

# Spatial statistics for EU directives reporting on coastal areas

## Copernicus for Coastal Zone Management

**Copernicus**  
Europe's eyes on Earth

Space

Copernicus EU  
 Copernicus EU

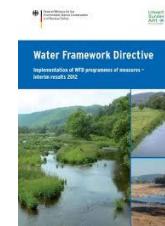
Copernicus EU  
 www.copernicus.eu



Marine  
Monitoring

## European Directives on coastal areas

- ✓ Water Framework Directive (WFD)
- ✓ Marine Strategy Framework Directive (MSFD)
- ✓ Recommendation on Integrated Coastal Zone Management
- ✓ Bathing Water, Habitats (Natura2000), ...



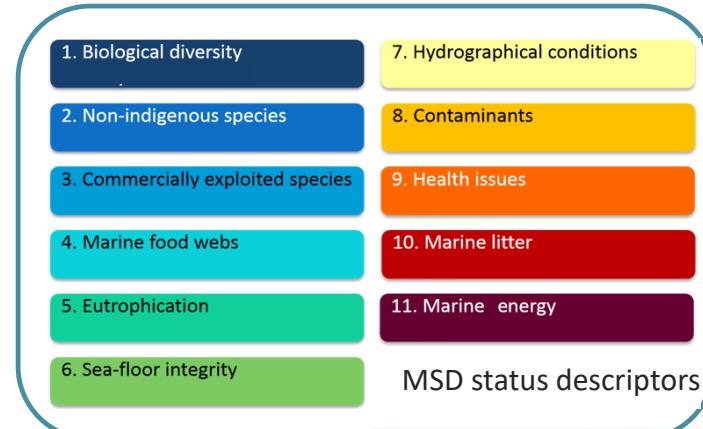
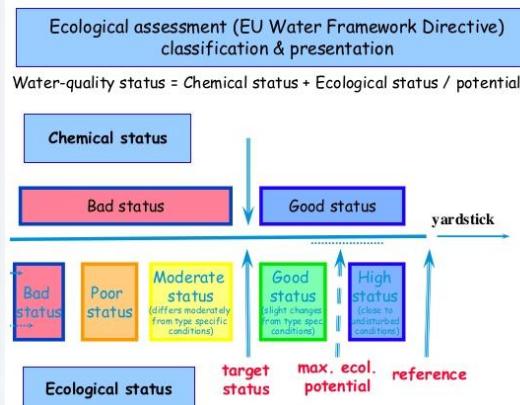
WFD: Good Status for all EU surface and ground waters by 2015. 2027 final deadline for meeting objectives

MSFD: Good Environmental Status (GES) of EU marine waters by 2020



## Initial assessment and following regular monitoring of:

- set of environmental indicators to evaluate ecological status (WFD)
- 11 status descriptors on marine waters up to 12 n.m. (MSFD)





## MSFD implementation into Member States laws ->

- Appointing of a national referent
- Definition of a national monitoring strategy
- Bodies responsible for performing at sea monitoring

### Representative example: Italian implementation

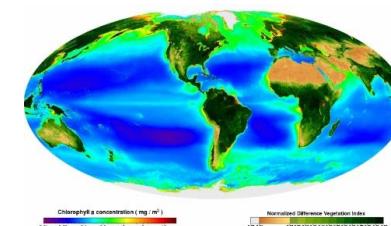
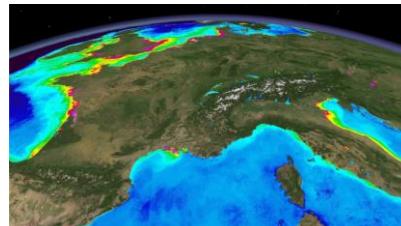
- National referent/coordination: Environment Ministry
- EU reporting and scientific guidance: ISPRA (National Institute for Environmental Protection and Research)
- ISPRA defined practices and parameters to be measured
- Monitoring mainly by regional bodies: ARPA (Regional Agency for the Environmental Prevention and Protection)



## 20 years of water quality measurements from Earth

### Observation (EO):

- ❖ Large area coverage
- ❖ High temporal frequency
- ❖ Constantly advances in methods and technology (→ Sentinel-3)
- ❖ Scientific community recognizes its value for complementing in situ measurements

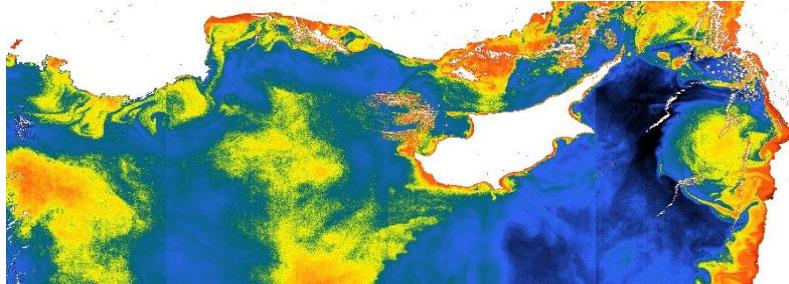




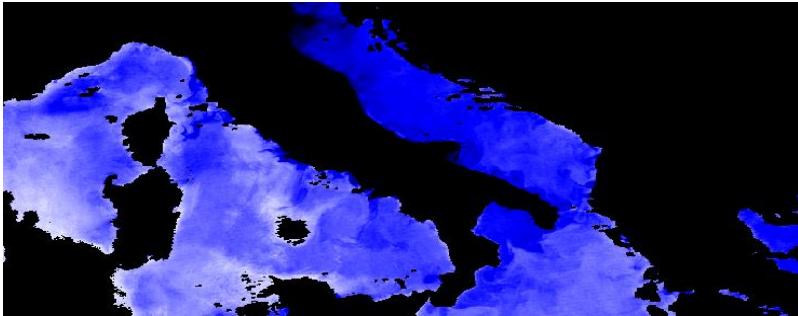
# Estimation of eutrophication: useful data

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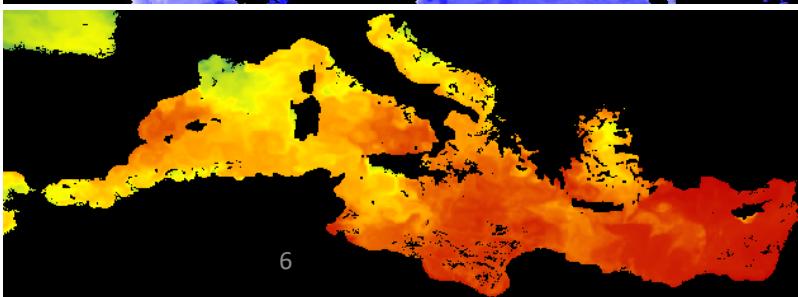
**Chlorophyll-a concentration**



**Water transparency**



**Sea surface temperature**





## 2016: implementation MSFD monitoring programs

- ✓ Traditional in situ measurements: gaps
- ✓ Increasing awareness on the value of EO data: long time series and new sensors (Sentinel-3)
- ✓ Evaluation of descriptors using above information: statistical synthesis on representative sea areas → Reporting
- ✓ Technical tables between Member States over the same sea basin to agree:
  - Statistical figures to be considered
  - A definition of homogeneous areas for each descriptor with no discontinuity across Member States borders





## Long time series of EO derived water quality parameters maps allow to:

- ✓ Identify homogeneous areas

For example the trophic characteristics of an area can be estimated by combining chlorophyll, water transparency and other measurements (salinity, temperature, etc.)

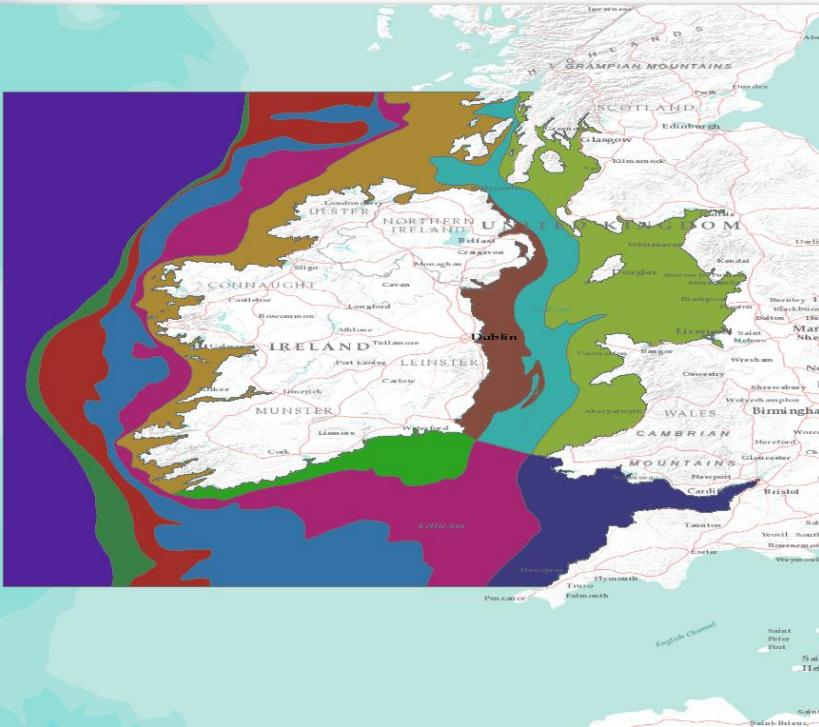
- ✓ Perform continuous monitoring on such areas

Obtaining statistics which can be directly used for the reporting



# Zoning of Irish seas

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Example of a possible zoning of the Ireland seas using the bathymetry.



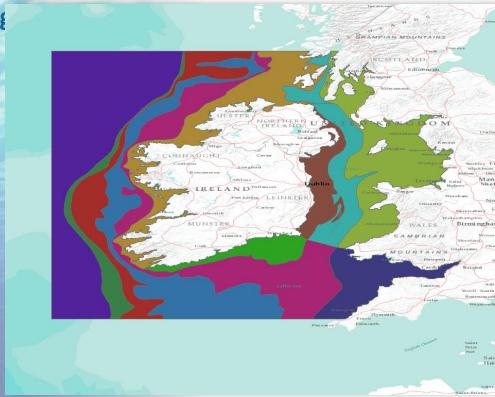
D E M O

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# DEMO



## Demonstration content



**Use of CMEMS and MarCoast monthly maps over the Ireland seas for extracting statistics on the various zones over a period of one year, as required for the reporting of MSFD.**

**CMEMS products:** European North-West Shelf Seas Monthly Interpolated means of Surface Chlorophyll Concentration from Satellite observations and monthly water transparency

**Period considered:** In the demo only the month of august 2017 is considered



D E M O

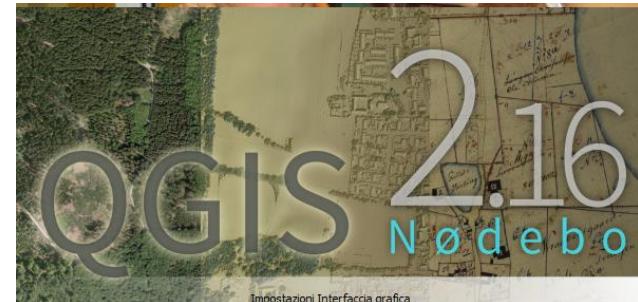
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Software used:

ESA -SNAP



QGIS





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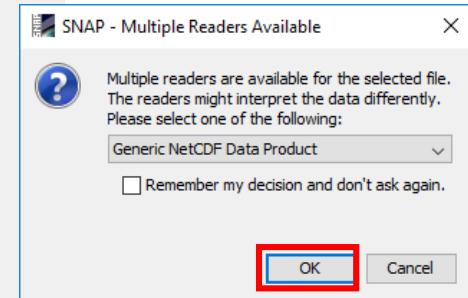
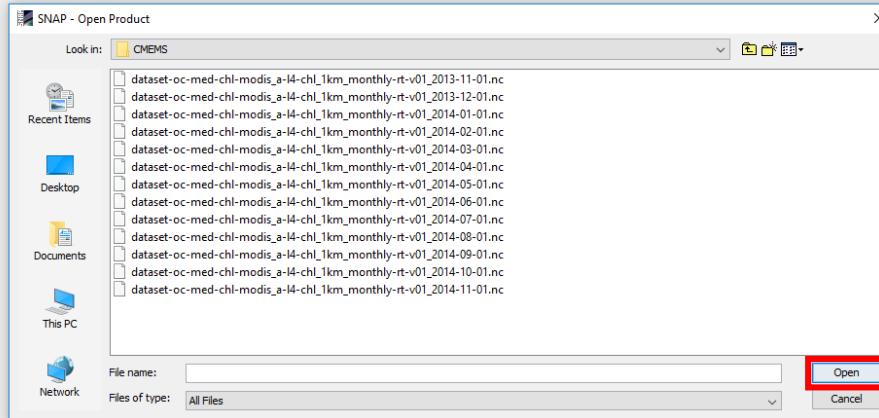


File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help



Product Explorer x Pixel Info

This tool window is used to manipulate the colouring of images shown in an image view. Right now, there is no selected image view.





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SNAP

File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help

Search (Ctrl+F)

Product Explorer x Pixel Info

[1] dataset-oc-med-chl-modis\_a-l4-chl\_1km\_monthly-r-v01\_201

- Metadata
- Vector Data
- CHL

Mediterranean Sea Monthly Chlorophyll Case 1 and Case 2 Concentration, 857 x 988 pixels, (milligram m<sup>-3</sup>)

Product Library Mask Manager Layer Manager

Navigation World View Colour ... Uncertai...

This tool window is used to manipulate the colouring of images shown in an image view. Right now, there is no selected image view.

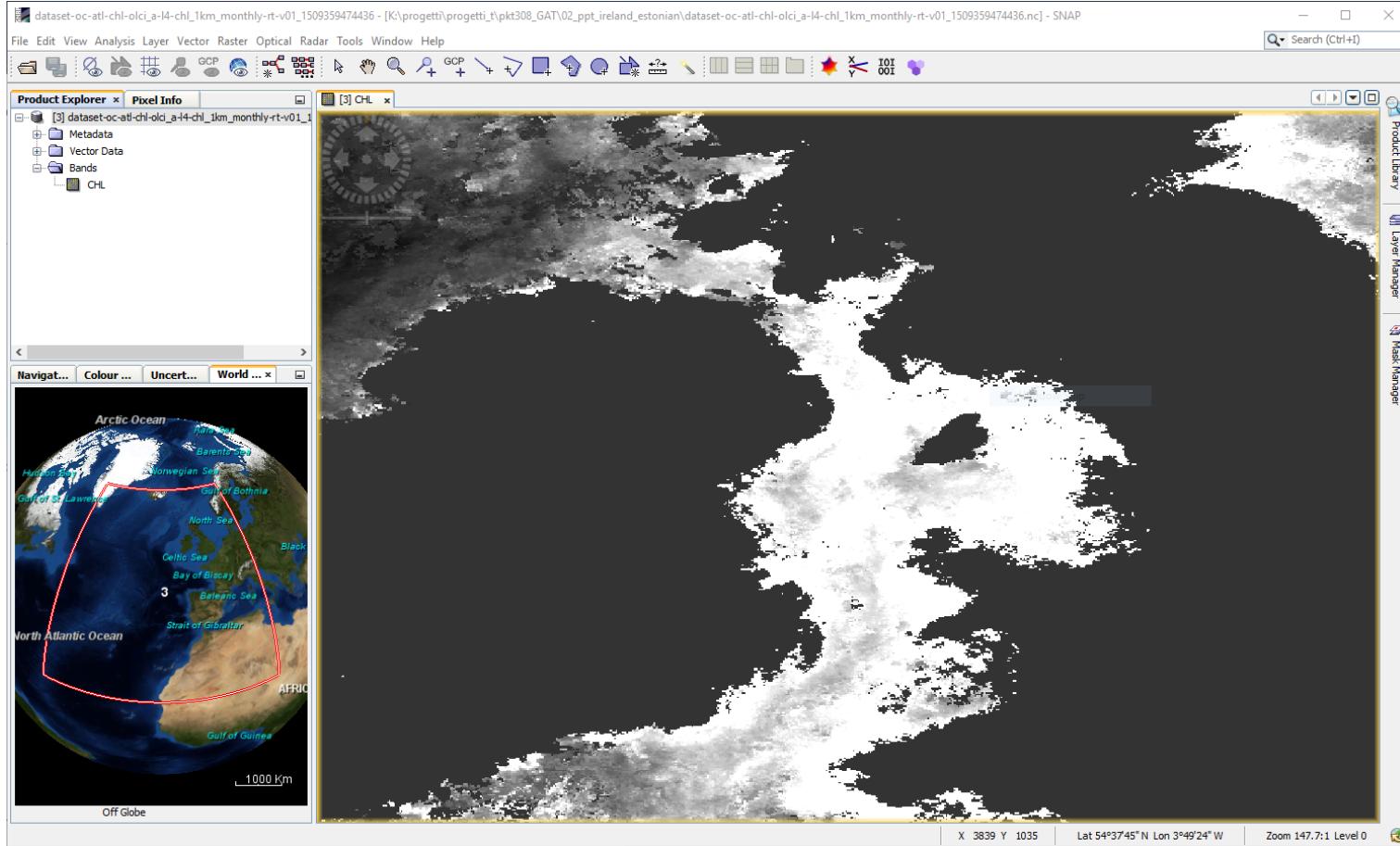
X Y Lat Lon Zoom Level

European Commission

The screenshot shows the SNAP (System for Nonlinear Analysis and Processing) software interface. The main window has a dark blue header bar with the title 'SNAP' and a search bar. Below the header is a toolbar with various icons for file operations, analysis, and processing. On the left, the 'Product Explorer' panel is open, showing a tree structure of a dataset. A red box highlights the 'CHL' folder under the dataset root. A tooltip for 'CHL' indicates it contains 'Mediterranean Sea Monthly Chlorophyll Case 1 and Case 2 Concentration, 857 x 988 pixels, (milligram m^-3)'. To the right of the Product Explorer is a large, mostly empty workspace. At the bottom, there's a 'Colour...' tool window with tabs for 'Navigation', 'World View', 'Colour...', and 'Uncertai...'. A note in this window says: 'This tool window is used to manipulate the colouring of images shown in an image view. Right now, there is no selected image view.' On the far right, there are three vertical tabs: 'Product Library', 'Mask Manager', and 'Layer Manager'. The bottom right corner features the European Commission logo.

