NORTHEASTERN STORM BUSTER

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Northeastern StormBuster is a quarterly publication of the National Weather Service Forecast Office in Albany, New York, serving the weather spotter, emergency manager, cooperative observer, ham radio, scientific and academic communities, along with weather enthusiasts, who all have a special interest or expertise in the fields of meteorology, hydrology and/or climatology.

WINTER 2014-15: A TURN TOWARD BITTER COLD

Evan L. Heller
Climatologist, NWS Albany

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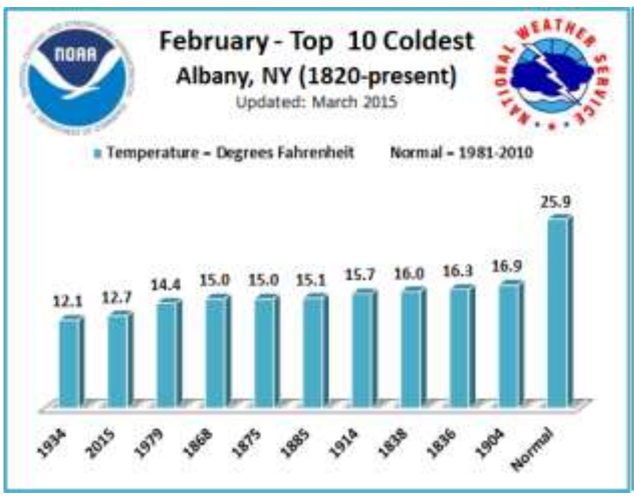
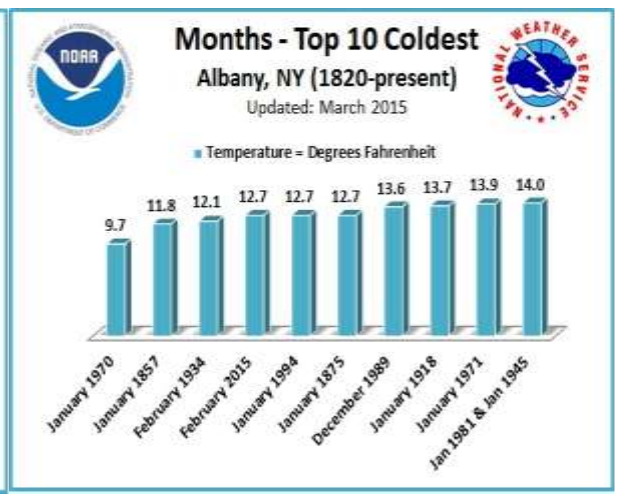
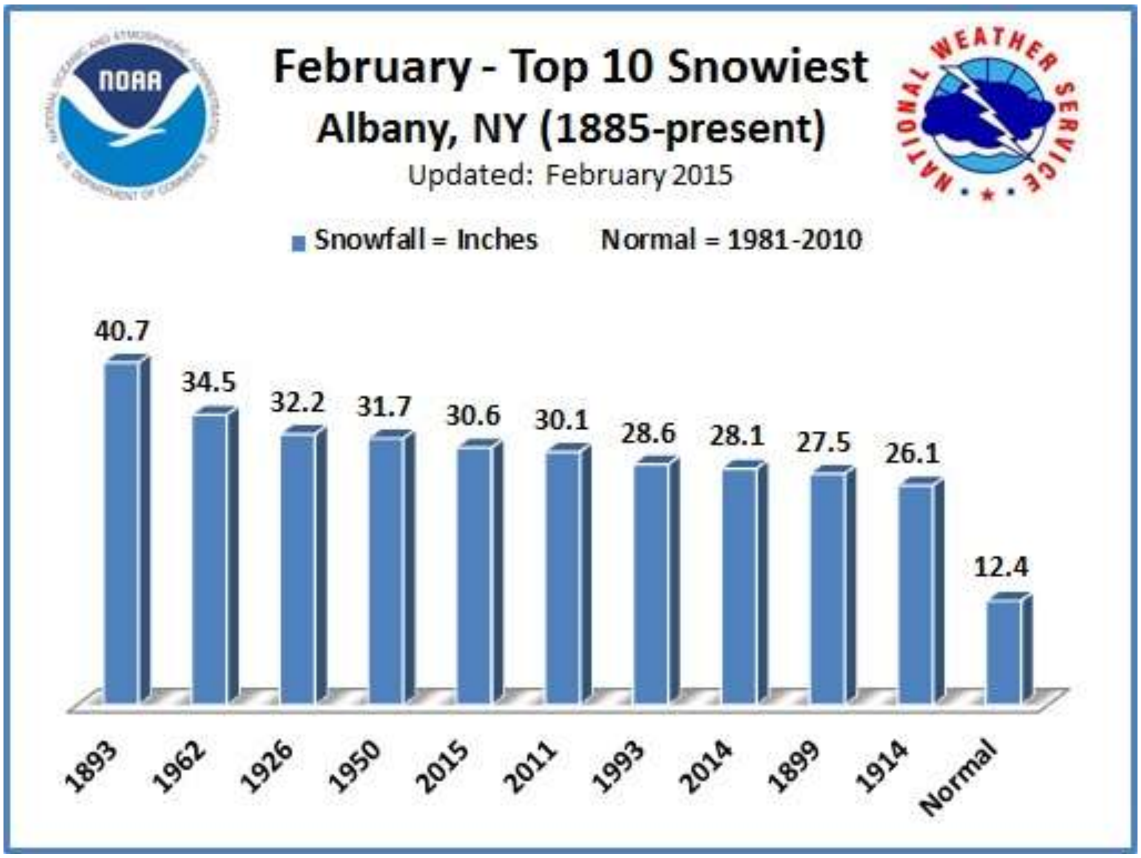
Given the brutal cold of the last half of climatological winter, it's hard to believe that the Winter of 2014-15 as a whole was only about 4 degrees below normal (Table 1). December was actually 4 degrees above normal, but the season became progressively colder. January wound up around 3 degrees below normal. February was the whopper, though…13.2 degrees below normal, making it the 2nd-coldest February on record, and putting it in a 3-way tie for the 4th-coldest month of all-time at Albany (Table 3c). Both the mean high and the mean low temperatures for the month also placed February in the top 3 of both the Top 10 Coldest Mean Maximum Februaries and Top 10 Coldest Mean Minimum Februaries lists. Albany's Top 10 Coldest Februaries plus the current 30-year normal, and the Top 10 Coldest Months of all-time, are shown in the charts below.





