AMARSS Meta Data List

Contents

Sensor List

Items	Manufacturers	Model Names	Model #s	Costs	Web Sites
Data Logger	Onset	HOBO® Weather Station Data Logger	H21-001	$399.00	http://www.onsetcomp.com/
Software	Onset	HOBOware Pro for Windows	BHW-PC	$99.00	http://www.onsetcomp.com/
Light Sensor	Onset	HOBO® Weather Station Photosynthetic Light (PAR) Smart Sensor	S-LIA-M003	$210.00	http://www.onsetcomp.com/
Light sensor bracket	Onset	Light Sensor Bracket	M-LBA	$20.00	http://www.onsetcomp.com/
RH/Temp	Onset	HOBO® Weather Station Temperature/RH Smart Sensor	S-THA-M002	$135.00	http://www.onsetcomp.com/
Shield	Onset	Solar Radiation Shield	M-RSA	$90.00	http://www.onsetcomp.com/
Barometric Pressure	Onset	HOBO® Weather Station Barometric Pressure Smart Sensor	S-BPA-CM10	$119.00	http://www.onsetcomp.com/
Soil Temperature	Onset	HOBO® Weather Station 12-bit Temperature Smart Sensor	S-TMB-M002	$90.00	http://www.onsetcomp.com/
Soil Moisture	Onset	HOBO® Weather S-SMA Station Soil Moisture Smart Sensor	S-SMA-M005	$139.00	http://www.onsetcomp.com/
CO2 Sensor Probe	Vaisala	Probe	GMP222	included in below	http://www.vaisala.com/
CO2 Sensor Module	Vaisala	Vaisala CARBOCAP® Carbon Dioxide Transmitter Module	GMM220	$680.00	http://www.vaisala.com/
CO2 Sensor Adaptor	Onset	12-bit 4-20mA Input Adapter	S-CIA-CM14	$79.00	http://www.onsetcomp.com/
Psychrometer Probe	Wescor	Probe	PST-55 5F	$63.00	http://www.wescor.com
Psychrometer	Wescor	Dew Point Microvoltmeter	HR-33T	$3,000.00	http://www.wescor.com
Nitrate Sensor	Sentek	Nitrate Sensor	360-073	£299.00	http://www.sentek.co.uk/
Ammonium Sensor	Sentek	Ammonium Sensor	362-073	£299.00	http://www.sentek.co.uk/
Data Logger	Onset	HOBO® U12 Outdoor/Industrial 4-Channel External Data Logger	U12-008	$199.00	http://www.onsetcomp.com/

Data Logger Database Field Name List

Field Name	Description	Unit & Format	Source	Calibration
Loc	Lcation number along AMARSS transect	Integer	See fig. 1.	n/a
Node	Node Number	Integer	See fig. 1.	n/a
Date_Time	Date and time in pacific standard time	mm/dd/yyyy hh:mm:ss	HOBO® Weather Station Data Logger	at factory
Date	Date calculated from Date_Time	Integer	MS Access database; Int function	n/a
WeekNum	Week number calculated from 1/2/2005	Integer	MS Access database; DateDiff function	n/a
kPa	Pressure in kPa	kPa	HOBO® Weather Station Barometric Pressure Smart Sensor	at factory
Soil_Temp_2	Soil temperature in deg C at 2 cm depth	deg C	HOBO® Weather Station 12-bit Temperature Smart Sensor	at factory
Soil_Temp_8	Soil temperature in deg C at 8 cm depth	deg C	HOBO® Weather Station 12-bit Temperature Smart Sensor	at factory
Soil_Temp_16	Soil temperature in deg C at 16 cm depth	deg C	HOBO® Weather Station 12-bit Temperature Smart Sensor	at factory
WC_2	Water content in (-) at 2 cm depth	m^3 / m^3	HOBO® Weather S-SMA Station Soil Moisture Smart Sensor	at factory
WC_8	Water content in (-) at 8 cm depth	m^3 / m^3	HOBO® Weather S-SMA Station Soil Moisture Smart Sensor	at factory
WC_16	Water content in (-) at 16 cm depth	m^3 / m^3	HOBO® Weather S-SMA Station Soil Moisture Smart Sensor	at factory
Atm_Temp_C	Atmospheric temperature in deg C	deg C	HOBO® Weather Station Temperature/RH Smart Sensor	at factory
Dew_Pt_C	Dew point in deg C	deg C	HOBO® Weather Station Temperature/RH Smart Sensor	at factory
RH_%	Relative humidity in %	%	HOBO® Weather Station Temperature/RH Smart Sensor	at factory

