

The International TOVS (Soundings) Working Group (ITWG)

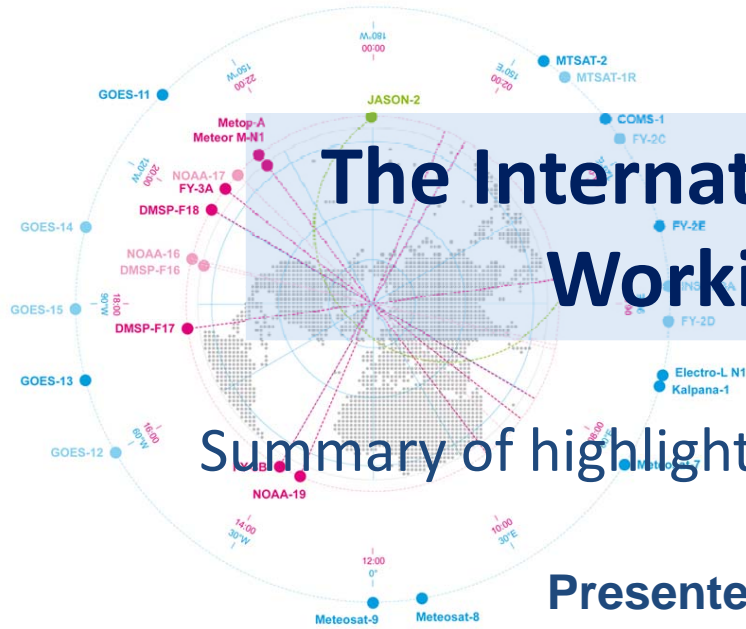
Summary of highlights and request for guidance from ITSC-20

Presented to CGMS-44, Plenary E5.4

Niels Bormann (ECMWF)

Mitch Goldberg (NOAA/NESDIS)

ITWG Co-Chairs



International TOVS Working Group (ITWG)

- Established in 1983 as a working group of the International Radiation Commission (IRC) of the International Association of Meteorology and Atmospheric Physics (IAMAP)
- Formally adopted as sub-group of CGMS in 2012
- Provides a forum where operational and research users of atmospheric infrared and microwave sounders exchange information on:
 - Sensor status
 - Processing methods and derived products
 - Data use in Numerical Weather Prediction
 - Radiative transfer developments
 - Climate studies
 - etc



ITSC-20

Hosted by SSEC in Lake Geneva, Wisconsin, USA

- 28 Oct – 3 Nov 2015
- 160 participants
- 62 oral, 112 poster presentations
- <https://cimss.ssec.wisc.edu/itwg/itsc/itsc20/program/>

Topics Covered:

- Current, new and future observing systems
- Reports from space agencies and NWP Centres
- Data assimilation applications
- Climate applications
- Processing software systems
- Advanced sounder science
- Radiative transfer models
- Cloud and precipitation applications
- Retrieval Science



Working Groups

Six Working Groups

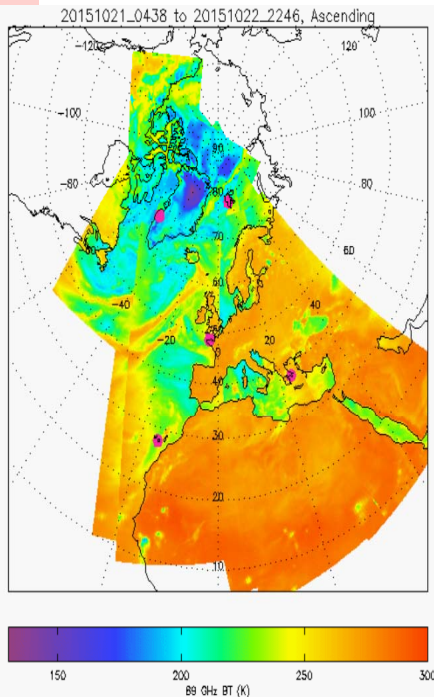
- Radiative Transfer and Surface Property Modelling
- Climate
- Data Assimilation and NWP
- Advanced Sounders
- International Issues and Future Systems
- Products and Software

Technical Sub-Groups

- RTTOV
- CRTM
- RARS and direct broadcast packages
- (Remote Sensing and Modelling of Surface Properties)

