

## News in This Quarter Implementation Update

### Navy Updates Global 4D-Variational Data Assimilation System

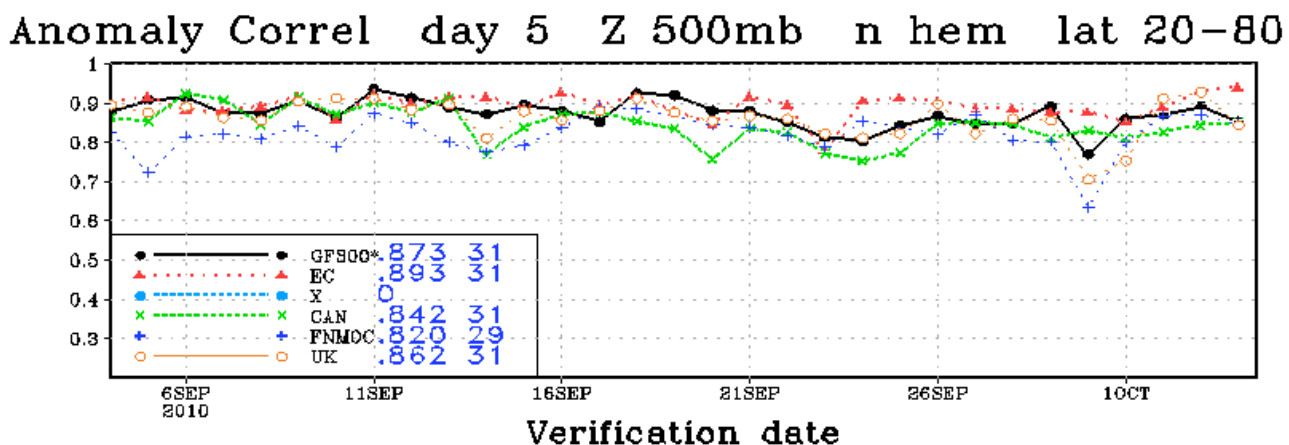


Fig 1. 120h 500 hPa anomaly correlation for the first 20 wave numbers of the spectral model.

This brief note summarizes recent changes made by JCSDA partner Naval Research Laboratory (NRL) to the NRL Atmospheric Variational Data Assimilation System—Accelerated Representer (NAVDAS – AR), the Navy’s 4D-Var data assimilation system. NAVDAS – AR is part of the Navy Operational Global Atmospheric Prediction System (NOGAPS) – which includes a T319/L42 spectral model - of the Fleet Numerical Meteorology and Oceanography Center (FNMOC), the Navy’s operational Numerical Weather Prediction Center in Monterey, CA. These recent updates include:

