744 Overview of the 2013 Aviation Weather Testbed Summer Experiment

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1. Introduction

The overall goals of the Aviation Weather Testbed (AWT) 2013 Summer Experiment were to demonstrate and evaluate new technology, create and strengthen relationships between the Aviation Weather Center (AWC) and other government laboratories, academia and private sector entities, and to form an Operations-to-Research (O2R) link with the external community. The 2013 Summer Experiment was a success largely due to the enthusiasm and participation of a diverse group of individuals. The pseudo-operational nature of the AWT allowed for constructive exchanges between operational AWC forecasters, external product developers, and end-users. Several seminars introduced participants to a wide range of new and emerging technologies in the field, from simulated GOES-R products to advanced forecast algorithms. Valuable feedback collected during the two week experiment will influence future experiments and aid in the transition of new products to the operations floor at the AWC.

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One of the major successes of the experiment was how smooth the process of publishing pseudo-operational forecasts was made. The use of common Graphical User Interfaces for each forecast desk to publish their assigned products was extremely valuable. This allowed for participants to focus on evaluating new products and giving valuable feedback instead of being consumed by the process of creating the product. This major success allowed for the operational issuance of the experimental Aviation Weather Statements (AWS) on 22 August 2013. This day was a highly impactful day to the National Airspace System (NAS) as there was organized convection in the Northeast United States. The National Aviation Meteorologist (NAM) at the Airspace Traffic Control System Command Center (ATCSCC) was too busy to handle the additional responsibility of issuing the experimental Aviation Weather Statement so it was done by forecasters at the Summer Experiment without interruption. The centerpiece of the Summer Experiment was 5 pseudo-operational desks: Convective SIGMET, Collaborative Convective Forecast Product (CCFP), Global Convection Forecast, NAM, and Situational Awareness (GOES-R).

There were three primary goals met during the Aviation Weather Testbed (AWT) 2013 Summer Experiment. First, the experiment provided resources to demonstrate and evaluate new capabilities combined with the forging of professional relationships between public, private, and academic entities. Additionally, the 2013 Summer Experiment was a useful training opportunity for AWC forecasters because it exposed them to new data sets, tools, and products, and afforded them the opportunity to discuss them with researchers and developers. Several individuals, both internal and external, gave brown bag lunch seminars that provided valuable information and generated productive discussions. Finally, the experiment played a role in establishing an Operations-to-Research (O2R) link which is critical to the success of developing new products to support existing operations. Tangible successes of the 2013 Summer Experiment are evident by the amount of recommendations and actions that resulted from the interactions of the participants. These recommendations and action items will be addressed in the following section by experimental desk.

2. Desk by Desk Overview

The experiment was designed to simulate operational desks during the convective season. Each desk was asked to produce pseudo-operational products throughout the day while making use of new methodologies, data sets, displays, and tools. The primary desks operated during the experiment were: Convective SIGMET, Collaborative Convective Forecast Product (CCFP), Global Graphics (convection), National Aviation Meteorologist (NAM), and Situational Awareness (GOES-R). Two additional desks were used to demonstrate the CONUS AutoNowCaster (ANC) product and the Integrated Support for Impacted Air-Traffic Environments (INSITE) tool. During the experiment, members of the AWC Aviation Support Branch (ASB) took notes and logged information in a blog. Paper surveys were distributed to all participants so they could provide valuable feedback. The comments and survey results were collated and a summary was created. For highlights of the different desks, visit the Summer Experiment blog page at: http://awtse.blogspot.com/

2.1 Situational Awareness Desk

2.1.1 Desk Structure

This section contains a brief summary of the activities and products uses at the Situational Awareness desk. For a full detailed summary please see Terborg, 2013. Additional information can be found on the GOES-R Summer Experiment blog located at: http://goesrawt.blogspot.com/ The Situational Awareness desk was dedicated to supporting the other desks during the experiment by providing real-time experimental imagery of the current or near-future state of the atmosphere using remote sensing instruments. The primary focus of the desk was the GOES-R simulated imagery, followed by a comparison of available lightning products, and finally a comparison of available radar mosaics. Additionally, an AutoNowCaster AWIPS-2 desk was set up for evaluation of the boundary input tool and nowcasting products it could provide to the other experimental desks. The situational awareness desk had no required products to issue, but they did have an available drawing tool to use and publish to the experiment website to indicate areas of concern to the other desks. However, much of the success of the Situational Awareness desk came from the verbal collaboration with the other experimental desks.

2.1.2 GOES-R Data

One of the primary objectives of this desk was to examine the simulated GOES-R products for areas of convective weather concern. Additionally, some of the fog detection products were used when convective weather was not a great concern during the experiment. This added an unanticipated (but most welcome) dynamic that was not expected during the experiment. The available satellite products that were made available during the experiment are in Table 1, below.

Table 1. List of GOES-R producs available during the 2013 Summer Experiment (modified from Terborg, 2013).

Demonstrated Product	**Category**
Simulated Cloud and Moisture	Baseline
Nearcasting Model	Risk Reduction
Convective Initiation	Future Capability
Cloud Top Cooling/Overshooting Top Detection	Future Capability
Psuedo Geostationary Lightning Mapper	Baseline
GLD360, NLDN, and ENTLN Lightning Stroke/Density	Baseline
GOES-14 Super Rapid Scan Imagery	Baseline
ACHA Cloud Height Algorithms	Baseline
Fog and Low Stratus	Baseline
Category Definitions: **Baseline Products -** GOES-R products providing the initial operational implementation **Future Capabilities Products -** New capability made possible by ABI **Risk Reduction** – Research initiatives to develop new or enhanced GOES-R applications and explore possibilities for improving current products	

An example of a summary graphic published on the experiment's website is shown in Figure 1. This image was taken during the most impactful aviation day during the 2-week experiment. It can be noted that 2 distinct areas were noted by the Situation Awareness desk. One area over the Great Lakes highlighting an area of continued development indicated by the Nearcasting Model (Walker et al. 2012). A second area was highlighting continued development over the New York terminals indicated by GOES-R products. This graphical product is representative of the verbal interaction that was happening with the other desks at this time.

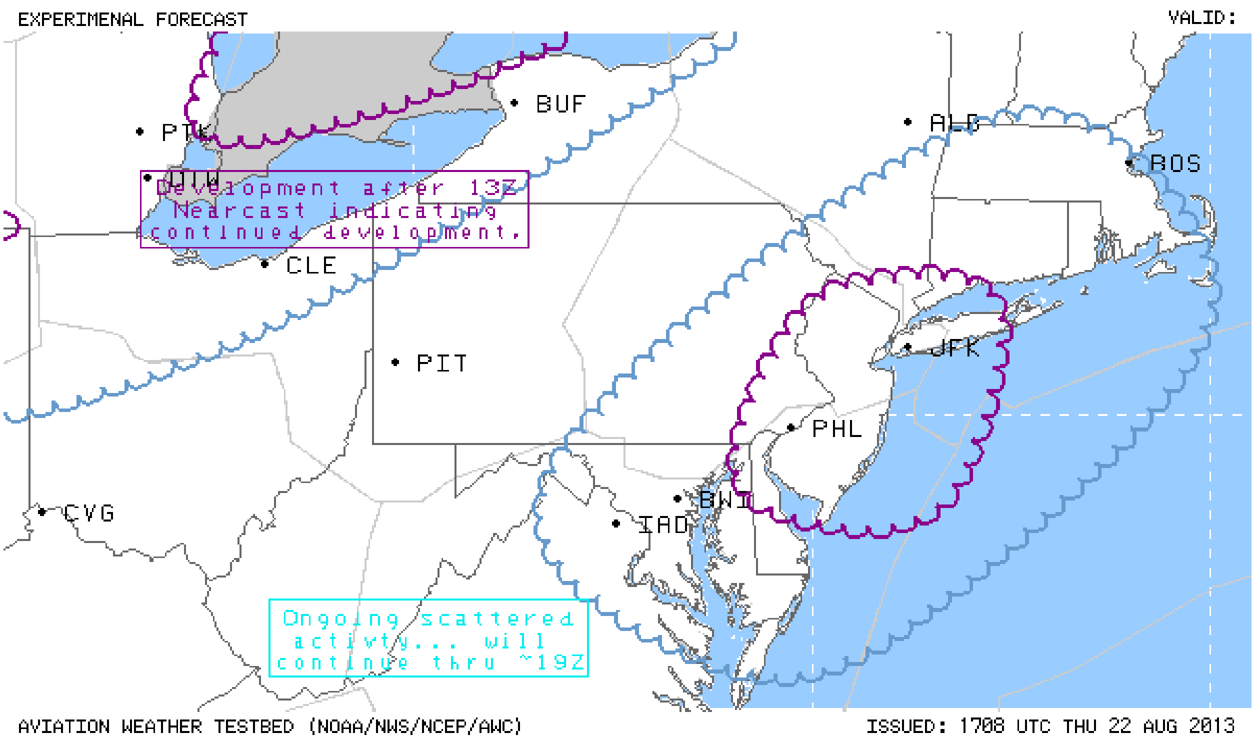

Figure 1. Experimental graphic used to highlight areas of concern indicated by GOES-R products during 22 August 2013.

