

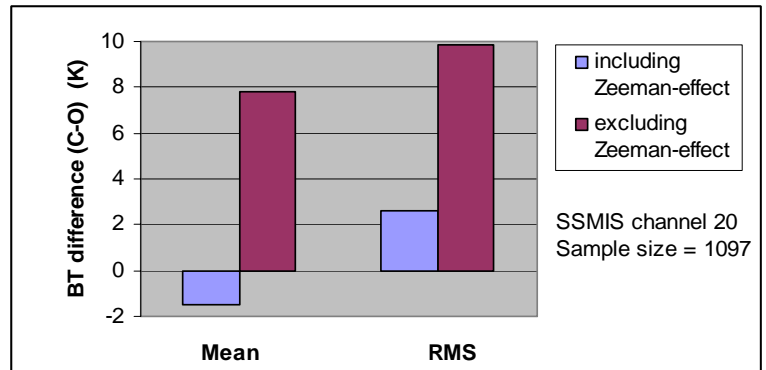
News in This Quarter Science Update

Toward Assimilation of SSMIS High Atmosphere Temperature Information

The JCSDA Community Radiative Transfer Model (CRTM) team has recently developed a fast radiative transfer (RT) model for assimilation of radiance measurements of the upper atmosphere sounding (UAS) channels of the Special Sensor Microwave Imager/Sounder (SSMIS) on board the Defense Meteorology Satellite Program (DMSP) F-16 satellite. To develop this RT model, the team had to overcome complications introduced into the radiative transfer physics by the phenomenon known as Zeeman splitting. The accompanying figure shows that the large errors in simulating observed SSMIS brightness temperatures – ~10 K – without accounting for the Zeeman Effect are eliminated with the new RT scheme.

The spectral passbands of the six UAS channels are near the line centers of the O₂ magnetic dipole transitions at 60.43478, 61.15056, 62.99798 and 63.56852 GHz. The measurements from these channels contain air temperature information for the upper stratosphere and mesosphere (30 to 80 km). Because the air pressure is low and the line widths are very narrow, the Zeeman-effect, induced by the Earth's geomagnetic fields, becomes important. Each of the spectral lines is split into a number of sub-lines with a splitting width (~ 1-3 MHz) depending on the strength of the magnetic field. In addition, the radiation is polarized and the polarization depends on the orientation of the magnetic field vector with respect to the electromagnetic wave propagation direction.

In the fast model, a passband-averaged transmittance is defined and the optical depth derived from it is parameterized with a linear regression equation. The predictors are combinations of air temperature, the strength of the geomagnetic field, and the cosine of the angle between the magnetic field vector and the wave propagation direction. With this approach, the radiance simulation avoids computationally expensive monochromatic radiance calculations and spectral integration within a spectral band. The coefficients in the linear equations are obtained through a regression process, in which the Rosenkraz's 1988 model (R88) and a diversified atmospheric profile set are used to derive a set of training data.



The differences of brightness temperatures (BT) between radiative transfer model calculations (C) and SSMIS observations (O) for SSMIS channel 20, which peaks at about 75 km. Blue bars: Between the fast model and observations. Red bars: Between an RT model that does not include the Zeeman-effect and observations.

For the comparison of observed and computed SSMIS brightness temperatures, the atmospheric profiles for the calculations are from the temperature measurements of the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument on NASA's Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics satellite. The SABER observations extend to 105 km and are supplemented by the COSPAR International Reference Atmosphere (CIRA) model above 105 km.

Currently, JCSDA partner agencies operate NWP models with the following upper limits: NOAA, 60 km; Navy, 65 km; and NASA, 80 km. To take full advantage of the SSMIS observations, the NOAA and Navy models would have to be extended vertically.

For more detailed descriptions of the model algorithm and validation results see Han et al., 2007 (Han, Y., F. Weng, Q. Liu and P. van Delst, "A Fast Radiative Transfer Model for SSMIS Upper-atmosphere Sounding Channels", *J. Geophys. Res.* 112 D11121, doi10.1029/2006JD008208). (Yong Han, JCSDA)



5th Science Workshop on Satellite Data Assimilation



On May 1 and 2, 2007, the Joint Center for Satellite Data Assimilation (JCSDA) hosted the 5th Workshop on Satellite Data Assimilation at the Marriott Inn and Conference Center at the University of Maryland, College Park, Maryland. More than 100 scientists participated in this meeting, including a large contingent of young scientists and PhD students. The workshop's purpose was twofold: to review the ongoing and planned scientific development sponsored by the NASA-NOAA-DOD partners of the JCSDA, and to plan and coordinate future efforts.

