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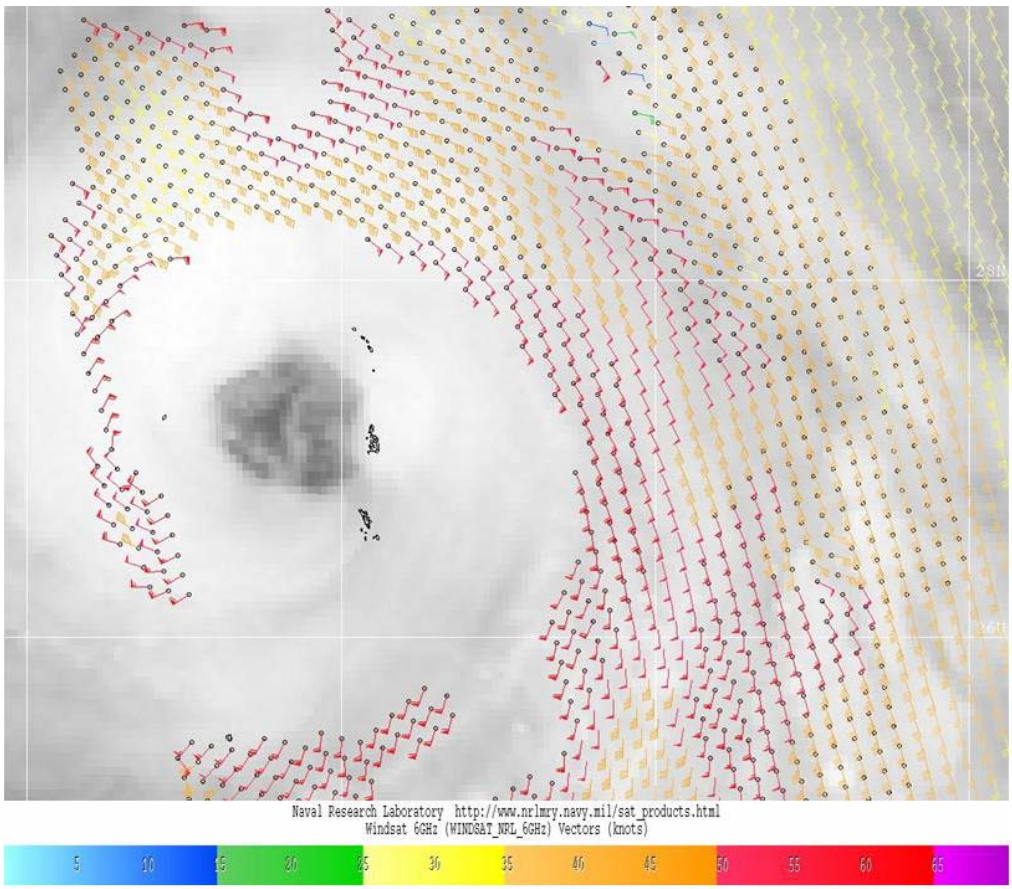
Joint Center for Satellite Data Assimilation • 5200 Auth Road • Camp Springs • MD • 20746 *Editor: George Ohring*
NOAA……..NASA……..US Navy……..US Air Force *Web-site: www.jcsda.noaa.gov*

News in This Quarter

Science Update

Assessing the Impact of WindSat and Scatterometer Observations on Tropical Cyclone Predictions



WindSat ocean surface wind vectors for Typhoon 13W Malakas on Sept 24, 2010 0755 GMT illustrating that WindSat is capable of measuring some of the inner core winds but is still unable to retrieve values within the intense eyewall (via the NRL TC web page).

The Marine Meteorology Division of Naval Research Laboratory in Monterey has performed numerical experiments to assess the impact of WindSat observations (both ocean surface wind vectors (OSWVs) and total precipitable water (TPW)) and scatterometer OSVWs from QuikSCAT and ASCAT on the prediction of tropical cyclones (TCs). In addition, the value of WindSat observations on real-time operational monitoring and warnings of TCs at the Joint Typhoon Warning Center (JTWC) has also been assessed. The study focused on the Western Pacific during a TC active period from August 17 to November 2, 2009.

