MOBY Data Documentation

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This document describes the format of the MOBY spectral data files. The readmld_is the function used to read in the files in MATLAB.

Spectral Data:

The Marine Optical Buoy (MOBY) data are organized in deployments (2-44). Each deployment is about 3-4 months long. MOBY's data collection schedule can change from deployment to deployment. The file naming convention is YYYYMMDDHHd.mby (YYYY = 4 digit year, MM is the 2 digit month, DD is the two digit day, HH is the hour when data collection started, and d means converted or engineering units and derived products). YYYYMMDDHH.mby is the raw data files for the derived file. The 20 hour files are for MODIS-Terra, 22 hour files are for SeaWiFS and 23 hour files are for MODIS-Aqua. For the data uploaded into the spectral_data directory I have added a M2DD_ to the front of all filenames. M2=MOBY and DDD is the deployment number.

All MOBY spectral data are stored in the Moss Landing Data Base (Mldbase) ieee-le binary file format. All programs used to process MOBY data are written in the MATLAB programming language (http://www.mathworks.com/). The program(readmld_.m) included will allow the user to either read in the files in MATLAB or write their own reading programs in what ever language they wish.

There are 2 spectrographs on MOBY. The blue spectrograph covers from ~340 - 630 nm (pixels 1-512). The red spectrograph covers ~540 - 959 nm (pixels 513-1024). Note that there is an overlap in wavelength coverage. When the data are satellite weighed this overlap is removed by concatenating the two spectrographs data together at 620 nm (Figure 1).

Example of reading in a MOBY file from the MATLAB command line:
>> readmld_ 2006060723c.mby

NOTE: All example in this document will use MOBY file 2009051423d.mby from deployment 43.

The program reads the binary file into global MLdbase variables CapS, DscS, Faux FdtS, FhdS, Fmt, FnmS, Mpts, Npts, Nvar, Scl, SymS, Vaux, Xdat. These variables are declared global in the readmld_ function, to see them on the MATLAB you must declare them global on the command ling by typing the following.

>> global Mpts Nvar FnmS FhdS FdtS Faux Xdat Npts DscS SymS CapS Scl Fmt Vaux

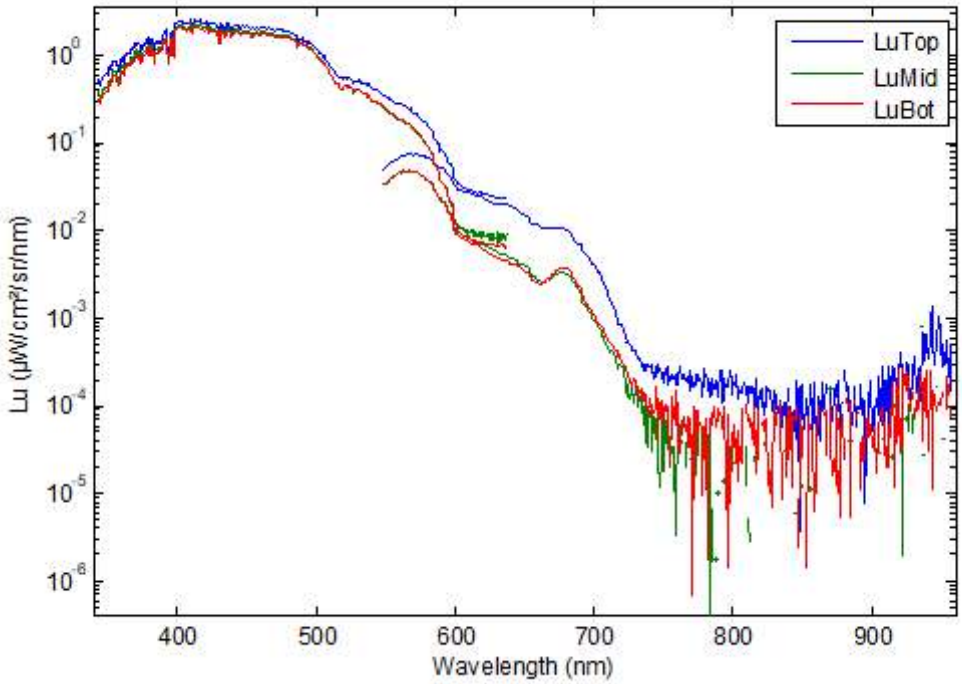

Figure 1 MOBY Lu data from the 3 arms showing the wavelength overlap.

