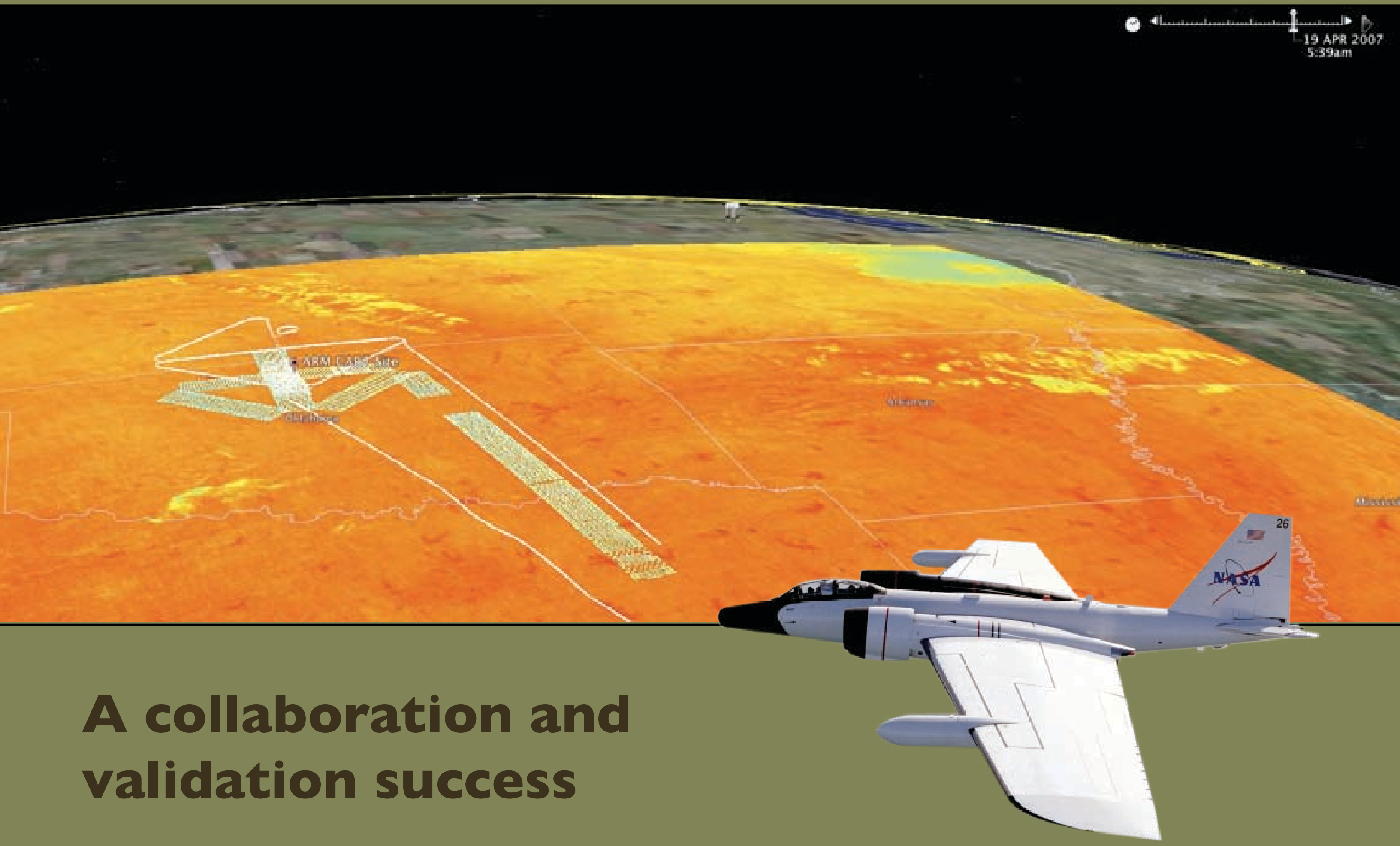
University of Wisconsin-Madison
Space Science and Engineering Center
Cooperative Institute for Meteorological Satellite Studies

through the atmosphere

Winter 2008

JAIVEx field campaign:



A collaboration and validation success

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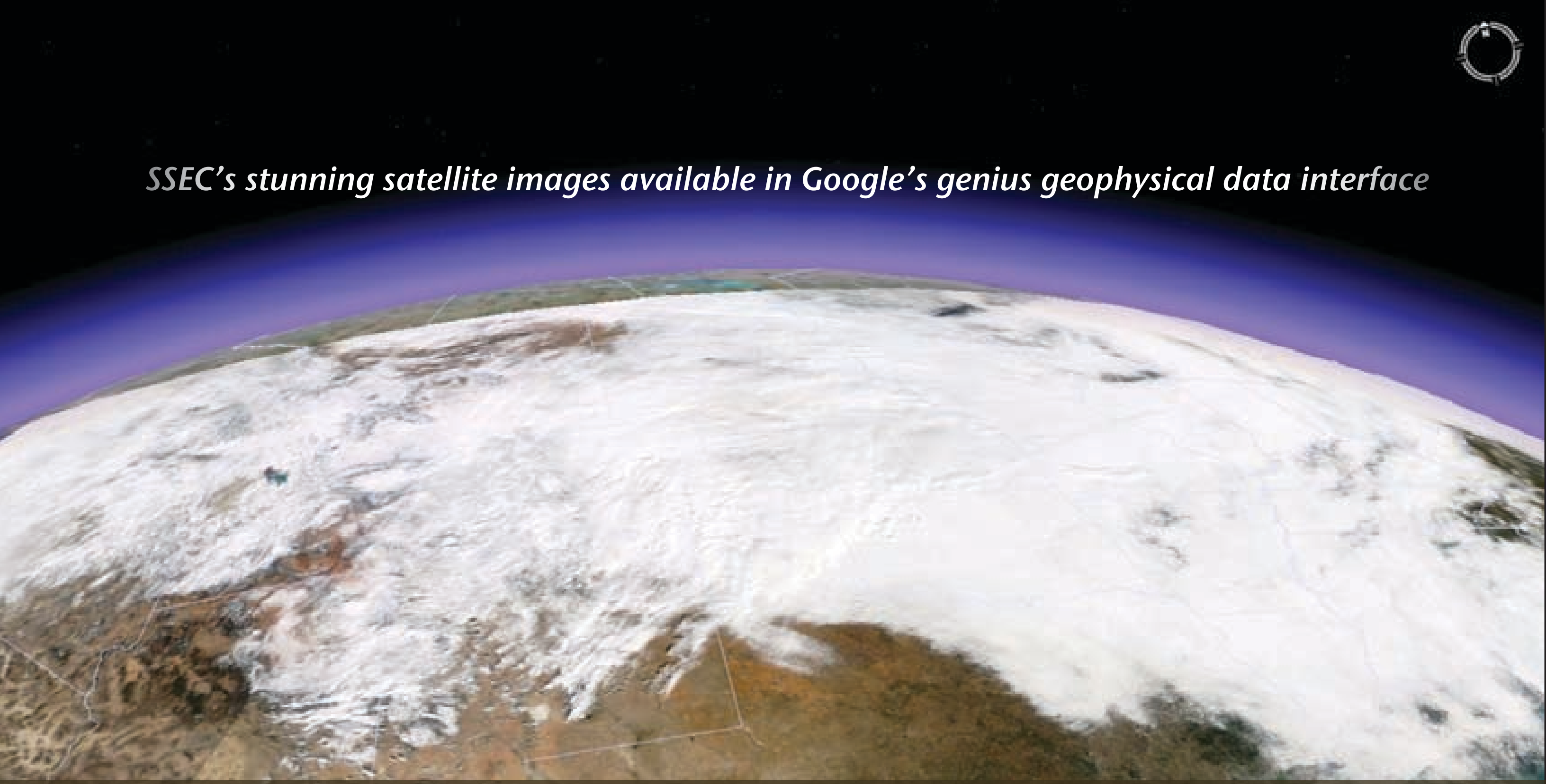

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Director's Note

From the beginning of the meteorological satellite era, SSEC's experts were involved in analyzing observations from geostationary satellites. Today SSEC and CIMSS scientists continue to work closely with NOAA and NASA scientists as the nation prepares for the next generation of weather satellites. But our dedication goes beyond research and analysis. We recognize the value of providing this critical data to users in effective and efficient ways. One article in this newsletter notes our collaboration with weather service organizations in South America to support forecasters using data from GOES-10. Visualization is another area important for the analysis of satellite data and its products. Modern visualization tools have roots in geographical data processing software developed at SSEC/CIMSS. We are currently developing a new analysis and visualization system to accommodate the increase in data volume and the need to effectively integrate satellite data with other meteorological data in multi-dimensional displays and animations. This newsletter includes an overview of this powerful system—McIDAS-V.

SSEC/CIMSS scientists are also involved in a variety of efforts to develop, test, and validate satellite observations as well as the derived products from science algorithms. The raw data transmitted from satellites requires calibration prior to distribution for visualization and analysis. Calibration includes analysis of the pre-launch and post-launch instrument performance. Comparison with high-spectral resolution sensors is one method used to validate broadband sensors. Of course this raises the question: "How does one calibrate the high-spectral resolution measurements?" Validation is often achieved through comparison with balloon-launched or aircraft-based instruments. An article about a recent calibration and validation field campaign caps this issue of *Through the Atmosphere*.

These articles offer a small sample of the research we conduct. If you are interested in learning more, come visit! ✳

Steven A. Ackerman
Director, CIMSS

Through the Atmosphere

Winter 2008

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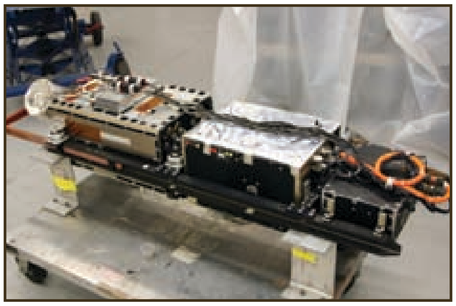


JAIVEx field campaign: A collaboration and validation success

In October 2006 the Europeans launched their first operational polar-orbiting satellite, MetOp-A. Among the new instruments flying on this platform, the Infrared Atmospheric Sounding Interferometer (IASI) has helped to strengthen an international effort to monitor and better understand our planet's environmental systems. To assess the accuracy of the data from this important instrument, American and European agencies successfully collaborated in the Joint Airborne IASI Validation Experiment (JAIVEx). Scientists and engineers from SSEC made significant contributions to JAIVEx during the Texas-based field campaign from 14 April to 7 May 2007 and to the data analysis that followed.

