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Using Satellite Imagery and Vegetation Indices to Monitor and Quantify the Performance of Different Varieties of Camelina Sativa

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Speaker Biography

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She finished her bachelor's degree in Environmental Sciences in 2019 and a master's degree in Assessment and Environmental Monitoring of Marine and Coastal Ecosystems in 2020 both in the Higher Polytechnic School of Gandia . On her end-of-degree project she worked on implementing Internet of Things and wireless sensor networks in smart cities for the monitoring of agricultural fields. She has already worked organizing conferences. She presented a paper in SoftNet 2019 (IARIA). Currently, her line of work is focused on remote sensing applied to marine monitoring. Her end-of-master project was on this topic.

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Introduction

Intensive agriculture is hard to monitor, remote sensing is an option.

Satellite imagery is usually employed to monitor parameters instead of yield.

Monitoring the yield would improve the productivity.

Introduction

Camelina sativa (sp) produce seeds that are used for oil extraction.

This plant from the Brassicaceae family is annual, which makes its monitoring easier.

Satellite images will be used for the monitoring of their production.

Related work

Mostaza-Colado et al. performed preliminary tests to check if Sentinel-2B images could be used to estimate the growth of Camelina sativa.

Vega et al. used a UAV to monitor a sunflower crop. They correlated the NDVI with aerial biomass, plant nitrogen, and grain yield.

Yawata et al. used satellite images to extract the spectral values and then estimated the rice yield employing a mixed model.

Material and Methods

Sentinel-2 imagery chosen for this experiment; it has 12 bands.

Images from: February 28th, March 30th, April 29th, May 29th, and June 30th.

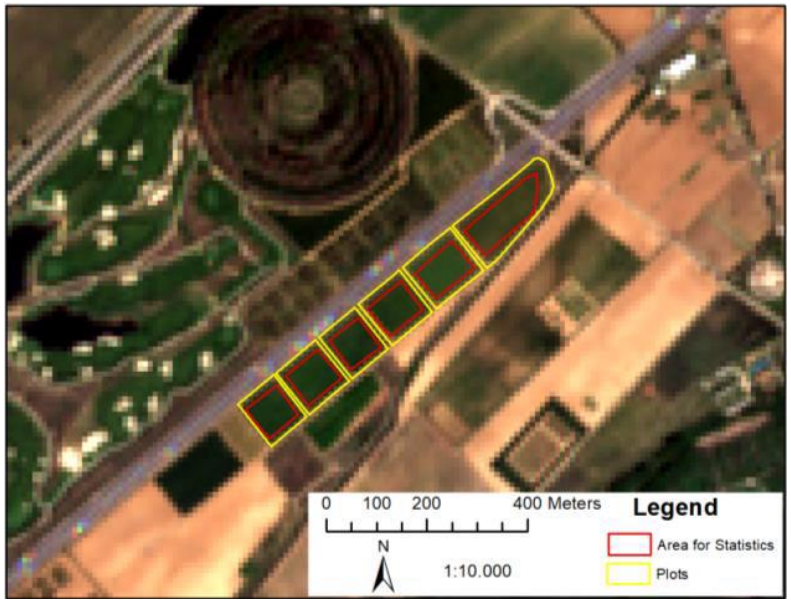
The first four images will show the changes in the vegetation, while the last picture will represent the soil status after the harvest.

ArcMap > Zonal Stadistic as a Table > Excel > Indices

Material and Methods

Six different varieties of Camelina sativa used: 1), 2), 3), 4), 5) and 11)

Not the entire crop is considered for statistical analysis.



Material and Methods

Existing indices calculated:

- Normalized Difference Water Index (NDWI)
- Normalized Difference Moisture Index (NDMI)
- Enhanced Vegetation Index (EVI)

