NORTHEASTERN STORM BUSTER

SKYWARN

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Evan L. Heller, Editor
Steve DiRienzo, WCM/Contributor
Ingrid Amberger, Webmistress

FEATURES

DEPARTMENTS

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 and/or climatology. Original content contained herein may be reproduced only when the National Weather Service Forecast Office at Albany, and any applicable authorship, is credited as the source.

THE ROLE OF METEOROLOGY IN PRESCRIBED BURNS

Ian Lee
Meteorologist, NWS Albany

Hugh Johnson
Meteorologist, NWS Albany

Each year, several entities participate in prescribed burns across the NWS Albany Forecast Area. These prescribed burns are conducted as a means of controlling the ecosystem of a particular area, to preserve historically or culturally significant areas, or simply as training exercises. Despite its destructive nature, fire can actually introduce nutrients back into an ecosystem that may have been previously depleted of them, allowing for renewed plant growth. A famous example of fire helping an ecosystem occurred in Yellowstone National Park in 1988, when hundreds of thousands of acres of the pristine park burned. Twenty-five years later, plants and wildlife are flourishing amidst a revitalized ecosystem.

Locally, Saratoga National Historical Park (NHP), located in Saratoga County, New York, performs prescribed burns annually to preserve or restore the historical landscape of one of the most important battles of the American Revolution. On September 6, 2013, NWS Albany was allowed to participate in one of these prescribed burns in order to study how meteorology affects fire behavior. This was a good opportunity to find out what our fire community specifically needs and wants from our office when doing these burns.

The location of the burn was to be near the Nielson House site on a calm and sunny day, with a focus on the parameters of temperature, relative humidity, wind direction, wind speed, 1-hr fuel moisture and 10-hr fuel moisture. The fuel moisture categories (1-hr and 10-hr) refer to the time it takes for a fuel to adapt to current atmospheric conditions. Thus, 1-hr fuels (i.e. grass) take less time to adapt to current atmospheric conditions than a 10-hr, or even a 1000-hr, fuel would.

To help with prescribed burns, NWS Albany issues Spot Forecasts - local fire weather-tailored forecasts that predict temperature, winds and humidity. These forecasts are utilized during critical situations such as hazmat incidents. Relative humidity and wind speed are the most important meteorological variables when it comes to fire weather. The relative humidity plays an important role in regulating fuel moisture, with ideal values being in the 30-40% range. Prescribed burns can also not be started unless the morning dew has completely evaporated. A light wind speed (3-6 mph) is optimal for a burn, as this allows the fire and smoke to move, promoting good ventilation. A light breeze also promotes a hotter fire that helps kill wooded vegetation and damages the root system, thereby eliminating any exposed material from contributing to a potential future fire. A slow-moving, creeping fire allows for vegetation to be completely burned, while strong winds would promote faster, more expansive burning, though at an uncontrollable pace. Temperature also plays a key role in fire behavior. Colder temperatures promote more of a ground fire, while warmer temperatures promote flame growth. Although fires are still possible with temperatures as low as 28º F, they will not explosively burn, as the cold, stably-stratified air serves to suppress flame growth.

Static stability, or the resistance against the air to move, is also a major factor in fire behavior. Direct sunlight is preferred, as it promotes mixing, enabling vegetation to reach much warmer temperatures. This helps to speed up drying of the vegetation. Surprisingly, the sun angle is another contributing factor. The sun angle determines the amount of time available to do a prescribed burn, mainly because low sun angles slow the drop in relative humidity. This makes it more difficult to effectively burn. Low sun angles also increase shadows, which will not allow a fire to burn as efficiently. Fuel type also plays a large role in fire weather. The type of forest or vegetative cover can determine whether explosive fire behavior is possible. For example, forests dominated by hardwoods are less likely to burn than a forest consisting of mainly evergreens simply because of the differences in their root systems and water capacities. Dead trees, regardless of species, can easily promote fire growth. For this prescribed burn, the main fuel type was live grass. The stage of vegetation reached is also critical, as fire behavior can vary greatly based on this factor regardless of whether the vegetation is dormant.

