

Documentation of The Taylor Valley Blue Boxes for season 2011/12



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TABLE OF CONTENT:

1. Sensors	
1.1 Available Sensors	3
1.2 Sensors, Data Logger, Programming Information and Manuals at the Internet	4-5
1.3 Field equipment diagram	6
2. Blue Box Field Setup	7
3. Sensors/setup changes	
3.1.1 Lake Fryxell	8
3.1.2 Lake Hoare	8
3.1.3 East Lobe Bonney	8
3.1.4 West Lobe Bonney	8
3.1.5. Lake Miers	8-9
3.2.1 Software changes	9
3.2.2 Notes on Multipliers	9
4. Programs and Datalogger Wiring:	
4.1 Lake Fryxell	
4.1.1 Wiring	10
4.1.2 Program	10-13
4.2 Lake Hoare	
4.2.1 Wiring	14
4.2.2 Program	14-18
4.3 Lake Bonney East Lobe	
4.3.1 Wiring	19
4.3.2 Program	19-21
4.4 Lake Bonney West Lobe	
4.4.1 Wiring	22
4.4.2 Program	22-24
4.5. Lake Miers	
4.5.1 Wiring	25
4.5.2. Program	25-28

1. Sensors

1.1 Available Sensors

Blue Box Sensor List									
SENSORS	SENSOR TYPE	Applications	Company	Units	Deployment Date				
					Fryxell	Hoare	ELB	WLB	Miers
Surface PAR	LI190 SB Quantum	Measures incident Photosynthetically Active Radiation	LI-COR Biosciences 4421 Superior St. Lincoln, NE 68504 Phone: 800-447-3576 Fax: 402-467-2819	micromoles of quanta per second per square meter (mmol s ⁻¹ m ⁻²)	10/20/10	10/28/10	11/9/10	11/11/10	11/28/11
Underwater PAR	LI-193 Spherical Quantum Sensor	Measures PAR coming from all directions.	LI-COR Biosciences 4421 Superior St. Lincoln, NE 68504 Phone: 800-447-3576 Fax: 402-467-2819		10/25/11	11/2/11	11/11/11	11/10/11	11/28/11
Ablation Transducer (pressure transducer)	CS455 (at LF, LH, ELB) and Druck Pressure Transducer	Continuous lake ice ablation measurement	Campbell Sci. Logan, UT	m	10/21/10	10/28/10	11/9/10	11/11/11	11/28/11
Lake Level (Stage) Transducer	PDCR 1830 (at WLB and Miers)	Continuous lake level measurements	Campbell Sci. Logan, UT	m	10/21/10	10/28/10	11/9/10	N/A	11/28/11
Water Temperature	CS455 (at LF, LH, ELB) and Druck Pressure Transducer PDCR (at WLB)	Continuous water temperature measurements	Campbell Sci. Logan, UT	°C	10/21/10	10/28/10	11/9/10	N/A	N/A

1.2 Sensors, Data Logger and Programming Information and Manuals at the Internet

(1) *LI190 SB Quantum*



Sensor details:

http://www.licor.com/env/Products/Sensors/190/li190_description.jsp

Instruction Manual from Campbell Scientific:

<http://www.campbellsci.com/documents/manuals/li190sb.pdf>

(2) *LI-193 Spherical Quantum Sensor*



Sensor details:

http://www.licor.com/env/Products/Sensors/193UW/li193_description.jsp

http://www.licor.com/env/PDF_Files/193SA.pdf

(3) *Druck's Pressure Transducer (WLB and Lake Miers only)*



Sensor details:

<http://www.gesensing.com/products/resources/datasheets/PDSA065june02.pdf>

Instruction Manual from Campbell Scientific

<http://www.campbellsci.com/documents/manuals/cs420-l.pdf>

Note: Ablation Transducer (frequently called Pressure Transducer) and Lake Level Transducer (also known as Stage Transducer) are both the same type of transducers. The only difference between two is that they are differently

programmed – one for measuring the Ice ablation and the other for measuring the lake level.