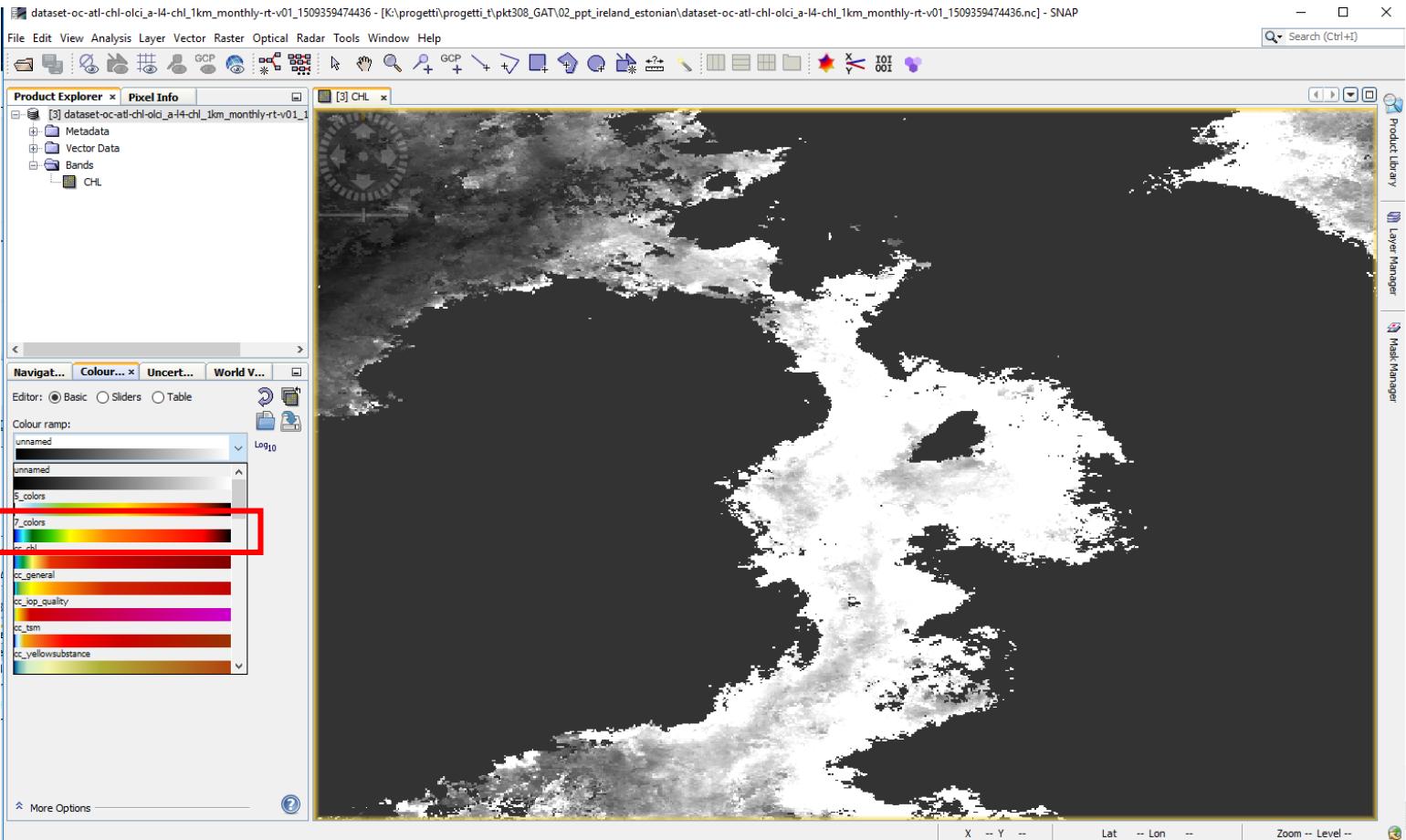


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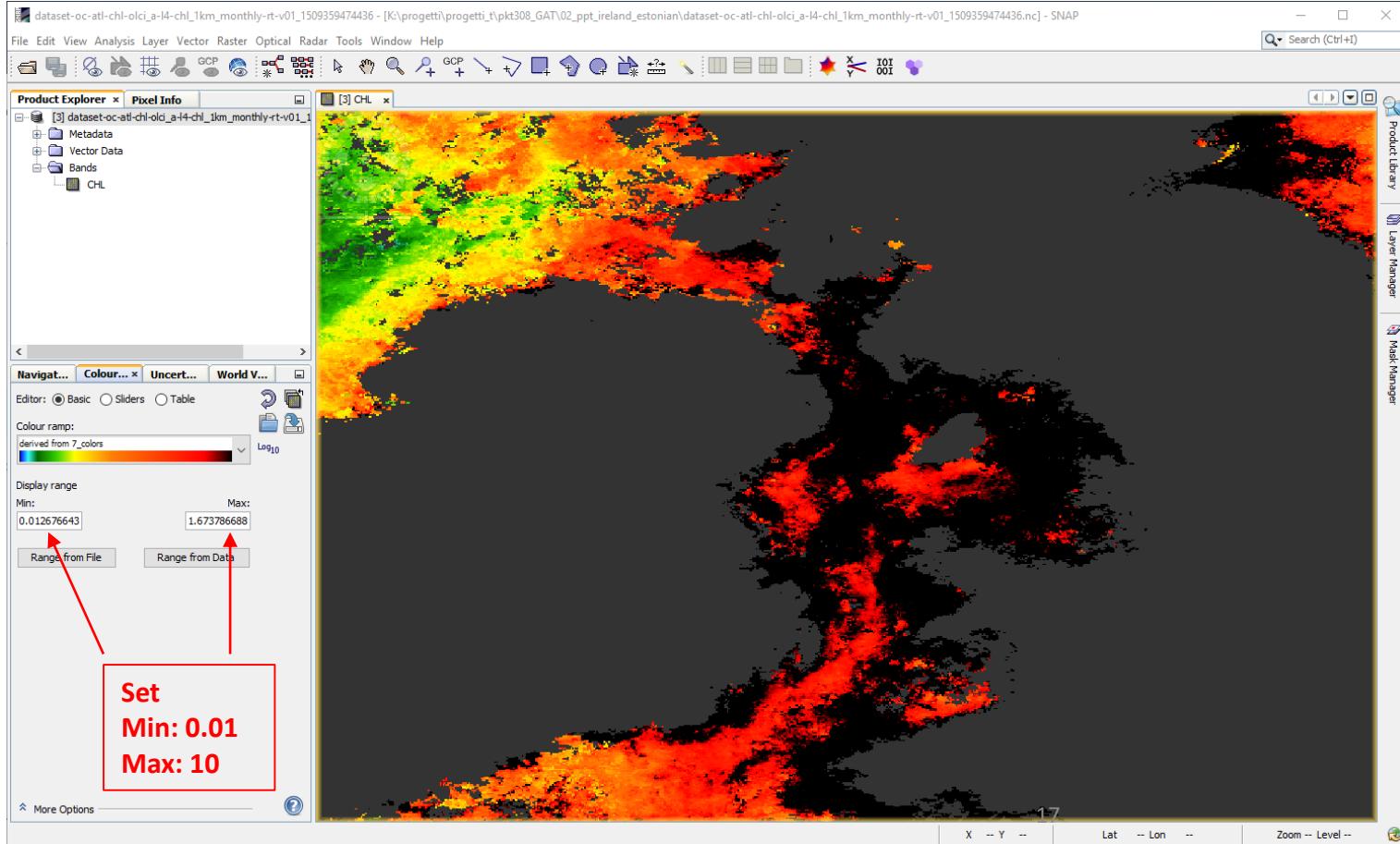


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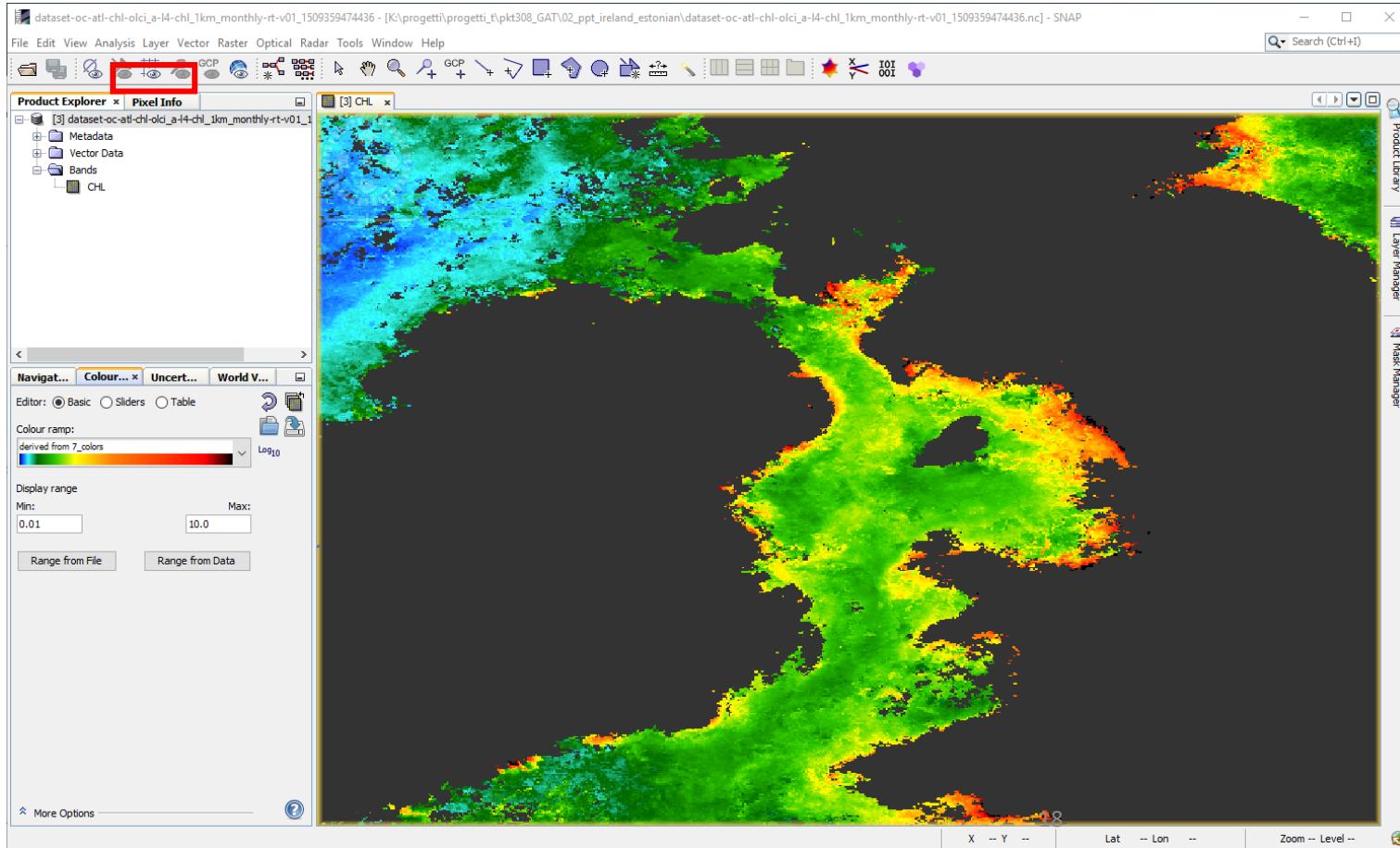
Set  
Min: 0.01  
Max: 10

