

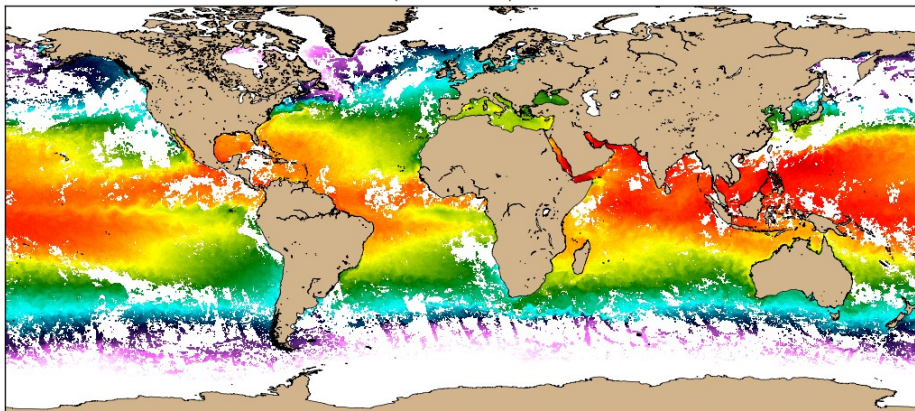
## ESA–MOST China Dragon 4 Cooperation

# → ADVANCED TRAINING COURSE IN OCEAN AND COASTAL REMOTE SENSING

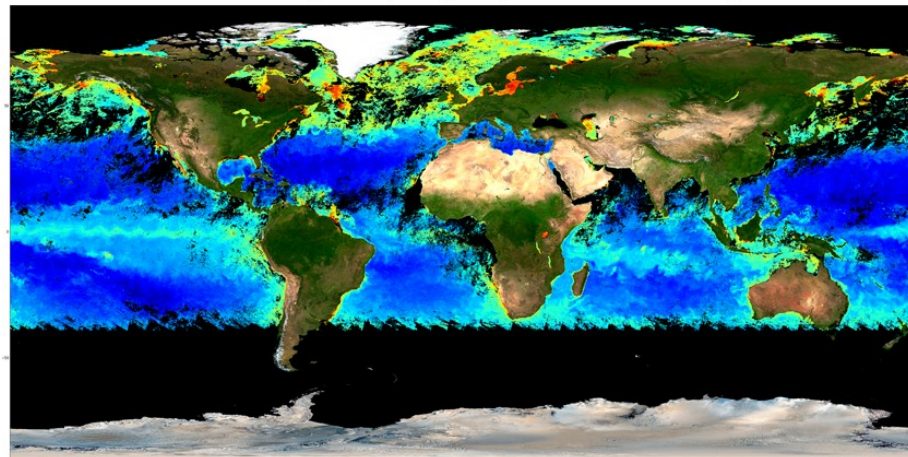
12 to 17 November 2018 | Shenzhen University | P.R. China

SST & OC synergy - SNAP S3 OLCI & SLSTR Data  
Francesco Nencioli, Plymouth Marine Laboratory

sea surface skin temperature  
15-19 Jun 2017 composite - Sentinel-3A / SLSTR WST NR [PB2.16]-  
N = 1427346, min = -1.99 C, max = 36.71 C



Sentinel-3A OLCI algal pigment concentration  
14-27 June 2017, 14-day composite, OC4ME clear water algorithm



- Ocean is a complex system (feedbacks between different components)
- Patterns of chlorophyll and SST similar
- Influence of ocean dynamics on biology:
  1. Upwelling=> enhanced nutrient inputs (low SST - high Chl)
  2. Summer stratification => reduced nutrient inputs (high SST - low Chl)

In this practical session you will use the SNAP GUI to:

- 1) Re-grid SST and OC products on same grid.
- 2) Apply cloud masks across products.
- 3) Explore synergy between SST and OC data.
- 4) Plot SST and OC together (transect and scatter plots).



## IMPORTANT NOTE:

This lesson requires **Sentinels Application Platform (SNAP) software** and **Sentinel Toolboxes** which can be downloaded at :

<http://step.esa.int/main/download/>

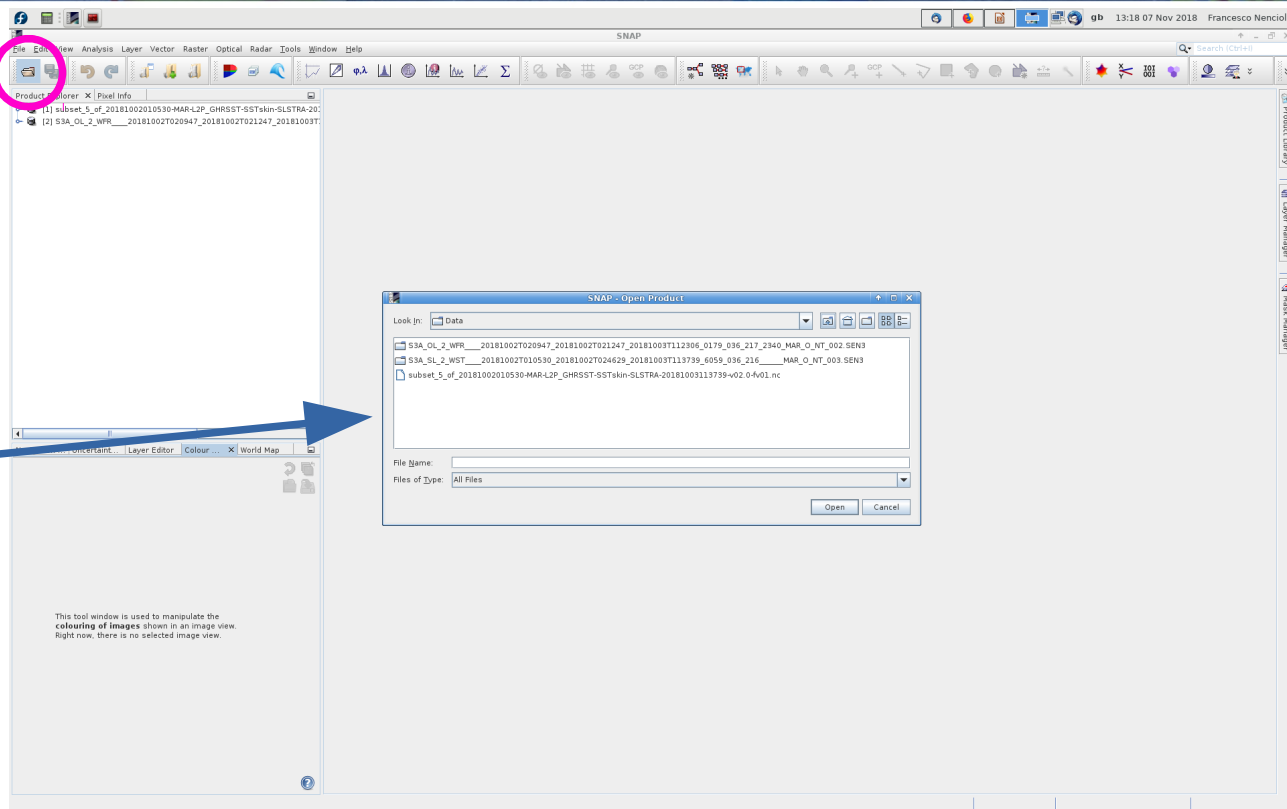
This should already be available on your machines.

# Exercise 1: Re-grid data to common grid



You will use the same files used for the OC and SST practicals

- Using the instructions provided in the previous two practicals load the .nc files for:
  1. The OC granule
  2. The SST subset domain

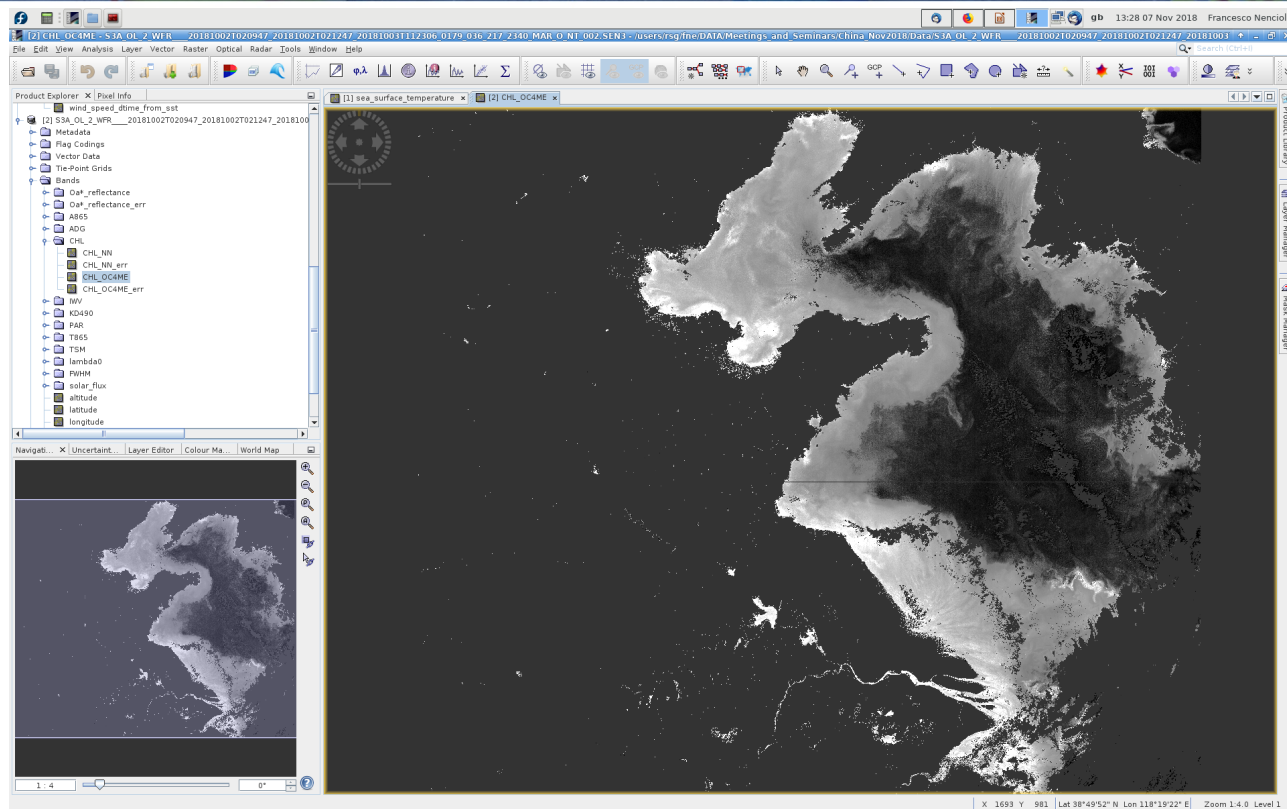


# Exercise 1: Re-grid data to common grid



You will use the same files used for the OC and SST practicals

- Using the instructions provided in the previous two practicals load the .nc files for:
  1. The OC granule
  2. The SST subset domain
- Open the variables **sea\_surface\_temperature** and **CHL\_OC4ME** (Note: they are in different products)



# Exercise 1: Re-grid data to common grid

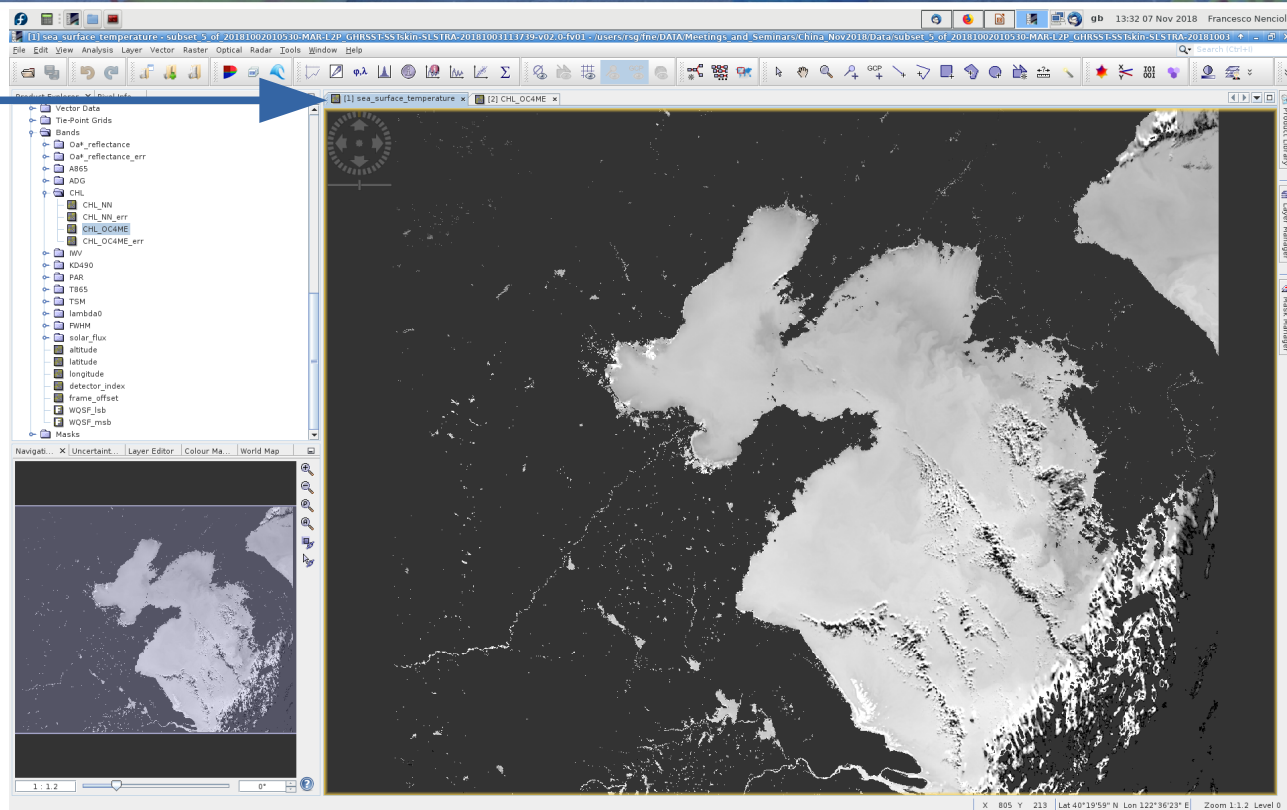


- Switch view between the two maps

The two products have:

1. Different domain extension
2. Different spatial resolution

To better compare the two fields (e.g. plot data against each other) they need to be **re-gridded on a common grid**

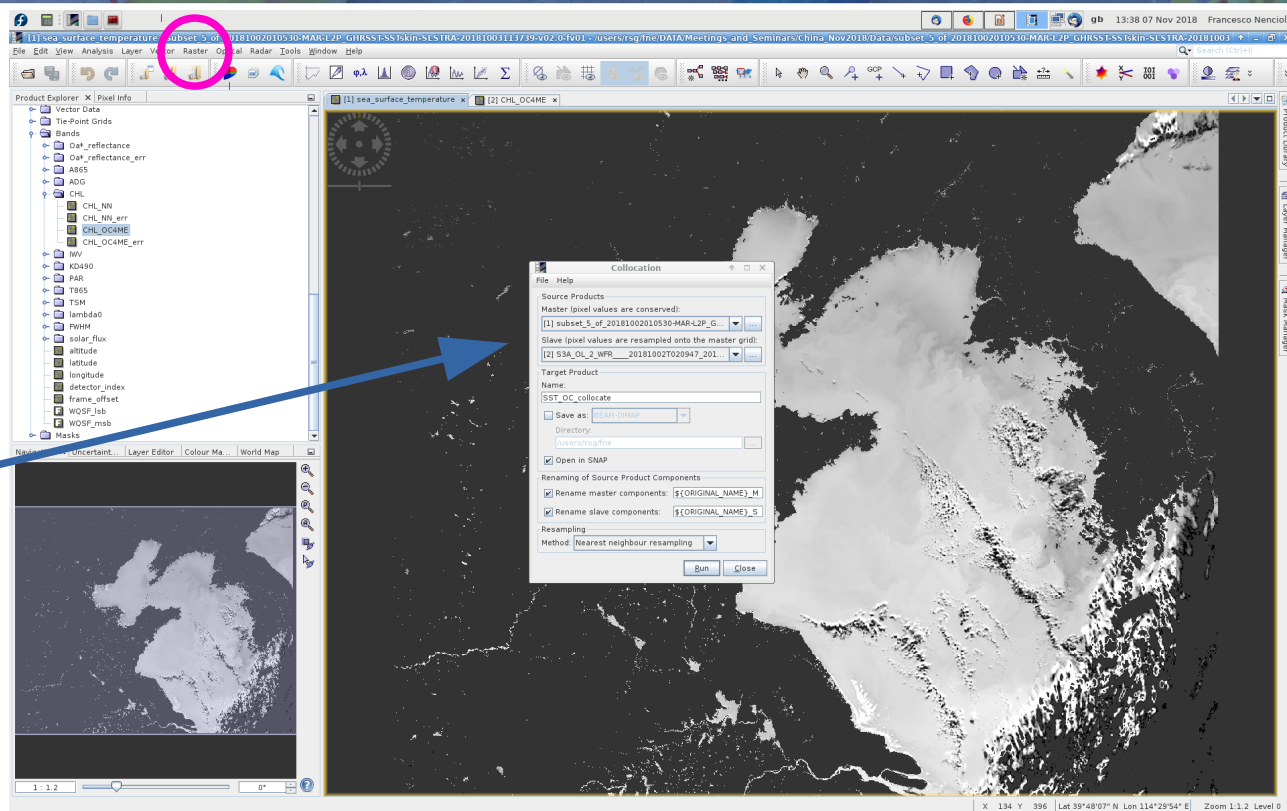


# Exercise 1: Re-grid data to common grid



- Click on the **“Raster”** button
- From the menu select the **“Geometric Operations”** and then the **“Collocation”** method

