NOAA REPORT

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NOAA Forecasts Global Climate

—By Carmeyia Gillis

NOAA's new global Climate Forecast System, the first system capable of producing "skillful" operational climate forecasts using a fully interactive computer model of the global ocean-land-atmosphere system, became operational Aug. 24.

In the past, seasonal forecasts have relied mostly on past conditions and trends to make projections into the future, based largely on statistical relationships that describe climate behavior.

The new system, developed by scientists at the Environmental Modeling Center of NOAA's National Centers for Environmental Prediction in Camp Springs, Md., in collaboration with NOAA's Geophysical Fluid Dynamics Laboratory in Princeton, N.J., uses NOAA's weather and climate supercomputer run by NCEP Central Operations in Gaithersburg, Md., to make operational forecasts of climate.

"A hallmark of the Climate Forecast System involves the explicit representation of the interactions between the ocean and the atmosphere," said Stephen Lord, director of the Environmental Modeling Center. "These interactions are critical to determining the evolution of Earth's climate on seasonal time scales because we are now attempting to more accurately depict what actually happens in nature."

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David Hall/NOAA

Researchers from NOAA and East Carolina University and engineers from the Anteon Corp. launch a sonar towfish from the stern of the Office of Naval Research's Afloat Lab off Cape Hatteras, N.C., to search for the sunken USS Alligator, the Navy's first submarine.

NOAA Joins Navy Hunt for Lost Civil War Sub *Alligator*

—By David Hall

Using a variety of remote sensing instruments, researchers from NOAA, the Office of Naval Research and East Carolina University last month began the first comprehensive hunt for the lost Civil War vessel *Alligator*, the U.S. Navy's first submarine.

The search took place August 22-29 off Cape Hatteras, N.C., in the shipwreck strewn "Graveyard of the Atlantic," where the 47-foot-long, green Union sub was lost during a fierce storm in 1863.

Operating from the 108-foot *Afloat Lab*, a former Navy training ship now used for outreach, education and research, the 10-person expedition team used sidescan sonar, a magnetometer and a remotely operated vehicle to comb more than 50 nautical miles of the sea floor for the elusive sub.

After carefully surveying the search area for 17 hours during the expedition's first cruise, the team recorded two large magnetic anomalies that indicate possible shipwrecks and warrant further investigation during future expeditions

"What an exciting way to start off the hunt!" said National Marine Sanctuary Program marine archae-

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Alligator

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ologist Michael Overfield, chief scientist for the *Alligator* expedition.

The search area was based in part upon research conducted by the Hazardous Materials Response Division of NOAA's Office of Response and Restoration in Seattle, Wash., which has experience in predicting how wind, currents and other oceanographic processes might move an object on the water.

"The challenge is going back 150 years and interpolating the data to find a sunken vessel," said Marc Hodges, a trajectory analyst with the Office of Response and Restoration. "From a trajectory modeling perspective, it's a very interesting challenge. But it's one we welcome."

A National Weather Service meteorologist, meanwhile, reviewed historical records to develop a portrait of the storm during which *Alligator* was lost.

"I went through some old Civil War letters and ships' logs and they mentioned that they had a terrible storm around Cape Hatteras," said James Eberwine, Marine and Hurricane Program leader with the National Weather Service office in Mt. Holly, N.J. "From [the records], I surmised that it intensified off Hatteras. It must have been quite a ferocious storm."

Faculty and students from East Carolina University's program in maritime studies and the U.S. Naval Academy sailed with the "*Alligator* hunters" during the expedition, helping to deploy and recover the yellow, torpedo-shaped sidescan sonar and metal-detecting magnetometer "towfish" from the research ship—when the weather cooperated.

"Weather at sea is always variable," wrote National Marine Sanctuary Program director Daniel J. Basta in a log for the expedition's Web site during a visit to *Afloat Lab*. "Today is like any other day: some wind, some rain and periodic high seas. Searching for shipwrecks, especially the *Alligator*, is not for the timid, nor the impatient."

Also on board, on a rare calm day at sea, were a teacher and student from the Stone Ridge School of the Sacred Heart in Bethesda, Md., who had the opportunity to learn first-hand what goes into conducting ocean-based research as part of the *Alligator* Teacher and Student at Sea Program.

