

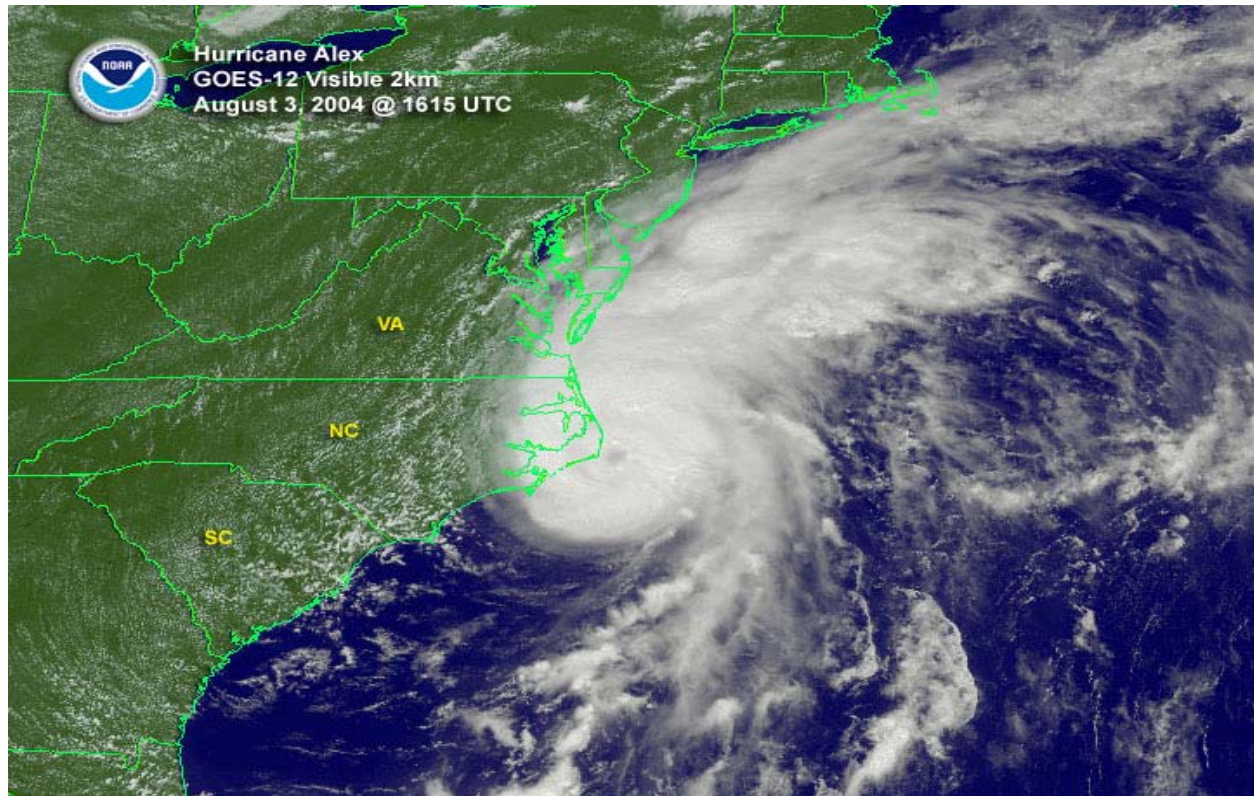
WEATHER SATELLITE IMAGERY

Fact Sheet



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

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WEATHER SATELLITES

In the silent vacuum of space, weather satellites orbit the Earth. They are the platforms from which the atmosphere and underlying surfaces are carefully watched from above.

Weather satellites give an almost continuous view of weather events while providing valuable information on the atmosphere between earthbound weather stations. This has helped to fill data gaps over the oceans and sparsely populated areas.

The detection and surveillance of hazardous weather conditions (especially severe thunderstorms and hurricanes) are major benefits arising from the use of weather satellites.

