

# CIRA '99

Volume 12 ■ Fall

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# CIRA

## **Fellowships in Atmospheric Science and Related Research**

The Cooperative Institute for Research in the Atmosphere at Colorado State University (CIRA) offers a limited number of one-year Associate Fellowships to research scientists. Awards may be made to senior scientists including those on sabbatical leave or recent Ph.D. recipients. Those receiving the awards will pursue their own research programs, collaborate with existing programs, and participate in Institute seminars and functions. Selection is based on the likelihood of an active exchange of ideas between the Fellows, the National Oceanic and Atmospheric Administration, Colorado State University and CIRA scientists. Salary is negotiable based on experience, qualifications, and funding support. The program is open to scientists of all countries. Submitted applications should include a curriculum vitae, publications list, brief outline of the intended research, a statement of estimated research support needs, and names and addresses of three professional references.

CIRA is jointly sponsored by Colorado State University and the National Oceanic and Atmospheric Administration. Colorado State University is an equal opportunity employer and complies with all Federal and Colorado State laws, regulations, and executive orders regarding affirmative action requirements. In order to assist Colorado State University in meeting its affirmative action responsibilities, ethnic minorities, women, and other protected class members are encouraged to apply and to so identify themselves. The office of Equal Opportunity is in Room 101, Student Services Building. Senior scientists and qualified scientists from foreign countries are encouraged to apply and to combine the CIRA stipend with support they receive from other sources. Applications for positions which begin January 1 are accepted until the prior October 31 and should be sent to: Prof. Thomas H. Vonder Haar, Director CIRA, Colorado State University, Fort Collins, CO 80523, USA.

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**Cover Image:** A thick coating of rime ice covers the summit of New Hampshire's Mount Washington. In the background stands the instrument tower of the Mount Washington Observatory.

### ***Editor's Note***

To submit articles for future issues (which will probably be twice-yearly), please contact Jeff Lemke either by a direct visit in Room 002, or by phone at 491-2209 or via e-mail at [lemke@cira.colostate.edu](mailto:lemke@cira.colostate.edu).

# Weather Education at the Mount Washington Observatory

Dean Paschall

In August of 1997, the Mount Washington Observatory (MWO) Organization launched a major Weather Education Outreach Program with funding and cooperation from NOAA and CIRA. The purpose of this program is to integrate atmospheric research with educational outreach targeting visitors to the Mount Washington, New Hampshire area and schools throughout New England.

CIRA, working in cooperation with NOAA/Forecast Systems Lab (FSL), has made significant contributions to the educational content and resources displayed in the Weather Discovery Center (WDC)—the core of the MWO weather educational outreach effort. CIRA and FSL are also working closely with the University of New Hampshire and Plymouth State College to develop and transfer information about cutting-edge technology for improving atmospheric research.

## Why Mount Washington?

This region has long been touted as the home of the world's worst weather. Mount Washington presents the most severe combinations of wind, cold, icing and storminess available anywhere on the planet where people are on hand to take measurements. The summit lies in the path of the principal storm tracks and air mass routes affecting the northeastern United States. In April 1934, observers measured a wind gust of 231 mph, which remains a world record for a surface station.

Consider these facts:

Mount Washington  
Elevation: 6,288 feet  
Latitude: 44° 16' N  
Longitude: 71° 18' W

- \* Highest wind (world record, April 12, 1934): 231 mph
- \* Average wind velocity for the year: 35.3 mph
- \* Lowest temperature (January 1934): -47°F
- \* Highest temperature (August 1975): 72°F
- \* Average temperature for the year: 26.5°F
- \* Maximum snowfall in a season (1968-69): 566.4 inches
- \* Winds exceed hurricane force (75 mph) on an average of 104 days a year.
- \* The summit is in the clouds about 60% of the time.

Because the summit of Mount Washington is one of the most interesting and provocative locations in New England, observations have been conducted on the summit continually since 1870. The Observatory continues to record and disseminate weather

information and also serves as a benchmark station for the latest research in atmospheric measurement. Projects include wind profile investigations utilizing the latest in ground-based LIDAR technology, water vapor research using GPS, investigation of cosmic ray activity in the upper atmosphere, and developing robust instrumentation for severe weather environments. The intent of the Mount Washington Observatory Organization is to couple atmospheric research activities with educational outreach. In conjunction with the observations they have taken, the observatory has also been called upon to educate the public.



Figure 1. Observer explains instruments to summit visitor

## MWO Educational Outreach Program

Beginning in 1973, with the creation of its Summit Museum, the observatory actively pursued an educational agenda such as presenting annual symposia and short courses in the sciences and humanities and audio/visual and interactive outreach programs for schools and groups. The observatory also sponsors the nationally syndicated radio program, *The Weather Notebook*, heard on NPR stations across the nation. In August of 1997, the MWO proposed to vastly expand their education outreach efforts. The MWO applied to NOAA for assistance to create an educational outreach program to complement their atmospheric research activities and were awarded a \$3.8 million grant in April of 1999. The elements of the outreach program include the following components:

- \* The development of an interactive Weather Education Web Site
- \* The initiation of a traveling Weather Education Program to reach schools throughout New England
- \* The renovation of the Summit Museum and the creation of a Weather Discovery Room located in the museum on the summit of Mount Washington
- \* The creation of an interactive "Weather Discovery Center" in North Conway, New Hampshire.