By the early afternoon, all of the favorable meteorological variables were in place. Temperatures had warmed to nearly 70º F, winds were 3-7 mph, and humidity values were around 40%. Despite these conditions, a fire could not be started as the fuel moisture had remained too high. The fuel (grass) was also too “green”, with very little cured fuels available, hindering ignition. The long-term soil moisture anomaly was also high, helping to keep the fuel moisture high. Perhaps if the winds had been a little stronger in the morning, the dew might have evaporated quicker, helping the fuel moisture to lower, and thus increasing the burn potential. Regardless of the outcome, prescribed burns such as the one that was attempted at the Saratoga NHP on September 6 show how crucial a role meteorology plays in fire behavior.

Fire personnel taking weather observations during the prescribed burn.□

VOLCANIC EFFECTS ON GLOBAL CLIMATE

Kevin S. Lipton
Meteorologist, NWS Albany, NY

Snowflakes falling in Albany, New York during early June; hard freezes killing crops across the higher elevations of western New England during June, July and August; ice cover lingering on some rivers and ponds into the summer months; these were just some of the features of "The Year Without a Summer" in 1816 across the northeast U.S. It is believed that this unusually cold summer was largely due to the effects of a tremendous volcanic eruption that occurred in April of 1815 near Indonesia. This volcano (named Tambora) is believed to be the largest-known historic eruption, and it had significant global effects. It's estimated that the stratospheric aerosol cloud produced by this eruption led to a peak global surface cooling of nearly 2° F. How can a volcanic eruption have impacts on climate literally around the globe? Contrary to popular belief, the global cooling effect is not simply due to the shadowing effects from the ash cloud emitted by a volcano. Rather, it's largely dependent on how much sulfur dioxide (SO_2) gas is contained within its plume, and how high this sulfur-rich plume extends into the atmosphere. The particles within the ash cloud are relatively large, and tend to fall out over a period of a few weeks. So, although this may lead to local or regional cooling effects, by the time the ash cloud expands to a larger area, most of the particles have usually fallen out of the atmosphere, and the ash cloud has dispersed. However, when sulfur dioxide from the eruption reaches high into the atmosphere – into the layer known as the stratosphere - chemical reactions between the sulfur dioxide and water vapor create sulfate aerosols. These sulfate aerosols can then form into a reflective haze layer approximately 12 or more miles above the earth's surface, which can then spread via wind currents across the globe. This haze layer tends to reflect incoming energy from the sun, limiting the sun's full warming potential at the earth's surface and lower atmosphere, and resulting in a cooling effect.

Just how much cooling can occur from a volcanic eruption? As mentioned above, the cooling effect from the 1815 Tambora eruption led to an estimated peak surface cooling of nearly 2° F. In more recent times, the 1991 eruption of Mount Pinatubo in the Philippines led to an estimated peak surface cooling of around 1° F. The Pinatubo eruption was actually much smaller relative to the cataclysmic Tambora eruption, but still ejected enough sulfur dioxide into the stratosphere to allow for global surface cooling. A sudden drop in earth's average temperature, even of less than 1° F over a period of several months to a year, can still have profound effects on overall circulation patterns and weather. Perhaps some of the extreme weather events observed during the early to mid 1990's, including the October 1991 "Perfect Storm," the March 1993 "Superstorm", and the extreme northeast winter of 1993-94 could, at least in part, be attributed to the shock to the climate system produced by the sudden cooling from Mount Pinatubo's May-June 1991 eruption.

