# American Meteorological Society Palmetto Chapter
## 24th Annual Allen Weber Mini-Technical Conference
### Thursday, March 22nd, 2018

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<td>Brian J. Viner, Sydney Goodlove, Savannah River National Lab</td>
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What Happens When the Sun Sets at Midday?

or

A Solar Eclipse Did It!

Dale Linville, (Emeritus) Clemson University

Abstract

Astronomers predicted a solar eclipse to occur on August 21, 2017. The moon’s shadow was expected to traverse the United States from west to east crossing South Carolina. The shadow’s umbra was predicted to pass directly over Clemson, South Carolina. Needless to say, the Astronomers were correct in their forecast and Clemson became a destination to view the eclipse attracting visitors from near and far. My Granddaughter and I traveled to the Clemson’s Lamaster Dairy Farm to observe how birds and animals responded to the eclipse and to record local weather.

In order to determine the Eclipse’s impact on weather, we need to compare August 21st with other, preferably clear sky, August days. Weather on the 20th and 22nd of August featured almost completely cloud free skies. Thus these two days were indicative of how solar radiation could change through the day on August 21st.

Solar radiation measured at Lamaster, Death Valley and the Musser Farm were combined to remove cloud effects during the eclipse. Total energy during the eclipse after cloud cover was removed is 1.38 KWh/m². The model total energy was 2.48 KWh/m². Thus the moon lowered solar energy about 45% during its eclipse.

Air temperature when the eclipse started was about 91 °F. Air temperature during the eclipse fell to 85 °F. When compared to expected air temperatures, the eclipse dropped maximum air temperature 9 °F.

Fair weather Cumulus clouds started to form around 13:00 and continued to form until 14:15 when the sky suddenly cleared. The land surface’s cooling by losing sensible heat through radiation created an inversion of the temperature profile.

The difference between ETp calculated using measured solar energy and cloud free solar energy on the 21st is 0.03 inches. The difference between measured evaporation on the 22nd and 21st is 0.09, nearly the same as difference in ETp. Thus loose of solar energy reflected back to space by the moon reduced evapotranspiration by about 0.05 inches.

The eclipse decreased solar energy that heated the ground during the time of maximum solar energy input. This decreased heating of the overlying air by both conduction and convection. Thus maximum air temperature on the 21st occurred at 14:48, more than two hours earlier than time of maximum air temperature on clear sky days.
Wind, Temperature, and Pressure Perturbations During a Solar Eclipse

Michael Stewart, University of South Carolina
April Hiscox, University of South Carolina
Alexandria McCombs, University of South Carolina

Abstract

Total solar eclipses supply both visual captivation and a controlled meteorological experiment through a sudden decrease in solar radiation from the Sun. This research provides first results from a field experiment focused on atmospheric surface layer changes before, during, and after the total solar eclipse. Suites of instruments were deployed at multiple locations in relation to the eclipse centerline, housing thermometers, sonic anemometers, and microbarographs. Additionally, a series of radiosondes were deployed within the path of totality. These results not only confirm the commonly expected changes in sensible heat, but also provide insight into eclipse induced internal gravity waves (IGW). These waves transfer both energy and momentum vertically to and form the upper levels of the atmosphere and characteristics can be calculated from upper level wind perturbations captured by radiosondes. Other anticipated results include changes in turbulence stationarity and pressure perturbations. Temperature and wind measurements presented changes in turbulence stationarity over the course of the total eclipse.
Using Flux Tower Measurements to Model the Depletion of a Tritium Oxide Plume by a Forest Canopy

Brian J. Viner, Savannah River National Lab
Sydney Goodlove, Savannah River National Lab