Note than currently LuMOS is not stray light corrected, this is the cause of the large difference at 620 nm

Using the whos function you can see a listing of the variables in the MATLAB workspace.

```
>> whos
  Name        Size                    Bytes  Class

  CapS       26x32                     1664  char array (global)
  DscS       26x80                     4160  char array (global)
  Faux      105x1                       840  double array (global)
  FdtS        1x11                       22  char array (global)
  FhdS        8x80                     1280  char array (global)
  Fmt         1x26                      208  double array (global)
  FnmS        1x15                       30  char array (global)
  Mpts        1x1                         8  double array (global)
  Npts        1x26                      208  double array (global)
  Nvar        1x1                         8  double array (global)
  Scl        15x26                     3120  double array (global)
  SymS       26x8                       416  char array (global)
  Vaux      192x26                    39936  double array (global)
  Xdat     1024x26                   212992  double array (global)
```

Variable Description

MLdbase files contain numerical data and descriptive headers (See Appendix A). Xdat is the primary data variable and contains the calibrated wavelength and spectral Lu, Ed and Es (also Eu if it exists). Xdat contains 1024 rows. The number of columns in Xdat are determined by the data collected. DscS, CapS and SymS are character arrays which describe the columns in Xdat. Each row in these three variables contains a character description of a column in Xdat. FhdS is a description string that describes the entire file. Faux and Vaux are auxilliary data variables. Faux contains file auxilliary data and Vaux contains data which describes a column in Xdat. Other variables (FnmS, FdtS, Scl and Fmt) which are not used much are described in Appendix A.

The listing below shows the contents of the DscS. This shows the 3rd column in Xdat contains Ed data from the top arm (EdTop). Column 5 contains the Surface Irradiance data for EdTop. Es data for each underwater sensor is stored two columns over. So if column 7 has LuTop data then column 9 is the Es data for LuTop.

```
File: 2006060723C.MBY

DscS  1: MOS Calibrated Wavelength (nm)
DscS  2: MOS Calibrated Wavelength (nm)
DscS  3: MOS Downwelled Irradiance  (µW/cm²/nm), P =  1.2
DscS  4: MOS Coefficient of Variation (%)
DscS  5: MOS Surface Irradiance  (µW/cm²/nm)
DscS  6: MOS Coefficient of Variation (%)
DscS  7: MOS Upwelled Radiance (µW/cm²/sr/nm), P =  1.3
DscS  8: MOS Coefficient of Variation (%)
DscS  9: MOS Surface Irradiance  (µW/cm²/nm)
DscS 10: MOS Coefficient of Variation (%)
DscS 11: MOS Downwelled Irradiance  (µW/cm²/nm), P =  5.0
DscS 12: MOS Coefficient of Variation (%)
DscS 13: MOS Surface Irradiance  (µW/cm²/nm)
DscS 14: MOS Coefficient of Variation (%)
DscS 15: MOS Upwelled Radiance (µW/cm²/sr/nm), P =  5.1
DscS 16: MOS Coefficient of Variation (%)
DscS 17: MOS Surface Irradiance  (µW/cm²/nm)
DscS 18: MOS Coefficient of Variation (%)
DscS 19: MOS Downwelled Irradiance  (µW/cm²/nm), P =  8.9
DscS 20: MOS Coefficient of Variation (%)
DscS 21: MOS Surface Irradiance  (µW/cm²/nm)
DscS 22: MOS Coefficient of Variation (%)
DscS 23: MOS Upwelled Radiance (µW/cm²/sr/nm), P =  9.0
DscS 24: MOS Coefficient of Variation (%)
DscS 25: MOS Surface Irradiance  (µW/cm²/nm)
DscS 26: MOS Coefficient of Variation (%)
```

CapS contains similar information which is used to label graphs and SymS is a short 8 character description used as the column header in file listings.

```
File: 2006060723C.MBY

CapS  1: Wavelength (nm)
CapS  2: Wavelength (nm)
CapS  3: Ed Top  (µW/cm²/nm)
CapS  4: Coefficient of Variation (%)
CapS  5: Ed Sfc  (µW/cm²/nm)
CapS  6: Coefficient of Variation (%)
```

```
  CapS  7: Lu Top  (µW/cm²/sr/nm)
  CapS  8: Coefficient of Variation (%)
  CapS  9: Ed Sfc  (µW/cm²/nm)
  CapS 10: Coefficient of Variation (%)
  CapS 11: Ed Mid  (µW/cm²/nm)
  CapS 12: Coefficient of Variation (%)
  CapS 13: Ed Sfc  (µW/cm²/nm)
  CapS 14: Coefficient of Variation (%)
  CapS 15: Lu Mid  (µW/cm²/sr/nm)
  CapS 16: Coefficient of Variation (%)
  CapS 17: Ed Sfc  (µW/cm²/nm)
  CapS 18: Coefficient of Variation (%)
  CapS 19: Ed Bot  (µW/cm²/nm)
  CapS 20: Coefficient of Variation (%)
  CapS 21: Ed Sfc  (µW/cm²/nm)
  CapS 22: Coefficient of Variation (%)
  CapS 23: Lu Bot  (µW/cm²/sr/nm)
  CapS 24: Coefficient of Variation (%)
  CapS 25: Ed Sfc  (µW/cm²/nm)
  CapS 26: Coefficient of Variation (%)
```

