Application of remote sensing for managing aquatic weed in Lake Victoria

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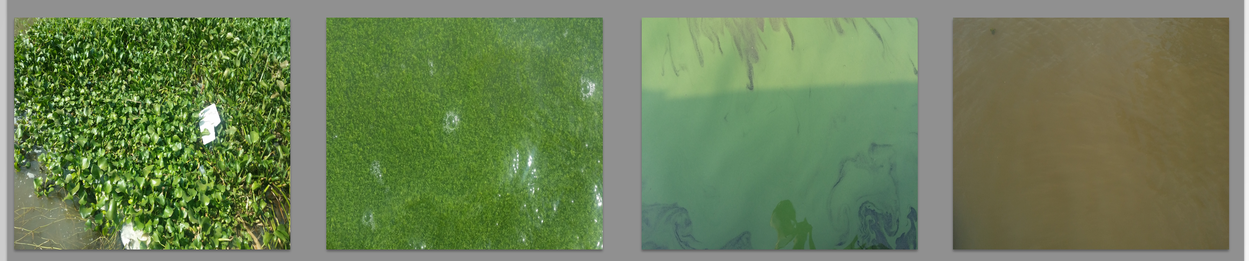
ABSTRACT

Lake Victoria is the second largest freshwater lake in the world by surface area, and represents a significant natural resource, in terms of both economics and biodiversity potential. Currently, the lake is under severe pressure from a number of anthropogenic drivers, including: overexploitation, eutrophication, and introduction of invasive species (Hecky et al.2010, Kolding et al. 2008). Here, we demonstrate the potential use of satellite remotely sensed Landsat-8 imagery as a low-cost, consistent and reliable data to provide thematic products for monitoring and managing invasive aquatic weed in the lake. Our results could be used to develop a decision-support system for long-term monitoring and management of the lake.

SPECIFIC OBJECTIVES

- ❑ To develop a method for semi-automatic detection of floating vegetation in L.Victoria (Runya-Index)
- ❑ To characterize the spatio-temporal trends of floating vegetation in L.Victoria
- ❑ To use multitemporal satellite imagery to map the proliferation hotspots of floating vegetation in L.Victoria



Water hyacinth | Duckweed | Algal bloom | Turbid waters

METHODOLOGY

STUDY AREA

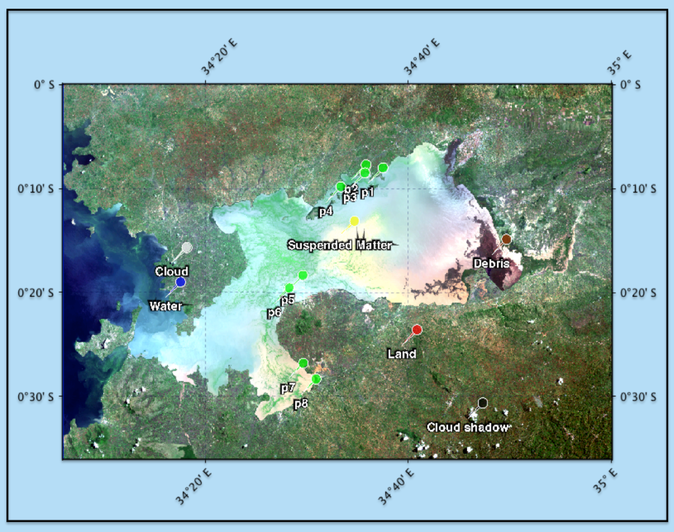


Figure 1: Training pixels from Landsat-8 OLI, scene L8_OLI_2013_04_19_07_56_L2 (Source: USGS). Winam Gulf is ~1920Km^2 by area.

R-INDEX DEVELOPMENT

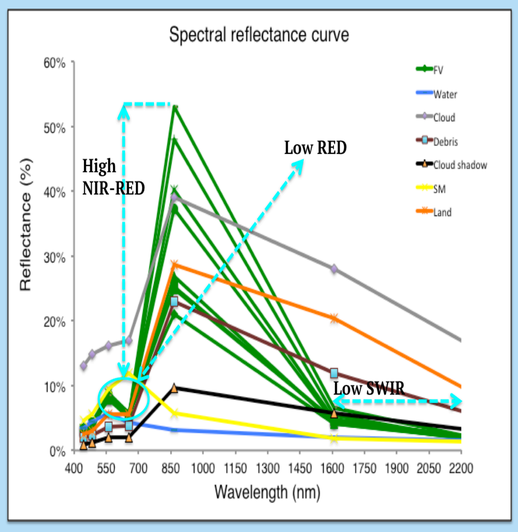


Figure 2: Spectral reflectance of different optical features (Processed in SeaDAS)

Spectral reflectance slicing to determine the best band combination and thresholds for detecting floating vegetation

