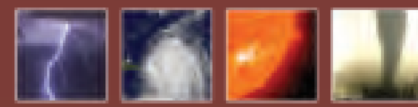
Volume 37, Fall 2012



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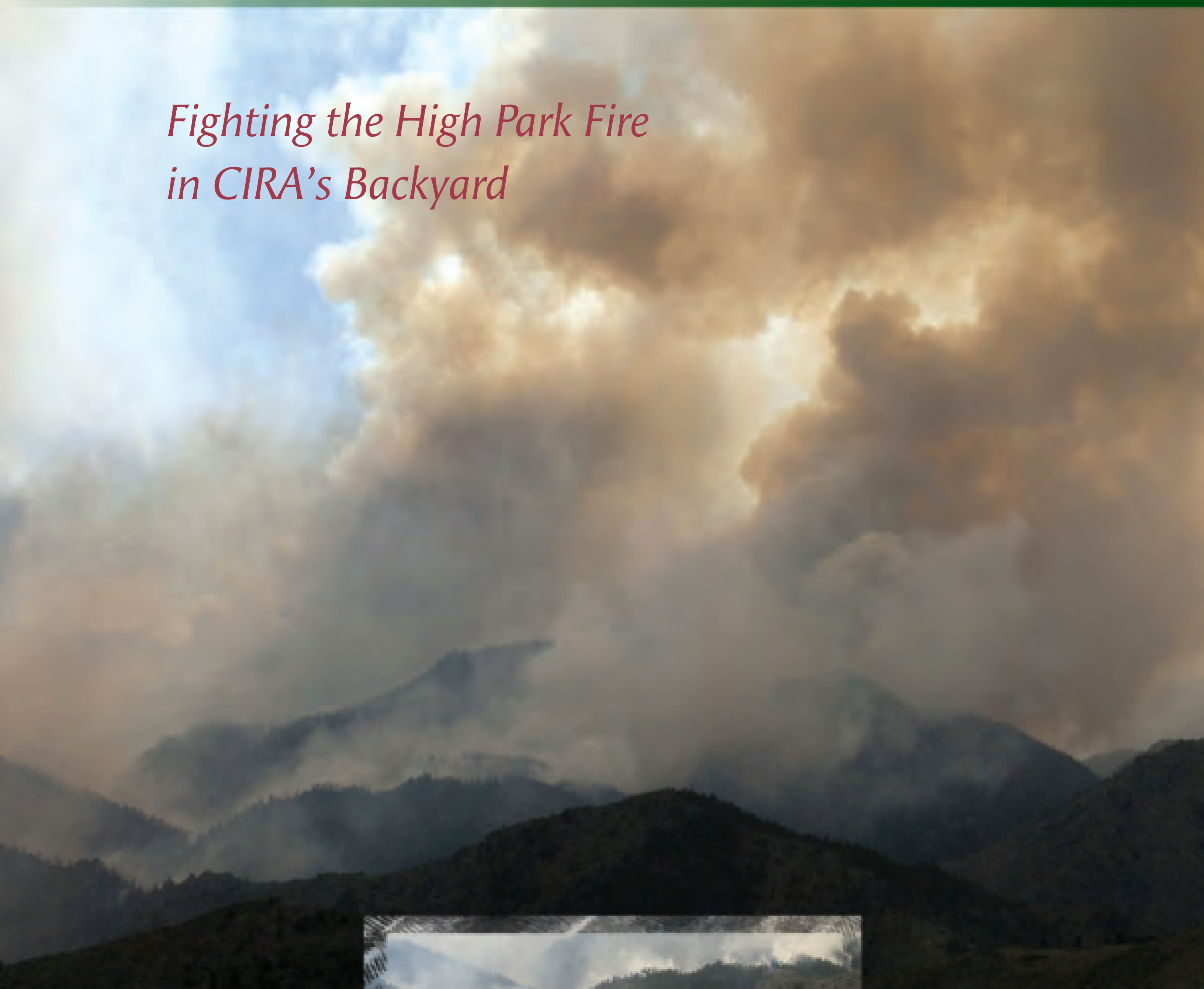
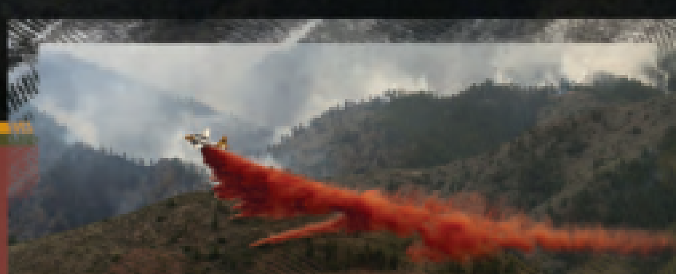


Fighting the High Park Fire in CIRA's Backyard



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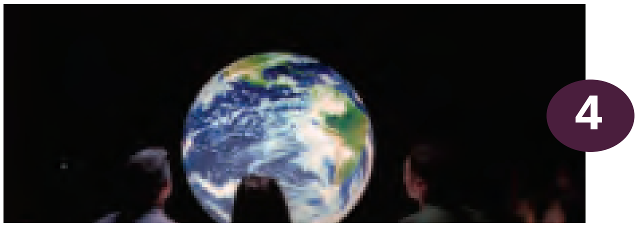

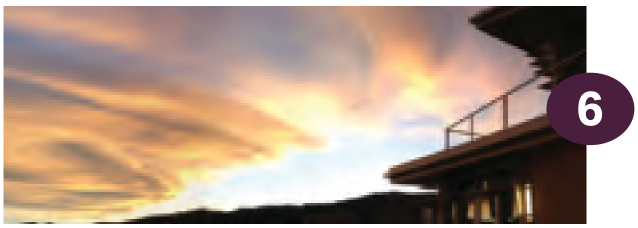

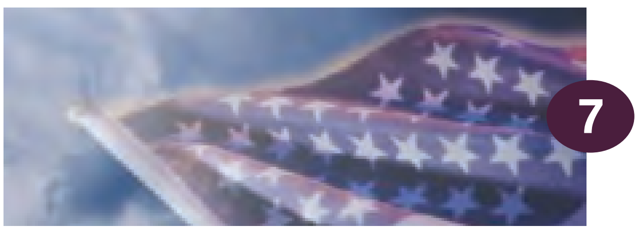

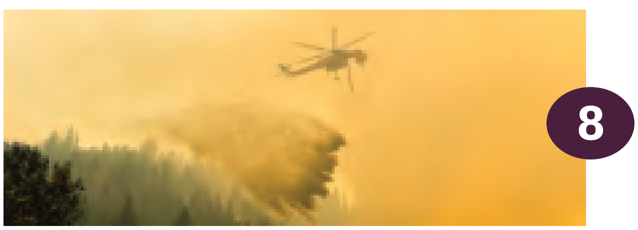

COMMUNIQUÉ 16

Contents

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Photo Information and Credits for fires in High Park in Poudre Canyon about 15 miles from Ft. Collins: Colorado National Guard provided red-card certified aviators representing National Guard units from Colorado, Wyoming, Kansas and Nebraska to fight the fire by helicopter and hose. Communications troops provided an interoperability communications platform for multiple agencies. Military policemen with the 193rd assisted the Larimer County Sheriff's office with evacuations and protected personnel and property in the High Park fire June 21, 2012 throughout Larimer County.

Photos by: Colorado National Guard staff and Official Army National Guard Sgt. Jess Geffre; the Nebraska National Guard crewmembers; and Staff Sgt. Tate Petersen, Company C, 2nd- 35th General Support Aviation Support.