On 20 August 2013, convection was approaching Houston's George Bush airport (IAH). The GOES-R Convective Initiation (CI) product (Mecikalski and Bedka, 2006 and Mecikalski et al. 2013) from 1332 UTC is shown in Figure 2 with the 1545 UTC experimental Aviation Weather Statement (AWS). The GOES-R CI product was showing increased probabilities near the terminal areas which provided confidence for the issuance of the AWS for the IAH terminal area. This was a prime example of how the Situational Awareness desk collaborated with the other desks during the experiment.

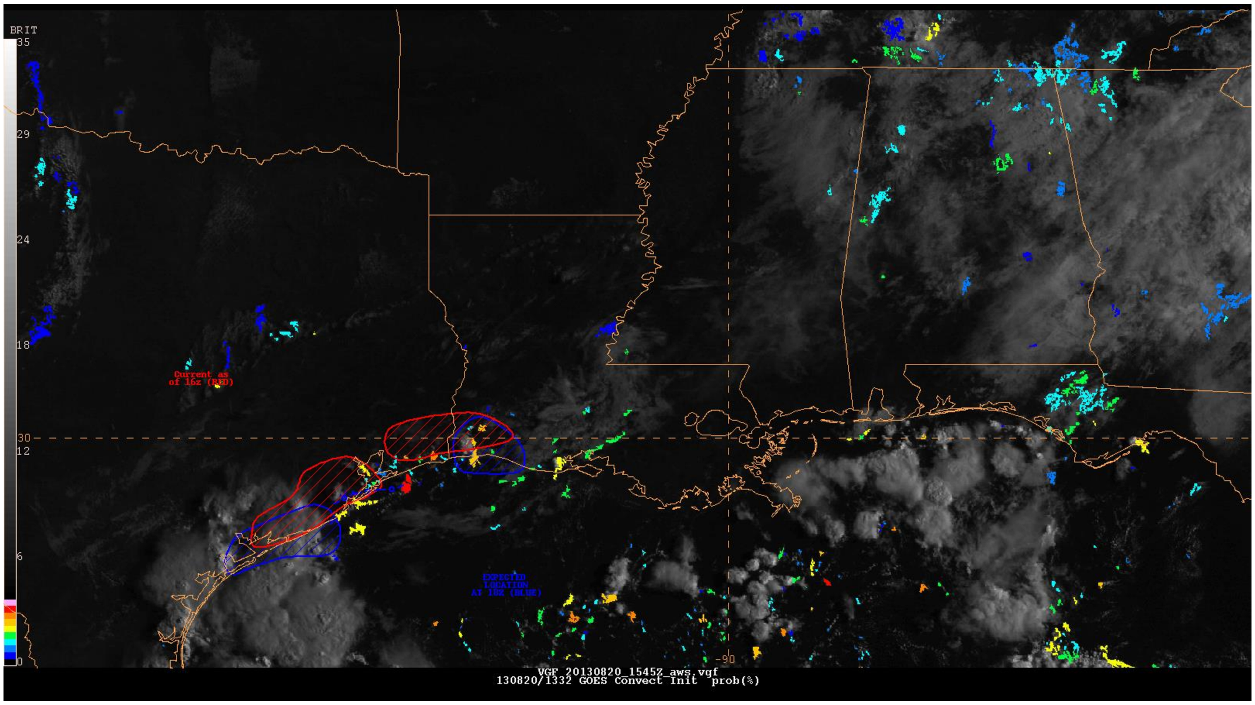

Figure 2. GOES-R CI from 20 August 2013 at 1332 UTC and the 1545 UTC AWS. An increasing trend in probabilities was noted along the TX and LA coast, and the first CTC signals further narrowed down particular issue areas, one in TX associated with the ongoing convection, and the other on the border of TX and LA associated with both higher CI probabilities and moderate CTC cooling signals (from Terborg, 2013).

An important task of the Situational Awareness desk was to evaluate different lightning products that were available during the experiment. Earth Network's Total Lightning Network (Earth Networks, 2013) was made available throughout the experiment and was plotted primarily as a density product in NMAP. It was commonly overlaid with satellite data for evaluation. Vaisala's GLD360 product (Said et al. 2013) was also displayed as a lightning density for comparison. The primary difference between ENLTN and GLD360 is the sensor type. GLD360 is less data rich due to the nature of the sensing technology; GLD360 is longer range detection with fewer sensors versus a higher density of sensors exclusive for ground contact detection (ENTLN). GLD360 utilizes long range detection with fewer concentrated sensors unlike typical ground based detecting technologies (i.e. ENTLN, NLDN) in order to capture lightning strokes (not specific to CG or IC) globally in regions where ground based technologies cannot be used. Comparisons were also made using Vaisala's National Lightning Detection Network (NLDN: Cummins and Murphy, 2009). It was noted that the 2013 upgrades to Vaisala's network (Nag et al. 2013) should be evaluated in the near future without the GLD360 domain restriction currently received by AWC.

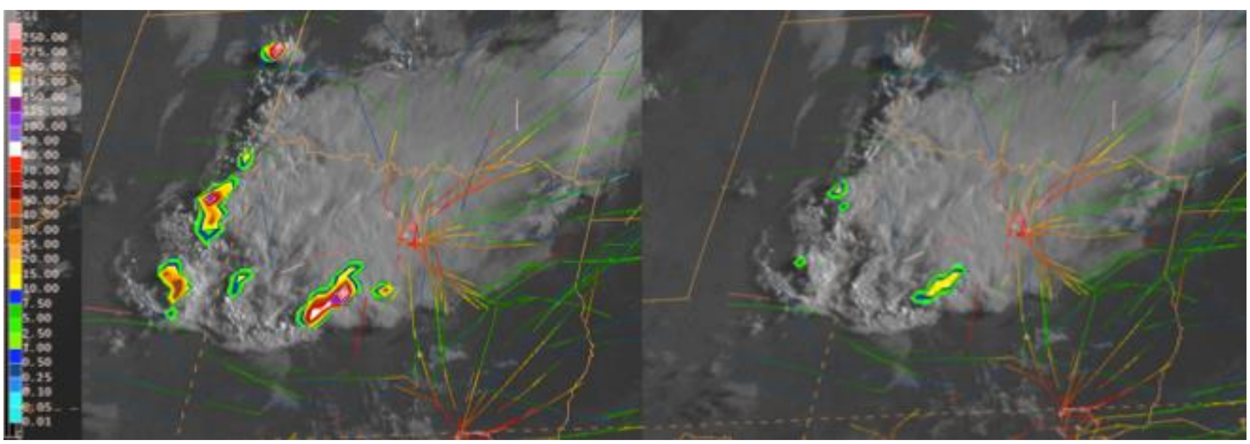

Figure 3. ENTLN lightning density compared with Vaisala's GLD360 total lightning density. The color scale indicates lightning density in 10^{-3} strokes/km^2/min. The ENTLN lightning density detects much more lightning than the low-frequency sensors used by GLD360.

2.1.3. AutoNowCaster Desk

An AWIPS-2 workstation was configured with the AutoNowCaster (ANC: Mueller et al. 2003) boundary tool. The ANC boundary tool allows forecasters to draw a surface boundary on the AWIPS-2 CAVE display, give it motion (if applicable), and submit it back to the ANC system at the NWS Meteorological Development Laboratory (MDL) for inclusion in subsequent model runs. Once the output ANC grids were received, they were converted to GEMPAK format for display on the simulated forecast workstations during the experiment. Two primary products were available for viewing: the 60-min lead-time extrapolated reflectivity and initiation fields and the 60-min lead-time convective likelihood field. An example of the convective likelihood field is in Figure 4. The example shown in Figure 4 compares well with the outlined areas of convective initiation identified by GOES-R Nearcasting Model (Figure 1) as both are highlighting areas near the Great Lakes and NY/NJ areas at approximately the same time.

