1st INIOAS Training Course on Ocean Remote Sensing, 2023

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Investigating the Ocean Color from Space

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Courtesy

esa

European Space Agency

1. Sentinel data for water quality
    1. Sentinel-3 OLCI display
    2. Atmospheric effects
    3. L2 processing and analysis: C2RCC
    4. Simple retrieval of water quality parameters
    5. Validation

The aim of this exercise is to process an OC image (S3-OLCI) from L1 data to L3, going step by step and understanding the implications of each pre-processing and processing step necessary to retrieve water quality products.

We will use SNAP tools and processors for both processing and analysing the results.

https://step.esa.int/main/download/snap-download/

Exercises

1.1 Sentinel-3 OLCI display

1.2 Atmospheric effects

1.3 L2 processing and analysis: C2RCC

1.4 Simple retrieval of water quality parameters

1.5 Validation

Material

S3B_OL_1_EFR____20190618T093412_20190618T093712_20190619T143145_0179_026_307_1980_MAR_O_NT_002.SEN3

S3B_OL_2_WFR____20190618T093412_20190618T093712_20190619T163055_0179_026_307_1980_MAR_O_NT_002.SEN3

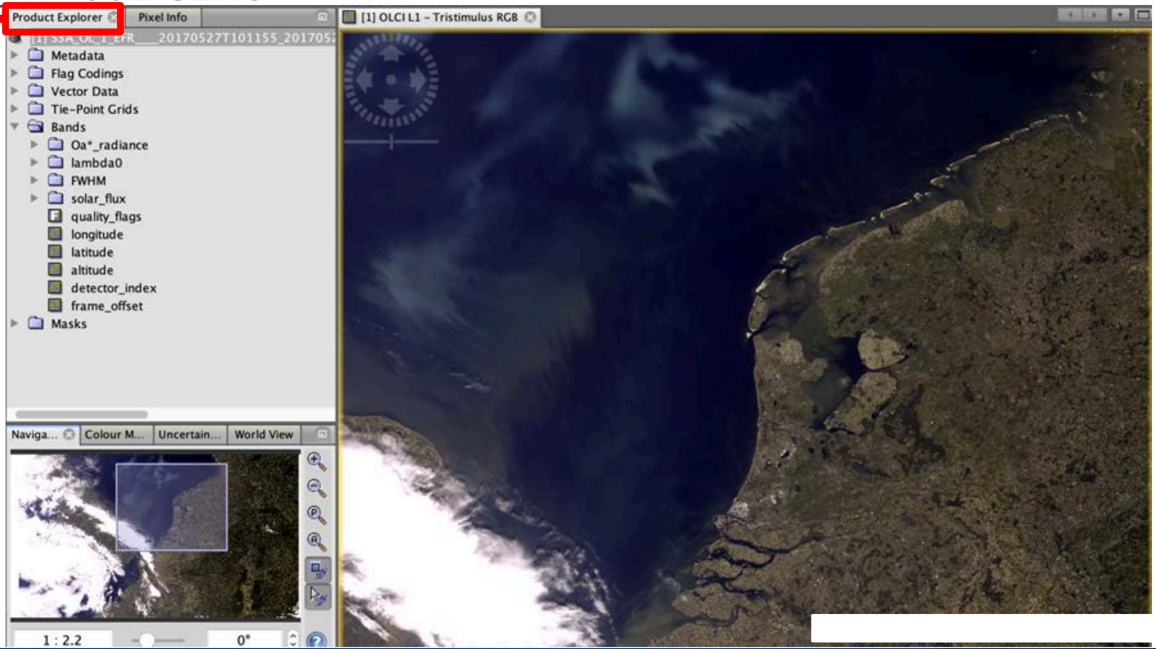
Import or open in SNAP the OLCI image (*xfdumanifest.xml*):

S3B_OL_1_EFR____20190618T093412_20190618T093712_20190619T143145_0179_026_307_1980_MAR_O_NT_002.SEN3

Product explorer shows the file content and detail information about the, metadata, bands, mask, flag coding, vector data and tie-point grids of the product.

Click on the (+) sign in each item and the different bands per folder will be shown.

Click in one of the bands of folder “Oa*radiance” and the image will be displayed in the right panel.



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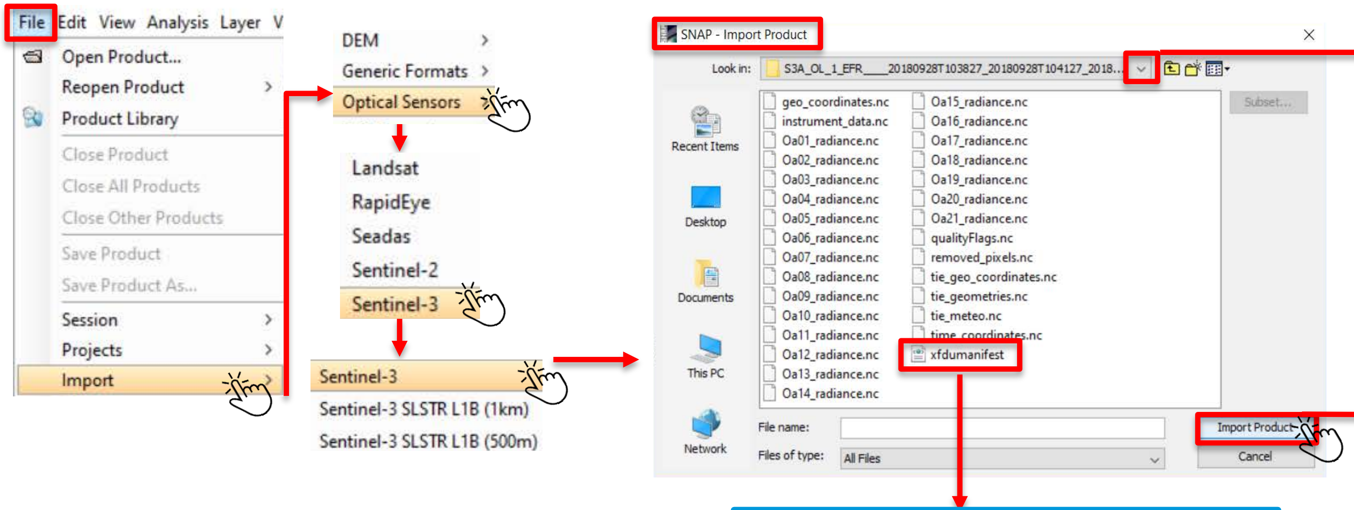
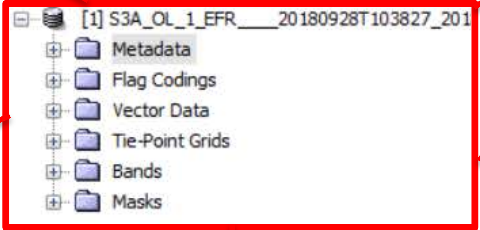


Drag and drop: It allows to select a S3 image stored in an specific site.

Once selected the xml file you must apply Import Product to open S3 image

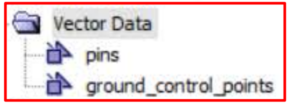
xfdumanifest: S3 metadata file. It is on xml format. The file gathers together metadata associated with the instrument and file processing.

MAIN FOLDERS IN S3 OL L1

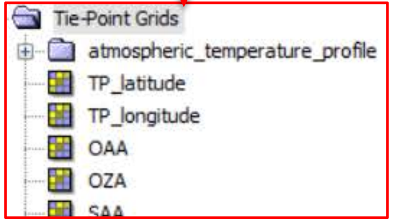


Metadata: it contains a detailed spacecraft technical information (acquisition period, orbit reference, etc.) and dataset –variable attributes of each band (start time, stop time, units, etc.)

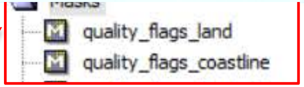
Flag coding: special values containing flag coding metadata for quality control datasets (bright, sun glint risk, coastline, etc.)



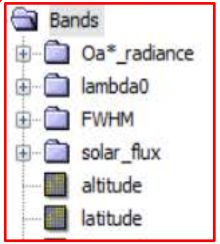
Vector data: it contains all geometries of a product: pins, ground control points and geometric figures.



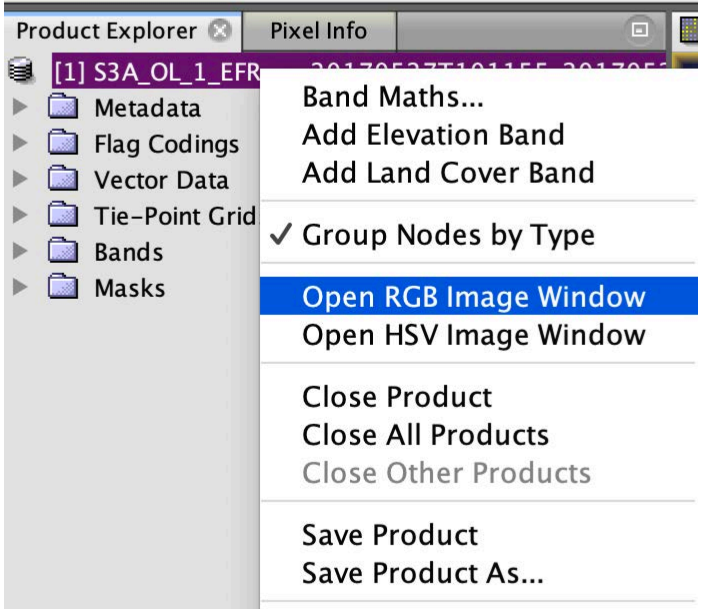
Tie-point grids: it contains all tie point grid raster datasets of meteorological data (atmospheric temperature profile, horizontal wind, humidity, sea level pressure, total ozone)

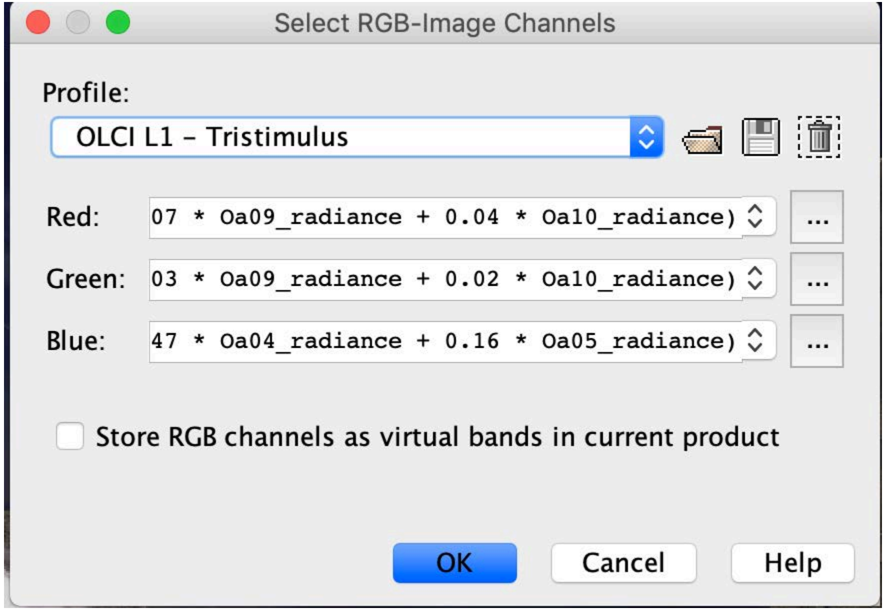


Masks: the quality flags are showed as a raster layer. It has a boolean value: true or false.



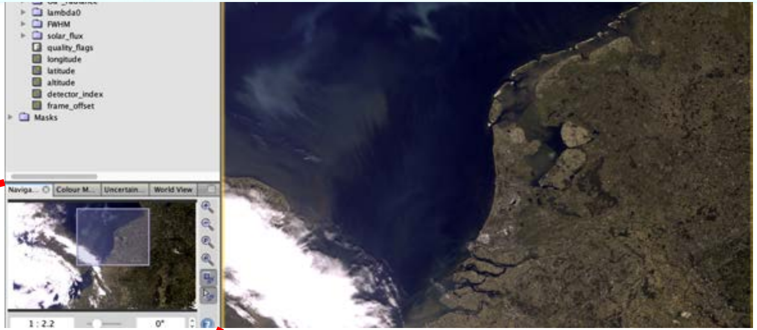
Bands: it contains data by each band as radiance, characterized wavelength band, full widths at half maximum, solar irradiance, detector index, geographic data, etc.

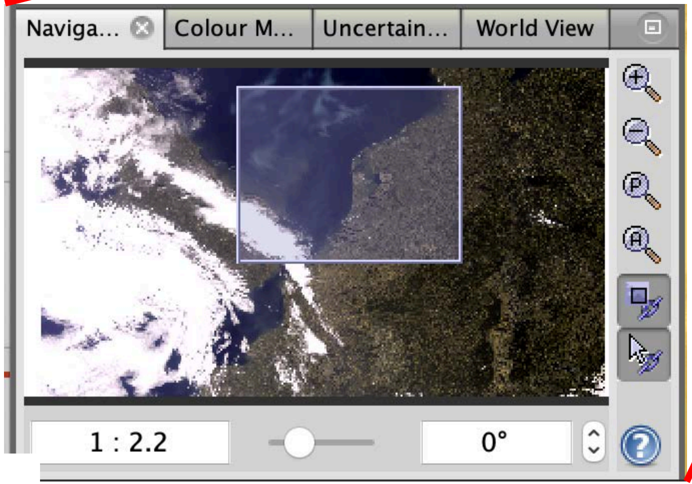




Create an RGB composition by right-clicking on the name of the products and selecting “Open RGB Image Window”.
Select the profile by default (OLCI L1 - Tristimulus) since it contains the best band combination for each colour to be assigned.

In the bottom left you will find the Navigation label, click on it to have an overview of the whole scene.





Zoom-in

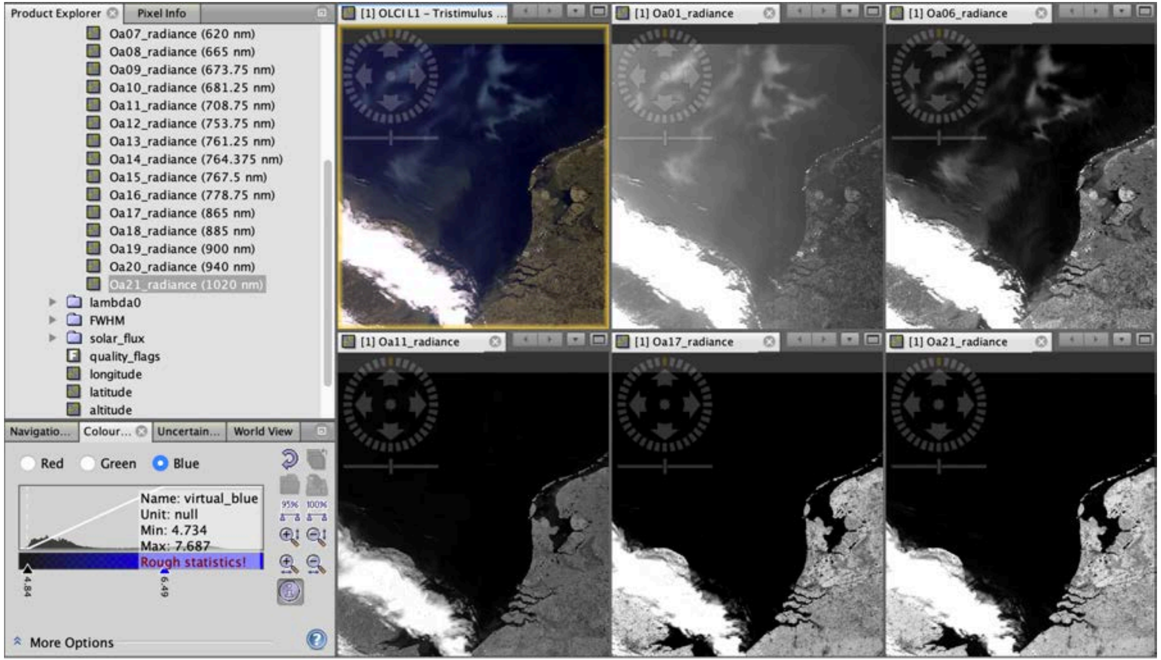
Zoom-out

Central zoom

Show the whole image

Synchronization of view

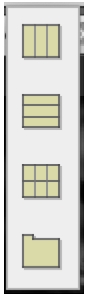
Synchronization of

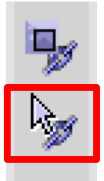


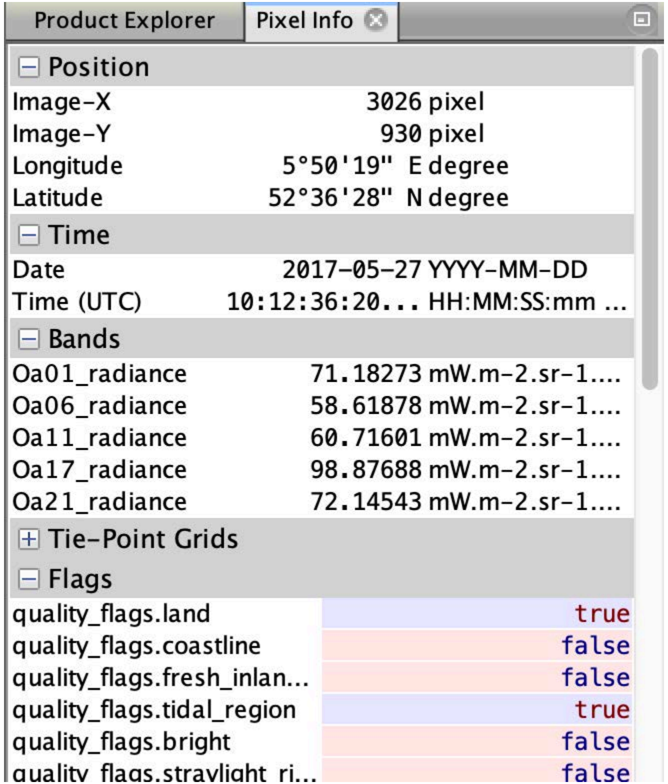
With the Windows Arrangement tools we can visualise side by side the different open bands: View → Toolbars→ Window Arrangement.

Only if the views are synchronized the navigation tools will affect all open windows.

To see the cursors synchronized in all views, select the arrow with the chain label.

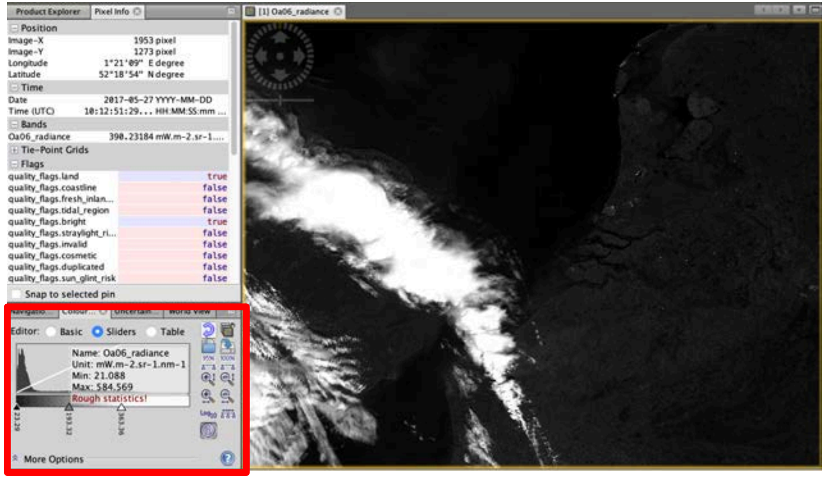


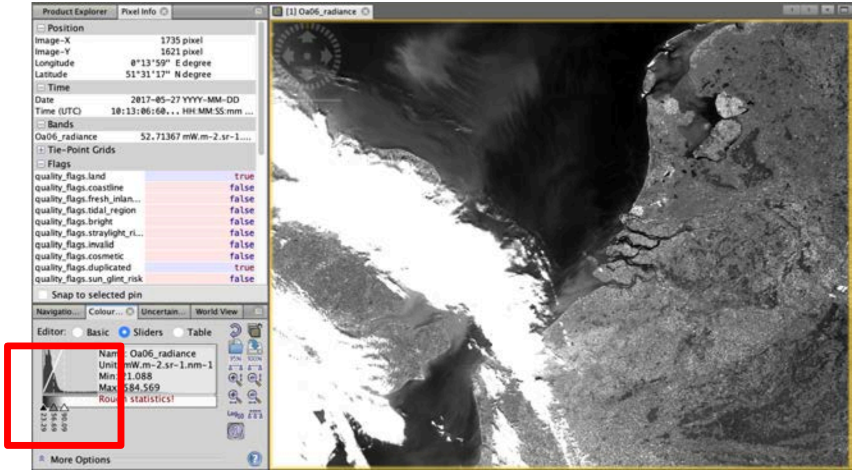




The pixel information can be seen from the Pixel Info tab:
View → Tool Windows → Pixel Info

Moving the cursor over the image will continuously change the values in the Pixel Info





It is possible to improve the visualisation of bands using the Colour Manipulation tool: View → Tool Windows → Colour Manipulation.

Stretching the histogram or normalized the contrast will enhance the visualization by 'stretching' the range of intensity values it contains to span a desired range of values (the range of the pixels in the current image).

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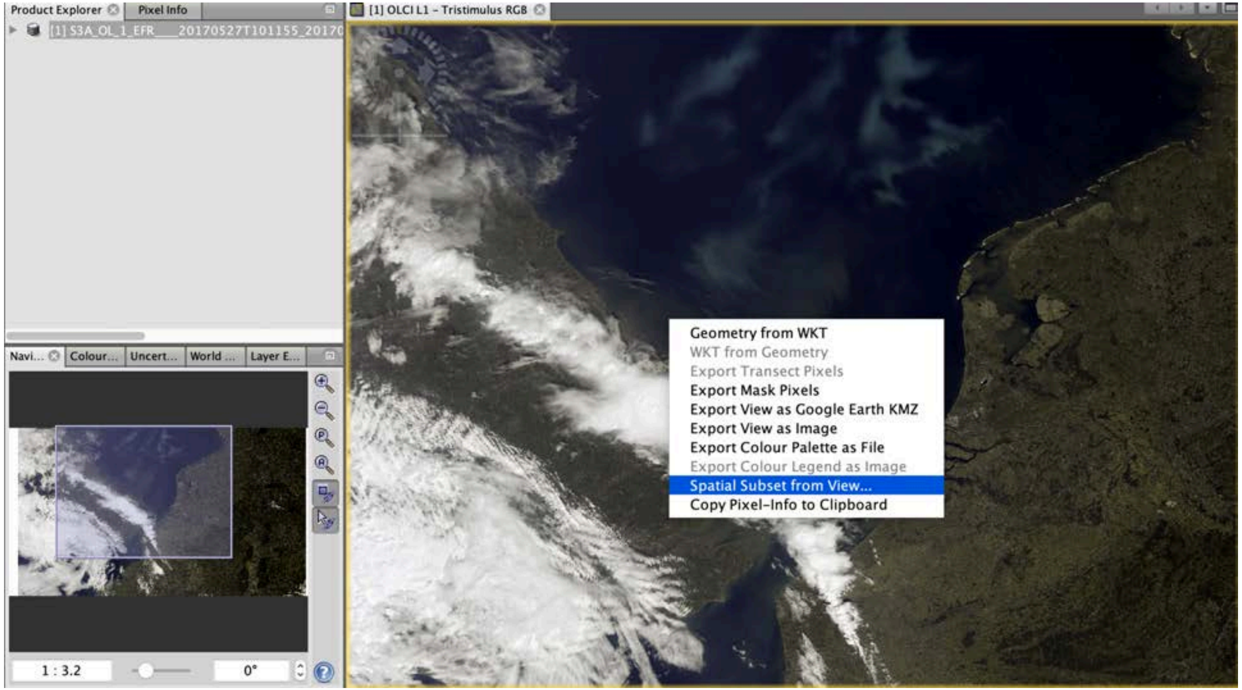

Right click over the image and select → Spatial Subset from View...

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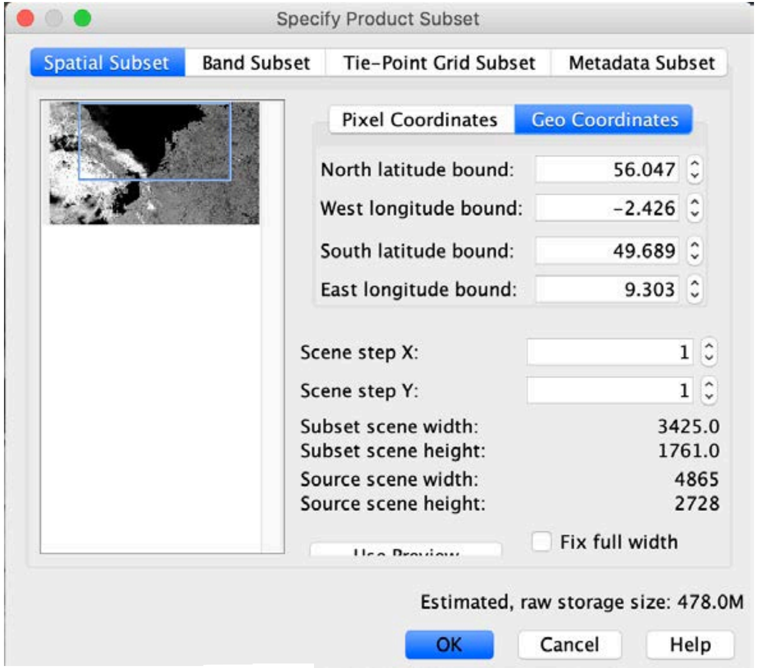
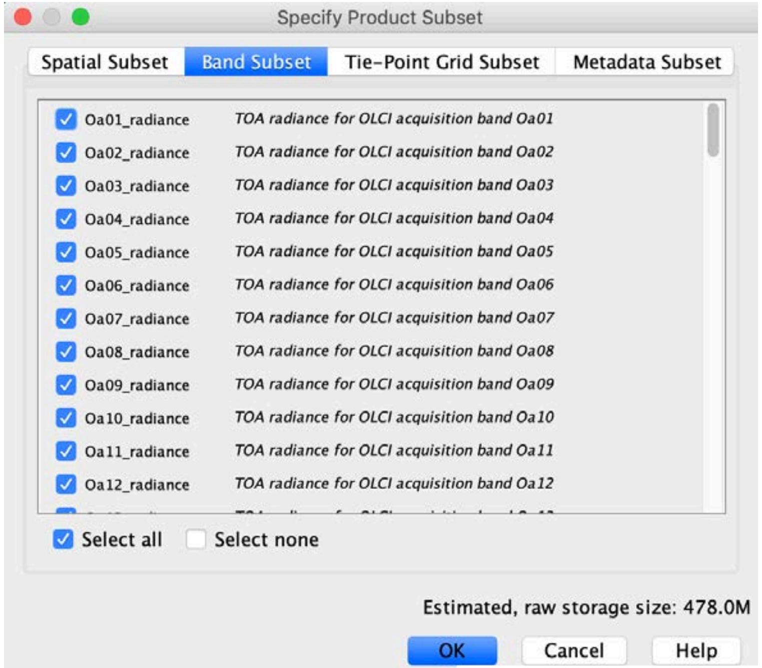
Modify the area to be subseted using the rectangle on the view or introducing coordinates.



It is possible to subset also for the bands, tie-point grids or metadata. We need everything this times.



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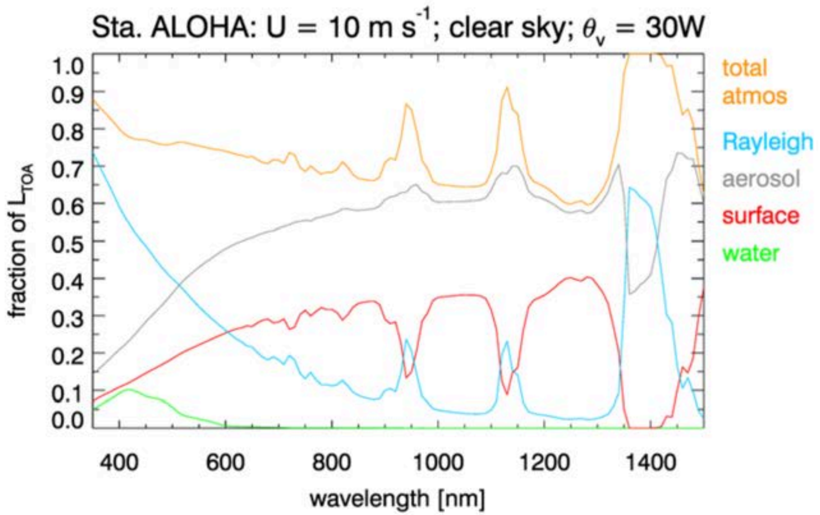
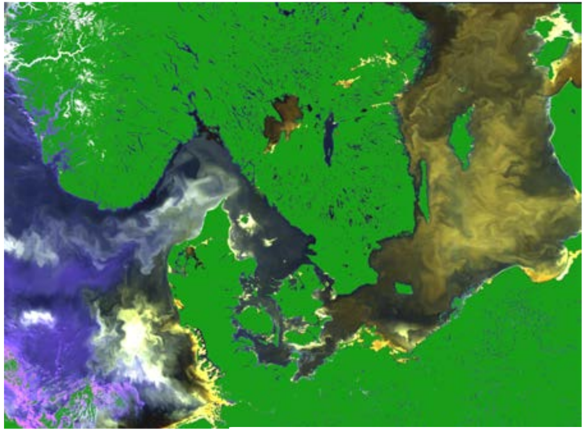


Figure 2.3: The fraction of L_t due to various processes, for the particular simulation of Fig. 2.2. (Need to add a curve for total atmos plus glint.)



Atmospheric path radiance: 70-90% of L_t
Below 500 nm and over 1350 nm Rayleigh scattering is the largest contributor. In between aerosols are the greatest contributors.

Algorithm Specification

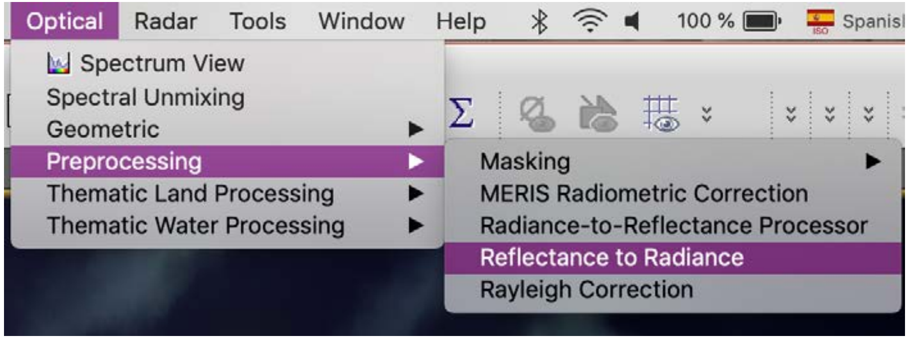
The conversion from TOA radiance (L_{TOA}) to TOA reflectances (R_{TOA}) done by the following equation:

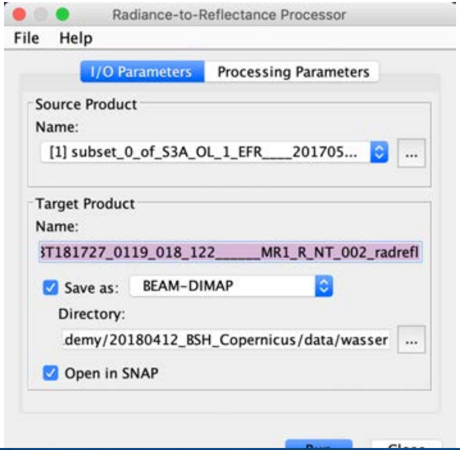
$$R_{TOA}(\lambda) = \frac{\pi \, L_{TOA}(\lambda)}{E_0(\lambda)\cos(\theta)}$$

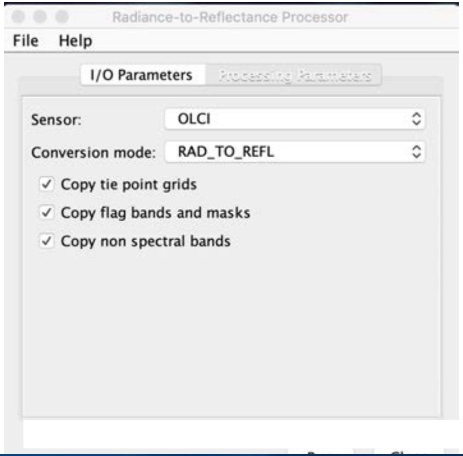
where E_0 and θ are the solar spectral irradiance and the sun zenith angle, respectively.

