Spatial-temporal variability in surface layer deepening and lateral advection in an embayment of Lake Victoria, East Africa

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ABSTRACT: Vertical and horizontal exchanges in Pilkington Bay, a shallow (9 m) embayment of Lake Victoria, were determined from a surface energy budget, time series measurements of temperature, and quasi synoptic transects of conductivity, temperature, and depth conducted over a 2-d period. The surface energy budget is the first from a tropical lake over a diurnal timescale. Strong stratification developed during morning and early afternoon (>40 cycles h^{-1}) but was eroded beginning in the afternoon by the combination of wind and heat loss. Surface heat losses contributed >70% of the energy for surface layer deepening 82% of the time from midafternoon until midmorning. Circulation times of the surface layer were <2 min as it deepened to 1.5 m in the afternoon and were <12 min at night even when mixing extended to the lake bottom. Spatial differences in the rates of heating and cooling and in the depth of wind mixing caused fronts to develop on spatial scales of kilometers within the bay. Convergence of these fronts led to downwelling of surface waters and upwelling of deep waters during the stratified period. Horizontal pressure gradients due to differential heating contributed to thermocline downwelling, lateral movement of deep, anoxic waters, and generation of high-frequency internal waves, all of which contribute to vertical and horizontal transports. Although wind and heat loss at one location generally determine the depth of the surface layer and thermocline, the depths of these key features may be strongly influenced by rates of heating and cooling elsewhere in a basin.

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