

2.3 THE USE OF TOVS/ATOVS IN DATA ASSIMILATION/ NUMERICAL WEATHER PREDICTION (DA/NWP)

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2.3.1 Introduction

There were many substantive presentations at this meeting that indicated very positive results using satellite data from different instruments. The trend towards the use of level 1b sounder and imager radiances has continued with almost all centres now using or preparing to use radiances. OSEs presented at this meeting demonstrate that satellite data has an extremely important impact on weather forecasting and promising new results suggest the potential for future enhancements in the use of satellite sounder and imager data. The microwave and infrared sounding data continues to have a very large impact and it is important that future instruments as a baseline maintain, and if cost effective improve upon, the quality of AMSU and AIRS.

Since the last meeting most operational centres are now assimilating AIRS data, and several of the centres are working intensively on SSMIS data. Substantial effort has been directed towards correcting and/or flagging incorrect SSMIS data resulting from instrument problems. Use of the flagged/corrected SSMIS has given a small positive impact in the Southern Hemisphere and as a result the data has been implemented operationally at the Met Office. However, results in the Northern Hemisphere have not been as good. Further correction/screening of the data appears to be necessary.

Initial radiative transfer experiments including the effects of clouds indicate further progress has been made towards the potential future assimilation of cloudy radiances. These results indicate that radiative transfer models are now sufficiently accurate to begin the development of theoretically sound assimilation systems for clouds and precipitation. While significant progress has been made, the inclusion of clouds and precipitation remains a very difficult data assimilation problem and developments will be ongoing over at least the next 5 years.

At this ITSC meeting, there were several presentations by groups describing their development and enhancement of radiance bias correction schemes. There was an increase in the number of centres using or working towards use of variational bias correction. We believe that much of this development has been spurred by the ECMWF bias correction workshop last year. The group is supportive of the efforts directed towards this important problem.

2.3.2 Evaluation and use of TOVS/ATOVS in Data Assimilation/NWP

The use of satellite data remains very dependent on the monitoring and evaluation procedures for the satellite data. Prior to the use of the data, it is important to diagnose the significant biases between background and radiances which still remain. After implementation, monitoring is necessary to ensure that changes to the data or data assimilation system do not adversely affect the results. Many difficulties have been diagnosed and resolved by monitoring procedures. As more and more centres get involved in radiance data assimilation, better coordination of the monitoring procedures and more documentation, particularly on the bias correction method should be exchanged between the various data assimilation groups. The group continues to encourage the development and documentation of monitoring procedures as part of any centre's analysis procedure and to post monitoring results and documentation on their external Web site.

The group acknowledged the continued excellent support to users of AIRS data. The very detailed information distributed and the response to users when possible anomalies are spotted has been very helpful. The group would like to see support, similar to that provided for AIRS, for other current and future missions.

Recommendation DA/NWP-1 to satellite agencies

The Working Group feels that the notification of users about significant changes to current and future observation systems has not been sufficient. For example, information concerning the turning on of the RADCAL instrument on the DMSP F-15 satellite was not communicated quickly enough to the users to react. Also the cancellation of the HES instrument was not widely advertised. Early communication of these decisions is necessary for planning and preparation by the NWP community

The Working Group noted that a new email list server has been established for exchange of information on ATOVS data quality issues and also discussion of other topics relevant to the NWP WG. The address is itwg_nwp@metoffice.gov.uk and the administrator for the list is Stephen English.

Action DA/NWP-1

All members of the Working Group to examine the mail list for missing e-mail addresses. Steve English to maintain and update the e-mail list.

Action DA/NWP-2

NWP WG Co-Chairs to ask developers of software packages (e.g., JCSDA and NWPSAF) to announce new software releases on the ITWG mailing list.

The results of the ITWG survey presented at this meeting and reproduced in the Table 2.3-1 below, indicate that the NWP community still has an operational requirement for NOAA/NESDIS ATOVS data processing from instrument counts to calibrated radiances, preprocessed radiances and through to retrieved products. The group again wished to recognize the effort of Tony McNally (ECMWF) for coordinating the survey and to all centres that responded.