The conversion from reflectances to radiances simply follows the inverse of this equation.

For all sensors supported by the Radiance-to-Reflectance Processor, the sun zenith angle is provided per pixel with the L1b products. The solar spectral irradiance values are provided per pixel in case of OLCI L1b products, taken from the L1 product metadata in case of SLSTR products, and taken from auxiliary data in case of MERIS products.







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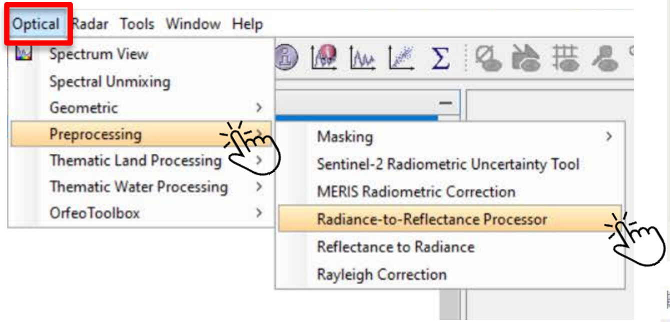
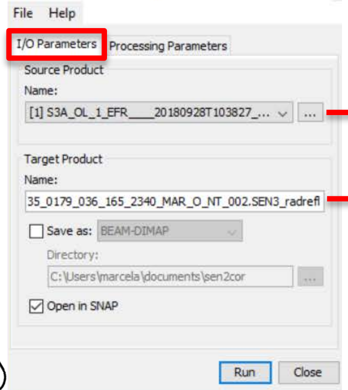
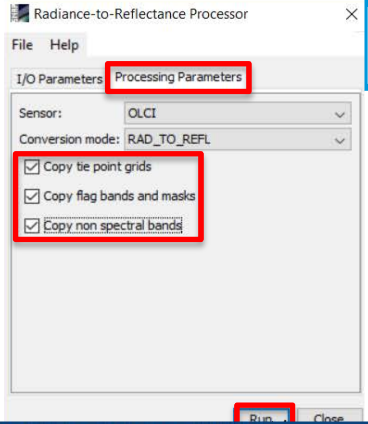




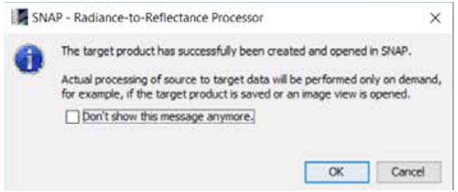
Source Product: By default, it is associated to the open image. You can select another image.

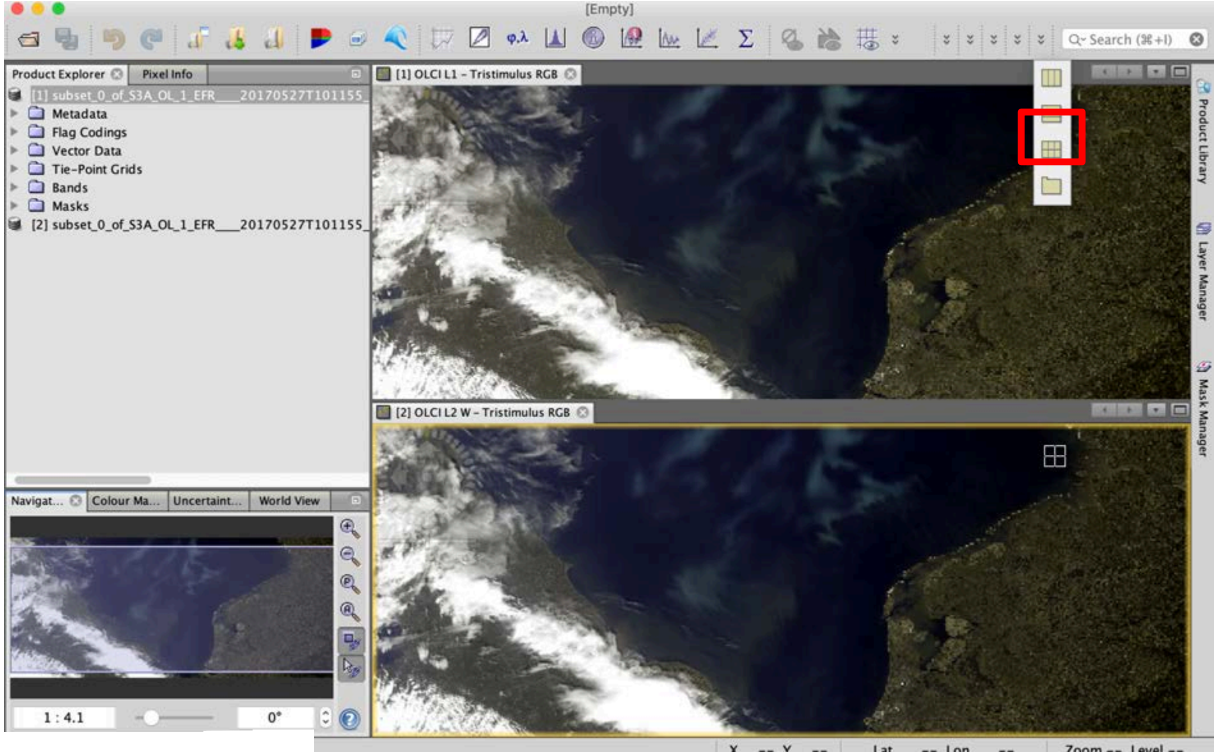
Target Product: By default, the name corresponds to the same open image name plus _radrefl suffix.



Apply the 3 Copy options to conserve all the original data in the reflectance product. Finally, Run the process.

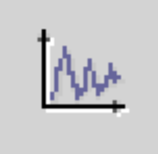
If the process is correct:

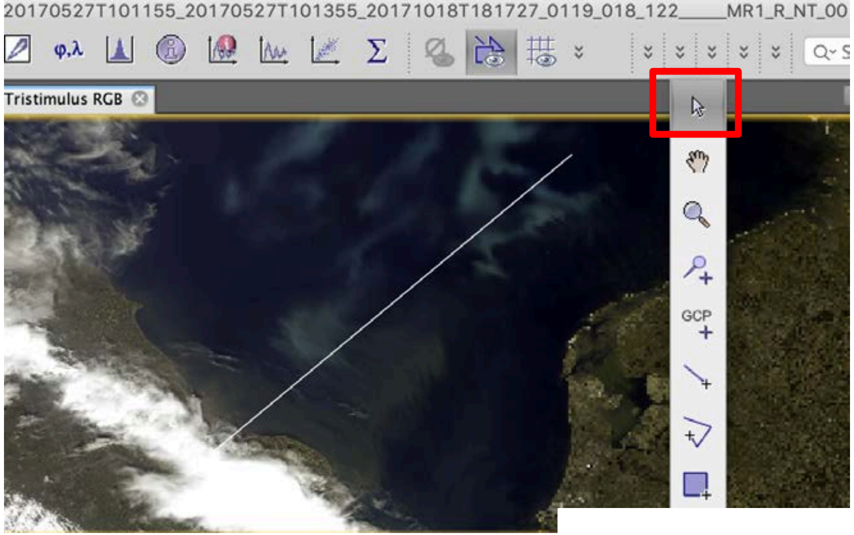


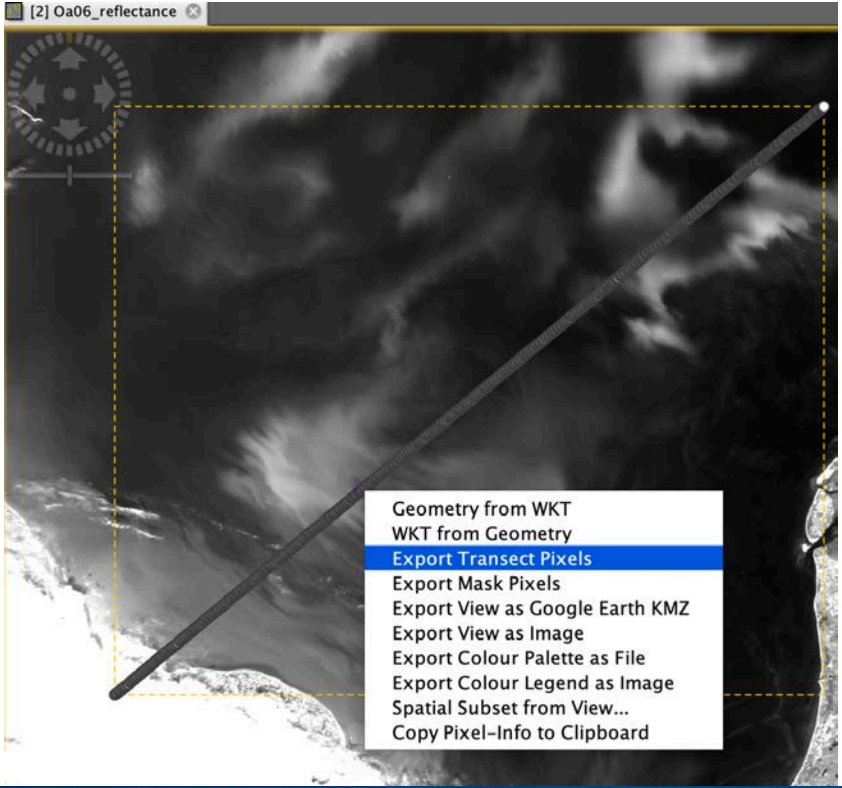


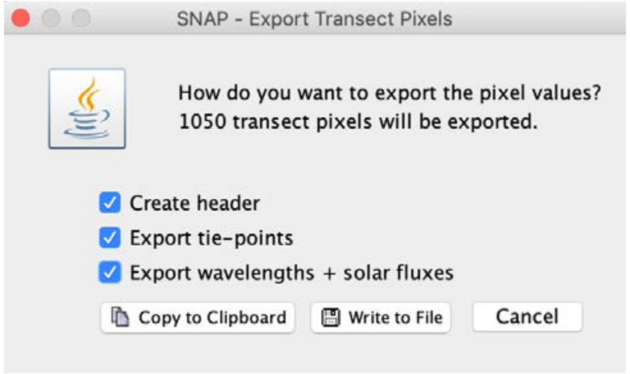
Open the two products (RGB composite) and arrange the view horizontally

- Draw a line with the Line drawing tool.
- After drawing the line select again the cursor appearance.
- Select band Oa06_reflectance and the line will appear. Click on the profile plot icon

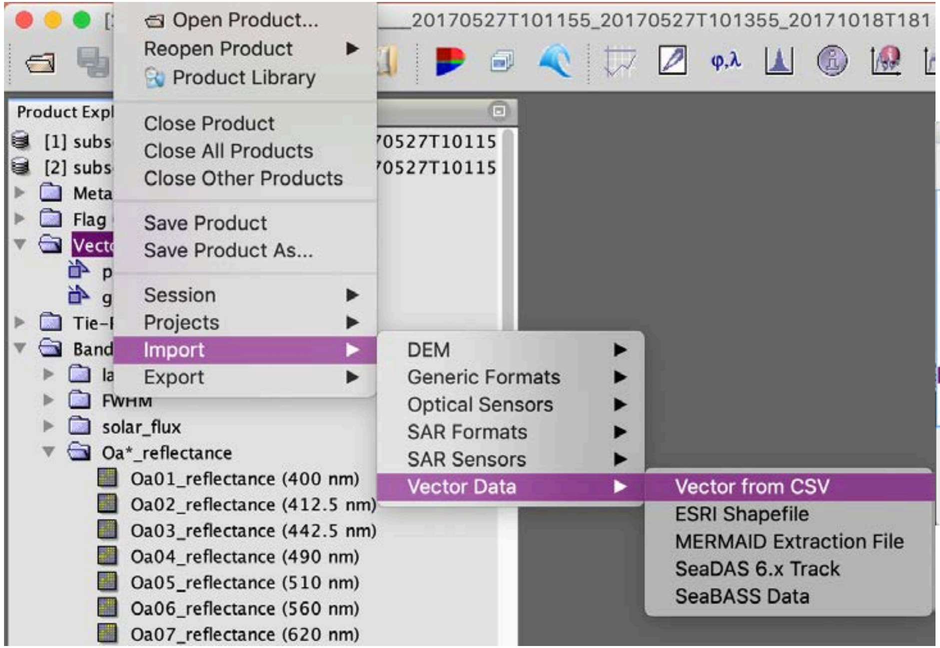


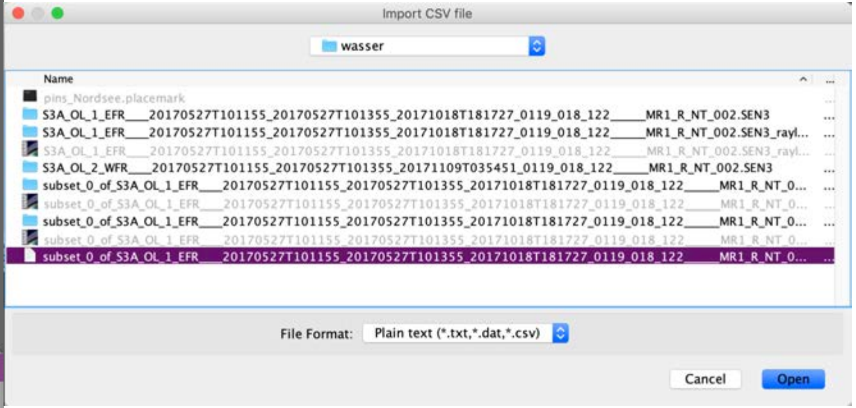






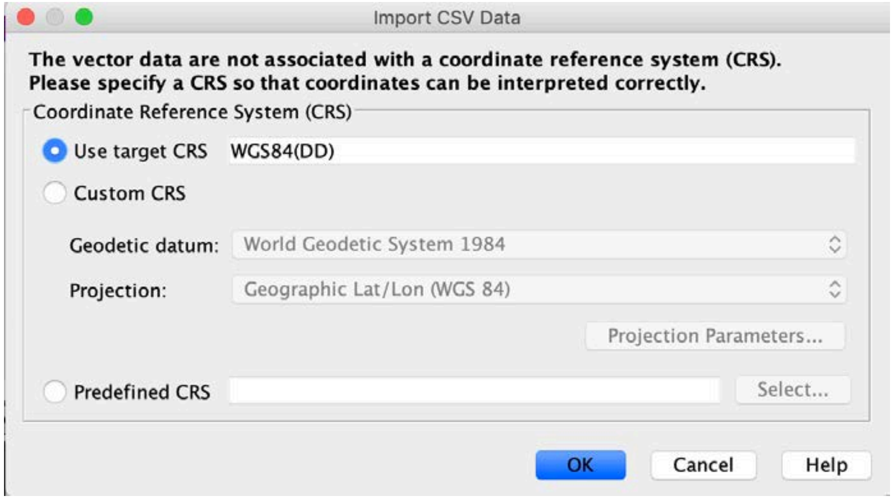
Export the geometry (line) as a transect and save in the same directory.

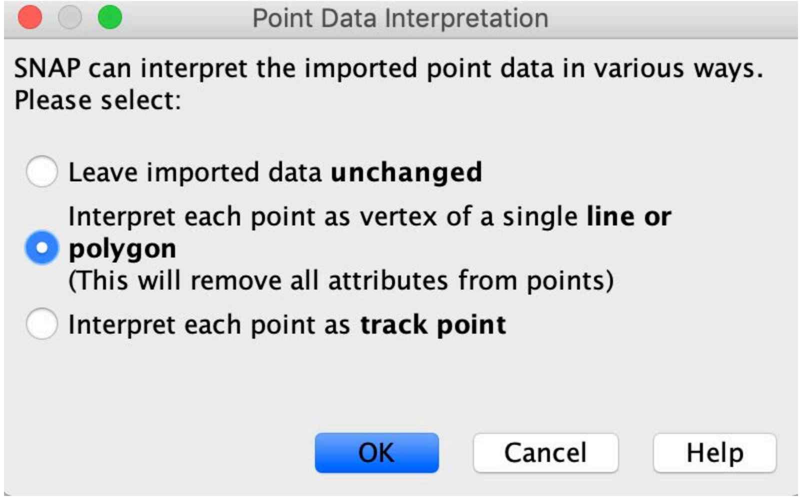




Import the transect in the TOA reflectance image.

Import the standard L2 product (located in the same directory), open band Oa06_reflectance and import the vector geometry.





Import the transect: Interpret each point as vertex of a single line or polygon

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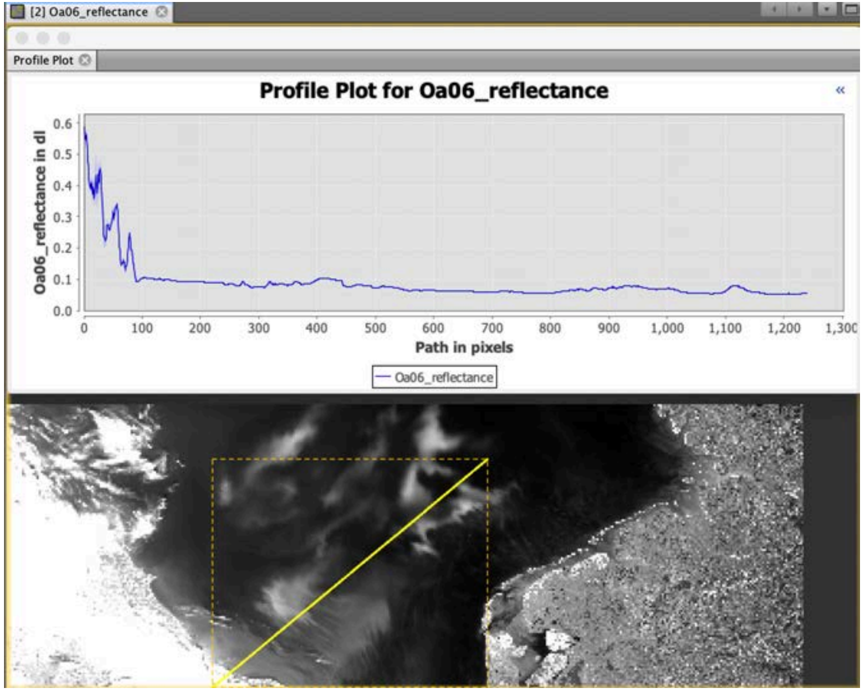

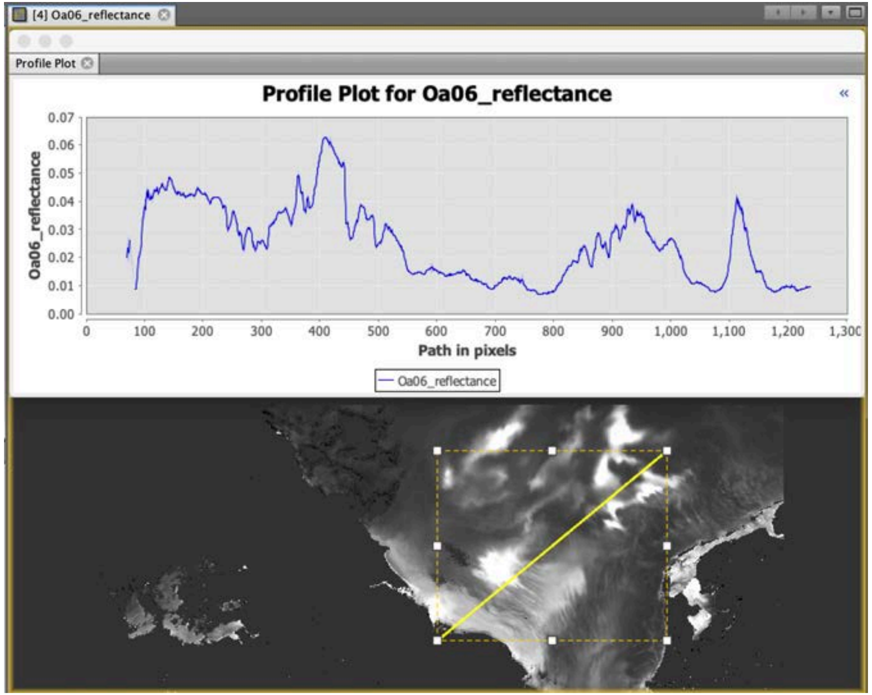

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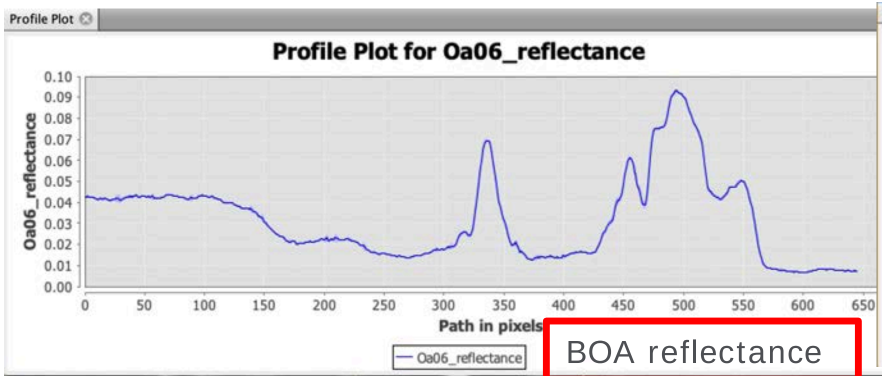
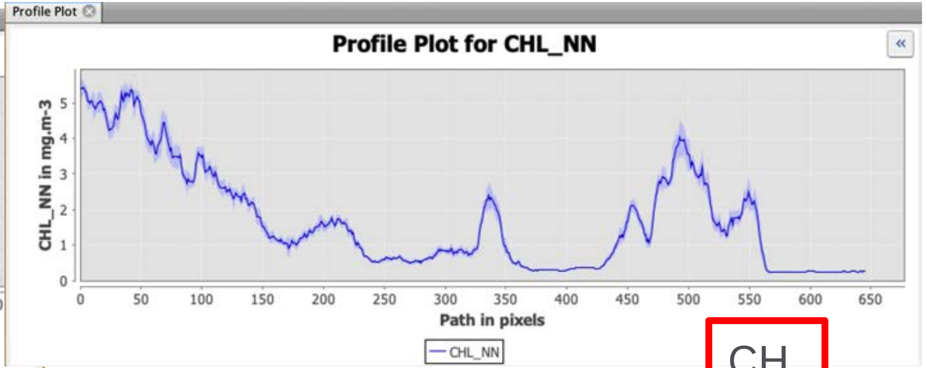
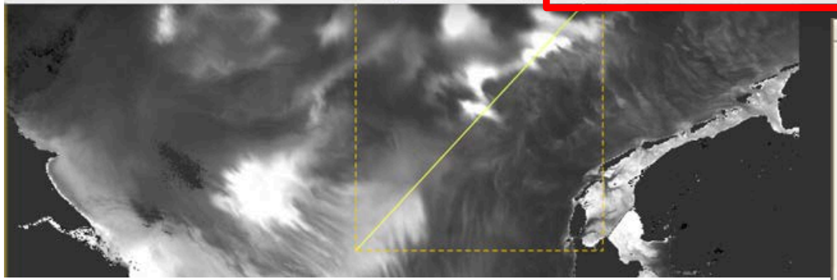
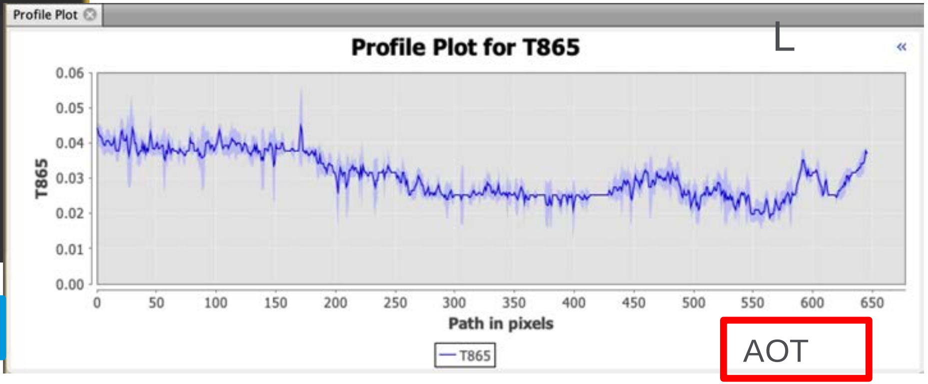


BOA reflectance



CHL





AOT

Import "second_transect.csv" on the L2 product.

The atmosphere contributes more than 90% of the top of atmosphere radiance. The atmospheric correction over the ocean is a very critical processing step.

A good indicator of the quality of the atmospheric correction is the decoupling of the atmospheric signal (e.g. Aerosol optical thickness) from the water leaving reflectance.

SNAP provides the spectrum view to quickly investigate spectral quantities.

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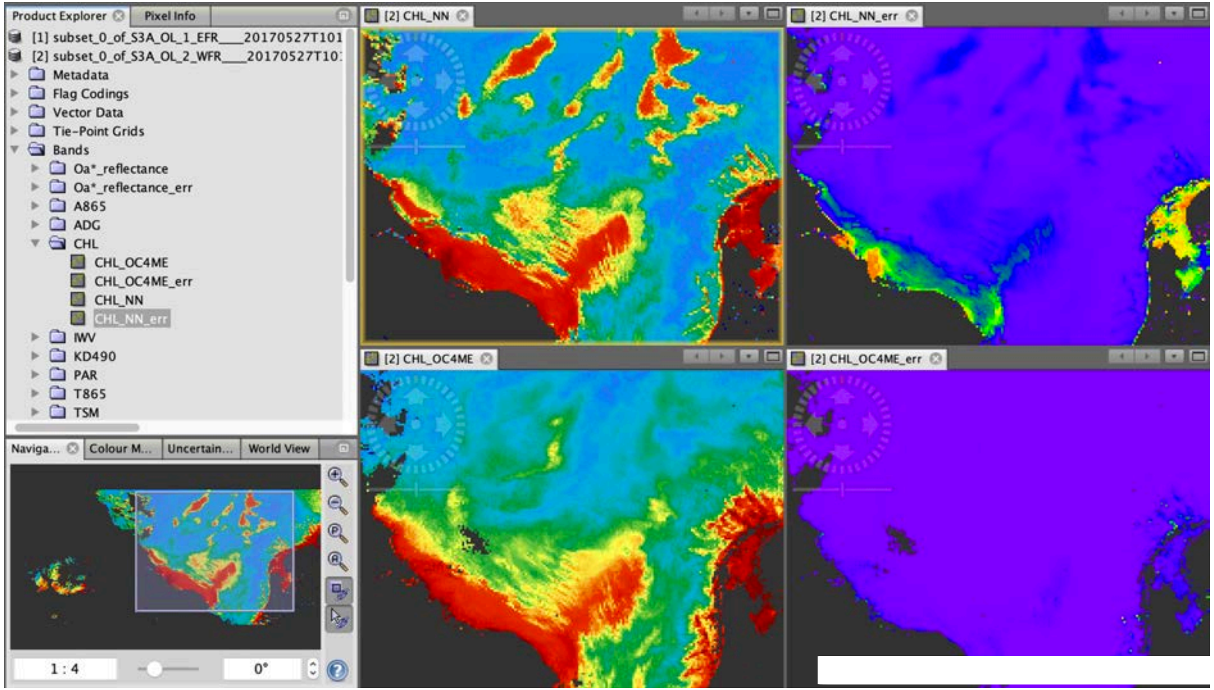
If we open the L2 standard product, besides the reflectance (atmospherically corrected radiance), we have geo-physical variables like chlorophyll (CHL), CDOM absorption (ADG), total suspended matter (TSM), transparency (KD490), aerosol optical thickness (T865) and so on.

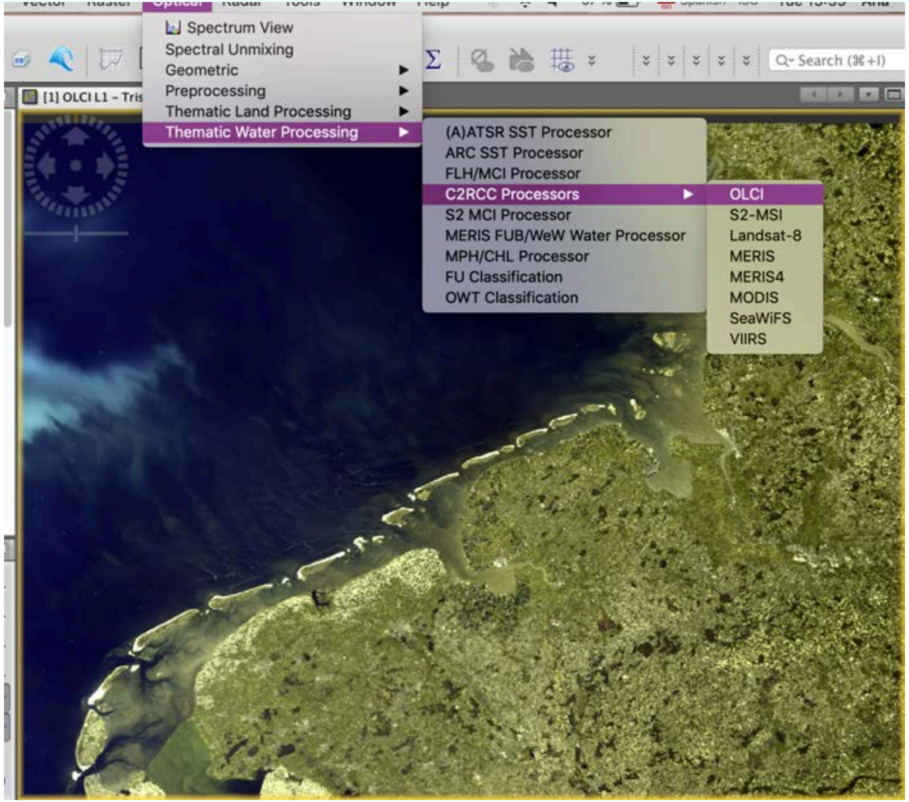
Click on the CHL folder, there are two products: CHL_OC4ME and its equivalent uncertainties (CHL_OC4ME_err); CHL_NN and its uncertainties (CHL_NN_err).
These two CHL images are calculated with different algorithms. CHL_OC4ME uses the standard OC4 algorithm developed by NASA and adjusted to OLCI bands; CHL_NN is a product of the Case 2 Regional Coast Colour neural net processor.



C2RCC NN is one of the processors available in SNAP to atmospherically correct and retrieve bio-geophysical parameters from L1 images.

The C2RCC processor uses a large database of radiative transfer simulations inverted by neural networks as basic technology.

