



SPoRT Quarterly
Oct. – Dec. 2011

The SPoRT REPORT

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Short-term Prediction Research and Transition (SPoRT) Center
NASA Marshall Space Flight Center (MSFC), Huntsville, AL
<http://weather.msfc.nasa.gov/sport/>

The SPoRT Center is a NASA-funded project to transition unique observations and research capabilities to the operational community to improve short-term weather forecasts on a regional scale. While the direct beneficiaries of these activities are selected Weather Forecast Offices (WFOs) in the Southern Region, the research leading to the transitional activities benefits the broader scientific community.

Quarterly Highlights

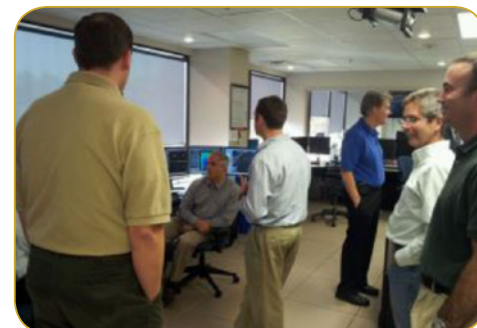
NWS Office of Science and Technology (OST) Director Visits SPoRT

In an effort to learn about unique meteorological research and development being infused into NWS operations, OST Director, Don Berchoff, made a visit to Huntsville, Alabama to meet with the SPoRT staff on November 1–2, 2011. During his visit, Mr. Berchoff and his staff which included John Murphy (OST Programs and Plans Division Chief), John Hahn (OST Program Management Branch Chief), and Mike Johnson (OST Satellite Team Lead-PPD), were briefed on current SPoRT transitional activities and saw the direct use of SPoRT products in NWS operations during the tour of the WFO. A field trip to the Huntsville-Madison County Emergency Operations Center gave the group perspective on how well the local WFO works with its

EMAs. The SPoRT/NWS AWIPS II development team also provided demonstrations of research data displayed in AWIPS II using a locally developed database and visualization plug-ins.

Both NWS Huntsville and NASA SPoRT staff found the interactions to be very beneficial because it allowed for a direct face-to-face interaction between managers, developers, and forecasters on the use of advanced meteorological information. SPoRT team members were really impressed with the time the group spent in Huntsville. Their excitement and enthusiasm about what we are doing has provided additional motivation to the SPoRT team to aid forecasters in using cutting edge technologies to address their weather challenges. The SPoRT-NWS

collaboration in Huntsville, AL will continue to energize and invigorate science and technology advancements and transition into NWS operations at all levels for years to come.



Recent Accomplishments

AWIPS II software developments

In early December, Matt Smith and Jason Burks (ITO at WFO/HUN) travelled to Silver Spring, MD to present a poster and demonstration of SPoRT AWIPS II plug-ins for the NWS Corporate Board. The demonstration was similar to the presentation to NWS OS&T Director Don Berchoff on his November visit to Huntsville, AL. The Board (which consists of about 20 members from various segments of the NWS) viewed eight different demonstrations involving the latest AWIPS II software developments. The Scientific Services Division chiefs also visited the demonstration areas. The SPoRT team received favorable feedback from participants.

SPoRT greenness vegetation fraction (GVF) impacts on 2010–2011 severe weather events

To further examine the sensitivity of the WRF model to real-time SPoRT/MODIS GVF compared to the default climatology GVF, additional model runs were made following methodology explored by NASA's summer intern. General results from ten severe weather events from 2010 and 2011 indicated that most events experienced relatively minor impact from the new GVF dataset. Various factors led to small impacts of the real-time GVF data, including (1) limited surface heating due to prevailing cloud cover and pre-existing precipitation, (2) strong synoptic dynamics that overwhelm the effects of differential surface heating, and (3) overall poor model performance due to atmospheric initial condition uncertainty.

