Prevailing Winds

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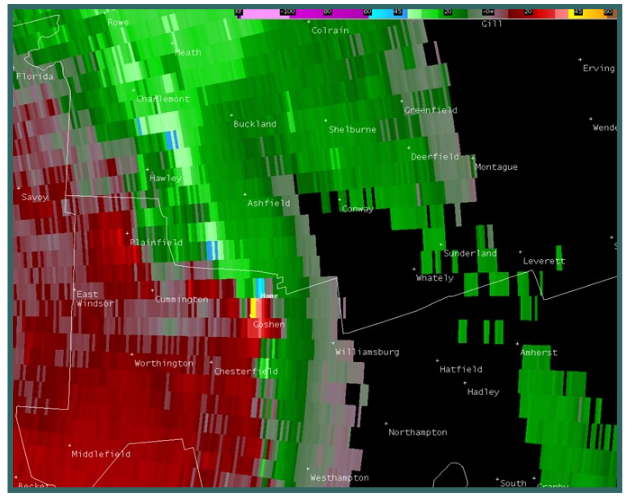
A February Tornado in Massachusetts?

by Stephanie Dunten, Meteorologist

On the evening of February 25th 2017, an EF-1 Tornado briefly touched down in Goshen and then lifted for several miles before touching down and cutting path through the town of Conway, MA. It was the first ever confirmed February tornado in Massachusetts, since records began back in 1950. The tornado had a path length of 5 miles and a path width of 200 yards. Maximum wind gusts were estimated around 110 mph.



Above: KENX (Albany) storm relative motion showing the tornado couplet, with 97 knot gate-to-gate shear.

The tornado resulted in significant structural damage in the area. In Goshen, several pine trees were snapped mid-way and two homes were damaged by trees falling onto them from the brief touchdown. The tornado then touched down with a vengeance in the western part of Conway. A sharp gradient of damage versus no damage was very evident. Large sections of forest had thick pine trees that were snapped mid-way up and some closer to their bases. Numerous power lines were downed and there were numerous road closures. From there, there was a continuous path into downtown Conway. In the area just to the southeast of the town hall, there were several houses that were severely damaged on Whately road. Roofs were blown off, with some metal wrapped around the middle and upper portions of the trees. In one case, the side walls of a house were missing with the interior of the house exposed. On Hill View road there was a large barn that had collapsed. Numerous trees and power lines were down. One injury occurred when a tree landed on a house just northeast of there, on South Deerfield road (Route 116). That was approximately where the visible damage path ended.

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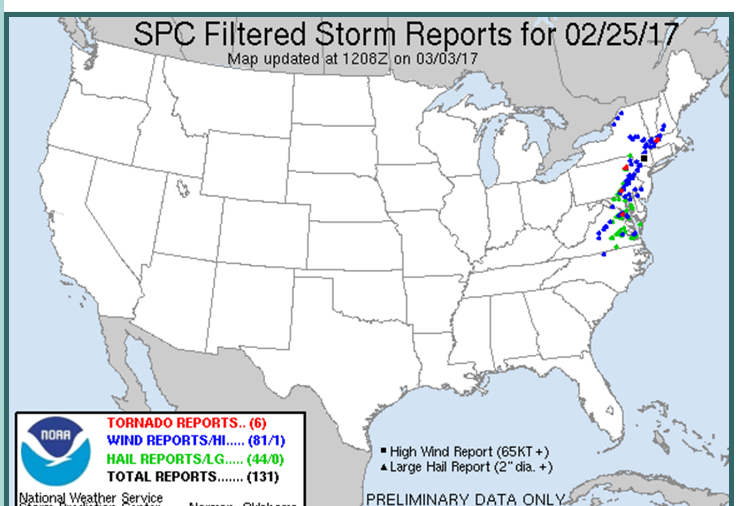

Left: Storm Prediction Center (SPC) storm reports for February 25th 2017

Cont'd from pg 1…February Tornado

Above: **Tornado** Damage in Conway, MA.

There were several ingredients that came together to aid in the development of this unusual strong tornado. There was a potent cold front approaching from the west, while a strong low level jet transported anomalous temperatures and dewpoints northward from the Mid-Atlantic into New England. The winds aloft were quite strong, veering with height in the environment. In meteorology terms, this is referred to as wind and speed shear. The greater the amount of wind and speed shear increases the greater the chance for a tornado. Severe weather also requires a certain amount of instability, which acts as fuel for thunderstorms. Instability was lacking for this event. However, the steep mid-level lapse rates, or the rate of temperature change with height, made up for it enough to produce a tornado.

Overall, this weather event was quite anomalous for late February. In fact, the cold front associated with this system resulted in a fairly widespread severe weather event from Virginia all the way into New England. There were more than 131 severe weather reports with 3 other tornadoes that occurred in Pennsylvania and Maryland.

Skywarn Spotters, don't forget to call the National Weather Service and report the following:

- **What you see (hail, wind, tornado etc.)**
- **Your location**
- **The time you witness the event**
- **Your spotter ID**

SKYWARN

What to report to the NWS

Hail		Wind	
Plain M&M	0.50 inches		
Penny	0.75 inches	39-46 mph	Twigs and small branches are broken from trees, walking is difficult.
Nickel	0.88 inches	47-57 mph	Slight damage occurs to buildings, shingles are blown off of roofs.
Quarter (Severe)	1.00 inches	58-63 mph (Severe)	Trees are broken or uprooted, buildings damage is considerable.
Half Dollar	1.25 inches	64-72 mph	Extensive widespread damage.
Ping Pong	1.50 inches	73+ mph	Extreme destruction, devastation.
Golf Ball	1.75 inches		
Lime	2.00 inches		
Tennis Ball	2.50 inches		
Apple	3.00 inches		
Grapefruit	4.00 inches		
Softball	5.00 inches		

MIC Musings

by Robert Thompson, Meteorologist-In-Charge

When you think about it, not many creditable organizations have forecasting the future as a cornerstone of their mission. We in the National Weather Service (NWS) are an exception. As we witness from sports, political, economic and other pundits, predictions for what will happen in the future do not constitute an exact science and in fact often have more of an entertainment than informative value. Operational meteorologists (public and private sector) join a small number of people whose forecasts have serious implications. Other examples include intelligence forecasts of emerging areas of unrest, forecasts involving the emergence or spread of diseases, and power supply forecasts, although weather forecasts and/or climate outlooks can be an underlying factor in these and other predictive efforts. A common element to all forecasts is uncertainty. Understanding of and adapting to the inherent uncertainty in forecasts can increase the value of predictive information to the consumer.

