

2.5 INTERNATIONAL ISSUES AND FUTURE SYSTEMS

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2.5.1 Introduction

The ITSC-20 Working Group on International Issues and Future Systems (IIFS) convened on Saturday 31 October 2016 and discussed the following topics:

- The CGMS High Level Priority Plan
- Global Design of the GOS, Implementation and Continuity Issues
 - Best practices in the design phase of new instruments
 - Provision of Nature Runs for OSSEs
 - Pre-flight characterisation and traceability of calibration to SI standards
 - User interaction before launch (Satellite User Readiness Navigator- SATURN) and during operations
- Radiative transfer standards
- RFI and frequency management
- Commercial satellite observation providers
- Links between ITWG and other CGMS International Science Groups

The attendance at the IIFS was slightly higher than at previous ITSCs, which was considered at least in part to be due to the decision of the ITWG co-chairs to have only three of the six WGs in parallel on Saturday, enabling more people to participate. The decision of the ITWG co-chairs was therefore welcomed by the IIFS.

2.5.2 Summary of ITSC-19 Actions and Suggested Topics for Discussion

Progress has been made on some but not all actions and recommendations from ITSC-19. Action IIFS19-1 remains open, and all other actions are closed. All recommendations remain valid.

The status of the actions and recommendations was agreed to be as follows:

- **Recommendation IIFS19-1: Still valid.** Expectation that results are likely to be presented at the WMO OSE workshop in Shanghai.
- **Recommendation IIFS19-2: Still valid.** EUMETSAT and CMA plan to provide hyperspectral geo sounders. Recommendation remains valid for other agencies to follow suit.
- **Action IIFS19-1: Open,** the action is continuing for feedback on the CGMS contingency plan.
- *Action IIFS19-2: Closed.*
- *Action IIFS19-3: Closed.*
- **Recommendation IIFS19-3: Still valid.** More feedback on SATURN is strongly encouraged.
- *Action IIFS19-4: Closed.*
- **Recommendation IIFS19-4: Still valid.** Implementation of notification procedure still recommended.

- **Recommendation IIFS19-5: Still valid.** Roshydromet still recommended to make DB software available to the community. This was discussed at ITSC-20 and there was encouraging progress.

The status of the valid recommendations and open action will be reviewed again at ITSC-21.

2.5.3 The CGMS High Level Priority Plan (HLPP)

The coordination activities of CGMS are reflected in a High Level Priority Plan (HLPP) initially endorsed by the CGMS-40 plenary session in 2012. Items relevant to the IIFS from the HLPP were reviewed. In general the HLPP was welcomed. The IIFS would like to see a greater emphasis on the latency requirement for research and pre-operational observations, which would greatly facilitate their uptake by operational centres. The IIFS members will continue to review progress against the HLPP at future ITSCs and provide feedback where appropriate.

Recommendation IIFS-1

Emphasize latency requirement in the HLPP Action 2.3 to increase the use of research and pre-operational satellites. (Action: Mitch Goldberg to propose to CGMS).

2.5.4 Global Design and Calibration of the GOS

The group noted that WMO was convening two weeks later a workshop on the vision of the space-based observing system in 2040, which was an opportunity to convey a message regarding future design of the GOS from an ITWG viewpoint.

The success of the dual Metop satellite configuration was noted. At ITSC-19 the group had remained inconclusive whether it was best to stagger the orbits or adopt an “A-train” type configuration. At ITSC-20 the group agreed there was a significant advantage to staggering satellites of the same nominal orbit (i.e., am, pm, e-am) in order to improve the sampling and coverage. Bearing in mind the spacecraft operations constraint, it was considered that similar spacecraft of a same agency could be staggered in phase within the same orbital plane, while different spacecraft could be staggered by small differences in Equatorial Crossing Time (ECT).

Recommendation IIFS-2

When an agency has two or more satellites in the same nominal orbit (e.g. 2pm) that they be staggered by phase (as Metop). With multiple satellites from different agencies it is recommended to stagger them in ECT. (Action: Mitch Goldberg to present to CGMS).

The group went on to discuss the Metop configuration in more detail, noting that it is considered to be sub-optimal for some instruments (e.g., scatterometer, where a closer separation is better) but optimal for others (e.g., the sounders). In order to provide clear guidance for future configurations the group considered that more evidence was needed to determine the best overall orbital separation.