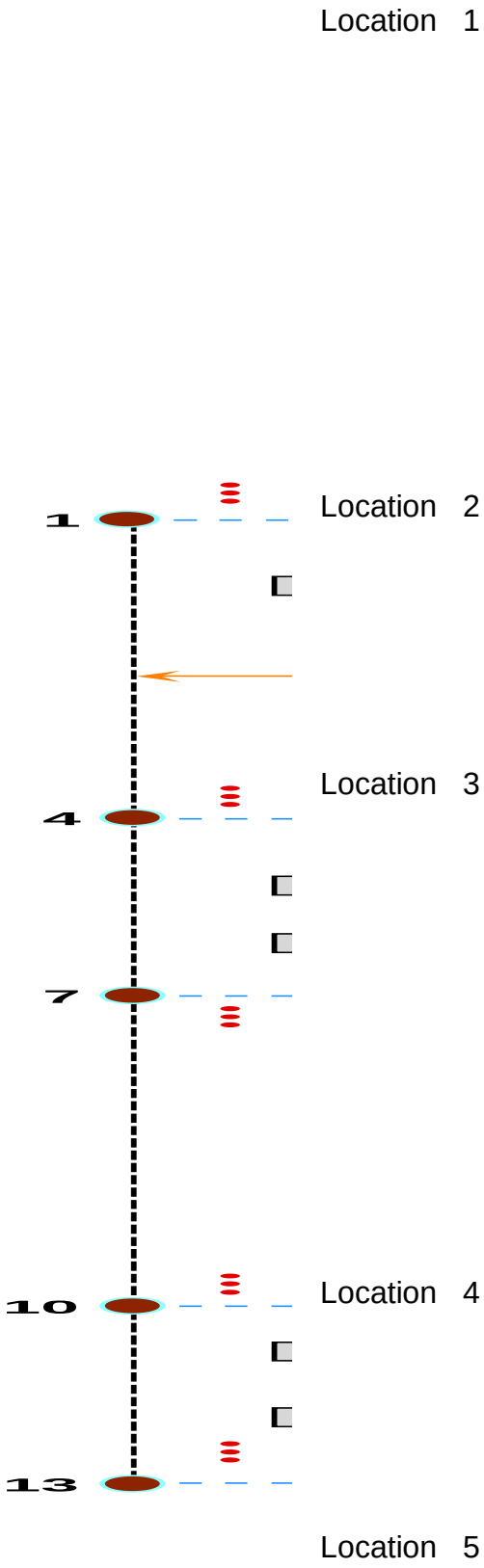
PAR_uE	Photosynthetic ally available radiation in u Jules ????	u Jule	HOBO® Weather Station Photosynthetic Light (PAR) Smart Sensor	at factory
CO2_2	Carbon dioxide concentration at 2 cm depth	ppm	Vaisala Carbon Dioxide Probe	twice anually at lab
CO2_8	Carbon dioxide concentration at 8 cm depth	ppm	Vaisala Carbon Dioxide Probe	twice anually at lab
CO2_16	Carbon dioxide concentration at 16 cm depth	ppm	Vaisala Carbon Dioxide Probe	twice anually at lab
CO2_AG_5	Carbon dioxide concentration at 5 cm above ground	ppm	Vaisala Carbon Dioxide Probe	twice anually at lab
Flux	Calcualted from above parameters	u mol / m^2 / sec	MS Access database Visual Basic module	n/a
Cor_2 cm	Water content correction factor	m^3 / m^3	R. Vargas	n/a
Cor_2 cm	Water content correction factor	m^3 / m^3	R. Vargas	n/a
Cor_2 cm	Water content correction factor	m^3 / m^3	R. Vargas	n/a
S	Silt and Sand content in soil	m^3 / m^3	H. Estrada-Medina	n/a
Bulk Density	Bulk soil density of soil	g / cm^3	H. Estrada-Medina	n/a