IASI was designed to gather operational meteorological sounding data with a very high level of accuracy, as part of the Global Earth Observation System of Systems (GEOSS). Begun in 2005 the GEOSS project seeks to utilize existing and new hardware and software to supply data and information at no cost to the global science community. In addition to improving medium-range weather forecasts, IASI data will complement the measurements from the U.S. advanced sounder, the Cross-track Infrared Sounder (CrIS), that is scheduled for launch in 2009 on the NPOESS Preparatory Platform (NPP).

Conducted shortly before MetOp-A went operational, JAIVEx was centered around three primary objectives. First, participants sought to validate and characterize the radiometric performance of IASI. The second objective was to validate the performance of different algorithms designed to retrieve temperature, humidity, ozone and carbon monoxide profiles from IASI spectral radiance measurements, over land and ocean, and under cloudy as well as clear sky conditions. Finally, the field program allowed participants to gather a diverse set of IASI spectra with co-located airborne and in-situ observations. This data set will further the development of innovative techniques to assimilate IASI data into numerical weather prediction models, utilizing as many channels as possible.

The IASI sensor design has roots in a concept developed at SSEC in the late 1980s. The concept also inspired two similar aircraft-based, high spectral resolution infrared interferometer sounders that measure upwelling terrestrial and atmospheric emitted radiance: SSEC's Scanning High Resolution Interferometer Sounder (S-HIS) and the NPOESS Airborne Sounder Testbed-Interferometer (NAST-I). S-HIS and NAST-I have participated in numerous field campaigns where the data have been applied to the development and validation of radiative transfer models, atmospheric sounding algorithms, surface and cloud properties, and sensor trade studies. Primarily funded through the U.S. Integrated Program Office (IPO), both S-HIS and NAST-I contributed to the JAIVEx campaign as a part of the high altitude NASA WB-57 instrument suite.

JAIVEx also included a second aircraft: a modified BAe 146 from the United Kingdom. The Facility for Airborne Atmospheric Measurements (FAAM) BAe 146, carried the Airborne Research Interferometer Evaluation System (ARIES). Much like S-HIS and NAST-I, ARIES is similar in design to IASI. The FAAM also carried a number of in-situ aircraft probes, and had the ability to release dropsondes to further assess the atmospheric state of the troposphere.

Both aircraft flew out of Ellington Field in Houston, Texas, the home base of the NASA WB-57. This location provided access to uniform scene conditions for flights over the Gulf of Mexico and a wealth of ground-based measurements from the Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) program central facility located in north central Oklahoma.

For most of the field campaign the WB-57 flew at a nominal altitude of 59,000 ft, while the BAe 146 sampled the atmosphere below the WB-57 at altitudes between 100 and 35,000 ft. High-altitude observations coincident with the satellite overpasses provide NIST (National Institute for Standards and Technology) traceable validation of the on-orbit satellite observations. Flight durations of five to six hours facilitated comparisons of the MetOp-A operational measurement capability with observations from NASA's A-Train research satellites, primarily from the Atmospheric Infrared

Flying high:
JAIVEx benefits from SSEC aircraft instrument

The Scanning High-resolution Interferometer Sounder (S-HIS) is an advanced version of SSEC's HIS instrument. The S-HIS was developed between 1996 and 1998 at SSEC with the combined support of the U.S. DOE, NASA, and the NPOESS Integrated Program Office. The S-HIS was initially designed to fly on an unmanned aircraft vehicle (UAV) with limited payload capacity. These goals led to a small, light-weight, and modular instrument with low power consumption. The S-HIS instrument now flies on a number of aircraft platforms including the NASA ER-2, the NASA DC-8, the Scaled Composites Proteus, and the NASA WB-57. On the Proteus and WB-57 aircraft, an upward (zenith) view is available, providing a means for upper atmosphere studies and at-altitude calibration verification.

The S-HIS is a cross track scanning airborne Fourier Transform Spectrometer (FTS) that measures emitted thermal radiation at high spectral resolution between 3.3 and 18 microns. The S-HIS field of view is 100 milliradians, providing a spatial resolution of 2 kilometers (at nadir) across a 40 kilometer ground swath from a nominal altitude of 20 kilometers (typical NASA ER-2 and WB-57 cruise altitude).

The S-HIS calibration techniques achieve the high radiometric accuracy needed for atmospheric state retrieval, calibration validation of satellite instruments, and spectroscopic applications. To verify the S-HIS calibration accuracy and provide direct NIST traceability of the S-HIS radiance observations, laboratory tests of the S-HIS and the NIST Transfer Radiometer (TXR) were successfully conducted earlier this year. An SSEC thermal chamber was used to simulate flight temperatures for the S-HIS instrument. *

Joe Taylor

http://deluge.ssec.wisc.edu/~shis/

Sounder (AIRS) aboard the EOS Aqua platform. Because both MetOp-A and the A-Train are in ascending polar orbits with a four-hour time gap, a five- to six-hour aircraft sortie ensured that the aircraft sensor data could be used as a calibration transfer reference for each of the satellite systems. A breakdown of the individual flight missions is summarized in Table 1. The data analysis team is focusing on results from one case, a clear sky IASI, S-HIS, and NAST-I measurement intercomparison which occurred over the ARM site on 19 April 2007.

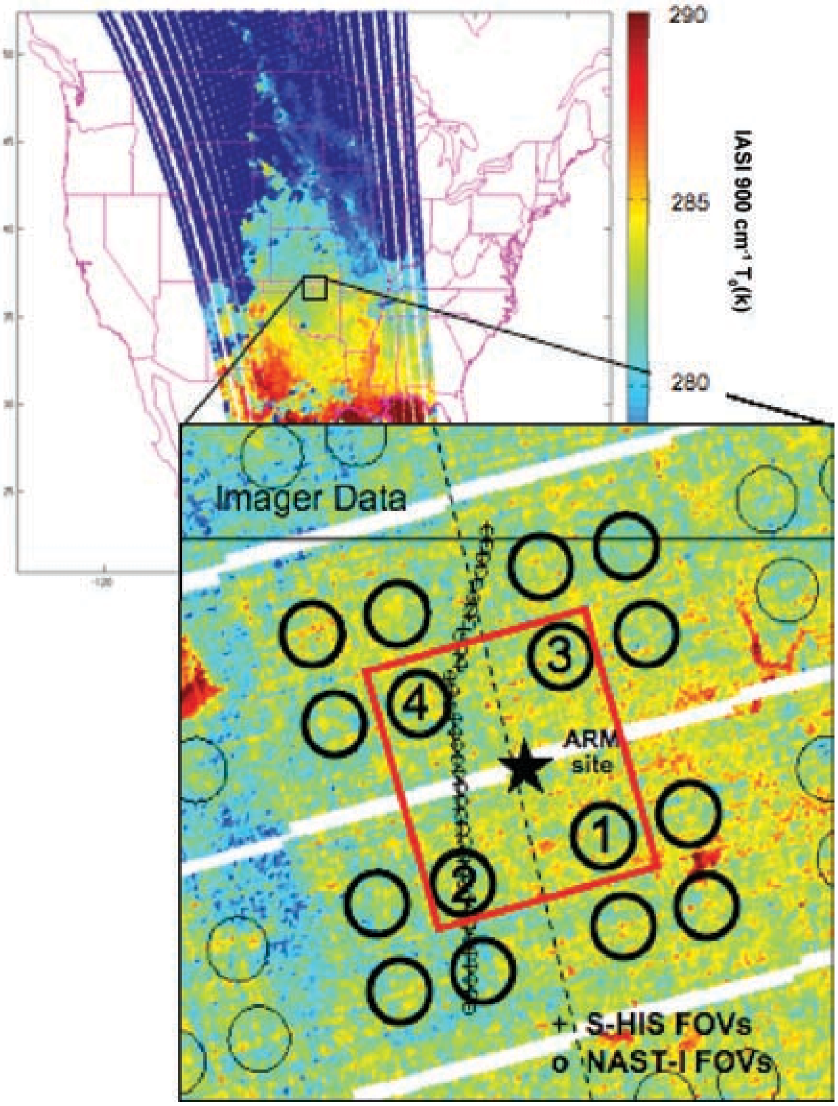


Figure 1. IASI 900 cm^{-1} window brightness temperature swath on 19 April 2007 (background image). ARM site enlargement shows imager data with individual IASI FOVs (large circles) and WB57 flight track with S-HIS and NAST-I nadir view FOVs. Spectral data averaged within the red box is provided in Figure 2.

IASI Radiometric Validation Study

The 19 April 2007 flight offered a prime opportunity to compare IASI to both S-HIS and NAST-I measurements during clear sky conditions above the ARM site. The IASI ground swath was nearly centered over the ARM site, which provided coincident nadir views with the aircraft instruments within minutes of the MetOp-A satellite overpass. The background image in Figure 1 shows the IASI 900 cm-1 window brightness temperature measurement swath over the continental United States for this case. These data yield a quick, rough estimate of the effective surface temperature for each point (e.g., a synopsis of clear versus cloudy conditions). Ground-based lidar measurements at the ARM site confirmed that the sky was clear. The foreground image in Figure 1 is an enlargement of the original image that shows select IASI, S-HIS, and NAST-I FOVs superimposed over IASI imager data. Given the large variation in FOV size between the satellite and aircraft instruments, the data within the red box were averaged for each instrument to allow more accurate comparisons.

