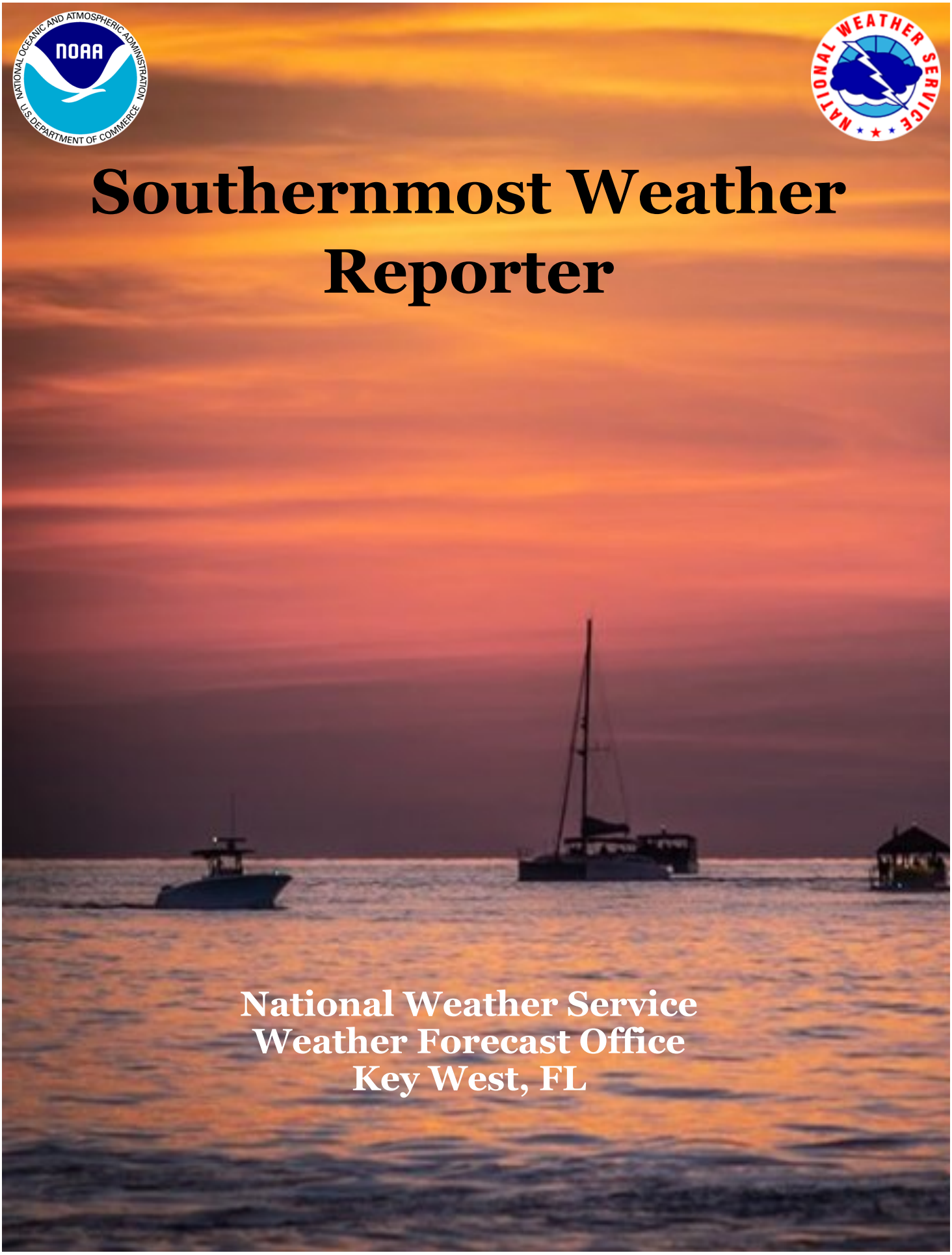


Southernmost Weather Reporter

National Weather Service
Weather Forecast Office
Key West, FL

Southernmost Weather Reporter

National Weather Service • Key West, FL

Welcome to the First 2020 Edition!

March 2020

Inside this Report:

Welcome to the first edition of the *Southernmost Weather Reporter* of the 2020s! The year 2020 is an anniversary year for both the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS). The NOAA celebrates its Golden Anniversary this year. Since its inception on October 3, 1970, NOAA has become one of the world's premier science agencies that protects life and property, leads stewardship of the ocean and Great Lakes, and drives the blue economy — a mission that spans from the surface of the sun to the floor of the ocean. Although NOAA was formally established 50 years ago, its roots originated a century earlier with the Survey of the Coast in 1807. NWS celebrates 150 years saving lives, protecting property, and enhancing the nation's economy! On February 9, 1870, President Ulysses Grant signed a joint resolution of Congress authorizing the Secretary of War to establish a weather service within the Army. This resolution required the Secretary of War "to provide for taking meteorological observations at the military stations in the interior of the continent and at other points in the States and Territories and for giving notice on the northern (Great) Lakes and on the seacoast by magnetic telegraph and marine signals, of the approach and force of storms."

