An Introductory Method For Evaluating the MODIS Cloud Mask Over Water

Corey Calvert
UW/CIMSS, Madison, Wisconsin

Andrew Heidinger
NOAA/NESDIS Office of Research and Applications

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Outline

- Method
- Data used
- Cloud mask error estimation
- Examples
- Results / Comparisons
- Future work

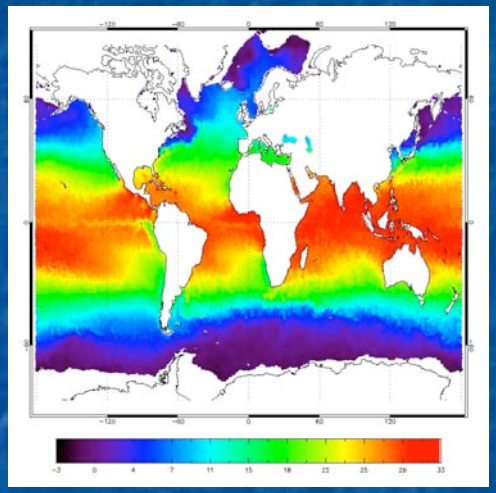
Motivation?

- Currently there are little or no globally quantitative tools to evaluate the MODIS cloud mask over water
- Evaluation/validation tools will be needed for the instruments aboard future satellites (e.g., GOES-R, NPOESS VIIRS)

Methodology

- MW SST measurements relatively insensitive to cloud and aerosol effects
- IR SST measurements will likely have a cool bias in the presence of clouds
- Differences between IR and MW measurements should be indicative of clouds

Data



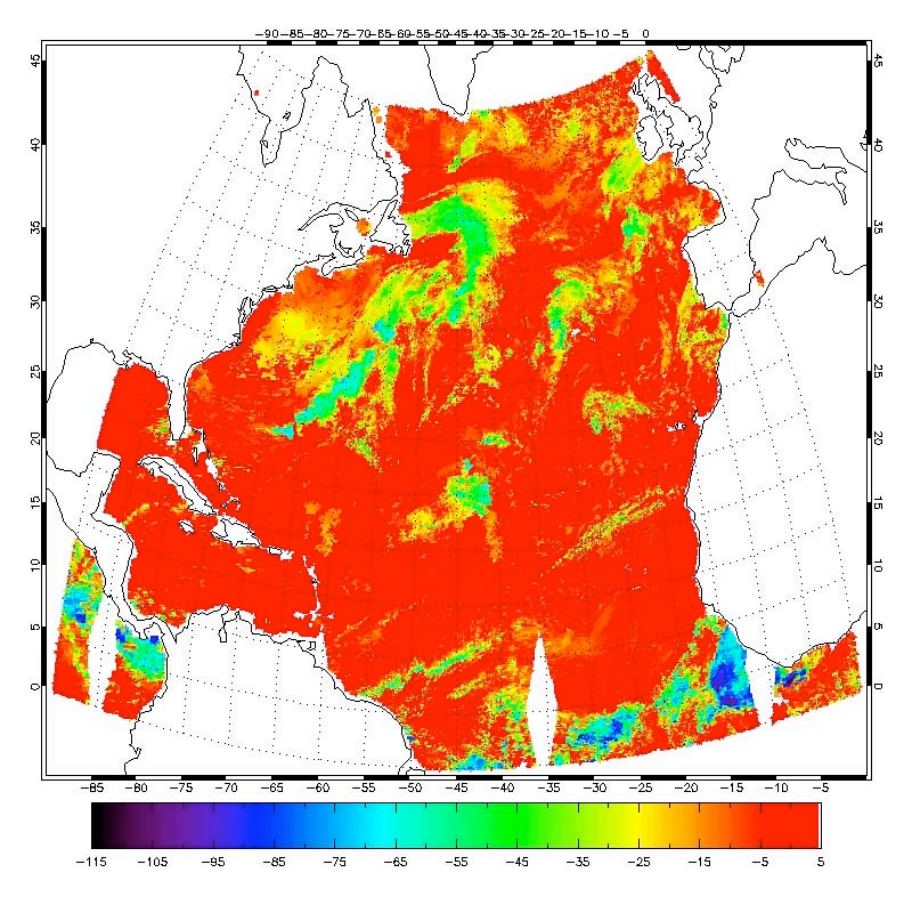
- OI MW SST product combining TMI and AMSR-E data

