

Career Options in Meteorology and Atmospheric Physics

3rd Edition

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Currently, universities and colleges in the U.S. graduate 600 to 1000 meteorologists each year. The number of new, traditional, National Weather Service (NWS) entry-level positions has not been increasing along with the number of meteorologists entering the workforce, nor is it expected to in the next few years. These trends suggest that some meteorologists will have a difficult time finding a traditional NWS job. Thus, flexibility in job location and the type of meteorology-related job will enhance a person's chances of being hired. Furthermore, growth in non-traditional weather-related jobs is increasing in the private and public sector. Diverse skills and a willingness to seek a variety of weather and climate related jobs will ensure a long, fulfilling career.

This document is designed to provide career guidance for students who are interested in careers in meteorology, environmental science, and/or atmospheric physics. This document is divided into 6 sections.

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Operational Meteorology

Introduction

Atmospheric scientists who forecast the weather are known as **operational meteorologists**. Forecasting has always been at the heart of meteorology. Meteorologists who have worked in the field of forecasting in recent decades have seen significant advances in their ability to predict the weather. This means that the accuracy of a forecast is much greater and extends further into the future. 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](#) (NWS) forecasts help the 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.

Education Advice

The NWS is America's largest employer of operational meteorologists. Typically, NWS hires about 50-75 new meteorologists annually, which means that entry-level NWS positions are highly competitive. To increase your chances for employment at the NWS, there are two important bits of advice:

1. In order to meet the education requirements of the NWS, CofC students **must** complete the [Operational Meteorology Concentration](#). If you plan to apply for an NWS job at the end of your senior year, then you must complete **ALL** of the course requirements for the Operational Meteorology Concentration (except for PHYS 420/499) **BEFORE** the last semester of your senior year.

2. Because of the competitiveness of the job market, it is **VITAL** to do a weather-forecasting internship, preferably at a local NWS station (such as the NWS-Charleston weather station). Nationally competitive applicants usually complete at least one year of internship experience. The Department of Physics and Astronomy has a course, PHYS 381, that allows an internship to receive academic credit, which may apply to your major or general course requirements. For more information, see Section 6.4 of the [Physics Department Handbook](#).

Because of the [increasing emphasis of numerical weather prediction \(NWP\) in weather forecasting](#), aspiring operational meteorologists would be advised to demonstrate proficiency in NWP. This can be done by taking an independent study course in NWP with one of the faculty in the Meteorology and Atmospheric Physics program. If this cannot be arranged, students should complete the following COMET/MetEd courses before graduating:

- [NWP Training Series: Introduction](#)
- [NWP Training Series Course 1: NWP Basics and Background](#)
- [NWP Training Series Course 2: Using and Adding Value to NWP in the Forecast Process](#)

In the private sector, it is very useful that operational meteorologists become proficient in computer programming. Across the country, it is becoming commonplace for operational meteorologists to have at least a minor in computer science. In particular, the competitive applicant for weather forecasters jobs in private industry (such as Wunderground, AccuWeather, etc.) is usually proficient in Python, C++, and/or PHP. For this reason, it is a good idea for aspiring operational meteorologists to take courses in the Department of Computer Science such as

- CSCI 220/220L (Computer Programming I)
- CSCI 221 (Computer Programming II)
- CSCI 230 (Data Structure and Algorithms)
- CSCI 320 (Programming Language Concepts)
- CSCI 362 (Software Engineering)

Finally, another way to increase one's marketability is to further one's education by obtaining a Professional MS degree in operational meteorology. Some examples of these programs are

- The [Applied Meteorology Program at Plymouth State University](#)
- The [Applied Meteorology Program at Mississippi State University](#)
- The [Weather Forecasting MPS Program at University of Miami](#)
- The [Meteorology MS Program at Florida Institute of Technology](#)

For more advice on the future trends of this industry, see the website [Operational Meteorology in the Future](#) and The [Future of Weather Forecasting](#).

Broadcast Meteorology

Introduction

Everyone has probably seen a television (TV) meteorologist, otherwise known as a broadcast meteorologist or a weathercaster. They work in small, medium, and large markets. A growing number of TV stations have at least one meteorologist on station, depending on the size of the station's market, and interest in hiring meteorologists by the program manager. Each TV meteorologist is an independent contractor that negotiates his/her own contract with station management. Some TV meteorologists also have radio or newspaper contracts that generate additional income. Normally, TV meteorologists cover various on-air hours from 4:00 am to 11:30 pm (time-zone dependent), with longer hours during hazardous weather situations.