Highlights: New data – “new” agencies

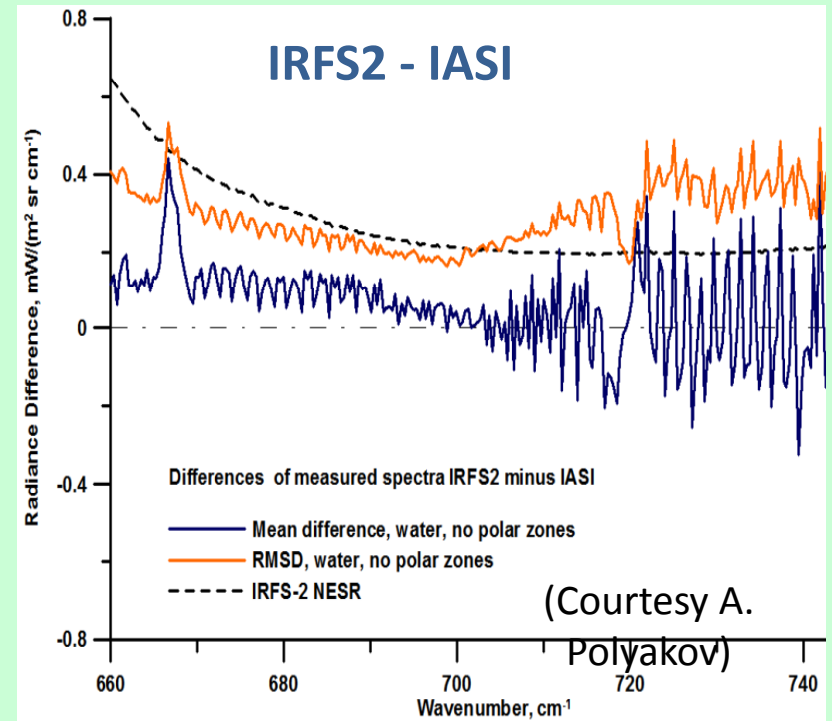
EARS-VASS coverage



Ascending (night)

(Courtesy N. Atkinson)

- Promising results from China's FY-3C MWHS-2
- International collaborative effort for data dissemination and evaluation
- Planned use at NWP centres



- First results from Russia's Meteor M N2, microwave sounder and hyperspectral IR

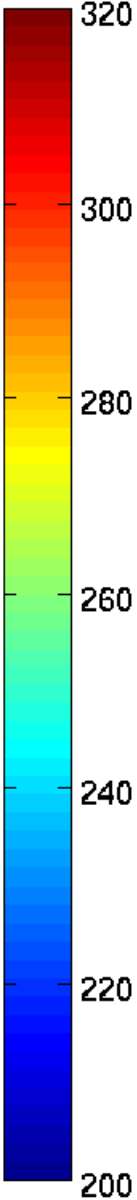
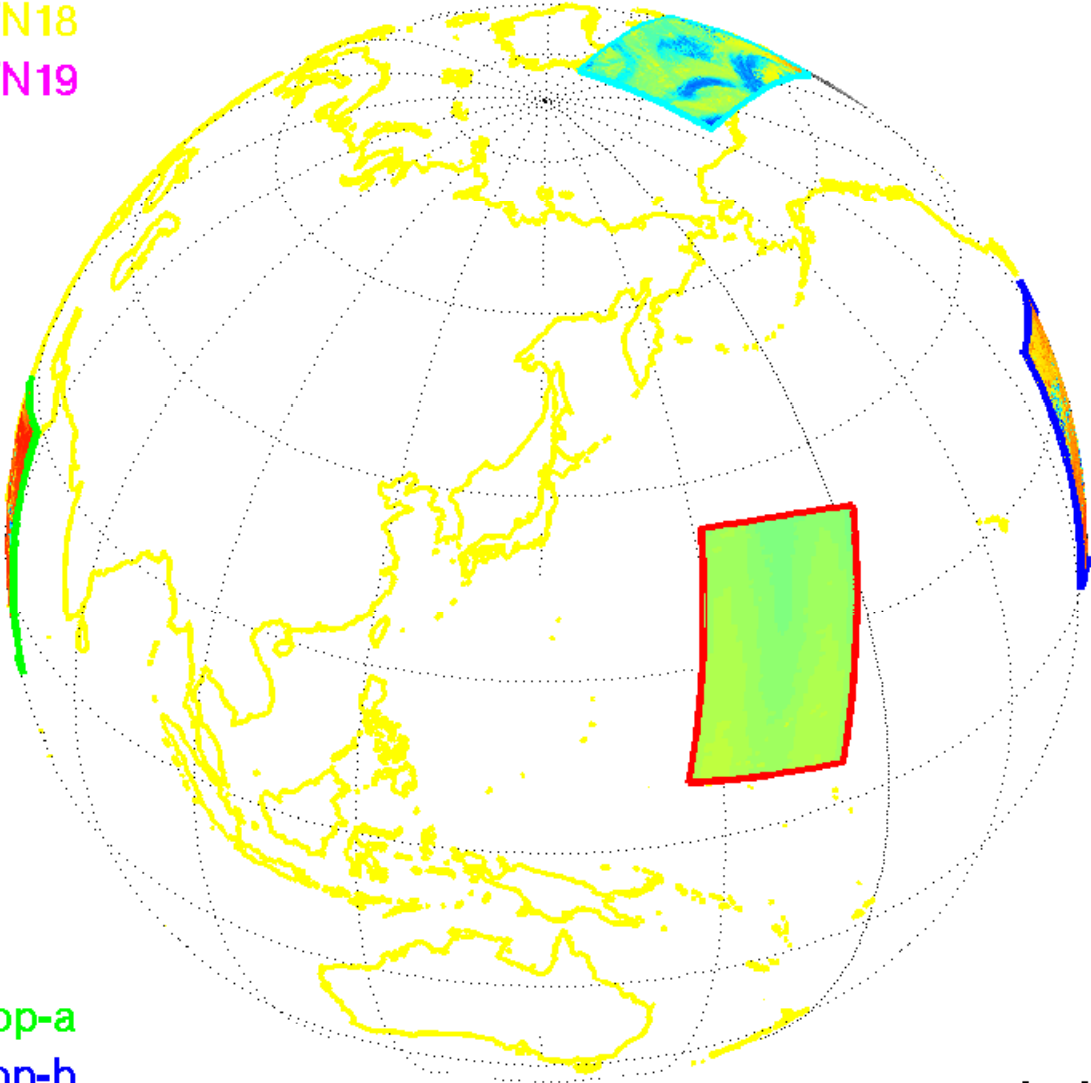
Coordination Group for
Meteorological Satellites