WindSat, designed by NRL and onboard the Coriolis spacecraft, was the first passive satellite sensor to obtain ocean vector winds, and thus prove the feasibility of microwave polarimetric radiometry in measuring ocean surface wind vectors (speed and direction) from space. The figure displays WindSat wind vectors near the center of Typhoon Malakas (2010). The figure demonstrates that the sensor provides retrievals even in strong wind or cloudy conditions and is able to measure speeds up to 20-30 m/s. WindSat ocean surface wind vectors augment the few other satellite sensed surface wind vectors (ASCAT), and provide valuable wind field structure details. The WindSat 37 GHz

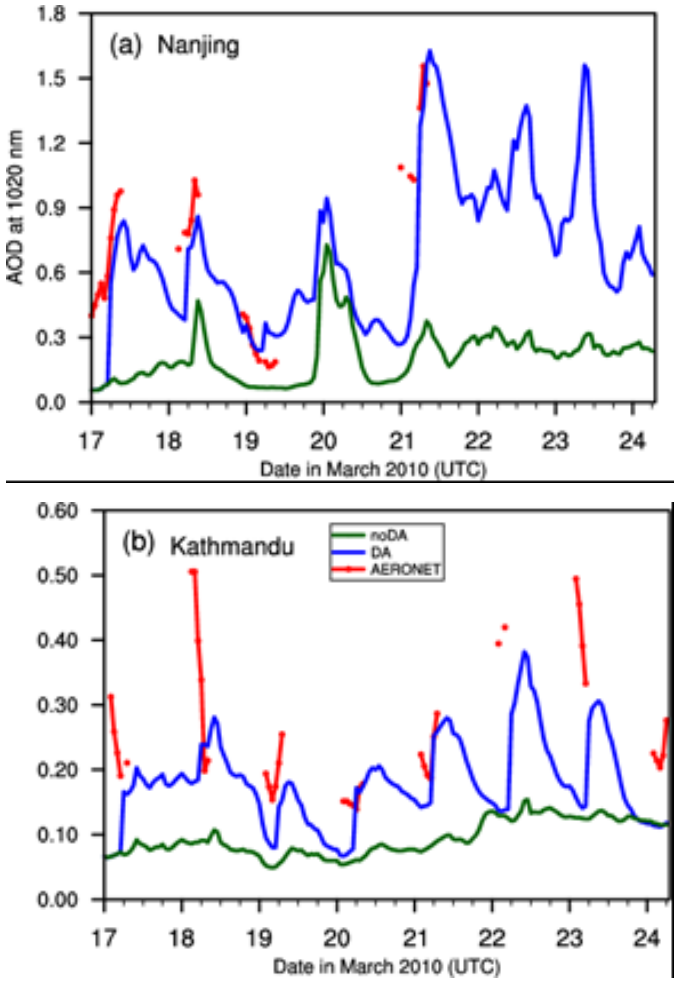
brightness temperature (T_B) imagery represents a key analysis tool at the JTWC due to its factor-of-three improvement in resolution over the SSM/I and SSMIS sensors, and its ability to map low-level inner-core cloud liquid water features associated with storm structure and intensity. In addition, the WindSat TPW values highlight a storm's moisture environment and reveal dry-air intrusions.

The data denial experiments were conducted using the Navy global (NOGAPS/NAVDAS-AR) and regional tropical cyclone (COAMPS-TC/NAVDAS) prediction systems. The three experiments are designated: (1) "control," with all data included, (2) "No SCAT," with no scatterometer or WindSat wind and TPW observations included, and (3) "No WindSat", with no WindSat wind and TPW observations. To create synthetic TC observations for the data denial experiments, best track TC positions, motion vectors, and intensities re-derived by JTWC without the use of WindSat and scatterometer data were used. The study results indicate that the assimilation of WindSat observations and/or the scatterometer OSWVs do not have significant impacts on the NOGAPS global model extratropical forecasts or TC track forecasts, or the COAMPS-TC mesoscale track and intensity forecasts. This result is not unexpected since the WindSat provides only a small fraction of assimilated observations (e.g., only ~0.3% of the total observations assimilated into NOGAPS). However, it is noteworthy that without the assimilation of WindSat and scatterometer observations, Tropical Storm Krovanh erroneously vanished in several COAMPS-TC forecasts.

