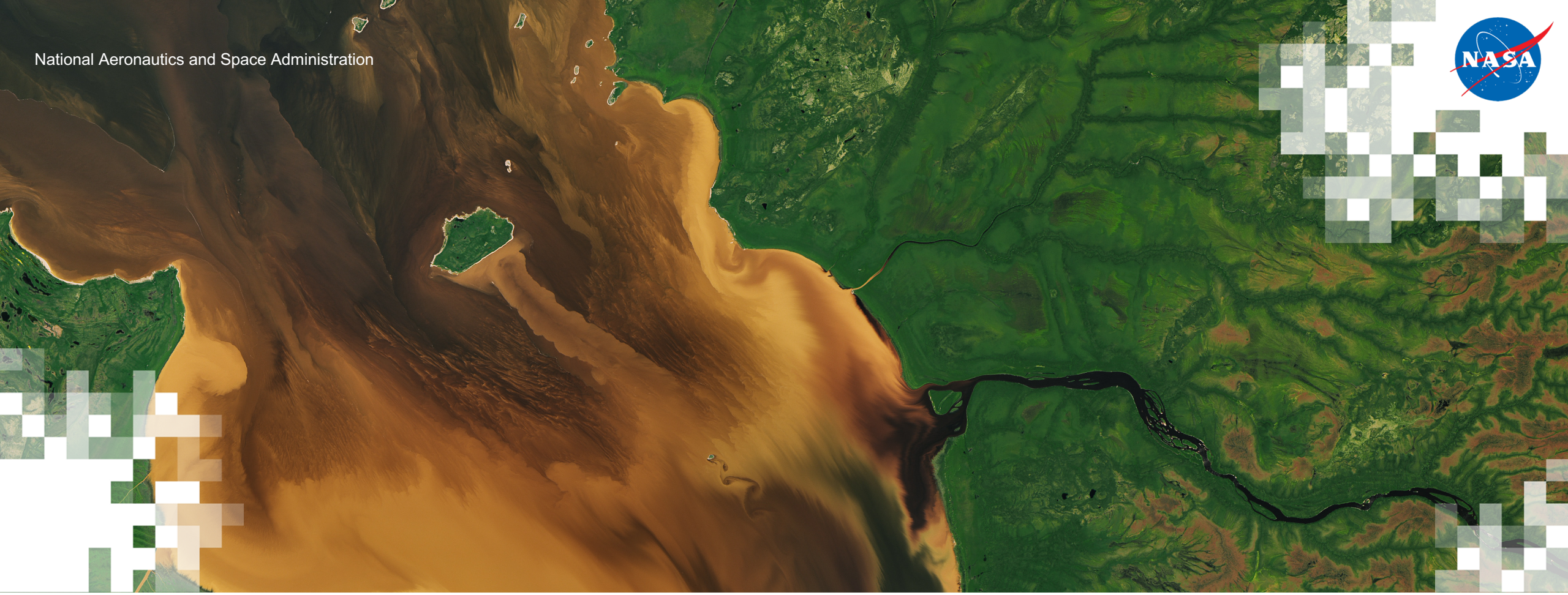
National Aeronautics and Space Administration



Generate Algorithm Coefficients from MODIS and VIIRS Reflectance Data and GCOOS Observations

Optional Exercise

- This exercise is an optional continuation of Exercise 2. This exercise is not mandatory but will help in learning the algorithm development procedure.
- An example of generating algorithm coefficients for chlorophyll-a from reflectance in MODIS blue and green wavelengths was demonstrated.
- The next exercise will follow similar steps getting coefficients from VIIRS data.

Download Multi-day VIIRS Level-2 Images

- Download the following VIIRS Level-2 files from the meeting links:

  - V2013286190600.L2_SNPP_OC.x.nc
  - V2013290190600.L2_SNPP_OC.x.nc
  - V2013291190600.L2_SNPP_OC.x.nc
  - V2013301190600.L2_SNPP_OC.x.nc

Note: These files are downloaded from NASA Ocean Color Level 1&2 Data Browser.

https://oceancolor.gsfc.nasa.gov/cgi/browse.pl?sen=amod

Download GCOOS In Situ Chlorophyll Data Files

- Download the following GCOOS files written in SeaBASS format from the meeting links:

