CERES CLOUDS STATUS -

DAWNING OF THE AGE OF AQUA

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AS&M: P. W. Heck, D. Spangenberg

CERES STM, Norfolk, VA, May 6, 2003

TOPICS

- **Terra Edition1a**
  - Results / validation
  - Calibrations
  - Comparisons
- **Aqua Beta1**
  - Algorithm changes
  - Global results
  - Preliminary comparisons/validations
- **Algorithm Improvements in Future Ages**
  - Polar Night
  - Land cloud heights
  - Validation from climatology

COMPLETED DATA PROCESSING

- VIRS Edition 2: January 1998 - July 2001
- Terra Edition 1a: February 2000 - January 2002
- Aqua Beta 1: September - October 2002

MODIS CALIBRATION

- **VIRS & MODIS thermal calibrations differ by 0.1 to 0.5 K**

  => 3.7-μm difference yields MODIS re is 0.5 μm < VIRS

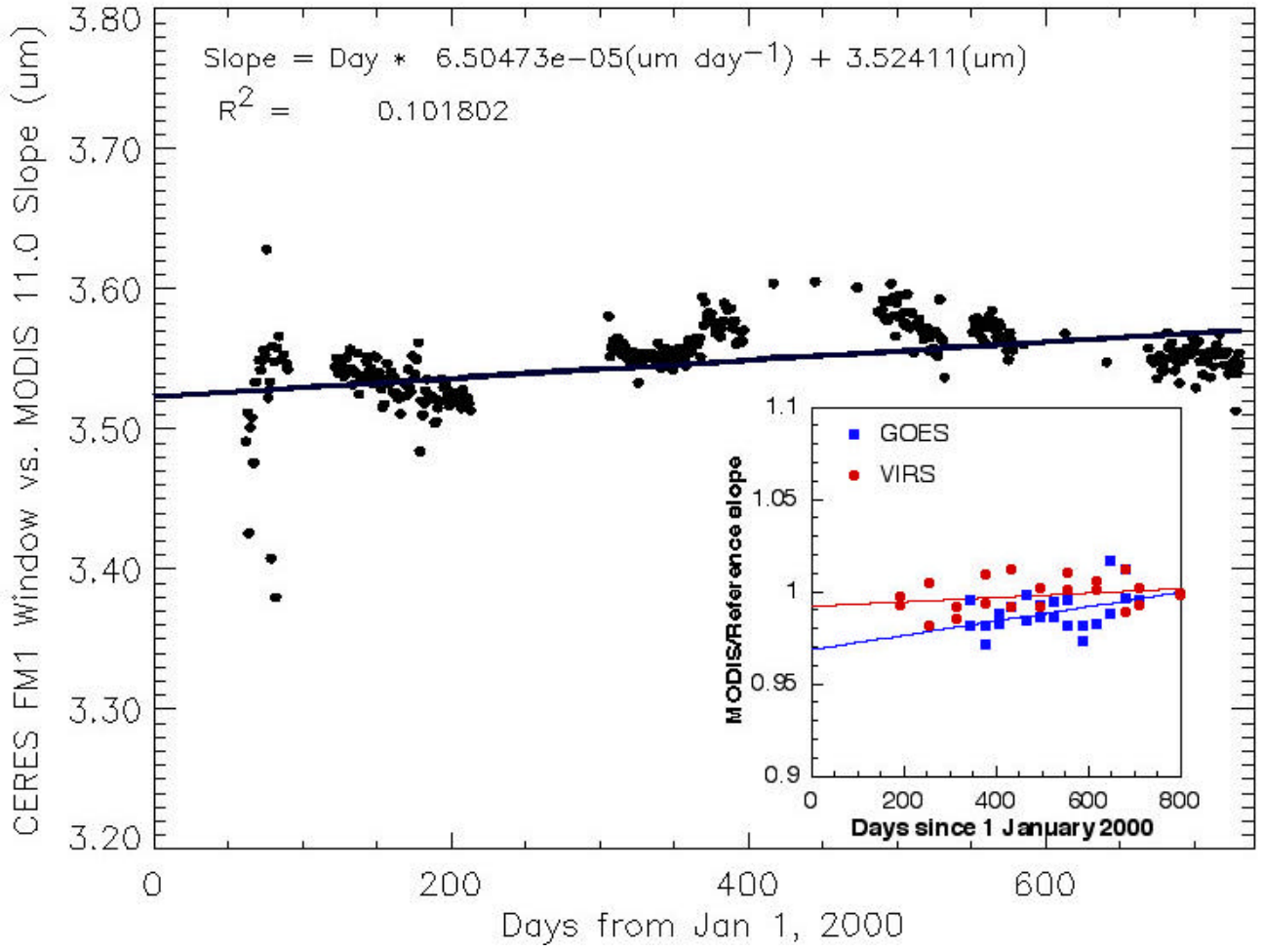
  MODIS team announced a change in solcon for 3.7 μm