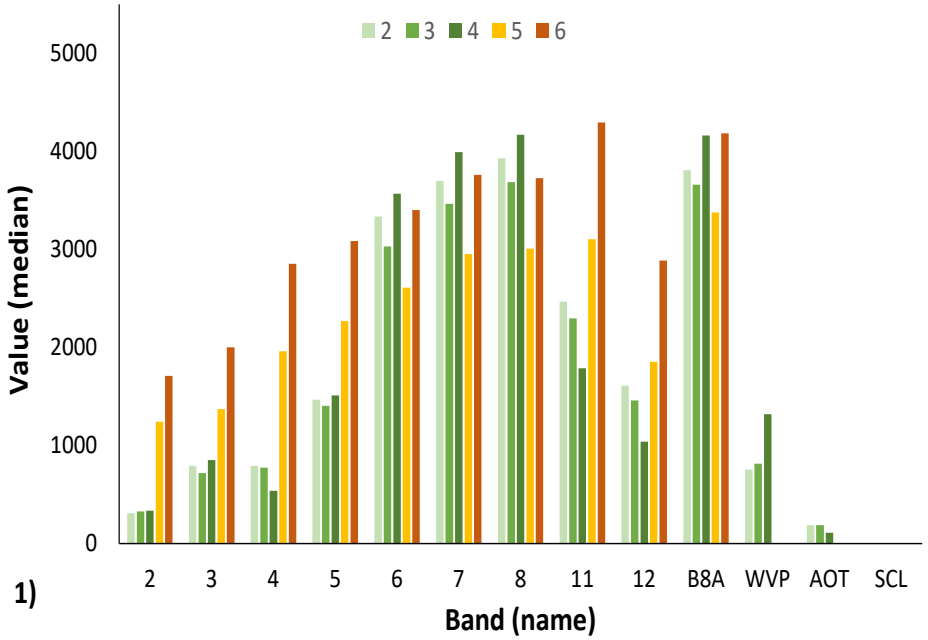
New correlations:

Multivariate analysis to find a possible association between different bands and indices and the harvested seeds of the different varieties

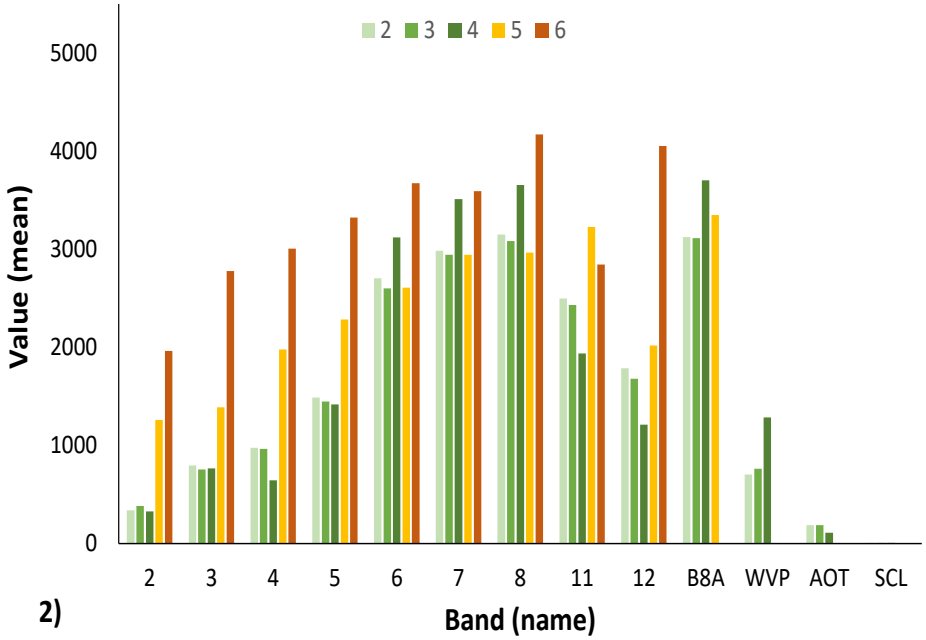
Results

Issue: missing data

The spectral signature for every variety is represented in different colors corresponding to the phenological conditions of the crop.

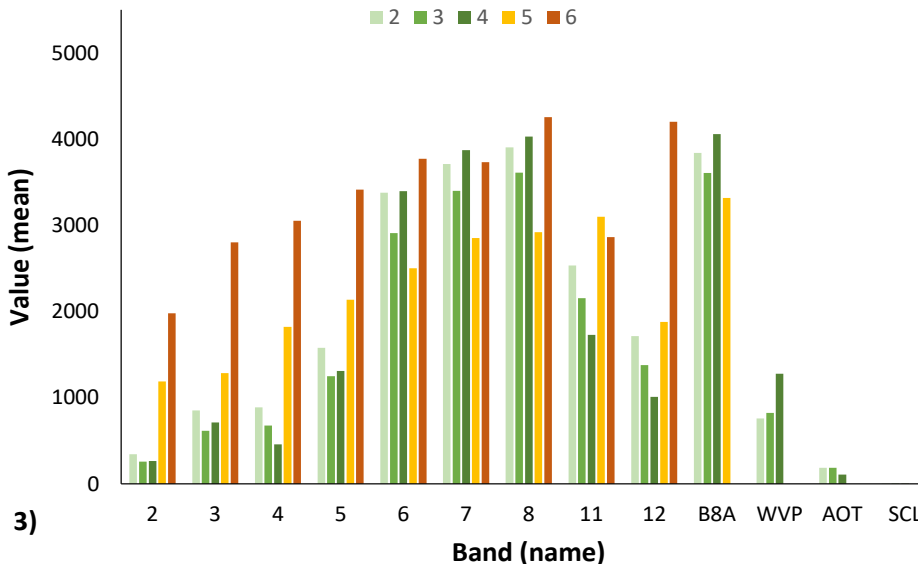


1)