Education Advice

To enter the broadcast meteorologist industry, it is **VITALLY** important to do an internship at a local news station. It is becoming commonplace across the country for aspiring broadcast meteorologists to have at least 1 year of internship experience at a local news station. Within the Charleston area, the major news stations that offer internships are [WCBD \(Count on 2\)](#), [WCIV \(ABC News 4\)](#), and [WCSC \(Live 5 News\)](#). It is also useful for students to produce a [demo tape](#) that can be handed to prospective employers. The Department of Physics and Astronomy has a course, PHYS 381, that allows an internship to receive academic credit, which may apply to your major or general course requirements. For more information, see Section 6.4 of the [Physics Department Handbook](#).

To further stand out in this industry, it is **strongly encouraged** to arrange your academic schedule in such a way that you can obtain certification in broadcast meteorology. The two most common industry certification programs for broadcast meteorology are the [Certificate for Broadcast Meteorology \(CBM\)](#) from the American Meteorological Society (AMS) and the [National Weather Association \(NWA\) Seal of Approval](#). A short FAQ page regarding the difference in these certifications can be found at this [webpage](#). Some tips on navigating the CBM program can be found at this [webpage](#).

Students will fulfill the educational requirements for the CBM if they complete the following coursework, **in addition** to those required by the [Operational Meteorology Concentration](#):

1. CHEM 111/111L (Principles of Chemistry) (4 cr.)
2. CSCI 220/220L (Computer Programming) (4 cr.)
3. MATH 250 (Statistical Methods) (3 cr.)

Plus, one of the following:

1. BIOL 204 (Man and the Environment) (3 cr.)

2. ENVT 200 (Introduction to Environmental Studies) (3 cr.)
3. GEOL 213 (Natural Hazards) (3 cr.)
4. GEOL 288 (Global Change: A Geological Perspective) (3 cr.)

Although there are no specific course requirements for the NWA Seal of Approval, the applicant will be required to take a written online exam covering all or part of the following topics: general meteorology, radar and satellite meteorology, severe weather, synoptic meteorology, climatology, and technology/terminology. These topics are covered in the following courses:

1. PHYS 105 (Introduction to Meteorology)
2. PHYS 215 (Synoptic Meteorology)
3. PHYS 225 (Climate)
4. PHYS 425 (Mesoscale Meteorology)
5. PHYS 457 (Satellite Meteorology)
6. PHYS 459 (Cloud and Precipitation Physics)

In order to prepare for the written exam, the NWA provides a [study portal](#) for the written exam.

Because of the increasing emphasis of digital media over print media, broadcast meteorologists are usually expected to be proficient at social media communication and to make weather graphics. For this reason, it is a good idea for aspiring broadcast meteorologists to take courses in the Department of Communication which emphasize digital media such as COMM 214/214D (Media in the Digital Age) and COMM 216 (Principles and Practices of Strategic Communication). Across the country, it is becoming commonplace for broadcast meteorologists to double-major in meteorology and communication (or at least to have a minor in communications). Our advice is to choose the path best suited for your skill set. There are two common educational paths for those who pursue broadcast meteorology at CofC:

- Obtain a BA in Meteorology and a BA in Communications while pursuing the NWA Seal of Approval.
- Obtain the Operational Meteorology Concentration with a minor in Communications while pursuing the CBM through the AMS.

For more advice on entering this industry, see the following [link](#).

Research and Academia

Introduction

A common career path for those who are interested in the Meteorology and Atmospheric Physics program is in research and academia. While there are numerous research topics in meteorology and atmospheric physics, the most common subfields are

- Aeronomy and space weather
- Atmospheric boundary layer and turbulence
- Atmospheric chemistry
- Climatology
- Cloud microphysics and atmospheric electricity
- Convection and atmospheric thermodynamics
- Geophysical and atmospheric fluid dynamics
- Mesoscale meteorology and dynamics
- Numerical weather prediction
- Remote sensing and radiation
- Synoptic-dynamic meteorology
- Tropical meteorology

For students who are interested in a career in academia or as a research scientist, a master's degree, at the minimum, is required. However, for many positions, a PhD is typically required. This means that undergraduate students should prepare themselves for graduate education. The section below gives advice for those interested in attending graduate school.

Education Advice

Across the country, it is becoming commonplace for incoming graduate students in meteorology to double-major in meteorology and another STEM-related field (such as physics, chemistry, mathematics, and computer science). For this reason, we suggest the following paths for students interested in pursuing graduate study:

1. For those interested in fields associated with numerical weather prediction (NWP) or climatology, one should pursue the [Operational Meteorology Concentration](#) with a [BS Computer Science](#) or [BS Data Science](#) degree. Since NWP and climatology both require an understanding of statistical methods and probability theory, additional courses in statistics will also be helpful.
2. For those interested in atmospheric dynamics and related fields (such as mesoscale meteorology, tropical meteorology, and atmospheric boundary layer), one should pursue the [Operational Meteorology Concentration](#) and the [Atmospheric Physics Concentration](#). Additional upper-level mathematics courses [such as MATH 423

(Partial Differential Equations)] and statistics courses [such as MATH 250 (Statistical Methods I) and MATH 350 (Statistical Methods II)] will also be useful.