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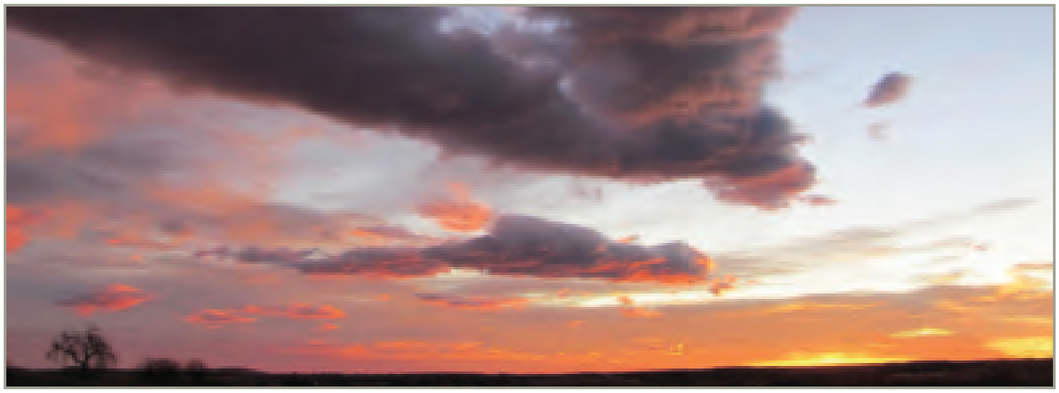
 

From the Director's Desk …

As Director of an institute such as CIRA, I am occasionally blamed for things that I did not do. I've learned to live with that. On the other hand, I also get credit for accomplishments where my contribution is only minimal. Fortunately, when you have a great organization such as CIRA, the latter greatly outnumber the former and the job, as a whole, remains very positive. And so I am happy to report that despite a really hot summer and disastrous wildfires in Colorado, CIRA continues to march forward in its mission related to satellite algorithm development, regional/global weather and climate modeling, education/training, data assimilation, as well as data distribution technology.

With wildfires still fresh on our minds, and the hills behind us still charred, this issue of the magazine highlights the activities of our CIRA team led by Sher Schranz related to fire weather. At Boulder's NOAA Earth System Research Laboratory, researchers from NOAA and CIRA have been working with local and national fire weather forecasters since 2002 to develop and deliver new technologies and improved weather forecast models to fire-fighting teams in the field. We're making use of fully coupled atmospheric weather and smoke models via the High-Resolution Rapid Refresh/ Chemistry/Smoke (HRRR/Chem/Smoke) and Urban Scale (100 meters), wind forecasts in complex terrain, and Local Area Prediction System (LAPS). This effort is coupled with FX-Net, a web-based thin client that disseminates real-time information to National Weather Service Incident Meteorologists (IMETs) in the field. Together, the modeling, the visualization, and the training of weather forecasters and emergency response personnel are three examples of what CIRA researchers do well. Thanks to Sher and the team in Boulder, these components have come together for a particularly important benefit. With fires now burning in the Northwestern US, these tools are quickly becoming indispensable.

When we published the last *CIRA Magazine*, you may recall, we were all thrilled at the just-launched Suomi National Polar-orbiting Partnership (NPP) satellite. As is usual when new sensors with new capabilities are launched, we are often surprised by what we see. The new Day/Night Band on the Suomi NPP Visible/Infrared Imager/Radiometer Suite (VIIRS) sensor has indeed surprised us all with its capabilities not only in moonlight, but on moonless nights when only the illumination from a layer of airglow and starlight are present. CIRA's Steve Miller, together with co-authors from Northrup Grumman, NOAA, and the Naval Research Laboratory, looked at some of the features in depth. The first paper showing detailed imagery of clouds, the airglow layer itself, and even fantastic examples of wave phenomena in the mesosphere is being published in the *"Proceedings of the National Academy of Sciences."* Look for the open access article entitled "Suomi satellite brings to light a unique frontier of nighttime environmental sensing capabilities" by Steven D. Miller, Stephen P. Mills, Christopher D. Elvidge, Daniel T. Lindsey, Thomas F. Lee, and Jeffrey D. Hawkins. As the paper's title implies, this capability stands to change the paradigm for nighttime environmental sensing from space and opens many new avenues of basic and applied research.

Let me conclude by recognizing some outstanding individuals who will be recognized this fall with CIRA's 2012 Research and Service Initiative Awards. For their work in conceiving, designing, and developing the NOAA Environmental Information Services data access and visualization framework, we are honoring the team of Jebb Stewart, Jeff Smith, Randy Pierce, and Chris MacDermaid. Chris MacDermaid is additionally being recognized for his outstanding service in administrative oversight, project management and outreach. Separately, Dr. Haidao Lin is being recognized as an outstanding young scientist who has already made his mark with very impressive methods for assimilating singe pixel AIRS temperature and moisture information in a mesoscale data assimilation system. Finally, the team of Robert DeMaria and Andrea Schumacher are being recognized for their role in improving the accuracy of hurricane wind speed predictions. Their work was quickly taken up by the Hurricane Research Center. Congratulations to all.

Chris Kummerow

Antarctic Glacier
Named for CIRA Scientist
Glen Liston

By Karen Milberger
CIRA

CIRA senior research scientist Dr. Glen Liston has done extensive research in the Arctic and Antarctica on snow and ice, weather, and environmental change. Dr. Liston's cold-regions field research includes leading and participating in snow and glaciological research expeditions around the world. His professional focus has been the research and parameterization of land-surface hydrology and boundary layer processes for local- regional- and global-scale land-atmosphere interaction models operating at climate, and shorter, time scales. In addition, he has been actively involved in process studies and modeling of snow and ice found in high-latitude and high-elevation environments.

> **The Liston glacier is about 3 km long and 1.5 km wide, and located at 77° 39' 13.65" S 161° 4' 28.23" E.**

In recognition of his scholarly renown and impact on this field of research, Dr. Liston received word on October 18, 2011 that the United States Board on Geographic Names had approved the name "Liston Glacier" for a geographic feature in Antarctica. As Dr. Liston humbly noted, "This is pretty rare, and a real honor." The nomination originated from a fellow Antarctic glaciologist who remarked that, "Our papers will come and go and eventually get buried under a pile of new methods and insights, but when someone wonders why the glacier is called *Liston*, you will again be remembered by future generations." The glacier itself is about 3 km long and 1.5 km wide, and located at 77° 39' 13.65" S 161° 4' 28.23" E. Figure 1 shows where the Liston Glacier is located in Antarctica. The glacier can be seen in Figure 2.

Highlights of Dr. Liston's research recognized by this honor include:

In 1982-83 he wintered over at the United States Amundsen-Scott South Pole Research Station, Antarctica, where he received a United States Congressional Service Medal. He worked as a meteorologist during the summer of 1982 including launching weather balloons to measure vertical temperature, humidity, wind, and pressure profiles; then remained for the 9 months of winter during which planes can't fly in or out, including 6 months of continual darkness. During this time, he experienced his lowest temperature of -104 °F (-76 °C), in his words "frosty."

From data he collected during the 1996-97 Norwegian Antarctic Research Expedition (NARE) to Queen Maud Land, he developed a snow and ice melt model for blue-ice and coastal glaciers and ice sheets which accounts for subsurface melting caused by penetration of solar radiation into the ice. This model is described in Liston *et al.* (1999). Surface and subsurface simulations of Antarctic-wide coastal melt distributions and rates were performed using this model and the results published in Liston & Winther (2005).

A Norwegian stamp celebrates Dr. Liston's Arctic research.

