

GOES-R Proving Ground Demonstration at NHC

Mid-Project Report

September 2011

1. Project Overview

The purpose of the GOES-R Proving Ground (PG) demonstration at the National Hurricane Center (NHC) is to provide NHC forecasters with an advance look at tropical cyclone forecast products for evaluation and feedback during the peak of the 2011 Hurricane season (August 1 – November 30). On September 13, 2011, the mid-term review for this demonstration was held at the NHC to evaluate the progress of the PG demonstration and strategize to make adjustments for the second half of the evaluation period, if necessary.

In October 2011, Jack Beven will be presenting some interim results at the GOES Users Conference and a project summary will be presented at the Interdepartmental Hurricane Conference in March 2012.

Nine GOES-R Products and decision aids provided by NESDIS/STAR, CIRA, CIMSS, SPoRT and OAR are currently being evaluated at the NHC. This mid-term report will provide interim feedback on each of them in the sections that follow. The ABI products are being produced using proxy data from Meteosat, GOES, and MODIS, and the GLM product is being produced from ground based lightning network data. Feedback on the utility of these products has been gathered through email exchanges between the NHC forecasters and Mark DeMaria.

2. Mid-Term Meeting Participants

The mid-term review for the PG demonstration at the NHC consisted of informal conversations with NHC demonstration participants from the Hurricane Specialist Unit (HSU) and the Tropical Analysis and Forecasting Branch (TAFB) and watching the forecasters view the various GOES-R products in N-AWIPS and via the CIRA webpage.

The meeting participants included:

- NCEP/NHC/HSU
 - Mike Brennan, Jack Beven, and Eric Blake
- NCEP/NHC/TAFB
 - Hugh Cobb
- NESDIS/STAR
 - Mark DeMaria
- OAR/HRD/CIMAS
 - Jason Dunion
- CIRA/CSU
 - Andrea Schumacher
- GOES-R Program Office/NWS
 - Bonnie Reed

3. Tropical Cyclone Activity Summary, 2011

The tropical cyclone activity for the 2011 season up to the day of the review was somewhat mixed. The number of Atlantic named storms was above average (15), but the number of hurricanes (2) was below normal. The majority of the Atlantic storms occurred in the western half of the basin and occurred after Aug. 1st. There were two U.S. landfalling storms (Irene and Lee). The east Pacific activity up through the mid-year review was the converse of that in the Atlantic. The number of named storms (7) was somewhat small, but three of them became major hurricanes. Figure 1 shows the tracks of the 2011 tropical cyclones as of the mid-term review.

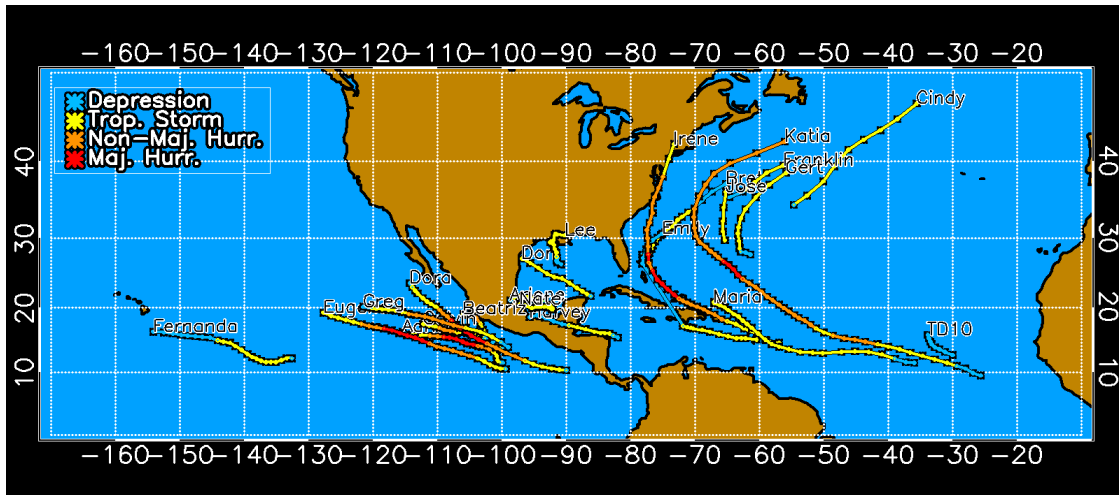


Figure 1. 2011 Tropical cyclone tracks and intensities as of September 13, 2011.

