THE EXPERIMENTAL WARNING PROGRAM

2017 EXPERIMENT SUMMARY

NOAA Hazardous Weather Testbed, Norman, OK

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1. INTRODUCTION

The Hazardous Weather Testbed (HWT) is a joint project of the National Weather Service (NWS) and the National Severe Storms Laboratory (NSSL). The HWT provides a conceptual framework and a physical space to foster collaboration between research and operations to test and evaluate emerging technologies and science for NWS operations. The HWT emerged from the “Spring Program” which, for more than a decade, has been used to test and evaluate new forecast models, techniques, and products to support NWS Storm Prediction Center (SPC) forecast operations. Now, the HWT consists of two primary programs. The original NSSL/SPC “Spring Program” is now known as the Experimental Forecast Program (EFP).

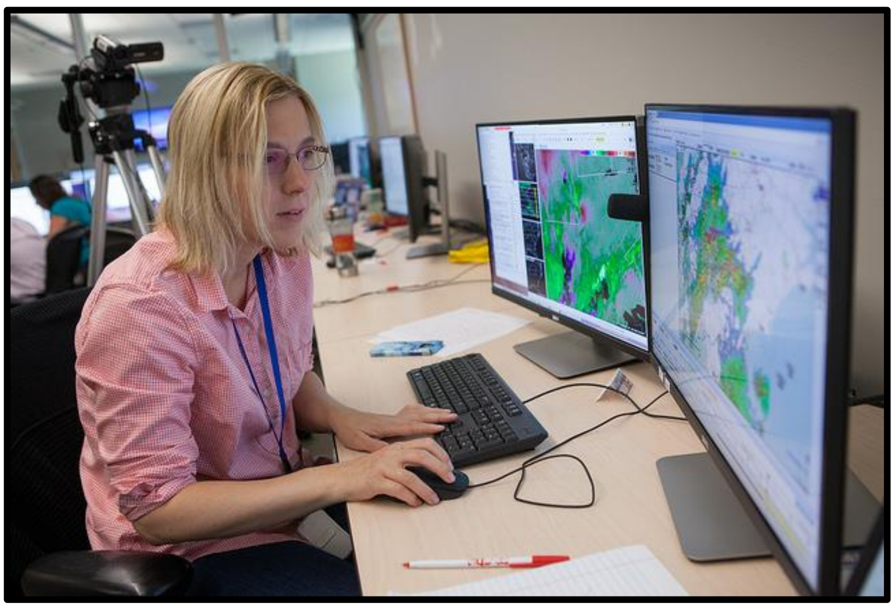

Figure 1. An EWP forecaster examines a developing storm.

The other activity in the HWT, and the subject of this summary, is the **Experimental Warning Program (EWP),** which is designed to test and evaluate new applications, techniques, and products to support Weather Forecast Office (WFO) severe convective weather warning operations. This was the eleventh year for warning activities in the testbed. Feedback was gathered from NWS operational meteorologists, broadcast meteorologists, and emergency managers. The experiment participants issued experimental warnings, published live blogs, engaged in shift debriefings/discussions, and completed a host of surveys. User comments were also collected during shifts, which have also been used to inform product development. This kind of input is vital to improving the NWS warning process, which ultimately leads to saved lives and property.

2. OVERVIEW

The National Oceanic and Atmospheric Administration (NOAA) Hazardous Weather Testbed (HWT) Experimental Warning Program (EWP) at the National Weather Center (NWC) in Norman, Oklahoma hosted the 2017 EWP Spring Program. Several experiments to improve National Weather Service severe weather warnings were conducted this spring in the NOAA Hazardous Weather Testbed (HWT) as part of the annual Experimental Warning Program, a joint project of the National Weather Service and NSSL/CIMMS to support NOAA's goal to evolve the National Weather Service and build a Weather-Ready Nation. This year, the 2017 EWP Spring Program featured 3 projects, which operated for 13 calendar weeks.

EWP Project	Operation Dates	Operational Weeks	Number of Forecasters
[1]Hazard Services PHI Experiment	20 March – 21 April	3 weeks	6
[1]Prototype PHI Experiment	8 May – 9 June	3 weeks	9
[2]GOES-R / JPSS Spring Experiment	19 June – 21 July	4 weeks	16

Table 1: Details for the 2016 Experimental Warning Program.

[1] "PHI" is "Probabilistic Hazards Information"

[2] "GOES-R / JPSS" is Geostationary Operational Environmental Satellite – R-series / Joint Polar Satellite System

3. PROJECT DETAILS AND RESULTS

Hazard Services – Probabilistic Hazards Information Experiment

Summary by Greg Stumpf, Chen Ling, and Joseph James

Overview

NSSL has been developing a prototype tool for testing the early concepts of FACETs[1] known as Probabilistic Hazard Information (PHI). This PHI Tool has been evaluated by NWS forecasters and human factor experts in the HWT from 2014 to the present. A USRWP grant known as "Probability of What?" is funding an effort to transfer the capabilities of the prototype into AWIPS2 Hazard Services (HS), and the project has just concluded its second year. The second HS-PHI Hazardous Weather Testbed (HWT) experiment was conducted during March-April 2017. As with previous experiment years, this evaluation included NWS forecasters and human factor experts. We evaluated the software design using archive and real-time data. We also evaluated the concept of PHI as it relates to hazardous weather warning operations.

