GPS-音響測距観測の短周期変動と海中内部重力波について
On the short-period fluctuation of GPS-Acoustic measurement and underwater internal gravity wave

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GPS-acoustic (GPS-A) measurement is usually carried out for geodetic purposes to detect seafloor movement relevant to earthquake generation. However, it also measures or estimates sound speed in ocean for accurate underwater acoustic ranging. Although the sound speed is generally treated as average or integrated quantity in the GPS-A measurement, it has an ability to provide oceanographic information such as seafloor pressure together with information on sea surface height for calibration of Ocean Bottom Pressure Gauges (OBPGs). GPS-A measurement is especially sensitive to short period (shorter than semidiurnal) fluctuation of sound speed structure relative to a certain reference state, which is often ignored in oceanographic point of view. Most of such fluctuation is considered to be originated in internal gravity wave, which excites vertical oscillation at a certain depth extent in a water column. The amplitude of the oscillation generally reaches to a couple to several tens meters, which produce non-negligible change in average sound speed quantity through a water column. In this study, we demonstrate the existence of short period fluctuation using intensive XBT profilings. Then vertical oscillation in the profiles are extracted to evaluate the contribution of internal gravity wave. Such intensive measurement, however, is limited to short time. Therefore we examine that GPS-A measurement alone can monitor such a oscillation on behalf of intensive XBT measurement.

We employed two time-scales of observations of XBT profiling at Kumano-nada region in the west of Japan. The first one is for semi-diurnal variation associated with M2 tidal internal wave. The measured interval is every 6 hours lasting for 2 days, which clearly shows vertical oscillation of 20-50m amplitude. In the traveltime of the concurrent GPS-A measurement also shows coherent variation, which demonstrated that GPS-A can properly resolve such timescale of oscillation. The second example is for short period (~0.5-1 hours) fluctuation. XBT profiling was carried out every 10 minute lasting for 2 hours. Even such a short period fluctuation, vertical oscillation of the profile is clearly visible and coherent variation of GPS-A derived traveltime was also observed. The results encourage the use of GPS-A data to configure a snapshot of single XBT (or CTD) profiling to for time-averaged quantity. And it also pointed out that the precise profile can be changed during a single CTD cast.

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