

Advanced Sounder WG

(New) Co-Chairs:

Dorothee Coppens (EUMETSAT) and David Tobin (Univ. of Wisconsin)

Friday morning, 1 Nov 2019

Working Group Goals

The Advanced Sounder Working Group (ASWG) focuses on **scientific issues** affecting the **optimal performance** of advanced satellite sounder systems. The working group reviews **the status of the development** of advanced sounder systems and **recommends changes** pertaining to instrument **specification, performance, data processing, and utilisation**. For the purpose of this group, “Advanced Sounders” are defined as instruments that present **significant new scientific and technological challenges** and which require **new methods** for data processing and utilization. Thus, Advanced Sounders currently include high spectral/spatial resolution passive **infrared and microwave** sounders and **active** sensors.

Advanced Sounders Working Group

ADVANCED SOUNDERS

Web site: <http://cimss.ssec.wisc.edu/itwg/aswg/>

Working Group members: Dieter Klaes (Co-Chair, EUMETSAT), William L. Smith (Co-Chair, SSEC/UW-Madison and Hampton Univ.), Reima Eresmaa (ECMWF), Nigel Atkinson, (Met Office, UK), Olivier Coopmann (Météo-France), Vincent Guidard (Météo-France), James Cameron (Met Office, UK), Stephan Havemann (Met Office, UK), Robert Tubbs (Met Office, UK), Allen Larar (NASA LaRC), Francesca Vittorioso (Météo-France), Imane Farouk (Météo-France), Stefano Migliorini (Met Office, UK), Keyi Chen (CU2T), Will McCarty (NASA GSFC), James Jung (CIMSS), Dorothee Coppens (EUMETSAT), Bertrand Theodore (EUUMETSAT), A.K. Sharma (NOAA/NESDIS), A.K. Mitra (I.M.D., MDES, Delhi), Tim Hultberg (EUMETSAT), Qiang Zhao (NESDIS/STAR), Chu-Yong Chung (NMSC/KMA), Norio Kamekan (JMA), Hyeyoung Kim (NMC/KMA), Kim Meeja (NMC/KMA), Chris Burrows (ECMWF), Kozo Okamoto (JMA/MRI), Yong Chen (NOAA/STAR UMD), Alexander Polyakov (SPBSCU), Kirsti Salonen (ECMWF), Liam Gumley (CIMSS/SSEC), Joe Taylor (SSEC), Hank Revercomb (CIMSS/SSEC), Agnes Lim (CIMSS/SSEC), Zhenglang Li (CIMSS/SSEC), Mohamed Dahoui (ECMWF), Alexander Upensky (SRC "Planeta"), Likun Wang (Univ. of Maryland), Qifeng Lu (CMA/NSMC), JunhYang Heo (NMSC/KMA), Ed Pavelin (Met Office, UK)

(Member list from ITSC-21)

**Status of
Working Group Action Items
from ITSC-21**

Rec-1

In order to make very fast best use of the data it is considered that the availability of the new data and the provision of scientific support to the new Chinese hyperspectral Sounders (GIIRS and HIRAS) are ensured. They will provide an important contribution to the global observing system.

The Russian Meteor-M satellite is flying a hyper-spectral sounding instrument (IKFS-2) the data of which will as well provide an important contribution to the global observation system. It was noted that no Direct Broadcast capability is available so far, which reduces the timeliness of the data for international users. It was noted that the next Meteor satellite will be launched into a morning orbit.

The ASWG noted progress establishing a geostationary ring of hyperspectral sounders to provide global coverage. With the arrival of FY-4A and the planned arrival of MTG-S important building blocks of such systems will be available. ASWG likes to re-enforce its recommendation for a geo-hyperspectral sounding coverage over the Americas, where a crucial gap exists,.

Recommendation AS-1 to Space Agencies (CMA)

Consider to make available as soon as possible the data of the GIIRS hyperspectral data on FY-4A and of HIRAS on FY-3D to the international User community.

Status: Closed; data is available since beginning of 2019 for both

REC-2, REC-3 and Action-1

4) ASWG strongly supports the activities of Roshydromet & Roscosmos of the further development of hyperspectral sounders (of IKFS-2 type) for Meteor-M series satellites as well as encourages providing in Near Real Time (NRT) the data from IKFS-2 to the international community. Along with this the ASWG notes the importance of the works on the development of a new generation of IKFS-sounders with improved spatial and spectral resolution. ASWG noted that next year (2018) a Meteor-M satellite will be launched into a morning orbit.

Recommendation AS-2 to Space agencies (Roshydromet and Roscosmos)

ASWG recommends establishing a Direct Broadcast capability for the data on the Meteor-M satellite, in particular for the hyperspectral IKFS-2 data.

Recommendation AS-3 to Space agencies (Roshydromet and Roscosmos)

ASWG further welcomes the planned development of an improved IKFS sounder and recommends to pursue an availability as soon as possible.

Status: Closed; presented at CGMS in 2018

Action AS-1 to ITWG Co-chairs:

Bring these recommendations to the attention of Space Agencies at CGMS

Rec-4 and Action-2

The ASWG noted with interest and satisfaction that further work has been performed to increase the spatial resolution in order to improve the probability of a uniform scene with the instrument FOV (all clear or all cloudy). Studies were presented to the ASWG (references W. Smith and H. Revercomb and Harris) which provide a trade-off for smaller FOVs.

Recommendation AS-4 to Space agencies

Implement the presented approach with future hyperspectral infrared Sounder developments.