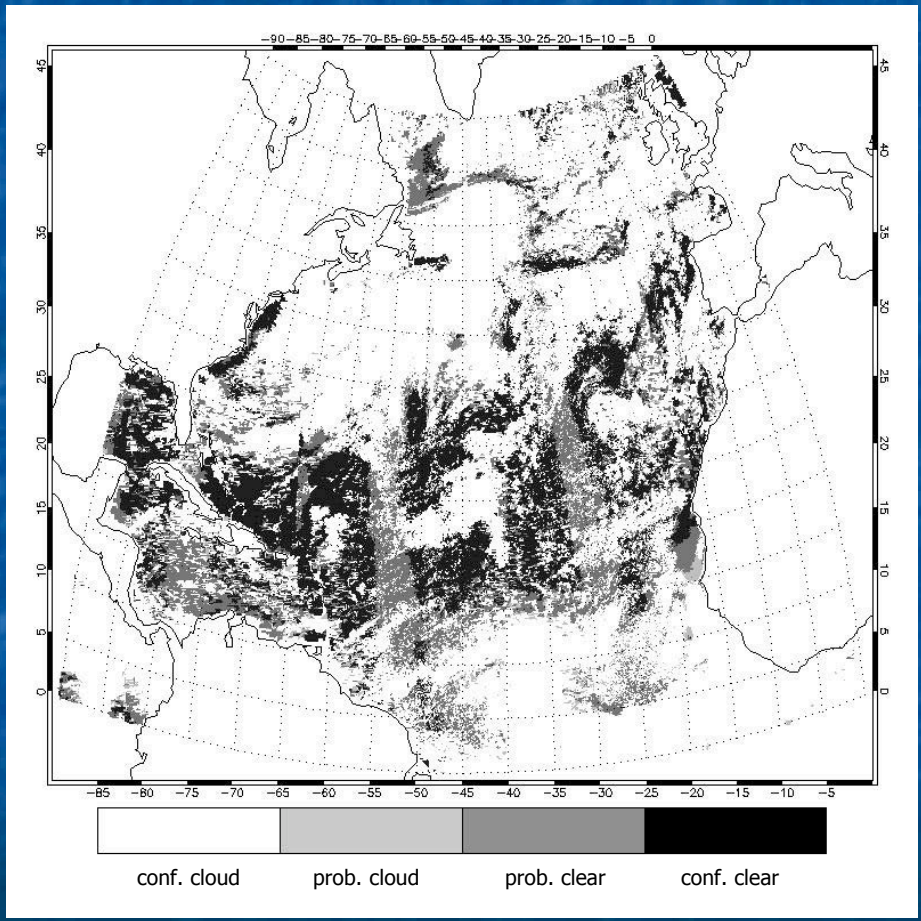
  (daily – 25 km) (www.ssmi.com)

- MOD28 - MODIS SST (day) and SST4 (night) products (1km)

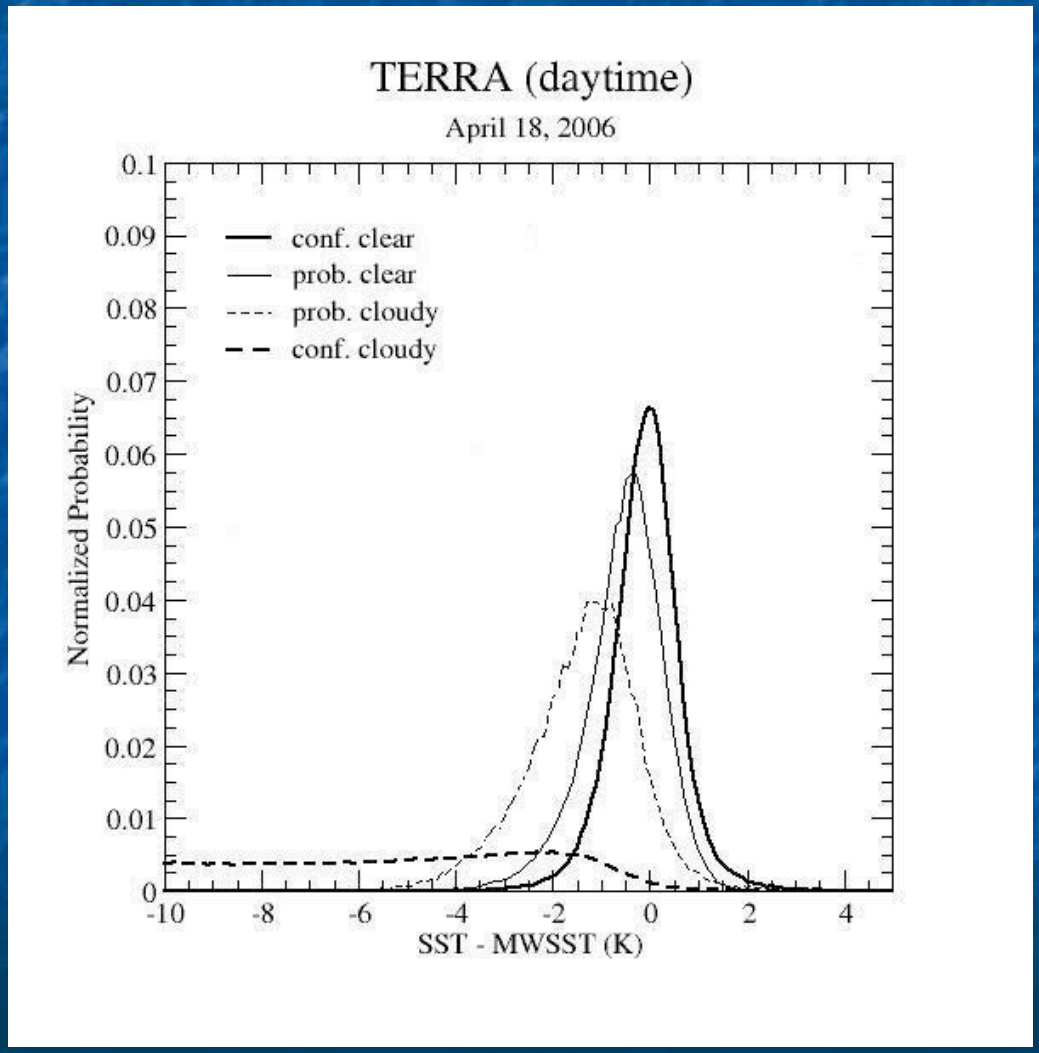
- MOD35 - MODIS cloud mask (1 km)

