Validation and Maintenance of ABI Shortwave Radiation Budget Algorithm

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1. Abstract

The retrieval component of the ABI Shortwave Radiation Budget (SRB) algorithm was updated, and code for preparing gridded inputs was incorporated. Visualization and validation tools have also been updated to monitor and validate the ABI SRB retrieval products. Version 2 software was expanded with object graphic display on top of the developed IDL graphic interface, which improved the flexibility and functionalities of the visualization of retrieval products. Validation of ABI SRB retrievals with proxy MODIS data against ground and TOA measurements showed that the accuracy and precision of retrieved downward shortwave radiation at surface (DSR) and reflected shortwave radiation at TOA (RSR) meet the requirements. The concept of real-time monitoring and validation has been realized with the current GOES Surface and Insolation Product (GSIP), results of this activity are also presented in this poster.

2. Algorithm Updates

- The ABI Shortwave Radiation Budget (SRB) algorithm was updated with gridded input preparation subroutines that
  - set the retrieval grid as equal angle or equal area at specified resolution based on the configuration input,
  - average the pixel-level inputs (geometry, location, satellite reflectance, retrieved atmospheric parameters including precipitable water, ozone, aerosol optical depth, aerosol type, water/ice cloud optical depth, top height and radius, etc.) within the retrieval grid for each scene type (clear-sky snow-free, clear-sky over snow, water cloud, ice cloud), and
  - interpolate the ancillary model inputs to the retrieval grid and set the input quality flags.
- A general quality flag indicating the overall success or failure of the SRB retrieval was added to the algorithm.
  - The general retrieval quality flag is set if (1) the retrieval failed, (2) the solar zenith angle is larger than 70°, (3) unphysical retrieval values: DSR greater than 1500 W/m^2 or less than 0 W/m^2 ; RSR greater than 1300 W/m^2 or less than 0 W/m^2.
- A coastal quality flag is set when land/water pixels co-exist within the retrieval grid.

3. Visualization/Validation Tool Updates

The ABI SRB visualization tool was updated with extended functionalities using IDL interface and object programming :

- The "File" menu allows saving displayed figure in various formats (PNG, GIF, JPEG, TIFF, BMP)
- The "Image" menu allows displaying images of primary outputs (DSR and RSR), Diagnostic outputs (clear-sky composite, etc), and all quality flags (Figure 1).
- The "Colors" menu allows the change of color palette and background.
- The "Metadata" menu allows the display of metadata (Figure 2).
- The "Pixels" menu allows the interactive display of detailed retrieval results at individual pixels (Figure 3).

The ABI SRB routine and deep-dive validation tools were developed with the functions of generating scatter plot, time series and statistics against of satellite or ground measurements under general or specific scenarios.

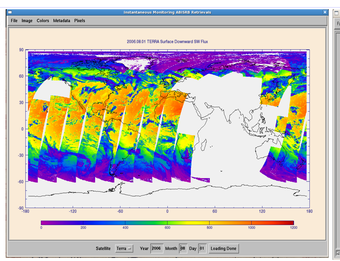


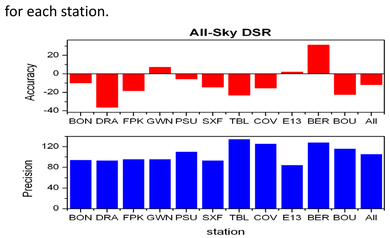
Figure 1

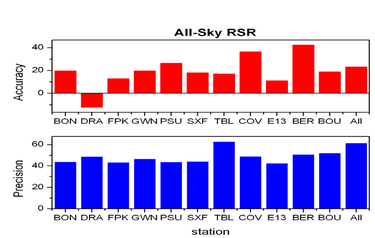
Figure 2

Figure 3

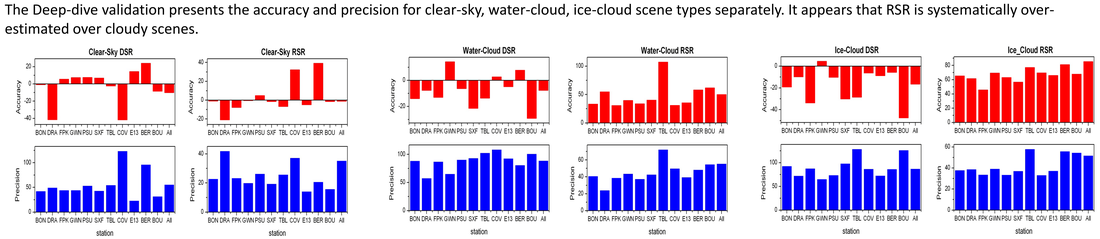
4. Routine and Deep-Dive Validation Over Ground Stations

Validation of ABI SRB algorithm was performed at 11 stations over the period of 03/2000-12/2009 with proxy MODIS data from both Terra and Aqua. The Routine validation calculates the all-sky accuracy and precision for each station.





