NWP SAF

Design proposals for EPS-SG pre-processing in AAPP and MWIPP

Version 1.0

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EPS-SG pre-processing in AAPP and MWIPP

This documentation was developed within the context of the EUMETSAT Satellite Application Facility on Numerical Weather Prediction (NWP SAF), under the Cooperation Agreement dated 7 December 2016, between EUMETSAT and the Met Office, UK, by one or more partners within the NWP SAF. The partners in the NWP SAF are the Met Office, ECMWF, DWD and Météo France.

Change record			
Version	Date	Author / changed by	Remarks
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1. INTRODUCTION

This document presents a proposal for accommodating EPS-SG data in the deliverables AAPP and MWIPP. This relates to pre-processing operations such as filtering and re-mapping. It does *not* include processing of direct broadcast data to level 1B – that will be achieved using dedicated level 1 processors to be procured by EUMETSAT and made available to users by the NWP SAF through the "EPSSGL1" activity.

An important aim of this document is to provide a reference for user consultation. Consolidated user requirements for the software packages will later be fed into formal NWP SAF Product Specification documents and Top-Level Design documents.

Prototype software has already been developed to demonstrate most of the functionality described in this document, using test datasets already made available by EUMETSAT[1]. This provides confidence that the designs are realistic.

2. INPUTS

2.1 Supported instruments

The following instruments are to be supported by the AAPP and MWIPP software packages:

On Metop-SG-A satellites:

- MWS
- IASI-NG

On Metop-SG-B satellites:

- MWI
- ICI

It should be noted that AAPP currently generates products derived from visible/IR imagers (i.e. AVHRR and VIIRS), but it is not planned to do this (within AAPP) for the METimage sensor. Instead, it is planned that the NWC SAF, which provides support to nowcasting and very short range forecasting, will extend its PPS deliverable to include a cloud mask for METimage. Then for direct broadcast users this cloud mask can be fed into the IASI-NG level 1 processor in order to populate fields such as cloud fraction in the IASI-NG level 1c dataset. However, this is not the subject of the NWP SAF software under discussion.

The characteristics of the instruments are summarised below, together with key differences compared with current instruments. For details, see the relevant pages on https://www.wmo-sat.info/oscar/instruments or https://www.eumetsat.int/metop-sg.

[1] https://www.eumetsat.int/eps-sg-user-test-data

- MWS is a 24-channel microwave sounder with frequencies ranging from 23.8 GHz to 229 GHz. Its scanning principle is similar to NOAA's ATMS instrument, i.e. all channels are sampled at the same rate. Low frequencies are therefore over-sampled, and noise reduction is possible through spatial filtering[2].
- IASI-NG has the same spectral range as IASI (645 to 2760 cm^{-1}) but sampled at 0.125 cm^{-1} as compared with 0.25 cm^{-1} for IASI. Thus IASI-NG has 16921 spectral samples compared with IASI's 8461. It has the same spatial sampling as IASI (approximately 25km) but achieved using a 4x4 detector array, compared with IASI's 2x2. Also, IASI-NG has 4 spectral bands, compared with IASI's 3 bands.
- MWI is a 26-channel microwave imager with conical-scan geometry and with frequencies ranging from 18.7 to 183 GHz. The spatial resolution varies from 50km at low frequency to 10km at high frequency. The data are heavily over-sampled in the scan direction in order to facilitate re-mapping. There are 1394 samples per scan, separated by 1.6 km, with 9 km between scans. It has 8 feedhorns that are *not* aligned spatially, and therefore pre-processing is needed if they are to be aligned for user applications. Details are available in a EUMETSAT presentation[3].
- ICI is a 13-channel microwave imager with frequencies ranging from 183 to 664 GHz. The spatial resolution is approximately 16 km. It has 7 feedhorns, and like MWS it is over-sampled in the scan direction: 784 samples/scan, separated by 2.7 km, with 9 km between scans. ICI scans in the opposite direction to MWI.

2.2 Datasets

EUMETSAT have decided, following an earlier user consultation, that the primary distribution format for EPS-SG data will be netCDF version 4, which has an underlying hdf5 structure. Therefore the packages described here will need to ingest:

- MWS, MWI and ICI level 1b in netCDF
- IASI-NG level 1c and level 1d in netCDF

Some of these datasets may also be produced by EUMETSAT in BUFR format, but details are not yet available. It is likely that any datasets generated as part of WMO's DBNet system (Direct Broadcast Network) will need to be in BUFR, in order to facilitate distribution via the Global Telecommunications System (GTS).

Ancillary files are also required for some operations (e.g. for handling Principal Components) and these will normally also be in netCDF or hdf5.

2.3 User facilities

It is assumed that users will be running the NWP SAF software on a workstation running Linux or a similar Unix-like environment. Windows operating systems will not be supported.