Sensor Serial Number List

= replaced

Node number	1	2	3	4	5	6	7	8	9	10
Datalogger	870050	870043	870049	870051	870052	870047	870046	870058	870048	870089
Light sensor bracket	M-LBA-1	M-LBA-2	M-LBA-3	M-LBA-4	M-LBA-5	M-LBA-6	M-LBA-7	M-LBA-8	M-LBA-9	M-LBA-10
RH/Temp	865969	865966	865973	865963	865965	865956	865960	865971	865962	865972
Barometric Pressure	847190	847186	847178	847177	847189	847171	847168	847188	847183	847169
PAR	866529	866521	866536	873170	866522	866528	866533	866525	866531	866526
4-20mA (CO2 depth 2cm)	859638	859650	881181	859633	859647	859639	859635	859657	859628	881197
4-20mA (CO2 depth 8cm)	859627	859658	859629	859637	881177	881174	859645	881180	859648	859626
4-20mA (CO2 depth 16cm)	859659	859646	859640	881179	881185	859632	881202	881186	881184	859651
Soil Temp (depth 2cm)	893929	911900	911891	893935	911895	893937	911894	911898	893923	911899
Soil Temp (depth 8 cm)	893928	893926	911896	893925	893932	911893	893934	911902	893936	893927
Soil Temp (depth 16 cm)	911901	893940	911892	893939	893930	893924	876729	893931	893933	893938
ECHO depth 2cm	875263	875331	875274	875314	875275	875290	875276	875304	875286	875309
ECHO depth 8cm	875265	875328	875270	875268	875302	875273	875335	875306	875284	875308
ECHO depth 16cm	875271	875319	875313	875264	875289	875291	875269	875272	875305	875307
Psychrometer (depth 2cm)	PO55	PO52	PO49	PO44	PO61	PO51	PO37	PO57	PO32	PO40
Psychrometer (depth 8cm)	PO43	PO54	PO50	PO08	PO60	PO48	PO39/38	PO35	PO39	PO42
Psychrometer (depth 16cm)	PO59	PO53	PO47	PO45	PO58	PO46	PO62	PO36	PO41	PO56
CO2 sensor board (1)		A2010030	A1940104	A1940093	A2010048	A1940099	A1940108	A2010043	A1940072	
CO2 sensor board (2)		A2010049	A2010015	A1940079	A1940098	A2010032	A2010010	A1940073	A2010055	
CO2 sensor board (3)		A1940074	A2010038	A1940096	A2010054	A1940076	A1940080	A2010028	A2010045	
CO2 sensor probe (1)		A2210081	A2140080	A2140057	A2140082	Z0950013	A2140076	A2210058	A2140051	A2210057
CO2 sensor probe (2)		A2210085	A2210084	A2140061	A2140078	A2210079	A2150067	A2140062	A2210078	A2210076
CO2 sensor probe (3)		A2140052	A2210087		A2210052	A2140072	A2210070	A2150068	A2140083	A2210077
MOXA serial to ethernet		A14HA2633269	A14HB0234466	A14CL2032461	A14HA2633129	A14CL2031885		A14CL2032453	A14HA633277	

AMARSS Transect Map (Fig. 1)



Data Correction and Flux Calculation

Data Correction

1. Remove out of control points due to sensor failures, using Qry_1_Remove Bad Points.
2. Atmospheric temperature less than – 50 C was removed.
3. Dew point less than – 50 C was removed.
4. PAR less than 0 was removed.
5. CO2 concentration < 4 was removed. This is because of calibration equation:
6. (625 * [CO2] – 2500)/101.3*(273 + Temp)/298.15/kPa
7. If CO2 concentration is < 4, then corrected concentration would be negative.
8. Water contents < -0.1 or > 1.0 were removed.
9. Soil temperatures less than – 50 C and less than < -10 C for 16 cm were removed.

