

# Working group on Data Assimilation and Numerical Weather Prediction

The Working Group was held in the form of a remote (online) meeting on 7th June 2021. The attendees are listed in Appendix 1.

## 1. Actions from the previous meeting

The status of the actions from the previous conference can be found on the DA/NWP website: [https://groups.ssec.wisc.edu/groups/itwg/nwp/action\\_status\\_tracker](https://groups.ssec.wisc.edu/groups/itwg/nwp/action_status_tracker)

Most actions were completed and standing actions can be seen in Appendix 2.

The only action remaining open that is not captured in the report below is:

**Action DA/NWP 22-13 on WG Members:** Share impact assessment results for FY-3E with the group and CMA as soon as possible after data becomes available, in particular to provide evidence for support of the early morning orbit.

FY3E is to be launched imminently and we look forward to progress on this action at the next conference.

## 2. Radio Frequency Interference

Radio Frequency Interference (RFI) has the potential to seriously impact the usefulness of microwave data used for NWP. At the last World Radiation Conference conf (WRC-19) Spectrum was allocated to 5G in an adjacent band to our 24GHz channels where the level of protection is lower than ITU had recommended. The 183 GHz band has also potentially been opened up for new applications.

Steve English, Nancy Baker, Rich Kelley and Jean Pla have proposed, with the support of working group co-chairs, to reactivate the RFI Technical Subgroup. This Subgroup will collect inputs, acting as a single point of contact for collating evidence; have more detailed discussions; and prepare arguments for the World Radiance Conference (WRC) every 4 years. The intention will be to hold the RFI Subgroup meeting ahead of ITSC to identify issues of concern for discussion within particular Working Groups.

The NWP Community needs to work together to identify Instances of RFI to provide evidence to spectrum managers regarding the need to safeguard the passive bands that NWP relies on.

DA/NWP Working Group members were encouraged to support the activities of the RFI Technical Subgroup and to attend their first meeting on Friday 19th June. From this point, evidence of RFI should be sent to the Subgroup Co-chairs.

**Action DA/NWP 23-1 on NWP WG members:** Send any evidence of RFI in the observations and results investigating the effects of RFI on forecast skill to the co-chairs of the RFI Technical Subgroup Stephen English ([stephen.english@ecmwf.int](mailto:stephen.english@ecmwf.int)), Richard Kelley ([barometer@verizon.net](mailto:barometer@verizon.net)), Nancy Baker ([nancy.baker@nrlmry.navy.mil](mailto:nancy.baker@nrlmry.navy.mil)) and Jean Pla ([jean.pla@cnes.fr](mailto:jean.pla@cnes.fr)).

### 3. WMO activities in support of satellite data for NWP

The WMO has a new [Expert Team for Space Systems and Utilization](#) (ET-SSU). This group sits under the Infrastructure Commission (INFCOM), and the Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON), is chaired by Stephen English (ECMWF) with Ken Holmlund being the primary interface to the WMO Secretariat. The first task of the team was to write a Position Paper on Satellite Data Requirements for Global Numerical Weather Prediction. The paper was recently presented to CGMS and was subsequently formally accepted by WMO's INFCOM-1 meeting. The WG members were encouraged to read the Position Paper.

### 4. NWP-SAF support for EUMETSAT's future missions.

EUMETSAT's next generation satellites, Metop-SG A and B and MTG-S will be supported by software from the NWP-SAF for their MW and IR sounders. Nigel Atkinson (Met Office, NWPSAF) presented the status of this software, and seeks feedback from NWP users to ensure the software meets users' needs.

The future data standard format is netCDF, not traditionally used by many NWP systems. Direct Broadcast processors will be available for generating standard netCDF products. The SAF advocate that users generate their own BUFR according to local requirements and are requesting feedback for this approach.

MTG-IRS L1 data will be available as full spectra (but not in NRT) and as PC scores, however this product is expected to be too large for the GTS. The SAF IRSP package will allow various steps of processing to generate BUFR radiances from PC scores. The software design document is available [on the NWPSAF website](#). A software release is planned in late 2021 and beta testers are requested.

EPS-SG's MWS and IASI-NG will be supported via an add-on to AAPP. The baseline is netCDF input for locally-generated direct broadcast data and netCDF and/or BUFR for global reception (e.g. EUMETCast), depending on the instrument, with PC Scores for IASI-NG. Various tools are planned eg spatial filtering, radiance reconstruction, microwave to IR mapping, and conversion

of IASI-NG to IASI spectral resolution. MWI and ICI have considerable geolocation complexity. They will be supported via the [MWIPP](#) package which will provide tools for spatial averaging, mapping, coregistration, thinning, BUFR encoding etc.

