Abstract View

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Theoretical and Experimental Study of Wind- and Wave-Induced Drift

D.T. Tsahalis

Shell Development Company, Westhollow Research Center, Houston, TX 77001

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ABSTRACT

A study has been carried out of the surface drift on open water due to the combined action of currents, winds and wind-generated waves for cocurrent and countercurrent air flow. It has been shown theoretically that the nondimensional groups necessary for the modeling of the surface drift are $(T - c)/c$ and U_{10}/c, where U_{10}, T and c are the wind, water surface and current velocities, respectively, the wind being measured at the uniquely adopted height of 10 m. Surface drift experiments, carried out in a current tank/wind tunnel, have verified the dependence on the above groups and led to the derivation of relationships for the calculation of the total surface drift. The surface drifts, calculated from the above relationships, are in excellent agreement with available field and laboratory data. The present results support Charnock's expression relating the surface roughness and shear velocity for completely rough flow due to gravity waves and Wu's Froude number scaling of wind-stress coefficients. Furthermore, the present results show that wind-generated waves generally cause a net decrease or increase of the surface drift for cocurrent and countercurrent air flow, respectively. Finally, laws have been formulated for the scaling of current tank/wind tunnel data for wind velocities and significant wave heights to prototype (atmospheric boundary layer) conditions.