



Spatial statistics for EU directives reporting on coastal areas

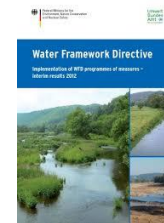
Copernicus for Coastal Zone Management



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), ...**



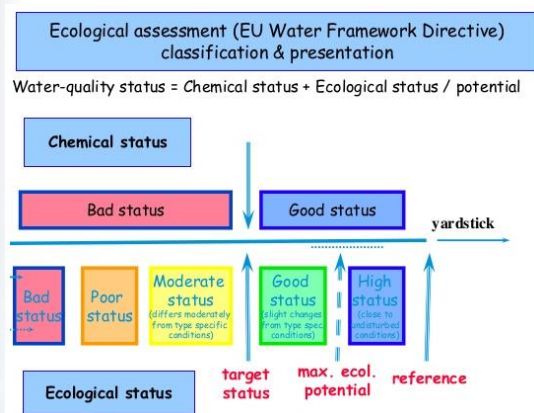
WFD: Good Status for all EU surface and ground waters by 2015. 2027 final deadline for meeting objectives

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)



- | | |
|-----------------------------------|------------------------------|
| 1. Biological diversity | 7. Hydrographical conditions |
| 2. Non-indigenous species | 8. Contaminants |
| 3. Commercially exploited species | 9. Health issues |
| 4. Marine food webs | 10. Marine litter |
| 5. Eutrophication | 11. Marine energy |
| 6. Sea-floor integrity | |
- MSD status descriptors



MSFD implementation into Member States laws ->

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

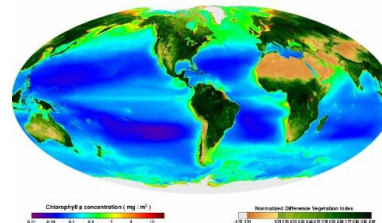
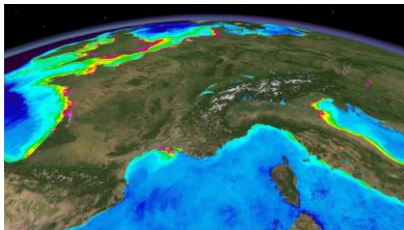
Representative example: Italian implementation

- 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

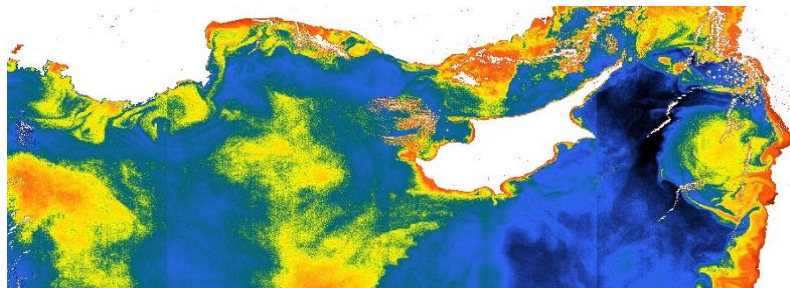




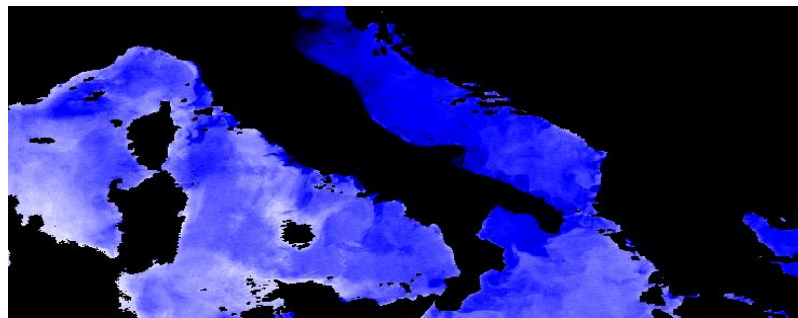
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Estimation of eutrophication: useful data

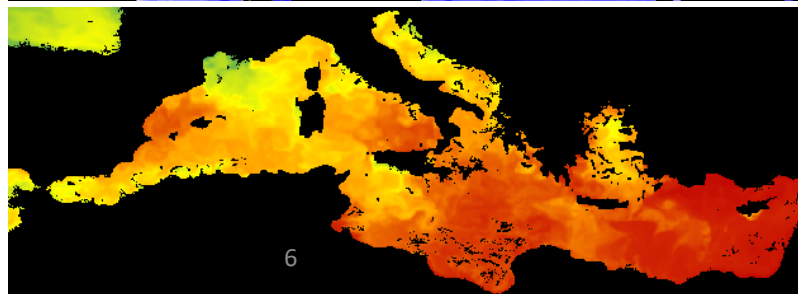
Chlorophyll-a concentration



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





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

- ✓ **Identify homogeneous areas**

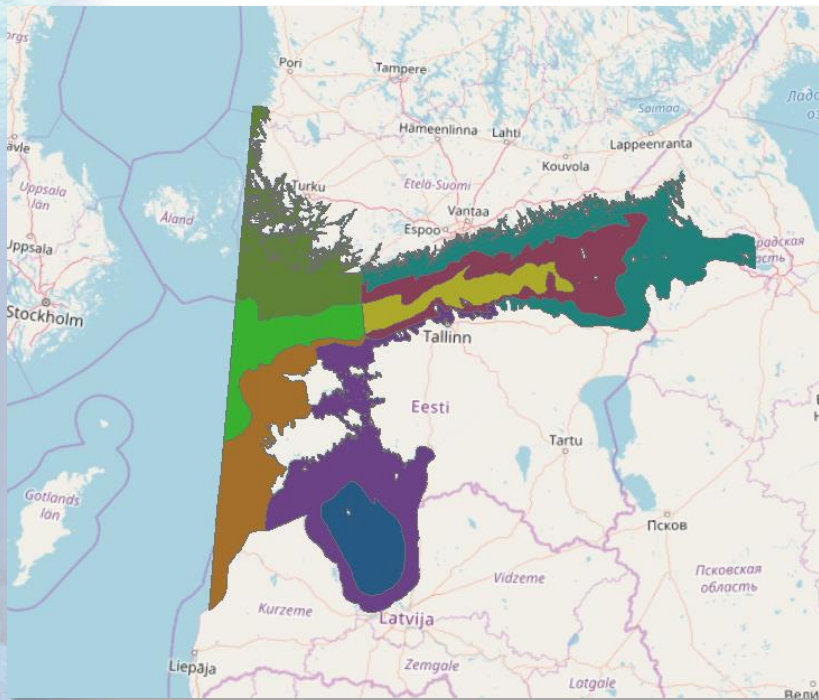
For example the trophic characteristics of an area can be estimated by combining chlorophyll, water transparency and other measurements (salinity, temperature, etc.)

- ✓ **Perform continuous monitoring on such areas**

Obtaining statistics which can be directly used for the reporting



Zoning of Irish seas



Example of a possible zoning of the east part of Baltic sea using the bathymetry.



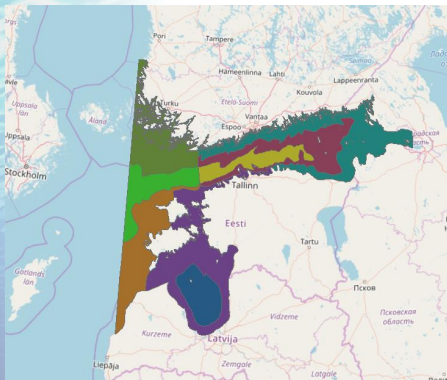
Marine
Monitoring

D E M O

DEMO



Demonstration content



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

CMEMS products: Baltic sea Monthly means of Surface Chlorophyll Concentration from Satellite observations and monthly water transparency

Period considered: In the demo only the month of September 2017 is considered



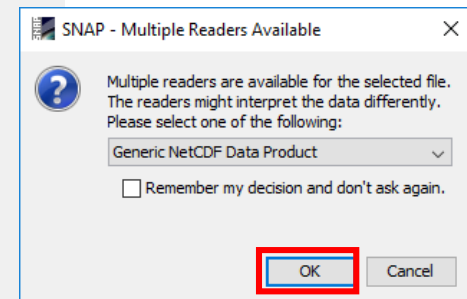
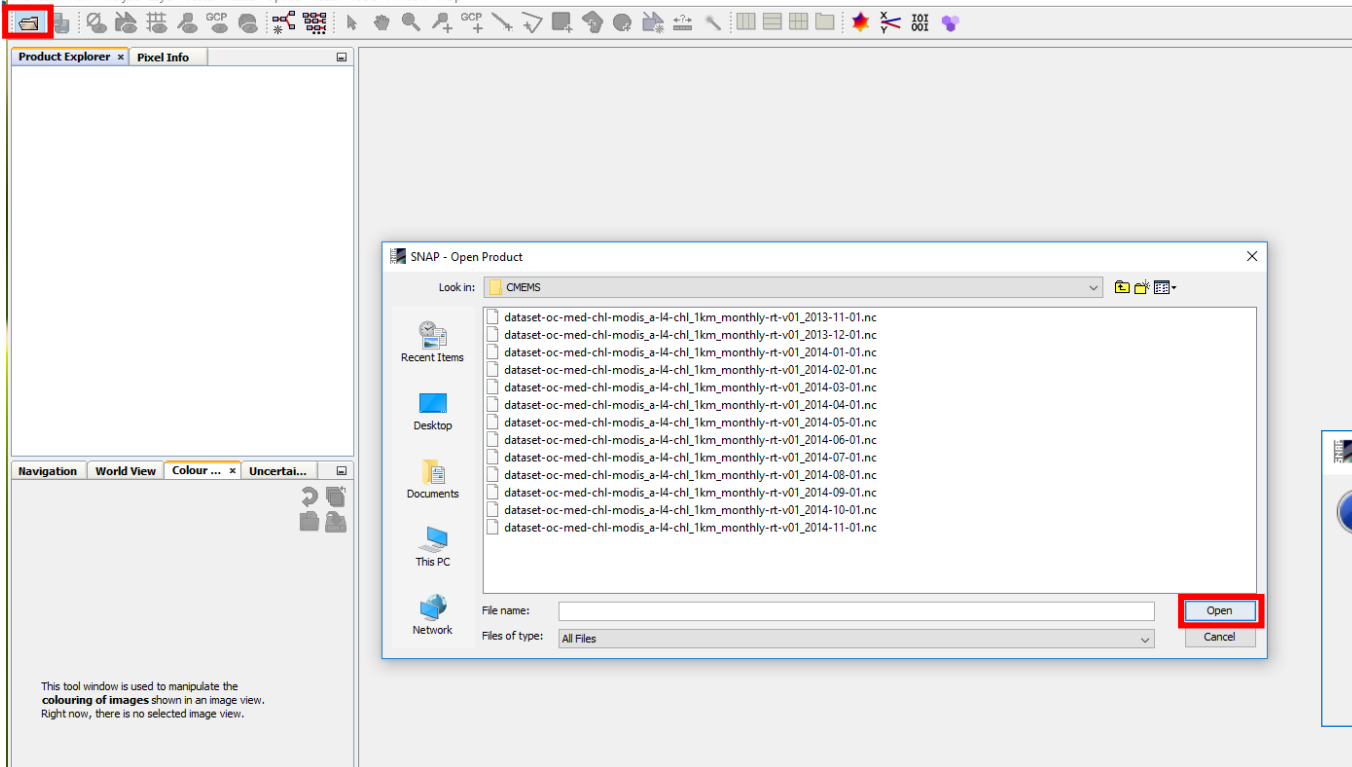
Software used:

ESA -SNAP



QGIS







SNAP

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

Search (Ctrl+F)

