

TRANSPORT Program

Metadata for CTD data from 2010, 2011 and 2012 mapping cruises

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I. CTD Processing

1. Equipment and Software

a. CTD description

An SBE25 SEALOGGER CTD, made by Sea-Bird Electronics, was used for this project. It was equipped with a fluorometer (WET Labs WETstar), an Optical Backscatter Sensor (OBS, D & A), dissolved oxygen (SBE 43) and PAR (Biospherical/Licor) sensors. Because of the plumbing system on the CTD, there is delay between the dissolved oxygen/fluorometry readings and the pressure sensor.

b. Software

The SBEDataProcessing package of SeasoftV2 software (SBEDataProcessing_Win32_V7_21d.exe) was downloaded from the Sea-Bird website (<ftp://ftp.halcyon.com/pub/seabird/OUT/>) and installed.



2. Processing Overview

The raw CTD data files were processed using SBEDataProcessing with four steps:

- a. Data Conversion – converts the raw hex data to engineering units
- b. Align CTD – aligns the Oxygen Voltage data with an appropriate advance time
- c. Bin Average – averages the variables over bins of the specified size
- d. ASCII Out – creates text files that can be read by other programs

a. Data Conversion

Using SBEDataProcessing, select **Data Conversion** from the *Run* menu. The specifications in the DatCnv-2010.psa file are used. In the *File Setup* Tab, select the appropriate folders and files, and make 'A' the name to append. In the *Data Setup* tab, these options are selected:

- Process scans to end of file (checked)
- Scans to skip over = **34** (Note: this was derived by looking at aligned .cnv files to determine number of scans before negative voltage values are eliminated and the fluorometer readings stabilized. May need to adjust for each cruise.)
- ASCII output
- Downcast only
- Create converted data (.CNV) file only
- Merge separate header file (unchecked)
- Output variables: **Depth** [salt water, m]; **Salinity**, Practical [PSU]; **Temperature** [ITS-90, deg C]; **Density** [density, Kg/m³]; **Fluorescence**, WET Labs WETstar [mg/m³]; **Voltage 4** (Fluorometer voltage); **OBS**, Backscatterance (D & A) [NTU]; **Voltage 1** (OBS Voltage); **PAR**/Irradiance, Biospherical/Licor; **Oxygen**, SBE 43 [mg/l], **Oxygen**, SBE 43 [% saturation], **Conductivity** [S/m]; **Scan Count**
- Instrument's time stamp (selected)

In the *Miscellaneous* Tab, all are set to Defaults, including the following for Oxygen:

- Window size (s): 2
- Apply Tau correction (checked)
- Apply hysteresis correction (checked)

Select the 'Start process' button on the *File Setup* tab.

b. Align CTD

Using SBEDataProcessing, select **Align CTD** from the *Run* menu. The specifications in the AlignCTD-2010.psa file are used. In the *File Setup* Tab, select the appropriate folders and files (with 'A' at end), and make 'B' the name to append. In the *Data Setup* tab under 'Enter Advance Variables', set the oxygen and fluorometer to the advance values of 6.5 s and 2.5 s. The fluorometer was plumbed in line before the oxygen sensor.

Select the 'Start process' button on the *File Setup* tab.

Enter Advance Values ✖

Variable Name [unit]	Advance [s]	Clear All
Salinity, Practical [PSU]	0	
Temperature [ITS-90, deg C]	0	
Density [density, Kg/m ³]	0	
Fluorescence, WET Labs WET star [mg/m ³]	2.5	
Voltage 4	2.5	
OBS, Backscatterance (D & A) [NTU]	0	
Voltage 1	0	
PAR/Irradiance, Biospherical/Licor	0	
Oxygen, SBE 43 [mg/l]	6.5	
Oxygen, SBE 43 [% saturation]	6.5	
Conductivity [S/m]	0	

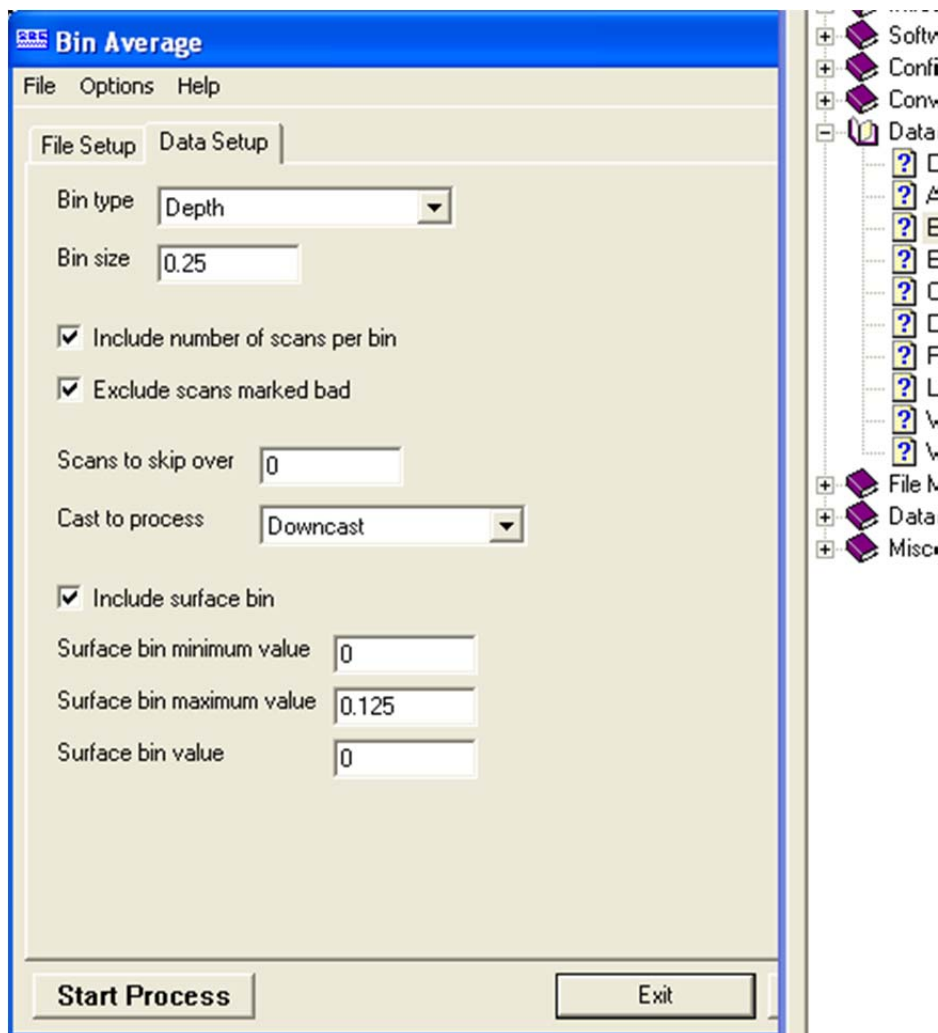
OK Cancel

c. Bin Average

Using SBEDataProcessing, select **Bin Average** from the *Run* menu. The specifications in the BinAvg-2010.psa file are used. In the *File Setup* Tab, select the appropriate folders and files (with 'AB' at end), and make 'C' the name to append. In the *Data Setup* tab, these options are selected:

- Bin type = depth
- Bin size = 0.25
- Include number of scans per bin (checked)
- Exclude scans marked bad (checked)
- Scans to skip over = 0
- Cast to process = downcast
- Include surface bin (not checked)

Select the 'Start process' button on the *File Setup* tab.



d. ASCII Out

Using SBEDataProcessing, select **ASCII Out** from the *Run* menu. The specifications in the ASCII_Out_2010.psa file are used. In the *File Setup* Tab, select the appropriate folders and files (with 'ABC' at end), and make 'D' the name to append. In the *Data Setup* tab, these options are selected:

- Output header file (checked)
- Lines per page: 800
- Output data file (checked)
- Exclude scans marked bad (NOT checked)
- Label columns - Top of file
- Column separator – space
- Select time conversion formats – all should be 'do not convert'
- Add first column (checked)
- First column name: Cruise

- First column value: BTMAP01 (change this to be the name of the folder)
- Select output variables – all should be selected

Select the 'Start process' button on the *File Setup* tab.

Additional Notes for Data Conversion

Our goal was to have data from depths <1m so the data was processed in Seabird using 10 skips for 2010, 2011 and 2012 cruises. The data was processed in MatLab and the excel files generated resulted in depths of ≤ 1 m at each station. These excel files were published to the project website (<http://northweb.hpl.umces.edu/TRANSPORT/home.htm>). These files contain negative voltage values and unstable fluorescence data but contain important data from other parameters (DO, salinity, temperature, etc.).

One additional note for BT12-05 station 2b:

1. Data Conversion was done processing **upcast**
2. Align CTD - no changes made
3. Binavg - **changed "Cast to process - upcast" in "Data Setup"**
4. ASCII Out - no changes made

II. Instructions for post-processing CTD data in MatLab

1. Sort Decimal Degree files and save them as .csv files.

Open each Decimal Degree file in excel and make sure the stations are in sequential order. This may be done by highlighting the data and selecting 'Sort...' under the 'Data' menu. In the Sort Window that appears tell it to sort the data 'Ascending' by the first column and click 'OK'. Next, make sure no stations are missing. A row must be present for every station, if a station was skipped in that cruise put the station number and 0.0 for lat and long. If that station was not skipped but the data is missing, check the station log book to get the correct data. Once data exists for every cruise, save the file as a comma separated value file with the extension '.csv' Note: Decimal degrees files were generated using the coordinates (latitude and longitude) recorded in the cruise logs. The following website was used to convert latitude and longitude to decimal degrees: <http://transition.fcc.gov/mb/audio/bickel/DDDMSS-decimal.html>

2. Rename any files with an additional letter after the cast number.

The CreateCastFile matlab program you are going to run is not set up to handle letters in the filenames after the cast number. The simplest solution is to save the files under a different name. For example the file "bt1020_st16bABCD.asc" would be renamed "bt1020_stb16ABCD.asc", and "bt1020_st16bABCD.hdr" would be renamed "bt1020_stb16ABCD.hdr". Be aware that only the files ending in "ABCD.asc" and "ABCD.hdr" are used by the model, and as such are the only ones you need to rename.

Note: In 2010 and 2011, stations H1 and H2 were renamed 21 and 22 respectively before being process in MatLab. The excel files that result from processing have 21 and 22 instead of H1 and H2. H1 and H2 would be the station names used in all other files (TSS/Chla, logs, plans, reports, etc.). In 2012, stations H1 and H2 were sampled again but named 20 and 21, respectively, in CTD files. H1 and H2 labels are used in all files except raw CTD data and process CTD data.

3. Run 'CreateCastFile.m' for each CTD cast.

The only code you need to change is found at the very top of the file and is shown below. Everything that will need to be changed has been highlighted in different colors which are then explained at the bottom of the page.

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%  
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
%Need to change this value for each cast. It should always be 2 digits
```

```
%(e.g., '02' or '13')
```

```
castnum = '16';
```

```
%Need to change the following paths for each cruise. These include the cruise
```

%number (year.cruise), the path for the CTD header file, the path for the CTD data file,
 %the path for the station lat/long file, and the path where the new file
 %should be placed.

