



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



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_280ct2013.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 \rightarrow 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 \rightarrow Bands \rightarrow Rrs.

V2013286183000.L2_SNPP_OC.x.nc
 V2013290185400.L2_SNPP_OC.x.nc
 V2013291183600.L2_SNPP_OC.x.nc
 V2013299174200.L2_SNPP_OC.x.nc
 V2013299192400.L2_SNPP_OC.x.nc
 V2013301184800.L2_SNPP_OC.x.nc

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[7] V2013286183000.L2_SNPP_OC.nc	
🕨 🛅 Metadata	
🕨 🛄 Flag Codings	
🕨 🛅 Vector Data	
🔻 🔄 Bands	
🔻 🔄 Rrs	
Rrs_410 (410 nm)	
Rrs_443 (443 nm)	
Rrs_486 (486 nm)	
Rrs_551 (551 nm)	
Rrs_671 (671 nm)	
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Calculate Ratio of Blue and Green Wavelength Reflectance

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33. On the top SeaDAS ribbon ao to	Geometric Operations
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- A window will open with	Convert Band
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blue0green reflectance ratio. ———	Description:
Rbg 1 is chosen here	Spectral wavelength: 0.0
	Virtual (save expression only, don't store data)
- Click on Edit Expression	✓ Replace NaN and infinity results by NaN
	Generate associated uncertainty band Band maths expression:
	Rbg_1
	Load Save Edit Expression
	OK Cancel Help



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

🕂 Correla	ativePlot 🙁	[7] Rbg_1	8		
pixel_no	pixel_x	pixel_y	latitude	longitude	Rbg_1_mean Rbg_1_sigma CHL_ref [?]
1	167.5	146.5	26.55501	-82.17492	-0.2 Copy Data to Clipboard

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

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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 \rightarrow GCOOS_17Oct2013.sb V2013291190600.L2_SNPP_OC.x.nc \rightarrow GCOOS_18Oct2013.sb

V2013301190600.L2_SNPP_OC.x.nc \rightarrow GCOOS_28Oct2013.sb

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



VIIRS Blue-Green Reflectance Ratio and GCOOS Chlorophyll

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1	pixel_no	pixel_x	pixel_y	latitude	longitude	Rbg_1_mear	bg_1_sigm	CHL_ref	pixelPos_ref	geoPos_r	ef	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 (-8	32.17150115	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 (-8	32.06310272	2013	10	17	18	0	0	
4	2	157.5	149.5	26.523825	-81.998825	-0.8032603	c	2.91	POINT (157.5	POINT (-8	32.00319671	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 (-8	31.96469879	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 (-8	32.17150115	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 (-8	31.88099670	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 (-8	32.06300354	2013	10	18	18	. 0	0	
9	2	200.5	152.5	26.528095	-82.002686	-0.3331799	c	2.93	POINT (200.5	POINT (-8	32.00319671	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 (-8	31.96469879	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 (-8	32.17150115	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 (-8	31.88099670	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 (-8	32.00319671	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 (-8	31.96469879	2013	10	25	18	0	0	
15	3	199.5	132.5	26.651941	-81.88078	-0.3813396	c	7.76	POINT (199.5	POINT (-8	31.88099670	2013	10	25	18	0	0	
16																		



- 36. Use Excel to generate Algorithm Coefficients
 - The reflectance ratio are Log10(Rrs₄₄₃/Rrs₅₅₁)
 - Make a column with Log10(CHL)

	А	В	С	R
1	Rbg_1_mea	Log10(CHL)	CH_ ref	
2	-0.2016123	=LOG10(C2:0	C15)	
3	-0.8830771		4.24	
4	-0.8032603		2.91	
5	-0.4587329		2.99	
6	-0.47161		2.61	(
7	0.24415463		6.34	
8	-0.5186713		3.77	
9	-0.3331799		2.93	
.0	-0.5128928		3.1	
.1	-0.5191602		2.42	
.2	-0.6112377		5.69	
.3	-0.4270411		5.45	_
.4	-0.7377421		2.16	-
.5	-0.3813396		7.76	
.6				

А	В		С	
Rbg_1_mea	Log10*CHL)	CH	ref	
-0.2016123	0.55990663		3.63	
-0.8830771	0.62736586		4.24	
-0.8032603	0.46389299		2.91	
-0.4587329	0.47567119		2.99	
-0.47161	0.41664051		2.61	
0.24415463	0.80208926		6.34	
-0.5186713	0.57634135		3.77	
-0.3331799	0.46686762		2.93	
-0.5128928	0.49136169		3.1	
-0.5191602	0.38381537		2.42	
-0.6112377	0.75511227		5.69	
-0.4270411	0.7363965		5.45	
-0.7377421	0.33445375		2.16	
-0.3813396	0.88986172		7.76	
		_		



37. Make a scatter plot of Log10(Rrs₄₄₃/Rrs₅₅₁) as X axis and Log10(CHL)as Y axis.



Log10(Rrs ratio)

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6	-0 47161	0.41664051		Pictu	re			Waterfall			
7	0.24415463	0.80208926		Audio)		•	Funnel			
8	-0.5186713	0.57634135		Movi	е		•	Stock			
9	-0.3331799	0.46686762		Symb	ol			Surface			
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-og10(CHL)

- 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





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/m³ https://oceancolor.gsfc.nasa.gov/atbd/chlor_a/



- The results will be displayed n the scatter plot
- Note the coefficients a_0 to a_4 from the equation: y = 8.9354x⁴ + 12.418x³ + 3.8933x² - 0.2991x + 0.4304 R² = 0.2689
- Log10(CHL)=a0+ \sum =a_i(Log10(Rrs(λ blue)Rrs(λ green)))^{I)} Where i = 4

Chlorophyl can be derived as: exp(a0+ Σ =a_i(Log10(Rrs(λ blue)Rrs(λ green)))^{I)}



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