JCSDA Quarterly

No. 10, March, 2005

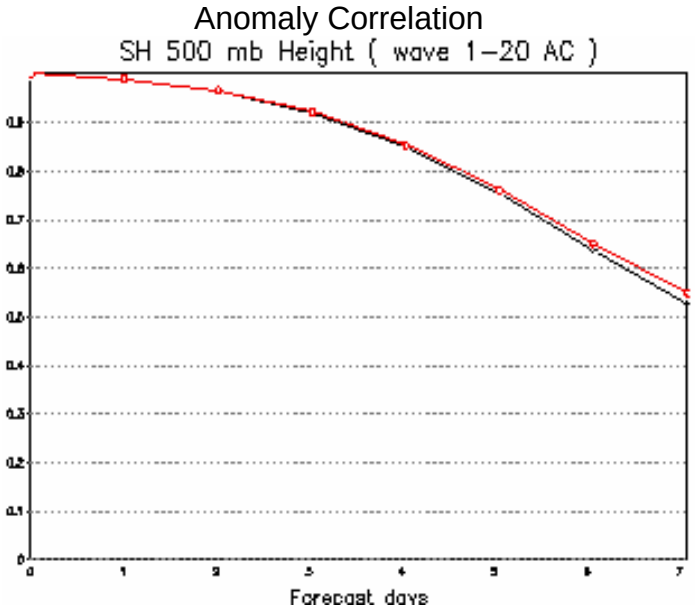
Joint Center for Satellite Data Assimilation • 5200 Auth Road • Camp Springs • MD • 20746 *Editor: George Ohring*

NOAA……..NASA……..US Navy……..US Air Force *Web-site: www.jcsda.noaa.gov*

News in This Quarter

Science Update: Direct Assimilation of SSM/I radiances in NCEP Global Data Assimilation System

Experimental forecasts conducted at the JCSDA indicate that assimilating SSM/I radiances directly – rather than the retrieved products – significantly improves the accuracy and extends the range of useful weather predictions. The accompanying figure shows that the anomaly correlation for the Southern Hemisphere height field increases by about 0.25 (red curve is experimental, black is operational system) at a forecast range of 6-7 days, representing an extension of forecast capability of several hours. Forecast accuracies also increased slightly in the Northern Hemisphere. The experimental forecasts were conducted on a daily basis for the 1 July to 31 August 2004 test period. The operational system includes SSM/I retrievals of precipitation and ocean surface wind speed; the experimental system deletes the SSM/I wind speeds and substitutes SSM/I radiances containing information on wind speed and atmospheric moisture. Quality Control and Bias Correction procedures are crucial for the assimilation, as is accurate screening of clouds/precipitation. This research was performed by JCSDA Visiting Scientist Kozo Okamoto, who returned to Japan on March 30.



International Items

In this issue of the newsletter, we initiate a new column on international items. This column will feature news on satellite data assimilation activities at major international centers. Our first report is from the European Center for Medium-Range Weather Forecasts (ECMWF).

Assimilation of Satellite Data at ECMWF

Over the past years, the importance of satellite data has progressively increased, to the extent that satellite systems now provide the main sources of information for assimilation in the ECMWF forecasting system. Its contribution to forecast skill in the Northern Hemisphere is now clearly more important than that of radiosonde data. In the Southern Hemisphere forecast skill has improved dramatically over the last five to seven years, and is now at a similar level to that of the Northern Hemisphere. This is largely due to enhanced utilization of satellite data with improved data assimilation techniques. Indeed, 4D-Var assimilation system (implemented in November 1997) ensures that observations are used at the appropriate time and in a dynamically consistent way. Recent successes obtained at ECMWF include the operational assimilation of AIRS radiances, the use of water vapor radiances from the global geostationary constellation (including Meteosat Second Generation) and the assimilation of polar winds from MODIS (onboard NASA's TERRA and AQUA). Data counts of the number of processed and actively used data from each of the current satellite systems are given in the Table, for 20050228-00 UTC, for a 12 hour window. It is worth mentioning that the total number of used data from these space-based observing systems (2,273,437) represents about 90% of the total number of used data. It is nevertheless striking that a vast amount of processed satellite observations are currently not assimilated actively (around 98%). While some rejections are perfectly sound (sick instrument, large biases, etc…), most of the rejections are due to inadequacies in the model and/or data assimilation to represent what is actually observed by the instruments.

