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# HIGH RESOLUTION IMAGERY FROM NOAA'S CUURRENT AND FUTURE GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE INSTRUMENTS – OPPORTUNITIES FOR ADVANCEMENTS AND COLLABORATIONS

NOAA-WP-18 discusses special data sets that NOAA has collected from its most recently launched GOES-14 and GOES-15 geostationary satellites and has simulated for its future GOES-R Advanced Baseline Imager (ABI). These datasets bring new opportunities for the scientific advancement and improvement of products and services. NOAA's research and operational communities are working to exploit these opportunities. In the spirit of the scientific collaboration described above, NOAA expects and is willing to share these data with its partners in the CGMS community.

This NOAA working paper has been prepared in response to the following CGMS 38 Recommendation:

Recommendation 38.08: NOAA to consider sharing 1 minute simulated imagery upon request from CGMS agencies planning new advanced imagers in geostationary orbit. (Due: CGMS 39)

# High Resolution Imagery from NOAA's Current and Future Geostationary Operational Environmental Satellite Instruments – Opportunities for Advancements and Collaborations

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## 1 INTRODUCTION

NOAA's current and future geostationary satellites bring new opportunities for scientific advancement and improvement of qualitative and quantitative products derived from the onboard imager instruments. Such improvements, in turn, bring new opportunities to improve the utility of these data by NOAA's user community whose goal is to improve the services they provide to their customer base. This scenario is not unique to NOAA, but to other operational satellite data processing centers as well. Since NOAA and these other operational satellite processing centers share many common goals, collaborations involving future instrument planning, algorithm and data sharing, and general satellite data processing approaches is important. Data sharing agreements and/or policies, such as those between NOAA and EUMETSAT for example, seek to promote and encourage such collaborations.

Special data sets collected from NOAA's most recently launched GOES-14 and GOES-15 satellites and simulated data generated for NOAA's future GOES-R Advanced Baseline Imager (ABI) are examples of datasets that bring new opportunities described above for scientific advancement and improvement of products and services. NOAA's research and operational communities are working to exploit these opportunities. In the spirit of the scientific collaboration described above, NOAA expects to share these data with its partners in the CGMS community.

## 2 SPECIAL DATASETS COLLECTED FROM GOES-14 AND GOES-15

NOAA's most recently launched GOES include GOES-14 (launched 27 June 2009) and GOES-15 (launched 4 March 2010). As part of the NOAA Science Test (as part of the overall Post-Launch Tests (PLT)) performed after each launch of a new GOES, NOAA performs dedicated science tests that involve detailed analysis, testing, verification, and validation of Level-1b and Level-2 product data that are expected to become operational.

The NOAA science tests also provide an opportunity to exercise scanning scenarios with the new instruments that are not done operationally in order to collect, process, analyze, and use data and derived products in new and different ways. In fact, one of the major goals of these dedicated NOAA science tests is to collect nearly-continuous rapid-scan imagery of interesting weather cases at temporal resolutions as fine as every 30 seconds - a capability of rapid-scan imagery from the future GOES-R ABI that is not implemented operationally with the current GOES imagers. The rapid-scan data that is collected, for example, may augment available radar and lightning data to investigate the potential for improving severe weather forecasts.

The NOAA Science Test web pages for GOES-14 and 15 can be found via the following web links (Hillger and Schmit, 2007; Hillger and Schmit 2011):

GOES-14 http://rammb.cira.colostate.edu/projects/goes-o/
GOES-15: http://rammb.cira.colostate.edu/projects/goes-p/

There is a tremendous amount of information presented in each of these pages that include:

A link to the NOAA Technical Reports for each of the conducted NOAA Science Tests
Descriptions of the various Science Test Scanning Schedules and a history of their daily implementations
Numerous illustrations of imagery, products, and analysis results

Given the reference to NOAA's geostationary 1-minute imagery in the CGMS Recommendation 38.08, the following case study examples from the GOES-15 Science Test are provided and highlighted below:

*Convection over the Mid-West of the United States:* On 21 September 2010, 1-minute interval GOES-15 visible images centered in the Midwest (see Figure 1) offers a compelling demonstration of the value of frequent imaging for monitoring the development and evolution of convection. This animation can be found at http://cimss.ssec.wisc.edu/goes/blog/archives/6849.