3. For those interested in graduate study in atmospheric physics topics [such as remote sensing, radiation, aeronomy, and cloud physics], one should pursue the [Atmospheric Physics Concentration](#). Since atmospheric physics graduate programs are typically housed in physics departments, it is recommended that students consider taking additional courses such as
 - a. Laboratory-based physics courses [such as PHYS 320/320L (Electronics) and PHYS 340/340L (Photonics)]
 - b. Upper-level courses in the major physics subject areas when available [such as PHYS 404 (Quantum Mechanics II) and/or PHYS 410 (Electromagnetism II)]
 - c. Upper-level mathematics courses [such as MATH 423 (Partial Differential Equations)].

It is often a good idea to pursue a double major in [BS Mathematics](#) as well.

Since many graduate schools prefer prospective graduate students to have some research experience, it is STRONGLY recommended that students spend at least one year in undergraduate research beyond PHYS 420. This also means that it is important to cultivate a good relationship with the faculty so that they can write stronger recommendations.

A fairly comprehensive list of graduate programs in meteorology and atmospheric science can be found through the [National Weather Association \(NWA\)](#). For those interested in atmospheric physics, the most popular graduate programs in the United States for atmospheric physics PhDs are

1. [University of Maryland at Baltimore County](#)
2. [New Mexico Institute of Technology](#)
3. [Michigan Technological University](#)

For more advice on graduate school preparation, see Section 6.1 in the [Physics Department Handbook](#).

Applied Meteorology Careers

There are numerous professional meteorologists who do not work as weather forecasters or TV weathercasters. For those who are interested are careers in meteorology outside of operational meteorology and broadcast meteorology, there are many [possible options](#) in applied meteorology.

Agrometeorology

Agrometeorology (also known agricultural meteorology) is the study of weather and use of weather and climate information to enhance or expand agricultural crops and/or to increase crop production. Entry-level positions in agrometeorology require a student with a strong educational background in a physical science (e.g. meteorology, physics, environment, etc.) and mathematics along with a working knowledge of agriculture. For more information regarding this field, see the article [Application of Meteorology to Agriculture](#).

For students interested in this career path, it is recommended that students augment the [Meteorology BA degree](#) with courses in mathematical modeling [such as MATH 470 (Mathematical Modeling)], computer programming in C++ or Python, and biology courses connected to agriculture [such as BIOL 300 (Botany), BIOL 301 (Plant Taxonomy), BIOL 302 (Plant Anatomy), and BIOL 444 (Plant Ecology)]. Since many meteorologists who work in the agricultural industry work as consultants, the [AMS Certified Consulting Meteorologist \(CCM\) Program](#) may be useful. For students who are interested in the business side of agrometeorology, the [Business Applications of Weather and Climate minor](#) will be useful.

Aviation Meteorology

Aviation meteorologists provide weather information to airline flight dispatchers and pilots. He or she must determine current and forecasted weather conditions for all altitudes, including the direction and speed of wind, cloud cover, and precipitation. Aviation weather reports are different from other weather reports because they consider what conditions may affect a flight. If heavy turbulence is likely at one altitude, the pilot needs to know ahead of time what altitude he or she can fly to avoid the turbulence. Aviation meteorologists rely on weather radar, computers, weather station information, and other tools to compile their reports. An aviation meteorology may pursue a career in [corporate aviation](#), [commercial aviation](#), or in the public sector for organizations as the Federal Aviation Administration (FAA) and the National Oceanic and Atmospheric Administration (NOAA).

For students interested in this career path, it is recommended that the student complete the [Operational Meteorology Concentration](#). Furthermore, it is recommended that the student pursue an internship for the [FAA](#) or another organization in the aviation industry. Since CofC does not have any official course in aviation, it is recommended that the student complete the following COMET/MetEd course: [Review of Aeronautical Meteorology](#).

