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A Theory of Steady Wind-Driven Currents in Shallow Water with Variable Eddy Viscosity

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ABSTRACT

A theory is given for steady wind-driven currents in shallow water (friction depth comparable to total depth) in which the vertical eddy viscosity varies linearly with depth, from zero at the bottom to a maximum at the surface. The theory is presented in a form suitable for numerical computations of currents in real, enclosed basins. The local surface value of the vertical eddy viscosity depends on the surface wind stress, the bottom roughness, and the flow itself; this leads to a quasi-linear equation for the determination of the surface slope or the vertically-integrated mass flux. Results are given for the simple case of a pure drift current in water of uniform depth, and these results are compared with those for a constant vertical eddy viscosity.

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