Copernicus Master in Digital Earth
Student: Emanuel Goulart Farias
Student number: 12413874
Big Earth Data Concepts
Assignment 2: EO Browser.

Watching the news about the tragedy that took place in Valencia, Spain, I saw compelling images shared by Copernicus about the floods. Inspired by that, I decided to reproduce the image and try to gain a glimpse into the understanding of solids transportation and its spectral response in multispectral satellite images captured by Sentinel-2.

Therefore, I looked up the date range from October 29th, to November 1, 2024. Which was the period of the event and the data range that many videos of the tragedy were circulating on the most popular social media platforms. Due to the rainstorm, the weather was expected to be cloudy, but I managed to find one Sentinel-2 image from October 31, 2024, with acceptable cloud cover to visualize the extent of the floods in the lake just above the city of Valencia. The image below represents the true colour composition of the lake.

Figure 1 - L'Albufera, Valencia's lake in a true colour composition.

I used the existing indexes available on the EO Browser to capture an image showing the extent of the flood, specifically selecting the Normalized Difference Water Index (NDWI), which

is the normalized difference between bands B3 and B8. The images presented below are of the same region of interest, L'Albufera Lake, depicting the NDWI on two dates: October 31, highlighting the extent of the flooding, and October 11, showing the average spatial extent of the lake. This date range was chosen because October had been a particularly cloudy month over Valencia, and most days the cloud cover hindered a good visualization of the lake.