  10.51 -> 11.297 $Wm^{-2}\mu m^{-1}$ yields 0.5-μm rise in re

- **Terra MODIS 10.8-μm channel appears to have a drift**

  - Monitoring with CERES, VIRS, GOES-8

MODIS Channel-31 Comparisons with CERES, VIRS, & GOES-8



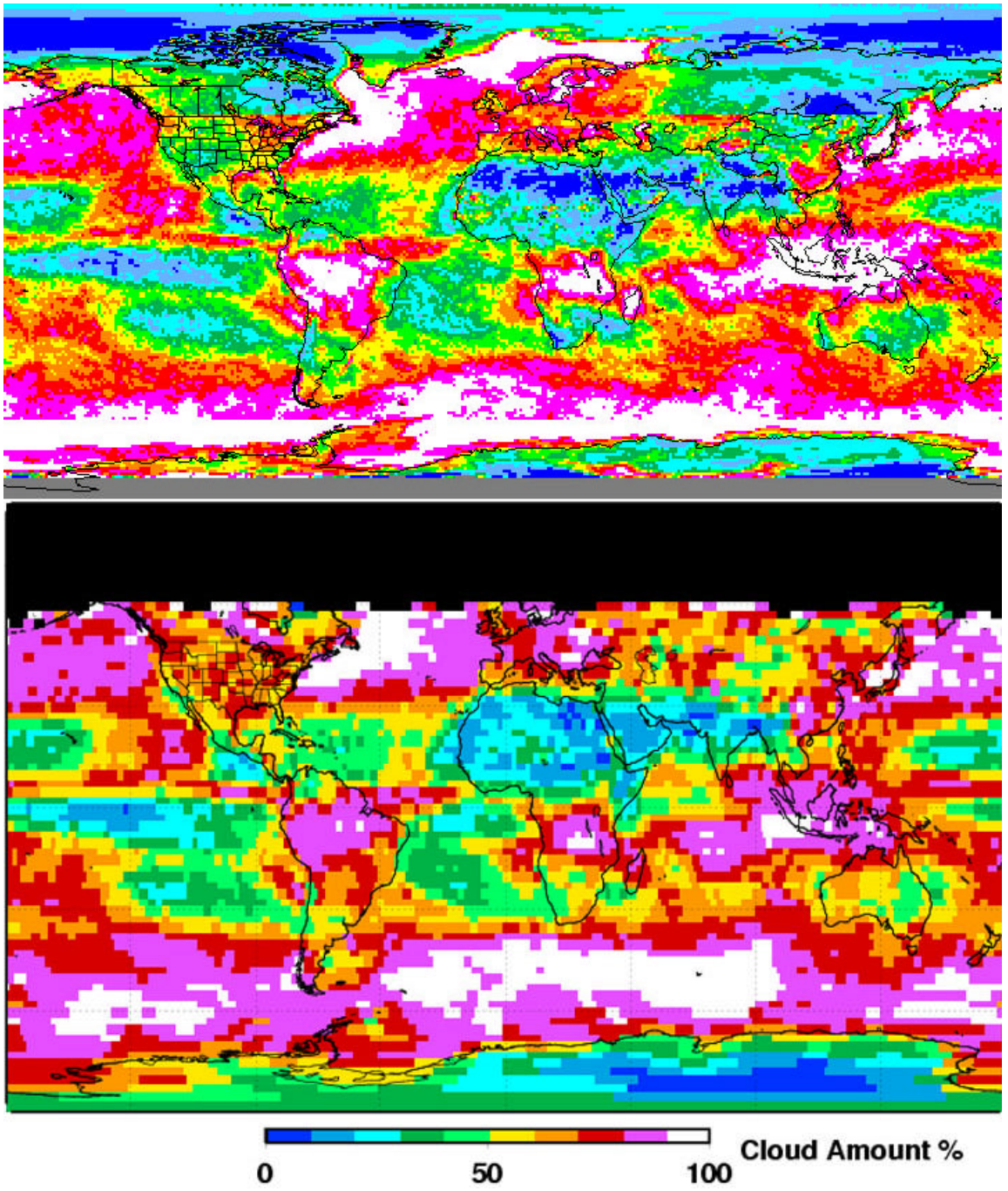
CERES night

CERES Terra vs ISCCP

Cloud Amount

Jan. 2001

ISCCP mean



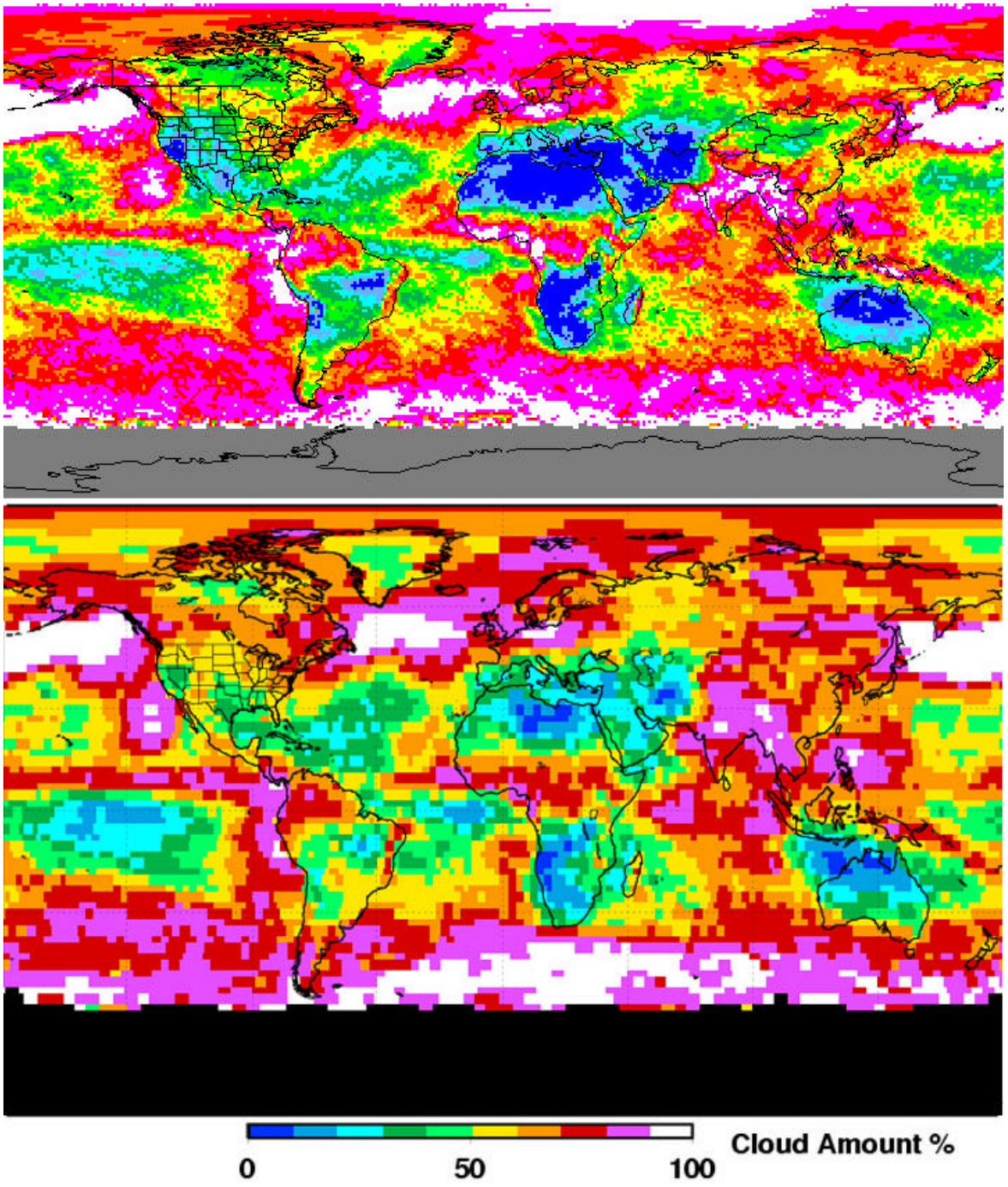
CERES day

CERES vs ISCCP

Cloud Amount

Jul. 2000

ISCCP mean



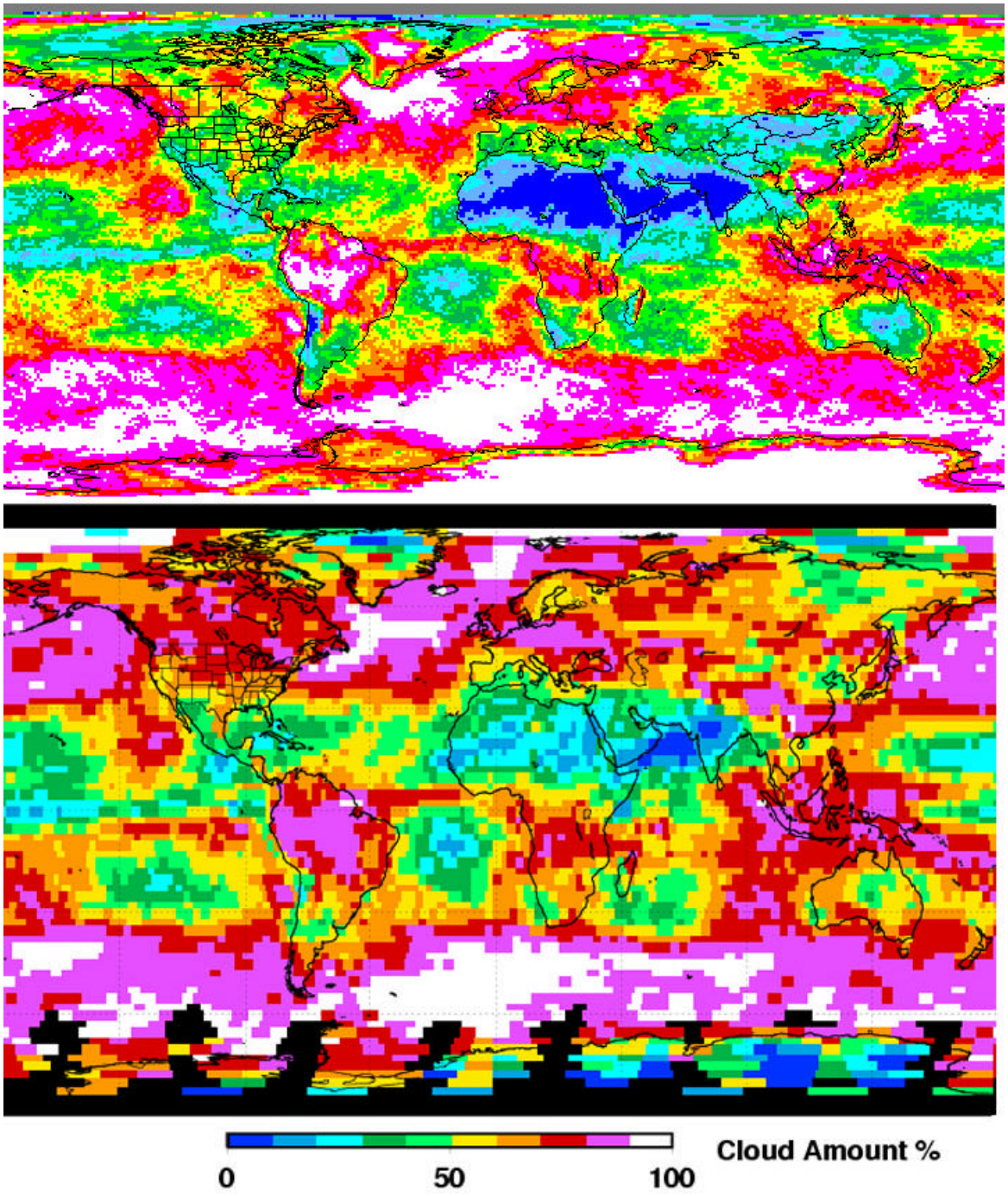
CERES day

CERES Terra vs ISCCP

Cloud Amount

Jan. 2001

ISCCP mean



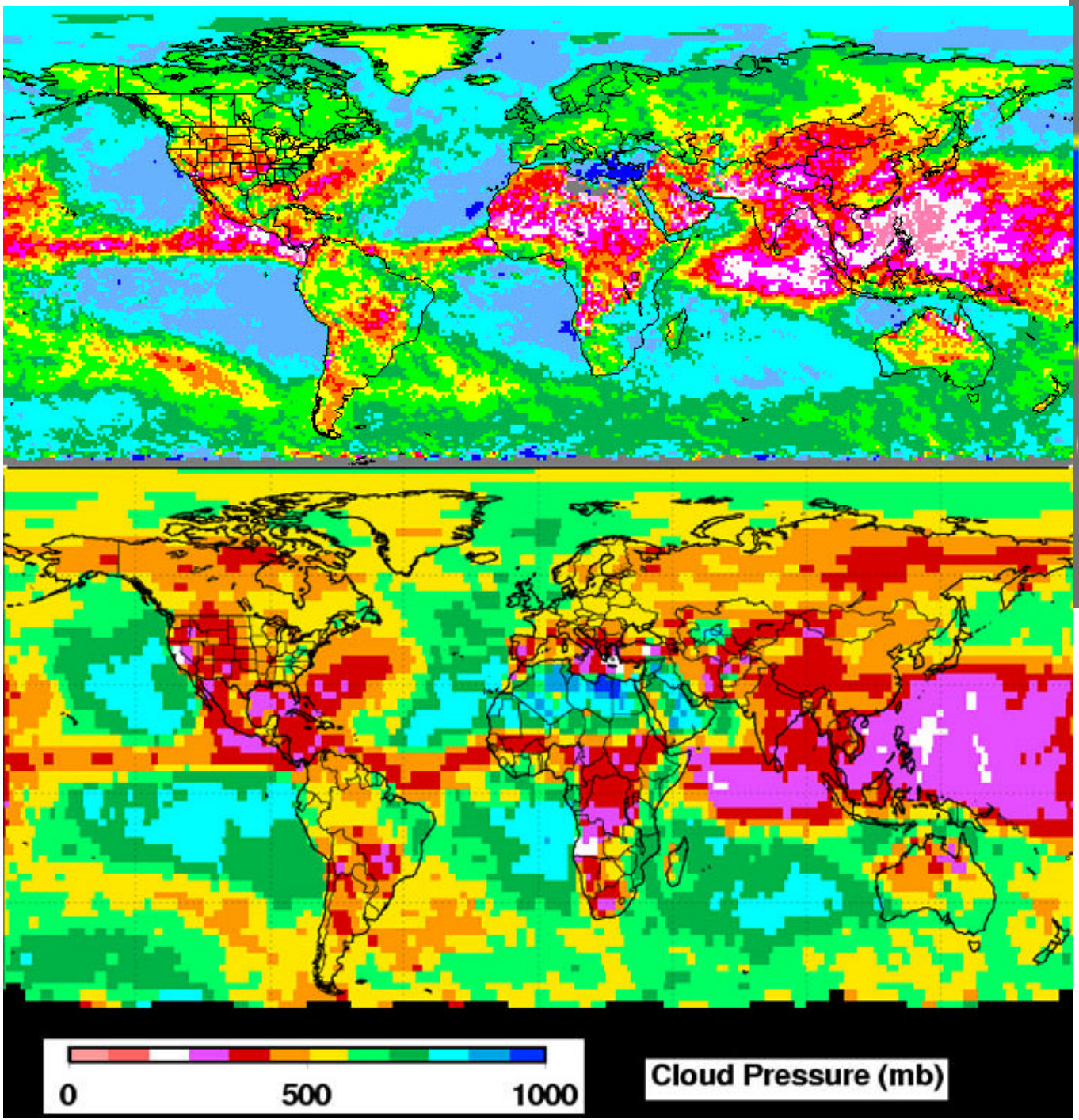
CERES day

CERES/ISCCP

Cloud Height

