Performance of microstructure measurements using a deep float with a fast-response thermistor

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Vertical turbulent mixing is an important process which drives general ocean circulation and controls nutrients supply which maintains marine ecosystem. Turbulence observations need to be increased to know the temporal and spatial variability of turbulent vertical mixing. In particular, turbulence measurements in the deep ocean or near the bottom are necessary because of the scarceness of the observations. Autonomous microstructure observations will not only enable us to measure abyssal turbulence but also yield time-series in winter which is difficult to obtain because of rough weather through ship-based measurements. In order to make use of the observed microstructure data using floats, vibrational impacts caused by active motors and uncertainty of measurements under weak turbulence in the deep ocean have to be considered. An observation with a recently developed deep float with turbulence sensors was firstly carried out in the North Pacific off Tohoku. In the present study, we attempted to develop a method to estimate turbulence intensity using fast-response thermistors attached to floats which are less sensitive to vibration from the action of motors to adjust float buoyancy. In particular, to estimate weak turbulence in the deep ocean and near-bottom enhanced turbulence, we try to estimate effects of both basic (including electric noise) and vibrational noise on turbulent kinetic energy dissipation rates and temperature dissipation rates . The frequency response of the basic noise which is inherent to the sensor and the instrument is evaluated. Unrealistically large and remain when the float starts to ascend even after the subtraction of the basic noise. This overestimation is evident when the ascending speed was small and the motor vibration was active for acceleration. This overestimate was proportional to , and this relation is successfully explained by the vibrational noise generated by high-frequency vertical motion of the instrument under the vertical gradient of ocean temperature. Because the float does not directly measure vertical vibration, noise model is used to estimate the noise level from vertical vibration, and the noise level is showed to be proportional to the measured horizontal vibration. By subtracting the vibrational noise computed from the horizontal vibrational data and by considering the dependence on ascending speed, turbulence data in abyssal ocean or near ocean bottom is corrected. The present study is the first study which discusses the effect of vibration on the turbulence estimation using fast-response thermistors. This study contributes to improving turbulence measurements by indicating the importance to attach vertical vibrational sensors to floats and by proposing effective methods to obtain turbulence data using fast-response thermistors which can be applied to gliders, CTDs or any other non-freefall platforms.

Keywords: turbulent mixing, deep float