CGMS

Tb (K) at 10.9 μm or 52.8 GHz

AMSU-A/N15
AMSU-A/N18
AMSU-A/N19

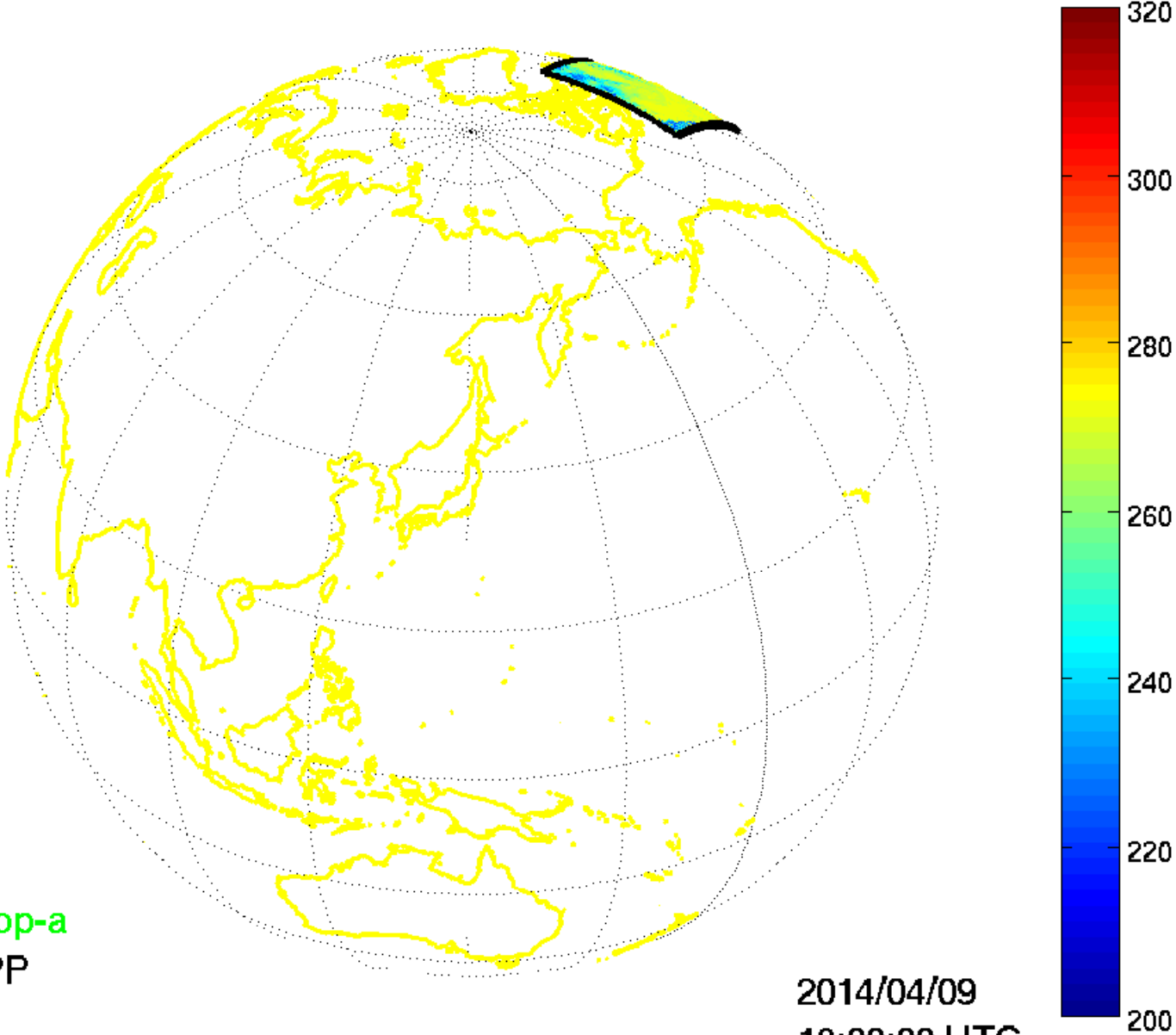


IASI/Metop-a
IASI/Metop-b
CrIS/SNPP
AIRS/Aqua

2014/04/30
18:00:00 UTC



Tb (K) at 10.9 μm or 52.8 GHz



