Near-Real-Time Simulated ABI Imagery for User Readiness, Retrieval Algorithm Evaluation and Model Verification

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*** NOAA/NESDIS**

Goals

This project supports GOES-R Algorithm Working Group (AWG) Weather Research & Forecasting with Chemistry (WRF-CHEM) Advanced Baseline Imager (ABI) proxy data capabilities through generation of near-real-time data sets that include aerosols and ozone. These proxy data sets are generated on S4 using WRF-CHEM air quality simulations coupled to global chemical and aerosol analyses from the Real-time Air Quality Modeling System (RAQMS).

- Generate simulated ABI radiances using output from coupled RAQMS/WRF-CHEM ozone and aerosol simulations and the Joint Center for Satellite Data Assimilation (JCSDA) Community Radiative Transfer Model (CRTM)
- Supply data to the Algorithm Integration Team (AIT) and Proving Ground partners for testing all GOES-R algorithms over a greater range of conditions than is possible with current proxy ABI datasets
- Provide near-real-time validation capabilities based on GOES imager/sounder observations to assess the accuracy of the simulated radiances
- Support GOES-R Analysis Facility for Instrument Impacts on Requirements (GRAFIIR) by providing proxy ABI data to address government-specified waivers

Production of Simulated ABI Data

CIMSS Real-time Proxy Framework

2:50Z — **Initial conditions/Lateral Boundary Conditions**
- Meteorology: NCEP Global Forecasting System (GFS)
- Aerosol/O_3: Real-time Air Quality Modeling System (RAQMS)

WRF-CHEM interface
- WF-ABBA wildfire detections
- Calculate fire emissions
- Generate IC/LBC

3:07Z — **WRF/Chem 36hr Forecast (CONUS 8km grid)**
- Archive last 24hrs at hourly intervals

CRTM interface
- Compute cloud particle diameters
- Generate WRF cloud mask
- Blend WRF/RAQMS (stratospheric T, O3)

5:47Z — **CRTM Forward Model**
- all ABI bands (6 SW, 10 LW)
- GOCART aerosols
- Output reflectance, Tb, radiance, etc.

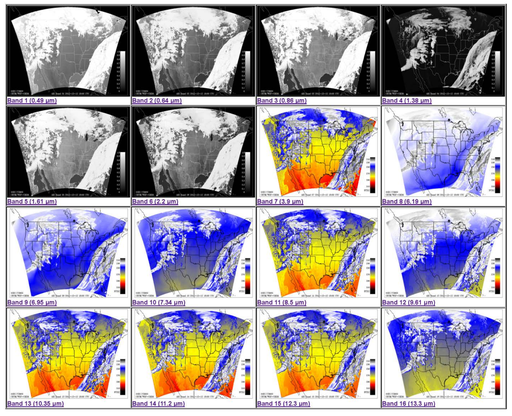
7:22Z — **ABI Proxy GRB generation**
- Interpolate radiances to 2km ABI Fixed Grid Format
- Scale radiances and produce ABI Proxy GRB files
- Archive ABI Proxy Val files with WRF Cloud mask

7:58Z — **ABI Proxy GRB Delivery (12Z today - 12Z tomorrow)**
- Web posting of imagery
- GEOCAT proxy product generation
- AIT Framework testing

Simulated ABI imagery and data products will allow forecasters and other users to prepare for the new information that the ABI will provide on the atmosphere, clouds and the surface and make use of the future GOES ReBroadcast (GRB) data. These data will also be used for GOES-R pre-launch activities, such as testing ABI data throughput and retrieval algorithms.