(4) **CS455 Pressure Transducer (LF, LH, ELB)**



Instruction Manual from Campbell Scientific

<http://s.campbellsci.com/documents/us/manuals/cs450-cs455.pdf>

(5) **CR1000 DataLogger**



Measurements and Control Module Operator's Manual

<http://s.campbellsci.com/documents/us/manuals/cr1000.pdf>

1.3 Diagram

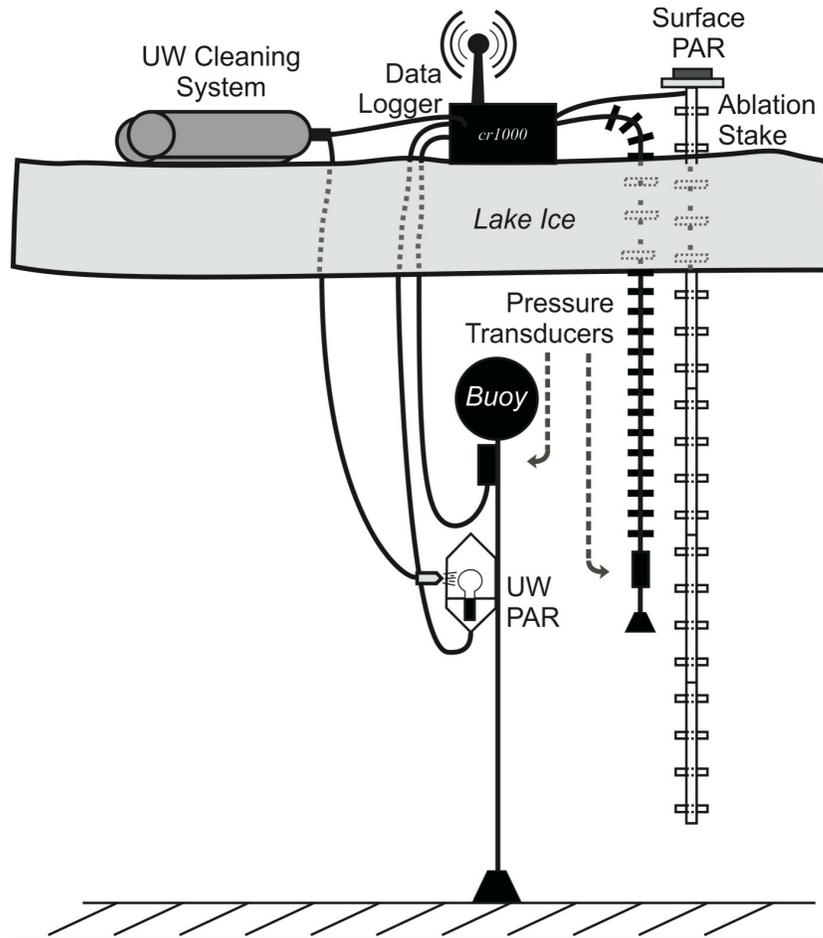


Fig.1: Lake cross-section showing buoy, data logger, position of deployed sensors and ablation stake.

UW PAR deployment depths are measured from piezometric water level:

- Lake Fryxel: 8.06 m
- Lake Hoare: 10.96 m
- ELB: 10.66 m
- WLB: 10.65 m
- Lake Miers: 9.90 m

Note: UW PAR is fixed to the buoy. However, due to continuous lake level change, depth corrections are necessary for UW PAR data.

Year round telemetry has been installed at Lake Hoare and Miers.

