Prevailing Winds

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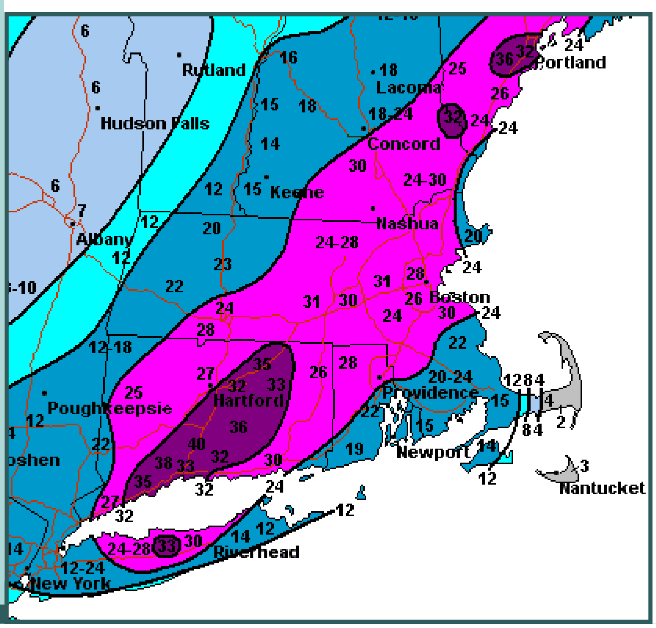
Historic Blizzard Slams Southern New England

by Hayden Frank, Senior Forecaster

After a very dry, snowless January, significant changes took place in early February. While the overall pattern did not become extremely cold, it was supportive of a much stormier pattern. The first and biggest of these storms occurred on 8-9 February 2013 in the form of a blizzard with widespread 15 to 30 inch snow amounts, with even locally higher amounts across portions of Connecticut. The storm went down officially as the 5th biggest snowstorm in Boston's history, with 24.9 inches of snow measured. It was also the 3rd largest storm ever recorded in Worcester MA, with 28.7 inches.

This storm featured key elements that are common in many of our major winter storms. It all began as low pressure moved off the North Carolina coast during the early morning hours of Friday, 8 February 2013. The storm moved northeast and rapidly intensified as it passed southeast of Nantucket the following day. A large high pressure system was in place over eastern Canada, during this time as well. This is often necessary to keep it cold enough along the Boston to Providence corridor for all snow. The large high pressure system was also a key player in producing strong damaging northeasterly winds along the coast and significant coastal flooding along the eastern Massachusetts coast.



Snow began to overspread the region during the morning hours of Friday, 8 February 2013. Conditions slowly deteriorated during the afternoon, but the worst conditions occurred Friday night into early Saturday morning. During the height of the storm, snowfall rates of 2 to 3 inches per hour occurred along with strong northeasterly winds resulting in an all out blizzard with whiteout conditions. In fact, there was even a localized band that developed in Connecticut that resulted in astonishing snowfall rates of 5 to 6 inches per hour!

The hardest hit areas were along the immediate eastern Massachusetts coast, as well as portions of far southeastern Massachusetts, including the upper Cape.

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Cont'd from pg 1…Historic Blizzard

Boston, MA. Picture taken by Matt Meister.

The first issue was that the snow that fell in this region was quite wet. Very wet snow, combined with winds gusting to over hurricane force resulted in numerous downed trees and widespread power outages. Many people in this region were without power for days. In addition, strong northeast winds resulted in widespread coastal flooding through several consecutive high tide cycles. This resulted in some structural damage and numerous roads becoming impassable along the coast due to debris and several feet of water over the roads.

Winter storm watches were issued for portions of the region during the early morning hours of Wednesday, 6 February 2013. The Winter Storm Watches were expanded to cover the entire region by the afternoon, with Blizzard Watches issued for portions of the coastal plain. These watches indicated the potential for an historic storm. In addition, coastal flood watches were issued for the potential of significant flooding. The forecasts called for 18 to 24 inches of snow for much of the region more than 48 hours before the event. All watches were upgraded to warnings on Thursday, allowing emergency managers and local officials time to prepare for this historic storm. Travel bans kept many people off the roads across the region late Friday through Saturday, but the effects of the storm lasted much longer along portions of the coast where significant coastal flooding and widespread power outages plagued the region.

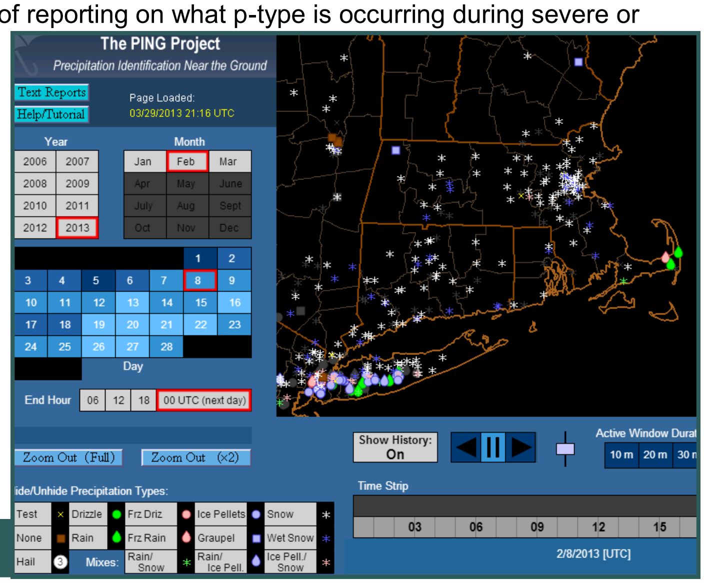
Want to Help with Precip. Research? "Just PING It"

by Eleanor Vallier-Talbot, General Forecaster

The National Severe Storms Laboratory (NSSL) in Norman, OK., needs your help to improve precipitation type (p-type) forecasting. NSSL has been conducting research on p-type forecasting since 2006, when "PING" was born. The PING Project, or Precipitation Identification Near the Ground, receives real time data from volunteers across the United States. Correlating these ground reports with radar data helps researchers improve current radar algorithms or create new ones. The project also helps researchers to develop techniques to improve precipitation type forecasting.

But ***why***? Whenever severe weather or winter storms occur, data are collected from National Weather Service (NWS) Dual Polarization (Dual-Pol) weather radars. Some of the new Dual Pol products include the Correlation Coefficient (CC) and Hydrometeor Classification (HCA) algorithms. Both the CC and HCA products help forecasters determine the precipitation types. However, several factors interfere with accurate reports of either CC or HCA. Including: the increasing height of the radar beam as it propagates away from the site, beam blockage, the mixture of hydrometeors, and changes in the melting layer. So the CC and HCA can "see" different types of precipitation aloft than what actually reaches the ground, especially farther away from the radar site.

