L2 Batch Processing – script based processing of Level-2 satellite data

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1 Introduction

Multiple satellite sensors generate many images per day even for a small region. Processing of these images can be automated with scripts based on Windows batch files. This manual describes how to set up this process with WIM/WAM for your area.

2 Data subscription and processing

It is possible to start data subscription and automate the whole process from downloading to processing and it is described in http://www.wimsoft.com/Course/2/DataSubscriptionProcessing.pdf. However, due to various technical problems, it may be better to order L2 data manually and then run the processing in a sequence of batch processes as described in this manual.

3 Preparing the directory structure

The batch files assume a certain directory structure that is essential for them to work. You cannot download and extract the data files to your desktop or some other user folder and assume them to work. Therefore you need to follow the instructions and set up the directory structure EXACTLY as described. Note! You cannot have spaces in the directory or file names that we use here! Therefore, you cannot use anything like "My Data" or "My files". Select the top level directory, e.g. C:\Sat. Under that you specify the areas of interest. You can have more than one area but the files and processing will be separate for each of the areas. For example, we choose our area Algarve. Therefore we will make a directory C:\Sat\Algarve. You can put it in another location, e.g. H:\L2data\Algarve. Each year will be a separate directory under that top directory. Here we will process only data from year 2015, therefore we will manually make only one directory:

C:\Sat\Algarve\2015. The directories under the year folder (i.e.. 2015) can be made using a batch file called setup_2015.bat. You can download this and other files - instructions will be given below.

4 Ordering and downloading the L2 data

First you need to decide your area of interest specified by the latitude and longitude ranges: pick the northern and southern latitudes and the western and eastern longitudes (negative for Southern hemisphere latitude and for Western longitude!). Then order the data at the Level 1-2 browser of NASA's ocean color web at http://oceancolor.gsfc.nasa.gov/cgi/browse.pl?sen=am

Fig. 1. Ordering satellite data with NASA Level 1 and 2 browser.

The required latitudes and longitudes are shown with the red circles (figure above). Then select all available sensors. Currently (middle of 2015) we have 3 sensors: **MODIS-Aqua** (MODISA), **MODIS-Terra** (MODIST) and **VIIRS**. For SST we have data from MODISA and MODIST only (from this website). **Select all 3 sensors**! This is essential as the scripts assume that you have data from all three. Confirm and finish the order (see below).

Fig. 2. Finishing the order of satellite data with NASA Level 1 and 2 browser.

The red ovals show the important selections, e.g. your email. The latitude/longitude values are just for a sample order in California. You must choose "**Do**" "**extract my order for me**" and **Level 2 (OC)** and **Level 2 SST (11 um)**. Unless you know what you are doing, do not order other levels of data (e.g. Level 0 or 1) or other types (e.g. Level 2 IOP or Level 2 SST 4 um).

Pick which data products you want for your selected scenes.

☐ Level 0 *(MODIS only) Note that we currently do not extract level-0 data regardless of what you may have sele*

☐ Level 1 *(VIIRS and MERIS data cannot be extracted at level-1)*

☑ Level 2 (OC)

You may elect to receive only a subset of the products that would normally be stored in the level-2 files you o groupings listed below. If you select none of the product groups below and simply check "Level 2" above, th stored in our standard level-2 files.

The 2009 and 2014 reprocessings expanded and changed the list of standard level-2 products that we distri subsets below and only check "Level 2" above, then you will receive all of the products in each ordered stan reprocessing.

☐ chlorophyll *a*

☐ Kd490 (K490)

☐ remote sensing reflectances *(normalized, water-leaving radiances)*

☐ aerosol products

☐ particulate inorganic carbon

☐ particulate organic carbon

☐ colored dissolved organic matter index *(no longer available after Reprocessing 2014.0)*

☐ fluorescence line height and instantaneous PAR *(MODIS only)*

☐ photosynthetically available radiation

☐ Level 2 (IOP) *(Only available for missions reprocessed since 2014)*

☑ Level 2 SST (11 µ) *(MODIS only)*

☐ Level 2 SST (4 µ) *(MODIS nighttime only)*

☐ Remind me when my order is about to expire.

☐ Require my email confirmation for early file deletion.

☐ Notify me when my data have been deleted from the staging area.

Review order

Fig. 3. Selecting the products in your order of satellite data with NASA Level 1 and 2 browser.

The red ovals show the important selections, e.g. your email. You will receive an email when your order is ready to download and you can also see the status of your order at http://oceancolor.gsfc.nasa.gov/sdpscgi/registered/orders_manager.cgi

In the email that you received from *noreply@seawifs.gsfc.nasa.gov*, you need to click on the link for the Manifest URL and download the manifest file *http_manifest.txt* to the **tmp** folder of your Area\Year folder. Here "Area" and "Year" mean your specific area, e.g. Algarve and year, e.g. 2015.