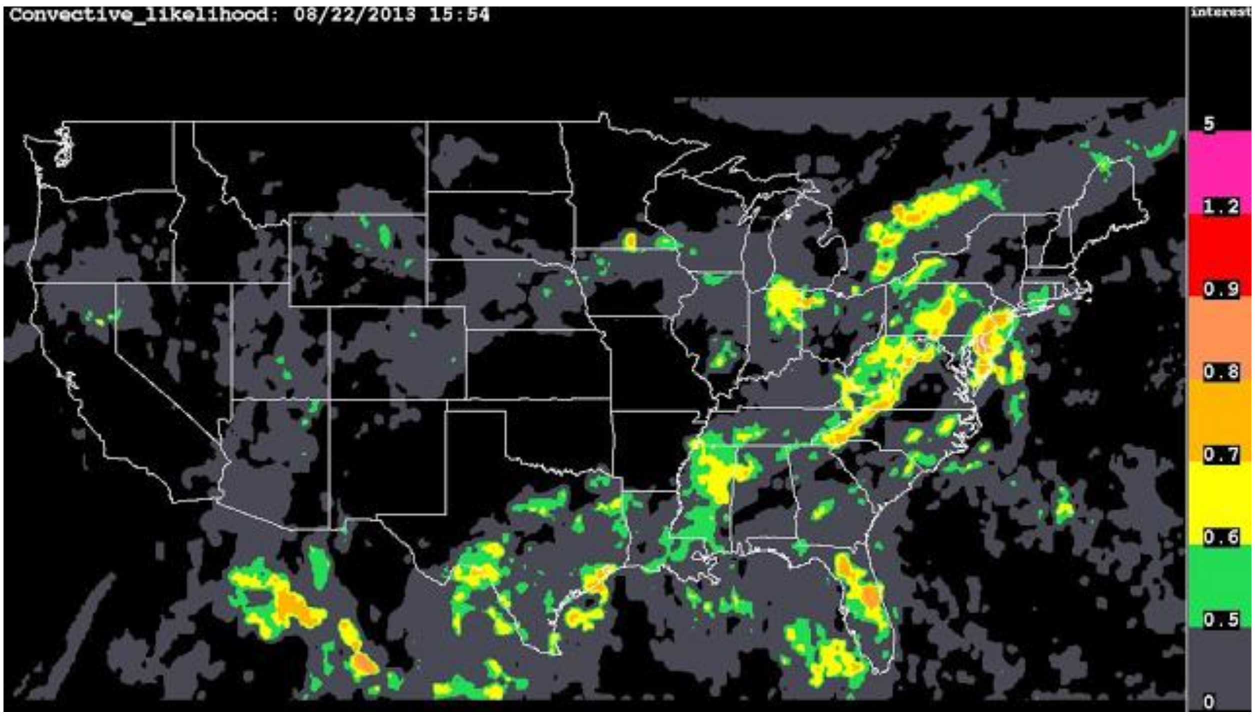

Figure 4. ANC Convective Likelihood field issued at 1554 UTC valid at 1654 UTC. Notice the areas greater than 0.7 (empirically derived) indicate a strong signal for an environment conducive for convective development.

2.2 Convective SIGMET (CSIG) Desk

2.2.1 Desk Structure

There were two primary goals at the Convective SIGMET desk during the experiment. The first goal was to experiment with changing the current 2-6 hour (time smear) convective outlook to a 2-hour (snapshot) convective outlook. The goal of this task was to answer the question, "Can the Convective SIGMET forecaster successfully deliver a product that fills the 2-hour convective forecast gap left when CCFP moved from 2/4/6-hour to the current 4/6/8-hour forecast product without degrading the quality and timeliness of the Convective SIGMETs." The second goal was to evaluate new and existing products that may enhance the CSIG forecasting process for both SIGMET and outlook issuance. This desk had the most internal participation from AWC forecasters as many of them are trained to work the CSIG desk. Therefore, this desk had some of the highest quantity and quality comments from the evaluation forms. The operational environment was mimicked as best as possible by having a product due every hour from through the early afternoon of the experiment.

An example of the experimental forecast product is shown in Figure 5.

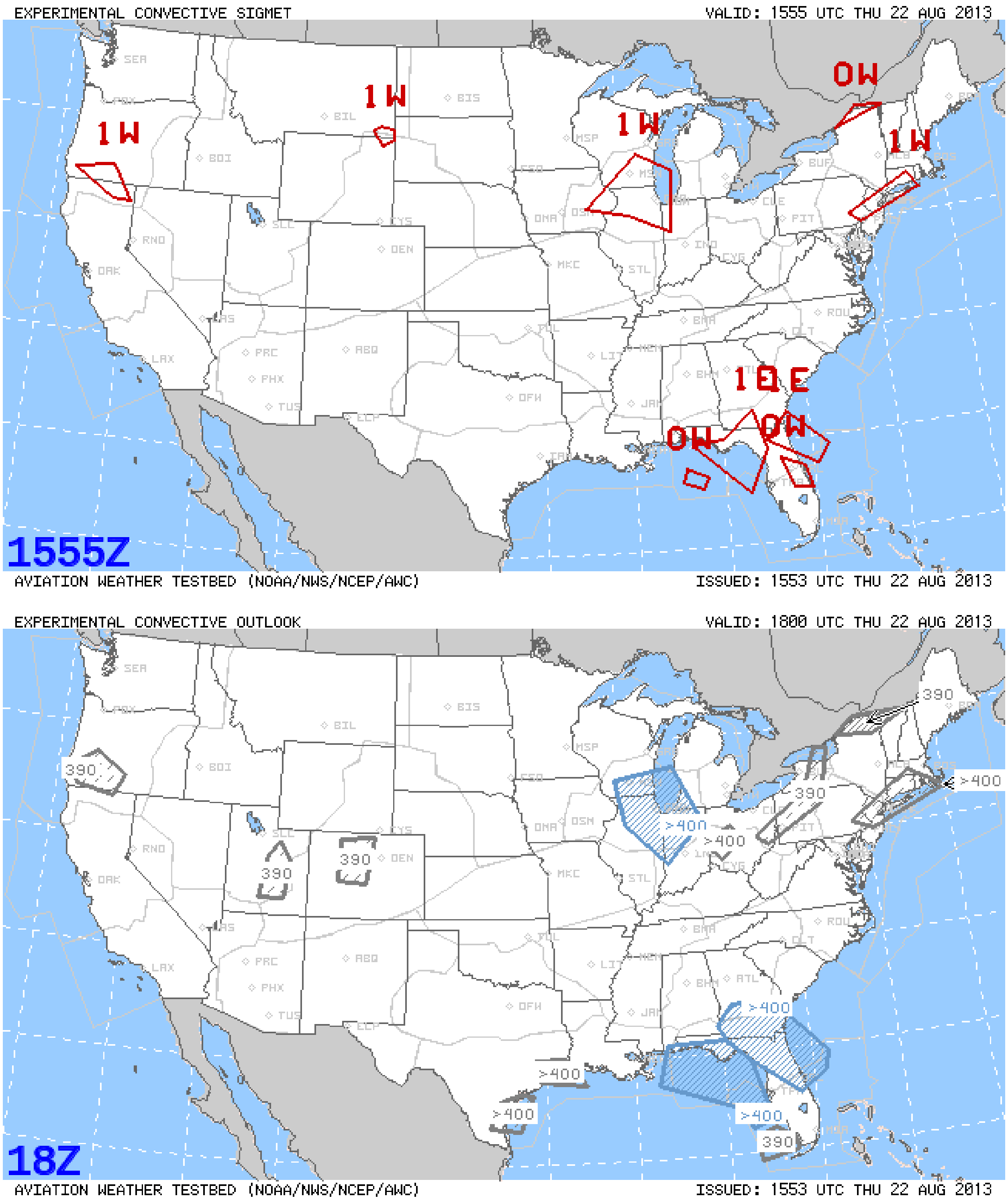

Figure 5. Example CSIG valid at 1555 UTC (top) and a 2-h Convective Outlook valid at 18 UTC (bottom) from 22 Aug 2013. The Convective Outlook has a look and feel to the CCFP but is used to forecast SIGMET criteria.

In the example in Figure 5 (top), it is evident that the look of the SIGMET product is unchanged. The labels of the polygons if moved to operations would be updated with proper identifying tags. The 2-hour Convective Outlook (bottom of Figure 5) is a new product that utilized the current CCFP drawing tool in NMAP. The idea for the convective outlook is to forecast CSIG criteria for a 2-hour snapshot in the future. The polygons should always be labeled with an appropriate echo top. The blue polygons represent convection that exists while the gray polygons represent areas of potentially new initiation to CSIG criteria. Trend arrows were also used during the experiment to indicate whether or not there was an intensifying trend or a weakening trend to forecasted convection. Since the CCFP drawing tool was used for convenience, the final 2-hour snapshot will likely look different than the example shown here.

