National Aeronautics and Space Administration

2008 SPoRT Biennial Report


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Preface

Established in 2002 to demonstrate the weather and forecasting application of real-time Earth Observing System (EOS) measurements, the Short-term Prediction Research and Transition (SPoRT) project has grown to be an end-to-end research-to-operations activity focused on the use of advanced modeling and data assimilation techniques, nowcasting, and unique high-resolution multispectral observational data to improve short-term weather forecasts. SPoRT currently partners with several universities and other government agencies for access to real-time data and products and works collaboratively with them to develop new products and infuse these capabilities into the operational weather environment. While the majority of the SPoRT end users are forecasters at various National Weather Service (NWS) Weather Forecast Offices (WFOs) in the Southern Region (12 of the 13 offices), the inclusion of private sector users in SPoRT shows the relevance of NASA data and research capabilities to a broader segment of the weather community. In this way, SPoRT strives to be an Agency focal point and facilitator for the transfer of NASA Earth science data and technologies to the operational weather community on a regional and local scale.

This Biennial Report describes current research and transition activities being conducted by the SPoRT project. Most SPoRT staff members have made significant contributions to the report including Rich Blakeslee, Dennis Buechler, Jonathan Case, Shih-Hung Chou, Kevin Fuell, Stephanie Haines, Melody Herrmann, Gary Jedlovec, Frank LaFontaine, Wayne MacKenzie, Will McCarty, Bill McCaul, John Mecikalski, Andrew Molthan, Geoffrey Stano, and Brad Zavodsky. The report provides an update on activities since the last meeting of its Science Advisory Committee (SAC) in June 2007. While not all inclusive of the SPoRT activities, it does provide the SAC and others an overview of the project.

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The Delta II rocket launches from Vandenberg Air Force Base carrying the CALIPSO and CloudSat satellites into space.
Image credit: Boeing/Thom Baur

2007 Science Advisory Committee (SAC) Review

The SPoRT SAC met for the fourth time on June 12–14, 2007 in Huntsville, Alabama, to review recent progress of the SPoRT activities. The SAC members (Appendix 3) in attendance were Tsengdar Lee, Allen White (attending for Marty Ralph), Bernard Meisner (attending for Rusty Billingsley), Chris Barnet (attending for Mitch Goldberg), Ronald Gelaro, Ralph Petersen, and Bill Bauman (Chair). The 2½-day review, which occurs every 2 years, included technical presentations on major research and transition topics by staff scientists as well as a visit to the Huntsville NWS Forecast Office (collocated with SPoRT at the National Space Science and Technology Center (NSSTC)).

The SAC was impressed with the breadth and depth of research and transitional activities since the last review. The committee report specifically commended SPoRT scientists for their work on its Moderate Resolution Imaging Spectroradiometer (MODIS) Sea Surface Temperature (SST) composite product and its transition, its Atmospheric Infrared Sounder (AIRS) data assimilation work, profile dissemination plans, and collaboration with the Goddard Space Flight Center (GSFC) land surface community (through the Land Information System (LIS)). While the report recognized recent publications on SPoRT research capabilities, the research focus resulted in few new products being transitioned to operations during the preceding year. The report also expressed concern about insufficient leadership in the area of atmospheric electricity and modeling/data assimilation and the loss of staff in the liaison position. Additionally, the committee recommended a more regular reporting process and the development of a SPoRT strategic plan.

SPoRT takes the recommendations of the SAC very seriously. The SAC recommendations are used as program guidance to better address the NASA weather focus area goals and the needs of the operational weather community. SPoRT is responsive to the specific recommendations of the committee and has already made suggested project changes. For example, additional staff has been hired to provide a more engaged interface with the end users. SPoRT is also in the process of publishing a strategic plan (an executive summary is presented at the end of this report) to better communicate our goals and objectives to the external community and to guide internal activities. More regular reporting of SPoRT accomplishments is being made to the SAC and the community through the dissemination of a quarterly newsletter and with this biennial report, distributed during nonreview years.

Staffing

SPoRT is functionally organized into four working groups led by a management and integration group consisting of the SPoRT Co-Principal Investigators (Co-PIs) and the Project Manager (PM). The functional diagram shown in Figure 1 lays out this group structure. The Co-PIs look both outward and inward, providing technical direction to the project functions and maintaining relevance to NASA needs. The PM assists the Co-PIs in running day-to-day activities, providing financial oversight, and carrying out other project management activities. The short-term forecasting, data assimilation, and nowcasting groups represent three technical areas whose scientists conduct cutting-edge research related to operational weather forecasting. The groups draw on in-house technical expertise from NASA, The University of Alabama in Huntsville (UAH), and collaborative research partners, much of which has been in existence at NASA and UAH for the last 20 years. The short-term forecasting group concentrates on regional weather forecast model expertise to link these models with other unique NASA research capabilities. The data assimilation group works closely with the remote sensing experts and short-term forecasting group to devise the best strategies to assimilate NASA remote sensing observations in the models. The nowcasting group focuses on the use of real-time data streams, total lightning data, and a suite of nowcasting products to address observational and very short-term weather forecasting problems. The data and transition group provides remote sensing expertise, integrates research with weather forecast problems, and facilitates the transition of beneficial capabilities to the operation forecasting environment. It also focuses on training and the assessment of new forecast capabilities in the WFO or end-user environment. It also explicitly includes NWS information technology and forecasting staff to facilitate successful transitions. It should be noted that there is considerable overlap of personnel between the groups and a mix of personnel from various organizations in each group. This mix brings a dynamic blend of perspectives and expertise to each group.

Figure 1. SPoRT Project Organization Chart.

1.0

Short-term Forecasting

Research and Transitional Activities

1.0 Short-term Forecasting

Weather Research and Forecast (WRF) Local Forecasts With MODIS SSTs

Numerical modeling experiments at SPoRT this past year continued to make use of the high-resolution MODIS sea surface temperature (SST) composites (Haines et al. 2007; LaCasse et al. 2008). The primary focus has been on a numerical model initialization comparison over south Florida in which a "Control" run included the coarser resolution National Centers for Environmental Prediction (NCEP) Real-Time Global (RTG) SSTs while an experimental run used the MODIS composites (Case et al. 2007a; Case et al. 2008c). The work has been done jointly with the Miami, FL (MFL) NWS WFO and the Florida Institute of Technology (FIT). This project supports SPoRT's objective of using NASA EOS datasets to help improve short-term weather forecasting by providing improved initial lower boundary information to regional mesoscale modeling. This experiment is leading to the transition of the MODIS SST composites into operational use by several SPoRT coastal WFO partners in the Southern Region and others interested in using these data to initialize their local model runs. Additionally, the SST composites are used by several private sector companies to initialize water temperature in regional weather forecast models or in the preparation of marine weather forecasts and data dissemination. These newly funded collaborations will be described later in this report.

The NWS MFL office currently runs the WRF in realtime to support daily forecast operations, using the NCEP Nonhydrostatic Mesoscale Model (NMM) (Janjic et al. 2001) dynamical core within the NWS Environmental Modeling System (EMS) software. The EMS is a standalone modeling system capable of downloading the necessary daily datasets and initializing, running, and displaying WRF forecasts in the Advanced Weather Information Processing System (AWIPS) with little intervention required by forecasters.

Twenty-seven-hour forecasts are run daily with start times of 0300, 0900, 1500, and 2100 Coordinated Universal Time (UTC) on a domain with 4-km horizontal grid spacing covering the southern half of Florida and adjacent coastal waters. Each model run is initialized using the Local Analysis and Prediction System (LAPS) analyses available in AWIPS, invoking the "hot-start" capability. During an early phase of the experiment, SPoRT identified problems in the initial temperature fields from LAPS. Upon confirmation of this problem, the LAPS analyses at WFO Miami were corrected by removing the balancing constraint prior to model initialization. Forecasters report that the change over this winter season has resulted in a noticeable improvement in model initialization. In the real-time MFL runs, the SSTs are currently initialized with the RTG analyses.

For flexibility and ease of use in the WRF modeling system, the SPoRT MODIS SST product is written to a Gridded Binary-1 (GRIB-1) data format, which requires the original 1-km product to be subsampled to a 2-km resolution due to its large dimensions combined with the limitations of the GRIB-1 format. SPoRT conducted WRF EMS runs identical to the operational configuration at NWS MFL except for the use of these 2-km MODIS SST composites in place of the RTG product. The incorporation of the MODIS SST composites into the SPoRT WRF runs was staggered so that each model run was initialized with a different SST composite. The LAPS analyses were excluded from this experiment entirely due to the problem described above. From mid-February to August 2007, 733 parallel WRF simulations were collected for analysis and verification.

Figure 2 shows a plot of WRF-initialized RTG SSTs, MODIS SSTs, and latent heat flux differences from a sample forecast initialized at 1500 UTC 21 March. What becomes immediately apparent is the difference in the level of detail of the initial SST fields. The RTG SST shows a smoothly varying field with ~4 °C temperature increase from north to south off the west coast of Florida and only ~1 °C variation off the east coast, with little variation around the shallower waters of the western Bahamas (Fig. 2a). In contrast to the RTG plot, the MODIS-initialized SSTs show a very distinctive gradient of 2–3 °C over a short distance on either side of the well-defined Gulf Stream current from the Florida Straits south of the Keys to off the Florida east coast (Fig. 2b). A narrow wedge of cool SSTs is found hugging the east coast to the north of Lake Okeechobee over the Florida-Hatteras Shelf, coinciding with the location of buoy 41114, labeled in Figure 2b. Noticeably cooler MODIS SSTs are found in the shallows of the western Bahamas. In general, the largest differences in SSTs are well-correlated within the regions of the shallowest ocean bottom topography (not shown).

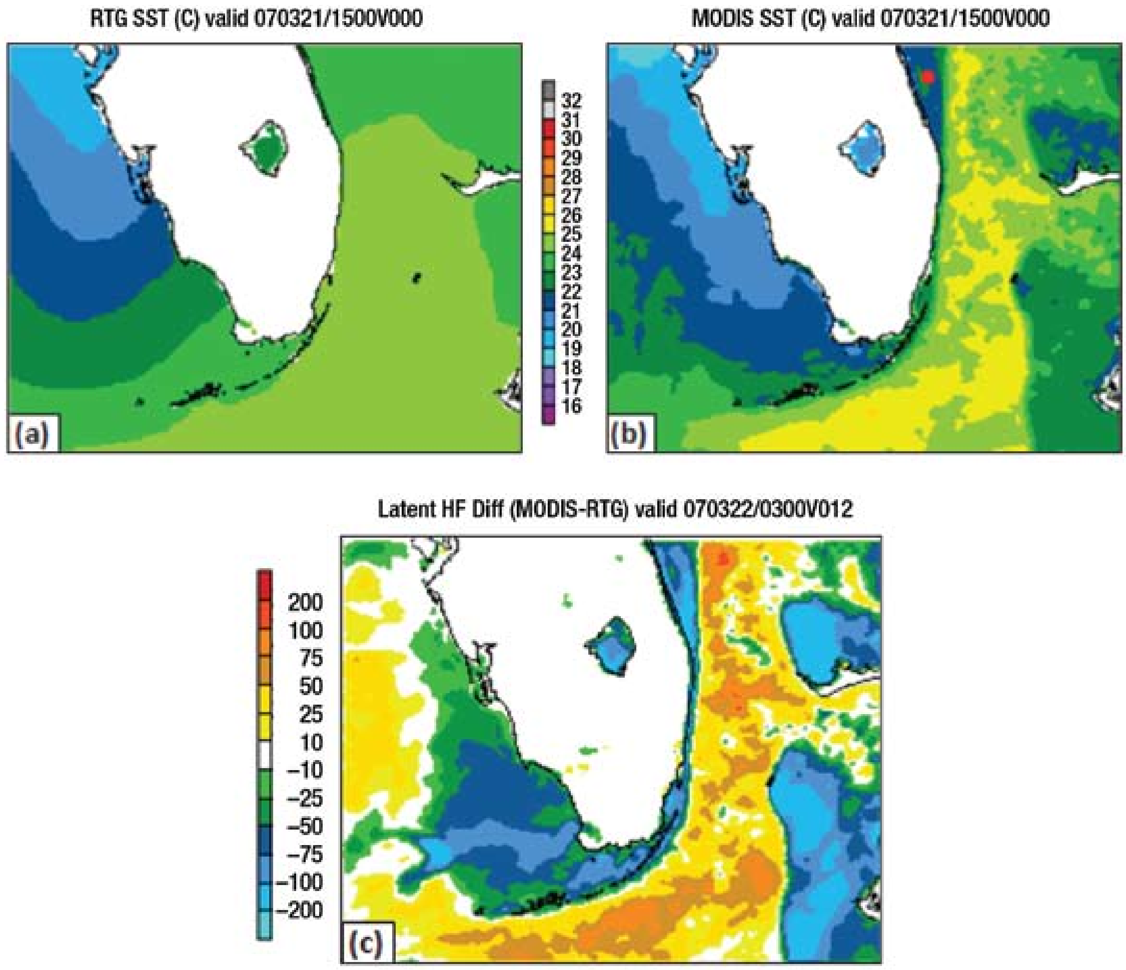


Figure 2. SSTs in the WRF simulation initialized at 1500 UTC 21 March 2007 for (a) the 1/12° RTG SST product and (b) the MODIS composite, and (c) the difference in 12-hr forecast latent heat flux (W/m^2) between the MODIS and RTG WRF simulations, valid at 0300 UTC 22 March 2007.

These differences in SSTs translate directly into variations in the latent heat fluxes over the water. The difference in the 12-hour simulated latent heat flux (Fig. 2c) shows as much as 100 W/m^2 or more reduction in the latent heat flux over the cooler shelf waters near the Florida peninsula and western Bahamas, along with an increase in latent heat flux of comparable magnitude over the well-defined Gulf Stream region. Such variations in heat fluxes over small distances can lead to simulated mesoscale circulations that may not be resolved by predictions initialized with the much smoother RTG SST field.

Based on SST verification at six marine sites, the MODIS composites improved upon the RTG errors in nearly all months (February to August 2007) for the 0300 and 2100 UTC WRF initialization times, which correspond to the 1900 UTC and 1600 UTC MODIS composite times, respectively. The initial SST Root Mean Square Error (RMSE) was reduced the most substantially in February and July, but also improved in March, April, and August (Figs. 3a and 3d). April to June had little or no reduction in the overall RMSE.

The largest improvement in initial SST RMSE was found at buoy 41114, located within the region of cool shelf waters east of the central Florida east coast (Fig. 2b). In every month except May, the RMSE was reduced by as much as 1 °C or more in all model initialization times (Fig. 3). The RMSE improvement was directly attributed to a reduction in the positive RTG bias at this station (not shown). In each model cycle, the RTG SST was too warm at buoy 41114 and the MODIS SST composite reduced this bias (sometimes too much as in the case of May and especially in the 1500 UTC forecast cycle).

There are a few instances when the MODIS SST RMSE increased over the RTG initialization. Both the 0900 and 1500 UTC forecast cycles (which used the 0400 and 0700

UTC MODIS composites, respectively) had larger SST RMSE (Figs. 3b and 3c) and negative biases from May to July, especially during the period from mid-June to mid-July (not shown). The possible causes of larger errors during these times and specific model initialization times include: (1) cloud contamination/latency problems in the MODIS SST compositing technique, particularly in the mid-June to mid-July time frame (Haines et al. 2007), and (2) the time difference between the MODIS composite and the model initialization. The 0700 UTC composite in particular may not be representative of the sea surface at the 1500 UTC model initialization time due to diurnal fluctuations in the SST. The enhanced SST composite being developed jointly by SPoRT and the Jet Propulsion Laboratory (JPL) (Section 7.0 New Partnerships) should help improve these latency issues due to cloudiness through the use of SSTs obtained from the Advanced Microwave Precipitation Radiometer for the Earth Observing System (AMSR-E) data combined with the MODIS data.

During Summer 2008, SPoRT and FIT will complete the analysis of selected cases studies, summarize the objective verification statistics, and prepare a final report of the findings. In addition, SPoRT will begin sending the 2-km MODIS SST composites to the Miami and Mobile WFOs for initializing their local WRF EMS model runs. SPoRT is developing instructions and configuration files so that each office can set up their WRF EMS to incorporate the MODIS SSTs in an optimal manner for real-time WRF simulations. Once tested by Miami and Mobile, the instructions and configuration files will be provided to all of SPoRT's coastal WFO partners. Finally, once the enhanced SPoRT/JPL SST product is developed, SPoRT will rerun selected WRF simulations during the project period for days when the latency of the MODIS product was especially large due to cloud contamination.

WRF Lightning Forecasts

The first phase of an investigation into the feasibility of using output from 2-km cloud-resolving WRF simulations as a means to make quantitative short-term (0–12 hr) predictions of total lightning flash rate density has been completed. A full-length journal article (McCaul et al 2008) has been prepared documenting the findings and methods.

Several fields from the WRF output were considered as potential proxies for lightning flash rate density, with the most promising being upward graupel flux at the –15 °C level and vertically integrated total ice content. To convert the proxy fields to lightning flash rate density, a calibration analysis was conducted to determine the functional form of the calibration curves that transform each proxy to its corresponding lightning field, with observed total lightning flash origin densities from case studies sampled by the North Alabama Lightning Mapping Array (NALMA) serving as ground truth. Because cloud-resolving models cannot be expected to reproduce the details of convective cloud location and timing

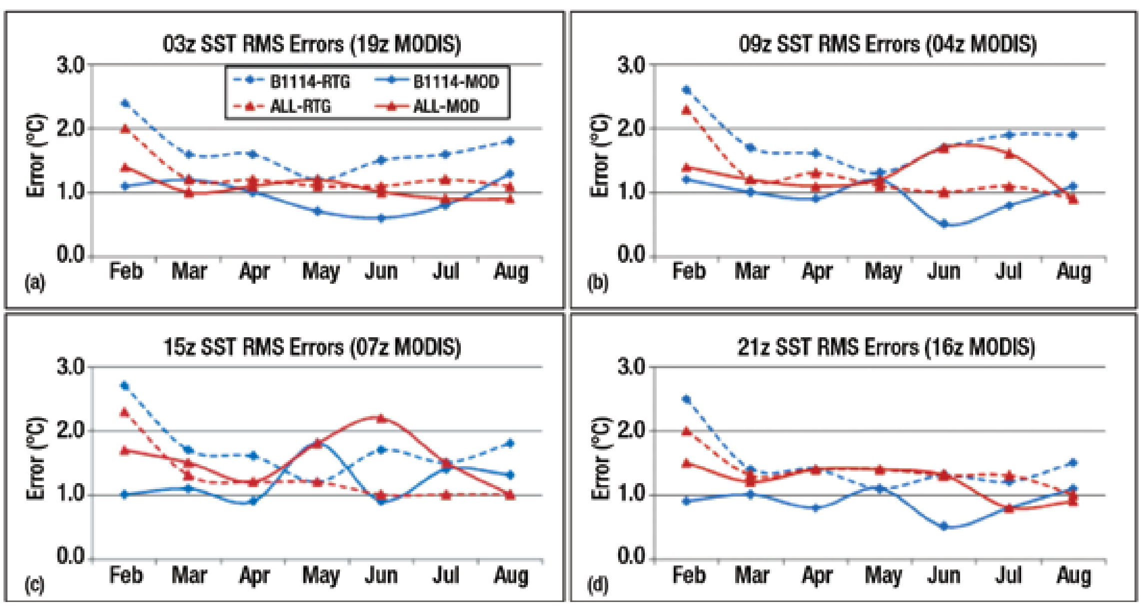


Figure 3. Monthly sea surface temperature root mean square errors for all 6 marine stations in the MFL WRF domain (red lines) and buoy B1114 on the Florida east coast (blue lines) at model initialization times (a) 0300 UTC, (b) 0900 UTC, (c) 1500 UTC, and (d) 2100 UTC.

perfectly during the 12-hr simulations, the calibration procedures used domain-wide peak values of proxy and observed lightning fields in the calibration step. Correlation analysis shows that models such as WRF produce proxy field peak values that exhibit a linear relationship with peak values of observed total lightning flash rates, with correlations reaching 0.7–0.9 or larger. The selected proxy field peak values thus appear to be valid bases for predicting peak lightning flash rate densities in storms.

