

# MANUAL FOR WORKING WITH MODIS IMAGES IN SEADAS 6.2

Version 2011

*By : Vera De Cauwer, Polytechnic of Namibia*

This manual was written for the students of the School of Natural Resources and Tourism, Polytechnic of Namibia during the pilot project “Assessing potential to produce final Ocean Colour maps of Namibia’s marine environment”, which is supported by the BCLME Programme and the Polytechnic of Namibia.

The manual is written for students working with the SeaDAS software on the Linux computer of the Department of Land Management (operating system is Fedora Core 10) or the version of SeaDAS which can be installed in Windows through a virtual application Vmware player (seadasva). The images used are MODIS Aqua provided by NASA (HDF version 4 format).

## Table of Contents

A. Downloading MODIS images.....	2
B. Decompressing MODIS images.....	3
1. In Linux.....	3
2. In Windows.....	3
C. Processing in SeaDAS.....	4
1. Start SeaDAS.....	4
2. Displaying MODIS products.....	4
2.1 L2 products.....	4
2.1.1 Load and display L2 product.....	5
2.1.2 Give color to L2 image.....	5
2.1.3 Projecting images.....	6
2.1.4 Exploring the L2 product.....	7
2.1.5 Creating true colour images.....	7
2.1.6 Layout.....	7
2.1.7 Saving as a picture.....	8
2.1.8 Creating profile.....	8
2.1.9 Display flags.....	8
2.1.10 Make a bit map of a flag.....	9
2.2 L1 products.....	9
3. Exporting MODIS products.....	10
D. Processing in ILWIS.....	11
1. Creating colour composite.....	11
2. Digitising plumes.....	11
3. Export ILWIS segment map.....	12
D. Final processing in ArcView.....	12
Convert imported line files to polygons.....	12

## A. Downloading MODIS images

Select and download Level 1 and 2 images from the Ocean Color website :

<http://oceancolor.gsfc.nasa.gov/cgi/browse.pl?sen=am>

(or go the OceanColor website at <http://oceancolor.gsfc.nasa.gov/> and click on the Level 1 and 2 Browser).

You will be able to enter the parameters of the image(s) you are searching for. Enter the following details :

**Sensors:** MODIS(Aqua) and MODIS (Terra)

Select one or more regions: **NamibiaCoast (or:** region bounded by N: -17.0S, S: -28.0S, W: 10.0 and E:16.0)

**Mission:** indicate period desired (if you want the entire mission, do not indicate any period)

Click on **Find Swaths**

Have a better look at the most cloud free images by clicking on the thumbnails.

If an image is of satisfactory quality (a significant area of the Namibian EEZ is cloud and haze free and/or turquoise plumes are visible in the Namibian EEZ), then :

- Right click on each picture (quasi true colour, chlorophyll and SST) and save the pictures under a directory with a name reflecting the date of the image YYYY\_MM\_DD e.g. '2004\_12\_01'. Make sure there are no spaces in the directory name .
- Open the true colour picture (\*.L1A\_LAC\_BRS) that you saved with an image viewer. If you can see turquoise plumes or hints of them (you may have to zoom in), you download the L2 image. Order the image by clicking on **Select this scene** and placing an order.

OR to download the bzip2 compressed hdf file of the L2 image directly :

- right click on the L2\_LAC\_OC hyperlink,
- copy link location,
- open Getright,
- **File > enter new URL to download,**
- OK,
- indicate correct directory and click **Save.**

## **B. Decompressing MODIS images**

The MODIS images that are downloaded from NASA are in a compressed format ( \*.gz or \*.bz2). After decompressing they are in hdf format (HDF4 format).

### **1. In Linux**

Double click on the bz2 folder.

Click on **Extract** and indicate the directory you want to extract to (normally in the same folder as the bz2 folder is located, a directory with a name reflecting the date of the image YYYY\_MM\_DD).

Click **Extract**.

