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THE SHORT-TERM PREDICTION RESEARCH AND TRANSITION (SPoRT) CENTER: A COLLABORATIVE MODEL FOR ACCELERATING RESEARCH INTO OPERATIONS

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1. INTRODUCTION

The NASA Short-term Prediction Research and Transition (SPoRT) Center in Huntsville, Alabama was created to accelerate the infusion of NASA Earth science observations, data assimilation and modeling research into NWS forecast operations and decision-making. The principal focus of experimental products is on the regional scale with an emphasis on high impact weather forecast improvements on a time scale of 0-24 hours. The SPoRT Center research is aligned with the NASA Earth Science Enterprise strategy to improve forecasts through new observation capability and the regional prediction objectives of the US Weather Research Program dealing with 0-1 day forecast issues ranging from convective initiation to 24-hr quantitative precipitation forecasting. The transition from research to operations priorities are established at SPoRT jointly by the research scientists and the WFO Science Operations Officer (SOO) based on scientific merit, technological readiness, societal benefit, programmatic relevance, and resource constraints. These transition requirements adhere to the model construct described by Serafin et al. (2002). In addition, a SPoRT technology transfer meteorologist, acting as a liaison between the research and operational communities, provides a critical element for enabling the effective and timely assessment of new products (Darden et al., 2002). SPoRT updates its research and implementation plan annually with advice from a science advisory committee composed of senior researchers in the federal government and university community.

The SPoRT Center, together with its other interagency partners and universities is a joint collaboration to transition NASA Earth Science Enterprise (ESE) observations and technology to National Weather Service operations and decision makers at both the global/national and regional scales. This paper describes the process for the transition of experimental products into forecast operations, current products undergoing assessment by forecasters, and plans for the future. SPoRT is offered as a collaborative model to accelerate the transition of new research and observations into forecast operations and overcome the shortcomings recently addressed by the National Research Council (NRC, 2000, 2003). The SPoRT Web page can be found at (http://www.ghcc.msfc.nasa.gov/sport).

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2. OBJECTIVES

The goal of the SPoRT Center is to accelerate the transition of unique observing, modeling, and data assimilation capabilities developed under the auspices of ESE to NWS Forecast Offices (NWSFO's) and decision makers. Specific objectives necessary to accomplish this goal are:

- Develop, evaluate, and *transition* near-real time experimental NASA data products to operational use at regional scales;
- Develop a *framework to effectively transfer* experimental ESE-supported forecast and data products to forecasters;
- Execute *high-resolution assimilation experiments* using ground- and space-based ESE observations in an operational environment and provide regional output in near real-time;
- Develop metrics and *conduct quantitative assessment studies* with forecasters to evaluate the impacts and benefits of ESE-supported experimental products on forecast skill.

The ability of the Center to meet its goal and assess the potential impact of experimental forecast products at the decision making level is based on several requirements. Research conducted at the Center must utilize ESE observations and advanced technologies to improve the accuracy of short-term forecasts. Given that NASA is not tasked with issuing forecasts, SPoRT must place experimental products in the hands of NOAA forecasters. All products delivered are accompanied with training on their use.

Finally, a detailed assessment plan is developed with the end user to identify the product value added.

3. RESULTS

Two new data sources were introduced during 2003 into three WFOs located in the NWS Southern Region (Huntsville, HUN; Birmingham, BMX; and Nashville, OHX). Multi-spectral imagery from the Moderate Resolution Imaging Spectroradiometer **(**MODIS) on board the NASA low Earth orbiting Terra and Aqua satellites, and total lightning discharge mapping from a ground-based 3-D VHF lightning mapping sensor array are providing early opportunities for forecasters to develop operational experience with measurements similar to those that may be provided by the next generation of Geostationary satellites. The Advanced Weather Information Processing System (AWIPS) forecaster workstation ingests, displays, and integrates these experimental data sets in addition to the standard data products and model output, allowing the forecaster to readily issue the forecasts and warnings. Early on in the development of the joint collaboration between NASA and NWS, it was clear that product assessment would be most effective if the products were available in near real-time to the forecasters with minimum latency within AWIPS. Within this operational environment the researchers and forecasters are jointly able to assess the utility of the new experimental products.

