

## **1. EXECUTIVE SUMMARY**

### **1.1 INTRODUCTION**

The Fourteenth International TOVS Study Conference, ITSC-XIV, was held on the Chinese Meteorological Administration campus in Beijing, China from 25 - 31 May 2005. One hundred and twenty-five participants attended the Conference and provided scientific contributions. Twenty-two countries, and three international organizations were represented: Australia, Austria, Belgium, Brazil, Canada, China, Denmark, France, Germany, Hungary, India, Italy, Japan, South Korea, New Zealand, Norway, Poland, Portugal, Sweden, Taiwan, the United Kingdom, the United States of America, ECMWF, EUMETSAT and WMO. This was the largest conference to date in terms of total number of presentations and posters. The conference attendees were able to witness images and products from the successful deployment of the new ATOVS instruments on NOAA-18, which had been launched the previous week.

Most of the meeting was occupied with presentations on a range of issues which included:

- ATOVS radiance and retrieval studies
- ATOVS cloud studies
- Climate applications
- Radiative transfer and surface modelling
- Operational use of ATOVS
- Use of ATOVS in NWP
- Direct reception and software packages
- Preparations for METOP and NPOESS
- Future instruments

There were 77 oral and 80 poster presentations during the conference. An effort was made to reduce the number of oral presentations for this conference compared with ITSC-XIII in order to create a less crowded agenda (which can be found starting on page 63).

Working Groups were formed to consider six key areas for the International TOVS Working Group (ITWG), including Radiative Transfer and Surface Property Modelling; Use of TOVS and ATOVS for Climate Studies; Use of TOVS and ATOVS in Numerical Weather Prediction; Advanced Sounders; International Issues and Future Systems; and Satellite Sounder Science and Products. The Working Groups reviewed recent progress in these areas, made recommendations on key areas of concern and identified items for action. Working Group reviews and recommendations comprise Section 2 of this Report. A summary of the key points are listed below.

During the Conference, a session on Status Reports considered summaries of activities that had taken place since ITSC-XIII. This session also reviewed progress on the Action Items identified by the ITSC-XIII Working Groups. Many of these items formed the basis for further discussion by the Working Groups at ITSC-XIV. Several technical sub groups met during ITSC-XIV to discuss developments and plans concerning specific software packages, shared and in common use in TOVS, ATOVS and Advanced Sounder processing centres. Brief reports on these sub group meetings are recorded in Section 3. Holding the conference in Beijing also allowed the conference participants to learn more about the latest developments in the Chinese meteorological satellite program which is now well advanced after the successful operation of its new generation geostationary satellite, FY-2C.

### **1.2 SUMMARY OF MAJOR CONCLUSIONS**

The ITSC-XIV presentations, Working Group meetings and discussions documented significant gains in many areas and noted areas for future activity. In particular, it noted that:

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1. Two operational NWP centres are now assimilating radiances from the advanced infrared sounder, AIRS, on the EOS Aqua satellite and getting significant positive forecast impacts even though the radiances assimilated are a small fraction of those available. Work is underway to allow a more complete use of the AIRS data (e.g. more channels especially in the shortwave infrared, more data over land, and possibly cloud cleared radiances).
2. A new AIRS dataset containing the warmest field of view in the AMSU-A footprint instead of the central field of view is about to be made available operationally to NWP centres. Tests at ECMWF suggest this dataset allows more AIRS data to enter the analysis. NOAA are about to provide to NWP centres a dataset which uses MODIS to identify the clearest AIRS fields of view.
3. In addition to AIRS, several centres are also assimilating the Aqua AMSU-A radiances to increase the robustness of their systems to possible loss of data from the NOAA constellation.
4. The number of NWP centres using level 1b ATOVS radiances in their variational assimilation systems continues to grow but there are still some centres that rely on the level 2 retrievals provided by NESDIS.
5. Several NWP centres have started using ATOVS radiances from the EUMETSAT Advanced Retransmission Service, EARS, in order to provide more timely data (within 30 minutes) to their NWP models. This was originally envisaged to be for regional models but global models are also benefiting from the improved timeliness of these data.
6. With the success of EARS the group encouraged further initiatives, now being setup to expand the coverage beyond Europe and North America (e.g. RARS), to be implemented.
7. The group also supported plans by the satellite agencies to reduce the delay in the blind orbits for the global dataset by using ground stations closer to the poles.
8. The assimilation of higher resolution ATOVS data in local area models was presented, (e.g. Met Office, HIRLAM) expanding the exploitation of ATOVS data for NWP.
9. The first data from the Microwave Humidity Sounder (MHS) on NOAA-18 was shown during the conference. Although very similar to AMSU-B there are a few minor differences in the instrument characteristics. NWP centres are planning to assimilate NOAA-18 ATOVS data within a few months of its availability.
10. All satellite agencies should be urged to provide their data to NWP centres as part of the cal/val program. Recent experience with SSMI(S) data has once again shown the value of NWP to help diagnose unforeseen instrument characteristics. It is also important to allocate resources for dedicated cal/val campaigns for new sensors using aircraft to measure both in-situ parameters and co-incident radiance measurements.
11. Preparations for the METOP launch in 2006 are well underway. The offer of NESDIS to provide simulated IASI data to NWP centres will help ensure they are prepared for IASI data soon after METOP launch. Only a subset of IASI channels will be available to NWP centres on the GTS and so activities are underway to define the optimal channel subset for NWP applications.
12. Since the last ITSC a second high spectral resolution sounder workshop was held at Ravello, Italy in May 2004 to allow a more detailed discussion of scientific issues related to advanced sounders. These workshops can educate and train young scientists entering the field. Another workshop is planned before the next ITSC.

