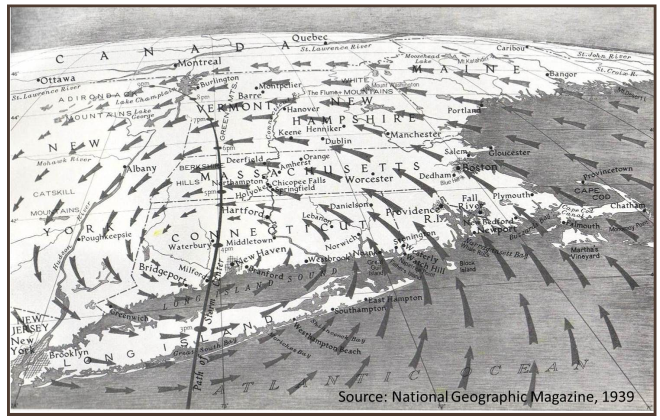
Prevailing Winds

Volume 3, Issue 2 October 15, 2013

Inside this issue:

75th Anniversary of the Great New England Hurricane of 1938

by Stephanie Dunten, Meteorologist



Above: Wind Direction at Landfall for the '38 Hurricane.

The Great New England Hurricane of 1938 was one of the most destructive and powerful storms ever to strike Southern New England. This system developed in the far eastern Atlantic, near the Cape Verde Islands on September 4th and slowly moved towards the Caribbean. Originally, it was forecast to make landfall in South Florida and the Jacksonville Weather Bureau issued hurricane warnings on Sept 16th. At the last minute, the system and the forecast changed and Florida was spared. Because of the previous warnings, hardly any mariners were out at sea taking observations and relaying data. Very little data came in to help guide the forecasters. This led to the storm crashing ashore in Suffolk County, Long Island, then into Milford, Connecticut with very little warning, on the afternoon of September 21st. There are anecdotal accounts observing the eye of the hurricane in New Haven, Connecticut, 10 miles east of Milford. Unlike most storms, this hurricane did not weaken on its way toward Southern New England, due to its track and rapid forward speed (moving north at 51 mph). The average forward motion of New England tropical systems is 33 mph.

This storm strengthened to a category 5, near the Bahamas, then weakened slightly as it approached New England. It made landfall as a category 3 Hurricane. In fact, sustained hurricane force winds occurred throughout most of Southern New England. The strongest winds ever recorded in the region occurred at the Blue Hill Observatory with sustained winds of 121 mph and a peak gust of 186 mph. Sustained winds of 91 mph with a gust to 121 mph were reported on Block Island. Providence, Rhode Island recorded sustained winds of 100 mph with a gust to 125 mph. Extensive damage occurred to roofs, trees and crops. It has been estimated that 70-80 percent of the trees throughout New England were destroyed. To put it in perspective, Irene only destroyed 1-2 percent of the trees in New England. Widespread power outages occurred, which in some areas lasted several weeks. Downed power lines resulted in catastrophic fires in sections of New London and Mystic in Connecticut as well as in Peterborough, New Hampshire. The lowest pressure at the time of landfall occurred on the south side of Long Island, at Bellport, where a reading of 27.94 inches was recorded. Other low pressures included 28.00 inches in Middletown, Connecticut and 28.04 inches in Hartford, Connecticut.

Hurricane Edition — THE WESTERLY SUN — Local and Shore News

Vol. 46. No. 39 — WESTERLY, R. I., FRIDAY SEPTEMBER 23, 1938 — Price Three Cents

Misquamicut Wiped Out; Napatree Point Gone; 50 Dead; Scores Missing

Westerly Paralyzed by Tropical Hurricane; Cottages at Charlestown Beach and Quonochontaug Washed Away; 4 Dead, 4 Missing In Stonington

List of Dead and Missing

Above: The front page of the Westerly Sun.

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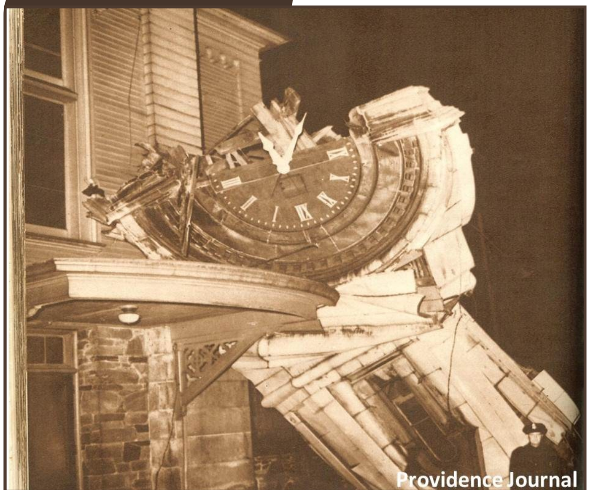
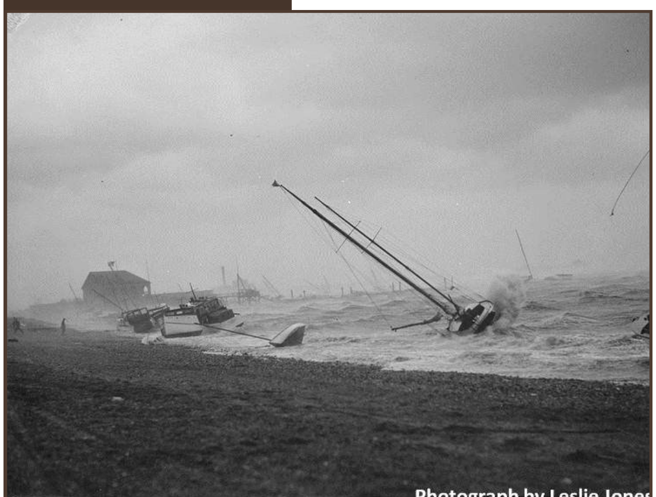
Cont'd from pg 1…1938 Hurricane



Above: Steeple from the Pawtucket Congregational Church was blown to the ground by the '38 Hurricane.

This hurricane produced storm tides (storm surge plus astronomical high tide) of 14 to 18 feet along most of the Connecticut coast, with 18 to 25 feet storm tides from New London east to Cape Cod. Downtown Providence, Rhode Island was submerged under a storm tide of nearly 20 feet. Sections of Falmouth and New Bedford, Massachusetts were submerged under as much as 8 feet of water from the storm tide. This powerful storm tide was caused by the destructive power of the storm surge which was felt throughout the coastal community. Narragansett Bay took the worst hit, as a storm surge of 12 to 15 feet destroyed most coastal homes, marinas and yacht clubs. All of these locations had very rapid tidal increases within 1.5 hours of the highest water mark.

Rainfall from this hurricane resulted in severe river flooding across sections of Massachusetts and Connecticut. Three to six inches of rain fell across much of western Massachusetts and all but extreme eastern Connecticut. Recall that the heavy rain is on the left side of the track, while the stronger wind is on the right side. Therefore, considerably less rain occurred to the east across Rhode Island and the remainder of Massachusetts. The rainfall from the hurricane added to the amounts that had occurred several days before the hurricane struck with a frontal system that sat on top of New England for several days prior. The combined effects from the frontal system and the hurricane produced rainfall amounts of 10 to 17 inches across most of the Connecticut River Valley. The results were devastating, amounting to some of the worst flooding ever recorded in this area. Roadways were washed out along with several sections of the New York, New Haven, and Hartford Railroad lines. The Connecticut River at Hartford reached a level of 35.4 feet, which was 19.4 feet above flood stage. Farther upstream, in the vicinity of Springfield, Massachusetts, the river rose to 6 to 10 feet above flood stage, causing significant damage. Flooded rivers occurred throughout New Hampshire as well.



Above: The '38 Hurricane hits in Dorchester.

A total of 8,900 homes, cottages and buildings were destroyed, and over 15,000 were damaged by the hurricane. The marine community was devastated. Over 2,600 boats were destroyed, and over 3,300 damaged. Entire fleets were lost in marinas and yacht clubs along Narragansett Bay. This damage to the fishing fleets in Southern New England was catastrophic. The hurricane was responsible for 600 deaths and at least 1,700 injuries in Southern New England. Approximately 2 billion trees were destroyed across the Northeast and into Canada. Overall this Hurricane caused over $620 million 1938 dollars according to a FEMA report. This would equate to about $9.8 billion 2013 dollars.