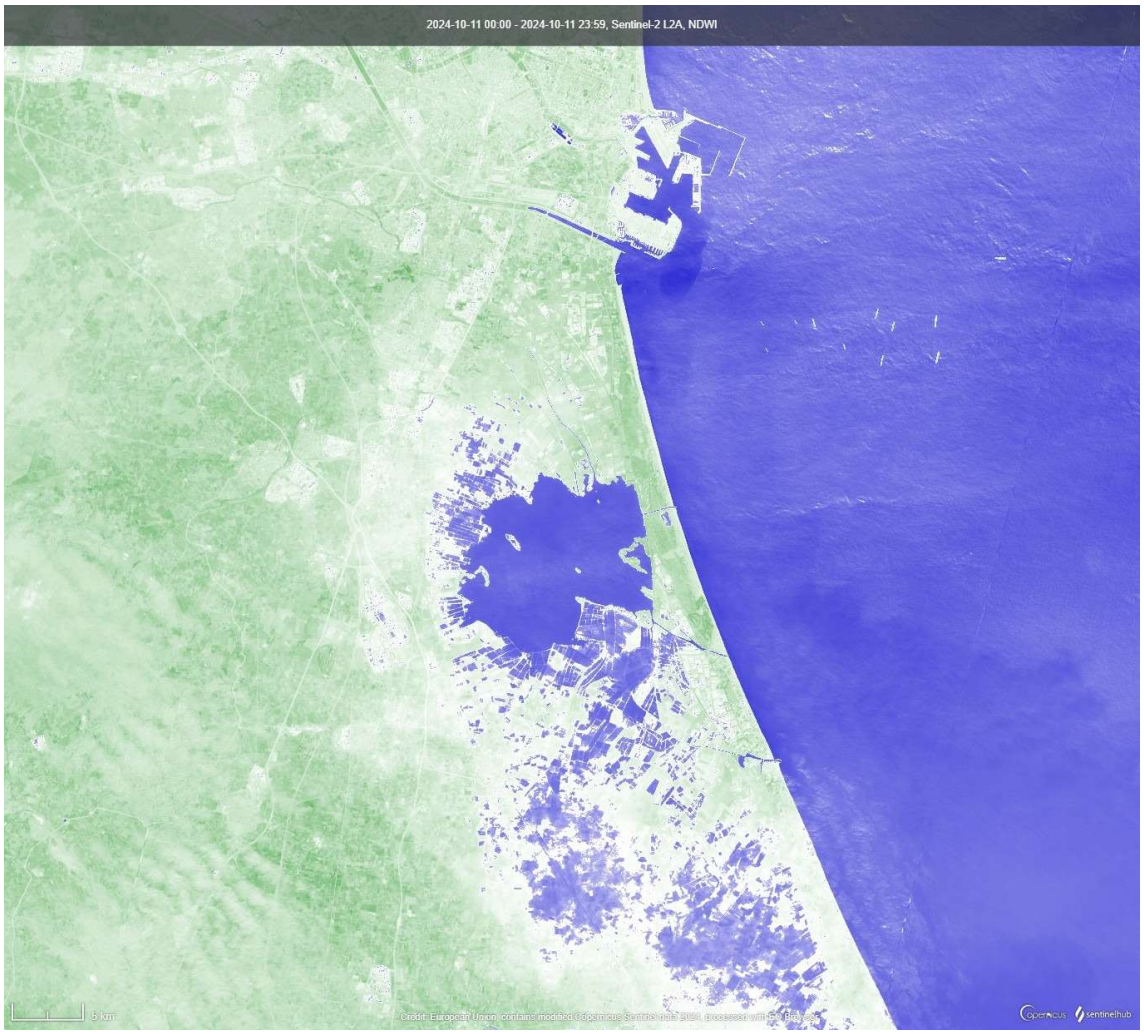

Figure 2 - NDWI for L'Albufera lake in its average extension.

