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Identifying the Existence of Grass Coverage in Vineyards Applying Time Series Analysis in Sentinel-2 Bands

Daniel A. Basterrechea, Lorena Parra, Jaime Lloret and Pedro V. Mauri.

Email: dabasche@epsg.upv.es loparbo@doctor.upv.es, jlloret@dcom.upv.es, pedro.mauri@madrid.org.

Resume of the presenter

Graduated in Environmental Sciences and with a Master in Environmental Assessment and Monitoring of Marine and Coastal Systems. Currently, I am working as a researcher in the European project "SMARTWATIR" developing low-cost sensors and methods to monitor different parameters in agriculture.

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INTRODUCTION

INTRODUCTION

Food demand = **Necessity to maximize the production of food**

Existing farming systems ≠ **Efficient food production levels**

Pressure of the increment of food demand and the decrease in prices = **Forces the farmers to try to increment their crop production**

In some cases = **Farmers are using dangerous substances for the environment, massive use of water, or excess use of fertilizer to maximize their harvest**

INTRODUCTION

Sustainable agriculture

Increase productivity

Management of natural resources

Interesting way of solving the actual problem

INTRODUCTION

Precision Agriculture

+ Reduction of environmental impacts
+Solution for food segurity

- Erosion
+ Water retention

Image processing

Detecting weed plants.

Monitoring the plant health

Low resolution of images
High resolution images are expensive

INTRODUCTION

Propose the use of images from the Copernicus Sentinel-2 satellite, with 10 m pixel resolution

To determine the existence or absence of grass coverage in vineyards.

Evaluation will be done using images obtained at different moments of the year

Application

In the inner region of Spain, in the crops of IMIDRA, which is located in Alcala de Henares (Madrid).

Used bands

Red band, green band, blue band, Water Vapour Band (WVP), Near-Infrared Band (NIR), and Normalized Differential Vegetation Index (NDVI)done using images obtained at different moments of the year

RELATED WORK

Related work

MONITOR THE CHLOROPHYLL CONTENT IN THE FIELD	• *Used a multispectral image to monitor the chlorophyll content in the field.* ***Sun et al.***
FOREST DETECTION IN DRY SAVANNA ECOSYSTEMS	• *Applied for advances in Object-Based Image Analysis (OBIA) and machine learning algorithms.* ***Mishra et al..***
DETECTION OF PREJUDICIAL WEEDS IN LAWNS	• *Proposed image techniques to detect prejudicial weeds in lawns.* ***Parra et al.***
ESTIMATION OF TOTAL CROP AND GRASS CHLOROPHYLL AND N CONTENT	• *Used the Sentinel-2 and Sentinel-3 images for the estimation of total crop and grass chlorophyll and N content by studying in situ crop variables and spectroradiometer measurements obtained for four different test sites.* ***Clever at al.***

MATERIAL AND METHODS

MATERIAL AND METHODS

TABLE I. SENTINEL-2 SPECTRAL BANDS

Bands	Wavelength (nm)	Resolution (m)	Description
B2	490	10	Blue
B3	560	10	Green
B4	665	10	Red
B8	842	10	Visible and Near Infrared (VNIR)
B9	945	60	Water vapour

- **Free satellite images to obtain a low-cost system of determining the existence of grass coverage.**
- **We use images from Copernicus Sentinel-2.**
- **The highest resolution is 10m x 10m**

