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A European vision for hydrological observations and experimentation

On the potential cross-mixing of Lake Bogoria and Baringo in the Rift Valley of Kenya

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The Rift Valley lakes of Kenya are biodiverse ecozones, classified not only as RAMSAR wetlands of international importance, but also as UNESCO World Heritage. In the last decade, starting in 2010, several Kenyan lakes have experienced significant rises in water levels. The consequences have been severe. Inundations of the riparian areas have not only flooded homes, schools and hospitals, but also the basis for the local livelihoods and economy such as agricultural fields, national parks or tourism infrastructure has been destroyed. Nearly eighty thousand households with 400,000 people are affected according to a governmental report published in 2021.

There is fear of an ecological catastrophe, should the water levels of the alkaline Lake Bogoria continue to rise. The result would be an overflow and mixing with the freshwater Lake Baringo, the basis of the local community supporting drinking water provision, agriculture, tourism and fisheries. Currently no analysis exists to understand the topographical conditions between the two lakes and the potential flow paths. It is unclear, what climatic rainfall conditions are necessary to lead to an overflow and sustained flows from Lake Bogoria towards Baringo. This analysis therefore assesses (i) the overflow or sill point location and potential flow paths towards Lake Baringo, (ii) the required lake water volume changes, until the sill point is reached and (iii) the mean rainfall conditions, which would be necessary to provide the required volume and a sustained flow towards Lake Baringo. The analysis relies on satellite altimetry-based lake levels and lake volume variations, remote sensing-based rainfall data and lake areas but also high-resolution space-borne and UAS-based DEMs. Field surveys and electrical conductivity measurements used as a proxy to understand flow paths in the flat and swampy Loboi plain between Bogoria and Baringo complement the data basis.

To reach the sill point elevation, the lake level of Bogoria would have to increase by around 0.6–0.8 m, compared to the maximum water levels of 2020. This translates to an additional water volume of around 0.033 km³. To put this into perspective: From 2009-2014, mean annual lake levels increased by 3 m (or 0.11 km³), and after a recession phase, from 2017-2020 by 2.3 m (0.10 km²). If the sill point would be reached, the rainfall conditions in the last decade would have allowed for a permanent flow towards Baringo, at least in single years. These preliminary results suggest that it is feasible that the sill point can be reached and that a permanent flow from Bogoria towards

Baringo can be sustained, if wetter conditions – as we have observed in the last decade - persist for a longer period.