13. The community software packages for processing locally received ATOVS data have been upgraded to allow data to be processed from NOAA-18. The updates will shortly be available for free distribution to users. This kind of ATOVS processing software has been essential in the use of ATOVS data by the meteorological community.
14. The issue of maintaining consistency between globally processed ATOVS and locally processed ATOVS was discussed and recommendations were made to ensure this is the case for METOP and equivalent NPP/NPOESS sensors.
15. Community software for processing Terra and Aqua locally received data (i.e. AIRS, AMSU-A, HSB, AMSR-E and MODIS) is available for direct broadcast users. The conference discussed plans to provide similar software for the NPP and NPOESS data.
16. The group noted the development of the Community Radiative Transfer Model at the Joint Centre for Satellite Data Assimilation (JCSDA) and encouraged all radiative transfer (RT) modelers to standardize on the interfaces to their models to make it easier for users to incorporate the RT models into their own applications and to facilitate comparisons.
17. Results from an intercomparison of radiative transfer calculations for AIRS co-coordinated by the group were presented. This study will help to quantify the forward model errors for advanced sounders.
18. It was recommended to set up an ITWG surface property modeling sub group to better co-ordinate developments in infrared and microwave surface modeling. It will report to the RT and surface modeling group but may hold its own meetings.
19. Several radiative transfer models for rain affected microwave radiances have been developed and preliminary experiments demonstrating the assimilation of rain affected radiances have begun. This offers a new source of information from satellite data not yet exploited in NWP.
20. As with previous conferences the group reiterated the importance of using more data over land. There were no major advances reported in the use of infrared radiances over land however promising results were presented for the use of more microwave radiances over land.
21. The group was updated about plans for a reference network of radiosonde stations, with additional surface based measurements to ensure the accuracy of the in situ sounding. This reference network has been proposed to the GCOS group in WMO and is planned to be implemented in the next 5 years. The group supported this proposal for climate monitoring applications.
22. The ITWG hosted the satellite frequency co-ordination group meeting, SFCG-24, in September 2004 in Lannion, France. R. Saunders (ITWG Co-chair) gave a presentation to the meeting on the issues of frequency protection for NWP applications. It was noted the RF interference is now evident in all the AMSR-E low frequency bands in spite of some of them being protected.
23. The Working Group noted that WMO and CGMS have developed the Virtual Laboratory for Training in Satellite Meteorology (VL). The ITWG Members were asked to review and provide guidance for the VL material related to ATOVS. The ITWG will establish an outreach and education focal point to serve as liaison between ITWG and the VL focus group.
24. Access to documents describing NPOESS/NPP ground processing and raw data and sensor data records (content and format) still needs to be established to allow review by members of the group. IPO representatives undertook to ensure early release of these documents.

25. The new 10km field of view on the NOAA-18 HIRS will allow comparisons with the 17km field of view on NOAA-16 HIRS in terms of the yield of cloud free radiances. The effect of this field of view difference should be studied to consider the requirement for the field of view size for the CrIS and other advanced sounders.
26. The ITWG noted there are differences between the AMSU and ATMS sounder specifications and recommended studies are undertaken before ITSC-XV to determine the impact of these differences for users. This will provide guidance for specifications for future microwave sounders.
27. The ITWG recommended the Integrated Program Office (IPO) to consider placing NPP into a 1430 UTC ascending orbit (instead of the planned 1030 UTC descending orbit in order to complement the METOP/IASI with NPP/CrIS and to provide continuity with Aqua/AIRS).
28. The ITWG noted and endorsed studies underway that demonstrate the feasibility of a microwave imager/sounder in geostationary orbit.

