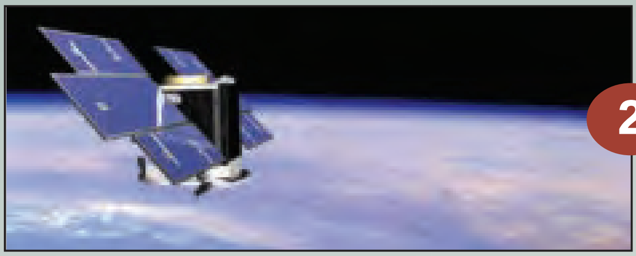
CIRA

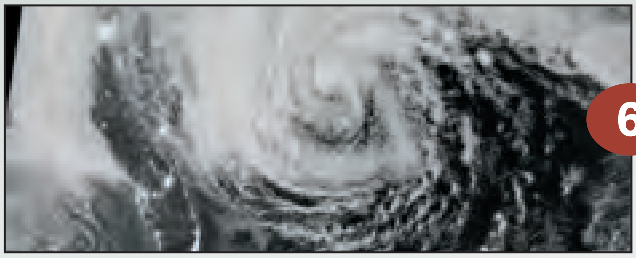
Cooperative Institute for Research in the Atmosphere

Volume 39, Fall 2013

College of ENGINEERING

Colorado State University







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From the Director's Desk . . .

In the last update I reported that despite the continued drought, our Cache la Poudre river in Fort Collins was still fairly black from ash following the previous summer's wildfires. Since then, we've had terrible flooding that occurred in early September and caused tremendous heartache as well as financial damage to the region. While the rain and resulting floods in Fort Collins were not as bad as they were in Boulder and the canyons leading into the mountains, I think we were all reminded just how destructive weather events can be in this region of the country. As destructive as the weather was, however, I must say that I was impressed with the quality of both the forecasts and the observations of precipitation in the region. Over the three days that it rained almost uninterrupted, it seemed that the amount and location of forecast precipitation was certainly of great use to prevent greater losses than what we experienced. We're clearly on the right path.

One of the highlights of this summer was the mid-term review conducted by NOAA of our current 10-year cooperative agreement. The review was led by Ray Ban of Ban and Associates, and included Bill Lapenta of NOAA EMC, Robert Moorhead of Mississippi State Univ., Joe Tribbia of NCAR and Karen Yuen of JPL. The review panel generally concluded that CIRA created an extremely productive partnership between academia and government and through these partnerships, had leveraged an impressive array of research support that has added value, not only to NOAA, but to other agencies and society at large. They further noted that CIRA, and therefore NOAA, had become a leader in understanding satellite observations and atmospheric modeling and the effective transfer of research in these areas to operations. As part of that, they noted the extremely high quality of CIRA's staff. They also noted that the ability of CIRA to fully realize its potential is limited by short term funding challenges which inhibit longer term planning and some disconnects between CIRA employees at different locations around the country. While we cannot do much about the funding, we do plan to better connect the different organizations so that everyone can more fully benefit form CIRA as a whole.

This issue of the CIRA magazine focuses on two groups within CIRA that are not directly associated with NOAA. The Center for Geosciences and Atmospheric Research houses researchers on a cooperative agreement with the Department of Defense. It is led by CIRA Director Emeritus, Tom Vonder Haar and focuses on issues such as cloud properties as well as data fusion issues discussed in this issue. The synergy in both these areas with NOAA's Cooperative work is obviously quite strong which allows everyone to benefit from this arrangement. The other Cooperative agreement is with the United States Park Service that focuses on air quality and visibility issues. The synergy with the NOAA's CIRA focus is also quite strong and becomes evident when issues related to visibility in the nation's National Parks are highlighted in the same issue as NOAA's work on fire weather and satellite capabilities to detect wildfires. Here too, we all benefit from different cooperative agreements working towards a common goal of improving algorithms, data assimilation weather forecasts, weather and climate processes understanding, and data distribution.

This magazine also reminds us how quickly time can pass. While it seems like only yesterday, Suomi NPP has already reached two years in orbit after its October 28th, 2011 launch. We reflect on the accomplishments of this mission in the magazine. The next mission to go up with significant involvement from CIRA will be the Global Precipitation Mission currently scheduled for a launch in February of 2014. That mission will hopefully go a long way in improving rainfall estimates and in synergy with GOES-R, stands to revolutionize retrievals of high resolution precipitation in areas where ground based radars are not available. JPSS is next.

Let me end by noting that the government has been shut down for almost two weeks now and negotiations appear at a standstill. Nonetheless, I know from e-mails of some of those who are shut out of federal facilities, that work continues although perhaps not as efficiently as possible. This issue will hopefully be long behind us by the time this magazine is printed but let's remember it for future planning.

Center for GEOSCIENCES

PRODUCT EVOLUTION CONTINUES

by Matt Rogers, Andy Jones, and John Forsythe/CIRA

Scientific research in the atmosphere encompasses several disparate sources of information, including satellite, radar, surface, and other observations, as well as numerous forms of data from numerical weather prediction models. Particularly with satellite data, the use of differing data formats (and differing structures within those formats) confounds the easy application of the data to any given problem, and most scientists have had at least one experience where simply handling data processing was the most time-consuming aspect of a research project, eclipsing even the research part itself.

To address this perennial issue, CIRA researchers from the Center for Geosciences/Atmospheric Research have developed a tool to overcome these difficulties. The Data Processing and Error Analysis System (DPEAS) was created by Andy Jones and CIRA Director Emeritus Tom Vonder Haar, and utilizes a sophisticated parallel computing environment for processing disparate satellite data inputs. By using memory structures that are fully compliant with the popular Hierarchical Data Format – Earth Observing System (HDF-EOS) format, DPEAS can take in any format (including native HDF-EOS datasets) and convert data to match a common structure, making data analysis using different sources much easier.

ANALYSIS SYSTEM

The initial version of the system runs natively in a Windows environment, and a port of the program to the IBM AIX operating system runs operationally at NOAA NESDIS to produce blended water vapor and rain rate products. A continued development of the software for the Linux operating system, overseen by the CG/AR team and led by CIRA researcher Steve Finley, has new potential for use in improving cloud forecasts from satellite observations. The application for this new development of DPEAS would have marked impact in the fields of hydrology and cloud climatology, and includes improvements in cloud detection products among other innovations. Additional NOAA activities led by CIRA's Dr. Stan Kidder, are adding new DPEAS functionality to meet NESDIS operational requirements, including use of new polar orbiting data sets. CG/AR recently hosted two visitors from the Air Force Weather Agency and the U.S. Army Engineer Research and Development Center to demonstrate the improved system.

One of the key priorities of CIRA research is developing cutting-edge technologies that bridge the gap between research and operations. The DPEAS system perfectly demonstrates the capabilities that CIRA can draw on to improve operational forecasting using increasingly sophisticated observations from the research world, with the Center for Geosciences/Atmospheric Research leading the way.