IR-MW Differences & Cloud Mask

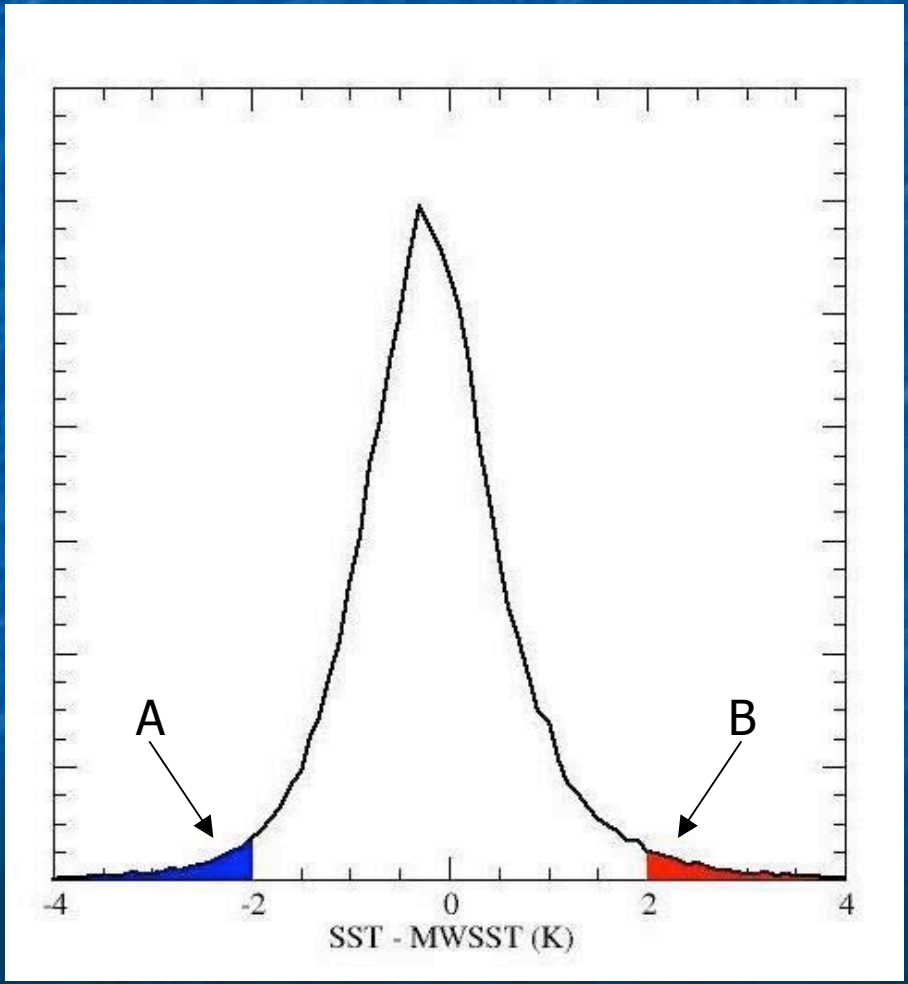




Example Distribution of Temperature Differences



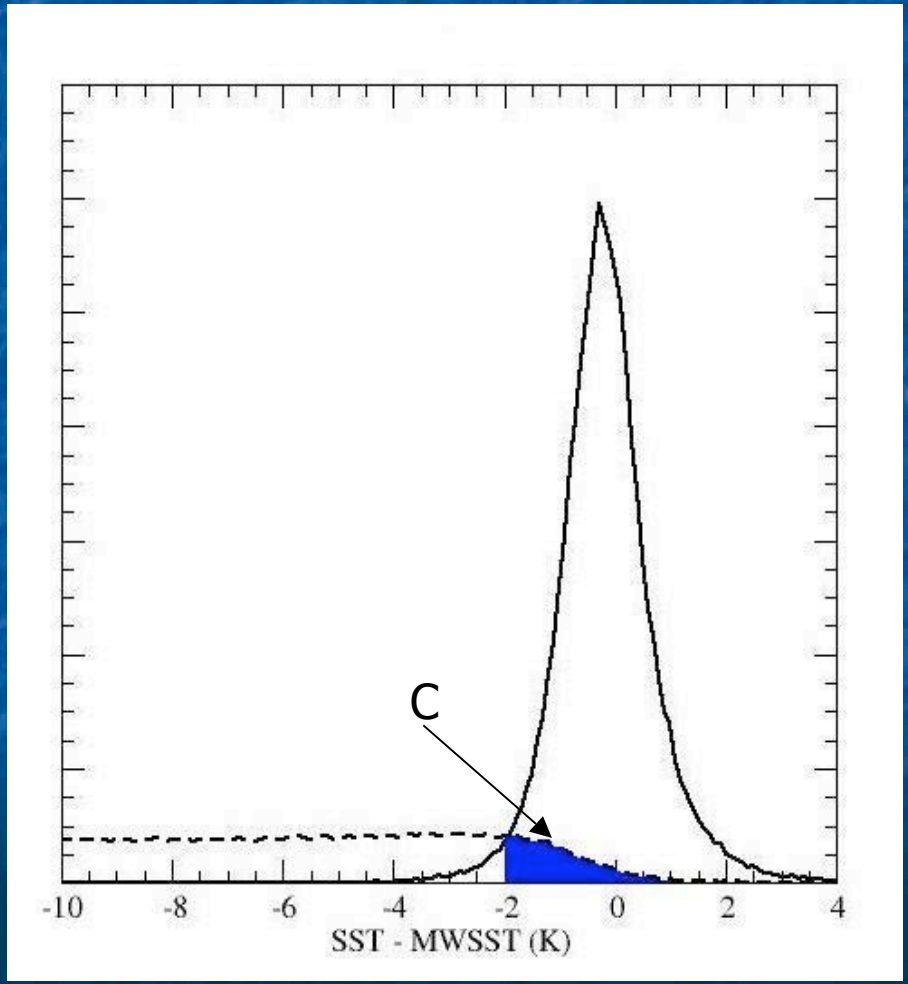
Calculating Error for Clear Categories



- Differences in region B are assumed to be attributed to non-cloud issues

