Imagery from the ABI on GOES-R

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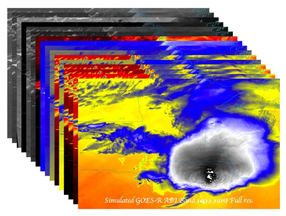
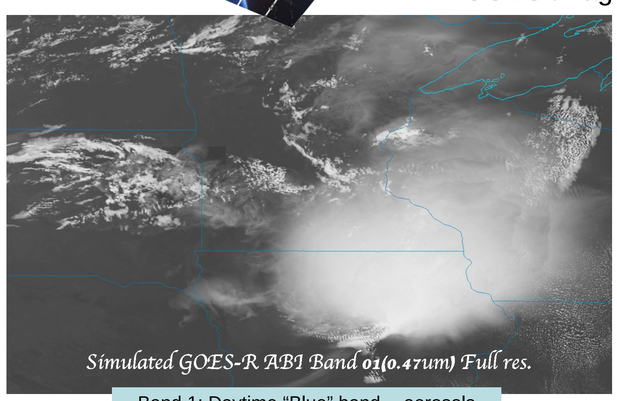
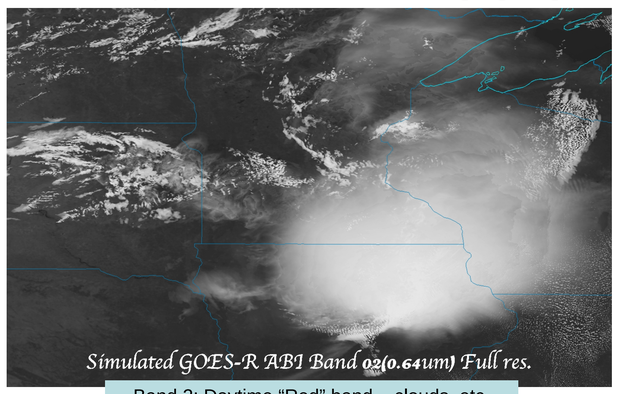


Special Thanks to the AIT (East and Central)

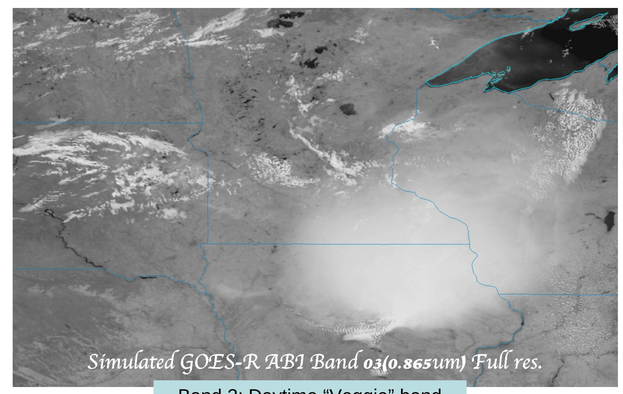
The Advanced Baseline Imager (ABI) on the Geostationary Operational Environmental Satellites (GOES)-R series will address a wide range of phenomena, such as weather/climate, oceanographic, climate, and environmental (e.g., hazards) applications. The ABI will improve upon the current GOES Imager with more spectral bands, faster imaging, higher spatial resolution, better navigation, and more accurate calibration.



