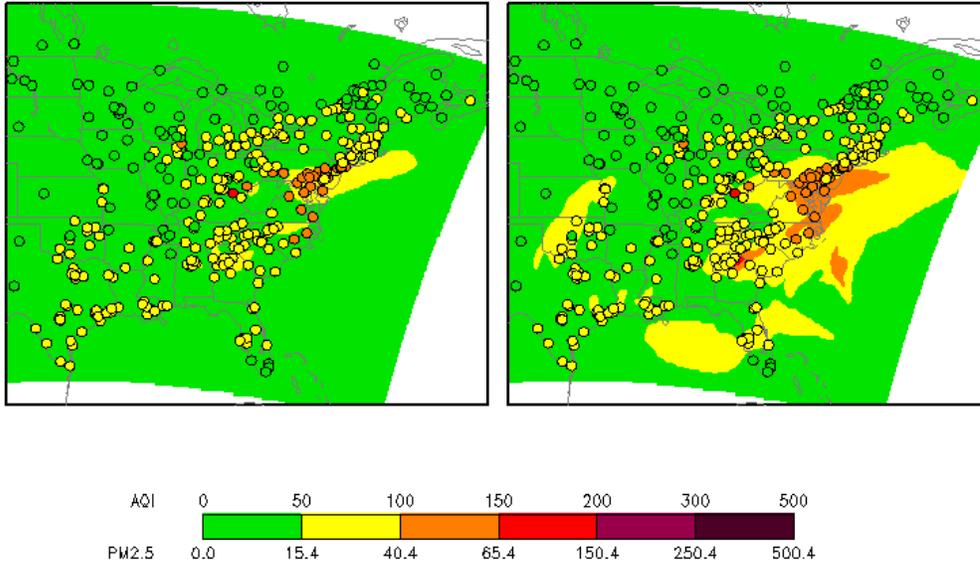


## News in This Quarter - Science Update

### Assimilation of GOES Aerosol Optical Depths to Improve Air Quality Predictions



**Predictions of 24-hr average surface PM<sub>2.5</sub> (fine particle) concentrations ( $\mu\text{g}/\text{m}^3$ ) on August 2, 2006 are shown as color contours and *in situ* observations are shown as circles. Right panel: With hourly GOES Aerosol Optical Depth (AOD) assimilation; Left panel: without GOES AOD assimilation. PM<sub>2.5</sub> concentrations are related to the Air Quality Index (AQI) as shown in the color bar**

NOAA's National Weather Service (NWS) uses the Community Multiscale Air Quality (CMAQ; <http://www.cmaq-model.org/>) model to provide air quality forecast guidance. The CMAQ model is run off-line using the WRF model predictions of meteorological fields. We are developing a GSI based GOES Aerosol Optical Depth (AOD) assimilation interface for the CMAQ model to improve surface fine particle (PM<sub>2.5</sub>, particles smaller than 2.5  $\mu\text{m}$  in diameter) predictions. We conducted some preliminary experiments, using a Cressman analysis scheme, to test the impact of assimilating hourly GOES AOD on surface PM<sub>2.5</sub> predictions.

The figure compares 24-hour average PM<sub>2.5</sub> from CMAQ model predictions of an urban/industrial haze event on August 2, 2006 - with and without assimilation of GOES AODs - to *in situ* observations (<http://www.epa.gov/airnow>). Surface measurements (color circles) show high PM<sub>2.5</sub> concentrations on the east coast whereas the CMAQ (color contours)

predictions without assimilation (left panel) underestimate the concentrations. The CMAQ assimilation run (right panel), however, shows high PM<sub>2.5</sub> and AQI over a much broader region, in agreement with observations.