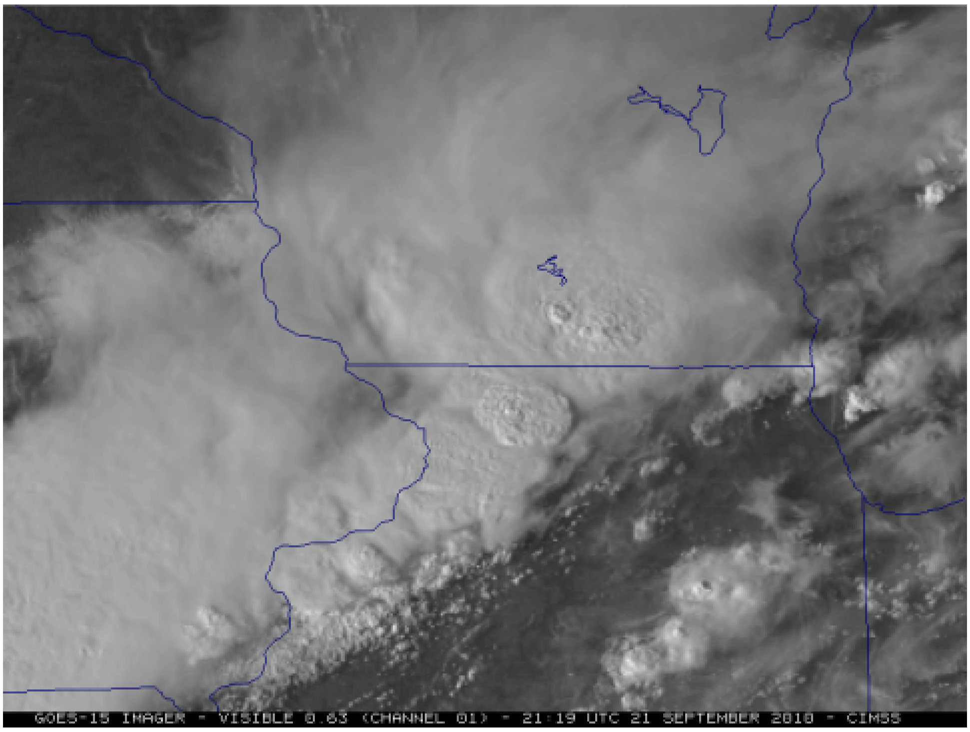


**Figure 1.** GOES-15 visible image captured at 21:19 UTC on 21 September 2010 that shows the developing convection over the Midwest of the United States

*Special 1-minute scans of Hurricane Igor:* A comparison of 1-minute interval GOES-15 SRSO images with the normal operational 30-minute interval GOES-13 visible images on 13 September 2010 (see Figure 2) clearly demonstrates the advantage of higher temporal resolution for monitoring the evolution of the eye structure of the hurricane. More information including an animation can be found at: http://cimss.ssec.wisc.edu/goes/blog/archives/6790.