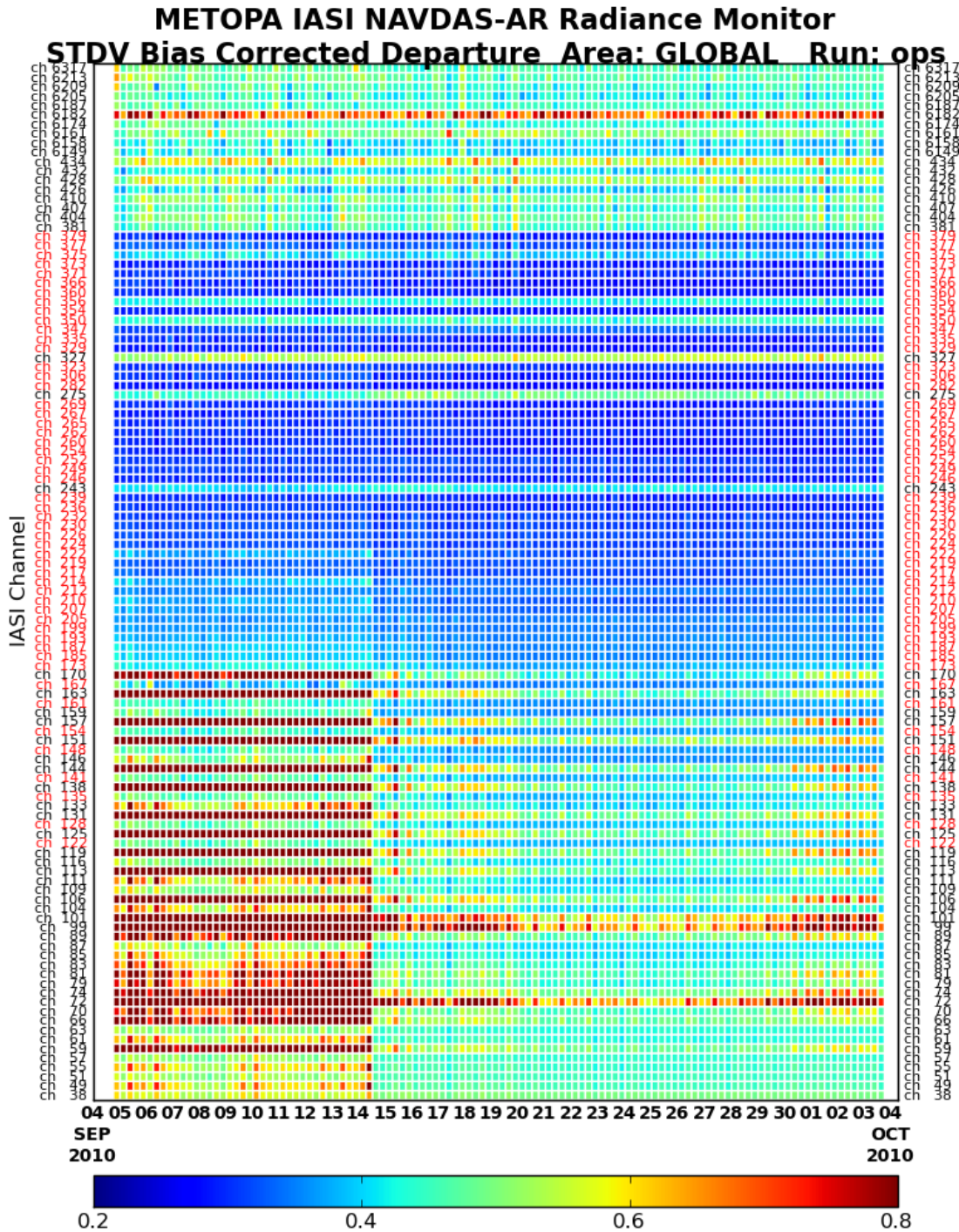
- Assimilation of GPS bending angle (COSMIC-FM, GRACE-A, GRAS);
- Addition of IR/MW radiances for the stratosphere;
  - 4 AMSU-A channels: 11-14
  - 3 SSMIS channels: 22-24
  - 10 IASI channels: 122, 128, 135, 141, 148, 154, 161, 173, 185, 187
- Inclusion of 24 IASI channels over land/sea-ice;
- Performing a consistent antenna pattern correction for all AMSU-A;
- Supplementing the real-time AMSU-A data feed with Regional ATOVS Retransmission Service (RARS)

These changes were added in unison with a restart of the operational NOGAPS/NAVDAS-AR system (OPS) from FNMOC *beta* spectral histories. Comparison of the 120-hour 500-hPa anomaly correlations for the first 20 zonal wave numbers of the NWP models from NCEP, ECMWF, Environment Canada, FNMOC and the UK Met Office shows that the Northern Hemisphere skill of FNMOC OPS has significantly improved following the September 15<sup>th</sup> upgrade (Fig. 1). Prior to that time, FNMOC OPS was trailing the aforementioned centers. Since then, it is “in the mix” in the Northern Hemisphere—not first, but not typically last, either. In other words, it is a competitive system, even given its lower model resolution.

When implementing these new data types in operations, the restart from beta spectral histories and addition of the GPS data corrected a stratospheric bias that had developed in FNMOC OPS. This bias correction then allowed the addition of more stratospheric IR/MW radiances. Figure 2 shows the standard deviation of the observed-minus-simulated brightness temperatures in Kelvin for each IASI sensor channel over a one month period. The shift in the middle of September can



readily be seen, particularly in channels 222 and below, as can the ability of the system to maintain this correction nicely.



**Fig 2.** The standard deviation of the observed-minus-simulated brightness temperatures (in Kelvin) for the IASI sensor channels from early September until early October 2010. Channels assimilated in OPS are listed in red along the sides of the diagram.

