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Using process-based coupled ecological-hydrodynamic models to support regional lake water quality protection planning in Northern Italy

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ABSTRACT

In this contribution, we present an application of the process-based coupled ecological-hydrodynamic model QWET over 9 lakes in Northern Italy (Alserio, Annone Est, Annone Ovest, Como, Endine, Garda, Iseo, Idro, Pusiano). The regional water quality protection plan for these lakes is based on limit depth-averaged total phosphorus concentrations at spring mixing. These concentrations have been previously used to determine threshold external loads through Vollenweider-OECD steady-state empirical models, which have also been employed to estimate in-lake concentrations following external load reductions. However, such approaches have several limitations and have often produced inaccurate results. Process-based coupled ecological-hydrodynamic models offer much wider possibilities, yet their application has been up to now restricted to individual lakes due to calibration effort and data availability burdens. Here, by developing a simplified model structure, adopting automatic calibration and employing data from public monitoring, we made a regional-scale application possible. Models were calibrated over past observations, simulating then nutrient reduction scenarios for the future decades. The advantages over empirical models were identified, determining the strengths and limits of the employed simplified approach over lakes with different features. Model results highlight that for the water quality improvement of these lakes, external load reduction from their watersheds is still central.