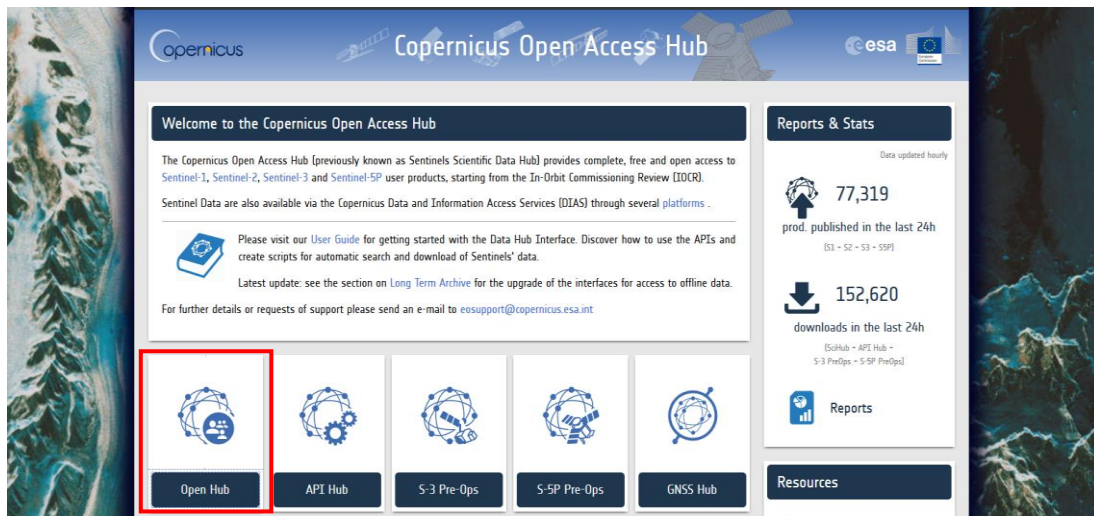# Downloading Sentinel 2 Image Data, and basic Image Analysis using SNAP

Downloading Sentinel 2 Image Data

The primary source for Sentinel satellite data is the **Copernicus Open Access Hub**. Following the link: https://scihub.copernicus.eu/ you will be brought to the Copernicus Open Access Hub landing page.

Figure 1

Multiple links are available on this page, these provide additional information about the Copernicus project and Sentinel satellites; explore these if interested. When you want to download satellite data, click **Open Hub.**
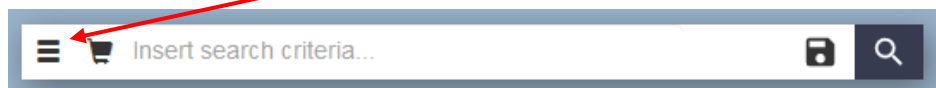
Figure 2
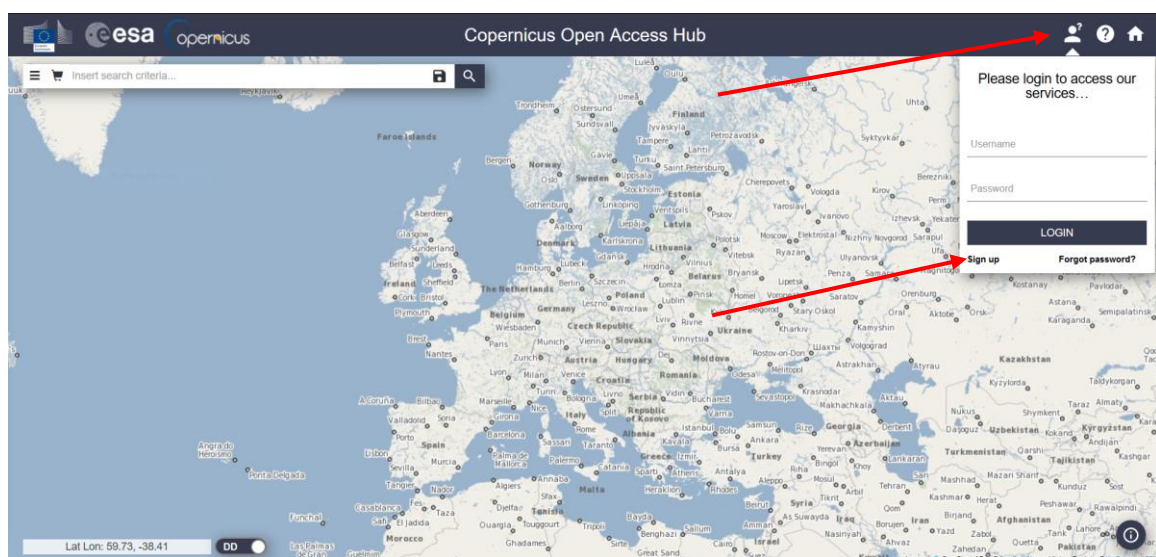
Once the map appears, you will need to create an account in order to download data. To do this, click the **Login Icon** on the top right-hand corner of the webpage, then click **Sign Up,** as seen in Figure 2 above.