> *"The Data Processing and Error Analysis System (DPEAS) was created by Andy Jones and CIRA Director Emeritus Tom Vonder Haar, and utilizes a sophisticated parallel computing environment for processing disparate satellite data inputs."*

Clearing the Air

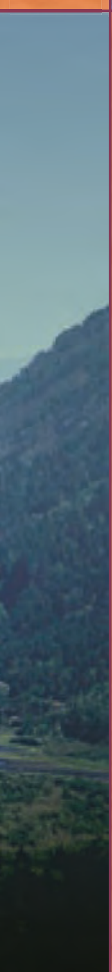
CIRA and NPS Analysis Demonstrate the Impact of Clear Air Regulations

By Matt Rogers and Jenny Hand CIRA/NPS

Prior to the passage of the Clear Air Act in 1970, trips to many of the nation's national parks would have left visitors disappointed with hazy views of national treasures due to high levels of air pollution. Fast forward to the present and the views in our national parks have improved markedly, thanks in large part to federal regulations and stringent emissions standards. CIRA National Park Service research tools show us precisely how much better things have become.

(Photo Credit, National Park Service/CIRA)

(Photo Credit, National Park Service/CIRA)



To do this, CIRA researchers use observations of atmospheric conditions from current and historical records along with a sophisticated software package to simulate scenic views under both conditions.

"The simulated photographs illustrate that at places such as Great Smoky Mountains National Park, mountains that were once regularly obscured by haze are now clearly visible," said Jenny Hand, a CIRA scientist who is working with the National Park Service to study air pollution trends and their causes.

In the 1960s and 1970s, high air pollution levels, often referred to as acid rain, damaged terrestrial and aquatic ecosystems and in some cases resulted in die-offs of fish and trees. This same air pollution contributed to haze, reducing visibility to a few miles in many cities and obscured majestic vistas in national parks.

The primary cause of the pollution had been identified as fossil fuel burning largely by coal-fired power plants, factories, and automobiles, which released sulfur dioxide and nitrogen oxides into the atmosphere.

To address air pollution, **Congress passed the 1970 Clean Air Act** and its **Amendments in 1977 and 1990**. The 1977 amendments identified certain national parks and wilderness areas as places having high scenic values and set the national goal of reducing human-caused haze in these areas. The introduction of the **Acid Rain Program** in **1990** set further goals of reducing the sulfur oxide and nitrogen oxide emissions from coal-fired power plants and automobiles. As a result, **from 1990 to 2012, sulfur dioxide emissions dropped from 23 million tons to 5.5 million tons, and nitrogen oxide emissions were cut in half.**

These and other emission reductions have led to remarkable improvements in visibility in many national parks, say CIRA scientists who have simulated the visual scenes at many national parks and wilderness areas.

"Though there have been dramatic improvements in air quality, high levels of air pollution still occur and are environmentally harmful," Hand said. "Diligence is required to maintain the improved air quality we now enjoy and to resolve remaining issues."

2 SUOMI NPP Years On Orbit

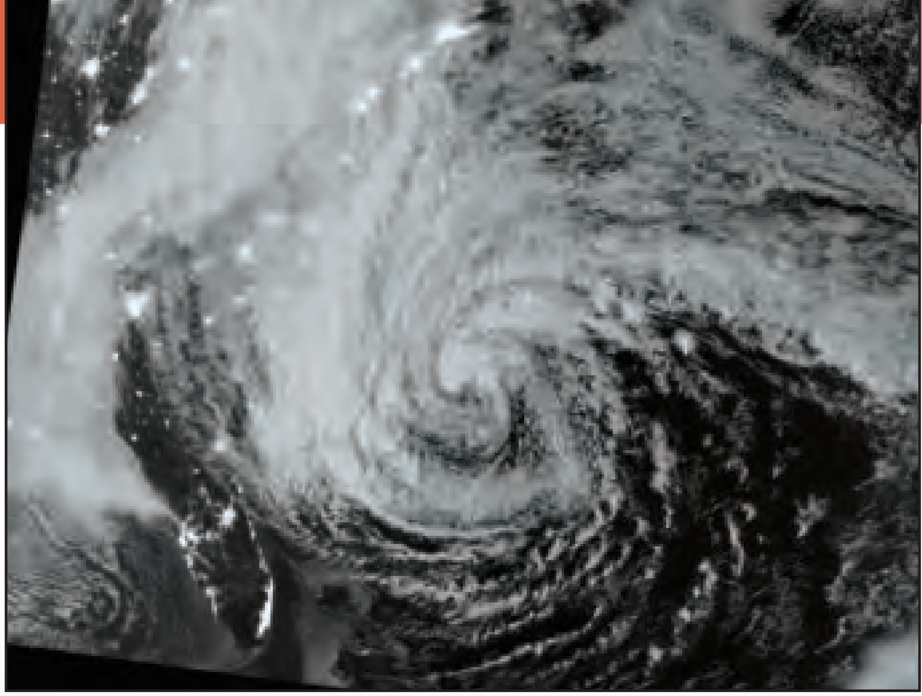


Figure 1. Hurricane Sandy redeveloping in the warm waters east of Florida, as seen by the day-night band instrument aboard Suomi NPP.

by Matt Rogers/CIRA

As any parent knows, children grow up much faster than a strict accounting for time elapsed would suggest. After a flurry of excitement after the birth and the reaching of those first few precious milestones, before you know it, you're watching a toddler run full-steam across the living room, reading through picture books and wreaking havoc in the Tupperware drawer, and you wonder where the time went.

In a very similar way, we find ourselves amazed at how quickly time passes for satellite missions. It was just two years ago, on October 28th, 2011, that a Boeing Delta II rocket lifted off from Vandenberg Air Force Base along the coast of California, carrying onboard the Suomi NPP spacecraft. Representing the culmination of years of careful planning and development between NASA and NOAA, the proud 'parents' of the newborn mission, the satellite promised new observations and new insight into the Earth and it's environment through the use of the five sophisticated instruments being launched into polar orbit.

