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Relative Diffusion as Related to Quasi-Periodic Current Structures

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ABSTRACT

Experiments were performed in Lake Huron in which the relative diffusion of a dye plume and the lateral component of turbulent velocity were measured simultaneously. The standard deviation of the plume width varied in the same manner as the lateral turbulent intensity for cases of “regular” diffusion, although the precise relationship could not be established because Eulerian, rather than Lagrangian, time scales of the current fluctuations were measured.

Rapid vertical diffusion was associated with horizontal striations in the plume, with a quasi-periodic structure being observed simultaneously in the lake current. These striations were always aligned with the wind and rapidly followed shifts in the wind direction. It appears that these quasi-periodic current structures ensure “accelerated diffusion” when there is a variation in the direction of the current with depth. Since there is a strong association among the surface wind, the striations and current skewness, it is postulated that the surface wind plays a significant role in diffusion processes in the top few meters of the lake.

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