There was discussion about the fact that netCDF is not optimised for data transmission. Sreerekha TR (EUMETSAT) said that EUMETSAT's data distribution is being reviewed with respect to new data services and the plan will be released in Q3 2021.

**ACTION DA/NWP 23-2 on WG Members:** Please review the software design documents for ISPP and MWIPP/AAPP on the NWPSAF website and provide feedback to Nigel Atkinson by the end of July 2021 ([nigel.atkinson@metoffice.gov.uk](mailto:nigel.atkinson@metoffice.gov.uk))

**ACTION DA/NWP 23-3 on WG Members:** Contact Nigel Atkinson by the end of July 2021 ([nigel.atkinson@metoffice.gov.uk](mailto:nigel.atkinson@metoffice.gov.uk)) to beta test IRSPP

**ACTION DA/NWP 23-4 on Sreerekha TR:** Circulate EUMETSAT's data distribution plan to the DA/NWP WG when it is released.

## 5. NOAA Future Architecture

Sid Boukabara (NOAA) and Will McCarty (NASA) introduced the System Performance Assessment Team (SAT), a science team set up to provide regular feedback to NOAA on next generation space architecture from a science and user expectation perspective and discuss cost/performance trade-offs. Members cover all applications including NWP, nowcasting, ocean, land and hydrology. The team meet bi-weekly, and agenda varies including technology, requirements, impact of legacy sensors etc.

The SAT have produced various recommendation documents which are available on the website <https://www.star.nesdis.noaa.gov/sat/index.php>. These include tables with product priorities (e.g. temperature and humidity sounding performance, ice and precipitation retrieval performance, spatial resolution, swath width etc) and various levels of desired performance for each priority (for example number of channels and spectral ranges).

Items that raised particular controversy at the previous ITSC include:

- the spectral coverage of the infrared sounding instrument. SAT have currently made a recommendation that IR sounders should have a long-term objective to cover LW+MW+SW for long-term objective, but SW+MW should be considered for a pathfinder.
- Instrument collocation. NWP has stated that this is not a strong requirement for IR+MW to be collocated, but the retrieval product community do consider this to be important. Both options are considered for future systems. IR sounder/imager collocation has not been discussed to such a great extent. WG members expressed the view that perhaps for NWP heterogeneity information from an imager is more important than collocated MW.

Questions that the SAT would like the NWP community to contribute to include:

- For a sounder constellation what is the best combination of sensor quality and constellation-driven temporal refresh and spatial coverage?
- In a budget constrained environment, what is the best balance of quality vs quantity?
- What is the role of GEO sounders and how should we seek to fill gaps between GEO coverage and the poles where there are frequent LEO overpasses?
- To what extent is the community ready to embrace new sensors vs skeptical of proposed changes. What mechanisms need to be in place to help the user community be ready?

Discussion during the WG covered the following aspects (for brevity, the term “Small Satellites” will be used to cover SmallSat, CubeSat and MicroSat type missions that are typically of short duration and considerably smaller than traditional LEO satellites)

- The extent to which RFI has been considered for small satellites.
- Lack of clarity around the role of these small satellite missions - are they complementary to a JPSS follow-on, or are they intended to be the follow-on?
- A more ambitious trade-off envelope could be recommended as the high-end of the requirements range in the SAT memos seem to be not very demanding in comparison with, for example, specifications of the EPS-SG missions.
- Are requirements for improved footprint size adequately captured?
- Regarding coincident MW/IR and IR/Imager, do the recommendations adequately reflect future more advanced DA techniques we can envisage?
- Do small satellite instruments benefit from intercalibration with large longer-term and stable platforms and has this been planned for?

Other points to note:

- Under the JPSS/LEO-Sounder Project there is a LEO Constellation Architecture Study with a workshop on future Microwave sounders tentatively scheduled in July/Aug time.
- ESA also has a project to look at future microwave sounder constellations. See poster by Katie Lean at this conference.

It was proposed to hold a meeting of interested WG members to collate feedback on the SAT's questions listed above.

**ACTION DA/NWP 23-5 on WG members:** email Fiona and Brett if they are interested to be part of SAT feedback discussion group

**ACTION DA/NWP 23-6 on WG chairs and Will McCarty:** organise an online meeting to discuss feedback to the SAT on the questions discussed during the WG meeting.

