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Verification and comparison of methods to estimate surface fluxes under various time scales – Application to Lake Kinneret, Israel

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Lake Kinneret is the only substantial free-water reservoir in Israel, supplying about 400±100 million cubic meters annually (Mcm/a) to the national water consumption. Evaporation losses (240±30 Mcm/a) significantly reduce available water for water supply, and have a direct effect on changes in salinity. Therefore, evaluation of evaporation losses from the lake is needed. Currently evaporation is calculated only on a monthly basis by employing the energy balance method, using meteorological data from single meteorological station. In this study we use several methods to calculate evaporative and sensible fluxes, on various time scales (10 minutes, hourly, daily, monthly and annually), by using continuous (every 10 minutes) meteorological measurements from 4 meteorological stations around the lake, and measurements of the lake's temperature from 1996 to 2008.
The calculation of surface fluxes for a large lake under any time scale requires a variety of simultaneous measurements, depending on the method of calculation adopted. Here we verify and compare the following methods: 1. energy and mass balance, 2. simplified evaporation balance (Penman's approach), and 3. Hydrodynamic method with and without atmospheric stability considerations (four different algorithms). The usage of the following measurements is examined: water temperature (surface layer, lake profile, inflows, outflows), meteorological parameters (long and short wave radiation, water surface and air temperature, air humidity, and wind speed), and pan 'A' evaporation. The potential usage of spatial interpolations of wind speed and direction is explained. Comparing the different applied methods and data allows us to better quantify and understand the evaporation process on a variety of time scales. Moreover, although the entire analysis is based on past measurements, we also show how some of the methods are suitable for the prediction of future evaporation losses from large water bodies, using regional climate models.

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