Multiple experimental assimilation runs for different air quality episodes have shown that the impact of aerosol assimilation on surface PM<sub>2.5</sub> predictions depends on aerosol vertical profile, aerosol type, planetary boundary layer dynamics in the model, and the quality of the satellite data. This work is expected to lead to enhanced use of satellite observations to improve forecasts and prepare for the air quality observables from the next generation operational satellite sensors such as Joint Polar Satellite System (JPSS) OMPS (Ozone Mapping and Profile Suite), VIIRS (Visible Imager/Infrared Radiometer Suite), and GOES-R Advanced Baseline Imager (ABI). (Shobha Kondragunta, NESDIS/STAR, and Qiang Zhao, IMSG)



## JCSDA-HFIP Joint Workshop on Satellite Data Assimilation for Hurricane Forecasting



The Joint Center for Satellite Data Assimilation (JCSDA) and NOAA's Hurricane Forecast Improvement Project (HFIP) organized a joint workshop on satellite data assimilation for hurricane forecasting that was held at the Atlantic Oceanographic and Meteorological Laboratory (AOML) in Miami, Florida December 2 -3, 2010. Some 50 scientists from JCSDA, NESDIS, NCEP, NHC, AOML/HRD, NRL, JPL, NASA, AER, and Academia, with a wide range of expertise in data assimilation, hurricane modeling, satellite observations and products, participated in this first of its kind workshop.

The purpose of this workshop was to: (1) assess the status of using satellite data in hurricane forecasting, and identify the potential challenges associated with it, and (2) obtain recommendations from scientific experts to guide future directions that would be most likely to optimize the usage of satellite data in improving track and intensity forecasts. These recommendations will help both JCSDA and HFIP in their future calls for proposals. The JCSDA supports scientific development work with proposal-based, internally directed funds as well as with external grants and contracts awarded via competitive funding opportunities open to the broader scientific community.

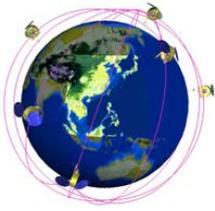
The workshop was organized around three plenary sessions: (1) Current models and data assimilation

systems used for hurricane prediction, (2) Satellite data used for NWP in support of hurricane prediction

and (3) Future directions. The plenary sessions were followed by three parallel breakout sessions organized by theme: (1) Methodology and modeling, (2) Satellite Observations I: IR and MW sounders, and (3) Satellite Observations II: Other sensors. The working group recommendations were discussed at a final plenary session. Some of the key recommendations were:

- The need for flow dependency which is provided by EnKF or 4D Var/EnKF Hybrid approaches.
- The need to utilize state-dependent techniques for thinning data.
- The need to make more effective use of satellite imagery, atmospheric motion winds, scatterometry, as well as sounding data (IR and MW) as close to the hurricane core as possible.
- The need for a greater three-way interaction between data assimilation scientists, satellite observations experts and forecast modelers.
- The need to prepare for future observations from polar and geostationary platforms.

Copies of the oral presentations and complete breakout group summary reports from the workshop are posted online. They can be downloaded from the JCSDA web site: <http://www.jcsda.noaa.gov> .  
(Sid Boukabara, JCSDA)



## Cosmic Corner:

### COSMIC- 2 on Track

Taiwan (National Space Organization) and US (NOAA) are moving forward with the joint COSMIC-2 mission. The Joint Program Office (JPMO) met in early December to discuss the proposed satellites, constellation architecture, and payloads. Several participants from the NESDIS/Office of Systems Development, and Lidia Cucurull, NCEP/Environmental Modeling Center, attended the meeting. The US Air Force also participated to discuss secondary payloads. Following the JPMO meeting, several of the NESDIS participants traveled to JPL to attend the Preliminary Design Review for the GPS payload.

COSMIC-2 will use a constellation of twelve remote sensing microsattellites to collect atmospheric data for weather prediction and for ionosphere, climate and gravity research. The new constellation provides improved performance and a five-fold increase in number of measurements over COSMIC-1. It will collect at least 8000 profiles per day.

NSPO will design, procure, and integrate 12 spacecraft and integrate the GPS payloads supplied by JPL. NOAA will provide the launch vehicles, which will be procured through the USAF. UCAR is NOAA non-profit collaborator on the program. The first launch of six satellites of the low inclination constellation is planned for 2014; the second launch into the high inclination orbits will take place in 2017.

