Optical remote sensing of Lake Victoria

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Lake Victoria is the second largest freshwater lake in the world by surface area. The transboundary lake is of great economic and ecological importance supporting fishing activities of local populations and also serves as a biodiversity hotspot. Despite joint actions by the lake basin countries to enhance management and monitoring, the lake still remains under severe human pressure. The introduction of Nile perch (*Lates niloticus*) in the 1980s and increasing eutrophication from land-based nutrients with consequent anoxia and reduced water transparency are among the impacts that may lead to massive growth of invasive water hyacinths. Studies indicate that light penetration in the lake plays a significant role in primary production and also in determining the hunting and survival success of visual predators and their prey. Underwater visibility also affects feeding and mating choices of fish.

This study aims to demonstrate the suitability of using remotely sensed satellite data to enhance management of Lake Victoria and for providing an inexpensive way to gather, on a large spatial scale, optical properties of the lake. Use of remote sensing products has a wide application in both marine and freshwater bodies, and can aid natural resources managers to make optimal decisions to ensure sustainability of fisheries, biodiversity and ecosystem resources. We will explore the use of the Landsat-8 satellite, that provides imagery free of charge, every 16 days, with 30m spatial resolution. Landsat-5 provides an additional temporal dimension with imagery back to 1984.

Other data sources that are considered are the similar Sentinel-2/MSI satellite, currently in ramp-up phase, and the geostationary SEVIRI series (images every 15minutes during daylight since 2003, with 3 km resolution at the sub-satellite point, and free of charge for research use.

None of these missions provide standard water quality products, moreover atmospheric correction algorithms have to be adapted for inland waters. Standard atmospheric correction algorithms assume sea level altitude for calculation of molecular scattering in the atmosphere, which will cause an overestimation for Lake Victoria that is at 1134 m elevation. RBINS has designed algorithms and processing software for Landsat, Sentinel-2 and SEVIRI that supports the processing of data for inland waters.

The objective of this thesis is to provide thematic products, retrievable from satellite imagery such as floating vegetation, suspended particulate matter and water transparency. These products - if available with proper time frequency - will be useful in identifying conditions for the occurrence of turbid waters, floating vegetation, which can potentially be linked to declining species richness. The imagery could be used to develop an up-to-date decision support system for long-term monitoring and management of the lake. A review of the scientific literature on the environmental status of Lake Victoria with a focus on fisheries, phytoplankton, floating vegetation, benthic vegetation, suspended sediments and water transparency will be conducted. Water color maps of floating vegetation, suspended sediments and water transparency will be generated. The literature review together with ground-truthed data will be used to validate and make a critical discussion on the quality of the satellite imagery.

Keywords: Lake Victoria; satellite; remote sensing; optics; ocean color