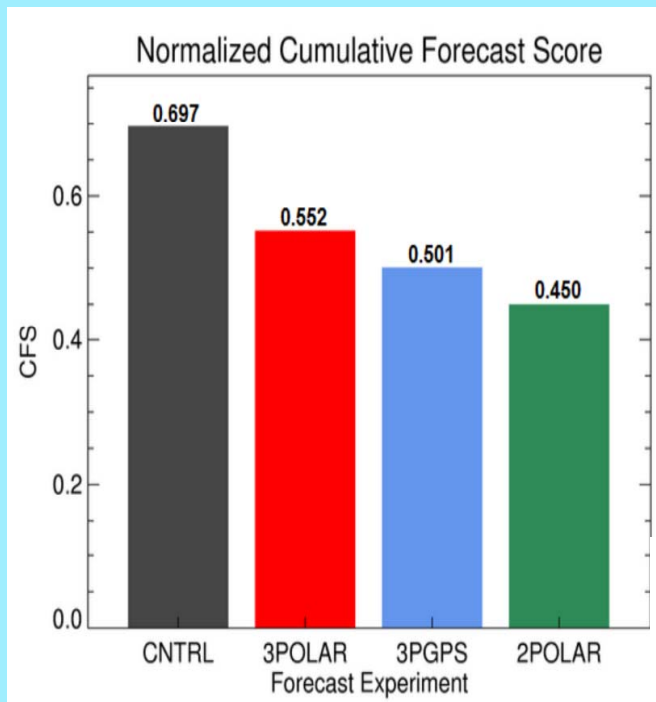
IASI/Metop-a
CrIS/SNPP

2014/04/09
18:00:00 UTC

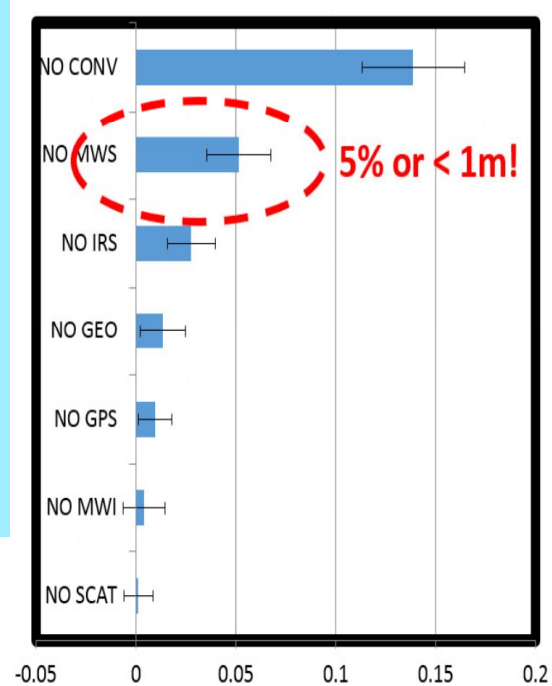


Coordination Group for Meteorological Satellites - CGMS

Highlights: Large forecast benefits – and the future?