(Lidia Cucurull, NCEP/EMC)



### Impact of Targeted Observations

The THORPEX International Data Assimilation and Observing System (DAOS) working group now has the report out from its third meeting, held in Montreal last summer. The full report is available at <http://tinyurl.com/3665n9r>. A main focus of this meeting was attempting to come to consensus on the impact of targeted observations.

With targeted observations, some weather feature of interest is identified where supplemental observations are expected to be helpful. In the extratropics, this may be a sensitive

region where the spread from an ensemble of forecasts is expected to grow rapidly, and, hence, where decreasing the analysis uncertainty would be helpful. In the tropics, this may be the environment around a hurricane. Sharanya Majumdar, a professor from the Rosenstiel School at the University of Miami, was an invited lecturer at the DAOS meeting and provided several presentations that summarized the general lessons learned from more than a decade of research in targeted observations. Majumdar also has a draft overview article on targeted observations in preparation.

The impact of targeted observations is generally thought to be positive for tropical cyclones but is still debated for mid-latitude winter cyclones. The assimilation of extra reconnaissance data that samples the environment around tropical cyclones consistently reduces forecast error. In the extratropics, on the positive side, results were presented that indicate that a targeted observation provides much more impact *per observation* on the analysis than a standard in-situ observation. Further, scientists such as Yucheng Song of NOAA have shown a reduction in forecast errors in a small region downstream of the targeting site. On the negative side, the verification studies to date have not demonstrated a consistent positive impact over wider regions or hemispherically. Further, many of the studies that were described are now ten years old. During this time, data assimilation/forecast systems have matured and the global observing network has expanded, so that the impact of an observation in a modern 2010 system may be less pronounced than it was circa 2000. Finally, in-situ data such as from aircraft are expensive (per observation) to obtain, so maintaining a regular targeting program could be costly.

To provide a more current assessment, NOAA THORPEX-funded scientist Yucheng Song is currently carrying out experiments to test the impact of the mid-latitude winter targeted observation data taken in the last several years. Parallel cycles of the NCEP GFS and GSI data assimilation system with and without the targeted data will be conducted and the forecast impact evaluated, including metrics that measure the impact over wider regions and for high-impact components of the forecast such as precipitation amount.

The type of targeted observations that are collected may change in the future. Rather than taking expensive in-situ measurements, possibly the regions of interest can be used to identify where satellite observations should be assimilated at higher resolution, or where additional cloud-track winds should be assimilated. Perhaps future instruments such as spaceborne lidars, instruments that consume significant power and are better used sporadically, can take more measurements in regions that have been identified as being of synoptic interest. THORPEX expects this to be an area of active research in the coming years.

(Tom Hamill, NOAA/OAR)



## New Computing Facility



NASA has acquired a new high performance computing resource dedicated to the JCSDA. An IBM Linux Cluster powered by 572 Intel Westmere processors and featuring 200 TB of storage was delivered to Goddard Space Flight Center on October 25, 2010, and NASA systems engineers and technicians have completed installation, configuration, and acceptance testing of the hardware (see photo) and basic software. They also have installed the GSI/GFS code in order to provide an operational global data assimilation and modeling system that will be available to both internal and external researchers and developers whose work is supported by the JCSDA.

In addition to hosting the HW, NASA will provide systems administration for the computer. NESDIS is supporting a Science Integrator (Eve-Marie Devaliere, see People column) to install common software (such as the JCSDA CRTM) to assist users to access and use the system and tools, and to help them integrate their delivered software packages on the JCSDA machine. Pioneer researchers and projects will be on the system shortly after the Holiday Season.

