An update on NWP SAF satellite data processing packages to support EPS-SG and MTG

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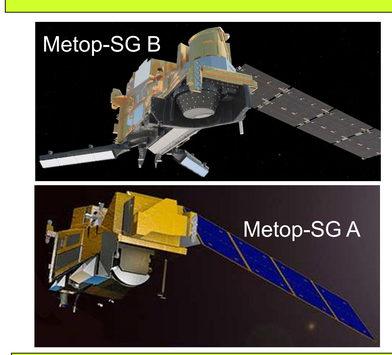
1. Introduction



The NWP SAF aims to improve and support the interface between satellite data/products and European activities in NWP.

This poster describes the satellite data processing packages that are being developed to support the new EUMETSAT missions that will be launched in 2024-2025: Metop-SG and MTG, with a particular focus on the sounding instruments.

During the course of 2022, new test datasets have been released by EUMETSAT, and there have been several NWP SAF software releases to allow users to evaluate the new test data. Users are encouraged to try out the new releases and provide feedback via the NWP SAF Helpdesk

2. Microwave Imager Pre-processor (MWIPP)

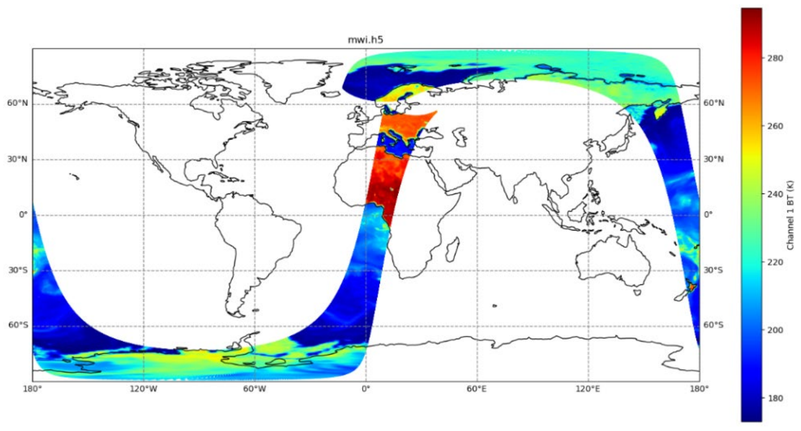


Figure 1. MWI test orbit issued by EUMETSAT in Nov 2022. Channel 1 brightness temperature is shown.

MWIPP is a generic microwave imager pre-processor, first released in 2019. It supports several current MW imagers: SSMIS, AMSR-2, GMI, MWRI. Functionality includes: creation of BUFR files; spatial averaging and thinning; re-mapping channels to a common grid.

The package was updated in 2022 to process the first release of EUMETSAT simulated MWI/ICI data in netCDF format.

Latest release: February 2023 (version 1.2) – supporting EUMETSAT test data issued in November 2022. This is a full orbit of level 1B data for MWI and ICI.

The software performs the following steps when processing MWI and ICI for use in NWP:

- Map ICI, and all MWI channels, to a reference geolocation which is chosen to be that of a central feedhorn (118 GHz recommended)
- Spatial averaging and thinning (if requested by the user), to reduce noise and data volume. The input data are heavily over-sampled for both MWI and ICI.
- BUFR encoding, using a generic MWIPP sequence

Gives a factor 20 decrease in data volume compared with EUMETSAT's 1B input, while still retaining a spatial resolution of ~10km.