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MIC Musings

by Robert Thompson, Meteorologist-in-Charge

What Did Sandy Teach Us

About a year ago Hybrid Storm Sandy devastated portions of the Mid Atlantic coast and caused major damage as far north as the Connecticut and Rhode Island coasts. As New Englanders, what should we take away from Sandy?

Sandy was a rare event. As mother nature occasionally does, she broadened the possibilities of what can happen. The odds of witnessing something quite as dramatic as a tropical cyclone making a sharp left hook into the Mid-Atlantic states are indeed low. But Sandy highlighted risks that are not as remote as we might think.

Although Sandy was an extreme example, tropical cyclones can curve toward the northwest (ie. the 1938 Hurricane and Agnes back in 1972). The ingredients for such a curvature do occasionally occur in the form of a deep east coast upper trough with a negative tilt along with a blocking pattern of high pressure across southeast Canada and the northwest Atlantic. Although the interaction of a tropical cyclone with the jet stream structure of such a mid latitude pattern spells impending doom for the tropical cyclone's warm core, it can also infuse a robustness into the storm just when it is preparing to make landfall. If it's happened before, there's no reason why it will not happen again sooner or later.

Sandy along with Katrina and a few other recent storms illustrated that the storm surge (and wave) impact depends upon more than the intensity of the hurricane. Sandy was a category 1 hurricane, but a *very large* category 1 hurricane. Sandy's size can be attributed to its interaction with a strong high pressure area centered north of New England. This caused a tight surface pressure gradient and associated strong winds far north of the center – a condition we frequently see with some of our stronger nor'easters. Similarly, Katrina, a category 3 storm on the Saffir-Simpson scale, generated a higher storm surge in many Gulf coast locations than category 5 Camille did in 1969. Thus, when it comes to storm surge, size matters! The distance the wind is acting upon the ocean (called the fetch), the duration that the wind acts upon the water, and the local bathymetry/topography also matter. Sandy agitated the western Atlantic with a long fetch and duration. Hence, Sandy decimated the entire barrier beach protective dune along much of the Rhode Island south coast from the surge and huge waves (nearly 50 feet offshore and breaking in excess of 25 feet along the beach) with just a sideswipe!

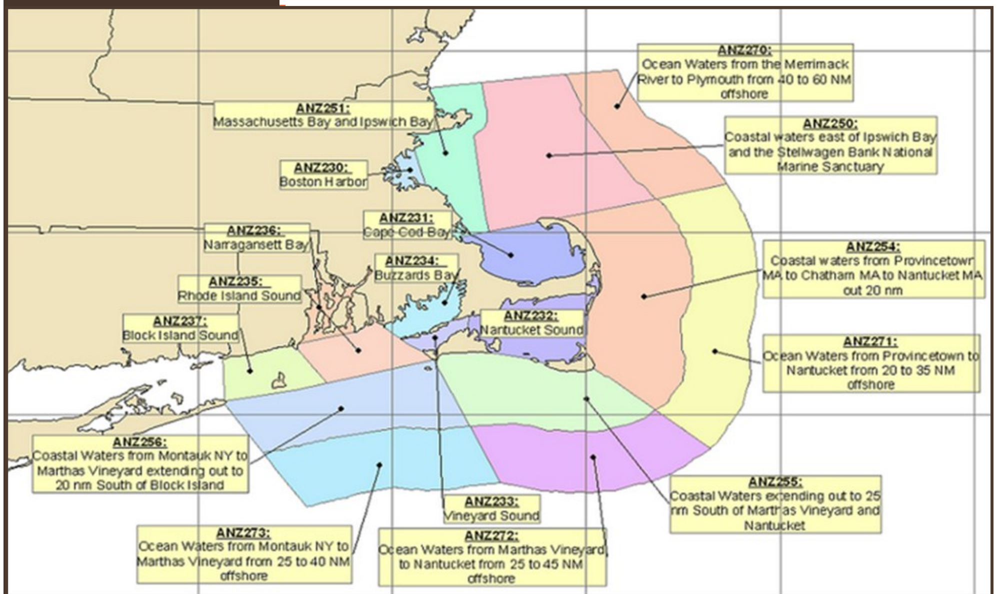
Finally, Sandy was a wake-up call to the vulnerability of our own east coast in New England. Sandy illustrated a scenario that could similarly devastate our east facing shoreline. And the risk doesn't stop with tropical cyclones. In fact, Sandy was just one of several recent situations where we dodged a storm surge bullet for Boston Harbor. The highest recorded water level for Boston Harbor is 15.25 feet above Mean Lower Low Water (MLLW) set during the Blizzard of 1978. We suspect that a few historical storms such as the Minot's Light Storm of 1851 would have surpassed this mark, but we don't have the measurements. We have seen recently several situations where a difference in timing by just hours or in storm track by little more than 50 miles could have given the current record a run for its money. Based on one model storm track that brought Sandy close to the New England south coast, we saw a storm surge model projection of 6.5 feet for Boston. That surge occurring at the time of high tide would have exceeded the 1978 total water level record. Unknown by most people, a quick moving but intense extratropical storm during the early morning of February 24, 2010 produced a surge over 6.5 feet in Boston Harbor. Fortunately, the surge occurred a few hours after high tide, and disaster was averted with the result being an "extra" high tide for that day. Even more recently, the peak surge from the February 2013 Blizzard (a little over 4 feet) would have caused the total water level to exceed 16 feet above MLLW, if it had occurred on top of a spring tide (when the gravitational pull of the sun and moon act in concert). And then we have the backdrop of rising sea level, which makes the extreme water levels easier to be reached. All of this means that the record total water for Boston harbor may not stand all that much longer. Our office is leading an effort to better understand the impact of such higher water levels on the City of Boston with a seminar planned for late fall and a tabletop exercise targeted for the spring.

" Sandy was a wake-up call to the vulnerability of our own east coast in New England. Sandy illustrated a scenario that could similarly devastate our east facing shoreline."

As rare as Sandy was, the storm highlighted vulnerabilities that exist along our New England coastline. Now is the time to prepare before the next extreme event looms.

National Weather Service Marine Products and Services

by Hayden Frank, Senior Forecaster



Above: NWS Taunton's Marine area of responsibility

Weather is a mariner's largest concern when out to sea. A change in wind direction, visibilities, and wave heights can threaten the vessel and the safety of the crew. The National Weather Service provides marine warnings and forecasts to serve all mariners. Given that the New Bedford Harbor is the number one fishing port in the United States, accurate forecasts and warnings from our office are crucial.

The National Weather Service in Taunton provides marine forecasts from Merrimack River MA, to Watch Hill RI extending outward 25 nautical miles (nm) into the open Atlantic Ocean. Given the unique shape of our coastline, these forecasts also include Boston Harbor, Cape Cod Bay, Buzzards Bay, and Narragansett Bay.

Our office has access to special computer models that forecast wave heights and winds seven days into the future. The nooks and crannies in our coastline require high resolution models to produce accurate wave height forecasts. Buoy data provides real time wave heights, winds, and visibilities across our waters. However, these data are more sparse than our network of observations over land. Therefore, we also rely on real time reports from ships and ferries which we contact by phone each day.

We issue several different marine headlines depending on expected wind speeds and wave heights. The criteria for those headlines are listed below:

SMALL CRAFT ADVISORY	Sustained winds 25-33 kts AND/OR Seas ≥ 5 feet within 24 hours
GALE WARNING	Sustained winds 34-47 kts within 24 hrs from a non-tropical system
STORM WARNING	Sustained winds 48-63 kts within 24 hours from a non tropical system
HURRICANE FORCE WIND WARNING	Sustained winds or frequent gusts ≥ 64 kts (> 2 hrs) within 24 hours *from a non-tropical system*
TROPICAL STORM WARNING	Sustained winds 39-73 mph (34-63 kts) (no gust criteria) *associated with a tropical storm* expected to affect a specified area within 24 hours
HURRICANE WARNING	Sustained winds ≥ 74 mph (64 kts) (no gust criteria) *associated with a hurricane* expected to affect a specified area within 24 hours
SPECIAL MARINE WARNING	Brief/sudden occurrence of sustained wind or frequent gusts ≥ 34 kts, usually associated with thunderstorms; AND/OR hail ≥ 3/4" in diameter; also issued for waterspouts

Coastal flooding is a crucial part of the Marine program. Powerful nor'easters and tropical systems sometimes combine with high astronomical tides, resulting in significant coastal flooding.