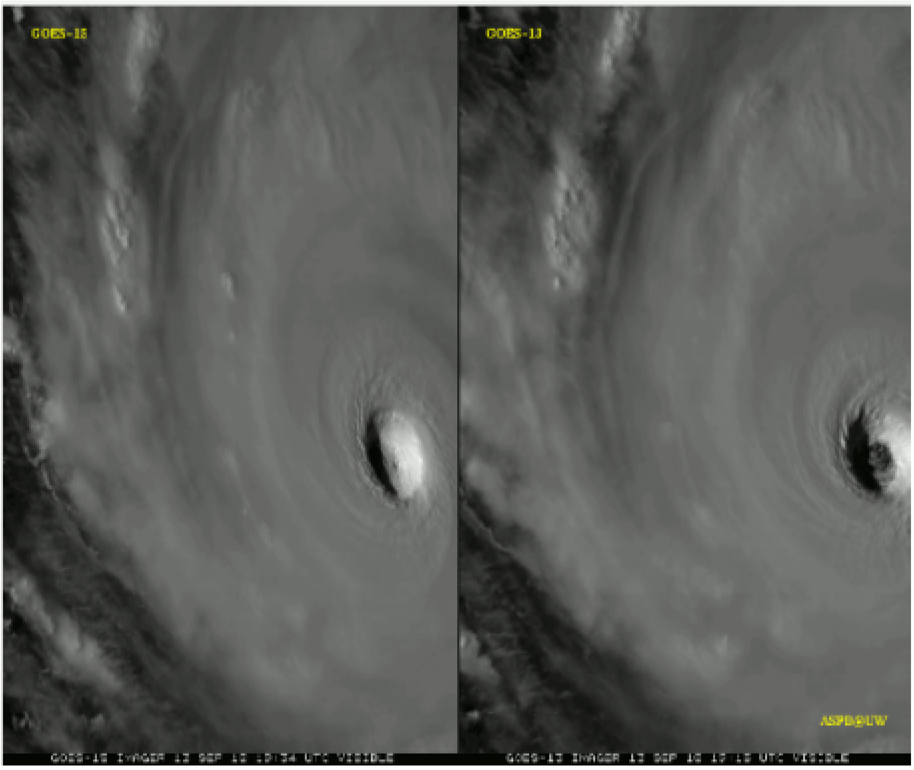


**Figure 2.** GOES-15 (left) and GOES-13 (right) visible images captured on 13 September 2010.

NOAA continues to work to improve its processes to capture and archive pre-operational data from its satellites, such as GOES-14 and GOES-15, via its Comprehensive Large Array-data Stewardship System (CLASS). Potential users of such data are asked to visit NOAA's CLASS web site (www.**class.noaa**.gov). Users should contact the CLASS Help Desk (class.help@noaa.gov) to request access to the data since it is pre-operational.

## 3 SIMULATED ABI IMAGERY

The Geostationary Operational Environmental Satellite - R Series (GOES-R) is the next generation of NOAA's geostationary Earth-observing systems. The Advanced Baseline Imager (ABI), a sixteen channel imager with two visible channels, four near-infrared channels, and ten infrared channels, will provide three times more spectral information, four times the spatial resolution, and more than five times faster than current GOES satellites.

Cloud and Moisture Imagery is the satellite imagery that forecasters and the public are accustomed to viewing in weather forecast offices, on the web, and in the news. Cloud and Moisture Imagery includes digital maps of the observed land, water, atmosphere and clouds.

The GOES-R ABI is designed to observe the Western Hemisphere in various intervals and at 0.5, 1, 2 km spatial resolutions in visible, near-IR, and IR wavelengths, respectively. The ABI has two main scan modes, of which the most likely mode will allow full disk imagery every 15 minutes, along with the Continental U.S. (CONUS) every 5 minutes, and a meso-scale as often as every 30 seconds (or two locations every 60 seconds).

As a means to better prepare for the GOES-R series, the GOES-R Algorithm Working Group (AWG) has simulated ABI images for several cases that include hurricanes, rapidly forming severe convection, fires, and aerosols. CGMS-38 working paper, NOAA-WP-20, provided nice illustrations of ABI simulated imagery (all bands) for Hurricane Katrina.

As discussed in NOAA-WP-20, the simulated ABI images have been generated using high-spatial resolution meso-scale models, coupled with advanced 'forward' models (Otkin et al, 2007; Otkin et al, 2009). The simulated imagery covers views from both 75 and 137 W longitude and is available at spectral, spatial, and temporal resolutions that mimic to the extent possible what the ABI is capable of providing when it is on-orbit. ABI simulations have been done for all ABI channels at time intervals as small as 30 seconds over geographic areas that closely mimic the meso-scale sectors that will be scanned by the ABI.