(Courtesy S. Boukabara, NOAA)



(Courtesy M. Dahoui, ECMWF)

- Large forecast benefits from sounding data, including from secondary orbits
- “Golden age” of temporal coverage from polar satellites
- **But:** future coverage less certain

Coordination Group for
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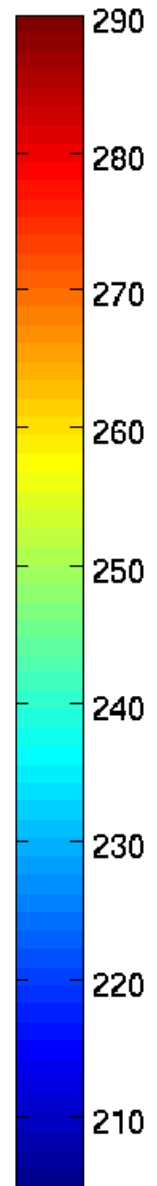
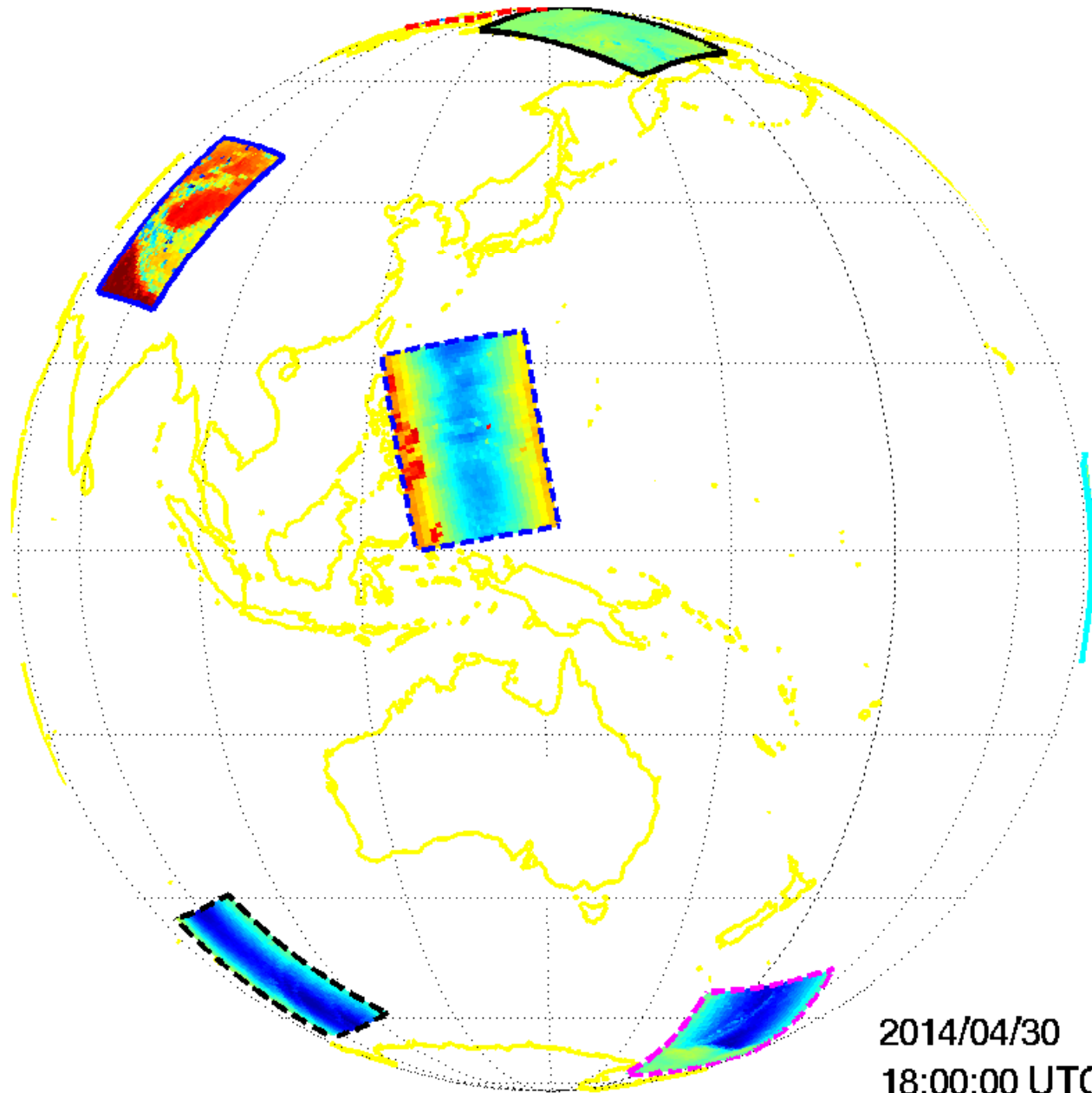


