NOAA's National Weather Service

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The Lake Breeze

The Newsletter of the Buffalo Forecast Office

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The Effect of Wind Power Farms on the Weather Radar

Wind power is a lot more than a gentle breeze that causes trees to sway or waves to move across a lake. We all know that the power in the wind can blow a semi tractor-trailer truck off the road and flatten buildings. However, it can also be harnessed to be a non-polluting, never-ending source of energy to meet electric power needs around the world.

Wind power is converted to electricity by a wind turbine. In a typical, modern, large-scale wind turbine, the kinetic energy in the wind (the energy of moving air molecules) is converted to rotational motion by the rotor - typically a three-bladed assembly at the front of the wind turbine. The turbine eventually sends this energy to a generator that converts the rotational movement into electricity.

Parts of western and northern New York provide excellent conditions for tapping the energy of the wind. An area between Watertown and Syracuse, known as the Tug Hill is in many respects the ideal location for New York's largest wind energy project. This site consists of approximately 12,000 acres at an average elevation of 1600-1800 feet. The Tug Hill plateau experiences strong lake-effect weather patterns and has long been known not only for tremendous snowfall but for its exceptional wind resource.

The Maple Ridge Wind Farm, located on Tug Hill is the largest alternative-energy project east of the Mississippi, The project will eventually consist of nearly 200 wind turbines, each stretching over 300 feet into the sky, covering approximately 12 miles of leased, privately-owned land.

Other projects completed or underway throughout upstate New York include the western portion of the state in rural Wyoming county and the Lake Erie shoreline south of Buffalo. Studies are also being conducted for additional wind farms in Jefferson county east of Lake Ontario. This move is all part of a White House Advanced Energy Initiative to have American wind farms produce 20% of the nation's electricity consumption.

The presence of the wind farms is not just apparent to those who live in the area. The large profile that several large wind turbines clustered together provides, may actually create interference or blockage of the signals emitted by weather radars located close by. As a result, the wind farms may produce an erroneous pattern on those weather radars.

According to an article entitled Impacts of Wind Farms on WSR-88D Operations and Policy Considerations "experience has shown that when wind farms are located close to weather radar systems, the turbine towers, rotating blades, and the wake turbulence induced by the blades negatively impact data quality and so degrade the performance of radar algo-

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Maple Ridge Wind Farm on the Tug Hill

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The Effect of Wind Power Farms on the Weather Radar (cont.)

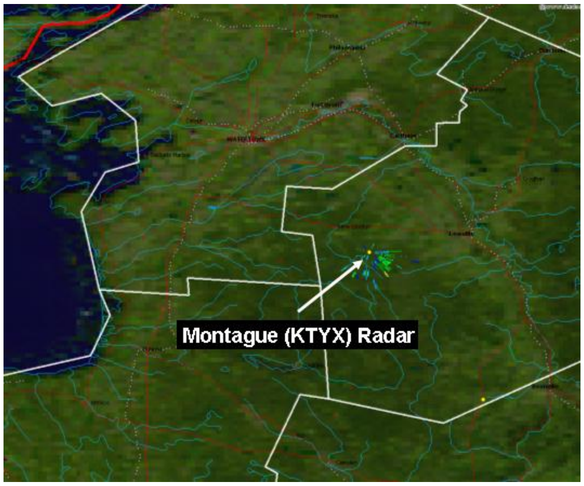

Figure 1. Montague Radar before wind farm

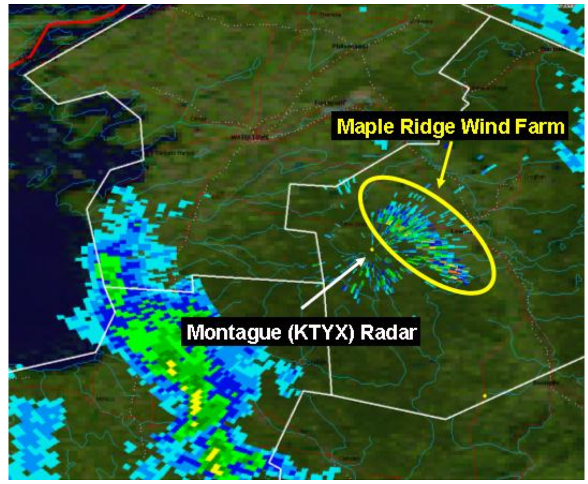

Figure 2. Montague Radar after wind farm

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rithms". One example of the effect is shown in Figures 1 and 2, which shows a radar display from the Montague WSR-88D weather radar located only about 10 miles from the Maple Ridge Wind Farm on the Tug Hill Plateau. Figure 1 shows the radar display before the wind farm was constructed in 2005. Figure 2 shows the same radar after the wind farm was partially constructed in the fall of 2006. In that image, the Maple Ridge Wind farm is readily apparent to the east of the radar as a cluster of erroneous radar echoes.

