JOINT CENTER FOR SATELLITE DATA ASSIMILATION

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NEWS IN THIS QUARTER

SCIENCE UPDATE

Highlights of the ROSES and FFO Funded JCSDA Projects

It is our privilege to provide an introductory note to accompany this *JCSDA Quarterly* issue, which is dedicated to external research projects funded by the JCSDA. As readers of the newsletter probably know, the JCSDA has always been and continues to be committed to engaging, on an annual basis, with the external research community involved in satellite data assimilation. This issue exemplifies that commitment by highlighting current JCSDA-funded projects.

These are funded either from NOAA, through the Federally Funded Opportunity (FFO) call, or NASA, through the Research Opportunities in Space and Earth Sciences (ROSES) call. This rotating mechanism between JCSDA partners NASA and NOAA, with contributions from DoD when possible, allows us to reach out to a variety of expertise and institutions from academia, private entities and Federal agencies, and mixes grants and contracts when executing the projects.

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IN THIS ISSUE

The projects highlighted in this newsletter cover many aspects important to satellite data assimilation and the JCSDA, ranging from the improvement of forecast skills by assimilating more surface-sensitive channels, utilizing all-weather microwave and infrared radiances, to more fundamental efforts such as improving the line-by-line radiance computation accuracy.

As you will likely notice when reading these articles, the projects offer a common trait in that they work closely with one or more JCSDA partners and have as their overarching objective the improvement of forecast skill or readiness to assimilate new sensors with new technology. We hope that reading this newsletter will allow you to learn where things are headed in these projects, and perhaps give you the opportunity to engage with the scientists leading them.

For those who might be interested in working more closely with the JCSDA in the future through this external research program, it is important to mention that its main objective is to bring projects and ideas to a perhaps more mature stage, in order to benefit our JCSDA partners for operational implementation in the short to medium terms, as well as to get us ready more quickly to take advantage of new sensors and new technologies coming down the pipeline.

We hope you will enjoy as much as we did reading the articles in this current issue, and end this note by encouraging you to submit your ideas and proposals to the JCSDA future opportunities. Perhaps one day we will read about your own project in a future *JCSDA Quarterly.*

S.-A. Boukabara (NOAA FFO) and T. Lee (NASA ROSES)

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

Land surface models (LSMs) exist within a wide spectrum of complexity. Current NOAA/NCEP/EMC LSMs, such as the Noah LSM, use a bulk surface treatment, meaning the vegetation, snow, and soil surface are treated as a combined unit with one surface temperature. Bulk LSMs have been effective at providing accurate lower boundary condition fluxes of heat and water to the atmosphere in operational settings.

Recent LSM developments such as the Noah-MP LSM consider a more process-based approach, with multi-layer snow packs and

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explicit vegetation canopies that have dynamic growth. These new LSMs can more accurately simulate situations when surface heterogeneities exist (e.g., canopy overlying snow), provide more detailed information about individual land surface processes (e.g., multiple surface temperatures), and may increase the assimilation of atmospheric and land surface observations to enhance model performance.

To satisfy the increasing demand of predicting the earth system (hydrology, water quality and resources, agriculture, etc.), it is likely that U.S. operational centers will transition from the bulk approach to the process-based approach, with explicit canopies and dynamic vegetation modules, and expand the utility of the LSM beyond its traditional purpose of providing atmospheric boundary conditions. These LSM structural changes provide opportunities to assimilate more satellite land data, such as albedo and leaf area index (LAI).

The changes will also present a challenge to the land data assimilation community, however, as LSMs move beyond using satellite data directly (e.g., prescribing albedo or vegetation as is done in current operational models) to using satellite-observed land surface states. These new models also contain many more unobservable parameters that can be estimated using satellite land products, especially those from relatively high frequency global sensors, such as MODIS and VIIRS.

As part of our JCSDA-funded project, we are developing a framework for land data assimilation systems (e.g., NASA LIS) to effectively use available satellite land data products (e.g., MODIS BRDF/albedo and LAI) to update model states, and to estimate model parameters. As an example, we have extracted the Noah-MP canopy two-stream radiative transfer model to create a forward model for estimation of model radiation-relevant parameters.

The forward model takes inputs of LAI (either from a prescribed climatology or satellite observations), solar zenith angle, and canopy leaf/stem reflectivity and transmissivity (in broadband VIS and NIR) and outputs surface albedo comparable to the MODIS surface albedo product (MCD43C1). To estimate canopy parameters, we use the forward model and minimize a cost function of surface-absorbed solar radiation.

Initial results of the parameter estimation system have shown promise in improving canopy radiation-relevant parameters. For example, the system was tested for a 10°x10° section of the U.S. Midwest containing the states of Minnesota, Iowa, and Wisconsin at 0.05° spatial resolution and dominated by cropland and forest. Figure 1 shows the June diurnal cycle of surface albedo in the cropland pixels from the MODIS product, default Noah-MP model, and Noah-MP model with estimated parameters termed as "optimal." The "optimal" clearly reproduces the MODIS albedo with higher fidelity than the default Noah-MP. These simulations also yielded a 30–40 percent reduction in temperature bias over the domain. To date, the sys-

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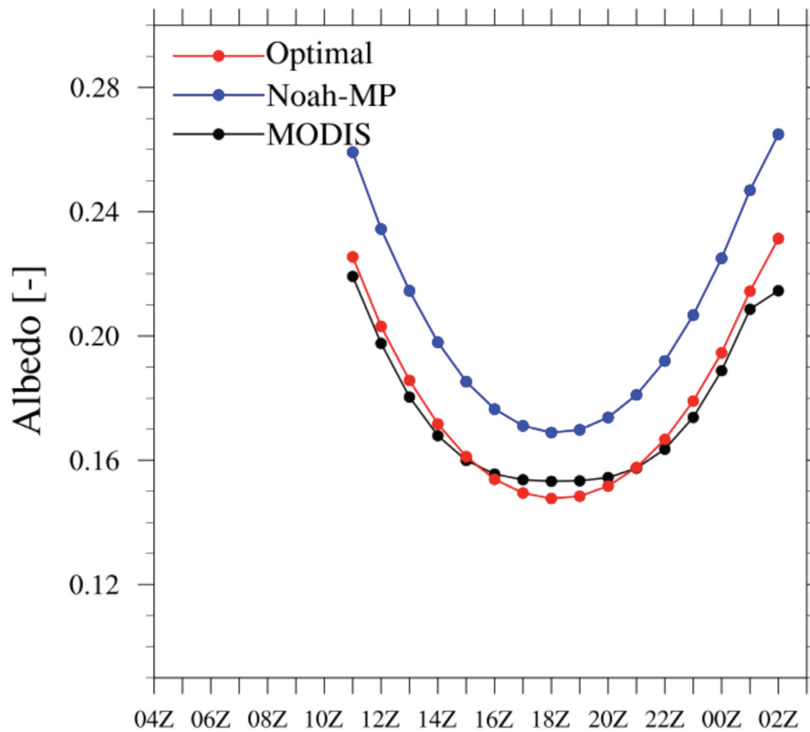

Figure 1. *Diurnal cycle of albedo from MODIS (black), Noah-MP with estimated parameters (red) and default Noah-MP (blue).*

tem has only been used in hindcast mode for parameter estimation. In the time remaining in our project, we plan to extend the capabilities to near real-time parameter adjustment.

