Abstract View

Volume 12, Issue 6 (June 1982)

Journal of Physical Oceanography
Article: pp. 501–514 | Abstract | PDF (1.73M)

Water Mixing in a Tidal Current and the Effect of Turbulence on Tidal Exchange through a Strait

Toshiyuki Awaji

Geophysical Institute, Kyoto University, Kyoto 606, Japan

(Manuscript received December 9, 1980, in final form November 9, 1981)

DOI: 10.1175/1520-0485(1982)012<0501:WMIATC>2.0.CO;2

ABSTRACT

By means of numerical calculations of the Lagrangian movement of water particles released in a turbulent tidal current during three cycles of the M_2 tide, the mechanism of tidal mixing of the inner and outer waters divided initially by a strait and the effect of turbulence on tidal exchange through the strait are studied. In the vicinity of the strait, combined with the large Stokes drift due to the spatially rapid changes of the amplitude and the phase lag of the tidal current, turbulence strongly affects the Lagrangian movement of particles. Some of initially adjacent particles moving in a turbulent tidal current have much larger drifts than the Stokes drifts (non-turbulent) and the others much smaller drifts than those. As a result, the adjacent particles released in a turbulent tidal current are widely scattered, and they are well mixed with water particles initially far apart from them, i.e., local mixing of water amplified to a great extent occurs compared with that due only to turbulence. By the interaction of a large degree of local mixing induced by the Stokes drift and turbulence in the vicinity of the strait and the dynamic process of tidal exchange through the strait, the inner and outer waters are also well mixed with each other over an extensive area around the strait. With regard to the effect of turbulence on tidal exchange between two basins connected by the strait, turbulence has a minor influence on water volume exchanged through the strait, but it has a major influence on the enlargement of sea areas affected by tidal exchange. It is also shown that the dispersion coefficient evaluated from the variance of particle spread reaches 8×10^6 cm^2 s^{-1} in the vicinity of the strait.