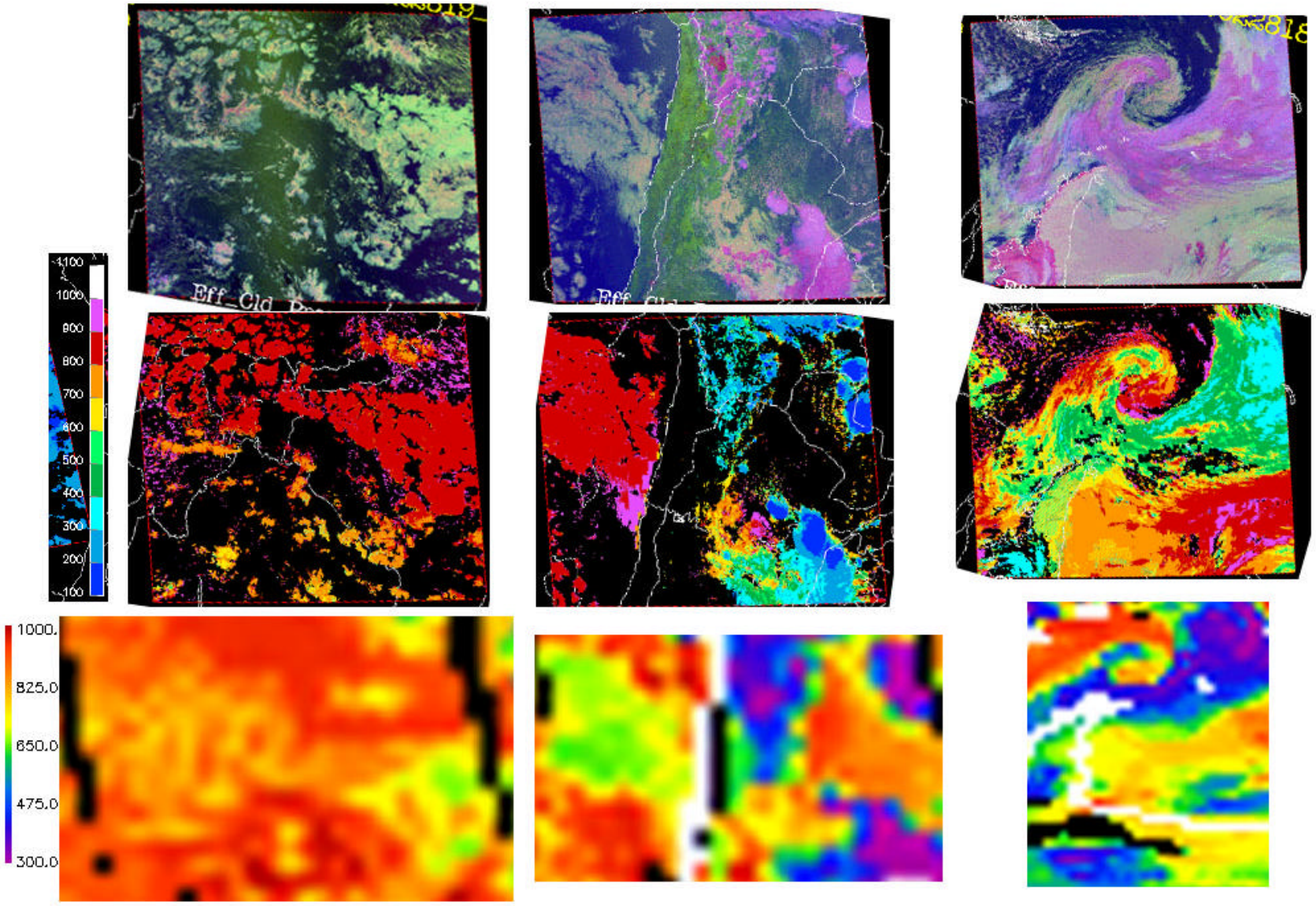
Jul. 2000

ISCCP mean pressure

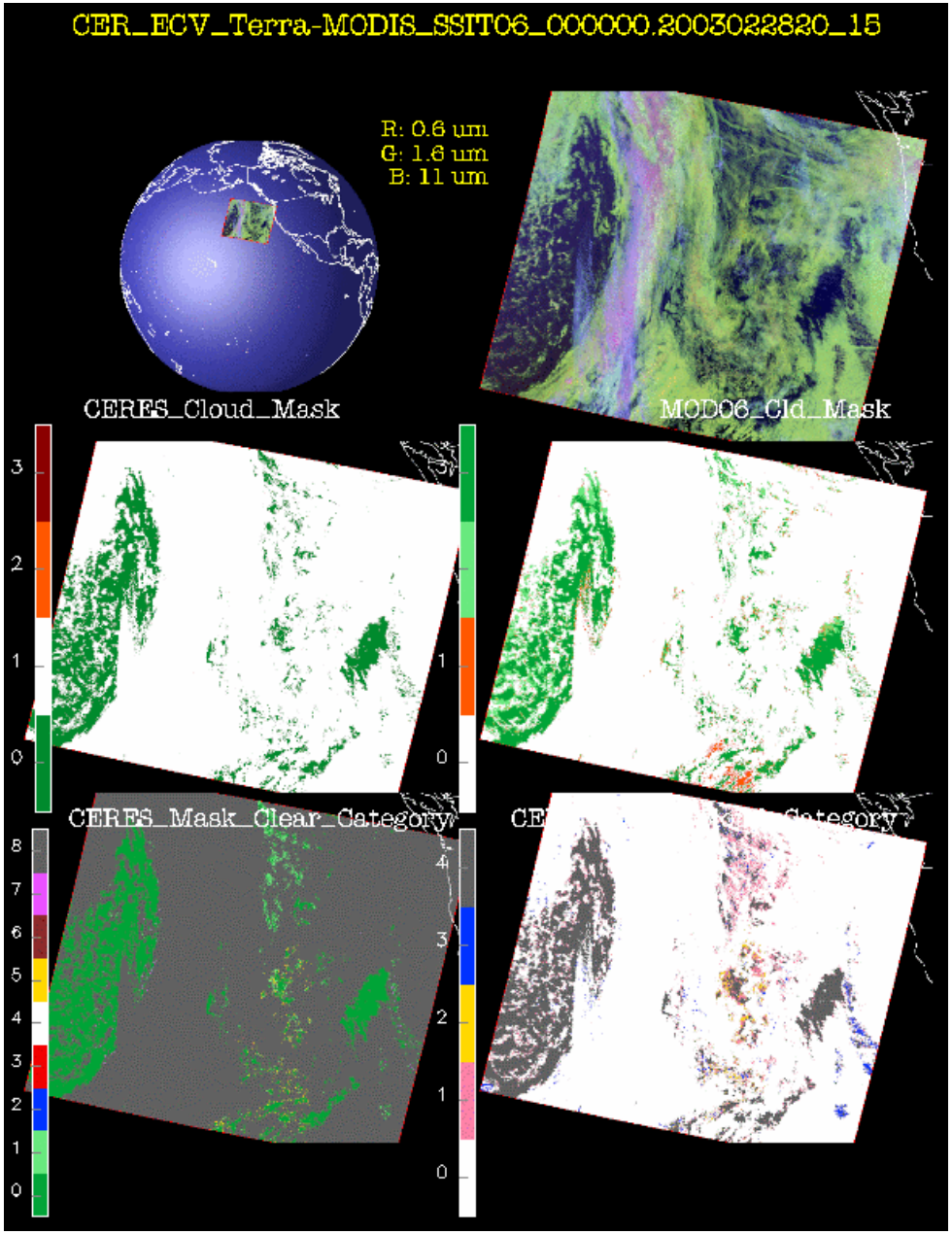


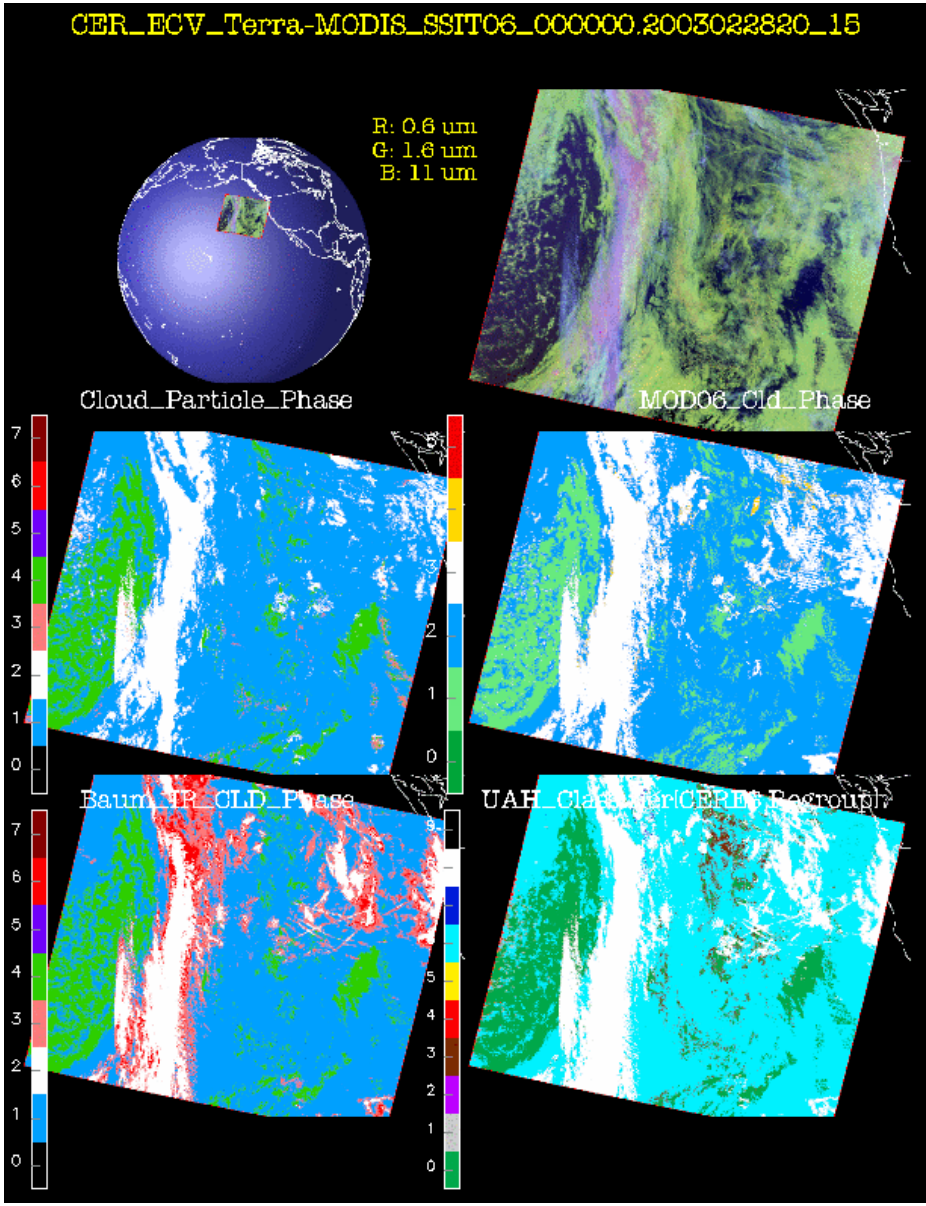
Comparison of MOD06 and CERES *Aqua* Cloud Pressure

February 28, 2003

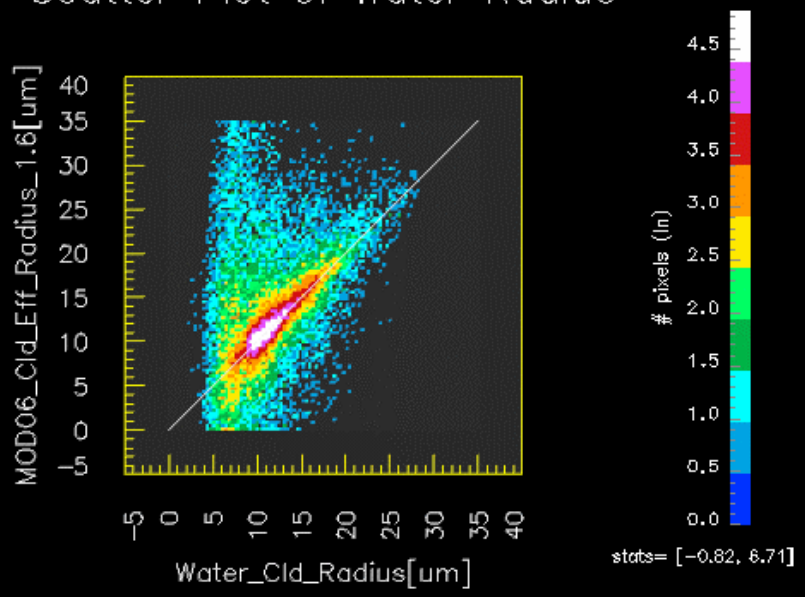


RESULTS

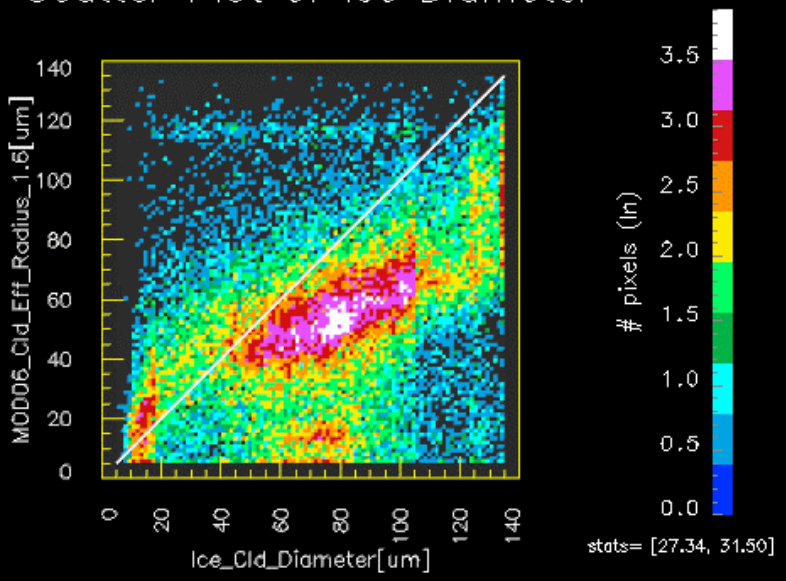

CER_ECV_Terra-MODIS_SSIT06_000000.2003022820_15
R: 0.6 um
G: 1.6 um
B: 11 um
CERES_Cloud_Mask
MOD06_Cld_Mask
CERES_Mask_Clear_Category

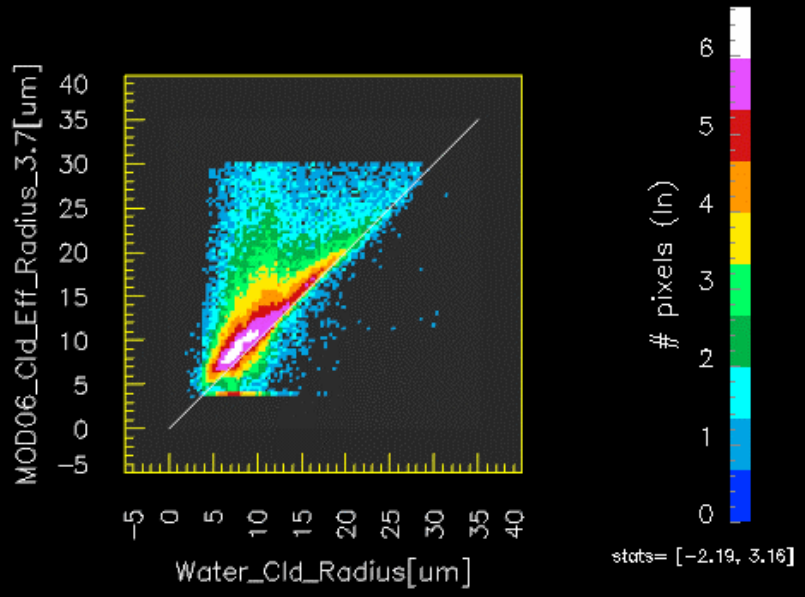

CER_ECV_Terra-MODIS_SSIT06_000000.2003022820_15
R: 0.6 um
G: 1.6 um
B: 11 um
Cloud_Particle_Phase
MOD06_Cld_Phase
Baum_IR_CLD_Phase

