



With Better Information, Unmanned Systems Steer Clear of Bad Weather

Like commercial airline and private civilian pilots, pilots and crews who fly the MQ-1 Predator and MQ-9 Reaper unmanned aircraft systems (UAS) try to avoid bad weather. Thunderstorms, icing, and turbulence can more easily endanger Predators and Reapers, which are far lighter and fly much slower than airliners. While airline pilots can look out the window and see the weather around them, UAS pilots do not have that option. In combat, Predator and Reaper pilots fly their aircraft remotely from ground control stations located some 7,000 miles away at Creech Air Force Base, Nev., and other Air National Guard (ANG) bases located throughout the US. Although they can scan the horizon with their sensor ball to detect cloud formations, mission needs often force pilots to keep the sensor on target for extended periods—depriving them of critical weather awareness.

Like their manned-aircraft counterparts, UAS crews need understandable, comprehensive up-to-date weather information. While commercial airline pilots can often access graphical weather radar data while en route, until recently, UAS crews depended entirely on meteorologists who translated complex weather data into useful information. Unlike the commercial airline’s weather radar, this information was not incorporated into a common situational awareness display for the Predator and Reaper.

A few years ago, Robert Bahnij and Col. Jeff Eggers started investigating the problem. Bahnij is MITRE’s technical advisor to the 432d Air Expeditionary Wing at Creech AFB. Col. Eggers is director of Intelligence, Surveillance, and Reconnaissance (ISR) Innovations for unmanned aircraft and a former deputy group commander at Creech AFB. With the help of Daniel Hebert, chief engineer of MITRE’s weather department at the time, and lead software systems engineers Jason Walonoski and Jon Homer, a development process was started. The result is a weather information service that provides weather forecast overlays that UAS pilots use with their situation display tool called FalconView.

Maj. Jason Bialon, a former Air Force meteorologist and now a Predator pilot and squadron supervisor states: “The weather tool provides Predator 15th Reconnaissance Squadron crews the ability to integrate and execute their mission requirements, as well as do airspace management and navigation—all with near-real time weather awareness. This added capability significantly enhances our combat capability in our dynamic environment.”

In executing their missions, the Predator and Reaper pilots use FalconView to display various types of maps and image overlays for situational awareness. With the addition of forecasts, observations, pilot reports, and satellite imagery data regularly published by the Air Force Weather Agency, a more complete picture is now available to UAS operators. The weather information service supports daily Air Force combat operations in Iraq and Afghanistan, allowing UAS pilots to see predicted weather conditions such as clouds, icing, turbulence, winds (direction and speed), and thunderstorms.

Starting as Research, Moving into the Field

Funding was originally provided through MITRE’s internal research program and the weather program office in the 651st Electronic Systems Squadron of the 551st Electronic Systems Wing at Hanscom Air Force Base, Mass. As the project evolved, further funding was provided by the Air Force ISR Innovations Directorate at the Pentagon.

(continued...)



The weather services allow UAS operators in ground control stations to confidently guide Predators and Reapers around bad weather, which could interfere with their missions.

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The information system’s design fell to Walonoski and Homer. To get valuable user input, they interviewed UAS pilots, Hanscom and Creech AFB meteorologists, and personnel involved with the Air Force Weather Weapons System. They rapidly prototyped the necessary services and software plug-ins, delivering a new version every three to six months over an 18-month period.

The two researchers started with an Air Force Web-service that provides weather information called the Joint Meteorological and Oceanographic Broker Language (JMBL). It provides access to weather data such as observations, forecasts, weather warnings and bulletins, and radar and satellite imagery. However, the JMBL weather services were designed by and built for meteorologists. They didn’t directly support the route concept of flying, so determining the weather along a flight plan was difficult. Nor did the services provide images that could be overlaid on a map.

“Unless the UAS pilot is a meteorologist, he or she won’t know how to interpret raw weather data and take action on it,” says Walonoski.

For a friendlier user interaction, the team developed a new set of weather information services that sit on top of the JMBL layer. Currently, the server renders the meteorological data into geo-located images that are easily displayed on a map. The server can also provide the forecasted conditions as Cursor-on-Target messages—a format that many existing systems already understand.

The team created two main pieces of software—a plug-in for the UAS pilots using FalconView and a server for the Wing Operations Center (WOC) at Creech AFB. The server retrieves the weather information via JMBL and creates imagery from the data, making it available to the plug-in. The plug-in uses XML messaging to determine what images are available and then retrieves them from the server. Satellite imagery from the Air Force Weather Agency’s Web Mapping Service is also provided by the server.

The team designed the weather information services so they would be “mission-agnostic” in their assumptions and requirements; they would deal entirely with the “weather” domain but wouldn’t use mission-specific data such as aircraft performance limits or target locations. In addition to the Creech WOC, the weather information service is installed at the nation’s four ANG units that fly the Predator.

Weather Information Services Impact

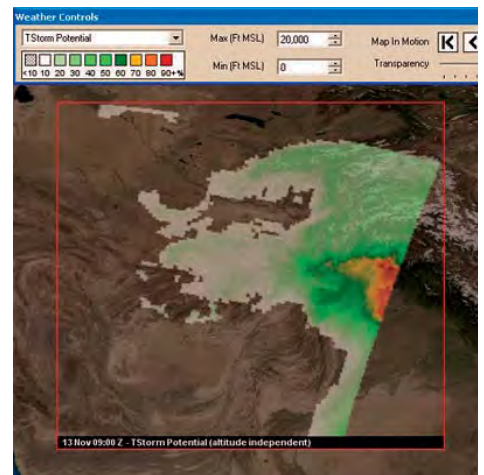
Since the end of its development cycle, the Navy and Air Force’s Joint Meteorological and Oceanographic Architecture Working Group “has adopted components of our weather service architecture into their official service architecture and several of our concepts into their service taxonomy,” Homer says.

“Our work has been featured at two new-technology showcases, Coalition Warrior Interoperability Demonstration ’08 and Empire Challenge ’08. The final version is certified for use on the Air Force’s Global Information Grid by the Air Force Communications Agency.”

Rob Bahnij notes that “the weather information project was accomplished by a tight collaboration between the Air Force and MITRE, and the software is now stable and mature. As we often do with such projects, MITRE will start facilitating the transitioning of this capability to government and industry. It already has strong sponsor support with a real possibility of transitioning into an official program of record.

“Most important, though, the Air Force’s UAS operators can execute their missions with more confidence now that they have a better view of the weather their aircraft might encounter.”

—by David A. Van Cleave



Weather forecast overlay shows a thunderstorm potential over Afghanistan. The color legend at the top shows the potential, or probability, of a thunderstorm.

Contact: For more information on this and other MITRE programs, see www.mitre.org/news/digest

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