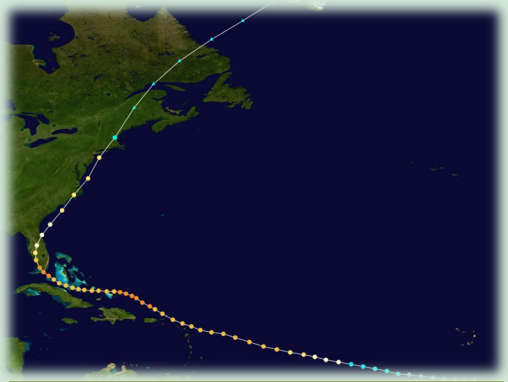
On November 1, 1870, at 7:35 a.m., the first systematized and synchronous meteorological reports were taken by observer-sergeants at the 24 stations in the new agency and the word "forecast" officially became established. These observations, which were transmitted by telegraph to the central office in Washington, D.C., commenced the beginning of the new division of the Signal Corps. A Weather Observing Station in Key West was among the original stations. Observations were taken at the Russell House on the west side of Duval Street, between Front and Green Streets. Although the science, technology, and communications associated with weather observing, analysis, prediction, and warning are much different in 2020, an uninterrupted federal weather service presence has existed in Key West, Florida since the birth of the agency in 1870! Enjoy this edition of the *Southernmost Weather Reporter*, and please stay safe and "Weather-Ready" in 2020.

Sincerely,

Kennard "Chip" Kasper
Meteorologist-in-Charge
Florida Keys NWS

2020 Marks the 60th Anniversary of Hurricane Donna

By: Sandy Delgado



Official Track of Hurricane Donna (1960)

The year of 2020 marks the sixtieth anniversary of Hurricane Donna, one of the strongest systems to impact the Florida Keys in recorded history. For those unfamiliar with Hurricane Donna, you might be more familiar with the more recent Hurricane Irma back in 2017. The track of Hurricane Donna is shown to the left. The track of Donna was very similar to Irma.

Hurricane Donna was a classic, long-lived Cabo Verde system. It developed in late August to the south of the Cabo Verde Islands from a strong tropical wave that left the African coast and strengthened into a tropical storm on August 31st and into a hurricane the next day. Late on September 2nd, Donna became a major hurricane as it approached the Leeward Islands, making landfall in Barbuda on September 4th and in Saint Maarten on September 5th. While passing north of Hispaniola on September 6th, the forward speed of Donna decreased and the hurricane turned to the west, affecting the Turks and Caicos and the eastern Bahamas.

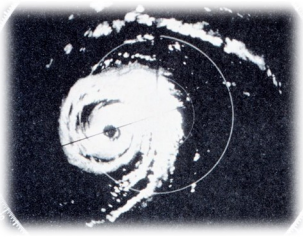
Late on September 6th, Donna reached a peak intensity of 145 mph, making it a very powerful Category Four hurricane. On September 7th, a hurricane watch was issued for the Florida coast from Melbourne south to Key West. On September 8th, Donna made landfall in the central Bahamas with maximum sustained winds of 125 mph. At 11 am on September 8th, hurricane warnings were issued for the Florida Keys from Key Largo to Key West, including the Dry Tortugas. Donna made landfall at Conch Key in the Middle Keys in the early morning hours of September 10th with maximum sustained winds of 145 mph and wind gusts near 180 mph. The hurricane affected the entire Florida Keys, with the most significant damage occurring near the area of landfall. Tavernier reported sustained winds of 120 mph, the highest that the anemometer was capable of measuring, with the instrument measuring this speed for a full 45 minutes. Sombrero Key Light recorded wind gusts around 150 mph. Impressively, both stations were outside the radius of the strongest winds.

The northern section of Tea Table Key Bridge was destroyed during Hurricane Donna.

About 75% of the structures from Marathon to Tavernier were extensively damaged. The storm surge reached a devastating 13 feet in Marathon! The storm surge covered the Overseas Highway and washed out several sections of the road. Boats and docks were also damaged or destroyed, and the storm surge pushed some boats over the islands in the Middle Keys. Donna also ravaged the northern section of the Tea Table Key bridge. The pipeline supplying the Keys with fresh water was broken in at least five places. After departing the Florida Keys, Donna made another landfall in southwest Florida and moved across the state, exiting near Daytona Beach as it accelerated to the northeast. Donna later made landfalls in North Carolina and New England, leaving its mark across the entire Eastern Seaboard. The National Hurricane Center retired the name "Donna" because of the massive devastation it created.

