

Careers in Meteorology

Job Information for those interested in Meteorology



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Why Meteorology?

Are you curious about the world and the atmosphere around you? Have you ever questioned why a certain weather event happened? How do tornadoes form? How do clouds and rain develop? As a meteorologist, you can satisfy these curiosities by investigating the natural forces that shape our weather and climate. We find ourselves in the weather every day. In one way or another, the weather impacts our lives in subtle or not so subtle ways. You can use your knowledge to warn others when dangerous weather is approaching. You can use the latest tools of modern technology such as computers, radars, and satellites to discover how natural processes affect our atmosphere. You can learn how human activities are changing the climate and global systems. One thing many meteorologists share is the excitement and love of the weather and the challenge of understanding and forecasting it.

What is Meteorology?

Meteorology is the science of the atmosphere. The word comes from the Greek word *meteorol*, which refers to something that occurs high in the sky. The ancient Greeks observed clouds, winds, and rain and tried to understand how they interrelate. Modern meteorologists must address many complex issues and answer many difficult questions about the behavior of the atmosphere and its effects on the people of our planet. The science of meteorology is young; a lot of understanding of the atmosphere's behavior still remains to be discovered.



What is a Meteorologist?

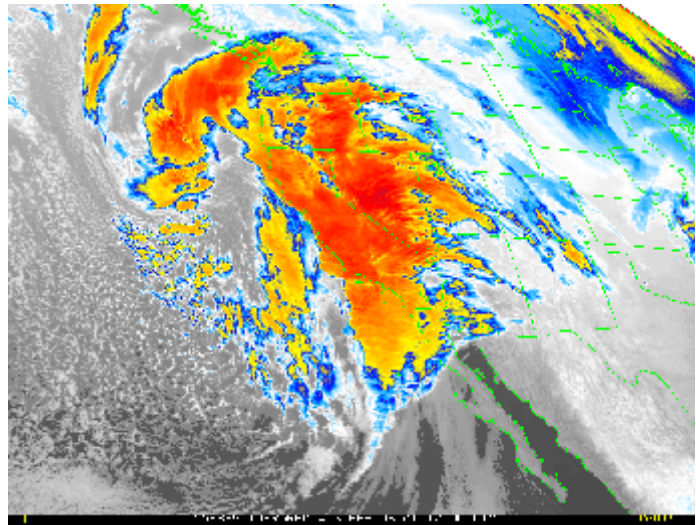
A lot of people don't even know what a meteorologist is (or even how to pronounce it). Because it may be a misunderstood word, it sometimes stimulates well-meaning but inappropriate layman questions such as, "Do you have a telescope?" or "What about that new comet?" Others think of the weather personality on television who tells us about tomorrow's weather. Some of these weather broadcasters are professional meteorologists, but many are simply broadcasters relaying weather information from the National Weather Service.

A meteorologist is one who studies the atmosphere. Meteorologists are not licensed professionals like doctors or engineers; anyone can call themselves a meteorologist. The American Meteorological Society defines a meteorologist as a person with a specialized education who uses scientific principles to explain, understand, observe, or forecast the earth's atmospheric phenomena. This education usually includes a bachelor's degree or higher from a college or university.

What do Meteorologists do?

Meteorologists work in weather forecasting, atmospheric research, teaching, and other kinds of applied meteorology such as air pollution control.

Weather Forecasting - Forecasting has always been at the heart of meteorology. Many people have been drawn to the profession by the challenge of forecasting a natural event and seeing that forecast positively affect the lives of thousands of people. Meteorologists who have worked in the field of forecasting in recent decades have seen significant advances in their ability to predict the weather. The accuracy of a forecast is much greater and extends further into the future. New knowledge about interactions between the tropical ocean and the atmosphere make it increasingly possible to predict regional climate patterns months or even years in advance.



