Aviation Weather Testbed

2012 Summer Experiment
GOES-R desk final evaluation

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The following report summarizes the Aviation Weather Center's 2012 Summer Experiment, specifically the details and highlights of the dedicated GOES-R desk; daily workflow, evaluated products, cases, and feedback. Additionally, a brief overview of future Research to Operations (R to O) efforts will be given.

1. Introduction and Overview

Unlike the previous year, the 2012 Summer Experiment at the Aviation Weather Center (AWC) included a desk dedicated to the demonstration and evaluation of a number of GOES-R products. This data was supplied by various research institutes including the Cooperative Institute for Meteorological Satellite Studies (CIMSS), the Cooperative Institute for Research in the Atmosphere (CIRA), NASA's Short-term Prediction Research and Transition Center (SPoRT), University of Alabama – Huntsville (UAH), and NASA's Langley Research Center (LaRC).

The star of the show this year was undoubtedly the traffic flow management (TFM) desk demonstration and experimental issuance of the Aviation Weather Statements (AWSs), and in that regard, the GOES-R desk was able to assist in this venture using the new satellite products. At the same time, those assigned to the desk, particularly the forecasters, were able to get a first glance at what GOES-R will have to offer. The comments and feedback gained from this initial exposure will provide vital information for the product developers as the launch data for the new satellite draws nearer.

a. Daily workflow

Daily workflow for the GOES-R desk was split into two main sections: a morning weather outlook, and afternoon nowcasting. After roughly thirty minutes of training, during which time the forecasters were provided with a brief overview of the GOES-R products to be demonstrated, the remaining hours of the morning were spent on a weather outlook. The participants were instructed to 'drive' the desk, using the tools they normally would in operations, as well as the GOES-R products, to forecast areas in which convective initiation (CI) was likely to occur over the U.S. Given the nature of the experiment, they were asked to key in on events that had the potential to cause constraints to more significant flight routes and centers.

Later in the afternoon (or earlier depending on the weather anticipated for the day), the desk transitioned into a more 'weather watch' frame of mind. During this time a number of GOES-R products, such as the CI and PGLM, were utilized in an effort to nowcast developing convection. Additionally, much collaboration was done with the TFM desks in order to aid them in updating or issuing AWS statements given the impending weather.

b. GOES-R product demos in N-AWIPS:

The amount of new satellite data available for the experiment was plentiful and included products from the GOES-R Baseline and Future Capabilities. The GOES-R Baseline products are those products that are funded for operational implementation as part of the ground segment base contract whereas Future Capabilities Products refer to a new capability made possible by ABI as option in the ground segment contract. Table 1 lists the GOES-R Baseline and Future Capabilities Products.

Baseline Products		Future Capabilities
Advanced Baseline Imager (ABI)	**Geostationary Lightning Mapper (GLM)**	**Advanced Baseline Imager (ABI)**
Aerosol Detection (Including Smoke and Dust) Aerosol Optical Depth (AOD) Clear Sky Masks Cloud and Moisture Imagery Cloud Optical Depth Cloud Particle Size Distribution Cloud Top Height Cloud Top Phase Cloud Top Pressure Cloud Top Temperature Derived Motion Winds Derived Stability Indices Downward Shortwave Radiation: Surface Fire/Hot Spot Characterization Hurricane Intensity Estimation Land Surface Temperature (Skin) Legacy Vertical Moisture Profile Legacy Vertical Temperature Profile Radiances Rainfall Rate/QPE Reflected Shortwave Radiation: TOA Sea Surface Temperature (Skin) Snow Cover Total Precipitable Water Volcanic Ash: Detection and Height	Lightning Detection: Events, Groups & Flashes **Space Environment In-Situ Suite (SEISS)** Energetic Heavy Ions Magnetospheric Electrons & Protons: Low Energy Magnetospheric Electrons: Med & High Energy Magnetospheric Protons: Med & High Energy Solar and Galactic Protons **Magnetometer (MAG)** Geomagnetic Field **Extreme Ultraviolet and X-ray Irradiance Suite (EXIS)** Solar Flux: EUV Solar Flux: X-ray Irradiance **Solar Ultraviolet Imager (SUVI)** Solar EUV Imagery	Absorbed Shortwave Radiation: Surface Aerosol Particle Size Aircraft Icing Threat Cloud Ice Water Path Cloud Layers/Heights Cloud Liquid Water Cloud Type Convective Initiation Currents Currents: Offshore Downward Longwave Radiation: Surface Enhanced "V"/Overshooting Top Detection Flood/Standing Water Ice Cover Low Cloud and Fog Ozone Total Probability of Rainfall Rainfall Potential Sea and Lake Ice: Age Sea and Lake Ice: Concentration Sea and Lake Ice: Motion Snow Depth (Over Plains) SO_2 Detection Surface Albedo Surface Emissivity Tropopause Folding Turbulence Prediction Upward Longwave Radiation: Surface Upward Longwave Radiation: TOA Vegetation Fraction: Green Vegetation Index Visibility

Table 1. GOES-R Baseline and Future Capabilities

There were eight new products slated to be demonstrated via N-AWIPS, including synthetic satellite imagery, a number convective initiation products, several lightning threat forecasts, and also a low cloud and fog probability tool. A brief description of each is detailed below:

1) SIMULATED CLOUD AND MOISTURE IMAGERY

Using several variables, synthetic satellite imagery is generated from the 0000 UTC NSSL WRF-ARW run and is available daily starting at 1200 UTC. While this is **only model data**, it allows the user to become familiar with the future satellite imagery of GOES-R. For the 2012 Summer Experiment, bands 8-16 were available, with a specific focus on bands 8-10 (high, mid, and low-level water vapor), and band 14 (traditional IR). Additionally, CIRA provided several band differences including a fog product, which discriminates low-level clouds from high-level clouds, and a low-level water vapor convergence band, which identifies areas of moisture convergence and/or pooling.

2) PSEUDO GEOSTATIONARY LIGHTNING MAPPER (PGLM)

Current lightning analysis products within AWC operations consist of Cloud to Ground (CG) strike threats. The PGLM uses the Lightning Mapper Array (LMA) to collect raw observations of total lightning, i.e. CG, Cloud to Cloud (CC), etc. to demonstrate another GOES-R baseline product. While this product is not a true proxy for the GLM, it was pulled into the experiment to expose the forecasters to GLM-type data in preparation for the real product, slated for launch with GOES-R.

3) WRF/HRRR LIGHTNING THREAT FORECAST

The Lightning Threat Forecast uses output, both dynamical and microphysical, from the high resolution convection runs of the HRRR and WRF models, and generates three quantitative forecast fields of lightning threats. Threat field 1 focuses the flux of graupel in the layer near -

15°C, i.e. the lightning threat within a convective core, and threat field 2is based on vertically integrated ice content within simulated storms. A composite threat, threat field three, is created by blending field 1 (95%) and field 2 (5%), and was the focus for this year's experiment.

4) UNIVERSITY OF WISCONSIN CIMSS NEARCASTING MODEL

The NearCasting model uses observations from the GOES-13 sounder water vapor channels in an effort to define areas most susceptible to convective initiation via areas of mid-level destabilization. It is a 9 hour forecast, using Rapid Update Cycle (RUC) winds to advect the sounder information forward in time. There are several outputs from this model including a vertical precipitable water difference, a vertical theta-e difference, and mid-level CAPE. For the 2012 experiment, the focus was on the mid-level CAPE.

5) UNIVERSITY OF WISCONSIN CIMSS CLOUD-TOP COOLING (CTC)

The UWCI CTC algorithm is used to examine vertical growth of immature convective clouds via GOES imagery. Specifically, it looks for rapid cooling of pixels within the infrared imagery, and also utilizes cloud phase information to identify the stage of growth of a cooling cloud (immature water cloud to completely glaciated cloud). Additionally, cloud optical depth was utilized recently to allow for detection of rapidly cooling pixels below a thin cirrus deck

6) UAH CONVECTIVE INITIATION SATCAST

The SATellite Convection Analysis and Tracking (SATCAST) algorithm is similar to the CTC produced by UW CIMSS as it does examine rapidly cooling pixels within infrared imagery. However, the SATCAST also utilizes information from the other available IR channels through a number of additional spectral tests which describe the convective environment. In the first stages of development this algorithm used a simple "yes/no" classification scheme. However, recently it has been upgraded to output a "Strength of Signal" (SOS), giving a score of 1-100 to each detected cloud object.

