



JCSDA Quarterly

NOAA | NASA | US NAVY | US AIR FORCE

NEWS IN THIS QUARTER

SCIENCE UPDATE

Satellite Data Assimilation Updates in Navy's New Global Prediction System

The Navy's high-resolution global weather prediction system, run operationally at the Fleet Numerical Meteorological and Oceanographic Center (FNMOC), is the critical component of the Navy's atmospheric prediction capabilities, providing 180-hour forecasts every six hours and 16-day guidance twice-daily using a 20 member global ensemble. On February 13, 2013 a significant milestone in the U.S. Navy's weather forecast system development was achieved as the Navy Global Environmental Model (NAVEM) replaced the Navy Operational Global Atmospheric Prediction System (NOGAPS) for operational global weather prediction (Hogan et al. 2013). This new operational system, NAVEM 1.1, combines a semi-Lagrangian/semi-implicit dynamical core with advanced physical parameterization schemes for moisture, convection, ozone, and radiation. Model physics improvements in the transition to NAVEM include the representation of cloud liquid water, of cloud ice water, and of ozone as fully predicted constituents. Following the successful testing of a new eddy diffusivity mass flux (EDMF) scheme, developed under the Office of Naval Research "Unified Parameterization for Extended Range Prediction" Departmental Research Initiative, a second transition to the NAVEM (NAVEM 1.2) occurred on November 6, 2013 (Hogan et al. 2014, submitted). The implementation of NAVEM 1.2 at FNMOC has

(continued on page 2)

IN THIS ISSUE

1 NEWS IN THIS QUARTER

Satellite Data Assimilation Updates in Navy's New Global Prediction System

Assimilation of Blended Soil Moisture Products from SMOPS in the NCEP GFS

9 OTHER NEWS

Summary of Awarded Projects through JCSDA Federal Funding Opportunity for FY13

Assimilation of All-Sky Microwave and Infrared Satellite Radiances: from Research to Operations

Evaluation and Improvement of Land Surface States and Parameters to Increase Assimilation of Surface-Sensitive Channels and Improve Operational Forecast Skill

Modernization of the Community Line-by-Line Radiative Transfer Models

Improvement and Validation of JCSDA's Community Radiative Transfer Model (CRTM) Optical Properties

12 MEETING REPORTS

Summary of the 6th WMO Symposium on Data Assimilation

14 PEOPLE

Welcome Aboard, Erin Jones

14 CAREER OPPORTUNITIES

NOAA

15 A NOTE FROM THE DIRECTOR

16 SCIENCE CALENDAR

brought with it updates to satellite data processing by the 4D-Var assimilation component, NAVDAS-AR. These updates include the assimilation of MetOp-B sensors AMSU-A and MHS, as well as the activation of the Suomi-NPP ATMS.

Since the Suomi-NPP ATMS is a new technology, we will detail some of the procedures used in the assimilation of these data. The NAVGEM 1.2 system, which includes NAVDAS-AR, has active assimilation of ATMS channels 04-15, and 18-22. A Gaussian spatial filter is used to increase the signal-to-noise ratio for channel 03-22. An average brightness temperature at scan position, s , and beam position, b , can be computed using a weighted mean as follows:

$$\hat{T}_B(s, b) = \sum_{i=1}^N w_i(b) T_B(\delta s_i, \delta b_i)$$

We have chosen to use pre-computed Gaussian weights, w_i , using $\sigma = 36$ km, corresponding to a Full Width at Half Maximum (FWHM) of ~ 85 km. The Gaussian weights are defined as follows:

$$w_i(p) = \exp\left(\frac{-r_i^2}{2\sigma^2}\right),$$

where the scene separation distances, r_i , are computed for the ATMS scan geometry using the distances between the scene at (s, b) and the closest 100 points ($i=1$ to 100) in the domain as follows:

$$r_i = \|(s, b), (s + \delta s_i, b + \delta b_i)\|.$$

The quality control applied to ATMS consists of checks for sea-ice, cloud liquid water, and a scattering index. These checks mostly target the imaging and sounding channels that have sensitivities to the surface, cloud liquid water, and to rain, and do not apply to

channels 09-15. The cloud liquid water and scattering index checks apply successively lower thresholds for higher peaking channels, as was described in more detail in the JCSDA seminar presented by Ruston on 12 Dec, 2012. A final 1.25⁰ thinning is applied before assimilation into the system. After the innovation, defined as the departure of the bias corrected observation from the background simulated brightness temperature, is computed, an observation is rejected if its innovation exceeds three times the square root of the sum of the assigned channel-dependent observation and background errors $(\sigma_o^2 + \sigma_b^2)^{1/2}$. An example of the resulting standard deviation of the global innovations in the NAVGEM/NAVDAS-AR system for temperature sounding channels, computed using these quality control procedures, is shown in Figure 1. It can be seen that the global standard deviation of the innovations for the ATMS channels compares very well with that of the various AMSU-A sensors with channels having similar weighting functions.

Another widely-used method to gauge the relative impact of the various observing systems employs the adjoints of the forecast model and the assimilation system, NAVGEM and NAVDAS-AR. This adjoint methodology allows for the simultaneous determination of the impact of any or all individual observation types on the 24-hour forecast total moist static energy error norm. This can be shown for a single observation, but is often shown as a cumulative measure with single channels or entire sensors aggregated over both space and time. An example of the ATMS impacts on a channel-by-channel basis is shown in the left panel of

(continued on page 3)

JOINT CENTER FOR SATELLITE DATA ASSIMILATION

5830 University Research Court
College Park, Maryland 20740

Website: www.jcsda.noaa.gov

EDITORIAL BOARD

Editor:

Kevin Garrett

Assistant Editor:

Erin Jones

Support Staff:

Ana Carrion
René Brown

Director:

Lars-Peter Riishojgaard

Deputy Director:

Sid-Ahmed Boukabara

Chief Administrative Officer:

James Yoe

Figure 1. Global innovation statistics from AMSU-A and ATMS for 08Dec2013 at 00UTC. Each channel's standard deviation of the bias corrected innovation is shown as a horizontal bar aligned with the peak of the channel temperature weighting function.