Figure 2 shows the mean brightness temperature spectra for IASI (black), S-HIS (red), and NAST-I (blue) measurements within the red box in Figure 1. Because each instrument has a different spectral resolution, IASI and NAST-I data have been mathematically resampled to match the S-HIS spectral resolution. Spectral regions that provide atmospheric contributions (e.g., 2200-2400 cm-1) between the satellite and aircraft altitude (about 59,000 ft) have noticeable differences resulting from the atmospheric emission that occurred above the aircraft. However, focusing on select spectral regions where the emission contributions are limited to sub-aircraft altitude, shows that measurements from all three instruments agree to within 0.2 K. This first look at clear sky results from the flight on 19 April 2007 demonstrates that IASI performance is outstanding, with data suggesting that radiometric calibration is on the 0.1 K level. Such accuracy is necessary to provide improved temperature, water vapor and trace gas soundings, and to initialize numerical weather prediction models.

Overall, the JAIVEx flights included four ARM flights and three Gulf of Mexico flights—including five joint MetOp-A and Aqua missions. Results shown here are only a subset of the data gathered in this campaign.

JAIVEx has been heralded as not only a rewarding calibration/validation field program but also a successful US-European collaboration. The latter is likely the most important--a precursor to the future of operational remote sensing measurements within the GEOSS objectives—as our planet depends on successful global collaboration to overcome the fiscal responsibilities required to place state-of-the-art satellite systems in orbit; and to provide the human resources necessary to analyze, comprehend, and validate an otherwise overwhelming amount of data. ✴

Dan DeSlover and Dave Tobin

Date	Mission Goal
16 April 2007	ARM (Clear Sky)
19 April 2007	**MetOp-A over ARM (Clear Sky)**
20 April 2007	MetOp-A/Aqua over Gulf of Mexico (Cloudy)
24 April 2007	CALIPSO over Gulf of Mexico (Subvisible Cirrus)
27 April 2007	MetOp-A/Aqua over ARM (Cloudy)
28 April 2007	MetOp-A over ARM
29 April 2007	MetOp-A/Aqua over Gulf of Mexico (Clear Sky)
30 April 2007	MetOp-A over Gulf of Mexico
02 May 2007	MetOp-A/Aqua over ARM
05 May 2007	MetOp-A/Aqua over Gulf of Mexico

Table 1. NASA WB57 aircraft missions during the JAIVEx field campaign.

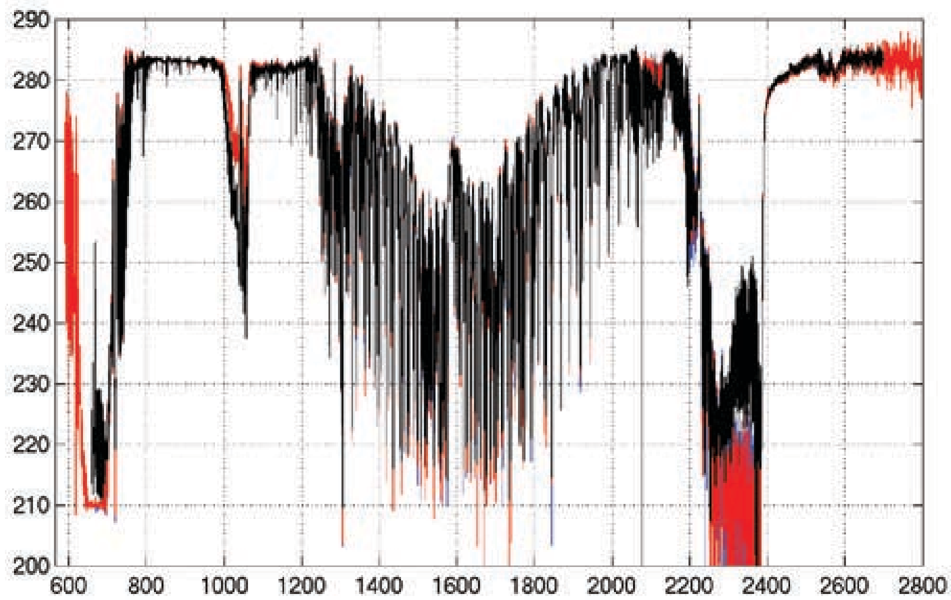
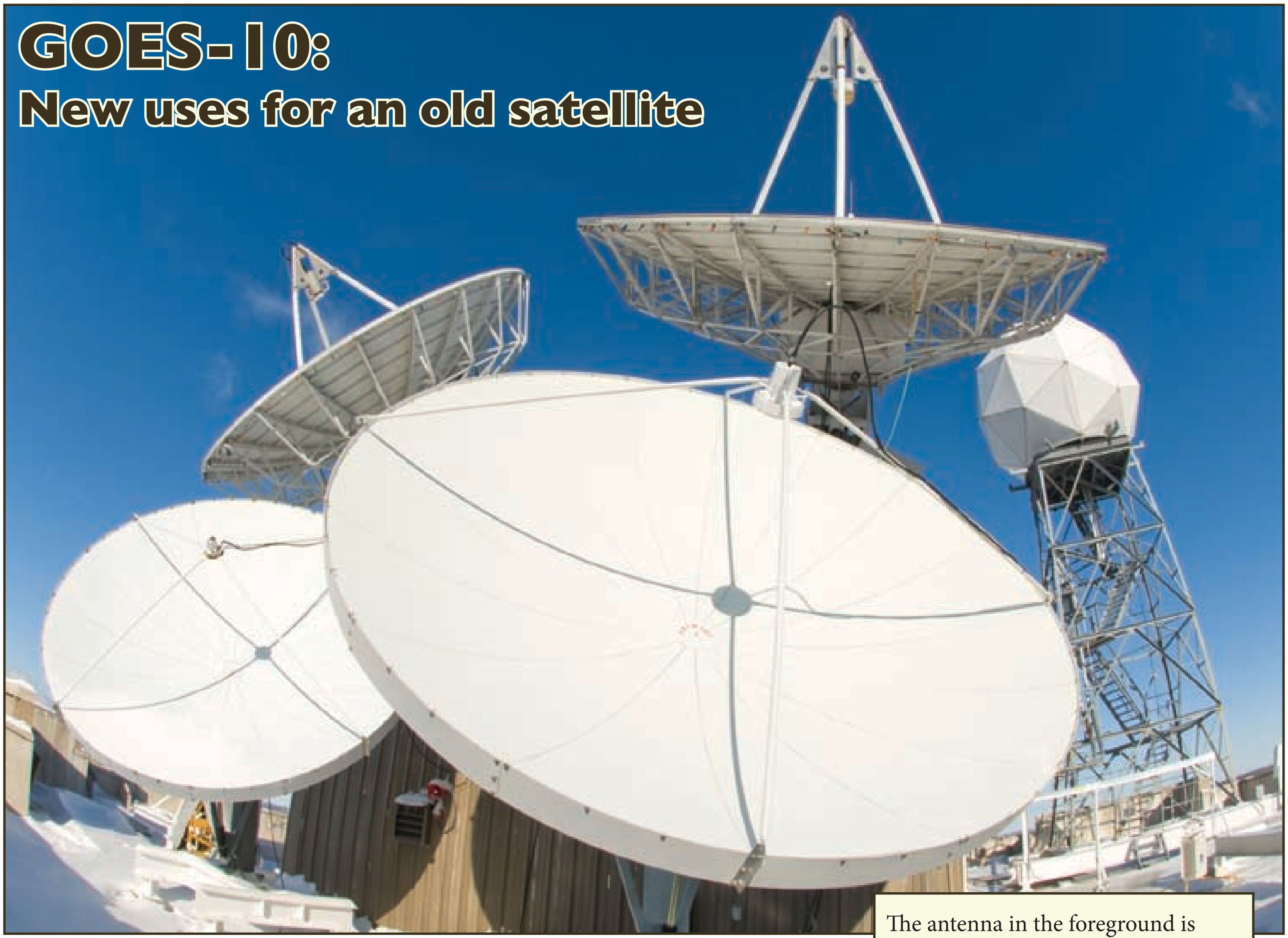


Figure 2. IASI (black), NAST-I (blue), and S-HIS (red) measured brightness temperature, apodized to match S-HIS spectral resolution, for the respective instrument FOVs represented within the red box in Figure 1. Discrepancies are due to atmospheric contributions between the satellite (IASI) and WB57 aircraft (NAST-I and S-HIS).

GOES-10:
New uses for an old satellite



The antenna in the foreground is SSEC's GOES-10 tracking antenna.

GOES-10 served as the western geostationary satellite for the U.S for nine years. In 2006, NOAA offered the services of GOES-10 to South American scientists to improve their weather analyses and forecasts. After capturing and archiving the GOES-10 data stream during the transfer from its position as GOES-West over the U.S. to 60° west longitude, SSEC now provides data product support for meteorologists in the Southern Hemisphere.

Operated by NOAA/NESDIS, GOES-10 scans the Southern Hemisphere using both imaging and sounding instruments. Before GOES-10 moved, the Southern Hemisphere had no GOES sounder coverage and irregular imager coverage. In addition to providing consistent imagery, GOES-10 carries the first operational geostationary sounder to routinely gather data over South America. The transfer of GOES-10 is part of the Global Earth Observation System of Systems (GEOSS) in the Americas project, which is a collaborative effort between NOAA and partners in the Americas and the Caribbean.

GOES-10 imagery demonstrates the value of having a satellite positioned at 60° W longitude, sampling the entire South American continent three to four times per hour. In its current position, the GOES-10 imager scans a full disk image every three hours and scans an "extended Southern Hemisphere" sector every 15 minutes. The sounder has 19 spectral bands and gathers observations over South America and its surrounding regions in four sectors over four hours. Data from GOES-10 allow Southern Hemisphere meteorologists to monitor convection and a variety of phenomena over the continent.

Funded by the NOAA Office of Systems Development, the SSEC Data Center recently installed a tracking antenna on the roof of SSEC. This antenna allows SSEC to directly receive GOES-10 data. CIMSS produces experimental Sounder products and posts them on a web page in near real time. The sounder products include Derived Product Images (DPI) of Cloud Top Pressure (CTP), Total Precipitable Water (TPW), and Lifted Index (LI). Animations of these DPIs, as well as select sounder and imager spectral bands, are also available. The

CIMSS GOES-10 web page also has a Spanish language counterpart.

