Stokes drift and vertical shear at the ocean surface: evidence and implications for upper ocean transport & mixing and remote sensing.

Authors: F. Ardhuin, E. Terrill, S. Merrifield, F. Nouguier, L. Marié & B. Chapron

Surface gravity waves are expected to cause a drift that is strongly amplified at the surface where it is of the order of 1.2% of the wind speed, but varies with the sea state, and a return flow that is more uniformly distributed over depth and is influenced by stratification (e.g. Rascle and Ardhuin JGR 2009). In practice it is very difficult to separate the wave-induced drift from the rest of the Lagrangian mean flow, and the usual estimate of the Stokes drift is an weighted sum of the surface elevation spectrum following Kenyon (1969) that generally agrees with the few estimates of the difference between the mean velocity of surface-following drifters and the mean Eulerian mean velocity near the surface. Here we review the contribution of Stokes drift to different measurement systems, from wave buoys to HF radars or near-nadir airborne Doppler radars. It is found that the Eulerian-mean velocity (in the absence of a density stratification in the top few meters) has a shear that is much weaker than that of the Stokes drift. Also, the measured fluctuations of surface drift at a time scale of a few minutes appear to be correlated to and of the order of magnitude of the Stokes drift fluctuations estimated from measured wave spectra. As the possible main source of surface shear, Stokes drift is thus an important source of near-surface turbulence, that is also enhanced by wave-current interactions.