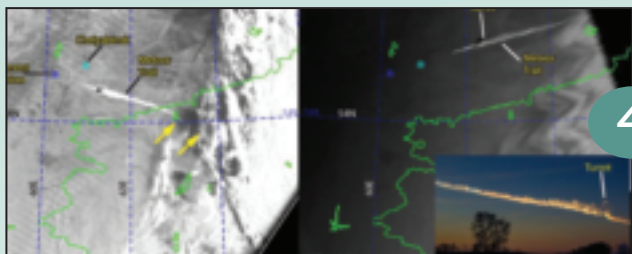


Russian Meteor Trail Captured by Weather Satellite

Feb 15 2013 ~0320 UTC Surface Photograph from Chelyabinski, Russia



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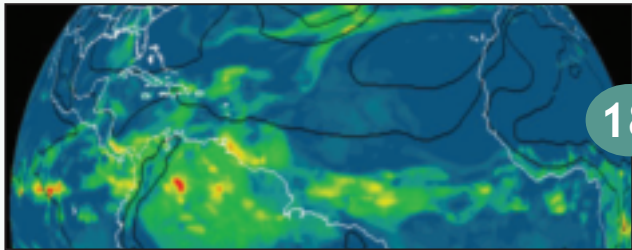
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CIRA Magazine Contributors:

Managing Editor: Mary McInnis-Efaw

Designer: Maureen Murray

Editor/Photographer: Matt Rogers

Story and Photo Credits:

Andy Jones/aWhere, Dan Vietor/Aviation-Weather.gov Website, NASA, NOAA, Phil Partain/Data Fusion, Steve Miller/Chelyabinsk Meteor, White House Photo Office



From the Director's Desk ...

Our last issue of the CIRA magazine, in October of 2013, appeared soon after devastating floods had hit the northern Front Range of Colorado and the government was shut down in a seemingly endless battle over spending limits, and the budget sequester was taking a toll on all government sponsored organizations including CIRA. Fortunately since then, a fairly normal winter has passed. March 2014 average maximum and minimum temperatures were both a bit above average ranking this the 26th warmest year out of the 126 year record we have at Colorado State University. Snowfall in the mountains has been plentiful and except for Southeast Colorado which continues to suffer from a persistent drought, things are returning to normal. Congress even managed to come to a budget agreement and funding for CIRA, while impacted, is back on a more even course.

I also reported in the last newsletter that we had recently had our 5 year review by NOAA and that the review panel had 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 had added value, not only to NOAA, but to other agencies and society at large. The final report has since been delivered and NOAA has formally recommended that the CIRA contract be extended for another 5 years. While the new proposal, which will run from July 1, 2014 through June 30, 2019, is not quite in place, we do expect that to be finalized any day now. NOAA is planning on implementing a new formula for general support of its Institutes. Under that formula we expect to get some additional funding primarily for education and societal applications – two areas that we are excited about expanding.

This issue highlights a number of activities that CIRA researchers and its partners have been involved with recently. The first story focuses on applications of CIRA datasets, in collaboration with private industry, to bring in situ precipitation to bear on agriculture in the developing world.

We then highlight work by Steve Miller, CIRA's Deputy Director, and his Incredible ability to jump on stories as they develop. One or two days after February 15 (2013) when a large meteor hit outside of Chelyabinsk Oblast, Steve was busy scouring all the CIRA satellite datasets for coincidence with that event. Sure enough, he found the DMSP-F16 satellite was over the area at just the right time to observe a cloud that formed in the wake of the meteor. This work was helpful in defining the trajectory of the meteor and received wide media attention.

The magazine also highlights work on arctic clouds done by one of our Research Scientists, Yoo-Jeong Noh, who was on sabbatical from May through December of last year as a Rossby Visiting Fellow at Stockholm University, followed by an article on the work CIRA researchers are doing to update the AviationWeather.gov site to help the aviation community with new tools. Even if you don't fly yourself, you should take a look at AviationWeather.gov to see what your colleagues are up to and where you are likely to encounter turbulence on your next flight. The final article deals with an important topic related to our computing infrastructure at CIRA and what we are doing to facilitate research in Data Fusion.

Let me end by congratulating Mark DeMaria, the former Branch Chief of NOAA's Regional and Mesoscale Meteorology Branch here at CIRA, for being a finalist in the prestigious Samuel J. Heyman Service to America medal that honors federal employees who have made a significant contribution to America. Congratulations to Mark and the other CIRA employees whose awards we highlight in this issue.

Chris Kummerow



CIRA-Derived Precipitation Data Gains Wider Availability Through Partnership

By: Matt Rogers and Andy Jones

High-technology solutions improving agricultural success and environmental health are no stranger to the developed world; satellite-derived maps of fields leading to optimal use of seeding and fertilization, GPS-driven combine harvesters, or accurate, customized databases of hydrology and soil composition are staples of modern agricultural production, while sophisticated scientific techniques are used to track invasive species and inform methods to combat the recent spread of infectious diseases such as pertussis.

Bringing the benefits of applied scientific data and technology to the developing world remains a challenge; a partnership between CIRA researchers and private industry looks to address this issue with the launch of a new product.

Specifically, precipitation data created by CIRA is being used commercially for the first time in a product developed by aWhere Inc., a Wheat Ridge, Colorado-based company. The product, the aWhere Location Intelligence Platform, offers interactive access to historical, daily-observed, and forecasted local weather data, which can be used by agri-services, private and public efforts, agricultural and health ministries, and international organizations to make decisions about global food security, vector born disease control, climate-smart agriculture, and address other challenges in developing countries.

The CIRA-developed precipitation product is based on a blended dataset of microwave observations from a constellation of polar-orbiting satellites, was licensed



through CSU Ventures, the technology commercialization office for CSU. The precipitation product creates a truly global view of precipitation, and enhances the value of aWhere's data provisioning services, which also distribute additional weather variables : temperature, humidity, solar radiation, wind speed, and calculated variables like growing-degree days.

A free version of the platform -- available with data from eastern, western, and southern Africa, south Asia, Central America, and Mexico -- allows users to interact with gridded data through maps, graphs, and analytic tools, all accessed by the public via the aWhere website.

"This represents a great opportunity to address many of the enormous challenges facing real people working in the field of global development," said Dr. Andrew Jones, a senior research scientist at CIRA.

"Being able to make these data readily available will help solve some of the world's most pressing development problems."

aWhere's CEO, Dr. John Corbett, said his company is thrilled to be providing access to this unique global weather resource through the aWhere Platform. "There is a tremendous and growing need for quality, localized precipitation data," he said. "This signals a significant advancement for the global development community."

Fire on High:

Satellite Perspectives on the **Chelyabinsk Meteor Event**

By Steve Miller and Matt Rogers

In the southern Ural mountains in western Russia, an unheralded event briefly lit up the sky during the morning of February 15th 2013. A large meteor, approximately 20 m in diameter, and weighing between 12,000-13,000 metric tons, entered the Earth's atmosphere at a speed of over sixty times the speed of sound over Chelyabinsk Oblast. Rivaling the 1908 Tunguska event, the resulting air burst from the meteor's fiery destruction, while not as powerful as the famed 1908 Tunguska air burst event, outstripped the earlier event in terms of damage done and injuries caused. More than 1,400 people were injured by the blast, and damage estimates exceeded 1 billion rubles (approximately \$33 million USD) including damaged schools and collapsed factories.

Air burst events due to meteors are somewhat common; including the Chelyabinsk and Tunguska events, some 28 air burst events have been documented since the mid-nineteenth century. What makes the Chelyabinsk event so notable was the proximity of the event to large centers of population, and perhaps more importantly, the prevalence of recording technology (such as webcams, automobile dashcams, and

mobile phone cameras) that provided the scientific community with a wealth of information to provide critical tracking information about the event. And, halfway around the world, in an office at CIRA, one more tool was being used to learn about this event; observations from meteorological satellites.

As often happens after a notable environmental event, CIRA received several press enquiries regarding the event. Eschewing the obvious joke that meteorologists don't actually study meteors, CIRA Deputy Director and research scientist Dr. Steve Miller checked to see if there



CIRA Deputy Director and research scientist Dr. Steve Miller checked to see if there were recent overpasses from one of the myriad platforms available to CIRA researchers. Sure enough, there was an overpass of the F-16 satellite from the Defense Meteorological Satellite Program (DMSP) over the region only a few minutes from impact.

