Satellites See Wisconsin: A History

Space Science and Engineering Center, University of Wisconsin-Madison

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For more than 50 years, the University of Wisconsin-Madison has been a leader in devising ways to view our planet through the eye of a satellite. In particular, scientists at the UW-Madison Space Science and Engineering Center (SSEC) have been at the forefront of developing the satellite technology that makes it possible to see and study the intricacies of Earth's atmosphere from space. Some of the earliest experiments, beginning in the 1950s, were led by Professor Verner E. Suomi, founder of the Space Science and Engineering Center, and Professor Robert J. Parent, of the UW-Madison College of Engineering.

Continuous observations of the Earth's atmosphere from space revolutionized scientists' understanding of the motions of the atmosphere, paving the way for more accurate weather forecasts and faster and more precise warnings for severe weather, which have saved many lives and mitigated damage from storms and other severe weather events. Suomi's contributions set the foundation for the technologies that made the routine observing of the Earth's weather from space possible. For those contributions, he is widely considered to be the "father of satellite meteorology."

With the establishment at Wisconsin of the Cooperative Institute for Meteorological Satellite Studies (CIMSS) in 1980, satellite meteorology research at UW-Madison was bolstered through a more formal working relationship with the National Oceanic and Atmospheric Administration (NOAA). NOAA stations scientists at CIMSS to work side-by-side with Wisconsin researchers to continue the pioneering research begun by its founder, Verner E. Suomi.

For more information please visit:
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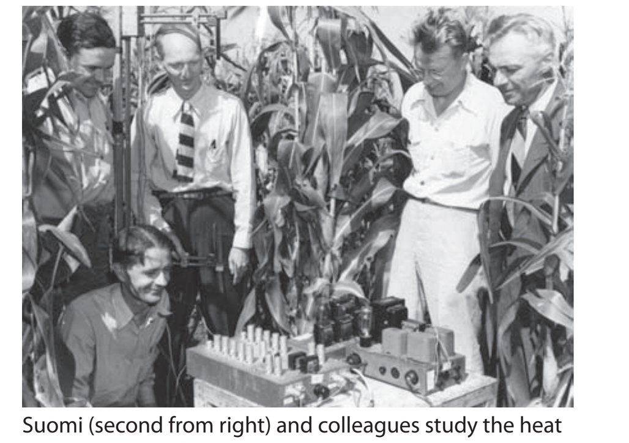
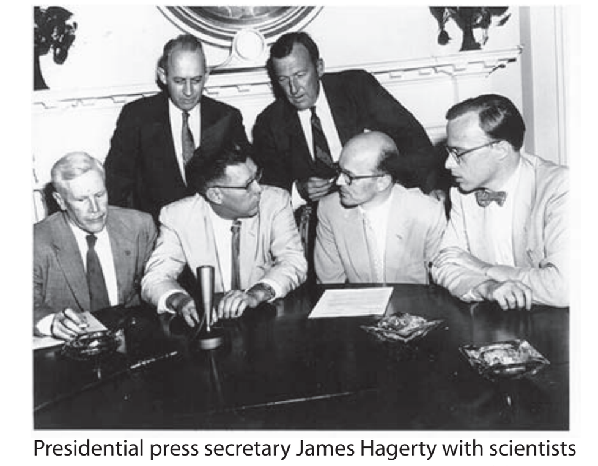
First rocket launch from Cape Canaveral, July 1950. Using a V-2 missile base, the upper stage was able to reach nearly 400 kilometers, higher than modern space shuttles fly today.
Credit: NASA

1950
First rocket launch from Cape Canaveral.

1953
Satellite weather pioneer Verner E. Suomi measured the heat budget of a corn field in support of his doctoral thesis from the University of Chicago. He measured the difference between the amount of energy absorbed and the amount of energy lost in a cornfield. This led him to think about the Earth's heat budget.