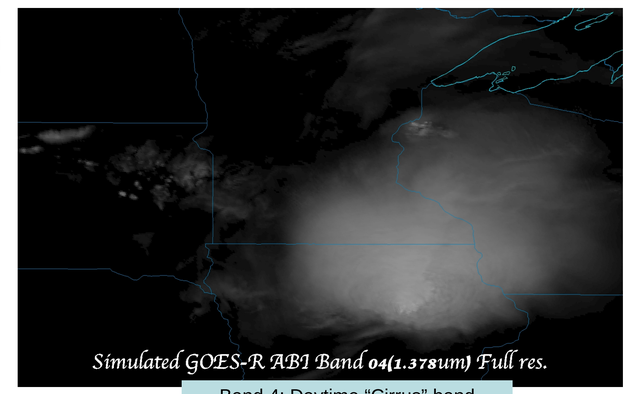
Band 1: Daytime "Blue" band -- aerosols



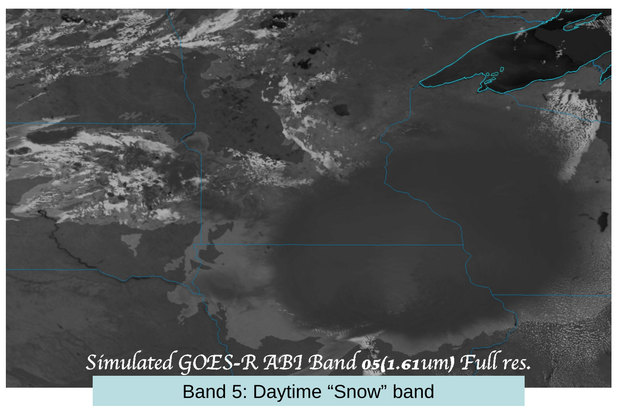
Band 2: Daytime "Red" band – clouds, etc.



