MODIS Snow and Ice Products Preliminary Results

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June 8, 2000

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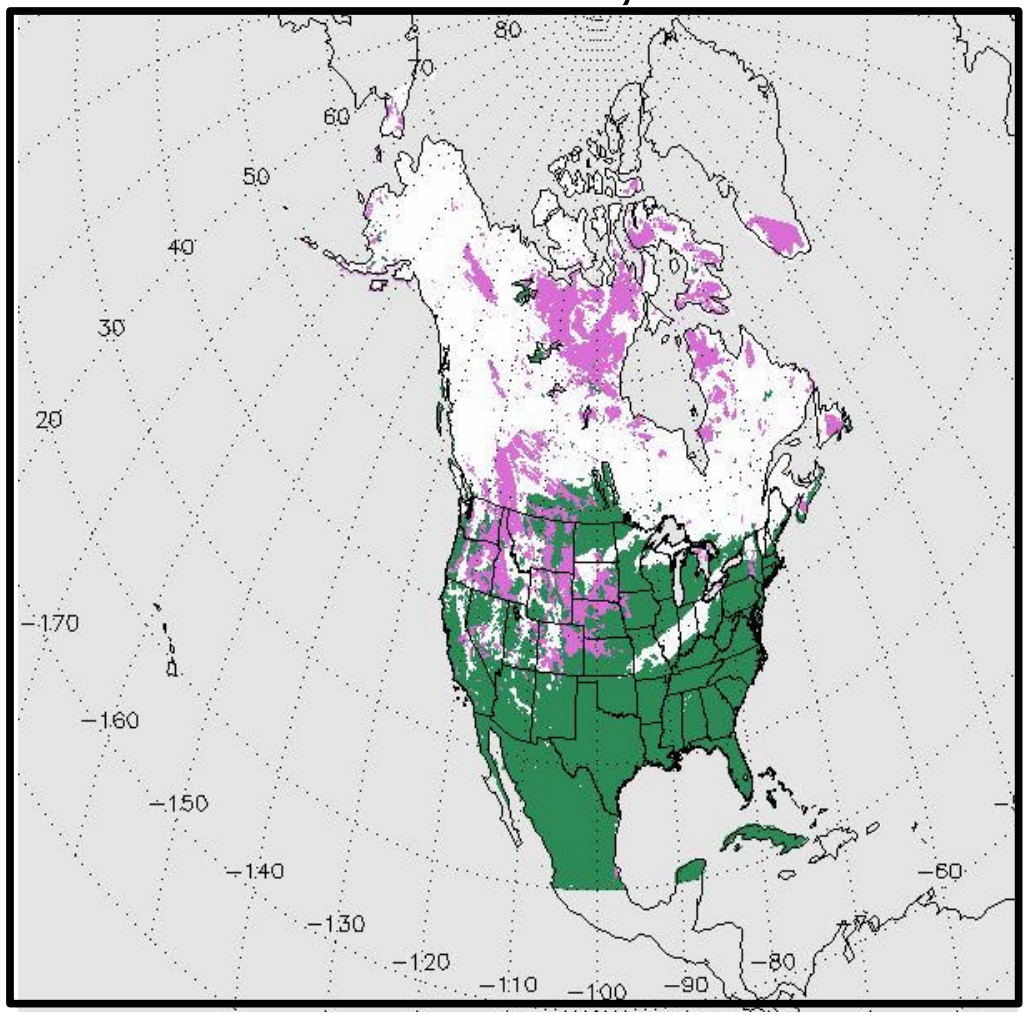
- J.C. Shi/UCSB

Outline

- Examples of snow and sea ice maps
- Preliminary validation of snow and sea ice maps
- Near-term enhancements (post-launch products)
  - Fractional snow cover
  - Snow and sea ice albedo
- Outstanding issues
  - Band 6 striping
  - Release dates
- Discussion/Conclusion

