Future validation efforts
- Outreach Acitivity - SVS Animation

Snow Products

Archived and Distributed by NSIDC

http://nsidc.org

Daily 500-m resolution swath

Daily 500-m resolution tile

8-day composite 500-resolution tile

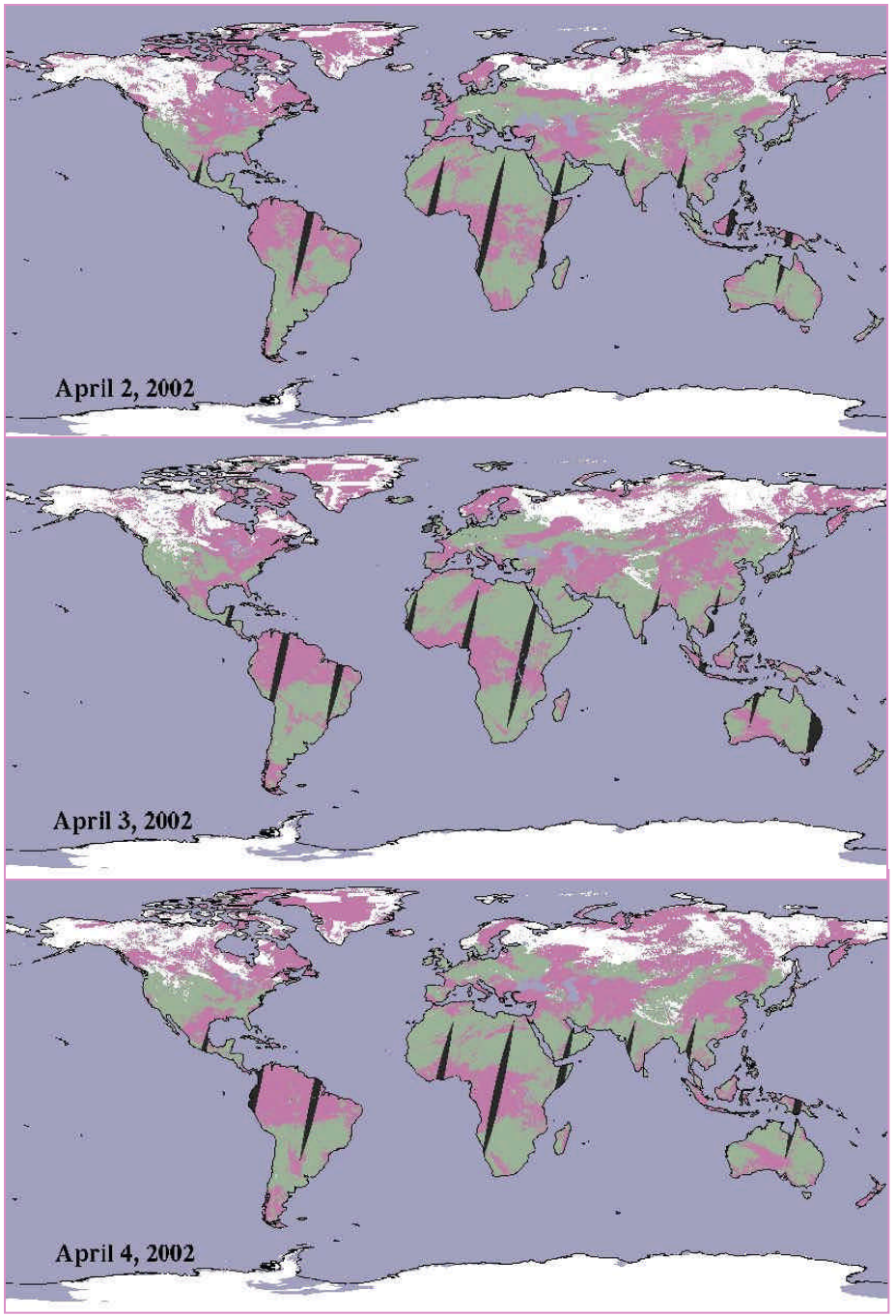
Daily climate-modeling grid (CMG)