All members are encouraged to review the SAT documents and to provide feedback, regardless of whether they join the discussion group.

**ACTION DA/NWP 23-7 on WG members:** Review SAT recommendation documents and provide any feedback to Will McCarty ([will.mccarty@nasa.gov](mailto:will.mccarty@nasa.gov)) by the end of July 2021

**ACTION DA/NWP 23-8 on WG members:** Contact Lihang Zhou ([lihang.zhou@noaa.gov](mailto:lihang.zhou@noaa.gov)) by the end of June 2021 to be invited to the LEO Constellation Architecture Study workshop on future Microwave Sounders.

## 6. CrIS Status

### S-NPP Bands

The DA/NWP working group recently provided feedback to NOAA by email on their preferences for the future configuration of the S-NPP CrIS instrument (LW+SW or MW+SW). The WG thank NOAA for their efforts to collect user feedback before making a final decision, and to support the majority view that LW+SW is the preferred option.

The majority of NWP users are not able to use the SW to mitigate the loss of the LW band at the present time. Centres are not able to use the MW without the LW to assist with cloud screening. The WG note that work at NOAA STAR and JPL are showing promising results for MW+SW assimilation (see poster by Erin Jones at this conference). Continued Research into the use of MW+SW is encouraged.

**ACTION DA/NWP 23-9 on WG members:** Forward any results of studies for the use of MW-only or MW+SW channels to the working group.

### Sub-pixel heterogeneity

The previous conference had the following action:

**Action DA/NWP 22-11** on Andrew Collard: Check with NESDIS-STAR on plans to implement the VIIRS cluster algorithm for global CrIS data dissemination.

Advice received from Tom King is that NOAA are normally unwilling to implement external code or algorithms, such as the clustering algorithm from AAPP, without their science team extracting the code and supporting it scientifically. Furthermore the AAPP code uses a different geolocation process from the operational NOAA procedure and the clustering algorithm would need to be adapted prior to implementation.

Working group members continue to have a requirement for sub-pixel heterogeneity information for CrIS but it was felt that mean and sd of VIIRS radiances within each footprint would suffice if NOAA would be more willing to implement this. The current CrIS BUFR sequence accommodates mean and standard deviation of VIIRS radiances.

Progress on this item, having been slow for many years, is now progressing rapidly and NESDIS are examining the AAPP code and comparing algorithms.

**Action DA/NWP 23-10 on WG co-chairs:** Follow progress on implementation of CrIS sub-pixel heterogeneity information at NOAA and report back to WG members bi-annually.

## 7. POES continuation

There was discussion on the important contribution to the observing network from the POES series of satellites (NOAA-15, 18 & 19). Orbital drift since launch has meant that these satellites help to improve data coverage for AMSU-A and MHS (NOAA-19). Several NWP centres have already sent evidence (FSOI and data denial studies) to help support the case for continuing the data dissemination from these satellites and there will be further discussions on this as part of the group meeting to discuss the SAT questions above. The orbital drift will continue and so these results provide a current snapshot of impact. It was noted that several of the POES AMSU instruments continue to have excellent noise performance for critical sounding channels.

**Recommendation DA/NWP 23-1 to NOAA:** Continue to produce POES L1 sounding products for near-real time dissemination

**Action DA/NWP 23-11 on WG members:** send results of forecast studies that indicate the continuing impact on NWP of POES satellites to Mitch Goldberg ([mitch.goldberg@noaa.gov](mailto:mitch.goldberg@noaa.gov))

## 8. GIIRS BUFR Sequence

GIIRS data is available via CMA/EUMETCast Terrestrial in HDF-5. For NWP applications Nigel Atkinson and Chris Burrows have developed a draft BUFR sequence. The sequence has been derived from first principles; it is not based on CrIS and IASI. This is because some characteristics of the data stream are specific to the GIIRS instrument. For example, the geolocation of the medium wave and long wave bands are different. Chris and Nigel are seeking feedback on the sequence within the next month; in particular the choice of metadata and also whether there is enough flexibility to handle future developments of the GIIRS instrument.

**ACTION DA/NWP 23-12 on Chris Burrows:** Provide Working Group with the draft GIIRS BUFR sequence and invite comment.

**ACTION DA/NWP 23-13 on WG Members:** Provide feedback to Chris Burrows ([chris.burrows@ecmwf.int](mailto:chris.burrows@ecmwf.int)) on the draft GIIRS BUFR sequence by the end of July 2021.