4. 2011 NHC Demonstration Products

Each of the proving ground products was discussed with HSU and TAFB forecasters at the review meeting. Below is a summary of the discussion for each. Although the discussions with the HSU and TAFB forecasters were held separately for scheduling reasons, the summaries below combine input from both.

A. Hurricane Intensity Estimate (HIE)

The HIE product was generated from MSG and GOES-East and available to the NHC forecasters via a web page. Although there have been very few storms in the eastern Atlantic this season, the forecasters were able to use the HIE product during Katia when deciding to upgrade the storm. Mike Brennan, Senior Hurricane Specialist, said, "I found the GOES-R Proving Ground HIE product useful on my midnight shift on August 30 when I made the decision to upgrade TD 12 to Katia. The HIE was more responsive in showing intensification compared to the operational ADT, and reached a 2.5 by the time I put out the 09Z advisory in agreement with the 06Z classifications from SAB and TAFB." It was noted that the HIE was higher than the ADT during Katia (perhaps a factor of higher temporal resolution) and was a supporting factor in upgrading the storm. It was also mentioned that addition of GOES-east HIE estimates this year is providing a much larger sample for evaluation.

Dan Mundell from TAFB will assist with the post-season quantitative evaluation of the HIE. Due to technical difficulties at CIMSS, a few days of HIE values from Hurricane

Katia were missed but will be provided by CIMSS for the post-season evaluation. An effort will be made to evaluate the pressure estimates in addition to the wind estimates from the HIE, since it was noted in 2010 that the pressure values seemed inconsistent at times. An adjustment was made to the algorithm by CIMSS to correct this problem, and the 2011 evaluation should provide confirmation of that improvement.

B. Super Rapid Scan Imagery

The SRSO was called for GOES-West for one day during Tropical Storm Don and three days during Tropical Storm Nate in the Western Gulf and made available on a CIRA web page. This enabled the forecasters at NHC and satellite analysts at the NESDIS Satellite Analysis Branch to get several visible images just after sunrise to aid in determining Nate's center position, which was further north than originally indicated in the multi-channel IR imagery before sunrise on September 11th. Currently, the multi-channel IR imagery used at night is only produced every 30 minutes due to an internal limitation at the NHC, so the SRSO visible imagery provided a much higher temporal refresh rate supporting NHC operations. The hurricane specialists identified one application of SRSO was that it may be utilized at sunrise to support (1) center finding and (2) aircraft reconnaissance go/no go decisions. They commented that it would be nice to get a mini-super rapid scan just after sunrise to provide decision support. It was recommended that a web site be created to provide access to the SRSO cases from the Proving Ground for later analysis and training. This has since been established at CIRA at <http://rammb.cira.colostate.edu/products/srso/>.

C. Tropical Overshooting Top Detection

The Tropical Overshooting Top Detection product has not been heavily used by the NHC forecasters up to this point. For tropical cyclones, there are multiple overshooting tops so it is not yet clear what information this product provides. It was suggested that there might be some relationship between the OT and lightning, which the product developers could investigate in more detail. TAFB indicated that this product might be useful for narrowing down the most active areas of convection and said they would make an effort to look at it more in the second half of the Proving Ground. TAFB and HSU forecasters both indicated that it would be helpful if the product was also available from GOES-east.