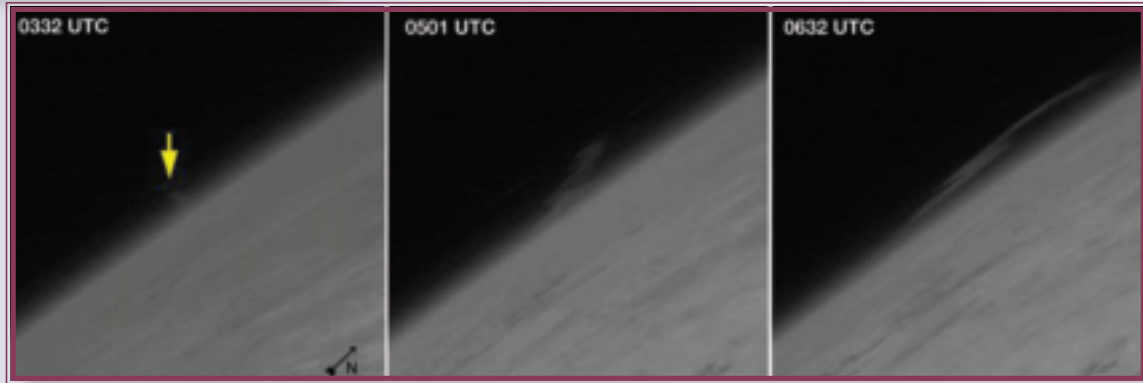
were recent overpasses from one of the myriad platforms available to CIRA researchers. Sure enough, there was an overpass of the F-16 satellite from the Defense Meteorological Satellite Program (DMSP) over the region only a few minutes from impact. Further investigation revealed that one of the Meteosat platforms also observed the event. These observations raised an important question – could Earth-observing meteorological satellites be used to provide tracking information for meteor events?

According to NASA scientists, approximately 95% of the so-called “doomsday” asteroids (the ones having the potential to extinguish all life on Earth) are tracked by observatories. However, there exist a far larger number of smaller (< 100 m, or about the size of a football field or less) objects that can destroy a large region (e.g., cities) if the circumstances of an object’s composition and trajectory permit. As mentioned, the Chelyabinsk meteoroid was about 20 m (or about the size of a two-story house), and a second asteroid that also made a close pass on the same day was about twice that size. It is estimated that only about half of one percent of these latter objects have been identified at this time, and they are not being tracked like the larger objects. Thus, the Earth is more or less blind to what remains a serious threat.





energy release and direction of travel. However, detailed information about the trajectory of the meteor, and its remnants after breaking up in the atmosphere, can only be determined from the surface in a very limited way - from line of site sensors (a radar network detected a smaller event previously, and of course the video documentation of the Chelyabinsk event). So, the satellites in this case provide a useful, complementary piece of information, which if generalized could provide tracking information for meteor events where surface networks of radar and/or population centers aren't prevalent.



Meteor trail over Russia as seen from the Japanese Multifunctional Transport Satellite (MTSAT) on 15 February 2013

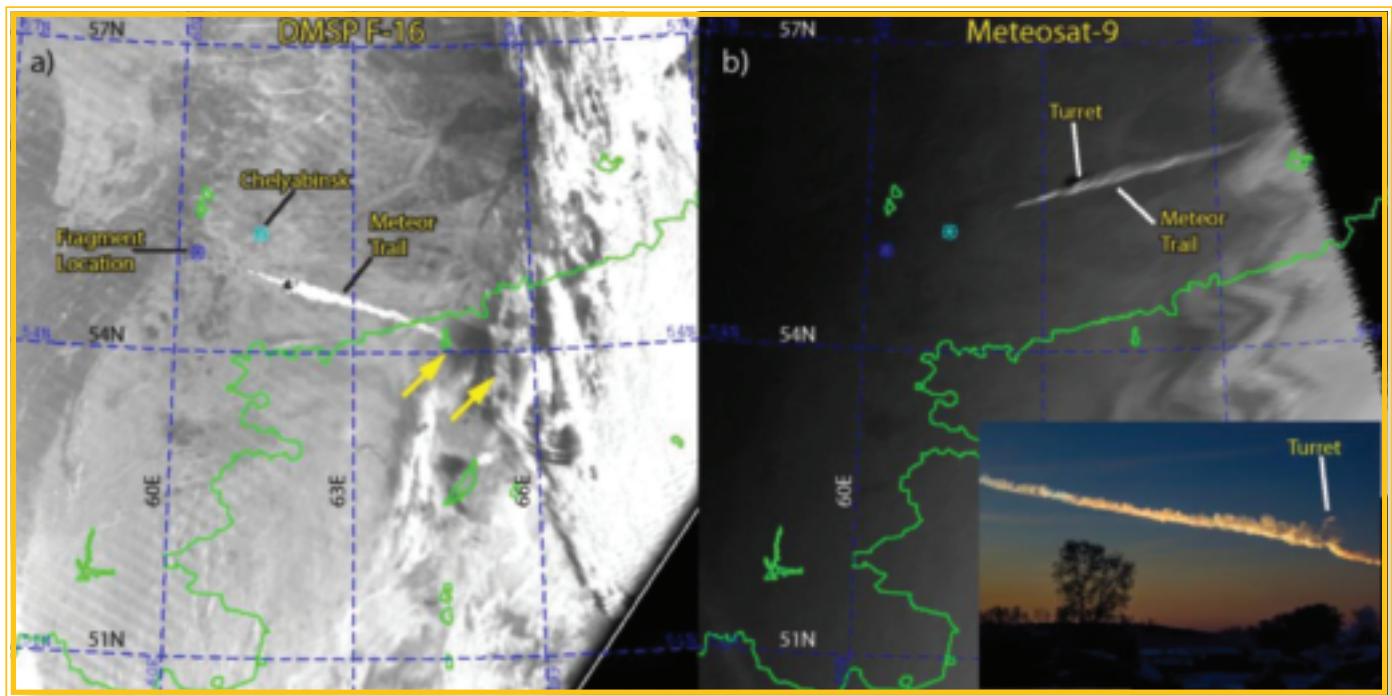
Earth-viewing environmental satellite sensors are, of course, primarily designed to measure things like cloud cover, aerosols, surface and atmospheric temperature and moisture, among other geophysical parameters. However, when a large object enters the atmosphere, the titanic forces resulting from the high-speed entry forms what is known as a superbolide (a meteor fireball,) these same satellite-based sensors are able to detect and map details of the debris trail left behind. This gives scientists important information that can be used to determine the original orbit of the body, as well as the break-up properties of the object (which give insight to its composition).

There are surface networks made up of infrasound sensors that are capable of detecting the occurrence of such impacts globally (through measure of pressure waves, which in the case of the Chelyabinsk event travelled around the world two times over), the approximate location, and a rough estimate of the