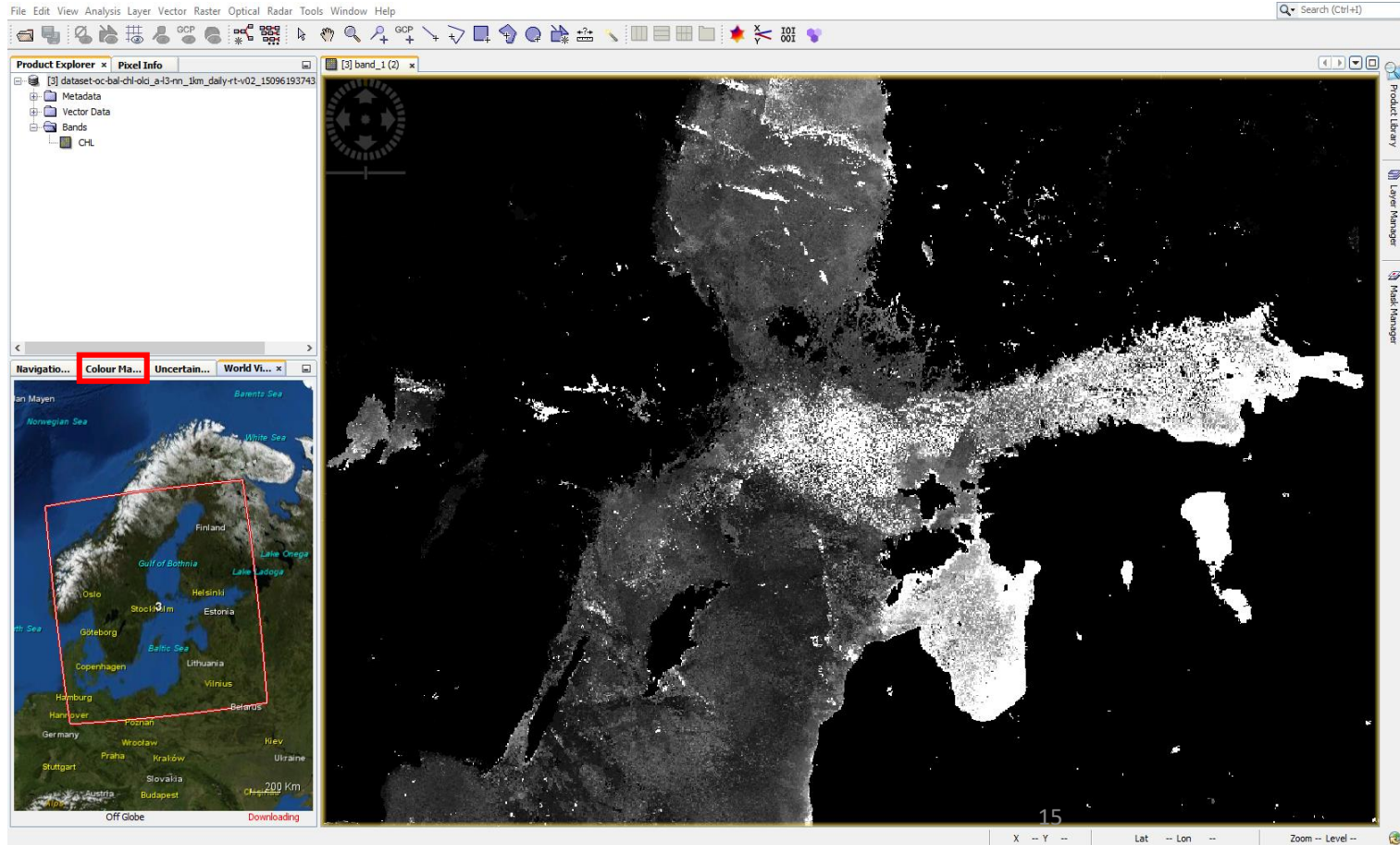
Product Explorer x Pixel Info

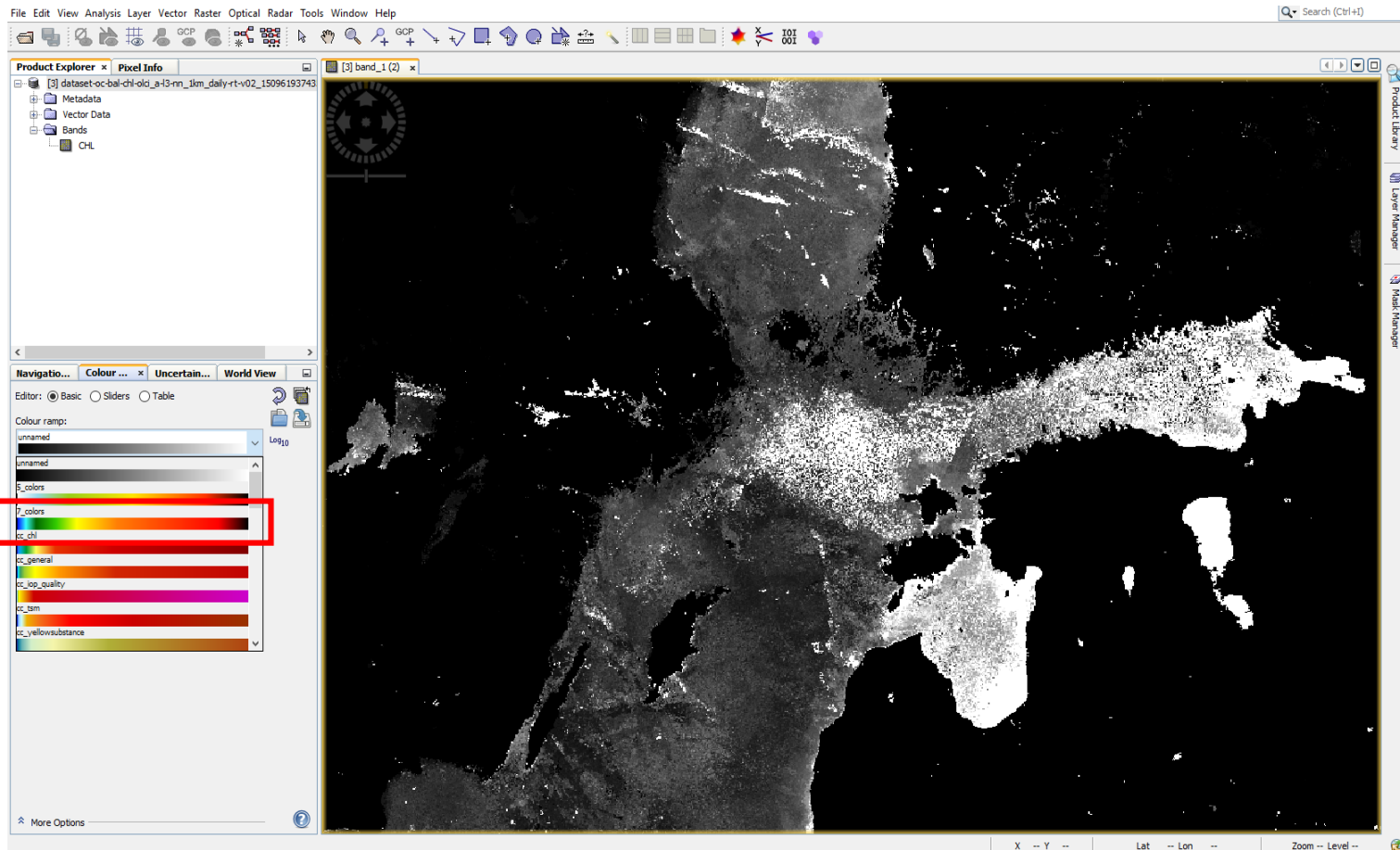
- [1] dataset-oc-med-chl-mods_a44-chl_1km_monthly-r1-v01_201
- Metadata
- Vector Data
- CHL
- Mediterranean Sea Monthly Chlorophyll Case 1 and Case 2 Concentration, 857 x 988 pixels, (milligram m⁻³)
- chl_error

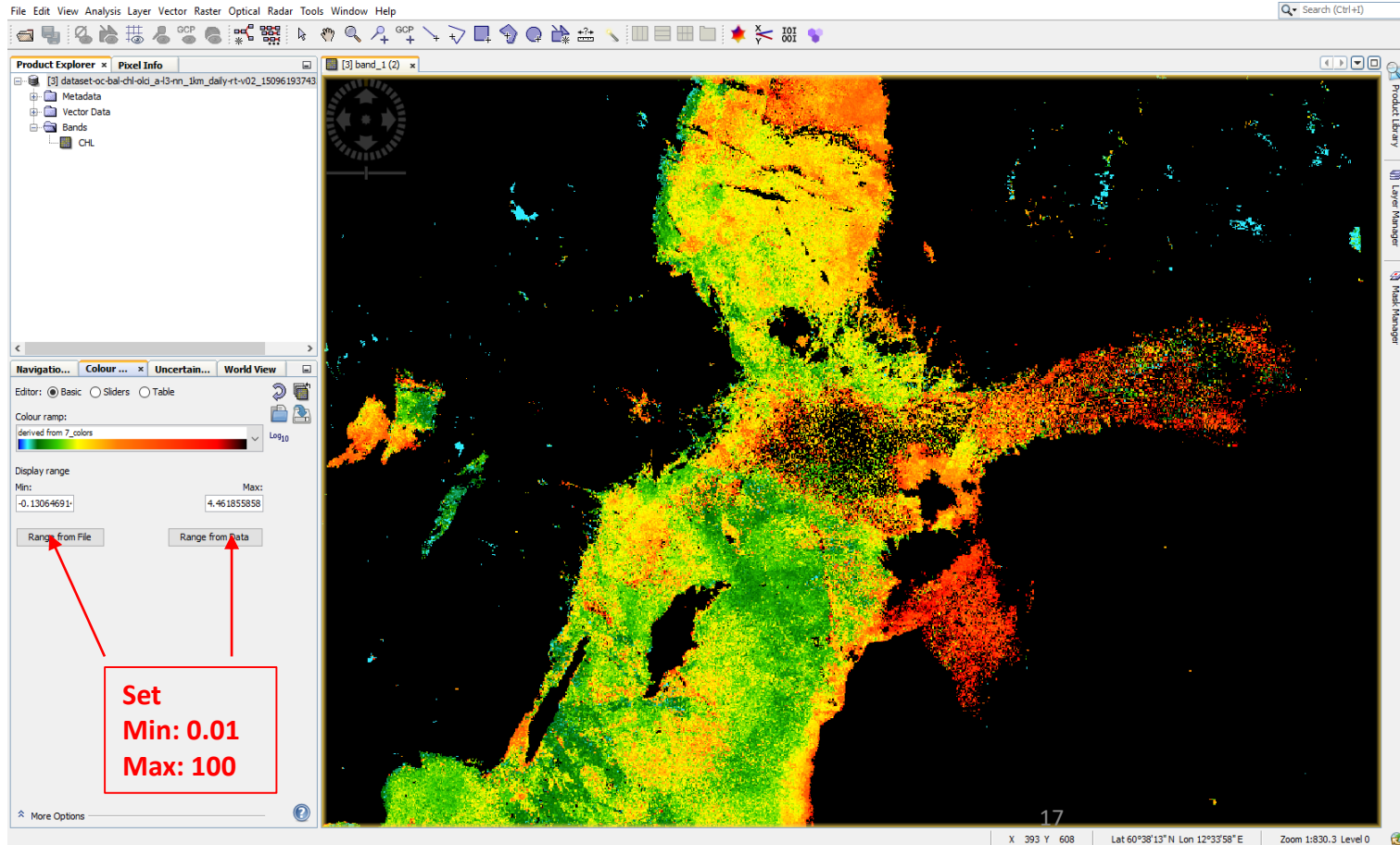
Navigation World View Colour ... x Uncertal...

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

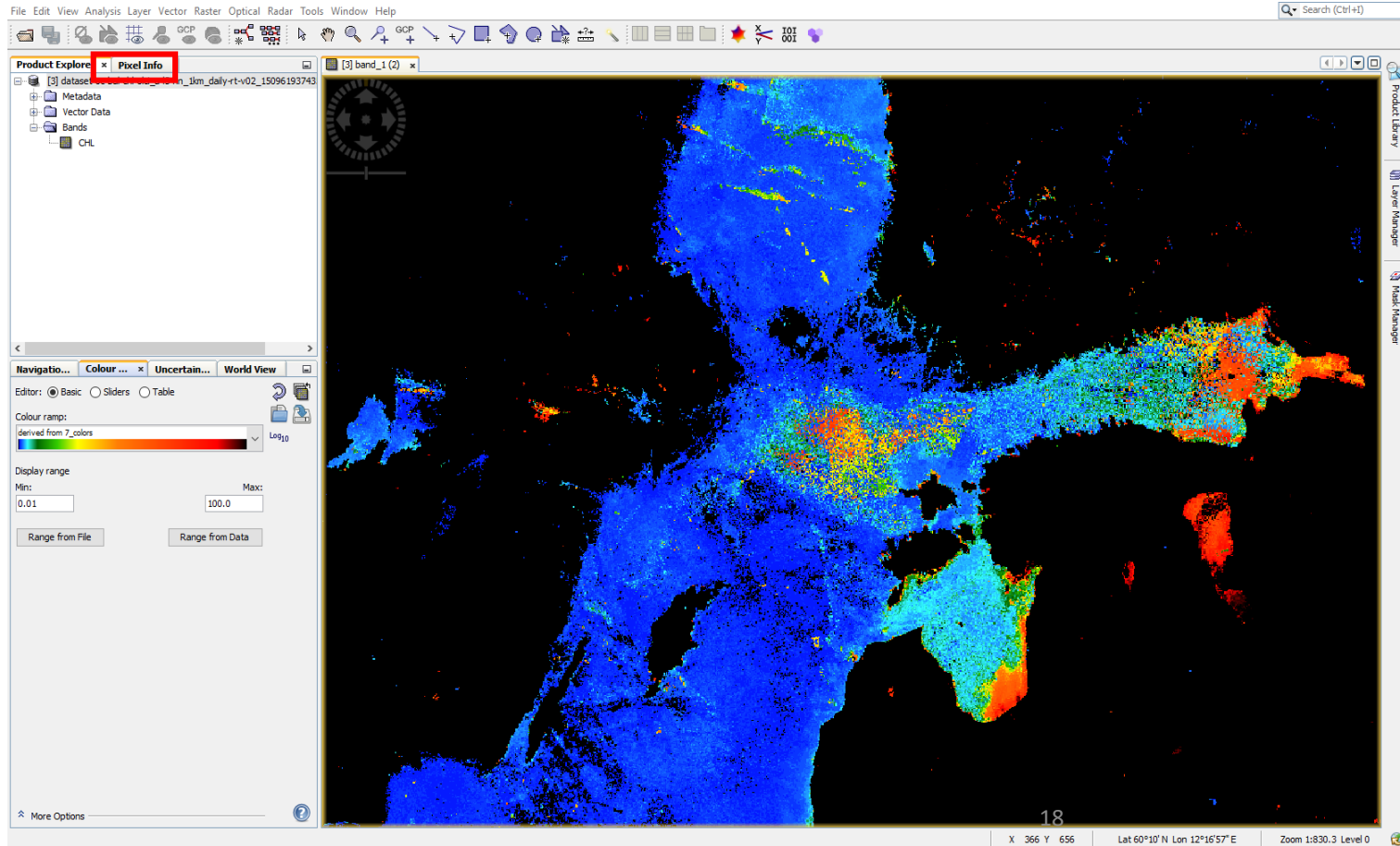
X Y Lat Lon Zoom Level

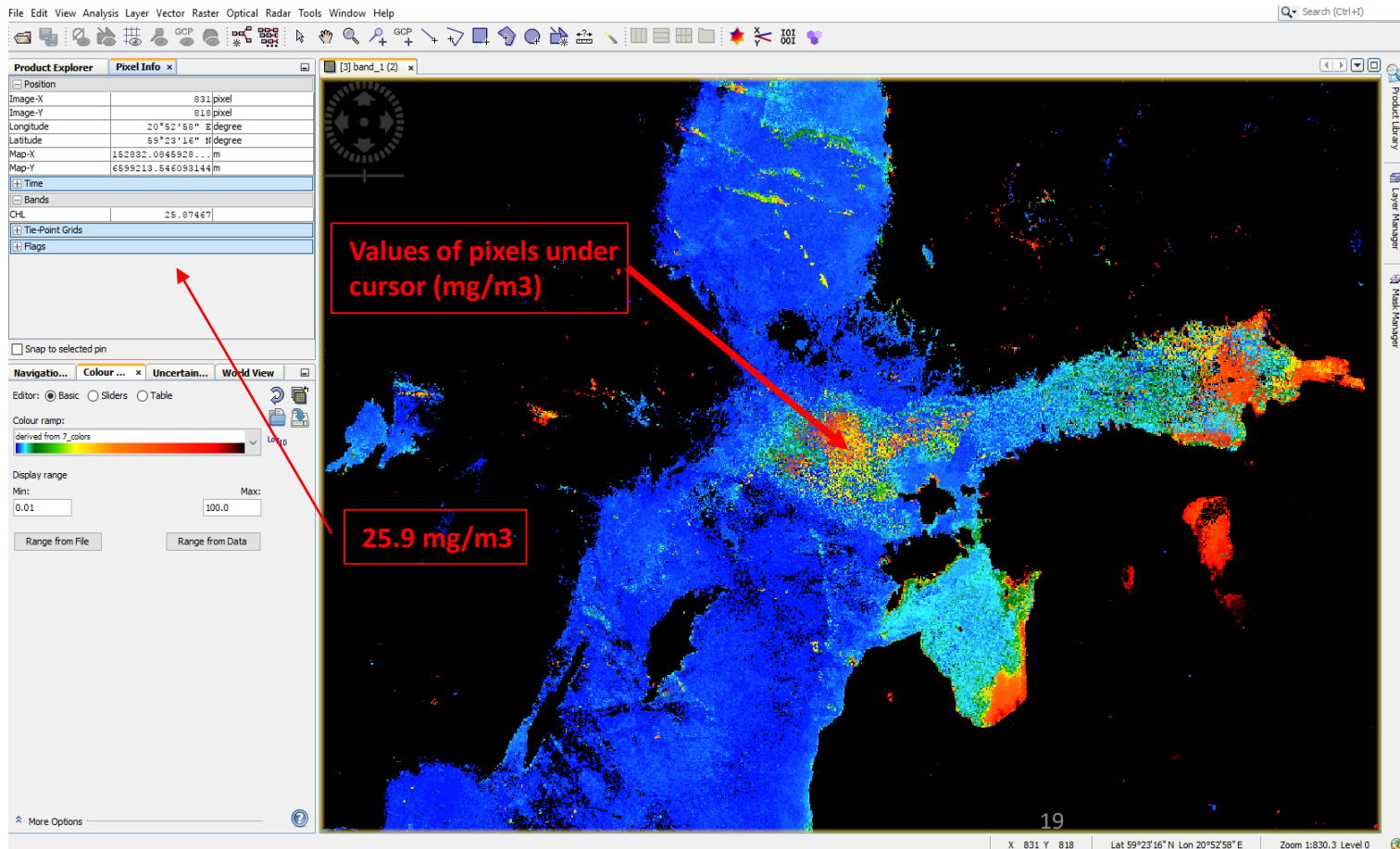






Next





Next



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

Search (Ctrl+F)

Product Explorer Pixel Info x

Position

Image-X	831 pixel
Image-Y	818 pixel
Longitude	20°52'58" E degree
Latitude	59°23'16" N degree
Map-X	162832.0845928... m
Map-Y	6599213.546093144 m

Time

Bands

CHL	25.87467
-----	----------

Tie-Point Grids

Flags

☐ Snap to selected pin

Navigation... Colour ... x Uncertain... World View

Editor: ☒ Basic ☐ Sliders ☐ Table

Colour ramp: derived from 7 colors

Display range

Min: 0.01 Max: 100.0

Range from File Range from Data

More Options

SNAP - Open Product

Look in: data

- dataset-oc-bal-chl-olci-a-l3-nn_1km_daily-rt-v02_1509613633603.nc
- dataset-oc-bal-opt-olci-a-l3-kd490_1km_daily-rt-v02_1509622828375.nc