Cont'd on page 5

Cont'd from pg 4…Marine Products & Services

Above: Marine Customer Advisory board meets at NWS Taunton to listen to future changes with a few of the Marine products.

The Great New England Hurricane of 1938, along with Hurricane Carol in 1954, brought devastating storm surges to the South Coasts of Massachusetts and Rhode Island. The Blizzard of 1978, the Perfect Storm of 1991, and the December Nor'easter of 1992, all brought major coastal flooding to the Eastern Massachusetts coastline. We will often highlight the potential for coastal flooding a week in advance, via the Area Forecast Discussion and Hazardous Weather Outlook. Coastal Flood Watches and Warnings may be issued within 48 hours of the potential event.

One of the newer products we implemented a few years ago is our surf zone forecast. This not only provides the expected surf and water temperatures for beaches, but highlights the risk for dangerous rip currents. High surf advisories are issued when there is a high risk of dangerous rip currents. This alerts lifeguards and beachgoers to use extra caution when swimming in the ocean.

The National Weather Service in Taunton is heavily involved in marine outreach. Our office conducts many marine talks focusing on safety for fisherman, recreational boaters, sailing clubs, etc. These talks often result in feedback from our customers, which is crucial to improving our forecasts and warnings. We also have put together a Marine Customer Advisory Board, which is composed of a diverse group of mariners. Any possible changes to the Marine Program go through the board before considering implementation. Overall the Taunton Weather Forecast Office continues to advance and improve its vast Marine program.

Getting to know your NWS Team: Electronic Technician Staff

Above: Boston Logan Airport Automated Surface Observation System (ASOS).

Working behind the scenes at the National Weather Service Office in Taunton, MA is a group of employees assigned to the office who have little to do with forecasting or even meteorology. Most of them may not know the difference between a cumulus cloud and a stratus cloud, or what a partly sunny day is versus a partly cloudy one, but without their work none of these conditions could be measured or broadcast to the public. These employees work in the Electronic Technician (ET) Shop which serves both the Weather Forecast Office (WFO) and the Northeast River Forecast Center (NERFC) in Taunton. They install, maintain, and repair the hardware systems, PC workstations, servers, and communications network assigned to those offices. The complement of equipment they are responsible for include the two completely individual and separate AWIPS systems; a WSR-88D radar, NOAA Weather Radio Console Replacement System, and over 100 PCs and servers at the Taunton location. They are also the ones staff members go to first when building problems arise within the facility. Beyond the Taunton office, their responsibility extends to 25 Automated Surface Observing System (ASOS) systems located throughout Southern New England. The airports hosting the ASOS sites include 3 hub airports, an additional 14 towered airports, and airports on both Nantucket and Martha's Vineyard. This is the largest ASOS assignment for any NWS office in the country. The security associated with these ASOS sites is a huge challenge for the ET Shop. Beyond the ASOS, the Taunton technicians' responsibility extends to the Upper Air system in Chatham, MA and the AWIPS hardware located at the Center Weather Service Unit (CWSU) in Nashua, NH. They also maintain seven NOAA Weather Radio transmitters spread throughout the WFO's County Warning Area (CWA).

Cont'd on page 6

Cont'd from pg 5…Electronic Staff

Above: NWS Taunton electronics staff from left to right: Mike Esip, John Moots, Ken Croll, Bob Metzler, Ken Chouinard, and Doug Hayward

Unlike many other NWS offices that have outside contractors maintaining their NOAA Weather Radio (NWR) transmitters, the Taunton Techs do the maintenance themselves resulting in a cost savings to the government.

There are six Electronic and Information Technology Technicians that are part of the ET Shop in Taunton. They all understand and take seriously the mission of the National Weather Service, which in part states "…for the protection of life and property…" The techs that are currently assigned to the Taunton WFO include John Moots, Doug Hayward, Ken Croll, Ken Chouinard, Bob Metzler, and Mike Esip the Electronic Systems Analyst (ESA). All have wide and diversified backgrounds with a common link of each having some prior military service.

John Moots transferred as an Electronics Technician to Taunton from the WFO in Eureka, CA. John had prior NWS work service at the National Reconditioning Center in Kansas City, MO and the Weather Service Office in Worcester, MA. John originally came to the NWS as an Electronic Engineer with the Census Bureau. His earlier background includes experience as a Copier Technician in the private sector, and 9 years as a Communications Weather Specialist in the US Navy. In his free time, John is a computer gamer and loves traveling anywhere he can on his Harley Davidson motorcycle. Doug Hayward came to the National Weather Service after transferring as a civilian employee from the Air Force Reserve. Doug was activated and has served in both Gulf wars. His prior experience with the Air Force was in the Avionics career field. Doug has since retired from the Air Force and is an avid outdoors man and fisherman. Ken Croll came to the Taunton WFO after spending 10 years in the US Navy. Ken worked as an Electronics Technician on Meteorological Systems at sea on LHD Marine Troop Carriers while in the Navy. When off duty, Ken's hobbies include helping his wife take care of their two young children and trimming the hedges. Ken Chouinard came to Taunton having prior federal service as a Federal Bank Examiner with the FDIC and has an extensive Air Force Reserve background in the Avionics career field. Ken served in both Gulf wars and now is retired from the Air Force. In his private life, Ken is a pilot with an interest in meteorology. Most recently, Bob Metzler came to Taunton as a civilian field engineer working on NIKE Tracking Radars in the Bahamas. Prior to that, he spent two years in Thailand along the Myanmar border teaching basic skills such as Math and English to refugees. He has seen service in the Air Force, serving in Iraq and Afghanistan. While in the Air Force, Bob held a Ground Radar Systems specialty code. Since coming to Taunton, Bob and his wife enjoy taking advantage of the vast New England culture the Northeast has to offer. Lastly, Mike Esip transferred to the NWS as a civilian Phased Array Radar Technician with the US Air Force. He entered Federal civilian service as an Electronic Systems Technician with specialties in computer, radar, and radio systems with the Air National Guard and the Tactical Air Command. After graduating from college, and before entering public service, he spent several years in the private sector employed in the fabrication and design of integrated circuits. Mike has since retired from the Air National Guard. Off duty, he enjoys time with his four grandchildren. He takes pride that two of them call him "Grumpy", another calls him "Beast", while the fourth has not yet made up her mind what to call him. Having these names somewhat mirrors his personality at work as a grumpy beast.

While the Taunton workload is extensive, the group of ETs assigned here, along with their individual personalities provides a good mix of experience, talent, and dedication to the needs and mission of the National Weather Service. Their backgrounds and teamwork all contribute to the success of the equipment programs in Taunton.

"Working behind the scenes at the National Weather Service Office in Taunton, MA is a group of employees...they install, maintain, and repair the hardware systems, PC workstations, servers, and communications network assigned to those offices."

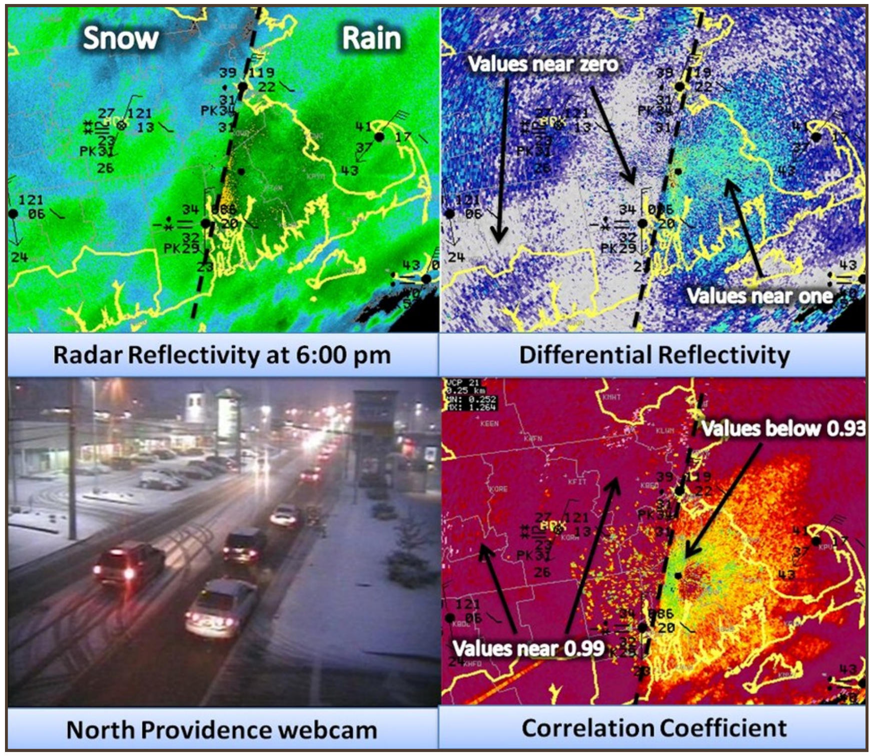
Using Dual-Pol Products to Help Assess Precipitation Type