Action AS-2 to ITWG Co-chairs:

Bring this recommendation to the attention of Space Agencies at CGMS

Status: Closed; presented at CGMS in 2018

Rec-5 and Action-3

The cost and complexity of hyperspectral instruments are some of the obstacles for their fast and widespread development. If proven and flying technologies are used as the basis for a new development, it could be possible to achieve a faster implementation and a wider distribution of this measurement technology.

ASWG noted with interest a presentation discussing these aspects on the basis of the ABI instrument (reference H. Revercomb and Harris). In particular, because of the use of ABI on US, as well as Japanese and Korean geostationary satellites, the ability to achieve geo-hyperspectral sounding, as well as the current imagery, with an upgrade of the ABI instrument appears to be an optimal approach for enhancing the desired global geostationary sounding system.

Recommendation AS-5 to Space agencies (NOAA?)

Consider to implement the presented approach with future imager and hyperspectral infrared Sounder developments.

Action AS-3 to ITWG Co-chairs:

Bring this recommendation to the attention of NOAA.

Status: Closed, will discuss more at WG

Rec-6 and Action-4

Recommendation AS-6 to Space Agencies (NOAA & NASA)

a) Make greater use and interpretation of available airborne systems.

This will serve as pathfinder for new systems, and will be much more cost effective.

(Primarily to NOAA) recommend greater field campaign use / exploitation of existing aircraft validation sensors for enhanced measurement system (sensors, algorithms, data products) validation AND data processing / algorithm improvements for handling complex scenes of most meteorological significance (ie cold scene retrievals, surface emissivity over snow and ice, aerosols and clouds, etc).

b) Invest in hardware for next generation sounder Specification.

(NOAA and NASA). Recommend investment for developing advanced aircraft sensor system hardware to enable new and improved airborne validation sensors to serve as pathfinders for the development and risk mitigation for the next generation atmospheric satellite sounding system sensors. The aircraft sensor specifications (spatial, spectral, radiometric, temporal) should far exceed current day SOP to fulfill the desired pathfinder role.

Status: Closed, but needs further formulation/discussion

Action AS-4 to ITWG Co-chairs:

Bring these recommendations to the attention of Space Agencies at CGMS.

Rec-7 and Action-5

Recommendation AS-7 to Space Agencies

Consider to provide non-apodised data to Users and have Users perform the application related apodisation.

Alternatively users could use reconstructed radiances

Action AS-5 to ITWG Co-chairs:

Bring this recommendation to the attention of Space Agencies

Status: Closed for MTG-IRS

MTG IRS software package issues

MTG-IRS software package – questions for NWP and/or Advanced Sounder WG

Were discussed in the working Group and endorsed.

Which of the following would you like to see implemented in IRSP?:

- Ingest of the MTG-IRS NetCDF4 input files (obviously this has to be done).
- Generation of RRs for specified channels. A channel selection appropriate for RRs would need to be defined. Who will do this? Not more than ~150 in each band.
- Conversion to some other PC basis set – different from the one used by EUMETSAT.
- Output in BUFR for the RRs and/or PC scores? If so, somebody needs to propose a BUFR sequence because we don't want multiple sequences to evolve.

A note on NetCDF4 and BUFR, saying that BUFR still will be needed and NetCDF will have to be formalised.

- Output in NetCDF4 (or some other format?) for the RRs.
- Spatial sub-sampling, e.g. thinning. How?
- Ability to change the apodisation (e.g. light to heavy). Can be done by manipulating the eigenvectors.
- Options to use, or not to use any “extra PCs” that might be generated dynamically by EUMETSAT (see Tim Hultberg's talk 8.04).
- Ability to generate eigenvectors from *full-spectrum* datasets. This will in any case be done by EUMETSAT, but do users want to do it themselves also? *Note: think carefully before requesting this because it will need many spectra (>100000). May need access to EUMETCast-terrestrial.*
- Produce modular code that can be integrated into NWP Centre's own software.

Rec-8 and Action-6

ASWG encourages concept studies and missions utilizing hyperspectral IR instruments with reduced spectral range and higher spatial resolution on constellations of small sats (including, cube sats), to evaluate the benefit of high temporal measurements, and retrievals of temperature and humidity. These could provide a baseline for upcoming geostationary missions in terms of: ideal spatio-temporal sampling and spectral tradeoffs for new applications in clear sky and above cloud such as 3D winds (AMVs derived from humidity fields on vertically stacked pressure surfaces in the troposphere) and time rate of change in atmospheric stability (precursors of severe weather). These types of missions have the endorsement of the National Research Council, NASA, and the NWP community as a potential source of global 3D wind information.

There is a need to study the utility of sounder measurements from small satellites as supplements to the global observing system. This first includes the characterization of the instruments, which are fundamentally expected to be different from the existing global observing system due to their low-cost, small-sized nature. Second, how these instrument effects translate onto the exploitation of these observations, be it as retrieved products or within assimilation, should be studied.

Recommendation AS-8 to Space Agencies

Consider to conduct such studies.

Action AS-6 to ITWG Co-chairs:

Bring this recommendation to the attention of Space Agencies.

**Status: Closed; presented at CGMS in 2018.
More discussion on small sats at WG**

Available expertise in ASWG

The lack of expertise in the room on microwaves, active sounding etc. was noted. However the WG encouraged the development of higher spatial resolution microwave sounder systems to enable these data to be used with hyperspectral infrared measurements for obtaining convective-scale atmospheric sounding measurements.

**See Advanced Sounder WG “charter” ...
Microwave, IR, and active sensors please join
us on Saturday**