CGMS

AMSU-A Tb (K) at 52.8 GHz

- sat1
- sat2
- sat3
- sat4
- sat5
- sat6

- sat7
- sat8
- sat9
- sat10
- sat11
- sat12

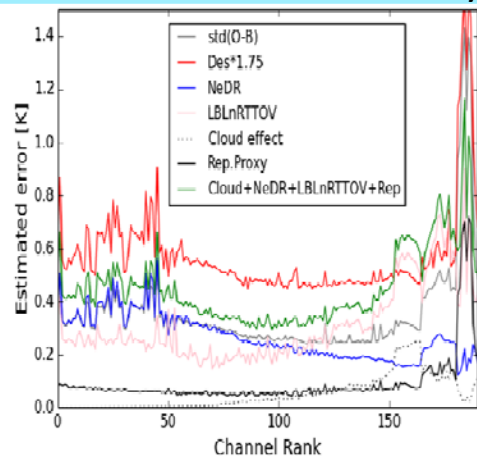


2014/04/30
18:00:00 UTC

Coordination Group for Meteorological Satellites - CGMS

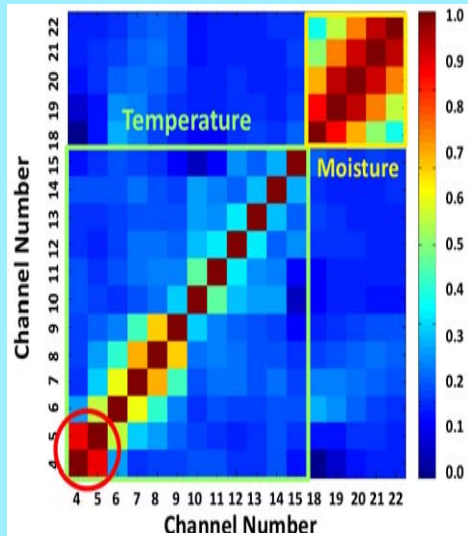
Highlights: Uncertainty characterisation

IASI error inventory



(H.-W. Chun)

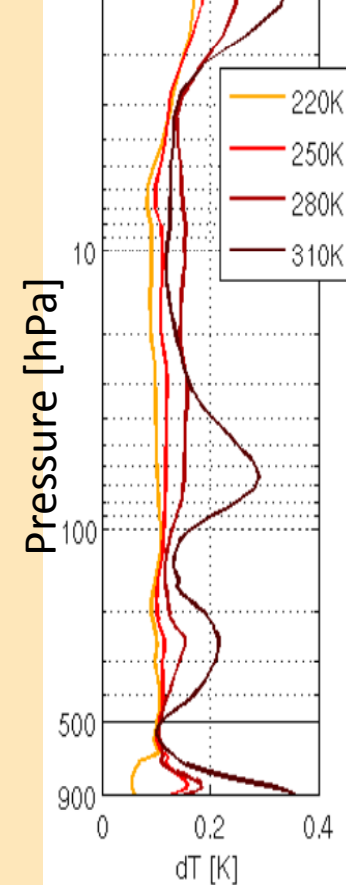
ATMS error correlations



(W. Campbell)

- Renewed efforts to characterise and account for uncertainties
- NWP, cal/val and climate communities
- Benefits demonstrated in NWP
- Use of “physical” uncertainty models/metrological approaches

Error propagation for CrIS retrievals



Fiduceo



(N. Smith)



CGMS

Top Recommendations from ITSC-20

Evolution of the observing system

To CGMS and satellite agencies:

- The constellation of **at least three polar orbits** (early morning, morning, afternoon), each with full sounding capabilities (IR and MW), should be maintained. The overpass times of operational satellites with sounding capabilities should be coordinated between agencies to maximize their value.
- Noting the excellent news regarding the move of FY-3E to the early morning orbit, the group recommends to consider how the **early morning orbit will be covered post FY-3E or the DMSP** satellites.
- When an agency has **two or more satellites in the same nominal orbit** (e.g. 2pm) they should be staggered by phase (as Metop).