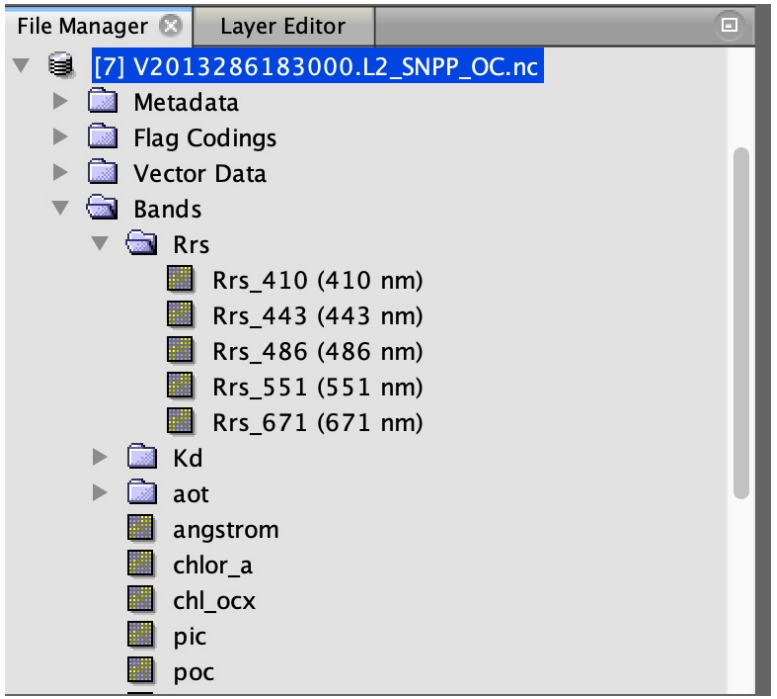
  - GCOOS_13Oct2013.sb
  - GCOOS_17Oct2013.sb
  - GCOOS_18Oct2013.sb
  - GCOOS_28Oct2013.sb

Open Multi-day VIIRS Level-2 Images in SeaDAS

31. Open SeaDAS.
32. Navigate to the directory where the VIIRS files are downloaded.

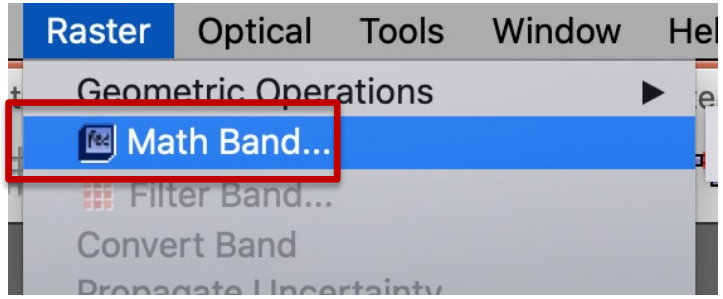
    -From SeaDAS go to **File → Open product** and select all the files to open the VIIRS images.

    -In SeaDAS **File Manager** click on the down arrow next to **V2013286183000.L2_SNPP_OC.nc → Bands → Rrs**.



Calculate Ratio of Blue and Green Wavelength Reflectance

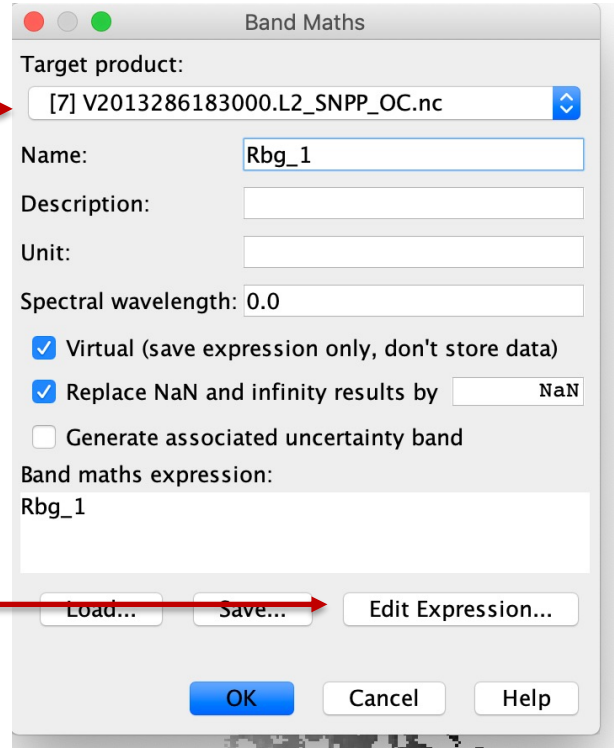
33. On the top SeaDAS ribbon **go to Raster → Math Band**



