The Four Seasons

National Weather Service Burlington, VT

VOLUME IV, ISSUE II

SUMMER 2017

Table of Contents

Letter from the Editors

Welcome to the summer edition of The Four Seasons, a quarterly newsletter issued by the National Weather Service in Burlington, VT. In this edition we'll take a look back at two severe weather events from this spring, the current Hurricane Season, the new GOES-16 Satellite technology, and recent support we provided to emergency management and health officials during the Vermont City Marathon. We hope you enjoy the newsletter and thank you for reading!

Two Damaging Microbursts on 18 May 2017

-Brooke Taber & Paul Sisson

On 18 May 2017, scattered strong to locally severe thunderstorms erupted across portions of the Champlain Valley as well as parts of central and northern Vermont. A warm, moist, and unstable air mass was in place from the Eastern Adirondack Mountains into Vermont with surface temperatures in the mid-80s to lower 90s. The temperature reached 93 degrees in Burlington, VT, which tied the all-time record for warmest maximum temperature for the month of May, along with breaking the daily maximum temperature for the date. This impressive heat helped to fuel the afternoon and evening showers and thunderstorms.

This severe weather event had three areas of concentrated activity that included western Addison County on Potash Bay Road, South Burlington/Williston area, and across the Northeast Kingdom near Barton, VT. The NWS Burlington Office determined from a storm survey the damage which destroyed a camp and knocked down trees and powerlines on Potash Bay Road in the town of Addison, VT

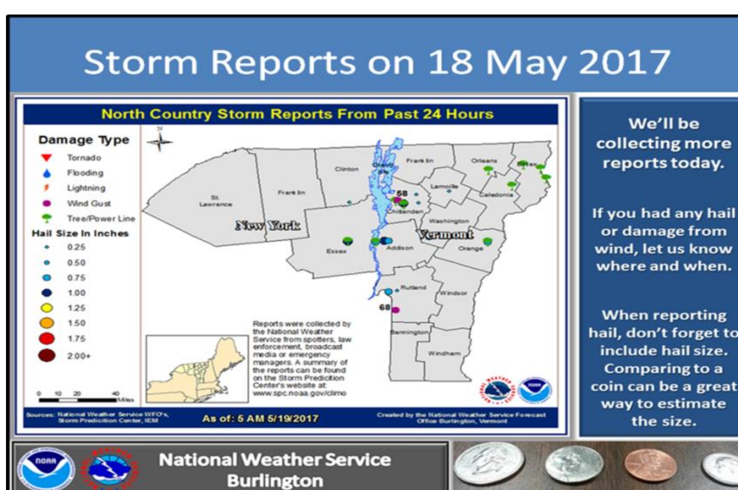


Figure 1. Plot of storm reports across the North Country on 18 May 2017

...Continued from Page 1

was caused by a microburst with estimated wind speeds of 80 to 100 mph. Also, another microburst occurred in South Burlington causing trees and power lines to come down, along with a measured 58 mph wind gust at Burlington International Airport, before we lost power to the equipment. Additional damaging thunderstorm wind gusts blew over a tractor trailer in Barton, VT with areas of trees and powerlines down in parts of the Northeast Kingdom. Figure 1, on page 1, shows a plot of storm reports across the North Country on 18 May 2017.

Pre-Storm Environment:

The NOAA/NWS Storm Prediction Center (SPC)'s Day 1 Convective Outlook on May 18th indicated a "Slight Risk" of severe thunderstorms from northern New York eastward across most of Vermont. As the morning unfolded, it became increasingly clear that severe weather event was likely to impact parts of the region. Figure 2, below, shows the 8:00 AM Day 1 Convective Outlook and the associated probabilities of damaging wind and severe hail. The severe hail and wind probabilities were up to 15% across most of the North Country (i.e., there was a 15% probability of at least 1 severe hail or wind report occurring within 25 miles of any point shaded in yellow).

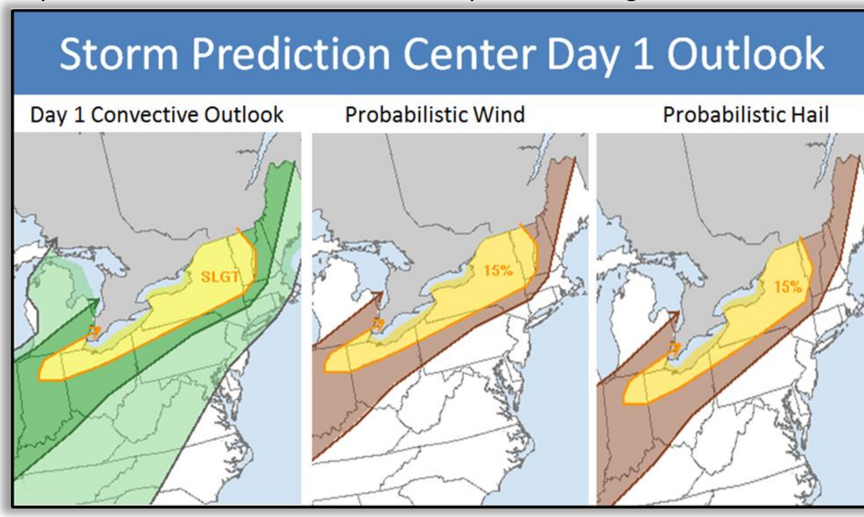


Figure 2. : Storm Prediction Center Day 1 Severe Weather Outlook issued at 8 AM, valid for 18 May 2017

The 2:00 PM May 18th rawinsonde observation at Albany, New York (Figure 3) shows modest instability, and favorable deep-layer shear, due to the development of a strong mid-level jet of 40 to 50 knots. The combination of surface temps in the mid-80s to lower 90s and dewpoints only in the 50s created convective available potential energy (CAPE) values of 1264 J/kg and a lifted index (LI) of -5° Celsius.