$$error = \frac{(A - B)}{total}$$

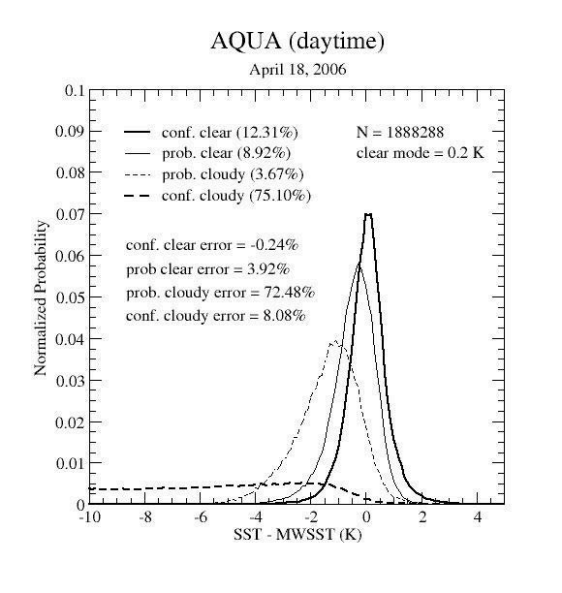
Calculating Error for Cloudy Categories

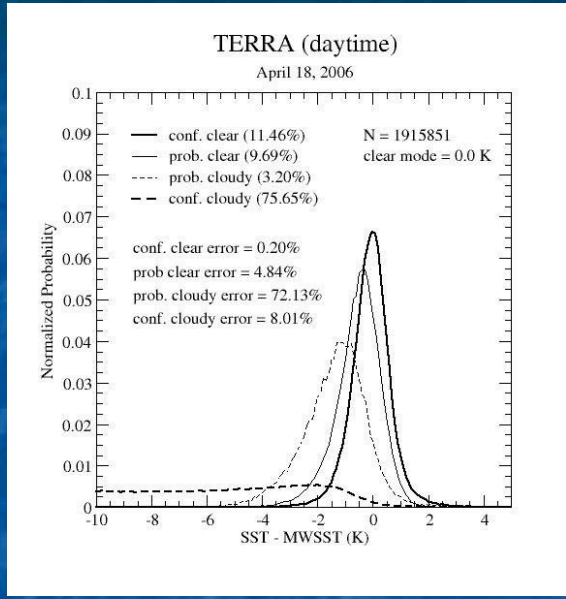


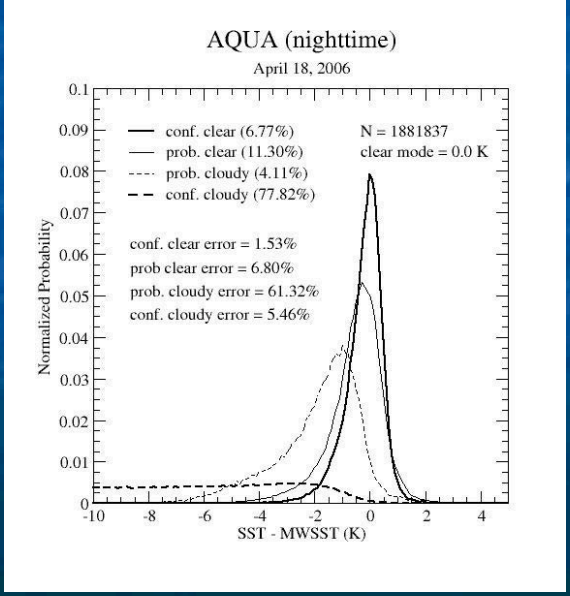
- Points in region C may be clear pixels misidentified as cloudy

