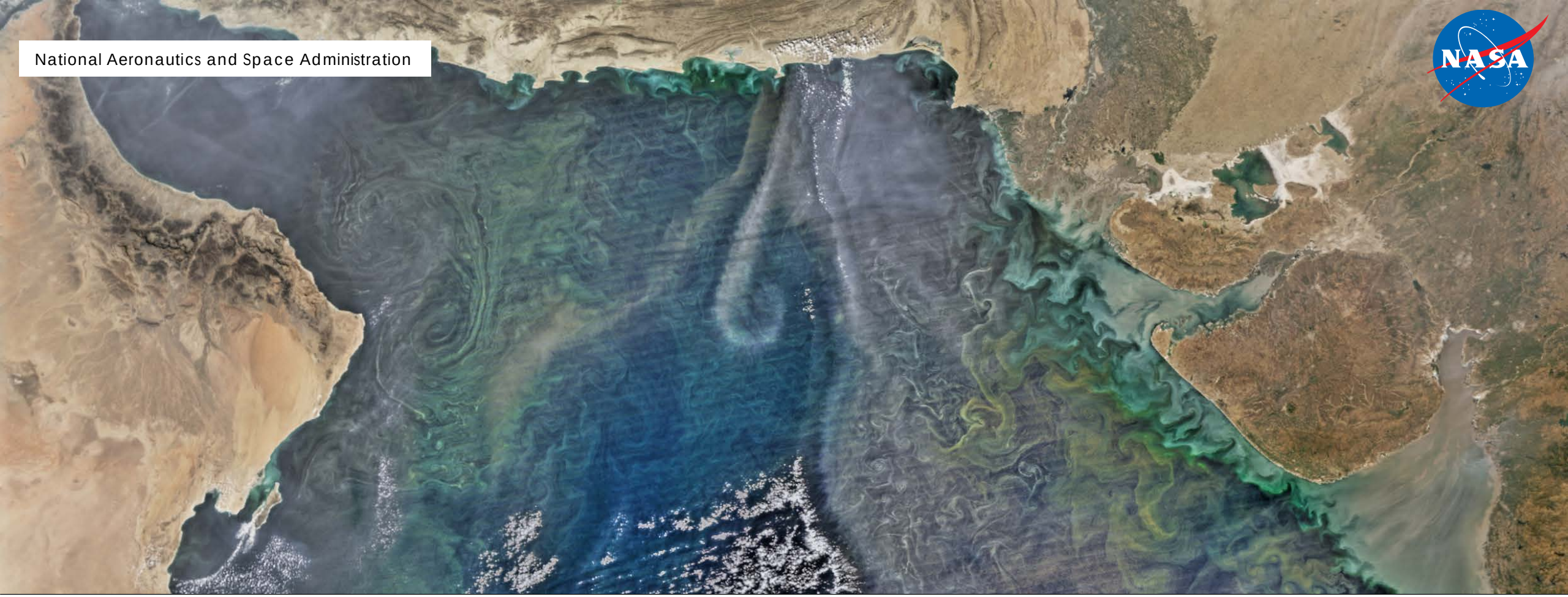

Exercise 2: Analyze MODIS Level-2 Chlorophyll Concentration and Images

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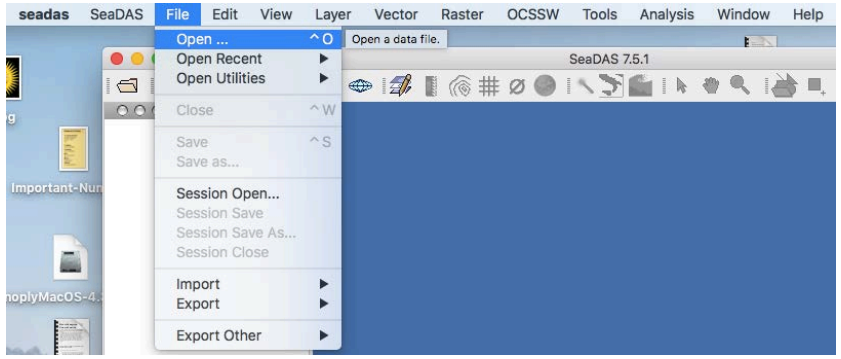
12 September 2018

Objective

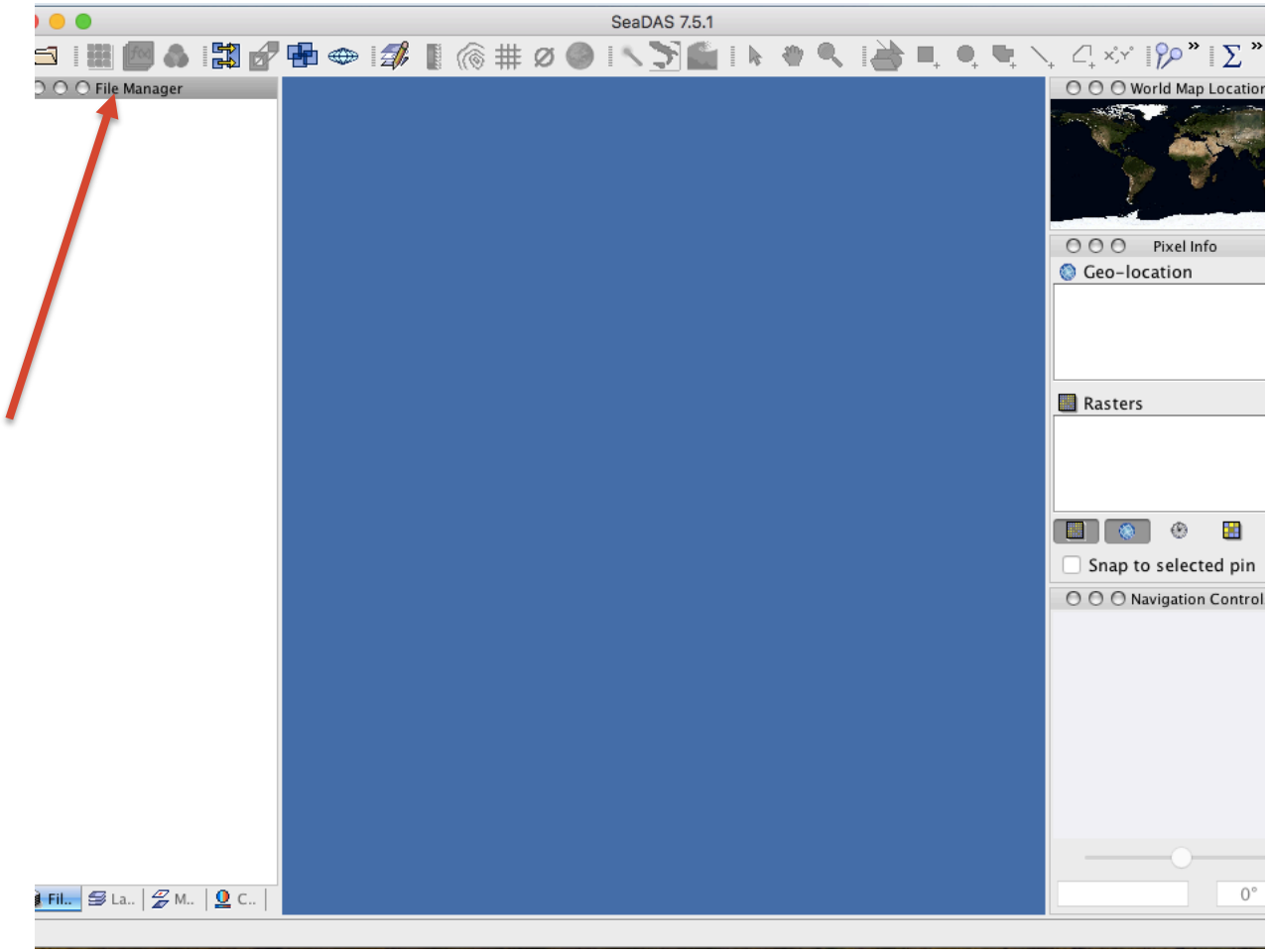
- Learn to use SeaDAS to analyze MODIS Level-2 Ocean Color data and images

Open MODIS Level-2 Files in SeaDAS

1. Open SeaDAS GUI on your computer
2. Locate the MODIS Chlorophyll data file that was saved from the Ocean Color Web in Exercise 1 for Lake Victoria (A2018024112500.L2_LAC_OC.nc)
3. Explore the options on by moving the computer cursor on each option
4. On the top bar click on **File > Open**