Areal coverage of the lightning threat can be made to match observations by judicious thresholding of the predicted flash rate density field. It is found that the calibrated graupel flux proxy field successfully captures not only the peak amplitude of flash rate density but also a large part of its temporal variability, while the vertically integrated ice proxy field provides an easier match for lightning threat areal coverage. A weighted average of the two calibrated proxy fields can be devised that retains the advantages of both proxies. A sample lightning (LTG) forecast field map based on one of our 2-km WRF model runs is shown in Figure 4.

Ideally, a large database of case studies should be examined to establish the calibration constants accurately. However, our observational data time series from the NALMA is of limited length, with considerable redundancy in terms of storm regime. To construct our calibration curves so that the case study spans as much of the flash rate density spectrum as possible, we chose a subset of NALMA case studies representing a wide diversity of storm types.

To deal with the underlying issue of the stochastic nature of observed and predicted convective cloud fields, it is suggested that these lightning forecasts be applied to ensembles of cloud-resolving model forecasts, from which explicit probabilities of lightning flash rate densities exceeding various thresholds could be inferred.

WRF LIS Sensitivity Studies

The SPoRT project has been conducting separate studies to examine the impacts of high-resolution land-surface initialization data from the GSFC LIS (LIS, Kumar et al. 2006, 2007) on subsequent numerical weather prediction

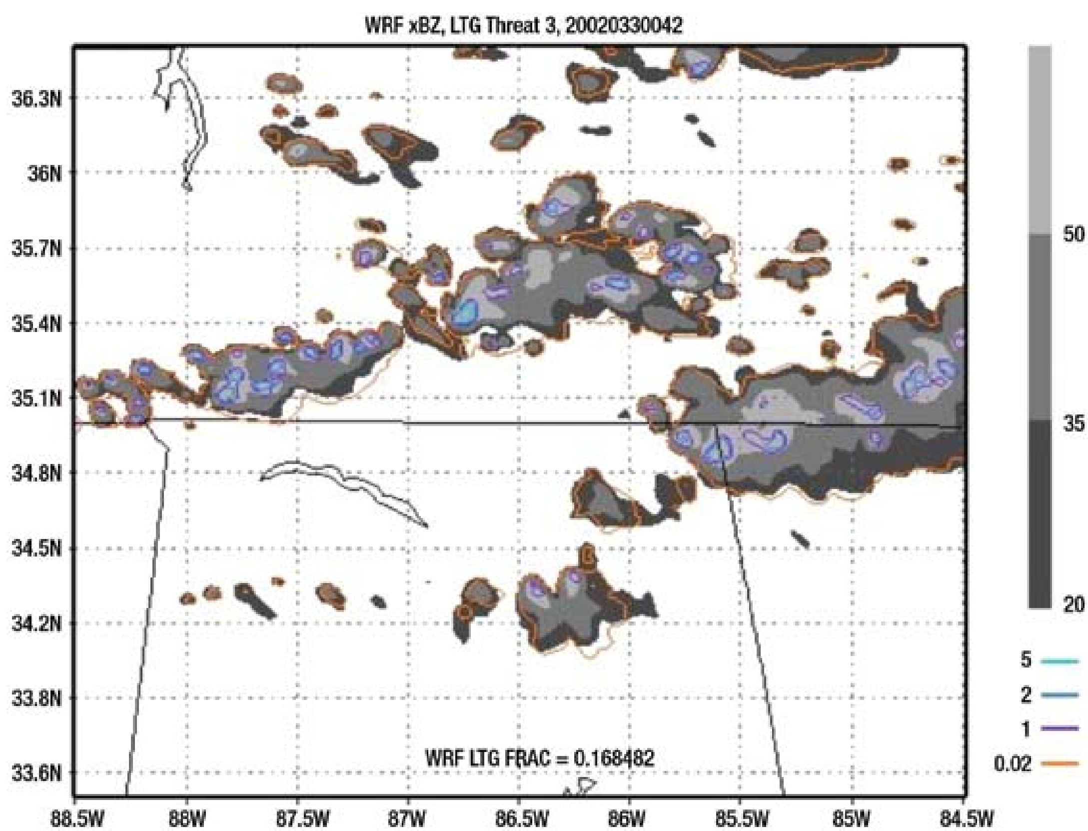


Figure 4. WRF-derived reflectivity at the –15 °C level at 0400 UTC 30 March 2002 (gray shades) and WRF-predicted flash origin density (contours) for a 5-min period at the same time, based on a blend of fields of WRF graupel flux at the –15 °C level and vertically integrated ice content. Instantaneous areal coverage of predicted flash density is printed at the bottom of the figure and agrees well with observed flash extent density field (not shown).

(NWP) forecasts (Case et al. 2007b, 2008a), as well as the influence of initializing an NWP model with high-resolution MODIS SST composites (Haines et al. 2007; LaCasse et al. 2008; Case et al. 2007a; Case et al. 2008c). Both of these projects conform to the mission of SPoRT by examining the utility of NASA datasets and tools on short-term NWP, with the goal of transitioning unique products to NWS WFOs. Furthermore, these activities have enhanced collaborations between SPoRT, FIT, GSFC, and the National Severe Storms Laboratory (NSSL).

This past year, SPoRT examined the combined impacts of using high-resolution lower boundary data over both land and water on daily NWP forecasts over Florida during May 2004 (Case et al. 2008d). Using the WRF model in conjunction with the LIS land surface and MODIS SST initialization data, SPoRT evaluated the impacts of these high-resolution lower boundary data on regional short-term NWP (0–24 hr). In addition to this work, SPoRT has teamed with GSFC and NSSL to conduct modeling sensitivity studies for selected severe weather events from the 2007 and 2008 Spring experiments. The goal of this study is to determine the potential utility of NASA assets (i.e., LIS land surface initialization datasets, MODIS SST composites, and new GSFC physics routines in WRF) to predictions of severe convection by conducting sensitivity simulations of the NSSL WRF configuration in postanalysis mode (Case et al. 2008b). Real-time NSSL WRF runs are available at <http://www.nssl.noaa.gov/wrf/>.

Twenty-four-hour simulations of a Control, LISWRF (i.e., LIS land surface initialization), and LISMOD (i.e., LISWRF initialization with MODIS SSTs) configurations were run daily for the entire month of May 2004. All atmospheric data for initial and boundary conditions for each simulation came from 0–24 hr forecasts from the NCEP Eta model data projected to a 40-km grid. The Eta model provided boundary conditions to an outer 9-km WRF grid every 3 hr, while the 9-km grid provided boundary conditions every model time step to an inner 3-km grid in a one-way nested mode.

Land surface initial conditions in the Control runs were obtained through a spatial interpolation of the soil temperature and moisture values from the NCEP Eta model data to the 9-km and 3-km WRF grids, using the WRF Standard Initialization (WRFSI) utilities. The SSTs from the NCEP Eta data (i.e., RTG SSTs) were interpolated to the WRF grids for the Control and LISWRF simulations, also using WRFSI. Daily output from an offline LIS spin-up run (Case et al. 2008a) initialized the land surface fields in the LISWRF and LISMOD runs during May 2004. The LIS software was called in the first WRF model time step to initialize the land surface variables with the LIS output. For the remainder of the integration, the Noah land surface model within the standard WRF was called. Therefore, the only differences between the Control and LISWRF simulations are those that resulted from differences in the initial land/soil conditions.

In the LISMOD runs, the MODIS SST composites subsampled to a 3-km resolution grid were interpolated to the WRF grids using the WRFSI utilities. Since the SSTs remained static throughout the model integration, the only differences between the LISWRF and LISMOD runs are those that resulted from differences in the SST state (i.e., RTG vs. MODIS). All evaluations, comparisons, and verifications were done on the inner 3-km grid.

Surface verification statistics were computed separately over land sites (Aviation Routine Weather Report (METAR) and Florida Automated Weather Network) and marine sites (buoy and Coastal-Marine Automated Network). Selected composite error statistics for land and marine sites for the 0000 UTC forecast cycle are presented in Figure 5. In general, the most significant improvements in surface errors were with the land sites associated with the addition of LIS land surface initialization data in the LISWRF experiment. Based on the hourly 2-m temperature errors at land stations (Fig. 5a), the LISWRF clearly improves upon the Control predictions. The LISWRF reduced both the nocturnal warm bias from hours 0–11 and the daytime cool bias from hours 16–23. This improved diurnal range in predicted 2-m temperatures can be attributed to the lower soil moisture initial conditions in the LISWRF compared to the Control (not shown), resulting in a greater partitioning of sensible heat flux in the overall surface energy budget. The addition of the high-resolution MODIS SSTs (LISMOD plot in Fig. 5a) produced very little change in the 2-m temperature errors over land.

The 10-m wind speed errors indicate that LISWRF improved slightly over the Control during the nighttime hours (Fig. 5b). Between forecast hours 0 and 12, the RMSE is lower by a few tenths of a meter per second during most hours. Once again, the total error reduction can be attributed to a reduction in the bias. Both the Control and LISWRF experience a positive bias in the wind speed

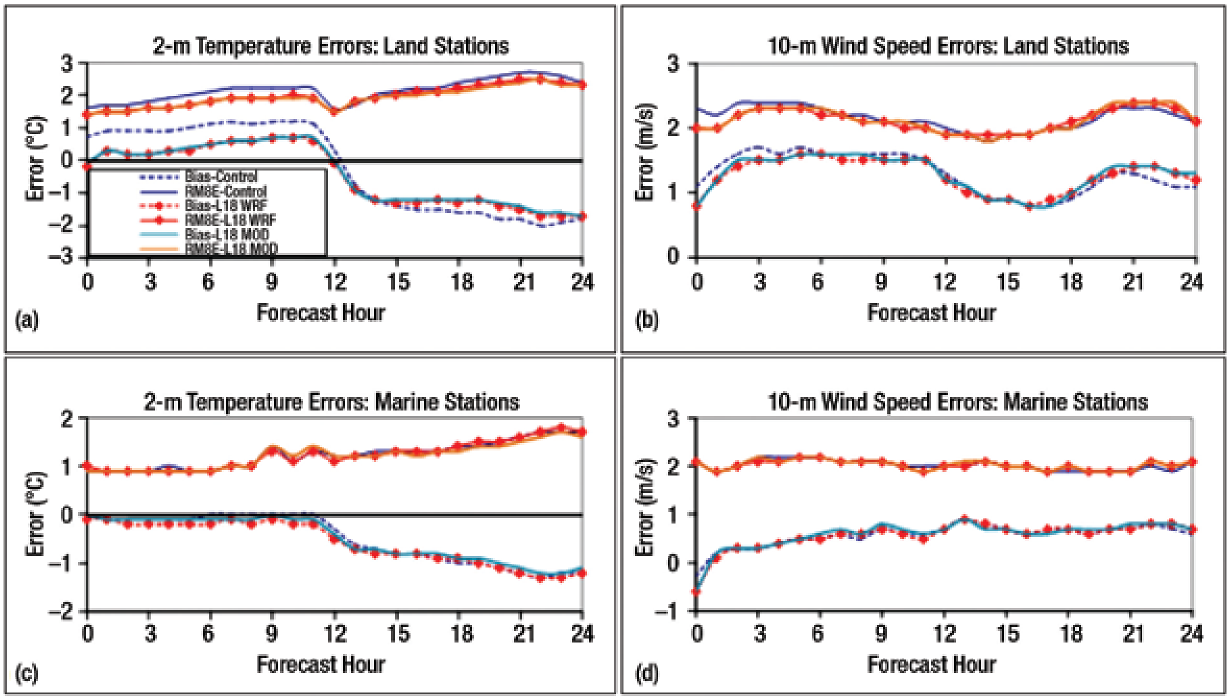


Figure 5. Surface verification statistics for the 0000 UTC WRF forecast cycle during May 2004 for (a) 2-m temperature errors (°C) at land stations, (b) 10-m wind speed errors (m/s-1) at land stations, (c) 2-m temperatures at marine stations, and (d) 10-m wind speed errors at marine stations. The legend in panel (a) indicates the plot associated with each experiment type.

during all forecast hours; however, during the nocturnal hours, the LISWRF improves upon the Control bias until forecast hour 11. Between hours 21–24, the LISWRF has a slightly higher positive wind speed bias, possibly due to stronger postsea-breeze winds at numerous coastal locations, given the larger land-sea temperature contrast of LISWRF. Again, only very small variations are found between the LISWRF and LISMOD errors over land stations (Fig. 5b). The 0000 UTC surface verification statistics computed at the marine sites generally indicate nominal changes in errors when including LIS or MODIS SSTs. In general, only small variations in errors occurred in the 2-m temperature and 10-m wind speed (Fig. 5c and 5d).

Future work in the upcoming year will include detailed sensitivity tests within the NSSL WRF model domain using LIS and new GSFC radiation and microphysics routines in WRF. These combined NASA assets are part of a first step toward a "Unified NASA" WRF system, from which research experiments can be conducted from a common modeling platform that contains NASA contributions from several different arenas. These sensitivity tests will require enhancements to the LIS in order to develop a robust LIS spin-up run for initializing land surface variables on the NSSL WRF domain. The LIS configuration used over Florida for the May 2004 studies does not correctly spin-up the soil moisture over portions of Canada and Mexico due to limitations in the precipitation forcing of the North American Land Data Assimilation System (NLDAS) analyses. Therefore, SPoRT plans to implement a mask that will use the NLDAS dataset only over the Continental U.S.

Finally, SPoRT plans to work toward a real-time implementation of LIS to produce a high-resolution land surface dataset (i.e., soil temperature and moisture over multiple soil layers). The goal for such a product is to have it displayed in AWIPS for diagnostic purposes and/or be available to initialize the land surface in local WRF model runs at NWS WFOs, in a similar manner as the MODIS SST composites.

WRF Microphysical Adjustments With CloudSat

On the time and space scales of regional weather, accurate forecasts of cloud cover are required to predict the diurnal temperature cycle and likelihood of precipitation. Clouds and precipitation disrupt transportation networks, and in severe cases, may contribute to flooding, property damage, or agricultural losses. Many of these problems may be alleviated through risk mitigation strategies, enhanced by accurate weather forecasts issued in the form of watches and advisories. Numerical models assist with the issuance of these operational forecast products. Gains in forecasting will come from improved simulation of clouds and their microphysical processes, achieved through steady increases in computer resources and forecast models that operate at cloud resolving resolution, rather than current convective parameterization schemes. Accurate short-term weather forecasts have a demonstrable benefit to society, but will also translate to the improved simulation of present and future climate, as global models transition to the use of cloud-resolving models in the form of superparameterizations. Improving cloud processes in operational, daily weather forecasts will translate to greater forecast skill on relatively short time periods, a primary goal of the SPoRT project.

The NASA CloudSat 94-GHz Cloud Profiling Radar was launched as a member of the A-Train of Earth Observing Satellites in order to obtain vertical profiles of cloud layers and properties, building on the significant heritage of ground-based 94-GHz profiling systems (Stephens et al. 2002). Data from CloudSat may be used to compare the properties of real clouds to their counterparts, as simulated within a high-resolution forecast model. Although cloud resolving models offer a wide range of microphysics packages, CloudSat is currently being used to evaluate the performance of the Goddard six-class, single-moment microphysics scheme (Tao et al. 2007) as implemented within the WRF Model. Due to the operating frequency of the CloudSat radar, the focus of current work is on cold-season, midlatitude cyclones producing light to moderate snowfall. Forecasts of these systems are less dependent upon an accurate forecast, initialization of mesoscale features such as severe convective storms and instead are forced by larger, synoptic-scale processes. Furthermore, these systems are well observed by observation networks within the continental United States. These cyclones produce cloud cover and precipitation over multiple states, often leading to difficult forecasts for these high-impact events. Within the WRF model, forecasts of precipitation and type depend upon the correct evolution and distribution of water mass among various hydrometeor classes. Meanwhile, forecasts of surface and profile temperatures depend upon diabatic processes in the form of latent heat exchange and the interaction of solar and terrestrial radiation with the modeled cloud shield.

Toward the aforementioned goals, CloudSat observations have been examined to locate orbital segments containing observations of clouds and precipitation associated with cold-season midlatitude cyclones. These orbital segments are assumed to be representative of a distinct feature (Fig. 6), such as clouds generated by warm frontal ascent, so that a comparable feature may be examined within a WRF model forecast.

Once the modeled feature is identified, representative model profiles are extracted and converted to an equivalent CloudSat radar reflectivity through application of the QuickBeam radiative transfer model (Haynes et al. 2008). Properties of the observed and modeled clouds are compared through a contoured frequency with altitude diagram (Fig. 7, Yuter and Houze 1995), which depicts the frequency distribution function of radar reflectivity at each altitude level. Deficiencies within the model forecast are noted, based on reflectivity characteristics. Preliminary work has focused on the snow crystal size distribution prescribed within the Goddard scheme. Currently, the Goddard scheme uses an inverse-exponential size distribution as in Gunn and Marshall (1958), where the intercept parameter is fixed. Other parameterization schemes have included an intercept that is temperature dependent, based on observational field campaigns. Operating under the assumption that the modeled snow profile is

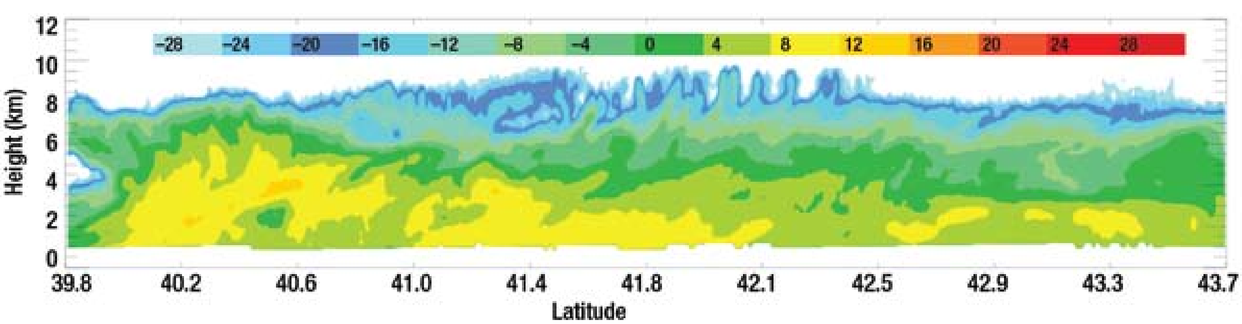


Figure 6. Cross section of CloudSat 94-GHz radar reflectivity profiles obtained in eastern Nebraska and western Iowa at 0830 UTC on 13 February 2007. Surface observations reported light to moderate snowfall with WSR-88D radars also suggesting a northward decrease in reflectivity.

reasonable, varying snow crystal size distributions are applied to determine which assumptions produce a better fit to CloudSat observations. This comparison effort is complicated by the remote sensing characteristics of the 94-GHz radar. At 94 GHz, oscillations in radar backscatter occur as the target diameter increases, so that an increase in target size does not consistently generate an increase in radar backscatter. In order to supplement CloudSat observations, the NWS Weather Service Radar–1988 Doppler (WSR–88D) network is leveraged as an additional observation. The WSR–88D network is most sensitive to precipitation and operates at a frequency where reflectivity is more sensitive to increases in target diameter.

Observations by Brandes et al. (2008) of snow crystals in upslope Colorado snowstorms have suggested that the distribution slope parameter could be parameterized as a function of temperature. This size distribution has been implemented within the QuickBeam model and used in calculation of WSR–88D reflectivity. CloudSat and the WSR–88D network observed light to moderate snowfall to the northwest of a midlatitude cyclone on February 13, 2007. This system was simulated well by the WRF model, with only minor displacement of the simulated snowfall and cloud features from observations. When applying the default snow distribution currently used within the Goddard scheme, CloudSat reflectivity is underestimated in the lowest 3 km, while WSR–88D reflectivity is greatly overestimated. Application of the Brandes et al. (2008) distribution increases CloudSat reflectivity toward observed values, while narrowing the WSR–88D reflectivity distribution to more appropriate values and a mean profile that provides a better fit to observations (Fig. 7). Similar findings have occurred for two other cold-season cyclones, suggesting that there may be value in applying the Brandes et al. (2008) parameterization or a similar methodology. Simulated reflectivity will also be sensitive to the snow content within the vertical profiles, as well as any change in vertical distribution of snow. It should be noted that there is no guarantee that the implementation of a different size distribution will produce comparable snow profiles.

