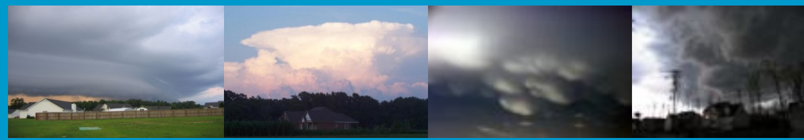


Changing Skies

Over Central North Carolina

VOLUME 12, ISSUE 1 SPRING 2015

NOAA'S NATIONAL WEATHER SERVICE RALEIGH, NC

INSIDE THIS ISSUE:

Weather Balloons Still Viable Data Source

NC State Meteorology Students Release Balloon

On Friday March 6, three North Carolina State University Meteorology students who were selected to participate in a semester long internship course got a rare opportunity to observe and participate in an operational weather balloon launch at the Piedmont-Triad International Airport in Greensboro.

It isn't a big secret that weather balloons have been a big part of operational forecasting for several decades but why is that, and why haven't they become obsolete by now? The answers have a lot to do with the fact that a big chunk of the observational data we collect as meteorologists is surface based. With many important processes occurring well above the surface it is vital to obtain some kind of observational verification at several levels in the atmosphere to help initialize and verify numerical models.

Once launched, a balloon can obtain data related to temperature, relative humidity, and winds along with many other parameters that can be derived from the base data. First and foremost, this data gives forecasters a look at the vertical profiles of these variables which can then be compared with those being shown in high resolution short term models. Forecasters are then able to tell how well the models are performing and make adjustments to the forecasts as needed. This is the verification of the model.

In addition to grading how well a model forecast is doing, observational data from a weather balloon can also help the next model forecast to be better than the last one. This is because of a process called data assimilation which occurs when observational weather data from the balloon is placed into the forecast models before they run the forecast. By doing this, an initial dataset more representative of the current state of the atmosphere is placed into the model and after it runs the equations for the (continued on page 7)

NWS Raleigh Tests New Satellite Capabilities

NWS Operations Proving Ground

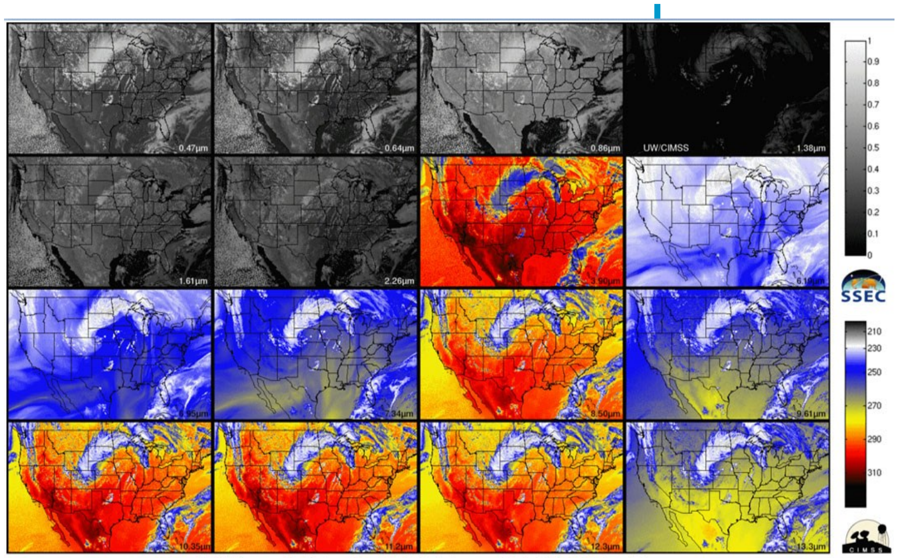
Last summer, the forecasters at NWS Raleigh had a chance to look at a relatively simple, but extremely powerful new satellite capability that will be available to forecasters after the launch of the Geostationary Operational Environmental Satellite – R (GOES-R) satellite which is currently in the process of being developed: one minute satellite imagery. Satellite pictures available on a one minute time scale might not sound like a lot or even relatively impressive in today's modern world of super technology, but to weather forecasters it is a big deal for a variety of reasons. To appreciate this new technology, we first must take a look at the current state of geostationary satellite technology in the NWS today. GOES-13 and GOES-15 are currently in geostationary (meaning it stays in the same place relative to the spin of the Earth) orbit over the eastern and western halves of the continental United States (CONUS), respectively. On a typical day, CONUS imagery is made available to the forecaster every 15 minutes with one scan of the entire western hemisphere, called a full-disk scan, once every 3 hours, during which time the regularly scheduled 15 minute CONUS image is not available. While this time-step is good for looking at large scale weather patterns and slow moving systems like hurricanes, it is not good at all for looking at smaller scale fast moving features like an individual thunderstorm or any of the features associated with a thunderstorm. It becomes even worse when considering that it takes 30-45 minutes for the imagery to reach the forecaster after it is taken by the satellite. So, for example, a forecaster will get an image at 12:45 PM that was actually taken at 12:15 PM and then another image at 1:00 PM that was taken at 12:30 PM. For small scale features like a thunderstorm it is very possible that the event could be over before the satellite image depicting it even gets to the forecaster.