"It was good to assist in some small way in the search for the *Alligator*," said Paula Charbonneau, a senior at Stone Ridge School who, as a 2003 summer intern with the National Marine Sanctuary Program, helped research weather conditions at the time of the *Alligator*'s loss. "It really isn't just a story for the archaeologists. It's something we should all be interested in and excited about."

During the expedition, NOAA and the Navy provided residents and visitors to North Carolina's Ocracoke Island, where the expedition was based, with an inside look at the hunt for *Alligator* through tours of the research vessel, a display at the Ocracoke Preservation Society and a free public presentation. An overflow crowd of more than 250 people attended the event, which was held on Ocracoke under a large tent next to the docked research vessel.

The NOAA-cooperative National Undersea Research Center at the University of Connecticut worked with the *Alligator* expedition team to develop educational video and materials about the search. According to center director Ivar Babb, the video will be available for teachers and students to

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NOAA Scientists Study Microbursts With Mobile Doppler Radar

—By Keli Tarp

For the first time, researchers from NOAA's National Severe Storms Laboratory in Norman, Okla., have used a truck-mounted Doppler radar to intercept thunderstorm microbursts and study their impact on the electronic grid in the U.S. desert Southwest.

The NOAA scientists joined forces this summer with engineers and meteorologists from the Tempe, Ariz., based Salt River Project, which funded the research and is the largest provider of electricity to the greater Phoenix area, with about 825,000 customers.

"Microbursts are a form of downbursts, which are winds bursting down from a thunderstorm as a result of the rain-cooled air sinking," said Ken Howard, National Severe Storms Laboratory research meteorologist and program manager. "Known for their devastating effects on aviation called 'wind shear,' they potentially can also damage power systems, especially in the desert Southwest."

Extreme microbursts typically occur in August during the Southwest's monsoon season.

Researchers gathered data using a Shared Mobile Atmospheric Research and Teaching-Radar, or SMART-Radar for short, a five-centimeter Doppler radar mounted on a truck. The radar, developed by the laboratory in collaboration with the University of Oklahoma, Texas Tech University and Texas A&M University, scans lower and faster than conventional radars, providing

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Tejuana Michael/NOAA

Alison Hammer.

Alison Hammer Is the Employee of the Month

—By Glenda Powell

Imagine 100 NOAA employees in sweltering heat as they wade through warm, murky, knee-high water planting over 1,000 wetland plants and lifting and hauling away many pounds of shore debris.

This vision became a reality June 15, thanks to the hard work and dedication of Alison Hammer, who organized the first NOAA-wide Restoration Day at the Chesapeake Bay Environmental Center on Maryland's eastern shore.

"I am flattered to be nominated, but I just helped to coordinate the event," Hammer said. "It was the volunteers who made this event a success."

As a physical scientist with the Special Projects Office in NOAA's National Ocean Service, Hammer's primary duties are planning, facilitation and data base management. For the past seven years, Hammer has worked on a wide variety of projects, ranging from conducting coastal resource assessments to developing World Wide Web portal sites. However, it is her passion for education and outreach that led her to organize the restoration event.

"She is a great employee and was one of the driving forces behind this event," said her supervisor, Tom Culliton, chief of the Coastal Resource Assessments Branch. "She has always been a 'take charge' kind of person, and we are lucky to have her on our team."

At the Chesapeake Bay center, NOAA volunteers restored an oyster reef, stabilized the shoreline with native growing plants and cleaned up debris that had been deposited on the shore by Hurricane Isabel. All activities were aimed at improving habitat and water quality of the Chesapeake Bay, a local treasure that is severely degraded due to human impacts. Bay grass provides important food and habitat for fish, shellfish and waterfowl and helps keep water clean.

At the end of the day, the NOAA volunteers had accomplished their goals, which included planting 45 trays of submerged aquatic grasses and installing a floating dock and 45 feet of coir fiber logs.

Volunteers from NOAA headquarters and every line office participated, providing a real-world demonstration of how NOAA employees, working as "one NOAA," can make a difference.