CIMSS scientists recently traveled to Cachoeira Paulista-Sao Paulo, Brazil to train South American meteorologists in remote sensing applications. With the support of the NOAA Office of International Affairs, CIMSS presented a weeklong workshop class that included lectures and hands-on laboratory exercises directly dealing with the GOES-10 imager and sounder. Lectures covered topics such as: the fundamentals of remote sensing, how the imager and sounder collect the signal to build their images, and product production and applications. There were 33 participants from 12 countries including Argentina, Bolívia, Brazil, Chile, Colombia, Costa Rica, Equador, México, Paraguay, Peru, Uruguay and Venezuela

With the help of CIMSS researchers, Instituto Nacional de Pesquisas Espaciais (INPE) in Brazil is able to generate a number of GOES-10 sounder products directly from their reception of the GOES-10 data stream. Some of these products include various level temperature and moisture information, along with vertical profile information.
While in transit during the fall of 2006, SSEC used GOES-10 to collect a unique dataset of one-minute imagery. The GOES-10 one-minute images allow researchers to closely monitor the evolution of atmospheric features. The dataset includes many interesting examples of convection, clouds and hurricanes. These data offer a preview of the improved temporal resolution imaging anticipated with the next generation geostationary imager.

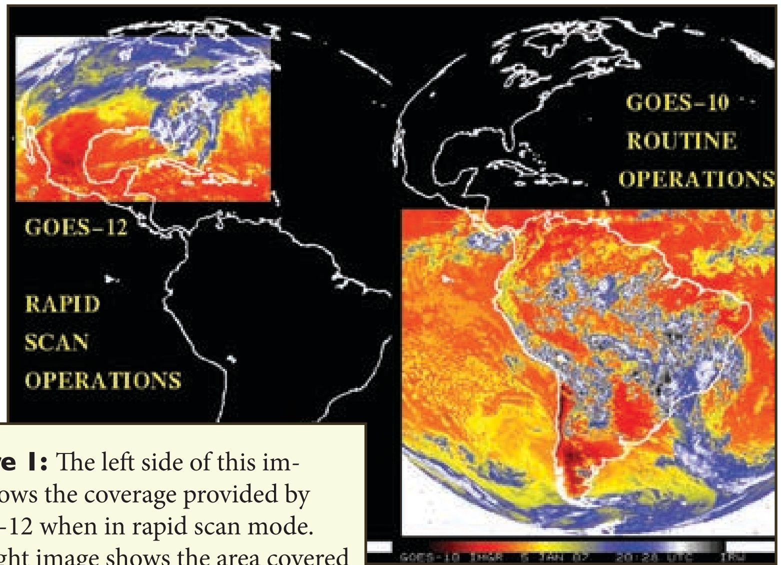


Figure 1: The left side of this image shows the coverage provided by GOES-12 when in rapid scan mode. The right image shows the area covered by GOES-10 in its new position.

Researchers have found many other uses for the GOES-10 data stream. SSEC's Antarctic Meteorological Research Center (AMRC) uses data from the GOES-10 Imager to improve satellite composite imagery used to monitor weather-related aviation concerns over Antarctica. SSEC also provides GOES-10 data to the Washington DC Volcanic Ash Advisory Center (VAAC), so that volcanic ash plumes can be monitored. The GOES-10 sounder cloud information is being used to initialize a regional Numerical Weather Prediction (NWP) model. These activities are in addition to uses of the GOES-10 imager and sounder data in Central and South America.

The GOES-10 instruments still function well, but the satellite has exhausted its north-south station-keeping fuel. The lack of fuel means that the satellite inclination (or "wobble") will continue to increase by about one degree per year. To overcome this wobble, NOAA recently began remapping the GOES-10 imager data before the radiance data are re-broadcast. Current GOES operational spacecraft (east and west) operate within a 0.5 degree inclination limit that allows the on-board Image Motion Compensation system to scan imagery as if from a "perfect GOES projection" from a fixed point in orbit. The inclination constraints shorten the life of operational GOES spacecraft. As part of the Extended GOES High Inclination (XGOHI) mission, the current generation of GOES ground system was enhanced to accommodate on-ground remapping to extend the life of retired spacecraft such as GOES-10. ✳

Tim Schmit
http://cimss.ssec.wisc.edu/goes/rt/

The History of GOES-10

25 April 1997 - Launched

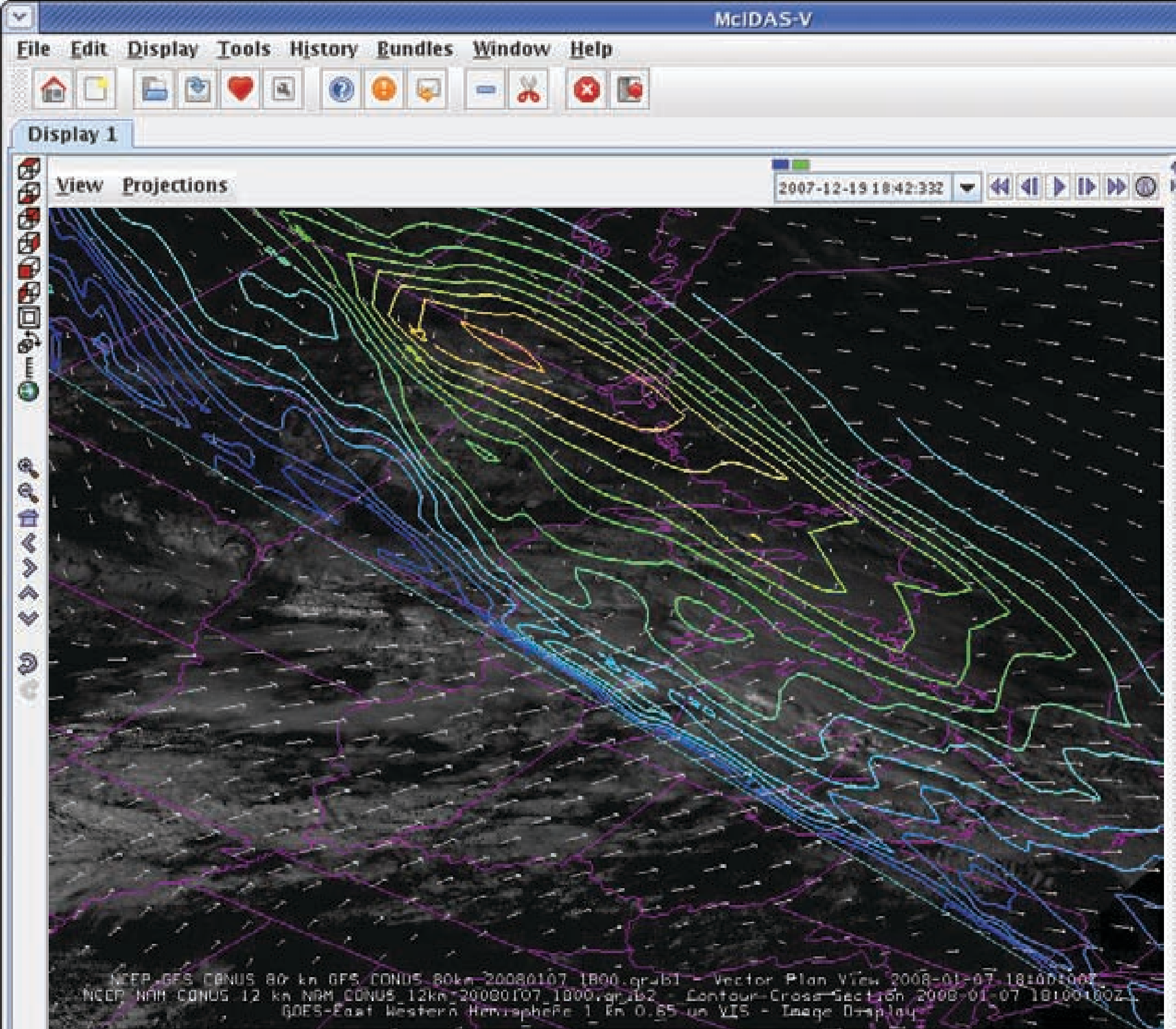
27 July 1998 - Replaced GOES-9 as operational Western satellite

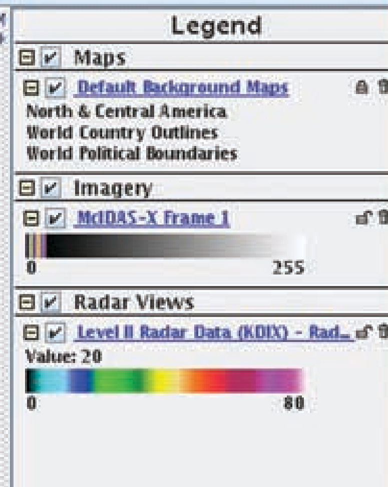
21 July 2006 - Replaced by GOES-11

Summer/Fall 2006 - Transition to South America

December 2006 - Arrived at 60° West

5-17 December 2007 - Served temporarily as operational GOES-East





To the left is a McIDAS-V interactive 3D display of GOES East, 1 km visible channel (base image), NCEP model moveable vertical cross-section of wind speed (colored contours) and 925 mb wind vectors (white arrows) from near 18 UTC on 7 January 2008 near the time of the Northern Illinois/ Southern Wisconsin EF-3 tornado.

Solving the McIDAS equation

The future of data analysis and visualization looms on the horizon as an SSEC development team puts the finishing touches on the beta release of the next step in the evolution of the Man-computer Interactive Data Access System (McIDAS). Appropriately named McIDAS-V, this iteration of the software will constitute the fifth generation of SSEC's 35-year legacy. The development team has spent the last year bringing the McIDAS concept to a modern, more versatile computing environment.