Recent research suggests that where a volcano erupts relative to its distance from the equator can create different patterns of cooling, and warming, too, within several years following an eruption. For instance, recent studies indicate that large volcanic eruptions which occur in tropical regions (low latitudes) tend to lead to significant cooling of Northern Hemisphere continents in the summer months following the eruption, yet actually are associated with winter warming of these continents for two years after the eruption. Such patterns were observed after the May-June 1991 Pinatubo eruption, as large portions of North America and western Europe experienced unusually warm winters in 1991-92 and 1992-93, with a very cold summer in 1992. Computer simulations of this and similar tropical eruptions are consistent with these observations. It is speculated that a change in atmospheric circulation patterns, particularly the Artic Oscillation (AO), may have lead to the observed winter warming, with the pattern favoring a positive phase of the AO. This would tend to limit the southward extent of cold air intrusions during the winter months, and would also allow for the frequent infusion of relatively warm oceanic air from the Pacific Ocean in North America, and the Atlantic Ocean in Europe, keeping these continental areas somewhat warm. However, the occasional warming of oceanic temperatures across the central and eastern equatorial Pacific Ocean, known as El Niño, also occurred during these winter months, so it is possible that the observed warming effects could have been amplified by this additional oceanic warming effect. The correlation with higher-latitude volcanic eruptions – those which occur closer to the Arctic regions – is somewhat weaker, as indicated by computer simulations. However, some computer simulations do suggest a reduction in the southeast Asian summer monsoon with higher-latitude eruptions.

It should be noted that another phenomena associated with large sulfur dioxide injections into the stratosphere from volcanic eruptions also occurs – increased stratospheric ozone loss. A reduction in the concentration of ozone (O_3) levels in the stratosphere occurs as the sulfate aerosol cloud resulting from the volcanic injection of sulfur dioxide increases ozone-depleting chemical processes in this layer of the atmosphere. This tends to lead to an increase in the areal extent of the polar “ozone hole” for a couple of years after such an eruption.

So, as you can see, large volcanic eruptions can have significant effects on the global climate. However, in order for this to occur, they must inject large amounts of sulfur dioxide high into the atmospheric layer known as the stratosphere. This can create a sulfate aerosol cloud within a few weeks to months after such an eruption, which can then spread across the globe, reflecting incoming solar energy, and leading to cooling temperatures at the earth’s surface and lower atmosphere. This can also alter circulation patterns in the lower atmosphere, leading to unusual weather patterns and temperature anomalies. The most important aspect of a volcanic eruption is the concentration of sulfur dioxide emitted, and how high into the atmosphere a plume of it can reach. Thick ash clouds with only limited sulfur dioxide gases can lead to temporary cooling on local to regional scales, but the ash tends to fall out of the atmosphere within weeks, therefore reducing its effect on cooling the earth’s surface on a global scale. On the other hand, the sulfate haze from a sulfur-rich plume can remain in the stratosphere for 2 to 4 years after an eruption, and therefore has a much greater capacity to influence the earth’s climate, for several years.□

SUMMER 2013: MUCH WETTER THAN NORMAL

Evan L. Heller
Climatologist, NWS Albany

During the Summer of 2013…June was wet, July was hot and August was pretty close to normal in Albany (Table 1). With temperatures very close to normal in June as well, the summer as a whole wasn’t that far from normal…just 1.3º above. Precipitation was another story, though. Right off the bat, June received more than twice the normal rainfall for the month, and July was also more than an inch above normal. While things eventually turned around, and August recorded a deficit, the Summer of 2013 still managed to eke out a spot in the Top 10 for wet summers…at #7 (Table 3d).

There were some notable highlights during this past summer. We had a mini heat wave in June followed by a bigger heat wave in July (Table 2b). There were thirteen 90 degree event days, higher than the seasonal normal of about 10. There were 2 days, both in July, where the mean temperature was 85 degrees or more. On the precipitation end of things, there were four days with over an inch of rainfall.

All the daily and monthly temperature records for the season in Albany were tied or set in July. There were four daily high minimum records and two daily high mean records, but no maximum temperature records (Table 3b). At a monthly mean temperature of 75.9º, July 2013 ended up in a 3-way tie for 13th-hottest month of all time, and it was tied with 1880 for 4th hottest July on record. But as wet as the season was, there was only one daily maximum precipitation record set when 1.55” fell on June 13th (Table 3a). Indeed it was a wet month; July 2013, with its 8.68” of precipitation, wound up in 3rd place for wettest Julys, and; it was the 16th-wettest month of all-time. Daily wind records spanned the three months, totaling six, with August recording half of these (Tables 3a-c).

