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*NOAA……NASA……US Navy……US Air Force* *Web-site: www.jcsda.noaa.gov*

# *News in This Quarter*

## *Science Update*

### Measuring the Global Impact of ASCAT Observations

Near-surface wind vectors over the oceans from the Advanced Scatterometer (ASCAT) on the MetOp satellite have been assimilated operationally since July 2008 in the global forecast system run by the Navy/FNMOC and, since May 2011, in the global forecast systems of NOAA/NCEP and NASA/GMAO. A recent paper by Bi et al. (2011) describes the impact of these data in the NCEP Global Forecast System (GFS), based on observing system experiments (OSEs) with an earlier operational version of the GFS. Those authors found that assimilation of ASCAT observations slightly reduces the bias and standard deviation of the analyzed near-surface wind fields, and has a neutral or small positive impact on standard measures of forecast skill (e.g., anomaly correlation for 500 hPa height) for multi-day forecasts. Similar metrics produced with both the Navy and GMAO systems support these results.

The adjoint of a data assimilation system provides another means of measuring the impact of observations on numerical weather forecasts. Here we use the adjoint of the GMAO's Goddard Earth Observing System (GEOS-5) to examine the global impact of ASCAT winds on 24-h forecasts from 00 UTC during the period 10 Nov 2010 – 02 Jan 2011. This period was chosen because of its use in testing other recent GEOS-5 implementations, and has no known advantages or disadvantages in the present context.

Fig. 1a shows the overall impacts of the major observing systems assimilated in GEOS-5 in terms of their fractional contributions to the reduction of a global measure of 24-h forecast error. The measure combines errors in wind, temperature and surface pressure with respect to the verifying analysis, in terms of energy per unit mass (J/kg). The results show that AMSU-A radiances, which are both numerous and of known high quality, have the largest overall impact, providing roughly 27% of the total error reduction due to the assimilation of all observations. Other observing systems known to be important for NWP, such as radiosondes and dropsondes (RaobDsnd), satellite winds, and aircraft, also have large overall impacts. In comparison, ASCAT winds provide a much smaller fraction (~2%) of the total error reduction.