Optical → Thematic Water Processing → C2RCC Processor → OLCI



C. Brockmann at al. Evolution of the C2RCC neural network for Sentinel 2 and 3 for the retrieval of ocean colour products in normal and extreme optically complex waters Living Planet Symposium 2016

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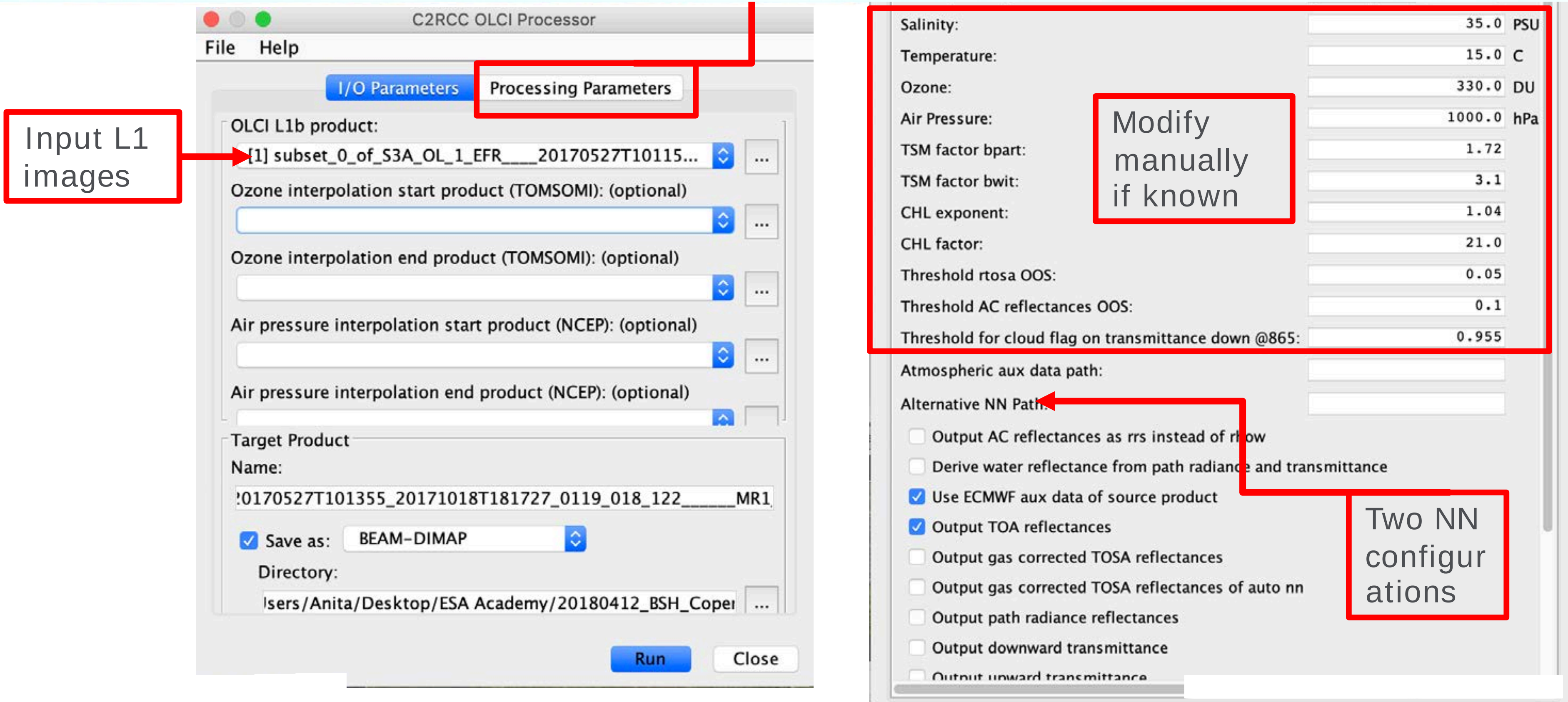


- The C2RCC processor breaks down into two major parts: the atmospheric correction part, and the in-water part.
- The main input to the atmospheric part are the top-of-atmosphere radiances/reflectances of the sensor.
- The in-water part gets as input the directional water leaving reflectances from the atmosphere part.

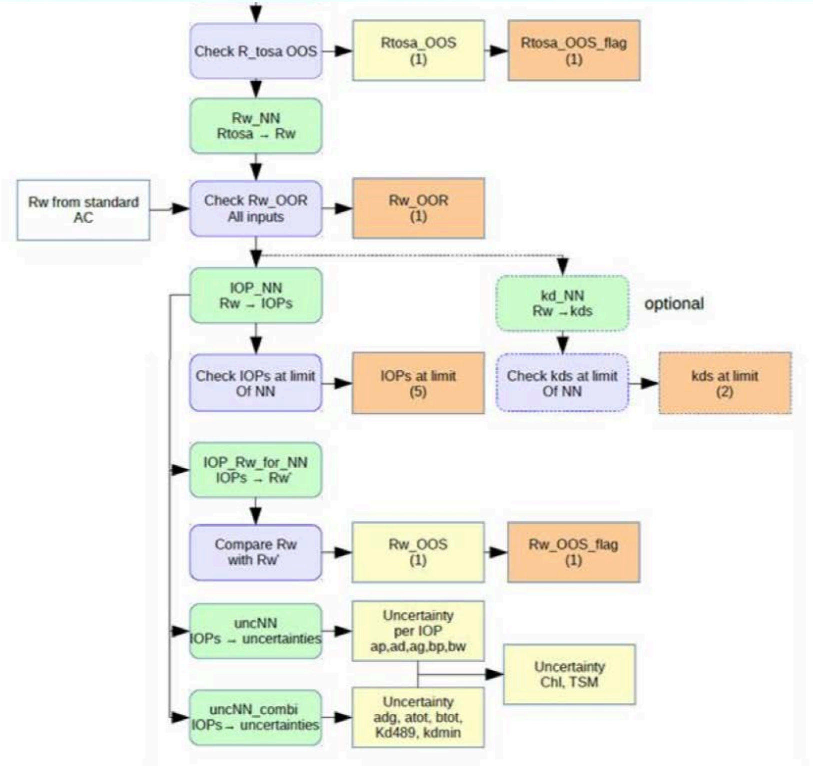
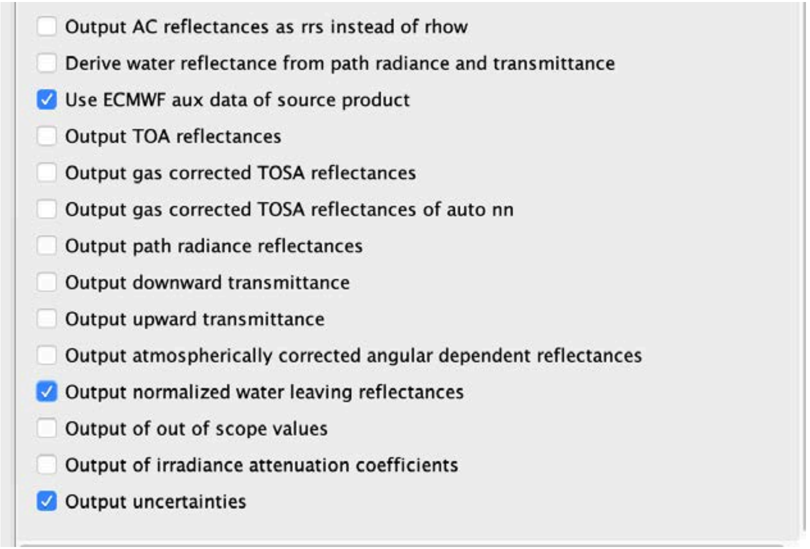
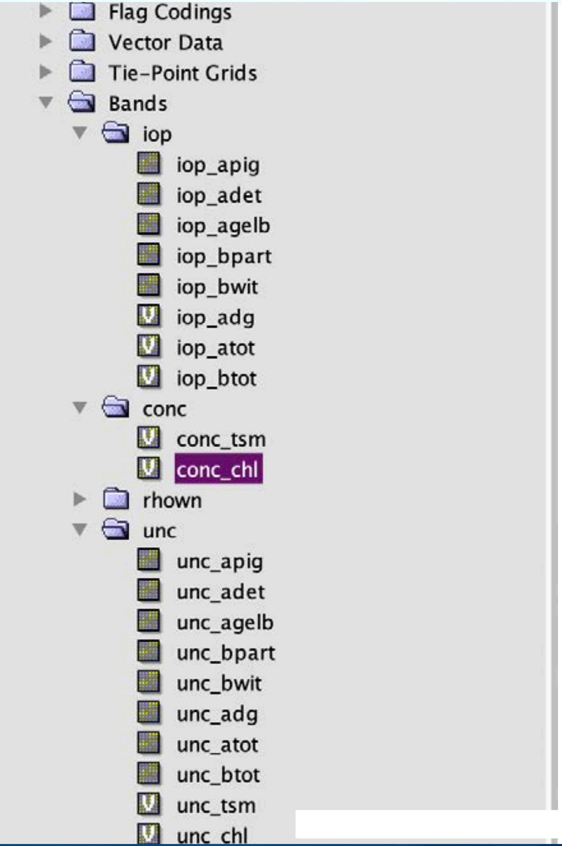


Figure 3: C2RCC processor architecture. Neural nets are shown as green boxes, and



We will get only a few of the outputs, this will automatically retrieve the water quality parameters too.



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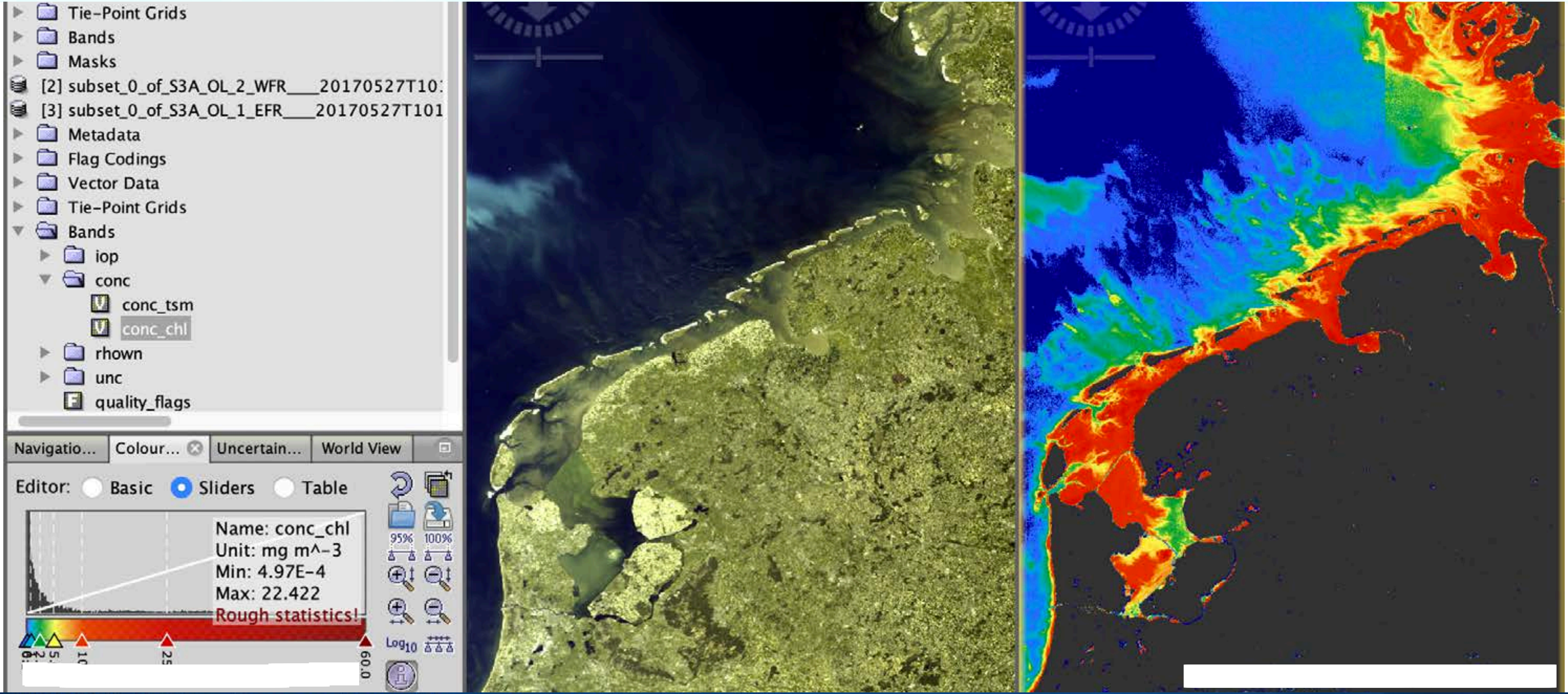

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L1 flags

Name	Type	Colour	Tran...	Description
quality_flags_land	Maths		0.5	quality_flags.land
quality_flags_coastline	Maths		0.5	quality_flags.coastline
quality_flags_fresh_inland_water	Maths		0.5	quality_flags.fresh_inland_water
quality_flags_tidal_region	Maths		0.5	quality_flags.tidal_region
quality_flags_bright	Maths		0.5	quality_flags.bright
quality_flags_straylight_risk	Maths		0.5	quality_flags.straylight_risk
quality_flags_invalid	Maths		0.5	quality_flags.invalid
quality_flags_cosmetic	Maths		0.5	quality_flags.cosmetic
quality_flags_duplicated	Maths		0.5	quality_flags.duplicated
quality_flags_sun_glint_risk	Maths		0.5	quality_flags.sun_glint_risk
quality_flags_dubious	Maths		0.5	quality_flags.dubious
quality_flags_saturated_Oa01	Maths		0.5	quality_flags.saturated_Oa01
quality_flags_saturated_Oa02	Maths		0.5	quality_flags.saturated_Oa02
quality_flags_saturated_Oa03	Maths		0.5	quality_flags.saturated_Oa03
quality_flags_saturated_Oa04	Maths		0.5	quality_flags.saturated_Oa04
quality_flags_saturated_Oa05	Maths		0.5	quality_flags.saturated_Oa05
quality_flags_saturated_Oa06	Maths		0.5	quality_flags.saturated_Oa06
quality_flags_saturated_Oa07	Maths		0.5	quality_flags.saturated_Oa07
quality_flags_saturated_Oa08	Maths		0.5	quality_flags.saturated_Oa08
quality_flags_saturated_Oa09	Maths		0.5	quality_flags.saturated_Oa09
quality_flags_saturated_Oa10	Maths		0.5	quality_flags.saturated_Oa10
quality_flags_saturated_Oa11	Maths		0.5	quality_flags.saturated_Oa11
quality_flags_saturated_Oa12	Maths		0.5	quality_flags.saturated_Oa12
quality_flags_saturated_Oa13	Maths		0.5	quality_flags.saturated_Oa13
quality_flags_saturated_Oa14	Maths		0.5	quality_flags.saturated_Oa14
quality_flags_saturated_Oa15	Maths		0.5	quality_flags.saturated_Oa15
quality_flags_saturated_Oa16	Maths		0.5	quality_flags.saturated_Oa16
quality_flags_saturated_Oa17	Maths		0.5	quality_flags.saturated_Oa17
quality_flags_saturated_Oa18	Maths		0.5	quality_flags.saturated_Oa18
[illegible]	[illegible]		0.5	quality_flags.saturated_Oa19

Mask Manager

Product Library

Layer Manager

Mask Manager

Name	Type	Colour	Tran...	Description
quality_flags_saturated_Oa16	Maths		0.5	Copied from OLCI
quality_flags_saturated_Oa17	Maths		0.5	Copied from OLCI
quality_flags_saturated_Oa18	Maths		0.5	Copied from OLCI
quality_flags_saturated_Oa19	Maths		0.5	Copied from OLCI
quality_flags_saturated_Oa20	Maths		0.5	Copied from OLCI
quality_flags_saturated_Oa21	Maths		0.5	Copied from OLCI
Rtosa_OOS	Maths		0.5	The input spectru
Rtosa_OOR	Maths		0.5	The input spectru
Rhow_OOR	Maths		0.5	One of the inputs
Cloud_risk	Maths		0	High downwelling
Iop_OOR	Maths		0.5	One of the IOPs is
Apig_at_max	Maths		0.5	Apig output of the
Adet_at_max	Maths		0.5	Adet output of the
Agelb_at_max	Maths		0.5	Agelb output of th
Bpart_at_max	Maths		0.5	Bpart output of th
Bwit_at_max	Maths		0.5	Bwit output of the
Apig_at_min	Maths		0.5	Apig output of the
Adet_at_min	Maths		0.5	Adet output of the
Agelb_at_min	Maths		0.5	Agelb output of th
Bpart_at_min	Maths		0.5	Bpart output of th
Bwit_at_min	Maths		0.5	Bwit output of the
Rhow_OOS	Maths		0.5	The Rhow input s
Kd489_OOR	Maths		0.5	Kd489 is out of r
Kdmin_OOR	Maths		0.5	Kdmin is out of ra
Kd489_at_max	Maths		0.5	Kdmin is at max
Kdmin_at_max	Maths			

New flags from C2RCC

Use SNAP‘s command-line tools:

- From a command-line shell
- From shell scripts
- From Python, IDL, MatLab…using dedicated systems

Many advantages

- ✓ No intermediate files written, no I/O overhead
- ✓ Reusability of processing chains
- ✓ Simple and comprehensive operator configuration
- ✓ Reusability of operator configurations

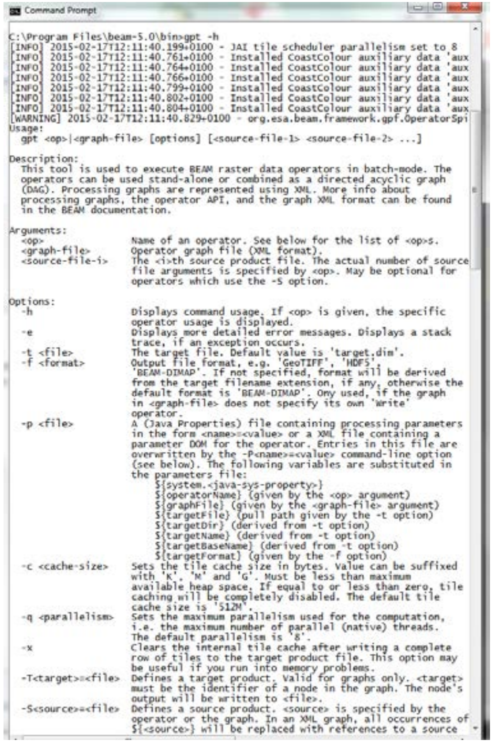
Graph xml: Graph_idepix_c2rcc.xml

- Look into ${SNAP-HOME}/bin directory:
- gpt (.exe in Windows)→used to execute various SNAP operators and chain of operators

ESA SNAP/SNAP command line>gpt –h

- pconvert→ used to convert product files into other data and image formats (quick-look generation)

- snappy-conf→ SNAP application configuration launcher for snap-py



```
Command Prompt
C:\Program Files\beam-5.0\bin>gpt -h
[INFO] 2015-02-17T12:11:40.199+0100 - JAI tile scheduler parallelism set to 8
[INFO] 2015-02-17T12:11:40.761+0100 - Installed CoastColour auxiliary data 'aux
[INFO] 2015-02-17T12:11:40.764+0100 - Installed CoastColour auxiliary data 'aux
[INFO] 2015-02-17T12:11:40.766+0100 - Installed CoastColour auxiliary data 'aux
[INFO] 2015-02-17T12:11:40.799+0100 - Installed CoastColour auxiliary data 'aux
[INFO] 2015-02-17T12:11:40.802+0100 - Installed CoastColour auxiliary data 'aux
[INFO] 2015-02-17T12:11:40.804+0100 - Installed CoastColour auxiliary data 'aux
[WARNING] 2015-02-17T12:11:40.829+0100 - org.esa.beam.framework.gpf.OperatorSpi
Usage:
  gpt <op>|<graph-file> [options] [<source-file-1> <source-file-2> ...]

Description:
  This tool is used to execute BEAM raster data operators in batch-mode. The
  operators can be used stand-alone or combined as a directed acyclic graph
  (DAG). Processing graphs are represented using XML. More info about
  processing graphs, the operator API, and the graph XML format can be found
  in the BEAM documentation.

Arguments:
  <op>               Name of an operator. See below for the list of <op>s.
  <graph-file>       Operator graph file (XML format).
  <source-file-i>    The <i>th source product file. The actual number of source
                     file arguments is specified by <op>. May be optional for
                     operators which use the -S option.

Options:
  -h                 Displays command usage. If <op> is given, the specific
                     operator usage is displayed.
  -e                 Displays more detailed error messages. Displays a stack
                     trace, if an exception occurs.
  -t <file>          The target file. Default value is 'target.dim'.
  -f <format>        Output file format, e.g. 'GeoTIFF', 'HDF5',
                     'BEAM-DIMAP'. If not specified, format will be derived
                     from the target filename extension, if any, otherwise the
                     default format is 'BEAM-DIMAP'. Ony used, if the graph
                     in <graph-file> does not specify its own 'Write'
                     operator.
  -p <file>          A (Java Properties) file containing processing parameters
                     in the form <name>=<value> or a XML file containing a
                     parameter DOM for the operator. Entries in this file are
                     overwritten by the -P<name>=<value> command-line option
                     (see below). The following variables are substituted in
                     the parameters file:
                         ${system.<java-sys-property>}
                         ${operatorName} (given by the <op> argument)
                         ${graphFile} (given by the <graph-file> argument)
                         ${targetFile} (pull path given by the -t option)
                         ${targetDir} (derived from -t option)
                         ${targetName} (derived from -t option)
                         ${targetBaseName} (derived from -t option)
                         ${targetFormat} (given by the -f option)
  -c <cache-size>    Sets the tile cache size in bytes. Value can be suffixed
                     with 'K', 'M' and 'G'. Must be less than maximum
                     available heap space. If equal to or less than zero, tile
                     caching will be completely disabled. The default tile
                     cache size is '512M'.
  -q <parallelism>   Sets the maximum parallelism used for the computation,
                     i.e. the maximum number of parallel (native) threads.
                     The default parallelism is '8'.
  -x                 Clears the internal tile cache after writing a complete
                     row of tiles to the target product file. This option may
                     be useful if you run into memory problems.
  -T<target>=<file>  Defines a target product. Valid for graphs only. <target>
                     must be the identifier of a node in the graph. The node's
                     output will be written to <file>.
  -S<source>=<file>  Defines a source product. <source> is specified by the
                     operator or the graph. In an XML graph, all occurrences of
                     ${<source>} will be replaced with references to a source
```

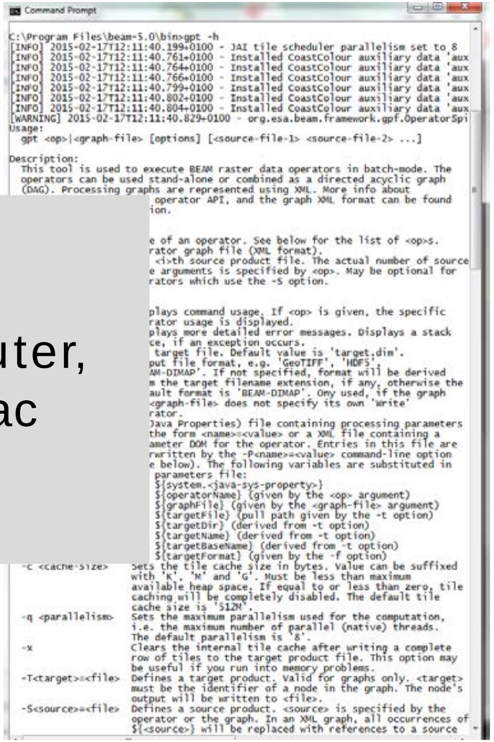
- Look into ${SNAP-HOME}/bin directory:
- gpt (.exe in Windows)→used to execute various SNAP operators and chain of operators

ESA SNA

- pconvert→
other data
generation)

- snappy-co
launcher for snap-py

Go to your SNAP folder and look
Call gpt
(if only one SNAP instance on your computer, just type gpt on the command line; on Mac you need to type the full path in your terminal)



- Most important SNAP batch-mode tool
- Usage:

    gpt <op>|<graph-file> [options] [<source-file-1> <source-file-2> ...]

- Which operator are available?

    gpt –h

- List of operators may vary depending on installed SNAP plug-ins

Investigating the Ocean Color from Space

```
PS C:\> C:\progra~1\snap6.0-PREVIEW6\bin\gpt.exe Idepix.Sentinel3.Olci -h
INFO: org.esa.snap.core.gpf.operators.tooladapter.ToolAdapterIO: Initializing external tool adapters
Usage:
  gpt Idepix.Sentinel3.Olci [options]

Description:
  Pixel identification and classification for OLCI.


Source Options:
  -SsourceProduct=<file>    The OLCI L1b source product.
                            This is a mandatory source.

Parameter Options:
  -PcloudBufferWidth=<int>                          The width of a cloud 'safety buffer' around a pixel which was classified as cloudy.
                                                    Valid interval is [0,100].
                                                    Default value is '2'.
  -PcomputeCloudBuffer=<boolean>                    Sets parameter 'computeCloudBuffer' to <boolean>.
                                                    Default value is 'true'.
  -PcomputeCloudShadow=<boolean>                     If applied, a cloud shadow is computed. This requires the cloud top pressure operator (Python plugin based on CAWA) t
o be installed. Still experimental.
                                                    Default value is 'false'.
  -PcomputeCtp=<boolean>                             Compute cloud top pressure (time consuming, requires Python plugin based on CAWA).
                                                    Default value is 'false'.
  -PoutputSchillerNNValue=<boolean>                  If applied, write NN value to the target product
                                                    Default value is 'false'.
  -PradianceBandsToCopy=<string,string,string,...>  The list of radiance bands to write to target product.
                                                    Value must be one of 'Oa01_radiance', 'Oa02_radiance', 'Oa03_radiance', 'Oa04_radiance', 'Oa05_radiance', 'Oa06_radian
ce', 'Oa07_radiance', 'Oa08_radiance', 'Oa09_radiance', 'Oa10_radiance', 'Oa11_radiance', 'Oa12_radiance', 'Oa13_radiance', 'Oa14_radiance', 'Oa15_radiance', 'Oa16_radiance
', 'Oa17_radiance', 'Oa18_radiance', 'Oa19_radiance', 'Oa20_radiance', 'Oa21_radiance'.
  -PreflBandsToCopy=<string,string,string,...>      The list of reflectance bands to write to target product.
                                                    Value must be one of 'Oa01_reflectance', 'Oa02_reflectance', 'Oa03_reflectance', 'Oa04_reflectance', 'Oa05_reflectance
', 'Oa06_reflectance', 'Oa07_reflectance', 'Oa08_reflectance', 'Oa09_reflectance', 'Oa10_reflectance', 'Oa11_reflectance', 'Oa12_reflectance', 'Oa13_reflectance', 'Oa14_ref
lectance', 'Oa15_reflectance', 'Oa16_reflectance', 'Oa17_reflectance', 'Oa18_reflectance', 'Oa19_reflectance', 'Oa20_reflectance', 'Oa21_reflectance'.

Graph XML Format:
  <graph id="someGraphId">
    <version>1.0</version>
    <node id="someNodeId">
      <operator>Idepix.Sentinel3.Olci</operator>
      <sources>
        <sourceProduct>${sourceProduct}</sourceProduct>
      </sources>
      <parameters>
        <radianceBandsToCopy>string,string,string,...</radianceBandsToCopy>
        <reflBandsToCopy>string,string,string,...</reflBandsToCopy>
        <outputSchillerNNValue>boolean</outputSchillerNNValue>
        <computeCloudBuffer>boolean</computeCloudBuffer>
        <cloudBufferWidth>int</cloudBufferWidth>
        <computeCtp>boolean</computeCtp>
        <computeCloudShadow>boolean</computeCloudShadow>
      </parameters>
    </node>
  </graph>
```

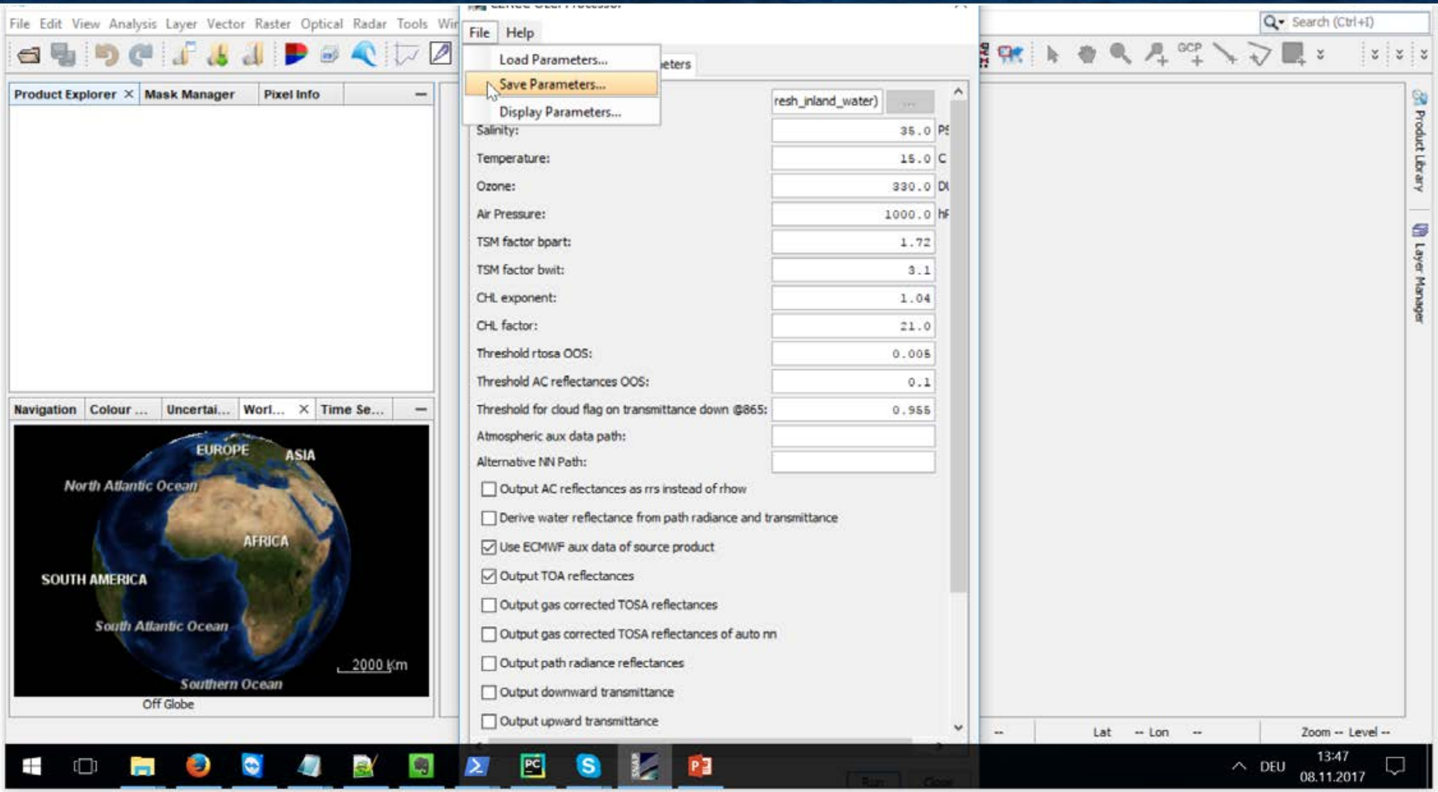
```
PS C:\> C:\progra~1\snap6.0-PREVIEW6\bin\gpt.exe Idepix.Sentinel3.Olci -h
INFO: org.esa.snap.core.gpf.operators.tooladapter.ToolAdapterIO: Initializing external tool adapters
Usage:
  gpt Idepix.Sentinel3.Olci [options]

Description:
  Pixel identification and classification for OLCI.
```

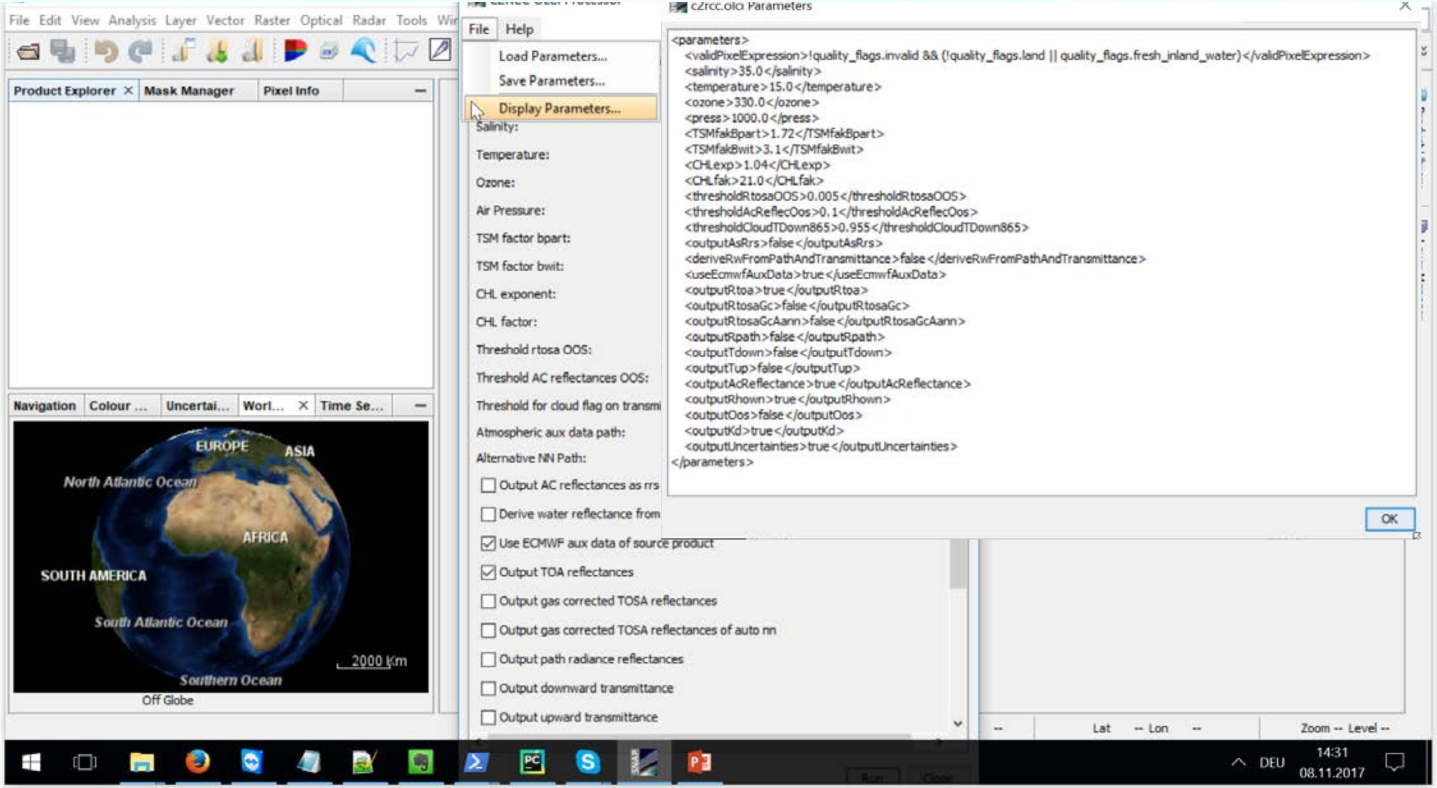
```xml
<graph id="Olci_HSC">
    <version>1.0</version>
    <node id="idepix">
        <operator>Idepix.Sentinel3.Olci</operator>
        <sources>
            <sourceProduct>${sourceProduct}</sourceProduct>
        </sources>
        <parameters>
            <computeCloudBuffer>true</computeCloudBuffer>
            <cloudBufferWidth>2</cloudBufferWidth>
        </parameters>
    </node>
```