Recent Items

- Desktop
- Documents
- This PC
- Network

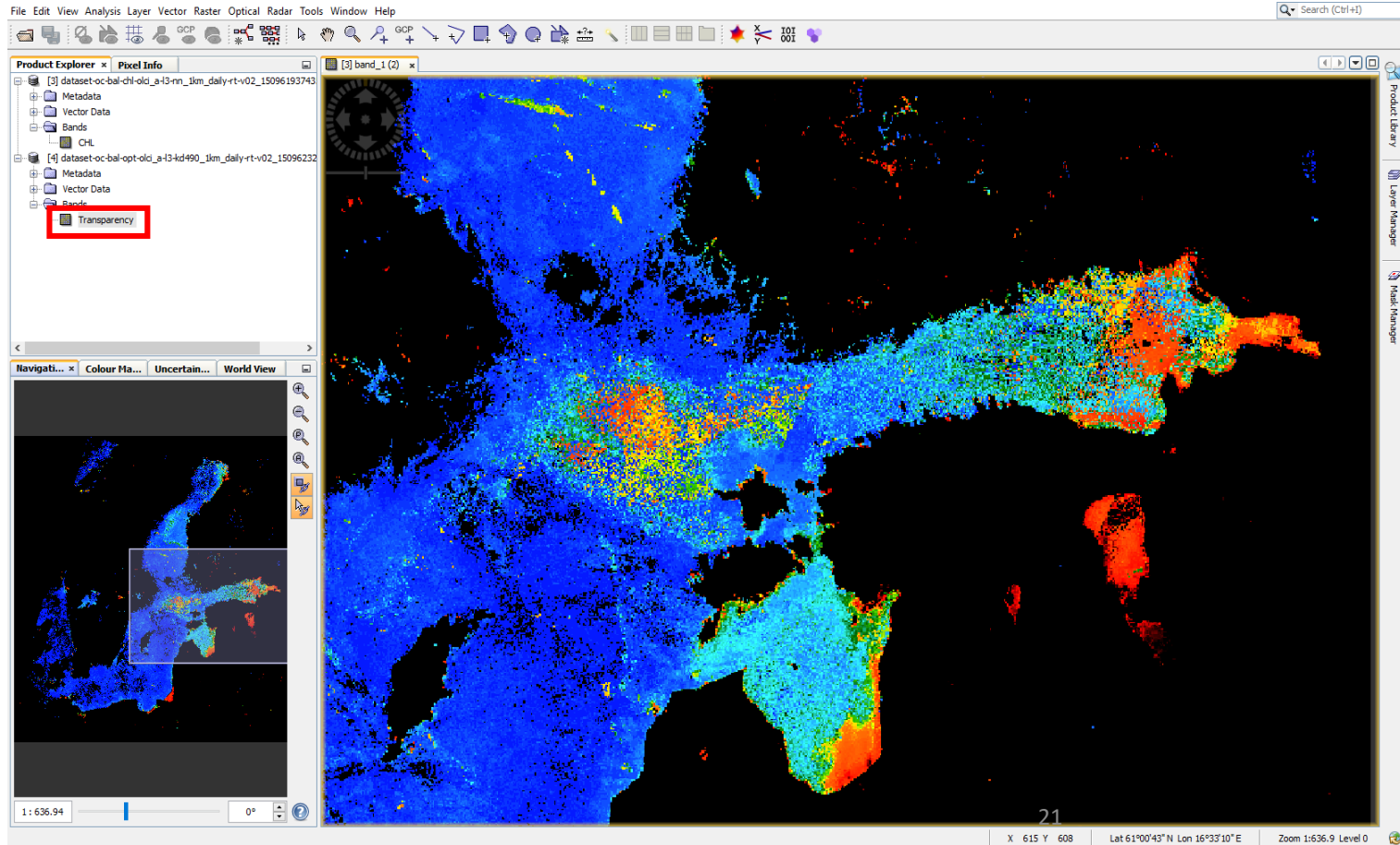
File name: dataset-oc-bal-opt-olci-a-l3-kd490_1km_daily-rt-v02_1509622828375.nc