When the funds were released, the MWO set to work to fulfill the educational objectives set forth in the grant. With help from NOAA / FSL and CIRA, the following objectives have been accomplished:

- \* The Traveling Education Program, “The Wonder of Weather,” has reached over 2,500 students and teachers in 17 separate settings.
- \* As of July 7, 1999, a complete renovation of the summit museum was finished, including the addition of a Weather Discovery Room. This is currently open to the public.
- \* The Web site is under development and will be launched on a limited test basis this fall.
- \* The WDC is nearing the final steps of completion.



Figure 2. The Weather Discovery Center in North Conway, NH

## The Weather Discovery Center

The Weather Discovery Center (WDC) represents the core of the MWO’s educational outreach effort. The WDC will open this fall to the 8.5 million annual visitors to the Mount Washington valley as well as offering special educational tours to visiting schools from the New England region.

Visitors to the center will first view a 10-minute introductory video designed to pique their interest in weather related activities. Upon entering the interactive area, they will utilize the flow tank and air cannon to experience how wind travels over surfaces and through space. There will be replication of the old stage stop, complete with rime ice on the shingles and chains used to hold the building in place in high winds. This will offer a glimpse of what it was like on that chilly morning in April 1934 when observers ventured out into sub zero temperatures to crack rime ice from the anemometer that measured the world record 231-mph gust.

## NOAA Weather Wall

A highlight of the center will be the NOAA Weather Wall (see Figure 3). This display will offer visitors an opportunity to learn more about the latest tools in technology. Demonstrations of the Advanced Weather Interactive Processing System (AWIPS), and the Local Data Acquisition and Dissemination

System (LDAD) and other tools used by meteorologists will offer visitors an insight into how forecasters apply these tools to predict weather and severe weather events. This display will reenact the May 3 tornado events in Oklahoma City and show how the forecasters foresaw the arrival of these storms in advance and were able to warn the public of their approach.

Included in the Weather Wall will be a direct, live, interactive feed to the observers on the summit of Mount Washington. This will allow visitors to interact with the observers and ask questions using the two-way video display.



Figure 3.

At the completion of Phase I, the MWO hopes to move on to Phase II, with plans to build a new facility on their property located down the road in Bartlett, New Hampshire. This is currently the home of the MWO Weather Research Center (WRC). The plan is to collocate the Weather Discovery Center with the WRC—a center known for cutting-edge research into weather sensing instruments. This move will bring school children and visitors in direct contact with the latest in atmospheric research.



Figure 4. NOAA scientists observing wind data at the Mount Washington Observatory

# Daily Hurricane Briefings at CIRA



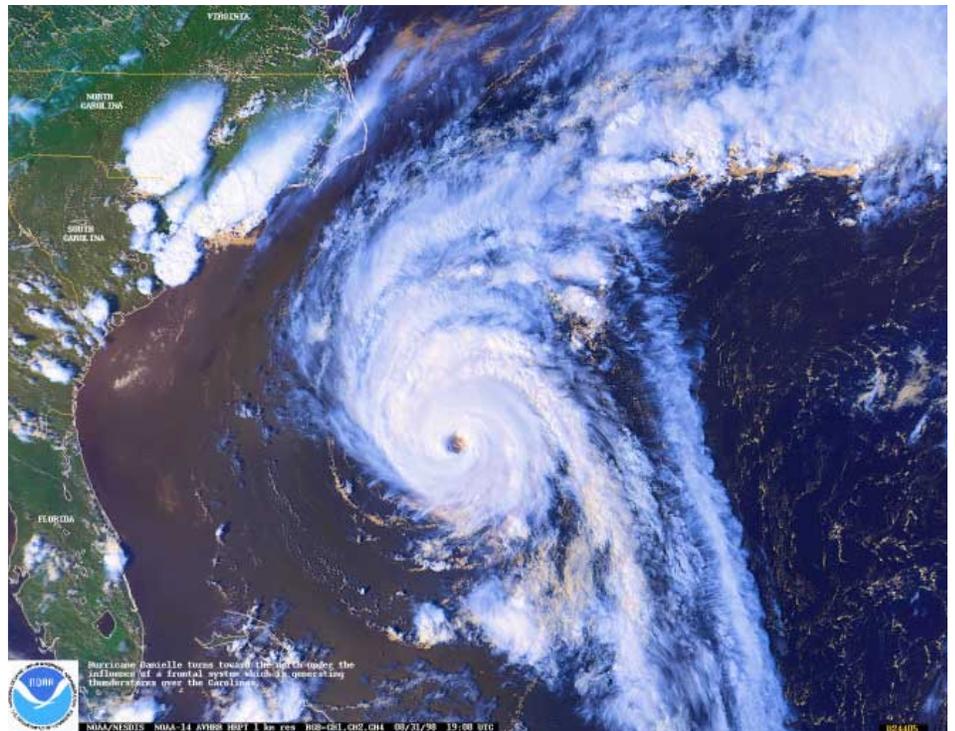
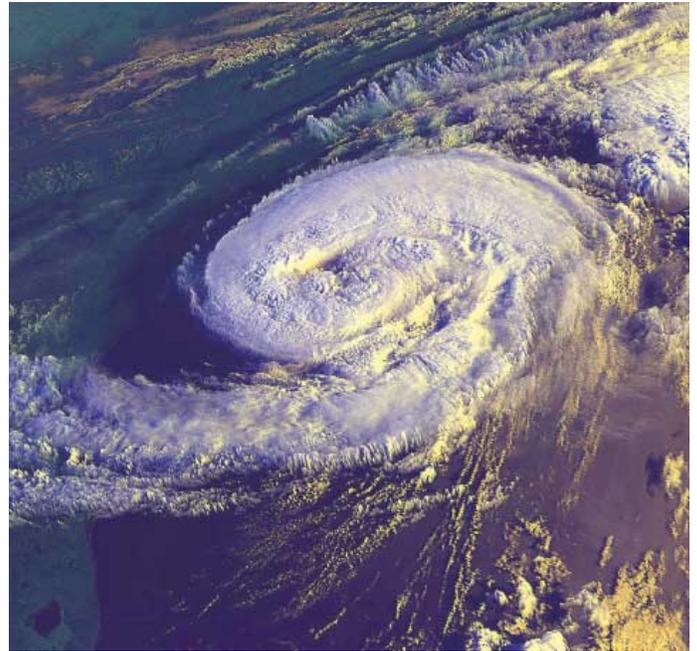
Ray Zehr