Michael Barlage (NCAR)

Assimilation and Evaluation of MISR Cloud-Tracked Winds with GEOS-5 Operational Data Assimilation System

The Multi-angle Imaging SpectroRadiometer (MISR) instrument aboard EOS-Terra has observed cloud-tracked winds (CTW) since early 2000, with observations expected to continue until at least 2020. MISR CTW are provided within a 3-hour observational latency, feasible for assimilation in near-real time. Among the strengths of MISR winds are 17.6 km resolution, wind heights with 330 m precision, and global pole-to-pole coverage including the latitude gap from 50°-70° N/S that falls between traditionally assimilated geostationary and polar-orbiting satellite winds (Horváth, 2013). The Naval Research Laboratory (NRL) has assimilated MISR winds into the Navy Global Environmental Model (NAVGEM) and obtained positive forecast impact (Baker et al., 2014). The goal of this project is to explore an optimal way to assimilate MISR CTW and

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assess the impact of MISR winds on short-term forecasts in the GEOS-5 operational data assimilation system.

We conducted MISR CTW assimilation from December 16, 2009, to January 15, 2010, with the GEOS-5 data assimilation system (DAS) at 0.5° x 0.6° resolution. We further evaluated the MISR wind observation impact on the 24-hour forecast accuracy starting from 00 UTC, 06 UTC, 12 UTC, and 18 UTC with the adjoint sensitivity method (Gelaro et al., 2007). Assimilating MISR wind observations in GEOS-5 has reduced 24-hour forecast errors, with the total magnitude comparable to MODIS winds (Figure 1a). On a per-observation basis, the impact of assimilating MISR winds (3.1x10-6 J/kg) is the third largest and, for reference, is much larger than that of MODIS (Figure 1b).

The positive impact of MISR winds on reduction of forecast errors is consistent with the results obtained from the NAVGEM system (Baker et al., 2014). We have also used the adjoint sensitivity analysis to identify MISR wind observations that have degraded the forecast. Whereas the net forecast error reduction over one month amounts to 1.31 J/kg, there are two particular orbits (black ovals in Figure 2) that contribute an error increase of 0.25 J/kg, underscoring the need for improvement in quality control prior to assimilation. A consistent along-track bias in the retrieved wind suggests an anomalous instance of georegistration error, echoing a similar case noted by Baker et al., 2014.

Building upon these very promising initial results, we will further optimize the way we assimilate MISR winds, including identifying and screening MISR winds on a per-orbit basis and optimizing the observation operator with respect to MISR error characteristics. MISR retrieves both along-track and cross-track winds, with the along-

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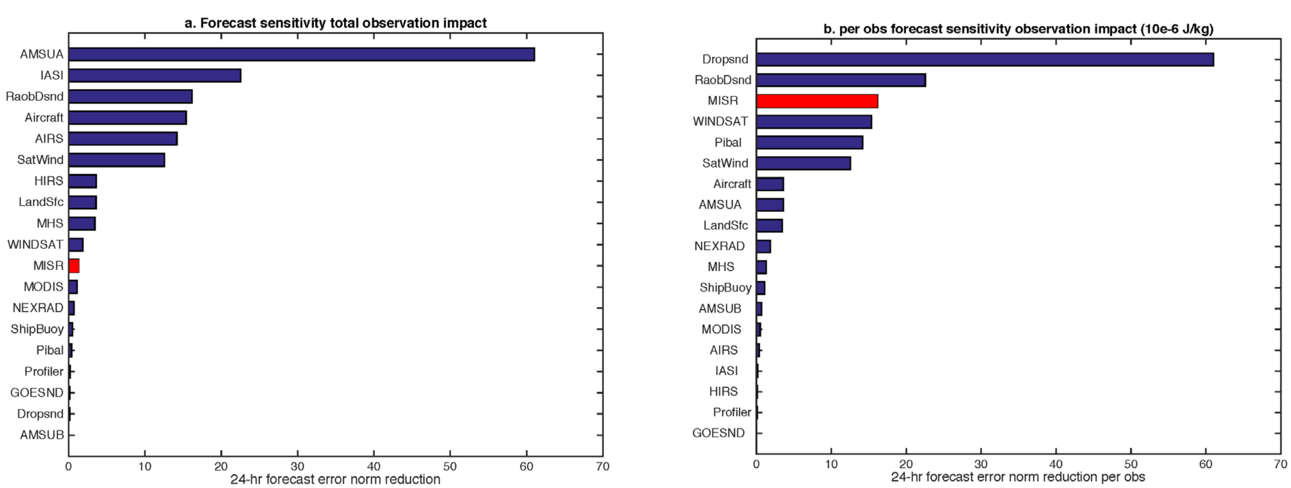

Figure 1. *Twenty-four hour forecast error norm reduction comparison between MISR winds (red color) and the rest of the observations assimilated in GEOS-5 operational assimilation system. a. Total impact (J/kg); b. Observation impact per obs (10-6 J/kg).*