The assessment of the impact of WindSat observations on real-time operational monitoring and warnings at the Joint Typhoon Warning Center (JTWC) revealed that when ocean surface wind vectors are "withheld" ("No SCAT" and "No WindSat" scenarios), there was a consistent overestimation of the intensity of tropical systems in their early stages compared with the analysis of best-tracks, and a tendency to declare systems to be tropical depressions and/or tropical storms too soon. In other words, if ocean surface wind vector data sets are not available, OVERWARNING occurs in the Western Pacific basin.
(Melinda Peng, Naval Research Laboratory, Monterey, CA)

Aerosol Optical Depth Assimilation

In the past year, NCAR, supported by the Air Force Weather Agency (AFWA), has developed the capability of assimilating the MODIS aerosol optical depth (AOD) retrieval product with the NCEP Gridpoint Statistical Interpolation (GSI) three-dimensional variational (3DVAR) data assimilation system. The aerosol analyses are used to initialize Weather Research and Forecasting/Chemistry (WRF/Chem) model forecasts. This newly developed capability allows the direct analysis of 3D mass concentration of 14 GOCART (Goddard Chemistry Aerosol Radiation and Transport) aerosol types by assimilating MODIS level-2 (10 km x 10 km) total AOD at 0.55 μm.



Hourly time series of AOD at 1020 nm from 0000 UTC 17 to 0600 UTC 24 March 2010, at Nanjing and Kathmandu AERONET sites. Red line denotes the AERONET observations, and blue (green) curves represent the DA (noDA) experiments, respectively.

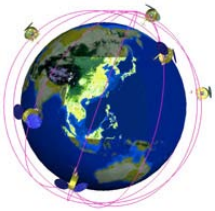
AOD is a measure of the attenuation of solar radiation and depends on the amount, and physical and radiative properties, of the aerosols. The JCSDA's Community Radiative Transfer Model (CRTM), which was originally designed for radiance data assimilation, was extended to calculate AOD from the vertical profile of aerosol concentrations and integrated into the GSI observation operator for AOD data assimilation purpose.

Experiments with and without the AOD DA have been conducted to evaluate the impact of AOD observations on the aerosol analyses and forecasts of a dust storm period (0000 UTC 17 ~ 0000 UTC 24, March 2010) over East Asia. Prior to running the AOD DA experiment, the corresponding background error covariance (BEC) statistics of 14 aerosol species were obtained using the traditional "NMC" method, in which the difference of 24-hr and 12-hr WRF/Chem aerosol forecasts valid at the same time are used to compute BEC statistics. For the experiment without the AOD DA, aerosol fields are produced by continuous WRF/Chem forecasts driven by GFS meteorological fields and the surface emissions. In the AOD DA experiment,

aerosol fields are updated at 0000 and 0600 UTC (daytime), when the MODIS provides coverage over East Asia.

Some results from the experiments are shown in the figure, which compares the hourly WRF/Chem model output to independent surface AOD (1020 nm) observations at two AErosol RObotic NETwork (AERONET) sites – Nanjing, China and Kathmandu, Nepal – for the experimental period. The noDA (green line) AOD markedly underestimates the AERONET AOD (red line). The AOD values from the DA experiment (blue line) agree much more closely with the AERONET observations. Maximum dust intensity on March 21st in Nanjing was well captured by the AOD DA experiment. For the Kathmandu site, which was unaffected by the dust storm, the diurnal variation of AOD in the AERONET observations, which is replicated by the DA experiment, likely reflects diurnal changes in traffic from the morning to evening.