7) ENHANCED-V/OVERSHOOTING TOPS

As with the CTC algorithm, the Overshooting Top (OT) detection utilizes infrared imagery, but in this case it searches for small clusters of pixels that are significantly colder than those in the surrounding anvil cloud (with a diameter consistent with commonly observed OTs). The Enhanced-V, or Thermal Couple (TC), detection uses the OT detection and looks for clusters of anomalously warmer pixels that are adjacent to the identified OT, i.e. a thermal couplet. While a turbulence and lightning probability associated with these two algorithms are provided, the summer experiment focused only on the OT and TC detections.

8) FOG AND LOW STRATUS

The GOES-R fog and low stratus (FLS) detection products use satellite and NWP model data, as well as ceilometer observations, to produce quantitative probabilities of Instrument Flight Rules (IFR) for each cloud pixel. Unlike the current legacy products, the low cloud/fog detection is available both during the day and night, and contains Cloud Thickness and Cloud Phase algorithms, along with IFR and LIFR probabilities. Given the focus on convection for this year's experiment, this product wasn't frequently viewed; however, the forecasters were able to utilize it a number of times, particularly for West Coast fog situations.

2. The "meat" of the Experiment:

Throughout the two weeks of experiment various records were kept and cases collected via personal notes, screen captures, and blog posts. Additionally, much forecaster feedback was compiled through both verbal discussion as well as a series of survey questions. Given the large amount of information, the highlights of each of the GOES-R products are summarized below.

a. Simulated Cloud and Moisture Imagery

1) WAVE CLOUD TURBULENCE OVER THE CENTRAL U.S.

On the morning of 15 June 2012, both the water vapor and IR imagery showed a broad area of transverse wave activity along the eastern edge of the cirrus shield associated with a dissipating Mesoscale Convective System (MCS) in the Central U.S (Figure 1). These wave clouds caused a fairly significant number of moderate turbulence reports at cruising altitude (~FL300 – FL350) from various large commercial aircraft, including several 737s, and A320, and a DC10.

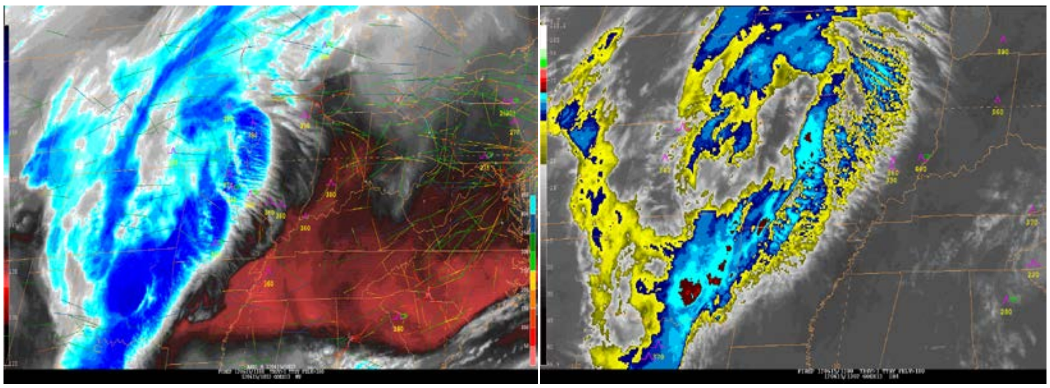

Figure 1. Water vapor (left) and IR (right) imagery from the morning of 15 June 2012.

The forecast runs of the WRF simulated water vapor (band 8) and traditional IR (band 14) for the same time period, while advancing the convection slightly too far east, did pick up on this wave activity (Figure 2). Not only did this case show the potential situational awareness utility of the synthetic imagery in picking up turbulence features, it also was a great example of just how similar the model imagery, particularly the IR, is to the real time GOES data. In fact, when the synthetic imagery was first displayed a number of forecasters believed it was the actual satellite imagery!

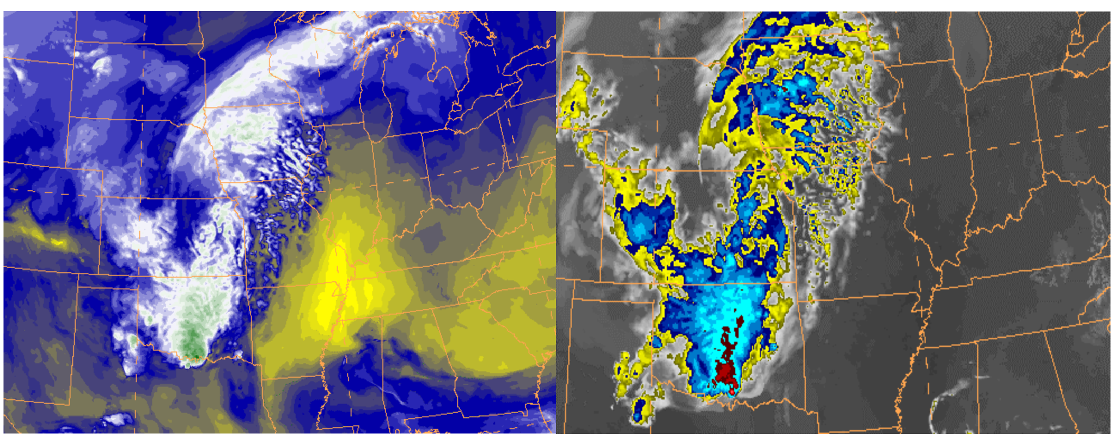

Figure 2. WRF-ABI Water Vapor (left) and IR (right) imagery on the morning of 15 June 2012.

2) "PHANTOM MCS" OVER OKLAHOMA

One of the main setbacks the forecasters noted with the synthetic imagery was just that; it is synthetic, simulated model data, and as such is only as good as the model run itself. At times the model will do very well in simulating various cloud features (noted in the above example of wave cloud turbulence), but there are also times in which it struggles.

An example of one of these times was found on 14 June 2012. The WRF simulated IR imagery, shown in Figure 3 below, was indicating MCS development over northern Texas and Oklahoma, and subsequent growth as the day progressed. However, the real time imagery from the same time periods showed no such development; in fact, there was nothing of note at all. Again, this is model imagery, and what will be launched with GOES-R will be real time. As such, the drawback here is relatively minor.

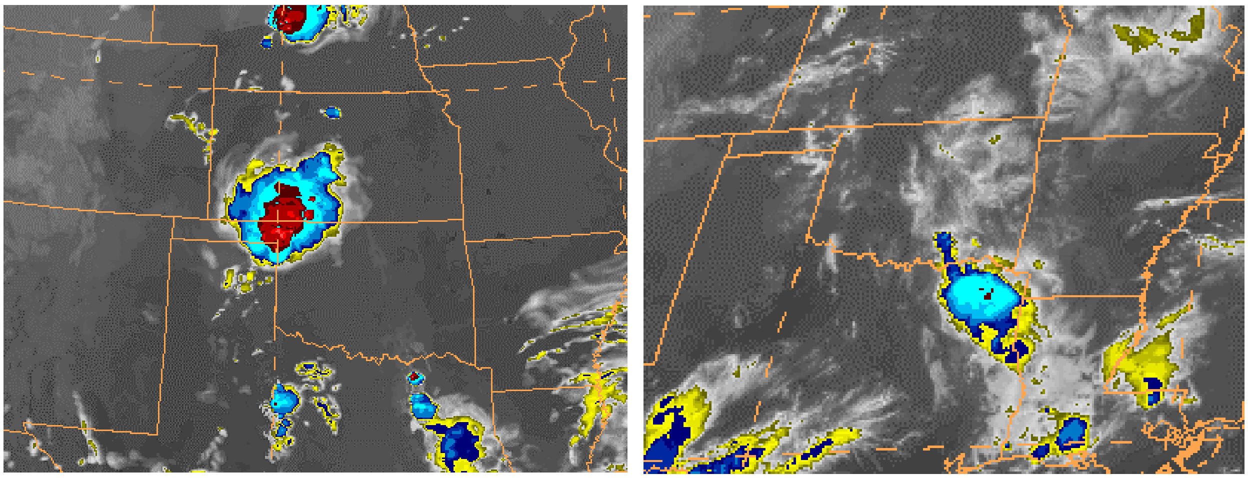

Figure 1. IR (left) vs. WRF IR (right) imagery for1300 UTC on 14 June 2012.

b. PGLM

The Pseudo Geostationary Lightning Mapper (PGLM) product was a relatively late addition to the summer experiment, resulting in some growing pains to bring this new product into the N-AWIPS environment. Producing the PGLM in an N-AWIPS friendly format resulted in an initial delay in receiving the product at the start of the experiment. Once these issues were dealt with, the PGLM was then available in near-real time for the forecasters in a mosaic format using all data from the Kennedy Space Center, North Alabama, Oklahoma, and Washington D.C. networks. An unrelated issue occurred when a power outage shut down the computer transferring the finished PGLM product to the Aviation Weather Center. Although these technical issues limited the number of events that could be observed, forecasters provided feedback on visualization improvements, such as an enhanced color curve, and focused on one of the very good examples with the PGLM described below.