The level of uncertainty can vary considerably from one event prediction to another. This fact is not realized, however, by many, if not most, people we serve. A comparison of the 2014-2015 and 2016-2017 winters illustrates how forecast uncertainty can change from one series of events to another. Many will remember extraordinary amounts of snow in late January into February 2015. Since this region was in the bullseye for one storm after another during that period, the uncertainty associated with those forecasts was actually relatively low. In contrast, every storm during this past winter had one or more portions of southern New England along the periphery of the heaviest snow axis. For example, there was a January storm that dumped over a foot of snow across southeast Massachusetts but no more than a few inches in other parts of the state. The March 14, 2017 winter storm brought well over a foot of snow to Connecticut and western and northern Massachusetts but much less along the heavily populated Boston to Providence corridor. The March 31 to April 1 storm brought nearly every precipitation type imaginable to the region with significant differences in accumulation a function of only a degree or so in temperatures aloft and just a few hundred feet of elevation changes at the surface. Those gradients due to being on the edge of the storm itself or along a boundary of mixed precipitation types result in a high level of inherent uncertainty.

We have instituted products, such as snowfall probability maps, that seek to express the uncertainty. For instance, if the snowfall probability maps reflect a large range between the least amount of snow that could fall and the most that could fall, then the uncertainty for that event in that location will be high compared with a case where the least and greatest possible amounts are close together. These tools have provided key decision-makers a better idea of the range of possible outcomes to prepare for. We have also circled or shaded areas where the level of uncertainty is especially high such as the I-95 corridor between Boston and Providence for the March 14 storm. Social media posts in connection with both the mid and late March storms suggest, however, that many folks from the general public struggle with how to respond to an event with inherently high uncertainty.

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Above: NWS Taunton Meteorologist-In-Charge Bob Thompson speaks to a media panel about coastal flood initiatives

Cont'd from pg 3…MIC Musings

This is magnified when those regions of high uncertainty intersect major population centers! Our experience this past winter challenges us to develop more effective tools to help the general public understand when the inherent uncertainty level is high and how to adapt accordingly.

We do (in spite of several media stories after March 14 to the contrary!) adjust our forecasts as the event draws closer. The degree of uncertainty usually diminishes as we get closer to an event but not necessarily in the same way from one storm to the next. The suite of computer model guidance that forecasters analyze sometimes comes into close agreement 2 to 3 days ahead of the event time but on occasion remains disparate even less than 24 hours from the start of the event as was the case with both the mid and late March storms. Another measure of model uncertainty is the consistency of one run of a particular model to the next run of the same model (i.e., when the same model is run 12 hours later, does it give a similar solution as the earlier run?). There can be multiple reasons why computer models may be slower in some situations than others to come into agreement. For example, the complexity of the interaction of two large scale systems for the March 14 winter storm led to variability in the track of the circulation pattern both at the surface and aloft. The issue with the March 31 to April 1 storm had more to do with the thermal pattern aloft when just a degree or two difference in temperature at the surface and aloft determined the precipitation type (snow versus sleet versus freezing rain versus rain).

Verification statistics validate that forecasting has improved markedly over the past 20 to 30 years. This in turn has led to greater dependence on weather forecasts and higher expectations for accuracy and detail. Nevertheless, the level of uncertainty inherently associated with a prediction varies from event to event. Even forecasters have to temper their decision-making on the issuance of watches and warnings to be commensurate with the confidence level for any particular event. Sometimes we simply need to state that we honestly don't know yet how the event will play out. And consumers of forecasts and warnings need to accept the fact that there's uncertainty with any event and more with some than others. After all, we're in the business of predicting the future. As one esteemed National Hurricane Center forecaster once said, "Only God knows for sure!"

"The level of uncertainty can vary considerably from one event prediction to another. This fact is not realized, however, by many, if not most, people we serve. A comparison of the 2014-2015 and 2016-2017 winters illustrates how forecast uncertainty can change from one series of events to another."

Want to be an official spotter for the NWS? Check out the following dates for a class near you!

5/8/17 - Taunton, MA at 7:00 PM
5/10/17 - Woodstock, CT at 7:00 PM
5/11/17 - Heath, MA at 6:30 PM
5/11/17 - Walpole, MA at 7:00 PM
5/16/17 - Huntington, MA at 7:00 PM
5/23/17 - Lowell, MA at 6:30 PM
5/24/17 - Tolland, CT at 7:00 PM
6/8/17 - Peabody, MA at 7:00 PM
6/10/17 - Plymouth, MA at 10:00 AM

More Information: **http://www.weather.gov/skywarnprogram**

2017 Preparedness Week Information

- **March 13th - 17th:** Flood Preparedness Week
- **May 1st - 5th:** Severe Weather Preparedness Week
- **May 22nd - 28th:** Safe Boating & Beach Safety Week
- **June 19th - 23rd:** Lightning Safety Preparedness Week
- **July 17th - 21st:** Hurricane Preparedness Week
- **October 30th - Nov 3rd:** Winter Weather Preparedness Week

http://www.nws.noaa.gov/om/severeweather/severewxcal.shtml

Getting to know your NWS Team: Kevin Cadima, Lead Forecaster

Above: Lead Forecaster Kevin Cadima

Kevin is a native southern New Englander, having grown up in Fall River, MA. His interest in weather began during the Blizzard of '78 and was the trigger for him wanting to become a meteorologist. Kevin studied meteorology at Lyndon State College in Vermont and earned a B.S. degree in meteorology in 1989.

Kevin's career with the National Weather Service (NWS) began as a student intern at the New York City forecast office during the summer of 1988. After returning to college to complete his senior year, Kevin began a full time position at the NWS in Binghamton, NY in June 1989. He spent just under a year in Binghamton then transferred to Providence, RI where he worked for 4 years. Kevin also worked at the NWS in Burlington, VT for 11 years, and has been in his current position as a lead forecaster in Taunton since 2005. Kevin is involved in the verification program, the digital forecast system, the training and science team, and leads the operations team in the office.

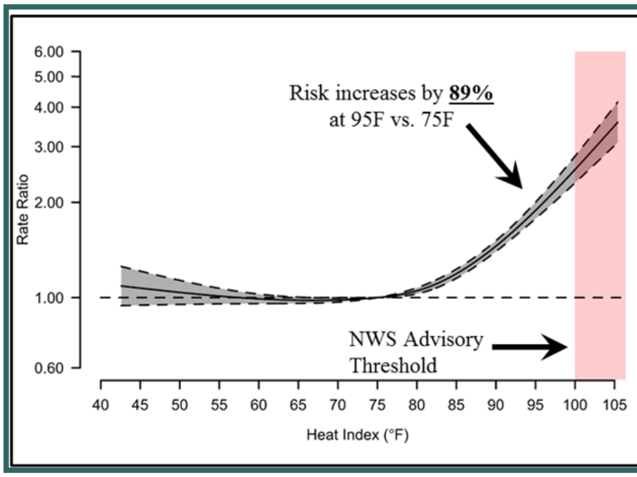
Kevin has been married for 24 years and has two children. His son is a freshman at the University of Maine studying civil engineering and his daughter is a freshman in high school. Kevin enjoys playing golf and is an avid sports fan.