- A window will open with **V2013286183000.L2_SNPP_OC.nc as Target Product**

- Enter any **Name** for the blue0green reflectance ratio. **Rbg_1** is chosen here

- Click on **Edit Expression**



Collect Collocated VIIRS Reflectance Ration and GCOOS Chlorophyll Data

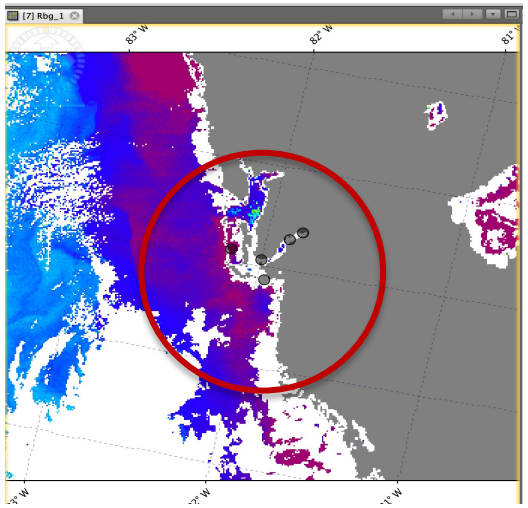
34. A map of the alog10 (Rrs_443/Rrs_551) will be displayed

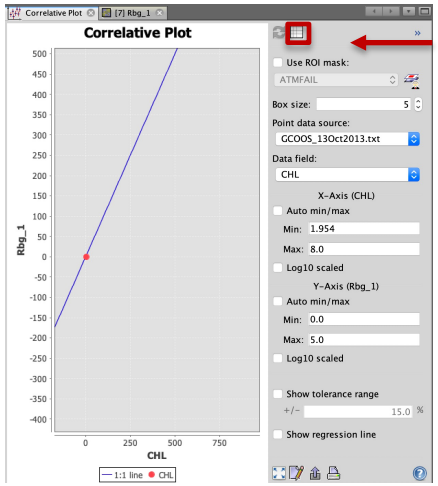
-Follow Steps 4-5 to import **GCOOS_13Oct2013.sb** (corresponding to the image date -Julian day 286) to the image.

- Follow Steps 7-10 to generate correlation plot to get values of reflectance ratio around the GCOOS in situ data.