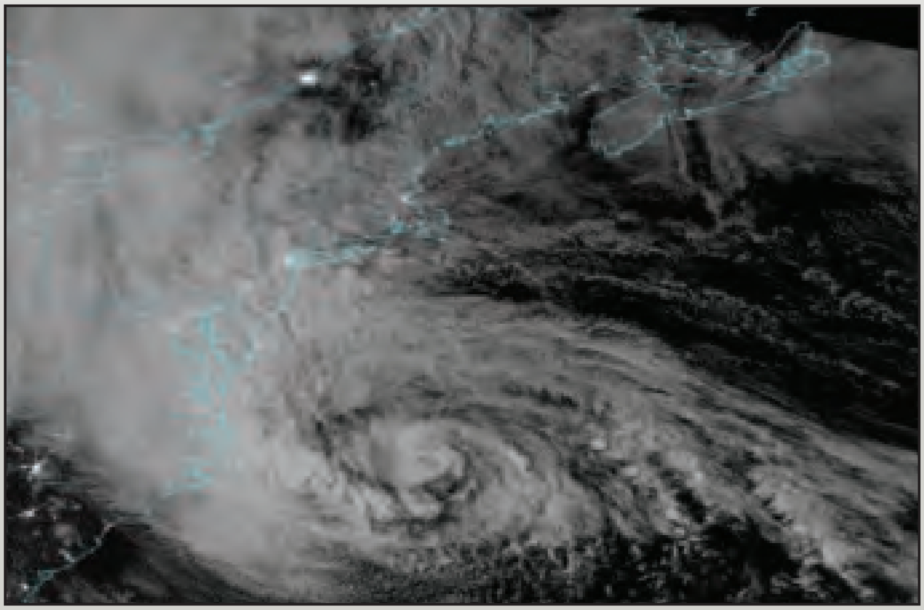


Figure 2. Hurricane Sandy undergoing extratropical transition on the 29th of October, 2012, as seen by the day-night-band sensor of the VIIRS instrument.

Two years ago, scientists eagerly awaited the first data from the mission. Now, we can flip through the 'baby photos' from Suomi NPP and see some of those milestones that the mission has reached.

HURRICANE SANDY: OCTOBER 2012

A year after the launch of Suomi NPP, one of the most devastating storms ever to hit the U.S. mainland was captured by the instruments of the mission. Hurricane Sandy, at its peak, a Category 3 storm on the Saffir-Simpson hurricane scale, formed over the central Caribbean on the 22nd of October, 2012. The storm moved northwards, making its first landfall over Kingston, Jamaica, before continuing to intensify to its maximum strength shortly before making another landfall over Cuba on October 25th. After traversing Cuba from south to north, the storm, greatly diminished from its interaction with land, and feeling the affects of dry air and wind shear, moved north towards the Bahamas, where continued interaction with dry air due to an approaching frontal system affected the system in a complex manner.

On October 28th, the Suomi NPP mission celebrated its first birthday by capturing an image from the Day-Night Band sensor on the VIIRS instrument of Hurricane Sandy, as it redeveloped off the coast of Florida **(Figure 1.)** Strictly speaking, the storm at this point was experience growing pains, exhibiting characteristics of both its tropical genesis and some extratropical characteristics, due to its interaction with the nearby frontal system. The result was a large, disorganized storm that skirted the boundaries between hurricane, tropical storm, and strong extratropical cyclone. This complex development of the storm would continue throughout the storm's remaining life, with the instruments of Suomi NPP chronicling the interesting and unique events to unfold.

Figure 3. Composite image of nighttime light sources over metropolitan New York, comparing light sources between 25 September and 1 November, 2012, as seen by the day-night band sensor aboard Suomi NPP. Red pixels denote areas without power after the passing of Hurricane Sandy on the 29th of October 2012.

As the storm continued to move up the eastern seaboard of the United States, the storm went through an extratropical transition, becoming extratropical approximately two hours before making a final landfall over New Jersey on the 29th of October. During this transition, the storm continued to hold on to a core of deep convection reminiscent of its origins as a hurricane – **Figure 2** shows another image of Sandy, again from the DNB sensor of the VIIRS instrument, showing some of these hybrid characteristics of the storm as it navigated its extratropical transition.

The meteorological evolution of Hurricane Sandy is a topic that will engage researchers for years to come; the immediate impact of the storm as it came ashore on the tens of millions of American citizens commanded a greater, if shorter, share of the national attention. Twenty-four of the fifty United States were affected by the storm, with a total damage estimate of $65 billion – second only to Hurricane Katrina in terms of monetary cost. Seventy-two lives were lost in the United States due to Sandy, and millions of residents were without electrical power for the days following the storm. Here again, the day-night band sensor aboard VIIRS demonstrated new capabilities to see the Earth; **Figure 3** shows a before-and-after nighttime image over New York City.

In this composite image of the nighttime city lights of New York, consisting of a 'before' image taken on September 25th, 2012, and an 'after' image, taken on November 1st, pixel coloration denotes the presence of visible radiation at night (primarily from city lights, but also some from reflected light off of cloud cover.) Yellow pixels denote areas where light was seen

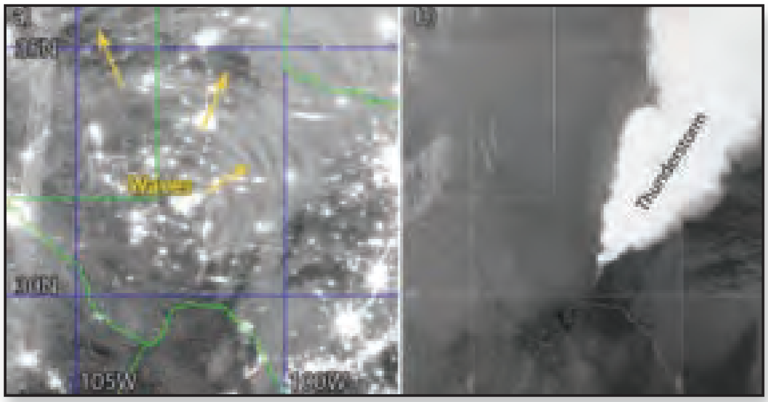


Figure 4. Discovery of mesospheric waves forced by nighttime convection as seen by the DNB instrument aboard Suomi NPP. Published in the Proceedings of the National Academy of Sciences.

by Suomi NPP for both the 'before' and 'after' image, green pixels denote where light was seen only in the 'after' image (primarily consisting of cloud cover present in the 'after' image that wasn't in the 'before' image) and red pixels denoting where light was seen only in the 'before' image. With this context, it becomes easy to understand that red pixels denote areas where the lights are out; a very large area of metropolitan New York is without power in the 'after' image for this case, including much of Long Island, Jersey City, and a large fraction of the New Jersey coastline.

As populations swell around coastal areas, the impact of landfalling tropical storms will continue to be of import. For Hurricane Sandy, our ability to see, forecast, and understand the impact of this unique storm was greatly enhanced by the one-year-old Suomi NPP mission.

SEEING AT NIGHT - THE DAY-NIGHT BAND SENSOR

The Day-Night Band sensor of the VIIRS instrument aboard Suomi NPP represents one of the most sophisticated, and anticipated, instruments ever to fly in space. Our ability to 'see' the Earth from space is entirely a function of our ability to collect light (or, more properly, electromagnetic radiation) of various frequencies. Those sources of electromagnetic radiation come from three processes: emission, scattering, and absorption. During the day, a huge amount of visible light (with a wavelength of around 0.5 μm) shines on the surface of the Earth courtesy of the Sun, and a significant fraction of this light reflects (or, scatters) off of the Earth and reaches the sensors of satellites in orbit. At night, with the Sun on the opposite side of the Earth, satellites have heretofore relied on emitted radiation in the infrared band (with a wavelength of around 10.0 μm) coming from the Earth's surface and atmosphere. This arrangement gives us some ability to 'see' at night, but many of the benefits of using visible light observations are lost. Because the infrared source of light used in nighttime observation is dependent on the temperature of the object emitting that light (be it the Earth's surface or a cloud, for example), two objects that are of similar temperature but very different composition will look essentially the same in the infrared, where they might be distinguished more easily in the visible spectrum, where their disparate scattering properties are more important. There are still some sources of visible light at night: reflected light from the surface of the moon, starlight, and to a much weaker extent, light emitted by photochemical processes high in the Earth's atmosphere provide some visible illumination at night, but prior to the launch of Suomi NPP, no spaceborne instrument was capable of detecting this faint light source.