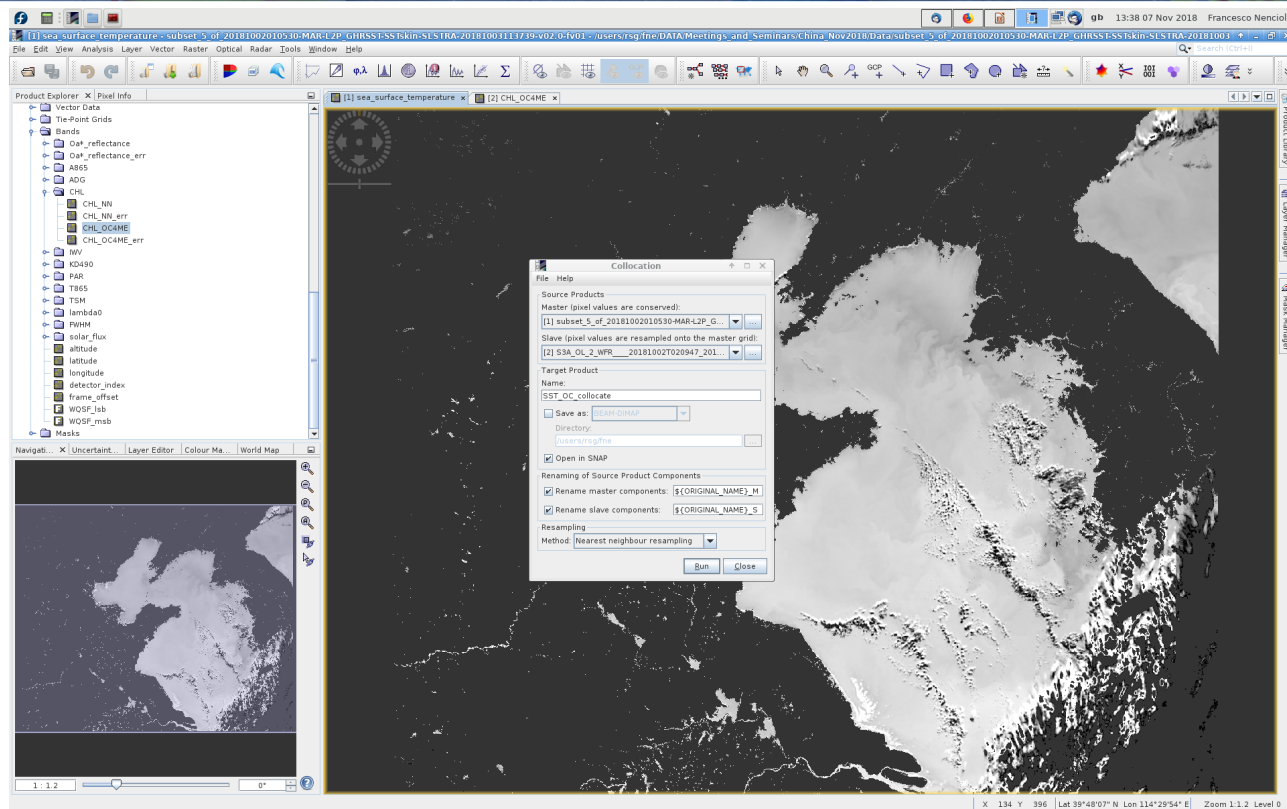
You should obtain a dialogue box like this one



# Exercise 1: Re-grid data to common grid



When **re-gridding**, it is good practice to go **from higher to lower resolution** data  
Thus, OC data will be re-gridded into the SST grid





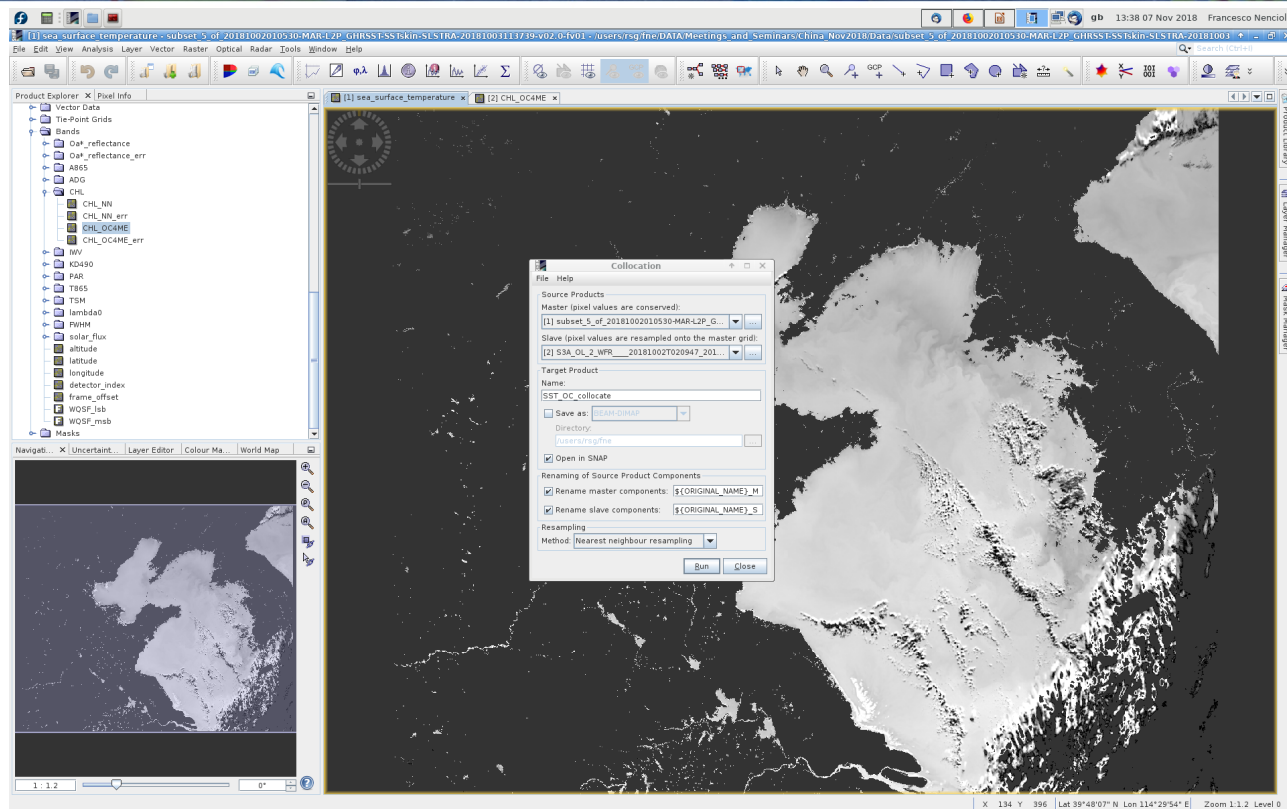
# Exercise 1: Re-grid data to common grid



When **re-gridding**, it is good practice to go **from higher to lower resolution** data

Thus, OC data will be re-gridded into the SST grid

- Select the SST product as **Master** and the OC product as **Slave**
- Change the “**Name**” to **SST\_OC\_collocate**
- Un-tick the “**Save As**”
- “**Method**” must be **Nearest neighbour** (good for flags)

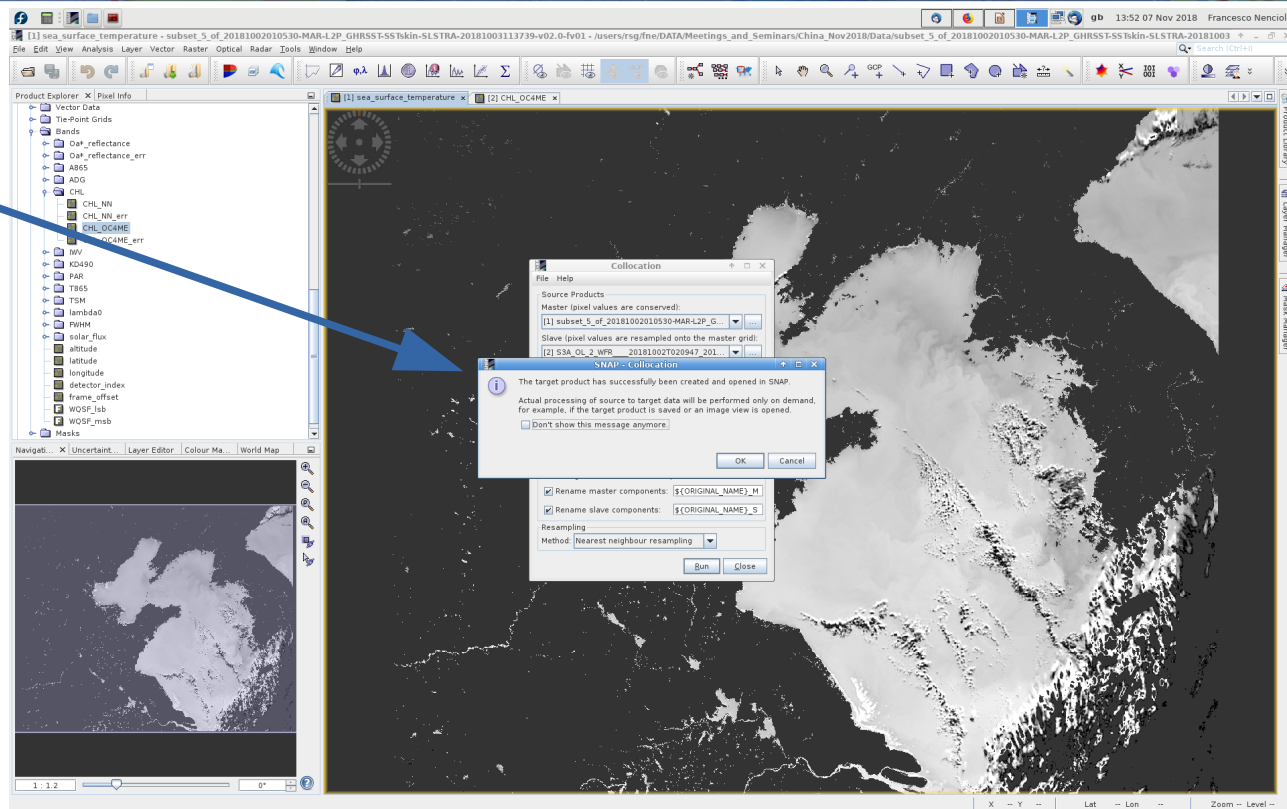


# Exercise 1: Re-grid data to common grid

- Hit **“Run”**
- Click **“OK”** if you obtain a message like this

It says that SNAP will effectively re-grid the data only when they will be used (i.e. lazy operation)

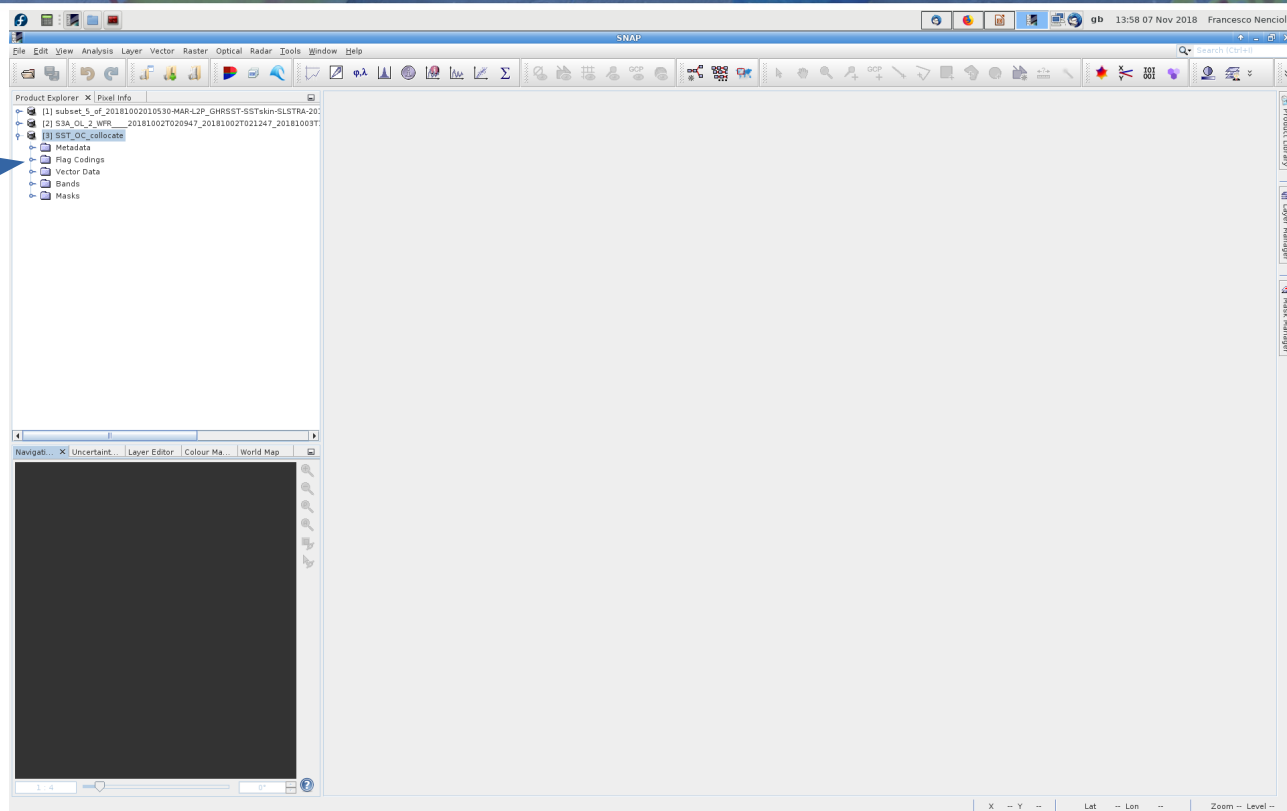
This saves time and resources (especially for big products such as the OLCI ones)



# Exercise 1: Re-grid data to common grid



You should see the new  
“**SST\_OC\_collocate**”  
product in the “**Product  
explorer**” tab



From now on we will work  
only with this product

- You can close both plots



# Exercise 1: Re-grid data to common grid



- Open the **Metadata**
- **Processing Graph** has info on the way the new product has been generated

The screenshot shows the SNAP software interface with the Processing Graph metadata table open. The table contains the following data:

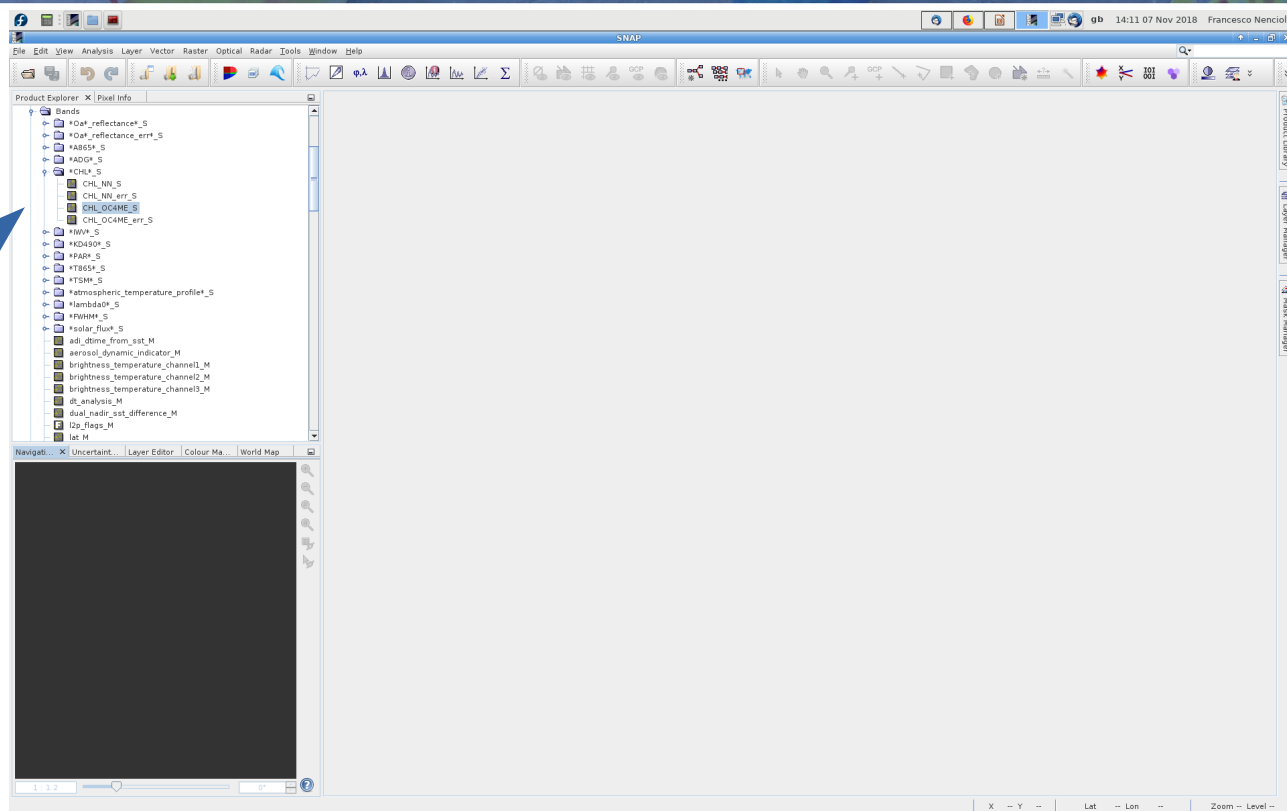
node 0	Name	Value	Type	Unit	Description
sources	master	file:/users/rsq/fine/DATA/Meetings_and_Seminars/China_b	ascii		
	slave	file:/users/rsq/fine/DATA/Meetings_and_Seminars/China_b	ascii		
parameters	resamplingType	NEAREST_NEIGHBOUR	ascii		
	targetProductType	COLLOCATED	ascii		
	masterComponentPattern	\$(ORIGINAL_NAME)_M	ascii		
	slaveComponentPattern	\$(ORIGINAL_NAME)_S	ascii		
	renameMasterComponents	true	ascii		
	renameSlaveComponents	true	ascii		
	id	Collocates\$166EE71D33A	ascii		
	operator	Collocate	ascii		
	moduleName	SNAP Collocation Operator	ascii		
	moduleVersion	6.0.4	ascii		
	purpose	Collocates two products based on their geo-codings.	ascii		
authors	Ralf Quast, Norman Fomferra	ascii			
version	1.2	ascii			
copyright	(c) 2007-2011 by Brockmann Consult	ascii			
processingTime	2018-11-07T13:52:09.019Z	ascii			