- There is only one valid point so regression line can not be calculated

- Get tabulated values of X and Y by clicking on the Table icon

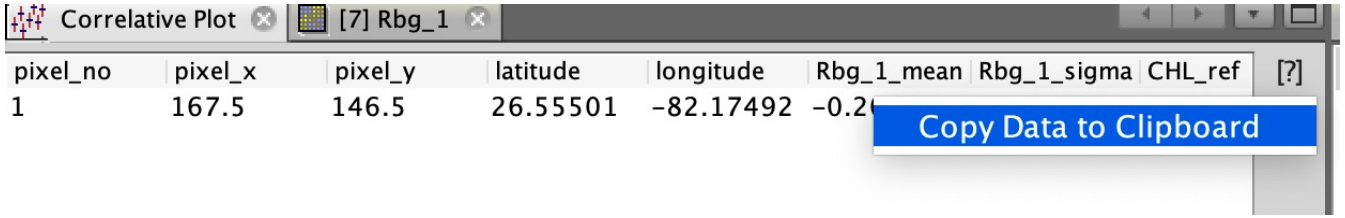




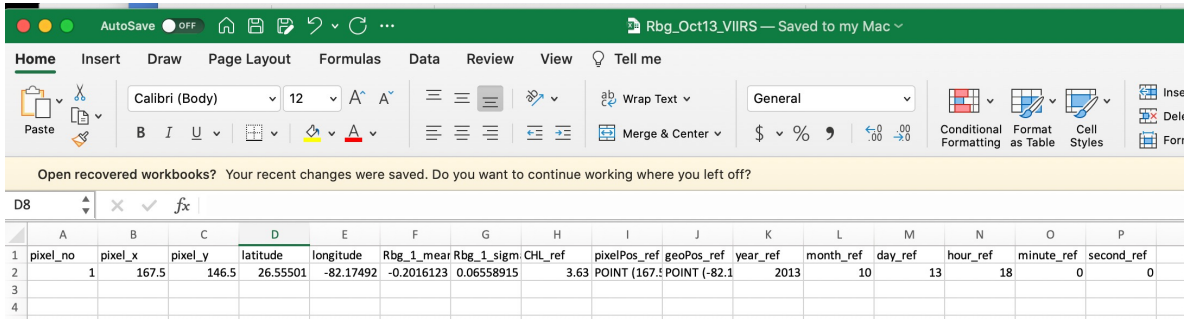
Get the Data Table

Import GCOOS Chlorophyll Data to VIIRS Reflectance Ratio Image

- Use ctrl-right click to copy the tabulated data to a clip board



- Open a new Excel spread sheet and paste the data from the clipboard



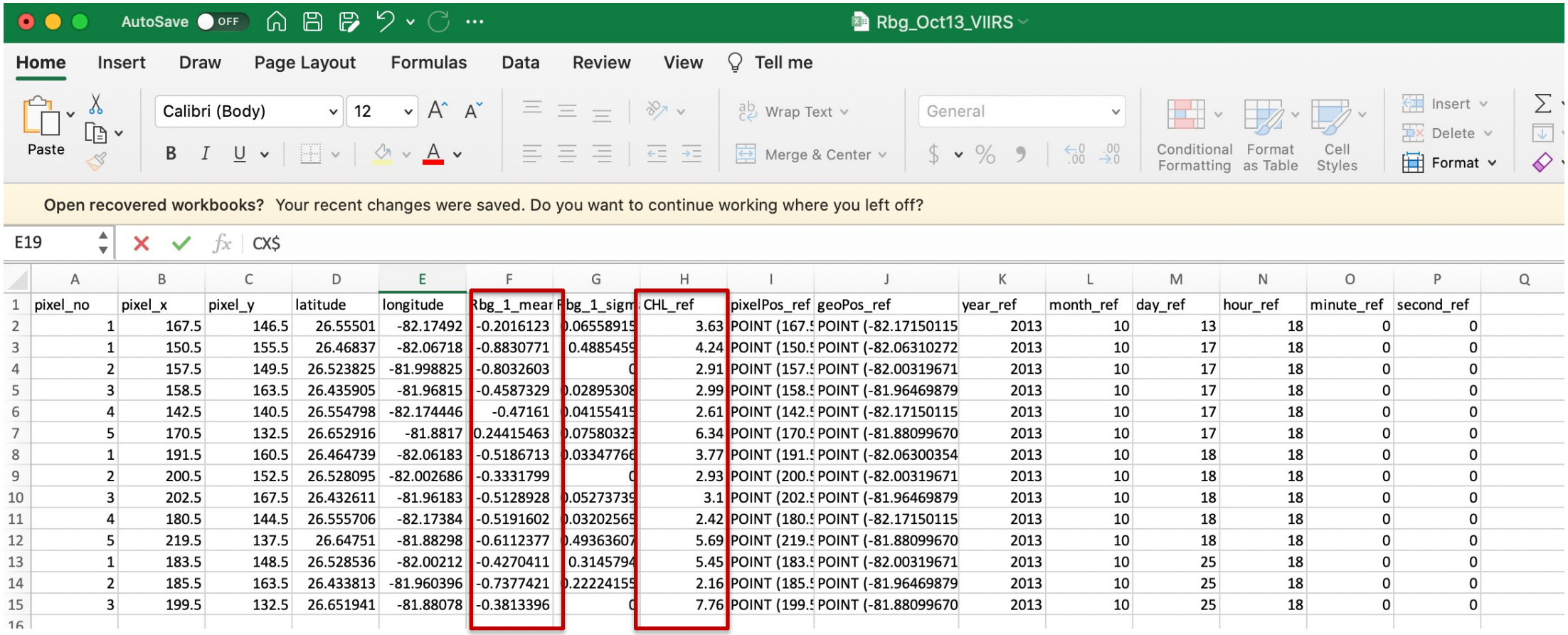
Collect multi-day Collocated VIIRS Reflectance and GCOOS Data

35. Repeat the Steps 31-35 for all the VIIRS and corresponding GCOOS files:

V2013290190600.L2_SNPP_OC.x.nc → GCOOS_17Oct2013.sb
V2013291190600.L2_SNPP_OC.x.nc → GCOOS_18Oct2013.sb
…
V2013301190600.L2_SNPP_OC.x.nc → GCOOS_28Oct2013.sb

- You will get the Excel spreadsheet with data values for these days.