On 14 June 2012, typical summertime scattered convection developed over the Gulf of Mexico and the Florida Peninsula early in the afternoon. At 1707 UTC one particular cluster of cells developed just north of Orlando Center. The current lightning threat, which detects Cloud to Ground (CG) strikes only, was noting the highest occurrence of lightning strikes within the core of the convection. As such, air traffic was diverted on a route between these cells (Figure 4).

At the same time, the PGLM, which detects total lightning (both CG and Cloud to Cloud (CC), was actually showing the highest electric threat in the direct path of the divert routes (Figure 5). This was very good example of how areas devoid of CG lightning strikes may still be electrically dangerous and how the anticipated GLM can be utilized. Particularly, this has great potential for traffic flow management and safety of aviation operations, as a lightning strike can badly damage and even disable an aircraft.

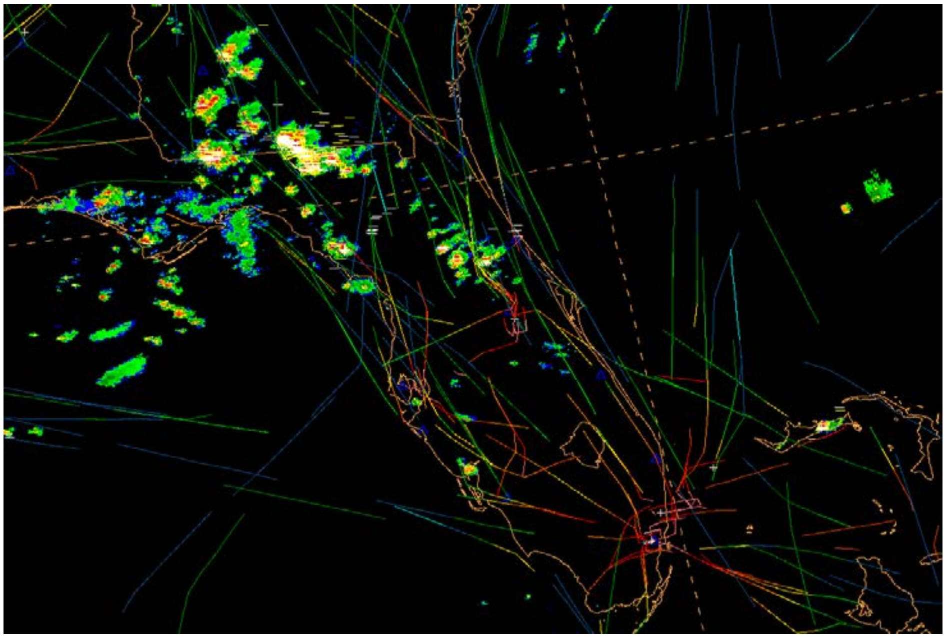

Figure 4. 120614 1707 UTC base reflectivity, CG lightning strikes, and ASDI flight routes.

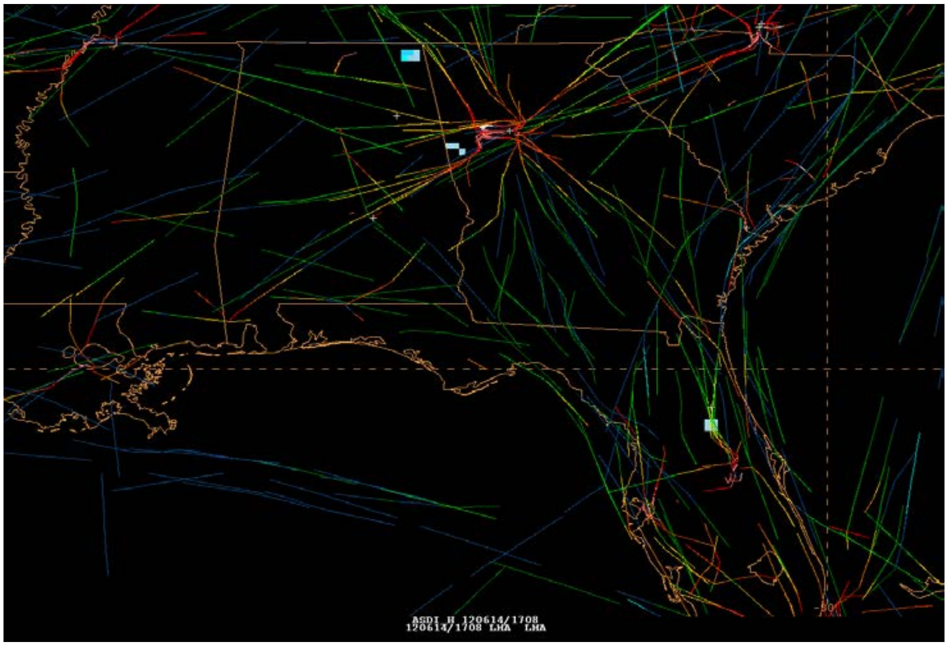

Figure 5. 120614 1708 UTC PLGM total lightning and ASDI flight routes

c. WRF/HRRR Lightning Threat and Forecast

1) SITUATION AWARENESS ADVANTAGE

The WRF and HRRR Lightning Threat Forecast is a model-based method of determining quantitative forecasts of lightning threats. For the summer experiment we focused on the composite threat, threat 3, and though a number of bugs prevented us from utilizing this product for a number of days, we received some positive response when it was available. The general opinion of the forecasters was that the product was a good situational awareness tool in forecasting CI. It can be used to not only highlight areas of potential CI, but also areas for which the potential of lightning is the greatest.

One particular example of this was found on 7 June 2012 in association with an anticipated line of storms in the Northeast. The lightning threat forecast indicated the potential area of CI where the squall line did develop, and the highest noted lightning threats did correspond relatively well with the strongest radar echoes. Again, it was noted to be a good situational awareness tool.

2) Bugs and struggles

As mentioned, there were several bugs associated with this product, one of the most significant associated with the order of magnitude. The lightning threat would display correctly in the first several frames, but then spontaneously increase in magnitude by an order of about 10 through another frame. The developers were notified of this issue and a fix is currently in the works.

Aside from the bugs, there were also some areas of struggle, one of which was in the percentage split of the threat 3 composite. In the same case noted above (7 June 2012), the threat 3 was showing a number of scattered lightning detections associated with the stratiform precipitation in the Northeast. Looking just at the lightning threat forecast one would assume that there was much more intense convection going on than plausible given the stratiform environment.

One forecaster hypothesized that this may be due to the way in which the composite is made; i.e., the forecaster knew there were no convective cores associated with the ongoing stratiform precipitation, which is where threat 1 comes from, and as such postulated that these marginal threats were all due to threat 2. The developers are also aware of this issue and working to correct it.

d. NearCasting Model

1) Low-Topped Convection in Pennsylvania

The NearCasting model was developed in an effort to forecast for mid-level instability. However, in this particular case the mid-level stability was utilized. Given the atmosphere conditions in the Northeast on the morning of 7 June 2012, there was a likelihood of developing scattered convection, particularly in Pennsylvania (Figure 6). The NearCasting model, though, was indicating some mid-level stability in the same area. After some time of discussion it was still believed that scattered convection would develop, but the mid-level instability would inhibit growth, resulting in storms of the low-topped nature. Later that afternoon there was, in fact, shallow topped convection scattered in a broad area over PA and parts of the Northeast.