8-day composite CMG

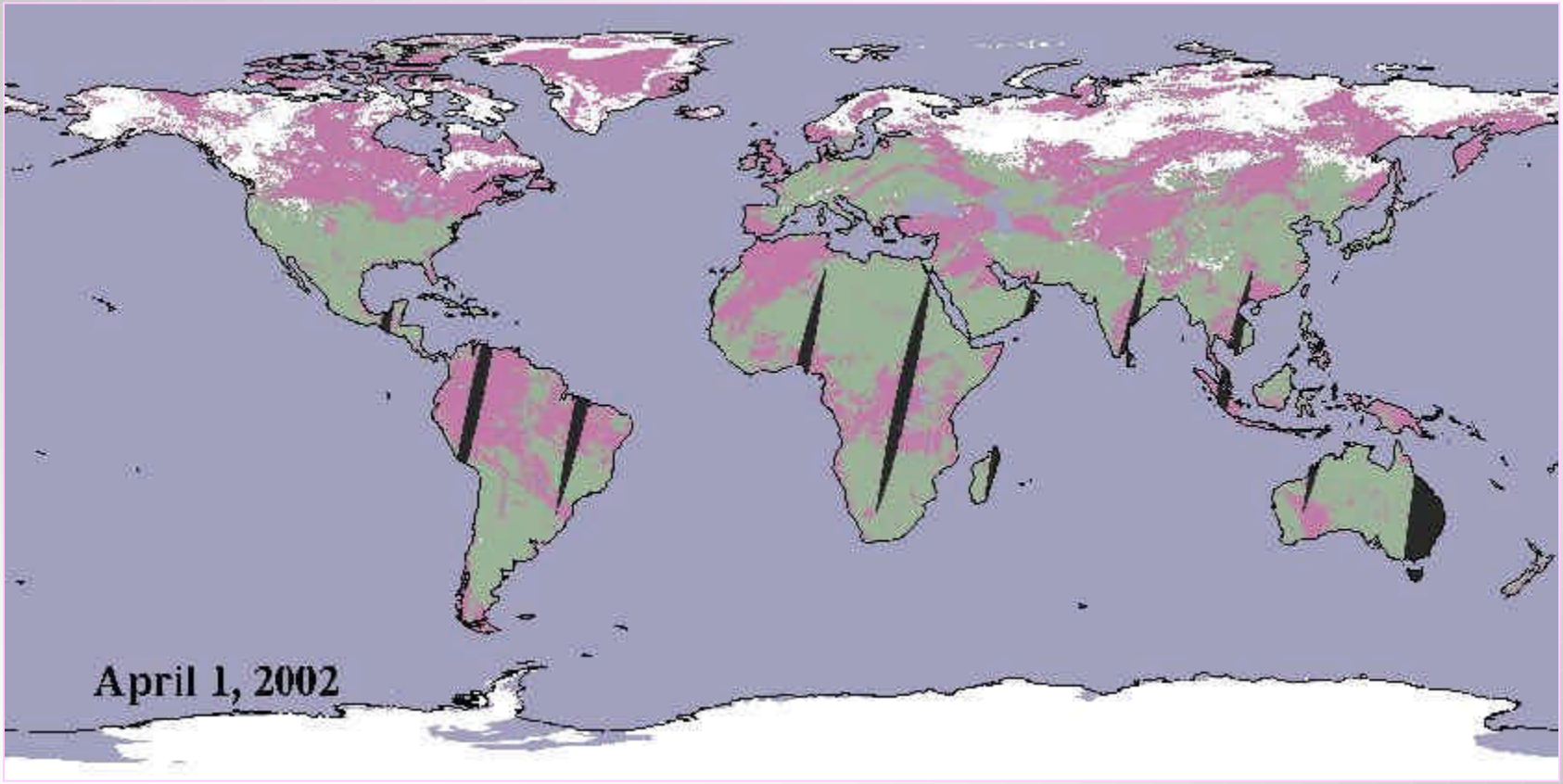
Snow albedo – planned for fall 2002

Fractional snow cover for 500-m maps - future

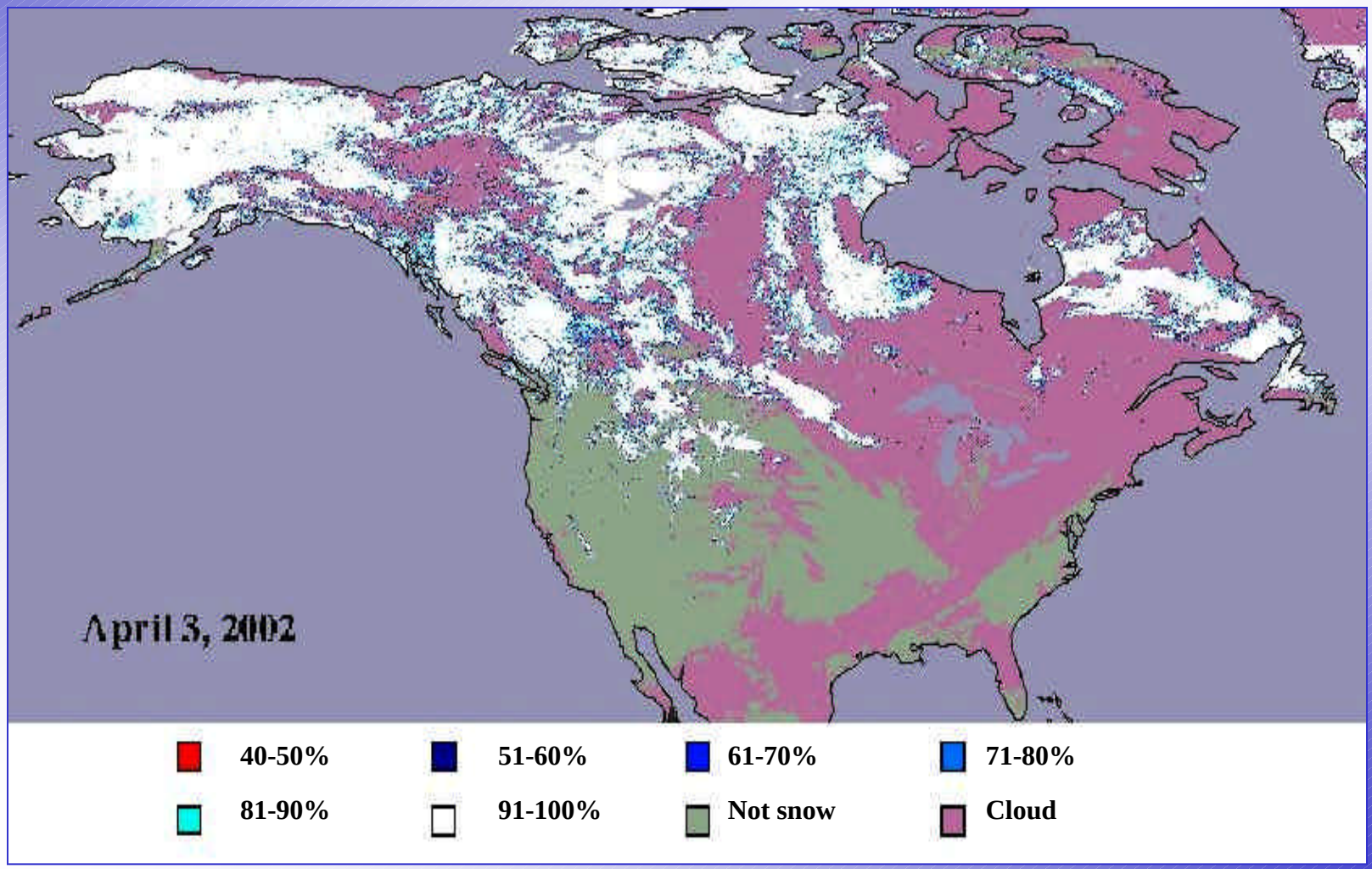
MODIS climate-modeling grid (CMG) daily snow maps at 0.05° resolution (~5.6 km at the Equator)



Daily MODIS CMG Snow Map

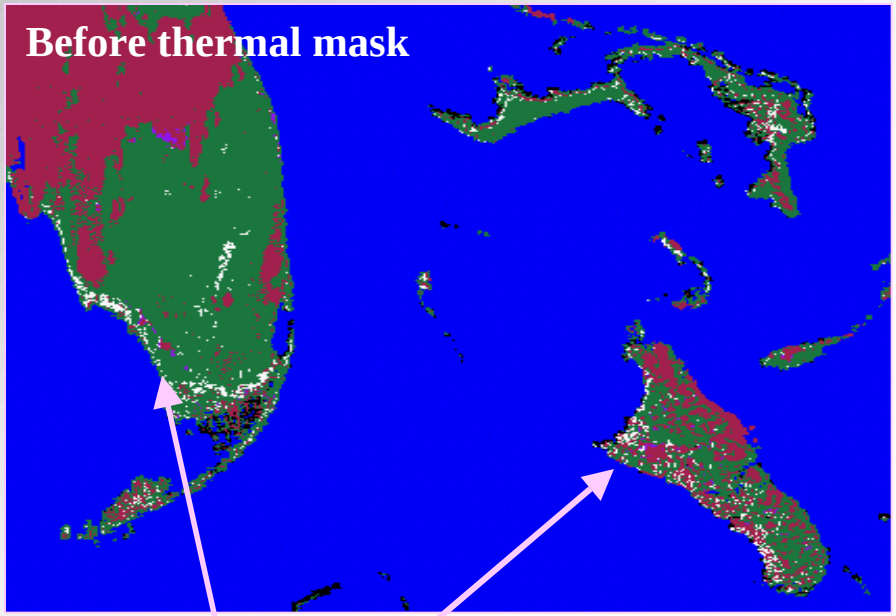


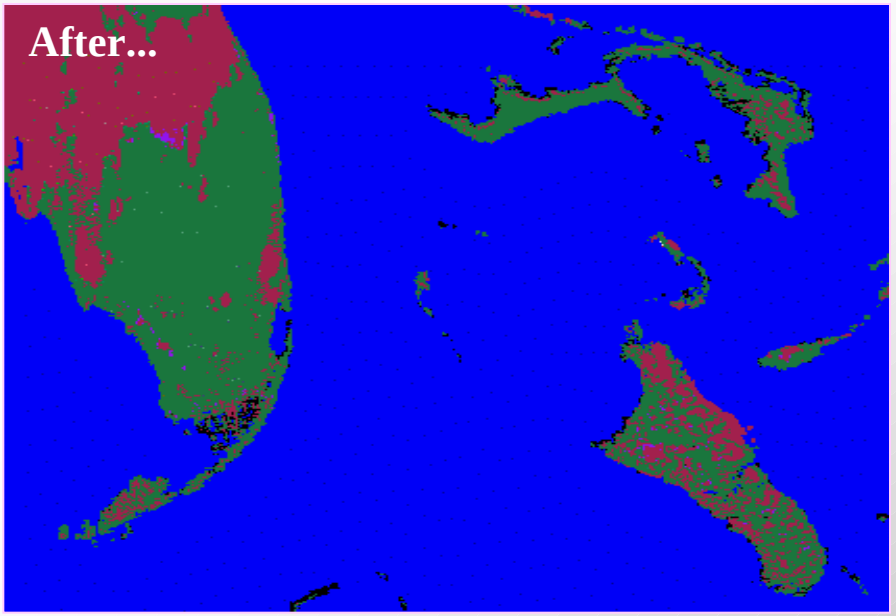
The Daily CMG maps show fractional snow cover from 40 - 100% in each pixel