Future work in this area will be targeted toward identifying additional case studies for model simulation and evaluation. Assuming that additional cases indicate similar, potential improvements from a Brandes et al. (2008) style of parameterization, this new distribution will be tested within the WRF/Goddard scheme framework. There are also opportunities to investigate snow terminal velocities as an additional parameterization. Analyses based upon a new size distribution will examine changes to microphysical evolution of forecast clouds and their similarities to CloudSat and WSR–88D radar reflectivity.

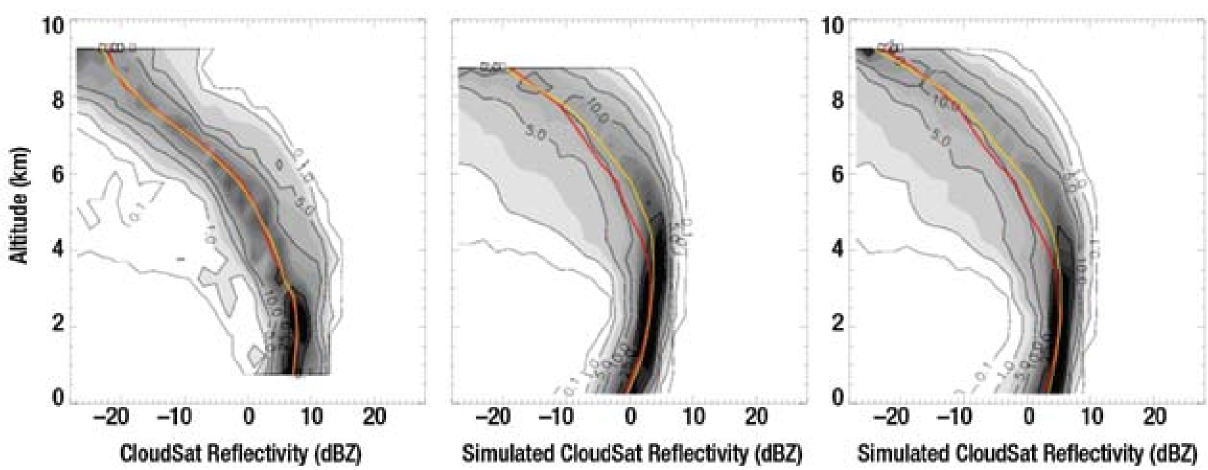
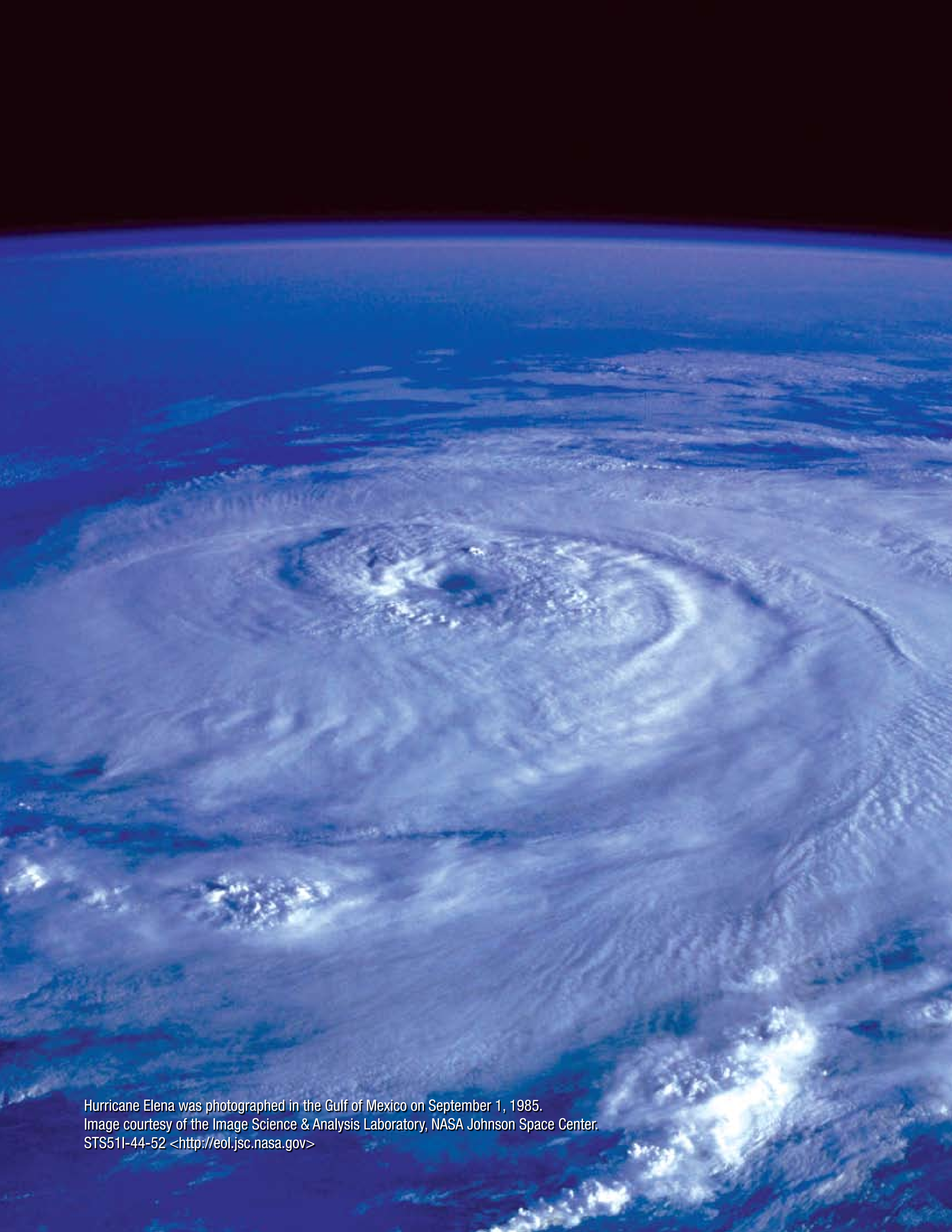


Figure 7. Comparison of CloudSat reflectivity Contoured Frequency by Altitude Diagrams (CFADs): (left) CloudSat observations, (middle) radar reflectivity CFAD at 94 GHz, simulated from WRF profiles believed to be representative of CloudSat observations using snow crystal distribution characteristics assumed within the Goddard scheme, and (right) as in the Goddard case but simulating 94-GHz reflectivity using the distrbution characteristics of Brandes et al. (2007).

2.0

Data Assimilation



Hurricane Elena was photographed in the Gulf of Mexico on September 1, 1985.
Image courtesy of the Image Science & Analysis Laboratory, NASA Johnson Space Center.
STS51I-44-52 <http://eol.jsc.nasa.gov>

2.0 Data Assimilation

AIRS Profile Assimilation and Forecast

At the time of the last SAC meeting, the SPoRT AIRS profile assimilation project was using the ARPS Data Analysis System (ADAS) to assimilate prototype version 5 AIRS profiles into a regional configuration of the WRF model. The near-term plans were to complete a near-real-time system for running the analysis/modeling system and to run a month-long case study to determine long-term impact of the AIRS profiles on model forecasts. This work was completed shortly after the meeting and was featured in a poster presentation at the Joint European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)/American Meteorological Society (AMS) Satellite Conference in Amsterdam, The Netherlands in September 2007 (Zavodsky et al. 2007). The version 5 AIRS profiles, with the most up-to-date profile algorithm, were released in October 2007 (and then rereleased in March 2008 after a failure of an AMSU channel used as the first guess for the profile retrieval and cloud clearing).

The feedback from the SAC was positive about the direction of the work, but some members expressed concern over the use of ADAS instead of a more robust variational data assimilation system. In the work leading up to the joint EUMETSAT/AMS Satellite Conference, it became apparent that ADAS analyses were not dynamically balanced between the mass field and the momentum field leading to large uncertainty in the early forecasts hours as the model attempted to adjust to the unbalanced ADAS initial conditions. Using the SAC feedback and the model spin-up issue as motivation, a decision was made to investigate implementing a three-dimensional variational (3DVAR) method. A logical first step was to use the WRF Variational Data Assimilation System (WRF-Var), since WRF-Var is the analysis component of the WRF modeling system and allows for direct initialization of the model without interpolations (which is another upgrade over the ADAS system). Because WRF-Var is not backward compatible with the WRF preprocessor and forecast model used at SPoRT, the system has been updated to include a new WRF preprocessing system (WPS) and WRF V2.2.1 model. Much of 2008 has been spent configuring the WRF-Var system. Using guidance from the work with ADAS, two key components of handling the AIRS profiles that needed to be transitioned to the new system were to: (1) effectively use the quality indicators to select only the highest quality observations and (2) assimilate the over land and over water soundings separately with different error characteristics to take into account emissivity issues that lead to degraded soundings over land. In order to separate the AIRS profiles into over land and over water soundings, changes to the WRF-Var source code were made to add AIRS-Water and AIRS-Land dataset with observation errors based on estimates cited by the AIRS Science Team.

Besides the observations and background field, one of the major components in WRF-Var system is the background error covariance matrix (B matrix). Correct use of the B matrix is important in determining the appropriate weighting between the background field and observations as well as how information contained in observations is spread horizontally and vertically. Optimal analysis configuration desires background errors that are consistent with the domain/grid spacing, the model used as the background, and the season. A B-matrix was calculated using the National Meteorological Center (NMC) method, which takes differences between multiple 12-and 24-hr forecasts to determine model error. Within the WRF-Var system, the B matrix is generated using the "gen_be" program. For this application, short-term WRF forecasts for a 2-week period (January 17–31, 2007) were used to generate the B matrix.

Figure 8 shows the preliminary results for January 17, 2007. Two swaths of AIRS profiles were used—one along the East Coast and the other over the Midwest. Figure 8b depicts the temperature difference between the AIRS profile and model background at 700 hPa and shows that AIRS is cooler than the background over Florida and the Great Lakes and warmer over the Southeast United States. The analysis increment (the difference between the analysis and background) in Figure 8c shows a similar pattern but with bull's eyes and stripping features, especially over Kansas and Missouri. The way that the analysis draws tightly to each observation indicates that the original horizontal length scale is too small. Tests were conducted using a WRF-Var tuning factor, which adjusts the spread of analysis variables by multiplying the length scale by a prescribed value. Subsequently, it was determined that increasing the length scale by 50% led to an optimal configuration that smoothed the bull's eyes and stripping features without compromising analysis fidelity. Figure 8d shows the magnitude and horizontal spread of the AIRS observations on the 700-hPa temperature analysis using the new length scale. Similar tests have been conducted for the moisture analysis, and it was determined that doubling the moisture length scale yields a satisfactory result.

The impact of the AIRS profiles on the WRF-Var analysis was also examined by comparing collocated soundings profiles of the short-term WRF-forecast background, AIRS profiles, and WRF-Var analysis near several radiosonde stations. In general, the temperature and moisture soundings of the AIRS-enhanced analyses lie between those of the background and AIRS profiles as it should for proper data assimilation. The inclusion of AIRS also produces a superior analysis to the background when compared to the radiosonde. Results indicate that AIRS profiles produce an analysis closer to in situ observations than the background field, which should lead to improved initial conditions and better forecasts when used to initialize a model forecast. Future work will focus on conducting model simulations using the AIRS-enhanced initial conditions for short-term (0–48 hr) regional WRF forecast. These forecasts will be verified against in situ observations and, if superior to control forecasts, will be transitioned to SPoRT's WFO partners for their local WRF runs.

AIRS Radiance Assimilation

One of the primary mission goals of the AIRS is to improve weather forecasting. The instrument provides high-spectral resolution measurements of the thermal infrared spectrum, providing 2,378 spectral channels from 3.74 to 15.4 μm. While other work at SPoRT focuses on the assimilation of retrieved profiles of temperature and moisture, work to assimilate direct radiance measurements has also been performed, eliminating the retrieval error from the total error of the observation and thus strengthening the impact of the observation on the analysis.

The impact of the assimilation of AIRS radiances in the framework of the NCEP/Environmental Modeling Center (EMC) operational North American Mesoscale (NAM) model at SPoRT, with cooperation and resources from the Joint Center for Satellite Data Assimilation (JCSDA) and NCEP/EMC, was investigated. Though the operational NAM runs to 84 hr, the focus of verification has been on the short-term (0–48 hr) forecasts as per the mission of SPoRT. The JCSDA has effectively shown that the use of AIRS measurements within an assimilation system can significantly improve medium range forecasts (Le Marshall

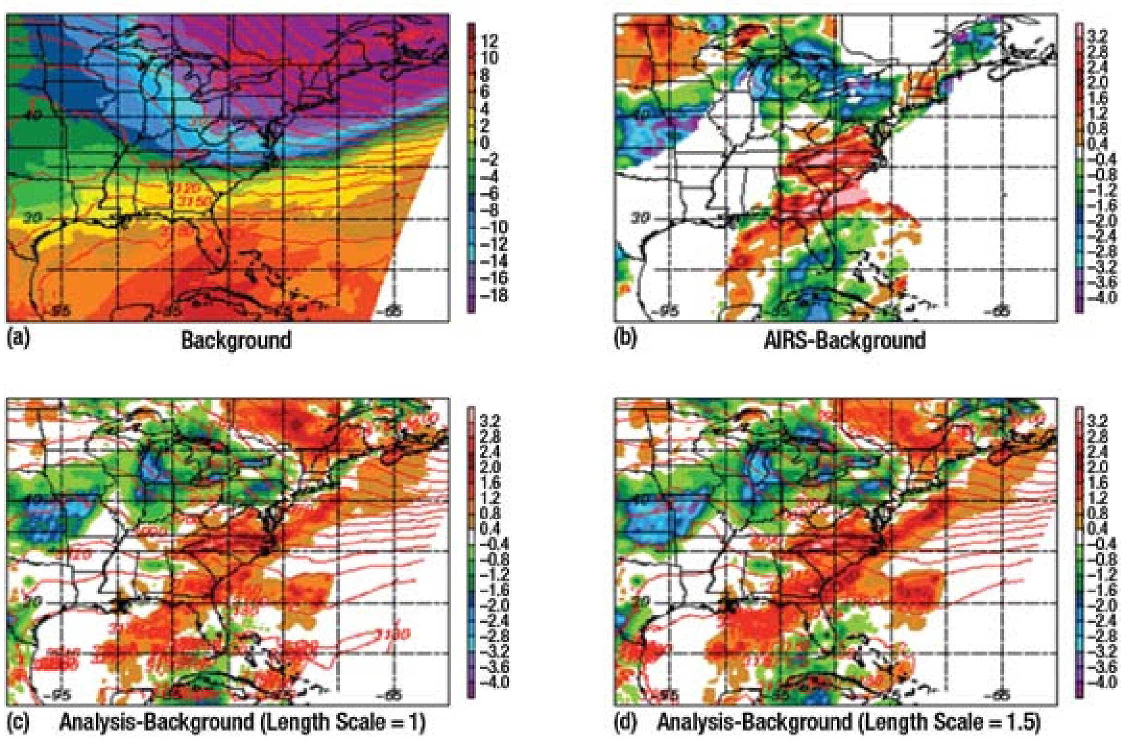


Figure 8. Analysis impact of AIRS on 700 hPa temperature. The difference between the AIRS and (a) the background field is shown in (b) resulting in the analyses in (c) and (d). Figure 8c shows the analysis with the original length scale that has obvious bull's eyes and streaking, while (d) shows the impact of tuning the length scale to remove some of those smaller scale features.

et al. 2006) within the NCEP operational Global Forecast System (GFS).

The research performed investigated forecasts, run four times daily, from April 9–16, 2007. A control run was performed using all data operationally assimilated in the NAM data assimilation system. For the AIRS experiment, AIRS radiances were used in addition to that of the Control. It is noted that the Advanced Microwave Sounding Unit (AMSU) onboard Aqua was not assimilated in either run. Assimilation is performed using the Gridpoint Statistical Interpolation (GSI) 3DVAR assimilation suite, which acts as the operational assimilation suite for both the GFS and the NAM at NCEP.

Results from the addition of AIRS to a system mimicking the operational NAM were positive. The incorporation of AIRS measurements resulted in the improved characterization of the troposphere in data void regions. The measurements were capable of detecting small-scale features in temperature and moisture in regions that are otherwise sparsely observed. By improving the initial analyses, the corresponding forecasts integrated from these initial states were also improved.

In considering the 500-hPa height anomaly correlations in Figure 9, a forecast improvement of 2.4 hr was observed by adding AIRS measurements to the data assimilation

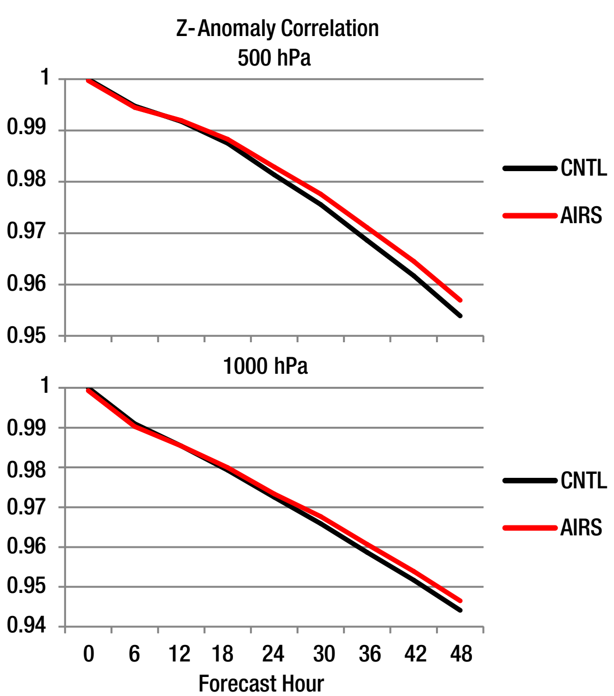


Figure 9. Height anomaly correlations for the control (black) and the AIRS experiment (red) at 500 hPa (top) and 1,000 hPa (bottom) for forecasts spawned during April 9–16, 2007

system. This improvement is defined as the time difference where the AIRS runs show equal skill or correlation to the corresponding analyses, as that of the control. For all forecasts spawned in the experiment, forecasts were improved consistently at 48 hr through the troposphere, as also shown at 1,000 hPa, which had a forecast improvement of 1.9 hr at 48 hr. These height anomaly correlations were performed over the continental United States.

The impact of including AIRS radiance measurements on precipitation forecasts was also considered. At 25 mm/6 hr, which is roughly an inch of rain in a 6-hr period, the bias and the equitable threat scores were improved by 8% and 7% over the control, respectively, showing that the AIRS data were improving the forecast of the heavier precipitation events. Though the AIRS experiment tended to have an increased bias toward the occurrence of precipitation below 25 mm/6 hr, the equitable threat scores over these thresholds were improved at thresholds of 11 mm/6 hr and greater.

The CO_2 sorting technique was developed and implemented to determine cloud contamination. Cloudy radiances were not assimilated in this work because the background fields and radiative transfer could not properly account for the effects of the cloud emission in the scene and the discontinuous nature of the cloud fields. The technique was based on the technique developed by Holz et al. (2006). Initially, it was used to classify cloud top pressure, but in this application, the tropospheric AIRS channel brightness temperatures in the 15-μm CO_2 absorption region were used to identify channels not affected by clouds. AIRS channels that sense emission from the lower part of the troposphere will be affected by the presence of a midlevel cloud and measure colder temperatures than a cloud-free spectrum of the same environment. Channels colder than the point where cloud contamination is determined to be present are not affected by the presence of clouds in the observed field of view and the brightness temperatures are lower for higher clouds, thus providing fewer channels uncontaminated by clouds, while low-level clouds have higher brightness temperatures. The magnitude of the cloud contamination signature, however, is a function of the effective cloud fraction (ECF), which is the product of the cloud emissivity and the physical cloud fraction of an instantaneous field of view (IFOV). Thus, the algorithm to detect cloud contamination incorporates more advanced approaches than a simple brightness temperature check.