Learn about the NWS's effort to help create a Weather Ready Nation: http://www.nwsnoaa.gov/com/weatherreadynation/

NWS Lowers Heat Advisory Thresholds Based on Health Study

by Glenn Field, Warning Coordination Meteorologist
and Julia Gold, Climate Change Program Manager, RI Dept of Health

National Weather Service (NWS) Forecast Offices throughout New England have lowered the Heat Advisory threshold to a Heat Index of 95°F (from 100°F), provided it lasts for 2 consecutive days. A Heat Index value between 100°F and 104°F for any duration will also trigger an Advisory. The Warning threshold of ≥ 105°F degrees remains unchanged.



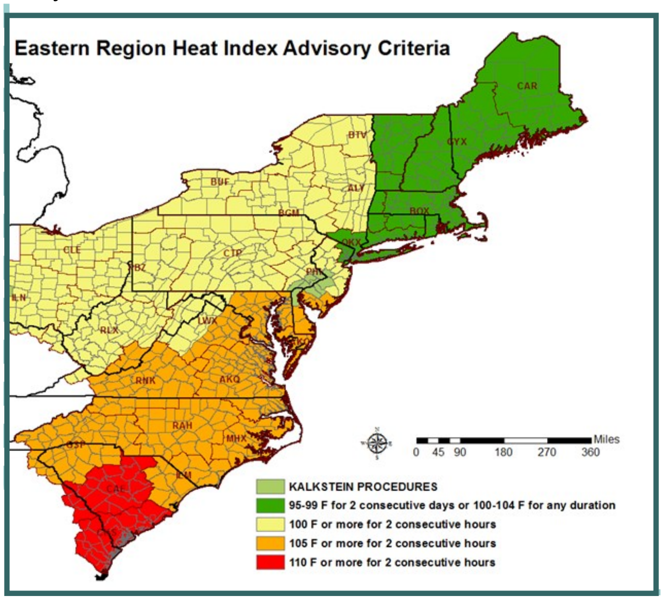
Above: Chart showing how the risk for heat related issues increases below the previous NWS advisory threshold.

The changes were the result of a comprehensive study done by the Northeast Regional Heat Collaborative, which has a mission to conduct research, improve the effectiveness of heat risk communication strategies, and to protect public health. Its partners include the RI and VT Departments of Health; the NH and ME Departments of Health and Human Services; the Brown University School of Public Health; and the Centers for Disease Control and Prevention.

Heat is a major public health threat. More people die from extreme heat than all other extreme weather events combined. The research study sought to answer these questions:

- How does the Heat Index impact health?
- Are current Heat Advisory thresholds optimal for protecting public health in the Northeast?
- What can state and local health agencies do to reduce risk?

Daily maximum Heat Index data were studied from May 1-Sept. 30 from 2005-2012 in RI, 2001-2010 in ME, and 2000-2009 in NH for towns that were within 10 miles of a NWS ASOS site, which covered an estimated 2.7 million people. The data were statistically compared to hospital Emergency Room (ER) visits, both from all-causes and from heat-specific illnesses. Standard methods in the field were used to estimate heat-attributable risk of ER visits and deaths in each city and then results were pooled across cities to get a regional average. Since heat may be associated with adverse health effects for the next several days, the study considered the impact of a single hot day over the next 0-7 days.



The results were undeniable. For a day when the maximum Heat Index reached 95°F, as compared with a day where it only reached 75°F:

- All-cause ER visits increased 7.5% over the following 7 days….. BUT
- Heat-related ER visits increased 89% over the following 7 days!
- Deaths increased 5.1% over the following 7 days.

Based on this information, the NWS offices in New England, in coordination with NWS Eastern Region Headquarters, have lowered the thresholds from 100°F to 95°F, with the stipulation that the 95°F values last for 2 consecutive days. This was because of the cumulative effects of heat build-up and also to prevent an over-abundance of Advisories being issued. The new criteria are now in effect.

Left: The new Eastern Region Heat Index Advisory criteria.

Warmer April High Temperatures for the Boston Marathon

by Emily Greenhalgh, NOAA's Climate Program Office

Ready, set, race! April 17th was Marathon Monday in Boston, and the first of more than 30,000 participants in this year's race bolted off the starting line. Runners in this day and age are more likely to face warmer temperatures than when the iconic race began in 1897.

The graph on the left shows the average maximum temperature (the daytime high) in April for Massachusetts Climate Division 3 (the division that includes Boston) from 1897 to 2016. The division has seen its average maximum temperature rise 0.3°F per decade since 1897. That's more than double the temperature rise recorded for the contiguous United States as a whole (0.12°F per decade).

Recent decades have warmed even more rapidly. In the last 30 years or so, the rate of warming more than tripled, ranging from 1.0° to 1.3°F per decade in the Boston area, depending on the exact start and end year you use to calculate the trend. (For 1984-2014, for example, the trend is 1.3°F per decade. For 1984-2016, it is 1.0°F per decade. You can calculate trends yourself using NCEI's Climate at a Glance tool.)

The Boston Marathon takes place every year on the third Monday in April. While recent temperatures are warmer on average, that doesn't mean the runners of the past have never experienced a hot race. The Boston Athletics Association (BAA) has a list of all the unusual race day weather. In 1905, the temperature was reported to have reached the 100-degree mark.

According to a 2012 study in *PLoS One*, the ideal temperature for marathon runners is between 35°F and 47°F, with faster runners favoring the cooler temperatures. This year's race was warmer than ideal conditions, with the high temperature reaching 75°F. This is the second warmest temperature in the past 12 years for the Marathon. The warmest temperature in recent memory occurred back in 2012 when the high temperature reached 87°F.

The National Integrated Heat Health Information System (NIHHIS), an inter-agency group that provides information on extreme heat, lists athletes as a high-risk group for heat stress. The combination of exposure and exertion means athletes are more likely to experience heat illness. BAA officials have stated that about 2,350 people were treated for heat stress during the 2017 race.

Access heat forecasts as well as information on how to prevent, recognize, and treat heat stress at: toolkit.climate.gov/NIHHIS.