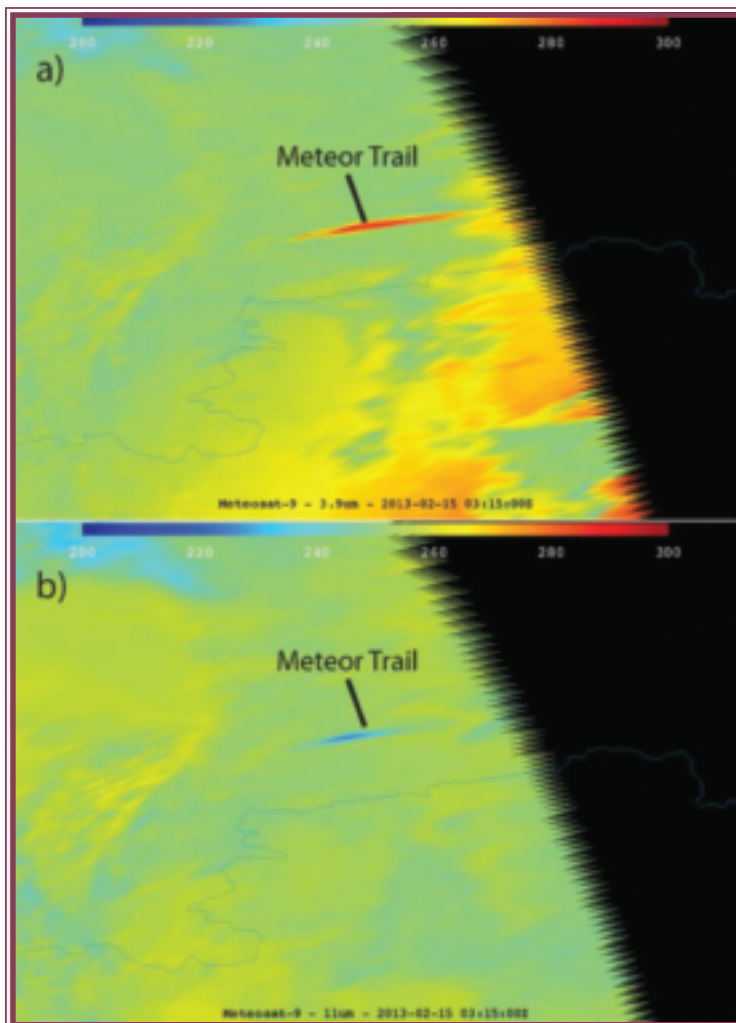
In the case of the Chelyabinsk event, there was, therefore, a compelling opportunity to develop a method to determine meteor tracks using satellite observations. Dr. Miller pulled the data from the F-16 DMSP satellite, which passed over just to the west of the area of the Chelyabinsk event. Looking closely at the data, an oddly straight cloud feature popped out that did not look like typical meteorological clouds. This feature turned out to be the meteor trail as seen from orbit, captured in real-time. By combining this observation with additional data from Meteosat-9, stationed to the southwest of the event, an additional twist in the story was observed: a major shift in the apparent debris trail orientation. Resulting from the well-known



Comparison of satellite and ground observed meteor tracks



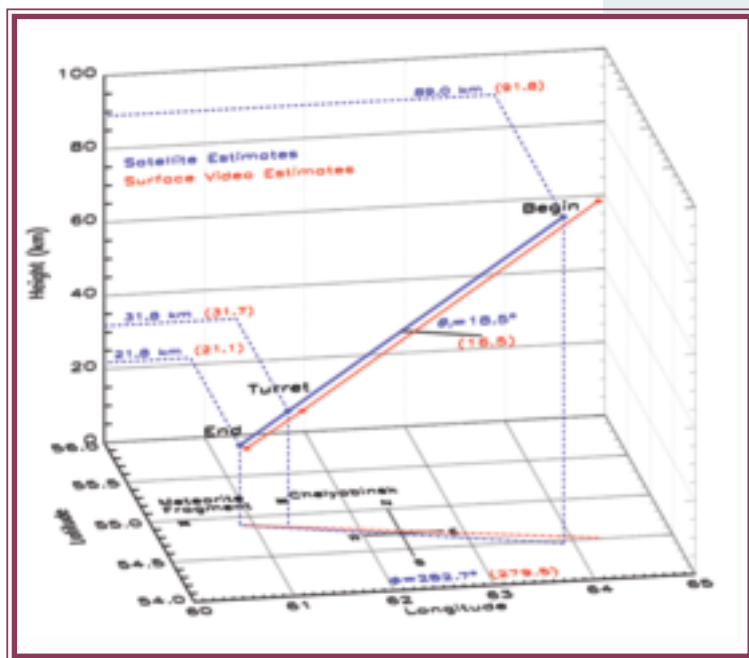
Comparison of views of meteor trail from DMSP F-16 (left), Meteosat-9 (right), and from the surface (inlay)



Meteor trail from Meteosat-9 in near- and thermal infrared

parallax effect, which results in apparent shifts in position when viewing any object from high altitude and strongly oblique angles, this shift in the trail's orientation suggested the use of triangulation, using the known geometry of the observing satellites position over the Earth, to provide an accurate estimate of the meteor's path, which could be compared to the surface-observed track from ground observers near Chelyabinsk.

The results of this work, which were published in the *Proceedings of the National Academies of Science* last fall, showed the potential utility of Earth-observing satellites as a valuable tool in tracking meteors. For the Chelyabinsk event, the satellite-derived meteor track pointed to an impact consistent with an impact on Lake Chebarkul, where a large fragment of the Chelyabinsk meteor was ultimately pulled from the water of the lake, lending credence to the technique.



Comparison of surface-based and satellite-based estimates of the Chelyabinsk meteor track.

Perhaps more importantly, working backwards from satellite-derived observations, meteors could lead to the early detection of potentially catastrophic encounters with near-Earth objects. With the potential advent of satellite platforms dedicated to the task of detecting and tracking near-Earth objects, including the smaller (yet still hazardous) objects like the Chelyabinsk meteor, given sufficient lead time, a space-based deflection system could provide minor deflection to an object's orbit, which would in most cases be sufficient to steer it on a course away from collision with Earth. Without early detection capabilities, that same deflection, now at a closer range, would require much more drastic measures – measures that might not be possible, in fact.

It's important to remember that Earth-observing satellites are not specifically designed, much less optimized, for monitoring meteor events, and it's too early to claim that Earth-observing satellites can be used operationally for meteor monitoring. For the Chelyabinsk

event, circumstances were fortuitous in that there were two satellites (DMSP F-16 and Meteosat-9) in position to observe the meteor trail, providing the necessary dual-view of the trail required for triangulation. There is a strong case, however, in looking at a 'top-down' approach, and the observation of the Chelyabinsk event from satellites perhaps offers a way forward for future satellite projects.

And perhaps most importantly, as with all scientific discoveries, there are new opportunities to collaborate with new colleagues – the capabilities of Earth-observing satellites and the vast knowledge base that has been developed in forty years of research using these tools brings new information to the field of meteor observations and near-Earth astronomy. In the course of his project, Dr. Miller and his team made new research contacts, and formed new collaborative paths for CIRA research to contribute to and benefit from. "I believe that some of the most innovative advances (and interesting results) stem from such interactions" said Dr. Miller, of his collaboration on this project, "I envision working with some of the new contacts I have made on studies related to characterization of the debris trail itself, using multispectral information to help determine details of its composition, the behavior of the objects ablation and fragmentation upon entry, and potentially examining other previous and less significant cases known by members of this community that satellite assets may have also captured. If these satellites do provide additional and useful information then there is no reason why we shouldn't try to take advantage of this whenever we can."

CIRA Abroad –

By: Matt Rogers

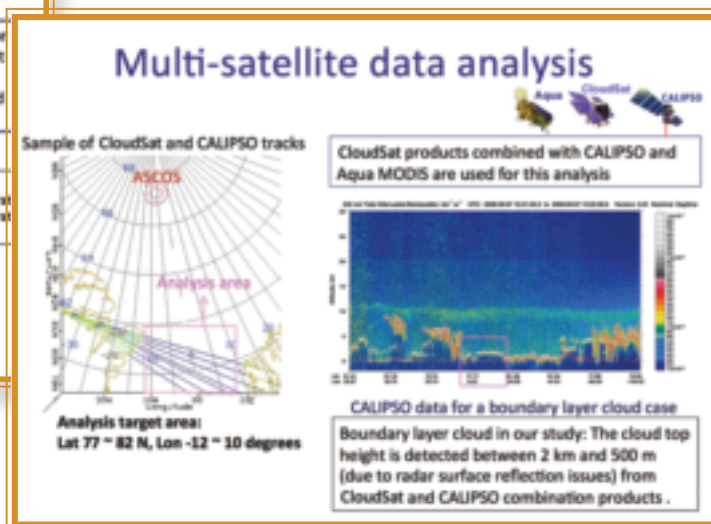
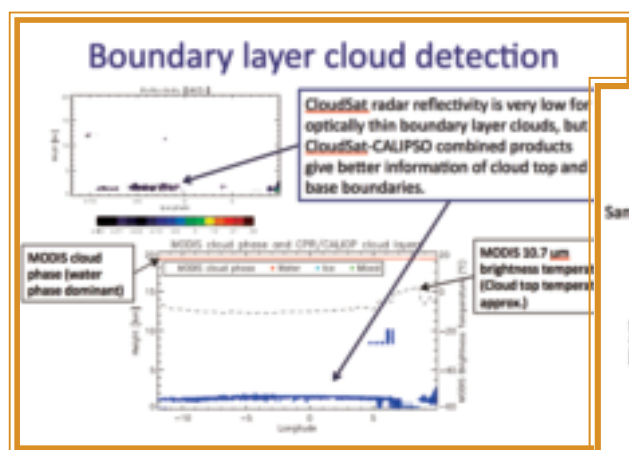
A Unique Opportunity for a Scientific Sabbatical

