

Seafloor Geodetic Survey in Taiwan - A Progress Report

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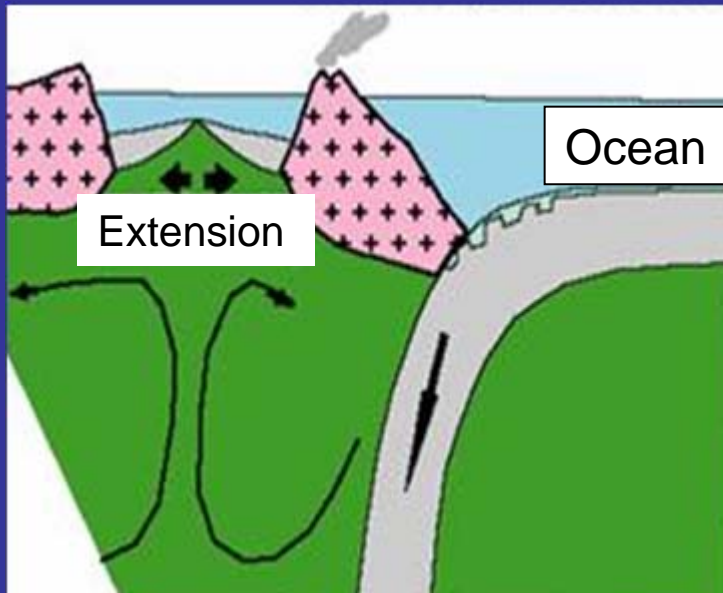
Cheng-Horng Lin



Yoko Tu

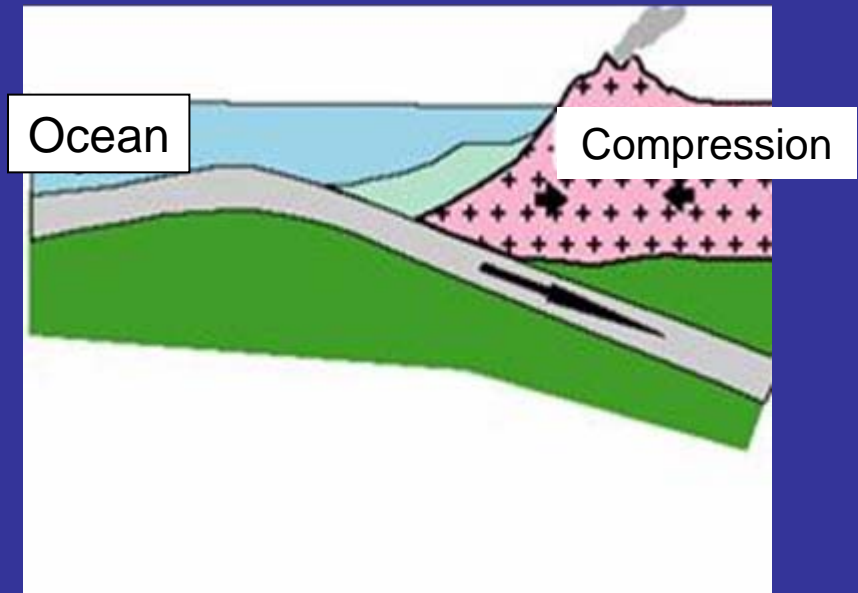
Ryukyu is "Mariana type" subduction?

Mariana type



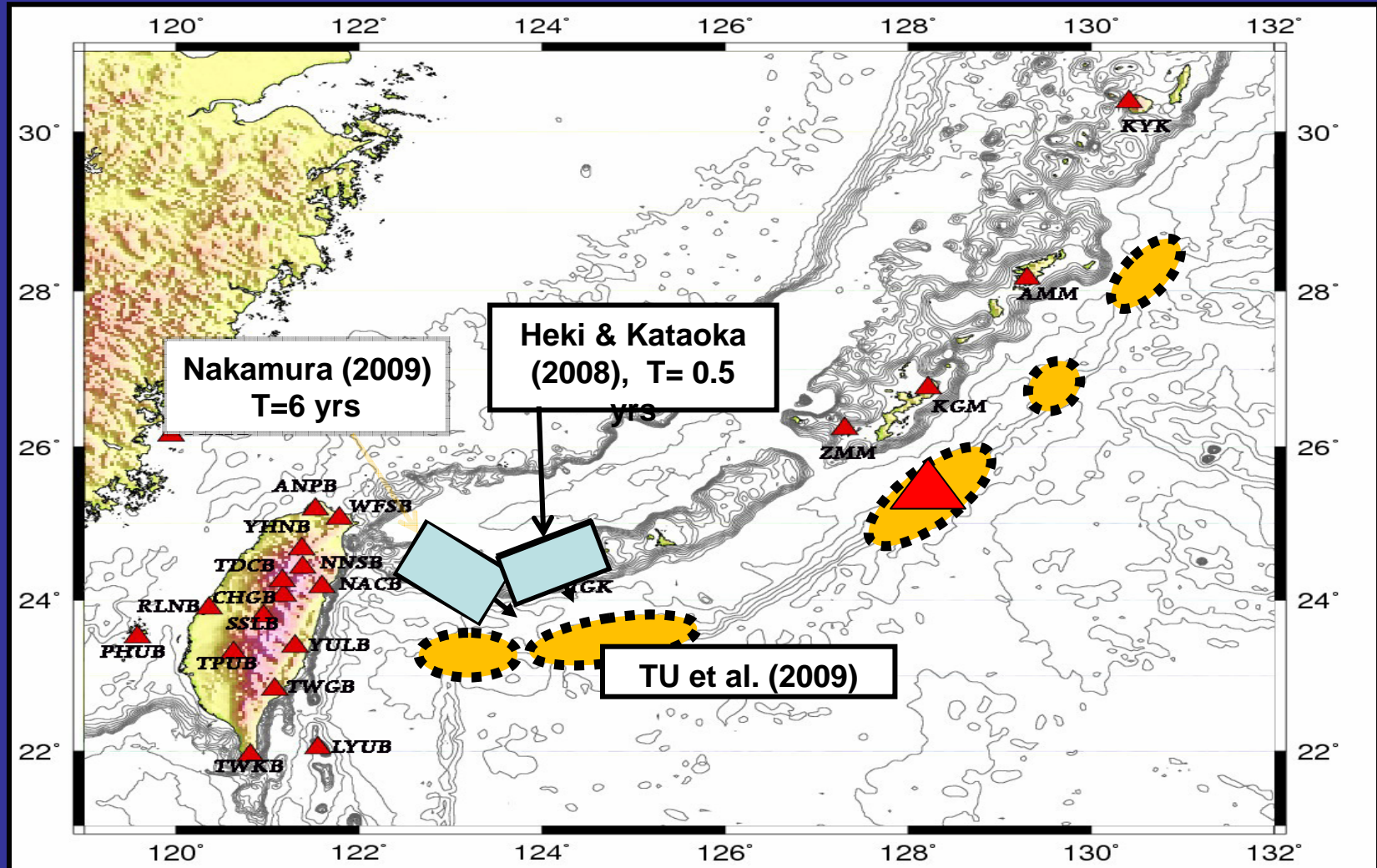
No large thrust earthquake
Back-arc spreading