The NWS and the WSR-88D Radar Operations Center (ROC), on behalf of the Next Generation Weather Radar (NEXRAD) Program, are part of a federal interagency working group charged with finding ways to improve collaboration with the wind energy industry. This group will address wind farms impacts on federal interests, including weather radar operations and will develop criteria for wind farm siting and expansion to allow co-existence of both systems with minimal interference.

In addition, the University of Oklahoma is currently sponsoring study to develop advanced techniques to discount wind turbine signatures on the weather radars while being able to maintain those signals produced by the weather.

In summary, the rapidly increasing number of wind farms used to generate electricity is beginning to impact weather surveillance radar data. To date, the impacts appear to be minimal. However, experiences to date indicate the expected near-exponential growth in the number of such installations is cause for concern. NOAA's NWS has become involved in studying the impacts of wind farms and mitigation opportunities to ensure the network of WSR-88Ds can continue to provide mission-critical support to forecast and warning operations.

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Enhanced Fujita Scale implemented by the National Weather Service

On February 1, 2007 NOAA's National Weather Service fully implemented the Enhanced Fujita (EF) scale to rate tornadoes, replacing the original Fujita Scale. The EF scale will continue to rate tornadoes on a scale from zero to five, but ranges in wind speed will be more accurate with the improved rating scale. The EF scale still estimates wind speeds but more precisely takes into account the materials affected and the construction of the structures damaged by the tornado.

The Fujita scale was developed in 1971 by T. Theodore Fujita, Ph.D., to rate tornadoes and estimate associated wind speed based on the damage they cause. The EF scale refines and improves the original scale. It was developed by the Texas Tech University Wind Science and Engineering Research Center, along with a forum of wind engineers, universities, private companies, government organizations, private sector meteorologists, and NOAA meteorologists from across the country.

Limitations of the original Fujita scale may have led to inconsistent ratings, including possible overestimates of associated wind speeds. The EF scale incorporates more damage indicators and degrees of damage than the original Fujita scale, allowing more detailed analysis and better correlation between damage and wind speed. The original Fujita scale historical data base will not change. An F5 tornado rated years ago is still an F5, but the wind speed associated with the tornado may have been somewhat less than previously estimated. A correlation between the original Fujita scale and the EF scale has been developed. This makes it possible to express ratings in terms of one scale to the other, preserving the historical database.

More information about the EF Scale is available on the web at http://www.spc.noaa.gov/efscale/

Judith Levan
Warning Coordination Meteorologist
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Friendship Woman Celebrates 50 years of Recording the Weather

In a ceremony which took place on November 29, 2006, Mildred Goodliff of Friendship, Allegany County, was honored for her 50 years of recording weather observations for the National Weather Service (NWS).

The NWS Cooperative Observer Program (Coop) is the Nation's weather and climate observing network of, by and for the people. The volunteer observer program was initiated by Thomas Jefferson, with the help of Benjamin Franklin. More than 11,000 volunteers across the nation take observations on farms, in urban and suburban areas, National Parks, seashores, and mountaintops. The data are truly representative of where people live, work and play.

The Coop program was created in 1890 under the Organic Act. Its mission is two-fold:

1. To provide observational meteorological data, usually consisting of daily maximum and minimum temperatures, snowfall, and 24-hour precipitation totals, needed to define U.S. climate and to measure long-term climate changes, and
2. To provide observational meteorological data in near real-time to support forecast, warning and other public service programs of the NWS.

Observers record temperature and precipitation daily and send those reports monthly to the National Climatic Data Center (NCDC) or an NWS office. Many Coop observers provide additional hydrological or meteorological data, such as evaporation. Data is transmitted via telephone, computer or mail.