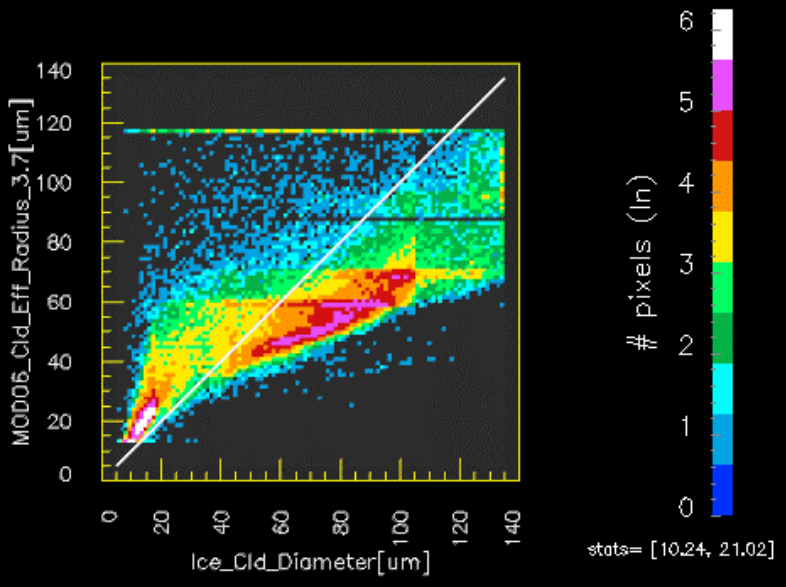
Scatter Plot of Water Radius

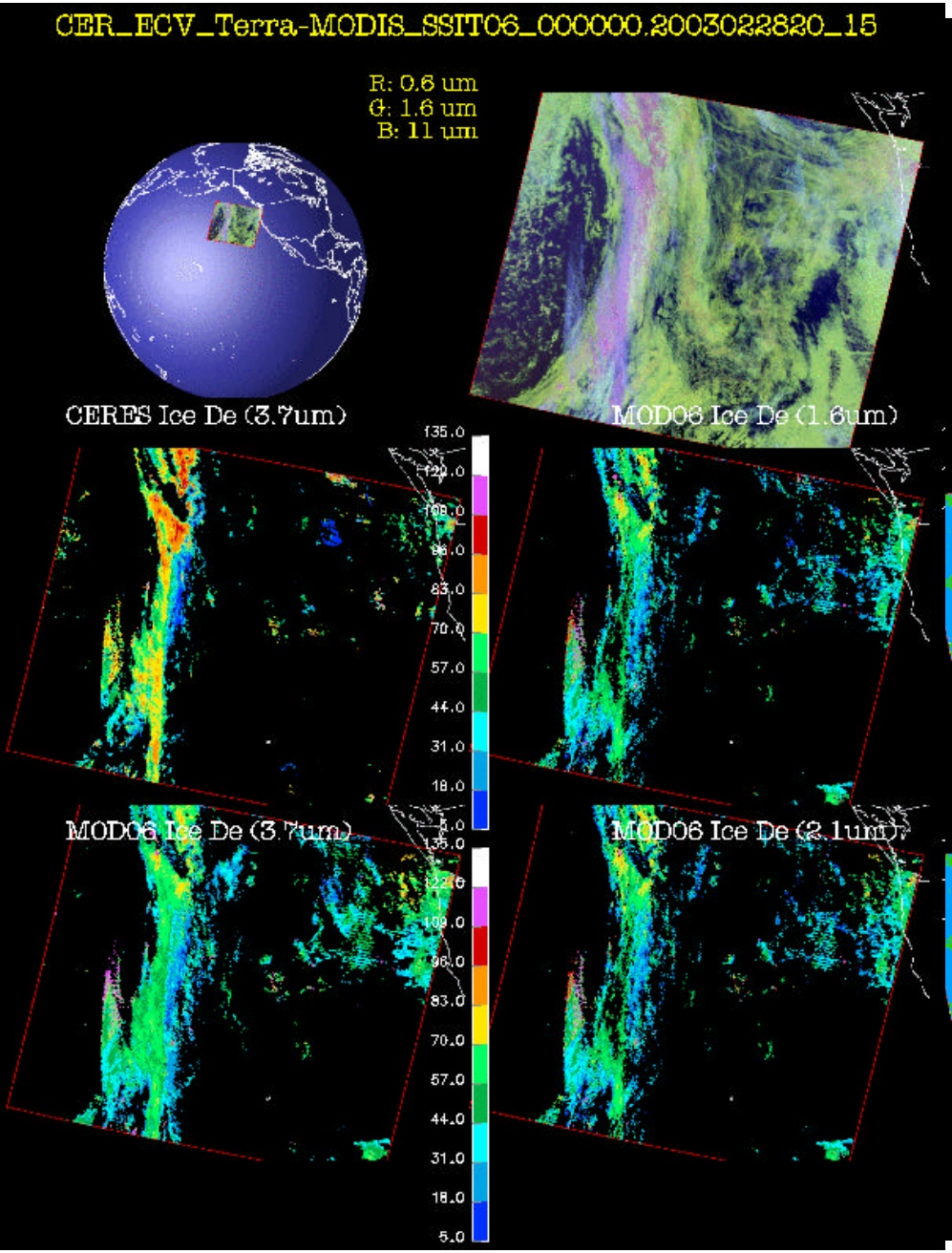


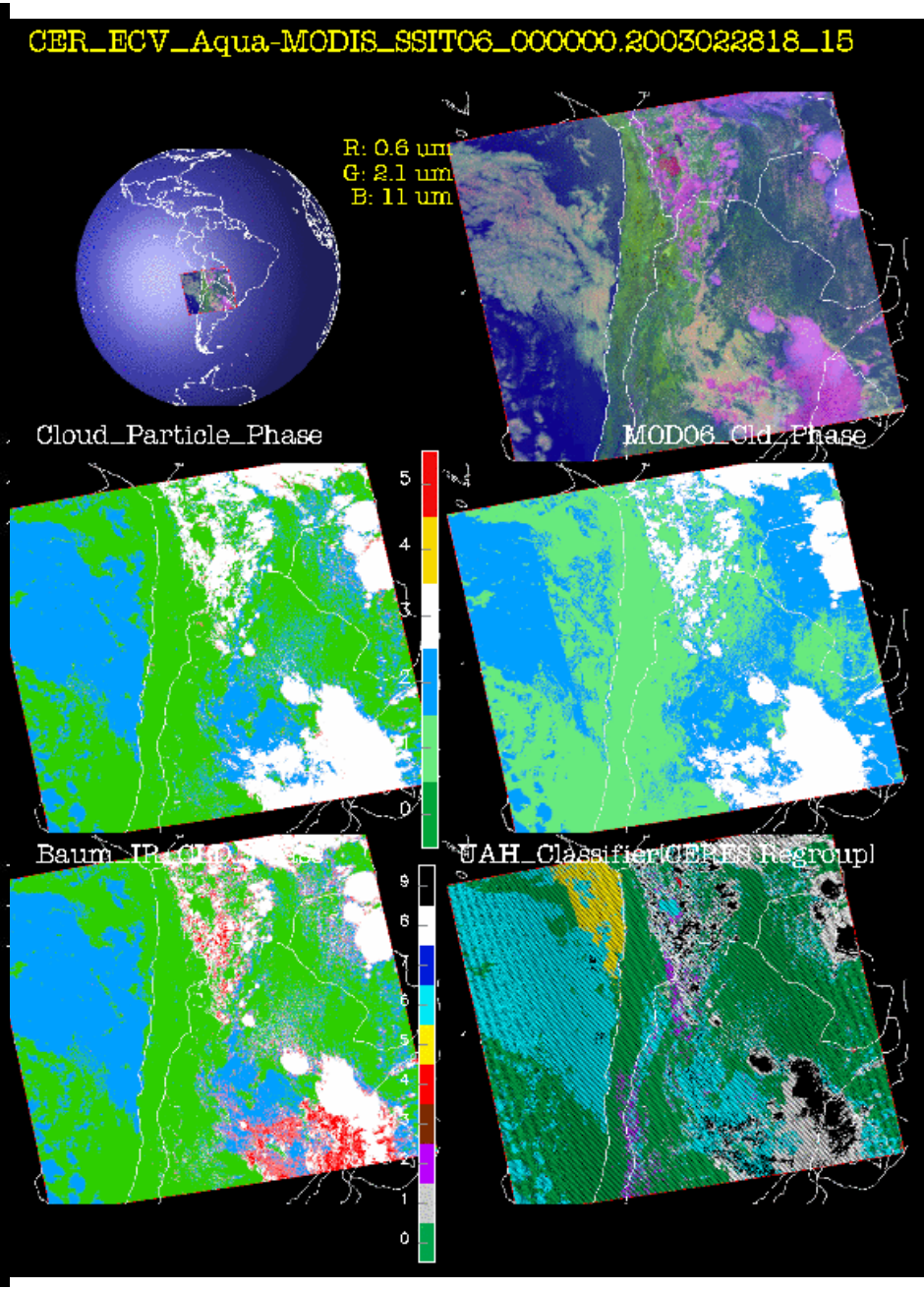
Scatter Plot of Ice Diameter





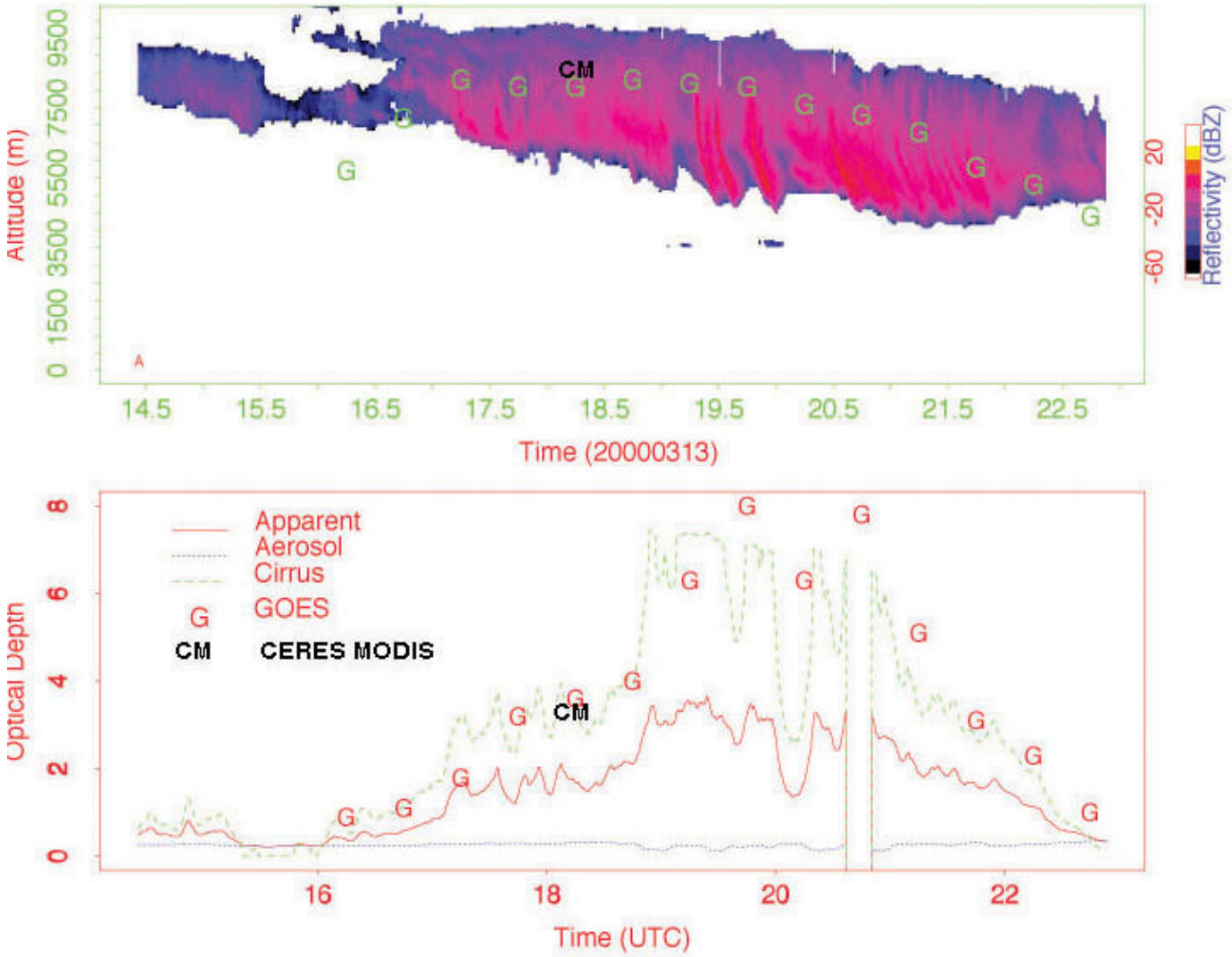



CER_ECV_Terra-MODIS_SSIT06_000000.2003022820_15
R: 0.6 um
G: 1.6 um
B: 11 um
CERES Ice De (3.7um)
MOD06 Ice De (1.6um)
MOD06 Ice De (3.7um)
MOD06 Ice De (2.1um)
135.0
122.0
109.0
96.0
83.0
70.0
57.0
44.0
31.0
18.0
5.0


CER_ECV_Aqua-MODIS_SSIT06_000000.2003022818_15
R: 0.6 um
G: 2.1 um
B: 11 um
Cloud_Particle_Phase
MOD06_Cld_Phase
Baum_IR_Cld
UAH_Classifier(CERES Regroup)
5
4
3
2
1
0
9
8
7
6
5
4
3
2
1
0

Cirrus Validation Using MFRSR Data

ARM SGP Site, March 13, 2000



courtesy of Q. Min

Aqua Beta1 Algorithm

1. Developed structure to replace 1.6 µm with 2.1 µm

- **Clear-sky albedo maps**
- **Kriebel BRDFs**
- **Empirical clear-snow albedo models**
- **Cloud reflectance models**
- **1.6-µm phase logic disabled**

