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Investigating Fast- and Slow-settling Phosphorus Fractions in Lakes using Steady-state Modeling

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Phosphorus (P) is the key and limiting nutrient in the eutrophication of freshwater resources. Modeling P retention in lakes using steady-state mass balance models (i.e. Vollenweider-type models) provides insights into the lake P management and a simple method for large-scale assessments of P in lakes. One of the basic problems in the mass balance modeling of P in lakes is the removal of P from the lake water column by settling. A fraction of the incoming P into the lake from the watershed is associated with fast-settling particles (e.g. sediment particles) that result in the removal of that fraction of P quickly at the lake entrance. However, existing models considering a constant fraction of fast-settling TP for all lakes are shown to result in overestimation of the retention of P in lakes with short hydraulic residence time. In this study, we combine a hypothesis of the fast- and slow-settling P fractions into the steady-state mass balance models of P retention in lakes. We use a large database of lakes to calibrate the model and evaluate the hypothesis. The results of this work can be used for the improvement of the prediction power of P retention models in lakes and help to better understand the processes of P cycling in lakes.