UW PAR cleaning system has been installed at Lake Hoare and West Lobe Bonney

2. BlueBox Field Setup

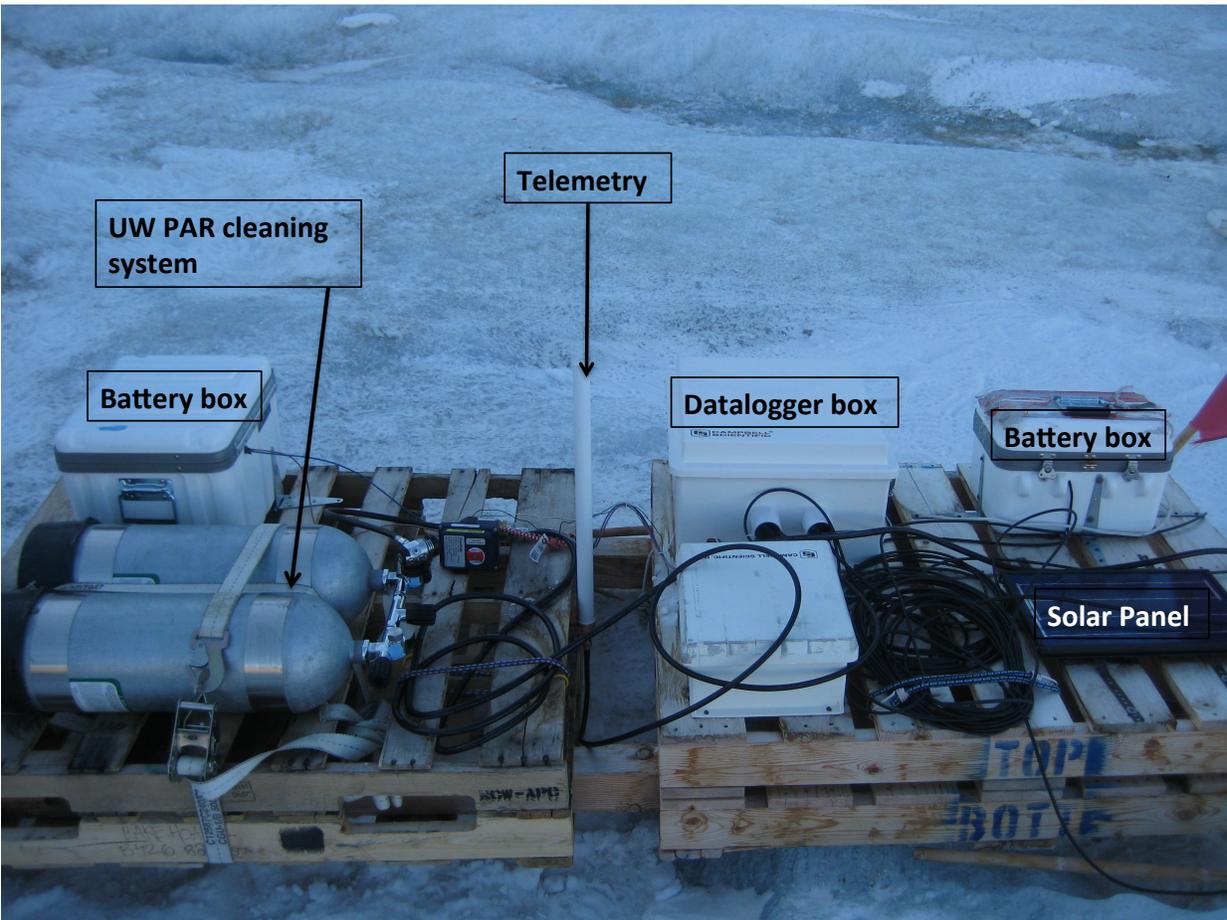


Fig. 2: Field setup and components of a Blue Box system. Outriggers are facing main wind direction (not shown) to prevent box from flipping.

3. Sensors/setup changes

3.1.1 Lake Fryxell

- UW PAR was replaced
 - Mult: -182.22 (in water)
 - Tcoff: 0.0036
 - Serial# SPQA 4628
 - Deployed date: 10/25/11

3.1.2 Lake Hoare

- UW PAR was replaced
 - Mult: -173.96 (in water)
 - Tcoff: 0.0036
 - Serial# SPQA 4627
 - Deployed date: 11/2/11
- UW PAR cleaning system was installed to prevent biofouling of the sensor
- Year round telemetry has been installed via Iridium modem

3.1.3 East Lobe Bonney

- UW PAR was replaced
 - Mult: -171.16 (in water)
 - Tcoff: 0.0036
 - Serial# SPQA 4629
 - Deployed date: 11/11/11

3.1.4 West Lobe Bonney

- UW PAR was replaced
 - Mult: -173.75 (in water)
 - Tcoff: 0.0036
 - Serial# SPQA 4623
 - Deployed date: 11/10/11
- Ablation pressure transducer
 - Mult: 103.18
 - Serial# 2009572

3.1.5 Lake Miers

- UW PAR installed
 - Mult: -171.36 (in water)
 - Tcoff: 0.0036
 - Serial# SPQA 4630
 - Deployed date: 11/28/11

- Surface PAR installed
 - Mult: 345.6428265
 - Serial# Q22174
- Stage pressure transducer installed
 - Serial# 2742650
- Ablation pressure transducer installed
 - Serial# 2206707
- Year round telemetry has been installed via Iridium modem

3.2.1 Software Changes

LF program was updated with psi to meter calculation. LH program was updated with telemetry and UW PAR cleaning system code. L. Miers program was installed with telemetry code. All programs were updated with decimal time calculations.

3.2.2 Note on Multipliers

In the program running at Blue Boxes, we always have multiplier value of:

- 100 for UW PAR (or “-100” - depending on how we wired the sensor).
- 200 for Surface PAR

4. Programs and CR1000 Datalogger Wiring

4.1.1 Lake Fryxell wiring

Stage transducer (instrument with desiccant-filled vent tube)

Red	12V
Black	G
Yellow	G
Blue	G
White	C5
Clear	G

Ablation transducer (instrument with desiccant-filled vent tube)

Red	12V
Black	G
Yellow	G
Blue	G
White	C7
Clear	G

Underwater PAR (diff channel)

Green	2H
Blue	2L
Jump	2L - G

Surface PAR (diff channel)

