Aviation Weather Testbed – Midterm Report: Evaluation 2014

Project Title: 2014 GOES-R/JPSS Proving Ground Demonstration at AWC

Organization: The Aviation Weather Center (AWC)

Evaluator(s): Aviation Weather Center (AWC) and National Aviation Meteorologist (NAM) Forecasters

Duration of Evaluation: 1 March August 2012 – 19 September 2014

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Contents

Overview

The GOES-R/JPSS Proving Ground (PG) demonstration at the Aviation Weather Center was designed to provide AWC forecasters with a pre-operational environment in which to deploy and demonstrate algorithms associated with weather-related aviation hazards while in addition familiarizing end users with its next generation geostationary and polar satellite systems. The 2014 demonstration is focused on evaluating specifically chosen baseline and future capability products as identified below, and more extensively on integrating them within AWC operations. It is split into two longer-term demonstrations, a winter evaluation period (Evaluation Period I) from March 1st – May 16th, and a summer evaluation period (Evaluation Period II) from May 19th – September 19th, and a weeklong intensive experiment, focusing on ceiling and visibility, during the latter period from August 11th – 15th.

Two JPSS and ten GOES-R products and decision aid tools were provided by CIMSS, CIRA, and NASA SPoRT, and are currently under evaluation at the AWC (Table 1). These products have been split up over both evaluation periods and the weeklong experiment according to the focus of each. The products are further split up according to the concerns of each forecast desk within the AWC. This midterm report will provide interim feedback on each product evaluated during the winter evaluation period (Evaluation Period I), set to conclude on May 19th, in the following sections.

Table 1. GOES-R/JPSS Proving Ground products in the 2014 demonstrations at the AWC.

GOES-R/JPSS Proving Ground Product	Formal Evaluation
ACHA Cloud Height Algorithms	Evaluation Period I Evaluation Period II
Aircraft Flight Icing Threat	Evaluation Period I
GOES/POES Hybrid Imagery	Evaluation Period I Summer Experiment
GeoColor Imagery	Evaluation Period I Summer Experiment
VIIRS Day/Night Band	Evaluation Period I Summer Experiment
Fog and Low Stratus	Summer Experiment
VIIRS/MODIS Nighttime Microphysics	Summer Experiment
NSSL – WRF/NAM Nest Simulated Forecasts	Evaluation Period I Evaluation Period II
Pseudo Geostationary Lightning Mapper	Evaluation Period II
Convective Initiation	Evaluation Period II
Cloud Top Cooling/OTD	Evaluation Period II
NearCasting Model Theta-E	Evaluation Period II
GOES SRSOR 1-minute Imagery	When available in operations

Feedback on the utility of each product is being gathered through one-on-one verbal discussion with forecasters out on the operations floor, and also informal email exchanges between the

AWC satellite liaison and forecasters. Feedback and case studies from each evaluation period are also posted on the Satellite Liaison blog at http://satelliteliaisonblog.wordpress.com.

1. Products Evaluated

There were five products slated to be evaluated during Evaluation Period I: 1) the Flight Icing Threat (FIT), the VIIRS day/night band, ACHA Cloud Height Algorithms, GeoColor Imagery, and GOES/POES hybrid imagery. The Simulated Satellite Imagery was also added post-completion of the original demonstration plan. All of these products were evaluated for their use in forecasting winter weather aviation hazards such as icing, turbulence, and ceiling and visibility. Subsequently, the majority of the evaluation took place at the AWC's domestic Area Forecast desks, with additional evaluation at the international, Tropical desk.

1.1 Flight Icing Threat

The Flight Icing Threat algorithm utilizes various cloud properties from the GOES-R baseline DCOMP algorithm to generate a probability and intensity of icing, and is available to forecasters in N-AWIPS. The product was introduced into the AWC during the 2013 Winter Experiment, and has since undergone several improvements, including a change in the projection and minor adjustments to color bar. Forecasters noted that these improvements have made the product much more aesthetically pleasing, and subsequently, easier to interpret.

In general, the FIT has been used a situational awareness tool for the issuance of icing AIRMETS, providing forecasters an at-a-glance overview of cloud layers that may contain moderate or greater icing. However, as the icing intensity is only available during the day, forecasters found little use of the product at night, when only a 'yes/no' mask is available. Furthermore, the current inputs only allow for icing intensity solutions to be available given that there are no higher ice clouds obscuring the lower layers. In the case of larger scale synoptic systems, where large areas of high ice clouds can exist, the product is also found to be of little use.

In previous years, there have been other inputs added by NASA LaRC to a similar algorithm, which increase the number of solutions in the presence of higher clouds. AWC forecasters have also viewed this algorithm in the past, and it has been noted that the addition of those inputs to the GOES-R FIT would be of great benefit to the product.

1.2 VIIRS Imagery

As one of two world area forecast centers (WAFC), the AWC is responsible for forecasting over the entire global, and as such utilizes polar satellites as well as geostationary satellites. VIIRS imagery, specifically the Day/Night Band and the Nighttime Microphysics RGB, have been made available to forecasters in N-AWIPS. Additionally, several Dust RGBs have also been made available to forecasters via web quick looks.

One of the challenges of polar imagery is the domain. Currently polar imagery (NOAA-15, 16,18, and 19) is stitched into a series of global mosaic imagery utilized by those in the

International Operations Branch (IOB). The eventual goal is for the VIIRS imagery to be assimilated into these mosaics, however what is currently being received via the testbed is limited to the CONUS domain. Also, the latency and spatial discontinuity of polar imagery does somewhat limit its use in an operational setting.