Table 2.3-1. Use of satellite data in operational NWP (ITWG survey of systems at 01/10/06)

<i>Institute</i>	Retrievals In Global NWP	Retrievals in Regional NWP	Radiances in Global NWP	Radiances in Regional NWP	external WWW DATA MON
Australia	NESDIS	NESDIS	YES-PP (1DVAR)	YES-PP (1DVAR)	
Canada (CMC)			YES – 1C (4DVAR)	YES – 1C (3DVAR)	YES (p-w)
ECMWF			YES – 1C (4DVAR)		YES
France			YES – 1C (4DVAR)	YES – 1C (3DVAR)	YES (p-w)
Germany			YES – PP (1DVAR)		YES
Hungary				YES – 1C (3DVAR)	
<i>India</i>	<i>NESDIS</i>				
Japan		NESDIS/JMA	YES – 1C (4DVAR)		
Korea			<i>YES – PP</i> (3DVAR)		
Spain				<i>YES – 1C</i> (3DVAR)	
Sweden				YES – 1C (3DVAR)	YES
UK			YES – 1C (4DVAR)	YES – 1C (4DVAR)	YES
USA (NCEP)			YES – 1C (3D SSI)	YES – 1C (3D GSI)	YES
USA (NRL)	NESDIS	NESDIS	YES – 1C (3DVAR)		YES

Notes

1) In the above table “1C” means that calibrated but unprocessed radiances are used. “PP” means processed radiances from NESDIS are used.

2) There is still a very limited use of tropospheric data (radiances or retrievals) over land and ice. This is true for both microwave and infrared.

3) *Where both the use of radiances and retrievals are used this generally means that some part of the retrievals (such as above the model top) are used to improve the usage of the radiances.*

4) *The responses from each NWP centre have provided much more information than is presented here and will be made available in full to all interested parties (hopefully on the ITWG Web site).*

5) *Responses in italics represent a carry over from the previous survey since no response was received prior to this meeting.*

Action DA/NWP-3 (open from ITSC-XIV)

Tony McNally to provide information from the ITWG NWP survey on the ITWG NWP group Web pages and if possible to allow updating as operational systems change.

2.3.3 Evaluation and use of other sounding instruments in NWP

The group agreed NESDIS should be congratulated for the past activity in providing AIRS data and be encouraged to continue with the current activity to provide clear fields of view in thinned data sets available to the operational community. The group discussed options for improved exploitation of AIRS, including new datasets. It was agreed that coordination was necessary in switching from the existing operational dataset to new datasets and that more evaluation of products using MODIS for cloud detection was required. There are two datasets using MODIS data to support use of AIRS:

1. The AIRS-MODIS dataset is an AIRS spatially thinned dataset where MODIS has been used to select the field of view most likely to be cloud-free. Its format is identical to the existing AIRS warmest field of view and AIRS central field of view datasets.

2. The MODIS BUFR dataset has products derived from MODIS on each AIRS field of view e.g., standard deviation of MODIS 11micron brightness temperature.

It was also noted that more work is required on developing and testing methods which aim to allow the full spectral information to be used efficiently.

Action DA/NWP-4

Walter Wolf to email content and format of MODIS BUFR dataset to ITWG NWP mailing list for comment.

Action DA/NWP-5

Walter Wolf to provide AIRS MODIS dataset and MODIS BUFR dataset as soon as possible on NOAA server.

Action DA/NWP-6

NWP centres to evaluate both MODIS datasets.

The group welcomed the on-going effort on correcting SSMIS data streams but noted that at present there are several different versions with different anomaly correction methods. Bill Bell (Met Office) will visit NRL in spring 2007 with a goal of developing a single agreed best processing method.

Recommendation DA/NWP-2 to SSMIS user community

The WG encourages development and implementation of a single SSMIS data correction and selection method.

Action DA/NWP-7

NRL, Met Office and NESDIS to participate in and report the results of unification of operational SSMIS processing, calibration (including corrections applied going from antenna temperatures to brightness temperatures) and distribution by April 2007.

Action DA/NWP-8

Nancy Baker to report on DMSP-F17 cal/val and data distribution plans.