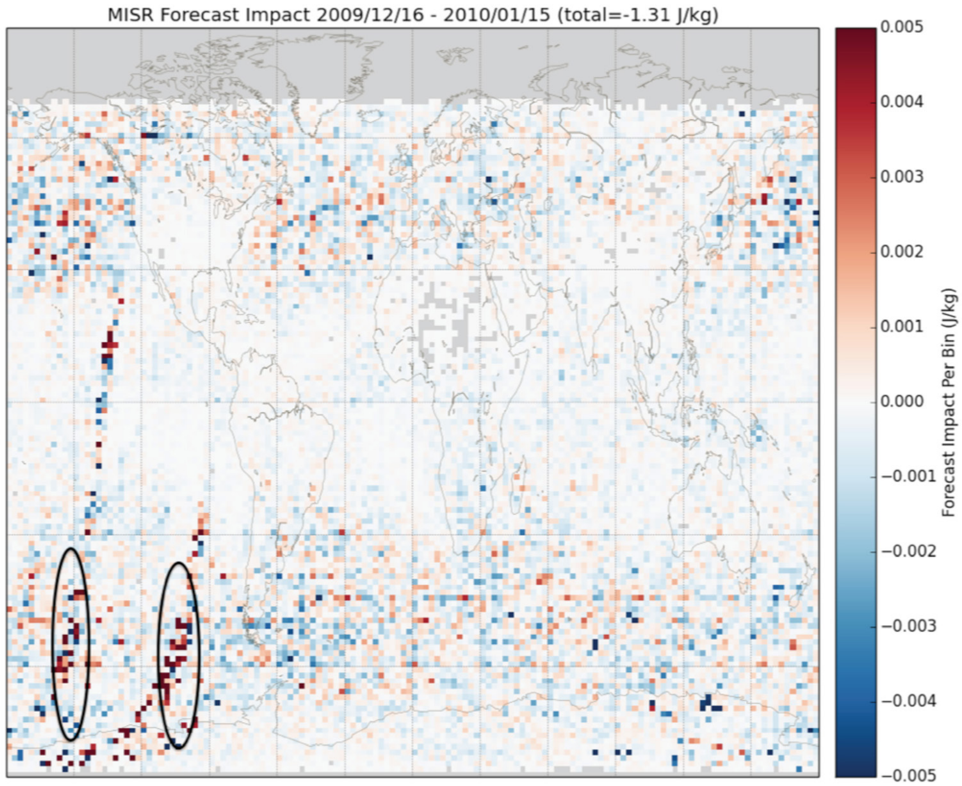

***Figure 2**. One-month cumulative MISR wind observation impact on 24-hour forecast error reduction (unit: J/kg). Black ovals indicate the two MISR orbits with georegistration errors. Note that positive values indicate that the 24-hour forecast error increases from assimilating MISR wind observations, as is the case with these misregistered orbits.*

track component having larger errors. We will configure the Data Assimilation System to assimilate along-track and cross track winds in GEOS-5 instead of zonal and meridional wind, which is expected to improve accuracy. In addition, we will evaluate the MISR wind observation impact in summer months, since the MISR wind observation coverage depends on season. Finally, we will assess the impact of MISR wind on hurricane forecasts, with Hurricane Sandy as a test case.

We acknowledge the support and help of Joe Stassi (GMAO), Dan Holdaway (GMAO), Meta Sienkiewicz (GMAO), Ron Gelaro (GMAO), and Nancy Baker (NRL). It is impossible to accomplish this project without their help.

Junjie Liu (NASA/JPL)
Kevin Mueller (NASA/JPL)

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Baker, N. L., P. M. Pauley, R. H. Langland, K. Mueller, and D. Wu, 2014, An assessment of the impact of the assimilation of NASA TERRA MISR atmospheric motion vectors on the NRL global atmospheric prediction system. AMS annual meeting, Atlanta. Georgia.

Gelaro, R., Y. Zhu, and R.M. Errico, 2007. Examination of various-order adjoint-based approximations of observation impact. Meteorologische Zeitschrift 16, 685–692.

Modernization of the Community Line-By-Line Models and CRTM-OSS Implementation

A separate version of the Community Radiative Transfer Model (CRTM) model based on open-source software (OSS), called CRTM-OSS, has been developed based on CRTM v2.0.5. Operating in the microwave, infrared (IR), and shortwave, the fast CRTM-OSS model handles either locally (Moncet et al., 2008) or globally trained (Moncet et al., 2015) channel radiance and principal component models in clear and cloudy conditions with run-time selectable number of variable molecules. The maximum number of variable molecules is limited only to those included in the training (currently 20).

Testing and validation of the new CRTM-OSS model is ongoing within JCSDA partners and is focusing first on hyper-spectral IR sensors such as the Infrared Atmospheric Sounding Interferometer (IASI) or full-resolution Cross-track Infrared Sounder (CrIS). The validation includes comparisons of radiances and Jacobians from CRTM and CRTM-OSS to Line-by-Line Radiative Transfer Model (LBLRTM) v12.1, using a standard validation data set assembled by JCSDA partners for the pre-release testing of the new model. This will ensure consistency in the results obtained independently at Atmospheric and Environmental Research (AER), Inc., and at NOAA. The comparison is also extended to assess execution times of the models in both clear and cloudy environments. CRTM-OSS is currently being merged with the main CRTM software repository trunk to produce a version that is compatible with the latest CRTM version (v2.2+).

The Community Line-By-Line Model (CLBLM) under development as a collaborative effort between AER and the JCSDA is a new modernized version of the AER LBLRTM (and MonoRTM) line-by-line model widely used in particular for training/evaluating fast radiative transfer (RT) models used operationally in retrieval and data assimilation. CLBLM consists of a modern FORTRAN wrapper calling independent modules for 1) atmospheric path calculations, 2) monochromatic layer optical depth calculations, 3) radiative transfer, and 4) post-filtering of the RT results. It has a highly simplified and flexible user interface and generic FORTRAN structures for exchanging data between the modules and CLBLM. Main features of CLBLM include:

- Separate files for input user-directive and control parameters as well as scene data
- Integrated local thermodynamic equilibrium (LTE)/non-LTE (NLTE) and single frequency (using exact specification of absorption line-shape) MonoRTM-like optical depth calculation capabilities
- Consolidated RT functions incorporating the baseline along-path LBLRTM radiance/transmittance and Jacobian computations, and multi-stream radiance and flux calculations based on a modernized LBLRTM-CHARTS engine
- Flexible panel structure and unlimited domain of the output spectral calculations

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- Automatic staging of computations for I/O minimization
- Parallelization capability.

At this stage of development, the original F77 LBLRTM subroutines are being ported to the new CLBLM environment (Figure 1) and individually tested by comparing their output to those of the original LBLRTM code to ensure complete traceability to LBLRTM. After this step has been completed, the modernization of the code inside individual modules will begin. At this point the design and functionality of the modules will be altered to provide the additional flexibility required to include new physics inside the line-by-line model. A CLBLM critical design review is planned for late summer.

Jean-Luc Moncet (AER, Inc.)