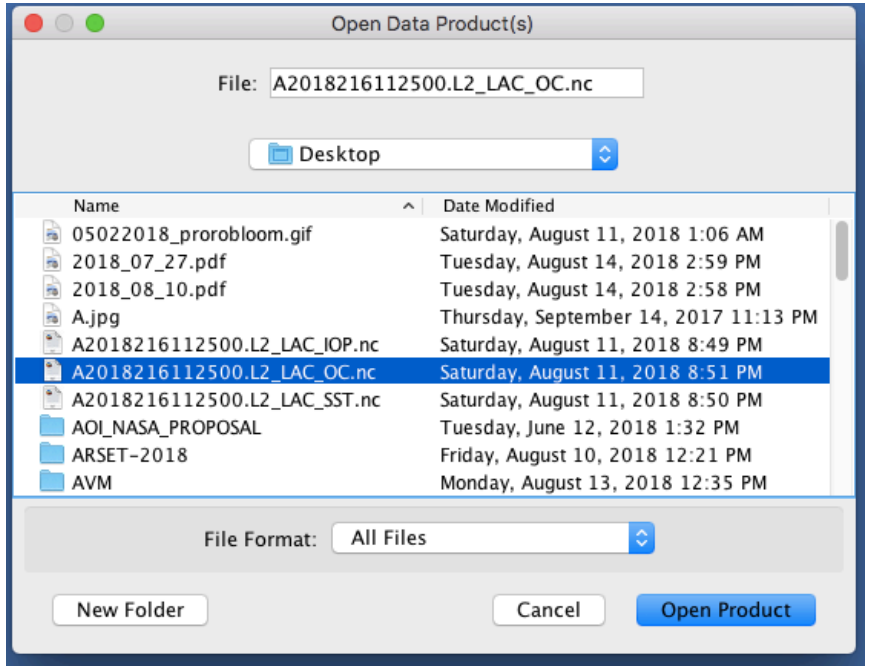


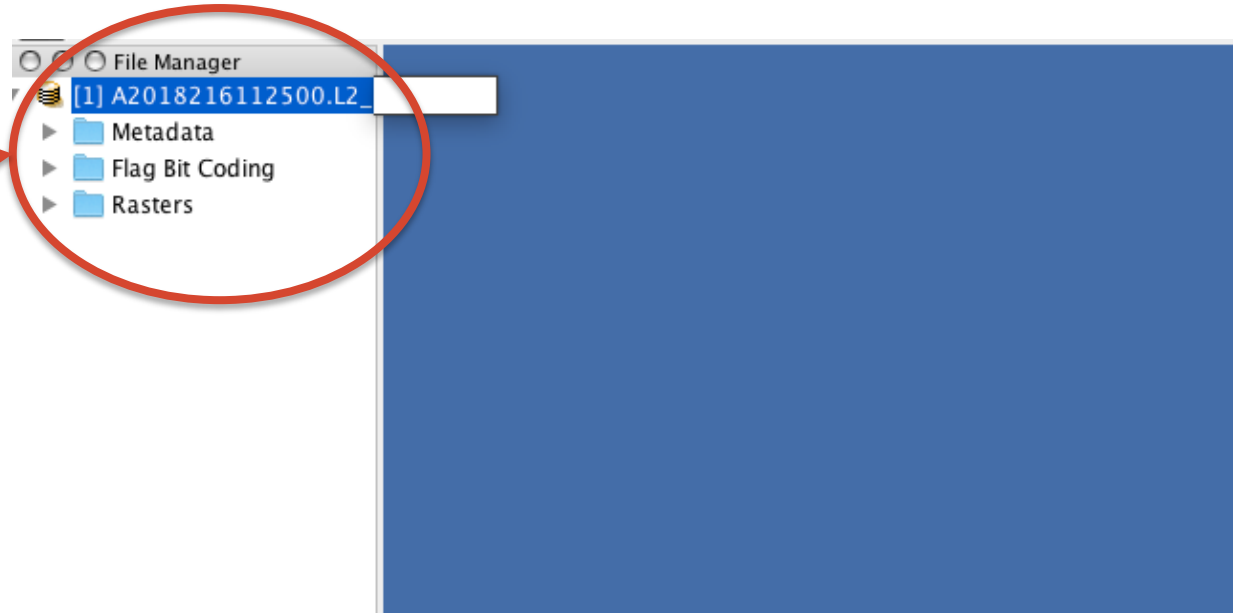
Blank SeaDAS GUI when opened



Open MODIS Level-2 Files in SeaDAS

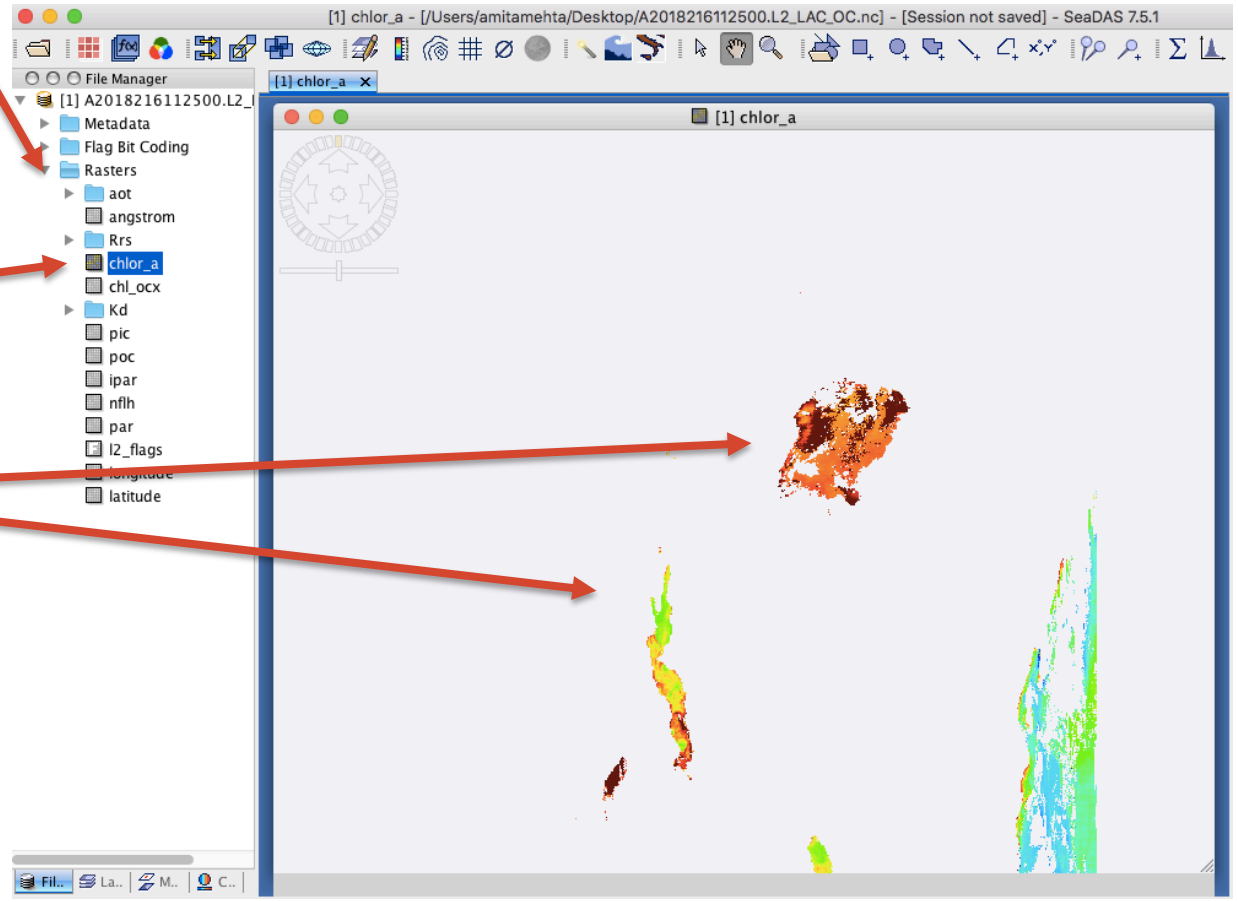
5. Navigate to the MODIS OC file on your computer
6. Click on the filename – you will see the file and data information in the File Manager window on the left





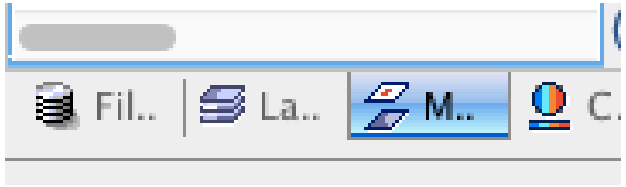
Open MODIS Level-2 Files in SeaDAS

7. Click on **Rasters** to see the available Level-2 data
8. Point your computer cursor on each parameter to read a brief description
9. Click on **Chlor_a** in the list
10. You will get the Chlorophyll image in the SeaDAS main window