### **1.3 FUTURE PLANS**

Following the success of the ITSC-XIV meeting in May 2005 the ITWG will continue to inform the ATOVS community of the latest news and developments through its Web site maintained by the University of Wisconsin and the email list server maintained by WMO. In particular, more information suitable for training will be incorporated on to the Web site. A workshop on high spectral resolution sounders is planned to take place during 2005/6. There will be an International Direct Broadcast Conference in Benevento, Italy in October 2005. The NWP Satellite Application Facility is hosting a workshop on radiance bias correction at ECMWF in November 2005. The AIRS radiative transfer model intercomparison sponsored by ITWG will be published. The links with international bodies such as the IRC, WMO and CGMS will be maintained and a report of this meeting will be made to forthcoming IRC and CGMS meetings.

In addition to this ITSC-XIV Working Group Report, the Proceedings for ITSC-XIV from the papers submitted will be provided to attendees and other interested persons on CD-ROM. The oral and poster presentations from ITSC-XIV are already available as pdf files which can be downloaded from the ITWG Web site. The next meeting of the ITWG is planned for Autumn/Winter 2006. Topics of interest will include detailed evaluation of NOAA-18 ATOVS data, initial assessments of METOP data and status of preparations for the NPP launch.

## ACTIONS AND RECOMMENDATIONS

### WORKING GROUP ON RADIATIVE TRANSFER AND SURFACE PROPERTY MODELING

#### ***Action RTSP-1***

RTSP-WG Co-Chairs to add revised version of Table 2.1-1 (see page 18) to RTSP-WG Web site. Revisions listed below to be accomplished by 31 August 2005.

1. Roger Saunders to provide the Web link for the trace gas profile set to add to Table 2.1-1
2. Hal Woolf to put CIMSS data sets on the Web and provide updated information for Table 2.1-1
3. Eva Borbas to provide details of her profile dataset. RTSP-WG Co-Chairs to add entry in Table 2.1-1
4. RTSP-WG Co-Chairs to add a column in Table 2.1-1 indicating data sets the RTSP-WG considers to be standard and only include URLs of datasets we endorse.

#### ***Action RTSP-2***

Fuzhong Weng to inform RTSP-WG when A-train matchup data set is available for RT model validation.

#### ***Action RTSP-3***

Xu Liu to contact MOZART model group for combined (co-located) temperature, humidity and trace gas profile data sets for independent RT validation and provide RTSP-WG Co-Chairs with details of data set availability (actual and planned).

#### ***Action RTSP-4***

Nicole Jaquinet-Husson to document observational datasets available for line-by-line (and fast model) validation and details on how to access these data sets if publically available.

#### ***Action RTSP-5*** (carried forward)

All members of the group to send information on validation datasets to RTSP-WG Co-Chairs who will post this information on the RTSP-WG Web site.

#### ***Action RTSP-6***

Louis Garand to provide his profile interpolation and associated adjoint/TL code to the group.

#### ***Action RTSP-7***

Louis Garand to survey NWP centres to establish the profile interpolation and adjoint techniques they use. The goal is to seek the best code to map Jacobians from RTM levels to NWP model levels (this implies an appropriate design of the forward interpolation routine).

#### ***Action RTSP-8***

Tom Kleespies to co-ordinate with Pascal Brunel and post links to all AVHRR SRFs.

#### ***Action RTSP-9***

Nicole Jacquinet-Husson to provide the updated IASI SRF dataset to the RTSP-WG as soon as it is available.

#### ***Action RTSP-10***

Peter Schluessel will be the point of contact for SRFs for ATOVS on METOP.

#### ***Action RTSP-11***

RTSP-WG Co-Chairs to update RTSP-WG Web page information on AIRS SRF and channel blacklist referred to above.

#### ***Action RTSP-12***

Rolando Rizzi to contact LbL modelers and invite them to provide a summary of LbL model

development status to RTSP-WG Co-Chairs by September 15, 2005. This summary should include model name, version, code access and licensing details, important technical features (including adjoint or analytical Jacobian capability, treatment of scattering) and literature references.

***Action RTSP-13***

RTSP-WG Co-Chairs to add a summary of LbL model information on RTSP-WG Web page by 15 December 2005.

***Recommendation RTSP-1 to RT modellers***

The RTSP-WG recommends that ozone absorption demonstrated to affect the AMSU 183 GHz channels is included in radiative transfer models.

***Action RTSP-14***

Stephen English will provide results of a study quantifying the impact for AMSU and SSMI radiances to the group.

***Recommendation RTSP-2 to spectroscopic database developers***

The RTSP-WG urges spectroscopic database developers to adopt a standard and rigorous version control system for spectroscopic databases.

***Action RTSP-15***

Modellers to provide fast RT model summary including name, version, code access and licensing details, supported instruments, technical features (including FM/TL/AD or analytical Jacobians, scattering properties, variable gases, spectroscopy, training set, generating LbL, vertical discretisation), literature references to RTSP-WG Co-Chairs.