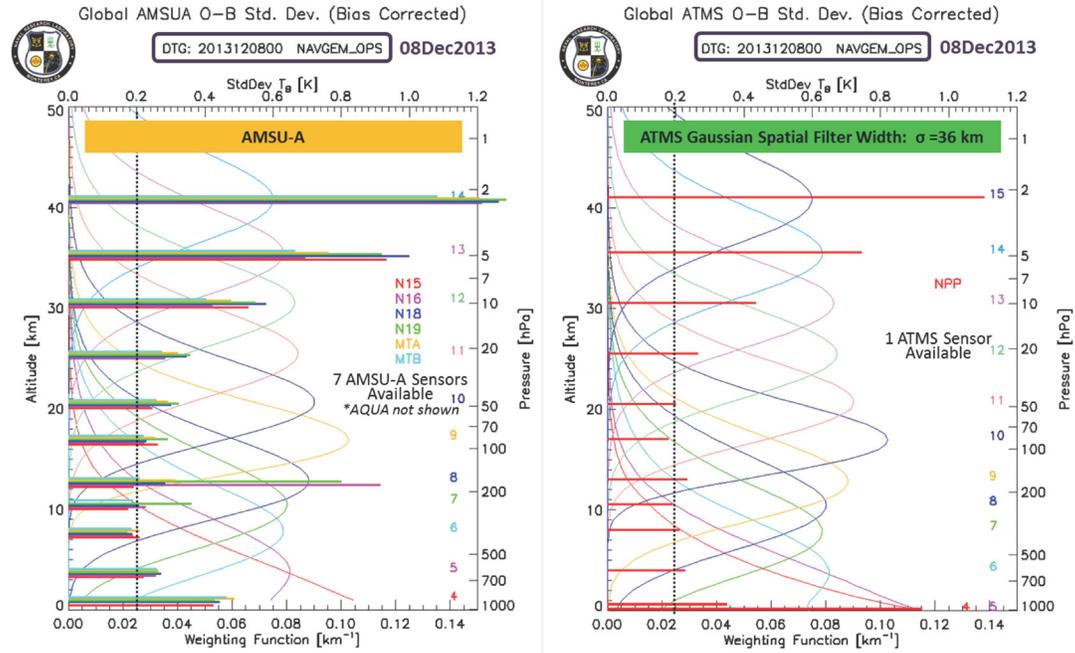
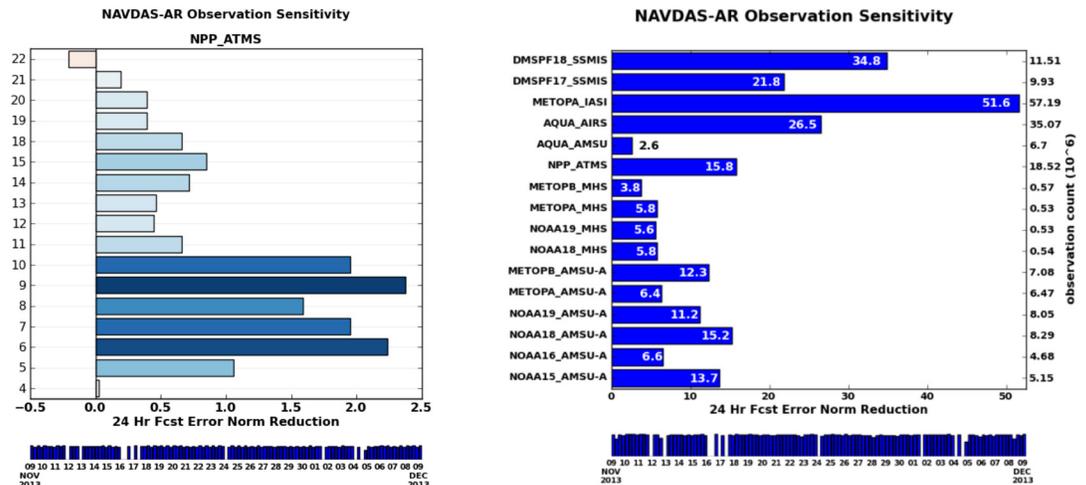


Figure 2, while the right panel illustrates the impact of the assimilated radiances from the various infrared and microwave satellite sensors. Most of the monitoring for innovation statistics and observation sensitivity can be found in near-real-time from the NAVDAS-AR monitoring page (www.nrlmry.navy.mil/metoc/ar_monitor). The Suomi-NPP ATMS sensor has been showing an impact similar to that of an AMSU-A sensor. Since

the ATMS includes moisture sounding channels, however, we hope to eventually gain more impact from the ATMS if it becomes possible to lower its observation errors or to include error correlation terms. At this time, correlated error can be diagnosed from the ATMS innovation statistics using the Desrozier technique (Desrozier et al. 2005). Analysis shows a strong correlation in humidity channels, as was expected, but a correlation (continued on page 4)

Figure 2. Global cumulative reduction in the 24-hour forecast total moist static energy error norm due to satellite observations. On the left is the channel-by-channel breakdown for the Suomi-NPP sensor, while the right shows the various infrared and microwave sensors. The time period is from 09Nov – 09Dec 2013.



in temperature channels also arises in ATMS due to $1/f$ noise in the sensor receiver electronics. Similar findings have been shown in technical reports by both the ECMWF (Bormann et al. 2012) and the UK MetOffice (Doherty et al. 2012). In NAVDAS-AR, each assimilated ATMS channel is assumed to be un-correlated. To compensate for this neglected channel correlation, the observation errors are inflated.