Measureable rainfall occurred on easily a third of the days of summer (Table 2a). In June alone, there were 8 days with at least a half inch of precipitation. June was also an active month for thunderstorms, having occurred in Albany on nine separate dates (Table 4a). July was the month with the highest recorded daily maximum, mean, and highest minimum temperatures, while June recorded the lowest daily minimum, mean, and lowest maximum temperatures (Table 1). The maximum precipitation date of summer…June 28th…happened to fall short of breaking the record for the date.

THE STATS

	JUN	JUL	AUG	SEASON
Avg. High/Dep. From Norm.	77.2°/-0.7°	85.0°/+2.7°	80.0°/-0.4°	80.7°/+0.5°
Avg. Low/Dep. From Norm.	58.0°/+1.5°	66.8°/+5.4°	59.3°/-0.6°	61.4°/+2.1°
Mean/ Dep. From Norm.	**67.6°/+0.4°**	**75.9°/+4.1°**	**69.6°/-0.5°**	**71.0°/+1.3°**
High Daily Mean/date	80.5°/23rd	85.5°/18th	77.5°/8th	
Low Daily Mean/date	55.0°/13th	63.0°/25th	62.5°/14th & 15th	
Highest reading/date	92°/24th	96°/19th	88°/21st	
Lowest reading/date	46°/5th	53°/25th	50°/15th & 25th	
Lowest Max reading/date	58°/7th	73°/25th	71°/14th	
Highest Min reading/date	70°/23rd & 26th	77°/18th	70°/8th	
Ttl. Precip./Dep. Fm. Nrm.	**8.68”/+4.89”**	**5.39”/+1.27”**	**2.70”/-0.76”**	**16.77”/+5.40”**
Ttl. Snowfall/Dep. Fm.Nrm.	**0.0”/-**	**0.0”/-**	**0.0”/-**	**0.0”/-**
Maximum Precip./date	1.77”/28th	1.40”/8th	1.21”/13th	
Maximum Snowfall/date	-	-	-	

Table 1

NORMALS, OBSERVED DAYS & DATES

NORMALS & OBS. DAYS	JUN	JUL	AUG	SEASON
NORMALS				
High	77.9°	82.3°	80.4°	80.2°
Low	56.5°	61.4°	59.9°	59.3°
Mean	**67.2°**	**71.8°**	**70.1°**	**69.7°**
Precipitation	**3.79”**	**4.12”**	**3.46”**	**11.37”**
Snow	**0.0”**	**0.0”**	**0.0”**	**0.0”**
OBS TEMP. DAYS				
High 90° or above	4	9	0	13/92
Low 70° or above	2	15	1	18/92
High 32° or below	0	0	0	0/92
Low 32° or below	0	0	0	0/92
Low 0° or below	0	0	0	0/92
OBS. PRECIP DAYS				
Days T+	19	17	11	47/92/51%
Days 0.01”+	14	9	8	31/92/34%
Days 0.10”+	13	7	5	25/92/27%
Days 0.25”+	9	6	3	18/92/20%
Days 0.50”+	8	5	2	15/92/16%
Days 1.00”+	2	1	1	4/92/4%

Table 2a

NOTABLE TEMP, PRECIP & SNOW DATES	JUN	JUL	AUG
90º+ Event	1st (90º)	4th (91º)	-
90º+ Event	23rd (91º)	5th (90º)	-
90º+ Event	24th (92º)	7th (91º)	-
90º+ Event	25th (91º)	14th (90º)	-
90º+ Event	-	15th (91º)	-
90º+ Event	-	16th (92º)	-
90º+ Event	-	17th (94º)	-
90º+ Event	-	18th (94º)	-
90º+ Event	-	19th (96º)	-
Hot Day (Mean 84.5º+)	-	18th (85.5º)	-
Hot Day (Mean 84.5º+)	-	19th (85.0º)	-
Heat Wave (High 90º+/3+ days)	23rd-25th (3 days)	14th-19th (6 days)	-
1.00”+ value/date	1.55”/13th	1.40”/8th	1.21”/13th
1.00”+ value/date	1.77”/28th	-	-