Joe DelliCarpini

By: Joe DelliCarpini, Science and Operations Officer

The Taunton Doppler Radar was upgraded with dual-polarization (dual-pol) technology in January 2012. This upgrade allows the radar to determine the size and shape of rain drops, snowflakes, hailstones, and other objects and gives forecasters much more information than was previously available.

NWS Taunton forecasters have made dual-pol radar products part of their routine assessment of various weather scenarios. In the warmer months, dual-pol radar products are used to give a better understanding of thunderstorm structure and severity and provide rainfall estimates used to assess the potential for flash flooding. In the winter, dual-pol radar products help us better determine precipitation type.



Radar Reflectivity at 6:00 pm | Differential Reflectivity | North Providence webcam | Correlation Coefficient

On November 8, 2012 a coastal storm brought early season snows to much of interior southern New England and rain to the coast. During the afternoon and evening, a coastal front set up across Rhode Island and eastern Massachusetts. Snow fell to the west of the front where temperatures were in the 30s, while to the east it was raining as temperatures held in the 40s.

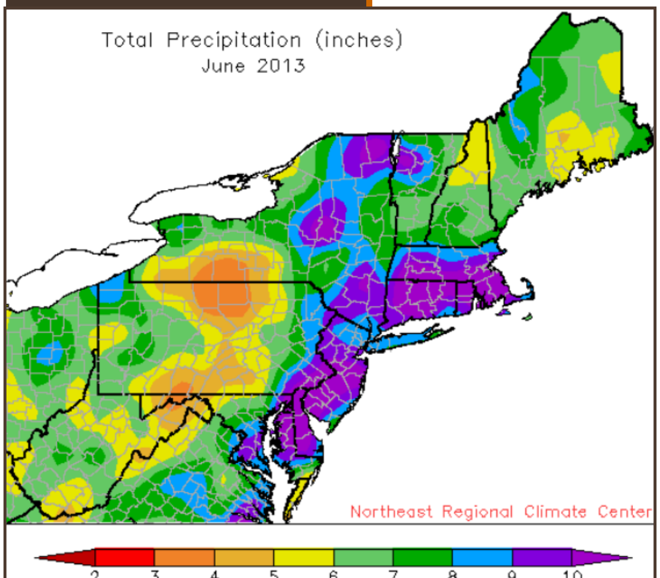
The images to the upper right show several dual-pol radar products at 6 pm on November 8th along with a webcam image from North Providence, RI at the same time. Reflectivity (upper left) shows where precipitation is falling, ZDR (Differential Reflectivity, upper right) is a measure of drop size, and CC (Correlation Coefficient, lower right) is a measure of drop size uniformity.

The rain-snow line is clearly evident on the images just to the northwest of the radar (dark circle) where the coastal front was located. Note the difference in ZDR (values near zero indicate snow and values near 1 indicate rain) and CC (higher values indicate snow and lower values show where rain or mixed rain and snow are present). You can see snow is falling in North Providence (lower left image) which is located in the colder air to the west of the coastal front.

By using these dual-pol products, forecasters were able to accurately track the slow southward progress of the rain-snow line that evening, which helped forecasters provide effective short term forecasts.

Abundant Rainfall for June 2013

by Kimberly Buttrick, Cooperative Program Leader



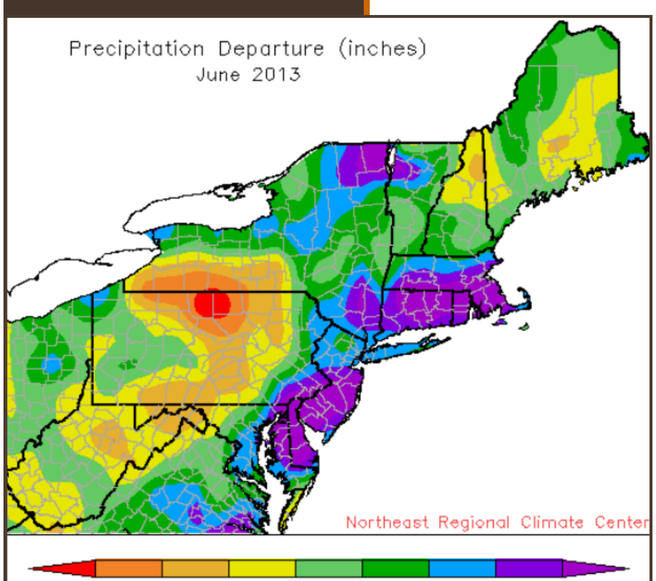
Above: June 2013 rainfall for the Northeast.

June 2013 was an extremely wet month for Southern New England. All of the climate sites across Southern New England reported above normal rainfall totals. So what is a climate normal? A climate normal is based off the latest 30 year average of a climatological variable – in this case the variable is precipitation. Climate normals are produced once every 10 years with the current normal dataset spanning 1981–2010. A climate normal is like a benchmark from which to measure. Anything below the benchmark is below normal. Anything above the benchmark is above normal. And anything right along or near the benchmark is considered normal or near normal. The June 2013 rainfall reported across Southern New England was well above the benchmark. In other words, above normal!

What brought on all the rainfall in June 2013? A number of weather systems gave Southern New England a dousing. They were the typical summertime warm and cold fronts that moved through the region spawning showers and thunderstorms. But there were 2 weather events that contributed significantly to June's surplus rainfall. The first and overall wettest weather event was the remnants of Tropical Storm Andrea. She moved through Southern New England June 6-8. Andrea may have only been a remnant, but tropical remnants are notorious for their abundant rainfall. Andrea held true to her tropical origins delivering Southern New England tropical downpours. The greatest 24 hour precipitation total from Andrea was 4.50 inches reported from the West Thompson Lake U.S. Army Corps of Engineers Project located in North Grosvenordale, CT. The second wettest weather event occurred June 13-14 which was caused by a low pressure area from the Ohio Valley that scooted east across Long Island then southeast of Nantucket. The greatest 24 hour precipitation total from the June 13-14 event was 2.90 inches reported from Shuttle Meadow Reservoir in New Britain, CT.

Following is a list of some climate sites across Southern New England. The 3 columns adjacent to the climate sites list: June rainfall totals; normal rainfall for the 1981-2010 time period; and departure from normal. All climate sites are on the plus side of normal – above the benchmark.

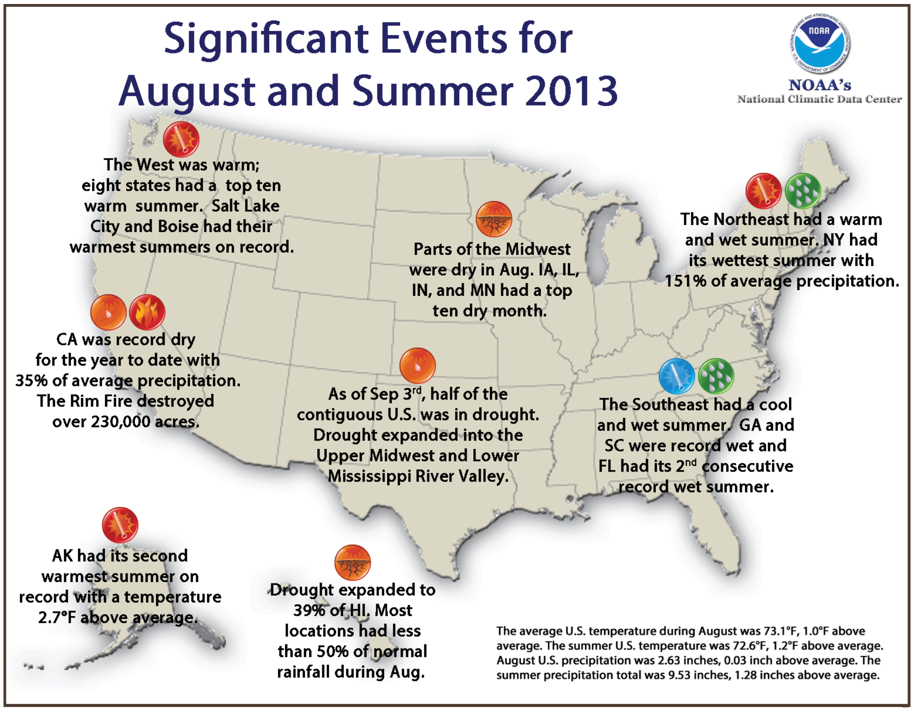
Below: June 2013 rainfall departure from normal.



