



# SeaDAS Tools

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Ocean Biology Distributed Active Archive Center (OB.DAAC)  
NASA - Goddard Space Flight Center  
[www.seadas.gsfc.nasa.gov](http://www.seadas.gsfc.nasa.gov)



## SeaDAS Tools (Part 1)

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## SeaDAS Tools (Part 2)

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- OCSSW Installer
- OCSSW Level-1 Browse Gen
- OCSSW Level-1 Map Gen
- OCSSW Level-2 Browse Gen
- OCSSW Level-2 Map Gen
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- OCSSW Get Ancillary
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- OCSSW Calibrate / Level-1B Gen
- OCSSW Extractors
- OCSSW Level-2 Bin
- OCSSW Level-3 Bin
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- OCSSW Level-3 Map Gen
- OCSSW Multilevel Processor



## SeaDAS Tools (Part 3)

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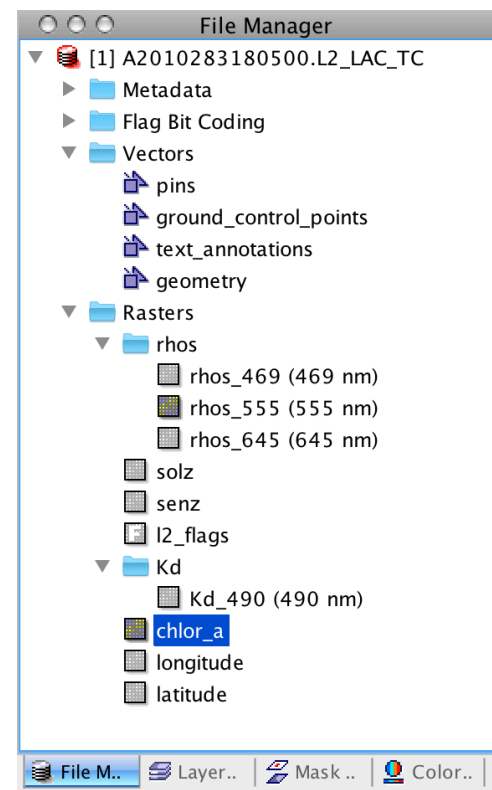
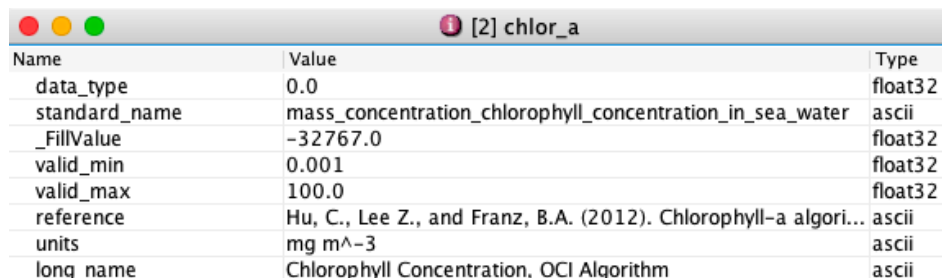
- Graph Processing Tool (GPT)
- Pixel Extraction
- Time Series Tools
- Filter Band
- Flip Data
- Find Matchup
- Mask Matchup
- Layout Tools
- Sessions
- Preferences
- Geo-Coding Attachment Tools
- Module Manager
- Ground Control Points
- Mask Area
- Geo-Coding Info
- World Map Layer
- SeaBASS
- Text Annotation



# SeaDAS Tools (Part 1)

## File Manager *Accesses and handles files, bands and vectors*

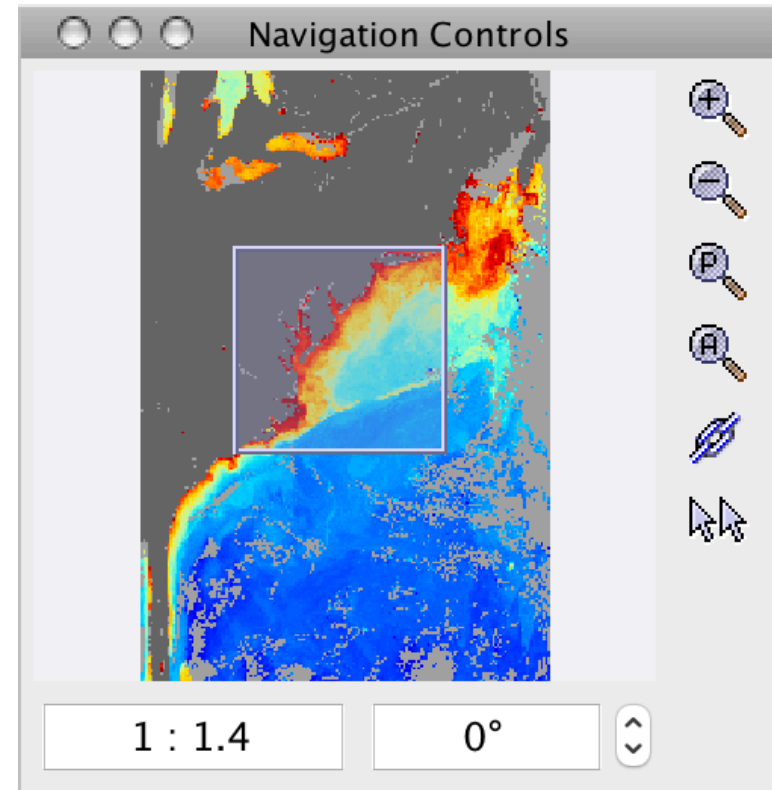
- File
    - Save
      - BEAM-DIMAP format
        - ✧ See File -> Export for other format options
    - Close
  - Band
    - View image
    - Access “Band Properties” tool
    - Delete
  - Vector
    - Export as ESRI shapefile
    - View coding
    - Delete
  - Metadata
    - File
    - Band
    - Sensor
  - Flags
    - View bit coding
- ❖ “File” may be referred to by some tools as “Product” due to shared software integration with Beam

Name	Value	Type
data_type	0.0	float32
standard_name	mass_concentration_chlorophyll_concentration_in_sea_water	ascii
_FillValue	-32767.0	float32
valid_min	0.001	float32
valid_max	100.0	float32
reference	Hu, C., Lee Z., and Franz, B.A. (2012). Chlorophyll-a algori...	ascii
units	mg m <sup>-3</sup>	ascii
long_name	Chlorophyll Concentration, OCI Algorithm	ascii

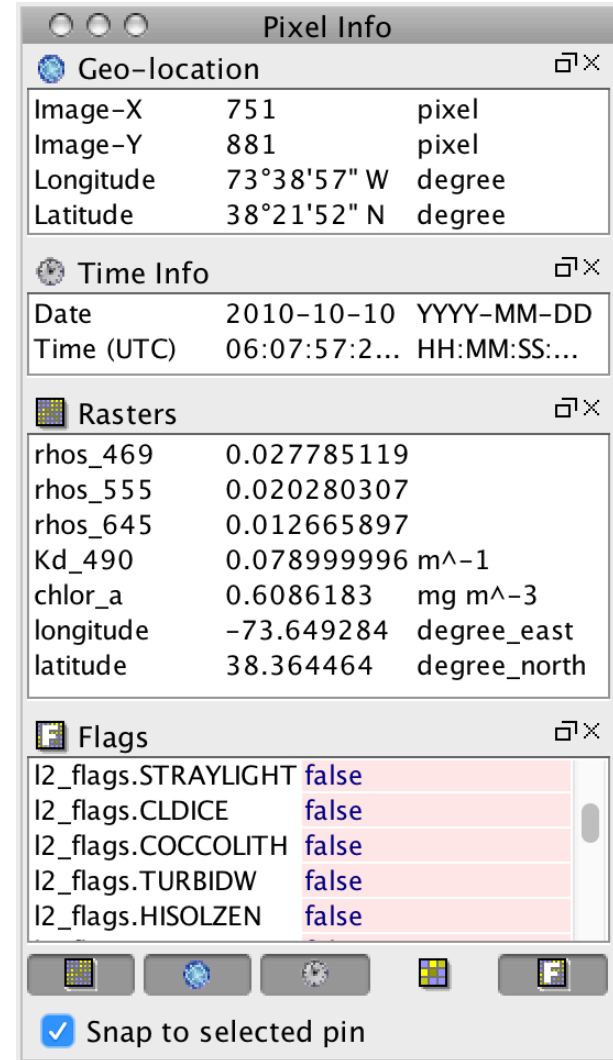
## Navigation Controls *Adjusts zoom levels and synchronization of images*

- Zoom image
  - in/out
  - pan
  - full image
  - data resolution
  - scaling factor
- Synchronize “compatible” image windows
  - view location
  - cursors
- Rotate image



## Pixel Info *Displays info of a pixel*

- Geographical coordinates
- Raster coordinates
- Time information
- Geophysical value along with values of all other open bands
- Flags
- ❖ Obtained by mouse hover or pin



Geo-location		
Image-X	751	pixel
Image-Y	881	pixel
Longitude	73°38'57" W	degree
Latitude	38°21'52" N	degree

Time Info		
Date	2010-10-10	YYYY-MM-DD
Time (UTC)	06:07:57:2...	HH:MM:SS:...

Rasters		
rhos_469	0.027785119	
rhos_555	0.020280307	
rhos_645	0.012665897	
Kd_490	0.078999996	m <sup>-1</sup>
chlor_a	0.6086183	mg m <sup>-3</sup>
longitude	-73.649284	degree_east
latitude	38.364464	degree_north

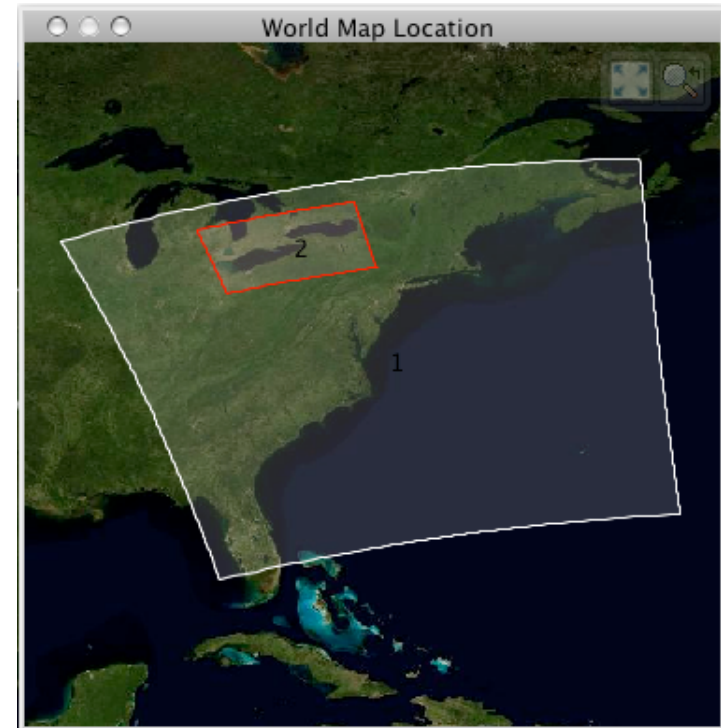
Flags	
I2_flags.STRAYLIGHT	false
I2_flags.CLDICE	false
I2_flags.COCCOLITH	false
I2_flags.TURBIDW	false
I2_flags.HISOLZEN	false

Snap to selected pin



## World Map Location *Displays geographical boundaries of file(s) on a world map*

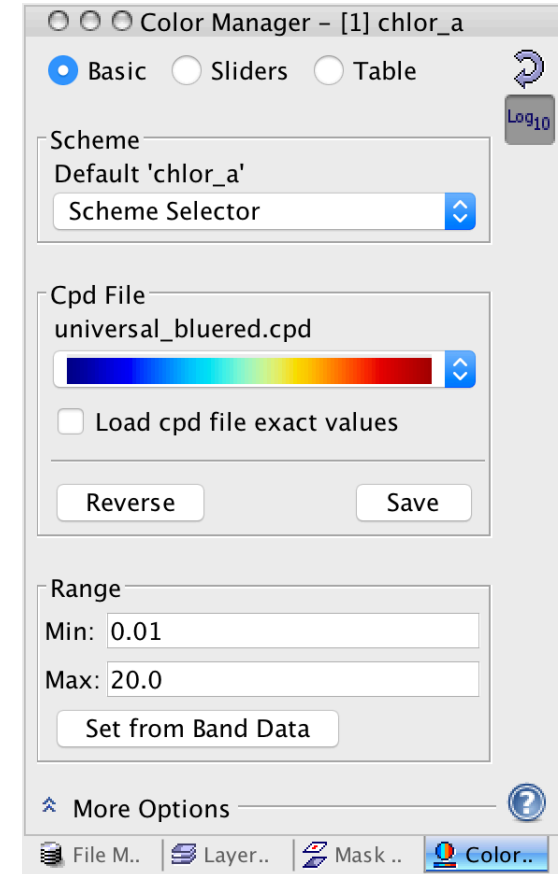
- Map
  - NASA Blue Marble
- Map projection
  - "Geographic Lat/Lon (WGS 84)"
- Boundary color
  - Red - selected file
  - White - all other files
- Zoom
  - In/out
  - Pan
  - Full world
  - Boundaries



## Color Manager *Loads, creates, or edits the color scheme used in a band image*

- Color palette
  - Load
    - Manual
    - Auto-load based on band name
  - Modify or reverse
  - Create
  - Export
    - CPD, CPT, PAL
- Data mapping
  - Range
    - Min and max
  - Scaling
    - Log or linear
- Color scheme (configuration files)
  - Color scheme look-up based on band name (wildcard)
  - User-selectable color schemes
- Preferences page
  - Standard or color blind compliant palettes

❖ Color scheme = color palette + data mapping



**Color Bar** *Creates and edits a color bar legend to represent the color scheme of a band image*

---

- Add to image
  - Location placement options
  - Image size scaling
- Export as file
- Format
  - Orientation
  - Color
  - Backdrop transparency
  - Decimal places
  - Data scaling factor (for small/large numbers)
- Tick mark distribution
  - Auto-generated points
  - Manually entered points
  - Lookup based on band name (wildcard)
- Preferences page
  - Most parameters

oceancolor\_standard



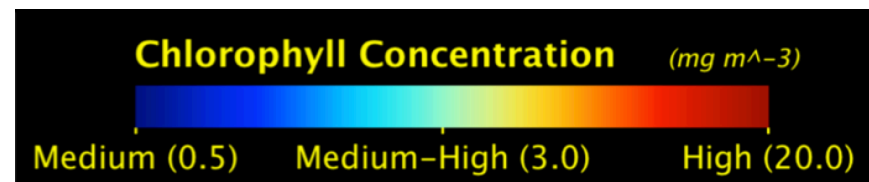
universal\_bluered



universal\_bluegreen

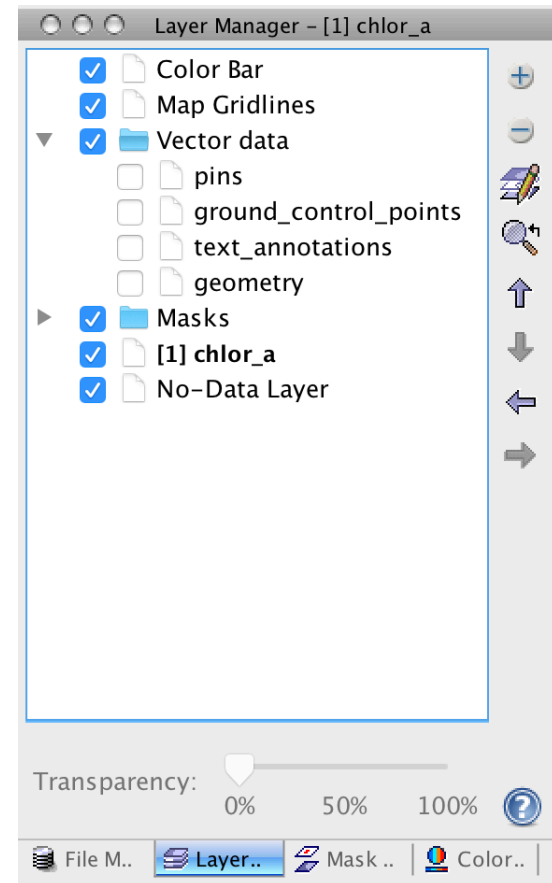


anomalies1\_universal



## Layer Manager *Creates layers and manipulates their stack order within a View Window*

- Alter stack order
- Toggle visibility
- Create
  - Image of band
  - Image of ESRI shapefile
  - Image of raster-based file
- Edit
  - access Layer Editor tool
- Delete
- ❖ Other tools also create layers
  - Color Bar, Map Gridlines, ...
- ❖ Layers are tied to each band image