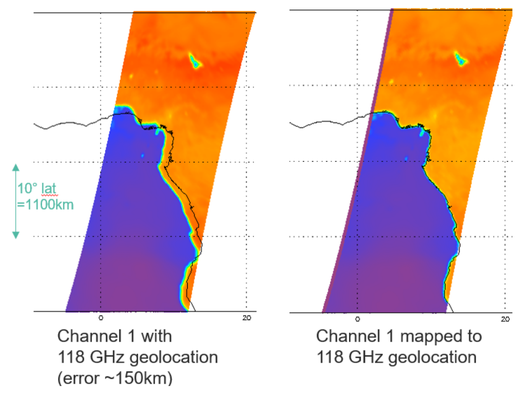


Figure 2. MWIPP maps all MWI/ICI channels to a common set of geolocation points

3. MTG Infrared Sounder Pre-processor (IRSPP)

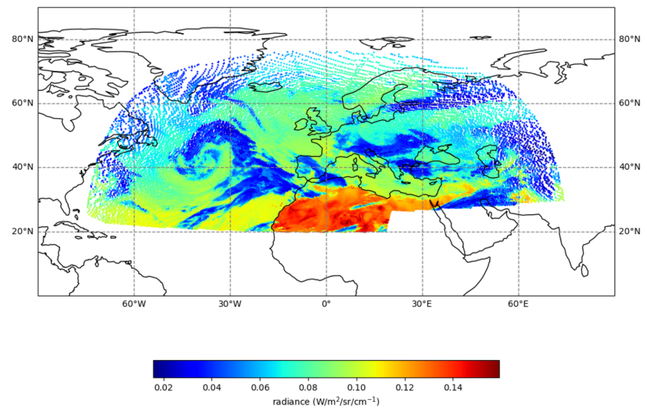


Figure 3. Reconstructed radiance at approximately 10.8μm for "LAC4" from test data issued by EUMETSAT in Nov 2022.

IRSPP is a pre-processor for the MTG-IRS instrument. The near-real-time dissemination of level 1 data will be in the form of *principal component scores, in netCDF format*. Many NWP centres will want to transform this to reconstructed radiances *in BUFR* before assimilating – IRSPP provides this capability.

Latest release: February 2023 (version 1.2) – supporting EUMETSAT test data issued in November 2022.

The software supports the following operations for MTG-IRS data:

- Ingests EUMETSAT's netCDF files for PC scores (available in NRT) or full spectra (available from the Data Centre). Also ingests EUMETSAT-supplied eigenvector files.
- Computes reconstructed radiances for a user-defined set of channels
- Optionally thins the data. A "warmest field of view" mode is available. Thinning specifications are user-defined: the user may wish to make this dwell-dependent (see Table 1).
- Encodes the reconstructed radiances and/or PC scores into BUFR
- As a research task, it can generate eigenvectors given full-spectra input files, or transform from one PC basis set to another

Thinning	Area	Run time for 1 dwell (sec)	Size of output BUFR file (MB)	Dwells per day	Daily volume (GB)
None	global	6.8	19.8	6720	133
1 in 4	global	3.2	4.94	6720	33
1 in 16	global	1.5	1.25	6720	8.4
None	LAC4 dwells 48, 49, 61, 62 (UK area)	6.8	19.8	192	3.8

Table 1. Data volume of BUFR products for various thinning strategies. These figures can be used to size storage datasets. The input dwell (PC format, netCDF) is 32.5 MB in size, corresponding to 10s of observation.

4. ATOVS and AVHRR Pre-processing Package (AAPP)

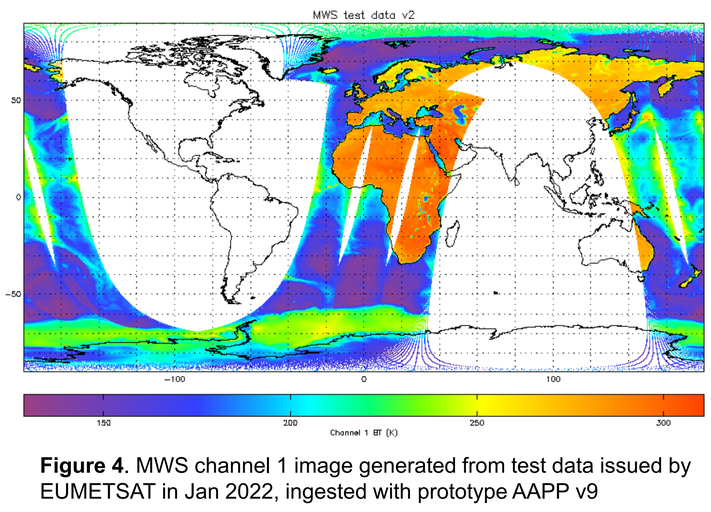


Figure 4. MWS channel 1 image generated from test data issued by EUMETSAT in Jan 2022, ingested with prototype AAPP v9