RESULTS

1. Detection of floating vegetation

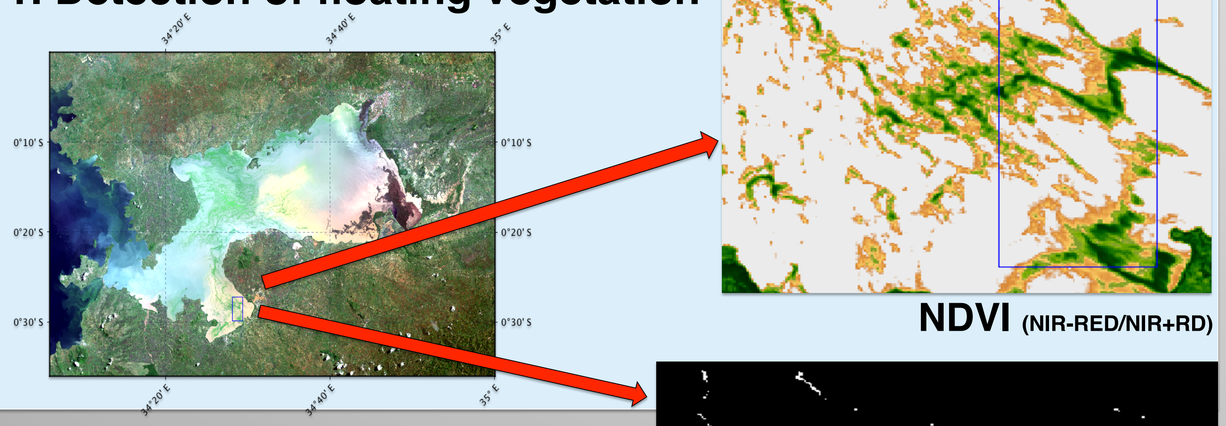
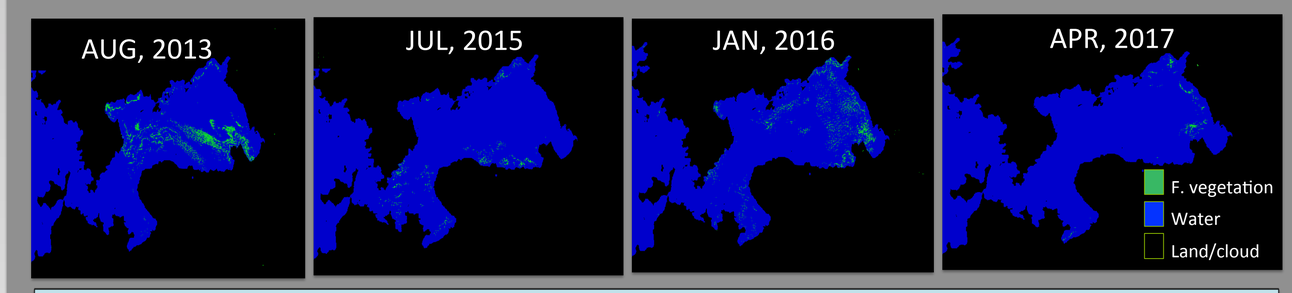


Figure 3: Best combination bands and threshold reflectance for discriminating floating vegetation from other features was found as follows: R-Index= R1+R2+R3, where R1=NIR$_{865}$-RED$_{655}$>0.01, R2=RED$_{655}$>0.1 and SWIR$_{1609}$<0.02. Results compared with traditional NDVI (NIR-RED/NIR+RED)