Working at the Foothills Campus of Colorado State University has a certain charm - the natural backdrop of the foothills brings a scenic beauty to the workday, punctuated by the occasional windstorm or wildlife encounter just to keep things lively. And certainly, working at CIRA isn't without its benefits; a diverse background of compelling research problems being solved in a professional, yet laid-back, work atmosphere is the ideal job description for just about any career. But even when you work at a place like CIRA, there are always benefits, both intellectually and professionally, for getting out of the office and experiencing new locales, new workplaces, and new ideas, which is why sabbaticals are so valuable for researchers and other professionals.

CIRA researcher **Dr. Yoo-Jeong Noh** recently took advantage of just such an opportunity. From May through December of 2013, YJ (as she's affectionately known around the office) traveled to Stockholm, Sweden as a Rossby Visiting Fellow at Stockholm University. Over the eight months of her visit, she made important new connections, brought some of CIRA's expertise to new audiences, and took advantage of opportunities to recreate in one of Europe's finest cities.

Established in 1878, Stockholm University is one of Scandinavia's largest universities. With a student population of over 66,000, the University focuses on two primary fields – natural sciences and social sciences and the humanities. The meteorological program at Stockholm University was pioneered by none other than the great Carl-Gustaf Rossby who, in 1947, emigrated from the United States to bolster the newly






Some of the work performed while on sabbatical with partners at Stockholm University

created Department of Meteorology (MISU.) In 1955, Rossby created the International Meteorological Institute (IMI), an independent institute within MISU, and which also hosts the editorial office of the scientific journal *Tellus*. The visitors' program at MISU has both short- and long-term opportunities for scientific visitors, with the long-term opportunity represented as the Rossby Visiting Fellowship, named after the noted scientist and prominent figure at Stockholm University.

The Rossby Visiting Fellowship at Stockholm University, which YJ was honored to receive, is supported in part by IMI, and accommodation, travel costs, and a stipend to cover living expenses for scientific visitors. Application for the fellowship requires a CV, a cover letter describing the kind of research the applicant wishes to accomplish during the tenure of the fellowship, and which also describes the contribution the applicant will make to the program at MISU and IMI. Opportunities are announced online and through EOS, the publication of the American Geophysical Union, and are typically due prior to 30 September of every year. YJ, who found this opportunity through EOS, applied to the program and was invited to join as a Rossby Visiting Fellow by IMI Director Dr. Michael Tjernström, working with a faculty hosting team of Drs. Gunilla Svenson, Annica Ekman, and Frida Bender.

Naturally, a visiting scientific fellowship involves more than simply packing up your code and catching a flight – relocating to a different continent, dealing with a new language, and the other details of life that accompany a move come into play. Fortunately for YJ, the program at Stockholm University made these details simple enough, including applications for a resident permit to live and work in Sweden, which required a trip to the Swedish Embassy in Washington, D.C. for biometric data capture. The program also provides a small apartment in Stockholm and a small (and cute!) office with a desktop computer within MISU. For YJ's program, she interacted with the Bolin Centre for Climate Research and the Swedish Meteorological and Hydrological Institute.

Life in Stockholm is a little different than here in Fort Collins – during the Swedish summer, for example, the sun doesn't set until around 11:30pm, giving 19-hour-long days to enjoy and explore Scandinavia. The opposite is true in winter, navigating the city by streetlights in the mid-afternoon. Many notable sites in Stockholm proper are easily accessed, including Stockholm's famous Old Town and City Hall, as well as the Nobel Museum, where annually the King of Sweden awards the world's best and brightest the Nobel Prize. Public



transportation, as is true throughout much of Europe, provides easy access to nearby cities, including Oslo, Norway and Copenhagen, Denmark via rail, or ferry cruises across the Baltic Sea to Helsinki Finland or the old port city of Tallinn, Estonia, makes for interesting weekend excursions. Swedish traditions, including an official weekly coffee klatsch (called Fika in Sweden) and a uniquely Swedish employee appreciation lunch celebrated near Christmas, round out the experience of living and working abroad.

Of course, it's not all charming old cities and novel travel experiences – as with all scientific positions, real and valuable research is expected to be performed. During the tenure of her Rossby Visiting Fellowship, YJ was pleased to work on two projects related to summertime mixed-phase Arctic clouds using CloudSat and CALIPSO data in collaboration with a number of Swedish partners, as well as executing research on cloud-aerosol interaction over the Maldives as part of the CARDEX field campaign, using data from CALIPSO and COMS. Her research in these areas opened new lines of collaboration for CIRA to engage in, and is contributing to several publications and presentations, including talks at this year's AMS Annual Meeting and the EUMETSAT Meteorological Conference, to be held this September in Geneva, Switzerland.

In addition to her collaboration in IMI- and MISU-proposed research, YJ offered her considerable expertise on behalf of CIRA to her program at Stockholm University, including presenting two talks at MISU seminars and IMI board meetings. She also provided expertise in CloudSat, CALIPSO, and MODIS data processing to an audience of Swedish scientists more used to dealing with model data, enriching their capabilities to perform cutting-edge research. Additionally, Dr. Noh helped supervise a visiting

master's student from India on a summer research project looking at radiative forcing issues related to dust over the Arabian Sea using MODIS and SBDART data.

When she had time away from her valuable contributions to the program at Stockholm University, of course, YJ was able to take advantage of the short flights from Stockholm to the capitals of Europe for brief visits. Among her journeys, YJ was privileged to visit the Deutsches Museum in Munich, Germany, including the satellite history section containing models of early Earth-observing satellites; a trip to the world-famous Blue Mosque in Istanbul, Turkey, and a memorable visit with her mother shopping in London, England. YJ also made visits to Paris, Barcelona, and Croatia, where she visited the coastline of the Adriatic near Dubrovnik.

YJ returned from her fellowship last December, and we're happy to have her back in the comfortable surroundings of CIRA. We are, however, very lucky to follow up on the many collaborative efforts she established with our new partners in Stockholm, and will benefit from the increased visibility CIRA gains from these visits. Perhaps most importantly, some of the wonderful byproducts of working here in our Foothills Campus was brought by YJ to a new place, and a complementary set of byproducts from YJ's hosts in Stockholm was brought back here, to the advantage of both of our institutions.



The New AviationWeather.gov Website

A GeoSpatial Approach to accessing Aviation Weather Data

By Dan Vietor, CIRA Research Associate
NWS Aviation Weather Center

In March 2014, an updated AviationWeather.gov website will be launched. This will offer a new layout and many new tools to help the aviation community.

Background

The first AviationWeather.gov website was launched over a decade ago based heavily on NCAR's Aviation Digital Data Service (ADDs) product. ADDs created graphics to display weather data but also allowed the user to access the raw data needed for flight planning. ADDs then added interactive tools written in Java that allowed users to query data displayed on a map.

With the release of Java version 7, the Java applets became unstable, especially on older platforms such as Windows XP. Many users who relied on the Java interactive tools now found themselves looking for alternatives. Add to this that Java can't run on a mobile device and it was clear new tools had to be developed to replace the Java applets.

In the fall of 2012, the National Weather Service released its new agency-wide website (weather.gov) with a new layout and a new approach to accessing data which provided technical opportunities not available with the original implementation. (See **Figure 1**) Moving the AviationWeather website to the new layout allowed the site to be redesigned and many other aspects of the website to be upgraded.