3.1 MODIS

MODIS has a swath width of 2,330 km and images the entire surface of the Earth in 36 spectral bands between 0.405 and 14.385 μm. SPoRT started acquiring near real-time NASA Terra satellite MODIS (Level 1b) data via the Internet from the University of Wisconsin's (UW) Direct Broadcast system in the Fall 2002. This data stream originally included only Level 1 radiances, but now also includes selected EOS Atmospheric science team (Level 2) products, namely cloud products, atmospheric moisture and stability. Ingest, data processing, and storage scripts were written to automate data selection and dissemination. A Web-based display was generated to monitor the quality and latency of real-time data obtained from UW. Early in spring of 2003, Terra MODIS images and products were reformatted and made available to the HUN NWS office AWIPS system from a local NASA server. MODIS data from the NASA Aqua satellite were obtained beginning in early May and are routinely sent to AWIPS. In July, the staging of the final images and products were changed such that these products became available to multiple NWS offices directly from the Southern Region server (in Fort Worth) via their Local Data Acquisition and Dissemination (LDAD) system. Additionally, SPoRT now provides access to additional MODIS Direct Broadcast (DB) data and limited ocean products from the University of South Florida DB. Additional sources of products such as fire products, aerosols, and LST are being explored.

Use of MODIS data by the NWS required some additional configuration of enhancement and data lookup tables for display and data output in AWIPS. We have worked extensively on this to provide enhancements and capabilities consistent with standard AWIPS operations and with enhanced features to best display and use MODIS data. Efforts throughout the year have reduced the data latency by 50%. Most MODIS data and products are available in AWIPS within 45 minutes of data collection.

In addition to the MODIS products available from the EOS atmospheric science team through UW, several key in-house products have been developed that provide useful tools for the NWS. First, a 3-channel color composite (500m resolution) is made in real time and provided to the WFOs (Figs. 1,2). This product is extremely useful for identifying thin cirrus, convergence lines and convective cloud structures, smoke from agricultural fires, land use and surface features. Second, a fog product, similar to that calculated with GOES, is made and displayed in AWIPS with specific enhancement curves to isolate regions of developing fog and low clouds. Third, a combined LST/SST product is produced with an in-house algorithm. The LST product, along with hourly GOES data, will be used to develop a minimum temperature algorithm for use in the AWIPS Interactive Forecast Preparation System (IFPS). The real time products and L1B radiances are cloud-cleared and made available in real time to the in-house SPoRT modeling group for use in data assimilation studies. Since the evolution of mesoscale phenomena in the planetary boundary layer is sensitive to differential land surface forcing, high-resolution MODIS land and sea surface temperatures can be used to initialize models at scales below 10 km with the potential to fill information gaps such as the improved specification of the pre-storm environment (Figure 3).

Training on the use of the new EOS data and products was provided in several forms to the three regional NWS offices thus far receiving the data. Science sharing sessions and presentations were made on several occasions to the various offices on both MODIS data and product utilization. Based on requests from a couple of these offices, VISITview modules are being developed on "MODIS Polar Orbiting Data and Display" and "Night time Fog Detection with MODIS". The development of these modules is also being coordinated with NWS COMET program.

3.2 Lightning Mapping Array (LMA)

The North Alabama 3-D VHF regional lightning mapping array consists of ten VHF receivers deployed across northern Alabama and a base station located at the National Space Science and Technology Center (NSSTC), which is on the campus of the University of Alabama in Huntsville. The LMA system locates the sources of impulsive VHF radio

signals from lightning by accurately measuring the time that the signals arrive at the different receiving stations (Thomas et al., 2000). Typically hundreds of sources per flash can be reconstructed, which in turn produces accurate 3-dimensional lightning density maps (nominally <50 m error within 150 km range).