[1]For more on FACETs, please visit http://www.nssl.noaa.gov/projects/facets/

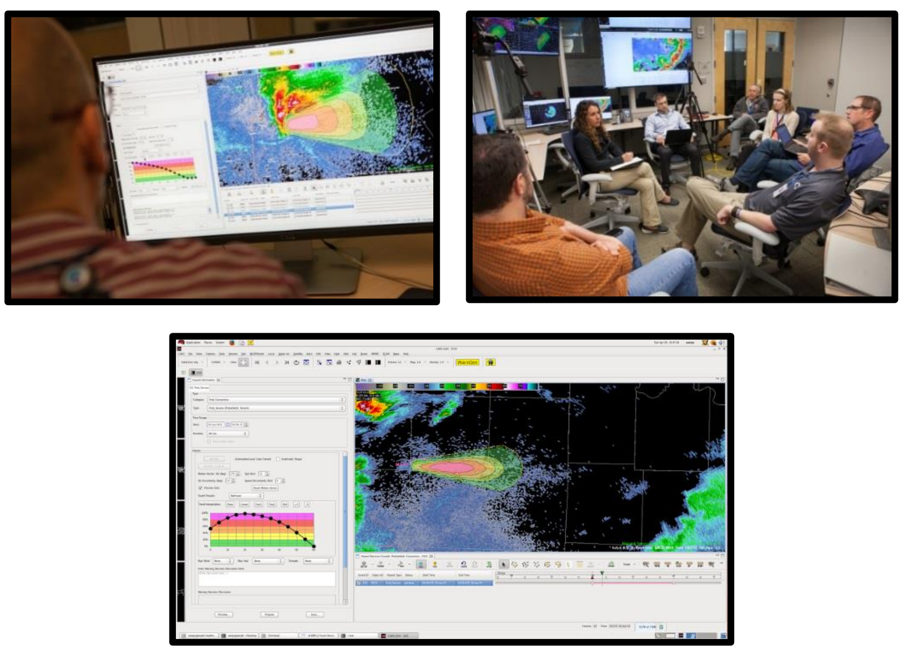

Figure 2. Images from the 2017 HWT HS-PHI experiment: Forecaster using HS-PHI on an AWIPS2 workstation (top left); post-scenario group discussion (top right), screenshot of HS-PHI on AWIPS2 (bottom).

2017 Accomplishments

The following is a list of accomplishments from the 2017 Hazard Services PHI Experiment.

- Continued to development of HS-PHI, with the goal to match the functionality of the 2015 version of the PHI Prototype. About 85% of the functionality was developed in time for the 2017 HS-PHI experiment. New capabilities that were available for 2017 included:
  - Convective Recommender
    - Processes ProbSevere detections into Hazard Services – PHI objects.
  - Workflow for editing objects including adjusting of the motion vector
  - Levels of Automation
    - Forecasters can create manual objects.
    - Forecasters can assume partial or full control of automated objects.
  - New object drawing tools: ellipses, rotation, resizing
  - PHI output grids
  - Warning Decision Discussion (timestamped entries)
- Developed two new archive case scenarios / use cases to test the software on a variety of severe weather conditions:
  - Quasi-Linear Convective System (QLCS) cool-season tornado event.
  - Low-shear summertime microburst and boundary initiation event.
- Tested HS-PHI in the NOAA Hazardous Weather Testbed for three alternating weeks from March-April 2017 with 6 National Weather Service forecaster participants using archived and real-time severe weather cases. The objectives of the test included:
  - Gathering feedback on software performance and design, with bug-fixes and improvements developed and tested during the off-weeks of the test.
  - Collecting forecaster workload data in collaboration with human factors scientists from the University of Akron. Analysis is still pending.
  - Capturing discussions on the FACETs and PHI concepts in NWS severe weather warning operations, including how adjacent forecast offices

    would collaborate and share severe storm objects to provide seamless service across forecast area boundaries.

- Major shift in team dynamics and development/test process:
    - Oct-Feb: Coding and Testing against Detailed Functional Tests using WebEx so developers could watch HWT in action
    - Mar-April: HWT with continued improvements in off weeks
    - May-June: Post-mortem to collect additional required functionality and to start identifying new functionality from the 2016-2017 PHI Prototype
    - August: Week-long code sprint at GSD with all developers present resulted in many major fixes as well as design planning for additional functionality.
    - Bi-weekly development planning meetings throughout.
- Set up dual-machine test environment at GSD.
- Upgraded systems to AWIPS Build 17.1.1.

2018 Plans

The following is a list of goals for the next iterations of the Hazard Services PHI experiments.

- Complete development of Year 3 version of HS-PHI by February 15. This to include finishing of 2015 PHI Prototype capabilities:
    - Address performance issues and stability
        - Hazard Services Registry implementation results in slow-downs
        - Need to incorporate the latest improvements
        - If necessary, explore alternative solutions
        - Buffering of commands for quicker responsiveness
        - PHI requires intense user interaction with hazard objects which warrants performance analysis and optimization
        - More robust error handling
    - Continue to refine functionality
        - Ownership of hazard objects and locking
        - Redraw polygon
        - Respond to user interface suggestions from forecasters

- Begin development of new functionality, including new items IDed by HS-PHI HWT tests, and those vetted by the PHI Prototype in 2016-2017. Candidates at the top of the list are:
    - Lightning PHI
    - Warning product output (with VTEC, etc.)
    - Deterministic Threats-In-Motion (TIM) polygons
    - Storm Longevity
- Shakedown testing of performance and stability will take place at the HWT in late February.
- HWT operational test with NWS forecasters on three weeks March-April 2018.
- A JTTI grant was awarded to fund continued HS-PHI development and experimentation through at least October 2018, with a possible 2-year extension beyond that, which would include HWT tests in 2019 and 2020.

