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Modeling lake surface energy budget at the global scale during the 20th century

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Ongoing climate change raises the question of an intensification of the hydrological cycle, which can be expressed as a change in time and space distributions of precipitation, radiative forcing, or air temperature. In this context, this work is a first attempt at characterizing the evolution of various lake variables during the 20th century at the global scale.
The lake surface energy budget is indirectly evaluated with a set of different off-line simulations using the FLake model. Flake model is used to solve the surface energy budget and to simulate the temperature structure of lakes, based on a two-layer parametric representation of the evolving temperature profile within the water column and on the integral energy budget for these layers. Three state-of-the-art forcing datasets are used at the global scale: Global Soil Wetness Project Phase 3 (GSWP3, 1910-2010), Princeton Global meteorological Forcing (PGF, 1948-2010), and ERA-Interim (ERA-I, 1979-2010). FLake has been run at 0.5° resolution with a 3 hour time step, simulating multiple lake geophysical variables, e.g. the surface temperature, the snow and ice temperatures and heights, the thermocline depth (the stratified layer between the upper mixed layer and the lake bottom), the evaporation, or the temperature profile with depth.
Simulations using the three forcing datasets are compared to in situ measurements of surface temperature and ice coverage. Larger scales are also studied and trends are derived from the simulated time series over the 20th century. Differences between the forcing datasets are discussed and their impact on lake variables are investigated to better understand where they originate. A focus on European lakes will also be presented using the Uncertainties in Ensembles of Regional Re-Analyses (UERRA) forcing dataset available at a resolution of 5.5 km from 1961 until now.