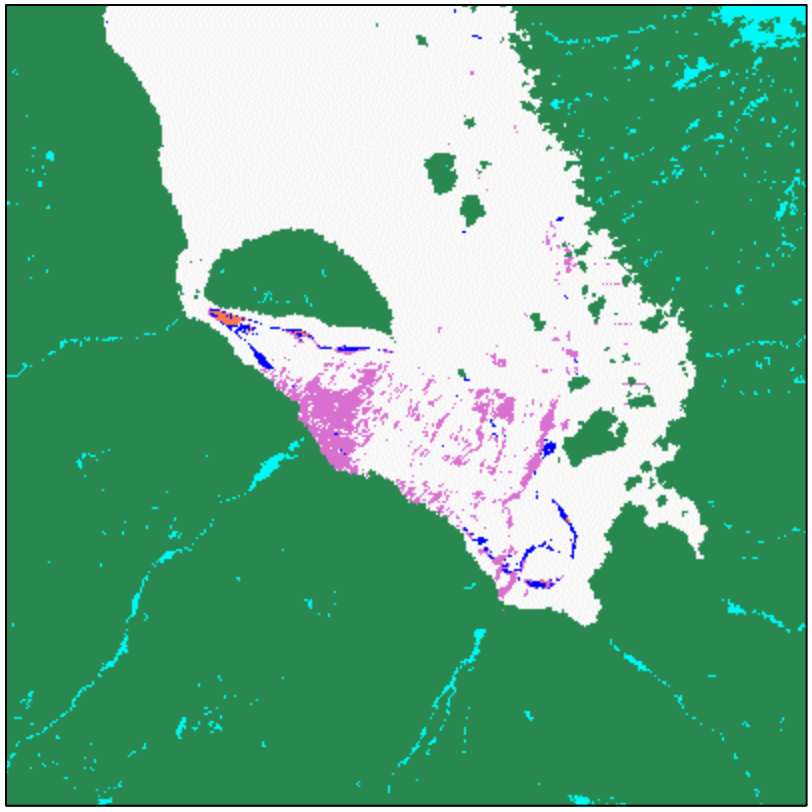
MODIS Snow Map

March 5-12, 2000

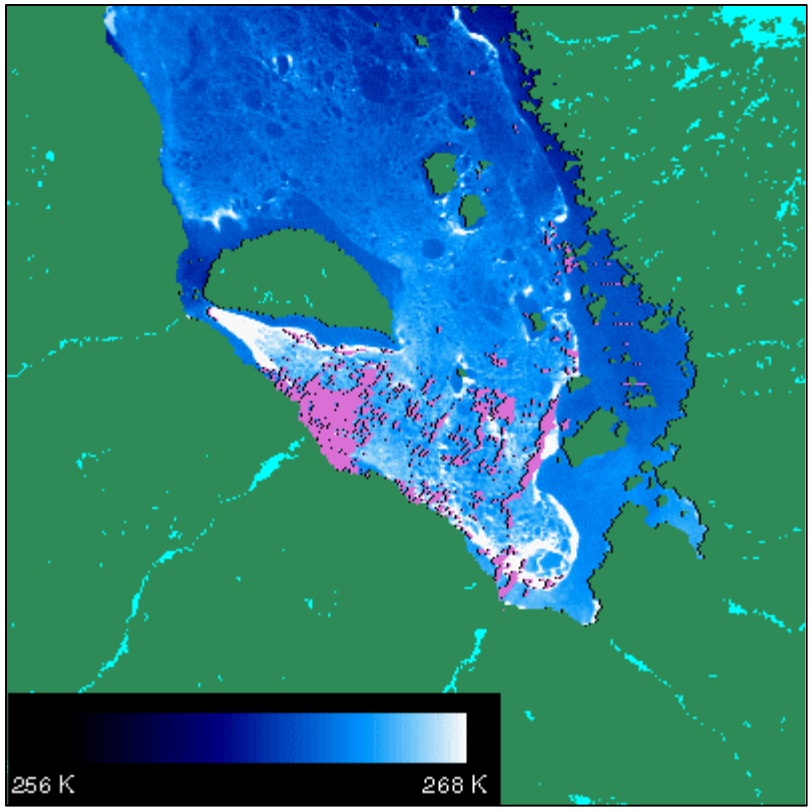


Sea Ice in James Bay, Canada

February 24, 2000



Sea Ice Extent

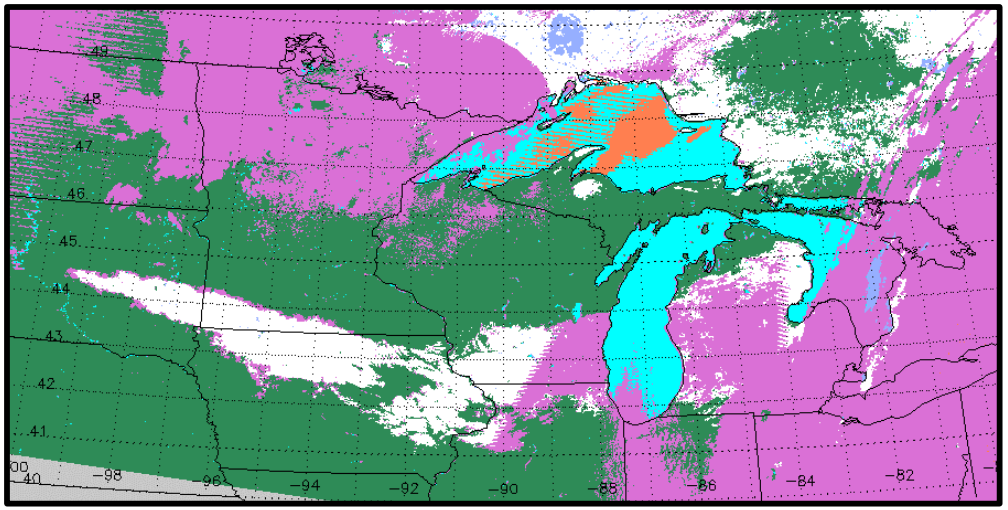


IST

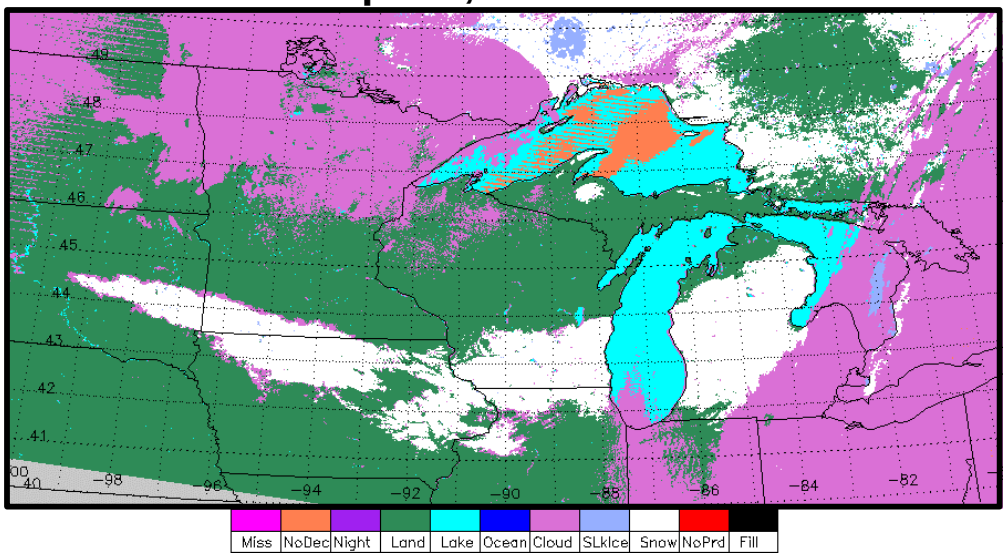
MODIS Snow Products

- 500-m resolution daily & 8-day composite
- CMG daily & 8-day composite
- Daily products will include sub-pixel snow cover
- Daily albedo product under development

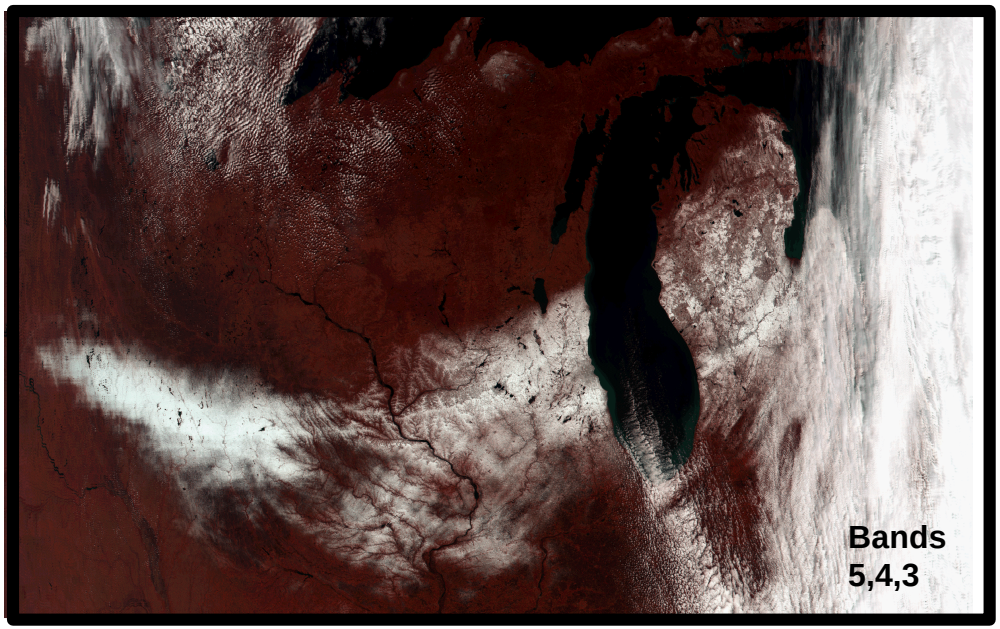
Comparison of original and revised cloud masks



