Mixing Observations in the Major Inflow of the Taiwan Stait : Penghu Channel

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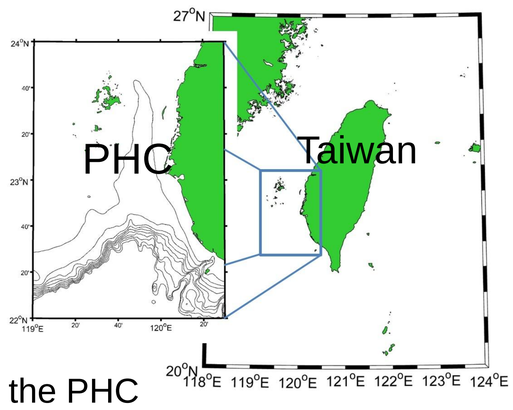
Introduction

- **Scientific Background**
  - A. Penghu Channel(PHC) has the characteristics of a canyon. Swift flow (M2 dominated) exists constantly in the PHC.
  - B. Canyon terrain will increase the mixing of internal tide or transmission of energy. Strong turbulence is generated in the bottom boundary layer(BBL).
  - C. Affected by the boundary, turbulence in the continental shelf or continental slope is bigger than in the open ocean.

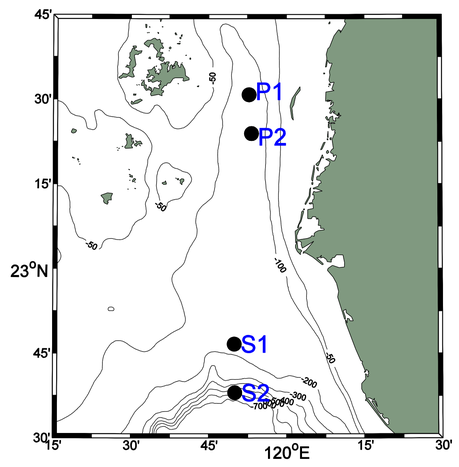
The turbulence package with CTD



- **Goal**
  To find out the mechanism for the unusual BBL structure in the PHC
- **Working hypothesis**
  The internal tide generates large BBL mixing in the PHC

Method and Mathematical

Yr / Mon	Station	Measurements
2011 / 09	P1	2 hour interval, a total of 11 casts
2012 / 03	P2	2 hr interval for the first 24 hours, then one hr interval for the remaining period. a total of 26 casts
2012 / 09	S1	1.5-2 hr interval, a total of 33 casts
	S2	



Dissipation rate of Temperature Variance (χ)

$$\chi = 6D\overline{\left(\frac{\partial T'}{\partial z}\right)^2} = 6D\int_0^\infty \Psi_t(\hat{k})\,d\hat{k}$$

$\Psi_t(\hat{k})$: wavenumber spectrum of temperature gradient
$\hat{k}$: wavenumber
D : thermal diffusivity

Open Ocean: $\chi \sim 10^{-7}$ K²/s
Internal Wave: $\chi \sim 10^{-2}$ K²/s

Instrumentation

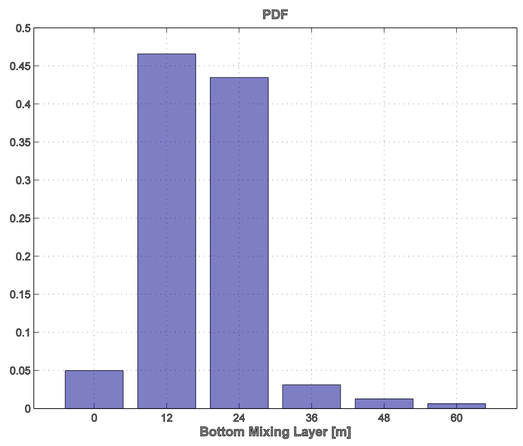
- ADCP, CTD, Microstructure

Result and Discussion

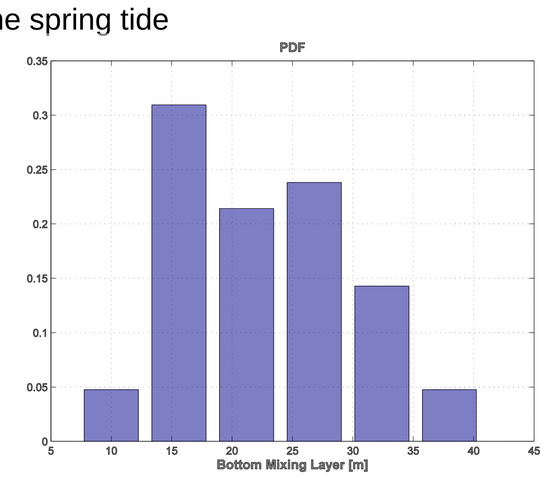
a) Large Overturning in the Bottom Mixing Layer on station P1 and P2

Distribution of Bottom thickness

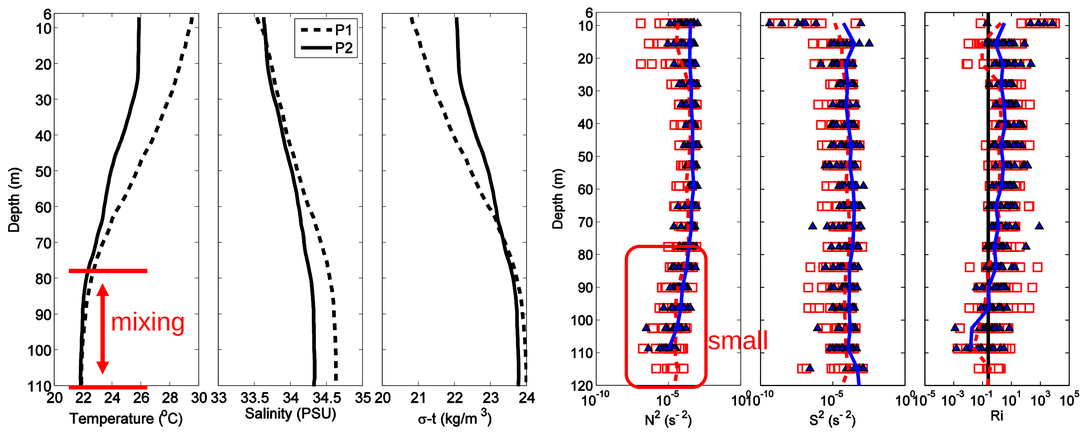
Historical hydrological data



Observation on station P1 and P2 during the spring tide



Vertical Profile of -



b) Tidal Current enhance the Turbulence in PHC

Estimate and compare U^3 (blue line) with chi (red line)

Chi VS. Time

c) Internal Tide occur in the Continental Margin

CEOF of V

	Barotropic	Baroclinic
P1 and P2	88%	10%
S1	75%	20%
S2	42%	50%

Internal tide

Velocity (V) profile VS. Time

Conclusion

a) Large overturning in the BBL was found at P1 and P2. The scale of overturning is about 20~40 meters.

b) Tidal currents enhance the turbulence in the BBL, with maximum current speed of 1.8m/s and a dissipation rate of temperature variance at the order of 10^{-3} K²/s.

c) Internal tide was present in the continental shelf and continental slope, but not all transmit to the PHC. Large barotropic current impact the BBL in the PHC.

d) Estimate the dissipation rate of temperature variance may not be a good value but it provides us with another way to observe the turbulent