Figure 5. The Earth at night, as seen in a composite image of DNB data from the Suomi NPP satellite.

With the advent of the DNB sensor, many new observations became possible (and for a great deal more information about the DNB sensor, see the Spring 2013 issue of CIRA) and our ability to see the planet at night improved in leaps and bounds. The three images of Hurricane Sandy on page 6 and 7 demonstrate some of the capabilities of the DNB sensor. **Figure 4** shows one of the genuinely new discoveries made through the Suomi NPP mission; a side-by-side visible and infrared image of a Texas thunderstorm demonstrates convectively-forced rippling in the extreme upper atmosphere (the photochemical light-producing layer) that had never before been seen by satellites. Finally, a poignant image, made by compositing months of DNB data, of our home planet at night, dubbed the 'Black Marble' is seen in **Figure 5.**

Figure 6. The High Park Fire at night, from 11 June 2012, taken by the day-night band sensor aboard Suomi NPP. City lights of Fort Collins, Loveland, Greeley, Longmont, Boulder, and Cheyenne, WY denoted by white text. Red arrow denotes actively burning wildfire signal (white pixels.)

Oftentimes, the promise of seeing new things in science is more a matter of greater resolution, or better temporal characterization. With Suomi NPP, the promise is much more literal.

CLOSE TO HOME: SUOMI NPP IMAGES THE HIGH PARK FIRE

As detailed in the Fall 2012 edition of CIRA, the High Park Fire, located immediately west of the CIRA Fort Collins campus, had a huge impact on the scientific, residential, and economic community. Burning over 87,000 acres, causing over $30 million in damages, and one fatality, the High Park Fire brought into sharp focus our need to understand wildfire, including the need for high-resolution imagery. Not even a year old at the time of the fire in June 2012, the Suomi NPP mission was poised to serve an important role in furthering our understanding of fire.

Figure 6, again from the day-night band sensor aboard Suomi

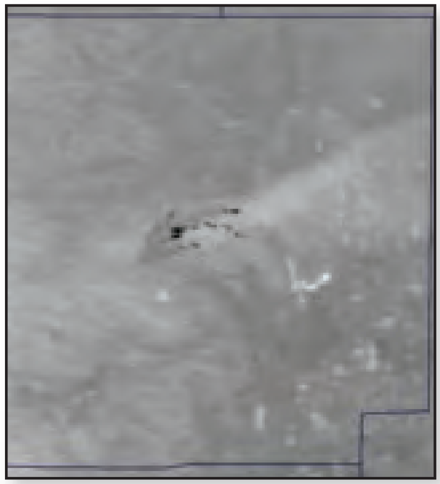


Figure 7. Infrared image of the High Park Fire, from the VIIRS instrument aboard Suomi NPP. Black pixels denote 'hotspots' in the wildfire, grey pixels denote surface pixels and/or smoke plume locations from the fire.

NPP, shows High Park Fire at night, burning outwards in a large perimeter from the ignition source. Taken on June 11th, 2012, the city lights of Fort Collins, Loveland, and Greeley can clearly be seen – as can the light from the flames of the fire, already covering a larger areal extent than the cities listed above. **Figure 7,** this time from an infrared band in the VIIRS instrument, shows the location of 'hotspots' in the fire, denoted by black pixels. As noted earlier, emitted light is dependent on the temperature of the emitting object; the extremely high resolution of the VIIRS instrument allows for discrimination of relatively small areas of actively-burning fire (with its much higher temperature and emission profile) than the cooler region of the surrounding forests. Other satellites, lacking the resolution of VIIRS, would 'smear' this signal across a larger area, making detection of the fire more difficult.

Finally, in **Figure 8,** we see a true-color image of the High Park Fire as seen by several visible bands of the VIIRS instrument, showing the

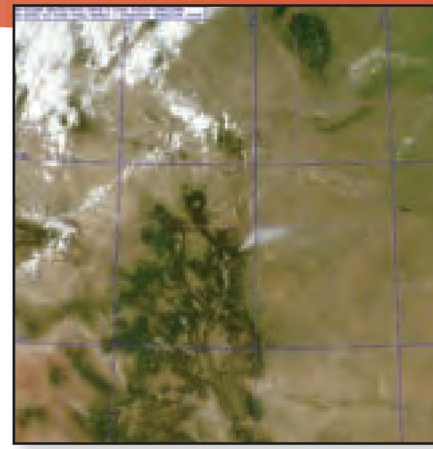


Figure 8. True-color composite image of the early stages of the High Park wildfire, from 9 June 2012, as seen by the VIIRS instrument aboard Suomi NPP. Grey smoke plume over the Front Range visible in center of image.

extent of the smoke plume early in the fire's development. Detecting smoke plumes from space is one of only many potential uses for the extremely high resolution visible imagery made possible by the Suomi NPP mission.

LOOKING TO THE FUTURE: NEW DATA, NEW DISCOVERIES

Since the launch of the Suomi NPP mission, there have been many notable events in the Earth-atmosphere system that have offered themselves to observation, and several instances of genuinely new science made possible by the careful examination of the data from the mission as well. In the same way that we might flip through a book of baby photos, we can go back over the last two years' worth of data from Suomi NPP and see how our world looks through the eyes of our creation. The key difference here, however, is that in this process of reflection on the data from Suomi NPP, we realize that we are the ones growing and learning new things. That continued growth is a very exciting thing to look forward to for the next several years' worth of data from the Suomi NPP mission.