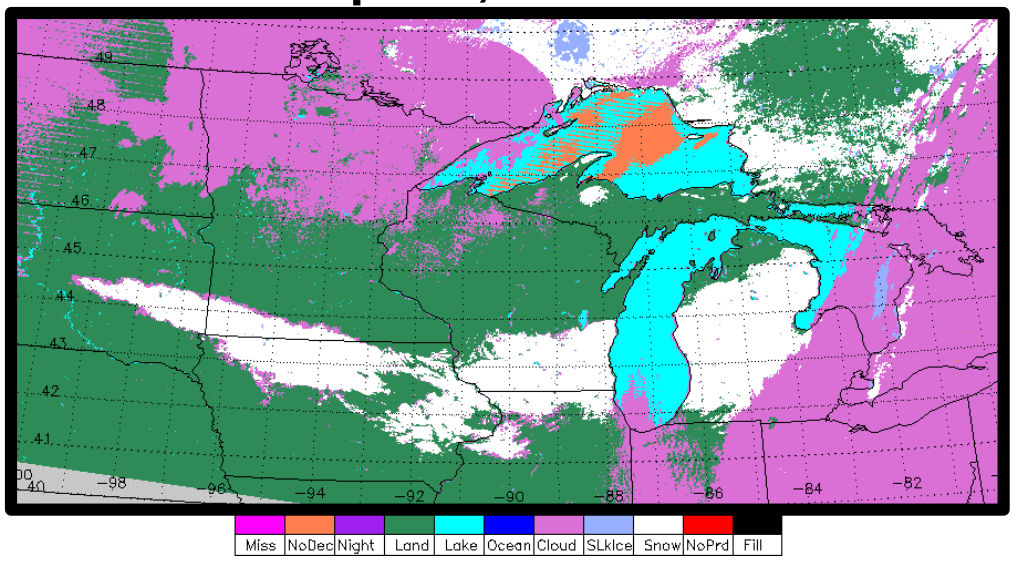
April 8, 2000



Comparison of MODIS image and snow map

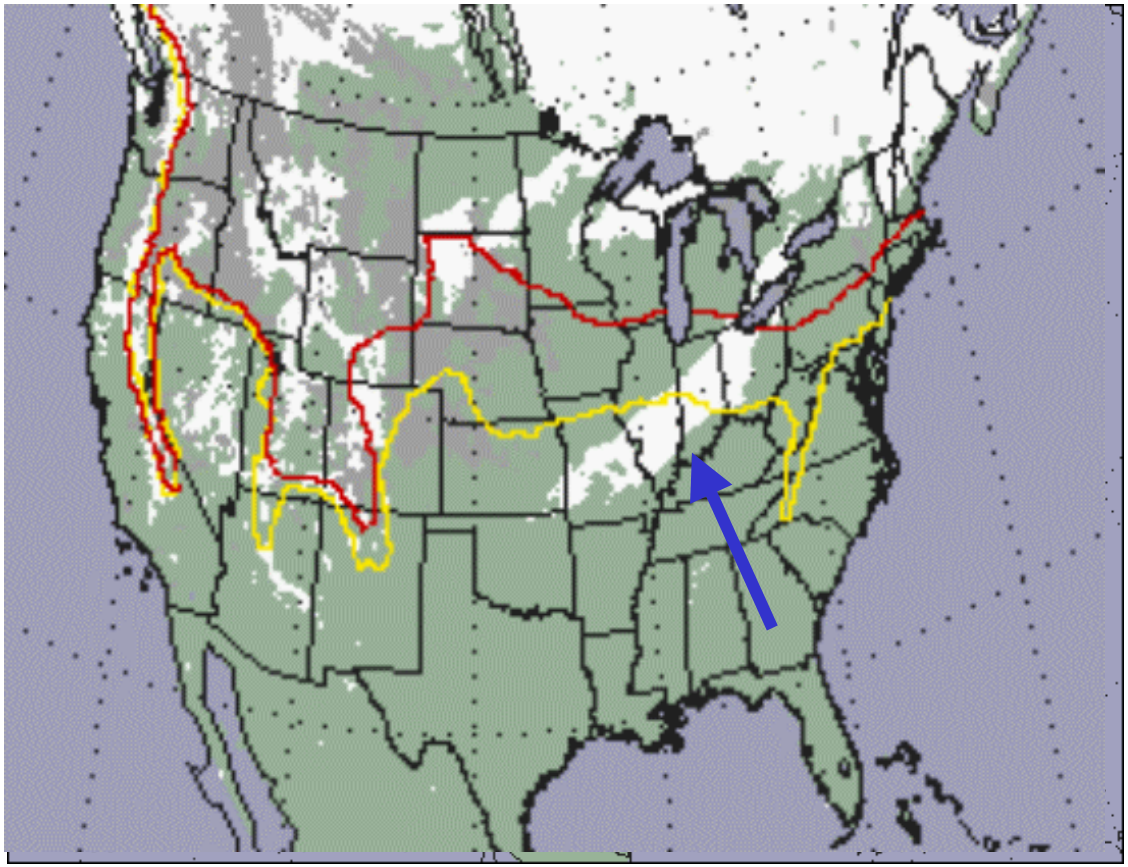


April 8, 2000



MODIS 8-day Composite Image

March 5-12, 2000



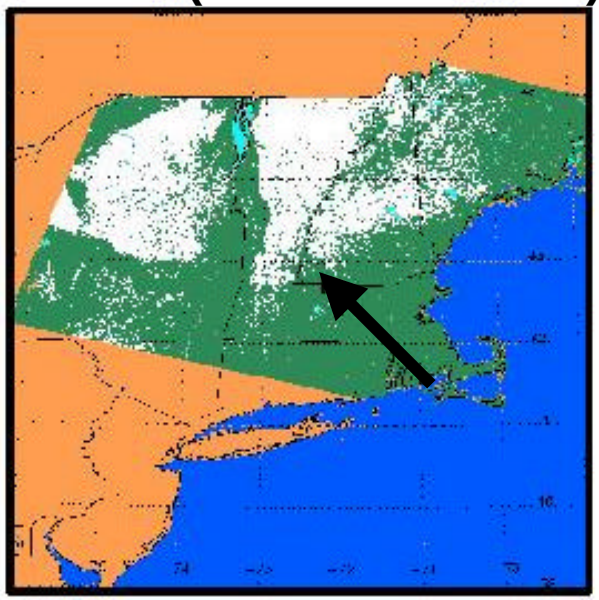
Average snowlines for February (yellow) and March (red) are also shown.

