METEOROLOGY

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WTAE

I THE SCIENCE OF METEOROLOGY

A. Definition: According to the American Meteorological Society, meteorology is the science of the atmosphere. It takes its name from the Greek word "meteoron"- something that happens in the sky.

B. History and Timeline

350 BC - Aristotle writes *Meteorology*. The book is not about the science, as we know it today. ***Meteorology*** was more an earth science book that dealt with air and water. A very notable and impressive achievement in *Meteorology* was his description of the hydrologic cycle. In his own words:
"*Now the sun, moving as it does, sets up processes of change and becoming and decay, and by its agency the finest and sweetest water is everyday carried up and is dissolved into vapour and rises to the upper region where it is condensed again by the cold and so returns to the earth."*

1494 - Christopher Columbus experiences a tropical cyclone. First written European account of a hurricane.

1606 - Galileo Galilei invents the thermometer.

1647 - Blaise Pascal determines that atmospheric pressure decreases with height.

1654 - Ferdinand de Medici finances the first weather observing network in Tuscany, Italy.

1686 - Edmund Halley identifies solar heating as the mechanism which drive atmospheric motions.

1686 - Edmund Halley shows a relationship between barometric pressure and atmospheric sea level.

1714 - Gabriel Fahrenheit creates the reliable temperature measuring scale.

1742 - Anders Celsius, a Swedish astronomer creator the Centigrade temperature scale.

1841- first known weather maps prepared.

1847 - Hermann von Helmholtz publishes a statement on The First Law of Thermodynamics. Also called the law of conservation of energy.

1849 - Smithsonian Institute establishes an observation network with 150 observers who send data via telegraph.

1860 - Robert FitzRoy creates first daily "weather forecast" in England.

1873 - First hurricane warning issued by the U.S. Army Signal Corp.

1902 - Stratosphere is discovered.

1919 - Cyclone Model is introduced.

1941 - Pulsed radar network is introduced during WWII. Operators notice echoes from rain and snow.

1954 - Numerical weather prediction done on a routine basis.

1959 - Vanguard 2, the first weather satellite is launched on Feb 17.

1969 - Saffir-Simpson Hurricane Scale created.

1970 - NOAA becomes the NWS

1975 - First Geostationary Operational Environmental Satellite (GOES) launched into orbit.

1988 - WSR-88D type weather radar implemented in the U.S.

C. Technology

Since 1959 meteorological satellites have provided an overview of the atmosphere's cloud patterns. Infrared sensors mounted on meteorological satellites now provide observations of the vertical temperatures of the atmosphere, and research efforts continue the development of computer forecasting models. There is a large use of computers for modeling.

II METEOROLOGY AS A CAREER

A. What Is a Meteorologist?

The American Meteorological Society defines a meteorologist as a person with specialized education "who uses scientific principles to explain, understand, observe, or forecast the earth's atmosphere and/or how the atmosphere affects the earth and life on the planet." Meteorologists study and predict weather and climate and its relationship on other environmental processes and the impact on our lives and economy. Specifically meteorologists can have many different jobs including daily weather forecasting, atmospheric research, teaching, broadcasting and supporting clients through private sector meteorological companies.

B. How many mets are there?

In the United States it is estimated that there are about 30,000 to 35,000 men and women whose professional activities involve some aspect of the atmospheric sciences. Some call themselves atmospheric scientists, environmental engineers, atmospheric physicists or chemists. Very closely allied to meteorology are fields of oceanography and hydrology.

1. Mets usually fall into one of five sub-categories:
   - Public/Government Sector (apt. 5000)
   - Private Sector (Apr. 8000)
   - Military
   - Education/Research Sector
   - Media Forecasting (over 2000)

C. Is it for you?

Depends, can you answer yes to most of these questions?
Do you like to work with people?
Are you curious about the physical world? The sky? Maps?
Are you intrigued by the concept of using math to describe things that happen in the natural world?
Like computers?
Like math?
Like physics?
I mean really...like math and physics?