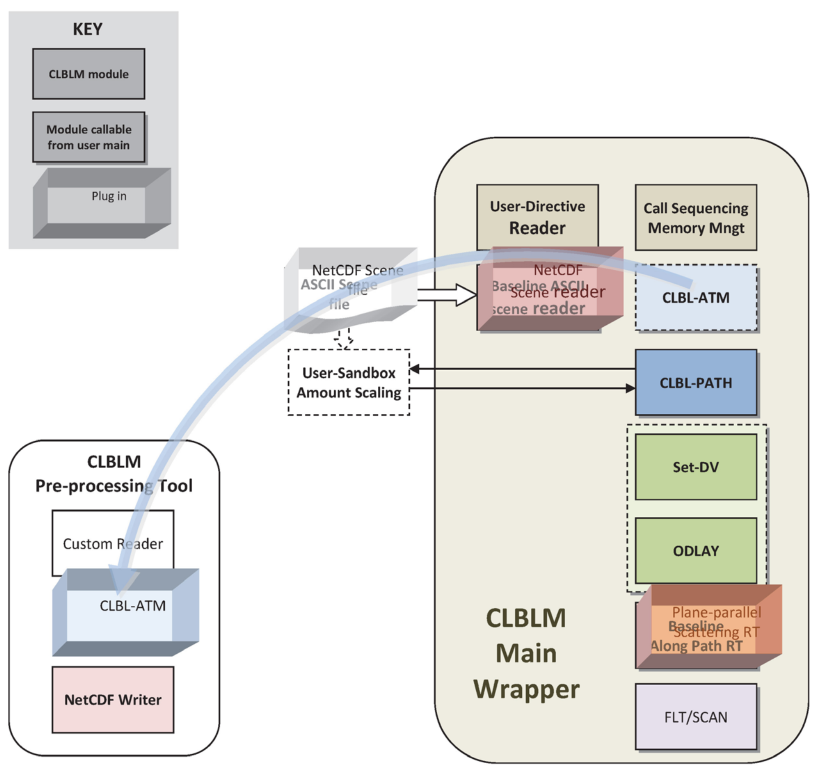

Figure 1. *Schematic of the modernized Community Line-By-Line Model environment.*

Preparatory Work for Assimilation of Precipitation-affected GPM Observations into Numerical Weather Prediction Models

Atmospheric and Environmental Research (AER), Inc., in collaboration with the University of Maryland and Colorado State University, has been developing a testbed/validation framework for the Community Radiative Transfer Model (CRTM) toward the assimilation of cloud- and precipitation-affected satellite observations. At the core of this forward-model evaluation testbed is the NASA Tropical Rainfall Measurement Mis-

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sion (TRMM) joint active/passive hydrometeor profile retrieval algorithm currently being extended to Global Precipitation Mission (GPM) Core Observatory satellite sensors.

The main outputs of the algorithm are profiles of precipitating hydrometeors at the Precipitation Radar/Dual-frequency Precipitation Radar (PR/DPR) spatial resolution. The TRMM/GPM product provides the best characterization of precipitation available on large scales and will be used as our benchmark to assess CRTM errors in the modeling of GPM Microwave Imager (GMI) and other passive microwave sensors, such as an Advanced Microwave Sounding Unit (AMSU) or Advanced Technology Microwave Sounder (ATMS).

AER generates a rainy match-up database binned as a function of rain type and viewing angle in rainy environments. The CRTM is embedded into a simple one-dimensional variational analysis (1DVAR) retrieval framework allowing adjustment of atmospheric temperature and water vapor profiles, as well as surface parameters and cloud liquid water (CLW) at the AMSU/ATMS field-of-view (FOV) scale to improve the radiance fit. The 1DVAR also provides the capability to adjust hydrometeor profiles together with the clear-sky parameters.

The retrieval may be constrained by climatology or by regional ensemble forecasts produced by numerical weather prediction (NWP) models. Direct comparison of the retrieval output with co-located radiosonde or with NWP model fields (in the context of fuzzy data assimilation) provides information that will be used to assess the forward-model errors under different meteorological conditions/precipitation types and under different viewing geometries. The same testbed is also used to assess sensitivity to different cloud parameterizations included in the CRTM, impact of sub-FOV inhomogeneities, and quality of the forecast first guess.

Jean-Luc Moncet, Alan Lipton, and Thomas Nehrkorn (AER, Inc.)

Assimilation of All-Sky Radiances From CrIS and GPM

Our work is addressing the challenges related to the assimilation of satellite observations in all-sky conditions including clear, cloud, and rain-affected radiances. A few examples of progress during the last six months are below.

Cloud contamination can strongly impact the radiance bias correction due to a detrimental feedback loop between cloud detection and bias correction (Auligné and McNally, 2007). For all-sky radiances, one concern is that bias predictors can absorb some useful signal and thus hide model deficiencies that should be corrected in the analysis. For this reason, we removed cloud liquid water from the list of bias-correction predictors for all-sky radiances.

We identified the interface between the model microphysics and the radiative transfer in the observation operator, the Community Radiative Transfer Model (CRTM), as a

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prime source of biases. Hypotheses about various particle shapes and radiative properties do not necessarily correspond. For example, with the Thompson microphysics scheme in the Weather Research and Forecasting (WRF) model, we found that taking 20 percent of the forecasted snow and considering this as ice in the CRTM calculation would significantly improve the fit to observation. We are now planning on a more systematic approach by considering this parameter estimation problem within the framework of the variational observation-bias correction scheme.

The Multivariate Minimum Residual (MMR) (Auligné, 2014a,b) retrieves profiles of cloud fractions for each pixel, which can be used for cloud detection purposes. This algorithm has been implemented in the Gridpoint Statistical Interpolation (GSI) system for multiple infrared instrument including AIRS, IASI, CrIS, GOES, and MODIS. Every hour, the retrievals are interpolated onto a regular latitude/longitude grid and advected using the WRF model, with new observations overwriting the advected information.

The GEN_BE software has been updated to compute background error statistics of cloud microphysical variables (i.e., mixing ratios for cloud liquid water, cloud ice, snow, and rain) for both regional and global models (Descombes et al., 2015). These statistics represent the input parameters for the static background error covariance matrix, which is modeled via a sequence of operators in the GSI variational system.

Joshua Hacker (NCAR)
Jason Otkin (UWisc/CIMSS)
Ralf Bennartz (UWisc/CIMSS)

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Descombes, G., T. Auligné, F. Vandenberghe, and D., M. Barker, 2015, Generalized Background Error Covariance Matrix Model (GEN_BE v2.0). *Geosci. Model Dev.*, 8, 669-696.

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

We have made significant steps in evaluating forecast brightness errors and toward a consistent processing of microwave and infrared all-sky radiances inside the Gridpoint Statistical Interpolation (GSI) system. Progress is described briefly below.

