CAWA-SSP-FMT-GFZ-006

CAWA

Hymet

System Software
Output Format Specification

CRD

Preparation/Review	Name
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Table of Contents

Change Control Sheet

Date	*Version*	*Author*	*Items*
31.10.2010	0.1	Tilo Schöne	Initial Document
03.01.2011	0.2	Tilo Schöne	Parameter added
20.09.2011	0.3	Tilo Schöne	Parameter for SPA added
08.12.2011	0.4		Parameter for river monitoring added
04.07.2012	0.5	Tilo Schöne	Unit for Pressure is changed from mmHg to mBar

INTRODUCTION AND SCOPE

The document provides the description of the data records from the CAWA Hymet system. All data are sampled according to a pre-selected sampling rate. Data is being written to files. All files will be transmitted to the SOPAF using file oriented TCP/IP services (scp, ncftp).

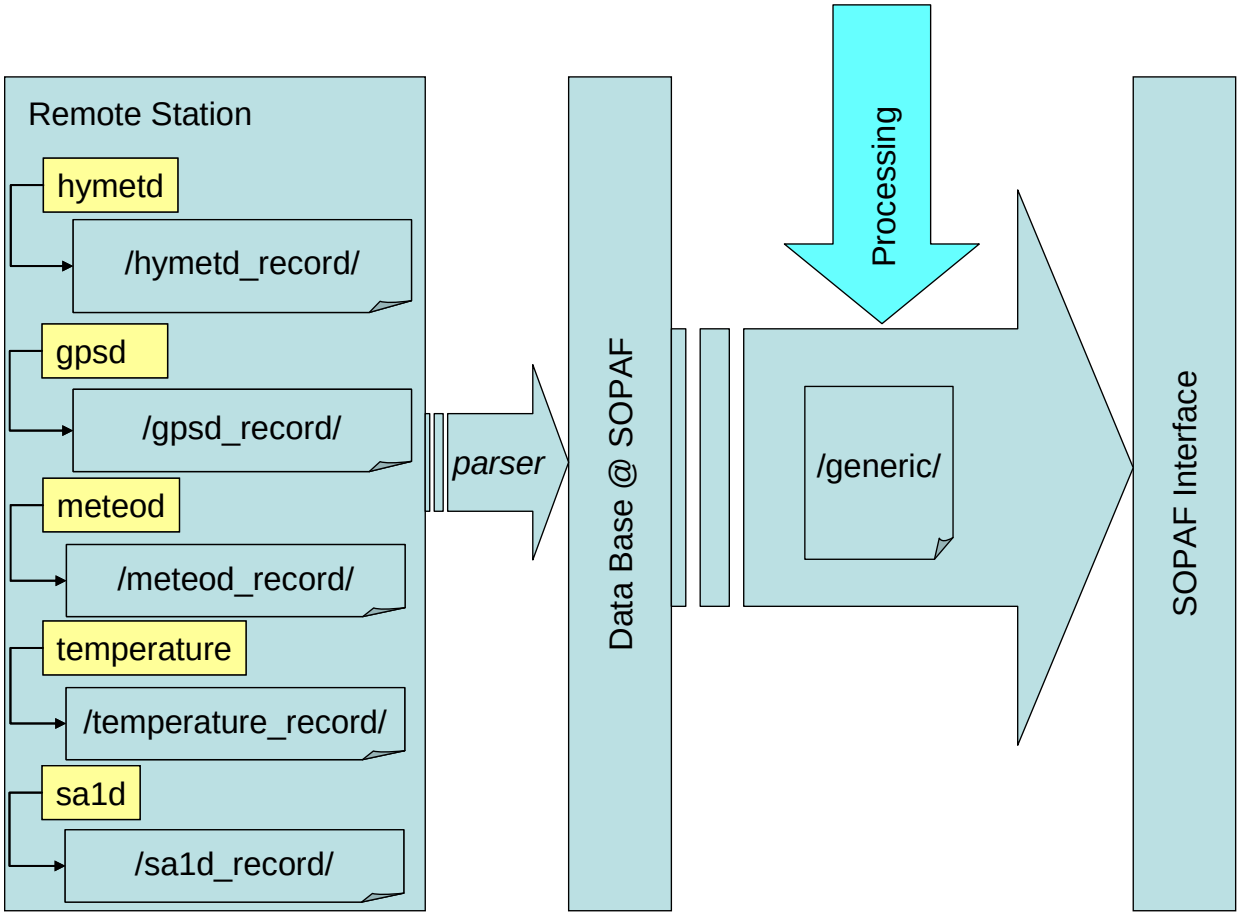

Figure 1: General Data Flow Concept

The scope of this document is to describe the data format and content which is available at the remote Hymet station. The document is also the basis for processing of data within the SOPAF center.