III EDUCATION

A. High School ... college preparatory classes / AP classes to work towards college credits while attending high school

1. focus on math/science
2. remember that a higher GPA/ASCT/SAT scores, the more money colleges/universities offer for your education
3. check out the AMS website (www.ametsoc.org) for more reading materials to get a jumpstart on your meteorology knowledge and to learn if this is really what you'd like to pursue
4. GREAT IDEA...CALL ME AT WTAE TO SET-UP A DAY TO 'SHADOW' ME (GOOD WAY TO DETERMINE IF YOU LIKE THE CAREER)

B. Schools / Universities ...

1. a list on the AMS website/ www.theweatherprediction.com
    a. locally, Indiana University of PA ... Penn State University
2. CALIFORNIA UNIVERSITY OF PENNSYLVANIA
AMS Member

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C. Meteorology Curriculum

1. General objectives

a. The objectives of a bachelor's degree program in atmospheric science should include strong preparation for:

b. a successful career in atmospheric science or a closely related field through a combination of in-depth education and the development of a range of relevant professional skills; or

c. graduate study in atmospheric and related sciences through in-depth education and focus on critical thinking, problem solving, reasoning, and analytic and other scientific skills.

2. Course offerings

A curriculum leading to a Bachelor of Science or Bachelor of Arts degree in atmospheric science should contain

a. at least 24 semester hours 2 of credit in atmospheric science courses that include the following:

• 12 semester hours of lecture and laboratory courses, with calculus as a prerequisite or corequisite 3, in atmospheric thermodynamics and dynamic, synoptic, and mesoscale meteorology that collectively provide a broad treatment of atmospheric processes at all scales;

• 3 semester hours of atmospheric physics, with emphasis on cloud/precipitation physics and solar and terrestrial radiation 3;

• 3 semester hours of atmospheric measurements, instrumentation, or remote sensing, including both lecture and laboratory components;

• at least 3 semester hours in applied/specialty meteorology topics such as:

• advanced dynamics, agricultural meteorology, air pollution meteorology, applied climatology, aviation meteorology, broadcast meteorology, hydrology or hydrometeorology, physical geography, oceanography, tropical meteorology, and weather forecasting;

• up to 3 semester hours of a synthesizing experience 4 such as an undergraduate research project a capstone course; an internship focused on a career in atmospheric science or a closely related field; or work experience closely related to the atmospheric sciences;

2) a minimum of a three-semester sequence of calculus that includes vector calculus and ordinary differential equations, in courses designed for majors in either mathematics, physical sciences or engineering;

3) a one-year sequence in physics lecture and laboratory courses, with calculus as a prerequisite or corequisite;

4) at least one course (3 semester hours) in chemistry appropriate for physical science majors;

5) a course with a multi-disciplinary and/or integrative approach to an environmental topic, such as a course on climate change

6) an appropriate level of coursework or demonstrated competency in the following areas: computer science or information technology appropriate for physical science majors, including a course that teaches scientific, structured

programming skills; statistics appropriate for physical science majors; technical, scientific, and professional writing, and oral communication; Whenever possible and where appropriate, course requirements should include components that utilize modern computer and instrumentation labs and facilities.

As in any science curriculum, students should have the opportunity and be encouraged to supplement minimum requirements with additional course work in the major and supporting areas. This supplemental course work may include: The use of computers and numerical models in the atmospheric sciences has increased dramatically in recent years. Students should be strongly encouraged to build skills in computer programming, graphic and web design, data manipulation, statistics, and numerical modeling. Students with strong backgrounds in statistics and computer science will be especially well-positioned to contribute to the advancement of the atmospheric sciences within most specialty areas

Finally, as noted in the introduction, the curriculum described above differs from federal civil service requirement. However, it is recommended that courses required to fulfill federal employment requirements-even if not required for the curriculum-be made available. Further, if the offering of such courses is not consistent with the educational objectives of the program, then the institution has an obligation to inform prospective students that the completion of their undergraduate degree will not fully qualify them for entry-level employment in federal agencies.

IV RESPONSIBILITIES OF A BROADCAST METEOROLOGIST

A. Watches &/or Warnings

1. #1 responsibility is to forewarn the public of any watches &/or warnings (ominous conditions); In turn, it's our jobs are to inform and protect the viewer(s).

    a. use technology like Live Pinpoint Doppler 4 to depict real-time weather conditions

1. extremely important during severe weather

    b. it's important to express excellent oral and visual skills while on-air; It's not our job to scare. but it is our job to inform.

2. Watches & Warnings

A. **The Severe Storms Forecast Process:**

Outlook to Mesoscale Discussion to Watch to Warning

SPC forecasters have a huge variety of tools at their disposal. Foremost is their formal training and experience in severe storms forecasting, which is unique to SPC. Past and current weather observations allow them to closely monitor changes in the atmosphere that lead to severe and hazardous weather. These observations come from satellite imagery, radars, surface weather stations, weather balloon soundings, wind profilers, lightning detection network, and information from local NWS offices. They also use such tools to assess how well the computer models are doing; then they use this knowledge to judge how reliable the models are for forecast purposes.

