ASLO
Association for the Sciences of Limnology and Oceanography

In situ pCO2 and O2 measurements in a lake during turnover and stratification: Observations and modeling

Baehr, Matthew M., Michael D. DeGrandpre

Limnol. Oceanogr., 49(2), 2004, 330-340 | DOI: 10.4319/lo.2004.49.2.0330

ABSTRACT: Sensors for the partial pressure of CO_2 (pCO_2) and dissolved O_2 (DO) were deployed near the surface and bottom of a freshwater lake (Placid Lake, Montana) during the period from ice cover to seasonal stratification. Sources of variability were examined using one-dimensional physical and biogeochemical models. Model predictions for pCO_2 and DO were compared to further constrain model parameters. A number of transient processes were documented that have not been well characterized in previous studies. The models made it possible to link these short-term events to specific forcings. We found that (1) 11 d of the 13-d turnover period occurred under ice through lightdriven convective mixing, (2) phytoplankton biomass increased to its highest seasonal level under ice, (3) weak stratification set up immediately after ice-out, causing bottom water pCO_2 and DO to diverge from surface levels, (4) subsequent diel convective mixing brought bottom pCO_2 and DO back toward surface levels, and (5) before stable stratification, vertical entrainment of CO2-rich water, net production, and air-water exchange drove 100-200 µatm daily changes in pCO_2, but, because of their counterbalancing effects, surface pCO_2 remained >1,000 µatm for nearly 1 month after ice-out. Upon stable stratification, net production and air-water exchange overcame pCO_2 gains from mixing and heating and reduced pCO_2 to near atmospheric levels within 20 d. Net production and gas exchange accounted for ~75% and 25%, respectively, of the decrease in surface pCO_2 observed after ice-out. Diel convection was the dominant mixing process both under ice and after ice-out and may be an important underrepresented mechanism for CO2 and DO exchange between surface and bottom water.

Article Links

Download Full-text PDF

Return to Table of Contents

Please Note