Being able to identify potential areas of convective initiation was definitely a plus for the AWC forecasters. Convection is the single biggest cause of traffic constrains and ground stops to the various centers, and as such, being able to predict this unfavorable weather is vital. One individual summed up what seemed to be the common opinion of this tool:

> "The product was VERY useful in terms of assessing where the atmosphere would be most favorable for convection should there be a trigger and/or broad-scale lift support."

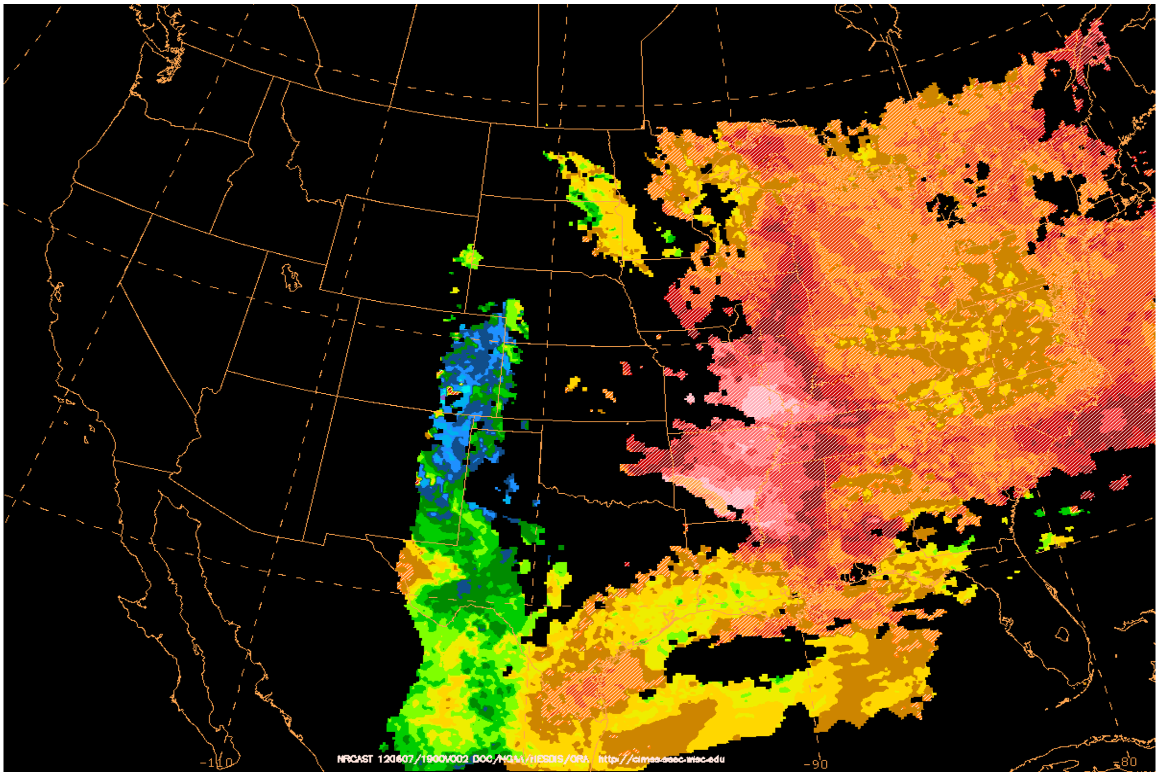

Figure 6. 120607 1900V002 NearCasting run

2) BOW ECHO IN THE CENTRAL U.S

Another utilization of this tool came in the examination of a potentially unstable environment ahead of ongoing convection. Very early on 11 June 2012, a line storms formed just west of the Kansas City, MO, area and moved east into the Central U.S. Throughout the morning the NearCasting model forecasts consistently showed an area of significant mid-level instability ahead of this convection, indicating the likelihood of further development. As the afternoon progressed the squall line did strengthen into an intense bow echo that resulted in a broad area of severe weather reports as well as significant air traffic constrains to centers such as St. Louis and Memphis.

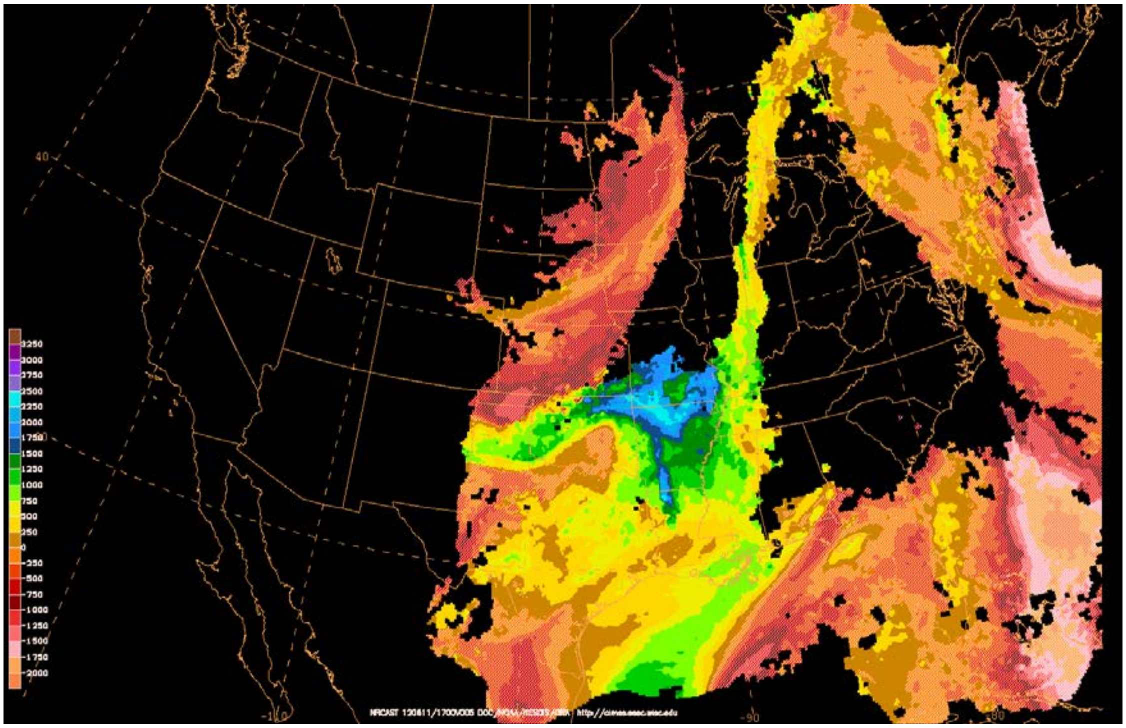

Figure 7. 120611 1700V002 NearCasting run

There were a number of forecasters who were pleased to discover this utility. As the product was originally developed to identify mid-level instability, particularly in areas where convective initiation in likely to occur, finding that it is also useable for areas of ongoing convection was a big plus.

To this same effect, it was pointed out that this utility of the NearCasting model may also be very helpful in data sparse areas.

> “It may aid in evaluating the evolution of mid-level instability in data void areas and between radiosonde launches in both space and time.”

In evaluating conditions for convective and possible severe weather, forecasters rely heavily on current observations to gauge the evolution of approaching weather systems. However, some areas, such as the higher terrain of the West, the less populated areas of the central and northern Plains, and various coastal areas, have little in the way of observing systems. Additionally, because radiosonde launches occur only twice a day, keeping track of observed instability can be rather difficult. The NearCasting model may be able to aid in filling in some of these temporal and spatial gaps.

e. UWCI Cloud Top Cooling

1) FORT WORTH CENTER CONVECTION

On 6 June 2012, a dying MCV was located in northern Texas, its center rotating almost directly over Amarillo. Throughout the day it was forecast to slowly move east and set off convection within the “toes” of its chicken foot feature. This convection was of particular concern to forecasters as it had a high likelihood of impinging on Forth Worth Center’s airspace.

Just after 1800 UTC, the CTC algorithm began to show scattered detections just north of the center. Shortly thereafter rapid convective development occurred and eventually intensified into a broad squall line that significantly impacted air traffic in and around Forth Worth Center.