```
cruise = 11.20
prefixheader = 'D:\TRANSPORT-CTD2010\From Kaley\2010d\btMap20\bt1020_st';
prefixCTD = 'D:\TRANSPORT-CTD2010\From Kaley\2010d\btMap20\bt1020_st';
decimalfile = 'D:\TRANSPORT-CTD2010\Decimal degrees 2010\BT-10-20 decimal
degrees.csv';
exportfile = ['D:\TRANSPORT-CTD2010\From Kaley\2010d\btMap20\BT10-20-' castnum
.csv'];
```

%%%%%%%%%%
 %%%%%%%%%%

Cast Number	Cruise Number
Year	Extension for the output file
Path to CTD data files	Path to Decimal Degrees files
Part of CTD file name prior to castnum (e.g. if CTD file names is 'bt1020_st16ABCD.asc' then put 'bt1020_st', be aware that there has been a lot of inconsistency in the naming of this file)	

NOTE: If the cast had a letter after the cast number and you have renamed the files you need to make the following changes: 1) add the letter to the end of the CTD file name (if the letter was b then 'bt1020_st' becomes 'bt1020_stb') and 2) add the letter to the beginning of the extension for the output file (if the letter was b then '.csv' becomes 'b.csv')

4. Run the 'MergeCastFile.m' to combine all the cast files into one big file.

There are a few things that need to be changed in this file for each cruise:

At the top change: paths to input/output, year, and cruise numbers:

```
exportfile = ['C:\D-folder\g_TRANSPORT\CTD-2010\From
Kaley\2010a1\btMap01\BT10-11-ALL.csv'];
prefixCTD = 'C:\D-folder\g_TRANSPORT\CTD-2010\From
Kaley\2010a1\btMap01\BT10-11-';
```

There are three sections of code that follow in which you will need code for each cast in that cruise. In each of the three sections code has already been written for 16 casts. If a cast is not present in this cruise then the code regarding that particular cruise needs to be

commented out. It is simple to comment and uncomment code in matlab, simply highlight the code that needs to be commented/uncommented, right click and choose either ‘Comment’ or ‘Uncomment.’ Since casts with letters are sporadic, no code has been written to handle them yet, so this must be added for each lettered cast. Below are two examples, to the left is an example of what cast ‘01’ looks like in each of the three sections, to the right is an example of code that would need to be added to each section if there were a cast ‘01b’ (the differences are indicated in red):

Cast 01	Cast 01b
castnum1 = '01';	castnum1 b = '01 b ';
⋮	⋮
path1 = [prefixCTD castnum1 '.csv'];	path1 b = [prefixCTD castnum1 b '.csv'];
C1 = importdata(path1, ',', 1)	C1 b = importdata(path1 b , ',', 1)
⋮	⋮
C1(1,1).data(:,:);	C1 b (1,1).data(:,:);

5. Open the new merged file with all the casts, paste the header information into it, and save it.

Unfortunately the matlab program does not yet have the ability to add header information so this must be done manually. The header information is in the excel file in the TRANSPORT-CTD2010 folder.

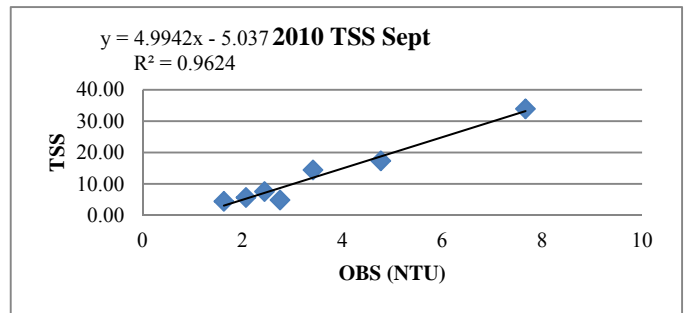
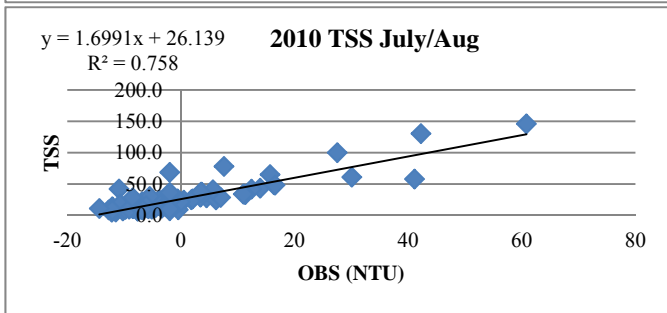
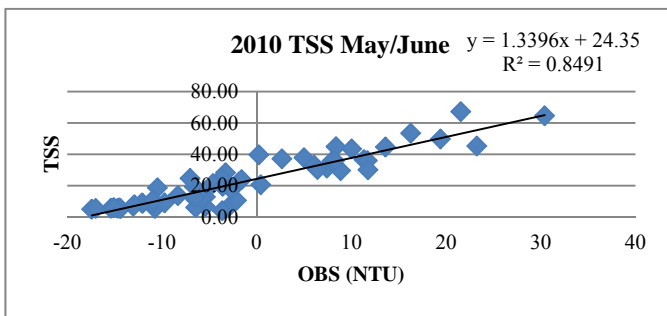
III. TSS and chl-a regressions.

Additional Notes for TSS and Chla Regressions

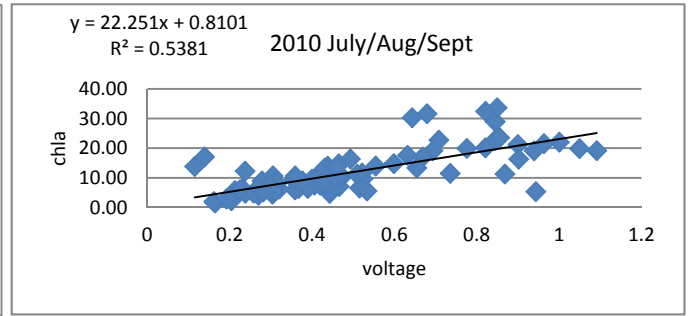
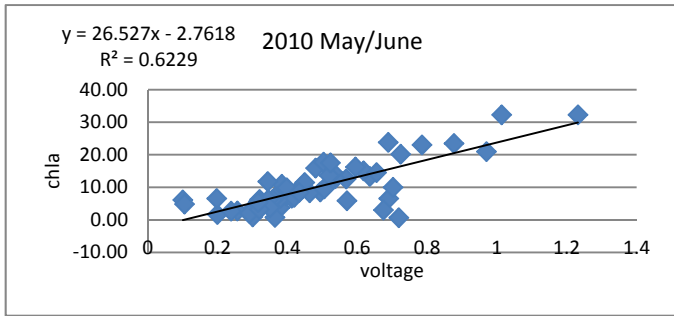
In order to eliminate negative voltage values and have stable fluorometer readings, 34 skips were used in the data conversion component of the data processing protocol for each cruise during 2010 and 2011. 10 skips were used in the data conversion component of the data processing protocol for each cruise in 2012. The files generated from this method were then processed in MatLab (instructions below) and TSS and Chla regressions were done (see TSS/Chla section below for additional details). The regression equations generated were then used to extrapolate the data so all stations and depths had TSS and Chla values.

Water samples were collected for chl-a pigment (using a syringe/filter apparatus) to calibrate the fluorometer and for total suspended solids (using a water bottle provided by Analytical Services) to calibrate the OBS (Table 3). Samples for chl-a pigment and TSS were collected and delivered to UMCES Horn Point Laboratory Analytical Services (<http://www.umces.edu/hpl/analytical-services>).

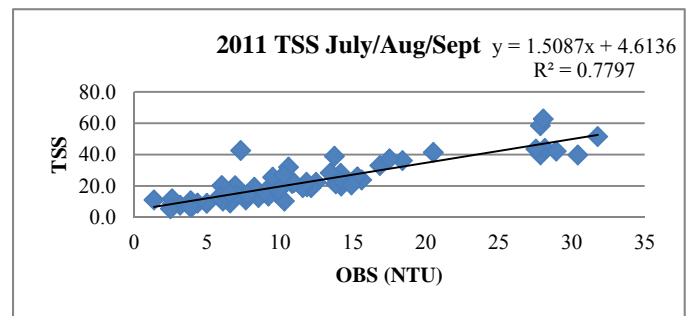
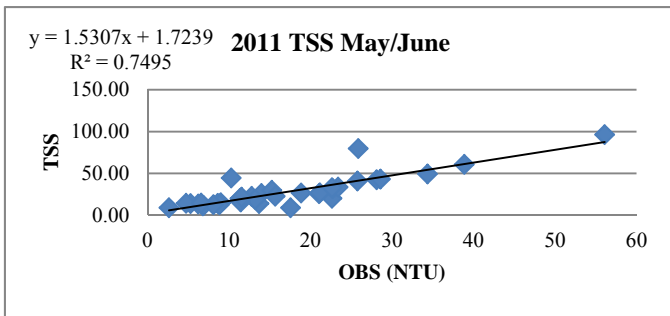
2010 TSS data was regressed using a scatter-plot of OBS (NTU) versus TSS values in which May/June, July/Aug and Sept data were plotted in separate graphs. The regression equations that resulted were used to extrapolate TSS data for the remaining depths and stations sampled during the 2010 Transport cruises. One outlier from BT10-17 station 6 in July was removed prior to generating regression equations. Below are the graphs and equations used to calculate TSS values in 2010.



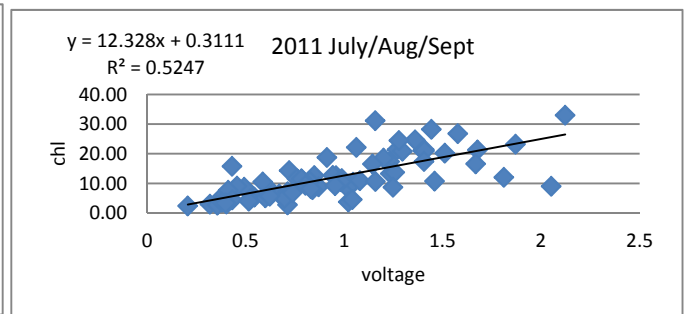
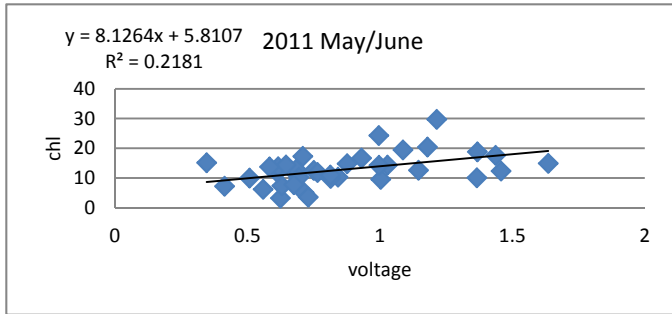
2010 Chla data was regressed using a scatter-plot of voltage versus Chla values in which May/June and July/Aug/Sept data were plotted in separate graphs. The regression equations that resulted were used to extrapolate Chla data for the remaining depth and stations sampled during the 2010 Transport cruises. Two outliers from July cruises were removed (BT10-09 station 13 and BT10-16 station 8). Below are the graphs and equations used to calculate Chla data in 2010.



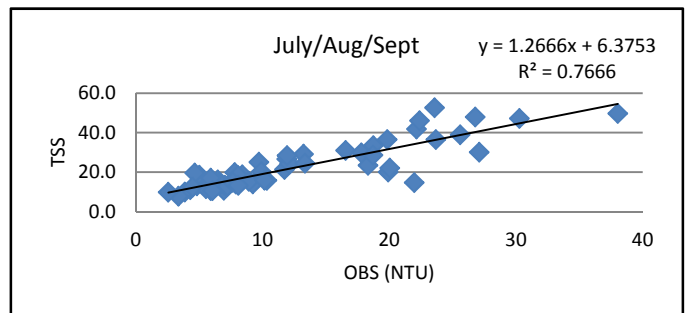
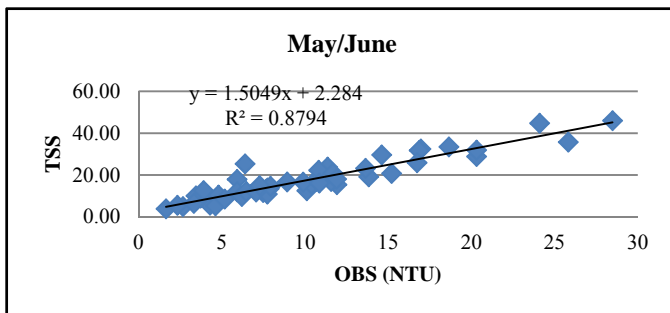
2011 TSS data was regressed using a scatter-plot of OBS (NTU) versus TSS values in which May/June, July/Aug/Sept data were plotted in separate graphs. The regression equations that resulted were used to extrapolate TSS data for the remaining depths and stations sampled during the 2011 Transport cruises. One outlier from BT11-09 station 13 in July was removed prior to generating regression equations. Below are the graphs and equations used to calculate TSS values in 2011.



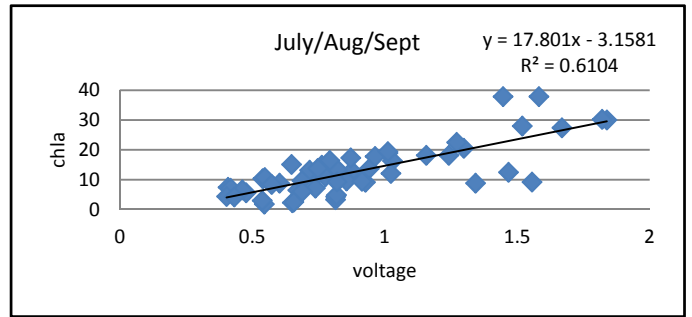
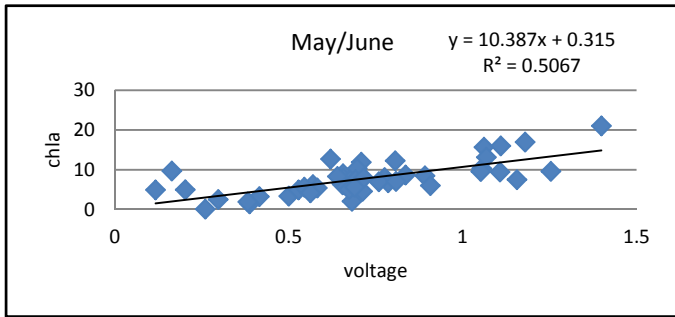
2011 Chla data was regressed using a scatter-plot of voltage versus Chla values in which May/June and July/Aug/Sept data were plotted in separate graphs. The regression equations that resulted were used to extrapolate Chla data for the remaining depth and stations sampled during the 2011 Transport cruises. One outlier was removed (BT11-03 station 11). Below are the graphs and equations used to calculate Chla data in 2011.



2012 TSS data was regressed using a scatter-plot of OBS (NTU) versus TSS values in which May/June, July/Aug/Sept data were plotted in separate graphs. The regression equations that resulted were used to extrapolate TSS data for the remaining depths and stations sampled during the 2012 Transport cruises. Two outliers were removed in June - BT12-05 station 21 and BT12-07 station 2- prior to generating regression equations. Below are the graphs and equations used to calculate TSS values in 2012.

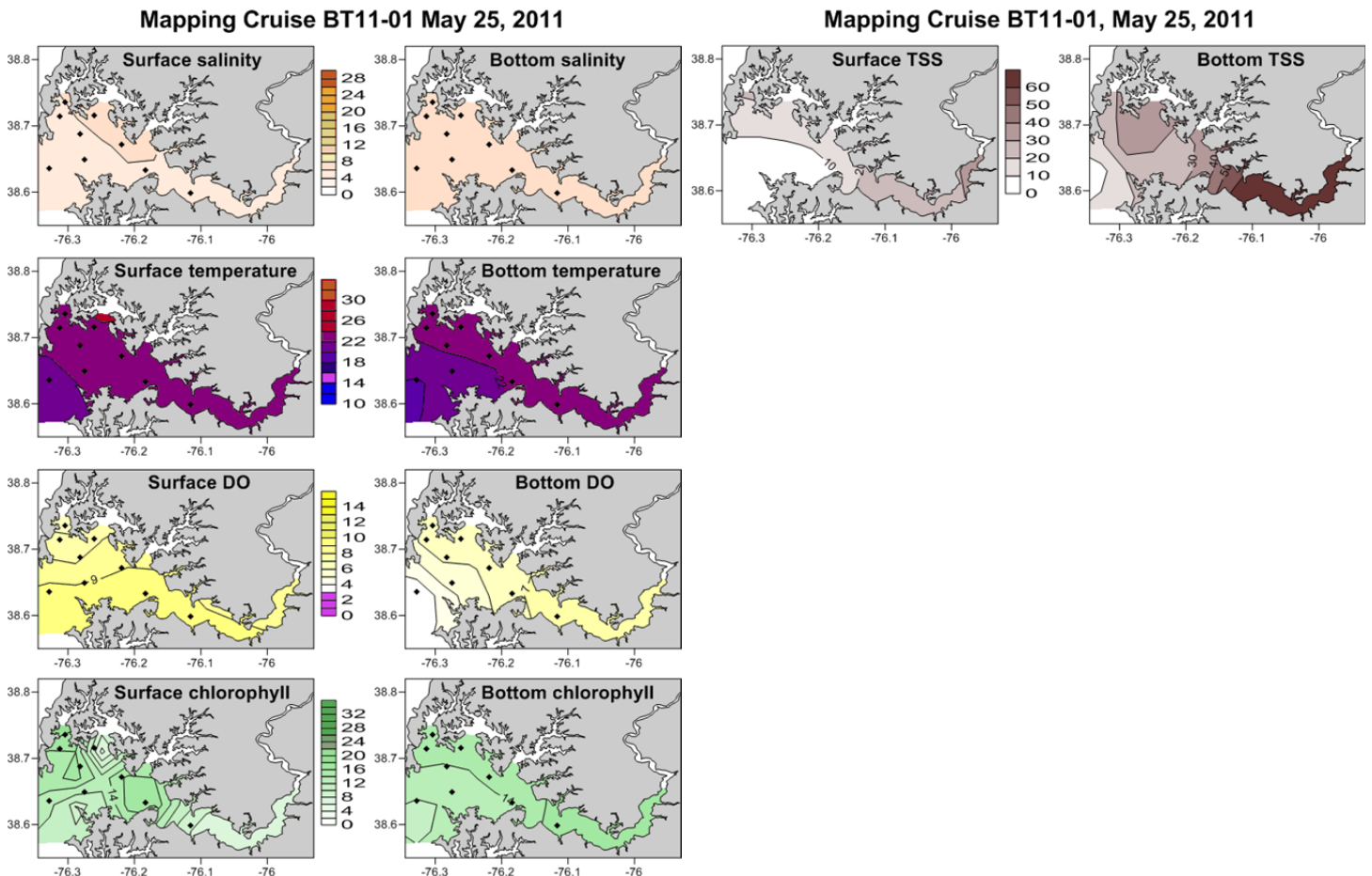


2012 Chla data was regressed using a scatter-plot of voltage versus Chla values in which May/June and July/Aug/Sept data were plotted in separate graphs. The regression equations that resulted were used to extrapolate Chla data for the remaining depth and stations sampled during the 2012 Transport cruises. One outlier was removed (BT12-14 station 6) in July/Aug/Sept data. Below are the graphs and equations used to calculate Chla data in 2012.



IV. Making contour plots using Surfer/Scripter.

Separate Excel spreadsheets were generated for cruises in 2010, 2011 and 2012 that included surface and bottom data for each station sampled during each cruise. Minimum and maximum spreadsheets were generated for entire years (2010, 2011 and 2012) so minimum and maximum values for each parameter measured (i.e. dissolved oxygen, salinity, depth, etc.) could be set for the Surfer/Scripter programs. If data for a parameter was not consistent with other values for that cruise then the next closest “real” value was used in the spreadsheet and the “new” depth recorded in a separate column for future reference. This means not all surface values for each parameter is at the true surface but may be at a slightly deeper depth however most values are from depths <1.0m. The same can be said for bottom values. The surface and bottom spreadsheets were used to generate plots for each cruise. The parameters plotted include salinity, temperature, dissolved oxygen, chlorophyll and TSS. Below is a sample plot from 2011. See appendix for Scripter code used to generate Surfer plots.



Appendix A: Create Cast File code (Matlab)