*Acknowledgements:* The GPS assimilation was a collaborative effort between NRL-MRY (Ben Ruston) and NRL-DC (Karl Hoppel) with guidance from UKMO (Mike Rennie). This effort was also assisted by Tom Rosmond and Pedro Tsai (SAIC). The MW/IR

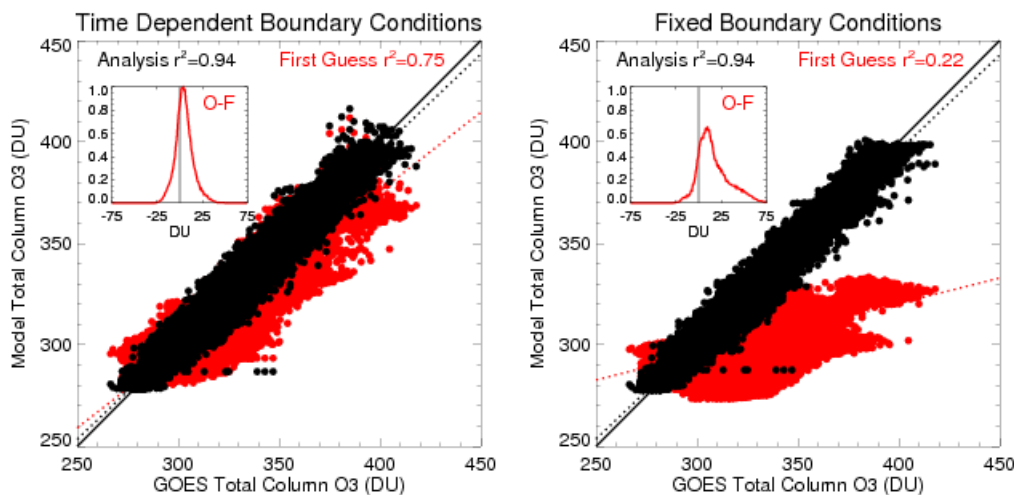


radiance assimilation work was performed by Ben Ruston, Steve Swadley and Nancy Baker (NRL MRY). Monitoring and diagnosis of system performance was performed by Steve Swadley, Rolf Langland (NRL MRY) and Gerald Nedoluha (NRL DC). Steve Eckermann, Karl Hoppel, and others at NRL DC have also been involved in evaluating the impact of these data on stratospheric modeling with the Advanced Level Physics High-Altitude mode (NOGAPS-ALPHA), ranging up to 100 km with Data Assimilation.

(Benjamin Ruston, NRL)

## Science Update

### GOES Total Column Ozone Assimilation within the Community Multi-scale Air Quality Forecast Model



**Scatter plots of total column ozone (TCO in Dobson Units, DU) analysis (black) and first guess (red) versus GOES TCO for assimilation experiments using time dependent (left) and fixed (right) lateral boundary conditions within the Community Multi-Scale Air Quality (CMAQ) model. The distribution of observation-first guess (O-F) is shown in the upper left corner of the scatter plots.**

NOAA’s National Air Quality Forecasting Capability (NAQFC; [http://www.nws.noaa.gov/ost/air\\_quality/](http://www.nws.noaa.gov/ost/air_quality/)) provides operational air quality forecast guidance using the Community Multi-scale Air Quality (CMAQ; <http://www.cmaq-model.org/>) regional forecast model. We are developing capabilities to assimilate GOES Sounder Total Column Ozone (TCO) retrievals within CMAQ using the NCEP Grid-point Statistical Interpolation (GSI) analysis scheme. CMAQ/GSI data assimilation experiments have been conducted using bias corrected GOES-11 (West) and GOES-13 (East) TCO retrievals with both operational fixed and experimental time dependent Lateral Boundary Conditions (LBC) from the global Real-time Air Quality Modeling System (RAQMS; <http://raqms-ops.ssec.wisc.edu/>). NCEP Global Forecast System ozone predictions were used to specify ozone profiles above the CMAQ model top, which is necessary to compute a first guess TCO, but introduces discontinuities in the first guess ozone profile, which may adversely impact the GOES TCO assimilation.