Project Details: Forecaster Workload Survey

Three standardized questionnaires were used to collect data from forecasters. The NASA-TLX mental workload survey, confidence survey and Post Study System Usability Questionnaire.

Mental Workload (NASA TLX) Survey

The NASA-TLX (Hart & Staveland, 1988; Hart, 2006) workload index is a questionnaire based workload rating tool. The tool encompasses 6 aspects of workload: mental demand, physical demand, temporal demand, performance, effort and frustration. The analysis of workload includes a weighting dimension used to calculate an overall workload score. The questionnaire was modified slightly by adding a question “what made it so?” after each rating. Forecasters input optional text response to provide further explanation as to what events or situations contributed to their workload score. The raw scores of the mental workload ranges from 1 to 100, with 1 stands for extremely low workload and 100 stands for extremely high. The ratings were averaged from all the sessions for each of the 6 aspects of workload, and the importance factors were calculated for each aspect to create the workload figure for the HWT. The red line shows the overall workload score for the experiment.

Figure 3 shows the average workload for all responses from all archived hazardous weather events. Each bar in the figure represents the average workload for each of the 6 sub-dimensions of workload. The width of the each bar represents the importance of each sub-dimension. The red line represents the average workload for 2017 and the blue line represents the 2016 workload average. The average workload for 2017 Hazard Services PHI HWT was 58 (out of 100, standard deviation 15.2, range 58.8), which is higher than 2016 workload average of 49.9. All workload aspects increased, notably mental and physical demand represented the most significant increase, mental demand increased from 52.5 to 72.7 and physical demand increased from 42.4 to 60.5, in 2016 to 2017 respectively. Significant contributors to workload based on forecaster's input were: the new PHI tool and paradigm, system lag, large number of storms, rapid storm evolution and complex meteorology.

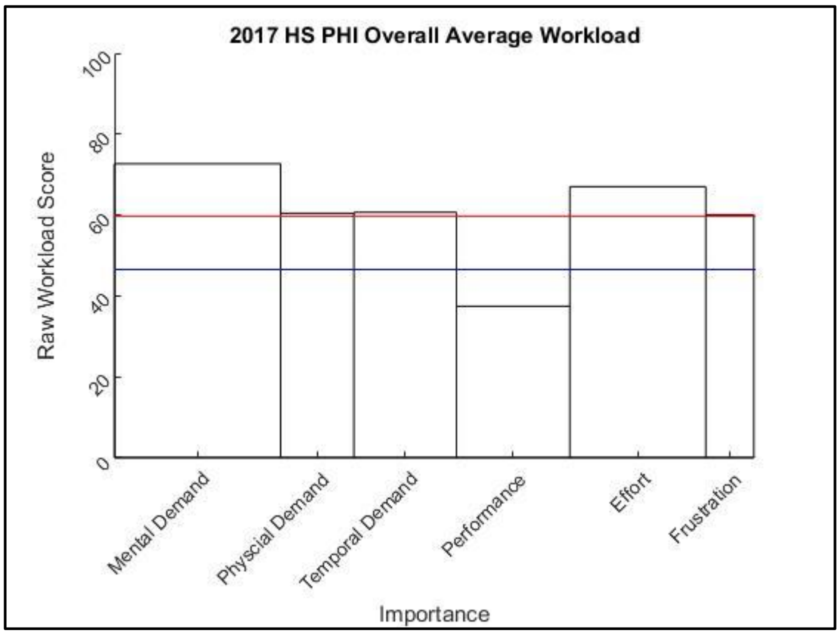

Figure 3. Hazard Services PHI NASA-TLX workload, with 2016 average workload comparison. (red and blue line are workload averages for 2017 and 2016, respectively)

<u>Confidence Survey</u>

Participants were asked to respond to a confidence survey, a 7-point Likert scale, ranging from not confident at all (rating of 1) to very confident (rating of 7). The neutral response has a rating of 4. They were asked to respond to their confidence on understanding the weather, in the automated guidance, and in producing PHI information. They were given an optional text box to provide more details about what situations or events contributed to their confidence level designation. Analysis of the text was performed to determine the top contributing factors to forecaster confidence.

Forecasters responded to their confidence working with the Hazard Services PHI system while working archived hazardous weather scenarios. Figure 4 shows the average confidence score 5.24 (out of 7, standard deviation 0.59, range 1.4). Forecasters stated their confidence was influenced by working with the new paradigm, automated guidance and collaborating over CWA boundaries. Forecasters' confidence changed little from 2016, with an average of 5.27.