Eight-Day Composite Global CMG MODIS Snow Map

A thermal mask (>277 K) was instituted in order to eliminate spurious snow cover



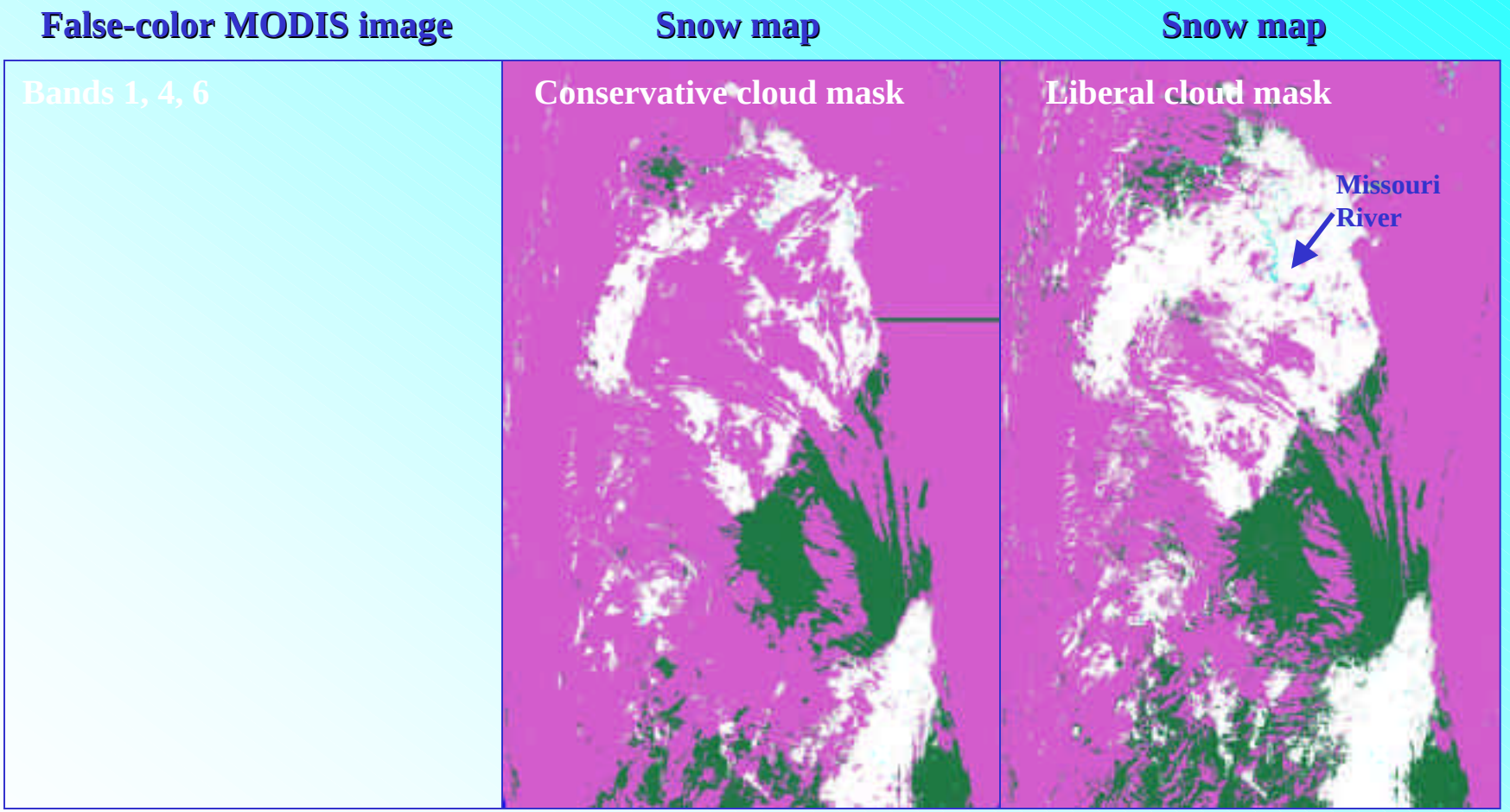


14 Nov 2000

Confusion with sand and clouds and some water bodies is eliminated in Florida and the Bahamas

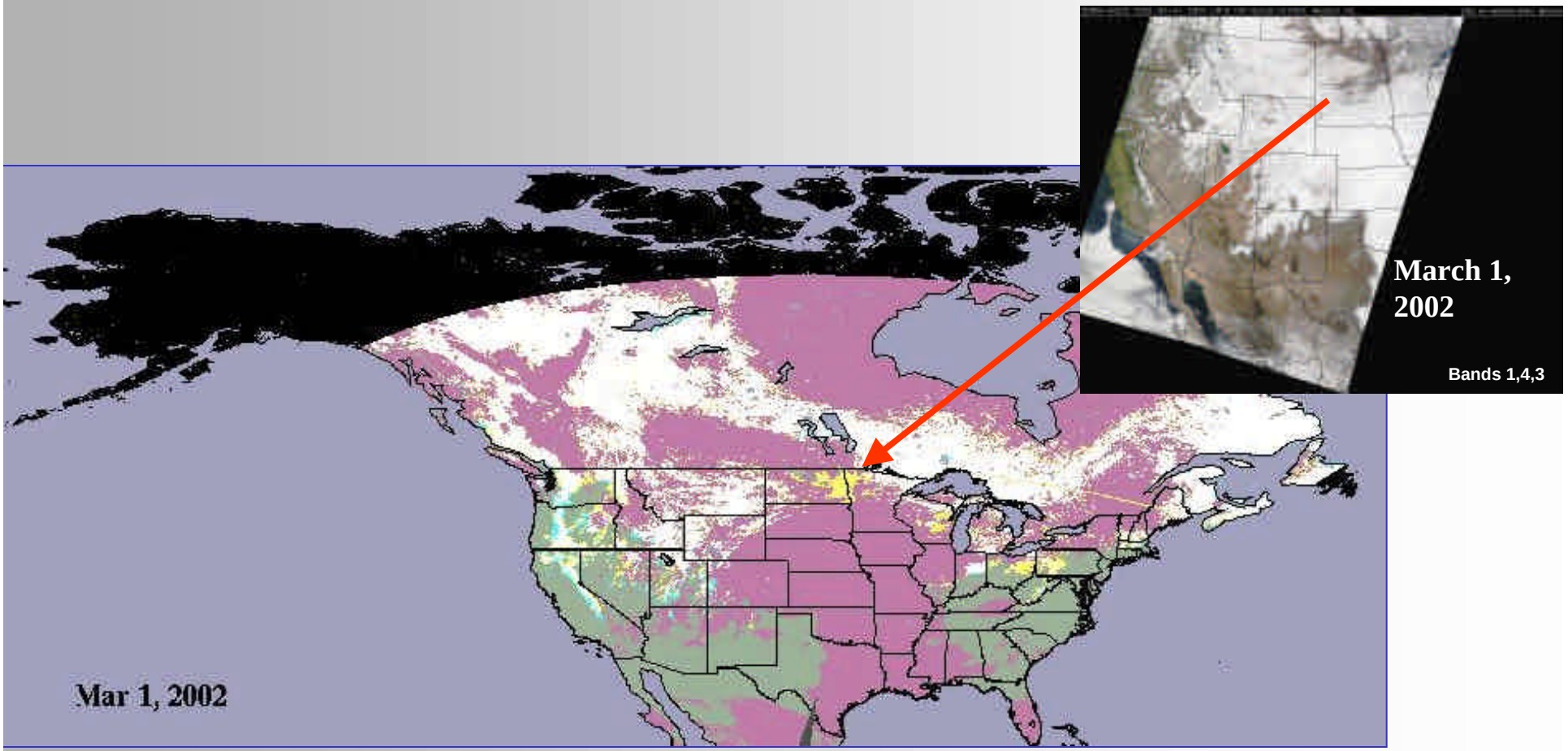
Cloud Masking – Mid-Western U.S.