# Exercise 1: Re-grid data to common grid



- Open the **Metadata**
- **Processing Graph** has info on the way the new product has been generated
- **Bands** and has all variables from the OC and SST products
- OC variables end with **\_S** (slave)
- SST variables end with **\_M** (master)

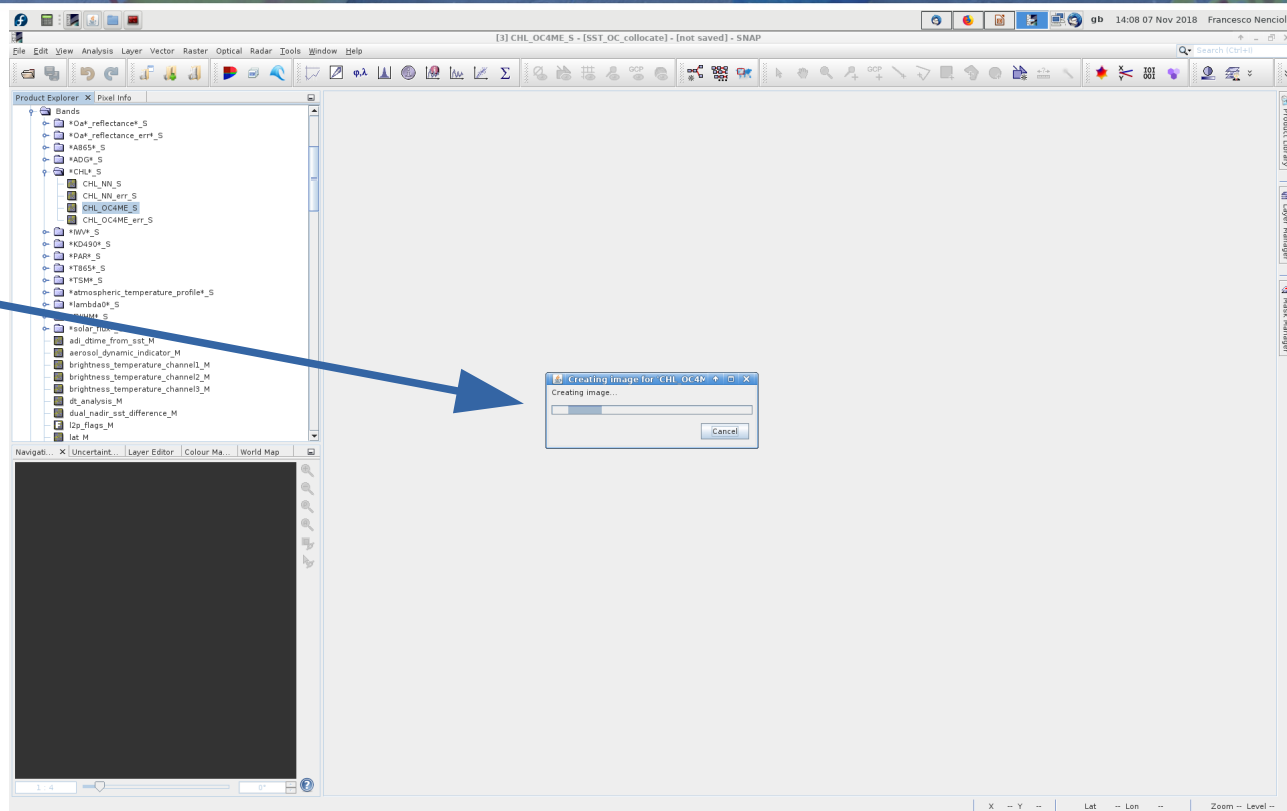


# Exercise 1: Re-grid data to common grid



- Open the **CHL\_OC4ME\_S** variable

You will get this message (it takes a while because it is only now that SNAP re-grid the variable into the SST grid!!!)



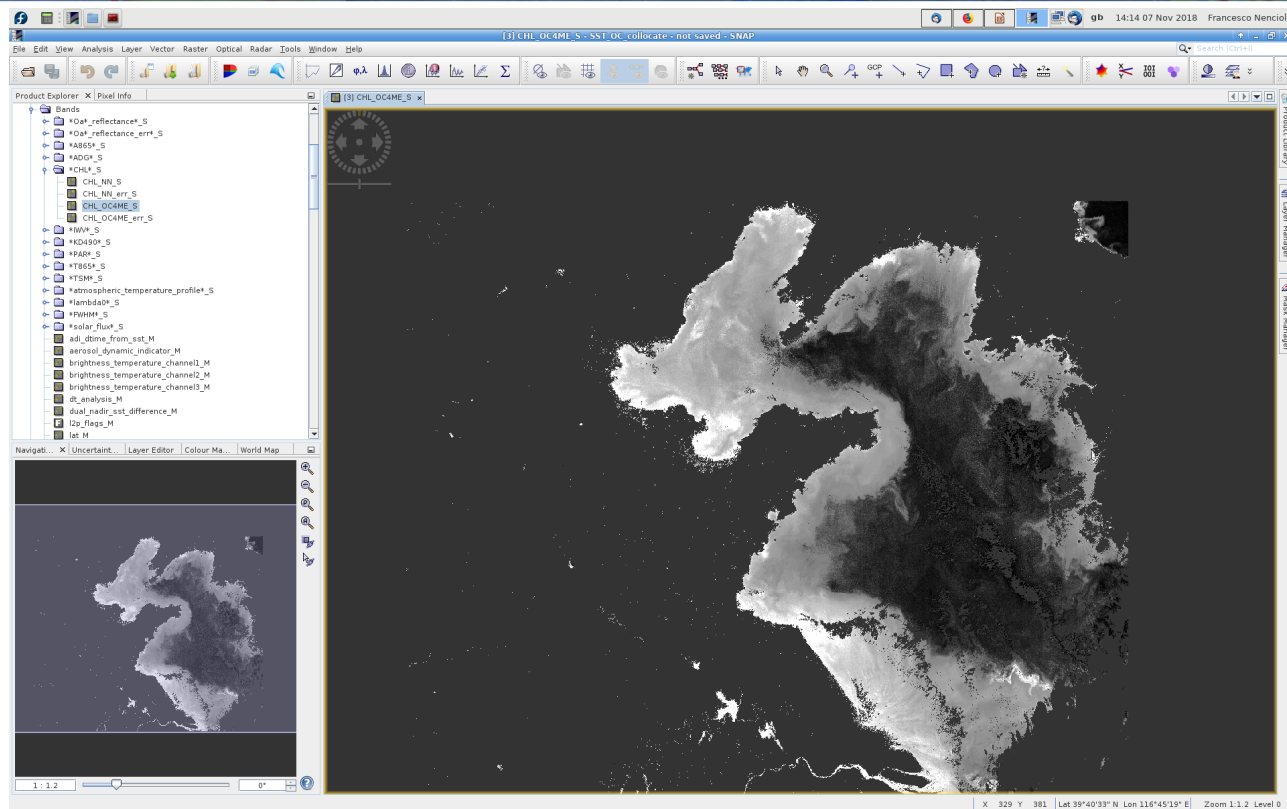
# Exercise 1: Re-grid data to common grid



- Open the **CHL\_OC4ME\_S** variable

You will get this message (it takes a while because it is only now that SNAP re-grid the variable into the SST grid!!!)

Eventually you should obtain this



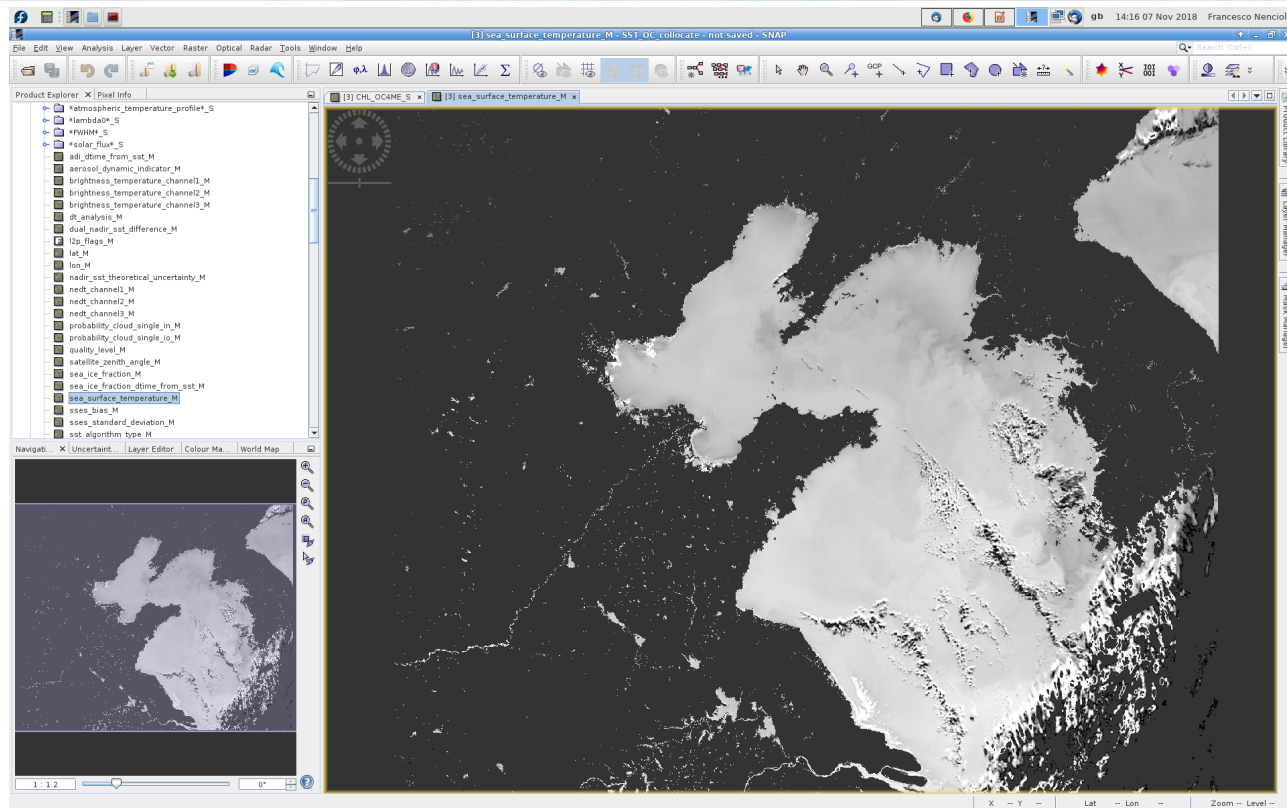
# Exercise 1: Re-grid data to common grid



- Now open the **sea\_surface\_temperature\_M** variable

(Master variables open instantly because they do not need to be re-gridded)

- Switching between the two fields, you should see that they are on the same grid (although with different boundaries)



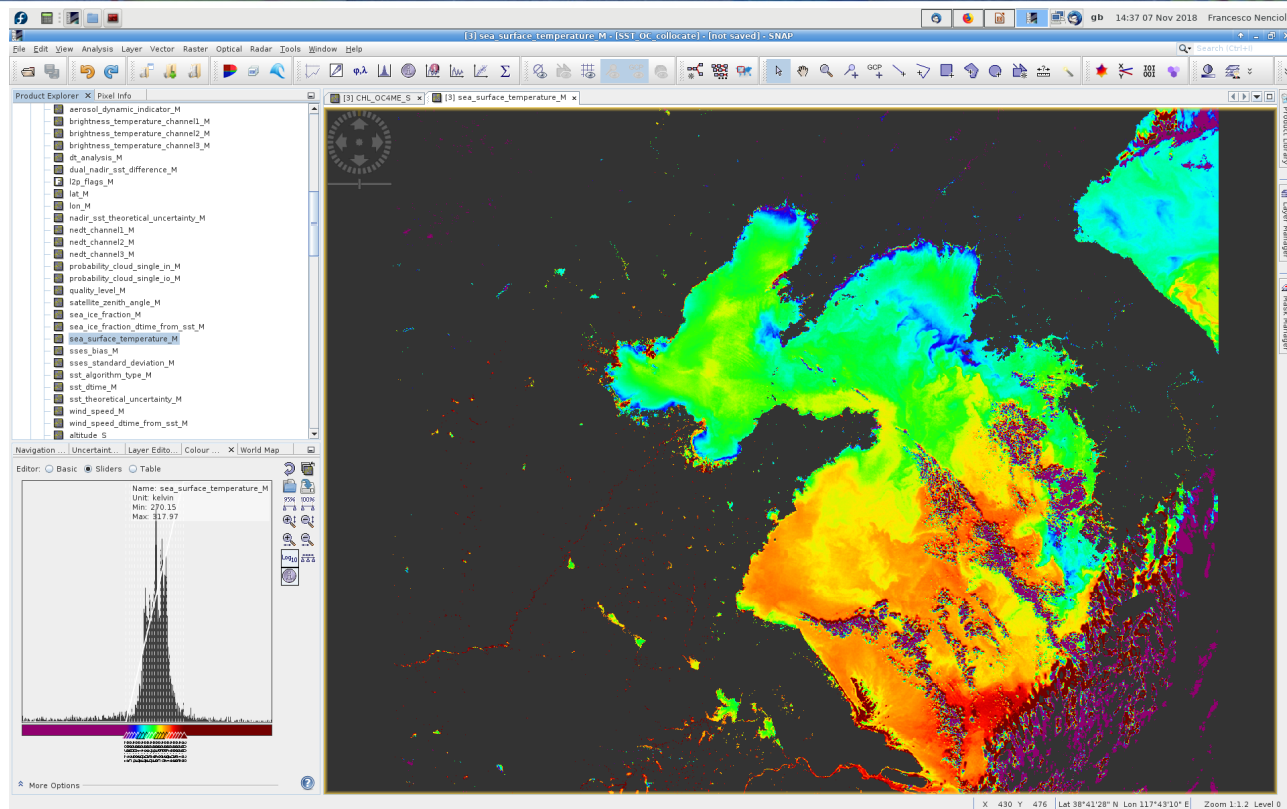
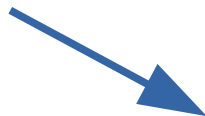


# Exercise 2: OC cloud-masking on SST



- From the **Colour Management** tab, change the colour palette (as explained in the previous practical) to better display the SST features

(You can use the **CHL\_SeaWiFS** palette to have cold SST in blue and warm SST in red)