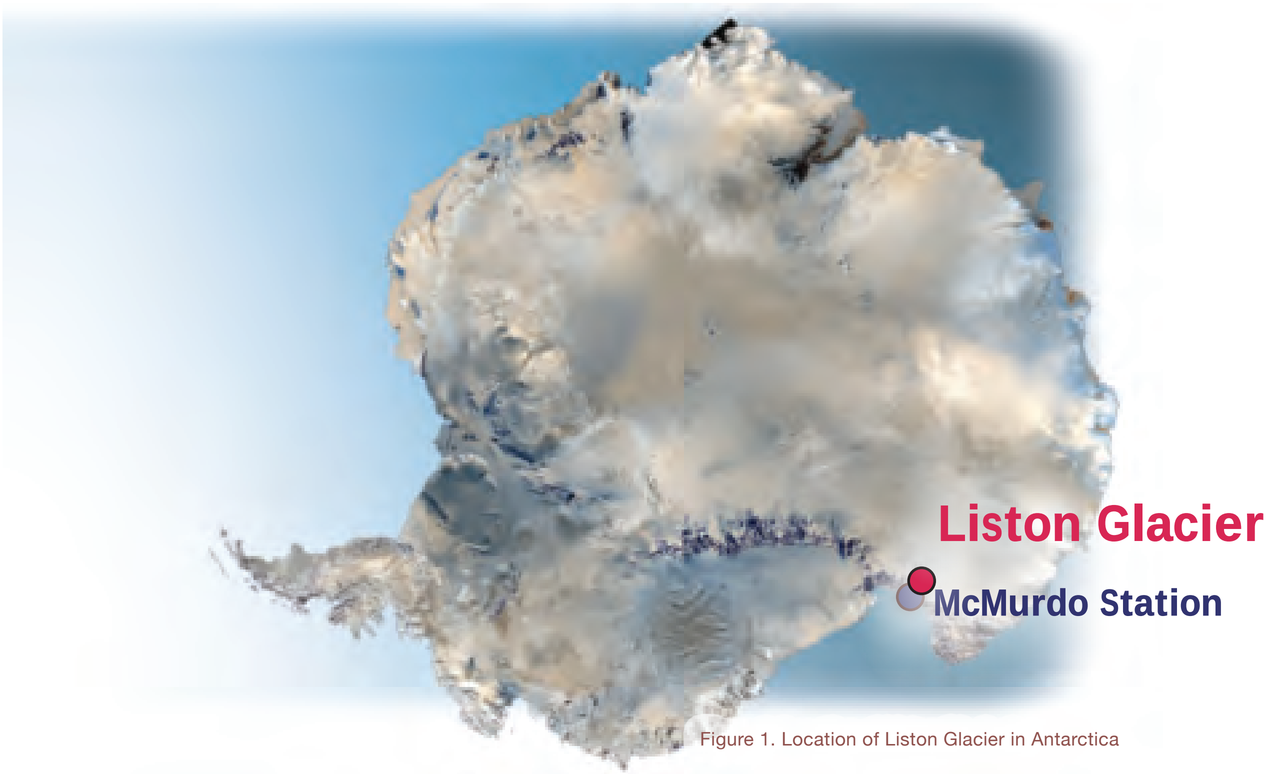


Figure 1. Location of Liston Glacier in Antarctica

During the 2007-08 Norway-United States International Polar Year (IPY) overland traverse and ice coring expedition from the Antarctic coast to the South Pole, he was responsible for handling and measuring the ice cores where careful sampling and analysis are essential to avoid contamination. Physical, electrical and chemical properties of the ice were measured to investigate questions about whether the rate of ice accumulation is changing in East Antarctica, what regional climate patterns are evident over the last 2000 years, what the thermal response of this area is to global climate variations, and to detect events such as volcanos and industrial pollution.

Figure 2. Liston Glacier can be seen in the center of this view from a Landsat 7 image.

Dr. Liston is not one to rest on his laurels and, true-to-form, is currently preparing for another trip to the frozen ends of the Earth. This time it's a Norwegian Arctic expedition where they will freeze an icebreaker in the Arctic Ocean at approximately 84° N latitude and use it as a research platform to study changing Arctic sea ice. About 15 years ago most of the Arctic Ocean was covered by very thick multiyear sea ice and now only about 10% of the Arctic Ocean contains multiyear ice. Since Global Climate Models are based on a large proportion of Arctic ice being multiyear ice, which has different properties from first-year ice, these models will need to be updated and the planned expedition will collect data for this work.

References

G. E. Liston and J. Winther. Antarctic surface and subsurface snow and ice melt fluxes. *Journal of Climate*, 18:1469–1481, 2005

G. E. Liston, J. Winther, O. Bruland, H. Elvehøy, and K. Sand. Below-surface ice melt on the coastal Antarctic ice sheet. *Journal of Glaciology*, 45:273–285, 1999.

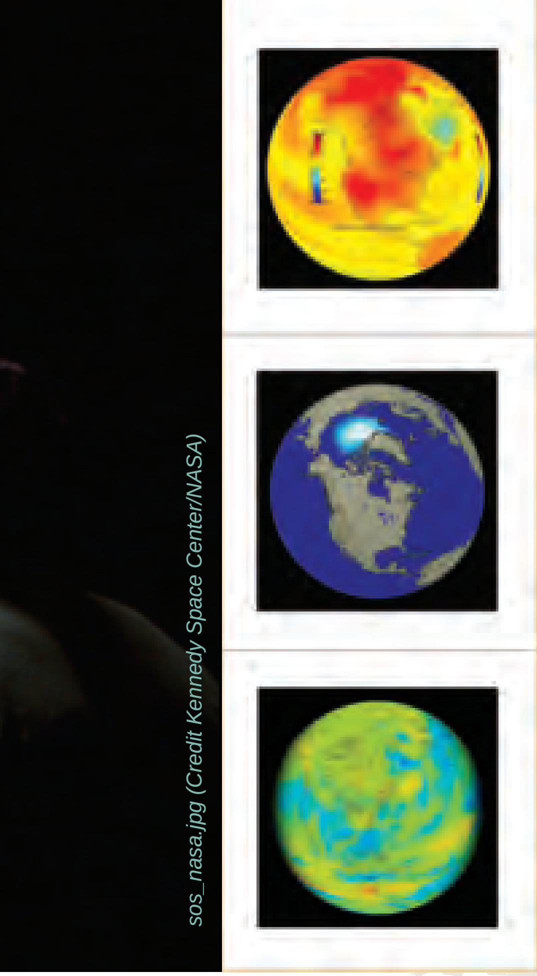
CIRA Brings Science on a Sphere Community Together through Website

By Jennifer Raab
CIRA

Science on a Sphere (SOS) is a revolutionary way to visualize Earth science data, bringing imagery and data together in a format that not only faithfully represents the source material, but also wows audiences and stimulates interest in the Earth sciences. CIRA has played a prominent role in the genesis and distribution of this groundbreaking technology, and recently one of our interns has created a new online project that brings together the many users of SOS technology with a larger audience of individuals who are seeking out new ways to look at our planet.

Irfan Nadiadi first joined the CIRA Boulder staff in June of 2010 and worked on projects with the NOAA/Global Systems Division (GSD). In the fall of 2011, he began taking classes at CU-Boulder, and transitioned to a CIRA position in the Technology Outreach Branch (TOB) of GSD. In this most recent assignment, he has been working with Beth Russell of NOAA to help overhaul the SOS website. This update finally went live in May 2012, with much credit to Irfan from the project leader.

The Science On a Sphere website (online at: sos.noaa.gov) serves



sos_nasa.jpg (Credit Kennedy Space Center/NASA)

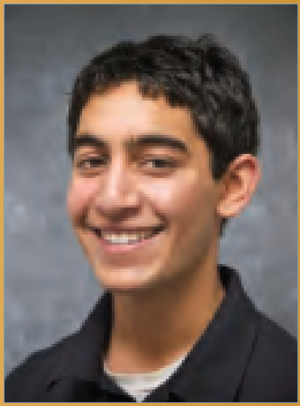
Visitors to the Kennedy Space Center view Earth science datasets on NASA's Science on a Sphere unit. The small images to the right (top to bottom) show simulated air temperature change 1870-2100, sea ice shrinking 1861-2100, and precipitation anomaly, based on NOAA GFDL models.

hundreds of users each day from around the globe. Most are users with an SOS installation, but many visitors are also interested in the public data NOAA provides, as well as scripts and lesson plans available for educators. With such a diverse user base, the SOS team found it necessary to remodel their website, aiming to reorganize and deliver their content with a new, modern look and feel.

In developing the website, a significant amount of time was spent simply dividing the content in such a way as to allow any user to easily find the information they need. The result was to create five different 'sub-sites': Home, Getting SOS, Education, Datasets, and Support – each providing visitors with a dedicated navigation appropriate to the sub-site.

Along with the redesigned content organization, another new feature is the Data Catalogue. Where SOS Datasets were once split into hundreds of difficult to manage HTML pages, the new website takes advantage of a MySQL database to deliver dynamically-generated pages. The datasets have been consolidated into a single database, allowing easier management and updates by the SOS team.

Once the informational foundation was established, it was all brought together by Irfan's unique creative touch complete with edgy graphics, vibrant colors, and the latest web technologies to produce a visually stunning website. Through the use of this new tool, scientists and science educators alike will be able to engage a larger audience and have a greater impact in communicating research results to the community at large.



Irfan Nadiadi first joined the CIRA Boulder staff in June of 2010, working with the ITS Branch of the GSD as a physical science technician where he assisted the branch with the management of data centers and the intranet. During his internship, he developed a semi-autonomous program to search the division intranet for broken links. After graduating from high school, Irfan returned to CIRA in June of 2011, this time working with the NOAA/ESRL Public Affairs Officer, Katy Human. In this role, Irfan assisted with the design and development of web pages which highlight the diverse research activities throughout the NOAA offices in Boulder. In the fall of that year, Irfan began taking classes at CU-Boulder, and transitioned to another CIRA position in the TOB of GSD working on the SOS website.