November 29, 2001



The liberal cloud mask result, on the right, results in a 75% increase in snow being mapped, and an 18% decrease in the amount of clouds mapped.

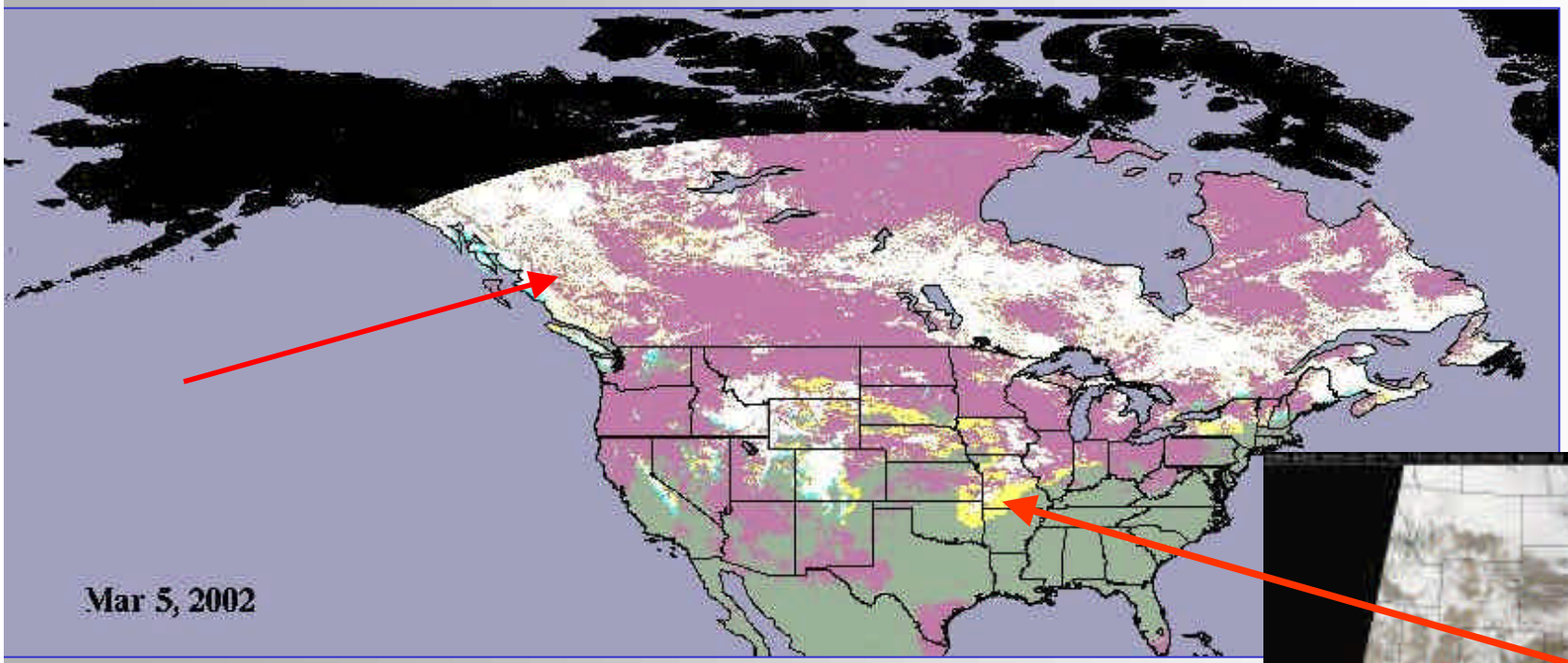
MODIS-IMS Daily Difference Maps



- Snow on both maps
- Snow on MODIS maps only
- Snow on IMS maps only
- Clouds from MODIS maps

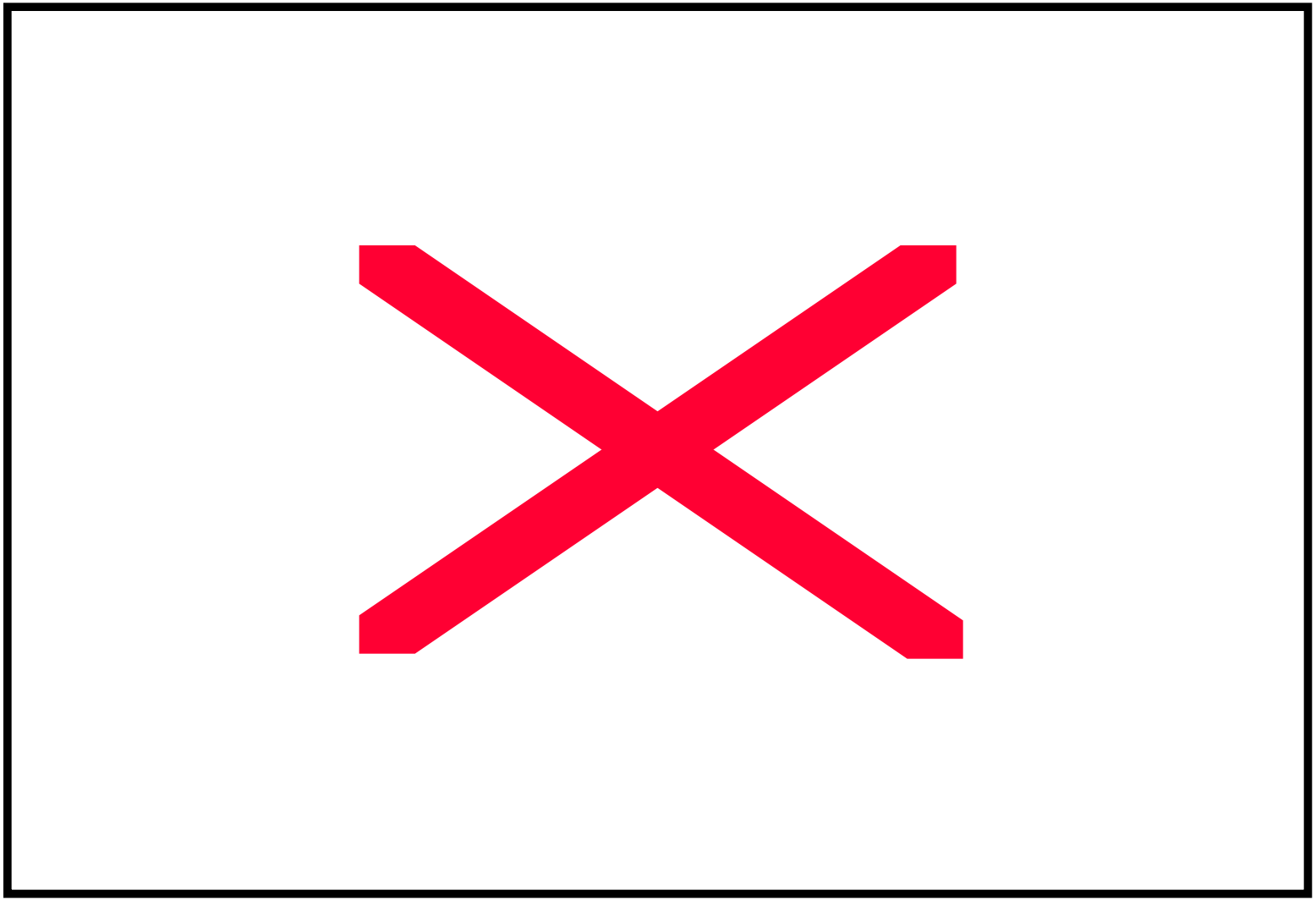
NOAA Interactive Multisensor Snow and Ice Mapping System (IMS) map showed snow cover in North Dakota and Minnesota and MODIS shows no snow

