
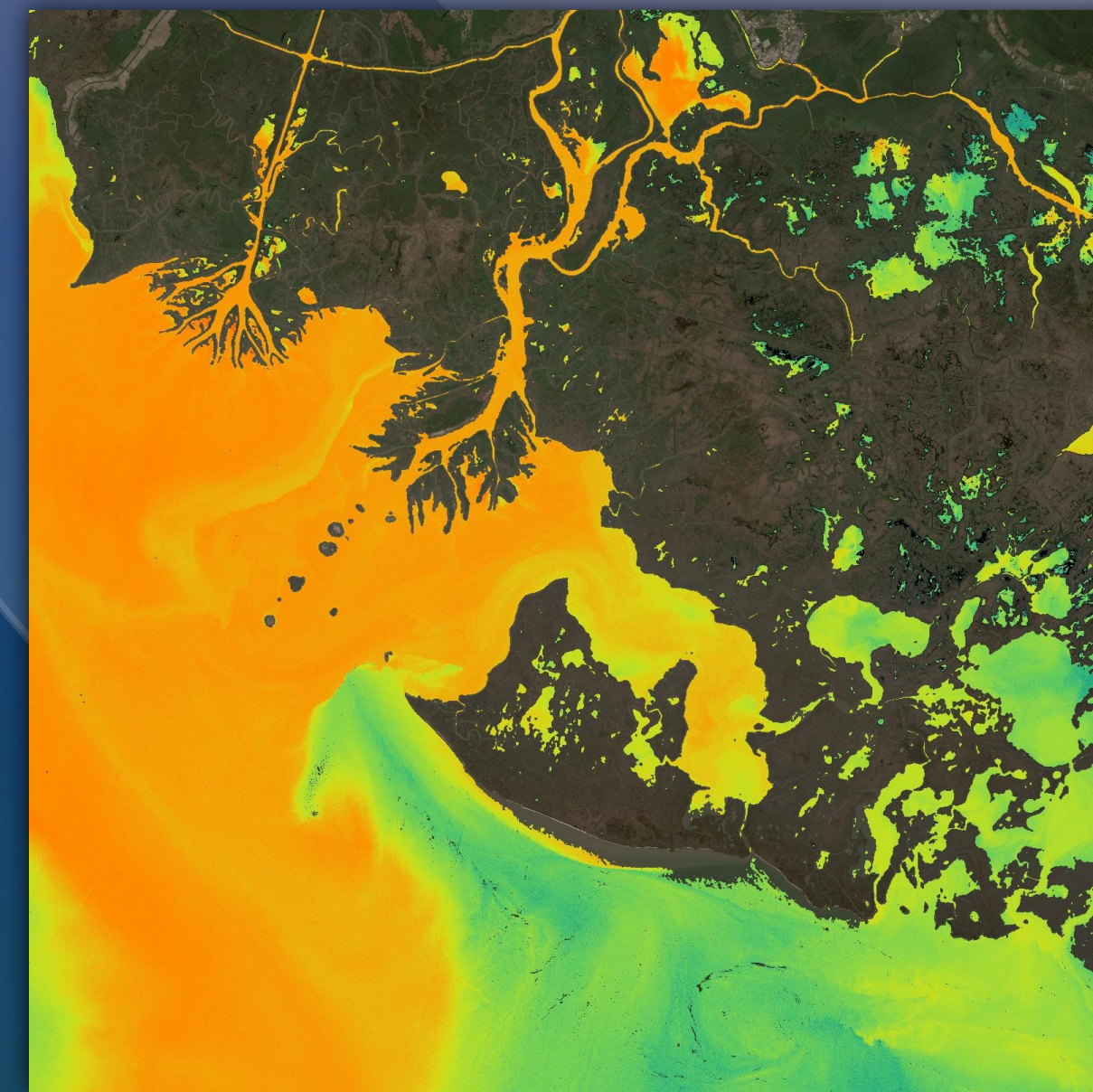


CoastWatch Utilities Updates: True Color Correction and Hybrid Rendering

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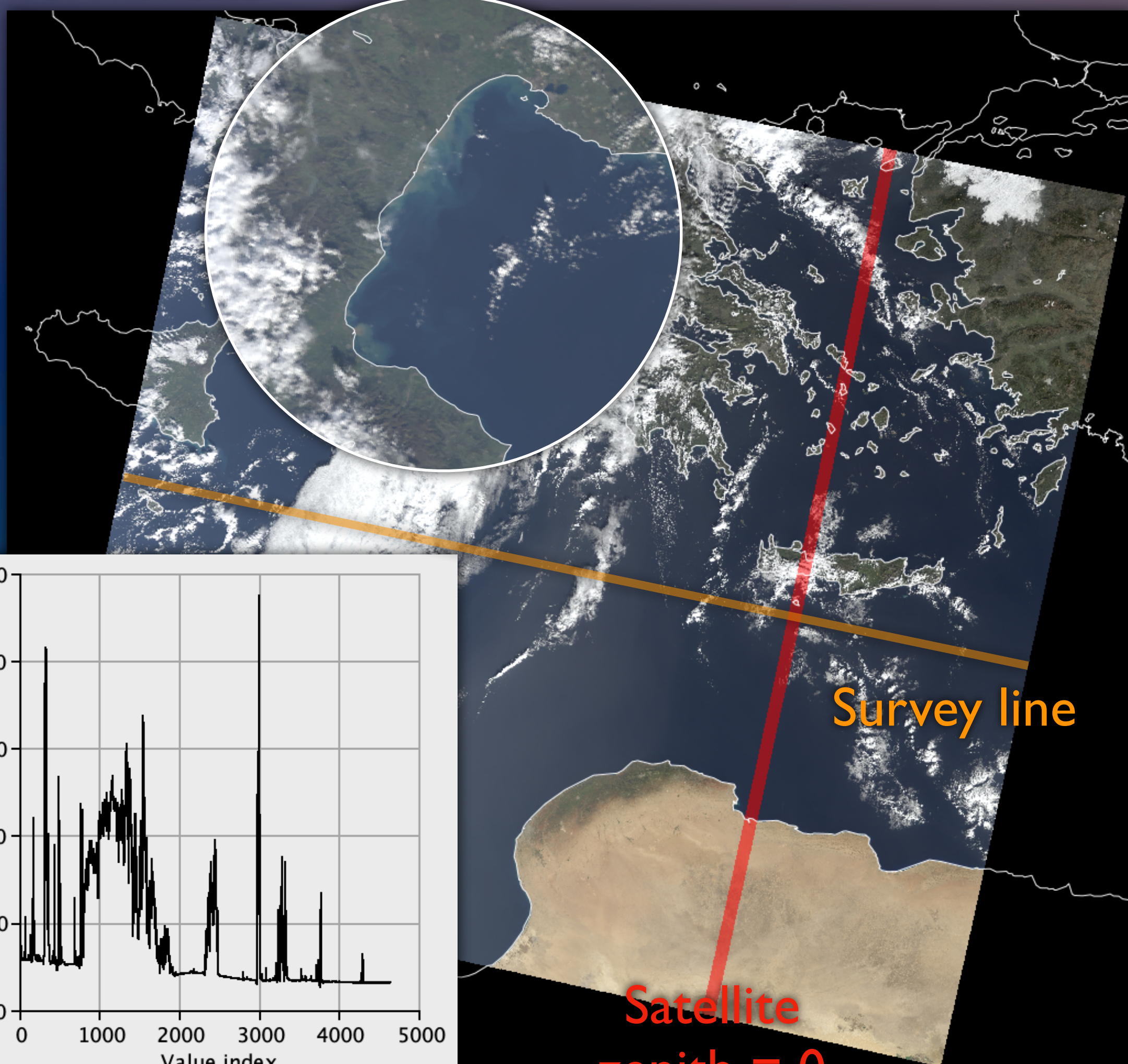
CoastWatch Operations Managers Monthly Meeting
Feb 16, 2023