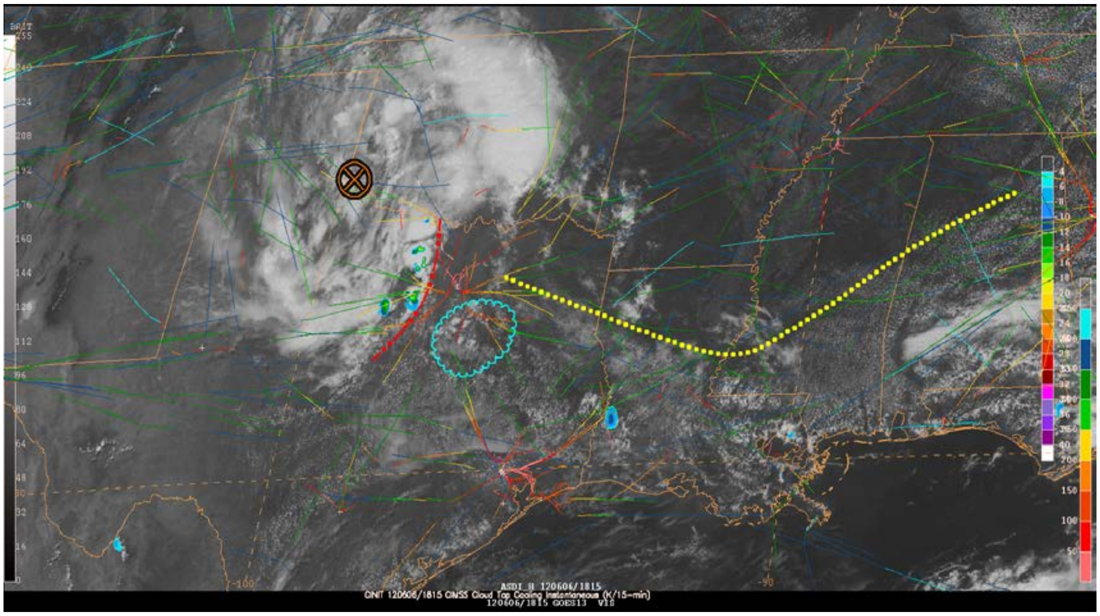

Figure 8. 120606 1815 UTC Cloud Top Cooling near Fort Worth Center.

In this case there was much discussion of the use of the CTC algorithm as a situational awareness tool. Many of the forecasters shared the opinion that, while typically radar echoes are already appearing on radar by the time the detection is noted, this product could be very useful in identifying which cell will intensify the quickest. In regards to traffic flow management, it was noted that this could provide additional lead time for air traffic controllers as they work to divert various aircraft in and out of centers, as well as around convective cells.

However, one forecaster made sure to stress the situational awareness only utility of this product; i.e. that the product shouldn't be used by itself.

> "It provides excellent situational awareness, however for the undertrained and under experienced met it could have been over detecting cloud growth prior to CI. **Therefore it's important to know the environment and not just take the detections verbatim."**

Instead, this product should be used as an additional tool in which to consult and gain confidence when forecasting for convective initiation. In particular, it was noted that it would be an excellent additional to the arsenal utilized for the Convective SIGMET (CSIG) desk, especially when deciding when to pick up or not pick up a certain area of developing convection.

There was also a significant amount of discussion on lead times, and the overall consensus was that while there is a utility in the CTC algorithm for lead times, it is also a struggle to try and quantify. Yes, the algorithm does in fact provide some lead time, particularly for robust development. However, given the varying environments in which CI can occur it is difficult to say with certainty how much lead time there will be.

2) PA CONVECTION: LACK OF DETECTIONS

It was the overall opinion of forecasters that the Cloud Top Cooling Algorithm provides excellent situational awareness when diagnosing convective development within a cumulus field. However, there was one notable weakness, associated with the strict constraints placed on the algorithm. The product was developed to only detect the most robust development, subsequently lowering the number of false alarms. However, in using more stringent constraints, it was noted in several cases that shallow, low-topped convection was not detected.

One such example was seen on 7 June 2012. The forecast from the GOES-R desk called for the slow development of convection with the Northeast, specifically in PA and given the mid-level stability indicated by both the NearCasting Model and a number of soundings, it looked as if it would be fairly low-topped. In fact, this did turn out to be the case (with the highest tops at FL200), and there were no noted CTC detections despite the obvious development occurring both on visible satellite and radar (Figure 9).

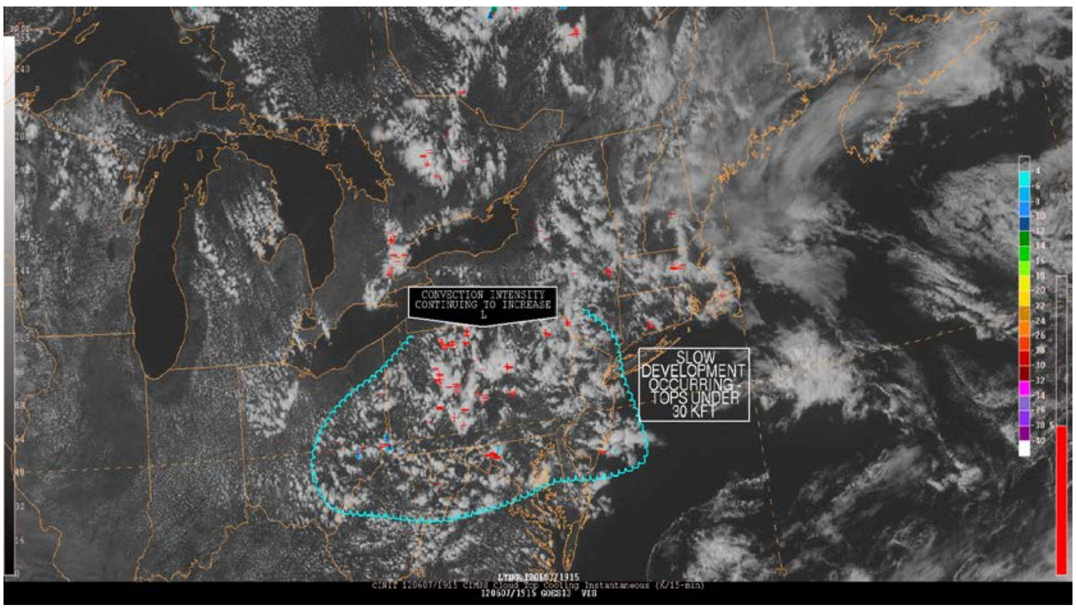

Figure 9. 120608 1915 UTC Cloud Top Cooling over the Northeast

Again, the issue here is likely the stringent constraints on the algorithm. As the development in this case was rather slow, the cooling in the IR imagery wouldn't have been significant enough to set off a detection. Additionally, it was also noted by a participant that the cloud tops were -20°C, i.e. not completely glaciated, and since the CTC algorithms looks for a cloud which develops from immature water to completely glaciated, these partially glaciated tops may also have caused the cells to escape detection. In the case of traffic flow, one forecaster noted that these low-topped convection situations were relatively common, particularly in the Northeast. As such, it may be prudent to investigate this further.

However, in this regard, it is important to note that the original design of the CTC was to diagnose cooling rates for more robust convection. This algorithm has certainly been shown to provide some useful information for aviation forecasting in its current form, but research into an aviation-focused version of this algorithm, one that will target a wider variety of convection such as low topped or slower developing convection, may be warranted.

f. UAH SATCAST

1) SUCCESSFUL DETECTIONS IN TEXAS

Similar to the UWCI CTC algorithm, the UAH SATCAST identifies significant cooling of pixels in the IR imagery. Additionally, it uses a number of additional IR spectral tests to analyze the environment in which CI is occurring, giving a Strength of Signal (SOS) of CI within a cumulus field. Being able to see the likelihood of convection within a broad cumulus field was noted as one of the big advantages of this product, as it could be used a situational awareness tool for determining where convective initiation will first occur within the field.

One particular case of this success was on 12 June 2012 over north central Texas. As a dissipating MCV edged east along the TX/OK border, convection was anticipated in the “toes” of the feature. At 1515 UTC, the SATCAST showed several higher SOS detections within a broad cumulus field (indicated in the red). Both of these positive detections were successful as rapid development was noted several scans later.