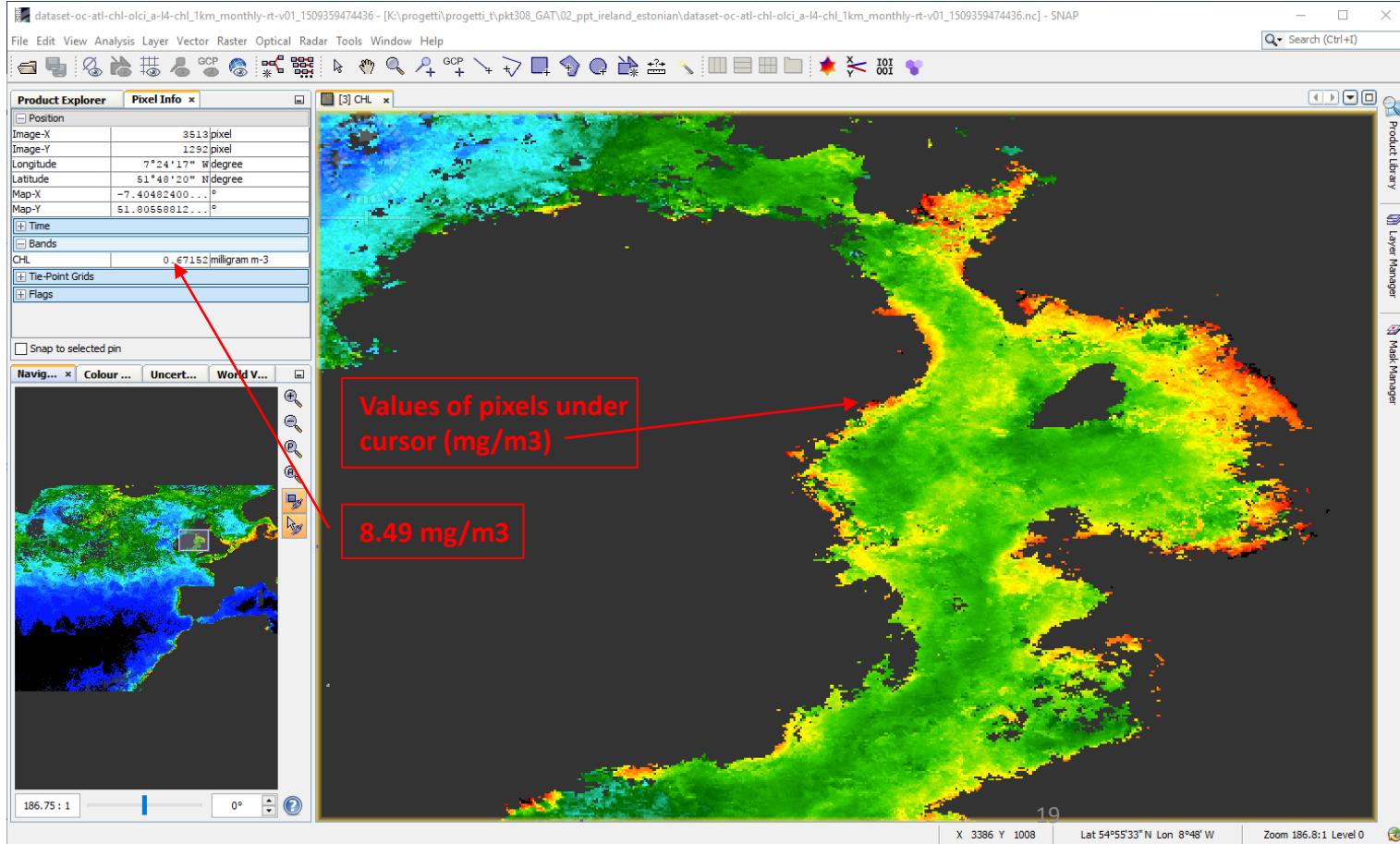
Next

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Commission



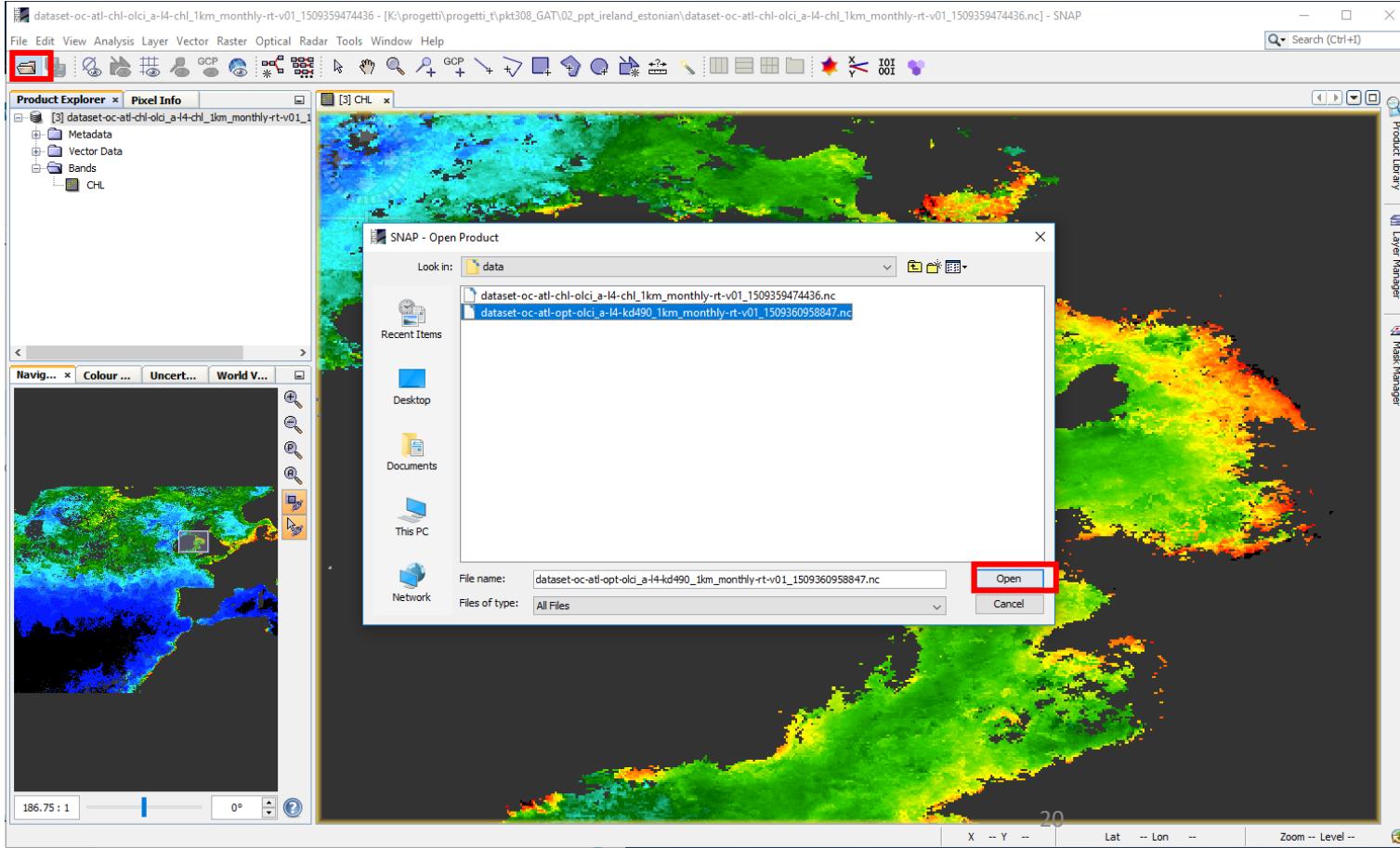
Marine  
Monitoring





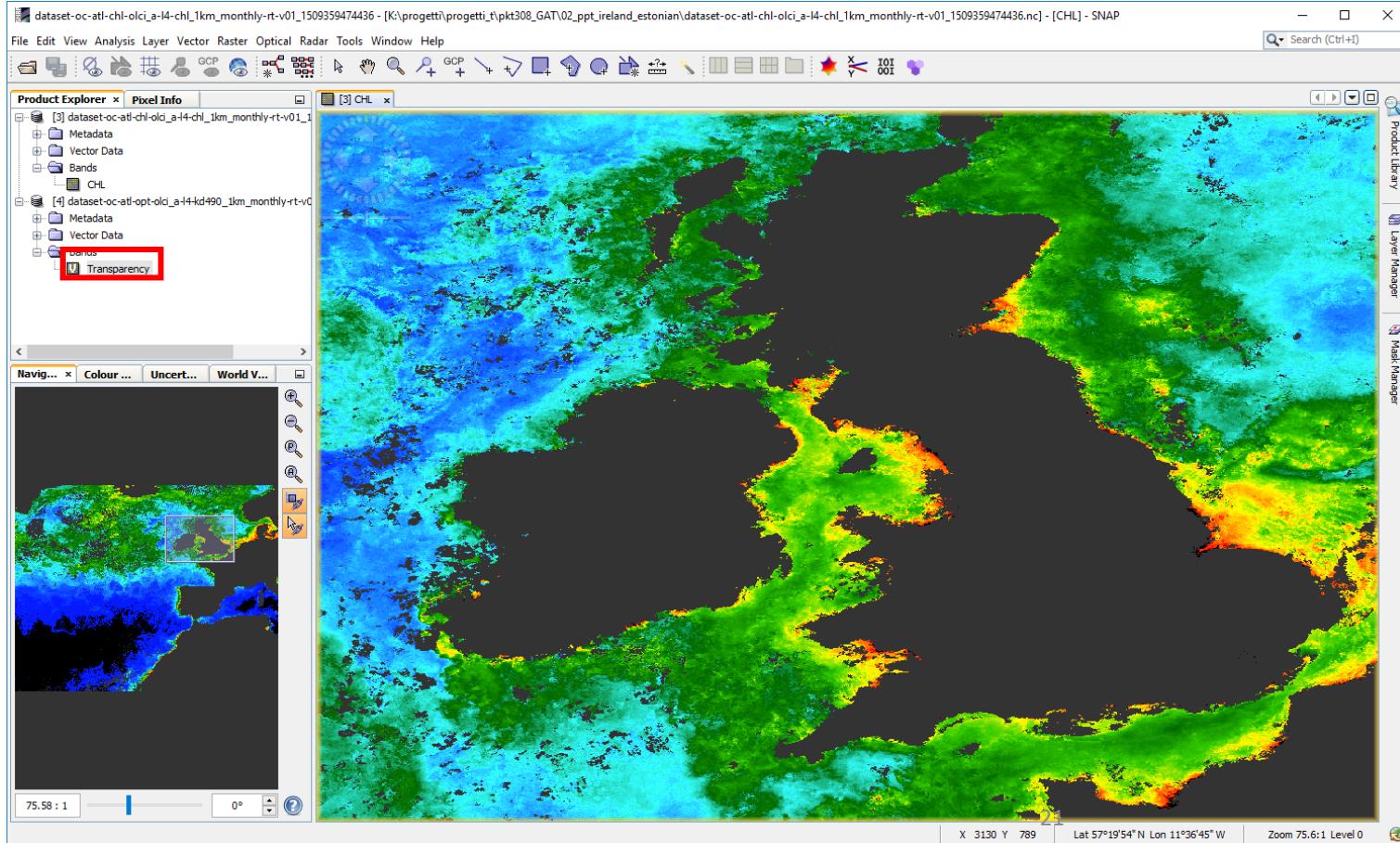


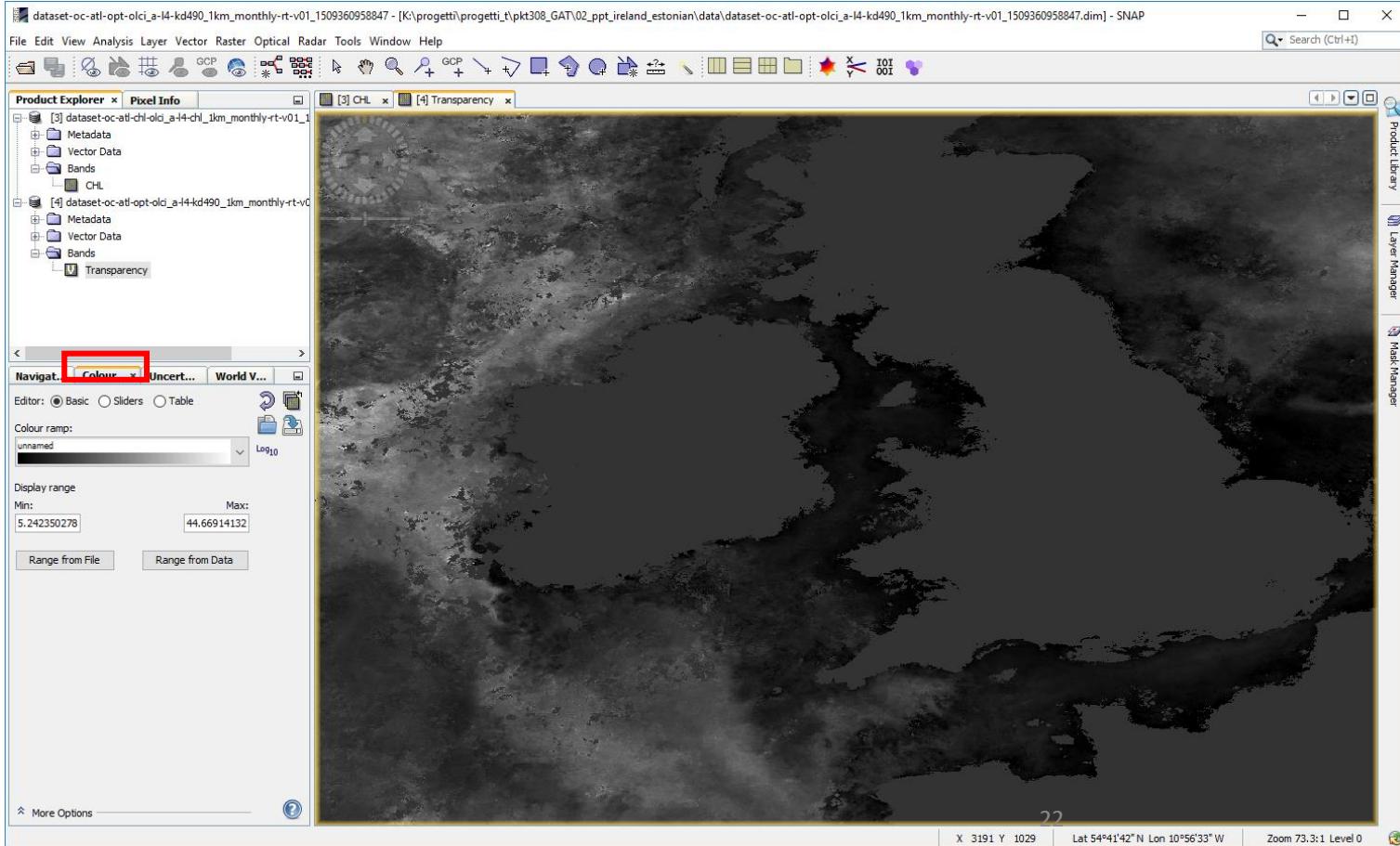
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Monitoring