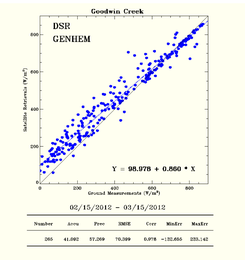
The Deep-dive validation presents the accuracy and precision for clear-sky, water-cloud, ice-cloud scene types separately. It appears that RSR is systematically over-estimated over cloudy scenes.

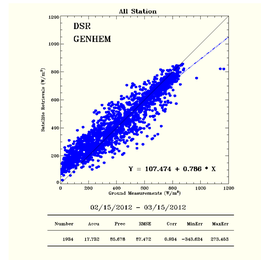


5. Demonstration of Real-time Monitoring – Application to GSIP

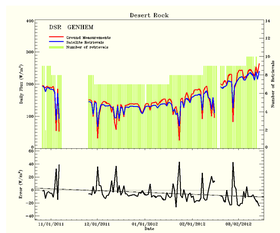
The concept of real-time monitoring of SRB retrievals has been implemented with the current GOES Surface and Insolation Product (GSIP). Through automatic acquisition of ground measurements and satellite retrieval products, spatial and temporal match, computation of instantaneous, hourly and daily average, validation results are available in the format of graphical image and numerical statistics to the public via a dedicated webpage. The following functionalities are present in the interface:

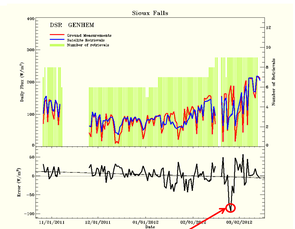
- Select date (default is the latest validation).
- Select validation scheme.
  - *Daily Plot*: displays a time series of ground measurements, retrieval values and errors for each individual ground stations. Scatter plot and statistics (number of retrievals, accuracy, precision, RMSE, correlation, min/max error) are also presented.
  - *30 Day Statistics*: displays a scatter plot of retrievals against measurements within the previous 30 days for each station and all retrievals as well. Validation reports can be obtained as a PDF file.





- *Daily-Mean Time Series*: displays the time series of daily mean measurements, retrieval values and errors. Automatic "alarm" capability is implemented by sending a warning message to the product monitoring staff if the daily error is beyond the prescribed threshold, thus allows the timely investigation of potential retrieval problems.

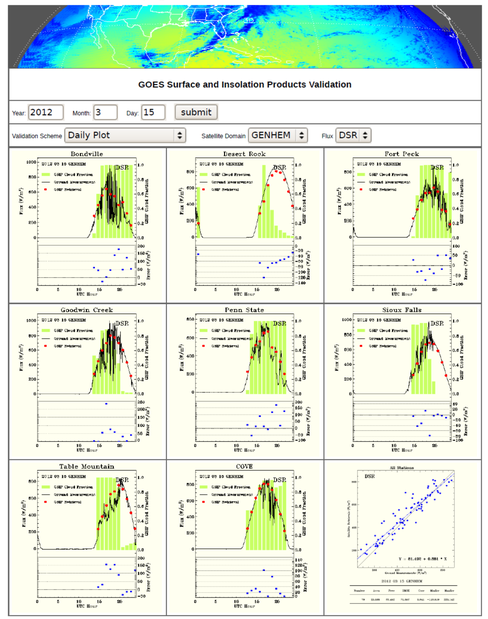




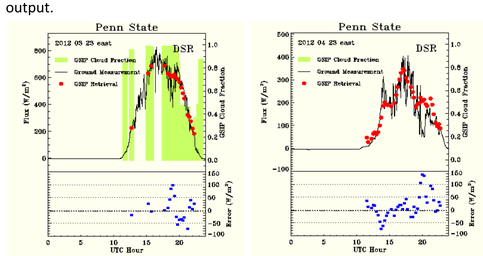
Warning email is issued

- Select satellite domain.
  - The current GSIP retrievals are performed for four satellite domains: GOES-East Northern Hemisphere (GENHEM), GOES-East Full Disk (GEDISK); GOES-West Northern Hemisphere (GWNHEM), and GOES-West Full Disk (GWDISK).
- Select the radiation variable to be displayed. The current GSIP retrievals produce shortwave and photosynthetically active radiation at surface.

Webpage of the real-time GSIP validation



Similar product monitoring is realized for the experimental CIMSS GOES retrieval at higher spatial and temporal resolution. As an example of the merit of real-time monitoring, routine inspection of the validation webpage revealed the issue of missing cloud fraction in the product output.



6. Summary

- The ABI Shortwave Radiation Budget (SRB) algorithm was updated with the gridded input preparation subroutines.
- Visualization and validation tools were updated with interactive functions.
- Routine and deep-dive validation were performed over ground stations with proxy MODIS data. It appears that over cloudy scenes RSR is systematically overestimated.
- Real-time monitoring tool was implemented and assessed with current GSIP retrievals.