A review of Japanese PX-40 -16 years with *T/V Miyagi Maru* -

Shoichi Kizu (Tohoku University, Japan)

Co-work with Yasushi Yoshikawa (JAMSTEC) Kimio Hanawa (Tohoku University)

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SIO High Resolution XBT/XCTD **Network Site** Home Introduction 10m file info 60°N Pacific- active **PX05** 40°N PX06/09 **PX30** X41 **PX34** 20°N PX37 PX05 PX37-South 0° **PX38 PX40 PX44** 20°S PX06 **Pacific-inactive** PX50 PX06-Loop 40°S PX38 USA-SIO AX22 USA-SIO **PX08** IX15/21 USA-SIØ/AUS/SAF PX08 USA-SIO PX30 AUS/USA-SIO PX40 USA-SIO/JAPAN **PX10** AUS/FR/USA-SIO PX09 USA-SIO PX31 USA-SIO PX44 USA-SIO IX28 PX34 AUS/NZ/USA-SIO AX22 60°S PX05 USA-SIO PX10 USA-SIO PX50 USA-SIO PX25 USA-SIO/NZ PX37/PX37S USA-SIO USA-SIO/CHILE PX06 PX81 **PX50** 120°E 40°E 80°E 160°E 160°W 120°W 80°W PX81 Atlantic- active Scripps Institution of Oceanography (SIO) is part of the University of California San Diego (UCSD) AX22 Send questions and suggestions to web@www-hrx.ucsd.edu

Indian- active

http://www-hrx.ucsd.edu/

Earlier experience

TOLEX (Tokyo-Ogasawara Line Experiment)



- Started by Prof. Kimio Hanawa in 1988
- Tokyo Chichijima (Bonin Is.)
- Ogasawara Maru (Passenger-Cargo Ship)
- Partnership with JAMSTEC
- Aug 1988 Mar 2005 **90 transects**

- Every two months
- Every about 30 min in latitude (10 min in Kurosh)
- ADCP (130 kHz, 1991-2005)
- Had to quit due to national policy



TOLEX (Tokyo-Ogasawara Line Experiment)



Overview

- Hawaii Japan
- Oct 1998 June 2014
- Initially named "JAHMP", labelled as PX40 in 2002
- > XBT (mostly TSK T-7, see the following slides)
- 150 kHz ADCP (2003 -)

Japan-Hawaii Monitoring Program (JAHMP)

New data (June 2014) added.

- General Information
- History of JAHMP
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JAHMP (Japan-Hawaii Monitoring Program) is a research project by Physical Oceanography Laboratory of Tohoku University, and is enabled by courtesy of Miyagi Prefecture and the crew of *Miyagi Maru*.



Platform: T/V Miyagi Maru

- ✓ Training vessel owned by Miyagi Prefecture
- ✓ Operated for students in two local high schools for fishery
- ✓ Runs three far-ocean training cruises per year to near Hawaii
- Miyagi Maru (4th) Oct 1998 Dec 2002



497 t

Miyari Maru (5th) Jun 2003 – Jun 2014



650 t

XBT system

Probes

TSK T-7 (Oct 1998 - Jun 2013, and part of Jun 2014) XCTD-1 (2000-2008, replacing part of TSK T-7) Sippican DB (Nov 2013, Mar 2014, and most of Jun 2014)

> Launcher

Handheld launcher (LM-3A)

*) Auto-launcher was not allowed by the ship.

Deck units

Murayama Denki Z-60-16 II (1998 – 1999) TSK MK-130 (2000-2014)

≻ FRE

H95 throughout the period

Resolution

Spatial

every 30 min in longitude (160W – 140E, nominally 121 pts)

> Temporal

3 times per year (nominally)

*) uses the return leg of the ship's far-ocean training cruises.

*) one transect needed 11-12 days.

nsec	ts	JAHMP (PX40) Cruises							October-Decembe				
Year J	Jan	Fob	Mar	Apr	May	lun	hul	Aug	Sep	Oct	Nov	Dec	
1998		<mark>Ma</mark>	irch:	14	<mark>ر ا</mark>	une:	<u> </u>			9810			
1999			9903			9906				9910			
2000			0003			0006				0010			
2001			0103			0106				0110			
2002			0203			0206				0210		0212	
2003						0306					0311		
2004			0403			0406				0410			
2005			0503			0506	All realizations except the last three transects were made solely by TSK T-7.				0511		
2006			0603			0606					0611		
2007			0703			0706					0711		
2008			0803			0806					0811		
2009			0803			0906					0911		
2010			1003			1006					1011		
2011			1103			1107				1110			
2012			1203			1206							
2013						1306					1311		
2014			1403)		1406							

Total : 46

Supported by AOML/NOAA (Sippican DB). "1406" is "mixed".

Difficulties / Problems

> Cost

3.5-4 Million JPY (35,000-40,000 USD) per year for the probes only

- Unstable tracks (sea condition, accidents, operational policy, etc.)
- Incomplete transects, insufficient sampling for WBC (i.e. Kuroshio)



Good example



A very happy case. The ship ran almost straightly from Hawaii to Japan (more specifically, to Misaki at this time).