## Map Gridlines *Displays world map location labels, gridlines and border on an image*

### ➤ Grid lines

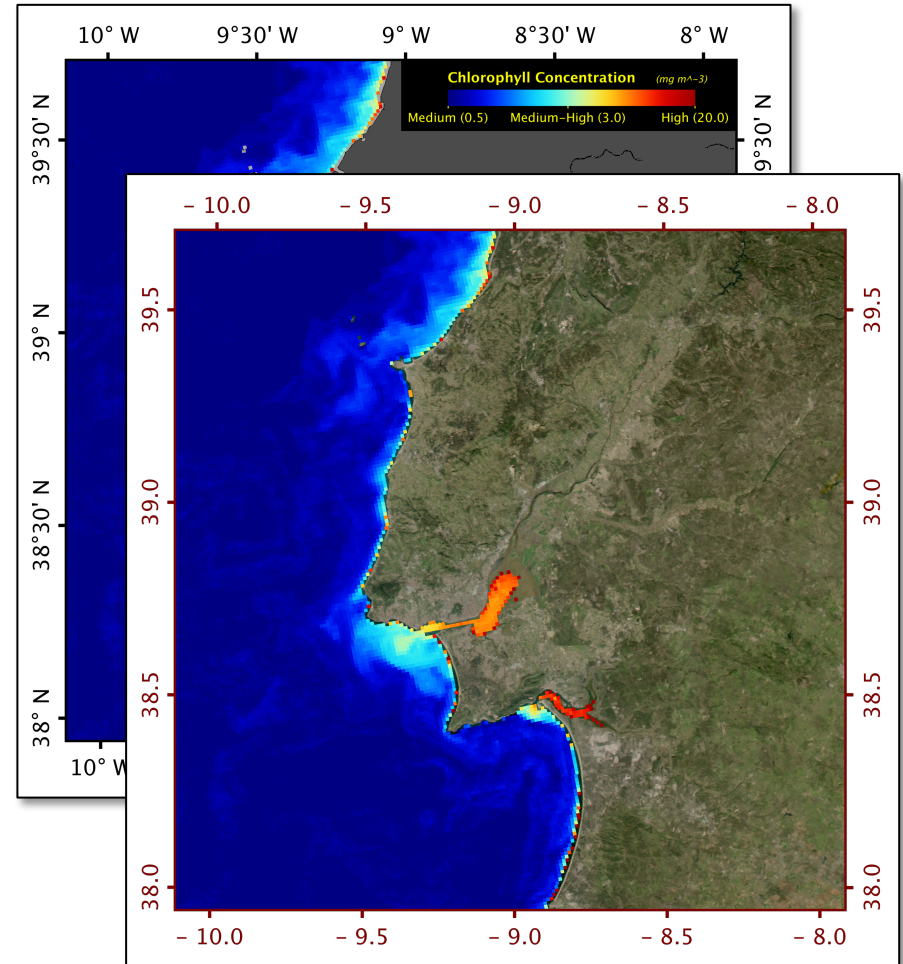
- Geographical spacing
- Line format
  - color, thickness, dashed, solid, ...
- Visibility and transparency

### ➤ Labels

- Text format
  - color, size, ...
- Text rotation
- Placement
  - inside or outside image
- Visibility toggle for each side (N,S,W,E)
- Number format
  - 90°W, -90°, 90.0W, -90.0
- Border
- Format
  - color, size, visibility

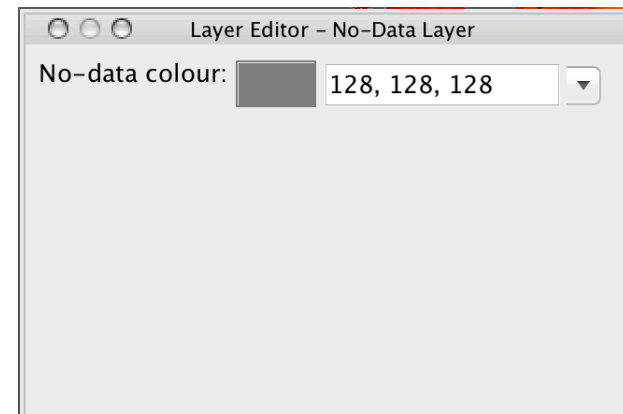
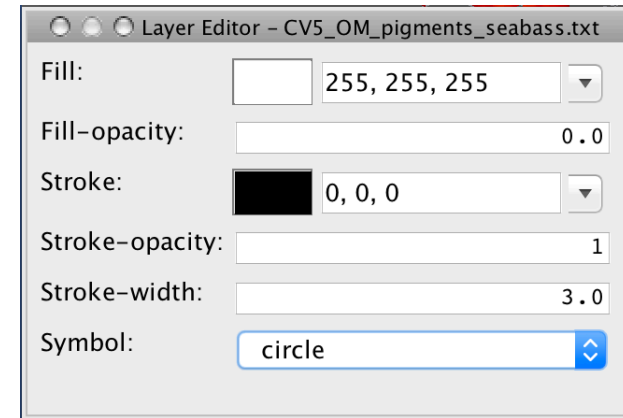
### ➤ Preferences page

- All parameters



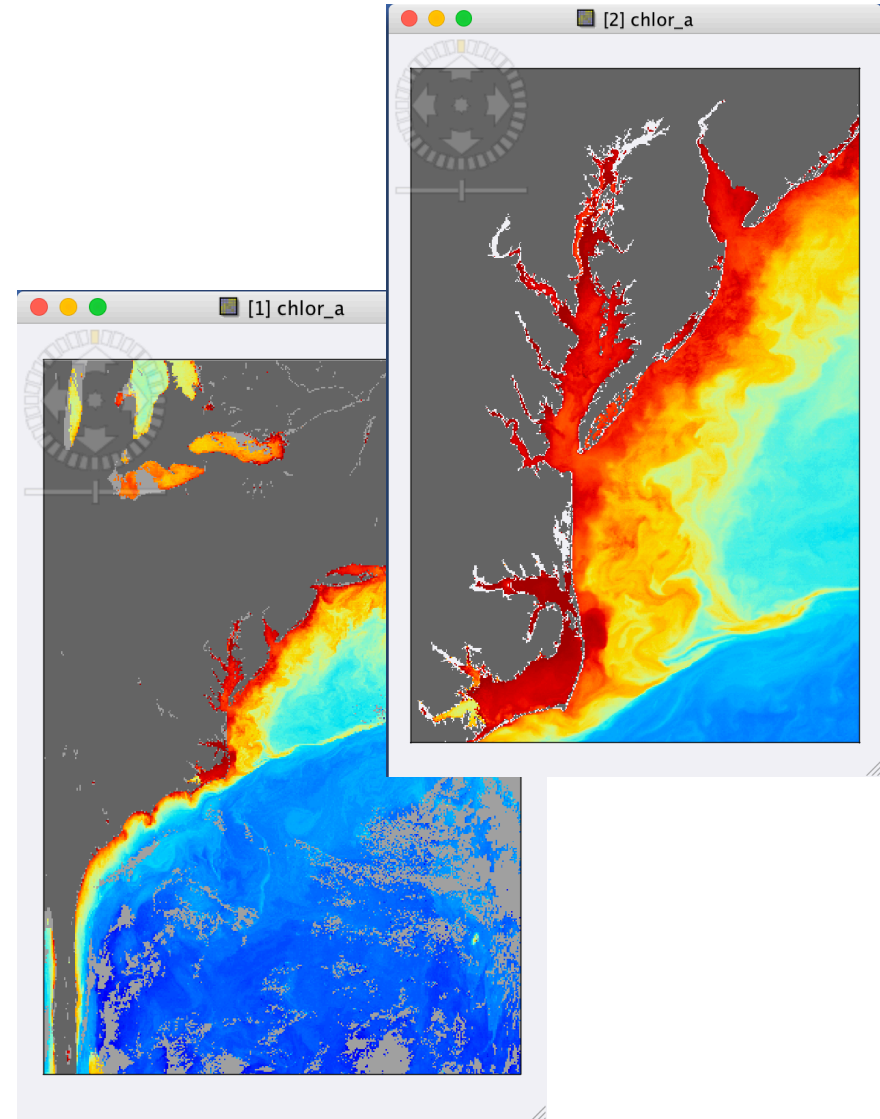
## Layer Editor *Edits properties of a layer*

- Editable properties dependent on each tool
- Raster layers
  - No-Data
  - Masks
  - World Map
  - ❖ Color Bar layer not supported by this tool
- Vector layers
  - Vector Data
  - Map Gridlines
  - Contours
  - Shiptrack - SeaBASS



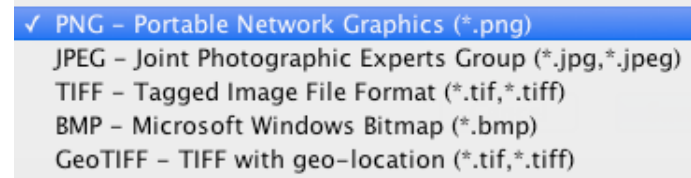
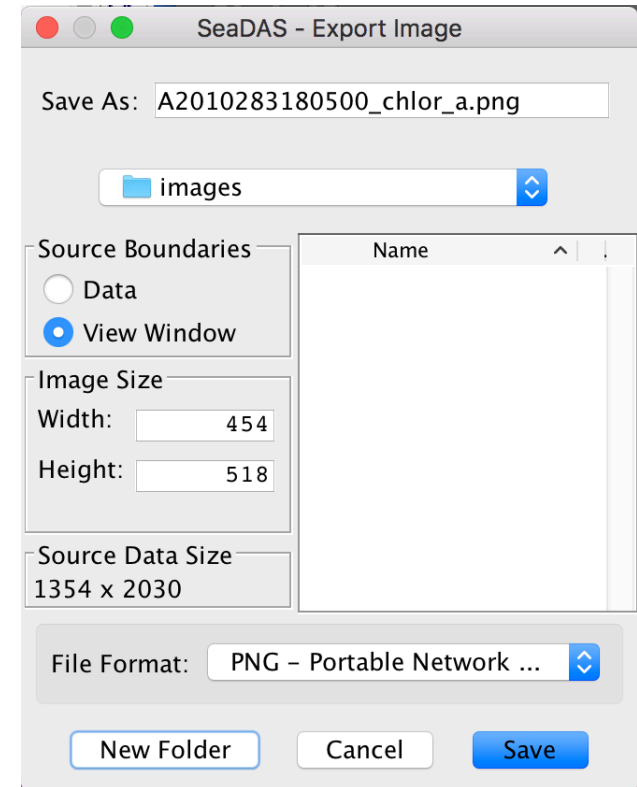
**Crop** *Crops a file to create a new reduced file (by area, band deletion or subsampling)*

- Crop spatially
  - Pixel coordinate boundaries
  - Geographic coordinate boundaries
  - ❖ Default is the boundaries image view
- Crop bands
  - ❖ Default is to retain all bands
- Subsample
  - Increment in X direction
  - Increment in Y direction
  - ❖ Default is no subsampling (increment=1)



## Export Image *Exports an image file from the image view window*

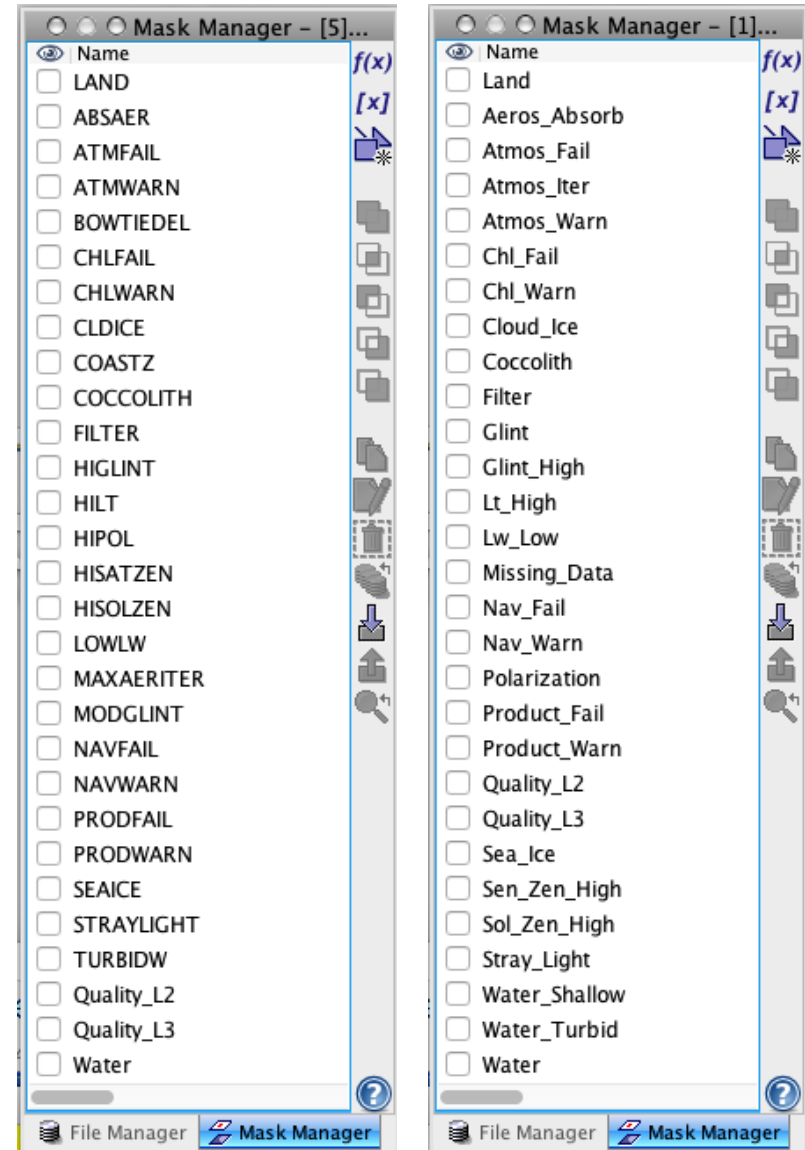
- Boundaries
  - Data – exact boundaries of raster
  - View Window – boundaries as displayed in view window
- Image size
  - Default for “Data” boundaries is full raster of pixels
  - Default for “View Window” is pixels of computer monitor being used to display image
  - ❖ Source data size [full raster] is displayed to aid user in determination of a reasonable output file size
  - ❖ Note: image size aspect ratio is locked so as not to stretch the image.
  - ❖ Note: any specification other than “Data” retaining original size, results in an image created by interpolation from the data, not from the computer monitor
- Output file format
  - png, gif, ...





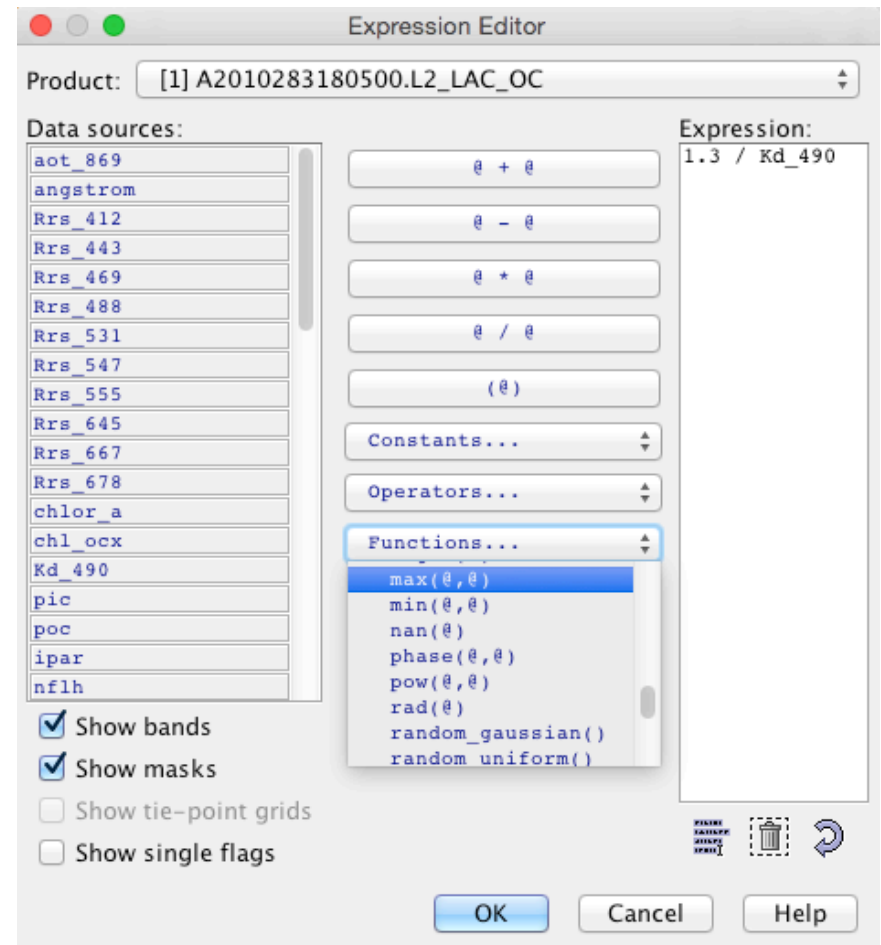
## Mask Manager *Creates and edits masks and their properties*

- Create/edit
  - Logical expression
    - Expression Editor
    - Selection shortcuts
  - Name
  - Color
  - Transparency
- Delete
- Import/export
  - Mask
  - Group of masks
  - ✧ Note: only mask properties, NOT raster data
- Toggle visibility
  - In each band
- ❖ Preferences page available for level-2 files



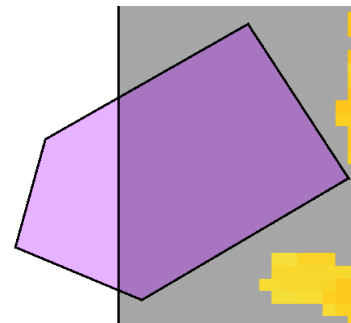
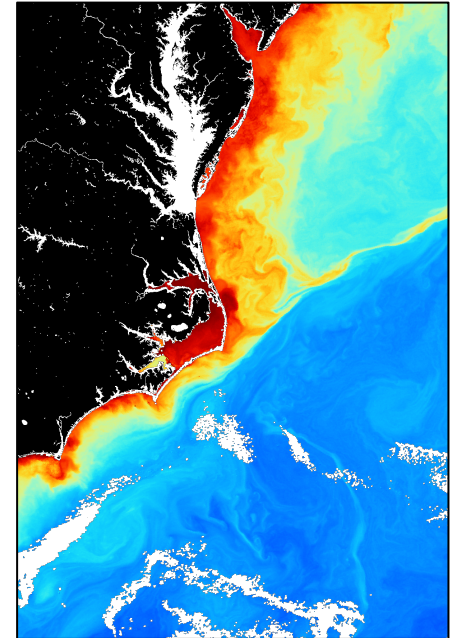
## Expression Editor *Creates a logical expression derived from any comparable raster data*

- Pixel-based
- Expression type
  - Boolean value
  - Numerical value
  - ✧ Note: this editor called by many tools which determine needed type
- Data sources (current and/or “compatible” files)
  - Bands
  - Masks
  - Flags
- Create the expression
  - Build it by selection
  - Type it in
  - Auto-check is performed
- Operators
- Mathematical functions
- Constants
  - LAT, LON, X, Y, PI ...