2. NoVIS (VINT) algorithm over snow using 2.1, 3.7, 10.8 µm

3. Polar night/twilight mask algorithm improved

4. Improved daytime non-polar mask (snow in Tropics)

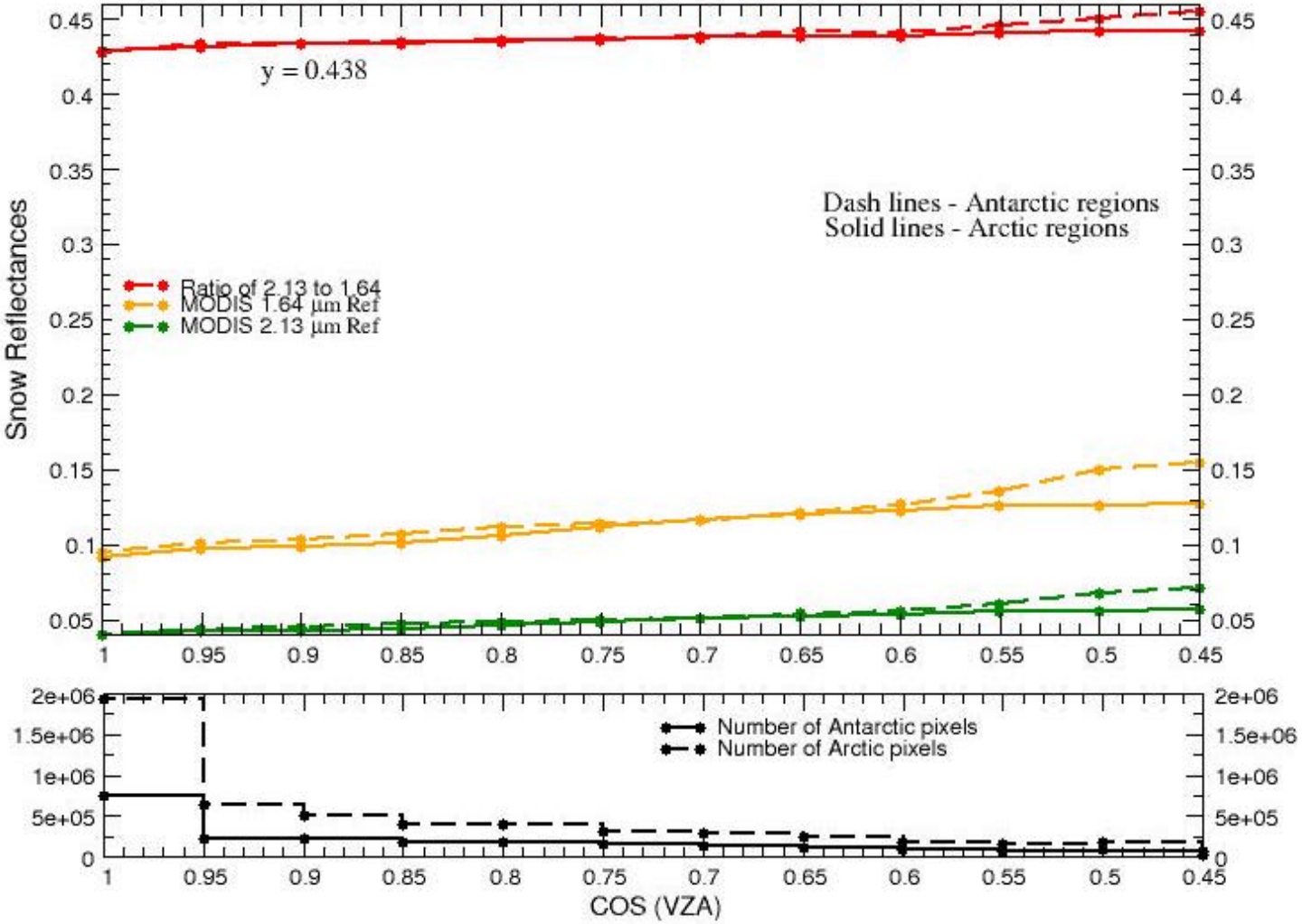
5. Daytime polar mask using 2.1 µm

6. Removed overwrites from Welch mask when TBD over polar region in daytime.

7. Aqua-MODIS aerosol product: MYD04_L2 does not contain SDS: Dust_Weighting_Factor_Land. MODIS reader now fills SDS with defaults.

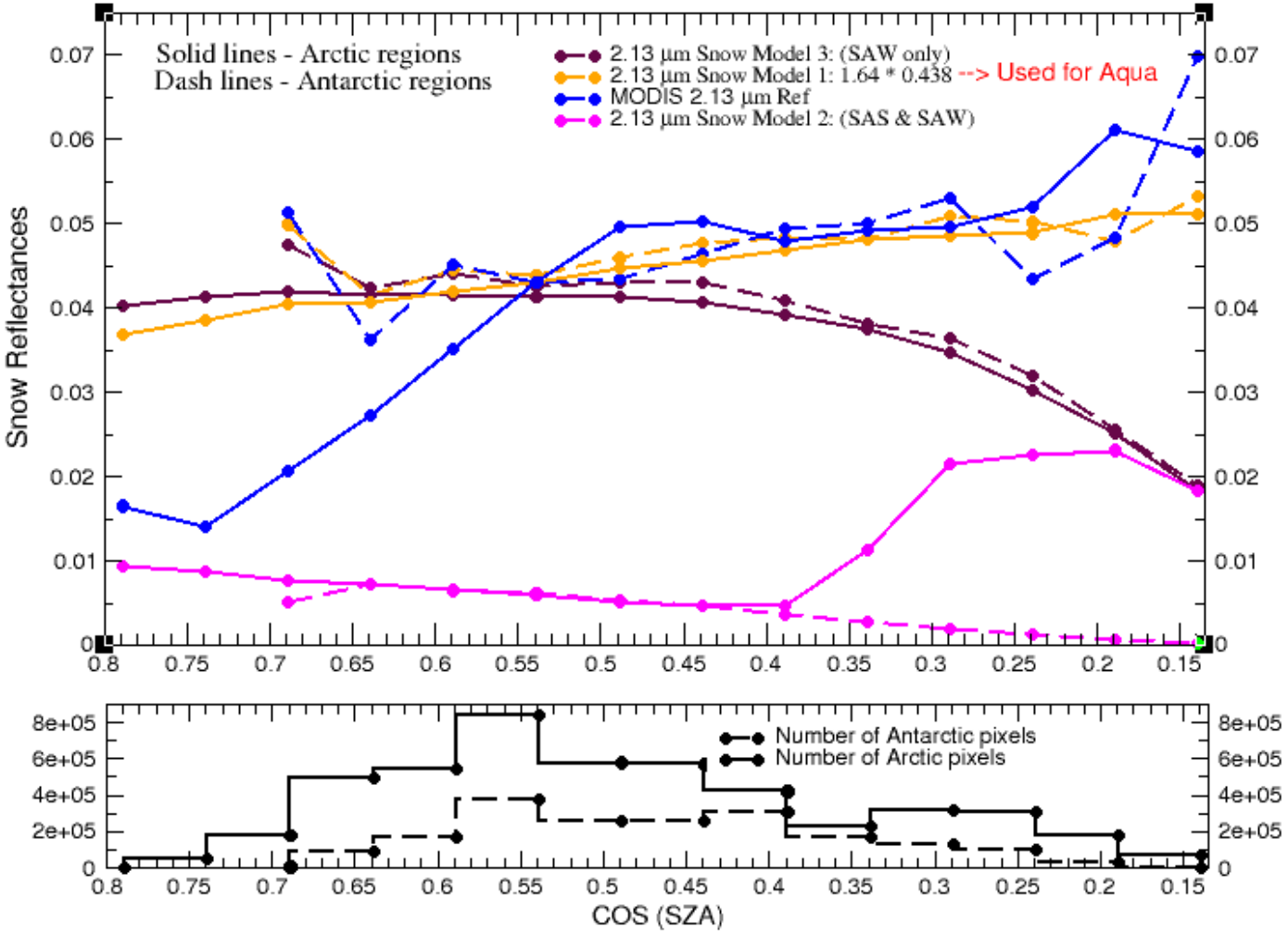
Terra MODIS Reflectances over Snow Surfaces

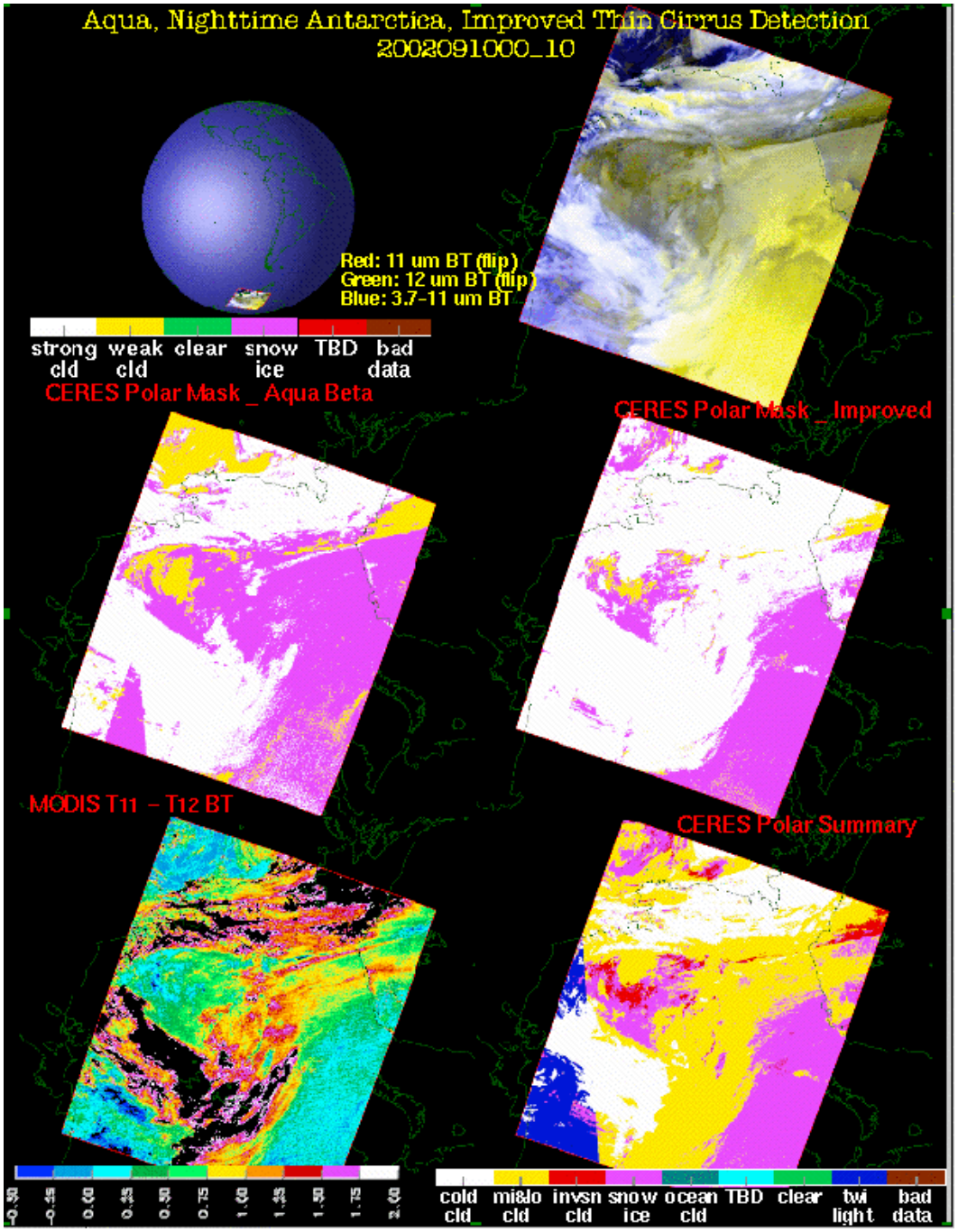
Averaged from 24 Arctic granules and 19 Antarctic granules