That's where PING and the volunteers come in. With two ways of reporting on what p-type is occurring during severe or winter weather events, NSSL researchers can correlate real-time reports of precipitation type to the NWS weather radar data. The data are archived for research purposes, and can be used by anyone that accesses the PING website. To become a spotter, all one has to do is sign up through the PING website (www.nssl.noaa.gov/projects/ping/)! You can even take PING wherever you go using an application (app) for Android and other smart phones, called mPING. This app will allow anyone to send in their current p-type and it will plot your current location. The PING data are available on a real-time and archival basis on the NSSL PING website (www.nssl.noaa.gov/projects/ping/display/).



So, when anyone complains about why weather forecasters can't tell whether it will rain or snow in their backyards, just tell them to PING it!

MIC Musings

by Robert Thompson, Meteorologist-in-Charge

After a slow start, this past winter gave us an opportunity to put some new concepts into operations and be tested not so much by fire, but as by snow and water. Many folks acknowledge how busy we must be when it's stormy but probably have a less clear picture of what we do between storms. This brief article takes a look at a few items we have been quietly (but intensely) working on in the background and how they played a role in a few events during the course of this winter.

In January we gave a shift, originally designed to augment operations during active weather, a new mission. This shift is now dedicated to Decision Support Services (DSS) Monday through Friday. The National Weather Service (NWS) has been talking a lot about creating a Weather-Ready Nation and the DSS shift fits well within this realm. Arguably, the NWS has provided DSS since its very inception in the Signal Corps days, but today's focus is on a whole new level of DSS. We have come to realize that the most perfect forecasts fall short if they do not help key officials with effective response decisions. Through a more integrated partnership with the entities we serve (in particular the emergency management community), we now attempt to provide weather hazard information in a more focused way that allows emergency managers and other key decision-makers to take more informed and effective actions for the sake of public safety and economic efficiency.

Since we inaugurated the DSS shift, we have focused our flow of weather information on community response/preparedness. For example, we have provided additional information on specifics and confidence levels regarding just a couple of inches of snow, which is expected to fall during the meat of the rush hour. We are also better positioned to provide greater lead time for potential major events that in turn buys more time for emergency managers and others to start their preparations ahead of a storm.

We have made snow probability maps a standard part of our DSS briefing package for winter storms. These maps help better communicate our level of confidence of reaching various snowfall thresholds across the area. For the early February blizzard, the snowfall probability maps depicted a high confidence situation with very high percentages – even for snow totals greater than 12 inches! In contrast, the more complicated and challenging early March snowstorm yielded much lower forecast probability values, which reflected a much higher level of uncertainty.

The Taunton WFO has engaged in various efforts over the past few years to enhance the coastal flood forecast and warning program, and both the early February and early March coastal storms helped to showcase these new initiatives. For example, we now produce a Coastal Hazards page on the web that is a nice portal for one stop shopping when it comes to coastal flood threats. This page (http://www.erh.noaa.gov/box/cfwGMdisplay.php) depicts storm tide, storm surge, wave, and impact category forecasts for the next several tidal cycles. This page also provides a link to any Coastal Flood Statements (including the full text for any watches, warnings, or advisories issued), a time series of water level observations and forecasts, and reference inundation maps. A relatively new tool, StormReporter, provides forecasters, emergency managers, coastal plain managers, and others near real-time information on coastal impacts by inundation, wave battery, and/or erosion. And more behind the scenes, WFO forecasters now have the ability to adjust the storm surge guidance from one of two models for various reaches of the coastline to better reflect the upcoming situation. Forecasters at WFO Taunton substantially improved upon the guidance by use of this methodology for both the early February and early March coastal flood events.

These are a few examples of where we have been able to insert new research into operations. The point of this message is that as important as it is to attend to our mission today, it is also important to find the time to plan for tomorrow. This winter has allowed us to reap some fruits of those labors that were accomplished in between storms.

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

Sandy: Hurricane/Nor'easter/Superstorm

by Glenn Field, Warning Coordination Meteorologist

Above: Sand deposited in a home located on Misquamicut Beach, RI.

Sandy, by any name, was a storm that will be long-remembered, especially for residents near New York City and along the New Jersey coast. Here in southern New England, we dodged a real bullet, but we still had considerable damage on the south-facing shores of Massachusetts and Rhode Island.

Synopsis: Sandy was a Category 3 hurricane with 115 mph sustained winds when it was over eastern Cuba. In the Bahamas, it weakened to a Category 1 hurricane and grew to be very large in size. It then continued to grow in size, despite weakening to a tropical storm just north of the Bahamas. The track of Sandy was very well forecast several days in advance, it was forecast to head northeast then make a sharp left turn into New Jersey. This highly unusual track resulted from an anomalous blocking pattern in the North Atlantic, preventing it from heading out to sea. It was also forecast to become an extremely intense storm, with some models indicating barometric pressure as low as 929 mb or 27.43". A piece of a deep upper level trough in the Midwest moved into the southeast U.S. and provided a temperature gradient as well as less vertical wind shear, which allowed Sandy to re-strengthen to a Category 2 hurricane (85 knots, or nearly 100 mph) while it began its turn northwest toward the mid-Atlantic region. At that point, its wind field was so large that New England, which was more than 500 miles away, was experiencing gusty winds to 30 to 40 mph and building seas. In that sense, it was like a big nor'easter (extratropical), with a hurricane at the center… i.e., a "hybrid" storm.

According to the National Hurricane Center (NHC), it was Sandy's tremendous size that helped drive a catastrophic storm surge into the NJ and NY coastlines. Preliminary U.S. damage estimates are near $50 billion, making Sandy the second-costliest cyclone to hit the U.S. since the Galveston hurricane of 1900. There were 147 direct deaths associated with Sandy in the Atlantic basin, with 72 of these occurring in the mid-Atlantic and northeastern U.S. This is the greatest number of U.S. direct fatalities related to a tropical cyclone outside of the southern states since Hurricane Agnes in 1972. For the full report, see: http://www.nhc.noaa.gov/data/tcr/AL182012_Sandy.pdf

> "Sandy, by any name, was a storm that will be long-remembered, especially for residents near New York City and along the New Jersey coast."

Sandy was declared to be "post-tropical" in structure just before making landfall near Brigantine, NJ, with 80 mph maximum sustained winds, mainly north of the center. The combination of the hurricane moving over much cooler waters and into a colder air mass over the northwest Atlantic Ocean contributed to Sandy's loss of tropical characteristics. In our region, Sandy brought hurricane force wind gusts of as high as 75 to 85 mph along the MA and RI coasts, with Westerly RI recording the highest reading at 86 mph (see listing below). Winds gusted to 50 to 60 mph across interior portions of southern New England.