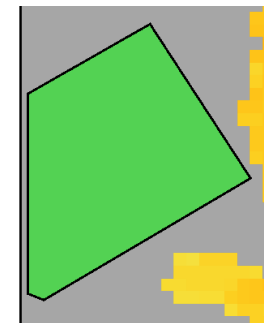


## Geometry Vectors *Add vector shape regions (with associated raster masks) to a file*

- Draw geometric shape vector
  - line, square, circle, polygon, ...
- Import/export a vector
  - ESRI shapefile
  - Benefit of use by other files
- Mask auto-created for each geometry vector
- Vector container
  - Contains any number of vector shapes
- ❖ Vectors such a coral reef outlines, land coastlines may be exported from a higher resolution file and then imported into a lower resolution file
- ❖ Some problems may arise on import if the shapefile extends beyond boundaries of the file (draws new connection between where shape leaves image)



Exported shapefile (purple)



Imported shapefile (green)

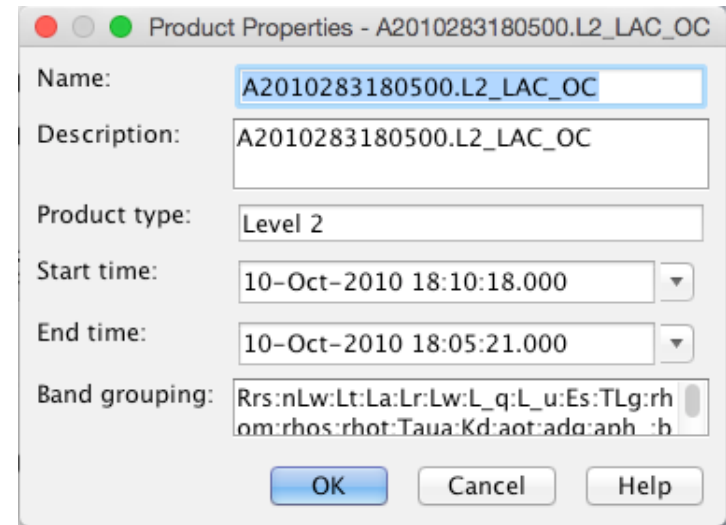
## Band Properties *Edit band and file metadata*

### ➤ File metadata

- Name, description and type
- Start and end time
- Band grouping

### ➤ Band metadata

- Name, description and units
- No-data value
- Valid pixel expression
  - Expression Editor
- Spectral wavelength



Product Properties - A2010283180500.L2\_LAC\_OC

Name: A2010283180500.L2\_LAC\_OC

Description: A2010283180500.L2\_LAC\_OC

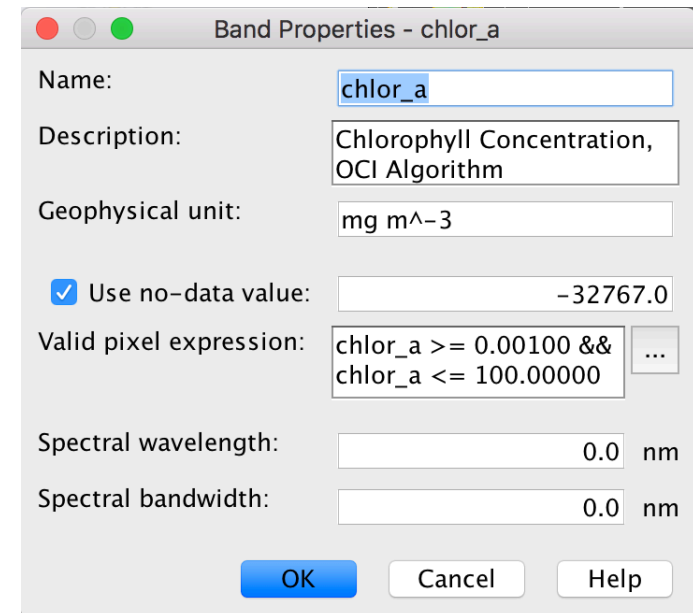
Product type: Level 2

Start time: 10-Oct-2010 18:10:18.000

End time: 10-Oct-2010 18:05:21.000

Band grouping: Rrs:nLw:Lt:La:Lr:Lw:L\_q:L\_u:Es:TLg:rh  
om:rhos:rhoT:Taua:Kd:aot:ada:anh:b

OK Cancel Help



Band Properties - chlor\_a

Name: chlor\_a

Description: Chlorophyll Concentration, OCI Algorithm

Geophysical unit: mg m<sup>-3</sup>

Use no-data value: -32767.0

Valid pixel expression: chlor\_a >= 0.00100 &&  
chlor\_a <= 100.00000 ...

Spectral wavelength: 0.0 nm

Spectral bandwidth: 0.0 nm

OK Cancel Help

## Band Info *Displays band and file metadata*

### ➤ File metadata

- Name, description and type
- Raster dimensions
- File location
- Start and end time

### ➤ Band metadata

- Name, description and units
- No-data value
- Valid pixel expression
- Scaling factor and offset
- Spectral wavelength

Information - [1] A2010283180500.L2_LAC_OC	
Product name:	A2010283180500.L2_LAC_OC
Product type:	Level 2
Product description:	A2010283180500.L2_LAC_OC
Product format:	SeaDAS-L2
Product reader:	SeaDAS-Supported Level 2 Products
Product reader class:	gov.nasa.gsfc.seadas.dataio.L2Produ
Product reader module:	seadas-reader v 1.7.2
Product file location:	/Users/seadas/Desktop/A20102831
Product scene width:	1354 pixels
Product scene height:	2030 pixels
Product start time (UTC):	10-OCT-2010 18:10:17.1000000
Product end time (UTC):	10-OCT-2010 18:05:17.4000000

Information - [1] chlor_a	
Name:	chlor_a
Type:	Band
Description:	Chlorophyll Concentration, OCI Al
Geophysical unit:	mg m <sup>-3</sup>
Geophysical data type:	float32
Raw data type:	float32
Raster width:	1354 pixels
Raster height:	2030 pixels
Scaling factor:	1.0
Scaling offset:	0.0
Is log 10 scaled:	false
Is no-data value used:	true
No-data value:	-32767.0
Geophysical no-data value:	-32767.0
Valid pixel expression:	chlor_a >= 0.00100 && chlor_a <
Spectral band index:	0
Wavelength:	0.0 nm
Bandwidth:	0.0 nm
Solar flux:	0.0 mW/(m <sup>2</sup> *nm)

## Bathymetry & Elevation *Adds bathymetry, topography & elevation bands and masks to a file*

### ➤ Bands

- Elevation
  - elevation relative to sea level
- Bathymetry
  - water depth [NaN over land]
- Topography
  - elevation relative to sea level [NaN over water]

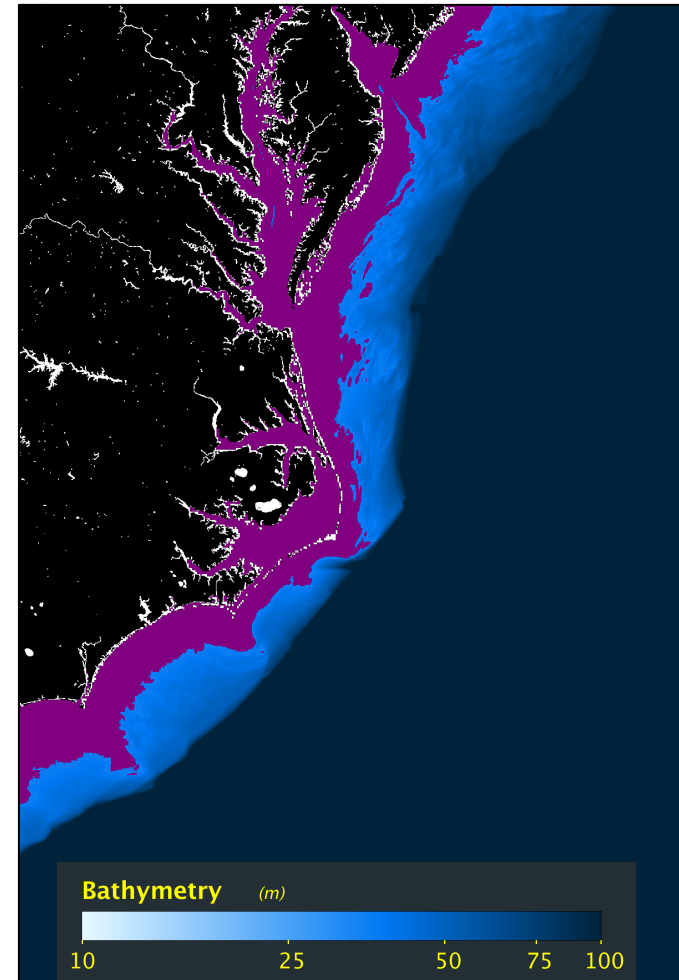
### ➤ Mask

- Water depth range

❖ Note: these bands are created by doing a bilinear interpolation of 2km elevation source data

❖ Note: bathymetry is now “true” bathymetry, correcting for lake surface height

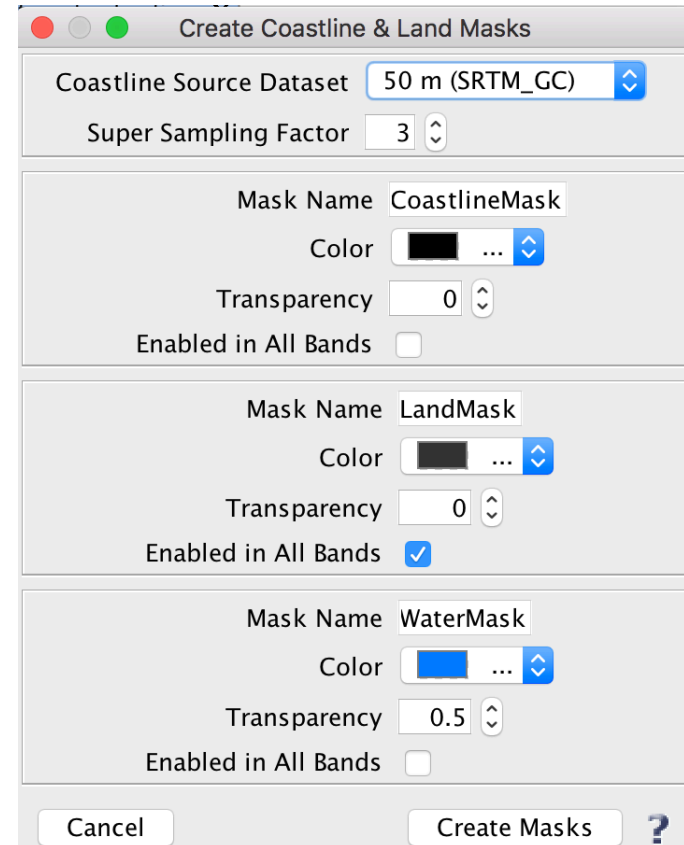
- ❖ SeaDAS versions prior to 7.2 did NOT make this correction



Mask shown in purple  
[water depth  $\leq$  25m]

## Coast, Land & Water *Adds land, coast and water masks to a file*

- Masks
  - land, water, and coast
- Bands
  - water band and smoothed (3x3 mean) water band
- Source land data resolutions
  - 50m, 150m (downloadable)
  - 1km, 10km (included with package)
- Super sampling factor
  - Improves accuracy of the source land data interpolation to the band, but increases processing time
  - ✧ Hint: ideally at least  $\text{bandRes}/\text{sourceRes}$
- Adjust thresholds for coast pixel determination
- ❖ Coast mask is created by applying a smoothing filter to determine water/land edges
  - ❖ Hint: a broader coast mask could be made by increasing the filter size applied to the water band
- ❖ Hint: a vector coastline can subsequently be generated by applying the Contour tool to the water band



Create Coastline & Land Masks  
 Coastline Source Dataset: 50 m (SRTM\_GC)  
 Super Sampling Factor: 3  
 Mask Name: CoastlineMask  
 Color: [Black]  
 Transparency: 0  
 Enabled in All Bands:

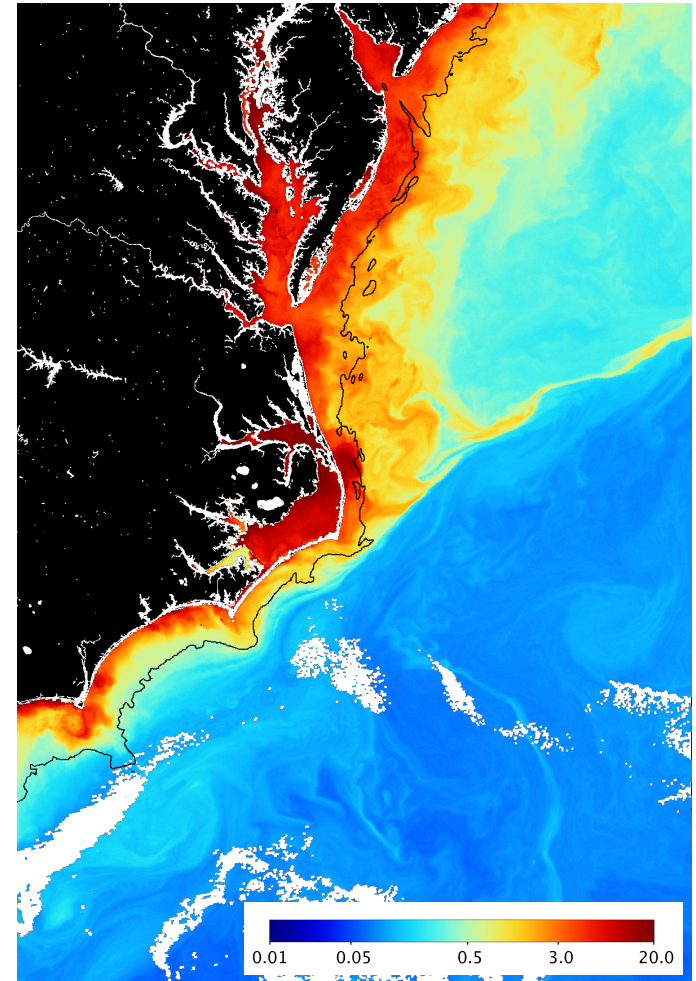
Mask Name: LandMask  
 Color: [Black]  
 Transparency: 0  
 Enabled in All Bands:

Mask Name: WaterMask  
 Color: [Blue]  
 Transparency: 0.5  
 Enabled in All Bands:

Cancel      Create Masks      ?

**Contour** *Displays contour lines on an image (e.g., isobath lines, isotherm lines, coastlines, ...).*

- Filter
  - Hint: runs faster and lines are smoother when using a filter
- Name
  - Default “contour\_{BANDNAME}\_{VALUE}\_{FILTER}”
- Value
- Line color
- Multiple contours lines
  - Manual
  - Automated
- ❖ Runs on selected band
- ❖ Line formatting options available in Layer Editor



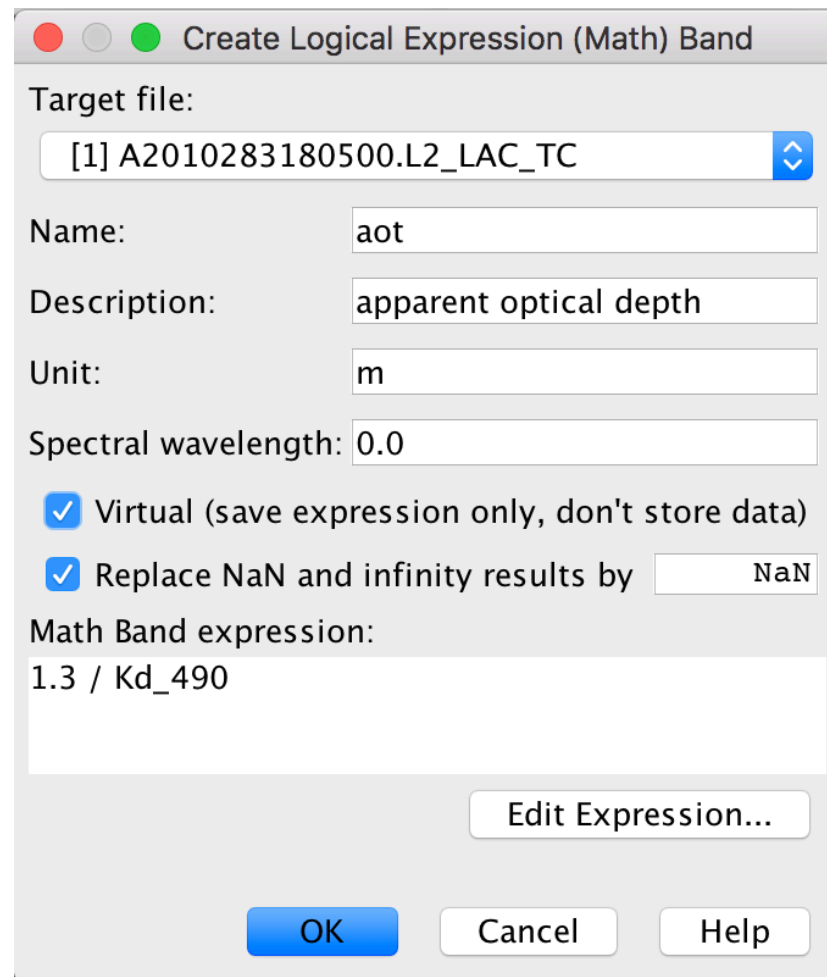
25m Isobath



## Math Band *Creates a band mathematically derived from comparable raster data*

- Metadata
  - name, description, units, ...
- Math expression
  - Pixel-based
  - Expression Editor
  - Same and/or “compatible” files
  - Geographical coordinates
  - Pixel coordinates
  - ❖ **Caution: IGNORES validation criteria\* of source(s)**
- Virtual band
  - Pixel is link to source(s)
  - Valid expression is linked to source(s)
- Real band
  - Pixel is “validated” real data
  - Valid expression is empty (already applied)

\* Validation criteria = valid pixel expression and no-data value



Create Logical Expression (Math) Band

Target file: [1] A2010283180500.L2\_LAC\_TC

Name: aot

Description: apparent optical depth

Unit: m

Spectral wavelength: 0.0

Virtual (save expression only, don't store data)

Replace NaN and infinity results by NaN

Math Band expression: 1.3 / Kd\_490

Edit Expression...