This CAPE profile and high equilibrium levels (39,000 feet) indicated thunderstorm tops would extend to 40,000 feet above ground level and be capable of producing severe winds or large hail. The equilibrium level is the level at which the rising parcel equals the actual air temperature at that given height. The rising air parcel becomes stable at the equilibrium level; it no longer accelerates upward. The Albany sounding also showed surface to 6-km shear of 40 knots. This shear increased through the day, as the embedded mid-level jet moved across the forecast area. Thunderstorms tend to become more organized and persistent as vertical shear increases. The steep low level lapse rates, modest CAPE values, and strong mid-level winds indicated the primary threat would be damaging thunderstorm winds and 1 inch hail from isolated thunderstorm microbursts.

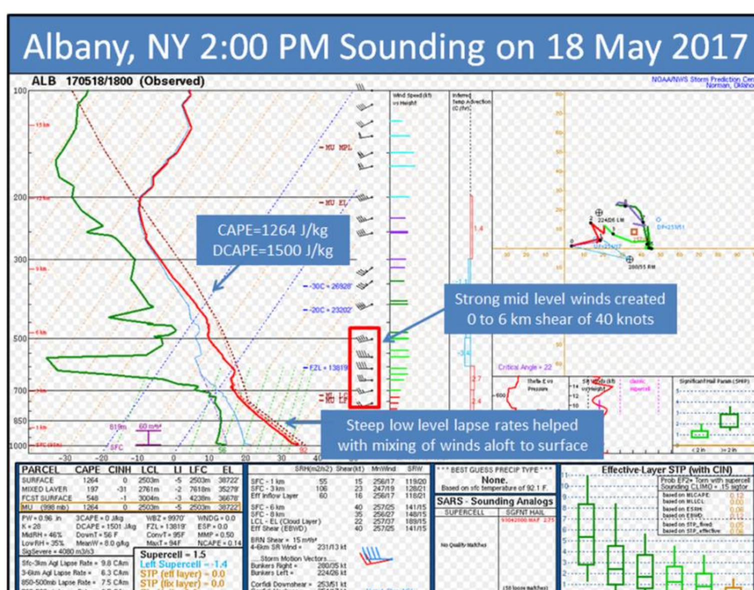


Figure 3. : Albany, New York observed sounding on 18 May 2017 at 2:00 PM

...Continued from Page 2

In this section we will examine the radar data and storm structure of the two thunderstorms that produced the microbursts resulting in property damage, trees and powerlines down, along with 1 inch hail. The first microburst we will investigate occurred at 5:20 PM over South Burlington and continued to move east producing wind damage and hail in Williston. This isolated microburst produced a 58 mph wind gust at the airport, before the equipment lost power.

Radar Analysis

Figure 4, below, shows the 0.5° KCXX velocity data (left) and KTYX vertical reflectivity cross section (right) at 5:20 PM on 18 May 2017. Given the closeness to the KCXX radar in Colchester, VT this storm was very poorly sampled aloft, but captured the low level velocity downburst signature very well. Meanwhile, the KTYX radar in Montague New York was too many miles away for good data sampling in the low levels, but displayed the reflectivity structure aloft well. The 0.5° velocity data clearly showed a divergence signature with 60 knots (green) moving toward the radar and 40 to 45 knots (red) moving away from the KCXX radar associated with a downburst of wind within a severe microburst thunderstorm. The reflectivity cross section from the KTYX radar indicated a storm top of 40,000 feet or over 7 miles tall, and 50 dBZ reflectivity core to 25,000 feet. This strong reflectivity core aloft and favorable mid-level wind fields with good mixing in the low levels created an environment conducive for damaging microburst winds.

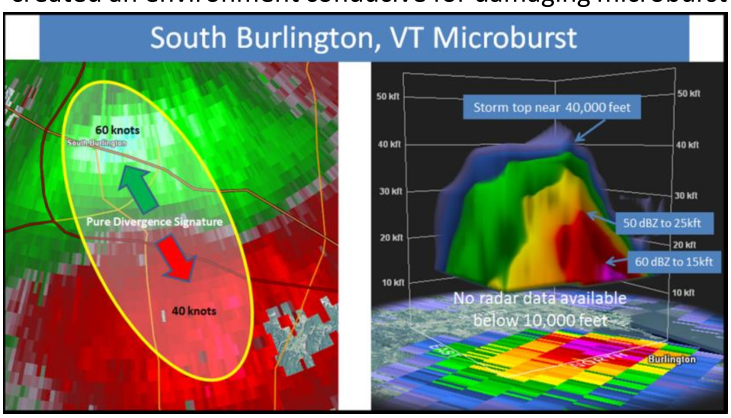


Figure 4. : The KCXX 0.5° velocity (left) and KTYX reflectivity cross section (right) at 520 PM on 18 May 2017

