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MULTITEMPORAL ANALYSES OF AGRICULTURE IN A REGION IN SOUTH-EAST OF ROMANIA

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Abstract

The main source of food comes from agriculture, depending on the factors of environment, light, temperature, water, air, soil, plants grow and develop. One way of efficiently monitor the development process of the plants is remote sensing. Using free-of-charge data, such as Sentinel-2, we can compare the condition of the harvest in different years with the help of the various indices computed from the many satellite bands, bands in the visible spectrum with a resolution of 10 m and the invisible spectrum, resolution shifting between 20 and 60 m.
In this study, we want to focus on climate change and how it affects the condition of crops using satellite data for three consecutive years in the same area. Lack of precipitation and abnormal temperatures for certain periods of the year can affect crops and reduce food quality and quantities.

Keywords*: crops, food, monitoring, remote sensing, satellite, Sentinel-2A.*

INTRODUCTION

Agriculture is dealing with the production of plant and animal products, fiber and various useful materials through the systematic cultivation of certain plants.
In our area of interest, the population main occupation is agriculture; most of the families have smaller or larger areas of land in their property or in the lease.
They cultivate annually, wheat, corn, barley and others, hence they get to feed their animals but also benefit from the harvest.
As we know, for the plant to grow they need certain temperature and precipitations, in the past years these indices have changed.
The temperatures are higher and the precipitations are absent.

Figure 1.Wheat harvest ©Wikipedia

MATERIALS AND METHODS

Considering our multitemporal study we used optical images, Sentinel-2, from three different years, 04 December 2016, 11 November 2017 and 28 October 2018, with 20% cloud coverage.
Sentinel-2 is a European wide-swath, high-resolution, multi-spectral imaging mission.
Sentine-2 has 13 spectral bands, 10 m resolution bands: B2: blue, B3: green, B4: red B8: Near Infrared, 20 m resolution bands: B5: Vegetation Red Edge, B6: Vegetation Red Edge, B7: Vegetation Red Edge, B8A: Vegetation Red Edge, B11: Short Wave Infrared, B12: Short Wave Infrared and 60m resolution bands: B1: Coastal Aerosol, B9: Water Vapour and B10: Short Wave Infrared-Cirrus.
Thus, we have used different band combination and indexes to compare and analyse different spectral response from different years of the same area.
We started with the natural colour combination of the bands R:B4 B:B3 G:B2, in addition we used the two indexes the Normalized

Differential Vegetation Index and the Chlorophyll Index Green.

"This most known and used vegetation index is a simple, but effective VI for quantifying green vegetation. It normalizes green leaf scattering in the Near Infra-red wave length and chlorophyll absorption in the red wavelength.

Values description: The value range of an NDVI is -1 to 1. Negative values of NDVI (values approaching -1) correspond to water. Values close to zero (-0.1 to 0.1) generally correspond to barren areas of rock, sand, or snow. Low, positive values represent shrub and grassland (approximately 0.2 to 0.4), while high values indicate temperate and tropical rainforests (values approaching 1)." (© Sentinel Hub by Sinergise)

$$\mathrm{NDVI} = \frac{\mathrm{NIR} - \mathrm{RED}}{\mathrm{NIR} + \mathrm{RED}}$$

As for the Chlorophyll Index green, is known that the plant absorption is different from one spectral reflectance to another. Green leaves absorb more than 80% of incident light and in the NIR they are minimum sensitive to pigment content.

$$\mathrm{CIgreen} = \frac{\mathrm{NIR}}{\mathrm{GREEN}} - 1$$

We manage to do the bands combinations and the index with the open-source software Snap.

Snap has different toolboxes for Sentinel-1, Sentinel-2, Sentinel-3, SMOS and Proba-V, is a very useful tool.

In addition to our results we added the temperature and precipitation date from https://rp5.ru/, Fetești weather station,

1 September- 31 October 2016, 1 September- 31 October 2017, 1 September- 31 October 2018.

RESULTS AND DISCUSSIONS

For the first set of images we only did a visual analysis.

Figure 2. Natural colour image of Sentinel 2, 04.12.2016

Figure 3. Natural colour image of Sentinel 2, 12.11.2017

Figure 4. Natural colour image of Sentinel 2, 28.10.2018

The first assumption was that the 2016 year and 2017 year have big cultivated areas, but there is a huge difference between these two yeas and the year 2018, to be more accurate we analyzed the NDVI and the CI green indexes for each image.