MODIS-IMS Daily Difference Maps



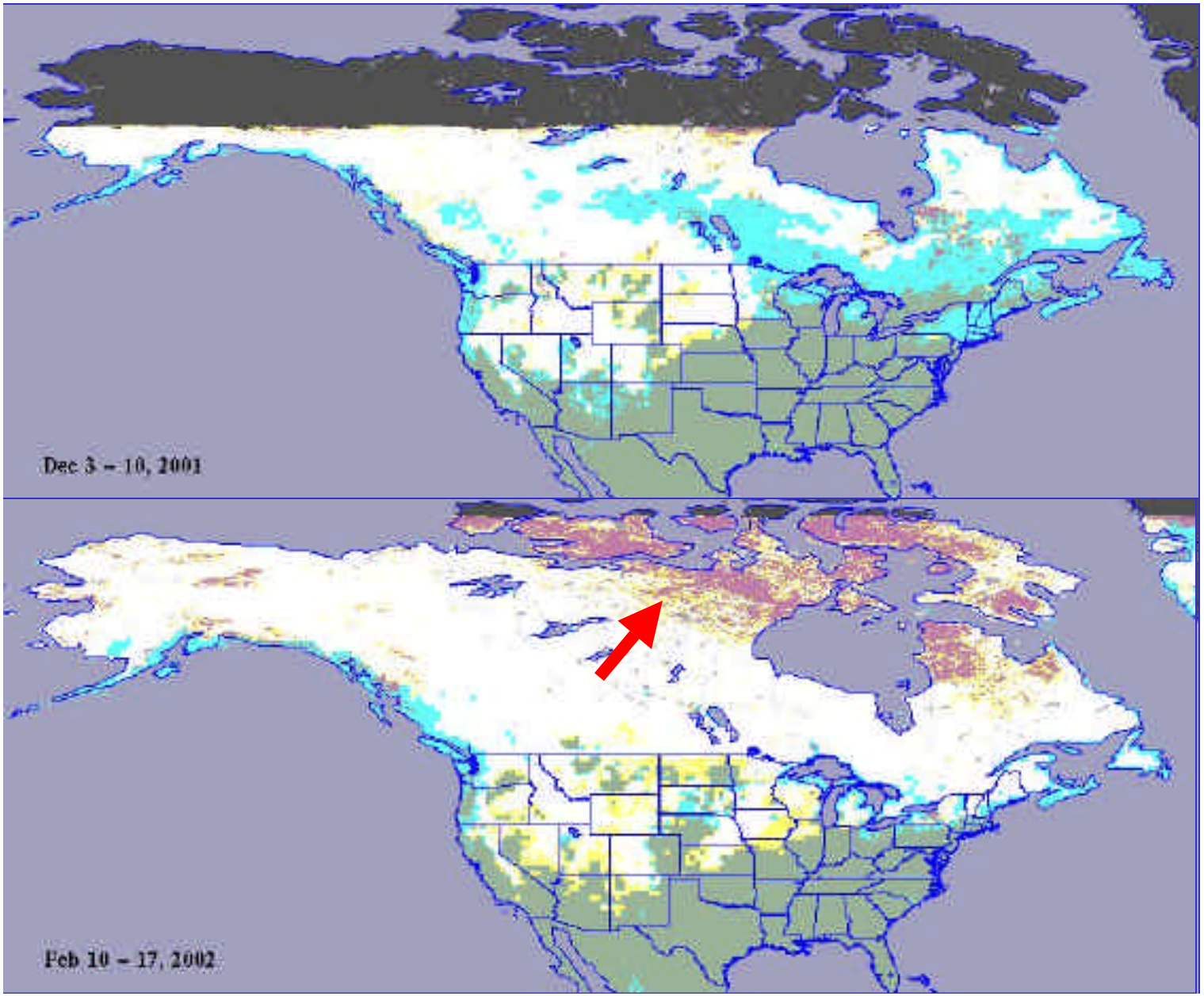
- Snow on both maps
- Snow on MODIS maps only
- Snow on IMS maps only
- Clouds from MODIS maps

IMS maps showed more extensive snow cover in Missouri and Oklahoma than did the MODIS maps

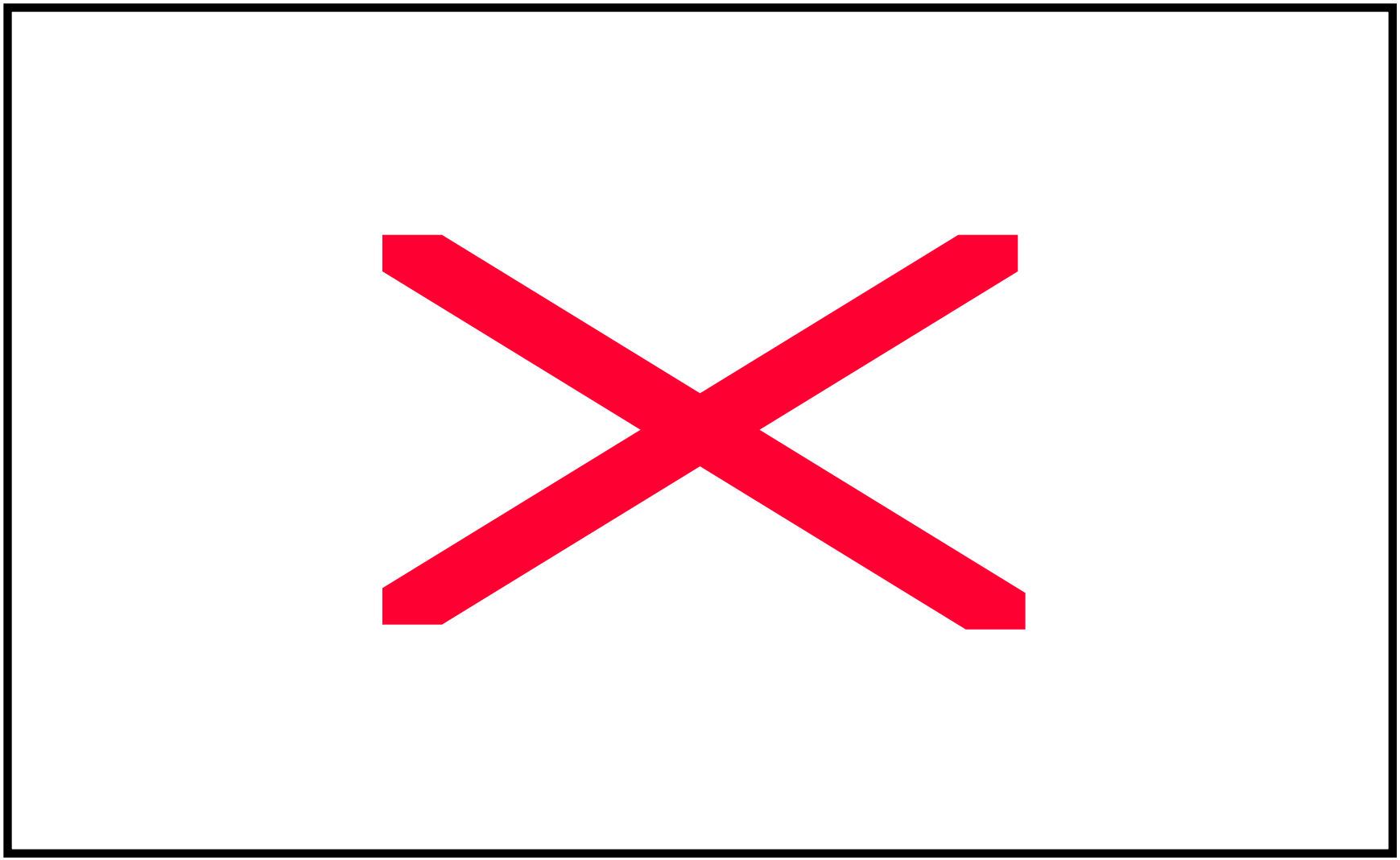


For this 8-day period, the MODIS and IMS maps agree more than 80%of the time. The IMS maps consistently map more snow cover than do the MODIS maps.