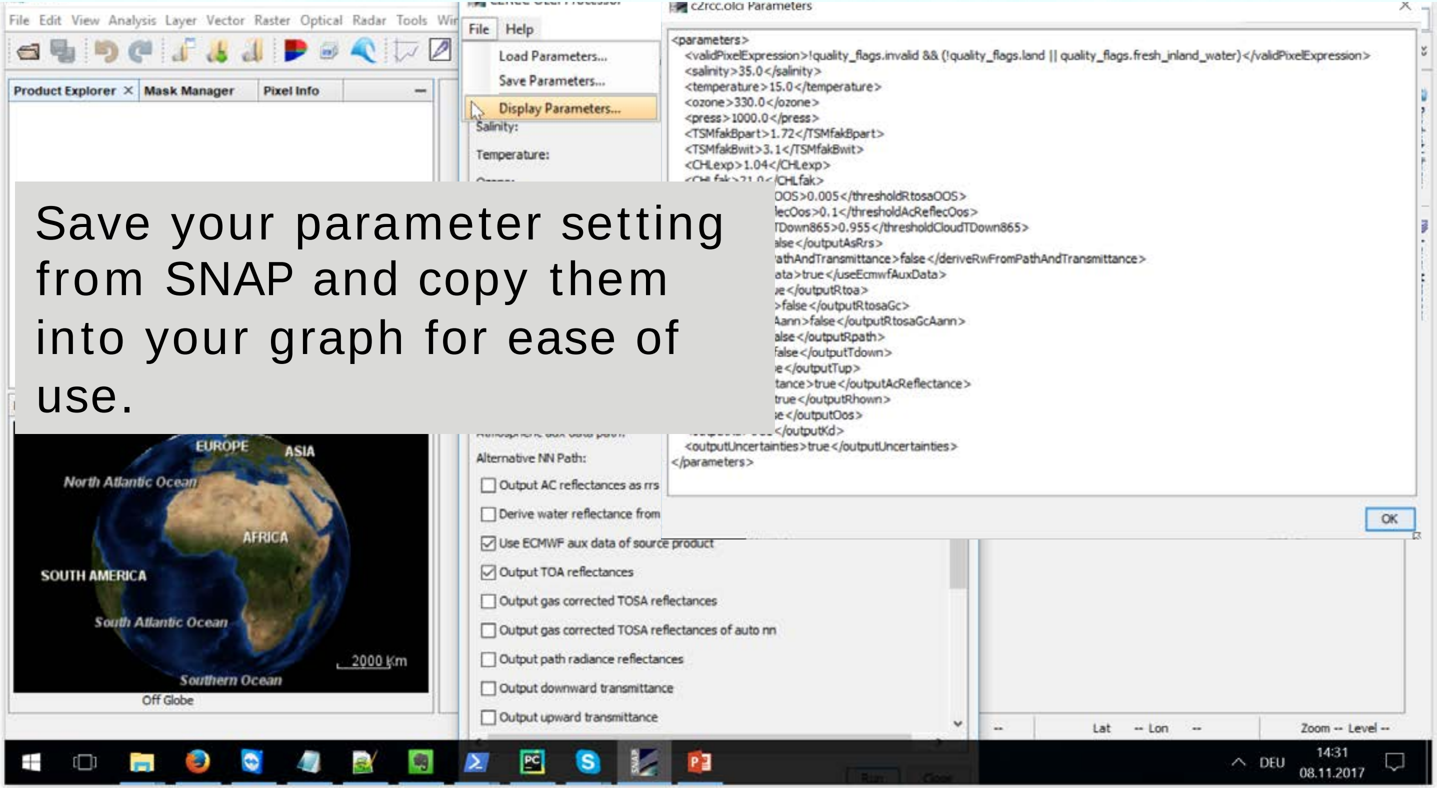
```
      <computeCloudBuffer>boolean</computeCloudBuffer>
      <cloudBufferWidth>int</cloudBufferWidth>
      <computeCtp>boolean</computeCtp>
      <computeCloudShadow>boolean</computeCloudShadow>
    </parameters>
  </node>
</graph>
```

Investigating the Ocean Color from Space



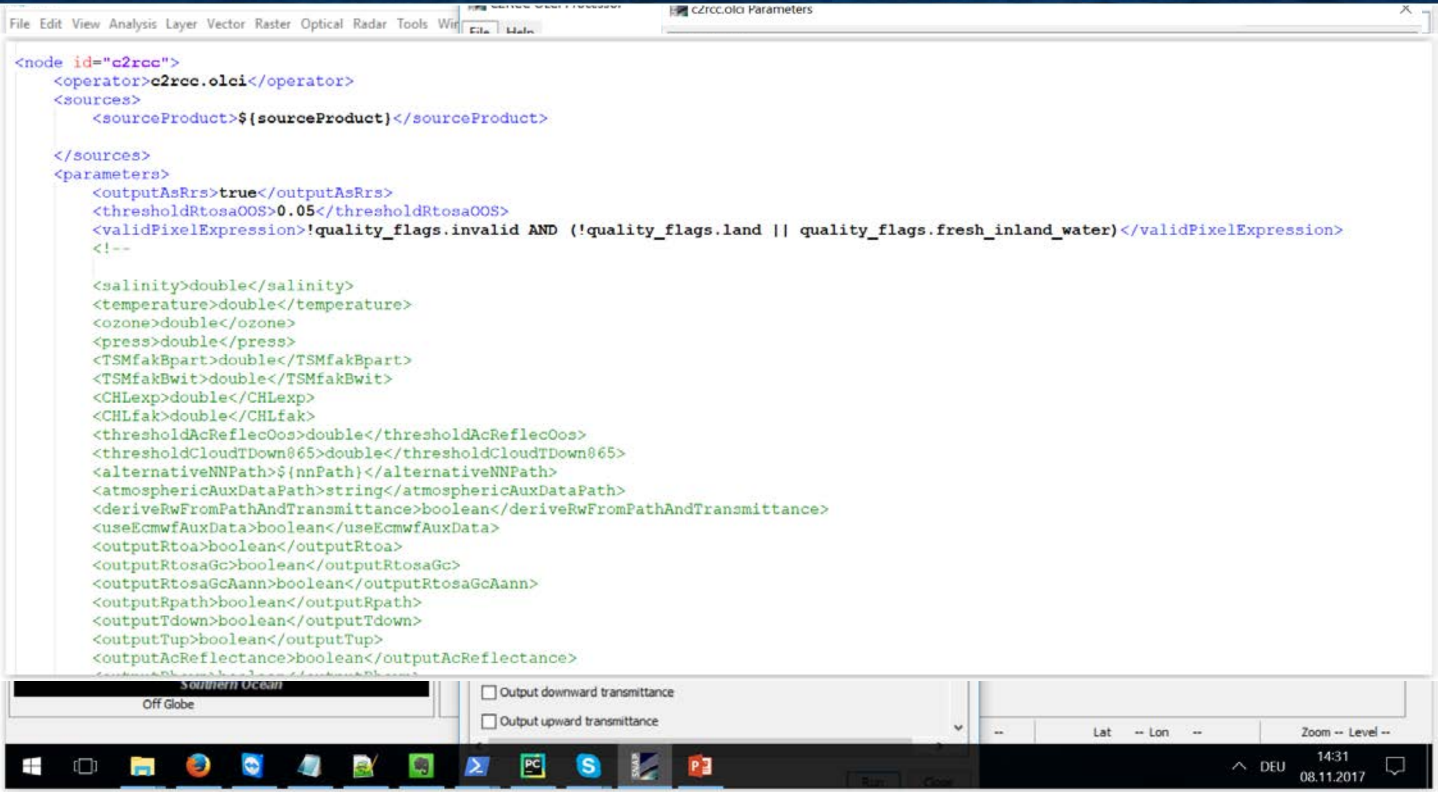
Investigating the Ocean Color from Space





Save your parameter setting from SNAP and copy them into your graph for ease of use.

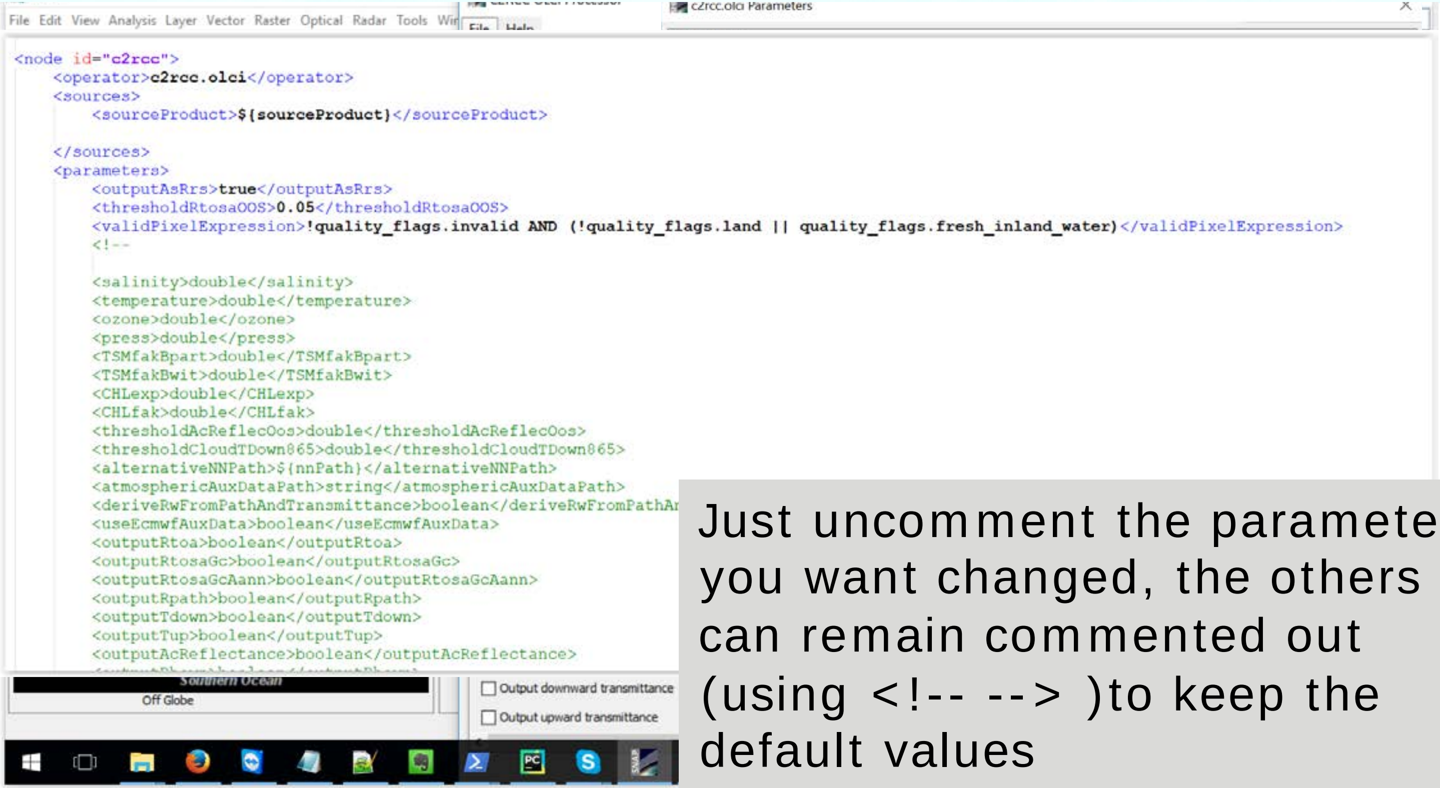
Investigating the Ocean Color from Space



```xml
<node id="c2rcc">
    <operator>c2rcc.olci</operator>
    <sources>
        <sourceProduct>${sourceProduct}</sourceProduct>

    </sources>
    <parameters>
        <outputAsRrs>true</outputAsRrs>
        <thresholdRtosaOOS>0.05</thresholdRtosaOOS>
        <validPixelExpression>!quality_flags.invalid AND (!quality_flags.land || quality_flags.fresh_inland_water)</validPixelExpression>
        <!--

        <salinity>double</salinity>
        <temperature>double</temperature>
        <ozone>double</ozone>
        <press>double</press>
        <TSMfakBpart>double</TSMfakBpart>
        <TSMfakBwit>double</TSMfakBwit>
        <CHLexp>double</CHLexp>
        <CHLfak>double</CHLfak>
        <thresholdAcReflecOos>double</thresholdAcReflecOos>
        <thresholdCloudTDown865>double</thresholdCloudTDown865>
        <alternativeNNPath>${nnPath}</alternativeNNPath>
        <atmosphericAuxDataPath>string</atmosphericAuxDataPath>
        <deriveRwFromPathAndTransmittance>boolean</deriveRwFromPathAndTransmittance>
        <useEcmwfAuxData>boolean</useEcmwfAuxData>
        <outputRtoa>boolean</outputRtoa>
        <outputRtosaGc>boolean</outputRtosaGc>
        <outputRtosaGcAann>boolean</outputRtosaGcAann>
        <outputRpath>boolean</outputRpath>
        <outputTdown>boolean</outputTdown>
        <outputTup>boolean</outputTup>
        <outputAcReflectance>boolean</outputAcReflectance>
```



```
<node id="c2rcc">
    <operator>c2rcc.olci</operator>
    <sources>
        <sourceProduct>${sourceProduct}</sourceProduct>

    </sources>
    <parameters>
        <outputAsRrs>true</outputAsRrs>
        <thresholdRtosaOOS>0.05</thresholdRtosaOOS>
        <validPixelExpression>!quality_flags.invalid AND (!quality_flags.land || quality_flags.fresh_inland_water)</validPixelExpression>
        <!--

        <salinity>double</salinity>
        <temperature>double</temperature>
        <ozone>double</ozone>
        <press>double</press>
        <TSMfakBpart>double</TSMfakBpart>
        <TSMfakBwit>double</TSMfakBwit>
        <CHLexp>double</CHLexp>
        <CHLfak>double</CHLfak>
        <thresholdAcReflecOos>double</thresholdAcReflecOos>
        <thresholdCloudTDown865>double</thresholdCloudTDown865>
        <alternativeNNPath>${nnPath}</alternativeNNPath>
        <atmosphericAuxDataPath>string</atmosphericAuxDataPath>
        <deriveRwFromPathAndTransmittance>boolean</deriveRwFromPathAr
        <useEcmwfAuxData>boolean</useEcmwfAuxData>
        <outputRtoa>boolean</outputRtoa>
        <outputRtosaGc>boolean</outputRtosaGc>
        <outputRtosaGcAann>boolean</outputRtosaGcAann>
        <outputRpath>boolean</outputRpath>
        <outputTdown>boolean</outputTdown>
        <outputTup>boolean</outputTup>
        <outputAcReflectance>boolean</outputAcReflectance>
```

Just uncomment the parameters you want changed, the others can remain commented out (using <!-- -->)to keep the default values

```xml
<node id="final_merge">
  <operator>Merge</operator>
  <sources>
    <masterProduct>c2rcc</masterProduct>
    <sourceProducts>idepix</sourceProducts>
  </sources>
</node>

'graph>
```

This operator is ONLY available from the command line

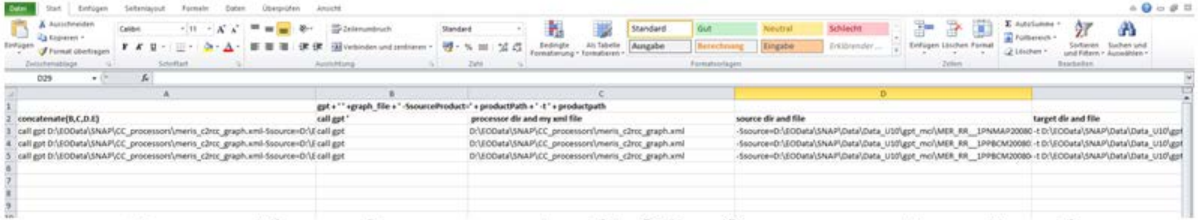
```xml
<!--
<graph id="Olci_HSC">
    <version>1.0</version>
    <node id="idepix">
        <operator>Idepix.Sentinel3.Olci</operator>
        <sources>
            <sourceProduct>${sourceProduct}</sourceProduct>
        </sources>
```

```
C:\progra~1\snap6.0-PREVIEW6\bin\gpt.exe C:\Users\bc\Desktop\HIGHROC\Training\olci_c2rcc.xml -t “C:\Users\bc\Desktop\HIGHROC\Training\c2rcc_graph_test.dim“ “path/to/your/.SEN3”
```

```xml
            <validPixelExpression>!quality_flags.invalid AND (!quality_flags.land || quality_flags.fresh_inland_water)</validPixelExpression>
            <!--

            <salinity>double</salinity>
            <temperature>double</temperature>
            <ozone>double</ozone>
            <press>double</press>
            <TSMfakBpart>double</TSMfakBpart>
            <TSMfakBwit>double</TSMfakBwit>
            <CHLexp>double</CHLexp>
            <CHLfak>double</CHLfak>
            <thresholdAcReflecOos>double</thresholdAcReflecOos>
            <thresholdCloudTDown865>double</thresholdCloudTDown865>
            <alternativeNNPath>${nnPath}</alternativeNNPath>
            <atmosphericAuxDataPath>string</atmosphericAuxDataPath>
            <deriveRwFromPathAndTransmittance>boolean</deriveRwFromPathAndTransmittance>
            <useEcmwfAuxData>boolean</useEcmwfAuxData>
            <outputRtoa>boolean</outputRtoa>
            <outputRtosaGc>boolean</outputRtosaGc>
            <outputRtosaGcAann>boolean</outputRtosaGcAann>
            <outputRpath>boolean</outputRpath>
            <outputTdown>boolean</outputTdown>
            <outputTup>boolean</outputTup>
                      eflectance>boolean</outputAcReflectance>
                      wn>boolean</outputRhown>
```

- **Running on several images (batch mode):**
  - **Use Excel or other spreadsheet /editor for making a list with all products to be processed (*merisc2rcc_gpt_batch. xlsx*):**



	A	B	C	D	
1		gpt + " " +graph_file + " -SsourceProduct=" + productPath + " -t " + productpath			
2	concatenate(B,C,D,E)	call gpt '	processor dir and my xml file	source dir and file	target dir and file
3	call gpt D:\EOData\SNAP\CC_processors\meris_c2rcc_graph.xml-Ssource=D:\E	call gpt	D:\EOData\SNAP\CC_processors\meris_c2rcc_graph.xml	-Ssource=D:\EOData\SNAP\Data\Data_U10\gpt_mci\MER_RR__1PNMAP20080	-t D:\EOData\SNAP\Data\Data_U10\gpt
4	call gpt D:\EOData\SNAP\CC_processors\meris_c2rcc_graph.xml-Ssource=D:\E	call gpt	D:\EOData\SNAP\CC_processors\meris_c2rcc_graph.xml	-Ssource=D:\EOData\SNAP\Data\Data_U10\gpt_mci\MER_RR__1PPBCM20080	-t D:\EOData\SNAP\Data\Data_U10\gpt
5	call gpt D:\EOData\SNAP\CC_processors\meris_c2rcc_graph.xml-Ssource=D:\E	call gpt	D:\EOData\SNAP\CC_processors\meris_c2rcc_graph.xml	-Ssource=D:\EOData\SNAP\Data\Data_U10\gpt_mci\MER_RR__1PPBCM20080	-t D:\EOData\SNAP\Data\Data_U10\gpt

  - **Compile a bat or shell file for running in the command line(*merisc2rcc-gpt-bat.bat*)→go to dir where the bat file is and call it from the terminal:**

>merisc2rcc-gpt-bat.bat

SNAP / ... / Processing

Bulk Processing with GPT

Marco Peters
Zuletzt geändert 2017-07-27

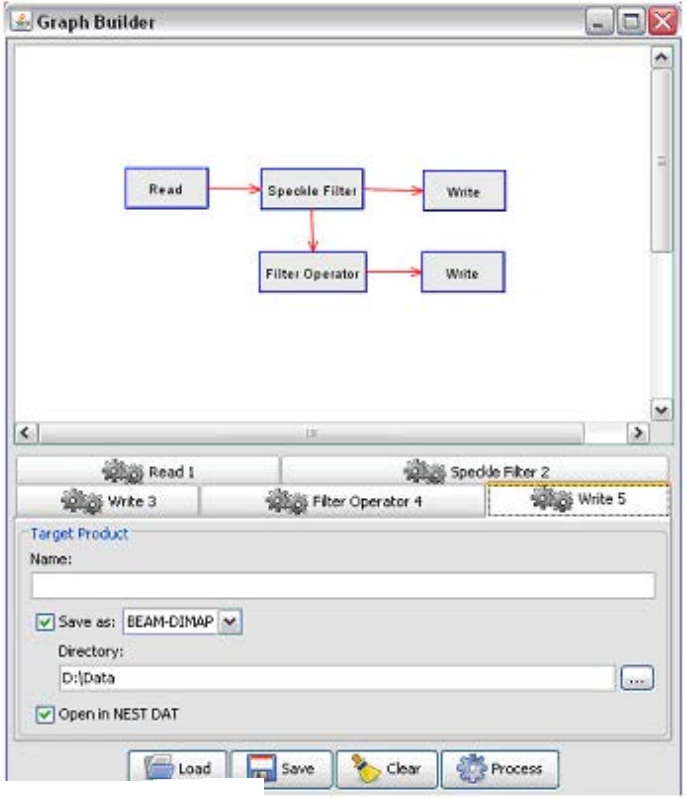
Bulk Processing with GPT

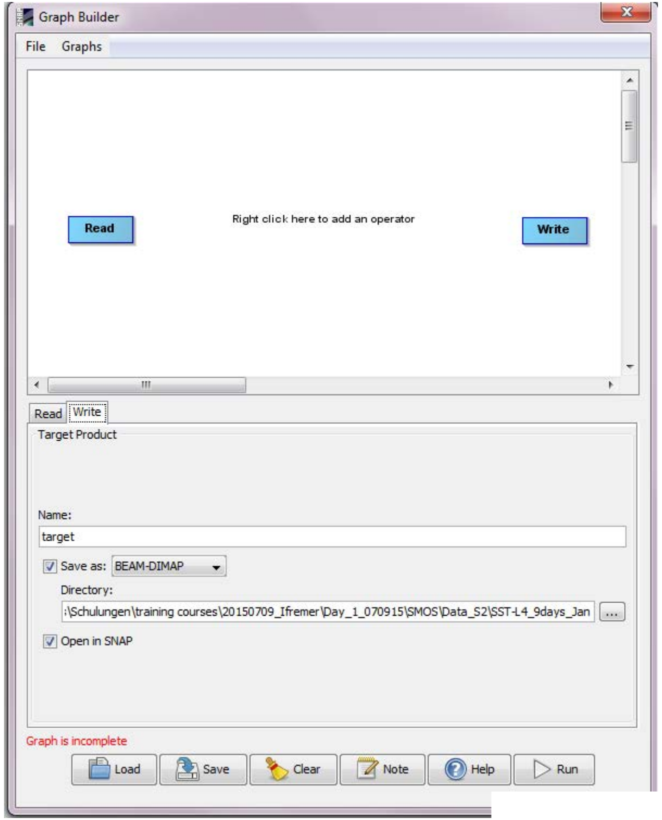
This little tutorial gives an introduction on bulk processing with the command shell on Windows and Unix systems. The provided scripts try to stay very generic in order to serve multiple processing requirements. However, not every edge case can be covered. The intention is to cover at least the main use cases. The scripts can probably be improved at multiple points but they can give you a starting point to write your own scripts. If you know improvements to the scripts or have questions regarding the usage of the script you are kindly invited to the SNAP Forum.
A general introduction to GPT and graphs can be found at Creating a GPF Graph.

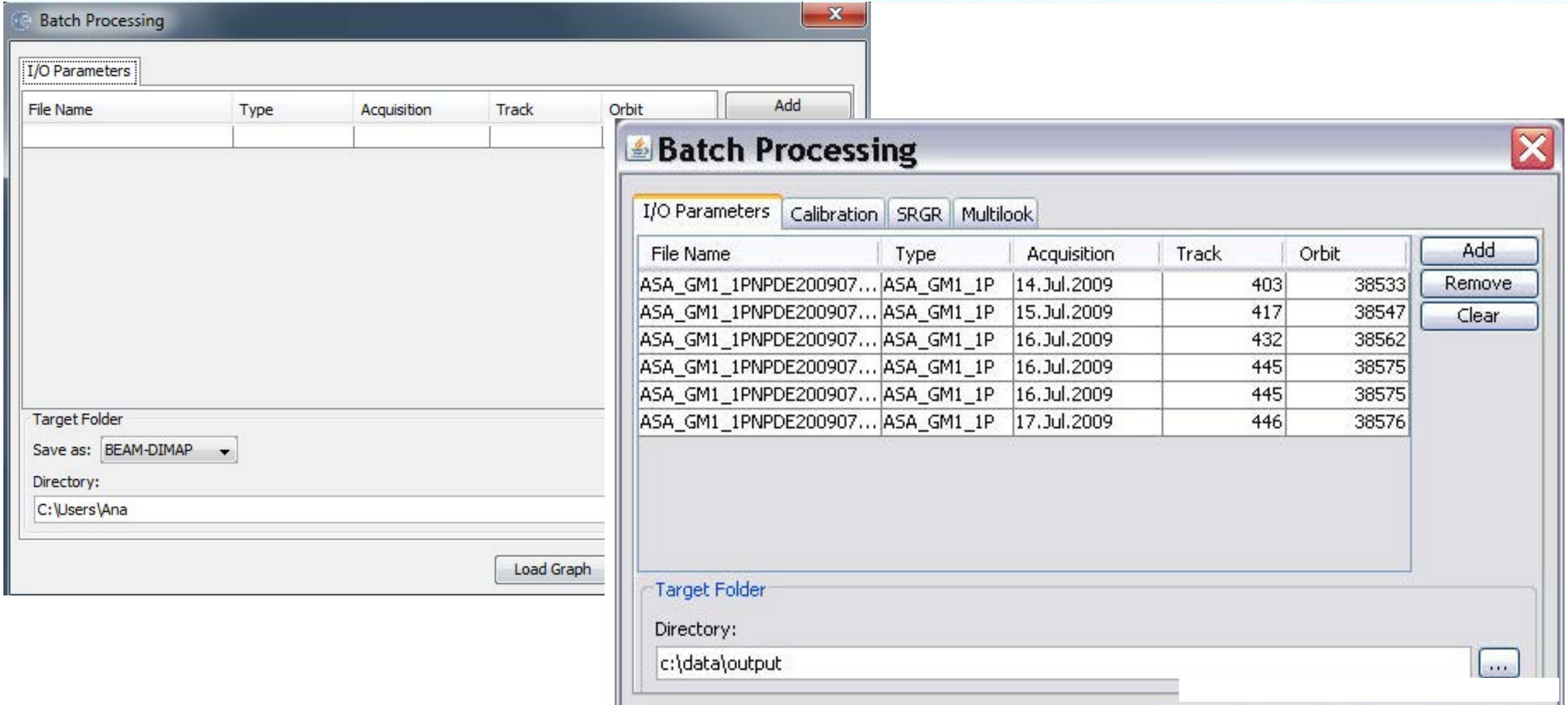
The four files mentioned below are attached for download.

- processDataset.bat (Windows)
- processDataset.bash (Unix)
- reasmple_s2.xml
- resample_20m.properties

Table of Contents


Graph Builder
Read
Speckle Filter
Write
Filter Operator
Write
Read 1
Speckle Filter 2
Write 3
Filter Operator 4
Write 5
Target Product
Name:
Save as: BEAM-DIMAP
Directory:
D:\Data
Open in NEST DAT
Load
Save
Clear
Process

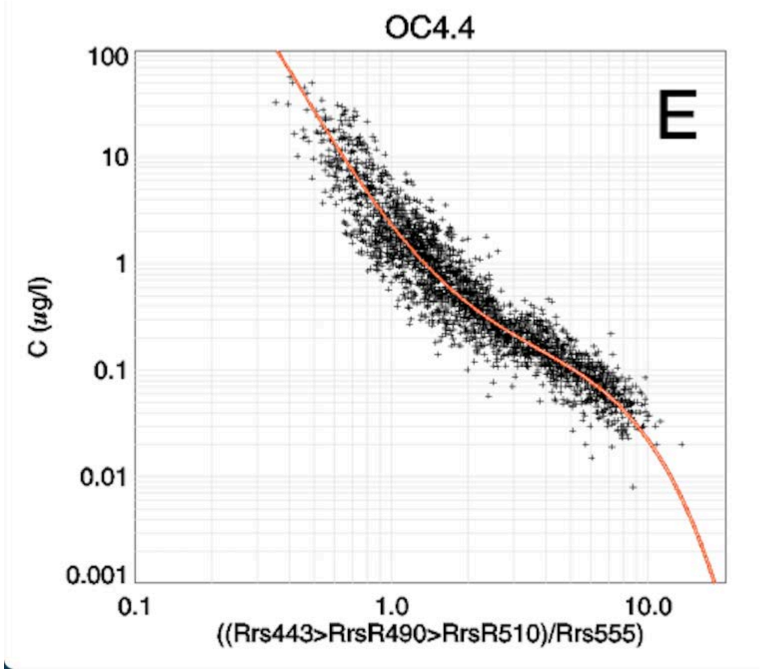

Graph Builder
File Graphs
Read
Right click here to add an operator
Write
Read
Write
Target Product
Name:
target
Save as: BEAM-DIMAP
Directory:
:\Schulungen\training courses\20150709_Ifremer\Day_1_070915\SMOS\Data_S2\SST-L4_9days_Jan
Open in SNAP
Graph is incomplete
Load
Save
Clear
Note
Help
Run


Batch Processing
I/O Parameters
File Name
Type
Acquisition
Track
Orbit
Add
Target Folder
Save as:
BEAM-DIMAP
Directory:
C:\Users\Ana
Load Graph
Batch Processing
I/O Parameters
Calibration
SRGR
Multilook
File Name
Type
Acquisition
Track
Orbit
ASA_GM1_1PNPDE200907... ASA_GM1_1P 14.Jul.2009 403 38533
ASA_GM1_1PNPDE200907... ASA_GM1_1P 15.Jul.2009 417 38547
ASA_GM1_1PNPDE200907... ASA_GM1_1P 16.Jul.2009 432 38562
ASA_GM1_1PNPDE200907... ASA_GM1_1P 16.Jul.2009 445 38575
ASA_GM1_1PNPDE200907... ASA_GM1_1P 16.Jul.2009 445 38575
ASA_GM1_1PNPDE200907... ASA_GM1_1P 17.Jul.2009 446 38576
Add
Remove
Clear
Target Folder
Directory:
c:\data\output
...

- There are several ways of obtaining chlorophyll_a and other water quality parameters using empirical or semi-analytical algorithms.
- Input bands can be atmospherically corrected or not, depending on the method selected. This selection will depend on the final objective, for instance, to detect cyanobacteria in lakes, MCI could be a good solution.
- The selection of the algorithm would also depend on the availability of in situ data to calibrate them.
- The optical water type pre-knowledge is always recommended. The OWT classifier could be used in case we do not know the area.

- Apply in-water algorithms for the detection and quantification of chlorophyll-a and related algae blooms.
- Empirical algorithms: apply a simple band ratio algorithm to retrieve a proxy to chlorophyll
- Understand the MCI algorithm.
- Write algorithm in the band math with and without the valid pixel expression.
- Compare results with standard product.

