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The Horizontal Diffusion of Tracers by Surface Waves

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ABSTRACT

The horizontal dispersion of tracers in the presence of a random field of ocean surface waves is examined. Random fluctuations in the local Stokes-drift current cause a water particle to follow a random-walk path. The associated diffusion coefficients for individual particles, particle pairs and a continuous tracer patch can be calculated rigorously within the framework of perturbation analysis. For a fully developed Pierson-Moskowitz wave spectrum all diffusion coefficients scale as the third power of the wind speed and are typically of the order $10^{-2} \text{ m}^2 \text{ s}^{-1}$ for a wind speed of 10 m s^{-1} . The diffusion coefficients are strongly anisotropic and decrease approximately exponentially with depth below the sea surface.

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