Highest Wind Gusts – Oct. 29, 2012

Westerly, RI	Citizens WxObs	86 mph 244 PM	
Buzzards Bay Tower	BUZM3	83 mph 300 PM	Elevation 80 feet
Point Judith, RI	Mesonet	81 mph 240 PM	Elevation 18 meters
West Island, MA	Mesonet	80 mph 335 PM	
Marstons Mills, MA	Amateur Radio	79 mph 447 PM	
Barnstable, MA	Amateur Radio	79 mph 101 PM	
Mattapoisett, MA	Amateur Radio	76 mph unknown	
Blue Hill – Milton, MA	KMQE	74 mph 332 PM	
Pleasure Bay, MA	Mesonet	73 mph 300 PM	
Warren, RI	Spotter	73 mph 410 PM	
East Falmouth, MA	Spotter	72 mph 200 PM	
Kalmus-Hyannis, MA	Mesonet	72 mph 325 PM	
Conimicut, RI	NOS PORTS	71 mph 324 PM	CPTR1

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Cont'd from pg 4…Sandy

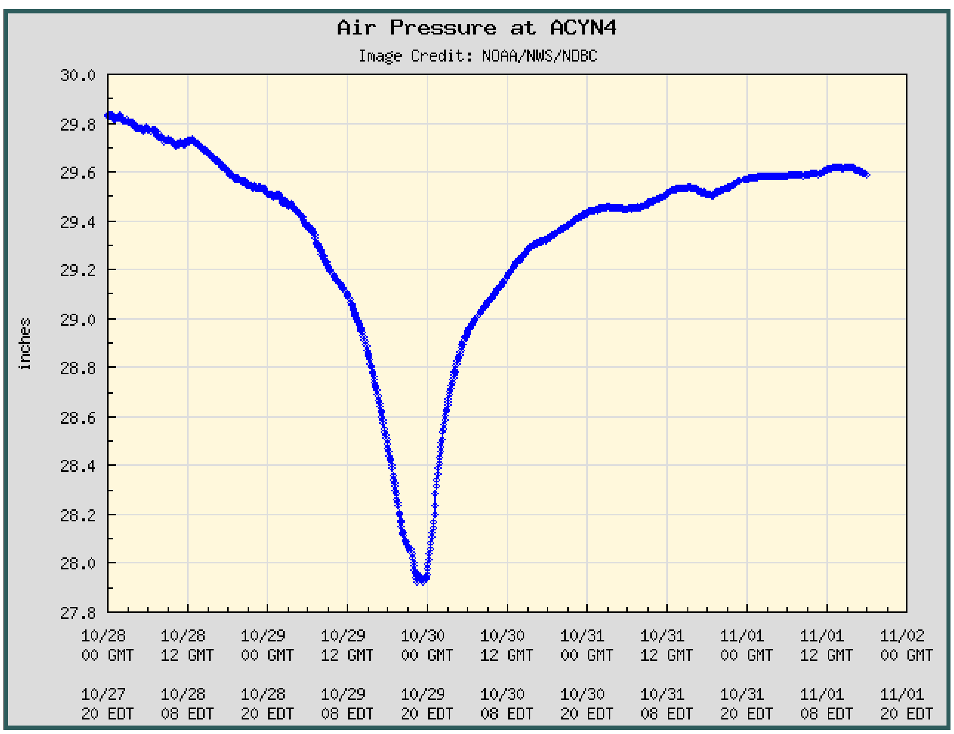
Above: A car frame, used to strengthen the dune system in 1957, was uncovered during Sandy.

Interestingly, the highest wind gust related to Sandy occurred on Oct. 30th, a full day after the center of Sandy had moved into Pennsylvania. A severe thunderstorm embedded in an outer band well to the east of Sandy produced a damaging microburst in Wareham, MA. A National Weather Service survey team estimated the wind gusts at 90 mph there.

In general, moderate coastal flooding occurred along the MA coastline and major coastal flooding impacted the RI coastline. The storm surge was 2.5 to 4.5 feet along the MA east coast but peaked late in the afternoon on the 29th in between high tide cycles. Seas built to between 20 and 25 feet just off the MA east coast. Along the south coast, the storm surge was 4 to 6 feet and seas from 30 to 36 feet were observed on the outer coastal waters. The very large waves on top of the storm surge caused destructive coastal flooding along stretches of the RI south coast during the Monday evening (Oct. 29th) high tide. The worst coastal damage happened in Westerly, South Charlestown, South Kingstown, Narragansett, and Block Island. Numerous power outages also occurred.

The destruction in RI rivaled the impact from Hurricane Bob in 1991. A survey of the impact along Misquamicut Beach revealed an inundation extent consistent with the upper boundary of a Category 1 hurricane and very severe erosion. In places, the entire protective dune system was destroyed. It should be noted that the previous high tide (in the morning) had produced minor to moderate impacts and likely weakened dunes in advance of the more destructive Monday evening high tide. Our survey team found sand up to the doorbells of houses along the beach. So much sand was moved that at one location, it unearthed frames of cars, which, had been purposely buried there in 1957, to strengthen the dunes that were wiped out by Hurricane Carol in 1954!

Warning decisions: Because Sandy was expected to lose tropical characteristics before reaching the coast, NHC and NWS Eastern Region Headquarters decided that north of North Carolina, the local NWS Forecast Offices would issue products associated with a non-tropical cyclone. In other words, Hurricane Warnings (a tropical type of warning issued by NHC) were not issued for the mid-Atlantic, NJ, NY, or New England. Instead, we issued a "Hurricane Force Wind Warning" for the coastal waters south of New England (which verified), a High Wind Warning for land areas, and a Coastal Flood Warning for the coastlines. The text of our products expressed the serious nature of the event.



The barometric pressure dipped below 27.95" at Atlantic City, NJ.

It was very important to NHC and the NWS local offices not to switch gears in the middle of the storm and go from a Hurricane Warning to a Gale or Storm Warning or vice-versa, which was the primary driving factor for making the decision well in advance. In reality, after the decision was made, Sandy retained hurricane characteristics for much longer than expected, while also attaining extratropical characteristics (i.e., hybrid storm).

There has been much discussion about the effectiveness of this decision. The fact is that at landfall, there were no hurricane force sustained winds…only hurricane force gusts. So, technically a Tropical Storm Warning would have been correct… but would that have conveyed the threat to people in NY or NJ as effectively as emphatically worded High Wind and Hurricane Force Wind Warnings?