Overall, the performance of ATMS has been stable and on an observation-by-observation basis, is similar to the performance of observations from AMSU-A, MHS, and SS-MIS. The wider swath width and additional channels in the water vapor band, however, more than double the observations from the heritage AMSU-A/MHS sensors, thereby increasing the cumulative impact of ATMS. In summary, the ATMS sensor has proven to be an asset to the Navy NAVGEM/NAVDAS-AR system, and will be relied on to provide temperature and moisture sounding data throughout its lifetime.

(Benjamin Ruston, Steve Swadley, Nancy Baker and Rolf Langland, Naval Research Laboratory, Monterey, CA)

References

- Bormann N., A. Fouilloux, W. Bell, 2012. Evaluation and assimilation of ATMS data in the ECMWF system. *ECMWF Tech Memo #689*.
- Desroziers, G., L. Berre, B. Chapnik, and P. Poli, 2005. Diagnosis of observation, background and analysis-error statistics in observation space. *Q. J. R. Meteorol. Soc.*, 131, 3385-3396.
- Doherty A., N. Atkinson, W. Bell, B. Candy, S. Keogh, C. Cooper, 2012. An Initial Assessment of Data from the Advanced Technology Microwave Sounder. *UK Met Office Forecast R&T Report no. 569*.
- Hogan, T., S. Eckermann, M. Flatau, M. Liu, J. McCormack, J. McLay, J. Moskaitis, M. Peng, C. Reynolds, J. Ridout, K. Viner, T. Whitcomb, N. Baker, B. Ruston, L. Xu, C. Chen, and S. Chang, 2014. The Navy Global Environmental Model. *Oceanography*, submitted.
- Hogan, T., M. Peng, N. Baker, C. Reynolds, B. Ruston, M. Liu, J. Ridout, S. Eckermann, J. Moskaitis, T. Whitcomb, K. Viner, J. McLay, P. Pauley, L. Xu, R. Langland, M. Flatau, J. McCormick, S. Chang, 2013. The Navy Global Environmental Model. *WGNE Blue Book*, section 6, 11-12.

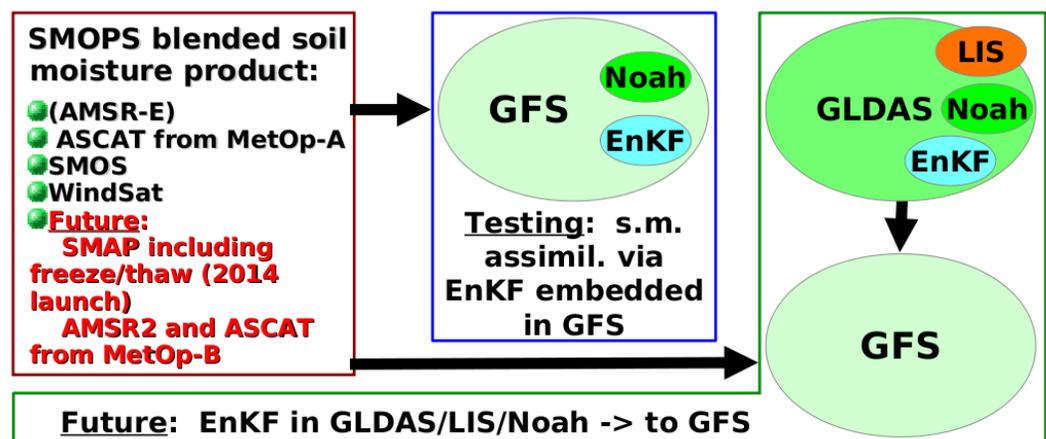
Assimilation of Blended Soil Moisture Products from SMOPS in the NCEP GFS

Soil moisture is a critical hydrospheric state variable that often limits the exchanges of water and energy between the atmosphere and land surface, controls the partitioning of rainfall among evaporation, infiltration and runoff, and thus may have significant impacts on numerical weather, climate and hydrologic predictions. The Global Forecast System (GFS) of National Centers of Environmental Prediction (NCEP) at NOAA is the primary weather forecast model that provides a greater than two-week weather forecast for users around the world. For each GFS run, a set of initial values of system state variables including soil moisture is required. For the state variable of soil moisture, the current GFS operational version basically uses soil moisture estimates that are provided by previous GFS forecasts. Because of the uncertainties associated with the precipitation estimates and other meteorological forcing data for the Noah land surface model, the initial values used for the GFS runs may not represent the real world

soil moisture level, which may contribute to errors in the GFS forecasts. In the past decade, several sets of global soil moisture data products have been generated from satellite observations and become available for various applications (Njoku et al. 2003, Wagner et al. 2007). Recently, many studies have explored the approaches to assimilating satellite soil moisture observations into land surface models to improve land surface process simulations and in turn to improve numerical weather predictions (Reichle et al. 2002, Crow and Wood 2003, Walker and Houser 2004, de Rosney et al. 2013a, 2013b).

In this study, we attempt to implement the well documented soil moisture data assimilation approaches in the NCEP GFS as we prepare to ingest the future global soil moisture data products from NASA's SMAP mission (Figure 1). The preparation for applying SMAP data products includes the following steps: 1) develop an operational soil mois-
(continued on page 6)

Figure 1. Schematic representation of assimilating satellite soil moisture products from NESDIS/SMOPS into NCEP Global Forecast System (GFS).