## 9. CGMS HLPP

Relevant parts of the CGMS High Level Priority Plan (HLPP) were reviewed and discussed.

*4.2.7 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.*

The hybrid methodology developed at EUMETSAT has been discussed at previous ITSC meetings. The WG thank EUMETSAT for their continued work in this promising area. EUMETSAT will disseminate IASI PC scores via the hybrid methodology from Nov/Dec 2021. All NWP centres are encouraged to investigate use of the hybrid PC score dataset. In particular this is an important activity for readiness for MTG-IRS. The following recommendation is retained.

**Recommendation DA/NWP 22-14 to NWP Centres:** All centres should use the IASI Hybrid PC-compressed dataset to ensure they are prepared for MTG-IRS. Users are requested to provide feedback to EUMETSAT on the use of these data.

It was also noted that the hybrid approach is also being developed for PC representation of CrIS data and may become an official product.

A ECMWF/EUMETSAT study is underway to investigate the effects on radiance reconstruction if the eigenvectors are changed. This study aims to address concerns that long lead times would be required if a change of eigenvector basis is proposed. See poster at this conference presented by Cristina Lupu.

*4.4.2 Agree on standardized procedures to derive NedT estimates for microwave sounders and include such estimates in the disseminated BUFR data.*

There was a general feeling in the WG that the timeseries of NedT estimates is very useful, as it allows users to identify when changes to the instrument occur. In particular websites showing the time series can be very helpful in making decisions on instrument/channel rejection. This is not just a requirement for short-range NWP; timeseries spanning the lifetime of instruments can be useful to reanalysis applications.

With regards to consistency in the method used to estimate NedT, it was pointed out that it is not always possible to perform the calculation in the same way for all instrument types. Consequently it was felt that we modify the recommendation previously DA/NWP 22-8 to reflect this. The following two new standing recommendations were made.

**Recommendation DA/NWP - Standing 13 to Data Providers:** Provide NedT estimates for inclusion within BUFR for microwave data.

**Recommendation DA/NWP- Standing 14 to Data Providers:** Make NedT estimates from microwave instruments available as time series on publicly available websites to enable monitoring of instrument health in near real time.

Joerg Ackermann who was unable to attend the meeting requested that the WG make the following additional recommendation, to aid instrument characterisation:

**Recommendation DA/NWP- Standing 15 to Instrument Developers:** Pre-launch calculation of NEdT should use the same algorithm as will be used in-orbit using warm target counts variability divided by the instrument gain.

*4.6.3 Through coordination between IPWG, ITWG and ICWG, continue to improve microwave radiative transfer models to include complex surfaces (e.g., snow, desert, etc.) and scattering atmospheres (e.g., frozen hydrometeors) to support improved algorithm development for current and future sensors.*

Discussion focused on how this working group can support this effort, for example by coordinated effort to test new scattering tables or other improvements to the RT modelling. It was noted that RTTOV version 13 includes a major upgrade of RTTOVSCATT (for instance, allowing for the first time an arbitrary number of hydrometeor types, and improved hydrometeor tables of scattering properties). The group proposes to seek advice from the RT Working Group

**Recommendation DA/NWP 23-1:** Radiative Transfer Working Group to outline what support they require from NWP community regarding CGMS HLPP Item 4.6.3.

Also the question was raised whether the new instruments MWI and ICI on Metop-SG (that have channels sensitive to scattering) are also included in the remit of this working group. This was agreed.

## 10. Science Topics for discussion

### Satellite data in convective scales, and challenges of increasing volumes of radiances

The group discussed the challenges of assimilating radiance data as global NWP model resolutions are moving towards the convective scale. One area of ongoing research is how to move towards a higher density of data in the assimilation, which means potentially dealing with temporal and spatial error correlations. Technical aspects can be difficult to deal with, especially in a multi-processor environment. The Desroziers method can help estimate correlations and several centres have attempted assimilating geostationary imagery at higher density, but the temporal error correlations appear to be different for different centres. Another approach investigated at ECCO as presented at the previous conference is to reduce spatial thinning and inflate observation errors, this appears to favour channels sensitive to the lower troposphere. There are plenty of open questions with regards to improving data density.