This shows a data listing with the SymS at the top.

```
Xdat:
 lambda       lambda          Ed Top       Covar        Ed Sfc
  341.9        341.9
  342.5        342.5       3.96e+001        16.4     3.92e+001
  343.1        343.1       3.77e+001        16.6     3.79e+001
  343.7        343.7       3.41e+001        16.4     3.38e+001
  344.2        344.2       3.41e+001        16.5     3.45e+001
  344.8        344.8       4.01e+001        16.8     3.93e+001
  345.4        345.4       3.94e+001        17.1     3.90e+001
  345.9        345.9       3.97e+001        16.1     3.89e+001
  346.5        346.5       4.16e+001        16.8     4.06e+001
  347.1        347.1       4.01e+001        17.1     3.99e+001
```

The most complicated variables are Vaux and Faux. They contain the meta-data which numerically describes the data (See Appendix B and C).

For example to find all the Lu data in the file you would search for all the 21's in Vaux(6,:). The indexes returned would be the columns in Xdat which contain Lu data.

```
>> ind = find(Vaux(6,:) == 21)

ind =

   7   15   23
```

Columns 7, 15 and 23 in Xdat contain the Lu data.

Appendix D is a partial data listing so the user can check to see if the file is being read in correctly. Using the readmld_ function and this documentation you should be able to read in the MOBY data file. If you have any questions please feel free to call or email me.

Appendix E contains references with more detail on MOBY data and processing.

APPENDIX A

Explanation of MLdbase program variables

MLdbase files contain numerical data and descriptive headers. In MLdbase parlance, the term 'Variable' is used to describe a data structure containing

* numeric data:	Xdat, Vaux
* annotation for those data:	DscS CapS SymS
* graphic scaling parameters:	Scl
* listing format:	Fmt

A second numerical array Vaux is associated with Xdat. DscS is intended as textual description of the contents, and Vaux as numerical annotation. One use of Vaux would be to contain coefficients to describe a data processing algorithm. CapS is placed on graphs, and SymS is used to label listings.

Variable names are global in MATLAB and should not be used in any other context. The global variables are established using global statement on the MATLAB command line.

Variable names use mixed upper and lower case, the first character is uppercase. String variables end in upper case S.

The following four fields annotate the file:

FnmS (1,xx)	= Filename string
FhdS (8,80)	= File header strings
FdtS (1,20)	= File creation time and date string
Faux (1,10)	= File header auxiliaries numeric data (Lat,Long, etc) The length and content of this variable varies from application to application.

The following three parameters describe the size of the data:

Mpts (1,1)	= Maximum number of data elements (rows) in matrix
Nvar (1,1)	= Number of Variables (columns) in memory
Npts (1,Nvar)	= Number of elements in a Variable

They are set by the various procedures that manipulate data.

The following seven fields are associated with Xdat:

CapS (Nvar,32)	= Variable caption (used in axis labeling)
DscS (Nvar,80)	= Variable description (data identifier)
SymS (Nvar,8)	= Variable symbol (i.e. variable names)
Vaux (n,Nvar)	= Variable auxiliary such as calibration coefficients. The length and content of this variable is application dependent. One of its main uses is with NOAA radiometric data where Vaux contains several

hundred fields.

Xdat (Mpts,Nvar) = Data matrix

Fmt (1,Nvar) = Variable listing format (width.dec, neg=scientific)
Scl (15,Nvar) = Variable scale and graphic parameters
Scl(1,V) = Axis Minimum
Scl(2,V) = Axis Maximum
Scl(3,V) = Tick Interval
Scl(4,V) = Ticks/Label
Scl(5,V) = Label Decimal Place
Scl(6,V) = Axis Type
Scl(7,V) = Label Type
Scl(8,V) = Label Offset from Minimum
Scl(9,V) = Label Offset from Maximum
Scl(10,V) = Latitude/Longitude
Scl(11-15,V) = Undefined available to user
V = column

NaN is a special Matlab value that acts as a place holder for missing values. It is passed over in plots, and the NaNs (not-a-number) must be filtered out before performing calculations.