At 4 PM each afternoon in CIRA's computer lab, an enthusiastic group of scientists gather around the computer workstations. They are then briefed with up-to-the-minute information on the tracks, intensities, and forecasts of hurricanes and tropical storms. The main attraction however is the opportunity to view the high-quality animated satellite images along with observations and computer model analyses. An informal lively discussion often interrupts or follows the briefing. Participants represent a diverse group with a wide variety of interests, including CSU Atmospheric Science faculty, research associates, and graduate students.

The daily briefings take place from mid-July to mid-October, and a volunteer is assigned to lead the discussions each week. This provides an excellent opportunity for graduate students to refine their presentation and analysis skills. The discussions that often expand to include specific problem areas in forecasting, remote sensing, media issues, and disaster preparedness, offer excellent learning experiences regardless of an individual's expertise.

The daily hurricane briefings began in 1995 in response to CIRA's enhanced access to automated real-time satellite display capabilities through association with the NESDIS (National Environmental Satellite Data and Information Service) RAMM (Regional and Mesoscale Meteorology) Team. Ray Zehr (RAMM) and Kevin Schrab (former CIRA research associate, now with National Weather Service Western Region Headquarters) developed the first version of what became known as "Tropical RAMSDIS." RAMSDIS (RAMM Advanced Meteorological Satellite Demonstration and Interpretation System) workstations were developed for use at National Weather Service Forecast Offices, and each system was tailored for a specific geographical region. Tropical RAMSDIS, on the other hand, employs the same hardware and software design but is designed for global coverage of the tropics with geostationary satellite images. The high resolution satellite ingest is moved to follow individual hurricanes, typhoons and tropical storms through their entire lifetime. Access to five geostationary satellites provides excellent coverage of all tropical weather systems around the world.

It may seem a bit odd that there is so much interest in hurricanes at a high plains location such as Fort Collins, far removed from the hurricane threat. However, a great deal of expertise and resources at CIRA and Colorado State University are devoted to a long tradition of involvement in hurricane and tropical meteorology research. This includes the Atmospheric Science Department's founder, the late Dr. Herbert Riehl, who published the textbook *Tropical Meteorology* in 1954. The projects of CSU Atmospheric Science Professors Gray, Schubert, Montgomery, Johnson, and Pielke, among others have been investigating tropical meteorology research topics.



# New Windows NT Data Collection Platform



Michael Hiatt



Duane Whitcomb



Dale Reinke

## Introduction

CIRA has operated a satellite earthstation since 1978. Historically, CIRA used Digital Equipment Corporation VAX and PDP mini-frames to perform data collection tasks due to their fast performance and advanced operating system. Unfortunately, these systems were very expensive to purchase and maintain. They also required annual software licenses and annual service contracts which added to the expense. With the advancement of Microsoft's Windows NT operating system running on inexpensive Intel personal computer (PC) hardware, CIRA's engineering staff took the opportunity to develop an entirely new data collection system.

The new Windows NT data collection platform offers real-time full-resolution McIDAS and JPEG products to researchers within minutes after they are received from the satellite. The new system incorporates a new single chip hardware processor and a Windows NT computer. Within the Windows NT computer are new software tools including a new graphical ingester, sectorizer, and process logger. Shown in Figure 1 is CIRA's earthstation topology with these new components highlighted. This topology collects a single meteorology product. CIRA operates several earthstations to collect a multitude of meteorological data.

## Hardware Processor

A hardware processor is used to pre-process the data from the satellite receiver. The new single chip hardware processor consists of a Xilinx Field Programmable Gate Array (FPGA), Integrated Device Technologies First In First Out (FIFO), and National Instruments high speed Direct Memory Access (DMA) controller. The data output from the satellite receiver is decoded and error checked by custom firmware in the Xilinx FPGA. This FPGA replaces several hundred discrete components, minimizes development time, and increases reliability. The FIFO memories provide a buffer to accommodate delays by the host computer. A high speed DMA controller is used to rapidly transfer the data to the host computer memory subsystem and to avoid using significant CPU resources. Shown in Figure 2 is the hardware processor layout.

