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[Volume 10, Issue 11 \(November 1980\)](#)

Journal of Physical Oceanography

Article: pp. 1814–1823 | [Abstract](#) | [PDF \(784K\)](#)

Vortex Modes in Southern Lake Michigan

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(Manuscript received October 16, 1979, in final form August 1, 1980)

DOI: 10.1175/1520-0485(1980)010<1814:VMISLM>2.0.CO;2

ABSTRACT

Current velocities and water temperatures were observed in southern Lake Michigan with an array of AMF vector-averaging current meters during late spring, summer and fall 1976. Analyses of the recorded current data have revealed that persistent oscillations of nearly 4 days in period were at least as energetic as inertial oscillations in the kinetic energy spectra and current hodographs. The 4-day oscillations were present at all stations, including a very clear signal at stations near the center of the lake basin. This lake-wide oscillation was present during both stratified and unstratified seasons and current vectors rotated cyclonically near the center of the lake and anticyclonically elsewhere. The observed rotational oscillations closely fit the characteristics of barotropic second-class motions of a basin with variable depth first described by Lamb (1932). While such topographic vortex modes are of the same class as low-frequency shelf waves, their kinematic properties and natural period are governed by the lake shape as well as the bathymetry. Moreover, the gravest mode is unique among these waves in having nonzero velocity at the lake center. The present observations give clear evidence for the existence of the gravest mode of such oscillations in southern Lake Michigan.

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