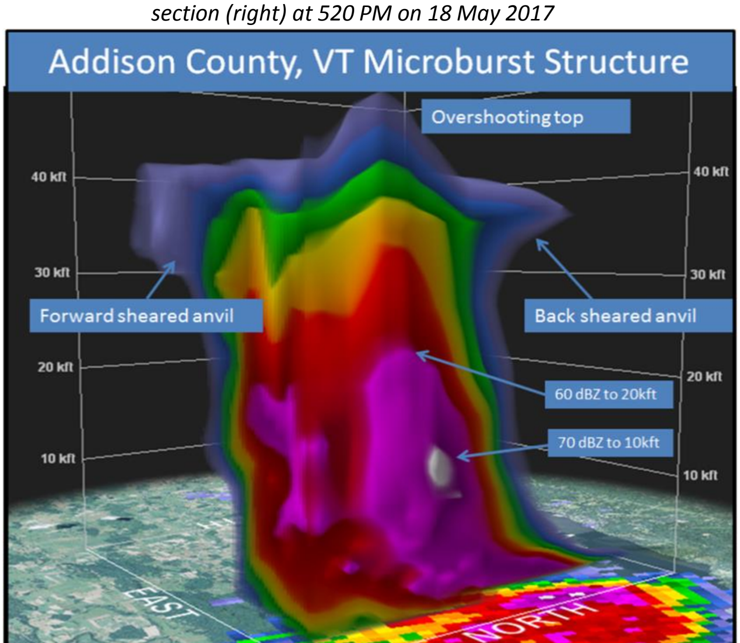


Figure 5 (bottom left) shows the KCXX radar reflectivity cross section at 6:20 PM on the evening of May 18th near Potash Bay Road in the town of Addison, VT where a severe microburst occurred with estimated winds of 80 to 100 mph. These winds blew a camp along Lake Champlain off its foundation and caused trees and power lines to come down across western Addison County. The storm structure clearly shows an overshooting top with reflectivity values greater than 40, 000 feet above ground level, along with a forward and back sheared anvil. This well organized storm also exhibited a very deep/strong reflectivity core with 70 dBZ to 10,000 feet and 60 dBZ to 20, 000 feet, along with a tilted west to east core, indicating very strong mid-level winds.

Figure 6, on page 4, shows the evolution of the Addison County Microburst from 6:10 PM to 6:20 PM on 18 May 2017. At 6:10 PM you can see a very strong core of reflectivity aloft with a tilted west to east column associated with brisk winds of 35 to 45 knots between 4000 and 7000 feet above the ground. As the storm continue to approach western Addison County the reflectivity core at 6:15 PM started to descend toward the surface with damaging winds and large hail.

Figure 5. : KCXX reflectivity cross section at 6:20 PM on 18 May 2017

...Continued from Page 3

Note in the middle image from figure 6 below, the increased higher reflectivities of 60 to 70 dBZ (pink/white colors) at the surface, indicating the core aloft was collapsing with strong winds and large hail. By 6:20 PM the areal coverage of the 60 to 70 dBZ continued to expand at the surface, with a solid core of strong reflectivity persisting up to 30,000 feet above the ground. Also, note the strongly tilted reflectivity core at this time period and the sharp decrease in echoes on the back side, associated with the descending rear inflow jet. This very strong thunderstorm produced plenty of lightning and a pocket of significant damage on Potash Road in the town of Addison.

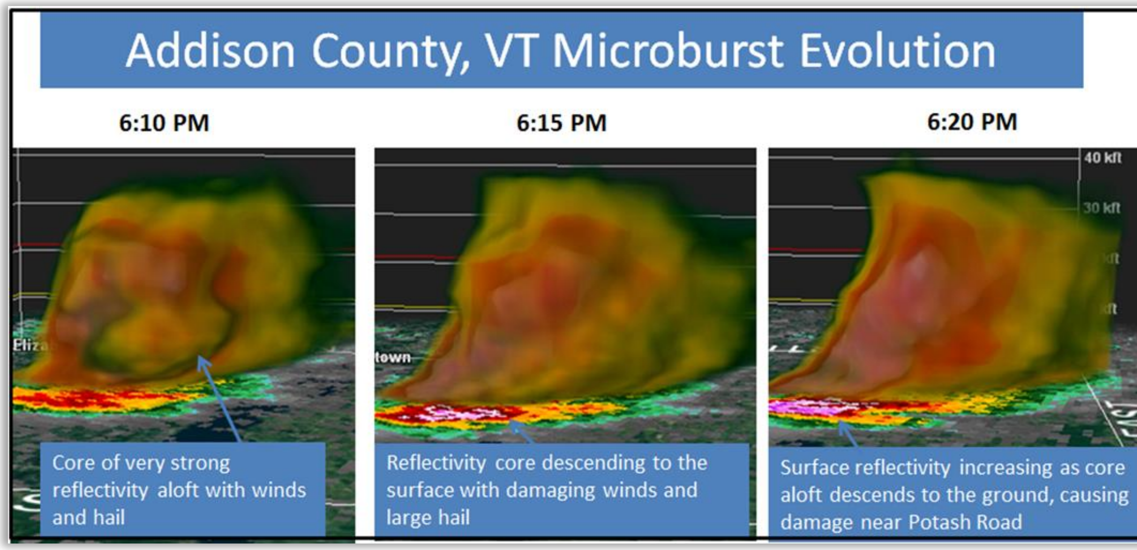


Figure 6. : KCXX reflectivity cross section from 6:10 PM to 6:20 PM on 18 May 2017.

Conclusion:

This event featured the necessary ingredients to produce strong to locally severe thunderstorms, which caused isolated areas of significant damage. NWS BTV conducted a storm survey in the town of Addison along Potash Road and determined a microburst produced 80 to 100 mph winds, which caused softwood tree damage and a small summer camp to get blown off its foundation. Figure 7, below, shows pictures taken by the NWS Burlington survey team during their investigation of damage in western Addison County.

Additional damage occurred associated with another microburst in South Burlington/Williston areas, where we received multiple reports of trees down and 1 inch diameter hail. Additional damage occurred associated with another microburst in South Burlington /Williston areas, where we received

Figure 7. : Storm survey photos taken by NWS BTV

...Continued from Page 4

multiple reports of trees down and 1 inch diameter hail.

The final area of concentrated damage occurred in the Northeast Kingdom of Vermont, with a tractor trailer getting blown over in Barton and reports of trees and power lines down in Brighton, Maidstone, and East Burke.

Figure 8, below, shows the University of Vermont UAS Team imagery around the intersection of Potash Bay Rd and Lake St. The yellow arrows show where trees have been blown down by the microburst all in a straight line from west to east. The UAS aerial imagery can be key data set to help meteorologists see things from the air that cannot readily be seen from the ground and confirm whether storm damage was due to a microburst or a tornado.

Figure 8: University of Vermont UAS Team imagery on Lake St just south of the intersection with Potash Bay Rd. The yellow arrows show where trees have been blown down by the microburst all in a straight line from west to east.

What was unique about the imagery the University of Vermont UAS Team acquired is that it was mapping-grade imagery. The team flew a fixed-wing UAS over the area, collecting hundreds of images over 150 acres.