Add Masks and a Color Table

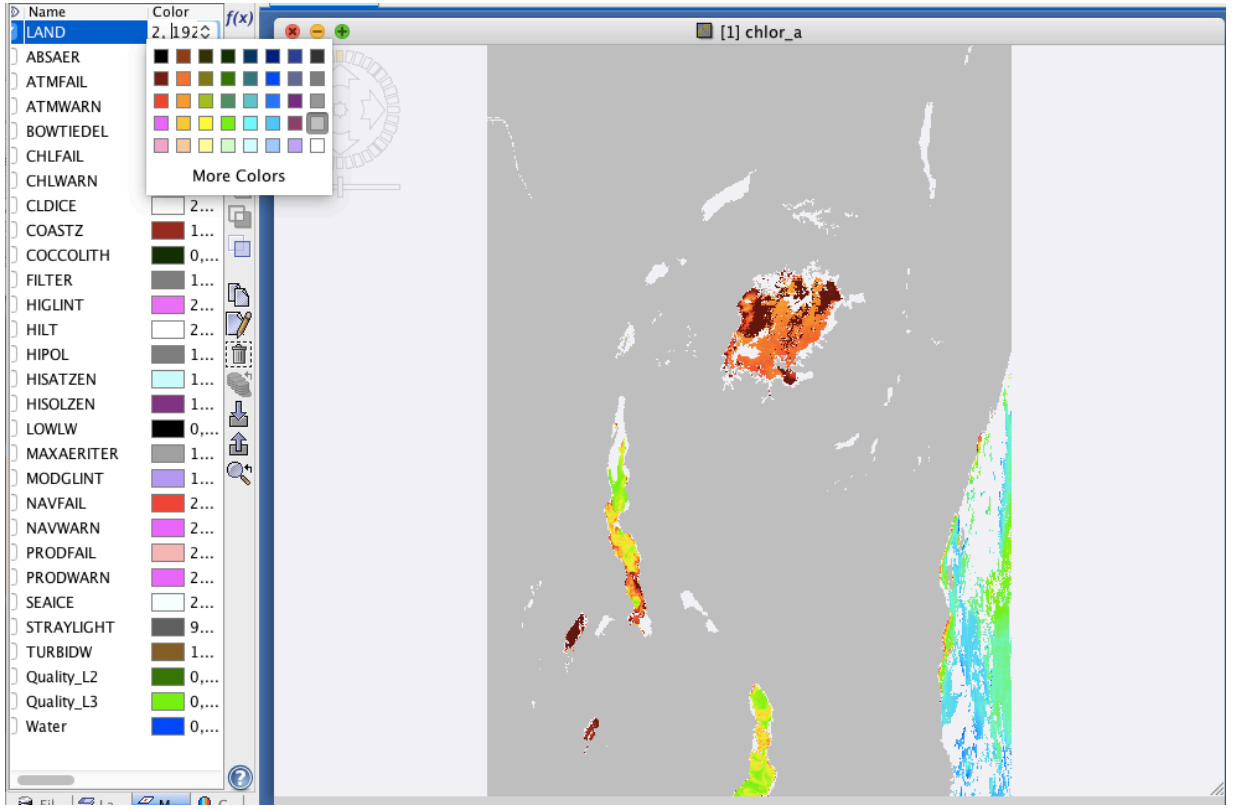
11. On the bottom of the left-hand window, click on the **Manage binary data masks and ROI**



12. You will see the masks option in the left window

Add Masks

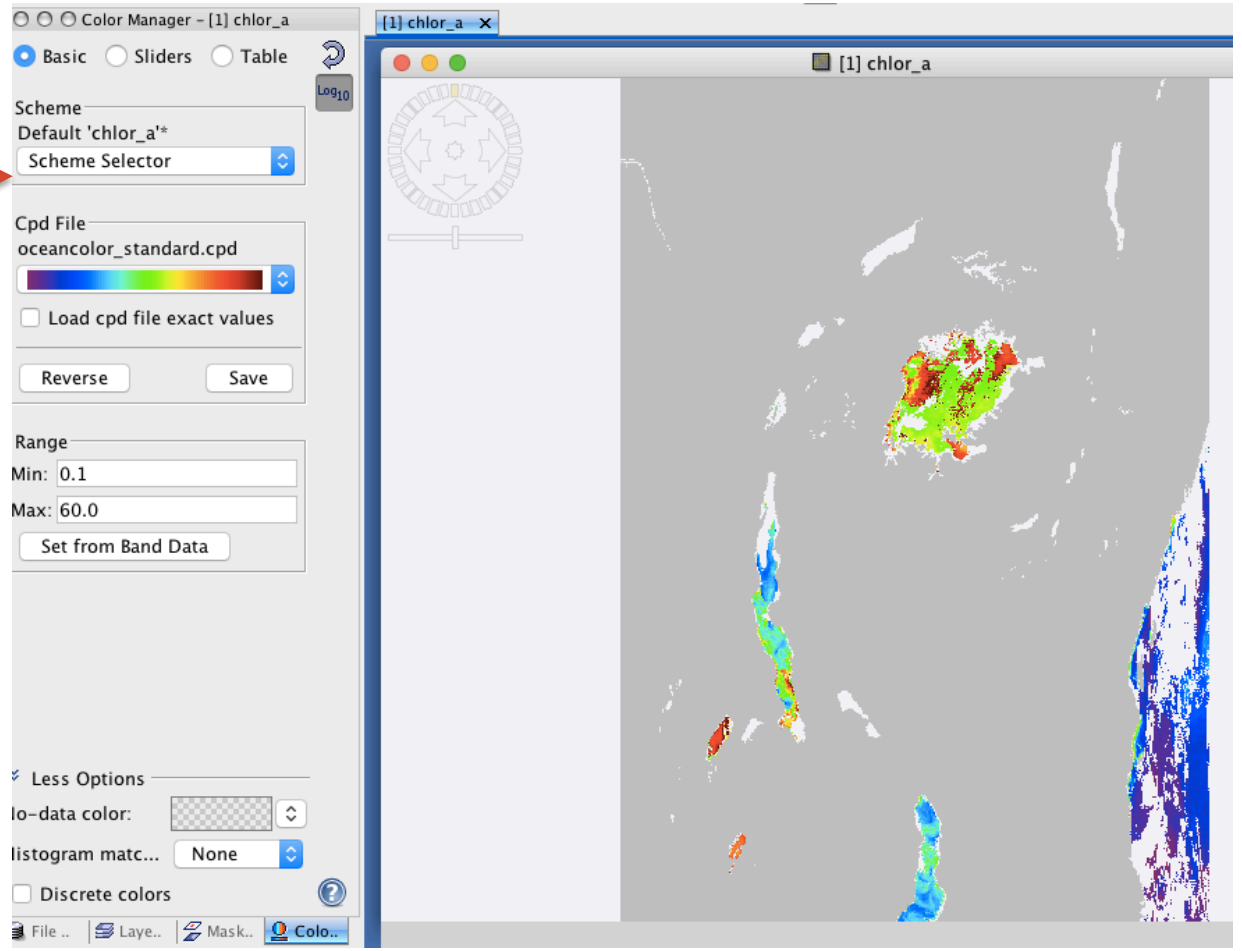
13. Select the land mask by clicking the **LAND** box
    - The land mask will be added to the chlor_a image with the default color
    - You can click on the color box and pick other colors from the drop-down menu
14. Next, select the **CLDICE** mask and change the color to see the locations where data are missing because of clouds



Change the Color Table

15. Select the **color palette of band image**
    - You will see the color options

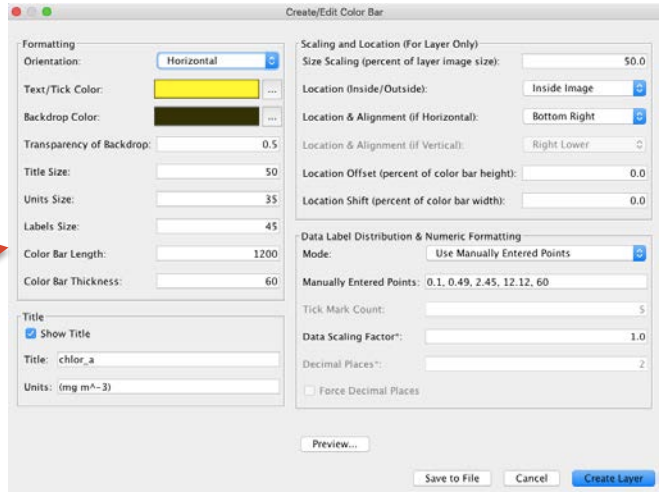
16. Under **Range**, change the min value to 0.1 and the max value to 60
    - You will see the chlor_a image changing colors
17. You can select another color palette from the drop-down menu under **Cpd File > Oceancolor_Standard.cpd**



Add a Color Bar

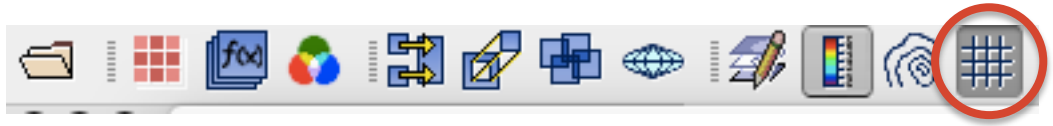
18. From the top menu, select **View and/or Export the color bar**

19. You will get a **Create/Edit Color Bar** window
    - keep the default options for now – you can explore the options at your convenience