(Continued on Page 3)

60th Anniversary of Hurricane Donna (continued)



WSR-57 radar image of Hurricane Donna over the Florida Keys on Sept. 10, 1960

Hurricane Donna still today remains one of the most intense hurricanes to hit Florida and the United States. It is the only recorded hurricane to have produced hurricane-force winds in every state along the U.S. East Coast from Florida to Maine.

On a positive note, Donna is also remembered as a triumph in hurricane forecasting. Advancements in technology, such as radar and reconnaissance aircraft flights, and improved knowledge of what drives hurricane movement and intensification, allowed for more accurate tracking and intensity forecasts for Donna. Proper measures and protective actions were taken by authorities and the public that saved lives. Sixty years later, we continue to use some of the same techniques to accomplish our mission to save lives and properties, as was the case for Hurricane Irma in 2017 for the Florida Keys.

Bahia Honda State Park Temperature Observations Return

By: David Ross

(From left to right):
Park Rangers Mark Tuschel, Todd Jamison, and Keely Kessler-Final

After a 2-year hiatus due to damage from Hurricane Irma in September 2017, Bahia Honda State Park Rangers and volunteers are once again collecting temperature observations for the National Weather Service (NWS) Cooperative Observer Program (COOP)!

An idea from Park Manager Don Bergeron led to former Assistant Park Manager Meredith Kruse and Park Ranger Todd Jamison designing and building a lighthouse for the temperature sensor and display. This new structure is located near the Nature Center and allows for the equipment to be solar-powered.

The new Bahia Honda temperature sensor is harbored in a lighthouse structure that is solar-powered.

Daily reports from Bahia Honda and other locations throughout the Florida Keys are included in our Regional Temperature and Precipitation Summary (RTP) that is issued around 10:00 AM every day. The RTP product can be accessed here.

Staff Visits Observation Site at Dry Tortugas National Park

By: Sandy Delgado

Dry Tortugas National Park

Last November, NWS Key West Observation Program Leader (OPL) Dave Ross and myself visited the Cooperative Observer Program (COOP) weather station in the Dry Tortugas for routine maintenance. The most important item addressed was replacing the temperature display, as the numbers were illegible on the old screen. The salty environment is harsh to electronics. The temperature sensor was also cleaned to remove the accumulated dust. The wooden structure that houses the temperature sensor and display was repainted to give it a layer of protection against the elements. In addition, the rain gauge was replaced as the sun breaks down the plastic over time. Lastly, we recorded the distances from the rain gauge to the foliage and other structures that could affect the rain collection. It was a very productive trip! Dry Tortugas is a beautiful place and it is certainly a treat to visit.

The NWS COOP program is the nation's weather and climate observing network of, by, and for the people. More than 8,700 volunteers take observations on farms, in urban and suburban areas, National and State Parks, seashores, and mountaintops. Volunteer observers, like those at Bahia Honda, Curry Hammock, and John Pennekamp State Parks, Fort Jefferson in Dry Tortugas National Park, the Florida Keys Electric Cooperative in Tavernier, and the Wagner Family on Duck Key, conscientiously contribute their time or host equipment for these vital observations. For more information on the NWS COOP program, visit https://www.weather.gov/coop/overview.

Observation Program Leader David Ross servicing the COOP station at Dry Tortugas National Park

2019 Florida Keys National Weather Service Staff Changes

In 2019, there were several staff changes at the Florida Keys National Weather Service (NWS):

- Adam Futterman, former Meteorologist, accepted a position as a Marine Forecaster at the Ocean Prediction Center in College Park, Maryland. He completed his year tenure at at Key West in December 2019.
- Katherine Lenninger and Nancy Barnhardt joined the office in August 2019 as Meteorologists.
- Martin Rieman joined the office in March 2019 as an Electronics Technician.

We wish those departing the best and a warm welcome to those joining the Florida Keys NWS!

Getting to Know the New Staff!

By: Bryce Tyner

What were you doing before joining the team at the Florida Keys National Weather Service (NWS)?

Nancy: Before joining the NWS, I was pursuing my Master's degree in Earth and Atmospheric Sciences at University of Nebraska-Lincoln.

Katie: Before joining the team, I was a grad student at the University of Maryland researching atmospheric chemistry. More specifically, I was studying and modelling how lightning produces nitrogen in the atmosphere during thunderstorms and how that affects atmospheric ozone chemistry.

Martin: I worked at the Department of Veterans Affairs in Charleston, South Carolina as an electronics technician for 2 years. Before that, I worked for a private company that contracted work for the United States Marine Corps as an electronics technician for 18 years

Where do you see yourself in ten years?

Nancy: In ten years, I see myself continuing with the NWS, being promoted as a Lead Meteorologist.

