

2.4 ADVANCED SOUNDERS

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2.4.1 Review of the Scope of the Advanced Sounder Working Group

Meetings of the Advanced Sounder working group will focus on scientific issues affecting the optimal performance of advanced satellite sounder systems. The working group will review the status of the development of advanced sounder systems and recommend changes regarding to instrument specification, performance, data processing, and utilization where necessary. For the purpose of this working 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 infrared and microwave sounders and active sensors.

2.4.2 Status of plans for advanced sounding instruments

The working group noted the successful implementation of the first US advanced Atmospheric Infrared Sounder (AIRS) and significant progress on the development of the IASI (Infra-red Atmospheric Sounding Interferometer), CrIS (Cross-track Infrared Sounder), IRFS-2 (Infra-Red Fourier transform Spectrometer), and the GIFTS (Geosynchronous Imaging Fourier Transform Spectrometer) advanced sounding instruments. Table 2.4-1 summarizes characteristics of these instruments, and Figure 2.4-1 summarizes their planned operating periods. The characteristics of these instruments are described in more detail on the ITWG web site. The working group also noted progress on plans for advanced microwave sounders and their characteristics are listed on the ITWG web site.

Action

J. Eyre to update IR and MW sounder tables on ITWG web site before ITSC-14.

Action

A. Huang to implement a web page for the Advanced Sounders Working Group on the ITWG web site.

2.4.3 New initiatives for geostationary sounding

The working group discussed developments since ITSC-12 in sensors for sounding of the atmosphere from geostationary orbit.

Recommendation (to space agencies):

The ITWG recommends that system design simulations and other studies be completed for the purpose of identifying optimized performance/cost/risk/benefit approaches for candidate geostationary and MEO microwave sensors. This microwave system would supply data for temperature and moisture soundings and time-resolved precipitation mapping.

2.4.4 The use of the NPOESS requirements change process

Recommendations for NPOESS requirements updates or changes can be facilitated through a U.S. Dept. of Defense (DOD) process. This process requires members to make a performance/cost/benefit presentation to the Joint Agency Requirements Group (JARG) which may be an interactive process. Users are then polled to determine if the proposed requirement change is beneficial to their respective agency. Once consensus is reached, JARG members from NOAA and DOD ask their respective agency to fund the change. Once funding has been identified and the requirements approval by the JARG and the Senior Users Requirements Group (e.g. weather and oceanography service directors from agencies), the proposed change is handed to the NPOESS executive committee for approval. Once approved, the NPOESS IPO executes the change. Recommendations for NPOESS requirements changes or updates should use the above process, which for the ITWG can be facilitated by Mitch Goldberg, the NESDIS liaison to the JARG.

Recommendation to ITWG

Any recommendation concerning NPP and NPOESS advanced sounding instruments' requirements change should use this process by presenting the relevant study results to the JARG through Mitch Goldberg.

2.4.5 Implementation of advanced sounders

The working group discussed improvements which could be made to the CrIS instrument on NPOESS. Several recommendations are made below:

Recommendation (to NPOESS Joint Agency Requirements Group (JARG)):

ITWG recommends that the entire interferogram be sampled and transmitted to the ground for all three spectral bands of the NPOESS CrIS instrument. This will allow full spectral resolution to be achieved for the midwave and shortwave N₂O/CO₂ bands as well as for the longwave bands. Full spectral resolution in all three bands is important for improving boundary layer temperature and upper tropospheric water vapor sounding as well as for extraction of trace gas profiles for climate data records. In addition the longwave extent of the shortwave band of the CrIS be extended to include the 4.7 μm band of CO lines. Measurement of tropospheric CO is important for monitoring and forecasting air quality and for associated impacts to atmospheric chemistry climate.

Recommendation (to NPOESS Joint Agency Requirements Group (JARG)):

ITWG recommends that the 0530LT and 1330LT NPOESS platforms retain full CrIS and ATMS measurement capability. These two satellites together with the 0930 METOP satellite will be able to provide 4-hour frequency high resolution soundings that are important for improved global weather predictions (see recommendation in 2.3.4 related to this)

Recommendation (to NASA):

ITWG recommends that the orbit of the NPP satellite be changed from 1030 to a time that better complements the 0930 orbit of the METOP satellite. This is important to improve the global sampling of high vertical resolution soundings for global weather prediction.

Experience with AIRS' data has revealed that 90% of the AIRS 15 km FOVs contain cloud which limits the accuracy and vertical resolution of tropospheric soundings. The proper combination of instantaneous FOV and radiometric sensitivity should be defined so as to optimize CrIS sounding performance for the most generally occurring partly cloudy scene condition. Specifically, FOVs with a linear dimension of 8 km, or smaller (as suggested by the Huang et al. study presented at ITSC-13) should be considered after investigation of the spatial sampling impacts of the smaller FOV sizes on the accuracy of the retrieval results.

