P10.3

Confronting data delivery challenges of the future via the GOES-R Proving Ground

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The Geostationary Operational Environmental Satellite R-Series (GOES-R) Proving Ground is a preparedness exercise between multiple government agencies and academia which aims to prepare National Weather Service (NWS) operations for the capabilities and applications of GOES-R, such that field use of imagery and products derived from GOES-R observations are maximized as soon as data is transmitted after launch. The advantages and enhanced capabilities of GOES-R compared to current GOES are numerous. Based on the spatial, temporal, and spectral improvements of the Advanced Baseline Imager (ABI) compared to the existing imager, data amounts will increase by a factor of 60.

There are many components to a successful proving ground effort and research to operations transfer exercise, including: relevant training, consistent and reliable delivery, and user interactions and feedback. Challenges lie ahead in effectively delivering data to NWS forecasters such that the received information from GOES-R is timely and useful. A new paradigm for data delivery is needed and functional data implementations and interrogation applications into the new Advanced Weather Interactive Processing System (AWIPS) are necessary.

In order to assess the value of high-resolution sea surface temperatures (SSTs) on NWP simulations of lake-induced mesoscale circulations, the WRF-ARW version 3 core was run twice out to 36 hours at a spatial resolution of five kilometers.

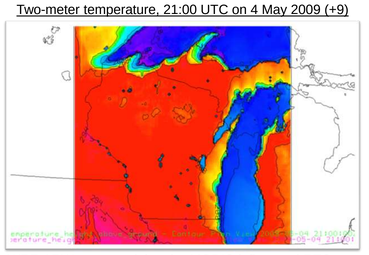
The runs were identical aside from the initial surface skin temperature analysis: the control run, with the standard SST analysis from the RTG-SST, was compared with the experimental run, containing the improved-RTG static analysis with an additional set of cloud-filtered satellite observations from MODIS. The applied schemes were identical to those used in the case study.

MODIS SST observations were used as truth over the RTG background; there is not a spatial variability or integrity check aside from among the MODIS SST data itself.

Initial conditions and boundary conditions were provided from the Global Forecasting System (GFS) at approximately 40 kilometers spatial resolution.

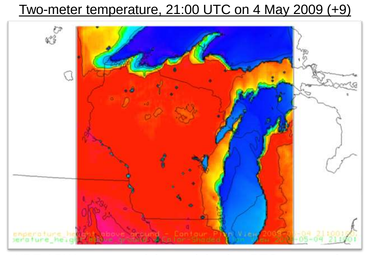
The 180 by 130 grid-point domain of the simulation covered all of Wisconsin, Lake Michigan, Lake Superior, and the Upper Peninsula of Michigan, as well as eastern Minnesota, northern Illinois, northeastern Iowa, and western Lower Michigan.

Two-meter temperature, 21:00 UTC on 4 May 2009 (+9)



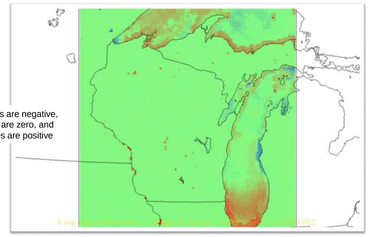
WRF-ARW run containing the MODIS-influenced RTG sea surface temperatures

Two-meter temperature, 21:00 UTC on 4 May 2009 (+9)



WRF-ARW run containing solely the RTG sea surface temperature data

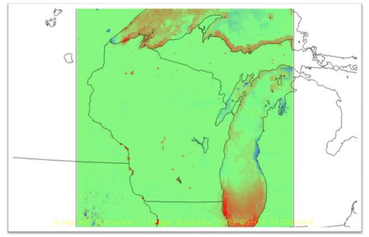
Surface skin temperature (both land and water), -5 K to 5 K



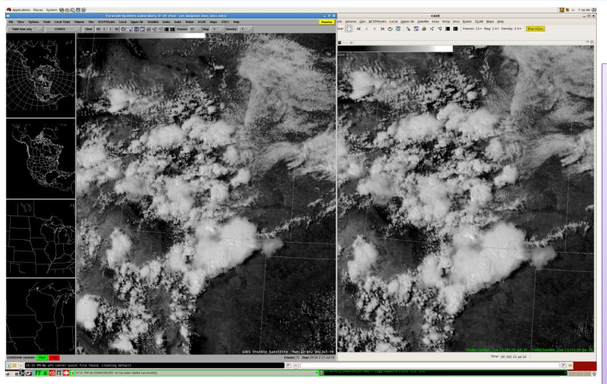
A pixel-by-pixel difference subtracting the second image from the first image (the run without MODIS sea surface temperatures from the run with the sea surface temperatures)

the blue shades are negative, pastel greens are zero, and the red shades are positive