Weather forecasting involves many people in many countries because the systems that bring us our weather are hundreds of miles in extent and move across huge regions of the earth's surface as they grow and change. The weather forecast that you get is the end product of a worldwide effort by thousands of meteorologists in many nations. Synchronized weather observations are made all over the world and these atmospheric measurements become the



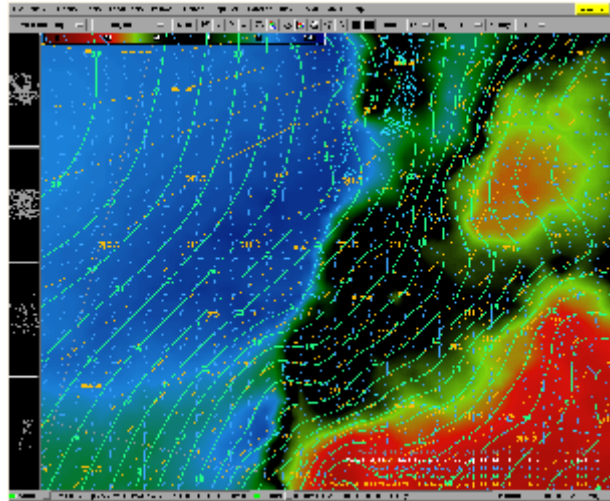
starting point to produce sophisticated computer models that simulate the motions of the atmosphere. These models become important weather guidance. Meteorologists use this guidance together with data from satellites, radars, weather balloons and numerous weather instrument stations to produce a forecast. The forecasts are used by broadcast meteorologists who deliver their own local and national forecasts on television, radio, and the Internet.

National Weather Service forecasts help the general public and large specialized groups such as the aviation, marine, and fire control communities. Private forecasting organizations also serve these groups as well as clients with very specific needs for highly specialized forecasts. They take on tasks such as detailed agriculture forecasts for fruit growers who need to take preventative action against crop damage when cold weather is on the way.

Private forecasters work for commodities traders who are concerned about the effects of weather on crop production and prices. They make forecasts to assist transportation industries distribute goods and services. They forecast the weather for athletic events such as professional

football games and golf tournaments. They keep utility companies informed about impending hot or cold weather that will put heavy demands on generating plants and transmission systems. They provide local weather forecasts to many radio and television stations that do not employ their own meteorologists.

Research - Research meteorologists often work closely with chemists, physicists, and mathematicians as well as with oceanographers, hydrologists and researchers in other branches of environmental science. They seek to better understand complex weather phenomena such as hurricanes, tornadoes, severe thunderstorms, snowstorms and the dangers that accompany them so that forecasters may improve their forecasts and save lives and property. Mathematicians and computer scientists help meteorologists design computer models of atmospheric processes. Meteorologists and oceanographers work together to study many important ocean-atmosphere interactions such as El Niño.



Teaching - Atmospheric science education at the college and university level has grown tremendously in recent years. In addition to classroom teaching, many university atmospheric scientists direct research that graduate students are performing to earn their degrees. Many institutions offer a major in meteorology or atmospheric science, while others provide atmospheric science courses to supplement related science and engineering fields or as part of a broader educational curriculum. Some colleges and universities offer courses in global change and earth systems science. In high schools and lower grades, atmospheric science usually is taught as part of earth science courses. Training in meteorology is good preparation for a career as a science teacher at any level.

Where do Meteorologists Work?

By far the largest employer of meteorologists in this country is the United States government. The majority of meteorologists work for the National Oceanic and Atmospheric Administration (NOAA), which includes the National Weather Service. The following outline is a breakdown.

Employers of Meteorologists

- I. U.S. Government
 - A. Department of Commerce
 - 1. National Oceanic and Atmospheric Administration (NOAA)
 - a. **National Weather Service**
 - b. National Environmental Satellite and Data Service
 - c. National Ocean Service
 - d. National Marine Fisheries Service
 - B. National Aeronautics and Space Administration (NASA)
 - C. Department of Energy
 - D. Department of Agriculture
 - E. Department of Defense
 - 1. Navy
 - 2. Air Force
- II. Universities
 - A. Research (meteorology theory, cloud physics, experimental numerical model guidance)
- III. Private Industry
 - A. Specialized weather companies and consulting (custom-tailored weather information for paying customers, forensics)
 - B. Airlines
 - C. Air quality management (pollution control and hazardous materials)
 - D. Utility companies
 - E. Weather modification (cloud seeding, fog dispersal, etc.)
 - F. Private research organizations (global warming, computer applications)
 - G. Broadcast media (television, news radio, Internet)

What kind of Education Do I Need to be a Meteorologist?

