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LakeMIP Kivu: Evaluating the representation of a large, deep tropical lake by a set of 1-dimensional lake models

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The African great lakes are of utmost importance for the local economy (fishing), as well as being essential to the survival of the local people. During the last decades, these lakes experienced fast changes in ecosystem structure and functioning and their future evolution is a major concern. In this study, for the first time a set of one-dimensional lake models are evaluated over East-Africa, in particular over Lake Kivu (2.28 °S; 28.98 °E). The unique limnology of meromictic Lake Kivu, with the importance of salinity and geothermal springs in a tropical high-altitude climate, presents a worthy challenge to the 1D-lake models currently involved in the Lake Model Intercomparison Project (LakeMIP). Furthermore, this experiment will serve as the basis for a future, more complex intercomparison, coupling lake models with atmospheric circulation models to analyse climate change effects on the lake. Meteorological observations from two automatic weather stations, one at Kamembe airport (Rwanda, 2003-2008), the other at ISP Bukavu (DRC, 2003-2011), are used to drive each of these models. For the evaluation, a unique dataset is used which contains over 150 temperature profiles recorded since 2002. The standard LakeMIP protocol is adapted to mirror the limnological conditions in Lake Kivu and to unify model parameters as far as possible. Since some lake models do not account for salinity and its effect upon lake stratification, two sets of simulations are performed with each model: one for the freshwater layer only (60 m) and one for the average lake depth (240 m) including salinity. Therewith, on the one hand it is investigated whether each model is able to reproduce the correct mixing regime in Lake Kivu and captures the controlling of this seasonality by the relative humidity, which constrains evaporation except during summer (JJA). On the other hand, the ability of different models to simulate salinity- and geothermal-induced effects upon deep water stratification is analysed. Finally, different models are tested for their sensitivity to variations in respectively the light extinction coefficient, the geothermal heat flux, the applied wind speed correction and the bottom sediments routine.