Once you have created an account, you can then select a geographic area to limit your search results to. To do this, use the scroll wheel on your mouse to zoom to your area of interested (AOI); Dublin is used as an example in Figure 3. Next, use your right mouse button to place vertices to define your AOI, double click to place the final vertex in order to define your polygon. See Figure 3 below.

Figure 3
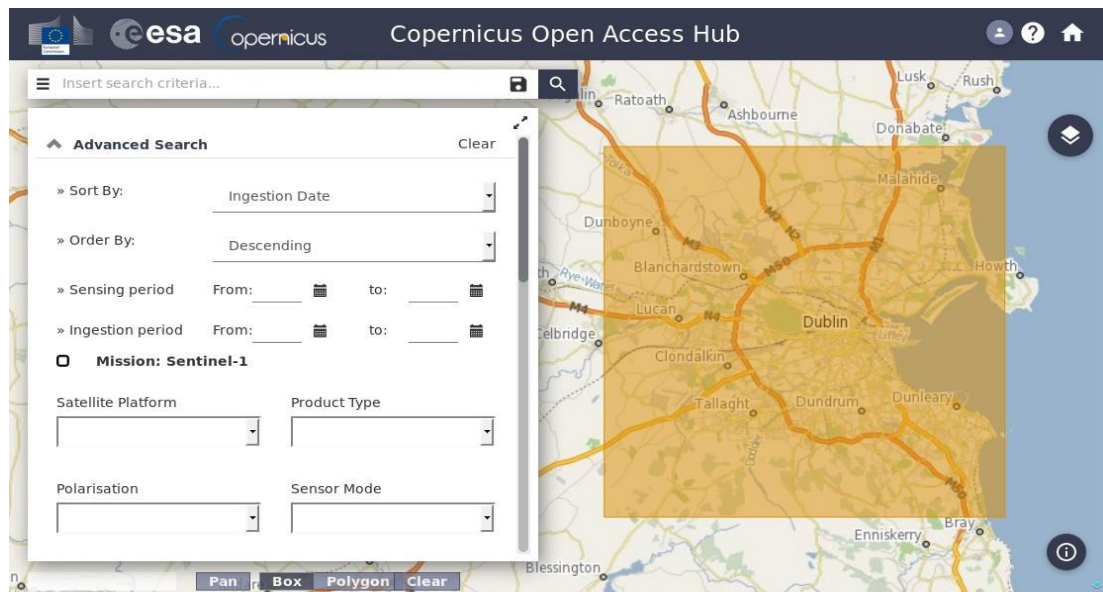
Once you select an area, click the **Advance Search** icon (≡) located on the search bar. This will allow you to filter the results of your search.

Here you can sort by parameters such as: ingestion date, sensing period, etc. if you would like to. For now, you can leave these as is.

There are three 'Missions' that are currently available on the Copernicus Open Access Hub: Sentinel 1, Sentinel 2, and Sentinel 3. These correspond to three separate satellite constellations. We will just focus on Sentinel 2.

In order to filter your search results to only display Sentinel 2 data, tick the small box beside '**Mission: Sentinel-2'**, seen in Figure 5.

Figure 5

Select your **Product Type** from the drop-down menu. In this case, we will select 'S2MSI2A'. "S2" stands for: "Sentinel 2"; "MSI" stands for: "Multi Spectral Imager" (the sensor which captured the data); and "2A" means that the data is already atmospherically corrected.

To filter the data by cloud cover you will need to enter values in a specific format. For example, if I want to display data with less than 10% cloud cover, you will enter: **[0 TO 10]**. Be sure to include the brackets and the capitalised "TO". As additional examples: for data with less than 35% cloud cover, you would enter: **[0 TO 35]**, and for data with between 10% and 20% cloud cover you would enter: **[10 TO 20]**. You can leave the **Sensing Period**, **Ingestion Date**, **Satellite Platform**, and **Relative Orbit Number** boxes empty for now.

