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FAA Weather Tech Aids Forecasters in Puerto Rico

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Focus FAA Story by John Croft:

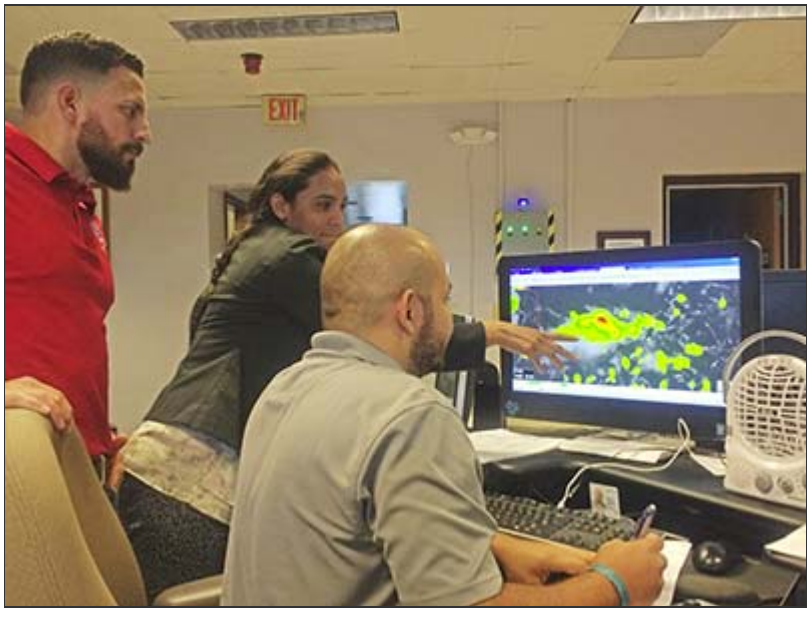
When Hurricane Maria slammed into Puerto Rico on September 20 and knocked out the NEXRAD weather radar, forecasters there turned to an FAA web-based prototype weather

analysis tool as a surrogate radar.

Called the Offshore Precipitation Capability (OPC), it was developed by the FAA and MIT-Lincoln Laboratory (MITLL) to give controllers, airline dispatchers and planners a view of the internal makeup of weather systems over the oceans, where NEXRAD is not available. But the developmental tool is also proving to be a successful backup when failures or disasters strike.

National Weather Service forecasters in San Juan are using OPC in combination with other satellite-based and ground sensor systems to issue weather advisories and warnings to the population. The NEXRAD radar, which provides FAA controllers with six color-coded levels of precipitation intensity based on radar echoes, was disabled by winds at about the time the eye of the storm made landfall.

“We are using OPC to estimate the amount of rainfall coming from the clouds we are seeing on the satellite images,” says Ernesto Rodriguez, science and operations officer for the National Weather Service forecast office in San Juan. “It’s a proxy for what the radar would have shown us.”



National Weather Service meteorologists in San Juan used the Offshore Precipitation Capability (OPC) on the afternoon of October 6 to track heavy thunderstorms that threatened recovery efforts from Hurricane Maria. Pictured from left to right are Carlos Anselmi, Amaryllis Cotto, and Ian Colon. Credit: National Weather Service.

OPC estimates the precipitation location and intensity of storms outside of radar coverage by using machine learning techniques and data from nearby NEXRAD sites, visual and infrared imagery from geostationary weather satellites and global lightning detection system data.

“Machine learning is a way to create models out of data,” says Mark Veillette, a technical staff member at MITLL. He says the models are made by analyzing “huge volumes” of historical data from radar and non-radar sources and identifying links between the two. “We learn the relationship and use it to create a weather picture outside of the radar areas,” says Haig Iskenderian, another MITLL technical staffer on the program. Along with a snapshot of current weather conditions, OPC in the future may be able to provide a 12-hour forecast as well.

The FAA is operating OPC in demonstration mode as a situational awareness aid for controllers

at the Houston, Miami, Puerto Rico and New York en route centers and at the Air Traffic Control System Command Center in Warrenton, Virginia. Controllers have been using the tool for situational awareness since early summer following a demonstration test in the Houston and Miami centers.

In Puerto Rico, Rodriguez's team began using OPC in the wake of Maria after the Federal Emergency Management Agency (FEMA) and the San Juan airport provided access through a web portal. The tool is being used in tandem with a software package that bundles the more traditional sources: weather satellites, NEXRAD, surface observations, rain gauges, river gauges and other input, much of which was knocked out by the hurricane.

Rodriguez's team is primarily using OPC precipitation and storm height estimates generated every 5 minutes. The National Weather Service says it expects the San Juan NEXRAD weather radar system to be back in service by the end of January 2018.

During both Hurricane Irma and Maria, FEMA officials in the National Response Coordination Center and regional offices also used OPC to gain an awareness of offshore precipitation and weather system movements. "Instead of being forced to wait for the storm to come into view of ground-based radar [for indications of storm intensity], emergency managers were able to receive an early look from OPC and maximize situation awareness," says Department of Homeland Security (DHS) Science and Technology program manager, Darren P. Wilson. DHS, the parent organization of FEMA, would like to make the OPC available through its next-generation hurricane evacuation system, called HURREVAC-eXtended, set to be rolled out next year, says Wilson.

The U.S. Air Force has also taken a keen interest in the program after MITLL provided an OPC demonstration last winter. Veillette says the Air Force is planning to provide funding to develop a global version of the tool as well as the 12-hour forecast capability, an enhancement that will also be available to the FAA and other users.