Table 2b

RECORDS

ELEMENT	JUNE	
Daily Max. Precipitation Value/Date | Previous Record/Year	1.55”/13th	1.48”/1898
Top Ten Wettest Junes Value/Rank | Remarks	8.68”/#3	-
200 All-Time Wettest Months Value/Rank | Remarks	8.68”/#16	-
Daily Max. Wind Speed Value/Dir./Date | Prev. Rec./Dir/Year	52 mph/W/17th	39 mph/S/1989
Daily Max. Wind Speed Value/Dir./Date | Prev. Rec./Dir/Year	38 mph/S/28th	33 mph/S/2008

Table 3a

ELEMENT	JULY	
Daily High Min. Temp. Value/Date | Previous Record/Year	74°/3rd	73°/1911
Daily High Min. Temp. Value/Date | Previous Record/Year	73°/15th	73°/1901
Daily High Min. Temp. Value/Date | Previous Record/Year	77°/18th	75°/2005
Daily High Min. Temp. Value/Date | Previous Record/Year	74°/19th	74°/1930
Daily High Mean Temp. Value/Date | Previous Record/Year	85.5°/18th	85.5°/1905 (tie)
Daily High Mean Temp. Value/Date | Previous Record/Year	83.5°/19th	83.5°/1964
200 All-Time Hottest Months Value/Rank | Remarks	75.9°/#13	3-way tie
Top Ten Mean Minimum Julys Value/Rank | Remarks	66.8°/#4	Tie with 1880
Daily Max. Wind Speed Value/Dir./Date | Prev. Rec./Dir/Year	38 mph/NW/19th	34 mph/NW/1996

Table 3b

ELEMENT	AUGUST	
Daily Max. Wind Speed Value/Dir./Date | Prev. Rec./Dir/Year	32 mph/W/4th	31 mph/ NW/2007
Daily Max. Wind Speed Value/Dir./Date | Prev. Rec./Dir/Year	28 mph/S/7th	28 mph/W/2009
Daily Max. Wind Speed Value/Dir./Date | Prev. Rec./Dir/Year	33 mph/NW/10th	26 mph/NW/2001

Table 3c

ELEMENT	SUMMER	
Top Ten Wettest Summers Value/Rank | Remarks	16.77”/#7	-

Table 3d

MISCELLANEOUS

JUNE

Avg. wind speed/Dep. Fm. Norm.	5.7 mph/-1.7 mph
Peak wind/direction/date	52 mph/W/17th
Windiest day avg. value/date	17.7 mph/14th
Calmest day avg. value/date	0.9 mph/10th
# Clear days	5
# Partly Cloudy days	18
# Cloudy days	7
Dense fog dates (code 2)	None
Thunder dates (code 3)	1st, 2nd, 17th, 24th, 25th, 27th, 28th, 29th & 30th
Sleet dates (code 4)	None
Hail dates (code 5)	None
Freezing rain dates (code 6)	None

Table 4a

JULY

Avg. wind speed/Dep. Fm. Norm.	5.3 mph/-1.5 mph
Peak wind/direction/date	38 mph/NW/19th
Windiest day avg. value/date	10.2 mph/24th
Calmest day avg. value/date	2.3 mph/13th & 14th
# Clear days	1
# Partly Cloudy days	25
# Cloudy days	5
Dense fog dates (code 2)	9th & 27th
Thunder dates (code 3)	2nd, 7th, 8th, 10th & 28th
Sleet dates (code 4)	None
Hail dates (code 5)	None
Freezing rain dates (code 6)	None