Once you have selected your AOI, and defined your search parameters, click the search icon . The search results will then be displayed, as seen in Figure 6.

Figure 6

When you hover your mouse over each product in the list of results you will see five icons appear.

Hovering over each icon will reveal information about them. The two most important icons are the **View Product Details** 👁 and the **Download Product** ⬇ icons. Click the **View Product Details** icon to view the products metadata, and to see a preview of the data. Use this preview to make sure there are no clouds covering your AOI. You can then download your chosen product using the **Download Product** button. There is also a download product button on the bottom right hand corner of the **View Product Details** window, see Figure 7.

Figure 7

Optional: Once you download the compressed file, you may extract it and explore its folders if you wish. The individual raster files can be found in the 'GRANULE' folder. Search within this folder structure for a folder named **IMG_DATA**, you will find that the raw data files are divided into three separate folders, each corresponding the three different spatial resolutions of Sentinel 2 MSI (10m, 20m, 60m). These files will have the extension .jp2 and correspond to individual Sentinel 2 MSI bands.

Some Image Analysis using SNAP…

SNAP is a free but powerful remote sensing image processing/analysis software; it can be downloaded for from ESA's website:

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

Figure 8

You should download and install the 'Sentinel Toolboxes' file which corresponds to your operating system. This will install SNAP, along with Sentinel Toolboxes. Sentinel Toolboxes contain the tools which you will use to carry out processing/analysis tasks on the Sentinel 2 data you downloaded.

Figure 9

	Windows 64-Bit	Windows 32-Bit	Mac OS X	Unix 64-bit
Sentinel Toolboxes	These installers contain the **Sentinel-1, Sentinel-2, Sentinel-3** Toolboxes, download size is close to 900MB.			
	Main Download	Main Download	Main Download	Main Download
	Mirror Download	Mirror Download	Mirror Download	Mirror Download
SMOS Toolbox	These installers contain only the **SMOS Toolbox**, download size is close to 500MB. Download also the Format Conversion Tool (Earth Explorer to NetCDF) and the user manual.			
	Main Download	Main Download	Main Download	Main Download
	Mirror Download	Mirror Download	Mirror Download	Mirror Download
All Toolboxes	These installers contain the **Sentinel-1, Sentinel-2, Sentinel-3** Toolboxes, **SMOS** and **PROBA-V** Toolbox, download size is close to 1GB.			
	Main Download	Main Download	Main Download	Main Download
	Mirror Download	Mirror Download	Mirror Download	Mirror Download

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Once you have installed SNAP, you can import the Sentinel 2 product you downloaded. It is not necessary to unzip this file, as SNAP can read the zipped file. To import the product, go to **File > Open Product** then navigate to the product file and open it.

Figure 10
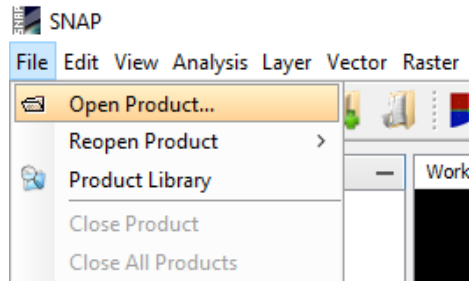
When the product has loaded, it will appear in the table of contents (TOC) on the left-hand side of the interface, as seen in Figure 11. You can expand the product using the "+" icon to the left of the product name. You will find the individual band data for all 12 of Sentinel 2's bands in the folder labelled 'Bands'. Double click on the band name to view it in the workspace viewer window.

