Appendix A: Acronyms

ACF	Auto Correlation Function
AIT	Advanced Intelligent Tape
ALT	The "Alt" key on the computer keyboard.
ATX	A type of intelligent power supply in PCs shipped with Profiler radars
BNC	Bayonet Neill Concelman (RF connecter)
CDR	Compact disk recordable
CDROM	Compact disk read only disk
CPU	Central Processor Unit
DB	Decibel - logarithmic power units.
DVD	Digital Video Disk
HF	High Frequency (3 MHz - 30 MHz)
Hz	Unit of frequency in repetitions (or cycles) per second – Hertz
FTP	File Transfer Protocol
FSU	Frequency Synthesis Unit
GPS	Global Positioning System
GUI	Graphical User Interface
MF	Medium Frequency (300 kHz – 3 MHz)
NIS	Network Information Service
NSR	Noise to signal ratio (cross channel)
NTP	Network Time Protocol
PC	Personal Computer
POST	Power-On Self Test
PRF	Pulse Repetition Frequency
RDAS	Radar Data Acquisition System
SMB	Sub-miniature coaxial cable connector
SNR	Signal-to-Noise Ratio
SSWMA	Spaced sensor wind measurement analysis
SWR	Standing Wave Ratio (often a voltage ratio: "VSWR")
UFS	Universal File System
URL	Universal Resource Locater
UTC	Coordinated Universal Time
VHF	Very High Frequency (30 MHz - 300 MHz)
XCF	Cross correlation function

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Appendix B: SSWMA Control Parameters

The following parameters may be used on a per-experiment basis to control the behaviour of the SSWMA analysis plugin. Default values are noted where applicable.

Parameter	Description	Default Value
ACF_FIT	Number of lags of ACF to fit about zero lag	4 (int)
ACF_LENGTH	Number of seconds of ACF to calculate	10.0 (float)
ANTENNA_COORDS	The receiver antenna coordinates (Range (m), Bearing (deg))	No default – mandatory (float, float) per antenna
CHANNELS	Number of digital channels acquired	No default – mandatory (int)
COMMENT	The experiment comment	"default" (string)
DIGITISATION	Select 8, 12, or 16-bit digitisation	16 (int)
DYNAMIC_PEAKSELECT	Flag to select whether to allow dynamic XCF peak selection algorithm	1 (on) (int)
EXPTAG	The name of the experiment	"default" (string)
FREQUENCY	Radar operating frequency in Hertz	No default – mandatory (int)
GATE_END	Optionally select highest gate to analyse (metres)	0 (int)
GATE_START	Optionally select lowest gate to analyse (metres)	0 (int)
GATES	Number of range gates sampled	No default – mandatory (int)
G0_SYNC	Flag which controls whether to discard lowest gate of data	1 (on) (int)
INTEGRATIONS	Number of coherent integrations applied	No default – mandatory (int)
LO_FREQUENCY	The 1st local oscillator frequency in Hertz	0 (int)
LOCATION	The latitude & longitude of the site	0, 0 – (float, float)
NPTS_ANALYSIS	The number of data points to analyse in a single record	No default – mandatory (int)
NRX_ANALYSIS	Number of receivers to analyse	No default – mandatory (int)
NTD_THRESHOLD	Maximum allowable NTD for analysis to proceed (percentage)	35.0% (float)
POLARISATION	Transmission & reception mode	"unknown" (string)
PRF	Pulse repetition frequency in Hertz	No default – mandatory (int)
RANGE	Sampling start range in metres	No default – mandatory (int)
RDAS_ID	Data acquisition ID number	0 (int)
RECORDS	Number of records to analyse during off line analysis	0 (int)
RESOLUTION	The sampling resolution in metres	No default – mandatory (int)
RX_GAIN	Receiver gains in dB	0 (int)
RX_LIST	List of receivers to use in analysis (1-based, NRX_ANALYSIS elements)	No default – mandatory (list of ints)
SITENAME	The name of the radar site	"default" (string)
SNR_THRESHOLD	Minimum allowable SNR for analysis to proceed	-6.0 (float)
SS_BINS	Number of spectral "bins" to notch in sea scatter removal algorithm	5 (int)
SS_HIGHEST	Highest range at which to apply sea scatter notch in metres	0 (int)
SS_LOWEST	Lowest range at which to apply sea scatter notch in metres	0 (int)
SS_NOTCH	Flag which controls whether to notch sea scatter	0 (off) (int)
SS_PWR_RATIO	Sea scatter to atmospheric power ratio threshold	0.3 (float)
XCF_THRESHOLD	Minimum allowable XCF magnitude for analysis to proceed	0.2 (float)

Note that some of these parameters are restricted to off-line analysis only.

