Deriving Structural And Spectral Features From Aerial Multispectral Imagery For Crop Monitoring

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Introduction

- Crop parameters such as biomass and height are critical for crop management
- Crop parameters can be found in the field with drones equipped with multispectral cameras [1]
- Multispectral images allow estimate biomass through spectral (vegetation indices) and structural (crop height) features [2]
- Creating an automated pipeline allows for straightforward image processing

Figure 1: Aerial Map of a Barley Field

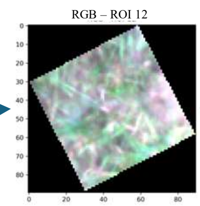
Objectives

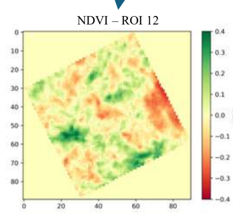
- Use drones to collect aerial multispectral imagery
- Monitor crops using collected spatial and spectral features
- Automate the process to expedite data analysis

Materials and Methods

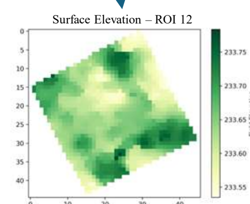
1. Images of a barley cover crop were collected using a Matrice 350RTK equipped with a MicaSense RedEdge-P camera

2. Fifteen regions of interest (ROI) were chosen, biomass samples were taken for each ROI





3. The ROIs were selected in Qgis, and feature extraction was automated with a Python script



Results

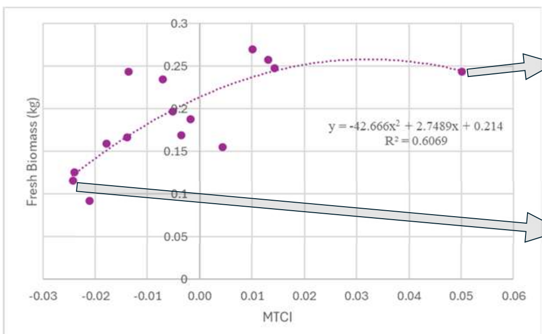


Figure 2: Prediction of Fresh Biomass with MERIS Terrestrial Chlorophyll Index (MTCI)

	NDVI	MCARI	OSAVI	MTCI
R	0.68	0.57	0.68	0.68

Table 1: Linear Correlation between biomass and vegetation Indices

Of the spectral indices, MTCI was best with R of 0.68

Plant elevation had an R of 0.42 for fresh biomass

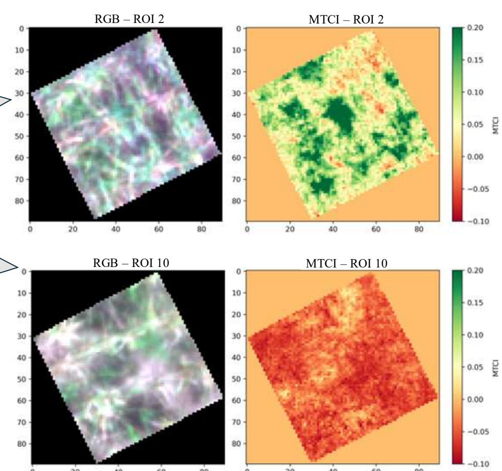


Figure 3: RGB and MTCI Images of ROI 2 and 10

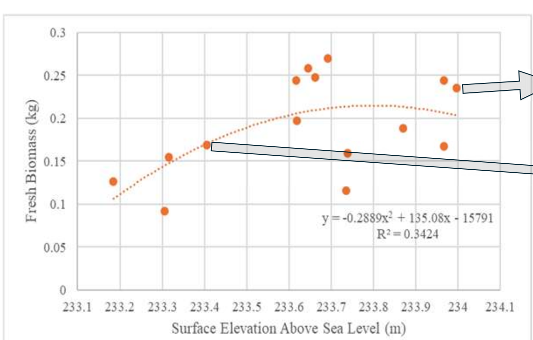


Figure 4: Prediction of Fresh Biomass with Plant Elevation

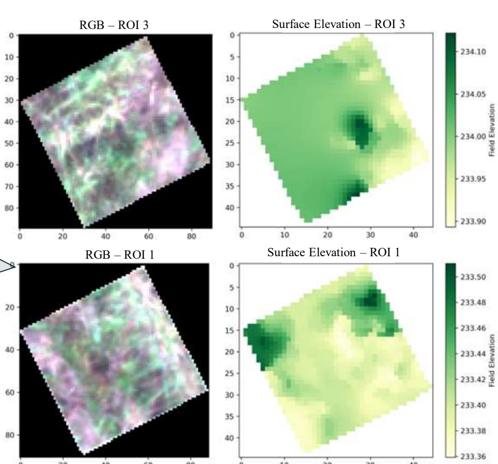


Figure 5: RGB and Surface Elevation Images of ROI 3 and 1

Conclusion

- Successfully automated extraction of four vegetation indices, NDVI, MTCI, OSAVI, MCARI, with **MTCI** having the best linear correlation
- Vegetation indices showed best results for a **polynomial trend**, showing a possible saturation curve
- Automated the extraction of surface elevation from aerial images.
- Surface elevation had a medium strength correlation to biomass, further research into the correlation will be needed

Next Steps

- Determine plant height from surface & soil elevation values
- Add a RTK module to the drone for more accurate elevation
- Use the results to create a preliminary dataset for machine learning modeling of crop biomass
- Collect more data in following growing seasons to create a larger and more robust dataset

Acknowledgements

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References

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2. Michez, A., P. Lejeune, S. Bauwens, A. Herinaina, Y. Blaise, E. Castro Muñoz, F. Lebeau and J. Bindelle. 2019. Mapping and Monitoring of Biomass and Grazing in Pasture with an Unmanned Aerial System. *Remote Sensing* 11(5): 473. https://doi.org/10.3390/rs11050473