APPENDIX B

Explanation of File Auxiliaries Variable

Each raw MOBY file contains numerical header information to annotate the file contents. The following gives the meaning of each field.

Faux(01) = 612	Identifying this as Raw MOBY file
Faux(02) = 105	Number of values in Faux

Analog and GPS data taken before the scans

Faux(03) = 41	Number of Analog Data Elements including Faux(03)
for C = 1:Faux(03)/2	C = Analog Channel
Faux(4+2*(C-1))	Analog Sensor Code (see next page)
Faux(5+2*(C-1))	Converted Sensor Value
end	
Faux(44) = 10	Number of Data Elements including Faux(44)
Faux(45) = 12.9790	Lower Battery 1 (Volts)
Faux(46) = 12.9670	Lower Battery 2 (Volts)
Faux(47) = 13.1260	Lower Battery 3 (Volts)
Faux(48) = 12.5890	Lower Battery 4 (Volts)
Faux(49) = 0	Battery Status
Faux(50) = 0	GPS Time (HH.MMSS)
Faux(51) = 0	GPS Latitude (DDD.MMmmm)
Faux(52) = 0	GPS Latitude (DDD.MMmmm)
Faux(53) = 0	GPS-TT7 Time Difference (seconds)

Analog and GPS data taken after the scans

Faux(54) = 41	Number of Analog Data Elements including Faux(54)
for C = 1:Faux(54)/2	C = Analog Channel
Faux(55+2*(C-1))	Analog Sensor Code (see next page)
Faux(56+2*(C-1))	Converted Sensor Value
end	
Faux(95) = 10	Number of Data Elements including Faux(95)
Faux(96) = 12.9790	Lower Battery 1 (Volts)
Faux(97) = 12.9670	Lower Battery 2 (Volts)
Faux(98) = 13.1260	Lower Battery 3 (Volts)
Faux(99) = 12.5890	Lower Battery 4 (Volts)
Faux(100) = 0	Battery Status
Faux(101) = 22.0000	GPS Time (HH.MMSS)
Faux(102) = 20.4838	GPS Latitude (DDD.MMmmm)
Faux(103) = 157.1187	GPS Latitude (DDD.MMmmm)
Faux(104) = 31.65	GPS-TT7 Time Difference (seconds)
Faux(105) = Code	MOBY time corrected with GPS (1 = Yes, 0 = No)

Analog Sensor Code and description

100	TT7 upper bat (Volts)
101	TT7 board temp (deg C)
102	TT7 case temp (deg C)
103	TT7 case humidity (%RH)
104	Solar panel #1 current (Amps)
105	Solar panel #2 current (Amps)
106	Solar panel #3 current (Amps)
107	Solar panel #4 current (Amps)
108	Upper bat. charge current (Amps)
109	Upper arm collector depth (Meters)
110	Upper bat. drain current (Amps)
111	N/A
112	TT5 mains power (Volts)
113	Lower bat. charge current (Amps)
114	MOS current (Amps)
115	MOS voltage (Volts)
116	Lower Battery #1 (Volts)
117	Lower Battery #2 (Volts)
118	Lower Battery #3 (Volts)
119	Lower Battery #4 (Volts)

GPS data taken before the scans (Faux(50:53)) are zero because the GPS was not on long enough to get a fix.

APPENDIX C

Explanation of Variable Auxiliaries for MOBY

Each instrument scan or profile may be accompanied by auxiliary data contained in Vaux. The first 30 words are used in common by several instruments. Instrument-specific data may follow. The following gives the meaning of each field.

Vaux [VN,Nscans]	Meaning
Vaux(01,N) = 212	Identifying Vaux Data Type
Vaux(02,N) = 192	Number of values in Vaux
Vaux(03,N) = 6	Instrument Type (MOBY)
Vaux(04,N) = 23401	MOBY deployment and config number
Vaux(05,N) = 20402	MOS instrument serial number
Vaux(06,N) = 21	Sensor DataType
Vaux(07,N) = 2.01	SignalSource Position
Vaux(08,N) = 1..10	MUX Position
Vaux(09,N) = 4	Instrument Deployment Method
Vaux(10,N) = YYMMDD.HHMMSS	Calibration Date.Time
Vaux(11,N) = YYMMDD.HHMMSS	Observation Date.Time
Vaux(12,N) = NOT USED	
Vaux(13,N) = 1	Navigation Method
Vaux(14,N) = DD.MMm	Latitude (-S/+N)
Vaux(15,N) = DDD.MMm	Longitude (-W/+E)
Vaux(16.N) = ZZZ.Z	Sensor Depth (meters)
Vaux(17.N) = Code	Primary Data Processing
Vaux(18,N) = NOT USED	
Vaux(19,N) = NOT USED	
Vaux(20,N) = Time	Blue Integration Time (sec)
Vaux(21,N) = Time	Red Integration Time (sec)
Vaux(22,N) = NOT USED	
Vaux(23,N) = NOT USED	
Vaux(24,N) = NOT USED	
Vaux(25,N) = Year	4 Digit Year
Vaux(26,N) = jday	Julian day of the year
Vaux(27,N) = Code	Straylight Correction Code
Vaux(28.N) = Code	Primary Data Processing (cont. from Vaux(17,:))
Vaux(29,N) = NOT USED	
Vaux(30,N) = NOT USED	
Vaux(31,N) = NOT USED	
Vaux(32,N) = NOT USED	
Vaux(33,N) = Temp	MOBY - RSG TT7 temp
Vaux(33..38,N) NOT USED	

