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Circulation and turbulent exchange characteristics during the thermal bar in Lake Ontario

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ABSTRACT: We made observations from vertical moorings of thermistors and current meters in Lake Ontario to study the spring thermal bar circulation, its effect in inhibiting the horizontal mixing, and spatial and temporal variability of vertical mixing during this period. Thermal bar progression rates were compared with two analytical models; both produced overestimates during the early part of the thermal bar and underestimates during the late spring. In a zone between the shore and the thermal bar, currents were influenced by the local wind stress and flowed in a counterclockwise direction. The mean cross-shore flows in the nearshore zone were reduced during the thermal bar period. The alongshore horizontal exchange coefficients were higher than cross-shore exchange coefficients. During the thermal bar period, the magnitude of both alongshore and cross-shore exchange coefficients decreased when the bar was still within middepth (<40 m); when it was further offshore, the thermal bar did not have any significant effect on alongshore exchange coefficients, but cross-shore exchanges decreased marginally. The vertical exchange coefficients were high in the water column because of convective mixing during the thermal bar period. During the evolution of spring thermal bar, the vertical mixing decreased considerably in the nearshore regions under stable stratification, whereas the high vertical mixing levels continued in the offshore region for a longer period.

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