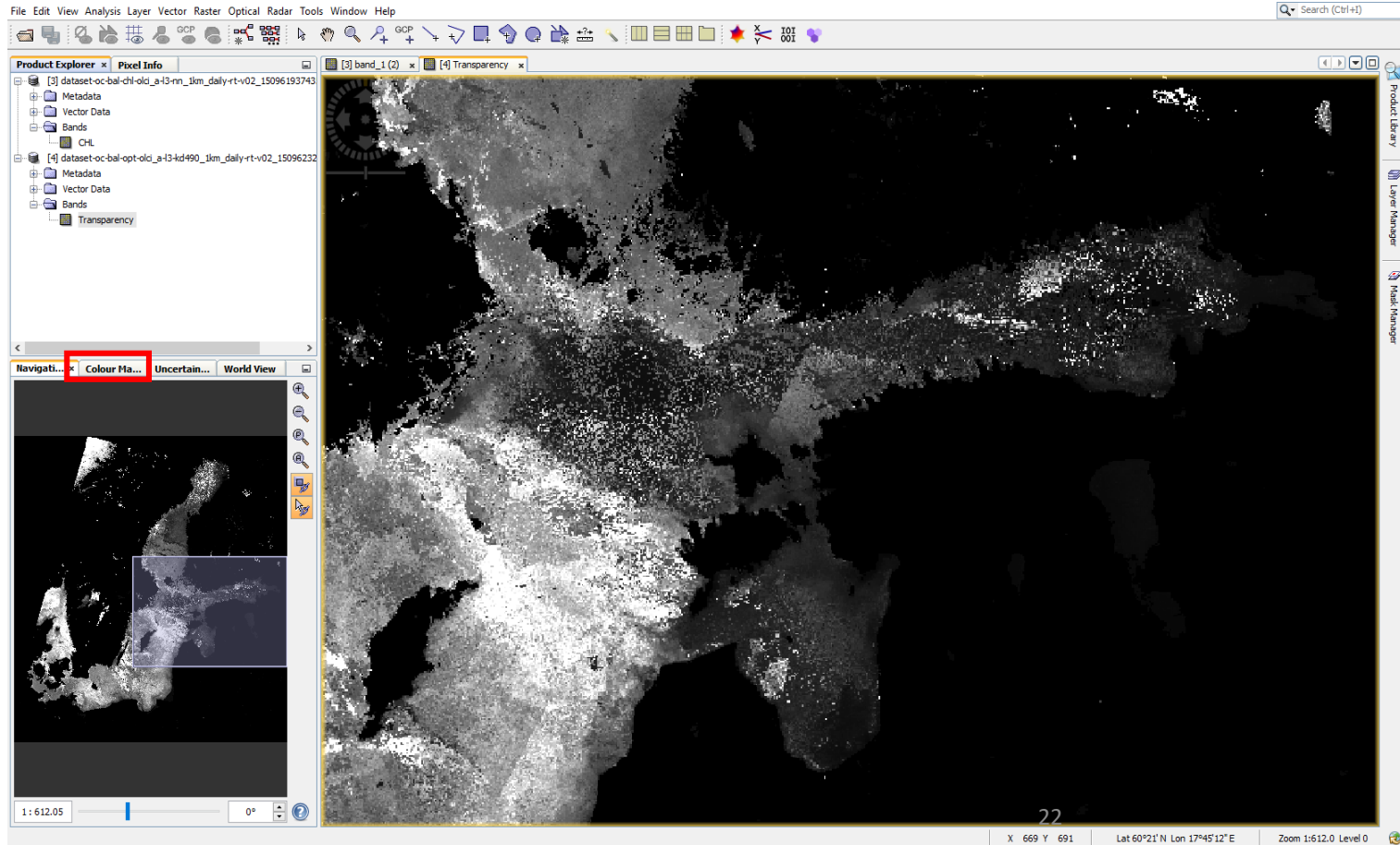
Files of type: All Files

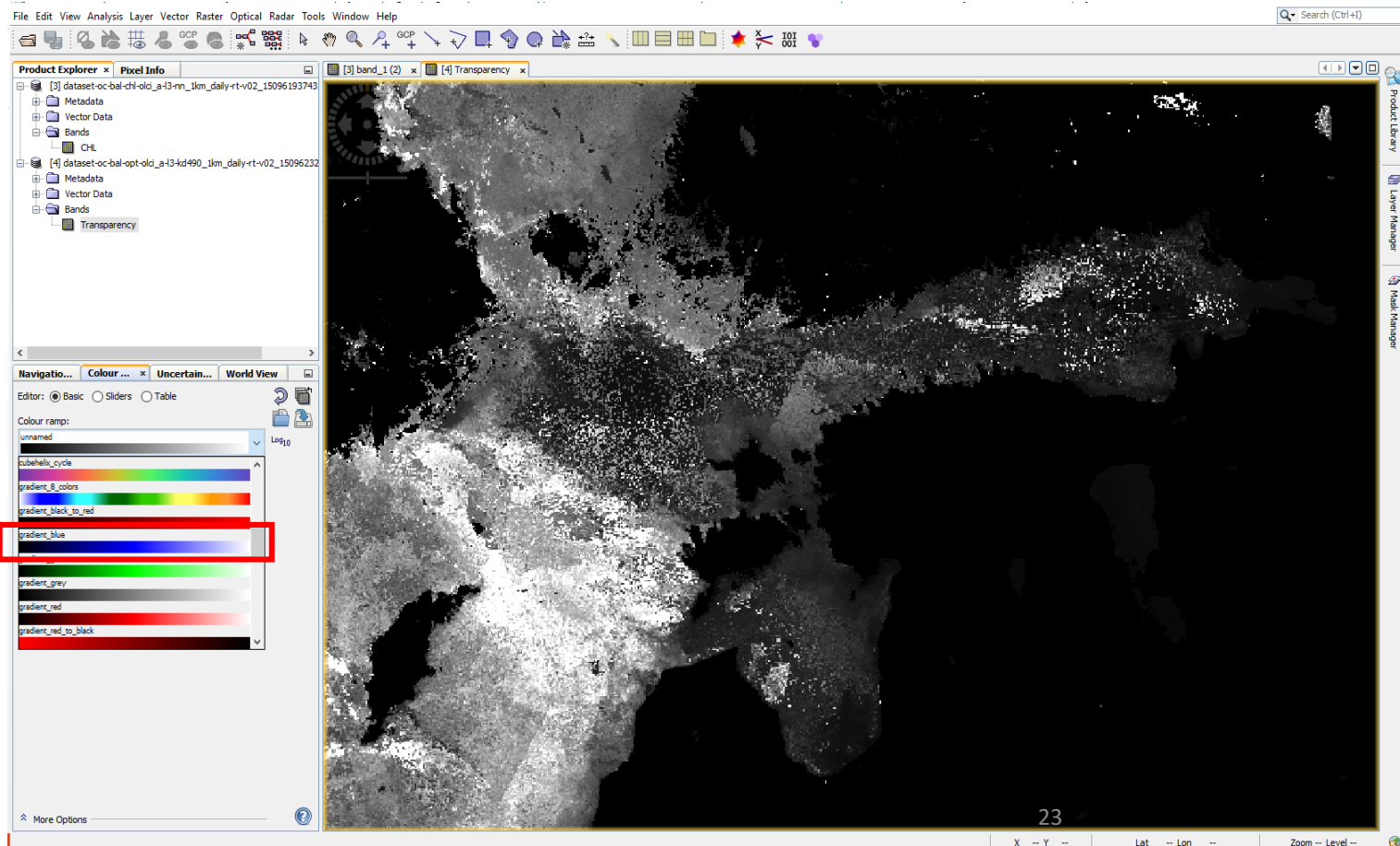
Open Cancel

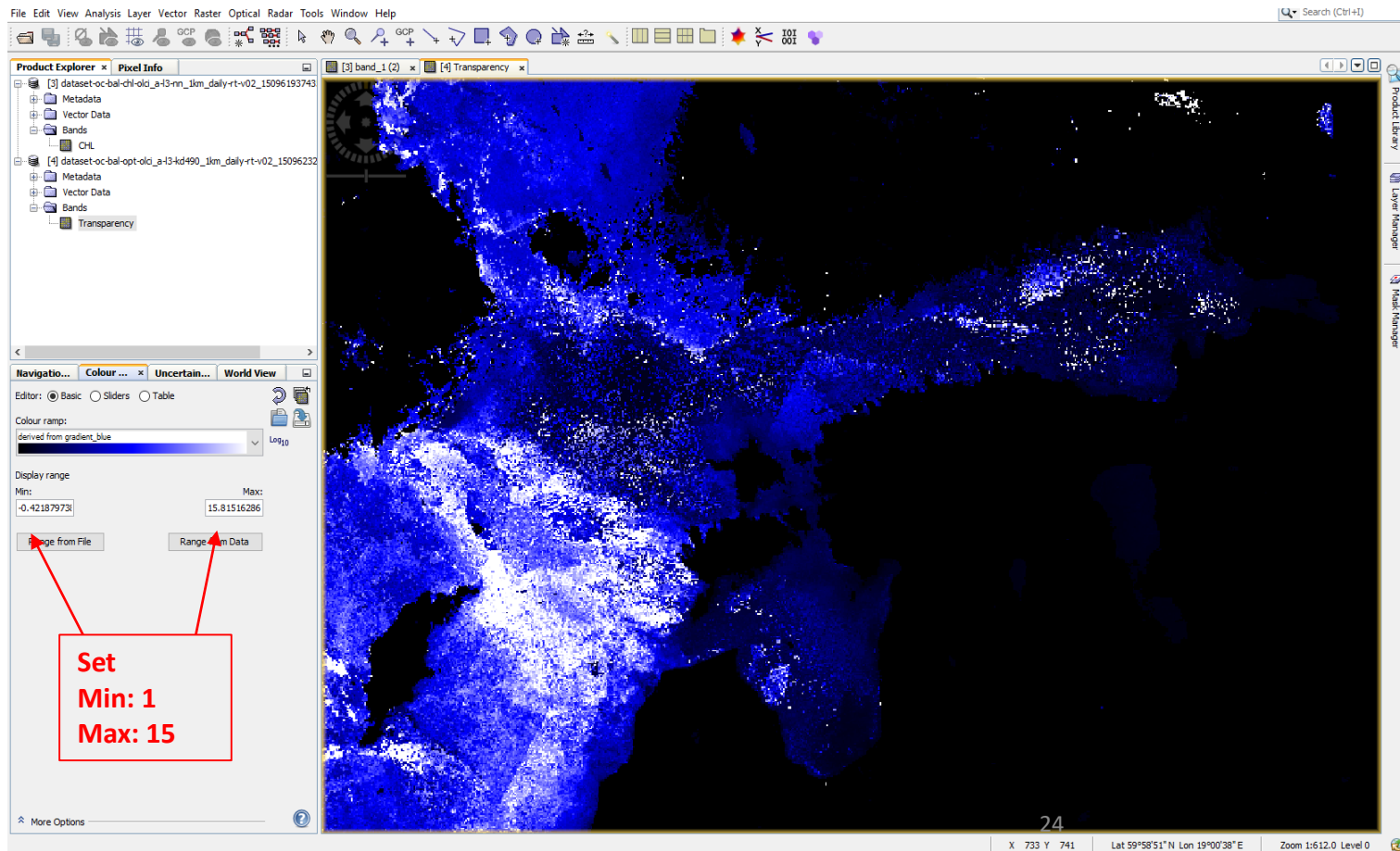
20

X 831 Y 818 Lat 59°23'16" N Lon 20°52'58" E Zoom 1:830.3 Level 0

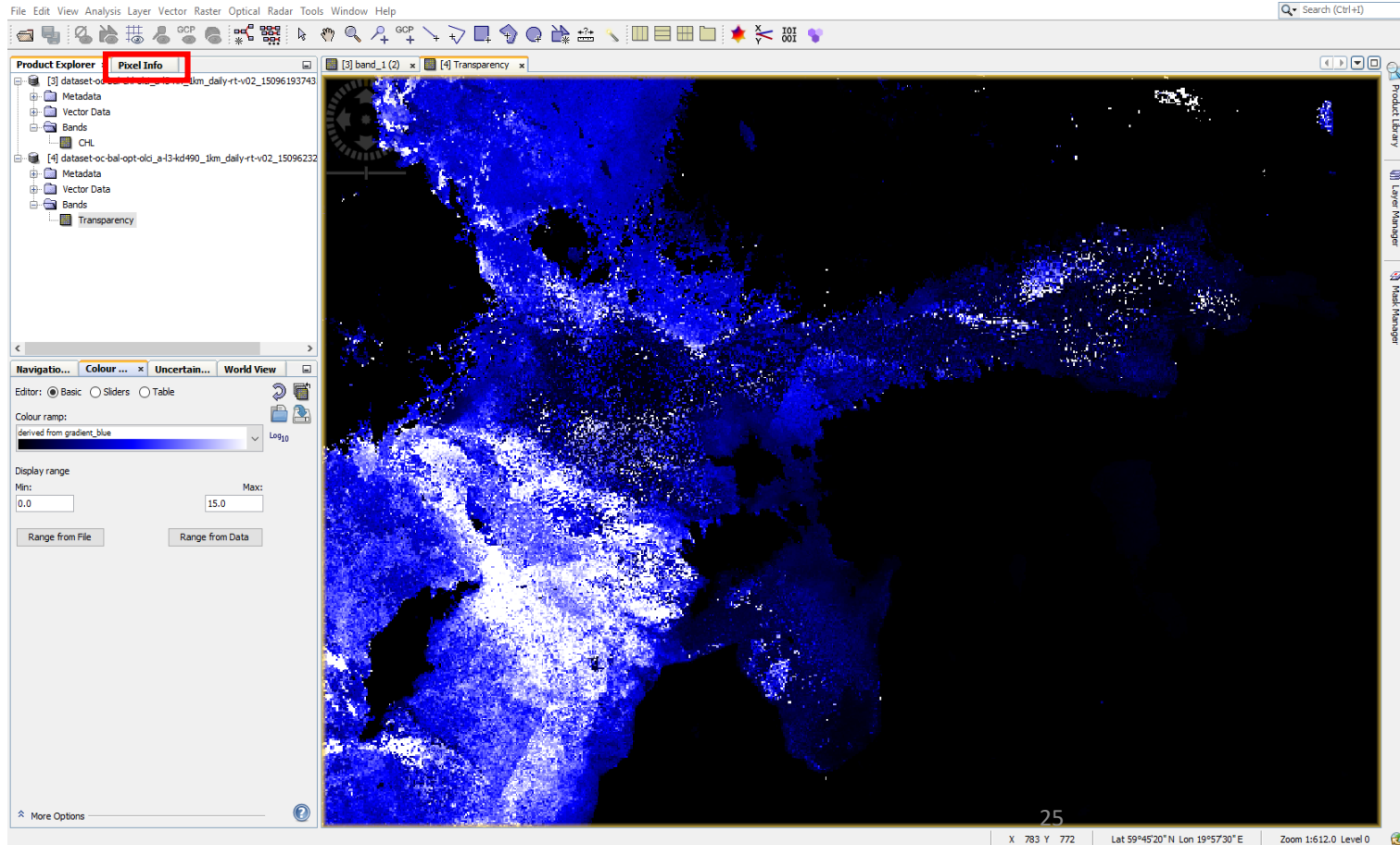


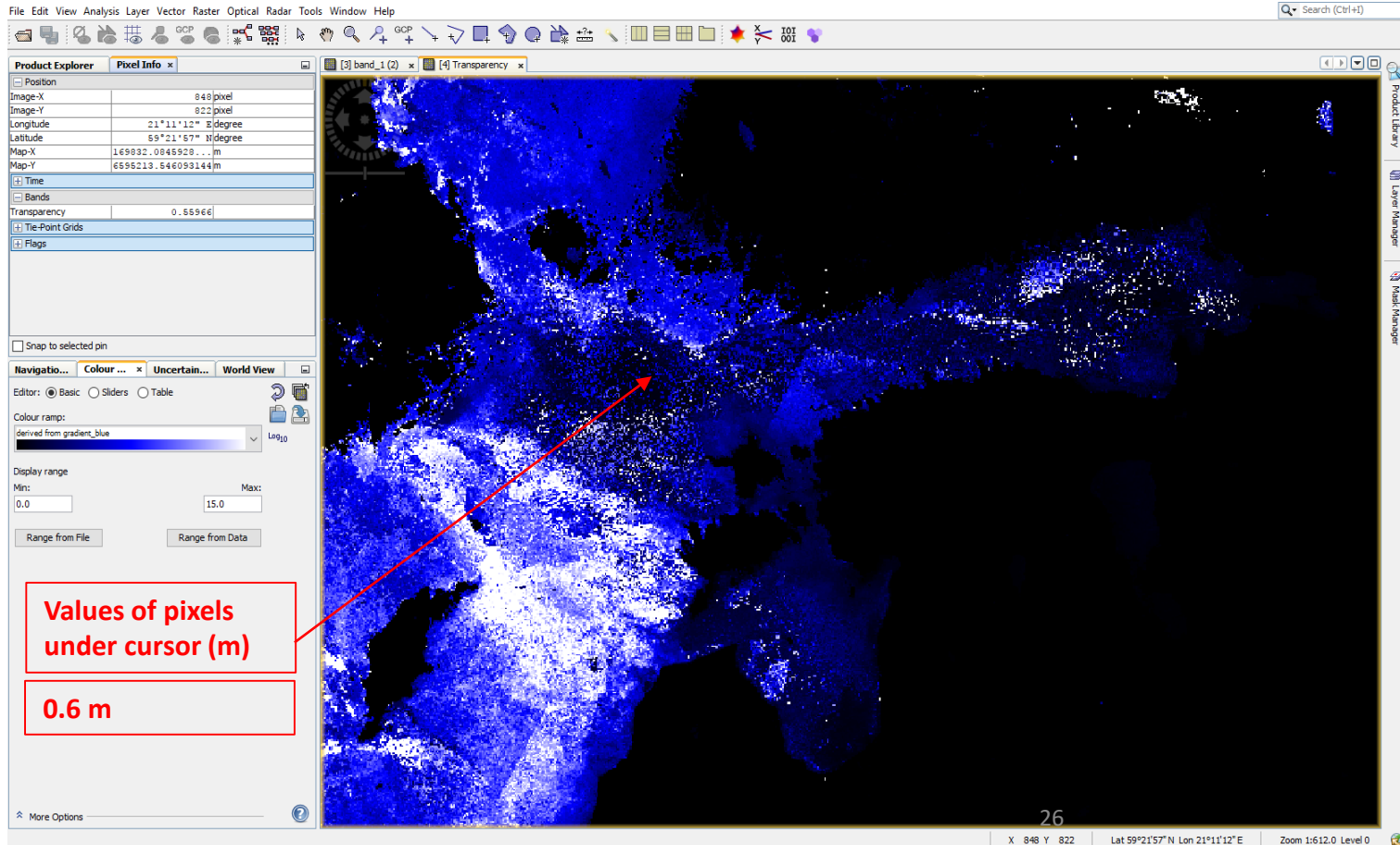






Next

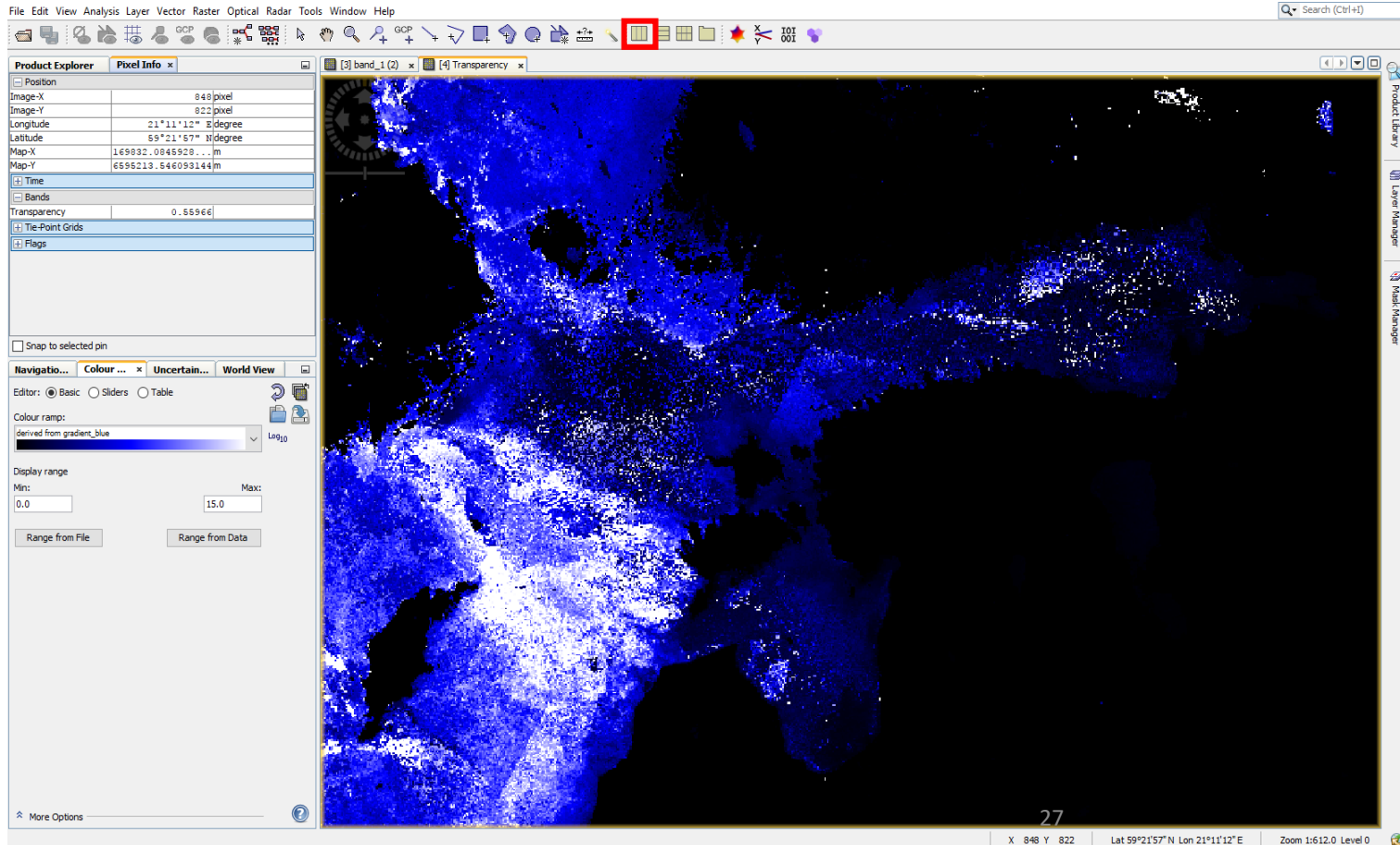


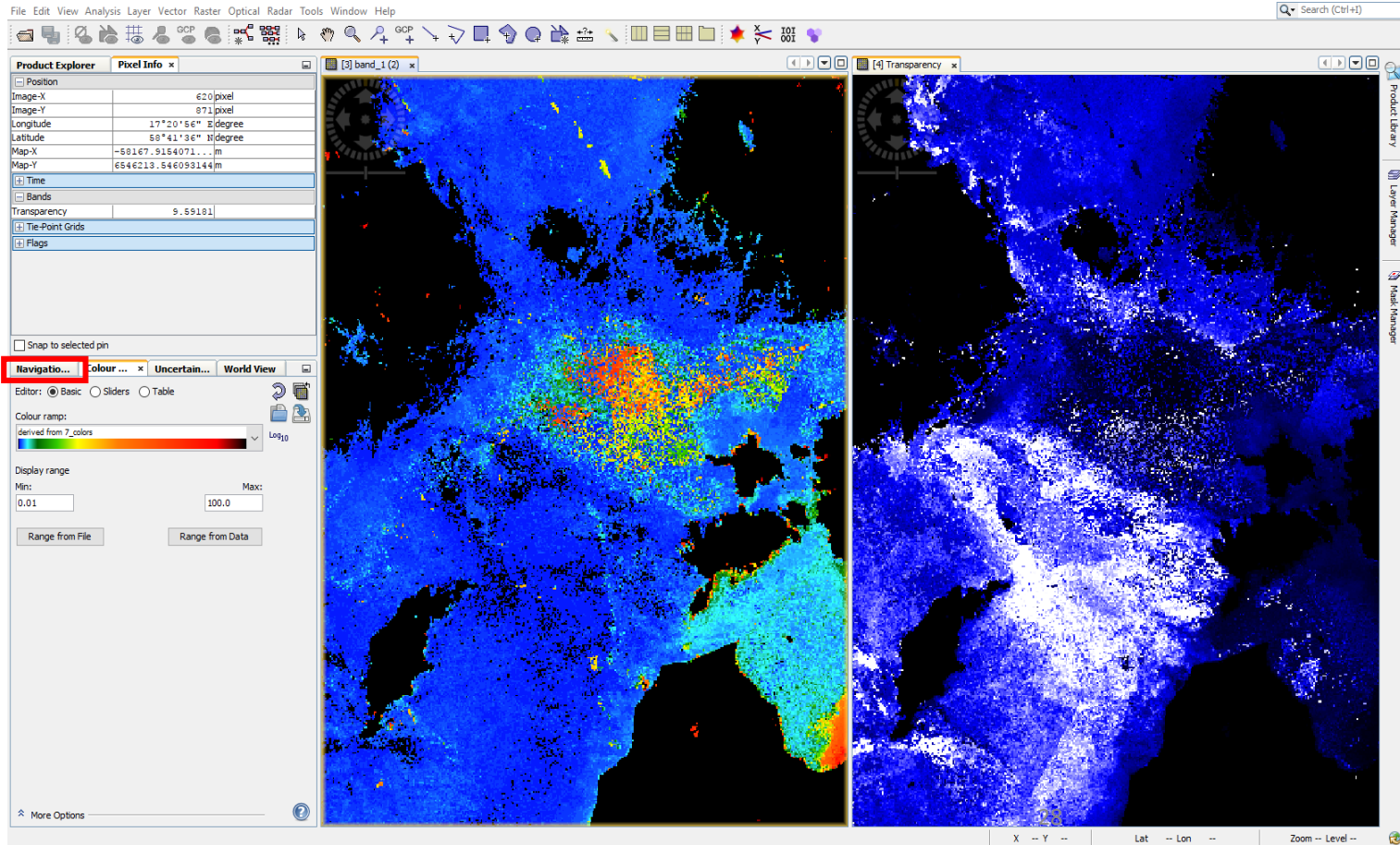


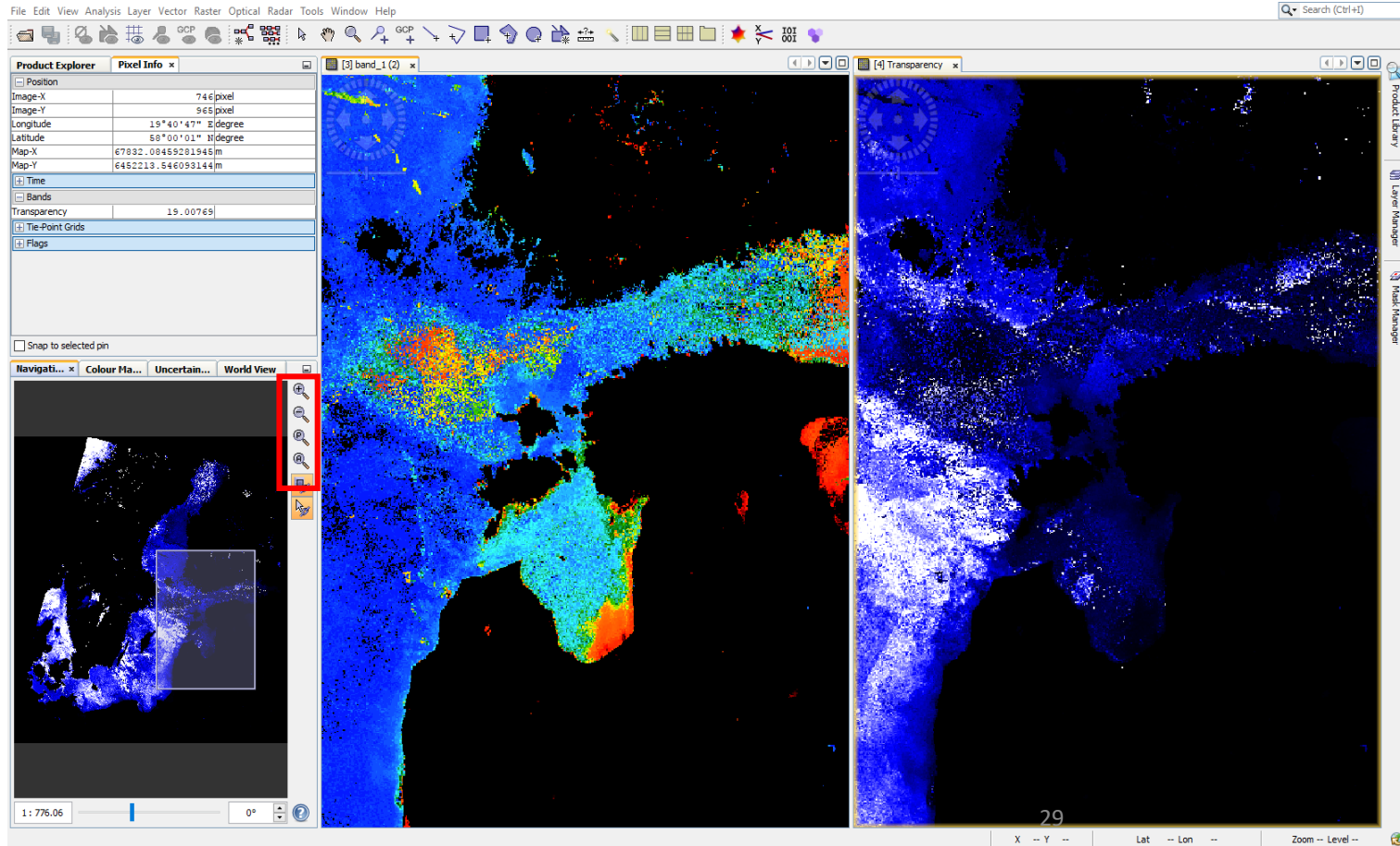
Values of pixels
under cursor (m)

0.6 m

Next









The screenshot displays the Marine Monitoring software interface. The main window shows a map with a color-coded overlay. The 'File' menu is open, and the 'Import' option is selected, leading to a submenu where 'ESRI Shapefile' is highlighted. The 'Import Shapefile' dialog is open, showing the file 'Zones_TSI.shp' in the 'Look in: Zones' folder. The 'Open' button is highlighted. The 'Import Geometry' dialog is also open, asking if the vector data set (containing 10 polygonal shapes) should be imported separately. The 'Yes' button is highlighted.