Vaux(39,N) = -85	MOS Compass Offset Correction (degs)
Vaux(40,N) = offset	Degrees to correct the compass to true for know magnetic variation (MOS - correct)
Vaux(41,N) = 1	Blue: Begin Element #
Vaux(42,N) = 512	Number of Elements
Vaux(43,N) = 1	Gain/Intensifier
Vaux(44,N) = 1	Cooler Setting
Vaux(45,N) = 0	LED Setting
Vaux(46,N) = 513	Red: Begin Element #
Vaux(47,N) = 512	Number of Elements
Vaux(48,N) = 1	Gain/Intensifier
Vaux(49,N) = 1	Cooler Setting
Vaux(50,N) = 0	LED Setting
for C = 1:32	C = Analog Channel
Vaux(51+4*(C-1),N)	Analog Sensor Code 51:4:175
Vaux(52+4*(C-1),N)	# Values Averaged (0=timeout) 52:4:176
Vaux(53+4*(C-1),N)	Sensor Gain Code 53:4:177
Vaux(54+4*(C-1),N)	Sensor Value 54:4:178
end	
Vaux(179,N) = 1024	Blue: Length
Vaux(180,N) = 1	Average Flag
Vaux(181,N) = 64	CCD Start Row
Vaux(182,N) = 384	CCD Num Row
Vaux(183,N) = 32	CCD Bin Fact
Vaux(184,N) = 1024	Red: Length
Vaux(185,N) = 1	Average Flag
Vaux(186,N) = 64	CCD Start Row
Vaux(187,N) = 384	CCD Num Row
Vaux(188,N) = 64	CCD Bin Fact
Vaux(189,N) = 94.3714	Compass.dir
Vaux(190,N) = 1	Compass.mag/true (0 = mag, 1 = true)
Vaux(191,N) = 10175	14 bit relays

Detailed description of Vaux rows

MOBY deployment and config number

23401 means deployment 34 (the 2 on the front means the second version of the buoy) and 01 means first buoy configuration. Most deployments only have one configuration. MOBY202 had many configuration changes during the deployment.

MOS instrument serial number

MOBY deployments alternate buoys, each buoy has a unique Marine Optical System (MOS)with its own serial number. The MOS contains the red and blue spectragraph.

Sensor DataType

This code tells the program which Sensor is in the coresponding column in Xdat.
1 = Wavelength, 10= Ed, 11= Eu, 12 = Es, 21 = Lu
For example if Vaux(6,7) = 21 then the 7th column in Xdat has Lu data.

Fractional part. If the number is 21.0 then the column contains data if the number is 21.3 then the column contains a Coefficient of Variation.
0 = Data, Covar = 0.3

SignalSource Position

2 = inwater data and the fraction part is the arm position. So 2.01 means the Top arm and 2.02 means the middle arm.

MUX Position

Not needed

Instrument Deployment Method

4 means a moored buoy

Navigation Method

1 means GPS

Primary Data Processing , also see Vaux(28,:)

A binary code which tells which processing steps have been applied. So if the number in Vaux(17,7) = 1096. And we convert this to a binary string we can see which bits are set. 1096 -> 10001001000. So the 8 bit is set meaning the data is converted, the 64 bit is set so the data are derived and the 1024 bit is set so the Vaux data have been converted to engineering units.

0	na	1	Raw	2	Edited	4	Adjusted
8	Converted	16	Smoothed	32	AvrScans	64	Derived
128	AvrMerged	256	Clipped	512	OverLapped	1024	CnvVaux
2048	Pixels Removed	4096	Kl normalized	8192	Spike Removed	16384	Sensor Bad

```
-1  BADSCAN
```

Stray light Correction Code

If there is a non-zero number then the data has been stray light corrected. The number is the serial number of the stray light correction applied.