Despite February's extreme cold, only one new daily record for temperature was set. A daily minimum temperature of -10° on the 21st only barely nudged out the previous record for the date…from 1950 (Table 3c). There were 11 other days during the month when the temperature dipped to zero or below (Table 2a), and there were 7 more instances in January. Albany experienced a 17-day deep freeze, from January 26th through February 11th, when the mercury failed to climb above freezing (Table 2b), and a 4-day cold wave from February 15th to the 18th, when the mercury bottomed out at zero or colder each day. An interesting statistic of note…34° was the highest temperature recorded in February (Table 1). (Indeed, only two days in February rose above the freezing mark.) (Table 2a)). This makes it the February with the lowest daily maximum temperature on record at Albany, breaking the previous February record, 1978, which holds a highest daily maximum temperature of 36°. Special thanks goes out to our Brian Frugis for digging up the information on this.

And February was about as snowy as it was cold. Two significant snow events (Table 2b) during the month helped contribute to the 30.6" total that made it the 5th-snowiest February on record, and the 26th-snowiest month overall, at Albany (Table 3c). February was so cold that it meant that all precipitation came in the form of snow. Indeed there was no sleet or freezing rain recorded (Table 4c). February of 2015 will stay in our memories for a long time to come. Here's a look at Albany's Top 10 Snowiest Februaries plus the current 30-year normal:



The only other significant snow event of note was another snowstorm in December. This occurred from the 9th to the 11th, when 11.3" fell. Just over half of it fell on the 10th, producing a daily record for that date (Tables 2b and 3a). It was a very wet snow, particularly at the onset, with a record daily precipitation value set on the 9th. With a precipitation total of 5.37", December 2014 became Albany's 9th-wettest December. January became Albany's 81st-coldest month of all time (Table 3b), and one daily wind record was broken, on the 7th of that month.