```
%This program assembles information for each TRANSPORT Program CTD cast and
%creates one export file for each cast. Written by ENorth 6/3/11
%Updated on 7/11/12 to work with MATLAB 7.0.1.24704 (R14) Service PAck 1
clear
close all
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%Need to change this value for each cast. This is the cast number. It should always be 2 digits
%(e.g., '02' or '13')
castnum = '06';
%Need to change the following paths for each cruise. This includes the cruise
%number (year.cruise), the path for the CTD header file, the path for the CTD data file,
%the path for the station lat/long file, and the path where the new file
%should be placed.
% NOTE: H1 and H2 need to be renamed in decimal degrees as stations 21 and
% 22 here and everywhere
cruise = 11.01
prefixheader = 'G:\www\TRANSPORT\Data\Erin working folder\2011\BT-
11\2011processedCTDdata\btMap2011\btmap1101\btmapst';
prefixCTD = 'G:\www\TRANSPORT\Data\Erin working folder\2011\BT-
11\2011processedCTDdata\btMap2011\btmap1101\btmapst';
decimalfile = 'G:\www\TRANSPORT\Data\Erin working folder\2011\BT-11\Decimal Degrees 2011\BT-11-01
decimal degrees.csv';
exportfile = ['G:\www\TRANSPORT\Data\Erin working folder\2011\BT-
11\2011processedCTDdata\btMap2011\btmap1101\BT11-01-' castnum '.csv'];

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%Import Header Information: Date
path1 = [prefixheader castnum 'ABCD.hdr']

[t4] = textread(path1, '%s', 'headerlines',7);
month = cell2mat(t4(6))
day = str2num(cell2mat(t4(7)))
year = str2num(cell2mat(t4(8)))
timestring = cell2mat(t4(9))
hour = str2num(timestring(1:2))
min = str2num(timestring(4:5))

if month == 'May'
    mon = 5
end
if month == 'Jun'
    mon = 6
end
if month == 'Jul'
    mon = 7
```

```

end
if month == 'Aug'
    mon = 8
end
if month == 'Sep'
    mon = 9
end

%Import station number at Latitude/Longitude
B = importdata(decimalfile, ',', 1)
Sta = B.data(str2num(castnum),1)
Latitude = B.data(str2num(castnum),2)
Longitude = B.data(str2num(castnum),3)

%Import the CTD data
path1 = [prefixCTD castnum 'ABCD.asc'];
A = importdata(path1, ',', 1); %Notes from .hdr file
depth = A.data(:,1); %depSM: Depth [salt water, m], lat = 38.00
salinity = A.data(:,2); %sal00: Salinity, Practical [PSU]
temp = A.data(:,3); %t090C: Temperature [ITS-90, deg C]
density = A.data(:,4); %Density00: Density [sigma-t, Kg/m^3 ]
Fluor = A.data(:,5); %wetStar: Fluorescence, WET Labs WETstar [mg/m^3]
V4 = A.data(:,6);
OBS = A.data(:,7); %obs: OBS, Backscatterance (D & A) [NTU]
V1 = A.data(:,8);
PAR = A.data(:,9); %par: PAR/Irradiance, Biospherical/Licor
DOmgL = A.data(:,10); %sbeox0Mg/L: Oxygen, SBE 43 [mg/l]
DOSat = A.data(:,11); %sbeox0PS: Oxygen, SBE 43 [% saturation]
Cond = A.data(:,12); %c0mS/cm: Conductivity [mS/cm]
scan = A.data(:,13); %scan#:
Nbin = A.data(:,14); %nbin: number of scans per bin
Flag = A.data(:,15); %flag: flag

%Replace flagged values with NAN
% outside = find(salinity<0);
% salinity(outside)=NaN;
% outside = find(temp<0);
% temp(outside)=NaN;
% outside = find(density<0);
% density(outside)=NaN;

%Create columns with cruise, station, time info
Cruise = zeros(size(depth));
Cruise(:,1) = cruise+2000;
Station = zeros(size(depth));
Station(:,1) = Sta;
Lat = zeros(size(depth));
Lat(:,1) = Latitude;
Long = zeros(size(depth));
Long(:,1) = Longitude;
Month= zeros(size(depth));

```

```

Month(:,1) = mon;
Day = zeros(size(depth));
Day(:,1) = day;
Year = zeros(size(depth));
Year(:,1) = year;
Hour = zeros(size(depth));
Hour(:,1) = hour;
Min = zeros(size(depth));
Min(:,1) = min;

%Put everything in a final matrix
FIN = [Cruise Station Lat Long Year Month Day Hour Min depth salinity temp density Fluor V4 OBS V1 PAR DOmgl
DOsat Cond scan Nbin Flag];

% Write matrix to file;
dlmwrite( exportfile,FIN,'precision', 8);

```

Additional Notes:

For this section of code, 2010, 2011 and 2012 cruises differed slightly. The code below was used for 2011 data.