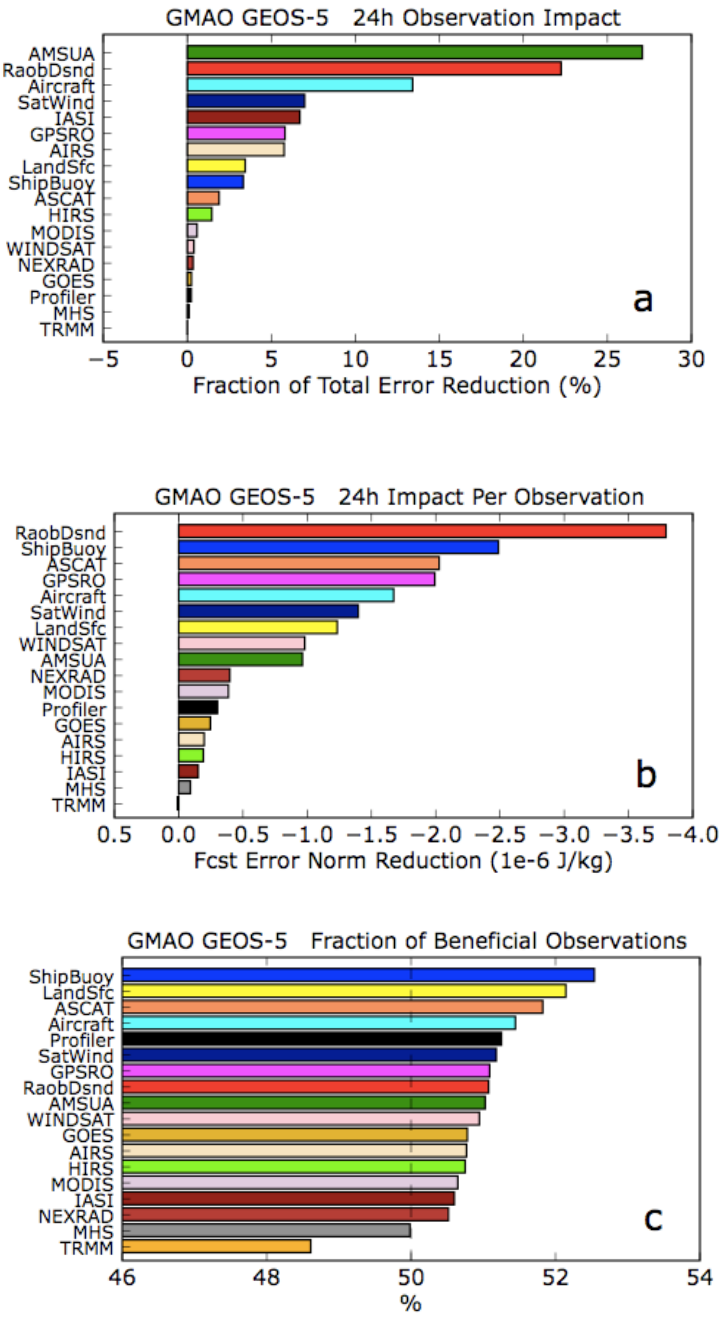



***Fig. 1. Impacts of various observation types on GEOS-5 24-hr forecasts from 00 UTC during the study period: (a) total impact, (b) impact per observation, and (c) fraction of beneficial observations.***

Because the current adjoint forecast model does not include moist physics, the impacts of moisture-related observations (e.g., from the Microwave Humidity Sounder (MHS) and TRMM-Microwave Imager (TMI)) are likely under-represented in these results. Nonetheless, the results in Fig. 1a are consistent with our general knowledge of observing system impacts obtained from previous studies, and with the results for ASCAT reported by Bi et al. (2011).

There are far fewer observations from ASCAT (~17,000) assimilated in each GEOS-5 analysis than from, say, AMSU-A (~503,000) or radiosondes (~105,000). The impact per observation shown in Fig. 1b provides a measure of the average influence of individual observations of a given type on the forecast. Results are expressed in terms of the average reduction in the error measure per observation, so that negative values indicate a positive impact. Note that ASCAT winds provide one of the largest positive impacts per observation. A large impact per observation usually reflects the high quality of the observations, their location in otherwise data-sparse regions, or both. ASCAT observations also have one of the highest percentages of beneficial impacts, with roughly 52% of these data improving the 24-h forecast on average (Fig. 1c).

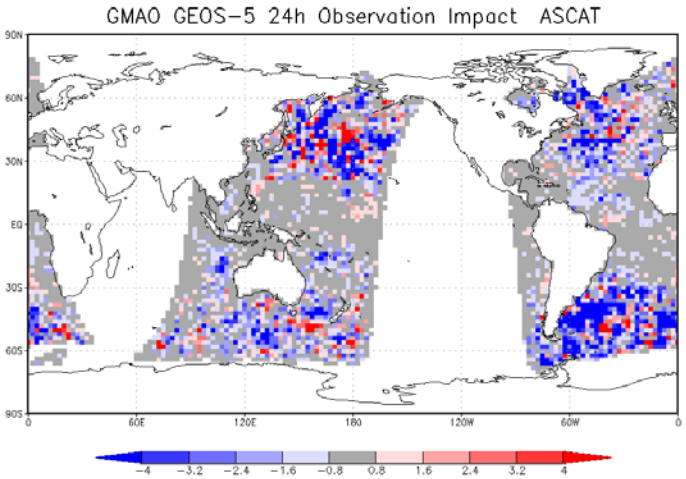



***Fig. 2. Average impact of ASCAT observations on GEOS-5 24-hr forecasts from 00 UTC during the study period. Results represent 2° × 2° gridded average values. The units are $10^{-5}$ J $kg^{-1}$. Bluish areas represent positive impacts.***

Fig. 2 shows the time-averaged spatial distribution of observation impacts from ASCAT winds assimilated at 00 UTC. Large forecast error reductions (blue) occur due to assimilation of these data over the North Pacific and South Atlantic Oceans, with smaller, but overall positive, impacts in other mid-latitude locations in both hemispheres. As with all data types, ASCAT observations in some locations degrade the forecast on average (red). However, the results clearly reflect the positive overall impact of ASCAT.