Surprise Freezing Rain Event on February 8th

by Hayden Frank, Lead Forecaster

As the New England Patriots were having a parade across downtown Boston, celebrating yet another Super Bowl Championship, a burst of wet snow was falling. This was on the morning of Tuesday, February 7th when a quick 1 to 2 inches of snow fell across the region. Most of the snow accumulated on grassy surfaces with temperatures at or just above freezing. By Tuesday afternoon the precipitation had changed to rain and drizzle, which continued into the evening. There were no issues for the Tuesday evening commute as temperatures rose into the upper 30s as expected.

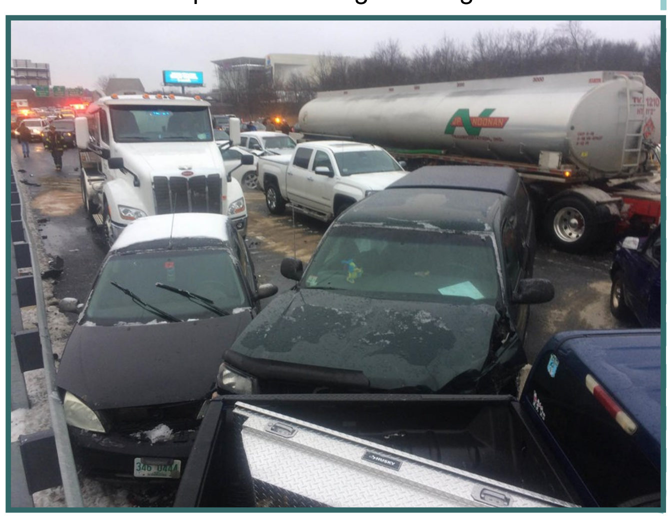
"Although computer models and weather forecasting have improved markedly over the past few decades, there is still plenty of room for improvement. Forecasters need to recognize situations where model guidance may struggle and adjust as necessary."

While there was still a bit of snow and ice that lingered Tuesday afternoon across interior southern New England, forecasters at our office turned their attention to a potential major winter storm and blizzard that would strike the region on Thursday, February 9th. Winter storm watches were posted for all of southern New England with the Tuesday afternoon package. This storm occurred as expected with much of Southern New England receiving a widespread 10 to 16 inches of snow. Strong winds resulted in blizzard conditions with near zero visibility at times along the Boston to Providence corridor and onto Cape Cod.

While our office was focused on this major winter storm that would impact us on Thursday, we were about to get a lesson in mesoscale meteorology. Mesoscale weather events happen on a much smaller scale and are more difficult to forecast than large storms that impact a significant area. Increasing technology has allowed for higher resolution computer models, which perform much better in some of these small scale events. Unfortunately, in this case even our most advanced computer models completely missed this event.

Pockets of light freezing rain persisted across interior southern New England Tuesday evening, which was expected. However, temperatures were expected to warm well above freezing even in these locations by daybreak Wednesday, February 8th. In the Boston metropolitan area, temperatures in the upper 30s Tuesday evening were expected to rise near 50 by daybreak Wednesday! Instead, a very weak low pressure system moved northeast of the region very late Tuesday night. Our computer models failed to capture this system since it was so weak, but it was enough to switch winds from the east northeast to the north in Boston. This allowed cold air right near the ground to ooze south from southern New Hampshire, and temperatures in Boston fell into the mid to upper 20s after midnight. At the same time, a brief band of freezing rain showers moved across the region just before the Wednesday morning rush hour, setting the stage for the disaster of a commute that would occur several hours later.

Forecasters were very situationally aware and quickly caught on to the mesoscale processes that were occurring overnight. A Freezing Rain Advisory was issued at 145 am for the Boston Metropolitan area right through the Wednesday morning rush hour. However, it was too late to get the attention of many road crews and motorists who were unaware of what would await them. Numerous accidents occurred, including a 55 car pileup on Route 128 in Wakefield, MA resulting in minor injuries. Unfortunately, there was a fatality in Needham when a man tried to assist two vehicles stuck on the ice and was hit by another vehicle that was sliding on the icy road. In addition to the accidents, extremely long commute times made this one of the worst rush hours in recent memory.



Above: Route 128 in Wakefield, MA on Feb 8th 2017. Photo by the Boston Herald.

Although computer models and weather forecasting have improved markedly over the past few decades, there is still plenty of room for improvement. Forecasters need to recognize situations where model guidance may struggle and adjust as necessary. This event proves that forecasters still have a very large role in weather forecasting especially in these high impact small scale events. Communication of this information to decision makers as well as the public is as important as the forecast itself.

Four Record Southern New England Spring Snowstorms

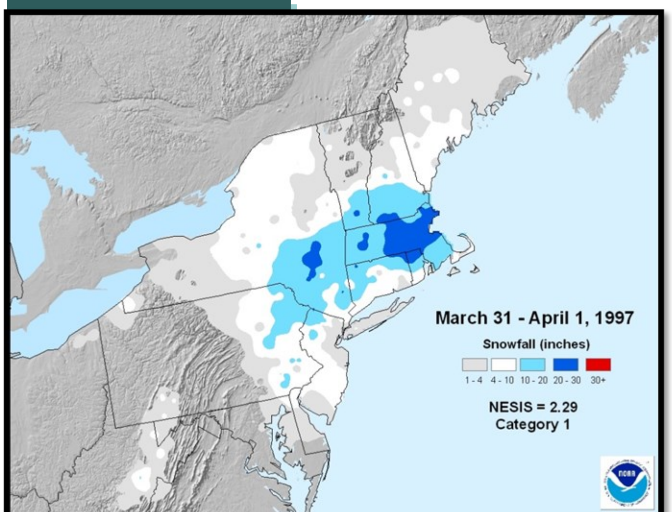
by Eleanor Vallier-Talbot, Meteorologist

Most New Englanders think that heavy snow falls during the traditional winter snow season, generally from late October through early March. However, there have been occasions when remarkably strong snowstorms occurred late in the season. Over the years, four systems developed from late March into early May, which were highly unusual but impactful to the region.

Two of these storms landed on the Northeast Snowfall Impact Scale (NESIS) not only due to heavy snowfall, but strong winds which caused blizzard conditions and enormous impacts to the populous. Massive power outages and closed roadways which effectively closed portions of the region during each event.