Figure 11
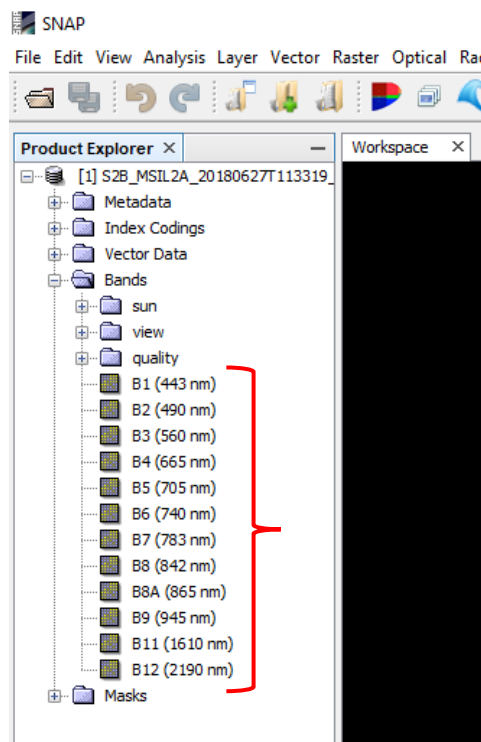
Now would be a good time to become familiar the tools which you will use to navigate around the images (Zoom, Pan, etc.). These are located on the top toolbar and look like this:
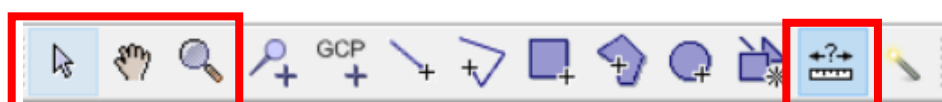
Along with the navigation tools, there are tools which allow you to draw points, lines, and polygons on the images, as well as a distance measurement tool. The main tools are illustrated above.

Creating an RGB (Red, Green, Blue) and False Colour Composite (FCC) Image

Now that the Sentinel 2 data has been imported, you can carry out processing and analysis tasks on the data. Firstly, to create an **RGB** (Red, Green, Blue) image, also known as a **True Colour Image**, right click on the product name in the TOC and select **Open RGB Image Window** from the drop-down menu, as seen in Figure 12 below.

Figure 12
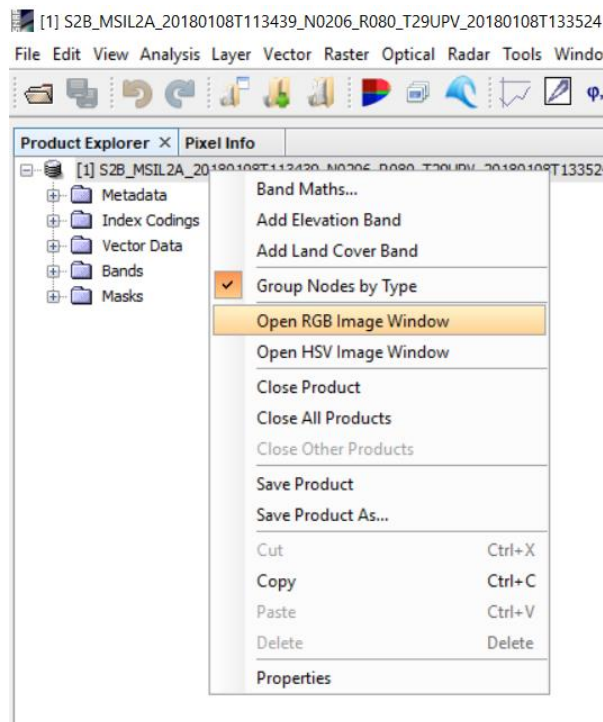
A window will appear, seen in Figure 13 below, which will allow you to select the bands you would like to allocate to each colour (Red, Green, Blue). By selecting **Sentinel 2 MSI Natural Colours** as the profile, the bands will automatically be allocated, i.e. Red = Band 4, Green = Band 3, and Blue = Band 2. Alternatively, you may select the band allocations manually if you wish. Click **OK** when you are happy with your allocation. Finally, the RGB image will then be loaded into the viewer window and will look something like Figure 14.