20. Click on the **Create Layer** option on the bottom right of the window

21. Click on **Show/Hide map gridlines layer**



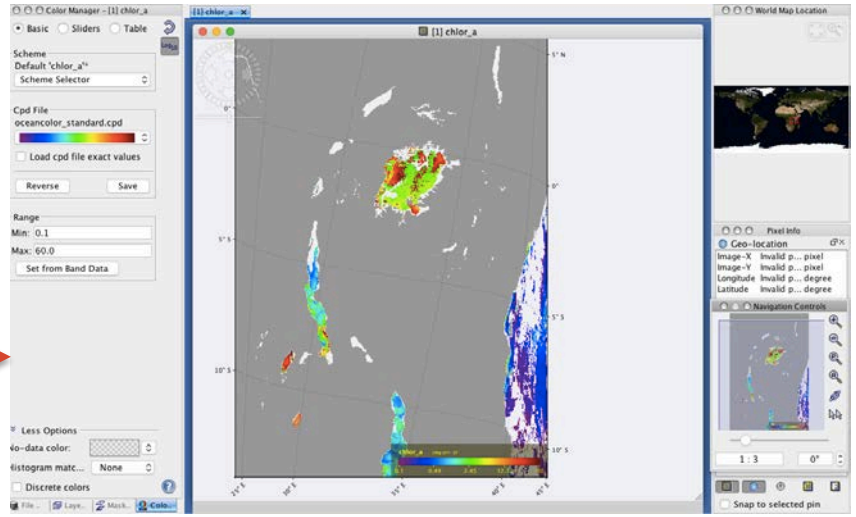
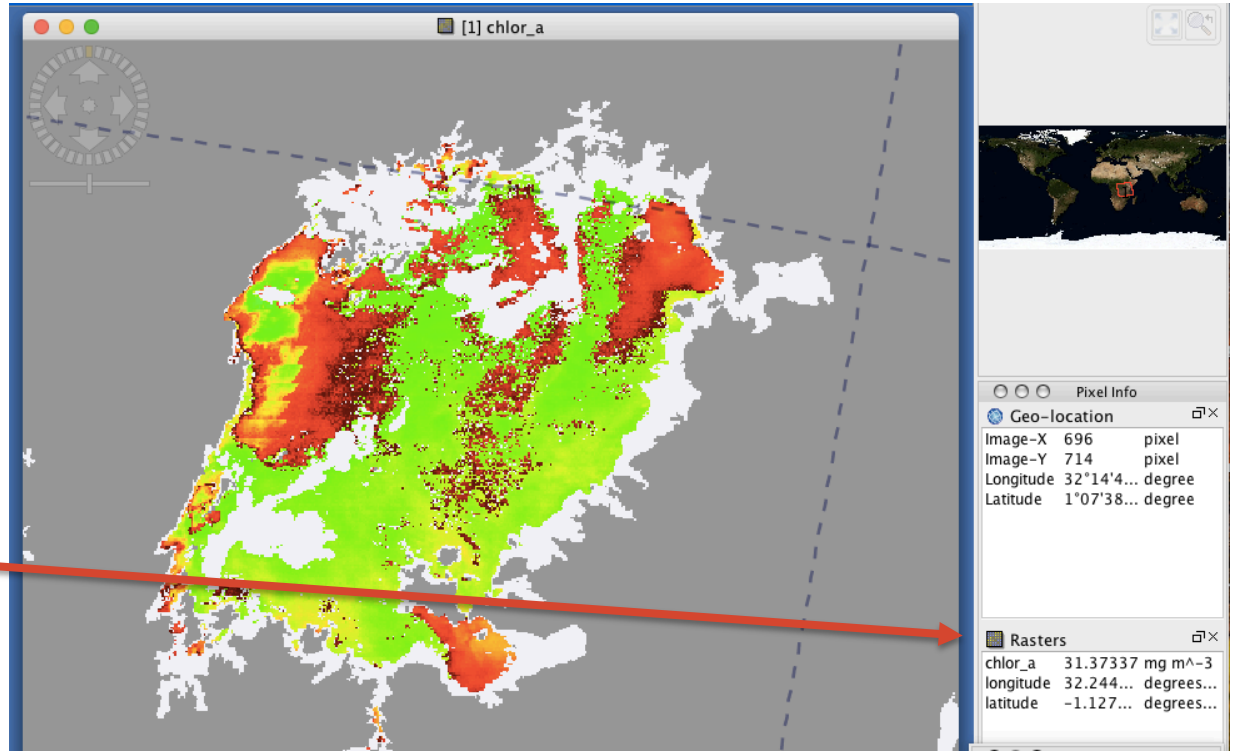


Image with the color bar and grid lines

Zoom in and Examine Chlor_a Values

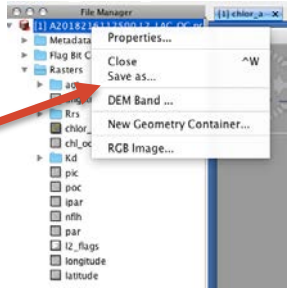
22. Zoom in on Lake Victoria by using the **Navigation Controls** window on the right
    - Or use the top menu to zoom and pan the image

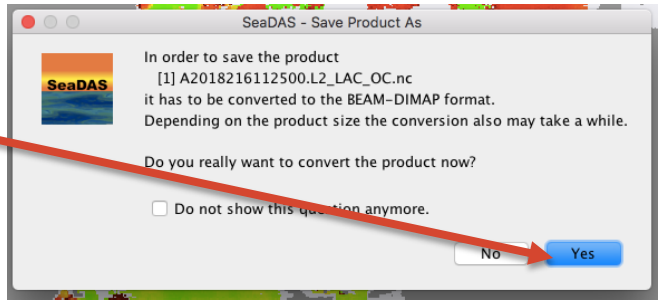
23. Move the cursor onto the image and examine the **Rasters** window on the right to see longitude, latitude, and corresponding chlorophyll values

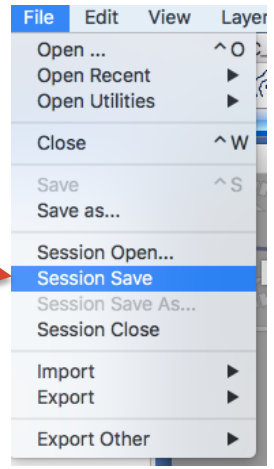


Save the File and the Session

24. To save the session, first the data file has to be saved in a BEAM-DIMAP format
25. Right click on the file name in the **File Manager Window** and click **Save As**
26. You will be asked to convert the file into the dimap format
27. Click **Yes** and save the file on your computer
28. Go to **File > Session Save** and follow the steps to enter a name for the session, ending in .seadas, and click **Save**
29. You can open this session later by using **File > Session Open**

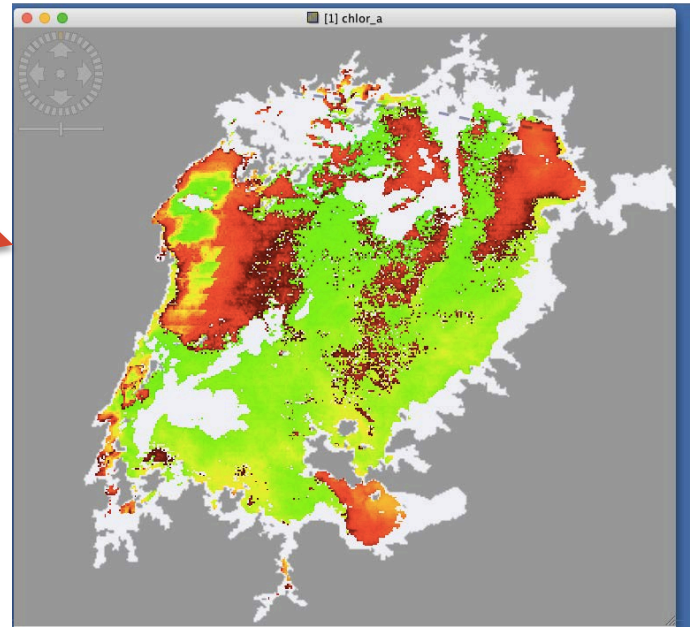


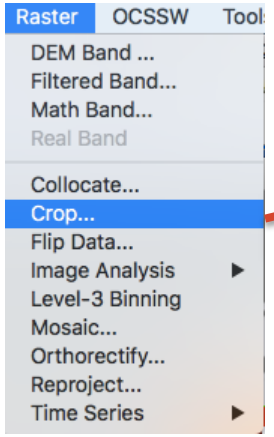


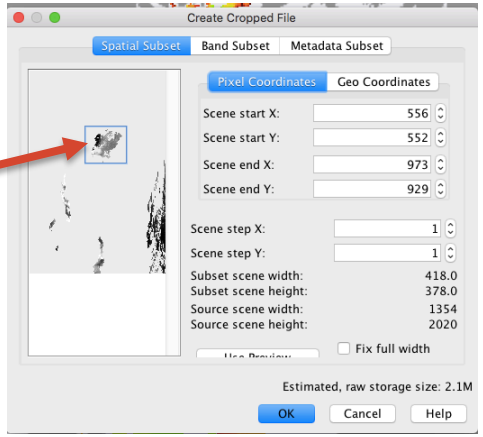


Crop the Raster Layer

30. Zoom in on Lake Victoria so that the main SeaDAS window covers only the lake
31. On the top menu, go to **Raster > Crop**
32. You will see a window showing the zoomed-in region available to be cropped
33. Select **OK** and you will get the cropped raster as a new layer