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
Files of type: ESRI Shapefiles (*.shp)
Open
Cancel

Import Geometry

The vector data set contains 10 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.

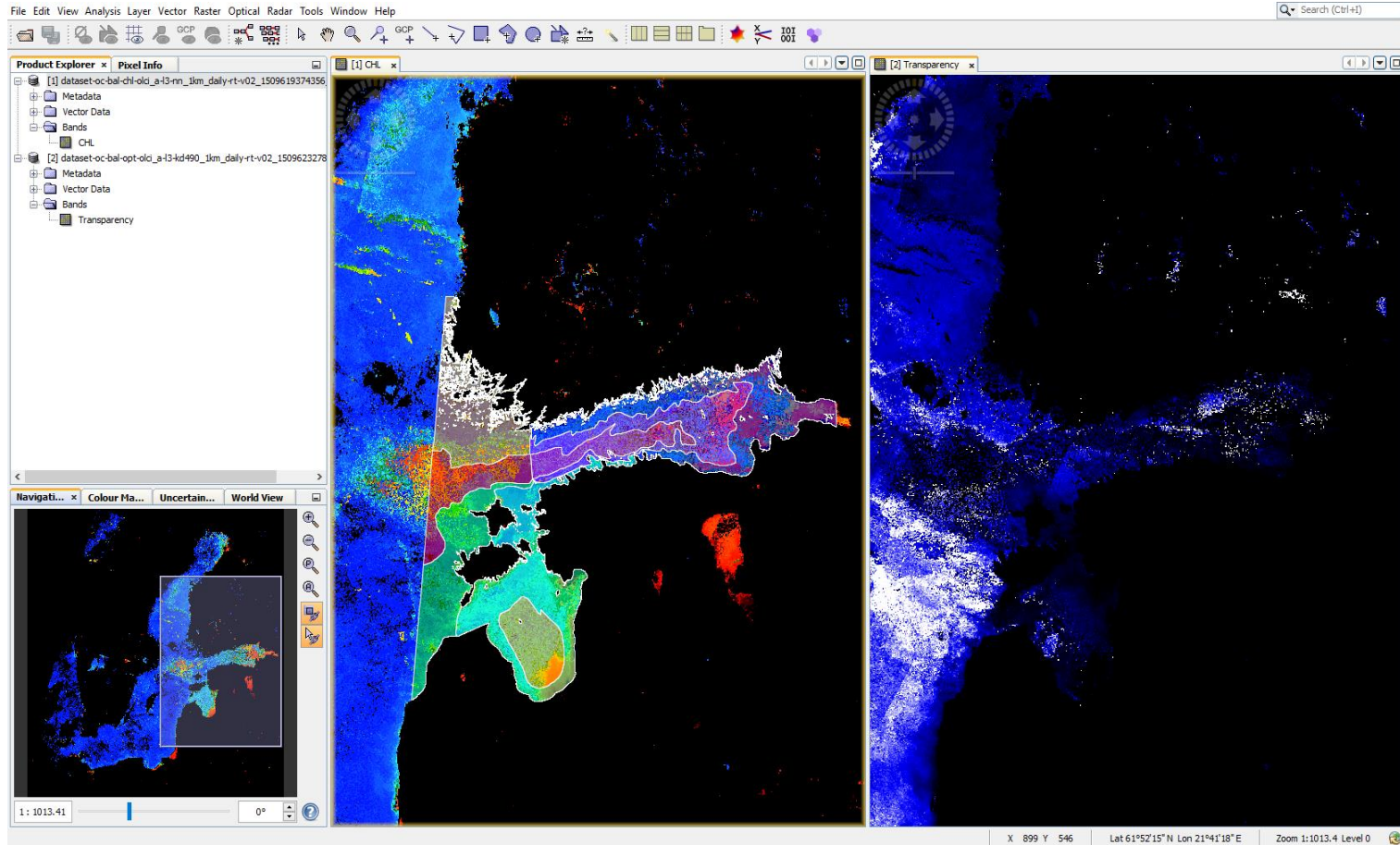
Attribute for mask/layer naming: terra

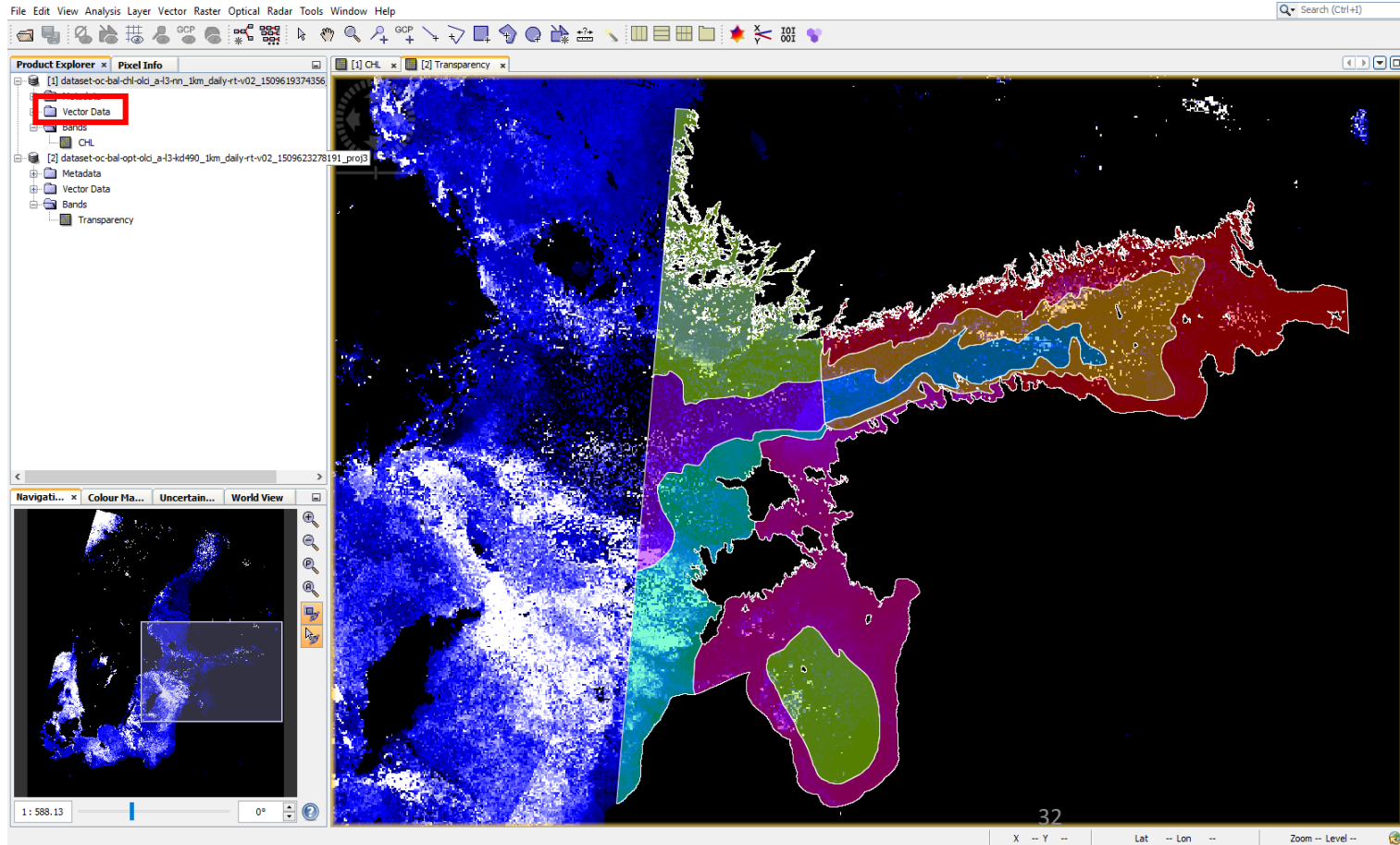
Yes No Help

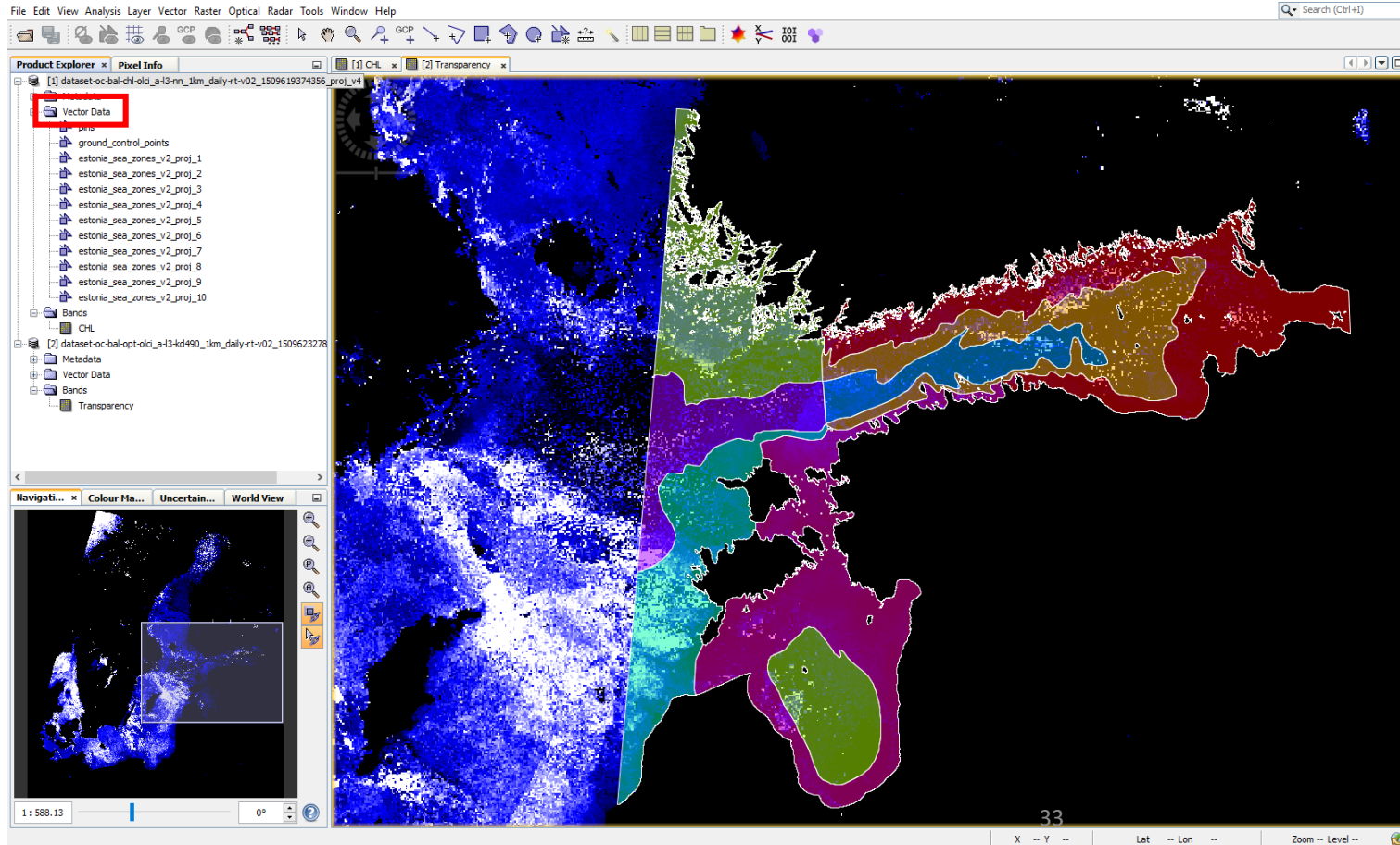
1: 776.06 0°

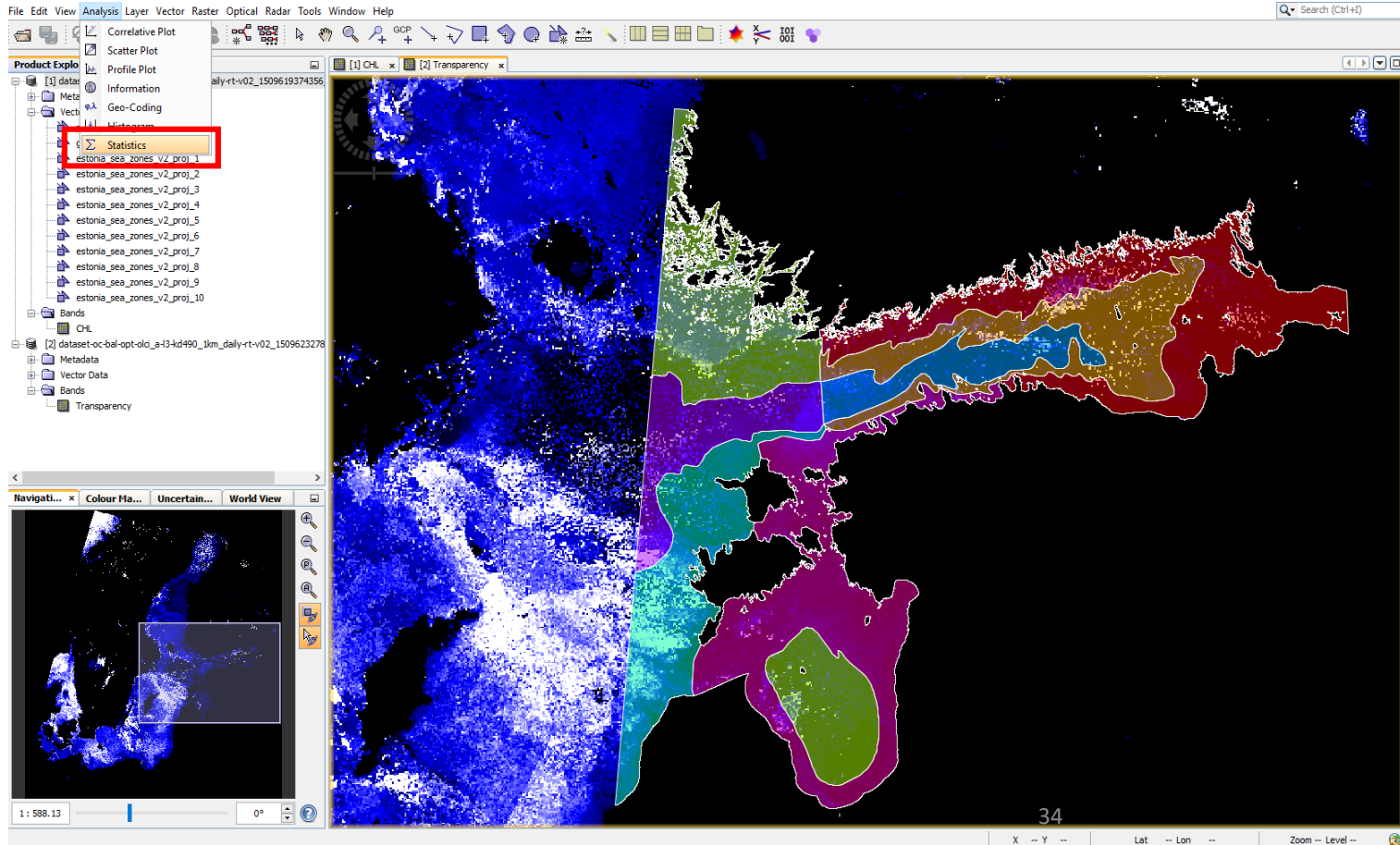
30

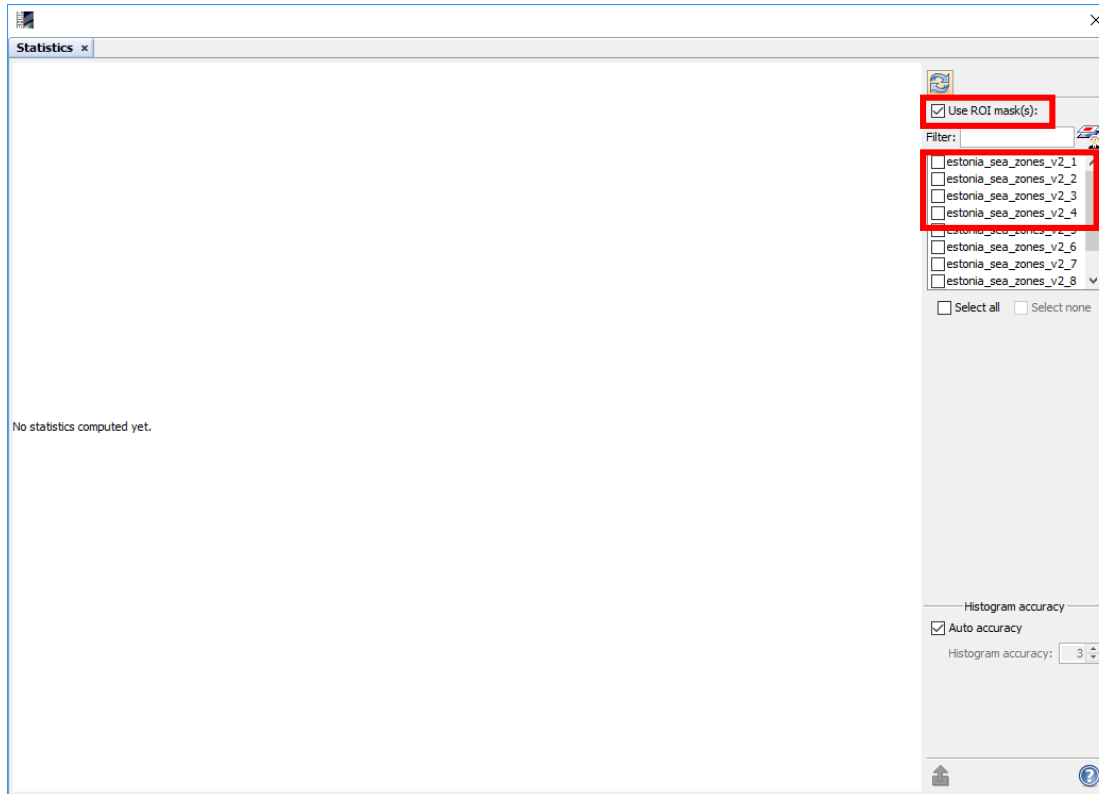
X -- Y -- Lat -- Lon -- Zoom -- Level --

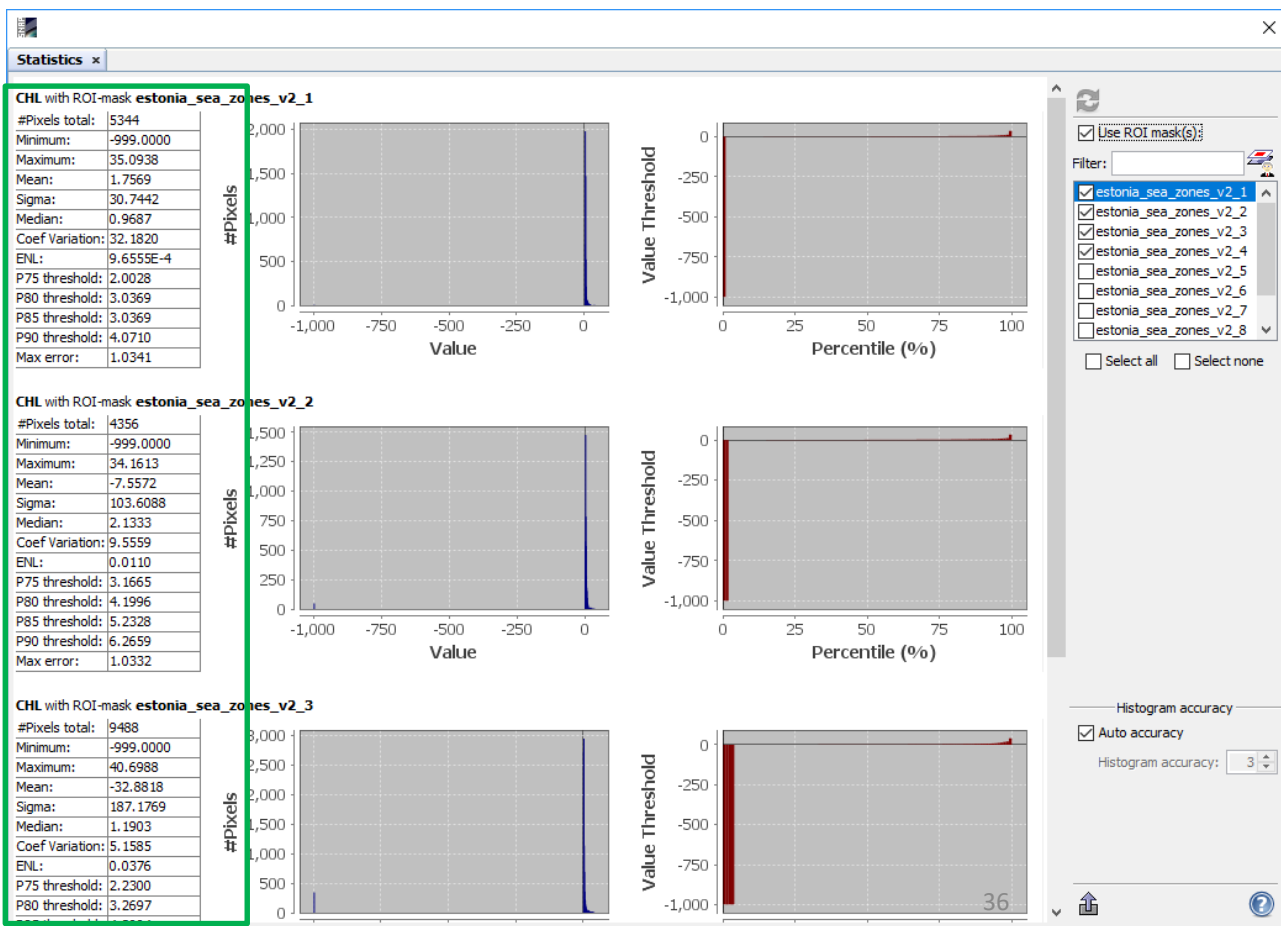












Next



```
D:\pke115_Coastal_2\SNAP_Zonal_Statistics\Launch_modello.bat - Notepad++
File Edit Search View Encoding Language Settings Macro Run Plugins Window ?

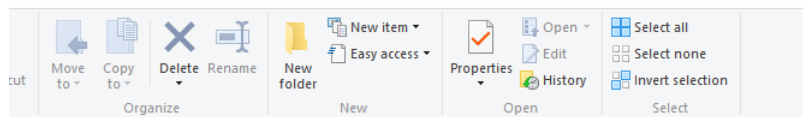
Launch_modello.bat
