CIRA

VOLUME 33, SPRING 2010

Global Impact:
CIRA brings SOS to the U.N. Conference on Climate Change

Colorado State University

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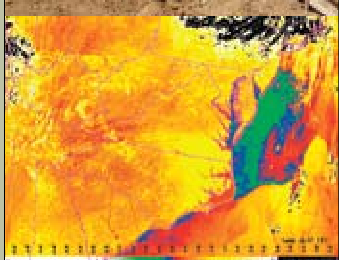

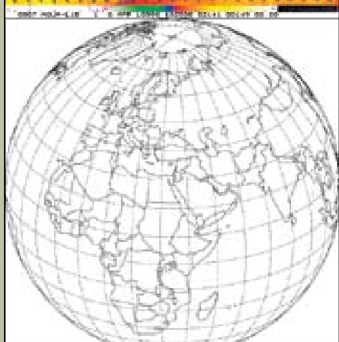

CIRA

Cooperative Institute for Research in the Atmosphere

www.cira.colostate.edu

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ISCCP GOES-West Sector Processing Center Transitioned to NCDC Operations

Stan Kidder and Tom Vonder Haar

The International Satellite Cloud Climatology Project (ISCCP) was established in 1982 as the first project of the World Climate Research Program. The objectives are[1]

1. Produce a global, reduced-resolution, calibrated and normalized, infrared and visible radiance dataset, along with basic information on the radiative properties of the atmosphere, from which cloud parameters can be derived.
2. Coordinate basic research on techniques for inferring the physical properties of clouds from satellite radiance data.
3. Derive and validate a global cloud climatology.
4. Promote research using ISCCP data to improve parameterizations of clouds in climate models.
5. Improve understanding of the earth's radiation budget (top-of-atmosphere and surface) and hydrological cycle.

CIRA's team, initially led by Tom Vonder Haar, has been involved in ISCCP since its scientific design in 1979-80 and the beginning of data collection in 1983. This research project has been the longest continuous project in CIRA; it was included in the original planning documents for CIRA with NOAA in 1980. The heart of ISCCP is the visible and infrared satellite observations from geostationary and polar-orbiting satellites. On July 1, 1983 (the start date of ISCCP data collection), the CIRA Ground Station (Fig. 1) became the GOES-West Sector Processing Center, collecting data every three hours from the GOES-West satellite, processing them into the reduced-resolution ISCCP format, and delivering them to NCDC and the Goddard Institute for Space Studies (GISS), where they were and are further processed into the ISCCP products. This collection and processing continued at CIRA for the following 26 years and 4 months. Figure 2 shows the first and last ISCCP image pairs collected by CIRA.

It was always planned to transition the ISCCP GOES data collection and processing developed at CIRA to an operational agency. In fact, this transition to NOAA/NESDIS was originally planned for about 1989! The ISCCP participants (Japan, Canada, France, NASA and NOAA in the U.S. and the European Space Agency) planned to continue to collect the data "operationally," thus allowing scientists at CIRA and elsewhere to focus on global and regional cloud research. The other countries made these changes in due course, and in 2009 CIRA received funding to transition the Java-based processing code written at CIRA by G. Garrett Campbell to the NOAA/NESDIS National Climatic Data Center (NCDC). The transition effort was successful, and on November 1, 2009, NCDC took over ISCCP GOES-West processing from CIRA. It was a great 30-year research project for the CIRA-NOAA partners and has supported hundreds of scientific papers using the ISCCP global cloud dataset by scientists and students at CSU and around the world.

Figure 1. Some of the antennas used to collect GOES data for ISCCP. The 10-meter dish in back was the first antenna. In the foreground are engineers Michael Hiatt and Duane Whitcomb. Photo taken ca. 1995.

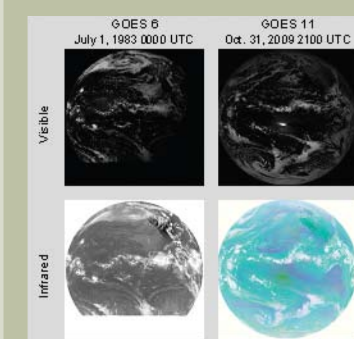

Figure 2. The first and the last GOES-West image pairs collected by CIRA for ISCCP. Note that with GOES 9 came the ability to collect five channels of data, thus the 2009 infrared photo (bottom right) shows three infrared channels in a false color image.

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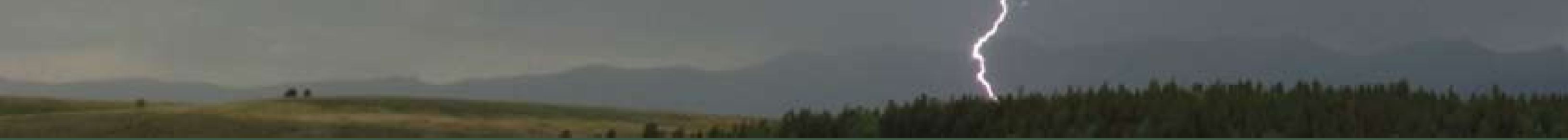
[1] Rossow, W.B., and R.A. Schiffer, 1991: ISCCP cloud data products. Bull. Amer. Meteor. Soc., 72, 2-20. An extensive list of ISCCP's accomplishments and publications may be found at http://isccp.giss.nasa.gov/accomplishments.html.



SOS

Science on a Sphere® featured at COP 15 in Denmark!

Mike Biere

CIRA Fellow, Dr Alexander "Sandy" MacDonald, inventor of SOS, gives the first international SphereCast in Denmark.

CIRA staff member, Michael Biere has been very busy travelling all over the world installing SOS exhibits.

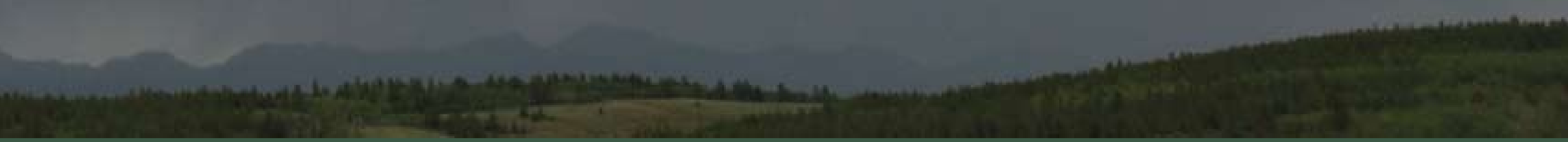
In December, Mike had the good fortune of attending the 15th Annual Session of the Conference of the Parties to the U.N. Framework Convention on Climate Change (COP15) in Denmark as a Sr. SOS Engineer. Organizing the first international "SphereCast" and meeting NOAA Administrator Jane Lubchenco were only two highlights of the trip.

A SphereCast is an SOS presentation done simultaneously at multiple sites by a single presenter, via the Internet. Many sites can receive the SphereCast, but only one site is the host. There are two components to a SphereCast: remote control of a presentation on an SOS system, and a live video (or audio) lecture that accompanies the SOS presentation. Remote control of the SOS system means that whatever commands the presenter issues to the SOS system at the host site are immediately replicated on all the SOS systems that are watching the SphereCast. When the presenter uses the remote control to start or stop animation, or orient the sphere, all the remote spheres behave identically.

In Denmark, the SphereCast was led by CIRA Fellow, Dr. Alexander "Sandy" MacDonald in Copenhagen and beamed to Science on a Sphere locations in the U.S. and overseas. Institutions receiving the SphereCast include: Discovery Science Center, Santa Ana, CA; Museum of Science and Industry, Chicago, IL; Boonshoft Museum of Discovery, Dayton, OH; Maryland Science Center, Baltimore, MD ; The Wildlife Experience, Parker, CO ; The Alaska State Museum, Juneau, AK ; Science Museum

Left to right: CIRES staffer Beth Russell, NOAA Exhibits Manager Les Adams, NOAA Administrator and Undersecretary of Commerce, Dr. Jane Lubchenco and CIRA staffer Mike Biere.