***Action RTSP-16***

RTSP-WG Co-Chairs to add a summary of fast models to RTSP-WG Web page by 15 December 2005.

***Action RTSP-17***

Tom Kleespies and Roger Saunders to collect notes on developing and testing tangent linear and adjoining code and post a summary on the ITWG RTSP-WG Web site.

***Action RTSP-18***

All AIRS RT modellers should facilitate the publication of the intercomparison results without delay.

***Recommendation RTSP-3 to RT modellers***

The RTSP-WG recommends that future RT model validation studies be undertaken when collocated A-train sensor data sets become available.

***Action RTSP-19***

A surface property task group of the RTSP-WG to be set up and co-ordinated by Ben Ruston.

***Recommendation RTSP-4 to RT modellers***

The RTSP-WG recommends standardization of emissivity model interfaces, e.g. within CRTM framework.

***Recommendation RTSP-5 to RT modellers***

The RTSP-WG recommends studies into the relationship between retrieved IR and MW skin temperatures (and retrieved/modelled emissivities).

***Action RTSP-20***

F. Weng and R. Bennartz to summarize recent progress on modeling of radiation in cloudy/precipitating

atmospheres (including discussion of the effects of FOV and 3D cloud structure).

***Action RTSP-21***

RTSP-WG Co-Chairs to review and update RTSP-WG Web pages by 15 December 2005.

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**WORKING GROUP ON TOVS/ATOVS DATA IN CLIMATE**

***Action Climate-1***

John Bates to provide the ITWG Climate WG with further details of the Climate Data Record (CDR) measurement maturity index and include their feedback in the further development of the index.

***Recommendation Climate-1 to agencies/investigators producing climate data records***

It is vital to produce multiple independent climate data records for a given atmospheric parameter or satellite instrument to thoroughly understand the effects of methodological choices and better discern the true climate signal. The ITWG endorses the development of criteria to assess the level of capability and maturity of climate data records by defining a set of 'best practices' that would include criteria such as the multiple independent production of CDRs by different groups and their intercomparison.

***Recommendation Climate-2 to agencies/investigators producing climate data records***

Many CDRs are produced within universities or other science institutions. To provide a continuous treatment and data access of those data sets meeting GCOS climate monitoring requirements, the ITWG climate group recommends continuation of such research efforts as well as the transition of mature products into operational climate activities.

***Recommendation Climate-3 to agencies/investigators producing climate data records***

ITWG endorses activities that lead to a comprehensive analysis of the existing temporal records either by intercomparison in the framework of the GEWEX Radiation Panel (or its successor, the WCRP Observations and Analysis Program) or their use in applications at operational climate centers.

***Action Climate-2***

ITWG Co-Chairs to report Recommendations Climate-1-Climate-3 to GEWEX radiation panel and any responses to these Recommendations to the ITWG Climate WG.

***Recommendation Climate-4 to WMO Coordinator for satellite observations***

Numerous efforts have been made to intercalibrate satellites with each other and against in situ data. Better coordination between relevant agencies and long-term archive and access is required to the various calibration and intercalibration efforts.

***Action Climate-3***

ITWG Co-Chairs to report Recommendation Climate-4 to WMO and response of WMO to this recommendation.

***Recommendation Climate-5 to GCOS/NOAA climate observation requirements WG***

ITWG strongly supports the vision of a reference network that consists of multiple instruments to fully characterize the atmospheric column, providing a continuous rigorous ground truth, which would have benefits not just to the climate community. GCOS/NOAA are encouraged to continue to strongly pursue this vision and coordinate with other relevant bodies.

***Action Climate-4***

Peter Thorne to advertise reports and progress from the GCOS/NOAA workshop series to the ITWG list to permit feedback from the ITWG community to ensure that the needs of the satellite community are incorporated.

***Recommendation Climate-6 to reanalysis centers***

Reanalyses efforts would greatly benefit from undertaking observing system experiments to understand what input data, particularly the start of different observing systems such as TOVS/ATOVS and hyperspectral sounders, affect the analysis system. This will help future reanalyses mitigate these changes in the observing system and better capture long-term behavior free of biases.

***Action Climate-5***

ITWG Co-Chairs to report Recommendation Climate-6 to appropriate reanalysis centers and any responses to recommendation to the ITWG Climate WG.

***Recommendation Climate-7 to space agencies***

Space Agencies should ensure archival of and access to all level 0 data along with any metadata for future use by the climate research and monitoring community.

***Recommendation Climate-8 to satellite archive centers***

Satellite archive centers must ensure the collection, retention, and accessibility of complete and rich metadata. The rich metadata inventory should include compatibility with international standards for metadata and include reference, context, provenance, and integrity information.