Chilean type

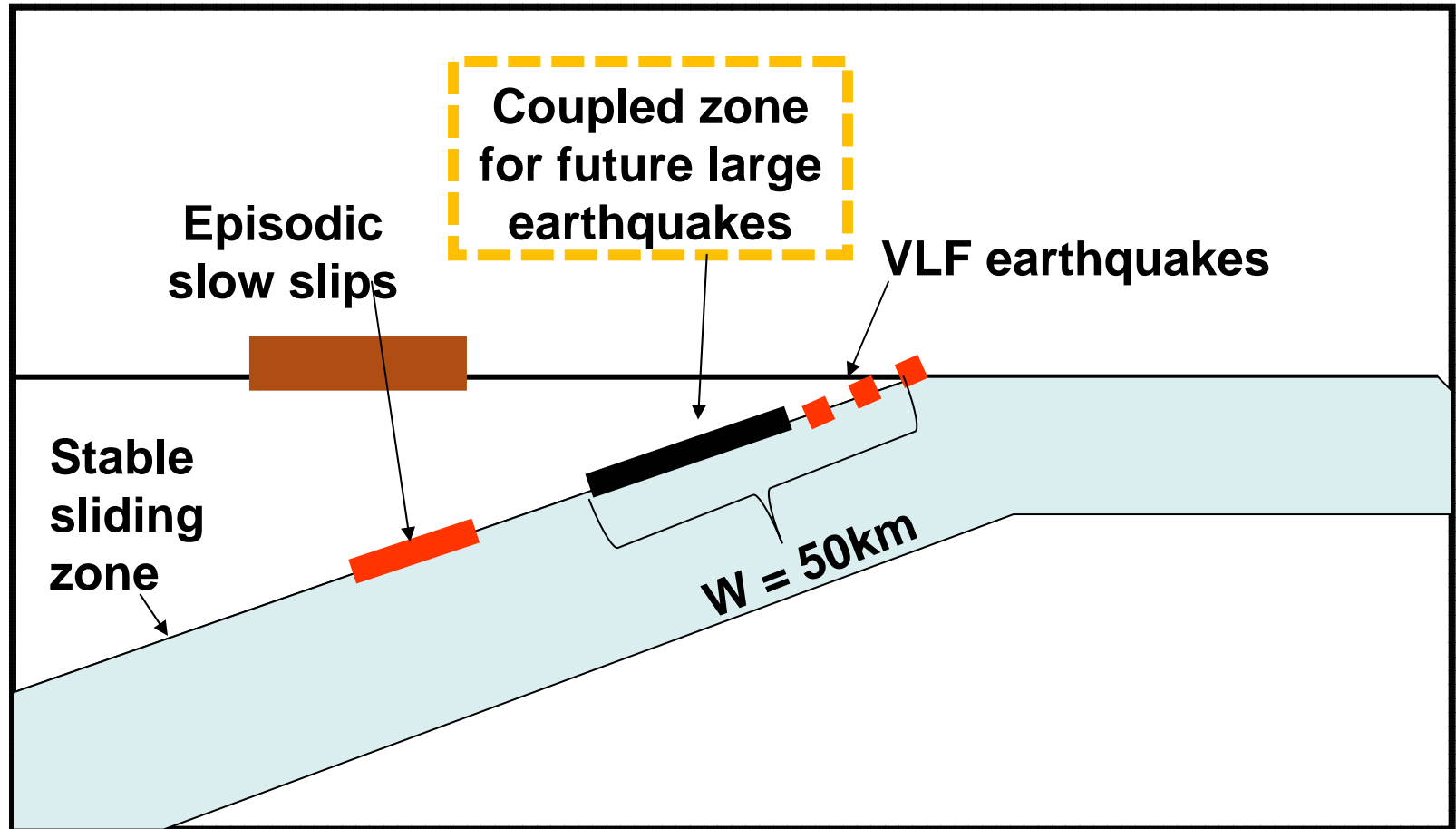


Large thrust earthquake

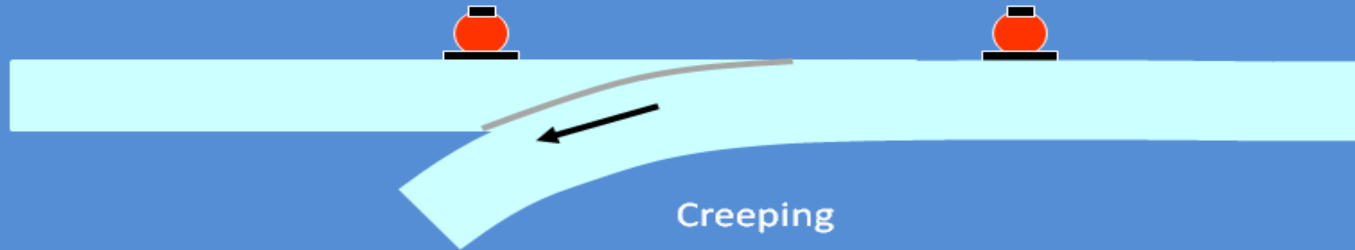
Very Low Frequency Earthquakes and Slow Slips, suggesting the western Ryukyu subduction is locked