[2] https://nwp-saf.eumetsat.int/site/download/documentation/aapp/NWPSAF-MO-UD-027_ATMS_CrIS.pdf
[3] https://events.ecmwf.int/event/146/contributions/1157/attachments/401/773/JCDSA-Cloud-WS-Accadia.pdf

Detailed requirements (e.g. cores, memory) will be specified later. But in general we would expect the software to run satisfactorily on a mid-range server similar to that currently specified for AAPP. See, for example, the AAPP v8 Product Specification, available at https://nwp-saf.eumetsat.int/site/software/aapp/documentation/

3. SOFTWARE DESIGN

As with other NWP SAF deliverables, it is planned that the software will normally be made available in the form of source code, to be compiled by the user. But this is an aspect that users made wish to provide feedback on. For example, in recent years there has been interest in building AAPP in Singularity containers, see under "Links to external resources" in the AAPP User Guide.

In common with most other NWP SAF software deliverables, it is planned that the EPS-SG software will be written in Fortran90, with some extensions that are available in modern compilers (e.g. using Fortran2003 constructs to handle variable length strings in hdf5). Use of Fortran90 is consistent with NWPSAF-MO-SW-002 "Development Procedures for Software Deliverables".

MWIPP v1.0 currently supports several microwave imagers (SSMIS, GMI, MWRI, AMSR-2) and inclusion of MWI and ICI does not require major changes to the design. The only significant difference is that calls to the netCDF Fortran API will be needed, whereas currently only the hdf5 library is used. The existing build system, using a shell *configure* script and simple Makefiles, will be retained.

AAPP v8, on the other hand, is a package with several decades of history, predominantly written in Fortran77, but with some parts written in C and others in Fortran90. It has a perl-based configure script that is rather complex. For AAPP v9 it is proposed to split AAPP into two sections:

1. The existing AAPP functionality will continue as-is, with the existing build system
2. The EPS-SG functionality will be a separate module, written entirely in Fortran90 and using the build system that is successfully implemented in MWIPP (and will also be used in the IRSPP deliverable for processing data from MTG-IRS).

This arrangement ensures that existing functionality can be easily supported (as there are few changes), but also facilitates rapid development of the new functionality. It also recognises the fact that not all AAPP users will need the EPS-SG modules and not all users of the EPS-SG modules will need the legacy AAPP functions.

The user will need access to external libraries, which will be common to AAPP, MWIPP and IRSPP:

- hdf5, with Fortran enabled
- netCDF C
- netCDF Fortran
- ecCodes

A script will be provided to allow users to download and install these easily, without the need for Administrator privilege.

4. FUNCTIONALITY OVERVIEW FOR AAPP (EPS-SG COMPONENT)

4.1 MWS standalone

For MWS, the following requirements are foreseen:

1. Ingest MWS level 1b data in netCDF format
2. Perform spatial filtering and thinning in the same way as is implemented for ATMS, in order to reduce noise and to match the footprint sizes. The user can select either FFT methods or *n* x *n* averaging. See document "Appendix: Pre-processing of ATMS and CrIS"[4]
3. Write out data in BUFR, or append the filtered brightness temperatures to the input netCDF file. A prototype BUFR sequence is given in Section 6.
4. Microwave tests as currently implemented in AAPP, including surface classification, precipitation, scattering. The surface-sensitive channels are the same as AMSU/ATMS (apart from polarisation), but we have the additional 229 GHz channel available for ice cloud detection. Details to be worked out. The BUFR sequence mentioned above does not include these fields, so a second BUFR sequence may be needed (equivalent to the current ATMS1D).

This workflow for steps 1-3 is illustrated in Figure 1.

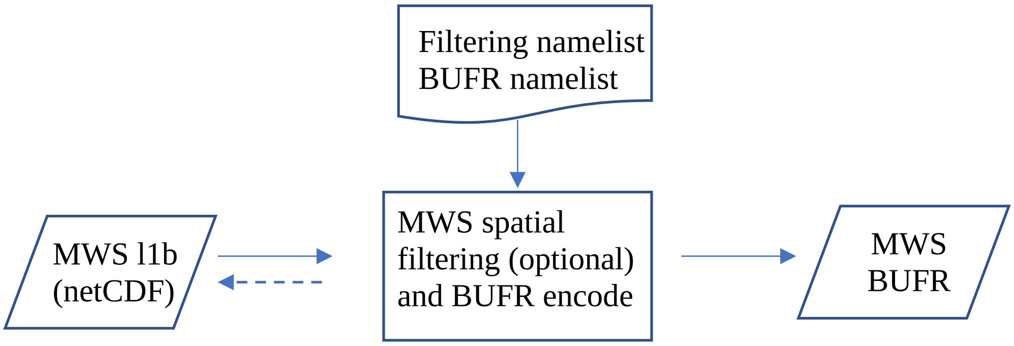

Figure 1: Workflow for the MWS processor (MWS_main.exe)

4.2 IASI-NG and MWS

For IASI-NG, the following requirements are foreseen

1. For normal NRT use, most users would expect to ingest IASI-NG level 1d files (netCDF), which include PC scores but no radiances. However, some centres may wish to use level 1c instead of, or in addition to, the level 1d.

[4] https://nwp-saf.eumetsat.int/site/software/aapp/documentation/

2. Generate reconstructed radiances for a channel selection, or alternatively raw radiances for a channel selection if level 1c has been read
3. By converting the eigenvectors, there should be an option to generate reconstructed radiances equivalent to those from IASI first generation.
4. Map MWS to IASI-NG (with spatial filtering for MWS as discussed in 4.1)
5. Spatial thinning for IASI-NG. Similar to that implemented for IASI
6. Write out data in BUFR, or append the filtered brightness temperatures to the input netCDF file. A prototype BUFR sequence is given in Section 6.
7. Direct broadcast users may need to convert from level 1c to level 1d, if this functionality is not provided in the level 1 package.