The CoastWatch Utilities true color correction removes Rayleigh scattering and gaseous absorption (water vapour, ozone) from true color bands.

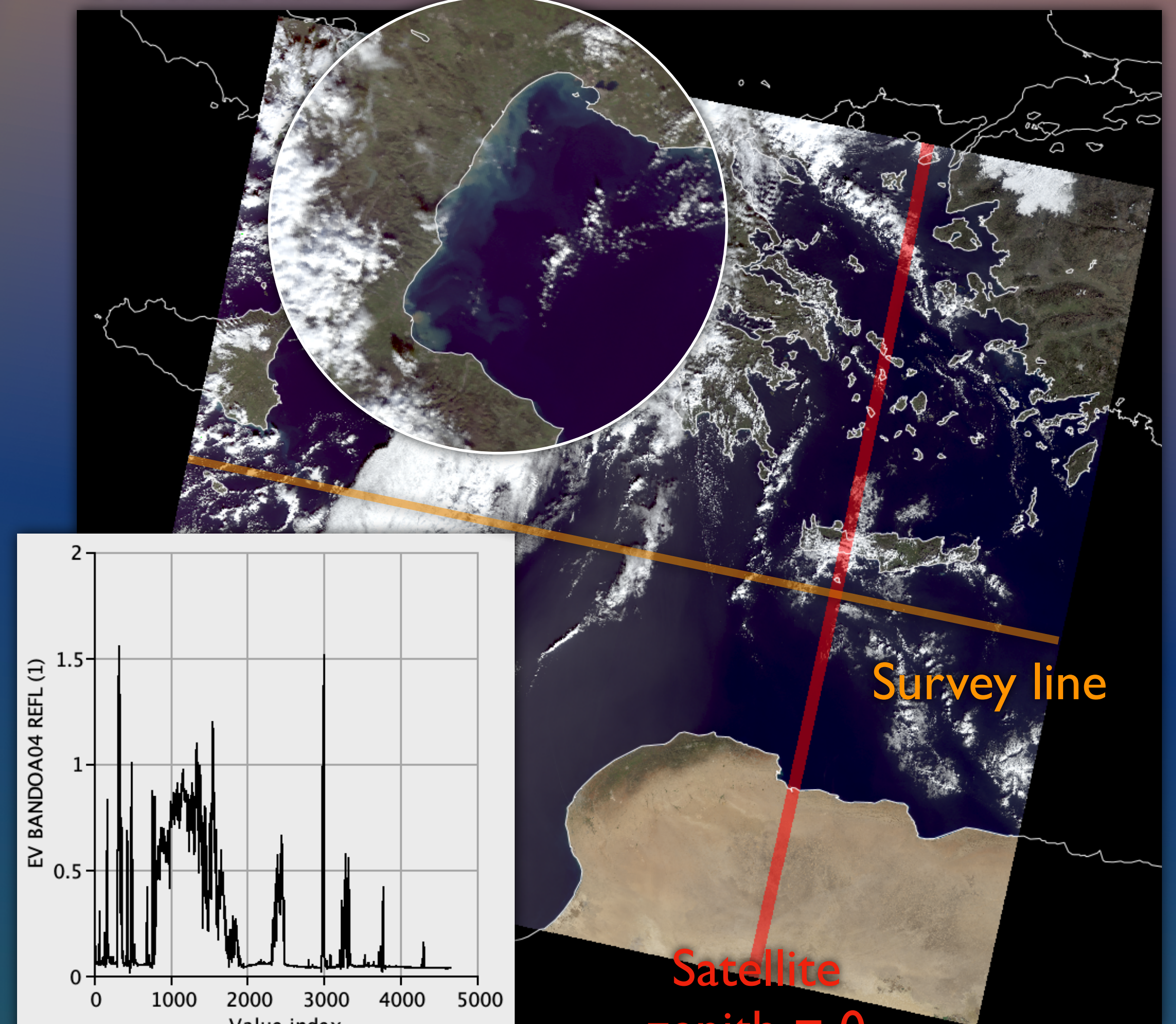
Example data from Sentinel-3A OLCI 2023/01/23 08:46:23 UTC (Bands 7/6/4)

