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Mapping Potential Fishing Grounds in Lake Malawi Using AVHRR and MODIS Satellite Imagery

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ABSTRACT

This paper discusses a procedure that was developed to delineate potential fishing grounds in Lake Malawi using data on chlorophyll-a concentration derived from Moderate-resolution Imaging Spectroradiometer (MODIS/AQUA) in combination with lake surface temperature (LST) data obtained from Advanced Very High Resolution Radiometer (AVHRR) and MODIS/Terra satellite sensors. The paper draws from findings of studies [1,2] on development of algorithms for estimating chlorophyll-a and lake surface temperature in Lake Malawi from satellite imagery, respectively. To estimate chlorophyll concentration (a proxy for phytoplankton) in Lake Malawi using data from MODIS satellite imagery, *in situ* measurements of chlorophyll concentration were conducted at three selected sampling stations over the southeastern arm of Lake Malawi concurrent with satellite image acquisitions. These were regressed on chlorophyll-a concentration values obtained from Ocean Color (MODIS/AQUA) Data using SeaWIFS Data Analysis System (SeaDAS) software. From this, an equation for estimating chlorophyll-a concentration in Lake Malawi from MODIS satellite imagery was developed and used for mapping the spatial distribution of chlorophyll-a concentration in the lake. Since Lake Malawi is an oligotrophic lake, with an average value of chlorophyll concentration of 1 μg/L, areas in the lake with relatively high chlorophyll-a concentration were identified as potential locations for the development of the fishery industry. Estimation of lake surface temperature using satellite imagery involved two main activities. Firstly, *in situ* measurements of lake surface temperature were conducted at the three selected sampling stations over Lake Malawi concurrent with satellite image acquisitions. The second activity involved downloading and processing AVHRR and MODIS/Terra satellite imagery. AVHRR data covered the period September 1997 to February 1998 whereas MODIS/Terra data covered the period May to November, 2006. Both MODIS Land Surface Temperature (MOD11A1) and Ocean Color Sea Surface Temperature (SST) were downloaded from EOS Gateway website and processed into lake surface temperature. Two glass thermometers were used to measure temperature directly from the lake surface at a depth of 0 - 7.0 cm (i.e., skin temperature) and the average of the two readings was recorded as the lake surface temperature at a particular sampling station. Observed temperatures were regressed on remotely sensed data. ER Mapper was employed in drawing maps showing the distribution of lake surface temperature using the regression equation that was developed. Upwelling and downwelling zones were demarcated from lake surface temperature maps. Upwelling zones were identified as areas with a high potential for the development of the fishery industry because of their association with primary productivity. Using a simple overlay technique, data from both the spatial and temporal distribution of chlorophyll-a and lake surface temperature were used to delineate potential fishing grounds in Lake Malawi. The zone extending from Salima up to the northern part of Nkhotakota and the area on the northeastern tip of Lake Malawi were identified as areas of high primary productivity and therefore potential fishing grounds. These areas generally exhibit persistent cool surface waters, indicative of upwelling; and have relatively abundant phytoplankton.

KEYWORDS

Mapping; MODIS; AVHRR; Lake Surface Temperature (LST); Chlorophyll-a

Cite this paper

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