Two-meter temperature, -3 K to 3 K



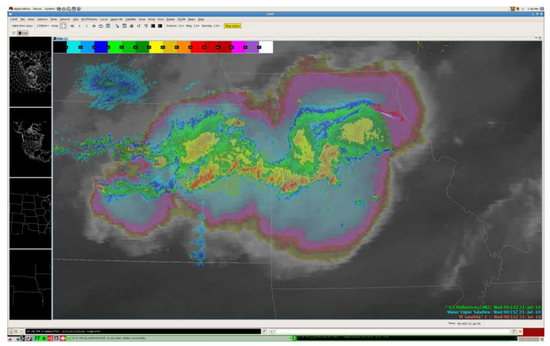
A pixel-by-pixel difference subtracting the second image from the first image (the run without MODIS sea surface temperatures from the run with the sea surface temperatures)



AWIPS II does not regionalize high-resolution geostationary satellite imagery like legacy AWIPS

AWIPS II

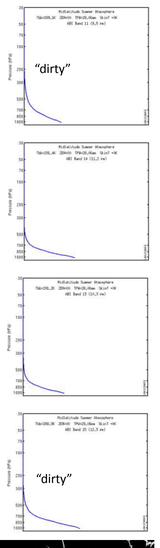
- Necessary to meet the requirements of tomorrow's hydrometeorological datasets
  - Effectively and dynamically producing displays using the graphics card
- Integrating multiple datasets "on the fly" to minimize forecaster use of multiple products for similar information
  - Modernizing and standardizing data storage repositories and the discovery database (for metadata)
- Optimizing access attempts for quickest ingest and display
  - Development must continue to keep pace with existing technology
- Because of the complexities resulting from a service-oriented architecture, developers will need more training to effectively extend the software
- Local application development should not occur without adequate governance
  - Plug-ins are essentially required to run within AWIPS II, and it is unlikely most will be able to run independently as with legacy AWIPS



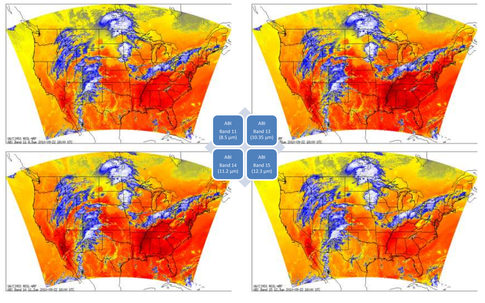
GOES-R

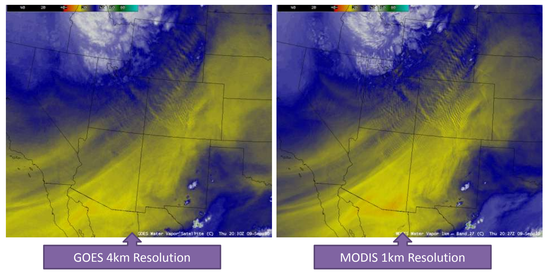
- The Advanced Baseline Imager (ABI) will provide 5x faster spatial coverage, 4x improved resolution, and 3x more spectral channels than currently on GOES-13/14/15 (N/O/P)
- An optical sensor on the Geostationary Lightning Mapper (GLM) will provide continuous lightning flash rates
- No Sounder until at least GOES-U, scheduled for launch in 2027, expected operational in 2028
- The additional capabilities of the ABI will produce approximately 60 times (5x4x3) more data than the current GOES Imager
- If data is delivered at full bit depth (12 to 14 bits), approximately 50% more bandwidth will be required
- Delivering geostationary satellite data in 2020 using a similar methodology as today may require up to **90** times more bandwidth than currently, compression aside, not including products
- The questions we have to answer:
  - Are the visualization tools in place to allow for effective interrogation of this data?
  - How can we better devise blended products to deliver more information to the forecaster without requiring the review of multiple images (from different bands, satellites, times)?
  - Is *all* satellite imagery needed by *all* AWIPS sites *all* the time?
- Is it time to rethink the delivery paradigm? Delivery data format?