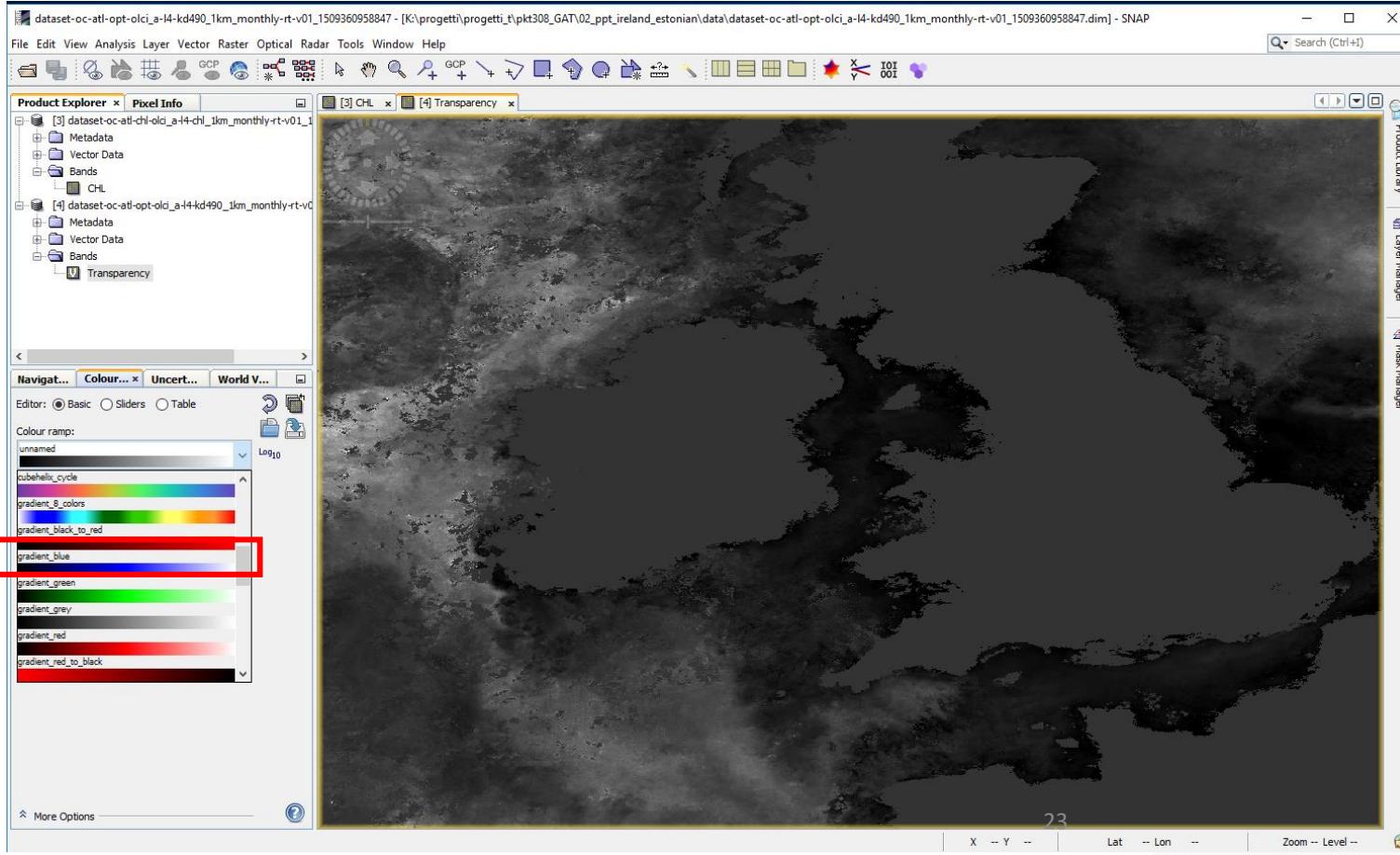
Marine  
Monitoring





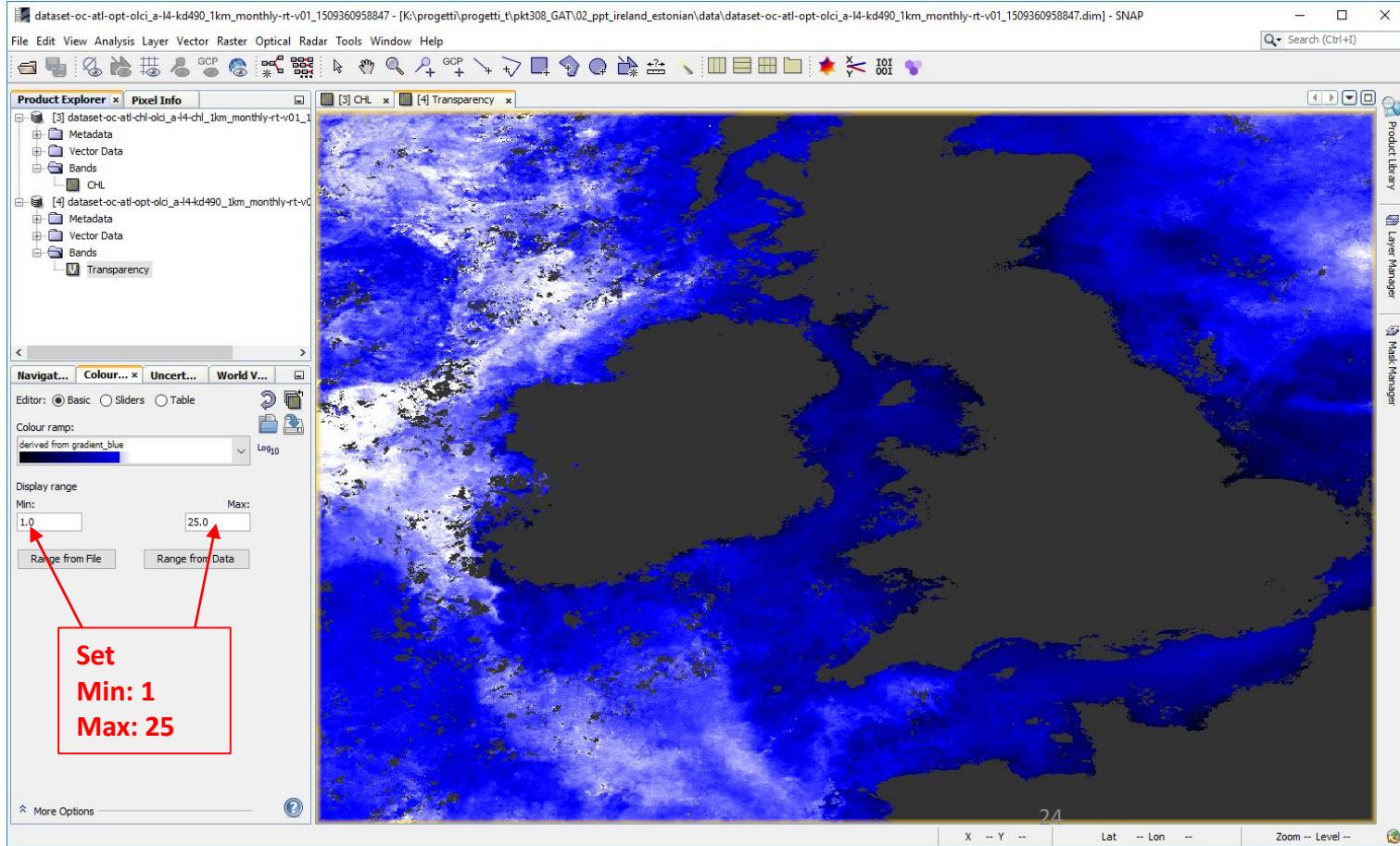


Marine  
Monitoring



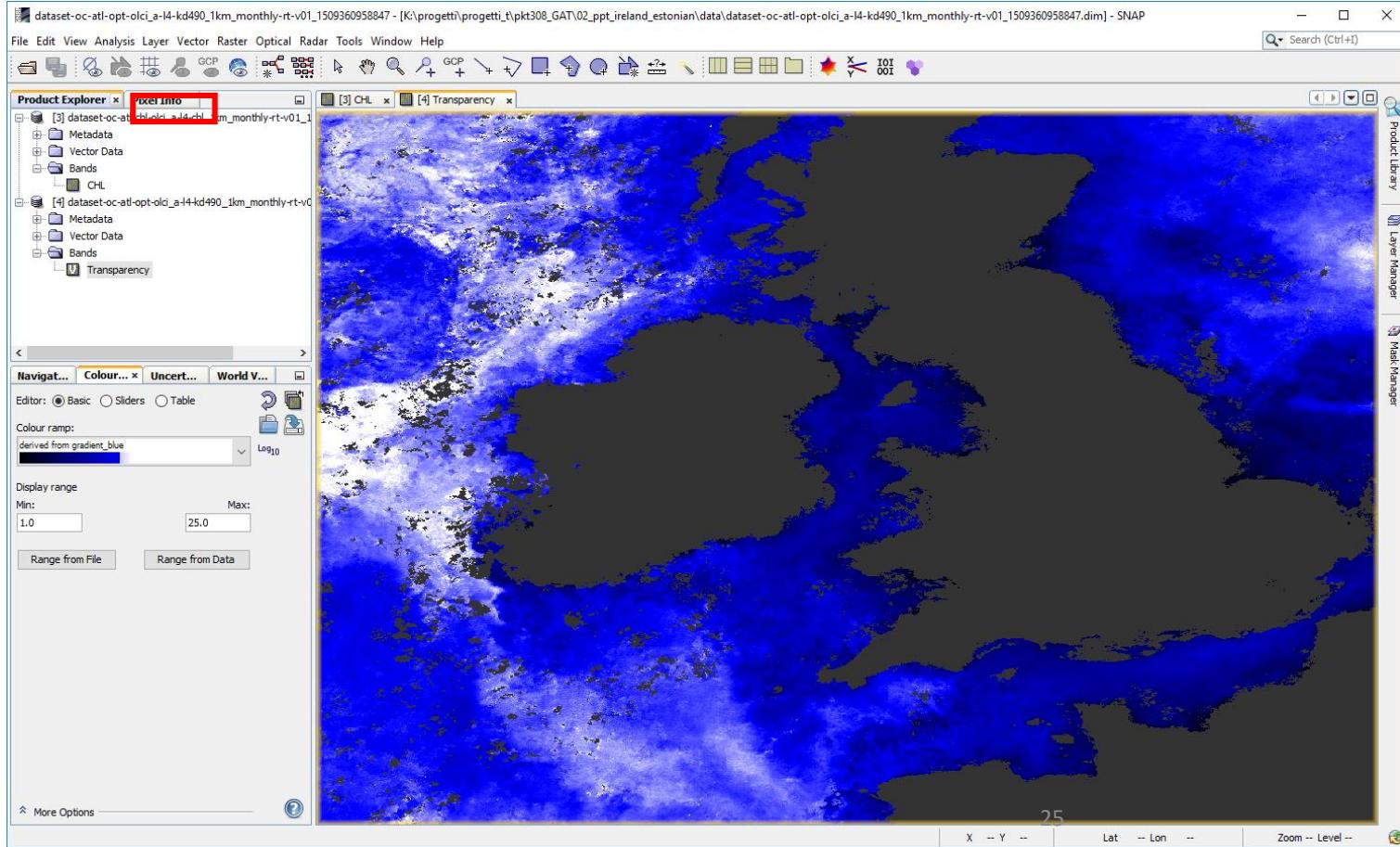


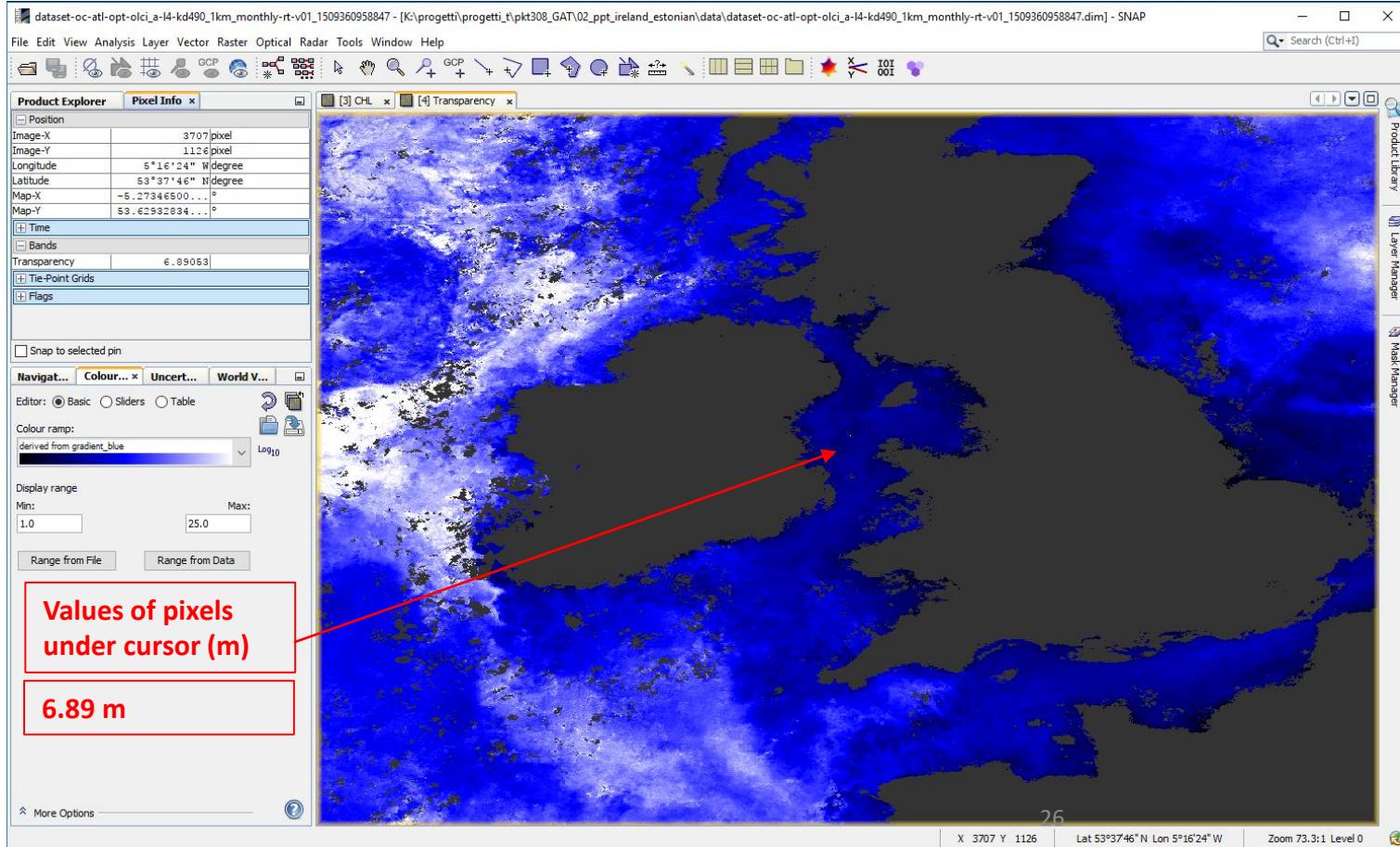
Marine  
Monitoring





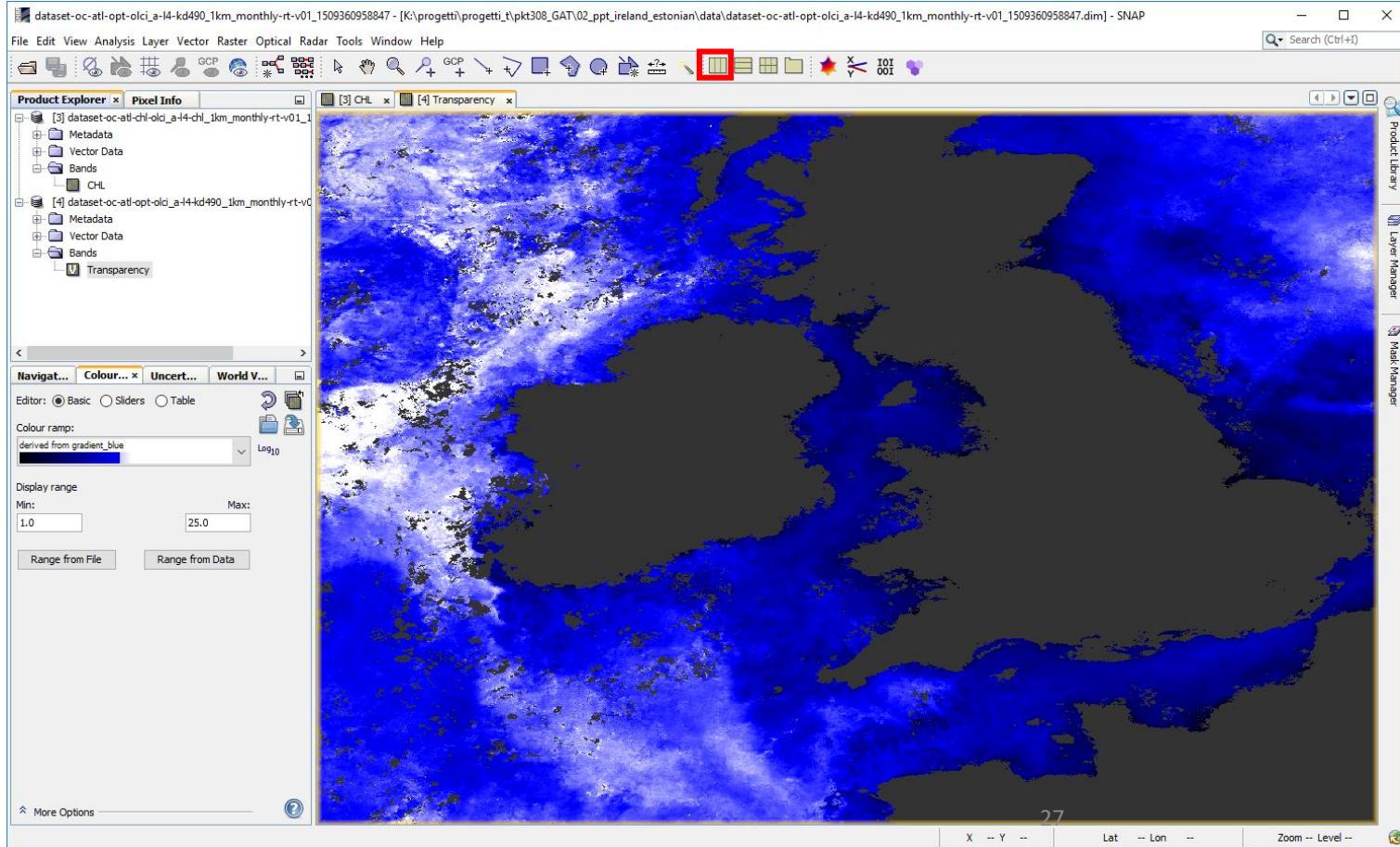
Marine  
Monitoring





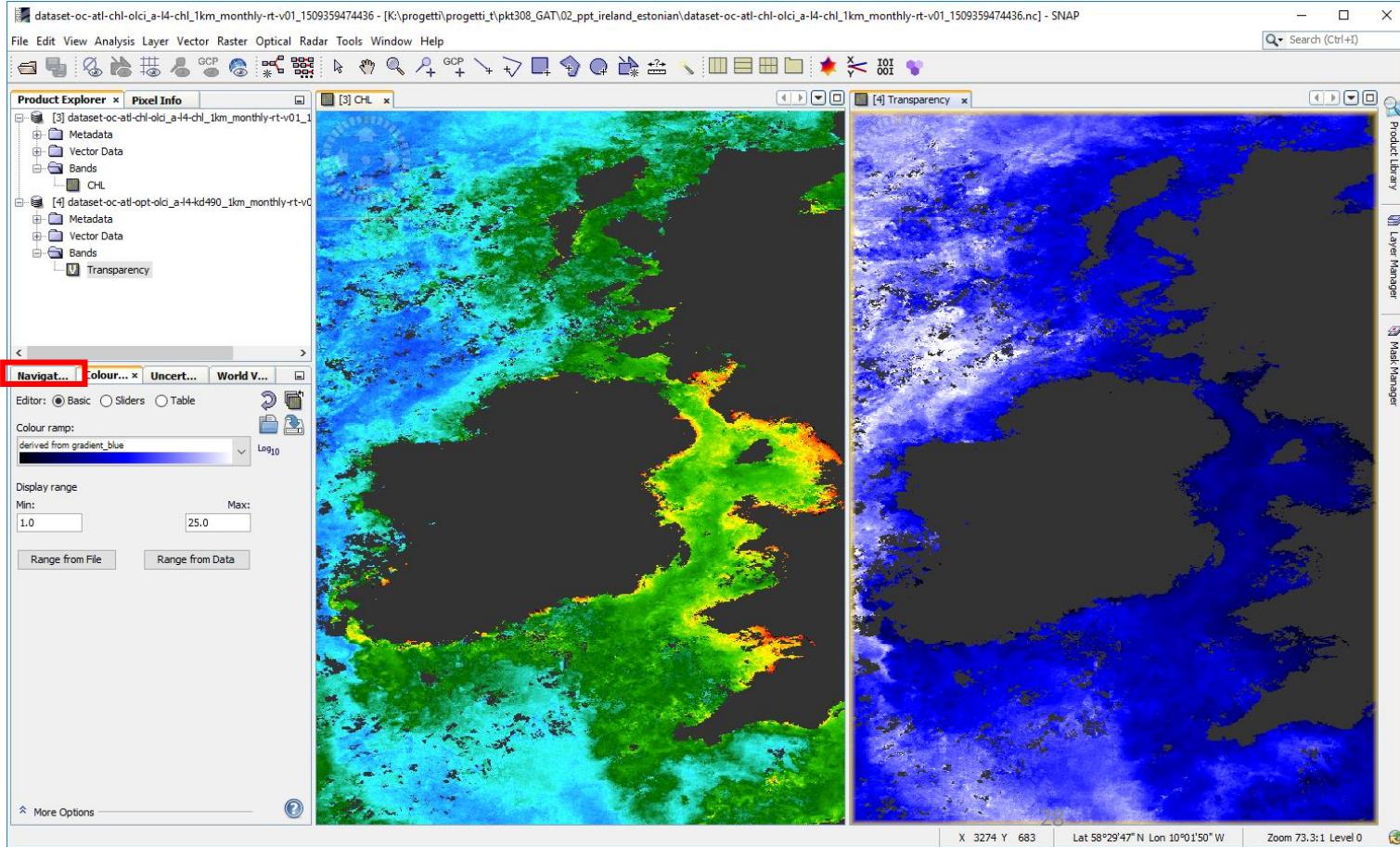


Marine  
Monitoring



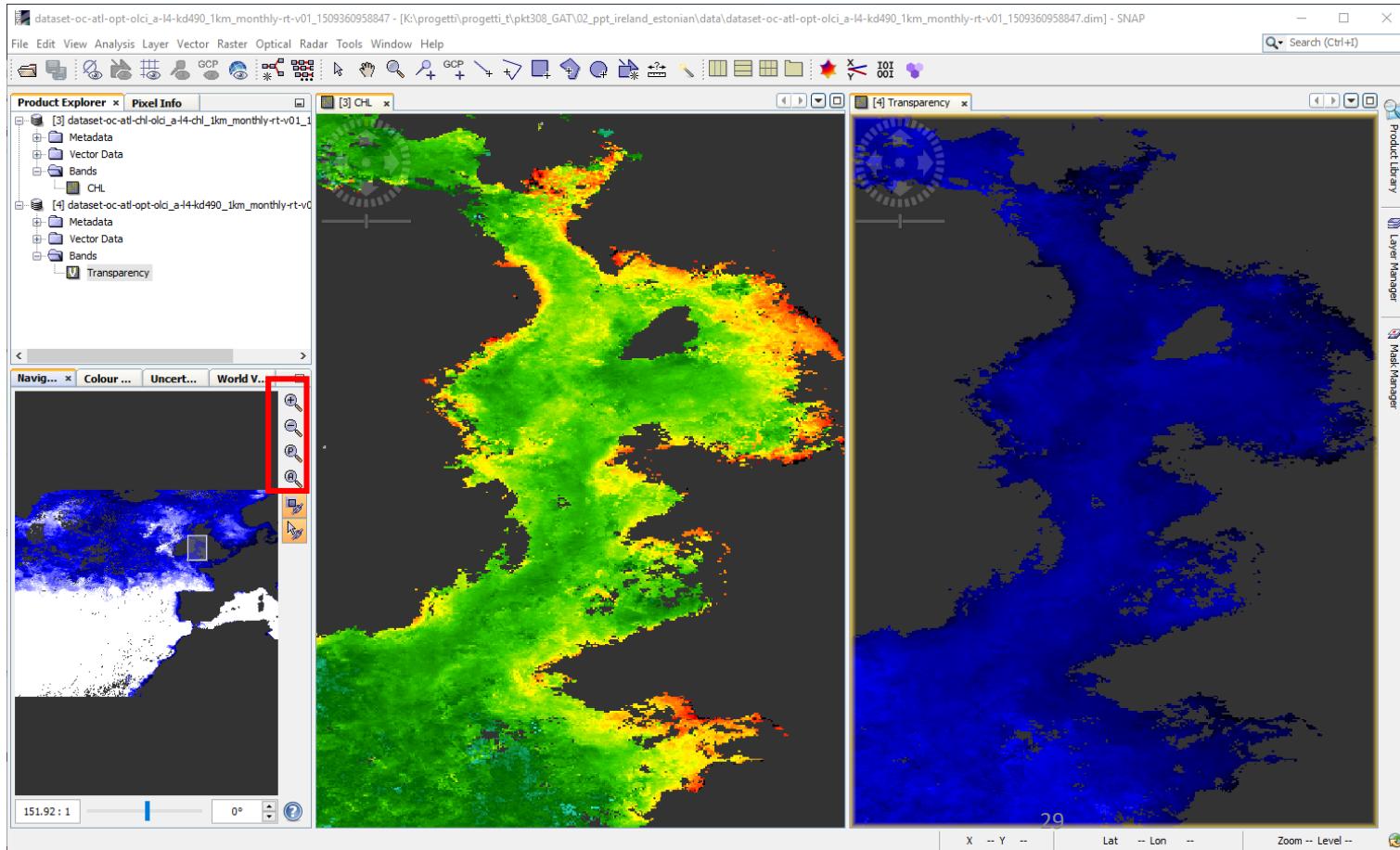


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Monitoring





Marine  
Monitoring





Marine  
Monitoring

dataset-oc-atl-opt-olci\_a-l4-kd490\_1km\_monthly-rt-v01\_1509360958847 - [K:\progetti\progetti\_t\pkt308\_GAT\02\_ppt\_irland\_estonian\data\dataset-oc-atl-opt-olci\_a-l4-kd490\_1km\_monthly-rt-v01\_1509360958847.dim] - SNAP