Qualitative verification was also done on both the CSIG and the 2-hour Convective Outlook product. Verification of the 2-hour Convective Outlook product for the image in Figure 5 is shown in Figure 6. The example in Figure 6 is fairly indicative of the expected skill during the 2-week experiment. In the example below one can see good skill in indicating the developing line across W NY and PA, while missing some isolated convection across N AL and N GA as well as KY-WV-VA. These images were used to stimulate discussion at the end of the day.

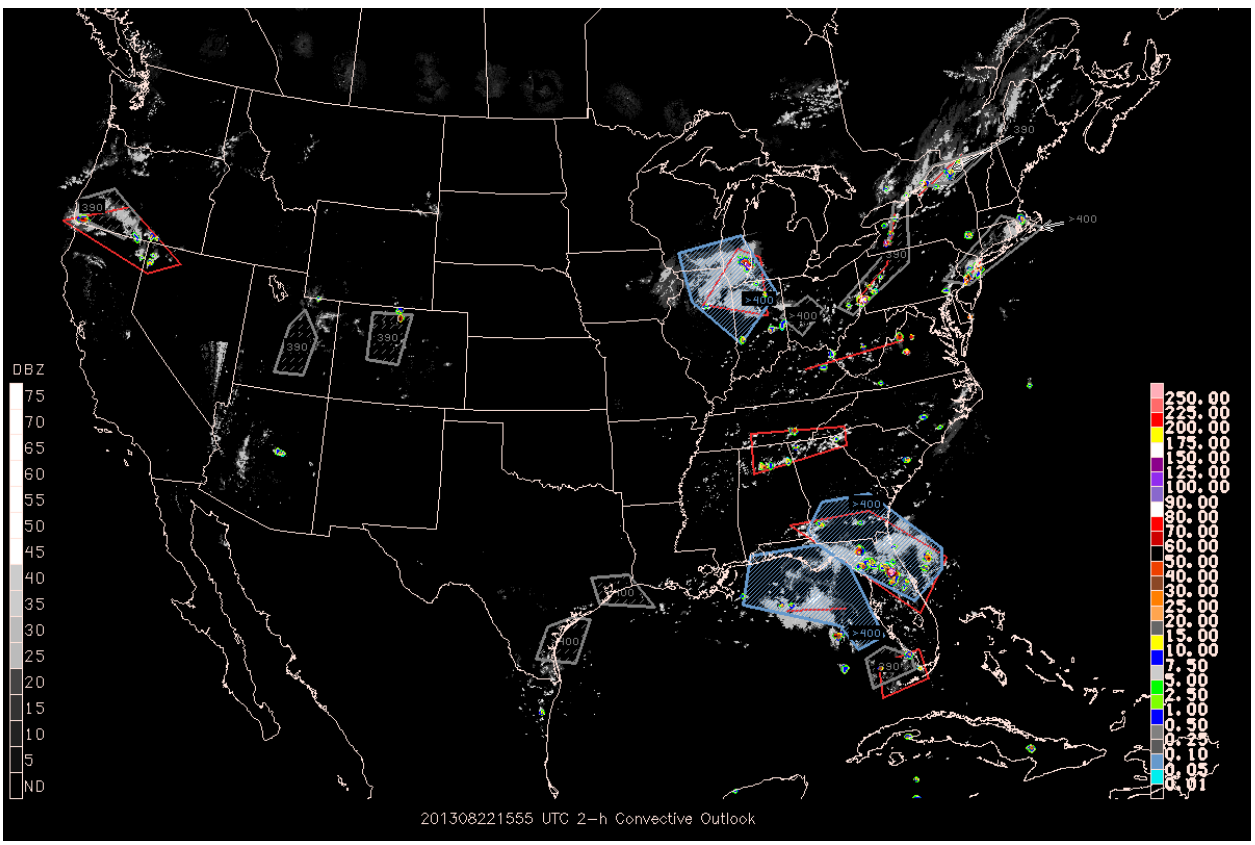

Figure 6. Verification of the 2-h Convective Outlook issued 22 Aug 2013 at 1555 UTC valid at 1800 UTC. Red overlays show operational CSIGs valid at 1755 UTC. Gray scales indicate reflective in dBZ. The color scale indicates lightning density in 10^{-3} strokes/km^2/min.

2.3 Collaborative Convective Forecast Product (CCFP) Desk

2.3.1 Desk Overview

The Experimental CCFP desk had a lot of participation from AWC forecasters and external participants. This is due in large part to the exposure many have of the operational CCFP product. CWSU forecasters from Kansas City Center (ZKC) also participated at this desk. The experimental CCFP desk tried to mimic operations as much as possible and there were 3 routine issuances of the experimental CCFP product daily throughout the experiment. There were two requirements for the experimental CCFP product that were different from the operational CCFP. One was a requirement to write a brief meteorological discussion geared toward traffic flow management (TFM). This discussion would get published along with the graphical CCFP product. The intent was to deliver a discussion to those users who were not part of the chatroom collaboration on the product. It is worth mentioning that, during the experiment, no external collaboration was done on the experimental product. Forecasts were made based on the expertise of the forecaster and discussions with other experiment participants. The second requirement was to annotate the CCFP graphic with supporting text when appropriate. For instance, a forecaster could briefly describe convective mode in a textbox annotation on the final graphical product. This too would add more detail to the convective forecast than currently available in the operational product. An example of the graphical product is shown in Figure 8.

The discussion was noted to be more effective if it was written with a paragraph for each valid time. The content of the text was considered more easily digestible to an end-user than just a single paragraph discussion.

The required discussion that went along with the images is found after Figure 8.

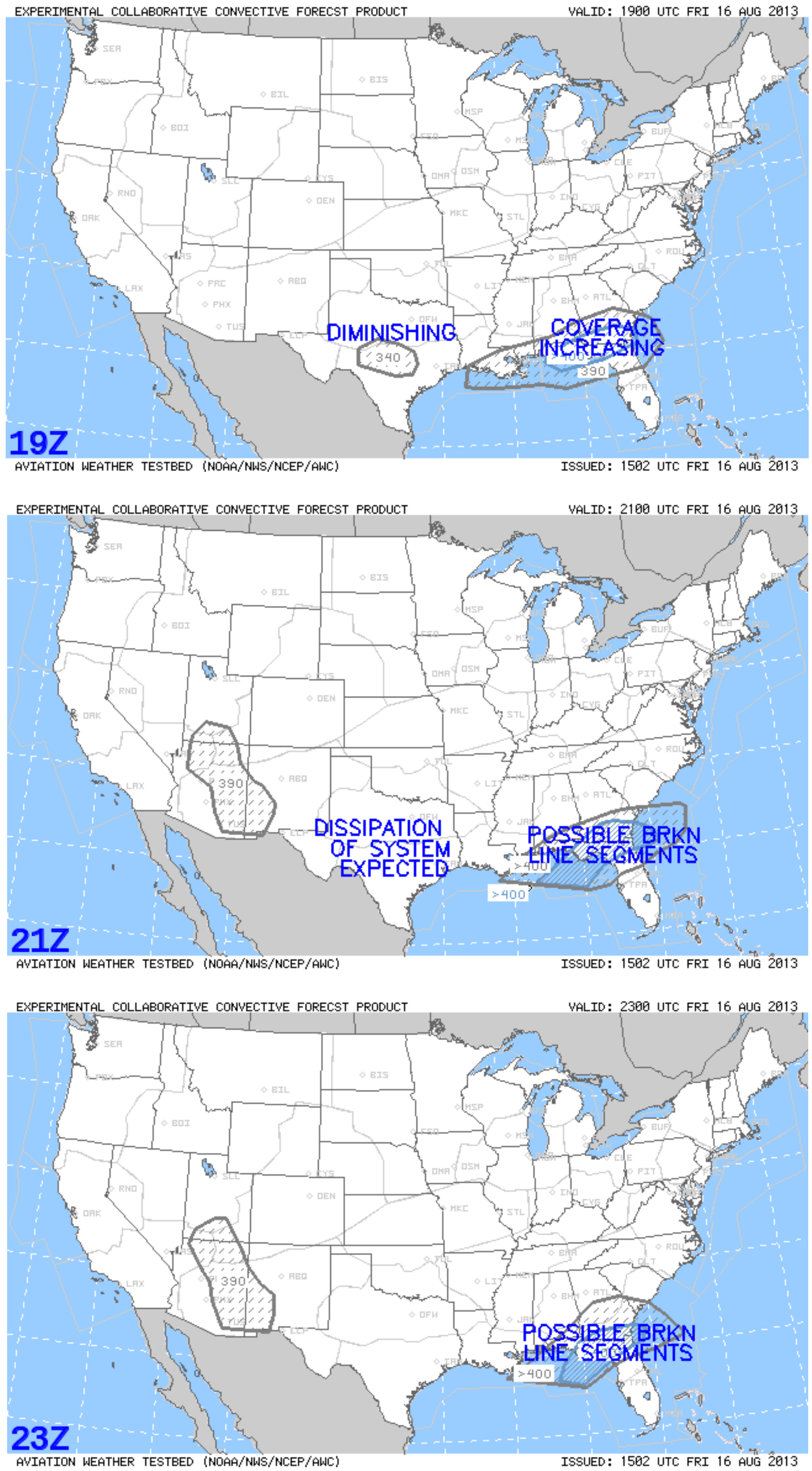

Figure 7. Example of an experimental CCFP issued 16 August 2013 at 1500 UTC valid for 1900, 2100, and 2300 UTC.