Recommendation IIFS-3

IIFS members to investigate optimal staggering to test working assumption that dual Metop configuration separated by about 180° is best option for future missions.

(Action: IIFS members to provide evidence to IIFS co-chairs of advantages of orbit staggering).

The group noted the significant progress in the use of and impact of MW humidity sounding radiances, in particular the success of the SAPHIR instrument on Meghatropiques and GMI on GPM building on the AMSU-B, MHS, ATMS, MWHS and SSMIS heritage. In particular there is now evidence for the need for high temporal frequency MW humidity sounding observations, alongside microwave imagery data. The group noted that there is more than one proposal being considered for how high temporal resolution MW observations could be provided (polar LEO constellation, Geo MW, HEO MW, low inclination LEO missions).

Recommendation IIFS-4

Provision of high temporal frequency MW humidity sounding radiances (alongside cloud and precipitation sensitive observations). (Action: Jerome Lafeuille to present to WMO Vision 2040 workshop).

Results presented at ITSC-20 showed the specific value of low-inclination LEO missions such as SAPHIR to sample the diurnal cycle, which is helping to separate biases arising from the observations and those arising from temporal sampling during the diurnal cycle.

Recommendation IIFS-5

Provision of low-inclination MW humidity sounding to monitor diurnal cycle. (Action: Jerome Lafeuille to present to WMO Vision 2040 workshop).

The group went on to consider the absolute calibration of satellite observations, noting efforts such as the Horizon2020 projects GAIA-CLIM and Fiduqueo in Europe to establish SI traceability of MW and broadband IR observations to reference observations, as well as CLARREO for hyperspectral observations in the United States. The group welcomed these efforts and encouraged their continuation. The group noted GSICS leadership in this area and encourage GSICS to pay specific attention to SI traceability of hyperspectral sounders.

Recommendation IIFS-6

Achieve SI traceability of operational hyperspectral IR sounders, and ultimately MW sounders, recognising growing need for assessment of calibration uncertainties. (Action: Mitch Goldberg and Peng Zhang to present to GSICS).

The group noted that an issue for the GAIA-CLIM and Fiduqueo projects is the small number of reference observation sites (e.g., only 16 GRUAN stations), and were concerned that some tropical ARM sites may not continue to be funded.

Recommendation IIFS-7

Provide more GRUAN and tropical ARM sites, given the need for ground-based reference measurements. (Action: Mitch Goldberg and Peng Zhang to present to GSICS).

The group noted that the provision of pre-flight characterisation data is very important to the efforts to achieve SI traceability and to diagnose and understand observed biases. However the quantity and quality of this pre-flight characterisation information from MW sensors is not consistent between different agencies. Agencies are encouraged to develop and adopt best practices.

Recommendation IIFS-8

Develop best practices in pre-flight characterisation of MW sensors (Action: Mitch Goldberg and Peng Zhang to present to GSICS).

Finally, in this section, the group noted that whilst efforts to improve the absolute SI traceable calibration of the observations was making progress, this must be complemented by similar efforts in characterising biases in the Line by Line (LBL) model and from quality control procedures such as cloud screening for hyperspectral sounders. Only when the biases in all these areas are well understood and characterised can hyperspectral and MW sounders be considered as an absolute reference within the GOS. The group noted with appreciation the efforts to improve understanding of LBL errors at 183 GHz recently organised by LATMOS, ECMWF and Météo-France.

Recommendation IIFS-9

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. (Action: Mitch Goldberg to ensure this is delivered to IRC and RTWG.)

2.5.5 Radio Frequency Interference Issues

The group welcomed recent successes in work carried out by many agencies including NOAA, EUMETNET, EUMETSAT and ESA, including substantial preparations for the WRC15 due to take place shortly after ITSC-20. However there remains a clear and growing risk to the activities of ITWG from other users of the spectrum. The group therefore discussed in some detail ITWG's role in this area.

Richard Kelley noted that very few incidents of RFI were being noted and reported by the ITWG community. He felt that this was probably down to the ITWG members not knowing what to report or how to report it. Therefore procedures will be circulated to ITWG members and ITWG members are encouraged to be more pro-active.

