

THE NEW BUFR ENCODER FOR ESACA DATA DESCRIPTION AND VALIDATION RESULTS

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T A B L E O F C O N T E N T S

1	INTRODUCTION	4
2	CONCLUSION AND RECCOMENDATION.....	4
3	ACRONYMS AND ABBREVIATION	4
4	REFERENCE.....	5
5	BUFR ENCODER MODIFICATIONS	6
5.1	Kp re-scaling	6
5.2	Missing Source packets.....	6
5.3	Yaw angle flags.....	7
6	BUFR ENCODER VALIDATION	8
6.1	Validation set up	8
6.2	Validation results	9
6.2.1	Kp results	9
6.2.2	Missing source packets results	9
6.2.2.1	Nominal number of samples per node	9
6.2.2.2	Low number of samples per node or no samples.....	10
6.2.3	PCD flag results	10

1 INTRODUCTION

Since August 22nd, 2003 ESACA is the new operational processing chain for ERS-2 fast delivery products. The new system is able to process ERS Scatterometer raw data acquired in ZGM and to produce auxiliary information on satellite attitude. For that reason the UWI format has been updated and a new version of the BUFR encoder (based on the existing version V503) has been implemented in ESRIN in order to produce a compatible data format for the existing V503 decoder. In that way users can continue to use V503 decoder without any modification on their assimilation system.

Scope of the document is to describe the modification applied on BUFR encoder to take care of the new ESACA UWI format and to report on validation results. New ESACA UWI format is reported in the Annex.

2 CONCLUSION

The BUFR encoder has been successfully modified to take into account the new ESACA UWI data format. The new BUFR encoder has been installed in the ISS environment in ESRIN and the analysis of test files does not show any anomalies.

The new BUFR encoder is qualified for the operations.

3 ACRONYMS AND ABBREVIATION

BUFR	Binary Universal Format for data Representation. A WMO approved encoding method otherwise known as Format Number 94 (FM94)
DSR	Data Set Record
ESACA	ERS Scatterometer Attitude Corrected Algorithm
LRDPF	Low Rate Data Processing Facility
MPH	Main Product Header
PCD	Product Confidence Data
SAG	Science Advisor Group
SPH	Specific Product Header
UWI	User Wind data
UWIGT	UWI Global Telecommunication system format
ZGM	Zero Gyro Mode

4

REFERENCE

- [R-1] Minutes of twenty-third ASCAT SAG meeting
- [R-2] Encoding Software for ERS data – Detail Design Document - ER-SD-UKM-GS-0001
Version 4, Issue 3
- [R-3] Encoding Software for ERS data – Software User Manual - ER-MA-UKM-GS-0001 Version
4, Issue 2
- [R-4] ERS Ground Station Product Specification – ER-IS-EPO-GS-0201 issue 3/1
- [R-5] ERS Products WMO FM94 BUFR Format – ER-IS-UKM-GS-0001 Version 4 Issue 2

5 BUFR ENCODER MODIFICATIONS

The changes applied to BUFR encoder are described in the following paragraphs and were agreed during the 23rd ASCAT SAG meeting in EUMETSAT February 25th – 26th 2003 (see R-1)

All the changes have been done on UWI_IO subroutine in the FDPIO.FOR module (See R-2 and R-3).

5.1 *Kp re-scaling*

In the old encoder, in order to maintain the compatibility with the two possible units for the Kp: % (percent) and 0.1% (per thousand) a scaling factor of 10 was applied if the value was below 25. That choice was done because nominal range for the Kp was in the range [5%-15%] and therefore a Kp below 25 is assumed to be in % unit and a Kp above 25 is assumed to be in 0.1%. ESACA includes a more precise Kp estimation algorithm and as result the Kp ranges between [2%-7%]. Therefore the old BUFR encoder mechanism for the Kp cannot be used and it has been removed.