Bad example – incomplete transect



An unhappy case. The ship met rough sea, which often occurred near Japan in spring/autumn cruises. The crew had to give up launching the XBTs for their safety.



Bad example – unstable track



An unhappy case. The ship got some accident and had to change the course of their cruise. This case was for injury, but there were also cases when the US Coast Guard did not allow the ship to visit Hawaii for safety reason.



High variability, low sampling

- > Only 3 transects a year, and unstable ship track
- > 30 min resolution (in longitude) 🔶 insufficient for resolving Kuroshio



Qiu and Chen, 2005, JGR

Comparison of satellite-derived current products by AVISO and ADCP measurements along the line of Japan-Hawaii Monitoring Program

Shoichi Kizu⁽¹⁾, Kimio Hanawa⁽¹⁾, and Yasushi Yoshikawa⁽²⁾

(Abstract)

((1) Tohoku University, (2) JAMSTEC)

Tohoku University and JAMSTEC have started ocean current measurement of the western North Pacific since 2003 by installing a 130kHz acoustic Doppler current profiler (ADCP) on a fishery training ship *Miyagi Maru*, as a part of the Japan-Hawaii Monitoring Program. The ship cruises three times a year (Apr-Jun, Oct-Nov, Jan-Mar) between Japan and Hawaii.

The surface current by ADCP is compared to sea surface height anomaly (SSHA) and absolute geostrophic current (AGC) product derived by joint satellite altimetry and distributed by AVISO. Both of SSHA and AGC show very good agreement with ADCP measurement in the Kuroshio Extension (KE) region where the western boundary current and well-developed eddies dominate. Although the number of cruises available for the comparison is still small, this results support the reliability of not only SSHA but also AGC product by AVISO in this region.



Miyagi-Maru : Training ship of Miyagi Pref., Japan (650t, 64m length)



@WPGM 2006

Accident which struck T/V Ehime Maru

February 2001



Anger After U.S. Sub Sinks Japanese Boat

By ABC NEWS Feb. 10



As rescuers continue to search for nine Japanese still missing after their fishing sunk by a surfacing U.S. Navy submarine, officials are trying to understand how a accident could have happened.

Nine Japanese are still missing — four 17-year-old students, two teachers, and th members.

Twenty-six survivors were found stranded amid debris Friday, huddled in three li

The 499-ton Japanese trawler was carrying 35 people, including 13 high-school students and two teachers, when it was hit and critically damaged Friday by a 6, U.S. Navy attack sub about nine miles from Honolulu's Pearl Harbor, officials said.

The Japanese boat sank in just minutes, leaving only an oil slick, rafts, and scattered debris by the time Coast Guard rescuers arrived on the scene.

http://abcnews.go.com/US/story?id=94115&page=1



T/V Ehime Maru, sunk by a US submarine on 10 Feb 2001 (JST), off Hawaii.

9 crew (incl. 4 students) were killed, and more injured.

The operation of similar training vessels (incl. *Miyagi Maru*) has been badly changed after that.



Japan-Hawaii Monitoring Program



Giant quake on Mar 11, 2011 (Mw=9.0)



Sendai Station Where I live



Sendai Airport





One of the two high schools which has been using the ship is still not recovered.



Technical fruits

Surface transient identified in winter mixed layer (ML)



(Kizu and Hanawa, 2002a)

Technical fruits : Bowing

Near surface temperature profiles in winter mixed layer (ML)



(Kizu and Hanawa, 2002b)

Technical fruits : Bowing



Side-by-side XBT/CTD comparison (**not from PX40**)

(Kizu and Hanawa, 2002b)

Oceanographic fruits (Uehara, Kizu, Hanawa, Yoshikawa, Roemmich, 2008)

Estimation of heat and freshwater transports in the North Pacific using high-resolution expendable bathythermograph data

Hiroki Uehara,^{1,2} Shoichi Kizu,¹ Kimio Hanawa,¹ Yasushi Yoshikawa,³ and Dean Roemmich⁴

Received 16 February 2007; revised 6 August 2007; accepted 17 September 2007; published 15 February 2008.



Oceanographic fruits (Uehara, Kizu, Hanawa, Yoshikawa, Roemmich, 2008)



Oceanographic fruits

Nagano, A., Ichikawa, H., Yoshikawa, Y., Kizu, S., Hanawa, K. (2012): Variation of the southward interior flow of the North Pacific subtropical gyre, as revealed by a repeat hydrographic survey. *J. Oceanogr.*, DOI 10.1007/s10872-012-0102-3

Nagano, A., Kizu, S., Hanawa, K., Roemmich, D. (2016?): Heat transport variation due to change of North Pacific subtropical gyre interior flow during 1993-2012, *Clim. Dyn.*, (just accepted!)



Coming up tomorrow.

New generation of PX40

Between Hawaii and Yokohama, by SIO



PX40 Cruises:												
year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012											1211	
2013	1301			1304			1307					1312
2014		1402			1405	1406		1408			1411	
2015	1501			1504		1506			1509			
2016				1604		1606						

Click here to go to Japan-Hawaii Monitoring Program (JAHMP) website for more PX40 data (note you will leave the www-hrx.ucsd.edu website).

JRS CANIS (7545t)