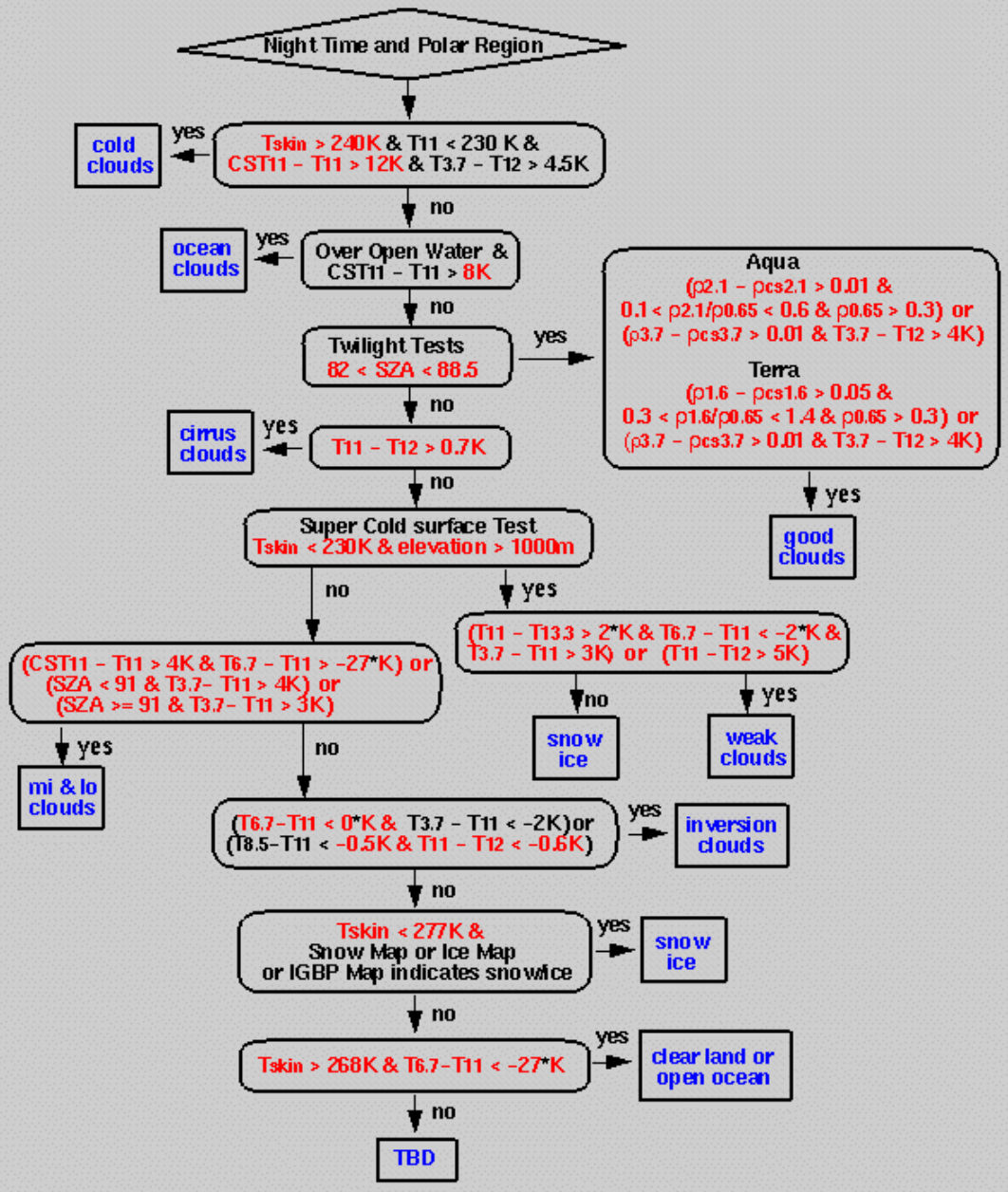
Terra MODIS 2.13 µm Reflectance and the Snow Models

Averaged from 23 Arctic granules and 16 Antarctic granules



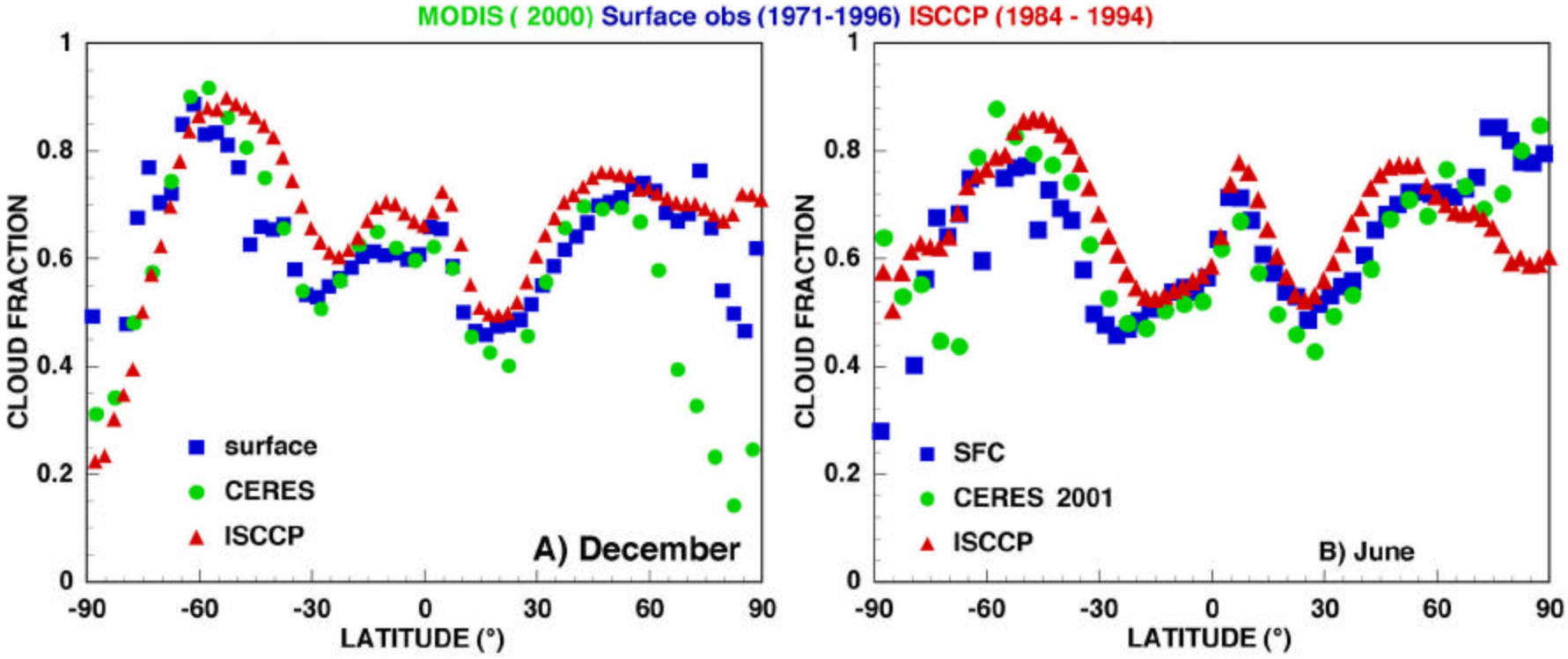

Aqua, Nighttime Antarctica, Improved Thin Cirrus Detection
2002091000_10
Red: 11 um BT (flip)
Green: 12 um BT (flip)
Blue: 3.7-11 um BT
strong cld
weak cld
clear
snow ice
TBD
bad data
CERES Polar Mask _ Aqua Beta
CERES Polar Mask _ Improved
MODIS T11 - T12 BT
CERES Polar Summary
-0.50
-0.25
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
cold cld
mid/lo cld
invsn cld
snow ice
ocean cld
TBD
clear
twi light
bad data

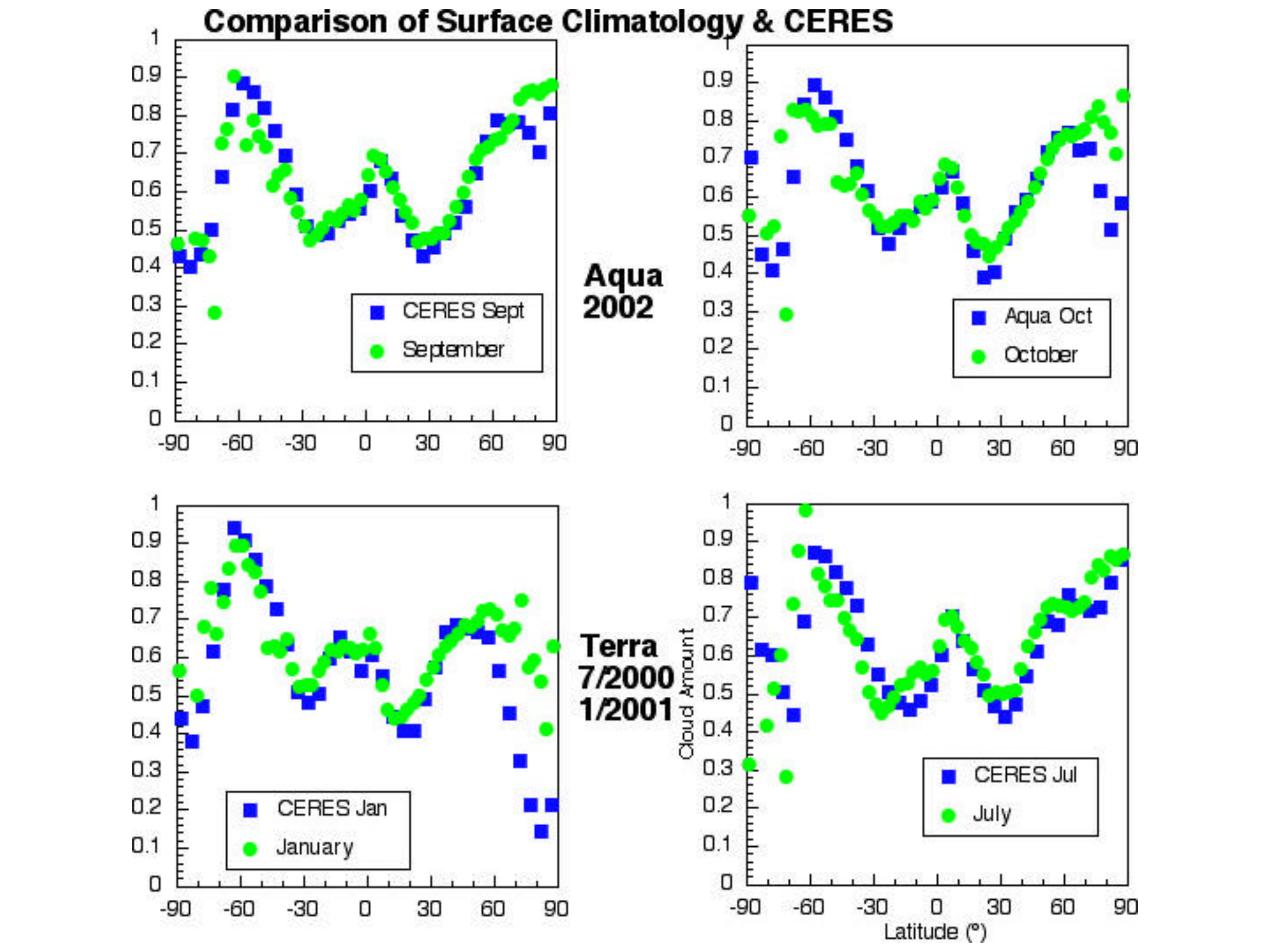
MODIS Night Time Polar Cloud and Snow/Ice Mask Flowchart



*hard-coded thresholds will be changed to T11 dependent.
Tests in red are the new or improved tests since Aqua Beta delivery.

Terra Edition 1A Polar Night Problem




Comparison of Surface Climatology & CERES
CERES Sept
September
Aqua
2002
Aqua Oct
October
CERES Jan
January
Terra
7/2000
1/2001
CERES Jul
July
Cloud Amount
Latitude (°)