Geostationary satellites provide the imagery seen on most television weathercasts. They are located in orbits some 22,300 miles above the Earth's surface. These

satellites remain above the same point on the equator, requiring the same time to orbit the planet as the Earth takes to make one rotation.

VISIBLE AND INFRARED IMAGERY

Satellites supply visible light and infrared images. The visible pictures are made with sunlight while the infrared ones are based on heat radiating from the earth and the atmosphere. Visible and infrared images complement each other. Used in combination, they provide a much more detailed picture of the atmosphere than would otherwise be possible.

The photograph above is a typical visible light image received from a weather satellite. The photo is the result of reflected sunlight, and looks very much like a standard color photograph. Actually, such photos are constructed here on Earth, line by line, from digital information gathered by the satellites sensors, but they can be interpreted just as if they were taken by a

regular camera in space. In this respect, visible imagery can be thought of as an old familiar tool being used in a new, unfamiliar area. Certain features are common to all visible light pictures. Clouds are excellent reflectors of light so they appear very white. The land masses are often shades of gray (unless snow-covered), and the water areas are very dark, almost black. Map outlines have been added to the photo so that land, water, and atmospheric features can be easily located.

At night, when there is no sunlight, there can be no visible imagery. Most weather satellites have sensors that “see” both day and night. They detect the Earth’s heat, or infrared radiation. Since the Earth radiates heat all the time, infrared images are available day and night.

The chances are good that you have seen many infrared images. Most satellite pictures seen on television weathercasts are probably infrared pictures.

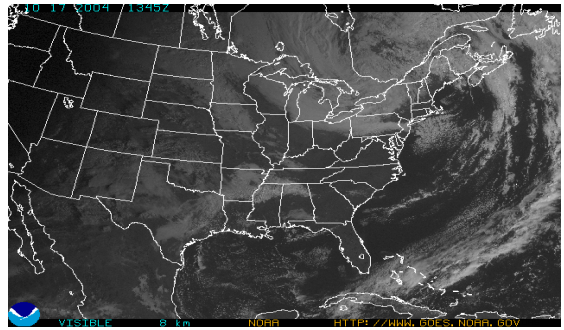
Infrared imagery is really just an ordinary picture showing different temperatures as black, white, or some shade of gray. Very cold temperatures are shown as white and very warm as black. A rough comparison of cloud heights can be made from the different shades of gray.

The tops of high clouds are very cold so they will appear white in the infrared photos. Mid-level clouds are somewhat warmer so they will be a light gray shade. Low clouds are warmer still, so they will be a darker shade of gray. Often low clouds are nearly the same temperature as the surrounding terrain and cannot be distinguished at all. In that case, you need a visible light satellite photo to detect them.

All satellite photos are initially received and processed as black and white images. However, most satellite pictures appearing on television have been colored. Often land surfaces are shown as brown, water as blue, and clouds as white or shades of gray.

ENHANCED INFRARED IMAGERY

Satellite infrared data can be further processed by computer to produce enhanced images. In the enhancement process, any shade of gray may be assigned to any temperature when more contrast is needed to highlight a certain temperature range. For example, on an ordinary infrared photograph, the cold tops of high clouds appear uniformly white. Since high cloud tops are often associated with violent weather, adding greater contrast helps to locate areas of more intense weather. Enhanced infrared imagery is especially useful in locating and tracking severe thunderstorms and hurricanes.



SATELLITE IMAGE INTERPRETATION

Almost all television weathercasters use satellite imagery as a vital part of their weather presentation. A single image, such as the one shown on the preceding page, is often used by weathercasters to illustrate the current state of the atmosphere. This photograph shows the weather conditions across the United States at a particular time. Compare the satellite photo to the surface weather photo to the surface weather map, shown above, for the same time. Quite clearly, the satellite view and the weather map show several noticeable relationships.

Regions of high surface air pressure, such as the high pressure system located over the south-central United States, are typically associated with clear skies. Cloudiness and precipitation are likely to be found in surface lows and along fronts. Showers and thunderstorms often form along cold fronts. Broad expanses of clouds and steady rain (or snow) form in advance of warm fronts.