Climate Site	June 2013 Rainfall Total	June Normals	Departure from Normal
Westfield, MA	13.23	4.50	+8.73
Hingham, MA	12.37	3.92	+8.45
Walpole, NH	8.73	4.29	+4.44
Fitzwilliam, NH	8.28	4.15	+4.13
Burlington, CT	14.11	4.74	+9.37
Storrs, CT	12.18	4.46	+7.72
Tiverton, RI	11.79	3.88	+7.91
North Foster, RI	11.15	4.58	+6.57

Quarterly Climate Outlook

by Ellen Mecray, NOAA Eastern Region Climate Services Director



Highlights for the East

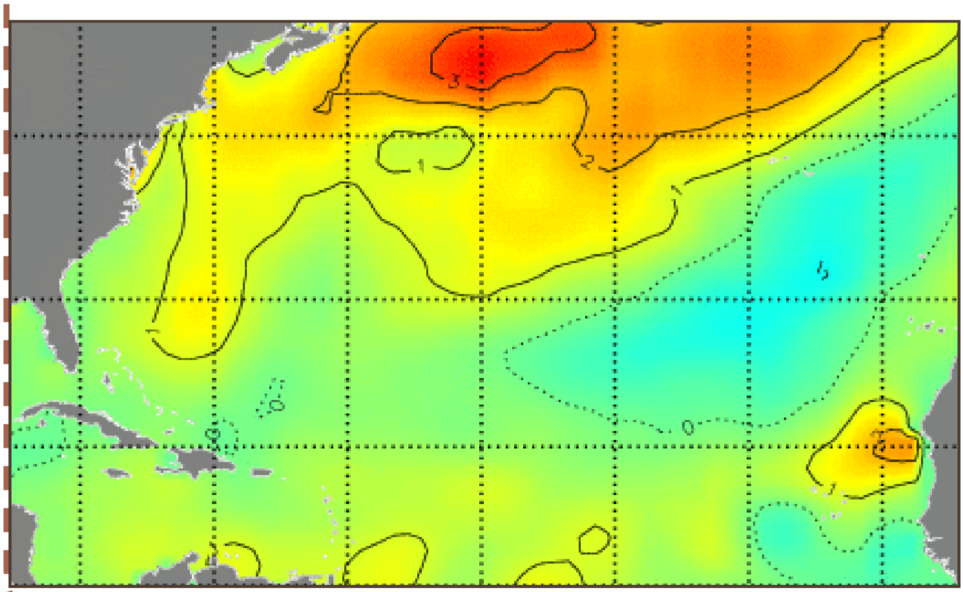
Flash flooding occurred in every east coastal state in June or July. In New York, the Oneida Creek reached a record-high 17.23 feet on June 28th. On July 29th in North Carolina, the South Fork Catawba River had its third highest crest on record at 17.31 feet. Also, Lake Champlain rose to a record-high July level of 99.68 feet on July 7th and 8th due to heavy rain runoff.

Wallops Island, VA, set a record when the temperature did not drop below 70 degrees Fahrenheit (F), even at night, from June 23rd – July 24th. Several other cities set similar records, including Washington D.C., where the temperature did not drop below 80 degrees F from July 16th – 20th . The warm weather also caused New York City and Westchester County, NY, to set an all-time peak electric usage record of 13,322 Megawatts (MW) on July 19th.

Philadelphia, PA, had back-to-back record wet months: June with 10.56 inches and July with 13.24 inches. Wilmington, DE, had its wettest June on record with 13.66 inches. The following cities had their wettest Julys on record: Roanoke, VA, with 12.73 inches; Greenville-Spartanburg, SC, with 14.45 inches; and Asheville, NC, with 13.69 inches.

Updated 2013 Atlantic Hurricane Season Outlook

The Atlantic hurricane season is still expected to be above-normal, according to NOAA's updated outlook issued on August 8. As atmospheric and oceanic conditions are expected to be favorable for storm development (see above-normal sea surface temperatures map to the left), the updated outlook calls for a 70% chance of each of the following: 13-19 named storms, 6-9 hurricanes, and 3-5 major hurricanes. In comparison, the outlook issued in May predicted 13-20 named storms, 7-11 hurricanes, and 3-6 major hurricanes. The reduced numbers resulted from a decreased likelihood of La Niña development, the lack of July hurricanes, variable tropical Atlantic wind patterns, and lower hurricane season model predictions. The season, which runs from June 1– November 30, has already produced eleven named storms.



Above: Sea Surface Temperature Anomaly (°C) September 14, 2013 (Credit: National Hurricane Center)

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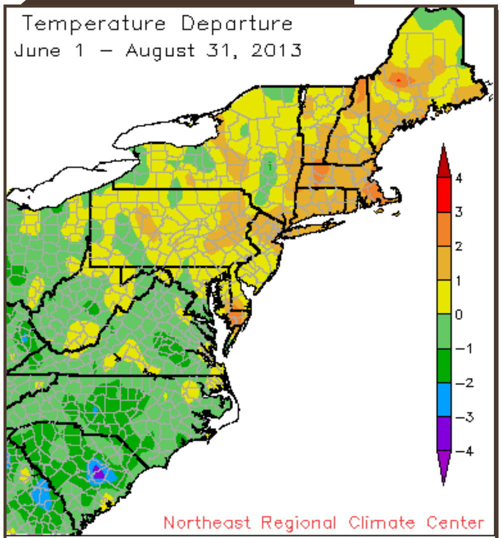
Cont'd from pg 9…Quarterly Climate



Above: Temperature Departures from June 1 - August 31.

Temperature and Precipitation Anomalies

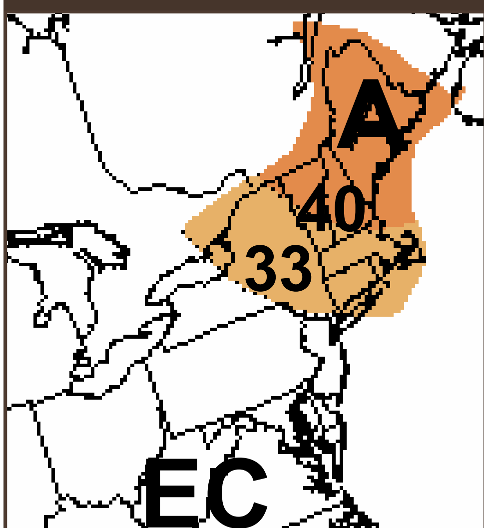
With an average temperature of 71.0 degrees F, summer was 0.1 degrees F warmer than normal in the region. Eleven of the sixteen states in Eastern Region were warmer than normal, with seven states ranking this summer among their top 20 warmest. While June was warmer than normal, the northernmost states sweltered in July. Eleven states ranked this July among their top 20 warmest. At +4.6 degrees F and +4.5 degrees F respectively, Rhode Island and Massachusetts had their warmest July on record. August was a cool month in the region with fifteen of the sixteen states cooler than normal.

The Eastern Region had its wettest summer on record with 18.47 inches of rain, 144% of normal. All sixteen states ranked this summer among their top eleven wettest, with South Carolina (173% of normal) and New York (137% of normal) seeing their wettest summers on record. Philadelphia, PA, Asheville, NC, and Greenville-Spartanburg, SC, also had their wettest summers on record. On the heels of an extremely wet June, July was also quite wet, with nine states ranking it among their top fifteen wettest. August was nearly split with nine wet states and seven dry states.