RESULTS

2. Spatio-temporal trend of floating vegetation



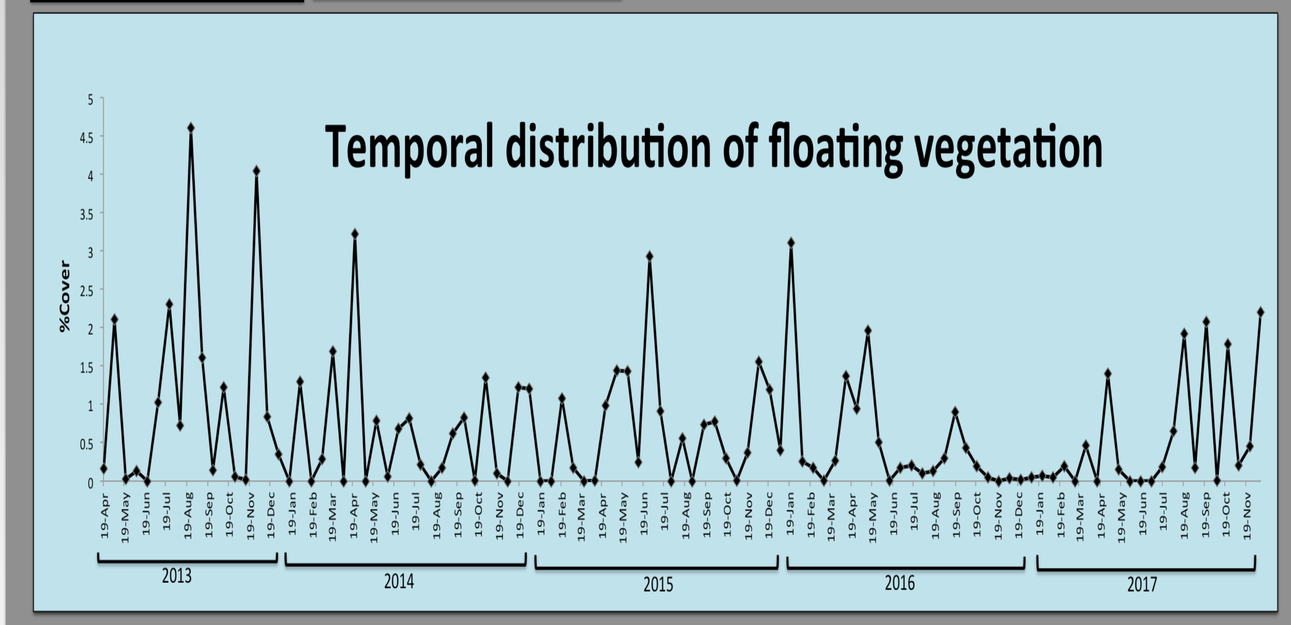
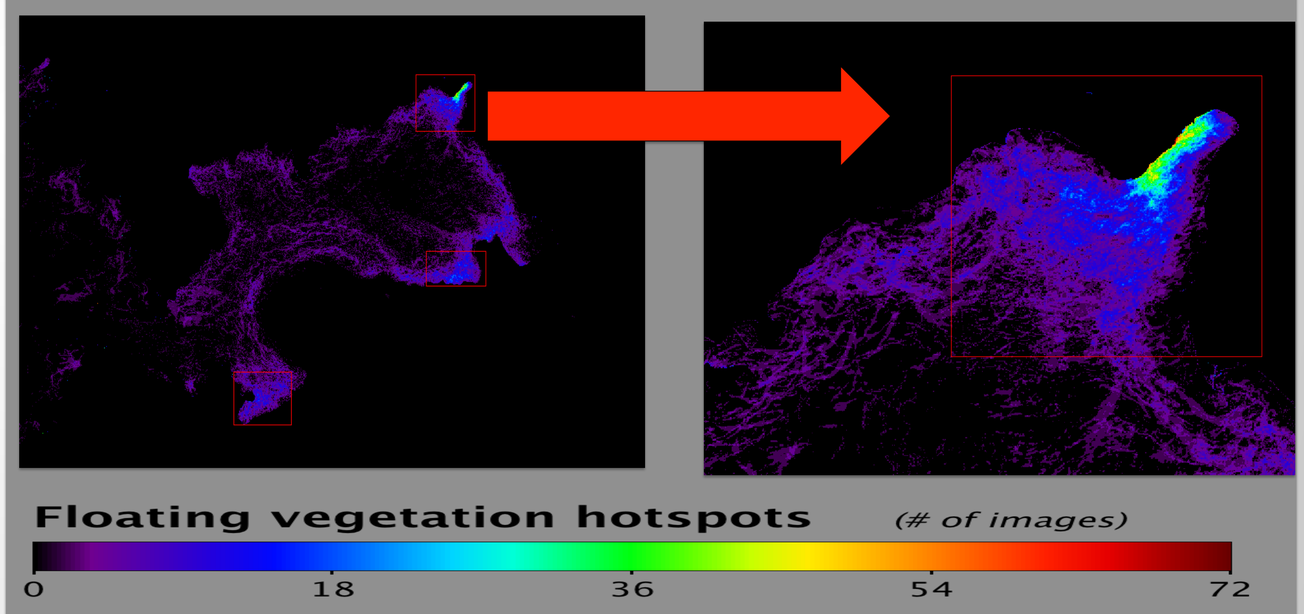


Figure 4: Spatial variation for selected images (top) and monthly trends in floating vegetation cover in L. Victoria . Water hyacinth is a freely-floating weed and its spatial and temporal variation could be influenced by wind, water currents and also availability of nutrients especially during the rainy seasons leading to surface run-offs. (1% cover = 1924ha)

3.Proliferation hotspots of floating vegetation



Frequency of floating vegetation occurrence showing bays and shorelines as hotspots almost 50% of the time for the period 2013-2017.

CONCLUSION

- Multispectral sensors are suitable for aquatic vegetation mapping
- Best combination bands for detecting floating vegetation are NIR, RED and SWIR
- Bays and shorelines are the proliferation hotspots for aquatic weed due to their stability
- Accuracy assessment with a temporally-coincident Sentinel-2 aided in refining the thresholds for the detection algorithm (R-index)
- Validation with field spectral data is needed to enhance accuracy of detection and refine this new algorithm to be able to resolve different species of floating vegetation.

References

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- Kolding J., van Zwieten P., Mkumbo O., Silsbee G. & Hecky R.E (2008). Are the Lake Victoria fisheries threatened by exploitation or eutrophication. Towards an ecosystem based approach to management. Pages 309-354 in G. Bianchi and H. R. Skjoldal, editors. The Ecosystem Approach to Fisheries.

Acknowledgement

Study funded through the VLIROUS-ICP Master of Science programme (O&L) and publication supported by VCRS Ulster university