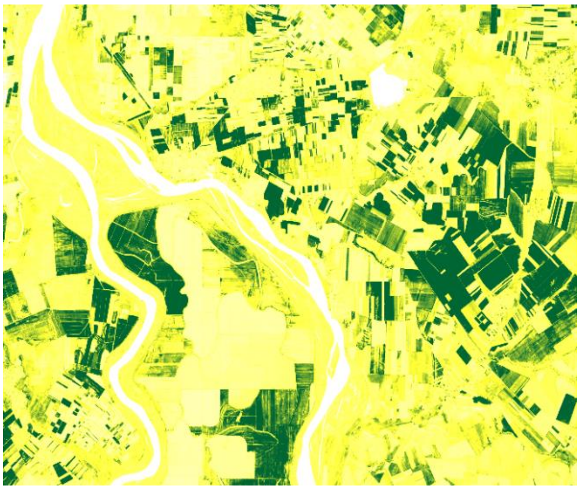

Figure 5. Normalized Differential Vegetation Index, 04.12.2016

Figure 6. Normalized Differential Vegetation Index, 12.11.2017

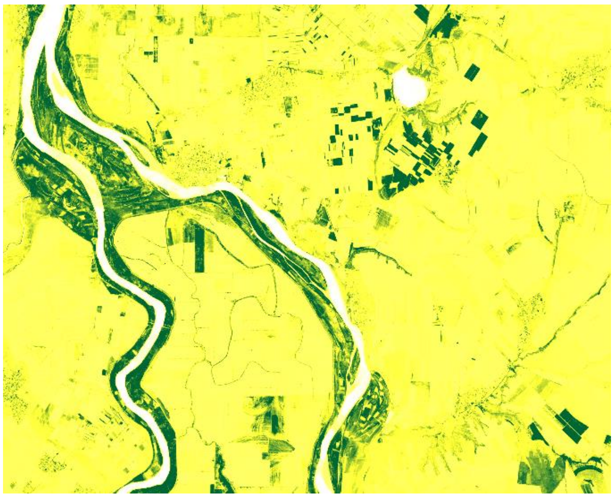

Figure 7. Normalized Differential Vegetation Index, 28.10.2018

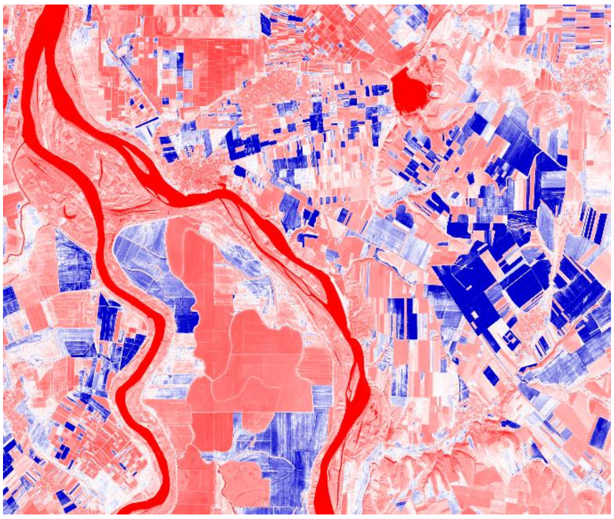

Figure 8. Chlorophyll Index Green, 04.12.2016

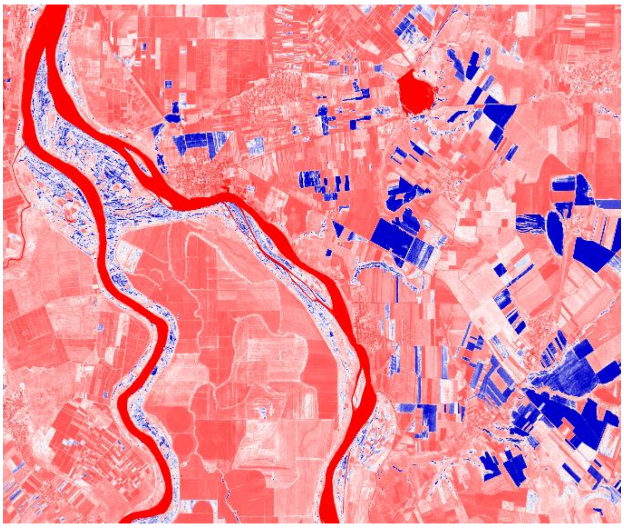

Figure 9. Chlorophyll Index Green,12.11.2017

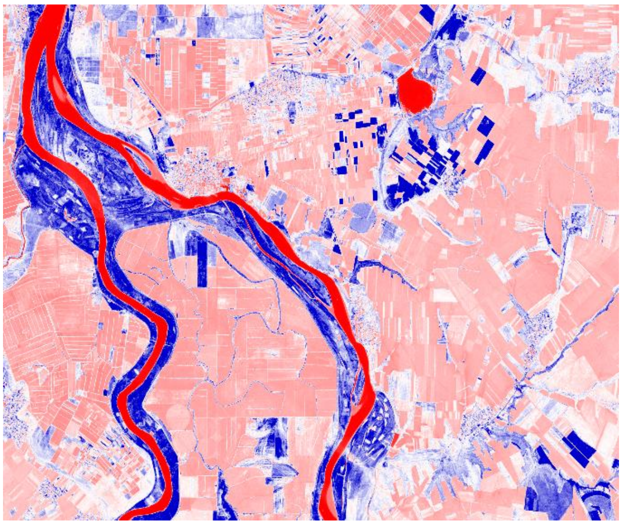

Figure 10. Chlorophyll Index Green, 28.10.2018

As we can see in the figures 5, 6 and 7 the NDVI ensure us that the image from 2018 has less cultivated areas than images from the other years.

To be more precise, the blue area from figures 8, 9 and 10 represents the crop area.

In the Figure 10, year 2018, the blue area next to the red one represents the forest next to the river, not to be confused with the cultivated area.

The difference between the year 2018 and the other ones is that we can see exactly the area occupied by the forest.
The year 2016 in association with the year 2017 has more blue areas, so the amount of harvest was bigger.
To clarify why the cultivated areas are diminishing will use precipitation and temperature data.