In preparation for the impending influx of multispectral and hyperspectral satellite data, McIDAS needed to evolve. Building on the solid, ingenious origins of the system in the early 1970s, the data analysis and visualization capabilities of McIDAS-V integrate powerful and innovative methods that will engage many atmospheric scientists from both research and operations. With new features and functionalities, McIDAS-V will have all the capabilities to support a smooth transition to the next generation of environmental satellites.

We like to think of the development of McIDAS-V using the following "equation:"

McIDAS-V ⟼ VisAD + IDV + HYDRA + McIDAS-X Bridge + New Development

Defining the terms in the equation provides a clear picture of how the integration of these elements creates a powerful system capable of handling complex data analysis and visualization tasks.

McIDAS-V ⟼ **VisAD** + IDV + HYDRA + McIDAS-X Bridge + New Development

The foundation of McIDAS-V is the Visualization for Algorithm Development (VisAD) open source, Java™ library. VisAD serves as a building block for creating interactive and collaborative data analysis and visualization tools. Developed by SSEC's Bill Hibbard in the 1990s, VisAD is used by a wide variety of scientists. VisAD combines several important attributes, including:

- The use of Java for platform independence
- A mathematical data model that describes virtually any numerical data in a systematic way
- A general display model that supports 2-D and 3-D displays, and also supports direct manipulation of multiple data views
- Metadata that is integrated into each data object (e.g., units, error estimates)
- Adapters for multiple data formats (NetCDF, FITS, HDF-EOS, McIDAS-AREA, MD and Grid files, Vis5D, etc.) and access to remote data servers through HTTP, FTP, DODS/OPeNDAP, and ADDE protocols

McIDAS-V ⟼ VisAD + **IDV** + HYDRA + McIDAS-X Bridge + New Development

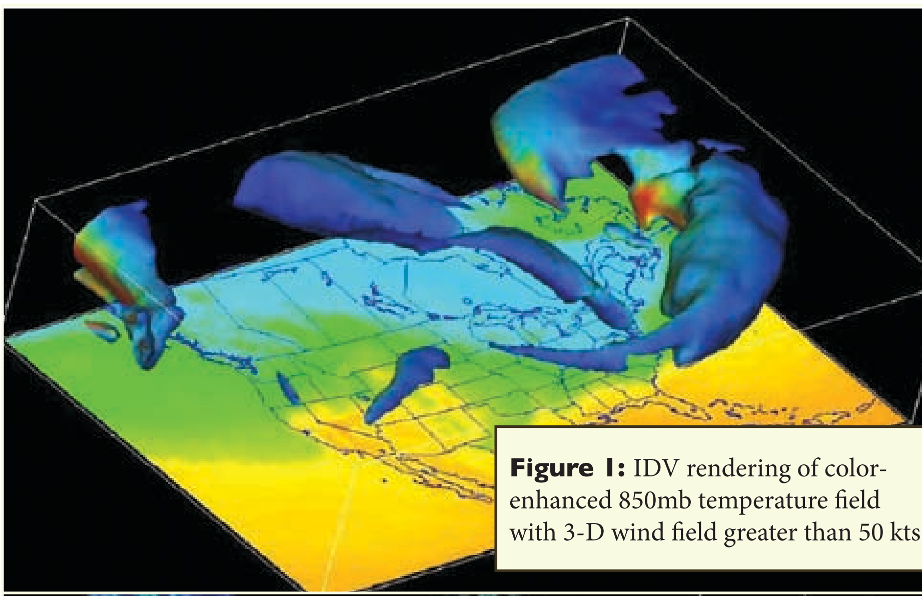


Figure 1: IDV rendering of color-enhanced 850mb temperature field with 3-D wind field greater than 50 kts.

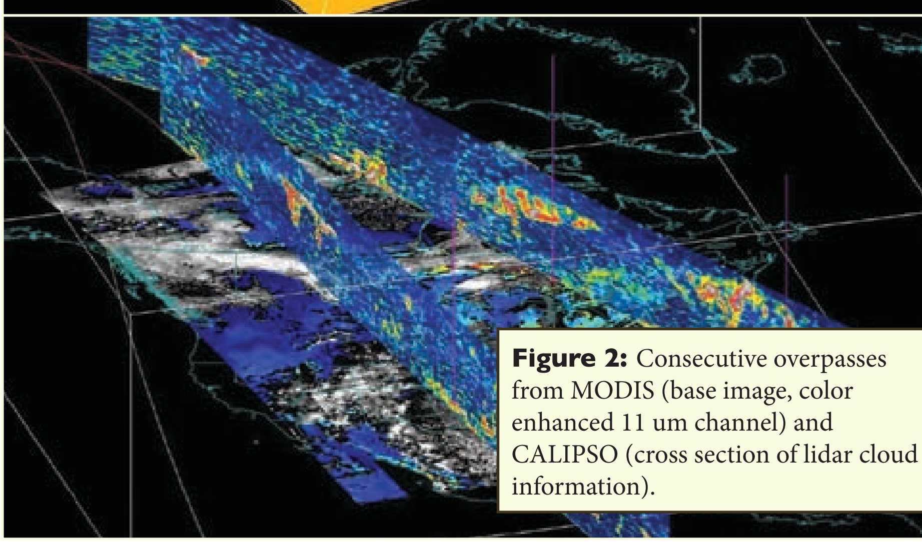


Figure 2: Consecutive overpasses from MODIS (base image, color enhanced 11 um channel) and CALIPSO (cross section of lidar cloud information).

The Integrated Data Viewer (IDV) adds interactive data selection and visualization capabilities to McIDAS-V. Developed at Unidata, the IDV is also an open source, Java-based software framework built on top of the VisAD library to provide a versatile data analysis and visualization toolkit for geoscience data. The IDV brings together the ability to display and work with multiple observations within a unified interface, including satellite observations, surface and upper air (radiosonde) observations, gridded data, and radar and profiler data. Together, VisAD and the IDV provide 3-D views of the atmosphere and allow users to interactively slice and probe the data. Users can create cross-sections, profiles, animations and value read-outs of multi-dimensional data sets. The combination will allow McIDAS-V users to easily integrate data from various sources and to interact with flexible displays. The IDV software is freely available from Unidata under the terms of the GNU Lesser General Public License. Figures 1 and 2 provide examples of IDV displays.

McIDAS-V ⟼ VisAD + IDV + HYDRA + McIDAS-X Bridge + New Development

SSEC scientists have developed a powerful tool to interrogate multispectral and hyperspectral satellite data. The Hyperspectral Data Research Application (HYDRA) allows scientists to delve deeply into these data. Using HYDRA, scientists can display radiance spectra, multi-band imagery, scatter plots and transects. Created to facilitate the manipulation of observations from the aircraft-based Scanning HIS and EOS/AIRS, HYDRA has also been used to work with EOS/MODIS, MSG/SEVIRI, and METOP/IASI data. With the forthcoming NPP/NPOESS and GOES-R programs in the U.S., the HYDRA data interrogation capability is a key feature being added to the McIDAS-V suite.

Figures 3 and 4 show examples of HYDRA applications to detect the SO_2 plume in the October 2002 Mount Etna volcanic eruption and to differentiate cloud types and surface features in western Europe and the Mediterranean Sea. These examples demonstrate how HYDRA capabilities can assist scientists in probing hyperspectral and multispectral data and in developing useful products from current and forthcoming advanced remote sensing instruments. Integrating HYDRA into McIDAS-V will connect this powerful tool with the many features of VisAD and IDV.

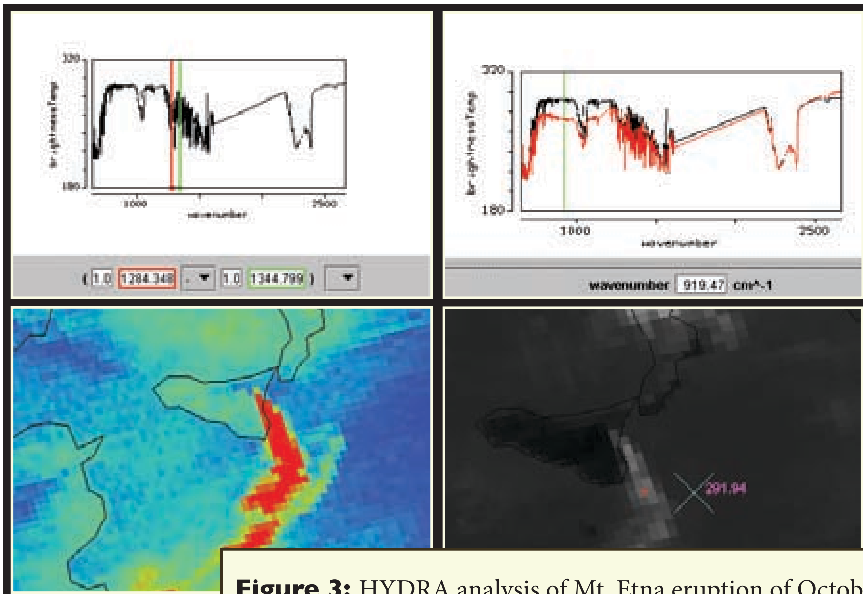


Figure 3: HYDRA analysis of Mt. Etna eruption of October 2002. The user has selected two EOS/AIRS channels (top left) and by differencing them brings out the SO_2 signature of the volcanic eruption (lower left). An image from the IR window channel is shown in the lower right. The top right image shows the AIRS spectra from the SO_2 plume and a nearby clear sky area.

