# Abstract View

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# On Wind-Driven Current and Temperature Profiles with Diurnal Period in the Oceanic Planetary Boundary Layer

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ABSTRACT

This paper describes a physically reliable model of the ocean surface layer. A Richardson-number-dependent stability function obtained from atmospheric boundary-layer data is applied to the oceanic layer. A nonstationary system of equations for motion and thermodynamics was solved numerically. The wind-driven current and water temperature profiles, with diurnal period, were obtained for various meteorological conditions.

The results show fairly good agreement with existing observational data. The present model predicts a much faster penetration of the mixed-layer current to depths greater than that of the thermocline because of a larger eddy diffusivity for momentum than for heat under stable conditions. An oceanic mixed layer is formed at night and deepens; its daily mean value is approximately proportional to the wind speed. The surface drift current is found to be about equal to the wind friction velocity. The present ratio of the surface drift current to the friction velocity is somewhat larger than that obtained by Madsen (1977) based on the assumption of a linear increase of eddy viscosity with depth. The angle between the surface drift current and the wind stress is found to be about 17° (10°–24°) which is somewhat larger than 10° obtained by Madsen, and somewhat smaller than 45° of the prediction from the classical Ekman theory based on a constant vertical eddy viscosity.

The temperature deficit of the surface skin layer can be expressed in terms of friction velocity, solar radiation, solar zenith angle and conductive heat flux at the sea surface. The diurnal range of water temperature in the top 1 m layer is dependent on the wind speed. This range is about 1°C under light winds on a clear day and about 0.1–0.3°C under moderate winds.

The general agreement between the present numerical results and available observations tends to support the basic assumption of the similarity of the stability-dependent transports of turbulent quantities in both the oceanic and atmospheric boundary layers.

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