Black	1L
Red	1H
Jump	1L - G

4.1.2 Lake Fryxell program

'CR1000 Datalogger

'Lake Frxyell

'Sensors installed: Stage, Ablation, UW PAR, and surface PAR

'Control port (sw12V) for: Electronically Actuated Valve switch

'Program written on: Oct 28 2010

'by Maciej Obryk

'Program updated on May 11 2011 by Hilary Dugan

'Declare Public Variables

Public PTemp

Public batt_volt As Float

Public CS455(2) As Float

Public ablation As Float

Public UW_PAR As Float

```

Public UW_PAR_2 As Float
Public surface_PAR As Float
'Public flag As Boolean = true
'Public PortOn

'Declares array for Julian time and decimal time
Public rTime(9) As Float
Alias rTime(1) = Year
Alias rTime(9) = Day_of_Year
Alias rTime(4) = Hour
Alias rTime(5) = Minutes
Public MilitaryTime As Float
Public DecTime As Float
Public DecTime_2 As String * 16
Alias CS455(1) = stage
Alias CS455(2)= W_Temp
'declares MilitaryTime/100 for decimal time conversion
'Dim A 'military time/100
'Dim B 'integer of A

'Declare Units
Units ablation = m
Units stage = m
Units W_Temp = degC
Units UW_PAR = mol/s/m
Units UW_PAR_2 = mol/s/m
Units surface_PAR = mol/s/m
Units batt_volt = volts
Units PTemp = degC

'Define Data Tables - what is being stored
DataTable (LF,true,-1)
'store data points every 20min, averages where indicated below
DataInterval (0,20,Min,10)
'data to storage module; CFM100
CardOut (0 ,-1)
Sample (1,Year,IEEE4)
Sample (1,Day_of_Year,IEEE4)
'Sample (1,Hour,IEEE4)
'Sample (1,Minutes,IEEE4)
Sample (1,MilitaryTime,IEEE4)
Sample (1,DecTime,IEEE4)
Sample (1,DecTime_2,String)
Average (1,ablation,IEEE4,False)
Average (1,stage,IEEE4,False)

```

```

Average (1,W_Temp,FP2,False)
Average (1,UW_PAR,FP2,False)
Average (1,UW_PAR_2,FP2,False)
Average (1,surface_PAR,IEEE4,False)
Average (1,batt_volt,FP2,False)
Sample (1,PTemp,FP2)
EndTable

```

'Main Program

BeginProg

'measurements every 60 seconds

Scan (60,Sec,1,0)

RealTime (rTime)

MilitaryTime = (Hour*100)+Minutes

'pressure transducer - ablation

'multiplier of "0.704088" is used to covert psi to m, i.e

'psi to feet = 2.31; feet to m = 0.3048; hence $2.31*0.3048 = 0.704088$

SDI12Recorder (ablation,7,0,"M!",0.704088,0)

'pressure transducer - stage

'multiplier of "0.704088" is used to covert psi to m, i.e

'psi to feet = 2.31; feet to m = 0.3048; hence $2.31*0.3048 = 0.704088$

SDI12Recorder (CS455,5,0,"M!",0.704088,0)

'surface PAR - Licor 190

VoltDiff (surface_PAR,1,mV25,1,True ,0,250,200,0)

'underwater PAR - Licor 193

VoltDiff (UW_PAR,1,mV7_5,2,True ,0,250,-182.22,0)

VoltDiff (UW_PAR,1,mV7_5,2,True ,0,250,-173.75,0)

'datalogger's temp

PanelTemp (PTemp,_60Hz)

'battry voltage

Battery (batt_volt)

'To get high resolution on decimal date, did not add the year to the decimal.

Must do this in post processing.

'ie) 2011 + DecTime_HD

If (Year/4 - INT(Year/4)) = 0 Then

DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/366)

Else

DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/365)

EndIf

DecTime_2 = 2011 + Replace (DecTime,"0.",".")

CallTable LF

NextScan

'control port for UW PAR cleaning system - valve
'scan every min; every 2 min days look for one min interval; if one min set port 1 to high, keep it open for 1sec and close it

```
' SlowSequence 'allows for concurrent sequence scanning
' Scan (7200,Sec,1,0)
' If (Day_of_Year >= 300) OR (Day_of_Year <= 60) Then
'   If IfTime (0,7,day) AND flag = true Then
'     'power is constantly supplied to the pump
'     PortSet (9,1) 'activates 12V switch port to open SPDT switch
'     Delay (0,2,Sec)
'     PortSet (9,0) 'closes SPDT switch
'     flag = false
'   EndIf
' EndIf
'
' If IfTime (1,7,day) Then
'   flag = true
' EndIf
' NextScan
```

EndProg

4.2.1 Lake Hoare sensors wiring

Stage transducer (instrument with desiccant-filled vent tube)

Red	12V
Black	G
Yellow	G
Blue	G
White	C5
Clear	G

Ablation transducer (instrument with desiccant-filled vent tube)

Red	12V
Black	G
Yellow	G
Blue	G
White	C7
Clear	G

Underwater PAR (diff channel)

Green	2H
Blue	2L
Jump	2L - G

Surface PAR (diff channel)