- Open OLCI L1C image and analyse the contents
- Convert TOA radiance to TOA reflectance
- Create a new band containing a chlorophyll index with band math operator
- Design a good colour palette for the index
- Copy the band into the L2 product
- Comparing chlorophyll index with chlorophyll bands from OLCI L2 product



OC4 version 4

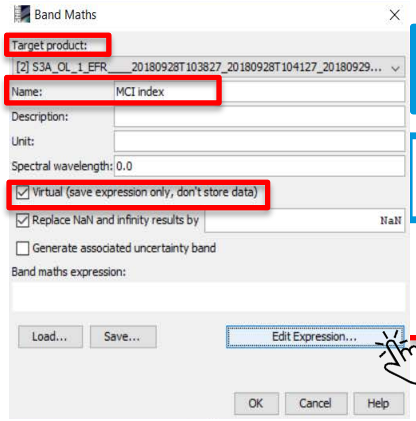
C = 10.0^(a(0) + a(1)*R + a(2)*R^2 + a(3)*R^3 + a(4)*R^4)

R = ALOG10((Rrs443>Rrs490>Rrs510)/Rrs555)

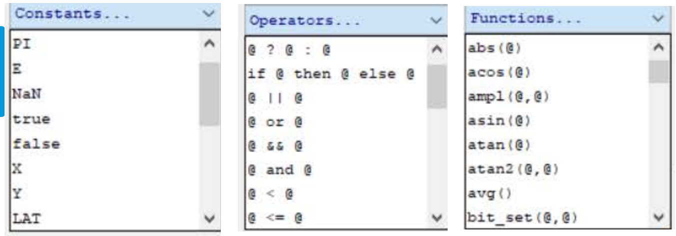
a = [0.366,-3.067,1.930,0.649,-1.532]

Generate three band ratios with Band Maths and select the highest values of the three per pixel.

Reflec_443/Reflec_560
Reflec_490/Reflec_560
Refkec_510/Reflec_560

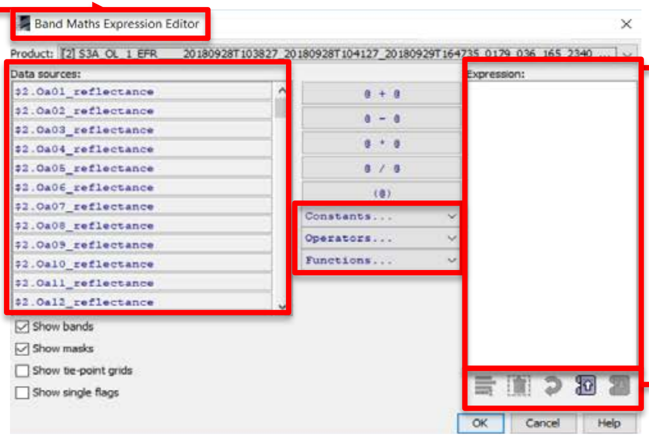


constants operators al functions



Target Product: By default, it corresponds to the open image. You can select any S3 product.

Name: it is the band name that will be create. Here, MCI index.

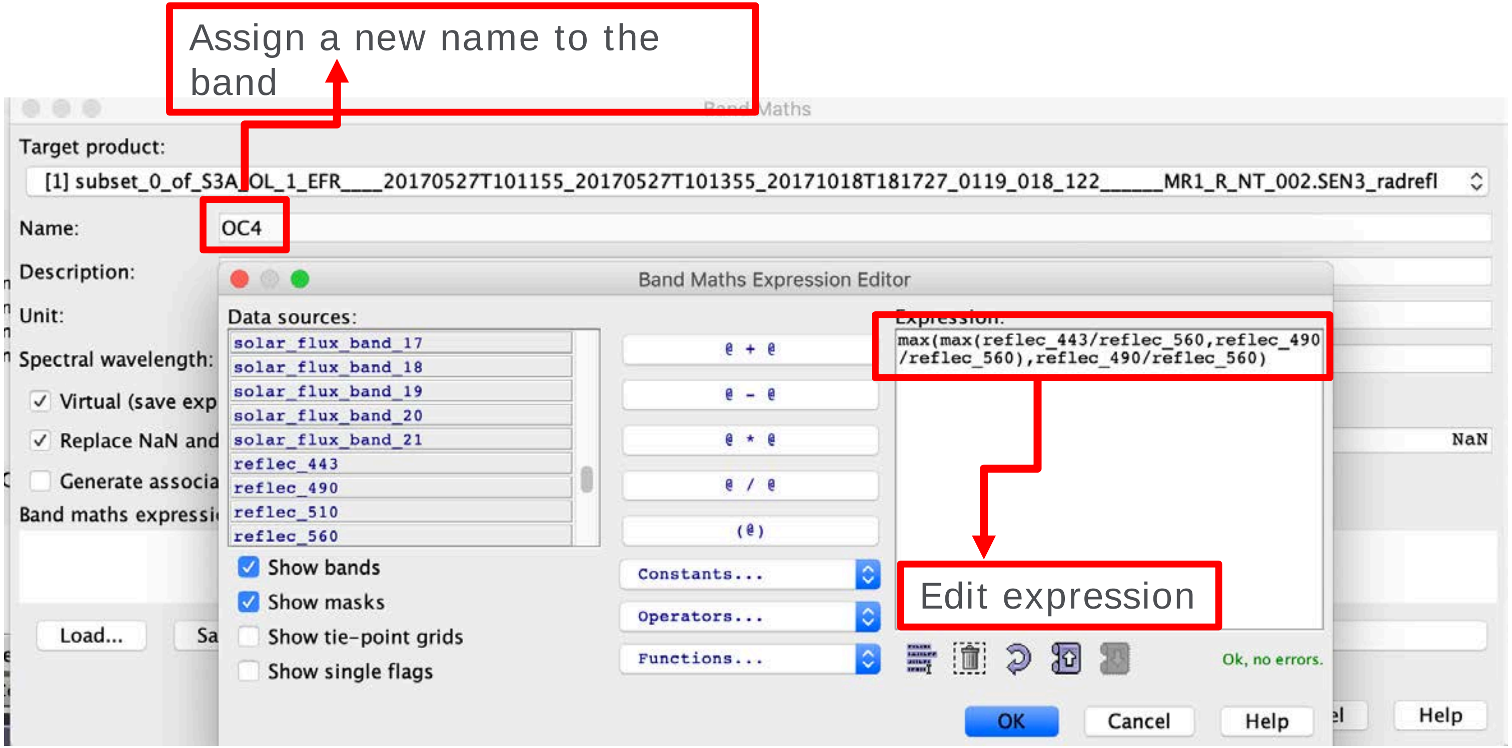


Expression: area to set up the math expressions. Here you can apply: mathematical constants, unary operators and mathematical functions.

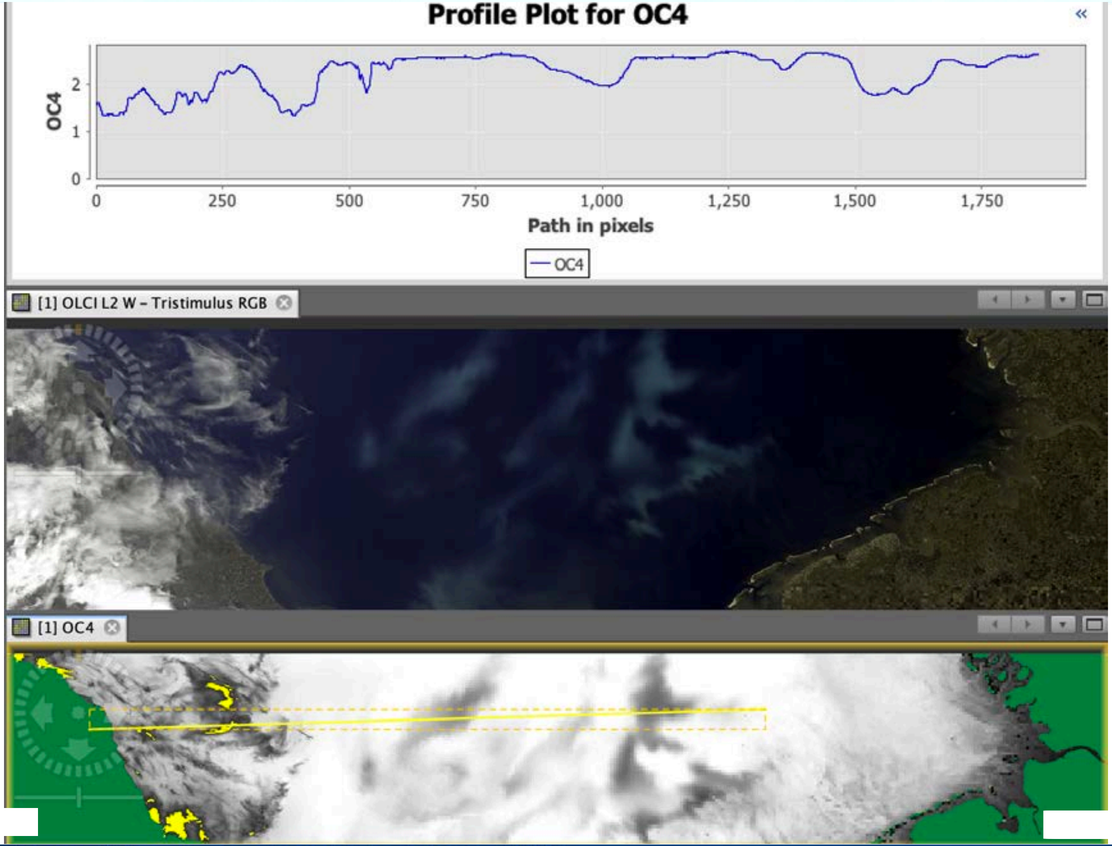
Data sources: S3 original data (bands, tie-point grids and flag values). You should select specific data to generate an expression.

Tools to edit expressions:

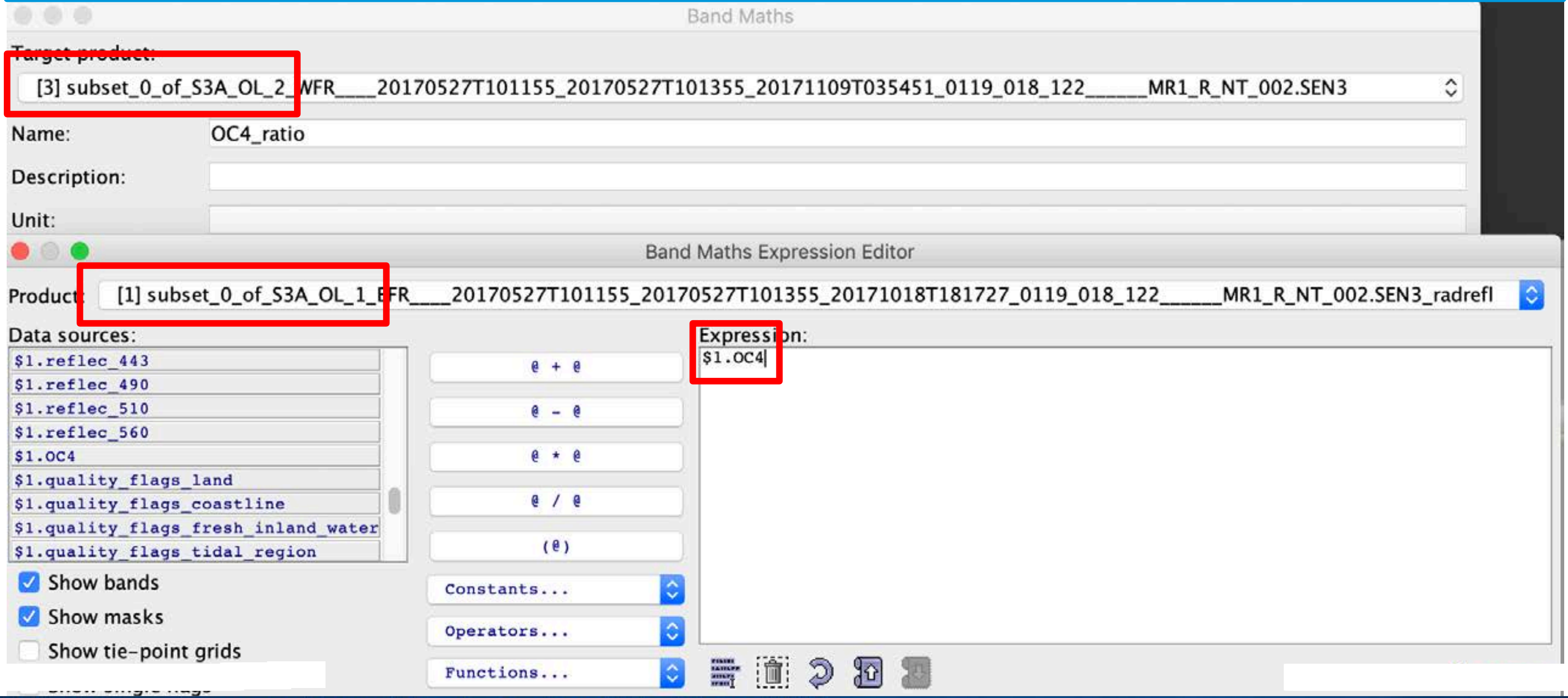
- Select all
- Clear
- Undo
- Scroll history up
- Scroll history down

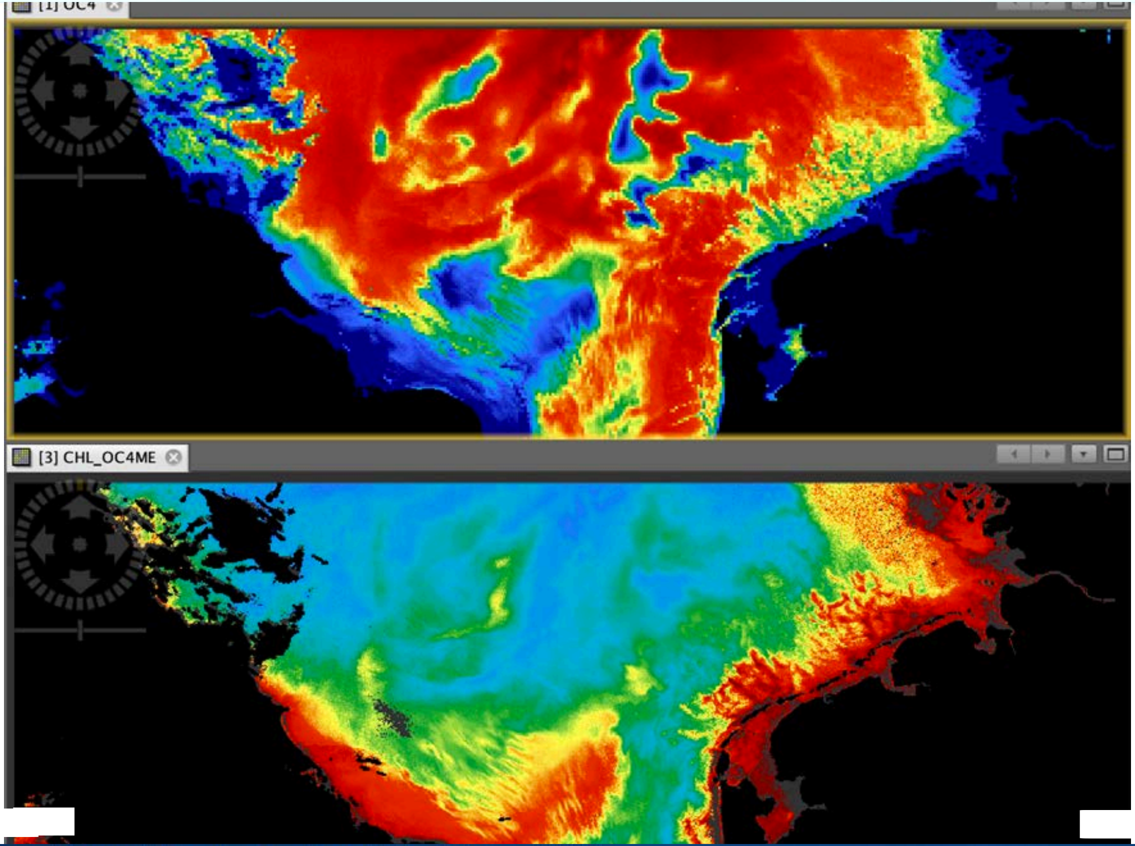

Assign a new name to the band
Band Maths
Target product:
[1] subset_0_of_S3A_OL_1_EFR____20170527T101155_20170527T101355_20171018T181727_0119_018_122______MR1_R_NT_002.SEN3_radrefl
Name:
OC4
Description:
Unit:
Spectral wavelength:
Virtual (save exp
Replace NaN and
Generate associa
Band maths expressi
Load...
Band Maths Expression Editor
Data sources:
solar_flux_band_17
solar_flux_band_18
solar_flux_band_19
solar_flux_band_20
solar_flux_band_21
reflec_443
reflec_490
reflec_510
reflec_560
Show bands
Show masks
Show tie-point grids
Show single flags
@ + @
@ - @
@ * @
@ / @
(@)
Constants...
Operators...
Functions...
max(max(reflec_443/reflec_560,reflec_490/reflec_560),reflec_490/reflec_560)
Edit expression
Ok, no errors.
NaN
OK
Cancel
Help

Investigating the Ocean Color from Space



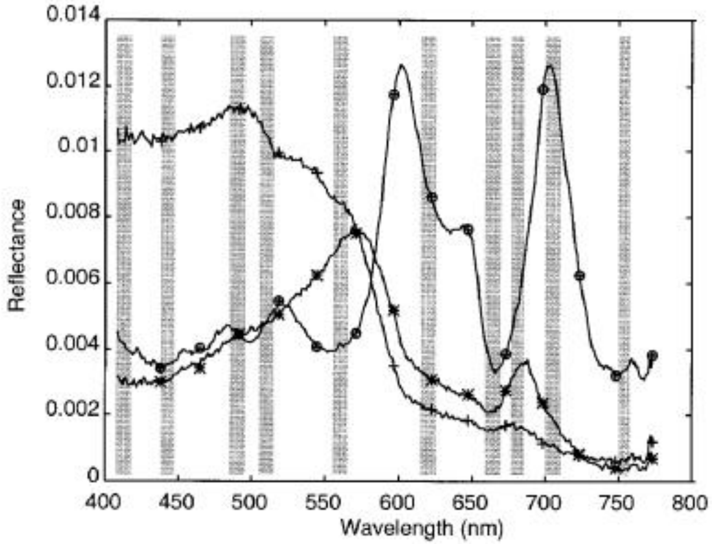
Using the band math, copy the OC4 band into the L2 product. This would allow a direct comparison of their values in the Pixel Information Window.




[1] OC4
[3] CHL_OC4ME

- Open OLCI L1C image and analyse the contents
- Apply MCI to L1 data using the graphic interface
- Manual calculation of MCI with Band Math
- Comparison of both products

S3B_OL_1_EFR____20190618T093412_20190618T093712_20190619T143145_0179_026_307_1980_MAR_O_NT_002.SEN3



$$LineHight = L_2 - L_1 - (L_3 - L_1)\frac{(\lambda_2 - \lambda_1)}{(\lambda_3 - \lambda_1)}$$

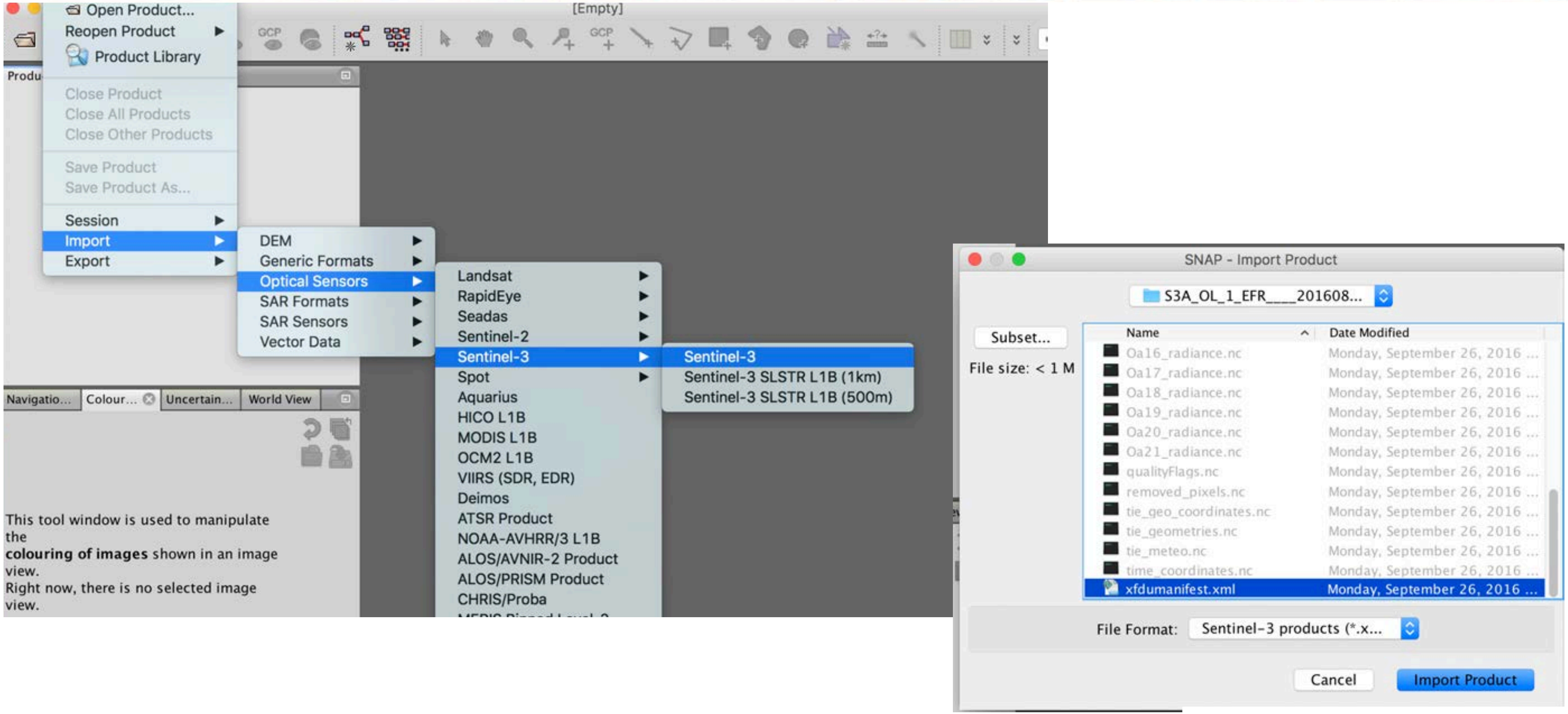
FLH / MCI

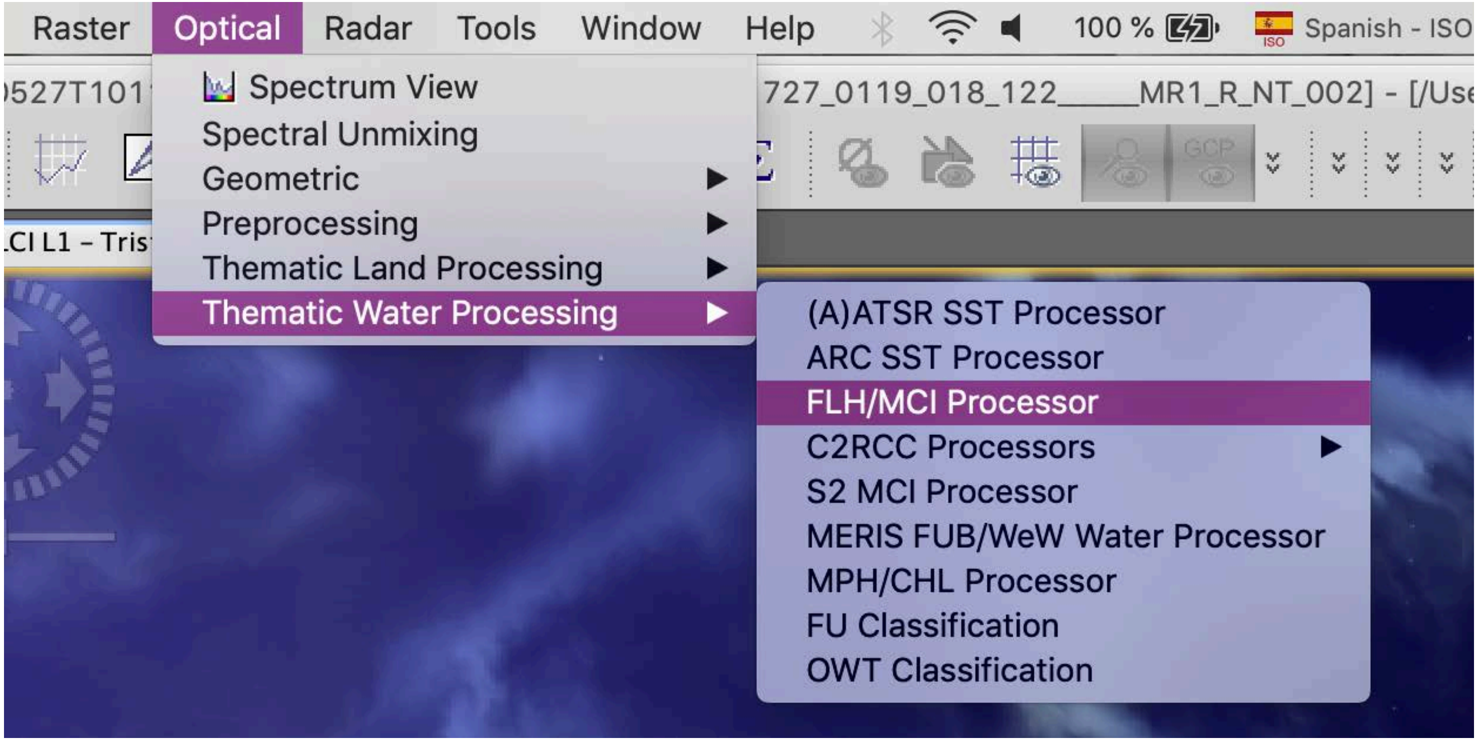
The fluorescence line height and maximum chlorophyll index algorithms exploit the height of the measurement in a certain spectral band above a baseline, which passes through two other spectral bands.

The maximum chlorophyll index (bands 680.5, 708 and 753nm), which can be applied, for example, to L1b measurements can help to indicate red tides.

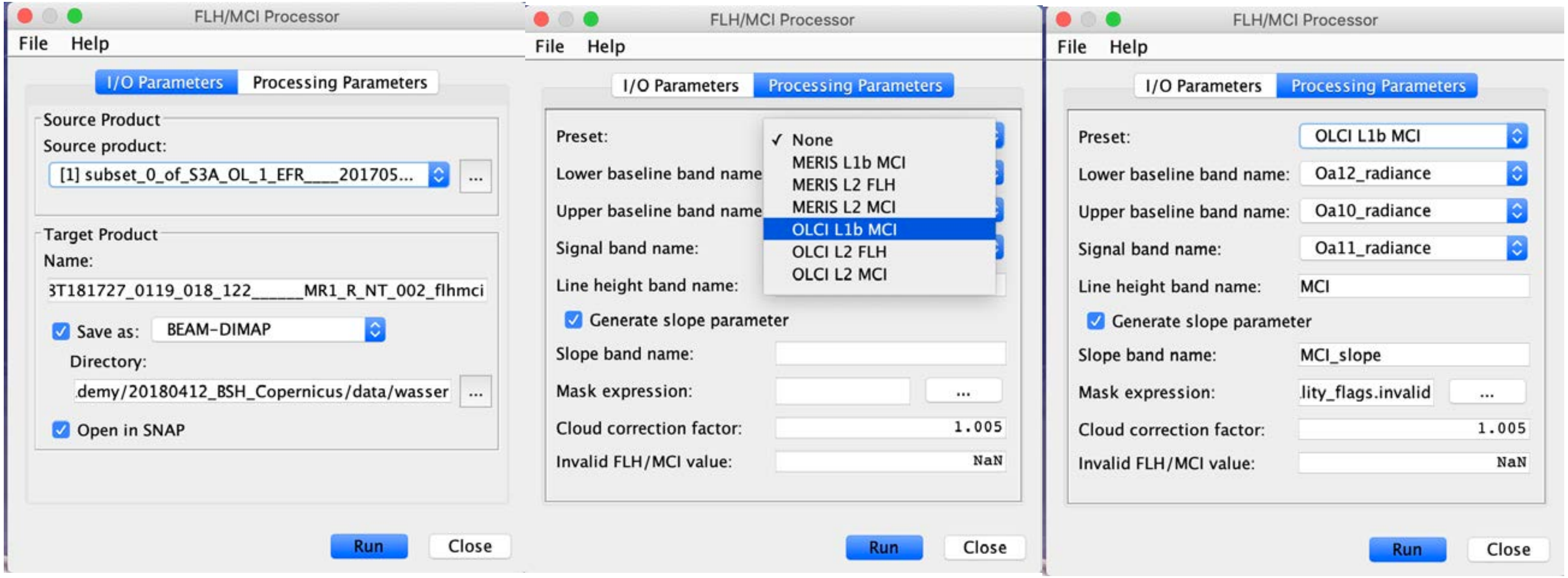
Relevant wavelengths: 680nm, 708nm, 753nm

Investigating the Ocean Color from Space




Raster
Optical
Radar
Tools
Window
Help
100 %
Spanish - ISO
Spectrum View
Spectral Unmixing
Geometric
Preprocessing
Thematic Land Processing
Thematic Water Processing
727_0119_018_122____MR1_R_NT_002] - [/Use
(A)ATSR SST Processor
ARC SST Processor
FLH/MCI Processor
C2RCC Processors
S2 MCI Processor
MERIS FUB/WeW Water Processor
MPH/CHL Processor
FU Classification
OWT Classification

Investigating the Ocean Color from Space

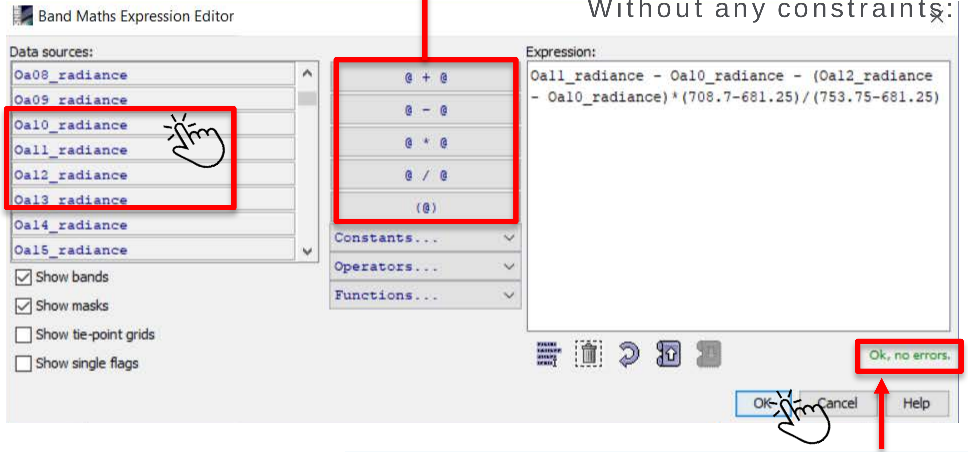


Cloud correction factor: 'If we use K=1, then FLH increases as radiance rises in thin cloud. We correct this using K=1.005. This is what I mean by "reducing the effect of thin cloud." We then find a mask at band 7 level 1 at about 50 radiance units gives a good picture. Using the same formula on level 2 reflectance data requires a mask at about .017 reflectance in band 7.' , J.F.R. Gower.

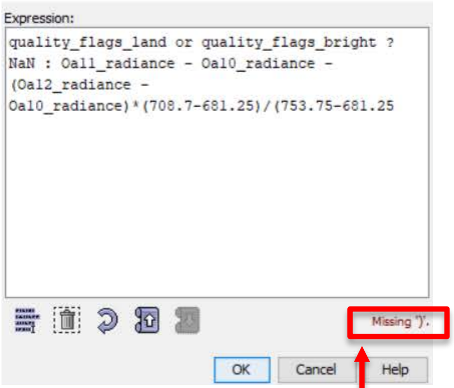
Basic operations: models by default. You must replace "@" by specific data.

Expression: Use the basic operations to add the MCI index. You must replace each @ by selecting required radiance bands.