```

[t4] = textread(path1, '%s' , 'headerlines',7);
month = cell2mat(t4(6))
day = str2num(cell2mat(t4(7)))
year = str2num(cell2mat(t4(8)))
timestring = cell2mat(t4(9))
hour = str2num(timestring(1:2))
min = str2num(timestring(4:5))

```

The code below was used for 2010 and 2012 data (the change is in bold):

```

[t4] = textread(path1, '%s' , 'headerlines',5);
month = cell2mat(t4(6))
day = str2num(cell2mat(t4(7)))
year = str2num(cell2mat(t4(8)))
timestring = cell2mat(t4(9))
hour = str2num(timestring(1:2))
min = str2num(timestring(4:5))

```


Appendix B. Merge Cast File code (Matlab)

```
%This program opens the CTD files created by CreateCastFile.m and merges  
%them into one array, then exports all the CTD for each cruise of the  
%TRANSPORT Program. Written by ENorth 6/3/11  
%Updated on 7/11/12 to work with MATLAB 7.0.1.24704 (R14) Service PAck 1
```

```
clear  
close all
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%  
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
% Need to change the following paths for each cruise:
```

```
exportfile = ['G:\www\TRANSPORT\Data\Erin working folder\2011\BT-  
11\2011processedCTDdata\btMap2011\btmap1101\BT11-01-ALL.csv'];  
prefixCTD = 'G:\www\TRANSPORT\Data\Erin working folder\2011\BT-  
11\2011processedCTDdata\btMap2011\btmap1101\BT11-01-';
```

```
% Need to comment out the code below that cooresponds to cast numbers  
% if they are not in the cruise folder. Highlight and right click to  
% comment and uncomment blocks of code.
```

```
% Need to open excel file, insert a row at the top, and paste headers into  
% the file.
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%  
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
%Import the CTD data  
castnum1 = '01';  
castnum2 = '02';  
castnum3 = '03';  
castnum4 = '04';  
castnum5 = '05';  
castnum6 = '06';  
%castnum7 = '07';  
%castnum8 = '08';  
castnum9 = '09';  
%castnum10 = '10';  
%castnum11 = '11';  
%castnum12 = '12';  
%castnum13 = '13';  
%castnum14 = '14';  
%castnum15 = '15';  
%castnum16 = '16';  
castnum21 = '21';  
castnum22 = '22';
```

```

path1 = [prefixCTD castnum1 '.csv'];
C1 = importdata(path1, ',')

path2 = [prefixCTD castnum2 '.csv'];
C2 = importdata(path2, ',')

path3 = [prefixCTD castnum3 '.csv'];
C3 = importdata(path3, ',')

path4 = [prefixCTD castnum4 '.csv'];
C4 = importdata(path4, ',')

path5 = [prefixCTD castnum5 '.csv'];
C5 = importdata(path5, ',')

path6 = [prefixCTD castnum6 '.csv'];
C6 = importdata(path6, ',')

%path7 = [prefixCTD castnum7 '.csv'];
%C7 = importdata(path7, ',')

%path8 = [prefixCTD castnum8 '.csv'];
%C8 = importdata(path8, ',')

path9 = [prefixCTD castnum9 '.csv'];
C9 = importdata(path9, ',')

%path10 = [prefixCTD castnum10 '.csv'];
%C10 = importdata(path10, ',')

%path11 = [prefixCTD castnum11 '.csv'];
%C11 = importdata(path11, ',')
%
%path12 = [prefixCTD castnum12 '.csv'];
%C12 = importdata(path12, ',')
%
%path13 = [prefixCTD castnum13 '.csv'];
%C13 = importdata(path13, ',')
%
%path14 = [prefixCTD castnum14 '.csv'];
%C14 = importdata(path14, ',')
%
%path15 = [prefixCTD castnum15 '.csv'];
%C15 = importdata(path15, ',')
%
%path16 = [prefixCTD castnum16 '.csv'];
%C16 = importdata(path16, ',')
%
path21 = [prefixCTD castnum21 '.csv'];
C21 = importdata(path21, ',')

path22 = [prefixCTD castnum22 '.csv'];
C22 = importdata(path22, ',')

```

```
ALL = [C1(:,:);  
      C2(:,:);  
      C3(:,:);  
      C4(:,:);  
      C5(:,:);  
      C6(:,:);  
      % C7(:,:);  
      % C8(:,:);  
      C9(:,:);  
      % C10(:,:);  
      % C11(:,:);  
      % C12(:,:);  
      % C13(:,:);  
      % C14(:,:);  
      % C15(:,:);  
      % C16(:,:);  
      C21(:,:);  
      C22(:,:);  
      ]  
  
dlmwrite( exportfile,ALL,'precision', 8);
```

Appendix C: Contour plots of salinity, temperature, dissolved oxygen, chlorophyll (Surfer/Scripter)

Sub Main

'This program creates a eight plots, each of which includes a basemap of the Chotpank River,
' a blanking map to cover up the areas which are outside the bounds of the countour data,
' a contour map of a water property, and a post map of station locations.
'Created by Elizabeth North, September, 2012

'Change these values to match the plot title, the folder where all files are located, input data
' files, export file names, and level files For Each cruise. See KEY below for explanation of
' each entry. Note that export data files (.grd, .srf, .gif) will be written to the same folder which
' contains the CTD data (.xlsx), blanking (.bln), and level (.lvl) files.

```
ChopMAP "Mapping Cruise BT12-01 May 22, 2012", _  
    "C:\www\TRANSPORT\Data\2012\2012processedCTD\BT12-01\", _  
    "simplified_combined_online_final.bln", _  
    "boundary_map_donut.bln", _  
    "BT12-01-salt-temp-DO-Chla.srf", _  
    "BT12-01-temp-DO-Chla.gif", _  
    "A.Upper Left Panel_ Surface Salinity (column 11)", _  
    "BT12-01-ALL_surface.xlsx", _  
    "BT12-01-ALL-surface_salt.grd", _  
    "salt-2010.lvl", _  
    "B.Second Left Panel: Surface Temperature (column 12)", _  
    "BT12-01-ALL_surface.xlsx", _  
    "BT12-01-ALL-surface_temp.grd", _  
    "temp-2010.lvl", _  
    "C.Third Left Panel: Surface Dissolved Oxygen (column 19)", _  
    "BT12-01-ALL_surface.xlsx", _  
    "BT12-01-ALL-surface_DO.grd", _  
    "DO-2010.lvl", _  
    "D.Fourth Left Panel: Surface Chlorophyll (column 26)", _  
    "BT12-01-ALL_surface.xlsx", _  
    "BT12-01-ALL-surface_Chla.grd", _  
    "Chla-2010.lvl", _  
    "E.Upper Right Panel: Bottom Salinity (column 11)", _  
    "BT12-01-ALL_bottom.xlsx", _  
    "BT12-01-ALL-bottom_salt.grd", _  
    "salt-2010.lvl", _  
    "F.Second Right Panel: Bottom Temperature (column 12)", _  
    "BT12-01-ALL_bottom.xlsx", _  
    "BT12-01-ALL-bottom_temp.grd", _  
    "temp-2010.lvl", _  
    "G.Third Right Panel: Bottom Dissolved Oxygen (column 19)", _  
    "BT12-01-ALL_bottom.xlsx", _  
    "BT12-01-ALL-bottom_DO.grd", _  
    "DO-2010.lvl", _  
    "H.Fourth Right Panel: Bottom Chlorophyll (column 26)", _  
    "BT12-01-ALL_bottom.xlsx", _  
    "BT12-01-ALL-bottom_Chla.grd", _
```

"Chla-2010.lvl"

'KEY: These lines above are as follows:

- ' page title text
- ' folder path for CTD, blanking, and basemap data files
- ' Choptank Base map file name
- ' CTD Region blanking map file name
- ' name to assign to the Surfer export file
- ' name to assign to the .gif export file
- ' "A.Upper Left Panel_ Surface Salinity" place holder name - does not do anything
- ' data file name for surface salinity data file
- ' name to assign to the surface salinity grid file
- ' level file name for salinity
- ' "B.Second Left Panel: Surface Temperature" place holder name - does not do anything
- ' data file name for surface temperature data file
- ' name to assign to the surface temperature grid file
- ' level file name for temperature
- ' "C.Third Left Panel: Surface Dissolved Oxygen" place holder name - does not do anything
- ' data file name for surface dissolved oxygen data file
- ' name to assign to the surface dissolved oxygen grid file
- ' level file name for dissolved oxygen
- ' "D.Fourth Left Panel: Surface Chlorophyll" place holder name - does not do anything
- ' data file name for surface chlorophyll data file
- ' name to assign to the surface chlorophyll grid file
- ' level file name for chlorophyll
- ' Remaining variables are for the plots of bottom properties on the right side of the page
- ' and follow the same format as those On the Left side

End Sub

```
Sub ChopMAP (titletext As String, folderpath As String, _
    basemap As String, blankingmap As String, _
    srfexport As String, gifexport As String, _
    upperleftpanel As String, datafile1 As String, _
    saltgrid As String, _
    levelfilesurfacesalt As String, _
    secondleftpanel As String, datafile2 As String, _
    saltgrid2 As String, _
    levelfilesurfacesalt2 As String, _
    thirdleftpanel As String, datafile3 As String, _
    saltgrid3 As String, _
    levelfilesurfacesalt3 As String, _
    fourthleftpanel As String, datafile4 As String, _
    saltgrid4 As String, _
    levelfilesurfacesalt4 As String, _
    upperrightpanel As String, datafile11 As String, _
    saltgrid11 As String, _
    levelfilesurfacesalt11 As String, _
    secondrightpanel As String, datafile12 As String, _
    saltgrid12 As String, _
    levelfilesurfacesalt12 As String, _
    thirtrightpanel As String, datafile13 As String, _
    saltgrid13 As String, _
```

```

    levelfilesurfacesalt13 As String, _
    fourthrightpanel As String, datafile14 As String, _
    saltgrid14 As String, _
    levelfilesurfacesalt14 As String)

'data file path, title, level file path, iteration start, _
'iteration end, iteration step, sediment start

'Declare variable types
Dim SurferApp, Plot, Title
'Upper Left Panel
Dim baseframe, basem, postmap,postframe, _
    blankm,blankframe,contourframe, contourm, newmap,Text1 As Object
Dim Infile,InfileCSV,InfileB,Gridfile As String
'Second Left Panel
Dim baseframe2, basem2, postmap2,postframe2, _
    blankm2,blankframe2,contourframe2, contourm2, newmap2,Text2 As Object
Dim Infile2,InfileCSV2,InfileB2,Gridfile2 As String
'Third Left Panel
Dim baseframe3, basem3, postmap3,postframe3, _
    blankm3,blankframe3,contourframe3, contourm3, newmap3,Text3 As Object
Dim Infile3,InfileCSV3,InfileB3,Gridfile3 As String
'Fourth Left Panel
Dim baseframe4, basem4, postmap4,postframe4, _
    blankm4,blankframe4,contourframe4, contourm4, newmap4,Text4 As Object
Dim Infile4,InfileCSV4,InfileB4,Gridfile4 As String