There was an overwhelming response to a call for participants in the event, with many volunteers having to be placed on a waiting list. Although the principal goal was to help repair Chesapeake Bay habitat, the restoration provided a rare, and greatly appreciated, opportunity for NOAA headquarters staff to work outdoors.

"Restoration Day gave NOAA employees who are usually in the office an opportunity to do field work," Hammer said. "I wanted to

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Hua-Lu Pan/NOAA

Alan Robinson.

Alan Robinson Is the Team Member of the Month

—By Dane Konop

As part of the NOAA planning process for fiscal years 2007 to 2011, each of NOAA's 44 programs was required to prepare '07 program baseline assessments by Aug. 4. Last year, the PBAs were written using word processing programs, an unwieldy approach that made it very difficult to tabulate and compare information. In early May, NOAA management decided to use a new, automated system for the process.

It turned out to be a daunting task, one that would not have been achieved without the contributions of September Team Member of the Month Alan Robinson, a retired Air Force meteorologist now with General Dynamics Corporation, working with the NOAA Program Planning and Integration Office in Silver Spring, Md.

Last year, NOAA adopted a new way of looking at program planning—organizing everything NOAA does into about 40, often cross-cutting programs.

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Focus On...

NOAA Science Camp

—By Rebecca Reuter

When asked what he thought about science after attending the second annual NOAA Science Camp in Seattle, Wash., Juwuan Buchanan, age 12, said, "Now I know that there are more science things than exploding...like oceanography, weather…and umm…and fisheries."

Juwuan was one of 55 students, from 21 Seattle-area middle schools who attended the week-long science camp this summer at the NOAA Western Regional Center campus.

This year's science camp was created by the NOAA Science Camp committee, a core group of about a dozen NOAA employees representing all NOAA offices in Seattle, with help from Washington Sea Grant, the Puget Sound chapter of the American Meteorological Society, the Seattle public schools and parks department, and the Rotary Boys and Girls Club of King County.

The group began recruiting students and creating an information and registration Web site last November.

With financial funding provided by the various NOAA offices involved, the committee hired a camp director and coordinator, five science teachers and 10 high school and college student interns to assist with camp implementation. NOAA employees were also recruited to assist.

Laurie Usher for NOAA

Members of the "Gillrakers" student group check the condition of a female king salmon at a NOAA Fisheries table.

Rebecca Reuter/NOAA

Pacific Marine Environmental Laboratory scientist Sonya Noor describes the components of an ocean climate buoy for students during NOAA Science Camp.

Their combined efforts paid off when the campers arrived on a sunny morning June 21.

Leaving their middle school identities behind, the students were divided into five groups—the Explorers, Forecasters, Gillrakers, Orcas and Tsunamis—that then embarked on a series of hands-on NOAA-related science activities designed to allow the campers to discover the science in their everyday lives, and learn about NOAA.

"We used chocolate pudding and surplus fish otoliths to make fake pinniped scats for the campers to process, so they could experience how a scientist studies the diet of marine mammals," said Lisa Hiruki-Raring, a wildlife biologist at the NOAA Fisheries National Marine Mammal Laboratory.

Two divers from the NOAA National Dive Center fielded student questions from a 30-foot dive tank: "Have you ever seen a shark? What's the deepest you've gone? How do you go to the

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bathroom?"

Nearby, at the docks of the NOAA Western Regional Center, Pacific Marine Environmental Laboratory staff showed campers equipment and instruments used in the Tropical Atmosphere-Ocean Project's array of moored buoys.

In addition to the hands-on activities, campers were led on various NOAA "field trips."

Campers participated in a Global Positioning System navigation demonstration by staff from the National Ocean Service's Office of Coast Survey and released a weather balloon with Weather Service meteorologitsts.

During the week, science-camp interns created a "Science Jeopardy" game to evaluate what the campers had learned. Campers were asked, "What does an anemometer measur? What is a pinniped? Where is a nautical mile used? What is a watershed? And, how have humans helped salmon swim up dams?"

On Thursday, NOAA Science Camp staff had a special surprise for the campers—a hypothetical environmental incident that required the scientists-in-training to utilize what they had learned earlier in the week.