Katie: In 10 years, I see myself still enjoying the Florida sun while working for the NWS as a lead forecaster.

Martin: I see myself working and enjoying life in Key West .

What do you like to do in your free time?

Nancy: A few things I like to do in my free time are running, reading and visiting the multitude of state parks in the Florida Keys.

Katie: I used to do a lot of fun things before graduate school, but that consumed my life and I had to give up a lot. Since graduate school, I'm rediscovering what I enjoy doing and what makes me happy. I love baking, riding my bike in this gorgeous weather, reading, trying new restaurants, food, beer, watching Star Trek, photography, and hiking the White Mountains whenever I'm in New Hampshire over the summer.

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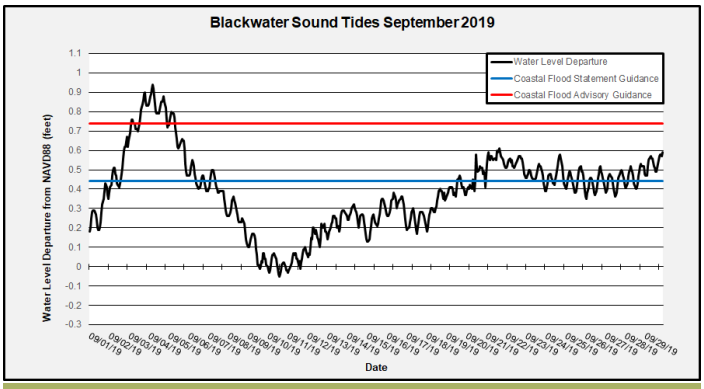
- SKYWARN training does not have to wait for a scheduled public course. If you would like SKYWARN storm spotter training for your government agency, employees, or homeowner's association in the Florida Keys, please contact Jon Rizzo, our Warning Coordination Meteorologist, at phone number 305-295-1316 extension 223 or email address jonathan.rizzo@noaa.gov.

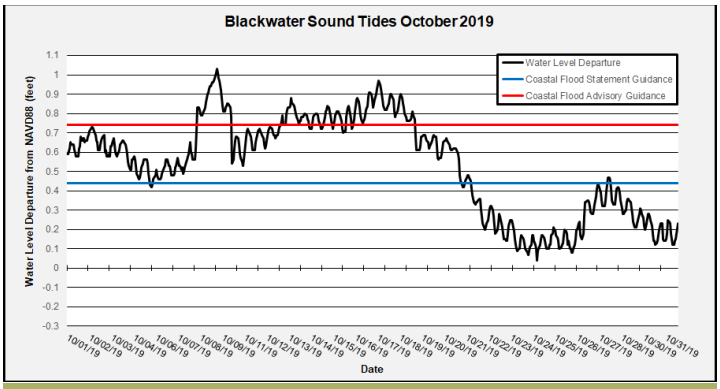
Prolonged Coastal Flooding in the Upper Keys Late in 2019

By: Luis Ingram-Westover

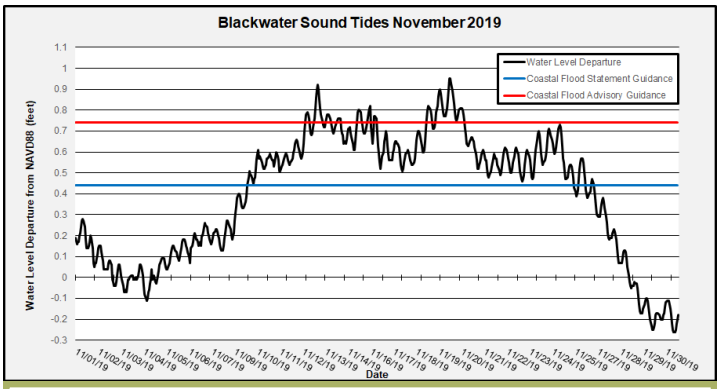


Time series of water level at Blackwater Sound for Sept. 2019

The forecasters at the Florida Keys National Weather Service (NWS) issue three products for coastal flooding across the island chain. The first level is a Coastal Flood Statement. A Statement is issued when the total water level (tide plus anomaly) at higher tides results in saltwater inundation of low-lying streets and lots. The second-level product is a Coastal Flood Advisory. An Advisory is issued when the total water level within low-lying neighborhoods makes it nearly impossible to avoid saltwater inundation. Corrosive damage of automobiles is likely during an Advisory. The final, third-level, is a Coastal Flood Warning. A Warning is issued when the total water level is a threat to life and property. Saltwater inundation in low-lying neighborhoods can reach one to three feet during an Advisory. Some ground story dwellings will experience minor inundation during an Advisory. Late last year, portions of the Upper Keys experienced a prolonged period of coastal flooding. Over the course of three months, we issued nearly continuous Coastal Flood Statements and Advisories for the Bayside communities of Key Largo. The last time there was a sustained coastal flooding event in the Upper Keys was Sept.-Oct. 2015, when saltwater inundation of low-lying streets and neighborhoods lasted nearly five weeks.