D. RGB Air Mass Product

The RGB Air Mass product has been generated by using MSG and the GOES sounder and was initially provided to NHC via web page from CIRA for viewing in Google Earth. Shortly after the start of the project, SPoRT began to supply the products in an N-AWIPS format. The availability in N-AWIPS has greatly increased the use of the product compared with last year. The RGB Air Mass product has been a very popular aid at the NHC and helped identify the extratropical transition of Lee, Irene, and Katia. Mike Brennan mentioned the RGB Air Mass Product in his forecast discussion product for Tropical Storm Lee. For Tropical Storm Irene, the RGB Air Mass Product clearly showed a polar front intersecting the storm when it was near the North Carolina coast, which suggested an earlier than normal beginning of extratropical transition and may be something to look for in future systems. Senior hurricane specialist Jack Beven commented that the contrast between the blues and the greens are more subtle in the sounder version of the product and these subtle variations get lost because the colors are not as distinct as in the SEVIRI version. This might be a limitation of the horizontal resolution of the sounder, which is almost an order of magnitude lower, in terms of pixel size, than SEVIRI. Sometimes there are also limb effects in the SEVIRI product and the developers might consider adding a limb correction.

TAFB forecasters commented that the RGB Air Mass product may be useful for identifying oceanic frontal boundaries for the tropical surface analysis product. TAFB will investigate this possibility later in the season as fronts begin to penetrate farther into the subtropics and tropics. They also indicated that it has application to some of their marine products.

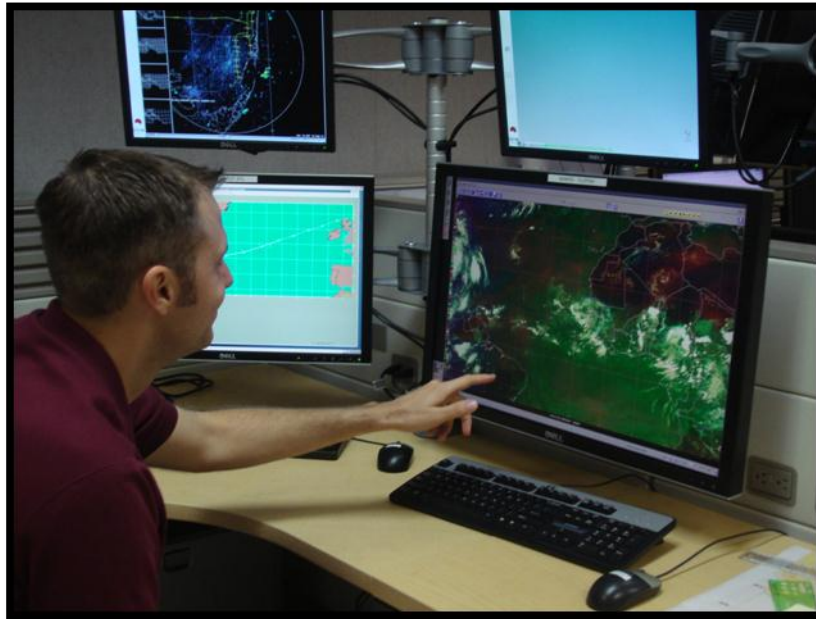


Figure 2. Eric Blake pointing out features in the RGB Airmass Product displayed in N-AWIPS at NHC

E. RGB Dust Product

The RGB Dust product has been generated by using MSG and was initially provided to NHC via web page from CIRA for display in Google Earth. Similar to the Air Mass product, SPoRT began providing the product in N-AWIPS forecast early shortly after the start of the NHC demonstration and its utilization has increased. Senior hurricane specialist Jack Beven noted that the “RGB Air Mass and Dust products were very useful in showing that the pre-Irene disturbance was going to have dry air issues initially. I think this helped us give the system a low chance of development in the early tropical weather outlooks.” Another comment about the Dust product was that some of the big dust outbreaks could be identified all the way to the edge of the picture and it was clearly evident that the dust and dry air got trapped. The product has received favorable reviews within the HSU and they look forward to using it more frequently as a decision aid. One item to note is that stratocumulus shows up as dust in the RGB dust product and the Saharan Air Layer product, and forecasters need help in distinguishing the two. Steve Miller from CIRA is developing a refined version of the Dust Product that might be used next year.

TAFB forecasters are also finding the RGB Dust Product useful for their tropical weather discussions and marine products. The product is useful for identifying large scale dust outbreaks and regions with limited visibility.

