Data Subscription Processing – automatic downloading and processing of satellite data

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1 Introduction

Routine generation of satellite images involving downloading and multiple steps of processing can be very time consuming. It is therefore useful to automate this process, so that selected files are downloaded automatically every day or night at a certain time and subsequently processed. This manual describes how to set up this process with WIM/WAM.

2 Data subscription and processing

We will show how to set up a data subscription at the NASA ocean color web, set up automatic downloading of these data to your computer and automatic processing to your products, e.g. daily, 5-day, 15-day and monthly chlorophyll-a images merged from MODIS, MODIST and VIIRS data.

2.1   Setting up data subscription

You need to select your area of interest and set up a Near-Real Time Service at NASA's ocean color web at http://oceancolor.gsfc.nasa.gov/sdpscgi/public/subscriptions_home.cgi . In particular, I recommend picking "Extracted/Mapped NRT Data Subscription" (bottom of the page). For example, in my case I have selected a region of interest that I call *CalCoast* with the following boundaries: North=37.285, South=31.46, West=-126.285, East=-116.145. I make three separate subscriptions for the same *CalCoast* region: each for MODISA (MODIS-Aqua), MODIST (MODIS-Terra) and VIIRS. You need to register (you get a user name) and you will receive 4-digit subscription number. Let's assume my user name is *user1234* and my subscription numbers are respectively 1234, 1235 and 1236. Every day your data files will be put into the following FTP directories:

ftp://samoa.gsfc.nasa.gov/subscriptions/MODISA/XM/user1234/1234/   (MODISA files)

ftp://samoa.gsfc.nasa.gov/subscriptions/MODIST/XM/user1234/1235/   (MODIST files)

ftp://samoa.gsfc.nasa.gov/subscriptions/VIIRS/XM/user1234/1236/   (VIIRS files)

Remember, the user name and the subscription numbers for you will be different! As I had selected "Extracted/Mapped" files, I receive both extracted HDF files and mapped PNG files. I don't care about the mapped PNG files and only need the extracted HDF files. You can manually download the files from the above location using a browser or a FTP client but we will set up automatic download.

Fig. 1. Setting up Extracted/Mapped NRT data subscription at http://oceancolor.gsfc.nasa.gov/sdpscgi/public/subscriptions_home.cgi.