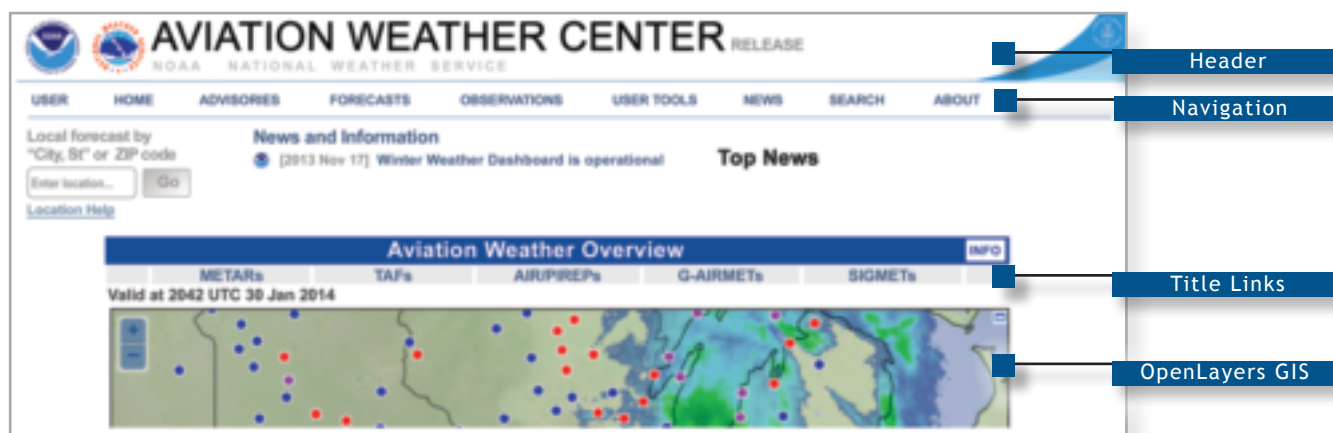


Figure 1. New AviationWeather Website

Replacement of the Java applets

The initial priority was to find a replacement technology for the Java applets. Several technologies were discussed such as the ADDs Flight Path Tool, Google Maps and OpenLayers.



Even though the Flight Path Tool had been immune to the Java 7 issues the applets had, it fell victim to the many security issues in Java 7, forcing many institutions to limit or totally disable the use of Java on desktop computers.

Google Maps was investigated but its API was found to not be flexible enough to display all the data needed on the website without relying on Google to do data transformations. KML has limited formatting capabilities. Plus, the background maps were too cluttered with geopolitical labels to clearly display weather data.

OpenLayers, a JavaScript API which runs on the browser gave access to the data with the formatting and styling needed to replace the functionality of the applets. Plus it offered direct access to a variety of common GeoSpatial services such as Web Mapping Service (WMS) for providing access to backgrounds, maps and other imagery as well as Geography Markup Language (GML) and GeoJSON for point and polygon data.

OpenLayers, the Approach

There were three main issues that needed to be resolved before OpenLayers could start displaying data. First, was the choice of background maps. As mentioned, the Google Maps backgrounds were too cluttered with labels to be useful on a weather display. As a result, GeoTIFF background maps based on NASA Blue Marble imagery were created, one dark and one light. The light image emulated the Google satellite and terrain views. Also, basic

map overlays were created by converting simple map data to ESRI shapefile format. The map overlays were not too detailed to obscure the data. These could be rendered by a mapserver and imported as WMS layers into OpenLayers.

Second, there was the rendering of point data such as surface observations and aviation related weather symbols. A Truetype font had been created within NWS for some weather symbols such as wind barbs, cloud coverage and some weather symbols (rain, snow, thunderstorms). But this font was incomplete for this effort and needed to be extended and cleaned up before it could be used. The PHP GD extension allowed for the generation of weather icons and station model (full data plot with temperature, winds, cloud cover, weather, etc) icons as PNG files. The anti-aliasing of the fonts produced more readable text than the applets produced. These icons could be rendered from style parameters within the vector layers of OpenLayers, resulting in customized icons for each observation.

Third, was the need for a quick, bandwidth efficient means to get the data to the client. XML formats were discussed but they were bandwidth intensive and required too much post-processing on the client to be used. OpenLayers offers another approach using GeoJSON. JSON is a native way to serialize Javascript objects for transmission to clients. GeoJSON can be interpreted directly by OpenLayers with virtually no overhead and requires much less bandwidth for transmission.

Development began on creating GeoJSON output services from the data in the ADDS database. The GeoJSON scripts did minimal post processing of the data preserving the reliability of the ADDS data processing. This is critical for safety and risk mitigation.

While writing the OpenLayers clients, it became clear that for efficiency, the clients needed a single payload with all the data needed to display within the vector layers. This meant reformatting location (point, linestring, polygon) data to meet the GeoJSON standard, adding in all data needed for a pop-up display such as station name, raw and decoded data seen in **Figure 2**. Therefore, the scripts had to access data from multiple database tables to create the proper output to minimize the processing on the client.



Figure 2. METAR Pop-up window in new AviationWeather Website

By the summer of 2013, the OpenLayers clients were ready for production. There was one for METARs (surface observations), TAFs (airport aviation forecasts) and PIREPs (pilot reports). Work continued on several more displays including aviation warning (SIGMET) and advisory (AIRMET) polygons which will be released with the new website.

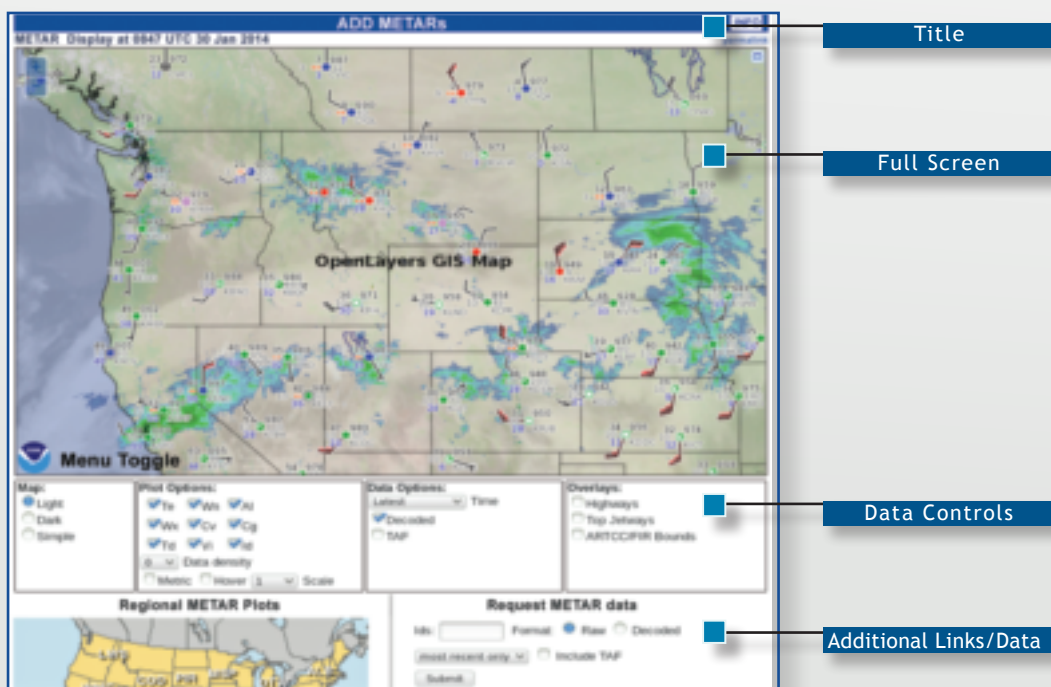


Figure 3. OpenLayers GIS map with weather information overlay

A byproduct of the OpenLayers API is to leverage the whole ADDS database which is global in nature. The Aviation Weather Center has been a global forecasting entity since its inception but the website



lacked the same global reach. OpenLayers now frees the website of its contiguous US restrictions. **Figure 3** shows weather overlays and menu options on the new website.

Finishing the New Website

Although the new OpenLayers displays were released to production, additional work was done to make the displays work with the new website. The new weather.gov layout expanded the page width from 680 pixels to 980 pixels which worked better with the OpenLayers displays. An 800 pixel wide display was needed to display a contiguous US view. This with the wider layout allowed for white space on each side of the display which is critical for web page navigation on mobile browsers.