'Upper Right Panel
Dim baseframe11, basem11, postmap11,postframe11, _
    blankm11,blankframe11,contourframe11, contourm11, newmap11,Text11 As Object
Dim Infile11,InfileCSV11,InfileB11,Gridfile11 As String
'Second Right Panel
Dim baseframe12, basem12, postmap12,postframe12, _
    blankm12,blankframe12,contourframe12, contourm12, newmap12,Text12 As Object
Dim Infile12,InfileCSV12,InfileB12,Gridfile12 As String
'Third Right Panel
Dim baseframe13, basem13, postmap13,postframe13, _
    blankm13,blankframe13,contourframe13, contourm13, newmap13,Text13 As Object
Dim Infile13,InfileCSV13,InfileB13,Gridfile13 As String
'Fourth Right Panel
Dim baseframe14, basem14, postmap14,postframe14, _
    blankm14,blankframe14,contourframe14, contourm14, newmap14,Text14 As Object
Dim Infile14,InfileCSV14,InfileB14,Gridfile14 As String
Dim TempC,TempDegree,DOunits,ChlaUnits As Object

'Create the Surfer Application object and assign it to the "SurferApp" variable
Set SurferApp = CreateObject("Surfer.Application") 'SurferApp = name of Surfer Application object
SurferApp.Visible = True 'Make Surfer visible

'Create a plot document in Surfer and assign it to the variable named "Plot"
Set Plot = SurferApp.Documents.Add(srfDocPlot)
'Plot = name of PlotDocument object, a Surfer plot file

```

```

'Make Title for whole page
  Set Title = Plot.Shapes.AddText(x:=1.8, y:=10.7, Text:= titletext)
  Title.Font.Size = 20
  Title.Font.Bold = True

*****
***** LEFT SIDE PANEL MAPS: SURFACE PROPERTIES *****

***A. Surface salinity (upper left panel) *****

'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name
  Infile = folderpath + basemap
  Set basem = Plot.Shapes.AddBaseMap(ImportFileName:=Infile) 'Create base map
  Set baseframe = basem.Overlays(1) 'Assigns the base map to a specific overlays collection
  baseframe.Name = "basemap" 'Names the overlay: gives it an Object ID
  'Change the line and fill attributes
  baseframe.Line.ForeColor = srfColorBlack
  baseframe.Fill.Pattern = "Solid"
  baseframe.Fill.ForeColor = srfColorBlack20

'Create Post Map of Station Locations
  InfileCSV = folderpath + datafile1
  'Create a post map. Assign the map frame to the "PostMapFrame" variable
  Set postmap =
Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV,DataFileOptions:="sheet=data",xCol:=4,yCol:=3)
  Set postframe = postmap.Overlays(1) 'Assigns the base map to a specific overlays collection
  postframe.Symbol.Set = "Default Symbols"
  postframe.Symbol.Size = 0.07
  postframe.Symbol.Index = 6

'Create Base Map to blank out regions of the contour map that are outside the bounds of the data
  InfileB = folderpath + blankingmap
  Set blankm = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB) 'Create base map
  Set blankframe = blankm.Overlays(1) 'Assigns the base map to a specific overlays collection
  blankframe.Name = "blanking map" 'Names the overlay: gives it an Object ID
  'Change the line and fill attributes
  ' blankframe.Line.ForeColor = srfColorBlack
  blankframe.Line.Style = "Invisible"
  blankframe.Fill.Pattern = "Solid"
  blankframe.Fill.ForeColor = srfColorWhite

'Create Contour Map
'1. Grid Data
  InfileCSV = folderpath + datafile1
  Gridfile = folderpath + saltgrid
  SurferApp.GridData2 Datafile:=InfileCSV, DataFileOptions:"sheet=data", Algorithm:=srfKriging, _
    DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile, _
    xMin:= -76.367, xMax:= -75.935, yMin:= 38.55, yMax:= 38.75, _
    xCol:=4, yCol:=3, zCol:=11, numCols:=12, numRows:=6
'2. Create contour map
  Set contourm = Plot.Shapes.AddContourMap(Gridfile)

```

```

Set contourframe = contourm.Overlays(1)
'3. Edit contour map properties
contourframe.Levels.LoadFile(folderpath + levelfilesurfacesalt)
contourframe.FillContours = True 'Fill the contour map levels
'4. Add colorscale
contourframe.ShowColorScale = True
contourframe.ColorScale.Height = 1.5
contourframe.ColorScale.Width = 0.3
contourframe.ColorScale.Top = 9.94
contourframe.ColorScale.Left = 3.94
contourframe.ColorScale.LabelFont.Size = 28

'Overlay contour and basemap, send contour map to back
basem.Selected = True
contourm.Selected = True
postmap.Selected = True
blankm.Selected = True
Set newmap = Plot.Selection.OverlayMaps
blankframe.SetZOrder(zorder:=srfZOToBack)
contourframe.SetZOrder(zorder:=srfZOToBack)

'Change the map limits and size, format axes
newmap.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap.yLength = 2.114
newmap.xLength = 3.250
newmap.Top = 10.3
newmap.Left = 0.24

For Each axis In newmap.Axes
    If axis.AxisType = srfATTop Then
        axis.MajorTickType = srfTickNone
    End If
    If axis.AxisType = srfATRight Then
        axis.MajorTickType = srfTickNone
    End If
Next

'Add text to graph
Set Text1 = Plot.Shapes.AddText(x:=1.6, y:=10.19, Text:="Surface salinity")
Text1.Font.Size = 16
Text1.Font.Bold = True

'Deselect newmap
newmap.Selected = False

'***B. Surface temperature (second panel on left side) *****

'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name
Infile2 = folderpath + basemap
Set basem2 = Plot.Shapes.AddBaseMap(ImportFileName:=Infile2) 'Create base map
Set baseframe2 = basem2.Overlays(1) 'Assigns the base map to a specific overlays collection
baseframe2.Name = "basemap" 'Names the overlay: gives it an Object ID

```



```

'Change the line and fill attributes
baseframe2.Line.ForeColor = srfColorBlack
baseframe2.Fill.Pattern = "Solid"
baseframe2.Fill.ForeColor = srfColorBlack20

'Create Post Map of Station Locations
InfileCSV2 = folderpath + datafile2
'Create a post map. Assign the map frame to the "PostMapFrame" variable
Set postmap2 =
Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV2,DataFileOptions:="sheet=data",xCol:=4,yCol:=3)
Set postframe2 = postmap2.Overlays(1) 'Assigns the base map to a specific overlays collection
postframe2.Symbol.Set = "Default Symbols"
postframe2.Symbol.Size = 0.07
postframe2.Symbol.Index = 6

'Create Base Map to blank out regions of the contour map that are outside the bounds of the data
InfileB2 = folderpath + blankingmap
Set blankm2 = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB2) 'Create base map
Set blankframe2 = blankm2.Overlays(1) 'Assigns the base map to a specific overlays collection
blankframe2.Name = "blanking map" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
' blankframe.Line.ForeColor = srfColorBlack
blankframe2.Line.Style = "Invisible"
blankframe2.Fill.Pattern = "Solid"
blankframe2.Fill.ForeColor = srfColorWhite

'Create Contour Map
'1. Grid Data
InfileCSV2 = folderpath + datafile2
Gridfile2 = folderpath + saltgrid2
SurferApp.GridData2 datafile:=InfileCSV2, DataFileOptions:="sheet=data", Algorithm:=srfKriging, _
DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile2, _
xMin:= -76.367, xMax:= -75.935, yMin:= 38.55, yMax:= 38.75, _
xCol:=4, yCol:=3, zCol:=12, numCols:=12, numRows:=6
'2. Create contour map
Set contourm2 = Plot.Shapes.AddContourMap(Gridfile2)
Set contourframe2 = contourm2.Overlays(1)
'3. Edit contour map properties
contourframe2.Levels.LoadFile(folderpath + levelfilesurfacesalt2)
contourframe2.FillContours = True 'Fill the contour map levels
'4. Add colorscale
contourframe2.ShowColorScale = True
contourframe2.ColorScale.Height = 1.5
contourframe2.ColorScale.Width = 0.3
contourframe2.ColorScale.Top = 7.47
contourframe2.ColorScale.Left = 3.94
contourframe2.ColorScale.LabelFont.Size = 28

'Overlay contour and basemap, send contour map to back
basem2.Selected = True
contourm2.Selected = True
postmap2.Selected = True
blankm2.Selected = True

```

```
Set newmap2 = Plot.Selection.OverlayMaps
blankframe2.SetZOrder(zorder:=srfZOToBack)
contourframe2.SetZOrder(zorder:=srfZOToBack)
```

```
'Change the map limits and size, format axes
newmap2.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap2.yLength = 2.114
newmap2.xLength = 3.250
newmap2.Top = 7.8
newmap2.Left = 0.24
```

```
For Each axis In newmap2.Axes
  If axis.AxisType = srfATTop Then
    axis.MajorTickType = srfTickNone
  End If
  If axis.AxisType = srfATRight Then
    axis.MajorTickType = srfTickNone
  End If
Next
```

```
'Add text to graph
Set Text2 = Plot.Shapes.AddText(x:=1.5, y:=7.70, Text:="Surface temperature")
Text2.Font.Size = 16
Text2.Font.Bold = True
```

```
'Deselect newmap
newmap2.Selected = False
```

C. Surface dissolved oxygen (third left panel) **

```
'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name
  Infile3 = folderpath + basemap
Set basem3 = Plot.Shapes.AddBaseMap(ImportFileName:=Infile3) 'Create base map
Set baseframe3 = basem3.Overlays(1) 'Assigns the base map to a specific overlays collection
baseframe3.Name = "basemap" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
baseframe3.Line.ForeColor = srfColorBlack
baseframe3.Fill.Pattern = "Solid"
baseframe3.Fill.ForeColor = srfColorBlack20
```

```
'Create Post Map of Station Locations
  InfileCSV3 = folderpath + datafile3
'Create a post map. Assign the map frame to the "PostMapFrame" variable
Set postmap3 =
Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV3,DataFileOptions:="sheet=data",xCol:=4,yCol:=3)
Set postframe3 = postmap3.Overlays(1) 'Assigns the base map to a specific overlays collection
postframe3.Symbol.Set = "Default Symbols"
postframe3.Symbol.Size = 0.07
postframe3.Symbol.Index = 6
```

```
'Create Base Map to blank out regions of the contour map that are outside the bounds of the data
  InfileB3 = folderpath + blankingmap
```

```

Set blankm3 = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB3) 'Create base map
Set blankframe3 = blankm3.Overlays(1) 'Assigns the base map to a specific overlays collection
blankframe3.Name = "blanking map" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
' blankframe.Line.ForeColor = srfColorBlack
blankframe3.Line.Style = "Invisible"
blankframe3.Fill.Pattern = "Solid"
blankframe3.Fill.ForeColor = srfColorWhite

'Create Contour Map
'1. Grid Data
InfileCSV3 = folderpath + datafile3
Gridfile3 = folderpath + saltgrid3
SurferApp.GridData2 datafile:=InfileCSV3, DataFileOptions:="sheet=data", Algorithm:=srfKriging, _
    DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile3, _
    xMin:= -76.367, xMax:= -75.935, yMin:= 38.55, yMax:= 38.75, _
    xCol:=4, yCol:=3, zCol:=19, numCols:=12, numRows:=6
'2. Create contour map
Set contourm3 = Plot.Shapes.AddContourMap(Gridfile3)
Set contourframe3 = contourm3.Overlays(1)
'3. Edit contour map properties
contourframe3.Levels.LoadFile(folderpath + levelfilesurfacesalt3)
contourframe3.FillContours = True 'Fill the contour map levels
'4. Add colorscale
contourframe3.ShowColorScale = True
contourframe3.ColorScale.Height = 1.5
contourframe3.ColorScale.Width = 0.3
contourframe3.ColorScale.Top = 4.97
contourframe3.ColorScale.Left = 3.94
contourframe3.ColorScale.LabelFont.Size = 28