The UAS operated autonomously based on a pre-defined flat plan, taking pictures at regular intervals. The pictures were processed into a single, seamless orthophoto mosaic. An orthophoto mosaic is an image map, such as what is present in popular online mapping platforms like Google Maps. Unlike the Google Maps imagery, which is over a year old for the area, this imagery was acquired within 36 hours of the event. Having access NWS team to overlay the imagery on top of existing imagery to observe change in addition to making detailed measurements. Because the UAS was able to cover such a broad area it gave NWS a more comprehensive perspective of the storm damage, giving them information on areas that field teams could not access due to time or permission constraints. This was the first time UAS technology was used to assist NWS damage assessments in Vermont and it showed that UAS not only offer unique capabilities, but also can help to reduce costs and improve safety.

The NOAA UAS Program in the Office of Atmospheric Research is investigating best practices and protocols for efficiently providing NWS offices all around the country with UAS-based aerial imagery to support such post-hazard damage assessment operations. As advocated by that program, this case represents a splendid example of the benefits that may be obtained through local partnerships between NWS, EMA, and capable UAS operator teams within the community.

New Satellite Data Helps Forecasters Warn for Severe Thunderstorms

- Paul Sisson

The National Oceanic and Atmospheric Administration's (NOAA) new weather satellite GOES-R or GOES-16 is the most advanced weather satellite NOAA has ever developed as mentioned in our Spring 2017 newsletter. National Weather Service forecasters in Burlington, VT have had access to the preliminary non-operational data after it was launched on November 19, 2016. The satellite is undergoing an extensive checkout and validation process and if everything checks out the spacecraft will be moved to the GOES-East position at 75 degrees west longitude, once it is declared operational in November. Once there, GOES-16 will afford forecasters optimal viewing of severe storms over the eastern United States including the Burlington area which is located at 73 degrees west longitude.

On May 31, 2017 severe thunderstorms occurred over our region and caused localized wind damage and hail. GOES-16 was operating with a mesoscale sector over our region which provided 1-minute updates and very high definition (0.5 km resolution) imagery of these severe storms never before available to NWS forecasters.

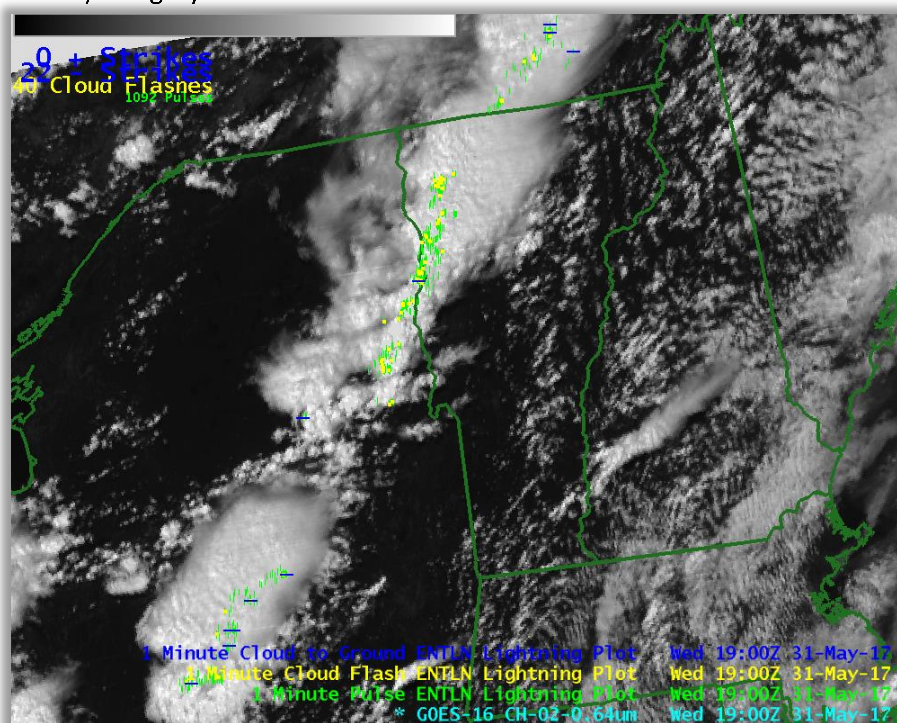


Figure 1: GOES-16 imagery showing channel 2 - 0.62 µm Visible band at 1900 UTC 31 May 2017(shaded %).

Figure 1 (right) shows the GOES-16 one minute imagery from channel 2 - 0.62 µm - known as the visible band at 1900 UTC or 3 p.m. EDT 31 May 2017. Clouds show up as bright white and total lightning data including pulses (green dashed), cloud flashes(yellow squares), and cloud-to-ground lightning strikes(blue -/+) are also seen. You can see the line of thunderstorms in the Champlain Valley of northern New York and Vermont with high detail both in the tops of the very tall thunderstorm's anvil clouds and also the much smaller and low-level fair weather or cumulus clouds. A video showing the evolution of these clouds from 3- 5 pm 31 May 2017 as they move across Vermont and New York can be seen here: https://youtu.be/fYxStyoG0yU

Figure 2, on the next page, is similar time frame as Figure 1 but shows one minute data from channel 13 - 10.35 um - known as the Clean Window Infrared (IR) band from the GOES-16 mesoscale sector at 1900 UTC 31 May 2017. In the IR imagery, the temperature of the cloud tops is derived and generally the higher the clouds, the colder the temperatures. The thunderstorm cumulonimbus cloud's anvil are seen in red and are about -40 °C (or -40 °F or 30,000 ft above mean sea level) while the very tip or "overshooting" tops of the clouds are about -50 °C (40,000 ft above mean sea level). The very detailed temperature information can tell forecasters if the storms are intensifying or weakening every minute. Never before have we had such detail about a thunderstorm. At this time, the storms over Burlington were producing local winds of over 50 mph

...Continued from page 6

along with 1 inch hail. A video showing the evolution of these clouds from 3- 5 pm 31 May 2017 as they move across Vermont and New York can be viewed here: https://youtu.be/2K2oBgF312Q