Volunteer weather observers conscientiously contribute their time so observations can provide the vital information needed. These data are invaluable in learning more about the floods, droughts, heat and cold waves affecting us all. The data are also used in agricultural planning and assessment, engineering, environmental-impact assessment, utilities planning, and litigation. Coop data plays a critical role in efforts to recognize and evaluate the extent of human impacts on climate from local to global scales.

From Left: Tom Niziol (Meteorologist in Charge), Mildred Goodliff, Steve Francis (Data Acquisition Program Manager), Chuck Tingley (Hydrometeorological Technician)

The National Weather Service Forecast Office in Buffalo congratulates Mrs. Goodliff on this milestone.

Judith Levan
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Winter Weather Safety

Despite a warm start to the season, winter has arrived with a vengeance with lake effect snows being measured in feet and bitter wind chills forcing the closing of some area schools.

Don't forget some of these basic winter safety tips:

During major winter storms, it's usually best to remain at home rather than venturing outdoors. You should always be prepared to ride out any adverse weather. Your primary concerns at home include the possible loss of heat, electricity, and telephone service. You may also run out of supplies if the storm persists for several days.

You should keep a three day supply of non perishable food which requires no cooking or refrigeration. Have a non electric can opener available. Store one gallon of water per person, each day.

Your disaster supplies for the home should also include a first aid kit along with essential prescription medication, a portable radio with extra batteries, a NOAA weather radio, flashlights with extra batteries, and several blankets.

Remember, if you lose power, you will probably lose your primary source of heat as well since most furnaces need electricity to function. If you do have an alternate source of heat such as a fireplace or wood stove, make sure that it is in good condition. If you lose power and have a generator, make sure you follow all the manufacturers directions and safety precautions. Be sure your smoke alarms and fire extinguishers are in good working order.

When outdoors, be sure to dress properly for the cold. Wear several layers of warm, loose fitting clothing. The layers help to trap your body heat better than one heavy layer, and a few layers can be removed to avoid perspiration and subsequent chill. The outer layer should also be water repellent.

Also, remember to wear a hat to shield yourself from the cold since a significant loss of body heat occurs from your head. In addition, mittens are better than gloves at protecting your fingers from the extreme cold.

Winter weather poses many challenges to travelers who take to

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Winter Weather Safety (cont.)

the roads. Visibility is often reduced by snow, fog, and the accumulation of road salts on the windshield. Traction can be reduced by snow, ice, and water ponding on roadways. Winter weather also increases the stress on your vehicle's electrical and cooling systems.

Be sure your vehicle is ready for the winter driving season. Have your engine tuned up, your battery checked, and your engine coolant or antifreeze tested to see if it can withstand the extreme cold. Also, you can increase your visibility by installing new windshield wipers. Finally, be sure your snow tires or all season tires are properly inflated and have enough tread to grip the road.

You should consider a survival kit for your car, especially if you drive in rural areas. Have a blanket or sleeping bag on hand along with a supply of non perishable food, a first aid kit with prescription medication if necessary, and bottles of drinking water or juice. If you become stuck or stranded, your chances of survival will be greater. Also include a shovel, sand or cat litter, booster cables, an ice scraper, and a snow brush.

Always check with the latest National Weather Service Forecasts, warnings and statements. NOAA Weather Radio is a good source for the latest information 24 hours a day. If a storm is occurring or about to begin, consider postponing your trip until conditions improve. If you must travel during inclement weather, remain on well traveled main routes or highways. Let someone at your destination know that you're on your way, and tell them your estimated time of arrival.

Travel with someone if possible. If you get stuck, stay in or near your vehicle. It's easy to get lost or disoriented in a blinding snowstorm or blizzard. Also, rescue personnel can find you much more easily if you stay put.

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Upgraded Radiosonde System At Buffalo

Every day, twice a day, at 69 sites in the continental United States, 13 in the Alaskan Region, 1 in the Caribbean, and 9)in the Pacific region, balloons carrying radiosondes are launched. Extensive information on wind speed and direction, temperature, relative humidity, and barometric pressure is gathered from the surface up to 20 miles. This data is not only used on station, but is also sent to super computers where it is utilized in forecast models to aid in weather prediction.