By Matt Rogers
CIRA

CIRA
Weather Station
Another addition to CIRA's observational toolbox

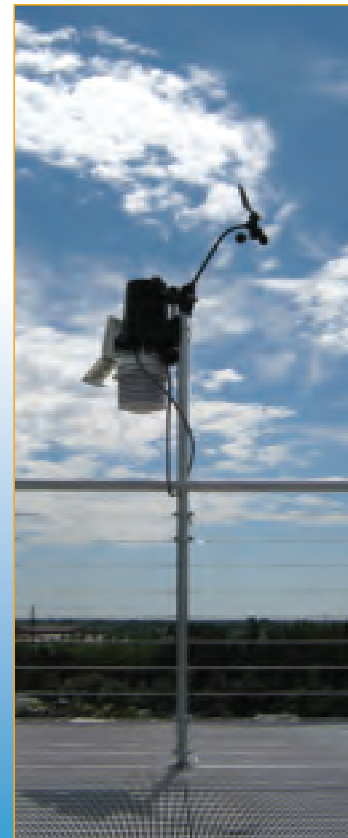


Figure 2. Weather Station on CIRA Bridge

As part of the continued transformation of its Collaborative Weather Lab, CIRA recently installed a Davis Vantage Pro2 Plus automated wireless weather station at the end of the 'weather bridge' attached to the Weather Lab. The station contains temperature, humidity, and barometric pressure sensors housed in a constantly ventilated shelter, along with an anemometer, a tipping-bucket raingauge accurate to 1/100th of an inch, and integrated UV and solar radiation sensors. Solar panels provide power to the station as well as charging a set of batteries, which power the station at night. All of the station's sensors are connected to an onboard radio transmitter, which beams the observations from the sensors to the station's console and Davis WeatherLink data logger, which is in turn connected to a computer. The station operates continuously, taking observations every thirty seconds, and data is archived using five-minute averages and stored by the data logger.

Data from the new station is hosted online at taipan.cira.colostate.edu/wview and is also linked to the main CIRA website. The website (Figure 1) was created in part using the freely available WView software package (online at www.viewweather.com) and can be configured to display station data in a number of ways. Currently, the webpage provides the options to display strip charts of station data from daily, weekly, and monthly observations, along with up-to-the-minute current observations, a local radar image, links to the Christman Field, CSU Campus weather station pages and local CoCoRaHS precipitation maps, as well as an almanac that is automatically computed using the complete station archive.

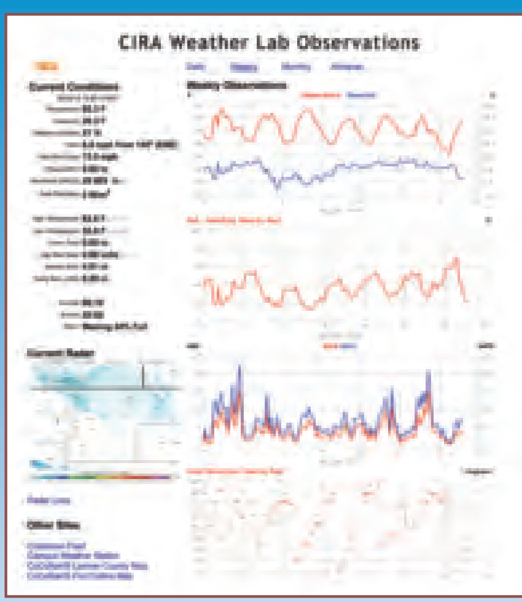


Figure 1. Weather Station Website

The CIRA weather station is the first step in an expansion of CIRA's surface observation capabilities – a CoCoRaHS-approved 4-inch raingauge will soon be added to supplement the automated raingauge on the Davis station, and a four-camera panoramic cloud camera system is also planned to go into service to improve upon the current Atmospheric Science webcam. And finally, production of the local, high-resolution radar product developed by former ATS employee Brian McNoldy will begin on the station's computer system. Combined, the planned upgrades will provide CIRA with a comprehensive visual and observational data archive, complementing the data already available from the weather stations located at Christman Field and the on-campus weather station.

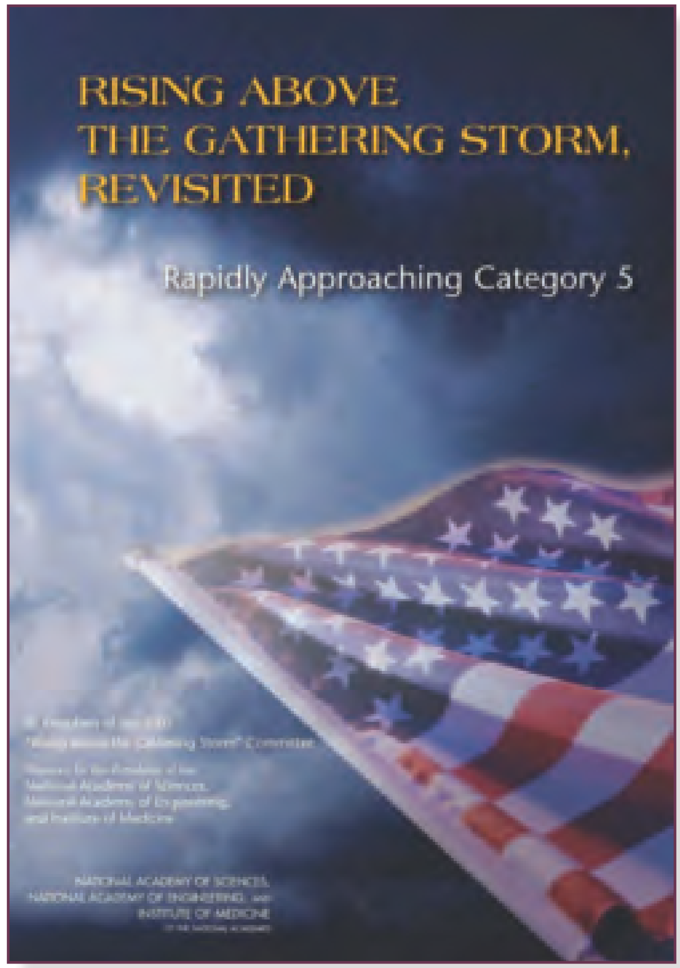
Observations from the new station are already part of the weather briefing held in the Weather Lab each weekday afternoon, and could feature prominently in other briefings, training sessions and workshops planned to be held in the Lab. Satellite observations, numerical weather prediction output, and now local surface observations are all part of CIRA's comprehensive observational capabilities.

Rising Above the Gathering Storm

A call for more action for Science and Engineering Education

By Thomas H. Vonder Haar
Director Emeritus and Founder, CIRA
University Distinguished Professor of Atmospheric Science
Member, National Academy of Engineering

In 2006 the U.S. National Academies studied and reported on the serious shortfalls in Science and Engineering Education in the United States. They also provided several thoughtful ideas and plans for action to greatly improve the U.S. situation with bi-partisan support. Congress followed the Academies' recommendations and passed the "America Competes Act" which was signed into law. Then the Great Recession of 2008-09 arrived with its lingering national financial difficulties. So little new has been done thus far to restore our Science and Engineering Education from K-12 through Undergraduate, Graduate and Postdoctoral training.



Book Cover for Rising Above the Gathering Storm, Revisited

The serious problem continues and a recent Academy Report "Rising Above the Gathering Storm Revisited: Rapidly Approaching Category 5" (**www.nap.edu/catalog.php?record_id=13151**) again sounds the call for action! We urge all to read this report; to discuss it with friends and colleagues; and to join in some way with activities to remedy our national shortfall.

Many CIRA staff, Fellows and associates have already recognized the need to encourage and support science and engineering careers. Some volunteer, tutor, mentor and encourage science and engineering learning and professional development. CIRA itself has an active education and outreach program as part of its Mission and the *CIRA Magazine* routinely features related articles.

Many courses of action are open for participation.

