

## 2.6 SATELLITE SOUNDER SCIENCE AND PRODUCTS

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

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### 2.6.0 Introduction

The Working Group on Satellite Sounder Science and Products (SSSP) was formed to identify and promote international activities in the science of derived meteorological products from environmental satellite measurements. The learning environments associated with such work, both operational and research, on global, regional and local (direct readout) scales, are fundamental to improving our understanding and utility of such data in weather forecast and climate applications. They encompass a wide variety of activity, for example, the multiple parameters (temperature, moisture, precipitation, clouds, gases, etc.) produced, the different stages of scientific development and applications, and the numerous opportunities for cross validation and analysis. The main goal of SSSP is to facilitate access and dissemination of this information mainly through our web site: <http://cimss.ssec.edu/itwg/sssp>

The following report summarizes the topics of discussion, recommendations and actions from the SSSP working group meetings held at ITSC-XVI.

The main recommendations and actions focus on a re-structure of the web site main topic areas and organization of sub-topics within and distribution among WG members to perform these actions. All topic and sub-topic areas are also to include brief descriptions informing users of the purpose and content to be found in the respective areas.

### 2.6.1 Web Site Cover Page

#### Discussion/Recommendation

It was agreed that the web site cover page needs to be updated. All topic and sub-topic areas are also to include brief descriptions informing users of the purpose and content to be found in the respective areas.

#### Action SSSP-1 (L. Lavanant, T. Reale T. Achtor, Bozena, Natalie )

- Review and revise SSSP site cover page (Achter and Bellon)
- Provide brief descriptions of topic and sub-topic areas (as identified below)
- Mailing list
- Statistics on site use

## **2.6.2 Direct Readout Facilities (RARS and EARS networks)**

### **Recommendation/Discussion**

This topic area identifies local sites that are actively receiving, ingesting, processing and/or archiving polar satellite data facilitated via HRPT survey to attain feedback and to update associated directories.

The identification and contact with HRPT, X-band direct readout facilities for operational and research polar orbiting satellites shall continue.

Sites comprising the EARS (EUMETSAT ATOVS Retransmission Service) HRPT network are identified with links. In parallel, the Asia-Pacific RARS (Regional ATOVS Retransmission Service) for the Southern Hemisphere is discussed but has wide coverage gaps. The identification of participating RARS sites is needed and requests for facilities within the Pacific (Hawaii, Guam, French Polynesia) and Antarctica regions to join RARS in the interest of further extending RARS coverage shall be pursued.

Special identification and coordination of direct readout stations in developing Latin America and Africa countries need to be pursued

Broad revision of the direct readout topic area and sub-areas to include tabular listings of the subsets of sites as described above and associated inputs received, including the satellites, instrument data, processing packages, associated measurements and products, validation, distribution and site links to be pursued as feasible.

The wider goal is to develop/maintain direct readout facility correspondence with the hope to draw wider participation of this grass roots community to the ITSC conferences.

### **Action SSSP-2 (L. Lavanant, K Strabala, G. Weymouth, D Griersmith, Gloria Pujol, Nigel, Bill B, )**

- **Continue the search and solicitation of inputs from the global direct readout community via existing survey, internet and other WG members (Lydie)**
- **Specific identification and solicitation from sites in Hawaii, Guam, French Polynesia and Antarctica regions to improve RARS coverage (Weymouth, Griersmith)**
- **Identify direct readout sites in Latin American and African countries (Gloria Pujol and Lydie)**
- **Review/revise tabular format to summarize direct readout sites and information (Bellon...)**
- **Develop mailing lists/communication among identified direct readout sites and ITSC-WG (Lydie)**

### **2.6.3 Derived Product Categories**

#### **Recommendation/Discussion**

Among the existing derived products categories (sounding, wind, cloud, precipitation, surface, gas Radiance, Level-3) it was agreed to add net radiation and to clarify radiance as a subsequent process of adjustment after calibration.

It was agreed to distribute among specific WG members the responsibility for contacting and as necessary updating existing contributions and to pursue the identification of new contributions.

It was agreed to categorize each contribution base on Research, Operational, Global, Regional, Direct Readout, Weather and Climate

#### **Action SSSP-3**

**The respective products under this topic area shall be maintained by assigned WG members and will include contacting existing contributors to assure currency and to pursue additional inputs through internet search. This will include a brief description of each product and revised categorization to identify among the following aspects: operational, research; global, regional, direct readout; weather, climate.**

- **Soundings (Tony, Lihan)**
- **Surface, Precip (Sid, Limon)**
- **Cloud/Arosol (Lydie, Filomena...)**
- **Trace Gas (Anton and Lihang)**
- **Radiance (Tony)**
- **Radiation (Limon and Lihang); new product**

## 2.6.4 Information/Access To Direct Readout Processing Packages

### Discussion/Recommendations

Software packages to ingest and process HRPT data from existing and planned satellites are needed by the direct readout community to create navigated, calibrated datasets and to derive products.