Time series of water level at Blackwater Sound for Oct. 2019



Time series of water level at Blackwater Sound for Nov. 2019

What caused the water levels to be so high for so long? Through a combination of factors (the sun and moon's gravitational "pull", warm sea surface temperatures, lower regional surface pressure), the tides in the fall months tend to be the highest of the year. Furthermore, portions of the Gulf Stream experienced fairly persistent strong northeasterly winds that resulted in a backup of the poleward transport of warm water. Finally, there were a number of storms across the western North Atlantic, including Hurricane Dorian and Hurricane Humberto. The combination of high astronomical tides and unusual meteorological conditions resulted in a long-duration coastal flooding event in portions of the Florida Keys . Finally, the Florida Bay basin is semi-closed with a complex hydrography, and this combined with equally complex hydraulics associated with the upper Florida Keys likely resulted in the persistent high water levels.

Sugarloaf Marine Science Community Night

By: Chris Rothwell

Use of a "tornado tube" to teach students about several meteorological topics

Last October, as the Marine Program Focal Point, I represented the Florida Keys National Weather Service (NWS) at Sugarloaf School's Marine Science Community Night. I joined two dozen local, state, federal, and private marine partners from across the Florida Keys to showcase marine science with the students of Sugarloaf School. One of the tools that I use for these sorts of events is a "tornado tube" to teach students about cumulus congestus, waterspouts, thermal imbalance, and global heat exchange. Inevitably, the tornado tube leads to other interests and questions to explore with the students. Many students have questions about climate change, hurricanes, lightning, and what to study for a career in meteorology.

Part of the Florida Keys NWS' best practices during outreach events is to set up our booths and tents next to our colleagues from NOAA. I joined Nicole Uibel from the Florida Keys National Marine Sanctuary (FKNMS) for Sugarloaf's Marine Science Community Night. Any weather questions Nicole gets at her booth can be redirected to the Florida Keys NWS booth; likewise, reef and fish questions can be redirected to the FKNMS booth. "One-NOAA" is typically thought of as an operational principle, but we try to extend the value of intra-NOAA partnerships during our community outreach.

2019 Florida Keys Climate Summary

By David Ross

The Florida Keys experienced their warmest year on record in 2019, with the official readings at Key West and Marathon averaging 80.3°F (2.5° above normal) and 81.7°F (3.3° above normal), respectively. The average of 80.3°F at Key West also marks the first year on record where the average temperature was 80°F or higher. Annual temperature records at Key West date back to 1874 and at Marathon date back to 1952, although the official observing locations for each city have moved slightly over the years. In 1958, the observation from Key West moved from the Weather Bureau to the current location of Key West International Airport. Marathon's observations over the years have been sited at Marathon Shores, Conch Key, Duck Key, and now at Marathon Airport.

Last year at Key West marked the 4th out of the past 5 years that ranked in the top 5 warmest on record, joining 2015 (now 2nd warmest) and 2017/2018 which are tied for the 4th warmest. It was the 3rd such year for Marathon, joining 2015 (now 2nd warmest) and 2017, the 3rd warmest. Outside of the airport locations, three other Florida Keys observation sites recorded their warmest year on record. Fort Jefferson at Dry Tortugas National Park was one of these sites, with records at this location dating back to 1951.

(Continued on page 8)

2019 Florida Keys Climate Summary (continued)

In addition to the warmest year on record, Key West experienced its warmest February on record and five other months in their top 10 warmest. Marathon experienced its warmest February, April, May, June, and October on record, and with the exception of January saw the remaining months of the year all in their top 10 warmest. Among records set or tied in 2019, there were 57 daily temperature records at Key West and 149 daily temperature records at Marathon. The majority of these records at both sites were warm minimum temperature records. There were also three monthly temperature records set or tied at Key West and seven such records at Marathon.

Regarding warm minimum temperatures, there were 113 days at Key West with a low temperature of 80°F or higher, second only to 2015 with 120 such days. Marathon experienced a record 131 days with lows of 80°F or higher. The previous record for Marathon was 105 days from 2017.

RECORDS *(Set or Tied)*	**DAILY TEMPERATURE**				**DAILY RAINFALL**
	Maximum	Low Maximum	High Minimum	Minimum	
Key West	12	0	45	0	3
Marathon	71	0	78	0	4

Summary of daily records that were either set or tied at Key West and Marathon. Daily records date back to January 1871 for the Key West area and June 1950 for the Marathon area.

Hot and dry seem to be a common phrase, and it fits for the Florida Keys last year, as all observation sites along the island chain recorded below normal rainfall totals. Deficits ranged from 4.45" at the Key West International Airport to 17.56" at John Pennekamp Coral Reef State Park.