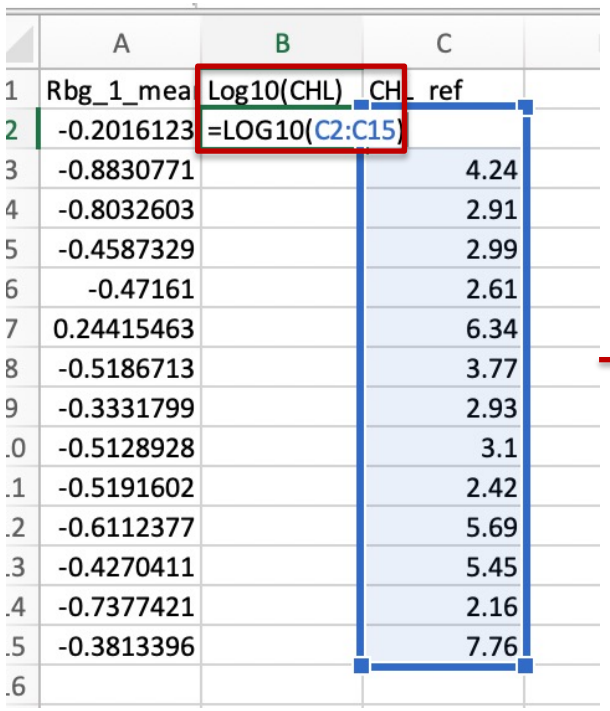
VIIRS Blue-Green Reflectance Ratio and GCOOS Chlorophyll