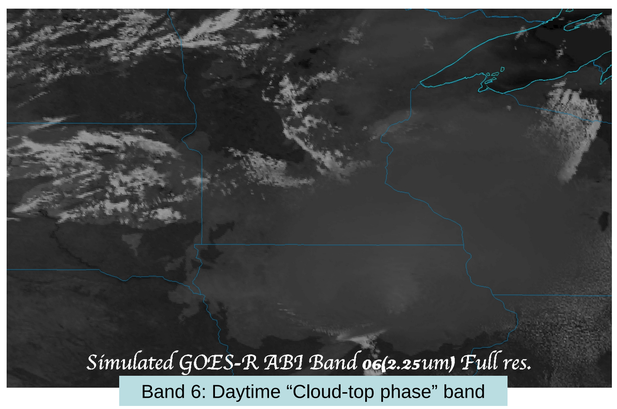
Band 3: Daytime "Veggie" band



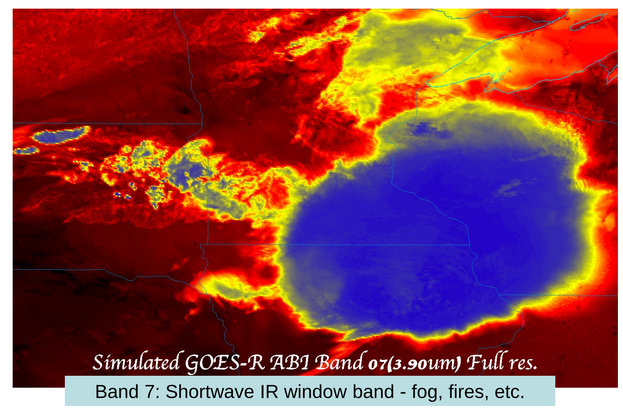
Band 4: Daytime "Cirrus" band



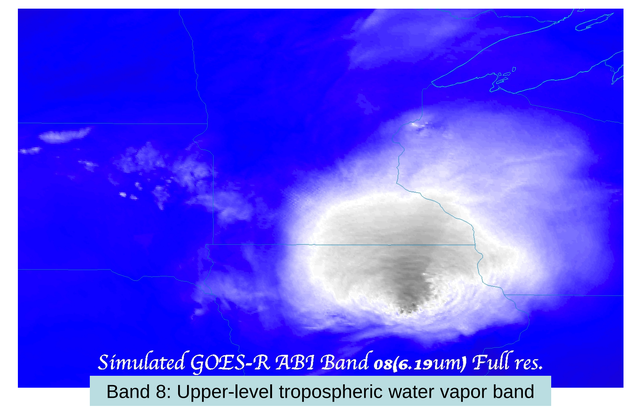
Band 5: Daytime "Snow" band



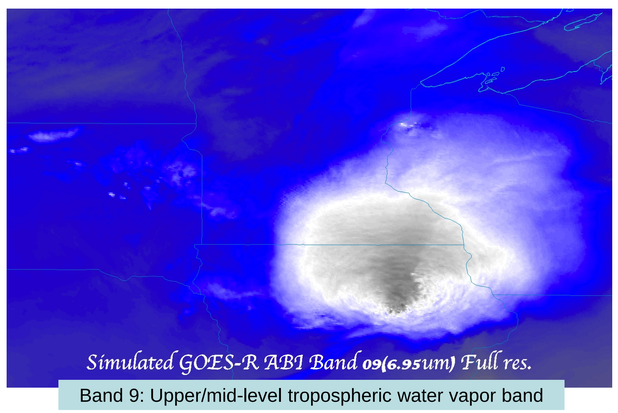
Band 6: Daytime "Cloud-top phase" band



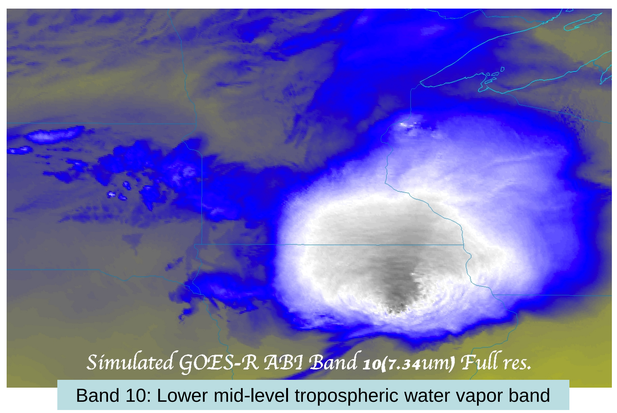
Band 7: Shortwave IR window band - fog, fires, etc.



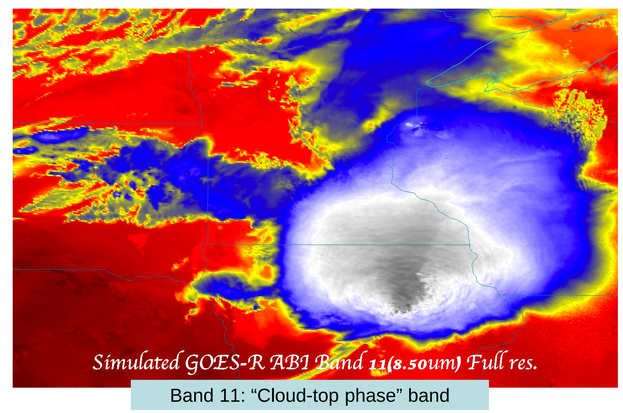
Band 8: Upper-level tropospheric water vapor band



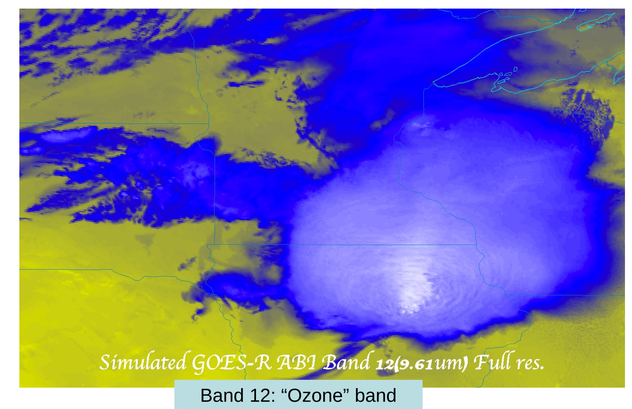
Band 9: Upper/mid-level tropospheric water vapor band