Abstract

The objective of the project is to determine an appropriate deposition velocity for tritium oxide which includes the effects of forests on atmospheric dispersion including turbulence generation; uptake and re-emission by the trees; and the shearing of the wind (changes in speed and direction) that occur within the forest. Because of the complex land-cover at SRS (e.g., the forests), typical regulatory atmospheric dispersion models do not appropriately represent atmospheric transport at SRS. Three-dimensional transport of a tritium oxide plume was modeled by coupling a Gaussian dispersion model (for transport above the forest) with an advection-diffusion transport model (for transport within the forest). Over 10,000 simulations were performed, each using a distinct wind profile taken from the 30-minute averages of wind speed and water vapor flux (which is analogous to tritium oxide since HTO and H$_2$O have similar molecular structures and interactions with vegetation) to ensure a representative sampling of realistic atmospheric transport conditions. Because most models do not have the ability to account for resuspension, we calculated a net deposition velocity for each simulation (deposition velocity minus resuspension velocity). Results include:

- Resuspension velocity was found to be approximately 1/3 the value of deposition velocity.
- The 95$^{th}$ and 99$^{th}$ values for net deposition velocity (deposition – resuspension) were 1.25 cm/s and 0.75 cm/s, respectively.
- This is comparable to the value of 0.50 cm/s which was previously used by the Savannah River Tritium Enterprise and to published literature.
- Compared to straight-line Gaussian models with no deposition, the current modeling study generally showed a 30-40% reduction in concentration and dose after being transported 10 km (the distance was chosen as a representative distance between the tritium facilities and the nearest site boundary).
- The modeling results are encouraging for the prospect of having a defendable non-zero deposition velocity at SRS.
A satellite examination of the January 17, 2018 Heavy Snow Event in the Carolinas

Frank Alsheimer, NOAA/NWS Columbia, SC
Gail Hartfield, NOAA/NWS Raleigh, NC

Abstract

On January 17, 2018, a fast-moving cyclone brought locally heavy snow to the Carolinas. The largest snow accumulations fell in north central North Carolina, with up to a foot measured on the ground in towns north and west of Raleigh. This presentation will show a variety of satellite images and products following the storm, specifically demonstrating some of the remote sensing capabilities gained with GOES-16, which had become GOES-East just one month before the event. Special emphasis will be placed on the improved spectral and temporal capabilities of GOES-East. Additionally, some polar products, as well as hybrid polar-model products, will also be shown.
Operational Examples of the Benefits of GOES-16 and Advantages over Previous GOES Satellites

Hunter Coleman, NOAA/NWS Columbia, South Carolina

Abstract

In November, 2016, the launch of GOES-16 (now GOES-East) marked the beginning of a new generation of geostationary satellites with coverage of the Americas and surrounding oceans. This new satellite (along with its sister satellite GOES-S, which launched on March 1, 2018) has numerous improvements over the previous GOES series of satellites. Some advantages of GOES-16 include 5 times faster coverage, 4 times better spatial resolution, and 3 times more spectral bands of information available. These improvements are being utilized operationally to provide improved forecast and warning services to our partners and customers, including emergency managers, pilots, transportation officials, and the general public. This new data source has helped forecasters in areas such as convective weather, aviation, fire weather, winter weather and more. This presentation will show some of the ways this new data can be used to provide forecasters with better detail, more information, and be integrated with other datasets to improve forecast and warning services.
Using the Multi-Radar/Multi-Sensor System (MRMS) Products to Predict the Occurrence of Severe Hail: A Regional Hail Study of Virginia and the Carolinas in Development

Anthony W. Petrolito, NOAA/NWS Columbia, SC

Abstract

The Multi-Radar/Multi-Sensor System (MRMS) has been used operationally by NWS forecasters since 2016. By rapidly integrating data from multiple platforms including radar, satellite, observational data and numerical weather prediction models, the MRMS can provide valuable and robust severe weather products to the NWS forecasters in a timely manner. A statistical analysis of various MRMS products including the Maximum Expected Size of Hail (MESH) for the period 2017 to the present is planned. To maximize the size of the independent data sample, the domain extending from Virginia through the Carolinas was chosen. The purpose of the analysis is to quantify the potential statistical correlations between the products and the occurrence of severe hail. It is also hypothesized that the discriminating product values between non-severe and severe hail may be ascertained from the analysis leading to improved severe thunderstorm warning lead times.
Radar Derived Rainfall: A Preliminary Evaluation at SRS

