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Modeling bubbles and dissolved gases after a breaking-wave JUNHONG LIANG, JAMES MCWILLIAMS, UCLA, PETER SULLIVAN, NCAR, BURKARD BASCHEK, UCLA — We developed a bubble concentration model and a dissolved gas concentration model for the oceanic boundary layer. The bubble model solves a set of concentration equations for multiple gases in bubbles of different sizes, and the dissolved gas concentration model simulates the evolution of dissolved gases and dissolved inorganic carbon. The models include the effects of advection, diffusion, bubble buoyant rising, bubble size changes, gas exchange between bubbles and ambient water, and chemical reactions associated with the dissolved CO_2.To study the bubble and dissolved gas evolution after a single wave-breaking event, the model is coupled with a fluid-dynamical Direct Numerical Simulation model with spatially and temporally distributed momentum and bubble injection for a typical breaking wave. The modeled bubble size spectrum compares well with the laboratory measurements. The breaker-induced vortex not only advects the bubble-induced dissolved gas anomalies downstream, but also entrains the surface diffusion layer to greater depth. Due to the hydrostatic pressure and surface tension exerted on bubbles, bubbles do not contribute to the total air-sea gas flux when the water is at a saturation level $\sigma_m^b > 100\%$. When the actual saturation level $\sigma_m < \sigma_m^b$, the integrated bubble contribution to gas flux is dissolution. When $\sigma_m > \sigma_m^b$, bubbles add to the venting of dissolved gases.

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