The current AAPP software allows for the processing of locally received MetOp observations up to level-1d for IASI, HIRS, AMSU and MHS and up to level-1b for AVHRR.

*“The International MODIS/AIRS Processing Package (IMAPP) provides ground stations the capability to ingest direct broadcast data from Aqua and produce calibrated and geo-located AIRS/AMSU/HSB radiances (and selected AIRS level-2 products)”.*

International Polar orbiting Processing Package (IPOPP) is more newly developed (in alpha stage) for processing of level 2 products from IASI and Cris....

Status and availability of ICI and 3I for ATOVS and expansion to process IASI is required.

1DVAR processing capabilities based on NWP apriori and or NWP independent (climate, regression) apriori (and including the availability of coefficients as needed) are also identified in this area.

Plans for processing packages from NPOESS (CrIS and VIIRS (also planned for NPP satellites) and associated scientific approach are needed.

Plans for local processing systems using (as available) direct broadcast from Chinese FY-3,3A/B, India and Russian satellites need to be clarified.

Procedures for co-registering the GOME and AVHRR observations with IASI data on MetOp need to be developed and made available, either inside the AAPP package (as it is done for AVHRR to HIRS) or through an independent route.

Wide review/restructuring of HRPT area segregated by processing up to the 1d level and the level 2 respectively shall be pursued

### Actions SSSP-4

- **Review, update and restructure the direct readout processing packages topic area to clearly delineate latest status of available packages for processing existing (and historical) satellite observations and plans for future satellites. (Katheleen Strabala, John Overton, Lydie, L Gumley, Nigel A, Bozena ...)**

### Action SSSP-4a A. Kaifel, P. Schlüssel, N. Atkinson, R. Saunders, K. St Germain, Overton ...

- **Determine the current status of planned instrument co-registration onboard MetOp and planned NPP and NPOESS satellites**
- **Define requirements for additional instrument co-registration.**
- **Encourage processing package providers (EUMETSAT, CIMSS) to incorporate available co-registration procedures**

## **2.6.5 Scientific Agencies**

### **Discussion/Recommendation**

This topic area is intended to identify scientific organizations and respective links to identify status of current polar satellites programs (NOAA, EUMETSAT, NASA, China, India, Russia).and plans for future satellite programs

Topic area contains several mis-placed links to instrument descriptions, data access and scientific processing packages which are addressed elsewhere within the SSSP site and need to be removed.

It was agreed that the satellite survey previously forwarded to each agency as a guide toward their providing sufficient information is no longer needed and to be removed.

The sub areas for this topic are to include Scientific Organizations and Satellite Programs

### **SSSP-5 Actions (Session 11 speakers, Karen St Germain ...)**

- **Update/append scientific Organizations web sites as needed (Canada, China...)**
- **Update Satellite programs and include links to polar satellite programs from China and India and Russia (session 11)**
- **Restructure web set (Bill Bellon)**

## **2.6.6 Current Instrument Description/Status and Future Instruments Description Recommendation/Discussion**

The topic area on instrument status includes links to identify NOAA and EOS satellite status and various links to indicate health and monitoring. Similar links for EUMETSAT MetOp are required

There are also inappropriate links, for example, which identify calibration coefficients and other data useful for processing respective sensor data that need to be removed and/or relocated.

Better access and identification to routine, daily Level-1 monitoring (ie SAF) need to be appended.

Current and future Instrument characteristics and associated agency programs as identified through specific link to WMO web site areas to be appended.

Topic area needs to be expanded to include polar satellites from India, Russia and China (supplemented through link to WMO site)

Similarly, access to information concerning near term future satellites, for example NPP, FY-3A/B and NPOESS, is also needed to facilitate timely planning for the processing of these data. Most (all) of these are available on the WMO site.