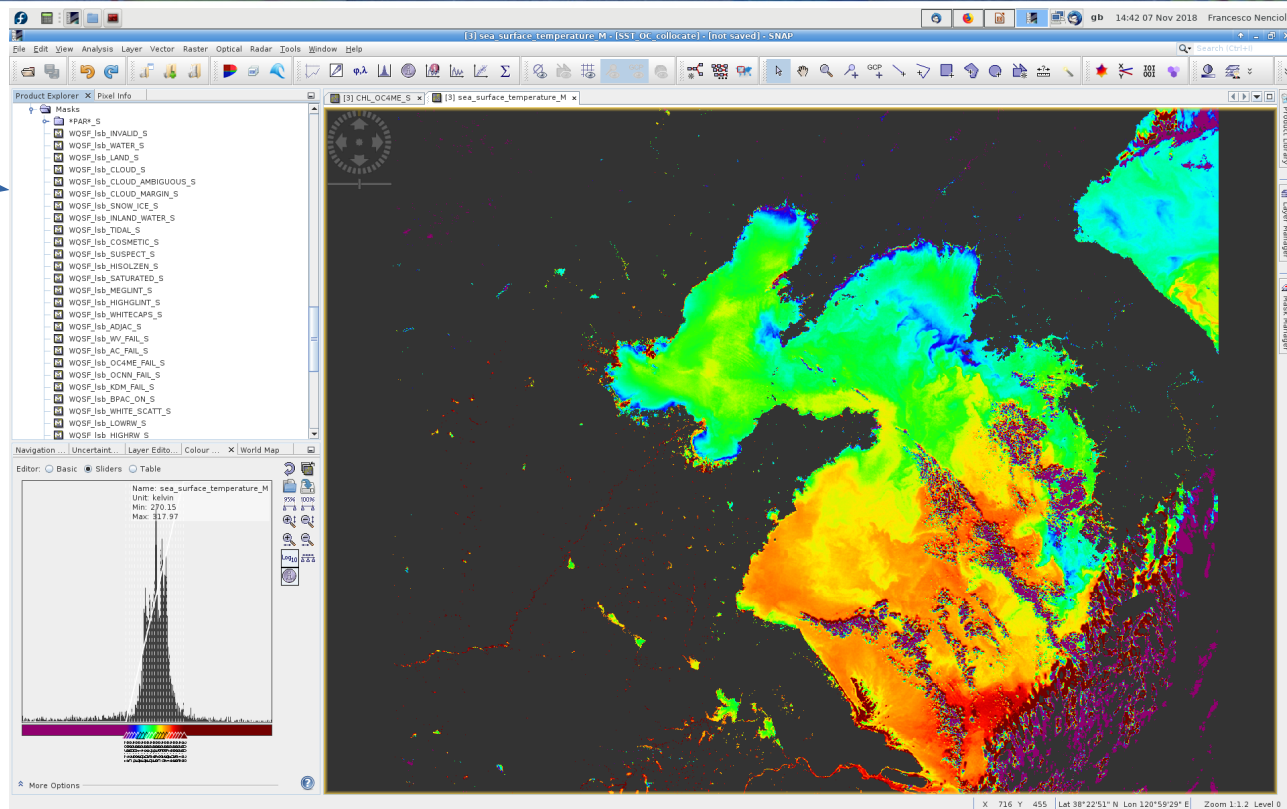
# Exercise 2: OC cloud-masking on SST



- Expand the **Masks** list in the “**Product explorer**” tab



All the masks from the OC product have also been re-gridded on the SST grid



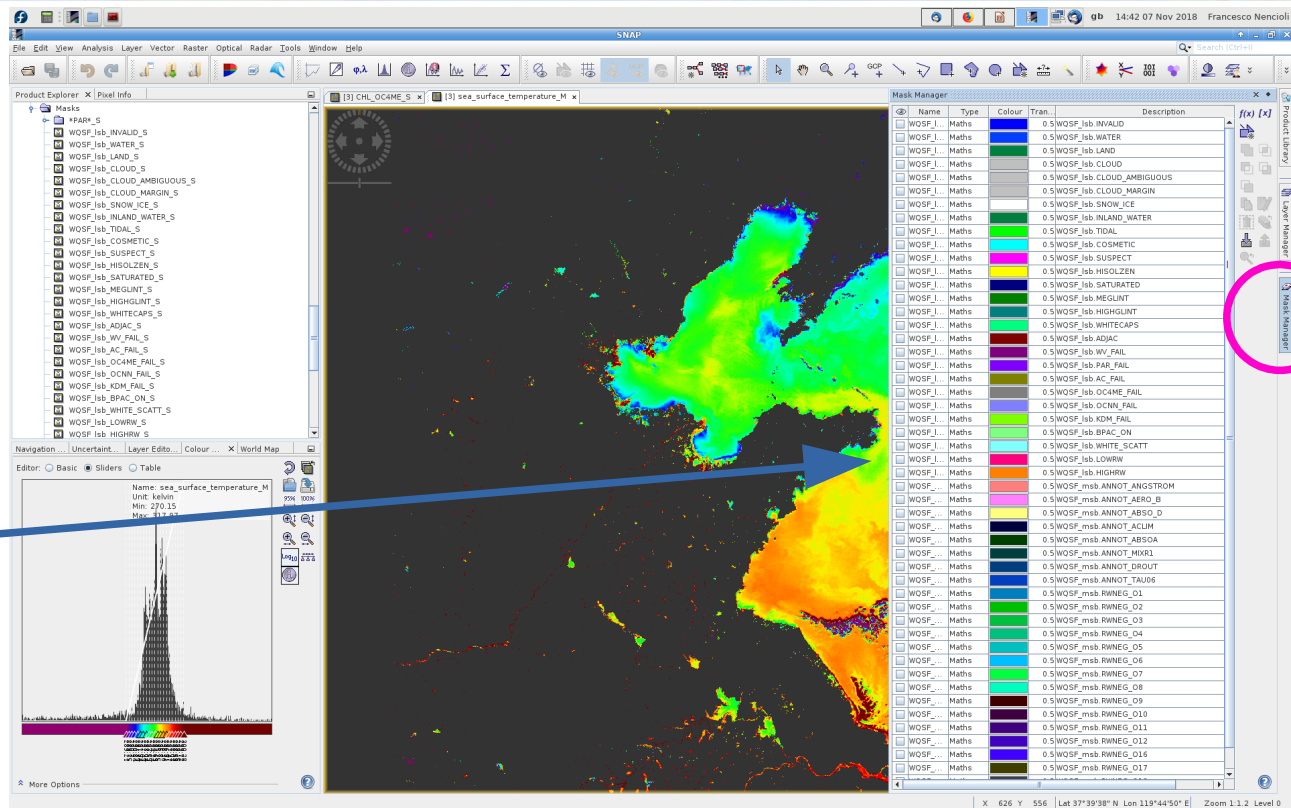
# Exercise 2: OC cloud-masking on SST

- Expand the **Masks** list in the “**Product explorer**” tab

All the masks from the OC product have also been re-gridded on the SST grid

- They are also listed in the “**Mask Manager**” menu

OC cloud masks can be used on the SST products

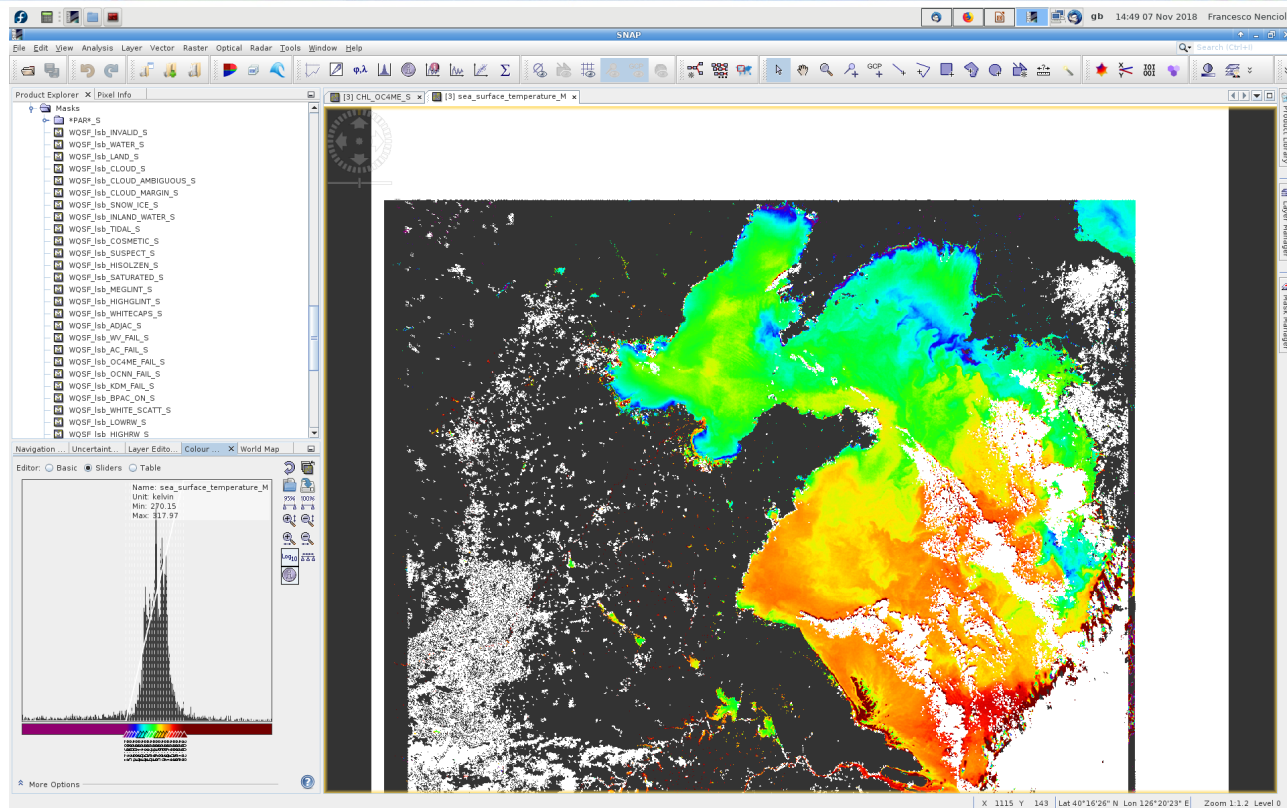


# Exercise 2: OC cloud-masking on SST



- Select the **CLOUD** and **CLOUD\_MARGIN** flags from the list of **WQSF\_Isb** flags
- Change the mask **colour** and **transparency** (white and 0 in this case)

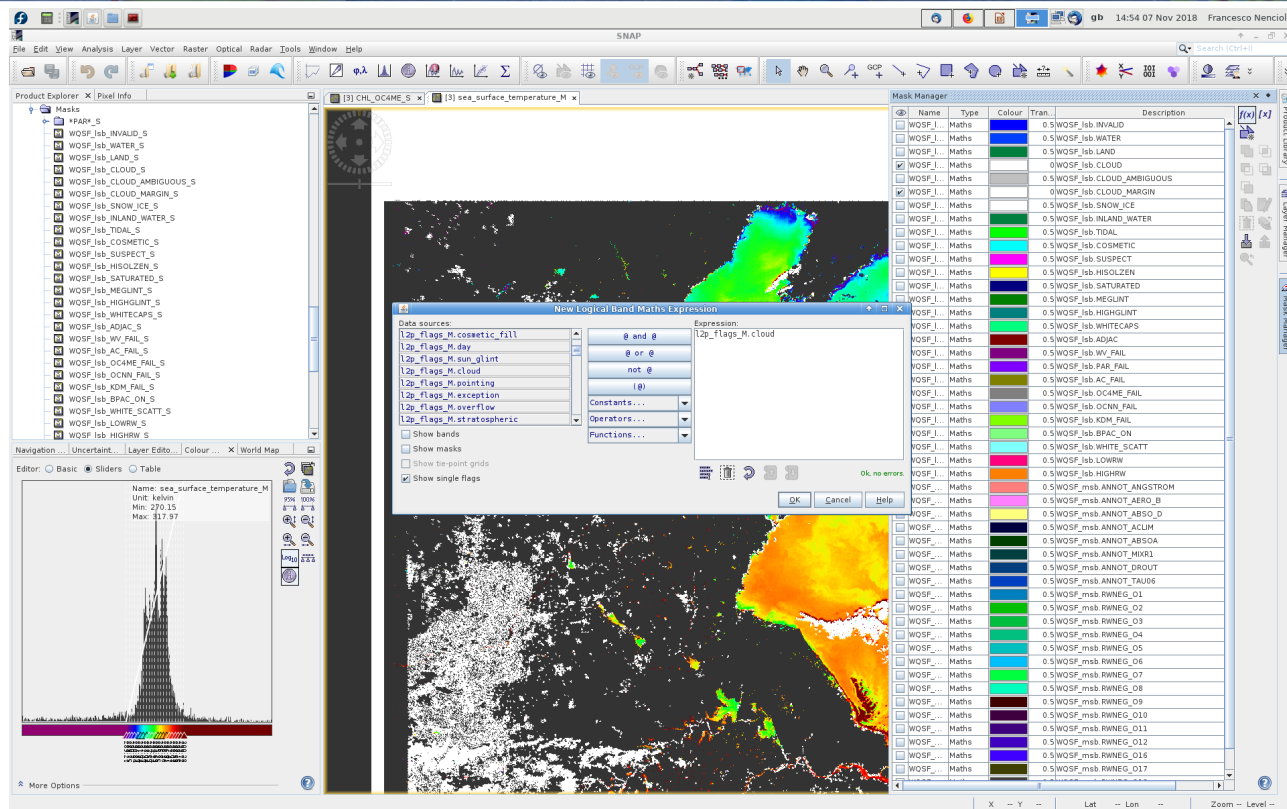
Most of the clouds pixels (very high or very low values of SST) are successfully masked



# Exercise 2: OC cloud-masking on SST

As a comparison, create a mask using the SST cloud flag

- Select the **f(x)** button from the **Mask manager** menu
- Select the **I2p\_flags\_M.cloud** flag



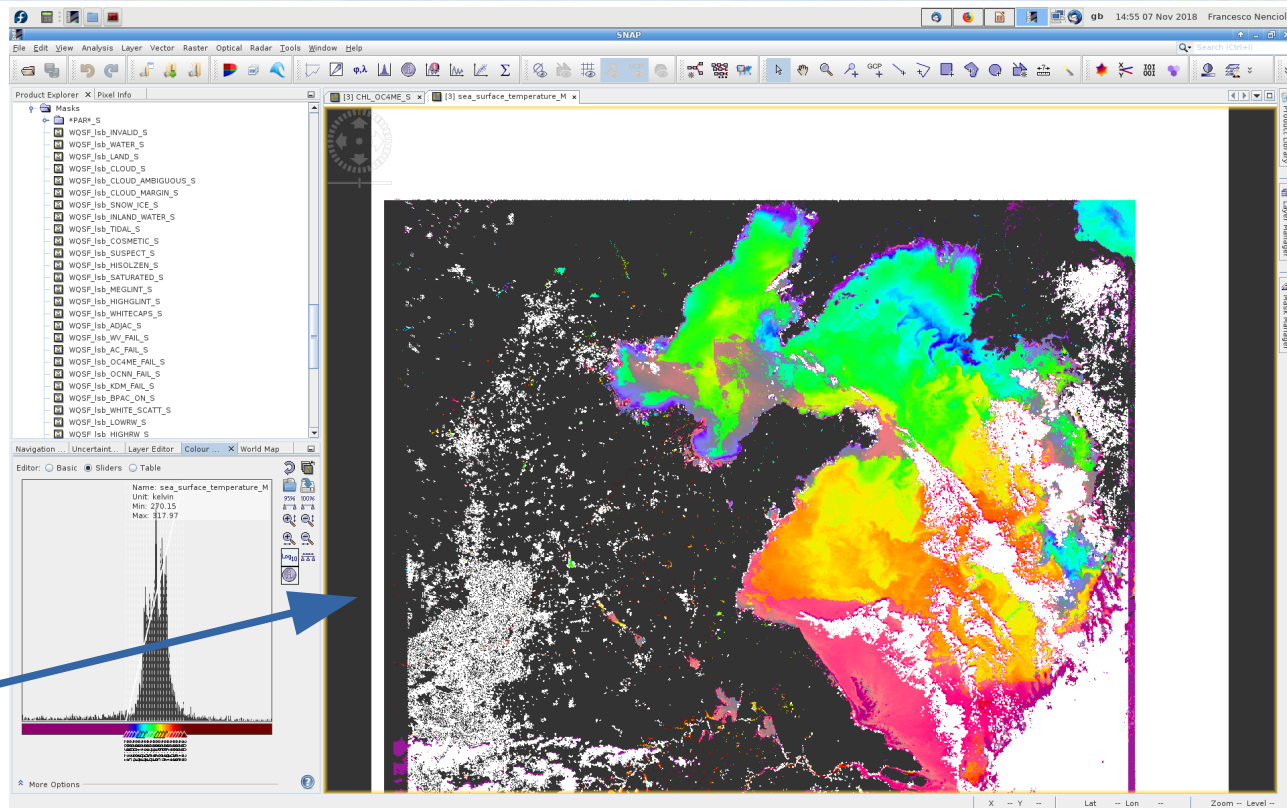
# Exercise 2: OC cloud-masking on SST



As a comparison, create a mask using the SST cloud flag

- Select the **f(x)** button from the **Mask manager** menu
- Select the **I2p\_flags\_M.cloud** flag
- Change the colour (pink in this case) but keep the transparency

(You should obtain something like this, confirming the better accuracy of the OC mask)