The method had been developed previously utilizing the entire AIRS spectrum of the 15-μm absorption continuum. The method, however, had to be adjusted to the 281-channel subset available in near-real time for assimilation purposes. The technique, which is implemented within the GSI system, utilized a forward radiative transfer algorithm to determine the clear-sky IFOV. The implementation of the technique showed similar results to the cloud screening inherent in the GSI but did not require the use of tangent linear or adjoint calculations (Fig. 10).

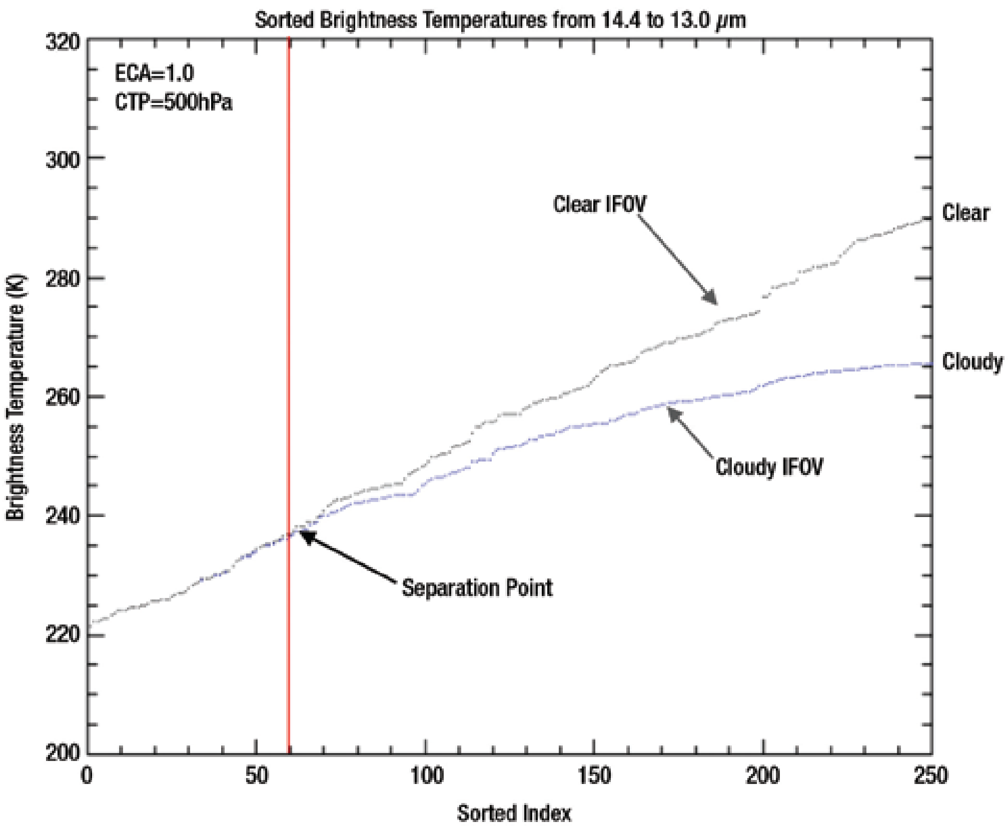


Figure 10. Simulated sorted AIRS brightness temperature spectra for a clear (black) and cloudy (blue) instantaneous field of view. The red line denotes the point where the two curves diverge, or the separation point, which distinguishes channels which are (right of line) and are not (left of line) sensitive to cloud emission.

3.0

Nowcasting

3.0 Nowcasting

LMA Use at WFOs Birmingham, Huntsville, Knoxville (Tri-Cities), and Nashville

The total lightning product derived from the NALMA data is a very useful tool that supports the SPoRT mission. The NALMA product provides high-spatial (2 km) and temporal (2 min) resolution lightning observations for real-time ingest into AWIPS. These data are regularly used by NWS forecasters for short-term severe and hazardous weather (cloud-to-ground lightning) situations. Discussions with NWS forecasters and their completed surveys (see “Assessments”) indicate that the NALMA data are one of the most valuable products that the SPoRT Center has transitioned.

The NALMA data provide several advantages to forecasters. One of the best documented is the lightning jump, as shown in Figure 11. Many storms show this rapid increase in lightning activity shortly before a tornado, hail, or strong wind event, providing forecasters valuable minutes to issue warnings to the public. The NALMA has been found to be most effective in low to moderate severe weather events, when radar signatures may not definitively indicate severe weather or when radar data are unavailable. The intracloud NALMA data have been shown to give a 3–5 min advanced notice to the onset of cloud-to-ground lightning activity. This has improved lead times for Terminal Aerodrome Forecasts (TAFs) and Airport Weather Warnings (AWWs).

In addition, a large number of new SPoRT lightning activities have occurred since the last SAC meeting. The Knoxville WFO has begun ingesting NALMA data for the western portions of their county warning area. SPoRT members have been involved in several presentations describing NALMA data and how it serves as a prototype for the eventual Geostationary Operational Environmental Satellite-R Series (GOES-R) Lightning Mapper. These presentations include the Intermountain Workshop with forecasters from both the western and central regions of the NWS, the Innovation Share Fair involving the regional WFOs surrounding Huntsville, and the SPoRT science sharing with the NWS Huntsville.

Visits to partner offices have indicated that total lightning data has garnered a great deal of interest, but there is plenty of room for training on how to best utilize the data.

SPoRT has also responded to its partners and their requests. A detection efficiency product and lightning warning threat product for lightning safety are currently under development. The latter product will be used by the NWS and potentially the Marshall Space Flight Center (MSFC) Emergency Operations Center. MSFC has expressed interest in collaborating with SPoRT to help in the Center’s lightning safety warning responsibilities. All of these capabilities will also be transitioned to the new AWIPS II operating system as that becomes operational in 2009. SPoRT will utilize AWIPS II’s enhanced visualization capabilities to develop new products using total lightning data.

Finally, the NALMA network is expected to undergo major renovations. Efforts are underway to upgrade the network to an Internet-based communication system to improve data flow. There also are plans to add one or two more sensors to the NALMA network.

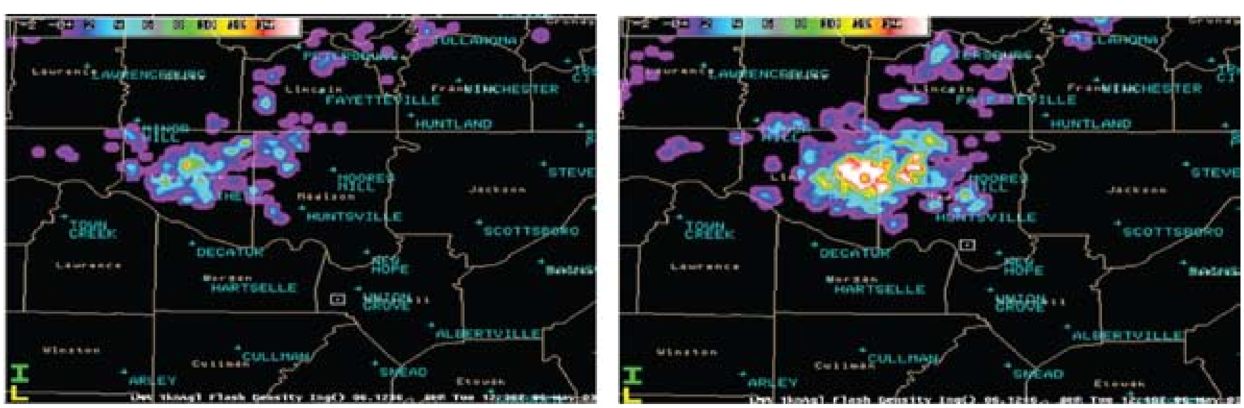


Figure 11. (Left) NALMA source density product as a storm approaches Madison County at 1236 UTC. Source densities at this time are less than 60 sources. (Right) NALMA source density product at 1246 UTC, showing a very intense lightning jump. The maximum source density reaches nearly 175 sources and a distinctive lightning hole can be seen. This jump preceded two tornadoes (F0, F1), with a lead time for the first of nearly 20 min.

Convective Initiation Product Use at WFOs

Convective Initiation (CI) activities within NWS WFOs are currently in a phase of redevelopment. During the summer of 2007, a CI assessment was held with the NWS WFO Huntsville. Several exercises were held to train the forecasters of the usefulness of the algorithm along with the advantages and disadvantages. Due to the prevailing drought conditions over the southeastern U.S. and subsequent lack of convection during summer 2007, few significant convective events were observed. Efforts are underway to transition a nighttime CI product to the Huntsville WFO in order to have both a day and night version operational. Additional improvements will be made to give WFOs easy access to the CI nowcasts for their specific county warning area. During this transition, WFO Huntsville will continue to receive data.

The CI nowcast product is also being supplied to the NASA SPoRT FAA project (see Section 6: Other Related Projects). This product will help forecasters identify regions of convective activity in the NYC TRACON domain. The algorithm has been set up over the region (Fig. 12) and data are being supplied to ENSCO forecasters for evaluation.

As part of a recently-funded NASA Research Opportunities in Space and Earth Sciences (ROSES) 2007 proposal, the CI algorithm is being optimized for different convective regimes. Using satellite-based radar data from Cloudsat and Calipso, differences are being identified among the various indicators currently in use so as to tune the CI algorithm and ultimately improve the probability of detection and minimize false alarm rates for a wide range of convective regimes.

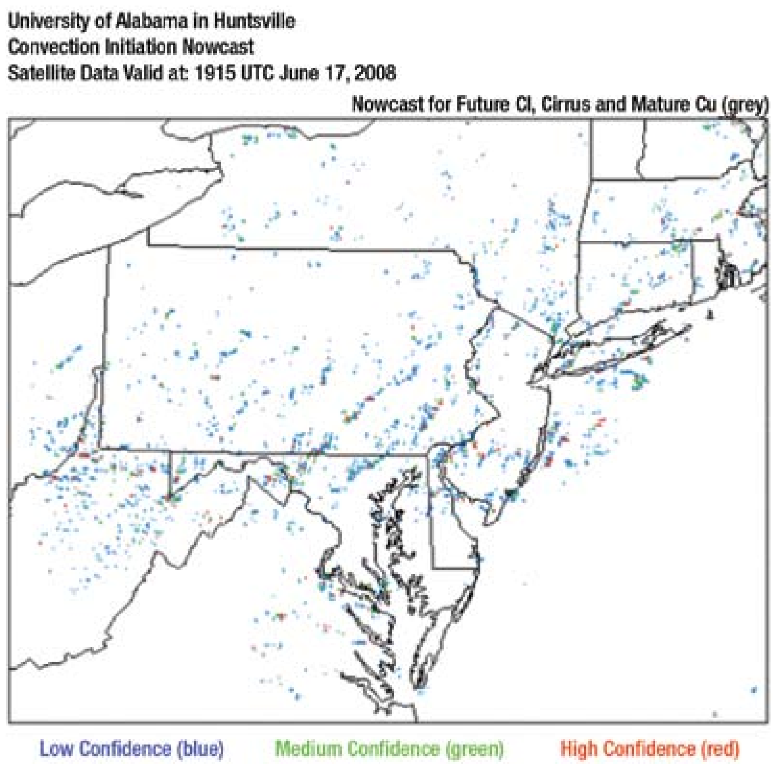


Figure 12. Example of the CI product centered over the domain of the NYC TRACON.

4.0

Data and Transition

This image depicts a full view of the Earth, taken by the Geostationary Operational Environment Satellite (GOES – 8).
Image credit: NASA MSFC

4.0 Data and Transition

New Products to Operations

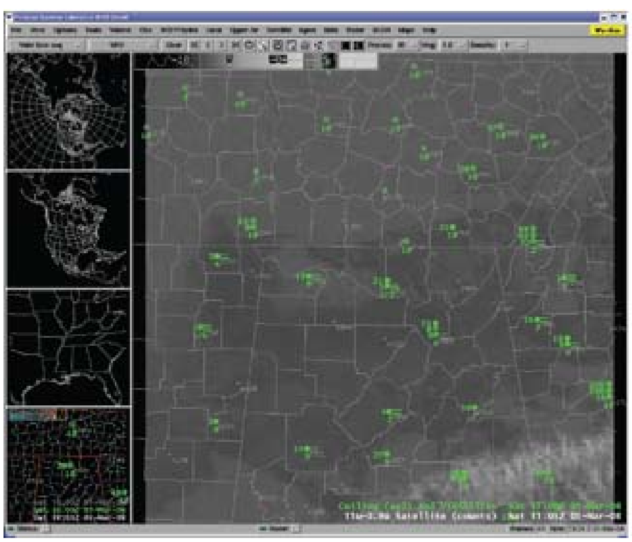
Typically, inclusion of new products into the baseline AWIPS software can be a lengthy process involving multiple stages and requiring approval from numerous groups. Due to SPoRT's test bed capabilities, close proximity to the Huntsville WFO, and close relationship with Southern Region Headquarters, several organizations have partnered with SPoRT to transition their products to the operational framework in a more timely manner. Feedback on test bed products will lead to improved products that may eventually become standard in the baseline AWIPS software. Among the organizations partnering with SPoRT is the National Oceanic and Atmospheric Administration (NOAA)/ National Environmental Satellite, Data, and Information Service (NESDIS), the Cooperative Institute for Research in the Atmosphere (CIRA), and the AIRS Science Team. What follows is an overview of the recent products that SPoRT has added to AWIPS.

GOES Aviation Products

SPoRT has partnered with NOAA/NESDIS to provide a set of aviation products derived from 4-km GOES images. Four new products have been transitioned: Icing (2-D extent), Icing Height, Low Cloud Base, and Fog Depth. Because forecasting aircraft icing is not a local WFO problem, the Fog Depth and Low Cloud Base products are the primary products of interest to the NWS. The Fog Depth and Low Cloud Base products aid aviation forecasters at the WFO in monitoring cloud ceilings, horizontal visibility, and fog characteristics by allowing them to monitor the two-dimensional development and advection of fog events. Such capabilities are difficult using low-density, point observations such as METARs, which require a forecaster to visually interpolate these fields over the forecast area (the coarse resolution of METAR stations in the Tennessee Valley is shown via the green points in Figure 13). In addition, since ceiling and visibility conditions can change rapidly in space and time, operational mesoscale numerical models can not typically capture localized events. Hence, the Fog Depth and Low Cloud Base products can provide longer nowcasting lead times than using METARs alone. Additionally, METARs do not provide an indication of fog depth, which affects how a forecaster will anticipate the dissipation of fog or low stratus related to aviation safety thresholds.

Both the Huntsville and Melbourne WFOs had been acting as test beds for the initial evaluation of these products. Positive feedback from the test bed WFOs along with the significant interest from other SPoRT partner WFOs led to this new product being more widely distributed. In March of 2008, work began to transition these products to every SPoRT partner WFO in conjunction with a move to the Local Data Manager (LDM) software (see "Data Dissemination" section for details).

Fog Depth is available every 15 min, and Low Cloud Base is available every hour; both are only valid at night. Fog Depth is created using the difference in brightness temperature of the 11-μm channel minus the 3.9-μm channel



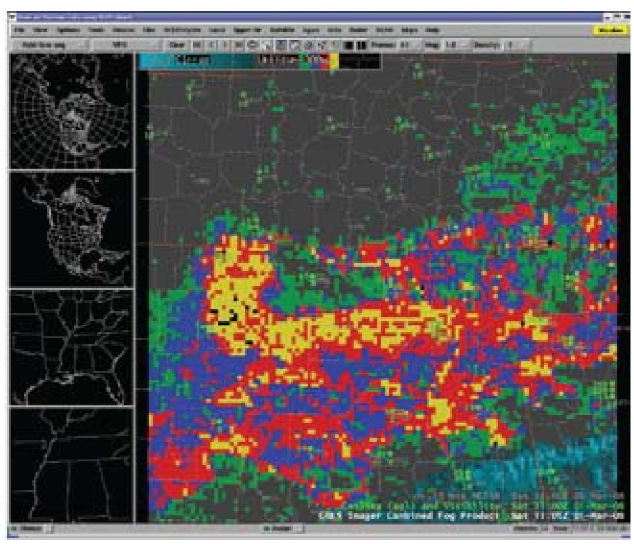


Figure 13. Example GOES 11-3.9 μm Difference Product in AWIPS with a standard black and white enhancement on the left and the NESDIS Fog Depth enhancement on the right. Both images are at the same time and show the METAR locations (green) where point values of ceiling and visibility are available.

along with a unique NESDIS enhancement developed by Gary Elrod using correlations to Pilot Reports (PIREPs). The estimates of the fog depth are based on variations in the positive values in the brightness temperature difference. While the 11–3.9 µm difference is not necessarily a new product to forecasters, the addition of the fog depth enhancement allows forecasters to more easily and quickly glean the information they need from the imagery. The left-hand image in Figure 13 is the 11–3.9 µm difference product with no enhancement, and the right-hand image is the same data with the new Fog Depth enhancement. The right-hand image clearly demonstrates that the extent and depth of the fog is more easily determined. The Low Cloud Base product complements the Fog Depth product by focusing the forecaster's attention on areas likely to have ceilings less than 1,000 ft and eliminating false indications of fog due to weaknesses in the fog depth estimate. The Low Cloud Base uses the 11–3.9 µm difference as a start and applies a threshold to the difference between the 11 µm and surface-analyzed temperatures in order to categorize cloud bases less than 1,000 ft.

The Knoxville/Morristown WFO has used these products to see fog developing in low lying lake areas and to monitor its advection toward local airports. The Huntsville WFO has experienced fog events where conditions improve at a forecasted airport to allow visual flight rules and then rapidly deteriorate due to a secondary fog area passing the same airport within the next hour. Seeing the extent and depth estimate of the fog in this case allowed the forecaster to maintain low ceilings and visibility in the short-term forecast. In addition, the fog depth estimate via the GOES product allows forecasters to better anticipate the timing of fog and low stratus dissipation and hence improved aviation conditions.

Future plans include a more intensive evaluation period of the Fog Depth product by the WFOs, coordinated by SPoRT. This evaluation will provide feedback to the AWIPS Program Office regarding operational value of this product. In addition, there is interest in applying this same NESDIS enhancement to 1-km MODIS imagery as an example of future GOES-R capabilities and to allow greater detail in areas of varying topography.

Total Precipitable Water Products

Recently, SPoRT has begun collaborating with CIRA to transition two Total Precipitable Water (TPW) products to SPoRT's WFO partners. Water vapor products from satellites provide a unique capability to view moisture patterns over data sparse regions such as oceans. Besides radiosondes, which have coarse spatial resolution, most observations only report surface conditions; however, upper-level moisture plumes and gradients signal the potential for severe weather events, flooding, and tropical systems. Remotely-sensed products aid in filling the data void.

Discussions to transition the CIRA TPW products began during the Science Operations Officer workshop held in Huntsville in July 2006. Many of the attendees—representing all 32 WFOs in the Southern Region—expressed interest in receiving these data to enhance forecasts. This interest was repeated during the June 2007 SAC meeting. With this level of interest, SPoRT has worked with CIRA to provide TPW and TPW Anomaly (TPWA) products for AWIPS.

The CIRA TPW and TPWA products are developed by blending over-water data from AMSU, Special Sensor Microwave/Imager (SSM/I), and over-land TPW observations from GPS over the continental United States. Aside from the GPS data, the CIRA products are developed from polar orbiting satellites, resulting in a product that is updated every 6 hr. The TPWA product is derived by comparing the TPW product to the mean weekly field from the NASA Water Vapor Project (NVAP) climatology. These data are capable of being viewed as loops to assist forecasters in discerning trends.

As of June 2008, all but two SPoRT partners are receiving the CIRA products via the NWS Southern Region Headquarters LDM network (see "Data Dissemination"). Early feedback has been positive, particularly from the coastal WFOs. A training module on the application of CIRA TPW products is in development based on the experiences of the Miami WFO, the NESDIS Satellite Applications Branch, and the developers of CIRA. This module will likely be released by August 2008.