At the workshop, principal investigators participated in plenary sessions and keynote presentations were given by representatives from the JCSDA. The plenary sessions were followed by five concurrent breakout sessions where each PI presented progress, achievements, and plans for his or her own project—more than 40 science presentations were provided. The breakout sessions—covering radiative transfer, clouds and precipitation, advanced instruments, and land, ocean and air quality data assimilation—corresponded to the top scientific priorities for the JCSDA. On the second day, the breakout sessions reviewed each project's progress, plans, and future priorities. The workshop concluded with a plenary session where short summaries from the breakout sessions were presented to all workshop participants.

The benefits of the collaborative approach to the JCSDA became apparent by discussions on sharing common radiative transfer models and components (e.g., CRTM, emissivity models), jointly managing atmospheric data assimilation codes (e.g., GSI, Adjoints), jointly assessing the impacts of new satellite data and accelerating uses of new data into forecast models, exploring new data assimilation science (e.g., 4dvar, ensemble/Kalman filter, QC, ocean data assimilation systems), and providing the vision for defining the future satellite programs.

In summary, the workshop was well attended by senior scientists, managers, and students. Senior management from research and operational centers provided program overviews, the panel discussions and presentations were productive and thought-provoking, and the reaction from workshop participants was very positive.

All workshop materials and breakout group summaries are posted on the JCSDA web site at www.jcsda.noaa.gov. (Ken Carey, JCSDA)



NOAA Upgrades Global Forecast System

Both the analysis and model components of the NCEP Global Forecast System (GFS) were upgraded on 1 May 2007. The analysis module was replaced with the Gridpoint Statistical Interpolation (GSI) system, which will enable new analysis techniques to be implemented in the future. The forecast model was upgraded with introduction of a new hybrid sigma-pressure coordinate and improvements to the GFS radiation module. In addition, new observations from the Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC) and full fields of view from the AIRS instrument were added. Pre-implementation testing showed better forecast performance in the tropics, in mid-latitudes at 1-3 day lead times and in the vicinity of the Asian jet (Himalaya) area. (Steve Lord, NOAA/NCEP and Deputy Director, JCSDA)

Steering JCSDA Science

The Science Steering Committee (SSC) of the JCSDA convened at the University of Maryland, Baltimore Campus from May 30 to May 31 for its annual meeting. The members include data assimilation experts from JCSDA participating agencies, US Universities, and non-US weather forecasting centers. The SSC members received summaries of JCSDA related work from each of the participating agencies together with a summary of results from JCSDA federally funded research opportunities. After discussion and deliberation, the SSC members submitted individual comments and suggestions to the acting director of the JCSDA, Lars Peter Riishojgaard.



UMBC Baltimore

The comments indicate general agreement that the JCSDA is to be commended for (a) its contributions to the assimilation of observations from the Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC) and from the Special Sensor Microwave Imager/Sounder (SSMIS), (b) for new work on Radiative Transfer Models (RTMs) that account for Zeeman splitting, and (c) for assessments of observation error covariances associated with cloud affected radiance measurements. The SSC applauded the development of observation sensitivity tools that make quantitative estimates of the effect of individual observations on forecast accuracy and also the observation simulation experiments designed to test these predictions. Studies to compare and contrast the predictions of observation sensitivity tools from differing centers were encouraged.

There was considerable disagreement, however, about the extent to which the JCSDA should invest in Observation System Simulation Experiments (OSSEs). Some members cautioned that the ability of OSSEs to accurately predict the impact of proposed satellite sensors on forecast accuracy was strongly limited by uncertainties in observation and forecast error characteristics and by our ignorance of the performance characteristics of future data assimilation schemes. Other members countered that knowledge of the effect of a proposed sensor on forecast accuracy under the assumptions of an OSSE was one of the best available estimates of the effect of a proposed sensor on forecast accuracy and hence would usefully inform decisions. Others pointed out that the design of future observational networks was not the only motivation for investment in OSSEs. In particular, OSSEs can assist (a) the understanding of observation impact and data assimilation performance, (b) the development and testing of new data assimilation techniques, and (c) preparation for new satellite instruments, in that OSSEs provide frameworks where issues associated with observation thinning and the computational overhead of new observation data streams can be addressed before a new instrument begins transmitting data. (C.H. Bishop, SSC Chair, NRL)