MOS Compass Offset Correction

Value added to the MOBY compass direction so the compass tells the arm direction.

Degrees to correct the compass to true

Value subtracted from the MOBY compass direction so the compass direction is true.

Analog Sensor Codes

10	Water Temperature (deg C)
11	Blue array temp (deg C)
12	Red array temp (deg C)
13	Calib src block temp (deg C)
14	Depth Sensor temp (deg C)
15	Blue CCD head temp (deg C)
16	Red CCD head temp (deg C)
17	TT7 board temp (deg C)
18	TT7 case temp (deg C)
20	Depth (meters)
21	X Tilt (degrees)
22	Y Tilt (degrees)
2122	Inclination
23	Blue cal diode mon (Volts)
24	Red cal diode mon (Volts)
25	Blue heat mon (Volts)
26	Red heat mon (Volts)
27	Coolant flow (liters/min)
28	System current (amps)
29	TT7 Mains (Volts)
30	TT7 case humidity (%RH)

Blue/Red CCD Bin Factor

The bin factor is the number of CCD pixels combined during readout.

14 bit relays

Used to determine which internal LED are on. LED data does not exist in the converted MOBY data file.

APPENDIX D

File header, Describtion Data listing of every 50th pixel and the first 10 columns of MOBY data in 2006060723C.MBY.

```
  File: 2006060723C.MBY
  26 Variables, 1024 Data Points

  FhdS 1: MOBY2 Radiometer Scans
  FhdS 2: DEPLOYMENT: MOBY234, Launched June 2006
  FhdS 3: START: 2006:06:08:00:01:31  Position: 20° 48.62' N   157° 11.23' W
  FhdS 4: STOP:  2006:06:08:00:39:22  Position: 20° 48.62' N   157° 11.23' W
  FhdS 5:
  FhdS 6: Stray light corrected
  FhdS 7:
  FhdS 8:

  DscS  1: MOS Calibrated Wavelength (nm)
  DscS  2: MOS Calibrated Wavelength (nm)
  DscS  3: MOS Downwelled Irradiance  (µW/cm²/nm), P =  1.2
  DscS  4: MOS Coefficient of Variation (%)
  DscS  5: MOS Surface Irradiance  (µW/cm²/nm)
  DscS  6: MOS Coefficient of Variation (%)
  DscS  7: MOS Upwelled Radiance (µW/cm²/sr/nm), P =  1.3
  DscS  8: MOS Coefficient of Variation (%)
  DscS  9: MOS Surface Irradiance  (µW/cm²/nm)
  DscS 10: MOS Coefficient of Variation (%)
```

Xdat:

N	lambda	lambda	Ed Top	Covar	Ed Sfc	Covar	Lu Top	Covar	Ed Sfc	Covar
1	341.95	3.4195e+002								
51	370.50	3.7050e+002	6.7077e+001	1.7522e+001	6.4363e+001	9.8099e-001	1.2628e+000	7.6240e-001	6.6964e+001	4.8958e-001
101	399.13	3.9913e+002	1.2164e+002	1.8125e+001	1.1358e+002	9.9248e-001	2.4045e+000	6.6801e-001	1.1800e+002	5.1306e-001
151	427.85	4.2785e+002	1.3139e+002	1.9109e+001	1.2197e+002	1.0343e+000	2.1668e+000	7.4830e-001	1.2720e+002	5.0510e-001
201	456.66	4.5666e+002	1.7090e+002	1.9727e+001	1.5919e+002	1.0416e+000	2.0748e+000	8.3361e-001	1.6587e+002	5.0822e-001
251	485.55	4.8555e+002	1.5004e+002	2.0218e+001	1.4012e+002	1.0161e+000	1.5348e+000	8.4056e-001	1.4504e+002	5.3650e-001
301	514.53	5.1453e+002	1.5113e+002	2.0687e+001	1.4674e+002	1.0488e+000	6.0247e-001	1.2488e+000	1.5202e+002	5.5205e-001
351	543.59	5.4359e+002	1.5011e+002	2.0857e+001	1.4818e+002	1.0838e+000	3.9918e-001	1.5119e+000	1.5322e+002	4.9876e-001
401	572.74	5.7274e+002	1.4115e+002	2.1141e+001	1.4532e+002	1.0734e+000	2.1025e-001	1.7587e+000	1.4971e+002	5.3927e-001
451	601.97	6.0197e+002	9.6928e+001	2.1029e+001	1.3510e+002	1.0819e+000	3.4594e-002	2.0461e+000	1.3881e+002	5.4681e-001
501	631.29	6.3129e+002	8.5065e+001	2.1128e+001	1.2784e+002	1.0671e+000	2.3688e-002	1.7513e+000	1.3129e+002	5.7737e-001
551	576.70	5.7670e+002	7.4618e+001	2.1131e+001	1.0273e+002	1.1905e+000	7.1037e-002	1.9930e+000	1.0735e+002	6.8184e-001
601	616.71	6.1671e+002	8.5670e+001	2.1374e+001	1.2650e+002	1.0524e+000	2.4740e-002	2.7744e+000	1.3136e+002	5.9594e-001
651	656.82	6.5682e+002	6.9718e+001	2.1354e+001	1.1825e+002	1.0535e+000	1.1945e-002	3.2197e+000	1.2212e+002	5.8334e-001
701	697.04	6.9704e+002	5.0854e+001	2.1436e+001	1.1443e+002	1.1088e+000	4.8356e-003	4.6831e+000	1.1867e+002	6.6280e-001
751	737.36	7.3736e+002	2.4152e+000	2.8231e+001	1.0412e+002	1.1521e+000	2.4521e-004	1.2530e+001	1.0793e+002	6.0979e-001