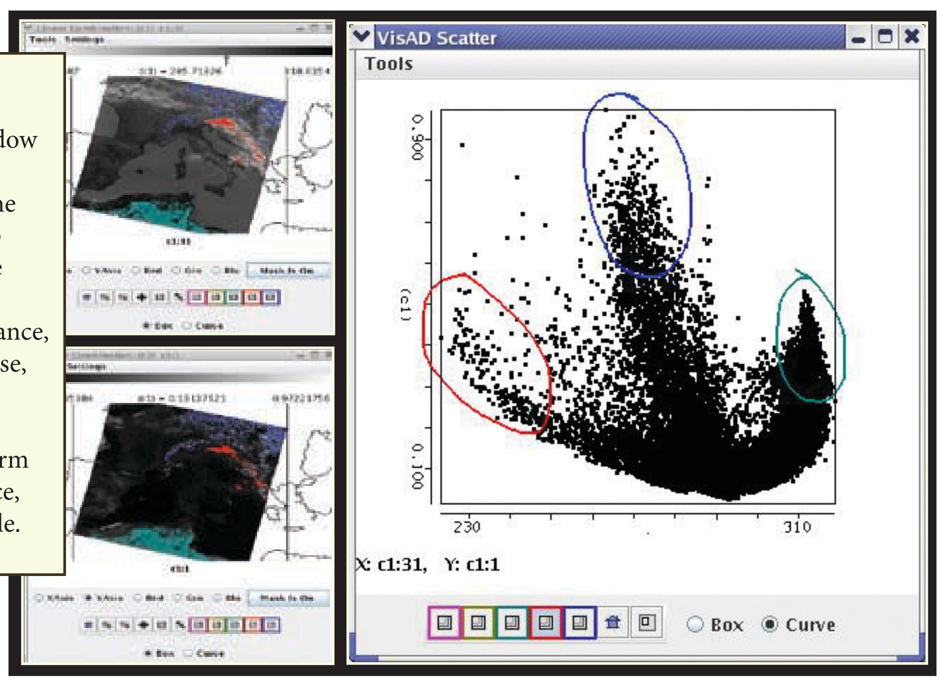


Figure 4: The user has selected a MODIS visible channel image (top left) and an IR window channel image (lower left) and displayed the visible reflectance vs. IR emitted radiance in the scatter plot (right). The user can select a group of pixels and color enhance those pixels on the imagery, identifying specific features from the data. The cold 11µm radiances and low reflectance, indicative of cirrus clouds, are colored turquoise, pixels with 11µm radiances near freezing and high visible reflectances, indicative of snow cover, are colored red, and pixels with very warm 11µm radiances and medium visible reflectance, indicative of hot desert sand, are colored purple.

SSEC developers have ensured that the McIDAS-X user community will have a smooth transition to McIDAS-V. While the original McIDAS software was developed in the 1970s, McIDAS-X, McIDAS-V's predecessor, debuted in the early 1990s (see timeline on page 14) to operate on computers running the UNIX operating system (the X in McIDAS-X represents the X UNIX). McIDAS-X contains over one million lines of code, written primarily in the Fortran and C programming languages, and has a tremendous amount of functionality. Many McIDAS-X users have developed their own software to enhance McIDAS-X for their specific needs. In developing McIDAS-V, it was immediately evident that to rewrite the software to reproduce the functionality in Java would be a huge undertaking … there would need to be another solution.

That solution is a two-way communication between McIDAS-V and a session running McIDAS-X. The "Bridge" consists of two parts: a McIDAS-V data chooser that communicates with a McIDAS-X session and the McIDAS-X "Listener" which allows outside clients to communicate with the McIDAS-X session via any available, user-specified network port. Together, these two components provide a "Bridge" between McIDAS-X and McIDAS-V. Commands initiated from within McIDAS-V are run in McIDAS-X and the results are visualized in the McIDAS-V environment. This allows sites to continue to use McIDAS-X (including locally developed code) while transitioning to McIDAS-V.

Figures 5 and 6 show an example of the Bridge being used to display McIDAS-X data in McIDAS-V.

An example of how McIDAS-V will provide greatly improved analysis and visualization capabilities is demonstrated in Figure 6, which displays an aviation weather Icing Potential product. A 2-D display can only slice through a single layer of the atmosphere (Fig 6A), while the 3-D display from McIDAS-V (Fig 6B) allows the scientist to see both the horizontal and vertical depth of the super-cooled water potential. This user can also zoom into and around the display, using probes to get precise readouts or cross sections to plan routes.

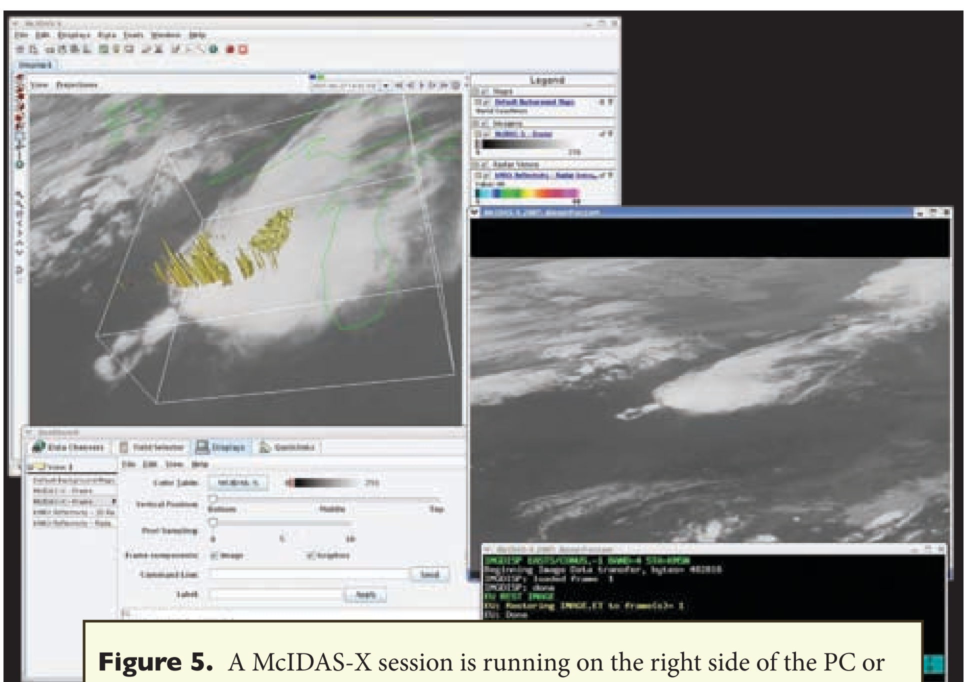


Figure 5. A McIDAS-X session is running on the right side of the PC or Mac screen, and a McIDAS-V session is running on the left side. Using the Bridge, the GOES image in its native resolution was brought into –V; the projection was changed to account for the GOES E-W oversampling. Next, the Milwaukee/Sullivan Level 2 radar was overlaid in -V. This figure demonstrates the ability to bring an –X image and data into –V and the powerful capabilities of –V to add 3-D information.

McIDAS-V ⟼ VisAD + IDV + HYDRA + McIDAS-X Bridge + New Development

With the completion of the first four elements of McIDAS-V, the development team will turn to new development. The McIDAS-V environment will offer great opportunities to scientists and other users of McIDAS-V to not only create new ways to analyze combinations of data, but also invent new ways to visualize the data. One focus for the future is producing unique combinations of data from disparate sources. The rich environment that the VisAD data and visualization models bring to this equation provides an excellent platform for these explorations.

Developing for the Future

McIDAS-V is a software ensemble containing many valuable features and builds upon the enhanced functionality stemming from more than ten years of VisAD and several years of IDV development. McIDAS-V will also integrate the multispectral and hyperspectral satellite data capabilities from HYDRA and allow a two-way dialog with a McIDAS-X session to make available those data and products. Along with these powerful attributes are improved data and server management, and a friendly and user-configurable interface. Finally, since the software is freely available and open source, we will add our own improvements and those of our collaborators to continue to evolve the capabilities of the McIDAS-V software.

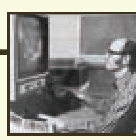
An alpha version of McIDAS-V has been demonstrated and released to McIDAS Users' Group (MUG) members at their annual meeting in October 2007 (see sidebar). Work continues on completing the integration of HYDRA into the McIDAS-V core, adding features to the Bridge and working with Unidata to enhance the IDV. We anticipate a beta version of McIDAS-V will be available for general release in spring 2008. ✴

Tom Achtor, Dee Wade and Tom Whittaker
http://www.ssec.wisc.edu/mcidas/

A look at the past

1968
WINDCO generates wind vectors from ATS images

1972
First Generation of McIDAS



1979
Wichita Falls, TX tornado: Congress directs Operational McIDAS system to be installed at the National Severe Storms Forecast Center

1983
People's Republic of China funds port of McIDAS software to IBM mainframe

1985
McIDAS runs on PCs under DOS operating system

1987
McIDAS runs on PCs under OS/2 operating system and McIDAS Users' Group is formed

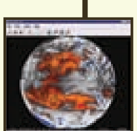
1991
McIDAS runs on UNIX workstations

1994
Satellite and conventional data is served from UNIX workstations, beginning the use of ADDE (Abstract Data Distribution Environment)