Significant anniversaries will be marked in 2017 for each of these storms. They left indelible memories for those that experienced them. Here's a look back on each of these storms:

20th Anniversary – "April Fool's" Blizzard of March 31 to April 1, 1997



Above: Northeast Snowfall Impact Scale (NESIS) for the April Fool's Blizzard of 1997

Credit: NOAA/ National Centers for Environmental Information (NCEI)

Coastal low pressure rapidly intensified as it passed south of New England on the 31st of March into the morning hours of April 1st 1997. Light rain began early, then changed to heavy, wet snow by midday into the early afternoon as colder air worked into the region. Snowfall rates of 2 to 3 inches per hour were common during the height of the storm. Three inch per hour snow rates were reported at Logan International Airport between the hours of 11 PM March 31 to 3 AM on April 1. Numerous reports of thunder-snow and lightning strikes were reported as well. This Blizzard was rated as a Category 1 "Notable" high impact snow event on the Northeast Snowfall Impact Scale (NESIS)

Impacts:

A state of emergency was declared in Massachusetts by Governor William Weld through April 2 as over 700,000 people were without power as trees and large limbs fell due to the heavy, wet snow. Roadways were impassable as thousands of motorists were stranded in their vehicles or in shelters. Massachusetts Bay Transportation Authority (MBTA) trolleys shut down, unable to move in the heavy snow and Logan Airport closed from the afternoon of March 31 to late night on April 1, stranding thousands of travelers. Three people reportedly died due to shoveling the heavy, wet snow during and after the storm

The cooperative weather observer in Milford reported 36 inches of snow, tying the station record from the Blizzard of February 1978. Two to 3 feet of snow fell in Boston, Worcester, the Blue Hill Observatory in Milton and several other cities and towns across Massachusetts and Rhode Island. This was the highest April snowstorm in Boston (25.4") and Worcester (24.0"), 2nd highest April snowstorm at Blue Hill in Milton at 30.0" (#1 – 30.1" on March 4, 1960). Overall wind gusts up to 50-70 mph were observed with Blue Hill Observatory gusting to 72 mph and Little Compton, RI reaching 71 mph.

35th Anniversary – April 6-7, 1982 Blizzard

Low pressure moved northward from the Gulf Coast to the Ohio Valley, then developed into a strong storm off the Delmarva peninsula early on April 6th. The low then tracked south of New England before pushing across Nantucket and into the Gulf of Maine late in the day. Snow continued to fall through the early morning hours of the 7th as the temperatures dropped into the 20s as the storm raged on. Numerous reports of thunder-snow and lightning strikes were reported as heavy snow fell. This blizzard was rated as a Category 2 "Significant" high impact snow event on the Northeast Snowfall Impact Scale (NESIS).

Cont'd on page 10

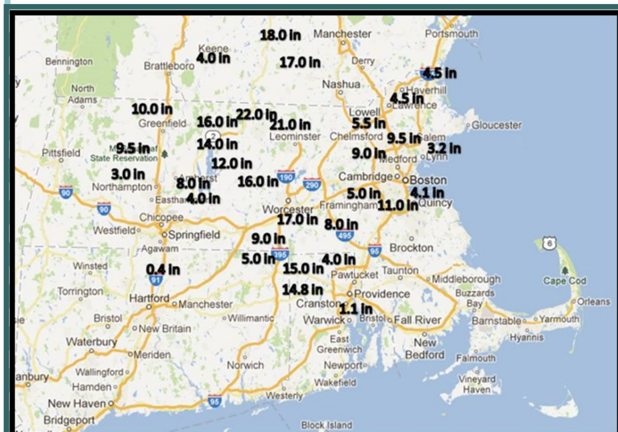
Cont'd from pg 9…Historic Snowstorms

Impacts:

Numerous power outages were reported due to strong winds taking trees and power lines down. A 50+ car pile-up occurred on Interstate 495 in Marlborough near the Route 290 exit due to blizzard like conditions. There were many reports of cars "sliding all over the place" due to snow covered roads. This record snow and cold was reported as far south as northern New Jersey and eastern Pennsylvania.

Snowfall at the long term climate sites across the region set records for April 7th with Worcester receiving 15.0", Windsor Locks 14.1", Blue Hill in Milton 14.0", Boston 13.3" and Providence 7.6". This single snowstorm placed April 1982 as one of the top five snowiest Aprils on record at these sites. Record snowfall was also reported across portions of New York and eastern Pennsylvania.

30th Anniversary – April 28-29, 1987 Snowstorm



Snowfall Amounts -- April 28-29, 1987

An upper level cold pool pushed out of central Canada into western New York state early on April 28th while a low pressure system began to develop over the Delmarva peninsula. The upper level system deepened as it shifted east across New England during the 28th into the 29th. Light rain changed over to heavy, wet snow as temperatures fell to near or below freezing during the 28th. The low tracked into the Gulf of Maine early on the 29th, but leftover light snow fell across the region through around midday, The highest snowfall amounts were 15 to 22 inches across northwest Rhode Island, central and northwestern Massachusetts into portions of New Hampshire, Vermont and Maine.

Impacts:

Hundreds of traffic accidents occurred across New England due to the heavy snow while over 180,000 lost power across the region, with many out of service for days. Several radio stations were knocked off the air in New Hampshire, as well as a station in Fitchburg, Massachusetts. The highest snowfall amounts occurred across north central Massachusetts where 22 inches fell in Ashburnham and Worcester recorded 17 inches of snow for this storm. Over a foot of snow also fell across the northwest hills of Rhode Island where North Foster, Rhode Island had 15 inches.

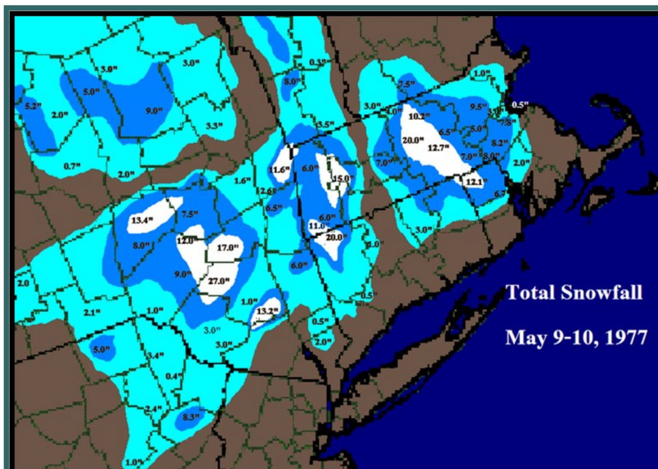
40th Anniversary – May 9-10, 1977 Snowstorm

Broad surface low pressure began to form during the night of May 8. By 8 AM on May 9, the surface low was east of the Mid-Atlantic coast and rapidly intensified southeast of Cape Cod through the afternoon of the 9th. Precipitation started out as a mix and changed over to heavy, wet snow. Heaviest snow fell from midday on the 9th into the early morning hours of the 10th. Highest snow amounts reported across the higher terrain of northwest Rhode Island, the Worcester hills and the Berkshires of Massachusetts into portions of eastern and central New York.