801	777.78	7.7778e+002	2.3664e+000	3.1319e+001	1.0057e+002	1.1208e+000	1.2673e-004	1.0510e+001	1.0437e+002	5.7292e-001
851	818.31	8.1831e+002	2.5279e+000	3.1084e+001	6.8737e+001	1.0937e+000	6.6896e-005	6.7305e+001	7.1561e+001	6.0637e-001
901	858.94	8.5894e+002	5.6910e-001	2.6214e+001	8.3826e+001	1.1481e+000	2.2270e-005		8.7070e+001	7.0019e-001
951	899.68	8.9968e+002	4.7533e-001	1.8211e+001	5.3811e+001	1.0338e+000	1.7381e-004	5.0971e+001	5.6145e+001	7.0748e-001
1001	940.52	9.4052e+002	2.2066e+000	2.5566e+001	5.7566e+001	1.2651e+000	4.3943e-004		6.0338e+001	2.3727e-001

MOBY Variable Auxillary Listing (Vaux) for first 7 columns:

Variable #	1	2	3	4	5	6	7
Vaux Data Type	212	212	212	212	212	212	212
Vaux Size	192	192	192	192	192	192	192
Instr Type	6	6	6	6	6	6	6
Instr S/N.Config	23401	23401	23401	23401	23401	23401	23401
Sensor S/N.Config	0	0	20402	20402	20402	20402	20402
Sensor.Datatype	1	1	10	10.3	12	12.3	21
DataSource.Position	0	0	2.01	2.01	2.05	2.05	2.01
Channel #	0	0	10	10	8	8	9
Deployment Method	0	0	4	4	4	4	4
Cal Date.Time	0.000000	0.000000	60609.104631	0.000000	60609.104631	0.000000	60609.104631
Obs Date.Time	0.000000	0.000000	60608.003238	60608.003238	60608.003239	60608.003239	60608.001638
Cruise.Station	0	0	0	0	0	0	0
Navigation Method	-1	-1	1	1	1	1	1
Latitude	20.4862	20.4862	20.4862	20.4862	20.4862	20.4862	20.4862
Longitude	-157.112	-157.112	-157.112	-157.112	-157.112	-157.112	-157.112
Depth	0	0	1.212	1.212	0	0	1.326
Primary Processing	9	9	1069	1061	1197	1189	1069
Secondary Processing	0	0	0	0	0	0	0
Derive Algorithm	0	0	2	0	2	0	2
Blue Integration Time	0	0	0.605415	0.6	0.752551	0.75	39.4664
Red Integration Time	0	0	0.605415	0.6	0.752551	0.75	39.4664
Red Integration Time	0	0	0	0	0	0	0
Red Integration Time	0	0	0	0	0	0	0
Red Integration Time	0	0	0	0	0	0	0
Red Integration Time	0	0	2006	2006	2006	2006	2006
Red Integration Time	0	0	159	159	159	159	159
Red Integration Time	0	0	4.021	0	4.021	0	4.021
Red Integration Time	0	0	2	0	2	0	2
Red Integration Time	0	0	0	0	0	0	0
Red Integration Time	0	0	0	0	0	0	0
Begin Element #	0	0	0	0	0	0	0
Number of Elements	0	0	0	0	0	0	0
Unused	0	0	0	0	0	0	0
Unused	0	0	0	0	0	0	0
Unused	0	0	0	0	0	0	0
Unused	0	0	0	0	0	0	0
Unused	0	0	0	0	0	0	0
Unused	0	0	0	0	0	0	0