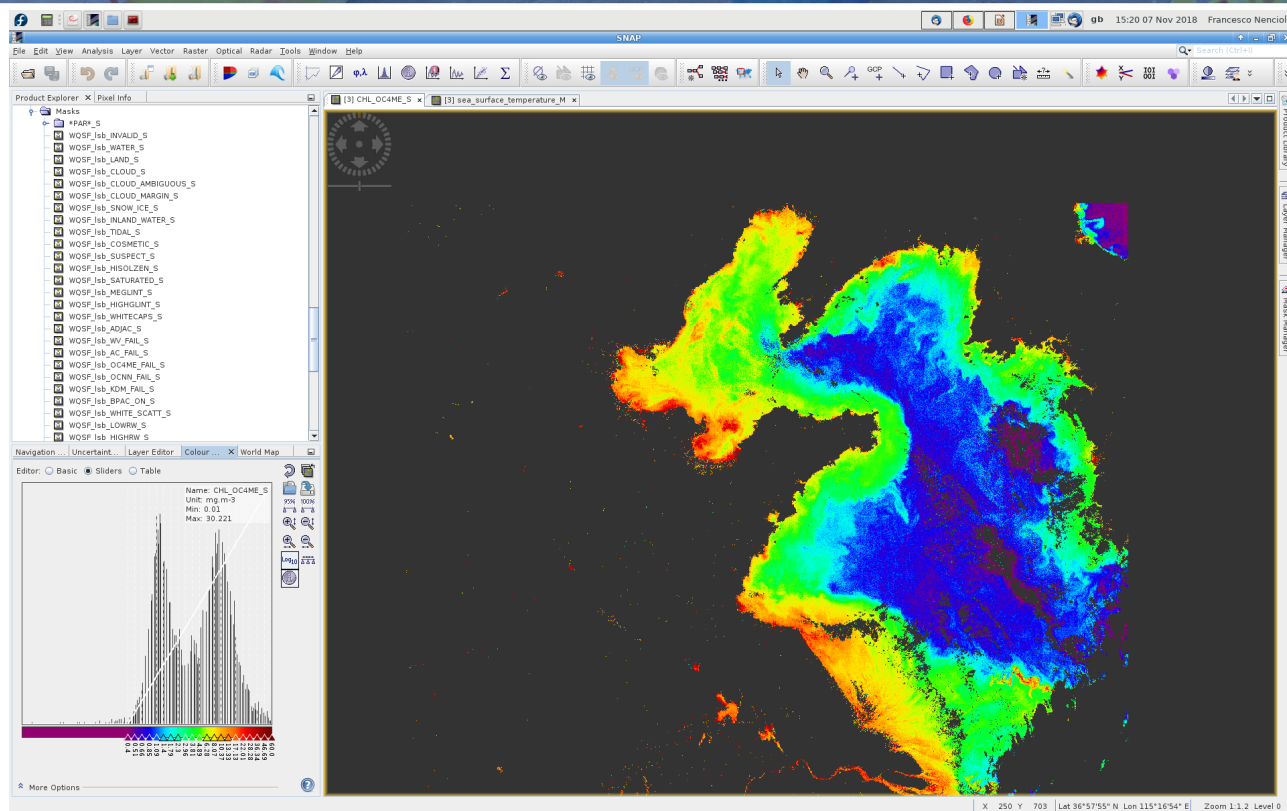
# Exercise 3: Synergy between the data



Time to explore the SST and OC data in synergy

Before doing that:

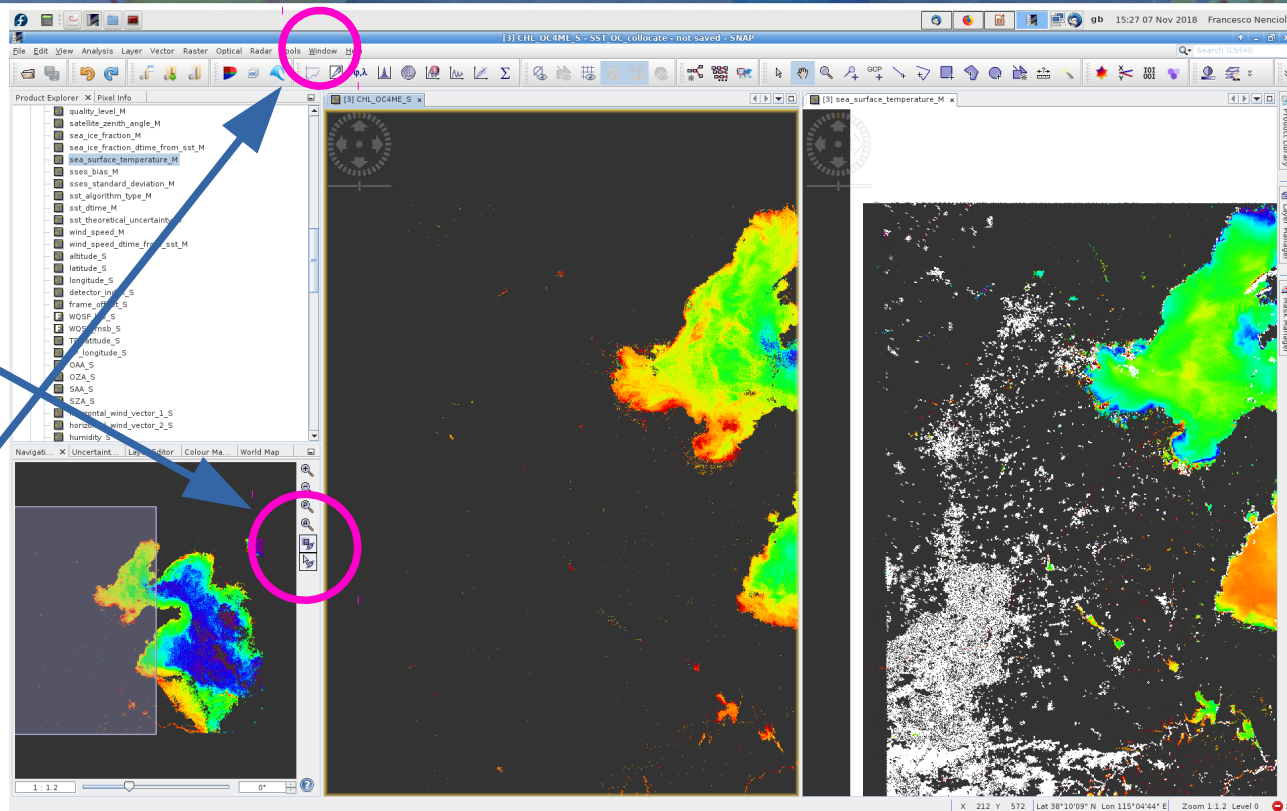
- Un-tick the SST cloud mask
- Change the colour palette in the CHL plot (use the **CHL\_SeaWiFS** one with the settings as explained in the OC practical)
- Adjust the colour limits to enhance the contrast (e.g. minimum value set to 0.4)



# Exercise 3: Synergy between the data

To show CHL and SST data together:

1. From the **Navigation** tab, select the **Synchronise view** and **Synchronise cursor** buttons
2. From the **Window** button select the **Tile vertically** option



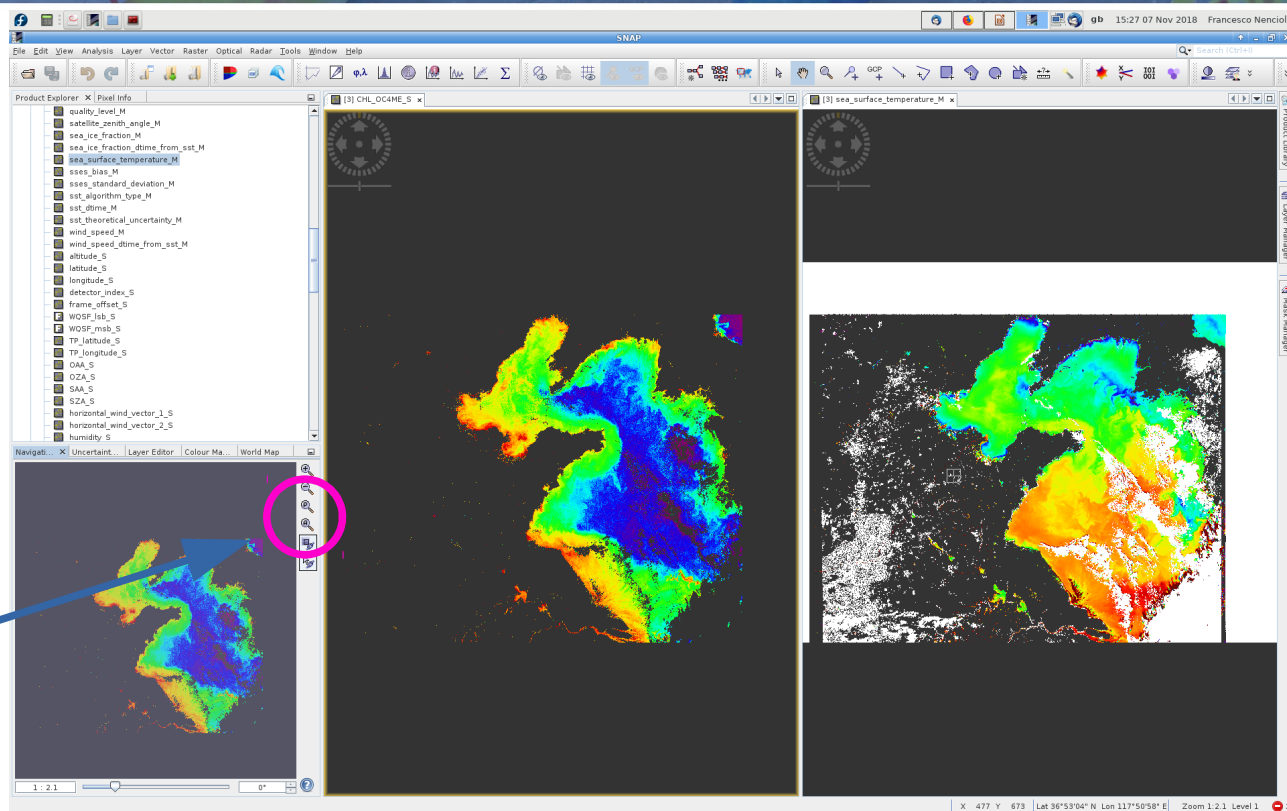


# Exercise 3: Synergy between the data



To show CHL and SST data together:

1. From the **Navigation** tab, select the **Synchronise view** and **Synchronise cursor** buttons
2. From the **Window** button select the **Tile vertically** option
3. From the Navigation tab click the **Zoom all** button

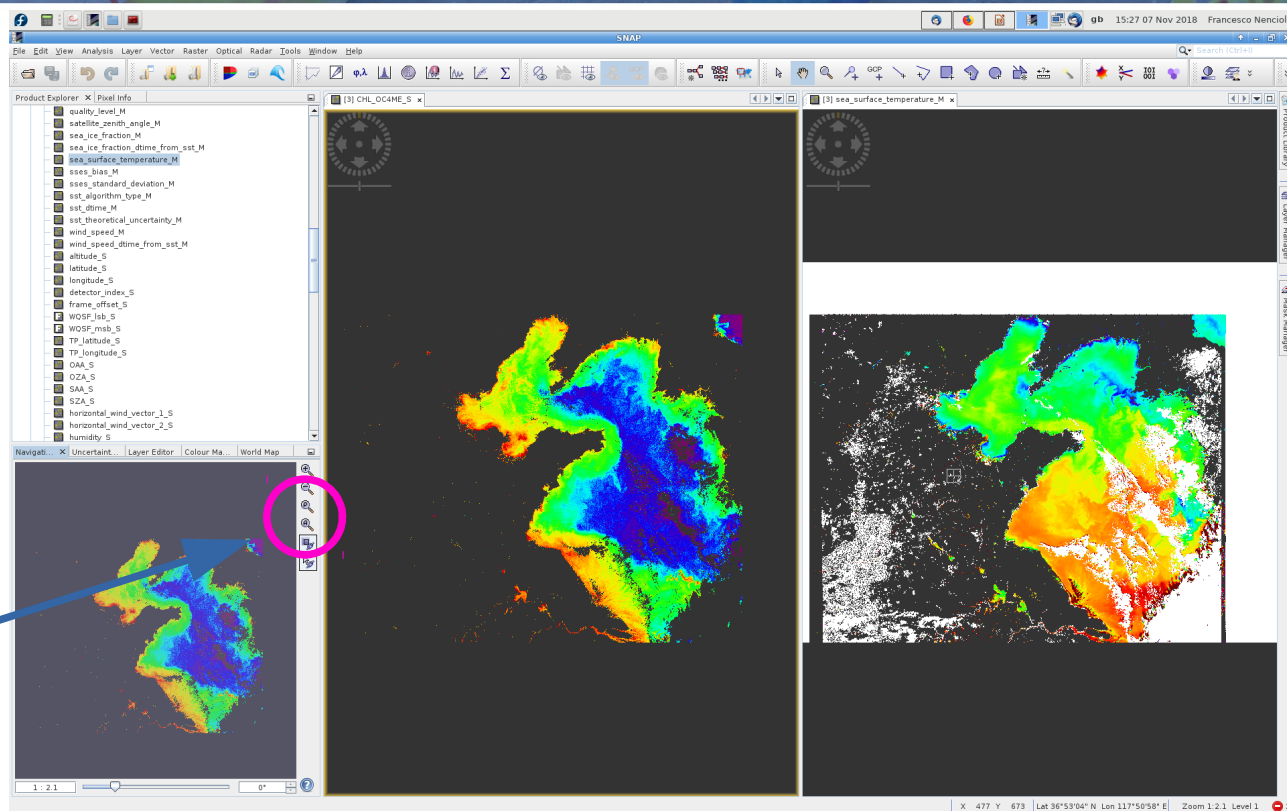


# Exercise 3: Synergy between the data



To show CHL and SST data together:

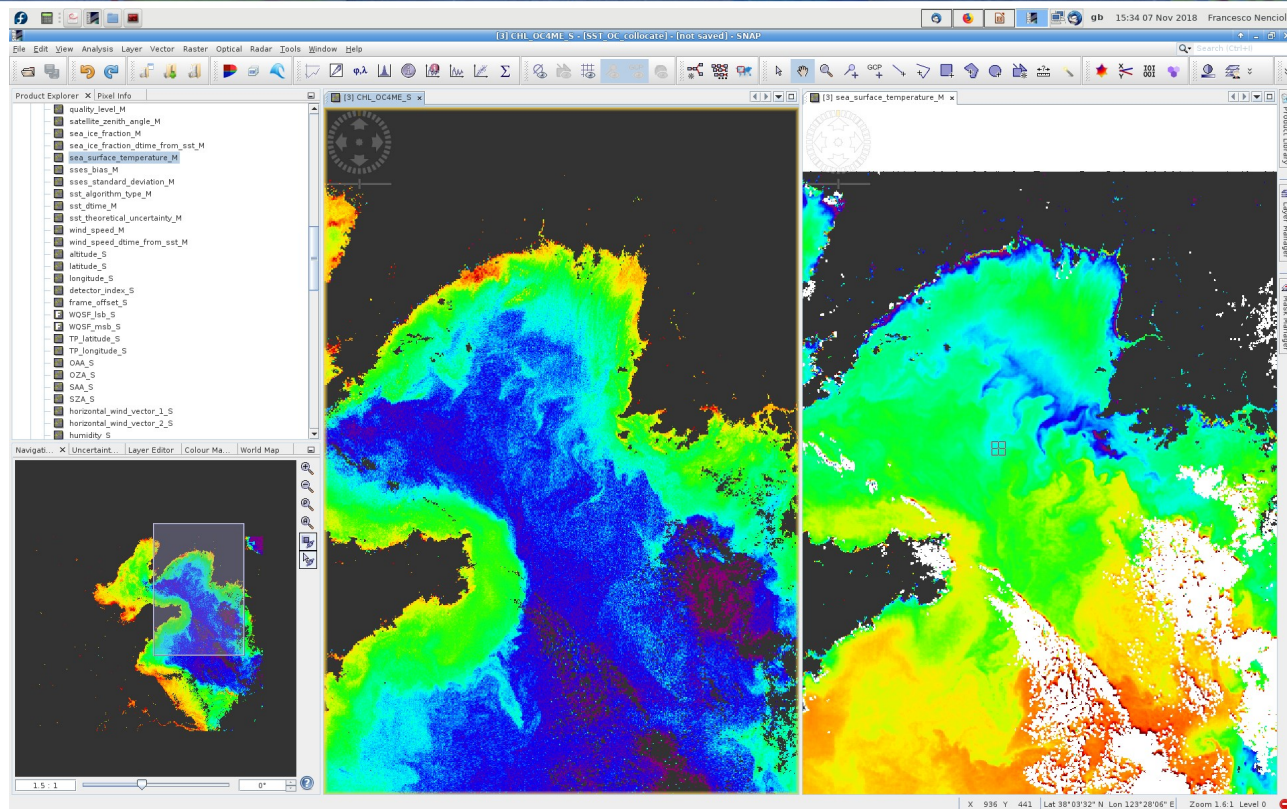
1. From the **Navigation** tab, select the **Synchronise view** and **Synchronise cursor** buttons
2. From the **Window** button select the **Tile vertically** option
3. From the Navigation tab click the **Zoom all** button



# Exercise 3: Synergy between the data



- Zooming in and out of a map will automatically update the other one
- Same if you move the map around
- The position of the cursor will be also displayed in both maps



