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The multi-year (2008-2016) water and energy balance of three small endorheic lakes in Burabay National Nature Park, Kazakhstan, Northern Central Asia

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Most of the endorheic lakes in the world have experienced a decline in water storage during the past decades. This deterioration of water storage concerns both large enclosed inland seas, such as the Aral and Caspian seas, as well small and medium endorheic lakes in arid and semi-arid climates. These drops in water levels are frequently attributed to an increase in open water evaporation in a warming climate. For example, a recent 1.5 m decrease of Caspian Sea water levels recorded from 1996 to 2015 is explained by higher evaporation rates. Here, we consider the energy and water balance of three small endorheic lakes located in Burabay National Nature Park (BNNP), Kazakhstan: Burabay, Shortandy and Ulken Shabakty lakes. BNNP is a small ecozone consisting of endorheic lake watersheds covered by mixed forests and steppe grasslands. The lakes differ in depth, area, volume, catchment area, hydrogeological conditions and degree of sheltering by nearby forested hills, which will affect their water-and energy balance via intricate lake-environment interactions. The collected data consist of: 1) daily hydrometeorological observations such as weather data, lake water levels, and surface water temperature from 2008 to 2016; 2) gridded global atmospheric reanalysis (ERA Interim) extracted for the same period for BNNP; 3) Eddy Covariance energy flux measurements 4) stable water isotopes sample analysis on BNNP lake, groundwater, streams, and precipitation water collected during one hydrological year (2016); 5) additional occasional in-situ hydrometric measurements such as column lake water temperatures, snow surveys, and groundwater levels. The daily weather data are processed in lake evaporation and energy balance models. The modeling results are discussed in terms of the influence of the lakes' surroundings, lake individual characteristics, and heat storage effects. The evaporation of Ulken Shabakty Lake is more influenced by wind speeds, while for Burabay and Shortandy Lakes the evaporation is more controlled by vapour pressure deficit. Stable water isotopes data indicate that groundwater feeds the lakes, in particular during periods of snowmelt in spring.