Click **Close** to close the window “Extracting files from archive” when the extraction is completed successfully.

### **2. In Windows**

A programme can be downloaded from the Internet to decompress bz2 files in Windows : go to the site <http://www.bzip.org/downloads.html> and download the file bzip2-104-x86-win32.exe. Download it under a directory that is easily accessible from a command line executable programme (high up in directory hierarchy and with a fairly short name, use no symbols like & because DOS seems not to recognise it when changing directory), for example something like : c:\My documents\bz2\_decompress.

Save the bz2 file(s) you want to decompress in the same folder as the programme. Let's assume this file is called NAMEOFFILE.bz2.

Start the command line executable programme (under accessories). Change the directory to the directory where you saved the bz2 unzip programme with the **cd** (change directory) function, for example : **cd bz2\_decompress**. If you want to see the subdirectories of the folder you are currently in, type : **dir**.

To see the help file of the programme, type : **bzip2-104-x86-win32.exe - -help**. To decompress your files, type : **bzip2-104-x86-win32.exe -d NAMEOFFILE.bz2**

Add the \*.hdf file extension manually to the decompressed files (by typing them after the name in Explorer).

## C. Processing in SeaDAS

The main processing activity for the ocean colour mapping project is loading the hdf images in the SeaDAS software, projecting the image and exporting it to a GeoTiff format. This is because most image processing software can not work with the HDF format.

Make sure the hdf images are saved under the seadas\_shared directory if you use seadasvm.

### 1. Start SeaDAS

#### Linux

Open Applications/System Tools/Terminal

Type 'seadas -em'

The SeaDAS main menu will appear.

#### Seadasvm

double click on seadasvm icon

### 2. Displaying MODIS products

If you only want to export the image to geotiff format, without exploring it in Seadas, you will have to load and display it (see 2.1.1) and move on to section 3.

#### 2.1 L2 products

Level 2 or L2 products refer to :

Modis Band	Own Reference	Name product	Explanation
8	Band 1	Rrs_412	Remote sensing reflectance at 412 nm (violet)
9	Band 2	Rrs_443	Same but at 443 nm (violet-blue), absorption peak Chl <i>a</i>
3	Band 3	Rrs_469	blue
10	Band 4	Rrs_488	blue
11	Band 5	Rrs_531	green
12	Band 6	Rrs_547	green
4	Band 7	Rrs_555	green
1	Band 8	Rrs_645	red
13	Band 9	Rrs_667	red
14	Band 10	Rrs_678	red, close to 675 nm Chl <i>a</i> absorption peak)
	chl <sub>a</sub>	chlor_a	chlorophyll a concentration (in mg/m <sup>3</sup> )

- sea surface temperature : sst (in degrees Celsius)
- eps\_78
- K\_490
- angstrom\_531
- tau\_869
- 12\_flags

### 2.1.1 Load and display L2 product

To load one or more of the L2 products, perform following actions :

- Click on **Display**
- Select the subdirectory where your image is stored (click only once for selecting a directory).
- Select the image you want to load (*remember that you are loading an L2 product !*)
- Click **OK**

The Product Selection for MODIS file window appears. To display the image :

- Leave pixel and line sample rate on 1.
- Select the product(s) you want to display : for example **chl\_a** or **Select All**
- Click **Load**

The Band List Selection Menu will appear.

- Select the band (product) you want to display and click **Display**.

The L2 product will be displayed in gray scale in a new window. You can close this window by clicking on **Quit**.

### 2.1.2 Give color to L2 image

This step is only necessary if you want to have a closer look at the images in SeaDAS. If your main aim is to export the image to a GIS compatible format, you can immediately move on to the next step.