First Executive Retreat



NRL Monterey

The Joint Center Executive held its first ever retreat at NRL Monterey on June 12 and 13. The retreat was hosted by the US Navy JCSDA Deputy Director Pat Phoebus, and the other attendees were Acting Director Lars Peter Riishojgaard, Deputy Directors Steve Lord, Fuzhong Weng and Michele Rienecker, Chief Administrative Officer Wayman Baker, US Air Force liaison to NCEP Major Dan Pawlak, Ken Carey from Noblis and Eric Bayler from NESDIS (on June 13 only).

The main purpose of the retreat was to review the various documents outlining the vision, mission and strategic goals of the Joint Center, and to discuss the mode of operation of the center – in particular how to improve the collaboration among the partners toward implementing the vision and accomplishing the goals.

The overall consensus at the retreat was that the current course of the Joint Center is the right one. However, in a couple of areas the participants decided to substantially raise the level of ambition of the center: It was decided that the Joint Center should take the lead in developing a multi-agency OSSE-based mission/space systems assessment capability, and that the center should develop and present a coordinated set of plans and funding proposals to those agencies thought to be receptive to such an initiative. The retreat also agreed that



based on the volume and quality of the aerosol and constituent assimilation work already taking place at several of the partners, the JCSDA is well positioned to lead the development of a national environmental assimilation and monitoring capability along the lines of the European GEMS project.

Among the major components of the JCSDA collaboration reviewed at the retreat were the internal (directed) research, the externally funded projects, the technical liaisons and the Science Workshops. In addition to fine-tuning some of the JCSDA processes, a major new initiative was the decision to form virtual project teams across the partner agencies. The project teams will be organized along the lines of the major types of data within the sphere of interest for the center, e.g. infrared sounders, microwave sounders, VIS/IR imagery, etc. Each team will be led either by the Director or by one of the Deputy Directors, and the team will consist of the main scientific personnel from each of the partners responsible for the work pertaining to that particular data type. The team lead will report on the progress of the work at the monthly Executive meetings.

In addition to the general topics discussed above, half a day was reserved to specifically focus on ocean data assimilation. This area has been one of the stated priorities for the Joint Center since it was formed, but ocean assimilation has arguably been living in the shadow of more visible JCSDA efforts aimed toward improving the use of satellite data in numerical weather prediction models. A major ocean data assimilation initiative is being developed within NOAA, and Eric Bayler was invited to the retreat to present the plans and to discuss the intersection with JCSDA interests. There are active ocean assimilation efforts underway within the partners, but there was general agreement that the planning and coordination could be improved. It was decided to start this off by holding an internal JCSDA Ocean Workshop – tentatively in the fall of 2007 – with the goal of bringing together the main staff from all the interested partners to discuss requirements, strategies and goals and explore the possibility of doing more of the work in collaboration.

At the end of the two days in Monterey, the participants agreed that the retreat had been useful in bringing the partners closer together, and they expressed optimism concerning the prospects of a more effective and better coordinated collaboration toward our common goals for the Joint Center in the future.

(Lars Peter Riishojgaard, Acting Director, JCSDA)

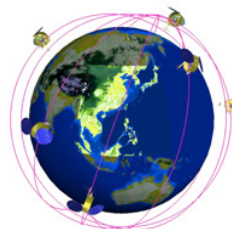


On the international governance scene, the annual meeting of the THORPEX International Core Steering Committee

(ICSC) took place April 25-27 in Geneva, Switzerland. The ICSC is the international governing body of THORPEX and Dr. Rick Rosen (NOAA Climate Program Office) is the U.S. representative to this committee. In response to a decision from the World Meteorological Organization (WMO) Fourteenth Congress to reorganize the World Weather Research Program (WWRP), the ICSC decided to broaden its representation in order to work more closely with other WWRP activities and to coordinate more effectively with the World Climate Research Program (WCRP) on joint products with the goal of filling the gap between weather and climate predictions. Two weeks following the ICSC meeting, the Fifteenth WMO Congress met in Geneva. Positive developments at this meeting from the THORPEX perspective occurred during the session on the WMO Atmospheric Research and Environment Program (AREP) under which the WWRP resides. There was strong endorsement of and urging for increased investments in THORPEX. There was praise for the development and early success of the THORPEX Interactive Grand Global Ensemble (TIGGE) and endorsement of close collaboration between WWRP and WCRP, including the development of joint projects. These decisions at the international level are critical to THORPEX and the JCSDA. The success of THORPEX and its need to link with the JCSDA hinges on the strength of international cooperation and support.

