

Update on the NWP SAF satellite data processing packages: AAPP, MWIPP, IRSPP



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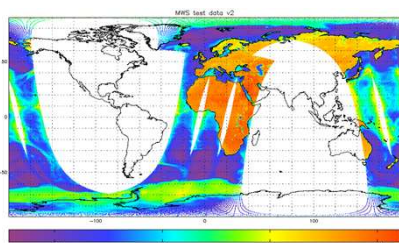
Supporting the use of satellite data for NWP

Introduction

The Arctic Weather Satellite Proto-Flight Model (AWS-PFM), launched in August 2024, carries the cross-track "Microwave Radiometer for AWS mission", MWR (AWS). In order for the radiometer data to be assimilated in NWP several processing steps may be needed. As such the AAPP software package has been extended to facilitating the remapping of the brightness temperatures from the four feedhorns to a common geolocation, and BUFR encoding of the level 1 product, preparing the data for use in NWP.

The poster summarises the latest updates for AAPP, MWIPP and IRSPP. Additionally, the NWP SAF is also involved in testing and hosting several Direct Broadcast level 1 packages; preliminary test result highlights are presented.

ATOVS and AVHRR Pre-processing Package (AAPP) – Extended to AWS and EPS-SG



MWS channel 1 image generated from test data issued by EUMETSAT in Jan 2022, ingested with prototype AAPP-EPSSG

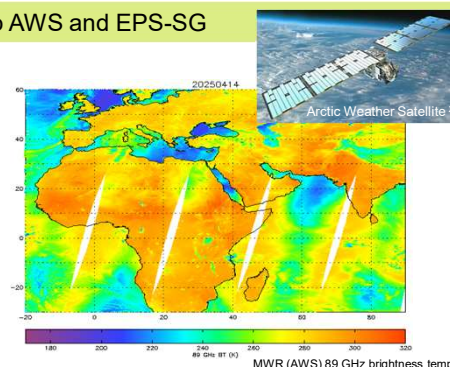
AAPP supports the processing of a variety of instruments on NOAA POES, METOP, JPSS and FY-3 satellites. These include HIRS, AVHRR, AMSU, MHS, IASI, ATMS, CrIS, VIIRS, MWTS, MWHS, and MWRI.

AAPP-AWS: For MWR (AWS)

AAPP v8.14 (Jan 2025): the AAPP-AWS module was introduced, facilitating the processing of MWS (AWS) by ingesting level 1B data, and performing filtering, re-mapping (described in the introduction) and BUFR encoding in a similar way to current AAPP Metop/JPSS/FY-3 capability. Spatial averaging noise reduction is also available for selected channels.

AAPP-EPSSG: For MWS and IASI-NG

Similar support for Metop-SG's MWS and IASI-NG payload is also being prepared. It will be available after the launch of Metop SG-A1 as the new, stand-alone "AAPP-EPSSG" package, alongside AAPPv9.



EPS-SG direct broadcast level 1 processors - testing the packages



Installation of new direct broadcast reception system at Exeter in 2024. Photo: Nigel Atkinson.

Package testing is underway for the software EUMETSAT procured to support direct broadcast users who receive raw EPS-SG data. The packages are:

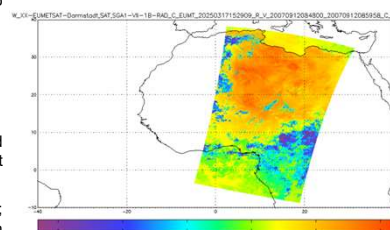
- Level 0 Processor: Transforms raw VCDU (Virtual Channel Data Units) to EPS-SG level 0.
- Level 1 Processors:
 - For METImage, MWS, and IASI-NG on the "A" satellite.
 - For MWI, ICI, and SCA on the "B" satellite.