OK Cancel Help

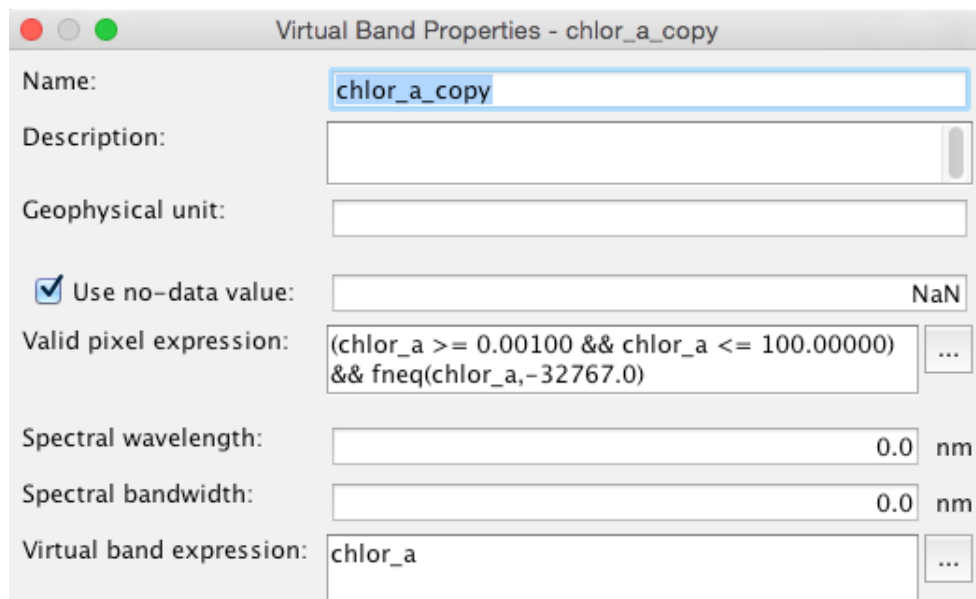
## Real Band *Converts a virtual band into a real band*

### ➤ Benefits

- Removes dependency on other bands/files
- Exportable raster data usable by other software

### ➤ No user specified criteria (currently)

- ❖ **Caution: validation criteria is ignored and thrown away, you may want to copy it, and transfer it to the validation criteria of the new real band.**



Virtual Band Properties - chlor\_a\_copy

Name:

Description:

Geophysical unit:

Use no-data value:

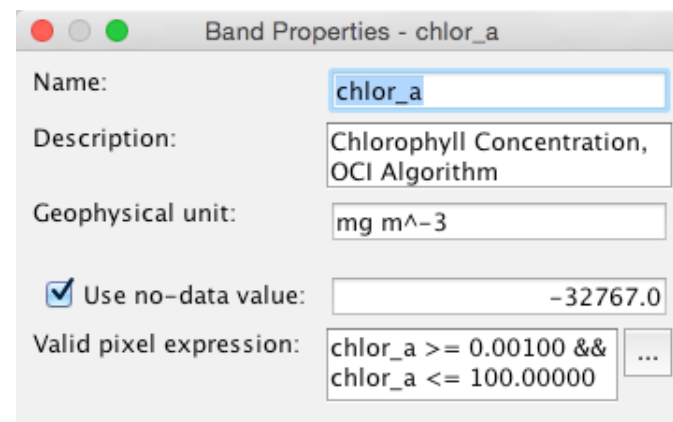
Valid pixel expression:

Spectral wavelength:  nm

Spectral bandwidth:  nm

Virtual band expression:

2. Math band (copy of source band)



Band Properties - chlor\_a

Name:

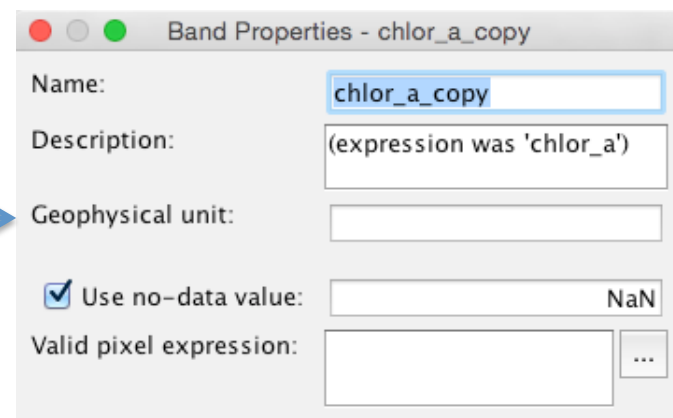
Description:

Geophysical unit:

Use no-data value:

Valid pixel expression:

1. Source band



Band Properties - chlor\_a\_copy

Name:

Description:

Geophysical unit:

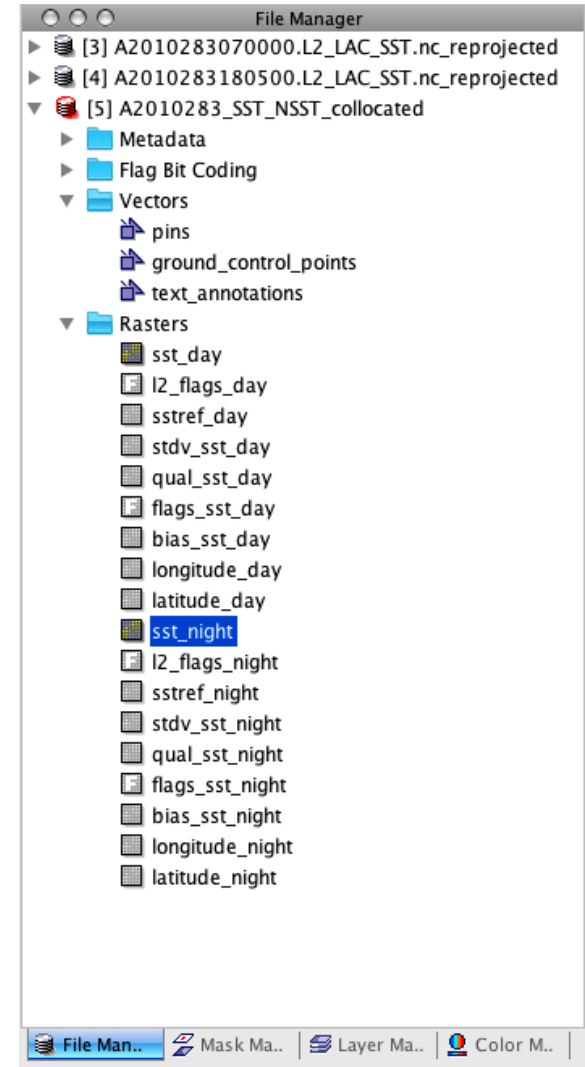
Use no-data value:

Valid pixel expression:

3. Real band (converted from math band)

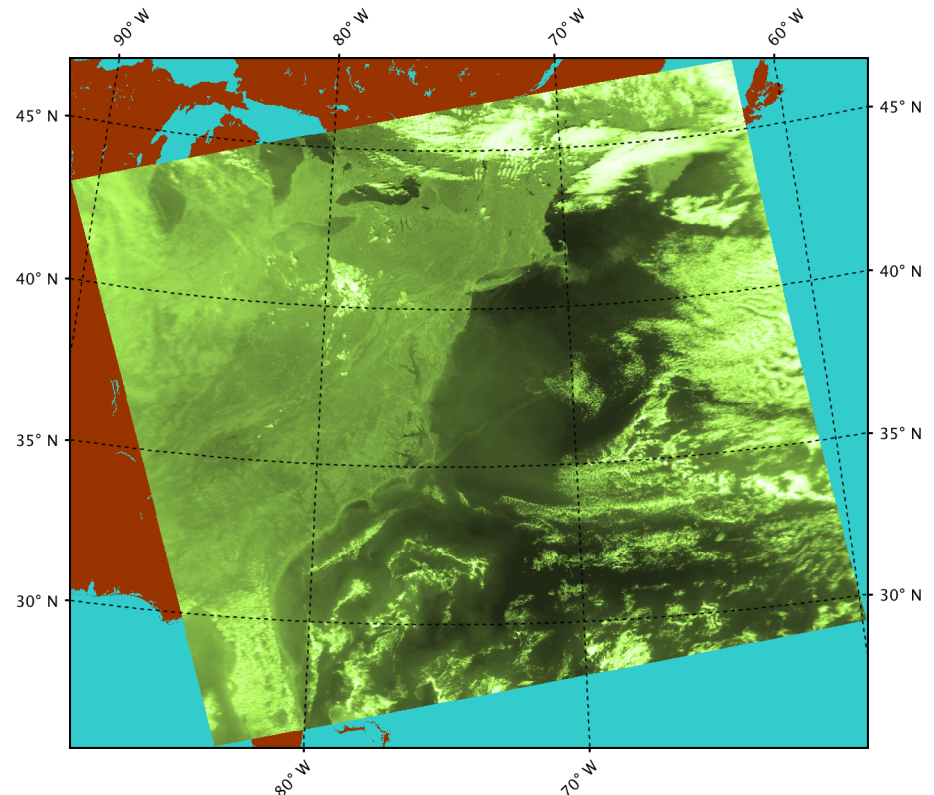
**Collocate** *Merges all the bands of two files into a single mapped file*

- Reference file
  - Boundaries and CRS of the collocated file
- Dependent file
  - Gets interpolated
- Interpolation method
  - Nearest neighbor
  - Bilinear
  - ...
- Band naming scheme for the collocated file
  - `${ORIGINAL_NAME}`
  - `${ORIGINAL_NAME}_R`
  - `${ORIGINAL_NAME}_D`
  - ...



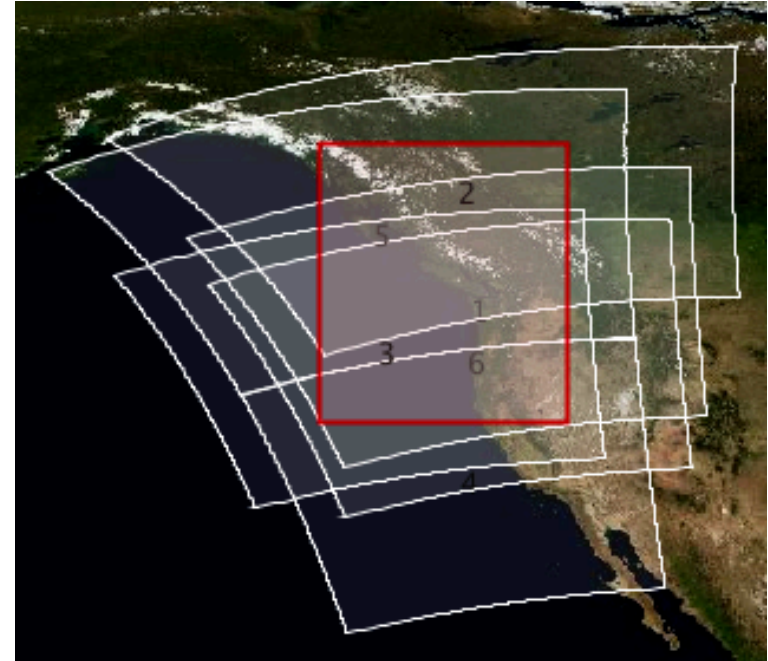
**Reproject** *Creates a mapped file from a source file*

- Input file
- Output file
  - Virtual
  - Save (real)
  - ✧ Hint: runs faster when creating virtual file because reprojection is only done when a band is viewed
- Coordinate reference system (CRS)
  - Set projection and its parameters
  - Choose from pre-defined EPSG CRS
  - Use the projection of existing file
- Resolution
- Geographic location and sizing parameters
- Interpolation method
  - Nearest neighbor, bilinear, ...
- View GPT parameters
- ❖ Applies validation criteria



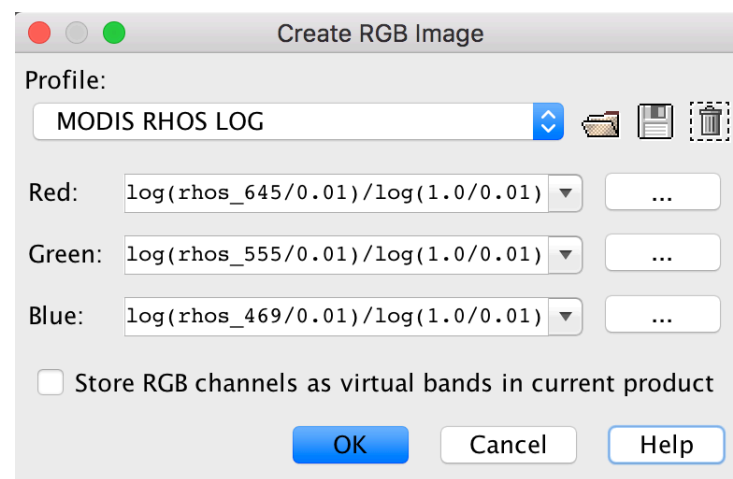
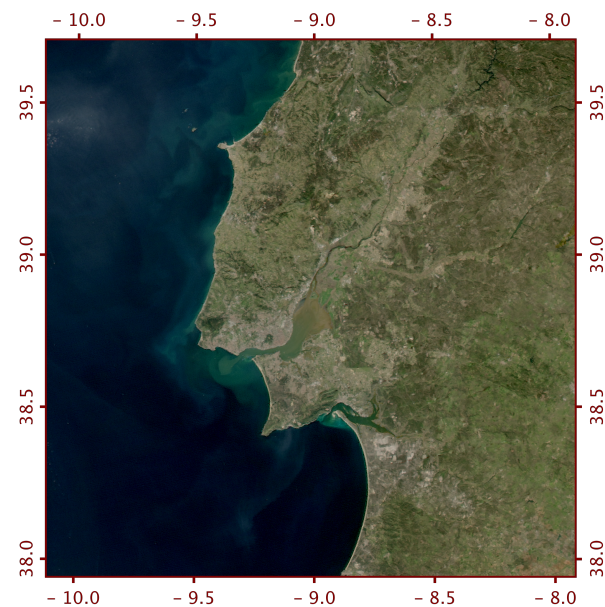
**Mosaic** *Aggregates multiple files with corresponding bands into a single mapped file*

- Input files
  - ✧ Hint: it is better to use mapped files as unmapped level-2 files are very inefficient
- Coordinate reference system (CRS)
  - Set projection and its parameters
  - Use projection of existing file
- Geographic coordinate boundaries
  - Type it in
  - Set with interactive graphic map
  - ✧ Boundaries of all source files displayed
- Bands
  - Specify band(s)
  - Math band using Expression Editor
- Masking
  - Input file masking using Expression Editor
- View GPT parameters
- ❖ [Orthorectification options available](#)



## RGB Image *Creates an additive color image (RGB color model) derived from bands in a file*

- ✧ RGB profiles are files which contain the mathematical expressions to create each of the red, green, and blue channels on the RGB image
- ✧ Most RGB profiles are mission dependent
- ✧ Only profiles which fully match the bands of the loaded file will be selectable
- Pre-defined RGB profiles
  - MODIS\_RHOS\_LOG
  - MODIS\_RHOS\_ATAN
  - GENERIC\_RGB\_LINEAR
  - GENERIC\_RGB\_LOG
  - ...
- Custom RGB profile
  - Expression Editor
  - Save/load
- Creates a band for each defined RGB channel
- Preferences page available
  - Auto-set color range and gamma



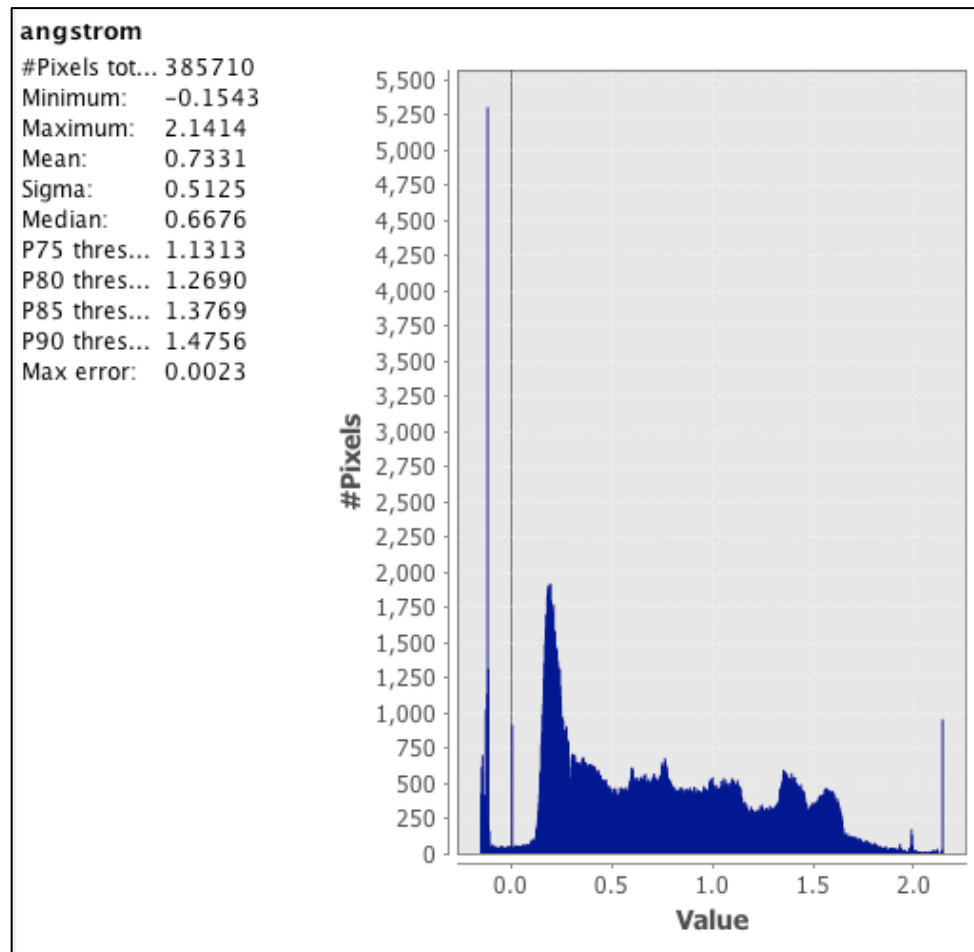
**Pins** *Adds a marker and mask to a given pixel of the raster*

---

- Interactive image placement
- Creates mask for a pinned pixels
- Pin Manager
  - Geographic location
    - Auto-changes to center of nearest pixel
  - Text label
  - Pin icon
    - Icon, color, visibility, ...
  - Import/export pin(s)
  - Display band pixel data in table form
  - Transfer pins to other files
- Used by
  - Pixel Info
  - Spectrum View
  - Time Series Tools
  - Pixel Extraction
  - ...