5 Preparing the maps

You need to set up several map files (maps) in HDF4 format. The easiest way to make the maps is to use the *File-New* menu in WIM. Instructions for creating maps are in various documents available at the Wimsoft website, e.g. http://www.wimsoft.com/Course/1/Exercises_WIM_WAM.pdf or http://www.wimsoft.com/Course/2/DataSubscriptionProcessing.pdf. Examples of the required maps for the Algarve example area are given below.

Algarve.hdf . This is the base map that specifies the projection. Other details are not important.
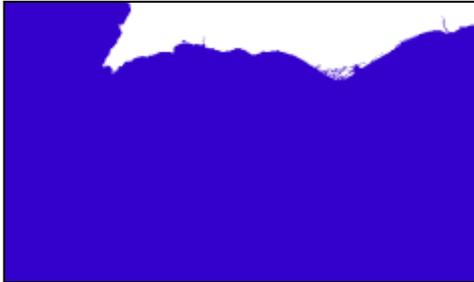
Algarve_sea.hdf. This "sea" map specifies the area to be considered, specified with pixel value 1. You can create it from the base map by filling the area of interest with pixel value 1. The sea mask is used to delete those Level-2 files that have no valid values (e.g. totally cloudy) over our area of interest. This is done in order to save disk space.
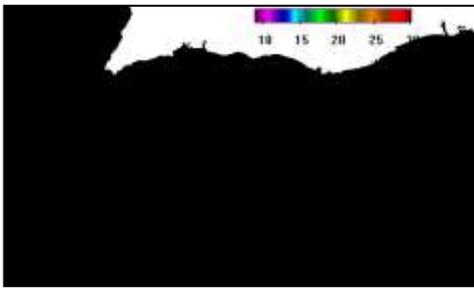
Algarve_sst_80_220_reduced.hdf. This is the overlay for SST with the respective color scale. Note that the scaling of this image must be *SST-Pathfinder* or *Linear* (*slope*=0.15, *intercept*= -3). The colors have been stretched between 80 and 220 corresponding to SST of 9 and 30 C. This is also noted in the file name.
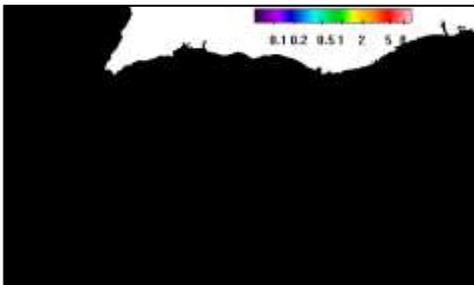
Algarve_chl_48_200_reduced.hdf. This is the overlay for Chl with the respective color scale. Note that the scaling of this image must be *Log-Chl* or *Logarithmic* (*slope*=0.015, *intercept*= -2). The colors have been stretched between 48 and 200 corresponding to Chl of 0.05 and 20 mg m^{-3}. This is also noted in the file name.

Fig. 4. Four sample map files needed for the batch processing.

You can put other details like latitude-longitude grid, stations, etc on the SST and Chl overlay maps. The overlays will be overlaid on all SST or Chl images, respectively. Pixel values different from 0 will overlay the SST or Chl image, while those with pixel value 0 will be transparent. Note that if you want to change the color range, you need to recreate the color scale with *View-Annotate*.

6 Setting up the directory tree

The basic directory tree and the batch files can be downloaded from http://wimsoft.com/Course/2/Algarve.piz. This is a zipped file with a true extension .zip but as Windows prevents downloading .zip files when they have batch or executable files inside then it has been renamed. After downloading it, move it to your Level-2 data directory, e.g. *C:\Sat* and rename to *Algarve.zip* and unzip it. Make sure that you now have a directory *Algarve* under *C:\Sat* (or wherever you prefer) and not *Algarve* under another *Algarve* directory. If you *cd* to the *Algarve* directory and type *dir*, you will see this:

```
Directory of C:\Sat\Algarve

07/18/2015  02:57 PM    <DIR>          .

07/18/2015  02:57 PM    <DIR>          ..

07/18/2015  02:56 PM    <DIR>          2015

07/18/2015  02:56 PM            10,801 Algarve.hdf

07/18/2015  02:56 PM            12,342 Algarve_chl_48_200.hdf

07/18/2015  02:56 PM             9,238 Algarve_chl_48_200_reduced.hdf

07/18/2015  02:56 PM             9,866 Algarve_sea.hdf

07/18/2015  02:56 PM            12,400 Algarve_sst_80_220.hdf

07/18/2015  02:56 PM             8,998 Algarve_sst_80_220_reduced.hdf
```