All photos of SOS at COP 15 courtesy of Beth Russell, Scientific Communications and Data Specialist for CIRES.



of Minnesota, St. Paul, MN ; James Madison University, Harrisonburg, VA ; Fiske Planetarium, Boulder, CO ; Heureka, The Finnish Science Center, Vantaa, Finland ; and NOAA ESRL, Boulder, CO.

After the conference, the SOS was moved to the Climate Factory in Lolland, Denmark, where it will be available for audiences of all ages and interests. The auditorium being built around SOS will hold up to 200 visitors. It is Denmark's first SOS installation.

Mike has recently installed SOS exhibits at the China Beijiko Meteorological Museum, Nanjing, PRC; Cite de l'espace, Toulouse, France; and for the Shanghai World Expo, Shanghai, PRC.

SOS has just been installed at the Denver Museum of Nature and Science, Denver, CO, making it the fifth installation in Colorado.

Enraptured by the exhibit, an audience in Copenhagen experiences the wonder of a Science on the Sphere presentation.

The U.S. Center in Copenhagen pictured from the exterior (left) and interior (right).

CIRA Staff member Mike Biere working diligently behind the scenes.

The SphereCast simultaneously presented at the NOAA ESRL Auditorium in Boulder.

From Design to Reality: CIRA's New Addition

Mary McInnis-Efaw and Steve Miller

The Mission and Vision of CIRA speak to our aspirations to advance science, develop new technology, and serve as a virtual bridge between cutting edge research conducted at Colorado State University and the practical application of this research to the operational mission of our federal partners and ultimately to the benefit of society at large. While we are indeed defined by our work, CIRA also has a unique character that relates to our place in CSU and our physical location against the scenic foothills of the Rocky Mountain Front Range. Bringing all of these dimensions together informed the 'techtonic' concept behind the design of CIRA's new western wing.

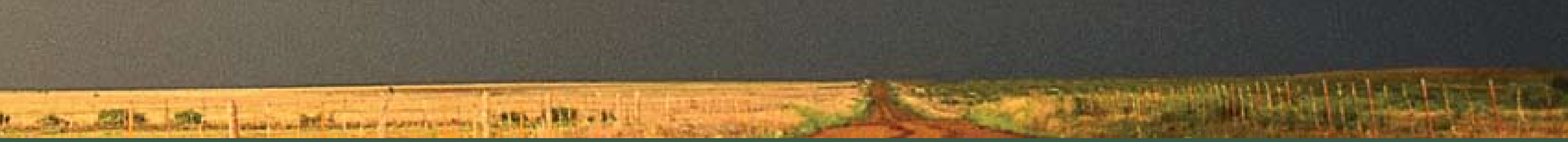
In the last issue of the *CIRA Magazine*, a sketch of our 4,000-square-foot addition was featured on the cover. The addition represents one of several key cost share measures included by the University as part of our successful re-competition bid to NOAA. With this generous support, we were fortunate to engage a very talented architect from the Denver area, Art Hoy, to work with us in bringing our vision for the addition to fruition. He spent a good deal of time interviewing staff members, exploring the terrain around our building, learning about the nature of our work and ultimately listened to us as we described needs and wants for a new space. In fact, Art took what could have been a simple rectangle appended to the present space and rotated the form to create a unique concept with multiple 'corner offices.' He even went a step further and suggested several remodeling ideas to help unify and enhance the functionality of our entire building. Thanks to the favorable construction climate at bid-time and a thoughtful design by our architect, CIRA was delighted to learn that the available funds would cover the addition and all of the proposed remodeling work.

Design + Function + a Dash of Inspiration

As many visitors and employees alike have noted, CIRA's present structure is highly modular – comprised of several rectangular-shaped wings added onto one another. CIRA is getting ready to celebrate 30 years as a Cooperative Institute at CSU, and as our research programs have grown these add-ons have grown in parallel. The new wing attempts to bring the outside in – reflecting both our location and also our natural research ties to the Colorado outdoors. More importantly, the new space is being added in a manner that is consistent with what is already here while introducing a modern element, and by its placement, attempting to provide a sense of balance and cohesion to the entire building.

The new wing will include several offices (both single and multi-person spaces), a new Director's Conference room, a larger lunchroom, and walk-out to an outdoor patio. All of the offices include floor-to-ceiling, corner windows to capture the view. The addition forms an inner courtyard (three-sided) for CIRA that will be protected from the windstorms that often sweep across the Foothills Campus, giving staff an opportunity to get outside and enjoy the outdoors on their breaks. The remodel includes a new, centralized entryway to the CIRA building which offers a less disorienting introduction to our building. The central hallway connects direct views of CIRA's satellite dishes, to the current Director's Conference Room (which will be converted into the CIRA Observatorium), and beyond to the atmosphere.

The Observatorium will be a multi-purpose space that is used as a weather laboratory and a convening venue for education and outreach activities. Here we will hold the daily weather briefings (and special tropical briefings during



hurricane season) that provide an important connection with our Atmospheric Science Department colleagues. An exterior "bridge to the atmosphere" will extend outward from the Observatorium. Dramatic, panoramic views available from this elevated structure will provide our staff, meeting attendees, and public/student tours an ideal location to observe and reflect upon the atmosphere at work. Lastly, the remodel will include a basement below the new wing for much needed storage as well as additional space to accommodate future computing resources. Rounding off the additions are several minor office remodels, the installation of an elevator on the central wing, and some new restrooms on the lower level of the central wing to improve the accessibility and functionality of our existing spaces.

What's Happening Now?

Construction began in mid-April and is in full gear at the time of this writing. The project hasn't been without its hiccups – cough, water outages, cough! – but with a responsive and agile team including Marilyn Watson (CIRA's Facilities Manager), our architect Art Hoy, the University Facilities team headed by Milt Brown, and our general contractor headed by Lindsey Crisanti, things have been progressing very well. Foundations are being dug, caissons drilled (to mitigate the expansive soil issues we have on the Foothills Campus), and utilities relocated to accommodate the plan. We will be closing the front entry of our current building for several weeks this summer, but the schedule was coordinated to minimize the downtime of critical areas of existing space. Our contractor predicts we will be very close to full completion by late August.

Included on these pages are a few photos of the progress to date. By the time of our next issue of the *CIRA Magazine*, we should be able to show off our beautiful new addition and remodel! Thanks go to all of our staff not only for their input in the design process, but also for their patience and perseverance throughout the construction process.

GOES-R Channel Differencing

Lewis D. Grasso, Donald Hillger, and Renate Brummer

Recent efforts at the Cooperative Institute for Research in the Atmosphere (CIRA) have concentrated on the development of synthetic satellite imagery. Motivation for such products is threefold: (1) to better understand and interpret currently available satellite imagery; (2) to prepare for next generation satellite systems: such as the Geostationary Operational Environmental Satellite-R (GOES-R); and (3) to verify operational numerical weather prediction models using synthetic satellite imagery. In addition to synthetic imagery, operational MODIS data can also be used to get a preview of some of the GOES-R Advanced Baseline Imager (ABI) bands.

A total of 16 bands will be available from GOES-R ABI. This is in contrast to the current 5 bands from GOES-11 and 12. Further, GOES-R ABI will produce imagery for each of the 16 bands every five minutes over the U.S. – three times as often as the fifteen minute imagery for GOES-12. One additional difference between the current GOES-12 Imager and GOES-R ABI will be the size of the footprints: 4 km for GOES-12 and 2 km for GOES-R ABI at the equatorial subpoint. As a consequence of the increased temporal and spatial resolutions, GOES-R ABI will produce far more data compared to GOES-12. For more information on the GOES-R ABI see http://www.goes-r.gov.

Subtracting images from two different wavelengths is a way to highlight subtle differences in aerosol optical properties.

