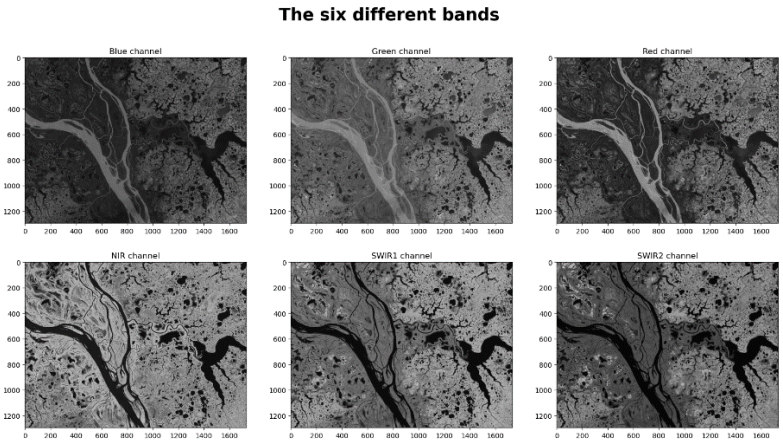
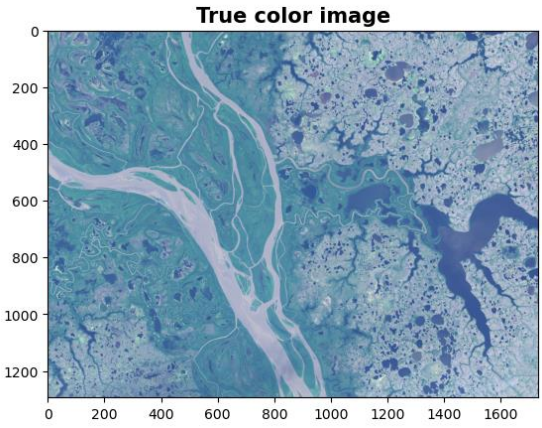
Lecture 2:

PCA Exercises

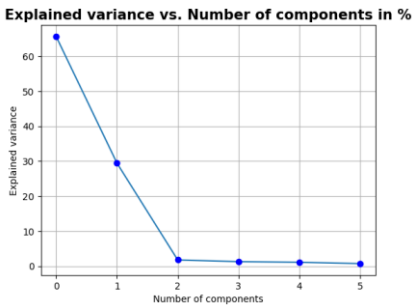
1) The Yukon River

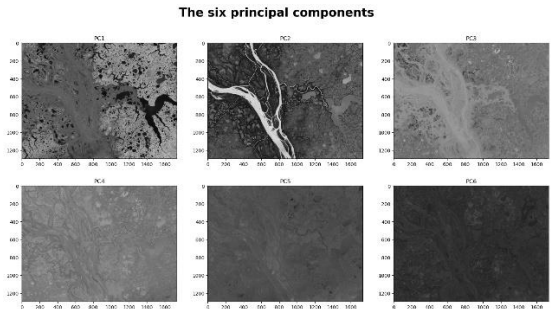
Here below on the left, the 6 different bands captured by the satellite over the Yukon River region. While on the right the true color image, with histogram stretching applied to guarantee a better visualization.

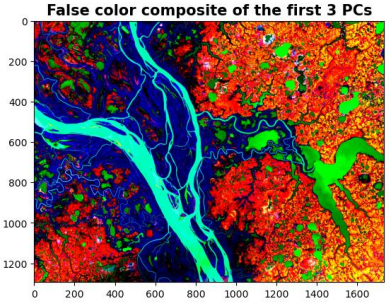




Then the matrices representing the bands were reshaped into a one-dimensional array and stacked together as columns in a new matrix. After standardizing the data, it was possible to carry out the PCA analysis, and the results are shown below. The variance described by the first 3 components is around 99.3%