Campers were challenged to create action plans to determine the cause of a mysterious, hypothetical fish kill in Puget Sound and to assess the potential impacts on marine animals and the environment.

The Tsunamis worked with Pacific Marine Environmental Lab scientists to test Puget Sound water for potential elements that could cause a fish kill.

The Forecasters worked with staff from the Weather Service and the National Ocean Service's Office of Response and Restoration to use weather data to model the movement of the suspected contaminant.

The Gillrakers worked with NOAA Fisheries to identify the threatened fish and find out where the fish's normal habitat is and how old it was.

Representatives from each group then met to pool their findings and participate in discussions, led by the science teachers, of the possible causes and effects of the fish kill. This activity enabled the campers to experience how NOAA offices work together to respond to real-life environmental incidents.

"Your goal—to encourage at least two to three of the youth that have attended this year's NOAA Science Camp to consider science as an exciting, interesting and fascinating discipline worth exploring into adulthood—has most likely been surpassed," said Victoria Brown, education director of the Rotary Boys and Girls Club of Seattle.

Laurie Usher for NOAA

National Weather Service meteorologist Chris Hill and students from the "Tsunami" group prepare to launch a weather balloon.

Laurie Usher for NOAA

Physical scientist Kaitlyn VanSant explains a NOAA nautical chart to students in the "Explorers" group.

Alligator

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view on their own time and schedule via a Web interface.

"The team is committed and enthusiastic," Babb said. "I hope we can encapsulate this excitement in our video content as well, for this is the essence of exploration and discovery."

Cable television's Science Channel also filmed the search for a feature documentary on *Alligator* that will air next year.

The current hunt for *Alligator* is part of an effort initiated in 2002 by the Office of Naval Research and NOAA to learn more about the largely forgotten submarine, while fulfilling NOAA's mission to promote scientific research, exploration and education.

"If we can find the Alligator, we can find anything," said Cdr. Jerry Stefanko of the Office of Naval Research.

"The wonderful thing about the *Alligator* is that it's getting people to learn about meteorology and oceanography," Basta said. "It's also about building partnerships—with the Navy, with the private sector, with universities. And it's getting people focused on the oceans and our maritime heritage."

Marine archaeologists from NOAA's Maritime Heritage Program, housed within the National Marine Sanctuary Program of NOAA's Ocean Service, are contributing to the *Alligator* project decades of experience studying and protecting historically significant shipwrecks, including the Civil War ironclad *USS Monitor*, which was discovered in what is now the *Monitor* National Marine Sanctuary off Cape Hatteras in 1973.

In December 2003, NOAA and the Office of Naval Research unveiled the only known blueprints of the sub, which were discovered in France last year by the National Marine Sanctuary Program's Catherine Marzin (see the January 2004 issue of the *NOAA Report)*.

The hand-powered *Alligator* represented a significant leap forward in naval engineering when built in 1862. Among the sub's most notable features was an airlock designed to allow a diver to exit the vessel while submerged and place an explosive charge on an enemy ship. *Alligator's* design also included an air purification system. Both are standard components of modern submarines.

But before it could prove itself in battle, *Alligator* was lost in April 1863 while being towed to Charleston, S.C., to participate in a Union assault on that city. No one was aboard.

Severe weather off the North Carolina coast halted the expedition before the research team could adequately groundtruth the two targets of interest, but their work continues on shore.

"We are now reviewing the sonar and magnetic data we collected for clues about the *Alligator's* whereabouts," Overfield said. "When we go through the post-processing phase of the search, new targets will be revealed. So, stay tuned," he said. "The hunt continues."

Even if the team doesn't find *Alligator*, Overfield said, the data will help scientists gain a better understanding of what lies off the shores of Cape Hatteras, whether biological, geological or man-made.

"The *Alligator* is an exciting project because it's a small object in a challenging part of the ocean," said expedition participant Cdr. Jerry Stefanko of the Office of Naval Research. "If we can find the *Alligator*, we can find anything."