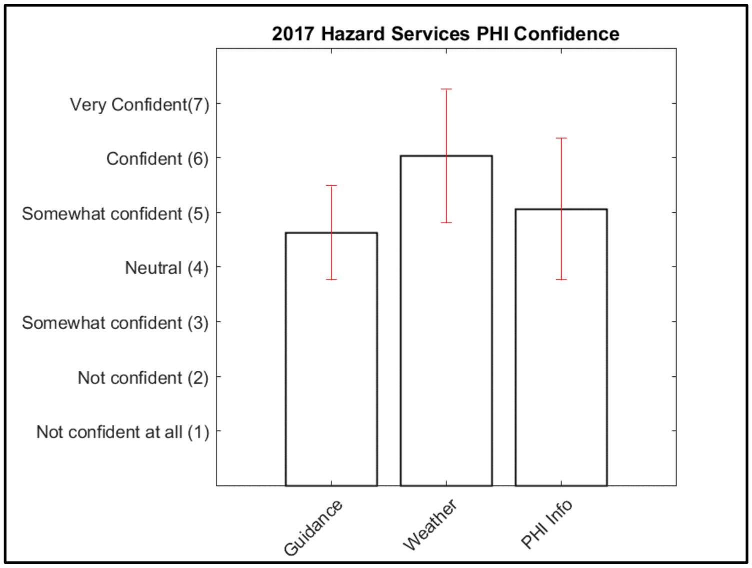

Figure 4. 2017 Hazard Services HWT forecaster confidence for guidance, weather and PHI info.

PSSUQ Usability Questionnaire

The Post Study System Usability Questionnaire (PSSUQ; Lewis, 2002) is a survey tool designed to evaluate usability of a computer system. The tool is designed with 19 usability questions to asses 4 different areas of System Usefulness, Information Quality, Interface Quality and Overall Usability. The rating ranges from 1 to 7, with 1 corresponds to low level of usability, 7 to high level of usability, and 4 corresponds to neutral level of usability. Specific groups of questions are averaged to calculate the final system usability characteristics.

The PSSUQ questionnaire was filled out by the participants on the last day of the testbed. Table 1 shows the average responses for each of the 4 categories: Overall Usability, System Usability, Information Quality and Interface Quality.

	2017	2016
Overall	5.39	4.62
System Usability	5.56	4.96
Information Quality	5.00	4.37
Interface Quality	5.72	4.72

Table 1. Usability results based on the PSSUQ for 2016/2017 HWT (7-point scale)
Overall usability was assessed at 5.39 (on a 7 point scale) for 2017, and increase from 4.62 during the 2016 HS HWT. Notable increases were shown in all categories, system usability, information quality and interface quality. This is due to significant improvements in software design in many aspects.

Hazard Services – Probabilistic Hazards Information Experiment

Web Presence

PHI – Hazard Services	https://vlab.ncep.noaa.gov/group/facets/hwt-2017-hs-phi-resources

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Prototype Probabilistic Hazard Information Experiment

Summary by Kodi Berry, Chris Karstens, Chen Ling, and Joseph James

Overview

The 2017 HWT Probabilistic Hazard Information (PHI) Experiment was conducted during the weeks of May 8-12, May 22-26, and June 5-9. During this experiment, participants worked in an integrated warning team: forecasters were tasked with issuing experimental probabilistic forecasts for real-time and displaced real-time severe convective events, and emergency managers (EMs) and broadcaster meteorologists used this experimental information to make simulated decisions. After each event, researchers brought the three groups together for discussions focused on the forecast information relevant to each forecast hazard type (tornadoes, severe thunderstorms, and lightning) and how each element could be improved.

Because the PHI system completes some tasks for the forecasters, they are able to use their time to focus on meteorological assessment and communication. This allows the forecaster to provide frequent updates to the hazard location, movement, and other attributes (e.g., severity, intensity, history of reports, forecast information), a concept we've termed "continuous flow of information." The objective of the 2017 HWT PHI Experiment was to understand what a continuous flow of information means to forecasters and end users.

Forecaster Experiment Details and Results

Three types of automated guidance were available to forecasters. These included the NOAA/CIMSS ProbSevere model for individual severe hazards (including tornadoes, wind, and hail), the NSSL Experimental Warn-on-Forecast System for ensembles (NEWS-e) for tornadoes, and probabilistic cloud-to-ground lightning algorithm developed by CIMMS/NSSL. An algorithm was implemented on ProbSevere objects to reduce breaks in the tracking of automated objects. The system design was re-strategized in 2017 such that generation and consumption of warnings and significant weather advisories was separated and prioritized, with probabilistic information reframed as supplementary within the geospatial confines of the warning/advisory polygon (i.e., relative probability). Thus, all locations within a probabilistic swath receive a binary warning supplemented with the likelihood of occurrence relative to surrounding locations based on forecaster confidence.

Tools were developed for the 2017 experiment to allow forecasters to effectively transfer between various levels of automated object-based guidance. As in previous experiments, forecasters preferred to assume more control of automation as the severity of hazard area increased. Forecasters relinquished control of the object shape to automation periodically throughout the hazard's lifetime. Additionally, forecasters often updated the object shape with the first guess provided by automation, and then made subtle adjustments to the object to quickly update the forecast while maintaining control of the object shape. Forecasters also detected hazard areas prior to the automated object identification, leading to the generation of a manual object. As the automated system caught up, forecasters released control of the object shape (as well as other forecast attributes) to the automated system.

In addition to working through the conditional use of automation, forecasters were presented with first guess probabilistic trends created from machine learning algorithms. Usage with this information revealed that forecasters found the automated predictions to be helpful in prioritizing hazards, with the highest priority given to hazard areas associated the highest predicted probabilistic values. Such hazard areas were typically assigned a warning, whereas hazard areas with lower probabilistic predictions were typically assigned a significant weather advisory.

