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Using lake sediment P records to estimate internal and external P loading and historic long-term lake water mean TP: a case study using published records from Søbygaard Sø, Denmark.

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Lake sediment records offer the opportunity to quantify past changes in catchment P exports, information essential if we are to understand the long-term drivers that control P cycling. However, the interpretation of such records generally depends on the assumption that sediment P concentration profiles remain intact after burial. This assumption appears to be in conflict with the phenomenon of internal P loading, whereby P is exported from sediment to the water column. Here we apply a simple long-term mass balance model to published sediment record data from Søbygaard, a site that has an exceptionally high internal P loading, and an exceptionally well-studied sediment P record (Søndergaard and Jeppesen, 2019). Repeat cores collected from 1985 to 2004 constrain the temporal evolution of a sediment P peak arising from past sewage inflows, providing a critical test of our modelling approach. We find that useful sediment inference of long-term mean lake water TP is preserved in the sediment record, and predict also useful inference of long-term mean external P loading. Limitation on temporal resolution of the records is examined.