The results shown here indicate that ASCAT surface winds provide a high-quality source of information for global NWP. Results from the Navy's adjoint data assimilation system support this conclusion, and will be included in a separate study (N. Baker, personal communication). While not discussed here, it is expected that ASCAT observations can have a substantial impact on forecasts of individual weather events such as tropical cyclones. This is a subject of ongoing study.

(Ronald Gelaro, NASA Global Modeling and Assimilation Office)

References:

Bi, L., J. A. Jung, M. C. Morgan and J. F. Le Marshall, 2011: Assessment of assimilating ASCAT surface wind retrievals in the NCEP global data assimilation system. *Mon. Wea. Rev.*, in press.

## A Wavelet-based Satellite Compression Method

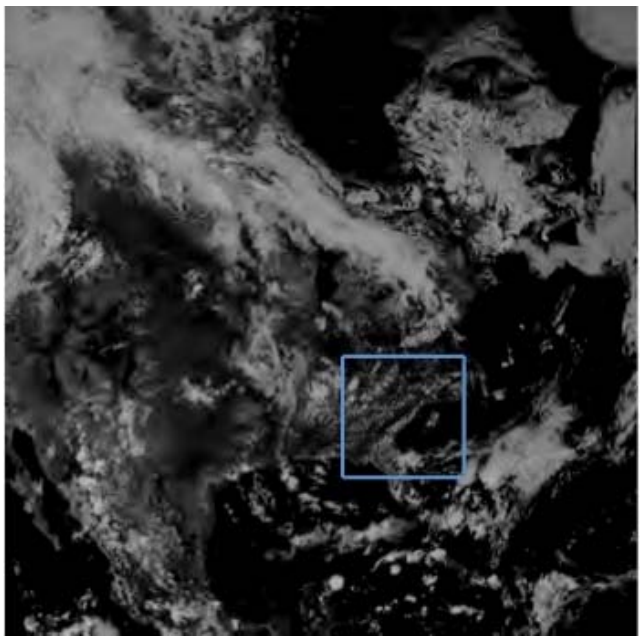
High-volume satellite data present challenges to assimilation systems. They may resolve features finer than the grid scale, introducing representativeness errors. Observation errors may not be independent, as is practical to assume. Additionally, satellite data are often produced at too large a data volume for the data assimilation system to handle efficiently. A thinning scheme is commonly used to reduce the computational cost in operational assimilation systems.

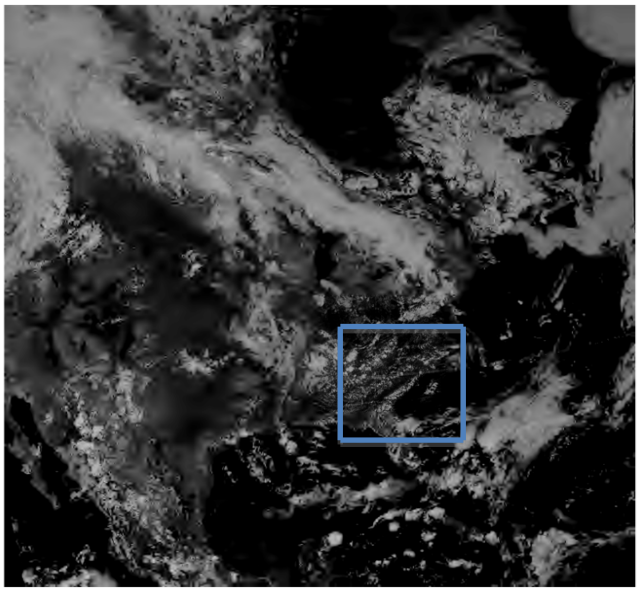
NOAA THORPEX is interested not just in data thinning but in adaptive data thinning, dynamically determining where and when the assimilation of fine-scale observations provides additional value despite these other complications. This process is also referred to as "targeting." Satellite data might thus be used inhomogeneously: fine-scale information in targeted areas and relatively coarse scale information in other regions. We think that a good data thinning method should be capable of (a) filtering the data, i.e., removing noise representative of sub-gridscale processes, and/or (b) appropriately thinning and compressing the data in-homogeneously, preserving detail in a targeted region, if desired.