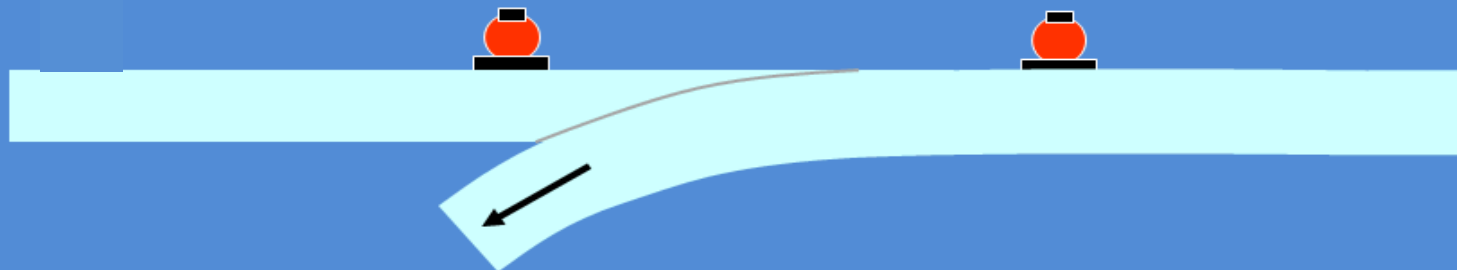
Schematic of the plate interface at the Ryukyu convergent boundary



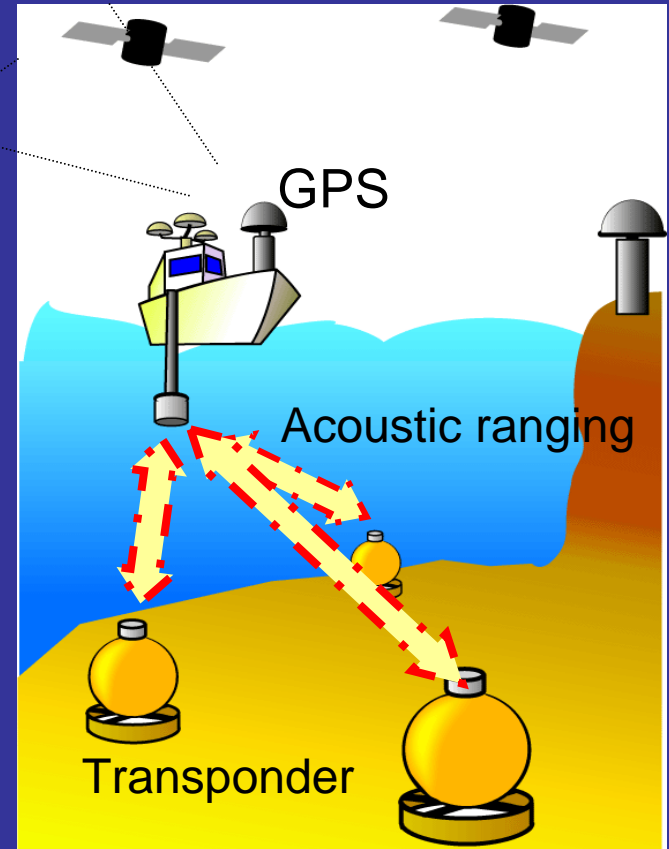
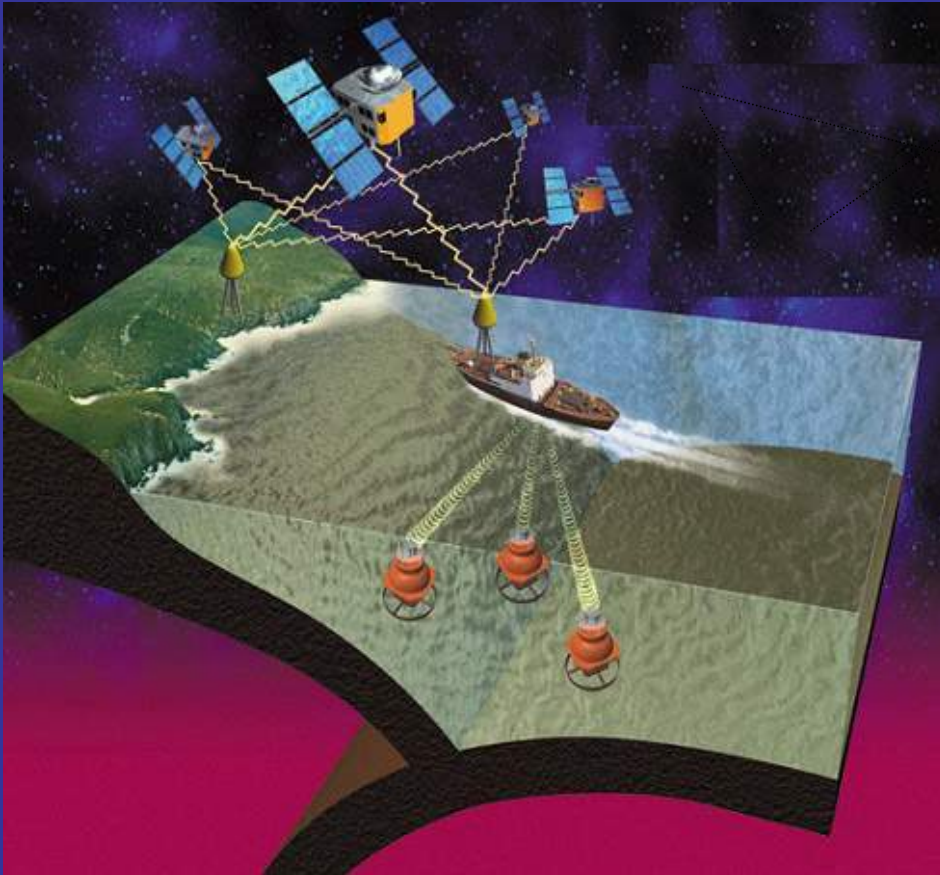
Decoupled, Unlocked, Aseismic