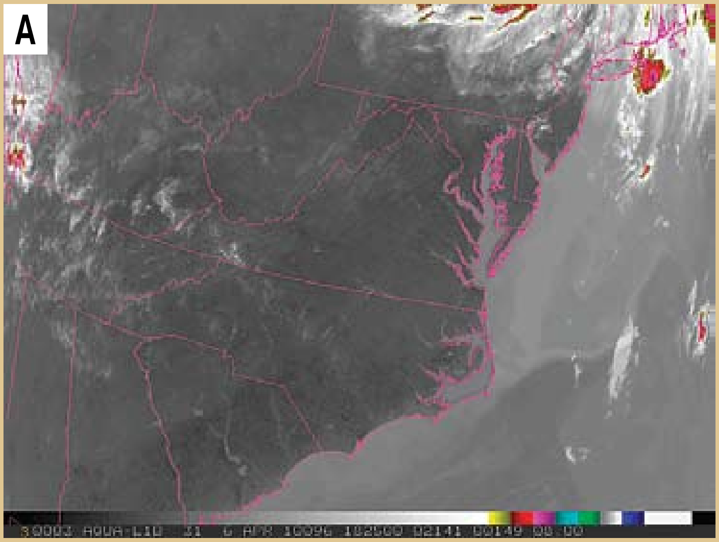
Ongoing research at CIRA is trying to determine the best, or most efficient, way to extract information from the large ABI datasets. One possibility may be the use of simple channel differencing.

Channel differencing is the procedure of literally subtracting the ABI brightness temperatures at, say, 12.3 µm from those at 11.2 µm. Subtracting images from two different wavelengths is a way to highlight subtle differences in aerosol optical properties. For example, blowing dust and thin cirrus can be prominent features in some channel differences. In addition, clear sky scenes can highlight dryline boundaries in some cases. This is a result of the different absorption properties of water vapor at different wavelengths. Differentiating between cloud tops composed of cloud liquid water verses cloud ice water is also possible with channel differencing. In this article, an example of channel differencing of MODIS data will be shown for two prominent ocean currents in the Atlantic: the Gulf Stream and Labrador currents.

With GOES-R ABI there will be more bands and more band differences to exploit, as well as what those image differences mean about the environment of the Earth.

Figures 1A, and 1B show MODIS images at 11.02 µm and 12.03 µm, respectively, at 1825 UTC on 6 April 2010. Off the east coast of the United States, two ocean currents are evident in the imagery: The cool, southward flowing, Labrador Current and the warm, northerly flowing, Gulf Stream. Figure 1C shows the color-coded 11.02 µm – 12.03 µm channel difference. In this image, red and orange colors represent positive values; blue and green represent negative values. Noticeable variations are evident between the two currents, within the Labrador Current, along the North and South Carolina coast lines, and between the waters east and west of the Outer Banks of North Carolina. Also evident is the change of sign from negative to positive within the Labrador Current and from the portions of the Labrador Current and the adjacent Gulf Stream.

Even though some of the features in this example difference image can't be explained at this time, this type of image difference should be somewhat familiar to current GOES users. But



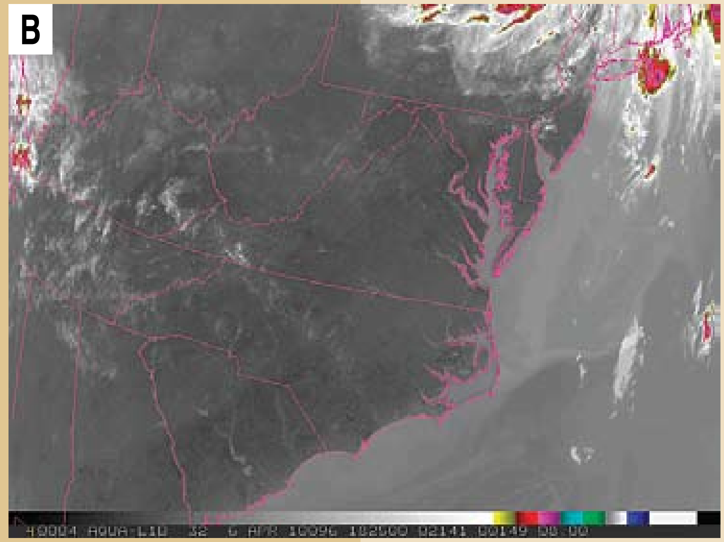
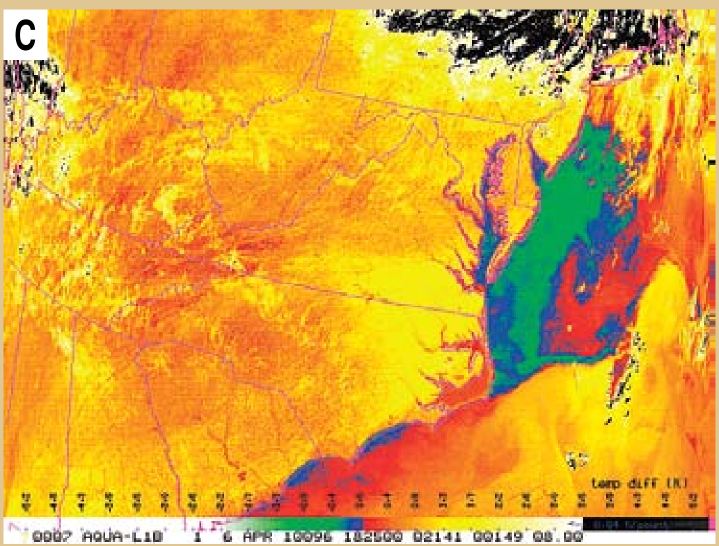


Figure 1. MODIS satellite imagery from 6 April 2010 at 1825 UTC: (A) 11.02 µm, (B) 12.03 µm, and (C) channel difference: 11.02 µm -12.03 µm.



with GOES-R ABI there will be more bands and more band differences to exploit, as well as what those image differences mean about the environment of the Earth. This leads to the investigation of those differences and how they relate to the land and ocean surfaces and atmosphere through which they are being viewed.

Synthetic GOES-R ABI satellite imagery or existing operational satellite imagery are being used as an ABI proxy aids in the understanding of future GOES-R ABI data. Here at CIRA, we are using both methods to learn as much as possible about a technically advanced remote sensor: GOES-R ABI.

CIRA COMMUNIQUÉ

The Prestigious NOAA Bronze Medal Award

CIRA is proud to acknowledge two of its on-site NOAA collaborators (and CSU alums!), John Knaff and Mark DeMaria, who were recently honored with the 2009 NOAA Bronze Medal. Also, three staff members from our Boulder CIRA team were celebrated as collaborators on Bronze-Medal winning teams. Read below for all the details!

The NOAA Bronze Medal is the highest honorary award granted to NOAA employees by a head of an operating unit or Secretarial Officer or equivalent. It is defined as superior performance characterized by outstanding or significant contributions which have increased the efficiency and effectiveness of the operating unit. All of the esteemed award recipients were honored at a ceremony held on Tuesday, April 27 in the NOAA Auditorium in Silver Spring, Maryland.