2.2   Setting up FTPDownloader

FTPDownloader is a Windows application that can be installed with WIM/WAM. When started manually (e.g. by clicking or double-clicking on its icon) *FTPDownloader* keeps running all the time. At a specified time each day (at full hour) it gets a listing of available data files at the FTP server, downloads only those files that it has not downloaded previously. *FTPDownloader* settings are controlled by a text file called *FTPDownloader.exe.Config* in the same folder as *FTPDownloader.exe* (i.e. in the folder *Wimsoft* where all Wimsoft programs are installed). A sample *Config* is give below:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
 <appSettings>
   <add key="OutputDir" value="C:\Data\2015" />
   <add key="Hour" value="23" />
   <add key="FtpServers"
value="MODISA,ftp://samoa.gsfc.nasa.gov/subscriptions/MODISA/XM/user1234/1234/
VIIRS,ftp://samoa.gsfc.nasa.gov/subscriptions/MODIST/XM/user1234/1235/
VIIRS,ftp://samoa.gsfc.nasa.gov/subscriptions/VIIRS/XM/user1234/1236/"/>
 </appSettings>
</configuration>
```

You can see the following setting in the above file:

- Output directory is C:\Data\2015

- Hour of downloading start is 23, i.e. every day at 23:00 downloading starts.

- MODISA data are downloaded from user1234 subscription 1234, MODIST data from user1234 subscription 1235, VIIRS data from user1234 subscription 1236.

You must edit the *Config* file in any text editor and (1) change your data storage location (replace *C:\Data\2015* with your location), (2) the user name (replace *user1234* with your user name), (3)

subscription names (replace *1234*, *1235* and *1236* with your respective subscription numbers). For example, if your user id is *JohnSmith* then you need to substitute *user1234* with *JohnSmith*. After modifying the *Config* file, you can start *FTPDownloader*. Notice that I have used downloading hour 23, i.e. local time 23:00 which should be a suitable for downloading daily data. As ocean color data are recorded within a couple of hours of local noon, this allows up to about 9 hours (i.e. 9 hours past 14:00 local time) for NASA to process the daily data and make the extracted files available at the FTP server. When you are testing *FTPDownloader* you may not want to wait until 23:00 to see if it works. E.g. if you are testing at 13:50 local time, you can set the hour to 14, so that in 10 minutes you will see if it starts to download something. If you see that it is working, you can stop *FTPDownloader* with Windows Task manager (Fig. 2), change the hour back to 23 and start *FTPDownloader* again. *FTPDownloader* will first download all HDF files in the MODISA folder, the all HDF files in the MODIST folder and then in the VIIRS folder. It build a list of downloaded files and when it starts next day (e.g. at 23:00) it will skip all the files that it has already downloaded on previous days. The downloaded data are saved in new folders, MODISA, MODIST and VIIRS, respectively, created by *FTPDownloader*. Remember that if you reboot your computer, e.g. after installing new software or updates, you must manually start *FTPDownloader* again!
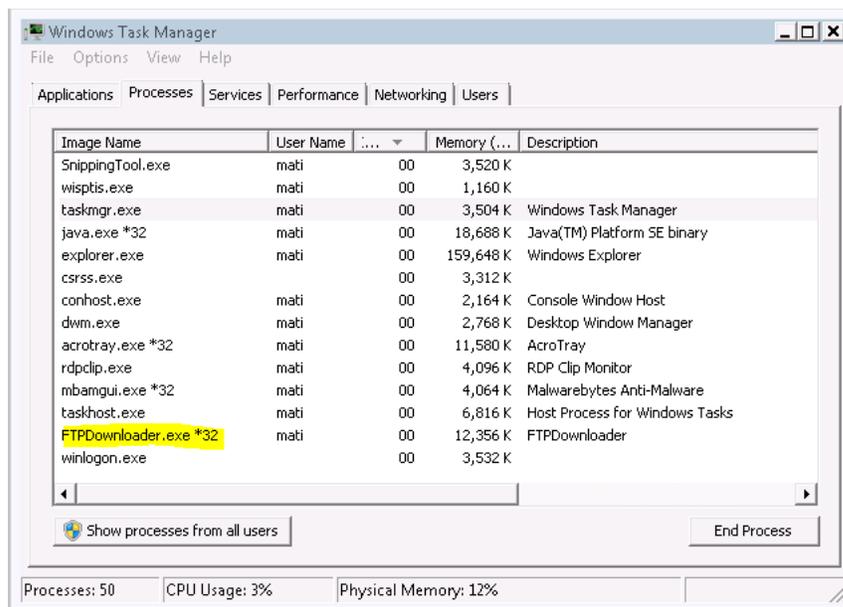

Fig. 2. Windows Task Manager showing that *FTPDownloader* is running.

2.3   Processing downloaded data interactively

You can process downloaded data in the MODISA, MODIST and VIIRS folders as you like, e.g. using examples in various WIM/WAM manuals, e.g. http://www.wimsoft.com/Course/2/2_Exercises_with_L2_satellite_data_Your_area.pdf.

However, for routine processing it is better to set up the processing as a scheduled, automated task.

2.4   Creating batch files for automated processing

We have created batch files that you can start automatically by setting up a task with *Windows Task Scheduler*. For testing and setup, it is recommended to run the processing scripts manually to see that they work properly.

There is one batch file *run.bat* that needs to be run (manually or by *Windows Task Scheduler*).

run.bat actually calls 2 other batch files: *sort.bat* and *chl.bat*. All these 3 batch files (*run.bat*, *sort.bat* and *chl.bat* **need be copied to the folder where you are downloading the data**, e.g. C:\Data\2015 in the example above. When testing manually, open the command window in that folder and run those batch files. Of course, before doing that you need to set up the batch files for your area. Here are the contents of *sort.bat*:

```
set YEAR=2015
set MAP=E:\Projections\California\CalCoast1km.hdf
set MAPSEA=E:\Projections\California\CalCoast1km_sea.hdf
set MAPCHL=E:\Projections\California\CalCoast1km_chl48-220.hdf

set XPOS=474
set YPOS=24
set LUT=chl1_white_end.lut

wam_screen_mask MODISA\*.hdf %MAPSEA%
rmdir MODISA\NoValid /S /Q
rmdir MODISA\Outside /S /Q
rmdir MODISA\Bad /S /Q

wam_screen_mask MODIST\*.hdf %MAPSEA%
rmdir MODIST\NoValid /S /Q
rmdir MODIST\Outside /S /Q
rmdir MODIST\Bad /S /Q

wam_screen_mask VIIRS\*.hdf %MAPSEA%
rmdir VIIRS\NoValid /S /Q
rmdir VIIRS\Outside /S /Q
rmdir VIIRS\Bad /S /Q

REM Aqua
wam_l2_map MODISA\Good\A*L2* %MAP% %MAPCHL% %XPOS% %YPOS% lut=%LUT%
mkdir A%YEAR%_chl_day
move MODISA\A*.hdf A%YEAR%_chl_day
move MODISA\A*.png A%YEAR%_chl_day
mkdir A%YEAR%\0\Good
move MODISA\Good\A%YEAR%*L2* A%YEAR%\0\Good

REM Terra
wam_l2_map MODIST\Good\T*L2* %MAP% %MAPCHL% %XPOS% %YPOS% lut=%LUT%
mkdir T%YEAR%_chl_day
move MODIST\T*.hdf T%YEAR%_chl_day
move MODIST\T*.png T%YEAR%_chl_day
mkdir T%YEAR%\0\Good
move MODIST\Good\T%YEAR%*L2* T%YEAR%\0\Good
```

```
REM VIIRS
wam_l2_map VIIRS\Good\V*L2* %MAP% %MAPCHL% %XPOS% %YPOS% lut=%LUT%
mkdir V%YEAR%_chl_day
move VIIRS\V*.hdf V%YEAR%_chl_day
move VIIRS\V*.png V%YEAR%_chl_day
mkdir V%YEAR%\0\Good
move VIIRS\Good\V%YEAR%*L2* V%YEAR%\0\Good