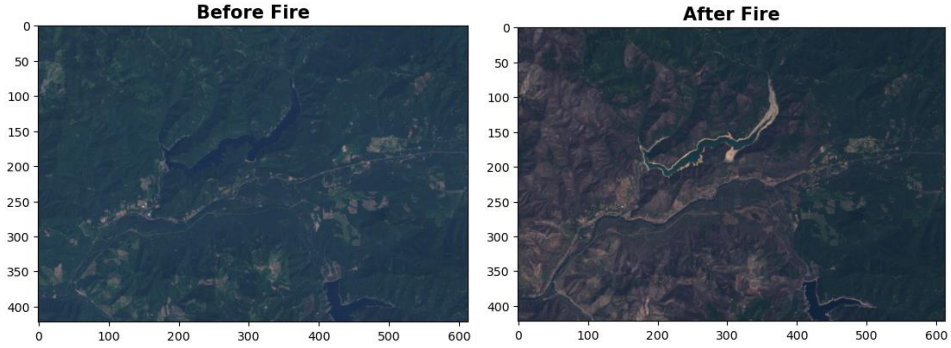






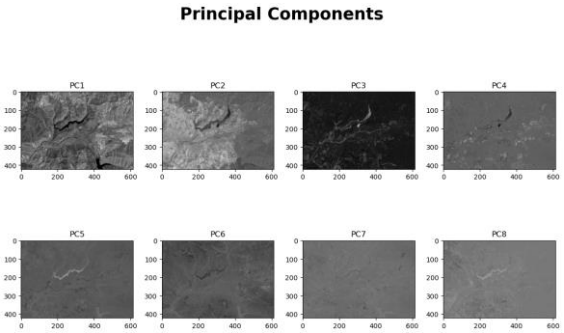
2) Detecting Wildfires

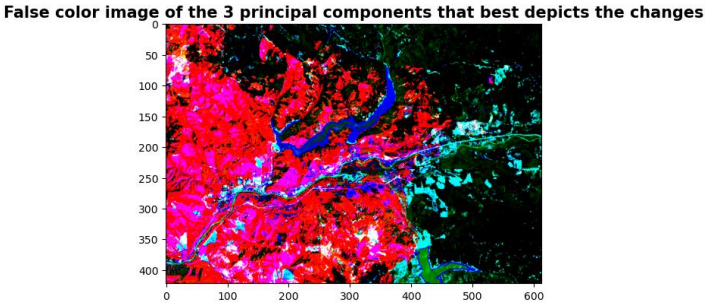
In this exercise two different images were given representing the situation before and after a wildfire.



As in the case before, the task was to perform the principal component analysis (PCA). However, this case differs from the Yukon River one for both the number of bands recorded (4) and number of pictures (2), but overall, the

process outline was the same. Each band of each picture was reshaped as a one-dimensional array and then put as a column in a matrix. Data were standardized and the PCA was applied. In this case, what drives the exercise is to understand which of the principal components depict the changes the best, and thus, produce a false color image with the top three selected.

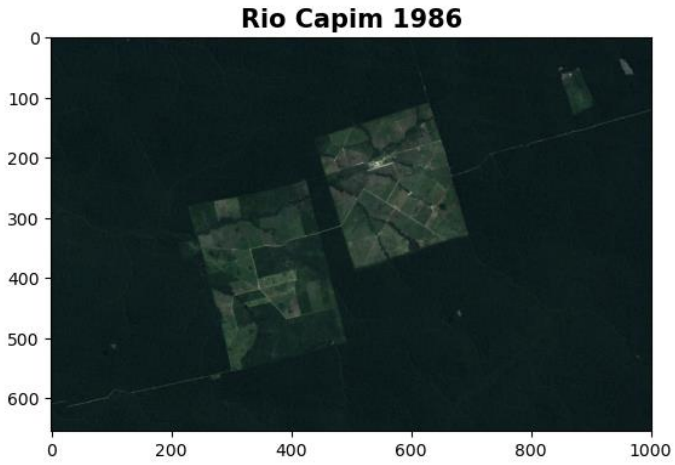


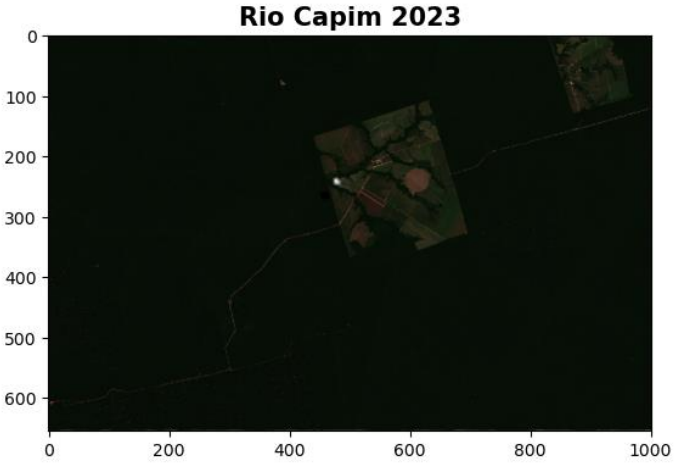


The picture to the left shows the results of the PCA and all the 8 principal components. The picture on the right is the false color image that include the second third and fourth components, and shows in red and purple where the fire affected the landscape the most.

3) PCA on a selected image

In this part of the exercise, the student was free to choose and analyze a case of particular interest. In the pictures below a case of reforestation of the amazon forest is shown. In particular, the region of interest is in Rio Capim. The time spans almost 40 years, with the picture on the left dated 1986 (retrieved from Landsat 5), while the picture on the right was taken in 2023 using data from the Sentinel-2 satellite.





As it can be appreciated in the image, the field on the left, where the man-footprint can clearly be distinguished by the surrounding forest, disappeared through time. After performing the PCA, the results are shown here below.

The red color clearly depicts where the landscape changed the most from 1986 to 2023.