Global Land Data Assimilation System (GLDAS), NASA Land Information System (LIS), Noah land-surface model

ture product system that meets all requirements of soil moisture data needs for NOAA applications, especially in the GFS; 2) implement the Kalman filter data assimilation algorithm to ingest satellite soil moisture data products into the GFS; 3) examine the impact of assimilating satellite soil moisture data products on GFS forecasts; 4) make the soil moisture data assimilation utility in GFS operational. The global Soil Moisture Operational Product System (SMOPS) has been developed and operational to provide global soil moisture data products ready for use in the GFS from observations of the Advanced Microwave Scanning Radiometer (AMSR-E) on the NASA Aqua satellite, the Advanced Scatterometer (ASCAT) on the operational MetOp-A satellite of the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), the WindSat of the Naval Research Lab (NRL), and the Soil Moisture Ocean Salinity (SMOS) satellite of the European Space Agency (ESA). An Ensemble Kalman Filter (EnKF) has been implemented in the GFS to assimilate the SMOPS data products. The spring of 2012 was selected as a case study with the GFS T574 version for one week forecasts (0-192 hours). SMOPS has used the Noah land surface model (LSM) multiple year grid-wise means and standard deviations to scale surface layer soil moisture retrievals from the individual satellite sensors before blending (Zhan et al. 2012). The blended soil moisture data are assumed to have the same climatology as the model simulations of the Noah LSM used in the GFS.

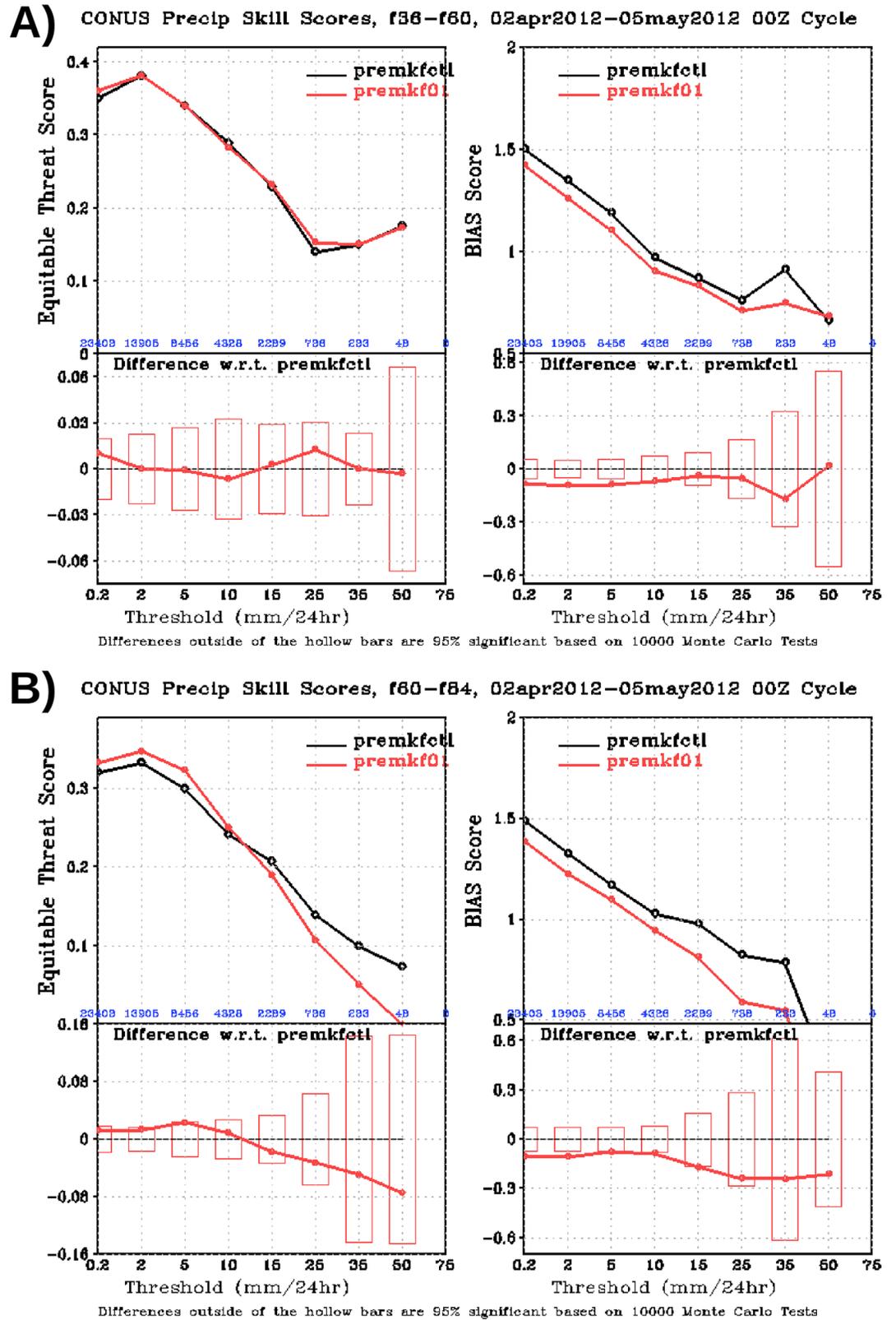
The impact of soil moisture data assimilation can be seen from the precipitation forecasts in the model. The quantitative precipitation estimate (QPE) is used for evalu-

ation of the GFS model performance. The precipitation observation estimates come from the Climate Prediction Center's (CPC) gauge observations over the CONUS, which is usually used in the NCEP global numerical weather prediction (NWP) model deterministic forecast verification package (Kuligowski 1997). Figure 2 illustrates the Equitable Threat Scores (ETS) and the bias scores of precipitation over CONUS for a period from April 2 to May 5, 2012. The ETS from the GFS EnKF for day 2 is slightly higher than that from the GFS control run, and the bias from GFS EnKF is lower than that from the GFS control run beyond the significance level. In terms of day 3 precipitation forecasts, the GFS EnKF makes a substantial increase of ETS for light and medium precipitation nearing the significance level, but also shows a big drop of ETS for heavy precipitation range though well within the significance level. It is noted that the station number of observed heavy precipitation is smaller, so the scores calculated may not be as accurate as the scores for light or medium precipitation. The bias score comparison between the two runs shows the GFS EnKF gives a substantial reduction of precipitation bias for all precipitation ranges with high significance. These impacts indicate that the assimilation of soil moisture data has a positive impact on precipitation forecasts. However, further development and testing is required before the GFS model can operationally ingest satellite soil moisture observations.