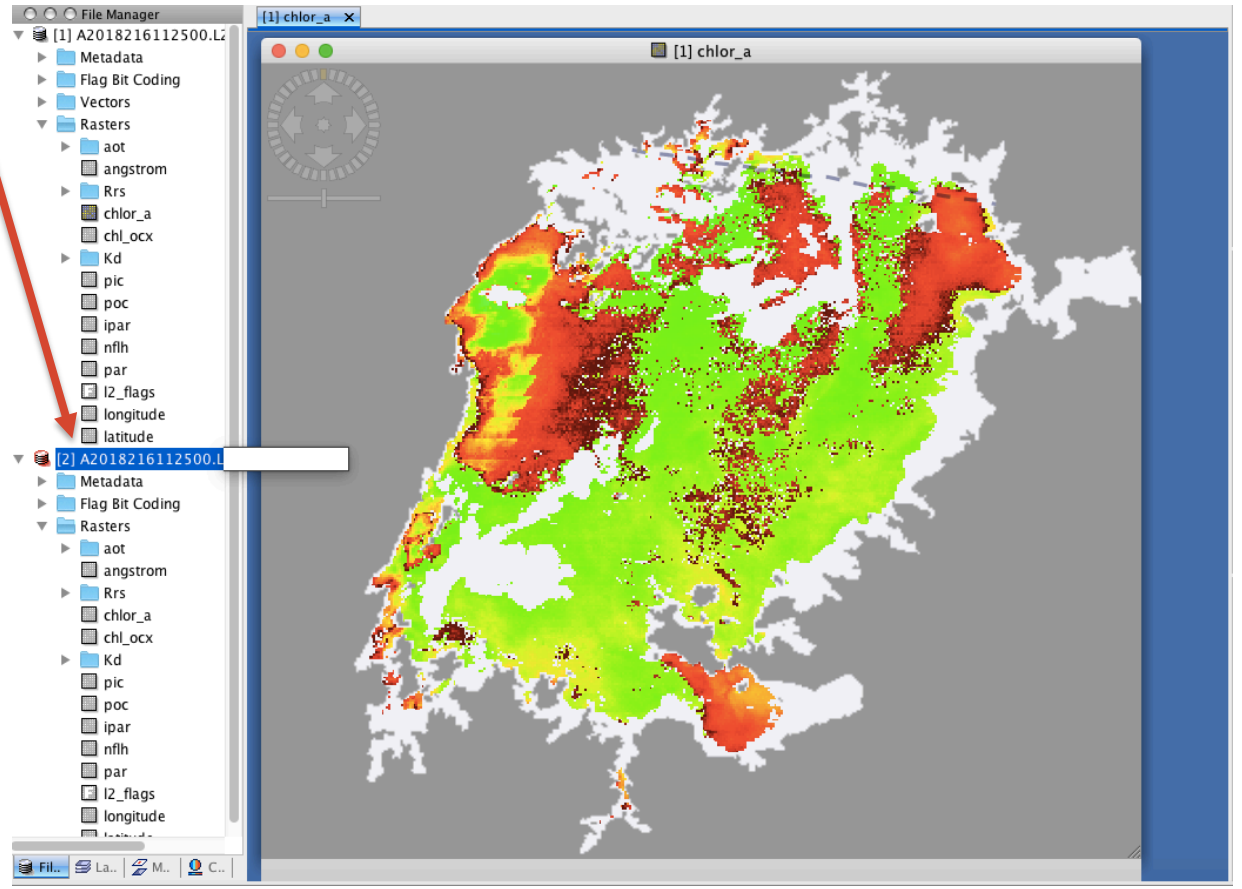






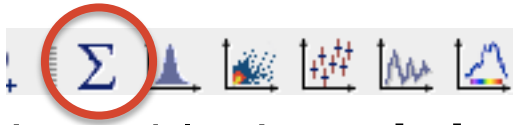
Display the Cropped Chlor_a Layer

34. You will see the new, cropped raster layer in the **File Manager** window
35. Click on **Chlor_a** to add the cropped raster layer
36. On the top menu, go to **Window > Tile Horizontally** to see both the original and cropped chlor_a layers
37. Zoom in on both layers to make sure that the cropped layer only covers Lake Victoria

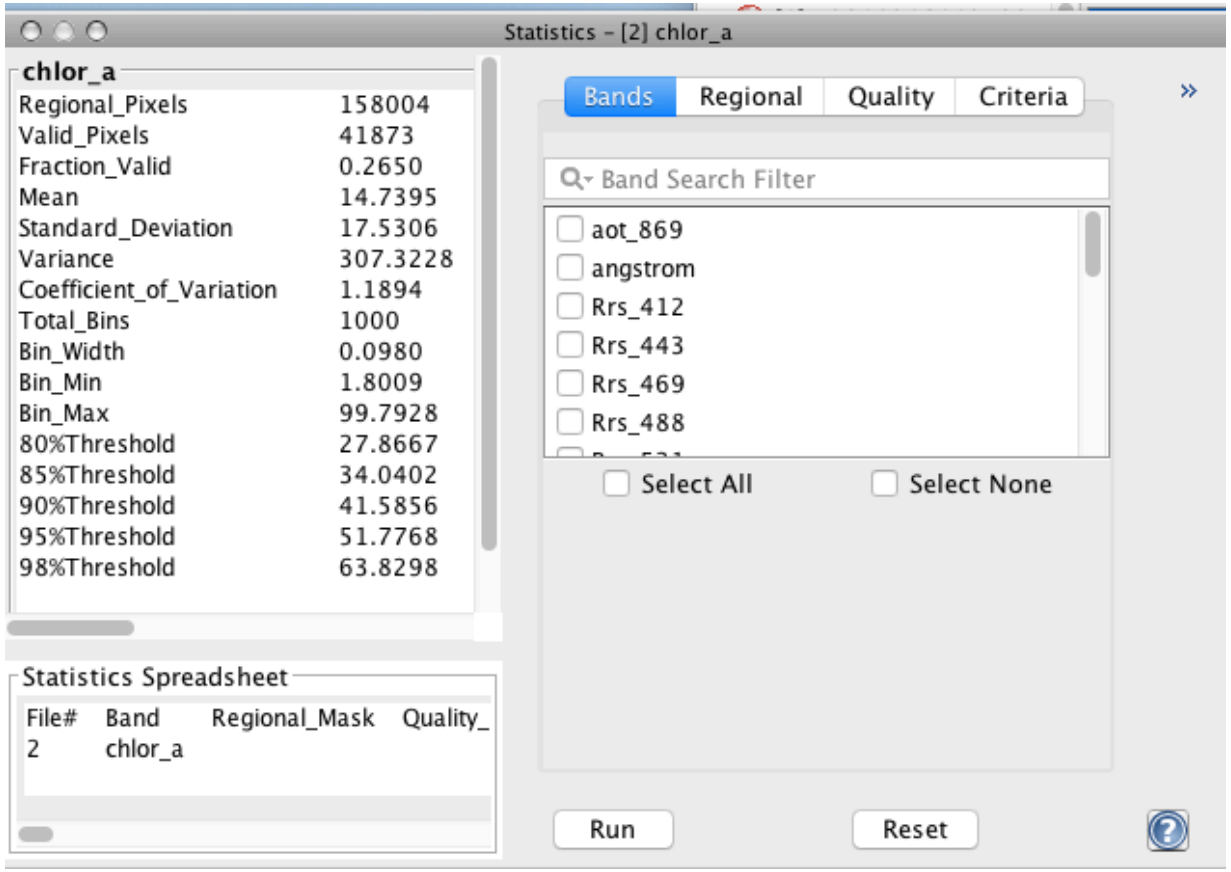


Calculate Statistics

38. Select the cropped chlor_a layer by clicking on the window
39. From the top menu bar, select **Display Statistics for selected band(s)**

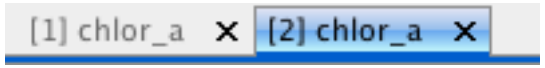


   – A window titled **Statistics – [2]chlor_a** will open
40. Select **Run** to get statistics of chlor_a for Lake Victoria on August 4, 2018