- Select : **Functions > Color LUT > Load LUT**

If you are loading a predefined color table (LUT) :

- Select a color table of **1. IDL predefined color tables**, e.g. Blue/Green/Red/Yellow
- Click **Apply**
- Click **Quit**
- Rescale for max Chl : **Functions > Rescale**
- type **40** as **Max**
- Click **Redisplay** and **Quit**

If you want to create your own LUT :

- Load a predefined LUT and make changes with :
- **Options** : you can adjust the sliders **Stretch Bottom** and **Stretch Top** to change the

- parameters
- **Functions > Rescale** : to rescale
- Save the color LUT by selecting : **Functions > Color LUT > Save LUT**
- Choose **ASCII LUT file**
- **Save**

If you are loading a LUT you created :

- Under **3. Load from ASCII or HDF file**, click on **Select**
- Remove the \*.hdf filter
- Browse to /home/vera/OC Research Results and select the color LUT file (make sure you scroll to bottom of files in directory)

### 2.1.3 Projecting images

An image has to be projected to the equatorial equidistant cylindrical projection if you want to export it in geotiff format with the new Seadas export tool. Currently, this is the only way that export to geotiff format can be done ; the image can not be projected to other projections (info from Seadas on-line assistance).

- Make sure the image you want to project is loaded
- **Utilities > Data Manipulation > Map Projection**
- Select a dataset to project by clicking on it in the selection list (you can select more than one band, they will all be projected with the same projection parameters)
- Missing value : -1
- Mapping option : individual <sup>1</sup>
- Automatically load defaults : Yes
- Projections : **Cylindrical**
- Central latitude : **0**, central longitude : **0**
- Keep **Unset Scale** selected
- Indicate latitude and longitude limits (boundaries of study area)
  - Walvis Bay : Lat Limit : -24, -22, Lon Limit : 10, 15
  - Luderitz : Lat : -27.5, -25, Lon : 11, 16
  - Namibia : lat : -30, -17, Lon : 8.5, 17
- Output size <sup>2</sup>:
  - for Walvis Bay : x = 515, y = 222
  - for Luderitz : x = 515, y = 167
  - for Namibia : x = 877, y = 1447
- Click **Go**.  
*The mapped image will be added to the loaded bands. This may take a while.*
- Quit

If you only want to export the image, without exploring it, move on to section 3.

---

<sup>1</sup> A composite would only stitch different swaths together

<sup>2</sup> 1 degree lat = 111,32 km ; 1 degr lon at -22 degr lat = 103,214 km

### 2.1.4 Exploring the L2 product

It is easier to explore the L2 product by making sure the roam and zoom windows are on by selecting : **Functions > Roam Window On** and **Functions > Zoom Window On**.

To find the coordinates of a certain pixel (e.g. Pixels of top left and bottom right corners), select : **Functions > Read and Profile**. This function can be used to define the pixels of certain longitudes and latitudes, i.e. those indicating the study area.

### 2.1.5 Creating true colour images

- Load an image as indicated in 2.1.1 : you should load at least 3 bands that will represent green, red and blue (you can load 1b bands, projected bands, l2 bands)
- Display each single band that you will use for the RGB and have a good look at its histogram : **Functions > Histogram**. This will allow you to determine an appropriate slope and intercept. Or rather with scatterplot : **Utilities > Data Visualisation > Scatter Plot** e.g. Max = 30000, S =  $30000/255 = 118$
- Go to : **Utilities > Data Visualization > Load True color image**
- Select **Band List**
- Select the band numbers (if all bands were loaded : **6 – 5 – 3 (or 4)** for nLw\_667 (R), nLw\_551 (G) and nLw\_488 (B))
- Enter the slopes and intercepts for each band (you will have to try a few combinations before obtaining a good composite)
- Click **Load**
- Select the true colour image in the Band List Selection Window (will be last band added to the list)
- Click **Display**

or : info of OC website [http://oceancolor.gsfc.nasa.gov/forum/oceancolor/topic\\_show.pl?tid=1863](http://oceancolor.gsfc.nasa.gov/forum/oceancolor/topic_show.pl?tid=1863) : Using the **User Defined Operations** function, create a new empty band