***Recommendation Climate-9 to reanalysis groups***

Reanalysis groups should seek to work with the new operational satellite climate centers on the optimal calibration and processing of archival data sets.

***Recommendation Climate-10 to space agencies***

Space Agencies should archive and make easily accessible radiances of all spectral channels available including geographically subsampled data sets.

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**WORKING GROUP ON THE USE OF TOVS/ATOVS IN DATA ASSIMILATION/NUMERICAL WEATHER PREDICTION (DA/NWP)**

***Action DA/NWP-1***

Mitch Goldberg to enquire (through NESDIS) if the same level of detailed real time information which has been provided for AIRS can be replicated for other instruments and similarly the response to user enquiries.

***Action DA/NWP-2***

Mitch Goldberg to provide to the ITWG NWP WG a list identifying the most appropriate contact for instrument problems for each instrument.

***Action DA/NWP-3***

John Le Marshall with ITWG input to facilitate the establishment of a Web page for instrument status (channel by channel being used where appropriate) and ensure this is linked to the ITWG Web page.

***Action DA/NWP-4***

John LeMarshall to ask NWP WG members to provide information to him on their current channel usage for each instrument (used now, used in the past, never used) for input to a summary table which he will put on the ITWG Web page.

***Action DA/NWP-5***

DA/NWP Co-Chairs and Tony McNally to provide information from ITWG NWP survey on ITWG Web page.

***Action DA/NWP-6***

Stephen English (Met Office) and Andrew Collard (ECMWF) to coordinate with NOAA the change to warmest fov over the US-Exeter link.

***Recommendation DA/NWP-1 to ECMWF/Met Office***

ECMWF/Met Office to evaluate AIRS "MODIS" product when it becomes available.

***Action DA/NWP-7***

Thomas Auligné and Stephen English to present recommendation DA/NWP-1 to ECMWF and Met Office for consideration.

***Action DA/NWP-8***

John LeMarshall to ask JCSDA to review AIRS 324 channel data set in light of full spectral resolution experiments and recommend any promising additions.

***Recommendation DA/NWP-2 to NOAA***

Add more MODIS cloud information on AIRS FOVS using existing AIRS BUFR tables rather than additional parameters.

***Action DA/NWP-9***

John LeMarshall to present recommendation DA/NWP-2 to NOAA, providing full details of what is required in consultation with the WG members.

***Recommendation DA/NWP-3 to all RT model developers***

Where possible use an existing interface (e.g. CRTM, RTTOV) for new models.

***Action DA/NWP-10***

Stephen English to ask Roger Saunders to communicate recommendation DA/NWP-3 to the wider RT development community.

***Recommendation DA/NWP-4 to JCSDA (Paul van Delst) and NWP-SAF (Roger Saunders)***

To work towards the same interface for CRTM and RTTOV.

***Action DA/NWP-11***

Stephen English to present recommendation DA/NWP-4 to the NWP SAF SG.

***Action DA/NWP-12***

John LeMarshall to present recommendation DA/NWP-4 to the JCSDA SG.

***Recommendation DA/NWP-5 to NWP SAF (Stephen English)***

To provide information to RTTOV users on sources of emissivity information and emissivity models.

***Action DA/NWP-13***

Stephen English to discuss with NWP SAF SG whether recommendation DA/NWP-5 can be undertaken by the NWP SAF.

***Recommendation DA/NWP-6 to CGMS***

Continue to support fast delivery initiatives (EARS, RARS), extending where possible (e.g. Hawaii).

***Action DA/NWP-14***

Stephen English to communicate recommendation DA/NWP-6 to EUMETSAT and to ask John Eyre to bring it to the attention of WMO and CGMS.

***Recommendation DA/NWP-7 to NOAA***

To use new global ground stations to mitigate blind orbit problems for NPOESS data.

***Action DA/NWP-15***

John LeMarshall to present recommendation DA/NWP-7 to NOAA.

***Recommendation DA/NWP-8 to all satellite agencies***

The assimilation community (all major NWP centres) to be part of the 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-16***

John LeMarshall and Stephen English to ask ITWG Co-Chairs to ensure recommendation DA/NWP-8 is conveyed to all satellite agencies via appropriate international bodies (e.g. CGMS).

***Recommendation DA/NWP-9 to all satellite agencies***

While current operational practice and very considerable benefits are based mainly on the use of microwave data and the longwave and midwave IR components of the hyperspectral frequency range, the potential exists for continued gains to be made through additional application of the shortwave IR component of the spectrum. It is recommended that research addressing the problems of solar contamination and surface emissivity be given enhanced emphasis.

***Action DA/NWP-17***

Stephen English to ask the IASI Sounding Science WG Co-Chairs to note recommendation DA/NWP-9.