Fifteen of the region's sixteen states ranked this June among their ten wettest. In fact, eleven states ranked it in their top five wettest. Delaware and New Jersey had their wettest Junes on record at 283% and 238% of normal respectively. Three of Pennsylvania's divisions, three of South Carolina's divisions and one of Connecticut's divisions also had their wettest June on record.

Dry conditions were found in thirteen states at the start of June, but abundant precipitation through early July erased dryness by mid-July. However, an area of abnormal dryness crept back into Pennsylvania by late August.

Three-Month Temperature Outlook



Computer models and long-term temperature trends indicate an increased chance of above-normal temperatures for part of the region. In the figure to the left, areas marked by a 40 are predicted to have a 40% to 50% chance of being warmer than normal, a 33.3% chance of being near-normal, and less than a 33.3% chance of being cooler than normal. Areas marked by a 33 have a 33.3% to 40% chance of experiencing above-normal temperatures, a 33.3% chance of near-normal temperatures, and less than a 33.3% chance of below-normal temperatures. Areas with no clear climate signals, marked EC, have equal chances of above-, near-, or below-normal temperatures, meaning each category has a 33.3% chance of occurring.

EC: Equal chances of above, near, or below normal

A: Above normal

33/40: Probability of above-normal temperatures

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www.weather.gov/boston

Winter Weather Preparedness Week: October 21st — 25th

Lots of Tropical Air Increases Number of Tornadoes

By: Matt Doody, General Forecaster

Widespread severe weather was relatively rare this summer across Southern New England, but that does not mean it was without a few tornadoes. In fact, in the National Weather Service (NWS) Boston County Warning Area (CWA), four tornadoes and one waterspout were confirmed. On the Enhanced Fujita (EF) scale there were two EF-1 and one EF-0 tornadoes in Connecticut; an EF-0 tornado and a waterspout occurred in Massachusetts.

The EF-0 in Stoughton, MA was the first confirmed tornado of the summer and occurred on May 9th. Damage from this tornado was quite localized, with a path length of only a quarter mile and maximum width of 50 yards. The storm knocked down two large pine trees and moved two large RV trailers about 6 feet, lifting them slightly off the ground. This tornado formed in quite a different airmass and set of circumstances than the two EF-1 and other EF-0 tornadoes, as it was determined to be a touchdown of a “cold air funnel,” a phenomenon that occurs with strong low pressure and very cold air aloft. While these typically do not reach the ground, on rare occasion they do, causing some minor damage.

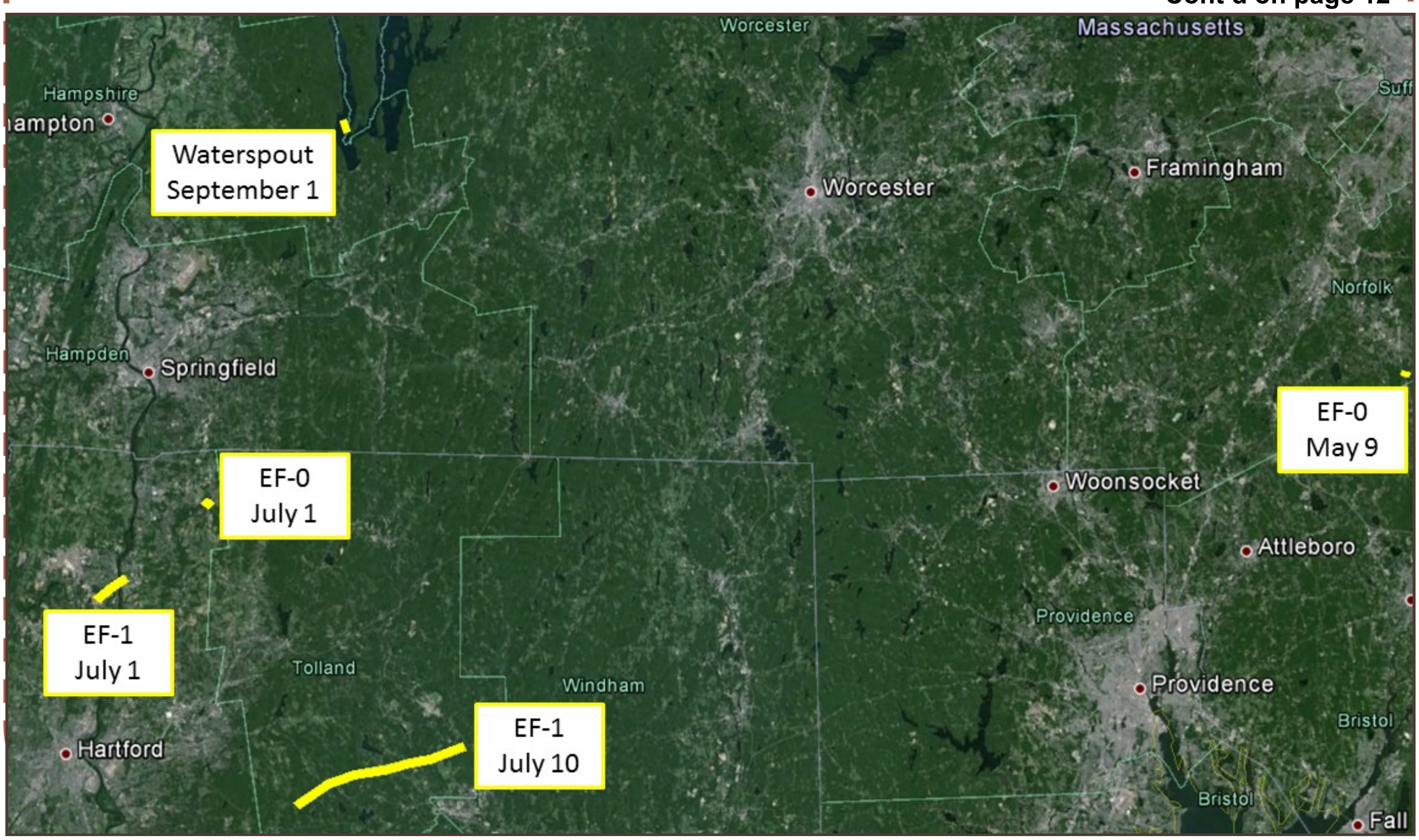
On July 1, two tornadoes occurred in Hartford County, Connecticut from the same parent storm. The first was deemed an EF-1 tornado which began in Windsor, traveled through the southern end of Windsor Locks and into East Windsor before dissipating. This tornado traveled two and a quarter miles and was 200 yards in length. The damage path started with a roof being torn off of a warehouse; it then downed several trees, some onto houses and cars before ripping tobacco tents off several fields and lofting them into the air. Finally in East Windsor, the tornado ripped up a sports bubble, which then collapsed onto I-91. (Many witnesses reported both of these incidents on I-91.)

However, this storm was not quite finished after the EF-1 tornado lifted. Northeast of this damage track, in Enfield, Connecticut, the storm dropped a second (although much weaker) tornado, an EF-0. This tornado traveled only three-quarters of a mile, with a maximum width of 50 yards before lifting. This tornado was what is sometimes known as a “tree-topper,” shearing off the top half of trees and only toppling a few full trees over. Damage was mainly confined to trees with little to no structural damage reported.

The final tornado to occur during the “summer” months (June, July, August) occurred on July 10th, and was once again in Connecticut.

Below: Locations and the tracks of the tornadoes and waterspouts for 2013

Cont’d on page 12



Cont'd from pg 11…Tornadoes

Above: Tornado damage in Coventry, CT.

Rated as an EF-1, this tornado had the longest damage path, traveling for 11.2 miles across a portion of Tolland County, beginning in Andover and culminating in Mansfield, just south of the University of Connecticut. Not only did this tornado have the longest damage path of any in 2013, it was also the widest, at 100 yards. Although this exceeded many of the metrics of the tornadoes confirmed in 2013, it traveled through a relatively rural area. The majority of the damage from this tornado was to trees. The worst of the damage occurred in the town of Coventry, where several very large, healthy trees were uprooted and the tops sheared off.