TOA Radiance



Satellite
zenith = 0

Corrected Reflectance

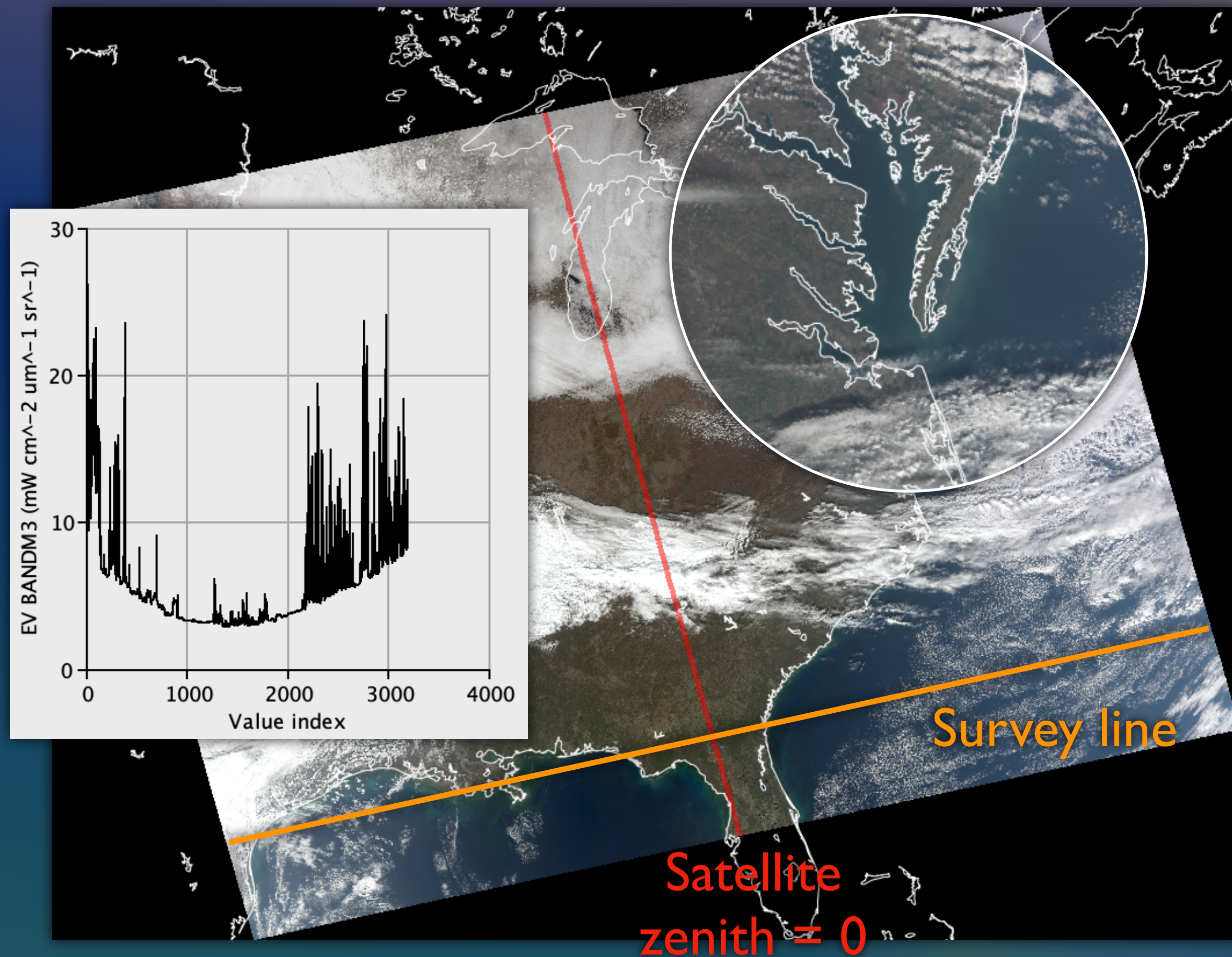


Satellite
zenith = 0

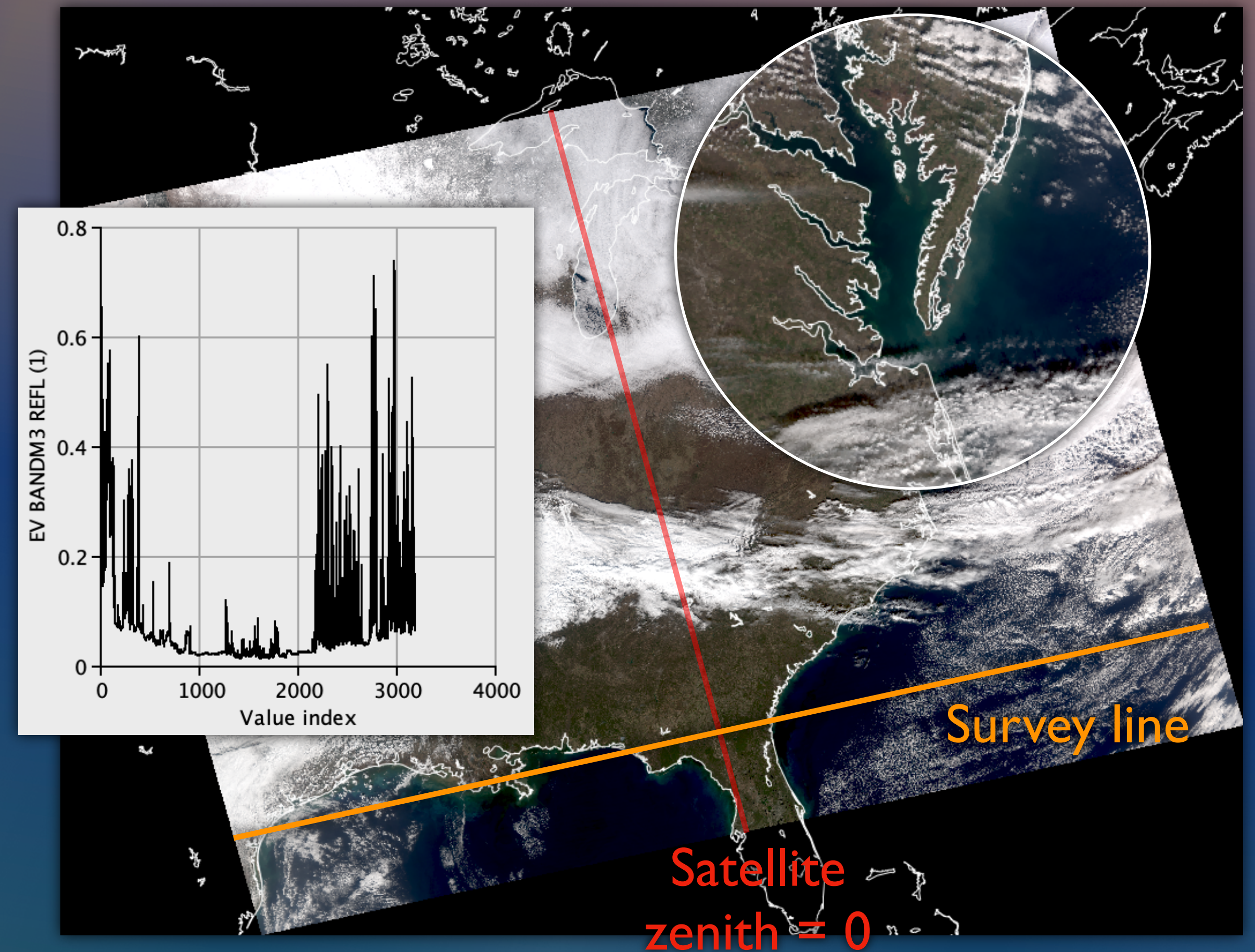
The tool automatically detects VIIRS, OLCI, and MSI in CoastWatch data files, and also supports user-defined sensors.