(Weizhong Zheng and Micheal Ek, NOAA/NCEP, Xiwu Zhan and Jicheng Liu, NOAA/NESDIS)

(continued on page 8)

Figure 2. Threat scores and bias scores of precipitation over CONUS for a period from April 2 to May 5, 2012. (a) The skill scores for the GFS forecast from 36h to 60h and (b) from 60h to 84h.



References

- Crow, W. T., and E. F. Wood, 2003, The assimilation of remotely sensed soil brightness temperature imagery into a land surface model using Ensemble Kalman filtering: A case study based on ESTAR measurements during SGP97. *Adv. Water Resour.*, 26, 137–149.
- de Rosnay P., M. Drusch, D. Vasiljevic, G. Balsamo, C. Albergel and L. Isaksen, 2013a, A simplified Extended Kalman Filter for the global operational soil moisture analysis at ECMWF. *Q. J. R. Meteorol. Soc.*, 139, 1199 – 1213.
- de Rosnay P., G. Balsamo, C. Albergel J. Muñoz-Sabater and L. Isaksen, 2013b, Initialisation of land surface variables for Numerical Weather Prediction. *Surv. Geophys.*, in press.
- Kuligowski R. J., 1997, An overview of National Weather Service Quantitative Precipitation Estimates. National Weather Service, Office of Systems Development. "Techniques Development Laboratory. TDL Office Note 97-4, 1-28.
- Njoku, E., T. Jackson, V. Lakshmi, T. Chan and S. Nghiem, 2003, Soil moisture retrieval from AMSR-E. *IEEE Geosci. Remote Sens. Lett.*, 41, 215–229.
- Reichle, R., D. McLaughlin, and D. Entekhabi, 2002, Hydrologic data assimilation with the Ensemble Kalman Filter. *Mon. Weather Rev.*, 130, 103–114.
- Wagner, W., V. Naeimi, K. Scipal, R. de Jeu, and J. Martínez-Fernández, 2007, Soil moisture from operational meteorological satellites. *Hydrol. J.*, 15, 121–131.
- Walker, J. P., and P. R. Houser, 2004, Requirements of a global near-surface soil moisture satellite mission: Accuracy, repeat time, and spatial resolution. *Adv. Water Resour.*, 27, 785–801.
- Zhan, X., J. Liu, L. Zhao, X. Wang, K. Jensen, M. Ek, F. Weng, and T. Schott, 2012, NOAA-NESDIS Global Soil Moisture Operational Product System (SMOPS). *18th Conference on Satellite Meteorology, Oceanography and Climatology, 92nd American Meteorological Society Annual Meeting*. New Orleans, LA, New Orleans Convention Center.

MESSAGE FROM THE EDITOR

The end of 2013 and beginning of 2014 have been a period of transition for JCSDA. While continuing our mission to accelerate and improve the operational use of satellite data and to foster enhanced collaboration in data assimilation across the partner agencies, we have undergone a number of staffing changes. As some of you may have noticed in the September issue, I have become the new Editor of the JCSDA Quarterly Newsletter, taking over for George Ohring who had a hand in creating and editing this publication since the first issue was published in December 2002. Just as George was, I am committed to sharing with you the diversity of work that is being done by partner agencies in NOAA, NASA, the U. S. Air Force, and the U. S. Navy as well as by those in the research community who are funded

to work with the JCSDA partners in advancing the timely assimilation of satellite-based atmosphere, land and ocean observations. In doing so, I look forward to sharing with you all the great successes and milestones to come.

You will have by now noticed that the Quarterly has a very new look. JCSDA's new contractor for the newsletter has worked with us to give the layout a bit of a facelift as well as some suggestions for a more dynamic content. While most of the structure and many of the sections will remain the same, you may notice some new features to the Quarterly over the next few issues. Let us know what you think by sending us your feedback. Happy 2014!

Kevin Garrett, Editor

Unsolicited articles for the JCSDA Quarterly Newsletter are encouraged, as are suggestions for seminar speakers or topics. Please send them to Kevin.Garrett@noaa.gov.

OTHER NEWS

Summary of Awarded Projects through NOAA Federal Funding Opportunity for FY13

The FY13 NOAA Federal Funding Opportunity (FFO) in support of the Joint Center targeted specific areas in its call for proposals. These areas focused largely on both the assimilation of surface-sensitive and cloud and/or rain-impacted radiances as well as for upgrades to the existing Line-by-Line model and codes in support of the Community Radiative Transfer Model (CRTM). The call not only encouraged collaboration between JCSDA partners and the external data assimilation community, but also stressed the importance of utilizing current Operations-to-Research (O2R) and Research-to-Operations (R2O) resources made available through the JCSDA. Four projects received two-year awards. The Principal Investigators (PIs) of each project have submitted a brief summary for the Quarterly. A list of all FFO awards may be viewed on the JCSDA website at <http://www.jcsda.noaa.gov/externalResearch.php>. The March 2014 issue of the Quarterly will highlight awarded projects supporting JCSDA through NASA ROSES.