As mentioned earlier, one difference between IASI-NG and IASI is that IASI has a 2x2 detector array whereas IASI-NG has a 4x4 array (see Figure 2). This means that the IASI thinning strategy of selecting 1 field of view per field of regard (i.e. 1 in 4, giving a spatial sampling of approximately 50km) is not applicable to IASI-NG. If the user selects thinning in the BUFR product, the following options are proposed, controlled via a namelist:

1. The FOVs most likely to be clear, based on METimage cloud mask (if present). Can choose 1 FOV per field of regard (~100km) or 4 FOVs (~50km)
2. A fixed set of FOVs in each field of regard. The user may choose a different set for different scan lines, e.g. a 4-scan repeating pattern.
3. Warmest IASI-NG FOV for a specified channel in band 1 (e.g. close to 10.8 microns).
4. Method 2 in polar regions (defined by a latitude threshold) and method 3 elsewhere.

The first option is new; the others mirror the options available in AAPP for CrIS.

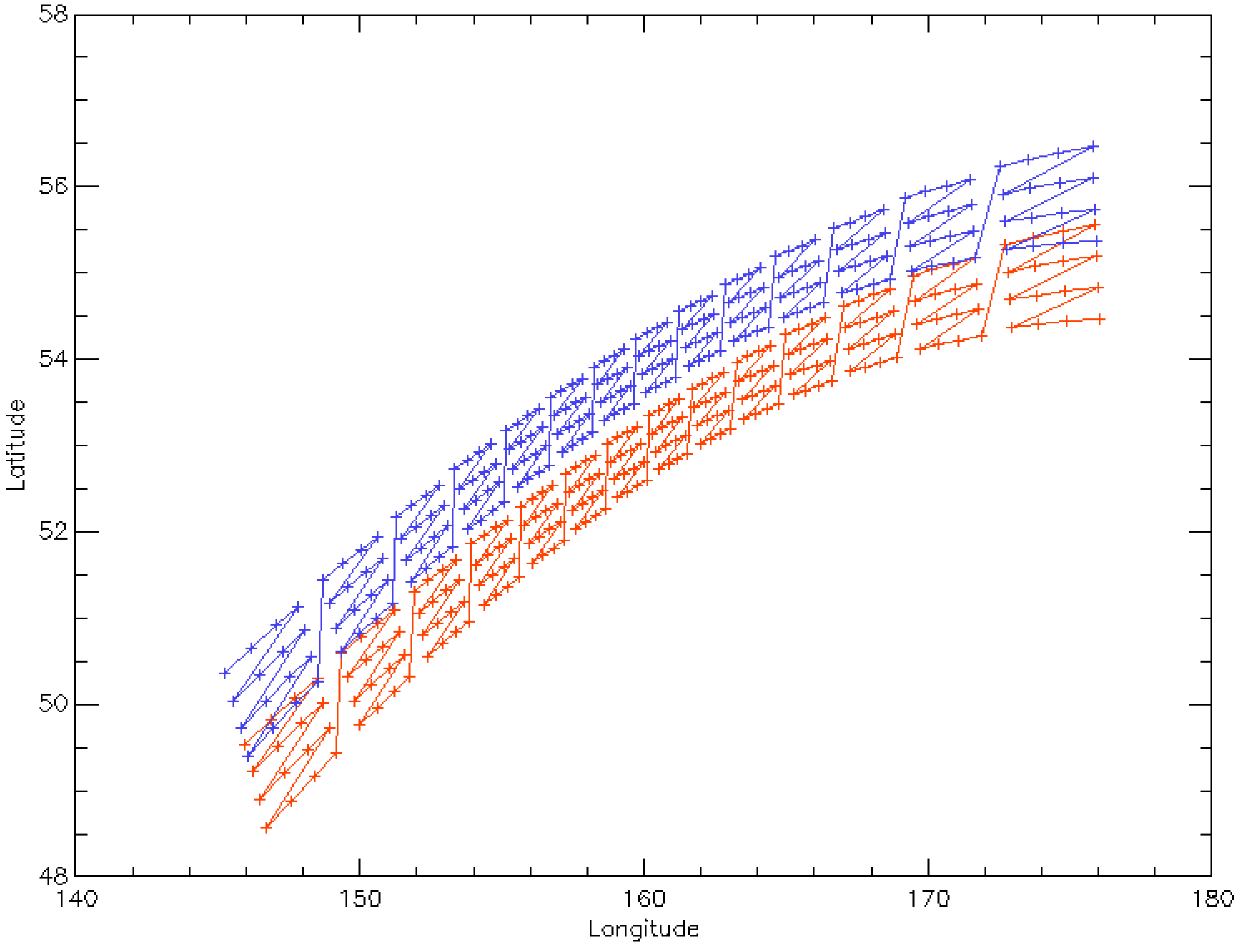

Figure 2: IASI-NG sample locations for 2 successive scan lines (red then blue). There are 14 fields of regard per scan (224 spectra)

For DBNet, there are some open issues:

- Normally in DBNet, instruments are provided in separate datasets. In the IASI-NG product, could there be advantages to including co-located MWS?
- For IASI-NG, it is assumed that PC scores would be included, and it would be full spatial resolution. Do users also wish to include raw radiances (derived from level 1c), for a channel selection? This is the case for the current IASI, but note that for IASI-NG the raw radiances might not be available routinely for the global stream, except on a high-volume service such as is provided by EUMETCast Terrestrial.