Suomi (second from right) and colleagues study the heat budget of a cornfield in 1953.
Credit: Iowa State College (University) Experiment Station, courtesy Space Science and Engineering Center, UW-Madison

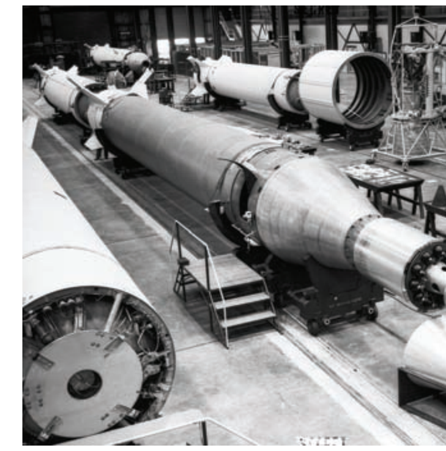
1955
U.S. announces plans to launch world's first man-made satellite.


Presidential press secretary James Hagerty with scientists during a meeting at which the announcement of President Dwight Eisenhower's approval of a satellite plan was made. Front, left to right, are: Dr. Alan T. Waterman, Hagerty, Dr. S. Douglas Cornell and Dr. Alan Shapley. Standing, left to right: Dr. J. Wallace Joyce and Dr. Athelstan Spilhaus.
Credit: NASA


Model of the Russian satellite Sputnik 1.
Credit: NASA

1957
In October, the Soviet Union successfully launches Sputnik 1 as a contribution to the IGY, triggering the space race between the United States and the U.S.S.R.

International Geophysical Year (IGY), 1957-1958, postal stamp. First day of issue. The U.S. participated in the IGY; meteorology was an area of global cooperation.
Credit: Don Hillger, Colorado State University


The Jupiter-C Assembly at the Army Ballistic Missile Agency (ABMA), Redstone Arsenal, in Huntsville, AL. Jupiter-C successfully launched the first American satellite, Explorer 1, into orbit on 31 January 1958.
Credit: NASA Marshall Space Flight Center (NASA-MSFC)

1958
Congress passes the Space Act, creating the National Aeronautics and Space Administration, or NASA.

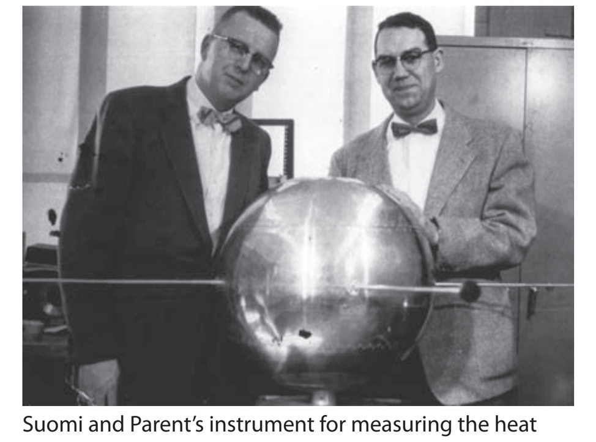
The United States successfully launches its first satellite, Explorer-1, on 31 January 1958.

Suomi and Parent had three launch attempts in 1959, an unprecedented effort. Two of the launches ended in failure, but the third, Explorer 7, was successful, resulting in the first meteorological experiment of Earth from space.
Credit: Wisconsin State Journal, Friday July 17, 1959, reprinted with permission

1959
Radiometer instrument designed by Suomi and Parent to conduct the first Earth radiation experiment flies on Explorer 7. With this experiment, Suomi establishes the critical role played by clouds in absorbing solar energy, setting the stage for the integration of satellites into the field of meteorology.