Black	1L
Red	1H
Jump	1L - G

4.2.2 Lake Hoare program

'CR1000 Datalogger

'Lake Hoare

'Sensors installed: Stage, Ablation, UW PAR, and surface PAR

'Control port (sw12V) for: Electronically Actuated Valve switch

'Program written on: Oct 28 2010

'by Maciej Obryk

'Program updated on May 11 2011 by Hilary Dugan

'Program updated on Dec 13 2011 by Thomas Nylen

'Declare Public Variables

Public PTemp

Public batt_volt As Float

Public CS455(2) As Float

Public ablation As Float

Public UW_PAR As Float

Public surface_PAR As Float
Public flag As Boolean
Public PortOn

'Declares array for Julian time and decimal time

Public rTime(9) As Float
Alias rTime(1) = Year
Alias rTime(8) = Day_of_Week
Alias rTime(9) = Day_of_Year
Alias rTime(4) = Hour
Alias rTime(5) = Minutes
Public MilitaryTime As Float
Public DecTime As Float
Public DecTime_2 As String * 16
Alias CS455(1) = stage
Alias CS455(2)= W_Temp

'Declare Units

Units ablation = m
Units stage = m
Units W_Temp = degC
Units UW_PAR = $\frac{1}{m}$ mol/s/m²
Units surface_PAR = $\frac{1}{m}$ mol/s/m²
Units batt_volt = volts
Units PTemp = degC

'Define Data Tables - what is being stored

DataTable (LH,true,-1)
'store data points every 20min, averages where indicated below
DataInterval (0,20,Min,10)
'data to storage module; CFM100
CardOut (0 ,-1)
Sample (1,Year,IEEE4)
Sample (1,Day_of_Year,IEEE4)
'Sample (1,Hour,IEEE4)
'Sample (1,Minutes,IEEE4)
Sample (1,MilitaryTime,IEEE4)
Sample (1,DecTime,IEEE4)
Sample (1,DecTime_2,String)
Average (1,ablation,IEEE4,False)
Average (1,stage,IEEE4,False)
Average (1,W_Temp,FP2,False)
Average (1,UW_PAR,FP2,False)
Average (1,surface_PAR,IEEE4,False)
Average (1,batt_volt,FP2,False)

Sample (1,PTemp,FP2)
EndTable

'Main Program

BeginProg

'measurements every 60 seconds

Scan (60,Sec,1,0)

RealTime (rTime)

MilitaryTime = (Hour*100)+Minutes

'pressure transducer - ablation

'multiplier of "0.704088" is used to covert psi to m, i.e

'psi to feet = 2.31; feet to m = 0.3048; hence $2.31*0.3048 = 0.704088$

SDI12Recorder (ablation,7,0,"M!",0.704088,0)

'pressure transducer - stage

'multiplier of "0.704088" is used to covert psi to m, i.e

'psi to feet = 2.31; feet to m = 0.3048; hence $2.31*0.3048 = 0.704088$

SDI12Recorder (CS455,5,0,"M!",0.704088,0)

'surface PAR - Licor 190

VoltDiff (surface_PAR,1,mV25,1,True ,0,250,200,0)

'underwater PAR - Licor 193

VoltDiff (UW_PAR,1,mV7_5,2,True ,0,250,-100,0)

'datalogger's temp

PanelTemp (PTemp,_60Hz)

'battry voltage

Battery (batt_volt)

'To get high resolution on decimal date, did not add the year to the decimal.

Must do this in post processing.

'ie) 2011 + DecTime_HD

If (Year/4 - INT(Year/4)) = 0 Then

DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/366)

Else

DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/365)

EndIf

DecTime_2 = 2011 + Replace (DecTime,"0.",".")

CallTable LH

NextScan

'control port for UW PAR cleaning system - valve

'scan every min; every 2 min days look for one min interval; if one min set port 1
to high, keep it open for 1sec and close it

```

SlowSequence 'allows for concurrent sequence scanning
Scan (1,Hr,1,0)
If (Day_of_Year >= 300) OR (Day_of_Year <= 60) Then
  If IfTime (0,7,day) AND flag = true Then
    'power is constantly supplied to the pump
    PortSet (9,1) 'activates 12V switch port to open SPDT switch
    Delay (0,2,Sec)
    PortSet (9,0) 'closes SPDT switch
    flag = false
  EndIf
EndIf
If IfTime (1,7,day) Then
  flag = true
EndIf

'For summer measurements between Oct 1 AND Mar 1
If Day_of_Year >= 274 OR Day_of_Year < 60 Then
  If batt_volt>12.0 Then'turn on if above 12V
    'Keep ComRS232 Open for 10 minutes because
    'the null modem PIN9 is not connected to PIN9 on the other end, and
executing
    'SerialOpen makes DTR high on RS232 port
    If TimeIntoInterval(0,360,Min) Then 'turn on at 0600, 1200, 1800 and 0000
      PortSet(1,1)
      SerialOpen (ComRS232,9600,0,0,2000)'for CR1000 comms
      Delay(0,2,Sec)'delay for iridium coms
    EndIf
    If TimeIntoInterval(60,360,Min) Then 'turn off ComRS232 at 0700, 1300,
1900 and 0100
      SerialClose (ComRS232)
      PortSet(1,0)'turn C1 off for relay to radio at 0800, 1400, 2000 and 0200
    EndIf
  EndIf
EndIf

'For winter measurements between March 1 and Oct 1, once a week
If Day_of_Year < 274 AND Day_of_Year >= 60 Then
  If batt_volt>12.0 Then 'only of voltage is greater than 11.5V
    If TimeIntoInterval(360,1440,Min) Then 'for CR1000 comms between 0600
and 0700 every day
      PortSet(1,1)
      SerialOpen (ComRS232,9600,0,0,2000)'for CR1000 comms
      Delay(0,2,Sec)'delay for iridium coms
    EndIf
  EndIf
EndIf