***Action DA/NWP-18***

Nancy Baker to get detailed instrument actual performance figures for ATMS and to then study the relative performance of AMSU-A and ATMS through experiments in the NRL NWP system. Note: JCSDA also plans an OSSE using ATMS this year.

***Action DA/NWP-19***

Tom Kleespies to repeat Kleespies & Watts MHS study for ATMS compared to AMSU-A.

***Recommendation DA/NWP-10 to IPO***

To add a 6.7 micron water vapour channel to VIIRS.

***Action DA/NWP-20***

John LeMarshall to present recommendation DA/NWP-10 to the IPO JARG.

***Action DA/NWP-21***

John LeMarshall to establish and report to the WG the NPP and METOP non-GTS data distribution policy for countries outside Europe.

***Action DA/NWP-22***

Thomas Auligné to propose and then circulate a monitoring strategy for IASI to be adopted by all NWP centres, to allow easy comparison of monitoring between centres.

***Action DA/NWP-23***

Stephen English to ask NWP WG members to study the proposal by Andrew Collard for IASI GTS products and provide feedback to Andrew Collard by the end of July 2005 (other IASI GTS questions/comments should be fed to Simon Elliot at EUMETSAT).

***Recommendation DA/NWP-11 to NWP Centres***

NWP centres to provide feedback to NESDIS if NOAA-16 data reception is not acceptable during

NOAA-18 commissioning.

***Action DA/NWP-24***

Stephen English to inform NWP centres of the expected situation for NOAA-16 to NOAA-18 transition and recommendation 14.11.

***Recommendation DA/NWP-12 to EUMETSAT***

EUMETSAT to provide NOAA-15, NOAA-16, NOAA-17, and NOAA-18 HRPT data as part of EARS where possible.

***Action DA/NWP-25***

Stephen English to inform EUMETSAT EARS team of recommendation DA/NWP-12.

***Action DA/NWP-26***

Graeme Kelly to re-advertise details of ECMWF bias correction workshop to ITWG.

***Action DA/NWP-27***

Stephen English to re-advertise existence of NWP SAF Web based guidance on bias correction on NWP SAF Web page to ITWG and to pass on positive feedback about the Web page to the NWP SAF SG.

***Action DA/NWP-28***

Mitch Goldberg to check with CMS (Pascal Brunel) whether NESDIS can provide any information which would allow AAPP processing of HIRS to be even closer to global processing.

***Action DA/NWP-29***

Stephen English to ask NWP WG members to supply him with information on assumed observation errors for radiance assimilation in order to create a summary Web page for the ITWG NWP WG Web page. This can then be updated as and when necessary.

***Action DA/NWP-30***

Stephen English to ask NWP WG members to provide him with text (with Web links where appropriate) to describe current techniques used at their centre for estimating observation errors (e.g. Chapnik method).

***Action DA/NWP-31***

All WG members to submit information on verification methods (including software tools where available) to Brett Candy, who will create a Web page for the NWP WG Web site.

***Action DA/NWP-32***

Stephen English to get initial information for NWP WG Web page to Leanne Avila.

***Action DA/NWP-33***

NWP Co-Chairs to review the status of the actions and recommendations in September 2005 and at regular intervals before ITSC-XV and email a status report to WG members and ITWG Co-Chairs.

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**WORKING GROUP ON ADVANCED SOUNDERS**

***Recommendation AS-1 to space agencies***

It is recommended that trade-off studies be performed to determine the optimal field of view size for the CrIS, considering existing detector noise performance and the desire to increase the density of observations as well as decrease the field of view size. As a first step, a comparison of the yield of NOAA 18 HIRS clear air data versus NOAA 16 HIRS data should be conducted. If the results of these

trade-off studies strongly support a change to the CrIS spatial sampling characteristics, a recommendation would be prepared to take to the Joint Agency Requirements Group.

***Recommendation AS-2 to the space agencies***

In order to ensure consistency of objectives and adequacy of the capabilities of various international contributions to the global observing system, it is recommended that space agencies follow the ITWG guidance on the minimum radiometric measurement requirements for advanced IR sounders to be carried on future polar and geostationary orbiting satellites.

***Recommendation AS-3 to the space agencies***

Cal/Val for advanced sounders needs to be an activity which receives sufficient resources. While radiosondes and NWP fields can provide a basic validation, high-altitude airborne sensors, such as those associated with the NAST and ARIES airborne sensors, and upper air reference networks (see Climate WG Report) need to also be included in order to validate the radiances, and derived products, to the very high accuracy, and precision, specified for advanced sounding instruments.

***Action AS-1***

NWP centers should review the channel selection method proposed at ITSC-XIV to ensure that the channels selected will meet their initial requirements for NWP applications and provide any comments to the ITWG Co-Chairs.