(see R-5 Table 5.15 Field 30)

5.2 *Missing Source packets counters*

ESACA does not change the rule to localize the node. The nodes have always a distance of 25 Km (along track and across track) independently by the acquisition geometry. The three Scatterometer antennae could see the node with a different geometry due to an arbitrary variation of the yaw angle. That fact causes that the number of measurement samples contributing to a node can also have an arbitrary value. Therefore it makes no sense to compute the missing packets (we do not have anymore a constant number of expected packets from a fixed geometry). A more reliable solution is to fill the Missing source packets field with the “Number of samples used to compute the node”.

In order to minimize the impact of that choice for the BUFR end users (now a “big” value does not indicate a problem) the BUFR encoder has been modified with the following rule:

1. The BUFR field number of missing source packet counter (see R-5 Table 5.15 Field 31) does not change its meaning
2. The BUFR field number of missing source packets counter is filled in agreement with Table 1

Table 1 criteria to fill the BUFR number of missing source packets counter

Antenna	UWI ESACA DSR fields 8,13,18 Number of sample to compute the node (Resolution is 8 samples)	BUFR Number of missing source packets
Fore & Aft	0 – 25	32 or –32 if wind/wave mode
	Above 25	0
Mid	0 –15	32 or –32 if wind/wave mode
	Above 15	0

5.3 Yaw angle flags

The two spare bits (bit-15 and bit-16) in the UWI DSR pcd (see R-4 table 18) has been used by ESACA to output information regarding the yaw.

The bit-15 is used as indicator of the status of the yaw computation. The bit is set if the yaw cannot be computed from Scatterometer raw data because the attitude is strong degraded.

The bit-16 is used as indicator of the quality of the yaw. In the current implementation the bit is set if the yaw is above +/- 2 deg. It indicates a possible degradation is in the sigma noughts.

The BUFR format does not have any spare bits (see R-5 Table 5.15). In order to give to the end user a warning about a possible degradation of the sigma nought the BUFR encoder implements the rule in Table 2.

Table 2 Criteria to fill the BUFR DSR pcd

BUFR DSR pcd (See R-5 Table 5.16)	Boolean Rule to set the BUFR pcd	BUFR DSR New Meaning
Bit 2 No Fore beam calculation	UWI ESACA bit 2 OR UWI ESACA bit 15 (see R-5 Table 18)	Fore beam not computed or Yaw angle not computed
Bit 3 No Mid beam calculation	UWI ESACA bit 3 OR UWI ESACA bit 15 (see R-5 Table 18)	Mid beam not computed or Yaw angle not computed
Bit 4 No Aft beam calculation	UWI ESACA bit 4 OR UWI ESACA bit 15 (see R-5 Table 18)	Aft beam not computed or Yaw angle not computed
Bit 7 Kp limit	UWI ESACA bit 8 OR UWI ESACA bit 16 (see R-5 Table 18)	Kp above the threshold or Yaw above the threshold

6 BUFR ENCODER VALIDATION

6.1 Validation set up

6.1.1 PCS ENVIRONMENT

The UWI_IO subroutine contained in the BUFR version V503 has been upgraded (see previous section). The make.com file contained in the BUFR version V503 has been used to build the executables files under OPEN-VMS 7.2_1 system.

Two orbits of new ESACA UWI data have been used for validation activity. BUFR files have been generated with the **encode_fdp** command and decoded with the **decode_fdp** command.

6.1.2 ISS ENVIRONMENT

The BUFR V503 has been re-compiled with the new fdpio.for module and new executables has been installed in a test environment to simulate daily operation.

The two orbits (total of 4 UWI files) used in PCS has been encoded and decoded in the ISS test environment.

UWI decoded data has been sent to PCS for validation.

Table 3 reports the validation data set used for the BUFR encoder upgrade.