The settings for each client are saved in browser cookies so that user preferences, such as map locations and enabled options, can be restored when the user navigates back to the page or refreshes it. Additionally, all the options have URL parameters so a particular display can be rendered from the address bar on the browser and bookmarked for future use. Permalinks are offered on some pages as well.

The website redesign was more comprehensive than the OpenLayers displays. Most of the underlying functionality was rewritten to adhere to a Model View Controller (MVC) web design allowing for reusable code and functionality throughout the website. Also, a strict layout format is used on all pages to make sure the user experience is consistent across the



website. Finally, the new layout was designed for the mobile user since the FAA has approved pilot's use of iPads for the display of aviation information. The goal was to make sure those using an iPad had the same user experience as desktop users.

Rollout and User Reaction

The initial prototype was rolled out for the Oshkosh EAA Air Show in late July 2013. Many of the pilots visiting the booth carried their iPads with them. The new mobile support allowed the users to view the website with all its new features right there at the show. The response was very positive and the reviews from the pilots guided the prototype upgrades in the following months. User reaction has continued to be positive as the March 2014 rollout approaches.

This has been a very interactive process with end users guiding much of the feature development. The AviationWeather website now has a foundation that will allow it to successfully evolve as new GeoSpatial tools and data become available. Adopting a new framework using OpenLayers has proved a substantial move forward for the AviationWeather website and the users of aviation weather data.

NOAA's Mark DeMaria

White House visit with President

By: Matt Rogers



Mark DeMaria, a renowned expert and pioneer in hurricane research and prediction with NOAA's National Hurricane Center in Miami, FL, met with President Barack Obama at the White House on Wednesday, October 23.

DeMaria, a long-time friend of CSU as both an alumnus of the Department of Atmospheric Science and formerly Branch Chief of the Regional and Mesoscale Meteorology Branch collocated at CIRA, was joined by 27 winners and finalists of the 2013 Samuel J. Heyman Service to America Medals. These award, affectionately known as Sammys, honor federal employees who have made significant contributions to America.

Honorees are chosen based on their commitment and innovation, as well as the impact of their work on addressing the needs of the nation.

DeMaria was named a finalist for his work in developing several hurricane and wind-speed prediction models. NOAA's National Hurricane Center uses these models to track tropical cyclone activity.



President Barack Obama with the 2013 Samuel J. Heyman Service to America Medal Winners. (Image courtesy of the White House Photo Office. This photo does not suggest approval or endorsement of the President, the First Family, or the White House.)

"Meeting the president was great," said DeMaria, a finalist for the award. "Although it was pretty brief, he talked with us as a group and individually and asked each of us what our award was for and shook our hands one by one."

Recognized as one of the top scientists in storm prediction, DeMaria created models to better forecast the path and intensity of hurricanes during the past 30 years that have helped emergency managers make critical decisions about evacuations and first responders prepare for the severe storms, saving lives, homes and businesses.

Some of DeMaria's forecast model advancements, for example, were used last year during Hurricane Sandy, providing information about the locations that would experience hurricane or gale force winds and when the hurricane would make landfall.

His other models help meteorologists understand how hurricanes decay after land-fall and help them forecast a storm's rapid intensification. DeMaria also has made heavy use of satellite data and analyses of lightning and oceanic heat content, to improve hurricane intensity forecasts.

Currently, Dr. DeMaria is working on the next-generation GOES-R geostationary lightning mapper, which aims to quantify what lightning can tell us about storm intensification, and the Hurricane Forecast Improvement Project, which seeks to further improve hurricane forecasting.



President Barack Obama meets with Mark DeMaria in the East Room of the White House. (Image courtesy of the White House Photo Office. This photo does not suggest approval or endorsement of the President, the First Family, or the White House.)



President Barack Obama meets with the 2013 Samuel J. Heyman Service to America Medal winners. (Image courtesy of the White House Photo Office. This photo does not suggest approval or endorsement of the President, the First Family, or the White House.)

Data Fusion:

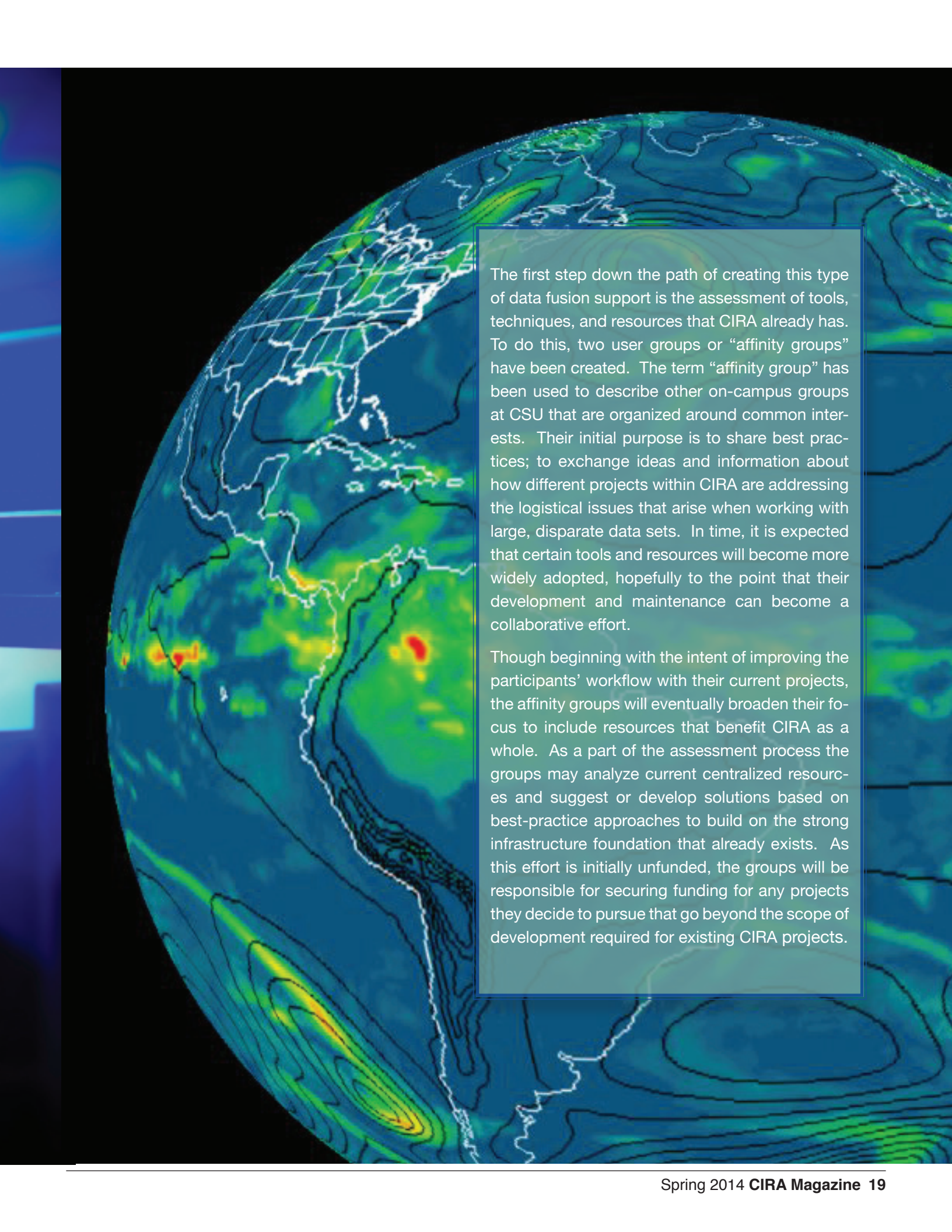
By Phil Partain and Matt Rogers

CIRA is an organization consisting of scientists who are experts in satellite and model data fusion for atmospheric research. Most of the projects initiated at CIRA use data fusion techniques of some sort to achieve project goals by integrating multiple input data sources and scientific knowledge in a manner that serves to create a more complete representation and analysis of atmospheric or environmental phenomena. As described in a Wikipedia article on Data Science (http://en.wikipedia.org/wiki/Data_science), success in this type of activity is related to the scientist's ability to:

- **discover and interpret data,**
- **manage large amounts of data,**
- **merge data sources together,**
- **ensure consistency of data sets,**
- **create visualizations to aid in understanding the data,**
- **build mathematical models using the data,**
- **and communicate findings to a varied audience.**

The Intersection of Science and the Data System

Applications such as those being developed by CIRA scientists increasingly require that data sources be merged to optimize their utility. To foster data fusion activities at an organizational level, emphasis has been placed on enabling tools and technologies to address the mechanics of the data fusion process which will lead to improved capabilities and efficiencies.