# Exercise 3: Synergy between the data



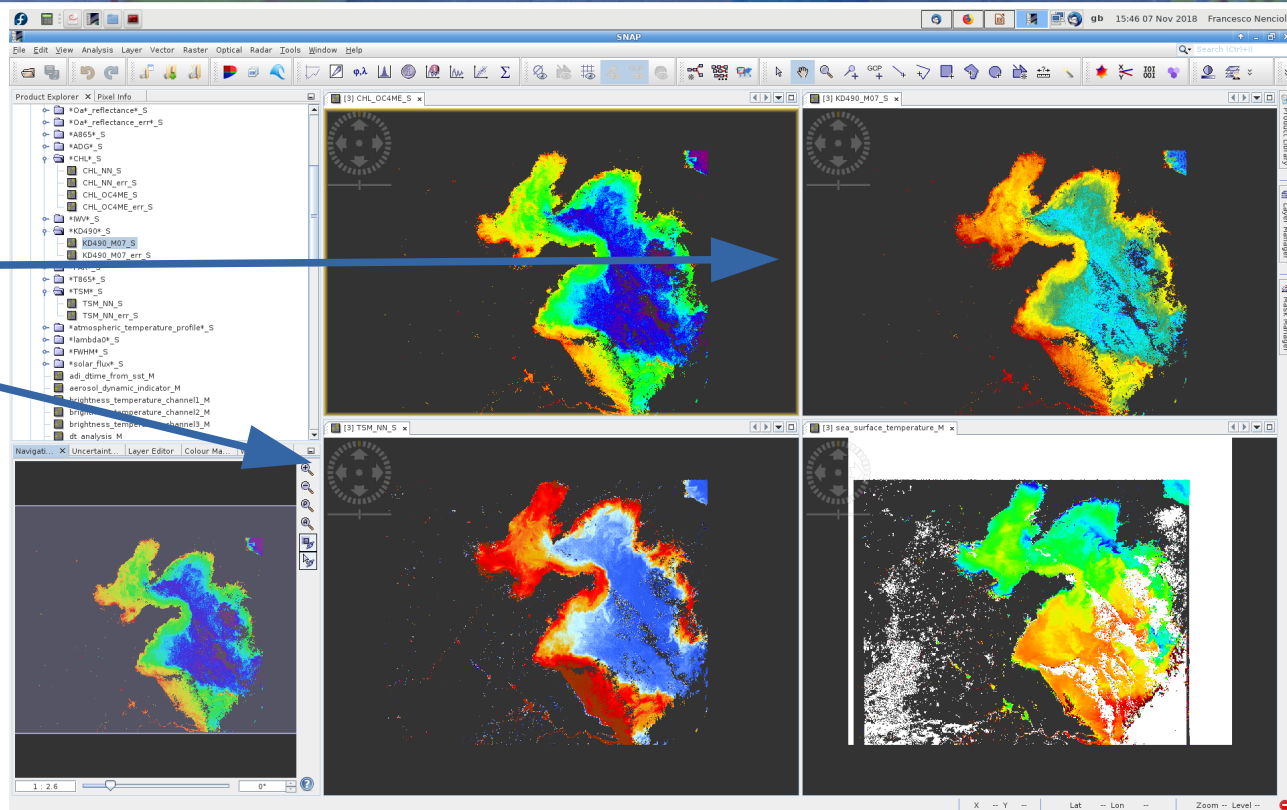
To extend the synergistic exploration, let's open other two variables from the OLCI product:

**1.KD490\_M07\_S**

**2.TSM\_NN\_S**

(for both it will take few seconds to generate)

- For both variables select a different colour palette (i.e. **cc\_tsm** and **cc\_general**)
- From the **Window** button select **Tile Equally**



# Exercise 3: Synergy between the data



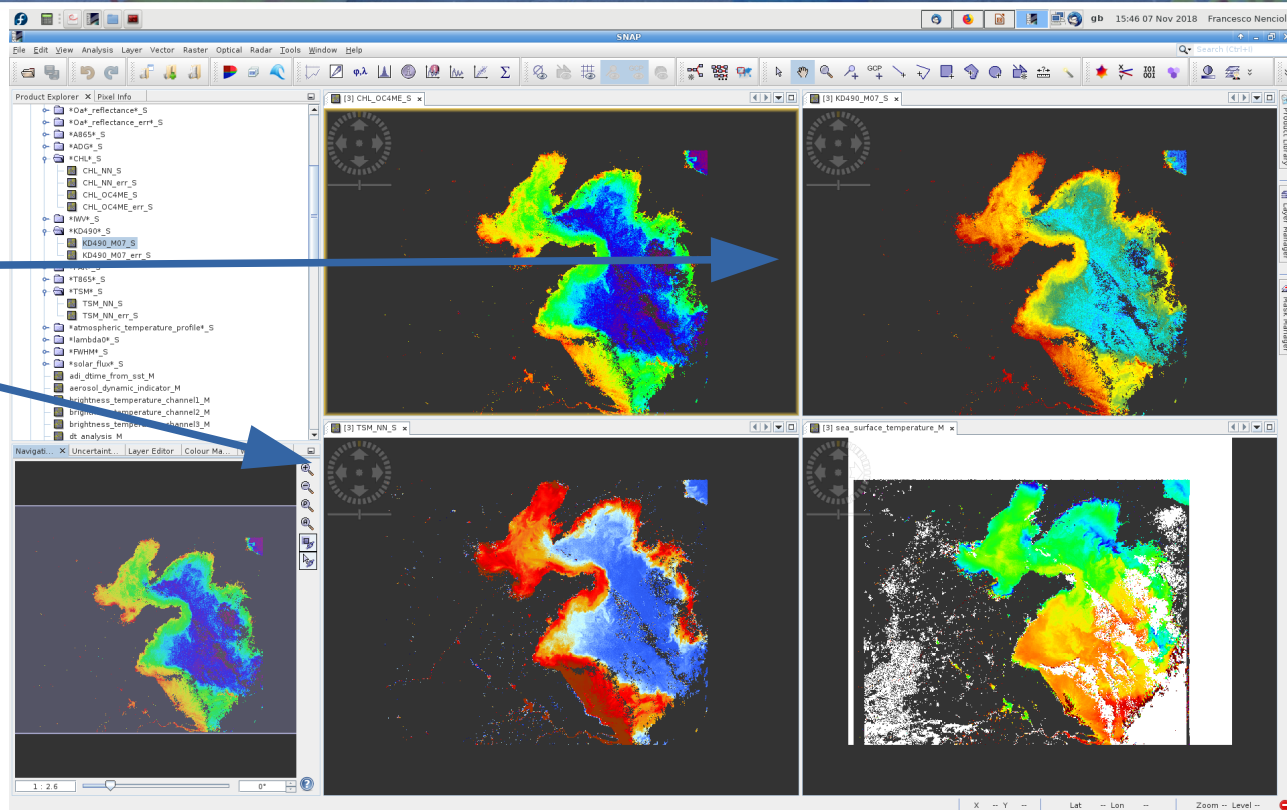
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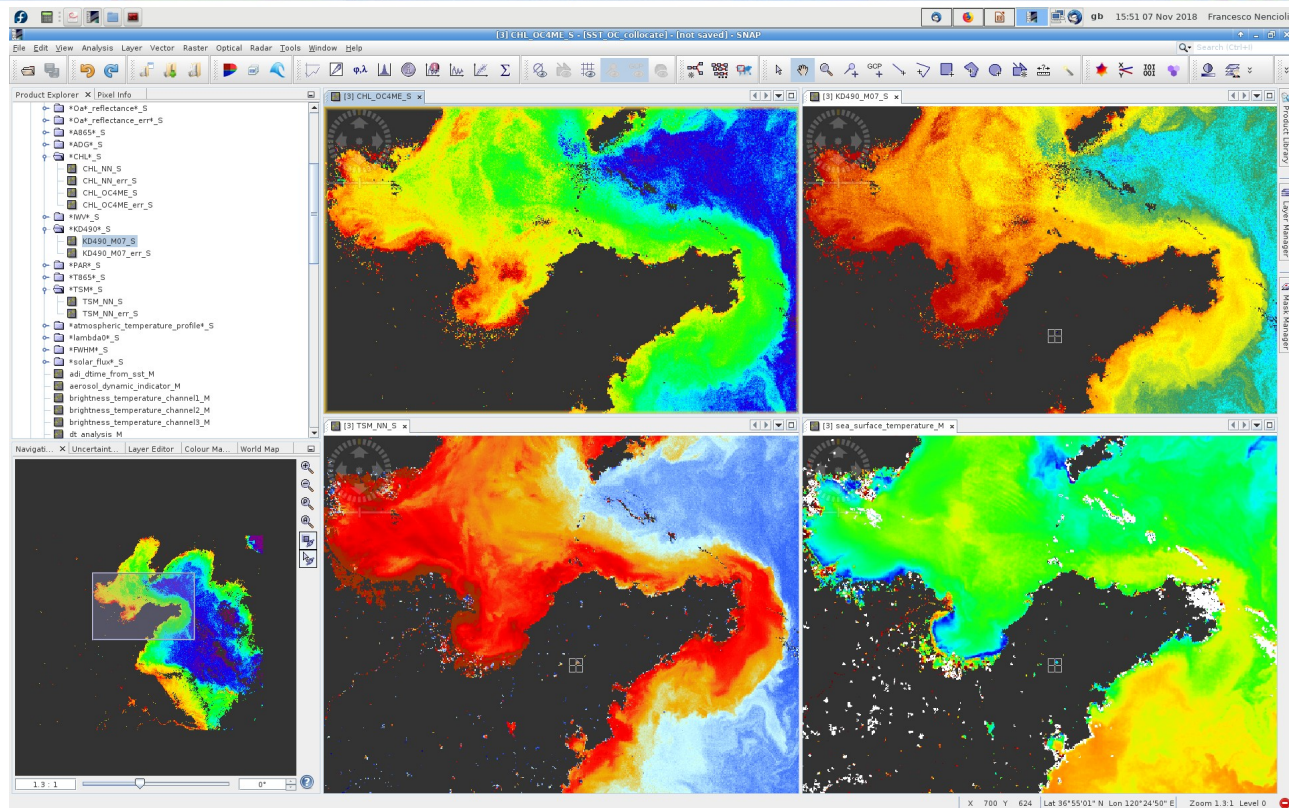


# Exercise 3: Synergy between the data

From the CHL window you can now zoom and move freely within the domain of all 4 variables

(the relative position of the zoomed area within the domain is showed in the **Navigation** tab)

- Which regions show similar patterns among all 4 variables?
- Which regions show correlation only among some of them?

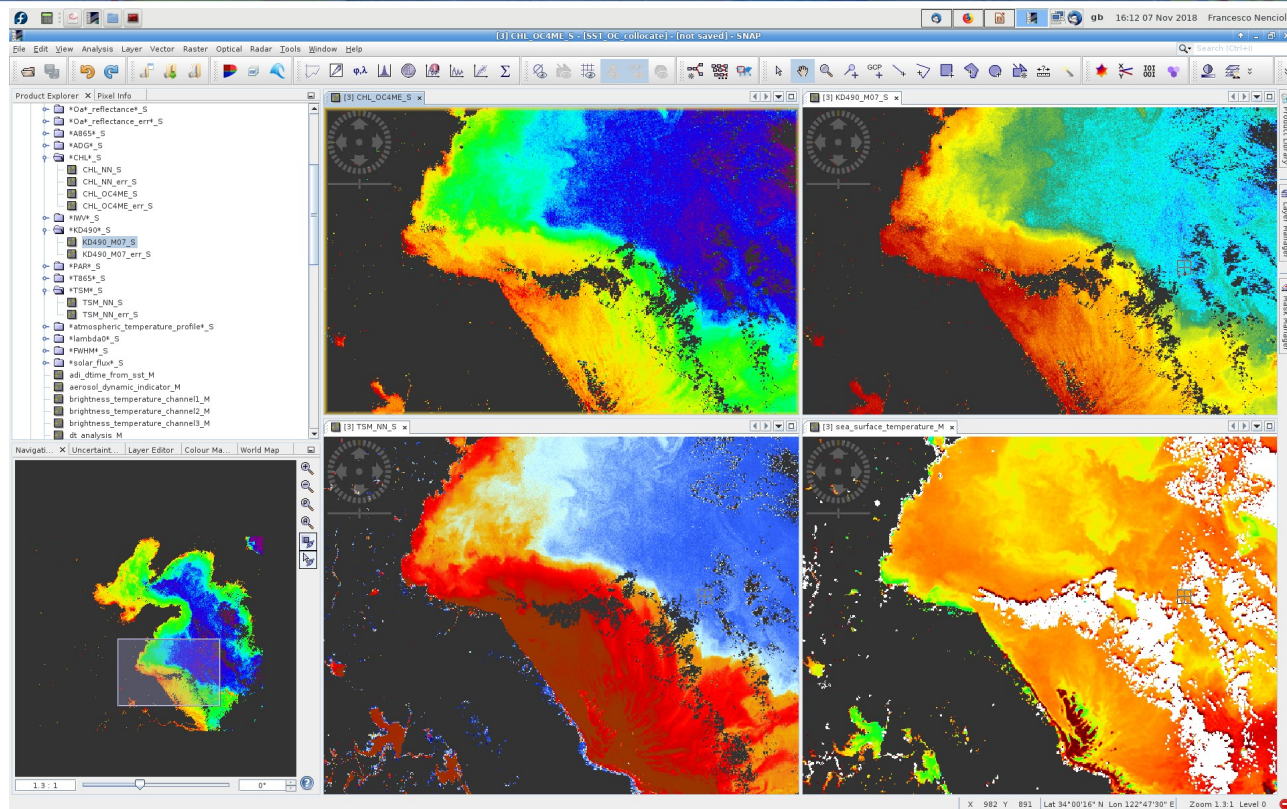


# Exercise 3: Synergy between the data



Here some examples:

1. Correlation near the coast between CHL, Kd and TSM
2. Strong gradient offshore
3. No major gradients in the SST field
4. Optics and SST not strongly correlated

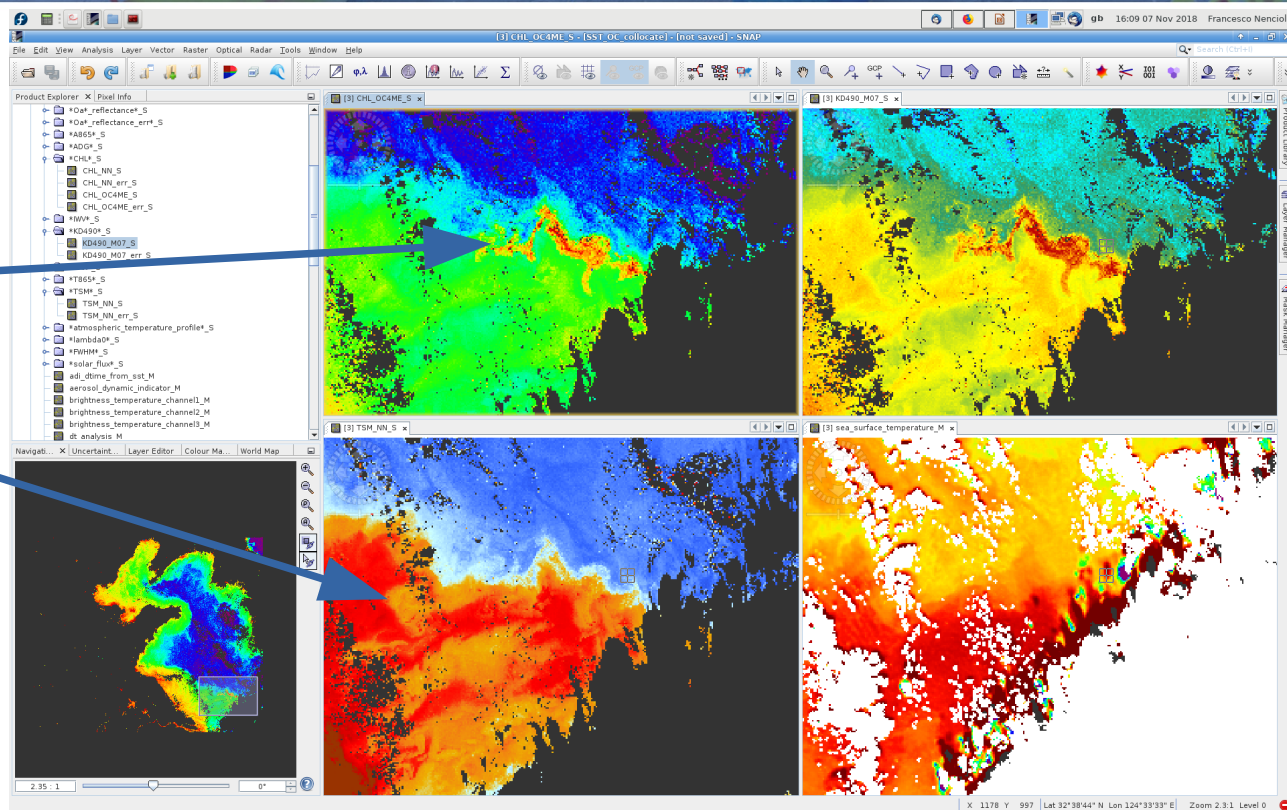


# Exercise 3: Synergy between the data



Here some examples:

1. KD mainly driven by TSM in the SW corner
2. KD mainly driven by CHL within the bloom
3. Decoupling between optical variables
4. Some correlation between TSM and SST