Of course, unless you really want to process images of the Algarve area, you should make a copy of the whole *Algarve* directory and name it to something that corresponds to your area. First you need to set up the directory tree with ***setup_2015.bat***. *Cd* to 2015 (or open your command window in the directory *Algarve\2015*). Type ***setup_2015***. This will create the following directories:

```
A2015
A2015_chl_day
A2015_SST
A2015_sst_day
C2015_chl_15day
C2015_chl_5day
C2015_chl_day
C2015_chl_month
M2015_sst_15day
M2015_sst_5day
M2015_sst_day
```

M2015_sst_month
T2015
T2015_chl_day
T2015_SST
T2015_sst_day
V2015
V2015_chl_day

These directories will be the same for all areas of interest (e.g. Algarve) but the corresponding year will, of course, change (e.g. instead of *A2015* you will have *A2014* for the year 2014).

7 Running the batch programs

Now you are ready to download the data and run the batch processing.

- Download the manifest file *http_manifest.txt* and move it to the **tmp** folder of your Area\Year folder (e.g. to *Algarve\ 2015\tmp*).

- While in the tmp folder, type *dload.* This runs *dload.bat* that downloads the files specified in the manifest file using *wget*. Downloading may take a long time – depending how much data you ordered.

- After downloading has finished, type *extract*. This runs the batch file *extract.bat* that extracts the L2 files.

- Type *cd ..* This will take you from the *tmp* folder up one level in the directory tree, e.g. in *C:\Sat\Algarve\2015*.

- Type *sort_2015*. This will run batch program *sort_2015.bat* that screens, remaps and composites daily mapped files for each sensor for both SST and Chl.

- Type s*st_2015*. This will run batch program *sst_2015.bat* that will merge daily SST images from MODISA and MODIST, make 5-day, 15-day and monthly composites of SST.

- Type *chl_2015*. This will run batch program *chl_2015.bat* and will merge daily Chl images from MODIST and VIIRS and then those merged with MODISA. It will then make 5-day, 15-day and monthly composites of Chl.
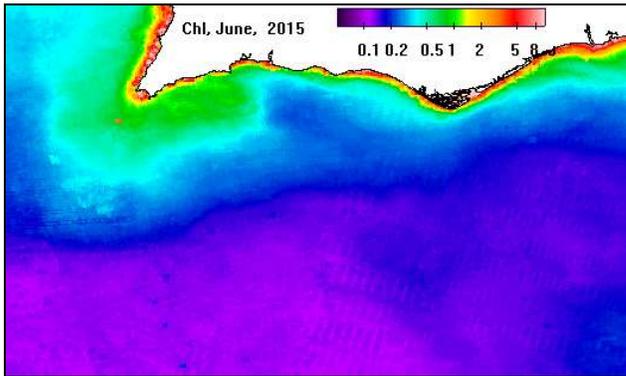
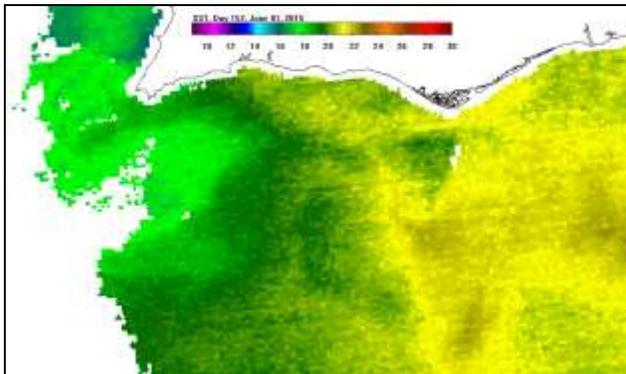Examples of processed images:
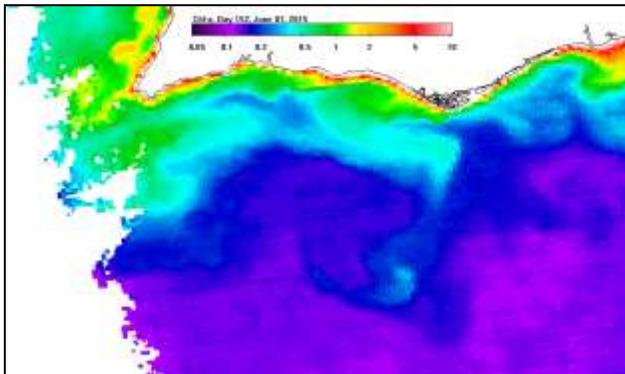
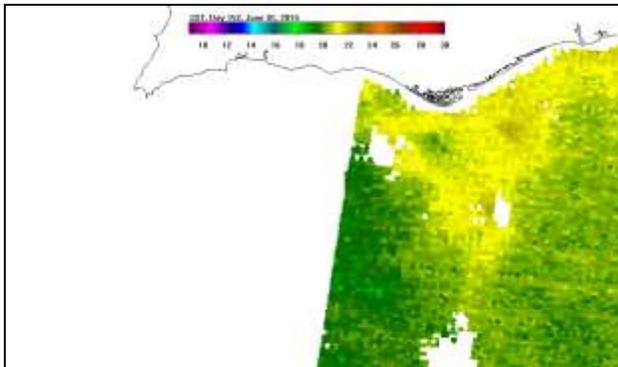Daily Chl image from MODISA
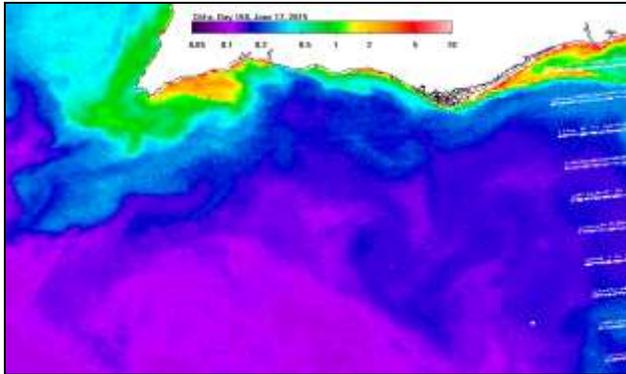
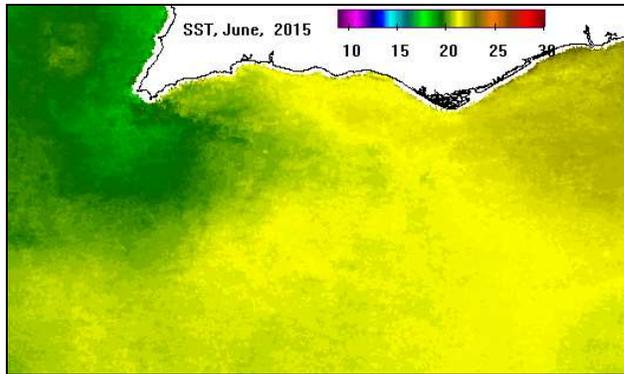Daily Chl image from VIIRS