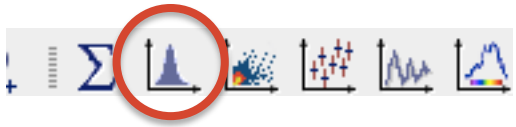


Plot Histogram

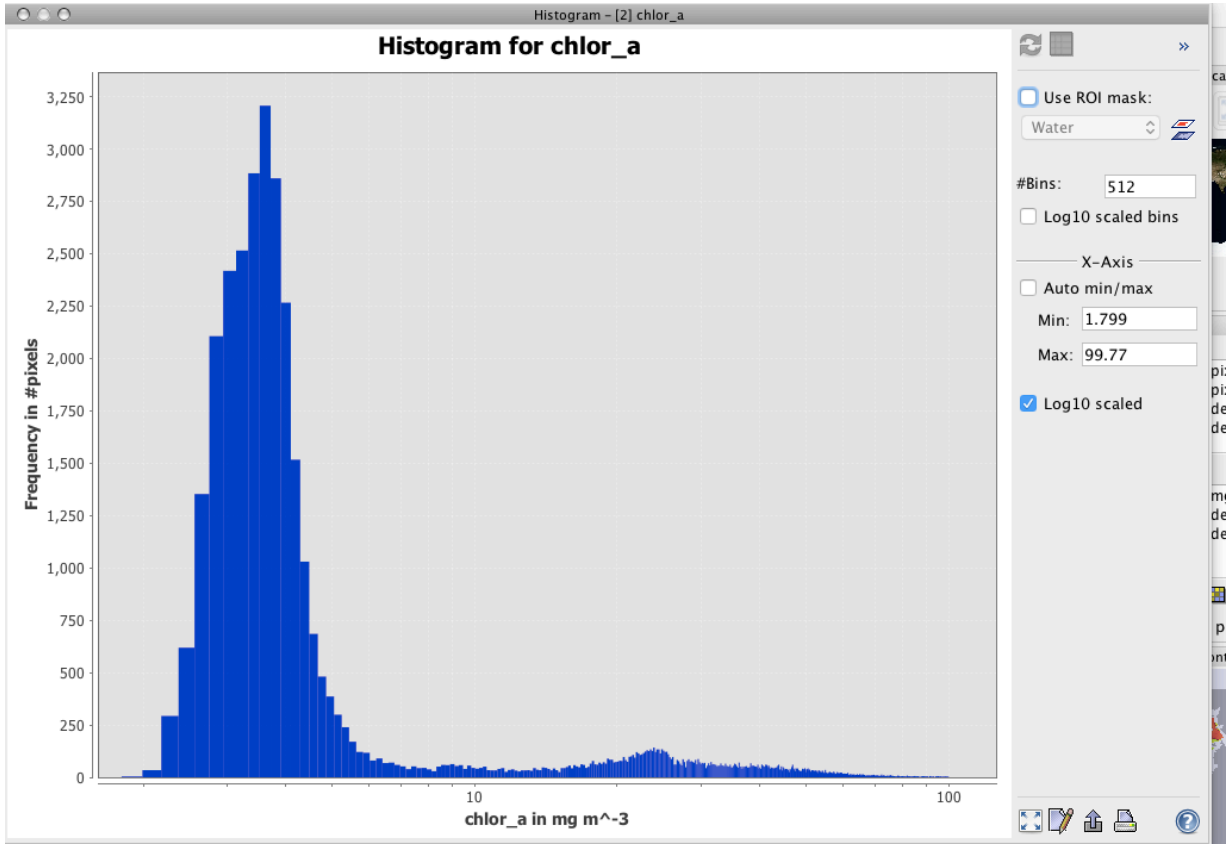
41. Make sure that you are working with the cropped layer
    - Note: you may remove the original chlor_a layer by clicking on the ‘x’



42. From the top menu bar, select **Display Histogram for a selected band**

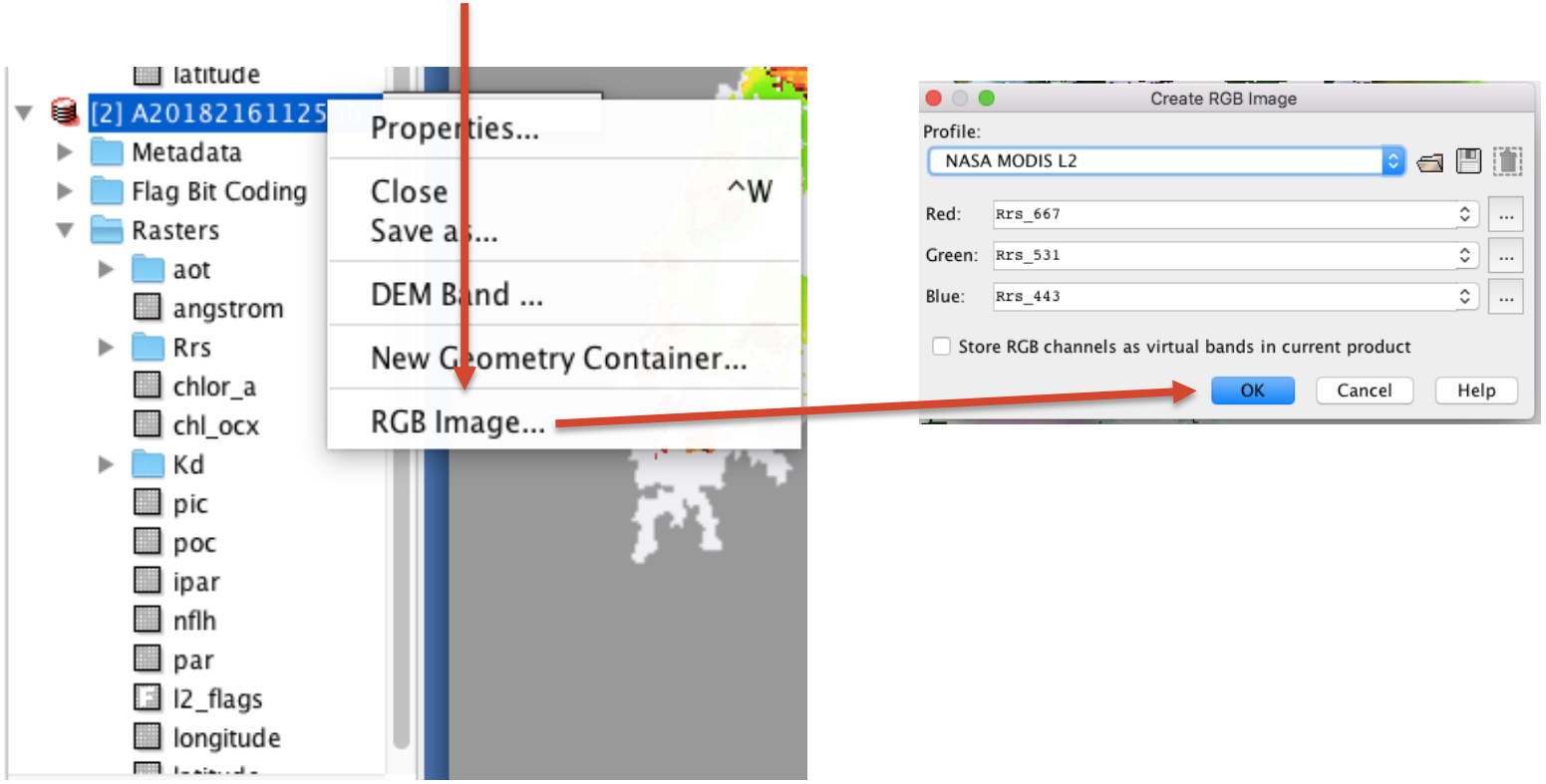


    - A window titled **Histogram – [2] chlor_a** will open
43. Select **X-Axis > Log 10 scaled**
44. You will see a histogram in the window