***Recommendation AS-4 to advanced sounder research community***

The advanced sounder research community needs to consider issues such as: (1) the ability to detect cloud such that the impact of undetected cloud on the observed radiances is less than 0.2K, (2) the correct usage of Principal Components (PCs), (3) effective and efficient quality control (particularly for PCs), (4) the continued development of fast models in super channel or PC space, that are robust, fast and sufficiently accurate, and (5) the quantification of the observational and forward model error covariance matrices.

***Recommendation AS-5***

It is recommended that relevant organizations conduct studies to identify the functions of microwave sounders, identify users, and develop consensus measurement requirements for future systems. This should be done for LEO as well as GEO sounders. It is recommended that this information be consolidated in a table similar to that presented above for the IR sounder.

***Recommendation AS-6***

For future microwave sounders, it is recommended that efforts be devoted to improving radiometric sensitivity and horizontal spatial resolution. It is further recommended that scattering models, which will enhance rain rate estimates and enable retrieval of vertically resolved rain, be further developed.

***Recommendation AS-7 to space agencies***

Microwave sounders should be considered to be flown with future advanced IR sounders, to provide simultaneous observations at the same time and at the same location.

***Recommendation AS-8 to space agencies***

Future imaging radiometers to be flown with advanced IR sounding instruments should possess lower tropospheric IR sounding channels to support the interpretation and enhanced utilization of advanced IR sounding spectrometer observations obtained for cloudy sky scene conditions.

***Recommendation AS-9 to space agencies***

A study should be undertaken to determine the impact of horizontal and vertical polarization for future MW sounders, taking into account the impact on "clear sky" information content as well as the ability to detect clouds and precipitation. The goal of this study should be to compare the AMSU and ATMS

systems to determine what is best for future microwave sounders. The study will also inform users what they can expect from the ATMS data.

***Recommendation AS-10 to science community***

The utility of applying the SNO (Simultaneous Nadir Observation) technique for an equatorial (inclination <20° degrees) LEO platform for the purpose of radiometric cross-calibration should be examined. Optimal orbital parameters (attitude and inclination), as well as sensor type, should be determined so that recommendations for possible sensors on future equatorial satellites can be put forward.

***Recommendation AS-11 to space agencies***

ITWG strongly recommends that certain elements of future satellite systems (e.g., the data processing, algorithm and product development system, the evaluation and validation, and the training program), be led by government agencies, together with its academic teams, in partnership with industry. It is also recommended that the users of the satellite system play a role in the definition of the characteristics of this system.

***Action AS-2***

Advanced Sounder WG Co-Chairs to forward recommendations to specified groups by end of 2005.

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**WORKING GROUP ON INTERNATIONAL ISSUES AND FUTURE SYSTEMS**

***Recommendation IIFS-1 to research and operational satellite operators***

Make data available in a form and browse display similar to that done by NASA on their rapidfire sites (e.g. <http://rapidfire.sci.gsfc.nasa.gov/realtime/>) that provide access to MODIS and AIRS data. While some providers may have specialized formats, all providers should strive to make their data also available in standard formats (e.g. hdf for images, BUFR for soundings).

***Action IIFS-1***

ITWG Rapporteur to take Recommendation II-1 forward at CGMS 2005.

***Recommendation IIFS-2 to WMO Space Program Office and CGMS***

Establish a process for similar data set distribution from other instruments whereby users can formally express their need for such data sets and conduct a dialogue with the data providers on issues of content and format.

***Recommendation IIFS-3 to the direct broadcast community***

An International Direct Broadcast Working Group should plan meetings like the forthcoming Benevento, Italy meeting on a regular basis to provide a forum for the international direct broadcast users to exchange vital technical planning information regarding achieving access to and maintaining consistency of level 0 and level 1 data. Annual plenary meetings would suffice, however, more frequent sub-groups should be considered. Failure to do so may put at risk the continuity of data access at some NWP centers and synergy within the international user community. All international DB users should plan to be represented at the October workshop.

***Action IIFS-2***

The ITWG rapporteur to encourage consideration for establishing an IDBWG within CGMS in the near future.

***Recommendation IIFS-4 to the WMO Space Program Office***

The WMO, with CGMS assistance, should continue to promote the implementation of a globally coordinated system of RARS. The 6th Asia-Pacific Satellite Data Exchange and Utilization (APSDEU-

6) meeting in Seoul in June 2005 will seek to reach agreement on implementation of an Asia-Pacific RARS. The WMO Space Program Office should organize a further global RARS meeting thereafter.

***Recommendation IIFS-5 to the WMO Space Program Office***

To coordinate the development of backbone reception stations and dissemination nodes, contacts and implementation standards, including quality, formats, and processing software requirements. A Web site should be established as a central reference for all global RARS information.