Recommendation DA/NWP-3 to science community (also AS-6)

The group encourages research into investigating some of the theoretical benefits of a combined microwave imager sounder (for example, it may help with assimilation over difficult emissivity surfaces) relative to the conventional cross-track scanning sounders.

2.3.4 Forward modelling

The WG welcomed the work towards integrating RTTOV into the CRTM. This will allow good comparisons between the two systems and enhancement of both.

Recommendation DA/NWP-4 to NWPSAF and JCSDA.

Continue on going collaboration on RT development and report on progress to ITWG.

Action DA/NWP-9

NWP WG Co-Chairs to ask Roger Saunders and Paul van Delst to circulate report to NWP WG mailing list and to present at next ITSC.

Surface emissivity estimation remains an important problem and the activities in this area at the JCSDA and the NWPSAF are also welcomed.

2.3.5 Observing systems and real time access to data

As the use of satellite data matures, the design of observing systems, availability of data, procedures for introducing new data sources and how the data is delivered continue to be major sources of concern for operational NWP centres. The group recognizes that the inclusion of NWP early on in the preparation for AIRS data was a positive step, and encourages future satellite programs to have similar plans. For the SSMIS data the operational NWP community was not included in the early stages of the evaluation, although a productive level of cooperation was achieved at a later stage of the cal/val process.

It has been an ongoing concern of the group that a significant portion of the observations arrive too late for complete inclusion in the data assimilation systems. The operational centres are under pressure to shorten the delivery times of their forecasts to the users and thus are shortening their cut-off times for data delivery. Also, a significant increase in the use of satellite data in limited area models has been noted. These limited area systems often have shorter time requirements than global systems. Two encouraging advances have been noted. The significant improvement in the expected delivery time for the NPOESS satellites (20-30min) and the creation of the RARS (e.g., EARS, SA-RARS, AP-RARS) system should both allow a significant improvement in the availability of data. The creation of the RARS system has been particularly innovative in providing a low cost system to significantly reduce delivery times of the data. The NWPSAF currently monitors consistency of EARS data compared to NESDIS global 1B data. Similar monitoring will be desirable for the SA-RARS and AP-RARS data.

Recommendation DA/NWP-5 to WMO

Continue to support fast delivery initiatives (e.g., RARS), extending this where possible (e.g. Hawaii). However, the group believes that the system should continue to be low-cost. Extension of RARS towards complete global coverage is encouraged until the point is reached where further improvements are no longer cost effective.

Action DA/NWP-10

NWP WG Co-Chairs to bring recommendation DA/NWP-5 to the attention of WMO.

Recommendation DA/NWP-6 to IPO

The short operational delivery time of NPOESS data to NWP centres is an extremely attractive component of the system design. The group would like to ensure that this component be retained in the restructuring of the NPOESS program.

Action DA/NWP-11

John Derber to ask JCSDA and NESDIS to present recommendation DA/NWP-6 to IPO.

The use of research satellites in operational NWP centres has been increasing. The group strongly welcomed the inclusion of research satellites in the global observing system as a very positive step forward. The availability of research data (e.g., the high spectral resolution data from AIRS) has allowed the NWP centres to develop techniques to use the data more quickly and allowing the monitoring components of the system to feed back to the instrument scientists. However, the group noted there continues to be development of satellite programs with limited or no real time access to the data.

The managers of new satellites and satellite programs have often been reluctant to allow outside users to access the data until it has been completely proven. However, NWP centres often have access to data, algorithms and monitoring capabilities which are unavailable to the satellite programs. This makes the NWP centres ideal partners in the initial evaluation process and allows them to begin early development of the infrastructure necessary to use the data.

Recommendation DA/NWP-7 to all satellite agencies

Operational NWP centres to be part of the early cal/val operation for future missions and to receive near real time data before final quality of the data has been established.

Action DA/NWP-12

John Derber and Stephen English to ask ITWG Co-Chairs to ensure recommendation DA/NWP-7 is conveyed to all satellite agencies and operational NWP centres via appropriate international bodies (e.g., CGMS).

The group welcomed the continuation of the “TOVS” heritage through future missions. The group reaffirmed the statement from past meetings that the positive impact of this data on NWP will be largest if satellite agencies choose complementary overpass times which optimize the data coverage.

