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Evaporation from the dried-up lake bed of Lake Urmia, Iran

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Abstract

Lake Urmia in north-western Iran was once one of the world's largest hyper-saline lakes and represented a unique ecosystem for a number of endangered species. The lake's shrinking over the past decades has attracted considerable attention and several studies have addressed its water balance. Yet, evaporation of shallow groundwater from the dried-up lake bed has not been fully quantified – despite the appreciable size of these areas (approx. 4000 km^2 in summer 2015).
Here, we target this water cycle component by combining column experiments with upscaling and regionalisation techniques. In the experiments, we studied evaporation from two undisturbed soil cores from the exposed lake bed in a climate chamber, mimicking diurnal temperature and humidity variations in the three summer months of the study area. Despite the dropping water levels in the columns and the formation of salt crusts, evaporation rates remained remarkably constant (0.12 and 0.20 mm d^{-1}). This suggests that the system is not driven by slow vapour diffusion, but controlled by capillary rise in the fine-grained sediments, ensuring steady water supply to the column surface. Thus, evaporation from the dried-up lake bed can be assumed to be largely independent from the unsaturated zone thickness (within the observed water level range) and evaporation rates can be simply upscaled and regionalised by considering the satellite-derived development of dried-up lake bed areas (1998–2020).
In this time-period, estimated summer evaporation from the exposed lake bed reached maximum values of 0.04 and 0.07 km^3 (summer 2015). While these absolute numbers are significant (comparable to the catchment's annual urban drinking water consumption), they correspond to only 4 and 7 % of the evaporation from the open lake surface (1.06 km^3).

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