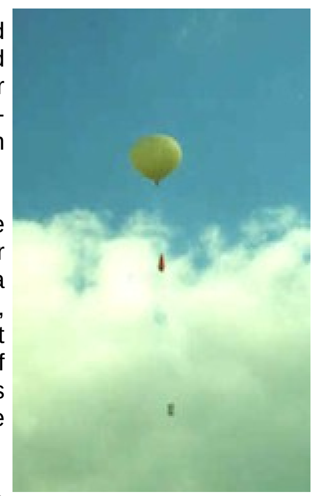
Your National Weather Service Office in Buffalo New York, has taken a great leap forward this past year by having been afforded the opportunity to become one of the first stations in the United States to have the new Radiosonde Replacement System (RRS) installed.

To meet the continuing requirement of a broad base of users for atmospheric sounding data, the NWS will replace its entire current network of radiosonde systems with the new RRS with the following goals in mind:

- Maintain or increase system availability and data accuracy
- Reduce the use of radio-frequency spectrum
- Require less operator interaction and maintenance
- Provide a complete high-resolution data set to users
- Provide a consistent and accurate measurement of surface weather parameters at the point of balloon release.

This new system combines the latest in computerized and digital technology to gather information. It is also inter-connected with the array of Global Positioning Satellites, to give extremely accurate wind data at all altitudes. In fact, with GPS, the radiosondes could conceivably be tracked right to the ground after the balloon bursts.

The new RRS system offers expanded functionality in many forms. Data is now being collected on a per second basis, as opposed to the 6 second interval of older systems, with many new parameters added that will greatly aid in forecasting the weather.



In the past, our balloons had to be tracked visually for a short time after launch so the tracking antenna could be properly positioned. Now, it's as simple as release and forget as the onboard GPS keeps track of the balloons position, and computes wind speed and direction at the same time.

Interestingly, the majority of the balloons launched from the Buffalo Office end up in Lake Ontario due to our prevailing southwesterly wind. We have had balloons returned from as far away as Nova Scotia, and some have even been known to return to the Buffalo Airport where they were launched from. If you should ever find one in your backyard, the radiosonde has a prepaid return envelope within that it can be put into and mailed. They are returned to the National Weather Service Reconditioning Center where they are refurbished and sent back into the field.

The new Radiosonde Replacement System offers exiting new possibilities as your National Weather Service continues to expand its capabilities, and endeavors to bring you the most accurate and timely forecasts possible.

Thomas Schmidt
Hydro-Meteorological Technician

Computer Models—Just What Are They?

Most science-related fields use models to represent or simulate a system. These models are usually simplified or approximate versions of the actual system. The essential components are displayed, and the extra, lesser important types of information are left out. For meteorologists, models help us understand the complex atmosphere of the Earth, how the atmosphere interacts with the Earth's oceans, and resultant weather patterns and phenomena.

Weather models are numerical models. That is, they consist of a large number of (very) complex mathematical equations that attempt to describe the state of the atmosphere at a certain point in time. These equations are then used to determine the state of the atmosphere at a future point in time. Sounds simple enough, right? Well, because a model is, well, a model, we can be assured that it will never perform exactly like the real atmosphere as it is just an approximation of the real thing, and there is therefore always some uncertainty to a weather forecast.

Why can't we make a better model? To answer this question, first look at the size of the Earth and try to organize the entire state of the atmosphere, all across the globe, from the surface to space, at every moment in time and place, and store that huge (unimaginable) amount of data into the biggest computer possible. Some of the key pieces of data you might want to store would include temperature, pressure, wind speed, and relative humidity. You might also want to know if it's rained or snowed recently, and how much over a given point in time, never mind the fact that over 70% of the Earth's surface is covered by oceans. Over land, you would want to know something about soil moisture, foliage, agriculture, snow coverage, topography, and even man made features (ex parking lots, homes, buildings, and how much energy they reflect and absorb from the sun). Thinking in terms of the sun, you would want to know about clouds, which of course are constantly changing in size and shape. Cloud height, thickness, and their moisture content are important as clouds have a significant impact on the amount of energy the earth receives from the sun. The list goes on and on, and you can see how a model of the atmosphere quickly becomes enormously complex.

Considering the near impossibility of storing all this data into a manageable weather forecast model, it's a wonder we can forecast at all. In fact, it's quite amazing that we can have any confidence in a forecast model that goes out five, seven, and even 10 days into the future. (There are also forecast models that go out several months (and years) into the future, attempting model the Earth's climate.) Often however, these models do have a good handle on the state of the atmosphere, and they can produce a decent forecast several days out.