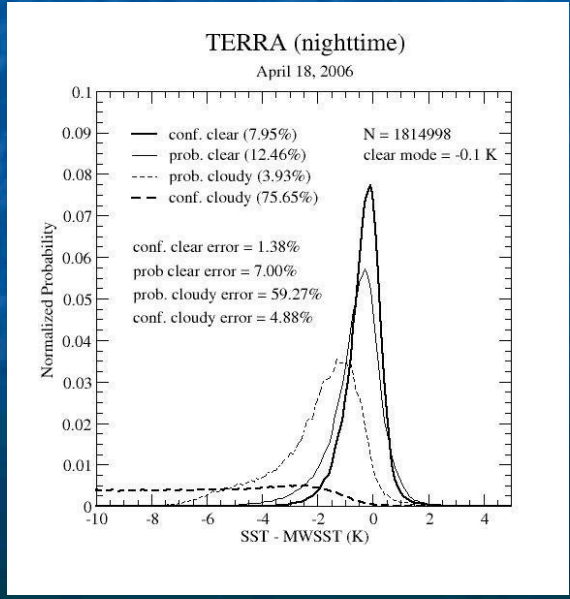
$$error = \frac{C}{total}$$

AQUA & TERRA

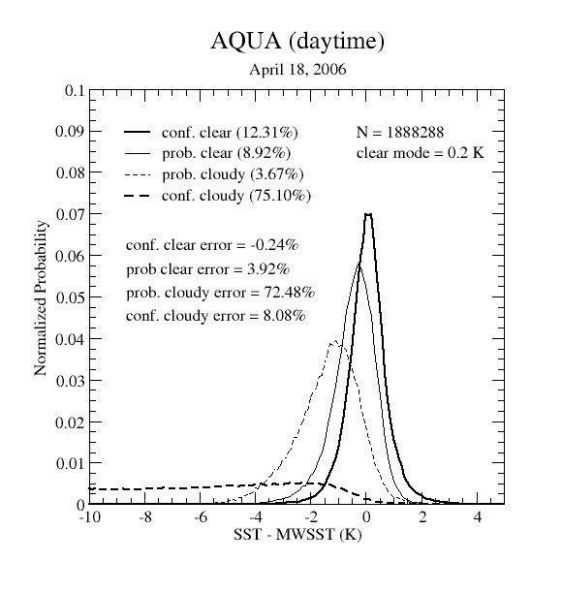

AQUA (daytime)
April 18, 2006
conf. clear (12.31%)
prob. clear (8.92%)
prob. cloudy (3.67%)
conf. cloudy (75.10%)
N = 1888288
clear mode = 0.2 K
conf. clear error = -0.24%
prob clear error = 3.92%
prob. cloudy error = 72.48%
conf. cloudy error = 8.08%
Normalized Probability
SST - MWSST (K)

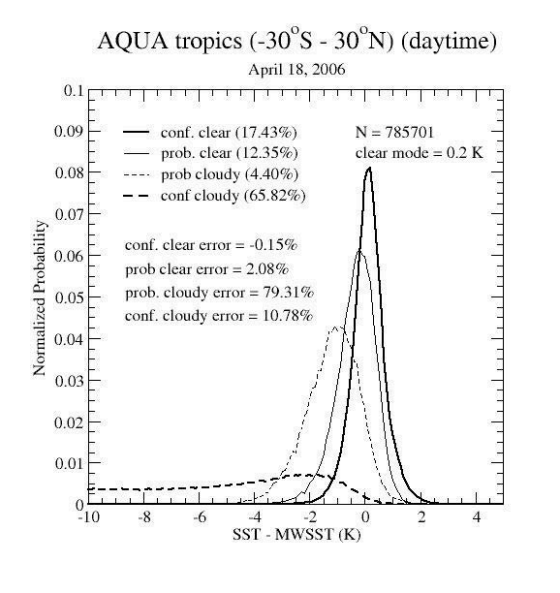

TERRA (daytime)
April 18, 2006
conf. clear (11.46%)
prob. clear (9.69%)
prob. cloudy (3.20%)
conf. cloudy (75.65%)
N = 1915851
clear mode = 0.0 K
conf. clear error = 0.20%
prob clear error = 4.84%
prob. cloudy error = 72.13%
conf. cloudy error = 8.01%
Normalized Probability
SST - MWSST (K)

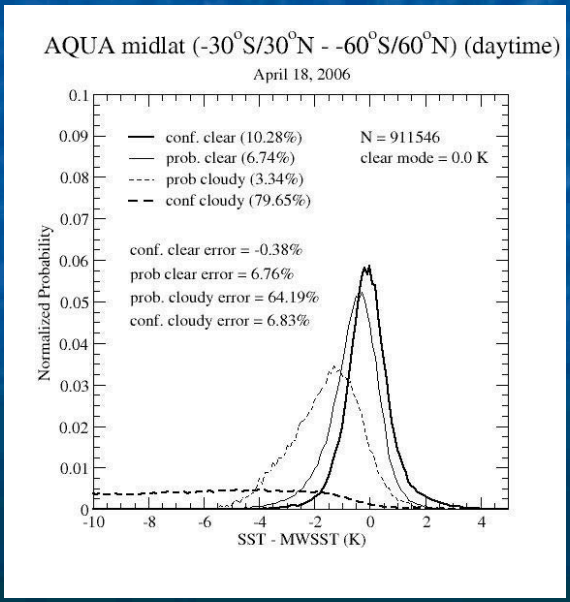

AQUA (nighttime)
April 18, 2006
conf. clear (6.77%)
prob. clear (11.30%)
prob. cloudy (4.11%)
conf. cloudy (77.82%)
N = 1881837
clear mode = 0.0 K
conf. clear error = 1.53%
prob clear error = 6.80%
prob. cloudy error = 61.32%
conf. cloudy error = 5.46%
Normalized Probability
SST - MWSST (K)

