

## Spatial heterogeneity strongly affects estimates of ecosystem metabolism in two north temperate lakes

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### *Abstract*

To characterize the spatial variability of metabolism estimates (gross primary production [GPP], respiration [R], and net ecosystem production [NEP]) in two Northern Wisconsin lakes, we collected data from 27 and 35 dissolved oxygen sensors placed in a two-dimensional array throughout the upper mixed layers over a period of 10 d per lake in midsummer. Averaged over the deployment, aerial metabolism estimates among sensor locations varied 1–2 orders of magnitude and were largely unrelated to physical habitat within the lake. For all sites and days, 76–90% of the explainable variance in GPP and R was attributable to location in the lake rather than day of the deployment. NEP, on the other hand, was less affected by location, with 79–93% of the explained variance attributable to the day of the deployment. Single-location estimates can yield errors of more than an order of magnitude in estimates of daily GPP and R and can mischaracterize the trophic status of the lake. Using a rarefaction approach, we found that using four randomly placed sensors increased the precision of the resulting daily metabolism estimates fourfold over single-location measures in both lakes.