Let's take a look at what goes into a weather forecast model. First you need data that describes the state of the atmosphere. Surface observations, upper air weather balloons, satellite and radar data, and even aircraft data are all stuffed into a massive data collection funnel that's least to a super computer programmed to describe the state of the atmosphere at a certain point in time. Note however, that we've already introduced several holes and unknowns. For example, aside from a few buoys and ships, we have very little information over the oceans. Although there are numerous weather balloons launched across the remaining (approximate) 30% of the Earth's surface each day, these are only launched twice per day, and the distance from one balloon to another can be hundreds, and in many cases outside of the U.S., thousands of miles from each other. All of this data also needs to be carefully calibrated. A thermometer that continuously reads 2 degrees off will contaminate the forecast model. The often referenced example of "butterfly flaps its wings" actually applies. There are simply a vast number of unknowns that go into a forecast model; we simply cannot determine the exact state of the atmosphere at a given moment in time.

We're actually touching upon two key points here. First, since models are approximations of the atmosphere, we have to understand that there will eventually be "model error". There's no way around this. Second, there's always some element of chaos in the atmosphere, and there's no way around that either.

How do we deal with these significant issues? Well for one, we never rely solely on one model. The NWS routinely runs at least three main models four times per day, and more recently, we run numerous subtle variations of these models. Some terms you may have come across include Eta, NAM, WRF, RUC, GFS, and MRF. These are (or in a few case were) acronyms for weather forecast models. Each model has a different resolution (vertically and horizontally), slightly different equations (and assumptions – remember, they are models), background information (ex topography and soil moisture), and different abilities to ingest incoming data (ex some models can use radar data, others cannot). No model is perfect, they each have some inherent error, and no model can fully account for the undetectable amount of chaos in the atmosphere. However, if you look at the output of several models and they all seem to produce a similar result, we can infer a higher confidence in the forecast output.

Over the past 10 years as computer resources and computational abilities improved dramatically, these models and their variations have been put together into ensembles, or collections of models. The idea behind an ensemble is that while no single model is perfect, ideally the truth lies in the "envelope of solutions". With a smaller the envelope, we usually have a better probability of getting the forecast right. Of course, there are times when the actual outcome lies outside the envelope. These are often the most important cases, as they are the extremes (big snow storms, flooding, high winds etc). While ensembles, like the individual models themselves, never produce a perfect forecast, they do provide us with a measure of confidence. They also demonstrate that models have come a long way, and that there is often some measure of weather forecast predictability.

What happens when the output of a model or a suite of models looks bad? Although these situations are becoming quite rare, there are times when they happen. Even with a forecast model

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NOAA Weather Radio WNG541 Frewsburg

Western and southern Chautauqua County residents, visitors, and boaters now have access to weather information anytime, thanks to a new NOAA Weather Radio All Hazards transmitter recently installed at Frewsburg, New York.

Residents of western and southern Chautauqua County can tune to 162.525 MHz on NOAA Weather Radio All Hazards for the broadcasts from NOAA's National Weather Service in Buffalo, N.Y. The broadcasts from station WNG541 began October 4, 2006. NOAA Weather Radio All Hazards (NWR), known as "The Voice of the National Weather Service," is a continuous 24-hour source of the latest weather forecasts and warnings broadcast directly from the Buffalo forecast office.

Recently, the Departments of Education, Commerce and Homeland Security joined together to distribute NWR receivers to all public schools in the Nation. The addition the new Frewsburg site was praised for providing schools in the area with NWR alerts.

This radio broadcast has been made possible through a partnership between NOAA and Chautauqua County to bring the National Weather Service's vital information to people in this area. The Frewsburg transmitter significantly increases the National Weather Service's ability to reach the western southern tier of New York with weather warnings and forecasts.