Workflows are illustrated in Figure 3 and Figure 4.

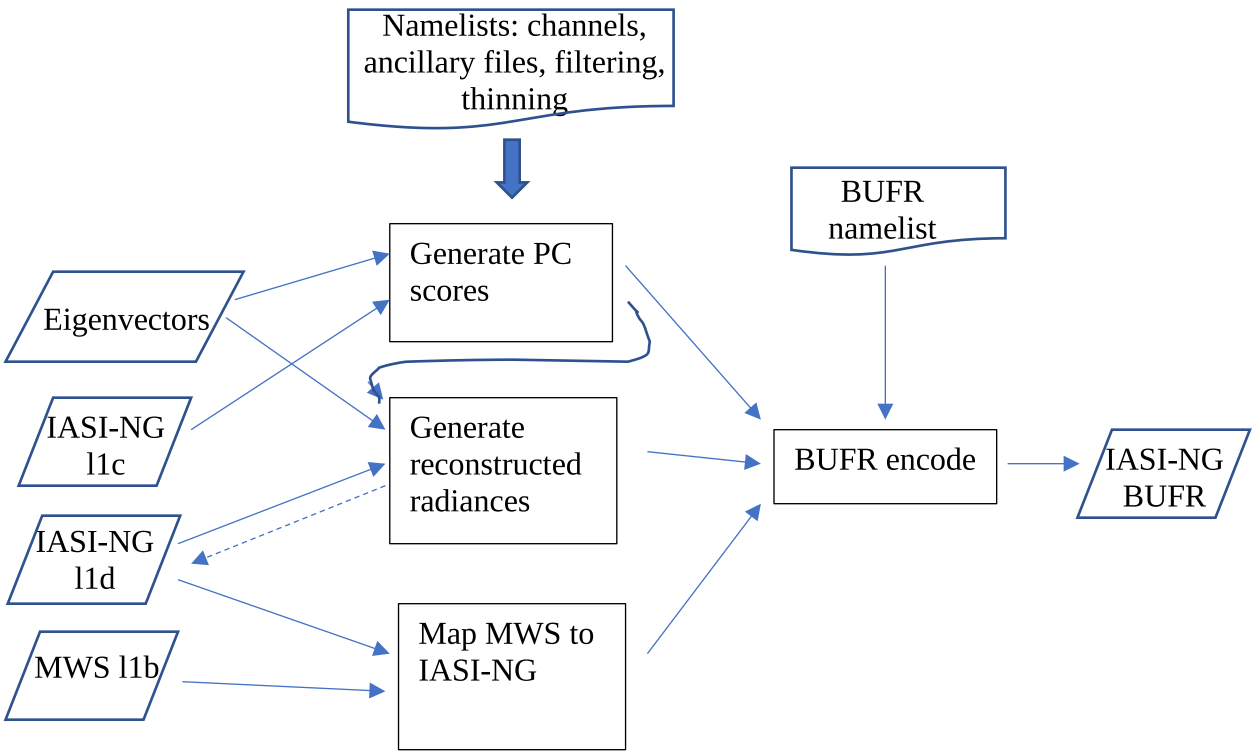

Figure 3: Workflow for the IASI-NG processors (NG_main.exe). Not all functions are mandatory, e.g. generation of PC scores is only needed if level 1d is not supplied.

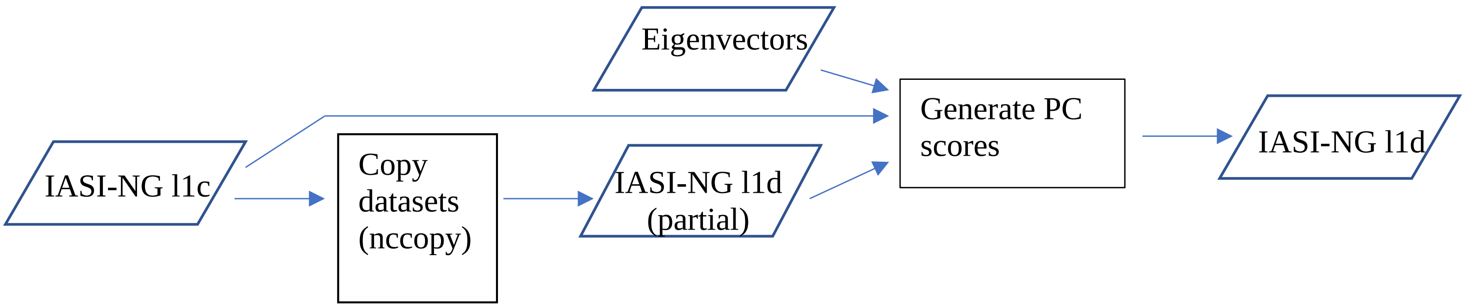

Figure 4 Workflow for IASI-NG conversion from level 1c to 1d (NG_1c_to_1d.sh)