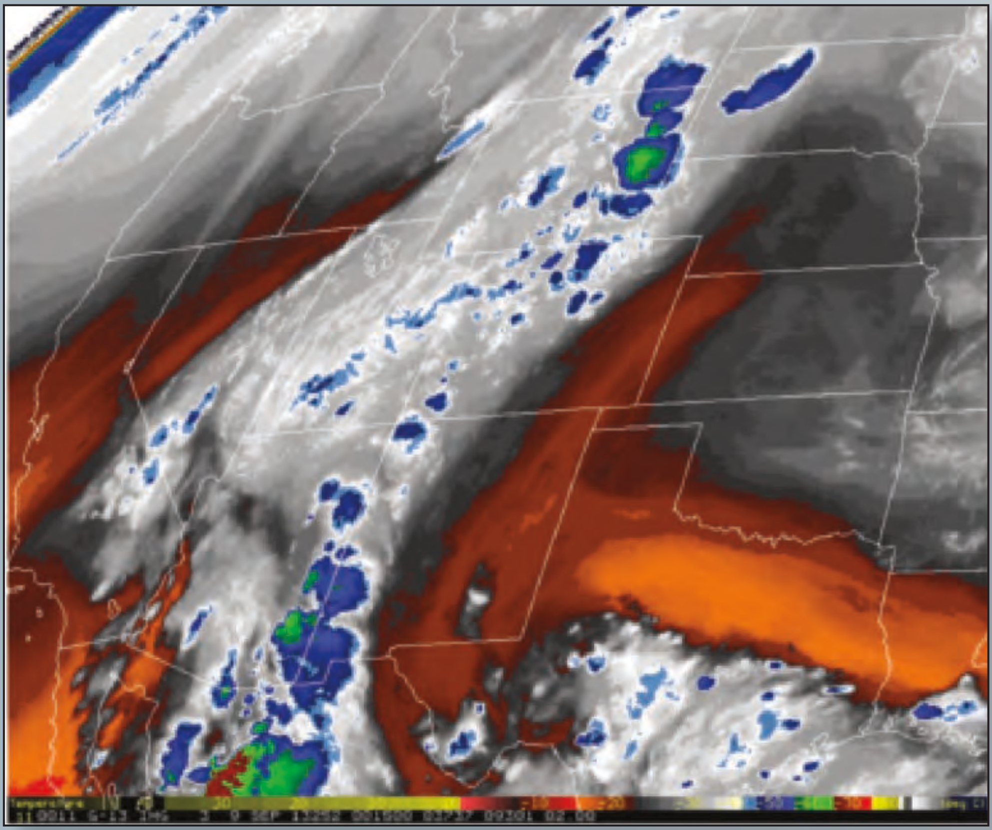


Figure 1. GOES-E water vapor image from 9 September 2013 showing a strong plume of deep moisture being drawn over Colorado due to a low pressure system. (Credit: Dan Lindsey, CIRA/RAMMB)

COLORADO FLOODS of 2013 Through CIRA's Eyes

by Matt Rogers/CIRA

Only a year after devastating fires swept through the state of Colorado, a week of near-constant rainfall led to widespread flooding in northern Colorado. The flooding, which caused eight fatalities and more than $430 million of damage as this article goes to press, affected communities along the Front Range from Colorado Springs through Fort Collins, hitting the Boulder and Longmont areas especially hard. Suburban areas of Denver, such as Aurora, were also affected by the storm, with residential flooding commonly occurring. Record amounts of rainfall were received by many parts of the state, and the event ended the 2013 drought for a large portion of northern Colorado.

As a significant meteorological event, continued analysis of the flood will be part and parcel of the research that CIRA performs in the coming months, and the reader can look forward to more detail-oriented articles in future issues of CIRA as research into this event progresses. This article hopes to summarize in brief the community impact of the storm as it affected Northern Colorado as seen through the eyes of CIRA researchers and staff.

BACKGROUND - SETUP FOR RECORD RAINFALL, INITIAL FORECASTS

Beginning on September 9th, 2013, a large, low-pressure system moving over the Great Basin became stationary overnight on the 10th, remaining in roughly the same place for the next several days. As the low pressure stalled, the circulation drew a plume of moisture from the Pacific and the Gulf of Mexico northwards, (Figure 1.) bringing a large amount of

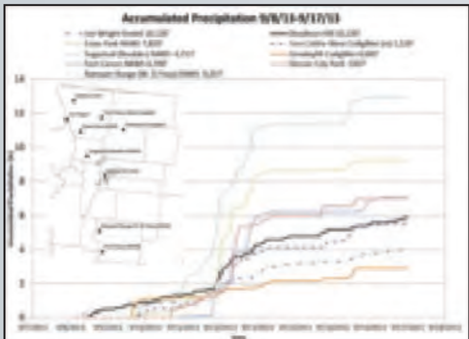


Figure 2. Accumulated precipitation for selected raingauges in Northern Colorado, showing the large and rapid accumulation of rainfall over a short period of time. Courtesy of the Colorado Climate Center, online at coflood13.colostate.edu (Credit: Colorado Climate Center)

deep moisture over the Front Range. Soundings from Denver during the event resembled tropical moisture profiles, setting records for total-column precipitable water amounts for September. Rainfall over large areas of Colorado began as early as the 8th of September, and heavy rain began to fall continuously on the 10th, continuing through as late as the 16th of September. (Figure 2.)

Total rainfall accumulations for the event ranged from six to thirteen inches for different stations located in the Foothills, with the heaviest precipitation amounts falling along the Front Range in central Boulder County. Some stations received what amounted to a year's average amount of precipitation in just four or five days, with predictable results in Northern Colorado: the St. Vrain, Big Thompson, and Cache La Poudre rivers began rising. As dams upstream were overwhelmed, notably the Lake Estes dam, additional water was released into the canyons. Soon, the communities of Boulder, Estes Park, and Lyons were flooding, and US Highways 34 and 36 were cut off, stranding residents of mountain communities for extended periods.

IMPACT OF THE FLOODS ON THE CIRA COMMUNITY

In Fort Collins, extensive irrigation networks managed by the City of Fort Collins were brought into play to manage the floodwaters of the surging Poudre. Extremely

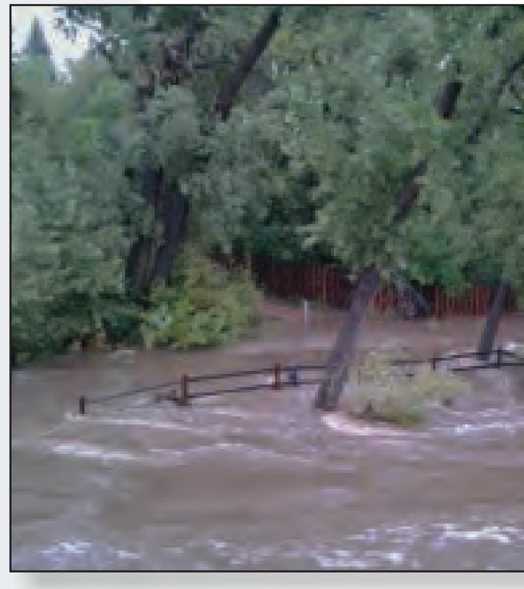


Figure 4. The Cache La Poudre River floods the Poudre Trail near Overland Trail in Fort Collins. (Credit, Tommy Taylor, CIRA)

high water began to impact the bridge network linking Fort Collins to I-25 and other highways (Figures 3. and 4.) which would result in bridge closures for safety inspections after the waters receded, trapping many Fort Collins residents and making travel through the city difficult. Colorado State University closed on Friday, 13 September due to uncertain road conditions throughout the city, although the improving road situation allowed for the Saturday football game against Cal Poly to proceed.