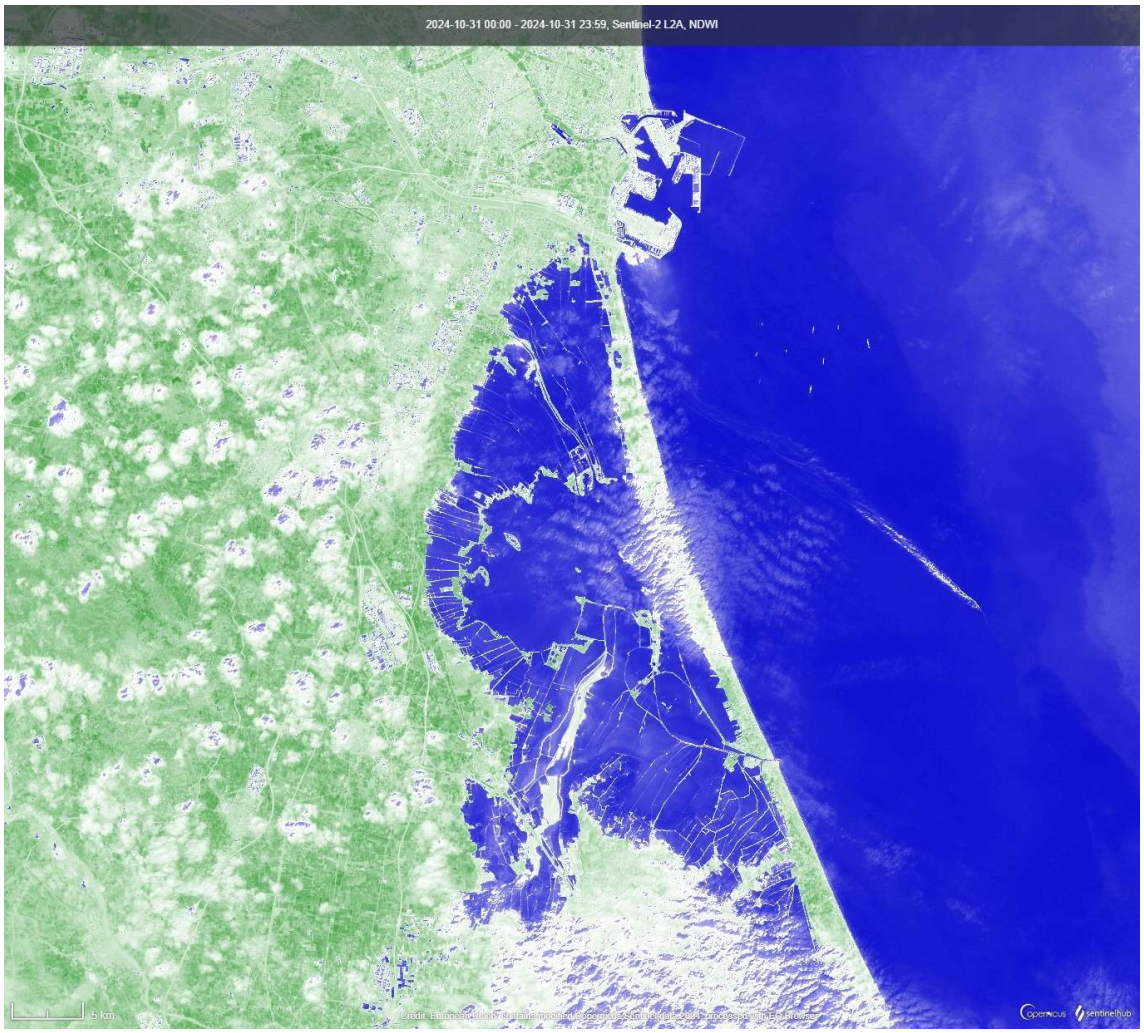

Figure 3 - NDWI L'Albufera lake, registered during the floods.

After noticing the significant extension of the floods in L'Albufera lake, which impressed me by showing that the area almost doubled during the event period, I decided to understand the dynamics of sediments during heavy precipitation events in the watershed. I stumbled upon an index called Se2WaQ - Sentinel-2 Water Quality Script - developed by Nuno Pereira at the Polytechnic Institute of Beja, Portugal. This index displays the spatial distribution of six relevant indicators for water quality, which are used to define the trophic state of inland waters. The indicators that can be analysed are: Concentration of Chlorophyll; Density of Cyanobacteria; Turbidity; Coloured Dissolved Organic Matter; Dissolved Organic Carbon; and Water Colour.

The image above show a snippet of the code develop by Nuno Pereira:

```
// Empirical models

var Chl_a = 4.26 * Math.pow(B03/B01, 3.94);           // FLAGparam = 0; S2-L2A; [1] Unit: mg/m3;

var Cya = 115530.31 * Math.pow(B03 * B04 / B02, 2.38); // FLAGparam = 1; S2-L2A; [1] Unit: 10^3 cell/ml;

var Turb = 8.93 * (B03/B01) - 6.39;                   // FLAGparam = 2; S2-L2A; [1] Unit: NTU;

var CDOM = 537 * Math.exp(-2.93*B03/B04);             // FLAGparam = 3; S2-L1C; [2] Unit: mg/L;

var DOC = 432 * Math.exp(-2.24*B03/B04);              // FLAGparam = 4; S2-L1C; [2] Unit: mg/L;

var Color = 25366 * Math.exp(-4.53*B03/B04);          // FLAGparam = 5; S2-L1C; [2] Unit: mg.Pt/L;
```

This snippet of code shows how the variables are calculated to create the indicator that will be displayed. The turbidity index, which is my choice for the indicator, is calculated based on the ratio of the Blue band (B3) to the Red band (B1), and then multiplied by 8.93 followed by a subtraction of 6.39. The code continues by creating numerical values that will populate the scale range and also creating the color scale, which depends on the chosen indicator. It uses the variable flagParam to control which variable will be displayed and switches using a case statement in JavaScript.

Manipulating the script, selecting the *'flagParam',* I was able to display the turbidity index, which, in the context of water quality, is an indicator of suspended sediments in the water and can be used as a proxy for sediments carried into the lake during the rainwater event. I set up the script to show values on a scale of 0 to 20 NTU, where NTU stands for Nephelometric Turbidity Unit, the unit used to measure the presence of suspended particles in water.

The image below corresponds to both October 11, 2024, and October 31, 2024, showing a significant contrast in turbidity levels in the lake. Under average lake conditions, the NTU is around a maximum of 10 NTU. However, after the historical hydrological event, a major part of the lake's extent reaches the maximum of the scale, which is 20 NTU. This limitation of the scale suggests that the values are likely even higher than 20 NTU. A high rate of sediments was carried all the way down the watershed to the lake, reaching regions that are not typically covered by water and exposing a drastic change in the land cover of the Valencia region. Besides the index being used for inland water, it is very interesting to notice how the sediments are carried to the ocean and can be spatially displayed with the index measurement. High turbidity values are assessed at the lake's exit and over a large extent of Valencia's coast.