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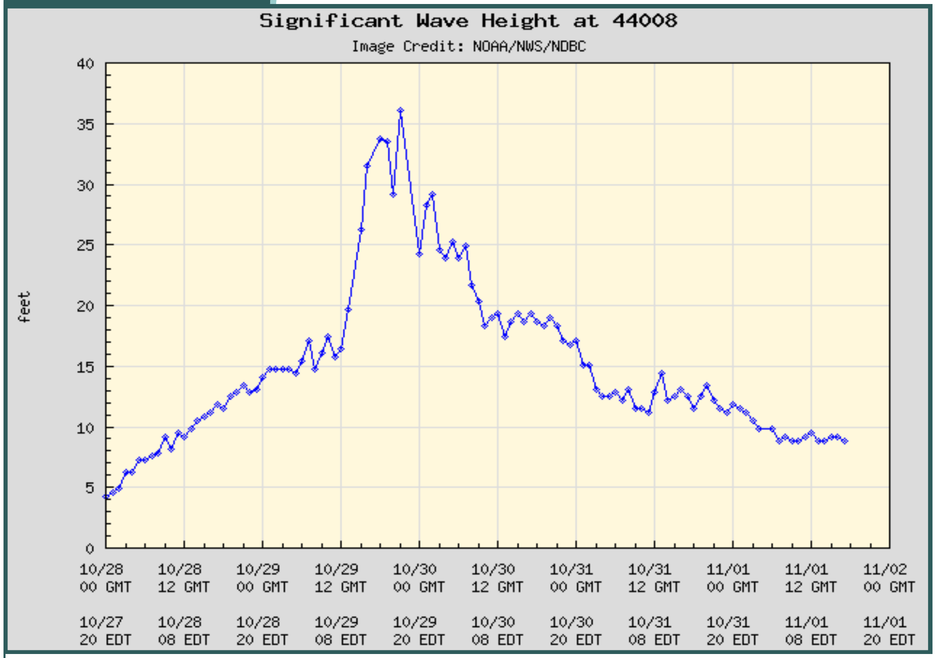
Cont'd from pg 5…Sandy



A significant wave height of 36 ft was recorded at buoy 44008, which is located 54 nautical miles southeast of Nantucket.

Some offices turned to social media to convey the message on how strong and life-threatening this storm really was. In fact, the NWS in Mt. Holly, NJ (Philadelphia Office) issued dire statements that likely saved many lives, such as "If you are reluctant (to evacuate), think about your loved ones, think about the emergency responders who will be unable to reach you when you make the panicked phone call to be rescued, think about the rescue/recovery teams who will rescue you if you are injured…". For the 2013 hurricane season, the NWS now has a new policy to retain Hurricane or Tropical Storm Warning terminology if a hurricane is expected to come this far north, but rather than switching suites of products (like to a Gale or Storm Warning), we would call it "post-tropical."

Sandy illustrated the vulnerability of our coastline to major storms and the importance of preparedness. Had Sandy made the sharp left turn only about 50 miles farther north, both the south and east coasts of New England would have been slammed. For this reason, our office has initiated a dialogue with the City of Boston on worst case scenarios and has developed new resources (found on our Coastal Hazards page) to assist response decisions by coastal managers.

Sandy Retired from List of Atlantic Basin Tropical Cyclone Names

Sandy has been retired from the official list of Atlantic Basin tropical cyclone names by the World Meteorological Organization's hurricane committee because of the extreme impacts it caused from Jamaica and Cuba to the Mid-Atlantic United States in October 2012. Storm names are reused every six years for both the Atlantic and eastern North Pacific basins. If a storm is so deadly or costly that the future use of the name would be insensitive or confusing, the WMO hurricane committee, which includes personnel from NOAA's National Hurricane Center, may retire the name. Sandy is the 77th name to be retired from the Atlantic list since 1954. The name will be replaced with "Sara" beginning in 2018.

2013 Preparedness Week Information

- **March 18th - 22nd:** Flood Preparedness Week
- **April 29th - May 3rd:** Severe Weather Preparedness Week
- **May 20th - 24th:** Safe Boating Preparedness Week
- **June 3rd - 7th:** 'Break the Grip of the Rip' Awareness Week
- **June 24th - 28th:** Lightning Safety Preparedness Week
- **July 15th - 19th:** Hurricane Preparedness Week
- **October 21st - 25th:** Winter Weather Preparedness Week

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

My Intern Experience at NWS Taunton

by Lance Franck, Graduate Student Volunteer

I can trace my interest in meteorology back to at least the age of eight. By the time I reached the 5th grade, I was well acquainted with the local television meteorologists and got quite a few on-air mentions by reporting the temperature at my house. Then, during my freshman year of high school, I decided to peruse a career with the National Weather Service. In fact, my first exposure to the National Weather Service was through Skywarn spotter training, taught by Glenn Field and Bill Babcock from the Taunton Office. After completing my spotter training, I often called in rain and snowfall amounts, including observations during a “gravity-wave” passage that prompted a thank-you letter from Walter Drag, a senior forecaster with the National Weather Service.

Thereafter, my long-standing passion for meteorology and forecasting led me to the University of Massachusetts-Lowell, where I recently completed my B.S. in Atmospheric Science, and am now studying for my Masters. During my senior year at UMass-Lowell, I applied for the NWS Taunton Office Summer Student Internship Program and was accepted. Being a native of Westfield, Massachusetts, I grew-up with the Taunton Office, and could not have been happier to be selected as one of their interns! Some of the duties interns are tasked with include shadowing operational forecasters and completing a research project with a forecast mentor. Ultimately, the purpose of the internship is for students to gain exposure to National Weather Service careers through on-the-job experience.

“It has been an exciting time to be an intern, following some extreme weather events in 2011, such as the June 1st tornado, Tropical Storm Irene, and the late October snowstorm.”

It has been an exciting time to be an intern (as well as a meteorology student), with the extreme weather events in 2011, including the June 1st tornado, Tropical Storm Irene, and the late October snowstorm. Over the summer of 2012, I began my internship by shadowing operational forecasters, observing everything from the creation of forecasts to the issuance of severe thunderstorm warnings. During severe weather, I assisted with taking storm reports over the telephone and entering them into the computer for the Public Information Statement (PNS) and/or Local Storm Report (LSR). I also gained experience using the Advanced Weather Information Processing System (AWIPS), which is an interactive computer system utilized for operations at the National Weather Service. I was also able to give my input with regards to hydrometeorological trends, including the forecast.

One such forecast involved Sandy, which came ashore just south of Atlantic City New Jersey on October 29th 2012. At least one week in advance of Sandy, the numerical weather prediction models were indicating a tempest from the mid-Atlantic to the northeast. In order to put the potential of this storm into perspective, I did a brief study looking at the tracks of tropical cyclones that took similar paths. That is, a turn to the west (toward the U.S. east coast), rather than the typical climatological turn to the northeast (out to sea). This study identified a handful of analogs (analogs are an historical occurrence of a given meteorological event) that took similar tracks, but none appeared as extreme as Sandy. In the days leading up to Sandy, the study became another example of “everyone putting their heads together” at the Taunton Office, to better understand and forecast such an unusual and ferocious storm.

