Abstract View

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A Model of the Turbulent Diffusion of Bubbles below the Sea Surface

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ABSTRACT

Bubbles produced by breaking wind waves are carried by, turbulence below the sea surface. In an earlier model of the distribution of bubble sizes with depth it was necessary to neglect certain terms in order to formulate a differential equation which was solved numerically. A model is devised in which this procedure is avoided. Turbulence is represented by a random walk or Monte Carlo simulation, and each bubble introduced at the surface is followed and a tally kept on its changing radius. Bubbles are continually introduced until a steady state is reached, when the distributions, gas fluxes, and acoustic scattering cross-sections are calculated. The results are compared with camera observations reported by Johnson and Cooke. The major contribution to both gas flux and to the acoustic scattering cross-section per unit volume at sonar frequencies of 248 KHz (corresponding to that which we have used to observe bubbles) comes from bubbles which, at the surface, have radii between ~ 40 and 100 μm. The model successfully reproduces the variation of the total number of bubbles with depth, but fails to describe the observed shape of the size distribution. Factors contributing to this discrepancy are discussed. It is possible that bubble populations measured by floating cameras are biased because of the effects of Langmuir circulation both on the float and on the bubbles.