echo Done run_sort !
```

You have to customize the following entries in *sort.bat*:

- YEAR=2015 – this is your current year

- MAP=E:\Projections\California\CalCoast1km.hdf – this is your standard map

You can create your standard map in a number of ways. The easiest way is to create a map in *Linear* projection using *File – New* in WIM, select *Pixel Size* = 1000 meters, *Latitude Range* = … - …, *Longitude Range* = … - … After creating the new map, overlay coastlines with *Geo - Get Map Overlay* and pick the full resolution coastlines file *coast_full.b* with *Background Value* = 0 and *Foreground Value* = 1, and select only *Land* (not *Lakes*, etc) coastlines. In my example the map file is stored in *E:\Projections\California\CalCoast1km.hdf* but you can store it in any folder, e.g. in *C:\Data* under a name that corresponds to your area.

- MAPSEA=E:\Projections\California\CalCoast1km_sea.hdf – this is the your "sea" map

You can create your "sea" map by taking your standard map that you just created, use *Edit – Draw*, select *Outline* = 1, *Fill* = 1 and fill the ocean area with pixel value 1. In my example the map file is stored in *E:\Projections\California\CalCoast1km_sea.hdf* but you can store it in your data folder, e.g. *C:\Data* under a name that corresponds to your area (use "sea" in the name to separate it from other map files). The idea is to mask your ocean area with pixel value 1 and the rest (e.g. land) with pixel value 0.

- MAPCHL=E:\Projections\California\CalCoast1km_chl48-220.hdf – this is your "Chl" map

You can create your "Chl" map by taking your standard map that you just created, use *Edit – Draw*, select Outline = 255, Fill = 255 and fill the land area with pixel value 255 (white). Make sure that the white color does not spill into the ocean. Be careful in filling islands with the white color as well. If the white color spills out, use the *Undo* button (back arrow in Toolbar). You may have to fill some empty coastlines manually with *Edit-Draw* and some tools. Now set the scaling to *Log-Chl* in *Settings* (the *hammer* icon in Toolbar) and stretch the colors with *Color Definition* from pixel value 48 to 220 (Fig. 3). Now select a rectangle for the color bar, then use *View-Annotate* and make the color bar somewhere in the white (land) area and leave some space on top of it for additional labels, e.g. date (Fig. 4). In my example I have used *Custom* tic marks of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 and 20. They correspond to the full range of Chl-a 0.05 – 19.95 mg m^{-3}. As you can see, I am using the text "chl" and the range ("48-220") in the file name to separate the file from others.

- XPOS=474 this is the X position where the label will be written in your Chl map; make it approximately near the left edge of the color bar

- YPOS=24 this is the Y position where the label will be written in your Chl map; make it right above the color bar

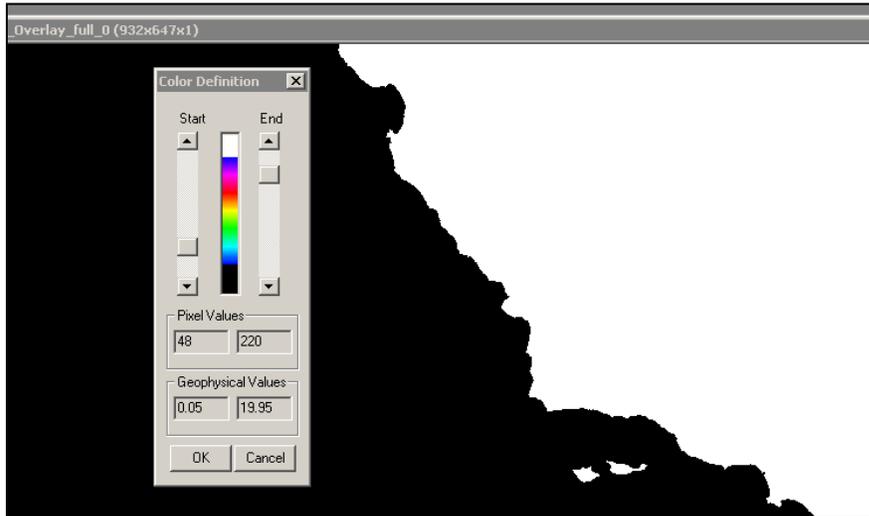- LUT=chl1_white_end.lut this is the color palette that I am using. You can pick another palette if you like.

Fig. 3. Stretching the colors of the Chl map to 48 – 220 corresponding to Chl-a concentration of 0.05 – 19.95 mg m^{-3}.
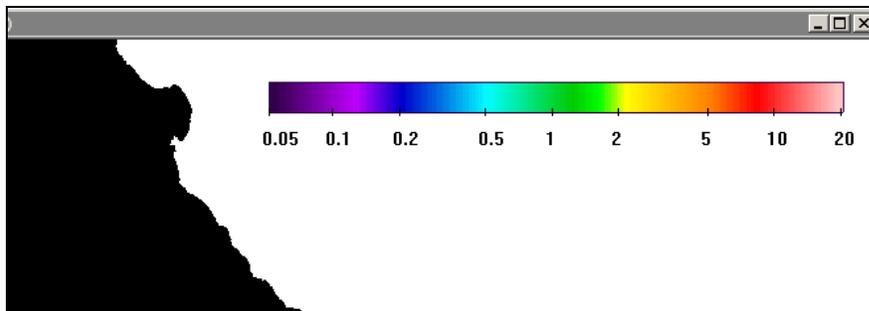

Fig. 4. Creating the color bar for the pixel value range from 48 to 220 with *Log-Chl* scaling corresponding to Chl-a concentration of 0.05 – 19.95 mg m^{-3}.

You can look at the text of the *sort.bat* file and see what commands it is calling. The main commands are wam_screen_mask and wam_l2_map. wam_screen_mask is using your sea mask file to find out if there is any useable data over your area of interest (masked with pixel value 1 in your "sea" mask). The level-2 files that have no valid data in your area of interest will be deleted; the "good" files will be moved to folders like MODISA\Good. Then wam_l2_map is run to create composited, mapped daily images of your area for each sensor (MODISA, MODIST, VIIRS). After that, the "good" Level-2 files will be moved to folders like A%YEAR%\0\Good for archiving (Note that %YEAR% here will be replaced by the year that has been selected, e.g. 2015). The composited, mapped daily files for each sensor will be in folders like A%YEAR%_chl_day ("A" for MODISA, "T" for MODIST, "V" for VIIRS).

Here are the contents of the 2nd batch file *chl.bat*:

```
REM merges Aqua + (Terra + VIIRS)
@echo off
set YEAR=2015
set DAY=
```

```
set MAPCHL=E:\Projections\California\CalCoast1km_chl48-220.hdf
set LUT=chl1_white_end.lut
set XPOS=474
set YPOS=24
set START=48
set END=220

REM Terra + VIIRS equal
mkdir U%YEAR%_chl_day
wam_composite_2sensors T%YEAR%_chl_day\T%YEAR%%DAY%*mapped.hdf
V%YEAR%_chl_day\V%YEAR%%DAY%*mapped.hdf %MAPCHL% %XPOS% %YPOS% lut=%LUT%
if not "%errorlevel%"=="0" goto err
move /Y U*_chl*mapped*.* U%YEAR%_chl_day
if not "%errorlevel%"=="0" goto err

REM Aqua/Terra+VIIRS yes
wam_composite_2sensors A%YEAR%_chl_day\A%YEAR%%DAY%*mapped.hdf
U%YEAR%_chl_day\U%YEAR%%DAY%*mapped.hdf %MAPCHL% %XPOS% %YPOS% yes lut=%LUT%
if not "%errorlevel%"=="0" goto err
mkdir C%YEAR%_chl_day
move /Y N*_chl*mapped*.* C%YEAR%_chl_day
if not "%errorlevel%"=="0" goto err

REM 5-day Chl
wam_composite_2x C%YEAR%_chl_day\N%YEAR%%DAY%*mapped.hdf 5 %MAPCHL% %XPOS% %YPOS%
%LUT% %START% %END%
if not "%errorlevel%"=="0" goto err
mkdir C%YEAR%_chl_5day
del /Q C%YEAR%_chl_5day\?%YEAR%%DAY%*.*
move /Y ?%YEAR%%DAY%*_?*_chl_comp*.* C%YEAR%_chl_5day
if not "%errorlevel%"=="0" goto err

REM 15-day Chl
wam_composite_2x C%YEAR%_chl_5day\?%YEAR%%DAY%*comp.hdf 15 %MAPCHL% %XPOS% %YPOS%
%LUT% %START% %END%
if not "%errorlevel%"=="0" goto err
mkdir C%YEAR%_chl_15day
del /Q C%YEAR%_chl_15day\?%YEAR%%DAY%*.*
move /Y ?%YEAR%%DAY%*_?*_chl_comp*.* C%YEAR%_chl_15day
if not "%errorlevel%"=="0" goto err

REM monthly Chl
wam_composite_month C%YEAR%_chl_day\*mapped.hdf %MAPCHL% %XPOS% %YPOS% %LUT%
%START% %END%
if not "%errorlevel%"=="0" goto err
mkdir C%YEAR%_chl_month
del /Q C%YEAR%_chl_month\*.*
move /Y ?*_chl_comp*.* C%YEAR%_chl_month
if not "%errorlevel%"=="0" goto err