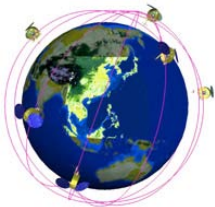
The figure compares results of the GOES TCO assimilation experiments for fixed and time dependent Lateral Boundary Conditions (LBC) at 06Z on June 18, 2010. Both experiments show similar TCO analyses which are in very good agreement with the GOES observations ( $r^2=0.94$ ). However, scatter plots of the first guess and GOES TCO observations show that the experiment with time dependent LBC has a significantly improved first guess. The time dependent LBC experiment also has a more Gaussian (O-F) distribution, which improves the analysis. Validation with CalNex (<http://www.esrl.noaa.gov/csd/calnex/>) ozonesondes shows that time dependent LBC improves the representation of upper tropospheric/lower stratospheric ozone in CMAQ, which accounts for the improved first guess. These initial experiments point to the need for realistic upper tropospheric/lower stratospheric ozone mixing ratios within CMAQ for GOES TCO assimilation. During the next year, we intend to work closely with the NAQFC team to improve the



GOES TCO assimilation capability and determine if GOES TCO assimilation leads to improved air quality forecasts.

We wish to acknowledge Dr. Daewon Byun's personal contribution to this effort. He conducted the first experiments on assimilation of GOES TCO within CMAQ nearly a decade ago, and always provided enthusiastic support for using satellite measurements to improve regional air quality predictions.

(R. Bradley Pierce, NESDIS/STAR, Allen Lenzen, and Todd Schaack, UW-Madison SSEC)



*Cosmic Corner*

**Upcoming Meetings**

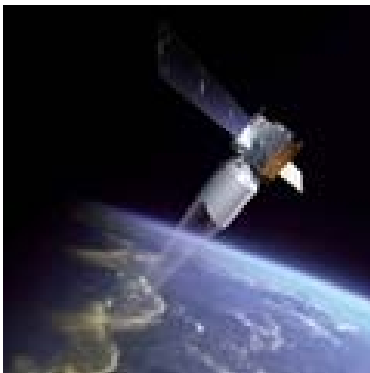
As the Joint Program Office (JPMO) moves forward toward the design and development of the COSMIC-2 mission, several program and science meetings will take place in Taiwan on April 11-15, 2011. The JPMO meetings are scheduled for the first two days, followed by the 5<sup>th</sup> FORMOSAT-3/COSMIC (Constellation Observing System for Meteorology, Ionosphere and Climate) Data Users Workshop. The science workshop will take place in conjunction with the Inaugural ICGPSRO (International Conference on GPS Radio Occultation).

For more information on the workshop, please visit the following page:

[http://www.nspo.org.tw/5th\\_FS3WS/index.html](http://www.nspo.org.tw/5th_FS3WS/index.html)

(Lidia Cucurrull, NCEP/EMC)

**LIDAR Winds**



*ADM-Aeolus*

The Working Group on Space-based Wind Lidars held its 35<sup>th</sup> meeting in Miami, FL, on February 8-9. Chaired by Mike Hardesty, NOAA/ESRL and Lars Peter Riishojgaard, JCSDA, the meeting was attended by close to 40 participants. Presentations covered updates on programmatic aspects from NASA and