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NWS AVIATION WEATHER TESTBED KANSAS CITY MO
1449 UTC FRI 16 AUG 2013

VALID TIME...1900Z-2300Z

19Z...Increasing coverage S GA / FL panhandle in unstable airmass with wave
moving up front.
Expect decay of remnant convective system in southcentral TX.
21Z...Continued development / increase in coverage across S GA / FL
panhandle. Expect dissipation for southcentral TX system. Scattered
development across AZ / desert monsoon region.
23Z...Ongoing convection across S GA / FL panhandle,possible route blockage
from line segments. Continued development southwest monsoon region.
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The desk was traditionally led by an AWC forecaster with CCFP experience. To this end many common convective tools were at their disposal with the addition of several experimental products not available on the operational floor. One example of such an experimental product was the Large-scale Convective Storm (LCS) product (Pinto et al. 2013) from the National Center for Atmospheric Research (NCAR). This product contained information from either the High Resolution Rapid Refresh (HRRR: Benjamin et al., 2014) model or the Air Force Weather Agency (AFWA) Ensemble and also forecasted convective initiation on larger scales (Figure 9). The AFWA Ensemble was also available for convective variables such as probability of lightning and exceedance probabilities for reflectivity and echo top. The HRRR Convective Probability Forecast (HCPF-Alexander et al., 2013) was available for half of the experiment; it uses time-lagged HRRR runs to product a probability forecast (Figure 10). Additionally, some operational fields were made available in a sub-sampled grid for faster loading and compared to their full resolution displays (HIRES Windows and HRRR simulated reflectivity and echo tops, for example).

2.3.2 CCFP Experimental Concepts

There were a lot of industry comments that were in favor of the discussion and the text annotations in the graphic. One comment was that it allowed for easier creations of weather briefs that are given to pilots, especially when an individual does not see the content provided in the CCFP chat. Of the Center Weather Service Unit (CWSU) forecasters that were present many favored the meteorological discussion to be part of the official product. This focuses collaboration on meteorology instead of air space considerations. It was mentioned that the text box annotations should be somewhat standardized to avoid confusion.

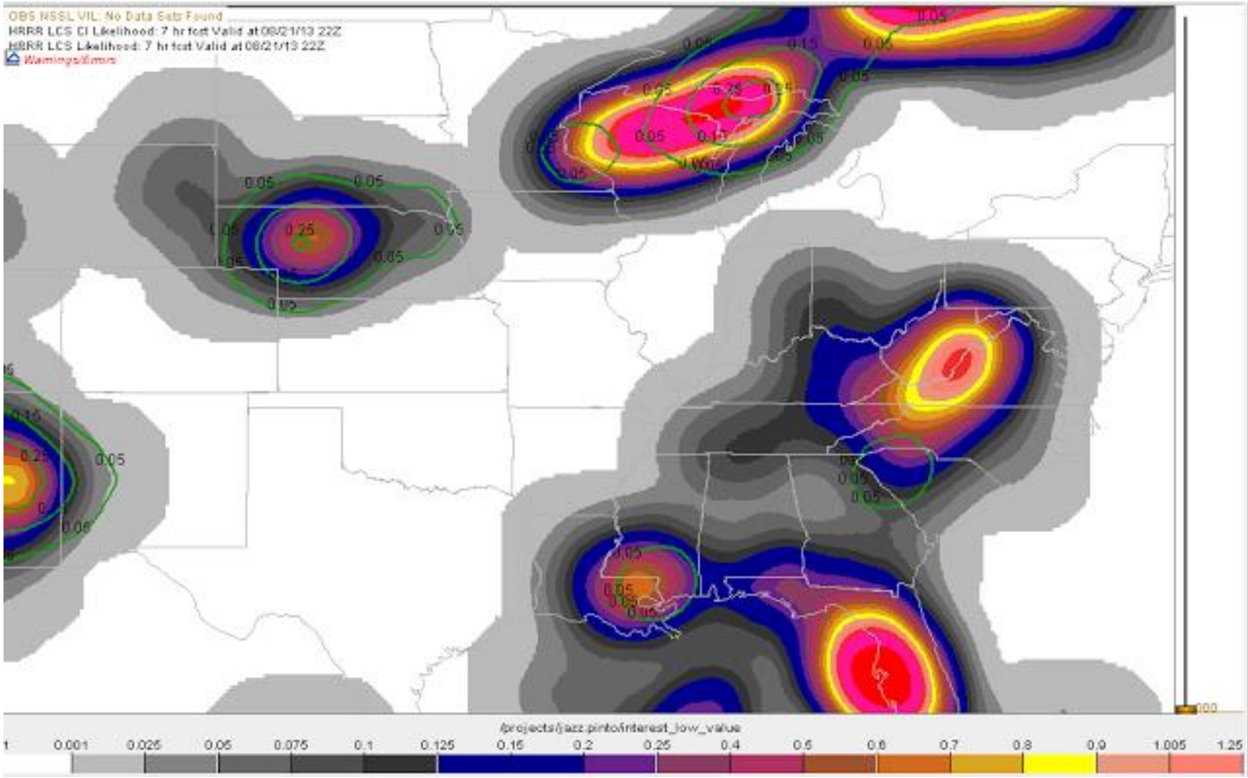


Figure 8. NCAR's experimental HRRR time-lagged ensemble-based Large-Scale Convective Storm Likelihood (filled contours) and Large-Scale Convective Storm-Convective Initiation Likelihood (green contours) issued at 1500 UTC and valid at 2200 UTC on 21 August 2013.