Judith Levan
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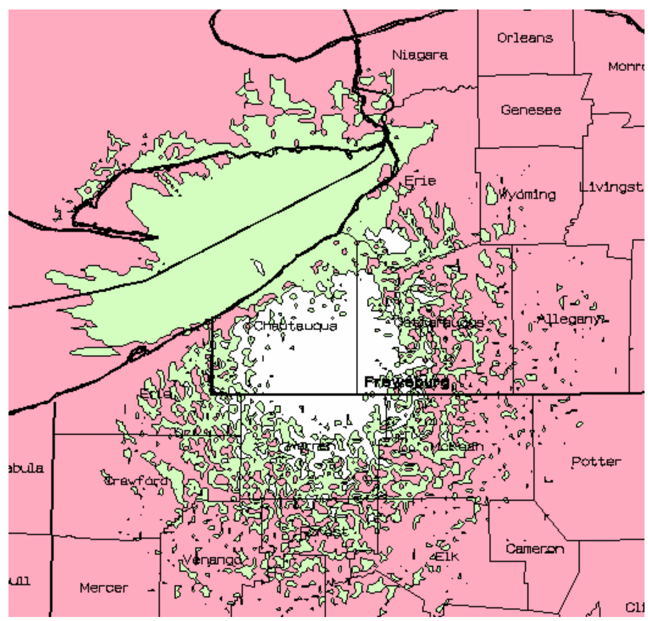
From left: Eric Amidon, representing Chautauqua County Executive Greg Edwards; Chautauqua County Sheriff Joseph Gerace; Julius Leone, Jr. Chautauqua County Director of Emergency Services; Andy Ippolito, BOCES Safety and Health; Thomas Niziol, Meteorologist in Charge, NWS Buffalo; and Judith Levan, Warning Coordination Meteorologist, NWS Buffalo.

Coverage Map of the WNG541 Frewsburg Transmitter

The coverage map shows estimated signal levels of the radio signal.

- White: Signal level of greater than 18dBuV: Reliable coverage
- Green: 0dBuV to 18dBuV: picking up a signal is possible but unreliable
- Red: Less than 0dBuV: Unlikely to receive a signal



Computer Models (continued)

(Continued from page 5)

running smoothly, for the first 12 to 24 hours in the forecast, forecasters sometimes rely more heavily on observed datasets (satellite, balloons, radar) than on model output. Partly due to the experienced forecaster alone, this short forecast period is where forecasters are most likely to improve on model output.

The next generation of satellites will have a far greater ability to remotely measure the state of the atmosphere a thousands of l levels. We'll have more surface datasets as well. Although there will continue to be errors in these data, our ability to model the atmosphere will continue to improve, and we expect weather forecasts will similarly improve.

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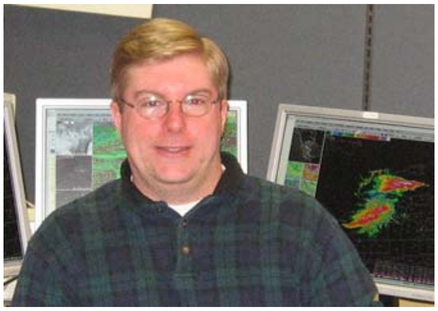
Personnel Changes at WFO Buffalo

Jon Hitchcock Joins the Staff



Jon Hitchcock has joined the staff of WFO Buffalo as a general forecaster.

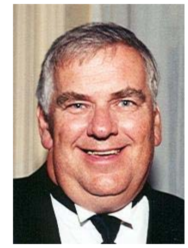
Originally from western New York, Jon graduated from Amherst Central High. He received a B.S. in Meteorology from Oswego State University in 2002.

Jon worked as an intern here at the Buffalo office from May 2000 through February 2003, then as a Meteorologist Intern and then General Forecaster at the Northern Indiana NWS Office.

Jon gained tremendous experience in severe weather operations in his years at the Northern Indiana WFO, particularly in the area of radar analysis of severe weather.

He also continues to hone his skills in winter weather forecasting, most recently making a presentation at the Great Lakes Workshop on Operational Meteorology. He rounds out his resume with extensive SKYWARN training and other Outreach activities during his time in his previous office.

Steve Francis Retires



After 30 years of dedication to the National Weather Service, Data and Program Acquisition Manager Steve Francis retired on January 3rd, 2007.

Steve began his NWS Career at Fort Totten, New York doing Upper Air observations in all types of weather conditions. Soon after, he moved to JFK Airport as an International Flight Briefer. After a number of years providing critical forecast support to the aviation community, he moved to the Weather Service Office at Syracuse New York, eventually becoming the Officer-In-Charge at that facility. Finally, he was promoted to the Weather Service Forecast Office in Buffalo, New York where he has served as the Data Acquisition and Program Manager.