MODIS-SSMI Difference Maps

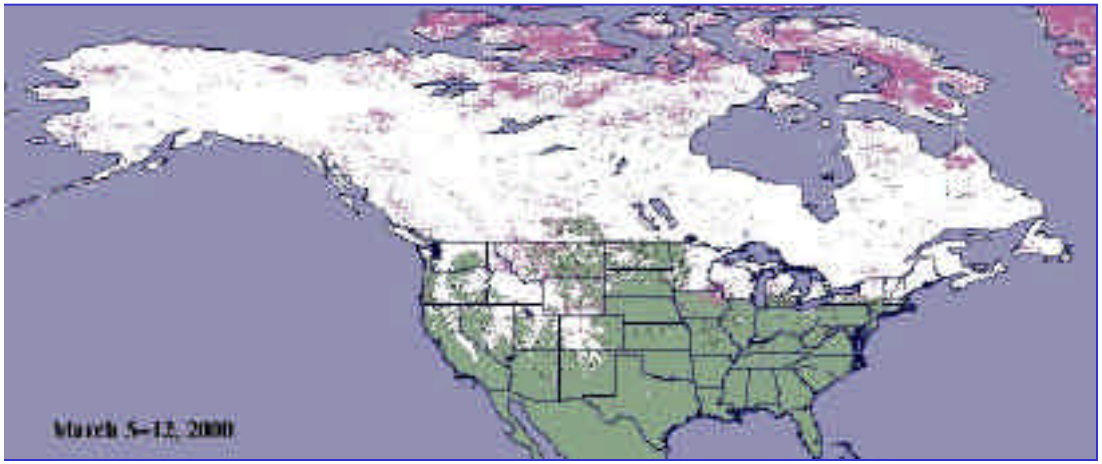


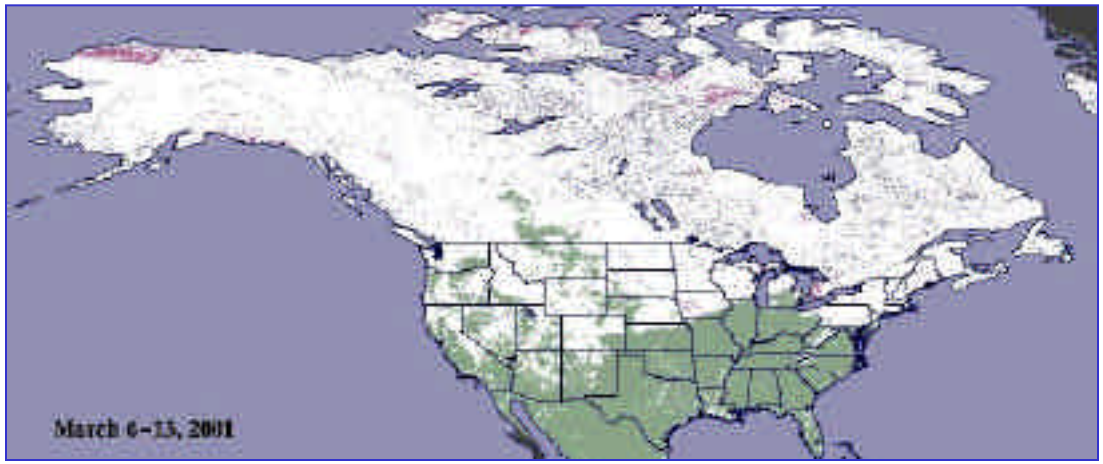
Results of the MODIS-SSM/I difference maps for the 2001-02 winter