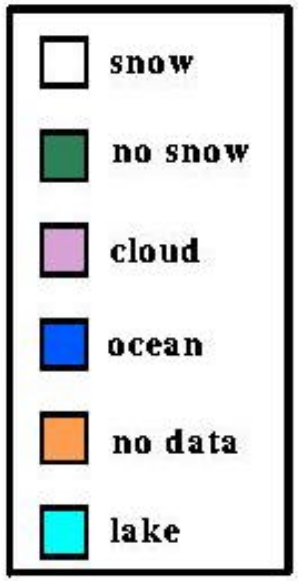
Field and Aircraft Mission

- ER-2 flight & field work March 6, 2000
- Patchy snow near Keene, NH
- MAS data received
- MAS, MODIS, NOHRSC and NESDIS maps will be compared

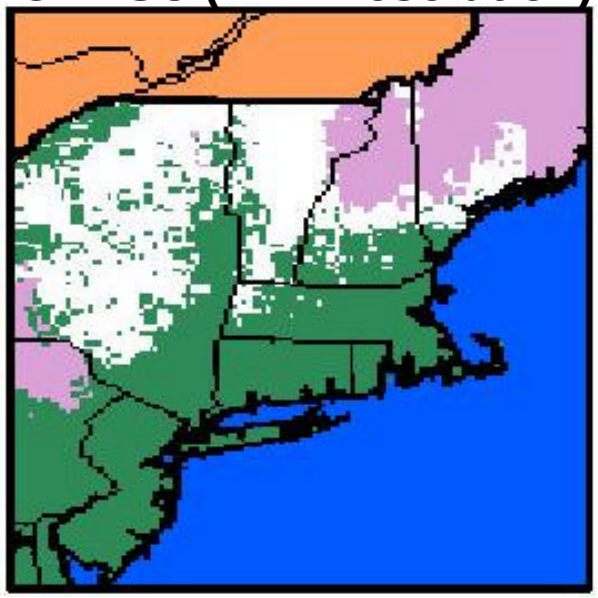
Northeastern United States

MODIS (500-m resolution)





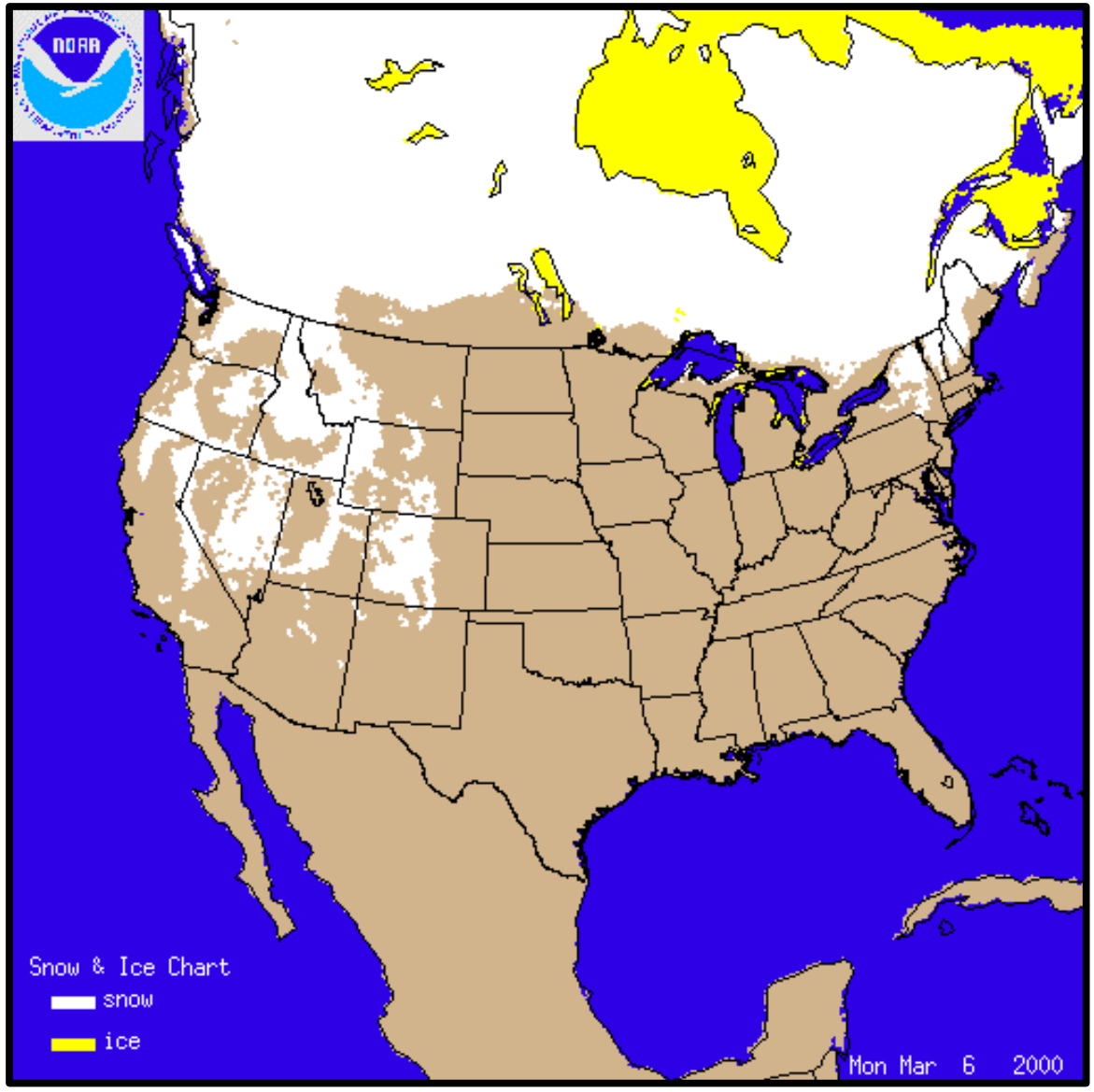
NOHRSC (1-km resolution)

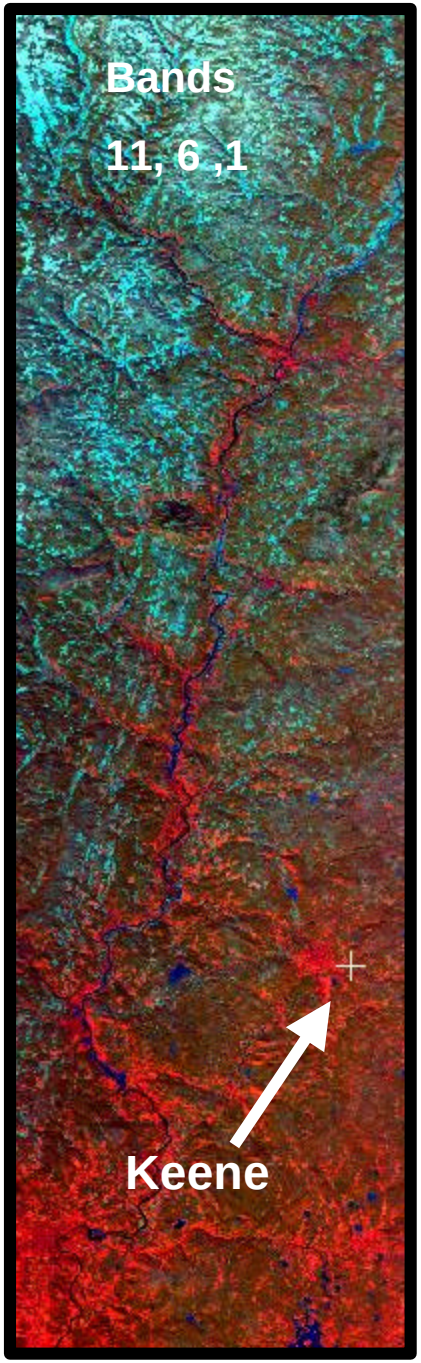


March 6, 2000

NOAA IMS Daily Snow-Cover Map of the U.S.