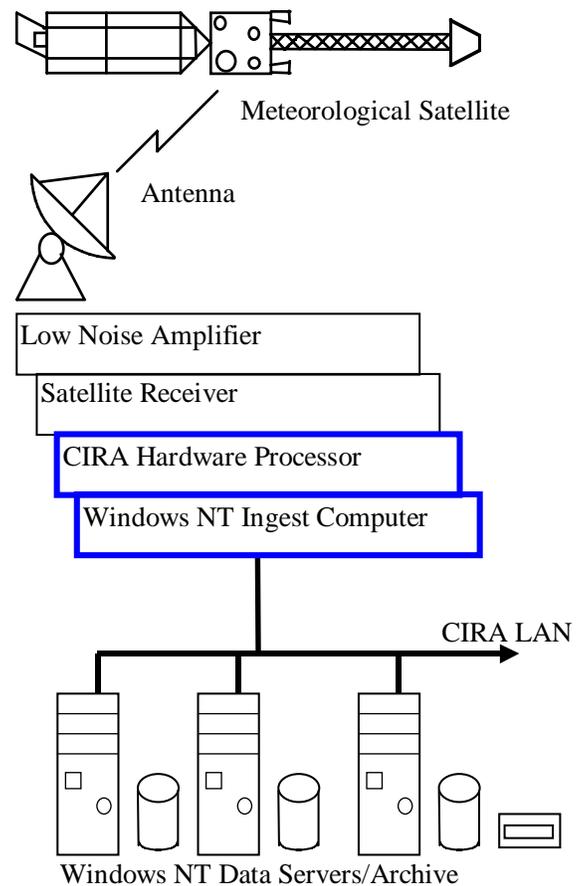


Figure 1. CIRA Earthstation Topology

## Software Routines

Several new software routines were developed to get the data from the frame synchronizer to the host computer. A multi-buffer process was developed to efficiently receive the data and yet make the computer responsive to other time critical tasks. Once the host computer receives the data, the satellite data is sectorized and navigated into McIDAS images using CIRA-developed software. The McIDAS image format was chosen in order to be com-

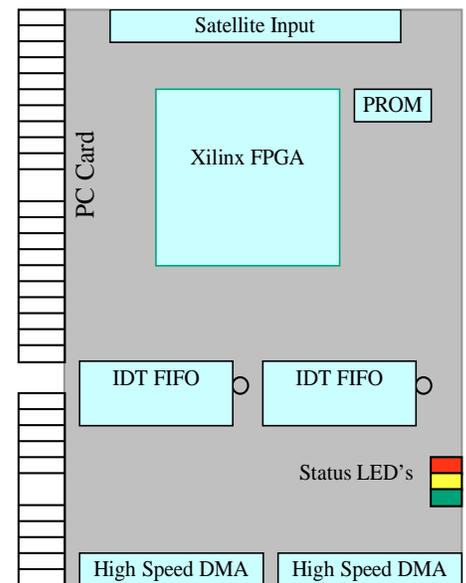


Figure 2. Hardware Processor Layout

patible with other research institutions. The new software uses a graphical interface, which displays real-time status. This yields enhanced operator information and significantly reduces troubleshooting time. A new file transfer mechanism was developed to distribute the satellite data, which makes the data available minutes after the products are completed. A CIRA-developed software compression algorithm compresses the imagery by half, thus reducing image storage and transmission time. Shown in Figure 3 is a screen shot.

## Data Archive - Monitoring Tools

Two network monitoring software tools were developed to automatically notify the staff in the event of satellite transmission problems, telemetry and hardware failures, and software issues. These tools use e-mail and web-based HTML pages to take advantage of existing popular technologies. The first network monitoring tool is called Data Collection Monitor (DCMon) and is a generic utility which checks for recent data on specified directories. An example of the web reporting for this program is shown in Figure 4.

The second network monitoring tool is specific to CIRA's new Windows NT ingest server and is called Ingest Monitor (Ingest-Mon). It creates web reports indicating when data is missing or has problems. Using these tools, CIRA's staff can easily monitor day-to-day data collection operations with minimal effort.

## Conclusion

The CIRA satellite earthstation plays a large part in the research at CIRA. This new technology will easily last CIRA throughout the lifespan of the GOES GVAR series scheduled to end in 2005, and will provide a solid foundation for the next generation of satellites. More information is available on CIRA's web page ([www.cira.colostate.edu](http://www.cira.colostate.edu)). In addition, over two months of select GOES, AVHRR and Meteosat images are available for display from the CIRA web page. These images are compressed, non-research quality JPEG images which can be easily viewed from the Intranet and Internet.