This computer addresses a pair of long-standing and widely recognized challenges that the JCSDA has faced. First, the lack of adequate computational resources to test new methods and satellite data sets quickly enough to provide the timely assessment that is a critical step on the path operational implementation. Second, the lack of opportunity for external researchers to develop and test their ideas in a computational environment that approximates an operational environment sufficiently to assess their results meaningfully and to minimize the difficulties in transitioning successful techniques from research to operations.

(Jim Yoe, JCSDA)

## People

### Farewell, Tom

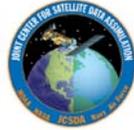


After a distinguished career of more than 32 years of Federal service, including stints with three of the JCSDA partner agencies – US Navy, US Air Force, and NOAA – Tom Kleespies retired on January 1st. Tom made significant contributions to a broad range of remote sensing topics. He was the first NESDIS scientist assigned to the JCSDA. His work on fast radiative transfer models, and the coding of their tangent linear, adjoint, and Jacobian versions, was instrumental in enabling NOAA's National Centers for Environmental Prediction (NCEP) to make dramatic improvements in the accuracy of medium range forecasting through direct assimilation of satellite radiances. For these contributions, he received several NOAA medals, including the Department of Commerce Bronze Medal "For pioneering development of optimal assimilation of satellite data into global forecast models and of fast, accurate radiative transfer algorithms" and the Department of Commerce Silver Medal "For accelerating the use of Advanced Microwave Sounding Unit satellite observations to advance the nation's capability in weather prediction."

His research included wind retrievals from tracking of atmospheric water vapor features, satellite image display and processing, cloud properties in the near-infrared, temperature profiles from tomography of satellite radiance observations, precipitable water measurements from the split IR window, a long series of collaborations with NESDIS and NCEP scientists on fast radiative transfer models for radiance assimilation, and calibration, and verification, navigation, display and post-launch checkout of satellite measurements.

Tom participated in all but two of the 17 International (A)TOVS Study Conferences held since their inception in 1983.

We will all miss the broad scope of Tom's remote sensing expertise and his conscientiousness, attention to detail, and integrity as a scientist. We wish him well on his retirement, and, hopefully, he will remain involved with NESDIS and JCSDA activities.



## Meet Eve-Marie



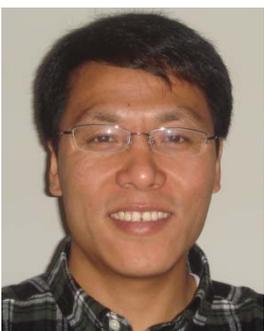
Eve-Marie Devaliere recently joined the JCSDA as its first Senior Science System and Software Engineer. In that capacity, she will be in charge of JCSDA's new supercomputer facility located at NASA's Goddard Space Flight Center. She will provide coordination and integration of the various existing and upcoming

software that are relevant to the JCSDA, as well as packaging and making them available to all JCSDA partners. As part of this effort, a comprehensive end-to-end testing system will be installed on the JCSDA supercomputer. This should greatly improve the transition process of codes and databases (generated from internal and external research activities) into operations. Tools will also be installed to visualize and perform impact assessments of these R to O efforts on weather forecast skill.

Eve-Marie holds a master's degree in Computer Information Systems from the University of Troyes (UTT), France. She first came to the USA seven years ago for an exchange semester at Humboldt State University in Arcata, CA. She then completed two six-month internships with the National Weather Service in Eureka, CA implementing a regional wave model into operations. In 2006, she moved to North-Carolina and worked for the Army Corps of Engineers, through the University of North-Carolina, where she continued her activities in the wave modeling field and developed scientific software in support of coastal research.

Welcome aboard, Eve-Marie.

## Visiting Scientist Zaizhong Ma



Dr. Zaizhong Ma recently joined the JCSDA as a University of Maryland Baltimore County (UMBC) Visiting Scientist at the Goddard Earth Sciences & Technology Center (GEST). Zaizhong will work with the Lidar Working group to perform Observing System Simulation Experiments (OSSEs) for the Global Wind Observing Sounder.

The Lidar OSSEs are mainly based on NCEP's Gridpoint Statistical Interpolation (GSI) system coupled with the Global Forecast System (GFS).