Recommendation IIFS-10

Clarify reporting procedure for notifying ITU of detected RFI. (Action: Rich Kelley to circulate proposed procedure and ITWG members to follow).

Richard Kelley noted that the WRC-15 will take place shortly after ITSC-20 and offered to provide a summary of issues relevant to ITWG.

Recommendation IIFS-11

WRC outcomes to be provided to ITWG. (Action: Rich Kelley to email summary to ITWG mailing list).

The group noted that it is important that those working on behalf of ITWG have detailed and up to date information on current usage of bands that may be the object of attention from other interested parties (e.g., mobile telecommunications). It was noted that in the United Kingdom the regulatory authority, Ofcom, has been pro-active in engaging with all interested parties, including ECMWF and the Met Office, and recently conducted a user consultation service where ESA and EUMETSAT were also invited. The group encouraged organisations

that provide information to user consultation exercises such as this in their own country to share the information with other agencies. Richard Kelley offered to be a point of contact to receive this information.

Recommendation IIFS-12

IIFS and other ITWG members to provide information on current usage of protected bands to Rich Kelley. (Action: Stephen English to provide copy of recent ECMWF submission to OFCOM, and to request Met Office to provide copy of their submission as well as encourage other NMSs to provide similar information where it exists).

The group noted that in addition to the very strong case for provision of MW Spectral Response Functions (SRFs) for radiative transfer calculations that was made during ITSC-20 there is an equally strong, and arguably stronger, case for their provision of SRFs in support of enforcement of RFI regulation. If RFI is detected by a user or data provider in a particular channel of an instrument (e.g., MHS), the regulatory authorities cannot act unless the detailed SRF is known, because the emission may be from outside the protected band.

Recommendation IIFS-13

To make MW SRFs available to facilitate RFI investigations when needed. (Action: Stephen English to ask co-chairs to combine with Recs from other WGs and communicate to CGMS).

The group noted that the case for allocations of frequency bands for exclusive or shared passive remote sensing is most convincing when based on societal and economic benefit. Therefore the group made two recommendations, the first to update the actual forecast impact of specific bands, and the second to attempt to quantify this in economic terms, as the Met Office did in 2005. Detailed information in such studies is often commercial in confidence, but the total economic impact is useful information. Regulatory authorities may request the detailed financial case, treating all information as commercial in confidence.

Recommendation IIFS-14

Update Steve English's study from 2005 on the value of individual MW protected bands. (Action: Sid Boukabara to ask Thomas Auligné to consider making this part of the FSOI intercomparison study and presenting to the WMO impacts workshop in Shanghai in 2016).

Recommendation IIFS-15

NMSs to attempt to provide an assessment of the economic value of bands based on the impact assessment, as was done by the Met Office in 2005. (Action: IIFS members to investigate in their countries).

2.5.6 Implementation of New Instruments and Continuity Issues in the GOS

The group continues to strongly support WMO's OSCAR and SATURN facilities and thanked WMO for their continuing strong support to the community through their provision. IIFS members reported that OSCAR is now very well established source of information in standard working practices and that the SATURN initiative is also very warmly welcomed. The group encourages WMO to continue to support these efforts and to help establish SATURN through constructive feedback.

Recommendation IIFS-16

WMO and CGMS satellite operators to further maintain OSCAR and SATURN, noting the strong positive feedback from ITWG Members. (Action: IIFS members to review SATURN and provide comments to Stephan Bojinski sbojinski@wmo.int)

It was noted that in addition to the information on SATURN, which is about the preparations for a new satellite, there is also a need to establish best practice in the design phase of new programmes. The group noted the success of the process followed by EUMETSAT for MTG and EPS-SG and Dieter Klaes offered to provide information on EUMETSAT's practices, that could lead to the adoption of best practice.

Recommendation IIFS-17

Provide information on best practice for the design phase of new programmes. (Action: Dieter Klaes to circulate his paper from the ECMWF satellite seminar, and IIFS members to provide similar information to IIFS co-chairs for their agencies if possible.)

As part of the design phase for new programmes some agencies are required to run Observation System Simulation Experiments (OSSEs). The group noted that these are complex to design and get right, and poorly designed OSSEs in the past have given these techniques a bad reputation in some agencies. However the view was expressed that if well designed they can provide useful information. A key part of the establishment of good OSSEs is the Nature Run, and the provision of new and improved Nature Runs with high resolution, more accurate dynamical core and improved physics is recommended. In the past ECMWF and GMAO have been active in provision of Nature Runs.