Impacts:

There was extensive tree damage due to the heavy snow taking down fully leaved trees and large limbs. Many power lines were snapped as well. Over 600,000 people were without power across Massachusetts and northern Rhode Island. It took hundreds of power crews several days to restore power across the region. There was also a varying degrees of fruit crop damage reported (Credit: Weekly Weather and Crop Report, U.S. Dept. of Commerce and Dept. of Agriculture, May 17, 1977)

Record May snowfall was reported in Worcester (12.7"), the Blue Hill Observatory in Milton (7.8"), Providence area (7.5"), and Windsor Locks (1.3"). Boston recorded 0.5 inches of snow for this event, the second measurable May snowfall dating back to 1891 as 0.9 inches fell on May 8, 1938. This date is also the latest measurable snowfall at Boston and Providence, the 2nd latest at Worcester (#1 -- 1.5" on May 11-12, 1945) and the only measurable May snow event in Windsor Locks dating back to 1905.



<u>Above</u>: Snowfall reports for the May 9-10, 1977 storm

CoCoRaHS: The Community Collaborative Rain, Hail, & Snow Network

by Joseph DelliCarpini, Science and Operations Officer

Do you consider yourself a “weather junkie” or do you just love following the weather? Do you find yourself saying “It doesn’t rain or snow the same here as it does at the airport.” If so, you should become a volunteer observer and join CoCoRaHS! It’s fun and educational for the entire family.

CoCoRaHS is a unique, non-profit, community-based citizen-science network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow). By using low-cost measurement tools and reporting via smart phone app or the web, you can help provide the highest quality data for weather forecasters, hydrologists, natural resources, education and research.

The network originated with the Colorado Climate Center at Colorado State University in 1998 from the Spring Creek Flood in Fort Collins a year prior. What started in Colorado grew nationwide. In 2008, Rhode Island was the first state in New England to join the network, followed by Connecticut and Massachusetts in 2009. Today, there are hundreds of active observers in southern New England and over 15,000 reporting volunteers nationwide in all 50 states, Canada, Puerto Rico, Virgin Islands, and The Bahamas. Even the White House reports for CoCoRaHS!

At our office in Taunton, and in other National Weather Service (NWS) offices nationwide, CoCoRaHS reports are invaluable. Reports from CoCoRaHS “fill in the gaps” and supplement reports we receive from automated airport weather stations. During winter storms, we include CoCoRaHS reports in our listings of snowfall totals. The National Operational Hydrologic Remote Sensing Center (NOHRSC) uses the reports for national analyses of snowfall, snow depth, and snow water content. Rainfall reports are used to help assess the potential for flooding. Over the past year, we used monthly and seasonal precipitation totals to assist with input to the national Drought Monitor. Observers also provided drought information by submitting Condition Monitoring Reports, which helped describe local effects from drought conditions.

CoCoRaHS observers can also submit Hail reports and Significant Weather Reports at any time for heavy rainfall, heavy snowfall, or flooding. These realtime reports alert at NWS forecasters’ workstations and are received in a matter of minutes. Back in July 2008, a report of very heavy rain from an observer in Hope Valley, Rhode Island led to the issuance of a Flash Flood Warning for the greater Providence area, and provided almost an hour’s notice for dangerous flooding.

To become an observer, go to www.cocorahs.org and click on the orange “Join CoCoRaHS” button. Enter your information in the online form, purchase a plastic rain gauge (available on the web site), and take the online training. As a member of CoCoRaHS in Southern New England, you’ll also receive an informative and entertaining monthly newsletter by email. We believe that precipitation is important and does not fall the same on all. Join today and share with all of us how precipitation falls where you are!

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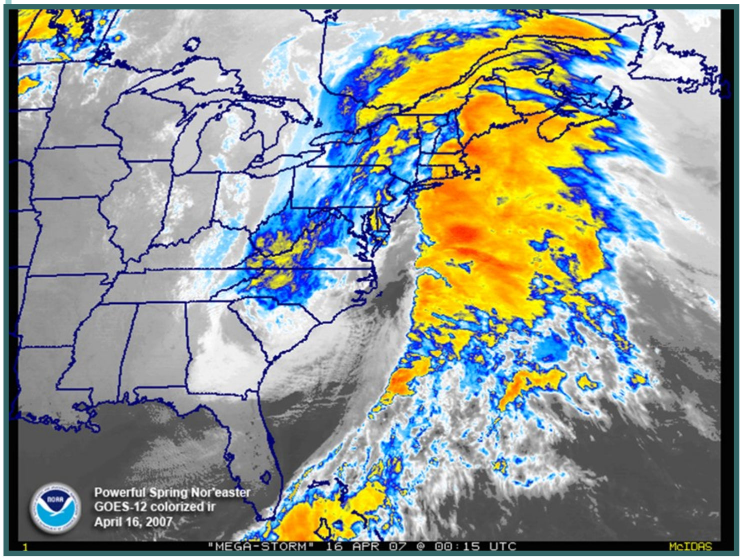
Patriots' Day Storm on April 16th 2007

by Nicole Belk, Senior Service Hydrologist



Above: Satellite Image from the April 16th storm

Let's take a look back 10 years ago, when southern New England was impacted by the "Patriots' Day Storm". A strong, moisture-rich low coastal storm tracked into western Long Island Sound on April 15th, and through Southern New England on the 18th, then slowly moved offshore during the 17th and 18th.

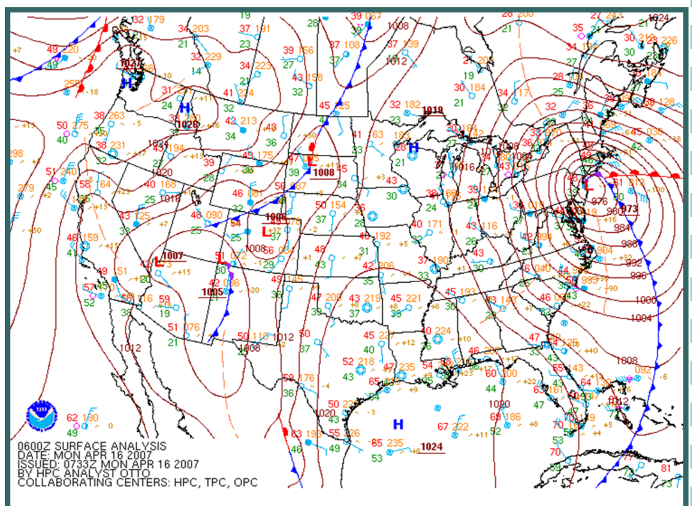
A combination of significant impacts occurred in southern New England during this timeframe. Heavy snow fell in the higher elevations of western Massachusetts. Snowfall totals of 3 to 7 inches were noted across the higher terrain in the east slopes of the Berkshires. The heavy, wet nature of the snow brought down trees and power lines.