Parent and Suomi work on their early satellite instrument.
Credit: UW-Madison Communications

1959
Failed Vanguard SLV-6 launch 22 June 1959.

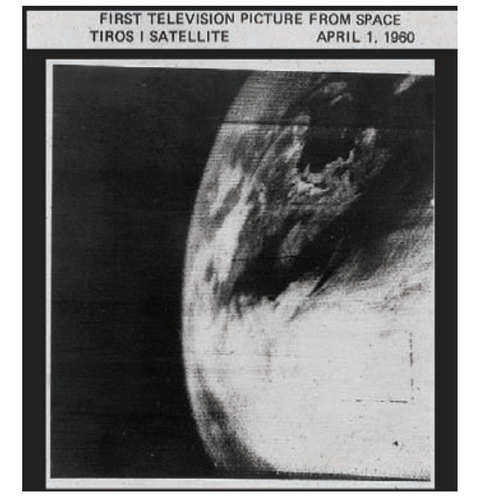

Suomi and Parent's instrument for measuring the heat balance of the Earth was carried on Vanguard SLV-6, launched on 22 June 1959. A faulty second stage pressure valve resulted in the mission's failure.
Credit: NASA

1959
Failed Explorer 7x launch 16 July 1959. (See WSJ article above.)


Suomi and NASA scientist Herman LeGow inspect Explorer 7. This photograph shows the actual satellite, not a model.
Credit: NASA Glenn Research Center (NASA-GRC)

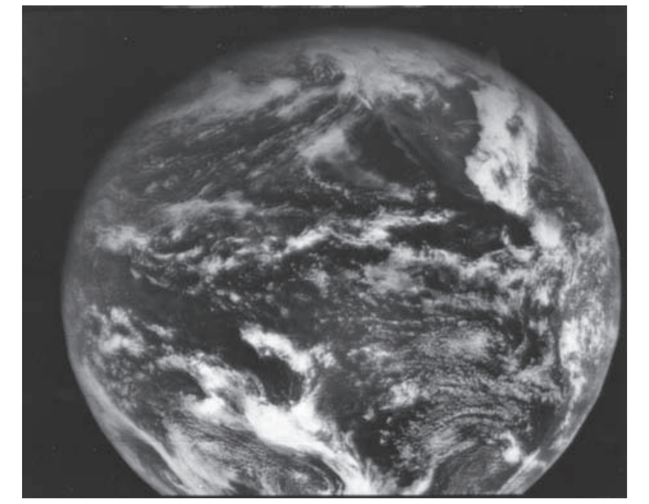
1959
Finally, success: Explorer 7 launches successfully 13 October 1959.


Explorer VII launches successfully on 13 October 1959.
Credit: NASA Marshall Space Flight Center (NASA-MSFC)


First picture of Earth from TIROS-I.
Credit: National Oceanic and Atmospheric Administration (NOAA)

1960
The TIROS Program (Television Infrared Observation Satellite) was NASA's early program to determine if satellites could be useful in the study of the Earth.

1966
ATS-I, the first geostationary satellite, launched on 7 December 1966 (UTC). It carried Parent and Suomi's Spin Scan Cloudcover Camera (SSCC), the technology that made viewing Earth from geosynchronous orbit possible. The launch of ATS-I ushered in the era of continuous viewing of weather from space. Suomi understood the benefits of observing a single weather phenomenon over time. These kinds of observations were not possible using the early, low-altitude polar-orbiting satellites.


ATS-I image, 11 December 1966.
Credit: Schwerdtfeger Library, Space Science and Engineering Center, UW-Madison

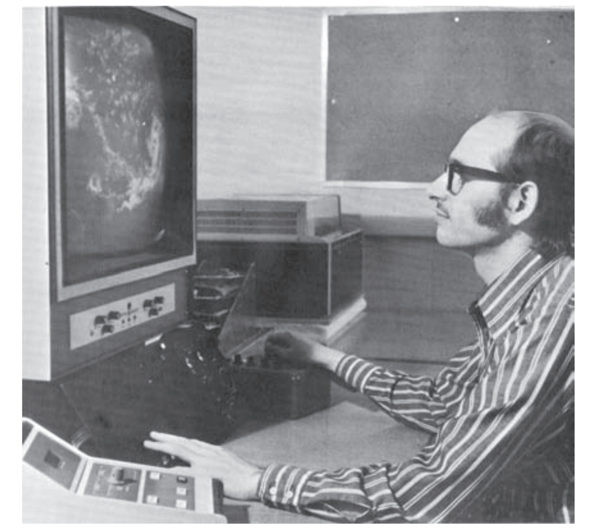
1967
ATS-III launched on 5 November 1967. It sent the first color images from the Multicolor Spin Scan Cloud-cover Camera (MSSCC), the second generation of Suomi's revolutionary technology. The ATS-III was the only geostationary satellite with a channel for observing phenomena in true blue color, which was, and remains, a unique feature for a weather satellite. The camera provided color pictures for approximately three months at which time the red and blue channels failed. The system continued to transmit black-and-white pictures until 11 December 1974.