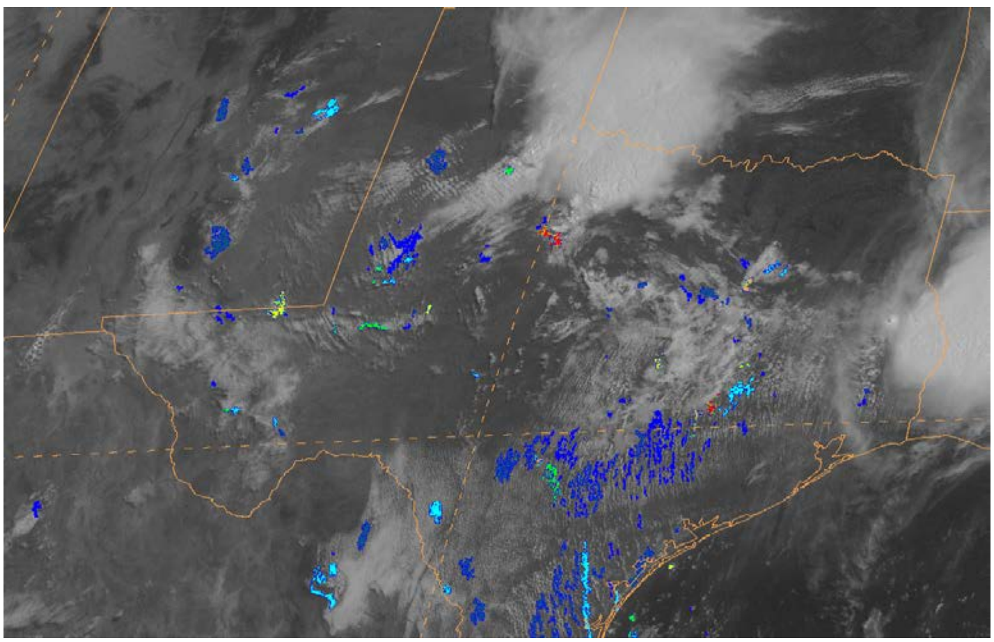

Figure 10. 120612 1515 UTC SATCAST over Texas.

2) FALSE ALARM CASE IN TEXAS

While the SATCAST showed a great amount of potential, particularly in the broad cumulus fields, many forecasters noted that as a relatively new product, it could benefit from some additional development. One particular participant suggested an area of improvement was in the “noise” of the algorithm; i.e. the large number of false alarms. While the constraints on the algorithm are purposefully relaxed, many forecasters commented that it was “the noise was overwhelming” and that “given the high false alarm rate, it is difficult to trust”.

One interesting case of this false alarm issue was found later in the afternoon of 12 June 2012. The MCV continued to meander east, leaving an area of wave cloud activity associated with the stable air behind the system (Figure 11) at 1815 UTC. Given the situation, these clouds were obviously not convective in natures, but the SATCAST noted some rather significant detections. The forecasters postulated that perhaps this occurred because the algorithm was simply picking up on a growing cloud feature. As such, it was suggested that more focus should be put on the environmental factor of the algorithm

> "If the probabilities were calibrated in tandem with environmental information… it could help identify areas of possible convective initiation."

Quite a bit of in depth discussion occurred on this point, both with the SATCAST and the CTC algorithm. The forecasters were very curious to know how much consideration goes towards the environment in which CI is occurring. For example, if there are two CI detections within a cloud field that develop into convective cells, but additionally eight other cells develop, what makes the two detected cells different than the other eight? How do their characteristics compare? Is it simply a question of cooling pixels? Or are the algorithms also relying on the environmental factors as well? Essentially they wanted to know, "What do those blips really mean?"

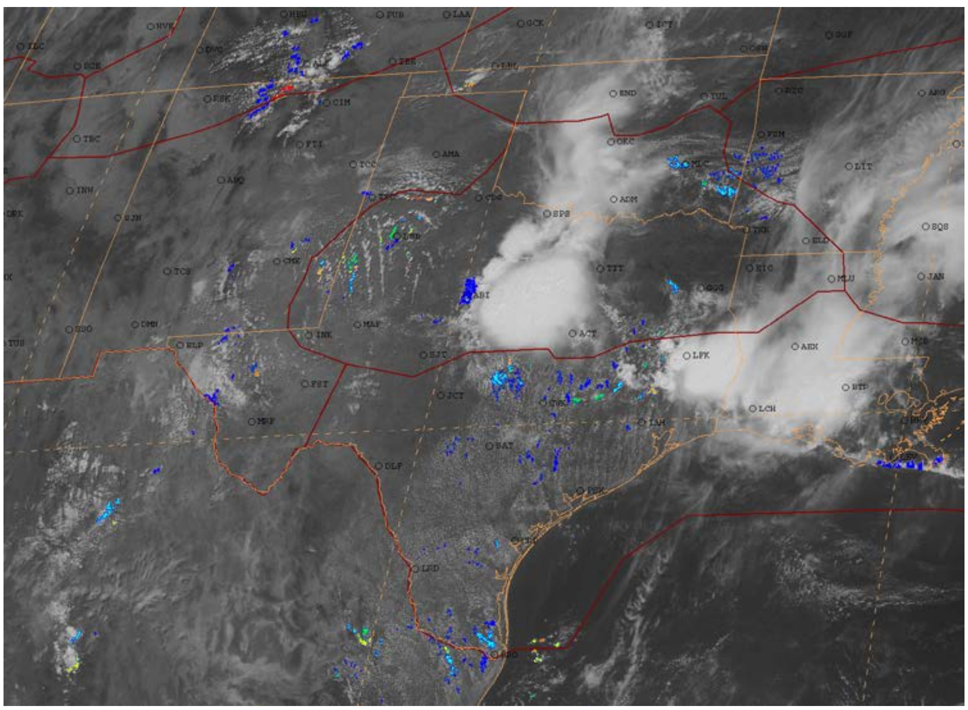

Figure 11. 120612 1815 UTC SATCAST over Texas.

g. Enhanced-V/Overshooting Top

1) UTILITY OVER RADAR SPARSE AREAS

The utility of the Enhanced-V/Thermal Couplet (TC) and Overshooting Top (OT) detections was a much debated topic throughout the two weeks of the summer experiment. One common question was, "What can we get from this that we don't already see on radar, particularly in the case of traffic flow management?"

One answer to this is radar sparse areas. As mentioned above with in the discussion of the NearCasting model, there are areas in CONUS in which radar coverage is limited. Offshore locations are also problematic, as the seas stretch far beyond the range of coastal radar coverage.

In these cases the algorithms may assist in situational awareness where radar returns aren't available, particularly in identifying the most intense areas of convection.

An example of this was noted on 5 June 2012 with an area of intense thunderstorms in the southern Gulf of Mexico. While this convection was not affecting any land, it was in the direct path of several of the Gulf flight routes and also beyond radar coverage. Taking note of the OT detections in a situation like this may aid traffic flow managers in diverting routes around the most intense convective cores.

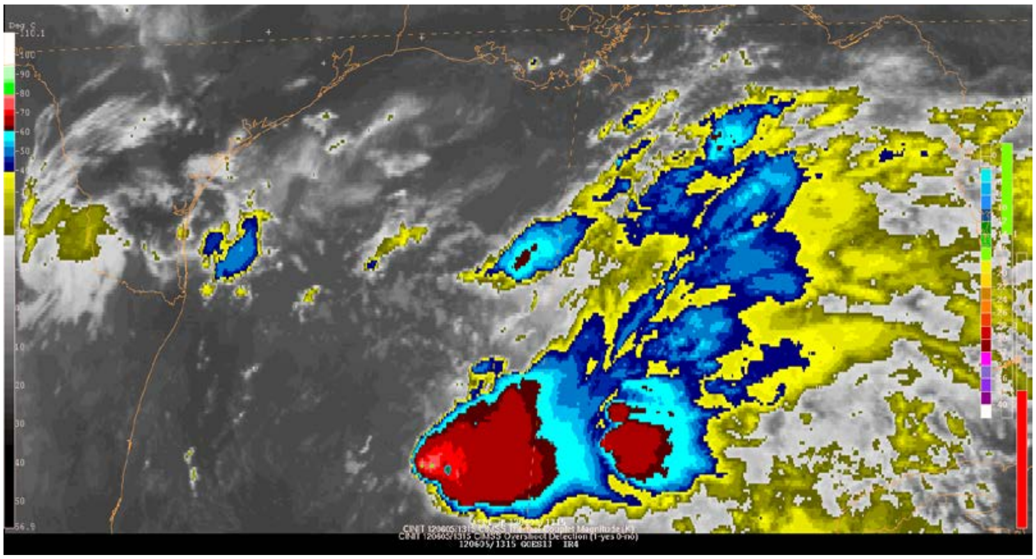

Figure 22. 120605 1315 UTC IR and Overshooting Top (IR) imagery.

