

## Products and Software Working Group

18<sup>th</sup> March 2023

Present:

Graeme Martin (SSEC) & Nigel Atkinson (Met Office) - co-chairs

Scott Mindock (SSEC), Liam Gumley (SSEC), Jean-Marie Lalande (Météo-France), Jun-Hyang Heo (KMA), Inchul Shin (KMA), Naoto Kusano (JMA), Haruma Ishida (JMA), Nathalie Selbach (DWD), Marc Crapeau (EUMETSAT), Anna Booton (Met Office), Guido Masiello (Univ. Basilicata), Thomas Lebrat (Météo-France), Andy Heidinger (NOAA), Bomin Sun (NOAA/STAR), Lihang Zhou (NOAA)

### Agenda:

1. Introductions
2. Review of open actions and recommendations from ITSC-23
3. Status of existing software packages  
(CSPP-LEO, AAPP, MWIPP, IRSPP, FY3, CSPP-GEO, IMAPP, PPS ...)
4. New and future sensors and plans for supporting software  
(NOAA-21, FY-4B, FY-3E, EPS-SG, MTG, GEO-XO, EPS-Sterna (AWS), GOSAT-2 FO, GK-2 series, KMA LEO, ...)
5. DBNet status and plans
6. Cloud services and cloud data distribution
7. Best practices for software, product distribution and data formats
8. CGMS High Level Priority Plan
9. PSWG web site
10. PSWG co-chairs
11. Any other business

### 1. Introductions

The participants introduced themselves. The group was reminded of the scope of the PSWG:

- Both Level 1 and Level 2 satellite products;
- Software tools and packages for generating, analyzing, and visualizing products;
- Enabling end users to obtain or generate the products they need;
- End user feedback and training;
- Exchange of information for validation of products;
- Informing the user community about requirements for future missions; and
- Informing agencies about requirements of the users

### 2. Review of actions and recommendations

Note: presentations from the 2022 “interim meeting” are linked from <https://cimss.ssec.wisc.edu/itwg/itsc/2022interim/index.html>.

ITSC22-PSWG-6: Migration of the UW/SSEC/CIMSS web site to Wordpress is ongoing. *Action remains open.*

ITSC23-PSWG-1 on VIIRS clusters: The software for performing the NOAA cluster analysis (presented in talk 6.03) is planned to be integrated into CSPP by the end of 2023, which will provide consistency

between NOAA products and direct broadcast products. Agreed that the *action can remain open* until that task has been completed.

ITSC23-PSWG-2 on developments in PC representation: The EUMETSAT “hybrid approach” is due to be made operational in EUMETSAT products on 30<sup>th</sup> March 2023. This approach has also been used by NOAA and by SSEC. It is still desirable to monitor the status therefore the *action remains open*.

ITSC23-PSWG-3 on NOAA CLASS access methods. Information had been shared at the Interim Meeting. Also, it was noted that there is a new access method for data in the Amazon Cloud called NOAA Open Data Dissemination (NODD). *Action closed*.

ITSC23-PSWG-4 on sharing experiences with working with containers. Liam has updated his guide for building AAPP, OPS-LRS and Metopizer in *Apptainer*. Graeme also presented a document on CSPP GeoSphere and a document on deploying containers in the Cloud. *Action closed*.

Other experiences: DWD have done some work on running software in the EUMETSAT cloud. EUMETSAT are considering making containers for the EARS processing software (on physical machines). Liam’s poster on ultra-low latency CrIS was noted: this makes use of the Amazon cloud.

**New action PSWG-1: PSWG co-chairs to share on the PSWG web site the documents related to containers that were presented at the meeting.**

ITSC23-PSWG-5 on facilitating running software in Windows. The next release of IMAPP will be via a container that is compatible with Windows. *Action closed*.

ITSC23-PSWG-6 and 7 have already been closed following input provided during or following ITSC-23.

### **Review of recommendations**

It was agreed that the following recommendations have continuing value and should be carried over. They are re-numbered below to reflect the fact that they are recommendations from ITSC-24.

Recommendation PSWG-1: Software providers should, where possible, offer their software with a choice of either pre-built binaries or source code.

Recommendation PSWG-2: For software that will be built from source by the user, software providers should list recommended versions of required external (COTS) libraries.

Recommendation PSWG-3: Costs to users should be considered when migrating software and data distribution to the cloud.

Recommendation PSWG-4: Users should continue to have free access to satellite data.

Recommendation PSWG-5: Software providers are encouraged to provide and test software in a cloud-ready format.