Figure 3. A bridge in Fort Collins is threatened by rising floodwaters as onlookers and emergency staff monitor. (Credit: Scott Longmore, CIRA)

Figure 5. Two UH-60 Blackhawk helicopters of the 159th Aviation Regiment of the Wyoming National Guard assist with evacuation efforts from the incident command center at Christman Field, near the CIRA campus in Fort Collins. (Credit: Scott Longmore/CIRA)

Figure 6. A CH-47 Chinook helicopter from the US Army 4th Combat Aviation Brigade, 4th Infantry Division assists with evacuation efforts. (Credit: Matt Rogers/CIRA)

Figure 7. Roiling storm clouds over Fort Collins. (Credit: Scott Longmore/CIRA)

As the road network in Fort Collins became under control, an incident command post at Christman Field, just down the road from the CIRA campus in Fort Collins. Reminiscent of the High Park Fire just a year prior, CIRA employees were required to show ID to get to work for much of the following week, as a helibase for evacuating stranded refugees was set up, hosting the US Army's 4th Combat Aviation Brigade as well as the Colorado and Wyoming National Guard. UH-60 Blackhawk and CH-47 Chinook helicopters (Figures 5. and 6.) as well as other aircraft made continual runs from the airfield, ultimately rescuing nearly 400 evacuees throughout Larimer county, to be led to waiting school buses and Red Cross shelters.

Figure 8. Floodwaters rush through the Poudre River, Fort Collins. (Credit: Scott Longmore/CIRA)

Figure 9. Floodwaters cover the intersection of Baseline Road and Country Lane in southern Boulder. (Credit: Ed Szoke/CIRA)

In Boulder, where flooding was much more pronounced, the situation was more severe. Heavy flooding along Boulder Creek submerged many roads and basements in the city, shutting down businesses and institutions throughout the city. Catchment basins quickly overflowed, and creeks and ditches overflowed their bounds. Figures 7., 8., 9., and 10. demonstrate the consequences of the storm in Boulder on the 12th of September, 2013.

Many more stories from this devastating storm will be forthcoming, as will significant research results from looking at the data from this event. A foretaste of this is presented as Figures 11. and 12., showing a false-color image of the South Platte river and many of its tributaries as seen from the VIIRS instrument aboard the Suomi NPP mission. The first image, taken from the 8th of September prior to the flooding event, shows the normal bounds of the river (in dark blue) surrounded by green irrigated fields.

(Credit: Scott Longmore/CIRA)

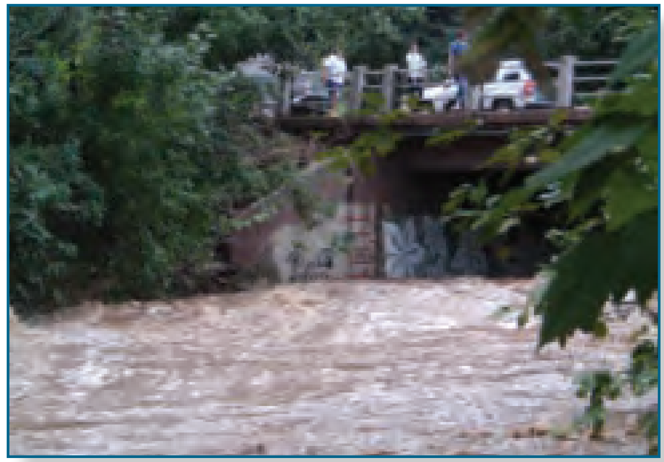


Figure 10. A painted flood gauge blends with graffiti under a bridge in central Boulder. (Credit: Ed Szoke/CIRA)

The second image, from the 17th of September, shows a much wider South Platte, and thick lines of tributaries and flooded margins around the Cache La Poudre, Big Thompson, and St. Vrain rivers feeding into the Platte. As continued observations of this event are processed, it is certain that more than a few degrees, papers, and presentations will come from the research CIRA performed on the 2013 Colorado flood event, and the knowledge we gain from this research will continue to deepen our understanding of flooding, improve our response to flood events, and prepare us better to live in our ever-changing world.

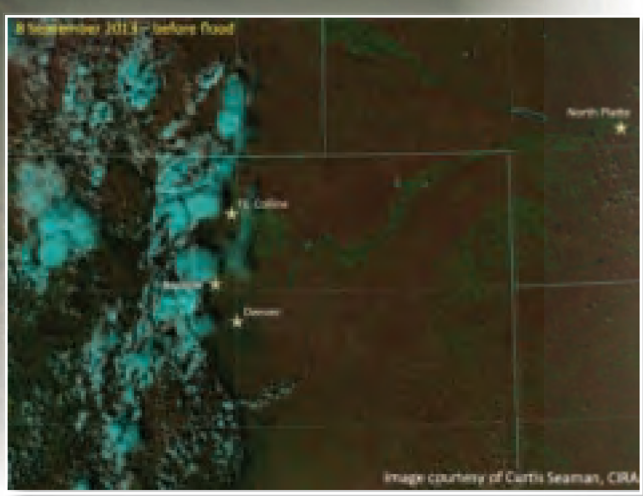


Figure 11. VIIRS false-color image of the South Platte and tributary rivers taken from 8 September 2013, prior to flooding. (Credit: Curtis Seaman/CIRA)

Figure 12. VIIRS false-color image of the South Platte and tributaries taken from 17 September 2013. Note the much thicker profile of the river due to flooding along the banks. (Credit: Curtis Seaman/CIRA)

by Matt Rogers

Outreach and Education: Application and relevance in challenging budgetary times

Developing education and outreach (E&O) programs is one of the most rewarding, and challenging, tasks facing the modern scientific research organization. For CIRA, the relevance of the scientific research performed here has perhaps never been higher; from climate observations, severe weather and tropical cyclone research, and progress on air quality and renewable energy, the topics of CIRA research represent the forefront of economic, political, and everyday life.

Communicating the fundamentals of this research to the taxpayer, citizen, and student is critical to securing the future of scientific research. Perhaps at some point in the past, the notion that scientific research was valuable in its own right was more popular than it is now (although history would perhaps suggest this a romantic opinion) – what is clear in a world of instant and widespread communication on all matters of policy is that scientific research needs to be relevant to the public if it expects to receive significant support.

Fortunately for CIRA, this metric is easier to achieve than perhaps some other research institutions. With a programmatic focus on transition between research and operations, explaining what it is that CIRA does is much easier for our E&O team because the public is often much more familiar with the operations side of the equation. Most people understand the utility of satellite observations in weather forecasts, for example – tying CIRA research into improved satellite observations and the obvious utility of instruments such as VIIRS in expanding the kinds of observations available to the forecaster is an easy case to make to the public on our behalf.

It's not enough, however to simply rely on the latest application of technology to make the case for support for atmospheric science research – to really engender the kind of support needed to make significant progress for the future, we as scientists must develop a sense of familiarity and excitement about our research in the next generation of scientists, citizens, and students. More students developing insight and awareness of the challenges and opportunities of atmospheric research leads to more interest and involvement, both professionally and politically, in our field. Making sure that that involvement is a positive impact is the overall goal of education and outreach programs, and requires that these programs provide accurate and relevant information to the public.