Despite the nominal impact, 2 days among the ten events simulated produced a net positive impact to the WRF model forecast precipitation: July 17, 2010 and May 22, 2011 (Joplin, MO tornado day). On July 17, 2010, optimal conditions existed to maximize the land-atmosphere impacts between

the climatology and SPoRT GVF datasets. Very little preexisting clouds and convection over the focus area of the upper midwest led to fairly substantial differences in the simulated heat fluxes and subsequent 2-m temperature, dew points, and convective available potential energy (CAPE). Higher GVF in the warm sector led to higher overall CAPE in advance of the convective precipitation and, ultimately, an improved evolution of the precipitation systems compared to observations. On the May 22, 2011 Joplin, MO tornado event, differences in the GVF datasets brought about an increase in the simulated precipitation rates of the convection that impacted Joplin in the hour preceding the tornado within the SPoRT GVF model run. Also, the hours following the time of the tornado, the model run using real-time SPoRT/MODIS GVF experienced an improvement to the evolution and orientation of the precipitation, as well as a reduction in false alarm convection. These results will be highlighted in the presentation and paper at the 2012 American Meteorological Society annual meeting

SPoRT-SERVIR Modeling Collaboration

In support of NASA's SERVIR program <http://www.nasa.gov/mission_pages/servir/index.html>, SPoRT scientists generated WRF model runs over mesoamerica in near real-time in order to collect a set of data for computing model verification statistics. An internal Web page was developed for display of selected output variables for qualitatively monitoring model performance. The Web page includes GOES satellite data and satellite precipitation estimates from the Climate Prediction Center Morphing (CMORPH) product that will be used to validate precipitation forecasts. SPoRT began developing a verification methodology based on available observations in the data assimilation dataset from the National Centers for Environmental Prediction Environmental Modeling Center.

WFO Corner

Eastern Region — SPoRT continues to develop and extend collaborations with the NWS Eastern Region. During the 2011 NWA Annual Meeting in Birmingham, AL, SPoRT team members met with Eastern Region Science Services Division meteorologist Dave Radell to discuss the region's upcoming plans for high-resolution weather forecast modeling in support of lake-effect snowfall prediction. The region's offices have reviewed their plans for a regional forecast ensemble approach, where each office contributes a unique forecast model physics configuration to produce a broad sampling of forecast possibilities. Many of these offices will include the SPoRT Great Lakes surface temperature and ice cover composite within their runs and will compare against other members with standard fields provided by larger scale forecast models. To supplement this activity with another Great Lakes regional office, SPoRT is collaborating with staff in Gaylord, MI (NWS Central Region) to evaluate forecast model impacts of ice cover and cloud microphysics. Given that these experiments will produce a large amount of data requiring quantitative evaluation, SPoRT is also working on developing a series of scripts that will allow each office to validate its local model forecasts against surface observations of temperature, dew point, wind speed, and precipitation. By the end of the season, the expected results will be a comparison between standard and SPoRT initializations of Great Lakes temperatures, characterization of forecast differences, and means of identifying ways to improve the Great Lakes product.

Huntsville — Efforts at NWS Huntsville over the past quarter have primarily centered on the use of the MODIS-GOES Hybrid spectral difference product to assess fog development and the use of the NASA LIS 1-km soil moisture analyses both to monitor for drought, and to assess the potential for flooding. The following description presents a typical application relevant to many WFOs in the southeast United States (U.S.).

MODIS-GOES Hybrid helps with fog detection

Early on the morning of January 28 locally dense fog developed in the valleys of northeastern Alabama and east Tennessee. At the time, temperatures were very close to freezing, complicating the situation, and leading to a potential freezing fog situation. Around the time the visibility from one of our sensors was falling below 1 mile, the GOES 4-km resolution data simply was not sufficient to show the fog in some of the narrow valleys of northeastern Alabama. However, around 4 a.m., as MODIS imagery from an Aqua satellite pass became available, the extent and location of the fog was a little more evident. Although automated ground observations at Scottsboro, AL in Jackson County, had not yet indicated the presence of fog, it was evident in satellite imagery in parts of the county. With the help of the Hybrid product, our office was able to issue a Special Weather Statement concerning the freezing fog development and include the appropriate counties. As the fog continued to intensify through 6 a.m. CST, a Dense Fog Advisory was eventually issued. The Hybrid product clearly demonstrated operational utility during this event and improved forecaster situational awareness.