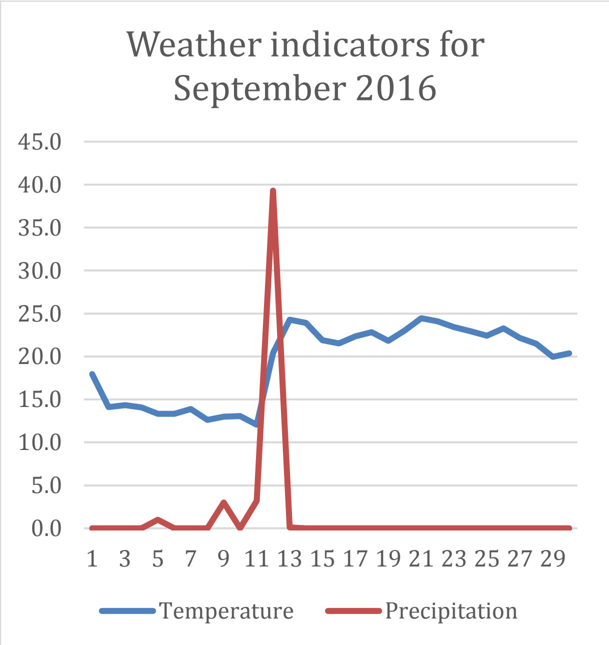

Figure 11.Weather indicator for September 2016

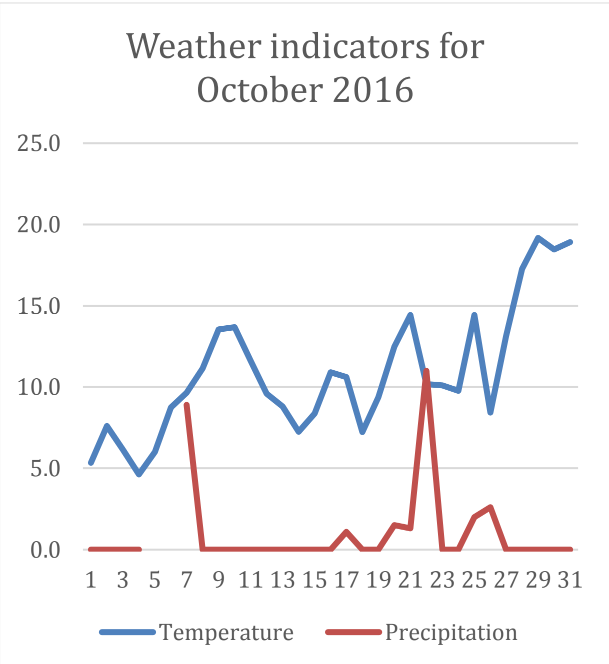

Figure 12. Weather indicator for October 2016

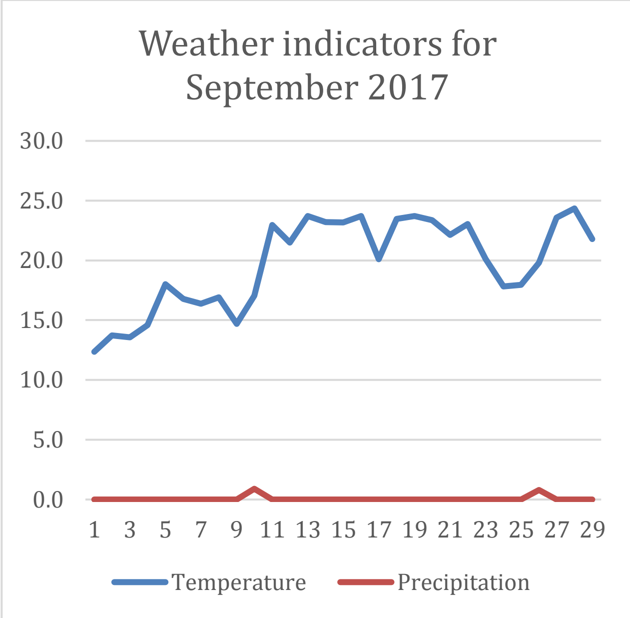

Figure 13. Weather indicator for September 2017

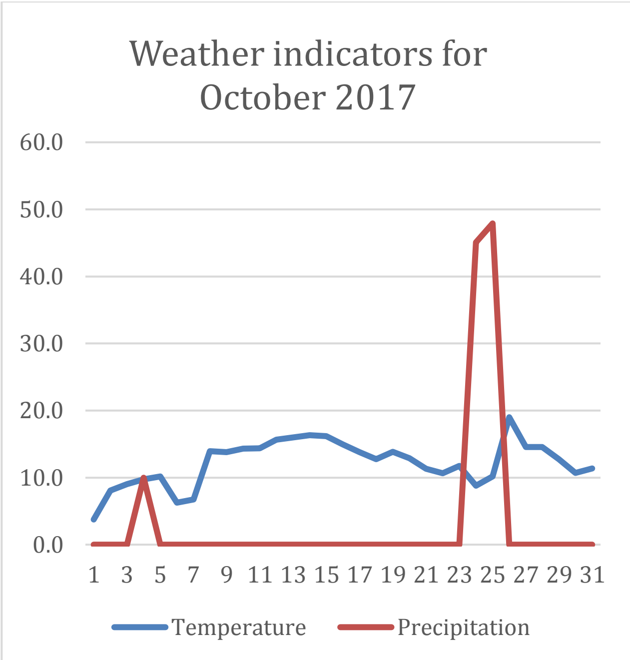

Figure 14. Weather indicator for October 2017

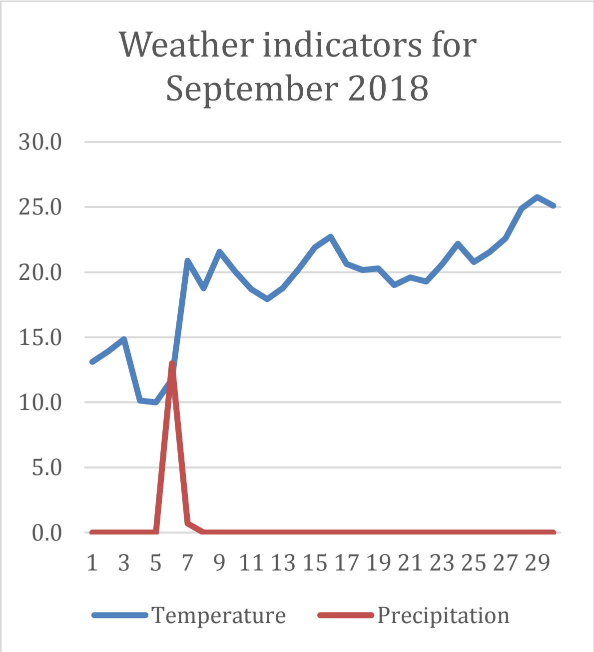

Figure 15. Weather indicator for September 2018

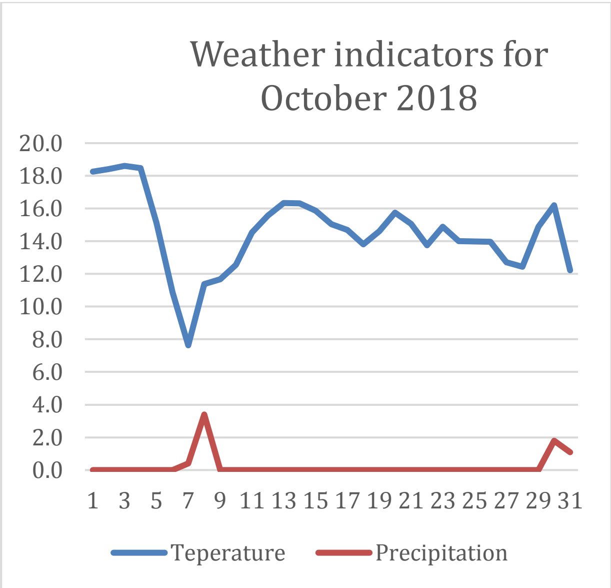

Figure 16. Weather indicator for October 2018

It is recommended that farmers start seeding on September 24, but they often prefer to do so in early October. After sowing, plants need water, so rains are welcome.