Figure 13
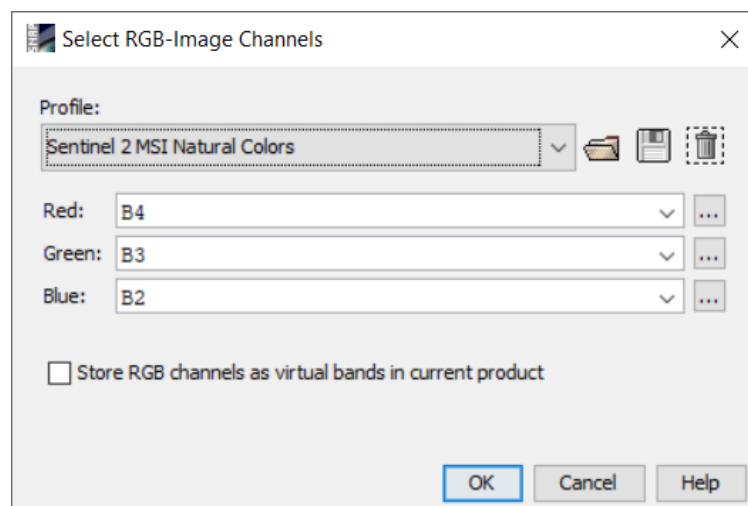
Figure 14

To create the False-Colour Composite (FCC) image, the process is identical to the one used to create an RGB image. However, the band allocations are different. Because we are not only interested in the visible wavelength bands Sentinel 2 MSI possesses (RGB), we need a way of visualising those spectral bands which lie beyond the wavelengths we humans can see, i.e. near-infrared. An FCC will allow us to do just that.

As seen in Figure 15 below, by selecting the profile: **Sentinel 2 MSI False-colour Infrared**, Band 8 (Sentinel 2's Near-Infrared band) is allocated to the colour Red, while Band 4 (Sentinel 2's Red band) is allocated to the colour Green, and Band 3 (Sentinel 2's Green band) is allocated to the colour Blue. Once you have allocated the bands correctly, click **OK** and the FCC image will appear in the viewer window.

Figure 15
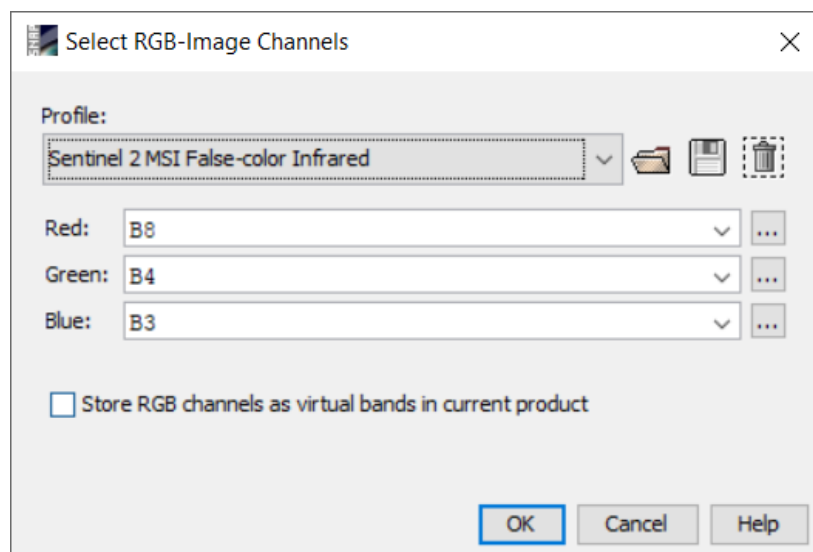
Subset (cropping the image)

You may also wish to subset your data, as is unlikely that you will require the whole Sentinel 2 scene for whatever your application is. The **Subset** tool can be used to clip the image to your specific AOI. It may be best to subset your image before you carry out any analysis tasks, as a smaller image will take less computing power to process – but this is up to you, you may subset at the end if you wish.

To subset the Sentinel 2 Product, click the product name in the TOC to highlight it, then click **Raster** on the toolbar and select **Subset** from the dropdown menu, as seen in Figure 16.
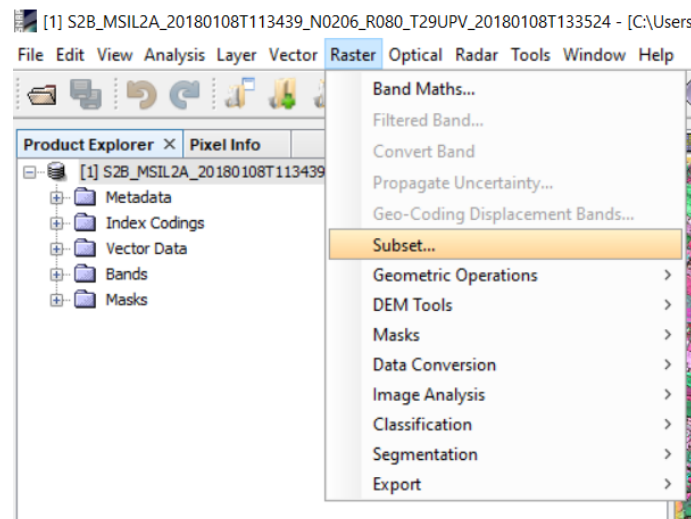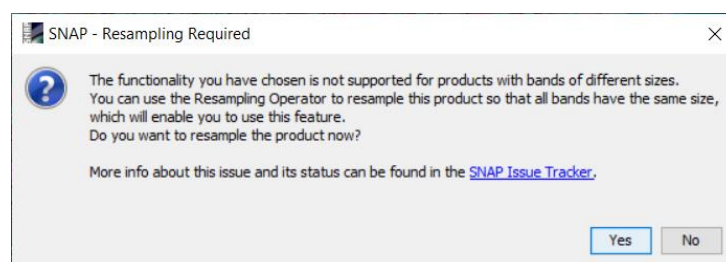
Figure 16