Mark and John are both members of NOAA's RAMMBranch: The Regional and Mesoscale Meteorology Branch (RAMMB) of NOAA/NESDIS, which is collocated at CIRA. Mark is the Branch head and John is both a former CIRA employee and now RAMMB team member. RAMMB conducts research on the use of satellite data to improve analysis, forecasts, and warnings for regional and mesoscale meteorological events. The work honored with the award focused on developing, implementing, and conducting outreach for the new National Hurricane Center Tropical Cyclone Surface Wind Speed Probability products. The entire winning team is listed below:

Mark DeMaria
John Knaff
Alison Krautkramer
Chris Lauer
Chris Sisko
Richard Knabb
Chris Juckins
Timothy Schott
Michelle Mainelli
Edward Rappaport

Since the Bronze Medal can only be awarded to NOAA employees, CIRA issues its own citations for employees who collaborated on winning teams, including a one-time special cash award for each CIRA winner. Among the CIRA staff associated with Bronze Medal winning teams are **Isidora Jankov, Kevin Brundage,** and **Bob Lipschutz.**

Isidora served as a key contributor in the NOAA/ Earth System Research Lab joint PSD-GSD (Physical Sciences Division-Global Systems Division) effort to develop the atmospheric river moisture flux tool. The tool combines observations and numerical model output so that atmospheric river conditions can be documented and monitored. Atmospheric rivers help scientists identify conditions which often lead to excessive precipitation. Isidora handled the modeling component of the project herself, which included both developing a strategy for submitting specialized WRF model runs and delivering timely model results that could be used in the tool on an hourly basis. Her work and commitment to the effort helped to strengthen the collaboration of all the scientists from GSD, PSD, and CIRA in working on HMT-related research. Congratulations and thank you to Isidora!

Kevin Brundage and Bob Lipschutz both collaborated with colleagues from NOAA's Earth System Research Lab Global Systems Division and the National Weather Service to develop the first NWS/NCEP (National Centers for Environmental Prediction) operational radar reflectivity assimilation technique to improve convective storm forecasting for the real-time RUC (Rapid Update Cycle) model. The RUC is an integrated high-frequency model/ assimilation system.

Operational assimilation of radar reflectivity data was thought to be unachievable for many years until the award-winning team developed a very effective technique that did not increase computational resources and was then successfully implemented at NCEP. Kevin did the scripting to add the radar assimilation to the real-time RUC where the testing occurred, as well as additional scripting to improve the radar assimilation with initialization files. Bob set up the real-time transfer of reflectivity mosaic files from NSSL to ESRL for real-time testing and evaluation. Both of their contributions were important components to the overall effort. Congratulations and thank you to Kevin and Bob!

Reflections on 50 years of Earth observation: Drs. Kidder and Vonder Haar featured in *Science* magazine

From their long and distinguished vantage point, **Dr. Stan Kidder** and CIRA Emeritus Director **Dr. Tom Vonder Haar** took to the pages of *Science* magazine recently to describe the evolution of space-based Earth observation. In their article appearing in the February 26th issue (Vol. 327, 1085-1086) Kidder and Vonder Haar wrote, "The first 50 years of space-based

Earth observation progressed from crude observation to scientific understanding to stewardship of the atmosphere and of Earth. The new observations will result in many scientific insights and should help humanity to weather what could be the worst of global warming and other environmental problems."

As a core mission of our Institute, this unique overview of how satellite observations have changed atmospheric science is a true must-read. The full article is available here: http://www.sciencemag.org/cgi/content/full/327/5969/1085

CIRA Employee Promotion News

All of the CIRA team wishes to acknowledge the following employees for their outstanding efforts which have earned them each a promotion.

2009

Robert DeMaria
Robert was promoted to Research Associate II on July 1, 2009. He has provided valuable computer programming support to RAMMB by collaborating with scientists and team members in support of the GOES-R Risk Reduction, GOES-R Algorithm Working Group, and the Joint Hurricane Testbed. Robert has been with RAMMB for almost nine years, starting out initially as a high school PACE student. It has been exciting to watch him grow through his education, interactions with others, and application of acquired knowledge.

Christopher Hiemstra
Dr. Hiemstra was promoted to Research Scientist/Scholar III on July 1, 2009. He is an integral member of CIRA's snow hydrology and snow-vegetation-atmosphere research team. His work focuses on understanding atmosphere, snow, and vegetation interactions and how land-cover variations influence weather, climate, and ecosystem structure and function. He is actively involved with leading field-measurement efforts in the Arctic and middle latitudes, and assisting with development of improved snow-vegetation-atmosphere interaction models. His work includes using a combination of field measurements, remote-sensing observations, and physically based models to improve our understanding of the associated system components and how they relate to each other.

Note: Recently Chris has accepted a position with CRREL in Alaska. He will be departing CIRA in July to start his new position. Best of luck to Chris!

Isidora Jankov
Dr. Jankov was promoted to Research Scientist/Scholar II on July 1, 2009. She transitioned to a Research Scientist more than two years ago following a two-year stint as a CIRA Postdoc. Her wide range of independent and specialized research efforts include high-resolution model ensemble used for experimental deterministic and probabilistic precipitation forecasts.

Andrew Jones
Dr. Jones was promoted to Senior Research Scientist/Scholar on July 1, 2009. As the new deputy director of CIRA's Center for Geosciences/Atmospheric Sciences (CG/AR), he is responsible for presenting program overviews to DoD leadership, developing new project initiatives within the program, and providing overall technical leadership to the staff. Dr. Jones also actively aids graduate students and postdoctoral fellows with their research and frequently presents technical lectures in local classes.

Scott Longmore
Scott was promoted to Research Associate III on July 1, 2009. He works with the CG/AR modeling and data assimilation group and the CloudSat Data Processing Center (DPC), and has been instrumental in coordinating and building tools for our 3D and 4DVAR mesoscale modeling and cloud analysis software systems.

Nan McClurg
Nan was promoted to Research Associate III on July 1, 2009. She has been the manager of the GLOBE Help Desk ever since the Program's transfer to the UCAR-CSU partnership in 2003. She has also provided outstanding support to the Program as its North American Regional Desk Officer over the past six years.

Note: Nan and the GLOBE Help Desk transferred to the University of Texas at Tyler on October 1, 2009.

Ning Wang
Dr. Wang was promoted to Research Associate IV on July 1, 2009. He has been with CIRA for nearly 14 years. During this time, he has contributed unique and indispensable expertise as a Ph.D. mathematician to several high-profile research projects, including his wavelet transform data compression algorithms for the FX-Net project and more recently his grid generation and other pre- and post-processing techniques for the ESRL global Flow-following finite volume Icosahedral global Model (FIM).

(continued on page 10)

2010

Min-Jeong Kim
Dr. Kim was promoted to Research Scientist/Scholar II on January 1, 2010. She works as a member of the GOES-R proxy data team and as a member of the Joint Center for Satellite Data Assimilation (JCSDA) scientists located at NOAA/NESDIS in Maryland. She is currently leading a project to assimilate satellite cloudy radiance observations in NCEP Global Data Assimilation System and to improve the numerical model predictions for severe weathers. Steve Miller is her supervisor and Fuzhong Weng is her technical advisor.

Wei Shi
Dr. Shi was promoted to Research Scientist/Scholar II on January 1, 2010. Previously, Dr. Shi worked for CIRA as a Postdoctoral Fellow located at the Center for SaTellite Applications and Research (STAR) of NOAA/NESDIS in Camp Springs, Maryland. From his duty station in Maryland, Dr. Shi aids development and validation of the new atmospheric correction algorithm for deriving accurate ocean optical and biological products in coastal regions. In addition, he uses the improved ocean color product data for various applications, such as studies for Hurricane Katrina-induced phytoplankton bloom, ecosystem responses to the cyclone Nargis in the Gulf of Martaban, flood-driven Mississippi River plume in the spring of 2008, monitoring green macroalgae bloom in the Yellow Sea, etc. Steve Miller is his supervisor and Menghua Wang is his technical advisor.

David Baker
Dr. Baker, who had been a Postdoctoral Fellow with CIRA in Fort Collins, transitioned into a Research Scientist II position in March 2010. He works on quantifying sources and sinks of CO_2 using 4D-variational assimilation of in-situ measurements of CO_2 concentration from flasks and aircraft, as well as the new data streams of column averaged CO_2 concentration from satellites such as Japan's Greenhouse gases Observing SATellite (GOSAT) and NASA's rebuild of its Orbiting Carbon Observatory (OCO-2). David works closely with NOAA's ESRL in Boulder to adapt his models so that they can be used with Carbon Tracker, a modeling tool for both scientific research and policy development. His supervisor is Denis O'Brien.