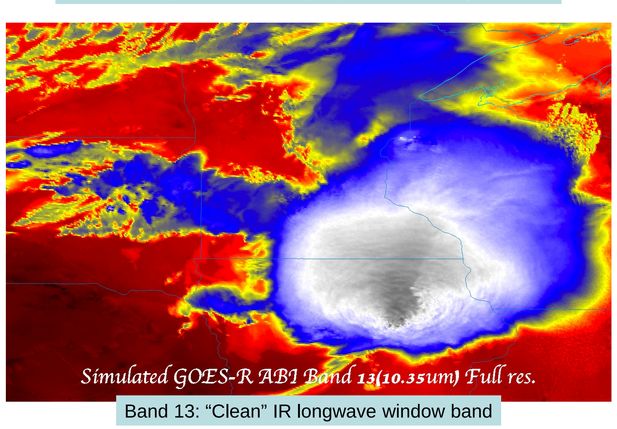
Band 10: Lower mid-level tropospheric water vapor band



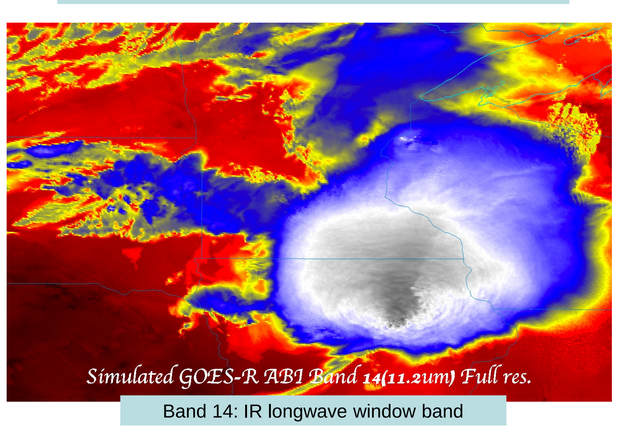
Band 11: "Cloud-top phase" band



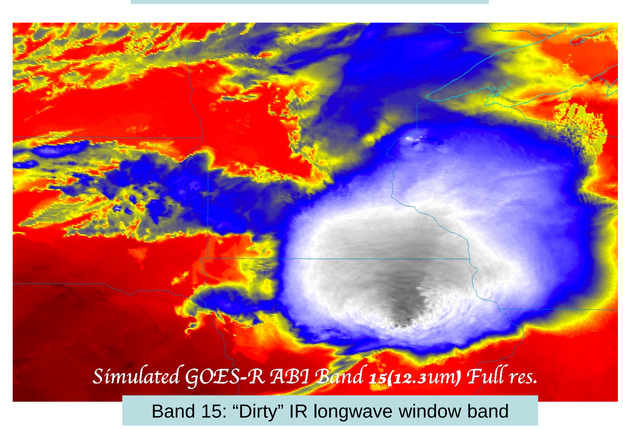
Band 12: "Ozone" band



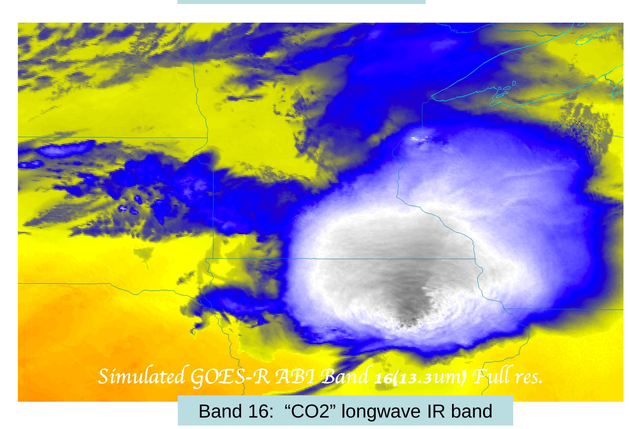
Band 13: "Clean" IR longwave window band



Band 14: IR longwave window band



Band 15: "Dirty" IR longwave window band



Band 16: "CO2" longwave IR band

The NWP model simulations for the above images were performed on the 'cobalt' supercomputer at the National Center for Supercomputing Applications at the University of Illinois. NWP model output is remapped into the ABI Fixed Grid Format (FGF) and turned into simulated ABI radiances via a sophisticated radiative transfer model. McIDAS-V was used to read the netCDF and generate the image files.