It was agreed that a recommendation related to AMSR-2 direct broadcast software could be dropped, as it has been established that there are no plans to make this software publicly available, and no strong user requirement has been identified.

### **3. Status of existing software packages**

Liam gave a presentation on the status of CSPP LEO. More information is available from the web site of the CSPP User Group Meeting in 2022.

- The next release of CSPP SDR will support OMPS Nadir Profiler and Nadir Mapper (not the Limb instrument).
- CSPP products are mostly defined by NOAA.
- CSPP SDR 4.0 will add support for NOAA-21, and is planned for release in April 2023, after NOAA-21 reaches provisional status
- CSPP packages currently run on CentOS7, which will reach end of life in June 2024
- CSPP SDR 4.0 will be the last package to be built on CentOS7. All subsequent CSPP LEO releases will be built on Rocky Linux 8.
- Users should avoid processing two JPSS satellites simultaneously. CSPP team recommends the use of 64 cores, 256GB RAM, SSD drive and Rocky Linux 8.

Nigel talked about the EPS-SG direct broadcast level 1 software:

- Being procured by EUMETSAT
- Separate package for each instrument
- NWP SAF will test each package and supply wrapper scripts, etc.
- NWP SAF plans to release to users 6 months before launch of the respective satellite (i.e. Metop-SG-A1 or Metop-SG-B1)
- The IASI processor in particular will require a large number of cores if processing is to be completed in a reasonable time, e.g. 88 cores would allow a 12-minute pass to be processed in 16 minutes, but 32 cores would increase this time to 47 minutes. These figures are provisional but are of some concern to users.

Experiences with the FY-3E DB package were shared. The Met Office and EUMETSAT are receiving FY-3E. The first release of the software package had some issues but an update (March 2023) appears to work well. The software has to be requested from CMA, but there are no known restrictions on sharing L0 data.

Graeme presented a slide on CSPP Geo and demonstrated the CSPP GeoSphere interactive website.

Liam reported that funding for the NASA Direct Readout Laboratory (DRL) will cease on 1 July 2023. It was noted that RT-STPS is still an important piece of software and ongoing support to users will be provided, though the exact mechanism for that support is not yet clear.

#### **4. New and future sensors and plans for supporting software**

Andy Heidinger gave a presentation on GEO-XO. This relates to a NOAA satellite with a hyperspectral sounder, for launch in 2036. To occupy a central location over the USA at 105 degrees west. There will be a rebroadcast service (like the current GRB) but it will be via a commercial satellite and will not have capacity to carry all the sounder data, only a subset. Instead, a terrestrial service will be used. It is likely that a PC compression will be used for the sounder but it is unknown whether it will be used for direct broadcast / rebroadcast. The list of products is not yet known.

**Recommendation PSWG-6 to data providers:** Explore the use of principal component (PC) compression to reduce the volume of hyperspectral sounder data in future geostationary direct broadcast or rebroadcast streams

Nigel introduced the EPS Sterna mission, pointing out that “Sterna” is an Arctic tern that migrates between the Antarctic and the Arctic. It will have a microwave sounder payload and there will be L-band direct broadcast. In parallel, the US is developing its own smallsat mission called SMBA. They will also be launching a spare ATMS flight model in 2025 called QuickSounder.

It was noted that Spire are also considering developing a microwave mission. (Spire have a highly successful GPSRO constellation).

**Recommendation PSWG-7 to space agencies:** Consistency in data content and data formats between the various planned smallsat microwave missions would be highly beneficial for users.

It was noted that Himawari-10, due for launch in 2029, will have a hyperspectral IR sounder.

As a general recommendation for new missions:

**Recommendation PSWG-8 to space agencies:** Direct broadcast should be preserved for users who cannot get timely data by terrestrial means

## 5. DBNet status and plans

Nigel gave a brief summary:

- NOAA-18, NOAA-19, Metop-B, Metop-C, S-NPP and NOAA-20 are received widely and the data disseminated.
- Aqua (AIRS) is received by SSEC stations
- FY-3D (MWTS/MWHS/MWRI) by EUMETSAT stations
- NOAA-21 and FY-3E will be added soon
- New stations in India, Africa and French Guiana were noted
- More information in Mikael Rattenborg's talk (16.02)

## 6. Cloud services and cloud data distribution

This has been largely covered in the review of actions.

A potential problem with cloud processing is that vendors of cloud facilities sometimes provide interfaces that allow users to access their systems, but these interfaces can tie users into the specific cloud system. Users still need to be able to run their software outside the cloud.