DEFINITIONS, ACRONYMS, ABBREVIATIONS

Abbreviation	Description
CAWa	Water in Central Asia
crd	hymet data daemon (Software module for communicating with Campbell data recorder peripherals)
SW	Software
TBD	to be defined
SOPAF	System Operation, Processing and Archiving Facility
UTC	Universal Time Coordinated

Data Representation:

For Bytes, the bit numbering is from right (0) to left (7). Data is represented in TCP/IP network byte order (big endian). Most significant byte is to the left.

Bytes:

7	6	5	4	3	2	1	0

Unsigned integers:

Binary 00000001 = Decimal 1; Binary 10000001 = Decimal 129; Binary 10010001 = Decimal 145

Signed integers:

Binary 10000000 = Decimal 1; Binary 11111111 = Decimal -1; Binary 11110111 = Decimal -17

If the document refers to the acronym ASCII, the extension ISO/IEC 8859-1 is applicable.

DOCUMENTS

All relevant information about data structures for the design and procurement of the Hymet Software is contained in this specification. The following documents are provided as additional information and reference. In case of incompatibilities between the document at hand and one of the following documents, this shall be brought to the attention of the customer for resolution.

The following documents are applicable documents to CAWa stations as a whole.

FILE NAMING CONVENTION

For historical reasons two different file name convention exist. Both can be used alternatively, but each subsystem provides only one type of filenames.

The filename consists of a 4-letter leading identifier, intermediate information, and a filename extension.

Filename type one is defined as follows

XXXXYYYYYYYYYY.EXT

Typical identifiers (“XXXX”) are “HM01” for a Hymet station, or “ts02” for a buoy. “YYYYYYYYYY” is the unix time stamp (since 1970). The count of digits is non-fixed. “.EXT” would be typical “.log” for the hymet system, “.tps” for the gnssd system.

Alternatively the a second format exist, which is closely defined to the international standard for high-rate GPS stations and is as follows

XXXXWEEKDHZSCND.EXT

“XXXX” are again identifiers (e.g. “HM01” for a Hymet station, or “ts02” for a buoy). “WEEK” is defined as the GPS-Week (a four digit number). GPS weeks are counted since the beginning of the year 1980. “D” is the GPS day of week, GPS day 0 is Sunday. “H” is a letter for the specific hour of the day; ‘a’ is hour 0, ‘x’ is hour 23. “Z” is a user-free definition, but typically ‘z’. “SCND” is the 4 digit number of seconds of the specific hour. “.EXT” would be typical “.log” for the hymet system, “.tps” for the gnssd system.

As examples, a *meteo* file for *hm01*, generated on *March 19th, 2008 11:23:20*, would be either named

hm011205922200.met or **hm0114713kz1400.met** .

The time system of the remote site is synchronized with GPS. Therefore, all time information is based on this time scale. Exceptions are stated in the text.

GENERAL DESCRIPTION OF *CRD* SOFTWARE RECORD FOR CAWA HYMET

Overview

The standard Hymet station is equipped with hydrometerological sensors and a Campbell data recorder. All header records are enclosed by speech marks and separated by a comma.

Header Record Definition Type I

"TOA5","CR1000","22872","CR1000.Std.15","CPU:TARA_20100905.CR1","45970","Table1"

Field	Data representation	Description
"TOA5"	Character	Table Oriented ASCII (refers to the output format, here ASCII)
"CR1000"	Character	Campbell Data Recorder Type
"22872"	Character	unknown
"CR1000.Std.15"	Character	Campbell Data Recorder Firmware Version
"CPU:TARA_20100905.CR1"	Character	Campbell Data Recorder Configuration file
"45970"	Character	Program Signature Number
"Table1"	Character	Internal Table for measured values

Header Record Definition Type II

```
"TIME-
STAMP","RECORD","BattV_Min","VW_1","PA_1","VW_2","PA_2","VW_3","PA_3","VW_4",
"PA_4","VW_5","PA_5","VW_6","PA_6","VW_7","PA_7","VW_8","PA_8","T107_1","T107
_2","T107_3","T107_4","T107_5","T107_6","T107_7","T107_8","AirTC","RH","Baro"
,"RadSW_Up_Avg","RadSW_Dn_Avg","RadLW_Up_Avg","RadLW_Dn_Avg","NR01TC_Avg","NR
01TK_Avg","NetRs_Avg","NetRl_Avg","Albedo_Avg","UpTot_Avg","DnTot_Avg","NetTo
t_Avg","RadLW_UpCo_Avg","RadLW_DnCo_Avg","WindSp_Avg","WindSp_Max","WindSp_TM
x","WindDir","Rain_Tot","R_vel","R_WL","R_Q"
```

For details refer to “Field” entries in Section 6.