5. FUNCTIONALITY OVERVIEW FOR MWIPP (EPS-SG COMPONENT)

For MWI and ICI, the following requirements are foreseen:

1. Ingest level 1b data in netCDF format

2. Convert from radiances to brightness temperatures
3. Spatial averaging to a user-defined beam width – as implemented in MWIPP for SSMIS processing. This will reduce random noise.
4. Map the channels to a common grid. For MWS, the 118 GHz feedhorn is fairly central in the cluster (the black ellipse in Figure 5) and therefore we suggest mapping the other channels to the 118 GHz locations. We can also map ICI (Figure 6) directly to these MWI locations. As part of this step, the number of spatial samples across-track can be chosen appropriately.
5. Write out data in BUFR. A prototype BUFR sequence is given in Section 6.

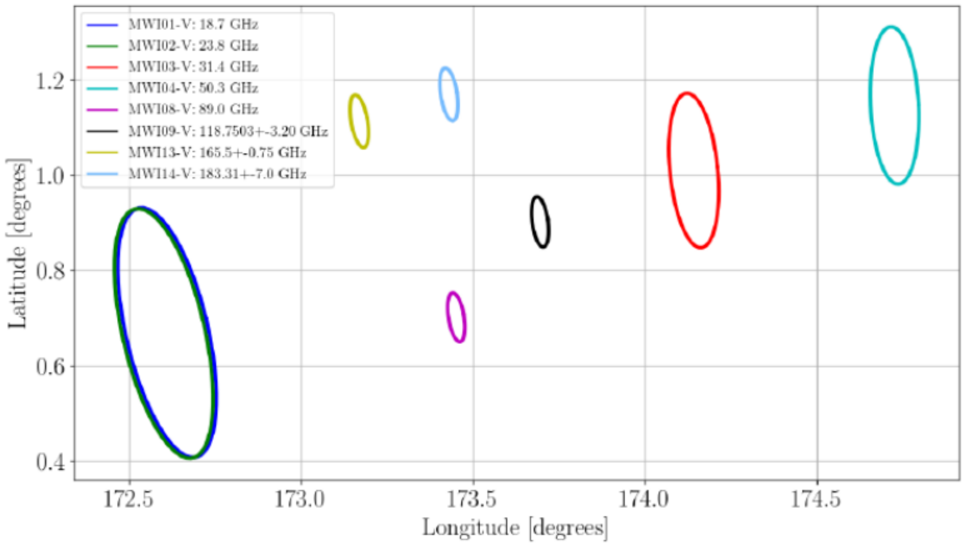

Figure 5: Fields of view for the MWI feedhorns (courtesy of EUMETSAT)

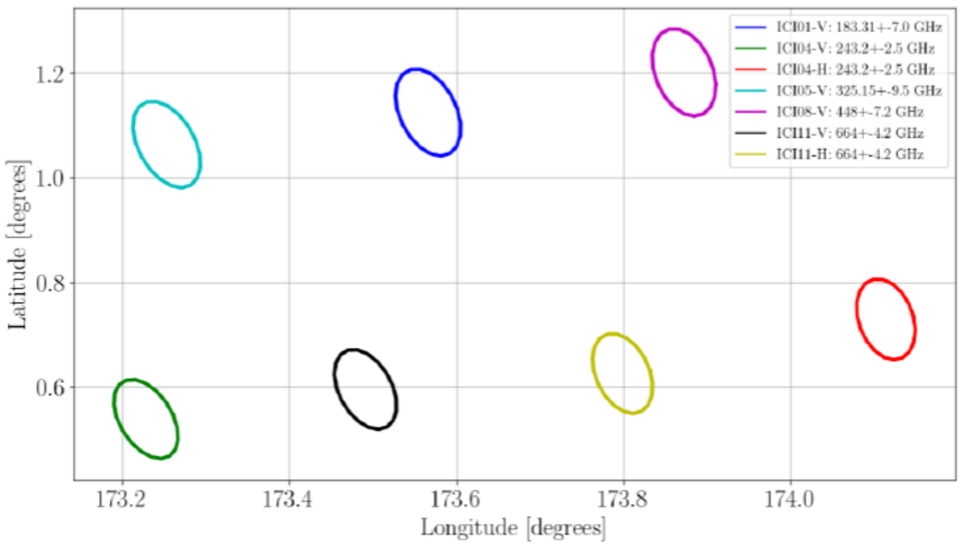

Figure 6 Fields of view for the ICI feedhorns (courtesy of EUMETSAT)

The MWIPP workflow is illustrated in Figure 7.