"What forecasters could not dream of seeing before will be easily seen in near real time."

One of the many great things about the new GOES-R satellite is that it will have the capability to send the forecaster an image once every minute that was only taken 40 seconds ago. Therefore, a forecaster may see an image of a timestamp of 7:01 PM that was actually taken by the satellite at 7:00 PM. In addition a full-disk image will be possible once every 15 minutes. Immediately, this changes everything. What forecasters could not dream of seeing before will be easily seen in near real time. In fact, even with recent Doppler radar upgrades, it still can only deliver an image of the lowest scan once every 2.5 minutes. Virtually overnight, the utility of satellite data will increase exponentially. That's not the only trick up GOES-R's sleeve. In addition to better time resolution and faster latency, the resolution of the imagery from GOES-R will be twice as good as it is now. Finally, if you think of a satellite as a

TV it currently has 5 bands, each like a different channel on a TV. This is how different products such as infrared satellite imagery or water vapor imagery are produced. Bands can also be combined to produce new products. GOES-R will not carry just 5 bands, it will carry 16 bands which can all be used in conjunction with each other to produce many products never capable before. These products can be used to track anything from aviation icing potential to overshooting tops on thunderstorms.

While the GOES-R satellite is scheduled to launch in March of 2016, much has to be done in the meantime to prepare not only the physical satellite for orbit, but to also prepare the forecaster for the new influx of data and to find situations where the data will be helpful in the forecasting process that is currently is not because of the aforementioned limitations of the current technology. Enter the NOAA/NWS Operations Proving Ground. The Operations Proving Ground, located in Kansas City, Missouri is tasked with running Operational Readiness Experiments (OREs) on certain technologies before they are implemented into the field. That is to say an area where researchers working on the new technology can introduce new products to forecasters and in return forecaster can provide feedback on what would be helpful to them to make the job of forecasting easier, where the new technology excels, and where it could use some work. This bridge of communication between researchers and forecasters is meant to help streamline the process of implementing new research into operations in an efficient manner. In the case of GOES-R, the Operations Proving Ground was able to attain sample 1-minute data for a variety of situations from the current satellite (which can be done for short times in small areas but with all the inherent other limitations still present). The data is then presented to the forecaster in a simulated environment that mimics the setup in a real NWS office and the forecasters "work" each case in real time just like they would in the office. As forecasters work with the new data they provide feedback on how the data helped or in some cases hurt them when trying to do their job in various scenarios.



ABI band data for 2005 June 04 22:00 UTC

16 Spectral Bands Available in on the GOES-R ABI

Ryan Ellis, a forecaster at WFO Raleigh, attended a week long session at the Operations Proving Ground in Kansas City and worked with other forecasters from different offices around the country to provide feedback to the Operations Proving Ground Staff. After spending a week with the team in Kansas City working with the new data, it was apparent that the new GOES-R technology will have a tremendous impact on forecasting as well as helping critical decision makers in the community receive better and more timely information that will hopefully allow them to do their jobs more efficiently, ultimately saving lives and mitigating weather related impacts within the community.

-Ryan Ellis

Lions and Lambs: Spring in NC is a Mixed Bag of Weather

"North Carolina has been spared severe storms so far this year, but the can change very fast."