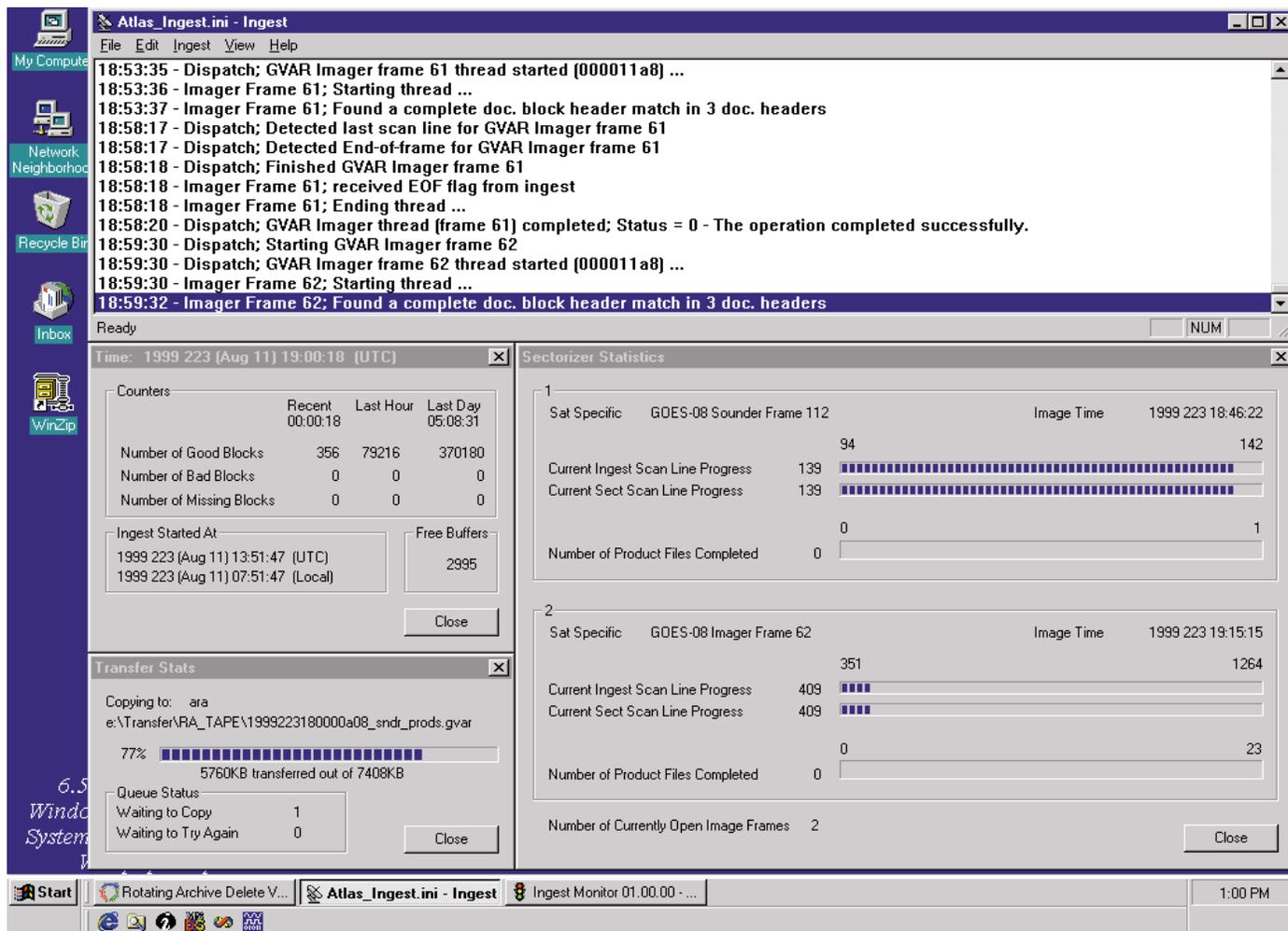


Figure 3. Windows NT Ingest Screen Shot

## Data Collection Monitor - July 1999

(This page will automatically refresh every 3 minutes)

Last Updated on 7/31/99 at 11:59 PM

[DCMon Initialization](#) | [DCMon Documentation](#)

[Dec 98](#) | [Jan 99](#) | [Feb 99](#) | [Mar 99](#) | [Apr 99](#) | [May 99](#) | [Jun 99](#) | [Jul 99](#) | [Aug 99](#) | [Sep 99](#) | [Oct 99](#) | [Nov 99](#) | [Dec 99](#) | [Jan 00](#)

Computer	Directory	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
<b>AVHRR-Gilmore</b>																																	
ALGOL	AVHRR GEMS\jpeg\current	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
MIRA	DCDrive\autoprocess	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
MIRA	DCDrive\current	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
MIRA	DCDrive\public	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
<b>AVHRR-Wallops</b>																																	
ALGOL	AVHRR GEMS\jpeg\current	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
CORVUS	DCDrive\autoprocess	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
CORVUS	DCDrive\current	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
CORVUS	DCDrive\public	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
<b>GOES-08</b>																																	
ANTLIA	GOES-8 1\fullres	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
CYGNUS	GOES-8 0\fullres	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
PICTOR	e\$\incoming	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
SPICA	GOES08 GEMS\jpeg\current	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
<b>GOES-10</b>																																	
AMALTHEA	GOES-10 1\fullres	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
CALYPSO	GOES-10 0\fullres	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
PERSEUS	e\$\incoming	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
PISCES	GOES10 GEMS\jpeg\current	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
<b>Meteosat</b>																																	
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TITAN	DCDrive\current	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
TITAN	DCDrive\public	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	

Figure 4 - Data Collection Monitor Screen Shot

## GOES-08 Ingest Status - August 1999

(This page will automatically refresh every 5 minutes)

Last Updated on 08/11/99 at 10:53 AM

[IngestMon Initialization](#)

[Dec 98](#) | [Jan 99](#) | [Feb 99](#) | [Mar 99](#) | [Apr 99](#) | [May 99](#) | [Jun 99](#) | [Jul 99](#) | [Aug 99](#) | [Sep 99](#) | [Oct 99](#) | [Nov 99](#) | [Dec 99](#) | [Jan 00](#)

Raw Data Quality						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 213	2 214	3 215	4 216	5 217	6 218	7 219
8 220	9 221	10 222	11 223	12 224	13 225	14 226
15 227	16 228	17 229	18 230	19 231	20 232	21 233
22 234	23 235	24 236	25 237	26 238	27 239	28 240
29 241	30 242	31 243				

Key to Calendar Colors

OK	Warning	Error
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Image Processing						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 213	2 214	3 215	4 216	5 217	6 218	7 219
8 220	9 221	10 222	11 223	12 224	13 225	14 226
15 227	16 228	17 229	18 230	19 231	20 232	21 233
22 234	23 235	24 236	25 237	26 238	27 239	28 240
29 241	30 242	31 243				

Key to Calendar Colors

OK	Pending	Error
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Figure 5 - Ingest Monitor Screen Shot

# Comparison of Cloud Climatologies



G. Garrett Campbell

For many years CIRA and CSU have been involved in the International Satellite Cloud Climatology Project (ISCCP). That project combines many operational geosynchronous and polar orbiting satellite observations into an estimate of cloudiness and cloud properties. Recently other climatologies over the last 2 decades have become available: an analysis of AVHRR polar orbiter data called NASA Pathfinder and the reanalysis of model initialization data into cloudiness by NCEP. By comparing these different cloud estimates, we can better understand the analysis algorithms and better understand the Earth's climate.