To WMO/CGMS/other space agencies:

- Future programs should include the provision of **high temporal frequency MW humidity sounding** radiances (alongside cloud and precipitation sensitive observations).

To satellite agencies:

- Noting that absolute calibration with on-orbit SI traceability is critical for significantly reducing uncertainties in monitoring climate trends, ITWG recommends to develop, test, and implement an **SI Traceable radiometric standard in space** as soon as feasible.

Top Recommendations from ITSC-20

International coordination

To WMO/CGMS/space agencies:

- ITWG continues to support **low-cost fast delivery initiatives** and welcomes the DBNet initiative for renewed coordination of such activities.

To Roshydromet:

- Roshydromet are encouraged to **release a direct broadcast processing package** for the Meteor-M N2 series, including level 1 processing for the MTVZA-GY microwave imager.

To WMO/CGMS:

- To secure **full government control** for observations classed as essential under WMO Res 40.

To WMO/CGMS:

- To further maintain **OSCAR and SATURN**, noting the strong positive feedback from ITWG Members.

To CGMS and other space agencies:

- To assign **Digital Object Identifiers (DOIs)** to their data sets of heritage instruments and provide these DOIs to a central portal like WMO-OSCAR.

To WMO/CGMS/GSICS:

- To develop **best practices in pre-flight characterisation of MW sensors**, and to make instrument channel characterization data for future instruments publically available.

Top Recommendations from ITSC-20

Design of future IR sounders

Background:

- Opportunity to reduce CrIS FOV size for JPSS-3, but at the expense of higher instrument noise and loss of contiguous sampling.

To space agencies and NWP centres:

- Noting the urgent need for **realistic trade-off studies regarding the field-of-view size, instrument noise and spectral resolution** of future infrared sounders, and the continued lack of a coherent analysis of these aspects, ITWG recommends dedicated studies to investigate these trade-offs in an NWP context. Such studies should also consider the effects of clouds and other geophysical uncertainties. Space agencies should consider commissioning such studies to optimize the usefulness of future infrared sounders.

Top Recommendations from ITSC-20

Dissemination of data from hyperspectral IR sounders

To agencies involved in the provision of CrIS data in dialogue with users:

- To develop plans for the dissemination and use of **full-spectral resolution CrIS data** from S-NPP, in preparation for JPSS-1.

To satellite agencies:

- If PC compression is used to disseminate hyperspectral IR observations, a **conservative approach** should be taken in order to mitigate information loss (e.g., by retaining as many principal components as possible).

To satellite agencies in dialogue with users:

- Devise and document a **mutually acceptable update strategy for the principal component basis** when a principal component scores product is disseminated to users. Users are encouraged to **monitor reconstructed radiances** in parallel to operations so that the PC update strategy can be properly tested.

Top Recommendations from ITSC-20

Uncertainty characterisation

To space agencies and all agencies involved in GRUAN/ARM:

- ITWG recommends the provision of **more GRUAN and tropical ARM sites**, noting the continued need for and scarcity of ground-based reference measurements.

To IRC and agencies involved in radiative transfer developments:

- Noting the progress made in characterising observation uncertainty for hyperspectral sounders encourage further **characterisation of LBL model error and errors arising from cloud screening**, with a view to considering hyperspectral sounders as an absolute reference.

To NWP centres:

- Consider studies into the use of **physical methods as well as diagnostic methods** to characterise observational uncertainties, including their correlations, to improve the assimilation of satellite radiances.