File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help

Open Product... Reopen Product > Product Library Close Product Close All Products Close Other Products Save Product Save Product As... Session > Import Export Exit

DEM > Generic Formats > Optical Sensors > SAR Formats > SAR Sensors > Vector Data > Vector from CSV > ESRI Shapefile MERMAID Extraction File SeaDAS 6.x Track

Look in: Zones Zones\_TSI.shp

Recent Items Desktop Documents This PC Network

File name: Zones\_TSI.shp Open Cancel

Import Geometry

The vector data set contains **11** polygonal shapes. Shall they be imported separately?

If you select Yes, the polygons can be used as individual masks and they will be displayed on individual layers.

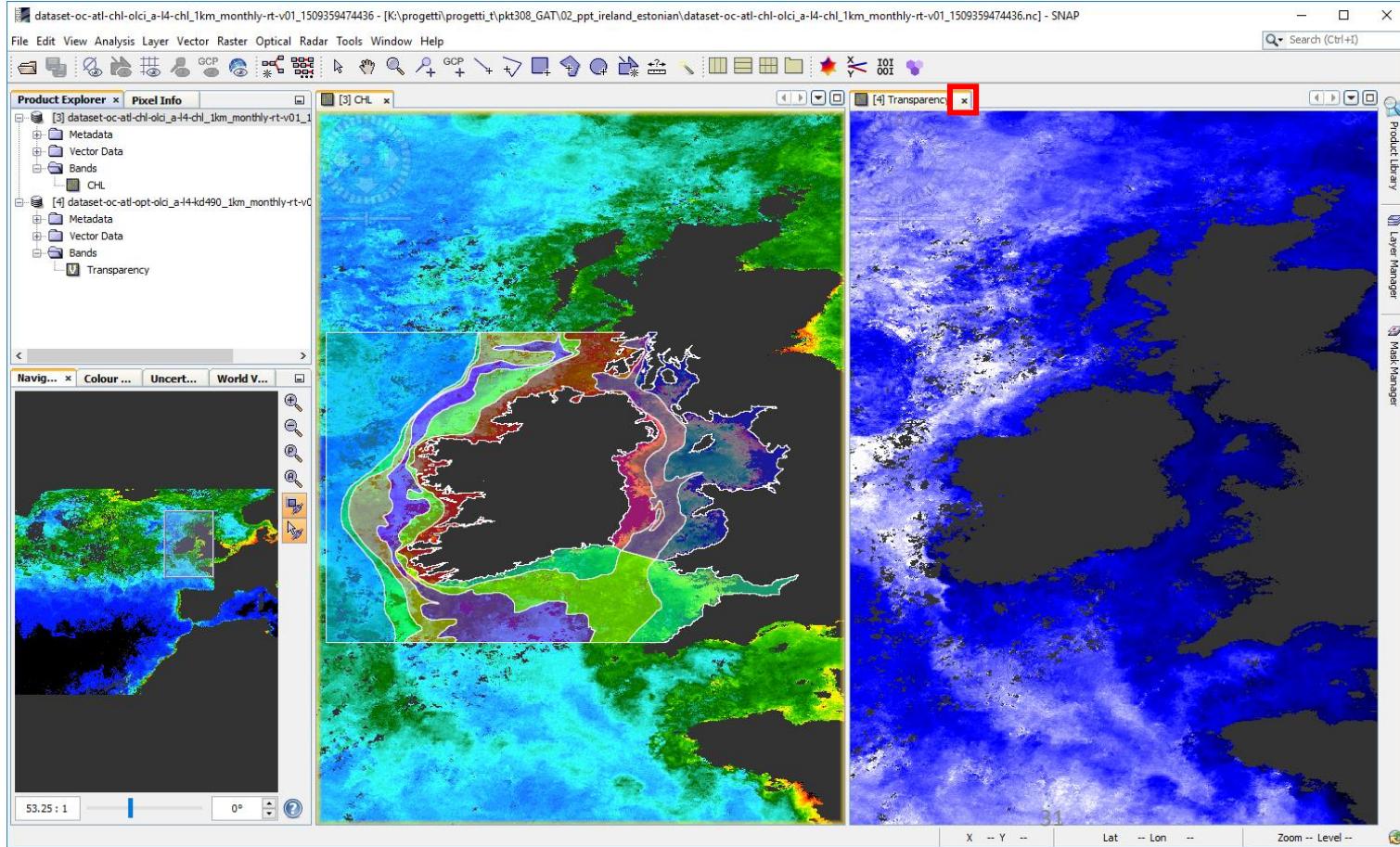
Yes No Help

151.92 : 1 0° X Y Lat -- Lon -- Zoom -- Level -- 30 European Commission

A red box highlights the 'ESRI Shapefile' option in the context menu. Another red box highlights the 'Open' button in the 'Import Shapefile' dialog. A third red box highlights the 'Yes' button in the 'Import Geometry' confirmation dialog.

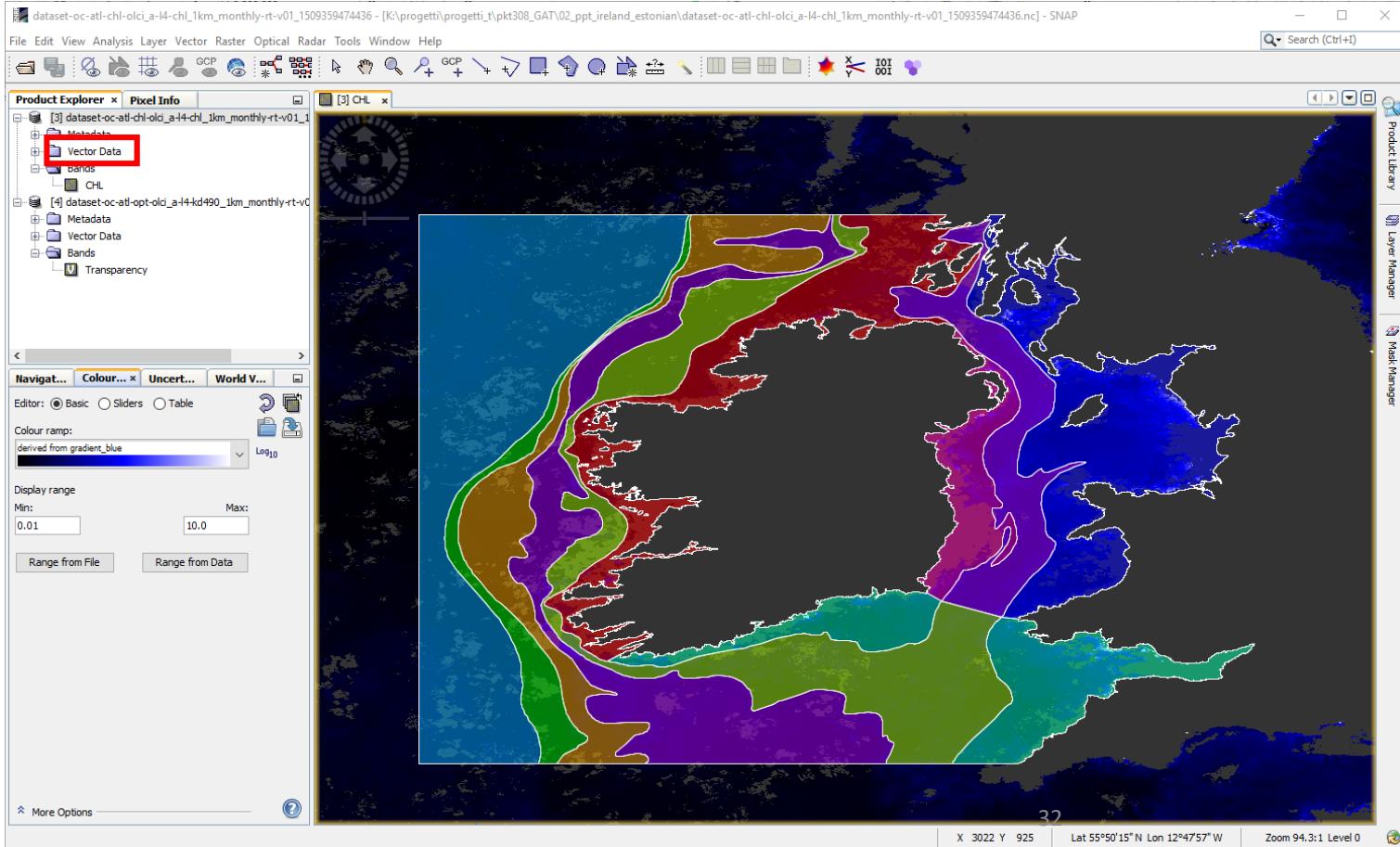


Marine  
Monitoring



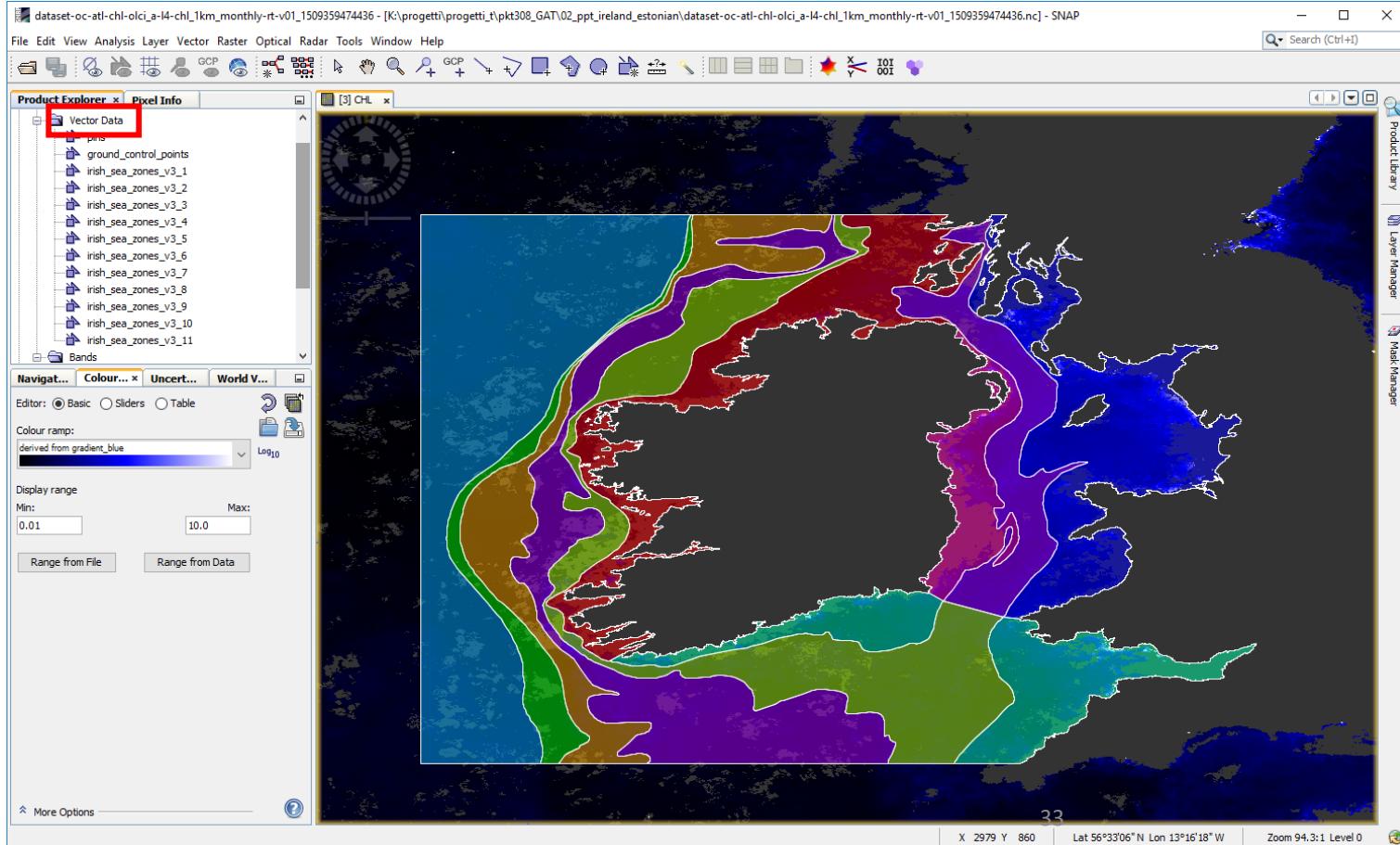


Marine  
Monitoring



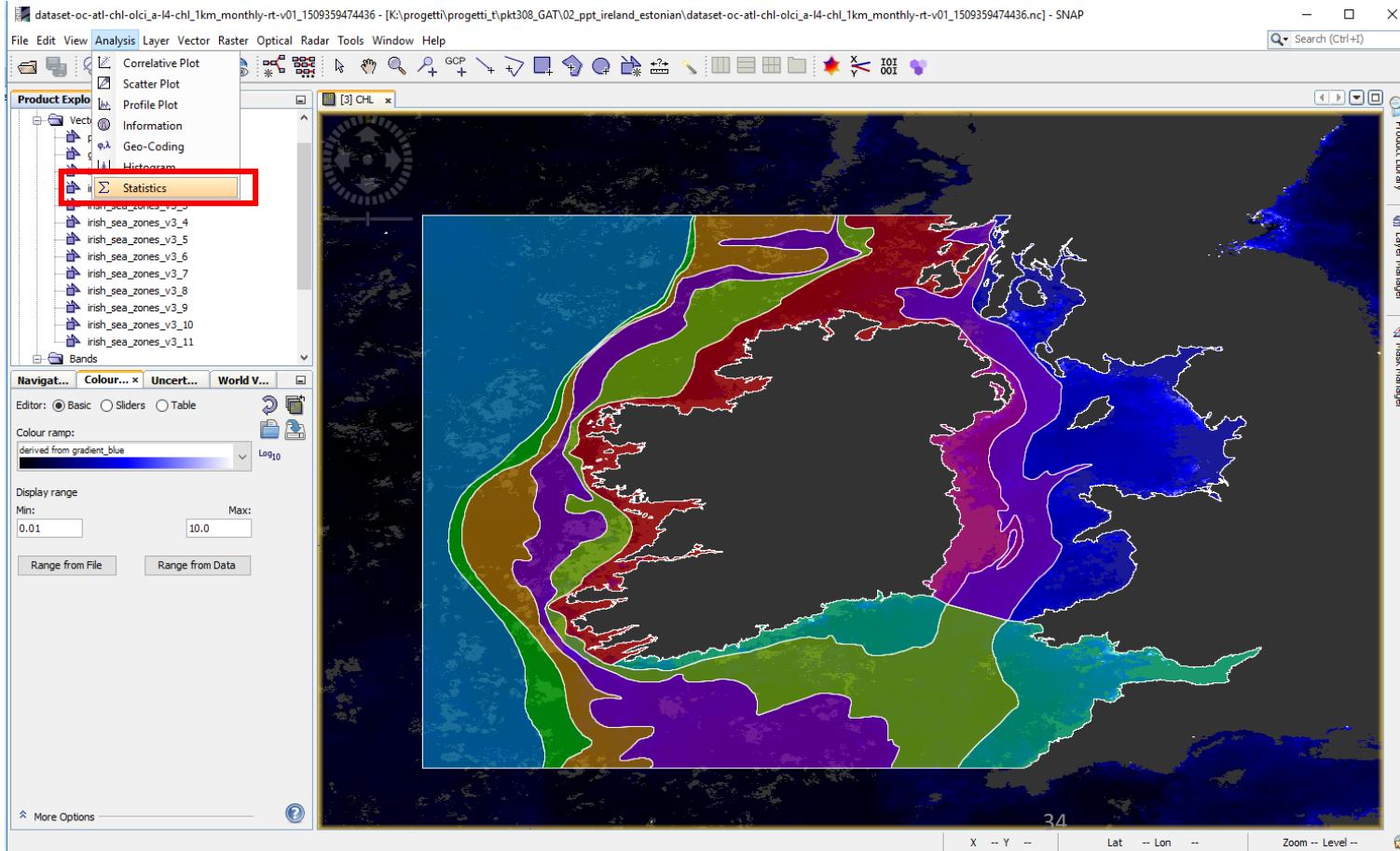


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No statistics computed yet.