## Statistics *Creates statistics (with masking options) for a band*

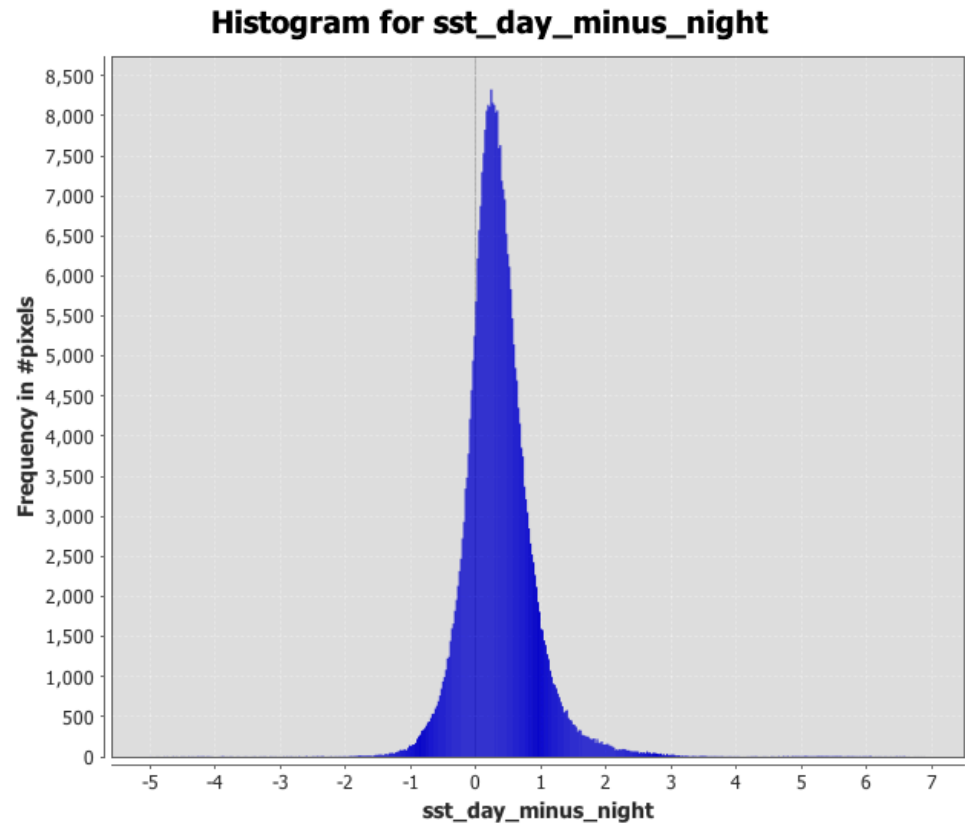
- Displays
  - Statistics for a band
  - Corresponding histogram plots
  - Corresponding percentile plots
- Binning
  - Bin count – set via an accuracy selector
- Masking
  - Region of interest (ROI) mask
- Format and export the plot images
- Export the histogram statistics data in spreadsheet form
- Add the statistics data to a vector
- ❖ **The median field is actually the median of the binned histogram data**
- ❖ **SeaDAS 7.5** will majorly revise this tool to include median, band and file info fields (including time) and many more criteria and options including a spreadsheet display





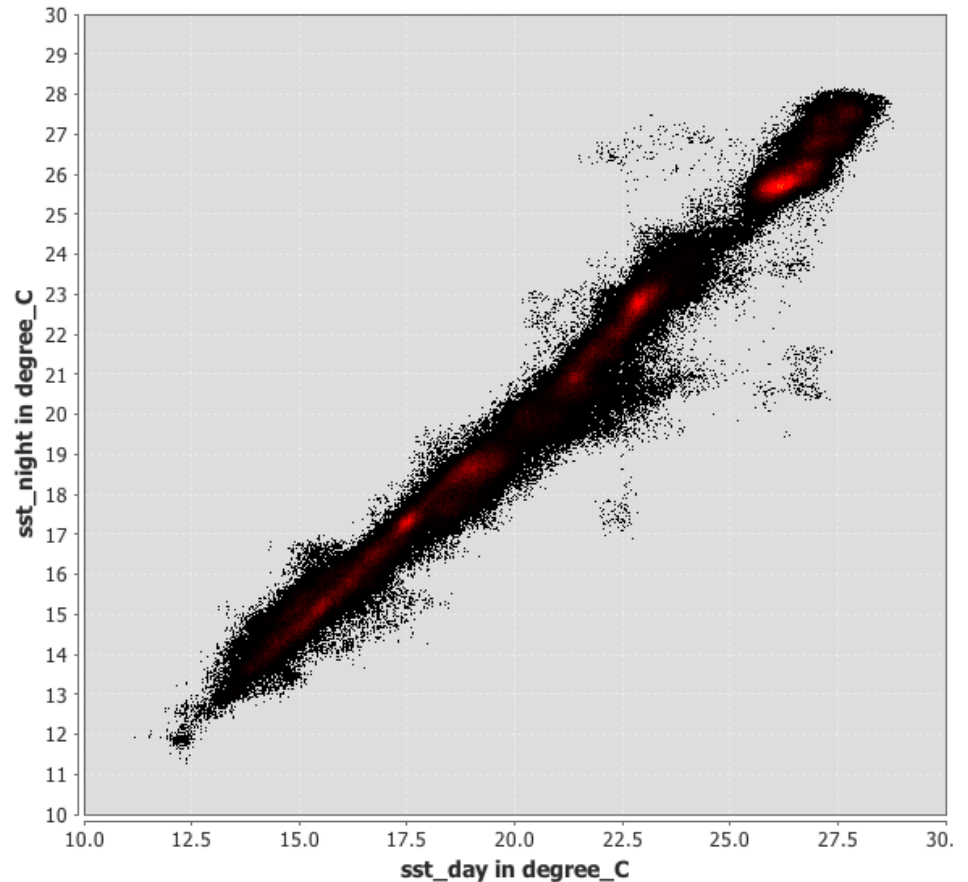
## Histogram Plot *Creates a histogram plot of a band*

- Input data
  - Selected band
- Binning
  - number of bins for histogram
  - bin range for histogram
- Masking
  - Region of interest (ROI) mask
- Format and export the plot
- Export plot data
  - spreadsheet form (csv) via the clipboard



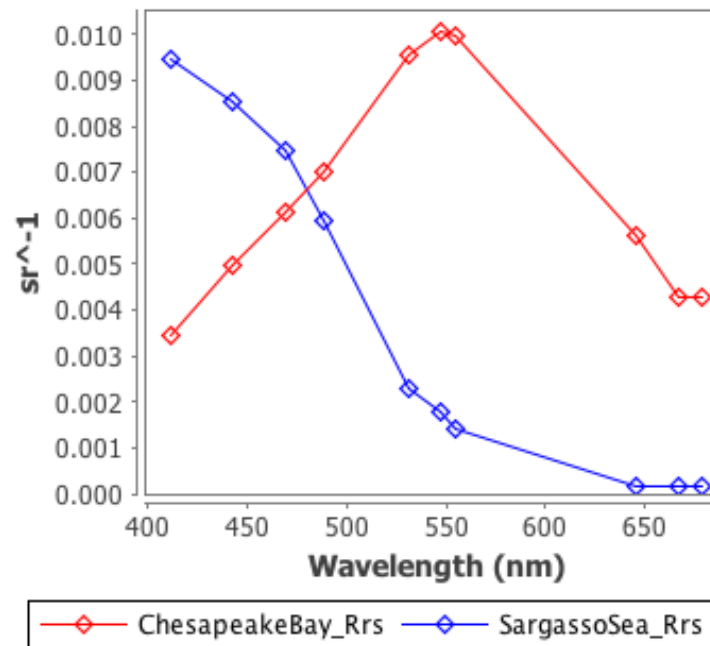
**Scatter Plot** *Creates a scatter plot of one band against another*

- Input data
  - Two bands
- Masking
  - Region of interest (ROI) mask applied to both bands
- Binning
  - Bin count = 512 (no user settings)
  - Bin range
    - Set bin range for each axis or
    - Default based on statistics of the bands
- Invert colors (which represent intensity)
- Format and export the plot



**Spectrum Plot** *Creates a plot of data across the wavelengths of “spectral” bands for any given pixel(s)*

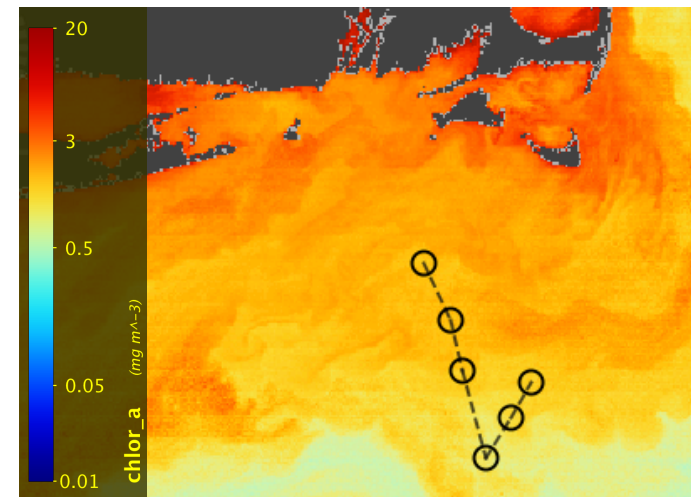
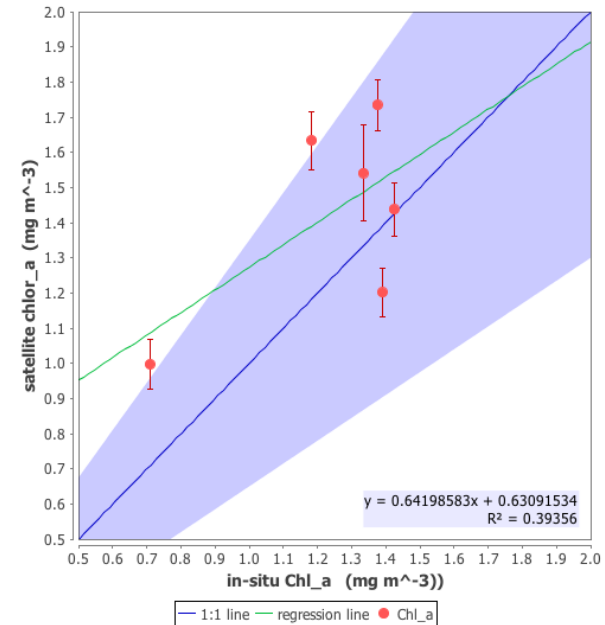
- Select desired band group(s) to plot spectrally
  - Rrs, rhos, Lw, ...
- Place pins over pixels of interest to create one plot line per pinned pixel
- Hover mouse to view dynamic spectrum line
- Modify pin name to affect legend name and pin color to affect line color in the plot
- Adjust range of X and Y axis
- Adjust axis labels and title
- Format and export the plot
- Export plot data
  - spreadsheet form (csv) via the clipboard
- ❖ Uses the band spectral wavelength metadata



Wavelength	ChesapeakeBay	SargassoSea
412	0.003450001	0.009456
443	0.004956001	0.008516
469	0.006150001	0.00745
488	0.006996001	0.005958
531	0.009536001	0.002298
547	0.010052001	0.001762
555	0.009972001	0.001408
645	0.005612001	1.76E-04
667	0.004278001	1.62E-04
678	0.004258001	1.56E-04

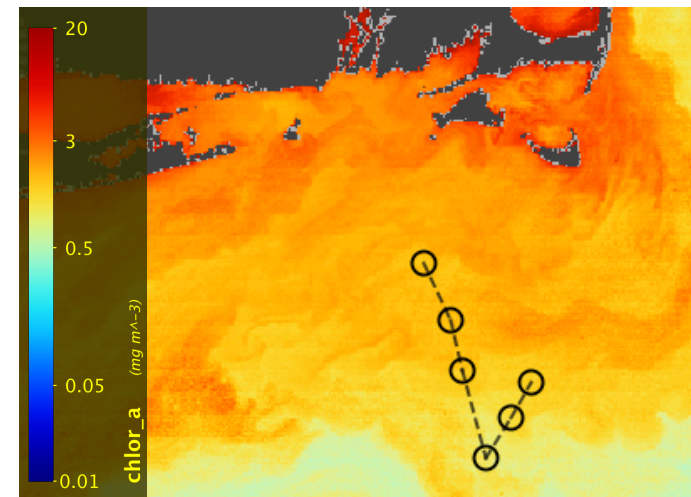
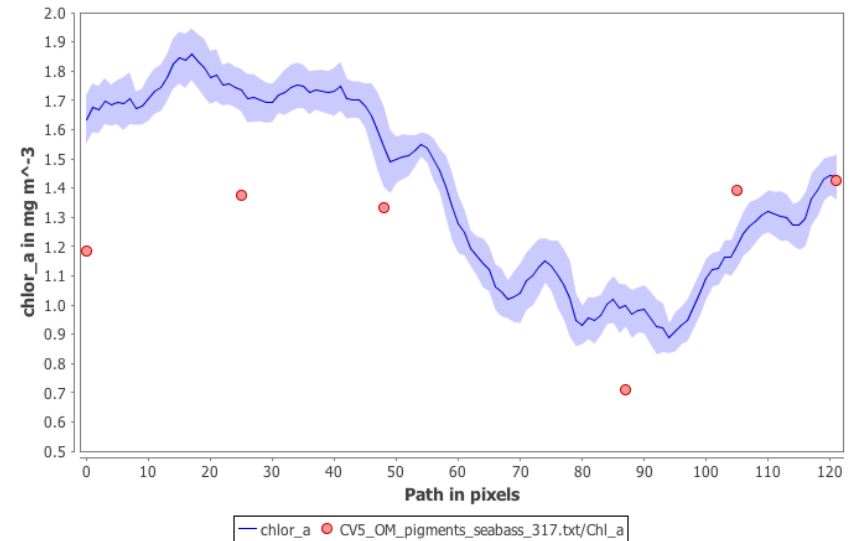
**Correlative Plot** *Creates a plot of in-situ data against the data of a band*

- Input data
  - Band
  - In-situ data field
- Pixel aggregation box size
  - Applied to band
  - ✧ Note: the center point is the aggregated mean, and the surrounding error bars are the standard deviation
- Masking
  - Region of interest (ROI) mask applied to band
- Tolerance
  - Percentage range (displayed in blue shade)
- Creates Regression line and equation
- Format and export the plot
- Export plot data
  - spreadsheet form (csv) via the clipboard



**Profile Plot** *Creates a plot of band and/or in-situ data along the path of a vector*

- Input data
  - Selected band
  - In-situ data field or vector
- Pixel aggregation box size
  - Applied to band
  - Note for plot of satellite data: the center point (or line) is the aggregated mean, and the surrounding error bars (or blue shade) is the standard deviation
- Masking
  - Region of interest (ROI) mask applied to band
- Plot satellite data
  - only at in-situ path locations
  - along the full vector path in-between points
- Pixel hover synchronization
  - Hover mouse over plot and view synchronized cursor band image
- Format and export the plot
- Export plot data
  - spreadsheet form (csv) via the clipboard



