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Teleconnections between ecosystem productivity and climate indices in a tropical great lake

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Productivity of deep tropical lakes is mainly determined by physical forcing. Located in the East African Rift, Lake Kivu [2.50˚S 1.59˚S, 29.37˚E 28.83˚E] is a deep meromictic lake. Phytoplankton biomass is generally low due to the lake's oligotrophic nature except when seasonal deeper mixing of the surface water layer brings up nutrients from deeper waters, allowing a seasonal peak of phytoplankton biomass. This seasonal mixing favours the development of diatoms, while, during the rest of the year, the phytoplankton assemblage is dominated by cyanobacteria, chrysophytes and cryptophytes. A long-term limnological survey on Lake Kivu conducted from 2002-2011 allowed us to delineate relationships between intra- and inter-annual variations of limnological parameters and lake productivity. During this survey, inter-annual variations of biomass and productivity were high, with for example a 5-fold maximum difference between the seasonal peak of biomass. The importance of the annual biomass peak was negatively correlated to the stability of the water column during the season preceding the bloom. This suggests that the importance of the annual bloom is not driven by weather conditions during the mixing period but by the stratifying conditions prevailing several months earlier. Statistically highly significant correlations were observed between intra- and inter-annual variations of water column stability, phytoplankton biomass and tropical ocean climate indexes, including Western Tropical Indian Ocean (WTIO) sea surface temperature (SST) anomaly index, Dipole Mode Index (DMI), Southern Ocean Index (SOI) and El Niño-Southern Oscillation (ENSO), were also observed. Inter-annual variations in relation to large scale climate oscillations can be used as natural laboratories and give indications how ecosystems will respond to climate change. This study allowed us to make some predictions on the effects of climate change on lake water column stability and lake productivity.