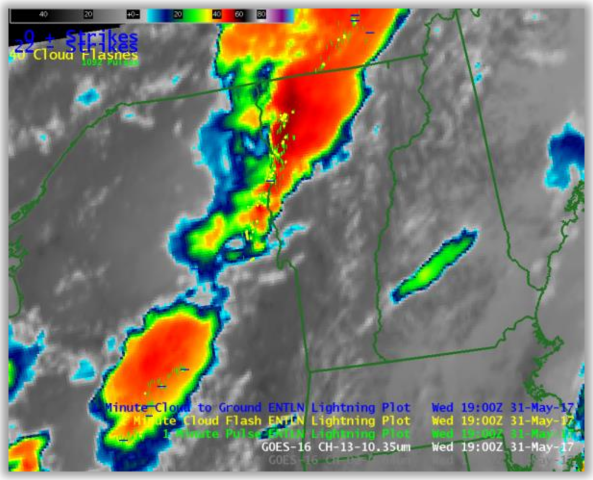
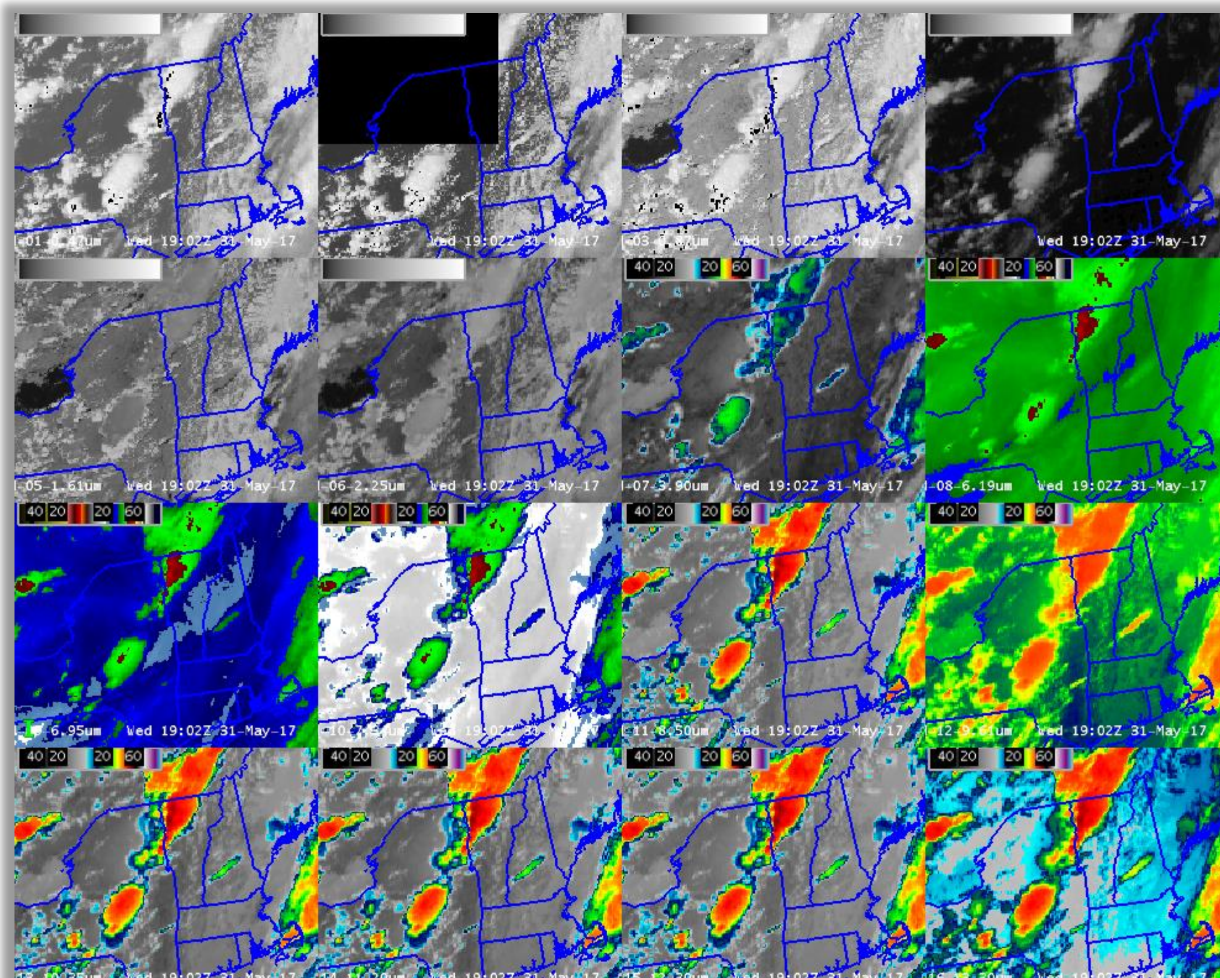


Figure 2: GOES-16 imagery showing channel 13 - 10.35 μm Clean Window IR band: 1900 UTC 31 May 2017(shaded °C).

Figure 3, below, shows a snapshot of all 16 channels of baseline GOES-16 data available to forecasters at 1902 UTC 31 May 2017. In addition, specially designed combinations of these channels have been developed to help forecasters view specific phenomena such as forest fires, volcanic ash, rainfall rate, snow cover, water and ocean temperatures. A video showing the 16 channels from GOES-16 from 1902 through 2127 UTC 31 May 2017 can be seen here: https://youtu.be/CldIYYlXsuc

Finally, forecasters can't wait to get their hands on both cloud-to-ground and in-cloud lightning data sometime this summer from the Geostationary Lightning Mapper (GLM) instrument on GOES-16 to provide even more information about summer severe thunderstorms. The GLM along with

Figure 3: GOES-16 imagery showing all 16 channels: 1902 UTC 31 May 2017.