Arelis Rivera-Giboyeaux, Savannah River National Lab

Abstract

Rainfall amounts are used for various applications around SRS, including use for procedural compliance. Currently, rainfall amounts are obtained from a set of wedge rain gauges on different locations around the site. These wedges and the measurements taken are not directly managed by ATG and the data has undergone very minimal quality assurance. In recent years, ATG has begun to maintain a data set of level III hourly radar derived rainfall and, daily rainfall totals from the MRMS product. Hence, the question arises: how comparable are these radar estimates to measurements taken on site? Using rainfall observations from 5 area wedge gauges and from 5 tipping bucket rain gauges (within the same area as the wedges), and comparing these with grid point values from the 2 different derived rainfall estimates, a quick comparison was done for a series of rain events. Rain events selected ranged from light, continuous rainfall to fast moving heavy rain showers, and included a tropical cyclone event. Results suggest that both radar rainfall estimation techniques are comparable to site measurements, and showed a good linear relationship with the observations. Level III and MRMS rainfall values tended to overestimate rainfall amounts for the rain events studied. More case studies are needed to further assess this tendency and to characterize possible errors inherent to the observation methods and to the derived values.
Providing Impact Based Decision Support Services in South Carolina during Hurricane Irma

Whitney Smith, NOAA/NWS Columbia, SC

Abstract

Although the National Weather Service (NWS) has been providing weather information to its partners for nearly 150 years, the agency is shifting to more partner focused support. Providing impact based decision support to core partners is a key aspect of the NWS’s Weather Ready Nation initiative and ultimately the NWS mission to protect lives and property. Three NWS meteorologists from the Columbia, South Carolina Weather Forecast Office deployed to the South Carolina Emergency Operations Center (SEOC) beginning on September 6th, 2017 and continuing through the 12th to provide decision support services as Hurricane Irma loomed near the region. Tasked with collecting the latest forecast data from the National Hurricane Center and each of the four NWS forecast offices that cover South Carolina and combining it into one concise forecast for the entire state, forecasters worked fast paced 8-12 hour shifts. Their forecasts were presented during daily conference calls with county emergency managers, executive briefings with the governor and agency heads, press conferences with the governor and media, and briefings for the State Emergency Response Team including the National Guard, working on-site at the SEOC. One of the most challenging aspects of Hurricane Irma decision support came as many of the forecast models began taking the storm on a track further west than previous model runs had. Even though the eye of the storm was no longer expected to track directly through South Carolina, significant impacts could still be expected across the state. Clearly communicating those impacts to decision makers and the public was crucial to decisions and preparations that had to be made days in advance.
A Limited Meta-Analysis Approach to Tropical Cyclones

B. Lee Lindner, College of Charleston

Abstract

The NHC HURDAT2 database that provides information on every tropical cyclone in the Atlantic only goes back to 1851. Inferring the existence of tropical cyclones further back in time is challenging as basic parameters such as wind speed and atmospheric pressure were not accurately measured before the widespread usage in the eighteenth century of barometers, anemometers, and other instrumentation. Eight previous studies (Bright, Calhoun, Chenoweth, Fraser, Jordan, Ludlum, Mock, Roth) have utilized various datasets such as newspaper stories, ship logbooks, British Colonial Office records, weather diaries, plantation accounts, and personal letters to compile differing chronological lists of tropical cyclones and list the various consequences sustained by the community. To reduce this uncertainty, a limited meta-analysis combined these historical studies to infer the properties of the 78 tropical cyclones that affected Charleston, South Carolina during the period of 1670–1850. Return rates for hurricanes and major hurricanes are estimated, as well as the seasonality of tropical cyclones for the period of 1670–1850 in Charleston, and compared to the modern era.
The Climatology and Variability of Tropical Cyclones Impacting Jacksonville, FL