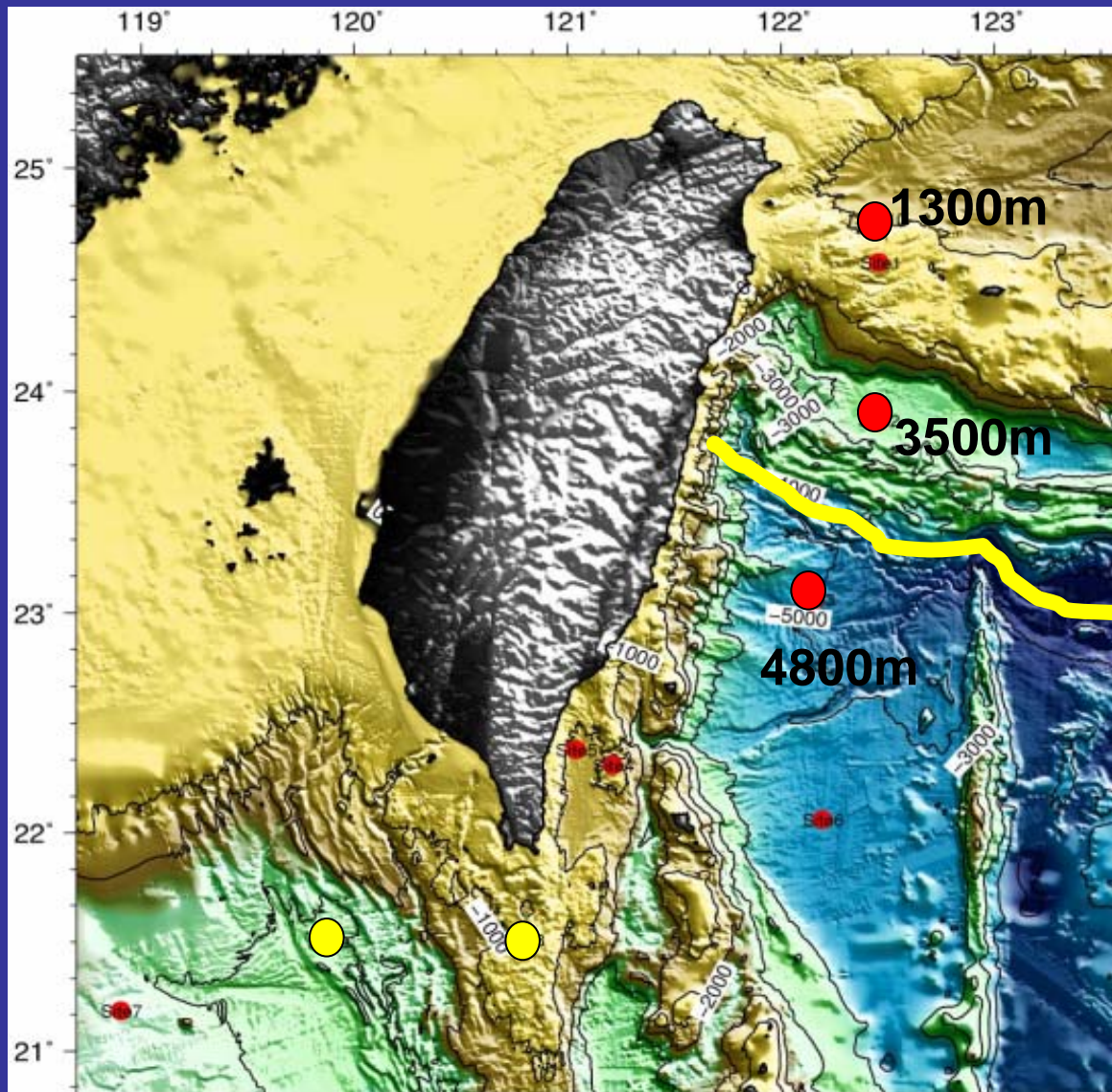
Coupled, Locked, Seismic



Seafloor Geodetic Survey



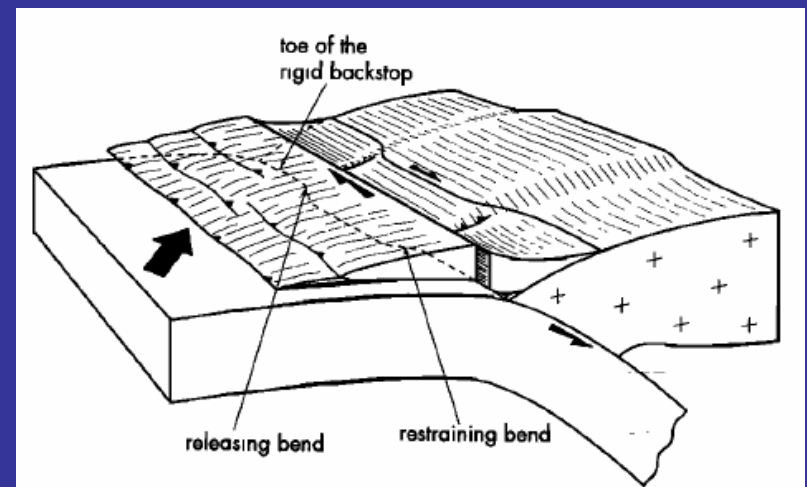
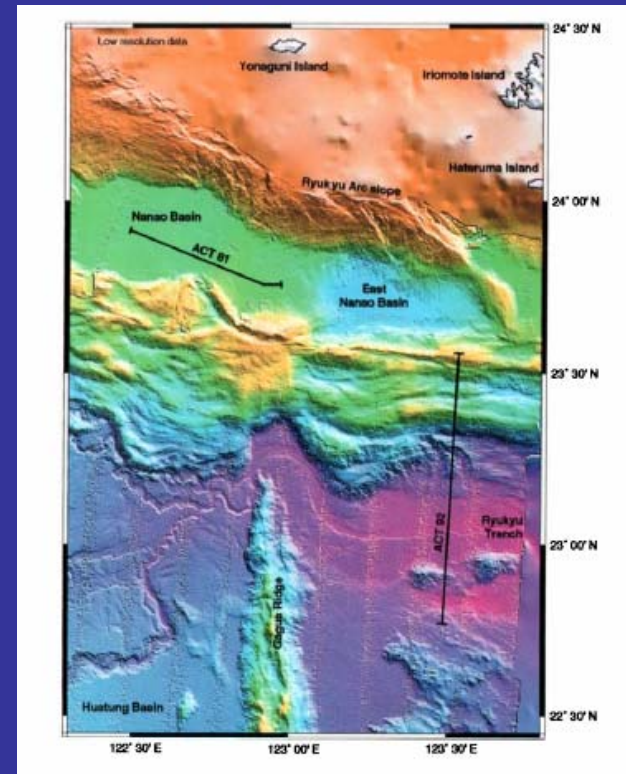
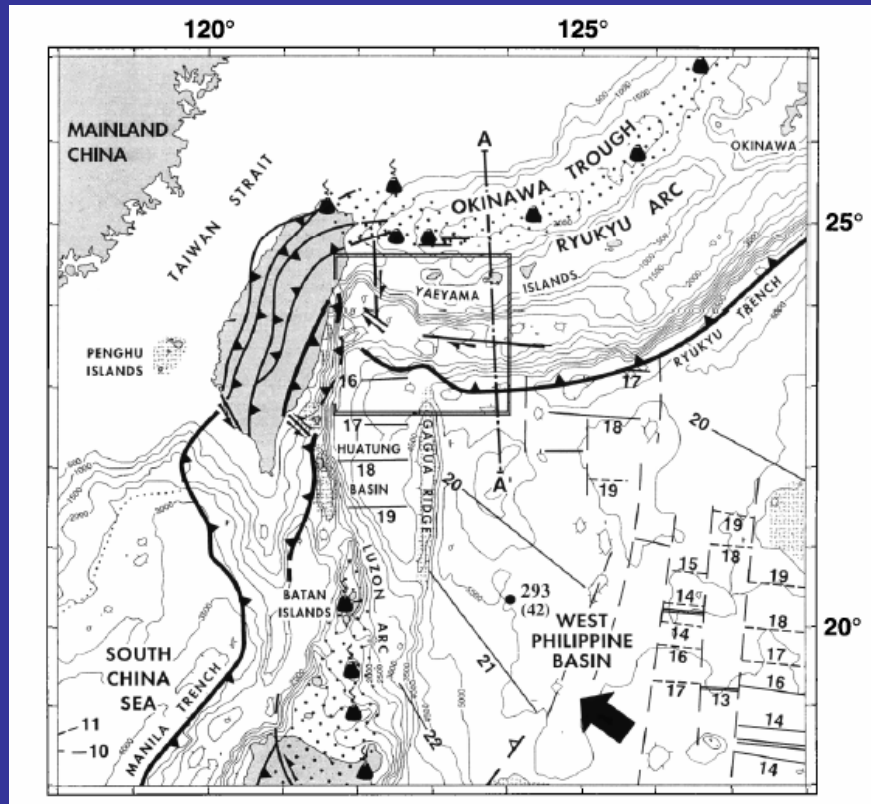
Seafloor geodetic observation sites



● Existing

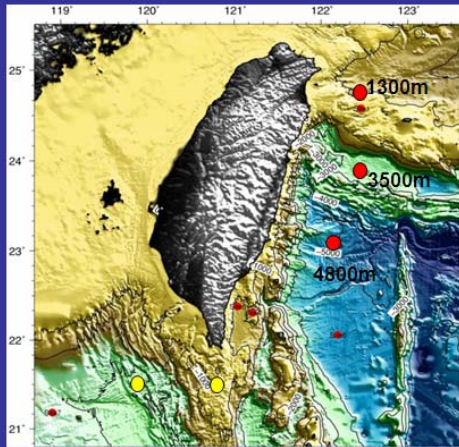
● Planning






















Lateral migration of the accretionary wedge in the southern Ryukyus



Lallemand et al. (1999)