Key West ended the year with 35.38" of rainfall, a couple of inches less than 2018 and well below the annual average of 39.83". Marathon ended up with 33.75", marking the second year in a row with a deficit over 1 foot (12.42" inches below average in 2019) and the 14th driest year on record for the Marathon area. Annual rainfall records at Key West date back to 1871 and at Marathon date back to 1952.

The wettest days recorded last year for Key West and Marathon occurred just before Christmas, when Key West recorded 5.48" on December 22nd and Marathon recorded 2.68" on December 23rd. Not only was the 22nd the wettest day of 2019 for Key West, it was also the wettest day at the airport since October 17th, 2011 when 6.94" was measured.

Interestingly, the wettest and driest months of 2019 for Key West and Marathon occurred during opposite times of the year. The wettest month of the year for Key West was December (7.71") and for Marathon was July (4.93"). The driest month of the year for Key West was June (0.88") and for Marathon was November (0.30"). December 2019 also entered the "top 10 wettest Decembers" for both sites, ranking 3rd for Key West and 7th for Marathon. Marathon had two other months enter top 10 rankings for wettest/driest months during 2019, September (2.92", 10th wettest) and November (0.30", 6th driest).

Between the two climate sites, there were seven daily rainfall records set in 2019. Three of these were at Key West, occurring in March, April, and December, and 4 were at Marathon, occurring in February, April, May, and December.

2019 Hydrology Workshop at the Florida Keys National Weather Service

By: Chris Rothwell

Participants meet in the Florida Keys NWS conference room for the 2019 Hydrology Workshop.

Forecasters from the Florida Keys National Weather Service (NWS) Weather Forecast Office (WFO) held a day-long Hydrology Workshop in Sept. 2019. Topics included freshwater flooding, both from overflowing rivers and heavy rainfall, hydrology training, WFO Miami hydrology operations, Southeast River Forecast Center (SRFC) operations, and the Coastal Flood Monitor application.

Although there are no threats of riverine flooding in the Florida Keys, our mission requires operational readiness for our three backup offices (WFO Melbourne, WFO Jacksonville, and WFO Miami), which all have the threat of overflowing rivers. Heavy rainfall is always a threat for the City of Key West, especially when rainfall rates exceed the storm water system's capabilities. Allison Higgins from the City of Key West discussed the city's short and long-term mitigation efforts for storm water and sea level rise. Robert Garcia, lead forecaster from WFO Miami, discussed the challenges of reinforcing the levee around Lake Okeechobee, and the very real threat from the compromised sections of the Lake's levee system. John Schmidt discussed the dynamic challenges the Southeast River Forecast Center faces, including their mediating role between WFOs and the National Water Center. Kelly Godsey, Senior Service Hydrologist (SSH) from WFO Tallahassee, discussed several new tools available to forecasters to assess and disseminate coastal flooding threats and impacts. This workshop proved to be a valuable hydrology refresher for our forecasters, and it also led to the formation of a collaborative hydrology team of all WFOs in Florida. Probably the biggest takeaway was the invaluable networking we nurtured with our intra-agency partners, especially the SRFC and our sub-regional SSH.

2019 Diversity Program Activities

By: Luis Ingram-Westover

It's been just over one year since I became an ambassador for the National Weather Service (NWS) Lesbian, Gay, Bisexual, Transgender, Questioning/Queer (LGBTQ) and Hispanic affinity groups. In that time, I have had many accomplishments in the way of educating my fellow colleagues as well as trying to expand the NWS' reach into the Science, Technology, Engineering, and Mathematics (STEM) field. In March 2019, I gave a talk titled, "Diversity and Inclusion in the Workplace" to the office staff here at the Florida Keys NWS. This talk was then presented in front of a larger audience across the entire NWS agency in April. I focused on reasons and benefits of building and becoming a more diverse and inclusive workplace. I also provided details of how to become an ally. There's a push from those who are seeking to be an ally, whether it be for the LGBTQ community or other minority groups, in order to show support and solidarity, particularly when the office only has one representing a specific minority group. The presentation was met with high praise and I was asked to do another talk at a later point, possibly in time for Pride Month in June 2020.

