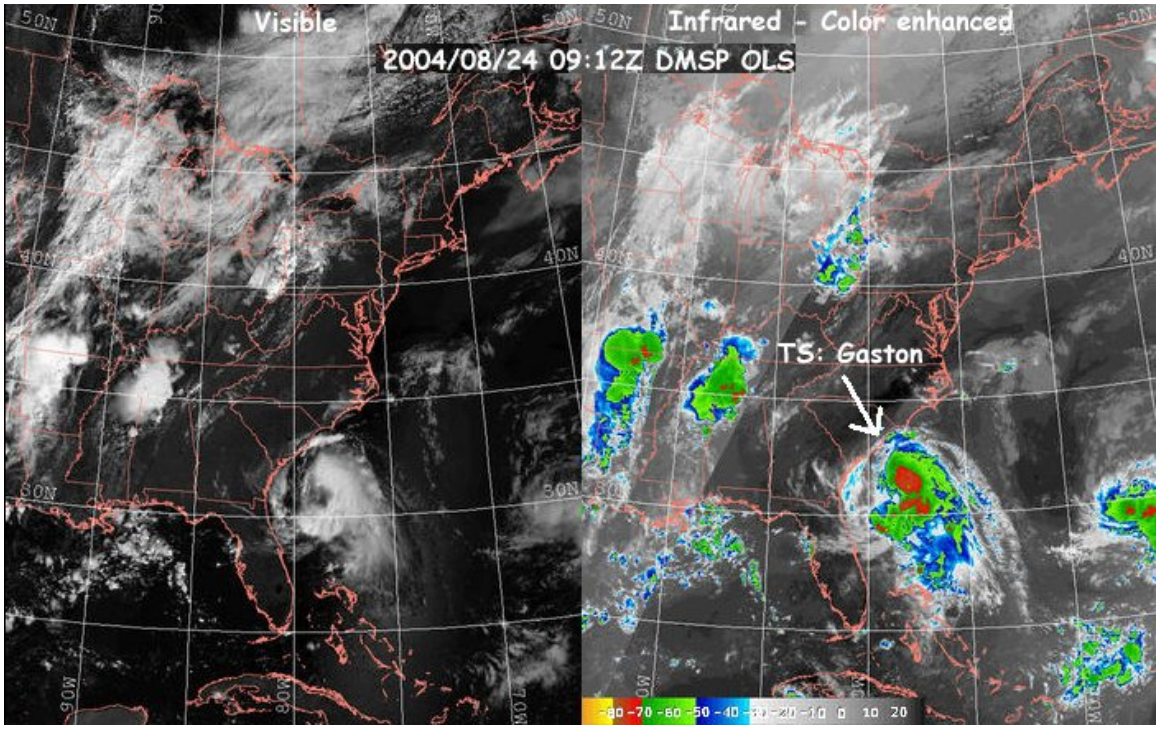
Satellite Product Tutorials:

Infrared Imagery



Above: Tropical Storm Gaston is about to make landfall on South Carolina. The storm's most intense components correspond to the coldest cloud tops (depicted here in red). Within the complex cloud features that occur on a regular basis over the United States, the user can quickly key in on the more vertically-developed clouds based on temperature information alone. These clouds are typically associated with lower temperatures, as depicted in clouds with embedded color contours. Note how the infrared-color enhanced image on the right panel displays the storm's intensive structure (red) much more clearly than the brightness features depicted in the visible image on the left. It is also easier to apply infrared imagery to distinguish the more intensive convective activity from other cloud cover as shown with thunderstorm activity over the southeastern US. Finally, the tiny cloud cells in the Gulf of Mexico provide little information as to the vertical extent within the visible image. Within the infrared (IR) image, the embedded

colors within these clouds represent a "tell-tale" sign of cumulus cloud development.

Why We're Interested…

Infrared (IR) images are a powerful tool for interpreting a variety of weather phenomena. Unlike visible images that require sunlight, IR images are products of electromagnetic emissions that emerge constantly from the earth/atmosphere system. Therefore, IR images are available for interpretation both day and night. As a result, a weather observer can continuously track features such as cold fronts and hurricanes during all hours of the day. In addition, since the IR energy received by the satellite can be directly related to temperature, one can determine the earth's surface (land, water) as well as atmospheric (cloud top) temperatures within the image. Additionally, the infrared portion of the electromagnetic spectrum covers a much broader band of energy than does visible light. This gives us the ability to glean more information about the different constituents of the atmosphere they all interact to various parts of the IR spectrum in unique ways.

How This Product is Created…

Conventional IR imagery has typically been displayed in gray shades, where dark shades (land during the day, water, low clouds) correspond to warm parts of the scene and white shades (high level clouds, mountains, or cool land at night) correspond to cold areas. To aid in image interpretation, various color-table enhancements can be applied to the IR image. One of the more popular formats is a color table where gray shades represent warmer features, followed by a "step up" to more vibrant colors that represent the colder cloud top temperatures (see above) that are often of interest to the meteorlogist. In this way, the observer can easily separate and analyze a) low clouds, land and fog and b) middle and high level clouds.

How to Interpret…

Gray-shade as well as color-enhanced IR satellite images (shown above) are actually measurements of "brightness temperature," (which for the infrared channels traditionally used for IR imagery are good approximations to the actual (thermodynamic) temperature) rather than reflected light as in visible satellite images. There is usually a color table bar (see legend in color-enhanced IR image in figure above) that matches the particular color

to a temperature. As shown above, colder (higher) cloud tops are indicated by shades of green, blue and purple, like those stretching from Missouri to South Carolina. Low clouds dominate the upper Midwest regions.

Looking Toward the NPOESS Era…

IR images have been available for as long as visible images—since the inception of weather satellites in the 1960's. Major improvements to recent IR sensors on board weather satellites include higher spatial resolutions, i.e., cloud and surface features appear sharper within higher resolution. The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Visible/Infrared Imager/Radiometer Suite (VIIRS) will continue to make the best use of the knowledge base established within the remote sensing community. Thermal and near infrared are very important to understanding how and what the weather is doing. NPOESS-VIRRS scanning system has greatly improved the age-old edge of scan problem, making VIIRS imagery of much higher quality and utility.

Did You Know…?

IR imagery looks softer to the eye than visible imagery. Two reasons really, IR sensors cover more earth surface per pixel then visible imagery, and because it is measuring temperatures, which do not change as rapidly as reflected light.

Want to Learn More?

http://climate.geog.udel.edu/~tracyd/geog674/geog674_history.html

Technical P.O.C.: Kim Richardson (kim@nrlmry.navy.mil)