Schedule of seafloor geodetic surveys in Taiwan



	2008		2009		2010	
Ilan 宜蘭沖			3 4 9	  	  	  
Hualien 花蓮沖		6 7 8	  	  	  	
Chenggong 成功沖				10 11 13	  	

Transponder deployment

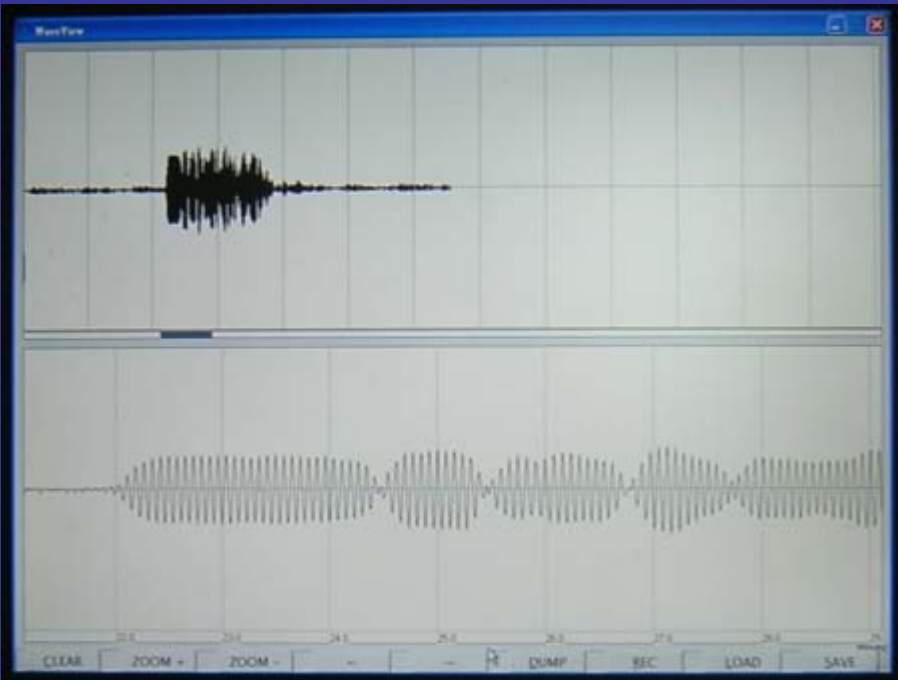
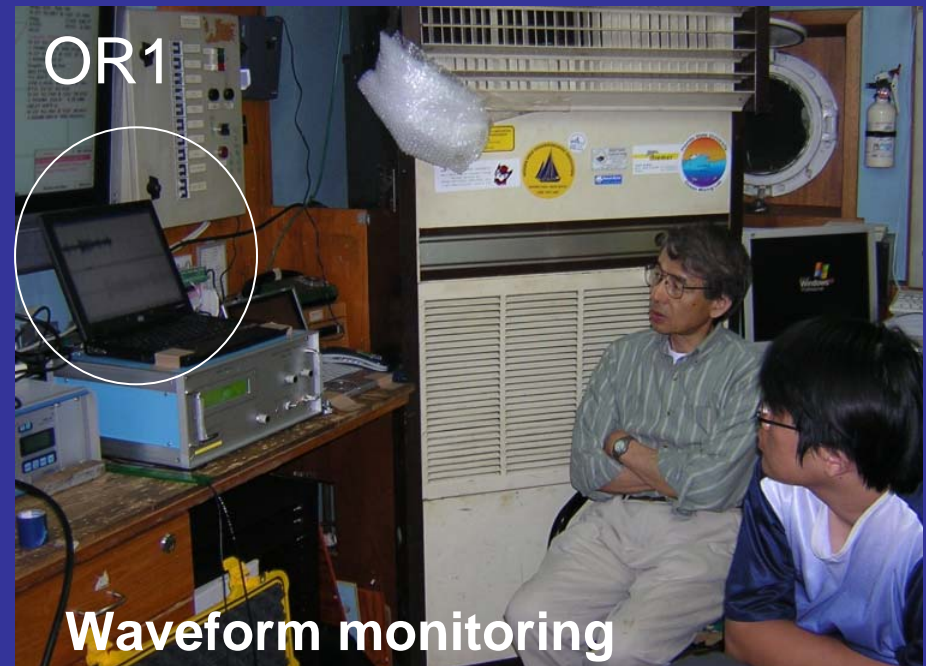
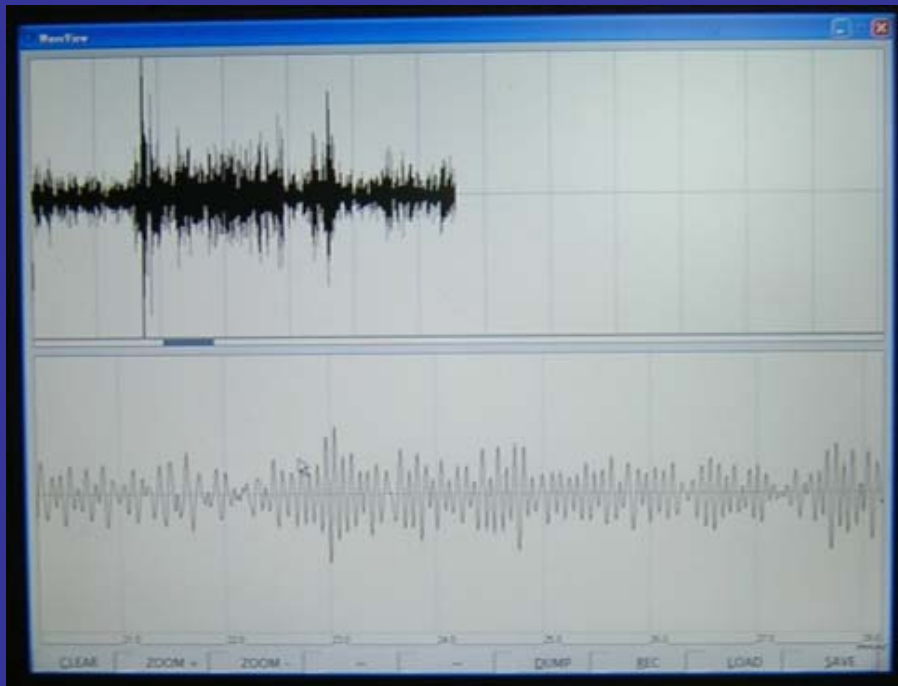