LIS data used in flash flood forecasting

The NASA LIS 1-km soil moisture analyses over Alabama have also demonstrated utility for drought monitoring and assessing the potential for flooding. In early December, through collaborative efforts, the modeling team at SPoRT began creating weekly soil moisture difference plots for the 1-km Alabama domain, making them available through the SPoRT Web page. These plots were useful in providing feedback to the U.S. Drought Monitor and, along with other data and information, resulted in a removal of D0 drought conditions from northwestern Alabama. Throughout the month of January, northern Alabama was hit with several rain events of decent magnitude, including a record setting daily rainfall at Huntsville, AL on the 11th. Subsequent rain events pushed the

area closer to the threat for flash flooding and river flooding later in the month. Although a formal study has not yet been conducted, preliminary analysis suggests that 0–10 cm relative soil moisture values exceeding 60–70% greatly increase the threat for local flooding, given a “standard” 1 to 3-inch rainfall in the Tennessee Valley. These values were even cited by a forecaster in an Area Forecast Discussion on the 20th, just preceding a couple of rain events. A Flash Flood Watch was issued for the area, partly driven by the knowledge of elevated soil moisture values. While flooding did not take place during this first event, from the 20th into the 21st (rainfall amounts were just around 1 inch or less), another rain event (around 1–3 inches) on the 22nd did produce significant flash flooding and river flooding. Efforts will continue with the use of the 1-km LIS for drought monitoring and assessing flooding potential, and more formal studies are planned for the future.

Corpus Christi — We continue to use the SPoRT products here at WFO CRP. In particular, at the very least we use the MODIS-GOES Hybrid PG products (IR, Water Vapor, 3.9 micron, and Visible) and the MODIS Enhanced SST Composite/Latency (1 km). The higher resolutions associated with the Hybrid PG products are useful. The Hybrid PG 3.9 micron product is used at times when investigating wildfires in the area. The SST product is also used since the SST can influence the surface wind by affecting the thermodynamic profile/stability. In particular, the MODIS SST is used to determine that the offshore waters (20–60 nautical miles offshore) were significantly warmer than that of the Nearshore waters, and thus influenced my decision to confine a Small Craft Advisory to the offshore waters during a period of onshore flow on November 15, 2011.

Mobile

NWS Mobile-Pensacola continues its partnership with NASA SPoRT during the 2011–2012 time frame with two primary ongoing projects. **(1) Local Modeling with SPoRT Data Sets** — Both WFOs MOB and HGX have set up special identical domains to examine

convective initiation and select heavy rainfall events over the next year or two using SPoRT Data Sets (MODIS SSTs, LIS, and VGF). SPoRT will run a control simulation without the data sets. The two will be compared to better quantify any potential positive impacts these may have with regard to improving forecast accuracy. **(2) Examination of 17 Feb 2011 Dense Fog Event** — Jeffrey Medlin (SOO NWS MOB), Dr. Geoffrey Stano (SPoRT Collaborator) and, Forecaster Brian Daly (NWS MOB) have coauthored a journal article to examine the meso-scale and synoptic-scale evolutionary details of a dense fog event that occurred last cold season along the U.S. Central Gulf Coast Region. The paper shows how MODIS imagery and products may be used to maintain operational situational awareness at key decision points in time as the event unfolds. The paper is written with respect to what tools would have been made available to a forecaster in real time. As successive MODIS images and products arrive, it is shown how these may bolster or dissuade a confidence of event occurrence in dense fog development. The article is still under review in the NWA E-Journal.

NASA SPoRT Now on NWSChat!

To help facilitate communication between the NASA SPoRT group and our collaborative NWS partners, NASA SPoRT has created a chat room in NWSChat! Have a question or want to provide us with information about how a SPoRT related product was useful on a forecast shift? You can use the chat room to let us know. Also, we plan to use the chat room to provide information or updates about SPoRT related products that may be beneficially useful to operational forecasters. Perhaps the MODIS-GOES Hybrid product offers utility in an operationally relevant way during a forecast shift. If we notice it, we may post it in our chat room and let you know. Of course, we would love to hear feedback from our collaborative offices too! That is one of the primary reasons for creating the chat room. Our chat room is listed as <nasa_sport>. Please contact Kris White in the Huntsville, AL WFO <kris.white@noaa.gov> to be added to this chat room!

Satellite Proving Ground Activities

SPoRT to provide Suomi NPP data to WFOs

On October 28, NASA launched a new member of its Earth-observing fleet called the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite as a demonstration for NOAA's reformulated Joint Polar Satellite System (JPSS, <<http://www.nesdis.noaa.gov/jpss/>>) program. In addition to extending the suite of long-term NASA measurements to measure variables critical to the understanding the Earth's climate, the NPP observations extend NOAA's operational weather forecasting support first begun with the polar observing program <http://www.nasa.gov/mission_pages/NPP/news/new-era.html>. SPoRT recently began developing procedures to ingest and display data from one of the Suomi NPP's instruments called the Visible Infrared Imager Radiometer Suite (VIIRS) into AWIPS II in order to demonstrate its new capabilities to forecasters at selected WFOs around the country. SPoRT scientists are working collaboratively with staff from several universities with direct broadcast ingest capabilities and the Naval Research Lab (NRL) in Monterey, CA to acquire and process VIIRS data, including imagery from a new low-light sensor that can detect moonlight reflected from the Earth's surface and clouds for nighttime weather monitoring. These new observational capabilities will enhance forecasters' ability to better monitor changing weather conditions at night.