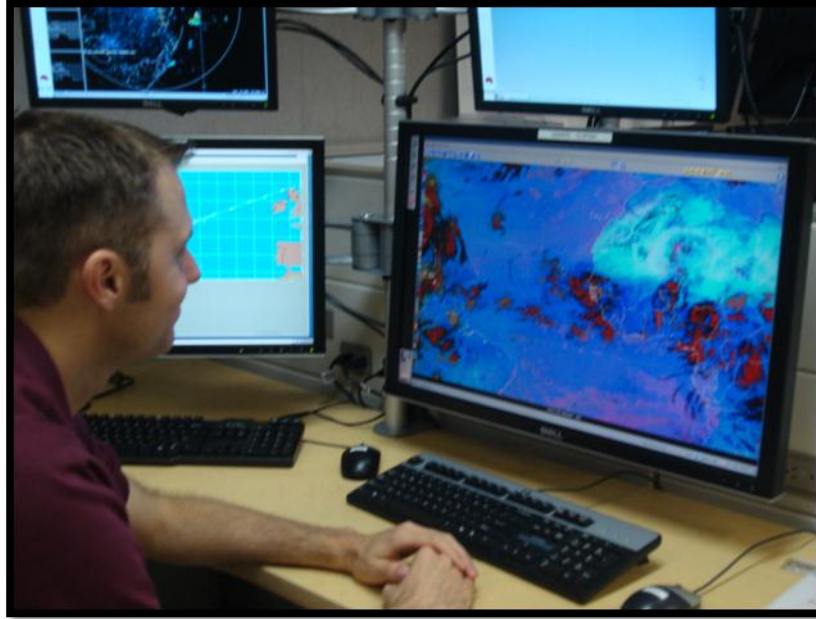


Figure 3. Eric evaluating the RGB Dust product displayed in N-AWIPS at NHC

F. Saharan Air Layer (SAL) Product

The SAL product is being provided to NHC forecasters via web page at CIMSS and the forecasters would like to have it available in N-AWIPS. This product currently runs off SEVERI (GOES-13 cannot product this product). There was not much discussion about this product. CIMSS, CIRA and SPoRT should coordinate in the off season to see if an N-AWIPS version of this product can be developed.

G. GOES-R Natural Color Imagery

The GOES-R Natural Color Imagery Product is generated from the MODIS instrument and provides an idea as to what the Natural Color Imagery product from GOES-R will look like. This product is available on the CIRA web page. In the future, forecasters would like to be able to make the same product from the NPOESS Preparatory Project Visible/Infrared Imager Radiometer Suite (NPP VIIRS). The PG demonstrations at the NHC have proven useful to the developers at STAR and CIRA. It has identified a problem where the product is too green in areas with large zenith angles; an example of this problem is shown below in Fig 4. The left panel shows that the GOES-R algorithm overestimated the green component on the left side of the image. The algorithm estimates the green component from GOES-R from neighboring channels, since the ABI does not have a green channel. A correction to the algorithm is under development at CIRA.