Products

- The purpose of the imagery team is two-fold:
  - Demonstrate how to convert from GRB scaled radiances (eg, GRB integers) to other physical units, such as radiance, brightness temperatures and brightness values.
  - Build files that can be used for processing most of the ABI products, such as clouds, soundings, etc.
- Imagery is the (only) key product for GOES-R.
- There are 54 KPP Cloud and Moisture Imagery End-Products (CMIP) (48 single band End-Products in netCDF format at the resolution native to each band and one multiband product at 2 km resolution in both netCDF & McIDAS Area file formats).
  - 16 products * 1 format (netCDF) * 3 coverage areas (Full Disk, CONUS, Mesoscale) Multiband products: 1 product * 2 formats (netCDF and McIDAS Area)* 3 coverage areas (Full Disk, CONUS, Mesoscale)

Routine Validation Tools

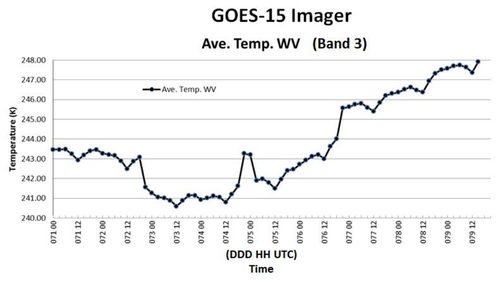
This tool set includes, but is not limited to:

- Time series of radiances/brightness temperatures
- Statistics of radiances/brightness temperatures
- Generate a host of images, thumbnail images
- Animations
- Generate zoomed images
- Monitor "forward model calc" vs "satellite obs"
- Monitor image quality
- Compare to other imagery (e.g., VIIRS)

Average of valid data samples
Number of valid data samples
Minimum value of valid data samples
Maximum value of valid data samples
Sum of valid data samples
Sum-of-squares of valid data samples
Total number of data samples within the sample set

Time Series (TBB)

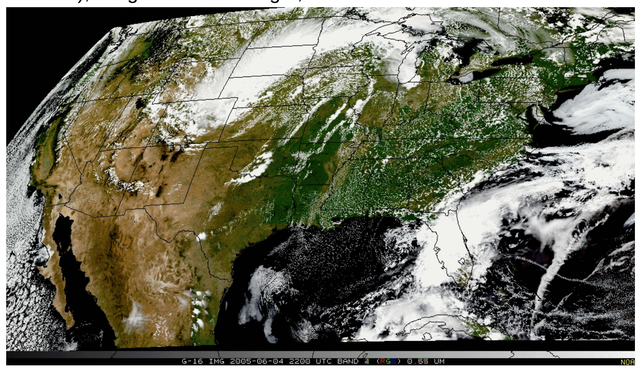
Time series of many statistics will be useful for inferring image quality. Of course images are also needed!



GOES Imager Water Vapor Mean brightness temperatures over water from 90 S to 90 N and 110 W to 170 W. Note the big drop in mean temperature late in the day on March 12, and the big increase last in the day on March 16 2012.

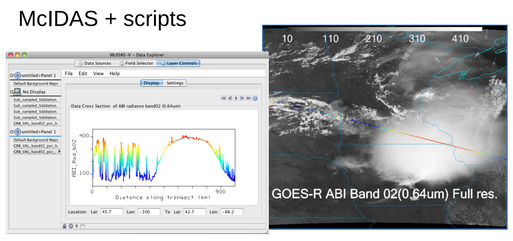
Validation – image combination

"True Color" with "synthetic" green band from ABI simulated data (from CIMSS); image from Don Hillger, RAMMB.