## SeaDAS Tools (Part 2)

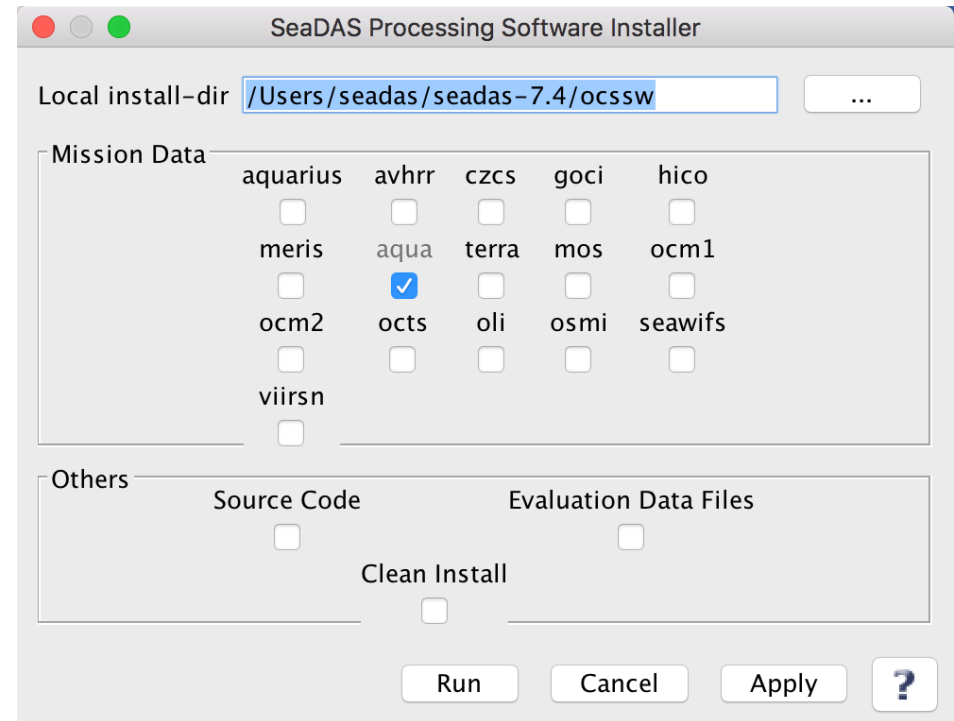
## Installer *Installs and updates the OCSSW processors*

- Installs and updates binaries
- Installs and updates source code
- ❖ OCSSW version updates can occur between SeaDAS version releases
- ✓ OLCI-S3A (currently command line only)
  - To install:
 

```
install_ocssw.py -i ${OCSSWROOT} -b v7.4 --olci
```
- Environment path
  - GUI configuration
    - Automated or...
    - Edit `${SEADAS_HOME}/config/seadas.config`

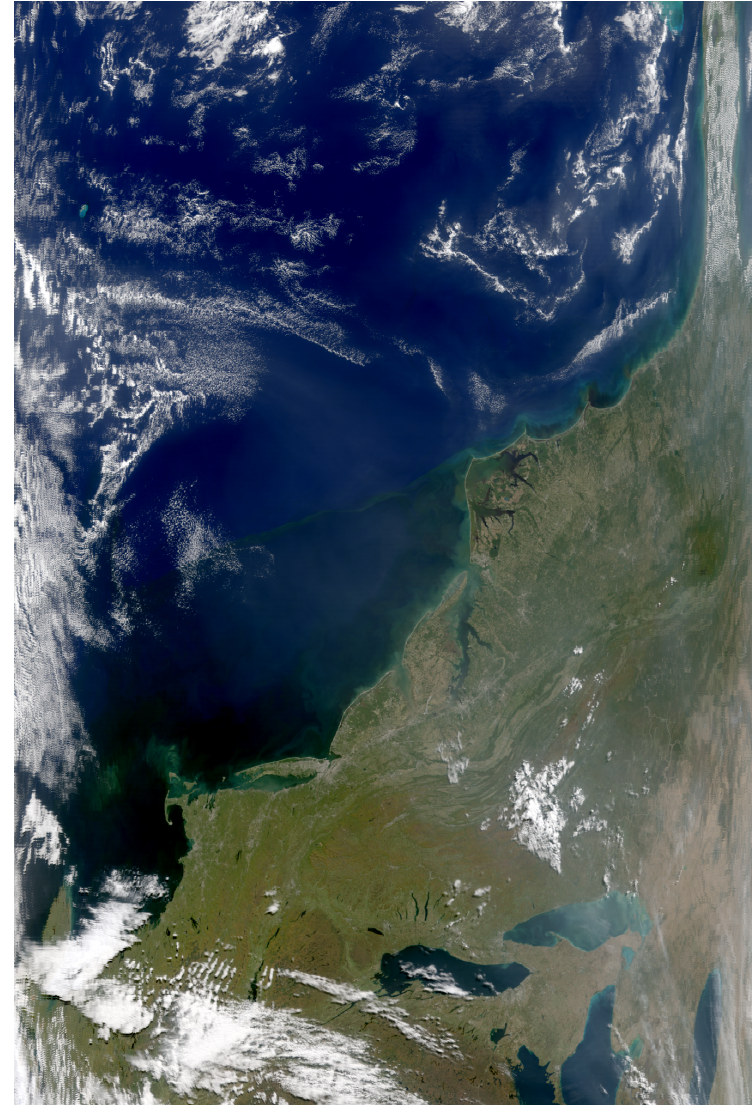
```
seadas.ocssw.root = [OCSSW_root_dir]
```
  - Command line configuration
    - User needs to set
    - Edit “.bashrc” (or equivalent) home file:
 

```
export OCSSWROOT=${SEADAS_HOME}/ocssw
source $OCSSWROOT/OCSSW_bash.env
```
- ❖ Processor failure will occur if mission not installed (and log message may not identify problem)



## Level 1 Browse Gen *Generates a true color "browse" image file from a level-1 file*

- Program
  - "l1brsgen"
- Input file
  - L1 (Mission dependent)
  - Geo file (MODIS/VIIRS only)
- Output file
  - "png", "ppm", ...
    - ❖ Default = HDF4
    - ❖ Does not add extension
- Parameters
  - Resolution (MODIS only)
  - RGB band selection
  - Subsampling interval
    - ❖ Default != 1 "therefore produces reduced size"
  - Atmospheric correction
    - ❖ Default = 0 "off"
  - Extract boundaries (pixel-based)
  - Palette range and scaling

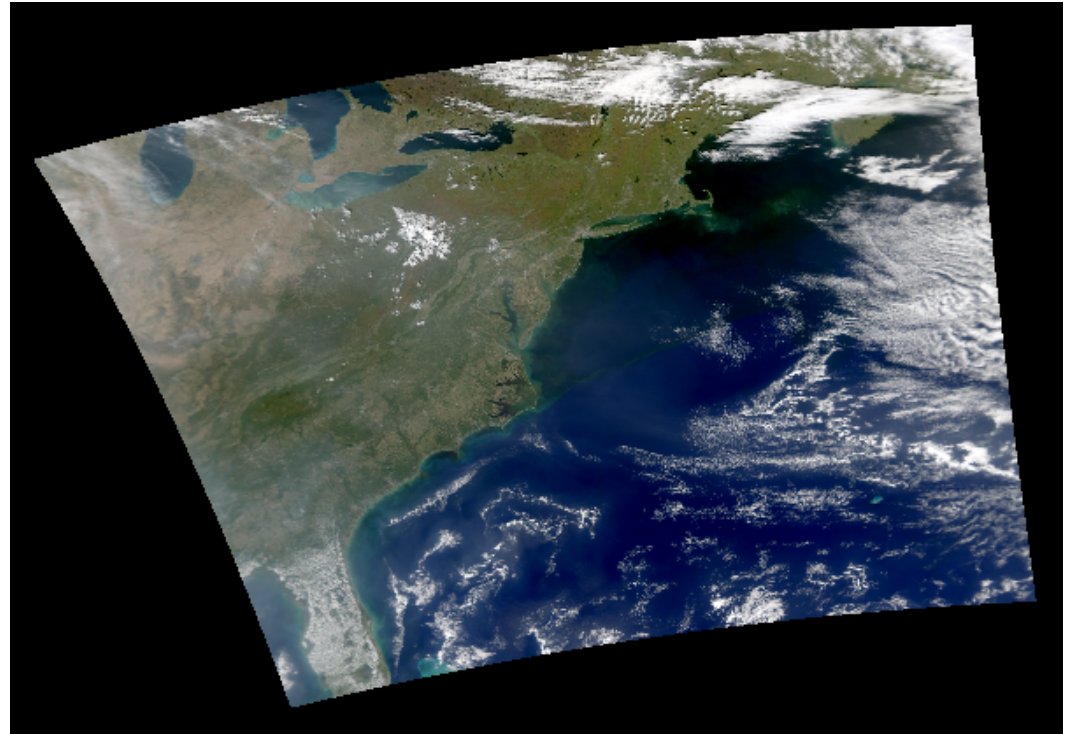


Atmospheric Correction = On



## Level 1 Map Gen *Generates a mapped true color image file from a level-1 file*

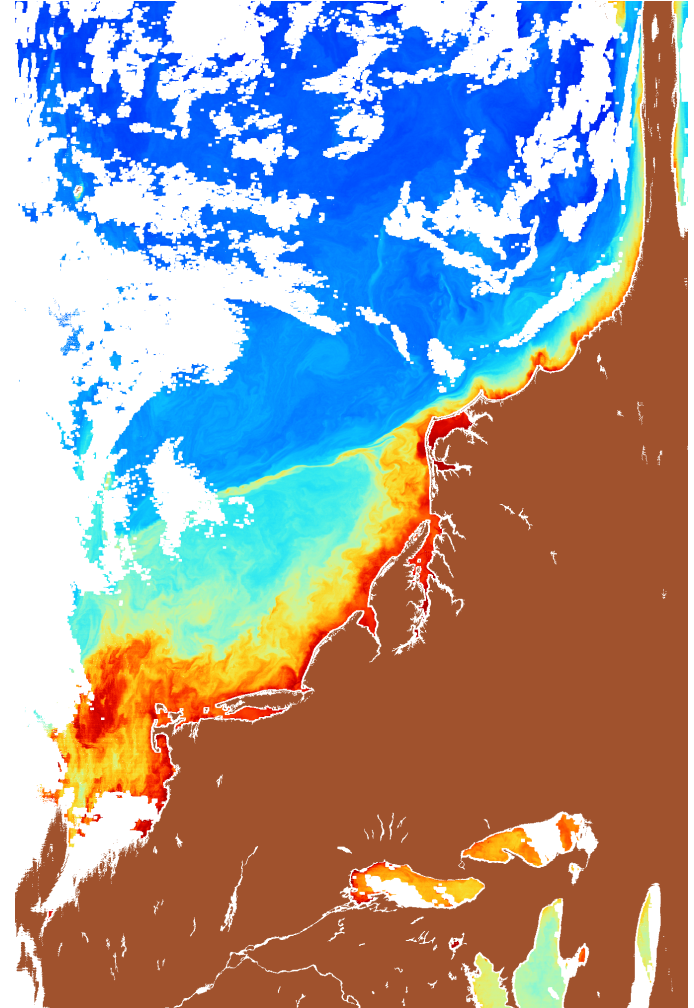
- Program
  - "l1mapgen"
- Input file
  - L1 (Mission dependent)
  - Geo file (MODIS/VIIRS only)
- Output file
  - "png", "ppm", ...
    - ❖ Default = ppm
    - ❖ Does not add extension
- Parameters
  - Resolution (MODIS only)
  - RGB band selection
  - Subsampling interval
    - ❖ Default != 1 "produces reduced size"
    - ❖ Parameter name not included in help
  - Atmospheric correction
    - ❖ Default = 0 "off"
  - Extract boundaries (pixel-based)
  - Palette range and scaling



Atmospheric Correction = On

## Level 2 Browse Gen *Generates a product "browse" image file from a level-2 file*

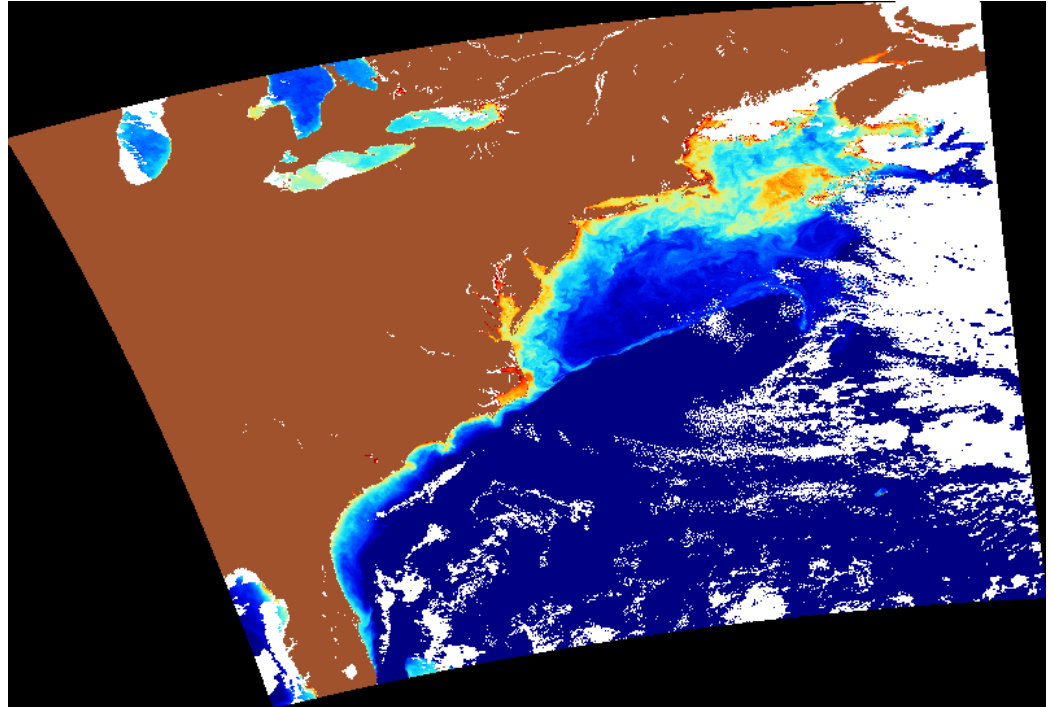
- Program
  - "l2brsgen"
- Input file
  - L2
- Output file
  - "png", "ppm", ...
    - ❖ Default = HDF4
    - ❖ Does not add extension
- Parameters
  - Level-2 product name
  - Flag masking
  - Subsampling interval
    - ❖ Default != 1 "produces reduced size"
  - Extract boundaries (pixel-based)
  - Palette (greyscale, default lookup or pal file)
  - Palette range and scaling
- ❖ Retains original data raster (does not re-orient images)
- ❖ `$OCDATAROOT/common/l2brsgen_product_table.dat`  
(`apply_pal=1`)
- ❖ Last 5 lines of pal file reserved for flags
- ❖ Cannot disable LAND flag



dpixl=1 dline=1; Color manager export palette (PAL)  
Last 5 lines set for masking

## Level 2 Map Gen *Generates a mapped product image file*

- Program
  - "l2mapgen"
- Input file
  - L2
- Output file
  - "png", "ppm", ...
    - ❖ Default = ppm
    - ❖ Does not auto-add extension
- Parameters
  - Product
  - Resolution (MODIS only)
  - Output image resolution "width"
    - ❖ Default != 1 "produces reduced size"
  - Atmospheric correction
    - ❖ Default = 0 "off"
  - Extract boundaries (pixel-based)
  - Palette (greyscale, default lookup or pal file)
  - Palette range and scaling
  - Apply masking
  - ❖ Does not ignore comment line in PAL file



Chlor\_a - universal\_bluered palette  
datamin=0.15 datamax=50

## Level-2 Gen *Creates a level-2 file from an appropriate level-1 input file*

---

- Program
  - "l2gen", "l2gen\_aquarius"
- Input file
  - Level 1 file (A/B mission dependent)
  - Geo file (MODIS/VIIRS only)
- Output file
  - Level-2 file identical with NASA-OBPG
  - Level-2 file with desired products and criteria
- Product(s)
  - Radiances/Reflectances
  - Derived Geophysical Parameters
  - Inherent Optical Products
  - Ancillary/Meteorological/Geometric Parameters
  - Atmospheric Correction Intermediates
  - Uncertainties/Error Estimates
  - Miscellaneous
  - ❖ **Product availability, resolution and quality are mission dependent**
- Product suite
  - Pre-defined (OC, IOP, SST, ...)
  - Custom
- Parameters
  - Processing Options
    - Atmospheric correction, masking, ...
  - Subsetting Options
  - Thresholds
    - cloud\_thresh, epsmin, epsmax, satzen, ...
  - Ancillary Input Data
    - ice, land, met, ozone, ...
  - IOP Options
  - Calibration Options
  - Resolution (currently only MODIS)
  - ❖ **Parameter defaults are what is used in OBPG production**
- ❖ **Many supported satellite missions**
  - MODIS, VIIRS, MERIS, SeaWiFS, OLI, OLCI, ...
- ✓ **OLCI-S3A (currently command line only)**
  - To run:  
`l2gen ifile=oa01_radiance.nc ofile=output.nc`

## Get Ancillary *Retrieves ancillary data*

### ➤ Program

- "getanc.py"

ocproc\_getanc



### ➤ Input file

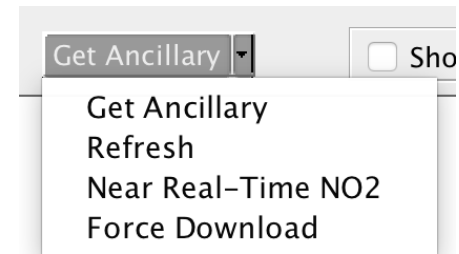
- L1A or L1B

### ➤ Output file

- Text file with extension ".anc"