CO2 concentration correction

1. Before this change, ideal gas low was assumed:
   Corrected = Uncorrected * 101.3 / [kPa] * (273 + t) / 298
2. This equation was given by VAISALA.
   a. Convert current (mA) to uncorrected conc.:
      Cm (ppm) = 625 * [mA] – 2500
   b. Caluclate Kt for temperature
      Kt_2: 0.06*([Cm_2]*10^-4)^3-0.125*([Cm_2]*10^-4)^2+0.12*[Cm_2]*10^-4+0.003
   c. Temp correction factor
      Ct (ppm) = 14000*(-[Kt]^2+[Kt])*(25-[Atmospheric Temp])/25
   d. Pressure correction factor:
      Cp (ppm) = 1380*[Cm]*10^-4*([kPa]-101.3)/101.3
   e. Corrected Conc (ppm) = [Cm]-[Ct]-[Cp]

Flux Calculation (Marshall Model)

1. Calculate Flux at 0 cm using Marshall model
   This is based on a paper by Tang et al, Agricultural and Forest Meteorology, 132(2005) 212-217, and it is applied to Marshall model by K. Kitajima

   Z= depth in m
   F=Flux in u mol / m^2 / sec
   C=CO2 concentration molar concentration in u mol / mol
   Cv=Volumetric concentration in m^3 / m^3
   P=barometric pressure in Pa
   R=gas constant in J/K/mol

T=absolute temperature in K
Da0=Diffusion constant of air at 25 deg C in m^2 / sec
ρb=bulk density in g / cm^3
ϕ=porosity in m^3 / m^3
θ=water content in m^3 / m^3

$Fz = - Ds \, dc/dz$
$C = CvP/RT$
$Ds = \xi \, Da$
$Da = Da_0 * (T/T_0)^{1.75} (P_0/P)$
$\xi = \varepsilon ^ {1.5}$
$\varepsilon = \phi - \theta = 1 - (\rho b/2.65) - \theta$
$Fz = -(Da_0 P_0)/(R*T_0^{1.75})*(\varepsilon^{1.5})*(T^{0.75})*(dc/dz)$

Flux for 2 cm depth is:
$F_2 = -(Da_0 P_0)/(R*T_0^{1.75})*(\varepsilon^{1.5})*((T_2+T_8)/2)^{1.75}* (C_2/T_2 - C_8/T_8)/(0.02 - 0.08)$

Flux for 8 cm depth is:
$F_8 = -(Da_0 P_0)/(R*T_0^{1.75})*(\varepsilon^{1.5})*((T_8+T16)/_2)^{1.75}* (C_8/T_8 - C_{16}/T_{16})/(0.08 - 0.16)$

Flux at 0 cm is
$F_0 = F_2 - (F_8-F_2)/(0.08-0.02) * 0.02$

MS Access Module in Visual Basic

2. Function MarshallFlux(BulkDensity, WC_2, WC_8, WC_16, S, CO2_2, CO2_8, CO2_16, SoilTemp_2, SoilTemp_8, SoilTemp_16) As Variant

3. Calculate Phi
   Phi = 1 - BulkDensity / 2.65

4. Calculate average moisture content, Theta, using water content at 2 cm, 8 cm and 16 cm

   Theta = (Nz(WC_2, 0) + Nz(WC_8, 0) + Nz(WC_16, 0)) / (3 + IsNull(WC_2) + IsNull(WC_8) + IsNull(WC_16))