```

```
    If TimeInInterval(420,1440,Min) Then 'off at 0700
      SerialClose (ComRS232) 'turn off com232 port
      PortSet(1,0)
    EndIf
  EndIf
EndIf

NextScan
EndProg
```

4.3.1 East Lobe Bonney wiring

Stage transducer (instrument with desiccant-filled vent tube)

Red	12V
Black	G
Yellow	G
Blue	G
White	C5
Clear	G

Ablation transducer (instrument with desiccant-filled vent tube)

Red	12V
Black	G
Yellow	G
Blue	G
White	C7
Clear	G

Underwater PAR (diff channel)

Green	2H
Blue	2L
Jump	2L - G

Surface PAR (diff channel)

Black	1L
Red	1H
Jump	1L - G

4.3.2 East Lobe Bonney program

'CR1000 Datalogger

'ELB

'Sensors installed: Stage, Ablation, UW PAR, and surface PAR

'Control port (sw12V) for: Electronically Actuated Valve switch

'Program written on: Oct 28 2010

'by Maciej Obryk

'Program updated on May 11 2011 by Hilary Dugan

'Declare Public Variables

Public PTemp

Public batt_volt As Float

Public CS455(2) As Float

Public ablation As Float

Public UW_PAR As Float

Public surface_PAR As Float

Public flag As Boolean

Public PortOn

'Declares array for Julian time and decimal time

Public rTime(9) As Float

Alias rTime(1) = Year

Alias rTime(9) = Day_of_Year

Alias rTime(4) = Hour

Alias rTime(5) = Minutes

Public MilitaryTime As Float

Public DecTime As Float

Public DecTime_2 As String * 16

Alias CS455(1) = stage

Alias CS455(2) = W_Temp

'Declare Units

Units ablation = m

Units stage = m

Units W_Temp = degC

Units UW_PAR = $\frac{1}{m}$ mol/s/m

Units surface_PAR = $\frac{1}{m}$ mol/s/m

Units batt_volt = volts

Units PTemp = degC

'Define Data Tables - what is being stored

DataTable (ELB,true,-1)

'store data points every 20min, averages where indicated below

DataInterval (0,20,Min,10)

'data to storage module; CFM100

CardOut (0,-1)

Sample (1,Year,IEEE4)

Sample (1,Day_of_Year,IEEE4)

'Sample (1,Hour,IEEE4)

'Sample (1,Minutes,IEEE4)

Sample (1,MilitaryTime,IEEE4)

Sample (1,DecTime,IEEE4)

Sample (1,DecTime_2,String)

Average (1,ablation,IEEE4,False)

Average (1,stage,IEEE4,False)

Average (1,W_Temp,FP2,False)

Average (1,UW_PAR,FP2,False)

Average (1,surface_PAR,IEEE4,False)

Average (1,batt_volt,FP2,False)

Sample (1,PTemp,FP2)

EndTable

```

'Main Program
BeginProg
'measurments every 60 seconds
Scan (60,Sec,1,0)
RealTime (rTime)
MilitaryTime = (Hour*100)+Minutes
'pressure transducer - ablation
'multiplier of "0.704088" is used to covert psi to m, i.e
'psi to feet = 2.31; feet to m = 0.3048; hence 2.31*0.3048 = 0.704088
SDI12Recorder (ablation,7,0,"M!",0.704088,0)
'pressure transducer - stage
'multiplier of "0.704088" is used to covert psi to m, i.e
'psi to feet = 2.31; feet to m = 0.3048; hence 2.31*0.3048 = 0.704088
SDI12Recorder (CS455,5,0,"M!",0.704088,0)
'surface PAR - Licor 190
VoltDiff (surface_PAR,1,mV25,1,True ,0,250,200,0)
'underwater PAR - Licor 193
VoltDiff (UW_PAR,1,mV7_5,2,True ,0,250,-100,0)
'datalogger's temp
PanelTemp (PTemp,_60Hz)
'battry voltage
Battery (batt_volt)

'To get high resolution on decimal date, did not add the year to the decimal.
Must do this in post processing.
'ie) 2011 + DecTime_HD
If (Year/4 - INT(Year/4)) = 0 Then
  DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/366)
Else
  DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/365)
EndIf
  DecTime_2 = 2011 + Replace (DecTime,"0.",".")

CallTable ELB
NextScan

EndProg