ATS-III image from 18 November 1967.
Credit: Space Science and Engineering Center, UW-Madison


Scientists work on ATS-III in preparation for launch.
Credit: NASA

1968
Visualization software developed at SSEC allowed display and manipulation of the ATS images.

"As he watched a football game on television, he realized that what he really wanted was an instant replay of weather pictures."

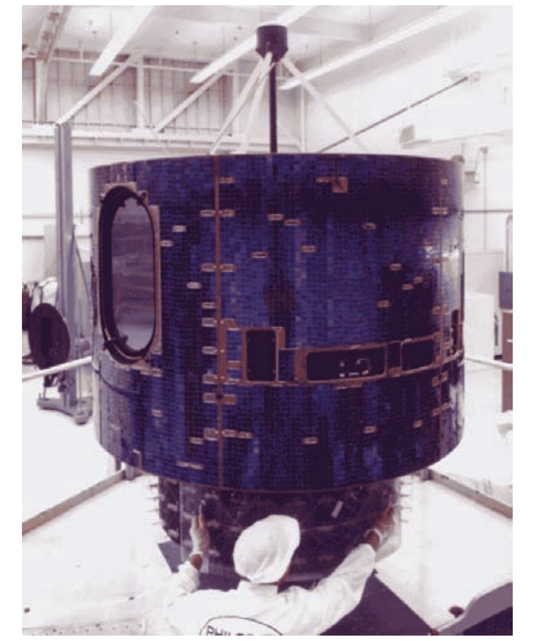

Man-computer Interactive Data Access System (McIDAS).
Credit: UW-Madison Communications

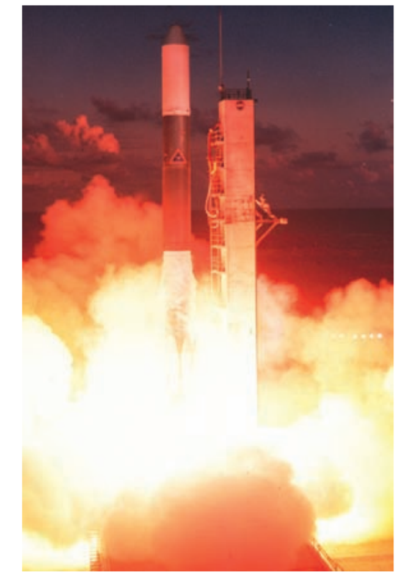
1972
Introduction of Man-computer Interactive Data Access System (McIDAS): the world's first system to visualize satellite images and obtain accurate cloud motions. McIDAS complemented Suomi's spin-scan camera in geosynchronous orbit, as a system for acquiring, storing, navigating (aligning images with Earth locations) and animating images from satellites. The combination of these two inventions enabled people to see, for the first time, animated cloud images, now a routine feature of television weather reports.

1974
The success of Suomi's camera on the ATS series of satellites led to NASA's Synchronous Meteorological Satellite (SMS) with an infrared camera, allowing scientists to see clouds at night and to estimate their height in the atmosphere. SMS launched on 17 May 1974.

The Global Atmospheric Research Program (GARP) Atlantic Tropical Experiment (GATE), benefitted from the infrared camera that Suomi recommended. GARP was the first truly global effort to gather data on atmospheric circulation and other weather phenomena.

By applying the video-processing capability of McIDAS, the 'nowcasting' concept evolved emphasizing intermediate-sized atmospheric features yielding better forecasts.

