Online Resource 1

Intra- and inter-annual variability in metabolism in an oligotrophic lake

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Caption for Online Resource 1

This online supplement examines dissolved oxygen (DO) and temperature profiles in Lake Sunapee, New Hampshire, USA at the center of the lake near the environmental sensing buoy used for metabolism calculations in the manuscript. The profiles were selected from mid-July across four years (2009-2012) within the period of study. Lake Sunapee is strongly stratified each year with the thermocline depth between 5 and 8 meters. DO profiles are indicative of an oligotrophic lake with small differences in DO concentration between the epilimnion and hypolimnion. We discuss the profiles in the context of vertical mixing and possibilities for DO exchange across the thermocline.

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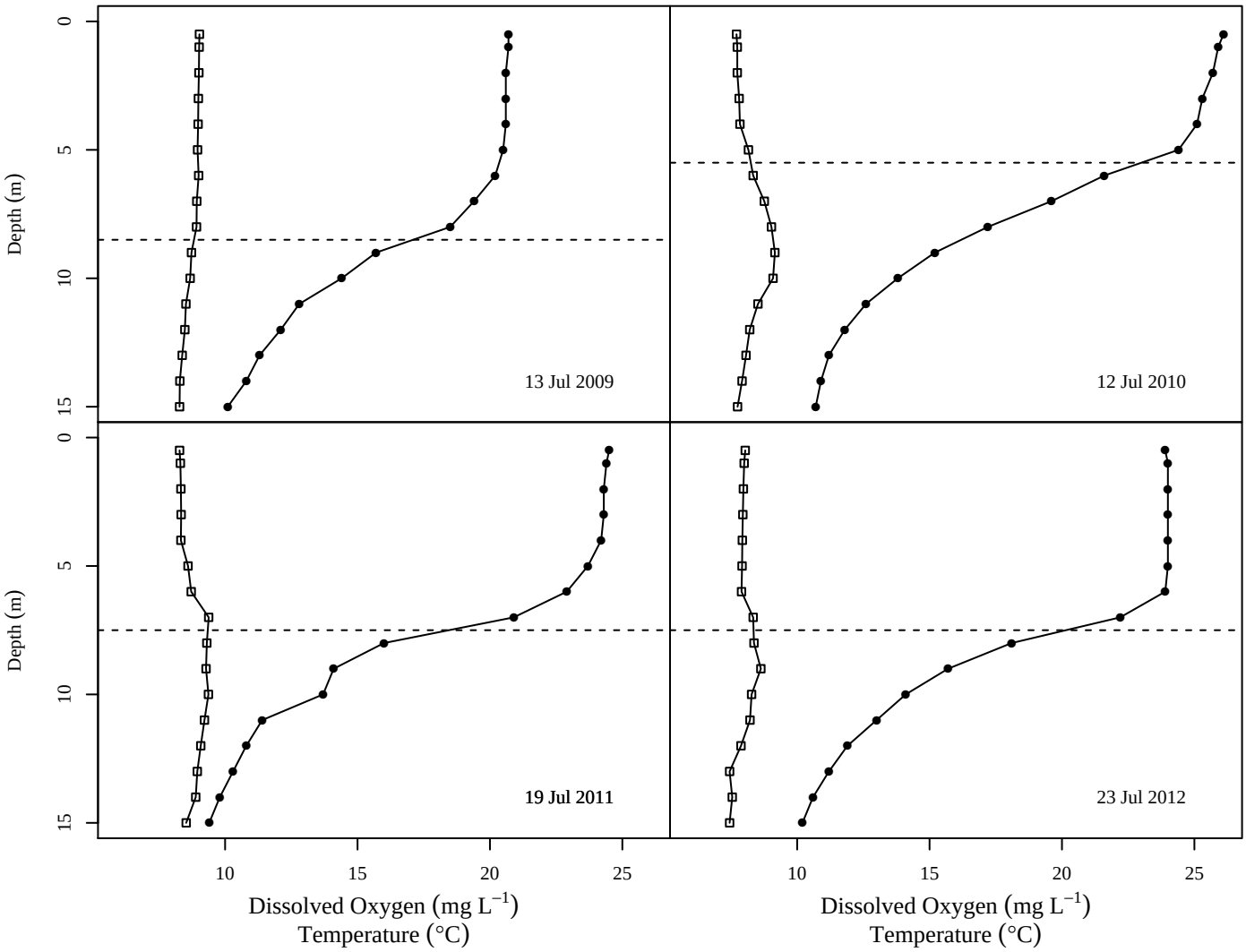
Manual vertical profiles of temperature and dissolved oxygen (DO) were measured near the buoy site approximately monthly in the summer. We selected profile data from mid-July measurements throughout our study period (Online Resource 1 Fig. 1). Lake Sunapee, New Hampshire, USA is seasonally stratified each year with a strong temperature change from the epilimnion to the hypolimnion (~15^{o}C). In July, the thermocline depth ranges in depth from 5.5 to 8.5 m. The oxygen profiles are similar across the strata with slight increases in DO concentration below the thermocline. This pattern is indicative of an oligotrophic system with physical factors (i.e., temperature) affecting dissolved gas concentration more than biological factors (i.e., respiration) below the thermocline. Additionally, these data indicate minimal water movement between the strata and suggesting low rates of primary production at or below the thermocline. Because the mixing depth is typically 8 m or shallower and the mean long-term Secchi depth is 7.9 m, we do not anticipate that there is significant light availability below the mixing depth in the middle of the summer. Additionally, none of the DO vertical profiles indicated large differences in DO concentrations between the epilimnion and hypolimnion, which is indicative of slow rates of diffusion across the metalimnion. Across 26 vertical DO profiles spanning our study period, the median difference between the mean epilimnetic and hypolimnetic DO concentration was 1.02 mg/L, and 13 out of 26 (50%) profiles exhibited <1 mg/L difference in DO across epilimnion and hypolimnion. There is a possibility that turbulent or eddy diffusion has caused vertical mixing and forced DO from the epilimnion to the hypolimnion, but the strong stratification based on temperature gradients (Online Resource 1 Fig. 1) does not support vertical mixing. Lake Sunapee is strongly stratified during the summer, and only extremely large and rare storm events (e.g., hurricanes) interrupt this stratification (see Klug et al. 2012 Fig. 2).

Works Cited

Klug J, Richardson D, Ewing H et al (2012) Ecosystem effects of a tropical cyclone on a network of lakes in northeastern North America. Environ Sci Technol 46:11693-11701.



Online Resource 1 Figure 1. Temperature (closed circles) and dissolved oxygen profiles (open squares) in Lake Sunapee in July from 2009 to 2012. The profiles were measured from a location near the LSPA buoy. The horizontal dotted lines indicate the thermocline, calculated as the maximum rate of change of the density of water with respect to depth.