Glider observation in the Bussol Strait

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Introduction

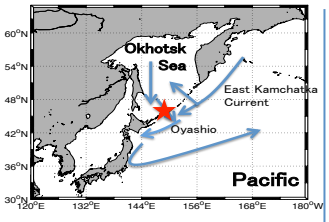
・Water exchange between the Okhotsk Sea & Pacific

→Origin of the North Pacific Intermediate Water (NPIW, e.g. Yasuda, 1997)

・Strong diurnal tide (e.g. Katsumata et al. 2004, right fig.)

・Strong diapycnal mixing (e.g. Yagi & Yasuda 2012)

・Important for the water-mass formation (Nakamura et al. 2004), ocean circulation (Kawasaki & Hasumi, 2010), biogeochemical cycling (Nishioka et al. 2013), and climate (Tanaka et al.2012) in the North Pacific

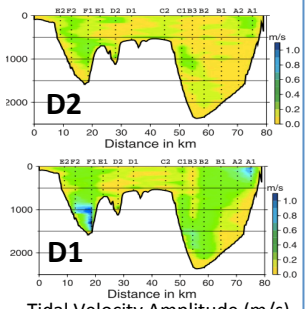


Bussol Strait(★)

・The largest strait in the Kuril Island

・About 8 Sv outflow to Pacific

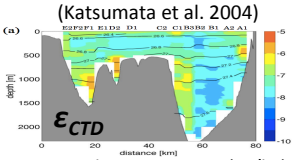
・Strong diurnal trapped wave can cause strong mixing at depth (Yagi et al. 2012; 2014)



Tidal Velocity Amplitude (m/s) (Katsumata et al. 2004)

Motivation

・To confirm the tidal fluctuations in the Bussol Strait using a glider



Energy dissipation rate (W/kg) @ Bussol Strait (Yagi et al. 2014)

Data & Methods

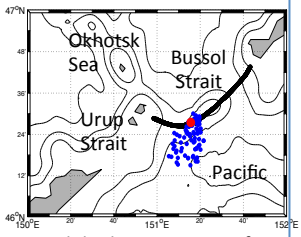
・**R/V Prof. Multanovskiy Cruise in 2014 Jun.**

・Glider Obs. (9-24th)

・equipped with a CTD sensor (Sea-Bird 41cp pumped), a DO sensor (Rinko-Ⅱ), a turbulence sensors (Micro Rider-1000), and a ADCP (RDI).

・186 dives & climbs

・4-5 h / 1000 m dive & climb



Glider locations @ surface

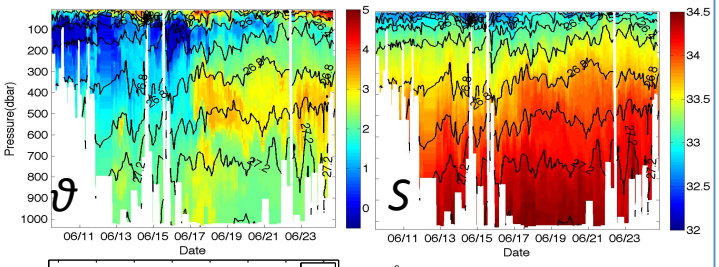
・Harmonic Analysis

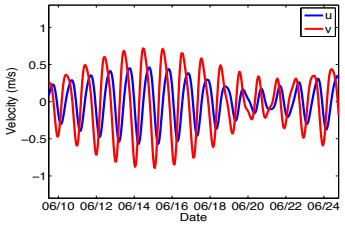
・harmonic fit (D1 & D2 period) during 2 days moving window

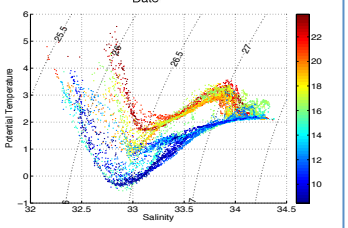
$\rightarrow \sigma_\theta'(t,z) = \sigma_\theta(t,z) - \langle\sigma_\theta\rangle_{2days}(z)$

$= A_{D1} \times \cos(\omega_{D1}t - \varphi_{D1}) + A_{D2} \times \cos(\omega_{D2}t - \varphi_{D2})$

Results: TS

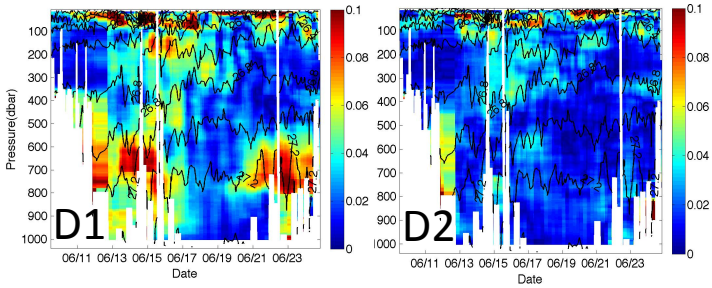






Barotropic tide (23.4° counterclockwise rotated) (Egbert and Erofeeva, 2002)

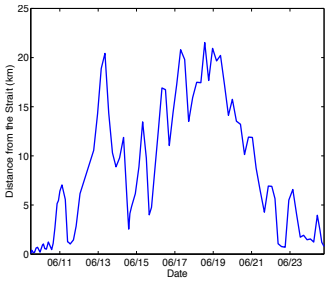
Results: Harmonic Analysis



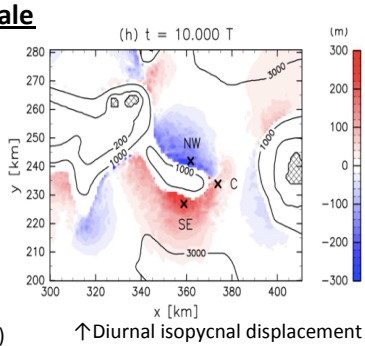
・Large amplitude of D1 at deeper depth (~0.1 kg/m^3) consistent with previous observation in 2012 (Tanaka et al., 2014)

・Large amplitude of D2 at shallower depth (~0.04 kg/m^3) consistent with the rapid velocity fluctuation @15-17th

Discussions: Trapped scale



↑Distance from the Strait (km)



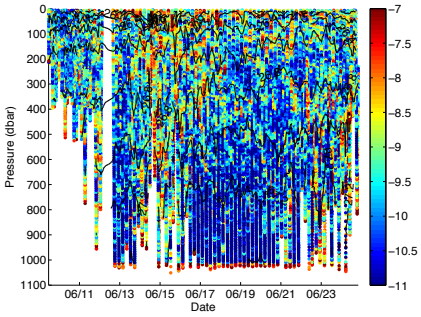
↑Diurnal isopycnal displacement from numerical model (Tanaka et al. 2010)

・Small amplitude of D1 @6/17~6/21 period of being away from the topography

estimated trapping scale: 10km

→consistent with the regional tidal model (Tanaka et al., 2014)

Discussions: Relation to turbulent mixing



Seems that strong mixing corresponds to the large diurnal fluctuations

→needs more screening for turbulence data

Summary

・Large density diurnal and semidiurnal fluctuations consistent with the behavior of internal tides at sub- and super-inertial frequencies

・Relationship between the density fluctuations and turbulence will be further investigated in the future

Acknowledgement

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