Assimilation of All-Sky Microwave and Infrared Satellite Radiances: from Research to Operations

PI: Thomas Auligné (NCAR)

Co-PI: Jason Otkin (UW-Madison, CIMSS)

Co-I: Ralf Bennartz (UW-Madison, CIMSS)

Clouds are an essential component of the atmosphere as they occupy a central role

in the earth system water cycle and radiative budget. Hence a proper depiction of the cloud microphysical parameters is crucial for climate modeling and numerical weather prediction. However, clouds are still poorly represented in the initial conditions of the state-of-the-art numerical models. This results in major limitations for short-term weather prediction, particularly for extreme events that can be uniquely sensitive to moist dynamical processes in cloudy regions. Satellite observations affected by clouds and precipitation are often discarded, which means that potentially valuable data are lost. Indeed, the assimilation of such data requires overcoming difficult challenges such as the accuracy of the radiative transfer models in cloudy conditions, the correction for biases, the estimation of background and observation errors, the ability to handle strong non-linearities, and the adaptation for non-Gaussian error distributions and multiple spatiotemporal scales.

Two distinct but complementary approaches are proposed. The first approach focuses on short-term forecasting (or nowcasting) and uses IR radiances from multiple sensors (e.g. AIRS, IASI, CrIS, MODIS, GOES) to retrieve three-dimensional fields of cloud fraction. The NWP model is then used as an advection/diffusion scheme to transport cloud fraction as a tracer. This approach is relatively inexpensive and closely fits the observations at initial time, similar to current nowcasting methods such as advection and statistical models. The second approach focuses on updating the model microphysical parameters such as cloud liquid water, ice, rain, snow, graupel. These are three-dimensional model fields and we propose to include them in the analysis control variable.

(continued on page 10)

This approach differs from that employed at operational NWP centers such as NCEP or ECMWF, that focus on total water content, which requires a (linearized) scheme to partition into individual hydrometeor variables.

We will transition to the GSI system the most promising developments regarding the assimilation of cloud-and-precipitation-affected radiances, leveraging previous work for the Air Force Weather Agency (AFWA) coupled analysis and prediction system, with a clear path for quick implementation into operations.

Evaluation and Improvement of Land Surface States and Parameters to Increase Assimilation of Surface-Sensitive Channels and Improve Operational Forecast Skill

**PIs: Michael Barlage (NCAR),
Xubin Zeng (University of Arizona)**

Significant bias in land surface temperature forecasts from NCEP regional and global models, both with and without snow present, results in the rejection of data from many surface-sensitive atmospheric channels, which limits data assimilation over land. Our proposed work addresses this bias by improving the land surface temperature (LST) across NCEP modeling systems with the goal of increasing the assimilation of data from surface-sensitive channels.

An initial step toward increasing the assimilation of surface-sensitive products, and

toward evaluating land model output and forecast performance, is addressing how to use remotely-sensed LST products over global land areas. We recently compared modeled, satellite (MODIS), and ground-based LSTs in clear-sky conditions (Wang et al. 2014). Compared to four surface stations (SURFRAD and CEOP), both MODIS and offline model LSTs show cold biases at all four MODIS overpass times analyzed. The MODIS bias is generally larger at night (-2 to -5°C) than during the day (-1 to 2°C), and the model is generally colder than MODIS both at night (by 1 to 2°C) and during the day (by 3 to 5°C). Modifications were made to improve the model representation of surface roughness length for heat, and to improve the modeled turbulence during stable near-surface conditions. These modifications improved the LST simulations at the surface stations both at night (by about 0.5 to 1.5°C) and during the day (by about 0.5 to 2.5°C). Additional comparisons between MODIS and model LSTs were made for all global sparsely-vegetated areas. The model LST is 5 to 10°C colder than MODIS LSTs during both daytime MODIS overpasses investigated. Model modifications increased model LSTs by about 1 to 3°C during both the morning and afternoon MODIS overpasses. In subsequent research, we will work with NCEP/EMC and GMAO colleagues to evaluate the impact of our work on LST assimilation.

Reference

Wang, A., M. Barlage, X. Zeng, and C. Draper, 2014, Comparison of land skin temperature from a land model, remote sensing, and in-situ measurement. *J. Geophys. Res.*, conditionally accepted.

Modernization of the Community Line-by-Line Radiative Transfer Models

**PIs: Jean-Luc Moncet and Eli Mlawer
(Atmospheric & Environmental Research)**

AER's Line-By-Line Radiative Transfer Model (LBLRTM) and its monochromatic version, the Monochromatic Radiative Transfer Code (MonoRTM), which allows for exact calculations at a number of discrete frequencies (used primarily in the microwave domain), provide the reference gaseous optical depths used to develop the fast radiative transfer parameterizations included in the JCSDA Community Radiative Transfer Model (CRTM). LBLRTM and MonoRTM are therefore integral elements of the radiative transfer modeling framework that supports high-quality U.S. operational weather forecasts. The models' physics and accuracies are continually improved (Alvarado et al. 2013) in order to provide the greatest possible enhancements in forecast skills. The software in these models, however, is considerably outdated, thereby making maintaining and enhancing their capabilities somewhat challenging. LBLRTM has its heritage in the AFGL FASCODE model (Smith et al. 1978), and was structured to make the best of the limited capabilities offered by computer hardware technology back in the '70s. It was written using now obsolete FORTRAN standards, making it increasingly cumbersome to incorporate new features. A major effort initiated by the JCSDA is underway to upgrade the existing models. This effort is being led by Dr. S. A. Boukabara (JCSDA), J.-L. Moncet, and E.

Mlawer (both from AER), and conducted in close collaboration with the CRTM development team. Our approach is modeled after the paradigm used to develop the CRTM, and will ultimately lead to the development of a community-based modern line-by-line modeling capability, the Community Line-by-Line (CLBL) model, built from existing AER models. This effort involves a complete rewrite of the existing line-by-line codes in modern FORTRAN, upgrading/simplifying the user-interface, and upgrading code documentation. The existing algorithm structure will be redesigned and enhanced, in particular to facilitate the incorporation of future expanded sets of spectroscopic parameters, including new capabilities AER has developed to allow advanced line shapes and appropriate consideration of the collisional broadening of one molecular species by a second species. The resulting CLBL model will be guided by an advisory committee of internationally renowned spectroscopists.