Recommendation (to NPOESS Joint Agency Requirements Group (JARG)):

The Field-of-View size for CrIS should be redefined so as to optimize sounding performance under partly cloudy sky conditions.

2.4.6 Data processing, inversion and assimilation

NOAA have started to make available some of the documentation to selected members of the ITWG for review. This is to be welcomed. However further documents for all sensors are still required. Several recommendations and actions given below were agreed during these discussions.

Action (Hal Bloom):

ITWG requests that the user communities be provided with, and invited to review, the draft specifications (content and format) for the raw data records (RDRs) and sensor data records (SDRs) for NPOESS/NPP instruments.

Recommendation (to IPO and NPOESS Joint Agency Requirements Group (JARG)):

ITWG recommends that the user communities be invited to assess and comment on the performance of NPOESS/NPP sensors and processing algorithms, especially calibration data and algorithms, in a timely fashion to enable suitable preparation for processing and interpretation of data from the flight mission.

Action (Allen Larar / Chair of SOAT):

Interact with the NPOESS IPO to facilitate a mechanism for ITWG members to obtain NPOESS ground processing and field terminal design parameters, including draft input data file formats, draft processing design documents, draft interface control documents and draft hardware specification documents through collaborations with the NPOESS SOAT.

Recommendation (to CGMS):

ITWG recommends that responsible agencies establish focal points to ensure that ingest and pre-processing code for future advanced sounders (and their complementary imagers) is provided, in a form suitable for use with locally-received direct read-out data, and yielding output consistent with globally processed data. Furthermore, activities are to be undertaken to integrate this

code into processing packages available for international distribution in a timely manner.

Recommendation (to IPO and NASA):

ITWG recommends that ingest code for NPP instruments (CrIS, ATMS and VIIRS) be made available by IPO to the external scientific community, and that such algorithms should be integrated into a processing package for locally received data available for international distribution.

2.4.7 Characterization of spatial response

The spatial responses of some sensor fields of view are still not being measured pre-launch to the required accuracy.

Recommendation (to space agencies):

ITWG recommends that the spatial responses of advanced sounders should be characterized to a level at which the associated error does not cause the total noise budget of the instrument to be exceeded, and, where achievable at reasonable cost, to a level at which the associated error is a negligible contribution to the total system noise.

2.4.8 Validation of data and products

To accelerate the full and early utilization of advanced sounders' data and products, validation of both data and products must be made as soon as possible. High quality global in-situ measurements are required to help achieve this goal.

Recommendation (to NOAA and NASA):

The Advanced Sounder working group strongly supports the Satellite Upper Air Network (SUAN) initiative proposed by the Satellite Sounder Science and Products working group (see action in 2.6.11).

The SUAN effort will provide a large quantity of in-situ measurements early in the lives of these satellite missions, potentially shortening validation times and accelerating the utilization of validated data and products.

2.4.9 Workshop for Soundings from High Spectral Resolution Sounders

A 3-day workshop for soundings from High Spectral Resolution Sounders was recently hosted by ITWG members from University of Wisconsin-Madison and demonstrated useful scientific exchanges and established shared resources and knowledge that may enable the optimal processing and future utility of advanced sounding data. These more in-depth workshops than are possible during the ITSC meetings would aim to accelerate the use of, and optimize the information provided by, high spectral resolution measurements from advanced sounders. The workshops would actively seek to involve young scientists in the field.

Recommendation (to ITWG):

The Advanced Sounders working group recommends that ITWG organize periodic Advanced Sounding workshops to be held independently of the main ITSC meetings and plans should be made to hold a workshop in Europe before ITSC-XIV.

2.4.10 Glossary of instruments

ABI	Advanced Baseline Imager (for GOES-R+)
AIRS	Atmospheric Infrared Sounder
AMSR	Advanced Microwave Scanning Radiometer
AMSU-A	Advanced Microwave Sounding Unit – A
AMSU-B	Advanced Microwave Sounding Unit – B
ATMS	Advanced Technology Microwave Sounder
AVHRR	Advanced Very High Resolution Radiometer
CMIS	Conical-scanning Microwave Imager/Sounder
CrIS	Cross-track Infrared Sounder
GIFTS	Geosynchronous Imaging Fourier Transform Spectrometer
GLOBUS	Multi-channel scanning radiometer
HSB	Humidity Sounder - Brazil
IASI	Infra-red Atmospheric Sounding Interferometer
IRAS	Infra-red Atmospheric Sounder
IRFS-2	Infra-Red Fourier-transform Spectrometer
HES	Hyperspectral Environmental Suite (for GOES-R+)
MHS	Microwave Humidity Sounder
MODIS	MODerate-resolution Imaging Spectroradiometer
MTVZA-OK	Module for atmospheric temperature and humidity sounding - oceans
MWTS	MicroWave atmospheric Temperature Sounder
MWHS	MicroWave atmospheric Humidity Sounder
VIIRS	Visible/Infrared Imager Radiometer Suite