Satellite Cloud Retrievals for ARM Sites and Field Experiments


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http://www-angler.larc.nasa.gov/satimage/products.html

Motivation: ARM needs satellite data to complement surface measurements

- Outgoing radiation not measured at the surface
- Satellite can provide outgoing longwave radiation and shortwave albedo, & some spectral radiances
- Surface measurements characterize clouds only over small area >> partial picture
- Satellite data can be used to estimate cloud fields over larger scales at lower resolution, less info content
- Cloud modeling studies need larger scale validation data and boundary/initial conditions
- Satellite data used both for validation and initialization of GCMs, ECM, WRF, etc.

Objective: Provide large scale cloud & radiation parameters for ARM

- Produce variables as consistent as possible with ARM site measurements, for all domains
- Calibrate satellites against a common reference
- Validate results using ARM surface and aircraft measurements
- Satellite data used both for validation and initialization of GCMs, ECM, WRF, etc.

Data & Methods

- Cloud & radiation parameters from geostationary (GEO) & low-earth orbiting (LEO) satellites
  - Visible channel calibration standard: Aqua MODIS channel 1 (0.63 µm)
  - Shortwave & longwave flux standard: CERES broadband data
  - Main cloud retrieval algorithms: VISST/SIST
    - Multilayer retrieval algorithm: MCAT
      - requires 13.3-µm channel, only on new GOES (12+), Meteosat, MODIS
      - uses WMS in place of VIS channel to retrieve τ
      - requires 1.2, 1.6, or 2.3-µm channel, only on Meteosat & MODIS
  - Special algorithms: SINT, applied to snow-covered regions
  - uses XNP in place of VIS channel to retrieve τ
  - uses WMS in place of VIS channel to retrieve τ
  - XNP in place of VIS channel to retrieve τ
  - uses WMS in place of VIS channel to retrieve τ
  - uses WMS in place of VIS channel to retrieve τ
- Other multilayer or thin cloud techniques for imagers lacking 13.3-µm channel
  - Split-window approach
  - Water vapor infrared technique (WIT) and WIT-VIST Multilayer System (WIMS)
  - Clear-sky updating for snow and snow-free surfaces
  - Improved cloud detection & retrieval
  - Provides data for monitoring surface albedo
  - Overshooting Convective Tops
  - Surface skin temperature
  - Cloud water content profiling
  - Provides reasonable estimate of vertical structure of clouds
  - Enables the development of 4-D cloud representation

- New domains added as when requested for AMF deployments or AAF or other field experiments
- Data are reprocessed on priority basis when new calibrations or improved algorithms become available

Validation: Comparisons to surface/in situ measurements from SGP, TWP, NSA, AMF, & AAF

Example: Comparison of cloud microphysics from SPARTICUS Lear Jet & GOES-W VISST retrievals, 19 Jan 2010

New Algorithms: Address shortcomings for snow & multilayer clouds

Example: Applying WIT to GOES to demonstrate capability for ML detection & retrieval, GOES-13 retrievals, 7 Mar 2012, SGP domain

Summary

- Langley continues to provide a variety of satellite products to the ARM Science Team & community at large
- Data are provided through two venues: ARM Data Center & Langley web site
- Data are reprocessed on priority basis when new calibrations or improved algorithms become available
- New domains added as when requested for AMF deployments or AAF or other field experiments
- Validation efforts ongoing using ARM & other measurements
- Algorithmic improvements made when possible and applied to real-time and archival data

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