Use ROI mask(s):

Filter:

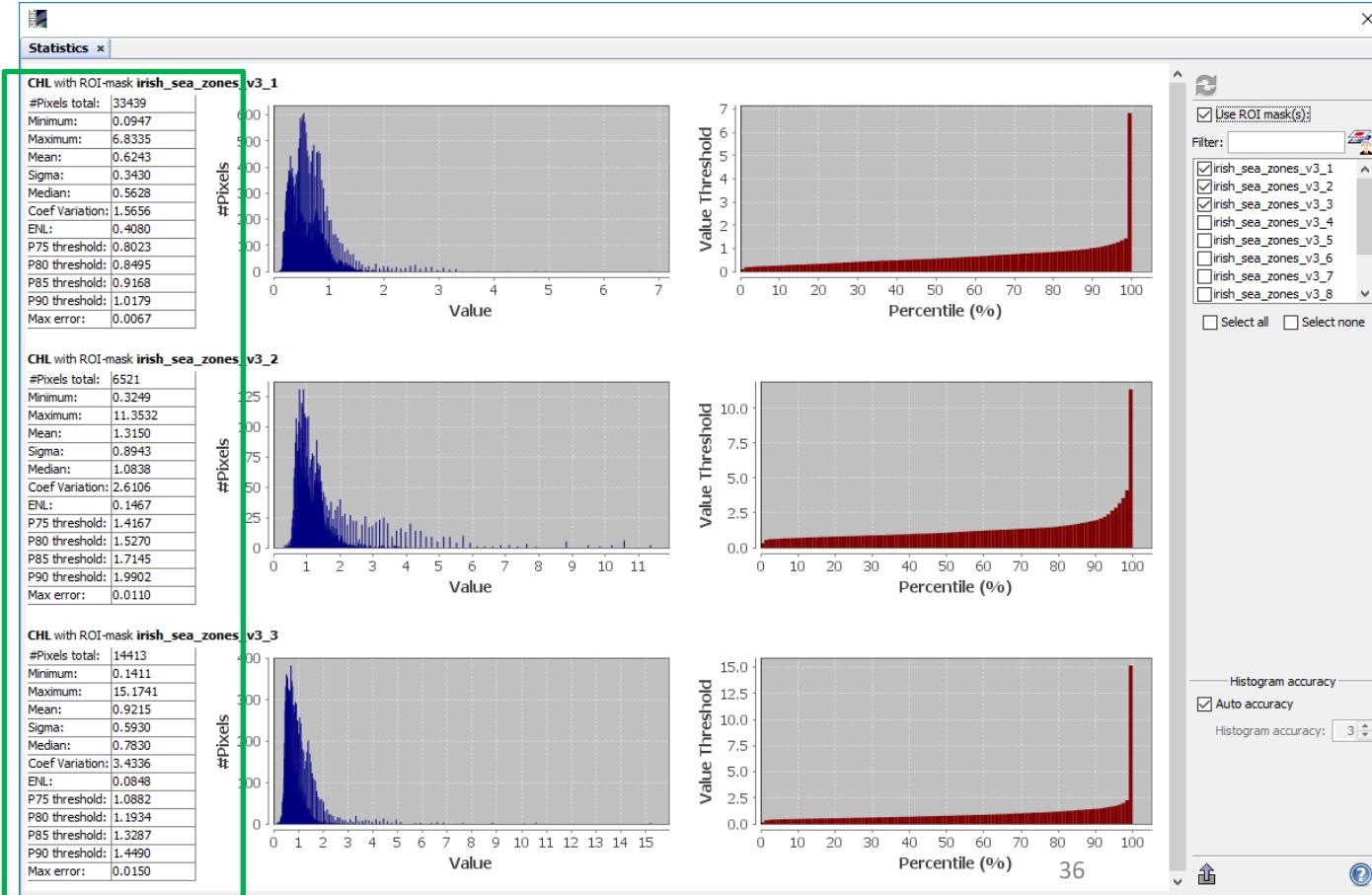
irish\_sea\_zones\_v3\_1  
 irish\_sea\_zones\_v3\_2  
 irish\_sea\_zones\_v3\_3 **(Selected)**  
 irish\_sea\_zones\_v3\_4  
 irish\_sea\_zones\_v3\_5  
 irish\_sea\_zones\_v3\_6  
 irish\_sea\_zones\_v3\_7  
 irish\_sea\_zones\_v3\_8

Select all  Select none

Histogram accuracy

Auto accuracy

Histogram accuracy:



Next



The image shows two Notepad++ windows side-by-side. The left window, titled 'Launch\_modello.bat', contains a DOS batch script:

```
1 gpt -e "D:\MarineZoneStats.xml"
2 -PProductPath="D:\CMEMS\*.nc"
3 -PBandName="CHL"
4 -PZonazione="D:\Zones\Zones_TSI.shp"
5 -POutName="D:\Temp\Chl_Stats.shp"
6
7 gpt -e "D:\MarineZoneStats.xml"
8 -PProductPath="D:\WT\*.tif"
9 -PBandName="band_1"
10 -PZonazione="D:\Zones\Zones_TSI.shp"
11 -POutName="D:\Zonal_Stats\WT_Stats.shp"
12
```

A green callout box highlights the first two lines of the script.

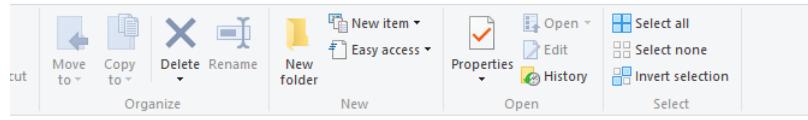
The right window, titled 'MarineZoneStats.xml', displays an XML configuration file:

```
1 <graph id="Graph">
2   <version>1.0</version>
3   <node id="StatisticsCalc">
4     <operator>StatisticsOp</operator>
5     <sources/>
6     <parameters>
7       <sourceProductPaths>$ProductPath
8       </sourceProductPaths>
9       <shapefile>$Zonazione</shapefile>
10      <startDate/>
11      <endDate/>
12      <bandConfigurations>
13        <bandConfiguration>
14          <sourceBandName>$BandName</sourceBandName>
15          <expression/>
16          <validPixelExpression/>
17        </bandConfiguration>
18      </bandConfigurations>
19      <outputShapefile>$OutName</outputShapefile>
20      <percentiles>90</percentiles>
21      <accuracy>3</accuracy>
22    </parameters>
23  </node>
24</graph>
```

A green callout box highlights the entire XML structure.

DOS batch script which invokes the  
SNAP GPT configuration file,  
providing input and output  
parameters

SNAP GPT configuration file (xml)



Name	Date modified	Type	Size
Chl_Stats.dbf	11/11/2016 18:05	DBF File	5 KB
Chl_Stats.fix	11/11/2016 18:05	FIX File	1 KB
Chl_Stats.prj	11/11/2016 18:05	IDL project file	1 KB
Chl_Stats.qix	11/11/2016 18:05	QIX File	1 KB
Chl_Stats.shp	11/11/2016 18:05	SHP File	2,413 KB
Chl_Stats.shx	11/11/2016 18:05	SHX File	1 KB
Chl_Stats_band_mapping.txt	11/11/2016 18:44	Text Document	1 KB
WT_Stats.dbf	11/11/2016 18:01	DBF File	5 KB
WT_Stats.fix	11/11/2016 18:01	FIX File	1 KB
WT_Stats.prj	11/11/2016 18:01	IDL project file	1 KB
WT_Stats.qix	11/11/2016 18:01	QIX File	1 KB
WT_Stats.shp	11/11/2016 18:01	SHP File	2,413 KB
WT_Stats.shx	11/11/2016 18:01	SHX File	1 KB
WT_Stats_band_mapping.txt	11/11/2016 18:01	Text Document	1 KB

D:\pke115\_Coastal\_2\Zonal\_Stats\Chl\_Stats\_band\_mapping.txt - Notepad++

File Edit Search View Encoding Language Settings Macro Run Plugins Window ?

Chl\_Stats\_band\_mapping.txt

```
1 vrg_CHL=average_CHL
2 mx_rrr_CHL=max_error_CHL
3 mx_CHL=maximum_CHL
4 median_CHL=median_CHL
5 mn_CHL=minimum_CHL
6 p90_thrs_0=p90_threshold_CHL
7 sigma_CHL=sigma_CHL
8 total_CHL=total_CHL
9
10
11
12
13
14
```

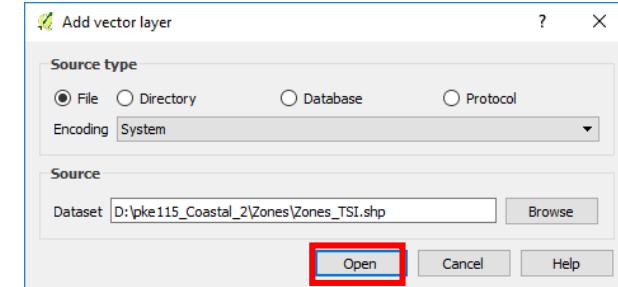
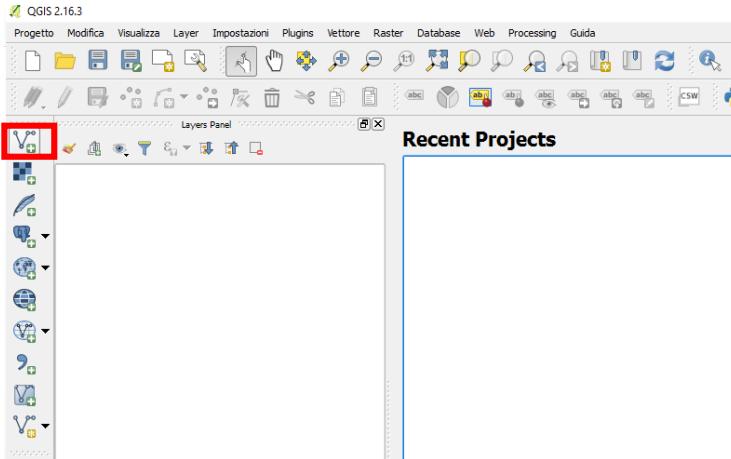
WT\_Stats\_band\_mapping.txt

```
1 vrg_bnd1=average band 1
2 mx_rrr_0=max_error_band_1
3 mx_bnd1=maximum_band_1
4 mdn_bnd1=median_band_1
5 mn_bnd1=minimum_band_1
6 p90_thrs_0=p90_threshold_band_1
7 sgm_bnd1=sigma_band_1
8 ttl_bnd1=total_band_1
9
```

Next

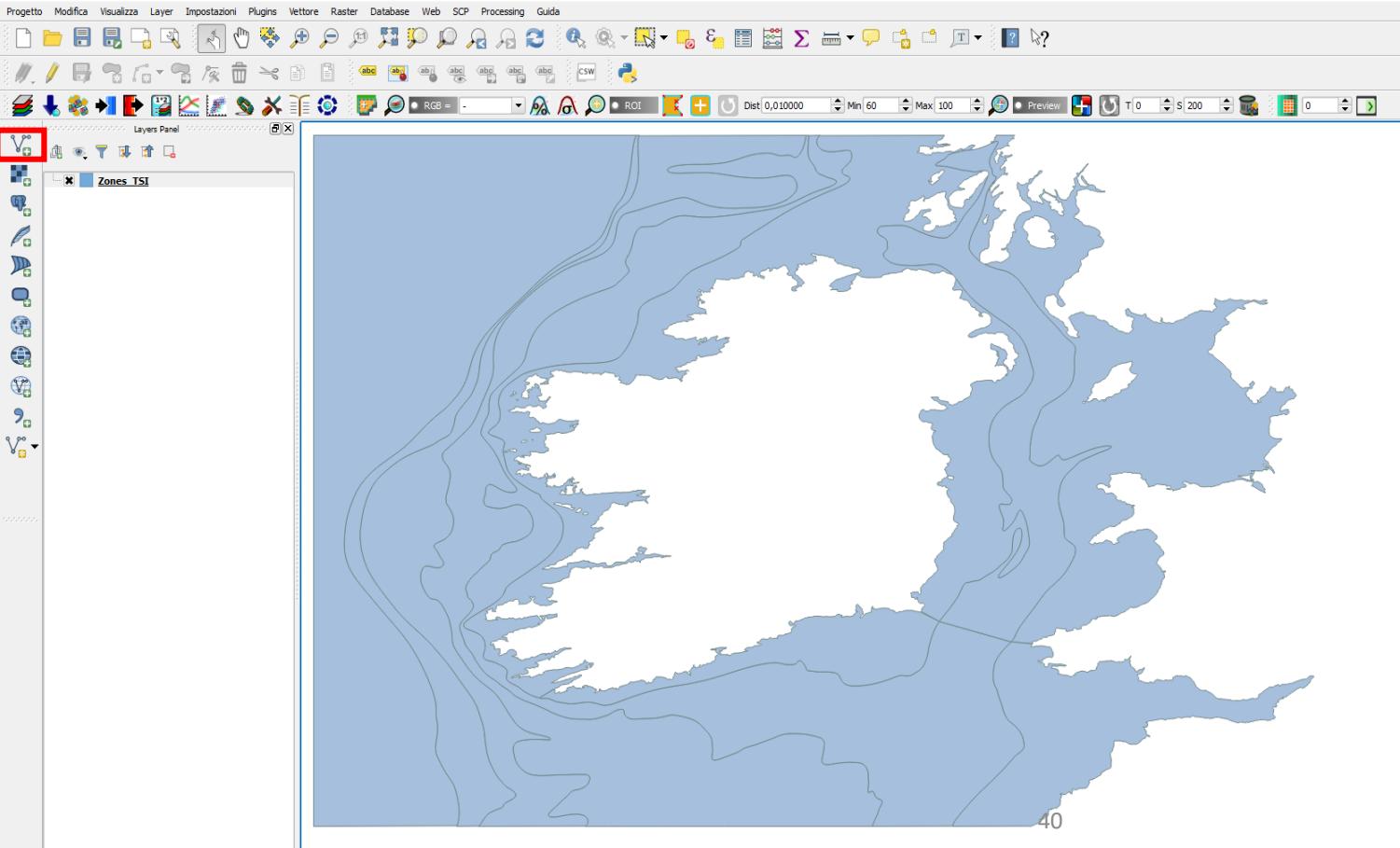


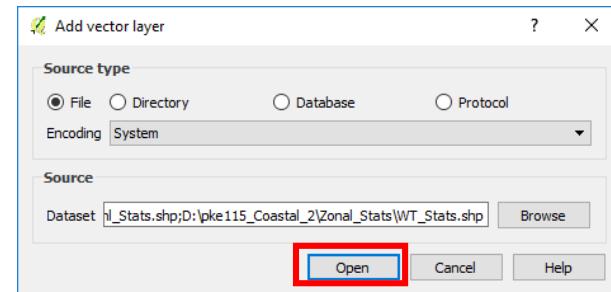
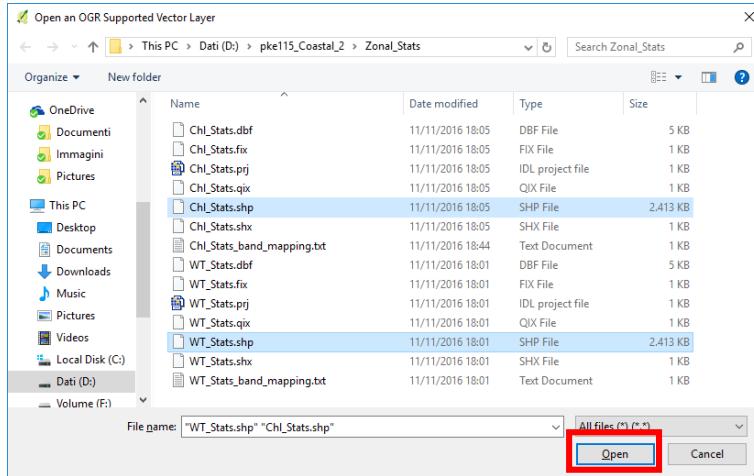
Marine  
Monitoring