As NWP models move to smaller spatial scales the correct treatment of the observation operator is important (satellite footprint vastly greater than the NWP grid scale). This may also influence the spatial resolution of future sounders.

As the volume of sounder data increases, there may be a lack of sufficient anchor observations for bias correction.

## Bias handling in LAMs

This is still an active area of research and there may be common issues between LAMs and global bias correction, as the global grids approach convective scale. VarBC with normal cycling in LAMs has been shown to work less well than 24-hour cycling. FMI are investigating the following approach: for each satellite, identify one cycle per day to update the bias coefficients with a relatively good satellite coverage, in conjunction with radiosonde launches to act as an anchor. This VarBC update cycle will differ depending on instrument overpass time.

**ACTION DA/NWP 23-14 on WG members** - contact Roger Randriamampianina ([rogerr@met.no](mailto:rogerr@met.no)) to join a group that will discuss bias correction in LAMs.

There was insufficient time to sufficiently discuss the topics proposed at this meeting. It was suggested to hold a science meeting for the WG in Q3 2021.

**ACTION DA/NWP 23-15 WG members:** contact WG co-chairs by the end of July 2021 with topics for a science meeting (already proposed are assimilation in LAMs and how to deal with instruments on small satellites)

**ACTION DA/NWP 23-16 on WG Co-chairs:** arrange another meeting in a few months to discuss the science issues.

## 11. Web Site

<https://groups.ssec.wisc.edu/groups/itwg/nwp>

The WG Co-chairs reviewed the web site prior to the meeting and removed some pages and information that are now out of date. This was done in consultation with the Working Group via email. The SSMIS page will be regularly updated with a chart showing the health of each instrument, courtesy of Steve Swadley (NRL). This is very useful as this information is not easily found on other sites.

Space Agency contacts are likely to be out of date and Working Group members are encouraged to review this page and let WG Co-Chairs know of any updates.

**ACTION DA/NWP 23-17** on WG members to review Space Agency contacts page on the website

The regional model page is still considered to be an important resource; a useful first step for someone starting to use radiances in a LAM. It should ideally comprise of a set of references and guidance for things that need consideration. In particular a missing topic is guidance on which metrics are useful in determining improvements to a convective scale model?

**ACTION DA/NWP 23-18** on WG members: Provide impact recent LAM study references to WG co-chairs for inclusion on the website

## 12. Recommendations from the previous conference

The DA/NWP Working Group has a long list of recommendations, many of which have been retained across conferences, which were previously embedded in the working group report. The WG co-chairs have decided to take standing recommendations out into an appendix to be quickly reviewed at future meetings. The standing recommendations can be found in Appendix 3.

This conference, the majority were retained, with several discussed as described below. Post-conference, the WG co-chairs discussed with conference co-chairs and those leading WMO activities the removal of recommendations that have already been taken up by CGMS. Such recommendations have thus been removed. For recommendations where CGMS has a related action, the HLPP text is provided in Appendix 3 in red.

**Recommendation DA/NWP Standing 4 (previously 22-5) to Space Agencies:** There should be open and early access to new satellite data for all NWP centres to help with calibration and validation

As part of the discussion of this recommendation it was noted that FY-3E will be launched in July 2021. It is anticipated that there will be 3 months of on-orbit tests and for the instruments that are more mature, such as the MW sounders, data will hopefully be released within the testing period. Newer instrument types, such as the scatterometer will be made available later.

~~**Recommendation DA/NWP 22-17 to DBNet providers:** Switch on the production of VIIRS cluster information for DBNet for IASI and CrIS.~~

This recommendation seemed inappropriate given that the cluster analysis is not present in the global data product. The feedback from users for DBNet data is always that it should be the same as the global data product where possible. Therefore this recommendation is dropped for now.

~~**Recommendation DA/NWP 22-22 to NASA and NESDIS:** Continue to provide AIRS Aqua data in real-time to NWP centres for as long as calibration of the instrument is possible.~~

It is noted that NESDIS have already stopped the supply of AIRS data, so we will modify the recommendation to be to NASA only (now renumbered).

**Recommendation DA/NWP 23-2 to NASA:** Continue to provide AIRS data in real-time to NWP centres for as long as calibration of the instrument is possible.

The following recommendation has been made for several meetings in a row but has not generated any response. It is proposed to retain it for one more conference and to encourage presentation of results at the next conference:

**Recommendation DA/NWP22-3 to the NWP Centres:** Work to assess the impact of the upper atmospheric sounding channels of SSMIS in NWP and determine the information content unique to those channels e.g. via data denial experiments.