The first step down the path of creating this type of data fusion support is the assessment of tools, techniques, and resources that CIRA already has. To do this, two user groups or “affinity groups” have been created. The term “affinity group” has been used to describe other on-campus groups at CSU that are organized around common interests. Their initial purpose is to share best practices; to exchange ideas and information about how different projects within CIRA are addressing the logistical issues that arise when working with large, disparate data sets. In time, it is expected that certain tools and resources will become more widely adopted, hopefully to the point that their development and maintenance can become a collaborative effort.

Though beginning with the intent of improving the participants’ workflow with their current projects, the affinity groups will eventually broaden their focus to include resources that benefit CIRA as a whole. As a part of the assessment process the groups may analyze current centralized resources and suggest or develop solutions based on best-practice approaches to build on the strong infrastructure foundation that already exists. As this effort is initially unfunded, the groups will be responsible for securing funding for any projects they decide to pursue that go beyond the scope of development required for existing CIRA projects.

The first affinity group will **focus on data inventory and storage** in an effort to enhance the scientist's ability to discover, access, store, manage, and distribute the data sets that they need or produce. Specifically, the group will:

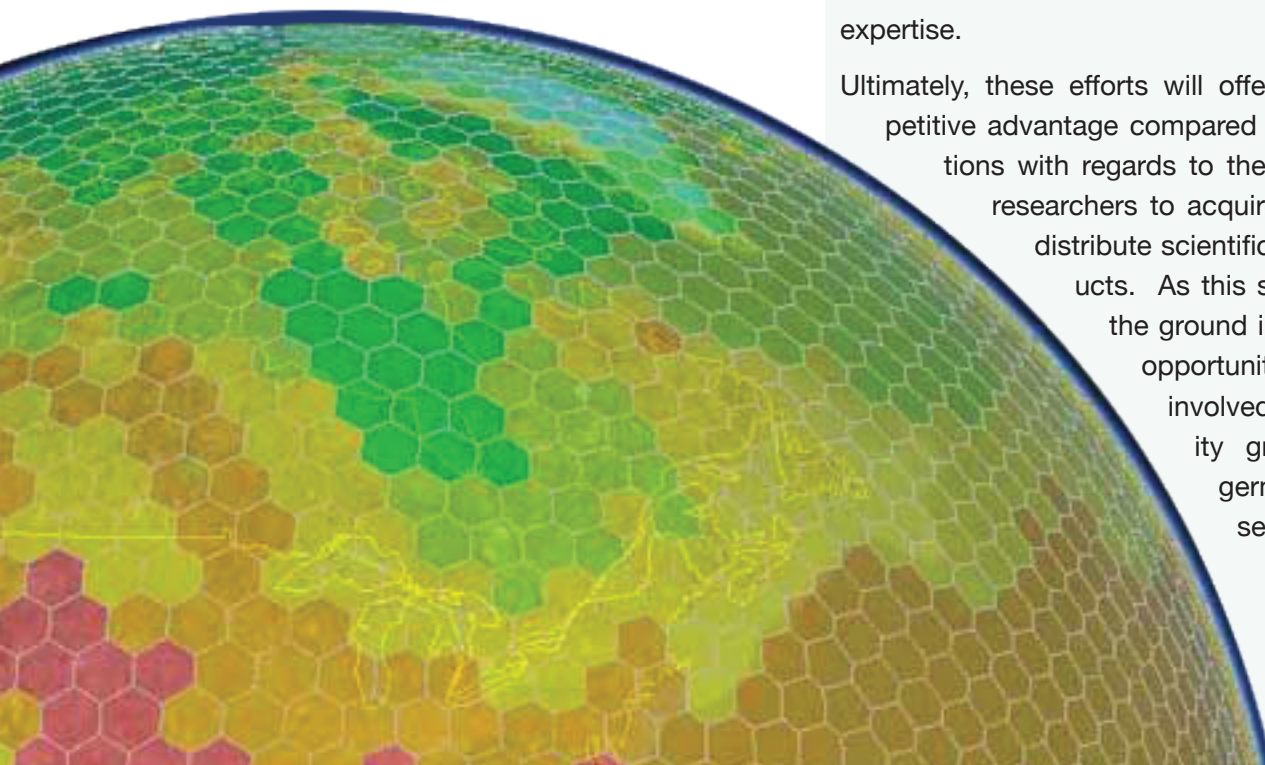
- Document current publicly available CIRA data holdings and make the information and access methods available to other researchers.
- Assess the current data storage hardware and software solutions used by individual projects.
- Assess the feasibility of the development and operation of a formal central data inventory and documentation resource.
- Summarize the current and possible use cases and capabilities for shared CIRA data storage.


The second affinity group will **focus on software tools that aid in reading, manipulating, merging, processing, and visualizing** the wide variety of data that CIRA scientists use. This group will:

- Exchange information about methods and tools they use to work with data.
- Collect software applications from willing contributors and make them available in a central repository.
- Collaborate on the maintenance or development of existing common tools and new tools to fill recognized needs.

These efforts will improve the scientist's data fusion-related workflow and will heavily leverage existing CIRA knowledge and resources with investigations into new technologies when deemed appropriate by the affinity groups. And although this will provide a more robust infrastructure of tools, methods, and resources, the choices involved in intelligently interpreting, merging, and applying scientific transformations to data sets of interest remains within the scientist's realm of expertise.

Ultimately, these efforts will offer CIRA a competitive advantage compared to other institutions with regards to the ability of CIRA researchers to acquire, process, and distribute scientific research products. As this strategy gets off the ground in 2014, look for opportunities to become involved with the affinity groups in areas germane to your research projects.





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COMMUNIQUE

Dr. Sandy MacDonald named AMS President-Elect

CIRA Executive Board Member Dr. Alexander E. “Sandy” MacDonald, who serves as the Chief Science Advisor for NOAA and Director of the Earth Systems Research Lab in Boulder, was announced as the American Meteorological Society (AMS) President-elect. Dr. MacDonald’s selection to lead the Nation’s principal scientific society promoting the advancement of atmospheric and related sciences, technologies, applications and services recognizes his preeminent scientific accomplishments, visionary nature, and reflects the high esteem held for him by his scientific colleagues.

Robert S. Detrick, Assistant Administrator of NOAA’s Office of Oceanic and Atmospheric Research noted: “Our participation in and leadership of the professional scientific societies which represent our scientists and our scientific endeavors is crucial to NOAA’s reputation as a preeminent science-based mission agency. I offer my deepest thanks and appreciation to all of you who expand the reach of our science and leadership through your participation on scientific society committees and boards, as well as editing journals and organizing meetings.”

GSD Team Member of the Month

Jebb Stewart, a CIRA Research Associate in Boulder, was designated as GSD’s Employee of the Month for December 2013. He received this in recognition for a number of outstanding efforts in assisting GSD and the Technology Outreach Branch throughout the year.

1) ***HIWPP - High Impact Weather Prediction Project***

The HIWPP Project manager was in the process of hiring a project manager and Test Program lead when the HIWPP Project Plan was due to OAR. As this hire was not completed before the Plan due date, Jebb stepped in to develop the HIWPP project plans for both the NEIS - (NOAA Environmental Information System), and the Test Program. NEIS and the Test Program are important and integral components of the HIWPP project. Jebb successfully worked with many groups in ESRL and other NOAA labs to develop the needed project plans and the budgets.