For the last decade or so, an extremely effective technique to achieve the goal of providing accurate and relevant information has been direct interaction with the world of education, both through working with students (from K-12 through undergraduate and post-graduate programs) and with teachers, through the use of professional development programs. Professional development in particular has been a hot topic in the education and outreach community, as working with motivated science teachers to develop a deeper understanding of the earth-atmosphere system is a simple and cost-effective way to get our message across. Particularly with the advent of standards-based education programs, made prevalent nationwide with the No Child Left Behind Act, bridging the gap between scientific research and a myriad system of education standards has been the bread and butter of education and outreach programs, where the fundamentals of atmospheric research are brought down to an appropriate level and matched to required standards.

Typically, to develop such a program, an institute or mission would develop a series of products based on their research (such as fire weather products, or cloud observation tools) for three or four different levels of expertise, and

would then match these products to a relevant standard (such as cloud identification for a 5th grade science standard, for example.) With the assistance of education experts, the institute would then develop curriculum for professional development that would bring the science knowledge to the teacher in a format that is easy to understand and apply to the classroom. Coupled with feedback and evaluation programs, this approach has seen much success over the last few years, with both NASA and NOAA gaining great experience in developing educational programs in atmospheric research, as well as a large dedicate audience of education professionals and teachers relying on science institute-led programs to improve standards-based education. CIRA in particular has enjoyed developing connections with the College of Education at Colorado State University, and has been directly involved in several proposals for professional development programs over the last two years.

All this is changing, however - the budgetary crisis of recent years has led to a paradigm shift in how science education and professional development will happen. The 2014 President's Budget contained several shifts in the structure of education and outreach programs, with a decrease in overall Science, Technology, Engineering, and Mathematics (STEM) programs from 226 to 112, and a programmatic shift of funding away from NOAA and NASA to the Department of Education. The intent of the changes is to reduce fragmentation of the Federal component of STEM education, among other programs, and as would be expected, offers new challenges and opportunities to the E&O community.

For CIRA E&O, there are many new opportunities available to pursue. As the core of our E&O program is not dependent on direct funding from the Federal government, the budget shifts do not affect us directly. Moreover, our organic connection to the University environment (in particular, our connections to the College of Education) offers some significant advantages for CIRA in the proposed system. While future funding opportunities shift towards the education community rather than the scientific community, there will still remain a great need to address the 'Science' part of STEM E&O programs, and CIRA is uniquely suited to offer content matter expertise for these new programs. Through our connections to the education community, CIRA is well-positioned to take advantage of the shift in direction in E&O support. Two programs in particular, developed jointly between CIRA and educational partners from CSU and from other universities, offer new opportunities to pursue a new role for CIRA in education and outreach – more details on these projects will be forthcoming as they develop.

Education and outreach work in science is always a complex and often exhausting process,

demanding constant attention and an ability to be flexible in a changing landscape of political support. The ability for Cooperative Institutes to leverage their many connections between research, operations, and University-based education programs provide them with a unique capability to adapt to these changing conditions, and CIRA remains poised to not only adapt, but to excel at the challenges facing E&O for years to come.

Communiqué

CIRA Research Initiative 2013 Award Winners Announced

Ken Sperow's technical leadership on a number of high-visibility NWS projects— one of which is specifically spelled out in the National Weather Services' Weather-Ready Nation Roadmap—provided ample evidence and outstanding examples of team leadership/mentoring capability and achievements that result in substantial impact within and external to a member's workplace worthy of the Research Initiative Award.

Sirish Uprety, an up-and-coming Research Associate with the STAR Satellite Meteorology and Climatology Division/Sensor Physics Branch, was recognized for his innovative and creative approaches and techniques in support of the Suomi-NPP VIIRS sensor data record radiometric calibration and validation efforts. His noteworthy list of contributions to the NOAA satellite mission as well as his publication record led to his selection as a recipient of this year's Research Initiative Award.

Sher Schranz's long list of critical responsibilities and outstanding accomplishments across a myriad of high-visibility programs and projects— fire weather research, NextGen aviation weather, unmanned aircraft systems, NEIS, FX-Net told the story of her contributions. Her involvement in all of the above provided evidence that she more than earned recognition for her outstanding service in administrative oversight, project management, and outreach.

Dr. Mark DeMaria Finalist for Prestigious Award

Dr. Mark DeMaria, a nationally known research scientist and branch chief for the Regional and Multiscale Meteorology Branch (RAMMB) group, hosted at CIRA, has been listed as a finalist for the 2013 Samuel J. Heyman Service to America Career Achievement Medal. The RAMMB team, part of the National Oceanic and Atmospheric Administration (NOAA)'s Center for Satellite Applications and Research (STAR) office, conducts cutting-edge research on the use of satellite data to improve analysis, forecasts, and warnings for regional-scale weather events.

The Samuel J. Heyman Service to America medals celebrate the accomplishments of the nation's foremost public servants. Known sometimes as the 'Oscars of government service', the medals are awarded annually at a gala event, which will occur on October 3rd, 2013. Recipients of the medal, according to President Obama, 'exemplify the spirit of service that marks our federal workforce.' Dr. DeMaria is one of five finalists announced for the Career Achievement Medal.

More information about the award and Dr. DeMaria's nomination can be found online at: http://servicetoamericamedals.org/SAM/finalists/cam/demaria.shtml

Professor Vonder Haar to Chair AMS Committee

Professor Tom Vonder Haar, Director Emeritus of CIRA, has been appointed Chairman of the American Meteorological Society's Committee on the History of Meteorology by the Council of the AMS. He is joined on the committee by Professor Wayne Schubert of the Department of Atmospheric Science.

Tom is interested in ideas or comments from all related to the History of Meteorology and he can be contacted via email at thomas.vonderhaar@colostate.edu.

Please welcome the following new employees:

John Crockett

John is a Research Associate III who joined CIRA in Silver Spring, Maryland, in July 2013. As a member of the NWS/MDL Decision Assistance Branch, John collaborates on the development of a suite of hydrometeorological decision assistance framework and tools implemented within NWS' AWIPS II. He will participate in a number of activities, including: a) streamlining the design of NCAR's AutoNowcaster (ANC) and updating and modifying the ANC system to perform under various climate regimes and b) porting and re-architecting existing MDL AWIPS II decision assistance tools to CAVE as well as architecting and developing new tools within CAVE. John will also participate in the development and enhancement of a Virtual Laboratory for the NWS as well as taking the lead on DAB's investigation into how to implement the NWS Weather-Ready Nation Roadmap's vision of an Impacts Catalog for helping make Impact-based Decision Support Services a reality. His supervisor is Cliff Matsumoto.