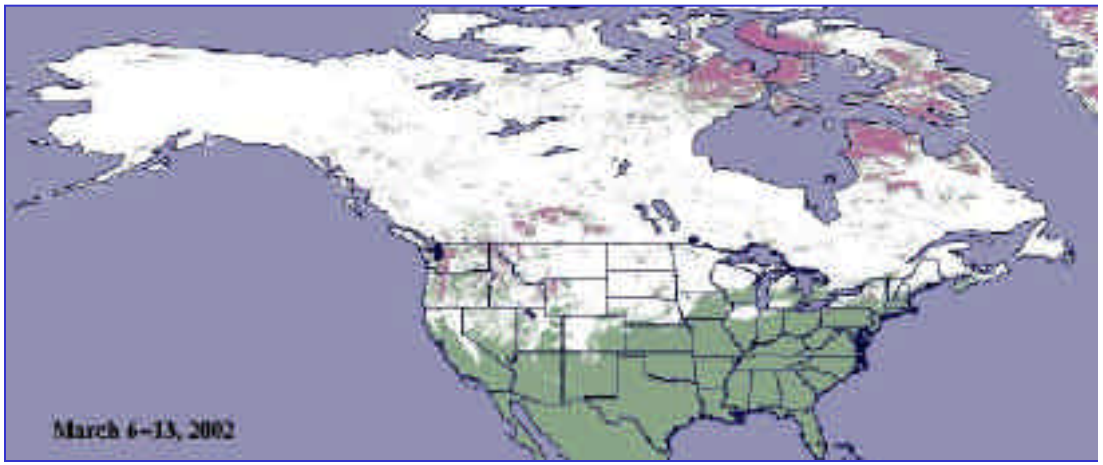


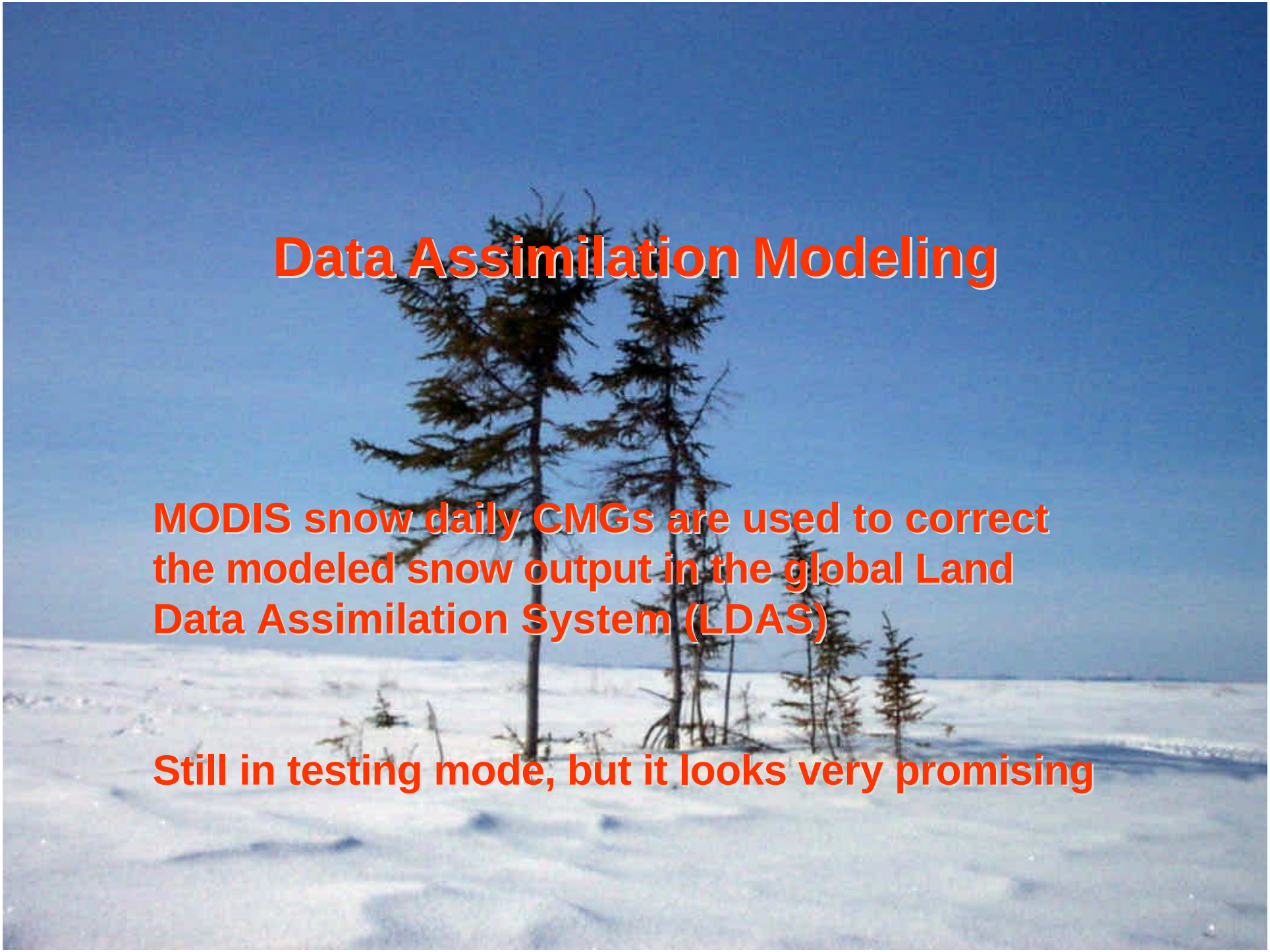
Interannual Comparisons

(8-day composite CMGs show maximum snow cover for the period)








Data Assimilation Modeling
MODIS snow daily CMGs are used to correct the modeled snow output in the global Land Data Assimilation System (LDAS)
Still in testing mode, but it looks very promising

MODIS Sea Ice Maps

- **Sea ice extent**
  - based on NDSI
- **Ice-surface temperature (IST)**
  - split-window technique using MODIS bands 31 and 32 developed by Jeff Key and others

MODIS Sea Ice Data Products

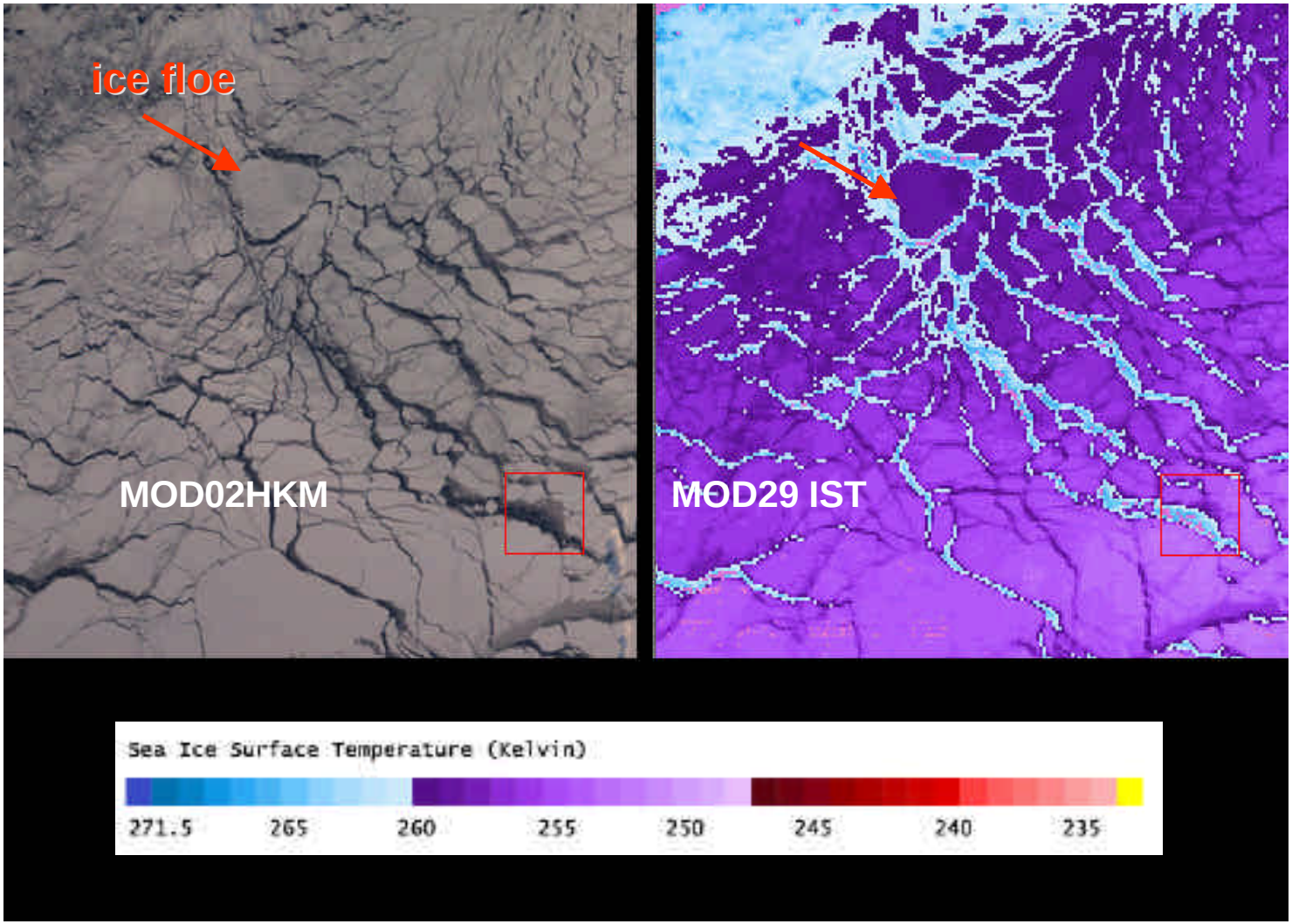
Archived and Distributed by NSIDC

http://nsidc.org

- Global, daily and 8-day composite 1-km resolution sea ice cover/IST maps
- Global daily climate-modeling grid (CMG) products at ~4-km resolution beginning late-fall 2002
- Global 8-day composite Climate-Modeling Grid (CMG) products at ~4-km resolution beginning late-fall 2002