As we can see in Figures 11 and 12, in September we have a pick for the precipitation and one in late October, so plant have the optimum environment, for year 2016, but year 2017, as seen in figures 13 and 14 has higher temperature than usual and only one pick of precipitation and late October.

In Figure 15, we have higher temperature than usual and almost no precipitation, same for the Figure 16, that is the motive why the crops are smaller in the year 2018.

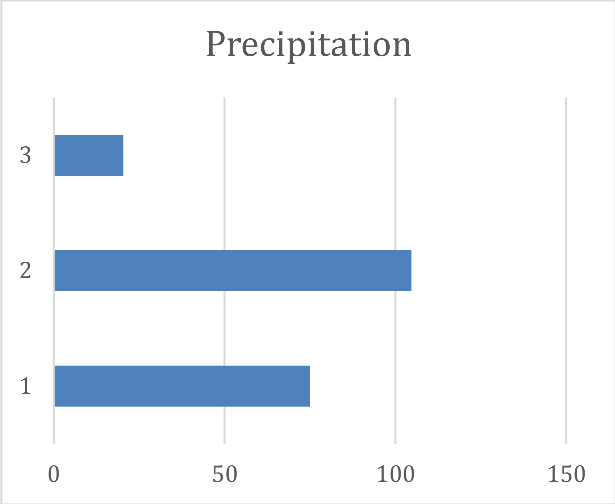

Figure 17. Total rainfall in September- October period

Figure 17 gives us a bigger view, and answers more precisely why is that big difference between these three years.

CONCLUSIONS

Weather is one of the most important factors for agriculture, plants are very sensitive to change, and need a certain amount of precipitation and a certain temperature to reach maturity. If the agricultural production reduces, it will also reduce the food portion for humans and animals and putting us in risc.

ACKNOWLEDGEMENTS

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REFERENCES

Ahmed T., Tian L., Zhang Y., Ting K. C., 2011. A review of remote sensing methods for biomass feedstock production. Biomass & Bioenergy

Rei Sonobe, Yuki Yamaya, Hiroshi Tani, Xiufeng Wang, Nobuyuki Kobayashi, Kan-ichiro Mochizukie, 2017. Crop classification from Sentinel-2 derived vegetation indices using ensemble learning.

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https://scihub.copernicus.eu/dhus/#/home

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The weather information was downloaded from rp5 archives https://rp5.ru/Arhiva_meteo_%C3%AEn_Fete%C5%9Fti