The two satellite-based cloud analyses use radiances measured in the visible and near-infrared with 4 to 8 km resolution pixels. Figure 1 shows a number of features of the different analysis methods. The ISCCP analysis (black) first constructs a background composite clear radiance and then assigns 100% cloudiness to pixels significantly colder (IR) or brighter (visible) than the background. Then the cloud fraction is the number of cloudy pixels in 280 km x 280 km regions. Monthly averages are shown in the plot. The AVHRR Pathfinder analysis constructs a similar composite background but then attempts to estimate a fractional cloudiness for those radiances different than the background. Thus one would expect that the Pathfinder cloudiness would be less than the ISCCP estimates and this is true for most areas of the globe. There are additional smaller differences because ISCCP uses geosynchronous observations which provide 8 observations per day, but the AVHRR are available only twice per day.

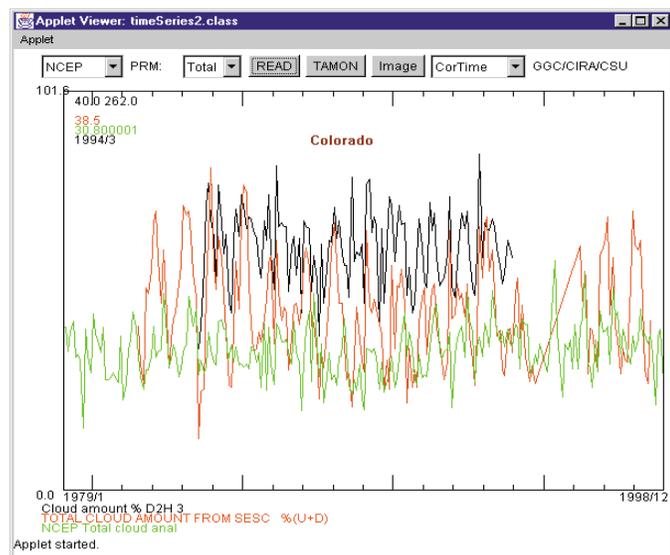


Figure 1. Time series of monthly cloudiness: ISCCP, AVHRR Pathfinder, and NCEP Reanalysis

The NCEP reanalysis product is an assimilation of temperature and water vapor profiles and surface observations as well as winds. Cloudiness is determined in the model when the water profile is near saturation. This will generally underestimate clouds which occur in thin layers like stratus or cirrus. In general the NCEP cloudiness is less than the satellite observations. Although the means are different, the month to month variations match between the different time series.

The second question is: Do the anomalies from the seasonal cycle in each data set give a similar estimate of the climate fluctuations over the last two decades? Figure 2 shows a location in the central Pacific with larger year-to-year changes in cloudiness because of El Niño. The two satellite observations show very similar time series, but the NCEP detection of cloud changes from El Niño occurs in a narrower band across the Pacific. Someday the model initialization schemes will assimilate cloudiness measurements and then produce a much better cloudiness estimate.

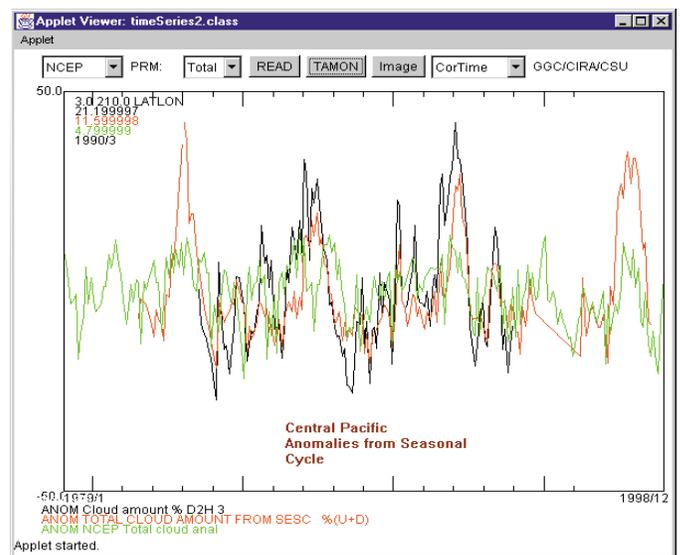


Figure 2. Time series of monthly anomalies : ISCCP, AVHRR Pathfinder, and NCEP Reanalysis

The most obvious signal in the observations beyond the seasonal cycle are the El Niño events over the last 20 years. Our primary interest in this analysis was to look for additional climate events in areas outside the central Pacific. Figure 3 shows the cloudiness anomaly over England with a long downward trend in cloudiness in 1988 and 1989. This is detected by all three independent cloud observation systems. This might be a long distance effect of La Niña. Because of its long persistence, this event provided the opportunity for long range prediction of the dry summer of 1989 in England. A literature survey is under way to see if a prediction was actually made in the spring of 1989.

I was recently asked the question: "Should we continue to construct ISCCP cloudiness?" This example shows that there are unexpected climate events in the Earth's cloudiness. Also

there is a vast array of information in the other parameters collected by ISCCP or the Pathfinder cloud analysis about cloud properties.