2) TURBULENCE UTILITY

A second answer to the question of utility, turbulence, was noted by a participant from the FAA, also a retired air traffic operations manager from Delta Airlines. Traffic flow management is an elaborate and complicated test of efficiency; trying to keep a large number of aircraft moving from place to place without compromising the safety of the pilots and flight crews, particularly in the face of impending weather. In the end, it is the operations managers giving their pilots the go or no go when it comes to both climbing over convection, as well as flying the gaps through it.

For this reason, the OT algorithm may have some usefulness. Generally it can be assumed that there is a high likelihood of moderate or greater turbulence associated with an OT, given the more intense updraft. As such, knowing which cell within a group of cells, or which portion of a squall line contained a OT would give the traffic flow managers an idea of which areas to direct traffic around or over, especially in cases where radar returns don't look particularly intense.

A good example of this occurred on 11 June 2012 near St. Louis Center. As a broad area of convection moved eastward through MO, it slowly began to develop into a squall line. At 1432 UTC there were still a number of gaps within the storms, through which many flights were diverting. Over one particular area of convection, which looked relatively docile on radar, a larger commercial aircraft encountered moderate turbulence. At generally this same time there was an OT detection in the direct vicinity (Figure 13).

Our FAA participant on this afternoon noted that while this was a good case, it would have even more utility when used in conjunction with cloud height information. As planes will generally try and fly over convection until safety prevents it, knowing the height of the cloud top is vital. Yes, an OT indicates a more intense updraft, but at what height is the OT? And how high is it reaching? Having this additional quantitative information, the FAA participant said, would greatly aid in the utility of the OT detection for aviation operations.

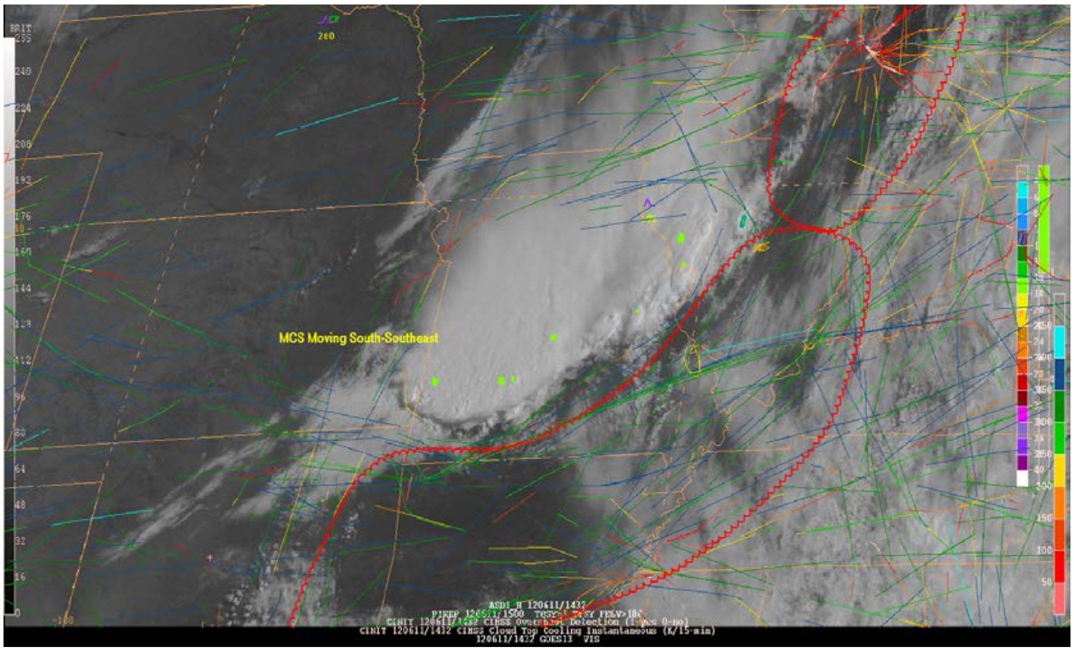

Figure 33. 120611 1432 UTC Overshooting Top (OT) detection and visible imagery over St. Louis Center.

h. Fog and Low Stratus

1) WEST COAST FOG

While this product was noted to have utility for both east and west coast fog, several forecasters from the FA desk at the AWC, which is responsible for issuing AIRMETs for low ceilings, expressed that this product will be extremely useful in West Coast fog situations, especially given the limitations (no day time availability) of the current products being used. An example of this utility, particularly with the IFR probability portion of the product, was noted on 13 June 2012. The CIRA fog WRF forecast for the morning was indicating West Coast fog to remain an issue until about 1700 UTC when it began to lift (Figure 14). Both the LIFR and IFR probabilities of the Low Cloud indicated them to remain until shortly after 1800 UTC, and did a very good job of forecasting these low ceilings as the fog did not in fact recede until shortly before 1800 UTC (Figure 15).

The feedback from this product was very positive all around. However, there was one suggestion for improvement that a majority of the forecasters brought up. While they appreciated the IFR and LIFR differentiation, this also expressed a need for and MVFR probability, allowing for a differentiation between that and IFR.