:bye
echo ***** Done! *****
exit /b 0
```

```
:err
echo ***** FAILED! *****
exit /b 1
```

The purpose of *chl.bat* is to merge daily maps from MODISA, MODIST and VIIRS and merged composites of Chl for daily, 5-day, 15-day and monthly periods in folders like C%YEAR%_chl_day, C%YEAR%_chl_5day, C%YEAR%_chl_15day and C%YEAR%_chl_month. MODISA is considered of higher quality and MODIST and VIIRS of the same but lower quality when merging. A sample monthly image is shown in Fig. 5. Notice that the label ("Chl, May, 2013") is written above color bar and its location is specified by the *XPOS* and *YPOS* variables in the *chl.bat* batch file.
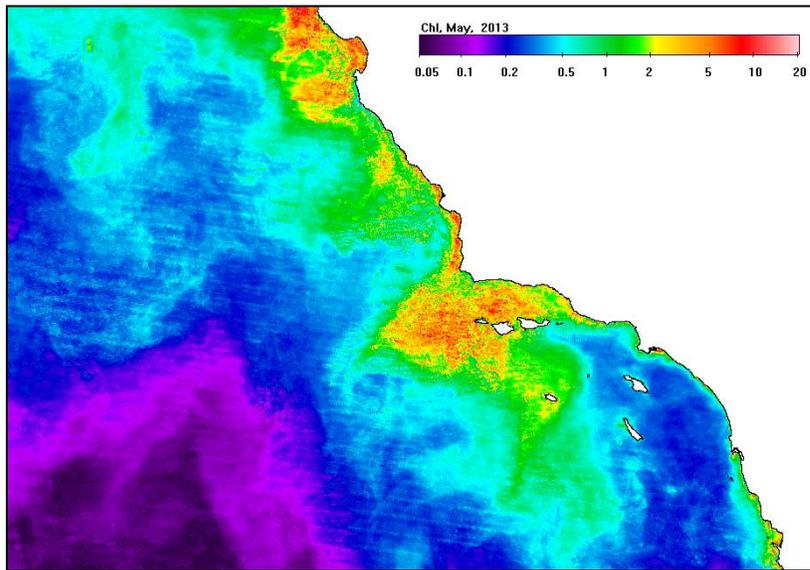
Fig. 5. A sample merged (MODISA + (MODIST + VIIRS)) monthly Chl image for May, 2013.

2.5   Creating task in Windows Task Scheduler

Open *Control Panel – Administrative Tools – Task* and use *Create Basic Task Wizard* to create a new task. I named my task *RunSortAndChl* (Fig. 6). It is set to start automatically at 11:55 PM every day. General and action properties of my task setup are shown in Figs. 7 and 8.

When the whole process is running correctly, each evening at 23:00 (or whatever time you set) new MODISA, MODIST and VIIRS Level-2 files will be downloaded by *FTPDownloader*. Then batch file *run.bat* is started by Windows Task Scheduler. *Run.bat* calls *sort.bat* and then *chl.bat*. You can also copy the produced files to a web server to make them immediately available on the web. After being set up correctly, the whole process should run without any need for manual data downloading and processing. Please note that when you reboot the computer, you need to manually start the *FTPDownloader* process. It can be set to start automatically after reboot but I have not done that yet.

Fig. 6. A task named *RunSortAndChl* is in *Task Scheduler*.

Fig. 7. General properties of a task named *RunSortAndChl* in *Task Scheduler*.
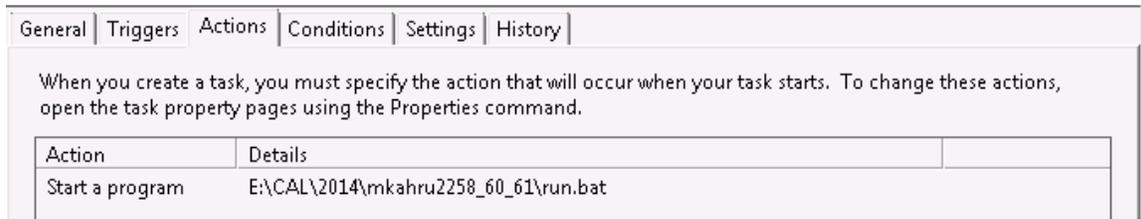
Fig. 8. Action properties of a task named *RunSortAndChl* in *Task Scheduler*.