Weighting functions



Simulated imagery



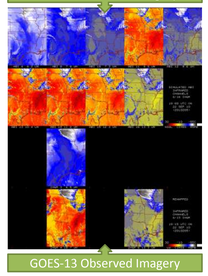


GOES 4km Resolution

MODIS 1km Resolution

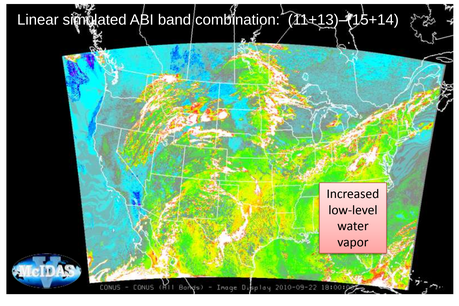
Some figures and plots appearing on this poster are courtesy of Justin Sieglaff, Mat Gunshor, and Scott Bachmeier.

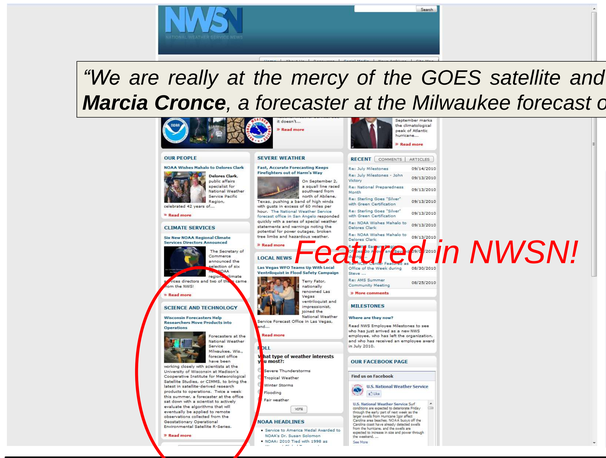
Simulated GOES-R Imagery



GOES-13 Observed Imagery

Linear simulated ABI band combination: (11+13) - (15+14)





*"We are really at the mercy of the GOES satellite and its temporal and spatial limitations," wrote **Marcia Cronce**, a forecaster at the Milwaukee forecast office who helped in organizing the testbed.*

Partners and Feedback

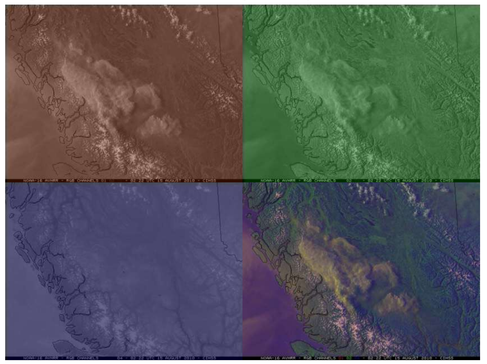
Twice a week this summer, a forecaster at the Milwaukee NWS office sat down with a CIMSS scientist to actively evaluate the algorithms that will eventually be applied to remote observations collected from GOES-R.

Delivery Mechanisms

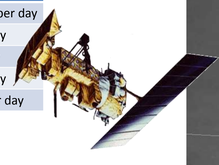
- NOAAPort: Satellite-based system used as the primary delivery mechanism for hydrometeorological data and model output to the field, as well as NOAA's partners
- Strengths: Reliable and operationally supported, transmits broad range of data, bandwidth increase expected in 2011
- Weaknesses: Approval process for transmission lengthy, not all data within geographic area important to the user
- Local Data Manager (LDM): Event-driven data sharing network that utilizes the Internet to mass move various data between NOAA agencies and universities
- Strengths: Easy delivery method to NWS field offices, widespread use throughout NWS enterprise and universities, user configurable to only ingest certain products
- Weaknesses: Not operational, strains bandwidth available to the field, limited connectivity to NOAA partners
- Web: Displaying text data or images on a web page
- Widespread access, but outside of AWIPS, so data interrogation limited

POES/AVHRR

All NOAA Polar Operational Environmental Satellites (POES) are equipped with an Advanced Very High Resolution Radiometer (AVHRR) which has a resolution of 1.09 km at nadir.



GINI Sector	Frequency
Alaska National	12 to 14 per day
East CONUS	10 per day
Hawai`i National	2 per day
Puerto Rico Nat'l	10 per day
West CONUS	4 to 6 per day



•In addition to the five bands, AVHRR products available to NWS operations include:
–Sea Surface Temperature
–Cloud Type
–Cloud Top Temperature
–Cloud Top Height
–Cloud Optical Depth
–Cloud Particle Effective Radius