We have designed a prototype wavelet-based process for compressing satellite data that partially addresses these issues. The accompanying figure shows how a satellite visible image data may be compressed outside of a hypothetical target area. The file size that would be input to the assimilation scheme is reduced from 25 MB of its full resolution to 0.4 MB without losing much detail.

Such a technique may be particularly helpful to the Grid-point Statistical Interpolation (GSI) scheme, where thinning is currently done inside the assimilation code. Large volumes of satellite data are read in, but then the majority of observations are thereafter discarded; the GSI is thus slowed

by unnecessary I/O. In the wavelet satellite-compression scheme, an information compression is performed outside of GSI analysis. The wavelet technique is very computationally inexpensive and reduces satellite data volume to a very small file consisting primarily of the wavelet coefficients. If desired, original-resolution information can be saved in a specified targeted region. We have developed a satellite prep-bufr encoder under this THORPEX project. The wavelet-compressed satellite data are re-constructed at each horizontal grid point and encoded into a prep-bufr data file. This prep-bufr data file, which is much smaller in size, is passed to GSI for analysis.



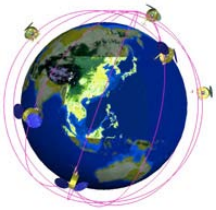


***A GOES east/west composite visible image before (above) and after (below) the wavelet-based information compression outside of a target area (blue box). The lower image contains the crisp detail of the upper image inside the box only. The file associated with the lower image is smaller in size, contains detail in the target area, and will provide appropriate thinned data to the rest of the domain.***

We will test this new satellite-thinning scheme for GSI on some retrospective case studies and then calibrate it for operations in the near future.
(Yuanfu Xie, NOAA/ESRL/GSD. Dan Birkenheuer and Ning Wang of ESRL/GSD also contributed to this research.)

## Precip-Cloud Workshop Summary

The Meeting Summary of the ECMWF-JCSDA Workshop on "Assimilating Satellite Observations of Clouds and Precipitation into NWP Models," held at ECMWF in June 2010, is being published on-line in conjunction with the **June 2011** issue of the Bulletin of the American Meteorological Society (BAMS). This electronic-only publication is listed in the table of contents of the paper issue, and is accessible on the BAMS website. A number of papers from the Workshop will be published in a special edition of the Quarterly Journal of Royal Meteorological Society later this year.



## Cosmic Corner:

After successful planning meetings for COSMIC-2 in Taiwan on April 11-12, 2011, scientists shared and presented their results in a workshop on the use of GPS RO data. Presentations can be downloaded from the following web page:

http://www.nspo.org.tw/5th_FS3WS/program_plan.html

On the scientific front, NOAA/NCEP continues to develop more accurate forward operators to increase the benefits of assimilating GPS RO soundings in NWP. In addition, NOAA is exploring ways to make RO soundings from international science missions available to the community in near real time. This will be crucial to cover the gap between COSMIC and a follow-on mission.

Finally, NCEP started to assimilate observations from the Argentinean SAC-C, US Air Force C/NOFS and German TerraSAR-X missions into its Global Data Assimilation System in May 2011.
(Lidia Cucurull, JCSDA)

# JCSDA 9th Workshop on Satellite Data Assimilation

More than 160 scientists from the JCSDA agencies, and academic and private sector institutions partnering with the Center, including program managers and JCSDA management/staff, participated in the 9th Annual JCSDA Workshop on Satellite Data Assimilation, held at the University of Maryland in College Park, MD, May 24 -25, 2011. This year's workshop established a record in the number of participants, clearly signaling an increased interest in satellite data assimilation in general, but also highlighting the wider circle of JCSDA partnerships and the increased activities made possible through the newly acquired JCSDA supercomputer machine.

The purpose of these annual workshops is to review the ongoing and planned scientific development sponsored by the Center, and to plan and coordinate future efforts. The Joint Center supports scientific development work with proposal-based, internally directed funds as well as with external grants awarded via a competitive process open to the broader scientific community. In addition, JCSDA individual partners undertake their own research contributing to the Center's objectives.

