Abstract View

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Verification of Numerical Models of Lake Ontario: Part I. Circulation in Spring and Early Summer

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ABSTRACT

Data from the 1972 International Field Year on Lake Ontario have been used to test the performance of three-dimensional hydrodynamical models of large lakes. The models vary with regard to computational details, but their common purpose is to predict water levels, currents and temperatures in the Great Lakes on the basis of prescribed atmospheric conditions. The period of observations dealt with in the present paper includes the passage of tropical storm Agnes during the latter part of June 1972.

Data from the meteorological buoy network on Lake Ontario are combined with routine observations at first-order synoptic stations around the lake to obtain hourly values of wind-stress and pressure fields. Initial temperature distributions as a function of depth and horizontal coordinates are derived from quasi-synoptic ship cruises. Verification of model results is based on hourly values of water level data from stations on the perimeter of the lake and currents and temperatures measured by the buoy network at four levels below the water surface. To determine the predictability of different time scales, both the data records and the model output have been treated by digital filters with sharp cutoffs at physically significant frequencies.

For periods of weak stratification the model is found to be most sensitive to parameters related to the vertical flux of momentum. Satisfactory simulations of observed water levels and currents require wind-stress coefficients considerably larger than those obtained from direct flux measurements. Short-term variations of vertical current profiles at individual stations can be modeled adequately by recourse to classical dynamic stability theories. Whereas inertial oscillations are governed largely by the magnitude of the vertical diffusion of momentum, the internal fluxes of momentum can be varied by an order of magnitude without changing the character of the solutions for time scales of a day or more.

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