The developed AOD assimilation method can be expanded to assimilate additional aerosol-related observations (e.g., surface measurements of particle matter, multi-spectral and multi-angle AOD retrievals from different satellite instruments, vertical extinction profiles from ground-based and space-borne Lidar etc.). Moreover, the 3DVAR approach adopted here permits simultaneous assimilation of aerosol-related data and meteorological observations typically assimilated by the GSI system.
(Zhiquan Liu, NCAR, and Jeffrey D. Cetola, Air Force Weather Agency)



Cosmic Corner:

The 2nd workshop of the Coordination Group for Meteorological Satellites (CGMS) "International Radio Occultation Working Group" (IROWG-2) will be held at The Stanley Hotel in Estes Park, CO, USA from **28th March to 3rd April 2012** together with the UCAR/COSMIC Workshop on GPS-RO Data Processing for Climate Applications. If you are interested in receiving information and details regarding this workshop, please be sure to pre-register on the IROWG mailing list by sending an email to: irowglist-subscribe@irowg.org

The workshop will cover all aspects of GPS-RO. In addition, contributions from research into LEO-LEO occultations and atmospheric ground based GPS observations are also encouraged. The format of the workshop will follow that of other CGMS working groups: a combination of talks, posters, and sub-working group discussions. These sub-groups will develop recommendations that could be relevant to CGMS, to the RO community, or to providers of RO data. The recommendations and findings of the sub-groups will be presented to and discussed with all participants. Sub-groups will include, but are not limited to: (1) Numerical Weather Prediction; (2) Climate; (3) Research to Operations; (4) Payload Technology; (5) Innovative Occultation Techniques; (6) Space Weather. A finalized version of the main recommendations by the sub-groups will be presented to CGMS.

Further information on the IROWG is available at http://www.irowg.org and on CGMS at http://www.cgms-info.org/.

Information on the location/Stanley Hotel is available at http://www.stanleyhotel.com/.
Co-chairs IROWG: Dave Ector and Axel von Engeln
http://www.irowg.org

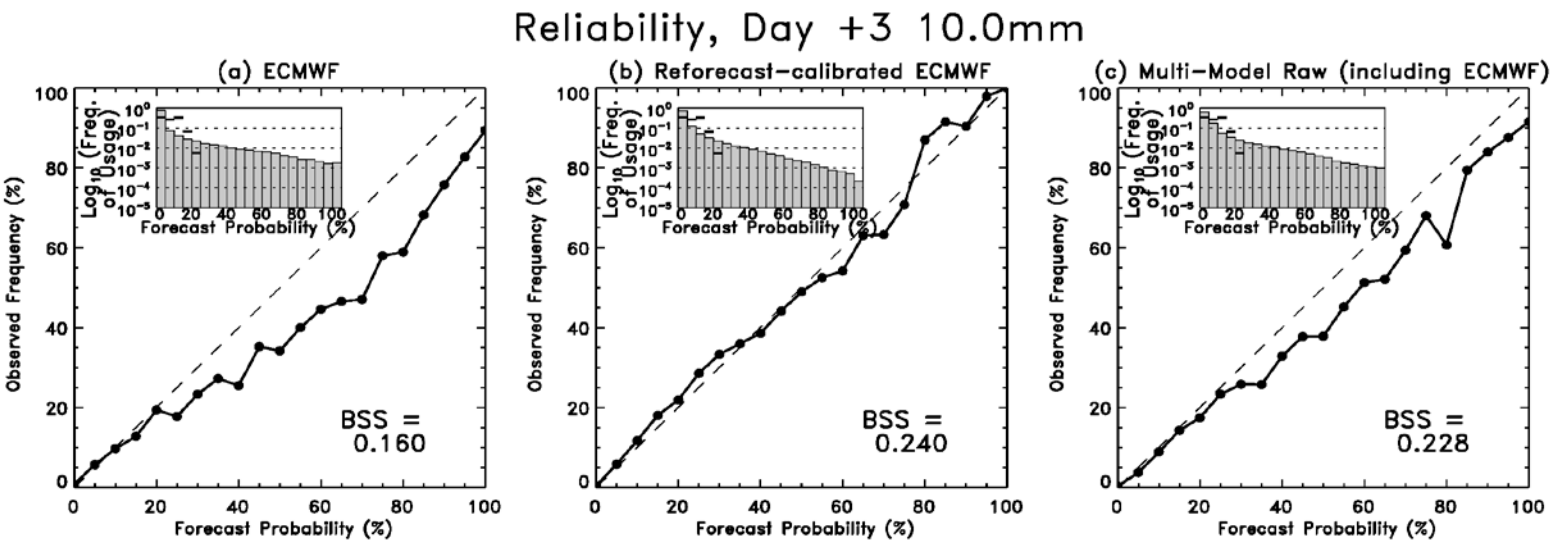
Co-chairs UCAR/COSMIC workshop: Bill Schreiner, Ben Ho, Bill Kuo.
http://www.cosmic.ucar.edu
(Lidia Cucurull, JCSDA)