...Continued from page 7

all the high definition imagery and derived products from GOES-16 will give NWS severe weather forecasters very important or "game-changing" tools to quickly identify severe weather such as thunderstorms or winter storms which are rapidly intensifying, and help us issue even more accurate and timely warnings.
The GOES-16 data posted on this page are preliminary, non-operational data and are undergoing testing. Users bear all responsibility for inspecting the data prior to use and for the manner in which the data are utilized.

Hurricane Season for the northern Atlantic started on June 1 and runs through November 30. The Atlantic This doesn't mean that a hurricane or tropical cyclone can't occur outside of these dates. It just means that we are in the part of the year when they are more likely to occur. In fact, we already had a named storm - Arlene. Wondering how you missed it? The NWS National Hurricane Center started issuing advisories on April 19th for a Subtropical Depression about 890 miles west-southwest of the Azores (figures 1 and 2). This storm circled counterclockwise around the northern Atlantic, never making landfall and weakened on the 21st, peaking at only Tropical Storm strength.

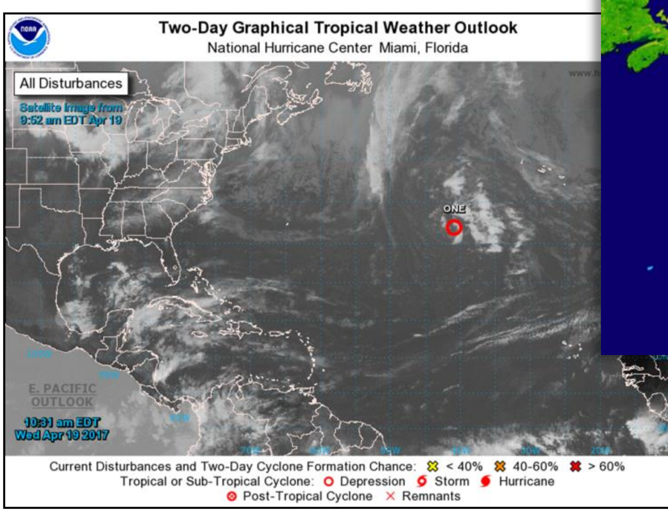


Figure 1 (left). Arlene 2 Day Tropical Weather Outlook from the National Hurricane Center. Figure 2. (right) : Arlene's track (source: wikipeida. Created by Meow using WikiProject Tropical cyclones/Tracks. The background image is from NASA. Tracking data is from NOAA.)

What does it take to become a named storm? Winds for a tropical cyclone must reach 39 mph (34kts, 63km/h) or higher to receive a name. This is also the threshold for a when an organized tropical depression becomes designated a tropical storm. The names go in alphabetical order (figure 3.).

Tropical Cyclone Names for Atlantic Basin 2017				
Arlene*	Franklin	Katia	Philippe	Whitney
Bret*	Gert	Lee	Rina	* Arlene occurred in April. Tropical Storms Bret and Cindy have developed as of June, 20, 2017.
Cindy*	Harvey	Maria	Sean	
Don	Irma	Nate	Tammy	
Emily	Jose	Ophelia	Vince	

The NWS National Hurricane Center in Miami, FL is forecasting an above average season for the Atlantic Hurricane Season. An average season consists of 12 named tropical cyclones, half of which become

...Continued from Page 8

Saffir-Simpson Hurricane Wind Scale		
Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	157 + mph 137 + kt 252 + km/h	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Figure 4. TheSaffir-Simpson Hurricane Wind Scale

hurricanes, and three of which become major hurricanes being category 3 or higher (winds 111+mph) on the Saffir-Simpson Hurricane Wind Scale (figure 4.) This year, the NWS National Hurricane Center is calling for 11 to 17 named storms, five to nine hurricanes, of which two to four developing into major hurricanes of category 3 or higher (figure 5).

While we do not face all the same hazards as coastal areas, nor the frequency to which tropical storms and hurricanes impact these areas, the North Country can see the following threats: Flooding from heavy rainfall, strong damaging winds, tornadoes, and thunderstorms.

With the possibility of these threats, it's important to pay attention to the forecast and prepare before any storms near the North Country. This includes knowing your evacuation routes and having an emergency kit. Here are some Hurricane awareness and preparation resources:

- http://www.nws.noaa.gov/os/hurricane/resources/TropicalCyclones11.pdf
- https://www.ready.gov/hurricanes
- http://www.nws.noaa.gov/om/hurricane/

Want to do some hurricane hunting of your own without leaving your computer? Check out these websites:

- National Hurricane Center: http://www.nhc.noaa.gov/
- Interactive historical plots: https://coast.noaa.gov/hurricanes/

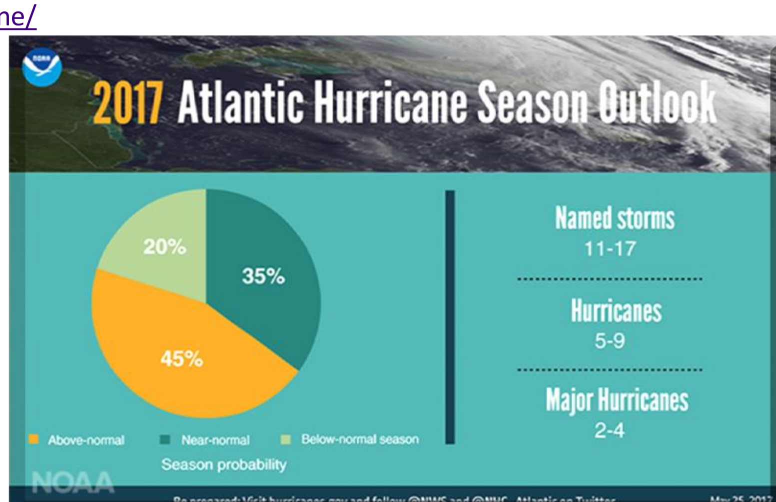


Figure 5. 2017 Atlantic Hurricane Season Outlook from the National Hurricane Center

Weather Impact Matrix for the 2017 Vermont City Marathon

-Brooke Taber

The National Weather Service (NWS) in Burlington, Vermont has developed a new Decision Support Services (DSS) forecast threat matrix that utilizes our local National Digital Forecast Database (NDFD) to display weather elements into a colorized matrix. This colorized weather matrix can be adjusted to meet specific user's needs for helping key local, state, and federal officials make important planning decisions based on expected weather conditions. This DSS threat matrix has the capability to display general weather elements such as temperature, apparent temperature, wind, snowfall, rainfall, and chances of precipitation, along with specific aviation elements which include visibility and ceiling heights. In addition, several fire weather and marine components are available in the matrix to help fire weather partners plan for prescribed burns or search and recuse operations on Lake Champlain.