Example data from NOAA-20 VIIRS 2023/01/07 18:35:51 UTC (Bands 5/4/3)

TOA Radiance



Corrected Reflectance



The command line tool `cwtccorrect` requires an input file in NetCDF or HDF, an output file, plus optional user-defined sensor parameters.

```
Peters-MacBook-Pro-16:olci phollema$  
Peters-MacBook-Pro-16:olci phollema$  
Peters-MacBook-Pro-16:olci phollema$ cwtccorrect -v OLCMCW.I2023023.084623.hdf OLCMCW.I2023023.084623.refl.hdf  
[INFO] Opening input OLCMCW.I2023023.084623.hdf  
[INFO] Creating output OLCMCW.I2023023.084623.refl.hdf  
[INFO] Found supported sensors: [n20_viirs, npp_viirs, s2a_msi, s2b_msi, s3a_olci, s3b_olci]  
[INFO] Detected sensor 's3a_olci'  
[INFO] Computing reflectance for red band 'EV_Band0a07'  
[INFO] Using Earth-Sun distance factor 1.0160995, solar irradiance 164.914 mW/cm^2/um  
[INFO] Using variable 'sun_zenith' in reflectance computation  
[INFO] Total grid size is 4091x4865  
[INFO] Using 12 parallel threads for processing  
[INFO] Processing 168 data chunks of size 362x362  
[INFO] Computing reflectance for green band 'EV_Band0a06'  
[INFO] Using Earth-Sun distance factor 1.0160995, solar irradiance 179.6854 mW/cm^2/um  
[INFO] Total grid size is 4091x4865  
[INFO] Using 12 parallel threads for processing  
[INFO] Processing 168 data chunks of size 362x362  
[INFO] Computing reflectance for blue band 'EV_Band0a04'  
[INFO] Using Earth-Sun distance factor 1.0160995, solar irradiance 193.6261 mW/cm^2/um  
[INFO] Total grid size is 4091x4865  
[INFO] Using 12 parallel threads for processing  
[INFO] Processing 168 data chunks of size 362x362  
[INFO] Using variable 'latitude' for latitude angle data  
[INFO] Using variable 'longitude' for longitude angle data  
[INFO] Using variable 'sun_zenith' for solar zenith angle data  
[INFO] Using variable 'sun_azimuth' for solar azimuth angle data  
[INFO] Using variable 'sat_zenith' for satellite zenith angle data  
[INFO] Using variable 'sat_azimuth' for satellite azimuth angle data  
[INFO] Computing atmospheric correction for true color bands  
[INFO] Total grid size is 4091x4865  
[INFO] Using 12 parallel threads for processing  
[INFO] Processing 168 data chunks of size 362x362  
Peters-MacBook-Pro-16:olci phollema$
```