Winds in excess of 60 mph brought damage, especially across eastern Massachusetts and Rhode Island. A peak wind gust of 72 mph was reported at Blue Hill Observatory. The combination of a slow moving storm, strong onshore winds, and high astronomical tides brought minor to moderate coastal flooding during multiple high tide cycles.

Flooding rainfall also impacted the area. Rivers were already running above normal prior to this event due to rainfall at the beginning of April. Soils were saturated, and vegetation was largely still dormant. The Patriots' Day Storm brought a widespread 3 to 5 inches of rain to southern New England. The significant rains prompted widespread river and stream flooding, as well as significant urban flooding. In addition to the flooding rains, a previously established snowpack in the Merrimack and Connecticut River Watersheds partially melted out during this event. This snowmelt contributed to the strong rises along the mainstem Connecticut and Merrimack Rivers, exacerbating the flooding.

Twenty-seven River Forecast Points in NWS Taunton's warning area went to flood during this event. The worst flooding was in the Merrimack Valley, where moderate to major flooding occurred on the Merrimack River, the Nashua River, and the North Nashua River in MA. These rivers experienced one of their top 5 floods on record. Other rivers that experienced one of their top 5 floods included the Squannacook River in Groton MA, the Farmington River in CT, and the Blackstone River in Northbridge. Within MA and CT, the lower Connecticut River experienced a prolonged, moderate flood. At Middletown CT, the river was above flood stage for almost 2 weeks!

Presidential Disaster Declarations were designated in portions of CT, RI and MA. Numerous evacuations occurred. Some communities, especially in the Merrimack River Valley, had only recently recovered from the May 2006 floods.



Right: Surface weather map from April 16th 2007

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www.weather.gov/boston

My NWS Experience

by Jonathan O'Brein, Student Volunteer

Above: Jonathan O'Brein

As a meteorology student, I'm always looking for ways to pair my rigorous classroom education with real world experience. This past summer, I found a way to do just that through the summer student intern program at the National Weather Service (NWS) Boston Office. My summer project was "Ensuring the Consistency of the Blue Hill Climate Record." The historic Blue Hill Meteorological Observatory, located 10 miles SSW of Boston, holds the oldest continuous climate record in the United States, with daily records dating back to 1885. My first real world experience with climate and meteorology came at Blue Hill when I interned there as a high school student in the summer of 2012. Not long after I became the Sunday weather observer there. In the years since I've continued to work there as an observer and have helped with many educational programs that the Observatory frequently hosts.

For this summer, I was looking to expand my experience, and the summer intern program at the NWS was the perfect opportunity. This year, one of the projects involved the Blue Hill climate record. It was a perfect fit for me, since I could remain actively involved at Blue Hill while also getting involved with the NWS. While Blue Hill's climate record is continuous on a daily basis, one of very few inconsistencies involves time of observation during the day. Blue Hill is first and foremost a "COOP" site, part of the NWS Coperative Observer Program (COOP), a nationwide network of weather observers. However, when the NWS took over operations of Blue Hill in 1959, it also became a site for Local Climatological Data (LCD), which is a method of data reporting in which all data is taken and reported as of midnight local time, convenient because it covers a calendar day. COOP data can be taken more flexibly. In the early days at Blue Hill, it was taken late in the evening, around 10 PM EST. That eventually became 7 to 8 PM, and then shifted to 7 AM EST in 1959, and continues that way to this day.

The problem lies in the fact that many years of data taken at 7 AM, specifically 1959-1998, are missing or incomplete in digital archives at the National Center for Environmental Information (NCEI). For that period, those records only existed in the original form as written in Blue Hills' observation books. For research and continuity purposes, it is important to maintain both the calendar day "LCD" record and the record of 7 AM-7 AM data. That's where I came in. My project was entering daily values of temperature (maximum, minimum and at observation), precipitation, snowfall, and snow depth ending at 7 AM for every day from 1959-1998. The only way to do this was to copy the data from the original records. As can be imagined, this was a large and tedious task. Roughly 40 years of daily information for six variables equates to nearly 90,000 individual pieces of information. For much of the summer, I spent a few days of the week methodically typing in daily weather records for all of the years I needed to fill. The hard work paid off, as towards summer's end I had keyed in all the necessary data.

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Left: Kim Buttrick handing Jonathan an award

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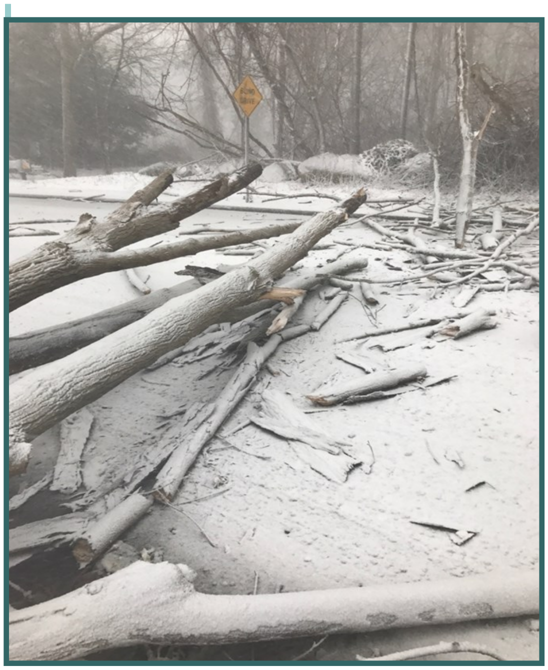
I received great support during this project. Kim Buttrick, my mentor for the summer, heads the COOP program at the Taunton office and is very knowledgeable and supremely passionate about the Blue Hill climate record. In addition, the staff at Blue Hill were very supportive. In particular, Mike Iacono, Blue Hill's chief climatologist, guided me along the way in helping to solve some of the challenges and inconsistencies I came across while working with the data. He is also working on his own database of daily Blue Hill weather data, and between our work and those supporting us at NWS Boston and at NCEI, I am confident the Blue Hill climate record is in excellent hands.