To examine the Community Radiative Transfer Model (CRTM) performance for all-sky conditions, the NOAA National Centers for Environmental Prediction (NCEP) Global

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Data Assimilation System/Global Forecast System (GDAS/GFS) was used to collect collocated observed and model-equivalent brightness temperatures for a 2-month period from April–May 2014. Version 2.1.3 of the CRTM was used with the current operational version of the GDAS Hybrid Ensemble Kalman Filter (EnKF) assimilation system at T670 resolution. Our analysis has focused on examining relationships in the departures between observed and model-equivalent brightness temperatures for several infrared and microwave sensors. Dependencies on sky conditions depicted by the instrument and GFS model have been found for the brightness temperature departures. To better understand how cloud characteristics determine biases, work is ongoing to evaluate forecasts conditioned on cloud characteristics.

The GSI code has been improved significantly to process all-sky radiances. Although there were already some initial capabilities with all-sky radiances, these were limited to very few sensors and to specific configurations of the GSI (e.g., AMSU-A for global domain only). In many instances, quality control decisions were hard-coded for specific configurations (e.g., reject data with a latitude above a fixed threshold or over land for microwave sensors in the global configuration). We followed a more systematic approach, considering both infrared and microwave sensors, and uniting code modifications under the namelist switch "l_allskyrad." These ensured that our modifications will be easily merged and committed without altering existing applications via the default option "l_allskyrad=false." Under the "l_allskyrad" option, modules for the following steps have been implemented:

- Calculate brightness temperatures with the CRTM using cloud input from the model guess. The all-sky calculation is done for all sensors, and over all surface types (including land and sea ice).
- Extend the gross check and first-guess check during the quality control procedure. A namelist parameter has been added to control the degree of tightness of the first-guess check.
- Add an option to skip the cloud detection step during the quality control process of the infrared and microwave observations. This ensures that cloud-affected radiances will no longer be discarded.
- Remove cloud liquid water from the list of predictors for the variational bias correction. This step is required to make sure that valuable cloud information is not removed by the bias-correction step.
- Down-weight the observations at each outer loop to approximate the Huber norm, which is more resistant to outliers.
- Set a floor value for cloud liquid water and ice mixing ratio prior to calculating the CRTM Jacobians. A small threshold is chosen so that it does not adversely affect the simulated model guess, but this step removes a singularity point in the minimization, in which a clear first guess (i.e., without clouds) will have exactly zero as its Jacobians with respect to cloud water and ice, and therefore the (linear) minimization would not be able to fit cloudy observations. Experiments have shown that this step is necessary to correct the model in regions where it misses clouds.

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The code was initially implemented for the WRF-ARW model in regional domains, and it has been extended to the global models using the NEMSIO interface. Hence the all-sky assimilation will be applicable for both regional and global models.

We have also refined the "middle-loop" procedure, where the observation operator is re-linearized several times and the non-linear problem is therefore segmented into a sequence of linear problems.

The concept of "trust regions" was introduced to determine the analysis increment magnitude that can be properly represented via the tangent-linear observation operator. If the observation operator were fully linear, the trust region would be infinite. But the CRTM in cloudy regions is quite non-linear and we need to limit the linear approximation to a small region around the guess. We found that the trust region is significantly smaller for infrared sensors compared to microwave, because the non-linearities in the radiative transfer are larger for cloudy regions.

Joshua Hacker (NCAR)
Jason Otkin (UWisc/CIMSS)
Ralf Bennartz (UWisc/CIMSS)

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

Accurately modeling the radiation process under ice cloud conditions is an important task for the Community Radiative Transfer Model (CRTM) developed by the JCSDA. A research group at Texas A&M University has been working to improve the representation of the ice cloud optical properties in the CRTM.

In the current CRTM version, the ice cloud optical properties are based on the Moderate Resolution Imaging Spectroradiometer (MODIS) Collection 5 ice cloud habit model, which is known for spectral inconsistency between the visible/near-infrared-based and infrared-based cloud property retrievals. The objective of this project is to replace these ice cloud optical properties with those from the MODIS Collection 6 habit model and to validate the improvements.

The MODIS Collection 6 ice cloud habit model assumes aggregates composed of severely roughened, solid, hexagonal columns. The necessary habit model scattering properties are derived from a comprehensive database (Yang et al., 2013). We assume a Gamma size distribution, with an effective variance of 0.1, and calculate the bulk scattering properties. For the CRTM application, the ice cloud bulk scattering properties are provided as functions of the effective particle size and are organized as look-up tables.

To validate the results simulated by the CRTM with the new ice cloud optical properties, the Line-By-Line Radiative Transfer Model + Discrete Ordinate Radiative Transfer Model (LBLRTM+DISORT) method is compared to the CRTM. Using the U.S.

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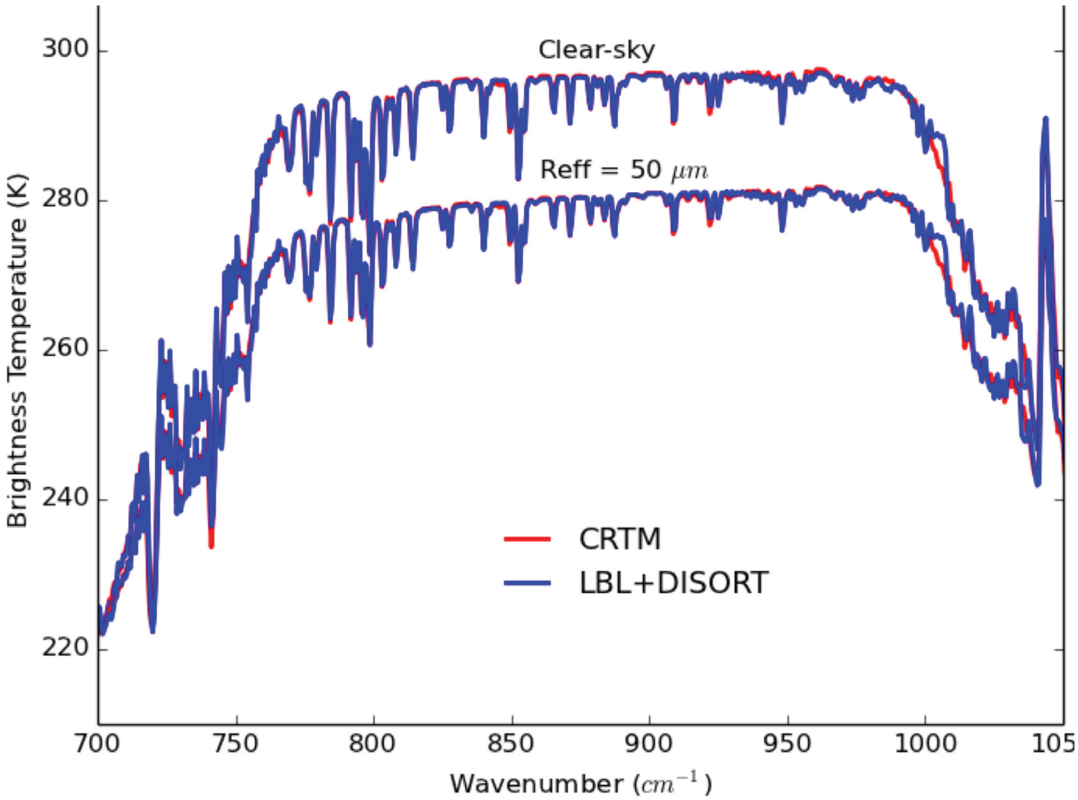