The processors are re-engineered versions of prototype software developed by EUMETSAT (in C++ and Fortran) with the exception of the IASI-NG processor, which is produced by CNES (Java). They output netCDF files suitable for passing to MWIPP and AAPP for onward processing (e.g. BUFR encoding)

Testing: Having installed the RPMs, processing for both L0 and L1 data is generally looking encouraging; we're working with EUMETSAT to resolve some (hopefully) minor issues. Software can be run natively on Redhat9 or using Apptainer on other OS. An example of successful processing of the sample METImage (aka Visible Infrared Imager (VII)), L1 data is shown (right).

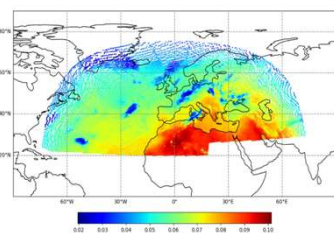
Other results of note are that IASI-NG data is big – it required 64 virtual cores and 128 GB memory to process 14 min data in 14 minutes!

Users can expect initial versions to be available on the NWP SAF website ~6 months after launch of each satellite.



METImage data, 10.6 µm channel. Processing 12 mins (1 min granules) segment was processed in 7 minutes on 16 cores (CPU time 21 minutes), using Redhat 9.

Infrared Sounder Pre-Processor (IRSPP) - a pre-processor for MTG-IRS



IRS radiance at 10.8 µm, pre-launch test data.

The IRSPP package will enable NWP centres to transform disseminated level 1 MTG-IRS data from *principal component scores* in netCDF format, into *reconstructed radiances* in BUFR, as required by many NWP data assimilation systems.

The software includes:

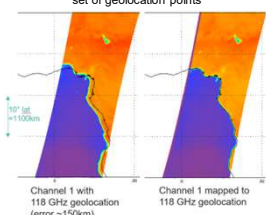
- Ingests EUMETSAT's netCDF files for PC scores (which will be available in NRT) or full spectra (available from the Data Centre). Also ingests EUMETSAT-supplied eigenvector files.
- Computes reconstructed radiances for a user-defined set of channels
- Optionally thins the data. A "warmest field of view" mode is available. Thinning specifications are user-defined: the user may wish to make this dwell-dependent
- Encodes the reconstructed radiances and/or PC scores into BUFR

IRSPP v1.3 (Oct 2024) – supports EUMETSAT's newer (July 2024) pre-launch test data, has improved output BUFR sequence and provides an option to convert to PC-RTTOV basis functions instead of HT-FRTC. It has also been successfully tested with EUMETSAT's January 2025 test data. Expect real data ~12 months after launch (i.e. mid-2026).



Microwave Imager Pre-processor (MWIPP)

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



MWIPP, a generic microwave imager pre-processor released in 2019, supports SSMIS, AMSR-2, GMI, and MWRI. It creates BUFR files, performs spatial averaging and thinning, and re-maps channels to a common grid.

- Initial support for processing EUMETSAT's EPS-SG simulated MWI/ICI data was added at v1.1. As such, ICI can be mapped onto MWI's central (118 GHz) feedhorn to form a super-instrument. Then, applying the (optional) spatial averaging to the heavily over-sampled data, a factor 20 decrease in data volume compared with EUMETSAT's 1B input can be achieved, while retaining ~10km resolution and reducing noise.
- BUFR encoders/decoders for MWI and ICI will be implemented in MWIPP v1.3, due autumn 2025.

Summary of the Updates

- AAPP
 - Processing of MWR (AWS) was introduced at AAPP v8.14
 - AAPP v9, and AAPP-EPSSG (a new stand-alone package) will be released after the launch of Metop SG-A1 and will include processing for MWS and IASI-NG.
- EPS-SG direct broadcast level 1 processors are being tested
 - IASI-NG processing is resource hungry!!
- IRSPP v1.3 is available now, v2 will be due on completion of MTG-S1 post-launch data validation (mid 2026)
- MWIPP v1.3 coming soon, v2 will be due after the launch of Metop SG-B1.