## News Briefs



Tom Greenwald

### CIRA to Celebrate Milestone



Next year will mark CIRA's 20th anniversary. CIRA has seen tremendous growth over the years. It began with a handful of people and now has grown to over 100 employees of diverse scientific backgrounds. To commemorate this special event, an expanded newsletter will be assembled for the fall 2000 issue. We are asking former CIRA employees to contribute. Please contact Dr. Tom Greenwald (970-491-8668, greenwald@cira.colostate.edu) or Joanne DiVico (970-491-8636, divico@cira.colostate.edu) for more information.

### Center for Geosciences Atmospheric Research Underway

Last year the Center for Geosciences was awarded a 3-year \$6.8 million grant by the U.S. Department of Defense (DoD) Army Research Laboratories to continue its efforts to conduct research on the effects of weather on civilians and military operations. This third phase of DoD-sponsored research, known as the Center for Geosciences / Atmospheric Research (CG/AR), focuses on, but is not limited to, atmospheric phenomena. Specific topics of study include developing advanced data assimilation techniques for coupling forecast models and satellite data, providing cloud drift winds derived from satellite data to initialize forecast models, deriving aerosol properties from satellite data, providing high-resolution measurements of the stable boundary layer and developing more sophisticated models to better predict flash floods, among others. The CG/AR's first year annual review was held on October 27-29.

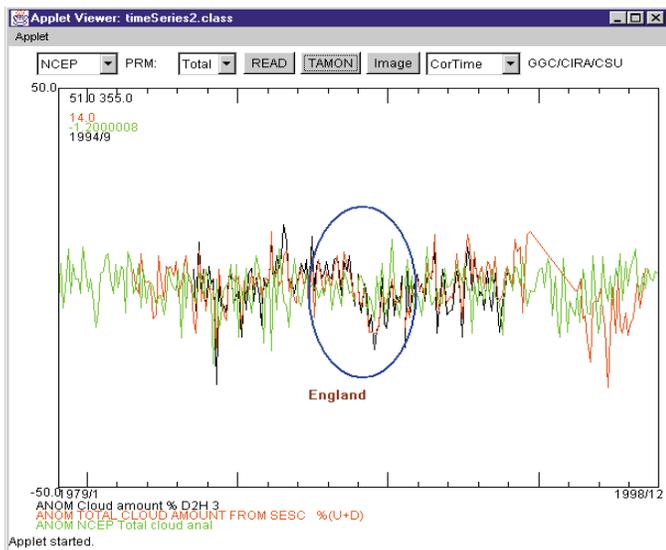


Figure 3. Time series of monthly anomalies for England: ISCCP, AVHRR Pathfinder, and NCEP Reanalysis

These plots and many others can be obtained by pointing your web browser to <http://acamar.cira.colostate.edu/climtime.htm>. These were discussed in a recent presentation: Campbell, G C and VonderHaar, T H, 1999, Global Satellite Cloud Observation Data Sets, IUGG, Birmingham, England.

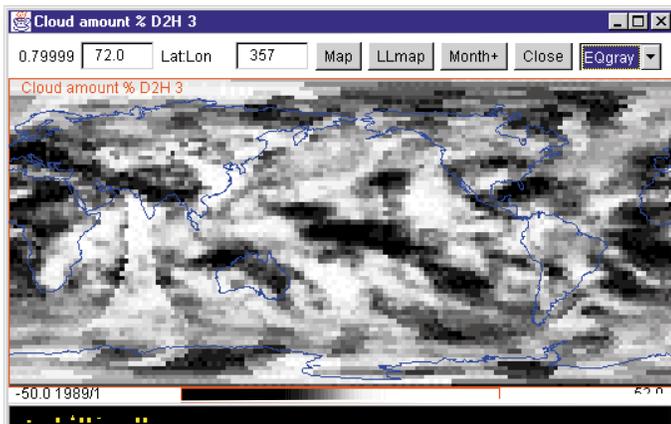


Figure 4. Significant cloud anomalies occurred in the 1989 El Nino areas in the central Pacific. Also there were large changes in cloud cover over Europe in the 1989 winter. This picture shows an example month: January 1989 ISCCP cloudiness anomaly from the January mean.

## CSU Researcher Leads Revolutionary Cloudsat



NASA recently approved the go ahead for Cloudsat, a satellite mission that will carry an advanced millimeter-wave radar to probe through cloud layers to study clouds and their role in climate. This is the first time that a radar of this kind will be flown on a satellite. Another instrument will also be on board to complement the measurement of cloud vertical properties and provide information about atmospheric aerosols. Cloudsat will be launched in 2003. Dr. Graeme Stephens, CSU professor and CIRA Fellow, is the principal investigator on the mission, which is a cooperative venture that includes the United States, Canada, Germany and Japan. Dr. Tom Vonder Haar is also a member of the science team. CIRA's principal role in the Cloudsat mission will be to process, archive and distribute the data. A complete follow-up article on this exciting mission will appear in the spring issue of the newsletter.

## CIRA Part of NASA's Effort to Study Urban Heat Island



A NASA-sponsored study called Project Atlanta (Atlanta Land-use Analysis: Temperature and Air-quality) has recently assessed the impact of the heat island effect on weather and air quality in Atlanta as a result of changes in land use. A large team of scientists was assembled to study this important problem, including CIRA researchers Dr. Stan Kidder and Dr. Jan Hafner. Drs. Kidder and Hafner have studied the interaction between clouds and the urban heat island from both an observa-

tional and modeling perspective. Some of the important conclusions drawn from their study are that clouds are very common in Atlanta, forming more frequently in the city than in surrounding areas; they cool the surface, decrease biogenic emissions of ozone precursors, reflect ultraviolet radiation, and are negatively correlated with ozone concentration. They also found that mesoscale models poorly simulate small clouds, which persist much too long after sunset in the simulations. The researchers hope to acquire additional funds to extend their studies.