Merged monthly Chl image for June, 2015

Daily SST image from MODISA

Daily SST image from MODIST

Merged monthly SST image for June, 2015

Fig. 5. Sample output products from the batch processing.

8 Modifying the batch programs for your area

To adapt the processing scheme to your area of interest you need to have analogs of the four map files shown in Fig. 4. After that you need to modify the batch files accordingly. In *sort_2015.bat* you need to the following lines:

```
set MAP=..\Algarve.hdf
set MAPSEA=..\Algarve_sea.hdf
set MAPCHL=..\Algarve_chl_48_200_reduced.hdf
set MAPSST=..\Algarve_sst_80_220_reduced.hdf
```

You need to replace these with **something** like that (replace *MyArea* with your area):

```
set MAP=..\MyArea.hdf
set MAPSEA=..\MyArea _sea.hdf
set MAPCHL=..\MyArea _chl_48_200_reduced.hdf
set MAPSST=..\MyArea _sst_80_220_reduced.hdf
```

Also, if you prefer a different range, you need to adjust that and make a new color bar. It would be a good idea to indicate the range in the filename, e.g. here the unscaled Chl range is 48 to 200 (corresponding to Chl concentration of 0.05 to 10 mg m^{-3}). The following lines specify wherethe annotation will be written (i.e. the X and Y coordinates in the image). Note that we may have 2 sizes of images: the base image may be bigger and the overlay images may be smaller. This may be useful if your area is very big and you want to process the full area but need the annotate images that are like quick-looks, i.e. smaller. Therefore the X4 and the Y4 are the X and Y coordinates, respectively, on the smaller image and X1 and Y1 that are currently not used, correspond to the coordinates if the annotation would be written into the big size image.

```
set X1=315
set Y1=22
set X4=148
set Y4=20


set LUT=chl1_white_end.lut
```

This sets the palette (LUT) file. We use different LUT files for SST and Chl. Of course, when processing other years (besides 2015), you need to modify the statement YEAR=2015

Currently SST data are merged between MODISA and MODIST and Chl data are merged between MODIST and VIIRS and the result is merged with MODISA. If data from other sensors is available, e.g. MERIS for 2003-2012 or new sensors in the future, the scripts should be modified to include those other sensors. Also, variables other than SST and Chl can be processed. Currently we have scripts for Kd490 and various Rrs bands. Other variables can be added.