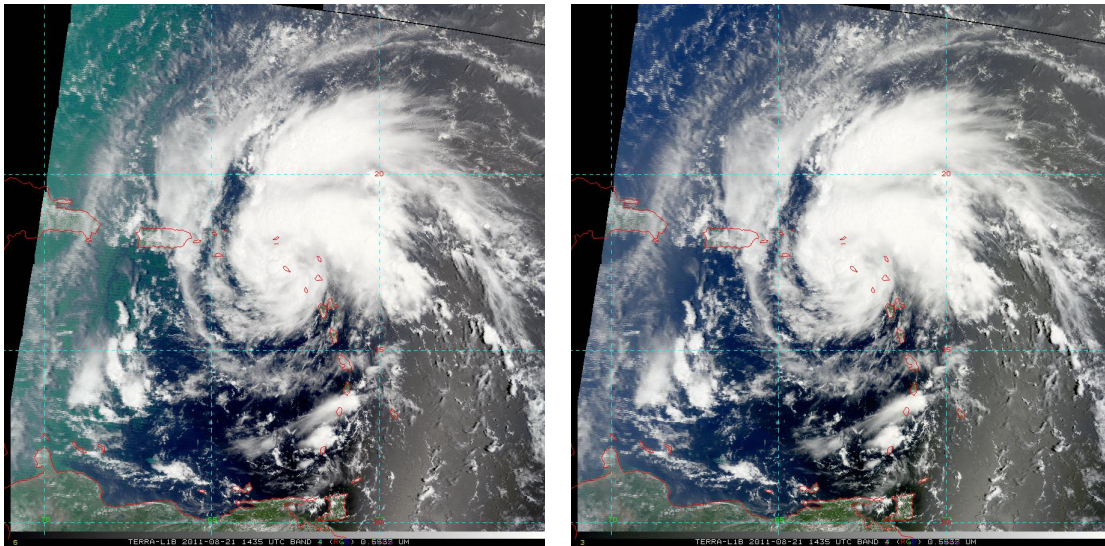


Figure 4. An example of the GOES-R natural color product using MODIS input (left) that includes the simulated green and the true color product (right) that includes the observed green component for Hurricane Irene on 21 Aug 2011.

H. Pseudo Natural Color Imagery

This product is a qualitative image combination of SEVIRI bands available from a CIMSS web page that illustrates some of the natural color capabilities that will be available from GOES-R. This product complements the Natural Color Imagery from MODIS in that it can provide looping, even though it does not use a quantitative color algorithm. One comment about the product is that dust shows up very well and the cyan color helps differentiate upper-level moisture from low-level moisture. Again this product would be more useful to the NHC forecasters if it was available in N-AWIPS.

I. Rapid Intensification Index (RII)

There have not been many rapid intensification cases in the Atlantic so far this season, although there were a few in the east Pacific before the start of the Proving Ground demonstration. There are plans for CIRA to perform a quantitative evaluation of this product during the post-season period, and this evaluation will include the entire 2011 hurricane season. The NHC forecasters have not really looked at the new rapid weakening index; however it shows some promise in the east Pacific so far. The rapid weakening index product may benefit from combined effects of shear and movement over colder water. It was discussed that a lightning time-series plot may be a useful new product for identifying intensifying or weakening systems. It was also discussed that there may be a correlation between rapid intensification and overshooting tops development, which the product developers should investigate if possible. NHC recently established a real time feed of the Vaisala GLD360 lightning in their N-AWIPS systems. Although this is not the same as the World Wide Lightning Location Network (WWLLN) data used in the rapid intensity change algorithm, it is qualitatively similar. This will help the NHC forecasters interpret the RII.

5. Adjustments for 2nd Half of 2011 Demonstration

The products will continue to flow to the NHC for the remainder of the demonstration period. Mark DeMaria has been getting feedback via email from the NHC forecasters, and this method has worked well. The only adjustment to make for the second half of the demonstration is to get some feedback on the overshooting tops product and have TAFB evaluate this product a little more, if possible.

6. Action Items

- a. Jack Beven will provide a summary of the NHC Proving Ground at the upcoming GOES Users Conference in mid-October.
- b. CIMSS should provide the missing HIE cases to Jack Beven and Dan Mundell for their post season evaluation.
- c. In future training it would be helpful to clearly spell out the differences between the HIE and the ADT.
- d. A web page should be set up at CIRA to archive the SRSO cases from the 2011 Proving Ground (already completed, see <http://rammb.cira.colostate.edu/products/srso/>)
- e. In the future CIMSS should determine if the OT algorithm can be run on GOES-east in addition to Meteosat.
- f. In the future CIMSS should determine if the OT product can be displayed in N-AWIPS.
- g. CIMSS and CIRA product developers should determine the relationships between OT and lightning activity. Do these provide independent information?
- h. CIRA should investigate whether a zenith angle correction can be added to the Air Mass RGB product.
- i. CIRA should present their updated Dust Product as an option for the 2012 NHC Proving Ground.
- j. CIMSS, SPoRT and CIRA should coordinate in the off season to determine if the SAL and Pseudo Natural Color products can be provided in N-AWIPS format.
- k. STAR and CIRA should modify the natural color imagery algorithm to correct the problem of the green bias for large zenith angles.
- l. CIRA will perform a quantitative evaluation of the RII after the end of the hurricane season that will include all cases, even those that occurred before the official starting date of the Proving Ground.
- m. The NHC Proving Ground team will put together a presentation for the Interdepartmental Hurricane Conference in early March of 2012.