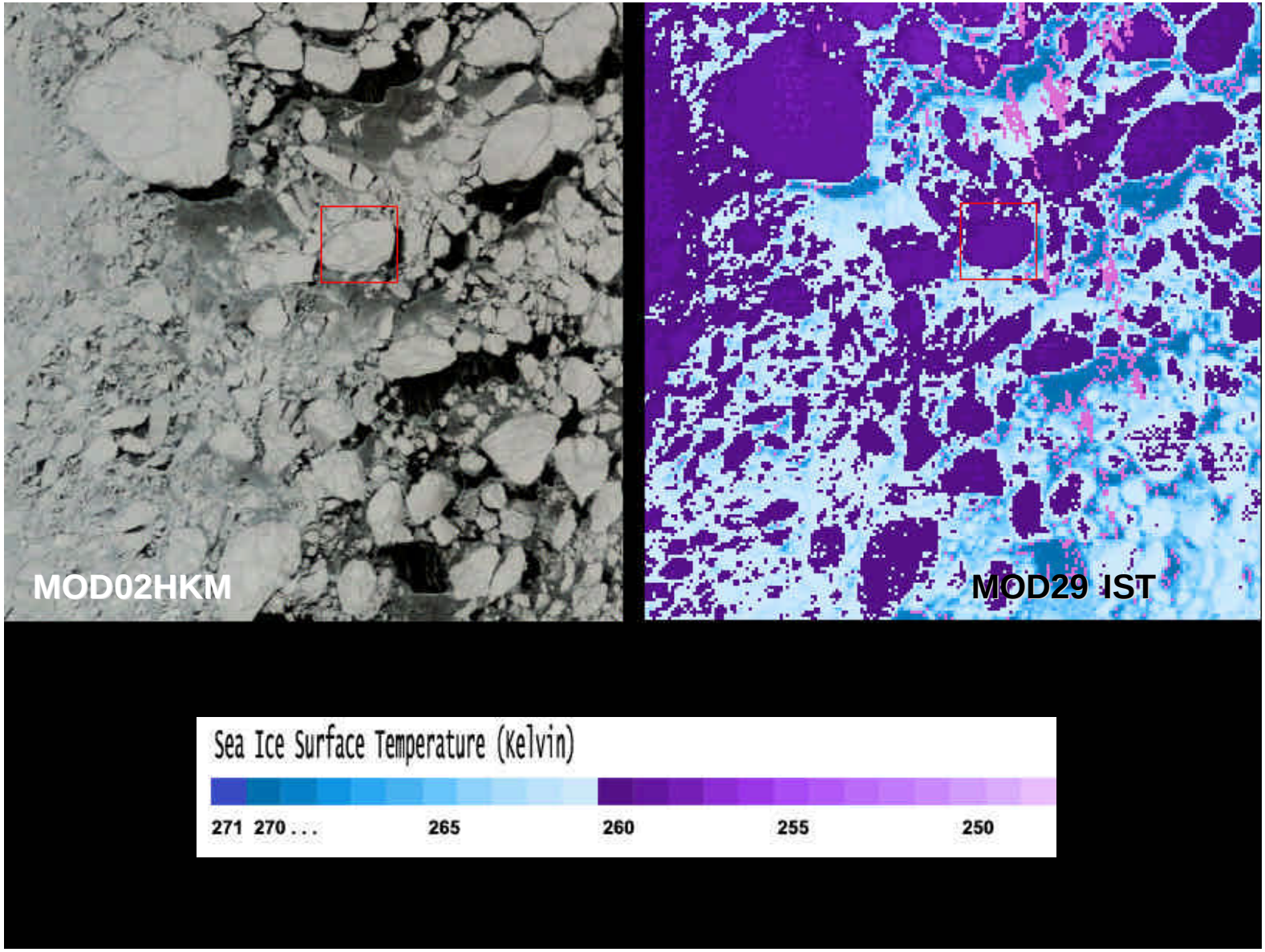
MODIS IST from an area near the tip of the Antarctic Peninsula

April 16, 2002 (fall)



MODIS IST map acquired in the Arctic Ocean west of Greenland

April 1, 2002



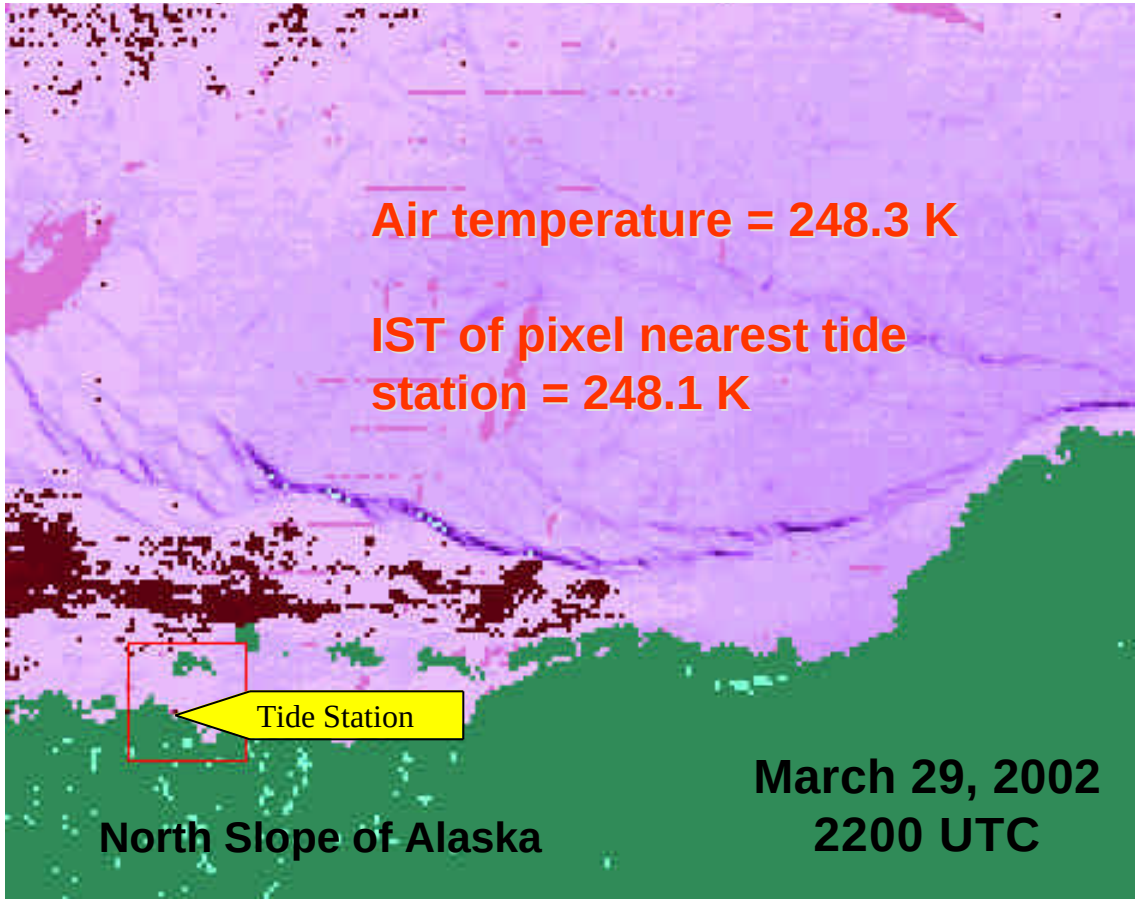
NOAA/NOS CO-OPS Tide Station Prudhoe Bay, AK

(NOAA / National Ocean Services Center for Operational Oceanographic Products and Services)

Latitude 70° 24.0'N
Longitude 148° 31.6'W

http://www.co-ops.nos.noaa.gov/co-ops.html

MOD29 Sea Ice Surface Temperature (IST) Map



IST Validation Summary

Prudhoe Bay, Alaska, Tide Station

Date	Time (UTC)	MODIS IST (°K)	P.B. Tide Station Air Temperature (°K)	Difference (°K)
03 Mar 2002	2100	245.0	244.7	0.3
29 Mar 2002	2145	248.1	248.3	0.2
30 Mar 2002	2230	250.0	248.5	1.5
31 Mar 2002	2135	251.5	251.2	0.3

Future Validation Opportunity - Sea Ice

Don Cavalieri/NASA/GSFC, Jim Maslanik/Univ. of Colorado, Matthew Sturm/CRREL, and others

Aircraft and Field Experiment March 2003

- **Wallops P3 based in Fairbanks**
- **AMSR, MODIS, field measurements on sea ice**
- **IR surface temperature from the aircraft**

Product Validation Status

Snow and sea ice cover products are validated

Ice surface temperature product is Provisional (or Validated at Stage 1 according to the new MODland model)


MODIS Snow Cover
NASA
SVS