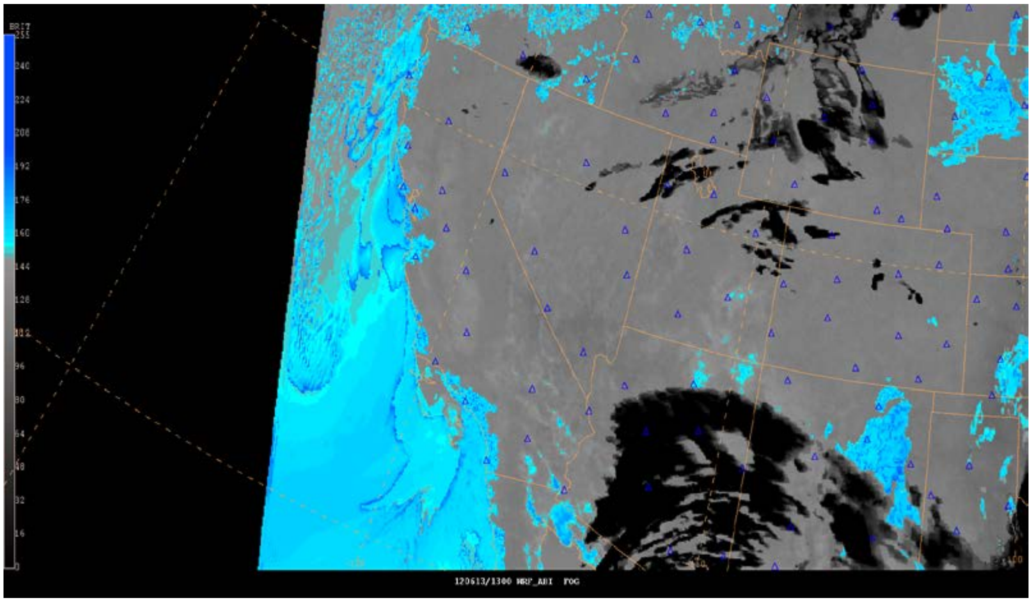

Figure 44. 120613 1300 UTC CIRA WRF fog forecast

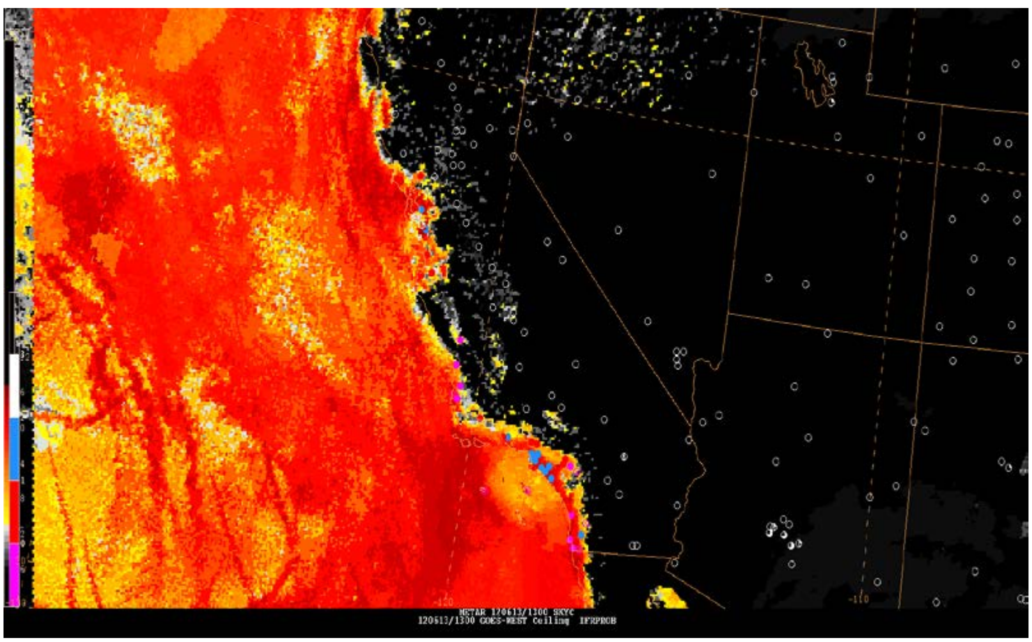

Figure 55. 120613 1300 UTC CIMSS IFR Probability

2) CLOUD PHASE UTILITY

As the suite of products associated with the Low Cloud and Fog were meant to be utilized for the detection and forecasting of low ceilings, the IFR and LIFR probabilities clearly displayed the most significant potential. However, there was also a utility discovered for the Cloud Phase (CPHASE) product.

At 1755 UTC on 8 June 2012, a DH-8 commercial prop plane reported moderate to severe icing in an area of agitated cumulus in one of our areas of interest for convective initiation. For this same time period, the CPHASE was showing a small, persistent area of supercooled cloud tops (Figure 16).

While surface dewpoints were only in the 40s to low 50s, a sounding taken at 1200 UTC that morning in Pittsburgh showed fairly moist and below freezing mid-levels between about 10,000 and 15,000 ft (~3 to 4 km). Additionally, cloud tops in this area, as tracked via the IR image at 1745 and 1815 UTC, were noted to be only around 17,000 ft. The lift associated with these developing shallow topped cells (while not noted in the 12Z sounding because it was still pretty early), along with this mid-level moisture would definitely allow for the formation of supercooled water droplets as the CPHASE indicated, and supported the icing PIREP.

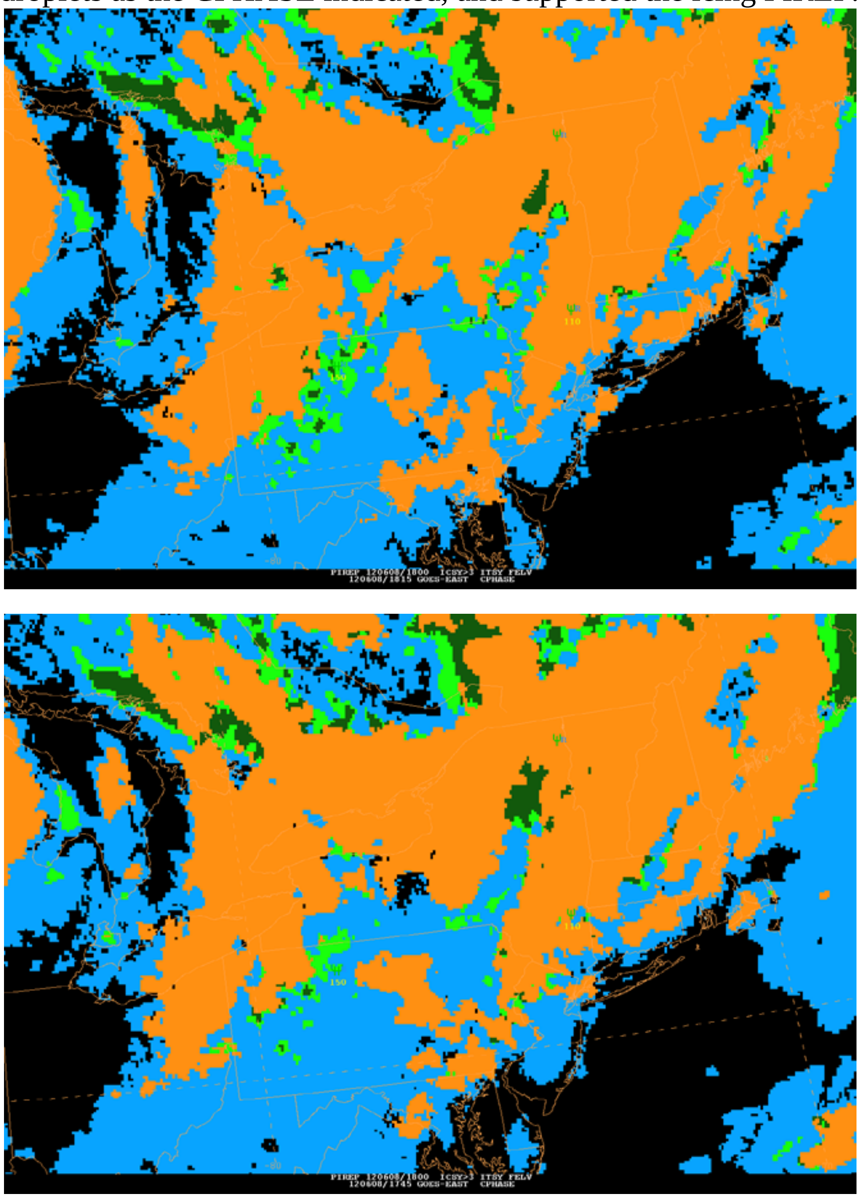

Figure 76. 120613 1300 UTC CIMSS IFR Probability

Could this product potentially assist in the forecasting of icing? It is possible. However, it is important to also note that the CPHASE product is cloud top phase. In this case the shallow topped convection and only partially glaciated cloud tops allowed for the detection of the supercooled droplets. However, in an area with more robust and deeper convection, the completely glaciated cloud tops would overshadow the supercooled droplets below, and hence limit the utility.

3. Conclusion

As mentioned previously, the products evaluated during the summer experiment included both Baseline products and Future Capabilities (Table 1). The Research to Operations effort at each GOES-R Proving Ground, including the AWC, focuses first on the transition of the Baseline products into operations, while keeping the Future Capabilities in mind for further evaluation if a viable route into operations can be found. In regards to the AWC, there are a number of baseline products for which a transition into operations is anticipated.

The Fog and Low Stratus products have been pushed into AWC operations and training is currently underway. Continual evaluation of the product will occur for the remainder of the year. In addition, there has also been much interest among forecasters for the PGLM lightning data, and a slow track into operations is anticipated for this product. With the help of the developers from SPoRT we continue to improve the lightning data and several individuals have been tasked with a continual evaluation of the product through the coming months. If the product continues to perform well, as it has thus far, it will be transitioned into operations in the near future.

While these baseline products are the main focus of the Proving Ground, there are also number of Future Capabilities products which are being further evaluated at the AWC. The UWCI products are not currently slated for transition into operations, but given the interest shown by forecasters there has been much discussion about implementing these products, particularly the UW Cloud Top Cooling, for further examination as “experimental” products. There have been many requests for the CTC, both at the AWC and elsewhere, and slow progress has been made towards this effort.

The NearCasting Model has also showed a lot of promise given the forecaster feedback, but along with the UAH SATCAST and the WRF/HRR lightning threat, a viable path into operations has not been found as of yet. However, these products will continue to be improved upon and evaluated, and will be available for possible future ingestion into operations.

While there was a large amount of data evaluated in the summer experiment, as noted above with the long list of products, the participants seemed to respond very well, and this is in part due to the training efforts being put forth by the developers. Much time has been dedicated to the creation and distribution of various training materials. Given the limited time available for training during each morning of the experiment we were not able to focus on some of the more in depth details of each products as we would have like, but the brief summaries provided were very well received by participants. As these products are pushed to operations these training materials will become a vital part of the transition process.

As is commonly said in this line of work, “feedback is feedback, good or bad,” and in that regard the dedicated GOES-R desk at the Aviation Weather Center’s summer experiment was very much a success. We were very pleased with the myriad of comments we received, and with the in depth discussions that occurred at the GOES-R desk as well as with the other desks. Despite the unfamiliarity of the new products, our participants showed a willingness to learn and explore, and gave an overall positive response to the experience.

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