MATERIAL AND METHODS

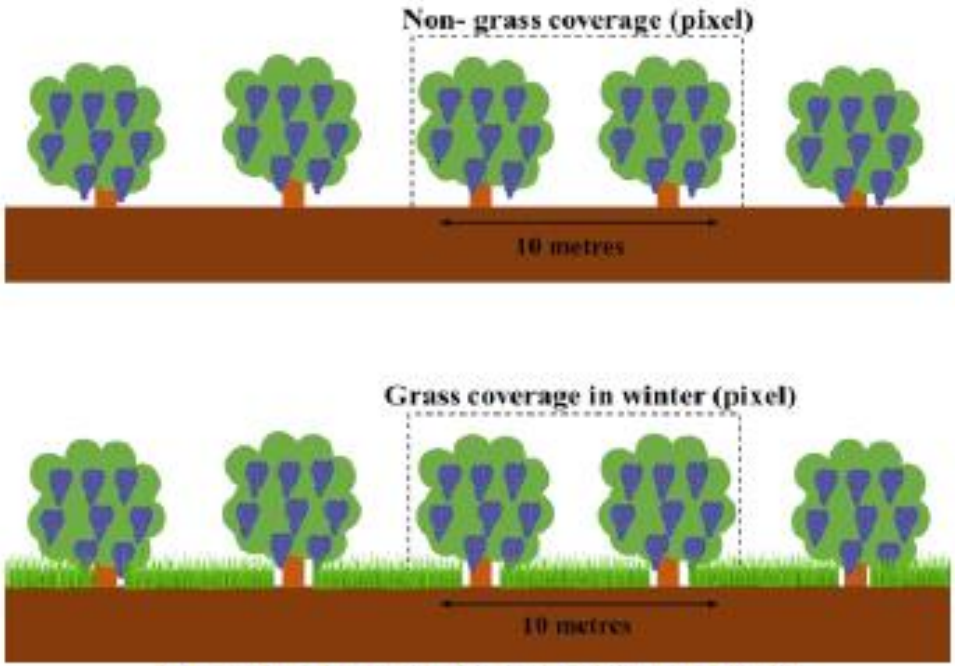

Figure 1. Scheme of pixel information content.

- **Each pixel contains information about the surface, which includes the vineyard, the soil, and if it exists the grass coverage.**
- **Maximum grass coverage in winter and almost null in summer.**
- **In winter, the plant cover is greater due to the climate conditions.**
- **In summer high temperatures predominate, causing vegetation to wither and tend to disappear.**
- **Changes along the season could be used to detect different pixel values in the bands.**

MATERIAL AND METHODS

Figure 2. Classification of plots in the studied zone.

- **Select zone is located in the community of Madrid in the facilities of IMIDRA.**
- **There are huge vineyards where we have plots with grass coverage and others with non-coverage.**
- **Is an optimum scenario to test the proposed system for monitoring the changes in the grass to determine the presence or absence of grass coverage.**
- **We use some operations using this ArcGIS software.**
  - **“Raster calculator”.(qualitative)**
  - **“Zonal Statistics as table” (quantitative).**

MATERIAL AND METHODS

TABLE II. SUMMARY OF EXPECTED CHANGES ACCORDING TO OUR HYPOTHESIS

Bands	Reflectance GC=1	Reflectance GC=0	Differences in reflectance GC=1	Differences in reflectance GC=0
B2	Low	Low	Low	Low
B3	Higher	High	High	Low
B4	Low	High	High	Low
B8	High	High	Low	Low
B9	Higher	High	High	Low
Pixels of:	**GC=1 Winter**	**GC=1 Summer**	**GC=0 Winter**	**GC=1 Summer**
Vid	High percentage	High percentage	High percentage	High percentage
Soil	Almost null	Low percentage	Low percentage	Almost null
Green grass coverage	Low percentage	Almost null	Almost null	Almost null

- **We classify the selected plots in two types:**
  - **Contain grass coverage (GC=1).**
  - **Do not present grass coverage (GC=0).**

RESULTS

RESULTS

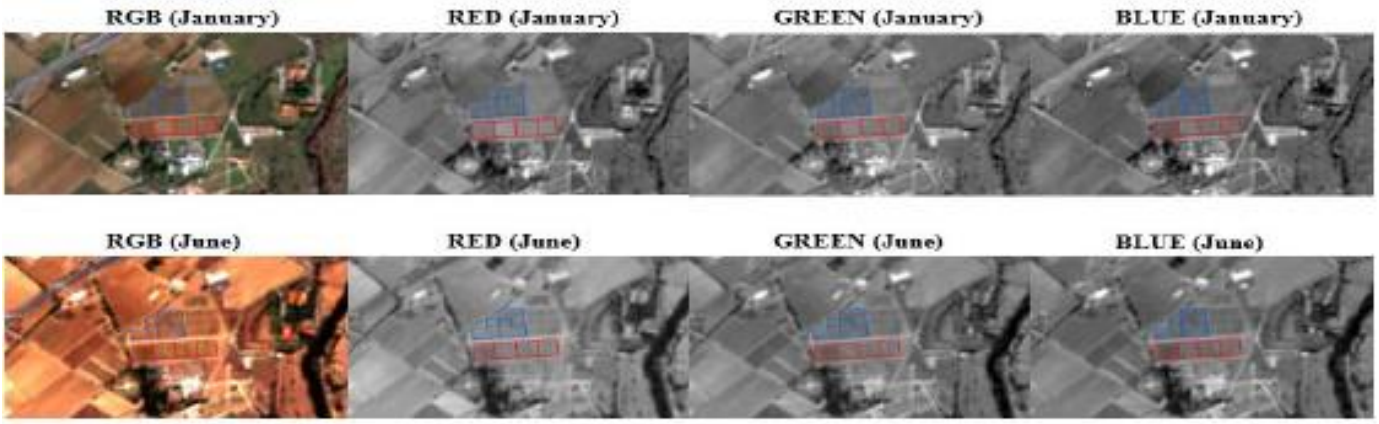

Figure 3. Visible spectrum bands.