HWT Spring Experiment

SPoRT is preparing for participation in the HWT Spring Experiment by making several new products available within AWIPS II. First, the Pseudo Geostationary Lightning Mapper (PGLM) product showcased last year in the legacy system has been refined for AWIPS II. In addition, SPoRT's AWIPS II development team lead by Jason Burks (HUN ITO) in collaboration with UAH scientists have developed a cell tracking tool in order to visually display time series of total lightning data associated with a particular area of storm activity. This new AWIPS II plug-in has been developed in response to the primary requests and feedback from user interactions during previous years at the Spring Experiment. Case examples of total lightning application using AWIPS II graphics are being used to update existing training modules and make them available on the NOAA's LMS

RGB Product Suite

For the last 3–6 months, SPoRT, in conjunction with or Proving Ground partners from CIRA, have been providing a suite of RGB products from SEVIRI, MODIS, and the GOES Sounder to the Ocean Prediction Center (OPC) and Hydrologic Prediction Center (HPC). GOES-R PG liaison, Michael Folmer (GOES-R Satellite Champion for OPC, HPC, and SAB) has been leading the effort to introduce these products to the forecast staff, conduct product training, and get feedback from forecasters on the utility of these products to their operations. Much of this feedback has been documented with regular posts on the SPoRT blog. Additionally, the SEVIRI air mass product was available to the forecasters in NAWIPS at the National Hurricane Center (NHC) last summer and fall. The utility of these products has been documented in the GOES-R PG NHC Demonstration report. SPoRT will continue to provide product enhancements to the NHC in for this upcoming hurricane season.

Launch of NASA's Suomi National Polar-orbiting Partnership (NPP) satellite toward Earth orbit from Vandenberg Air Force Base's Space Launch Complex-2 in California on a United Launch Alliance Delta II rocket built in Huntsville, Alabama. Photo credit: NASA/ULA



SPoRT Receives Space Shuttle Program Commendation

SPoRT has provided unique NASA satellite data to the Spaceflight Meteorology Group (SMG) at Johnson Space Center (JSC) to improve short-term weather forecasts in support of space shuttle launch and landing activities for the last 6 years. In recognition of this activity, the SPoRT program received

a commendation plaque from John Shannon, Space Shuttle Program Manager, in recognition of its dedication, commitment to excellence, and significant achievements in support of the Space Shuttle Program. The commendation included a patch that flew on STS-134 for 15 days making 248 orbits around the Earth.



Meetings

Global Precipitation Movement (GPM) Workshop Participation

Brad Zavodsky represented SPoRT at the 2nd NOAA User Workshop on the GPM Missions held at the Earth System Science Interdisciplinary Center in College Park, MD. GPM is a NASA collaboration with NOAA, the Japanese Aerospace Exploration Agency (JAXA), and a number of other national and international agencies with the goal of increasing the spatial and temporal resolution of global precipitation for weather and climate applications. The objective of this meeting was to determine how NOAA can best prepare for and accelerate the use of GPM data by operational weather forecasting entities including NCEP and NWS WFOs. SPoRT was invited to speak at the meeting because of its pedigree for transition of NASA research data to NOAA operations. Mr. Zavodsky took part in the panel entitled "Accelerating GPM Data Use at NOAA", in which he gave a short presentation on the SPoRT program and ideas for transitioning GPM data to NOAA operations. He also provided additional input to the discussion regarding the most effective path for developing GPM proving ground activities and ways to integrate end-users into the process of evaluating new imagery and products from GPM. The outcome of the meeting was that the GPM community has referenced SPoRT as a vehicle for GPM proving ground activities in collaboration with various NWS testbeds with the opportunity of more formal inclusion in the proving ground in the future. More information on the meeting can be found online at http://www.star.nesdis.noaa.gov/star/meeting_GPM2011.php.