1997
McIDAS Users' Group sunsets support for mainframe McIDAS

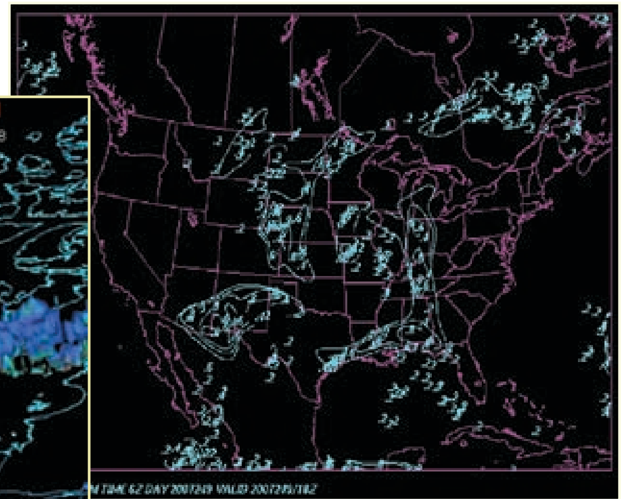
1999
Support for McIDAS on Windows NT

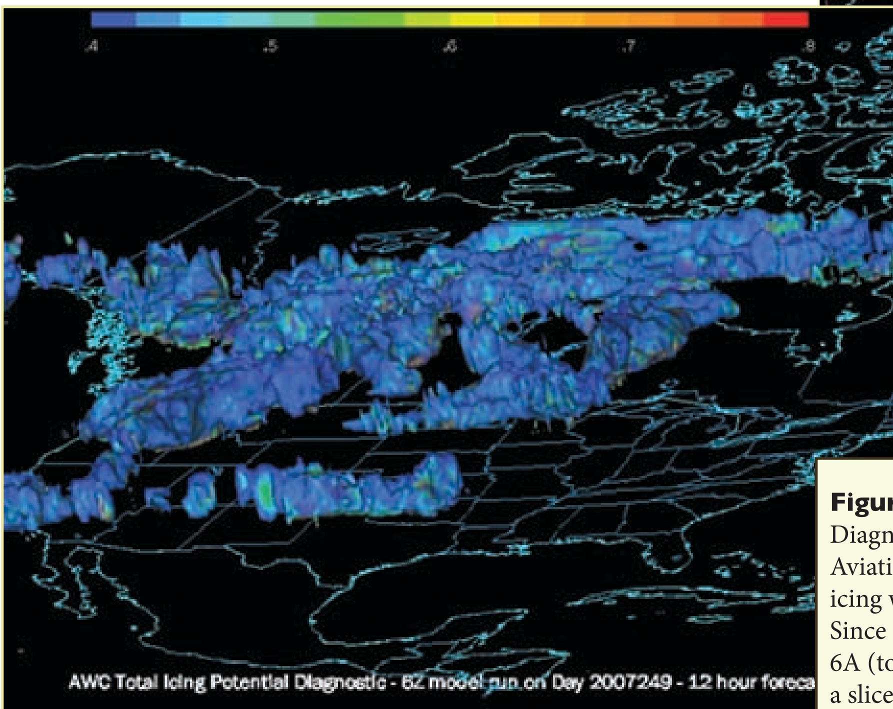
2004
Support for Apple's Mac and Windows XP



2005
OpenADDE

2007
Alpha version McIDAS-V





Figures 6A & 6B: The Total Icing Potential Diagnostic, a product developed by the NOAA Aviation Weather Center, displays the probability that icing will be found in a given area of the atmosphere. Since McIDAS-X displays only 2-D data, Figure 6A (top right; generated with McIDAS-X) displays a slice of the atmosphere where the potential for icing exists. Figure 6B (left) is from McIDAS-V, and displays the full 3-D depiction where the potential for icing exists. The 3-D display provides a much greater understanding of the depth of this field, as well as its horizontal distribution. This is one example of how McIDAS-V will enhance understanding of the 3-D atmosphere for users.

McIDAS Users Group meeting

After 35 years, the legacy of SSEC's geophysical data processing software continues. From 16-18 October 2007, more than 60 programmers and scientists gathered to discuss and try out the next step in the evolution of McIDAS. Attendees included many members of the McIDAS Users' Group (MUG)—some of whom traveled to Wisconsin from around the world.

The conference kicked off with an overview of the current state of satellite data options, including acquisition and processing. In addition to a summary of current weather satellite capabilities, participants heard about SSEC's current online data archive and data ingestion facilities. SSEC's Jay Heinzleman and Dave Santek also gave a presentation about recent updates to McIDAS-X.

After assessing the present, the conference switched to focus on the future of satellite data analysis and visualization tools. CIMSS Director Steve Ackerman explained why users need the functions that McIDAS-V will offer in the hyperspectral age. After lunch the group was given the first public viewing of McIDAS-V. SSEC's Jessica Staude and Becky Schaffer gave a demonstration of the new software. A lively group discussion followed.

During the final day of the conference, attendees had the chance to try out the alpha version of McIDAS-V. The morning covered the basics of operating McIDAS-V, including loading and manipulating images, working with maps, and creating enhancements. The afternoon sessions allowed users to work with IASI and AIRS sounder data, and MODIS and SEVIRI imager data in McIDAS-V and HYDRA sessions. The hands-on sessions were energetic, fast-paced and supported by many SSEC employees who roamed the room helping users with their questions.

Check out the MUG group web site for more information about the meeting, becoming a MUG member and about the upcoming beta release of McIDAS-V. ✳

Jen O'Leary

http://www.ssec.wisc.edu/mcidas/

Introducing the new CIMSS Tropical Cyclone Web Site

Thirteen years ago, CIMSS launched an innovative web site devoted entirely to Tropical Cyclones (TCs). From its inception, the site rapidly gained popularity with both the TC community as well as with a more general audience. The site remains a prominent source for hurricane information, and as a portal for cutting edge CIMSS research on TCs. It is not unusual for the National Hurricane Center to mention our satellite-derived products in public forecast discussions during important hurricane events. Our web site also has daily "hits" in the millions during a major hurricane. In fact, on several occasions, web traffic to the site has slowed down the entire UW-Madison network! Advancements in web technology have alleviated this problem and opened doors to new possibilities for data displays and interactive features.

Since the initial launch 13 years ago, the site itself had not undergone any major changes aside from frequent minor updates and product additions. However, this summer, the CIMSS TC group launched a major site upgrade, taking advantage of new display tools and highlighting new research algorithms. Intended for a slightly more sophisticated user, the upgraded TC site has a new layout and increased interactive capabilities. Interested analysts, researchers or just plain hurricane aficionados can find real time information for current storms, regional analyses based on satellite-derived variables, special satellite imagery, and examples of the SSEC/CIMSS TC Group research projects.

Featured on the new site is an interactive window for viewing and analyzing real time TCs. Known as the "TCTrak" window, this analysis tool uses McIDAS utilities and allows multiple data and product overlays, animation manipulation, satellite-based TC estimates and diagnostics, and more. The intent is to make this site a "one stop shop" for a user to interrogate the meteorological conditions of a storm in real time. Among the available products are: multispectral imagery (IR and microwave) from virtually all operational (and some research) geo- and polar-orbiting satellites; SST analysis; satellite-derived products such as winds, shear, and intensity estimates; scatterometer winds; conventional observations; current TC track and forecast discussions; numerical model track forecasts, and more.

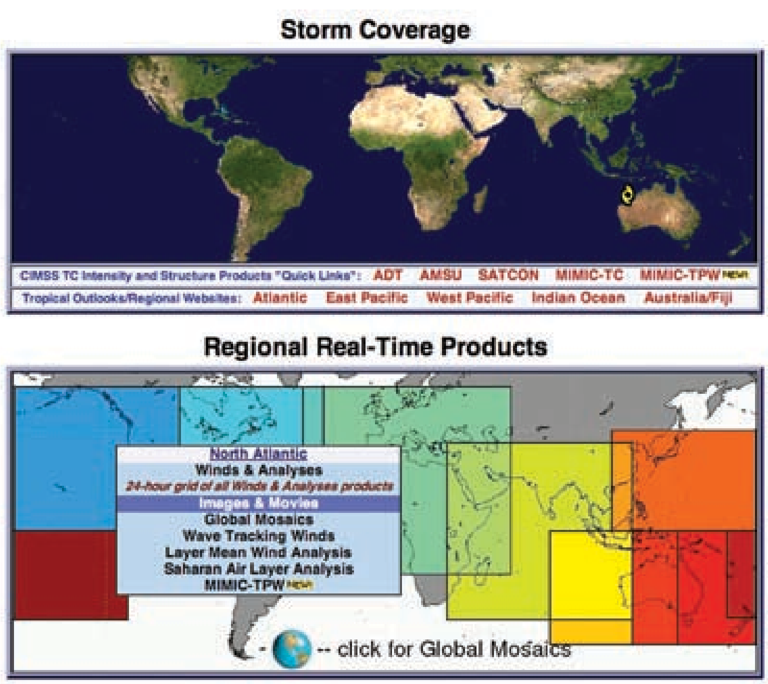


Figure 1: The front page of the new web site provides easy, visual access to current storm actvity and real time products.

Despite a few remaining glitches, CIMSS released the new site to the TC community in July of 2007 to get feedback during the recent Atlantic TC season. The new site relies on functions found in the latest versions of popular web browsers—an issue that kept a few users from being able to view the new site. However, initial feedback has been overwhelmingly positive. Most users have embraced the added functionalities and interactive access to the data and products. We will continue to add new features to the site, and are confident that it will be a valuable TC web resource and outreach element to those both inside and outside of the TC community.

In addition to the enhanced real time site, we will soon unveil a new online satellite data and product archive site that will allow interactive online browsing and retrieval of historical global TC satellite data, products, and

Welcome back to the Midwest

This summer, a UW-Madison alumnus returned to his roots in the Midwest. After spending the past 17 years at NASA's Langley Research Center in Virginia, Brad Pierce recently transferred to NOAA and is currently stationed at SSEC. In his new post he will continue his atmospheric modeling work and will facilitate the transition of CIMSS research into operations.

During his time at NASA, Pierce provided support for airborne field missions and worked on developing a global model of atmospheric chemistry. In recent years, he concentrated on improving an operational global chemistry forecasting model. He has also become a strong advocate for including more satellite data in forecast models.

Pierce received his PhD from UW-Madison and worked with Professor Don Johnson as a Postdoc in the Department of Atmospheric and Oceanic Sciences. As a student, Pierce worked on an early version of the UW Hybrid Model pioneered by Johnson. Since his time at UW-Madison, Pierce has continued to collaborate with Johnson and other colleagues at SSEC. Coupled with the chemistry model Pierce developed at NASA, the UW Hybrid Model constitutes one part of the Real time Air Quality Monitoring System (RAQMS)—a project that has perpetuated Pierce's collaboration with SSEC scientists. This existing partnership with SSEC is one of the reasons Pierce welcomed a chance to return to the Midwest.

Pierce also anticipates continued work with other groups of SSEC/CIMSS scientists. CIMSS has had a critical role in transitioning research algorithms into operations. Pierce's involvement in satellite data assimilation will contribute to this process.

In addition to making himself at home in his new work environment, Pierce enjoys living in Madison. Having grown up outside Minneapolis, he is happy to return to the Midwest. ✷

Jen O'Leary

locally produced diagnostics. We envision a graphical user interface that will allow researchers to easily peruse historical storms and access satellite data and products for their analyses.