Steve's contributions have been significant at local, regional and national levels. While at the Buffalo office, he led the Upper Air Team that won the Eastern Region Cline Award two years in a row and consistently finished in the top five in the nation for outstanding Upper Air scores. His leadership in maintaining a program considered to be so critical to the integrity of daily forecasts for our nation is a prime example of the extra effort and dedication our employees put forth to get the job done.

We wish Steve and his wife Deb all the best on this happy occasion.

2006 SKYWARN Recognition Day

The Eighth annual SKYWARN Recognition Day was held on December 2nd and was a tremendous success. SKYWARN Recognition Day was developed in 1999 by the National Weather Service and the American Radio Relay League. It celebrates the contributions that volunteer SKYWARN amateur radio operators make to the National Weather Service. Many NWS offices use the real-time information in their warning decision-making process.

During the 24-event, base operators here at the Buffalo office made 326 contacts in 38 states, including contact with 34 other NWS offices across the nation.
Congratulations to the Melbourne office which made 921 contacts in all 50 states (including 70 other NWS offices.

NWS Special Event

Many thanks to our base station operators including: John KA2RFT, Gary KC2HRW, John W2IV, Bill WB2AIV, Bill WB8JPX, and Joe WV2NY.

More information about the Special event and a list of participating NWS offices can be found at http://hamradio.noaa.gov

Judith Levan
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Weather and climate sensitive industries, both directly and indirectly, account for about one-third of the Nations' Gross Domestic Product, or $3 trillion, ranging from finance, insurance, and real estate to services, retail and wholesale trade and manufacturing.

-Dutton, 2002

SKYWARN Training—Spring 2007

SKYWARN

SKYWARN is a National Weather Service effort to save lives during severe weather emergencies with an expanding network of trained volunteer weather spotters. SKYWARN spotters support their local community and government by providing reports of severe weather directly to the National Weather Service in Buffalo through amateur radio or the NWS spotter toll-free hotline. The services performed by SKYWARN spotters have saved many lives.

The National Weather Service has a number of devices for detecting severe thunderstorms. Included in these are Doppler radar, satellite, and lightning detection networks. However, the most important tool for observing thunderstorms is the trained eye of the storm spotter. By providing observations, SKYWARN spotters assist the National Weather Service staff in their warning decisions and enable the National Weather Service to fulfill its mission of protecting life and property. Storm spotters are, and always will be, an indispensable part of the severe local warning program.

The training sessions review basic topics including the roles and responsibilities of the National Weather Service, severe weather safety, and basic severe weather meteorology including how thunderstorms, severe thunderstorms and tornadoes form. The session will also include discussion on storm reporting techniques and tips for staying in tune with the current and forecast weather.
For those who have already attended a training session, we recommend you attend another spotter training session at least once every three years to remain on our spotter list.
Anyone can become a severe weather spotter for the National Weather Service. SKYWARN training is free and open to the public and lasts about two hours.

If you know of any group (emergency responders, law enforcement, civic organizations, or amateur radio groups, for example) that would like SKYWARN training or refresher training, contact Judy Levan at judith.levan@noaa.gov.

The currently scheduled SKYWARN training sessions for the Spring of 2006 are:

3/12/07	7:30pm	Cheektowaga, Erie County
3/26/07	7:30pm	Jamestown, Chautauqua County
4/11/07	7:00pm	Canandaigua, Ontario County
4/12/07	7:30pm	Fredonia, Chautauqua County
4/14/07	1:00pm	Warsaw, Wyoming County
4/18/07	7:00pm	Fulton, Oswego County
4/21/07	9:30am	Newark, Wayne County
6/2/07	12noon	Rochester Hamfest, Monroe County

Specific times, locations and details, as well as any additional training sessions, will be posted as available on our website at http://www.weather.gov/buf/skywarnt.htm

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NOAA's National Weather Service

We're on the Web!
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EDITORS NOTE:

Published quarterly, each of issue of "The Lake Breeze" contain articles about our operations, new products and services, and interesting local weather submitted by various members of our staff. If you have a comment about our programs, or an idea for something you'd like to see included in an upcoming issue, we'd like to hear from you. You can email me at judith.levan@noaa.gov.

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