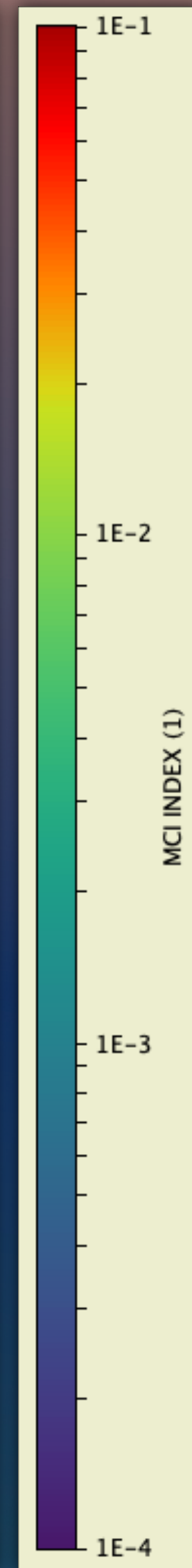
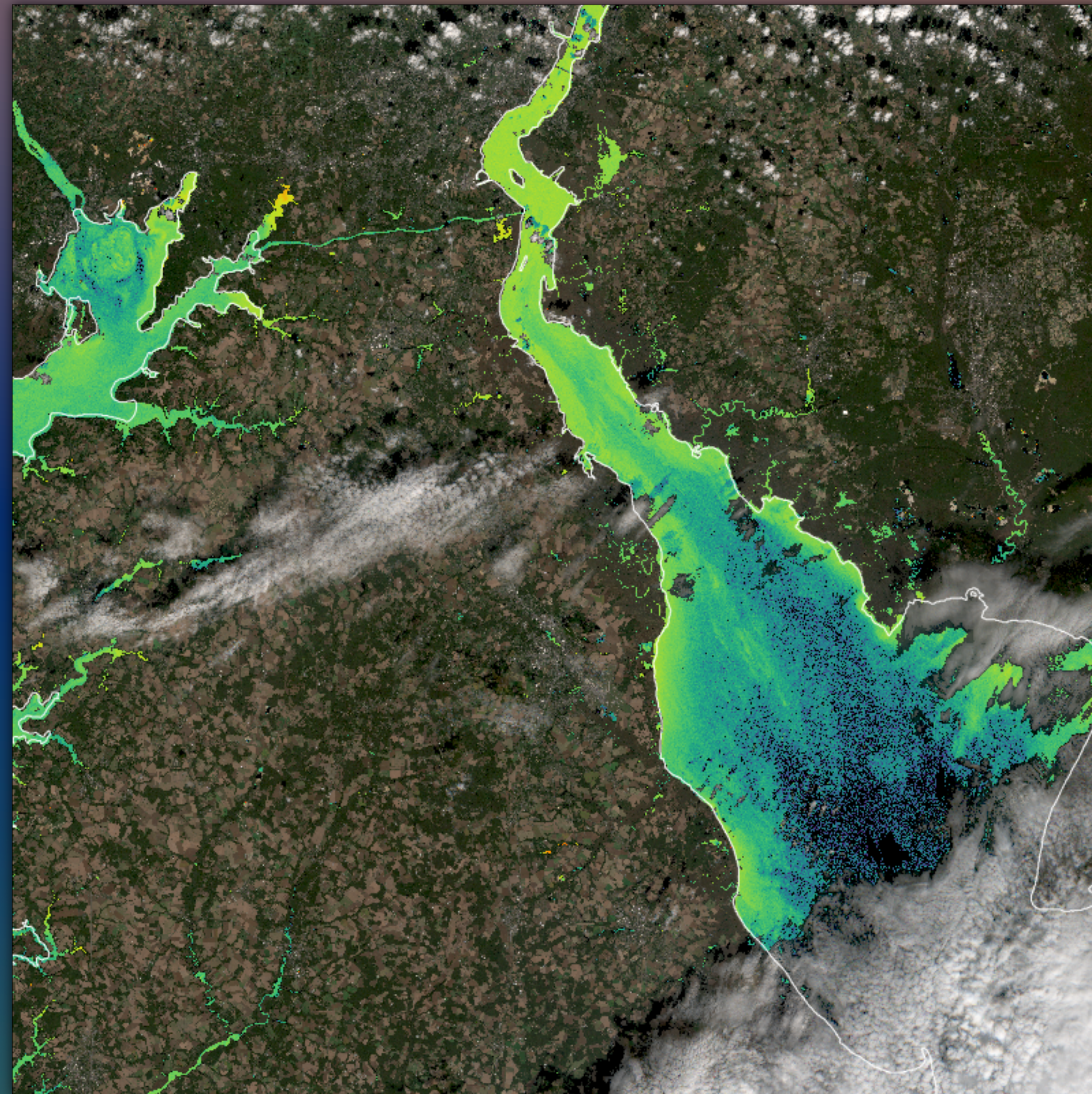