Helene Bennett
Helene was promoted to Program Assistant II within the State Classified system in February 2010. This promotion was very much overdue given the breadth of responsibilities Helene manages for the NPS Cooperative Agreement within CIRA. Helene has a proven record of reliable, accurate, and timely service for the NPS team as she covers accounting, purchasing, travel, and general administrative duties for the group. Her supervisor is Mary McInnis-Efaw.

Yong Chen
Dr. Chen transitioned into a Research Scientist/Scholar I position in March 2010. Formerly a Postdoctoral Fellow, he works as a member of the Community Radiative Transfer Model (CRTM) team and as a member of the Joint Center for Satellite Data Assimilation (JCSDA) at the NESDIS Center for Satellite Application and Research (STAR) in Camp Springs, Maryland. His main tasks include testing the impacts of CRTM in the NWP system, and developing new modules to improve the CRTM performance. Steve Miller is his supervisor and Fuzhong Weng is his Technical Advisor.

Prasanjit Dash
Dr. Dash transitioned into a Research Scientist/Scholar II position in March 2010. Formerly a Postdoctoral Fellow, he works with the Sea Surface Temperature (SST) Team at the NESDIS Center for Satellite Application and Research (STAR) in Camp Springs, MD. He is responsible for the Cal/Val and long-term monitoring of satellite SST products for stability, self- and cross-platform consistency. His most recent accomplishment is the development of the online web-based tool, SST Quality Monitor (SQUAM) http://www.star.nesdis.noaa.gov/sod/sst/squam/. The SQUAM monitors satellite SSTs with respect to several global analyses SSTs (including Reynolds, RTG, OSTIA, and ODYSSEA) from NOAA-16, -17, -18, -19, and MetOp-A. The SQUAM tool proved instrumental for quick near-real time diagnostics of the satellite SST products, and identifying root-causes of the anomalies (related to SST algorithm, cloud leakage, or sensor performance). Prasanjit is closely involved with the NPOESS Cal/Val Project and with the International Group for High-Resolution SST Team. His supervisor is Steve Miller and his Technical Advisor is Alexander Ignatov.

Steve Finley
Steve was promoted to Research Associate III in March 2010. Formerly a Research Associate for the Department of Atmospheric Science (1990-1997) and most recently a non-student hourly employee, he provides Linux IT

support and Linux cluster support to CIRA in Fort Collins. Steve holds a B.S. in Meteorology and an M.S. in Agricultural Meteorology from Iowa State University, but has largely been employed as a scientific computing systems engineer, in support of operational projects for NASA, the FAA, and the DoD. Most recently he was employed by a local start-up company, Privacy Networks, along with other former Atmos and CIRA folks. His supervisor is Michael Hiatt.

XingMing Liang
Dr. Liang transitioned into a Research Scientist/Scholar II position in February 2010. Formerly a Postdoctoral Fellow, he is a member of the Sea Surface Temperature (SST) Team at the NESDIS Center for Satellite Application and Research (STAR) in Camp Springs, Maryland. He joined the SST Team in February 2007 as a CIRA Postdoctoral Fellow. XingMing is responsible for implementation and validation of the Community Radiative Transfer Model (CRTM) in the newly developed NESDIS Advanced Clear-Sky Processor for Oceans (ACSPO) system. His most recent accomplishment is the development of the online web-based tool, Monitoring of IR Clear-sky Radiances over Oceans for SST (MICROS) http://www.star.nesdis.noaa.gov/sod/sst/micros/. The MICROS monitors Model (CRTM) minus Observation (AVHRR) biases for three AVHRR IR channels, from five platforms including NOAA-16, -17, -18, -19, and MetOp-A. MICROS proved critically important for a number of applications, including monitoring performance and improvements in ACSPO products, validation of CRTM, and Cal/Val of satellite radiances. XingMing is closely involved with NPOESS Cal/Val and GOES-R SST Development Projects. His supervisor is Steve Miller and his Technical Advisor is Alexander Ignatov.

Chris MacDermaid
Chris was promoted to Senior Research Associate in April 2010. He is the senior project manager and technical lead of the 11-person Data Systems Group within Information & Technology Services at the NOAA Earth System Research Lab Global Systems Division in Boulder. DSG is responsible for developing and configuring the computer systems for acquiring, processing, storing, and distributing approximately 500 GB of conventional and advanced meteorological data per day. Chris also assumed the technical lead role for GSD on the FAA NNEW (NextGen Network Enabled Weather) program to evaluate, identify, and develop web-enabled data services to integrate into the FAA's NextGen testbed at the FAA Tech Center in Atlantic City, N.J. Cliff Matsumoto is his supervisor.

Sean Madine
Sean was promoted to Senior Research Associate in April 2010. He is the deputy Program Manager for the Forecast Verification Section at the NOAA ESRL/GSD in Boulder and the Project Lead for Network Enabled Verification Service (NEVS), a key NextGen innovative technology that will form the bridge between weather forecasts and the integration of those forecasts into FAA operations. Sean is also the Project and Scientific Lead for in-depth and complex evaluations of several weather products used in aviation operations such as the National Ceiling and Visibility Analysis, Consolidated Storm Prediction for Aviation, Collaborative Convective Forecast Product/Localized Aviation MOS Product, and the World Area Forecast Center Global Icing Product. His supervisor is Cliff Matsumoto.

Christopher O'Dell
Chris was promoted to Research Scientist/Scholar III in April 2010. He is the PI for the Atmospheric CO_2 Observations from Space (ACOS) project at CSU, and he leads the L2 algorithm team for OCO-2, which is the successor to the ill-fated Orbiting Carbon Observatory that failed to reach orbit in February 2009. The L2 team, with members at CSU, JPL, and the University of Leicester, aims to deliver column-averaged concentrations of CO_2 to the international carbon cycle community in order to quantify regional sources and sinks of CO_2. This task is particularly challenging because the accuracy of the CO_2 measurements from space must be better than 0.5 percent, a stringent requirement rarely obtained in remote sensing measurements. Thus, Chris is leading an enterprise with elements of risk but enormous potential. Denis O'Brien is his supervisor.

Mariusz Pagowski
Mariusz was promoted to Research Scientist/Scholar III in April 2010. He is an integral and key member of the Air Quality group in the GSD Assimilation and Modeling Branch involved in the development of WRF-Chem (Weather Research and Forecasting – Chemistry), a meteorological and chemical data assimilation and modeling system with the purpose of improving forecasts of concentrations of chemical spe-

(continued on page 12)

Correction to Fall 2009 Communique

We neglected to include Tom Kent in the team award that was given in August 2009. Our apologies and congratulations go out to Tom.

NOAA/GSD Team Member of the Month (August 2009)

Randy Collander and **Tom Kent** were part of a team that was awarded the August GSD Team Member of the Month award for their work on MADIS (Meteorological Assimilation Data Ingest System). FSL's MADIS Project makes integrated, quality-controlled observations available to the meteorological community. More information on MADIS can be found here: http://www-sdd.fsl.noaa.gov/MADIS_Overview/MADIS_Overview.html.

cies. Biogenic and anthropogenic emissions, deposition, convective and turbulent chemical transport, photolysis, and advective chemical transport are all treated simultaneously with the meteorology. WRF-Chem model has the capability to simulate the coupling between dynamics, radiation, and chemistry and the implementation of the assimilation cycle for daily air quality forecasts over the continental US is anticipated very soon. His supervisor is Cliff Matsumoto.

Sher Schranz
Sher was promoted to Senior Research Associate in April 2010. She is a senior program manager leading a number of research projects at the NOAA ESRL/GSD in Boulder. She leads a team of researchers and software developers in the design, development, testing, deployment, and operational support for the NWS- and BLM-sponsored FX-Net, Gridded GX-Net, and Fire Weather projects. Sher recently began acting as the Deputy Program Manager for the ESRL NWS NextGen and NNEW programs and is responsible for developing the research program proposals, budgets, project management, and research plans for the program components such as IT, NWP models, verification and guidance algorithms, and forecast analysis research and development. Cliff Matsumoto is her supervisor.