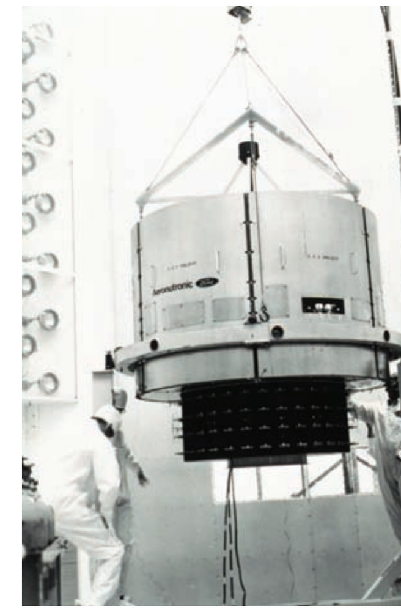

The Synchronous Meteorological Satellite (SMS).
Credit: NASA


GOES-1 launch 16 October 1975.
Credit: National Oceanic and Atmospheric Administration (NOAA)

1975
SMS led to GOES-1 launched on 16 October 1975, carrying Suomi's camera.

1977
GOES-2 launched on 16 June 1977 aboard a Delta rocket.


GOES-2 satellite before launch.
Credit: National Oceanic and Atmospheric Administration (NOAA)


GOES-1, the first geostationary orbiting environmental satellite.
Credit: National Oceanic and Atmospheric Administration (NOAA)

1978
First GARP Global Experiment (FGGE) planned for 1978-1979. SSEC was selected to archive satellite wind vectors from cloud heights. Suomi played a key organizing role. Europe and Japan adopted Suomi's basic concept to establish geostationary imaging over their parts of the world.

1979
UW-Madison Space Science and Engineering Center, working with industry, NOAA and NASA, led the design of the High-resolution Interferometer Sounder (HIS), the first hyperspectral GOES sounder, an instrument used to vertically probe the atmosphere.


SSEC scientists work on the High-resolution Interferometer Sounder (HIS).
Credit: Space Science and Engineering Center, UW-Madison

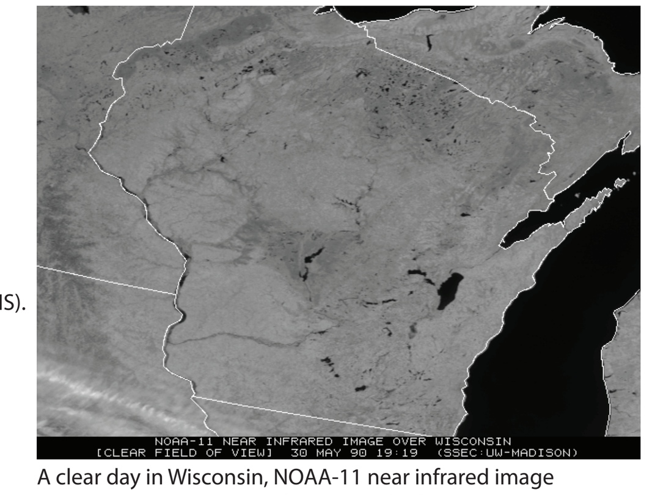

GOES-4 launch on 9 September 1980.
Credit: National Oceanic and Atmospheric Administration (NOAA)

1980
Cooperative Institute for Meteorological Satellite Studies (CIMSS) founded by Dr. Suomi through an agreement with NOAA and NASA.

GOES-4, launched 9 September 1980, was the first geostationary satellite to provide continuous vertical profiles of atmospheric temperature and moisture. A new instrument, the Visible Infrared Spin Scan Radiometer (VISSR) Atmospheric Sounder (VAS), was a modification of the original spin-scan design. It was the first geostationary sounder. Wisconsin researchers led the world in developing infrared sounders which dramatically improved weather forecasts. Real-time applications from VAS were demonstrated by the UW/NOAA team.

McIDAS installations continued to expand with support and systems provided to the National Hurricane Center, NASA (in support of space shuttle launches), weather agencies worldwide, and commercial entities such as United Parcel Service.