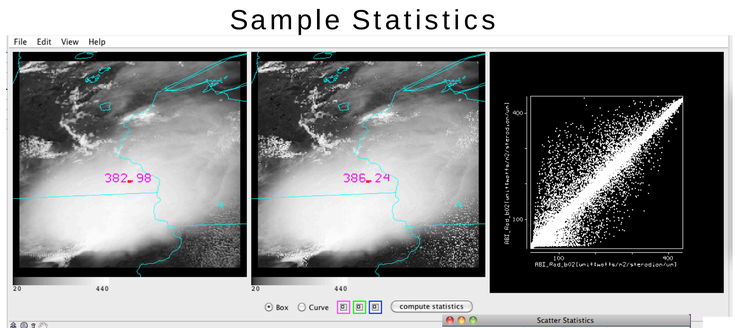


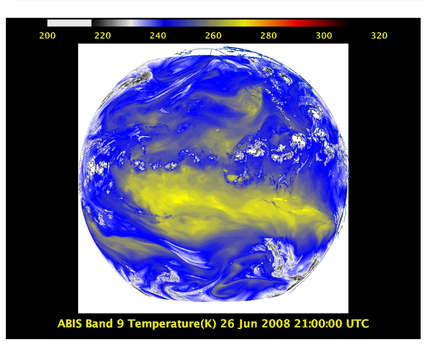
"Deep-Dive" Validation Tools

- This tool set includes, but is not limited to:
  - Additional Thumbnail images
  - Full size and/or zoomed images
  - Generate difference images
    - Temporal
    - Spectral
  - Times series of radiances/brightness temperatures
    - Longer time-series
  - Statistics of radiances/brightness temperatures
    - Longer times series
  - "Forward Model Calc" vs "Satellite Obs" information
    - From raobs, NWP, etc.
  - Correlate image artifacts with calibration events
  - Downscaling
- McIDAS + scripts



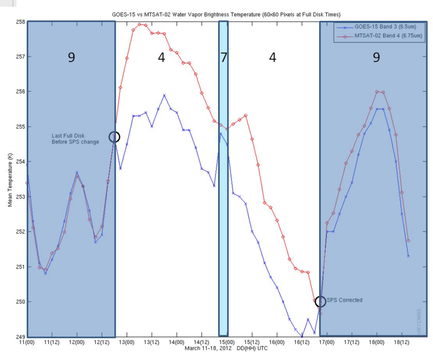
Sample Statistics





Ideas for the Further Enhancement and Utility of Validation Tools

- Comparison to other satellites (in realtime!)
  - Other images, Imagery correlations
  - High-spectral resolution IR sounders
- Radiance Quality assessment
  - Signal-to-noise ratio, Striping, INR
  - Forward model "calc" vs "obs"
- Product generation is a good check on the input values!
- Hard to know the dividing line between imagery and calibration and/or system monitoring tools



Geo-located GOES-15 and MTSAT Mean Water Vapor Brightness temperatures, below, show good agreement until 2045 UTC on March 12, when the SPS change that accessed incorrect values in a different database was implemented. the SPS unit used for the generation of GVAR is noted

Summary

- Imagery is the key product and hence needs a sufficient validation tool set. Imagery files are used to generate a number of products.
- This near realtime validation tool set should at least include:
  - Times series of radiances/brightness temperatures
  - Statistics of radiances/brightness temperatures
  - Thumbnail images
  - Full size and/or zoomed images
  - Animations
  - Temporal difference images
  - Spectral band differences
  - Combine images
  - "observations" vs "observations"
  - Product generation!
  - Forward model "Calc" vs "Obs" information
- Need a flexible system, which allows zooming, roaming, specialized enhancements, etc.
  - "Hope for the best, plan for the worst."
- NOAA Science Tests Tech Reports for the GOES
  - lead by Hillger and Schmit
  - *http://rammb.cira.colostate.edu/projects/goes-p/*

May 2012