### 2.1.6 Layout

Before saving a picture of an L2 product, make sure following elements are indicated :

- Color Bar : **Functions > Color Bar > On** (not necessary if you save picture as it is a separate option, see 2.1.7)
- Grid :
  - Change the color of the grid to black with : **Setups > Grid** (change value for latitude grid to 1, no labels), **Go**, close window
  - **Functions > Grid**
  - **Setups > Landmark, Go**
- Coastline :
  - Change the color of the coastline to white with : **Setups > Coastline**
  - **Go**

### 2.1.7 Saving as a picture

Save the L2 products as a picture with **Functions > Output > Display**.

- Change type to : **Image Display**
- Indicate **Color Bar On**
- Choose as **color bar background light**
- If necessary : Indicate the area of which you want to save a picture (start/end column and row).
- Chose as file type \*.png so it can be inserted in a document at a later stage.

The files are automatically saved to the home directory /home/vera and have to be moved to the /home/vera/OC Research Results directory afterwards.

### 2.1.8 Creating profile

Make sure the projected image is loaded and displayed

- Functions > Read and Profile
- Change Lat to line of profile e.g. Lat -23 and lon 14.3 for WB
- Click on move to lat/lon
- Click on profile plot set up : Data source : Geophysical, Interactive mode : on, Log scaling : no, set Min to 0 and test Max, Quit
- Click on Plot Row Profile
- Click on Output
- Save as Postscript, Colour
- Manually add extension \*.eps

To save : plot row profile

### 2.1.9 Display flags

As data is processed by msl12 from Level 1 to Level 2, checks are made for different defined conditions. When certain tests and conditions are met for a given pixel, a **flag** is applied to that pixel for that condition. The msl12 **Level 2 processing flags** are stored in the Level 2 data file as the "l2\_flags" product (Mike, Ocean Color Forum, 2006).

Make sure both the l2\_flags bands are loaded and the L1 or L2 image on which you want to apply them is displayed.

- **Utilities > Data Visualization > Level 2 Flags Display**
- Band number of loaded flag array : slide to number of band that contains the 12 flags (this is normally done automatically)
- Display window for flag to be applied : slide to number of window that contains band on which you want to display flags
- Make sure that the flag type is **l2gen L2 Flags**
- Indicate the flags you want to visualise. If you want to see one flag, check it and

click **Load One Mask** (it will be automatically set to the last flag you checked). Otherwise, click on **Load Multiple Masks**.

### 2.1.10 Make a bit map of a flag

This is useful if you want to project one of the flags, e.g. the coccolithophore flag. In that case, you first create a new band that is a bitmask of the flag.

- Make sure the l2 flags are loaded
- Select **Utilities > Data Manipulation > User-Defined Operation**.
- Type in the band command window :

```
maskvalue = b1 and 1024  
bitmap = maskvalue/maskvalue  
result = bitmap
```

b1 refers to the band of the loaded l2 flags. If the flags are in another band, you should change this to the number of that band. The reason to mask the value 1024, is that it is the bit value (in decimal) for the COCCOLITH flag. The l2 flags are a 32-bit array. The second line sets a value of 1 where the flag is set, 0 where it is not (Sean, Ocean Color Forum, 2010).

- Give a name to the new band, e.g. `cocco_mask`.
- be sure to set the navigation for this new band using the loaded `l2_flags`.
- You can save these settings by typing a name for the file to save (top of window) and clicking on **Save**. Later, you can load this file after you type its name.
- Click **Go** to run the operation.

You can project the resulting bitmap and save it as a geotiff.

## 2.2 L1 products

L1 products are uncalibrated raw radiances referred to as `ev_412`, `ev_443`, `ev_488`, `ev_531`, ...

L1A

L1B

### **3. Exporting MODIS products**

This section describes the export of L2 images to different formats.

Always make sure the image is already displayed before exporting it.

