Geophysical Research Abstracts
Vol. 19, EGU2017-15496, 2017
EGU General Assembly 2017

Estimation of water storage changes in small endorheic lakes in Burabay National Nature Park (Northern Kazakhstan, Central Asia); the effect of climate change and anthropogenic influences

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Both climate change and anthropogenic activities contribute to deterioration of terrestrial water resources and ecosystems worldwide. It has been observed in recent decades that water-limited steppe regions of Central Asia are among ecosystems found to exhibit enhanced responses to climate variability. In fact, the largest share of worldwide net loss of permanent water extent is geographically concentrated in the Central Asia and Middle East regions attributed to both climate variability/change and human activities impacts. We used a digital elevation model, digitized bathymetry maps and high resolution Landsat images to estimate the areal water cover extent and volumetric storage changes in small terminal lakes in Burabay National Nature Park (BNNP), located in Northern Central Asia, for the period 2000-2016. Based on the analysis of long-term climatic data from meteorological stations, hydrometeorological network observations as well as regional climate model projections we evaluate the impacts of past thirty years and future climatic conditions on the water balance of BNNP lake catchments. The anthropogenic water consumption was estimated based on data collected at a local water supply company and regulation authorities. One the one hand historical in-situ observations and future climate projections do not show a significant change in precipitation in BNNP. On the other hand both observations and the model demonstrate steadily rising air temperatures in the area. It is concluded that the long-term decline in water levels for most of these lakes can be largely attributed to climate change (but only via changes in air temperature, causing evaporation to exceed precipitation) and not to direct anthropogenic influences such as increased water withdrawals. In addition, the two largest lakes, showing the highest historical water level decline, do not have sufficient water drainage basin area to sustain water levels under increased evaporation rates.