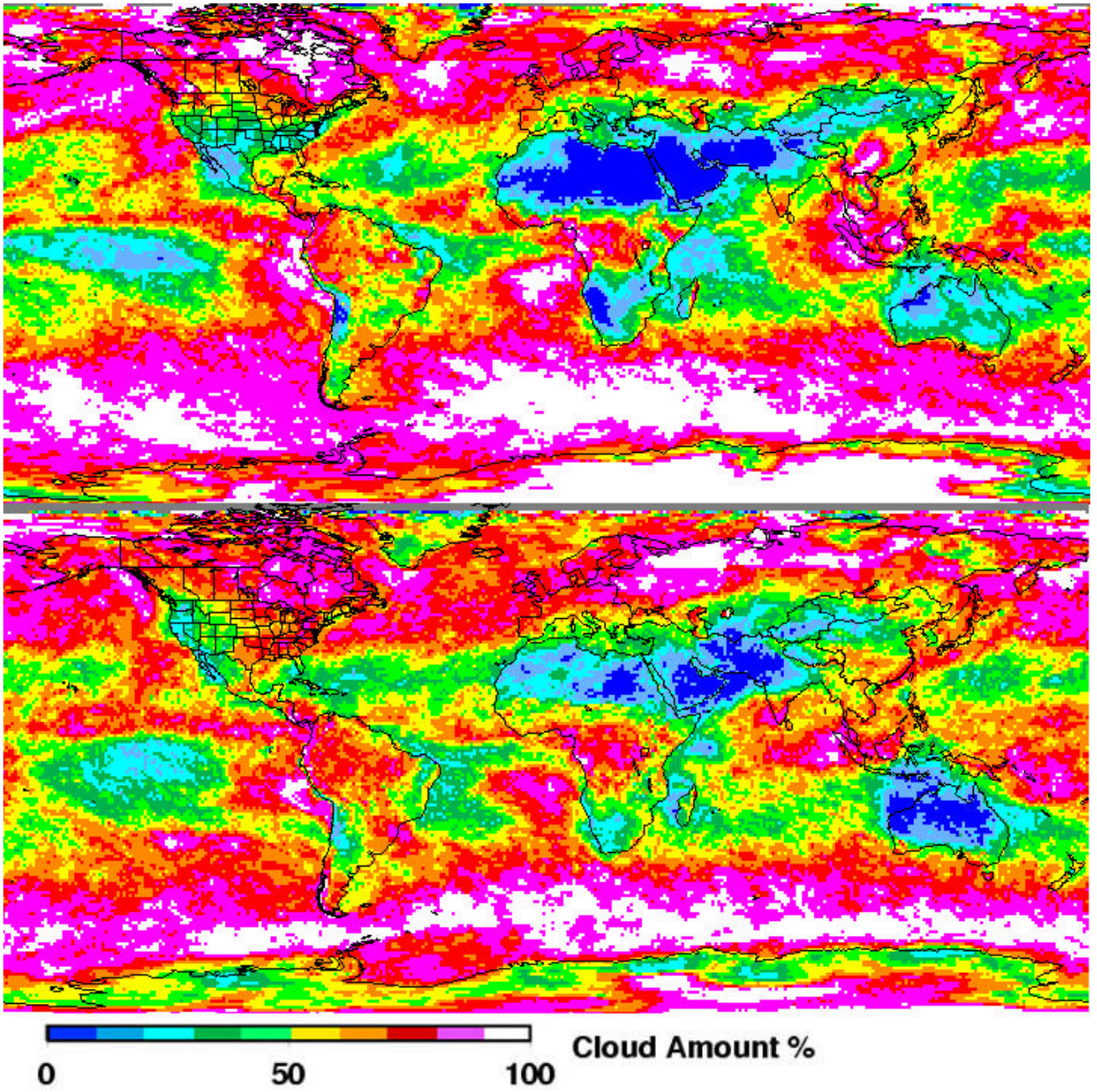
Terra Day
10/2001

Old polar day

vs New Polar day

Jan. 2001

Aqua Day
10/2002



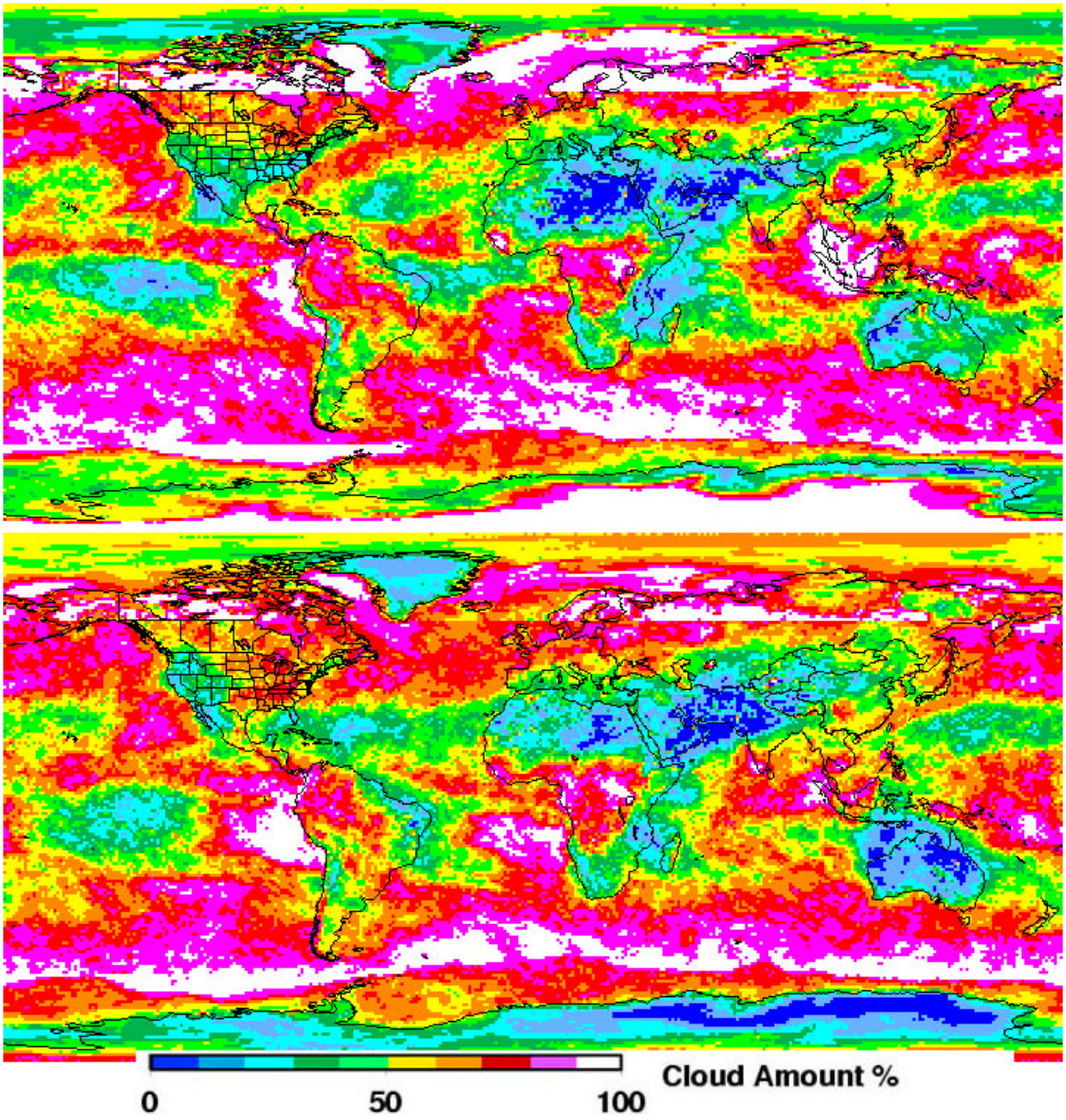
Terra Day
10/2001

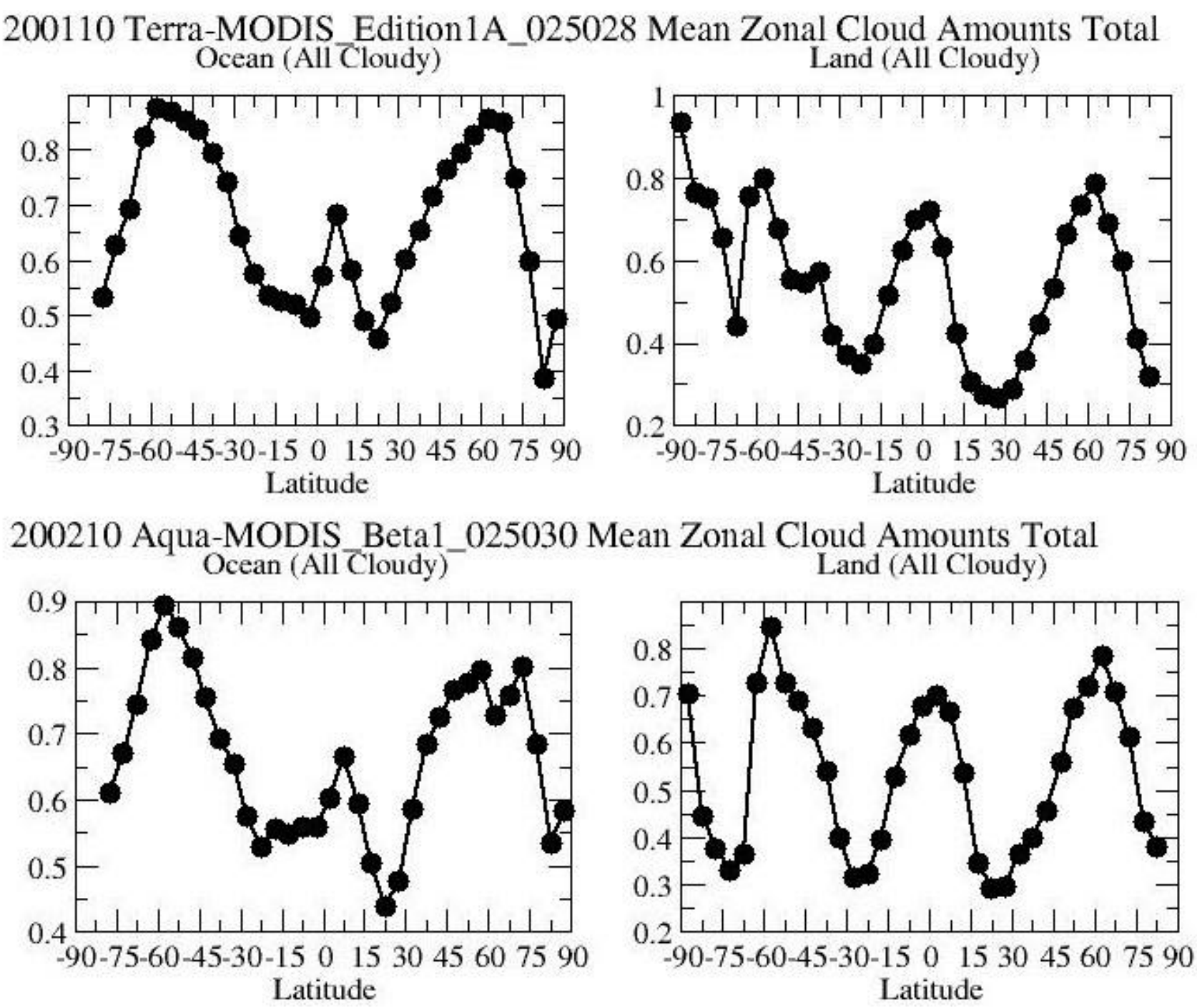
Old polar day

vs New Polar day

Jan. 2001

Aqua Day
10/2002

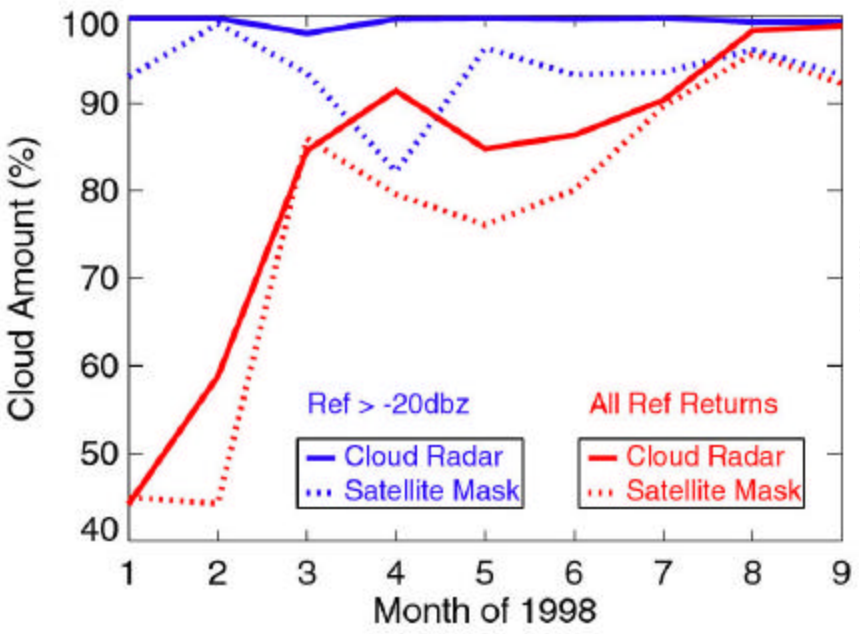



200110 Terra-MODIS_Edition1A_025028 Mean Zonal Cloud Amounts Total
Ocean (All Cloudy)
Land (All Cloudy)
0.8
0.7
0.6
0.5
0.4
0.3
1
0.2
-90-75-60-45-30-15 0 15 30 45 60 75 90
Latitude
200210 Aqua-MODIS_Beta1_025030 Mean Zonal Cloud Amounts Total
Ocean (All Cloudy)
Land (All Cloudy)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
-90-75-60-45-30-15 0 15 30 45 60 75 90
Latitude

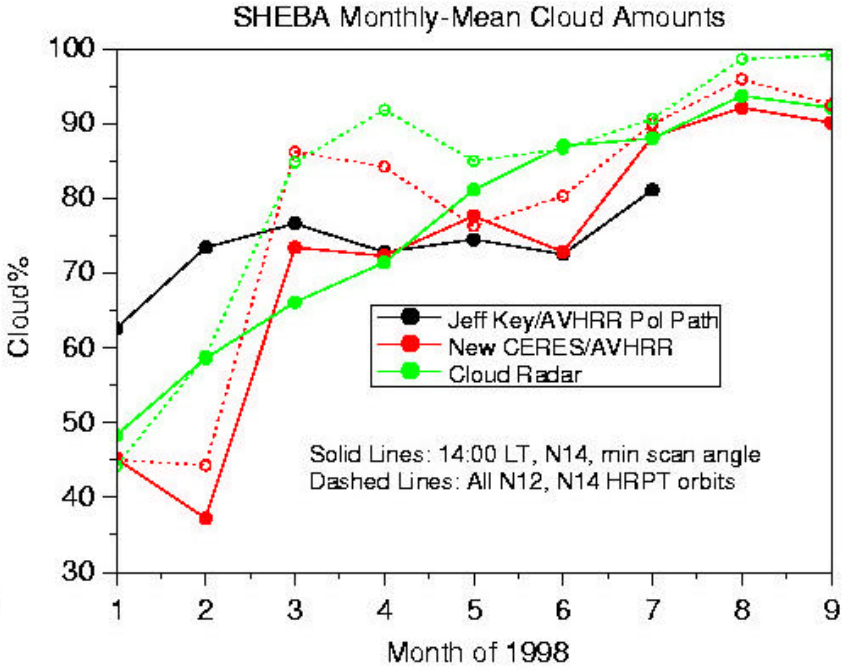
New Day+Night Mask Tested With 1998 AVHRR Over SHEBA