Consulting

There are many professional meteorologists who are employed as meteorological consultants in the private sector. For this reason, there is a demand for certified consultant meteorologists (CCMs). The [AMS Certified Consulting Meteorologist \(CCM\) Program](#) is the only organized testing and evaluation program in the United States that certifies meteorologists as qualified to market their services as independent consultants. Those who've earned the CCM certification are recognized worldwide as experts and as possessing the wherewithal to be competitive in their weather forecasting niches. CCMs also may deliver testimony in weather-related court cases, such as those involving slip-and-fall accidents. As can be seen in the [following presentation](#), CCMs are active in numerous industries such as

- Transportation and shipping
- Wind energy and solar power
- Agribusiness
- Construction and engineering

Thus, the CCM program may be useful for students who desire to be a professional meteorologist outside of the National Weather Service (NWS) and broadcast meteorology. For more information on the CCM program and the work done by CCMs, see the following video: <http://www.webinars.ametsoc.net/whatisaccm.wmv>.

Students will fulfill the requirements for the CCM from the AMS if they complete the following coursework, **in addition** to those required by the [Meteorology BA degree](#):

1. MATH 221 (Calculus III)
2. PHYS 272 (Methods of Applied Physics) **OR** [MATH 203 (Linear Algebra) and MATH 323 (Differential Equations)]
3. PHYS 215 (Synoptic Meteorology) (not additional to the BA if this is selected as the emphasis area)

Plus 3 out of the 4 following tracks:

1. Track 1: PHYS 459 (Cloud and Precipitation Physics)
2. Track 2: PHYS 415 (Fluid Mechanics)
3. Track 3: PHYS 230 (Modern Physics) and PHYS 405 (Thermal Physics)
4. Track 4: GEOL 438 (Hydrogeology) and PHYS 105 (Introduction to Meteorology)

NOTE: Students may not use PHYS 101/102 to satisfy the requirement of a year in introductory physics if they wish to obtain the CCM certificate.

Since most consulting meteorologists work in the private sector, it is also useful to develop skills that are useful for the private sector, such as communication skills, business/finance skills, and computer programming.

Forensic Meteorology

Forensic meteorologists use historical weather data to reconstruct the weather conditions for a specific location and time (consider the [following profile of a forensic meteorologist](#)). Forensic meteorologists provide past weather reports for law firms, insurance companies, engineering firms, and private individuals. They investigate events such as: slip-and-falls on snow, ice and/or water; motor vehicle accidents; wind damage; lightning strikes; sun glare; weight of snow on a roof; extreme heat and cold; floods; and other unusual events. Forensic meteorologists may be called as experts to testify in court.

Because a forensic meteorologist must demonstrate that he/she has the professional experience and educational requirements to render such expert opinions, forensic meteorologists are usually required to obtain the CCM certification from the AMS. For more information regarding the educational requirements necessary to obtain the CCM certification, see the section above on Consulting.

Since forensic meteorologists are often hired by the private sector, the [Business Applications of Weather and Climate minor](#) will be useful. Furthermore, since forensic science is a combination of law and science, it will also be helpful to complete some courses in political science and law. For the best advice with regards to the best courses in law, it will be useful to visit the [Pre-Law Advising Program](#) for more detailed guidance.

Insurance and Risk Management

Because of the growing concern over climate change, many insurance companies are hiring professional meteorologists. For example, meteorologists could assess the risks of how drought conditions in the Midwest could lead to wet weather in Europe. On a more local scale, insured losses due to meteorological events have increased dramatically over the past thirty years and meteorological expertise is useful for simulating events. Generally, meteorologists who work in insurance companies build catastrophe models, conduct meteorological research, and educate employees and clients about natural catastrophe risk.

Another subfield within insurance that uses meteorological expertise is risk management. Weather derivatives are financial instruments that can be used by organizations or individuals as part of a risk management strategy to reduce risk associated with adverse or unexpected weather conditions. Weather derivatives are index-based instruments that usually use observed weather data at a weather station to create an index on which a payout can be based. This index could be total rainfall over a relevant period—which may be of relevance for a hydro-generation business—or the number where the minimum temperature falls below zero which might be relevant for a farmer protecting against frost damage. Within the private sector, weather derivative trading has become a multi-billion dollar industry (see the following [video presentation](#) and the following [article](#) for more details).

In terms of education, meteorologists in insurance firms need business acumen, computer programming skills, and a solid knowledge of statistics and presentations skills. For students interested in applied meteorology to insurance, one could combine the [Meteorology BA](#) degree with a minor in [Pre-Actuarial Studies](#) and a minor in [Computer Science or Computer Information Systems](#). Furthermore, since business acumen is needed to work for insurance firms, the [Business Applications of Weather and Climate minor](#) will be useful.

Military

Various branches of the military employ meteorologists to assist with operations and perform research. Using the Air Force as an example you can be more of a [traditional forecast officer](#) stationed at a base or participate in field missions as a Special Operations Weather Technician. The [Navy](#) and [Army](#) also have meteorologists that serve in similar capacities. For students interested in a military career, Charleston Southern University (CSU) collaborates with CofC through the [Air Force ROTC](#) and [Army ROTC](#) program. Furthermore, CSU offers [coursework in military science](#). It is also recommended that interested students should consider doing an internship through [Charleston-AFB](#).

