

Evaporation suppression from reservoirs using floating covers: Lab scale wind-tunnel observations and mechanistic model predictions

Dani Or, Peter Lehmann, Milad Aminzadeh, Martina Sommer, Hannah Wey, Christiane Krentscher, Hans Wunderli, and Daniel Breitenstein

Soil and Terrestrial Environmental Physics, ETH Zurich, Zurich, Switzerland

The competition over dwindling fresh water resources is expected to intensify with projected increase in human population in arid regions, expansion of irrigated land and changes in climate and drought patterns. The volume of water stored in reservoirs would also increase to mitigate seasonal shortages due to rainfall variability and to meet irrigation water needs. By some estimates up to half of the stored water is lost to evaporation, thereby exacerbating the water scarcity problem. Recently, there is an upsurge in the use of self-assembling floating covers to suppress evaporation, yet the design and implementation remain largely empirical. We report a systematic experimental evaluation of different cover types and external drivers (radiation, wind, wind plus radiation) on evaporation suppression and energy balance of a 1.4 m² basin placed in a wind-tunnel. Surprisingly, evaporation suppression by black and white floating covers (balls and plates) were similar despite significantly different energy balance regimes over the cover surfaces. Moreover, the evaporation suppression efficiency was a simple function of the uncovered area (square root of the uncovered fraction) with linear relations with the covered area in some cases. The thermally decoupled floating covers offer an efficient solution to the evaporation suppression with limited influence of the surface energy balance (water temperature for black and white covers was similar and remained nearly constant). The results will be linked with a predictive evaporation-energy balance model and issues of spatial scales and long exposure times will be studied.