### **Action SSSP-6 (Dieter, Bellon, Reale)**

- **Provide Links for the monitoring of EUMETSAT MetOp instruments (Dieter, Lars F)**
- **Restructure and clean up this topic area (Bellon)**
- **Identify selected portions of WMO web site (from Jerome LaFeuille) identifying current and planned satellite instruments, respective specifications and associated agency program for inclusion (Reale)**

## **2.6.7 Consistency between local and global packages**

### **Recommendations/Discussion**

The coherence between local and global processing packages with respect to the scientific algorithms and output data formats is important to facilitate their simultaneous assimilation into NWP and Climate models.

This has been taken into account, for example, in the development of MetOp operational and AAPP processing software for ATOVS and IASI pre-processing through level-1c data which include format interface routines (in AAPP) to convert data from the core ground segment (CGS) to AAPP formats.

Similar efforts should be considered in conjunction with IMAPP (for MODIS, AMSU, AIRS) and for planned NPP, FY-3 and NPOESS (IPOP) processing systems.

Calibration consistency issue...

### **Action SSSP-7 (K. St. Germain, N. Atkinson, A. Huang, J. Overton, SSSP co-chairs)**

- **Report on the strategy of ensuring local/global coherence for IMAPP (Aqua)**
- **Report on the strategy for NPP, FY-3 and NPOESS through contacts with national agencies and direct readout packages developers responsible for software and data output data formats.**
- **Provide status and (calibration) information on the SSSP web site**

## 2.6.8 Data Access

### Recommendation/Discussion

Formerly the topic are “Useful Datasets for Satellite Processing”, it was discussed that this site scope should be widened to include the following:

- Routine data ... includes format descriptions and readers
- pre-launch data – simulated data set
- Test data – level-1 and level-2
- Coefficients
- Ancillary Data
- Selected field experiments (Jaivex ...)
- Collocated Observations

Routine data pertains to the ability to access (any time) the level-1 and level 2 products from global satellite and EARS/RARS programs (NOAA, NASA, EUMETSAT, China, India and Russia) along with data formats and as available software readers.

Pre-launch are the sets of simulated observations made available prior to launch for exercising newly developed software systems

Test data at the level-1 and level-2 are to be made available by the global centers, RARS and EARS, perhaps once per six months via dedicated FTP site, and intended for coordinated system checkout

Coefficients are those used in the respective processing ranging from calibration to those used for Level-2 (ie limb correction, RT bias...)

Ancillary data describe global geographical and physical parameters (ie, terrain, elevation, emissivity) typically as atlas useful for processing satellite observations

Selected field campaigns include the satellite, and associated field campaign observations (underflight/overflight, radiosonde, dropsonde, surface observations ...)

Capability to obtain collocated sample (daily, selected orbit or orbit segment) of raw (1a and 1b formats), pre-processed (1c and 1d formats) and processed (level-2) observations (including cloud mask) as available from operational centers (NESDIS, EUMETSAT) and direct readout sites (EARS, RARS) is considered highly useful. Observations of immediate interest would include HIRS, AMSU-A and AMSU-B, MHS, AVHRR, MODIS, AIRS and IASI.

As appropriate, include (particularly for Test data to check out the processing package) information on data format and optimally a software reader for the data.

### Actions SSSP-8

- **Routine data and software readers (Session 11...)**
- **Pre-launch data – simulated data set (St Germain...)**
- **Test data at the Level-1 and Level-2 (Session 11...)**
- *EARS/RARS via EUMETSAT, Tokyo, Melbourne ... (Dieter, Griersmith ...)*
- **Coefficients (AK, Dieter, Singh...)**
- **Ancillary (Lydie, Eva Borbas...)**
- **Selected Field experiments (Jaivex of current interest) (B. Smith...)**
- **Collocated observations (Tony, Lydie...)**

### **2.6.9 Impact of HIRS sounder fov size (... left over from ITSCXV)**

The ITWG was a strong proponent of decreasing the field of view of HIRS from 17km to 10km, which was achieved for the HIRS-4 sounder on-board NOAA-18. The scientific impact of this change on cloud detection (and also cloud and sounding products) needs to be demonstrated. Agencies such as NOAA and CIMSS that are routinely involved in the processing and validation of scientific products from operational polar satellites provide a suitable environment for such investigations.