1983
VAS data incorporated into many new products for the National Weather Service.



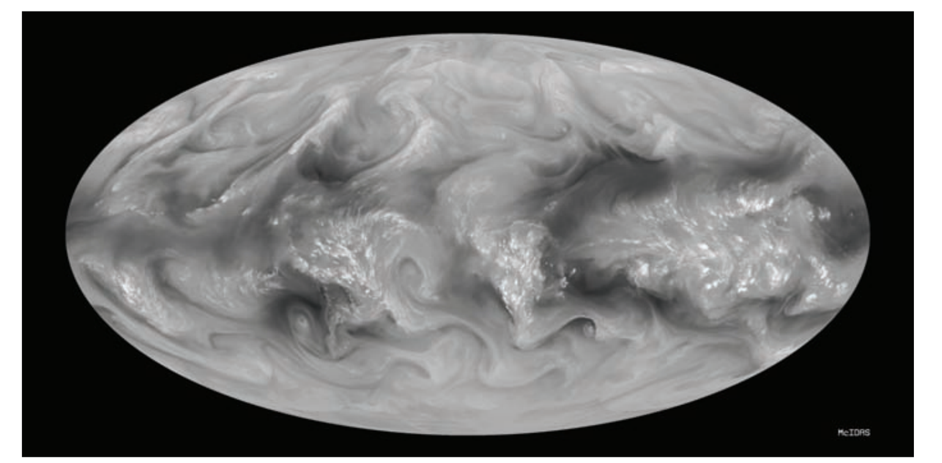
A clear day in Wisconsin, NOAA-11 near infrared image on 30 May 1990 processed using McIDAS.
Credit: Space Science and Engineering Center, UW-Madison

1988
SSEC participated in software and instrument development for next-generation geostationary satellites.


GOES-8 (artist's rendition).
Credit: National Oceanic and Atmospheric Administration (NOAA)

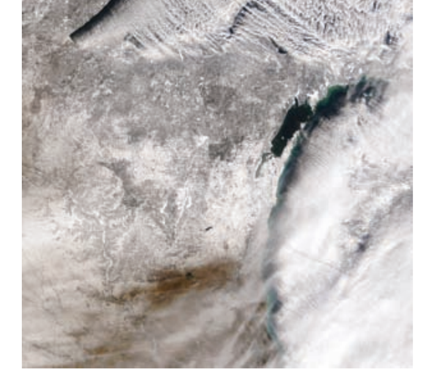
1991
World-wide network of McIDAS sites continued to expand.

1994
GOES-8 launched 13 April 1994 and is the first GOES satellite deployed on a three-axis stable platform. The National Oceanic and Atmospheric Administration (NOAA) team at SSEC developed ingestors (the devices that receive satellite data), simulations, and provided technical expertise.



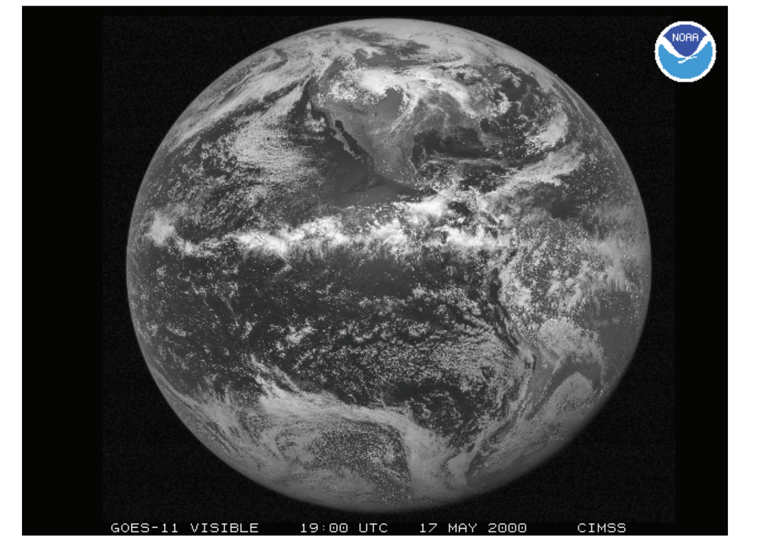
This global composite image, generated with McIDAS, combines GOES (United States), Meteosat (European), and MTSAT (Japanese) satellite data to show water vapor in the atmosphere.
Credit: Space Science and Engineering Center, UW-Madison

1999
The Terra satellite is an important part of NASA's Science Mission. The MODIS Science Team at UW-Madison utilizes imagery from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite to study developing weather patterns.