- **Visible spectrum (B2 to B4) of January → Green band (highest pixel) values in plots with grass coverage.**
- **The blue band (medium values), and the red band (minimum pixel) values in the plots with the grass coverage.**
- **Non-covered plots, the red band (higher values)→ more soil represented in the pixel, and it increases the reflectance in that specific wavelength.**

RESULTS

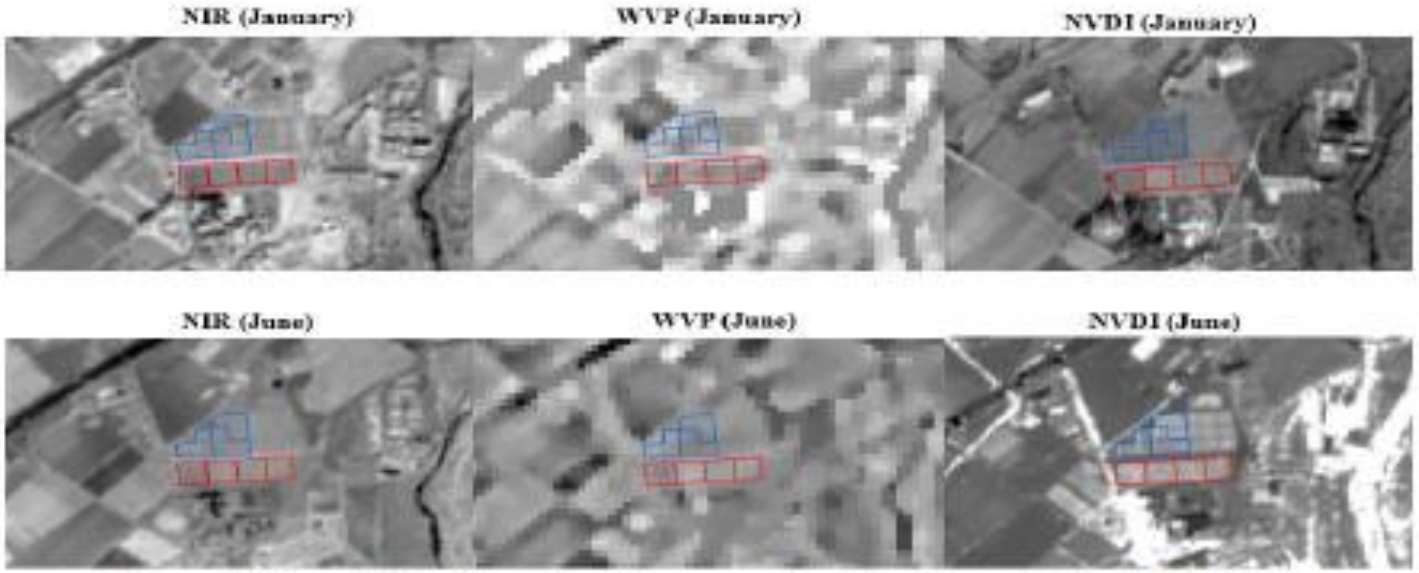

Figure 4. Near-infrared band, water vapour band, and vegetation index band.

- **Between NIR, WVP, and NDVI bands for the same season, the NIR band presents the highest pixel values for covered and no-covered plots**

RESULTS

TABLE III. MEAN OF THE PIXEL VALUES OF DIFFERENT BAND COMBINATIONS FOR COVERED AND NON-COVERED PLOTS.

Classific.	Red	Green	Blue	NIR	WVP	NDVI
1.GC=0	-775	-632	-456	-1336	-831	-0,12
2. GC=0	-618	-623	-422	-1464	-881	-0,16
3. GC=0	-775	-697	-491	-1399	-871	-0,11
4. GC=0	-892	-756	-557	-1411	-870	-0,09
5. GC=1	-1246	-854	-620	-1113	-785	0,02
6. GC=1	-1179	-797	-582	-1006	-763	0,03
7. GC=1	-1061	-798	-553	-1176	-799	-0,02

- **The Statgraphics software allows us to analyze the pixel values obtained from the combined results, getting statistical information from each image.**
- **Table 3 displays the "MEAN" for all the bands for different value in each one of the evaluated plots.**
- **With this, we can observe the differences between winter and summer, analyzing which band is the best for detecting changes.**