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STATS

	DEC	JAN	FEB	SEASON
Average High Temperature/Departure from Normal	37.9°/+2.1°	28.9°/-1.7°	23.0°/-11.6°	29.9°/-3.7°
Average Low Temperature/Departure from Normal	27.2°/+6.0°	10.5°/-4.0°	2.4°/-14.9°	13.4°/-4.3°
Mean Temperature/ Departure From Normal	32.5°/+4.0°	19.7°/-2.9°	12.7°/-13.2°	21.7°/-3.9°
High Daily Mean Temperature/Date	50.0/25th	39.0°/4th	28.0°/22nd	
Low Daily Mean Temperature /Date	19.5°/8th & 31st	4.5°/14th	1.5°/16th	
Highest Temperature reading/Date	58°/25th	45°/4th	34°/22nd	
Lowest Temperature reading/Date	12°/8th & 31st	-10°/14th	-12°/3rd	
Lowest Maximum Temperature reading/Date	27°/8th, 30th & 31st	14°/31st	10°/13th	
Highest Minimum Temperature reading/Date	42°/25th	33°/4th	22°/22nd	
Total Precipitation/Departure from Normal	5.37"/+2.44"	2.17"/-0.42"	2.15"/-0.05"	9.69"/+1.97"
Total Snowfall/Departure from Normal	12.2"/-1.5"	15.5"/-2.1"	30.6"/+18.2"	58.3"/+14.6"
Maximum Precipitation/Date	1.60"/9th	0.59"/18th	0.88"/2nd	
Maximum Snowfall/Date	6.1"/10th	5.6"/27th	11.9"/2nd	

Table 1

NORMALS, OBSERVED DAYS & DATES

NORMALS & OBS. DAYS	DEC	JAN	FEB	SEASON
NORMALS				
High	35.8°	30.6°	34.6°	33.6°
Low	21.2°	14.5°	17.3°	17.7°
Mean	28.5°	22.6°	25.9°	25.6°
Precipitation	2.93"	2.59"	2.20"	7.72"
Snow	13.7"	17.6"	12.4"	43.7"
OBS TEMP. DAYS				
High 90° or above	0	0	0	0/91
Low 70° or above	0	0	0	0/91
High 32° or below	7	20	26	53/91
Low 32° or below	22	30	28	80/91
Low 0° or below	0	7	12	19/91
OBS. PRECIP DAYS				
Days T+	23	25	23	71/91/78%
Days 0.01"+	15	10	11	36/91/40%
Days 0.10"+	9	6	6	21/91/23%
Days 0.25"+	5	2	2	9/91/10%
Days 0.50"+	5	2	2	9/91/10%
Days 1.00"+	1	0	0	1/91/1%

Table 2a

NOTABLE TEMP, PRECIP & SNOW DATES	DEC	JAN	FEB
Major Deep Freeze (10 or more consec. days not exceeding 32°F)	-	26th->	->11th (17 days)
Cold Wave (3 or more consec. days with lows zero or below °F)	-	-	15th-18th (4 days)
-10°F event (low temperature)/date	-	-10°/14th	12°/3rd; -10°/6th; -10°/21st
1.50"+ event/date	1.60"/9th	-	-
Significant Snow Event (6.5"+ 24-hour snowfall)	11.3"/9th-11th	-	11.9"/2nd; 9.1"/8th-9th

Table 2b

RECORDS

ELEMENT	DECEMBER	
Daily Maximum Precipitation Value/Date | Previous Record/Year	1.60"/9th	0.97"/1973
Daily Maximum Snowfall Value/Date | Previous Record/Year	6.1"/10th	4.0"/1903
Top 10 Wettest Decembers Value/Rank | Remarks	5.37"/#9	-

Table 3a

ELEMENT	JANUARY	
Top 100 Coldest Months Value/Rank | Remarks	19.7°/#81	3-way tie
Daily Maximum Wind Speed Value/Direction/Date | Previous Record/Direction/Year	47 mph/NW/7th	44/W/2014

Table 3b

ELEMENT	FEBRUARY	
Daily Minimum Temperature Value/Date | Previous Record/Year	-10°/21st	-9°/1950
Daily Maximum Precipitation Value/Date | Previous Record/Year	.88”/2nd	.80”/1981
Daily Maximum Snowfall Value/Date | Previous Record/Year	11.9”/2nd	5.5”/1892
Top 10 Coldest Februaries Value/Rank | Remarks	12.7°/#2	-
Top 10 Coldest Mean Maximum Februaries Value/Rank | Remarks	23.0°/#3	-
Top 10 Coldest Mean Minimum Februaries Value/Rank | Remarks	2.4°/#2	-
Top 100 Coldest Months Value/Rank | Remarks	12.7/#4	3-way tie
Top 10 Snowiest Februaries Value/Rank | Remarks	30.6”/#5	-
Top 100 Snowiest Months Value/Rank | Remarks	30.6”/#26	3-way tie