Key objectives of our research investigations using LMA data are:

- Identification of intensifying and weakening storms using the time rate-of-change of total flash rate;
- Improve severe storm potential situational awareness;
- Evaluation of the potential of total flash rate trend to improve severe storm probability of detection (POD) and lead time.

A 3-D gridded total lightning data set, updated every 2 min, provides full coverage of the Huntsville, AL and Nashville, TN NWS county warning areas, as well as partial coverage of the warning areas of five other NWS offices (Fig. 4). Forecasters can interrogate the data on any of the 17 horizontal levels or examine the cumulative source density map that includes all levels. Forecasters can also readily dither between NEXRAD and LMA maps and loop multiple frames to enhance situational awareness during severe weather episodes. The LMA products are automatically updated on the forecasters' workstation. In this way, the forecaster can optimally evaluate the added value of total lightning data within the forecast and warning decision-making process (Fig. 5).

4. Summary and Plans

This paper describes a successful research and operational collaboration between NASA scientists and NWS forecasters. Continued collaboration between researchers and forecasters will produce new opportunities to further evaluate the utility of experimental research data products. In 2004 the hyperspectral Atmospheric Infrared Sounder (AIRS) data and derived soundings will be made routinely available to the WFOs.

Acknowledgements

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7. References

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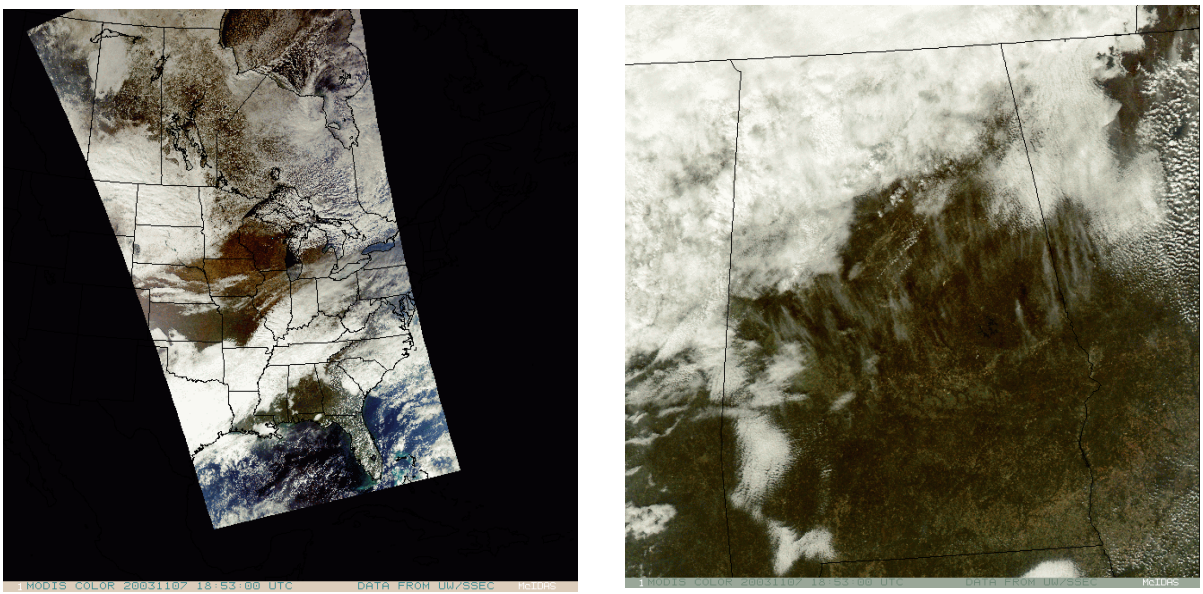
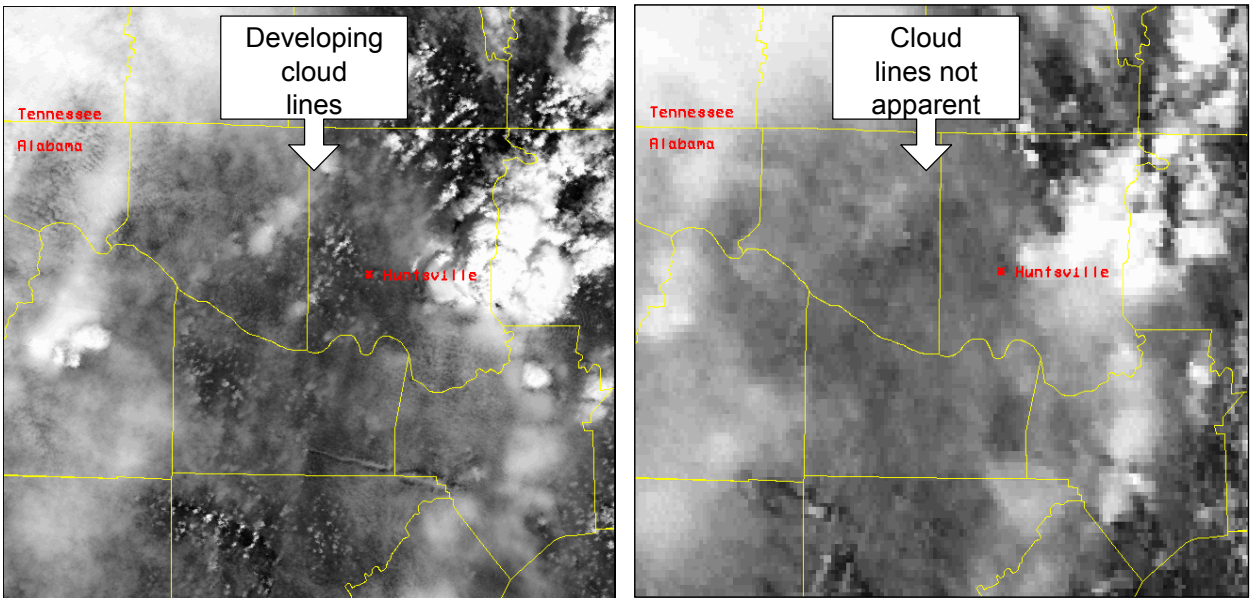
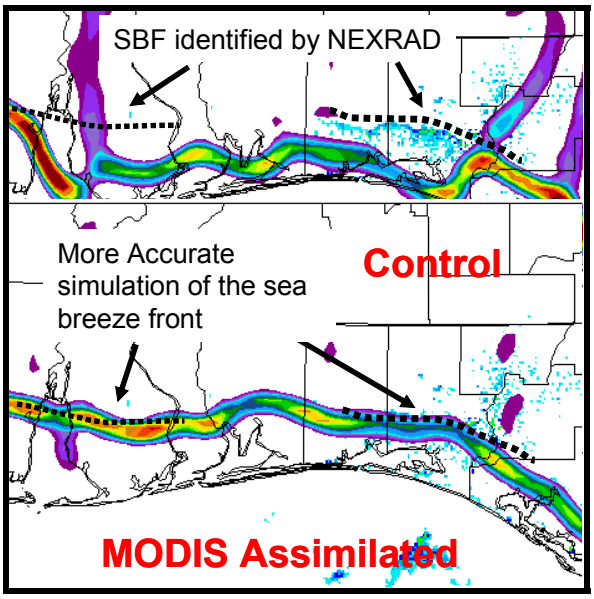


Fig. 1. MODIS Aqua CONUS swath (left) and high-resolution regional (right) 3-band color composite image of the southeast US at 1853 UTC 7 November 2003.