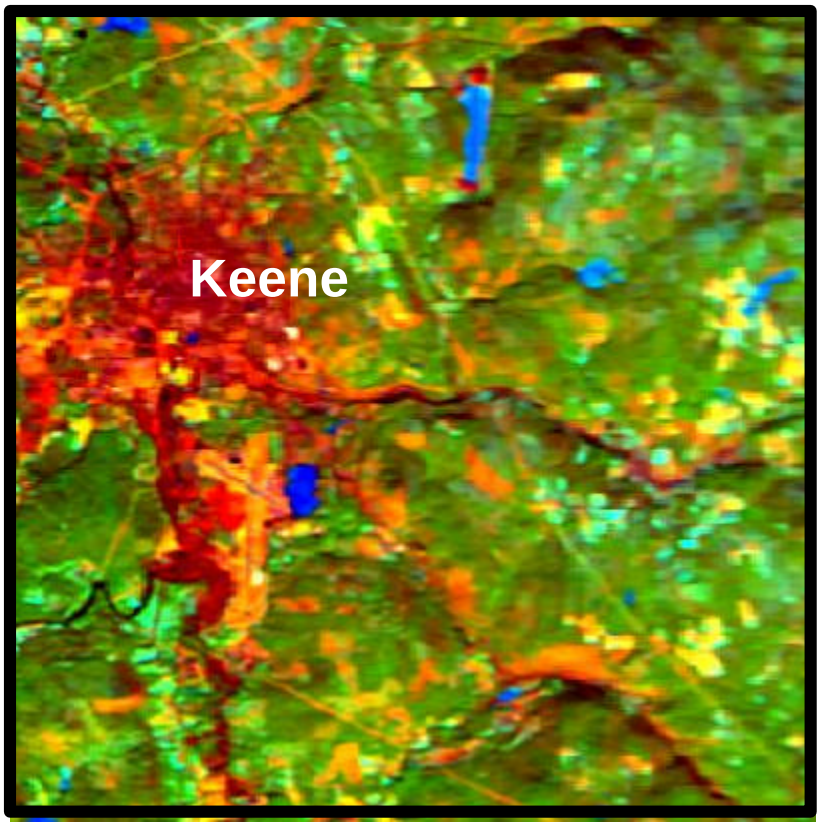
March 6, 2000





MAS Images

March 6, 2000



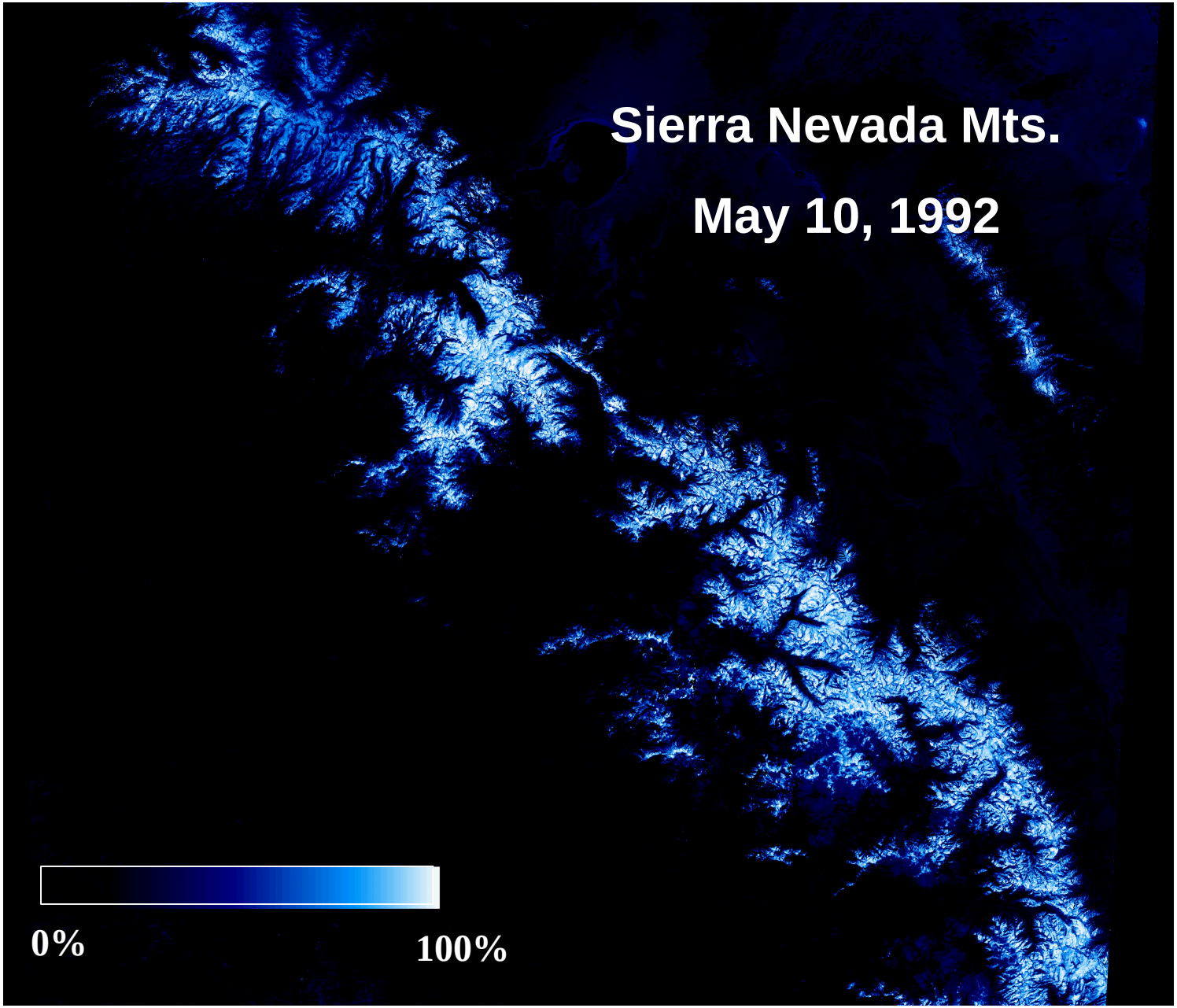
MODIS Fractional Snow-Cover Algorithm Under Development

$$FSC = f(NDSI, NDVI)$$

FSC = 0 where NDVI < -0.2 or NDVI > 0.45

or where $\rho_{0.55} < 0.11$ (water)