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@NWSBoston

Be sure to find

NWS Boston

on Twitter

http://www.twitter.gov/NWSBoston

Cont'd from pg 7…My Intern Experience

Above: Forecaster Eleanor Vallier-Talbot and Student Volunteer Lance Franck at the Museum of Science.

I also worked on two research projects, involving significant tornadoes and aviation hazards. My first project identified the radar characteristics of significant tornadoes (those greater than or equal to EF2 intensity), over the New York and New England area, dating back to 1995. The goal of this study was to aid forecasters during severe weather operations, possibly leading to enhanced wording in tornado warnings. Forecaster Hayden Frank (my research mentor) and I presented the findings at the Fourth Annual Tri-State Weather Conference and we plan on submitting the study for publication. My second project involves identifying the weather patterns associated with "IFR," an aviation acronym for "Instrument Flight Rules." These rules apply when the following conditions are met: Cloud ceilings 500 to less than 1,000 feet *and/or* visibilities 1 to less than 3 miles. The goal of this study is to improve the Terminal Aerodome Forecasts (TAFs) issued by the National Weather Service.

I also assisted in a variety of other duties at the Taunton Office. This past summer, I participated in an outreach event by helping the NWS Taunton Office at the Boston Museum of Science's "High Impact Weather" weekend. I also supported weather awareness activities via social media, including educational efforts, such as "Lightning Safety Awareness Week." More recently, I compiled mesoscale banding instructional modules for the training team. I also assisted the Storm Data focal point by compiling volumes of coastal flood reports from the Blizzard of 2013.

It's tough to find those that get into this field by accident, and I am no exception since I can trace my passion for meteorology back to my early childhood years. This May, I will graduate with my Master's degree in atmospheric science. I will also graduate, so to speak, from the NWS Taunton Office Student Internship Program. Overall, my time at NWS Office in Taunton has been invaluable. I couldn't have asked for a better internship experience.

For the latest weather information, check out:

www.weather.gov/boston

A Recipe for Thunderstorms

by Joseph Dellicarpini, Science and Operations Officer

Have you ever wondered why we don't see thunderstorms during some of the hottest and most humid days during the summer? Or why it sometimes thunders when it's a relatively cool day? Well it turns out that you need certain "ingredients" in order for thunderstorms to develop: **moisture, lift, and instability**. We call this the "recipe" for thunderstorms. Without any one of these, the chances you'll see thunderstorms develop are very low.

In order to develop thunderstorm-producing clouds, you need plenty of **moisture**, and not just near the ground in the form of high humidity. If drier air is present just a few thousand feet up, clouds cannot extend high up into the atmosphere. Moisture can come from many sources: from the tropics or Gulf of Mexico on southerly winds, from the Atlantic, and even from evaporation!

To get the air to rise, you need a source of **lift.** Most commonly, a frontal boundary acts as a way to lift the air. This includes cold fronts, warm fronts, and even sea breeze fronts, which can become a focus for thunderstorm formation as they move inland from the coast.

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Cont'd from pg 8…Thunderstorm

Shelf cloud moving across Cape Cod Bay in June 2012

Hills and mountains such as the Berkshires, Monadnocks, and Worcester Hills can also be a source of lift, since they force air upward. On some occasions, the difference in the sun's heating between clear skies and the edge of a cloud shield can become a focus for lift. Weather features located several thousand feet in the atmosphere can also induce lift.

Finally, you need **instability.** This will ensure the air will continue to rise once it's lifted. The air becomes unstable when temperature decreases steadily with height. The more rapidly the temperature decreases with height, the more unstable the air becomes the potential becomes greater for the storm to accelerate upward and produce thunderstorms. If the temperature increases with height (known as an inversion), the air is more stable and will begin to sink after being lifted, which is not favorable to produce thunderstorms.

Once you have all three "ingredients" in place, you have the potential for thunderstorms to develop. The more you have of each ingredient, the better the chance for a thunderstorm to occur. Add more factors, such as strong winds aloft or a rapid change of wind direction with height, and you enhance the potential for severe weather.

If you want to learn more about forecasting thunderstorms, check out the NWS Storm Prediction Center web site (http://www.spc.noaa.gov). It contains a wealth of information as well as the latest thunderstorm forecasts across the country.

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**

What to report to the NWS

Hail		Wind	
Plain M&M	0.50 inches	25-31 mph	Large tree branches move, telephone wires begin to "whistle" .
Penny	0.75 inches	32-38 mph	Large trees sway, becoming difficult to walk.
Nickel	0.88 inches	39-46 mph	Twigs and small branches are broken from trees, walking is difficult.
Quarter (Severe)	1.00 inches	47-57 mph	Slight damage occurs to buildings, shingles are blown off of roofs.
Half Dollar	1.25 inches	58-63 mph (Severe)	Trees are broken or uprooted, buildings damage is considerable.
Ping Pong	1.50 inches	64-72 mph	Extensive widespread damage.
Golf Ball	1.75 inches	73+ mph	Extreme destruction, devastation.
Lime	2.00 inches		
Tennis Ball	2.50 inches		
Apple	3.00 inches		
Grapefruit	4.00 inches		
Softball	5.00 inches		

SKYWARN

The Worcester Tornado…60 Years Later

by Eleanor Vallier-Talbot, General Forecaster

Hand Surface Analysis around 4 PM EDT from the WBO Worcester office.

After the June 1st, 2011 tornado moved through the Bay State, it was difficult not to look back on Massachusetts history to compare that storm to another significant tornado sixty years ago. A long-lived, massive tornado struck central Massachusetts on June 9, 1953. This storm remains the strongest tornado ever to occur in Massachusetts and quite memorable.

The low pressure system that developed the Worcester tornado actually dropped strong tornadoes in its entire trek across the central and eastern United States over a three day span. On Sunday, June 7, the low moved eastward across the central and northern Plains states. An excellent influx of low level moisture off the Gulf of Mexico interacted with the low to develop several tornadoes across Nebraska, Iowa and northern Kansas. An F4 tornado moved near Arcadia and Hays Creek, Nebraska, killing 11 people and injuring 5 in its 10 mile path. An F3 tornado and 12 F2 tornadoes also occurred in this region. The low continued to move east toward the Great Lakes on June 8, where more destructive tornadoes developed across eastern Michigan and northern Ohio. Unfortunately, most of the devastating tornado activity occurred after dark, making it nearly impossible for those along the path to see them coming. A total of eight significant tornadoes (F2 or higher) occurred the evening of the 8th, including the only F5 tornado to have occurred in the state of Michigan. This tornado passed across Genesee and Lapeer counties, including the cities of Flint and Beecher. In the end, 116 people were killed in this tornado, which was the last time over 100 people were killed in a single tornado until the EF5 tornado struck Joplin, Missouri on May 22, 2011, killing 156 people. The Flint tornado injured over 800 people and was 27 miles in length, causing $19 million in damage (1953 dollars; $165.2 million adjusted for inflation to 2013 dollars).