As of June 2007, SPoRT was providing a few unique, value-added GOES products to The Weather Channel for "on-air" tropical weather coverage. As this partnership matured, discussions to provide The Weather Channel with NASA-specific observation products (particularly over the Atlantic Basin) initiated. The result has been a multiorganizational collaboration that provides The Weather Channel with a TPW product for use in their Tropical Weather segment. The Weather Channel currently receives the Morphed Integrated Microwave Imaging at CIMSS (MIMIC)-TPW product from the Cooperative Institute for Meteorological Satellite Studies (CIMSS) via SPoRT. CIMSS uses microwave retrievals from AMSR-E and SSM/I to obtain TPW observations over the Atlantic Basin. Unlike the CIRA TPW, MIMIC does not use AMSU data because the MIMIC product is sensitive to the different instrument retrieval biases. Blending lower-tropospheric mean layer GFS winds and treating TPW as a conservative tracer, TPW is "advected" to provide nearly seamless hourly animations.

Recently, the Miami WFO has expressed interest in bringing the MIMIC product into AWIPS. Miami envisions the MIMIC product as a complement to the CIRA products benefiting from the hourly data. CIRA blended TPW products would remain in use, as it utilizes GPS data to provide TPW observations over land.

AIRS Profiles

SPoRT has collaborated with the AIRS Science Team to assist them in implementing their Level-2 thermodynamic profiles into AWIPS. AIRS profiles may aid in describing the preconvective environment where severe weather is forecasted. A limitation of the national radiosonde network is that observations only occur at 0000 and 1200 UTC (with some special asynoptic soundings). Because AIRS observations occur at asynoptic times, these soundings can assist in filling the temporal data void. In addition, AIRS soundings provide better spatial resolution than radiosondes with approximately 50-km spacing at nadir.

As of June 2008, initial steps have begun to introduce the AIRS profiles into AWIPS. The technique for adapting the profiles for AWIPS is similar to that of GOES sounder profiles. The forecaster is given a plane view of the available data and a number of configurable points that they can position and produce a Skew-T diagram of the nearest AIRS point to the locations they have selected. Additionally, a near-real-time sounding comparison tool has been created to expose forecasters to the strengths and limitations of AIRS profiles. This is a web-based display <http://weather.msfc.nasa.gov/sport/airsraob/> of Skew-T diagrams and convective parameters of AIRS side-by-side with traditional soundings from radiosondes and derived NAM forecast soundings. An example of the three types of soundings compared on the site is shown in Figure 14. From this particular comparison, a forecaster learns that AIRS performs as well as the NAM in picking up low-level moisture and the shallow dry slot between 300 and 400 hPa—both of which are observed in the radiosonde.

Data Dissemination

The SPoRT project is focused on transitioning NASA EOS data to our partners in support of short-term, regional forecasts. While SPoRT is not an operational weather data provider, SPoRT works with our partners to develop methods to improve the transition of products. These unique datasets combined with training leads to the successful transition of the knowledge necessary for SPoRT's partners to use these data effectively (see Appendix 4).

At the time of the last SAC meeting, SPoRT products were distributed through a local File Transfer Protocol (FTP) machine. This method has several inherent drawbacks. First, each partner had to individually establish a secure connection with the SPoRT FTP host, creating numerous security issues as multiple holes had to be established in the firewall. Second, the FTP system requires each partner to run retrieval scripts every 10–15 min to actively search for new products. If a product requires 30 min to create and is uploaded just after an active search is conducted, a partner may have a lag time of up to 45 min before the product is retrieved. Third, the FTP fulfills each request in the order it is received. Therefore, if several partners all initiate a download in rapid succession, each partner must wait "in line" for the previous partner to finish the download. This further deteriorates the timeliness of SPoRT products.

SPoRT was only supporting six WFOs and a single private entity (World Winds, Inc.) during the previous SAC meeting. Here, the limitations of the FTP system were not a major liability. Since late 2007, SPoRT has expanded to incorporate eight new NWS organizations. Including the new partner WFOs, SPoRT is now collaborating with 12 WFO organizations (see Appendix 5) and the Spaceflight Meteorology Group (Fig. 15). The FTP distribution system was simply too cumbersome for this.

SPoRT has made a concerted effort to work more closely with the NWS Southern Region Headquarters (SRH) located in Ft. Worth, Texas. The SRH is the main administrative center for all but the Great Falls, Montana WFO. SPoRT has worked closely with SRH to take advantage of the LDM distribution system that is installed in all Southern Region offices. The LDM provides several advantages

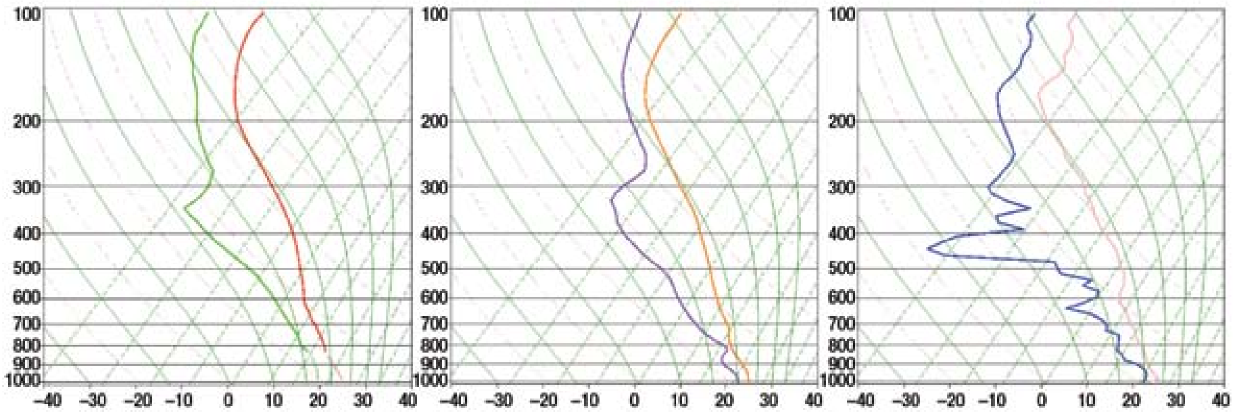


Figure 14. Sounding comparison for June 10, 2008 at Slidell, LA (LIX) for AIRS (0900 UTC; left), 12-km NAM (9-hr forecast valid at 0900 UTC; middle), and radiosonde (1200 UTC; right). Figures taken from interactive sounding comparison web site.

in the distribution of SPoRT products to our NWS partners. The LDM actively sends new products to partners requesting data at the moment that the data become available, greatly reducing the lag time. Southern Region Headquarters now plays a more prominent role in the data dissemination. This allows the NWS to be more involved in the development process, thereby enhancing the collaboration. Additionally, utilizing the LDM network simplifies the transition process. When a new product is developed, SPoRT only needs to send the data to SRH, instead of each partner individually. This greatly streamlines the process as new partners can easily be added, or existing partners can quickly modify what products to ingest.

With the LDM network active, SPoRT began documenting the flow of products to SPoRT partners. This effort has evolved into the interactive SPoRT Data Distribution web page <http://weather.msfc.nasa.gov/sport/nwsdistribution/>. Initially conceived as an in-house tool, the distribution page now provides a central site for information on SPoRT partners and the products being transitioned. The site also provides a record of SPoRT's efforts to switch all data distribution from the FTP client method to the LDM service.

SPoRT currently provides a wide variety of products developed both in-house and with collaborators utilizing

Figure 15. The current distribution of SPoRT partners. The green dots are the direct broadcast sites that provide data to SPoRT. The blue dot is World Winds, Inc., a private industry partner, while the red dots represent the 14 Weather Service Organizations that collaborate with and receive data from SPoRT.

SPoRT's ability to transition products into the NWS's AWIPS environment. The WFO partners receive a suite of products from both the MODIS and AMSR-E instruments. NALMA data are now sent to three of these offices (Birmingham, Huntsville, and Nashville), along with the newest WFO partner Knoxville/Morristown. The Huntsville office, which is colocated with SPoRT, serves as a test bed site and collaborates with SPoRT on transitioning every product. This ensures that each product is useable within the AWIPS environment. In addition, WFO Huntsville is testing the CI product (see "Convective Initiation Use at WFOs") and the redeveloped SPoRT ADAS surface analysis product. These products are still distributed via the FTP network, although the SPoRT ADAS is already using the LDM. By Fall 2008, all FTP connections with WFO partners will be switched to the LDM network.

All 12 SPoRT WFO partners as well as the Spaceflight Meteorology Group are linked to the LDM network for two new product transitions. These include the GOES Aviation and CIRA Total Precipitable Water products. By June 2008, all but two partner WFOs were ingesting these products.

There are several dissemination projects underway in addition to the switch to the LDM network. The most ambitious involves the deployment of the AWIPS II forecaster workstation. SPoRT is already working to ensure that products will be transitioned to, and enhanced by, the new environment as AWIPS II becomes operational in 2009. The CI group will be expanding the operational domain during the Fall of 2008, allowing most SPoRT partners to use this widely requested product. AIRS products are likely to be transitioned between Fall 2008 and Spring 2009. Finally, efforts are underway to develop model initialization products for use in mesoscale models run by the various WFOs. This effort is developing out of the "WRF Local Forecasts with SSTs" and "WRF LIS Sensitivities Studies" projects.

Training

Training is a key component to successful transition of new products and capabilities into operations. When the user does not have confidence and a level of comfort with the application and reliability of the new product or capability, he or she will inevitably resort to previous methods and tools, which may be less effective. This is not surprising because existing methodologies have familiarity that allows the user to efficiently develop a forecast in a time-sensitive 24-by-7 operational environment. To overcome this, SPoRT must incorporate training methods that provide interactive learning. Several successful approaches are used as well as a new distance-learning development tool.

SPoRT staff continues to make visits to the WFOs and other partners with plans to visit all partners by the end of the 2008 calendar year. A recent trip included stops at the Houston and Corpus Christi WFOs as well as the NWS Southern Region Headquarters and the Space Flight Meteorology Group in Houston. These opportunities allow SPoRT to highlight products and their applications that are relevant to the individual WFO needs. Training takes place through these presentations but is enhanced by the direct interaction with the users. SPoRT staff is able to answer questions and have discussions at the same time that the product is displayed and demonstrated in the operations area on the user's native software. Similarly, more frequent opportunities for interactions are occurring at the colocated Huntsville WFO through regularly scheduled presentations.

At the celebration of the 5th anniversary of SPoRT providing MODIS data to the NWS WFO in Huntsville (HSV), a revival of the "Science Sharing Sessions" was started. These are short demonstrations (~10 min) of a particular product with time for questions and interaction with the HSV staff in the operations area. These occur about every 2–3 weeks, often with the same product being discussed over consecutive sessions. This ensures the greatest number of staff are reached, since forecasters operate in shifts. The science sharing sessions had become very infrequent due to SPoRT staff changes, but additional staff was hired after June 2007, which helped provide resources to oversee this program. While this is very beneficial to the HSV staff, SPoRT still needs methods for reaching the other WFO partners in a similar manner without having to constantly travel to each location.

Therefore, a new method of delivering training via distance-learning has been made possible through the use of software by Articulate Global, Inc. Articulate Presenter and Articulate Quizmaker are software packages that allow anyone with PowerPoint software to create professional e-learning modules and/or courses. Articulate software transforms a PowerPoint file into a Flash-based object that can be distributed and viewed by anyone with a Web browser. The first benefit is that the presenter can add their own audio narration or can incorporate audio contributions from multiple authors. Secondly, the modules can incorporate animations and interactions such as moving text and objects over graphics and quiz questions from Articulate's Quizmaker. This third method complements the previously mentioned training techniques. Presentations given during visits to WFOs often are to a subset of the local staff due to the nature of shift work. These presentations can easily be converted to Articulate Presentations for not only absent staff but for use by other SPoRT partner WFOs with similar needs. Presentations developed for Science Sharing sessions are ideal for conversion to a Flash-based, e-learning module because the presenter has become practiced at speaking about the content over multiple sessions and has refined the presentation based on immediate feedback and direct interaction with the forecasters. Not only will this serve as a training tool, but also as a tool for communicating the assessment work for a given product. Articulate features and usage have been shown to the SPoRT staff with the idea that even conference presentations could be converted to Articulate for sharing with and benefiting SPoRT partners.

The methods of training just described meet the needs of SPoRTs partners in several ways. The visits and science sharing sessions provide opportunities for direct interactions. Through these interactions SPoRT is able to better understand the partner's needs as well as provide science and technical support. For example, during the recent trip to visit partners in Texas, SPoRT was able to address visualization problems at the Corpus Christi WFO regarding the CIRA TPW products. Being onsite allowed SPoRT to quickly diagnose the problem and demonstrate the solution. Additionally, there were a number of science-based questions about the CIRA TPW and the MODIS SST products including how they are derived and their strengths and weaknesses. The partners provided further feedback, requesting the transition of the Latency product for the MODIS SST Composite in order to provide quality assurance information. Additional training took place at WFO Houston. The Houston office has access to Lightning Detection and Ranging (LDAR II) data. During the visit, SPoRT had the opportunity to provide more application training. SPoRT presented examples of LMA use in Huntsville that focused on utilizing LMA data to flag nonsevere or marginally severe storms that could produce hail, discern cell intensification when radar data are inconclusive, and use LMA data as a possible warning to the onset of cloud-to-ground lightning.

The operational environment can be fast-paced and very time-sensitive. The science sharing sessions as well as the Articulate modules are designed to provide short, concise information with minimal interruption to operations. SPoRT has a goal of about 15 min in length or less for its training modules, but this can be tailored for a specific purpose.

A published module using Articulate occurred shortly after purchase and several different training efforts are currently underway. SPoRT has completed a Flash-based training module on the Fog Depth and Low Cloud Base products from the GOES Aviation Suite (see Fig. 16). This module stemmed from a science sharing session presented at the 5th anniversary event in addition to the recent transition of this data to all partners via LDM. Many forecasters found this information useful and as a result several changed their "fog procedure" in AWIPS to include these products. The module is available on SPoRT's training site and a download version allows local playback for NWS users with limited bandwidth.

Along with the transition of the GOES Aviation Product, the CIRA TPW and TPWA were included. The Miami WFO had already been testing the use of these products and had found great benefit in monitoring moisture plumes and tropical waves. SPoRT has begun developing a training module for these products. The Science and Operations Officer (SOO) from the Miami WFO, a CIRA TPW developer, and a forecaster from the NESDIS Satellite Applications Branch are collaborating with SPoRT to develop the content and contribute example graphics for this training. Publication will likely occur in August of 2008.

The Lightning Mapping Array (LMA) source density product is the next major training topic to be developed by the SPoRT Center. The LMA training will follow the format of the GOES Aviation Flash-based module to keep the presentations short and concise. There are three separate actions occurring for training with the LMA. The first is an LMA Primer. This primer is envisioned to be no more than 5–10 min in length and will focus on a brief overview of the LMA network. In addition, a quick synopsis of what the LMA can and cannot do will be included. Work on this has already begun with a NASA lightning expert. The next two LMA training initiatives are more involved than the initial primer. Particular cases where the LMA data were used are being selected for investigation. This may result in one or more short training modules focusing on

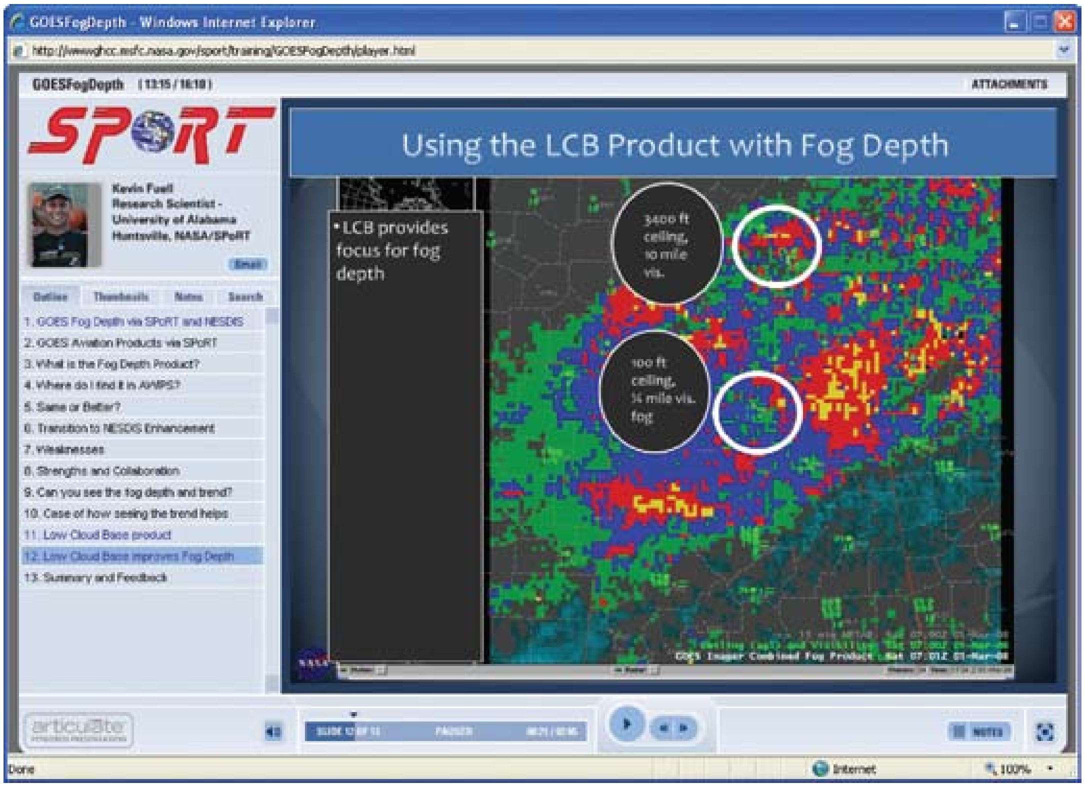


Figure 16. View of the Web interface of an Articulate Presentation created for training on the GOES Aviation Fog Depth Product. The PowerPoint slides are embedded within the Flash-based interface that shows the module outline, audio timeline, total time completed (upper left), and the presenter.

specific LMA forecast issues. This training will assume a basic understanding of the LMA, as provided by the primer. These specific LMA forecast issues range from understanding lightning jumps, using LMA data to give advanced warning to the onset of cloud-to-ground activity, as well as focusing how LMA observations can demonstrate that lightning remains a threat in a storm even if the cloud-to-ground activity appears to have ceased. Lastly, the SPoRT Center has begun a round of visits to each Weather Service partner. Discussions with offices that have access to total lightning data (not specifically North Alabama LMA data) indicate that there is a great deal of interest in incorporating total lightning data. Lastly, science sharing sessions have been conducted for the surface analyses from ADAS being provided to the Huntsville WFO. A Flash-based training module (via Articulate) will likely be developed from this science sharing as well as from future sessions being developed for select MODIS products.

Assessments

One of the key features of the SPoRT program is the policy of not throwing data over the fence. SPoRT makes a dedicated effort to communicate with our partners to learn what the forecast needs are and to provide products that directly address those needs. In effect, the transition process requires communication between both SPoRT and the partner WFOs. The working model SPoRT has developed involves discussing forecast concerns with the WFOs, who in turn provide feedback about the effectiveness of these products in the WFOs' forecast operations. This feedback is formalized in the SPoRT Assessment program.

For each product, or group of similar products, SPoRT provides an online assessment form for forecasters to submit. A great deal of work has been undertaken since the last SAC meeting to provide a greater range of assessments that cover more SPoRT products as well as improve on the SPoRT Assessment Web page <http://weather.msfc.nasa.gov/sport/sport_transition_assessment.html>. The design goal of the assessments is to create a survey that is as unobtrusive to the forecasters as possible. The assessments are designed to be filled out in just 2–3 min. By keeping the assessments concise, forecasters are more likely to submit the assessments, particularly after interesting events. Once the online assessment is finished, a copy is e-mailed to the SPoRT liaisons and archived in a product database.