AAPP was originally developed more than 25 years ago for processing ATOVS and AVHRR data from the NOAA POES satellites (both direct broadcast and level 1B from NOAA). Subsequently it has been extended to support Metop, JPSS and FY-3 satellites.

An extension to handle MWS and IASI-NG on Metop-SG is being prepared. Although formally part of AAPP v9 (to be released in 2024), this will be a standalone package – see the Top Level Design and other documents linked from . The software will ingest

- Global/regional data in netCDF or BUFR from EUMETSAT
- Direct broadcast data in netCDF from the EPS-SG L1 processors (section 5)

and will perform filtering, re-mapping and BUFR encoding functions in a similar way to current AAPP capability for Metop, JPSS and FY-3.

The main aim is to prepare the MWS and IASI-NG data for assimilation in NWP systems.

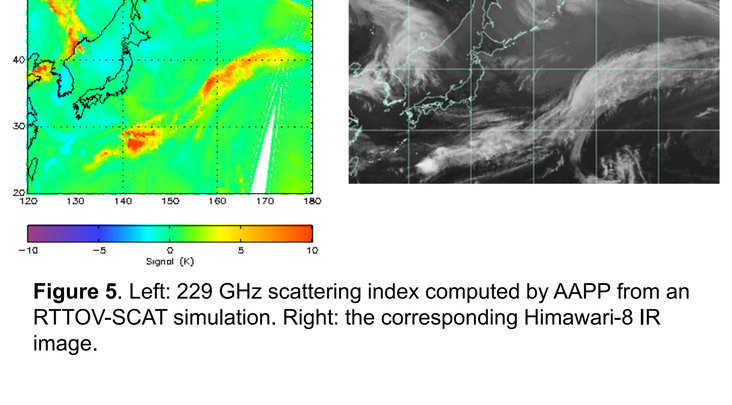


Figure 5. Left: 229 GHz scattering index computed by AAPP from an RTTOV-SCAT simulation. Right: the corresponding Himawari-8 IR image.

5. EPS-SG direct broadcast level 1 processors

EUMETSAT are procuring processors to support direct broadcast users who receive raw EPS-SG data:

- a "level 0" processor to transform from raw CADU to EPS-SG level 0
- level 1 processors for METimage, MWS and IASI-NG on the "A" satellite
- level 1 processors for MWI, ICI and SCA on the "B" satellite

In most cases, the processors will be re-engineered versions of prototype software developed by EUMETSAT. The exception is the IASI-NG processor which will be CNES software. Source code will be available (mainly C++ and Fortran90).

The output of these packages will be netCDF, in the same format as EUMETSAT use for the global data. These outputs can feed into MWIPP and AAPP for onward processing (e.g. BUFR encoding).

The IASI L1 processor will accept, as an input, the METImage cloud mask from NWC SAF's *PPS* package.

The NWP SAF will test each software package, distribute them to users and will provide user support. Users can expect initial versions about 6 months before launch of each satellite.

Figure 6: Direct broadcast reception system at Exeter

6. Summary

- New versions of MWIPP and IRSPP are already available that are compatible with test data publicly released by EUMETSAT. Prospective users are encouraged to download and try out the packages.
- For AAPP, the processing of IASI-NG and MWS will mirror the current processing of IASI and AMSU – but appropriately adapted to take account of new capabilities.
- EUMETSAT are actively preparing DB software for EPS-SG, and the NWP SAF plans to provide the software to users about 6 months before launch of each Metop-SG satellite.

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