You will then be greeted by a message, seen in Figure 17, which states that the data must be resampled so that each band's spatial resolution will be the same. Sentinel 2 has three different spatial resolutions for its bands, 10m, 20m, 60m (See the table at the end of this document for more information). Click **Yes**.

Figure 17

When the **Resampling** window appears, click the **Resampling Parameters** tab. Select 'B2' from the dropdown menu to define the reference band for the resampled product, see Figure 18 below. This will resample all the product's bands to a spatial resolution of 10m (the spatial resolution of Band 2). Leave the rest of the settings the same and click **Run**. The resampled product will be saved as a new file in the same directory as the original product, with "_resampled" appended to the original product's name. It should open automatically in the viewer once the process has run.

Figure 18
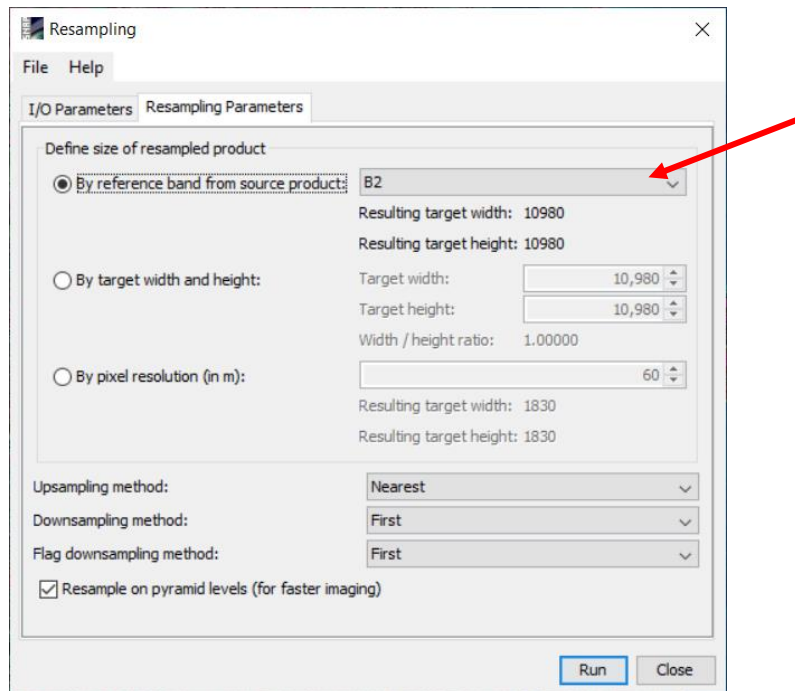
Once the resampled product appears in the TOC, click its name to highlight it. Then click **Raster > Subset** from the toolbar once more. This time the **Subset** window will appear. On the left-hand side, you will see a thumbnail image representing the entire scene. Surrounding this image is a blue bounding box, which you can drag to the bounds of your desired AOI, as seen in Figure 19 (I have selected an AOI covering Dublin City).