1 gpt -e "D:\MarineZoneStats.xml"
2 -PProductPath="D:\CMEMS\*.nc"
3 -PBandName="CHL"
4 -PZonazione="D:\Zones\Zones_TSI.shp"
5 -POutName="D:\Temp\Chl_Stats.shp"
6
7 gpt -e "D:\MarineZoneStats.xml"
8 -PProductPath="D:\WT\*.tif"
9 -PBandName="band_1"
10 -PZonazione="D:\Zones\Zones_TSI.shp"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

MarineZoneStats.xml
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>
```

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

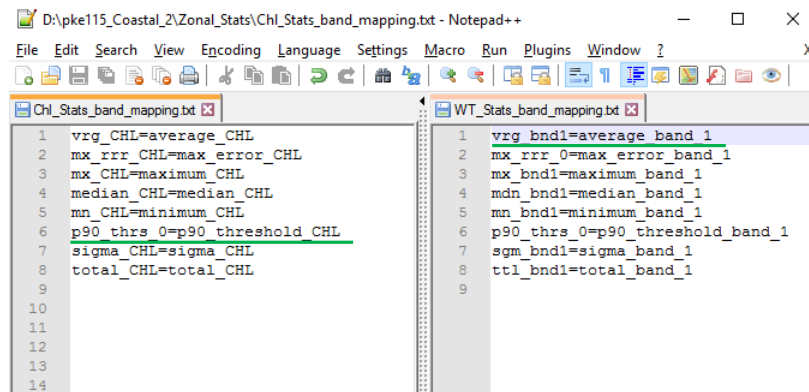
SNAP GPT configuration file (xml)

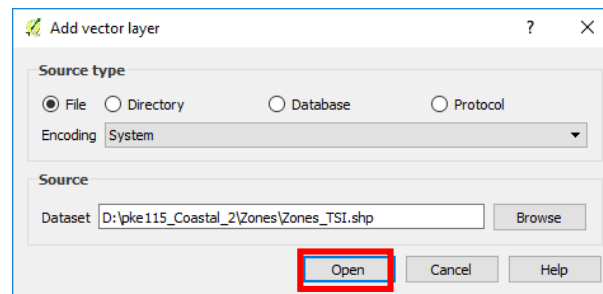
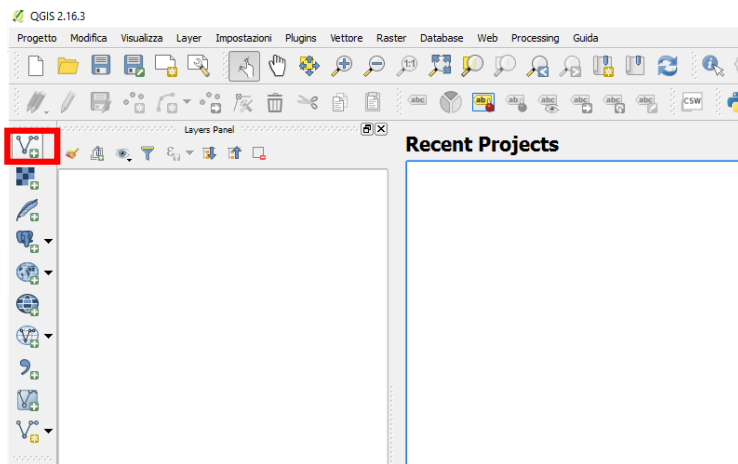
Next

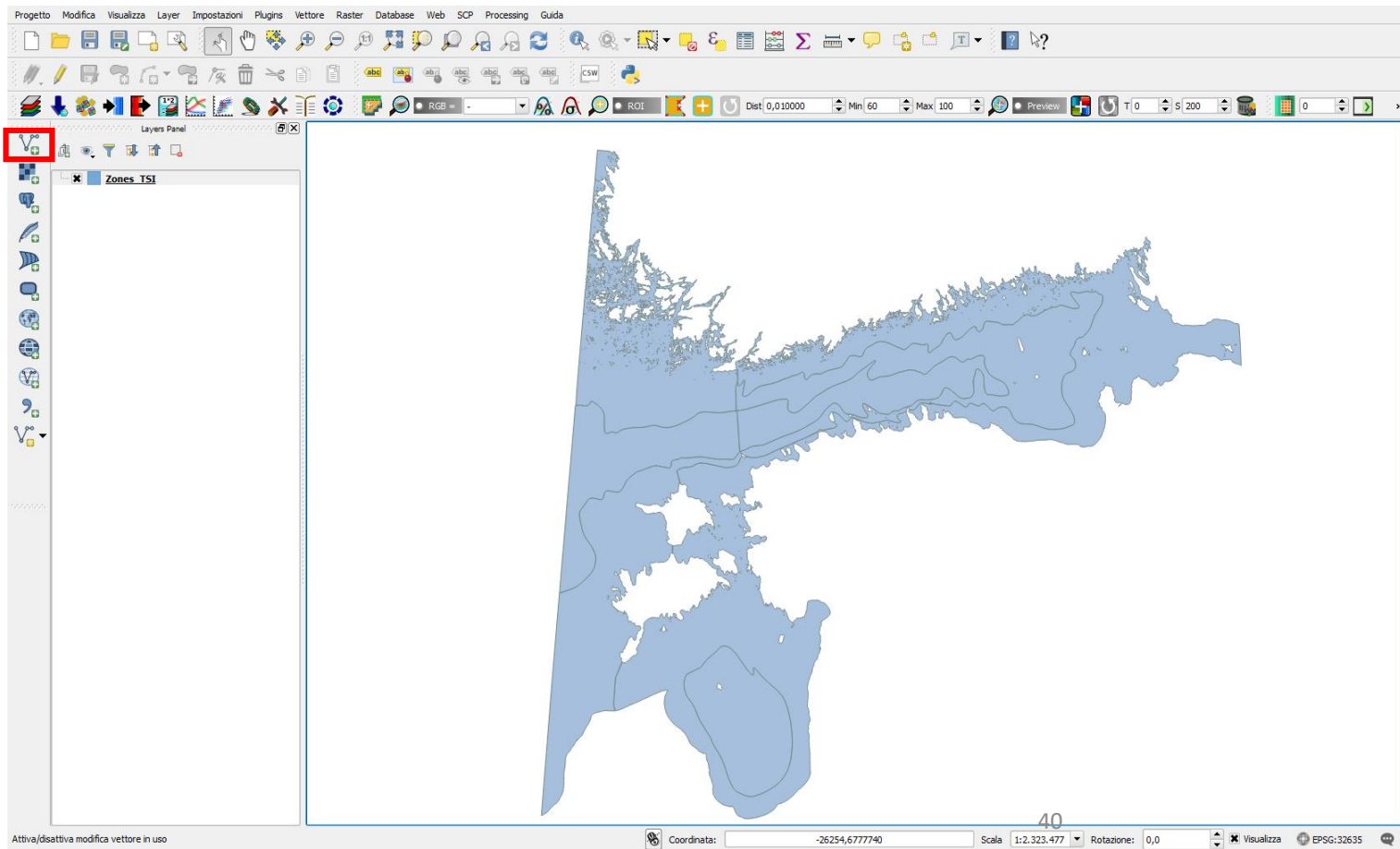


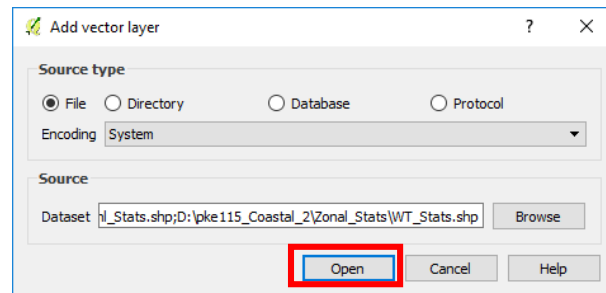
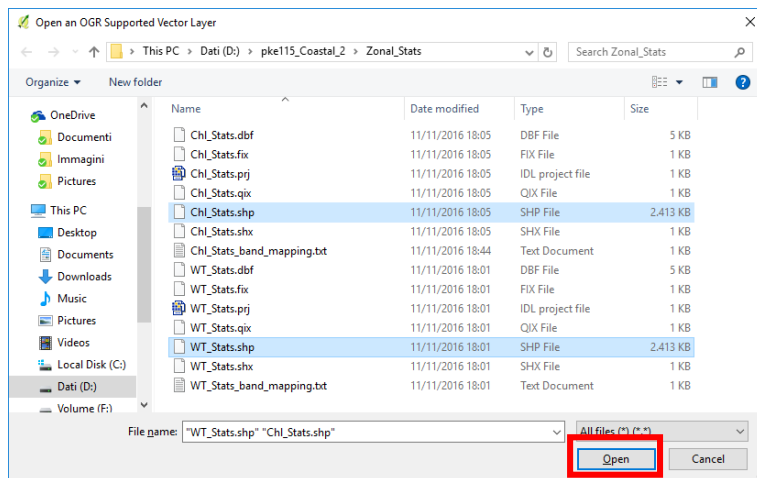
D:\ > pke115_Coastal_2 > Zonal_Stats