Without any constraints:



Excluding land and bright pixels (indicator for clouds):



Once you have added the expression, it is automatically evaluated. If it is successful the result is "Ok, no errors" and you can apply it. OK to run the process.

If the expression is not correct, the error will be pointed. Here, we need a final parenthesis.

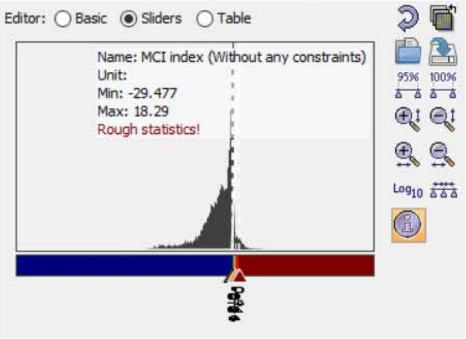
1. Without any constraints:

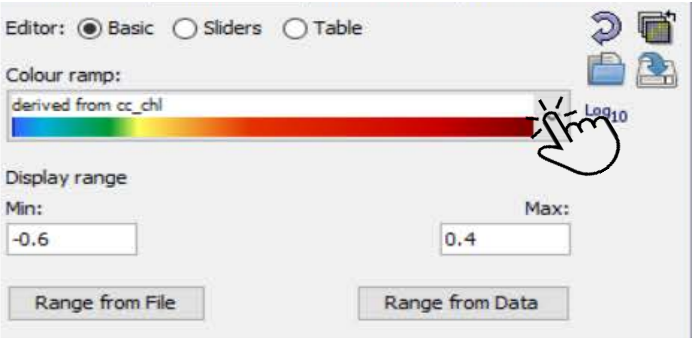
Oa11_radiance - Oa10_radiance - (Oa12_radiance - Oa10_radiance)*(708.7-681.25)/(753.75-681.25)

2. Excluding land and bright pixels (indicator for clouds):

quality_flags_land or quality_flags_bright ? NaN : Oa11_radiance - Oa10_radiance - (Oa12_radiance - Oa10_radiance)*(708.7-681.25)/(753.75-681.25)

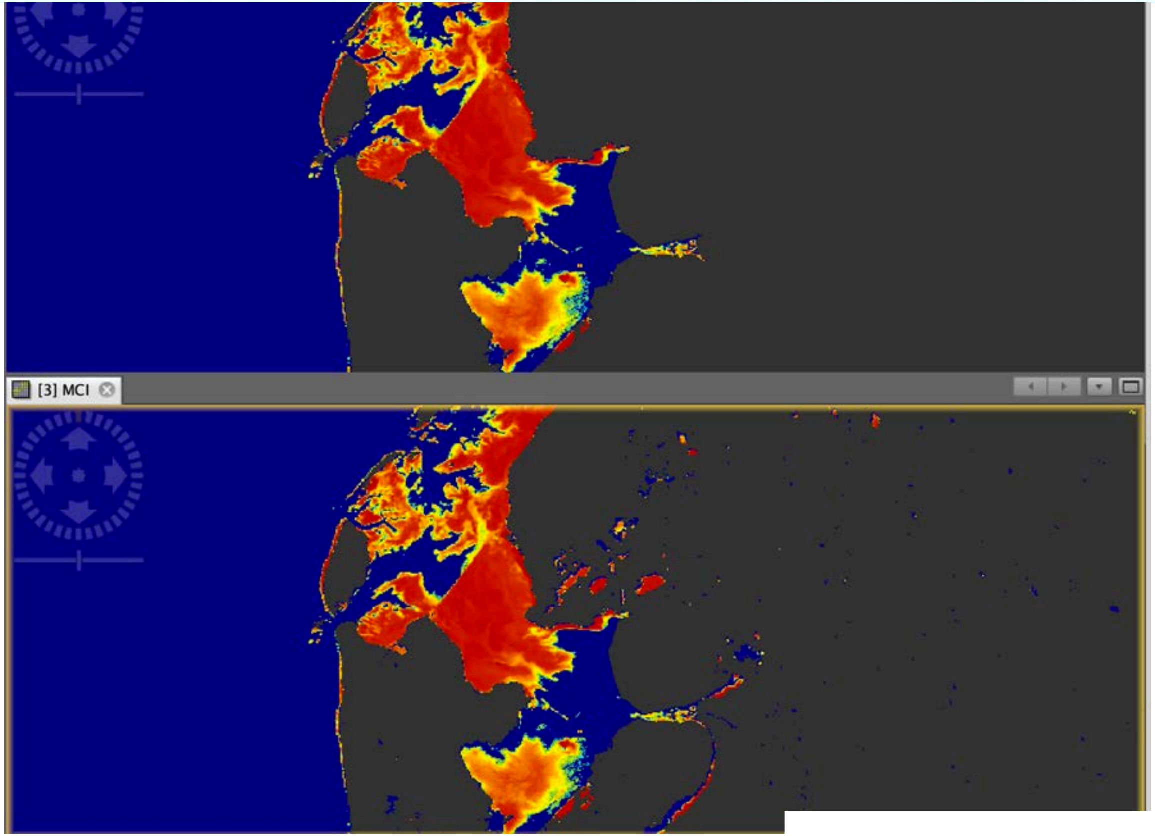
Colour manipulation: is used to add a color palette or modify it. The colour manipulation label is found besides the Navigation label. There are three modes to change the palette: basic, sliders and table.
Basic: Drag and drop it to select a specific palette. Several colour palettes are stored by default.





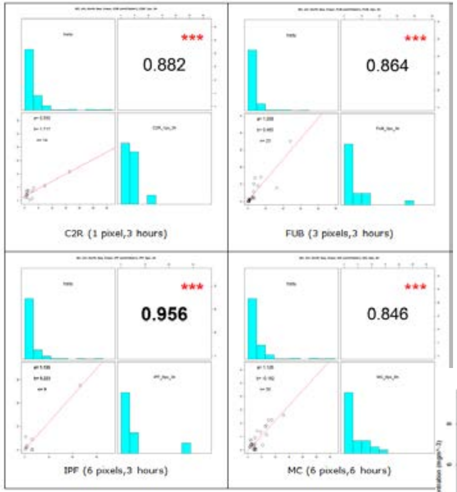
Display range: establish a minimum and maximum value. Explore the image values.
Sliders: As the white diagonal line above the histogram indicates, the colour palette will be linearly applied to the samples of the current band. By moving a slider with the mouse you can change its sample value.

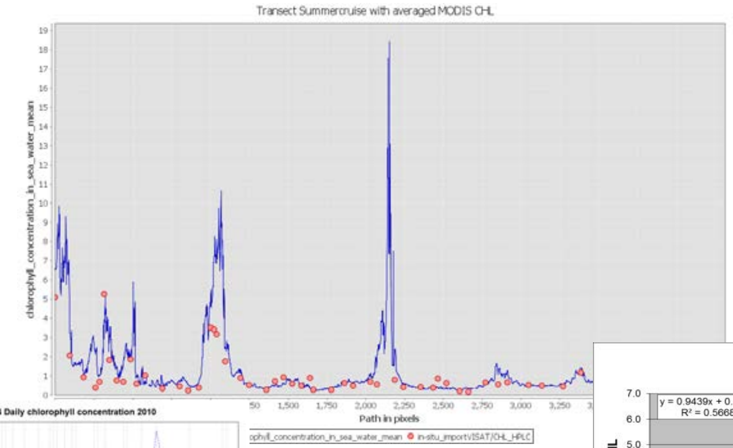
Table: the value range can be edited manually and adjusted it according to your necessities.

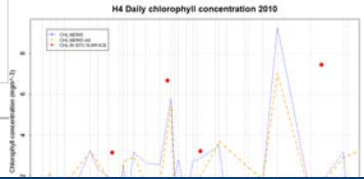

[3] MCI

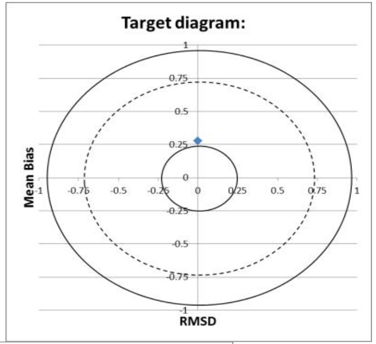
Investigating the Ocean Color from Space

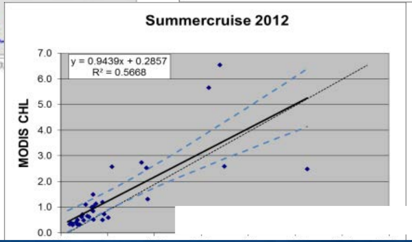
- Parameters to be validated (most common): water leaving radiance or reflectance (Lw, ρw), transmittance (t), inherent optical properties (absorption –a- and (back)scattering –b-of several substances), chlorophyll-a, suspended matter, yellow substance, turbidity, transparency.
- Methods used: linear regression statistics and its representation in scatter plots, histograms, time series plots, target diagrams, transects, etc.











Investigating the Ocean Color from Space

- Tabstop separated
- A CSV file must have a header line specifying the column names
    - Latitude: 'lat' or 'latitude'
    - Longitude: 'lon', 'long' or 'longitude'
    - Column(s) with in-situ values
- Points, Lines, Polygons

.csv, .txt

```
Name  Lon Lat Label CHL TSM
Station_1 8.433142  54.063217 Station_1 20  40
Station_2 8.248533  54.270275 Station_2 10  20
Station_3 8.100735  54.493687 Station_3 8 25
Station_4 7.9993324 54.66786  Station_4 12  20
Station_5 8.017196  54.945965 Station_5 13  18
Station_6 8.073449  55.284126 Station_6 14  1
Station_7 7.724219  55.33581  Station_7 16  4
Station_8 7.6007733 55.081173 Station_8 14  2
Station_9 7.526144  54.820965 Station_9 20  3
Station_10  7.4434566 54.583225 Station_10  1 5
Station_11  7.329495  54.252396 Station_11  1 6
Station_12  7.2102094 53.997543 Station_12  4 2
Station_13  7.622393  53.926735 Station_13  6 5
Station_14  8.13969 53.970703 Station_14  3 15
```

Vector file

```
# MULTIPOLYGONs
#
# Product:      subset_1_MER_RR__1PQBCM20030809_101416_000002002018_00466_07534_0168
# Created on:   Thu Apr 12 14:48:36 CEST 2012

# Wavelength:                                         884.94403
org.esa.beam.Multipolygon      Name:String     Geometry:MultiPolygon    radiance_14:Double
0       multipolygon_1  MULTIPOLYGON (((10 47, 0 43, 6 40, 10 47)), ((2 39, 3 39, 2.5 38, 2 39)))       59.383057
1       multipolygon_2  MULTIPOLYGON (((8 38, 2 45, 8 42, 8 38)), ((3 35, 5 36, 3.5 39. 3 35))) 59.383057
```

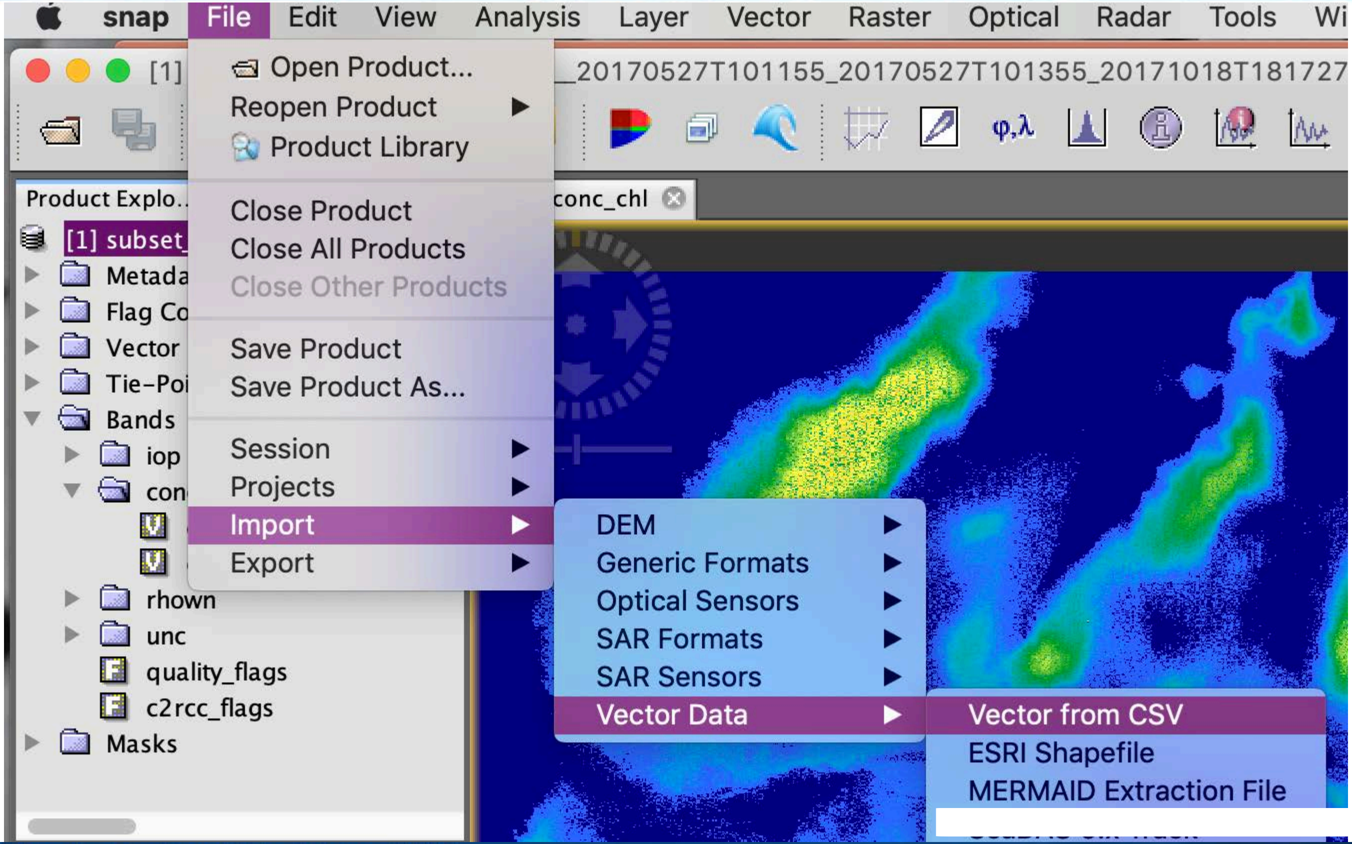
- Shapefile
  - ESRI shapefile
  - Points, lines, polygons
  - Import of elements as a whole or separately
- MERMAID Extraction file
  - Points

```
PROCESSING_VERSION;site;PI;lat_IS;lon_IS;TIME_IS;thetas_IS;PQC;MQC;chl_IS;
MEGS_8.0;BOUSSOLE;DavidAntoine;43.367;7.9;20030907T130033Z;42.237999;P00000100;M1101101011011110101;1.12E-01;
MEGS_8.0;BOUSSOLE;DavidAntoine;43.367;7.9;20030908T100033Z;41.848999;P00000100;M1101101011011110101;1.10E-01;
MEGS_8.0;BOUSSOLE;DavidAntoine;43.367;7.9;20030910T101533Z;41.109001;P00000100;M1101101011011110101;1.05E-01;
MEGS_8.0;BOUSSOLE;DavidAntoine;43.367;7.9;20030911T110034Z;38.824001;P00000100;M1101101011011110101;1.03E-01;
MEGS_8.0;BOUSSOLE;DavidAntoine;43.367;7.9;20030914T100033Z;43.737999;P00000100;M1101101011011110101;9.60E-02;
MEGS_8.0;BOUSSOLE;DavidAntoine;43.367;7.9;20030916T101535Z;43.101002;P00000100;M1101101011011110101;9.10E-02;
```

- SeaDAS 6.x Track
  - Points

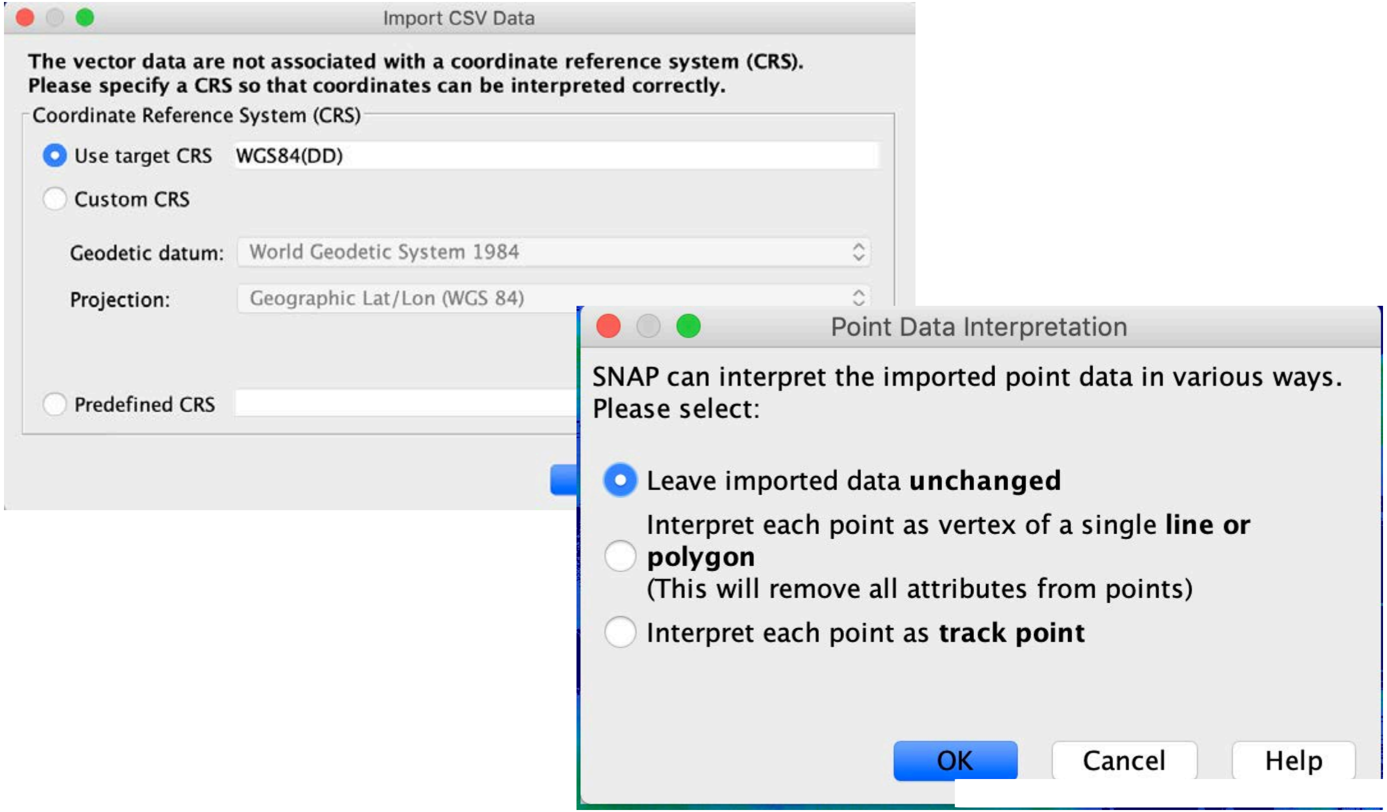
With the cursor on the name of the image, go to File → Import → Vector Data → Vector from CSV

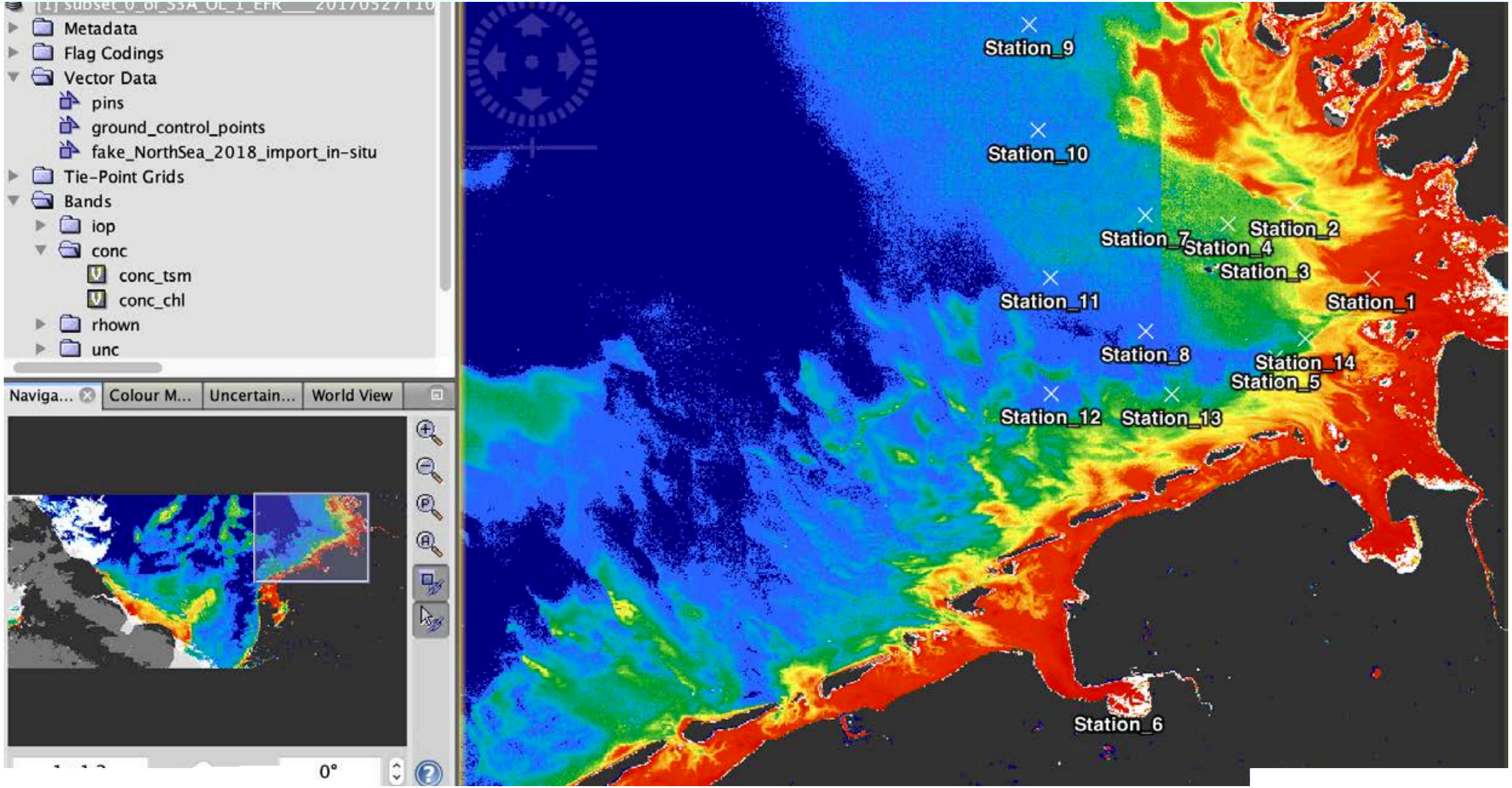
Import file: fake_NorthSea_2012_import_in-situ.txt



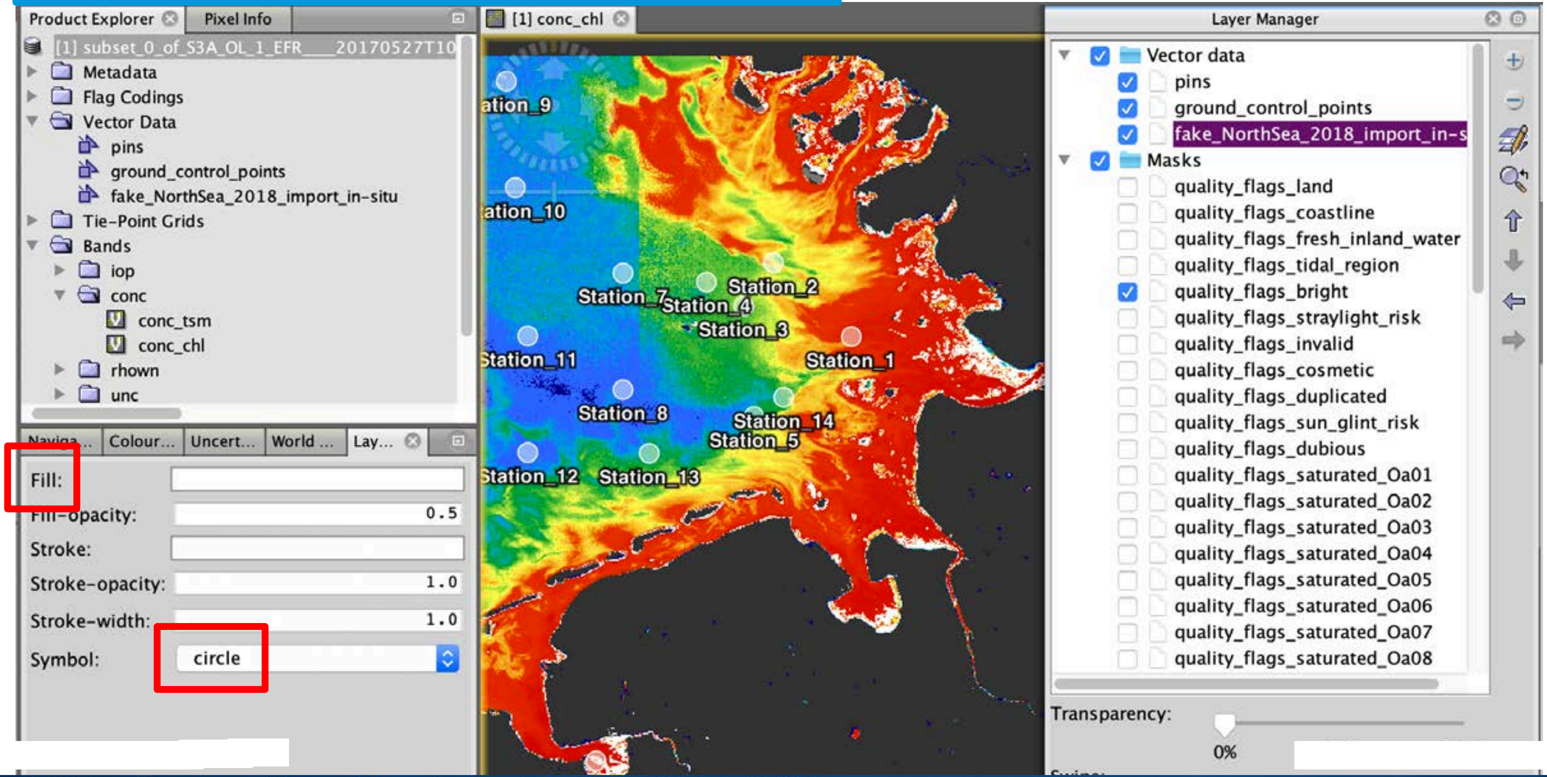
With the cursor on the name of the image, go to File → Import → Vector Data → Vector from CSV

Import file: faked_insitu_20190618.txt

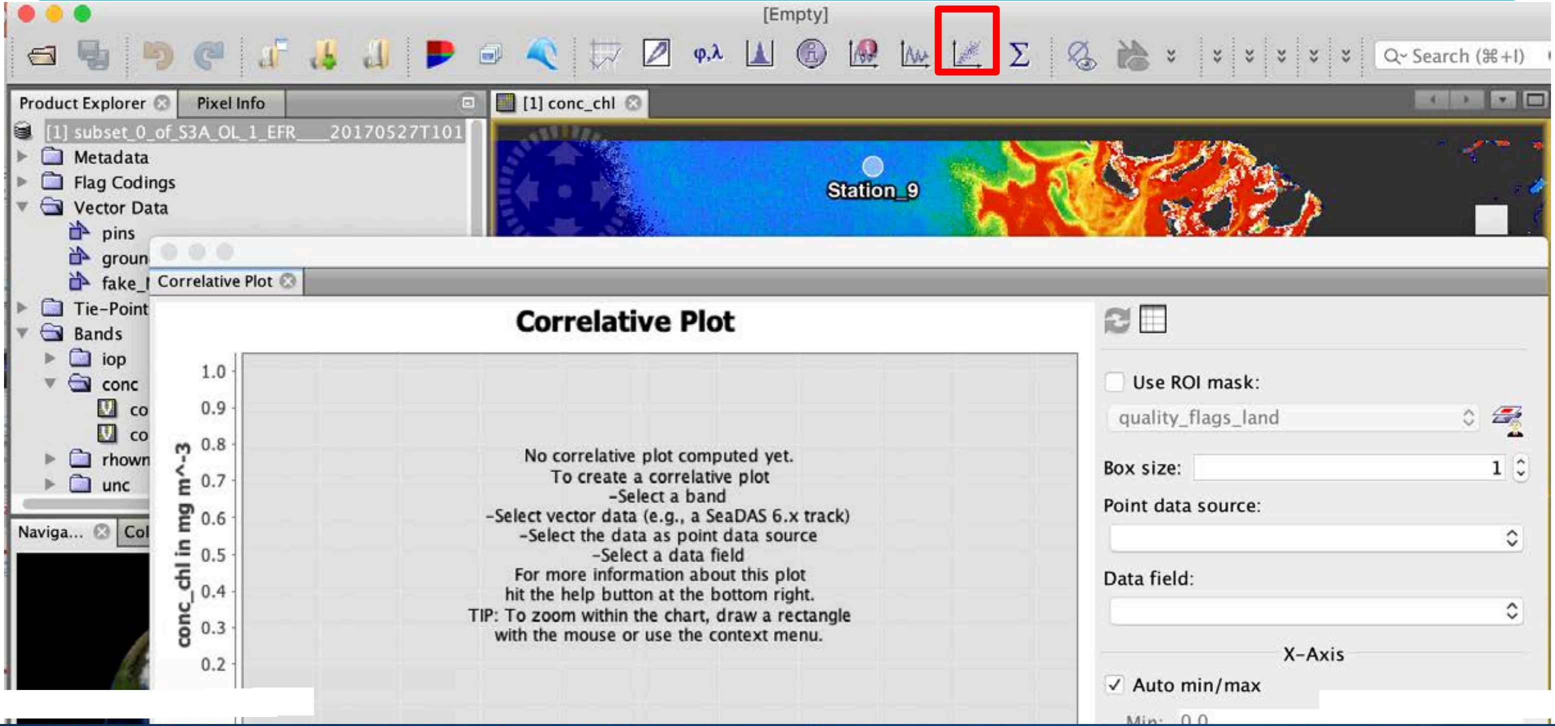


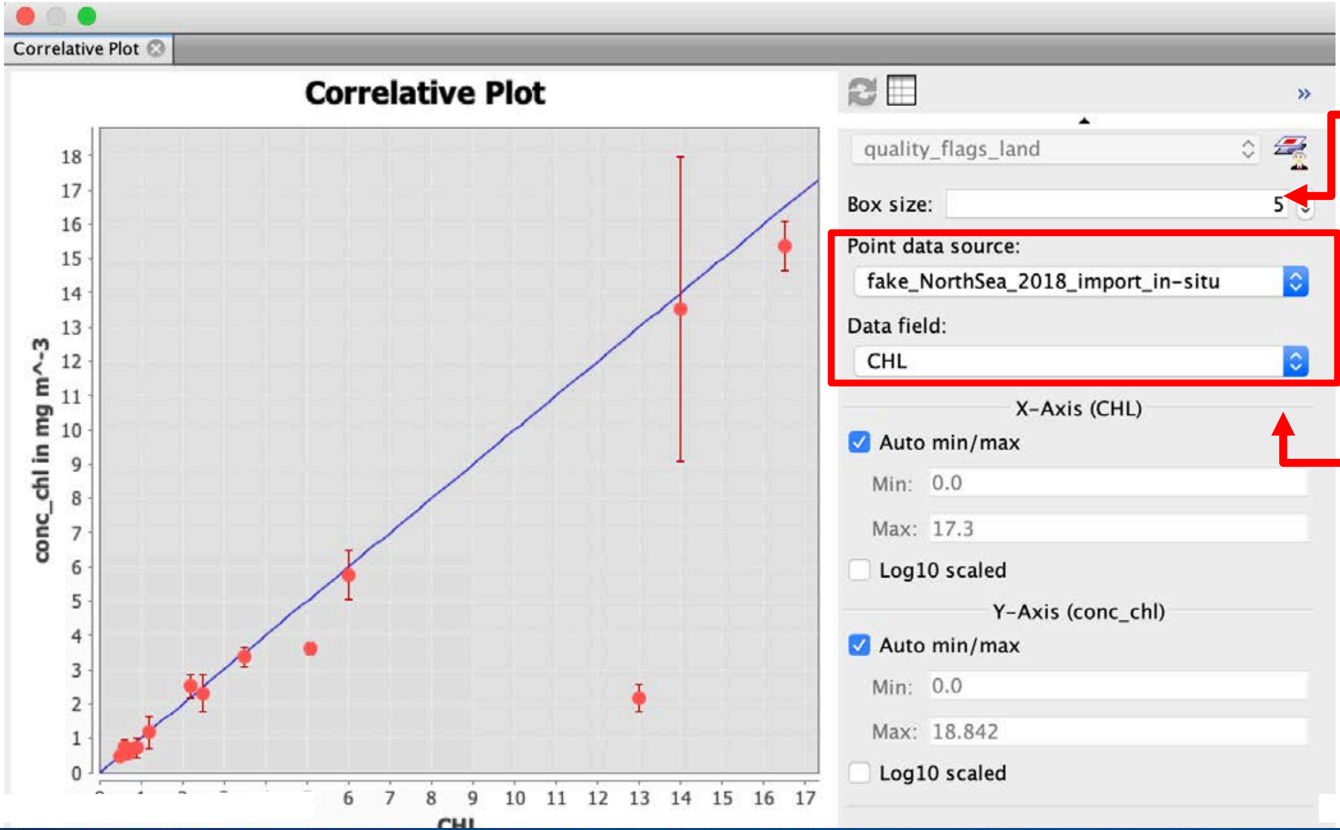

Metadata
Flag Codings
Vector Data
pins
ground_control_points
fake_NorthSea_2018_import_in-situ
Tie-Point Grids
Bands
iop
conc
conc_tsm
conc_chl
rhown
unc
Naviga...
Colour M...
Uncertain...
World View
0°
Station_9
Station_10
Station_7
Station_2
Station_4
Station_3
Station_11
Station_1
Station_8
Station_14
Station_5
Station_12
Station_13
Station_6