Climate Forecast

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The center began the global climate forecast process by running a long simulation of the model for some 30-plus years to test the coupled system for climate variability. The modelers chose the El Niño/Southern Oscillation, or ENSO, since it is associated with changes in sea surface temperatures in the tropical Pacific Ocean that can have significant impacts on weather around the world. Also, knowing that ENSO occurs about every four to five years and can last up to 12 to 18 months gave NOAA scientists a basis for their experiment.

"We wanted to see whether this new system could produce [warm] El Niño and [cold] La Niña events related to ENSO with any degree of reality, and it did," said Wanqiu Wang the meteorologist at the Climate Prediction Center who ran the simulation.

The model simulated realistic ENSO events both in amplitude and phase and had very small model bias in the evolution of sea surface temperature in the tropical Pacific Ocean. "This was very good news for us, and it meant that we could now try to develop a prediction system based on this model," said Hua-Lu Pan, the prediction center's climate modeling team leader.

But developing a truly good dynamic prediction system that is useful to the seasonal forecast process is a daunting task. "It is critical for Climate Prediction Center forecasters to have reliability estimates of forecast skill for any new technique," said center forecaster Huug van den Dool.

To estimate its skill, the NOAA scientists produced 15 different forecasts from each calendar month spanning a period from 1981 to

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Climate Forecast

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2003. Each of these was a nine-month forecast. To determine the model's skill, it was crucial to compare this large data set of many forecasts over many past years with actual observations. "Imagine running a model for the equivalent of 4,000 years and analyzing all the results, and then operationally implementing the system, all in one year," said the Environmental Modeling Center's Suru Saha, lead scientist on the project.

The next milestone was to evaluate these runs, which showed a respectable level of skill that could be used by the Climate Prediction Center in conjunction with other tools used in their seasonal prediction process.

Finally, the system had to be made operational.

"It's all very well to run a prototype system, but to actually make it run day after day in operations without any failures is a different ball game," said the Environmental Modeling Center's Shrinivas Moorthi, who helped make the system operational.

The project team used data from the Earth Observation System, which takes the "pulse" of the planet using observations and measurements of the oceans and atmosphere by buoys, ships, satellites, land surface stations and other sources, to set the initial operating conditions for the global climate forecast system.

"There is an international aspect to the use of this product," Lord said. "Developing nations can take advantage of this cutting-edge technology to help mitigate potential climate forces."

"The Climate Forecast System is the beginning of a new era for long-lead forecasting," said Climate Prediction Center director James Laver.

Microbursts

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more detailed information about the wind speed and shear structure in thunderstorms.

While the weather wasn't completely cooperative during the field period from late July to early August, the researchers were able to collect enough information to study until they return next year.

"We gathered a lot of data. There were a few days of special interest that we're doing analysis on," Howard said. "All in all, it was probably a good research field campaigns project because it generated more questions than answers.

"We hope this is the first of several years of documenting this and providing the Salt River Project with the strength of microburst winds and the background environment of the storms associated with them," Howard said. "We also used the radar to examine other storm structures such as those leading to Arizona flash floods and storms associated with extreme amounts of cloud to ground lightning."

The researchers learned that the area's terrain definitely affects local weather patterns. "Arizona is a very complex place," Howard said. "You have the terrain, you have the desert and you have monsoonal moisture coming up. You see a lot of things that are kind of atypical from what you see out here in Oklahoma.

"The area's high temperatures and sand storms tested the equipment to the extreme," he said. "There were many days we were operating in temperatures greater than 107 degrees. We had one day about 115. Many times we got ourselves into sandstorms where we had zero visibility.

"It was probably good from the standpoint that it allowed us to come back and recommend several things as far as modifying the equipment so that it performs better in such a harsh environment," Howard said.

The ultimate goal of this project was to help Salt River Project engineers and meteorologists forecast and mitigate extreme microbursts and other severe storm events. "I think we gained a better understanding of the Salt River Project engineers' perspective," said NOAA research meteorologist Steve Vasiloff.

"A large utility company like that has many operational challenges beyond just generating electricity," Howard said. "You can generate electricity; but if your poles won't stand up, you can't deliver it. So they're looking at ways to further harden their infrastructure against thunderstorms, microbursts and outflow from storms."