Recommendation IIFS-18

The NWP community to continue to produce and make available Nature Runs to support preparations for, and fair evaluation of, potential future observations. (Action: IIFS co-chairs to bring recommendation to attention of WMO, ECMWF and GMAO.)

The group welcomed the excellent news that CMA is committed to deploying FY-3E in the so called Early Morning Orbit. This will ensure good coverage of this orbital plane until the end of that mission. At present continuation of e-am coverage after FY-3E (and the plans for a post DMSP e-am mission) remain in the planning stage. The group encourages CMA and DoD to keep in mind during these considerations the need to provide continued coverage in the E-AM orbital plane.

Recommendation IIFS-19

Welcoming the decision of CMA to operate FY-3E on the e-am orbit but noting the current lack of any long-term plan for this orbit, to consider follow-up and back-up missions ensuring continuity of e-am post FY-3E and DMSP. (Action: Nancy Baker and Peng Zhang to pass Rec to DoD and CMA.)

The group recognised the pioneering work achieved for upper stratospheric and mesospheric sounding by the SSMIS instrument. Until recently most NWP models did not extend to these high altitudes. However the group noted that now many centres are becoming more interested in these altitudes both for improving medium range forecasts and seasonal prediction, as well as links to space weather. However given the low level of use of these channels to date

making the case for their continuity is not as straightforward as it is for observations that are already widely used. Nonetheless the group anticipated that their importance will grow significantly in the coming decade. It remains unclear if DMSP spacecraft will fly beyond F-19, and in any case no agency has plans to maintain this capability post-DMSP. The group also noted that RO observations are not sensitive to these very high altitudes so cannot be considered as a substitute. Therefore there is a risk of losing a capability to sound this region of the atmosphere that may be important to the future requirements of operational agencies. The group noted that the development of the WMO Vision for 2040 is an opportunity to emphasise the expected value of these observations on that timescale, and also to feedback to the US DoD the importance of maintaining this capability in the future.

Recommendation IIFS-20

Continue the SSMIS 60 GHz UAS capability, noting the trend for NWP models to extend higher in the stratosphere and lower mesosphere and the development of thermosphere modelling for Space Weather applications. (Action: Nancy Baker to report to DoD and Jerome Lafeuille to raise at WMO Vision 2040 workshop.)

The group noted that whilst in the past most observations have been provided by publicly funded Space Agencies there may be a trend in the future for more commercial companies to acquire observations. The group noted that users have worked closely with Space Agencies over many years to establish high standards of interoperability and usability of missions, coordinating with WMO, and it is important that these same standards are met by all providers of observations, regardless of their commercial interest.

Recommendation IIFS-21

WMO to promote standards to foster interoperability and usability of possible missions from commercial providers. (Action: Jerome Lafeuille or his successor to provide information when the need arises)

It was also agreed that whilst commercial providers may be able to enhance the GOS with provision of non-essential but valuable data it remains important that observations classed as essential are provided freely, with full government control to ensure that this happens.

Recommendation IIFS-22

Secure full government control for observations classed as essential under WMO Res 40. (Action: Mitch Goldberg to Report to CGMS)

Finally the group noted that in future there will be more overlap in the interest of ITWG and all the other CGMS International Science Groups than we have seen in the past (e.g., ITWG and IPWG for rain affected radiances; ITWG, ICWG and IWWG for MTG-IRS; ICWG and ITWG for clouds; IROWG and ITWG for UTLS sounding). The group encourages the co-chairs to continue to engage with the co-chairs of the other Science Groups, and to coordinate where appropriate.

Recommendation IIFS-23

Noting the strong overlap of interest among the CGMS international science groups for some subjects (e.g. ITWG, IWWG and ICWG about MTG-IRS) co-chairs to ensure coordination where appropriate of communications to CGMS. (Action: Mitch Goldberg to Report to CGMS)

The IIFS thanked Jérôme Lafeuille for his outstanding service as co-chair, and wished him well on his forthcoming retirement.

The actions and recommendations from IIFS at ITSC-20 will be reviewed every 3-6 months between ITSC-20 and ITSC-21.