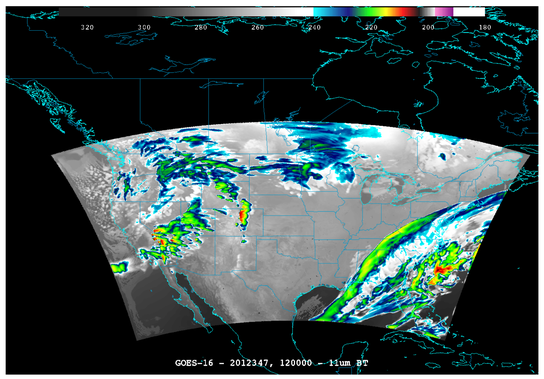
Near-Real-Time Website:

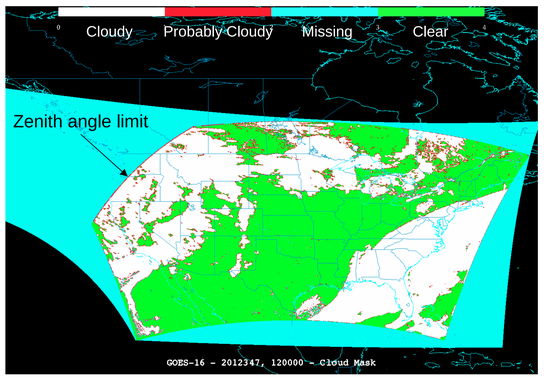
http://cimss.ssec.wisc.edu/goes_r/proving-ground/wrf_chem_abi/wrf_chem_abi.html



GOES-R Algorithm Evaluation

Proxy ABI data were supplied to the GEOstationary Cloud Algorithm Test-bed (GEOCAT), which contains many of the baseline GOES-R product algorithms. Below is a test of the cloud mask algorithm.





A Near-Real-Time Verification System

SSEC GOES Data Archive

GEOS Sounder Interface
- Extract GOES Sounder radiances from SSEC archive
- Generate GOES cloud mask

GOES Sounder GRB Generation (00Z - 24Z yesterday)
- Interpolate GOES radiances to 2km ABI Fixed Grid Format
- Scale radiances and produce GOES GRB files
- Archive GOES Val files with GOES Cloud mask

GOES-13 Sounder data (collected at SSEC) are used to verify select IR bands of the simulated ABI data (see table). Both simulated ABI data and observed sounder data are remapped to the currently accepted 2 km Fixed Grid Format (in NetCDF). These files are converted to GRB files (also in NetCDF), which contain Level 1b products with radiometric and geometric correction applied to produce parameters in physical units.
Clear and cloudy data points are identified in these data files and Glance (a Python software tool developed at CIMSS) is run to monitor statistics between the simulated data and observations.

Real-time Proxy Validation

Glance Real-time validation (00Z – 24Z yesterday)
- Identify GOES/WRF Clear/Clear, Cloudy/Cloudy pixels
- Hourly statistics and graphical output for each band
- Query Glance html output for statistical time-series

Retrospective validation (weeks to months)
- Identify GOES/WRF Clear/Clear, Cloudy/Cloudy pixels
- Long term Statistical summary output for each band

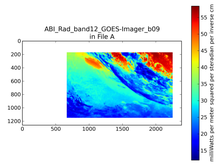
Sample Glance Output:

Statistical Summary

Finite Data Statistics a_finite_count : 1555866
a_finite_fraction : 0.5177
b_finite_count : 2104074
b_finite_fraction : 0.7002
common_finite_count : 1459856
common_finite_fraction : 0.4858
finite_in_only_one_count : 740228
finite_in_only_one_fraction : 0.2463