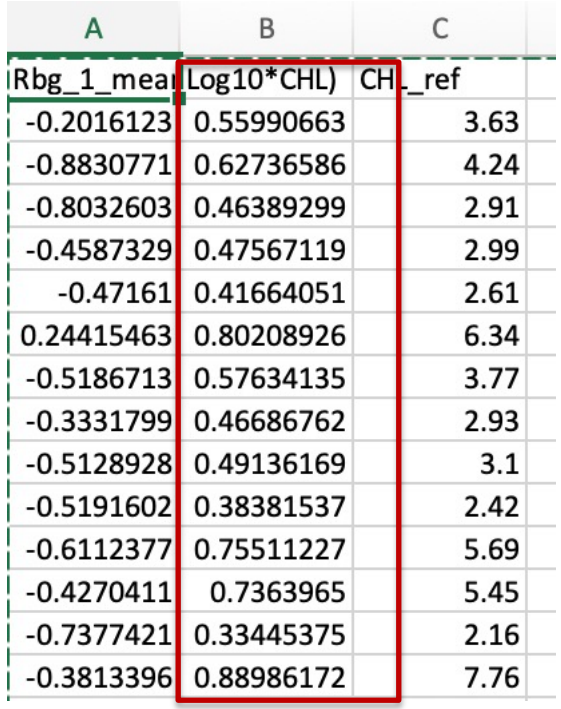


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	pixel_no	pixel_x	pixel_y	latitude	longitude	Rbg_1_mean	Rbg_1_sigm	CHL_ref	pixelPos_ref	geoPos_ref	year_ref	month_ref	day_ref	hour_ref	minute_ref	second_ref	
2	1	167.5	146.5	26.55501	-82.17492	-0.2016123	0.06558915	3.63	POINT (167.5	POINT (-82.17150115	2013	10	13	18	0	0	
3	1	150.5	155.5	26.46837	-82.06718	-0.8830771	0.4885459	4.24	POINT (150.5	POINT (-82.06310272	2013	10	17	18	0	0	
4	2	157.5	149.5	26.523825	-81.998825	-0.8032603	0	2.91	POINT (157.5	POINT (-82.00319671	2013	10	17	18	0	0	
5	3	158.5	163.5	26.435905	-81.96815	-0.4587329	0.02895308	2.99	POINT (158.5	POINT (-81.96469879	2013	10	17	18	0	0	
6	4	142.5	140.5	26.554798	-82.174446	-0.47161	0.04155415	2.61	POINT (142.5	POINT (-82.17150115	2013	10	17	18	0	0	
7	5	170.5	132.5	26.652916	-81.8817	0.24415463	0.07580323	6.34	POINT (170.5	POINT (-81.88099670	2013	10	17	18	0	0	
8	1	191.5	160.5	26.464739	-82.06183	-0.5186713	0.03347766	3.77	POINT (191.5	POINT (-82.06300354	2013	10	18	18	0	0	
9	2	200.5	152.5	26.528095	-82.002686	-0.3331799	0	2.93	POINT (200.5	POINT (-82.00319671	2013	10	18	18	0	0	
10	3	202.5	167.5	26.432611	-81.96183	-0.5128928	0.05273739	3.1	POINT (202.5	POINT (-81.96469879	2013	10	18	18	0	0	
11	4	180.5	144.5	26.555706	-82.17384	-0.5191602	0.03202565	2.42	POINT (180.5	POINT (-82.17150115	2013	10	18	18	0	0	
12	5	219.5	137.5	26.64751	-81.88298	-0.6112377	0.49363607	5.69	POINT (219.5	POINT (-81.88099670	2013	10	18	18	0	0	
13	1	183.5	148.5	26.528536	-82.00212	-0.4270411	0.3145794	5.45	POINT (183.5	POINT (-82.00319671	2013	10	25	18	0	0	
14	2	185.5	163.5	26.433813	-81.960396	-0.7377421	0.22224155	2.16	POINT (185.5	POINT (-81.96469879	2013	10	25	18	0	0	
15	3	199.5	132.5	26.651941	-81.88078	-0.3813396	0	7.76	POINT (199.5	POINT (-81.88099670	2013	10	25	18	0	0	
16																	

Develop Algorithm Coefficient to Derived Chlorophyll from GCOOS Chlorophyll and and VIRRS Reflectance Ratio

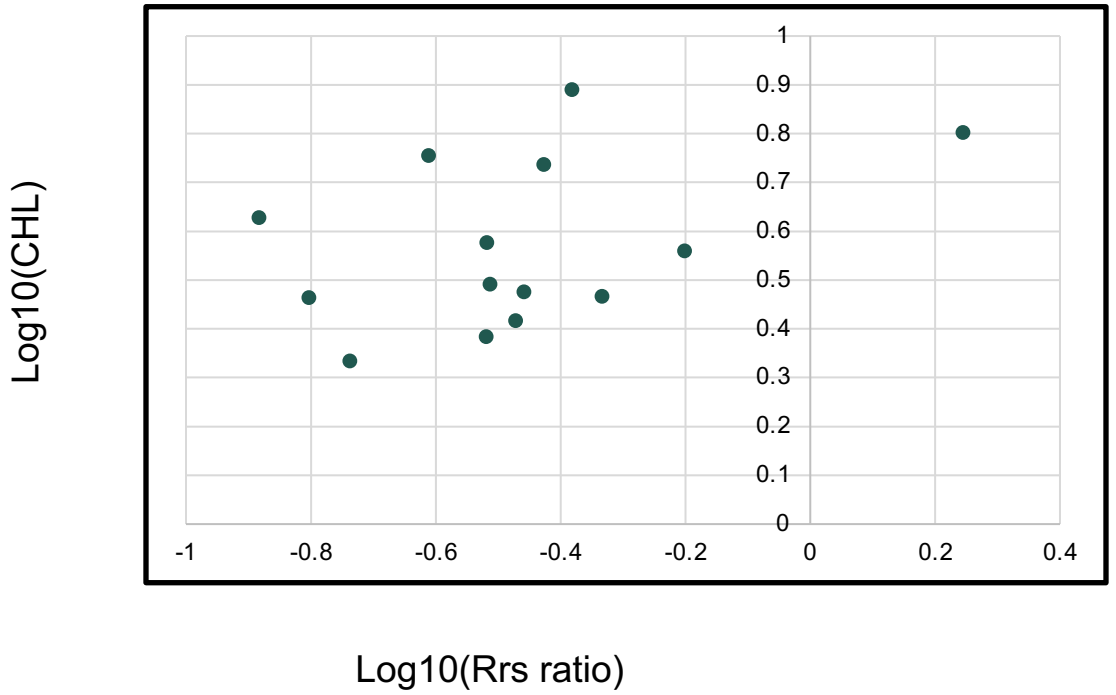
36. Use Excel to generate Algorithm Coefficients
    - The reflectance ratio are $Log10(Rrs_{443}/Rrs_{551})$
    - Make a column with Log10(CHL)