View →Tool Windows →Layer Manager



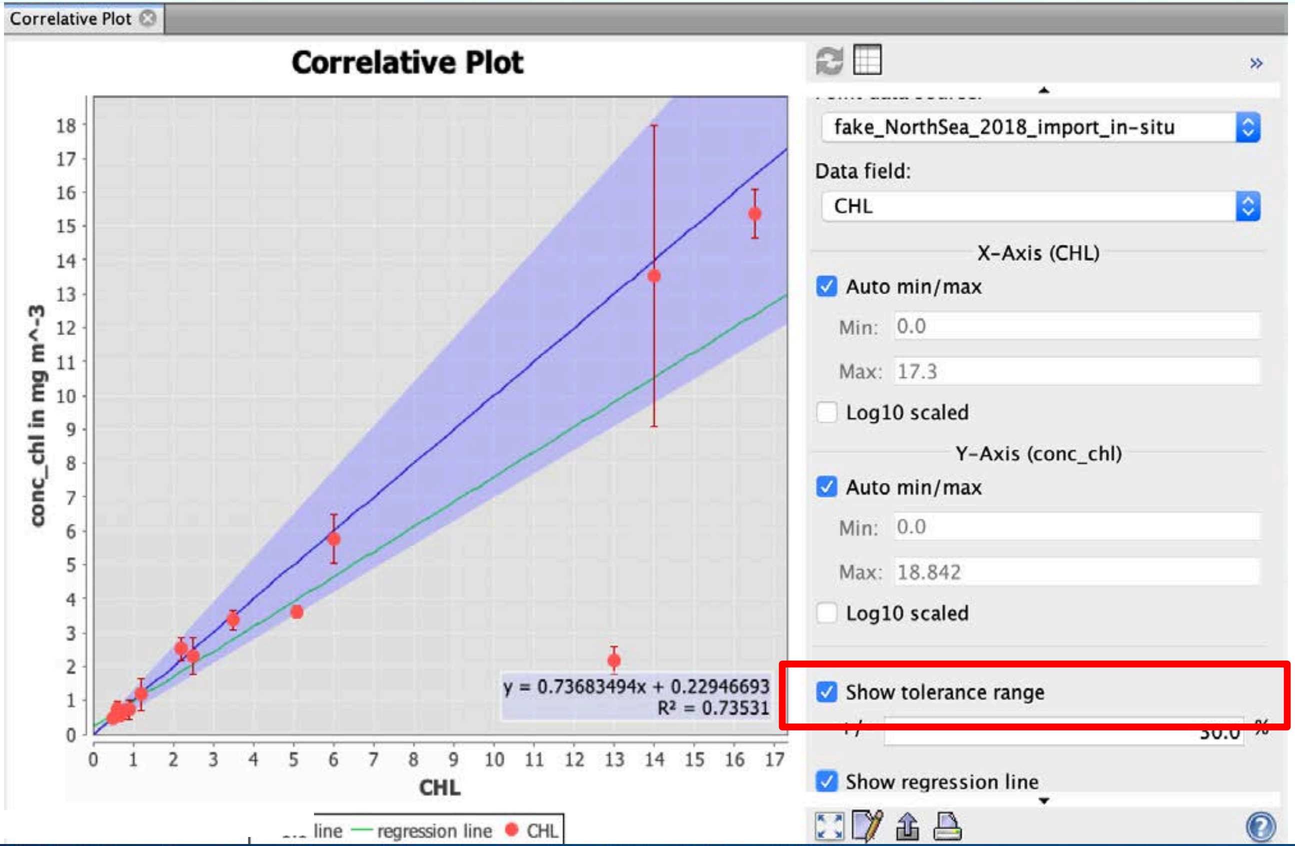
Investigate how the satellite data and in situ data match by using the correlative plot: Analysis → Correlative Plot





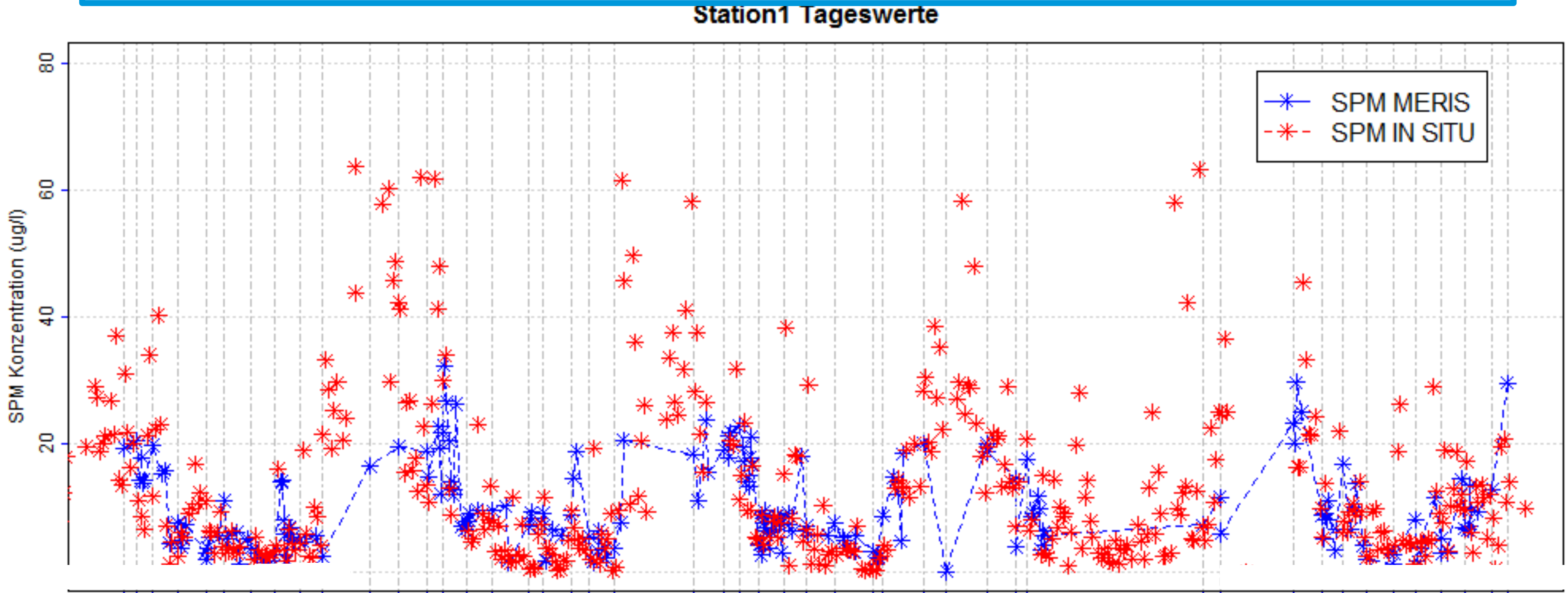
The box size indicates the number of pixels around the central location to calculate statistics: mean, standard deviation (plotted as vertical lines from the point).

Indicate the source of the point data to plot together with the satellite data.

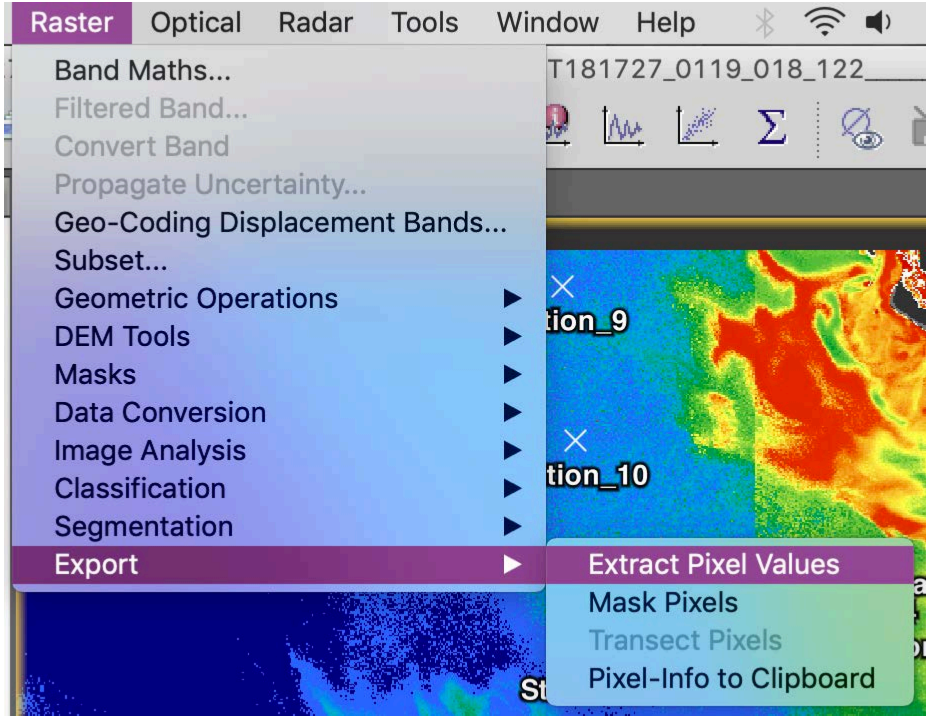


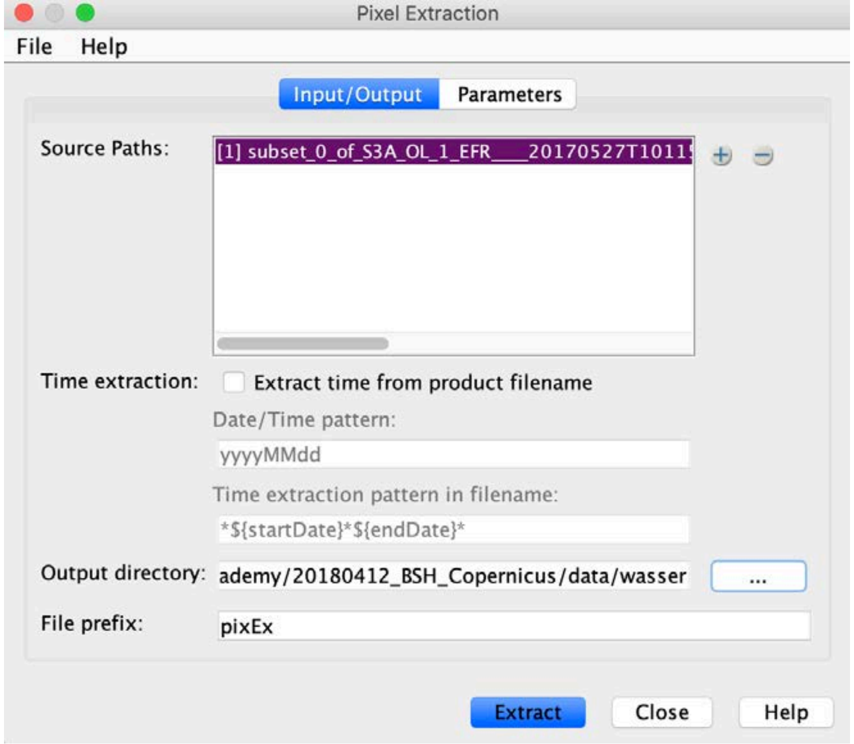
The uncertainty allowed boundaries can also be plotted and percentage change to match conventions.
The regression line can also be shown.

- Extraction of data with Pixel Extraction Tool: using pin locations, we will extract information from the image and expert in a .csv or .txt file
- For extraction of match-ups and time series generation using external tools.



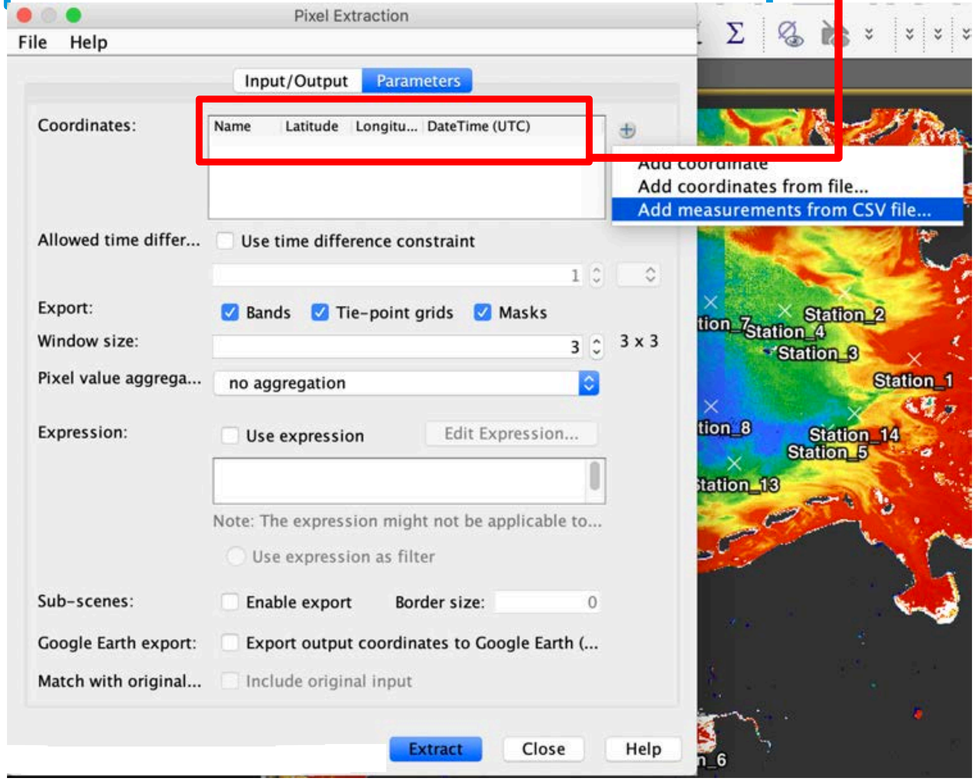
Raster → Export → Extract Pixel Values

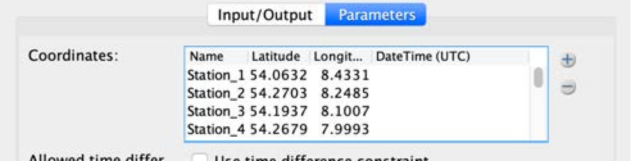


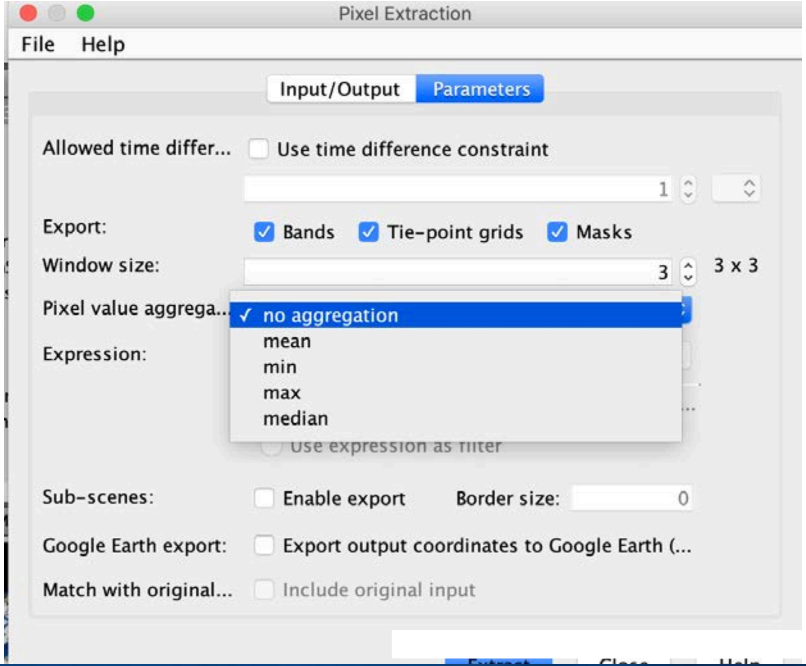


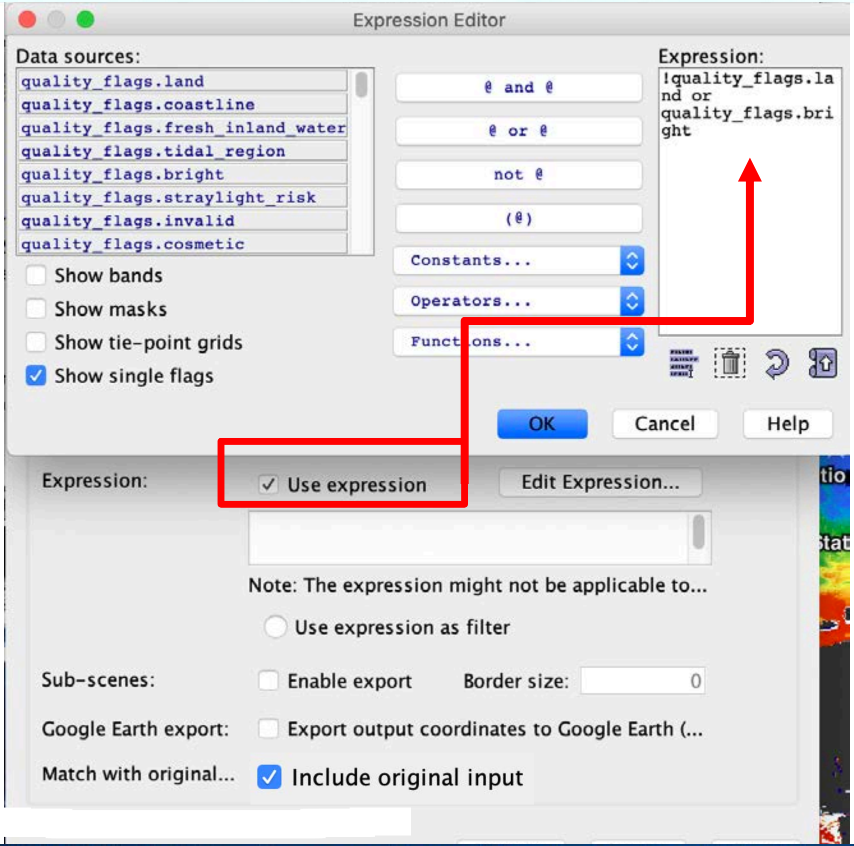
Investigating the Ocean Color from Space

Raster → Export → Extract Pixel Values

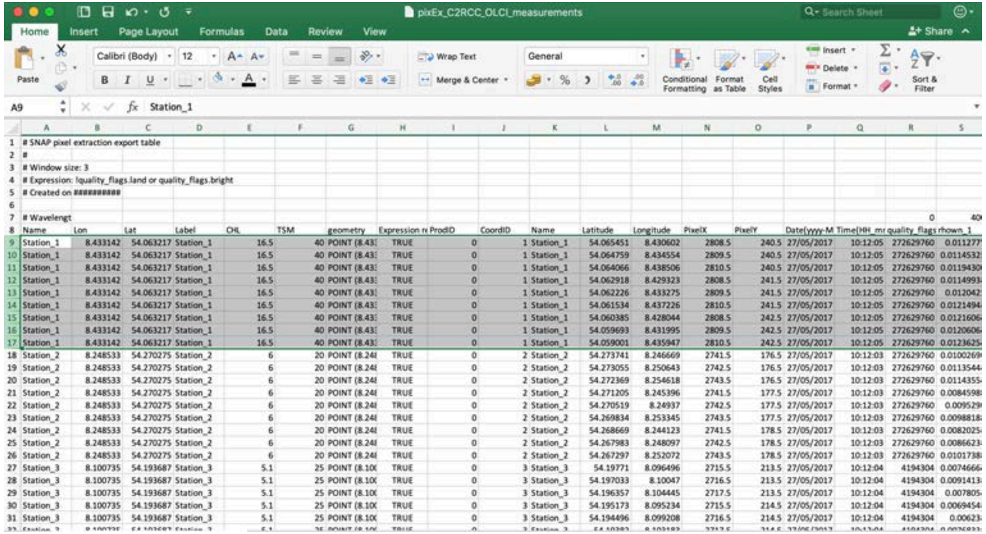








- Table of extracted pixels, all bands
- List of input products (product ID)



3 x 3 micropixel size with all bands for the list images available

- Without independent validation, satellite data products lack credibility.
- The main problem for a good validation is the scarcity of matched data sets consisting of reliable in situ measurements, and the estimate of the same variable retrieved from satellites.
- Another problem is the mismatch between a single point sample and the area average acquired from the remote sensor
- The definition of match-ups: is the value of an ocean variable determined from EO with an in situ measurement coincident in space and time.
- The algorithm should be tested using data spanning the whole range of variable values, and this is often difficult to achieve (several in situ campaigns).
- Some limits should be establish when interpreting data. Usually a ±35% of permissible limit is established.
- Validation activities should continue over the whole like of a mission.
- Consistency in the treatment of the complete time series of data from a mission should be ensured (several re-processing and validation tests, even when the mission has ended).

2. Ocean synergy

Spatial and temporal aggregation for analysis of time series and trends

Study correlation between parameters

Working with different sensors: collocation

1. Spatial and temporal aggregation
    - Open three OLCI WRR L2 images
    - Calculate the average product (L3)
        - Parameters of interest: chlorophyll concentration, suspended matter concentration
    - Investigate the L3 product and find the sources of artefacts
2. Combination of products:
    - Collocation of OLCI and SLSTR products
    - Analysis of the combined product:
        - overlay the chlorophyll concentration with the SST band
        - analyse both parameters by swiping and blending
        - show the correlation of both parameters in a scatterplot

Spatial and temporal aggregation

S3A_OL_2_WFR____20190622T101006_20190622T101306_20190623T203014_0179_046_122_1980_MAR_O_NT_002.SEN3

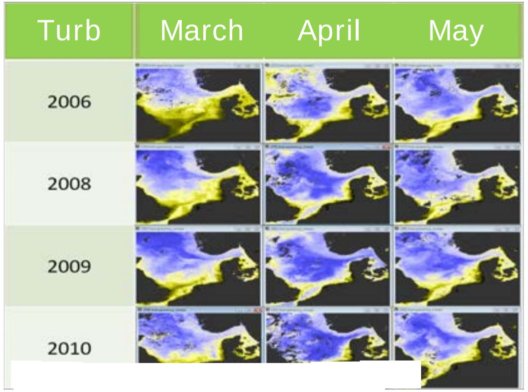
S3B_OL_2_WFR____20190618T093412_20190618T093712_20190619T163055_0179_026_307_1980_MAR_O_NT_002.SEN3

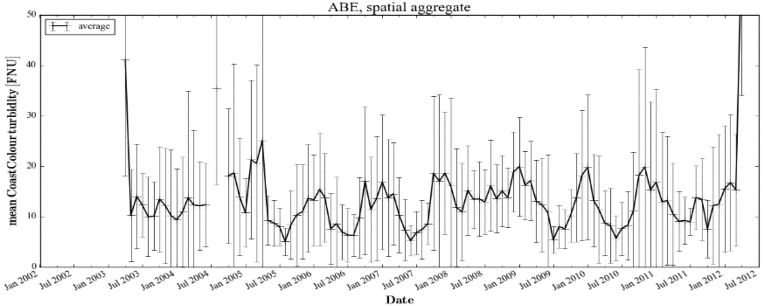
Combination of products:

S3A_OL_2_WFR____20170508T151414_20170508T151614_20171108T175554_0119_017_239______MR1_R_NT_002.SEN3

subset_0_of_S3A_SL_2_WST____20170508T022010_20170508T040109_20180929T011826_6059_017_231______MR1_R_NT_003

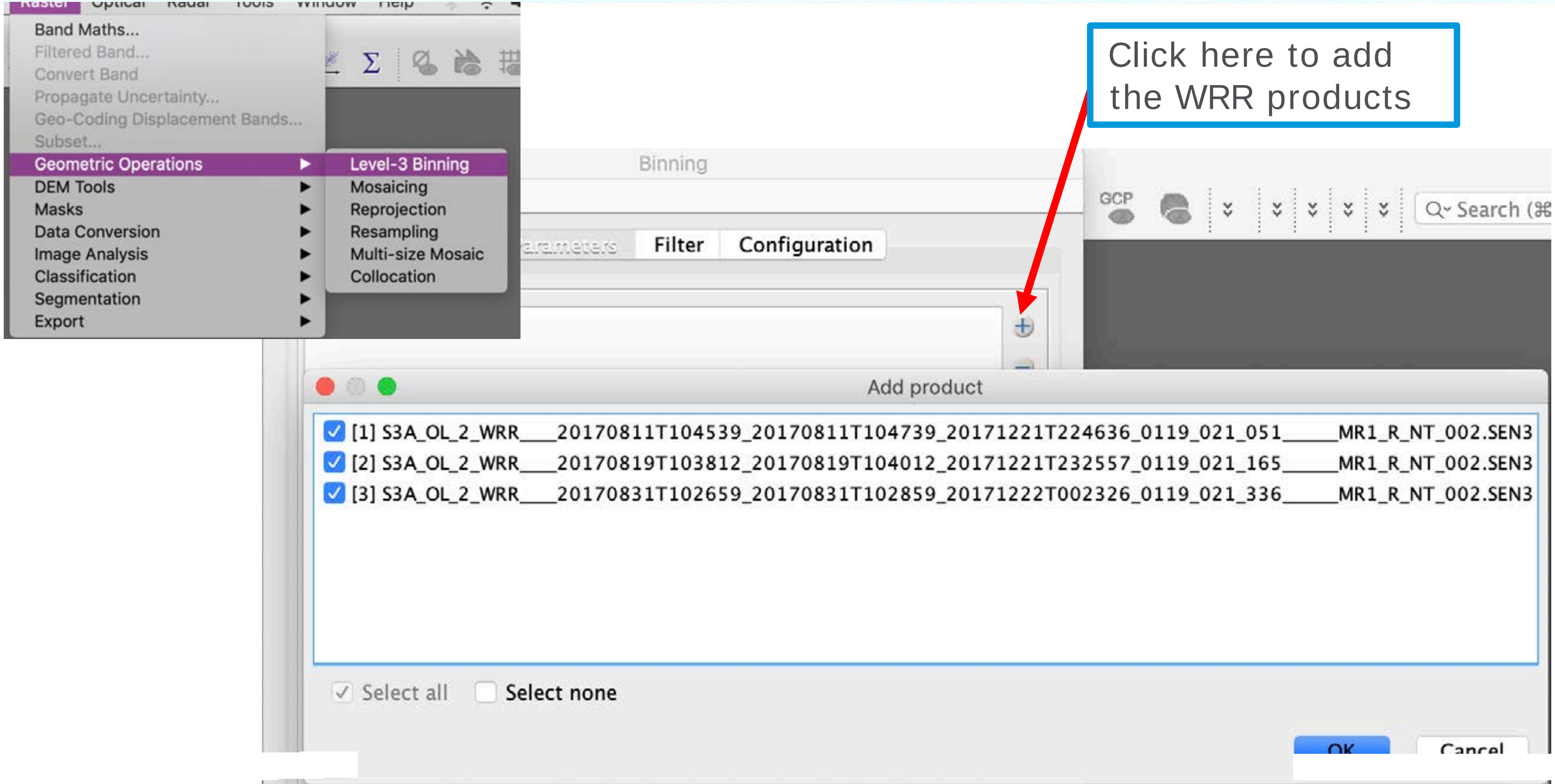
Temporal and spatial aggregation is needed for several applications. It reduces the scatter in time and space and is therefore good for analysing large data sets, e.g. full satellite archives. The temporal interval and the spatial resolution is driven by the question to be answered. Often those products used for further analyses such as heatmaps or time series plots and can be correlated to other data sets.

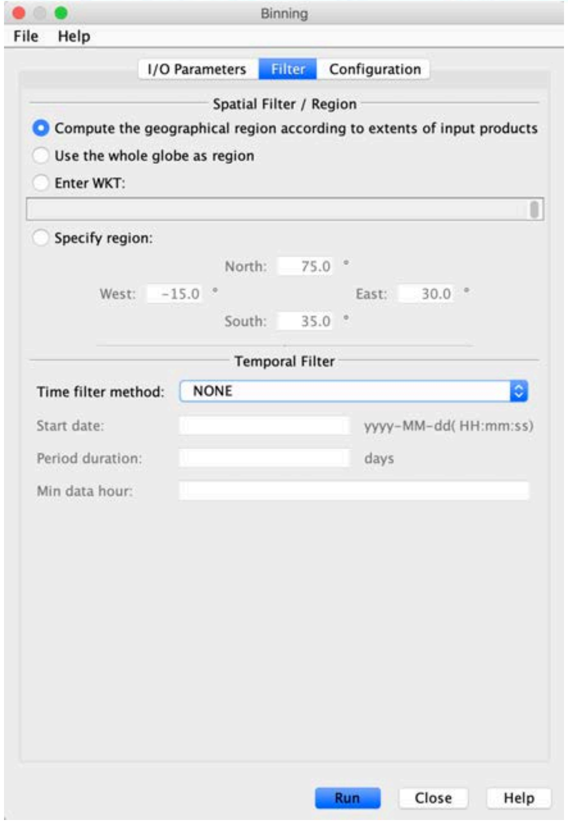




NLC2	1	2	3	4	5	6	7	8	9	10	11	12
2006					9.5	4.5	10.5	3.5	4.1	4.0	3.7	3.9
2007	3.0	2.3	4.0	16.1	9.9	7.6	4.6	5.4	2.9	3.6	3.6	
2008	1.1	2.7	5.6	12.8	12.9	8.2	7.4	5.2	4.9	3.8	2.9	3.6
2009	2.9	3.2	6.1	8.8	11.0	5.1	4.0	4.4	2.8	1.7		2.9
2010	3.0	2.0	6.2	11.3	4.6	11.0	8.5	5.8	5.0	4.4	3.7	5.6
2011	3.8	2.1	2.8	13.0	13.7	6.3	6.6	4.6	3.5	3.5		

Click here to add the WRR products




Binning
File Help
I/O Parameters
Filter
Configuration
Spatial Filter / Region
Compute the geographical region according to extents of input products
Use the whole globe as region
Enter WKT:
Specify region:
North: 75.0 °
West: -15.0 °
East: 30.0 °
South: 35.0 °
Temporal Filter
Time filter method:
NONE
Start date:
yyyy-MM-dd(HH:mm:ss)
Period duration:
days
Min data hour:
Run
Close
Help

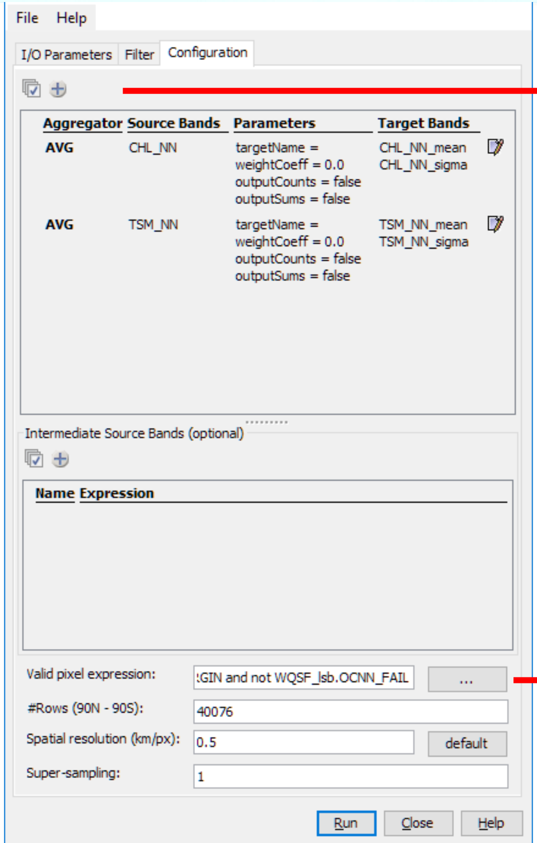
Selection of bands to be averaged

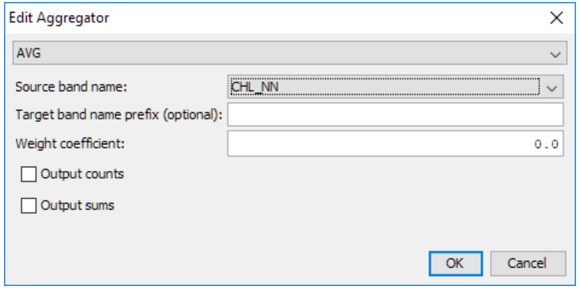
Specification of the aggregator

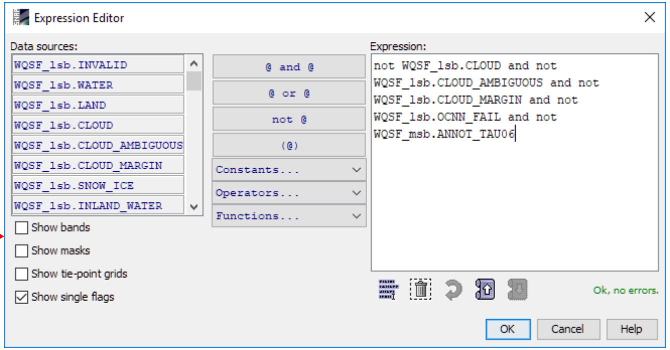
Definition of intermediate variables (e.g. band combinations)

Valid pixel expression (important!!)