### ➤ GUI access

- Level-2 Gen
- Multilevel Processor



```
# ANCILLARY INPUTS Default = climatology (select 'Get Ancillary' to download ancillary files)
icefile=/Users/seadas/seadas-7.4/ocssw/run/var/anc/2010/283/N201028300_SEAICE_NSIDC_24h.hdf
met1=/Users/seadas/seadas-7.4/ocssw/run/var/anc/2010/283/N201028318_MET_NCEPR2_6h.hdf
met2=/Users/seadas/seadas-7.4/ocssw/run/var/anc/2010/284/N201028400_MET_NCEPR2_6h.hdf
met3=/Users/seadas/seadas-7.4/ocssw/run/var/anc/2010/284/N201028400_MET_NCEPR2_6h.hdf
ozone1=/Users/seadas/seadas-7.4/ocssw/run/var/anc/2010/283/N201028300_O3_AURAOMI_24h.hdf
ozone2=/Users/seadas/seadas-7.4/ocssw/run/var/anc/2010/284/N201028400_O3_AURAOMI_24h.hdf
ozone3=/Users/seadas/seadas-7.4/ocssw/run/var/anc/2010/284/N201028400_O3_AURAOMI_24h.hdf
sstfile=/Users/seadas/seadas-7.4/ocssw/run/var/anc/2010/283/N2010283_SST_OIV2AVAM_24h.nc
```

## **Geo Locate** *Creates geo-location files*

---

### ➤ Programs

- "modis\_GEO" (MODIS)
- "geolocate\_viirs" (VIIRS)

## **Calibrate / Level-1B Gen** *Applies calibration and generates a level-1B file*

---

### ➤ Programs

- "l1bgen" (Not MODIS and VIIRS)
- "modis\_L1B" (MODIS only)
- "calibrate\_viirs" (VIIRS only)

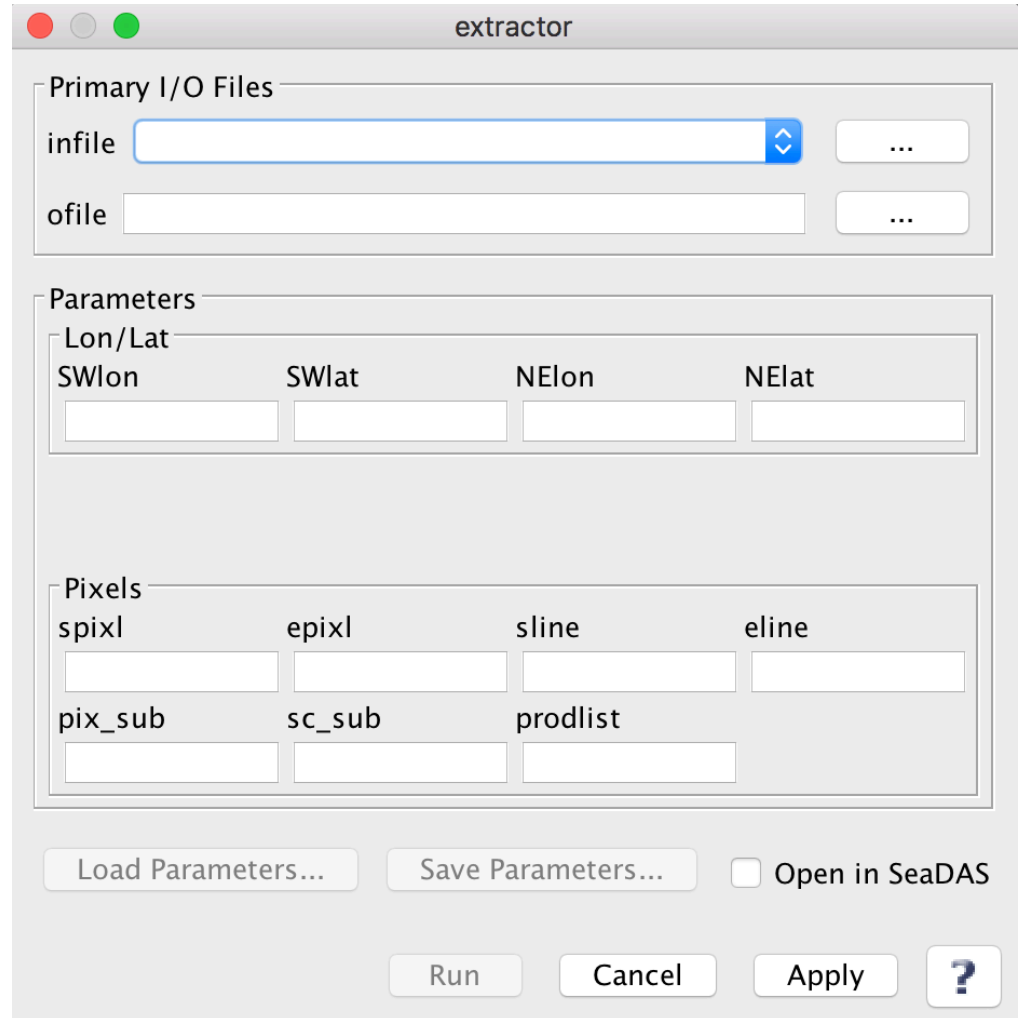
**Extractors** *Extracts spatially and by product, as well as subsamples level-2 files and level-1 files*

➤ Programs

- "l1aextract\_seawifs"
- "l1aextract\_modis"
- "l2extract"

➤ Parameters

- Boundaries
  - Geographic
  - Pixel
- Subsampling
  - ❖ "l1aextract\_seawifs" and "l2extract" only
- Products
  - ❖ "l2extract" only



extractor

Primary I/O Files

infile  ...

ofile  ...

Parameters

Lon/Lat

SWlon	SWlat	NElon	NElat
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Pixels

spixl	epixl	sline	eline
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
pix_sub	sc_sub	prodlist	
<input type="text"/>	<input type="text"/>	<input type="text"/>	

Load Parameters... Save Parameters...  Open in SeaDAS

Run Cancel Apply ?





## Level-2 Bin *Creates a level-3 bin file from any number of level-2 input files*

- Program
  - "l2bin", "l2bin\_aquarius"
- Input file
  - Level-2 file
  - Text list of level-2 files
- Output file
  - Level-3 bin file identical with NASA-OBPG
  - Level-3 bin file with desired products and criteria
- Product(s)
- Parameters
  - Spatial resolution
    - 500m, 1km, 2km, 4km, 9km, ...
  - Temporal resolution (optional)
    - day, 8-day, month, season, year
  - Time frame (optional)
    - start day, end day
  - Validation flags (or use OBPG defaults)

❖ Level-2 files of multiple missions may be binned together

❖ Note: no option for limiting geographic boundaries

## OCSSW Binning Methodology and Rules

- Integerized sinusoidal map projection with a modification which divides the Earth into bins of roughly equal area
- Each source data point goes into precisely one bin
- For each source data point, all products being binned must pass validation criteria
- Bin height is based on angular latitudinal distance (even fractions of 1°)
- Bin width is set for each latitude row, to achieve as close to equal Earth surface area as possible

Angular Distance (Latitude)	Number of Rows	Average Bin Height	Short Name
1/12°	2160	9.28 km	9
1/24°	4320	4.64 km	4
1/48°	8640	2.32 km	2
1/96°	17280	1.16 km	1
1/192°	34560	580 m	H
1/384°	69120	290 m	Q

## Level-3 Bin *Creates a level-3 binned file from any number of level-3 bin input files*

- Program
  - "l3bin"
- Input file
  - Level-3 bin file
  - Text list of level-3 bin files
- Output file
  - Level-3 bin file
- Product(s)
- Parameters
  - Downsampling "reduction" factor
  - Geographic boundaries
- ❖ Note: follows the same binning rules as l2bin except without the validation criteria options (flag, quality and temporal)

## OCSSW Binning Methodology and Rules

- Integerized sinusoidal map projection with a modification which divides the Earth into bins of roughly equal area
- Each source data point goes into precisely one bin
- For each source data point, all products being binned must pass validation criteria
- Bin height is based on angular latitudinal distance (even fractions of 1°)
- Bin width is set for each latitude row, to achieve as close to equal Earth surface area as possible

Angular Distance (Latitude)	Number of Rows	Average Bin Height	Short Name
1/12°	2160	9.28 km	9
1/24°	4320	4.64 km	4
1/48°	8640	2.32 km	2
1/96°	17280	1.16 km	1
1/192°	34560	580 m	H
1/384°	69120	290 m	Q



## Level-3 Bin Dump *Generates metadata for requested bins of a level-3 bin file*

- Program
  - "l3bindump"
- Input file
  - Level-3 bin file
- Output
  - Writes to standard out
- Parameters
  - Bin number
  - Geographic boundaries
    - Lat, lon and radius
    - North, south, west, east

bin	centerlat	centerlon	north	south	west	east	n	N	chlor_a sum	chlor_a sum_squared	weight	mean	stdev
68794408	26.59375	-79.92364	26.60417	26.58333	-79.93529	-79.91199	1	1	1.47619843e-01	2.17916183e-02	1.00000000e+00	0.14762	0.00000
68794410	26.59375	-79.87704	26.60417	26.58333	-79.88869	-79.86539	1	1	1.28224939e-01	1.64416358e-02	1.00000000e+00	0.12822	0.00000
68809859	26.61458	-79.92751	26.62500	26.60417	-79.93916	-79.91586	2	1	2.12122470e-01	3.18170451e-02	1.41421354e+00	0.14999	0.00039

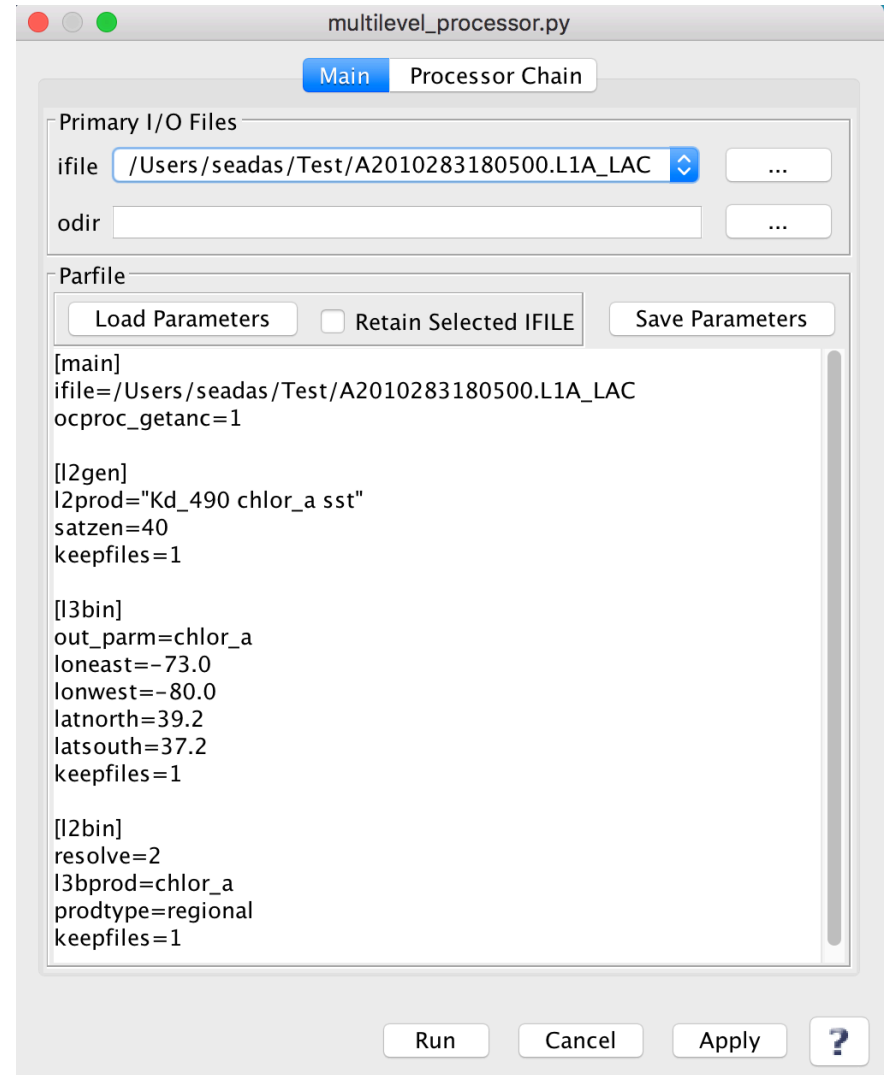
## Level-3 Map Gen *Creates a level-3 mapped file from a level-3 bin input file*

---

- Program
    - "l3mapgen"
  - Input file
    - Level-3 bin file
  - Output file
    - Level-3 mapped file
      - Level-3 smi file identical with NASA-OBPG
      - Level-3 mapped file with desired products and criteria
    - Format
      - netCDF4, png, TIFF, ...
  - Product(s)
  - Parameters
    - Map projection
      - Pre-defined projections
        - smi, platecarree, raw, ...
      - Enter a projection string (proj4)
        - "+proj=laea +lat\_0={value} +lon\_0={value}"
    - Interpolation method
      - nearest neighbor, bin, area
- Geographic boundaries and central meridian
  - Threshold on minimum pixels to produce image
  - Expansion tolerance for target pixels
    - Helps fill more of the mapped pixels (AKA fudge factor)
  - Color palette
    - Range (min and max)
    - Scaling (log or linear)
  - Produce an RGB image using 3 bands contained within the input bin file
- ❖ Geo-coding is included when using netCDF4 output format (currently only for the smi, and platecarree selected projections)
  - ❖ Note: this tool replaces the earlier tool "smigen"

## Multilevel Processor *Wraps and runs a chain of key OCSSW processors*

- Program
  - “multilevel\_processor.py”
- Input file(s)
  - First OCSSW processor input file in chain
  - Parameter text file
    - May contain the OCSSW input file
- Output file(s)
  - OCSSW processor output file(s)
- Parameters
  - Processor(s)
    - With parameter criteria for each
  - “keepfiles”
    - retains output files
  - “use existing”
  - “overwrite”
  - “ocproc\_getanc”
    - Runs getanc.py
- ❖ Runs any intermediate processors needed to achieve request
- ❖ All intermediate and output files are auto-named
- ❖ This tool does not yet support “l3mapgen”



## SeaDAS Tools (Part 3)

**GPT** *Many of the SeaDAS tools can be run alone or in a chain from the command line*

---

➤ Inputs

- Operator
  - node
- Processing graph file
  - XML format
- Source file
- Target file
- Parameters
  - Can be obtained from help
  - Can be obtained from GUI

✓ Runs on Mac, Unix, Linux, Windows

❖ Source file(s), target file and parameters may be either in graph file or command line

❖ GPT = Graph Processing Tool

➤ GPT Operators

- BandMaths
  - MathBand
- Collocate
  - Collocate
- Mosaic
  - Mosaic
- PixEx
  - Pixel Extraction
- Read
  - Open File
- StatisticsOp (note version 7.5 revision)
  - Statistics
- Subset
  - Crop
- Write
  - Export File
- WriteImage
  - Mask Manager, Contour, Text Annotation, Map Gridlines, Color Manager, Export Image
- Bathymetry (not supported yet)
  - Bathymetry & Elevation
- LandWaterMask (not supported yet)
  - Coast, Land & Water

## Pixel Extraction *Extracts data value(s) at user-specified coordinates into a text file*

---

### ➤ Geographic location

- Pins
- Geographic coordinates and datetime
- Import “coordinates” file
- Import “datetime-coordinates” file

### ➤ Aggregation

- Matrix size
  - 1, 3x3, 5x5, 7x7, ...
- Statistical operation
  - mean, median, min, max

### ➤ Validation

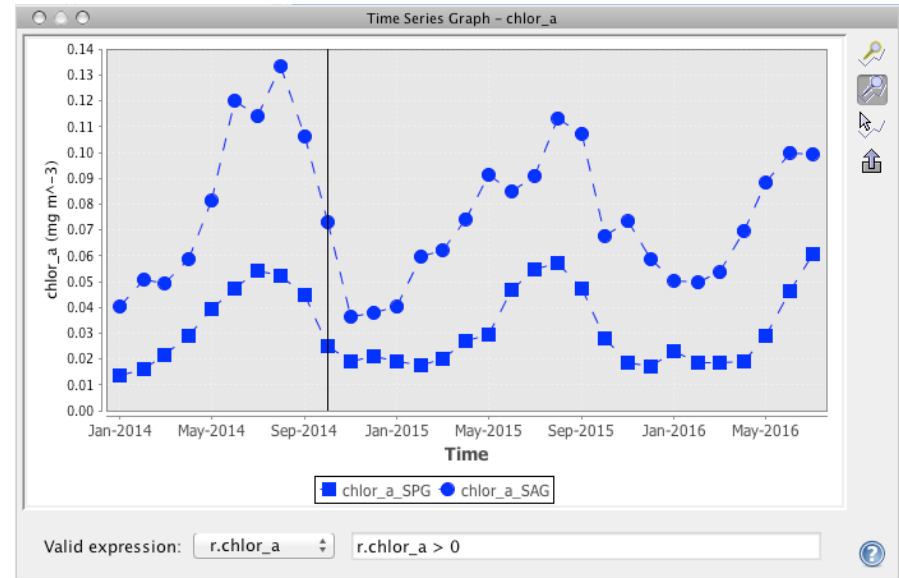
- Time difference
  - Data must contain time information
- Masks
  - Notably the level2 file quality flags (e.g., straylight, cloud-ice, sensor zenith angle, ...)