SPoRT Participates at the American Geophysical Union (AGU) 2011 Fall Meeting

The AGU fall meeting was held from December 5–9, 2011 in San Francisco, CA, and featured three presentations

by the SPoRT team. Andrew Molthan gave a poster presentation on cloud computing activities underway within the Earth Science Office. Examples included the use of Nebula Cloud Services to produce high-resolution ASTER imagery of the April 27, 2011 tornado damage across Alabama, and a collaborative modeling project with the NASA SERVIR team to provide high-resolution WRF model simulations over Central America in support of disaster early warning, mitigation, and response. Gary Jedlovec gave an invited presentation on collaborative activities between the SPoRT team and UAHuntsville staff members investigating various techniques to identify tornadoes and damage tracks following the April 27, 2011 event. His talk included the SPoRT satellite analysis performed and described within the SPoRT team's Eos article (Molthan et al., 2011) in addition to dual-polarimetric radar signatures observed by the ARMOR radar located at Huntsville International Airport. The week concluded with a poster presented in the GOES-R session, where SPoRT provided the community with an update on our ongoing GOES-R proving ground activities, emphasizing the use of lightning mapping arrays as a proxy for the Geostationary Lightning Mapper and the use of multispectral satellite imagery at NWS forecast offices and NCEP National Centers.

GOES Users Conference (GUC) participation

SPoRT had several presentations and posters at the GUC in October 2011. An overview of SPoRT's activities within the GOES-R Proving Ground led the first session. A specific presentation discussed the development of RGB imagery for use at NWS forecast offices, and a case study of a low cloud and fog event was demonstrated. SPoRT is leading efforts within the Proving Ground in the area of total lightning and used the GUC to demonstrate the potential impacts of the future Geostationary Lightning Mapper (GLM) to both the areas of modeling and severe weather operations. SPoRT's

development of the Pseudo-GLM has given forecasters attending the HWT Spring Experiment the opportunity to apply total lightning data in a simulated environment. User feedback of this product was described via poster. In addition, a poster was presented on RGB applications at National Centers that highlighted examples of NHC using both SEVIRI imager and GOES Sounder RGB composites to analyze the surrounding environment and development impacts to Atlantic tropical cyclones. SPoRT work in the area of data assimilation of AIRS thermodynamic profiles was also highlighted via poster in order to highlight the importance of future hyperspectral instrument applications. SPoRT's collaborations with National Centers as well as its eight specific Proving Ground WFOs continue to advance the efforts to promote GOES-R capabilities.

2011 National Weather Association Annual Meeting

SPoRT had a significant presence at the 36th National Weather Association annual meeting and 7th GOES Users Conference held in Birmingham, AL from October 16–21. Numerous presentations and posters were given covering a wide range of topics including the use of SPoRT satellite products following the April 27 tornado outbreak, Land Information System applications at the NWS Birmingham, AL and Huntsville, AL offices, total lightning visualization and evaluation of the pseudo-Geostationary Lightning Mapper product at the Hazardous Weather Testbed, preparing SPoRT datasets for AWIPS II, modeling and data assimilation using SPoRT datasets, GOES-R Proving Ground involvement, and RGB product development. Several posters and presentations were given by SPoRT NWS partners from Birmingham, AL, Huntsville, AL, Albuquerque, NM, Knoxville, TN, and Miami, FL, each highlighting applications of SPoRT products and datasets in their operations.

Publications and Presentations

Journal

Case, J. L., S. V. Kumar, J. Srikishen, and G. J. Jedlovec, 2011: Improving numerical weather predictions of summertime precipitation over the southeastern United States through a high-resolution initialization of the surface state. *Wea. Forecasting*, 26, 785–807.

Conference

National Weather Association Annual Meeting (Birmingham, AL):

Carcione, B., J. Burks, M. Smith, and K. McGrath, 2011: *Preparing NASA SPoRT Data Sets for the Next Generation of AWIPS*.

Carcione, B., K. White, and J.L. Case, 2011: *Case Studies of New Operational Applications for the NASA Land Information System*.

Carcione, B., K. Laws, G. Jedlovec, M. Smith, F. LaFontaine, and A. Molthan, 2011: *Use of NASA Satellite Data in Tornado Damage Path Assessment*.

Carey, L.D., C.J. Schultz, E.V. Schultz, W.A. Petersen, P.N. Gatlin, K.R. Knupp, A.L. Molthan, G.J. Jedlovec, and C.B. Darden, 2011: *Dual-polarimetric radar-based tornado debris paths associated with EF-4 and EF-5 tornadoes over Northern Alabama during the historic outbreak of 27 April 2011*.