Table 4b

AUGUST

Avg. wind speed/Dep. Fm. Norm.	5.3 mph/-0.9 mph
Peak wind/direction/date	36 mph/W/22nd
Windiest day avg. value/date	11.1 mph/8th
Calmest day avg. value/date	0.6 mph/18th
# Clear days	4
# Partly Cloudy days	21
# Cloudy days	6
Dense fog dates (code 2)	28th
Thunder dates (code 3)	4th, 9th, 22nd, 30th & 31st
Sleet dates (code 4)	None
Hail dates (code 5)	None
Freezing rain dates (code 6)	None

Table 4c

OWLIE SKYWARN WEATHER EDUCATION

Brian Montgomery
Senior Meteorologist, NWS Albany, NY

Students and educators are back in the classroom as another exciting school year is underway. The autumn season is upon us, and this time of year can be a challenge with drastic changes in the weather. With these changes, many students may wonder how weather happens. Perhaps an aspiring meteorologist in the classroom wishes to learn more about the weather world around us. Recently, the National Weather Service launched the updated Owlie Skywarn educational program.

Teaching the public about weather safety is a big part of what your National Weather Service does, and is a major component in building a Weather Ready Nation. During the past year, NWS's **Owlie Skywarn** has been refreshed, and you can visit the Young Meteorologist Program website to play a game related to weather safety. Simply go to: http://www.youngmeteorologist.org/.

As part of National Preparedness Month (September), the national NWS Outreach team launched Owlie Skywarn on Facebook and Twitter. The focus will be on safety messaging, but will also include educational posts featuring weather facts and fun activities. The primary audience for Owlie's page is students ranging in age from pre-school to high school.

If you are interested in a tour of our Albany National Weather Forecast Office, or would like one of our meteorologists to visit your classroom, please contact us at alb.stormreport@noaa.gov with several dates, times and any topics you would like to discuss.□

WEATHER ESSENTIALS

With Kevin S. Lipton

THE STRUCTURE OF THE EARTH'S ATMOSPHERE

As meteorologists, we discuss the weather, which is defined as the "current state of the atmosphere". But, exactly what is the "atmosphere", and what part of the atmosphere are we most concerned with as meteorologists when it comes to observed and predicted weather? This series of articles will explain some of the attributes of the "atmosphere" – the envelope of gas surrounding the earth which is held in place by the earth's gravity. We will start with a basic understanding of the structure of the atmosphere.

There are essentially five layers of the earth's atmosphere, each containing distinct characteristics of temperature, density, currents and chemical composition. We will start with the lowest atmospheric layer, the one with which we are most familiar – the troposphere. This layer is where most of the "weather" that we all know and love occurs. It starts at the ground (including the air we breathe), and extends upward to an altitude ranging from approximately 4 miles high at the poles, to nearly 12 miles high at the equator. Why is there such a difference in the thickness of this layer from the equator to the Polar Regions? You may have guessed it – temperature differences. At the equator, where much warmer temperatures occur within the lowest levels of the troposphere, this layer expands due to the added warmth, with the help of deep air currents. Meanwhile, at Polar Regions, the lower levels of the troposphere are colder, and the overall thickness of the troposphere is much less. Another feature of the troposphere is that the density of the gases within this layer decreases with height due to decreasing pressure with height. As density decreases with height, temperature also decreases with height, as is well-demonstrated when you climb a mountain. On average, temperatures within the troposphere fall at an approximate rate of 3.5° F per 1,000 feet of increasing altitude. This is merely an average, however, as this temperature change is actually quite variable – it largely depends on the amount of moisture in the air. Dry air cools slightly quicker with increasing height – at an approximate rate of 5.5° F per 1,000 feet, while saturated air cools more slowly, at around 3° F per 1,000 feet. Oddly enough, the temperatures at the top of the troposphere are actually coldest near the equator. This is because the top of the troposphere is higher at the equator compared to Polar Regions and thus contains air of even lower density, and therefore colder temperatures.

