

APPENDIX F: GUIDE: LANDSAT-8 AND SENTINEL-2 IMAGE PROCESSING AND DATA EXTRACTION

Downloading Satellite Imagery

USGS Earth Explorer: <https://earthexplorer.usgs.gov/>

Copernicus Open Access Hub: <https://scihub.copernicus.eu/dhus/#/home>

Earth Explorer Tip:

Use the Bulk Download Application if you need to download many images. Click on the



icon next to images to add them to your cart. Then click on Item Basket to see the link to download the application.

Landsat-8: USGS Earth Explorer

1. Search Criteria

a. Geocoder tab

i. Select a Geocoding Method > Address/Place

1. Address/place = "Chesapeake Bay"

ii. Or double click on the middle of the VCR on the map

b. Date Range

2. Datasets

a. Landsat > Landsat Collection 1 > Landsat Collection 1 Level-1 > Landsat 8 OLI/TIRS C1 Level-1

3. Results

a. Download Level-1 GeoTIFF Data Product



b. .zip will download

Sentinel-2: USGS Earth Explorer

1. Search Criteria

a. Double click on the middle of the VCR on the map

b. Date range

2. Data Sets

a. Sentinel > Sentinel-2

3. Results

a. Download L1C Tile in JPEG2000 format



b. .zip will download


Sentinel-2: Copernicus Open Access Hub

1. Reference the Sentinel-2 naming [convention](#). You want Level 1 images from the tile T18SVG.

2. Use the icon to draw a polygon around the VCR.



3. Select  to select search criteria

- a. Select sensing period
- b. Select **Mission: Sentinel-2**
- c. Product Type > S2MSI1C
- d. Download L1 image 

Processing Level-1 Images Using the Command Line

For help, you can use NASA's ocean color forum:

https://oceancolor.gsfc.nasa.gov/forum/oceancolor/forum_show.pl

1. Unzip .zips downloaded from USGS Earth Explorer or Copernicus. A fast way to do this is by using your computer's command line interface (CLI), by typing open and then dragging all .zip files into the line. Press enter to execute the code.
2. Copy the seadas-7.5.3 folder from Applications to Home (or whatever directory you would like to use).
3. Create new folder in /seadas-7.5.3/ocssw called "images."
4. Drag all unzipped L8 or S2 folders into this images folder.
5. Set your working directory in the CLI.

```
cd /Users/sarahlang/seadas-7.5.3/ocssw
```

- a. You can check your working directory by typing "pwd" (print working directory) or looking at the top of the CLI.
6. Type the following line into Terminal and follow directions for download of a JDK, a tool from Java to execute BEAM raster data (Hit "More Info" if on Mac)

```
/Applications/seadas-7.5.3/bin/gpt.command
```

- a. If you receive an error regarding the git operation (for example, xcrun:error: invalid developer path) run the line: xcode-select --install and install the command line developer tools
7. Install OLI (Operational Land Imager, Landsat-8) or MSI (MultiSpectral Instrument, Sentinel-2) processors

```
export OCSSWROOT=/Users/sarahlang/seadas-7.5.3/ocssw
source OCSSW_bash.env
install_ocssw.py --git-branch=v7.5 --msis2a --msis2b --curl --src --oli
```

- a. If you run into an error that states that the operation is not permitted, make sure Terminal has full disk access.
 - i. Apple Menu > Preferences > Security and Privacy > Privacy > Full Disk Access > Terminal

- b. You may receive the following error message if you've tried to download the processors previously on your system and the download failed:
 "Another git process seems to be running in this repository, e.g. an editor opened by 'git commit'. Please make sure all processes are terminated then try again. If it still fails, a git process may have crashed in this repository earlier: remove the file manually to continue."
 - i. In this case, execute

```
rm -f /Users/sarahlang/.cocoapods/repos/master/.git/index.lock
```

8. Process images using l2gen
 - a. Type "l2gen" and run to make sure the CLI can find the command. If it cannot, quit Terminal and run through the procedure of setting your working directory, executing gpt.command, and installing processors again.
 - b. Run code corresponding to L8 or S2, changing the file name to correspond to the one you are processing. Note the naming convention. Keep the file extension the same.
 - i. If you receive error messages, you may have to delete a parameter defined by l2prod (specifically aot_865). If you continue to receive errors, delete the entire l2prod line.