RESULTS

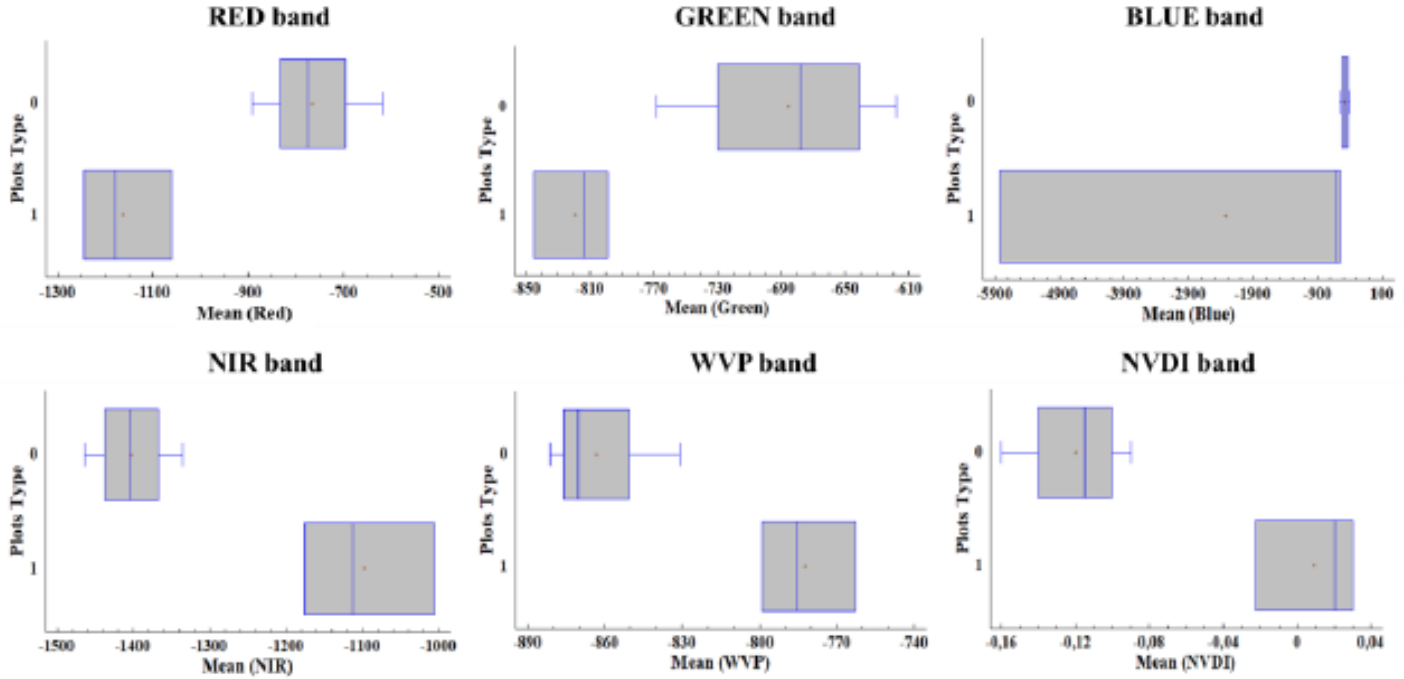

Figure 6. Box and Whiskers diagram of band values.

- **These graphics represent the data of the two classifications of plots as a box and whiskers diagrams.**
- **The data present higher similarities among them when there are higher overlapping between the plots classified as 1 and 0.**
- **We can observe that all graphics indicate a certain distance between the values of both groups of plots**

RESULTS

TABLE IV. THE P-VALUE OF ANOVA ANALYSIS FOR SELECTED BANDS

Bands	B4	B3	B2	B8	B9	NDVI
p-Value	0.0043	0.0184	0.2611	0.0020	0.0036	0.0021

- **We observe that all the bands have significant values, except for the blue band. The best range of values is represented in the NIR, NDVI, and WVP band, being the most accurate results of the NIR band (p-value of 0.0020).**
- **Plots with grass coverage have pixel values from -1000 to -1200. On the other hand, plots without grass coverage are composed of pixels with values from -1200 to -1500.**

CONCLUSIONS

Conclusions

- We present a methodology, based on time series analysis to determine the existence or absence of grass coverage in the vineyard.
- We use Sentinel-2 images, using different bands such as red, green, blue, NIR, WVP, and NDVI bands.
- Best band for the time series analysis is NIR band, followed by the NDVI band, and WVP band.
- For future work, we will improve our study by including different region vineyards to verify the efficiency of this application.
- We plan to test this method in orange crops
- The introduction of a soil gloss correction, such as the SAVI and MSAVI, will also be explored.

THANK YOU FOR YOUR ATTENTION

Daniel Andoni Basterrechea

dabasche@epsg.upv.es

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