High School - Recommended science courses include math, physics, chemistry, earth science and computer science. Math proficiency is very important and will establish a good foundation for further study, but do not be deterred if you are math-challenged; a well-rounded high school education is the most important consideration. Earth science courses provide a valuable introduction to the atmospheric environment. Computer science is also very helpful because the computer is the basic tool in meteorology. A good command of written and spoken English and some foreign language experience will help you communicate scientific knowledge effectively.

College and University - The most direct path to a career in meteorology is an undergraduate

program that leads to a bachelor's degree in meteorology or atmospheric science. Many colleges and universities have such programs. Choose an undergraduate program that will give you a broad and solid foundation in atmospheric science. If you are interested in a career in research, an undergraduate major in physics, chemistry, engineering, or mathematics can prepare you to study atmospheric science in graduate school. Although many careers in meteorology are available to college graduates with a bachelor's degree, graduate-level education opens the door to many more professional opportunities and makes you a more competitive job applicant. A master's or doctorate degree is very important if you plan to go into atmospheric research. A listing of institutions offering degrees in meteorology or atmospheric science can be found at: www.ametsoc.org/AMS/curricula/index.html.



National Weather Service Basic Qualification Requirements for a degree in Meteorology or Atmospheric Science

A Bachelor's degree in meteorology or atmospheric science must include:

1. At least 24 semester (36 quarter) hours of credit in meteorology including a minimum of:
 - a. Six semester hours of atmospheric dynamics and thermodynamics;*
 - b. Six semester hours of analysis and prediction of weather systems (synoptic/mesoscale);
 - c. Three semester hours of physical meteorology;
 - d. Two semester hours of remote sensing of the atmosphere and/or instrumentation.
2. Six semester hours of physics, with at least one course that includes laboratory sessions.*
3. Three semester hours of ordinary differential equations.*
4. At least nine semester hours of course work appropriate for a physical science major in any combination of three or more of the following:
 - Physical Hydrology
 - Chemistry
 - Physical Climatology
 - Aeronomy
 - Light and Optics
 - Computer Science
 - Statistics
 - Physical Oceanography
 - Radiative Transfer
 - Advanced Thermodynamics
 - Advanced Electricity and Magnetism

* There is a prerequisite or corequisite of calculus for course work in atmospheric dynamics and thermodynamics, physics, and differential equations. Calculus courses must be appropriate for a physical science major.

Salary

The U.S. Government (including the National Weather Service) - In the U.S. Government a base salary is calculated on a General Schedule (GS) pay scale and a paycheck is received every two weeks. In addition to the base pay, a small percentage is added as locality pay in many regions to account for the rising costs of living. Most NWS employees earn additional shift differential pay by working rotating shifts during nights, Sundays and holidays.

In the federal system pay raises come at regular intervals, but become increasingly less frequent. There are ten smaller pay increments, called steps, within each grade. The pay increases one step every year for the first three years (steps 2, 3, and 4), every other year for steps 5, 6, and 7, and every third year for steps 8, 9, and 10. For example, a meteorologist at the GS-12 position can earn regular raises each year up to step 4, then one raise (step increase) every other year through step 7, then one raise every third year up to the pay ceiling at step 10. In the intern and forecaster positions, a grade increase is built in. After that, a promotion is usually required to earn a grade increase.

Using the base pay level in 2006, without accounting for locality or shift differential pay, a hired intern fresh from earning a bachelor's degree in meteorology will receive a starting salary at the GS-5 or GS-7 pay level (starting at \$25,000 to \$31,000). The intern can earn grade increases each year up to the GS-11 level (starting at \$46,000). Traditionally, the next step is to become a general forecaster or meteorologist, with pay rising from the GS-9 to GS-12 levels (starting at \$38,000 to \$55,000) if not already beyond the GS-9 level. A general forecaster may then become a GS-13 senior forecaster starting at \$66,000. Beyond that, management positions at the local, regional or national level can be obtained with earnings up to the GS-15 level starting at \$91,000. Again, these values do not account for locality pay or shift differential. To see a current (2006) table of pay levels including locality pay, visit the Office of Personnel Management web site: www.opm.gov/oca/06tables/indexGS.asp.