Table 3c

ELEMENT	WINTER	
none	none	none

Table 3d

MISCELLANEOUS
DECEMBER

Average Wind Speed/Departure from Normal	7.6 mph/-0.9 mph
Peak Wind/Direction/Date	40 mph/WNW/3rd & 40 mph/W/25th
Windiest Day Average Value/Date	16.3 mph/25th
Calmest Day Average Value/Date	1.0 mph/23rd
# Clear Days	0
# Partly Cloudy Days	10
# Cloudy Days	21
Dense Fog Dates (code 2)	10th
Thunder Dates (code 3)	None
Sleet Dates (code 4)	2nd, 5th, 6th, 9th, 22nd & 23rd
Hail Dates (code 5)	None
Freezing Rain Dates (code 6)	5th, 6th & 9th

Table 4a

JANUARY

Average Wind Speed/Departure from Normal	8.9 mph/+0.2 mph
Peak Wind/Direction/Date	47 mph/WNW/7th
Windiest Day Average Value/Date	16.8 mph/5th
Calmest Day Average Value/Date	1.8 mph/14th
# Clear Days	3
# Partly Cloudy Days	20
# Cloudy Days	8
Dense Fog Dates (code 2)	18th & 30th
Thunder Dates (code 3)	None
Sleet Dates (code 4)	3rd
Hail Dates (code 5)	None
Freezing Rain Dates (code 6)	3rd & 4th

Table 4b

FEBRUARY

Average Wind Speed/Departure from Normal	8.7 mph/-0.4 mph
Peak Wind/Direction/Date	46 mph/W/15th & 46 mph/W/19th
Windiest Day Average Value/Date	17.9 mph/15th
Calmest Day Average Value/Date	1.2 mph/18th
# Clear Days	4
# Partly Cloudy Days	15
# Cloudy Days	9
Dense Fog Dates (code 2)	None
Thunder Dates (code 3)	None
Sleet Dates (code 4)	None
Hail Dates (code 5)	None
Freezing Rain Dates (code 6)	None

Table 4c

For more climate data and records, visit our climate page at: www.weather.gov/albany/Climate

ARE WE STILL IN A WET PATTERN?

Hugh Johnson
Meteorologist, NWS Albany

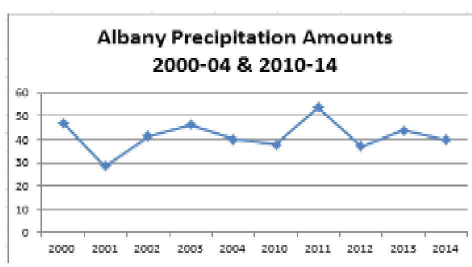
An article from the 2009-2010 winter edition of StormBuster discussed how the decade of the 2000s was officially the wettest on record at Albany. That decade ended up with a mean annual precipitation of 43.17", edging out the old record of 42.86" inches, from the 1870s, and being nearly four inches above our latest 30-year annual mean of 39.35 inches.

So, precipitation-wise, how did Albany fare in the first five years of the decade (2010-2014)? We ran a little wetter than the first five years of the 2000s (2000-2004), averaging 42.46" per year compared with 40.64" per year for the first half of the 2000s. Two years (2010 and 2012) were slightly below normal, while this past year (2014) was very close to normal. 2013 and, especially, 2011, were above normal. In fact, the 53.68" of precipitation that fell during 2011 was the third-wettest annual total in our nearly 190-year history of weather records here in Albany, and the wettest since 1871!

The largest monthly precipitation anomalies of the 2000s were in June, July, October and December. All these months averaged one to two inches above normal, while the remaining months actually averaged closer to normal. During the past five years, June and October remained well above average. March and July trended a little drier, but February trended wetter. The remaining months indicated no specific trends. By far, the wettest month of the first half of this decade was August 2011 when Irene dumped 4.69" in just one day. The monthly rainfall was 10.41", missing the all-time record for August by only 0.18"! The remaining August months were near or below normal.

Our latest "wet period" began in 1999. Since that year, only three years have averaged drier than our current 30-year mean, with no consecutive below normal precipitation years. It is interesting to note that our area experienced a similar "wet spell" in the mid to late 1800s. Then, as we entered the 20th century, a drying trend was noticeable that continued into the mid-1900s, peaking in 1964 when a mere 21.55" fell. This was our driest year ever, and, at one point, a drought emergency was declared throughout the state of New York. Since the late 1960s, Albany has trended wetter, with the wettest period being during the late 2000s. If this wet spell follows a similar cycle to the one in the 1800s, we might be wetter than normal for yet a few more decades.