Wisconsin in winter, taken from the Terra satellite on 22 December 2004.
Credit: Space Science and Engineering Center, UW-Madison


Workers at Vandenberg Air Force Base in California prepare NASA's Terra spacecraft (right) for encapsulation in its external structure (left) before launch.
Credit: NASA

2000
GOES-11 launched 3 May 2000. First official visible channel image from GOES-11 posted on SSEC website on 17 May.



GOES-11 image, 17 May 2000.
Credit: Space Science and Engineering Center, UW-Madison

2001
CIMSS and NOAA's Advanced Satellite Products Team (ASPT) participated in GOES-12 pre-launch activities and performed the GOES-12 science tests, checking data quality, producing products from data stream and comparing them to those from other satellites, investigating the impact of new spectral bands, and posting hourly displays of data from all 19 sounder channels.

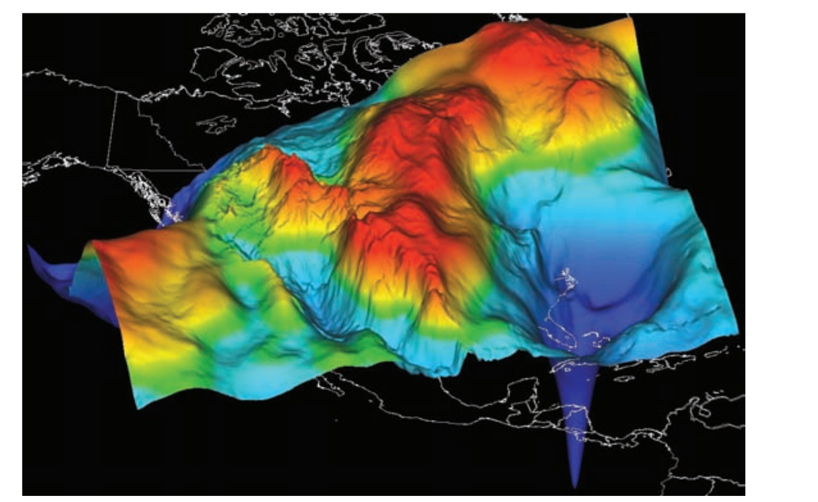

Fall color in Wisconsin, taken from the Aqua satellite on 6 October 2003.
Credit: Space Science and Engineering Center, UW-Madison

2002
Aqua, Latin for water, is a NASA Earth Science satellite mission named for the large amount of information that the mission will collect about the Earth's water cycle. The Aqua Science Team at UW-Madison and CIMSS processes the imagery to study the atmosphere, clouds, precipitation, sea and land ice, and snow cover.


GOES-14 launched at Cape Canaveral on 27 June 2009 with a mission to improve weather prediction in North America. GOES-15 followed in 2010.
Credit: National Oceanic and Atmospheric Administration (NOAA)

2009
GOES-14 launched 27 June 2009.

2010
McIDAS V, the fifth generation of SSEC's visualization software now displays weather satellite and other geophysical data in 2- and 3-dimensions for improved analysis of weather phenomena.


McIDAS V allows combination and manipulation of data to overlay atmospheric phenomena onto surface contours of the Earth.
Credit: Space Science and Engineering Center, UW-Madison


Technicians check the alignment of the GOES-O satellite onto a special stand for loading of its propellants.
Credit: NASA

2015
Anticipated launch of GOES-R. NOAA and CIMSS scientists are currently developing and testing instruments for improved and timely weather forecasts and detection of meteorological phenomena that affect public safety.

2016
The Climate Absolute Radiance and Refractivity Observatory (CLARREO) will use black body temperature sensors (used for temperature calibration and designed by SSEC) and a new type of interferometer.