The redesign of the SPoRT Assessment page has progressed rapidly, with assessments typically being posted as new products and are still being disseminated to the current SPoRT partners. At the time of the last SAC meeting, the only assessments available were for the MODIS products in general and for the NALMA. These have a good selection of product reviews from the original SPoRT partners (i.e., before the expansion in 2006 after the SOO Workshop). Most of the SPoRT partners, both original and new, have just received the first new product transitions in May 2008. As a result, many of the newer assessments have no submissions while the partner offices grow accustomed to the new products.

Another major change since the SAC meeting was the introduction of two new SPoRT members. Mr. Kevin Fuell and Dr. Geoffrey Stano have joined SPoRT in the role of liaisons to the National Weather Service. The arrival of both new SPoRT members also fulfills one of the key action items posed to the SPoRT Center by the SAC committee. In addition to supporting transition operations, both individuals have been tasked to work with the WFOs to develop additional assessments of the SPoRT products. One method to pursue this goal has been the initiation of a monthly SPoRT/National Weather Service coordination call. These calls allow SPoRT to discuss with every partner at once new developments as well as allowing the SPoRT partners to share findings about transitioned products.

The following paragraphs briefly describe the results from the current formal assessments. Several comments from forecasters also are included. These do not come from the formal assessments, but are simple feedback about various SPoRT products that came about in discussions with the forecasters.

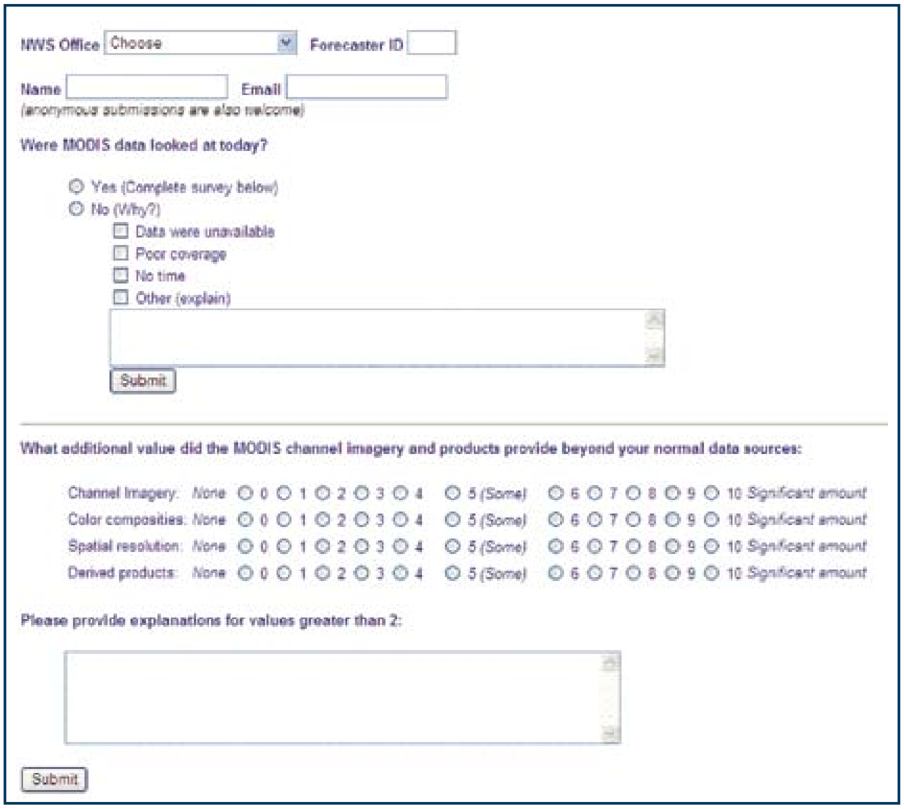
The MODIS products are currently available at six of SPoRT's partner WFOs. The remainder of the partner offices will begin to receive MODIS data by this fall. Since January 2008, there have been 17 assessments of the MODIS products being used. This particular MODIS assessment is generic in nature, allowing for comments on all available MODIS products. All 17 assessments have come from the Miami, Florida WFO, who has been a strong supporter of the SPoRT partnership. There were 20 more surveys submitted when the MODIS products were not used, with most of these coming from the Miami office and two from Huntsville, Alabama.

Among the times when MODIS data were not used, the vast majority were related to current weather conditions or the instrument itself. During quiet weather scenarios, the MODIS data have not provided additional information to the forecasters. In these situations, existing forecaster tools have been sufficient. Additionally, if the MODIS pass did not cover the county warning area, the data were not used. This accounted for most of the 20 assessments. Two of the twenty assessments were sent to alert the SPoRT liaisons of data outages, rather than to assess the MODIS products. This resulted in developing an online request support form, now included on the SPoRT Assessment page (Fig. 17). The remaining assessments had no comments listed.

The results of assessments for when MODIS products were used are encouraging, although two scenarios can be seen. MODIS data are "hit or miss" when used. In 11 of the 17 surveys, MODIS products are rated as 7–10 out of 10. Scenarios included filling in observation poor regions (e.g., Gulf of Mexico), detecting fire hot spots, detecting smoke plumes to update Hazardous Weather Outlooks, discerning multiple cirrus layers, and providing SST forecasts when the buoy observations were unavailable. Additionally, these positive assessments showed the forecasters using the low-temporal resolution MODIS products in unique ways.

This unique use is very encouraging to see, as the forecasters are looking to utilize the low-temporal, but high-spatial resolution MODIS data. One example is with the 11 – 3.9 μm or Fog product. Typically, this would be used to detect fog at up to 1-km resolution. However, forecasters have used this to detect fire hot spots, particularly when high cirrus clouds would obscure these locations in conventional GOES imagery. Additionally, the SST product has been utilized to support surf forecasts.

Six of the 17 assessments indicated that the MODIS data were used but received low rankings. However, only one can be considered negative. This occurred when the Fog product did not properly identify the location of fog, resulting in the forecasters not issuing a dense fog advisory when one should have. Three of the six were neutral, as the MODIS data were used to monitor current


NWS Office Choose Forecaster ID

Name Email
(anonymous submissions are also welcome)

Were MODIS data looked at today?

- Yes (Complete survey below)
- No (Why?)
  - Data were unavailable
  - Poor coverage
  - No time
  - Other (explain)

Submit

What additional value did the MODIS channel imagery and products provide beyond your normal data sources:

Channel Imagery: None 0 1 2 3 4 5 (Some) 6 7 8 9 10 Significant amount
Color composites: None 0 1 2 3 4 5 (Some) 6 7 8 9 10 Significant amount
Spatial resolution: None 0 1 2 3 4 5 (Some) 6 7 8 9 10 Significant amount
Derived products: None 0 1 2 3 4 5 (Some) 6 7 8 9 10 Significant amount

Please provide explanations for values greater than 2:

Submit

Figure 17. A generic assessment form for the SPoRT Center MODIS products.

conditions, but did not sway the forecast one way or another. Two received a rating of one, but occurred in quiet weather conditions. This indicates that the MODIS data simply were not valuable in these quiet situations.

Overall, the initial response to MODIS is positive. While not always available, in specifically focused scenarios, the MODIS data have been quite valuable. Discussions with several of the newer partners who are awaiting MODIS data indicate that the SST products are highly anticipated.

The Great Falls, Montana WFO is one of the original SPoRT partners and is the only Western Region partner. Great Falls' location gives it a unique status among the SPoRT partners as the others are located within the southern third of the United States. Because of the radically different climate, Great Falls presents opportunities to assess SPoRT products in ways that are simply not possible in warmer climates.

The clearest example is the assessment of the MODIS False Color composite product. This MODIS product can discern between clear ground, snow covered ground, and cloud cover; conditions that are more difficult to differentiate in standard visible satellite imagery. These data have been received by the Great Falls office for several years and SPoRT initiated an intensive evaluation period during February 13–March 3, 2008. A series of synoptic systems brought several inches of snowfall to the region from late January to early February. By February 13, the daily highs were reaching above freezing and remained so for the remainder of the evaluation period. During the evaluation period, the Service Hydrologist, Gina Loss, utilized the False Color product to monitor snow melt and river ice in order to maintain awareness of potential flooding conditions. Additionally, it was noted that the False Color product could be used to adjust surface temperature forecasts, based on the location of the boundary between snow covered and clear ground. This feature was not evaluated during the Spring season.

Even with eight days in the period obscured by cloud cover, the MODIS False Color product proved to be beneficial. Snow cover and snow melt were accurately located and the product provided information in regions that have sparse populations and limited in situ observations. Conditions did not change rapidly enough to warrant concern from large-scale flooding. However, the Hazardous Weather Outlook was modified to indicate ice jams on local rivers due to melting. Additionally, the MODIS True

Color composite product was used to augment the False Color product observations. The True Color product was used to get a clearer view of topographic features where the False Color product indicated snow and ice cover.

At the end of the assessment period, Gina Loss indicated that the MODIS False Color product was a valuable addition to her office's forecasting toolkit. This product helped look up to a week in advance to warn emergency managers about potential flooding conditions. The product also was valuable in more efficiently utilizing manpower. Before the MODIS product was available, individuals would be sent to remote locations to determine snow and ice conditions. Now, with the MODIS False Color product, there is a greatly reduced need to send individuals into the field to obtain these observations.

The best assessed product transitioned by SPoRT is the gridded total lightning source density product. This is received by four partner offices. There were a total of 42 assessments received by SPoRT. These assessments indicated clear scenarios when the NALMA data were valuable. Furthermore, comments by forecasters have led to SPoRT investigating additional uses for the NALMA data beyond the original "lightning jump" scenario (see "Training"). The assessments described below cover the period from November 2003 to June 2007.

The assessments covered a wide variety of events, from supercells to small hail producing storms. Overall, the assessments indicated that radar reflectivity was still the most useful tool, with a rating of 8.8 out of 10. However, the NALMA was rated second, overall, with a 6.9 rating. The forecasters indicated that the NALMA provided, on average 2.5–3.2 min of estimated lead time.

There are two groups of surveys. The first were for events with at least one tornado warning issued. This covered 11 surveys with 68 warnings. Here, radar observations and near-storm environment observations topped NALMA usefulness. The NALMA only provided 1.0–1.2 min of estimated lead time. What this demonstrates is that radar is highly effective in detecting tornadic signatures. While the NALMA had associated lightning jumps with these tornadic cells, it added no additional information above and beyond the radar observations. Further evaluations indicated that the NALMA was far more useful in marginal severe weather events.

These more marginal events were summarized in the second group of surveys. Here there were 31 surveys associated with 151 severe thunderstorm warnings. Unlike the tornadic cases, the surveys here indicated the NALMA data were far more useful (ranked second behind radar reflectivity) and provided 3.0–3.8 min of estimated lead time. In these severe, but nontornadic events, the NALMA was able to provide information about the strength of a cell's updraft, indicating a strengthening or weakening cell. Additionally, the NALMA data updating every 2 min was particularly powerful as a radar volume scan is no faster than 6 min.

The surveys and personal communications with forecasters revealed other uses. The NALMA data have been found to precede the onset of cloud-to-ground lightning by 3–5 min, assisting forecasters in updating their TAF forecasts. Additionally, NALMA data has been utilized to not issue a warning, point out a cell that may produce hail when radar observations are unclear, and to provide information at extreme ranges from the radar.

The SPoRT Center also maintains an open dialogue with our partners through the SPoRT liaisons. This communication provides valuable feedback about the various products, even if not formally described during an assessment period. Several of these have been mentioned in this SAC report, particularly for the uses of the GOES Aviation and CIRA TPW products as well as with the NALMA above. Lastly, this informal feedback and the formal assessments are leading to new training and methods of training on the SPoRT products. In addition to maintaining these initiatives, SPoRT is working with its WFO partners to develop intensive assessment periods. These periods will be designed to evaluate a limited number of products at one or several WFOs for a specific period of time. Current plans include assessing the GOES Aviation Fog products in the Fall of 2008, a renewed assessment with Great Falls during the Winter of 2008, and Convective Initiation and NALMA assessments in the Spring of 2009.

5.0

Supporting Activities

This photograph shows the development of a wall cloud.
Image credit: NWS HUN Office

5.0 Supporting Activities

AWIPS II Product

The AWIPS II software is currently in development as the next generation decision support system for the NWS. Operational implementation by the NWS of this software is planned to start in 2009. The key development of AWIPS II that sets it apart from the existing AWIPS environment is the flexibility to process data. Continued transition of unique NASA EOS data and products to its partners will rely on AWIPS II. The SPoRT Program is beginning to use AWIPS II in an effort to develop methods for the ingest of existing data into this new display system. As of April 2008 SPoRT had installed the "Task Order 8" release of the AWIPS II software, which includes the new version of the AWIPS D-2d display interface as well as the AWIPS Development Environment (ADE). The ADE is the part of the AWIPS II system where users can develop "plug-ins" and other software components to the AWIPS ingest, display, and menu options.

The plug-ins to be developed by SPoRT should allow both new and existing datasets to be ingested, manipulated, and displayed. This work is in parallel to development of AWIPS II software itself by the NWS contractor, Raytheon. In this capacity, SPoRT can test the ingest and display of existing SPoRT distributed products within the new AWIPS II system so that no partner office will lose the ability to use SPoRT products upon operational implementation of AWIPS II. Second, with the knowledge gained by transition the existing products, SPoRT will be positioned to develop new products to transition to the AWIPS II display environment. These new products may be improved visualization techniques of existing data or completely new products. The current generation AWIPS must have data fit into a predetermined mold. AWIPS II will have the flexibility to visualize datasets in ways not previously possible. Thus, many unique EOS data, such as the AIRS temperature and moisture retrievals, will be viewed more efficiently in AWIPS II without limiting the inherent benefits of the data. The display of LMA data will also be improved since three-dimensional displays will be possible, whereas only plane views are currently available in AWIPS (Fig. 18).

In addition to SPoRT's inherent interest in the continued transition of products to the NWS, other groups within NASA are also looking for ways to infuse their own data for application to forecast issues. SPoRT is committed to leading the way in the development of capabilities to support nonstandard data and product ingest and display within AWIPS II. For example, the SPoRT Center is working on new ways to visualize the LMA data and/or create new products for use by Weather Service forecasters to assist in their severe weather warning needs. One example is the cell tracking algorithm (see "Southern Thunder"). Thus, SPoRT will be a key collaborator in the transition of a host of new products from NASA's Applied Science Division by learning how to best utilize new technology available with AWIPS II.

SPoRT MODIS Cloud Mask Implementation and Validation

Numerous algorithms to derive atmospheric and surface products from MODIS require a cloud mask to identify cloudy pixels. For surface products, cloud contaminated

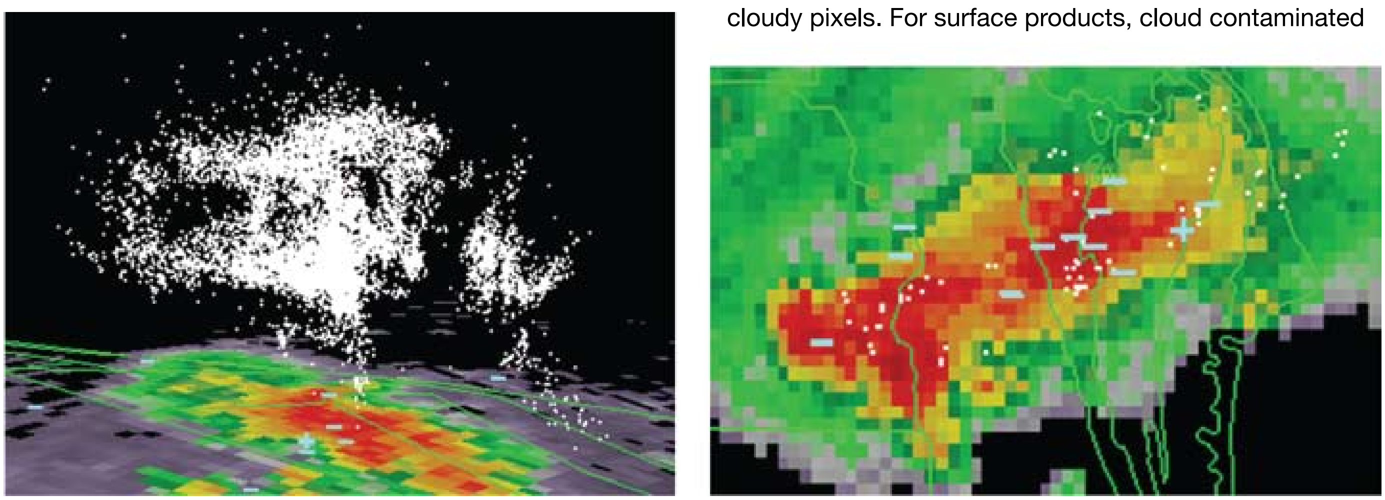


Figure 18. Left panel shows 3-D view of lighting initiation points over the Melbourne, FL area with radar reflectivity and cloud-to-ground strikes overlaid on the land surface. Right panel shows the 2-D view of the same data. The 3-D view provides a more native look at the data not currently available in AWIPS, which may lead to improved applications of the lighting data.

pixels must be identified and eliminated from the processing scheme. For atmospheric products, regions identified as cloudy need to be eliminated from cloud-free product generation or further processed to retrieve cloud information. While the various MODIS science teams produce their own cloud mask or flag cloudy pixels in their data stream, this cloud information is not appropriate for many product environments. Therefore, SPoRT has developed its own cloud mask approach and applied it to the real-time MODIS data streams to produce additional value added products to their end users. The SPoRT MODIS cloud mask is based on the Bi-spectral Composite Threshold (BCT) technique developed for GOES data (Jedlovec et al. 2008) and applied to both Aqua and Terra data streams (Haines et al. 2004). The approach uses only the shortwave and longwave infrared channels of MODIS in five spatial and spectral tests. Twenty-day composites of the channel differences are used to define test thresholds. The approach is applied to both day and night passes. Figure 19 presents a MODIS color composite image for June 9, 2005 at 1650 UTC and corresponding cloud mask. The regional performance of the SPoRT MODIS cloud mask is similar to that of the MODIS Atmospheric team's algorithm (Platnick et al. 2003). A more robust validation of the SPoRT MODIS cloud mask is being performed in for inclusion in a forthcoming paper.

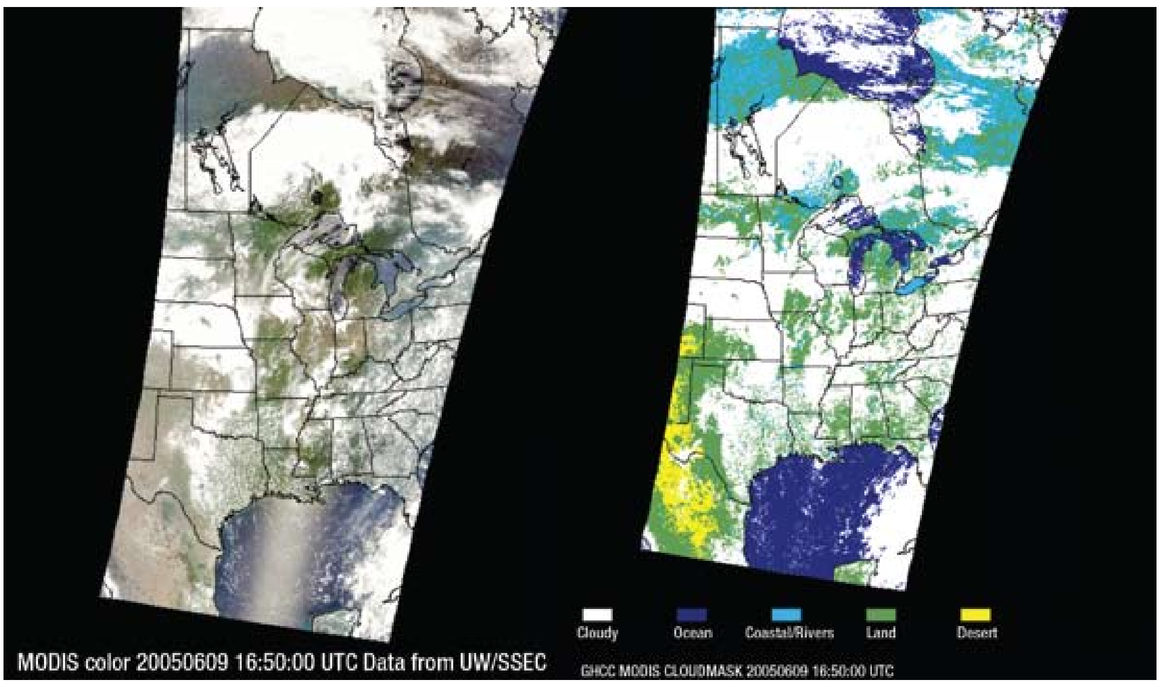


Figure 19. MODIS color composite image and corresponding cloud mask.