Tornado Damage from 2011 (NCDPS-NCEM)

The old saying that March roars in like a lion and rolls out like a lamb takes on new meaning when it comes to weather in North Carolina. While spring in this state brings leaves on trees and warmer temperatures, it can also be a time for unpredictable storms that strike quickly and leave devastating effects.

"North Carolina has been spared severe storms so far this year, but that can change very fast." said Mike Sprayberry, North Carolina Emergency Management director. "While spring and late fall are typically peak tornado season, severe storms and tornadoes can pop up any time."

Sprayberry said that it's critical to know what to do and where to go when storms threaten. Have a plan in place and listen for weather alerts to be ready for any weather-related emergency, he advised.

In 2014, the National Weather Service issued 81 tornado warnings and recorded 36 tornadoes that killed one and injured 34 people in our state. Nine of those tornadoes struck in one day in eastern North Carolina, damaging or destroying more than 300 homes. Tornadoes caused more than $22 million in damages last year.

In addition, the NWS issued more than 632 severe thunderstorm warnings, and recorded more than 686 incidents of severe thunderstorms with damaging winds and/or large hail. The severe storms killed three people, injured seven others, and caused $3.5 million in damages.

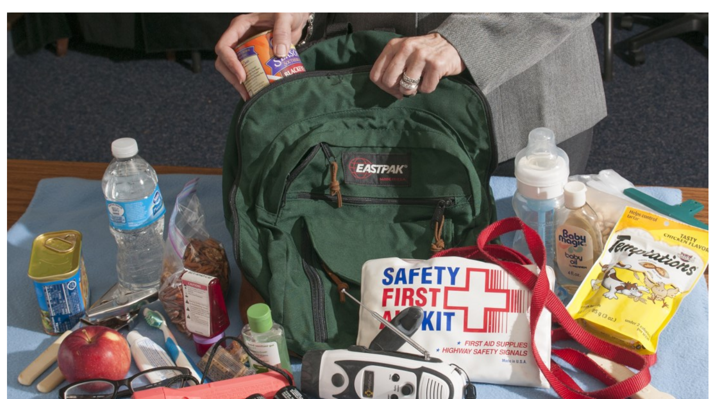
Warning Signs

Not every storm warrants an emergency. But many seemingly mundane storms can turn deadly quickly and without warning. Dangers linked with severe storms include lightning, tornadoes, strong winds, hail and flash flooding.

"There isn't much notice before a storm takes a dangerous turn but there are some key warning signs," said Sprayberry. "If after seeing lightning, you cannot count to 30 before hearing thunder, then you need to go indoors."

Lightning can strike as far as 10 miles away from the rain area in a thunderstorm. That's about the distance you can hear thunder. If the sky looks threatening, people should take shelter even before they hear thunder.

"Lightning strikes are one of the top three storm-related killers in the United States," said Nicholas Petro, warning coordinator meteorologist for the National Weather Service's Raleigh Office. "Over the past 30 years, flash



Emergency Preparedness Kit (NCDPS-NCEM)

flooding has been responsible for more deaths than any other thunderstorm-associated hazard."

means a tornado is possible. WARNING means a tornado has been spotted; take shelter immediately.

Tornado Damage from 2011 ((NCDPS-NCEM)

Tornadoes, nature's most violent storms, are formed from powerful thunderstorms. They show up as spinning, funnel-shaped clouds that reach from a thunderstorm to the ground with whirling winds that can reach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long.

Sprayberry reminds people to look for the warning signs, especially in the case of tornadoes, which are known by a large dark, low-lying cloud (particularly if rotating) and a loud roar, much like a freight train.

Safety Tips

North Carolina Emergency Management officials recommend having a weather radio that broadcasts NWS alerts when severe weather threatens. Many North Carolina tornado fatalities have occurred at night when people are asleep and less likely to receive a warning without a weather radio.

Emergency officials recommend people use the following safety tips:

- Know the terms: WATCH
- Know where the nearest safe room is, such as a basement or interior room and away from windows, and go there immediately if you hear or see a tornado.
- If driving, you should leave your vehicle immediately to seek safety in an adequate structure. Do not try to outrun a tornado in your vehicle, and do not stop under an overpass or a bridge.
- If you are outdoors, and there is no shelter available, take cover in a low-lying flat area. Watch out for flying debris.
- Following a storm, wear sturdy shoes, long sleeves and gloves when walking on or near debris, and be aware of exposed nails and broken glass.
- Be aware of damaged power or gas lines and electrical systems that may cause fires, electrocution or explosions.