Table 3 Validation data set

Data Type	File name	Statistics	
UWI lrdpf 9002 (ESACA)	UWI__030724KSEQ0631.E2	Total number of products	183
	UWI__030724KSEQ0632.E2	Valid products	168
	UWI__030724KSEQ0643.E2	Valid nodes	60648
	UWI__030724KSEQ0644.E2	Blank products	15
Encoded UWIGT (BUFR data)	UWIGT030724KSEQ0631.E2 UWIGT030724KSEQ0632.E2 UWIGT030724KSEQ0643.E2 UWIGT030724KSEQ0644.E2	N/a	
Decoded UWIGT	UWI__240612.E2	Total Number of products	168
	UWI__240711.E2	Valid products	168
	UWI__241803.E2	Valid nodes	60648
	UWI__241901.E2	Blank products	0
Decoded UWIGT from ISS	UWI__060907_1.E2T;1	Total Number of products	168
	UWI__060907_2.E2T;1	Valid products	168
	UWI__060907_3.E2T;1	Valid nodes	60648
	UWI__060907_4.E2T;1	Blank products	0

6.2 *Validation results*

6.2.1 KP RESULTS

No differences have been found between UWI and decoded UWIGT data.

Kp Fore beam UWI acquisition time: 24-JUL-2001 07:11:47.801 nodes 1 - 19
3.9 3.1 3.7 3.5 3.1 2.5 3.7 5.0 3.3 2.8 2.6 2.4 3.1 2.9 3.5 3.3 2.7 2.2 3.1

Kp Mid beam UWI acquisition time: 24-JUL-2001 07:11:47.801 nodes 1 - 19
5.7 5.5 4.7 4.5 4.3 3.7 4.0 4.1 3.3 3.8 3.5 3.3 3.0 3.2 3.8 3.5 3.2 3.2 3.0

Kp Aft beam UWI acquisition time: 24-JUL-2001 07:11:47.801 nodes 1 - 19
4.5 3.8 3.2 2.9 3.1 3.8 3.4 3.7 3.8 3.2 2.6 2.2 3.2 2.8 2.4 3.5 3.2 3.3 3.2

Kp Fore beam decoded UWIGT acquisition time: 24-JUL-2001 07:11:47.801 nodes 1 - 19
3.9 3.1 3.7 3.5 3.1 2.5 3.7 5.0 3.3 2.8 2.6 2.4 3.1 2.9 3.5 3.3 2.7 2.2 3.1

Kp Mid beam decoded UWIGT acquisition time: 24-JUL-2001 07:11:47.801 nodes 1 - 19
5.7 5.5 4.7 4.5 4.3 3.7 4.0 4.1 3.3 3.8 3.5 3.3 3.0 3.2 3.8 3.5 3.2 3.2 3.0

Kp Aft beam decoded UWIGT acquisition time: 24-JUL-2001 07:11:47.801 nodes 1 - 19
4.5 3.8 3.2 2.9 3.1 3.8 3.4 3.7 3.8 3.2 2.6 2.2 3.2 2.8 2.4 3.5 3.2 3.3 3.2

6.2.2 MISSING SOURCE PACKETS RESULTS

The result is as expected (see below).

6.2.2.1 *Nominal number of samples per node*

Fore beam Number of samples used to compute the node (Wind/wave mode)
UWI acquisition time: 24-JUL-2001 07:11:47.801 nodes 1 - 19
223 221 217 214 212 209 208 206 206 204 203 201 199 196 195 194 193 192 191

Fore beam Number of missing source packets (Wind/wave mode)
decode UWIGT acquisition time: 24-JUL-2001 07:11:47.801 nodes 1 - 19
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

6.2.2.2 Low number of samples per node or no samples

Fore beam Number of samples used to compute the node (Wind/wave mode)

UWI acquisition time: 24-JUL-2001 18:03:17.277 nodes 209 – 227

221 222 226 234 244 252 0 0 0 0 0 0 0 0 0 0 0 0

Fore beam Number of missing source packets (Wind/wave mode)

decode UWIGT acquisition time: 24-JUL-2001 18:03:17.277 nodes 209 – 227

0 0 0 224 224 224 32 32 32 32 32 32 32 32 32 32 32 32

6.2.3 PCD FLAG RESULTS

The results are summarized in Table 4 and Figure 1

Table 4 PCD statistics ESACA UWI and decoded UWIGT (BUFR)