By Matt Rogers
CIRA

CIRA Pitches In: Fighting the High Park Fire

Early in the morning on the 9th of June 2012, lightning struck the dry, beetle-kill forested foothills 15 miles west of Fort Collins, Colorado, and started a wildfire. By the time the fire would be fully contained, 87,284 acres would burn, 181 homes would be destroyed, and one resident would lose her life. The High Park Fire, as it came to be known, was briefly the most destructive wildfire in Colorado history before being eclipsed by the Waldo Canyon fire that struck west of Colorado Springs two weeks later. More than 1,900 residents were evacuated from their homes in the path of the fire, and the total costs of fighting the fire exceeded $30 million.

Burning literally at CIRA's doorstep, the High Park Fire threatened massive loss of life, destruction of vast swaths of forest and dozens of homes, and tens of millions of dollars in damage (over $97 million as this article goes to press). As with many natural disasters, the High Park Fire also offered an opportunity for CIRA researchers to hone their craft, focusing their considerable resources on observing, forecasting, and understanding this powerful force of nature. Unusually, CIRA's efforts during this time were also permeated by the pungent smell of smoke and the ever-present threat of evacuation for CIRA researchers, staff, and family living in the path of the fire. With these reminders of the severity of the growing wildfire, CIRA went to work helping to fight the High Park Fire.

Setting Up Shop Down The Road – The Christman Field Incident Command Post

Quickly reaching the status of a Type 1 wildfire, the High Park Fire commanded the quick attention of experienced firefighting crews and command structures to supplement the local city and county emergency management and firefighting resources. The nexus of planning and firefighting activities for the next several weeks was the incident command post (ICP) set up at the National Guard Armory located east of Christman Field, approximately a quarter-mile east of the Atmospheric Science/CIRA campus. Along with power, internet, and communications, the ICP offered food, lodging, and shower facilities for firefighting crews who came from across the country to fight the High Park Fire. An airstrip to stage helicopter operations, including dipping buckets used to transport water from Horsetooth Reservoir to the fire, added further drama to the activity at the ICP, all while the fire continued to grow.

Quickly CIRA and the Department of Atmospheric Science offered their facilities for use by the firefighting crews and command structure. Media vans soon parked in the Atmospheric Science parking lot with antenna reaching into the smoky sky for daily briefings. Furthermore, use of CIRA and Atmospheric Science conference facilities were offered to the logistics chief based out of the ICP. These were among the first steps in providing resources to fight the High Park Fire, and as the usually quiet western end of LaPorte Avenue bustled with traffic past the National Guard checkpoint station, CIRA employees couldn't help but be caught up in the effort to fight this looming wildfire.

CIRA Tools at the Front: FX-Net

CIRA had other tools to assist the firefighters besides simply offering spaces to meet. Forecasting and effectively fighting wildfire is predicated on understanding topography, fuels, and weather. Topography dictates the microclimates of wind, moisture, and temperature in mountainous terrain, all of which contribute to the kind and amount of vegetation that grows in the forecast domain. Vegetation, along with the impact of local climate (for example, drought) and biological considerations (such as trees killed by invasive species like the pine beetle) forms the basis for understanding the fuel stock for a potential wildfire. And finally, temperature, humidity, local winds, precipitation, and the presence of convection form the primary observations of weather that are relevant to wildfire management.

For the High Park Fire, as with all Type 1 wildfires, primary meteorological support comes from an Incident Meteorologist (IMET) dispatched from one of the National Weather Service forecast offices around the nation. IMETs deploy to the ICP with a range of specialized skills and a full set of tools including portable weather stations and pilot balloon launching kits, portable satellite internet connectivity, and critically, integrated forecast tools that combine numerical weather prediction models, satellite imagery, and surface and radar observations into a concise, readily deployable software package. In fact, CIRA researchers are responsible for the development and maintenance of this tool. Based on the Advanced Weather Interactive Processing System (AWIPS), the tool that IMETs use is called FX-Net (Figure 1) – a thin-client version of AWIPS that also incorporates forecast data from the fire-specific Rocky Mountain Center (RMC-Fire) model, based on the 8km Weather Research and Forecasting (WRF) model and which serves as the regional component of the Fire Consortium for Advanced Modeling of Meteorology and Smoke (FCAMMS).

Forecasting temperature, humidity, wind, and convection in the crenellated terrain and complicated conditions caused by fire is a challenging exercise in itself. Having to make snap forecasts to support logistical moves, safeguard fire crews as they maneuver to the most advantageous positions to fight the fire, and to evaluate evacuation needs for residents makes the exercise more challenging still. Simple and effective tools such as FX-Net help the responsible IMET to make accurate and timely forecasts, and during both the Hewlett Fire a month previous and the High Park Fire, CIRA researchers were able to communicate with IMETs deployed to the ICP and continue to collaborate with this important link in the fire command structure. (More information about FX-Net, and the comprehensive effort put forward by CIRA in the fire weather field, can be found in the Summer 2011 issue of *CIRA Magazine*.)

Making Fire Weather Accessible - Further Development of Forecast Tools for Fire Weather Management

As the High Park Fire burned, the need to continue development of fire weather forecasting tools such as the valuable FX-Net suite was made plain. For large, destructive fires such as this, the logistical challenge of effectively managing large groups of people and resources and executing firefighting operations across tens of thousands of acres required a comprehensive command and headquarters structure. Smaller fires typically cannot command these kinds of resources, yet the meteorological support requirements remain the same. How then to address these needs?

Based on this recent, albeit unplanned collaboration, CIRA researchers are working in concert with IMETs and fire command staff to put together a plan of action. Cooperating with IMETs, CIRA staff will begin to pull the most relevant and needed data from the FX-Net suite and export it to readily accessible software packages such as Google Earth. Looking ahead to the quieter winter months, CIRA staff will continue to collaborate with fire command staff to develop a training plan on how to effectively use weather data to help manage firefighting operations. Finally, training sessions for firefighting and emergency management staff, planned for Spring of 2013, will take place to introduce simplified tools to better provide weather information for managers of Type 2, 3,

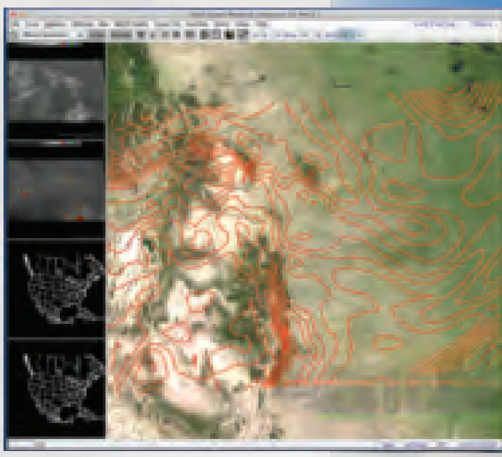


Figure 1. Screenshot of FX-Net, a thin-client version of AWIPS that allows incident meteorologists to get fast and accurate weather data in the field to assist with forecast analysis and planning.

and 4 fires. Having led the way in development of fire weather tools for the most destructive fires in the country, CIRA is now seeking a new way to extend these tools for all wildfires, improving forecasts and lessening property damage and the loss of life nationwide.

Summary

By the 4th of July, a change in the hot, dry weather pattern that dominated June along with a determined, constant effort by the firefighting crews had largely contained the High Park Fire. The ICP shifted to Pingree Park, and life around the CIRA campus slowly returned to normal. But the burn scars along the foothills of Lory State Park immediately west of CIRA remain a daily reminder of the powerful forces of nature that govern the planet we live on. Two CIRA researchers lost homes in the fire, while other CIRA employees and their family members were directly involved in firefighting operations during the period of peak activity. The High Park Fire was for every CIRA employee a personal, as well as professional, incident. An image of the High Park Fire as it approached the CIRA campus is shown in Figure 2.

Scientific research at CIRA is at its heart a labor of love for CIRA researchers – to scientists, the opportunity to study natural phenomena like wildfires is a challenging task that demands the best skills and tools that can be offered, and naturally appeals to our best senses of discovery and simple desire to understand the planet we live on. What makes the natural sciences compelling is the regularity with which the phenomena we study become a part of our daily lives; performing scientific research on wildfire in the midst of the smoke and heat is a unique vantage point for a scientist to have. And for the High Park Fire, CIRA researchers and staff put forward their best effort, to the benefit of the community we all share.

Figure 2. The High Park Fire crests the ridge near the CIRA campus.