Below is a table tracking the annual precipitation amounts at Albany International Airport, from 2000 to 2004 and 2010 to 2014.



NWS ALBANY PARTAKES IN LANDMARK 40TH ANNUAL NORTHEAST STORM CONFERENCE

Evan L. Heller
Meteorologist, NWS Albany

The 40th Annual Northeast Storm Conference was held March 6-8, 2015 at the Holiday Inn in Saratoga Springs, and was sponsored by Lyndon State College in Vermont, and the American Meteorological Society. This event marked a return to the venue, and the City of Saratoga Springs, after a 4-year hiatus. Last year's conference was held in Rutland, Vermont. Attendees this year numbered in the hundreds, mostly students and faculty representing numerous colleges in the northeast with atmospheric science curriculums, including SUNY Albany. There were also participants from various National Weather Service Offices, and a number of scientific corporations and media outlets. There were more than 50 presentations over this weekend-long event, including several from our office.

Jim Cantore of The Weather Channel was the Keynote Speaker for the Friday night opener which was followed by an ice cream social and refreshments. Saturday was the big day as things kicked off at 8 a.m. Coinciding presentations in two adjacent rooms offered attendees a choice of two at any given time throughout the weekend. Most of this day's presentations were 15 minutes in length, with breaks including an hour for lunch, during which was held a lunch banquet featuring another Keynote Speaker, Thomas Bogdan, of the University Corporation for Atmospheric Research. The vast majority of the day's talks were presented by students or faculty of the various colleges and universities in attendance, including several by SUNY Albany, and even a high school.

Poster presentations were held in the middle of the day's events, where attendees could get more personalized information from the authors/presenters. NWS Albany presented two posters. Representing our office, Luigi Meccariello revealed his poster "Storm-Scale Diagnostics of the EF-2 29 May 2013 and EF-3 22 May 2014 Schenectady County Tornadoes with Tornado Survey Analysis". Steve DiRienzo was also on hand to represent the poster he co-authored with our Service Hydrologist, Britt Westergard, entitled "The One Hundredth Anniversary of the Record Flood at Schenectady on the Mohawk River".

After the second of the day's two poster sessions, the presentations resumed. This was followed by a formal panel discussion session, providing an opportunity particularly for atmospheric science students to learn about career opportunities in meteorology. The six guest panelists represented a broad spectrum in the field of atmospheric sciences: television media; aviation; a scientific corporation; SUNY Albany, the military, and; the federal government. For the latter, our John Quinlan was on hand to answer questions pertaining to job opportunities within NOAA and the National Weather Service.

Saturday wrapped up with the annual evening banquet event at the hotel, which I was unfortunately unable to stick around for. This night featured Keynote Speaker Dr. Louis B. Uccellini, Director of The National Weather Service, and the topic was "8 Days a Week: Leading the National Weather Service & Tracking the Snow".

The conference came to a close on Sunday with more talks commencing inside the two rooms immediately after Paul Kocin, of NOAA's NWS Weather Prediction Center, opened the day with a lively and humorous presentation entitled "Northeast Snowstorms Volume 3: The 21st Century". The noontime session of presentations in the Win-Place-Show room was dominated by meteorologists from our local office. Hugh Johnson presented *A Look at Both Cold and Warm Season Mohawk-Hudson Convergence Events.* This was followed by Kevin S. Lipton with *Multi-Scale Analysis of the 22 May 2014 Supercell and EF3 Tornado at Eastern New York.* And wrapping things up for us was Thomas A. Wasula with *A Comparison of 2 Recent Anomalously Large Hail Events that Impacted the Albany Forecast Area.*

The conference ended shortly after 1 p.m. Special thanks needs to go out to the AMS and Lyndon State College for putting together yet another great event. All the presenters did a fine job. I personally found this year's event to be the most enjoyable Northeast Storm Conference yet. If you would like to view any or all of the abstracts from the conference, they are available at this link: http://www.lyndonams.com/agenda/4586518165.

SOME CHANGES TO OUR FIRE WEATHER PLAN

Hugh Johnson
Meteorologist, NWS Albany

I have been the Fire Weather Program Leader at our office for the past ten years. Each year, we have held conferences with our users prior to the start of the fire weather season, in an effort to improve our program. This year, our meeting was held on February 24th. At that meeting, we made a few changes to our program, including how we go about coordinating Fire Weather Watches and Red Flag Warnings.