Improving Probabilistic Precipitation Forecasts with Multi-Model Ensembles and Reforecasts

Ideally, a single-model ensemble prediction system like the NCEP Global Ensemble Forecast System (GEFS) should be able to produce probabilistic forecasts that are reliable. That is, the event occurred on average X percent of the time over all the situations when an X percent probability was forecast. At the same time, the probability forecast should be as "sharp" as possible (i.e., more 0% and 100% probabilities rather than probabilities near the climatological event frequency). Two ensemble research issues need to be attacked to produce such a reliable, sharp ensemble: (a) the ensemble of initial conditions must properly sample the distribution of plausible analysis states (see previous NOAA THORPEX contributions to the JCSDA newsletter on the ensemble Kalman filter and the hybridization with the variational analysis system), and (b) the uncertainty introduced by model imperfections, such as finite resolution and the use of deterministic parameterizations, must be addressed.

Here, this second issue, the "model uncertainty," is considered in more depth. There are many potential ways to address this. These might include improving the forecast model through increasing its resolution and/or incorporating physically based stochastic parameterizations. More ad-hoc methods might include using multi-model ensembles or applying post-processing to the ensemble system using the discrepancies noted between past forecasts (reforecasts) and observations.

In recent work at NOAA/Earth System Research Laboratory, these last two options were explored for probabilistic precipitation forecasts during Jun-Oct 2010. Multi-model ensemble forecasts (ECMWF, NCEP,



Reliability diagrams for day +3 forecasts from (a) the ECMWF ensemble system, (b) ECMWF forecasts post-processed using reforecasts, and (c) a multi-model ensemble. Inset histogram (log scale) provides the frequency with which each forecast was issued. Brier skill scores (the higher the score, the better the forecast) for the forecasts are noted in the lower right-hand corner of each panel.

Canadian Meteorological Center, and UK Met Office) were examined over the conterminous U.S. (CONUS) and compared against the forecasts from the individual centers as well as against a reforecast-calibrated ECMWF forecast product. Precipitation analyses at 1-degree over the CONUS were used for verification. The Brier Skill Score, which measures the improvement of the probabilistic forecasts relative to a forecast based on the sample climatology, was used as the measure of skill. Both the multi-model and the reforecast-calibrated products improved the skill significantly with respect to the skill of forecasts from the individual centers. The multi-model technique improved reliability significantly while maintaining relatively sharp forecasts. The figure shows that the reforecast-calibrated ECMWF product improved reliability, but decreased the forecast sharpness (see inset histograms) relative to the raw ECMWF ensembles. Reforecast improvements to skill were more marginal for light precipitation events, where the forecast was generally reliable, but large for heavier events where the ECMWF system wasn't as reliable.

These results suggest that expanding multi-model ensemble systems such as the NAEFS (North American Ensemble Forecast System, joint between the US and Canada) and calibrating the NCEP forecasts using reforecasts both appear to be viable methods for improving probabilistic precipitation forecast skill. Next year, a 30-year reforecast database will be available for the operational GEFS to facilitate statistical post-processing. For more information, contact tom.hamill@noaa.gov.
(Tom Hamill, NOAA/OAR)

JCSDA Summer Colloquium on Data Assimilation

Santa Fe, New Mexico
July 24 – August 3, 2012
Preliminary Announcement

The NASA/NOAA/DoD Joint Center for Satellite Data Assimilation (JCSDA) is pleased to announce a Summer Colloquium on Data Assimilation in 2012 engaging graduate students and individuals with early postdoctoral appointments in the science of data assimilation for the atmosphere, land, and oceans. The program will include lectures by internationally recognized experts in data assimilation and an opportunity for students to interact with the lecturers in an informal setting. The objective of the program is to foster the education of the next generation of data assimilation scientists.

