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Controls of δ^{13}C-DIC in lakes: Geochemistry, lake metabolism, and morphometry

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Abstract

We investigated δ^{13}carbon (C)–dissolved inorganic carbon (DIC) values in 72 lakes from diverse regions using literature data as well as new measurements for 32 lakes. δ^{13}C-DIC varied broadly among lakes from −31 to +2.6‰. This variation of surface-water δ^{13}C-DIC among lakes is greater than the seasonal variation within most lakes. Several statistical models account for a large portion of the interlake variation and indicate that geochemical (e.g., DIC, pH, alkalinity) and morphometric (area) variables are important, whereas biological (e.g., gross primary productivity [GPP], respiration [R], chlorophyll *a*) variables are generally not significant. A process-based model including gas exchange with the atmosphere, inorganic carbon speciation, and ecosystem metabolism was also constructed. The model provides a reasonable fit to the data for lakes, in which respiration exceeded GPP (heterotrophic lakes; 75% of lakes sampled). Lakes for which GPP exceeded respiration (autotrophic) were not fit well by the process-based model. The data and models indicate that metabolism creates substantial variation in δ^{13}C-DIC around the potential δ^{13}C-DIC that is set by geochemical factors of the watershed.