2)

Results



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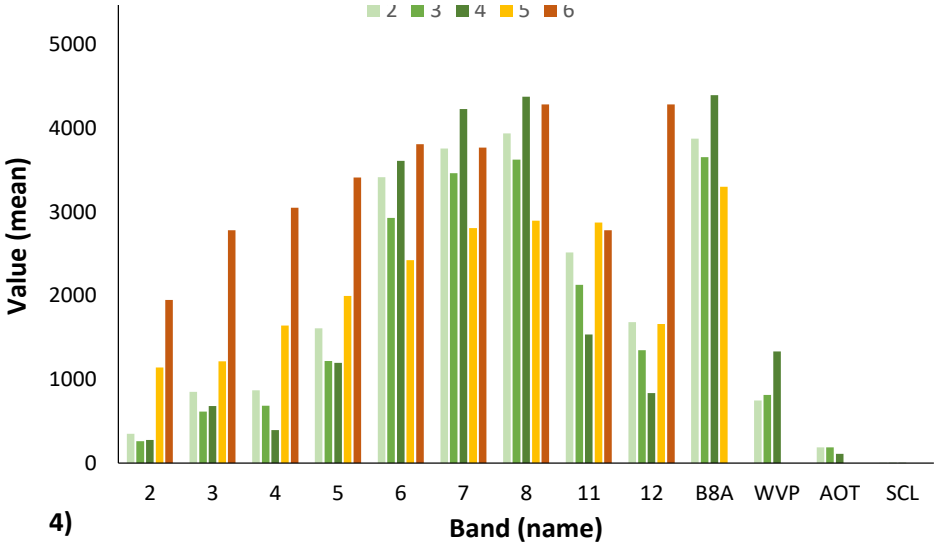

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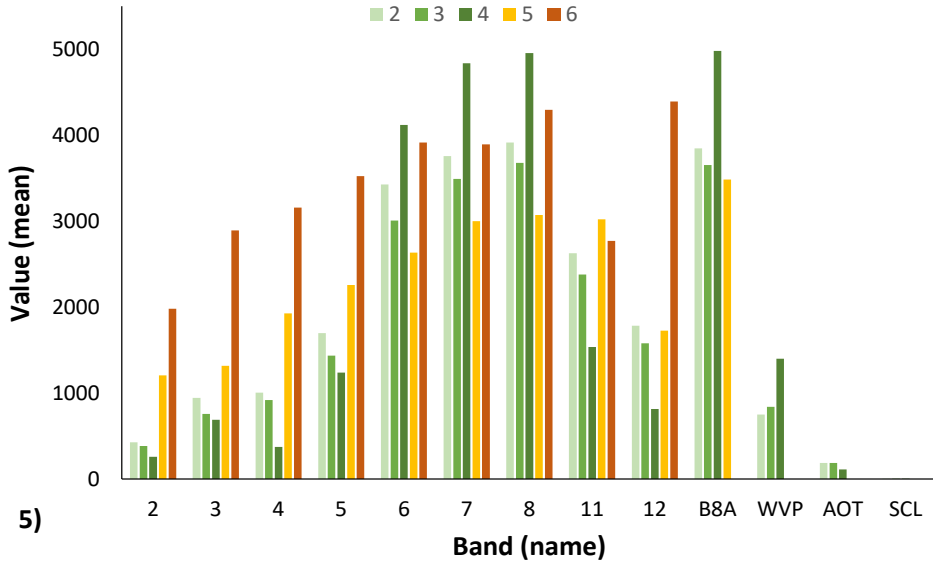
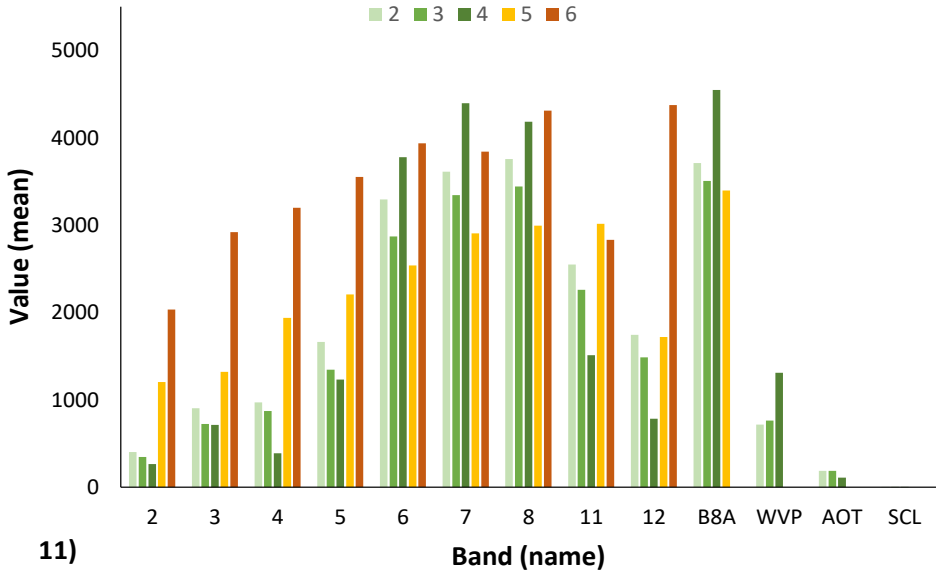