Header Record Definition Type III

```
"TS","RN","Volts","","uSec","","uSec","","uSec","","uSec","","uSec","","uSec"
,"","uSec","","uSec","Deg C","Deg C","Deg C","Deg C","Deg C","Deg C","Deg
C","Deg C","Deg C","%","mmHg","W/m^2","W/m^2","W/m^2","W/m^2","Deg
C","K","W/m^2","W/m^2","W/m^2","W/m^2","W/m^2","W/m^2","W/m^2","W/m^2","meter
s/second","meters/second","meters/second","Degrees","mm","mm/s","mm","m^3/s"
```

For details refer to “Unit” entries in Section 6. The entries are referring to the same field as Type II entries.

Header Record Definition Type IV

```
"","","Min","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp"
,"Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp
","Smp","Smp","Smp","Avg","Avg","Avg","Avg","Avg","Avg","Avg","Avg","Avg","Av
g","Avg","Avg","Avg","Avg","Avg","Max","TMx","Smp","Tot","Smp","Smp","Smp"
```

The field describes the data description for the measured quantity representation. The entries are referring to the same field as Type II entries.

Field	Data representation	Description
""	Empty	Empty fields are for e.g., time or record number
"Smp"	Character	Sample: Spot or instantaneous value
"Min"	Character	Minimum value within the past sampling period
"Max"	Character	Maximum value within the past sampling period
"Avg"	Character	Average over the past sampling period
"Tot"	Character	Total value, e.g. for Rain in the past sampling period

RECORD DESCRIPTION

Field	TIMESTAMP
Description	Gives the time of the measurements
Character Length	19
Data representation	Character
Unit	YYYY-MM-DD HH:MI:SS TS
Minimum	n/a
Maximum	n/a
Error Code	No error code available
Notes	Time is enclosed in speech marks The time system is originated from the Campbell data recorder and cannot be adjusted during run time. The time is set by the operator prior to deployment

Field	RECORD
Description	Internal record number
Data representation	Integer
Unit	RN
Minimum	1
Maximum	111360
Notes	The record number is increased every measurement. Measurement is defined as the internal sampling rate of the data logger.

Field	BattV_Min	
Description	Minimum of battery voltage of power supply during the last cycle	
Data representation	Float	
Unit	Volts	
Minimum		
Maximum		
ErrorCode	NaN	Enclosed in speech marks
Notes		

Field	VW_# (# = [0,9])	
Description	Volumetric soil water content at local position #	
Data representation		
Unit	n/a	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	PA_# (# = [0,9])	
Description	Measured travel time of the EM-wave along the probe CS616	
Data representation		
Unit	uSec	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	T107_# (# = [0,9])

Description	Soil temperature at local position #	
Data representation	Float	
Unit	℃	
Minimum	-35	
Maximum	50	
Error Code	NaN	Enclosed in speech marks
Notes		

Field	AirTC	
Description	Air Temperature	
Data representation	Float	
Unit	℃	
Minimum	-40	
Maximum	60	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	RH	
Description	Relative Humidity	
Data representation	Float	
Unit	%	
Minimum	0	
Maximum	100	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	Baro
Description	Barometric Pressure
Data representation	Float or Integer
Unit	mBar
Minimum	500 mbar

Maximum	1100 mbar	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	RadSW_Up_Avg	
Description	Incoming short wave solar radiation	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum	0	
Maximum	2000	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	RadSW_Dn_Avg	
Description	Outgoing (reflected) short wave solar radiation	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum	0	
Maximum	2000	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	RadLW_Up_Avg
Description	Incoming long wave solar radiation

Data representation	Float or Integer	
Unit	W/m^2	
Minimum	-1000	
Maximum	1000	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	RadLW_Dn_Avg	
Description	Outgoing (reflected) long wave solar radiation	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum	-1000	
Maximum	1000	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	NR01TC_Avg	
Description	Temperature at the solar radiation sensor in degrees Celsius	
Data representation	Float	
Unit	Deg C	
Minimum	-10	
Maximum	40	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	NR01TK_Avg