Fractional Snow Cover



Daily Snow and Ice Albedo Product under Development

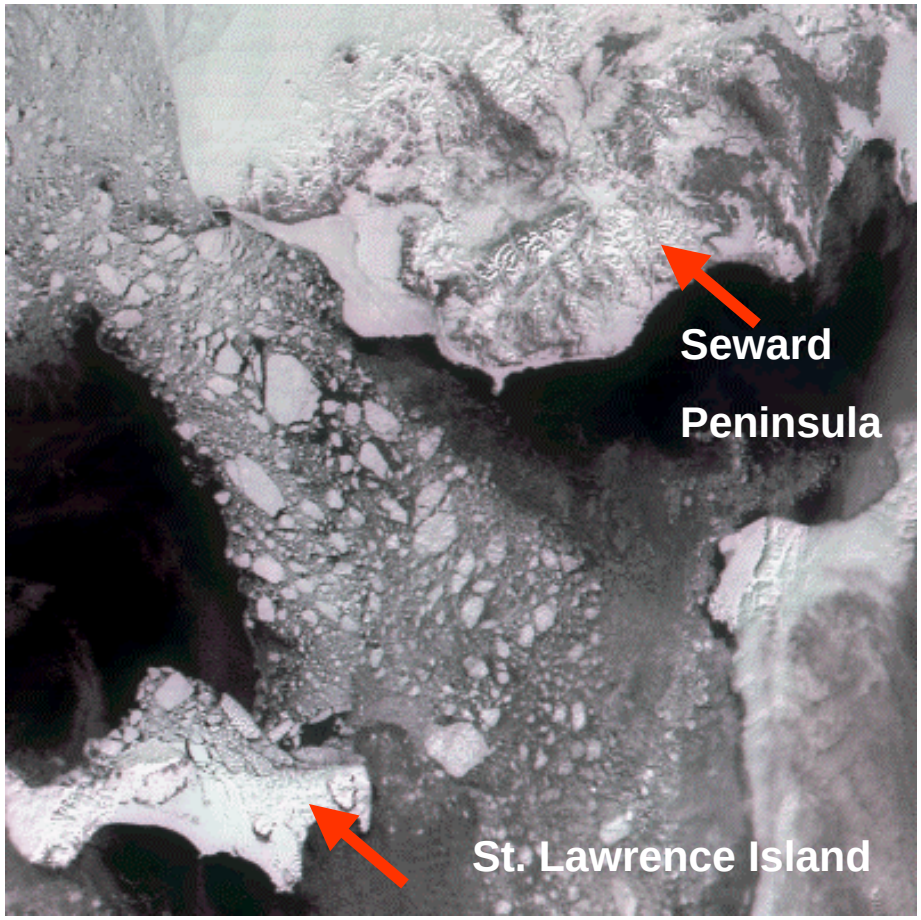
- **Spectral albedos from the 7 individual MODIS channels (visible to SWIR) will be derived and combined to produce broadband apparent albedos**
- **Over forests, an isotropic scattering model is used while for non-forested areas a snow BRDF model is employed**
- **Slope effects are considered**

MODIS Sea Ice Products

- Sea ice extent by NDSI and IST
  - 1-km resolution daily & 8-day composite
  - CMG daily & 8-day composite
  - Daylight and cloudcover permitting
  - Jeff Key/University of Wisconsin-IST coefficients