The following recommendation was made at the last meeting but has not generated any response. It is proposed to retain it for one more conference and to encourage presentation of results at the next conference:

**Recommendation DA/NWP 22-18 to NWP Centres:** Evaluate IKFS-2 data.

## 13. AOB

### Benefit of low inclination MW sounder

Forecast benefits have been reported by many NWP centres through assimilation of observations from the SAPHIR MW humidity sounder. This operates in a low inclination orbit which allows improved temporal sampling of the moisture and cloud field in the Tropics. Consequently the WG recommends continual use of a MW sounder in this orbit.

**Recommendation 23-3 to Space Agencies:** Following the successful use of the SAPHIR instrument, future MW missions operating on a similar low inclination orbit are recommended.

### Instrument monitoring by data providers

The real time monitoring of instrument status (ICVS, from NESDIS, for example) is invaluable for operational centres.

**Recommendation Standing 16 to Data Providers:** Develop and maintain public instrument status monitoring web pages similar to ICVS from NOAA/NESDIS .

## Appendix 1: List of Participants

Agnes Lane, Agnes Lim, Aya Kasai@JMA,  
Alain Beaulne, Alessandra Moneris, Awdhesh Sharma, Biaye Younousse,  
Bill Bell, William Campbell, Bill Smith, Brett Candy,  
Bryan Karpowicz, Camille Birman, Chawn Harlow, Hao Chen,  
Chris Burrows, Chris Tingwell, Christina Koepken-Watts (DWD), Chun-Hsu Su,  
Hyoung-Wook Chun, Cristina Lupu, Tony McNally, David Tobin,  
David Duncan, David Schonach, Di Di, Donatello Gallucci,  
Dorothee Coppens, Eunhee Lee, Emily Morgan, Emily Liu,  
Emma Turner, Erin Jones, Erin Lynch, Evan Fishbein,  
Fabien Carminati, Filomena Romano, Fiona Smith, Flavio Iturbide-Sanchez,  
Graeme Martin, Haixia Liu, Hejun Xie, Hui Christophersen,  
Tiger Yang, Kayo Ide, In-Hyuk Kwon, Indira Rani S (NCMRWF),  
Iriola Mati, Jin Lee, James Hocking, Jean-Marie Lalonde, Jerome Vidot CNRM,  
Jianjun Jin, Joe Predina, Joshua Lee, Jeon-Ho Kang,  
Katie Lean - ECMWF, Masahiro Kazumori, Keiichi KONDO (JMA/MRI), Kirsti Salonen,  
Toshiyuki Kitajima (JMA), Kozo OKAMOTO (JMA/MRI), Kristen Bathman, KUSANO Naoto  
(JMA),  
Bjorn Lambrigtsen, Larry Flynn, Leanne Avila, Seungwoo Lee,  
Liam Gumley, Leonhard Scheck, lihong zhou, Qifeng LU,  
MasamiMoriya, Mahdiyeh Mousavi, Rohit Mangla, Marco Matricardi,  
Mary Borderies, Marylis Barreyat, mashuo, Mate Mile,  
Mathieu Asseray, MA Yufen, Maziar Bani Shahabadi, Mikael Rattenborg,  
Mohamed Dahoui, Hidehiko MURATA (JMA), Nadia Fourrie, Niels Bormann,  
Nigel Atkinson, Normand Gagnon, Olaf Stiller, Olivier Audouin,  
Olivier Coopmann, Norio Kamekawa, Norio Kamekawa, Peter Steinle,  
Philippe Chambon, Chengli Qi - CMA, Reima Eresmaa, Ricardo Todling,  
Rich Kelley, Robert (Bob) Tubbs, Robin Faulwetter,  
Roger Randriamampianina, Rohit Mangla, Robert Knuteson, Ruth Taylor,  
Sabrina Gentile, Salvatore Larosa, Samuel Quesada-Ruiz, Satya Kalluri (NOAA),  
Sihye Lee, Hiroyuki Shimizu (JMA), Sid Boukabara (NOAA), Silke May,  
Simon Wood, Sreerexha Thonipparambil - EUMETSAT, Stefano Migliorini, Stephanie Guedj,  
Stephen English (ECMWF), Sylvain Heilliette, Tim Hultberg, Yong Chen,