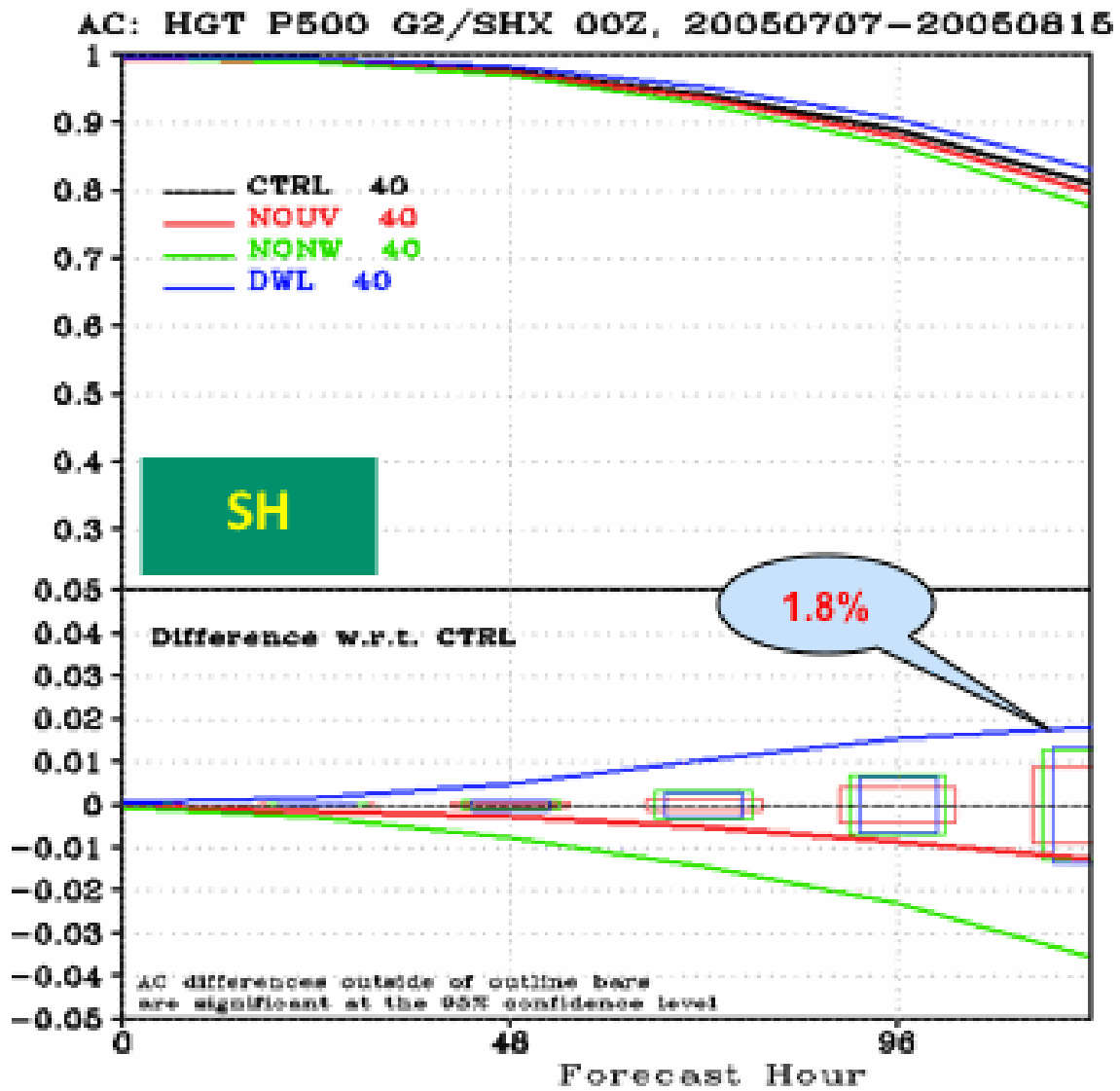
NOAA, expected impact of wind lidar observations on numerical weather prediction, technology development, airborne flight campaigns, etc. The lack of global coverage of mass-independent wind observations and the negative consequences of this for NWP are both well-documented, and a space-based wind lidar system remains the most promising way to remedy this shortcoming of the Global Observing System.

Beyond our general interest in space-based observing system issues there are two specific reasons why the Joint Center is actively involved in the Lidar Working Group: One is that we are preparing to ingest observations from the European ADM/Aeolus technology demonstration mission, hopefully to be launched in 2013. The Lidar Working Group has acted as a focal point for US involvement in this mission, both on the scientific and on the technical side. The other is the ongoing interaction taking place there between the NWP community - which we represent - and the developers of instrument or mission concepts that may one day provide these highly valuable measurements.

This last Working Group meeting featured an extensive discussion of Observing System Simulation Experiments (OSSEs), including experiments done in the Joint Center. A preliminary result is shown in the figure below, from which we can see that including simulated observations from a four-telescope hybrid wind lidar system improves the forecast skill (500 hPa anomaly correlation coefficient) by a very significant amount in the Southern Hemisphere. We expect to learn much more about this as we delve into the expected consequences of many of the trade-offs that must be performed during the refinement of this mission concept.

Immediately following the Lidar Working Group a Winds Mission Science Workshop was held at the same location. Most of the Working Group members stayed for the Science Workshop, which was attended also by a number of prominent representatives from the broader research community. The purpose of the Workshop was to develop the scientific rationale and user requirements for a prototype wind lidar system to be deployed on the International Space Station under the auspices of NASA's Earth Venture program.

Additional information about both meetings - including programs, presentations and lists of attendees - can be found at: <http://space.hsv.usra.edu/LWG/Index.html>



Upper panel: 500 hPa anomaly correlation coefficients for Southern Hemisphere forecasts with and without assimilation of simulated Doppler Wind Lidar wind observations. CTRL: control, NOUV: Same as control, but no RAOB winds, NONW: Same as control, but no wind data (any type), and DWL: Doppler Wind Lidar. Lower panel: Difference in anomaly correlation with respect to control forecasts. Differences outside of the outline bars are significant at the 95% level.