5)



11)

Results

Different varieties seem to have different patterns.

There are some changes in the region of 705 to 783nm (IR light).

- Plants were sowed at the same moment
- Soil was homogenized
- Same environmental conditions

The differences found are due to the different varieties.

Results

Month	NDWI per Varieties					
	5)	*2)*	*1)*	*4)*	*11)*	*3)*
2	-0.61	-0.66	-0.66	-0.65	-0.61	-0.64
3	-0.66	-0.65	-0.67	-0.71	-0.65	-0.71
4	-0.76	-0.68	-0.66	-0.73	-0.72	-0.70
5	-0.40	-0.36	-0.37	-0.41	-0.39	-0.39
6	-0.33	-0.31	-0.30	-0.32	-0.31	-0.31

Month	NDMI per Varieties					
	5)	*2)*	*1)*	*4)*	*11)*	*3)*
2	0.20	0.12	0.23	0.22	0.19	0.21
3	0.21	0.12	0.23	0.26	0.21	0.25
4	0.53	0.31	0.40	0.48	0.49	0.40
5	0.01	-0.04	-0.02	0.00	0.00	-0.03
6	-0.05	-0.07	-0.07	-0.06	-0.06	-0.07

Month	EVI per Varieties					
	5)	*2)*	*1)*	*4)*	*11)*	*3)*
2	1.08	0.84	1.23	1.18	1.06	1.14
3	1.09	0.88	1.24	1.27	1.06	1.28
4	2.18	1.49	1.86	2.13	2.12	1.87
5	0.51	0.46	0.48	0.75	0.47	0.56
6	0.29	0.27	0.27	0.31	0.27	0.30

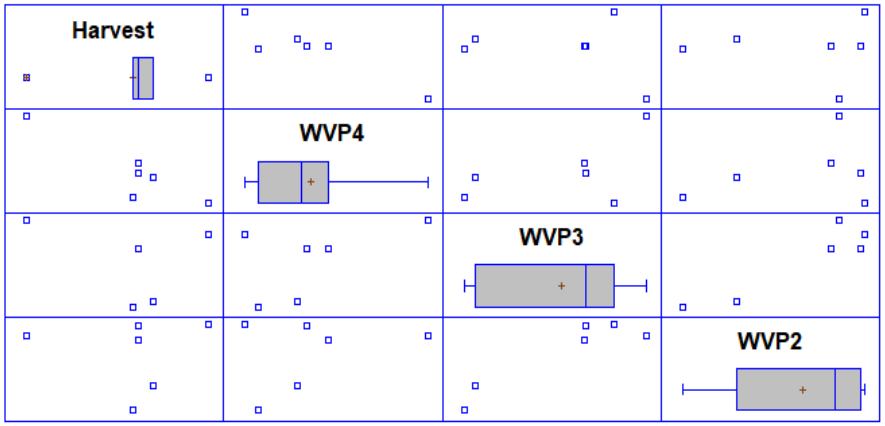
No correlation

Results

Multivariate analysis with up to 95 variables > Statgraphics

The band with the highest correlation with the harvest is the Water Vapor Map in April (WVM4)

It presents a p-value of 0.0117, and a correlation coefficient of -0.9103



Results

Simple regression > Statgraphics

Mathematical model that correlates both variables.

