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Water-level changes of Central Asian lakes during the last 1000 years based on historical maps

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To clarify the environmental changes in Central Asia during the past few hundred years, lake levels of three lakes, Aral Sea, Lake Issyk-Kul (Ysyk-kol), and Lake Balkhash in Central Asia were reconstructed by several historical maps and SRTM DEM data. These historical maps from the 17th-19th century were described in English, Russian, Mongolian, Manchu, Tibetan, Turkic, and Chinese languages during the Qing Dynasty for acquiring information about landscape and land-use of local people) in western countries. The maps show that water level of Aral Sea increased ~2m in the mid-19th from 1960s before lake shrinkage. Water level of Lake Issyk-Kul was 14m higher than at the present during the 17th-mid-19th century, because lake water had overflowed to Chu river. Water level of Lake Balkhash increased 2-3m from the present during the 17th-mid-19th century. The maps show three lakes, which have the same water sources in the Pamirs and Tien Shan mountains, expanded in the 17th-19th century on the same timing. As the previous studies, Aral Sea experienced the drastic decline of the lake-level in the 12th-14th century, and the old settlements around Lake Issyk-Kul in the 10th-12th century have sunk under present lake level. According to several proxy data such as summer temperature from tree-rings, snow accumulation from ice-cores, glacier variations, soil development, and historical documents, this lake-level decline occurred in the 12th-14th century under dry period, and the increase of lake-level in the 17th-mid-19th century under the cold and wet conditions of the Little Ice Age. However, drastic decline of the Aral Sea lake-level might be related with water irrigation systems in the 7th-12th century around the Syr Darya and Amu Darya or flow changes of Amu Darya to Uzboi to the Caspian Sea as shown in previous studies. In specially, the water-level decline of Aral Sea was large-scale in the 12-14th century, comparing with the degree of water-level changes in three lakes during the Little Ice Age. These facts highlight the significant environmental changes including human impacts that have occurred in the past millennium in Central Asia.

Keywords: Central Asia, historical map, lake-level change, proxy data