Previous results found that forecasters commonly adjusted the first guess probabilistic predictions to reinforce the communication of a warning, implying some level of mistrust of the guidance. To address this issue, the probability trend tool was given a formal definition, defined as the subjective probability (i.e., confidence) of a defined hazard type occurring at 5-minute forecast intervals through an assigned duration. The hazard type definitions were extended from the current warning paradigm (1" hail, 58 mph wind, tornado), and a single cloud-to-ground strike was used for lightning. A paraphrased version of this definition was provided in the title above the probability trend tool to reinforce the intended purpose of the tool. An analysis of all forecast trends issued during each of the previous four years of HWT experiments implies substantial improvement in reliability of the probabilistic information, particularly at long lead-times.

End User Experiment Details and Results

Two EMs and one broadcast meteorologist were included in the PHI experiment each week with the main objective of learning how the continuous flow of probabilistic information may impact them and their decision making. Probabilistic forecasts and warnings generated by the forecasters were viewed in an experimental version of the NWS Enhanced Data Display and GR2Analyst. The PHI objects were graphically rendered to quickly allow for quick identification of the hazard type, severity, direction of motion, level of automation, and time of arrival.

EM participants simulated decisions for outdoor events (e.g., graduation ceremony, convention, concert) in pre-selected areas that matched the scale of their jurisdiction (e.g., university, city, county, state) and researchers investigated how they used a combination of forecaster confidence, advisory/warning text, and hazard type, severity, and time-of-arrival information to make decisions during hazardous weather events.

Standard operating plans for EM have elements (e.g., sounding outdoor warning sirens) based upon warnings from the NWS. Traditional warning information in the PHI system helped forecasters and users connect with necessary and effective elements of the current warning system. In addition, preliminary results show that EM participants used both severe and sub-severe information in their decision making. EMs carefully watched the trends in probabilities, and depending upon circumstance, they made decisions based first on time of arrival, second on severity. For example, if a dorm at a university requires 18 minutes to get students to safe areas on the lowest floors, that EM might make a decision ahead of a warning because more time is required than a typical warning lead time.

Broadcast participants performed typical job functions under a simulated television studio environment as they received experimental probabilistic information from forecasters. Research protocols were used to systematically study how broadcast meteorologists interpreted, used, and communicated probabilistic information. Decision points of interest included when to run “crawls,” post to social media, interrupt commercials, and interrupt programming. Previous results indicate that participants were overwhelmed managing studio resources alone when multiple warnings were in effect and updating swiftly. Further, the hazard-following, probabilistic warnings presented unique challenges regarding the incorporation of PHI into both the on-air crawl and graphics system, which are currently optimized for binary polygons. In the 2017 project, warning update frequencies were varied daily to better understand optimal flow of information for the specific needs of broadcast meteorologists and their television stations. In addition, probability thresholds for coverage decisions were tracked.

Figure 5. Broadcast meteorologist assesses hazard probabilities during the Prototype PHI Experiment.

Preliminary results reveal that broadcast participants preferred the gradual increase in update frequency throughout the week. The default, two-minute updates were deemed too fast for crawl systems and potentially station bandwidth constraints. Participants stated that 5 to 10 minutes was a more optimal update frequency for on-air presentation and viewer consumption. However, the frequent updates coupled with multiple warnings led participants to believe that additional personnel would be needed to handle the workload. Participants also found that they preferred to view and communicate the warning polygon outlines with radar, while viewing the probabilistic plumes on a separate screen. Beyond this, participants preferred not to have their on-air coverage broadcasted to the other participants' rooms. By removing the pressure to perform, participants were able to interrupt themselves, allowing for discussions and questions concerning the experimental products during the events.

Overall, research with end-users continues to refine contemporary ideas about how continuous probabilistic information may be useful, usable, and used.

Project Details: Forecaster Workload Survey

Two standardized questionnaires were used to collect data from forecasters. The NASA-TLX mental workload survey and confidence survey.

NASA-TLX mental workload questionnaire

The NASA-TLX (Hart & Staveland, 1988; Hart, 2006) workload index is a questionnaire based workload rating tool. The tool encompasses 6 aspects of workload: mental demand, physical demand, temporal demand, performance, effort and frustration. The analysis of workload includes a weighting dimension used to calculate an overall workload score. The questionnaire was modified slightly by adding a question "what made it so?" after each rating. Forecasters input optional text response to provide further explanation as to what events or situations contributed to their workload score. The raw scores of the mental workload ranges from 1 to 100, with 1 stands for extremely low workload and 100 stands for extremely high. The ratings were averaged from all the sessions for each of the 6 aspects of workload, and the importance factors were calculated for each aspect to create the workload figure for the HWT. The red line shows the overall workload score for the experiment.

The 2017 PHI prototype workload average was 50 (out of 100, standard deviation 14.3, range 60.2). This was very close to the 2016 average of 49. Figure 6 shows the average workload for each sub dimension of workload and the relative importance factor, denoted by the width of the bar. Figure 7 compares the average values for each 2017 sub-dimension to 2016 values. The average value for 2017 and 2016 was very similar, however some differences were shown in sub-dimensions, including physical demand, temporal demand and performance. Physical demand decreased significantly, this could be due to the decrease in menu options required to produce PHI objects from 2016 to 2017 and additional improvements to the PHI creation process, such as the availability of LSR reports in the HID panel. Temporal demand increased and performance increased (a lower performance score is more desirable), these changes could be linked to the challenges in forecaster's ability to more quickly update PHI.