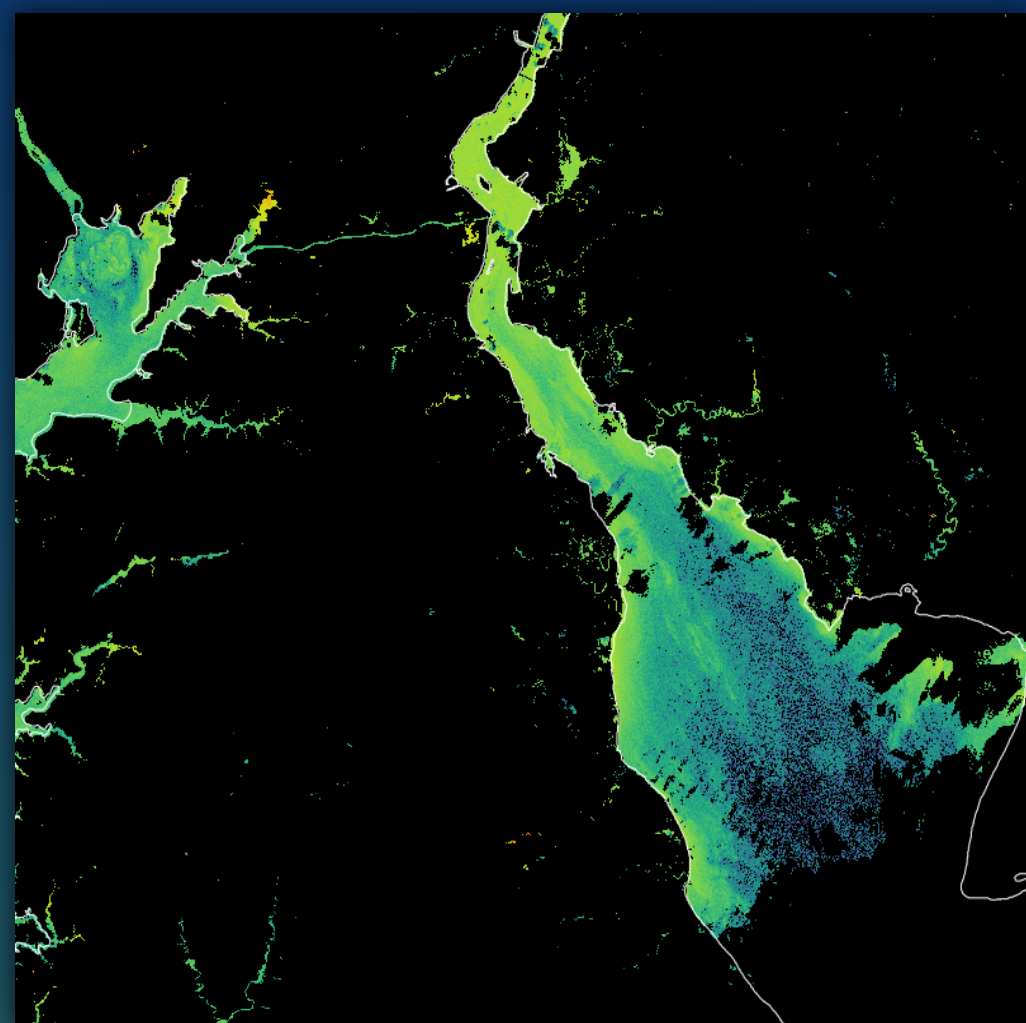
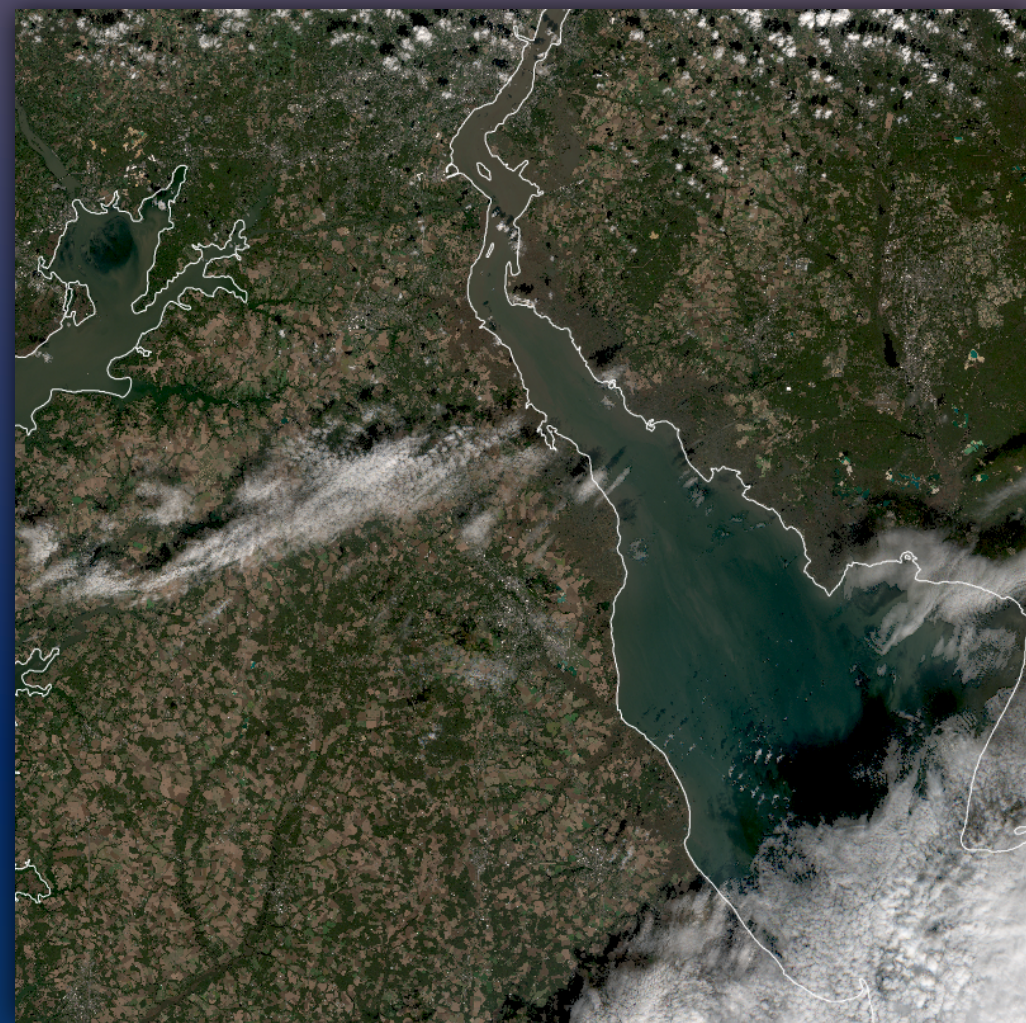
Detect sensor