As dawn broke across southern New England on Tuesday, June 9, people were reading about the devastation that occurred across Michigan and Ohio on the front page of the Boston Globe. The forecast on the front page read, "*SQUALLS, Thunderstorms, Clearing Tonight, Cool Tomorrow*." No one knew what would actually occur that day across central Massachusetts into southeast New Hampshire. The idea of severe weather seemed slim, as temperatures started out in the upper 50s with patchy dense fog prior to a warm front passing across the region late in the morning. Very warm, humid air streamed northward during the afternoon, while the strong cold front worked its way east across New York state.

The forecasters at the Weather Bureau Office in Boston were discussing their forecast for the late morning update, knowing full well about the tornadic history of the approaching system from the newspaper reports out of the upper Midwest. In 1953, there were several things that were NOT in place at that time which led to the devastating death toll that day, as well as other severe weather events prior to this:

- No organized warning system
- The United States Weather Bureau did NOT issue severe thunderstorm watches and warnings
- Weak information dissemination system in place
- Little if any coordination with emergency officials
- No radar system for weather forecasting; only research radars

Cont'd on page 11

Cont'd from pg 10…Worcester Tornado

After their internal discussion, it was decided not to mention the word "tornado" in their forecast, "so not to be unnecessarily alarming." (Chittick, 2003) However, they did decide to issue the first known severe thunderstorm wording in their late morning update.

Tornado approaching Shrewsbury, MA. Photo by Henry LaPrade.

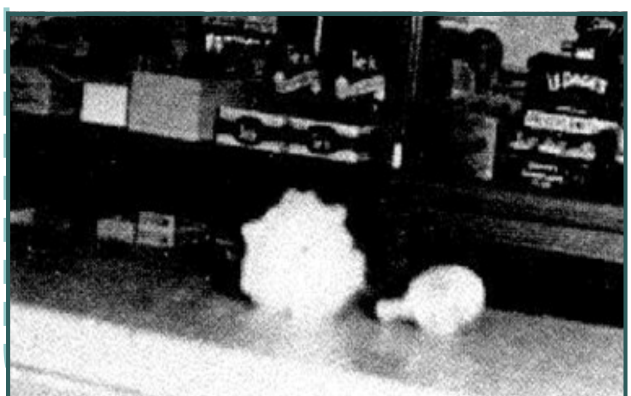
The first sign of trouble was seen on a hand drawn weather map from the Worcester Weather Bureau office, with the warm front lying from about Keene, N.H., to Boston and a squall line moving across the Berkshires by around 3 PM EDT. There was a report of 3 inch diameter hail in Colrain and baseball size hail in Northfield, both in northern Franklin county at about 345 PM. While these reports reached the Worcester office, it is unknown whether they were passed on to the Boston office. Then, the tornado began to form over the Quabbin Reservoir, as stated in a letter from a Harvard Forest research assistant stationed there that day to the Blue Hill Meteorological Observatory in Milton, MA. Fishermen on the Quabbin that afternoon also confirmed the development of the storm. The researcher also reported hail up to 2 inches in diameter and about 3/4 inch depth on the ground. (Chittick, 2003) The tornado finally touched down in Petersham at 425 PM EDT. This monster storm roared east-southeastward, cutting through nine cities and towns along its 46 mile track. This tornado was on the ground for a total of 84 minutes, with its highest intensity from Holden through northern Worcester to Shrewsbury and Westborough, where the tornado cut a path of up to a mile wide. Two researchers, Bernard Vonnegut at the Blue Hill Observatory and Alan Bemis at MIT, estimated the cloud tops of this storm upwards to 70,000 feet, some of the highest ever seen at that time in New England.

Debris began to fall on the Blue Hill Observatory after 5 PM. The observer at Blue Hill that day, John Conover, called the Boston Weather Bureau office and reported, "It's coming from great heights...shingles, small branches, papers, boards several feet long. I'm afraid there has been a bad tornado somewhere." Forecaster Drebert, on duty in Boston at that time, agreed. He issued the first ever tornado warning in New England. The report was issued at 545 PM.

At 549 PM, the tornado lifted; a total of 94 people were killed and 1288 were injured. Several neighborhoods were wiped clean, with six of the nine towns reporting damage at an F4 rating on the Fujita scale. Over 4000 buildings were destroyed, with damage totalling $52.1 million (1953 dollars; $455.2 million adjusted for inflation to 2013 dollars). Three other tornadoes were reported that day:

- F3 tornado, which spawned from the same supercell thunderstorm as the Worcester storm, touched down in Sutton and tracked to northern Mansfield (26 miles long, up to 3/8 mile wide, 17 injured)
- F3 tornado touched down in Exeter, N.H. (1 1/2 miles long, 100 yards wide, 15 injured)
- Brief F1 tornado reported in Rollinsford, N.H. near the Maine border (1 mile long, 40 yards wide)

Debris from the tornado fell across eastern Massachusetts, including reports of a frozen mattress landing in Massachusetts Bay east of Weymouth, as well as books and clothing falling on outer Cape Cod from Provincetown to Chatham, which was about 110 miles away!



Hail in Rutland, MA. Photo by Bill Chittick.

The Worcester tornado is one of four F4 tornadoes reported in New England to date (2013). The other tornadoes were reported in Connecticut -- the Windsor Locks storm of October 3, 1979 and the Hamden-New Haven tornado on July 10, 1989. Another severe tornado also occurred in Wallingford on August 9, 1878. The strength of this tornado was estimated at an F4 intensity, based on early stereoscopic photographs and artists' renditions of the massive damage. (Robert N. Dennis and New York Public Library)

Due to the severity and death toll of the tornadoes in Worcester and Flint, as well as another killer tornado in Waco, TX., in May 1953, changes happened in the U.S. Weather Bureau. On June 17, 1953, the relatively new Weather Bureau Severe Weather Unit (which formed in 1952) was reorganized and eventually moved to Kansas City from Washington, D.C., in 1954.

Cont'd on page 12

Cont'd from pg 11…Worcester Tornado

Research weather radar run by MIT for what was known as Project Lincoln, which actually caught the Worcester tornado from Lexington, Mass., showed that radar could be used as a valuable, real time tool to help forecast severe weather. Eventually, weather radars were deployed nationwide. With the realization that reports were not being disseminated in a timely fashion across the country during severe weather, emergency management officials, first responders and the media came together with the Weather Bureau to develop an organized warning system, along with the improvement of radio and television communications to spread the word to the citizenry in real time.

CREDITS:

The Worcester Tornado -- June 9 , 1953 by William F. Chittick, 20 pp., published in 2003.

