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A Lagrangian Approach to Wave-Induced Oceanic Mass Transport

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The mean mass transport induced by surface gravity waves is investigated theoretically for a deep, rotating ocean with a constant eddy viscosity. The waves are periodic in space, and have amplitudes that grow or decay slowly in time. The analysis is based on a Lagrangian description of motion, and the results are valid to second order in the wave steepness. An equation for the wind- and wave-induced mean Lagrangian mass transport in the oceanic surface layer is derived. The mean wave-induced mass transport is driven by the form drag associated with the fluctuating wind stress normal to the wave slope. In the present formulation this consists of two terms. One of these terms is the time-derivative of the total mean horizontal wave momentum. The analysis is based on an idealized ocean with monochromatic waves. The generalization to a realistic sea, and the application to general ocean circulation models are discussed.

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