The Private Sector - Salaries in weather businesses outside of the government have traditionally been slightly below those in the National Weather Service. However, opportunities in private weather companies are growing and the pay is becoming more competitive.

Meteorologists in the environmental science have great potential depending on the job skills they learn such as marketing, communications, and business development. After roughly five to seven years of employment in the environmental sciences, salaries can range from about \$45,000 to \$75,000.

Starting salaries for airline meteorologists may be 10 to 20 percent higher than those for many other jobs, but many airline positions require prior experience in supporting flight operations. Such experience typically is gained in the military or in some NWS jobs. It is also challenging to obtain employment in airline meteorology because personnel turnover in those jobs tends to be quite low.

Computer engineering and computer science is "where it's at," of course. Average starting salaries are close to \$50,000 for those hired into information systems (IS) departments. Broadcast meteorology, television and radio weather broadcasting, offers high profile positions, but does not necessarily offer commensurate salaries. Annual pay for a weather broadcaster just beginning a career at a small-market station is in the \$30,000 to \$40,000 range. The average salary is \$50,000, but the salaries in this field cover an enormous range. The top 10 percent in the field raked in over \$120,000 per year, but these big six-figure salaries are confined to the top 10

or 20 television markets in the country (as defined by the population of the viewing area). There certainly are opportunities in the field, since only about half of over 2,000 broadcast weather jobs are held by people with a degree in meteorology.

The degree level can make a difference in salary earnings. Given that positions are available, you will command a higher entry-level salary with a master's degree or Ph.D. than you will with a bachelor's. However, many young professionals with a master's degree, and most with a Ph.D., take research jobs, not forecasting positions.

Benefits and Time Off

In the National Weather Service, a large variety of benefits are available. Federal plans of health insurance and life insurance are very competitive. These insurance premiums are usually automatically deducted from the paycheck. The Federal Employees Retirement System is among the most aggressive and beneficial retirement plans available. As the employee contributes to the retirement fund, the government matches that contribution dollar for dollar. The employee then chooses to invest any percentage of the contribution in any combination of several low to moderate risk stocks and bonds.

As the employee works, a number of hours are earned for use when sick or for vacation time. With every two week paycheck, 4 hours of paid Sick Leave are earned. This Sick Leave “fund” accumulates hours, which can be deducted in the event of sickness, doctor visits or hospital stays, etc. Paid vacation time, called Annual Leave, is earned the same way. 4 hours of Annual Leave are earned with each paycheck during the first 4 years of employment, 6 hours are earned from 5 to 14 years of employment, and 8 hours of leave are earned with each paycheck after 14 years. A limit of 240 hours of leave may be carried through from one year to the next, or else the excess hours are forfeited.

For more details on benefits, vacation time or any other employment issue, visit the Employment Info section of the Western Administrative Support Center web site at: www.wasc.noaa.gov.

What is the job like for NWS forecasters?

Forecasting is an exciting and challenging job. Each day a forecaster enters the office and is given a new puzzle to solve: what is the weather going to do next? The day to day duties may not change, but the weather does and it is a stimulating challenge to understand and forecast. New technology such as the Advanced Weather Information Processing System (AWIPS) is a computer workstation that provides one-stop shopping for weather data such as satellite imagery, radar data and numerical model guidance, which attempts to graphically simulate atmospheric behavior on



charts or maps. A forecaster uses these tools to make critical decisions before issuing a forecast or a warning. Some days the main challenge may be to decide how hot or cold it will be tomorrow. Other days may be filled with activity during significant weather events such as flooding rain, heavy snow, or severe, damaging thunderstorms.

The mission of the NWS is to save lives and property of all Americans from the adverse effects of weather. Because NWS forecasters are tasked by Congress to monitor and forecast the weather 24 hours a day and seven days a week, rotating shift work is required. That means employees regularly work during nights, weekends and holidays, but earn extra pay by doing so. The drawbacks of working rotating shifts are obvious, but there are some advantages. Recreation may be pursued on weekdays, away from the crowds. You are not commuting during periods of peak traffic. Child care costs can be mitigated. Everyday tasks can be completed during business hours. Employees in specialized positions work rotating shifts only occasionally, such as hydrologists, fire weather forecasters or managers.