The next atmospheric layer above the troposphere is the stratosphere. The transition zone between these two layers is known as the tropopause. The stratosphere begins at the top of this transition zone, located approximately between 4 and 12 miles above the earth's surface, and extends up to an altitude of around 31 miles. Water vapor is quite scarce in this layer. Also, temperatures within this atmospheric layer increase with height, from nearly -60° F at the bottom, to as warm as +5° F near the top. The reason for this warming is that certain gases within this layer absorb incoming solar radiation related to the process of forming the infamous ozone layer. Unlike within the troposphere, the <u>increasing</u> temperatures with increasing altitude within the stratosphere greatly limit the vertical movement of the gases within this layer. This combination of little vertical movement of air currents, and extremely scarce moisture, limit much observable "weather" in this layer.

Above the stratosphere is the third layer, called the mesosphere. The transition zone between the top of the stratosphere and the lower portion of the mesosphere is the stratopause. The mesosphere extends from nearly 31 miles above to nearly 53 miles above the earth's surface. Within the mesosphere, temperatures fall sharply with increasing height once again, as within the troposphere, with temperatures at the bottom of the layer near +5° F cooling to nearly -185°F toward the top! However, the lack of moisture and the overall low density of gases once again adds little to what we observe as "weather." Meteors often burn up within the mesosphere since the gases are still dense enough to slow their downward descent, creating friction and leaving long, burning trails behind which we observe on earth as "falling stars". It should also be noted that in atmospheric science, both the mesosphere and stratosphere are commonly referred to as the "middle atmosphere".

The fourth layer of the atmosphere is called the thermosphere, with the transition zone beneath called the mesopause. The thermosphere extends from an altitude of approximately 53 miles to nearly 375 miles above the earth's surface. Within the thermosphere, the density of gases becomes very thin. However, the gases that are present tend to absorb incoming, high-energy radiation such as ultraviolet and x-ray from the sun, thereby heating the upper levels of this layer. So, similar to what occurs in the stratosphere, temperatures increase with increasing altitude, from nearly -185° F near the bottom of the layer, to as high as 3,600° F near the top! Within this layer, the interaction of gases with high-energy incoming radiation also produces the phenomena known as the aurora borealis, or northern lights (aurora australis/southern lights in the southern hemisphere)!

Finally, the top-most layer of the atmosphere is known as the exosphere, with the transition zone at its bottom known as the thermopause. This layer lies from nearly 375 to over 6,200 miles above the earth's surface. Due to greatly limited gravitational forces at this altitude, atmospheric pressure is extremely low, and atoms and molecules are very far apart and can escape out to space. Satellites orbit the earth within this layer.

So, as you can see, the atmosphere consists of several layers. Although each layer has its own unique characteristics and associated phenomena, the one layer in which we tend to be most concerned with as operational meteorologists is the troposphere – sometimes referred to as the "weather layer". This is not to say that other layers don't contribute to observable weather. In fact, the layer right above the troposphere – the stratosphere - can still have impacts on weather. There is increasing evidence that currents and temperature changes within portions of the stratosphere can affect air currents and circulation patterns in the troposphere. In addition, the eruption of some volcanoes can eject large amounts of sulfur-rich particles into the stratosphere, which, through chemical reactions, can then turn into sulfur aerosols and form a reflective haze within the stratosphere that can block some of the incoming solar radiation from reaching the earth's surface and lower troposphere, consequently leading to tropospheric cooling. This cooling phenemona was quite noticeable for several years after the 1991 eruption of Mount Pinatubo in the Philippines, which resulted in an average global surface cooling of nearly 1° F over the subsequent 2 years.

The figure below represents a graphical depiction of the earth's atmosphere, as well as the different layers and some of their notable features. Despite the troposphere being the main layer involved in everyday weather, as you can see, each layer has its own fascinating phenomena, and all these layers combined help to protect our planet and keep it a habitable place for us to live.