AutoNowcaster Team wins Recognition of Excellence – January 2010

Two more CIRA employees were honored for their work in collaboration with NOAA research teams. The Meteorological Development Laboratory Recognition of Excellence award was recently given to the NWS AutoNowcaster Demonstration Team. Team Members include: **Scott O'Donnell** and **Ken Sperow,** both of CIRA, as well as Steve Olson, Curt Neidhart (OST/PPD), Chris Adams, and Mamoudou Ba.

The team was recognized for the successful implementation of the NCAR AutoNowcaster system within AWIPS to provide real-time thunderstorm nowcasts at National Weather Service Forecast Offices in Dallas-Fort Worth and Melbourne, Florida in support of NextGen. Congratulations to Scott and Ken!

NOAA/GSD Team Member of the Month – October 2009

Technology Outreach Branch Chief Bill Bendel presented CIRA's own **Ning Wang** with the NOAA/GSD Team Member of the Month award last fall.

Ning Wang received this acknowledgement in recognition for outstanding contributions to the Flow-following Finite-volume Icosahedral Model (FIM) and Flow-following Non-Hydrostatic Icosahedral Model (NIM) work and for continuing support of the compression algorithms for FX-Net activities. In particular, Dr. Bendel cited the following achievements:

- implementation of the FIM – Icosahedral Grid Meta System and the FIM pre- and post-processing subroutines;
- improvement of FIM and NIM efficiency and accuracy through research on geometric optimization schemes; and
- continued support of the FX-Net Project through the optimizing of wavelet compression algorithms.

Congratulations to Ning!

Gavin Roy NSF Fellowship

Dr. Tom Vonder Haar, CIRA's Director Emeritus, is pleased to announce that one of his upcoming graduate advisees in the Department of Atmospheric Sciences has won an NSF Fellowship award. Gavin Roy will be starting at CSU this August and will be working on and supported through funding from the Center for Geosciences/Atmospheric Research, one of CIRA's main cooperative agreements. Gavin submitted what amounts to a mock grant proposal, along with a stack of other documents to the NSF Graduate Research Fellowship Program, and succeeded in winning one of these coveted awards despite rigorous competition that numbered well over 400 other applicants. There were five award winners in the field of "Geosciences - Dynamic Meteorology," and Gavin was the only undergraduate meteorology student to receive an award. The fellowship covers three years of funding: $10,000 of tuition per year, a $30,000 stipend per year, and a one-time international travel allowance of $1,000.

The Fellowship seeks to identify and reward individuals who are anticipated to become experts in their field of study. They are further expected to become individuals who can contribute to research, teaching, and innovations in science and engineering. As the NSF website cites: "These individuals are crucial to maintaining and advancing the nation's technological infrastructure and national security as well as contributing to the economic well-being of society at large."

The Department and CIRA is looking forward to working with such a talented young man this fall. Congratulations to Gavin!

NOAA/GSD Team Member of the Month – November 2009

CIRA Fellow **Dan Birkenheuer** was recently honored with a Team Member of the Month Award at NOAA/ESRL GSD. The award was a way to shine a light on the extraordinary efforts Dan made while stepping in to serve as the interim Branch Chief for the Forecast Aviation Branch of GSD. Dan in fact had to temporarily put his science career on hold as he prepared himself in a short amount of time learning on the job to carry out these duties. He put in lots of extra time and effort to ensure that all issues related to planning, reporting, and other branch and project activities were carried out in the best possible way, without interruption. He paid special attention to balancing the budget, which with the help of the branch he did successfully. And since the permanent Branch Chief, Zoltan Toth, arrived, Dan has been working with him to make the transition for Zoltan and the entire branch as painless as possible. Overall, Dan made outstanding contributions to FAB and GSD during a difficult transition period, and was more than deserving of the November 2009 GSD Team Member of the Month Award. Congratulations, Dan!

Please Congratulate the Following CIRA Employees on Their Years of Service:

1. Steven Albers - 20 years
2. Michael Biere - 10 years
3. Robert Cifelli - 10 years
4. Bernadette Connell - 15 years
5. Robert DeMaria - 10 years
6. Hiroyuki Gosden - 15 years
7. Lewis Grasso - 20 years
8. Hongli Jiang - 15 years
9. Robert Lipschutz - 15 years
10. Glen Liston - 15 years
11. Jacques Middlecoff - 10 years
12. James Ramer - 20 years
13. Sherri Schranz - 10 years
14. Tracy Smith - 20 years
15. Julie Winchester - 20 years

Job Opportunities in Atmospheric Science and Related Research

If you are interested in employment opportunities at CIRA, please visit http://www.cira.colostate.edu/personnel/employment_opportunities and enter your e-mail address. Then, when an open position is posted on the CIRA website, you will receive an e-mail prompt to view the position announcement and apply if interested/qualified. Topical areas relevant to CIRA include:

Research and Postdoctoral Research Fellowships:

- Satellite Algorithm Development, Training, and Education: development of algorithms and applications for weather forecasting, emphasizing regional and mesoscale meteorological phenomena. Development of environmental parameter retrieval techniques based on current and future satellites, potentially in concert with in situ, or other remote sensing observations. Development of training/educational materials for operational forecasters using distance learning methods and web-based demonstrations.
- Regional to Global Scale Modeling Systems: providing improvements to weather and climate numerical prediction. Topics include atmospheric and ocean dynamics, radiative forcing, clouds and moist convection, land surface modeling, hydrology, and coupled modeling of the Earth system.
- Data Assimilation: development and improvement of techniques to assimilate environmental observations (satellite, terrestrial, oceanic, and biological) to characterize the environmental state for use in analysis, modeling, and prediction of weather/climate.
- Climate/Weather Processes: use numerical models and environmental data, including satellite observations, to understand processes that are important to predicting weather and short-term climate and understanding the coupling between weather and regional climate.
- Data Distribution: identify effective and efficient methods for quickly distributing/displaying large environmental datasets (observational and model fields) using data networks, web map services, data compression algorithms, and other techniques.

Information Technology Support:

- Software Engineering, Electrical Engineering, Linux Cluster Administration, Linux and Windows IT, Data Acquisition, Large Data Set Processing and Archive, Satellite Operations, Infrastructure Management, Web Development, Database Development and Maintenance, Network Management

Administrative Support:

- Customer service, grants management and administration, and general office duties

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GIM Tool: A Global Icosahedral Atmospheric Model Viewer

Evan Polster, Jeff S. Smith, Ning Wang

CIRA researchers at Global Systems Division (GSD) of Earth System Research Laboratory (ESRL)

GSD is developing two global icosahedral weather models: the finite-volume flow-following icosahedral model (FIM) [1] and the non-hydrostatic icosahedral model (NIM). Our group was tasked with developing an innovative 3D viewing application for the purpose of displaying such global model data, which would be web-based, and intuitive to use as an outreach and diagnostic tool.