In the first session of the workshop, Director Riishojgaard presented an overall program update and overview, in which he highlighted progress in planning and developing satellite data assimilation systems and in establishing JCSDA's supercomputing capability, which allows the Center's affiliated scientists to run full scale assimilation and forecast impact assessment experiments at both global and regional scales. The scientific sessions focused on the Center's scientific priorities — radiative transfer, advanced sensors assimilation, clouds and precipitation, land data assimilation, ocean data assimilation and atmospheric composition — and featured 36 oral and 29 poster presentations by JCSDA investigators. A new session on *Software Packages and Science Integration* was introduced in this year's workshop. This provided information on available software packages at the JCSDA partners that could be shared to facilitate leveraging and avoid duplication. In the final plenary, breakout group chairs summarized issues and recommendations for their scientific areas to Joint Center management. Copies of the oral presentations and poster papers are all posted online. They can be downloaded from: http://www.jcsda.noaa.gov. For more information, please contact sid.boukabara@noaa.gov
(Sid Boukabara, JCSDA)

## 2011 Summer Gridpoint Statistical Interpolation (GSI) Community Workshop and Tutorial

***Group photo of the 2011 Community GSI Workshop participants***

The 2011 Community GSI Workshop and 2011 Summer Community GSI tutorial, hosted by the Developmental Testbed Center (DTC) and NCEP/EMC, were held on June 28-July 1, 2011 at the NCAR Foothills Laboratory, Boulder, Colorado.

The workshop — the first community GSI workshop — aimed to provide a pathway between operational centers and the research community to communicate and share experience on:

- GSI development, implementation and future plans
- New techniques and skills in data assimilation

The workshop included five invited talks from major operational and research centers, including NOAA/NCEP/EMC, NASA/GMAO, NOAA/ESRL, NCAR/MMM, and DTC, as well as a general section for community GSI data assimilation system users. Fifty researchers, university students, and agency employees participated in this first workshop.

The summer GSI tutorial was the second such event. Their purpose is to train potential users of the system. The tutorial was a three day venture (last day was optional) with 8 hours of lectures and 8 hours of hands-on sessions. Thirty-one students from the United States and several other countries/regions participated. The invited lecturers and practical session instructors, representing several GSI development/support teams, including two from NOAA/NCEP/EMC, one from NASA/GMAO, three from NCAR/MMM, and five from DTC (affiliated with NOAA/ESRL or NCAR/RAL), provided first-hand information on the GSI system.

The presentations and lectures of the GSI workshop and tutorial are posted at
http://www.dtcenter.org/com-GSI/users/docs/index.php

The GSI is a unified variational data assimilation system that is currently part of several NOAA applications, including the operational Global Forecast System (GFS), North American Mesoscale (NAM) Model, Weather Research and Forecasting (WRF) Rapid Refresh (RR) system, Hurricane WRF system, Real Time Mesoscale Analysis (RTMA), as well as the NASA global system. For more information on the GSI system, please visit:
http://www.dtcenter.org/com-GSI/users/index.php
(Hui Shao, JCSDA(DTC))

# Opportunities

## JCSDA Seeks 2 Experienced Scientists for ATMS and CrIS Data Assimilation and OSSE Efforts

The U.S. Joint Center for Satellite Data Assimilation (JCSDA) is dedicated to accelerating the transition of new sensors into U.S. operational Numerical Weather Prediction (NWP) models. The instruments onboard the future JPSS mission (and the more imminently upcoming NPP mission) will serve as the U.S. next-generation polar-based sensors. Major improvements are expected in terms of measurement accuracy, spectral and spatial resolution, with an unprecedented set of challenges associated with them. These challenges include technical aspects such as making sure the network bandwidth, the computing power and the storage space are sufficient to handle these data, but also include scientific aspects such as the optimal usage of the data, the proper extension of assimilation and radiative models and algorithms to tackle the new data. The challenges also include modeling advances that take advantage of the new sensors.