Software Development

Because of the central use of numerical weather prediction (NWP) in meteorology, atmospheric modeling is a skill that will be demand. There is demand for atmospheric models in research and development (i.e. improving global and mesoscale forecasting models) and in [software development for private weather forecast companies](#). Many of the atmospheric modeling jobs in the private sector also have the label of “meteorology developer” or “meteorological software developer.” There are many employers who are looking for students who are excellent at programming (using Python, C++, or PHP), but also understand meteorology.

For students interested in this career path, it is recommended that students couple the [Meteorology BA degree](#) with a [BS Computer Science degree](#) or a [BS Computer and Information Systems degree](#) at CofC. Some students may find it advantageous to pursue [MS in Computer and Information Science degree](#) (with the software engineering specialization) at CofC.

Technician and Instrumentation

Meteorological technicians collect much of the data that meteorologists use to construct weather models and make weather forecasts. Technicians work with meteorologists, geophysicists, air traffic controllers, and other atmospheric scientists to help forecast and observe atmospheric conditions. They are often involved in more than one task at one time, and use computers, weather balloons, and measuring instruments to collect, record, and interpret information. They read instruments that measure air pressure,

temperature, wind speed and direction, precipitation, and other conditions. Many meteorological technicians use their technical skills and knowledge of computers to transmit data to and from the National Weather Service (NWS), and supply information to other federal, state, and local agencies.

For students who are interested in pursuing this career path, entry-level positions require the [Meteorology BA degree](#) with additional course work in electronics (PHYS 340). Since many employers prefer technicians with many hours of practical hands-on experience, it is recommended that interested students pursue an internship at an NWS office that focuses on computer processing of weather maps and charts; atmospheric instrumentation use; and weather station operation. Finally, the [CCM certificate](#) from the AMS provides a special certification for all meteorological technicians.

Atmospheric Physics Careers

Introduction

In its simplest form, atmospheric physics is the application of physics to the study of the atmosphere. Atmospheric physicists attempt to model Earth's atmosphere and the atmospheres of the other planets using fluid flow equations, chemical models, radiation budget, and energy transfer processes in the atmosphere. To model weather systems, atmospheric physicists employ elements of scattering theory, wave propagation models, cloud physics, statistical mechanics and spatial statistics which are highly mathematical and related to physics. Consequently, atmospheric physics has close links to meteorology and climatology and covers the design and construction of instruments for studying the atmosphere and the interpretation of the data they provide, including remote sensing instruments. The common subfields in atmospheric physics are remote sensing and radiation; cloud physics and atmospheric electricity; and atmospheric fluid dynamics. The [Atmospheric Physics Concentration](#) is designed for students who are interested in these fields. There are many career paths for atmospheric physics students. (For research careers in atmospheric physics, see the section [Research and Academia](#))

Aerospace and Defense Industry

Atmospheric physicists are often employed by the aerospace and defense industry under different labels such as aerospace scientists. Aerospace scientists are engaged in the study of (1) the Earth and planetary atmospheres and ionospheres; (2) fields and particles in the interplanetary space environment; (3) the sun and extrasolar objects, and radiation emitted by them; (4) the chemical, physical and morphologic properties of moons, planetary bodies and other solid materials in the solar system and of samples therefrom; (5) data obtained from the above investigations; and, (6) development of instrumentation for these purposes.

In addition to completing the [Atmospheric Physics Concentration](#), entry-level positions in this field often require coursework in electronics (i.e. PHYS 320/320L) and optics (i.e. PHYS 340/340L). Other useful coursework includes PHYS 350 (Energy Production), PHYS 460L (NASA Space Mission Design Leadership Lab), and ASTR 306 (Planetary Astronomy).

Data Science

Data science is the study of extracting useful information from the plentiful datasets now available across a wide range of fields, such as atmospheric science. The ability to leverage data to improve understanding has always been important, but this is becoming increasingly so as data becomes more readily available. This is particularly true in climatology, numerical weather prediction (NWP), and remote sensing. Currently, data

science is being applied to atmospheric science research in order to generate improved deterministic and probabilistic nowcasts and short-range forecasts of precipitation, convection, severe weather, and tropical storm intensity ([this article](#) gives an example of data science can be used in the atmospheric science).

In addition to completing the [Atmospheric Physics Concentration](#), it is recommended that students who are pursuing a path in data science should complete the [Data Science BS degree](#). Furthermore, students who complete the Atmospheric Physics Concentration will also have the necessary background to pursue the [Master of Data Science and Analytics degree](#).