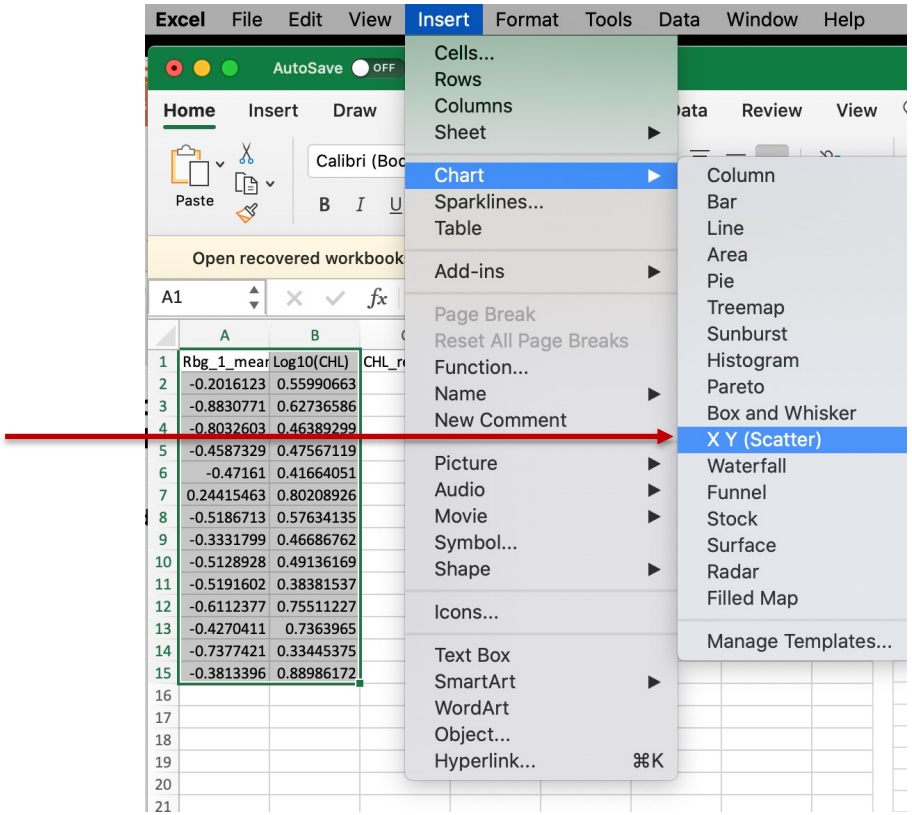




Develop Algorithm Coefficient to Derived Chlorophyll from GCOOS Chlorophyll and and VIRRS Reflectance Ratio

37. Make a scatter plot of Log10(Rrs_{443}/Rrs_{551}) as X axis and Log10(CHL)as Y axis.



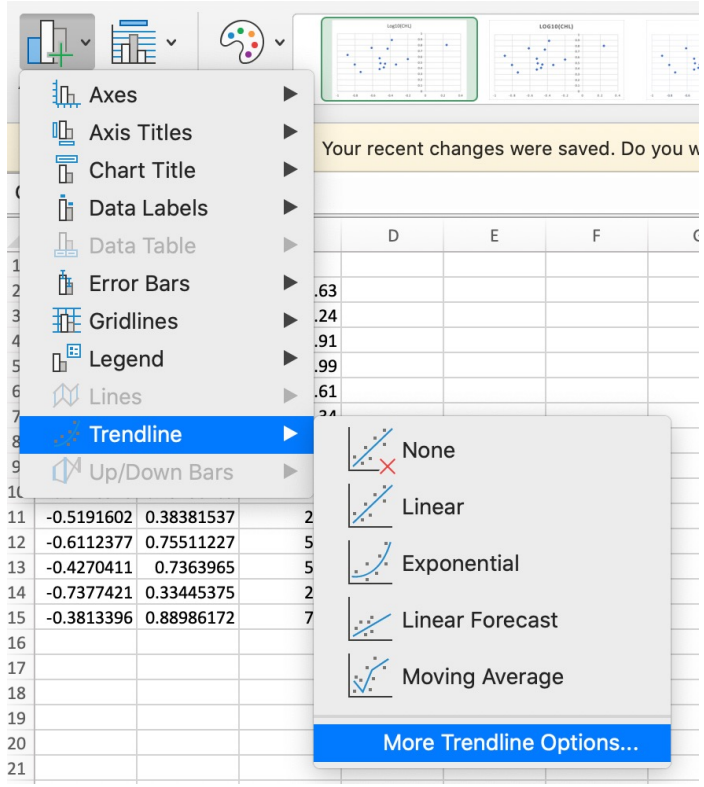


Develop Algorithm Coefficient to Derived Chlorophyll from GCOOS Chlorophyll and and VIRRS Reflectance Ratio