Sea Ice near St. Lawrence Island, Alaska

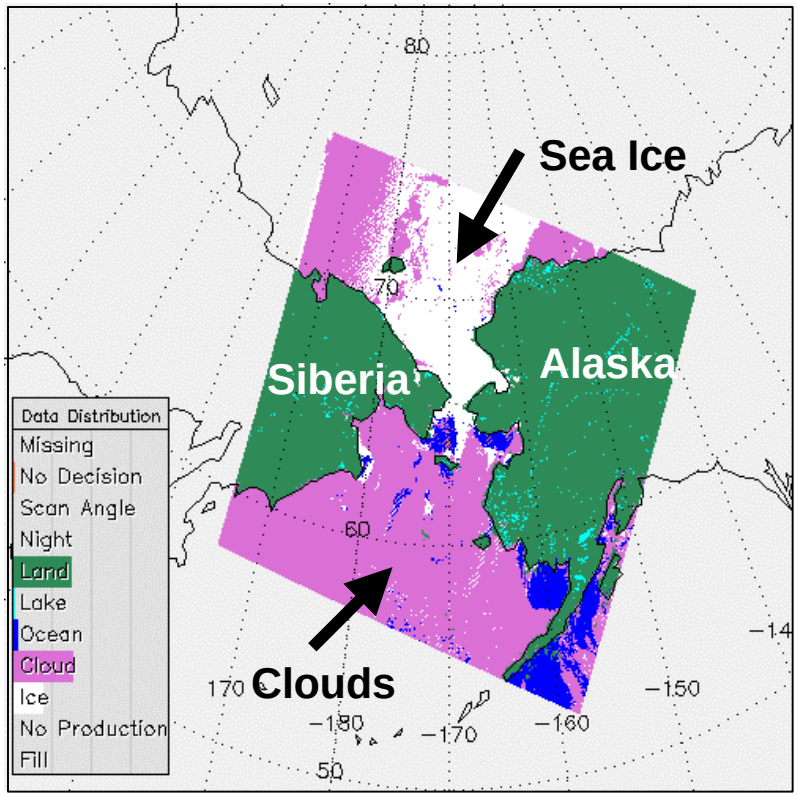
MODIS bands 1, 3, 4



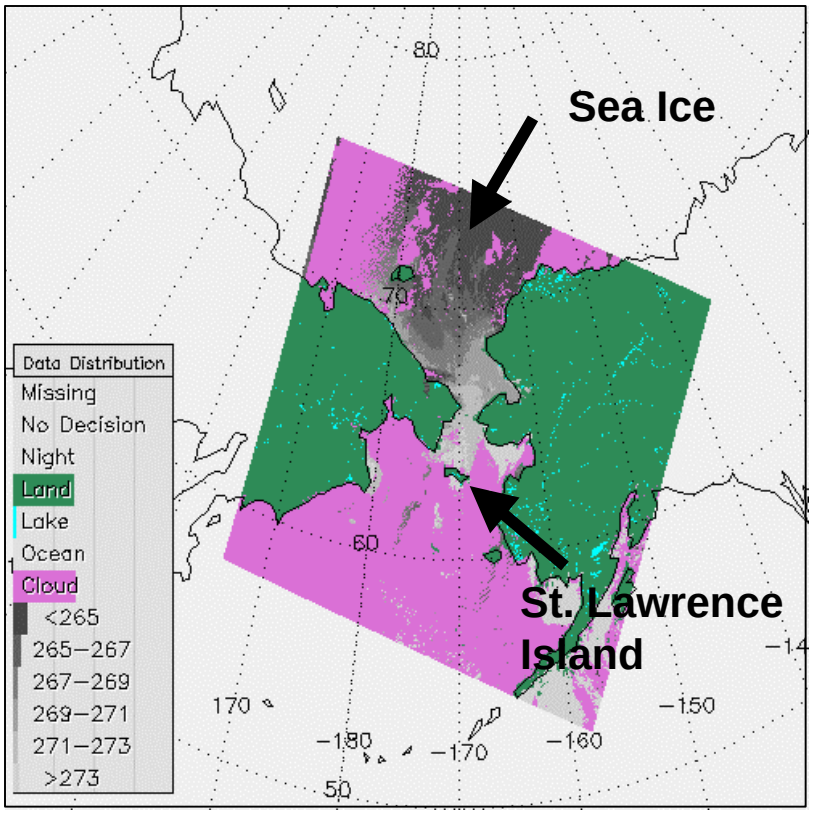
May 7, 2000

Sea Ice extent near St. Lawrence Island, Alaska

Extent by NDSI algorithm



Ice Surface Temperature



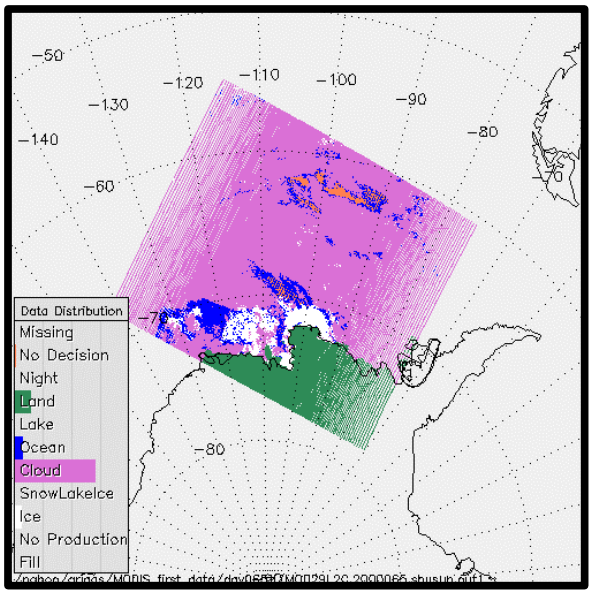
May 7, 2000

Southern Ocean Validation

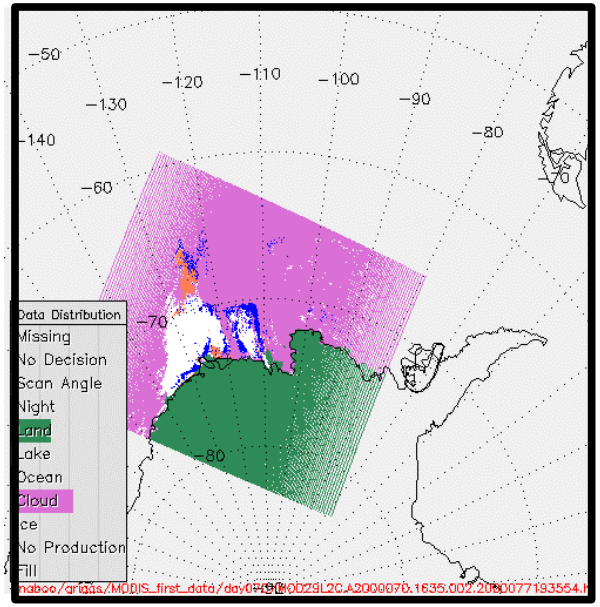
Ross and Amundsen Seas, Feb. 14 - March 31

Measurements included:

(1) All-wave irradiance and albedo measurements;
(2) Directional spectral radiance measurements;
(3) Surface temperature and thermal IR Tb;
(4) Air and ocean surface water temperatures;
(5) Digital camcorder recordings of sea ice;
(6) Hourly ice observations including ice concentration, ice type, floe size, floe surface topography and snow.



March 5, 2000



March 10, 2000

Conclusions

(1) MODIS ice extent and surface temperature products agree with our field measurements and observations in general.

(2) RADARSAT, DMSP OLS, and QuikScat images are useful tools for validating MODIS sea ice extent products.

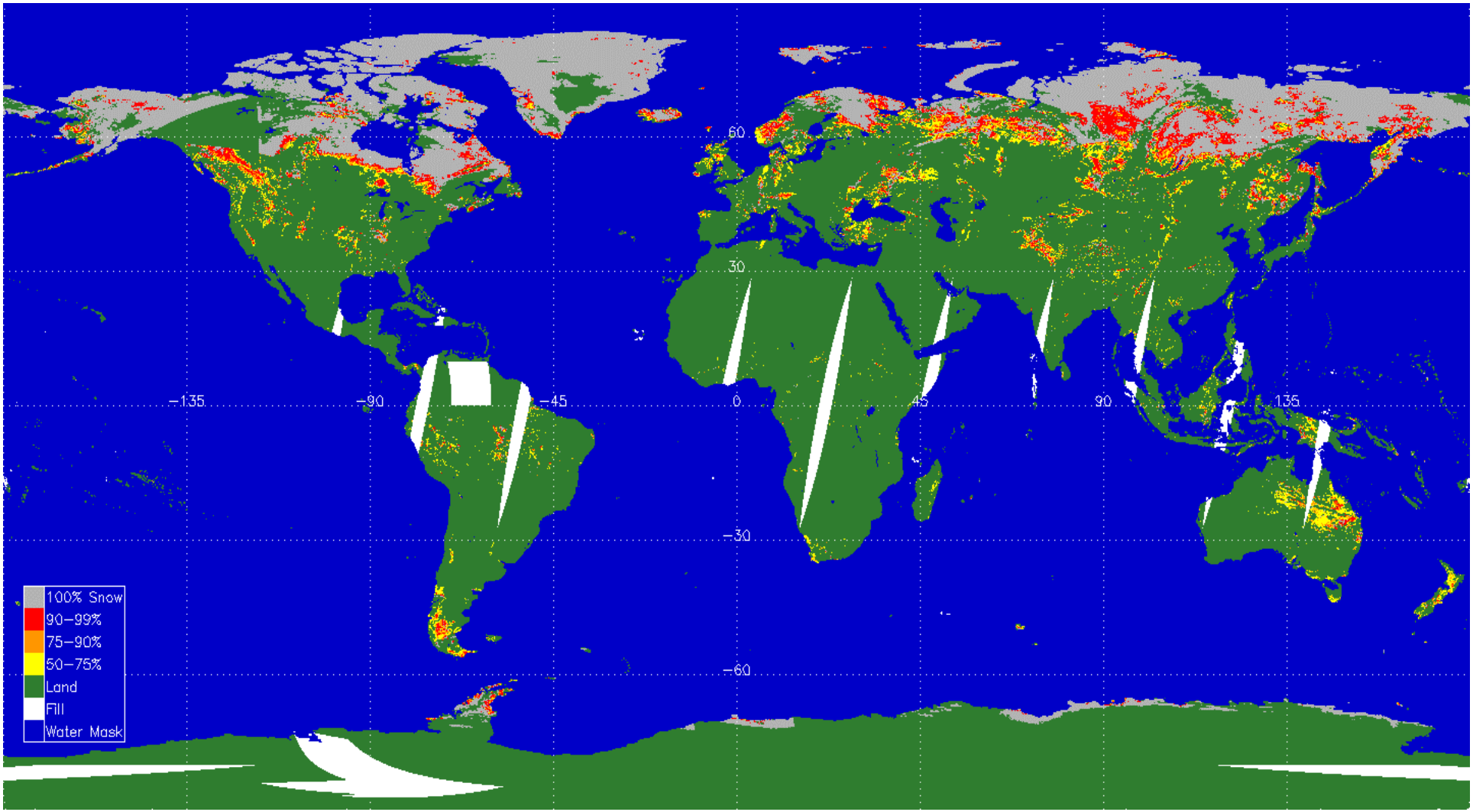
(3) The ice edge with known surface temperature (-1.7°C) is an effective means of sea ice surface temperature calibration.