While the project took up a lot of my time, I also experienced some of the everyday operations that take place at the NWS. I was on hand for a couple of the severe weather days we had this past summer, and was able to observe how storms were tracked, warned on, and how damage reports were gathered by the Skywarn team and logged by meteorologists, including the morning after the Concord, MA tornado on August 22, 2016. The quieter days allowed me to get some more relaxed experience learning about our public service desk and how forecasts are made and products are issued. I also joined Kim as she traveled to another pair of local COOP sites to ensure they were running smoothly. With a NWS career something I'm strongly considering for my future, this was all valuable experience.

Thank you to everyone at NWS Taunton for a great summer and I look forward to seeing you all again in the future!

WX1BOX Winter Weather Operations

by Rob Macedo, WX1BOX Ham Radio Coordinator



Above: Downed trees from heavy wet snow and damaging winds in Acushnet, Massachusetts from the February 9th, 2017 blizzard. Photo by: Tyler Pereira

The winter 2016-2017 season brought a pattern of extremes to the region from winter to severe weather and back to winter. This spring has also helped alleviate the drought conditions which were experienced over the course of 2016. There were a number of formal SKYWARN activations, due to these events, with amateur radio Operations at the National Weather Service (NWS) in Taunton over the course of the winter season. We will focus on three SKYWARN activations in detail which are the February 9th 2017 blizzard, the February 25th 2017 EF-1tornado in Goshen and Conway, Massachusetts and the March 14th, 2017 blizzard.

The Thursday February 9th, 2017 snowstorm resulted in several locations across eastern Massachusetts and Rhode Island achieve blizzard conditions. Widespread heavy snowfall with 2-4" per hour rates was observed with wind gusts as high as 70 MPH. About a dozen SKYWARN repeaters were active which reported snowfall totals, damage reports from strong winds and snow, and to document the high snowfall rates that occurred in the region. There were an unusually high number of reports of thundersnow across the area. Snowfall amounts ranged anywhere from 8-18" across much of Southern New England. At the height of this blizzard, over 50,000 people were without power, centered over Cape Cod and the Islands from damaging winds and wet snow. Pockets of minor coastal flooding were also observed due to the strong northeast winds and high tide conditions.

Both amateur radio and non-amateur radio SKYWARN spotters provided many critical reports for situational awareness purposes as utilized by the NWS office in Taunton.

After a period of wintry weather in early February, conditions turned unusually mild in late in the month with record breaking high temperatures for portions of Southern New England. This set the stage for a strong cold front to move through the region on the evening of Saturday February 25th. The cold front had a squall line associated with it which brought widespread pockets of wind damage to eastern New York and into Berkshire County, Massachusetts. As the line made its way into the east slopes of the Berkshires, a severe thunderstorm organized itself and exhibited strong rotation over Goshen and Conway, Massachusetts. In fact, a weather station in Goshen recorded a 67 MPH measured wind gust. Several trees and wires were downed in Goshen.

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Above: Conway Massachusetts tornado damage Photo by: W1NWS-Ray Weber and Alex Kamyshin

The most significant damage with this severe storm occurred in Conway with widespread tree and wire damage blocking the center of town. Also, there were additional pockets of wind damage through central and northeast Franklin county of Massachusetts.

During the morning hours on February 26th, several homes were found to be severely damaged in Conway which prompted W1NWS-Ray Weber and Alex Kamyshin from western Massachusetts SKYWARN to be sent to the area for an initial damage assessment. This was followed by a NWS Taunton storm survey, which determined that a high-end EF-1 tornado struck both Goshen and Conway Massachusetts. This is the first February tornado in the commonwealth of Massachusetts since records began in 1950. Critical near real-time surface and damage reports along with continued monitoring of the damage allowed for the storm survey to be initiated with a determination made quickly by Sunday afternoon.

The cold front that brought the first ever tornado in Massachusetts in February brought cooler conditions for most of March along with several damaging wind events. It also brought the second blizzard of the winter season on Tuesday March 14th, 2017 for the region. The main regions impacted were in north-central and western Massachusetts through north-central Connecticut with a moderate snowfall along and just north of the I-95 corridor. This blizzard was also accompanied by damaging winds with wind gusts exceeding hurricane force in a few areas.

Similar to the February blizzard, over a half dozen SKYWARN nets updated conditions from around the region. The reports included high snowfall rates of 2-3" per hour, whiteout/blizzard conditions and damage reports from wet snow and wind. Across southeast New England, a rain/snow line spread northward changing heavy wet snow to rain. This resulted in some urban and poor drainage flooding. Hurricane force wind gusts occurred with a 74 MPH wind gust at the Barnstable County Emergency Operations Center in Barnstable Massachusetts. A 71 MPH wind gust was also recorded by KA1WBH-ML Baron on West Island in Fairhaven, Massachusetts. These damaging wind gusts spread northward into the North Shore of Massachusetts with a 77 MPH wind gust recorded on Plum Island, a 70 MPH wind gust in Rockport, and a 61 MPH wind gust in Bradford, Massachusetts. At the height of the storm close to 70,000 were without power in Massachusetts with the highest outages centered over the north shore.

Snowfall totals from the March Blizzard ranged anywhere from 8-16" with higher amounts in parts of western and northwest Massachusetts between 16-20". Lower amounts occurred across the Boston area and south and east of the I-95 corridor. Thundersnow was reported in parts of northeastern Worcester and northwest Middlesex counties of Massachusetts, enhancing snowfall rates in some of these areas.

Over the course of these various events across the Winter 2016-2017 season, SKYWARN Spotter and amateur radio SKYWARN Spotter reports have been critical in understanding the conditions that are happening at the surface. These reports help improve forecasts and can tell the general public exactly what conditions are across the region in a clear and precise way. This helps the media and emergency management ascertain the conditions during severe weather and winter storm events. We greatly appreciate everyone's support in this past summer season.

Above: Tree damage in Georgetown, MA from the Tuesday 3/14/17 blizzard.

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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.

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Editor: Stephanie Dunten

2017 Hurricane Names

R	N	A	T	E	O	Y	E	P	P	Y	R	D	N	R
N	F	E	R	H	M	N	I	T	I	E	Y	R	Y	G
K	R	S	M	M	E	E	L	N	E	A	E	E	J	L
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L	L	N	C	I	N	D	Y	E	V	R	A	H	R	D

Find the following names:

ARLENE	HARVEY	OPHELIA
BRET	IRMA	PHILIPPE
CINDY	JOSE	RINA
DON	KATIA	SEAN
EMILY	LEE	TAMMY
FRANKLIN	MARIA	VINCE
GERT	NATE	WHITNEY