High Above the High Park Fire:

CIRA Scientists Use Satellites to Observe Wildfires from Space

By Matt Rogers
CIRA

The High Park Fire in Northern Colorado captured the attention of the nation for several days in June 2012. Video footage of flames on distant ridges, long smoke plumes and hazy valleys, and fire crews and emergency responders working tirelessly to save structures and evacuate residents of the more than 87,000 acres ultimately burned by the fire became part of the daily news cycle. Images of destroyed forests, roads, and homes in the wake of the blaze helped define the incident in the public eye and brought national attention to fire weather and firefighting during the time the fire was most active.

For CIRA scientists, the High Park Fire provided additional images every bit as compelling and important as those captured by the media. Large and destructive fires cover vast swaths of land, and have visible and infrared energy emissions that are distinctly different and readily observable from modern satellite platforms. Not only do these images provide a different point of view on an incident as notable as the High Park Fire, but they provide researchers and forecasters with valuable information about the location, growth, and direction of movement of wildfire; information that may someday be used to assist firefighting crews to more effectively combat backcountry fires.

Images from three different satellite platforms – the geostationary GOES series satellites, the MODIS sensor aboard the Aqua and Terra satellites, and the new VIIRS instrument aboard the recently launched Suomi NPP mission – were analyzed by CIRA scientists. Here are some of those unique observations of the High Park Fire as seen from space.

Constant view of the fire: GOES Images

High in their geostationary orbits, the GOES series instruments offer a unique view of the Earth not possible from instruments in lower orbits; a constant view of the same side of the Earth. The orbital speed and altitude of the GOES satellite family match exactly the rotation rate of the Earth, so that as the satellite orbits the planet, its view of the Earth never changes. Because of this property of geostationary images, GOES-derived products are of particular interest for relatively long-lived and rapidly-evolving situations such as a wildfire,

Figure 1. GOES-East captures the smoke plume from the High Park Fire extending across the Wyoming-Nebraska border, and nearly into South Dakota. Visible image from the 10th of June, 2135 UTC (3:35pm MDT). *Credit: RAMMB/CIRA*

and the view of the High Park Fire from the nation's two operational GOES satellites was spectacular.

GOES-East, located over the equator at a longitude of 75°W, provided the view of the smoke plume from the High Park Fire shown in Figure 1. Throughout most of the active lifetime of the fire, the weather remained hot and clear, affording crystal-clear views of smoke plumes from spaceborne platforms. As is seen in Figure 1, the long smoke plume begins over the darker, forested area in the foothills of the Front Range where the High Park Fire burned, and continues to the northeast for nearly 250 miles, spreading smoke from the fire across three states.

Air quality issues are of particular concern during large wildfires, especially when smoke plumes are blown over large populated areas. Figure 2 shows an image of the impact of the smoke plume from the High Park Fire as seen from the GOES-West satellite, located over the equator at 135°W longitude. During the night, temperature inversions can form over cloudless areas, creating a warm 'kink' in the normally decreasing atmospheric temperature as a function of height; the inversion serves to trap surface aerosols (such as smoke) near the ground and cause them to spread out according to the prevailing surface winds underneath the inversion. As the sun rises, these inversions dissipate; at the same time, an increase in temperature and a decrease in relative humidity due to the warming of the sun can serve to intensify wildfires as fuels warm up and dry out. As smoke plumes intensify with strengthening fires, they rise above dissipating inversion layers and encounter winds from different directions at higher levels in the atmosphere. These kinds of conditions can cause widespread coverage of smoke from a forest fire; as is seen in Figure 2, smoke from the fire on the morning of the 11th of June covered an arc that reached from central Nebraska all the way south past Colorado Springs, impacting the entirety of the population along the Front Range and eastward.

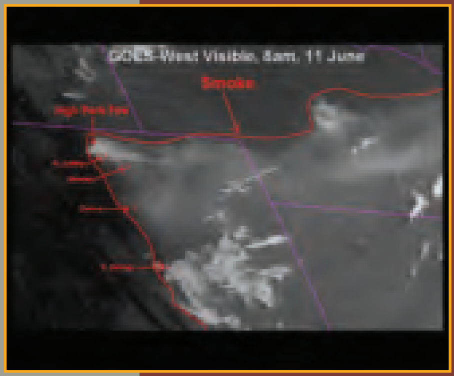


Figure 2. GOES-West visible image of the extent of the smoke plume from 11 June 1400 UTC (8:00am MDT). Wind shear at different levels of the atmosphere and shifting wind directions spread the smoke plume eastward through Nebraska, south along the Front Range and from there eastward across Colorado into Kansas. *Credit: Dan Lindsey/ RAMMB/CIRA*

The imager instrument aboard the current series of GOES satellites can make observations at five different wavelengths: one in the visible spectrum (between 0.55 and 0.75µm), one in the so-called 'shortwave' infrared (near 3.9µm), one in a spectral band sensitive to emission from water vapor (between 6.5 and 7.0 µm) and two in the 'thermal' infrared (10-12 µm). The shortwave infrared channel at 3.9µm is a particularly interesting channel to observe, as the energy at 3.9µm reaching the satellite is a blend of energy emitted by the Earth as well as energy reflected by the Earth from the Sun, during the daytime.

Typically used to help discriminate between clouds and surface snowfall, or to help determine whether clouds are composed of liquid or ice water, the cloud-free 3.9µm image from GOES-West shown in Figure 3 clearly showed the extent of the hot parts of the High Park Fire. The High Park Fire is seen in this image, from the 11th of June 2012 in the late afternoon, as a collection of very hot pixels (T > 40°C) distinguished against the relatively cooler surface background of the Front Range. Notable in this image is the spatial extent of the High Park Fire – with an individual pixel resolution of 4km, the large burned and burning areas of the fire are readily apparent in this image by the sheer number of 'hot' pixels.

Leveraging satellite observations for fire detection and observation: MODIS Images

Polar orbiting satellites play an important role in atmospheric research. Terra, a polar-orbiting spacecraft launched in 1999, and its sister spacecraft Aqua, launched in 2002, each carry a copy of the MODerate-resolution Imaging Spectroradiometer, or MODIS instrument. MODIS is a 36-band instrument that can see the Earth at wavelengths ranging from the visible through the thermal infrared at 250m, 500m, and 1km resolution. Each spacecraft makes an individual orbit of the Earth in approximately 90 minutes, scanning the surface and atmosphere continually.

Figure 3. Shortwave infrared view of the High Park Fire from the 11th of June, 2012 at 2241 UTC (4:41pm MDT). Black pixels indicate regions of unusually high emission of shortwave infrared energy near 3.9µm, corresponding to the hottest parts of the High Park Fire. *Credit: Bernie Connell/ RAMMB/CIRA*

The greater spectral and spatial resolution of the MODIS instrument allows for more sophisticated retrieval techniques to be employed. For example, researchers can model the emission structure of clouds, the surface of the Earth, and of fires at several wavelengths, and use these models to develop retrieval techniques to quantify certain properties of the Earth. For example, shortwave infrared information can be combined with thermal infrared imagery to isolate the presence of fire within individual pixels in a MODIS scene. An example of this fire detection product is shown for the High Park Fire as Figure 3.

Such fire retrieval products are useful not only to detect wildfires in remote regions, but can also be used to assess the evolution of fire behavior with respect to changing environmental conditions. Figure 4 provides an example of this – the earlier images from 1837 and 2020 UTC (12:37pm and 2:20pm MDT, respectively) show the MODIS fire detection algorithm for the High Park Fire during a hot, dry day. As a result, the fire spreads rapidly, with a much larger remnant fire footprint signal shown in the third panel, from 0545 UTC (11:45pm MDT). Between the second and third image, however, a front passed through the area, bringing a wind shift along with cooler temperatures and higher humidity. The impact of this frontal passage on the fire gradually weakened the fire's growth, which peaked around the time of the third image, and decreased in size as represented by the image in the fourth panel of Figure 4, from 0816 UTC (2:16am MDT, 20 June).

Figure 4. Series of MODIS images from 19 and 20 June outline the actively burning area of High Park Fire. Red pixels denote locations with a high probability of fire, while yellow pixels denote a high probability of very hot fire activity. MODIS-derived fire detection algorithms are used to locate active fires in remote areas and track movement of known fires. *Credit: Steve Miller/CIRA*

Determining the extent of wildfires is a challenging task for fire incident commanders to accomplish. Through the use of sophisticated retrievals like the CIRA MODIS fire detection algorithm, additional information can be brought to light.