Compute
reflectance

Detect angle
variables


Atmospheric
correction

The CoastWatch Utilities hybrid rendering mode combines an R/G/B composite plot with a color scaled data variable.

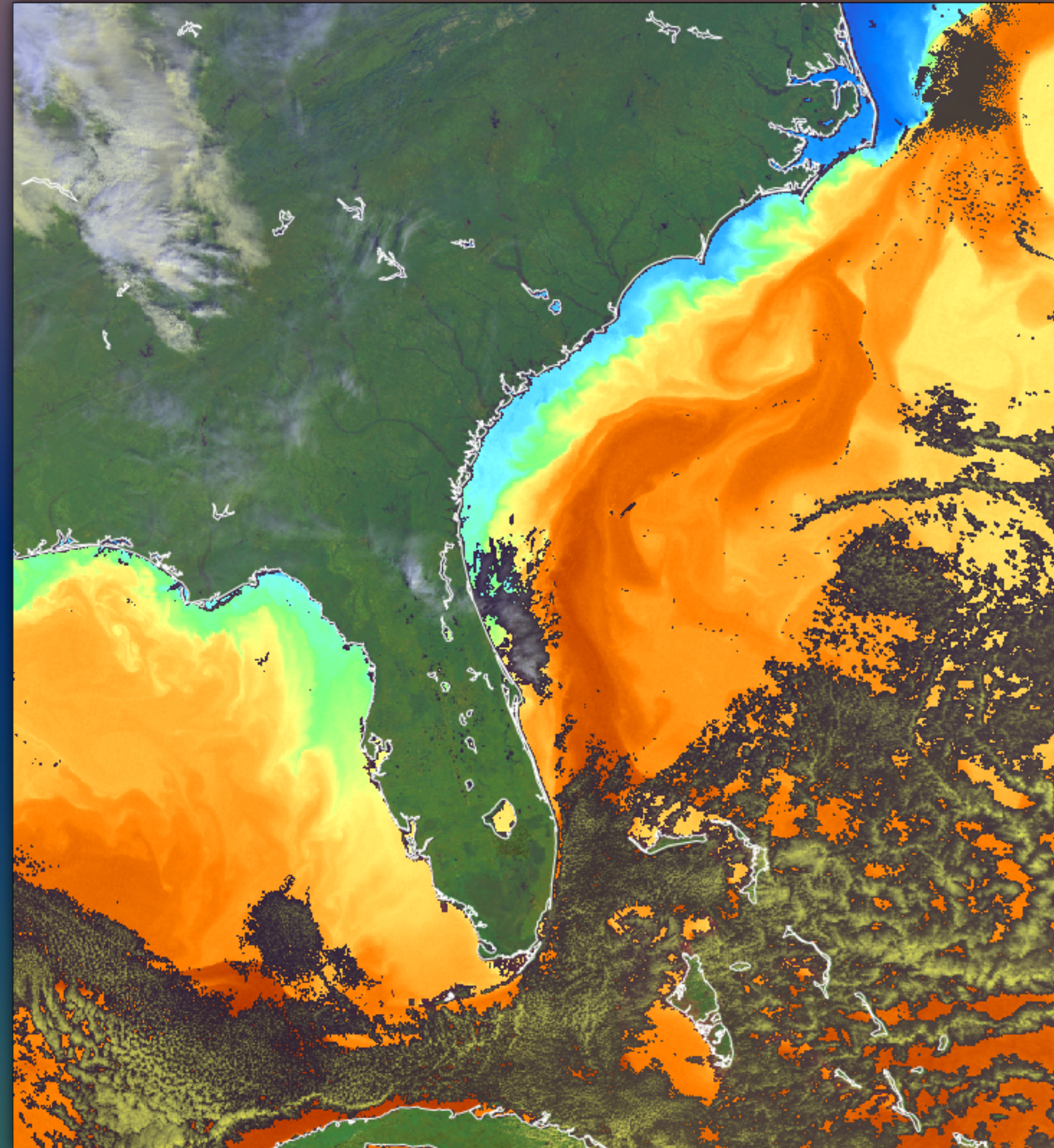
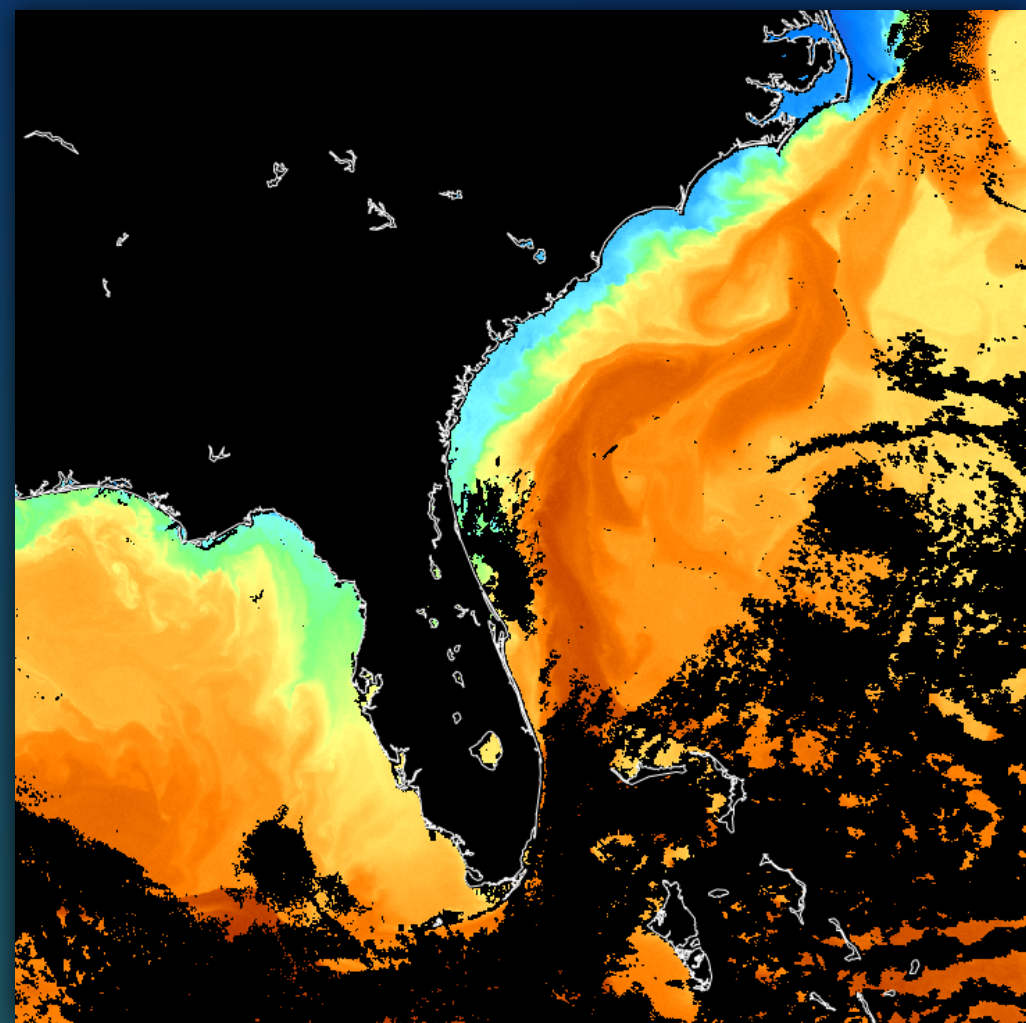
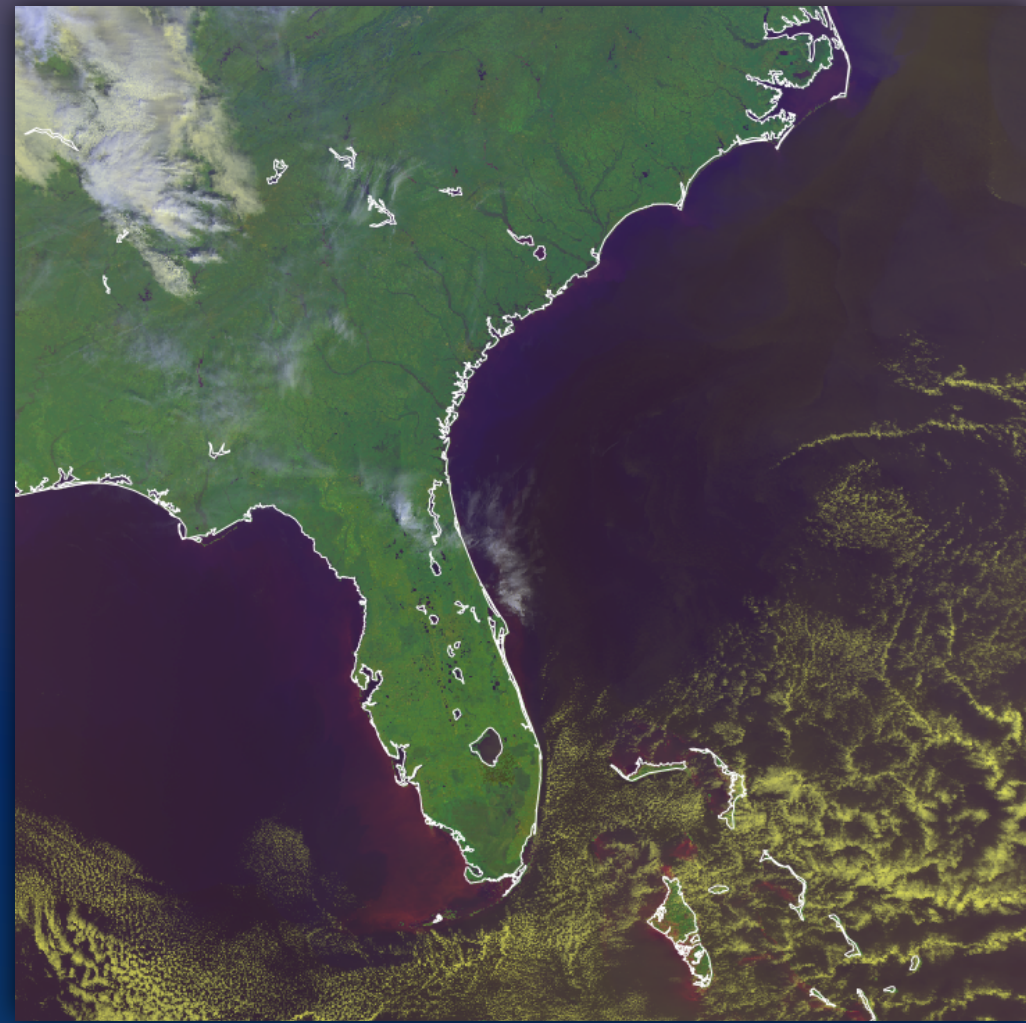