Figure 1. *Simulated brightness temperatures under clear-sky and ice cloud (with ice effective radius of 50 μm) conditions at the top of the atmosphere with the CRTM and LBLRTM+DISORT.*

standard atmospheric profiles, brightness temperatures are simulated at the top of the atmosphere by the CRTM and by the LBLRTM+DISORT to be used for the validation. The surface temperature, the carbon dioxide concentration, and the position and optical thickness of the ice cloud layer are identical in both models.

In Figure 1, the simulated brightness temperature under clear-sky and ice cloud (with ice effective radius of 50 μm) conditions are shown between 700 cm^{-1} and 1050 cm^{-1}. The preliminary results show close agreement between the CRTM and LBLRTM+DISORT simulations at most wavelengths; however, discrepancies are found at wavenumbers larger than 1000 cm^{-1}.

In the next step of the project, the simulated spectral range will be expanded to cover the visible and far infrared regions. Furthermore, the performance of the upgraded CRTM ice cloud simulation capability will be tested for specific instruments, such as MODIS, under real atmospheric conditions.

Ping Yang (Texas A&M University)

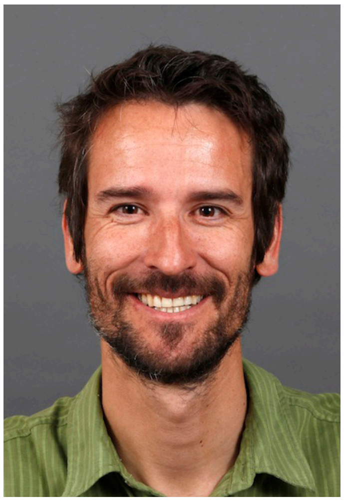
References:

Yang, P., L. Bi, B.A. Baum, K.-N. Liou, G. Kattawar, M. Mishchenko, and B. Cole, 2013, Spectrally consistent scattering, absorption, and polarization properties of atmospheric ice crystals at wavelengths from 0.2 to 100 μm. *J. Atmos. Sci*., 70, 330-347.

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*](mailto:Kevin.Garrett@noaa.gov).

OTHER NEWS

Dr. Thomas Auligné Joins JCSDA as New Director



Dr. Thomas Auligné began his tenure as the JCSDA Director on May 1. Since 2007, Dr. Auligné had been a Project Scientist at the National Center for Atmospheric Research in Boulder, CO. There, Dr. Auligné worked exclusively on improving the data assimilation and Numerical Weather Prediction (NWP) capabilities impacting both the broader research community and operational data assimilation systems at several JCSDA partner institutions. Much of his focus has been on the assimilation of cloud (and precipitation) impacted satellite observations.

For a number of years, Dr. Auligné led the effort to develop the Air Force Weather Agency (now the 557th Weather Wing) Coupled Assimilation and Cloud Prediction System (ACAPS), which aims to provide cloud analysis and forecast capabilities based on NWP. Recently Dr. Auligné has also worked on a multivariate minimum residual method to improve and increase the number of assimilated infrared (IR) satellite radiance observations, through the retrieval of cloud fraction profiles implemented in the Weather Research and Forecasting model and Data Assimilation system (WRF-DA). This technique was also extended for short-term forecasting of clouds for both aviation and solar energy applications. Additionally, Dr. Auligné developed the Ensemble-Variational Integrated Localized (EVIL) algorithm implemented in the Gridpoint Statistical Interpolation (GSI) data assimilation application for National Oceanic and Atmospheric Administration/National Weather Service (NOAA/NWS).

In the years leading up to his work at NCAR, Dr. Auligné earned his M.S. degree in Meteorology from the Ecole Nationale de la Météorologie in Toulouse, France. Dr. Auligné earned his Ph.D. in Atmospheric Physics from the Paul Sabatier University, also in Toulouse.

Dr. Auligné has held positions at both Météo-France and the European Centre for Medium-Range Weather Forecasts (ECMWF), focusing on assimilation of the first hyperspectral IR sensor (AIRS) and satellite radiance variational bias correction schemes, respectively. At NCAR, he collaborated on many other projects, including the development of a variational field alignment algorithm to resolve displaced cloud fields between the model background and satellite observations, as well as an observation impact diagnostic tool based on adjoint sensitivity.

Dr. Auligné is also dedicated to outreach in the atmospheric science community, mentoring several students and postdocs, participating and lecturing in various data assimilation tutorials, and organizing several conferences and workshops.

Dr. Auligné is an outdoor sports enthusiast who enjoys mountain biking, canyoneering, and kiteboarding, to name a few hobbies. He is also an avid world traveler, having visited over 60 countries. Tom and his wife Synthia have two boys: Eliot (4) and Teiva (2).

Please join us in wishing Dr. Auligné much success as Director of the JCSDA!

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Registration Now Open for the 2015 GSI/EnKF Community Tutorial

The Developmental Testbed Center (DTC) is pleased to announce a joint tutorial for the Gridpoint Statistical Interpolation (GSI) and the Ensemble Kalman Filter (EnKF) data assimilation systems to be held August 11–14, 2015, at the NCAR Foothills Laboratory in Boulder, CO.

The GSI system is a traditional variational data assimilation system, now with Ensemble-Variational (EnVar) and hybrid techniques as options. The EnKF system is an ensemble-based data assimilation system that can also be used as part of the GSI-based hybrid system. Both are operational data assimilation systems running in real time at multiple operational centers, including National Centers for Environmental Prediction (NCEP).