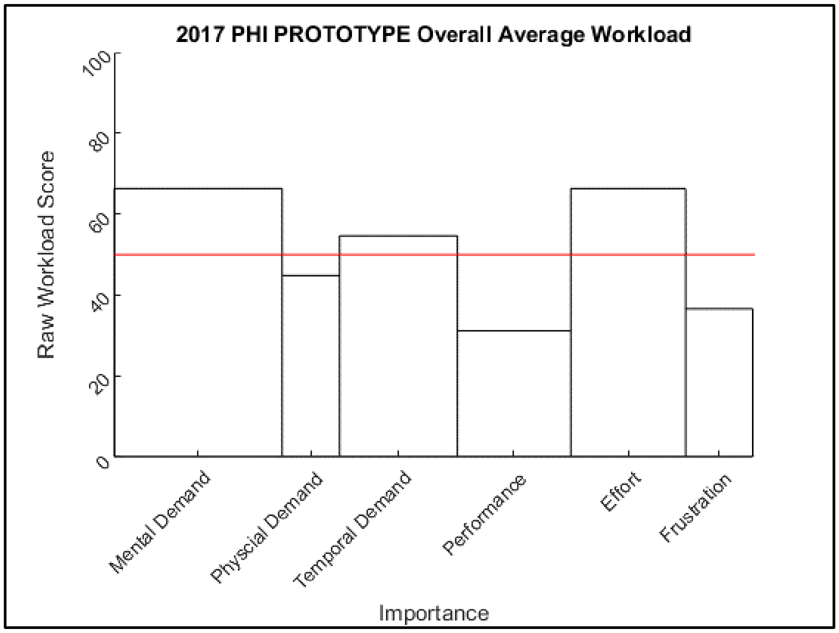

Figure 6. Average workload and workload aspects for 2017 PHI Prototype HWT.

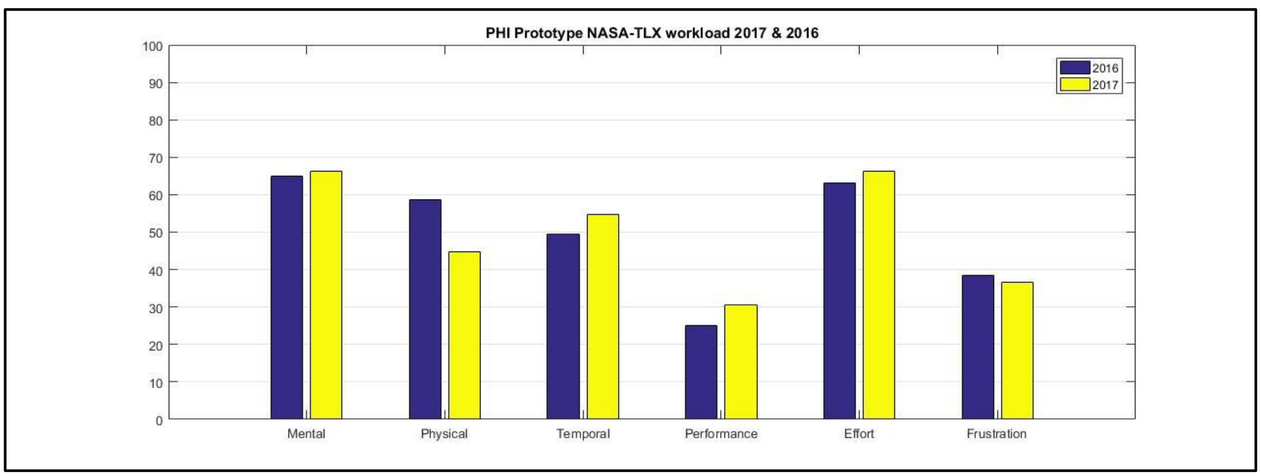

Figure 7. Comparison of 2016 and 2017 workload aspects.

Confidence

Participants were asked to respond to a confidence survey, a 7-point Likert scale, ranging from not confident at all (rating of 1) to very confident (rating of 7). The neutral response has a rating of 4. They were asked to respond to their confidence on understanding the meteorology, in the automated guidance, in NWP and in radar. They were given an optional text box to provide more details about what situations or events contributed to their confidence level designation. Analysis of the text was performed to determine the top contributing factors to forecaster confidence.

The average confidence for the 2017 PHI prototype was 5.6 (out of 7; SD: 0.9, Range 4.25; see Figure 8). According to forecaster's answers, contributing factors to forecaster confidence included an unfamiliar region, use of new PHI tool, and changes in weather. Learning the new PHI tool presented challenges in how to create and manage objects. Rapidly evolving storms, clusters, and marginal weather threats presented challenges in creating accurate PHI objects. There were also cases of conflicting MESH and Prob Severe data that resulted in forecasters having decreased confidence.