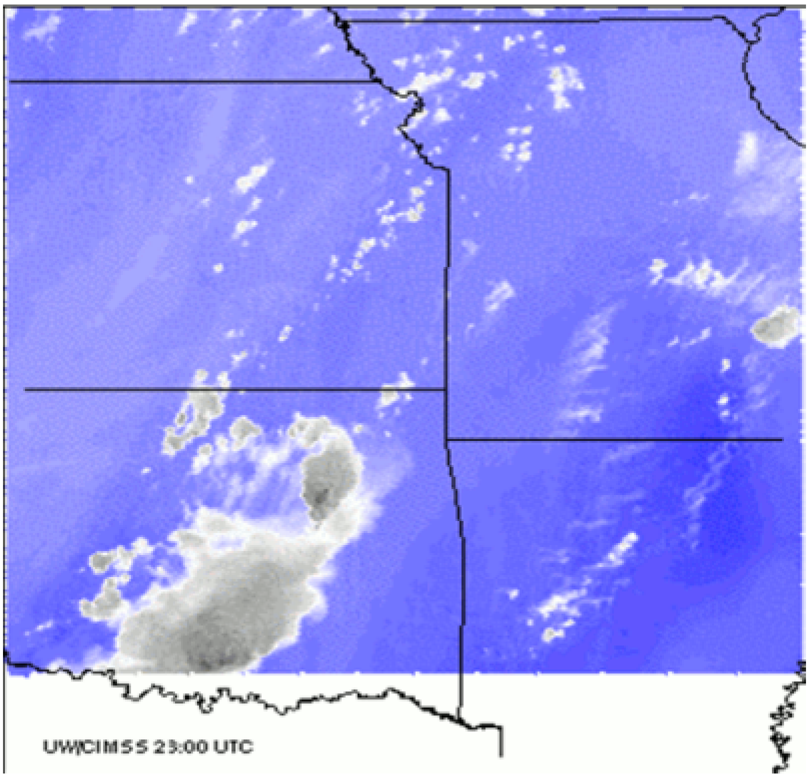


**Figure 3.** Simulated GOES-R ABI Band 8 (6.19um) imagery over a meso-scale sector over the central United States at 23:00 UTC on 04 June 2005.

Again, given the reference to NOAA's geostationary 1-minute imagery in the CGMS Recommendation 38.08, Figure 3 shows an example simulated imagery of band 8 (6.19um) imagery over a meso-scale sector where high temporal ABI observations will be taken.

The simulated imagery is not only useful for illustrative and qualitative purposes, but can and has been used by a number of the GOES-R AWG Product Application Teams to generate and test the Level-2 products they are responsible for. Figure 4 shows an example of the derived motion winds products generated from the GOES-R Derived Motion Winds Algorithm using 2 km simulated ABI 11.2um imagery whose temporal resolution is 5 minutes.

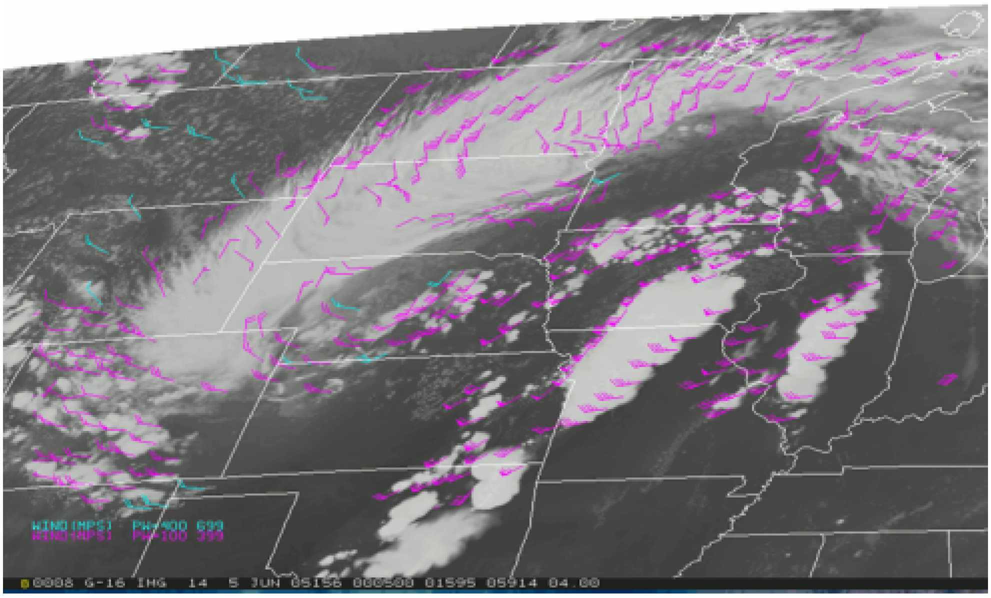


**Figure 4.** Cloud-drift winds derived from simulated GOES-R Band 14 (11.2um) imagery at 00:00 UTC 05 June 2005.

More examples of simulated ABI imagery can be found by going to the link below:

http://cimss.ssec.wisc.edu/goes/abi/loops/links.html

The cost and effort to generate simulated imagery for future geostationary imagers that are being designed to provide imagery at higher spectral, spatial, and temporal resolution is substantial. However, the benefits of having these data to prepare and test algorithms, data formats, user systems, and other elements of the ground system are invaluable.

## 4 SUMMARY

NOAA has collected special data sets from its most recently launched GOES-14 and GOES-15 satellites and has simulated data for its future GOES-R Advanced Baseline Imager (ABI). These datasets bring new opportunities for the scientific advancement and improvement of products and services generated as a result of these data. NOAA's research and operational communities are working to exploit these opportunities. In the spirit of the scientific collaboration that is the core of the CGMS itself, NOAA expects and is willing to share these data with its CGMS colleagues in any future collaborative efforts.

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