Jebb has done an excellent job leading the NEIS development since its inception. He has led a diverse team of researchers from groups across GSD to produce a system that has been demonstrated to groups around the country. NEIS has received funding from outside agencies and NOAA to continue developing this geophysical data delivery, analysis and display system.

2) **SOS – Science On a Sphere Program**

Jebb has made substantial contributions to the SOS program during the past year. He has developed KLM and WMS software that enhances the overall SOS activity. He has also provided excellent customer support, answering specific questions that have arisen at customer sites, to get the SOS systems back up and running smoothly.

Please welcome the following new employees:

Zach Blitstein is a Student Hourly Employee (General Labor I) who joined CIRA in Fort Collins in August 2013. A third year CSU Sports and Health Science student from Buena Vista, he supports CIRA's Facilities Manager, Marilyn Watson. Zach helps to monitor indoor temperatures, maintains potted plants and flowers, weeds and prunes CIRA's garden area, moves furniture and assists inventory and surplus processes. He also and hauls furniture, removes, installs, organizes, lifts, troubleshoots, photographs, and maintains data.

David Draucker is a Non-Student Hourly employee (Coordinator) who joined CIRA in Fort Collins in October 2013 to work on the CIRA website. David is currently enrolled at Front Range Community College where he pursues a Computer Information System degree specializing in Linux Administration. His role is to assist with the redesign of the CIRA website. His supervisor is Rob Viola.

Chad Hill is a Research Associate IV who joined CIRA at the Aviation Weather Center in Kansas City in September 2013. He is responsible for leading the system engineering team, which supports Aviation Weather Center forecasters and research scientists. This team plays a significant role in applied research for aviation weather forecasting and aviation hazards training. Chad's group also supports the development, testing and evaluation of NextGen web services and decision support systems, and supports forecasters with a 24x7, U.S. and international aviation weather mission. The group is also essential to the integration of aviation decision support tools and aviation weather hazards science algorithms into the operational forecasting system. Chad comes to CIRA from a previous position as a contractor with the National Weather Service. His supervisor is Sher Schranz.

Jeremy Kerr is a Non-Student Hourly employee (Intern) who joined CIRA in Boulder in October 2013 to work with ESRL/GSD. Jeremy 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.

Vincent Larson is a part-time Research Scientist III who re-joined CIRA in Fort Collins in May 2013. Following his PhD at MIT, Dr. Larson spent 2 years at CIRA as a postdoctoral fellow and worked with Professors Vonder Haar and Cotton on mesoscale modeling of clouds and related observations of mixed phase clouds. Since that time he has been a Professor of Atmospheric Science in the Department of Mathematical Sciences at the University of Wisconsin – Milwaukee. Dr. Larson continues his collaboration with numerous scientists at CIRA and the Center for Geosciences. His supervisor is Professor Tom Vonder Haar.

Chunchun Meng joined CIRA in Fort Collins as a Visiting Researcher (Guest Associate) in October 2013. She is a 3rd year PhD student who majors in Boundary Layer Meteorology at the Chinese Academy of Sciences and works on Regional Climate Modeling System (RAMS). She integrates several versions of numerical models with remote sensing data and explores the sensitivity of regional climate to changes of land cover and trace gas concentrations. Her supervisor is Lixin Lu.

Lee Powell is a Coordinator who joined CIRA at the Aviation Weather Center in Kansas City, MO in November 2013. As a member of the Aviation Weather Testbed (AWT) and as a part of the NWS Aviation Weather Center's (AWC) Systems Engineering Team, Lee contributes to the development and transition of modern IT products and services and standards-based infrastructure at the Center. He supports the AWC/AWT involvement in NextGen, enabling AWC products for the 4D Weather Cube and providing data support for the AWT. Among a host of other activities, Lee contributes to R&D of hosting the NextGen 4D Cube servers inside their Consolidated Aviation Weather Services, provide support for continuous NOAA Net connectivity with sufficient bandwidth for required data flows, and implement AWC IT architecture plans. His supervisor is Chad Hill.

Bonny Strong is a Research Associate IV who joined CIRA in Boulder in November 2013. Working out of the Office of the Director for the Global Systems Division, Bonny provides overall technical management for the new High Impact Weather Prediction Pilot Project (HIWPPP). The objective of the HIWPPP is to implement a system architecture to facilitate the development of next-generation

research-grade global weather forecast models, collect those model outputs produced on an ongoing basis from supercomputing facilities across the Nation, build systems to post-process those models into model output and products, and deliver those products to users for visualizing global weather information. Bonny provides project management, technical coordination, technical review and analysis, project reporting, and issue assessment, and she also recommends solutions for the technical infrastructure element of this project. Her supervisor is Cliff Matsumoto.

Hongli Wang is a Research Scientist I who joined CIRA in Boulder in October 2013. As a member of the Global Systems Division's Forecast Applications Branch, he contributes to FAB's research and development objectives in a number of areas, including a) OSSE experiments related to observations made from UAS and other platforms; b) OSSE-related research in generating synthetic observations, calibration, and other components; c) R&D related to adaptive observation schemes; and d) assessment of analysis, forecast, and observational errors such as forecast error covariances as estimated from a set of ensemble forecasts. His supervisor is Dr. Hongli Jiang.

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

Marouan Bouali transitioned from Postdoctoral Fellow to Research Scientist I in October 2013. During his 2 years as a Postdoctoral Fellow, his work has focused on examining the problem of striping artifacts in MODerate Resolution Imaging Spectroradiometer (MODIS) and Visible Infrared Imaging Radiometer Suite (VIIRS) satellite imagery. Through these analyses he has developed and demonstrated accurate de-striping algorithms that remove a majority of these artifacts. His novel techniques have been adopted by the NOAA research community working on Joint Polar Satellite System (JPSS) algorithm development for sea surface temperature (SST) and ocean color retrievals. At present, his research focuses on the analyses and suppression of Gaussian noise in brightness temperature data, with implications to the quality of SST retrievals.

Jack Dostalek was promoted to Research Scientist/Scholar II in November 2013. He recently received his Ph.D. degree from the Atmospheric Science Department and his thesis was entitled, Global Omega Equation: Derivation and Application to Tropical Cyclogenesis in the North Atlantic Ocean. Jack works on a wide variety of projects at CIRA, among them: validating soundings from the Microwave Integrated Retrieval System, studying water vapor structure in tropical cyclones, comparing lightning flash characteristics in developing and dissipating tropical disturbances, and using ozone retrievals to estimate tropopause wind speed.

Abell Research Faculty Award to Dr. Wayne Schubert

CIRA colleague and Department of Atmospheric Science professor Dr. Wayne Schubert was announced as this year's winner of the College of Engineering's Abell Outstanding Research Faculty Award. Wayne was recognized for his continued record of outstanding research in the field of atmospheric dynamics. Over the past few years he has graduated many PhD students, published numerous ground-breaking papers with his research group, and successfully directed several projects sponsored by NSF, NOAA, and ONR.

CoCoRaHS Honor

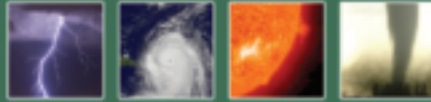
Our colleagues in Atmospheric Science recently shared the news that The Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) was selected to receive an American Meteorological Society Special Award.

"FOR BUILDING A COMMUNITY OF OVER
15,000 VOLUNTEER OBSERVERS DEDICATED
TO PROVIDING HIGH QUALITY, RELIABLE
OBSERVATIONS OF DAILY PRECIPITATION
ACROSS THE UNITED STATES."

Congratulations to CoCoRaHS Director Nolan Doesken and the entire CoCoRaHS team!

Charney Award to Dr. Randall

Bringing further recognition to CSU and our field, University Distinguished Professor Dave Randall has been named as the 2014 recipient of the American Meteorological Society's Jule G. Charney Award. This award, one of the highest honors bestowed by the AMS, is granted to individuals in recognition of highly significant research or development achievement in the atmospheric or hydrologic sciences. Dr. Randall's selection was given in recognition of his "transformative research into atmospheric convection and cloud processes and their improved representation in global weather and climate models."



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

College of Engineering - Foothills Campus, Colorado State University
1375 Campus Delivery, Fort Collins, CO 80523-1375
(970) 491-8448

www.cira.colostate.edu

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