Description	Temperature at the solar radiation sensor in Kelvin	
Data representation	Float	
Unit	K	
Minimum	263.15	
Maximum	313.15	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	NetRs_Avg	
Description	Net short wave solar radiation	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	NetRl_Avg	
Description	Net long wave solar radiation	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	Albedo_Avg	
Description		
Data representation	Float or Integer	
Unit	W/m^2	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	UpTot_Avg	
Description	Total incoming solar radiation	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum	0	
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	DnTot_Avg	
Description	Total outgoing solar radiation	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	NetTot_Avg

Description	Total Net solar radiation	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	RadLW_UpCo_Avg	
Description	Temperature corrected incoming solar radiation 'RadLW_UpCo=RadLW_Up+5.67*10^-8*NR01TK^4'	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	RadLW_DnCo_Avg	
Description	Temperature corrected outgoing solar radiation 'RadLW_DnCo=RadLW_Dn+5.67*10^-8*NR01TK^4'	
Data representation	Float or Integer	
Unit	W/m^2	
Minimum		
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

	Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.

Field	WindSp_Avg	
Description	Wind speed	
Data representation	Float	
Unit	meters/seconds	
Minimum	0	
Maximum	60	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	WindSp_Max	
Description	Wind speed maximum (Gust)	
Data representation	Float	
Unit	meters/seconds	
Minimum	0	
Maximum	60	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	WindDir	
Description	Wind direction	
Data representation	Float	
Unit	Degrees	
Minimum	0	
Maximum	355 (electrical) (360 mechanical)	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	WindSp_TMx	
Description	Gives the time of the maximum wind speed (Gust)	
Record length	19	
Data representation	Character	
Unit	YYYY-MM-DD HH:MI:SS TS	
Minimum	n/a	
Maximum	n/a	
Error Code	n/a	
Notes	For the Unit see Header Record Type III	

Field	Rain_Tot	
Description	Total amount of Precipitation within the sampling interval	
Data representation	Float or Integer	
Unit	mm	
Minimum	0	
Maximum		
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Values equal & above 800 may be truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”. This is firmware dependent and must not be true for all files.	

Field	SnowH_Avg	
Description	Average Snow Height	
Data representation	Float	
Unit	mV (will be converted to mm)	
Minimum	TBD	
Maximum	TBD	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Till January, 4th, 2011, unit in mV, for conversion contact thoss@gfz-potsdam.de	

	Values equal & above 800 are truncated to integer. A value of 799.99 would be float “799.99”, while 800.01 would be integer “800”

Field	S#_ice (# = [1,4])	
Description	Ice Content in snow by the SPA	
Data representation	Float	
Unit	%	
Minimum	0	
Maximum	100	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	S#_water (# = [1,4])	
Description	Water Content in snow by the SPA sensor	
Data representation	Float	
Unit	%	
Minimum	100	
Maximum	100	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	S#_dens (# = [1,4])	
Description	Snow Density by the SPA sensor (calculated)	
Data representation	Float	
Unit	kg/m^3	
Minimum	TBD	
Maximum	TBD	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III	

Field	S#_SWE (# = [1,4])

Description	Snow water equivalent by the SPA sensor (calculated)	
Data representation	Float	
Unit	mm	
Minimum	TBD	
Maximum	TBD	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III The SWE corresponds to the water column in mm resulting from the melting of the complete snow cover on a defined area. It is calculated from the snow density of sloping sensors with respect to the snow depth.	

Field	SH	
Description	Snow Depth by Ultrasonic of the SPA	
Data representation	Float	
Unit	m	
Minimum	TBD	
Maximum	TBD	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III The snow depth sensor output is zeroed during installations	

Field	Potmtr	
Description	Correction Length Sensor of the SPA sensor (Potentiometer measuring the variation of the length of the cross band)	
Data representation	Float	
Unit	mm	
Minimum	TBD	
Maximum	TBD	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III The deforming of sloping sensors due to the snow pack can be corrected by measuring the additional length of the sensor rope at the suspension.The sensor measures the rotation of the suspension roll and converts the values	

	into length. The correction is automatically included in the calculation.

Field	S#_C§ ((#=(1,4), §=(1,2))	
Description	Capacitance of the SPA sensor	
Data representation	Float	
Unit	pF	
Minimum	TBD	
Maximum	TBD	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III The capacitance of the SPA-sensor is measured at a low frequency of 10 kHz and a high frequency of 150 kHz. The capacitance of one meter sensor in the air is 16,7 pF at both frequencies and consequently about 84 pF for a 5 m long SPA-sensor. The values may vary with humidity and water on the sensor.	