'Overlay contour and basemap, send contour map to back
basem3.Selected = True
contourm3.Selected = True
postmap3.Selected = True
blankm3.Selected = True
Set newmap3 = Plot.Selection.OverlayMaps
blankframe3.SetZOrder(zorder:=srfZOToBack)
contourframe3.SetZOrder(zorder:=srfZOToBack)

'Change the map limits and size, format axes
newmap3.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap3.yLength = 2.114
newmap3.xLength = 3.250
newmap3.Top = 5.3
newmap3.Left = 0.24

For Each axis In newmap3.Axes
    If axis.AxisType = srfATTop Then
        axis.MajorTickType = srfTickNone
    End If
    If axis.AxisType = srfATRight Then
        axis.MajorTickType = srfTickNone

```

```

    End If
Next

'Add text to graph
Set Text3 = Plot.Shapes.AddText(x:=1.9, y:=5.2, Text:="Surface DO")
Text3.Font.Size = 16
Text3.Font.Bold = True

'Deselect newmap
newmap3.Selected = False

***D. Surface chlorophyll (fourth left panel) *****

'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name
    Infile4 = folderpath + basemap
Set basem4 = Plot.Shapes.AddBaseMap(ImportFileName:=Infile4) 'Create base map
Set baseframe4 = basem4.Overlays(1) 'Assigns the base map to a specific overlays collection
baseframe4.Name = "basemap" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
baseframe4.Line.ForeColor = srfColorBlack
baseframe4.Fill.Pattern = "Solid"
baseframe4.Fill.ForeColor = srfColorBlack20

'Create Post Map of Station Locations
    InfileCSV4 = folderpath + datafile4
'Create a post map. Assign the map frame to the "PostMapFrame" variable
Set postmap4 =
Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV4,DataFileOptions:="sheet=data",xCol:=4,yCol:=3)
Set postframe4 = postmap4.Overlays(1) 'Assigns the base map to a specific overlays collection
postframe4.Symbol.Set = "Default Symbols"
postframe4.Symbol.Size = 0.07
postframe4.Symbol.Index = 6

'Create Base Map to blank out regions of the contour map that are outside the bounds of the data
    InfileB4 = folderpath + blankingmap
Set blankm4 = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB4) 'Create base map
Set blankframe4 = blankm4.Overlays(1) 'Assigns the base map to a specific overlays collection
blankframe4.Name = "blanking map" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
' blankframe.Line.ForeColor = srfColorBlack
blankframe4.Line.Style = "Invisible"
blankframe4.Fill.Pattern = "Solid"
blankframe4.Fill.ForeColor = srfColorWhite

'Create Contour Map
'1. Grid Data
InfileCSV4= folderpath + datafile4
Gridfile4 = folderpath + saltgrid4
SurferApp.GridData2 DataFile:=InfileCSV4, DataFileOptions:="sheet=data", Algorithm:=srfKriging, _
    DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile4, _
    xmin:=-76.367, xmax:=-75.935, ymin:= 38.55, ymax:= 38.75, _
    xCol:=4, yCol:=3, zCol:=26, numCols:=12, numRows:=6

```

```

'2. Create contour map
Set contourm4 = Plot.Shapes.AddContourMap(Gridfile4)
Set contourframe4 = contourm4.Overlays(1)
'3. Edit contour map properties
contourframe4.Levels.LoadFile(folderpath + levelfilesurfacesalt4)
contourframe4.FillContours = True 'Fill the contour map levels
'4. Add colorscale
contourframe4.ShowColorScale = True
contourframe4.ColorScale.Height = 1.5
contourframe4.ColorScale.Width = 0.3
contourframe4.ColorScale.Top = 2.5
contourframe4.ColorScale.Left = 3.94
contourframe4.ColorScale.LabelFont.Size = 28

'Overlay contour and basemap, send contour map to back
basem4.Selected = True
contourm4.Selected = True
postmap4.Selected = True
blankm4.Selected = True
Set newmap4 = Plot.Selection.OverlayMaps
blankframe4.SetZOrder(zorder:=srfZOToBack)
contourframe4.SetZOrder(zorder:=srfZOToBack)

'Change the map limits and size, format axes
newmap4.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap4.yLength = 2.114
newmap4.xLength = 3.250
newmap4.Top = 2.83
newmap4.Left = 0.24

For Each axis In newmap4.Axes
  If axis.AxisType = srfATTop Then
    axis.MajorTickType = srfTickNone
  End If
  If axis.AxisType = srfATRight Then
    axis.MajorTickType = srfTickNone
  End If
Next

'Add text to graph
Set Text4 = Plot.Shapes.AddText(x:=1.5, y:=2.72, Text:="Surface chlorophyll")
Text4.Font.Size = 16
Text4.Font.Bold = True

'Deselect newmap
newmap4.Selected = False

```

```

*****

```

```

***** RIGHT SIDE PANEL MAPS: BOTTOM PROPERTIES *****

```

```

***A. Bottom salinity (upper right panel) *****

```

```

'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name
  Infile11 = folderpath + basemap
  Set basem11 = Plot.Shapes.AddBaseMap(ImportFileName:=Infile11) 'Create base map
  Set baseframe11 = basem11.Overlays(1) 'Assigns the base map to a specific overlays collection
  baseframe11.Name = "basemap" 'Names the overlay: gives it an Object ID
  'Change the line and fill attributes
  baseframe11.Line.ForeColor = srfColorBlack
  baseframe11.Fill.Pattern = "Solid"
  baseframe11.Fill.ForeColor = srfColorBlack20

'Create Post Map of Station Locations
  InfileCSV11 = folderpath + datafile11
  'Create a post map. Assign the map frame to the "PostMapFrame" variable
  Set postmap11 =
Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV11,DataFileOptions:="sheet=data",xCol:=4,yCol:=3)
  Set postframe11 = postmap11.Overlays(1) 'Assigns the base map to a specific overlays collection
  postframe11.Symbol.Set = "Default Symbols"
  postframe11.Symbol.Size = 0.07
  postframe11.Symbol.Index = 6

'Create Base Map to blank out regions of the contour map that are outside the bounds of the data
  InfileB11 = folderpath + blankingmap
  Set blankm11 = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB11) 'Create base map
  Set blankframe11 = blankm11.Overlays(1) 'Assigns the base map to a specific overlays collection
  blankframe11.Name = "blanking map" 'Names the overlay: gives it an Object ID
  'Change the line and fill attributes
  ' blankframe11.Line.ForeColor = srfColorBlack
  blankframe11.Line.Style = "Invisible"
  blankframe11.Fill.Pattern = "Solid"
  blankframe11.Fill.ForeColor = srfColorWhite

'Create Contour Map
'1. Grid Data
  InfileCSV11 = folderpath + datafile11
  Gridfile11 = folderpath + saltgrid11
  SurferApp.GridData2 DataFile:=InfileCSV11, DataFileOptions:="sheet=data", Algorithm:=srfKriging, _
    DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile11, _
    xMin:= -76.367, xMax:= -75.935, yMin:= 38.55, yMax:= 38.75, _
    xCol:=4, yCol:=3, zCol:=11, numCols:=12, numRows:=6
'2. Create contour map
  Set contourm11 = Plot.Shapes.AddContourMap(Gridfile11)
  Set contourframe11 = contourm11.Overlays(1)
'3. Edit contour map properties
  contourframe11.Levels.LoadFile(folderpath + levelfilesurfacesalt11)
  contourframe11.FillContours = True 'Fill the contour map levels
'4. Add colorscale
  'contourframe11.ShowColorScale = True
  'contourframe11.ColorScale.Height = 1.5
  'contourframe11.ColorScale.Width = 0.3
  'contourframe11.ColorScale.Top = 9.94
  'contourframe11.ColorScale.Left = 3.94
  'contourframe11.ColorScale.LabelFont.Size = 28

```

'Overlay contour and basemap, send contour map to back

```
basem11.Selected = True
contourm11.Selected = True
postmap11.Selected = True
blankm11.Selected = True
Set newmap11 = Plot.Selection.OverlayMaps
blankframe11.SetZOrder(zorder:=srfZOToBack)
contourframe11.SetZOrder(zorder:=srfZOToBack)
```

'Change the map limits and size, format axes

```
newmap11.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap11.yLength = 2.114
newmap11.xLength = 3.250
newmap11.Top = 10.3
newmap11.Left = 4.57
```

```
For Each axis In newmap11.Axes
  If axis.AxisType = srfATTop Then
    axis.MajorTickType = srfTickNone
  End If
  If axis.AxisType = srfATRight Then
    axis.MajorTickType = srfTickNone
  End If
Next
```

'Add text to graph

```
Set Text11 = Plot.Shapes.AddText(x:=5.93, y:=10.19, Text:="Bottom salinity")
Text11.Font.Size = 16
Text11.Font.Bold = True
```

'Deselect newmap

```
newmap11.Selected = False
```

B. Bottom temperature (second panel on right side) **

'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name

```
Infile12 = folderpath + basemap
Set basem12 = Plot.Shapes.AddBaseMap(ImportFileName:=Infile12) 'Create base map
Set baseframe12 = basem12.Overlays(1) 'Assigns the base map to a specific overlays collection
baseframe12.Name = "basemap" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
baseframe12.Line.ForeColor = srfColorBlack
baseframe12.Fill.Pattern = "Solid"
baseframe12.Fill.ForeColor = srfColorBlack20
```

'Create Post Map of Station Locations

```
InfileCSV12 = folderpath + datafile12
'Create a post map. Assign the map frame to the "PostMapFrame" variable
Set postmap12 =
Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV12,DataFileOptions:="sheet=data",xCol:=4,yCol:=3)
Set postframe12 = postmap12.Overlays(1) 'Assigns the base map to a specific overlays collection
```

```
postframe12.Symbol.Set = "Default Symbols"  
postframe12.Symbol.Size = 0.07  
postframe12.Symbol.Index = 6
```

```
'Create Base Map to blank out regions of the contour map that are outside the bounds of the data
```

```
    InfileB12 = folderpath + blankingmap  
    Set blankm12 = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB12) 'Create base map  
    Set blankframe12 = blankm12.Overlays(1) 'Assigns the base map to a specific overlays collection  
    blankframe12.Name = "blanking map" 'Names the overlay: gives it an Object ID  
    'Change the line and fill attributes  
    ' blankframe.Line.ForeColor = srfColorBlack  
    blankframe12.Line.Style = "Invisible"  
    blankframe12.Fill.Pattern = "Solid"  
    blankframe12.Fill.ForeColor = srfColorWhite
```

```
'Create Contour Map
```

```
'1. Grid Data
```

```
InfileCSV12 = folderpath + datafile12  
Gridfile12 = folderpath + saltgrid12  
SurferApp.GridData2 DataFile:=InfileCSV12, DataFileOptions:="sheet=data", Algorithm:=srfKriging, _  
    DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile12, _  
    xmin:=-76.367, xmax:=-75.935, ymin:=38.55, ymax:=38.75, _  
    xCol:=4, yCol:=3, zCol:=12, numCols:=12, numRows:=6
```

```
'2. Create contour map
```

```
Set contourm12 = Plot.Shapes.AddContourMap(Gridfile12)  
Set contourframe12 = contourm12.Overlays(1)
```

```
'3. Edit contour map properties
```

```
contourframe12.Levels.LoadFile(folderpath + levelfilesurfacesalt12)  
contourframe12.FillContours = True 'Fill the contour map levels
```

```
'4. Add colorscale
```

```
'contourframe12.ShowColorScale = True  
'contourframe12.ColorScale.Height = 1.5  
'contourframe12.ColorScale.Width = 0.3  
'contourframe12.ColorScale.Top = 7.47  
'contourframe12.ColorScale.Left = 3.94  
'contourframe12.ColorScale.LabelFont.Size = 28
```