Instrumentation

Atmospheric physicists may also work as instrument specialists who provide technical support for operating and maintaining meteorological instruments (such as anemometers, radiometers, soil sensors, etc.) and data collecting systems. At higher-level positions, atmospheric physicists design and create instrumentation that is used for research laboratories and for the aerospace industry.

In addition to completing the [Atmospheric Physics Concentration](#), this area requires a background in electronics (such as PHYS 320/320L), optics (such as PHYS 340/340L), a moderate level of experience in computer management and digital communications, and programming experience in Python. Interested students may consider pursuing a minor or major in [computer information systems](#) at CofC.

Remote Sensing Specialist

[With the growth of geospatial technology and its use in business](#), the demand for remote sensing specialists is growing. Careers in the field are available in all states and throughout the private, public, government, and academic sectors. Remote sensing specialists may be hired as geographers, cartographers, physical scientists, computer scientists, [GIS analysts](#), remote sensing scientists, surveyors, photogrammetrists, image analysts, or other professionals. Remote sensing specialists are also found in the [satellite technology industry](#) and in the [radar technology industry](#).

In addition to completing the [Atmospheric Physics Concentration](#), it is recommended that students who are pursuing a path in remote sensing technology should complete coursework in GIS [such as GEOL 442 (Geological Application of Remote Sensing) and GEOL 449 (Geographical Information Systems)], satellite technology [such as PHYS 457 (Satellite Meteorology)], and additional courses in electromagnetism [such as PHYS 320/320L (Electronics) and PHYS 410 (Electromagnetism II)]. Some students may find it useful to obtain a [Geoinformatics minor](#).

Interdisciplinary Careers

Introduction

There are many additional careers that use meteorology and applied physics in an interdisciplinary manner. In this section, we provide a number of interdisciplinary careers which can be pursued by combining the [Meteorology BA degree](#) with another degree at CofC.

Air Pollution Analyst

Because of the increased interest in environmental safety and the stresses currently being placed on the environment, the field of air pollution and air quality mitigation is a large, growing field. An air pollution analyst (also called air quality field technician) is a professional scientist that collects, organizes, and examines data from polluted air. Air pollution analysts will measure, sample, and analyze data gathered from polluted air. After theorizing or discovering the source of the pollutants, they work with other specialized scientists to develop future techniques for reducing or eradicating air pollution. Hence air pollution analysts. Air pollution analysts are often employed by government agencies on a federal, state, or local level. The data collected often inspires environmental policy changes. However, private corporations and business will sometimes hire air pollution analysts to determine the environmental detriments of their own procedures and practices. For more information on the possible jobs associated with air pollution and/or air quality mitigation, see the following [webpage](#).

At the minimum, air pollution analysts require a bachelor's degree in natural sciences, physical sciences, mathematics, or another related field. Higher education and research experience will help garner higher salaries, so attending Grad School is recommended in today's competitive job market. Some qualities that successful air pollution analysts possess are: (1) A basic background in chemistry and biology; (2) a basic knowledge of statistics and data analysis; and (3) ability to work well with other scientists, including engineers and chemists.

Students who are interested in this industry could combine the [Meteorology BA degree](#) (focused on air pollution) with a [Chemistry BS degree](#) (focused on environmental chemistry) or an [Environmental Studies minor](#). Additional statistical courses [such as MATH 250 (Statistical Methods I) and MATH 350 (Statistical Methods II)] are also useful. The graduates from any of our programs could also pursue the [Masters in Environmental Studies program](#).

Air Quality Modeling and Forecasting

Air quality modelers work with computer simulations to predict how pollutants will affect a geographical location immediately or later. In most cases, they work to ensure that polluting businesses comply with legislation. Air quality modelers source massive amounts

of data from many sources, from people working in meteorology and other weather-based research roles. They convert this hard data into readable reports such as graphical simulations, GIS imaging or written reports. Specialists in air quality may use this data in meteorology reports. Legislators, policy makers, and public health bodies will also use the information in a variety of ways. Most air quality modelers work for government agencies such as the Environmental Protection Agency (EPA) and other environmental protection groups, local, national, and international.

Entry-level air quality modelers usually will start with a meteorology degree. The strong data and statistics-based nature of the job means that interested students should take a minor in mathematics or statistics. A master's degree would be more suitable to advisory roles such as policymaking - you will need to be able to interpret data as well as understand and present if you are to work with policy makers in government or private business. Graduates will certainly need a doctorate for college and university research and teaching roles. Strong communication skills will be required for teaching and advisory / consultancy.