Progress has also been made with the THORPEX Pacific-Asian Regional Campaign in recent months (T-PARC). (See the March 2007 issue of the JCSDA Quarterly for more background on T-PARC.) Proposals to NSF are in the process of being reviewed. These proposals only address the three field phases of T-PARC (August 2008 – February 2009). Future proposals will address the analysis of the field observations. A draft implementation plan for the winter phase of T-PARC has been developed (<http://www.emc.ncep.noaa.gov/gmb/ens/THORPEX.html>). NOAA is the leader in this phase and the targeted observations gathered during the winter phase will be used to test ensemble assimilation techniques and strategies within the JCSDA. (John Gaynor, NOAA/OAR)

Cosmic Corner



NOAA went operational with assimilation of refractivity profiles from COSMIC observations on May 1st 2007 along with the implementation of NCEP's new Global Data Assimilation System (GSI/GFS).

Several parallel experiments are now being conducted to better understand the impact of refractivity assimilation in operational weather forecasting and to adjust the quality control checks applied to the data accordingly.



JCSDA is also working toward assimilation of bending angles from COSMIC. Bending angles, which are less processed observations than refractivities (analogous to radiance vs. retrieved temperatures from sounders), are preferred for assimilation. However, bending angle assimilation is also more challenging. Enhancement of the quality control of the data, better characterization of errors, and use of a more accurate forward operator should improve assimilation of bending angles.

UCAR is currently processing about 1400-1800 occultations per day. All six satellites and payloads are functioning and only two of them remain in a lower orbit. The others have been raised to their final orbit (~ 800 km). The final constellation will be achieved by October 2007. (Lidia Cucurull, JCSDA/NCEP & UCAR)

Correction

In an item on *Preparing for IASI Assimilation* in the March 2007 Issue of the Quarterly Newsletter it was stated that the results of Dr. Larrabee Strow's IASI research were presented at the Hyperspectral Imaging and Sounding of the Environment (HISE) conference. This statement is incorrect; this work was not presented at the HISE conference. (The Editor)

People

Michele Rienecker Appointed NASA Deputy Director of the JCSDA



Dr. Michele Rienecker has been appointed NASA Deputy Director for the Joint Center for Satellite Data Assimilation replacing Dr. Lars Peter Riishojgaard, who recently became JCSDA Acting Director. Michele currently serves as the Head of the Global Modeling and Assimilation Office (GMAO) at the NASA Goddard Space Flight Center. Her primary interests are modeling the ocean circulation, ocean data assimilation, and coupled climate modeling and prediction. Announcement of the appointment was made by Dr. Louis Uccellini, Director, NOAA National Centers for Environmental Prediction, and Chair, JCSDA Management Oversight Board.

Michele received her Ph.D. in applied mathematics from the University of Adelaide in 1980. In 1991, she joined the

Oceans and Ice Branch at Goddard and beginning in 1997 led the NASA Seasonal to Interannual Prediction Project (NSIPP). Michele used satellite data and models to investigate the large scale fronts in the Pacific Ocean, and developed methods to assimilate satellite altimetry into ocean circulation models, eventually initializing the ocean model as part of NSIPP's seasonal forecast system. She has served as a Technical Liaison to the JCSDA since its inception. Michele has also served on the Global Ocean Data Assimilation Experiment (GODAE) Steering Team, and was co-chair of the U.S. GODAE Steering Team until 2002. She is currently a member of the Climate Variability and Predictability (CLIVAR) Science Steering Group and chair of the Community Climate System Model (CCSM) Advisory Board. In 2006, Michele was awarded NASA's Outstanding Leadership Medal.

Welcome aboard, Michele.