```
'Overlay contour and basemap, send contour map to back
```

```
basem12.Selected = True  
contourm12.Selected = True  
postmap12.Selected = True  
blankm12.Selected = True  
Set newmap12 = Plot.Selection.OverlayMaps  
blankframe12.SetZOrder(zorder:=srfZOToBack)  
contourframe12.SetZOrder(zorder:=srfZOToBack)
```

```
'Change the map limits and size, format axes
```

```
newmap12.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)  
newmap12.yLength = 2.114  
newmap12.xLength = 3.250  
newmap12.Top = 7.8  
newmap12.Left = 4.57
```



```

For Each axis In newmap12.Axes
  If axis.AxisType = srfATTop Then
    axis.MajorTickType = srfTickNone
  End If
  If axis.AxisType = srfATRight Then
    axis.MajorTickType = srfTickNone
  End If
Next

'Add text to graph
Set Text12 = Plot.Shapes.AddText(x:=5.83, y:=7.70, Text:="Bottom temperature")
Text12.Font.Size = 16
Text12.Font.Bold = True

'Deselect newmap
newmap12.Selected = False

****C. Bottom dissolved oxygen (third right panel) ****

'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name
  Infile13 = folderpath + basemap
  Set basem13 = Plot.Shapes.AddBaseMap(ImportFileName:=Infile13) 'Create base map
  Set baseframe13 = basem13.Overlays(1) 'Assigns the base map to a specific overlays collection
  baseframe13.Name = "basemap" 'Names the overlay: gives it an Object ID
  'Change the line and fill attributes
  baseframe13.Line.ForeColor = srfColorBlack
  baseframe13.Fill.Pattern = "Solid"
  baseframe13.Fill.ForeColor = srfColorBlack20

'Create Post Map of Station Locations
  InfileCSV13 = folderpath + datafile13
  'Create a post map. Assign the map frame to the "PostMapFrame" variable
  Set postmap13 =
Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV13,DataFileOptions:="sheet=data",xCol:=4,yCol:=3)
  Set postframe13 = postmap13.Overlays(1) 'Assigns the base map to a specific overlays collection
  postframe13.Symbol.Set = "Default Symbols"
  postframe13.Symbol.Size = 0.07
  postframe13.Symbol.Index = 6

'Create Base Map to blank out regions of the contour map that are outside the bounds of the data
  InfileB13 = folderpath + blankingmap
  Set blankm13 = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB13) 'Create base map
  Set blankframe13 = blankm13.Overlays(1) 'Assigns the base map to a specific overlays collection
  blankframe13.Name = "blanking map" 'Names the overlay: gives it an Object ID
  'Change the line and fill attributes
  ' blankframe.Line.ForeColor = srfColorBlack
  blankframe13.Line.Style = "Invisible"
  blankframe13.Fill.Pattern = "Solid"
  blankframe13.Fill.ForeColor = srfColorWhite

'Create Contour Map
  '1. Grid Data

```

```

InfileCSV13 = folderpath + datafile13
Gridfile13 = folderpath + saltgrid13
SurferApp.GridData2 DataFile:=InfileCSV13, DataFileOptions:="sheet=data", Algorithm:=srfKriging, _
  DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile13, _
  xMin:= -76.367, xMax:= -75.935, yMin:= 38.55, yMax:= 38.75, _
  xCol:=4, yCol:=3, zCol:=19, numCols:=12, numRows:=6
'2. Create contour map
Set contourm13 = Plot.Shapes.AddContourMap(Gridfile13)
Set contourframe13 = contourm13.Overlays(1)
'3. Edit contour map properties
contourframe13.Levels.LoadFile(folderpath + levelfilesurfacesalt13)
contourframe13.FillContours = True 'Fill the contour map levels
'4. Add colorscale
'contourframe13.ShowColorScale = True
'contourframe13.ColorScale.Height = 1.5
'contourframe13.ColorScale.Width = 0.3
'contourframe13.ColorScale.Top = 4.97
'contourframe13.ColorScale.Left = 3.94
'contourframe13.ColorScale.LabelFont.Size = 28

'Overlay contour and basemap, send contour map to back
basem13.Selected = True
contourm13.Selected = True
postmap13.Selected = True
blankm13.Selected = True
Set newmap13 = Plot.Selection.OverlayMaps
blankframe13.SetZOrder(zorder:=srfZOToBack)
contourframe13.SetZOrder(zorder:=srfZOToBack)

'Change the map limits and size, format axes
newmap13.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap13.yLength = 2.114
newmap13.xLength = 3.250
newmap13.Top = 5.3
newmap13.Left = 4.57

For Each axis In newmap13.Axes
  If axis.AxisType = srfATTop Then
    axis.MajorTickType = srfTickNone
  End If
  If axis.AxisType = srfATRight Then
    axis.MajorTickType = srfTickNone
  End If
Next

'Add text to graph
Set Text13 = Plot.Shapes.AddText(x:=6.23, y:=5.2, Text:="Bottom DO")
Text13.Font.Size = 16
Text13.Font.Bold = True

'Deselect newmap
newmap13.Selected = False

```

D. Bottom chlorophyll (fourth right panel) **

'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name

```
Infile14 = folderpath + basemap
Set basem14 = Plot.Shapes.AddBaseMap(ImportFileName:=Infile14) 'Create base map
Set baseframe14 = basem14.Overlays(1) 'Assigns the base map to a specific overlays collection
baseframe14.Name = "basemap" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
baseframe14.Line.ForeColor = srfColorBlack
baseframe14.Fill.Pattern = "Solid"
baseframe14.Fill.ForeColor = srfColorBlack20
```

'Create Post Map of Station Locations

```
InfileCSV14 = folderpath + datafile14
'Create a post map. Assign the map frame to the "PostMapFrame" variable
Set postmap14 =
Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV14,DataFileOptions:="sheet=data",xCol:=4,yCol:=3)
Set postframe14 = postmap14.Overlays(1) 'Assigns the base map to a specific overlays collection
postframe14.Symbol.Set = "Default Symbols"
postframe14.Symbol.Size = 0.07
postframe14.Symbol.Index = 6
```

'Create Base Map to blank out regions of the contour map that are outside the bounds of the data

```
InfileB14 = folderpath + blankingmap
Set blankm14 = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB14) 'Create base map
Set blankframe14 = blankm14.Overlays(1) 'Assigns the base map to a specific overlays collection
blankframe14.Name = "blanking map" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
' blankframe.Line.ForeColor = srfColorBlack
blankframe14.Line.Style = "Invisible"
blankframe14.Fill.Pattern = "Solid"
blankframe14.Fill.ForeColor = srfColorWhite
```

'Create Contour Map

```
'1. Grid Data
InfileCSV14= folderpath + datafile14
Gridfile14 = folderpath + saltgrid14
SurferApp.GridData2 DataFile:=InfileCSV14, DataFileOptions:="sheet=data", Algorithm:=srfKriging, _
DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile14, _
xMin:= -76.367, xMax:= -75.935, yMin:= 38.55, yMax:= 38.75, _
xCol:=4, yCol:=3, zCol:=26, numCols:=12, numRows:=6
'2. Create contour map
Set contourm14 = Plot.Shapes.AddContourMap(Gridfile14)
Set contourframe14 = contourm14.Overlays(1)
'3. Edit contour map properties
contourframe14.Levels.LoadFile(folderpath + levelfilesurfacesalt14)
contourframe14.FillContours = True 'Fill the contour map levels
'4. Add colorscale
'contourframe14.ShowColorScale = True
'contourframe14.ColorScale.Height = 1.5
'contourframe14.ColorScale.Width = 0.3
'contourframe14.ColorScale.Top = 2.5
```

```

'contourframe14.ColorScale.Left = 3.94
'contourframe14.ColorScale.LabelFont.Size = 28

'Overlay contour and basemap, send contour map to back
basem14.Selected = True
contourm14.Selected = True
postmap14.Selected = True
blankm14.Selected = True
Set newmap14 = Plot.Selection.OverlayMaps
blankframe14.SetZOrder(zorder:=srfZOToBack)
contourframe14.SetZOrder(zorder:=srfZOToBack)

'Change the map limits and size, format axes
newmap14.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap14.yLength = 2.114
newmap14.xLength = 3.250
newmap14.Top = 2.83
newmap14.Left = 4.57

For Each axis In newmap14.Axes
    If axis.AxisType = srfATTop Then
        axis.MajorTickType = srfTickNone
    End If
    If axis.AxisType = srfATRight Then
        axis.MajorTickType = srfTickNone
    End If
Next

'Add text to graph
Set Text14 = Plot.Shapes.AddText(x:=5.83, y:=2.72, Text:="Bottom chlorophyll")
Text14.Font.Size = 16
Text14.Font.Bold = True

'Deselect newmap
newmap14.Selected = False

'Add units to color bars

'Temperature
Set TempC = Plot.Shapes.AddText(x:=4.3, y:=7.65, Text:="C")
TempC.Font.Size = 16
TempC.Font.Bold = False

Set TempDegree = Plot.Shapes.AddText(x:=4.2, y:=7.65, Text:="o")
TempDegree.Font.Size = 12
TempDegree.Font.Bold = False

Set DOunits = Plot.Shapes.AddText(x:=4.0, y:=5.2, Text:="mg/L")
DOunits.Font.Size = 16
DOunits.Font.Bold = False

Set ChlaUnits = Plot.Shapes.AddText(x:=4.0, y:=2.75, Text:="ug/L")
ChlaUnits.Font.Size = 16

```

```
ChlaUnits.Font.Bold = False
```

```
'TempC,TempDegree,DOunits,ChlaUnits
```

```
*****
```

```
***** SAVE SURFER PLOT, EXPORT GIF FILE *****
```

```
'Save surfer file, export .gif file
```

```
Plot.SaveAs(folderpath + srfexport)
```

```
Plot.Export(FileName:=folderpath + gifexport, Options:="Defaults=1,ColorDepth=8")
```

```
'Plot.Close 'uncomment these commands if you want Surfer to close automatically
```

```
'SurferApp.Quit
```

```
End Sub
```

Appendix D. Contour plot of TSS (Surfer/Scripter)

Sub Main

'This program creates a eight plots, each of which includes a basemap of the Choptank River,
' a blanking map to cover up the areas which are outside the bounds of the countour data,
' a contour map of a water property, and a post map of station locations.
'Created by Elizabeth North, September, 2012
'Change these values to match the plot title, the folder where all files are located, input data
' files, export file names, and level files For Each cruise. See KEY below for explanation of
' each entry. Note that export data files (.grd, .srf, .gif) will be written to the same folder which
' contains the CTD data (.xlsx), blanking (.bln), and level (.lvl) files.

