Hourly GEO clouds for TISA


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Introduction

- Available geostationary satellites provide up to 1-hour global monitoring between ~60°S and ~60°N.

- The CERES cloud retrieval algorithm (VISST/SIST) from MODIS adapted for the geostationary satellite data processing
  - The modular frame-work allows individual researchers/team-members to plug & play. e.g. mask, multi-layer, background / clear-sky, terminator, retrievals, etc.
  - Used as a test bed for MODIS offline processing and debugging – CERES
  - Easy adaptability to meet different applications— contrail studies, field experiments etc.
Current Status

• Retrieving Global GEO Cloud Properties
  – GOES-15, GOES-13, MET-9, FY2E, and MTSAT-2R
  – 1-hourly at 8-10 km resolution
  – Using GFS Soundings (supports MERRA data)

Calibration

To apply same algorithm across different geo-satellites, with varying response function, normalize all imagers to 1 or 2 "well-calibrated" reference POES imagers – need redundancy! Minnis et al., JTech, 2002, 2008

- Aqua MODIS calibration standard

• Satellite Calibration Provided by Dave Doelling’s Calibration Group
  Doelling et al., LGRS, 2012
# Global Satellite Coverage 2000 - 2012

<p>| Year | Month | GOES-1 | GOES-2 | GOES-3 | GOES-4 | GOES-5 | GOES-6 | GOES-7 | GOES-8 | GOES-9 | GOES-10 | GOES-11 | GOES-12 | GOES-13 | GOES-14 | GOES-15 | SMS-1 | SMS-2 | CMS-1 | CMS-3 | MET-3 | MET-4 | MET-5 | MET-6 | MET-7 | MET-8 | MET-9 | MTSAT-1R | MTSAT-2 | FY-2C | FY-2D | FY-2E | KALPANA-1 |
|------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|---------|---------|-------|-------|-------|-------|
|      |       | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16     | 17     | 18     | 19     | 20     | 21     | 22     | 23     | 24     | 25     | 26     | 27     | 28     | 29     | 30     |
|      |       | East-USA | Central-USA | Prime-USA | West-USA | S. America | Euro-Africa | I. Ocean | Asia | W. Pacific | Test | Drift | Unknown |</p>
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<th>Satellite</th>
<th>VIS .6-.75</th>
<th>NIR 1.6</th>
<th>SIR 3.7-3.9</th>
<th>WV 6.2-6.9</th>
<th>Phase 8.7</th>
<th>IR 10.7-11, 11.5</th>
<th>SW 12</th>
<th>CO2 13.3-13.4</th>
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Meteosat-9 Processing, 1200 UTC, 1 May 2012

RGB

• Processing stops at 60° latitude and ± 50° longitude
GLOBAL GEOSTATIONARY CLOUD PRODUCTS
18 UTC, 25 April 2012
Merged GLOBAL GEO products 18 UTC, 1 September 2011
HOURLY MERGED PRODUCTS, 25 April, 2012

TOTAL CLOUD HEIGHT

TOTAL CLOUD TEMPERATURE

CLOUD TEMPERATURE
HOURLY MERGED PRODUCTS, 25 April, 2012

CLOUD AMOUNT

OPTICAL DEPTH
Improvements to the Retrieval Algorithm
Accurate and reliable start-up reflectance maps are essential for improved retrievals

- Initial map produced by processing a month of data up to current day. Calculate monthly mean snow & non-snow (mm_sn & mm_nsn) clear-reflectance maps for each time slot using the cloud mask
- Use daily snow map to filter snow and non-snow regions

Updating Scheme

- Using mm_sn & mm_nsn clear ref as the start-up, reprocess day 1 time-slot n
- Based on cloud-mask results, calculate instantaneous clr-map for slot n using 20% clear filter in a region (1° grid box). If the calculated clr-ref differs from the monthly maps by a threshold (variable) update mm_sn & mm_nsn
  - Snow = 5% (coast 10%), Non-snow = 5% (coast 15%)

- Run day 2 with the updated map. Update the mm_sn & mm_nsn and process day 3 and so forth until current day

- Currently the update scheme is running every 3 hours for GOES-EAST full disk.
Non-Snow Clear Reflectance

Apr 27, 2012 Hour = 0245Z
Improvements to the cloud mask across the TERMINATOR region.
5 UTC, 25 April, 2012 MSG.

See presentation by Chris Yost in the CLOUDS working group for more information.
SATELLITE COVERAGE ISSUES

The FENG-YUNG series has bad 3.8 µm data between 15 – 18 UTC
The 3-hr full disk scan covers the full region

The NH and SH scans are merged for other hours
The merged NH /SH scans from GOES-WEST and GOES-EAST have gaps in global coverage.
### Satellites

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<tr>
<th>Year</th>
<th>GOES-10</th>
<th>GOES-8</th>
<th>GOES-8/12</th>
<th>GOES-12</th>
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- Only VIS and IR channel available on these satellites.

- Use a WV-IR Technique (WIT) to detect thin cirrus at night to give more accurate cloud heights?
Example of the WIT applied to GOES-13
1645 UTC, 7 March 2012

Retrievals yield cloud-top pressures less than VISST, consistent with CO2 method.
Future Work

- Update GEO Retrieval Code with Applicable CERES Ed-4 Algorithm Enhancements
- Provide the TISA Group with a month of GEO Global Cloud Retrievals to Identify Issues with Output Parameters, Formats, etc. (June, 2012)
- Implement Satellite Specific Correlated-k for All Satellites. GOES and MTSAT are Available Now.
- Update the GEO Retrieval Code to Utilize MOA Soundings (currently works with GFS & MERRA) to be Consistent with CERES. (September, 2012)
- Implement the Dynamic Clear-Sky Reflectance Updating Scheme for all GEO satellites. (July, 2012)
- Obtain Latest Calibration Information from the Calibration Group, and Process a Year of Data (November - December, 2012)
- Minimize Use of Defaults at Night
  - test theoretical optical depth limits for various emission channels
- Utilize 6.7 µm Approach When Only VIS/IR Channels are Available
Extra Slides
Task Distribution

• Dynamic Clear Sky Updating
  – Michele Nordeen, Rabi Palikonda

• Cloud Property Retrievals at the Terminator
  – Chris Yost

• Data Ingest/Georeferencing/Automated Data Quality Checks
  – Doug Spangenberg, Konstantin Khlopenkov

• WIT & VISST over snow Algorithm Development and Testing
  – Gang Hong

• Cloud Masking
  – Qing Trepte

• Narrowband2Broadband Conversion Coefficients
  – Mandy Khaiyer

• Cloud Retrieval Code
  – Pat Heck, Sunny Sun-Mack, Rabi Palikonda

• Cloud Thickness Parameterization/Validation
  – Helen Yi

• Code Integration and Management
  – Rabi Palikonda

• Satellite Specific Corr-K Updates
  – Doug Spangenberg

• Data Processing/Validation/Archival
  – By Committee