PCD Bit Number	UWI PCD Bit name as ER-IS-EPO-GS-0201	UWI PCD Bit name from LRDPF 9002 (ESACA) onwards	ESACA UWI data Number of nodes with bit set	UWIGT PCD Bit name from LRDPF 9002 (ESACA) onwards	Decoded UWIGT data Number of nodes with bit set
1	Summary PCD Factor	Summary PCD Factor	32679	Summary PCD Factor	32679
2	Fore beam flag	Fore beam flag	2095	Fore beam flag or Yaw angle not computed	2214
3	Mid beam flag	Mid beam flag	494	Mid beam flag or Yaw angle not computed	613
4	Aft beam flag	Aft beam flag	1852	Aft beam flag or Yaw angle not computed	1971
5	Fore beam arcing flag	Fore beam arcing flag	0	Fore beam arcing flag	0
6	Mid beam arcing flag	Mid beam arcing flag	0	Mid beam arcing flag	0
7	Aft beam arcing flag	Aft beam arcing flag	121	Aft beam arcing flag	121
8	Limit of Kp value	Limit of Kp value	2953	Limit of Kp value or Yaw angle out of limit	21607
9	Land/Sea	Land/Sea	15630	Land/Sea	15630
10	Rank1 solution	Rank1 solution	0	Rank1 solution	0
11	bit11 Ambiguity Removal method	bit11 Ambiguity Removal method	15630	bit11 Ambiguity Removal method	0
12	bit12 Ambiguity Removal method	bit12 Ambiguity Removal method	17819	bit12 Ambiguity Removal method	2189
13	MLD	MLD	0	MLD	0
14	Frame Checksum	Frame Checksum	0	Frame Checksum	0
15	Spare1	Yaw angle not computed	119	Spare1	0
16	Spare2	Yaw angle Out Of Limit	19671	Spare2	0