```
ChopMAP "Mapping Cruise BT12-01, May 22, 2012", _  
    "C:\www\TRANSPORT\Data\2012\2012processedCTD\BT12-01", _  
    "simplified_combined_online_final.bln", _  
    "boundary_map_donut.bln", _  
    "BT12-01-TSS.srf", _  
    "BT12-01-TSS.gif", _  
    "A.Upper Left Panel_ Surface TSS (column 25)", _  
    "BT12-01-ALL_surface.xlsx", _  
    "BT12-01-ALL-surface_TSS.grd", _  
    "TSS-2010.lvl", _  
    "E.Upper Right Panel: Bottom TSS (column 25)", _  
    "BT12-01-ALL_bottom.xlsx", _  
    "BT12-01-ALL-bottom_TSS.grd", _  
    "TSS-2010.lvl"
```

'KEY: These lines above are as follows:

' page title text
' folder path for CTD, blanking, and basemap data files
' Choptank Base map file name
' CTD Region blanking map file name
' name to assign to the Surfer export file
' name tp assign to the .gif export file
' "A.Upper Left Panel_ Surface Salinity" place holder name - does not do anything
' data file name for surface salinity data file
' name to assign to the surface salinity grid file
' level file name for salinity
' Remaining variables are for the plots of bottom properties on the right side of the page
' and follow the same format as those On the Left side

End Sub

```
Sub ChopMAP (titletext As String, folderpath As String, _  
    basemap As String, blankingmap As String, _  
    srfexport As String, gifexport As String, _  
    upperleftpanel As String, datafile As String, _  
    saltgrid As String, _  
    levelfilesurfacesalt As String, _  
    upperrightpanel As String, datafile11 As String, _  
    saltgrid11 As String, _  
    levelfilesurfacesalt11 As String)
```

'data file path, title, level file path, iteration start, _

```

'iteration end, iteration step, sediment start

'Declare variable types
Dim SurferApp, Plot, Title
'Upper Left Panel
Dim baseframe, basem, postmap,postframe, _
    blankm,blankframe,contourframe, contourm, newmap,Text1 As Object
Dim Infile,InfileCSV,InfileB,Gridfile As String
'Second Left Panel
Dim baseframe2, basem2, postmap2,postframe2, _
    blankm2,blankframe2,contourframe2, contourm2, newmap2,Text2 As Object
Dim Infile2,InfileCSV2,InfileB2,Gridfile2 As String
'Third Left Panel
Dim baseframe3, basem3, postmap3,postframe3, _
    blankm3,blankframe3,contourframe3, contourm3, newmap3,Text3 As Object
Dim Infile3,InfileCSV3,InfileB3,Gridfile3 As String
'Fourth Left Panel
Dim baseframe4, basem4, postmap4,postframe4, _
    blankm4,blankframe4,contourframe4, contourm4, newmap4,Text4 As Object
Dim Infile4,InfileCSV4,InfileB4,Gridfile4 As String

'Upper Right Panel
Dim baseframe11, basem11, postmap11,postframe11, _
    blankm11,blankframe11,contourframe11, contourm11, newmap11,Text11 As Object
Dim Infile11,InfileCSV11,InfileB11,Gridfile11 As String
'Second Right Panel
Dim baseframe12, basem12, postmap12,postframe12, _
    blankm12,blankframe12,contourframe12, contourm12, newmap12,Text12 As Object
Dim Infile12,InfileCSV12,InfileB12,Gridfile12 As String
'Third Right Panel
Dim baseframe13, basem13, postmap13,postframe13, _
    blankm13,blankframe13,contourframe13, contourm13, newmap13,Text13 As Object
Dim Infile13,InfileCSV13,InfileB13,Gridfile13 As String
'Fourth Right Panel
Dim baseframe14, basem14, postmap14,postframe14, _
    blankm14,blankframe14,contourframe14, contourm14, newmap14,Text14 As Object
Dim Infile14,InfileCSV14,InfileB14,Gridfile14 As String
Dim TSSunits As Object

'Create the Surfer Application object and assign it to the "SurferApp" variable
Set SurferApp = CreateObject("Surfer.Application") 'SurferApp = name of Surfer Application object
SurferApp.Visible = True 'Make Surfer visible

'Create a plot document in Surfer and assign it to the variable named "Plot"
Set Plot = SurferApp.Documents.Add(srfDocPlot)
'Plot = name of PlotDocument object, a Surfer plot file
'Make Title for whole page
Set Title = Plot.Shapes.AddText(x:=1.8, y:=10.7, Text:= titletext)
Title.Font.Size = 20
Title.Font.Bold = True

*****
***** LEFT SIDE PANEL MAPS: SURFACE PROPERTIES *****

```

A. Surface salinity (upper left panel) **

'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name

```
Infile = folderpath + basemap
Set basem = Plot.Shapes.AddBaseMap(ImportFileName:=Infile) 'Create base map
Set baseframe = basem.Overlays(1) 'Assigns the base map to a specific overlays collection
baseframe.Name = "basemap" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
baseframe.Line.ForeColor = srfColorBlack
baseframe.Fill.Pattern = "Solid"
baseframe.Fill.ForeColor = srfColorBlack20
```

'Create Post Map of Station Locations

```
InfileCSV = folderpath + datafile
'Create a post map. Assign the map frame to the "PostMapFrame" variable
Set postmap = Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV,xCol:=4,yCol:=3)
Set postframe = postmap.Overlays(1) 'Assigns the base map to a specific overlays collection
postframe.Symbol.Set = "Default Symbols"
postframe.Symbol.Size = 0.07
postframe.Symbol.Index = 6
```

'Create Base Map to blank out regions of the contour map that are outside the bounds of the data

```
InfileB = folderpath + blankingmap
Set blankm = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB) 'Create base map
Set blankframe = blankm.Overlays(1) 'Assigns the base map to a specific overlays collection
blankframe.Name = "blanking map" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
' blankframe.Line.ForeColor = srfColorBlack
blankframe.Line.Style = "Invisible"
blankframe.Fill.Pattern = "Solid"
blankframe.Fill.ForeColor = srfColorWhite
```

'Create Contour Map

```
'1. Grid Data
InfileCSV = folderpath + datafile
Gridfile = folderpath + saltgrid
SurferApp.GridData2 datafile:=InfileCSV,dataFileOptions:="sheet=data", Algorithm:=srfKriging, _
  DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile, _
  xMin:= -76.367, xMax:= -75.935, yMin:= 38.55, yMax:= 38.75, _
  xCol:=4, yCol:=3, zCol:=25, numCols:=12, numRows:=6
'2. Create contour map
Set contourm = Plot.Shapes.AddContourMap(Gridfile)
Set contourframe = contourm.Overlays(1)
'3. Edit contour map properties
contourframe.Levels.LoadFile(folderpath + levelfilesurfacesalt)
contourframe.FillContours = True 'Fill the contour map levels
'4. Add colorscale
contourframe.ShowColorScale = True
contourframe.ColorScale.Height = 1.5
contourframe.ColorScale.Width = 0.3
contourframe.ColorScale.Top = 9.94
contourframe.ColorScale.Left = 3.94
contourframe.ColorScale.LabelFont.Size = 28
```



```

'Overlay contour and basemap, send contour map to back
basem.Selected = True
contourm.Selected = True
postmap.Selected = True
blankm.Selected = True
Set newmap = Plot.Selection.OverlayMaps
blankframe.SetZOrder(zorder:=srfZOToBack)
contourframe.SetZOrder(zorder:=srfZOToBack)

'Change the map limits and size, format axes
newmap.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap.yLength = 2.114
newmap.xLength = 3.250
newmap.Top = 10.3
newmap.Left = 0.24
For Each axis In newmap.Axes
    If axis.AxisType = srfATTop Then
        axis.MajorTickType = srfTickNone
    End If
    If axis.AxisType = srfATRight Then
        axis.MajorTickType = srfTickNone
    End If
Next

'Add text to graph
Set Text1 = Plot.Shapes.AddText(x:=1.9, y:=10.19, Text:="Surface TSS")
Text1.Font.Size = 16
Text1.Font.Bold = True
'Deselect newmap
newmap.Selected = False

*****
***** RIGHT SIDE PANEL MAPS: BOTTOM PROPERTIES *****

***A. Bottom salinity (upper right panel) *****
'Create Base Map of Choptank River, assign it to the Overlays collection, and give it a name
Infile11 = folderpath + basemap
Set basem11 = Plot.Shapes.AddBaseMap(ImportFileName:=Infile11) 'Create base map
Set baseframe11 = basem11.Overlays(1) 'Assigns the base map to a specific overlays collection
baseframe11.Name = "basemap" 'Names the overlay: gives it an Object ID
'Change the line and fill attributes
baseframe11.Line.ForeColor = srfColorBlack
baseframe11.Fill.Pattern = "Solid"
baseframe11.Fill.ForeColor = srfColorBlack20

'Create Post Map of Station Locations
InfileCSV11 = folderpath + datafile11

'Create a post map. Assign the map frame to the "PostMapFrame" variable
Set postmap11 = Plot.Shapes.AddPostMap2(DataFileName:=InfileCSV11,xCol:=4,yCol:=3)
Set postframe11 = postmap11.Overlays(1) 'Assigns the base map to a specific overlays collection
postframe11.Symbol.Set = "Default Symbols"

```

```
postframe11.Symbol.Size = 0.07
postframe11.Symbol.Index = 6
```

```
'Create Base Map to blank out regions of the contour map that are outside the bounds of the data
```

```
  InfileB11 = folderpath + blankingmap
  Set blankm11 = Plot.Shapes.AddBaseMap(ImportFileName:=InfileB11) 'Create base map
  Set blankframe11 = blankm11.Overlays(1) 'Assigns the base map to a specific overlays collection
  blankframe11.Name = "blanking map" 'Names the overlay: gives it an Object ID
  'Change the line and fill attributes
  ' blankframe.Line.ForeColor = srfColorBlack
  blankframe11.Line.Style = "Invisible"
  blankframe11.Fill.Pattern = "Solid"
  blankframe11.Fill.ForeColor = srfColorWhite
```

```
'Create Contour Map
```

```
'1. Grid Data
  InfileCSV11 = folderpath + datafile11
  Gridfile11 = folderpath + saltgrid11
  SurferApp.GridData2 datafile:=InfileCSV11, DataFileOptions:="sheet=data", Algorithm:=srfKriging, _
    DupMethod:=srfDupNone, ShowReport:=False, OutGrid:=Gridfile11, _
    xMin:=-76.367, xMax:=-75.935, yMin:= 38.55, yMax:= 38.75, _
    xCol:=4, yCol:=3, zCol:=25, numCols:=12, numRows:=6
'2. Create contour map
  Set contourm11 = Plot.Shapes.AddContourMap(Gridfile11)
  Set contourframe11 = contourm11.Overlays(1)
'3. Edit contour map properties
  contourframe11.Levels.LoadFile(folderpath + levelfilesurfacesalt11)
  contourframe11.FillContours = True 'Fill the contour map levels
'4. Add colorscale
  'contourframe11.ShowColorScale = True
  'contourframe11.ColorScale.Height = 1.5
  'contourframe11.ColorScale.Width = 0.3
  'contourframe11.ColorScale.Top = 9.94
  'contourframe11.ColorScale.Left = 3.94
  'contourframe11.ColorScale.LabelFont.Size = 28
```

```
'Overlay contour and basemap, send contour map to back
```

```
basem11.Selected = True
contourm11.Selected = True
postmap11.Selected = True
blankm11.Selected = True
Set newmap11 = Plot.Selection.OverlayMaps
blankframe11.SetZOrder(zorder:=srfZOToBack)
contourframe11.SetZOrder(zorder:=srfZOToBack)
```

```
'Change the map limits and size, format axes
```

```
newmap11.SetLimits(xMin:=-76.345, xMax:=-75.93, yMin:=38.55, yMax:=38.82)
newmap11.yLength = 2.114
newmap11.xLength = 3.250
newmap11.Top = 10.3
newmap11.Left = 4.57
For Each axis In newmap11.Axes
  If axis.AxisType = srfATTop Then
```

```

    axis.MajorTickType = srfTickNone
End If
    If axis.AxisType = srfATRight Then
        axis.MajorTickType = srfTickNone
    End If
Next

'Add text to graph
Set Text11 = Plot.Shapes.AddText(x:=6.2, y:=10.19, Text:="Bottom TSS")
Text11.Font.Size = 16
Text11.Font.Bold = True

'Deselect newmap
newmap11.Selected = False
'Add units to color bars
'Temperature
Set TSSunits = Plot.Shapes.AddText(x:=4.0, y:=10.15, Text:= "mg/L")
TSSunits.Font.Size = 16
TSSunits.Font.Bold = False
*****
***** SAVE SURFER PLOT, EXPORT GIF FILE *****
'Save surfer file, export .gif file
Plot.SaveAs(folderpath + srfexport)
Plot.Export(fileName:=folderpath + gifexport, Options:="Defaults=1,ColorDepth=8")
'Plot.Close 'uncomment these commands if you want Surfer to close automatically
'SurferApp.Quit
End Sub

```