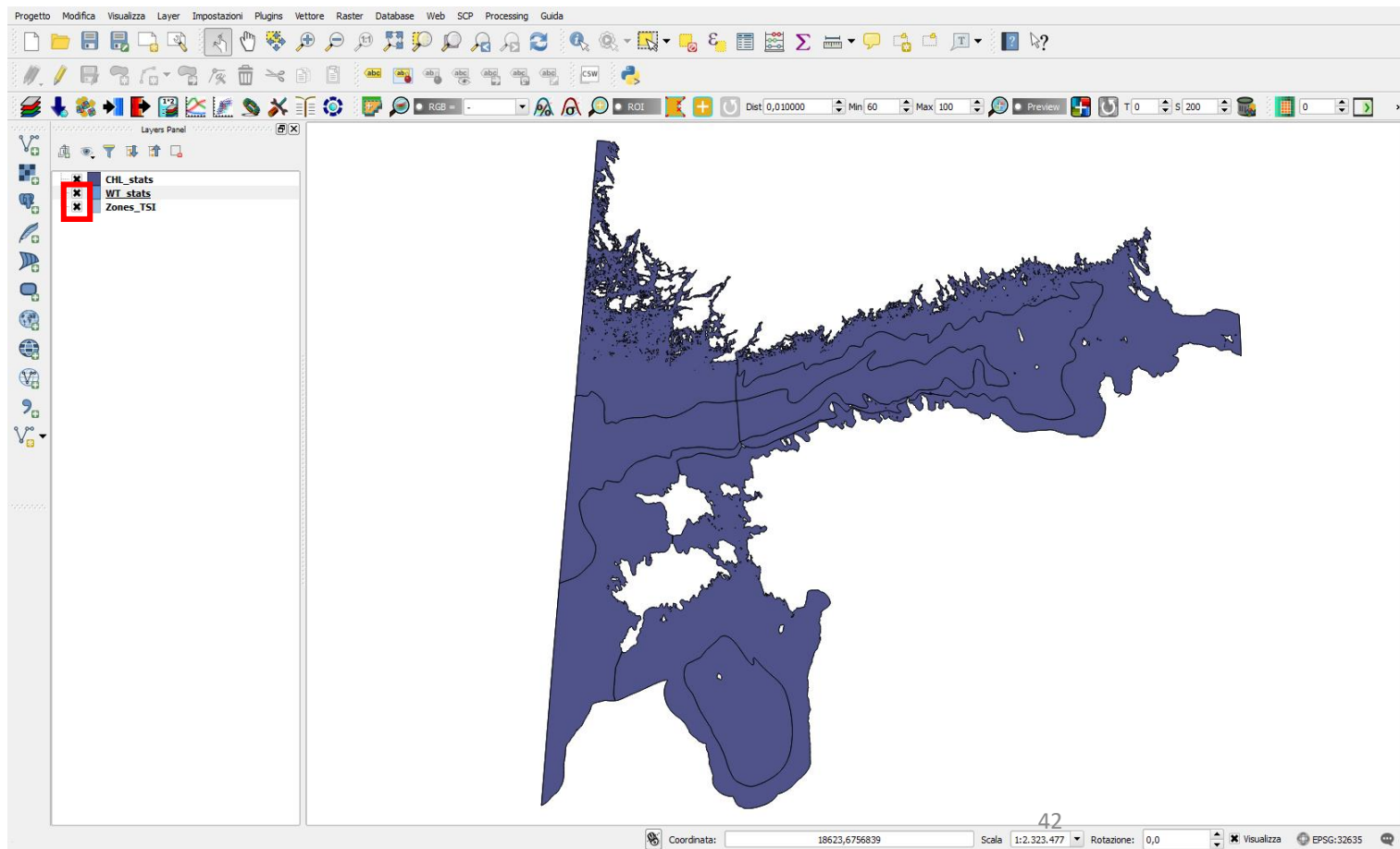
Name	Date modified	Type	Size
Chl_Stats.dbf	11/11/2016 18:05	DBF File	5 KB
Chl_Stats.fix	11/11/2016 18:05	FIX File	1 KB
Chl_Stats.prj	11/11/2016 18:05	IDL project file	1 KB
Chl_Stats.qix	11/11/2016 18:05	QIX File	1 KB
Chl_Stats.shp	11/11/2016 18:05	SHP File	2.413 KB
Chl_Stats.shx	11/11/2016 18:05	SHX 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











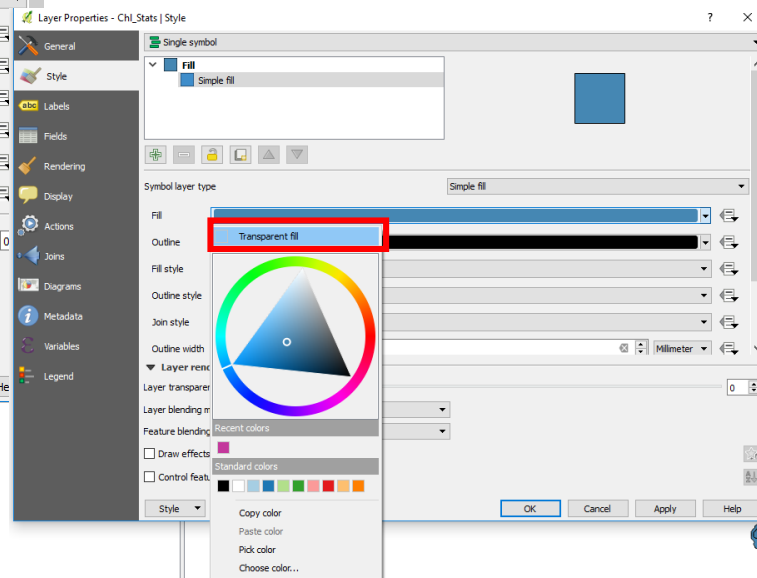
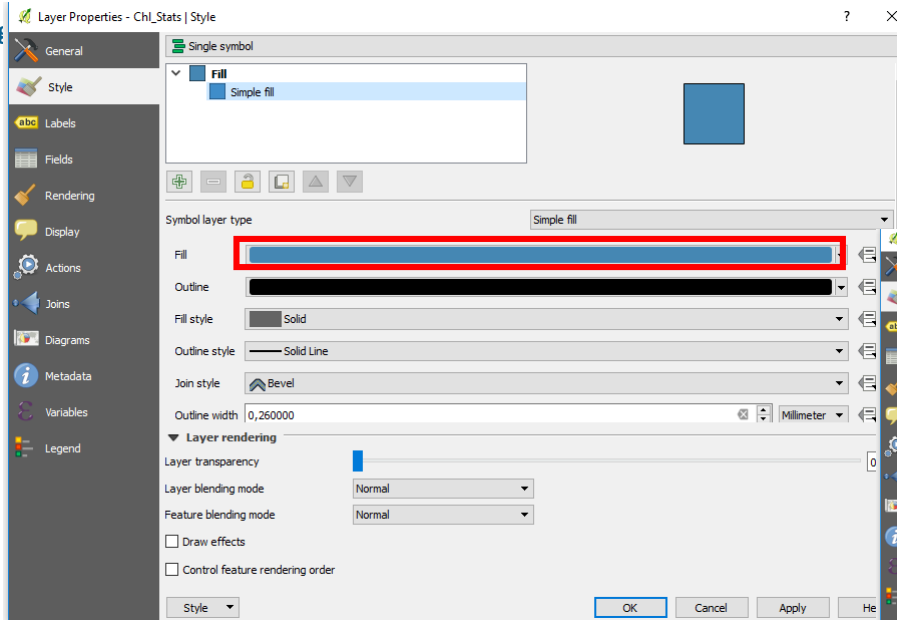


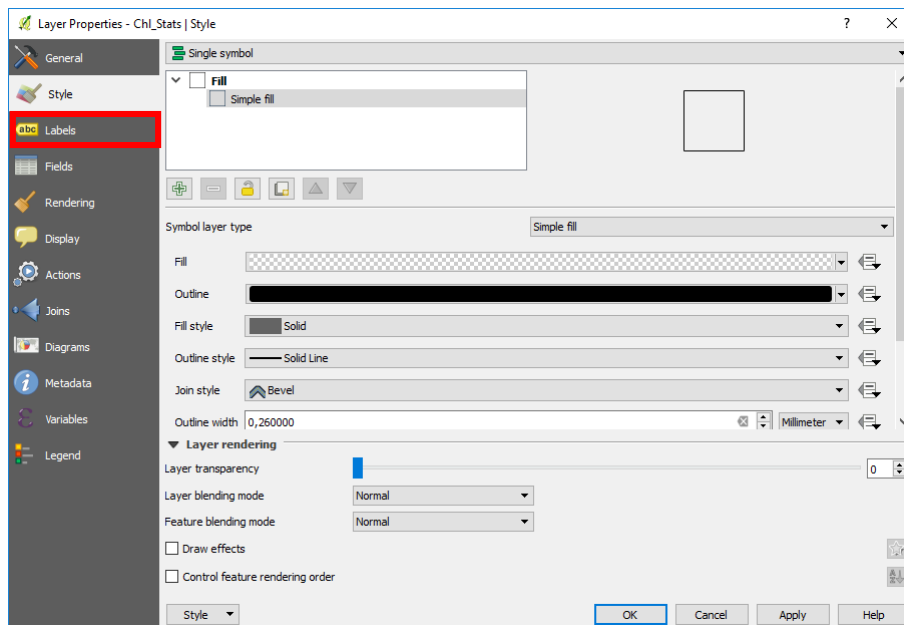
Layers Panel

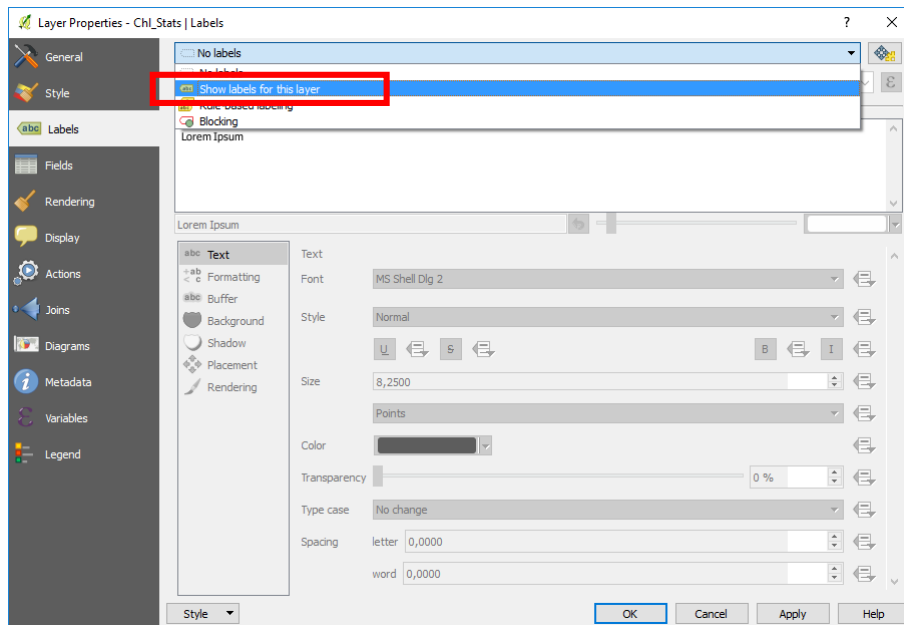
- Zoom sul layer
- ☐ Aggiungi alla panoramica
- ☐ Rimuovi
- ☐ Duplica
- Imposta la scala di visibilità del layer
- Imposta il SR del layer
- Imposta il SR del progetto dal layer
- Stili
- Apri tabella attributi
- Modifica
- Salva con nome...
- Salva come file di definizione del layer...
- Filtro...
-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

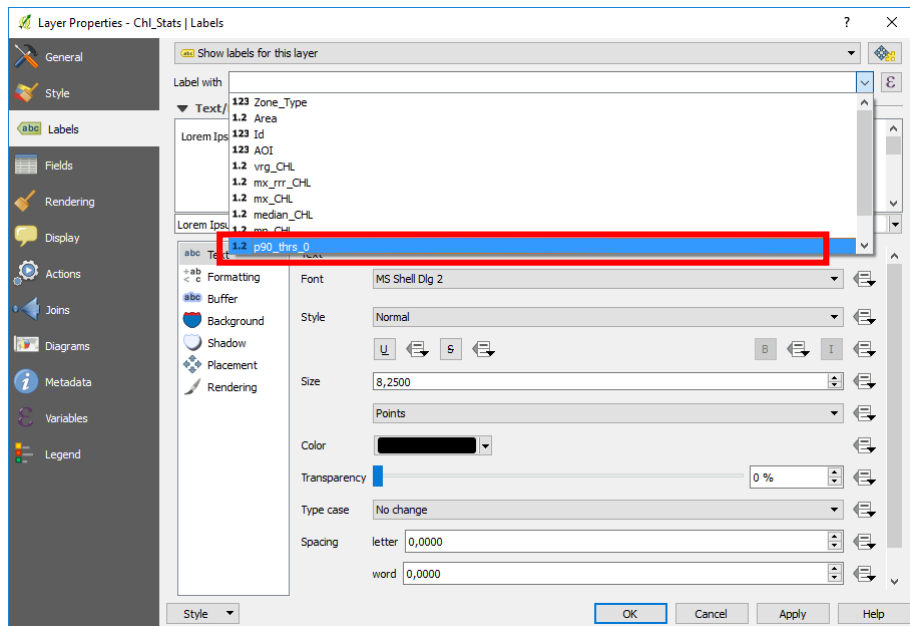
Attiva/disattiva modifica vettore in uso

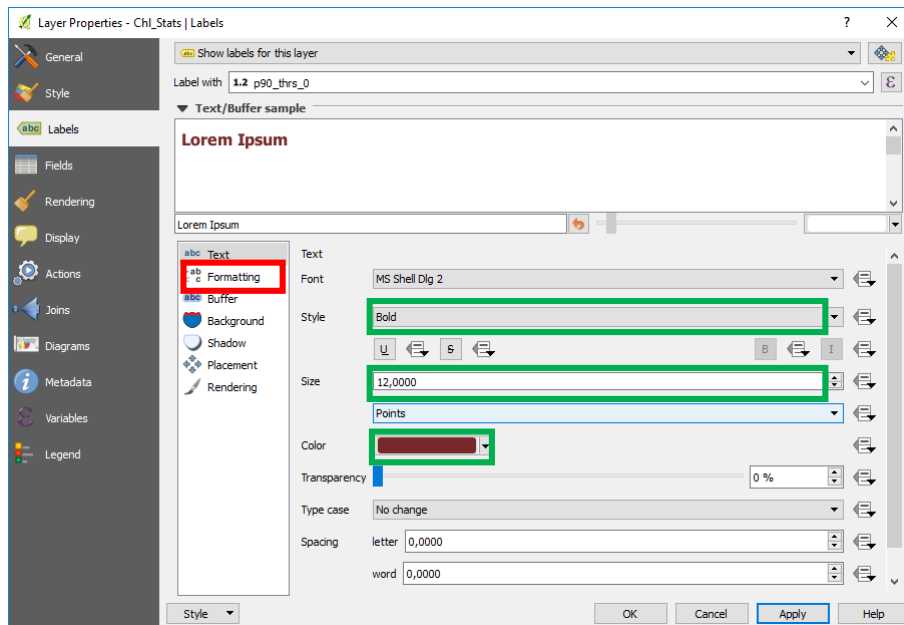
Coordinata: -15189,6760527 Scala 1:2.323.477 Rotazione: 0,0 Visualizza EPSG:32635