OR1



Buoy



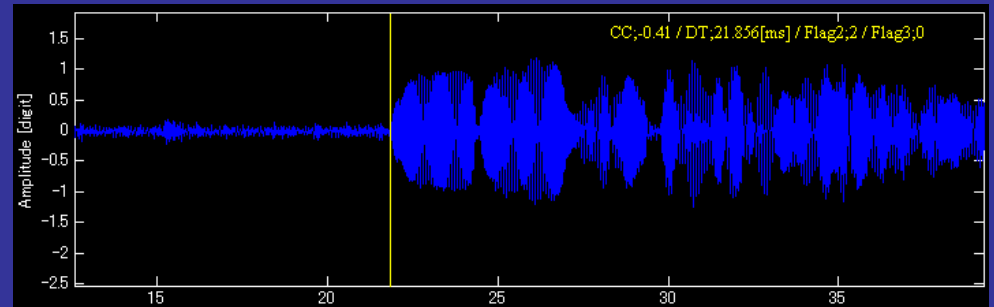
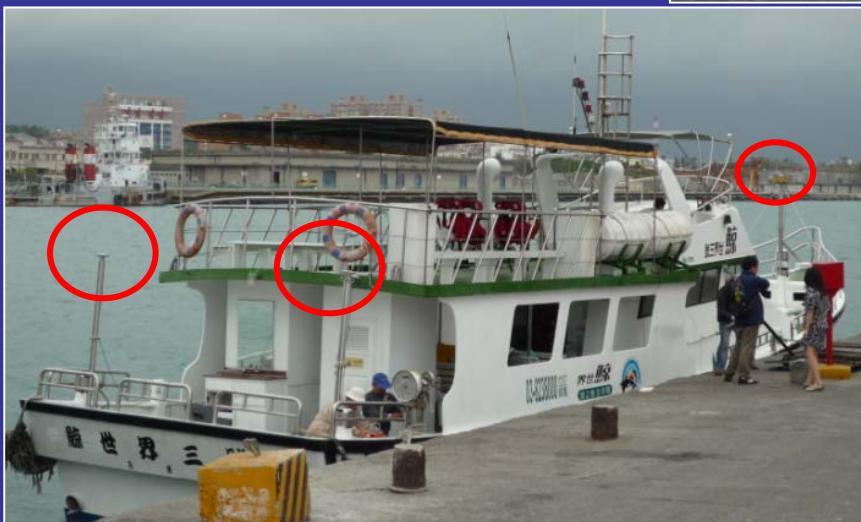