6.0

Other Related Projects

Image courtesy of the Image Science & Analysis Laboratory,
NASA Johnson Space Center.
NM21-766-65 <http://eol.jsc.nasa.gov>

6.0 Other Related Projects

FAA Terminal Radar Control (TRACON) Project for the New York Region

The Federal Aviation Administration (FAA) approached SPoRT asking for support in the creation of an Enhanced Convective Forecast (ECF) product to support national aviation traffic management and planning. The current national product used for this purpose is the Collaborative Convective Forecast Product (CCFP). The CCFP is limited in its level of detail with respect to the convection orientation and coverage, especially in cases of minimal spatial convective events. The ECF product will be tested on the New York Terminal Route Approach Control (NY TRACON) during the time period June through August. The major airports in the New York City area compose a large volume of the national airspace traffic and hence can have wide arching effects on flight delays. SPoRT solicited the help of ENSCO, Inc., who had recently been contracted to deliver operational weather forecasting support to United Airlines. While SPoRT served to manage the project, ENSCO was charged with the creation of the product itself. ENSCO configured a local version of the WRF model over the NY TRACON area to run every 3 hr out to 15 hr. This model output along with other operational data sources was used by their forecasters as guidance to develop an ECF product. SPoRT also coordinated the delivery of unique products to ENSCO for their consideration during the ECF creation. These products include the GOES satellite-based CI product as well as composite simulated reflectivity and derived echo tops from the NSSL daily WRF runs.

Aside from project management, SPoRT's primary role was to develop methods to assess the impact of the ECF on daily operations. SPoRT designed several tailored user assessments for those who would be using the ECF operationally during the study period (see Fig. 20). These groups were comprised of the Air Traffic Control System Command Center (ATCSCC), the NY TRACON, the NY Air Route Traffic Control Center (ARTCC), NAV Canada, the airline industry users, and the ENSCO forecasters who

Figure 20. Front page of the Web site where various users of the Enhanced Convective Forecast can access tailored assessment forms for evaluating the product.

make the ECF itself. These are Web-based forms that have about 5 to 8 questions, many of which are multiple choice, making it a quick task for the already demanding traffic management operations personnel. The questions focus on rating or describing the positive or negative value that the ECF had on operations for that day and how it compared with the current CCFP product. SPoRT visited several of these users and received input via teleconferences in order to become familiar with how the CCFP is currently used, its strengths and weakness, and changes the users would like to see in the CCFP. Project management and the development of tailored assessments greatly benefited from these interactions. SPoRT also plans to visit these users during the study period in order to evaluate the application and value of the ECF first hand. These visits will also assist with a final project assessment at the end of the study period.

Southern Thunder

The Southern Thunder Alliance brings together government, university, and industry groups to enable the transition of total lightning observations from ground-based research networks and NASA satellites (LIS/TRMM). SPoRT has been an active partner in Southern Thunder and hosted the first meeting in 2004. Partners in the Alliance include representatives from each site that has a VHF lightning mapping system, as well as NOAA NESDIS, New Mexico Technology, University of Oklahoma, and Vaisala. Bringing these organizations together to transition total lightning data to operations has been a clear example of SPoRT's mission to advance short-term, regional forecasts.

A positive outcome of the Southern Thunder Alliance was the creation of the Washington D.C. Lightning Mapping Array (DCLMA), with an example image from the DCLMA shown in Figure 21. More information about the DCLMA can be found at: <http://branch.nsstc.nasa.gov/PUBLIC/DCLMA/>. This network arose out of discussions at the 2005 Southern Thunder Alliance Workshop hosted by Vaisala in Ft. Worth, Texas. The network was established with sensors provided by New Mexico Tech., along with communications software and technical support from SPoRT's experience with the deployment of the NALMA in Huntsville, Alabama.

Since the 2005 meeting, Southern Thunder Alliance members have exchanged information at various conferences, particularly the AMS annual meetings and Vaisala's International Lightning Detection/Meteorology Conferences. At the 2008 annual AMS meeting, the Alliance decided to convene another workshop to update partners on new developments from each group. This workshop is scheduled to be held in Cocoa Beach, Florida in July 2009 with a followup meeting tentatively scheduled in Norman, Oklahoma in 2011.

The objectives for the upcoming workshop reflect several important developments with total lightning and correlate well with the SPoRT mission. There are now seven operational VHF total lightning networks in the United States, an increase of three since the last meeting. Additionally, the KSC network has had a major upgrade since 2005. There is also a need to develop risk reduction for the GOES-R Lightning Mapper scheduled for launch in 2014, including transitioning lightning products and applications into AWIPS II. This meeting plans to investigate new operational products for use with AWIPS II, new technology for communications and hardware, forecaster training, and the aforementioned risk reduction. A possible new product, as demonstrated by Steve Goodman's

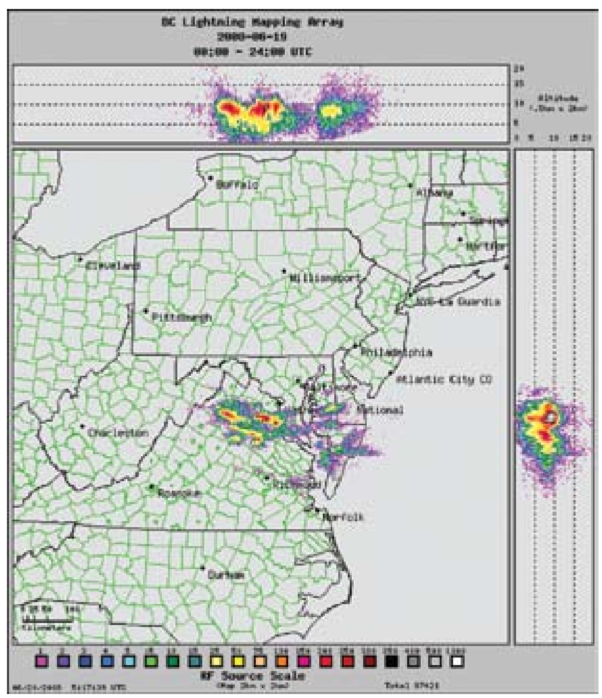


Figure 21. An example of a daily summary of DCLMA source density data, shown on 1-km resolution grid from June 19, 2008. Several storm tracks can be seen in Northern Virginia and Eastern Maryland south into the Delmarva Peninsula. The main section of the image is a plane view of total lightning source densities. The upper part shows the cross-sectional daily source densities in the east-west versus vertical plane. The right side of the image shows the cross-sectional daily source densities in the north-south versus vertical plane.

group in Washington D.C., tracks individual cells and provides a time series plot of the source density activity with each cell. This product improves on the current method of correlating a lightning jump to the onset of severe weather subjectively by the forecaster.

Daily Chlorophyll Products for Ecosystem and Fishery Applications

SPoRT has partnered with WorldWinds, Inc. in a rapid prototype capability (RPC) activity sponsored by NASA's Applied Science program to adapt MODIS data compositing techniques (developed for SST applications) to produce a daily chlorophyll composite for the Gulf of Mexico region. The chlorophyll composite product will be distributed by WorldWinds, Inc. to the coastal and marine weather community to enhance public safety, optimize fuel costs, and operational efficiency for anyone interested in offshore boating, fishing, or diving. WorldWinds, Inc. has developed a Marine Weather Prediction and Fish Forecasting System (MWPFFS), which transmits live graphics of Doppler radar, wave conditions, winds, SST, sea level pressure and more, directly to a mariner's boat over the S-band XM satellites. The continuous data broadcast in U.S. coastal waters (up to 600 miles off shore) keeps the mariner from having to guess hazardous weather conditions, greatly increasing public safety. The MWPFFS combines a variety of NOAA, Navy, and NASA EOS data products with the goal of enhancing public safety and optimizing time and fuel costs for commercial and leisure mariners and fishermen. The current MWPFFS does not include any chlorophyll data. Spatially continuous chlorophyll composites are available only in 7 day or longer averages (from MODIS), as they are developed for climatology studies. While chlorophyll-a fields derived from satellite and in situ data currently provide large-scale information on surface forcing, the small-scale gradients that are important for regional analysis and daily concentration predictions, particularly in coastal regions, are not adequately resolved.

The chlorophyll compositing technique is based on the work of Haines et al. (2007) for SSTs. A composite product is produced by considering a historical collection of chlorophyll for the most recent three cloud-free days evaluated on a pixel-by-pixel basis. The three cloud-free data points are averaged to produce a composite value as shown in the image below (Fig. 22). Spatial images that describe the latency of the averaged chlorophyll data are also produced. Unlike with SST, where the day-to-day variations in SST are relatively small, average values of the three most recent clear days may not be appropriate for the chlorophyll product. The chlorophyll product will be validated with in situ SeaBASS data (Fig. 23).

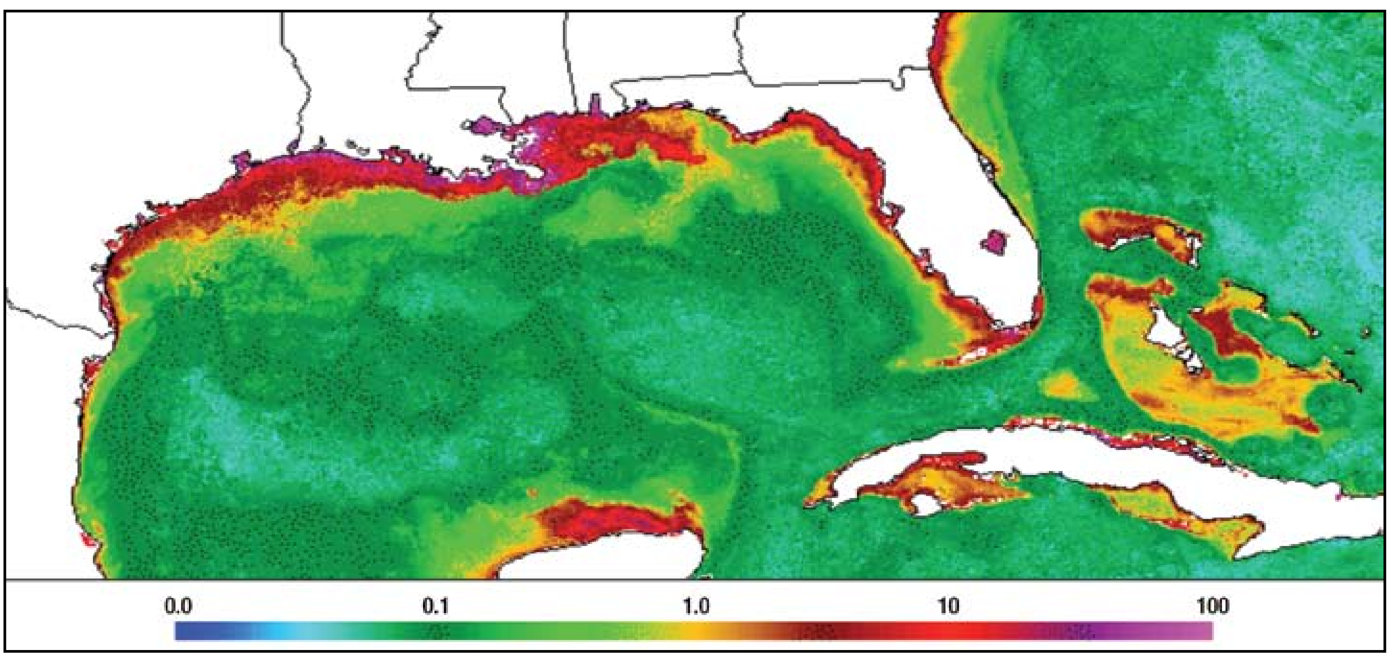


Figure 22. MODIS chlorophyll composite for June 12, 2008. Values are in mg/m^3.

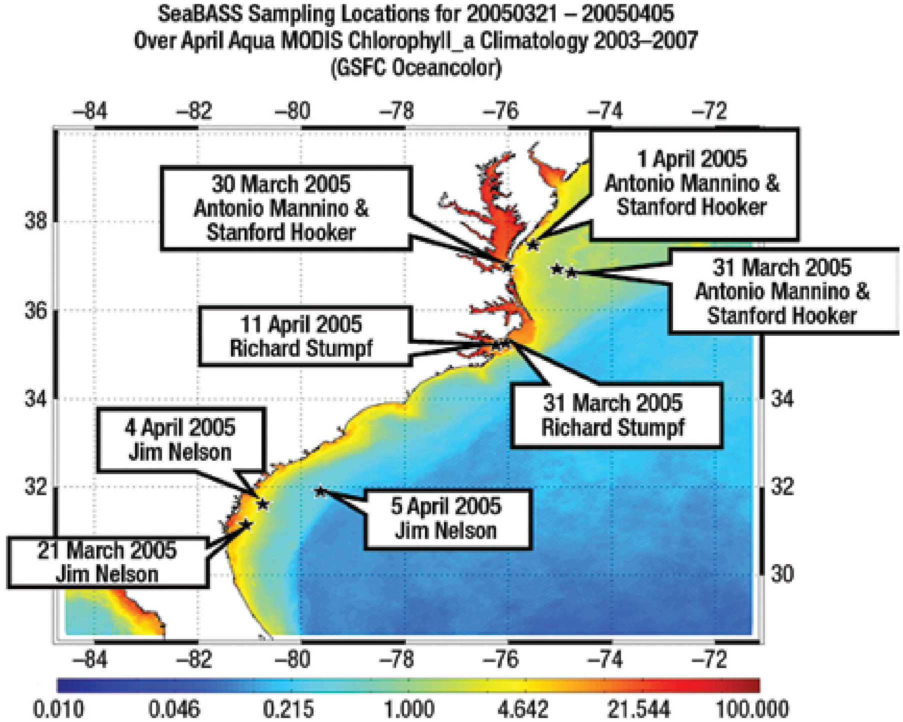


Figure 23. Sampling locations for the SeaBASS chlorophyll in situ data used for validation of the composite chlorophyll product under development.

7.0

New Partnerships


Image courtesy of the Image Science & Analysis Laboratory, NASA Johnson Space Center.
STS51G-46-5 <http://eol.jsc.nasa.gov>

7.0 New Partnerships

In order to better transition NASA research capabilities to the operational weather community, SPoRT looks to partner with other government agencies, universities, and private sector companies to submit peer-reviewed proposals to address pending forecast issues and problems, which can be mitigated by NASA data or research capabilities. SPoRT formed six such partnerships last year leading to the submission of proposals to the NASA ROSES 2007 solicitation. Three of those proposals were selected for funding and are now in their execution stage. The first project was discussed as part of the CI product use in WFOs section above. The second project is led by Dr. Jill Engle-Con of Battelle Memorial Institute and focuses on the application of high-resolution weather-related NASA Earth Science Data into key Decision Support Systems (DSS) used by energy utilities for short-term load forecasting. The end use customers of many energy utilities companies rely on these DSS to balance supply and load on the electric grid or dispatch natural gas. The DSS rely on weather data dictated by the spatial scales of ground-based stations, but are flexible enough to accept finer resolution data and model outputs uniquely provided by NASA's Earth science program. An end-user group will be formed to provide input on load forecasting, discuss long-term planning as relevant, and guide transition to the nationwide energy utility community. Other studies have shown energy savings through improvement in load forecasts based on satellite data (Fig. 25). The current research and transition activity will integrate NASA observations into DSSs to demonstrate similar load improvements in the southeast U.S. The result of enhanced performance of these DSS is cost savings to residential, commercial, and industrial energy users, and energy conservation.

The third new partnership developed as a result of last year's ROSES solicitation focuses on an advanced SST composite product. Recent applications of the SPoRT MODIS composite SST product have clearly shown the importance of developing high-resolution SST datasets for coastal applications and modeling. In general, coupling between the oceans and atmospheres has been closely linked to SST gradients and fronts, indicating a need for high-resolution SSTs, specifically in the areas of large gradients associated with coastal regions. Thus, an accurate determination of SST gradients has become critical for determining the appropriate air-sea coupling and the influence on ocean modeling. This new partnership with the with scientists at JPL and the Physical Oceanography Distributed Active Archive Center (DAAC) aims to improve the accuracy and increase the coverage of the current operational SPoRT MODIS SST composite and provide a near real-time product from Level 2P data for distribution to the user community. Validation with in situ data will be performed. SPoRT and JPL will use the Global High-Resolution SST Pilot Project (GHRSST-PP) MODIS data and microwave AMSR-E GHRSST data to produce composite datasets for both the West Coast and East Coast of the United States, including the Gulf of Mexico. The use of 1-km MODIS data has explicit advantages over other SST products including its global coverage and high resolution. The AMSR-E data will reduce the latency of the composites. Figure 24 shows an example of a MODIS 3-day composite, an AMSR-E 3-day SST composite and a merged product using the MODIS and AMSR-E data.

A strategy for utilizing the error characteristics contained in the GHRSST data will be developed. Part of this strategy will include using the error characteristics directly to calculate weighted SST composites. Another part will

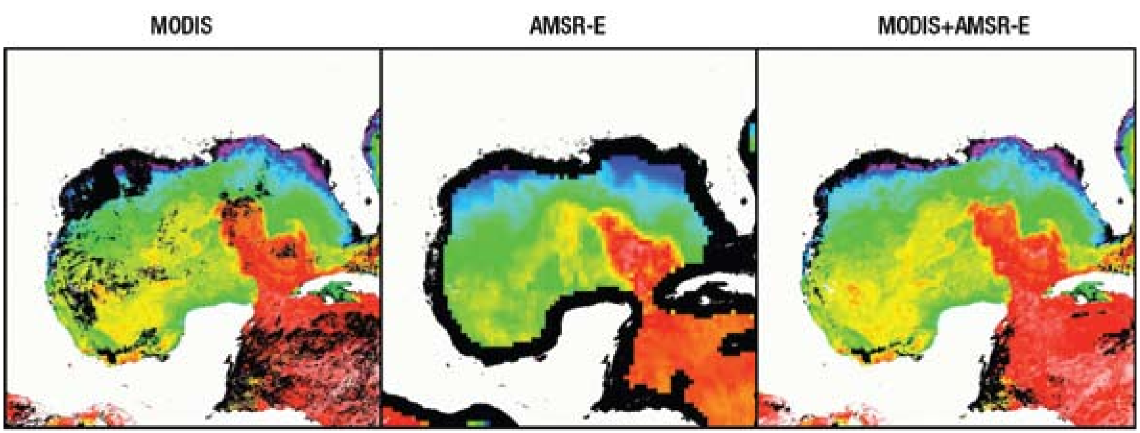


Figure 24. MODIS and AMSR-E 3-day SST composites and a merged product.

be to develop uncertainty maps based on the composite biases and RMS. This would be in addition to the latency maps that accompany the composites.

Recent accomplishments include the development of an enhanced compositing approach based on the error-weighted combination of recent clear MODIS SST values, where the error contributions come from measurement error, potential cloud contamination, and data latency sources. Future plans call for the inclusion of AMSR-E SST values with appropriate weights based upon measurement accuracy, MODIS-AMSR-E SST bias, and latency.