The severe weather forecast process at SPC begins with the **Convective Outlook**, which is a forecast of where both severe and non-severe thunderstorms are expected to occur around the country. Areas of possible severe thunderstorms are labeled "SLGT" (slight risk), "MDT" (moderate risk), or "HIGH" (high risk), depending upon the coverage and intensity of expected severe thunderstorms in a region. Many NWS offices use the Outlook to make emergency staffing decisions before severe weather begins.

As time progresses, a severe weather threat often becomes better defined over an area smaller than the Outlook, both in space and time. **Mesoscale Discussions** (MDs) are often needed to describe an evolving severe weather threat, and also to advise of possible watch issuance. [MDs are also issued for weather hazards that don't necessarily involve severe thunderstorms, including excessive rain, heavy snow and general thunderstorm trends.] Meteorological reasoning in MDs helps forecasters at local NWS offices to understand causes and prepare for the types of severe weather expected.

If development of severe thunderstorms is imminent, or likely to occur in the next several hours, the next step is a **Severe Thunderstorm** or **Tornado Watch**. Such watches alert the public, aviators and local NWS offices that environmental conditions have become favorable for the development of severe storms or tornadoes. Local storm spotter networks activate; and forecasters in the threat area closely monitor radar imagery and spotter reports to issue the appropriate severe thunderstorm and tornado warnings.

When severe hail (at least 3/4-inch diameter), damaging winds (at least 50 knots or 58 mph) or a tornado appear imminent, local NWS offices will issue a **Severe Thunderstorm Warning** or **Tornado Warning** as appropriate. The warning rapidly disseminated over NOAA Weather radio, commercial radio and TV stations and news wires, so that people in the warning area can find safe shelter to take cover from the storm.

B. We are the station's scientists

1. We need to understand the weather in detail, plus have limited knowledge about Astronomy and other scientific information that may be useful to add extra comments about news stories

C. Public Appearances/Community Service

1. It's important to get to meet your viewer, one-on-one, whenever possible. The more exposure you have in the community, the more likely you can elongate your career and possibly boost ratings. On-air talent drive the ratings, and ratings mean money. In other words, talent need to attract eyes in order for the station to prosper. Your job lies partly within the hands of Nielsen Media Research every February, May, July and November (sweeps/ratings periods)

V FORECASTING: WEATHER BASICS

A. The Vertical Structure of the Atmosphere

1. Divided into four layers.

Thermosphere > 50 mi.

Mesosphere 31-50 mi.

Stratosphere 7-7.5 mi. - 31 mi.

Troposphere (up to 7 mi.):

Makes up more than 50% of the atmosphere.

Heated largely from below so temperature decreases with ht. -6.5 degrees C/km.

Contains weather.

B. Low Pressure (Cyclone)

1. Air converges at the surface and diverges in the upper troposphere
2. The low pressure intensifies if more air is converging at the surface than is diverging at upper elevations
3. The flow around a low pressure system in the N.H. is counter-clockwise with the wind blowing in toward the center of the low.
4. Associated with unstable atmospheric conditions, cloudiness, and stormy weather.

C. High Pressure (Anticyclone)

1. Air converges in the upper troposphere and diverges at the surface.
2. The high pressure intensifies if more air converges in the upper troposphere and sinks than diverges at the surface.
3. The flow of air around the high pressure system in the N.H. is clockwise.
4. Associated with fair, dry conditions.

D. Air Mass: a widespread body of air extending over an area of several million square kilometers that is approximately homogeneous. Particularly with reference to temperature and water vapor concentration.

1. U.S weather is dominated by continental polar (cool/dry) and maritime tropical (warm and moist) from the Gulf of Mexico

E. Front: the boundary between two air masses. The less dense air is usually pushed up over the denser air which leads to cooling often resulting in precipitation.

1. cold front-generally involves wedging
2. warm front-generally involves overrunning
3. occluded front
4. stationary front

VI FORECASTING

A. Analysis of a Surface Plot

B. Analysis of a Surface Map

C. Analysis of an 850 mb Map

1. Warm and Cold air advection.
2. Meteorologists forecast snow if the temp at this height will 0 or below.

D. Analysis of a 500 mb Map

1. Troughs and ridges
2. Meteorologists forecast snow if the height of this level is to be at or below 5340m.

E. Analysis of a 300 mb Map

1. Upper winds steer lower features.
2. Jet streams/jet streaks are observed at this mb. They are "rivers of air" which drive the weather below.