<u>DateTime</u>	<u>Name</u>	<u>Lat</u>	<u>Lon</u>
2010-11-13T12:03:00	52A	40.7537	-70.7162
2010-11-13T14:05:00	53A	40.5477	-70.5050
2010-11-13T15:32:00	53B	40.3522	-70.3797
2010-11-13T18:02:00	54	40.0255	-70.1460
2010-11-13T20:00:00	54A	40.2033	-70.0627
2010-11-13T21:18:00	55	40.3577	-69.9882

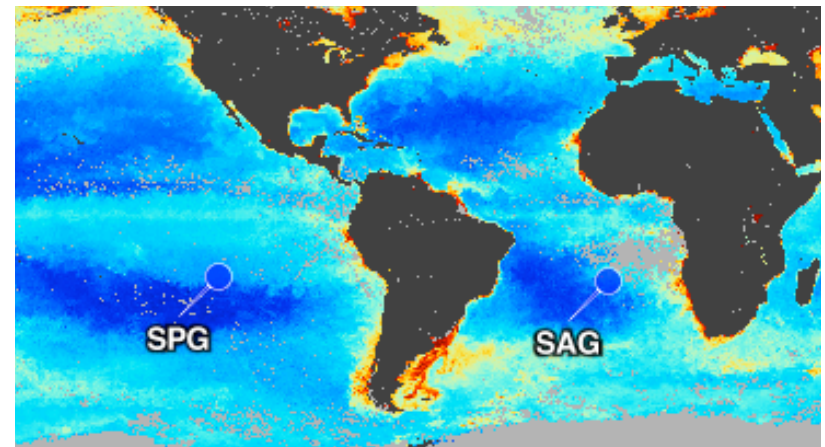


## Time Series Tools *Combines many time-stamped files for trending analysis of band data*

- Choose files and bands to join together into a time series file
  - Notes: bands of time series file will be named to contain source time info
- Projection and geographic boundaries
  - Source files (if identical)
  - Use the projection of existing file
- Time series plots (note: single pixel based)
  - Pinned pixels
  - Mouse-hovered pixels
- Import in-situ data
  - [currently does not support SeaBASS]
- Option to manually set time range
- View surrounding pixel matrix for any band at mouse hover position
- Play and export an animated gif
  - [very limited: no formatting and uses gray-scale color palette]



Aqua L3 Chlorophyll Monthlies Time Series



Sept 2014 Aqua L3 Chlorophyll Monthly

**Filter Band** *Creates a band by applying a convolution or non-linear filter to an existing band*

➤ Convolution filters

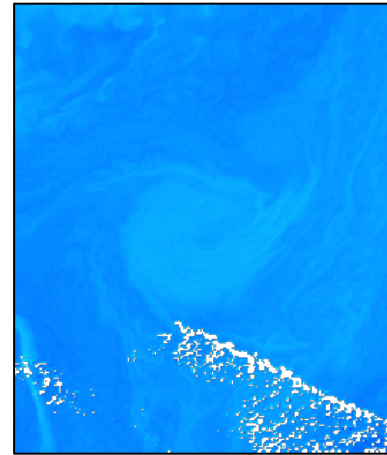
- Arithmetic Mean
- Straylight Mean
- High-pass
- ...

➤ Non-linear filters

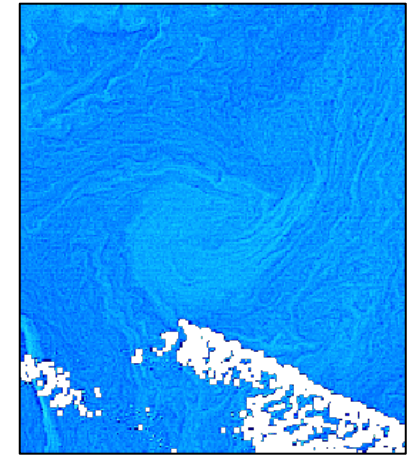
- Mean
- Median
- Standard Deviation
- ...

➤ Custom filter

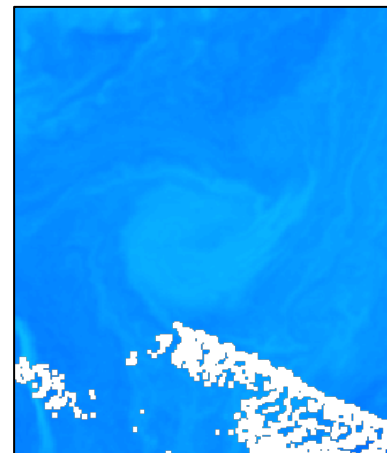
- Criteria
  - Operation
  - Kernel size
  - Kernel weighting and quotient
  - Name and suffix
  - Tags
- Save/Load



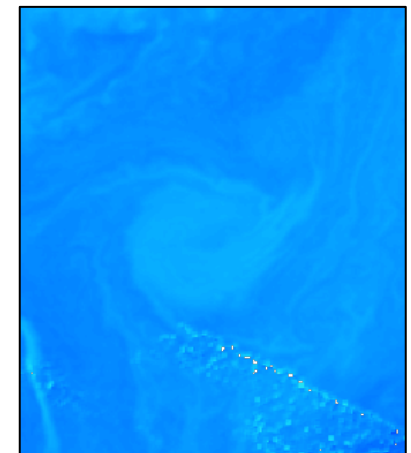
Original



High-Pass #1 (3x3)



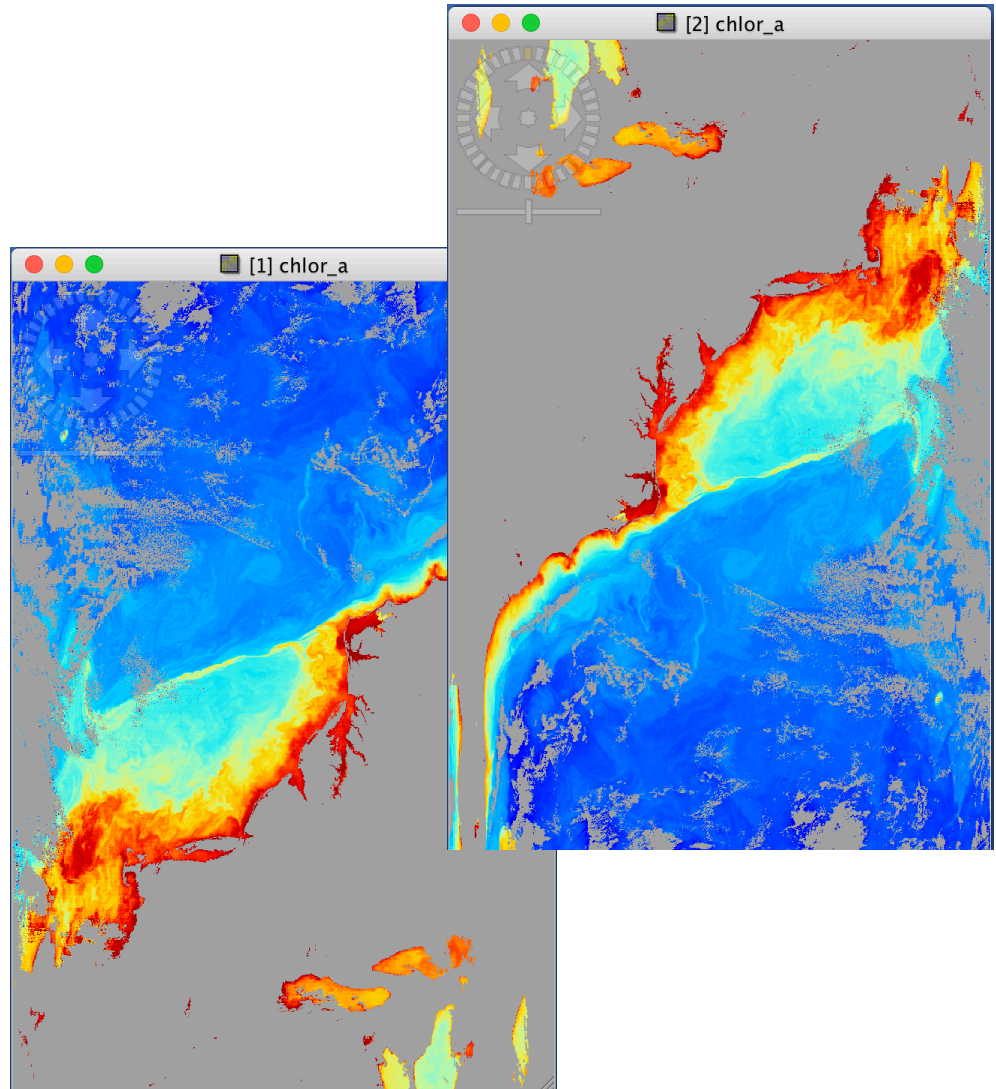
Arithmetic Mean(3x3)



Mean (3x3)

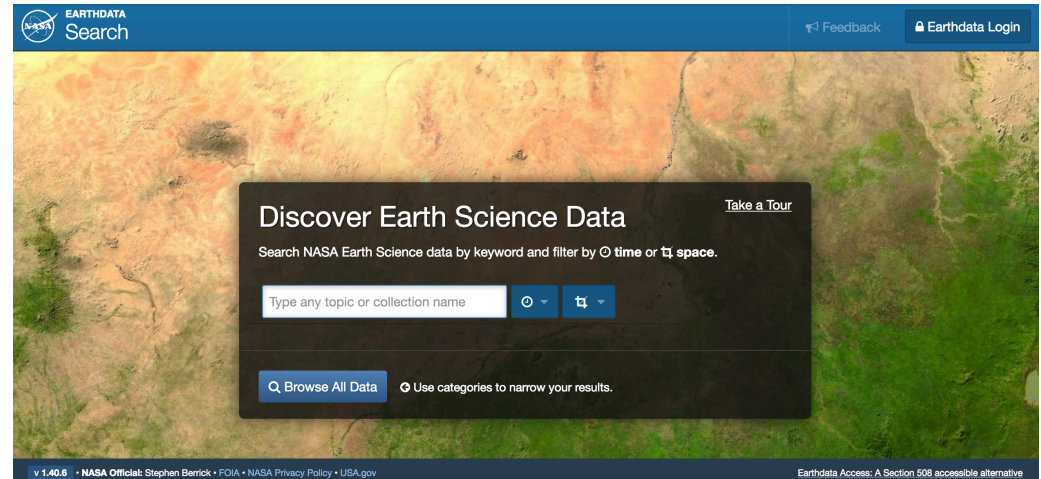
## Flip Data *Flips data (vertically and/or horizontally) to create a new file*

- Flip
  - Vertically
  - Horizontally
  - Vertically and horizontally
- ❖ Note: this could be useful in the case of some instruments, due to having an ascending orbit or due to their scan direction, may have data inverted in some fashion from that of a standard map view.
- ❖ Note: for supported missions SeaDAS automatically flips the data so this tool is less needed for this data.



## Find Matchup *Finds and downloads criteria/SeaBASS matched level-2 files from the OB.DAAC*

- Program
  - “fd\_matchup.py”
- Output file(s)
  - Level-2 file(s)
  - Standard output
    - Level-2 granule names and download links
- Parameters
  - Satellite name
  - Suite name
    - oc, iop, sst
  - Matchup criteria
    - Geographic location/boundaries
    - Time difference
  - SeaBASS file
    - Contains time and location



- ❖ Searches for satellite granules via the EarthData Common Metadata Repository (CMR)
- ❖ Command line only (currently)

More info: [https://seabass.gsfc.nasa.gov/wiki/validation\\_matchup\\_tools](https://seabass.gsfc.nasa.gov/wiki/validation_matchup_tools)

## Make Matchup *Adds satellite level-2 matchup data to in-situ data (SeaBASS file)*

- Program
  - “mk\_matchup.py”
- Input file(s)
  - SeaBASS file
  - Level-2 file
- Output file
  - SeaBASS file (with satellite matchups added)
- Parameters
  - Clobber flag
    - Write to original SeaBASS file
  - Geographic location information
    - Override lat/lon in SeaBASS file
  - Custom validation criteria
    - Geographic matrix pixel size
    - Satellite pixel count
      - as ratio with matrix size
    - Time difference
    - Coefficient of variation
      - OC suite only
- Flag masking constraints
  - Level-2 flags
    - (see table)
  - Level-2 SST quality QC rating

- ❖ Applies exclusion criteria from Bailey and Werdell, 2006 (exception: max solar zenith of 70 degrees instead of paper’s 75 degrees)
- ❖ Command line only (currently)
- ❖ Does NOT adjust in situ values to water-leaving values
- ❖ Does NOT correct for over-sampling in time and space

L2 Flags Applied	Meaning
LAND*	Pixel is over land
HIGLINT	Sunglint: reflectance exceeds threshold
HILT	Observed radiance very high or saturated
HISATZEN	Sensor view zenith angle exceeds threshold
HISOLZEN	Solar zenith exceeds threshold
STRAYLIGHT	Probable straylight contamination
CLDICE	Probable cloud or ice contamination
ATMFAIL	Atmospheric correction failure
LOWLW	Very low water-leaving radiance
NAVFAIL*	Navigation failure
NAVWARN*	Navigation quality is suspect

Matchup flags (SST on uses flags indicated by asterisk)

More info: [https://seabass.gsfc.nasa.gov/wiki/validation\\_matchup\\_tools](https://seabass.gsfc.nasa.gov/wiki/validation_matchup_tools)



## **Layout Tools** *Save and load GUI layout (e.g., window sizes, windows docked, toolbars displayed, ...)*

---

- Feature



## **Sessions Tools** *Save and load GUI sessions (e.g., loaded files, opened band image windows, ...)*

---

➤ Feature



## **Preferences Tools** *Set configuration preferences for many of the tools*

---

- Feature





## **Geo-Coding Attachment Tools** *Define, modify or remove the file geo-coding (i.e., pixel coordinates)*

---

- Feature



**Module Manager** *Update, install, remove exchangeable software components (e.g., file readers, ...)*

---

➤ Feature



**GCP Tools** *Add geo-coding to a file by defining the coordinates of one or more pixel(s) of the raster*

---



**Mask Area** *View pixel count and world surface area of a masked region in a file*

---

➤ Feature

**Geo-Coding Info** *View coordinate reference system and map location boundaries of a file*

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➤ Feature



**World Map Layer** *Display an image of the Earth below an image view (e.g., NASA Blue Marble)*

---

➤ Feature



## **SeaBASS** *Import SeaBASS format in situ data*

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## **Text Annotation Tools** *Display text annotation on an image view*

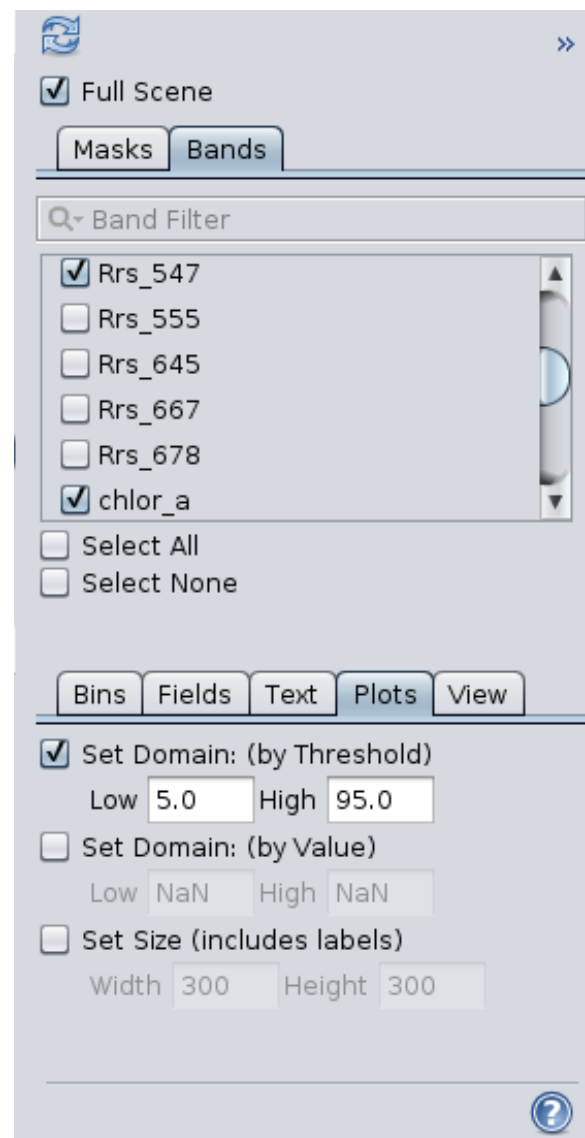
---

- Feature



## Statistics (7.5) *Creates a spreadsheet of statistics (with masking options) and band info for all bands*

- ✓ Multi-band spreadsheet added
- ✓ Binning run criteria added
  - Bin\_Count *(replaces accuracy)*
  - Bin\_Min, Bin\_Max, Bin\_Width
- ✓ Fields added
  - Median
  - PercentThreshold *(user defined values)*
  - File info fields
    - Name, Format, Time fields, ...
  - Band info fields
    - Units, Valid\_Pixel\_Expression, ...
  - Binning criteria fields
- ✓ Fields renamed
  - Standard\_Deviation was sigma
  - Bin\_Width was Max error
  - Median\_Binned was median
- ✓ Plot format options
  - set x-axis range by desired percent threshold
- ✓ Text format options
  - define decimal places
- ✓ Percentile Plot
  - line plot, inverted with band data as x-axis



**Statistics (7.5)** *Creates a spreadsheet of statistics (with masking options) and band info for all bands*

## Screenshot Preview of SeaDAS 7.5 Statistics Tool