Zaizhong has an extensive background in variational data assimilation, especially adjoint techniques. As a post-doc

with the WRF data assimilation group at the National Center for Atmospheric Research (NCAR) from 2008 to 2009, he worked on simplifying the adjoint model of the WRF 4D-Var System. His contribution resulted in a considerable reduction in computational cost. Zaizhong also has experience with OSSEs and GPS radio occultation (RO) measurement techniques. While at NCAR, he performed an OSSE to assimilate GPS RO data with non-local operators. He also evaluated the assimilation impact of COSMIC GPS data on the Atmospheric River event that produced a significant amount of precipitation over the Pacific Northwest in November 2006.

Zaizhong received his B.S. degree in Meteorology from the Lanzhou University of China in 1999, and his M.S. and Ph.D. degrees in Meteorology from the Chinese Academy of Sciences in 2003 and in 2008.

Welcome aboard, Zaizhong.

## Visiting Scientist Arulmani (Mani) Chinnaswamy



Dr. Arulmani Chinnaswamy recently joined the JCSDA as an Air Force Weather Agency (AFWA) Visiting Scientist. His primary goals are to facilitate the integration of JCSDA capabilities into AFWA operations (GSI focus) and to contribute to the development of a 4DVAR GSI system (regional NWP focus).

Arulmani (or Mani, as he likes to be called) has 20 years of experience in remote sensing, and satellite image data analysis, interpretation and validation. Before joining JCSDA he worked as a Senior Systems Engineer at the EROS Data Center (EDC), USGS, Sioux Falls, SD, where he led the development of a MODIS data processing system for mosaicking and reprojecting native sinusoidal projections into various user defined projections. At EDC, he also developed a cloud masking scheme for ASTER data products and worked on evapo-transpiration modeling using AVHRR data. As a Remote Sensing Specialist at the Environmental Protection Agency, Cincinnati, Ohio, he worked on the development of water quality retrieval algorithms from the Airborne Hyper Spectral Imager and isolated wetland mapping using Terra satellite's Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER).

Mani earned BS, MS & MTech Degrees in Physics, Applied Physics and Remote Sensing, respectively, in India. He did his PhD research in remote sensing at the Environmental Systems Science Center, NERC, University of Reading, UK.

Welcome, aboard, Mani.



## A Note from the Director



First of all, Happy New Year to the readers of the JCSDA newsletter!

Next, I am delighted to be able to say that our new computer is finally here. It is up and running at the Goddard Space Flight Center and it has passed various the acceptance tests it was put through. As

I indicated in the last issue of this newsletter, we had hoped to have our first "real" users on it by now, but a couple of hiccups on both the technical and administrative side have combined to postpone this by a few weeks. However, we are indeed getting closer. As you can see elsewhere on these pages we are gearing up to staff the scientific support for the machine. At the same time software ports are being prepared and account requests are being processed. Hopefully, by the time we meet at the annual JCSDA Science Workshop in May, we will be able to show the first results from experiments run on the new machine.

Many of you are keenly interested in working with us as external partners and in applying for funding from our various opportunities to do so. Our external research opportunity for FY 2011 is managed by NASA through its ROSES vehicle, and we are now in the middle of the evaluation process for the proposals we have received. Final decisions are likely to be made in February, and the successful investigators will be notified shortly thereafter. For FY 2012, the intention is to pass the baton onto our DoD partners before returning it to NOAA in FY 2013. Stay tuned for more specific information on the FY 2012 opportunity.

Last year was characterized by an unprecedented level of outreach by the Joint Center: We initiated – or substantially enhanced - collaborations both internationally (with ECMWF, WMO and with various national entities) and nationally, e.g. with GOES-R, JPO and HFIP. It was therefore only fitting that we closed the year on a successful note with the JCSDA-HFIP Workshop in Miami on Satellite Data Assimilation for Hurricane Forecasting. You can read more about that meeting elsewhere in this newsletter, but here I would like to personally commend both the invited speakers for the quality of their presentations and the participants for their engagement and contribution to a series of very lively and candid discussions. I am sure the output will be very useful for both the Joint Center and HFIP in the future.