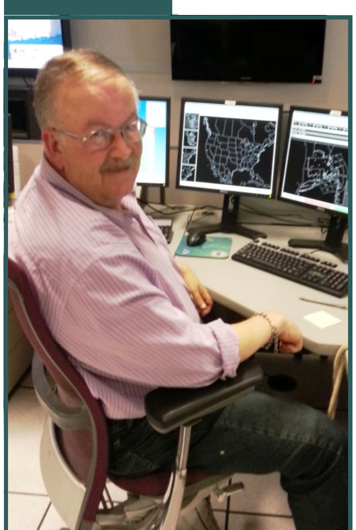
Robert N. Dennis Collection of Stereoscopic Views. "Stereoscopic Views of the Tornado at Wallingford, Connecticut, August 9, 1878." NYPL Digital Gallery, 1878. http://digitalgallery.nypl.org/nypldigital/dgkeysearchresult.cfm?keyword=wallingford+tornado

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

5/1/13 - Greenfield, MA at 6:30 PM
5/2/13 - Walpole, MA at 7:00 PM
5/4/13 - Townsend, MA at 11:00 AM
5/9/13 - Heath, MA at 6:30 PM
5/16/13 - Marlborough, CT at 7:00 PM
5/21/13 - Northbridge, MA at 7:00 PM
5/30/13 - New Braintree, MA at 7:00 PM
6/10/13 - Manchester, MA at 7:00 PM
6/11/13 - New Ipswich, NH at 6:30 PM
6/17/13 - Taunton, MA at 7:00 PM

More Information: **http://www.erh.noaa.gov/box/officePrograms/skywarn/skywarnTraining.shtml**

Getting to know your NWS Team: Alan Dunham, Observing Program Leader



Originally from Carver, Massachusetts, Alan began his weather career in 1971 in the United States Air Force. He then spent 10 years in the Air Force repairing weather equipment, observing and then forecasting weather. Afterwards, Alan joined the NWS in September of 1986. He had worked at the Weather Forecast Office in Portland, ME and the Weather Service Office at Bradley International Airport before arriving at the Boston Forecast Office in 1992.

Alan's current position at the NWS Taunton office is the Observing Program Leader. The Observing Program Leader manages the Cooperative Observer Program, a community of weather observing volunteers that serves as the backbone of the nations climate records. These observers submit daily and monthly weather observations, and demonstrate the truly wide assortment of weather phenomena that we see due to large scale and local effects. Alan also serves as the Hydrologic Program Leader, assistant Fire Weather Program Leader and is one of the office's lead investigators on storm damage surveys. In fact, Alan was one of the team leaders surveying the June 1st, 2011 tornado.

Alan also volunteered with the Carver Fire Department for 18 years before retiring last year. He also enjoys going on cruises, golfing, and spending time with his family.

Be sure to find

NWS Boston

on Facebook

http://www.facebook.com/US.NationalWeatherService.Boston.gov

Skywarn Recognition Day

by Rob Macedo, SKYWARN Coordinator

SKYWARN Recognition Day 2012 (SRD'12) occurred at the National Weather Service (NWS) Taunton, Massachusetts Forecast Office under call-sign WX1BOX. This event was very successful despite several Amateurs being unavailable due to relief efforts for Hurricane Sandy. There were 9 Amateur Radio Operators that participated in SRD'12.

KB1G-Bill Boyes

KB1REQ-Jeremy Breef-Pilz

W1VFB-Greg Glynn

KB1KQW-Jim Palmer

N1FY-Carl Aveni

N1YLQ-Mike "Sparky" Leger

KB1JKJ-Jim Bradley

K1FUG-Ken Bailey

KD1CY-Rob Macedo

In front from Left to Right, Jim Palmer-KB1KQW and Rob Macedo-KD1CY. In the back from Left to Right, K1FUG-Ken Bailey, W1VFB-Greg Glynn, KB1REQ-Jeremy Breef-Pilz.

The SRD event is done in cooperation with the National Weather Service and the American Radio Relay League (ARRL) also known as the National Association for Amateur Radio. The two entities have a Memorandum of Understanding (MOU) for support between the ARRL/ Amateur Radio Emergency Services (ARES) and the NWS SKYWARN program. In essence, it's a partnership between the two organizations. The event is designed to thank Amateur Radio SKYWARN Spotters across the country for their support within operations during hazardous weather events. This is the 14th year that the annual SKYWARN Recognition Day has occurred, and WX1BOX has been participating since 2002. During the SRD, different level of certificates are offered for the total number of NWS offices you reach out to during the event. It is a way to have fun but is not designed as much to be a contest, but more as a thanks to Amateur Radio SKYWARN spotters for their support in the past year.

There were 573 total station contacts made with 548 unique station contacts made across 43 states with 69 different NWS Forecast offices contacted earning the operation the 'Category 1 Hurricane Certificate'. This represents the highest totals the NWS Taunton. WX1BOX operation has had since it started participating in the SKYWARN Recognition Day. It even beat the record set in 2011 despite having more operators for SRD 2011. This placed the NWS Taunton Amateur Radio operation third in the country for total amount of NWS offices contacted, fourth in the country for total amount of contacts made with other stations (referred to in Amateur Radio by the abbreviation "QSOs") and 10th in the country for total amount of states contacted. For this year, Bill Boyes-KB1G, brought over an Elecraft-K3 HF (High Frequency) Radio. The radio performed extremely well and was able to cope with the high noise floor from all of the computers inside the NWS office.

Cont'd on page 14

Cont'd from pg 13…SKYWARN

Ham radio operators Rob Macedo (KD1CY) and Carl Aveni (N1FY) help out at the NWS office during the Febuary Blizzard of 2013.

This radio was used in lieu of the Alinco DX-70TH radio that is installed at the weather office.

For this year's SRD, ARRL HQ Assistant Manager of Preparedness and Response, Ken Bailey-K1FUG visited the WX1BOX SRD operation and operated the station at WX1BOX. Discussions were had regarding the 2013 National Hurricane Conference with Julio Ripoll-WD4R, Assistant WX4NHC Coordinator, and John McHugh-K4AG WX4NHC Coordinator after their stint as Net Control on the *WX_TALK* Echolink conference node: 7203/IRLP 9213.