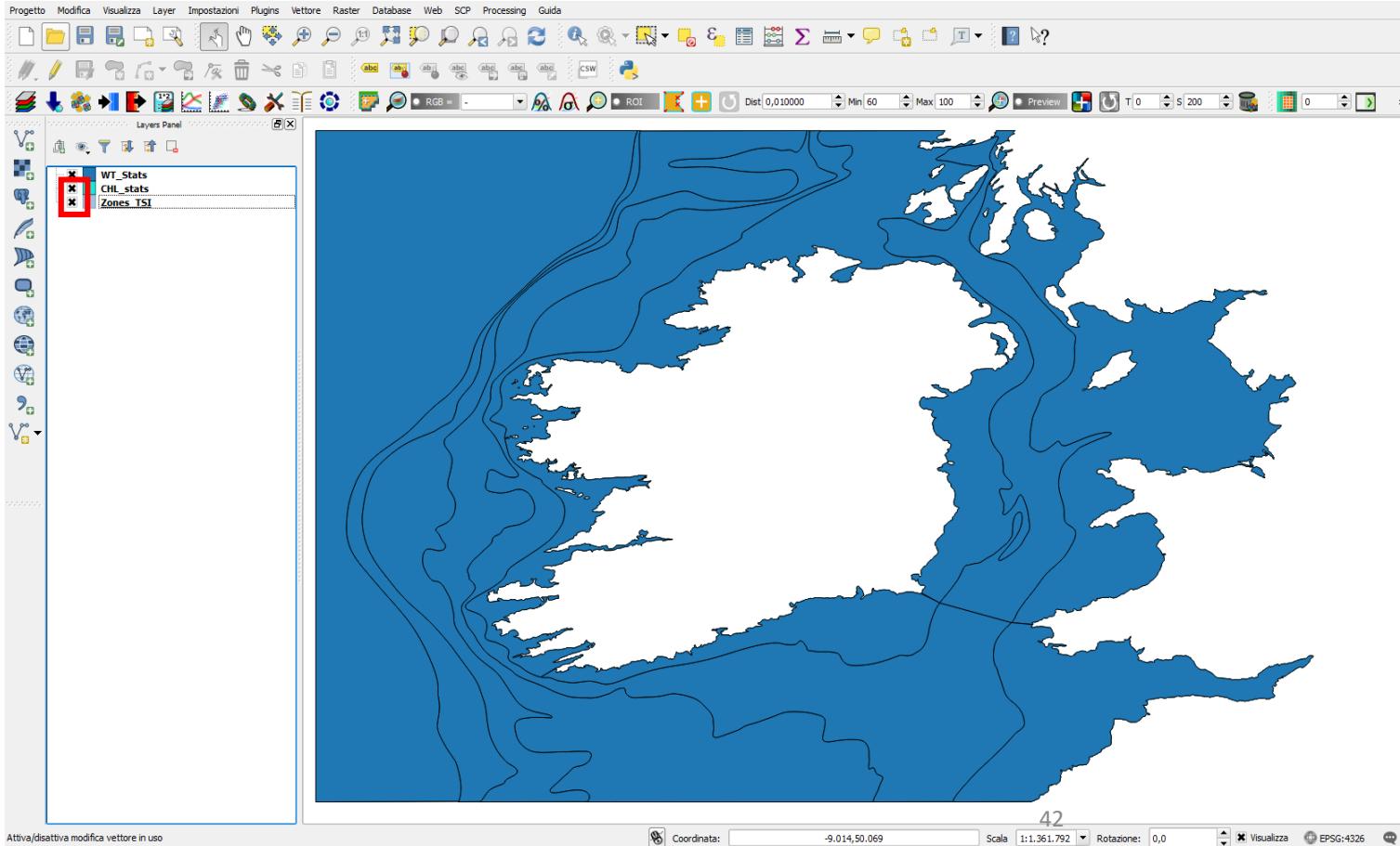
Marine  
Monitoring







Marine  
Monitoring





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Progetto Modifica Visualizza Layer Impostazioni Plugins Vettore Raster Database Web SCP Processing Guida

Layers Panel

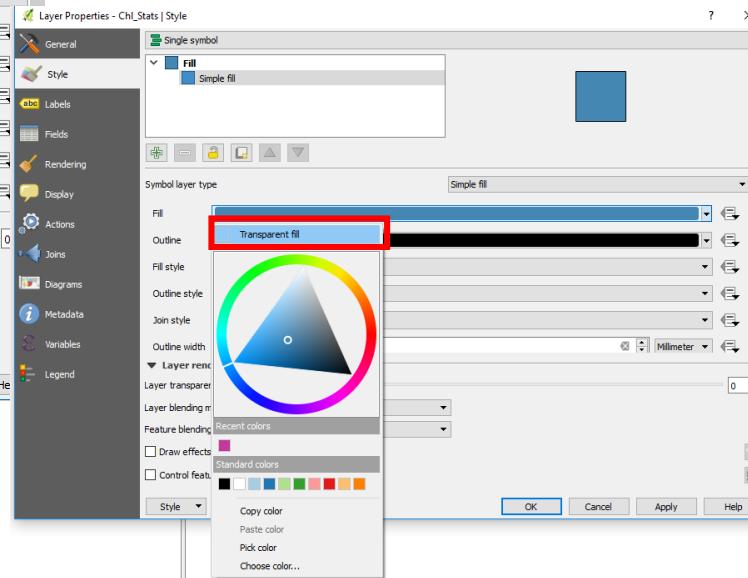
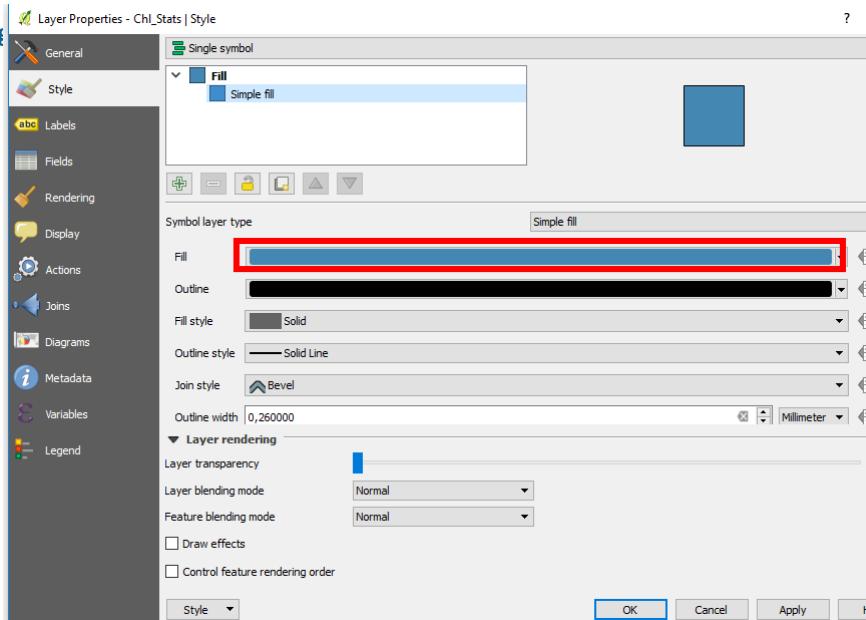
- WT\_Stats
- Chiavi
- Zon

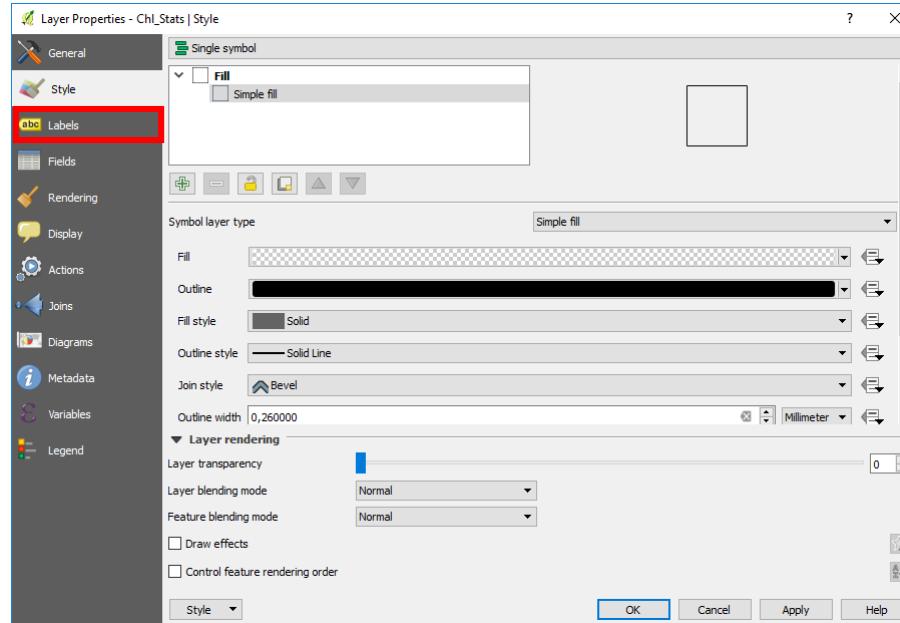
- Zoom sul layer
- Aggiungi alla panoramica
- Rimuovi
- Duplica
  - Imposta la scala di visibilità del layer
  - Imposta il SR del layer
  - Imposta il SR del progetto dal layer
  - Stili
- Apri tabella attributi
- Modifica
- Salva con nome...
- Salva come file di definizione del layer...
- Filtro...
- Mostra totale elementi
- Proprietà

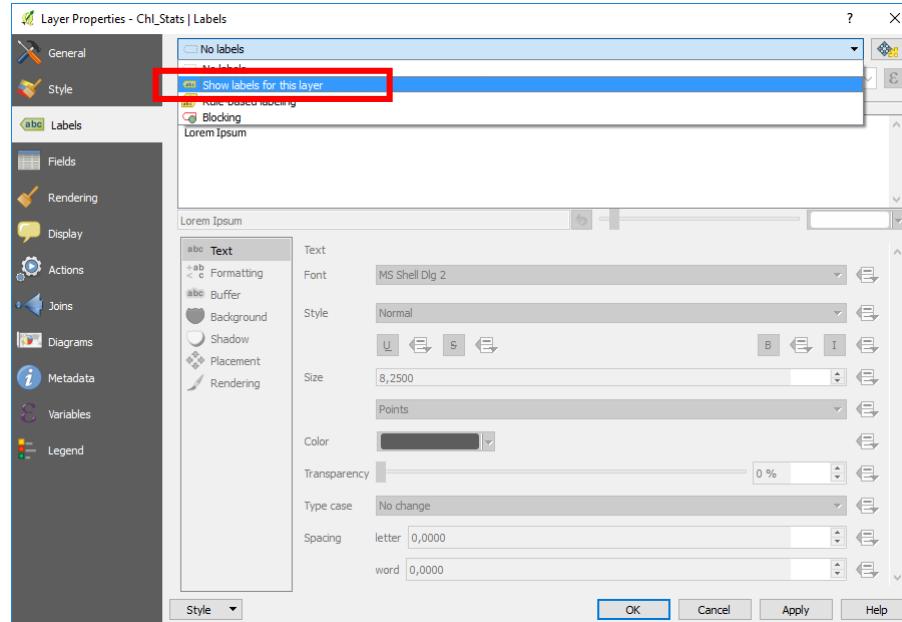
kinomino

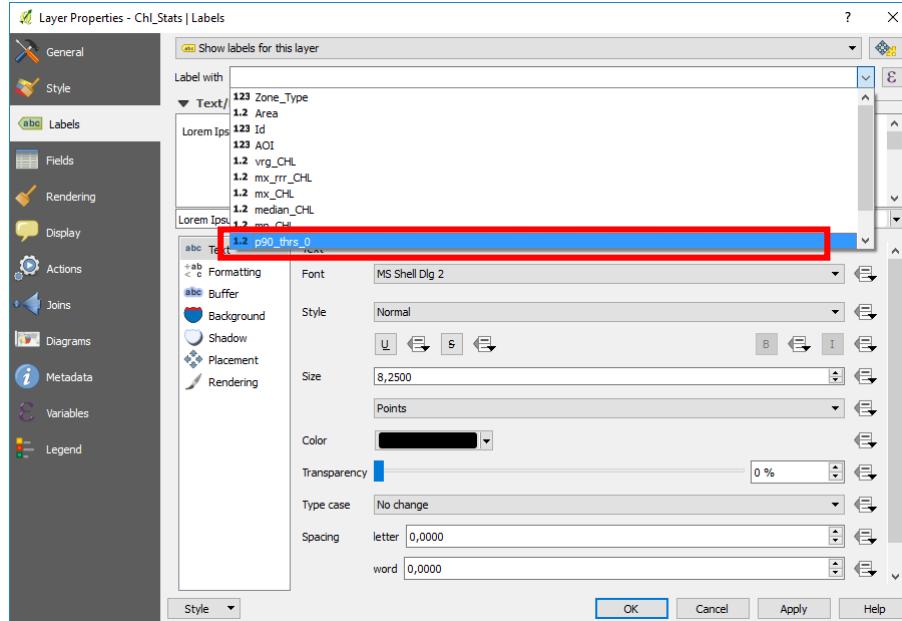
Attiva/disattiva modifica vettore in uso

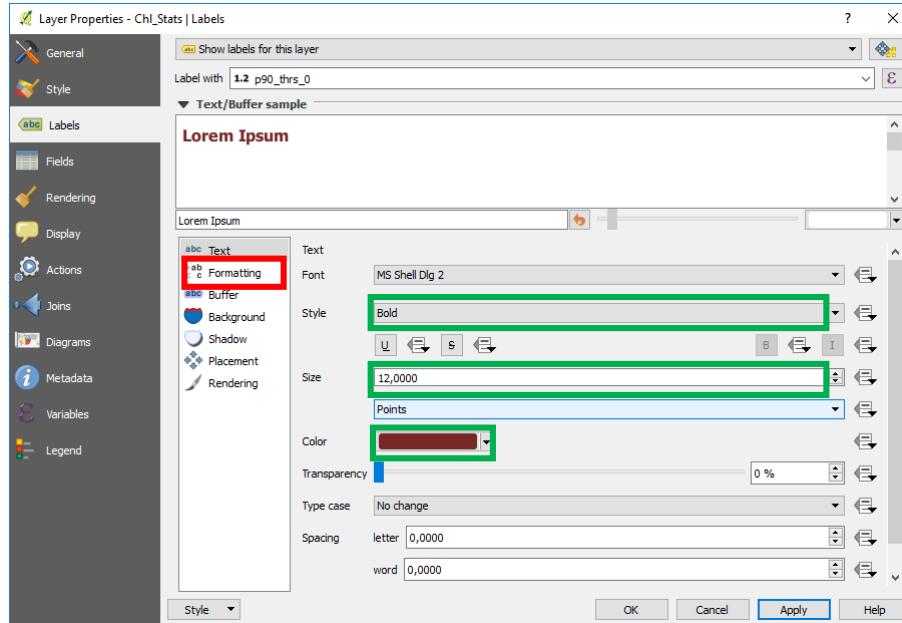
Coordinate: -12.214,55.604   Scale: 1:1.361.792   Rotazione: 0,0   Visualizza   EPSG:4326

