Evidence of tidal straining and its influence on the bottom mixing in the East China Sea

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In the coastal region under influence of freshwater inflow, the resulting strong horizontal density gradient sometimes causes tidal straining which strongly affects the mixing in the water column. We present here the results of field observations of current, hydrology and turbulence at two selected locations in the East China Sea where strong horizontal density gradient was found.
The hydrology structures of the whole water column at Stn. P01 and within the bottom 20 m at Stn. MT1 both showed semidiurnal variations associated with the dominant M_2 tidal flow. From the analysis of the time derivative of potential energy anomaly, we proved that tidal straining played a dominant role in controlling the variation of stratification at both stations. More specifically, the tidal straining eroded and intensified the stratification depending on tidal phases. Around the time of high tides, tidal straining was found to create unstable stratification which occupied the bottom 15 m at Stn. P01 and bottom 20 m at Stn. MT1. The associated Rayleigh number was estimated to be of the order of 10^{12}, much larger than the critical value 10^3, indicating the existence of convection. On the basis of the continuous high-resolution velocity measurement near the seabed, we showed that the mixing near the seabed is locally shear-induced during most of the time except during the unstable stratification period when the magnitude of dissipation exceeded that expected from the law of the wall by an order of magnitude.
Although the additional buoyancy production added by strain-induced convection can be one of the candidates to explain this discrepancy, the buoyancy flux calculated by the balance method is shown to be too small to make up for the existing discrepancy between dissipation and shear production. Another plausible candidate is the advection of turbulent kinetic energy (TKE) which should play an important role in the TKE budget during the period of convection.

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