***Recommendation IIFS-6 to CGMS***

To continue to provide a forum for discussion and coordination among satellite operators to avoid orbit overlap as much as possible.

***Action IIFS-3***

ITWG Rapporteur to CGMS to present Recommendation 14.6.

***Recommendation IIFS-7 to IPO***

To consider placing NPP into a 1430 local time ascending orbit (instead of the planned 1030 descending orbit) in order to complement the pending METOP/IASI with NPP/CrIS and to provide continuity with Aqua/AIRS.

***Action IIFS-4***

Goldberg to present Recommendation 14.7 to the IPO/JARG.

***Recommendation IIFS-8 to NOAA NESDIS***

To pursue added support from the new IPO/NESDIS antenna located in Svalbard, Norway to eliminate the blind orbits and hence significantly improve data timeliness for existing polar orbiting international users.

***Recommendation IIFS-9 to CGMS***

To add discussion of the distribution of development tasks to their agenda in November 2005.

***Action IIFS-5***

ITWG Rapporteur to CGMS to present Recommendation 14.9.

***Recommendation IIFS-10 to ITWG members***

To review WMO TD 1267.

***Action IIFS-6***

ITWG Co-Chairs to seek volunteers to review the WMO TD 1267 who will provide their comments to P. Menzel by end of July 2005.

***Recommendation IIFS-11 to the WMO Space Program Office***

To organize the production of a WMO Technical Document containing the characteristics, environmental utility, and need for each requested frequency.

***Action IIFS-7***

(a) ITWG Members to review and provide guidance for VL Materials on VRL Electronic Notebook to help assure updated materials for VRL (Available through WMO Space Program Web site for Virtual Lab and linking to CIRA VRL site). (b) ITWG to establish an outreach and education focal point to serve as liaison between ITWG and VL focus group.

## WORKING GROUP ON SATELLITE SOUNDER SCIENCE AND PRODUCTS

### ***Action SSSP-1***

Lydie Lavanant to continue HRPT survey and collect data and Leanne Avila to put the information on the ITWG/SSSP Web page.

### ***Recommendation SSSP-1 to space agencies and direct readout package developers***

Future NPP, METOP, FY-3 and NPOESS programs should provide data and products in a standard reference format. If not, then global centres should provide an interface routine (i.e., in FORTRAN and/or C languages which converts the data into a reference format such as HDF and/or BUFR). Local packages for direct readout should also use these formats or provide an appropriate interface similar to the global centres.

### ***Action SSSP-2***

SSSP Co-Chairs to forward these recommendations to space agencies and identified direct readout package developers.

### ***Recommendation SSSP-2 to NOAA and EUMETSAT***

Make available simulated IASI measurements (from NWP) in a routine manner, for example through ftp, to facilitate ITWG user access. It is recommended that such data be archived and accessible through interfaces to define time period and if possible geographic windows (i.e., similar as for ECMWF archived data) to help manage the high volume of these data.

### ***Action SSSP-3***

SSSP Co-Chairs to forward this recommendation to NOAA and EUMETSAT.

### ***Recommendation SSSP-3 to space agencies***

When defining their global processing systems, space agencies (EUMETSAT, NOAA) should consider the portability and availability of their software on standard platforms (e.g. Linux PCs). This would facilitate comparisons of local and global processed data that would be mutually beneficial to data providers and users alike. These comparisons should be routinely conducted by identified centres (e.g. NWP-SAF), and results made available to all users (i.e., via the SSSP Web site).

### ***Action SSSP-4***

SSSP Co-Chairs to forward these recommendations to space agencies and direct readout package developers.

### ***Action SSSP-5***

Hal Woolf/A. Reale to include some "global" ATOVS products from IAPP (available from CIMSS) in the cross-validation studies.

### ***Action SSSP-6***

The SSSP Co-Chairs shall forward these concerns to appropriate NOAA agencies in an effort to locate sources of information and software concerning the status of available meta-data and processing software for 1b-level TOVS from 1979-2001.

### ***Action SSSP-7***

Eva Borbas to provide information on the SSSP Web site under agency planning for RO-GPS. Specifically provide links to respective programs (NASA, UCAR, EUMETSAT) with respect to GPS data, and associated sites where such data and software (i.e., SAF GRAS) are available.

### ***Action SSSP-8***

SSSP Co-Chairs to identify contact points for agencies from China and Russia, contact them, gather

information and include them on the SSSP Web site.

***Action SSSP-9***

SSSP Co-Chairs and their collaborators will write a letter requesting that information on the SSSP Web site be updated and maintained. They will also solicit new inputs (including from non-ITWG members).

***Action SSSP-10***

The site needs to be reviewed by ITWG members with suggestions, recommendations and in particular areas of concern provided to the SSSP Co-Chairs.