Landsat-8 example code:

```
l2gen ifile=/Users/sarahlang/seadas-
7.5.3/ocssw/images/LC08_L1TP_014034_20200722_20200722_01_RT/LC08_L1TP_014034_2020072
2_20200722_01_RT_MTL.txt ofile=/Users/sarahlang/seadas-
7.5.3/ocssw/images/LC08_L1TP_014034_20200722_20200722_01_RT/LC08_L1TP_014034_2020072
2_20200722_01.L2_LAC_OC
l2prod=Es_vvv,Kd_490,Rrs_vvv,aer_model_max,aer_model_min,aer_model_ratio,aer_num_iter,aeri
ndex,angstrom,chlor_a,cloud_albedo,dpol_vvv,ipar,num_iter,polcor_vvv
```

Sentinel-2 example code:

```
l2gen ifile=/Users/sarahlang/seadas-
7.5.3/ocssw/images/S2A_OPER_PRD_MSIL1C_PDMC_20161019T100726_R054_V20161018T160122
_20161018T160122.SAFE/manifest.safe ofile=/Users/sarahlang/seadas-
7.5.3/ocssw/images/S2A_OPER_PRD_MSIL1C_PDMC_20161019T100726_R054_V20161018T160122
_20161018T160122.SAFE/manifest.safe.L2
l2prod=Es_vvv,Kd_490,Rrs_vvv,aer_model_max,aer_model_min,aer_model_ratio,aer_num_iter,aeri
ndex,angstrom,aot_865,chlor_a,cloud_albedo,dpol_vvv,ipar,num_iter,polcor_vvv
```

Tips

- Can create Makefile for easier code execution.

```
touch Makefile
open Makefile
```

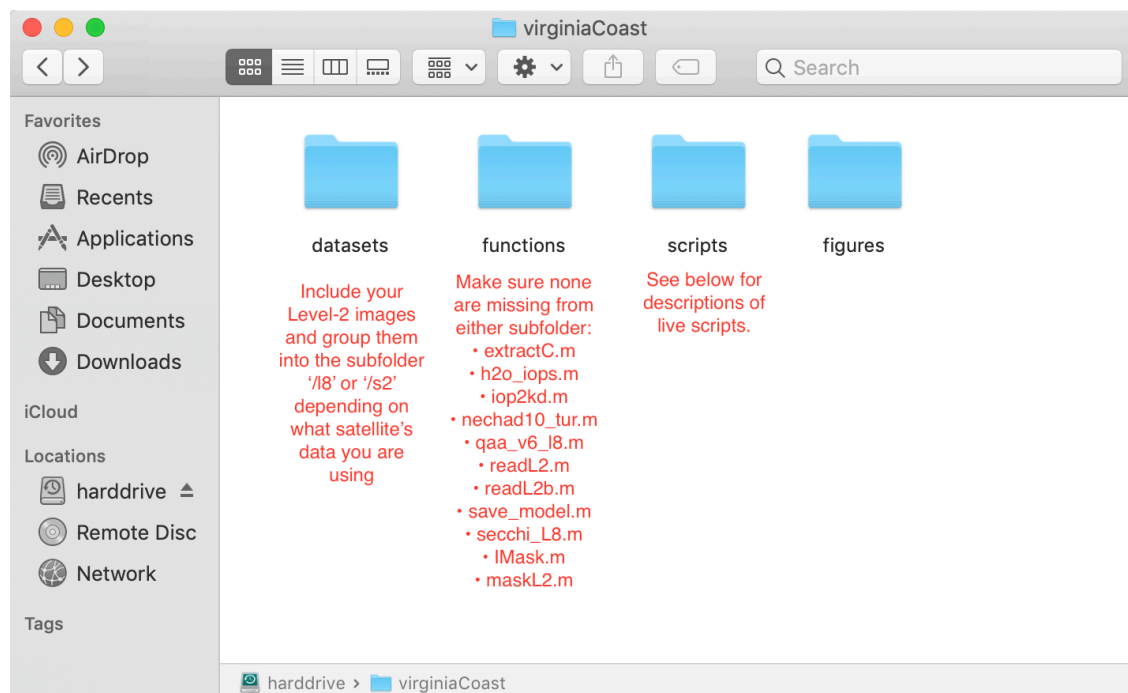
Then can copy and paste code into the Makefile, save it, and then type "make" into Terminal to execute the code.