References

- Alvarado, M. J., V. H. Payne, E. J. Mlawer, G. Uymin, M. W. Shephard, K. E. Cady-Pereira, J. Delamere, and J.-L. Moncet, 2013, Performance of the line-by-line radiative transfer model (LBLRTM) for temperature, water vapor, and trace gas retrievals: Recent updates evaluated with IASI case studies. *Atmos. Chem. Phys.*, 13, 6687-6711.
- Smith, H.J.P., D.J. Dube, M.E. Gardener, S.A. Clough, F.X. Kneizys, L.S. Rothman, 1978, FASCODE – Fast Atmospheric Signature Code (spectral transmittance and radiance). *Scientific Report 2, Hanscom AFB, MA, Air Force Geophysics Laboratory.*

Improvement and Validation of JCSDA's Community Radiative Transfer Model (CRTM) Optical Properties

PI: Ping Yang (Texas A&M University)

The bulk optical properties of ice clouds currently used in the CRTM were derived based on the MODIS C5 ice microphysical model that may cause spectral inconsistencies between the techniques based on infrared bands and those based on visible/near-infrared bands. This flaw is overcome by the MODIS C6 ice microphysical model. This project will work to update the representation of ice cloud optical properties in CRTM and to thoroughly validate CRTM under all-sky conditions.

In year one, we will provide the CRTM team with the spectrally consistent optical properties of ice cloud particles. This effort will

include the use of the particle habit and size distributions used in the MODIS C6 model to compute the bulk optical properties of ice clouds. We will then provide the Legendre expansion coefficients of the phase function with the truncation of the forward peak. In CRTM, the phase function is represented in terms of the Legendre expansion coefficients. The data format for delivery will be the same as that currently used in the CRTM, for which the Texas A&M University team already has extensive experience.

In year two, we will work to validate CRTM ice cloud optical properties by performing relevant radiative transfer simulations in comparison with various satellite observations under all-sky conditions. We will then deliver the documentation of datasets, software, and findings for updating the optical properties in CRTM and for validating the update.

MEETING REPORTS

Summary of the 6th WMO Symposium on Data Assimilation

Improving the quality of prediction requires advancement in theory, modeling, observing systems, and computing capacity. This, in turn, leads to advances in our understanding of the system itself. Dealing with the inherent uncertainty of environmental prediction is one of the major issues facing earth system sciences. As a result, society is looking for further significant benefits from the applications of data assimilation. It is therefore essential that the data assimilation community continues to meet to review and plan research and development. Given the importance of this topic across both op-

erations and research, international partnerships across governmental organizations and academia are also required. Since the WMO accepted the challenge of overseeing the development of data assimilation practices, there have been tremendous developments in the relevant areas of science and technology. A series of symposia, starting in Clermont-Ferrand, (France, 1990), followed by Tokyo (Japan, 1995), Quebec City (Canada, 1999), Prague (Czech Republic, 2005), and Melbourne (Australia, 2009), has been an important part of showcasing these *(continued on page 13)*

Lars Peter Riishojgaard,
Director of JCSDA, gives a talk
at the 6th WMO Symposium
on Data Assimilation (Photo
credit: Michiko Masutani)



developments and reporting on what fruitful directions research might take in order to meet increasing operational and societal demands. Following this path, the 6th Symposium was organized under the auspices of the WMO World Weather Research Program (WWRP). Over 300 international participants came together in College Park, MD on 07-11 October 2013. Sponsorship by NASA, NOAA, NSF, and the University of Maryland made it possible to provide domestic and international travel support to eight early-career scientists.

The Symposium's main goals were to: i) Assess recent progress in atmospheric, oceanographic, and hydrologic data assimilation, in both research and operational environments; and ii) Reach a common understanding of the main challenges and opportunities that lie ahead in data assimilation. The Symposium consisted of nine main themes: Global and Regional Atmospheric Data Assimilation; Convective Scale Data Assimilation; Atmospheric Constituent Data Assimila-

tion; Coupled Data Assimilation; Global and Regional Ocean Data Assimilation; Assimilation of Observations for the Land Surface; Assimilation of Satellite, In Situ, and Radar Observations; Methodology; and Diagnostic Tools. A total of 74 oral and 227 poster presentations were made from a wide range of perspectives representing the cross-disciplinary nature of data assimilation, which led to stimulating discussion and interaction. In the final oral session, the summary and conclusions of each theme were presented to highlight notable advances in recent years, and to identify pressing issues and challenges for the future.

The 6th WMO Symposium website (<http://das6.umd.edu>) contains all abstracts and most presentations (in both slides and video recording), and provides a valuable resource to the data assimilation community and beyond. A special collection of articles in the American Meteorological Society (AMS) journals highlighting the work presented at (continued on page 14)

the Symposium is being put together, and will include a brief, online-only summary article.

Despite its coincidental concurrence with the U.S. federal government shutdown, forcing a last minute relocation of the venue, the 6th WMO Symposium on Data Assimilation was a huge success thanks to everyone's

contributions, and particularly to those of the local volunteers, whose devoted efforts were essential. The Local Organizing Committee is also grateful for the partnership of the University of Maryland, which made the overhaul possible.

(Daryl Kleist, NOAA/EMC, and Kayo Ide, University of Maryland)

PEOPLE



Welcome Aboard, Erin Jones

Erin Jones joined NOAA's Center for Satellite Applications and Research (NOAA/STAR) in November 2013 as a Satellite Sensor Support Scientist in support of the JCSDA. Her key responsibilities will include adding new sensors to the Community Multi-purpose Formatting Toolkit (CMFT), aiding in the maintenance of the O2R and R2O environments, generating proxy satellite data for OSSEs, and serving as a point of contact for the JCSDA website. She comes to NOAA from NASA Goddard's Global Modeling and Assimilation Office (GMAO), where she served to facilitate the organization's science outreach.