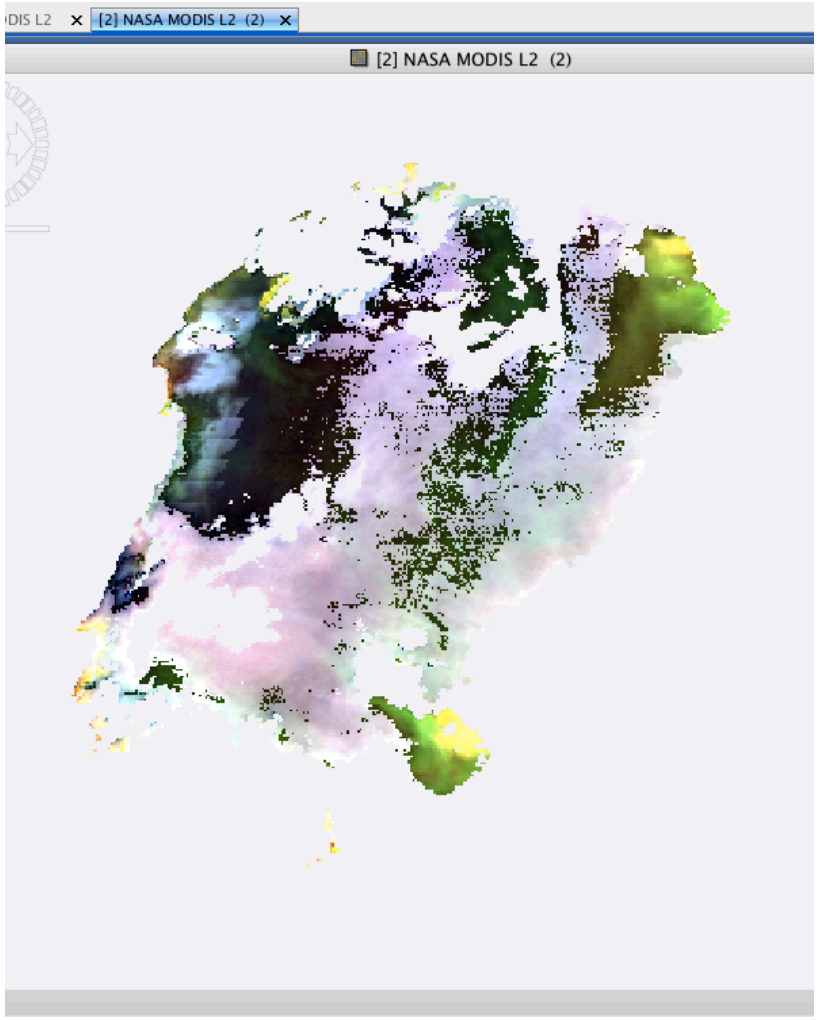


Analysis and Visualization of MODIS Band Reflectance

45. Click on the cropped layer file name and select **RGB Image**



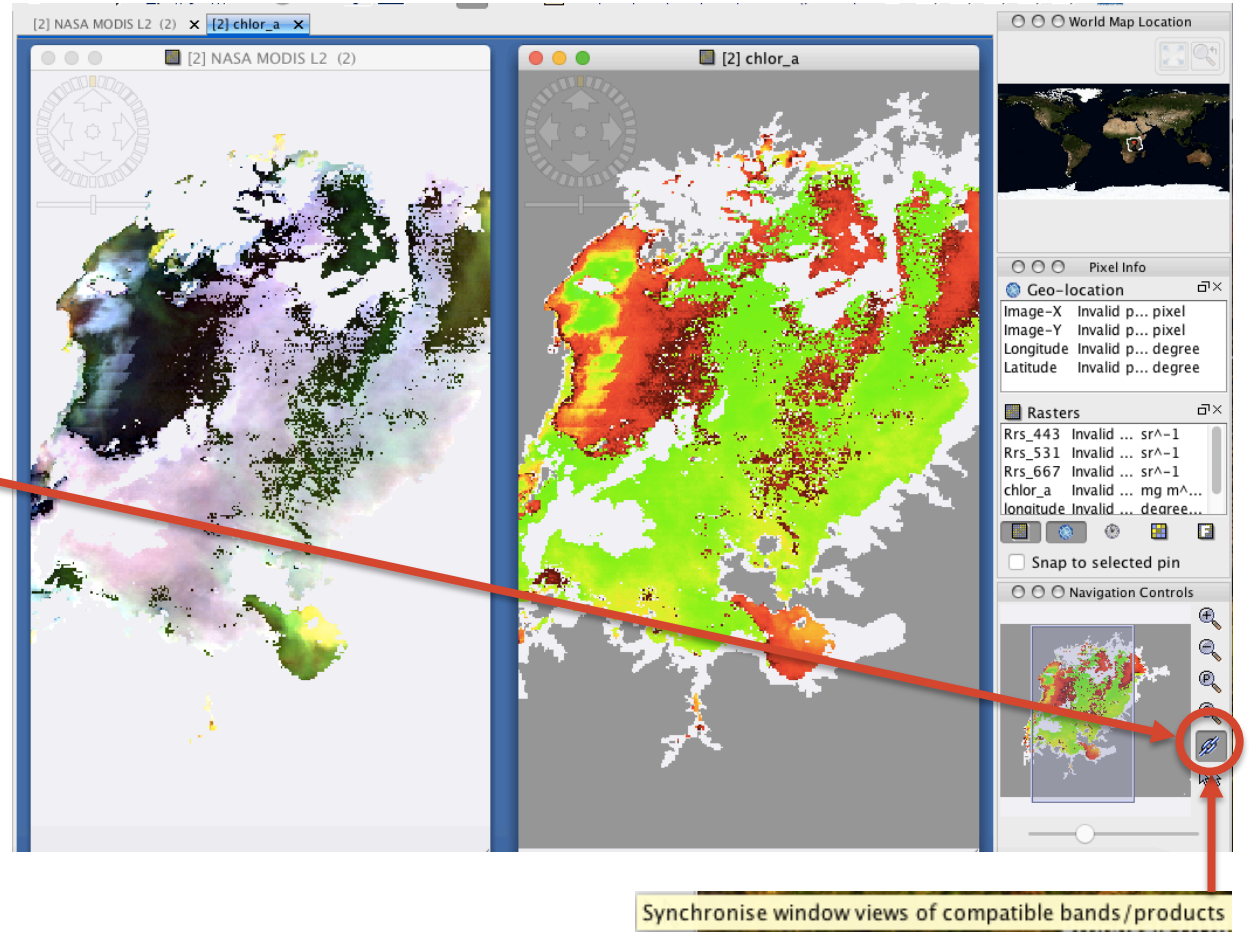
46. Click **OK** to get a true color RGB image



RGB Image

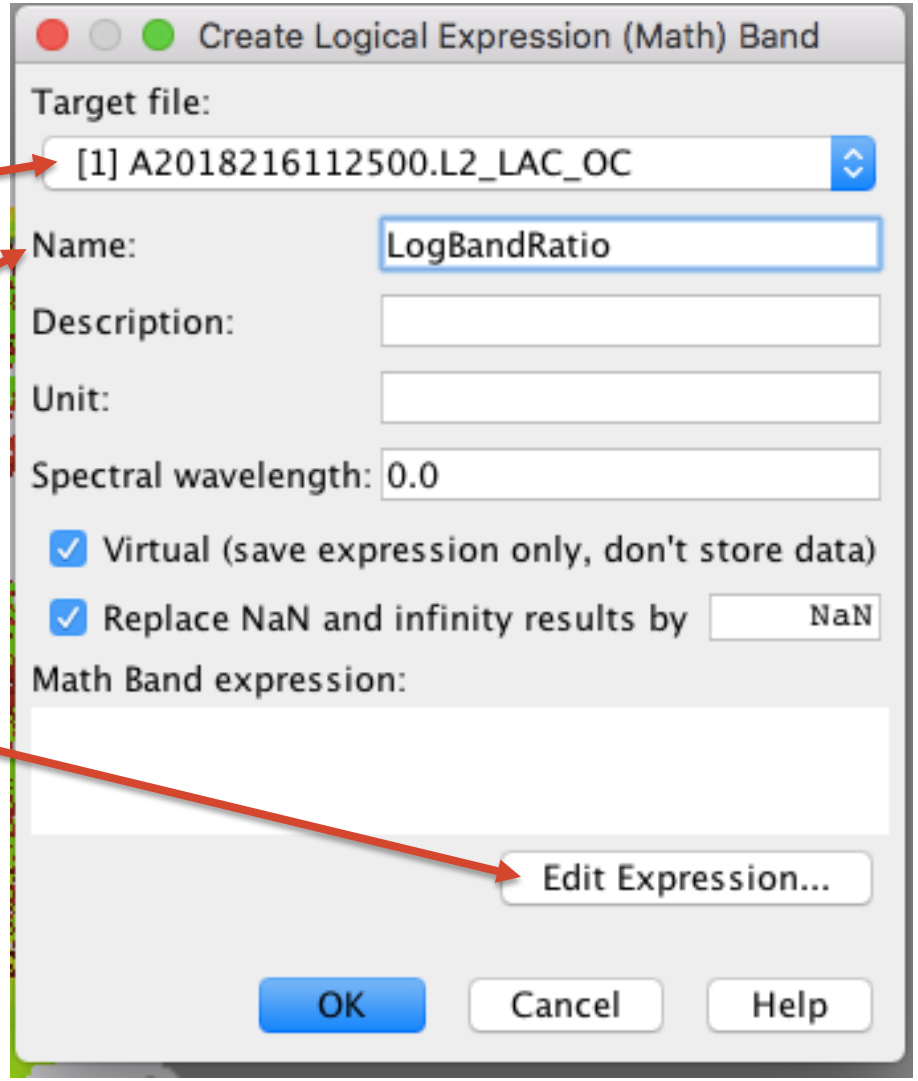
Synchronize Images

47. On the top menu bar, select **Window > Tile Horizontally**
48. You will see the chlor_a and RGB images
49. Go to the **Navigation Control** window (bottom right) and click on the **Synchronization Tool**
50. Now when you pan and move an image in one window, the other window will move along with it