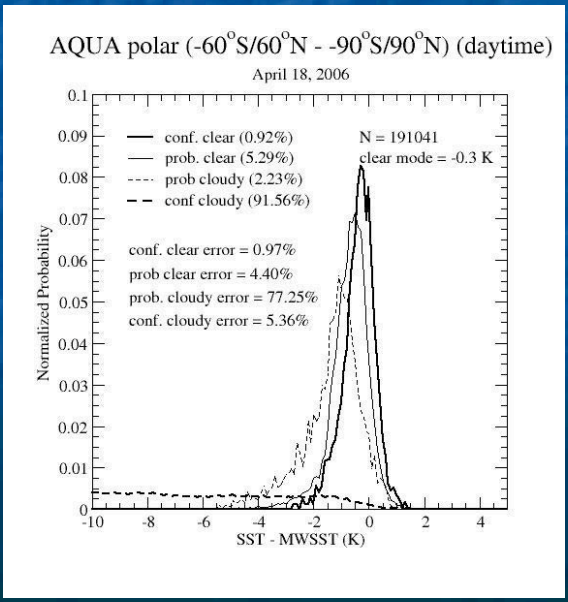

TERRA (nighttime)
April 18, 2006
conf. clear (7.95%)
prob. clear (12.46%)
prob. cloudy (3.93%)
conf. cloudy (75.65%)
N = 1814998
clear mode = -0.1 K
conf. clear error = 1.38%
prob clear error = 7.00%
prob. cloudy error = 59.27%
conf. cloudy error = 4.88%
Normalized Probability
SST - MWSST (K)