Figure 5. The extremely sensitive day-night band (DNB) sensor of the VIIRS instrument aboard Suomi NPP captures a nighttime image of the High Park Fire west of Fort Collins. City lights from Fort Collins, Loveland, Greeley, Longmont, and Boulder are clearly visible as are 'hot spots' from the fire under a clear sky. DNB image from 11 June 0957 UTC (3:57am MDT). *Credit: RAMMB/CIRA*

The Next Generation of Instruments Brings New Views from Space: NPP Images

Launched in October 2011, the Suomi National Polar-orbiting Partnership (Suomi NPP) mission is a new polar-orbiting partner mission between NASA and NOAA carrying advanced instruments (see Spring 2012 issue of *CIRA Magazine* for more info on NPP). Aboard the Suomi NPP spacecraft is the new Visible Infrared Imaging Radiometer Suite (VIIRS) instrument, a highly sophisticated

22-channel instrument which includes a revolutionary new Day-Night Band (DNB) sensor, capable of capturing images in the visible spectrum at night using reflected moonlight or emitted visible light (city lights, for example).

Figure 5 presents an image from the 11th of June, 2012 at 0957 UTC (3:57am MDT) taken by the DNB channel of VIIRS. The city lights of Fort Collins, Greeley, Loveland, Longmont, Boulder, and Cheyenne, Wyoming are clearly visible, as are the 'hot spots' from the High Park Fire. Prior to the launch of NPP, nighttime observations of fire were limited to shortwave- or thermal-infrared sensors – the VIIRS instrument now offers the capability to see hotspots of wildfires in the visible spectrum.

Finally, the thermal infrared image from the 10th of June, 2012 at 1959 UTC (1:59pm MDT) presented in Figure 6 shows the hotspots of the High Park Fire for the first time as seen in the thermal infrared. Previous spaceborne thermal infrared sensors have lower resolution than VIIRS offers, and fire signatures over these larger pixels were averaged out over non-burning areas, and were not detectable. The new high-resolution data from VIIRS offers new insights into fire behavior and new possibilities for fire detection algorithms at a scale that should prove even more useful to firefighters and researchers alike.

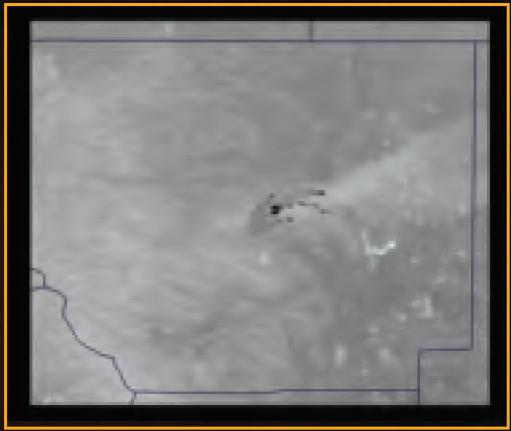


Figure 6. Hotspots from the High Park Fire are apparent in this thermal infrared (11.5μm) image from the VIIRS sensor aboard the Suomi NPP satellite from the 10th of June 2012 at 1959 UTC (1:59pm MDT). The unusual ferocity of the High Park Fire coupled with the high sensitivity of the VIIRS instrument manifested in never-before-seen signals in the thermal infrared, where fire signals typically go undetected. *Credit: RAMMB/CIRA*

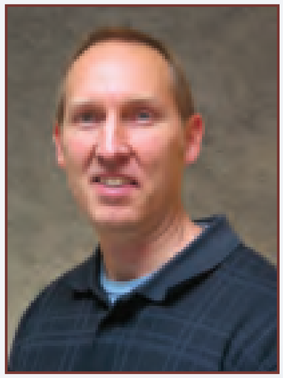
Summary

Coping with the significant impact of large, fast-growing wildfires is a challenge for forecasters and emergency managers alike. When a wildfire impacts a populated area as the High Park Fire did, the challenges only increase. Accurate and timely observations are a critical component of the fire weather forecasting process, and developing new ways to observe and quantify fire weather will help improve forecast accuracy, speed forecast development time, and ultimately, help fire managers and firefighting crews save lives and property. Through it all, CIRA researchers, using sophisticated techniques on the latest hardware, will continue to find new ways to see wildfires from space.

Communiqué

CIRA Research & Service Initiative Award Winners 2012

Jebb Stewart



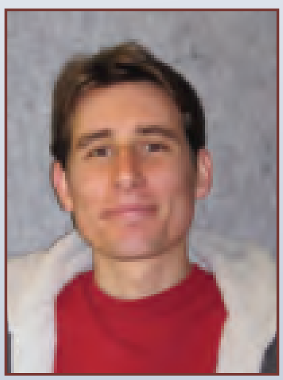
Jeff Smith

Randy Pierce

Chris MacDermaid

Innovative research accomplishments in conceiving, designing and developing the NOAA Environmental Information Services (NEIS) data access and visualization framework earned Jebb, Jeff, Randy and Chris this award. They used initiative and creativity to provide access to a wide variety of environmental data across different time scales in a platform-independent form that is easy to use and interpret.

Haidao Lin



Robert DeMaria

Andrea Schumacher

Chris MacDermaid

Dr. Lin was recognized for his innovative and creative effort to develop bias correction methods for the mesoscale model assimilation of AIRS Single-Field-of-View temperature and moisture retrievals. His results are recognized among his satellite data assimilation collaborators and have increased the visibility of the GSD Rapid Refresh satellite assimilation efforts.

Robert and Andrea's work substantially improved the operational products issued by the National Hurricane Center, the DoD and the Joint Typhoon Warning Center. The efficiency and accuracy of the hurricane wind speed probability program were improved, and it has become a fundamental part of determining the posting of hurricane watches and warnings around the world.

As the Data Systems Group lead and the NOAA/GSD technical coordinator for the FAA NNew and NWS NextGen projects, Chris performs many responsibilities and is recognized for his outstanding service in administrative oversight, project management and outreach.

CIRA welcomes the following new employees who have joined us in the last few months. We recognize them with brief introductions to the work they'll be doing at CIRA.

Galina Chirokova

Dr. Chirokova is a Postdoctoral Fellow who joined CIRA in Fort Collins in August 2012. She holds a PhD in Atmospheric and Ocean Sciences from the University of Colorado. She currently develops tropical cyclone applications using data from NOAA's newest generation of polar satellites, the Suomi National Polar-orbiting Partnership (Suomi NPP) and the future Joint Polar Satellite Systems (JPSS). She works with RAMMB scientists Mark DeMaria and John Knaff, using temperature and moisture retrievals from the Microwave Integrated Retrieval System (MIRS), in situ data, and numerical models to investigate thermodynamic influences on tropical cyclone formation, potential intensity, and structure changes. Renate Brummer is her technical advisor and supervisor.

James Fluke

Jim is a Research Associate II who transferred from CIRA in Boulder and joined CIRA's CloudSat team in Fort Collins in May 2012. He has been a CIRA employee since 1996 working at NOAA's Global Systems Division in Boulder as a senior programmer. With CloudSat, Jim develops system applications and software to improve interaction between developers and the Data Processing System. He also investigates methods and technologies to support user data access. Jim's supervisor is Phil Partain.

Lynn Johnson

Dr. Johnson is a Sr. Research Scientist who joined CIRA in Boulder in February 2012. An Emeritus Professor in Civil Engineering with the University of Colorado, Denver, and a Sr. Research Hydrologist with NOAA Earth System Research Lab, Dr. Johnson provides guidance and consultation on Hydrometeorological Testbed (HMT) research activities in the Water Cycle Branch of the ESRL/Physical Sciences Division. For the HMT Hydrologic Research and Applications Development project, he works on enhancing the coupling of atmospheric and hydrologic models and assists in the design and development of hydrological modeling and water resources management applications. For the HMT Water Resources Applications Outreach Coordination effort, Dr. Johnson provides guidance on the national water resources information system. His supervisor is Cliff Matsumoto and his technical advisor is Rob Cifelli.

Holly Kessler

Holly is a Non-Student Hourly (Coordinator) who joined CIRA in Fort Collins in June 2012. She is a student at Poudre High School and plans to attend Colorado State University after graduation. Holly works on administrative tasks related to VISIT training, including production and mailing of certificates of completion, recording keeping, and mailing training DVDs to offices with low bandwidth. She also assists Mark DeMaria with tropical cyclone related research. Her supervisor is Dan Bikos.

