The Parameterization of the Pressure-Strain Correlations in the Stably or Unstably Stratified Ocean Surface Layer.

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Turbulence in the ocean surface layer mixes momentum, heat, and nutrient vertically. It is therefore important for air-sea interaction, phytoplankton blooming, and other oceanic processes (e.g., Roxy et al. 2013; Obata et al. 1996). However, large-scale models such as ocean general circulation models cannot explicitly resolve small-scale turbulence because of their coarse resolution. For this reason, the vertical mixing should be parameterized using the turbulent closure scheme that successfully parameterizes the turbulent mixing. Recently, attention is paid to pressure-strain correlations, which redistribute stress due to fluctuating pressure, in the parameterization scheme used for engineering purposes (Jakilic and Hanjalic 2013). In the present study, therefore, the validity of the pressure-strain correlation parameterization used in the ocean (or atmosphere) (Rotta 1951, Gibson and Launder 1978, Gertski et al. 1992) was examined. To this end, we performed Large-eddy simulations of ocean surface boundary layer to simulate pressure-strain correlations and compared it with parameterized correlations. Here, we focused on the effects of stratification on the correlations, because the stratification is an essential factor in the ocean and atmospheric boundary layers but previous schemes did not include the stratification effects sufficiently. Results show that the parameterizations of the pressure-strain correlations had systematic errors depending on the stability (or stratification). It was also found that the error can be reduced by introducing new parameters related to the stability into the scheme.

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