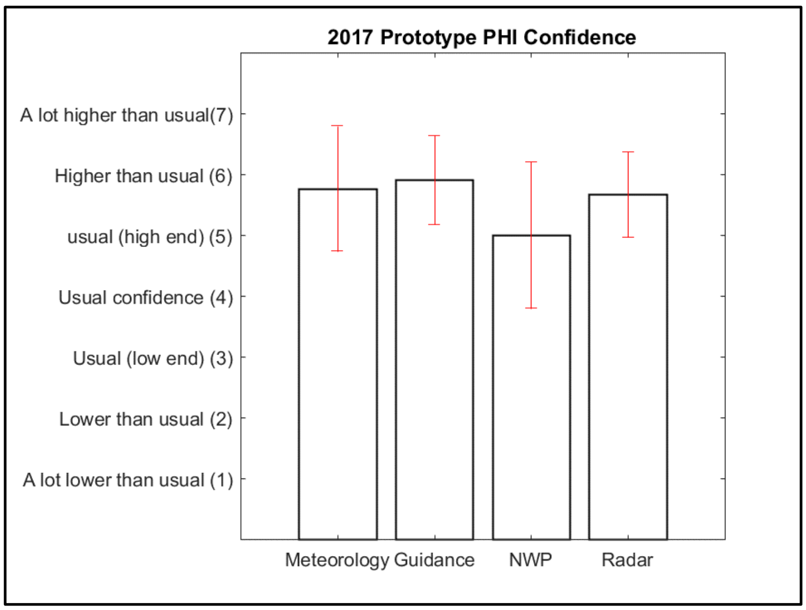

Figure 8. Average Confidence ratings for meteorology, automated guidance, NWP and radar.

Plans for Future Experiments

The 2018 HWT PHI Experiment will take place during spring/summer during which two EMs and two broadcast meteorologists will participate each week. Research interests common to both end user groups include confusion with the combination of hazard probability of occurrence and forecaster confidence, and removal of advisory level products from binary hazards (like tornadoes) that generated significant interpretation issues. . The 2018 Experiment will also explore alternate ways to link watches and warnings to the PHI; previous experiments have attempted a variety of ideas for linking the two, but enduring interpretation challenges remain for any system that automates warnings or advisories based on objective hazard probabilities alone.

Over the coming months, three years of HWT data collected on EMs will be analyzed in depth and used to shape the research objectives of the 2018 experiment. Preliminary results reveal that EMs found lightning objects, plumes, and probabilities confusing in meaning and appearance and struggled to understand and communicate lightning information. However, EM participants articulated a strong need for lightning hazard information, including time-of-arrival. EM participants will help researchers investigate and determine effective visual and textual communication of lightning hazards from the NWS.

In 2018, the increased number of broadcasters will allow participants to work together in a more realistic team environment. More details regarding commercial breaks (e.g., national commercial, local commercial, 30-sec station identification) will be incorporated into the programming schedule for more detailed analysis of preferred types of cut-ins for each hazard. The experiment will also incorporate actual participant use of social media (i.e., Facebook and Twitter) to allow researchers to better understand its role in the communication of hazardous weather by broadcast meteorologists.

Prototype Probabilistic Hazard Information Experiment

Web Presence

FACETS Program	http://www.nssl.noaa.gov/projects/facets/

Project Contacts

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Shadya Sanders	Howard University	Graduate Student Investigator

GOES-16 / JPSS Spring Experiment

Summary by Michael Bowlan

Overview

The Hazardous Weather Testbed (HWT) provides the Geostationary Operational Environmental Satellite 16 (GOES-16) and Joint Polar Satellite Studies (JPSS) Proving Ground with an opportunity to evaluate Baseline, Future Capabilities and experimental products associated with the next generation of GOES-16 geostationary and JPSS polar satellite systems. Many of these products have the potential to improve short-range hazardous weather nowcasting and forecasting. Feedback received from participants in the HWT has led to the continued modification and development of GOES-16 and JPSS algorithms.

Experiment Design

During the HWT 2017 GOES-16/JPSS Spring Experiment, GOES-16 and JPSS products were demonstrated within the real-time, simulated warning operations environment of the Experimental Warning Program using AWIPS-II. This experiment was conducted Monday through Friday during the weeks of June 19, June 26, July 10, and July 17. Each week, a new group of forecasters (3 NWS forecasters and 1 broadcast meteorologist) evaluated new GOES-16/JPSS algorithms and technology. Product developers from various institutions were also in attendance to observe the activities and interact with the forecasters. Monday through Thursday featured an eight hour forecast/warning shift, while Friday was a half-day dedicated to final feedback collection. During the forecast shifts, the four forecasters utilized the baseline and experimental satellite products – in conjunction with operationally available meteorological data – to issue short-term mesoscale forecast updates and severe thunderstorm and tornado warnings.

Forecaster feedback was collected through the completion of daily and weekly surveys, daily and weekly debriefs, and blog posts. The GOES-16 HWT Blog allows participants to record their thoughts on the products during experimental operations (www. goesrhwt.blogspot.com). During the 2017 GOES-16/JPSS Spring Experiment, over 400 posts were made to the blog by participants with a variety of topics including mesoscale forecast updates, reasoning behind forecast/warning decisions, best practices, and ideas for product improvement. Feedback from the experiment was reviewed and organized into a final report.