38. Fit a curve to the scatter plot to find the algorithm coefficients

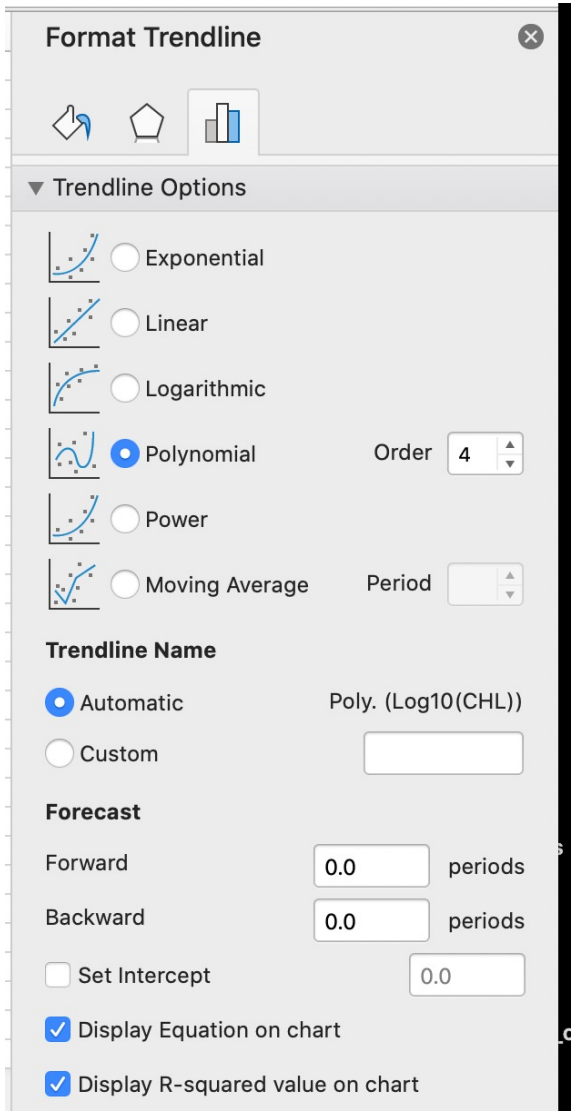
    - Click on the scatter plot

    - On Excel top bar click on **Chart Design → Add Chart Element → → Trendline → More Trendline Options**



Develop Algorithm Coefficient to Derived Chlorophyll from GCOOS Chlorophyll and and VIRRS Reflectance Ratio

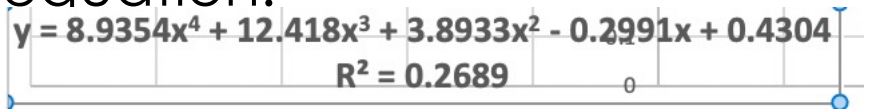
39. The Format Trendline window will open
    - Select **Polynomial** and **Order 4***
    - Select **Display Equation on Chart**
    - Select **Display R-squared value on Chart**



* NASA Ocean Color algorithm uses a 4th order polynomial for chlorophyll values > 0.2 mg/m^3 https://oceancolor.gsfc.nasa.gov/atbd/chlor_a/

Develop Algorithm Coefficient to Derived Chlorophyll from GCOOS Chlorophyll and and VIRRS Reflectance Ratio

- The results will be displayed n the scatter plot
- Note the coefficients a_0 to a_4 from the equation:



$$Log10(CHL)=a0+\sum=a_i(Log10(Rrs(\lambda blue)Rrs(\lambda green)))^{I)}$$

Where i = 4

Chlorophyl can be derived as:

$$exp(a0+\sum=a_i(Log10(Rrs(\lambda blue)Rrs(\lambda green)))^{I)}$$