Beyond the basic duties, NWS employees take on additional responsibilities called focal points. These include directing office programs, increasing technological performance, or participating in outreach activities, projects or studies. Two of these office programs include the fire weather and hydrology programs where weather support is given for fire fighting efforts and flooding potential. Many relationships are maintained with the public, emergency management in local governments, the media, law enforcement, the research and education community, marine and aviation communities, and the recreation industries.

How do I get a job in the NWS? What are my options?

First of all, if you haven't visited your local NWS forecast office, it is highly recommended. Talk with the Meteorologist-in-Charge (MIC) or a forecaster about a career in the NWS to get a feel for the job and to ask for help. You are always welcome to visit the office and learn about the job. Just give us a call.

There following student volunteer and employment opportunities are available to help you gain experience and exposure in the NWS.

The Shadowing Program: A student interested in a career in meteorology can "shadow" or observe a meteorologist at work and see what a career in the NWS is all about. This is available to high school students and is usually coordinated through a high school counselor.

The Student Educational Employment Program provides employment opportunities to high school or college students. The program comprises the following two components:

Student Temporary Employment Program (STEP): Job opportunities under this program offer you temporary employment at a forecast office in the NWS. Initial appointments are for one year, may be full time or part time, and can range from summer jobs to positions that last as long as you are a student. These employment opportunities need not be related to your academic field of study. Starting salary ranges between GS-1 and GS-4, depending on education and experience.

Student Career Experience Program (SCEP): This program offers you valuable work experience directly related to your academic field of study. It provides formal periods of work and study while you are attending school. You may be eligible for permanent employment under this

component after successfully completing your education and meeting work requirements.

Program Features Under Both Programs:

- Students may be employed year round.
- Flexible schedule of work assignments.
- Open to all students...high school, undergraduate, graduate, and vocational/technical.
- Benefits are provided: option for health and life insurance, and retirement.

Eligibility Requirements:

- A student enrolled or accepted for enrollment as a degree-seeking student (diploma, certificate, etc.).
- At least the minimum age required by Federal, State or local laws and standards governing the employment of minors.
- Taking at least half-time academic or vocational and technical course load in an accredited high school, technical or vocational school, 2-year or 4-year college or university, graduate or professional school.
- U.S. Citizenship is required.
- At the beginning of each semester/quarter, each student will produce a letter of verification from their educational institution showing proof of enrollment in school for the upcoming semester/quarter.

Salary and Promotions:

The pay you receive will depend on the education and work experience you already possess. As you advance in your education you may be eligible for promotions based on your work performance, grade point average, and credits earned. You can be converted without competing with other applicants to permanent positions within four months of graduation after working 640 hours and showing proof of graduation.

Student Volunteer Service (unpaid): These opportunities provide work experience related to your academic program. The program allows you to explore career options as well as develop your personal and professional skills. As a student volunteer, you will be exposed to the various missions and responsibilities of the U.S. Department of Commerce.

Further information about these programs, other internship programs, grants, etc., can be found by clicking on: **ohrm.os.doc.gov/Career/PROD01_001021.html** and/or calling Gloria Walker at 301-713-0692 ext. 198. For additional student opportunities and resources beyond the NWS, click on: **www.ametsoc.org/amsstudentinfo/index.html**.

When you complete your education with at least a bachelor's degree in meteorology or atmospheric science, you will be qualified for a meteorologist internship. Visit NOAA's job web site at **www.rdc.noaa.gov/~hrmo/quickhire.htm** and you can complete an application.

The traditional career path in the NWS follows a pattern. A university graduate with a bachelor's degree in meteorology is hired as a meteorologist intern at one of the nation's 122 forecast offices. The applicant can choose from any



intern job in the country that is available. Internship openings fluctuate based on need and is decided at the regional level for each office. A forecast office may be allowed four or five interns, but usually only one or two. After that, getting a promotion to positions such as a forecaster and higher up becomes competitive. That means you will be competing with all other applicants for any specific job that is available. The number of forecasters, hydrologists, fire weather forecasters and management positions are all fixed unless a need arises to change it.