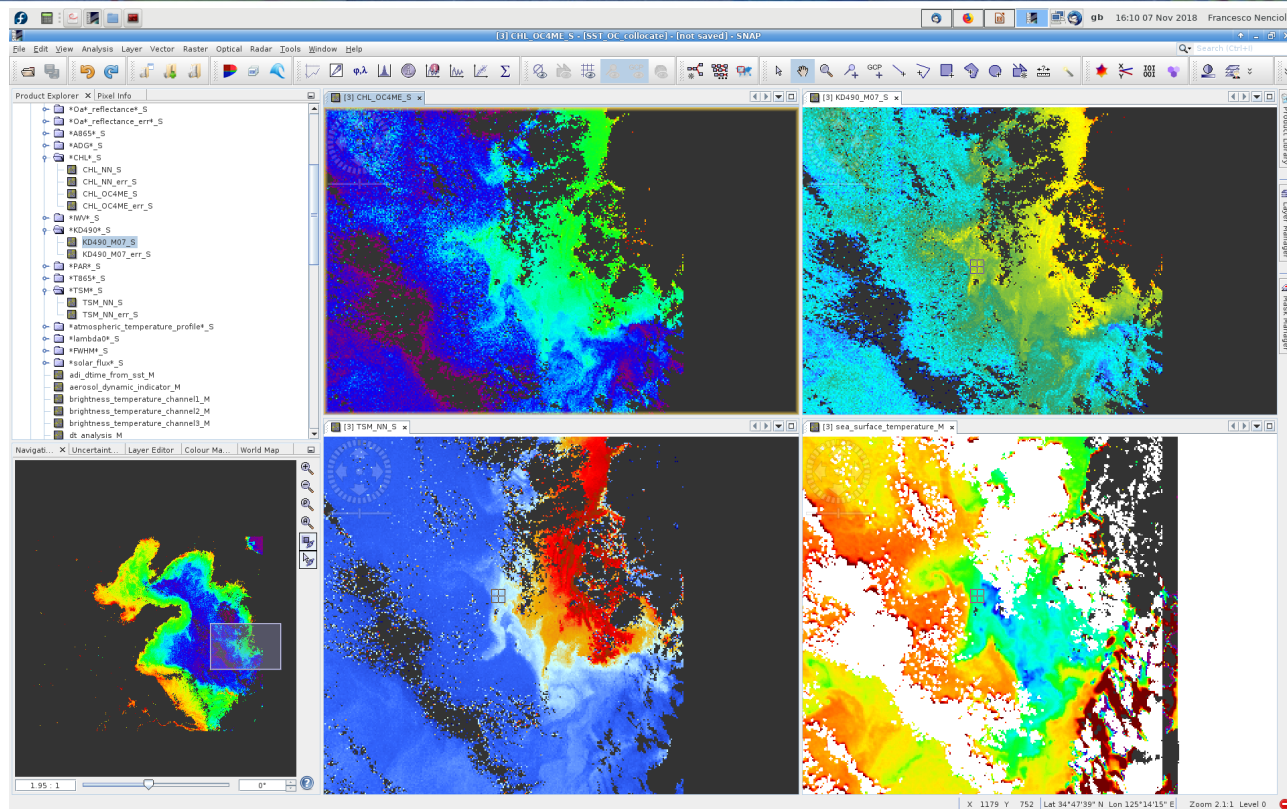


# Exercise 3: Synergy between the data



Here some examples:

1. KD correlated with TSM near the coast
2. Strong inverse correlation between CHL and SST
3. Possible upwelling or vertical mixing of nutrient rich waters from depth

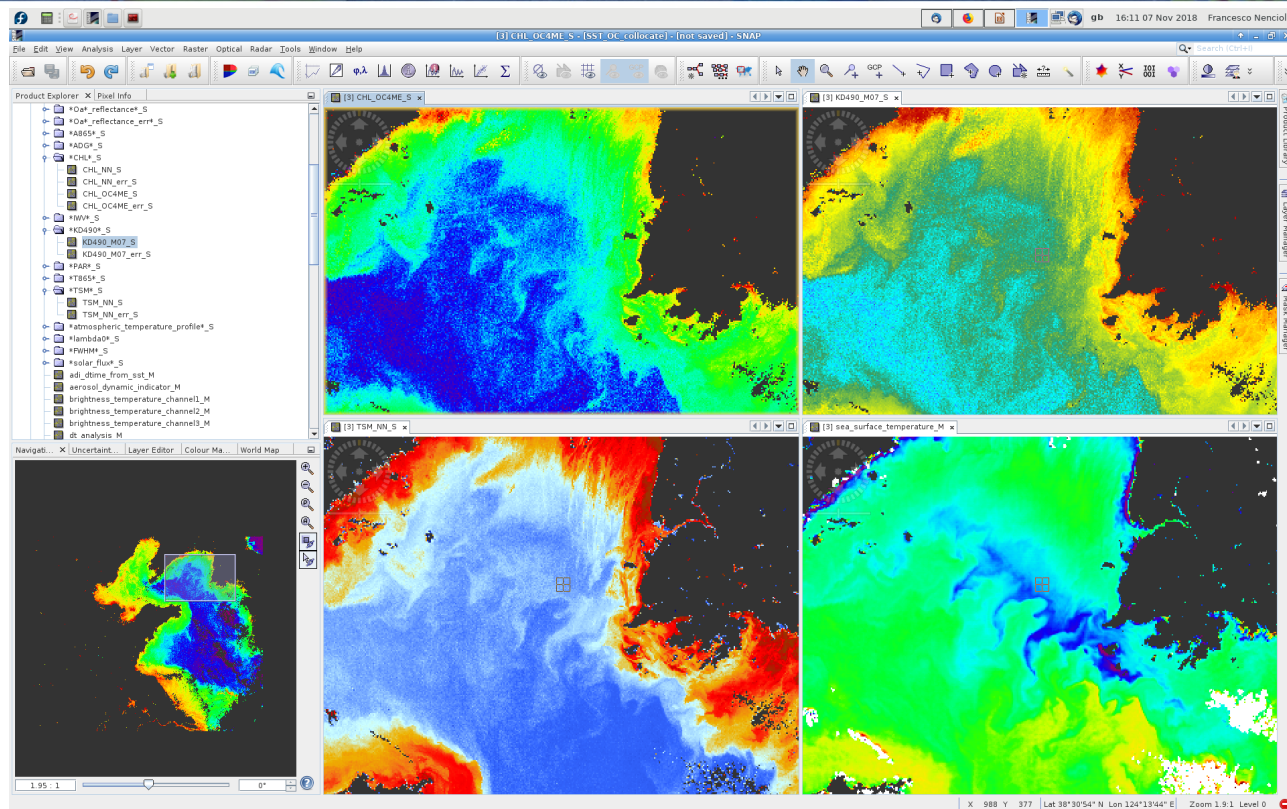


# Exercise 3: Synergy between the data



Here some examples:

1. Headland effect on SST (cold patch) due to enhanced turbulence
2. Weaker optical signature (TSM, KD) within cold water
3. Higher CHL within cold filaments (biological response)



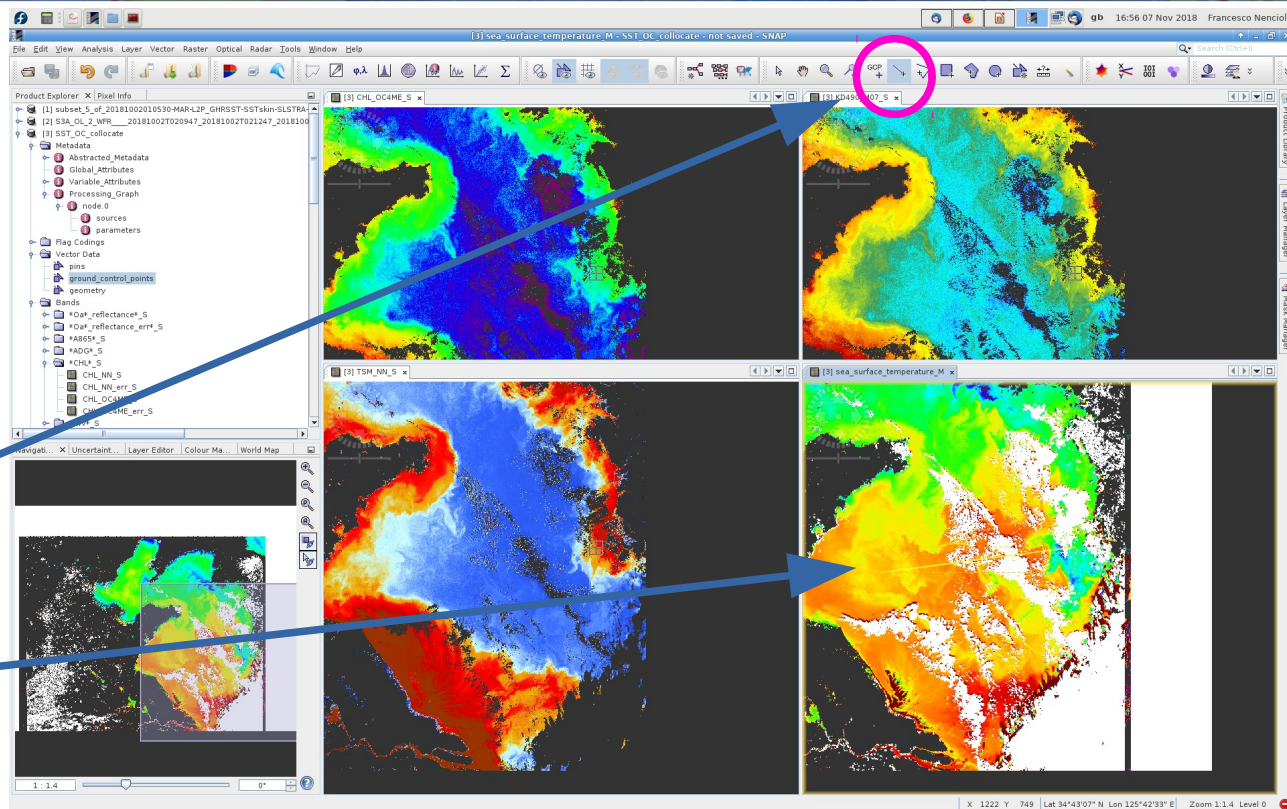
# Exercise 4: Combined plots (transect)

To further compare optical properties and SST, the variables can be plotted as:

1. Transects
2. Scatter plots

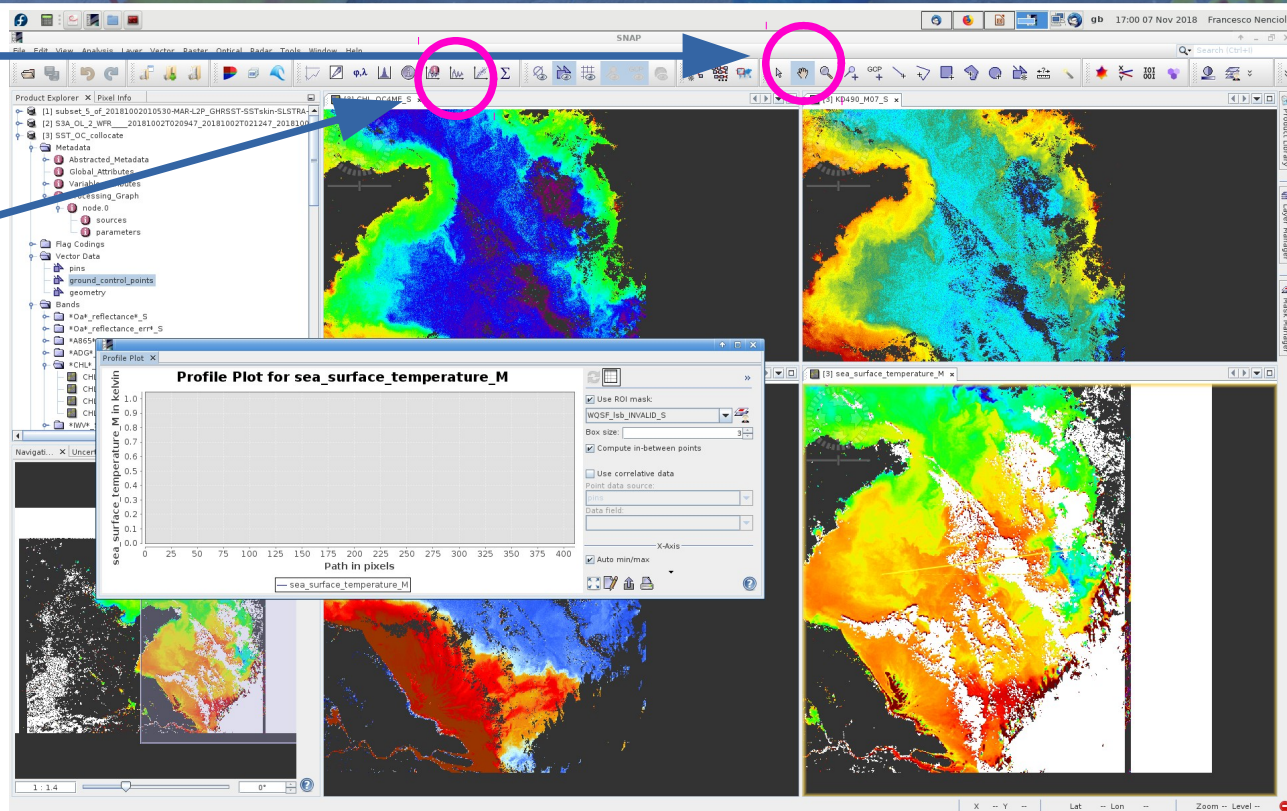
To plot a transect:

- Click on the **Line drawing tool** button
- Trace a transect in one of the maps (in this case SST from west to east)



# Exercise 4: Combined plots (transect)

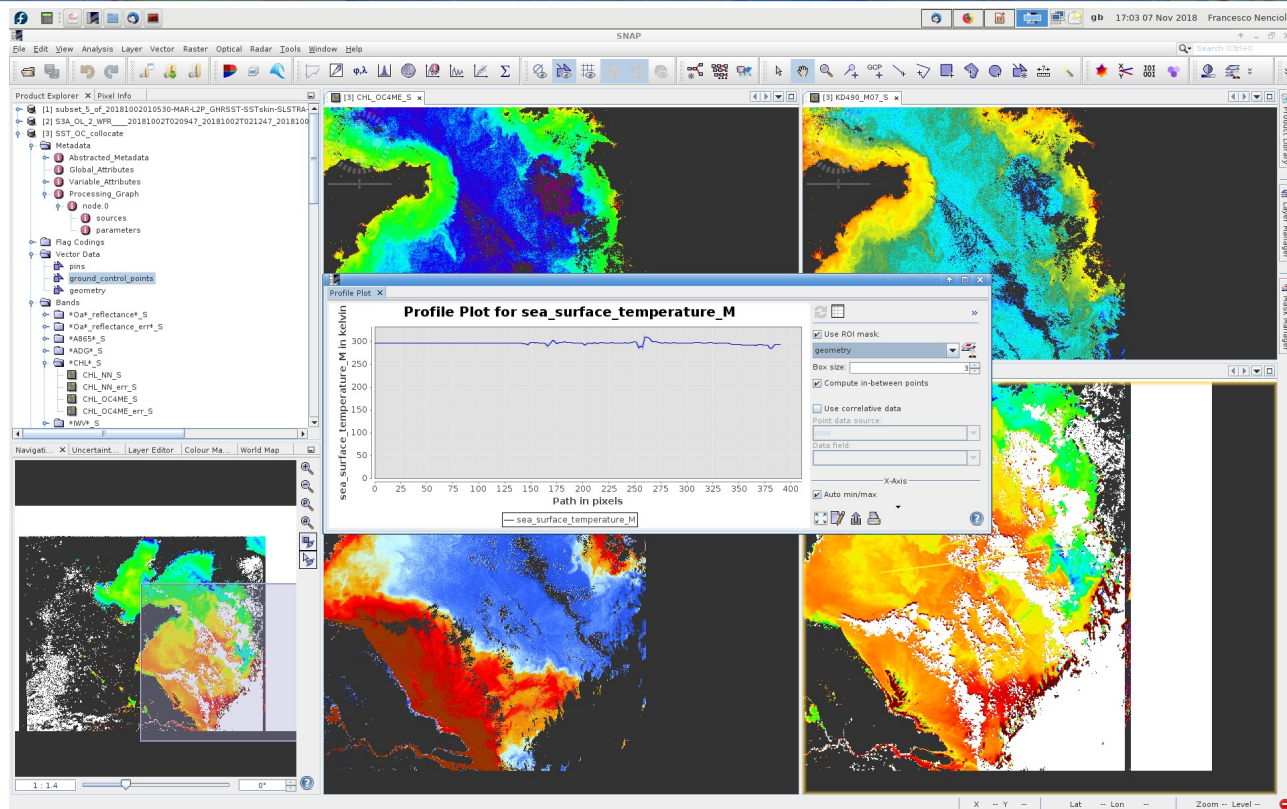
- Make sure to select back the **Panning tool** button
- Click on the **Profile Plot** button