The final tornado of the season was actually a waterspout, which happened to be caught by someone at the right place at the right time. The very short lived waterspout occurred on September 1, over Quabbin Reservoir in central Massachusetts. A worker happened to notice the funnel extending from the low cloud base, and snapped it with his camera. The spout very briefly touched the water, whipping the water upward. Due to the brief touchdown, and the fact that the spout only impacted the water, an EF rating was not established.

How does this compare with 2012? The simple answer is that there were more than twice as many tornadoes in 2013. Two EF-0 tornadoes were confirmed in 2012: one in Plymouth, MA and another in Block Island, RI. Therefore, not only were there more than twice as many tornadoes, but two of them were also one step stronger on the Enhanced Fujita rating scale.

A few questions might be coming to mind: why more this season, why did 3 of them occur within two weeks of each other, and why were there more tornadoes when overall severe weather was somewhat lacking in comparison to previous years? The answers to all of these questions are actually connected, and they have much to do with the hot, sweltering, tropical conditions we experienced during the latter half of June and early July and the fact that we were in this tropical airmass for a much longer period of time in 2013 than we were in 2012.

To understand the answer, it's time for a little meteorology 101: Chances are if you are reading this, you may already have some knowledge on the key for thunderstorm development and maintenance: instability. However, for those who may not know, an unstable atmosphere is created when hot, moist air rests closer to the surface than cool, dry air aloft. Like a pot of boiling water, the hot water closer to the heating element rises rapidly, creating the boiling effect. This rising motion is what leads to the development of an updraft, which both helps to form and maintain thunderstorms. We certainly had plenty of hot, moist air near the surface during the period in which the tornadoes occurred, while in the throes of a tropical airmass. However, in these warm tropical airmasses, the air aloft is also very warm. The fact that the difference between the temperatures near the surface and aloft was low means that updrafts remain quite weak. Generally speaking, the stronger the updraft, the potentially more severe the thunderstorm can be.

While this answers the question of why the number of severe storms during this period was low, it begs another question: why were there still tornadoes? To produce a tornado in a thunderstorm, not only do you need instability (and yes, it helps to have a lot of instability in most cases, particularly to generate long lived and damaging tornados like June 1, 2011) but you also need wind shear, which is a combination of speed and direction changes of the wind between two layers. A good amount of wind shear in thunderstorms is a necessary component to tornado development. In hot, humid, and tropical airmasses, the base of the thunderstorm tends to be lower to the ground thanks to the increase in moisture near the surface. This also allows for lift and shear to reach closer to the ground as well, enhancing the threat for tornado formation, even if the storm is not quite as strong as it may otherwise be.
Have you ever noticed that there are often short lived tornadoes in tropical storms and hurricanes? The same set of principles is at play. So, in general, in tropical airmasses like the type we saw earlier this summer, the risk for tornadoes increases, but most are very weak and very short lived. Hopefully this summary of the tornadoes of 2013 and the meteorology behind them gives you a little bit of insight into the meteorology behind weak tornadoes and tropical airmasses.

"In tropical airmasses like the type we saw earlier this summer, the risk for tornadoes increases, but most are very weak and very short lived."

The Storm Survey - Surveying Tornado Damage

By: Kimberly Buttrick, Cooperative Program Leader

Above: South street in Coventry, CT.

On Wednesday evening July 10, 2013, a National Weather Service (NWS) Taunton Lead Forecaster working the radar desk issued 3 separate Tornado Warnings for portions of northern Connecticut that included Tolland and Windham Counties. The warnings were based on radar imagery of thunderstorms that depicted rotation. Reports of thunderstorm wind damage and possible tornadoes were received that evening from Amateur Radio and Trained Spotters. A video of a tornado was even emailed to NWS Taunton! These reports were from the communities of Andover, Coventry, Mansfield and Tolland in Connecticut.

It became evident on the evening of July 10, 2013 that NWS Taunton would need to assign a storm survey team to northern Connecticut the next day to assess thunderstorm and possible tornado damage. The questions of where, when, what time, Enhanced Fujita (EF) scale rating, winds, path width/length and any fatalities or injuries needed to be answered, verified and documented.

In preparation for the next day's survey, the assigned storm survey team reserved a government vehicle, decided on what time to meet the next morning, printed out radar imagery depicting tornadic signatures, obtained street maps and an atlas of northern Connecticut, and retrieved the office GPS and camera. The storm survey team also collected some points of contact (POCs) from the four communities (Andover, Coventry, Mansfield and Tolland) to be surveyed the following day.

Early the following morning on Thursday July 11, 2013, before leaving the NWS Taunton parking lot, the storm survey team ensured they had their materials gathered from the night before as well as sunblock and enough water for a long day ahead. While en-route to Connecticut, they decided who would be the team leader, the scribe and the photographer. The team leader is the one who speaks to the media and serves as liaison to the POCs. The scribe takes good notes of eyewitness accounts and jots down names, places and street names along with the latitude and longitude at each site. The photographer ensures the damage is documented with an image.

Above: South street in Coventry, CT.

During the storm survey, the survey team realized two important things. The first was how useful their personal smartphones were, especially with a built in compass and latitude/longitude readout. Additionally, one can track the path of a storm with the smartphone. When using the smartphone camera, it geocodes the position of your location with a point (latitude and longitude). After a few pictures from different communities, one can plot a storm's path using any type of interactive web map application for the smartphone. The second important thing was how valuable the POCs were. The POCs served as navigators through their communities which included a lot of twists and turns down countryside roads. This saved the survey team precious time as there was much to survey that day in the four communities.

Cont'd on page 14

Cont'd from pg 13…Tornado Survey

Additionally, the POCs had already scouted out and canvassed much of the damage the night before, so they knew the best locations to which to escort the storm survey team. It became very apparent that storm surveying is a team effort and a community partnership of civil servants – at the local, state and federal levels.

Above: Wonderview Road in Tolland, CT (microburst damage – note trees lying parallel)

As the storm survey team visited the impacted communities, they met with many residents and heard firsthand accounts of what happened, what time it happened and what kind of damage occurred. In some cases there were no residents to talk to, especially in very rural areas. With or without eyewitness accounts, the team investigated the damage and debris objectively.

While conducting the storm survey, the survey team had many media outlets following them and filming them. Yet, it was important not to speak too soon to the media as the survey needed to be completed before any comments went on the record. One message and one voice are crucial during these storm surveys which is why it is important to assign a team leader.

The survey team leader made the final decision on whether a tornado occurred. And if one was confirmed, an EF rating would need to be assigned. To determine EF scale rating, the survey team had a couple of things to assist them: the surveyed damage, radar images of velocity (wind speed) and wind reports from nearby observation sites.

"It became very apparent that storm surveying is a team effort and a community partnership of civil servants – local, state and federal."

To assist the storm survey team in relaying their final findings to the media, the Emergency Management Director of Mansfield reserved a conference room at the Mansfield Town Hall Council Chambers. At briefing time, the official findings were conveyed to the media outlets as one message with one voice from the storm survey team leader. An EF-1 tornado was confirmed near Andover, Coventry and Mansfield in Tolland County Connecticut and a Microburst was confirmed near Tolland in Tolland County Connecticut.

After the media briefing, the team headed back to NWS Taunton where the surveyed storm data was compiled into a Public Information Statement (PNS) and then disseminated for local and national audiences. The findings outlined in the PNS will be archived at the National Climatic Data Center where the data will be incorporated in a Storm Data Publication and the Storm Events Database as well as be included in Severe Weather Climatology.

Storm surveys are vital because after the fact there are numerous media inquiries and insurance claims. There are also socio-economic effects that will be investigated and studies that will be conducted. Thus having storm survey data archived assists with inquiries, present and future, from all sorts of users.

WEA Messaging Saves Lives in CT Tornado

By: Glenn Field, Warning Coordination Meteorologist

A Wireless Emergency Alert (WEA) activated by a Tornado Warning from the NWS Taunton (Boston), MA office is credited with saving up to 35 lives on July 1, 2013 in East Windsor, CT. Kathy Russotto, Manager of the Sports World Complex and a counselor received the WEA on their cell phones at 1:30 pm. Ms. Russotto and five counselors were supervising 29 children in an inflatable soccer dome. Upon receiving the WEA, the counselors rushed the children into an adjoining building where they sheltered. Within a few minutes, the tornado hit the complex, ripped off the dome, and threw it high above Interstate 91. Thanks to the quick action taken by Ms. Russotto and her counselors in response to the warning, there were no injuries.