Appendix C: SSWMA Version 3 Data File Reference

Introduction

Spaced Sensor Wind Measurement Analysis (SSWMA) data files are written in a binary format which is defined in this document. Each data file is prefaced by a file header which contains general information about the data file itself. Following the file header are a series of records - one for each data acquisition period - containing the parameters derived by the SSWMA analysis program. SSWMA data files produced "on-line" are rotated on a 24-hour basis. There is no such restriction on post-analysed SSWMA data files. SSWMA data files from differing radars may not be combined into consolidated SSWMA data files.

This document describes the binary file format for the "Version 3" data files. These files incorporate new parameters describing the nature of the transmitted pulse, such as pulse width and pulse code. The results for each height have also been augmented by the inclusion of the zero lag cross correlation information for each analysed receiver pair. This information may potentially be used for angle-of-arrival calculations and correction of vertical velocity estimations. Version 2 files incorporated information required for dual mode operation where gains, filters and pulse characteristics may be switched on a point-to-point basis.

It is worth noting that there are three different channel counters used in the following document.

1. "CHANNELS" – the number of digital channels acquired. This is always twice the number of receiver channels acquired (IP/QP).
2. "RECEIVERS" - the number of receiver channels acquired. This is always half the number of digital channels acquired. The number of receivers acquired is denoted by the letter "N" in the following.
3. "NRX_ANALYSIS" – the number of receiver channels utilised by the analysis. This is denoted by the letter "K" in the following. Note that $K <= N$, $K >= 3$, and K often takes the value 3.

File Header

The file header appears once at the beginning of each SSWMA data file. The file magic number (FMN) is 0x23110301 which is a 4-byte hexadecimal number comprised of:

0x23	System type magic number (0x12 => RD12, 0x13 => skiymet/UD3, 0x23 => UD3A/profiler)
0x11	Magic number type (0x01 => Raw data file header MN, 0x11 => Primary analysis file MN)
0x03	File major revision number
0x00	File minor revision number

Offset	Size	Name	Format
0	4	File magic number (0x23110300)	int
4	4	No. of SSWMA records in this file (0 or more)	int
8	4	Offset to start of first record from start of file	int
12	4	Unit ID or serial number	int
16	32	Site name (null terminated)	char
Total	48		

Record Header

The record header appears once for each data acquisition period immediately prior to the actual results. The record magic number (RMN) is 0x23120300 which is a 4-byte hexadecimal number comprised of:

0x23	System type magic number (0x12 => RD12, 0x13 => skiymet/UD3, 0x23 => UD3A/profiler)
0x12	Magic number type (0x12 => Primary analysis record MN)
0x03	Record major revision number
0x00	Record minor revision number

Note that fields which have been added in version 3 are listed with offset values in bold typeface.

Offset	Size	Name	Format
0	4	Record magic number (0x23120001)	int
4	4	Record counter (0, 1, ….)	int
8	4	Offset to start of next record from start of this record (bytes)	int
12	4	Offset to start of data from start of this record (bytes)	int
16	4	Epoch time stamp of start of acquisition (seconds)	int
20	4	Millisecond component of time stamp (0,..,999)	int
24	32	Experiment tag name (null terminated)	char

Offset	Size	Name	Format
56	32	Experiment comment (null terminated)	char
88	4	Site latitude (from GPS) in degrees (positive implies North)	float
92	4	Site longitude (from GPS) in degrees (positive implies East)	float
96	4	RTC GPS engine status (0 = SEEK, 1 = LOCK, 2 = NOT FITTED, 3 = UNAVAILABLE)	int
100	4	Operating frequency (Hz)	int
104	4	First local oscillator frequency (Hz)	int
108	4	Number of IP/QP channels acquired (number of receivers * 2) or 2*N	int
112	4	Sampling resolution (m)	int
116	4	Number of range gates sampled	int
120	4	Start range of sampling (m)	int
124	4	PRF (Hz)	int
128	4	Integrations	int
132	4	Number of data points acquired	int
136	4	Polarisation (0 = "O" mode, 1 = "E" mode, 2 = linear mode1, 3 = linear mode 2)	int
140	4	Receiver filter setting index (0, 1, 2, 3)	int
144	4	Number of modes in use (1 or 2)	int
148	4	Dual mode index number for these data (0 or 1)	int
152	4	Dual mode range correction applied to these data (m)	int
156	4	Transmitted Pulse width (HPFW) in nanoseconds	int
160	4	Number of Pulse codes transmitted (1 = Barker, 2 = Complementary)	int
164	4	Number of bits in transmitted pulse code	int
168	4	Tx pulse code 1 (bitmask – MSB transmitted first)	int
172	4	Tx pulse code 2 (bitmask – MSB transmitted first)	int
176	4	Number of receivers used in analysis, K (normally, K = 3)	int
180	4	ACF length to calculate in seconds	float
184	4	ACF length of fit in lags	int
188	4	Sea scatter to atmospheric power ratio limit	float
192	4	Sea scatter notch (0 = no, 1 = yes)	int
196	4	Lowest height to notch sea scatter (m)	int
200	4	Highest height to notch sea scatter (m)	int
204	4	Number of spectral bins to notch to remove sea scatter	int
208	4	Minimum receiver signal-to-noise ratio allowable (dB)	float
212	4	Minimum cross correlation allowable	float
216	4	Maximum normalised time discrepancy allowable (percentage)	float
220	4*2*N	Antenna coordinates (Range (m), Bearing (deg)) – N pairs	float
220+8N	4*N	Receiver gains (dB) – N values	int
220+12N	4*K	List of receivers used for analysis – K values between 1 and N	int
Total	220+12N + 4K		