Because of this fact, a vacancy must be created by the departure of the person holding the job (retirement, taking new job, etc.). The job opening is said to be “open” to a bidding process up to a closing date, after which no more applications are accepted. The applications are reviewed at the regional level and a short list or “panel” of final applicants is made. There are usually no face-to-face interviews in this process. The MIC then selects one of these applicants for the job.

Of course, other career paths may be followed. A university graduate may choose to continue graduate work and earn graduate degrees. Many who do this become more qualified in the research arena. This can be desirable because of the higher entry-level pay and traditional work schedules. Hydrology, fire weather, aviation weather and marine weather are some other avenues to explore. Those who gain experience and qualifications in these areas may choose to work in one of many national or regional centers, rather than in a local forecast office. If you are technically inclined, you may choose to develop computer systems, atmospheric modeling or provide technical support. With the meteorology education and background, you can help tailor the vast networks of computer systems and other technology that will suit forecasters best. To get an idea of the structure of the NWS, click on: **weather.gov/organization.php**.

As in any career, there are some strategies to consider. To move up in the NWS, you obviously have to stand out a little from the crowd. You can do this by becoming involved in extra projects or training beyond that which is required. These may include writing papers about a local weather event, attending conferences and training seminars, completing additional college course work, participating in outreach activities, etc. Occasionally, there are scheduled “extra” shifts or some time during a routine shift when you can pursue these things. On the COOL web site, each job vacancy contains a list of questions about what training or extra work has been completed. These extra efforts separate the one who gets the job from the applicant merely qualified for the job.

The American Meteorological Society has prepared an excellent web site for career guidance in meteorology. You can see it at: **www.ametsoc.org/atmoscareers**.

Contacts:

The NWS Forecast Office in San Diego: 858-675-8700 **weather.gov/sandiego**

Miguel Miller, education specialist, miguel.miller@noaa.gov, ext. 226.

Jim Purpura, Meteorologist-in-Charge, jim.purpura@noaa.gov, ext. 222.

Weather Web Sites for Students

Weather Education

National Weather Service - San Diego	weather.gov/sandiego
NWS San Diego Weather Guide	www.wrh.noaa.gov/sgx/research/Guide/weather_guide.php?wfo=sgx
NWS – Jetstream Weather School	www.srh.noaa.gov/jetstream
NCAR/UCAR Weather Education	eo.ucar.edu/basics/index.html
Education for Meteorologists	meted.ucar.edu
How the Weather Works Homepage	www.weatherworks.com
University of Illinois Weather Tutorial	ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/home.rxml
USA Today Weather Basics	www.usatoday.com/weather/resources/basics/wworks0.htm
Discovery School Weather	school.discovery.com/lessonplans/weather.html
NOAA	www.education.noaa.gov
Weather Underground	www.wunderground.com/education/education.asp
The Weather Channel	www.weather.com/education
School Network (Weatherbug)	www.aws.com
Severe Weather Plan for Schools	www.nws.noaa.gov/er/lwx/swep/index.htm

Careers in Meteorology

American Meteorological Society Career Guide	www.ametsoc.org/atmoscareers
Meteorology Schools Nationwide	www.ametsoc.org/curricula/alphaindex.html , www.nssl.noaa.gov/edu/schools.html
National Weather Service Career Links	www.weather.gov/careers.php
National Severe Storms Laboratory	www.nssl.noaa.gov/faq/metcareer.shtml
NOAA Jobs and Volunteer Programs	www.noaa.gov/jobs.html
NOAA QuickHire application system	www.rdc.noaa.gov/~hrmo/quickhire.htm
Student Employment Opportunities	ohrm.os.doc.gov/Career/PROD01_001021.html
American Meteorological Society Student Guide	ametsoc.org/amsstudentinfo/index.html
Government Salary Tables (2006)	www.opm.gov/oca/06tables/indexGS.asp
Government Job Listings	www.jobs.doc.gov
American Meteorological Society Job Listings	www.ametsoc.org/ams/emplymnt/emplist.html
National Weather Association Job Listings	www.nwas.org/jobs.html

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