CERES CLOUDS STATUS -

DAWNING OF THE AGE OF AQUA

NASA : P. Minnis, D. F. Young
SAIC: S. Sun-Mack, Q. Trepte, Y. Chen, R. F. Arduini, R. Brown
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


• 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
  \[ \Rightarrow \text{3.7-\textmu m difference yields MODIS } re \text{ is 0.5 } \mu\text{m} \text{ < VIRS} \]
  MODIS team announced a change in solcon for 3.7 \mu m
  \[ 10.51 \rightarrow 11.297 \text{ Wm}^{-2}\mu\text{m}^{-1} \text{ yields 0.5-\mu m rise in } re \]

- Terra MODIS 10.8-\mu m channel appears to have a drift
  - Monitoring with CERES, VIRS, GOES-8
MODIS Channel-31 Comparisons with CERES, VIRS, & GOES-8

Slope = Day * 6.50473e-05 (um day\(^{-1}\)) + 3.52411 (um)

\( R^2 = 0.101802 \)
CERES Terra vs ISCCP
Cloud Amount
Jan. 2001

CERES night

ISCCP mean

Cloud Amount %
CERES vs ISCCP
Cloud Amount
Jul. 2000

CERES day

ISCCCP mean
CERES Terra vs ISCCP

Cloud Amount

Jan. 2001

CERES day

ISCCP mean
CERES/ISCCP
Cloud Height
Jul. 2000

CERES day
ISCCP mean pressure

Cloud Pressure (mb)

km
RESULTS
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

\[ y = 0.438 \]

- Dash lines - Antarctic regions
- Solid lines - Arctic regions
Terra Edition 1A Polar Night Problem


A) December

B) June
Comparison of Surface Climatology & CERES

Aqua 2002
- CERES Sept
- September
- Aqua Oct
- October

Terra 7/2000 1/2001
- CERES Jan
- January
- CERES Jul
- July

Cloud Amount vs. Latitude (°)
Old polar day vs New Polar day
Jan. 2001

Terra Day
10/2001

Old polar day vs New Polar day
Jan. 2001

Aqua Day
10/2002
Old polar day
Jan. 2001
vs New Polar day
Terra Day
10/2001
Aqua Day
10/2002

Cloud Amount %
200110 Terra-MODIS Edition1A_025028 Mean Zonal Cloud Amounts Total Ocean (All Cloudy)

200210 Aqua-MODIS Beta1_025030 Mean Zonal Cloud Amounts Total Ocean (All Cloudy)
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

SHEBA Monthly-Mean Cloud Amounts
Comparisons of cloud distributions over SHEBA ship

1998

January

March

July

Frequency

Cloud %
FUTURE NIGHTTIME POLAR

- MULTISPECTRAL IR: ADD 6.7, 8.5, 13.3
Lapse Rate Method for Low Clouds Over Land

Anchor $\Gamma$ 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