## CLEX Field Study to Take Place

The Center for Geosciences is planning to conduct its fifth in a series of field programs of the Complex Layered Cloud Experiment (CLEX-5) during November 4-19. The CLEX seeks to better understand the factors involved in the formation, maintenance and dissipation of complex and multi-layer cloud systems using a vast array of satellite, aircraft, and ground-based instrumentation. This year's experiment will include new instruments, such as an imaging device (Cloud Particle Imager or CPI) mounted on an aircraft to more accurately measure the microphysical properties of the clouds. The experiment will take place over the ARM-CART sites in Oklahoma and along the Front Range in Colorado.

## Special Recognition and Events

The National Weather Service was the recipient of a laureate medal in Computerworld's 1999 Smithsonian Institute Award for best and most innovative technology for its Advanced Weather Interactive Processing System (AWIPS). The Forecast Systems Laboratory in Boulder was instrumental in the development and implementation of the operational AWIPS. AWIPS is a new, highly advanced processing, display and telecommunications system to be run at all weather forecast offices for primarily improving severe weather forecasts. The system makes use of an array of different data, including satellite, radar, and numerical model data.

CIRA recently hosted the 1st Emergency Managers Weather Information Network (EMWIN) National Summit and Front Range Workshop on June 8-10. Fifty participants from four states attended. The goal was to learn more about how to receive critical, real-time weather information from the National Weather Service.

Congratulations go out to Tracy Smith, a Research Meteorologist for the Forecast Systems Laboratory, who will be featured in the upcoming 4th edition of "Geosystems: An Introduction to Physical Geography" by Robert Christopherson, a textbook published by Prentice-Hall. Tracy's decision to become a meteorologist and her work in predicting the weather is described in the section on careers in Meteorology.

# BRAVO: Big Bend Regional Aerosol and Visibility Observational Study



Julie Winchester

Since the mid 1980s the National Park Service has been concerned about air pollution from sources located in Mexico that may impact visibility in parks of the southwestern United States. The National Park Service, CIRA, the Atmospheric Science Department of Colorado State University, and the Environmental Protection Agency have been involved in a joint U.S.-Mexico effort investigating the causes of visibility impairment at Big Bend National Park. The Big Bend Regional Aerosol and Visibility Observational Study (BRAVO) is being conducted to understand the causes of visibility impairment in the park, identify the sources responsible, and to provide a scientific basis for informed bi-national policy decisions regarding transboundary air pollution between the U.S. and Mexico.

The study objectives are to:

- ◆ Quantify the impacts of major sources (or source regions) in both the U.S. and Mexico on Big Bend haze including: carbon I/II power plants in Mexico; industrial source areas on the Texas gulf coast and in Monterrey and Tula, Mexico; coal-fired power plants and refineries in Texas; and large sulfur dioxide source regions in the southeastern and midwestern U.S.
- ◆ Determine the chemical constituents of Big Bend haze
- ◆ Determine the role of meteorology on Big Bend haze
- ◆ Identify the most likely pollutant transport corridors associated with Big Bend haze
- ◆ Assess the changes to Big Bend haze levels that would result from emission controls.



Research focuses on:

- ◆ Characterizing inorganic and organic aerosol components
- ◆ Estimating the contributions of various sources to the carbonaceous fraction of the aerosol
- ◆ Measuring the physical aerosol size distribution of fine and coarse particles
- ◆ Estimating the contributions of scattering and absorption components of Big Bend haze
- ◆ Developing relationships between particle concentrations, composition, and light scattering
- ◆ Measuring the hygroscopic properties of various aerosols.



The BRAVO study is expected to cost about \$7 million. The monitoring program ran from July to October 1999, and preliminary data analysis should be completed within a year.

# CIRA Mission



The Cooperative Institute for Research in the Atmosphere (CIRA), originally established under the Graduate School, was formed in 1980 by a Memorandum of Understanding between Colorado State University (CSU) and the National Oceanic and Atmospheric Administration (NOAA). In February 1994, the Institute changed affiliation from the Graduate School to the College of Engineering as part of a CSU reorganizational plan.

The purpose or mission of the Institute is to increase the effectiveness of atmospheric research of mutual interest to NOAA, the University, the state and the nation. Objectives of the Institute are to provide a center for cooperation in specified research programs by scientists from Colorado, the nation, and other countries, and to enhance the training of atmospheric scientists. Multidisciplinary research programs are given special emphasis, and all university and NOAA organizational elements are invited to participate in CIRA's atmospheric research programs. Initial participation by NOAA has been primarily through the Environmental Research Laboratories (ERL) and the National Environmental Satellite, Data, and Information Service (NESDIS). At the university, the Departments of Anthropology, Atmospheric Science, Biology, Civil Engineering, Computer Science, Earth Resources, Economics, Electrical Engineering, Environmental Health, Forest Sciences, Mathematics, Physics, Psychology, Range Science, Recreation Resources and Landscape Architecture, and Statistics are or have been involved in CIRA activities.

During the past fiscal year, the Institute's research has concentrated on global climate dynamics, local-area weather forecasting, cloud physics, the application of satellite observations to climate studies, regional and local numerical modeling of weather features, and the economic and social aspects of improved weather and climate knowledge and forecasting. The Institute and the National Park Service also have an ongoing cooperation in air quality and visibility research which involves scientists from numerous disciplines. CIRA is playing a major role in the NOAA-coordinated U.S. participation in the International Satellite Cloud Climatology Program (part of the World Climate Research Programme).

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