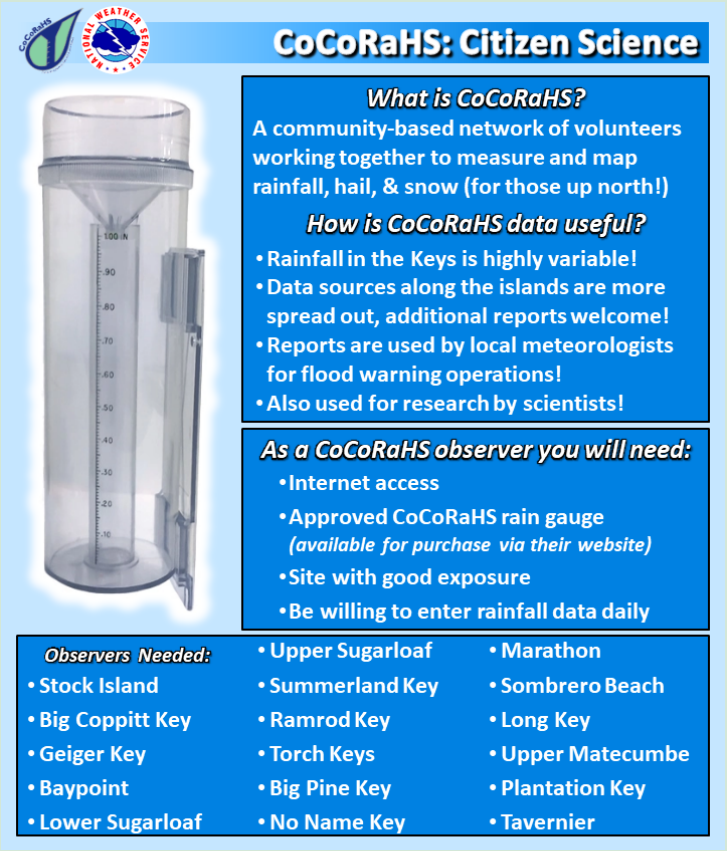
(Continued on Page 10)

2019 Diversity Program Activities (continued)

In April 2019, I was asked to speak as part of a panel to a classroom full of new managers and supervisors. I was incredibly honored to have been asked to participate and happily jumped at the opportunity to speak with the agency's newest managers. During the discussion, the panel and I were asked various questions about a number of topics, including ethics rules, diversity, and womens' topics. Florida Keys Meteorologist-in-Charge NWS Chip Kasper was actually a part of this class! Following the success of this panel, I plan on volunteering for future panels the NWS Training Center may host in the future.

Presenting to new managers and supervisors at the NWS Training Center in Kansas City, MO.

I concluded 2019 by attending the Out in Science, Technology, Engineering, and Mathematics (oSTEM) Conference at Detroit, MI in November. oSTEM serves as a resource depot for not only LGBTQ students and professionals but also those who are allies or looking to become an ally. The conference spanned across several days, with two days dedicated to talks and presentations. I was thoroughly surprised at the sponsors for this year's conference. There were big-name companies present such as Boeing, Ford, Texas Instruments, as well as government agencies including the CIA and NSA. Seeing such a large government presence, my goal is to have the NWS and our parent agency, the National Oceanic and Atmospheric Administration (NOAA) as sponsors for future conferences. It is important for the future of the NWS and NOAA to attend conferences such as oSTEM to promote a diverse and inclusive workplace.



Did you know that our office also contributes rainfall measurements to The Community Collaborative Rain, Hail, & Snow Network (CoCoRaHS)? Our White Street facility in Key West (across from City Hall) manually measures 24-hour rainfall at midnight standard time every day of the year. These reports are then submitted to the online CoCoRaHS database, one of 22 such observation sites in the Florida Keys. In 2019, Florida Keys CoCoRaHS participants recorded 3,868 observations & over 495" of rain!

Florida Keys National Weather Service
Fire Weather Support on Big Pine Key

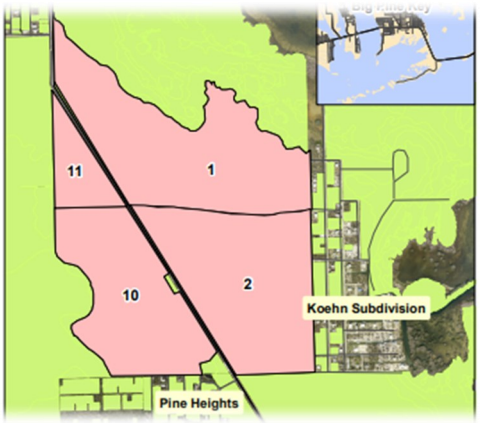
By: Andy Haner

Myself delivering a weather briefing to officials on the morning of the prescribed burn.

The Florida Keys National Weather Service (NWS) staff were on site to witness and support a 110-acre prescribed burn at Key Deer National Wildlife Refuge on Big Pine Key on Monday, October 28, 2019. Weather information is critical for fire planners as they make go/no-go decisions and tactical plans, and for ensuring firefighter and public safety.

As the new Fire Weather Focal Point at the Florida Keys NWS, I contacted both the United States Fish and Wildlife Service (USFWS) and the Florida Forest Service (FFS) in April 2019 to renew and build stronger relationships with the caretakers of the fire-prone refuge land. Fire managers welcomed and encouraged our office's close involvement in the burn.