"It's good to not only have an emergency plan in place but also to practice it annually so that you know where to go during severe weather," said Sprayberry.

Knowing what to do when severe weather threatens can save lives. There are different places that you need to go to depending on the weather emergency and your location.

- At Home – Go to the basement. Under the stairs or in a bathroom or closet also are good spots. Put as many walls as possible between you and the outside.
- At Work – Go to the basement if there is one. Stairwells, bathrooms and closets are good spots. As a last resort, crawl under your desk.
- At School – Seek shelter in inside hallways, small closets and bathrooms. Get out of mobile classrooms, gymnasiums, auditoriums and other rooms with a large expanse of roof. Bus drivers should be alert for bad weather on their routes.
- In Stores – Seek shelter against an inside wall. An enclosed hallway or fire exit leading away from the main mall concourse is a good spot. Stay away from skylights and large open areas.

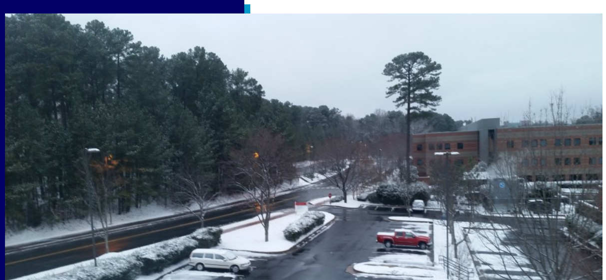
The free ReadyNC mobile app provides real-time traffic and weather information plus information about opened shelters and riverine flood levels. The app also provides basic instructions on how to develop an emergency preparedness plan. The ReadyNC.org website provides information to help you prepare for severe weather and tornadoes, including how to make an emergency supplies kit and what to do during and after severe storms.

-Laura Leonard
NC Emergency Management

Students Sheltering in Place During at Tornado Drill (NCDPS-NCEM)

Cold February Doesn't Tell the Whole Winter Story

If you were to ask someone living in Raleigh, "What was this past winter like?" you would probably get answers like "cold" and "freezing". The tendency is to remember the most recent memory, and since February was cold, the winter is remembered as cold. We'll delve deeper into the February numbers a bit later, but let us look at the winter as a whole first. Climatological winter is from December 1st through February 28th (29th in a leap year), or December, January, February. The normal average temperature for that three month period at the Raleigh Durham International airport (RDU) is 42.9 degrees, and at the Piedmont-Triad International airport (GSO) is 40.8 degrees. The winter of



Snow in NWS Raleigh Parking Lot 2/24/15

2014-2015 was actually only slightly below normal from a temperature perspective, with the average temperatures at RDU and GSO of 39.8 degrees and 38.7 degrees, respectively. In fact, the average temperature in the month of December was actually above normal at both locations (see tables below). Also, the average monthly temperature for January was only slightly below normal at both locations. Thus, for the seasonal average temperature at RDU and GSO to be 3.1 and 2.1 degrees below normal, respectively, February had to have been quite a bit below normal. As you can see from the table below, it was, and by nearly 10 degrees at that.

In fact, at RDU, February 2015 tied with 1934 for the 4th coldest February on record! Not to be left out, at GSO February 2015 tied with 1963 for the 6th coldest February on record. Also of note are the temperature records that were set, or not set, this winter. There were no temperature records set at either location during the month of December, and only one, a record low at GSO, in January. In contrast, there were 11 temperature records set between the two sites in February. At RDU, there were four record low maximum temperatures and one record low temperature. At GSO, there were also 4 record low maximum temperatures, two record low temperatures. It is no wonder the word that comes to mind when we think of this past winter is "cold," as the cold weather in February was pretty memorable.