Colloquium Topics: The following topics will be covered during the Colloquium: Data assimilation fundamentals including variational and ensemble techniques; Satellite data applications including infrared and microwave; Overviews of atmospheric, ocean, and land data assimilation; Overview of the global observing system.

Eligibility: Graduate students who expect to receive their PhD in the physical, environmental, atmospheric or related science prior to June 2012 are invited to apply as well as individuals with no more than two years of postdoctoral experience at the time of the Colloquium. Preference will be given to applicants with US citizenship or permanent residency.

Financial Support: Pending availability of funds, travel support to and from the Colloquium, lodging expenses, and per diem will be provided for the two-week program for number of exceptionally qualified participants. Additional applicants may be invited to participate, but they will need to provide their own financial support.

More detailed information concerning the venue, program, and application and selection process will be posted on the JCSDA Website by November 1, 2011.
(Jim Yoe, JCSDA)

A Note from the Director

We continue to make progress on porting various applications to jibb, the Joint Center computer at the Goddard Space Flight Center, and to its sister platform, the S4 machine operated by the University of Wisconsin for NESDIS/STAR. Several JCSDA investigators have accounts and are using these machines already, and more will follow in the future. We are in the process of doing validation experiments with a copy of the operational NCEP Global Forecast System on jibb, and once the validation has been completed, the JCSDA research community will have access to testing their algorithms and data in the context of a real "operational" system.

High on the list of initial experiments planned for this system is a comprehensive suite of data denial experiments aimed at identifying the respective contributions to forecast skill of the main components of the Global Observing System. This is something that we have not been able to do for several years due to a lack of computer resources, and we hope to have most of these experiments completed in time for the "Fifth WMO Workshop on the Impact of Various Observing Systems". This meeting is organized by the Joint Center for WMO and will be held in Sedona, Arizona, May 22-25, 2012. This will be the first time the workshop is held in North America, and both WMO and we in the Organizing Committee look forward to a strong showing by JCSDA investigators and other US contributors. Assuming that the validation experiments are successful, we plan to show a subset of the data denial experiments specifically focusing on satellite winds at the 11th International Winds Workshop in Auckland, February 20-24, 2012.

In spite of a very difficult budget environment, we remain hopeful that we will be able to roll out an opportunity for external participation in JCSDA research for FY 2012. We continue to work through the administrative details with our DoD partners, and the JCSDA Executive Team continues to work on refining the priority areas that will appear in the solicitation. Even though the wording is far from finalized, all signs indicate that Clouds and Precipitation will be a high priority area this time around.

Finally, we look forward to seeing the NPP satellite up in space later this month. This NASA mission, which was originally intended primarily as a flight demonstration of new instruments to be flown later on NPOESS (now JPSS) has now become even more important to us in its additional role as a quasi-operational gap-filler. The Joint Center is prepared both technically and scientifically to use the data from the new instruments flying on this mission, and we wish the NPP team a successful launch!

Lars Peter Riishojgaard, Director, JCSDA

Outlook for Next Quarter

Upcoming Events

Seminars

JCSDA seminars are generally held on the third Wednesday of each month in Room 707 of the World Weather Building. Presentations are posted at http://www.jcsda.noaa.gov/JCSDASeminars.php prior to each seminar. Off-site personnel may view and listen to the seminars via webcast and conference call. Audio recordings of the seminars are posted at the website the day after the seminar.

Upcoming Seminars

Date	Speaker	Affiliation	Title
October 19, 2011	Robert McCoy	Office of Naval Research	Ionospheric Data Assimilation
December 14, 2011	Tim Schmit	NOAA/NESDIS	The GOES-R Advanced Baseline Imager (ABI)

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

Editor's Note: Unsolicited articles for the JCSDA Quarterly Newsletter are encouraged as are suggestions for seminar speakers or topics. Please send them to George.Ohring@noaa.gov.