Recommendation DA/NWP-8 to space agencies

A three orbit system (ideally equally separated) of microwave and IR polar orbiting instruments has been shown to produce positive impact over a two orbit system. The group recommends consideration of a three orbit system containing state of the art microwave and IR sounders in each orbit.

Action DA/NWP-13

NWP WG Co-Chairs to pass recommendation DA/NWP-8 to WMO and space agencies.

The WG discussed data distribution for NPP and MetOp products and welcomed the developments for direct broadcast data for both satellites. Whilst the policy for GTS products is clear, the group needs more information on the policy for distribution of non-GTS products. The international distribution policy for the NPP satellite is currently unspecified.

Action DA/NWP-14 (open action from ITSC-XIV)

John LeMarshall to ensure establishment of the NPP non-GTS data distribution policy for countries outside the United States and report to the WG.

The WG considered it important that NWP centres have a system which easily allows comparison of monitoring results from various centres. Thomas Auligné has proposed and circulated a monitoring strategy for IASI to various NWP centres. Currently, several centres have agreed to adopt this strategy.

Action DA/NWP-15

Thomas Auligné and Tony McNally to propose a method for communicating a subset of the monitoring for IASI and set up a system for producing a Web-based display of participating centres results. The proposal will be sent to WG members for suggestions and approval through the NWP WG mailing list.

2.3.6 Other data assimilation issues

The geostationary orbit is useful for observing rapidly changing features of the atmosphere. The HES IR sounder has recently been cancelled on the GOES-R platform.

Recommendation DA/NWP-9 to satellite agencies and WMO

The WG encourages research and operational satellite agencies to work together towards developing the next generation of operational satellites.

Action DA/NWP-16

NWP WG Co-Chairs to pass recommendation DA/NWP-9 to WMO and space agencies.

Action DA/NWP-17

John Derber and Stephen English to ask ITWG Co-Chairs to ensure recommendation DA/NWP-9 is conveyed to all satellite agencies via appropriate international bodies (e.g., CGMS).

Recommendation DA/NWP-10 to satellite agencies and WMO

The geostationary orbit is ideal for observing the rapidly changing components of the atmospheric fields. The WG recommends the development of a demonstration system observing with high spectral resolution IR and/or microwave instruments. Ideally if both missions are possible the microwave and IR instruments should observe the same portion of the atmosphere at the same time.

Action DA/NWP-18

NWP WG Co-Chairs to pass recommendation DA/NWP-10 to WMO and space agencies.

Recommendation DA/NWP-11 to satellite agencies and WMO

Conical microwave imagers have a well established role in NWP which the WG wished to continue. The WG expressed concern that there could be a loss of continuity in microwave imagery in the NPOESS era.

Action DA/NWP-19

NWP WG Co-Chairs to pass recommendation DA/NWP-11 to WMO and space agencies.

Observing system design is the key to having a well observed atmosphere for use in NWP. Many of the decisions concerning the observing system are often made with little or no scientific evidence. This design information is extremely important for agencies to make cost-effective well thought out decisions.

Recommendation DA/NWP-12 to satellite agencies and NWP centres

The WG would like to encourage the development of an international effort directed towards improving the observing system design. The EUCOS (EUMETNET Composite Observing System) is an example. OSSEs are one tool that can be used for the observing system design problem; however, they must be done very carefully to ensure that they are unbiased and properly estimate the impact of new observing systems.

Action DA/NWP-20

John Derber will distribute an initial template for OSSE experiments to the WG for comment and enhancement.

2.3.7 ITWG NWP WG administration issues

The WG expressed a strong desire to provide a useful Web page under ITWG. The Working Group notes the excellent work of Leanne Avila in the establishment of the Web page.

Action DA/NWP-21

NWP WG to continue to update the NWP WG Web page with assistance of Leanne Avila.

Action DA/NWP-22

NWP WG Co-Chairs to review the status of the actions and recommendations in April 2007 and at regular intervals before ITSC-XVI and email a status report to WG members and ITWG Co-Chairs.

Action DA/NWP-23

NWP WG Co-Chairs to solicit ideas through NWP WG mailing list for WG topics 1 month prior to ITSC-XVI.