# Exercise 4: Combined plots (transect)

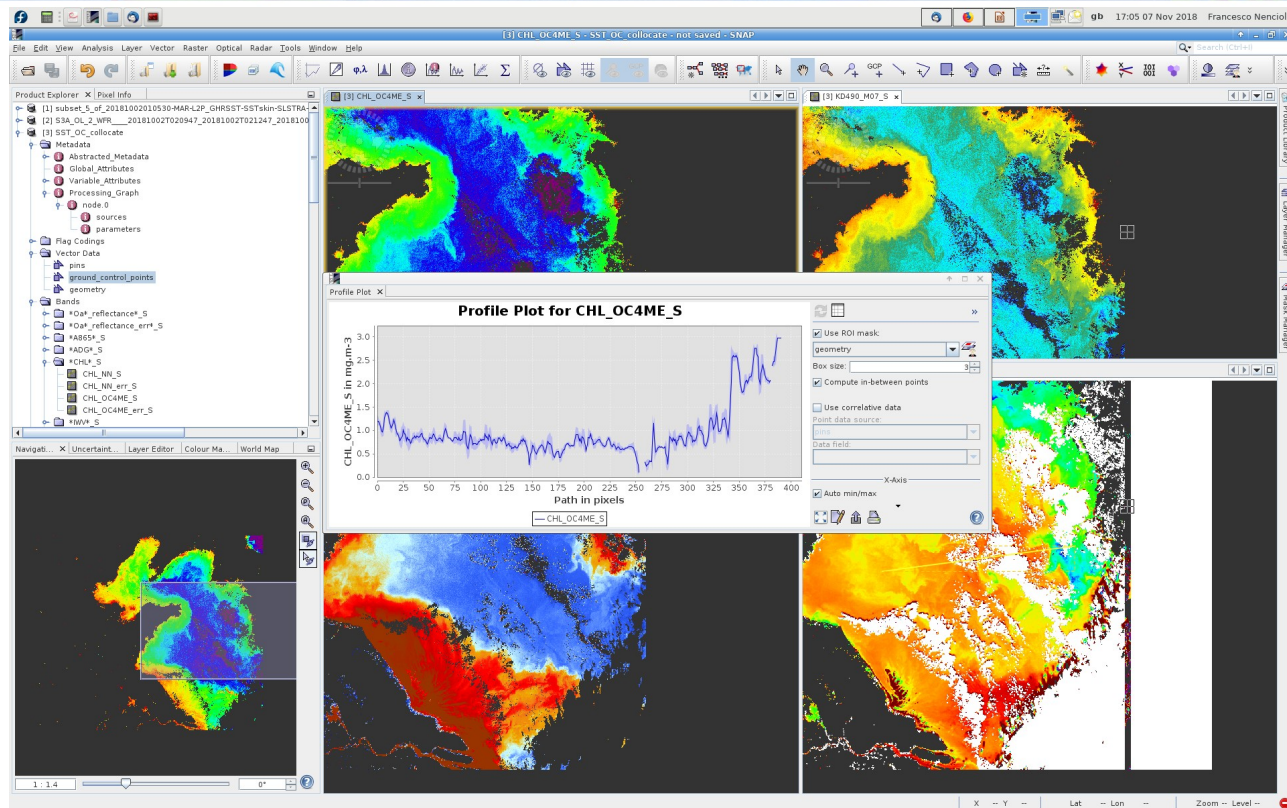
- Make sure to select back the **Panning tool** button
- Click on the **Profile Plot** button
- In the dialogue window tick **Use ROI mask** and select **geometry** (at the bottom of the menu)

(you should see the transect of SST data)



# Exercise 4: Combined plots (transect)

- Make sure to select back the **Panning tool** button
  - Click on the **Profile Plot** button
  - In the dialogue window tick **Use ROI mask** and select **geometry** (at the bottom of the menu)
- (you should see the transect of SST data)
- Clicking on the other maps show the transect for the other variables



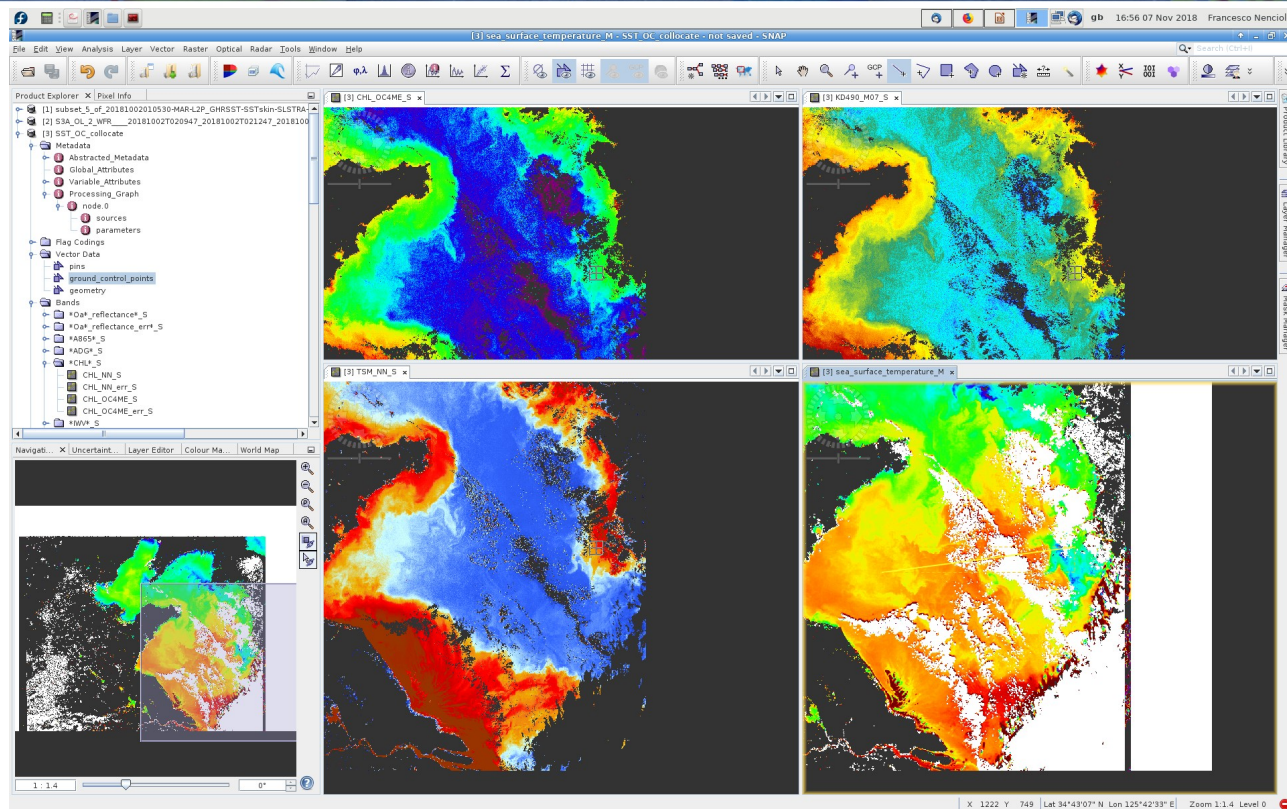
# Exercise 4: Combined plots (scatter)

Scatter plots can be plotted for:

1. whole domain
2. Sub-domains
3. single transect

To plot a scatter plot for a single transect:

- Select a transect as explained before



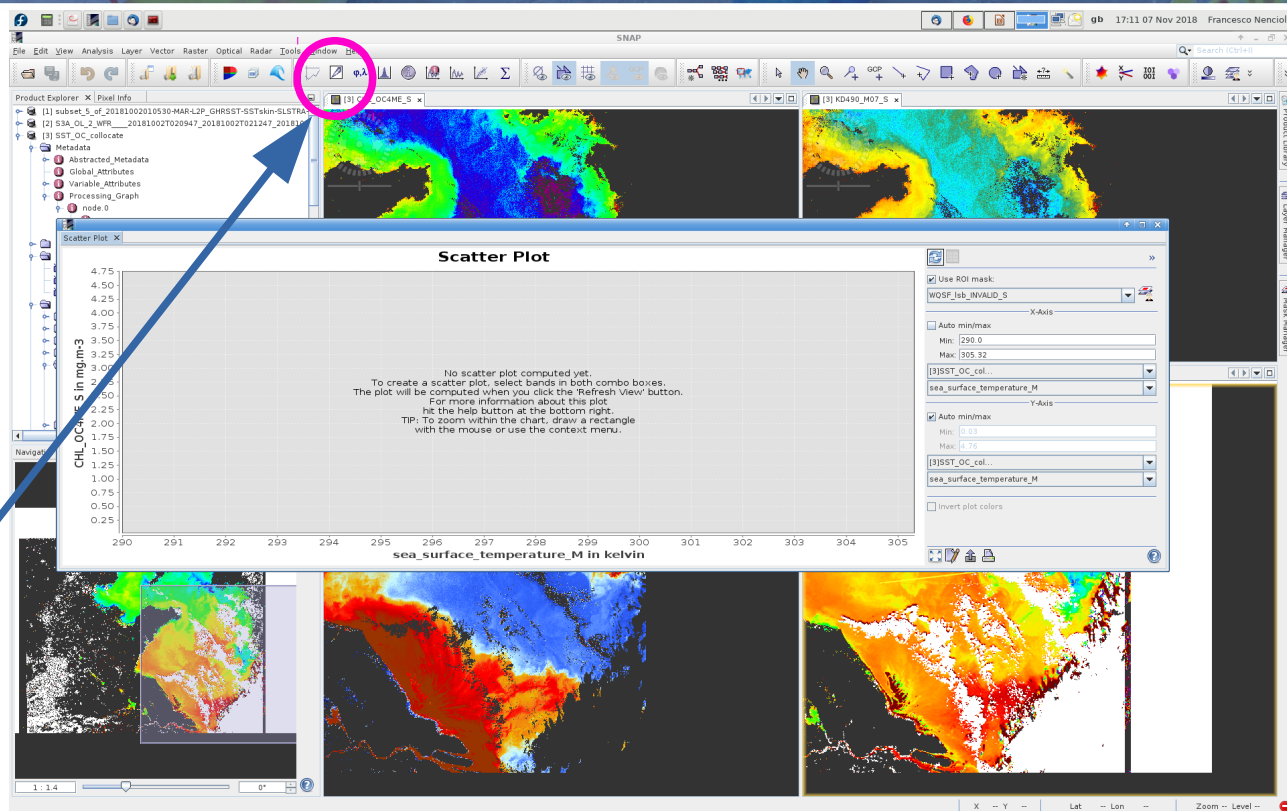
# Exercise 4: Combined plots (scatter)

Scatter plots can be plotted for:

1. whole domain
2. Sub-domains
3. single transect

To plot a scatter plot for a single transect:

- Select a transect as explained before
- Click on the **Scatter plot** button





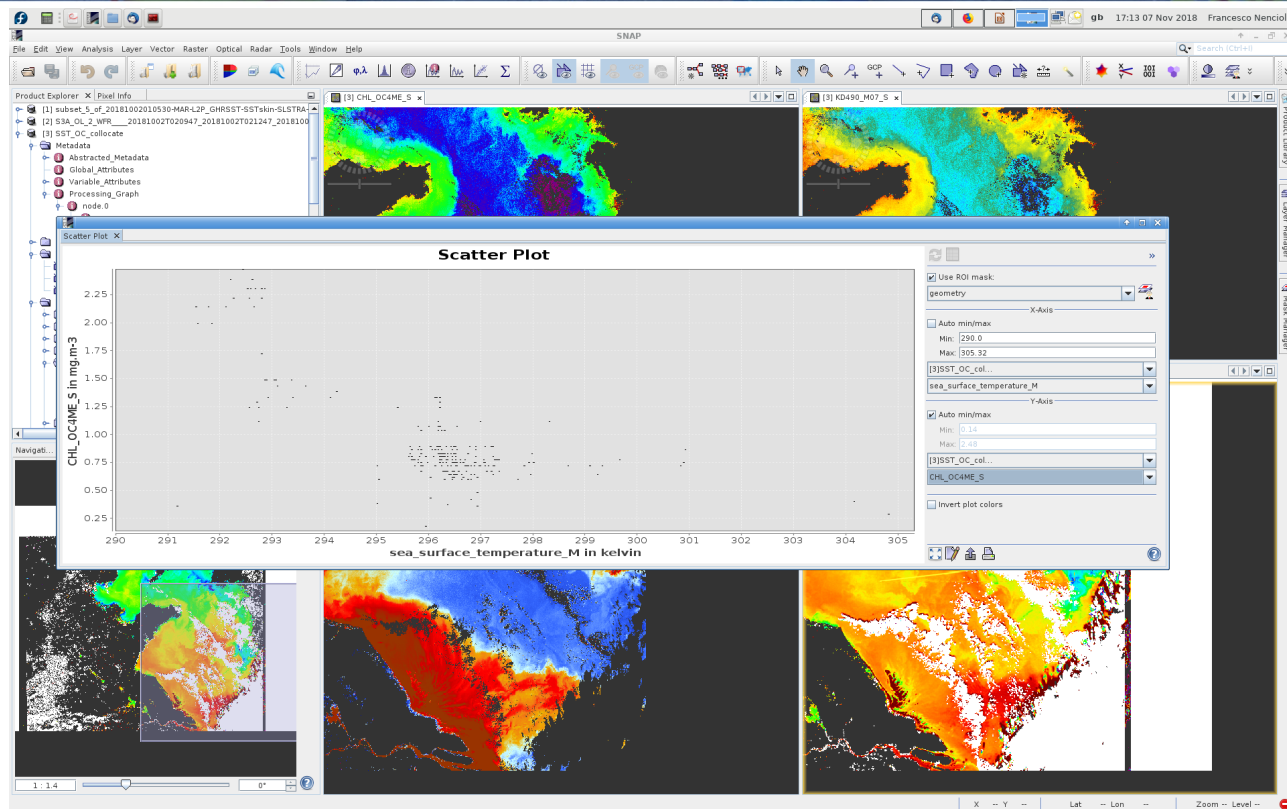
# Exercise 4: Combined plots (scatter)

- Tick **Use ROI mask**
- Select **geometry**
- Chose the variables to plot (in this case SST and CHL)

For SST adjust limits:

- Un-tick **Auto min/max**
- Set the limits (must be a decimal number!!!)

Unfortunately the marker size cannot be changed, but you should see CHL increasing for decreasing SST

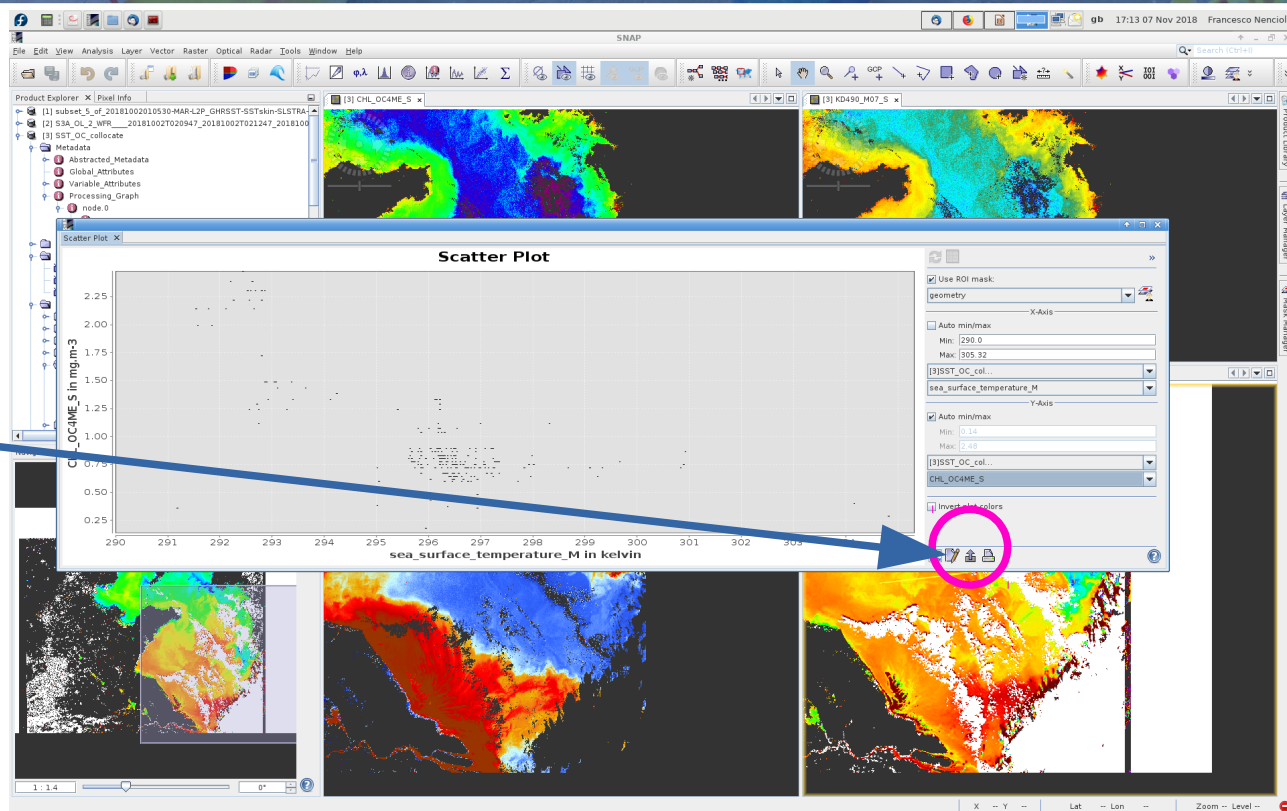


# Exercise 4: Combined plots (scatter)

Also remember that you can always output data

- Click on the **Export** button and save the data on disc to plot them later with your favourite plotting method

[NB: Python rules!!!]



# Exercise 4: Combined plots (scatter)



**Be curious!!!**

Feel free to explore different combinations of variables and different areas of the domain