Many months of planning and coordinating went into the successful operation. Resources from multiple agencies were on-scene to handle any unexpected developments, and local fire and law enforcement were proactively engaged from the start. USFWS built large fire breaks ("highways") earlier in the summer to keep the fire contained. During the morning operational briefing on October 28th, a supervisor from the Everglades National Park told firefighters that this needed to "be the slowest hundred acres that you burn all year". This was a nod to heightened concerns of a watchful local population following an escaped burn on Big Pine Key eight years earlier in 2011, and it was a tactical shift for firefighters, who more commonly burn in wide open places like the Everglades.



The prescribed burn included Units 10 and 11, totaling about 110 acres.

In the week leading up to the burn, Public Information Officers (PIOs) conducted a concerted public awareness campaign, using social media, traditional broadcast and print media, electronic highway signs, and a neighborhood flyer campaign. The Florida Keys NWS was a force multiplier by disseminating information on our own social media accounts.

This burn was truly an interagency effort, including representatives from the U.S. Fish and Wildlife Service (USFWS), Everglades National Park, Florida Panther National Wildlife Refuge (NWR), Merritt Island NWR, Ocala National Forest, Okefenokee NWR, Florida Wildlife Service (FWS), Monroe County Fire and Rescue, Monroe County Sheriff's Office, U.S. Border Patrol, Florida Department of Transportation (FDOT), and of course the Florida Keys NWS. The office provided vital weather support through spot weather forecasts, an onsite weather briefing, and a watchful eye during the burn.

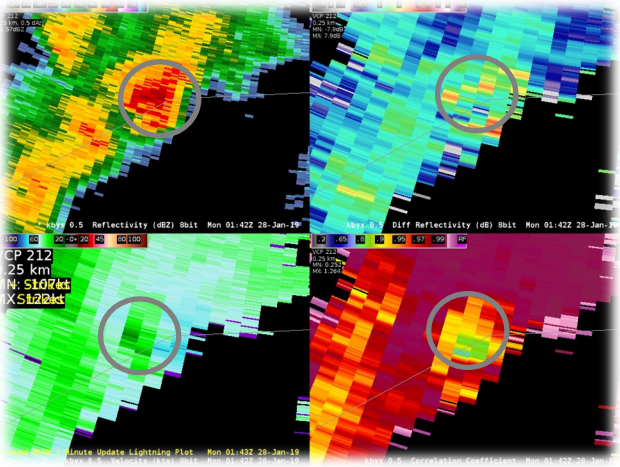
Violent, Destructive January 2019 Havana, Cuba Tornado

By: William Churchill

Extensive damage in Havana, Cuba from the violent EF4 tornado that

As the remote sensing focal point for the Florida Keys National Weather Service, I presented the results of my independent research at the September 2019 National Weather Association annual meeting in Huntsville, Alabama. The analysis was for a January 28th, 2019, severe weather event when a rare, violent equivalent F4 (EF4) tornado struck Havana, Cuba, shortly after 8 p.m. Six deaths and over 170 injuries were reported. This tornado was part of a larger weather system that also impacted the Florida Keys, but the Key West International Airport only measured a maximum wind gust of 40 mph. While not unusual for a wintertime storm system in the Keys, the tornadic destruction witnessed in Cuba is far less common. In fact, it had been nearly 80 years since an EF4 tornado swept across Cuba (December of 1940).

The storms began to move in around sunset, initiating along a cold front marching eastward toward Cuba and the Florida Keys. Radar imagery from Key West indicated a particularly strong cell moving towards Havana. The Key West WSR-88D doppler radar measured wind velocities in the range of 80-100 mph while simultaneously measuring a rotational rate of about 50 mph. The radar, located on Boca Chica Key, is over 100 miles away from Havana. At this distance the radar is scanning at about 10,000 feet above mean sea level by the time the beam reaches the Cuban coast. When detecting a storm at this relatively high altitude, it is hard to determine if anything significant is occurring at the surface. This uncertainty quickly and tragically faded as debris from the destruction began to appear at increasing altitude, peaking at 14,000-20,000 feet above the Earth's surface. Weather radars across the nation have been able to detect this type of debris signature since mid-2013, resulting in a large database of so-called "tornadic debris signatures" and their unique characteristics. The values from this storm correlate with an expected EF3-EF4 rated tornado, unfortunately confirming what was ultimately reported by the Cuban Meteorological Institute (an EF4 tornado) over the following days. While the Florida Keys were fortunately spared that day, this event is a solemn reminder of the potential for destructive tornadoes as far south, and even beyond, the southernmost point of the contiguous United States.



Tornado signature detected by WSR-88D radar from Key West, Florida at 8:42 p.m. on January 28, 2019.

National Weather Service

Weather Forecast Office

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