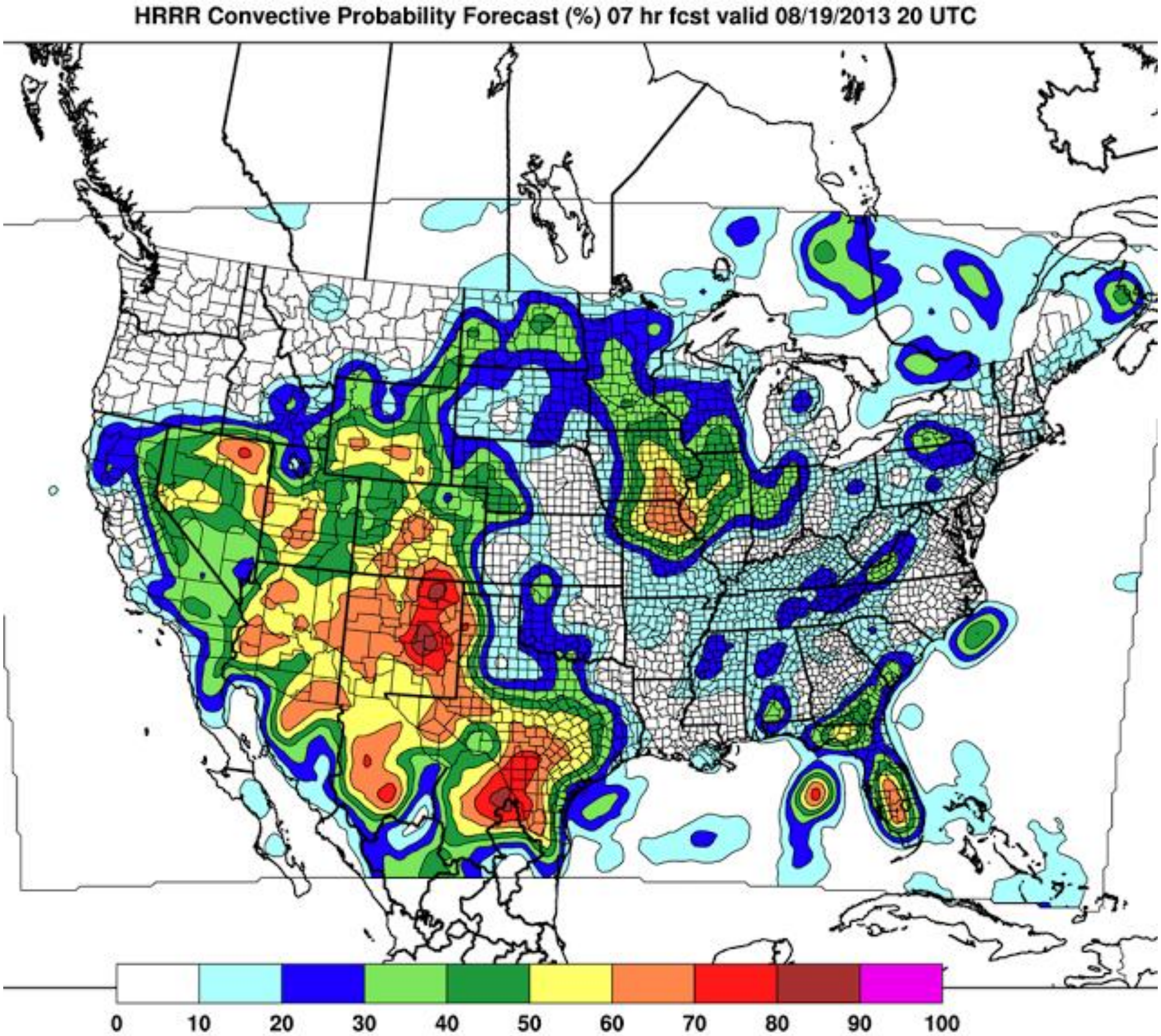


Figure 9. HRRR Convective Probability Forecast (HCPF) Product 7-h forecast valid at 19 August 2013 valid at 2000 UTC.

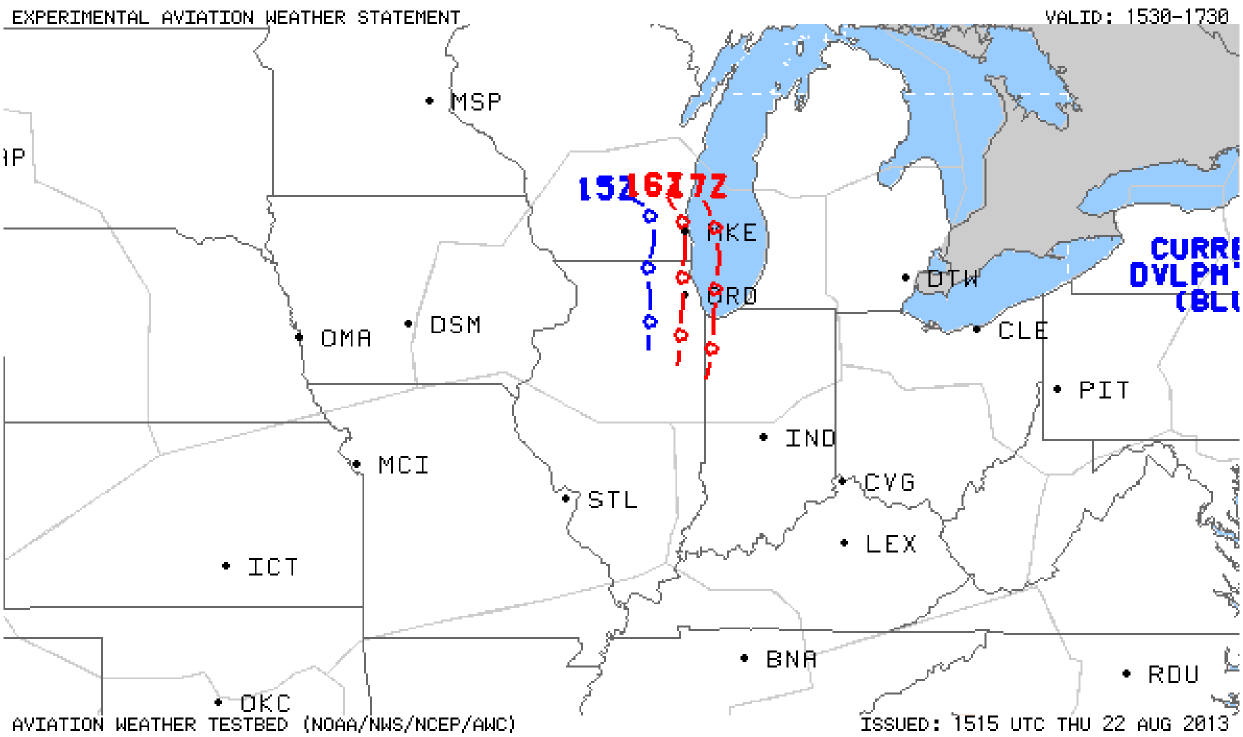
2.4 National Aviation Meteorologist (NAM) Desk

2.4.1 Desk Structure

The NAM desk was setup for two reasons: to demonstrate the work flow of the AWC meteorologists stationed at the Air Traffic Control System Command Center (ATCSCC) and to experiment with expanding the coverage of the Aviation Weather Statement (AWS). The current AWS is focused solely on the Northeast US. It is an event-driven product with no standard issuance times. Several meteorological hazards can be included in an AWS, including: ceiling and visibility, wind, thunderstorms, and winter precipitation events. Although the NAMs have more responsibilities in a given day than just producing the AWS, the focus of this experiment was mainly on the creation of the AWS over the entire CONUS. In addition, the forecasters stationed on the NAM desk were tasked to create a multiple day outlook if time permitted. The outlook was a summary of the potential aviation impacts on air traffic for a period 2-4 days in the future. Hazards depicted included convection, IFR conditions, strong winds, and winter precipitation. The NAM desk worked on a thin-client workstation and could load different virtual machines on each of the four monitors. The monitors could be configured to show an NMAP display, an AWIPS-2 display, and a Windows display. In addition, a workstation was set up next to the NAM desk that contained the Integrated Support for Impacted Air-Traffic Environments (INSITE) tool (Layne et al. 2014 and Petty et al. 2014). INSITE combines multiple forecast solutions and observations and displays them in an aviation impact framework using the strengths and weaknesses of the components. It was available to aid in the Northeast US domain only.

2.4.2 CONUS AWS

The Aviation Weather Statement (AWS) was designed as an impact-driven graphical product with an accompanying impact discussion focused on potential traffic management decisions. It is generally issued when an operational product is in disagreement with observations or the operational forecast needs additional specific information. For the experiment, the NAM desk was tasked with trying to expand the domain of the AWS to the CONUS. To facilitate this process, a special Graphical User Interface (GUI) was created to aid in the submission of the AWS. In order to make drawing AWS over the CONUS more efficient, a number of pre-defined domains were available to select from, these included, the Northeast US (NY and BOS terminals), the Upper-Midwest area (MSP and CHI terminals), the Southeast US (ATL and FL terminals), the Texas region (DFW and IAH terminals) , the North Pacific region (SEA and PDX terminals) , the South Pacific region (CA, AZ, and NV terminals), and the Rocky Mountain region (SLC and DEN terminals). The publish tool that was employed during the 2013 Summer Experiment actually allowed for the operational distribution of the AWS that took place on 22 August 2013 during a highly impactful day for the Northeast US. On that day, the AWS was operationally issued from the Aviation Weather Testbed at the AWC to support NAM operations at the ATCSCC. An example of an experimental AWS for a convective line issued for the Chicago terminals is shown in Figure 11, while an experimental AWS for IFR conditions in the Southeast US is shown in Figure 12.