The challenge that ECMWF is undertaking now is clearly to reduce this massive rejection rate. Moreover, the new generation of IR and MW instruments open new avenues in terms of improved accuracy of "classical" prognostic variables (temperature, moisture, wind) as well as a better description of clouds, rain, aerosols, surface properties and composition of the atmosphere. Areas of current active research in preparation for these future challenges therefore include:

- Consolidation and enhancement of the use of AIRS data and preparation for IASI/CrIS (in the area of data selection, data compression, bias correction and cloud detection)
- Assimilation of radiances (in particular microwave) in presence of rain and clouds)
- More agressive use of satellite radiances over land and sea-ice
- Development of a capability to assimilate limb radiances and radio-occultation bending angles
- Monitoring and assimilation of atmospheric composition (greenhouse gases, reactive gases and aerosols) from satellites
- Assimilation of wind profiles from Doppler Wind Lidar

(Jean-Louis Thepaut, ECMWF)

European Centre for Medium-Range Weather Forecasts

Satellite data used in ECMWF pre-operational tests, for the analysis date 20050228-00 UTC (12h window). The test system will be operational on 5th April 2005.

Spacecraft	Instrument	Total number processed	Number of used data	Measurement
METEOSAT-5	Imager	263,959	26,369	water-vapor clear sky radiances
		167,924	20,688	Atmospheric Motion Vectors
METEOSAT-7	Imager	235,943		water-vapor clear sky radiances
		113,746	13,402	Atmospheric Motion Vectors
METEOSAT-8	Imager	2,242,954	77,271	water-vapor clear sky radiances
		833,578		Atmospheric Motion Vectors
GOES-9	Imager	911,200	43,757	water-vapor clear sky radiances
		51,760	8,934	Atmospheric Motion Vectors
GOES-10	Imager	706,984	26,624	water-vapor clear sky radiances
		230,878	22,810	Atmospheric Motion Vectors
GOES-12	Imager	585,456	9,991	water-vapor clear sky radiances
		142,532	11,982	Atmospheric Motion Vectors
MODIS TERRA	Imager	64,298	3,672	Atmospheric Motion Vectors
MODIS AQUA	Imager	51,020	2,950	Atmospheric Motion Vectors
NOAA-14	HIRS	5,641,613		infrared radiances, temperature and humidity sounding
NOAA-15	HIRS	275,880		as above
NOAA-16	HIRS	6,688,665		as above
NOAA-17	HIRS	6,759,725	105,778	as above
NOAA-14	MSU	75,674		microwave radiances, temperature sounding
NOAA-14	SSU	28,995		stratospheric temperature sounding
NOAA-15	AMSU-A	2,673,505	170,135	microwave radiances, temperature sounding
NOAA-16	AMSU-A	3,414,225	258,576	as above
AQUA	AMSU-A	2,419,290	194,619	as above
NOAA-15	AMSU-B	488,326		microwave radiances, humidity sounding
NOAA-16	AMSU-B	558,071	29,835	as above
NOAA-17	AMSU-B	535,796	28,829	as above
DMSP-13	SSMI	85,876	33,994	microwave radiances, tropospheric humidity
DMSP-14	SSMI	88,431	36,098	as above
DMSP-15	SSMI	88,039	42,472	as above
AQUA	AIRS	52,246,600	972,853	infrared radiances, temperature and humidity sounding
QuikSCAT	Seawinds	243,302	122,456	Near-surface winds over ocean
NOAA-14	SBUV	3,402		ozone layers
NOAA-16	SBUV	4,110	3,882	ozone layers
NOAA-17	SBUV	3,930		ozone layers
ENVISAT	SCIAMACHY	10,495	5,460	total column ozone
ERS-2	GOME	349		total column ozone
Total		**89,764,955**	**2,273,437**	

Meet Megan Dunn

Megan joined the JCSDA in February 2005 as a Visiting Scientist. During her 6-month stay, she will be working with short wave infrared GOES-E winds and MODIS winds derived from tracking atmospheric water vapor and cloud features. In particular, Megan will analyze the errors in the observations, including the problem of determining the heights of the winds, and the impact of assimilating the winds on weather forecasts.

She has a Bachelors degree in Science/Arts (Honors Physics) from La Trobe University in Melbourne, Australia. She spent the last two years working towards her PhD in atmospheric physics at La Trobe University and the Australian Bureau of Meteorology ('Defining atmospheric state using high resolution radiances'). There, she has been investigating observational error characterization, height assignment accuracy, and regional impact of GMS-5 and GOES-9 atmospheric motion vectors.

Global Atmospheric Research Programme
THORPEX

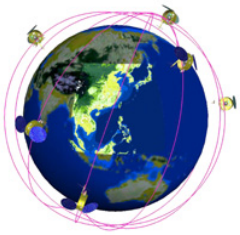
Between 1-4 March 2005, THe Observing System and Predictabilty EXperiment (THORPEX) organized a meeting, held at the European Center for Medium Range Forecasts (ECMWF) in Reading, England, to discuss plans related to the sharing of ensemble weather forecast and related data among operational Numerical Weather Prediction (NWP) centers and interested researchers. The purpose of the activities is the creation of a comprehensive database, called the THORPEX Interactive Grand Global Ensemble (TIGGE) that allows researchers access to all available ensemble forecast data. This will accelerate research and development activities related to the use of multi-center ensemble forecast techniques where weather forecast products are developed based on ensemble forecasts from different NWP centers. Potential applications, beyond 1-14 day weather forecasting, include data assimilation and adaptive observations.

