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The Impacts of Climate Change on the Thermal and Oxygen Dynamics of a Tropical Lake in Ghana, West Africa

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The Impacts of Climate Change on the Thermal and Oxygen Dynamics of a Tropical Lake in Ghana, West Africa

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Abstract: Man-made lakes in Africa are created primarily to produce hydro-electric power but their fisheries become an important industry for the economies of riparian communities. The lake and its catchment form a complex hydrological system because of the strong interactions between overland and in-lake physical and biogeochemical processes. While lake productivity is influenced by biogeochemical characteristics of the lake, these characteristics reflect the climate, geomorphology and vegetation-cover of the lake's catchment. Prospects of climate change have implications for the ecosystem of lakes viz. temperature, oxygen and primary production dynamics, which affect fish production. Models can aid in the understanding of potential impacts of climate change, and also serve as scenario tools that may support decision making processing in lake and watershed management. In this study, we set up and validated the one-dimensional GOTM-ERGOM model, to quantify the effects of climate change on the thermal stratification and oxygen dynamics and, primary production in meso-oligotrophic Lake Volta. The validated model was used to evaluate series of future climate change scenarios representing the period 2051-2080. Model simulations under the future scenarios indicated increased water column stability although the lake did not permanently stratify. Simulation further indicated a 1-m upward shift of the thermocline depth, resulted in 8 %-12 % volume loss in the upper mixed layer and reduced oxygen levels below this depth which may be significant in reducing the suitable habitat area for fish. Light limitation on primary production renders the lake somewhat resilient to intensive algae blooms both for present and future climate scenarios. Climate change presents challenges to water resources management therefore, the lake model presented together with catchment models can be informative tools for decision-support in watershed and lake management.

***Keywords**:* Lake Volta; GOTM-ERGOM; stratification; hypoxia; climate change