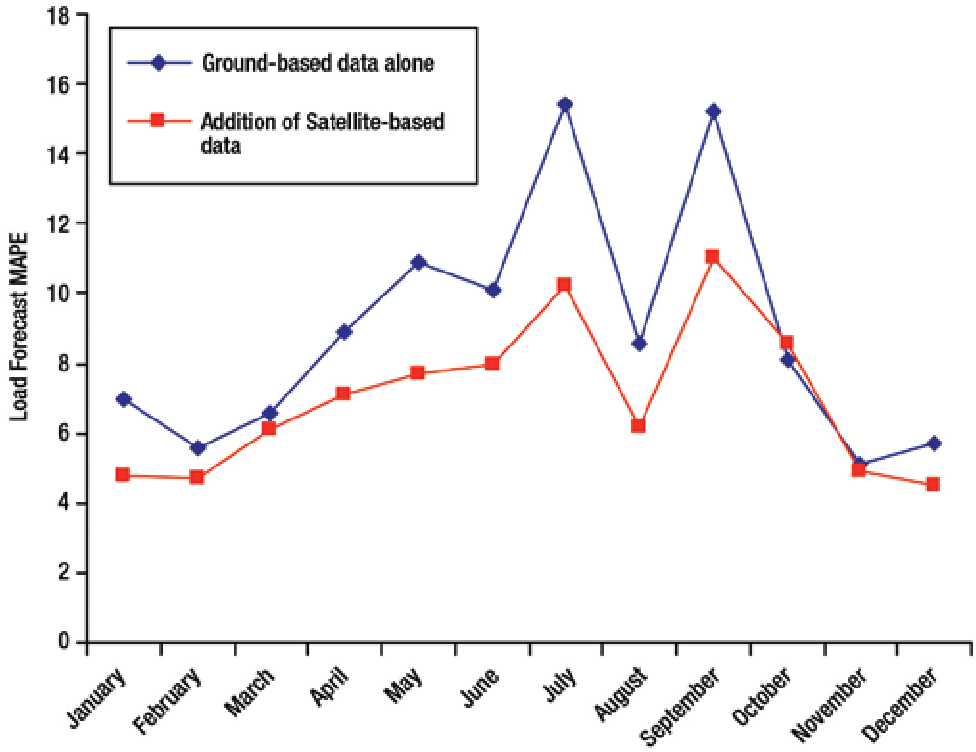


Figure 25. An example of energy load forecast improvements for Spokane, Washington based on satellite data. The greatest improvements in load forecasts were seen on days with peak loads, when improved load forecasts are critical.

SPoRT Strategic Plan (2009–2014)
Executive Summary

Strategic Plan (2009–2014)

One of the recommendations of the SPoRT SAC was to develop a strategic plan to guide the project and to articulate its vision and mission to the external community. The following paragraphs present an excerpt from the executive summary of the SPoRT 2009–2014 strategic plan, which will be published in the Fall of 2008.

SPoRT strives to be an Agency focal point and facilitator for the transfer of NASA Earth science data and technologies to the operational weather community on a regional and local scale. To achieve this vision, the SPoRT program focuses on access to new data and technologies and developing and testing solutions to critical forecast problems, and then integrating solutions into end user decision support tools. SPoRT will extend and enhance its current capabilities with MODIS, AMSR-E, and AIRS, total lightning measurements from ground-based networks at existing WFOs, and look to partner with other organizations and end users that have significant forecast needs that can be met by SPoRT objectives. New areas of focus will include fire weather and wildfire forecast problems, land falling hurricane track and intensity forecasts, National Polar-orbiting Operational Environmental Satellite (NPOESS) data and the transition of products and capabilities to AWIPS II. Over the next few years, SPoRT will enhance partnerships with NOAA/NESDIS for new product development and data access to exploit the remote sensing capabilities of instruments on the NPOESS satellites to address short-term weather forecasting problems. The Visible/Infrared Imager/Radiometer Suite (VIIRS) and the Cross-track Infrared Sounder (CrIS) instruments on the NPOESS Preparatory Project (NPP) and follow-on NPOESS satellites provide similar observing capabilities to the MODIS and AIRS instruments on Terra and Aqua.

The NWS is embarking on a new generation of information systems to aid forecasters in the development and dissemination of forecast products to the public. The next generation system, called AWIPS II, will be deployed beginning in the Fall of 2009. The architecture will allow for more flexibility in the use of new datasets and to enhance visualization of data streams where the old system was too constraining. SPoRT will transition NASA and NPOESS observing capabilities to the AWIIPS II environment to continue the continuity and growth of the transitional activities. Additionally, new display capabilities that better portray the four-dimensional variability of total lightning data will be developed and transition for use in AWIPS II.

The SPoRT program will evolve to stay relevant to the changing needs of NASA's research objectives and forecast issues in the Earth and atmospheric science community. Most of the current end users reside at the NWS WFOs, but expansion to include other government and private sector end users is seen as a bridge between the Research and Analysis (R&A) program and Applied Sciences programs. SPoRT will also strengthen ties with NOAA NESDIS to transition new observational datasets into advanced decision support tools.

The execution of this strategy requires the support of civil service leadership and technical expertise in core areas, including atmospheric electricity, regional modeling and data assimilation, remote sensing, and supporting technical expertise and transitional skills of associated research scientists and graduate students. Maintaining this blend of manpower is critical to the continued success of the SPoRT program. SPoRT will strengthen its civil service technical capabilities and core leadership through NASA new hiring opportunities, backfilling slots of transitioned or retiring scientists, and will use university and private sector research scientist support to augment required expertise.

Appendices

Appendix 1

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Appendix 2

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Appendix 3

SAC Members

Current SAC Members

Name	Affiliation	Tenure Served
Dr. Bill Bauman (2007 Chair)	ENSCO, Inc. at the NASA KSC Applied Meteorology Unit	2005 – present
Dr. David “Rusty” Billingsley	NWS Southern Region Headquarters	2007 – present
Dr. Ronald Gelaro	NASA/Goddard Space Flight Center (GSFC)	2007 – present
Dr. Mitch Goldberg	NOAA/ National Environmental Satellite, Data and Information Service (NESDIS)/ Center for Satellite Applications and Research (STAR)	2005 – present
Dr. Tsengdar Lee	NASA Science Mission Directorate	2003 – present
Dr. Martin Ralph	NOAA/Earth System Research Laboratory (ESRL)/Environmental Technology Laboratory (ETL)	2007 – present
Dr. Lars Peter Riishojgaard	Joint Center for Satellite Data Assimiliation (JCSDA)	2008 – present

Past SAC Members

Name	Affiliation	Tenure Served
Dr. Robert Atlas	NOAA, Miami Florida	2003 – 2005
Dr. James Dodge	NASA	2003 – 2004
Dr. John Le Marshall	NOAA	2005
Dr. John McGinley	NOAA/OAR	2003 – 2005
Dr. John Manobianco	ENSCO/NASA KSC/AMU	2003
Dr. Daniel Melendez	NOAA/NWS/OST	2003 – 2004
Dr. W. Paul Menzel	NOAA/NESDIS	2003 – 2004
Dr. Steven Mullen (2003 – 2004 Chair)	University of Arizona	2003 – 2004
Dr. Ralph Petersen (2005 Chair)	NWS NCEP/EMC	2003 – 2007
Mr. David Sharp	NOAA/NWS	2003 – 2005

Appendix 4

SPoRT Partners

SPoRT engages two types of partners (supporting and collaborative) in the planning and execution of the project activities. These partners are listed in the table below noting if the partner is an end user as well.

CP – Collaborative Partner — stakeholders and beneficiaries, often providing programmatic or financial support (direct or in-kind).

EU – End User

SP – Supporting Partner — help SPoRT conduct the research and transitional activities by providing capabilities such as technical expertise, computation resources, data, or other enabling capabilities.

SPoRT Partners	Role
Atlantic Oceanographic and Meteorological Laboratory (AOML)/ Hurricane Research Division (HRD) – CP, EU, SP	Products
Battelle – CP, SP	Products
Cooperative Institute for Research in the Atmosphere (CIRA)/ Colorado Statue University (CSU) – SP	Products
ENSCO, Inc. – EU, SP	Scientific expertise
Florida Institute of Technology (FIT) – SP	Scientific expertise
Goddard Space Flight Center (GSFC)/ Global Modeling and Assimilation Office (GMAO) – CP, SP	LIS software
HUN National Weather Service (NWS) – CP, EU, SP	IT, forecasting, and training expertise
Jet Propulsion Laboratory (JPL) – SP	Algorithms and data SST composites
Joint Center for Satellite Data Assimilation (JCSDA) – CP, SP	Transitional activities, computational resources
National Environmental Satellite, Data and Information Service (NESDIS) Center for Satellite Applications and Research (STAR) – CP, SP	Transitional activities, GOES and AIRS products
National Severe Storms Laboratory (NSSL) – CP, SP	Provide real-time WRF model forecasts
National Weather Service (NWS) Southern Region Headquarters – CP, SP	Data dissemination, WFO interface
NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) – SP	Satellite products
Raytheon – SP	Scientific expertise
Spaceflight Meteorology Group (Houston,TX) – CP, EU, SP	IT, forecasting, and training expertise
University Corporation for Atmospheric Research (UCAR)/ Cooperative Program for Operational Meteorology, Education and Training (COMET) – CP, SP	Training and outreach expertise
Universities Space Research Association (USRA) – SP	Scientific expertise
University of Alabama in Huntsville (UAH) – CP, SP	Radar and atmospheric electricity applications
University of Oklahoma (OU) – CP, EU	Data assimilation studies
University of South Florida (USF) – SP	Direct broadcast data and ocean products, real-time MODIS data and products
University of Wisconsin (UW)/ Cooperative Institute for Meteorological Satellite Services (CIMSS) – CP, SP	Direct broadcast data and value added products, real-time MODIS, AMSR-E, and AIRS data and products
Weather Channel – EU	Products
Weather Forecasting Offices (WFOs) – EU, SP	IT, forecasting, and training expertise
WorldWinds, Inc. – EU, SP	Ocean products, scientific expertise

Appendix 5

National Weather Service Weather Forecast Offices

The collaborations with the National Weather Service continue to grow as SPoRT added seven new partner WFOs from the Southern Region as of the Fall of 2007 to give a total of 12 WFO partners listed in the table below. This expansion resulted from discussions during the Science and Operations Officer Workshop held in Huntsville in July of 2006. The expansion has been aided by the collaborative efforts of Southern Region Headquarters, who have provided their services to support a systematic data dissemination network (see "Data Dissemination"). Based on local characteristics, individual offices have varying interests and forecast priorities. SPoRT works with our partners to identify these specific forecast issues and link these concerns with a particular, unique data product. As a result, only a small subset of a data suite, such as from MODIS or AMSR-E, may be transitioned with each WFO. However, by focusing on these specific issues, SPoRT will have better feedback as the WFO personnel can discuss their own, local issues. With such a wide array of interests and possible products, an internal Web site was created with access to the product distribution database. SPoRT realizes that a variety of groups have an interest in knowing who is receiving data from SPoRT, including the specific instrument, product, image, or resolution of these data. This not only includes SPoRT personnel for internal organizational purposes, but also includes our collaborators, sponsors, and other NASA or NOAA agencies. To this end we have developed a "Data Distribution" site that allows users to quickly find our partners, the points of contact, and product suite. In fact, specific queries to the databases allow users to develop searches based on partner, resolution, product, domain, or instrument. Please see <http://weather.msfc.nasa.gov/sport/nwsdistribution/> for this information. This page is updated only as necessary and not maintained in real-time.

NWS WFO	Primary POC	Product Suite
Albuquerque, New Mexico	Deirdre Kann, SOO	GOES Aviation, CIRA
Birmingham, Alabama	Kevin Pence, SOO	MODIS, LMA
Corpus Christi, Texas	Ronald Morales, Jr., SOO	GOES Aviation, CIRA
Great Falls, Montana	David Bernhardt, SOO	MODIS
Houston, Texas	Lance Wood, SOO	GOES Aviation, CIRA
Huntsville, Alabama	Jason Burks, ITO	MODIS, AMSR-E, LMA, GOES Aviation, CI, SPoRT ADAS, CIRA
Melbourne, Florida	David Sharp, SOO	GOES Aviation, CIRA
Miami, Florida	Pablo Santos, SOO	MODIS, AMSR-E, GOES Aviation, CIRA
Mobile, Alabama	Jeffrey Medlin, SOO	MODIS, AMSR-E, GOES Aviation, CIRA
Morristown, (Knoxville), Tennessee	David Hotz, SOO	LMA, GOES Aviation, CIRA
Nashville, Tennessee	Henry Steigerwaldt, SOO	MODIS, LMA
Tallahassee, Florida	Irv Watson, SOO	GOES Aviation, CIRA

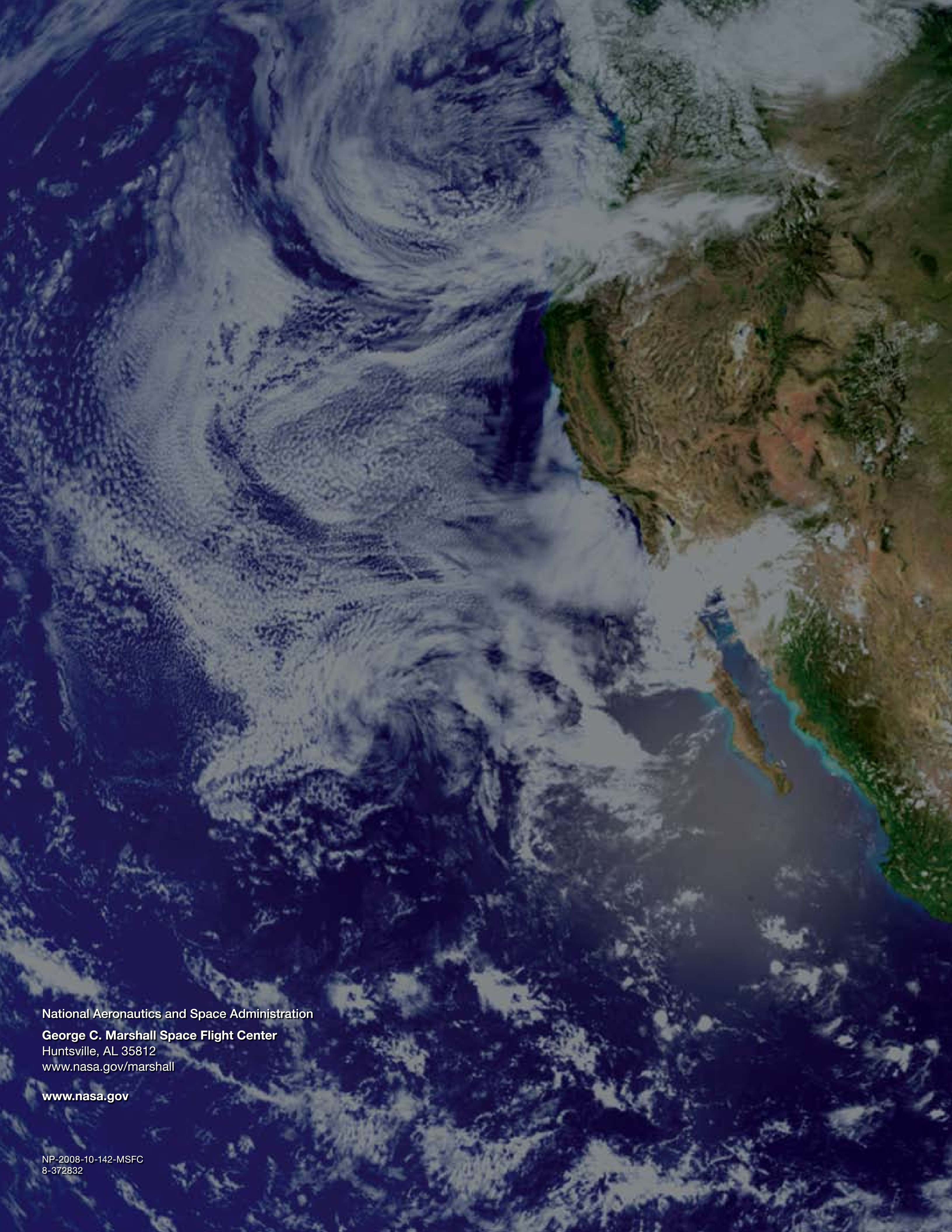
Appendix 6

Acronym List

3DVAR	Three-Dimensional Variational
ADAS	ARPS Data Analysis System
ADE	AWIPS Development Environment
AIRS	Atmospheric Infrared Sounder
AMS	American Meteorological Society
AMSR-E	Advanced Microwave Scanning Radiometer for the Earth Observing System
AMSU	Advanced Microwave Sounding Unit
ARPS	Advanced Regional Prediction System
ARTCC	Air Route Traffic Control Center
ATCSCC	Air Traffic Control System Command Center
AWIPS	Advanced Weather Interactive Processing System
AWW	Airport Weather Warning
BCT	Bi-spectral Composite Threshold
CCFP	Collaborative Convective Forecast Product
CI	Convective Initiation
CFAD	Contoured Frequency by Altitude Diagram
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CIRA	Cooperative Institute for Research in the Atmosphere
COMET	Cooperative Program for Meteorological Education and Training
Co-PI	Co-Principal Investigator
CrIS	Cross-track Infrared Sounder
DAAC	Distributed Active Archive Center
DCLMA	Washington D.C. Lightning Mapping Array
DSS	Decision Support Systems
ECF	Effective Cloud Fraction
ECF	Enhanced Convective Forecast
EMC	Environmental Modeling Center
EMS	Environmental Modeling System
EOS	Earth Observing System
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAA	Federal Aviation Administration
FIT	Florida Institute of Technology
FTP	File Transfer Protocol
GFS	Global Forecast System
GHRSST-PP	Global High-Resolution Sea Surface Temperature (SST) Pilot Project
GOES-R	Geostationary Operational Environmental Satellite-R Series
GRIB-1	Gridded Binary-1
GSFC	Goddard Space Flight Center

GSI	Gridpoint Statistical Interpolation
HSV	Huntsville
HWO	Hazardous Weather Outlook
IFOV	Instantaneous Field of View
JCSDA	Joint Center for Satellite Data Assimilation
JPL	Jet Propulsion Laboratory
KSC	Kennedy Space Center
LAPS	Local Analysis and Prediction System
LDM	Local Data Manager
LIS	Land Information System
LIS	Lightning Imaging Sensor
LISMOD	LISWRF initialization with MODIS SSTs
LMA	Lightning Mapping Array
LTG	Lightning
METAR	Aviation Routine Weather Report
MFL	Miami, FL
MIMIC	Morphed Integrated Microwave Imaging at CIMSS
MODIS	Moderate Resolution Imaging Spectroradiometer
MSFC	Marshall Space Flight Center
MWPFFS	Marine Weather Prediction and Fish Forecasting System
NALMA	North Alabama Lightning Mapping Array
NAM	North American Mesoscale
NCEP	National Centers for Environmental Prediction
NESDIS	National Environmental Satellite, Data, and Information Service
NLDAS	North American Land Data Assimilation System
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NPOES	National Polar-orbiting Operational Environmental Satellite
NPP	NPOESS Preparatory Project
NSSL	National Severe Storms Laboratory
NSSTC	National Space Science and Technology Center
NVAP	NASA Water Vapor Project
NWP	Numerical Weather Prediction
NWS	National Weather Service
PIREP	Pilot Report
PM	Project Manager
R&A	Research and Analysis
RMS	Root Mean Square
RMSE	Root Mean Square Error
ROSES	Research Opportunities in Space and Earth Sciences
RPC	Rapid Prototype Capability
RTG	Real-Time Global

SAC	Science Advisory Committee
SOO	Science and Operations Officer
SPoRT	Short-term Prediction and Research Transition
SRH	Southern Region Headquarters
SSM/I	Special Sensor Microwave/Imager
SST	Sea Surface Temperature
TAF	Terminal Aerodrome Forecasts
TPW	Total Precipitable Water
TPWA	Total Precipitable Water Anomaly
TRACON	Terminal Radar Control
TRMM	Tropical Rainfall Measurement Mission
UAH	The University of Alabama in Huntsville
UTC	Coordinated Universal Time
VHF	Very High Frequency
VIIRS	Visible/Infrared Imager/Radiometer Suite
WFO	Weather Forecast Office
WPS	WRF Preprocessing System
WRF	Weather Research and Forecast
WRF-Var	WRF Variational Data Assimilation System
WRFSI	Weather Research and Forecast Standard Initialization
WSR-88D	Weather Service Radar–1988 Doppler



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