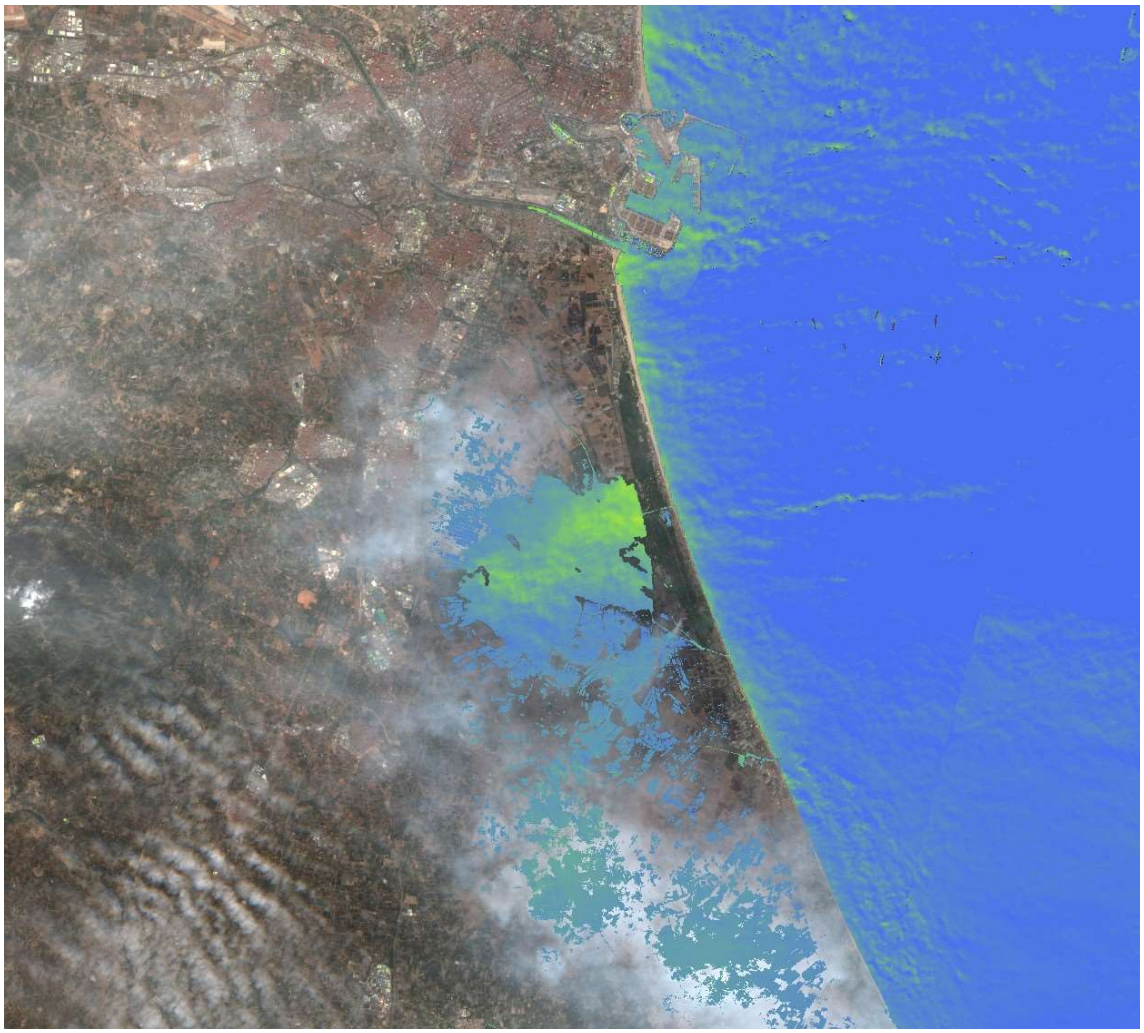

Figure 4 - Se2WAQ index applied for L'Albufeira lake at the 11/10/2024. .