(Mike Hardesty and Lars Peter Riishojgaard, Co-Chairs, Working Group on Space-based Wind Lidars)



## In Memoriam Dr. Moustafa (Mous) Chahine: 1935 – 2011



It is with great sadness that we announce the unexpected death, on March 23, 2011, of Moustafa ("Mous") Chahine, a giant in the field of remote sensing. He leaves behind a distinguished legacy of science, discovery, mentorship, and deep friendship.

Chahine was the "father" of the first hyperpectral infrared instrument to fly in space – the Atmospheric InfraRed SUnder (AIRS). He conceived it, campaigned for its funding, led its development, chaired its science team, championed its applications, and advanced climate science by his innovative research with its observations. Launched on the NASA Aqua satellite in 2002, it has led to significant improvements in weather prediction and climate measurements. The NOAA Administrator at the time, Vice Admiral Conrad C. Lautenbacher, stated, "The AIRS instrument has provided the most significant increase in forecast improvement in this time range of any other single instrument."

Chahine grew up in Lebanon. He came to the United States as a freshman to attend the University of Washington, where he obtained a bachelor of science in 1956. Four years later he received a doctorate in fluid physics from the University of California at Berkeley and joined JPL as a research scientist. From 1975 to 1978 he headed the Planetary Atmosphere Section, and in 1978 was responsible for establishing the Division of Earth and Space Sciences at JPL. In 1984 he was appointed Jet Propulsion Laboratory's Chief Scientist, a position he held for 17 years.

Throughout his time at JPL Chahine was directly involved in research in the atmospheric sciences and remote sensing. In 1969 he developed a method for the inverse solution of the full radiative transfer equation, called the Relaxation Method. This method is used today for deriving atmospheric temperature and composition profiles from satellite observations of Earth, Venus, Mars, and Jupiter. He then developed a multispectral method using infrared and microwave observations to eliminate the effects clouds from infrared radiances. These methods were applied in 1980 to provide the first global distribution of Earth's surface temperature. In 1988 NASA selected his instrument, AIRS, as a facility instrument to study the Earth's atmosphere as part of NASA's Earth Observing System.

Chahine was a member of the National Academy of Engineering and the International Academy of Astronautics. He was a Fellow in the American Physical Society, the American Association for the Advancement of Science, the American Geophysical Union and the American and British Meteorological Societies, and also was a Full Member of the Lebanese Academy of Sciences. He received NASA's Exceptional Scientific Achievement Medal (1969), Outstanding Leadership, and Exceptional Achievement Medals. He was also a recipient of the William T. Pecora Award from NASA and the U.S. Department of the Interior, the Jule G. Charney Award of the American Meteorological Society, the Losey Atmospheric Sciences Award of the American Institute of Aeronautics and Astronautics, the William Nordberg Medal from the Committee on Space Research, and the NASA Medal for Exceptional Scientific Achievements (2007). In 2005 Chahine was one of fifteen international participants invited to speak at the Pontifical Academy of Sciences "Working Group on Water and the Environment", which took place at the Casina Pio IV inside Vatican City. The working group was assembled to address the scientific frontiers of the main environmental issues related to the impact of hydrologic dynamics on sustainable development. Chahine considered his participation in this event as one of the highlights of his career.

Chahine and the JCSDA had a close relationship. In an early seminar at the JCSDA, he predicted that AIRS data would have a substantial positive impact on weather forecasting. His advocacy led NASA to award its Exceptional Scientific Achievement to John Le Marshall, Director of the JCSDA at the time, for his "Innovative use of AIRS hyperspectral data in numerical weather prediction models, demonstrating, for the first time, significant weather forecasting improvement in both hemispheres".

Farewell, Mous.



**People**



**Lidia Cucurull  
Receives David  
Johnson Award**

JCSDA's Lidia Cucurull has received NOAA's David Johnson Award for 2011 at a ceremony at the National Space Club's 53rd Annual Goddard Memorial Dinner on

April 1, 2011. The award recognizes achievements of young professionals who have show outstanding innovation in the use of satellite data for operational environmental applications. Lidia was chosen for her "Innovative contributions to weather prediction through developing and implementing a methodology to assimilate satellite-based Global Positioning System-Radio Occultation observations into the National Weather Service's operational global weather prediction model and demonstrating how these data improve the skill and extend the range of weather forecasts."