Case, J.L., F.J. LaFontaine, A.L. Molthan, and R.A. Rozumalski, 2011: *NASA SPoRT initialization datasets for local model runs in the Environmental Modeling System*.

Stano, G.T., C. Siewert, and K.M. Kuhlman, 2011: *Evaluation of NASA SPoRT's Pseudo-Geostationary Lightning Mapper Products in the 2011 Spring Program*.

Stano, G.T., and B. Carcione, 2011: *Total Lightning Visualizations to Enhance Forecast Operations*.

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NP-2012-03-26-MSFC
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Unger, S.W., K.B. Laws, G.D. Goggins, J. Talley, T.N. Golden, H.M. Britton, and J. Case, 2011: *Overview of summer convection study over central Alabama. Abstracts*.

Zavodsky, B.T., D.M. Kozlowski, A.L. Molthan, and J.L. Case, 2011: *Investigating the impact of AIRS thermodynamic profiles on convective forecasts for the April 25–27, 2011 severe weather events in the Southeastern United States*.

GOES Users Conference,

October 20–21, 2011, Birmingham, AL

Fuell, K.K., A.L. Molthan, M. Folmer, and M. DeMaria, 2011: *Demonstration of RGB Composite Imagery at NOAA National Centers in Preparation for GOES-R*.

Jedlovec, G., 2011: *Overview of GOES-R Proving Ground Activities at SPoRT*.

McCaul, E.W., J.L. Case, S.J. Goodman, S.R. Dembek, and F. Kong, 2011: *Optimizing the Lightning Forecast Algorithm within the Weather Research and Forecasting Model*.

Molthan, A.L., H.K. Oswald, and K.K. Fuell, 2011: *Developing and Evaluating RGB Composite MODIS Imagery for Applications in National Weather Service Forecast Offices*.

Morton, D., K. Harrison, B. Zavodsky, and G. Jedlovec, 2011: *Assimilation of Atmospheric Infrared Sounder (AIRS) data into the Prototype High Resolution Rapid Refresh for Alaska (HRRRAK)*.

AGU Fall Meeting (San Francisco, CA)

Jedlovec, G., A.L. Molthan, L. Carey, B. Carcione, M.R. Smith, E. Schultz, and F. LaFontaine, 2011: *Coupling Between Radar Signatures and Tornado Damage Tracks. SessionNH10: Land-Ocean-Atmospheric Processes: Implication to Natural and Man-Made Hazards*.

Jedlovec, G., K. Fuell, M. Smith, G. Stano, and A. Molthan, 2011: *SPoRT's Participation in the GOES-R Proving Ground Activity. IN32: The Near-Future: GOES-R and Next Generation Weather and Observation Constellations*.

Molthan, A.L., A.S. Limaye, and J. Srikishen, 2011: *Cloud Computing Applications in Support of Earth Science Activities at Marshall Space Flight Center. Session IN08: Computational and Software Engineering Challenges in Earth Science*.

SPoRT Brown Bag Monthly Lecture Series

October 13: Dr. Arastoo Pour Biazar, UAHuntsville, Earth System Science Center gave an informative presentation entitled “Improved Meteorological Simulations in Support of Air Quality Studies” that described his past collaborations with SPoRT personnel to use satellite observations in air quality models to improve their performance and to make such improvements available to the air quality community. Examples include the recovery of surface moisture to improve model representation of the boundary layer and correcting photochemical reaction rates for the radiative impact of clouds. He discussed his current work which focuses on the assimilation of observed clouds in the Weather Research and Forecast (WRF) model. Since clouds play a critical role in air quality simulations, this activity is of utmost importance to the air quality community.

Visitors

Don Morton — October 19: Learn about SPoRT, discuss modeling collaboration

Don Berchoff — November 2: Discuss SPoRT AWIPS II software development

Calendar of Events

- AMS Annual Meeting, January 23–26, 2012 New Orleans, LA
- LANCE Users Workshop, February 7–8, 2012 Washington, DC
- SPoRT Science Advisory Committee (SAC) Meeting, February 28–March 1, 2012 Huntsville, AL
- NOAA Testbed Workshop, May 1–3, 2012 Boulder, CO
- NOAA Science Week, April 30–May 4, 2012 Kansas City, MO
- MODIS/NPP Science Team Meetings, May 7–11, 2012