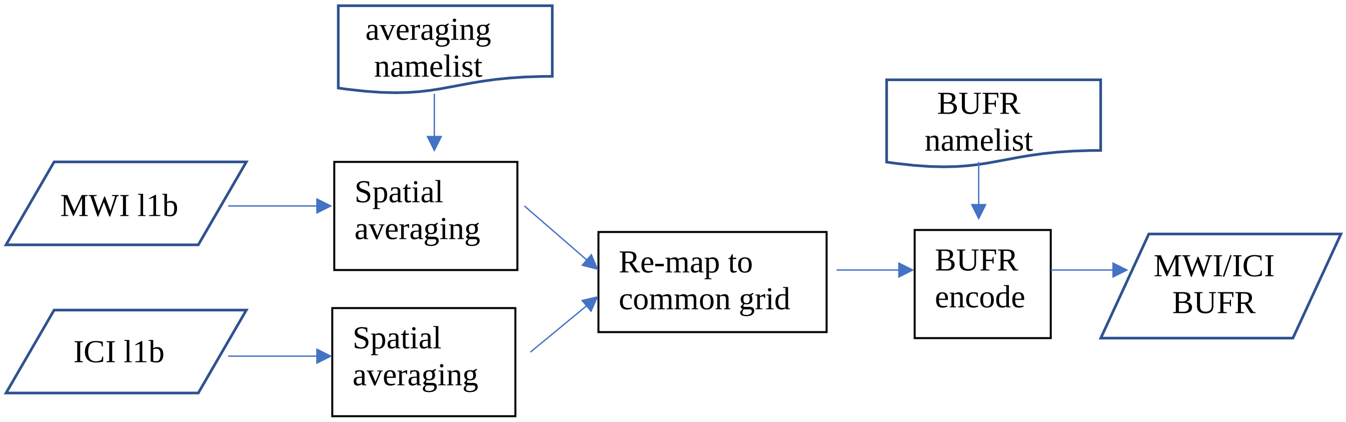

Figure 7: Workflow for processing MWI and ICI in MWIPP

The spatial averaging works in the same way as is implemented for SSMIS:

- The user defines either a distance threshold, for a sharp cutoff, or a distance parameter, σ, for a Gaussian weighting: $w = \exp(-r^2/(2\sigma^2))$
- A typical scan line is analysed to determine, for each spot, the weight to be applied to neighbouring spots
- The weights are applied to all samples in the dataset.

The re-mapping to the geolocation of a given band (feedhorn) is implemented as follows:

- For each MWI scan, find the ICI scan that immediately precedes it, based on time
- Taking a typical scan line, find, for each required spot in the reference band, the coordinates of 4 spots in the non-reference band that map onto that reference spot: 2 spots in one scan and 2 spots in the following scan; see illustration in Figure 8. Compute weights for interpolation.
- Perform bilinear interpolation of the brightness temperature field

This method works both for re-mapping channels within an instrument and for re-mapping from ICI to MWI.

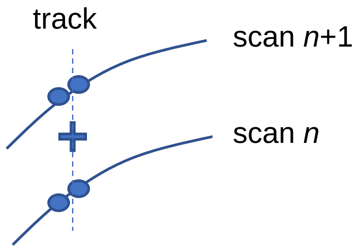

Figure 8: Mapping to a reference point marked with a cross, the four samples marked as circles are the ones to be used in the BT interpolation

6. PROTOTYPE BUFR SEQUENCES

In this section prototype BUFR sequences are proposed, for discussion by the user community. These are *not* yet endorsed by EUMETSAT or WMO, though they may be proposed formally in the future.

6.1 MWS

A prototype BUFR sequence for MWS is shown in Table 1. It is based on a draft sequence published in the EPS-SG MWS Level 1B Product Format Specification (PFS), EUM/LEO-EPSSG/SPE/14/777550, v3D, 2 October 2019. This was subsequently reviewed by the MWS Science Advisory Group, and some changes were proposed.

Note that MWS-specific quality flags are not included, but are expected to be added later after appropriate descriptors have been defined. Also, this sequence does not include the output of the AAPP surface and scattering tests.

Table 1: Prototype BUFR sequence for MWS

Descriptor	ecCodes mnemonic	Comment
Processing information		
008070	verticalSoundingProductQualifier	2 = L1B
001033	centre	Common Code Table C-1
001034	subCentre	
001007	satelliteIdentifier	Common Code Table C-5
002019	satelliteInstruments	Common Code Table C-8
005040	orbitNumber	
201133		Increase width
005041	scanLineNumber	
201000		Reset width
005043	fieldOfViewNumber	
Date and time		
004001	year	
004002	month	
004003	day	
004004	hour	
004005	minute	
207003		Change width and scale
004006	second	
207000		
Geometrical information		
005001	latitude	
006001	longitude	
102002		Replicate 2 descriptors, 2 times, for high- and low-resolution land surface database
021166	landFraction	
010001	heightOfLandSurface	

202126		Change scale
007001	heightOfStation	Satellite height to 0.1km precision
202000		Re-set scale
007024	satelliteZenithAngle	
005021	bearingOrAzimuth	
007025	solarZenithAngle	
005022	solarAzimuth	
[025084]	geometricRotationalAngle	Orbit angle (relative to solar plane)
101005		Replicate 1 descriptor, 5 times (for the 5 space views)
[040027]	sunGlintAngle	Use for lunar angles, but really need a proper descriptor
Instrument data		
012070	warmLoadTemperature	
101002		Replicate 1 descriptor, 2 times
012064	instrumentTemperature	inst_temperature and rr_temperature
113024		Replicate 13 descriptors, 24 times
005042	channelNumber	
002154	satelliteChannelBandWidth	
002104	antennaPolarization	
002153	satelliteChannelCentreFrequency	
025077	bandwidthCorrectionCoefficient1	
025078	bandwidthCorrectionCoefficient2	
207002		Change scale and width. BT to 0.001K precision
012063	brightnessTemperature	
207000		Re-set scale and width
207001		Change scale and width. NedT to 0.001K precision
033089	noiseEquivalentDeltaTemperatureNedtQualityIndicatorsForWarmTargetCalibration	Warm-view NeDT
033090	nedtQualityIndicatorsForColdTargetCalibration	Cold-view NeDT
207000		Re-set scale and width

6.2 IASI-NG

A prototype BUFR sequence for IASI-NG, with optional mapped MWS, is shown in Table 2. Some elements of this sequence are taken from the operational sequence 340008 used for IASI, which combines PC scores and channel selection.