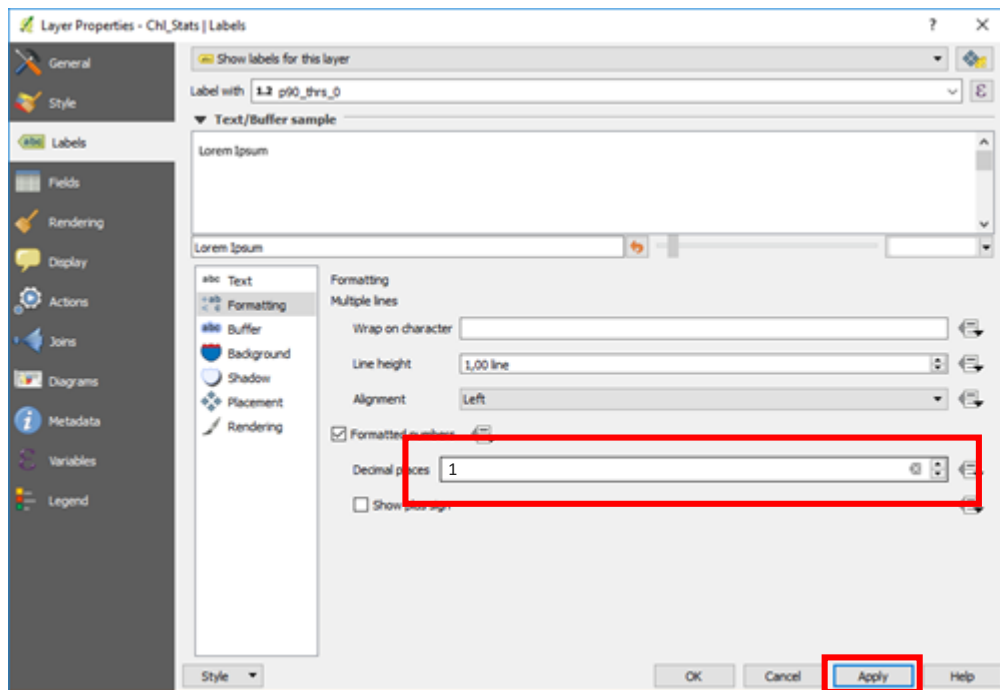


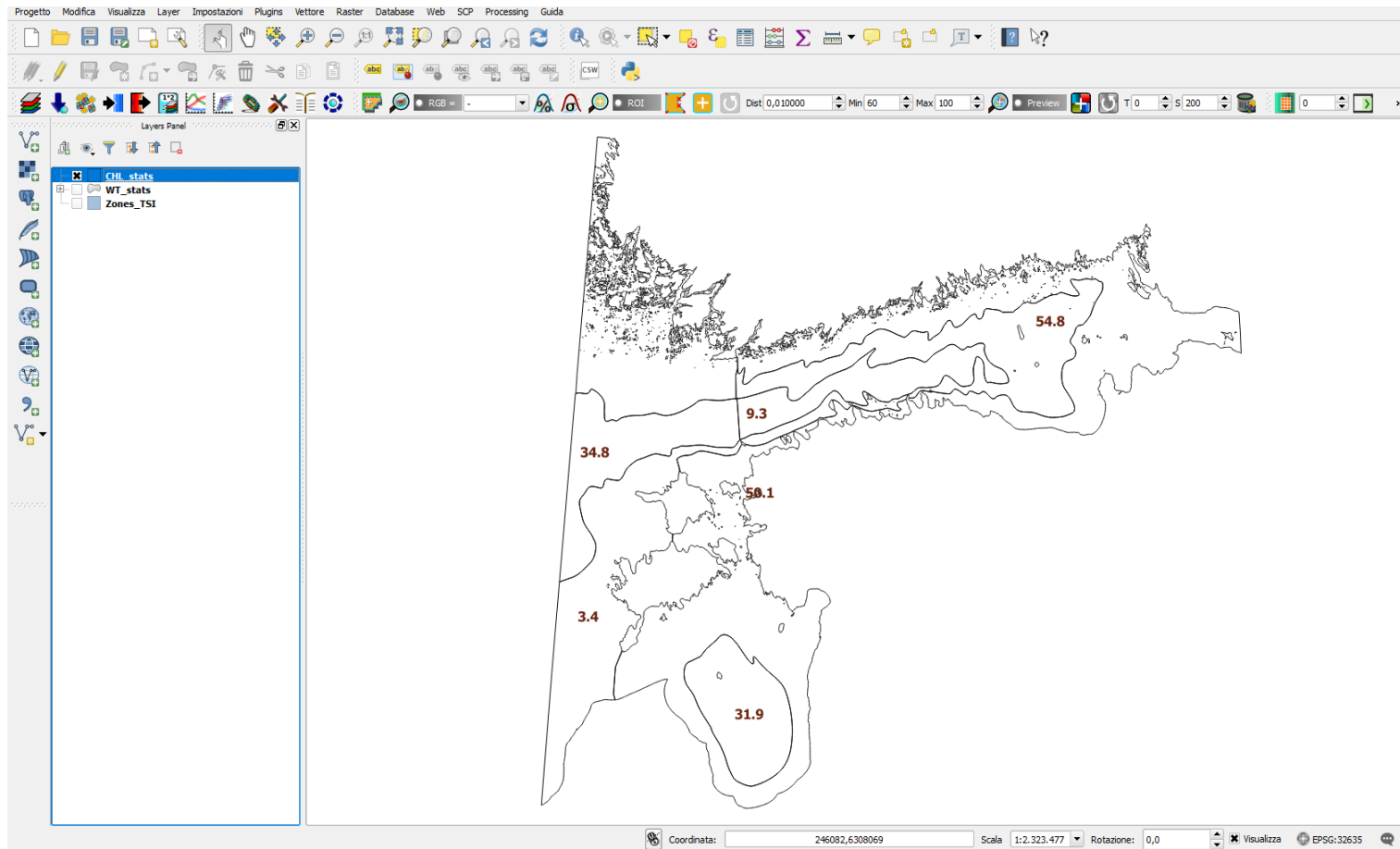




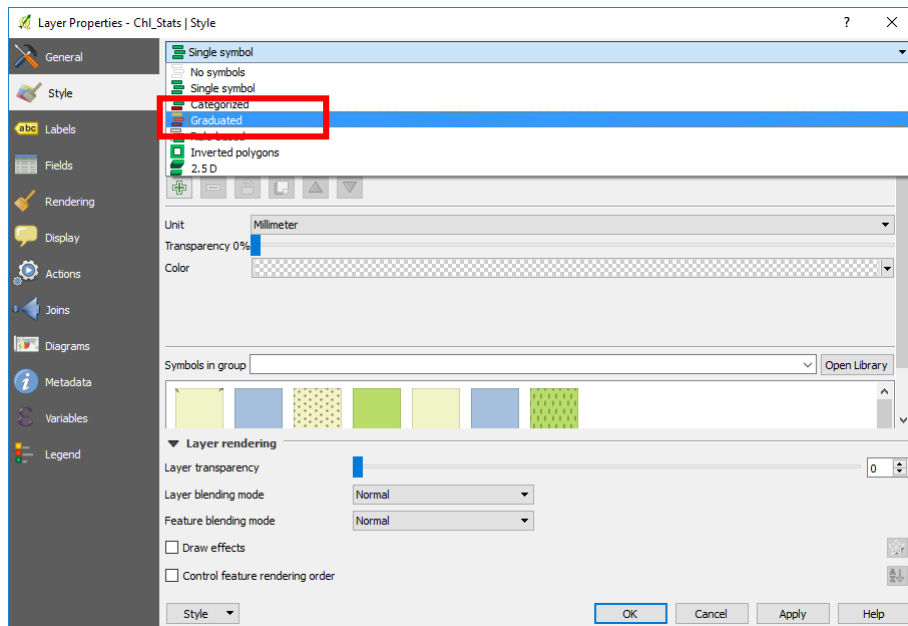








Next





Layer Properties - Chl_Stats | Style

General

Style

Labels

Fields

Rendering

Display

Actions

Joins

Diagrams

Metadata

Variables

Legend

Graduated

Column: 1.2 p90_thrs_0

Symbol: [Change...]

Legend Format: %1 - %2 Precision 1 Trim

Method: Color

Color ramp: [source] Edit Invert

Classes Histogram

Symbol	Values	Legend
<input checked="" type="checkbox"/> [Green]	0.100 - 3.926	0.0996 - 3.9258
<input checked="" type="checkbox"/> [Light Green]	3.926 - 7.752	3.9258 - 7.7521
<input checked="" type="checkbox"/> [Yellow]	7.752 - 11.578	7.7521 - 11.5784

Mode: Equal Interval Classes: 5

Classify [Add] [Remove] Delete all Advanced

☒ Link class boundaries

Layer rendering

Layer transparency: [Slider] 0

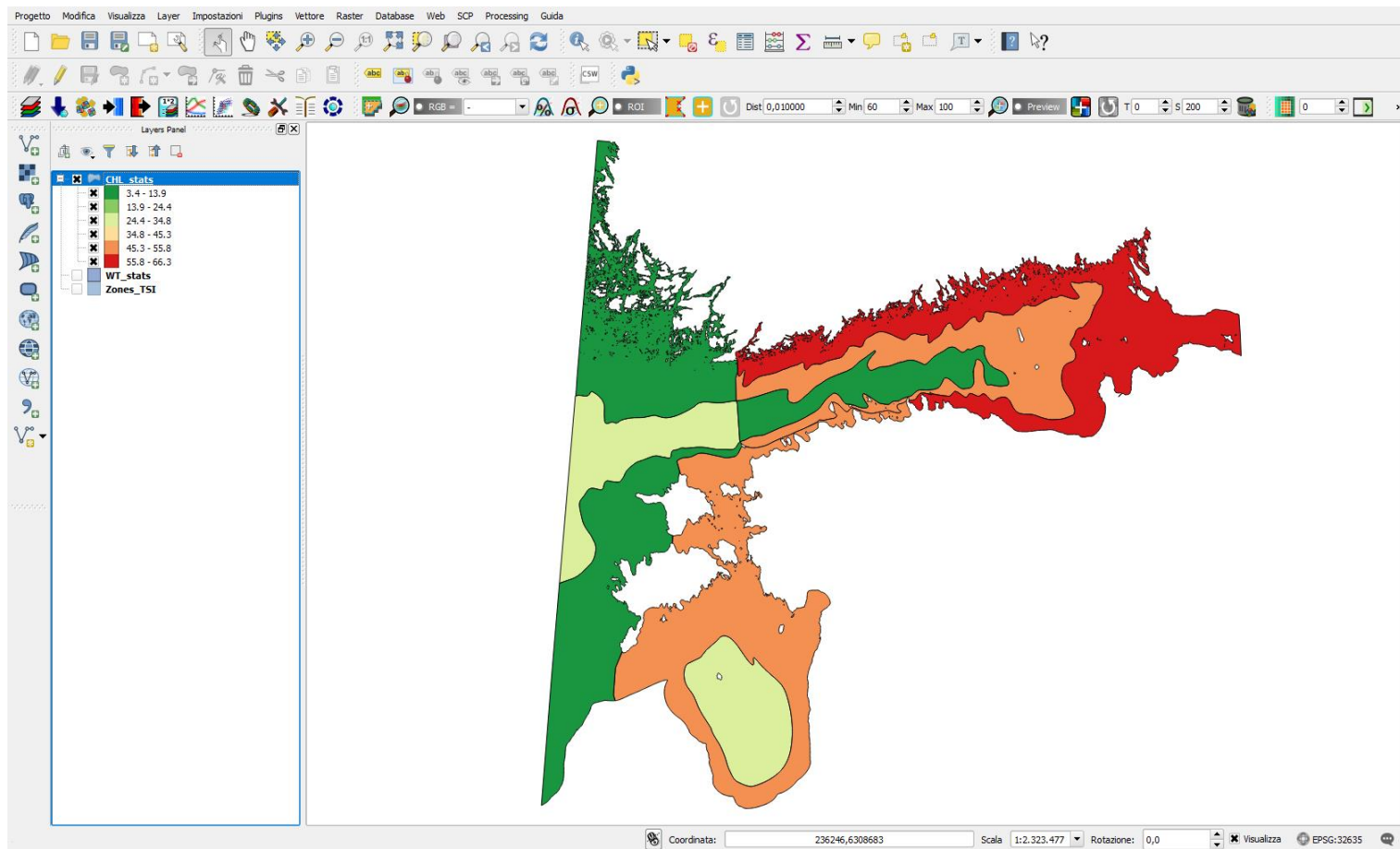
Layer blending mode: Normal

Feature blending mode: Normal

☐ Draw effects

☐ Control feature rendering order

Style [OK] Cancel Apply Help



Next



Layer Properties - WT_Stats | Style

General

Style

Column: 1.2_vrg_bnd1

Symbol: [Change...]

Legend Format: %1 - %2 Precision 1 Trim

Method: Color

Color ramp: [source] Edit Invert

Classes

Symbol	Values	Legend
<input checked="" type="checkbox"/>	2.352 - 8.126	2.3522 - 8.1265
<input checked="" type="checkbox"/>	8.126 - 13.901	8.1265 - 13.9007
<input checked="" type="checkbox"/>	13.901 - 19.675	13.9007 - 19.6750

Mode: Equal Interval

Classify [] [] Delete all

☒ Link class boundaries

Layer rendering

Layer transparency: []

Layer blending mode: Normal

Feature blending mode: Normal

☐ Draw effects

☐ Control feature rendering order

Style []

OK Cancel Apply

Layer Properties - WT_Stats | Labels

General

Show labels for this layer

Label with: 1.2_vrg_bnd1

Text/Buffer sample

Lorem Ipsum

Text

Font: MS Shell Dlg 2

Style: Bold

Size: 12,0000

Points

Color: []

Transparency: 0 %

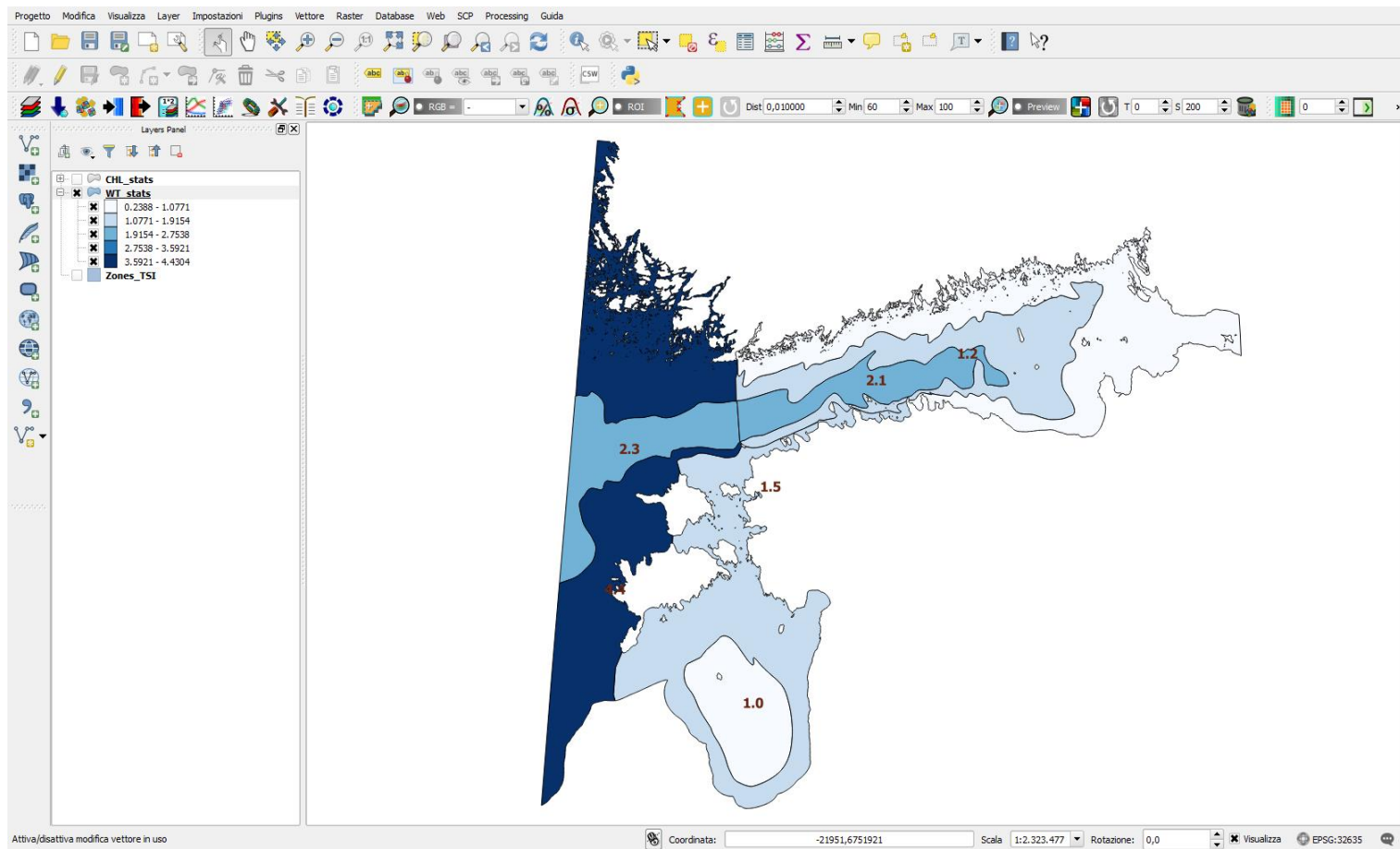
Type case: No change

Spacing: letter 0,0000 word 0,0000

Style []

OK Cancel Apply Help

Next





Marine
Monitoring

Thank you