Erin holds a Bachelor of Art in Communication Studies from the University of Michigan, and a Master of Science degree in Atmospheric Science from Purdue University. She is interested in the problems inherent in forecasting precipitating systems, and

looks forward to being a part of a process that seeks to determine how available satellite data can best be used to improve such forecasts. She has experience modeling with the Weather Research and Forecasting (WRF) at convective-permitting resolutions, and much of her past research has focused on severe weather and tornadic storms. Additionally, she participated in two major severe weather research field campaigns: the Verification of the Origins of Rotation in Tornadoes Experiment 2 (VORTEX2) and the Radar Observations of Tornadoes and Thunderstorms Experiment (ROTATE), as well as work on qualifying wind turbine interference in mobile Doppler radar data.

When Erin is not hoping for some thunder and lightning (or, when it's cold, snow) in the D.C. area, she enjoys arm balances, creating art, and scouting Washington, D.C. for the best coffee shops.

CAREER OPPORTUNITIES

NOAA

The National Oceanic and Atmospheric Administration, Center for Satellite Applications and Research (NOAA/STAR) is currently seeking qualified candidates in support of the JCSDA. Successful candidates will join the Directed Research Team (DRT) to work on high priority data assimilation projects, with focuses on passive microwave radiance, geostationary radiance, and Atmospheric Motion Vector (AMV)

assimilation. These positions are full-time, permanent contract positions with Riverside Technology, Inc. and located at the NOAA Center for Weather and Climate Prediction in College Park, MD. Descriptions of available opportunities can be found at

<http://www.jcsda.noaa.gov/careers.php>

NOTE FROM THE DIRECTOR

Happy New Year to the readers of the JCSDA newsletter! Any new year seems to bring a breath of fresh air and a sense of new opportunities, and for the Joint Center, there is no question that 2014 will bring changes. There will be turnover both in the Executive Team and the Management Oversight Board. Former Acting Director for NCEP/EMC Bill Lapenta was recently appointed as the next Director for NCEP, and he will therefore leave the JCSDA Executive Team and join the Management Oversight Board in this new capacity. Congratulations Bill! NASA MOB member Peter Hildebrand will retire from his current position at Goddard by the end of February, but intends to continue to serve on the MOB until a replacement has been found. And finally, I am about to step down from the position as Director to take up a position with the WMO Secretariat in Geneva. Our current Deputy Director Sid Boukabara will take over as Acting Director of JCSDA, effective January 15, and the MOB is actively engaged in the search for a new permanent Director.

The Hurricane Sandy projects mentioned in previous newsletters are now taking shape. The initial discussions about scientific ideas and priorities are now being turned into project plans, and the interagency funding transfers are underway. I see this as an extremely important step for the Joint Center, and I hope that these collaborations will serve as role models for future interagency projects when needs and opportunities arise.

Also, the computer upgrades made possible by the Hurricane Sandy funds are underway. The new hardware for JIBB that will double both the number of cycles and the available online storage has arrived at Goddard and will be installed and tested this month. The NESDIS-funded S4 platform at UW Madison is not far behind, and later this year JCSDA will therefore be fully equipped to keep up with the increasing resolution of the operational forecast systems, at least for the time being.

The JCSDA Symposium is now in what we hope will be its final form, and we are pleased to see that in spite of the continuing travel difficulties experienced by many of the prospective meeting attendees, there will be a full oral program and a fairly extensive poster session as well. I am also pleased to note that Sid Boukabara and the Executive Team are already now working with the organizers on a Symposium during the 2015 AMS Annual Meeting, so it looks as if the momentum started in Austin in 2013 continues to build.

As indicated above, this will be the final Note from the Director from me. I have spent nearly seven years in the job, acting since February 2007 and confirmed in June the same year, and I have enjoyed most of its many facets. I would therefore like to take

(continued on page 16)

this opportunity to thank the Management Oversight Board both for giving me the opportunity in the first place and for supporting me through the years. I would also like to thank my colleagues on the Executive Team and in the Joint Center as a whole for the collaborative spirit without which there would not be a JCSDA today. We did not do everything I wanted to do, but we did accomplish a few things that I am proud of. We now have supercomputers; we are doing impact experiments on an ongoing basis; we have new satellite data in operations; we

have a radiative transfer model that is now used by all JCSDA partners, etc. Most of all, I believe that we now have a stronger sense of “jointness” than ever before at several levels within the partner institutes. I wish Sid and the rest of the Executive Team good luck with whatever lies around the corner for the Joint Center, and I hope to continue to work with many of you in my new position with WMO.

Lars Peter Riishojgaard, Director, JCSDA

SCIENCE CALENDAR

JCSDA seminars are generally held on the third Wednesday of each month at the NOAA Center for Weather and Climate Prediction, 5830 University Research Court, College Park, MD. 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. Audio recordings of the seminars are posted at the website the day after the seminar. If you would like to present a seminar contact Kevin.Garrett@noaa.gov.

There are currently no seminars scheduled. Check: <http://www.jcsda.noaa.gov/JCSDASeminars.php> for updates.

UPCOMING MEETINGS OF INTEREST

DATE	LOCATION	WEBSITE	TITLE
02–06 Feb, 2014	Atlanta, Georgia	http://www.jcsda.noaa.gov/meetings_Symp2014.php	Second Symposium on the Joint Center for Satellite Data Assimilation 94th Annual AMS Meeting Abstract Deadline: Past
26 March–01 April, 2014	Jeju Island, South Korea	http://cimss.ssec.wisc.edu/itwg/itsc/	The 19th International TOVS Study Conference Abstract deadline: Past
22-26 September, 2014	Geneva, Switzerland	https://www.eumetsat.int/website/home/News/ConferencesandEvents/DAT_2076129.html	2014 EUMETSAT Meteorological Satellite Conference Abstract Deadline: Past