In collaboration with the developers of these two systems, the DTC has been providing centralized support to GSI since 2009 and now is adding EnKF to the supported systems. This will mark the first EnKF tutorial and the sixth annual GSI tutorial provided by the DTC. It will offer basic and advanced data assimilation topics based on the upcoming code release (GSI v3.4 and EnKF v1.0) scheduled for June 2015.

Both lectures and hands-on practical sessions will be provided. Options to attend GSI/EnKF (four days) and EnKF only (one and a half days) sessions will be available.

For registration and more information on the 2015 GSI/EnKF Community Tutorial, please visit http://www.dtcenter.org/com-GSI/users/tutorials/2015.php.

Hui Shao (JCSDA/DTC)

MEETING REPORTS

Symposium Sessions Examine Next-Generation Satellite Observing Systems

The Third Symposium on the Joint Center for Satellite Data Assimilation was held during the 95th American Meteorological Society (AMS) Meeting Annual Meeting in Phoenix, AZ, from January 4–8. Sessions were held jointly with the 20th Conference on Satellite Meteorology and Oceanography and the 11th Annual Symposium on New Generation Operational Environmental Satellite Systems.

The meeting got off to a start on Monday with a joint panel session discussing the Enterprise View of Satellites, which set the theme for the week on next-generation satellite observing systems, as well as integrated data assimilation and data fusion applications.

The JCSDA Symposium held a poster session on both Monday and Tuesday, and oral sessions were held across the week on Monday, Tuesday, and Thursday. Poster topics covered a variety of JCSDA priority areas, including partner Operations to Research (O2R) and Research to Operations (R2O)

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support, internal partner research and operational initiatives, and research by the external community sponsored by JCSDA partners. Many of the oral presentations focused on the progress of all-sky satellite data assimilation.

Sessions were well represented by JCSDA partners and were well attended. Selected posters and recorded oral presentations may still be accessed at https://ams.confex.com/ams/95Annual/webprogram/3JCSDASYMP.html.

We look forward to seeing the advances made in data assimilation during 2015 at the Fourth Symposium on the JCSDA at the 96th AMS Annual Meeting in New Orleans, LA, in January 2016. Preparations are underway, and the latest information including registration and abstract deadlines may be accessed at https://ams.confex.com/ams/96Annual/oasys.epl.

Kevin Garrett (JCSDA)

The 13th JCSDA Technical Review Meeting & Science Workshop on Satellite Data Assimilation was held past deadline and will be summarized in the Summer 2015 JCSDA Quarterly Newsletter issue.

PEOPLE

Dr. Lidia Cucurull Appointed NOAA/OAR Technical Liaison to the JCSDA

Lidia Cucurull received her Ph.D. in Physics, with specialty in Atmospheric Sciences, on the use of Global Navigation Satellite System (GNSS) signals in numerical weather prediction from the University of Barcelona, Spain, in 2001. Since then, she has worked at UCAR, NASA/GSFC, NOAA/NWS, and NOAA/NESDIS.

Dr. Cucurull has won several national awards in recognition of her work, including the UCAR Outstanding Scientific and Technology Advancement Award (2007) and the NOAA David Johnson Award (2011). She currently leads the Global Observing Systems Analysis (GOSA) group within the NOAA/ESRL Global Systems Division. A major objective of GOSA is to quantitatively evaluate the complementarity of different observing systems through Observing System Simulation Experiments (OSSEs) and Observing System Experiments (OSEs) to help NOAA management prioritize mission designs in a cost-effective way in support of NOAA's Quantitative Observing System Assessment Program (QOSAP). GOSA leads the utilization of GNSS Radio Occultation (RO) observations within NOAA, including the evaluation of current and future RO observations, as well as the enhancement of the current utilization of RO in improving weather forecast skill in NOAA's models.

Dr. Cucurull has 20 years of experience working with data assimilation and GNSS, including both ground-based and space-based applications of the technique. During her years at NCEP, she developed, optimized,

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tested and implemented the algorithms necessary to incorporate RO sounding data into the NCEP's operational global model. Following the excellent results of the data assimilation experiments with COSMIC, NCEP began operational use of the COSMIC data on May 1, 2007, roughly one year after the launch.

Finally, Lidia is the NOAA RO Program Scientist for COSMIC-2 and the chair of the Expert Team on New Remote-Sensing Technologies of WMO. In the role of technical liaison, she serves as a point of contact for the JCSDA partners and the external research community on satellite data assimilation activities at NOAA/OAR.

Meet the JCDSA Support Staff

René E. Brown

Supporting the JCSDA management, René Brown has served as the Administrative Support Specialist Lead for JCSDA, funded by NOAA/NESDIS, since late summer 2009, with responsibilities for planning and coordination. She has been instrumental in interacting with external research scientists for computer accounts, hosting, travel, workshop logistics, and the Federally Funded Opportunity Grants process. She is the point of contact for JCSDA New Hire Visiting Scientists/Contractors and supports the JCSDA office with various reports, presentations, and administrative tasks. In summary, she is a key person, working behind the scenes in making sure JCSDA functions are performed smoothly. Before joining JCSDA, she provided administrative support for 1½ years to the Center for Sponsored Coastal Ocean Research in Silver Spring, MD.

Her education and professional experience includes a B.A. in Communications/Film (minor in graphic design), producing educational documentaries with sonic images. She served with the *Hartford Courant* Washington Bureau for 16 years, providing research reporting and office management for the newspaper. She attended press conferences on Capitol Hill, specializing in the Connecticut state delegation. She held Senate press credentials during both the Bush and Clinton administrations, and a highlight of her special press credentials was to witness the visits of both Nelson Mandela and Mikhail Gorbachev to Capitol Hill.

An ordained minister, René has served as associate pastor for special services and has studied comparative religion. Her international travel embraces and provides both cultural enlightenment and personal regeneration.

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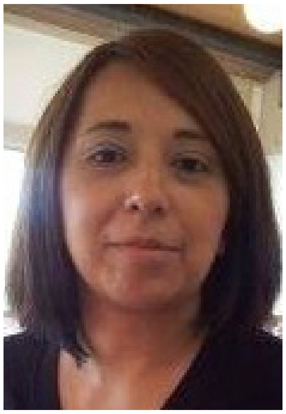
Ana Carrion



Supporting the JCSDA management, Ana Carrion has served as the Program Support Specialist for JCSDA, funded by NOAA/NESDIS, since August of 2010. She has been instrumental in interacting with all JCSDA partners and staff for scheduling and coordinating meetings, interviews, travel and similar activities. She is the point of contact for electronic inventory and supports all projects including seminars, workshops, and administrative tasks for the JCSDA main office. She is probably the person who will answer the phone if you call the main JCSDA headquarters line.