Heather Cronk

Heather is a Research Associate II who joined CIRA in Fort Collins in August 2013 to work with the CloudSat and CGAR groups. After graduating from CSU with a Masters in Atmospheric Science and working for four years as a NASA contractor in Washington, D.C., Heather returns to help CloudSat with system development and operational support. She also performs research with various global satellite water vapor and aerosol data sets for CGAR. Her supervisor is Phil Partain.

Rachel Knaff

Rachel is a Non-Student Hourly employee (Coordinator) who began to work with the RAMM Branch at CIRA in Fort Collins in September 2013. Among other tasks, she assists in archiving infrared and water vapor imagery associated with Atlantic and East Pacific tropical cyclones. Rachel is a junior at Rocky Mountain High School, where she plays trumpet in band and is active in the French Club. Jack Dostalek is her supervisor.

Jeff Lemke

Jeff is a Non-Student Hourly employee (Coordinator) who returned to work at CIRA in Fort Collins in August 2013. Jeff is a graphics artist who works with the National Park Service group on projects related to education outreach. He also works closely with researchers to help translate ideas into finished visual products. His supervisor is Jenny Hand.

Jason Santilli

Jason is a Non-Student Hourly Research Associate I (Research Assistant) who joined CIRA in Boulder in July 2013 to work with ESRL/GSD. Jason is currently enrolled at the Colorado School of Mines, majoring in Computer Science. He works with the Information Systems Branch to develop prototype gridded forecast monitoring and short- term forecast capabilities along with developing techniques to effectively use numerical forecast ensemble information in the forecast process. His supervisor is Jennifer Raab.

Wesley Smith

Wesley is a Non-Student Hourly Research Associate I (Research Assistant) who returned to work at CIRA in Boulder in late June 2013 for a summer job with ESRL/GSD. Wesley is in the midst of completing his Master's work at Willamette University in Computer Science. As part of the Forecast Applications Branch, Wesley will continue to work on his project that he began 2 years ago in the Hurricane Forecast Improvement Project (HFIP). He works on statistical post-processing for hurricane ensemble products in an effort to create and demonstrate an application to improve hurricane forecasting. His supervisor is Jennifer Raab.

Megan Troutman

Megan is a Non-Student Hourly employee (Coordinator) who began to work with the RAMM Branch at CIRA in Fort Collins in September 2013. Her work consists of monitoring the automated production of RAMMB products and assisting with the archiving of infrared and water vapor imagery associated with tropical cyclones in the Atlantic and East Pacific. A senior at Rocky Mountain High School, Megan plays saxophone in band and is the Editor-in-Chief of the school newspaper. Her supervisor is Jack Dostalek.

Please congratulate the following employees on their recent promotions/transitions:

David Baker

Dr. Baker was promoted to Research Scientist/Scholar III on July 1, 2013. He is the Lead Scientist for the CIRA OCO-2 team in Boulder and is responsible for the interactions between his team at CIRA and members of the Carbon Data Assimilation Program at GSFC. He also has established a cooperative research program with NOAA's ESRL in Boulder and conducts research into carbon data assimilation, including: a) leading a hierarchy of observation system simulation experiments (OSSEs) to assess the impact of OCO-2 data on attribution of sources and sinks of CO2; b) leading the development of assimilation techniques specifically for OCO-2 data; c) collaborating on the development of strategies for optimally selecting OCO-2 data for processing with OCO's full-physics retrieval algorithm; d) leading the development of methods to detect and correct satellite-based biased estimates of CO2; and e) collaborating with colleagues at GSFC and LSCE in France to develop global maps of sources and sinks of CO2 on a sixteen-day cycle.

Jennifer Hand

Dr. Hand was promoted to Research Scientist III in July 2013. Jenny leads a group at CIRA in Fort Collins which supports the National Park Service. She is the CIRA PI for the main NPS Cooperative Agreement, including interactions with the Night Sky program and web-based data support services—projects totaling $1.35M in total research volume over the past FY. She leads research in atmospheric chemistry and resultant visibility impact trends which are core to the NPS air quality mission. This past year she was appointed Vice-Chair of the AB6 visibility technical committee for the Air and Waste Management Association (AWMA). Responsibilities include organizing all manner of visibility sections for the AWMA annual meetings, as well as planning and convening the AWMA Visibility Specialty Conference that is held every 3-4 years. This high-profile activity is very prestigious for CSU/CIRA. In addition to these accomplishments, she supervises 8 CIRA employees and manages to maintain a highly productive publication record.

Lide Jiang

Dr. Jiang transitioned from Postdoctoral Fellow to Research Scientist II in July 2013. He works with the NOAA/NESDIS/STAR Ocean Color Team at CIRA in College Park, MD led by Dr. Menghua Wang, and is responsible for the expansion and maintenance of the NOAA-MSL12 processing system which is the main tool the team uses to process satellite ocean color data from Level-1B into Level-2 products including MODIS, VIIRS, and GOCI, as well as retrieving and archiving the VIIRS RDR, SDR, and ocean color EDR at near-real-time for VIIRS Cal/Val purposes. His major accomplishment includes the development of the team's ocean color global composite image website and automated the data retrievals, data processing (L1B->L2->L3), and image generation for the website. He also expanded the NOAA-MSL12 to include VIIRS and GOCI ocean color data processing, as well as adding new products such as photosynthetically available radiance (PAR) and ocean inherent optical properties (IOPs), and was continuously improving and refining the algorithms.

Jung-Eun (Esther) Kim

Dr. Kim transitioned into a Research Scientist/Scholar I position on July 1, 2013. Formerly a Postdoctoral Fellow, she works with the Non-Hydrostatic Icosahedral Model (NIM) development team at the NOAA ESRL/GSD at CIRA in Boulder. She has spent the past two years implementing the NIM physics packages. After implementing the GRIMs (which she had helped develop as part of her PhD dissertation with her advisor, Professor Hong, at Yonsei University in Korea) physics interface into the NIM modeling system, she successfully tested the dynamics and physics interactions with aqua-planet simulations for different cloud microphysics at various model resolutions. She is currently studying and exploring scientific aspects of various NIM physical processes for publication.

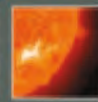
Tong Zhu

Dr. Zhu was promoted to Research Scientist III in July 2013. He originally joined CIRA as a Postdoctoral system simulation experiments, ATMS retrieval applications in tropical cyclones, and development of land surface emissivity models for the CRTM. Dr. Zhu has taken on management responsibilities for the GOES-R projects. In the past year he has prepared numerous proposals and soon will pursue JCSDA funding. His recent work on synthetic radiance simulation was published in *J. Geophys. Res., and a Geophys. Res. Lett.* article describes his ATMS/Tropical Cyclone work. Dr. Zhu's research contributions are key to addressing CIRA's Data Assimilation Theme.

Sirish Uprety is presented with this year's Research Initiative Award by Dr. Chris Kummerow.

Sher Schranz is recognized for her long list of outstanding accomplishments across a myriad of high-visibility programs and projects.






CIRA Vision and Mission

The Cooperative Institute for Research in the Atmosphere 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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