Vincent Guidard (CNRM MeteoFrance), Wang Hao, Wei Han, William Mccarty, Xiaoyan Zhang, Xishuang, Yanqiu Zhu, Yu (Judy) Deng , Ruoying Yin, Zheng Qi Wang , Zhenglong Li, Zhiyu Yang

## Appendix 2: DA/NWP Working Group Standing Actions

**Action DA/NWP- Standing 1 on ITSC Co-chairs:** To bring relevant recommendations to the attention of CGMS.

**Action DA/NWP- Standing 2 on DA/NWP WG members:** Send any evidence of RFI to co-chairs of the RFI Technical SubGroup - Jean Pla ([jean.pla@cnes.fr](mailto:jean.pla@cnes.fr)), Richard Kelley ([richard.kelley@noaa.gov](mailto:richard.kelley@noaa.gov)), Stephen English ([stephen.english@ecmwf.int](mailto:stephen.english@ecmwf.int)) and Nancy Baker ([nancy.baker@nrlmry.navy.mil](mailto:nancy.baker@nrlmry.navy.mil))

**Action DA/NWP- Standing 3 on DA/NWP WG members:** If you have estimates of revised channel characteristics resulting from post-launch diagnostics, please email these to the radiative transfer working group chairs ([Benjamin.T.Johnson@noaa.gov](mailto:Benjamin.T.Johnson@noaa.gov) & [Marco.Matricardi@ecmwf.int](mailto:Marco.Matricardi@ecmwf.int)).

**Action DA/NWP- Standing 4 on NWP centres:** Continue to provide information on instrument channels assimilated and their observation errors via the working group survey spreadsheet in advance of each conference.

**Action DA/NWP- Standing 5 on DA/NWP WG Members:** Make suggestions and corrections to the DA/NWP Working Group website

## Appendix 3: DA/NWP Working Group Standing Recommendations

**Recommendation DA/NWP-Standing 1 to the Satellite Agencies:** In support of maintaining a robust global satellite observing system, instrumentation to allow continued sounding of the temperature of the upper stratosphere and mesosphere (as for the SSMIS UAS channels) should be explored.

**Recommendation DA/NWP-Standing 2 to funding bodies of NWP centres and space agencies:** Consider, as part of the cost of satellite programmes, providing computational and personnel resources targeted at operational NWP centres to optimise the public's return on investment from these expensive measurement systems.

**Recommendation DA/NWP-Standing 3 to Data providers:** Include azimuthal viewing and solar angles as appropriate in BUFR for present and future instruments.

**Recommendation DA/NWP-Standing 4 to Space Agencies and data providers:** When designing new or modified BUFR formats, please circulate drafts to the NWP community via the NWP Working Group for feedback, prior to submission to WMO.

**Recommendation DA/NWP-Standing 5 to Data Providers:** When using PC compression, noise normalisation should be performed using the full noise covariance matrix.

[HLPP: 4.2.6 Establish together with the user community a commonly agreed approach for retrieval of Principal Component scores and associated parameters from hyperspectral infrared data, minimising information loss including the mutually acceptable update strategy for the principal component basis and to implement such an approach in a coordinated manner.]

**Recommendation DA/NWP-Standing 6 to Data Providers:** If a change to data processing results in a change in brightness temperature of 0.1K or 20% of NEdT (whichever is smaller), this should be made clear in notifications to users. These notifications should be made no later than 8 weeks before the change and test data should be provided if possible.

[HLPP: 3.17 Develop best practices for operational user notifications]

**Recommendation DA/NWP-Standing 7 to Data Providers:** The overlap period where one satellite resource is replacing another should be chosen after consultation with the user community and should follow WMO guidelines.

**Recommendation DA/NWP - Standing 8 to Data Providers:** Provide NedT estimates for inclusion within BUFR for microwave data.

[HLPP 4.4.2 Agree on standardised procedures to derive NedT estimates for microwave sounders, and include such estimates in the disseminated BUFR data. ]

**Recommendation DA/NWP- Standing 9 to Data Providers:** Make NedT estimates from microwave instruments available as time series on publicly available websites to enable monitoring of instrument health in near real time.

**Recommendation DA/NWP- Standing 10 to Instrument Developers:** Pre-launch calculation of NEdT should use the same algorithm as will be used in-orbit using warm target counts variability divided by the instrument gain.

**Recommendation Standing 11 to Data Providers:** Develop and maintain public instrument status monitoring web pages similar to the Integrated Calibration and Validation System (ICVS) from NOAA/NESDIS .