EXPERIMENTAL AVIATION WEATHER STATEMENT 0022
NWS AVIATION WEATHER TESTBED KANSAS CITY MO
1509 UTC THU 22 AUG 2013

VALID TIME...1530-1730

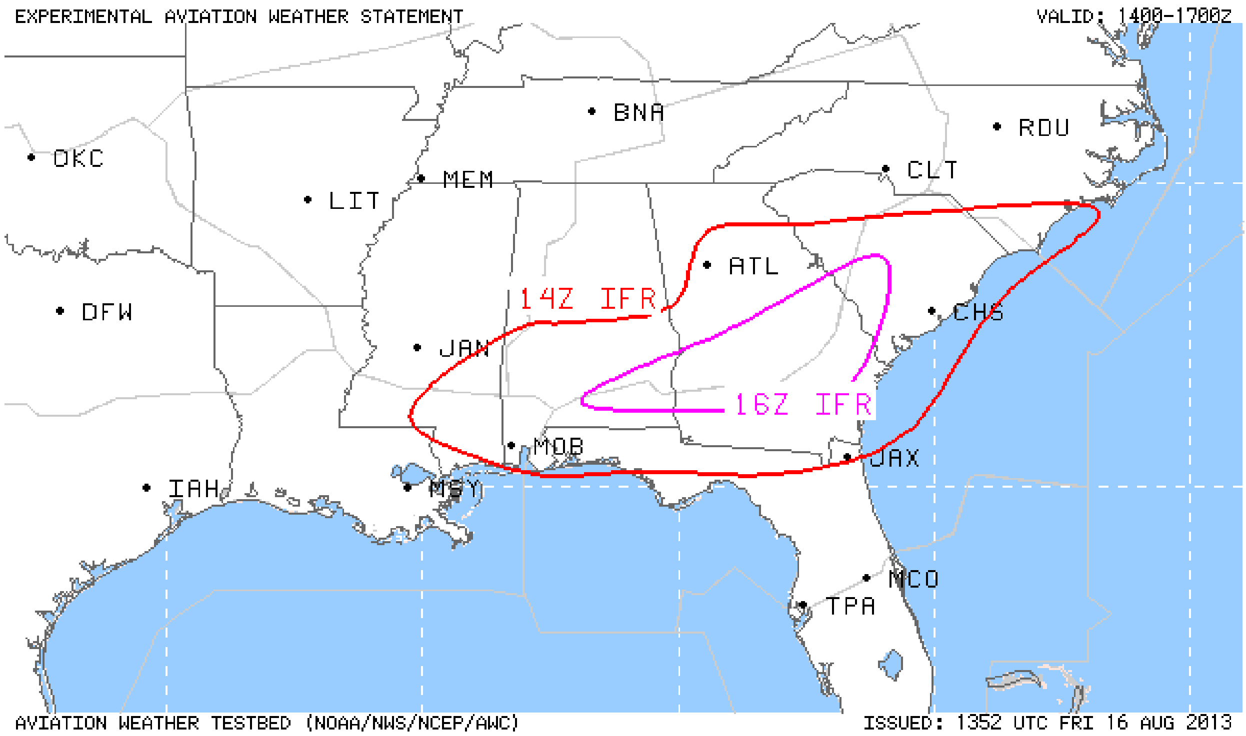
NAS ELEMENTS EFFECTED...C90 TRACON AIRSPACE...MDW...ORD

CONSTRAINTS...BROKEN LINE OF THUNDERSTORMS NOW MOVING THROUGH THE C90 AIRSPACE DEPICTED IN BLUE. LINE IS MOVING EAST AT 20KTS AND WILL IMPACT MDW/ORD BY 16Z. CONTINUED EASTWARD MOVEMENT IS EXPECTED WITH THE LEADING EDGE NEAR THE EASTERN BOUNDARY OF THE C90 AIRSPACE BY 17Z.

ONSET OF TERMINAL IMPACTS EXPECTED NEAR 1530Z...WITH CESSATION NEAR 17Z.

THUNDERSTORMS EXPECTED TO CLEAR THE C90 AIRSPACE NEAR 1830

Figure 10. Aviation Weather Statement for the Chicago Center (ZAU) issued at 1515 UTC on 22 August 2013 depicting the movement of a line of thunderstorms moving through the MKE, ORD, and MDW terminal areas in the next few hours.



EXPERIMENTAL AVIATION WEATHER STATEMENT 0011
NWS AVIATION WEATHER TESTBED KANSAS CITY MO
1350 UTC FRI 16 AUG 2013

VALID TIME...1400-1700Z

NAS ELEMENTS EFFECTED...ZTL ZJX

CONSTRAINTS...WIDESPREAD IFR CONDITIONS PERSISTING ACROSS THE SERN US. SHOULD BEGIN TO CLEAR OUT IN THE NEXT FEW HOURS WITH AN AREA PERSISTING ACROSS SE AL/SE GA/SRN SC. 18Z MOST CONDITIONS SHOULD BE MVFR/VFR.

Figure 11. Aviation Weather Statement for the Atlanta and Jacksonville Centers (ZTL and ZJX) issued at 1352 UTC on 16 August 2013 for persistent fog over the SE US which was forecasted to dissipate somewhat over the next few hours.

2.4.3 Multiple Day Hazard Outlook

The Multiple Day Hazard Outlook is a product intended to brief ATCSCC managers for potential staffing issues for the coming days. It summarizes potential weather impacts across the CONUS in the form of a graphical product with a number of colored hatched areas. An example of such an outlook is shown in Figure 13. The legend in Figure 13 shows the variety of impacts that could be forecasted for a particular day including, thunderstorms, IFR conditions, excessive winds, snow, and freezing participations. In the example shown in Figure 13, potentially impactful thunderstorms were forecast to impact the Northeast US on 22 August 2013. This experimental forecast, done 4 days in advance of this highly impactful day to air travel, verified very well. It is important to note that the outlook was produced at the discretion of the forecaster based on when they had time to complete this task. AWS issuance was a priority for the experiment.

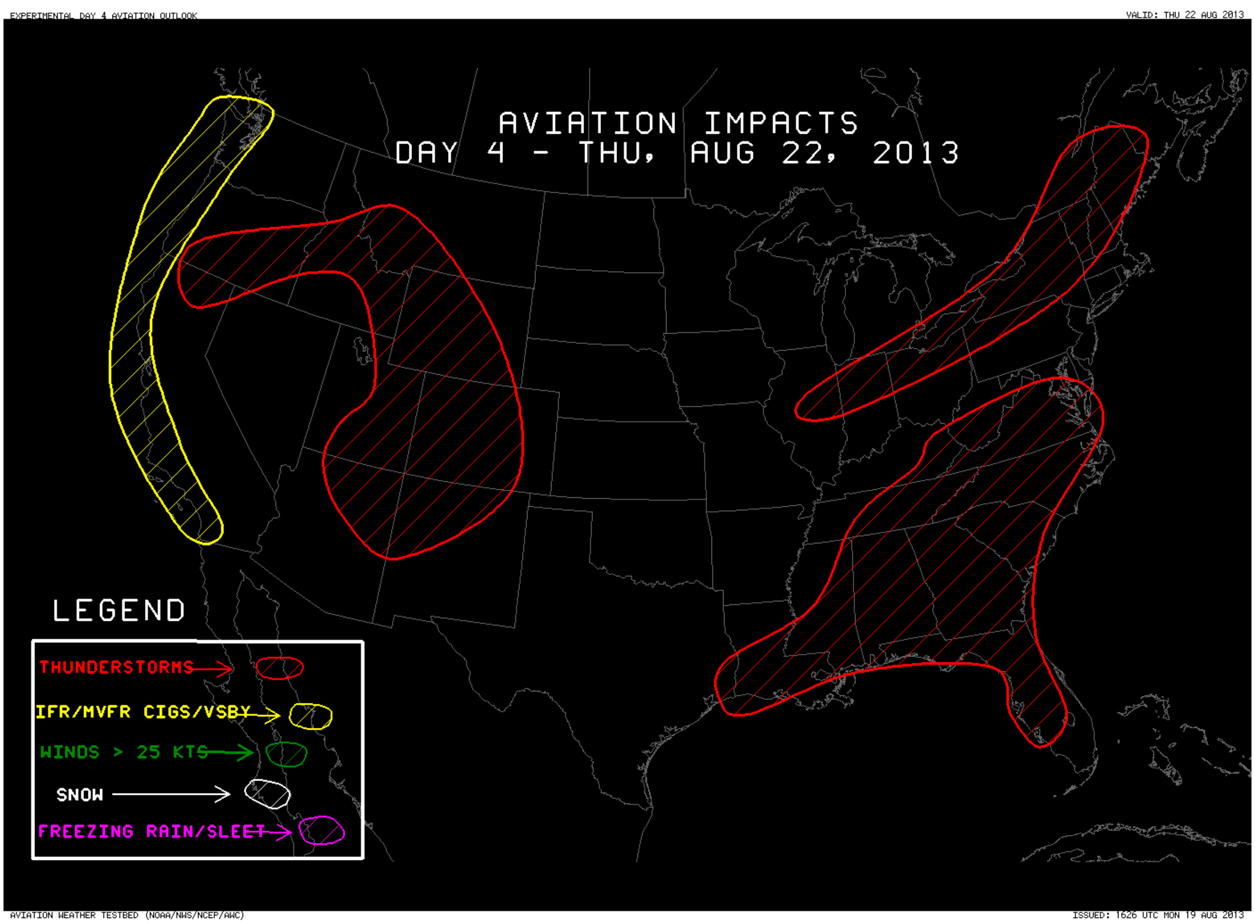


Figure 12. Day 4 outlook issued at the NAM desk for the significant thunderstorm impacts that would occur on 22 August 2013. The outlook is considered helpful for staff planning at the ATCSCC.

2.4.4 Product Generation Comments

The most valuable comments at the NAM desk came in the form of product generation comments. The GUI designed to create and publish the AWS to the web was far superior to that currently implemented at the ATCSCC. It was recommended that product generation for operational use should be designed similarly to that employed during the experiment. It is important to note that the design of the publish GUI allowed for the experimental NAM desk to issue operational AWSs during the impactful events of 22 August 2013.