Correlation coefficient = 0.926

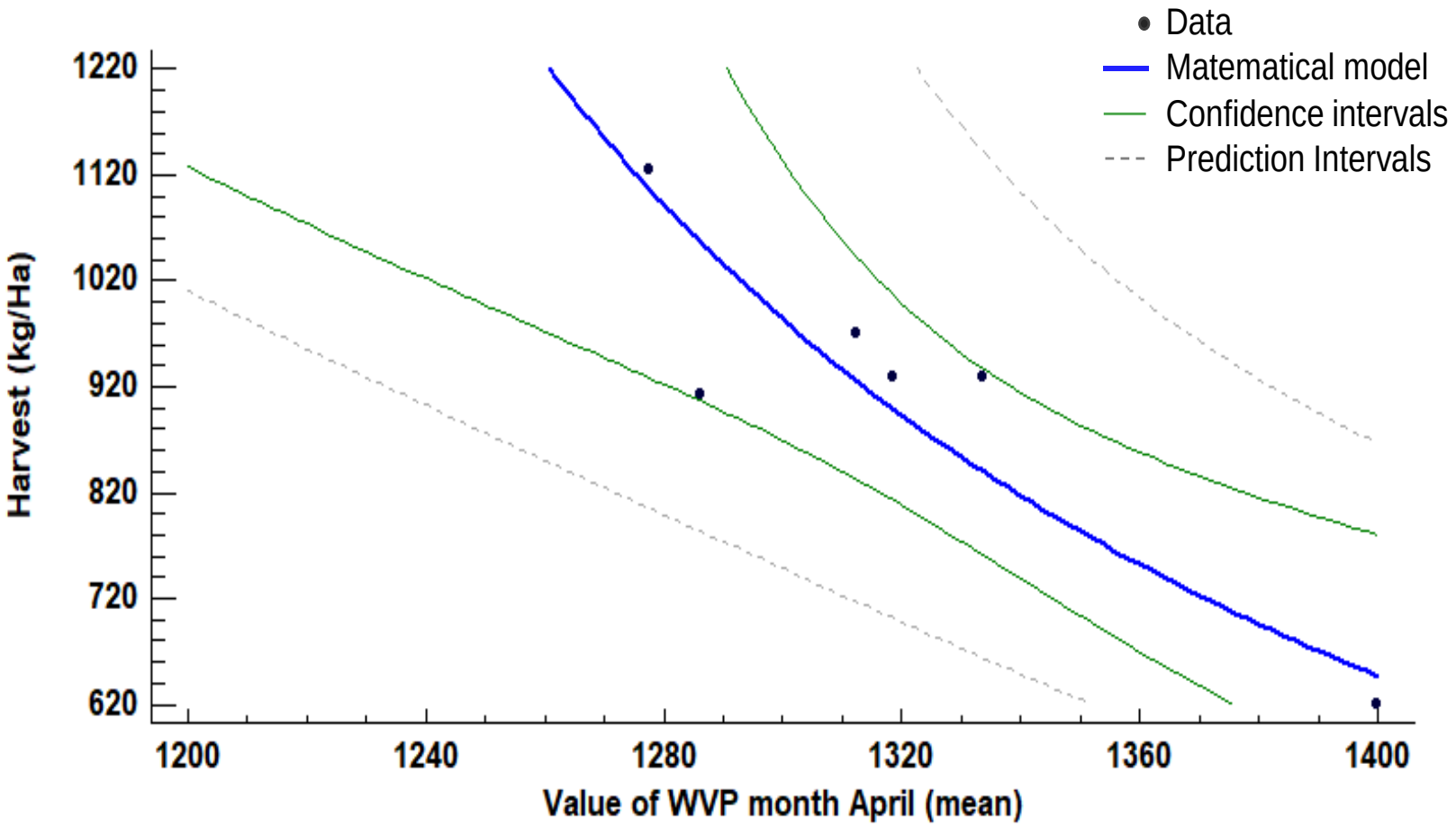
Squared-R = 85.81

Standard error = 0.0001

Mean absolute error = 0.00007.

p-value = 0.0079

Results



Harvest = 1/(-0.00229478 + 1.95954E-9*WVP4^2)

Conclusions

- The monitoring of crop yield is important
- None of the typical vegetation indices present a correlation
- A multivariate analysis proved the WVP values from April can be used to calculate the yield
- The model can be used for harvest prediction

Conclusions

- For future work, more images will be used to have a more accurate model.
- The utility of images obtained with a drone with a thermal camera will be evaluated. 7
- The study would be run for several years to eliminate a possible year-specific effect.

Thanks you for your attention!!

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