Data courtesy of:
Copernicus Program
(modified by NOAA
CoastWatch)

Data source:
SENTINEL-2A MSI
Date:
2021/10/22 JD 295
Time:
16:02:25 UTC
11:02:25 -0500
Scene time:
DAY
Projection type:
MAPPED
Map projection:
0.02 km/pixel
UNIVERSAL
TRANSVERSE
MERCATOR
Latitude bounds:
38 N -> 41 N
Longitude bounds:
77 W -> 74 W



Hybrid rendering mode works on any true color or false color composite of variables and provides the answer to "why is there no data there?"



NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Data courtesy of:
USDOC/NOAA/NESDIS
CoastWatch

Satellite:
METOP-1
Sensor:
AVHRR
Date:
2023/02/14 JD 045
Time:
15:13:13 UTC
10:13:13 -0500
Scene time:
DAY
Projection type:
MAPPED
Map projection:
1.47 km/pixel
MERCATOR
Latitude bounds:
22 N -> 38 N
Longitude bounds:
89 W -> 72 W

An inset map of the United States with a red box highlighting the Gulf of Mexico region.

To render a hybrid image, supply `cwrender` with all the same options as for both a composite and color enhancement, plus an optional hybrid mask.

```
2021_10_27_mike_soracco_hybrid_render -- -bash -- 112x34
Peters-MacBook-Pro-16:2021_10_27_mike_soracco_hybrid_render phollema$ cwrender -v --coast white --enhance mci_in
dex --function log --palette NCCOS-chla --range 1e-4/1e-1 S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W.nc S2A_MSI_2021
_10_22_15_53_21_T18SVJ_L2W_mci.png
[INFO] Reading input S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W.nc
[INFO] Preparing data image noaa.coastwatch.render.ColorEnhancement
[INFO] Rendering overlay noaa.coastwatch.render.CoastOverlay
[INFO] Writing output S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W_mci.png
Peters-MacBook-Pro-16:2021_10_27_mike_soracco_hybrid_render phollema$ cwrender -J-Xmx1g -v --coast white --compo
site=rhos_665/rhos_560/rhos_492 --compositedhint=true_color_vivid S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W.nc S2A_M
SI_2021_10_22_15_53_21_T18SVJ_L2W_true_color.png
[INFO] Reading input S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W.nc
[INFO] Set red component range to [0.02, 0.8]
[INFO] Set green component range to [0.02, 0.8]
[INFO] Set blue component range to [0.02, 0.8]
[INFO] Preparing data image noaa.coastwatch.render.ColorComposite
[INFO] Rendering overlay noaa.coastwatch.render.CoastOverlay
[INFO] Writing output S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W_true_color.png
Peters-MacBook-Pro-16:2021_10_27_mike_soracco_hybrid_render phollema$ cwrender -J-Xmx1g -v --coast white --hybri
dmask "l2_flags != 0" --composite=rhos_665/rhos_560/rhos_492 --compositedhint=true_color_vivid --enhance mci_inde
x --function log --palette NCCOS-chla --range 1e-4/1e-1 S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W.nc S2A_MSI_2021_1
0_22_15_53_21_T18SVJ_L2W_hybrid.png
[INFO] Reading input S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W.nc
[INFO] Set red component range to [0.02, 0.8]
[INFO] Set green component range to [0.02, 0.8]
[INFO] Set blue component range to [0.02, 0.8]
[INFO] Preparing data image noaa.coastwatch.render.HybridView
[INFO] Preparing data image noaa.coastwatch.render.ColorComposite
[INFO] Preparing data image noaa.coastwatch.render.ColorEnhancement
[INFO] Rendering overlay noaa.coastwatch.render.CoastOverlay
[INFO] Writing output S2A_MSI_2021_10_22_15_53_21_T18SVJ_L2W_hybrid.png
Peters-MacBook-Pro-16:2021_10_27_mike_soracco_hybrid_render phollema$
```

Read data

Create
composite image

Create scaled
color image

Merge images
and write output

The hybrid rendering mode and true color atmospheric correction are included in the latest packages.



Official releases (hybrid mode):
Visit coastwatch.noaa.gov and select Data Tools >
CoastWatch Utilities



Beta releases (hybrid mode + true color correction):
Visit terrenus.ca/download/cwutils/beta