~~Field~~	~~T_S_Box~~	
~~Description~~	~~NOT AVAILABLE AT MOMENT~~	
~~Data representation~~	~~Float~~	
~~Unit~~	~~n/a~~	
~~Minimum~~	~~TBD~~	
~~Maximum~~	~~TBD~~	
~~Error Code~~	~~NaN~~	~~Enclosed in speech marks~~
~~Notes~~	~~For the Unit see Header Record Type III~~	

Field	R_vel	
Description	RQ24 Water / River surface velocity	
Data representation	Float	
Unit	mm/s	
Minimum	0	
Maximum	TBD (9999?)	
Error Code	NaN	Enclosed in speech marks

Notes	For the Unit see Header Record Type III

Field	R_WL	
Description	RQ24 Water Level	
Data representation	Float	
Unit	mm or cm	
Minimum	TBD	
Maximum	TBD (9999?)	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Depending on the cross-profile section, the value may come as (static) mm/cm, while still a 4-digit (integer) value is distributed. This needs clarification in SOPAF.	

Field	R_Q	
Description	RQ24 river flow volume	
Data representation	Float	
Unit	m^3/s	
Minimum	0	
Maximum	TBD (9999?)	
Error Code	NaN	Enclosed in speech marks
Notes	For the Unit see Header Record Type III Depending on the cross-profile section, the value may have decimal digits, while still a 4digit (integer) value is distributed. This needs clarification in SOPAF.	

File Format Description

All data from the *hymet station daemon (crd)* is written to files. A typical file structure is given below.

```
"TOA5","CR1000","22872","CR1000.Std.15","CPU:TARA_20100905.CR1","45970","Tabl
e1"
"TIME-
STAMP","RECORD","BattV_Min","VW_1","PA_1","VW_2","PA_2","VW_3","PA_3","VW_4",
"PA_4","VW_5","PA_5","VW_6","PA_6","AirTC","RH","Baro","RadSW_Up_Avg","RadSW_
Dn_Avg","RadLW_Up_Avg","RadLW_Dn_Avg","NR01TC_Avg","NR01TK_Avg","NetRs_Avg","
NetRl_Avg","Albedo_Avg","UpTot_Avg","DnTot_Avg","NetTot_Avg","RadLW_UpCo_Avg"
,"RadLW_DnCo_Avg","WindSp_Avg","WindSp_Max","WindDir","Rain_Tot"
```

```
"TS","RN","Volts","","uSec","","uSec","","uSec","","uSec","","uSec","","uSec"
,"Deg C","%","mmHg","W/m^2","W/m^2","W/m^2","W/m^2","Deg
C","K","W/m^2","W/m^2","W/m^2","W/m^2","W/m^2","W/m^2","W/m^2","W/m^2","meter
s/second","meters/second","Degrees","mm"
"","","Min","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp","Smp"
,"Smp","Smp","Smp","Smp","Avg","Avg","Avg","Avg","Avg","Avg","Avg","Avg","Avg
","Avg","Avg","Avg","Avg","Avg","Avg","Max","Smp","Tot"
"2010-09-06
07:40:00",318,12.67,0.339,28.98,0.566,34.88,0.681,37.49,0.802,40.00,0.694,37.
76,0.546,34.42,13.63,17.95,638.5,917,227.0,348.7,76.80,19.86,293.0,689.5,271.
9,0.248,1265,303.8,961,766.9,494.9,3.607,4.505,331.3,0.000
"2010-09-06
07:45:00",319,12.63,0.340,29.01,0.566,34.88,0.681,37.49,0.802,40.01,0.693,37.
75,0.547,34.44,13.53,17.74,638.4,910,227.2,349.0,78.53,19.83,293.0,682.4,270.
5,0.250,1259,305.7,953,766.9,496.5,2.836,4.853,49.70,0.000
"2010-09-06
07:50:00",320,12.52,0.341,29.03,0.566,34.90,0.681,37.49,0.802,40.00,0.693,37.
75,0.546,34.42,14.04,16.30,638.4,907,226.5,347.9,77.62,19.33,292.5,680.4,270.
3,0.250,1255,304.1,951,763.0,492.7,3.939,4.457,18.24,0.000
```

The file typically contains four header lines, followed by several data lines.