Kirsten Broussard, College of Charleston
B. Lee Linder, College of Charleston

Abstract

The climatology of tropical cyclones is essential because it helps for a better understanding of how climate changes over time and affects humans. In this research, I analyzed hurricanes and tropical storms and how climatology is useful for planning for emergency purposes, inside medical facilities, infrastructures and insurance, and wildlife. My methodology for this research included using the archive maps, the Atlantic hurricane database, and historical hurricane tracking from the National Hurricane Center through the NOAA website. I analyzed all hurricanes and tropical storms in the 75-nautical mile radius of Jacksonville, FL. Specifically I evaluated the closest points on the paths of the tropical cyclones to find their date and times, wind speeds, translational velocity, and approach angle.
Tropical Cyclone Climatology for Savannah, Georgia

Aaron Neuhauser, College of Charleston
B. Lee Lindner, College of Charleston

Abstract

Coastal regions can benefit from the examination of local tropical cyclone climatology. Analysis of historic data provides insight into the average impact any specific location sees from tropical cyclones. This can be helpful information for emergency managers, insurance companies, medical personal, and any other industries or services traditionally affected by tropical cyclones. Data for the years 1851 to 2016 from the National Hurricane Center (NHC) were analyzed to compile a list of hurricanes and tropical storms whose centers passed within 75 nautical miles of Savannah, Georgia. Results of the analysis were compared to data from a previous study that focused on the tropical cyclone variability and climatology of Charleston, South Carolina. Seasonality, intensity, translational velocity, and approach angle were recorded for each system at its closest approach to Savannah. The return period for major hurricanes is 55 years, while the return periods for tropical storms and hurricanes are about 2.3 years and 4.7 years, respectfully. The frequency of tropical cyclones in the past 55 years is noticeably lower than the frequency in the previous time intervals. Further analysis could yield surprising implications to this relative lull in activity. As predicted, the majority of tropical storms approached Savannah from the west and southwest (220° to 250°) while most hurricanes approached from the south and southwest (180° to 210°). This indicates that Savannah’s tropical cyclone impact is influenced heavily by the flow from the Gulf of Mexico.
Hurricane Climatology of Wilmington, NC from 1851-2017

Ryan T. Evsich, College of Charleston
B. Lee Lindner, College of Charleston

Abstract

An analysis of National Hurricane Center data for the years 1851-2017 will produce a chronological list of tropical storms and hurricanes that passed within 75 nautical miles of Wilmington, NC. The final product will include date, intensity, approach angle, and translational velocity, while providing an insight of the return rate of Wilmington being struck by tropical storms and hurricanes. This will be completed by studying past tropical tracks to see if a storm passed within the given miles. If even just 1 of the data points approached Wilmington within 75 nautical miles, it will be considered a strike. If a TS and H was classified as both a TS and H while within 75 nautical miles of Wilmington, it will be considered a strike as a hurricane. The results will be distributed to government emergency officials, medical facilities, etc. to plan for hurricane seasons and provide helpful insight to the public. Also, Coastal natural resources within the Wilmington area are greatly affected by TS and H and this can be managed more efficiently with climatological data, which will contribute to better prepare for beach erosion, salt-water intrusion, etc.
Understanding and Utilizing Average Recurrence Intervals for Precipitation

