A theory on the horizontal spreading of contaminants in the surf zone is described in this paper. The surf zone is viewed as a narrow strip comparable to the characteristic wavelength, in which turbulence caused by wave breaking is strong. Flows inside the surf zone consist of both oscillatory motions and a steady current induced by breaking waves. The wave field in the shoaling zone is modeled by the linear theory for monochromatic waves, and it is assumed that the breaking wave height is proportional to the local depth in the surf zone.

The simplest scenario of longshore current on a straight beach of constant slope is considered, for which the longshore current velocity is predicted by a slightly mod- ified version of Longuet-Higgins' original theory developed in the 1970s. On the basis of the estimation that the time scale of horizontal diffusion is much longer than the wave period, the perturbation method of multiple scales is applied to derive the transport equation for the advective diffusion of a solute. The total advection velocity is found to be the sum of the steady current caused by radiation stresses and a contribution from the covariance of fluctuating velocity and concentration, which is the same as the Stokes drift in periodic waves. Numerical predictions for the movement of a solute cloud released, instantaneously or continuously, in a longshore current along a plane beach are examined. The solute is found to drift shoreward in addition to the expected transport along the shore. Computed examples are presented and comparisons with available laboratory experiments are also discussed.

DOI: 10.1061/(ASCE)WW.1943-5460.0000196. 

Descargar