Ms. Carrion also coordinates closely with René Brown for all aspects related to administrative and programmatic support—ensuring, for instance, that all logistics are in place for visiting scientists and other JCSDA visitors, including ensuring building access, reserving cubicles, and providing computers.

Prior to returning to the Washington metropolitan area from Pennsylvania with her family in 2009, she served as an Educational Technician at the Naval Air Station in Willow Grove, Pennsylvania, providing day care, encouragement, and a safe environment for children ages 1–2 years of age. Upon her return she continued to provide similar services at the Naval Medical Center, Bethesda, MD, for 4 years.

Ana attended Anthem Institute and received her certification in Medical Billing and Coding in 2009.

In her leisure time, she enjoys traveling, the outdoors life in general, and exercising her creative faculties by creating scrapbooks from her Disney vacations.

CAREER OPPORTUNITIES

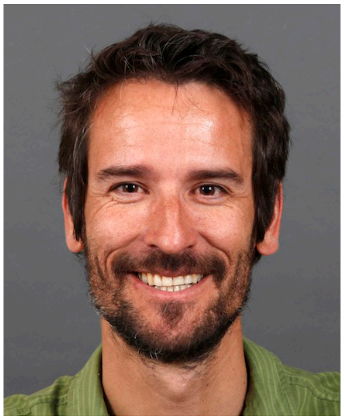
Further information on career opportunities listed here may be found at http://www.jcsda.noaa.gov/careers.php

NOAA

Research Scientists—Data Assimilation

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 assimilation of passive and active microwave radiance data, geostationary radiance data, and Atmospheric Motion Vectors (AMVs), as well as support current efforts on Observing System Simulation Experiments (OSSEs). These are full-time, permanent positions with Riverside Technology, Inc., Atmospheric and Environmental Research, Inc., the University of Maryland, or the University of Miami.

NOTE FROM THE DIRECTOR



It is a pleasure and honor to address you in my new responsibilities as director of the JCSDA. My thanks go to the Management Oversight Board (MOB) for this great opportunity and their indefatigable support. It is clear that the cohesion of the Joint Center entirely depends on the strong involvement of each of its partners and their commitment to foster collaboration. I also want to acknowledge Sid Boukabara for his fantastic job as acting director during the past year, masterfully handling the various transitions at the JCSDA. It is a real pleasure to work with Sid and the entire Executive Team, which combines a precious alchemy of skills and personalities.

There could not have been a better way to dive into the breadth of scientific developments than through the JCSDA Technical Review Meeting and Science Workshop held last May. Presentations portrayed a picture of the state of the art for atmosphere, ocean, land, clouds, and aerosol data assimilation. Updates were also given about new sensors and Observing System Simulation Experiments. The rich discussions provided useful material to help shape the future strategic directions of the JCSDA.

I want to use my first hundred days in office (the so-called "honeymoon period") to set in motion ambitious projects that will maximize the benefits to our partners in the years to come. We are exploring opportunities to expand the coordination within the JCSDA and with national and international partners. This will involve reinvigorating the working groups with clear objectives and charter.

A key goal for the Joint Center is to accelerate the use of new sensors and prepare for Day One readiness. The adjunct goal is to optimize the assimilation of existing instruments, which requires addressing various scientific frontiers. There is a fine balance between superficially addressing too many topics and focusing too closely on narrow areas. The metric that should be used in the decision process is where collaboration is most needed to leverage parallel efforts and produce superior outcome. In this context, we are exploring how the JCSDA can spearhead the development of transversal data assimilation tools and provide an improved portfolio of packages to the community.

Needless to say, I am still only at the bottom of the learning curve, and I invite you to share your vision on scientific, programmatic, and strategic directions for the JCSDA (http://tinyurl.com/jcsda). We are also initiating a national "tour" to learn from each partner and make sure their interests are properly represented.

Regarding the 2015 Federal Funding Opportunity, the decision on the funded grants should be announced imminently, with a starting date planned for August 2015. The JCSDA Summer Colloquium this summer will engage a group of bright young scientists on satellite data assimilation, and it will be hosted by Cooperative Institute for Research in the Atmosphere (CIRA) in Fort Collins, CO. We are also looking forward to the third occurrence of the Joint JCSDA-ECMWF Workshop on Cloudy Radiance Assimilation, which will be in College Park this November.

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Finally, I would like to welcome Melinda Peng, who is replacing Simon Chang as representative of the Naval Research Laboratory at the MOB. Simon is retiring and we are extremely thankful for his contribution to the JCSDA. Best of luck, Simon! Also congratulations to Nick Vincent for his recent promotion to the rank of captain. We are hopeful these new responsibilities will remain compatible with Nick's invaluable role as chairman of the MOB.

If you have not sensed this by now, I am deeply enthusiastic about the JCSDA vision and excited to join this collaborative effort. Without undermining all the challenges that will undoubtedly show their evil faces, I am convinced we have in our hands all the ingredients of success.

Tom Auligné, Director, JCSDA

SCIENCE CALENDAR

UPCOMING EVENTS

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 Erin.Jones@noaa.gov

JCSDA SEMINARS			
DATE	**SPEAKER**	**AFFILIATION**	**TITLE**
19 August, 2015, 2 p.m.	Mark Leidner	AER	A Severe Weather QuickOSSE to Examine the Impact of Super Constellations of GPS Radio Occultation Satellites
MEETINGS OF INTEREST			
DATE	**LOCATION**	**WEBSITE**	**TITLE**
27 July-7 August, 2015	Fort Collins, CO	http://www.jcsda.noaa.gov/meetings_SummerColloq2015.php	The JCSDA Summer Colloquium on Satellite Data Assimilation
11-15 August, 2015	Boulder, CO	http://www.dtcenter.org/com-GSI/users/tutorials/2015.php	2015 DTC Joint GSI and EnKF Tutorial
21-25 September, 2015	Toulouse, France	http://www.eumetsat.int/website/home/News/ConferencesandEvents/DAT_2305526.html	2015 EUMETSAT Meteorological Satellite Conference
28 October-3 November, 2015	Lake Geneva, WI	https://cimss.ssec.wisc.edu/itwg/itsc/itsc20/	ITSC-XX Abstract Deadline: 1 July, 2015
10-14 January, 2016	New Orleans, LA	http://annual.ametsoc.org/2016/	Fourth AMS Symposium on the Joint Center for Satellite Data Assimilation 96th Annual AMS Meeting Abstract Deadline: 3 August, 2015