#### Save mapped image as a Geotiff file :

- **Functions > Output > Data > Binary**
- In the Output Setup window near the top, for "Type:", select "Image Display"
- In the Output Setup window near the bottom, for "File Type:", select "TIFF/*GEOTIFF*"
- Click "Go" to save a new *GeoTIFF* file.

#### Save mapped image as an image :

- **Functions > Output > Display**
- Image data – Geophys
- Hdf sd

#### Save mapped image as an ascii file :

- **Functions > Output > Data > Ascii**
- (in Setup : Geophys data)
- Write file

The saved files are written to the home directory.

When loading/displaying such an image : rescale + log.

## D. Processing in ILWIS

Underneath steps are described for ILWIS 3.6. Note that you can choose another image processing package to create colour composites. In this case, ILWIS is also used to digitise the plumes because the colour composite can not be exported to another format <sup>3</sup>. The end product of this processing phase will be one vector file (line format) with digitised plumes per image.

### 1. Creating colour composite

Import bands 4, 5 and 10 into ILWIS (give them the names B4, B5 and B10) as follows :

- **File > Import > Geospatial Abstraction Data Library > raster > GeoTIFF**
- Indicate the file you want to import and accept the proposed output file name
- Check **Use as**
- Click OK.

The images are imported as foreign collections. Click on one of the raster images (the same raster image is shown in three fold) to view it.

Create a map list for the colour composite with **File > Create > Map List**. Give the map list the name 4\_5\_10. Select one time band 4, one time band 5 and one time band 10 and make sure they appear on the right list after you click on the > arrow. Click OK.

To view the colour composite of bands 4, 5 and 10, double click on the map list. Click on the left icon (Open as ColorComposite). Click OK.

### 2. Digitising plumes

If there are turquoise plumes, you will digitise them in a segment map. Make sure you are in the view with the colour composite.

- **File > Create > Segment Map**
- Indicate as map name : bloom\_yyyy\_mm\_dd with yyyy the year the image was taken, mm the month and dd the day
- Indicate the same min/max latitude and longitude as when you were projecting the image : latitude 30° S - 17° S and longitude 8°30' E - 17° E . Note that ILWIS does not use the minus sign to indicate southern latitudes.
- Zoom in to the bloom you want to digitise. Click on the icon for **Insert Mode** (or go to **Edit > Insert Mode**).
- Digitise the plume by clicking on its edges, double click to end digitising (this should be at your start point to close the polygon).
- The attribute table for this polygon will pop up. As 'Name' you give an indication of the clearness of the plume, e.g. you type **clear** or **vague**.
- Click on the **Exit Editor** icon.

---

<sup>3</sup> Error message : range too large for ERDAS format.

- Close the view with the colour composite.

### **3. Export ILWIS segment map**

To export the digitised plumes to a shape file :

- right click on the segment map that contains the digitised plumes and click **Export**.
- The format is **Arc/View shapefile**. Click **OK**.

The file is now saved as a shapefile in the same directory.

## **D. Final processing in ArcView**

Underneath steps are described for ArcView 3.1 with the EditTools 3.6 extension. You can use a GIS software of your choice to do the same steps. The end product is one clean, projected polygon file with the plumes per MODIS image.

### ***Convert imported line files to polygons***

To convert the imported segment maps of ILWIS to polygon files :

- open ArcView and add the shape file(s) with the plumes
- make sure the EditTools extension is loaded
- click on the ET icon
- click **Edit Theme** and indicate the shape file (ignore the message about the fact that your data is not projected)
- click **Build Polygons**.
- Accept the directory and name for the Temporary Polyline Theme.
- Click **Yes** to clean the polyline.
- Indicate the directory that contains the MODIS image for that shape file and give as file name the same name with a p behind, e.g. bloom\_2003\_04\_03p.shp is saved under the directory 2003\_04\_03.
- Click **No**.

In ArcView, for calculation area, project to 'New' Transverse Mercator (central meridian 17, ref latitude 0).