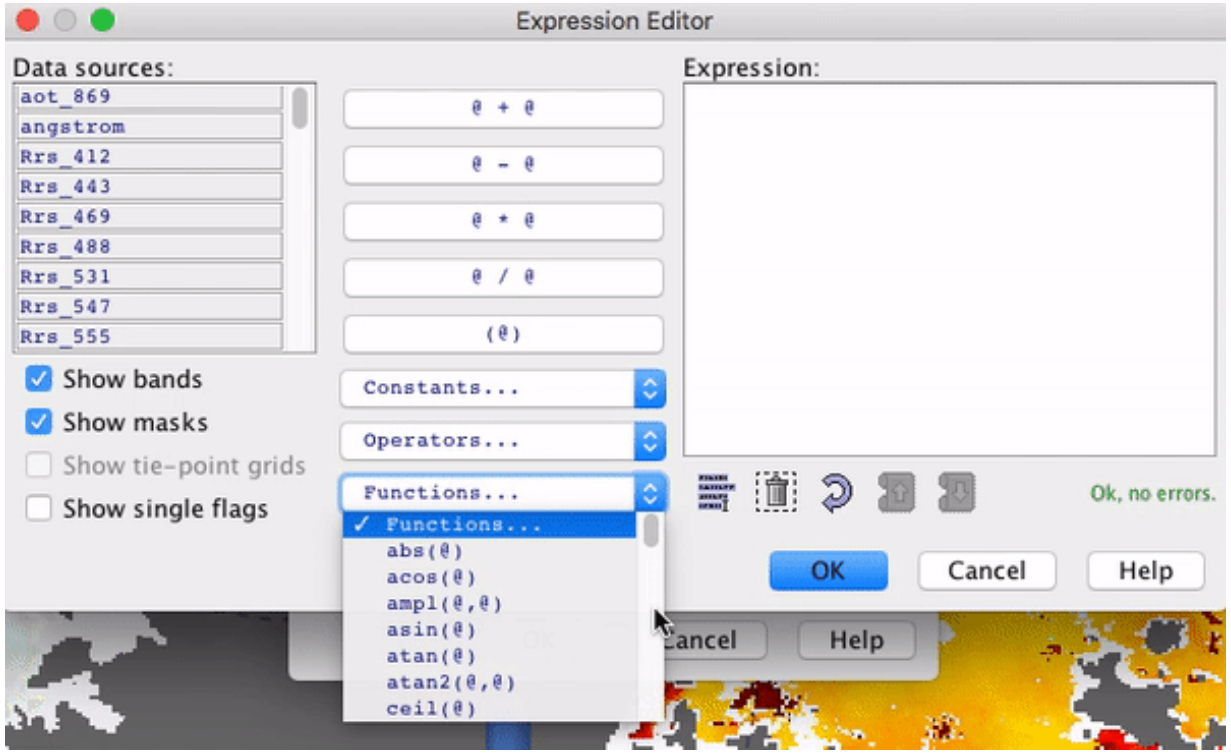
Calculate MODIS Band Ratios

51. Go to **Raster > Math Band**
    - a window will open
    - make sure the **Target File** is the MODIS OC file
52. Enter **LogBandRatio** (or name of your choice) in **Name:** for a new raster name
53. Click on **Edit Expression**



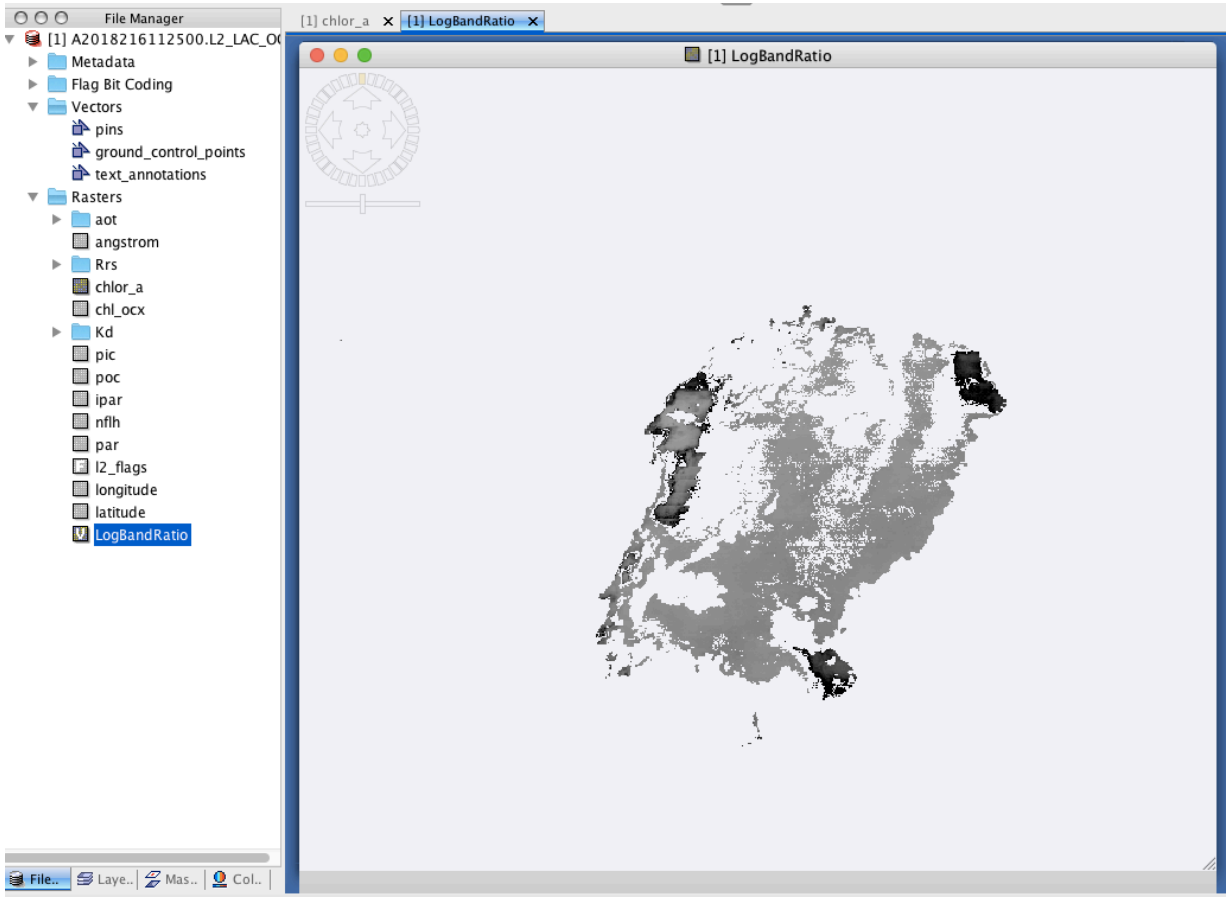
Calculate MODIS Band Ratios

54. You will get an **Expression Editor** window
55. Click on **Functions** and click **log10(@)** from the dropdown selections.
56. Now highlight @ in the expression
57. Enter the band ratio log10(Rrs_443)/(Rrs_555) using the **Data Sources** on the left and the operation @/@ in the middle window
58. Click **OK**



Calculate MODIS Band Ratios

59. You will get back to the **Create Logical Expression (Math) Band Window**
60. Click **OK**
61. You will get the image of the Log10(Rrs_443/Rrs555)
62. Move the cursor to examine the values of the band ratio



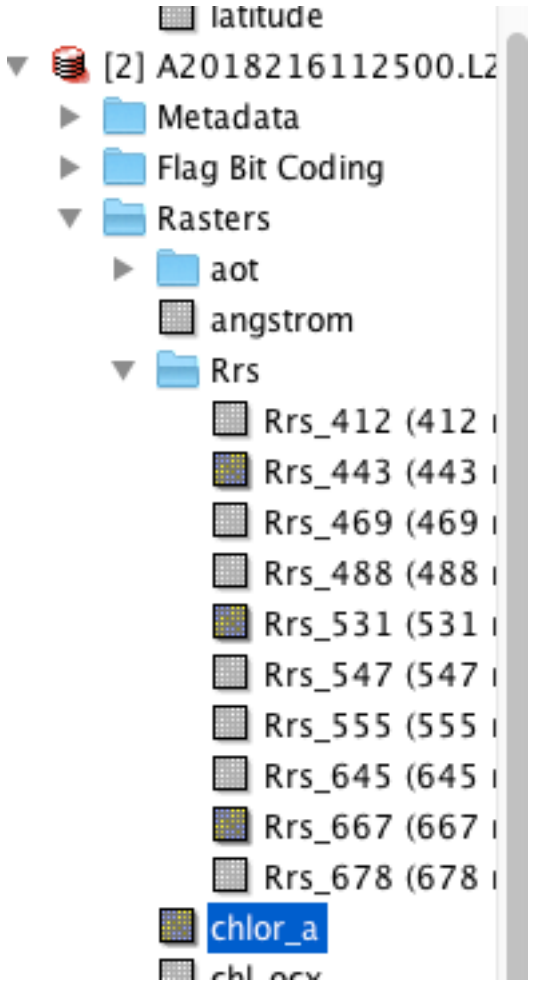
To Derive Your Own Algorithm

- You need in situ measurements of chlorophyll concentration in the lake
- You will compile the above ratio in a number of MODIS images over the lake using OceanColor Web
- Average the MODIS band ratios around the in situ measurement point, for example: use 3 to 5 pixels square centered at the in situ data location for each day
- Derive the statistical relationship between the in situ and the MODIS-based data

Note: The OC Chlor_a algorithm is a 4^{th} order polynomial in Log10(Rrs_443/Rrs555)

OPTIONAL: Examine Surface Band Reflectances (R_{rs})

1. In the File Manager, in the layer cropped to Lake Victoria, Click on **Rrs** to see various band reflectance layers
2. Click on the layers and examine features in corresponding images
3. You may want to repeat the analysis you did for the chlor_a (i.e. change colors, calculate statistics)



Homework Questions

Complete the google form available at https://arset.gsfc.nasa.gov/water/webinars/wq-image-processing

1. What are the units of MODIS chlorophyll concentration?
2. Which bands are used to make RGB images?
3. Based on the statistics for Lake Victoria, what was the mean and standard deviation for chlorophyll concentration?
4. How many distinct peaks can you see on the histogram?


APPLIED REMOTE SENSING TRAINING PROGRAM
TRAIN - EMPOWER - ADVANCE

Thank You