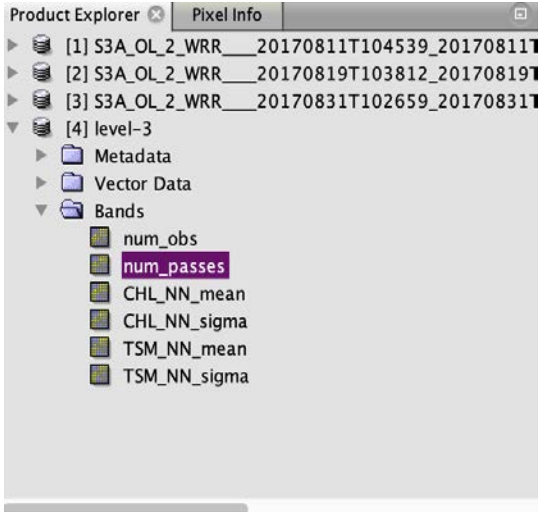
Spatial resolution: in our case we will use a 10km/pixel

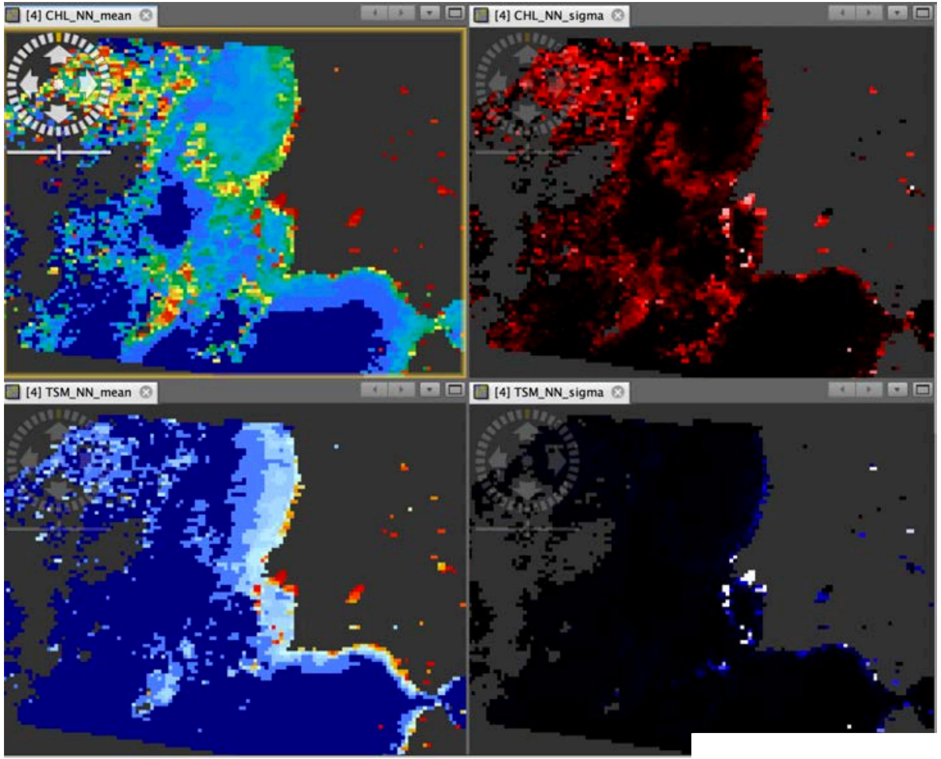






CHL_NN and TSM_NN, with 10 km/pixel spatial resolution

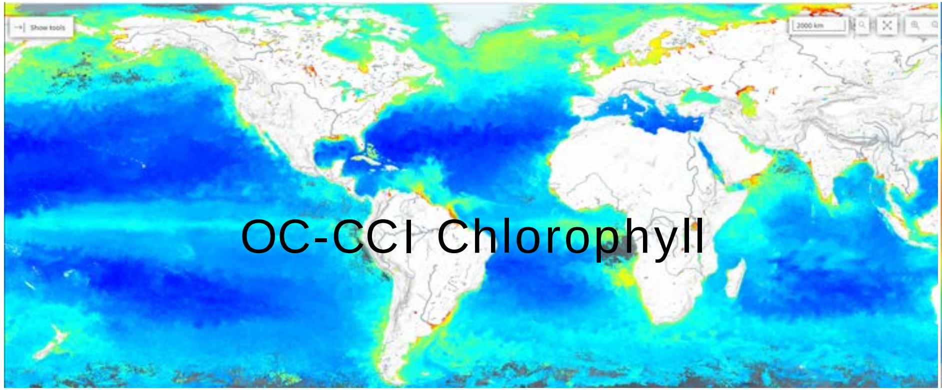


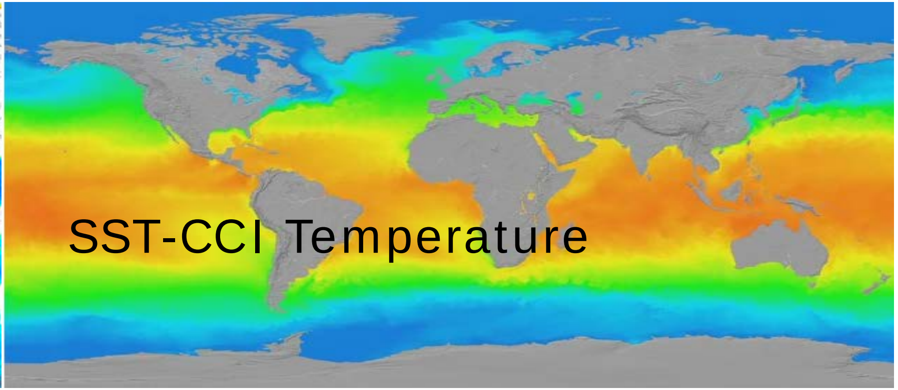


Investigating the Ocean Color from Space

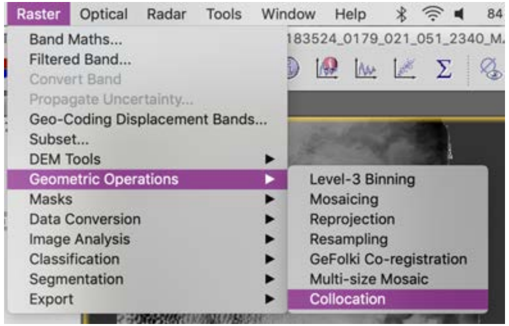
Combining information from different sources is key for a good analysis of the environment. The influence of the temperature and upwelling on the chlorophyll production is one example. Where phytoplankton grow depends on available sunlight, temperature, and nutrient levels. When cold and nutrient rich deep water reaches the surface, phytoplankton starts to grow in the combination with sun light.

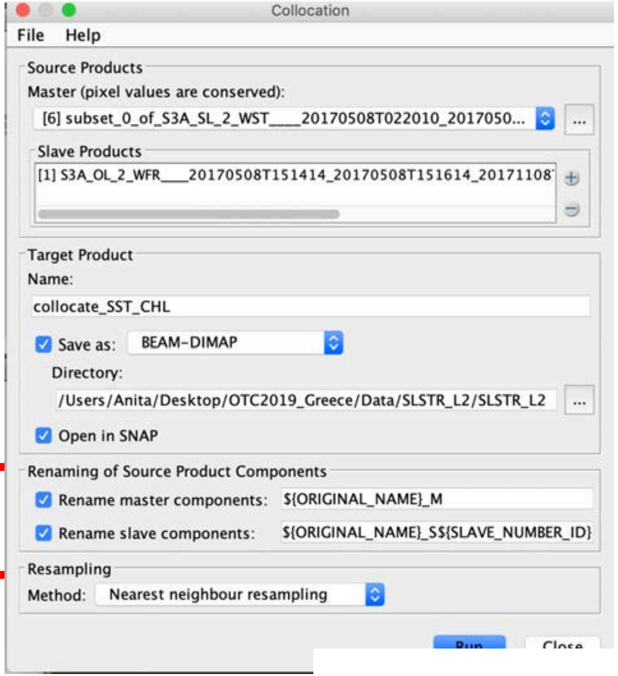
Coastal upwelling systems represent less than 1% of the total area of the oceans, but are responsible for about 11% of the world oceanic primary production (Chavez and Toggweiler, 1995).





The collocation tool enables to combine two different data sets to the same raster. The raster is defined by the master product.

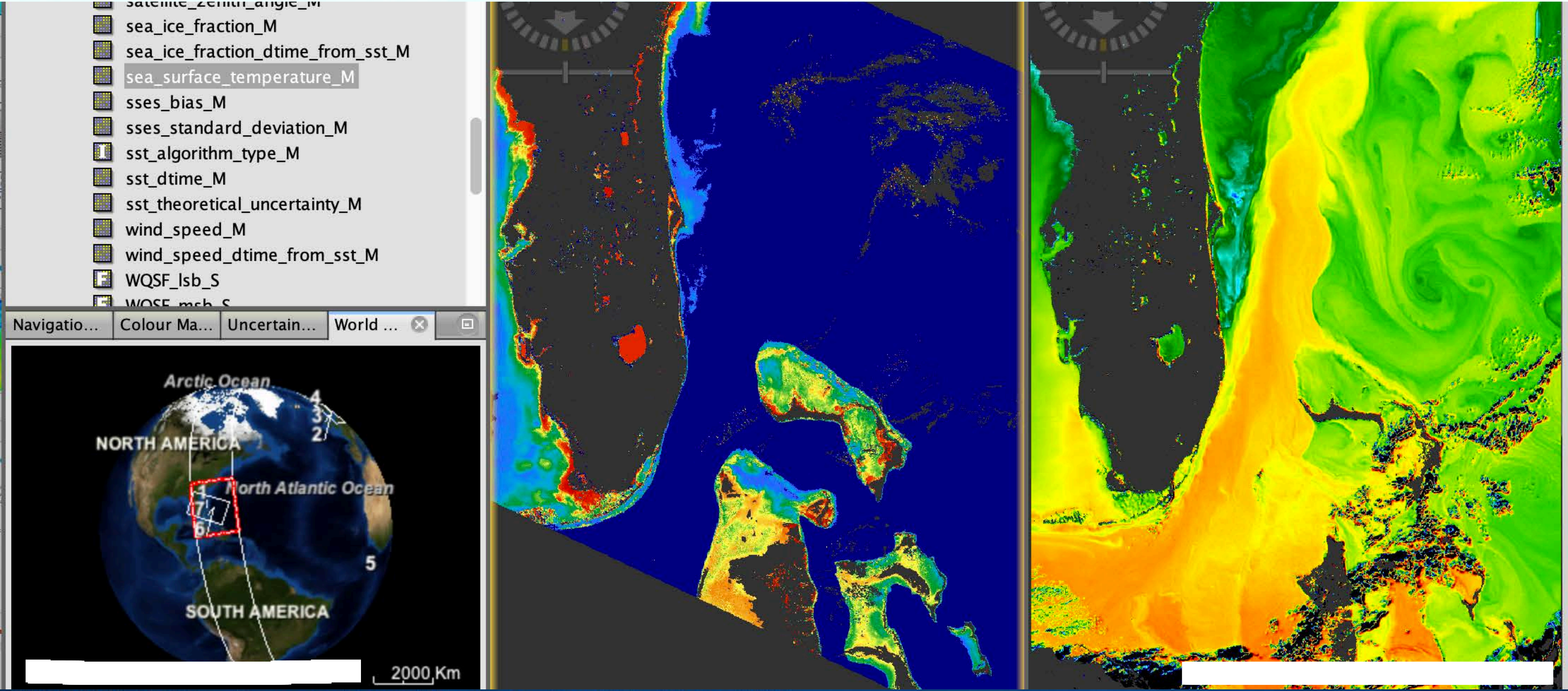


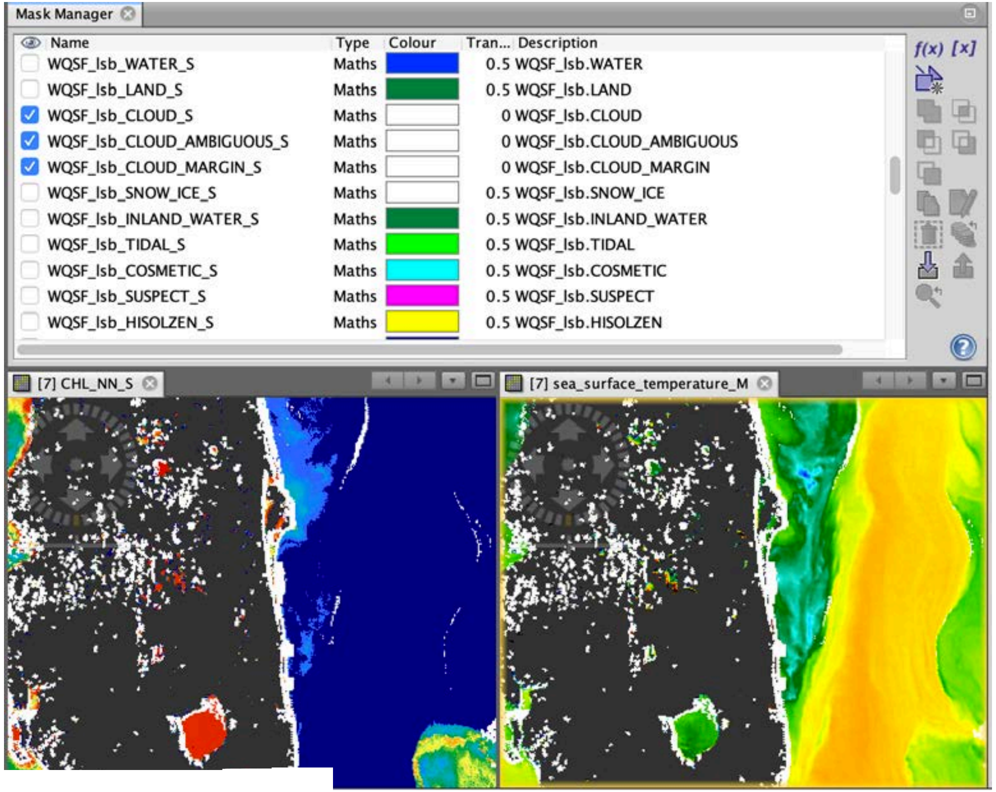


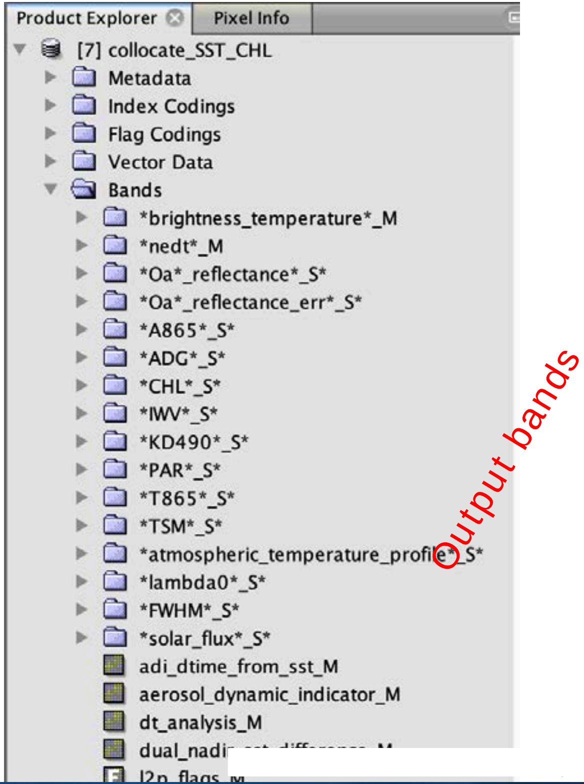
The bands of the input products can be pre or post fixed

Specification of interpolation method

Investigating the Ocean Color from Space




Mask Manager
Name
Type
Colour
Tran...
Description
f(x) [x]
WQSF_lsb_WATER_S Maths 0.5 WQSF_lsb.WATER
WQSF_lsb_LAND_S Maths 0.5 WQSF_lsb.LAND
WQSF_lsb_CLOUD_S Maths 0 WQSF_lsb.CLOUD
WQSF_lsb_CLOUD_AMBIGUOUS_S Maths 0 WQSF_lsb.CLOUD_AMBIGUOUS
WQSF_lsb_CLOUD_MARGIN_S Maths 0 WQSF_lsb.CLOUD_MARGIN
WQSF_lsb_SNOW_ICE_S Maths 0.5 WQSF_lsb.SNOW_ICE
WQSF_lsb_INLAND_WATER_S Maths 0.5 WQSF_lsb.INLAND_WATER
WQSF_lsb_TIDAL_S Maths 0.5 WQSF_lsb.TIDAL
WQSF_lsb_COSMETIC_S Maths 0.5 WQSF_lsb.COSMETIC
WQSF_lsb_SUSPECT_S Maths 0.5 WQSF_lsb.SUSPECT
WQSF_lsb_HISOLZEN_S Maths 0.5 WQSF_lsb.HISOLZEN
[7] CHL_NN_S
[7] sea_surface_temperature_M


Product Explorer
Pixel Info
[7] collocate_SST_CHL
Metadata
Index Codings
Flag Codings
Vector Data
Bands
*brightness_temperature*_M
*nedt*_M
*Oa*_reflectance*_S*
*Oa*_reflectance_err*_S*
*A865*_S*
*ADG*_S*
*CHL*_S*
*IWV*_S*
*KD490*_S*
*PAR*_S*
*T865*_S*
*TSM*_S*
*atmospheric_temperature_profile*_S*
*lambda0*_S*
*FWHM*_S*
*solar_flux*_S*
adi_dtime_from_sst_M
aerosol_dynamic_indicator_M
dt_analysis_M
Output bands

What to do:

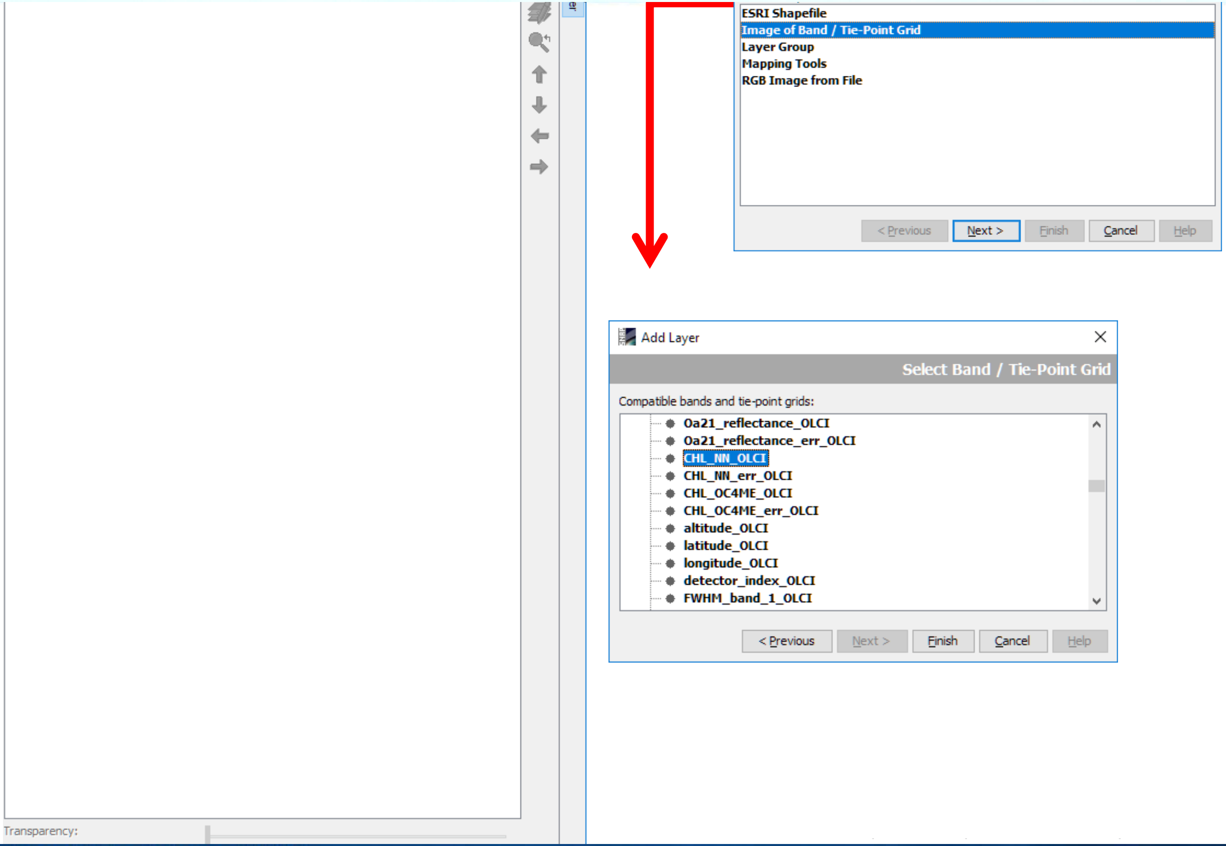
- overlay the chlorophyll concentration with the SST band
- analyse both parameters by swiping and blending
- show the correlation of both parameters in a scatterplot

Products:

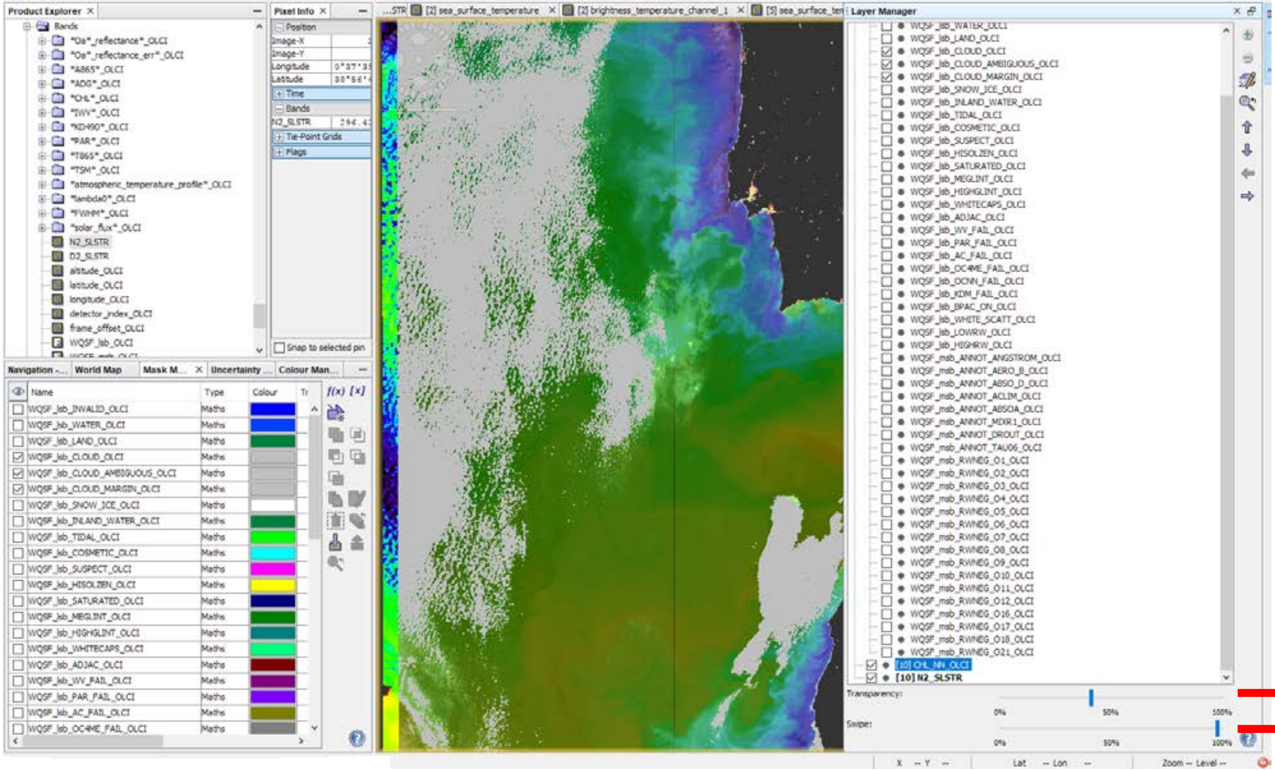
- Computed collocation product: collocate_SLSTR_OLCI.dim

layer management

The purpose is to overlay the chlorophyll NN product over the SST using the layer management.

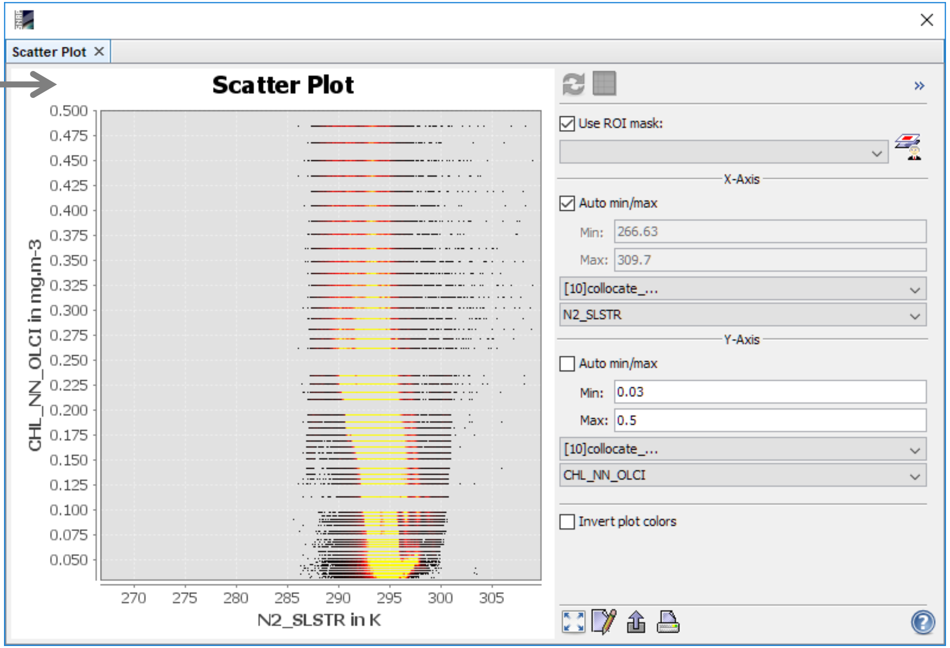


Investigating the Ocean Color from Space



SST overlaid with OLCI Cloud flags and chlorophyll semi-transparent overlay

Transparency
Swipe



Visualize possible correlation between the two variables.

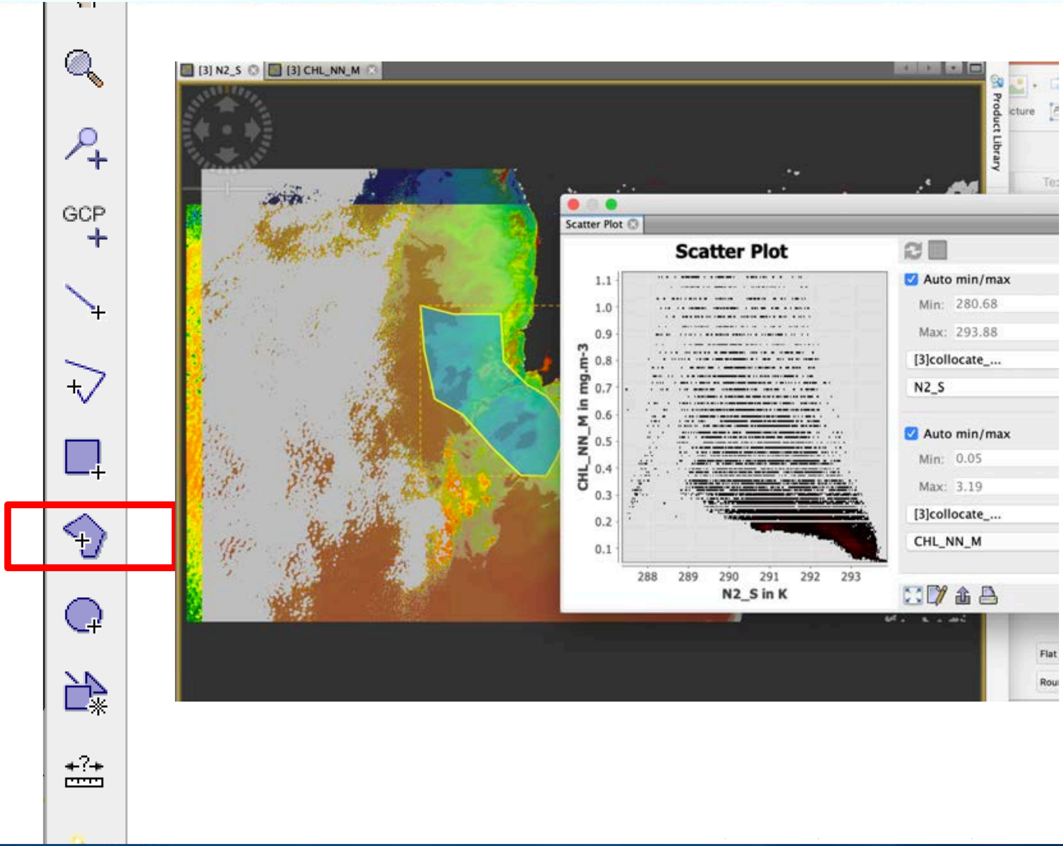
Select product and band for x-axes

Select product and band for y-axes

Scatter plots can be generated for a region of interest defined by a mask or a region.

Input bands need to be quality controlled for a generating a valid scatter plot.

Select are of interest using a geometry. This will be automatically converted into a mask.



- The L3 binner is one of many processors that are available in SNAP. They follow all the same structure (input/output, parameters) and they generate new products. All processors can also be called by command line by using the gpt framework of SNAP.
- Aggregated products are a first step for further analyses of large data archives. The quality of the input products is very important and a good valid pixel expression is mandatory.
- Overlays can be a good tool to combine visually different parameters. Products need to be in the same raster, this can be reached by the collocation operator.
- All analyses of data need a careful data handling and quality control by eliminating invalid pixels. The scatter plot tool is one option to analyse two data sets.
- SST and CHL have an inverse correlation in the upwelling zone at the Portuguese coast.

With appreciation and thanks to

ESA

A. Ruescas, K. Stelzer, C. Brockmann

I hope you learnt a lot!