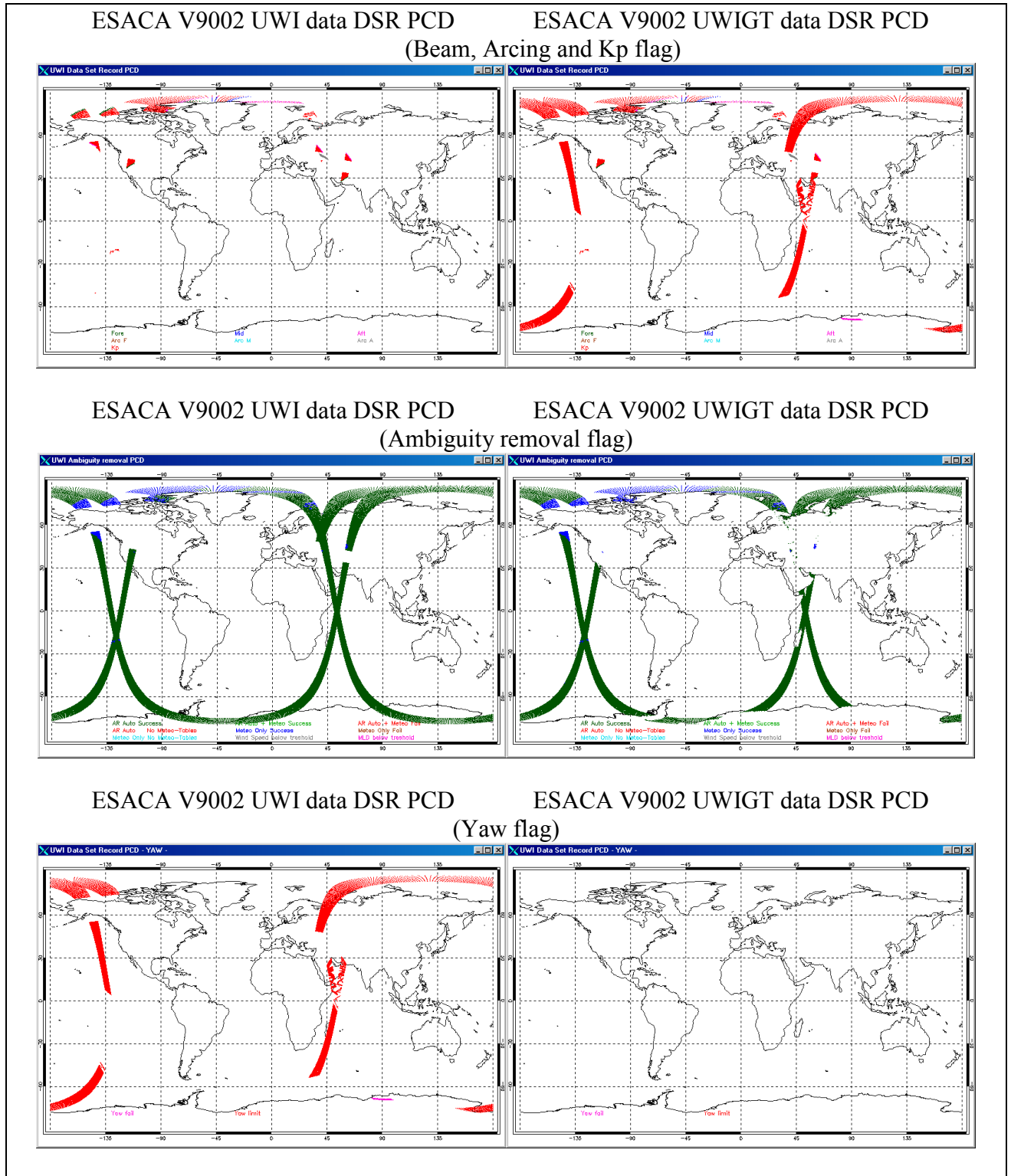


Figure 1 Comparison of the various pcd flags between UWI ESACA and decoded BUFR

6.2.4 ISS TEST RESULTS

The analysis of decoded UWI files from ISS does not show any anomalies. The result of a binary VMS diff command was “zero differences found”.

7 ANNEX

7.1 UWI format updates

The format of the UWI products is described in “ERS Ground Stations Products specification” [R-4] document in section 6.9. The MPH format is detailed in Table 5, the SPH format is detailed in Table 17 and the DSR format is detailed in Table 18.

The format of the UWI product is also reported on the paper “ERS Wind Product Specification” available on the web: <http://earth.esa.int/pcs/ers/scatt/articles>.

The ESACAUWI format is as described in the above references with the following changes:

Specific Product Header Updates

Field	Bytes	Type	UWI Description	ESACA UWI new description	Units
63	2	I2	Spare	WS Processor Version: 702	N/a
64	2	I2	Spare	Configuration file id: 1000	N/a

Data Set Records Updates

Field	Bytes	Type	UWI Description	ESACA UWI new description	Units
8	1	I1	Counter of Fore beam corrupted or missing source packets	Counter of Fore beam samples used to compute the node	8
13	1	I1	Counter of Mid beam corrupted or missing source packets	Counter of Fore beam samples used to compute the node	8
18	1	I1	Counter of Aft beam corrupted or missing source packets	Counter of Fore beam samples used to compute the node	8
21	2	B	Bit 15 Spare	Bit 15 :Yaw flag 0 Yaw computed 1 Yaw not computed or yaw not valid (failure in yaw estimation due to strong degraded satellite attitude)	N/a

			Bit 16 Spare	Bit 16 Yaw Limit 0 Yaw below or equal the threshold 1 Yaw above the threshold (Threshold +/- 2 degrees)	N/a
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