The motion of weather systems can be determined by quickly viewing a series of successive satellite photos. This makes it possible to determine the speed and direction of movement of observable weather systems.

Satellite images add a different perspective to weather viewing. By looking down from above, it is possible to see the weather systems and features that dominate the atmosphere and the resulting weather patterns.

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For more educational activities go to
www.ncdc.noaa.gov/oa/edu.html

Classroom Activity Sheet

THIS CLASSROOM ACTIVITY SHEET ACCOMPANIES A FACT SHEET ON THE SAME WEATHER TOPIC. IT IS ONE OF A SERIES WHICH PROVIDE SUGGESTIONS FOR THE TEACHING OF SELECTED TOPICS IN METEOROLOGY. INFORMATION FOR THE TEACHER IS GIVEN BELOW. THE STUDENT ACTIVITY ON THE BACK OF THIS PAGE IS DESIGNED TO BE COPIED AND GIVEN TO EACH STUDENT.

FOR THE TEACHER: How copies of current weather satellite imagery can be obtained and used in the classroom.

BACKGROUND: The clouds and cloud patterns seen on weather satellite imagery are related to the weather occurring at the Earth's surface. Adequate copies of satellite images can be made for use in current weather studies.

SUGGESTED APPROACH: A practical method for acquiring copies of current satellite photographs is to go the NCDC Historical Significant Events Imagery web page. This can be done by the teacher or a student volunteer.

- print copies of satellite images.
- using a blank map display cloud features.

Outline areas of complete cloud cover. Partly cloudy areas should be shaded using cross-hatching. High, thin clouds can be indicated by stippling.

A surface weather map can be obtained from the newspaper for the same date.

Display the satellite and map drawings on a classroom bulletin board or make copies for distribution to students.

MATERIALS: Satellite images, set of colored overhead projection pens (washable ink), student copies accompanying Weather Satellite Imagery Fact Sheet and Student Activity, blank maps (if used).

MODIFICATIONS: Contact the National Climatic Data Center, 151 Patton Avenue, Asheville, N.C. 28801, Tel: 828 - 271 - 4800. Request copies of satellite imagery. Though the copies will be for past weather, they make excellent classroom examples. Or, go to the NCDC Historical Significant Events Imagery page at <http://www5.ncdc.noaa.gov/cgi-bin/hsei/hsei.pl?directive=welcome>.

N. C. STANDARD COURSE OF STUDY AND GRADE LEVEL COMPETENCIES:

Grade 7 - Competency Goal 3

The learner will make observations and build an understanding of weather concepts.

Objectives

3.06 Assess the use of technology in studying atmospheric phenomena and weather hazards:

- Satellites.
- Weather maps.
- Predicting.
- Recording.
- Communicating information about conditions.

Student Activity

INVESTIGATION: What do weather satellite pictures show?

OBJECTIVES: After completing this activity, you should be able to:

1. Locate areas of cloud cover (completely overcast, partly cloudy, and high thin clouds) on a current weather satellite picture.
2. Relate weather satellite picture and surface map features.

METHOD:

1. Read the *Weather Satellite Imagery Fact Sheet* given to you by your teacher.
2. Follow your teacher's instructions to find out how to interpret the weather satellite picture available in the classroom.
3. Use the weather satellite picture and the available surface map to answer the questions below.

QUESTIONS:

1. What are the relationships between the cloud cover seen on the satellite picture and the centers of Highs and Lows shown on the weather map?
2. Can you detect any relationships between the cloud cover seen on the satellite picture and the locations of fronts indicated on the weather map? If you can, what are they?
3. Using the satellite picture as your only source of information, where would you expect to find precipitation? Explain.
4. Can you think of one kind of major storm that is easily detected with satellite imagery? Name the storm and make a drawing of what it might look like in a satellite photograph.