A number of these sensors (CrIS and ATMS for instance) will initially complement but ultimately replace a set of current sensors (AIRS/IASI, AMSU/MHS respectively) that have demonstrated an important role in the Numerical Weather Prediction (NWP) assimilation models and have shown that the forecast skills will degrade significantly if these data are no longer assimilated. The JCSDA is seeking experienced scientists who will complement the data assimilation efforts of the ATMS and CrIS sensors. These scientists are to be hired as contractors by a NOAA/NESDIS contracting company.

The efforts will aim at fully preparing the NOAA NWP global assimilation and forecast system (GDAS) for the assimilation of the NPP/JPSS ATMS and CrIS data, within the infrastructure of the Joint Center for Satellite Data Assimilation (JCSDA) and/or the NESDIS/STAR infrastructure. Part of these efforts will focus on performing Observing Systems Simulation Experiments (OSSEs) using CrIS and ATMS proxy data already produced by NESDIS. This will assess the expected impact of these sensors on global forecast skills.

Upon launch of NPP, the efforts will focus on testing the impact of assimilating real data from NPP ATMS and CrIS and performing data denials (OSEs). This will be coordinated with efforts performed in NESDIS for the sensor calibration, channel selection and the quality control aspect, with the JCSDA efforts regarding the Community Radiative Transfer Model (CRTM).

To accomplish these tasks, the two scientists sought (one dedicated to the assimilation of ATMS microwave data and one dedicated to the assimilation of CrIS hyperspectral IR data) must have strong experience in satellite data assimilation (previous experience with GSI and GFS a significant plus), OSSEs, passive remote sensing (using variational algorithms). Previous experience with AIRS, IASI and/or AMSU, MHS is a plus. Experience in computer languages such as FORTRAN 90/95 and IDL expected. Knowledge of a scripting language, such as BASH, Java, and software configuration subversion is also a plus.

- To apply for these positions, please send Sid Boukabara a resume and two references.

(Sid Boukabara, JCSDA)

# People

## *Profiling Jim Jung*

Jim Jung has been a member of the Joint Center's scientific staff since its inception about a decade ago. His research has focused on conducting Observing System Experiments (OSEs), sometimes referred to as data denial experiments, to evaluate the impact of the observations of different instruments on forecast accuracy. He initially performed (OSEs) with Steve Nieman and Tim Schmit on the impact of GOES data using the NOAA/NCEP Eta model. Jim later conducted a series of data denial experiments with Tom Zapotocny using NCEP's Eta and Global models. He has since carried out OSEs using GOES and MODIS atmospheric motion vectors, sea surface winds from WindSat and ASCAT, and radiances from HIRS and the GOES Sounder. His latest project is on the assimilation of AIRS and IASI radiances, specifically the water vapor channels.

Jim is a graduate of Purdue University (1985), South Dakota School of Mines and Technology (1989) and the University of Maryland (2008). His Ph. D. Dissertation at Maryland was on "The Assimilation of Hyperspectral Satellite Radiances in Global Numerical Weather Prediction" under the direction of Dr. John Le Marshall, former director of the Joint Center, and Dr. Eugenia Kalnay.

Shortly after receiving his Private Pilot's license, Jim started his meteorology career in North Dakota, directing summer weather modification (hail suppression) activities in the north-central section of the state. He later took the position of Chief Meteorologist for the North Dakota Atmospheric Resource Board. In 1991 Jim moved to Kwajalein Atoll, Republic of the Marshall Islands and assumed the duties of a Mission Meteorologist and Duty Forecaster for the U.S. Army – Kwajalein Atoll, as a contractor with Aeromet, Inc. He later moved to Aeromet's home office in Tulsa OK, where he was a crew member with Aeromet's High Altitude Reconnaissance Platform (HARP), a meteorologically instrumented Lear Jet, while continuing in a support role for the weather station at Kwajalein. In 1998 Jim moved to his present location in Camp Springs MD working for the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin.

In his spare time, Jim is an amateur musician, playing trombone in concerts and various fund raising events around Southern Maryland. You may also find him playing in the pit orchestra for various musicals at the local community college.