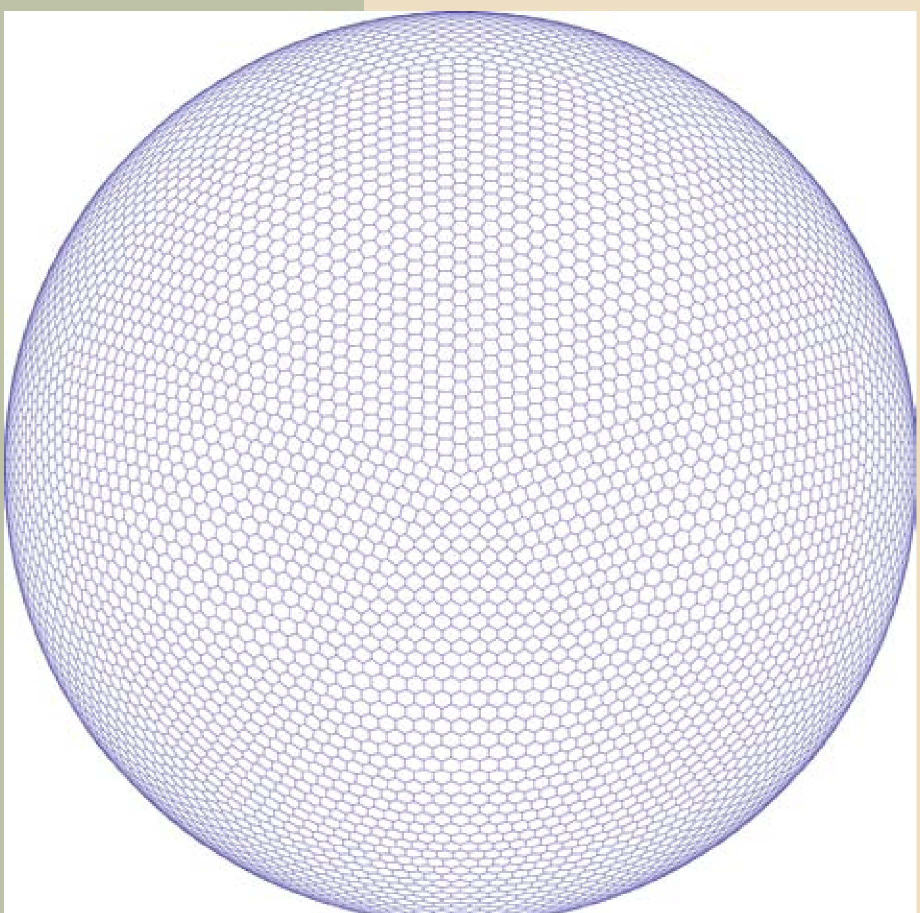

Figure 1: The icosahedral grid mesh composed of 10242 Voronoi cells (at grid refinement level 5).

What Is an Icosahedral Grid?

The icosahedral grid [2] is created by recursively bisecting the 20 triangular faces of the original regular polyhedral (icosahedron) and projecting bisection points to the sphere. The number of recursive refinements is referred to as grid level. The number of grid points is defined by $N = 10 * 22g + 2$, where g is the grid level. The areas of grid points are the spherical Voronoi cells defined by the grid points (Figure 1).

Viewing Global Icosahedral Grids

There is a myriad of ways to display global model data, but we will only discuss a few here. One option is to use a plotting tool that renders an orthographic projection of the gridded data as a static image. This projection offers a natural view of a hemisphere from a given center point. Modelers typically create these types of plots when they need to debug a model or analyze specific grid points (see Figure 2).

A second option is to convert the global data into a static snapshot of the equidistant cylindrical projection, enabling the display of all data superimposed onto a single global map. This is perhaps the most common projection employed by FIM developers for displaying and comparing their model data [1] (see Figure 3).

A third option is to display the global data in Google Maps [3]. Google Maps uses a variant of

Figure 2: The orthographic projection generated by a plotting tool. This projection gives a natural 2D representation of the sphere from a given center point.

the Mercator projection and does a good job of displaying data over much of the Earth, but with the same noticeable distortion as cylindrical equidistant projection (see Figure 4). Google Maps has the additional advantage of being interactive (i.e. dynamically controllable by the user).

A fourth option for viewing global data is a virtual 3D globe like Google Earth [4]. The virtual globe allows users to view the earth from any center point in a quasi-orthographic projection. It does a good job of displaying data at any given latitude, while avoiding the distortion of Google Maps at polar areas. Also, like Google Maps, the display is interactive (see Figure 5).

Google Earth enables users to view their data as geospatial geometries or images that are superimposed as layers over satellite imagery. The software also allows for animation of the data, either over time (e.g. looping satellite imagery), or over space (e.g. animating vertical layers of forecast model data). Geometries such as icosahedral polygons and images are described and rendered in Google Earth via KML (Keyhole Markup Language), an XML-based language [5]. A code snippet of KML is included in Figure 6.

The Two Versions of Google Earth

The Google Earth desktop application is a stand-alone native client which runs on Windows, Mac OS/X, and Linux. It loads and displays KML (or the compressed equivalent, KMZ files), and has a nice user interface with features such as bookmarks and rulers for measuring distances.

What the stand-alone version is to the desktop, the Google Earth plug-in is to the web browser. The Google Earth plug-in supports most of the features of the desktop version yet differs from the desktop in that it can only be viewed from within a web browser by being embedded into a web page. The plug-in supports a JavaScript API that enables developers to control the loading and display of data.

From a development perspective, there is no elegant way to create a customized application using the Google Earth desktop, let alone an application that is Internet accessible. Yet the plug-in allows for both customization and web integration. For this reason, it was decided that our research would focus on attempting to create a viewer using the Google Earth plug-in.

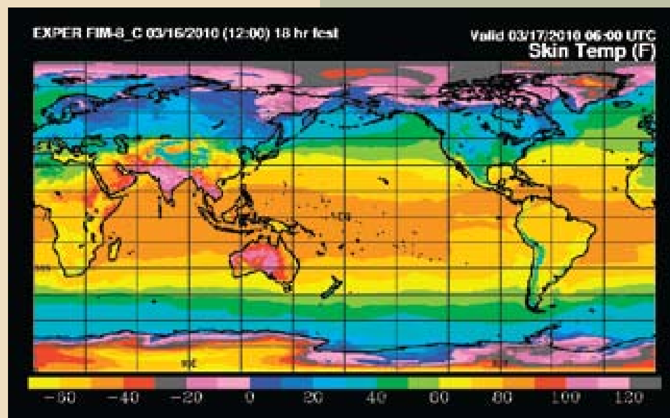

Figure 3: FIM Skin temperature mapped into a cylindrical equidistant projection with ½ degree resolution (with thanks to Brian Jamison). Distortion with this projection increases away from the Equator and is extreme in the polar regions.

GIM Tool (Global Icosahedral Model Tool)

Our research and development effort culminated in the creation of two versions of GIM Tool: one version based on the Google Earth plug-in, and another based on Google Maps. Both versions allow users to select and subset various display fields (variables) from FIM, choose color palettes and map backgrounds, and control polygon edge visibility and fill opacity (how much of the background shows through the color-filled FIM polygons). Additionally, users can move the mouse over individual polygons to view details about each FIM cell.

Both versions retrieve data by invoking custom-created Representational State Transfer or RESTful web services [6], written in Java, which run in Apache Tomcat [7]. This Java code subsets the raw FIM data for the requested variable within the requested geographic region, and then builds a KML document to return to the calling (GIM Tool) client application. Rather than construct bitmap images to return in the KML, we decided to go a more flexible route and return KML polygons. KML polygons are advantageous because they can be encoded with metadata about FIM cells – metadata that can be accessed with a simple mouse click.

Figure 4: A portion of the FIM grid displayed in Google Maps, from roughly the 50th to the 75th parallel. Notice the shape distortion (of the otherwise area-equivalent icosahedral grid cells) increases towards the upper latitudes.

Experimentation determined that Google Earth can handle the rendering of tens of thousands, but not hundreds of thousands, of polygons and still perform adequately. The GIM Tool server was therefore optimized to return anywhere from two thousand to ten thousand

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Figure 5: Google Earth employs a quasi-orthographic map projection.

polygons, at any given zoom level, which guaranteed acceptable performance.

To minimize the volume of FIM data being transferred to the clients, we down-scaled raw FIM 15 km resolution (G9) into lower resolutions, creating inter-grid mappings at resolutions of 30 km (G8), 60 km (G7), 120 km (G6), and 240 km (G5). As a point of reference, 240 km resolution is coarse enough to enable displaying FIM data over the entire globe with only a couple of thousand polygons. Testing revealed that the performance of this web service was good, with client requests for FIM data being fulfilled in as little as 36 milliseconds in the case of a single request, to as much as 74 milliseconds for 10 concurrent requests.