Unfortunately, the unstable operation of the HIRS onboard NOAA-18 prevented any meaningful evaluation using this satellite. However, the 10km resolution HIRS from MetOp can be used to measure impact with the potential for more meaningful results given the availability of concurrent HIRS and hyper-spectral infra-red data from IASI. Unfortunately, direct comparison against the lower resolution (17km) HIRS onboard NOAA-15 and 16 are also undermined by the relatively unstable operation of HIRS on those satellites; NOAA-17 has a stable HIRS but no AMSU-A which undermines cloud detection. The Advanced Sounder WG also discussed this issue in relation to recommendations for the CrIS field of view size (see recommendation AS-7)

#### **Recommendation SSSP-9 to NOAA, CIMSS and EUMETSAT**

**These agencies are encouraged to investigate the impact of the 10km vs. 17km field of view with respect to improved cloud detection and cloud clearing.**

#### **Action SSSP-9 (to SSSP co-chairs)**

- **Forward recommendation SSSP-9 to respective NOAA and CIMSS scientists to investigate the impact of the higher resolution (10km) HIRS on cloud detection and sounding products.**
- **Forward recommendation SSSP-9 to EUMETSAT scientists to quantify the impact of higher resolution HIRS with coincident IASI data on MetOp.**



## **2.6.10 Cal/Val**

### **Recommendation/Discussion**

It was agreed that routine access to currently available validation datasets of collocated radiosonde, operational polar satellite and numerical weather prediction soundings as compiled by operational agencies, for example NOAA, NASA and EUMETSAT, would provide users with important information to validate and tune their respective scientific algorithms and applications which utilize these observations.

The Cal Val area contains a (preliminary) utility which allows users to interrogate collocations of NOAA operational ATOVS soundings and radiosondes over a one week period (March 2007). It was agreed to expand to compare/analyze radiosondes and nwp versus expanded suite of satellites including NOAA /ATOVS/ MIRS from NOAA-18 and MetOp satellites, GOES, Aqua-AIRS and COSMIC level 2.

Historical Cal/Val studies using evolving collocation data base at NESDIS (beginning with TOVS) and SNO (ChengZhi) analysis to be facilitated.

The Cal Val area also contains several documents (web sites) discussing emerging validation protocols associated with the evolving GCOS reference upper air network (GRUAN) that are also in need of updating, as well as some older documents that need to be removed.

Discussions entertained possible validation strategies to designate selected global target areas in the vicinity of evolving GRUAN sites for which “useful” data describing the surface information, cloud classification (including cloud nephanalyses), ambient weather (temperature, moisture, precipitation) could be integrated with the routinely available satellite data and products from the global centers, EARS and RARS leading to potentially valuable research case studies (including RT model).

### **Actions SSSP-10**

- **update existing utility (NPROVS) to include Aqua-AIRS, COSMIC, GOES and MetOP inter-comparison/analysis (Reale, Bellon)**
- **Existing satellite program/agency collocated observations (Reale...)**
- **Availability/analysis of historical collocation database and SNO dating from TOVS (1979) (Reale, Cheng-Zhi Zhou, Bellon..)**
- **make available NOAA versus EUMETSAT ongoing case study comparison of respective level 2 products (Reale, McKernan, Lars F)**
- **Append GRUAN web site and pursue case study validation at GRUAN sites (Thorne...) ... synchronization and frequency protection studies**

### **Action SSSP-10a**

**Co-Chairs, Walter Wolf, all WG members**

- **Investigate and report on opportunities and feasibility of further developing the validation areas.**
- **Coordinate the expansion of the designated “Validation” topic area of the SSSP web site to provide an efficient validation tool**

### **2.6.11 Visualization Topic Area (new)**

#### **Discussion/Recommendations**

Discussions included the creation of a new topic area to provide access to available data visualization techniques.

McIDAS X and V.

Collection of known visualization tools for processing packages and links to the McIDAS or the RTTOV GUI including brief descriptions of these tools (Nathalie). (... new subscription in scientific processing packages...)

Multiple sensor horizontal co-registration visualization packages (Kleespies) for selected sensors

Available NESDIS visualization using Environmental Data Graphical Evaluation (EDGE)

Others to be determined

#### **Actions SSSP-11**

- **McIDAS X, V (Achter...)**
- **Processing packages ... (Natalie, Nigel, Lydie, Tom A...)**
- **Co-registration (Kleespies)**
- **NOAA global EDGE (Reale)**
- **Other (tbd)**

### **2.6.12 Education (new)**

#### **Discussion/Recommendations**

Discussions included the creation of a new topic area to provide access to education and training (J. Eyre suggestion that this topic area be moved from International to SSSP WG).

Initial discussions were to pursue existing resources at CIMSS and Cooperative Program for Meteorology Education and Training (COMET) from UCAR, and others to be determined.

#### **Actions SSSP-12**

- **Educational programs at CIMSS (Achter)**
- **COMET (Achter, Reale, Tony Mostek (UCAR)...) )**
- **Others from International (Paolo...)**