The former TC web site will remain active for another year or so while we transition to the upgraded site, which is still a work in progress. ✷

Chris Velden and Tim Olander

cimss.ssec.wisc.edu/tropic2

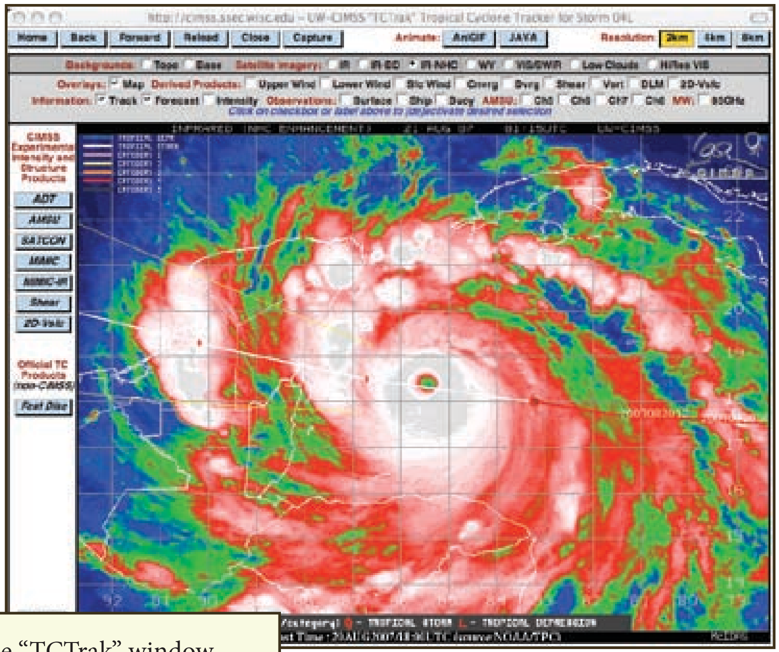


Figure 2: The "TCTrak" window displays information about a specific, currently active storm.

Dr. Ackerman goes to Washington

After 20 years at the UW-Madison (including 15 years as a faculty member in the Atmospheric and Oceanic Sciences Department and eight years as the Director of CIMSS), I am taking my first sabbatical and spending nine months at NOAA's Center for Satellite Applications and Research (STAR). As I planned my time away from Madison, I chose to focus on a few specific areas for research and collaboration: working with NOAA scientists as they plan future weather satellites systems, exploring methods of using satellite observations to measure cloud properties, and developing e-learning materials in support of teaching and learning satellite meteorology.

UW-Madison has a long history of collaborating with NOAA to develop and improve weather satellite technology. With the next generation of weather satellites in sight, I hope to use my visit to strengthen this ongoing partnership. CIMSS is already actively working with NOAA to develop the GOES-R Advanced Baseline Imager (ABI) by supporting instrument trade studies, algorithm development and data visualization. I'm currently working with a group of NOAA scientists developing a Satellite Recapitalization Plan. During my time at STAR, I have gained a better appreciation of how NOAA plans and implements its satellite systems.

In addition to taking part in GOES activities, I will also continue my research activities using data from NASA's MODIS and CALIPSO programs. In particular, I'll continue to work with Goddard, Langley and UW-Madison scientists to study the optical properties of cirrus clouds and improve methods of detecting clouds over polar regions during winter. When I first came to CIMSS, I got involved with remote sensing studies using collocated AVHRR, HIRS and ERBE observations – the emphasis was on cloud properties and changes in the spectral radiances in clear-sky scenes. I'm particularly interested in continuing this approach to observing Earth with collocated observations.

Beyond scientific research, I hope to take some time during my sabbatical to develop a better understanding of how to teach (and learn) satellite meteorology. Supported by education grants from NOAA, NASA and NSF, I have studied recent research on e-Learning. I am particularly interested in the effective use of graphics combined with audio in instruction for both introductory and advanced science courses. Through NASA-funded collaborations with the UW-Madison's Division of Information Technology, I have come to appreciate new approaches to effective use of web-based technologies. These efforts focus on material appropriate to satellite remote sensing courses for undergraduate juniors and seniors. One goal of the NASA proposal was to develop Reusable Content Objects, which can be used easily and effectively in developing new lessons and modules. I plan to incorporate these learning modules and develop new ones in order to create an e-Learning resource on satellite meteorology for undergraduate students.

Don't worry, I won't forget about CIMSS while I'm away. I plan to take time to reflect on the organizational structure of CIMSS. Since my arrival to UW-Madison 20 years ago, CIMSS has nearly doubled in size. All those who support the administration of CIMSS do a wonderful job and the current structure may remain the best one for our institute. It is important that we be guided by the traditions that have made CIMSS a collaborative and productive working place. But I think it is also important to now and then step back and ponder if there are ways of doing things better.

Finally, Anne (my wife) and I are enjoying the big city life. Visit our blog: http://ackandanne.blogspot.com/ ✳

Steven Ackerman

Honors and Awards

Paul Menzel
The scientific community honored his recent retirement from NOAA after forty years of service with a special plaque recognizing his contributions to the global understanding of atmospheric science and his enduring commitment to advancing the field across the globe.

Andy Heidinger (NOAA at SSEC)
NASA Group Achievement Award for NASA's Cloud-Aerosol Lidar and Infrared Pathfinder Satellite (CALIPSO) — The team won the award for "exceptional achievements in the successful development, launch, and operation of the CALIPSO satellite."

Jordan Gerth
National Weather Association Meteorological Satellite Applications Award Grant

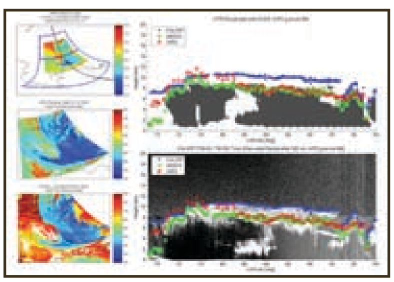
Publications highlights

Comparison of AIRS, MODIS, CloudSat and CALIPSO cloud top height retrievals

Geophysical Research Letters
11 September 2007

Weisz, E., J. Li, W. P. Menzel, A. K. Heidinger, B. H. Kahn, and C. Liu

Understanding the impact of clouds on the Earth's radiation budget and on climate change requires information about cloud properties such as cloud-top height. Hyperspectral infrared measurements from polar orbiting satellites provide valuable cloud-top information with global coverage. The cloud-top research product derived from NASA's Atmospheric InfraRed Sounder (AIRS) agrees well with observations from radar and lidar instruments onboard CloudSat and CALIPSO platforms. These instruments provide accurate cloud measurements but with limited spatial coverage.



A multispectral technique for detecting low-level cloudiness near sunrise

Journal of Atmospheric and Oceanic Technology
February 2007

Schreiner, A. J., S.A. Ackerman, B. A. Baum, and A. K. Heidinger

A technique using the GOES sounder radiance data has been developed to improve detection of low clouds and fog just after sunrise. The technique is based on a simple difference method using the Short Wave Window (3.7µm) and Long Wave Window (11.0µm) bands in the infrared range of the spectrum. The time period just after sunrise is noted for the difficulty in being able to correctly identify low clouds and fog over land. For the GOES sounder cloud product, this difficulty is a result of the visible reflectance of the low clouds falling below the "cloud" threshold over land. By requiring the difference between the 3.7µm and the 11.0µm bands to be greater than 5.0K, successful discrimination of low clouds and fog is found for 85% of the cases beginning 14 September 2005 through 6 March 2006 over the GOES-12 sounder domain.

The success rate further improved to 95% by including a difference threshold of 5.0K between the 3.7µm and 4.0µm bands, requiring that the 11.0µm band be greater than 260K, and limiting the test to fields of view where the surface elevation is below 999 meters. These final three limitations were needed to more successfully deal with cases involving snow cover and dead vegetation.

A more general framework for understanding Atlantic hurricane variability and trends

Bulletin of the American Meteorological Society
November 2007

Kossin, J. P., and D. J. Vimont

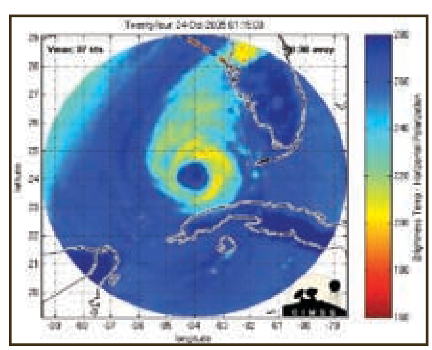
We reconsidered Atlantic hurricane variability in a new framework based on a pattern of coupled ocean–atmosphere variability known as the Atlantic meridional mode (AMM). We show that a large part of the variability of overall "hurricane activity," which depends on the number of storms in a season, their duration, and their intensity, can be explained by systematic shifts in the cyclogenesis regions. These shifts are strongly correlated with the AMM on interannual as well as multidecadal time scales. The AMM serves to unify a number of previously documented relationships between hurricanes and Atlantic regional climate variability.

MIMIC: A New Approach to Visualizing Satellite Microwave Imagery of Tropical Cyclones

Bulletin of the American Meteorological Society
August 2007

Wimmers, A.J., and C.S. Velden

Satellite-based microwave imagery of tropical cyclones (TCs) is a valuable source of information, which is particularly important when often no other observations exist. However, current microwave-sensing satellites make only semi-random passes over their targets, resulting in time gaps averaging four hours but varying from less than 30 minutes to more than 24 hours. To address this issue, we have developed a family of algorithms called Morphed Integrated Microwave Imagery at CIMSS (MIMIC) to create synthetic "morphed" images that use the observed imagery to fill in the time gaps and present time-continuous animations of tropical cyclones and their environment. MIMIC presents a storm-centered 15-minute resolution animation of microwave imagery in the ice-scattering range (85-92 GHz) that can be interpreted very much like a ground-based radar animation. MIMIC allows forecasters and analysts to use microwave imagery to follow trends in a tropical cyclone's structure more efficiently and effectively, which can result in higher-confidence short-term intensity forecasts.



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