For more than 10 years, the National Severe Storms Laboratory and the Salt River Project have collaborated on basic research projects to investigate and mitigate the impacts of extreme weather and flood prediction.

"This particular research project may lead to broader applications for improvements for the NEXRAD system of Doppler radars, especially in the area of electrical power generation and transmission," Vasiloff said.

The research with the Salt River Project has led to possible new applications of data from NEXRAD radars as well as from FAA radars, which are tuned for the identification of microorbursts that might affect aviation and are located in major populations centers, Vasiloff said.

The NOAA researchers believe their work studying thunderstorms in the Arizona desert could eventually help forecasters throughout the U.S. better predict severe winds.

Hammer

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give people a chance to get out, see the Chesapeake Bay and remind them why they first chose to go into the environmental field."

Hammer's role in coordinating this event was critical. She proposed the idea during a detail to NOAA's Chesapeake Bay Office in the summer of 2003.

She found willing partners and sponsorship from the Chesapeake Bay Office and the NOAA Restoration Office, and quickly gathered a team of enthusiastic restoration experts from government, academia and nonprofit organizations to organize various aspects of the event.

She oversaw the outreach and publicity effort to raise awareness of the day, worked with her team to plan the agenda of activities, coordinated the logistics and even created and maintained the NOAA Restoration Day Web site.

In the months leading up to Restoration Day, Hammer also led the distribution and coordination of bay grass tanks in 15 NOAA offices. She found sponsors, trained staff about growing bay grass, distributed growth tanks and associated materials and kept NOAA staff informed about the project.

Many participants in Restoration Day said the event helped "recharge" their enthusiasm and remind them of the environment and resources they are working to protect and that Hammer's vision and determination to make Restoration Day a reality were critical to the event's success.

Plans are already in the making for the second annual NOAA Restoration Day. Hammer hopes it will be even bigger and better. Her advice: Sign up early, or you may miss your opportunity to be a part of NOAA history.

Robinson

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The Internet-based interactive program NOAA chose was one already being used by General Dynamics in NOAA's Satellite Service called "CasaNOSA," an acronym for the "home of the NOAA Observing System architecture."

Susan Kennedy, deputy director of the Strategic Planning Office, said, "Our office and Program Analysis and Evaluation looked at it and we said, 'It looks like something useful and helpful. Let's do it.' Saying that was one thing. It was another thing to pull it off."

CasaNOSA needed major tweaking to make it useable for NOAA's PBAs. And time was short.

"All the programs had to have all their information submitted within the CasaNOSA system by July 27," Kennedy said.

CasaNOSA is a sophisticated interactive system, allowing users to input numbers, text and pictures. As with any new system, the 300 or so employees who would be using it needed computer set-up and training.

Because Robinson was a General Dynamics employee already working on the requirements management process in the program planning and integration office, he was assigned to be the "face of the project," he said, and the "go between" for General Dynamics software engineers and the NOAA users who would be working with CasaNOSA for the first time.

"We did a lot of this on the fly," Robinson said. "And there were some difficulties and challenges getting the system up and running, because we were under such a time crunch. We didn't have time to sit down and thoroughly create the data base and beta-test it before we launched it on the programs."

"CasaNOSA is basically a template," said Kay Weston, a NOAA Fisheries program analyst working on the ecosystems PBA. "It asks, "What is the purpose of your program? What are your performance measures? What are your capacities?"

Robinson learned the system, then tutored the users, generally in their own offices, sometimes in small groups, oftentimes one on one. Most of the users were budget and program analysts, but many had science or other backgrounds.

"All the people from all the programs put in information," Weston said. "If they had problems, if the template didn't work or if they couldn't find stuff, Alan would help them. The CasaNOSA system is not intuitive. He would help people work through that."

Eventually, all 44 programs were able to adapt to the CasaNOSA system and get their PBAs in on deadline. "It would not have been successful without Al," Kennedy said.

"Some people will tell you it went very well. Some people will tell you it was very time consuming," Robinson said. "From our perspective, the pain that we went through was worth the long-term beneficial results that will be derived from it."

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