2.5 Global Convection Forecast Desk

2.5.1 Desk Overview

The Global Convection Forecast Desk had the most straightforward product to issue during the experiment. The forecasters at this desk were there to provide a 24-hour forecast of convection using operational guidelines for locations greater than 20^0 south latitude. An example of the forecast (blue scalloped lines) with global lightning verification is shown in Figure 18. The Global Forecast desk is challenged by the lack of forecast data that has worldwide coverage. For the experiment, the Global Ensemble Forecast System and NCAR's Pacific Thunderstorm Probability product was made available in addition to the Global Forecast System (GFS) model and the European Center for Midrange Weather Forecasting (ECMWF) model that are currently available in operations. Some additional convective parameters were examined to see how they could help refine convective forecast areas. Figure 19 shows an example of a 36-hour forecast from NCAR's Ensemble Prediction of Oceanic Convective Hazards (EPOCH) product (Stone et al. 2013) with IR satellite overlaid for verification. EPOCH uses both GEFS data and the Meteorological Service of Canada's Canadian Model of Client-Centred Enablement (CMCE) ensemble product to produce a probabilistic convective forecast over the North Pacific Ocean. ENTLN was also provided for verification of previous forecasts as well as traditional satellite verification.

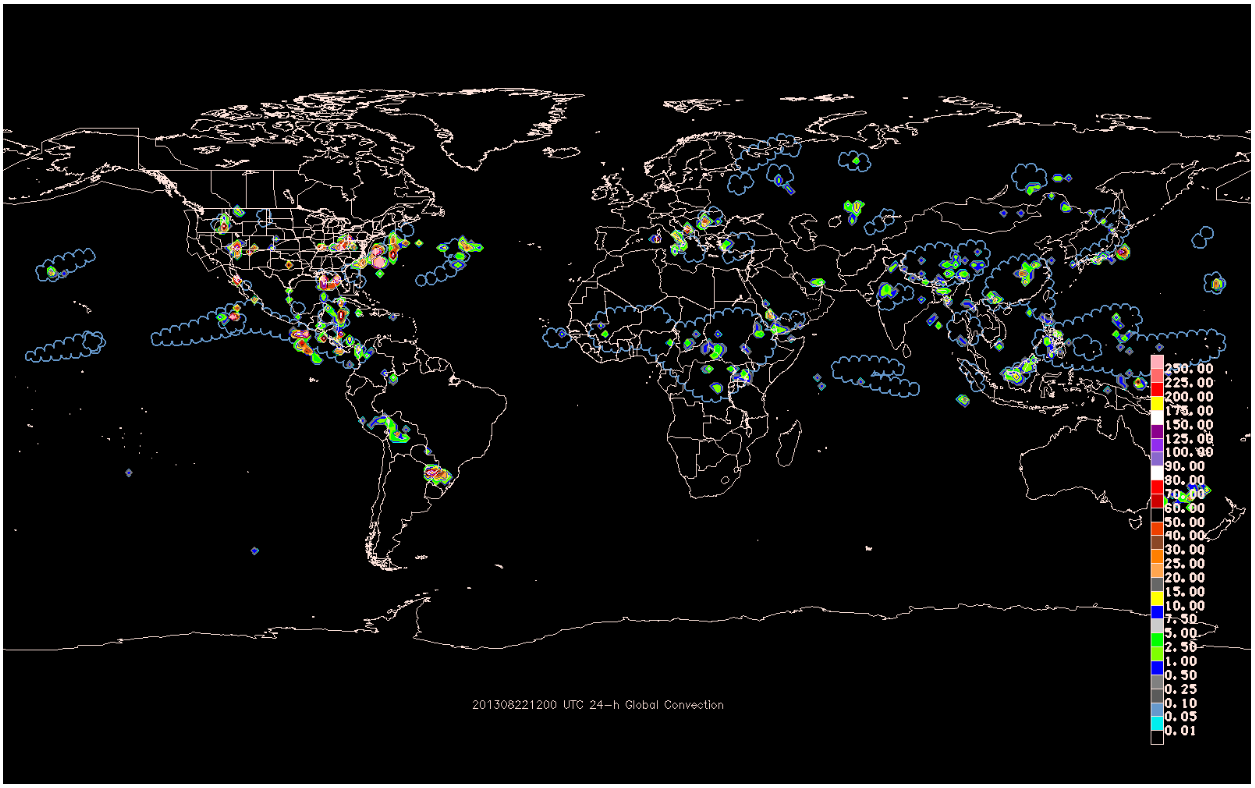


Figure 13. Verification image of a Global Convective forecast (blue scalloped lines) for areas above 20^0 S latitude. ENTLN density is displayed in units 10^{-5} strokes/km^2/min.

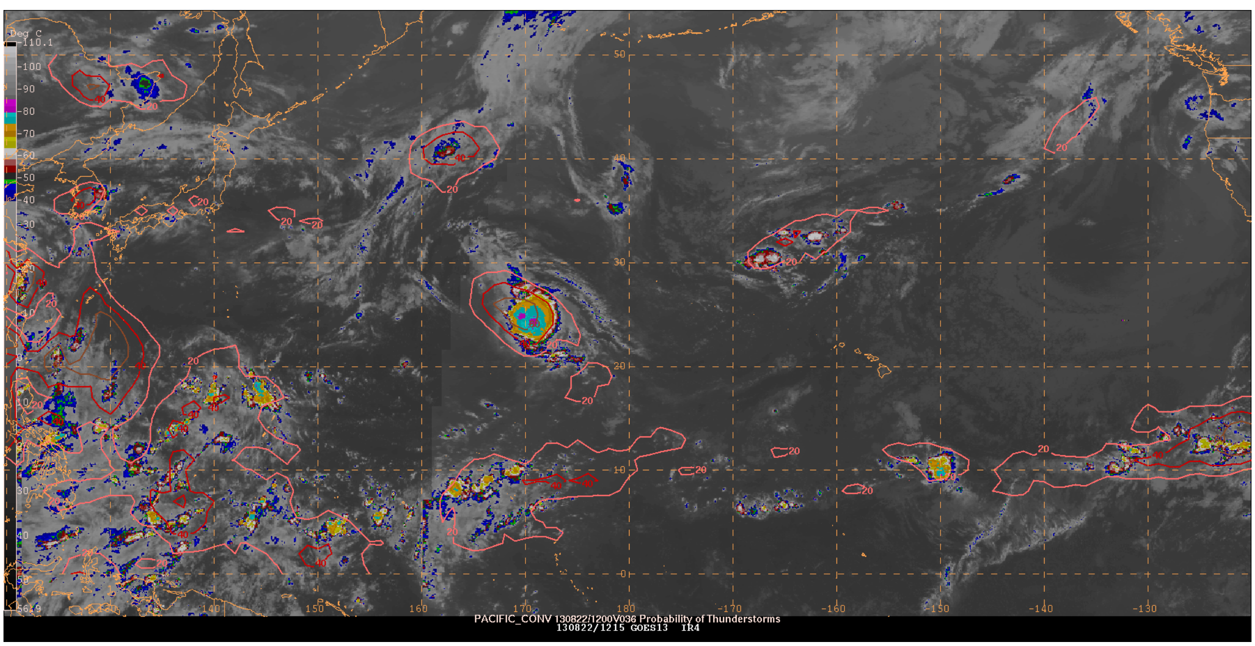


Figure 14. NCAR Pacific Convection Probability Product issued 21 August 2013 at 0000 UTC valid 22 August 2013 at 1200 UTC overlaid with an Infrared satellite mosaic valid 22 August 2013 at 1215 UTC.

3. Conclusions

The overall design of the experiment was to mimic the operational environment as much as possible and to allow the evaluation of new products and concepts seamlessly. This design was very similar to the 2013 Winter Experiment to maximize operational awareness while evaluating potentially valuable products for operational transitions. One drawback for a pseudo-operational experiment is that the weather may not always cooperate. This was buffered by having a number of external participants on hand to give daily seminars. On certain slow weather days, multiple seminars were given. The seminars that were given were interactive in nature and kept all participants engaged at a high level. In addition to the seminars, more interaction between external participants and AWC forecasters and staff was likely during a lull in the weather. This allowed for a greater understanding and appreciation of the processes that occur at AWC from external participants.

In order for success to be recognized at the AWC level, new products or techniques must find their way to the operations floor. After the 2013 Summer Experiment, a list of products were generated that could be effectively transitioned to the operational floor for continued evaluation by operational forecasters. This provides the first step in making a product officially operational.

Overall, the design and application of the 2013 Aviation Weather Testbed Summer Experiment was viewed as successful from both internal and external participants. Future experiment designs will leverage the successes of this year.

4. References

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