Christa Peters-Lidard Appointed NASA Technical Liaison to the JCSDA



Dr. Christa Peters-Lidard has been appointed as the NASA Technical Liaison for the Joint Center for Satellite Data Assimilation, replacing Dr. Michele Rienecker, who has assumed the responsibilities of NASA Deputy Director for the JCSDA. Christa currently serves as the Head of the Hydrological Sciences Branch at the NASA Goddard Space Flight Center (GSFC). Her research interests

include land-atmosphere interactions, soil moisture measurement and modeling, and the application of high performance computing and communications technologies in Earth system modeling.

Christa graduated summa cum laude with a B.S. in geophysics and a minor in mathematics from Virginia Polytechnic Institute and State University (Virginia Tech) in 1991. She then earned her M.A. and Ph.D. from the Water Resources Program in the Department of Civil Engineering and Operations Research at Princeton University in 1993 and 1997, respectively. Christa was an Assistant Professor in the School of Civil and Environmental Engineering at Georgia Institute of Technology from 1997 to 2001 before joining the Hydrological Sciences Branch at NASA GSFC as a physical scientist in 2001. She has served as an Editor for the American Meteorological Society Journal of Hydrometeorology (2004-2007) and an Associate Editor for Water Resources Research (2002-2004). Christa's Land Information System Team was awarded the 2005 NASA Software of the Year Award for their work in applying high performance computing and



communications technologies in Earth system modeling. She is a member of Phi Beta Kappa, and, in 2004, was awarded the Committee on Space Research (COSPAR) Scientific Commission A Zeldovich Medal. The Zeldovich Medals are conferred by the Russian Academy of Sciences and COSPAR to young scientists for excellence and achievements.

The appointment was announced by Dr. Louis Uccellini, Director, NOAA National Centers for Environmental Prediction, and Chair, JCSDA Management Oversight Board.

Welcome aboard, Christa.

Meet Yoshiaki (Yoshi) Sato



Yoshiaki (Yoshi) Sato joined the JCSDA in April 2007 as a Visiting Scientist. During his 2-year stay, he will be working on determining the flow dependent background error in the NCEP Gridpoint Statistical Interpolation (GSI) 3D-Var system. Yoshi is the latest in a series of long term visitors from the Japan Meteorological Agency (JMA), replacing Masahiro Kazumori, who

recently returned to Japan.

Yoshi has a Master's degree in Science (Geophysics) from the Hokkaido University and joined the Japan Meteorological Agency (JMA) in 1995. He started his research in satellite data assimilation in 2001 at the Meteorological Satellite Center of JMA and continued this work after transferring to the JMA's Numerical Prediction Division in 2003. He focused on satellite microwave imagers - DMSP/SSM/I, TRMM/TMI and Aqua/AMSR-E. His research demonstrated positive impact of these data on weather forecasts and they were successfully introduced into the JMA operational meso-scale data assimilation system in 2003 and into the global system in 2006. In addition, he developed a variational bias correction system for satellite radiance data that was implemented in the operational global data assimilation system in 2006.

Yoshi enjoys nature photography. He looks forward to exploring and photographing the natural wonders of America during his stay.

Upcoming Events

- **Lidar Working Group Meeting**, Snowmass, Colorado, July 17-20, 2007
- **JCSDA Sponsored Workshop on Application of Remotely Sensed Observations in Data Assimilation**, University of Maryland, July 23-August 10, 2007.

JCSDA Seminars

The JCSDA Seminar Series will be on vacation during the summer and will resume in September. Suggestions for



seminar speakers and topics for the 2007/8 series, which starts in September, are welcome. Please send them to the Editor. Thank to all the speakers in the 2006/07 Series for their excellent presentations:

Mihail Codrescu and Tim Fuller-Rowell	U. of Colorado/Ceres and NOAA Space Environment Center
James G. Richman	Oregon State University
Rolf Langland and Nancy Baker	Naval Research Laboratory
Christa D. Peters-Lidard	NASA Goddard
Stefan Kinne	Max Planck Institute for Meteorology, Hamburg, Germany
Ying-Hwa (Bill) Kuo	UCAR
Dale Barker	UCAR
Paul Chang, Zorana Jelenak	NOAA NESDIS
William Bell	UK Met Office
Tom Yunck	NASA JPL
Xiang-Yu Huang	UCAR
Derek Posselt	Colorado State University
James Gleason	NASA Goddard

Please submit news items 2 weeks prior to the end of each quarter to george.ohring@noaa.gov