**Recommendation PSWG-9 to software developers:** Software developed in the cloud should be vendor agnostic.

Containers and the cloud are closely related. Two approaches could be considered: either (i) develop the application in a container (not in the cloud) and then migrate to the cloud later, or (ii) develop the application in a container that is in the cloud.

## 7. Best practices for software, product distribution and data formats

It was pointed out that containers can be a valuable tool for software build purposes: by building a software package in a container the developer can control exactly what the environment needs to contain, even if the eventual deployment will not be in a container.

**Recommendation PSWG-10 to software developers:** Consider building software packages in a container with a controlled environment, even if the eventual deployment will be outside that container.

Nigel raised the issue of netCDF4 in which the Fortran API does not support all the features of the netCDF4 standard. Examples include variable length strings and enumerated datasets. These can be found in test data for MTG-IRS released by EUMETSAT. More worryingly, different versions of the test data alternate between using these constructs and not using them – with no mention of this in the EUMETSAT documentation. SSEC had also come across this issue some years ago. A workaround is to use the HDF5 API rather than the netCDF API.

**Recommendation PSWG-11 to data providers:** when creating or releasing test data, it is good practice to state which APIs the data are compatible with, and whether there are any changes (e.g. since the last release) that affect compatibility with the standard reader APIs.

There was a discussion on the use of Conda. This can be a valuable tool for allowing 3<sup>rd</sup> party software to be downloaded and run. But operational centres often have constraints on which Conda channels can be accessed.

**Recommendation PSWG-12 to software providers:** software intended to be run in an operational context should only link to open source 3<sup>rd</sup> party packages (e.g. on Conda Forge).

Graeme mentioned an issue with streaming geostationary imagery that has come up before in PSWG discussions. When the data are streamed in chunks, it would help greatly if metadata pertaining to a particular chunk could be transmitted alongside that chunk – rather than waiting for the end of the entire image. This is still a problem with GOES imagery data.

**Recommendation PSWG-13 to raw data providers:** in streaming data formats,, metadata should be transmitted inline with the corresponding section of raw data to which it pertains to support near real-time and low latency applications.

## 8. CGMS High Level Priority Plan

Several topics of relevance were picked out from the HLPP guidance issued by ITWG co-chairs:

- Protection of the band 1695-1710 MHz (used for LEO direct broadcast to user stations) from planned new frequency usage by commercial satellite systems, etc.
  - This is relevant to direct broadcast from NOAA POES and Metop. These data are used operationally (e.g. DBNet). L-band is also planned to be used by EPS Sterna, so protection remains important.
- Facilitate the transition to new LEO direct broadcast systems (JPSS, FY-3, MeteorM, Metop-SG)
  - This is an important part of the remit of PSWG. The group has reported progress in software for processing JPSS, FY-3 and Metop-SG.
- Develop efficient standardized data handling for high-resolution imaging and hyperspectral instruments
  - The principal components (“hybrid”) compression was discussed in the PSWG meeting, and is becoming an operationally accepted tool.
- Conduct an intercomparison study between the different methods to derive level 2 data from infrared hyperspectral sounders, recognising that there are several software packages available that utilize AIRS/IASI/CrIS data
  - NOAA Products Validation System (NPROVS), funded by JPSS operated at NOAA/STAR, is an enterprise products validation system. In conjunction with graphic tools developed, NPROVS has the capability of conducting routine monitoring and

analysis of satellite sounding products through comparing them with radiosondes (global conventional, and dedicated and GRUAN radiosondes) and NWP products, and through products intercomparison. NPROVS is capable of conducting the assessment of L2 products derived from new infrared sensors or new retrieval algorithms (POC: Bomin Sun and Tony Reale, NOAA/STAR).

- The PSWG cannot commission intercomparison studies but what we can do is to make sure that the list of software packages on the PSWG web pages are up to date, so that groups who are in a position to do comparisons have up to date information.

**Action PSWG-2:** PSWG co-chairs to port the current list of software packages to the new web site (when available) and to solicit the help of PSWG members to update the tables.

Finally, the question was asked as to whether FCI will scan south to north or north to south. It would be good if different GEO missions could have some consistency in this aspect.

## **9. PSWG web site**

Migration to Wordpress is underway. Covered by ongoing action ITSC22-PSWG-6.

## **10. PSWG co-chairs**

Nigel has been co-chairing this group for 11 years and would like to step down before ITSC-25. Suggestions welcomed for a replacement.

## **11. AOB**

There was no other business.