One of our main tasks for FY 2012 is to strengthen the links we have to our collaborators, and to make out new computer as useful as possible both to them and to us. This will not necessarily be smooth sailing from day one. Operating a resource of this magnitude in an interagency environment with very ambitious goals in mind leads us into uncharted territory. However, I firmly believe that the Joint Center must meet this challenge in order to fulfill its mission, and with the staff that we now have on board I have every expectation that we will.

Lars Peter Riishojgaard, Director, JCSDA

## Opportunity

### Early Career Research Scientist

The JCSDA is searching for a post-doctoral or early career scientist to develop effective means to assimilate cloud-affected or cloud-cleared hyperspectral infrared radiance data in NWP models. The position will be filled through the Earth System Science Interdisciplinary Center at the University of Maryland. Complete details and application instructions are at <http://www.jcsda.noaa.gov/careers.php>

## Upcoming Events

### Heads Up:

#### Summer Colloquium

The JCSDA is completing tentative plans to conduct a Summer Colloquium on Data Assimilation during the first half of July 2011. Based on the success of the 2009 event, the Colloquium will be aimed at senior graduate students and early post-doctoral researchers pursuing degrees and careers in environmental modeling, satellite remote sensing, and data assimilation. Please check the JCSDA Homepage at <http://www.jcsda.noaa.gov/> for more detailed information concerning the Agenda, Logistics, and Instructions for Applicants as our planning is completed and confirmed

The objective of these Colloquia is to foster the education of the next generation of data assimilation scientists. Lecturers' presentations from the 2009 event are posted at [http://www.jcsda.noaa.gov/meetings\\_2009SummerColloq.php](http://www.jcsda.noaa.gov/meetings_2009SummerColloq.php) (Jim Yoe, JCSDA)

#### Annual Science Workshop

Plans are being formulated to hold the Joint Center's 9th Annual Workshop on Satellite Data Assimilation in May 2011. The purpose of these workshops is to review the ongoing and planned scientific development sponsored by



the Center, and to plan and coordinate future efforts. The JCSDA supports scientific development work with proposal-based, internally directed funds as well as with external grants awarded via a competitive Federally Funding Opportunity open to the broader scientific community. In

addition, JCSDA individual partners undertake their own research that overlaps with JCSDA objectives.

Check the JCSDA website <http://www.jcsda.noaa.gov> for updates on workshop planning. (Sid Boukabara, JCSDA)

## JCSDA Seminars



JCSDA seminars are generally held on the third Wednesday of each month in Room 707 of the World Weather Building. Presentations are posted at <http://www.jcsda.noaa.gov/JCSDASeminars.php> prior to each seminar. Off-site personnel may view and listen to the seminars via webcast and conference call. Upcoming seminars are listed in the table.

Check <http://www.jcsda.noaa.gov/JCSDASeminars.php> for updates.

<b>Upcoming Seminars</b>			
<i>Date</i>	<i>Speaker</i>	<i>Affiliation</i>	<i>Title</i>
Jan 19, 2011	Stephen Eckermann	Naval Research Laboratory-DC	Assimilation of Middle Atmosphere Observations
Feb. 16, 2011	Ricardo Todling	NASA/GSFC/Global Modeling and Assimilation Office	The GMAO Data Assimilation System: Status and Future Directions
March 28, 2011	Kazumasa Aonashi	Japan Meteorological Agency	Displaced Ensemble Variational Assimilation Method to Incorporate Microwave Imager Brightness Temperatures into a Cloud-Resolving Model

Editor's Note: Unsolicited articles for the JCSDA Quarterly Newsletter are encouraged as are suggestions for seminar speakers or topics. Please send them to [George.Ohring@noaa.gov](mailto:George.Ohring@noaa.gov).