That said, it has still been beneficial for forecasters to take a look at the imagery, as it provides a first glance into the potential capabilities of higher resolution satellite imagery, such as will be available with the launch of GOES-R. For example, the Tropical desk examined the Nighttime Microphysics RGB for the issuance of Gulf FA's (Area Forecasts), as it aided in the discrimination of various cloud layers, and the Day/Night band was explored for the same FA at night. Also, the Dust RGBs where utilized as a validation tool for the issuance of a blowing dust SIGMET at the Central FA desk.

Further exploration will continue to determine exactly how these products could be integrated into AWC operations. One suggested option is via the GOES/POES Hybrids, and will be discussed in a later section.

1.3 ACHA Cloud Height Algorithms

Owing to the large data void areas, the IOB branch of AWC operations is perhaps one of the more challenging set of desks to work. In regions such as over oceans, or radar sparse areas, forecasters become completely reliant on satellite imagery. For this reason the ACHA Algorithms, specifically the Cloud Top Altitudes (height in feet) have been made available not only on a CONUS scale, but also on a hemispheric and global scale. Due to some delays in product generation and AWC data assimilation system issues, this imagery is not yet available on the operations floor, but has been previewed by some forecasters.

With the suggestion of forecasters, the generic color curve of the product has been split into two separate versions. One version highlights low clouds (< FL180) while the other highlights high cloud tops (> FL180), the threshold based on the National Airspace System (NAS) classifications. This will allow forecasters to utilize the imagery for ceiling and visibility purposes, as well as convection forecasting. Cloud bases and cloud top heights are required variables for the issuance of the vast majority of AWC products, and as such, the latter will be very beneficial, particularly over data sparse areas like the oceans.

1.4 GeoColor Imagery

The GeoColor Imagery, utilizing both GOES and MODIS/VIIRS provides an alternative way to overview current cloud conditions, and represents the potential for image combination that will be available GOES-R era. As with the ACHA imagery, issues with the AWC data assimilation systems have prevented the GeoColor Imagery from being viewed in operations, however it has been previewed with some forecasters.

While it doesn't provide specifics for determining IFR conditions or convective tops as other algorithms do, it provides a first glance at the future generation of satellite technology. This aesthetically pleasing imagery is a big improvement over the current black maps and does

discriminate between higher (white) and lower clouds (pink). Additionally it provides a 'visible' like image a night, which will be very useful in the issuance of ceiling and visibility forecasts during the night.

1.5 GOES/POES Hybrid Imagery

As mentioned in section 2.2, one of the ways in which to further explore and integrate polar imagery into AWC operations is via GOES/POES hybrid imagery. This imagery provides usual GOES imagery, while also overlaying POES imagery during the time of a polar swath. This provides forecasters a more consistent way to view polar imagery and also allows a very easy way in which to compare the resolutions of the two types of imagery.

This imagery is not yet available to forecasters, but will be ingested in time for the 2014 Summer Experiment. It will be explored for its uses in ceiling and visibility forecasting, as well as convection.

1.6 Simulated Satellite Imagery

Simulated Satellite Imagery has been available to forecasters since the 2012 Summer Experiment, and though not on the original demonstration plan for the Evaluation Period I, has been continually utilized and evaluated by forecasters. Specifically, the simulated IR and WV imagery from the NSSL-WRF were explored for the issuance of turbulence AIRMETS.

Typically forecasters use a variety of model parameters, most often from the NAM, for turbulence AIRMETS. These include the Ellrod-Knox Index, Richardson Number, Divergence Tendency, and upper level winds. To make use of these variables while also integrating the simulated satellite imagery, forecasters created overlays. Each of the modeled parameters, or a combination of several, were placed on top of simulated WV imagery. Areas where "bulls eyes' of each parameter were collocated with WV features typically associated with rough air (strong jets, building ridges, etc.) provided higher confidence of moderate or greater turbulence. Simulated IR imagery was used similarly, though for features such as transverse waves. Several AIRMET forecasts were even adjusted using this new technique.

2. Future Plans

The products above, as well the rest outlined in the 2014 plan, will continue to flow into the AWC for the remainder of the demonstration. However, the focus will shift to summer season aviation hazards for Evaluation Period II, and ceiling and visibility as well as convection for the 2014 Summer Experiment. While not noted on the plan, it is likely that the AWC PG will also begin to explore the various RGBs to determine what may be of interest for the 2015 demonstration plans. No other changes to the demonstration plan are anticipated and a final report will be composed after the conclusion of the Summer Experiment.

Once the report has been disseminated, the remainder of the year will be used for AWIPS-2 PG work. Depending on staffing and system readiness, forecasters are expected to begin training on AWIPS-2 workstations in the spring of 2015, beginning with those at the Convective SIGMET

and CCFP desks. As such, the goal is to transition some of the convectively based GOES-R/JPSS products into the National Centers Perspective (NCP) of AWIPS-2 to compliment this training. Actual evaluation of GOES-R products in NCP will likely be in the demonstration plan for 2015.

3. Action Items

A. Transition the Cloud Height and GeoColor imagery into experimental operations.

B. Continue exploring usage of polar imagery in AWC operations via mosaics, hybrids, RGBs, and other means. Forecasters love it, but we need to figure out where it fits. A second in-person meeting with Shawn Cochran from JPSS is being arranged in mid-summer to discuss this.