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">

<LookAt>
    <longitude>-105.08</longitude>
    <latitude>40.56</latitude>
    <altitude>0</altitude>
    <range>50000</range>
    <tilt>0.00</tilt>
    <heading>0.0</heading>
</LookAt>
```

Figure 6: This KML code moves the Google Earth camera view to approximately 50000 meters above Fort Collins.

The Google Earth version of GIMTool employs the Google Web Toolkit (GWT) [8] and the Google Earth browser plug-in and only runs on Windows or Mac Safari browsers – the Google Earth browser plug-in does not currently support Linux. We chose to develop with the plug-in's JavaScript API by using GWT because it allowed us to write our source code in a language we prefer, Java, and then have the GWT compiler automatically convert this code into its JavaScript equivalent. The Google Earth version of GIM Tool supports true 3D views of FIM variables superimposed over a rotating globe, and is particularly useful for displaying grids in the upper latitudes and over the poles (see Figure 7).

The Google Maps version of GIM Tool was written with Flash Builder 4 and Google Maps. Flash Builder [9] was chosen because of its simple to use yet powerful graphical user interface builder, the fact that it creates SWF files compatible across all browsers and which look the same on all browsers, and the fact that the underlying Actionscript language is object oriented and very similar to Java. The drawbacks of this Google Maps version, as compared to the Google Earth version, are that it displays data in the Google Maps Mercator-like projection (distorting the otherwise equal-area grid at the upper latitudes) and that it lacks the "wow" factor of seeing a global dataset on a rotating globe. Advantages include faster load time, no Google Earth plug-in installation requirement, and support for virtually all browsers on all platforms (that support Flash). Moreover, when users "zoom in" to a regional and non-polar area, the display looks very similar to the Google Earth version's display (see Figure 8).

Unlike most viewers which typically generate static image files, GIM Tool is a dynamic tool with automatic progressive disclosure. For example, when a user drags (or pans) the map to the left or right, new data is automatically retrieved to redraw the new display region. If the user "zooms-in" (to a smaller region of the map), finer resolution grids are generated. When the user "zooms-out" (exposing a larger region of the map), coarser resolution grids are generated. In either case, the data the server stores and delivers are based on the grid resolution the global model is run at. For purposes of this research, grid level 9 data was used.

The dynamic nature of GIM Tool both simplifies the user interface for the end user as well as makes for a more intuitive and immersive data visualization experience.

Future Work

The first versions of GIM Tool were warmly received by FIM researchers at GSD. Based on our meetings with the group, we plan to improve the tool in a number of ways:

- create a stand-alone version that doesn't require Tomcat
- add a dynamic palette editor
- support looping (animation)
- support additional FIM variables
- support overlaying other datasets such as vectors, contours, and shape files
- various user interface improvements
- support GSD's other global icosahedral model, NIM (Non-hydrostatic Icosahedral Model)

Acknowledgments

We'd like to acknowledge our esteemed colleagues: Mark Govett (NOAA/GSD), Eric Hackathorn (NOAA/GSD), Jacques Middlecoff (CIRA), Vivian LeFebvre (NOAA/GSD), and Doug Ohlhorst (NOAA/ESRL) for their valuable contributions to the project.

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[9] Official Adobe Flex site (http://www.adobe.com/products/flex)

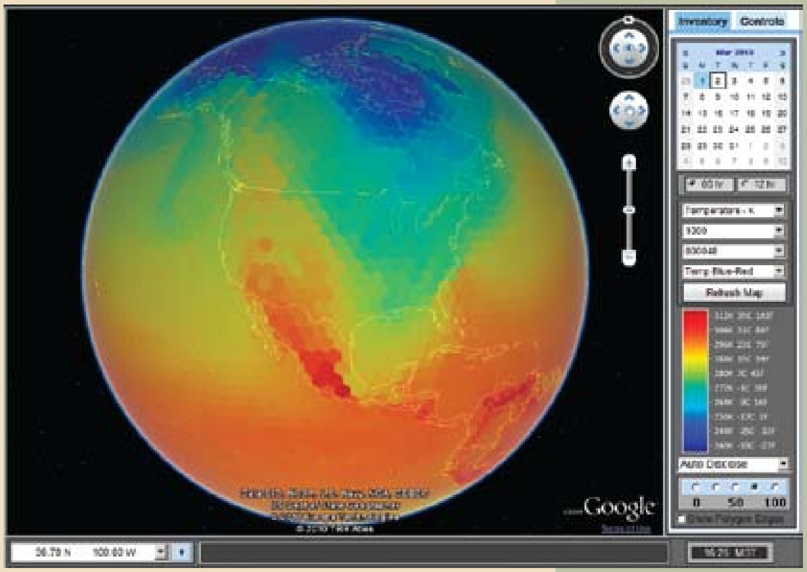

Figure 7: The Google Earth version of GIM Tool: a JavaScript based application that runs in a browser and uses the Google Earth plug-in to display FIM data.

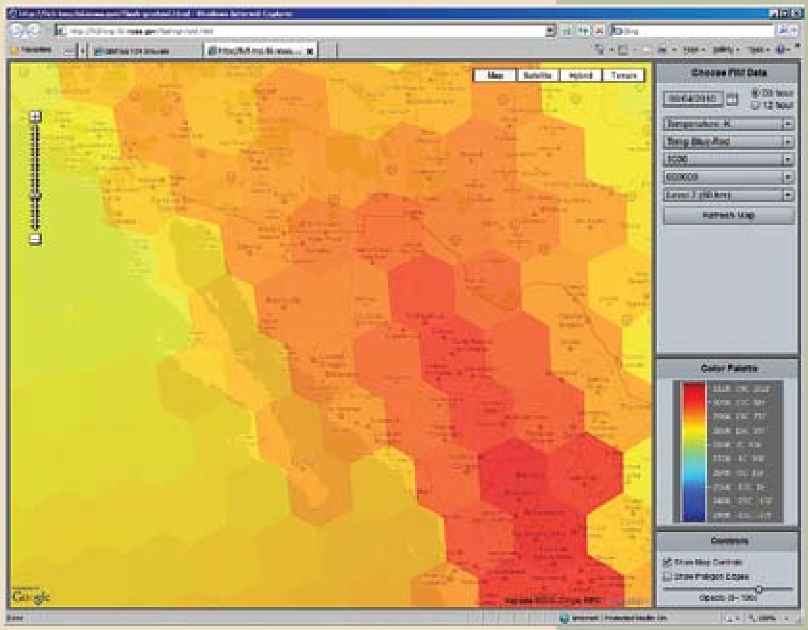

Figure 8: The Google Maps version of GIM Tool: a Flash based application that runs in a browser and uses Google Maps to display FIM data.

CIRA Mission

The Cooperative Institute for Research in the Atmosphere (CIRA) is a research institute of Colorado State University.

The overarching Vision for CIRA is:
To conduct interdisciplinary research in the atmospheric sciences by entraining skills beyond the meteorological disciplines, exploiting advances in engineering and computer science, facilitating transitional activity between pure and applied research, leveraging both national and international resources and partnerships, and assisting NOAA, Colorado State University, the State of Colorado, and the Nation through the application of our research to areas of societal benefit.

Expanding on this Vision, our Mission is:
To serve as a nexus for multi-disciplinary cooperation among CI and NOAA research scientists, University faculty, staff and students in the context of NOAA-specified research theme areas in satellite applications for weather/climate forecasting. Important bridging elements of the CI include the communication of research findings to the international scientific community, transition of applications and capabilities to NOAA operational users, education and training programs for operational user proficiency, outreach programs to K-12 education and the general public for environmental literacy, and understanding and quantifying the societal impacts of NOAA research.

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