Students who are interested in this industry could combine the [Meteorology BA](#) degree (focused on air pollution) with [Mathematics BS degree with the statistics track](#). Additional coursework in mathematical modeling [such as MATH 470 (Mathematical Modeling)] and environmental chemistry (such as CHEM 422/422L) will also be useful.

Climatology

Depending on the position, a climatologist might be called upon to wear many different hats. A climatologist might do hands on research such as taking water or soil samples, then analyze and report on the [data](#). They may make presentations on their research at seminars or conferences, or provide an analysis of other research to employers, government officials, or other interested parties. Climatologists can also be problem solvers, applying the research to address local climate issues, or to determine how to best work under different climate conditions. For example, they can work with or as weather forecasters, working to improve accuracy through developing new measurement tools and statistical models; conduct simulations; and translate findings into more easily understood terms for the public. Climatologists can work in academic and research institutions as well as government, public or private agencies, and nonprofits. Climatologists can also take on a consulting role, working for engineering and environmental consulting firms.

Entry level climatology positions will require a bachelor's degree in climatology or a related field such as meteorology or atmospheric science. Usually, climatologists have a solid foundation in chemistry, physics, mathematics, and oceanography, along with other technical skills for GIS, satellites, and radar. For students who are interested in this field, it is recommended that they combine the Meteorology BA degree with additional coursework in GIS, oceanography, computer programming, and data science. Some students may want to pursue a double major with the Meteorology BA and the [Data Science BS degree](#) in order to

increase their marketability. Another option is to pursue advanced graduate-level work in climate science. Some relevant programs include

- MS in Climate Science at [George Mason University](#)
- MS in Climate Science and Solutions at [Northern Arizona University](#)
- MS/PhD in Climate Sciences at [Utah State University](#)

For more information, see the following [webpage](#).

Education and Teaching

Because of the [teaching shortage within the STEM fields in South Carolina public schools](#), there is a growing demand for science and mathematics secondary education teachers. Because of the rigorous scientific education that is gained through the Meteorology and Atmospheric Physics program, graduates of our program also will have the background necessary to become a teacher. Apart from their scientific training, science educators should have excellent written and verbal skills and be able to communicate effectively with students, parents, and colleagues. Science teachers must be detail oriented, effective at problem-solving, and have excellent teaching skills. A bachelor's degree and a teaching certificate is typically required to teach in public schools. For those who are interested in become a secondary school teacher, one could pair the Meteorology BA degree with [Secondary Education BA](#).

For those who are interested in pursuing a career in science education research and pedagogy, CofC offers a [Master of Education in Science and Mathematics](#). The mission of this program is to develop K-12 science and math teachers and informal educators who are more effective at helping their students learn. The program seeks to increase and broaden students' knowledge in the natural sciences and mathematics, their ability to integrate knowledge across scientific disciplines and between science and mathematics and develop more sophisticated and diverse pedagogical content knowledge and instructional skills. The program also seeks to develop professional teachers who can critically and effectively reflect on teaching practice and contribute to improving science and math teaching at the school, district, or state-wide levels.

Energy Meteorology

A rapidly changing energy sector has created [new challenges](#) for meteorologists, not least because many renewable energy sources are highly weather sensitive. For this reason, renewable energy is a growing field for meteorologists. In the energy industry, atmospheric physics is needed for the assessment and forecasting of the power output from solar and wind energy systems, and thus for the planning, monitoring, and efficient operation of these systems. For students interested in this aspect of the renewable energy sector, the [Atmospheric Physics Concentration](#) would be a useful path to pursue along with courses in energy production (such as PHYS 350). Some students may want to pursue the Atmospheric

Physics Concentration and the [Energy Production Concentration](#) in order to increase their marketability.

Within the energy sector, climatological data are usually used for the assessment of solar and wind energy resources, whereas near real time data and forecast of atmospheric variables are needed for the prediction of fluctuating power outputs. For students who are interested in this aspect of the renewable energy sector, the [Operational Meteorology Concentration](#) along with courses in data science. Some students may want to pursue the Operational Meteorology Concentration with the [Data Science BS degree](#) in order to increase their marketability. Furthermore, students who complete the Operational Meteorology Concentration will also have the necessary background to pursue the [Master of Data Science and Analytics degree](#).

Environmental Law

Environmental law is a broad area of law that encompasses a range of issues surrounding the environment including water and air quality, hazardous waste, species protection, agriculture, wetlands, biodiversity, waste management, green initiatives, sustainability strategies and alternative energy sources. As sustainability becomes a global priority, lawyers who can advise clients on green standards and sustainability issues are in demand. It is predicted that climate change, global warming and other environmental legislation will increase the legal work for environmental lawyers in coming years.