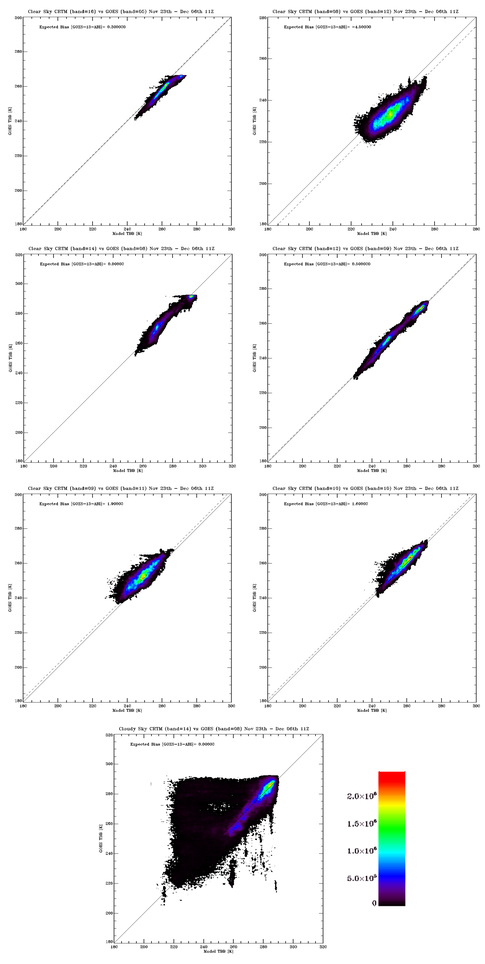
General Statistics a_missing_value : -999.0
b_missing_value : -999.0
epsilon : 0.000
epsilon_percent : None
max_a : 58.41
max_b : 56.58
min_a : 12.20
min_b : 12.14
num_data_points : 3005100
shape : (1260, 2385)
spatially_invalid_pts_ignored_in_a : 0
spatially_invalid_pts_ignored_in_b : 0

Numerical Comparison Statistics correlation : 0.6132
diff_outside_epsilon_count : 1459856
diff_outside_epsilon_fraction : 1.000
max_delta : 40.16
max_diff : 40.16
mean_delta : -0.9861
mean_diff : 4.519
median_delta : -0.9793
median_diff : 2.015
min_delta : -36.82
mismatch_points_count : 2200084
mismatch_points_fraction : 0.7321
perfect_match_count : 0
perfect_match_fraction : 0.000
r-squared correlation : 0.3761
rms_val : 7.764
std_val : 7.702

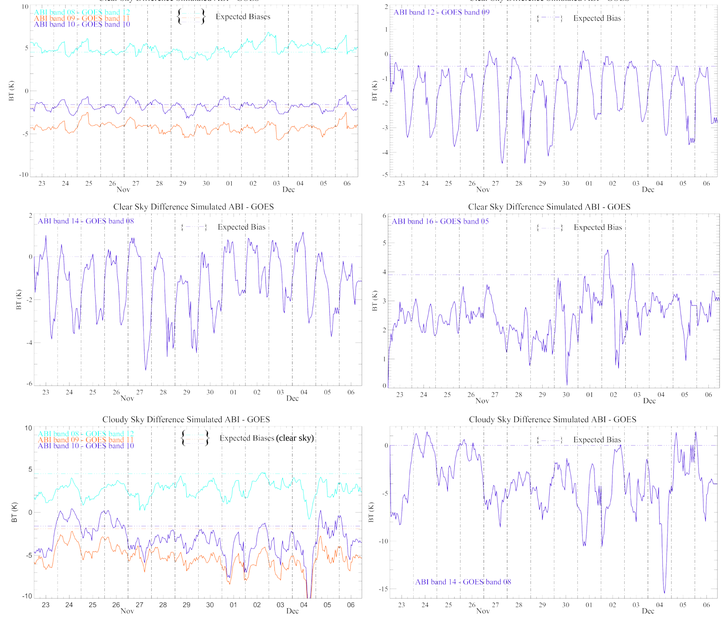


ABI Band	$\lambda_{central}$ (µm)	GOES-13 Sounder Band	$\lambda_{central}$ (µm)
8	6.19	12	6.51
9	6.95	11	7.02
10	7.34	10	7.43
12	9.61	9	9.71
14	11.2	8	11.03
16	13.3	5	13.37

Scatterplots Derived from Glance Output:



Time Series Derived from Glance Output:



Summary and Plans

- CIMSS is currently producing proxy ABI data for all 16 bands in near-real-time using WRF-CHEM simulations and the CRTM (data available upon request)
- These data files are in the same format as anticipated for GRB, which will help users familiarize themselves with the new data format
- A verification system has been developed but will need further testing; we plan to explore other validation metrics as well
- Near-term plans are to provide these data in near-real-time to the AIT
- Additional plans are to make available simulated GOES-R cloud/sounding (and other) products in near-real-time

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