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Formation of a Diurnal Thermocline in the Ocean Mixed Layer Simulated by LES

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The formation of a diurnal thermocline in the ocean mixed layer under the stabilizing buoyancy flux was simulated successfully by large eddy simulation, reproducing various features consistent with observation. The analysis of the simulation result revealed that turbulent kinetic energy (TKE) flux dominates TKE production within the mixed layer, but turbulence maintained by shear production at the thermocline causes restratification in the remnant layer. In addition, once the thermocline is formed, both the gradient and flux Richardson numbers maintain constant values at the thermocline. It was also found that a diurnal thermocline cannot be formed without wave breaking and Langmuir circulation. The effects of stratification on turbulence were investigated based on the time series of various physical variables of turbulence at the diurnal thermocline and within the mixed layer. Furthermore, it was found that the depth of a diurnal thermocline is determined by both the Monin-Obukhov length scale and the Ekman length scale.