The parameters for issuing a Red Flag Warning for our area remain the same. A Red Flag Warning is issued if there are 5 or more consecutive days with no significant rainfall, and if the relative humidity falls to under 30 percent for two or more consecutive hours in conjunction with wind gusts over 25 mph. Any Fire Weather Watches or Red Flag Warnings we issue must first be collaborated with our New York State liaison.

A Red Flag Warning means that any brush fires that break out might be difficult to contain, possibly growing very fast due to the gusty winds and dry conditions - a potentially very dangerous situation for fire fighters to deal with. Based on studies conducted by my Assistant Program Leader, Ian Lee, in collaboration with NOAA's Storm Prediction Center, we assigned a temperature threshold. We generally do not issue Red Flag Warnings at temperatures below 50° unless our fire weather experts believe a dangerous fire situation exists.

New for this year is that NWS Albany will be dealing primarily with our New York liaison while the Boston (Taunton) National Weather Service Forecast Office will directly deal with the liaison officials from our neighbors in Connecticut and Massachusetts. Meanwhile, NWSFO Burlington will deal with the liaison official for Vermont.

We will still be collaborating with all the offices, and voicing any concerns we may have. Also, we will be emailing our New York state liaison, who will inform all our New York county emergency and law enforcement officers when we feel there is a good chance of having a Critical Fire Day (potential Red Flag Warning) in the days to come.

Our Annual Operating Plan (AOP), available to all of our fire weather users, can be found on our webpage at: http://www.weather.gov/aly/EMfire. It contains the guidance and policy that describes how we conduct our Fire Weather protocol. The plan is expected to be updated in the weeks to come.

Our fire weather season has already begun, and it is tied into the fire ban in New York State. The season will continue into early fall though the fire ban will end May 14th (after green-up). If you have any suggestions about how to improve our products, please do not hesitate to contact either myself at Hugh.W.Johnson@noaa.gov, or Ian at Ian.Lee@noaa.gov.

WEATHER *ESSENTIALS*

With Kevin S. Lipton

COMPUTER MODELS AND WEATHER FORECASTING

In previous articles, we discussed the basics of meteorology, including how to interpret weather maps. We also looked at some of the properties of the atmosphere. The atmosphere is quite complex, and provides us with a huge amount of observational data of many variables – from the ground level right up through the troposphere and lower stratosphere. In order to be able to process all this data and use it to predict a future state of the atmosphere, the use of computers has become a requirement. In this installment of Weather Essentials, we discuss the basics of atmospheric computer models, and how they are used to assist meteorologists with developing weather forecasts.

Essentially, a computer model is a mathematical representation of the atmosphere at a given time. This mathematical representation consists of many complex equations, the basics of which are shown in Figure 1. These equations have many variables included within them which represent such atmospheric parameters as wind, pressure, temperature and water vapor concentration. The computer models process these equations in order to develop forecasts for all these parameters. Of course, predicting these parameters accurately relies on having accurate initial values. These initial values come from all the observational data that's available – including rawinsonde data (from weather balloons), surface observations, and radar and satellite data, just to name a few. In creating forecasts, tens of millions of computations are performed each second using the large amount of observational data.

Computer models represent the atmosphere via data points over a 3-dimensional grid. The closer these grid points are to one another horizontally and/or vertically within a grid, the higher the resolution of the model. Higher resolution models, in theory, should be able to more accurately depict smaller-scale atmospheric features such as fronts, or bands of precipitation within a storm. Higher resolution models are useful for forecasting the state of the atmosphere over shorter periods of time, and also over smaller regional areas. They also require greater computational power than lower resolution models. On the other hand, lower resolution models tend to be very useful in forecasting the state of the atmosphere over a larger area, such as across the globe, and also over a longer period of time.

Forecasts generated by computer models are only as accurate as the observational data (input) and predictive equations (numerical computer models) allow them to be. Errors can be introduced via: inaccurate or missing observations; failure of the models to resolve smaller-scale convection, boundaries and/or banding features associated with a storm system, or; imprecise first approximations factored into equations. These errors tend to grow with time, so that small errors in the observational data could end up having a huge negative impact on the predictability of important things such as the track and intensity of a potential storm system. The National Weather Service has many different numerical computer models, most of which are run through the National Centers for Environmental Prediction (NCEP). Atmospheric computer models are also produced by weather agencies and academic institutions throughout the world.