The NOAA David Johnson Award has been given annually since 2000 by the National Space Club in honor of the first Administrator of what was to become the NOAA National Environmental Satellite, Data, and Information Service (NESDIS). It is open to any United States citizen, national, or permanent resident who is not more than 40 years of age. The [National Space Club](#) is a non-profit organization devoted to fostering excellence in space activity through interaction between industry and government, and through a continuing program of educational support. Awards are offered to recognize significant achievements in space science and enterprise. Lidia was selected by a panel of experts led by Ms. Helen W. Wood, Senior Advisor, NOAA Satellite and Information Service.

Lidia joined the JCSDA in October 2003 as a University Corporation for Atmospheric Research (UCAR) Visiting Scientist, a position sponsored by the National Science Foundation. Lidia's primary responsibility was to develop the system for assimilating a completely new kind of satellite observations - COSMIC (Constellation Observing System for Meteorology, Ionosphere, and Climate) GPS-Radio Occultation measurements - into NOAA's National Weather Service global NWP model. Her remarkable success with COSMIC and other GPS-RO missions were the basis for her selection as the 2011 award recipient. Lidia is currently on an

Intergovernmental Personnel Act (IPA) Assignment at NOAA and serves as NOAA's Program Scientist for GPS Radio Occultation data.

- More about the [Johnson Award](#), (PDF, 1.39 MB)

Congratulations, Lidia.



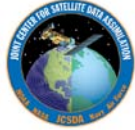
**Robert Atlas  
Appointed Chair,  
Management  
Oversight Board**

Dr. Robert (Bob) Atlas, Director, NOAA's Atlantic Oceanographic and Meteorological Laboratory, has been appointed the new Chair of

JCSDA's Management Oversight Board (MOB), succeeding Dr. Col. Mark Zettlemyer, who had served as Chair for the past three years.

Dr. Atlas received his Ph.D. in Meteorology and Oceanography in 1976 from New York University. Prior to receiving the doctorate, he was an operational weather forecaster in the U.S. Air Force where he maintained greater than 95 percent forecast accuracy. He joined NASA in 1973, and since that time has performed research to assess and improve the impact of satellite data on numerical weather prediction. He was a key member of the team that first demonstrated the significant impact of quantitative satellite data (temperature soundings), and also developed the methodology that led to the first beneficial impacts of satellite surface winds. From 1974-1976, he developed a global upper-ocean model and studied oceanic response to atmospheric wind forcing as well as large-scale atmospheric response to sea surface temperature (SST) anomalies. In more recent years, his research concentrated on the role of air-sea interaction in the development of cyclones, the role of soil moisture and SST anomalies in the initiation, maintenance and decay of prolonged heat waves and drought, and most recently on the modeling and prediction of hurricane formation, movement and intensification.

Dr. Atlas has served on numerous NASA Science and Instrument Teams, national and international Science Steering Groups, and the Council of the American Meteorological Society. He was Head of the NASA Data Assimilation Office from 1998-2003 and Chief Meteorologist for NASA's Goddard Laboratory for Atmospheres from 2003-2005. He is currently the Director of the NOAA Office of Oceanic and Atmospheric Research's Atlantic Oceanographic and



Meteorological Laboratory and an Adjunct Professor at the University of Miami.

The responsibilities of the MOB include reviewing and approving the policies, research and operational themes, and priorities of the Center, and facilitating and sustaining cooperation among the sponsoring organizations/institutions. The MOB includes members from the JCSDA partner agencies - NASA, NOAA, the Navy, and the Air Force - and the Chair rotates among these agencies

## Announcements

### Annual Workshop on Satellite Data Assimilation



**Computer & Space Sciences Bldg.  
University of Maryland**

The JCSDA 9th Annual Workshop on Satellite Data Assimilation is scheduled for Tuesday and Wednesday, May 24-25th, 2011. The 2 day workshop is intended to review the ongoing and planned scientific developments sponsored by the JCSDA, and to plan and coordinate future efforts. JCSDA invites Principal Investigators and affiliated scientists to report on their research and participate in

discussions about the progress and future plans of the Joint Center. The workshop will be hosted this year by the College of Computer, Mathematical and Natural Sciences (CMNS) of the University of Maryland, College Park. For more information and for registering online, please visit the JCSDA web site at <http://www.jcsda.noaa.gov>. If you have any questions, contact Sid Boukabara, Deputy Director, JCSDA: [sid.boukabara@noaa.gov](mailto:sid.boukabara@noaa.gov) (Sid Boukabara, Deputy Director, JCSDA)

### 2011 GSI Workshop and Tutorial: Registration Open



**NCAR Foothills Laboratory**

The Developmental Testbed Center (DTC) would like to invite you to attend the Community Gridpoint Statistical Interpolation (GSI) Data Assimilation System Workshop on June 28, 2011 and the second GSI Tutorial on June 29 – July 1, 2011 at the NCAR Foothills Laboratory, Boulder, Colorado.