Connecticut SKYWARN Recognized

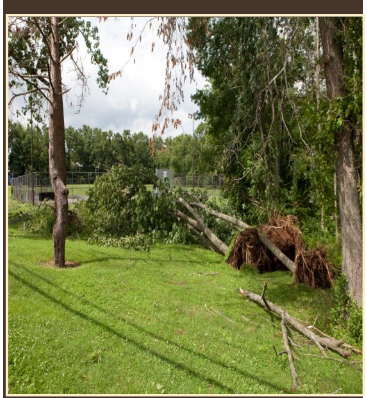
By: Robert Macedo, SKYWARN Coordinator

Above: Damage in Enfield, CT in the Westerly/Heron Drive/ Taylor Road area. Photo by: KB1SLZ: Howard Lunt

On July 1st, 2013, one of the biggest severe weather events of the 2013 season occurred with the area of most significant impact in the Connecticut River Valley region of Western Massachusetts and Connecticut. SKYWARN was activated to provide criteria reports to the National Weather Service (NWS) in Taunton. Western Massachusetts SKYWARN relayed reports to NWS Taunton of flash flooding in the Springfield and Westfield area and significant wind damage in a portion of Agawam, Massachusetts. Reports were relayed through the 146.94-Mount Tom Repeater with N1QKO-Eric Tuller and KA1JJM-Ray Weber assisting along with numerous Amateur Radio SKYWARN Spotters who checked into the net from this region.

After this activity in Western Massachusetts moved out, a new severe thunderstorm took shape over the Windsor Locks, East Windsor, Windsor, and Enfield, Connecticut area and rapidly became tornadic, prompting the issuance of a Tornado Warning for Northeast Hartford and Northwest Tolland Counties in Connecticut. Connecticut SKYWARN rapidly responded to ARES SKYWARN Coordinator for NWS Taunton, Rob Macedo-KD1CY, and provided reports from the Hartford-Tolland County region to the NWS in Taunton, MA.

The Amateur Radio Operators of the Hartford-Tolland County SKYWARN Net provided timely information on the rapidly evolving tornadic situation. K1PAI-Roger Jeanfaivre ran the Hartford-Tolland County SKYWARN Net. N1QLN-Mike, who was traveling in his tractor-trailer for work at the time of the tornado, briefly had his trailer lifted by the tornado and noted rotation aloft with 4-8" diameter tree branches snapped off near the Bradley International Airport in Windsor Locks CT. As the tornado tracked through the region, several Amateur Operators reported trees and wires down in Windsor Locks, CT. Amateur Operators also confirmed a tractor trailer flipped over by the tornado near East Windsor, CT along with the roof of the sports dome that was ripped off the complex in the same area.



Above: Damage on the grounds of the Nathan Hale School in Enfield, CT. Photo by: KB1SLZ: Howard Lunt

As the severe thunderstorm approached Enfield, CT, the tornado had lifted, however, Howard Lunt-KB1SLZ spotted rotation aloft and eventually a funnel cloud near his home. After taking cover, Howard-KB1SLZ found numerous trees down in the vicinity of the Nathan Hale School in Enfield, CT. This confirmed a second touchdown of the tornado in the town of Enfield, CT.

The Hartford-Tolland County SKYWARN Amateur Radio Operator's quick activation in a rapidly developing severe weather situation is an excellent example of how spotters help the NWS. They were able to confirm what was actually happening on the ground as the Tornado Warning was issued and helped with after-action damage surveys. This helped save lives as people took action to take cover immediately. They were recognized on the national web site of the American Radio Relay League (ARRL) at the following link - http://www.arrl.org/news/connecticut-skywarn-praised-following-tornado

The Amateur Radio Staff at WX1BOX, the Amateur Radio station at NWS Taunton, looks forward to working with you as we head towards the winter weather season. We hope to hear from you when weather begins to meet or reach the reporting criteria. If interested in joining the SKYWARN Announcement email list sign-up: contact Rob Macedo-KD1CY: rmacedo@rcn.com

My Volunteer Experience

by Chris McCray, Meteorology Student at Lyndon State College

Having been interested in weather since elementary school, I've been following the National Weather Service (NWS) and its forecasts for years. It's been a longtime dream of mine to work for the NWS. Being from Monson, Massachusetts, I realize how important the meteorologist's job is in keeping the public safe, so I was very excited to learn about the Summer Student Internship Program. I applied during the Spring semester of my Sophomore year studying Atmospheric Sciences at Lyndon State College in Vermont, and was thrilled to hear that I was one of three interns selected for the program.

I began my internship in early June of 2013. My main day-to-day tasks involved shadowing the forecasters at the Long Term, Short Term, Decision Support Services, and Public desks. I gained a strong understanding of computer systems used and learned more about the forecast processes employed by NWS meteorologists. I answered telephone questions from the public and local media, helped generate Local Storm Reports during severe weather events, and even helped with the forecast and wrote a portion of an Area Forecast Discussion.

In addition to shadowing forecasters at each of the forecast/support desks, I worked on several projects. I created a number of flyers for the office, involving rip currents, rip current safety and the surf zone forecast. Another flyer I created was on the subject of general weather safety, with sections on winter weather, severe weather, and flood safety.

My other main project involved working to increase the number of NWSChat users. NWSChat is an important tool in helping the office communicate with media, spotters, and emergency managers. To help these partners understand how to sign up for and use NWSChat, I created a brief guidebook. I emailed this guide to the weather departments of the TV news stations in the Springfield, Hartford, Boston and Providence markets. In addition, I created a version for emergency managers (EMs), emailing it to the local EMs for nearly every town in the County Warning Area (CWA). We received an excellent response from this outreach, receiving several dozen new sign-ups from the media and emergency management communities.

I was able to take part in several field trips during my time at the NWS office. The most exciting for me was taking part in the damage survey team for the July 10, 2013 Tolland County EF1 tornado and Microburst. I met up with Matt Doody and Kim Buttrick in Tolland, CT on the morning of July 11 and tagged along as they first toured damage in the town of Tolland. I was able to further my knowledge about patterns to look for in debris. With the downed trees all laying in approximately the same direction, the damage in Tolland was determined to be from straight-line winds or a Microburst. We then moved on to Andover, CT, where it very quickly became evident that a tornado had touched down, as branches had the appearance of having been twisted off. This type of damage continued through Coventry and into Mansfield, where we held a press conference to reveal our findings.

The other interns and I also went on two group field trips. The first was a trip to several Taunton area river gages with Service Hydrologist Nicole Belk. We visually inspected and photographed the gages. The last trip was alongside Kim Buttrick, visiting COOP sites at water treatment facilities in Bridgewater, Middleboro and Freetown, Massachusetts. There, we cleaned the temperature sensor housings and met with the observers, even getting tours of the facilities.

I am extremely grateful for the support I have been given by the entire staff at the NWS Taunton office. Everyone was very helpful and willing to answer any questions I had, and I couldn't have asked for a better internship experience. I hope to visit the office during the winter to experience operations during an entirely different type of weather. Thanks to my great experience at this office, I am excited for potential opportunities within the NWS once I complete my studies at Lyndon State!

NWS SUMMER INTERNS PRESENT A COOPERATIVE WEATHER OBSERVER AWARD

Pictured left: Mike Bumpus, Operator at the Middleboro Pumping Station, receives a 10 year Length of Service award for his contribution to weather observing in Middleboro, MA. Presenting the award are 3 summer interns with the National Weather Service (NWS) in Taunton. Pictured from left to right are: Chris McCray (sophomore at Lyndon State College in VT), Chris Roller (graduate student at UMASS Lowell), Mike Bumpus receiving his award, and Alyssa Hammond (Senior at Plymouth State University in NH). All 3 interns are studying Meteorology and have high hopes of some day working for the NWS! The Middleboro Pumping Station has a long history of weather records that date back to 1887 – a few years after the pump house was erected.

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The National Weather Service provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community.

Meteorologist in Charge: Robert Thompson

Warning Coordination Meteorologist: Glenn Field

Science and Operations Officer: Joe DelliCarpini

Editor: Stephanie Dunten

Southern New England Airports

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