Figure 19
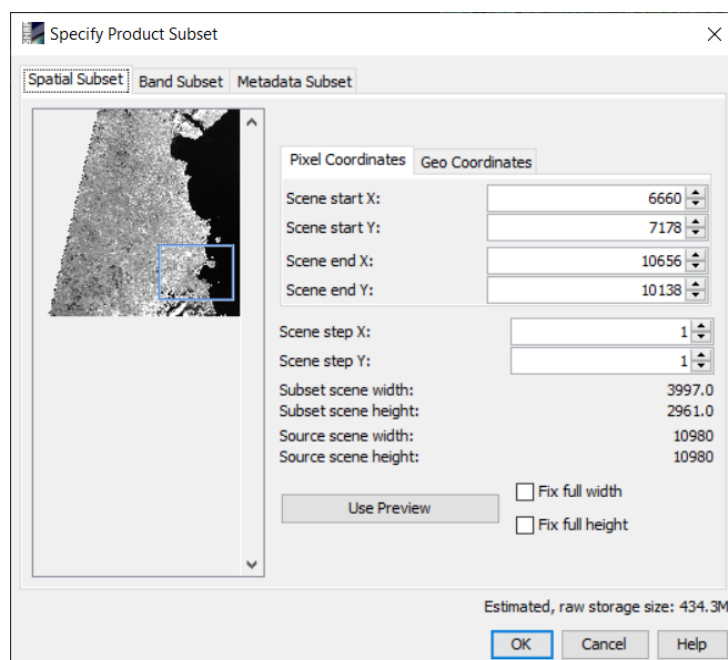
When you are happy with your defined AOI, click the **Band Subset** tab. Here you can select the bands you would like to carry over to your subset image. In this example, bands 2, 3, 4, and 8 were selected, as seen in Figure 20. Click **OK** and the subset product will appear in the TOC. Figure 14 above shows the result of this subset as an RGB image.

Figure 20
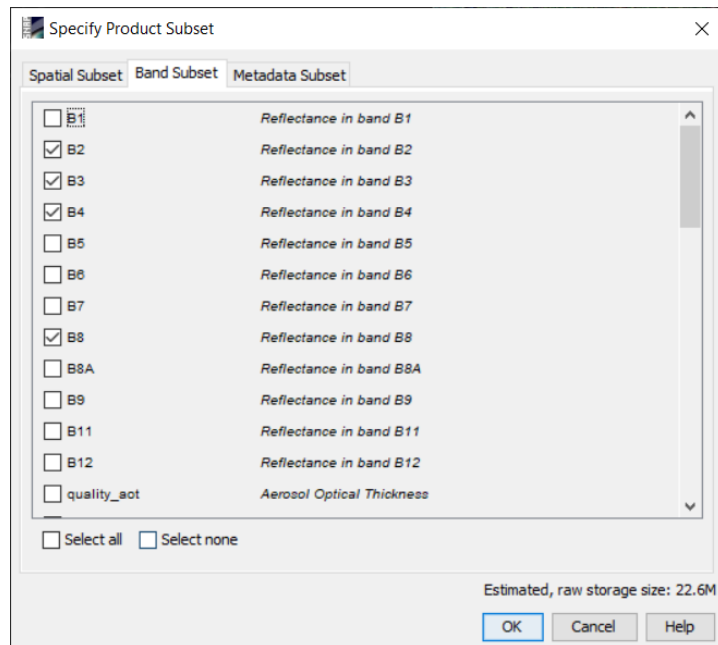
SNAP Tutorial Video on Exporting an Image

The final step is to export your image. The video linked below will show you how to do this.

https://www.youtube.com/watch?v=IIzl4ZdLecM

Additional Material

SNAP Tutorial Video on Creating an NDVI (**Normalized Difference Vegetation Index**)
https://www.youtube.com/watch?v=mD-JVUTCBkY

To learn more about remote sensing data analysis and processing using SNAP, look at the SNAP video tutorials available from the ESA website linked below.

Useful Links

Download Sentinel 2 Data
https://scihub.copernicus.eu/

Download SNAP
http://step.esa.int/main/download/snap-download/

SNAP Video Tutorials
http://step.esa.int/main/doc/tutorials/snap-tutorials/

Sentinel 2 Band Allocations

Sentinel-2 Bands	Central Wavelength (µm)	Resolution (m)
Band 1 – Coastal aerosol	0.443	60
Band 2 – Blue	0.49	10
Band 3 – Green	0.56	10
Band 4 – Red	0.665	10
Band 5 – Vegetation Red Edge	0.705	20
Band 6 – Vegetation Red Edge	0.74	20
Band 7 – Vegetation Red Edge	0.783	20
Band 8 – NIR	0.842	10
Band 8A – Narrow NIR	0.865	20
Band 9 – Water vapour	0.945	60
Band 10 – SWIR – Cirrus	1.375	60
Band 11 – SWIR	1.61	20
Band 12 – SWIR	2.19	20