Table 2 Prototype BUFR sequence for IASI-NG with optional mapped MWS

Descriptor	ecCodes mnemonic	Comment
Processing information		
001007	satelliteIdentifier	Common Code Table C-5

001033	centre	Common Code Table C-1
001034	subCentre	
002019	satelliteInstruments	Common Code Table C-8: IASI-NG
002020	satelliteClassification	62 = EPS-SG (TBC)
Date and time		
301011	year, month, day	
301012	hour, minute	
207003		Change width and scale
004006	second	
207000		Reset width and scale
Geometrical information		
301021	latitude, longitude	
021166	landFraction	
007024	satelliteZenithAngle	
005021	bearingOrAzimuth	
007025	solarZenithAngle	
005022	solarAzimuth	
005043	fieldOfViewNumber	
005040	orbitNumber	
201133		Increase width
005041	scanLineNumber	
201000		Reset width
202126		Decrease scale
007001	heightOfStation	Satellite height to 0.1km precision
202000		Reset scale
Channel radiances		
002165	radianceTypeFlags	4=apodised, 6=reconstructed
104000		Delayed replication 4 descriptors
031002	extendedDelayedDescriptorReplicationFactor	Number of channels
201137		Increase width
005042	channelNumber	
201000		Reset width
014044	channelRadiance	Unit: W m^{-2} sr^{-1} cm
PC scores for each band		
110004		Replicate 10 descriptors, 4 times (for the 4 spectral bands)
201129		Increase width
025140	startChannel	
025141	endChannel	
201000		Reset width
040026	scoreQuantizationFactor	
040016	residualRmsInBand	
025062	databaseIdentification	
101000		Delayed replication of 1 descriptor
031002	extendedDelayedDescriptorReplicationFactor	Number of PC scores
040017	nonNormalizedPrincipalComponentScore	
Mapped MWS		
002019	satelliteInstruments	Common Code Table C-8: MWS
104000		Delayed replication of 4 descriptors
031001	delayedDescriptorReplicationFactor	Number of MWS channels (or 0 if MWS is not included)

005042	channelNumber	
207002		Change scale and width
012063	brightnessTemperature	BT to 0.001K precision
207000		Reset scale and width
METimage		
002019	satelliteInstruments	Common Code Table C-8: METimage
102002		Replicate 2 descriptors, 2 times (for 2 different confidence levels)
020081	cloudAmountInSegment	*meti_cloudy_fraction*; *meti_prob_cloudy_fraction*
020082	amountSegmentCloudFree	*meti_clear_fraction*; *meti_prob_clear_fraction*
111000		Delayed replication of 11 descriptors
031001	delayedDescriptorReplicationFactor	Number of classes
025085	fractionOfClearPixelsInHirsFov	Fraction of pixels in this class
005060	yAngularPositionFromCentreOfGravity	
005061	zAngularPositionFromCentreOfGravity	
106000		Delayed replication of 6 descriptors
031001	delayedDescriptorReplicationFactor	Number of channels used
005042	channelNumber	
008023	firstOrderStatistics	4 = mean
014043	channelRadiance	
008023	firstOrderStatistics	10 = standard deviation
014043	channelRadiance	
008023	firstOrderStatistics	Set to missing

6.3 MWI / ICI

There is a draft BUFR sequence published in the EPS-SG MWI Level 1B Product Format Specification, EUM/LEO-EPSSG/SPE/14/767115, v3A, 29 June 2020. But this is intended for use with MWI level 1B. It is quite complicated because it has multiple sets of geolocation and because it contains radiances (not BTs) with different scaling factors for each channel.

A simpler sequence, more suited to the re-mapped product generated by MWIPP, is the generic sequence already included in MWIPP v1. For MWIPP v2, we propose some modifications, indicated in blue. This template can be used for MWI and ICI separately, or for the instruments mapped to a common grid – in which case it can be regarded as a super-instrument of 39 channels (26 MWI and 13 ICI).