The workshop will be a one-day event on June 28, 2011. The objective of this workshop is to provide a pathway between operational centers and the research community to communicate and share experience on:

1. GSI development, implementation and future plans;
2. New techniques and skills in data assimilation.

The workshop will include a few invited talks from major operational and research centers as well as a general section for community GSI and other data assimilation system users.

A two and half day tutorial (with the last half day optional), consisting of both lectures and hands-on practical sessions, will be held June 29-July 1, 2011. The lecturers are invited from various GSI development/support teams including NCEP/EMC, NASA/GMAO, NOAA/GSD, NCAR/ MMM and DTC. The practical sessions will provide essential skills to run the GSI system with basic and advanced implementations.

Please note: All are invited to the GSI Workshop and the GSI Tutorial lecture portion. However, due to the constraints of physical space and computers, we can only accommodate a maximum of 40 participants for the tutorial hands-on portion. Registration for the workshop and tutorial (lecture and practical session or lecture only) are separate.

For tutorial Information and on-line registration, please visit our web site at: [http://www.dtcenter.org/com-GSI/users/tutorials/11\\_2.php](http://www.dtcenter.org/com-GSI/users/tutorials/11_2.php)

For more information regarding the GSI system, please visit: <http://www.dtcenter.org/com-GSI/users/index.php> (Hui Shao, JCSDA)





## A Note from the Director



*At the time of writing, there is continued uncertainty about many aspects of the federal budget both for the current fiscal years and in future years. This affects the Joint Center both directly and indirectly. Unfortunately some of you are affected directly by this, at least temporarily. We have completed our reviews*

*and made our recommendations concerning the funding of both internal and external grants, but we cannot make a final decision or make any announcements until the budget uncertainties are resolved. Bear with us; we will announce the decisions as soon as we possibly can!*

*We look forward to seeing many of you at our Annual Science Workshop in College Park in May (more about this elsewhere in the Newsletter). After a couple of years at UMBC, we have moved this year's meeting to a location better served by public transportation and other urban amenities, and we hope this will provide for an overall enjoyable experience for the participants. As always, we look forward to hearing the reports from our external investigators, and we look forward to talking to you about our own progress and plans. From our side, much of the discussion this year will be focused on our new computer: Where is it, how big is it, what data assimilation systems are running on it, who has access to it, what kind of support can they expect, etc. We look forward to talking to you about this, and perhaps to getting some initial feedback from those of you who already have accounts on it.*

*Finally, it is with sadness I close this note by acknowledging Mous Chahine for his enormous contribution to remote sensing and to its impact on numerical weather prediction and many other disciplines. Mous was a great champion both of the data provided by his instrument and of the work that we did with it in the Joint Center and it was a great privilege for me to work with Mous in the last decade of his life and his career. Perhaps more than anything it was an inspiration to see that how a man even of his stature - with so many accomplishments to his credit - never stopped looking ahead. I know that many of us will be missing his intellect, his determination and his never-ending drive to provide better data and make us use them in better ways.*

Lars Peter Riishojgaard, Director, JCSDA

## Outlook for Next Quarter

### 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 presentation and off-site personnel may listen in via conference call. A complete listing of past and future seminars is at the above web-site.

Date	Speaker	Affiliation	Title
April 7, 2011	Xiaolei Zou	Florida State University	Preliminary Assessments of China's FY-3 Satellite Data for NWP Applications
April 20, 2011	David Crisp	Jet Propulsion Laboratory	The Orbiting Carbon Observatory-2 (OCO-2)
May (Date TBD)	Graeme Kelly	UK MetOffice	Assimilation of Geostationary Satellite Radiance Observations (title to be confirmed)
June 15, 2011	Fatima Karbou	MeteoFrance	The Assimilation of Surface Sensitive Microwave Observations Over Land: Recent Results and Open Issues

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).