MODIS 250 m 15 August 2002 16:34 UTC GOES Imager 1 km 15 August 2002 16:31 UTC

Fig. 2. MODIS Terra 250 m, 3-band color composite image (left) shows greater cloud and surface detail than the concurrent GOES 1 km visible image (right).



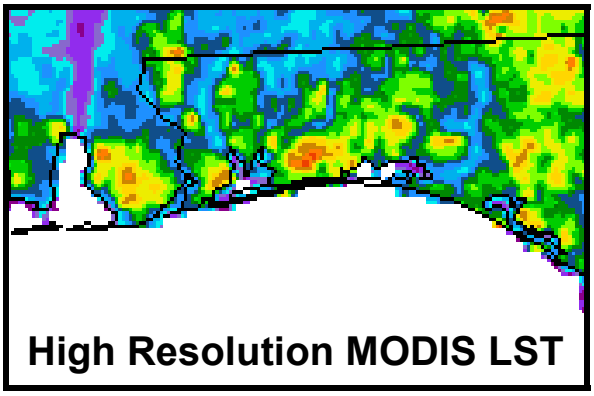


Fig. 3. MM5 model assimilation of MODIS land surface temperature (bottom) produces an improved forecast of the sea breeze front (SBF) position compared to a Control run (top).

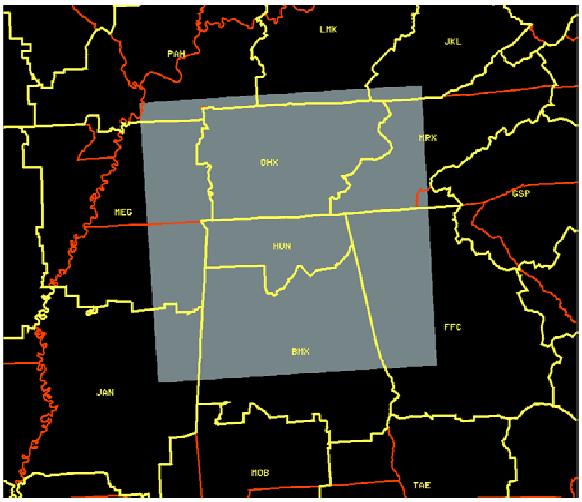


Fig. 4. Lightning Mapping Array 460 km x 460 km domain superimposed on the NWS Forecast Office County Warning Areas (yellow boundaries). Domain centered on Huntsville.

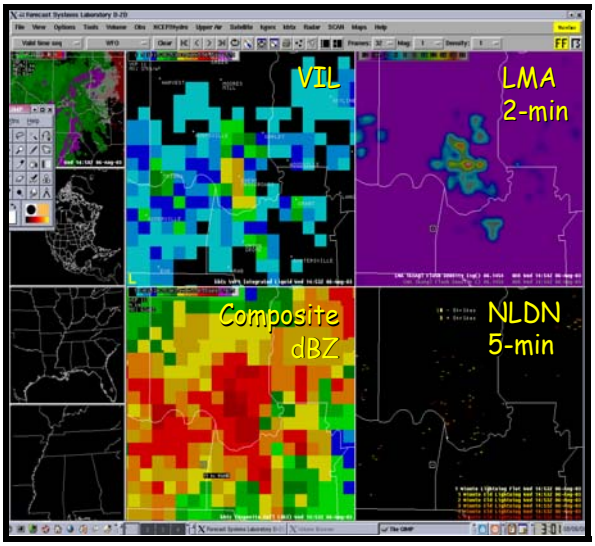


Fig. 5. AWIPS 4-panel product display at 1453 UTC during tornadic storm event on 6 May 2003. The Lightning Mapping Array gridded 2-min VHF source density is shown in the upper right panel. Also shown is KHTX NEXRAD Vertically Integrated Liquid, VIL (upper left), composite reflectivity (lower left), and lightning ground strikes from the National Lightning Detection Network (lower right).