Issues

- CMG
- Band 6 striping
- Release dates

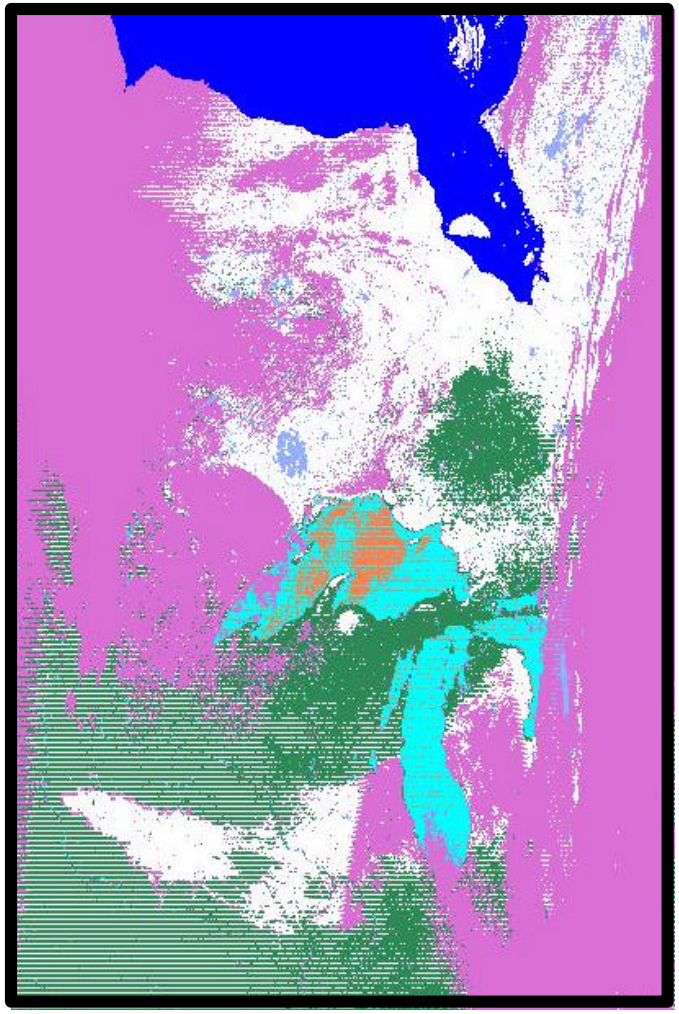
Daily Snow CMG

23 April 2000 (330 MOD10A1 tiles)

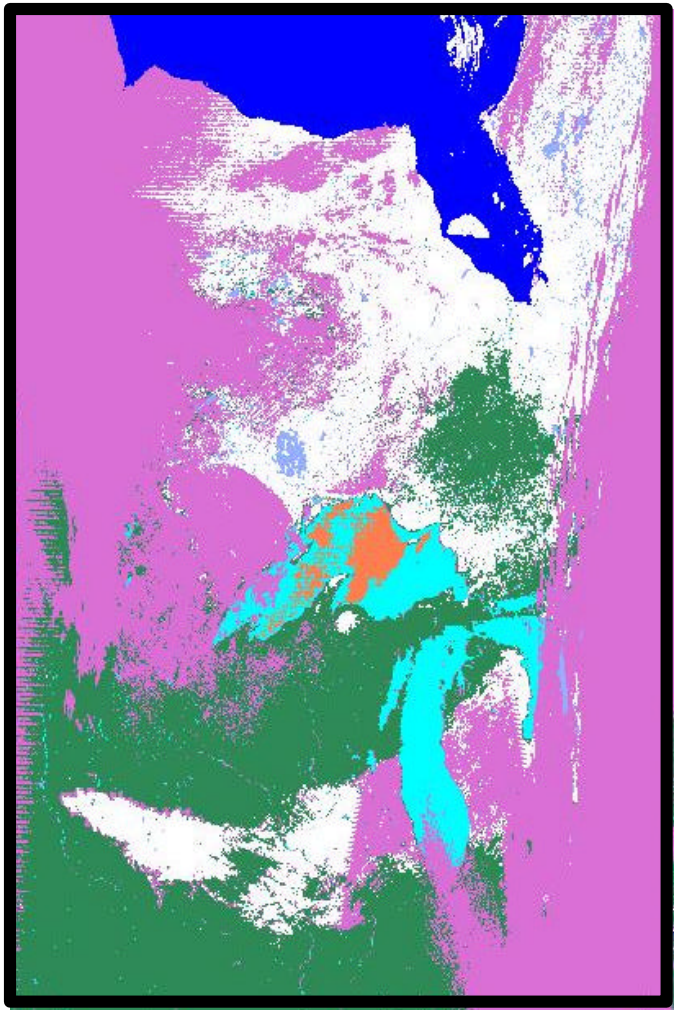


MODIS Snow Maps

Striped



Destriped



April 8, 2000

Band 6 striping

- Bad lines can easily be overwritten with the previous line
- Striping due to two “bad” detectors in band 6
- Erroneous snow cover is mapped as a result in composite products
- NSIDC helping with early release

Conclusions

- Early results are very promising
  - Comparisons with other snow maps ongoing
  - Field and A/C overflight March 6, 2000
  - Validation in the Southern Ocean Feb. & March 2000
  - Albedo development and validation is underway
- Band 6 striping must be removed once MCST finalizes the band configuration
  - Release delayed
  - NSIDC is helping to provide ‘research’ products to users
- Albedo and fractional snow-cover algorithms should be ready soon