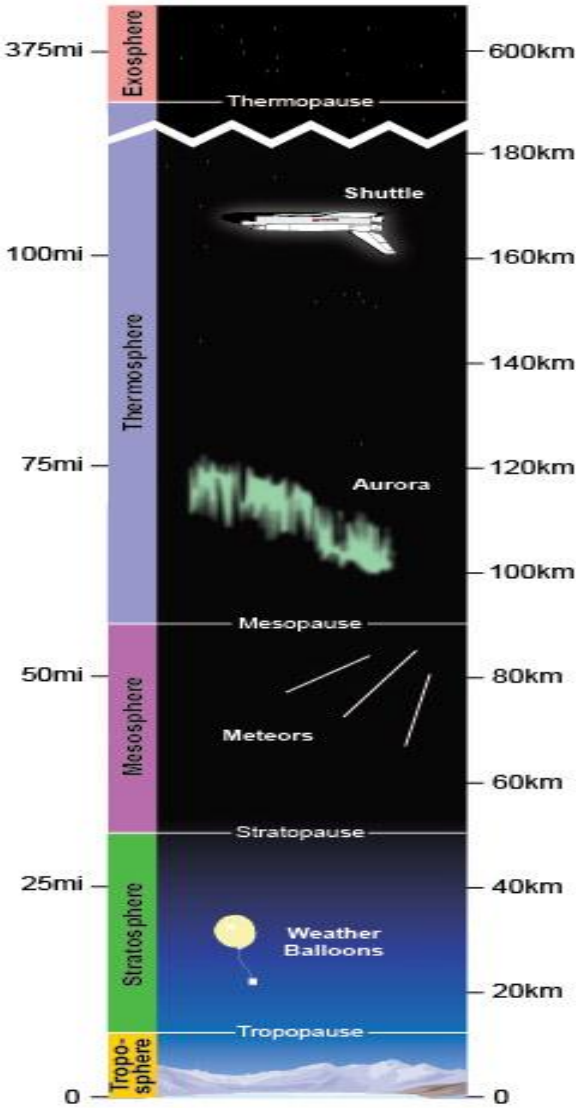

Figure 1. Atmospheric Layers and some of their associated phenomena. Altitude in miles is indicated on the far left. From NWS Jetstream – Online School for Weather.

From the Editor's Desk

This season's issue offers some interesting reading, opening with a look into the aspects of fire weather and prescribed burns. Then we move more into the climatological realm with an article on the impacts of volcanoes, followed by our local stats for the past summer. Then we round out the features with an introduction to our Owlie Skywarn educational program.

Beginning with this issue, we have a new department to introduce to you. Each issue, Kevin Lipton will be presenting *Weather Essentials*. These articles will provide an educational and informative look at some aspect of the weather. With this issue's debut article, he talks about the structure of the atmosphere.

The cool down has begun. The autumnal equinox is just hours away as I type this. Before you know it, we'll be back with more fine reading. Until then, enjoy the season.□

WCM Words

Steve DiRienzo
Warning Coordination Meteorologist, NWS Albany

As we transition out of summer into fall, and the leaves begin to change color, the National Weather Service (NWS) in Albany starts to see an increase in the number of questions from people interested in what the winter will be like. With winter in this part of the world usually cold, and often long, it makes sense to plan for the inevitable cold, snow and dreary days.

The NWS Climate Prediction Center (CPC) is the branch of our organization that issues the official forecasts for winter. The CPC forecasts, including monthly and seasonal outlooks and corresponding discussions can be found at:

http://www.cpc.ncep.noaa.gov/ and

http://www.cpc.ncep.noaa.gov/products/predictions/90day/

The CPC will issue an "Initial" winter outlook around the third week of October. Their "Official" winter outlook is expected around the third week of November. So, if you are curious about what the upcoming winter will be like, you can check the CPC web pages and keep up with their latest forecasts.

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 StormBuster, or any of the operations of the National Weather Service, please let me know at Stephen.Dirienzo@noaa.gov.□