While not a substitute for actual NEXRAD, OPC provides a weather picture that goes beyond the visual and infrared imagery of satellites by generating six color-coded precipitation intensity levels within clouds — light green for the most benign to purple for the most severe. Drawbacks of using a modeled version of radar include uncertainty in the precise location and intensity of precipitation. Air traffic controllers, however, say it is operationally accurate enough to help and it is a major upgrade to what they had before to watch oceanic storms — simple satellite imagery of clouds.

"The tool gives a remarkably accurate picture of weather areas where we had none before," says Matthew Deak, Manager of Operations Support for the Miami en route center. "Miami Center

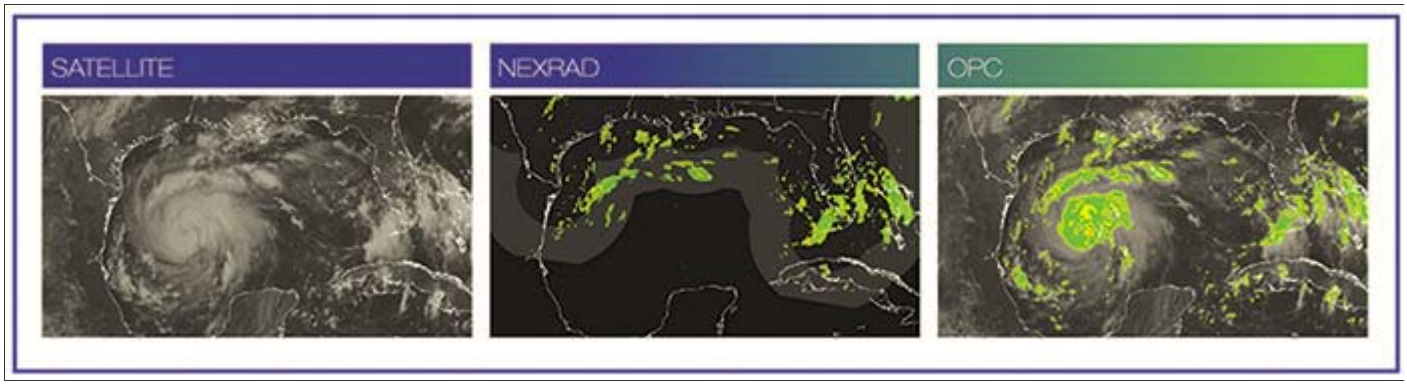
gets a great deal of offshore convective activity when tropical weather comes through. Before we relied on pilot reports, but this tool paints an accurate picture of what's going on."

Randy Bass, a meteorologist in the FAA's Aviation Weather Research Program, in front of an Offshore Precipitation Capability image of Hurricane's Irma (center) and Jose (right).

At the Center, controllers display the web-based OPC information on an external monitor. Since the tool is not yet an operational air traffic control tool, no air traffic surveillance information is included, and controllers cannot share the OPC precipitation intensity levels. That contrasts with NEXRAD weather intensity levels, which are shown on their automation displays, along with aircraft position and other information. "With NEXRAD, I can tell a pilot that there's moderate to heavy precipitation ahead," says Matthew Tucker, NATCA's weather representative and a controller at the Atlanta en route center. With OPC Tucker can give them the general position of the weather, but not the intensity. While not as granular, the information is nonetheless important. "In an area where we don't have anything, it's huge," says Tucker.

A key benefit for controllers using OPC in offshore areas is that they can more easily estimate how pilots will divert around weather. Tucker recalls one incident where a pilot flying northbound in the Gulf of Mexico had requested a deviation of 10-20 miles from his course for weather. "He wound up being 100 miles off course and strayed into military areas — nobody knew where he was." Following the incident, Tucker began asking if having lightning data could help controllers estimate how pilots might change course to avoid weather. In 2011, controllers in Miami separately filed a formal request for the FAA to study methods of obtaining NEXRAD-like coverage for the 11 air traffic control facilities that cover over 22 million square miles of the Atlantic and Pacific oceans as well as the Gulf that have no weather radar exposure. The request ultimately led to the formal development of OPC, a concept MITLL had already begun exploring.

At Miami Center, OPC has become an invaluable situational awareness tool. "Miami Center has so much traffic going north-south, and with Cuban airspace, it's really hard to have an idea what aircraft are going to do until they start deviating," says Tucker. "So you have to kind of guess at what they're going to do, and you have to plan to maintain separation from other aircraft. And if you're not sure how far they're going to deviate, it really adds to your workload."



Hurricane Harvey in the Gulf of Mexico on August 24, 2017.

“If controllers have OPC, they are able to say, ‘the weather is in this direction and it extends for so many miles,’” says Tucker. “I can expect most of the aircraft will go in this direction. I can plan for that and I can adjust the flow if it looks like the weather’s going to impact or close some routes. I can be proactive.”

Along with a forecast capability, near term improvements to OPC are expected when a new geostationary weather satellite becomes operational later this year. Veillette says the new satellite has twice the resolution and a faster update rate compared to satellite it is replacing.

The underlying concepts could also prove helpful in remote areas on land where there are gaps in NEXRAD coverage due to terrain. Randy Bass, a meteorologist in the FAA’s Aviation Weather Research Program, says the FAA next year will begin studying whether the algorithms can fill in those gaps for a continuous weather coverage picture over the Rocky Mountains in the Western U.S. “As you move out of radar coverage and into a gap area, you see the importance of continuity,” says Bass.

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