```

4.4.1 West Lobe Bonney wiring

Ablation transducer (instrument with desiccant-filled vent tube)

Red	EX1
Black	3L
Yellow	4H
Blue	4L
White	G
Orange	3H
Clear	G

Underwater PAR (diff channel)

Green	2H
Blue	2L
Jump	2L - G

Surface PAR (diff channel)

Black	1L
Red	1H
Jump	1L - G

4.4.2 West Lobe Bonney program

```
'CR1000 Datalogger
'Lake Bonney West
'Sensors installed: Ablation, UW PAR, surface PAR, and UW PAR cleaning
system
'Program written on: Nov 11 2010
'by Maciej Obryk

'Updated on Nov 8 2011 decimal time (by Hilary Dugan)
',and UW PAR cleaning code

'Declare Variables
Public batt_volt As Float
Public ablation As Float
Public UW_PAR As Float
Public surface_PAR As Float
Public Ptemp_C
Public flag As Boolean
Public PortOn

'Declares array for Julian time and decimal time
Public rTime (9)
Alias rTime(1) = Year
Alias rTime(9) = Day_of_Year
```

```

Alias rtime(4) = Hour
Alias rtime(5) = Minutes
Public Dec_Time As Float
Public MilitaryTime As Float
Public DecTime As Float
Public DecTime_2 As String * 16

```

```
'Declares Units
```

```

Units batt_volt=volts
Units UW_PAR = ¶ mol/s/m²
Units surface_PAR = ¶ mol/s/m²
Units ablation = cm
Units PTemp_C = Deg C

```

```
'Defines Data Tables
```

```

DataTable(WLB,True,-1)
'store data points every 20min
DataInterval(0,20,Min,10)
'data to storage module; CFM100
CardOut (0 ,-1)
Sample (1,Year,IEEE4)
Sample (1,Day_of_Year,IEEE4)
Sample (1,MilitaryTime,IEEE4)
Sample (1,DecTime,IEEE4)
Sample (1,DecTime_2,String)
Average(1,ablation,IEEE4,False)
Average(1,UW_PAR,IEEE4,False)
Average(1,surface_PAR,IEEE4,False)
Average(1,batt_volt,FP2,False)
Average(1,Ptemp_C,FP2, False)
EndTable

```

```
'Main Program
```

```

BeginProg
Scan(60,Sec,1,0)
RealTime rTime()
MilitaryTime = (Hour*100)+Minutes
'surface PAR - Licor 190
VoltDiff(surface_PAR,1,mV25,1,True,0,250,200,0)
'underwater PAR - Licor 193
VoltDiff (UW_PAR,1,mV7_5,2,True ,0,250,-100,0)
'CS420/CS425 Druck PDCR 1830/1230 Pressure Tansducer (4-wire)
measurement Lvl_m:
BrFull(ablation,1,mV2500,3,1,1,2500,True,True,0,_60Hz,101.53,0.0)
PanelTemp (Ptemp_C,_60Hz)
Battery (batt_volt)

```

'To get high resolution on decimal date, did not add the year to the decimal.
Must do this in post processing.

```
'ie) 2011 + DecTime_HD
If (Year/4 - INT(Year/4)) = 0 Then
  DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/366)
Else
  DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/365)
EndIf
DecTime_2 = 2011 + Replace (DecTime,"0.",".")
CallTable WLB
NextScan
```

'control port for UW PAR cleaning system - valve
'scan every min; every 2 min days look for one min interval; if one min set port 1
to high, keep it open for 1sec and close it

```
SlowSequence 'allows for concurrent sequence scanning
Scan (2,Hr,1,0)
If (Day_of_Year >= 300) OR (Day_of_Year <= 60) Then
  If IfTime (0,7,day) AND flag = true Then
    'power is constantly supplied to the pump
    PortSet (9,1) 'activates 12V switch port to open SPDT switch
    Delay (0,2,Sec)
    PortSet (9,0) 'closes SPDT switch
    flag = false
  EndIf
EndIf

If IfTime (1,7,day) Then
  flag = true
EndIf
NextScan
```

```
EndProg
```

4.5.1 Lake Miers wiring

Stage transducer (instrument with desiccant-filled vent tube)

Red	EX1
Black	3L
Yellow	4H
Blue	4L
White	G
Orange	3H
Clear	G

Ablation transducer (instrument with desiccant-filled vent tube)

Red	EX2
Black	5L
Yellow	6H
Blue	6L
White	G
Orange	5H
Clear	G

Underwater PAR (diff channel)

Green	2H
Blue	2L
Jump	2L - G

Surface PAR (diff channel)