Results Data

The results follow immediately after the recorder header. Each result is comprised of a set of calculated parameters which are repeated for each range gate of data. The results for each range gate are organised as defined below. Note that data fields for which results have not, or could not be calculated are filled out with a "bad value" indicator. The numerical value of the "bad value" is –9999.

Offset	Size	Name	Format
0	4	Range (m)	int
4	4	Analysis status code	int
8	4	Zonal wind velocity (m/s) positive Eastwards	float
12	4	Meridional wind velocity (m/s) positive Northwards	float
16	4	Vertical wind velocity (m/s) positive upwards	float
20	4	Uncorrected zonal wind velocity (m/s)	float
24	4	Uncorrected meridional wind velocity (m/s)	float
28	4	Corrected fading time (s)	float

32	4	Uncorrected fading time (s)	float
36	4	Normalised time discrepancy (percentage)	float
40	4	Ellipse major axis length (m)	float
44	4	Ellipse axial ratio (major/minor)	float
48	4	Ellipse orientation (bearing in degrees)	float
52	4	Sea scatter power calculated for this range (0 = no, 1 = yes)	int
56	4	Sea scatter removal algorithm applied to this range (0 = no, 1 = yes)	int
60	4*N	Receiver saturation (number of data points), one per acquired receiver channel	int
60+4N	8*N	Channel offset (digitiser units), one per acquired digital channel	int
60+12N	4*N	Receiver amplitude (linear units), one per acquired receiver channel	int
60+16N	4*N	Receiver SNR (dB), one per acquired receiver channel	float
60+20N	4*K	Cross channel NSR (dB), one per analysed receiver channel pair	float
60+20N+4K	4*2*K	Zero lag XCF information (magnitude, phase pairs), one per analysed receiver channel pair, phase in degrees.	float
60+20N+12K	4*N	Sea scatter relative power (dB), one per acquired receiver channel	float
Total	60+24N+12K		

Appendix D: SSWMA ANALYSIS STATUS CODES

Introduction

Each record analysed by the Spaced Sensor Wind Measurement Analysis (SSWMA) produces a set of results qualified by status codes. The status codes may be used to identify common failure modes in the analysis, and therefore may prove helpful in adjusting various acquisition or analysis parameters in order to eliminate or minimise the occurrence of such modes. A status code of zero indicates that the input data conformed to all conditions and criteria applied by the analysis, and that the result of the analysis can be considered as reliable. Other status codes indicate a failure of the analysis of some description, and that the results reported - if any - may not be reliable.

Status Codes

Status Code	Description
0	Successful analysis
1	Low signal amplitude on one or more receiver channels
2	Low signal to noise ratio on one or more receiver channels
3	Signal fading too fast compared to inter-pulse period after coherent integration
4	Signal fading too slow compared to acquisition record length or ACF calculation
5	Numerical fitting algorithm failure
6	One or more cross correlation functions has multiple large peaks
7	One or more autocorrelation functions are oscillatory
8	Diffraction pattern velocity is too slow for reliable calculation
9	Insufficient spatial coherence in pattern - XCF's have low magnitudes
10	Normalised time discrepancy is larger than specified limit
11	V_c^2 is negative
12	Ellipse coefficients are complex
13	The corrected velocity direction diverges substantially from the uncorrected velocity direction
14	The corrected velocity magnitude is substantially larger than the uncorrected velocity magnitude
15	The corrected velocity magnitude is substantially smaller than the uncorrected velocity magnitude
20	Internal program error - E.g., could not allocate memory
128	Channel saturation > 10%. This status code is "Or'd" with the usual status code.

For a more detailed discussion of the application of the rejection criteria outlined above, please see (for example) B. H. Briggs,, "The analysis of spaced sensor records by correlation techniques", Handbook for Middle Atmosphere Program, **13**, 1984.