GOES-16 Products

GOES-16 products demonstrated in the 2017 EWP Summer Experiment included: GOES-16 Advanced Baseline Imager (ABI) Cloud and Moisture Imagery, baseline derived products and numerous multispectral "Red, Green, Blue" (RGB) products, the Geostationary Lightning Mapper, and the University of Wisconsin/Cooperative Institute for Meteorological Satellite Studies (UW/CIMMS) Probability of Severe (Prob Severe) statistical model. Additionally, GOES-16 provided 1-minute imagery via two 1000-km x 1000-km mesoscale sectors, and its value was also assessed in monitoring convective storm life cycles. Forecaster utilized many of the baseline imagery and products available from GOES-16 in their convective operations. Forecasters found the derived stability indices and derived Total Precipitable Water (TPW) to be beneficial when looking for areas of convection initiation. Forecasters also found several RGB composite imagery products to be useful, particularly when looking for cloud glaciation and areas where convective towers had broken the "cap," or temperature inversion. The visible and infrared (IR) imagery form GOES-16 was also used heavily and most forecasters commented how the increased spatial and temporal resolution have made the data more useful in a warning environment than previous satellites. Forecasters are excited about the ProbSevere model, commenting that, at the very least, it increased their confidence in issuing tornado and severe thunderstorm warnings. In many cases, forecasters mentioned that the ProbSevere data helped to increase the lead-time in which they were able to issues warnings. Forecasters primarily used the Geostationary Lightning Mapper (GLM) data to monitor convective trends, and assess storm initiation and relative strength. In addition to the aforementioned algorithms, GOES-16 1-min mesoscale sectors were available in the HWT for the full duration of the experiment, illustrating the very high frequency scanning capability of GOES-16. The 1-min satellite imagery is one of the GOES-16 capabilities forecasters use most when in warning operations. In most cases, it was the first indication that convective initiation had taken place. Forecasters continued to view the 1-min data after convective initiation, finding it useful for identifying new development and for monitoring updraft trends between radar scans.

JPSS Products

From the JPSS program, the NOAA Unique Combined Atmospheric Processing System (NUCAPS) temperature and moisture profiles from Suomi National Polar-orbiting Partnership were demonstrated in the AWIPS-II NSHARP display system. In addition to the profiles, two-dimensional plan view and cross-section displays of various convective parameters were available in the HWT this year. Also, an experimental version of NUCAPS was evaluated, in which an automated correction was applied to the boundary layer using surface observations. In most situations, forecasters commented that NUCAPS provided an effective update on the current state of the thermodynamic environment. The early afternoon availability fills a temporal gap in observed vertical temperature and moisture information, while the high spatial density fills a spatial gap. The plan view displays allowed for a quick look at NUCAPS at any given level, while forecasters used the cross section displays for more detailed interrogation of important features. The experimental version was found to give more comparable values of Convective Available Potential Energy (CAPE) and other parameters, but oversimplified the boundary layer to be a well-mixed environment which is rarely the case. Overall, forecasters enjoyed having both sounding available for comparison with the observations.

2018 Plans

Satellite Proving Ground activities at the HWT 2018 Spring Experiment will include further demonstration of GOES-16 imagery and baseline products. The effectiveness of the GOES-16 training will be assessed, and best practices for using the GOES-16 data in operations will be learned. Additionally, some of the algorithms demonstrated in 2017 will return with updates based on past forecaster feedback. An updated NUCAPS algorithm from JPSS is also expected to be available, along with new versions of ProbSevere and the Convective Initiation product using GOES-16 data for the first time.

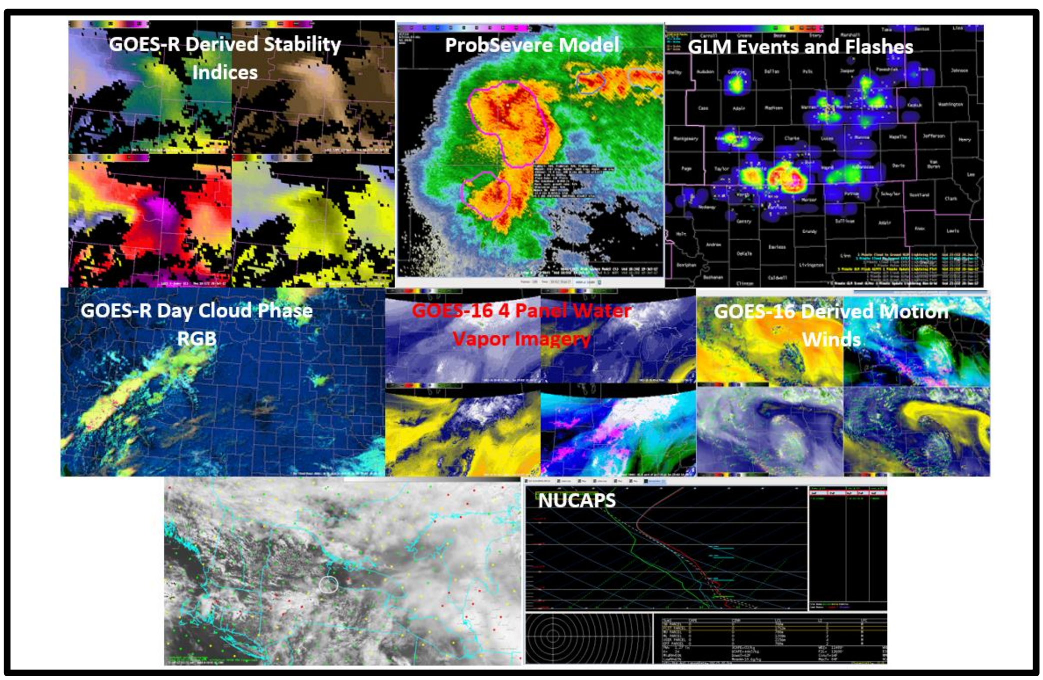

Figure 9. GOES-R and JPSS products and capabilities demonstrated during the HWT 2017 Summer Experiment.

GOES-16 / JPSS Spring Experiment

Web Presence

GOES-R HWT Blog	http://goesrhwt.blogspot.com/
EWP Blog*	http://hwt.nssl.noaa.gov/ewp/internal/blog/
Forecaster Training	http://hwt.nssl.noaa.gov/ewp/internal/2017/

*(LDAP user name / password required)

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