



## **Evaporation from the shallow Lake Massaciuccoli (Tuscany, Italy) studied using stable isotopes and evaporation pan data**

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Oxygen and hydrogen isotope variations monitored in Lake Massaciuccoli (7 km<sup>2</sup>, 2 m deep, seasonally variable water level) during summer 2008, were compared with those observed in a Class A evaporation pan (diameter 120.6 cm, depth 25.4 cm) placed on the lake eastern shore. Air temperature, pressure, relative humidity, wind speed and direction, solar radiation, water temperature in the lake and the pan were also measured. The pluviometer indicated that no precipitation occurred during the study period.

The pan was initially filled with groundwater up to the level of 19.2 cm (219 L), depleted in heavy isotopes with respect to the lake water. Sodium chloride was added up to the concentration of 1 g·L<sup>-1</sup>, which is assumed do not affect significantly the evaporation rate till the water volume is reduced to less than 10 %. The Cl<sup>-</sup> concentration was used to provide an estimation of the evaporated water fraction, in addition to the micrometer measuring the water level variations.

The pan water was sampled every 2-3 days and Cl<sup>-</sup> and stable isotopes determined. The set of stable isotope and evaporation data enabled us to compute the parameters governing the evaporation process and the isotopic exchanges with the atmospheric moisture, according to the procedure proposed by Gonfiantini (1986). The values were applied to test three working hypotheses of water balance of Lake Massaciuccoli: (i) surface inflow and outflow of liquid water are negligible and only evaporation is important; (ii) the inflow is negligible and outflow and evaporation are both significant; (iii) the three terms of balance are all important but the losses by evaporation and outflow exceed inflow (as the lake water level was decreasing). Water exchanges with groundwater are considered negligible.

The best agreement between lake and pan data was obtained with the second hypothesis, for which the fraction of water removed by evaporation was estimated to be about 40 % of the total water losses. This residual 60 % of losses consists essentially of water pumped from the lake for irrigation, in rough agreement with independent estimations.

In the final stages of pan water evaporation, the well known hook trend of heavy isotope delta values versus residual water fraction was observed.

The data elaboration is being continued and refined. Correction factors for the so called pan effect will also be applied. Collection of atmospheric vapour samples has been started.

R. Gonfiantini, 1986. Isotopes in lake studies, in Handbook of Environmental Isotope Geochemistry (P. Fritz and J-Ch. Fontes, Eds.), Vol. 2, pp.113-168.