Compass Offset Correction	0	0	-85	-85	-85	-85	-85
Compass correction	0	0	8.8	8.8	8.8	8.8	8.8
Blue: Begin Element #	0	0	1	1	1	1	1
Number of Elements	0	0	512	512	512	512	512
Gain/Intensifier	0	0	1	1	1	1	1
Cooler Setting	0	0	1	1	1	1	1
LED Setting	0	0	0	0	0	0	0
Red: Begin Element #	0	0	513	513	513	513	513
Number of Elements	0	0	512	512	512	512	511
Gain/Intensifier	0	0	1	1	1	1	1
Cooler Setting	0	0	1	1	1	1	1
LED Setting	0	0	0	0	0	0	0
Analog Channels							
Ch. 1 Water Tempe	0	0	10	10	10	10	10
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	25.3037	0.0545318	25.3377	0.0323488	25.3244
Ch. 2 Depth (met	0	0	20	20	20	20	20
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	9.9088	0.0846494	9.75874	0.111089	9.81927
Ch. 3 X Tilt (de	0	0	21	21	21	21	21
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	0.143859	0.747573	0.181028	0.764022	-0.0126483
Ch. 4 Y Tilt (de	0	0	22	22	22	22	22
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	0.427117	1.20234	0.380808	0.977616	0.122767
Ch. 5 Blue array	0	0	11	11	11	11	11
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	-34.644	0.205262	-34.5515	0.0891459	-34.8882
Ch. 6 Red array t	0	0	12	12	12	12	12
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	-37.3052	0.135175	-37.2828	0.107184	-37.6592
Ch. 7 Blue cal di	0	0	23	23	23	23	23
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	-0.00537117	0.000785152	-0.00549324	0.000393856	-0.00592049
Ch. 8 Red cal dio	0	0	24	24	24	24	24
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	-0.00512702	0.0012879	-0.00528979	0.000436135	-0.00549324
Ch. 9 Blue heat m	0	0	25	25	25	25	25
# Averaged	0	0	2	2	3	3	199

Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	-3.12694	0.151988	-3.10989	0.107052	-2.78159
Ch. 10 Red heat mo	0	0	26	26	26	26	26
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	0.598641	0.0898171	0.590066	0.0935366	0.958082
Ch. 11 Calib src b	0	0	13	13	13	13	13
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	31.424	0.0437603	31.4242	0.0291528	30.1046
Ch. 12 Coolant flo	0	0	27	27	27	27	27
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	0.193737	0.00059876	0.193155	0.000329118	0.193188
Ch. 13 Depth Senso	0	0	14	14	14	14	14
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	27.0233	0.0449617	27.0476	0.0156122	26.7718
Ch. 14 System curr	0	0	28	28	28	28	28
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	11.3132	0.127705	11.2324	0.186779	11.3602
Ch. 15 Blue CCD he	0	0	15	15	15	15	15
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	32.685	0.0196639	32.6807	0.0292497	32.2757
Ch. 16 Red CCD hea	0	0	16	16	16	16	16
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	33.0078	0.0262048	33.0329	0.0242562	32.7355
Ch. 17 TT7 Mains	0	0	29	29	29	29	29
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	12.2271	0.0171645	12.2304	0.0277069	12.2674
Ch. 18 TT7 board t	0	0	17	17	17	17	17
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	33.4259	0.00986039	33.4259	0.0058318	32.807
Ch. 19 TT7 case te	0	0	18	18	18	18	18
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	29.9574	0.0245694	29.9591	0.0194337	29.1148
Ch. 20 TT7 case hu	0	0	30	30	30	30	30
# Averaged	0	0	2	2	3	3	199
Sensor Gain	0	0	0	0	0	0	0
Sensor Value	0	0	9.23421	0.0159163	9.21053	0.006737	9.20392
Blue: Length	0	0	1024	1024	1024	1024	1024
Average Flag	0	0	1	1	1	1	1

CCD Start Row	0	0	64	64	64	64	64
CCD Num Row	0	0	384	384	384	384	384
CCD Bin Fact	0	0	32	32	16	16	6
Red: Length	0	0	1024	1024	1024	1024	1022
Average Flag	0	0	1	1	1	1	1
CCD Start Row	0	0	64	64	64	64	64
CCD Num Row	0	0	384	384	384	384	384
CCD Bin Fact	0	0	64	64	16	16	384
Compass.dir	0	0	94.3714	0	92.1001	0	71.5559
Compass.mag/true	0	0	1	1	1	1	1

APPENDIX E

Information Sources:

MOBY website at Moss Landing Marine Laboratories
http://physoce.mlml.calstate.edu/moby/

The Earth Observer article
http://eospso.gsfc.nasa.gov/eos_observ/9_10_97/p15.html

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