Latitudinal Comparison

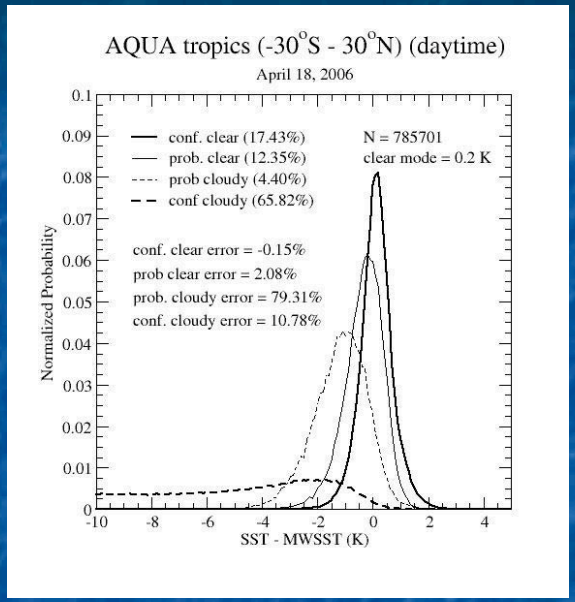


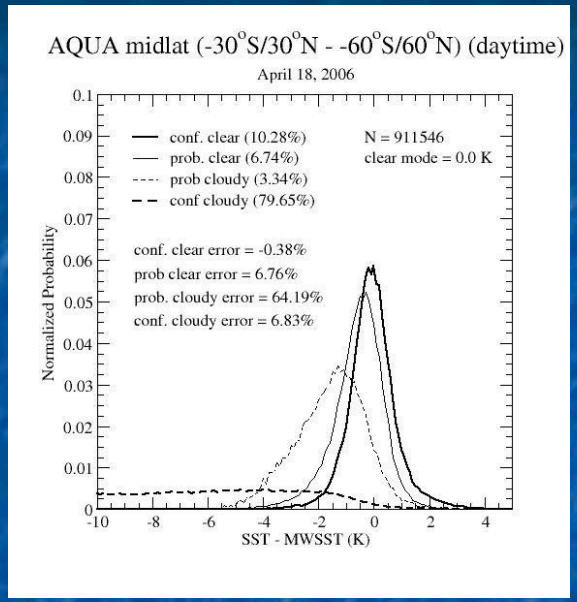


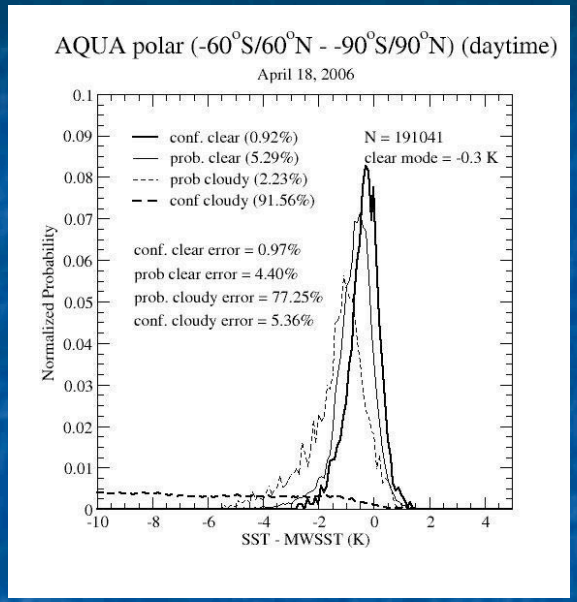


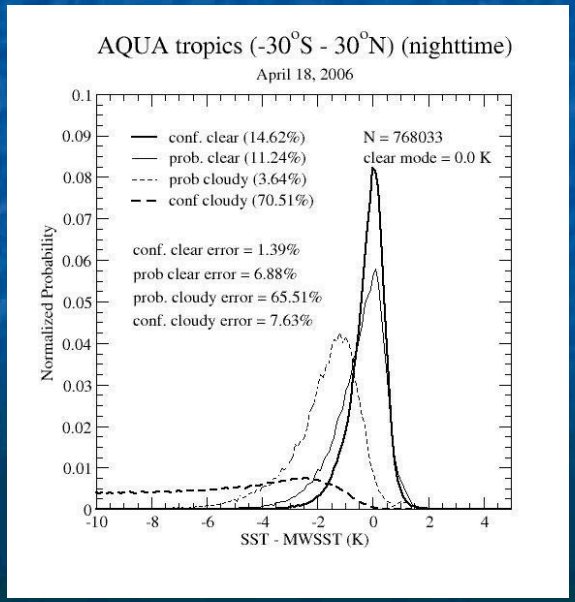


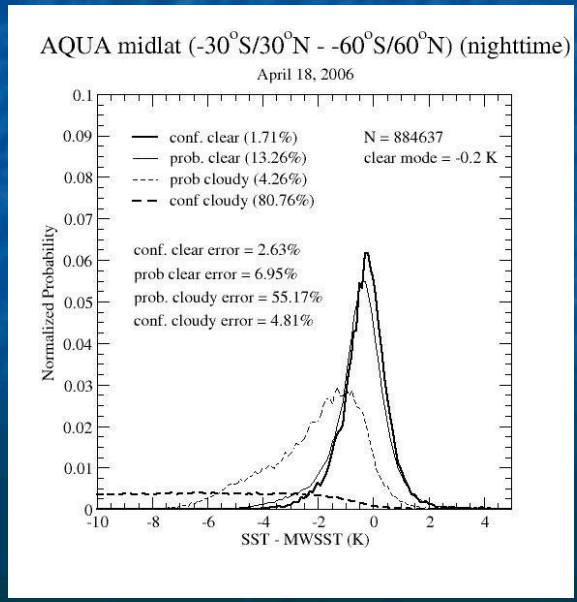
Day/Night Latitudinal Comparison

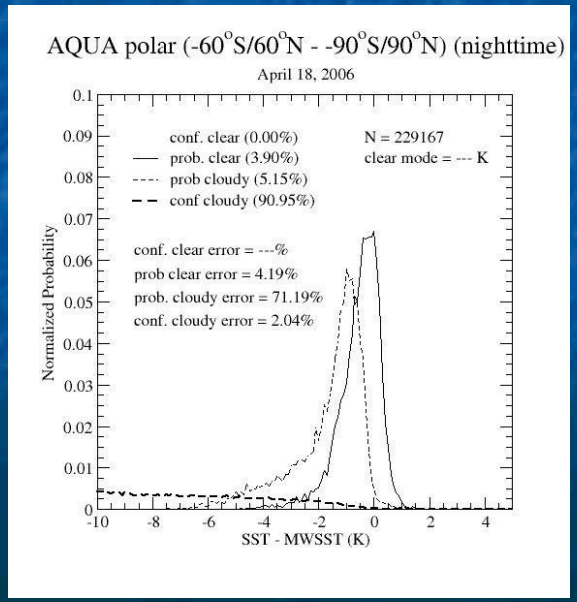






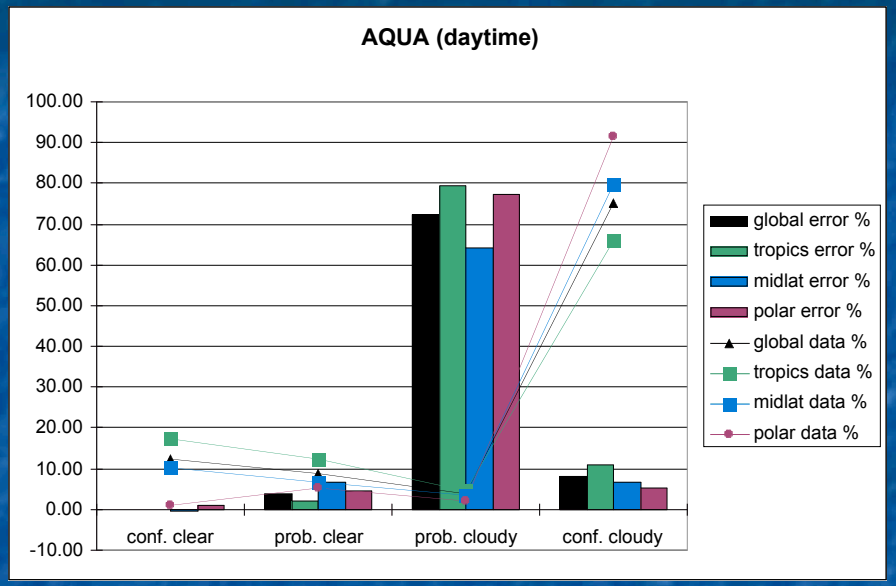


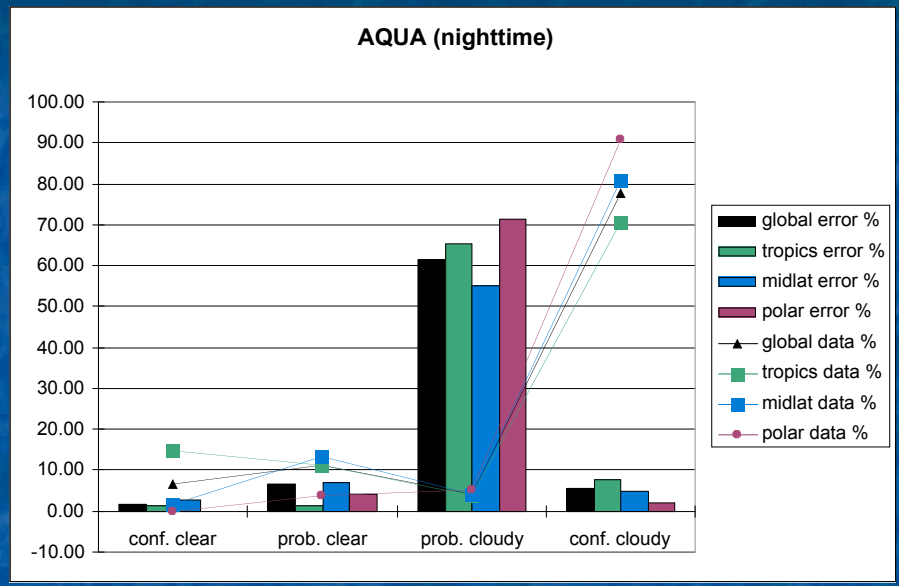


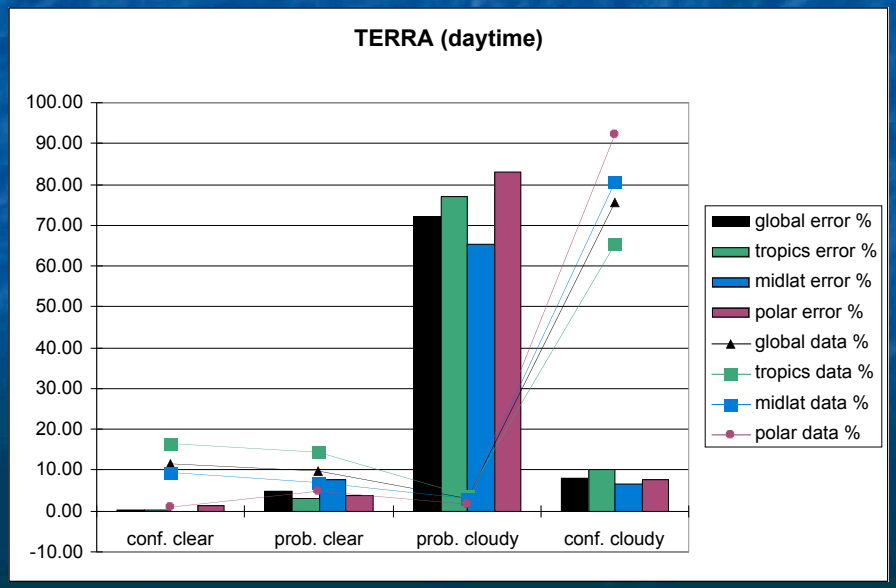


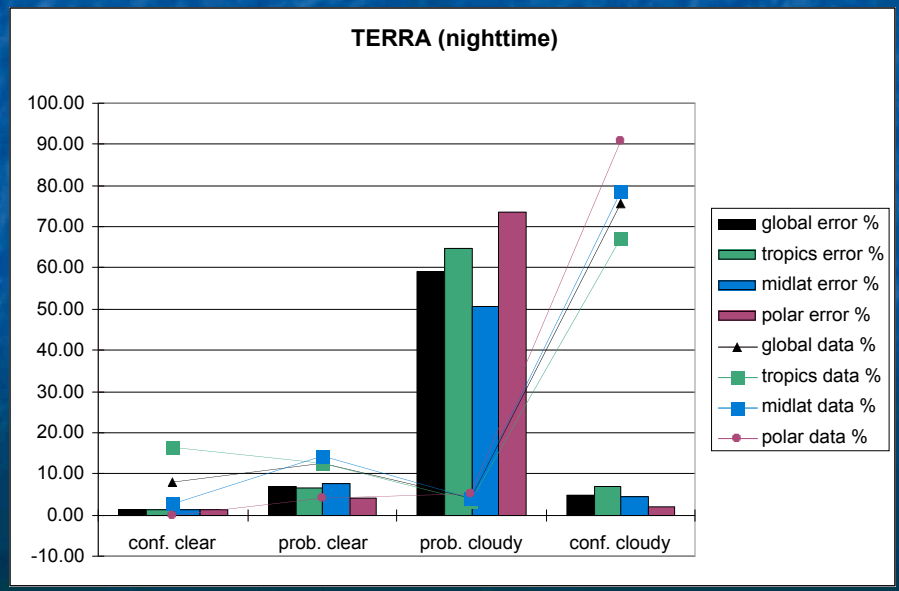
Graphical Comparison

(April 18, 2006)









Summary

- The MODIS cloud mask appears consistent
  - Between both Aqua and Terra
  - Between day and night
- Latitudinal differences are seen
  - Smaller % of clear pixels and larger % of cloudy pixels towards the poles
  - confident cloudy errors decreases towards the poles

Future Work

- Comparison between collect 4/5
- Seasonal comparisons
- Comparison between different instruments (e.g., AVHRR)

Operational Use of the MODIS Cloud Mask

- A regional real-time SST analysis is being created around Florida (Florida Tech)
  - Produced 4 times per day
  - Combines GOES SST composites and level 2 MODIS SSTs (DB UW) via 2DVar method
  - Will eventually be used as lower boundary initialization over water for ARPS/ADAS or WRF models at NWS offices in FL
- A consistent and reliable cloud mask for the MODIS SSTs is crucial to maintain the quality of the overall analysis

QUESTIONS?

Acknowledgements:

Richard Frey

Kathy Strabala