## Introducing Sean Casey

Dr. Sean Casey recently joined the JCSDA as an Earth System Science Interdisciplinary Center (ESSIC) Visiting Scientist. His primary goal is to investigate the effectiveness of assimilating cloud-cleared radiances from hyperspectral satellite instruments into NOAA's Global Forecast System.

Before joining JCSDA, Sean was a Postdoctoral Research Associate at the Jet Propulsion Laboratory, Pasadena, CA, where he worked with the Atmospheric Infrared Sounder (AIRS) science team. His research included analyzing AIRS/CloudSat coincident scans over the tropical ocean to investigate cloud/environment interactions, quantitative identification of midlevel cumulus congestus clouds [paper currently in Atmospheric Chemistry and Physics Discussions (ACPD)], study of the relation of cumulus congestus to the Madden-Julian Oscillation (MJO), and determining convective buoyancy from CloudSat overpasses.

Sean received a Bachelor of Science Degree from the University of Washington, Seattle, WA, in June 2005. He was awarded an M.S. degree in August 2007 and Ph.D. in December 2009 from Texas A&M University, College Station, TX.

Welcome aboard, Sean.

## Meet Aaron Pratt

Dr. Aaron Pratt joined the JCSDA in February 2011 as member of the ERT, Inc. team supporting the Center. As a scientific analyst/programmer, he will assist Eve-Marie Devaliere, the Center's lead software integrator, in the set-up of the JCSDA supercomputer (nicknamed "JIBB") located at NASA Goddard Space Flight Center, and in helping future users with scientific data analysis and programming issues.

Aaron received his B.S. in meteorology from North Carolina State University in 2002, M.S. in meteorology from Pennsylvania State University in 2005, and PhD from Howard University in Washington, DC in 2009. His PhD research focused on observations of the impact of Saharan dust on cloud microphysics and tropical cyclogenesis over the eastern Atlantic. During his doctoral tenure, he participated in the NASA African Monsoon Multidisciplinary Analyses, flying aboard the NASA DC-8 into cloud systems and developing tropical cyclones near West Africa. The data collected formed an integral portion of his dissertation. He continued this line of research as a NASA post-doctoral fellow, using the NASA Unified WRF (NU-WRF) system to simulate potential dust impacts on tropical storm formation.

Welcome aboard, Aaron.

# A Note from the Director

*It was good seeing many of you at the recent JCSDA Science Workshop in College Park in May. If success is measured purely in numbers, this was by far the most successful workshop we have had, with more than 160 registered participants. Although the reviews of the venue were somewhat mixed – we recognize that both seating and acoustics were less than perfect – the overall views on the meeting expressed in the wrap-up session were highly positive. We value the feedback we received both during and after the meeting and we will take it into account when we plan future meetings.*

*I am happy to report substantial progress in porting the NCEP data assimilation system to "JIBB", the Joint Center machine at Goddard. This project, which is critical to both internal and external JCSDA investigators, has been much more demanding than we expected, but the analysis system is now running, and we are in the process of validating the 7-day forecasts and comparing them to runs made on Vapor, the NOAA R&D machine. Once this process has been completed, we will be in a position to do data assimilation experiments for certain fixed periods with fixed observational datasets on JIBB. The next step will be to port the software for obtaining observational input on demand for different periods.*

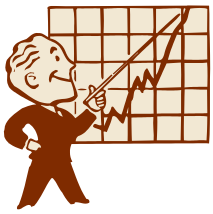
*We are still working on the plans for the 2011 external research opportunity. Considering the general state of the federal budgets, the prospects for obtaining at least some funding for this appear to be relatively good. However, since this is the first time our DoD partners will be responsible for managing the external projects, there are still a number of administrative issues to be sorted out. Hopefully we will have finalized this by the next issue of the Newsletter.*

*Have a great summer!*

*Lars Peter Riishojgaard, Director, JCSDA*

# Outlook for Next Quarter

## Upcoming Events



### 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**

| Date | Speaker | Affiliation | Title |
|---|---|---|---|
| September 13, 2011 | Eugenia Kalnay | University of Maryland | Recent Advances in Data Assimilation with the Local Ensemble Transform Kalman Filter |
| October 19, 2011 | Robert McCoy | Office of Naval Research | Ionospheric Data Assimilation |

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

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.