No 1.6-μm Data

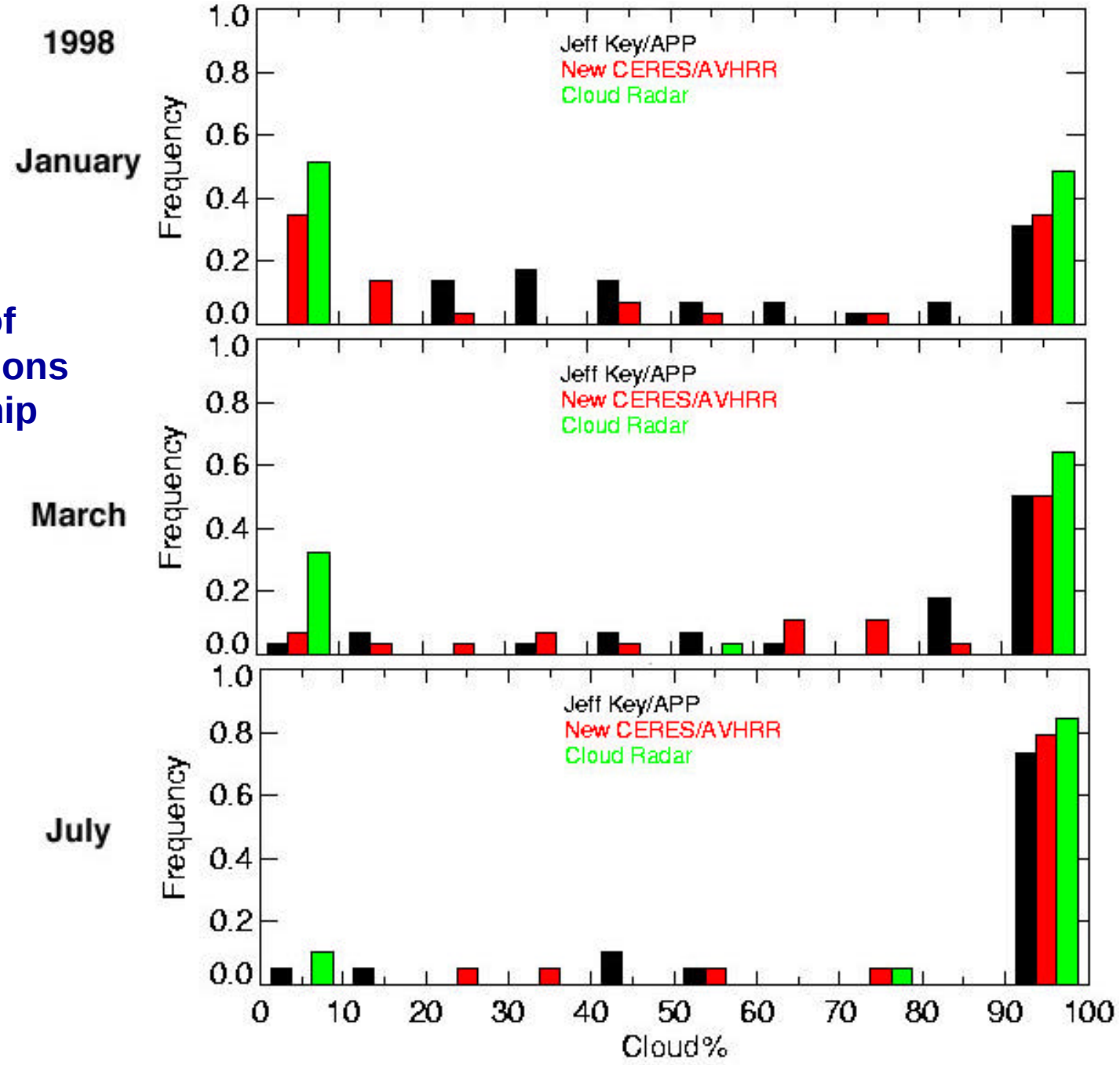
AVHRR Analysis vs SHEBA Radar



Comparison with Jeff Key Pathfinder Data

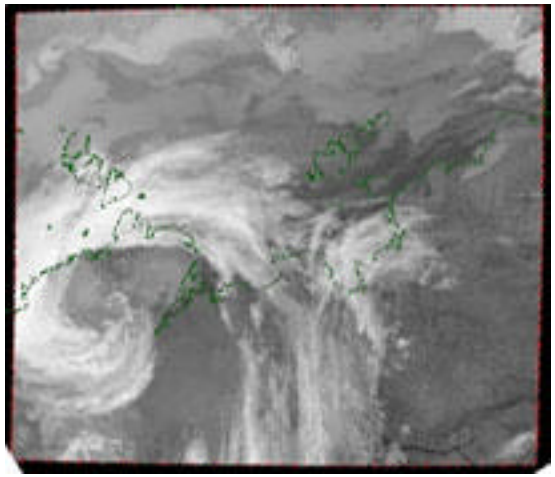


Comparisons of cloud distributions over SHEBA ship

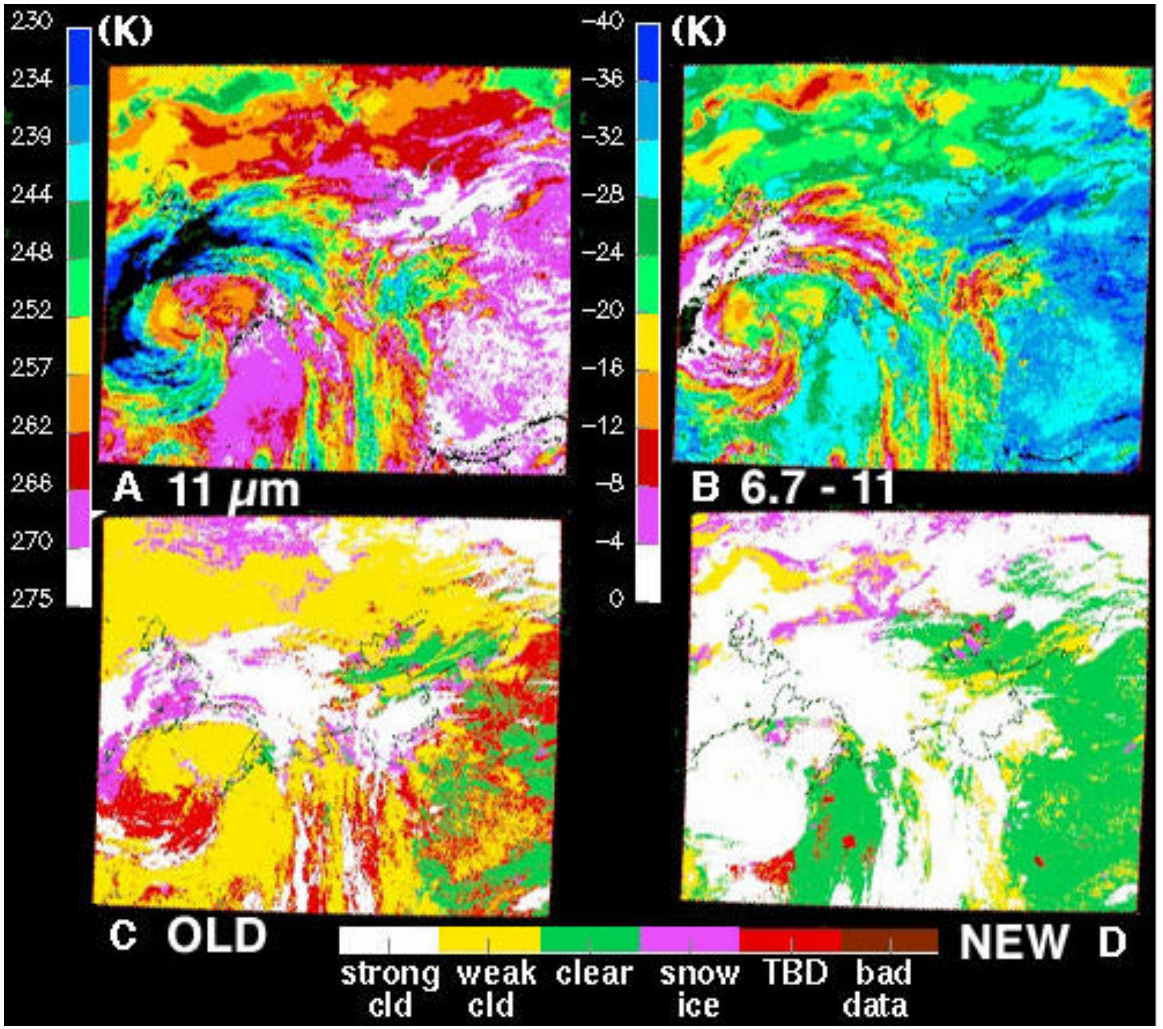


FUTURE NIGHTTIME POLAR

- MULTISPECTRAL IR: ADD 6.7, 8.5, 13.3

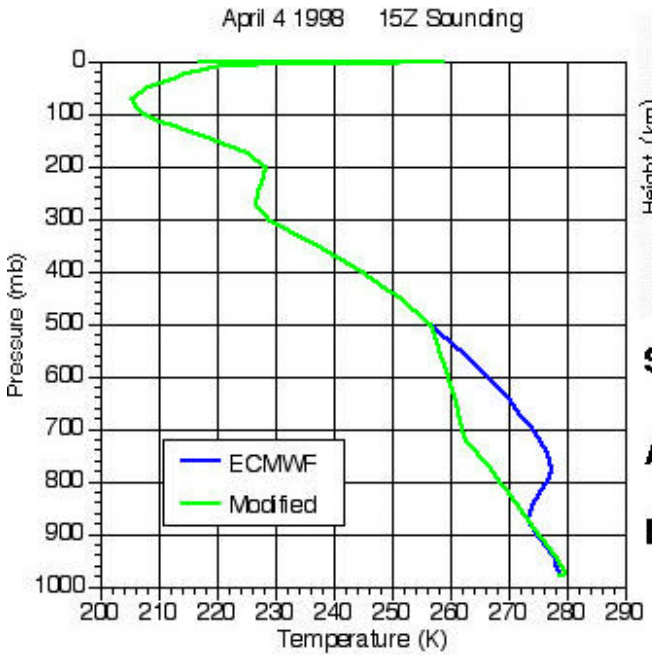


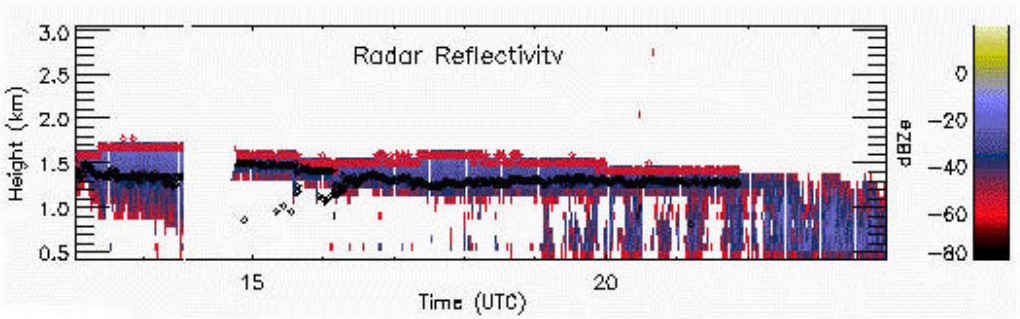
11 µm



Lapse Rate Method for Low Clouds Over Land

Anchor G to 24-hr running mean surface temperature





Satellite-derived cloud-top pressure at 658 hPa (z = 3.5 km) (blue line)

Actual cloud top at 850 hPa (1.7 km)

Lapse rate (green line) places cloud top at 840 hPa (1.6 km)

OTHER IMPROVEMENTS PROPOSED

- MULTI-LAYER CLOUD DETECTION & RETRIEVAL
  - MULTISPECTRAL, CONTEXT, & PHASE + re, SC
  - COMBINED MULTISPECTRAL IR W/ VISST

- FURTHER POLAR IMPROVEMENTS
  - MULTISPECTRAL IR FOR THIN CLOUDS

- PARTLY CLOUDY PIXELS
  - COMBINE 250-m + SPATIAL COHERENCE

SUMMARY

- COMPARE WELL WITH OTHER METHODS
    - CERES GETTING BETTER HEIGHTS OVERALL
- NEW CALIBRATION FOR 3.7 WILL INDUCE BETTER re CONSISTENCY
- POLAR NIGHT/TWILIGHT LOOKING BETTER
- ADDITIONAL VALIDATION SOURCES BECOMING AVAILABLE
- WE HAVE A ROADMAP FOR IMPROVEMENTS