Brenda Philips

Brenda is a Senior Research Associate who joined CIRA in Fort Collins in June 2012. Dr. V. "Chandra" Chandrasekar is her supervisor.

Andrew Schuh

Dr. Schuh is a Research Scientist II who joined CIRA in Fort Collins in March 2012 following three years as a Research Scientist I with Prof. Scott Denning in the Atmospheric Science Department. Andrew's research involves assimilating measurements of greenhouse gas concentrations (primarily CO_2) into regional and global carbon models coupled to chemical transport models, to make estimates of regional carbon fluxes. His recent work focuses on global surface and satellite measurements, using an Ensemble Kalman assimilation framework developed in part by Dr. Milija Zupanski. This work is part of CIRA's carbon initiative to improve our understanding of Earth's carbon cycle through observation and models. His supervisor is Chris O'Dell.

Ed Szoke

Ed is a Research Associate III from CIRA in Boulder who transferred to Fort Collins in August 2012. His primary duties are with CIRA/RAMMB and include the Next Generation GOES-R Proving Ground and providing training for VISIT and SHyMet. He also does some work for NOAA/ESRL/GSD evaluating high-resolution models such as various versions of the experimental Global FIM model and the convective-scale HRRR model. His supervisor is Renate Brummer.

Liqin Tan

Liqin is a Research Associate III who joined CIRA at NOAA/NESDIS/STAR in Camp Springs, Maryland in April 2012. With extensive experience in radiometric calibration software development and application for environment satellite instruments (e.g., MODIS Level-1B and VIIRS SDR), he works to develop the Algorithm Development Library (ADL) based VIIRS SDR testing and data reprocessing system for NOAA/STAR ocean color calibration. He also works with VIIRS SDR cal/val team on data product and algorithm evaluation to study the effect of calibration on ocean color products. His technical advisor is Menghua Wang and his supervisor is Steve Miller.

Julie Winchester

Julie is a part-time Research Associate II who returned to CIRA in Fort Collins in May 2012 after retirement. She serves as the lead education and outreach coordinator for the CIRA/NPS team and is responsible for conceptualizing, designing and producing all education outreach products for the CIRA/NPS group, especially as related to the IMPROVE (Interagency Monitoring of Protected Visual Environments) program. Her supervisor is Jenny Hand.

CIRA is pleased to recognize the following individuals for their recent promotions:

Mary McInnis-Efaw

Mary was formally promoted to Assistant Director in January 2012. While Mary has been the Assistant CIRA Director for quite some time now, this promotion formally matches her CIRA duties to recognized University titles. While this is a very real and deserved promotion, Mary continues to oversee activities in human resources, finance/accounting, facilities management, infrastructure, reporting, and grants management as she has done in the past.

Yong Chen

Dr. Chen was promoted to Research Scientist II in January 2012. 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) scientists located at NOAA/NESDIS in Maryland. His tasks include testing the impacts of CRTM in NWP system and developing new modules to improve the CRTM performance. He also works on cal/val of NPP/JPSS CrIS by using CRTM and NWP forecast data.

Robert Viola

Rob was promoted to Research Associate III in January 2012. He is an integral member of CIRA's CloudSat and RAMMB teams. His CloudSat work focuses on Data Processing System development and user interface design using new technologies. He interfaces with remote developers to assist with algorithm integration and developed the data distribution system for NASA JPL's Year of Tropical Convection project (yotc.cira.colostate.edu). He also develops applications for RAMMB projects.

Renate Brummer

Dr. Brummer was promoted to Sr. Research Associate in July 2012. Renate began working for CIRA in Boulder in 1995. For the following 10 years she was project manager of the GLOBE Systems Team and of FX-Net. In 2006, Renate joined the RAMM Branch in Fort Collins. She recently became RAMMB's Deputy Program Manager supporting Dr. Mark DeMaria, Federal Chief of RAMMB, with project management for the many different RAMMB activities.

Scott Copeland

Scott was promoted to Research Associate IV in July 2012. He was recently elected as Chair of the IMPROVE (Interagency Monitoring of Protected Visual Environments) Steering Committee. The IMPROVE program currently operates 170 sites nationwide, monitoring aerosol and visibility conditions. The program is managed by the Steering Committee that consists of representatives from the EPA, federal land managers, and organizations that represent state air quality associations. Scott's new responsibilities as Chair of the IMPROVE Steering Committee are in addition to the visibility and air quality research which he performs for the U.S. Forest Service.

Beth Kessler

Beth was promoted to Associate Manager of Finance in July 2012. After starting at CIRA in October 2010, she quickly established herself as a critical component of the CIRA Finance Team. She is responsible for financial oversight of non-NOAA grants and also administers the CIRA Infrastructure account.

Beth is a member of the Admin Pro Council and was recently elected co-chair of Campus Administrative Processing Advisory Council (CAPAC).

Haidao Lin

Dr. Lin was promoted to Research Scientist II in July 2012. He is a member of the ESRL/GSD/AMB (Assimilation and Modeling Branch) specializing in satellite data assimilation for the Rapid Refresh mesoscale model system which is run operationally by NOAA. Dr. Lin's work has focused on improving assimilation methods for hyperspectral sounding data from AIRS (LEO precursor to GEO Advanced IR Sounder) and AIRS Single-Field-of-View temperature and moisture retrievals. Dr. Lin has developed bias correction procedures for AIRS retrievals which have led to improvements in Rapid Refresh forecasts and in convective storm forecasts from the High Resolution Rapid Refresh.

Robert Lipschutz

Bob was promoted to Sr. Research Associate in July 2012. His initial work at CIRA dates back to 1981-82 when he developed prototype NEXRAD radar application software for NOAA's PROFS program in Boulder. He returned to CIRA in 1997 as part of the Data Systems Group (DSG) responsible for developing systems to acquire and distribute global meteorological data sets for NOAA's Forecast Systems Laboratory (FSL) and, more recently, the Earth System Research Laboratory's (ESRL) Global Systems Division (GSD). In his role as Production Control Manager for GSD's Central Facility, Bob has overseen the operation of systems that now process over 1.5 TB of data per day and was a principle architect of a 6-host Linux cluster that reliably performs much of the work.

Kevin Micke

Kevin was promoted to Research Associate III in July 2012. He is a core member of CIRA's RAMMB IT Team responsible for strategic planning and implementation of the RAMMB website at CIRA. He designs and develops database-driven web applications that provide easy access to satellite data to the scientific community. He incorporated Google Earth into a highly visible project with the National Hurricane Center to showcase the high-resolution satellite data display capabilities that minimize network traffic.

Steven Miller

Dr. Miller was promoted to Sr. Research Scientist in July 2012. He plays two important roles in CIRA. As Deputy Director, he oversees much of the research that occurs in the Fort Collins campus, which requires at least half of his time.   The Sr. Research Scientist title, however, was conferred primarily for his role in proposing and winning a significant number of internally and openly competed proposals, as well as the output of scientific journals articles stemming from this activity. Steve is publishing at a rate of 2-3 first author publications per year.   While the research and publications add up to at least another full time job, Steve still finds time to get involved with mentoring and outreach activities.

Service milestones:

Helene Bennett – 20 years
Derek Day – 20 years
Joanne DiVico – 30 years
Leslie Ewy – 15 years
Andy Jones – 25 years
Kevin Micke – 10 years
Lance Noble – 25 years
Mariusz Pagowski – 10 years
Glen Pankow – 15 years
Donald Reinke – 25 years
Karll Renken – 15 years
Richard Ryan – 10 years
Curtis Seaman – 10 years
Amenda Stanley – 15 years

Andrea Schumacher

Andrea was promoted to Research Associate III in July 2012 for her contributions to and increased responsibilities associated with the Tropical Research Group in RAMMB. She works in a NESDIS team on the development and transition of operational products for estimating the probability of tropical cyclone formation, intensity and track. These products are issued by the National Hurricane Center, the DoD, and the Joint Typhoon Warning Center.

Wei Shi

Dr. Shi was promoted to Research Scientist III in July 2012. He works in the Center for Satellite Applications and Research (STAR) of NOAA National Environmental Satellite Data and Information Service (NESDIS), Camp Springs, MD and has recently been developing ocean color data products for NASA MODIS data, as well as applications of these new products.

CIRA Vision and 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.

Cooperative Institute for Research in the Atmosphere

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