Let's not forget about wintery precipitation. Again, February contained just about all of it. Aside from trace amounts, there was almost no snow to speak of in December and January at both RDU and GSO. February was a completely different story. At RDU, 7.9 inches of snow fell during the month of February, which was also the season total. The normal seasonal snowfall at RDU is 5.4 inches. At GSO, 9.6 inches of snow fell in February, which was the seasonal total

GSO	Average T (*F)	Normal (*F)
Dec	43.8	41.3
Jan	38.3	38.9
Feb	33.9	42.4

RDU	Average T (*F)	Normal (*F)
Dec	44.7	43.5
Jan	39.8	41.0
Feb	34.8	44.5

as well. The normal seasonal snowfall at GSO is 6.6 inches. Given those numbers, it may be somewhat surprising that only one daily snowfall record was set between the two sites. Neither location fell in the top 5 snowiest February's on record, despite the monthly snowfall totals being higher than the seasonal normal. However, GSO did manage to make the top ten, coming in at the 6th snowiest February on record (last February is bumped to 8th). It may also be of interest, that at RDU, last February (2014) was the 5th snowiest February on record, having received 11.2 inches. So, were we above normal for snowfall and below normal for temperatures this past winter? Yes. However, the real significant snowfall and temperatures all occurred during the month of February at both RDU and GSO, while both December and January were relatively close to normal with respect to temperatures, and below normal with respect to snowfall.

-Kathleen Pelczynski

Weather Balloons (continued from page 1)

Jessica King, Kathleen Magee and Ruth Kimble (left to right)

forecast, the end result should theoretically be better. This occurs because a reduction in error at the beginning of the time period helps reduction in errors at the end of the forecast period. Thus, the old saying "garbage in, garbage out", which basically says if you put bad data into the model initially, the forecast is going to be bad.

Without a lot of ways to obtain data through the depth of the atmosphere, weather balloons continue to be the tried and true method of doing just that. So how is it done? To start with, weather balloons are launched at the same sites around the world every day at the same times twice a day (0000 and 1200 UTC). About an hour before the launch time, an instrument pack called a radiosonde is prepared for launch and tied to a helium filled latex balloon that when let go, ascends rapidly through the atmosphere to a height of near 100,000 feet before the balloon eventually bursts, and the instrument pack returns to earth via parachute. Now because the jetstream often can carry the balloon hundreds of miles from its original launch site, we don't often get the radiosondes back. That doesn't mean the data is lost though because a small gps tracker and radio antenna receives the data from the balloon as it is ascending. The data is then immediately transferred to the National Weather Service forecast office in Raleigh and integrated into the forecast process in the form of an atmospheric sounding or Skew-T plot. The same data is also sent to Washington, D.C. where it is incorporated into the forecast models run at the National Centers for Environmental Prediction (NCEP).

It is safe to say that without weather balloons, despite all the advances in technology, the advances we have seen in weather forecasting would not be what they are without the weather balloon. They are so important in fact, that when large impact storms, like Hurricane Sandy, come along special balloon releases are done to try to gather more observational data within the storm to help improve the track and intensity forecast.

On March 6, Jessica King, Kathleen Magee and Michael Scanlan participated in an operational balloon launch led by Ruth Kimble. From preparing the radiosonde, to blowing up the balloon and attaching the radiosonde and parachute and then finally launching and locking on to the balloon with the antenna, the process takes about an hour. The flight that follows takes about a half hour to complete. After that point the data is forwarded to the forecast office in Raleigh and to NCEP for inclusion into the models. While most of the forecast process takes place in the office, it is nice to get out into the field once in a while and see the data physically being harvested and appreciating all the work that goes into that process every day, twice a day.

-Ryan Ellis

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NWS Raleigh Welcomes New Electronics Technician

Steven Solana

Steven Solana has been selected as the second electronics technician at the NWS office in Raleigh. Steven comes to us from the NWS office in Birmingham, AL, where he has worked for 2 1/2 years and is a highly-respected technician at that office for his teamwork and skills in electronics. Prior to coming to the NWS, Steven was an electronics technician at Sheppard Air Force Base in Texas where, in addition to working on radar equipment, he maintained several UNIX-based Local Area Network (LAN) systems. He also was an Air Traffic Control Radar Electronics Technician for the U.S. Marine Corps in Yuma, AZ. Steven has a Bachelor's Degree in Business Administration from Wayland Baptist University and a Master's in Business Administration from the University of Phoenix. Steven will be moving to Raleigh with his family in April, and it will be nice for Steven to be much closer to family members that live in central North Carolina. Steven, congratulations and welcome to WFO Raleigh!

-Darin Figurskey