Risk or Threat Level	None	Limted/Sub-Advisory	Elevated/Advisory	Significant/Warning	Extreme/Historic
	Colorized Weather Element Thresholds				
Max Temp (°F)	<80	80-84	85 to 94	95 to 99	≥100
Min Temp (°F)	>0	0 to -10	-10 to -20	<-20	
Apparent Temp (HI) °F	<85	85 to 89	90 to 99	100 to 104	≥105
Apparent Temp (WCI) °F	>-10	-10 to -20	-20 to -30	-30 to -40	>-40
Wet Bulb Globe Temp (°F)	<65		65 to 73	73 to 82	>82
Pops (%)/Weather Type	<14	14 to 24	24 to 54	>55	
Average Wind Speed (MPH)	20 to 25	25 to 30	31 to 35	> 35	
Wind Gust (MPH)	<35	35 to 45	45 to 57	>57	
Lightning Activity Level	None	1-8 Strikes/15 mins	9-15 Strikes/15 mins	16-25 Strikes/15 mins	>25 Strikes/15 mins
Max RH (%) Recovery	>70%			<40%	
Min RH (%)	>30			<30	
Mixing Height (Feet)	>5000		2000 to 5000	<2000	
Transport Winds (MPH)	>15		15 to 25	>30	
Haines Index	<3	4	5	6	
Visibility (SM)	> 5		3 to 5	<3	
CIGS (feet)	>3000		1000 to 3000	<1000	
QPF (Inches)	<0.50	0.50 to 1.0	1 to 3	> 3	
Snowfall (Inches)	<1	1 to 3	3 to 5	>6	>24
Hourly Snowfall (Inches)	<0.5	0.5 to 1	1	1 to 3	>3
Ice Accumulation (Inches)	None	Trace to 0.10	0.10 to 0.50	0.50 to 1.0	>1
Watch/Warning/Advisory	Watch		Advisory	Warning	

The DSS matrix can display hourly and daily weather elements up to 7 days in advance and helps to communicate clearly and effectively any potential weather threats, which could impact public safety or help safety officials plan for expected wx conditions. Figure 1 shows a list of potential weather elements and associated colorized thresholds, which can easily be adjusted based on user requirements.

Figure 1. ***(above)*** *Default Weather Thresholds* *Figure 2. Sample DSS Weather Matrix*

National Weather Service Burlington, Vermont
Weather Impact Matrix for The 2017 Vermont City Marathon
Valid: 05/28/2017 05:00 - 05/28/2017 17:00 LST
Call 1-802-658-0207 for additional weather support

	Sun 05/28 5 AM	Sun 05/28 6 AM	Sun 05/28 7 AM	Sun 05/28 8 AM	Sun 05/28 9 AM	Sun 05/28 10 AM	Sun 05/28 11 AM	Sun 05/28 12 PM	Sun 05/28 1 PM	Sun 05/28 2 PM	Sun 05/28 3 PM	Sun 05/28 4 PM	Sun 05/28 5 PM
Temperature	55°F	57°F	60°F	62°F	65°F	69°F	71°F	74°F	75°F	77°F	78°F	78°F	77°F
Wet Bulb Globe Temp	61°F	63°F	65°F	67°F	69°F	71°F	73°F	74°F	74°F	75°F	76°F	75°F	75°F
Wind Speed	3 mph	3 mph	3 mph	3 mph	3 mph	3 mph	3 mph	3 mph	4 mph	4 mph	4 mph	5 mph	5 mph
Wind Direction	S	S	S	S	S	S	S	S	S	SW	S	S	S
Wind Gust	4 mph	4 mph	4 mph	4 mph	4 mph	4 mph	4 mph	4 mph	5 mph	5 mph	6 mph	6 mph	8 mph
Chance of Precipitation	1%	0%	0%	1%	2%	3%	4%	5%	5%	6%	6%	6%	6%
Weather	None	None	None	None	None	None	None	None	None	None	None	None	None
Sky Cover	32	29	27	24	26	27	29	31	34	36	34	33	31
Relative Humidity	80	77	72	70	65	57	55	48	46	42	42	42	45
Rainfall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lightning Activity Level	1	1	1	1	1	1	1	1	1	1	1	1	1

Issued: Sunday May 28, 2017 04:10 AM

Threat Level	None	Limited	Elevated	Significant	Extreme
Temperature	<85 °F	85 to 89 °F	90 to 99 °F	100 to 104 °F	≥105 °F
Wet Bulb Globe Temp	<65 °F	65 to 69 °F	70 to 72 °F	73 to 81 °F	≥82 °F
Wind Speed	<25 mph	25 to 29 mph	30 to 34 mph	35 to 39 mph	≥40 mph
Wind Gust	<35 mph	35 to 44 mph	45 to 57 mph	58 to 73 mph	≥74 mph
Chance of Precipitation	<15 %	15 to 24 %	25 to 54 %	≥55 %	
Lightning Activity Level	None	1-8 Strikes/15 min	9-15 Strikes/15 min	16-25 Strikes/15 min	>25 Strikes/15 min

After meetings and collaboration efforts with Vermont City Marathon Officials, NWS BTV was able to identify a list of critical weather elements to display on both a daily and hourly DSS matrix for planning and safety purposes prior to and during Vermont's largest outside sporting event. We developed specific colorized weather elements to match race course displays warning runners about the potential for weather related issues, especially associated with warm temperatures. One very important element utilized by race officials is the Wet bulb Globe Temperature (WBGT) which is a measure of the heat stress in direct sunlight that takes into account, temperature, humidity, wind speed, and cloud cover. For example, if WBGT reaches 82F or higher for 3 straight readings, then marathon officials cancel the race, due to the potential heat related impacts to the runners. This would be displayed as black in the DSS matrix. This new matrix is expected to help NWS meet the needs of our emergency management and public safety community by meeting their specific event needs and requirements.