ITSC-21



29 November – 5 December 2017,
Darmstadtium
Darmstadt, Germany

Local Hosts: EUMETSAT

**Coordination Group for
Meteorological Satellites**



Backup

- Following 2 slides have ITWG contributions to HLPP

3.2.5	To establish together with the user community a commonly agreed approach for retrieval of Principal Component scores and associated parameters from hyperspectral infrared data, minimizing information loss including the mutually acceptable update strategy for the principal component basis and to implement such an approach in a coordinated manner.	ITWG	<p>The following recommendations were developed at ITSC-20 from the Data Assimilation/NWP working group:</p> <p>Recommendation DA/NWP-12 to data providers: If PC compression is used to disseminate hyperspectral IR observations, a conservative approach should be taken in order to mitigate information loss (e.g., by retaining as many principal components as possible).</p> <p>Recommendation DA/NWP-13 to data providers and NWP users: A mutually acceptable update strategy should be devised and documented for the dissemination of PC products.</p> <p>Recommendation DA/NWP-14 to NWP Centres: Monitor Reconstructed Radiances in parallel to operations so that the PC update strategy can be properly tested.</p> <p>Recommendation DA/NWP-15 on Data Providers: When using PC compression, noise normalisation should be performed using the full noise covariance matrix.</p>
3.3.3	Conduct an inter-comparison study between the different methods to derive level 2 data from infrared hyperspectral sounders, recognising that there are several software packages available utilizing AIRS/IASI/CrIS data.	ITWG	<p>Achievement: A comparison of HSRTV and NUCAPS has been presented at ITSC-20 by Elisabeth Weisz, which included a description of the differences and similarities of the two systems. NOAA routinely intercompare soundings from NOAA and EUMETSAT operational level2 data using radiosondes.</p> <p>Recommendation: Results of level 2 comparison studies should be published in the open literature and also presented at ITSC-21.</p> <p>Recommendation: level2 algorithms should be implemented in direct readout packages to facilitate intercomparisons.</p>
3.5.1	Establish a common vocabulary and methodology with appropriate error propagation to include the errors associated with validation data (e.g. radiosonde temperature, water vapour, precipitation and winds).	ITWG	Martin Burgdorf to circulate the sections of the FIDUCEO framework doc that address errors associated with validation data as soon as they have been completed

3.5.3	Agree on standardized procedures to derive NedT estimates for microwave sounders, and include such estimates in the disseminated BUFR data.	ITWG	<p>Action PSWG-4 Nigel Atkinson to circulate his Technical Memorandum on NedT to the Product and Software (PSWG) group, and to the co-chairs of NWP group. Regarding encoding into BUFR, Nigel reported that two methods are currently in use: in the first an NedT descriptor is included in the BUFR sequence (implemented for ATMS); in the second (applicable to existing BUFR sequences), back references are given to the standard deviation of the brightness temperatures. It is planned to include this as an option in the next update release of AAPP, for AMSU, MHS and HIRS. Action PSWG-5 Action: Nigel Atkinson to inform PSWG when samples of AMSU/MHS/HIRS BUFR files with NedT encoding are available, in order to check whether they can be decoded OK.</p>
3.7.1	Continue support for line-by-line (LBL) reference model development and enhanced characterization of spectroscopy to ensure that product development teams and users of level 1 data have access to the latest updates in LBL forward modeling and the uncertainties involved.	ITWG	<p>Recommendation 1 : The Radiative Transfer and Surface Properties (RTSP) working group recommends the continued support of LBL model development and validation, both the forward model science/software and the measurements/calculations to improve the spectroscopy in all spectral regions covered by fast RTMs. <i>Characterising RTM error covariance</i> The group discussed the possible use of ensemble techniques for characterizing RTM error covariances, in particular for line-by-line (LBL) models. The group expressed the view that it is not an intractable problem but is still a very difficult one. It was felt the group should pursue the more classical approach of using colocated datasets for validation at this point. <i>Absorption line profile characterisation</i> It was noted that there is recent research about a reformulation of the absorption line shape profile – other than a Voigt line shape – used in LBL models. The rationale being that the simplified assumptions on which the Voigt profile is based (e.g. the collisional parameters are independent from the velocity of the absorber) can negatively affect the accuracy of the simulated spectra. The use of a new line shape would have an impact on not just the current LBL model implementations but also on the spectroscopic databases. There are many suggested models for the new line profile. Recently, the IUPAC task group recommended the adoption of the Hartmann-Tran profile. Implementation of a new line shape formulation is already being tested in 4A/STRANSAC at LMD. There are currently no plans to include this reformulation in the Community Line-by-Line (CLBL) model at NOAA/JCSDA. Recommendation 2 : Include the potential reformulation of the absorption line shape profile into other LBL model development plans (CLBL mentioned specifically, but applies to any LBL model)</p>

Coordination Group for Meteorological Satellites - CGMS

3.7.2	Perform validation and intercomparison of LBL models/spectroscopy to assess the impact of spectroscopic uncertainties and the differences between line-by-line and fast radiative transfer models.	ITWG	Significant progress: See ISTC-20 Radiative Transfer and Surface Properties working group report.
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