The purpose of an environmental lawyer is to work with environmental case law and legislation to represent various environmental interests. Environmental laws regulate and define the activities of humans upon the geological and biological systems that are affected by contact. Issues such as ecology, sustainability, responsibility, and stewardship are often cause for legal actions. Environmental lawyers can represent clients in environmental matters, advocate for development in environmental policy and law as well as write academically on environmental law.

Students who are interested in this industry could combine the [Meteorology BA](#) degree with a [Political Science BA degree with a law concentration](#). To practice as an environmental lawyer, you usually will need to obtain a law degree (JD). Further qualification is also available including a Master of Law (LLM), Master of Environmental Law, or a Doctor of Philosophy (PhD). These further options are a good option for lawyers seeking more senior roles or a higher pay grade. Once you have completed your law degree, you are required to gain practical experience and sit further examinations to be admitted to the bar. Once you are admitted to the bar you can represent clients and formally provide legal advice.

Hydrology

Hydrology is the science that encompasses the study of water on the Earth's surface and beneath the surface of the Earth, the occurrence and movement of water, the physical and chemical properties of water, and its relationship with the living and material

components of the environment. Hydrologists apply scientific knowledge and mathematical principles to solve water-related problems in society: problems of quantity, quality, and availability. They may be concerned with finding water supplies for cities or irrigated farms; controlling river flooding or soil erosion; or they may work in environmental protection (i.e. preventing or cleaning up pollution or locating sites for safe disposal of hazardous wastes).

Persons trained in hydrology may have a wide variety of job titles. Scientists and engineers in hydrology may be involved in both field investigations and office work. In the field, they may collect basic data, oversee testing of water quality, direct field crews and work with equipment. Many jobs require travel, some abroad. A hydrologist may spend considerable time doing field work in remote and rugged terrain. In the office, hydrologists do many things such as interpreting hydrologic data and performing analyses for determining possible water supplies. Much of their work relies on computers for organizing, summarizing, and analyzing masses of data, and for modeling studies such as the prediction of flooding and the consequences of reservoir releases or the effect of leaking underground oil storage tanks.

While a bachelor's degree is sufficient for some entry-level jobs, most hydrologists will need a graduate degree in the natural sciences. Students who are interested in this career path could combine the [Meteorology BA](#) with the [Environmental Geosciences BS](#) which focuses on water resources and hydrogeology. Furthermore, computer modeling, data analysis, and digital mapping are highly marketable skills for hydrologists.

Journalism

Environmental journalism is the collection, verification, production, distribution, and exhibition of information regarding current events, trends, issues, and people that are associated with the environment. To be an environmental journalist, one must have an understanding of scientific language and practice, knowledge of historical environmental events, the ability to keep abreast of environmental policy decisions and the work of environmental organizations, a general understanding of current environmental concerns, and the ability to communicate all of that information to the public in such a way that it can be easily understood, despite its complexity. Students who are interested in this career could combine the [Meteorology BA](#) degree with a [Communication BA degree](#) or a [English BA degree](#). For more information on science and environmental journalism, see the following [webpage](#).

Public Policy and Public Health

As the field of environmental studies has expanded, so has our understanding of the complexity of environmental issues. Many different concerns, including those of the public, private industry, and the scientific community must be balanced to approach the environmental concerns facing our society today. In training students to handle the challenges posed by a career in the environmental field, experts have found that an

interdisciplinary course of study offers the most comprehensive preparation. For this reason, environmental public policy is a field of growing importance. Students who pursue this career option can work within city, state, or federal government (such as the [Department of Health and Environmental Control](#)). Others can work as a legislative aide or a consultant.

Students who are interested in pursuing a career in environmental public policy and/or public health could combine the [Meteorology BA](#) degree with a [Political Science BA degree with a public policy concentration](#) or a [Public Health BS degree](#). Moreover, the [MPA/MES program](#) at CofC allows a student to attain two Master's degrees in three years without compromising any of the academic content in either program. This program is aimed at preparing students for professional level positions in public organizations that address environmental issues.

Additional Resources

Here are additional resources for careers in meteorology and atmospheric physics

- [American Geosciences Institute \(AGI\)](#) is the premier professional association for geoscientists of all stripes. It hosts a data hub for information about educational programs and careers. It also provides professional development, publishes Earth magazine, and makes the professional literature available through the GeoRef database.
- [American Meteorological Society \(AMS\) Career Guides and Tools](#)
- [American Geophysical Union \(AGU\) Career Resources](#)
- [National Association of Environmental Professionals \(NAEP\)](#) is a multidisciplinary association for all types of environmental professionals. NAEP organizes networking opportunities, including an annual conference and regional meetings and events. It also offers webinars and hosts a career center.
- [National Weather Service \(NWS\) Career Resources](#)