CoCoRaHS: Citizen scientists in action!

-Chuck McGill

Have you ever been driving in a thunderstorm and suddenly go from a soaked road to a dry one? That's a great illustration of the spatial variability of rainfall, especially during the warmer months when showers and thunderstorms are more prevalent. And that's where you can come in.

CoCoRaHS stands for the **Co**mmunity **Co**llaborative **Ra**in **H**ail and **S**now network. It's a network of thousands of ordinary citizens across the US, Canada and the Bahamas who take daily measurements of precipitation (and snow where and when it occurs), using a simple 4" plastic rain gauge.

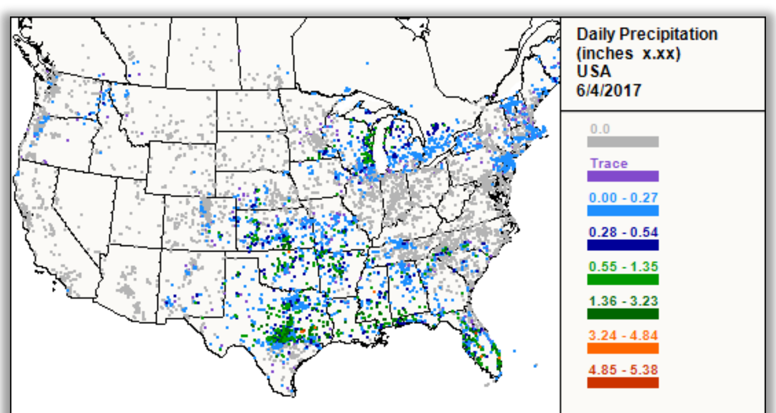
The origins of the network date to 1997, and a devastating flash flood in Fort Collins, Colorado, home of Colorado State University. Colorado State is also the home to the Colorado State Climatologist, Nolan Doesken, the founder of CoCoRaHS. Following the flood, he and his colleagues sought out precipitation measurements to try to map of the distribution of the rainfall. What they found astounded even them. Over a distance of just 5 miles, the rainfall ranged from 14.5 inches to 2 inches. It was always known that rainfall varied from place to place, but existing observation networks didn't have the spacing to resolve such large variations over such small distances. Thus, a grass-roots network was born.

The CoCoRaHS network has proven to be very beneficial to the National Weather Service, allowing forecasters to get a much better handle on the distribution of rainfall. This aids in determining flooding threats, and on the other side, drought assessment. Data from observers is also used by numerous other industries and professions, including Emergency Managers, Insurance adjusters, engineers, farmers, and teachers, among others.

Despite the growing numbers of official mesonets, along with other privately owned weather stations made available over the internet, gaps still exist in the observational record.

Using an inexpensive rain gauge, these gaps are being filled in by interested citizen scientists. The once daily readings also mean that there's only a small time commitment needed.

To join CoCoRaHS, or for more information, visit their website: http://www.cocorahs.org.



(Clockwise from top left)

Figure 1. Rain shaft as seen from aircraft.

Figure 2. 4 inch standard plastic rain gauge

Figure 3. Output of accumulated CoCoRaHS precipitation observations for June 6, 2017

William "Bill" Hanley : Still Crazy after 37 Years

-Marlon Verasamy

This issue is dedicated to William "Bill" Hanley. Bill Retired from NWS Burlington on May 1st after 37 years of federal service! Bill has spent the last 18 years serving the North Country. Bill graduated in late 70's from the University of Wisconsin with a Meteorology degree and then he started his NWS career at the NOAA NWS Aviation Weather Center forecasting for the first Hot Air Balloons and Dirigibles! (Just kidding Bill!) Bill then spent the latter half of the 80's working at the NOAA Satellite and Information Service in Silver Spring, MD. His next stop and where he spent most of the 90's was at NWS Boston MA when it was still at Logan Airport, working his most memorable shift during the "Perfect Storm" in 1993! All this before moving to the "Best Little NWS Office in the USA" (His words, and we can't argue) right here at NWS Burlington in 1999. As he moves on to retirement, Bill plans to continue following his two major passions, world travel (He's already hit all 7 continents! Including stops in Spain, Russia, Brazil, Manchu Picchu, Rome, just to name a few!) and of course, his beloved Red Sox (he's been to 2 World Series games and countless more). So to Bill, thank you for your years of service. Bon Voyage! And of course, GO SOX!

The Four Seasons

Volume IV, Issue II

Contributors:
Brooke Taber , Meteorologist
Paul Sisson, Science and Operations Officer
Chuck McGill, Information Technology Officer
Kimberly McMahon, Meteorologist
Marlon Verasamy, Observing Program Leader

Editors:
Kimberly McMahon, Meteorologist
Marlon Verasamy, Observing Program Leader

We Need Your Storm Reports!

Please report snowfall, flooding, damaging winds, hail, and tornadoes. When doing so, please try, to the best of your ability, to measure snowfall, estimate hail size, and be specific as to what damage occurred and when. We also love pictures!

For reports, please call:
(802) 863-4279
Or visit:
http://www.weather.gov/btv/stormreport

National Weather Service Burlington, VT
Burlington International Airport
1200 Airport Drive
South Burlington, VT 05403
Phone: (802) 862 2475
www.weather.gov/btv
Email: btv.webmaster@noaa.gov

Follow us on Facebook and Twitter!
Check out our YouTube Channel!

US National Weather Service Burlington, VT

@NWSBurlington

www.youtube.com/user/NWSBurlington