The new techniques and procedures developed through TIGGE-related research will be shared among all participants and will eventually be used in operations, such as the North American Ensemble Forecast System (NAEFS). The NAEFS was developed by the weather services of Canada, Mexico, and the USA, and can be considered as a prototype operational multi-center ensemble forecast system. The NAEFS is expected to expand, and will be renamed, to include more NWP centers that will cooperate at a new level to ensure that the weather forecasting capabilities of the participating countries will be used to their full potential for the provision of early warnings of high impact weather across the globe, as part of a new Global Interactive Forecast System (GIFS).

THORPEX is a 10-year long World Weather Research Program (WWRP) developed under the auspices of the World Meteorological Organization (WMO) with the objective of accelerating improvements in the quality and utility of high societal impact weather forecasts over the 1-14 days time range.

(Zoltan Toth, NWS)

Cosmic Corner



A mini-retreat on the Constellation of Satellites for Meteorology, Ionosphere, and Climate (COSMIC) was held in Boulder, CO on March 9-10, 2005. JCSDA staff including J. LeMarshall, L. Cucurull, M. Lohmann, and J. Yoe met with UCAR staff and reviewed status of launch preparation and the ground system development in addition to data assimilation issues. Although much work remains to prepare for launch, no serious deficiencies were identified. The "end-to-end" refractivity assimilation test will be complete this spring. It was agreed that the non-local bending angle operator now being developed at UCAR should be adapted for testing and use in the NCEP operational system. Extensive quality control results were presented. It was noted that some of these are receiver specific (for CHAMP) and will need to be revisited after COSMIC Launch in December 2005. Plans for subsequent meetings were made, including one in April, 2005 to consider how to incorporate preparation for a follow-on operational GPSRO constellation into NOAA's long-tern planning process, and for a GPSRO data assimilation workshop to be held in the Washington, DC area in August 2005.

(Jim Yoe, NESDIS)

Directed Research Announcement

The JCSDA has selected 12 proposals for funding in response to the NESDIS JCSDA 2005 Directed Research Announcement. The program supports Internal Investigators at NESDIS, NWS, OAR and the NESDIS cooperative institutes

who are conducting research on near-term payoffs in transition of research to operations.

AIRS Paper in AGU Publication

A short paper summarizing the positive results of JCSDA's experimental forecasts assimilating NASA's Atmospheric Infrared Sounder (AIRS) has been published in the 15 March issue of EOS, Transactions, American Geophysical Union.

Outlook for Next Quarter

Cloud/Precipitation Workshop

The JCSDA international workshop on the *Assimilation of Satellite Observations of Clouds and Precipitation in NWP Models* will be held at the National Conference Center, Lansdowne, VA, about 12 miles from Dulles airport, May 2-4, 2005. To date, assimilation of satellite measurements has focused on the clear atmosphere. But satellite observations in the visible, infrared, and microwave provide a great deal of information on clouds and precipitation. The issue is how to use this information to improve the initialization of clouds and precipitation in models. Since clouds and precipitation often occur in sensitive regions for forecast impacts, such improvements are likely necessary for continuing significant gains in weather forecasting. The workshop will bring together invited experts in: cloud/precipitation remote sensing, radiative transfer in cloudy or precipitating atmospheres, modeling clouds and precipitation, and assimilating cloud and precipitation observations. They will critically review the state of the art in these fields and develop findings and recommendations for accelerating progress in assimilating the observations of clouds and precipitation.

JCSDA 3rd Workshop on Satellite Data Assimilation

Some 30 scientists working on research projects sponsored by the JCSDA, and the JCSDA management team will converge on JCSDA Headquarters in Camp Springs, MD, on April 20-21, 2005. They will report on and review ongoing and proposed scientific developments, and plan and coordinate future efforts.

JCSDA 3rd Annual Meeting of Science Steering Committee

The JCSDA Scientific Steering Committee (SSC) will meet at the Earth System Science Interdisciplinary Center at the University of Maryland April 26-27, 2005. The SSC provides scientific guidance to the JCSDA Director on proposals submitted to the JCSDA for scientific projects. The Committee also reviews JCSDA scientific priorities and projects annually and provides a report to the JCSDA management. The SSC is chaired by Paul Menzel, NOAA/NESDIS Cooperative Institute for Satellite Meteorological Studies, and includes members from the major national and international NWP research groups and operational centers.

Upcoming JCSDA Seminars

JCSDA Seminars			
Date	**Speaker**	**Affiliation**	**Title**
4/19/05	David J. Lary	UMBC	Automatic Code Generation, Documentation, Web Site Creation, Neurological Code Acceleration and Optimized Earth Observation
5/18/05	Steve Mango	IPO-NPOESS	NPP and NPOESS

Suggestions for speakers and topics are always welcome: please send them to george.ohring@noaa.gov. Copies of seminar presentations are posted on the JCDA web-site www.jcsda.noaa.gov

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