Blair S. Holloway, NOAA/NWS Charleston, SC

Abstract

Over the last few years, several extreme rainfall events have occurred across the United States including Hurricanes Maria and Harvey, as well as significant events in Ellicott City, MD and West Virginia. A few extreme rainfall events have even occurred in the National Weather Service (NWS) Charleston, SC forecast area including Hurricanes Matthew and Irma, and the South Carolina record flooding event of October 2015. One way to describe an extreme rainfall event is to determine its Average Recurrence Interval (ARI). A recurrence interval is an expression of how frequently (in years) on average an event of a particular magnitude occurs. The event can be a flood, earthquake, or in this case rainfall. ARI’s for rainfall are derived from NOAA Atlas 14 precipitation frequency estimates and are a measure of the rarity of an observed rainfall amount at a particular location. The use of ARI’s has increased significantly in recent years, providing beneficial context to rare and extreme events. However, ARI’s can be a difficult concept to successfully communicate to the customers and partners of the NWS. Several ARI related tools and analyses are available including the NOAA Atlas 14-point precipitation frequency estimates, storm event analyses from the Hydrometeorological Design Studies Center, and the Weather Prediction Center’s experimental Extreme Precipitation Monitor.
ALGE3D development as an aqueous emergency response model

Grace Maze, Savannah River National Lab

Abstract

Current national response models employed by emergency response agencies have well developed models to simulate the effects of hazardous contaminants in riverine systems that are primarily driven by one-dimensional flows; however, there is a gap in the support for more complex systems. While many models exist, none are capable of quick deployment in emergency situations that could contain a variety of release situations including a mixture of both particulate and dissolved chemicals in a complex flow area. Adaptations of ALGE3D are underway to include particulate tracer and sedimentation capabilities to allow for a more comprehensive model. Quick deployment model inputs for Chesapeake Bay have been developed (more under development) to aide in the timeliness of emergency response in key locations.
An Update on RCWINDS

Benjamin Marosites, Richland County Emergency Services Department

Abstract

Beginning in 2012, Richland County Government began developing a network of weather stations with the intent to supply decision makers and first responders with near real-time weather data across the county to better serve the public. Over the past six years, Richland County Weather Information Network Data System (RCWINDS) has become a critical tool that is utilized by local meteorologist, weather enthusiasts, researchers, and emergency responders nearly every day.

RCWINDS utilizes automated weather stations reporting on a 5-minute interval to a private IP address. This data is then collected, processed, and stored on a county server using proprietary software and then it is displayed on the public website. The network spreads across Richland, Lexington, and Newberry counties with instruments installed at various county or state facilities with roof mounts or 30-foot mast towers.

Networking weather stations is no new development. Various networks have been around for decades, but these networks are generally developed and maintained by universities and/or state/federal governments or private companies that can be exceptionally costly to contract. RCWINDS is unique because it is operated and maintained by local government and its primary goal is to aid in emergency response. This presents a number of problems, but because of the recent increase in affordability of quality weather data, the dire need for real-time weather data across multiple sectors, and the success of RCWINDS, we expect more local government networks to expand across the state and country.
Analog Heat Stress Forecasting

David Werth, Savannah River National Lab

Abstract

As part of the regular daily weather forecast, the Atmospheric Technologies Group at the Savannah River Site is charged with issuing a forecast of heat stress, quantified by the wet bulb globe temperature (WBGT). As a warm, humid day progresses, WBGT will rise, and its value will be assigned to one of 5 ‘categories’ that determine what protective actions should be taken. To improve the forecasts, an analog forecasting algorithm, similar to the system now being used to predict solar radiation on site, is being developed, making use of past WBGT values and other meteorological data.

Analog forecasting involves the use of an algorithm to look through the weather data of the past to identify previous conditions similar to those of today. The analog process assumes that the daily cycle of WBGT depends strongly on a few forecasted weather variables, and that those variables can be used to create a composite cycle that can be used to guide the WBGT forecast. The analog process accepts as input the predicted daily maximum temperature ($T_{\text{max}}$), average dewpoint ($T_d$), and wind speeds ($W_s$), and searches the database of heat stress. All WBGT cycles from days that have similar values of $T_{\text{max}}$, $T_d$ and $W_s$ are composited, and used to get the forecast for that day. The forecasts will be evaluated during the upcoming summer.