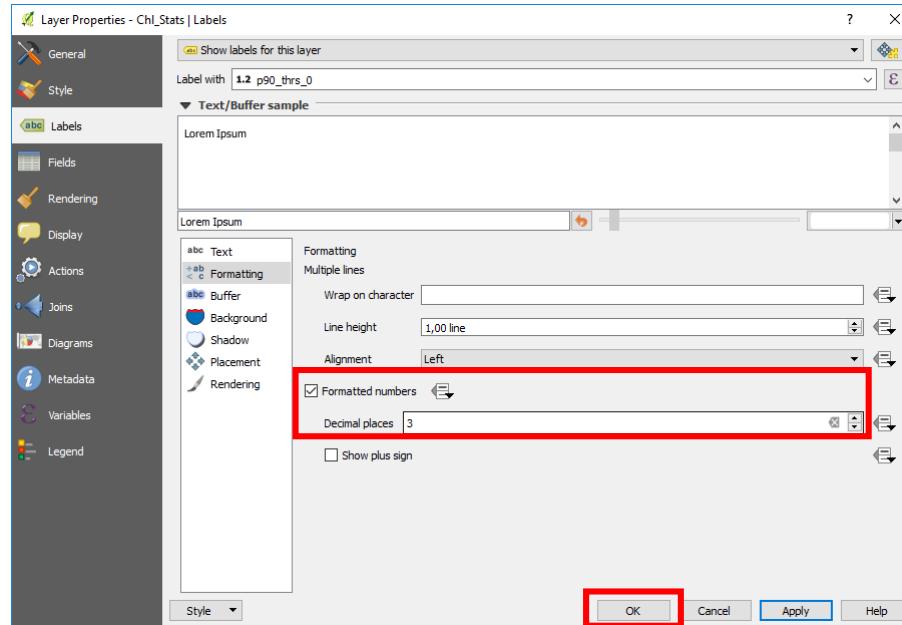






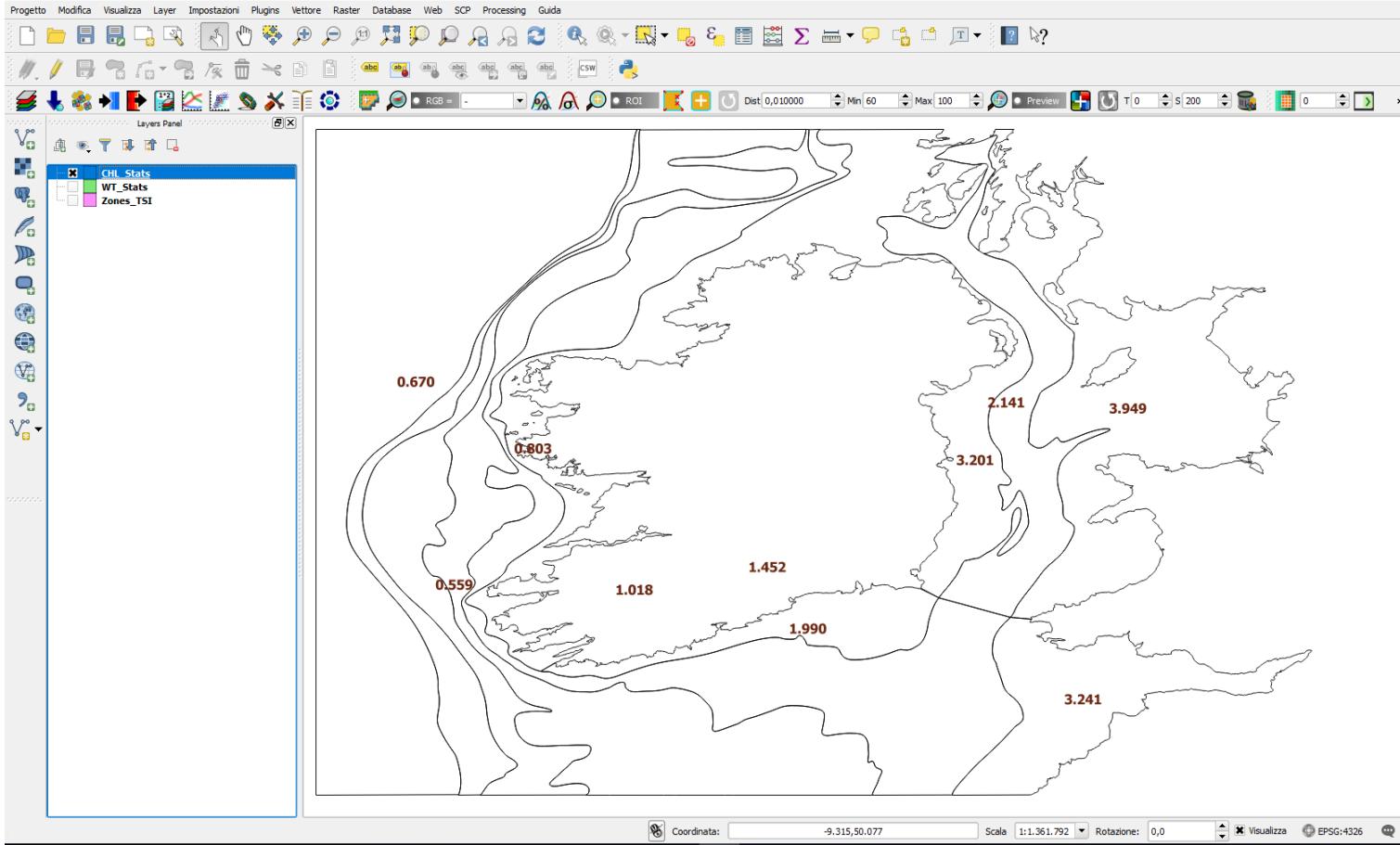


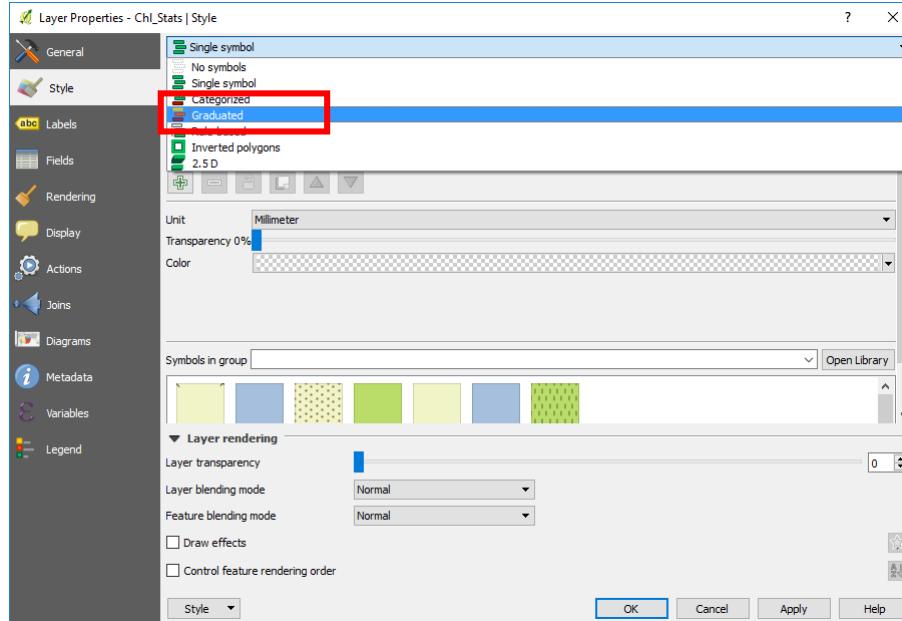






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Layer Properties - Chl\_Stats | Style

General

Graduated

Column: 1.2 p90\_thrs\_0

Symbol:

Legend Format: %1 - %2

Precision 1, Trim

Method: Color

Color ramp: [source]

Classes Histogram

Symbol	Values	Legend
Green	0.100 - 3.926	0.0996 - 3.9258
Light Green	3.926 - 7.752	3.9258 - 7.7521
Yellow	7.752 - 11.578	7.7521 - 11.5784

Mode: Equal Interval

Classes: 5

Classify, +, Delete all, Advanced

Link class boundaries

Layer rendering

Layer transparency: 0

Layer blending mode: Normal

Feature blending mode: Normal

Draw effects

Control feature rendering order

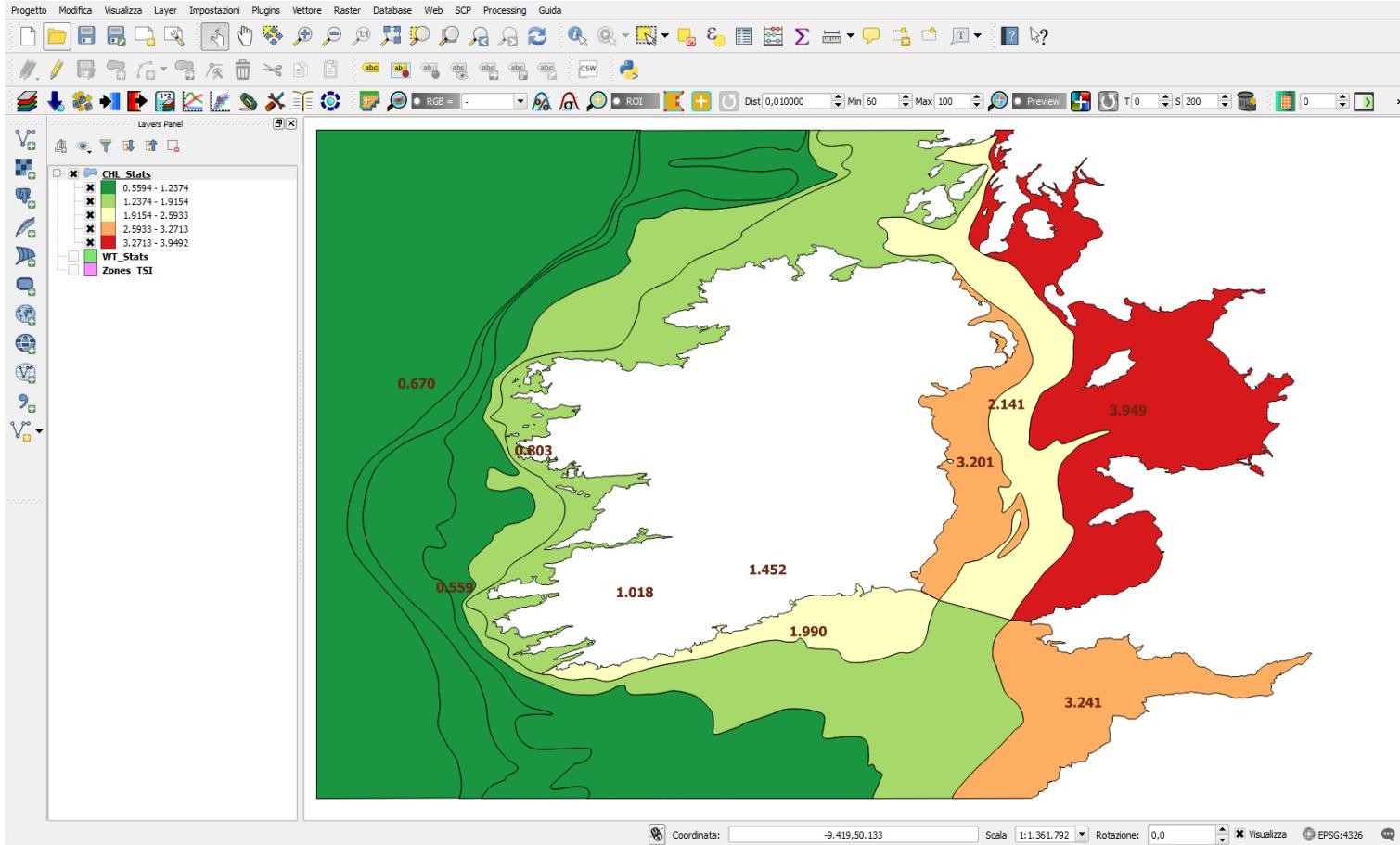
Style

OK (highlighted with red box)

Cancel, Apply, Help

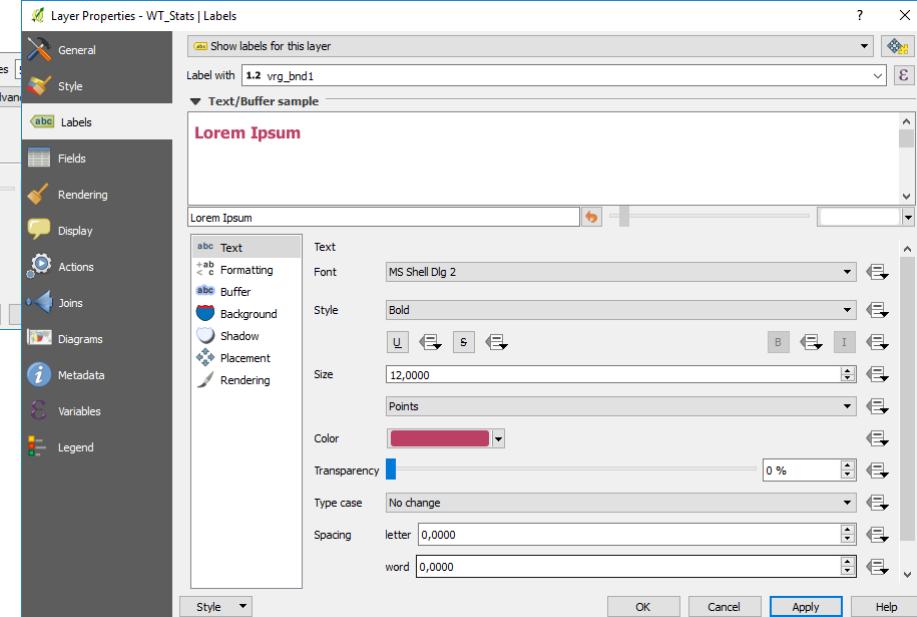
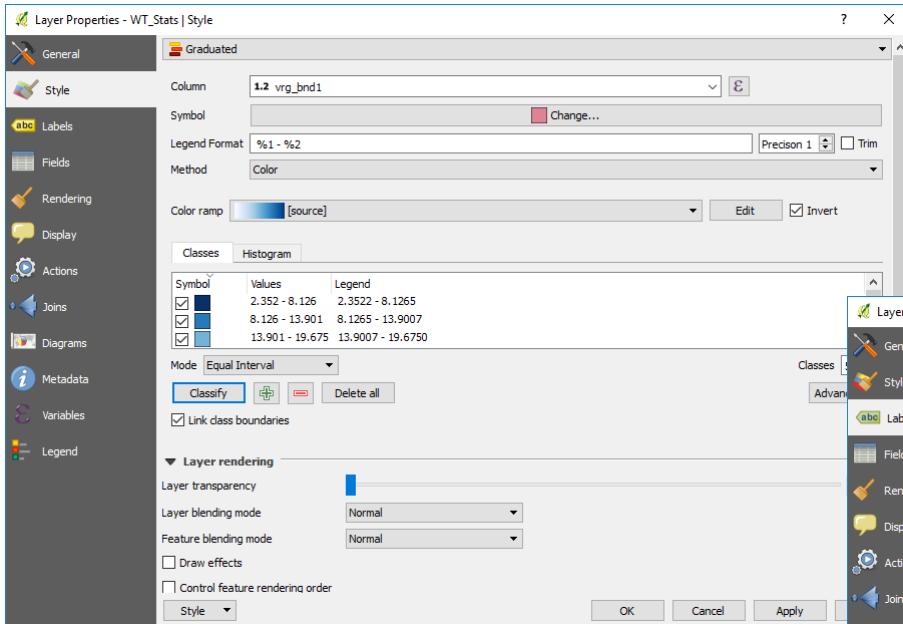


Marine  
Monitoring





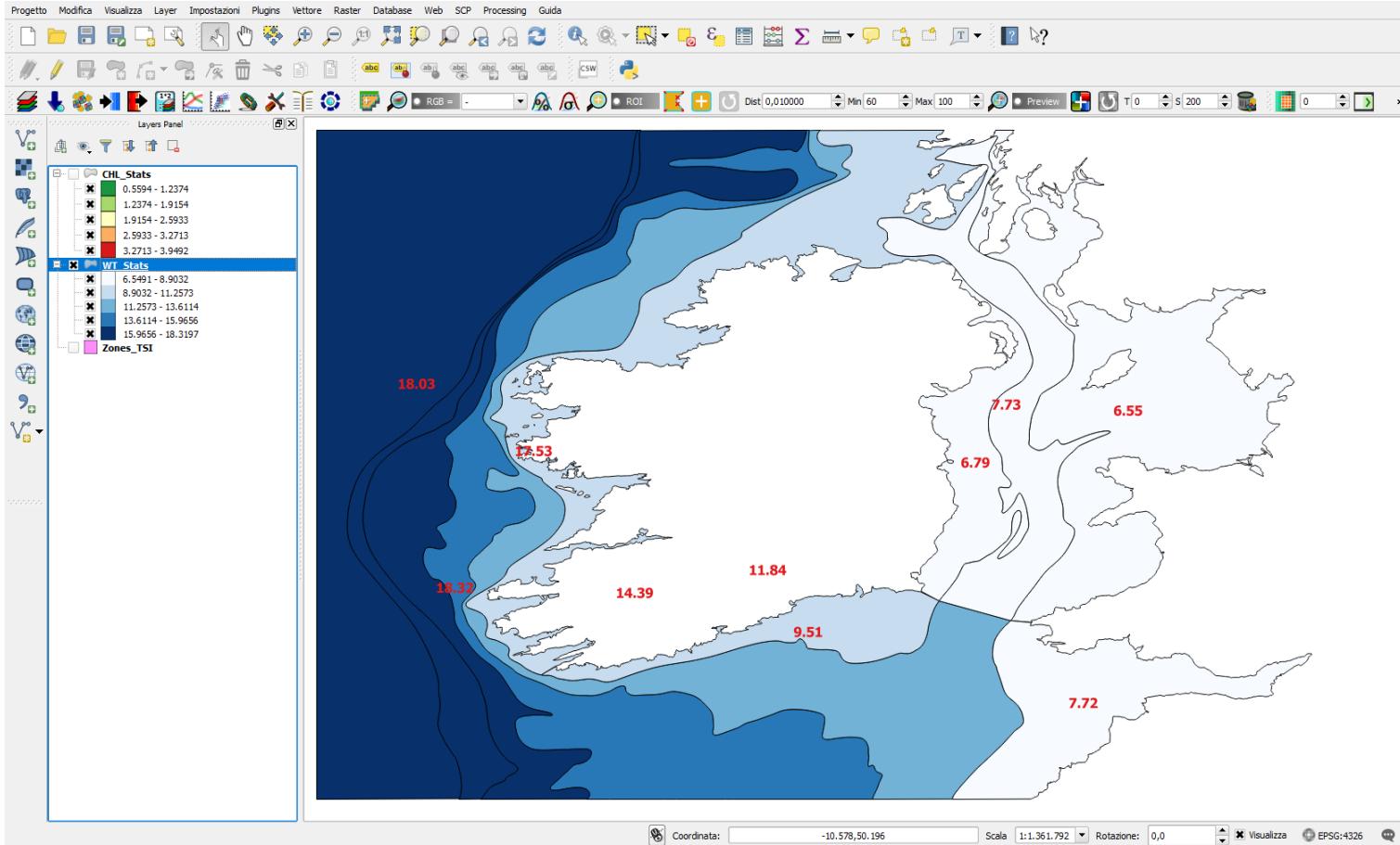
Marine  
Monitoring



Next



Marine  
Monitoring





Marine  
Monitoring

# Thank you