Black	1L
Red	1H
Jump	1L - G

4.4.2 Lake Miers program

```
'CR1000 Datalogger
'Lake Miers
'Sensors installed: Stage, Ablation, UW PAR, surface PAR
'Program written on: Nov 15 2011
'by Maciej Obryk

'Declare Variables
Public batt_volt As Float
Public stage As Float
Public ablation As Float
Public UW_PAR As Float
Public surface_PAR As Float
Public Ptemp_C
```

Public flag As Boolean

'Declares array for Julian time and decimal time

Public rTime (9)

Alias rTime(1) = Year

Alias rTime(8) = Day_of_Week

Alias rTime(9) = Day_of_Year

Alias rtime(4) = Hour

Alias rtime(5) = Minutes

Public Dec_Time As Float

Public MilitaryTime As Float

Public DecTime As Float

Public DecTime_2 As String * 16

'Declares Units

Units batt_volt = volts

Units UW_PAR = $\frac{1}{4}$ mol/s/m²

Units surface_PAR = $\frac{1}{4}$ mol/s/m²

Units stage = cm

Units ablation = cm

Units PTemp_C = Deg C

'Defines Data Tables

DataTable(LM,True,-1)

'store data points every 20min

DataInterval(0,20,Min,10)

Sample (1,Year,IEEE4)

Sample (1,Day_of_Year,IEEE4)

Sample (1,MilitaryTime,IEEE4)

Sample (1,DecTime,IEEE4)

Sample (1,DecTime_2,String)

Average(1,stage,IEEE4,False)

Average(1,ablation,IEEE4,False)

Average(1,UW_PAR,IEEE4,False)

Average(1,surface_PAR,IEEE4,False)

Average(1,batt_volt,FP2,False)

Average(1,Ptemp_C,FP2, False)

EndTable

'Main Program

BeginProg

Scan(60,Sec,1,0)

RealTime rTime()

MilitaryTime = (Hour*100)+Minutes

'surface PAR - Licor 190

VoltDiff(surface_PAR,1,mV25,1,True,0,250,200,0)

```

'underwater PAR - Licor 193
VoltDiff (UW_PAR,1,mV7_5,2,True ,0,250,-100,0)
'CS420/CS425 Druck PDCR 1830/1230 Pressure Tansducer (6-wire)
measurement:
BrFull6W (stage,1,mV2500,mV25,3,Vx1,1,2500,True ,True ,0,_60Hz,1.0,0)
BrFull6W (ablation,1,mV2500,mV25,5,Vx2,1,2500,True ,True ,0,_60Hz,1.0,0)
PanelTemp (Ptemp_C,_60Hz)
Battery (batt_volt)

```

'To get high resolution on decimal date, did not add the year to the decimal.
Must do this in post processing.

```

'ie) 2011 + DecTime_HD
If (Year/4 - INT(Year/4)) = 0 Then
  DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/366)
Else
  DecTime = (Day_of_Year + (Hour + Minutes*(1/60))*(1/24))*(1/365)
EndIf
DecTime_2 = 2011 + Replace (DecTime,"0.",".")
CallTable LM
NextScan

```

SlowSequence 'allows for concurent sequence scanning
Scan (1,Hr,1,0)

'opens coms port 1 to allow power for Freewave radio
'telemetry window is every day between 18:00 and 19:00

```

'For summer measurements between Oct 1 AND Mar 1
If Day_of_Year >= 274 OR Day_of_Year < 60 Then
  If batt_volt>12.0 Then'turn on if above 12V
    'Keep ComRS232 Open for 10 minutes because
    'the null modem PIN9 is not connected to PIN9 on the other end, and
executing
    'SerialOpen makes DTR high on RS232 port
    If TimeInInterval(180,360,Min) Then 'turn on at 0900, 1500, 2100 and
0300
      PortSet(1,1)
      SerialOpen (ComRS232,9600,0,0,2000)'for CR1000 comms
      Delay(0,2,Sec)'delay for iridium coms
    EndIf
    If TimeInInterval(240,360,Min) Then 'turn off ComRS232 at 1000, 1600,
2200 and 0400
      SerialClose (ComRS232)
      PortSet(1,0)'turn C1 off for relay to radio at 1000, 1600, 2200 and 0400
    EndIf
  EndIf
EndIf

```

```
'For winter measurements between March 1 and Oct 1, once a week
If Day_of_Year < 274 AND Day_of_Year >= 60 Then
  If batt_volt>12.0 Then 'only of voltage is greater than 11.5V
    If TimeInInterval(540,1440,Min) Then 'for CR1000 comms between 0900
and 1000 every day
      PortSet(1,1)
      SerialOpen (ComRS232,9600,0,0,2000)'for CR1000 comms
      Delay(0,2,Sec)'delay for iridium coms
    EndIf
    If TimeInInterval(600,1440,Min) Then 'off at 1000
      SerialClose (ComRS232) 'turn off com232 port
      PortSet(1,0)
    EndIf
  EndIf
EndIf

NextScan
EndProg
```