高速水温計を用いたCTDフレーム搭載型乱流観測の有用性検証

Availability of turbulence measurements using a microstructure profiler attached to a CTD frame

*Goto Yasutaka[1]、安田 一郎[1]、長澤 真樹[1]
*Yasutaka Goto[1], Ichiro Yasuda[1], Maki Nagasawa[1]

1.東京大学大気海洋研究所
1.Atmosphere and Ocean Research Institute The University of Tokyo

Turbulence observations have been limited because of difficulty in microstructure measurements. In order to efficiently obtain much more turbulence data down to the ocean floor without spending extra ship-time, we propose a new method, a microstructure profiler attached to a CTD-frame. Since microstructure measurements of velocity shear are sensitive and fragile to vibration of the instruments, measurements have been performed with free-fall or free-rise instruments. The profiler attached to the CTD-frame can't suppress vibrations. So the authors choose fast-response thermistors to measure micro temperature fields, less sensitive to vibrations than velocity fields. However, turbulence data from thermistors have not been common due to their insufficient temporal resolutions: High frequency components of a temperature spectrum are attenuated. In the present study, to overcome this deficiency, correction procedures for thermistor observations are firstly devised by comparing concurrently obtained energy dissipation rate εestimated from thermistors and velocity shear probes attached to a free-fall profiler. εestimated from thermistors by applying frequency correction assuming a single-pole low-pass filter function has bias which strongly depends on turbulence intensity. The correction with the form of double-pole low-pass filter derives less bias, and 3x10-3[s] of the time constant is found to be the best match withε from the shear probe. Next, this correction is applied to temperature spectra obtained from thermistors attached to the CTD-frame, and the turbulence intensity is compared with data from the free-fall profiler conducted at the same locations within 2 hours. Most of them are compatible, however, some εfrom the CTD-attached method overestimate when the variation of the fall speed of the CTD-frame, (dW/dz)/W, is large. Large (dW/dz)/W corresponds to violation of the shape of the temperature gradient spectrum in high wavenumber ranges, which makes spectrum peak obscure and possibly causes overestimation. This result indicates that large (dW/dz)/W collapses the Taylor hypothesis and turbulent eddies can't be resolved. Turbulence intensity estimated from free-fall and CTD-attached thermistors reasonably agree by rejecting spectra with unclear peaks, and spectra with (dW/dz)/W>0.3, where violations of spectra expand to peaks at higher wavenumbers. In future, turbulence observations are expected to expand widely by applying the present method to ship observations and to floats equipped with thermistors.

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