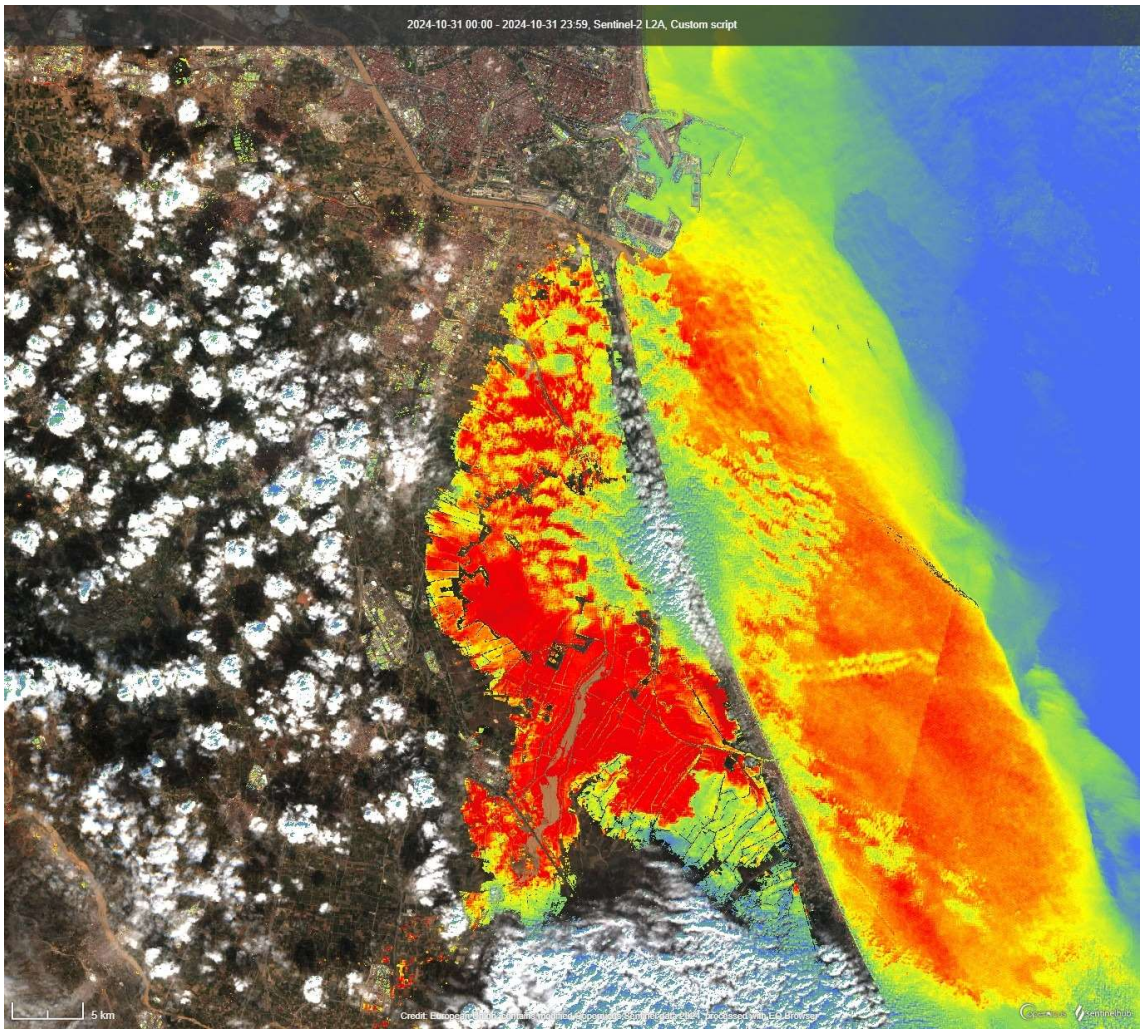

Figure 5 - Se2WAQ index applied for L'Albufeira lake at the 31/10/2024.