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Monitoring and modeling water temperature and trophic status of a shallow Mediterranean lake

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Lakes are sensitive to changes in climate and human activities. Over the last few decades, Mediterranean lakes have experienced various problems due to the current climate change (drought, flood, warming, salt accumulation, water quality changes, etc.), often amplified by water use, intensification of land use activities, and pollution. The overall impact of these changes on water resources is still an open question.
In this study we monitor the trophic status and the dynamics of water temperature of Lake Baratz, the only natural lake in Sardinia, Italy, characterized by high salinity and shallow depth. We extend the research carried out in the past 8 years by integrating new physical, chemical and biological data using a multidisciplinary approach that combines hydrological and biological dynamics. In particular, the lake water balance and the thermal and hydrochemical regime are studied with a lake dynamic model (the General Lake Model or GLM) which combine the energy budget method for estimating lake evaporation, and a physically-based rainfall-runoff simulator for estimating lake inflow, calibrated with measurements at the cross section of the main inlet stream. The trophic state of the lake was evaluated applying the OCDE Probability Distribution Diagrams method, which requires nutrient concentrations in the lake (total phosphorus), phytoplankton chlorophyll a and Secchi disk transparency data.
We collected field data from a raft station and a land station, measuring net solar radiation, air temperature and relative humidity, precipitation, wind velocity, atmospheric pressure, and temperature from thermistors submerged in the uppermost three centimeters of water and beneath the lake surface at depths of 1, 2, 3, 4, 5, 6, and 8 m. Samples for nutrients and chlorophyll a analyses were collected at the same above mentioned depths close to the raft station using a Niskin bottle. Temperature, salinity, pH, and dissolved oxygen were measured using a multi-parametric probe. Water temperature is modelled with a unidimensional model. The validation of the model is verified by comparing recorded with simulated data.
The results show a good fit of the modelled water temperature, with a mean error of 0.11 °C and a root mean square error of 1.31 °C. The largest of the mean error values is recorded in the bottom layers (0.71 °C), while in central (thermocline) and surface layers the average error is negligible.
Total phosphorus values confirmed the eutrophic state of the lake (>35 mg P m-3). On the contrary, chlorophyll a and Secchi disk data indicated a more probable mesotrophic state. This frame highlights the necessity of further investigations on the responses of the lake's biological community to the different hydrological regimes in the different years.