Band conditions on HF were not as good as 2011 with HF largely shutdown during Friday evening and 10 Meters (the 28 MHz band) not suitable for communications during the Saturday of the event. Nonetheless, 20 (14 MHz) and 40 Meters (7 Mhz) were open on the Saturday and resulted in the largest amount of HF contacts yet for SRD with 301 contacts. Jeremy Breef-Pilz-KB1REQ managed a several hour pile-up on HF on 20 Meters and also made contacts on 40 Meters. Jeremy put in an extra long day operating the radio for over a 10 hour period with very short breaks. Jeremy continues to be active in Amateur Radio and SKYWARN and was involved in a few of the SKYWARN Activations in the NWS Taunton coverage area during 2012. Additional HF operators included KD1CY-Rob Macedo, who got things started on HF before Jeremy arrives to operate the HF rig. We also had a number of contacts via Echolink/IRLP on the *WX_TALK* Echolink conference Node: 7203/IRLP 9219 system and the New England Reflector system. The Echolink and IRLP systems link Amateur Radio systems over the Internet with Echolink can also link computer and even cell phone users together or linking those stations with Amateur Radio systems. Echolink still requires an Amateur Radio license in order for people to use this program. As in past years, several of the operators at WX1BOX roved through a schedule of the local area SKYWARN repeaters making contacts with local Amateurs and thanking them for their support. These Amateur Radio Spotters assisted the NWS Taunton office with critical surface reports from across the region during severe weather situations.

"The event is designed to thank Amateur Radio SKYWARN Spotters across the country for their support of the National Weather Service with their severe weather reporting to protect life and property in severe weather events. "

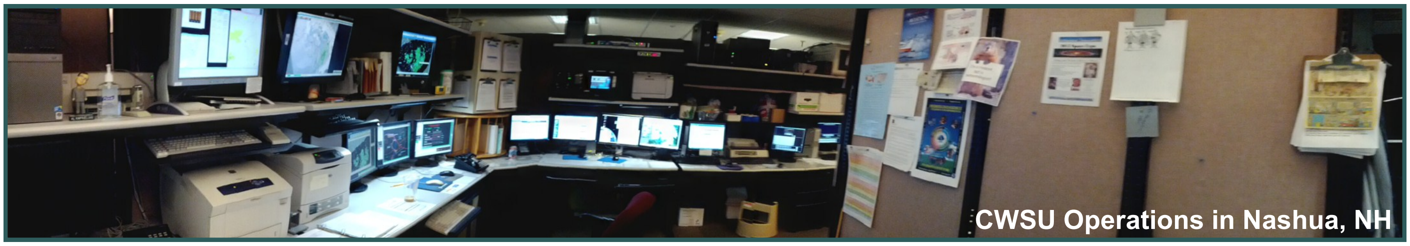
We also managed net control for WX4NHC, the Amateur Radio Station at the National Hurricane Center in Miami, Florida on the *WX_TALK* Echolink conference Node: 7203/IRLP 9219 system and fielded check-ins for 2 hours for WX4NHC. Close to 100 stations are typically gathered for WX4NHC during SRD'12 during the 2 hours WX4NHC is scheduled to be on the system. It is noted that NWS offices work scheduled 1 or 2 hour time slots on that system during SKYWARN Recognition Day every year since 2004.

We were very pleased with the results from SRD'12 and we are looking forward to another successful SRD in 2013! For more information on this nationwide event visit the SKYWARN Recognition Day (SRD) web site at http://www.wrh.noaa.gov/mtr/hamradio/ and if you worked NWS office stations during SKYWARN Recognition Day and would like a certificate, there is a link to print your own certificate on the SRD web site.

Learn more about becoming an Amateur Radio Operator: http://www.wx1box.org

Weather Forecasting for Air Travel

by Scott Reynolds, Meteorologist-in-Charge CWSU



CWSU Operations in Nashua, NH

Quiz question – which TWO New England states do NOT have an NWS office in them? If you said Connecticut and Rhode Island, give yourself a pat on the back. If you said New Hampshire, then you probably have never heard of a CWSU. (And that's OK – a lot of people don't know about us.) A warning to the readers, beware of excessive acronyms in the following paragraphs.

Center Weather Service Units, or CWSUs, are located at each of the 21 Air Route Traffic Control Centers (or ARTCCs) operated by the Federal Aviation Administration (FAA). For a map showing the location of the CWSUs, go to http://www.nws.noaa.gov/aviations/pages/CWSU/CWSU.php. The CWSUs first came into being in the late 1970s as a result of the 1977 crash of Southern Airways Flight 242 near Atlanta, Georgia due to a thunderstorm. The Nashua CWSU opened in April 1978, and today we operate 15 hours per day, 7 days per week, with a staff of 3 meteorologists and a Meteorologist-in-Charge.

"The CWSU provides forecasts for wind, turbulence, icing and thunderstorms to the ARTCC controllers. This allows for the ARTCC to better plan for and avoid areas of weather."

What Do We Do?

CWSU meteorologists provide weather forecast support for the ARTCC in Nashua (also known as "Boston Center"). We generally focus on 2 main things: the weather for Boston's Logan International Airport; and higher altitude weather for our entire airspace. The Boston Center airspace extends from roughly Syracuse, NY to near Islip, NY to Presque Isle, ME. So, we have to contend with a wide variety of weather on any given day. We forecast for lake effect snow, low clouds and fog (and not necessarily just along the coastline), thunderstorms, winter storms, and yes, even the occasional hurricane, just to name a few things. Even though the weather may seem okay to the average person, there could be things happening that have a big impact on aviation interests.

Let's start with Boston. Boston is the busiest airport in New England and is also one of the most weather-sensitive "big" airports in the US (along with the 3 big New York City airports: Newark, Kennedy and LaGuardia). Logan has 6 different runways available for use, but the specific weather conditions at any time dictates which of the runways can be used. For instance, on a clear and calm wind type of day, Logan could land a maximum of around 60 aircraft per hour. On a rainy and windy day, that number could drop down into the 20s (or worse), depending on the wind direction. During snowstorms, that number drops even more, and occasionally down to zero if it's bad enough. The CWSU works with the Taunton Forecast Office to provide detailed forecasts to the ARTCC and Boston Tower Air Traffic Controllers, so that they can better manage the flow of air traffic in and out of the airport.

The Boston Center Airspace

Higher altitude air traffic control has different needs. The CWSU provides forecasts for wind, turbulence, icing and thunderstorms to the ARTCC controllers. This allows for the ARTCC to better plan for and avoid areas of weather (such as severe icing or turbulence, or thunderstorms). This becomes especially important when the New York City airports are being impacted by any weather whatsoever. When NYC traffic slows down, everyone else's traffic slows down as well.

So, the next time you're flying from one place to another, rest assured that the NWS has many forecasters looking at the weather, to better help get you where you need to be.

National Weather Service Southern New England

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Phone: 508-823-1900
Fax: 508-823-2321
E-mail: box.webmaster@noaa.gov

Visit our Website:
www.weather.gov/boston

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

2013 Hurricane Names

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

Find the following names:

ANDREA
BARRY
CHANTAL
DORIAN
ERIN
FERNAND
GABRIELLE
HUMBERTO
INGRID
JERRY
KAREN
LORENZO
MELISSA
NESTOR
OLGA
PABLO
REBEKAH
SEBASTIEN
TANYA
VAN
WENDY