- Ctrl C will cancel executed processes

- Images take up A LOT of space on your computer. If processing on your personal computer, I recommend using a hard drive. In this case, copy the seadas-7.5.3 folder onto your hard drive and set the working directory to `cd /Volumes/harddrive_name/seadas-7.5.3/ocssw`

Extracting data from Level-2 Images

Because Landsat-8 and Sentinel-2 have different central wavelengths that have to be modified in the live scripts and functions, I separated the scripts and functions so you will see separate folders for the different satellites. Open the live script from the folder of whatever satellite your images are from.



- DataExtraction is for data extraction without visualization (useful for extracting larger amounts of data). It will loop through a folder of images.
- applyAlgo is for data extraction and visualization. It will loop through a folder of multiple images.
- extratSeaDAS is for data extraction and visualization for a single image. Does not apply Lee et al. algorithms.
- mappingZsd is for mapping an entire scene of satellite derived Secchi depths.

Sentinel-2:

1. Sentinel-2 images have bands with central wavelengths that can vary slightly (± 1 nm) between the 2A and the 2B. The image will be labeled according to whether it was taken by the 2A or 2B. If you are not sure, you can see the wavelengths of the four bands if you pull the Level-2 image into the SeaDAS GUI.

2. Use readL2.m if using Sentinel-2A data and readL2b.m if using Sentinel-2B data. These functions contain the correct wavelengths. Follow the comments in the live script of where to make the necessary change, or see below for list of modifications to make.
 - a. Note: Some images do not have the variable aot_865. If you get this error message in MATLAB, open readL2.m or readL2b.m and turn that line into a comment using % in front of the line.
3. Copy the Level-2 .safe file from the seadas-7.5.3 folder to your dataset folder in your MATLAB working directory. You will have to rename copied Sentinel-2 images so they have unique identifiers. This will allow you to loop through multiple images at a time. However, if you run multiple images at the same time, they must be from the same satellite (2A or 2B).
 - a. For example,
 S2A_OPER_PRD_MSIL1C_PDMC_20161019T100726_R054_V20161018T160122_20161018T160122.manifest.safe.L2
4. Run the code.

Landsat-8

1. Copy the Level-2 OC file from the seadas-7.5.3 folder to your dataset folder in your MATLAB working directory.
2. Make the necessary modifications and run the code.

Live script modifications

For all live scripts:

- Specify site names and corresponding coordinates

```
site_names = {'Site 6', 'Site 12', 'Site 17'};
coord = [37.36764 -75.73592; 37.4670924 -75.668335; 37.29038 -75.784927];
```

For data visualization:

- Change “3” to the number of sites.

```
subplot(1,3,pl)
```

- Update depending on the number of images you have. I recommend naming each by the date of the satellite image.

```
legend({'Image 1', 'Image 2'})
```

Possible errors

- Index exceeds array bounds (error in extract.m)
 - Check your coordinates. They are most likely outside your image bounds.
- Error in readL2.m, variable not found
 - If it is not a parameter of interest, use % to comment that line out in readL2.m
- Error using internal.matlab...

- Check that you defined the correct variables to extract from the satellite images. You most likely need to change your wavelengths defined in the live script or in readL2.m

Sources:

https://oceancolor.gsfc.nasa.gov/forum/oceancolor/topic_show.pl?tid=8666

https://oceancolor.gsfc.nasa.gov/forum/oceancolor/topic_show.pl?tid=8810

https://oceancolor.gsfc.nasa.gov/forum/oceancolor/topic_show.pl?tid=8654

<https://github.com/m11keluis>