Table 3: Prototype BUFR sequence for MWI/ICI

Descriptor	ecCodes mnemonic	Comment
Processing information		
001007	satelliteIdentifier	Common Code Table C-5
001033	centre	Common Code Table C-1

001034	subCentre	
002019	satelliteInstruments	Common Code Table C-8
Date and time		
301011	year, month, day	
301012	hour, minute	
207003		Change width and scale
004006	second	0.001s precision
207000		Reset width and scale
Geometrical information		
202126		Decrease scale
007001	heightOfStation	Satellite height to 0.1km precision
202000		Reset scale
025084	geometricRotationalAngle	Orbit angle relative to solar plane
201132		Increase width
005041	scanLineNumber	
201000		Reset width
201131		Increase width
005043	fieldOfViewNumber	Up to 2046 FOVs
201000		Reset width
005040	orbitNumber	
301021	latitude, longitude	0.0001° precision
013040	surfaceFlag	Missing for MWI/ICI (not in level 1b)
020029	rainFlag	Missing for MWI/ICI (not in level 1b)
021166	landFraction	
010001	heightOfLandSurface	
007025	solarZenithAngle	0.01° precision
005022	solarAzimuth	0.01° precision
See note[5]		
007024	satelliteZenithAngle	0.01° precision
005021	bearingOrAzimuth	0.01° precision
Channel data		
104000		Delayed replication of 4 descriptors
031001	delayedDescriptorReplicationFactor	Number of channels
005042	channelNumber	Channel number
002153	satelliteChannelCentreFrequency	Unit: Hz
002104	antennaPolarization	0=H, 1=V
012163	brightnessTemperature	BT to 0.01K precision

[5] The original sequence had provision for more than one set of satellite angles, which was the case for GMI. For MWI/ICI we could potentially have 15 sets of angles, for the 15 feedhorns, but this seems unnecessary for NWP applications. The new version of the code will insert the following descriptors only if multiple angles are supplied to the subroutine: 104000, 031001, 025140, 025141.

7. FILE SIZES

In Table 4 we show typical input (netCDF) and output (BUFR) file sizes based on test data provided by EUMETSAT and prototype versions of AAPP-EPSSG and MWIPP. Note that for IASI-NG, no METimage information is available in the test data, so eventual sizes will be somewhat larger.

Table 4: File sizes, based on test data provided by EUMETSAT

Input data	**Time period**	**Mbytes**	**Mbytes per orbit (101 min)**
MWS 1B netCDF	1 orbit	87	87
IASI-NG 1C netCDF	3 min	153	5150
IASI-NG 1D netCDF	3 min	4.63	156
MWI 1B netCDF	25 min	275	1110
ICI 1B netCDF	25 min	107	432
BUFR Product	**Time period**	**Mbytes**	**Mbytes per orbit**
MWS	1 orbit	16	16
IASI-NG, 500 channels, 340 PCs, with mapped MWS	3 min	2.84	96
IASI-NG, 500 channels, 340 PCs	3 min	2.75	93
IASI-NG, 340 PCs with mapped MWS	3 min	0.67	23
IASI-NG, 340 PCs only	3 min	0.58	20
MWI with mapped ICI, ±5km averaging boxcar, 1 spot in 6 (10km), all scans	25 min	21.1	85
MWI only (no ICI)	25 min	14.5	59

We can note the following:

- The proposed BUFR products are, in general, significantly smaller than the input netCDF, and should be suitable for NWP use, without overwhelming the meteorological databases.
- MWI+ICI, in particular is a factor 18 smaller than the input. It is slightly smaller than the current AMSR-2 BUFR product which is about 100 MB/orbit, but larger than GMI which is 37 MB/orbit. The size could be further reduced, if required, by averaging over a larger area and increasing the thinning distance, but we would then lose spatial resolution at the high frequencies.
- Adding MWS to the IASI-NG BUFR product does not significantly impact the product size. Adding the channel selection does have an impact, but it is still similar in size to the current IASI format as configured for DBNet (500 channels, 300 PC scores)
- The IASI-NG 1c netCDF product (containing all channels) is very large (73 GB/day) – much larger than the current IASI 1c BUFR product (16 GB/day). It is expected to be only available via EUMETCast Terrestrial (global service) or direct broadcast.

8. CONCLUSIONS

The AAPP and MWIPP software deliverables will allow NWP and research users to tailor EUMETSAT's disseminated data (netCDF format) to suit their requirements. The optimum trade-off between, for example, noise and spatial resolution may differ from model to model, e.g. high-resolution regional models may require different data to global models. The level 1b formats defined by EUMETSAT are comprehensive and versatile, but in general will need onward processing before the data can be used in NWP.

There are a number of open issues, particularly concerning DBNet:

- Is there a requirement for the software packages to *ingest* BUFR data? It is unclear to what extent "raw" BUFR data might be disseminated internationally, i.e. data that needs further processing before it can be used.
- For DBNet, should the disseminated IASI-NG comprise PC scores, channel selection or both? If channel selection is included, should it be raw radiances (level 1c) or reconstructed?
- For DBNet, would it be useful to map MWS to IASI-NG before dissemination of the IASI-NG? Such an approach was pioneered by NOAA in the BUFR version of their AIRS radiance product, but has not been widely adopted since then.
- If MWI/ICI are to be included in DBNet, should the disseminated data be level 1b (heavily over-sampled; bulky; channels not aligned) or a processed format more suitable for direct use in NWP (as discussed in section 7)? If the latter, how should we choose the averaging constants and the spatial thinning?

We welcome comments from the user community on the proposals outlined in this document – whether it is to confirm that the software packages will be useful, or to suggest modifications. The ticket system of the NWP SAF Helpdesk[6] can be used to submit suggestions.

[6] https://nwp-saf.eumetsat.int/site/help-desk/