It should be emphasized that computer models are intended for use only as tools to assist meteorologists in predicting the future state of the atmosphere. They are guidance – not to be used for predicting a definite solution. Meteorologists, through education and experience, develop knowledge of the strengths and weaknesses associated with the various computer models. They look at historical atmospheric patterns, or analogs, to help determine whether a particular computer model may be more useful than another. And – perhaps most importantly – experienced meteorologists will first examine observational data, and only then assess whether a particular computer model is accurately representing the atmosphere. If it is not – he or she will likely shy away from that solution, because the forecast would likely also not be accurate.

So, as you can see, given the great complexity of the atmosphere, trying to determine its state at some point in the future requires computer models, but they must be used in conjunction with the education and experience of a meteorologist.

Wind Forecast Equations

1a. $$\frac{\partial u}{\partial t} = -u\frac{\partial u}{\partial x} - v\frac{\partial u}{\partial y} - \omega\frac{\partial u}{\partial p} + fv - g\frac{\partial z}{\partial x} + F_x$$

1b. $$\frac{\partial v}{\partial t} = -u\frac{\partial v}{\partial x} - v\frac{\partial v}{\partial y} - \omega\frac{\partial v}{\partial p} - fu - g\frac{\partial z}{\partial y} + F_y$$

Continuity Equation

2. $$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial \omega}{\partial p} = 0$$

Temperature Forecast Equation

3. $$\frac{\partial T}{\partial t} = -u\frac{\partial T}{\partial x} - v\frac{\partial T}{\partial y} - \omega\left(\frac{\partial T}{\partial p} - \frac{RT}{c_p p}\right) + \frac{H}{c_p}$$

Moisture Forecast Equation

4. $$\frac{\partial q}{\partial t} = -u\frac{\partial q}{\partial x} - v\frac{\partial q}{\partial y} - \omega\frac{\partial q}{\partial p} + E - P$$

Hydrostatic Equation

5. $$\frac{\partial z}{\partial p} = -\frac{RT}{pg}$$

Figure 1. Basic Equations of the Atmosphere. **Courtesy of COMET/UCAR MetEd course "Impact of Model Structure and Dynamics."**

From the Editor's Desk

We are at the end of one of our coldest late winters. For many of us, including myself, it couldn't have come soon enough. But as we experience the first full week of astronomical spring, it seems there still isn't expected to be a great deal of spring in the air. Hopefully, this cycle will change, and we get the warm-up we deserve. Our first article rehashes the entire winter season, while our second article deals with our snow pattern changes, with special focus on the past 15 years. Then we talk about the Northeast Storm Conference just held in Saratoga Springs, and changes to our local fire weather plan. Kevin Lipton's Weather Essentials feature talks about how computer models are used in forecasting. A special thanks to this issue's contributors! Enjoy the warming season!

WCM Words

Steve DiRienzo
Warning Coordination Meteorologist, NWS Albany

The National Weather Service office in Albany will present summer/severe weather SKYWARN® training to the public in April and May of 2015 for those who want to be weather spotters. The schedule of dates and times can be found on our web page at weather.gov/aly, or directly at http://cstar.cestm.albany.edu:7775/skywarn/Talks.htm.

To obtain critical weather information, NOAA's National Weather Service (NWS), part of the U.S. Department of Commerce, established SKYWARN® with partner organizations. SKYWARN® is a volunteer program with nearly 290,000 trained severe weather spotters across the country. These volunteers help keep their local communities safe by providing timely and accurate reports of severe weather to the National Weather Service.

Although SKYWARN® spotters provide essential information for all types of weather hazards, the main responsibility of a SKYWARN® spotter in the summer is to identify and describe severe local storms, flash flooding and damage from the storms.

If you plan to attend one of the training sessions, please register at http://cstar.cestm.albany.edu:7775/skywarn/Register.htm. If you have any questions about the SKYWARN® program, please contact me at the email below. We hope to see you in the upcoming weeks.

Here at the National Weather Service, we strive to be the source of unbiased, reliable and consistent weather information. We're here to answer your weather and water questions 24 hours a day, 7 days a week. If you have concerns, please call us. If you have comments on Northeastern StormBuster, or any of the operations of the National Weather Service, please let me know at Stephen.Dirienzo@noaa.gov.