5. Calculate first term in flux equation

   MarshallFirstTerm = 1.47 * 10 ^ -5 * 1.013 * 10 ^ 5 / 8.3144 / 293.15 ^ 1.75

6. Calculate second term in flux equation

MarshallSecondTerm = (Phi - Theta) ^ 1.5

7. Calculate CO2 concentration slope between 2 cm and 8 cm

   Slope2to8cm = (CO2_8 / (273.15 + SoilTemp_8) - CO2_2 / (273.15 + SoilTemp_2)) / 0.06

8. Calculate CO2 concentration slope between 8 cm and 16 cm

   If IsNull(SoilTemp_16) Then 'This is to avoid a problem with node 7 where soil_temp_16 is zero
   SoilTemp_16 = SoilTemp_8
   Else
   End If

   Slope8to16cm = (CO2_16 / (273.15 + SoilTemp_16) - CO2_8 / (273.15 + SoilTemp_8)) / 0.08

9. Calculate flux at 2 cm

   MarshallFlux_2 = MarshallFirstTerm * MarshallSecondTerm * ((273.15 + (SoilTemp_2 + SoilTemp_8) / 2) ^ 1.75) * Slope2to8cm

10. Calculate flux at 8 cm

    MarshallFlux_8 = MarshallFirstTerm * MarshallSecondTerm * ((273.15 + (SoilTemp_8 + SoilTemp_16) / 2) ^ 1.75) * Slope8to16cm

11. Calculate Marshall flux at 0 cm assuming constant slope

    MarshallFlux = MarshallFlux_2 - (MarshallFlux_8 - MarshallFlux_2) / 0.06 * 0.02

12. If flux is negative, flux value is null

    If MarshallFlux < 0 Then
    MarshallFlux = Null
    Else
    MarshallFlux = MarshallFlux
    End If

13. End Function

Minirhizotron Image Database Field Name List

Field Name	Description	Unit & Format	Source
EXPERIMENT	file name for each session	"JAMES RESERVE"	file name in minirhizotron camera
SESSION	session number starting from 1	integer	file name in minirhizotron camera
DATE	date observation was made	date in "mm-dd-yyyy"	file name in minirhizotron camera
OBS	observer's initials	three characters	observer's input
READER	image reader's input	three characters	observer's input
TUBE	tube ID number	integer, 1 through 15	file name in minirhizotron camera
LOC	frame ID for counting	integer	file name in minirhizotron camera
FRAME	frame ID of a tube	integer	file name in minirhizotron camera
ROOTSD	dark roots	integer	image reader's input
ROOTSL	light roots	integer	image reader's input
ROOTSO	other kind of roots	integer	image reader's input
TIPSD	dark tips	integer	image reader's input
TIPSL	light tips	integer	image reader's input
TIPSO	other kind of tips	integer	image reader's input
RHID	dark rhizomorphs	integer	image reader's input
RHIL	light rhizomorphs	integer	image reader's input
RHIO	other kind of rhizomorphs	integer	image reader's input
HYPHAE	hyphae	0 for none, 1 for yes	image reader's input
NOTES	any comments	characters	image reader's input

File Locations

Database	File Name	Computer	Path	Program Format	Notes
AMARSS Corrected Data	AMARSS Corrected Data	Internet	http://sensorbase.org/	HTML output	under construction
Image database	Master James Reserve.xls	CCB_Mary	C:\Documents and Settings\Kuni\My Documents\AMARSS Data\Images	MS Excel	
Data Logger database	Data Logger.mdb	CCB_Mary	C:\Documents and Settings\Kuni\My Documents\AMARSS Data\Data Logger	MS Access	
AMARSS meta file	AMARSS Meta File.xls	CCB_Mary	C:\Documents and Settings\Kuni\My Documents\AMARSS Data\Metadata Files	MS Excel	
AMARSS meta file	AMARSS Meta File.doc	CCB_Mary	C:\Documents and Settings\Kuni\My Documents\AMARSS Data\Metadata Files	MS Word	