Seafloor geodetic survey



鯨鑑賞船 花連港

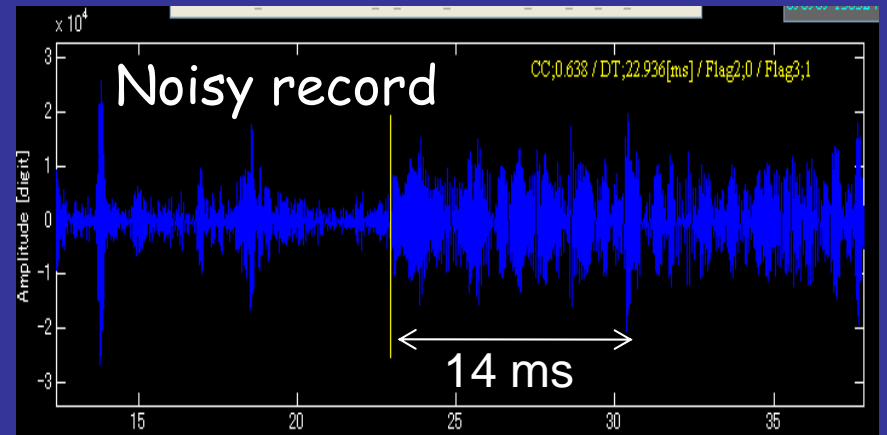
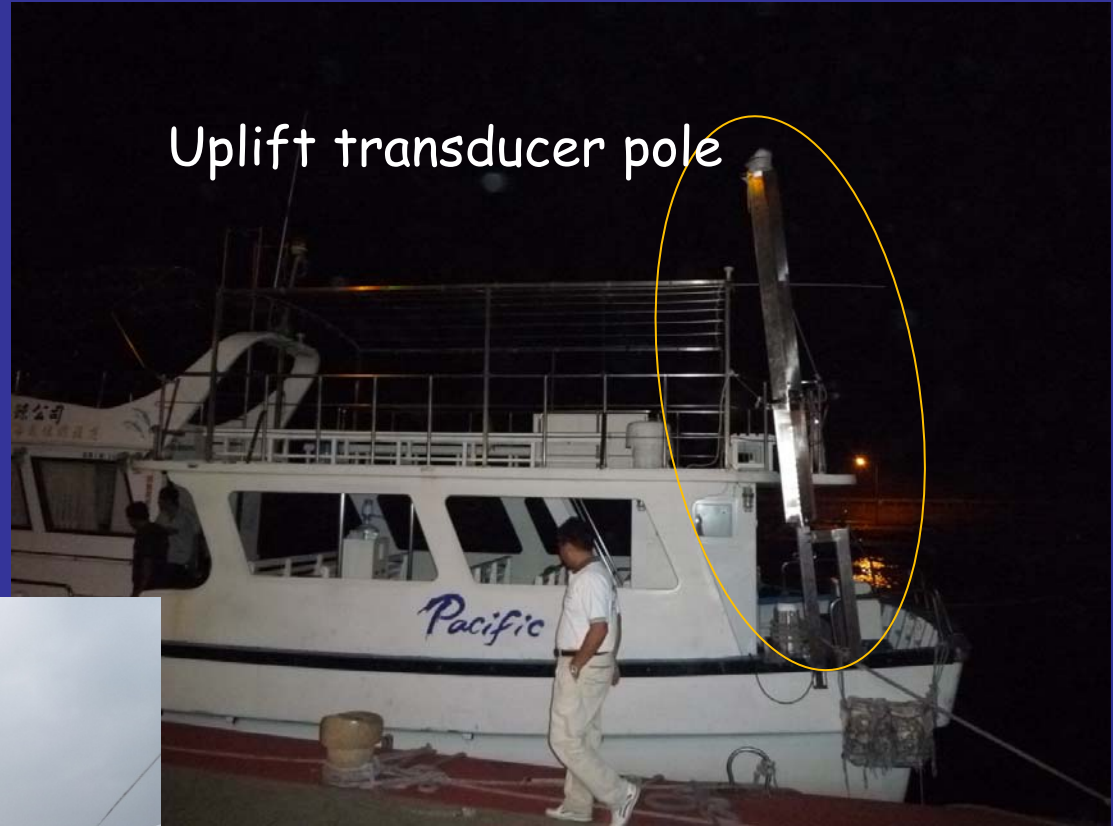
Transducer attached near the bow, causing the noise level low?



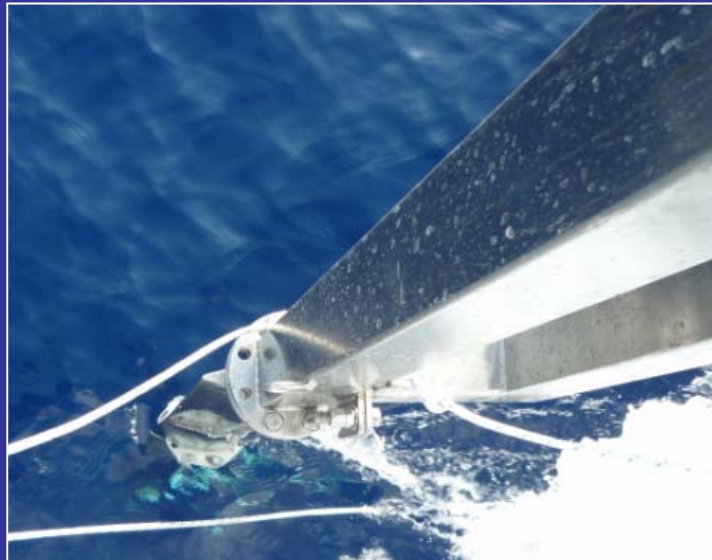
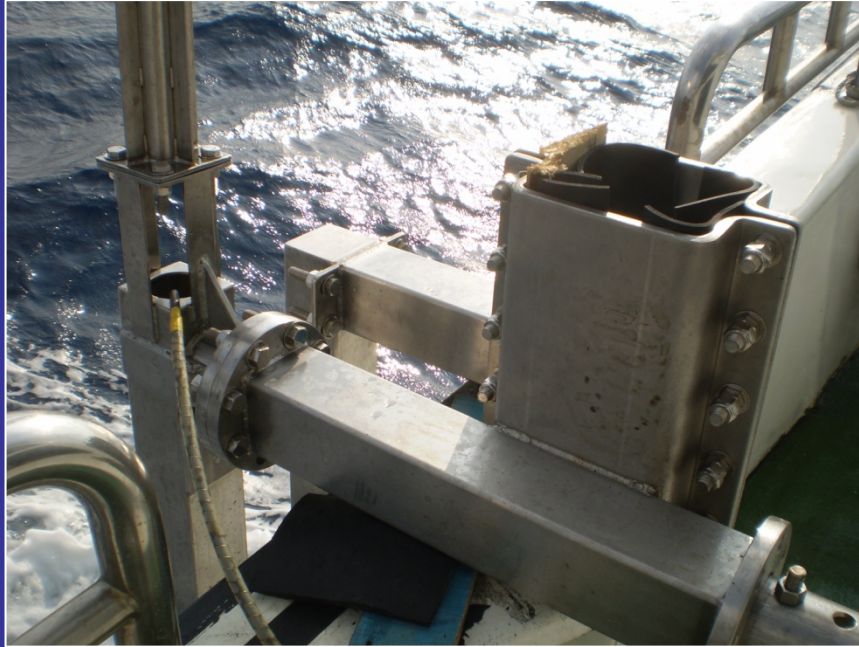
Low noise level

鯨鑑賞船太平洋 花連港

Transducer attached
near the stern,
causing the noise
level high?



Transducer pillar



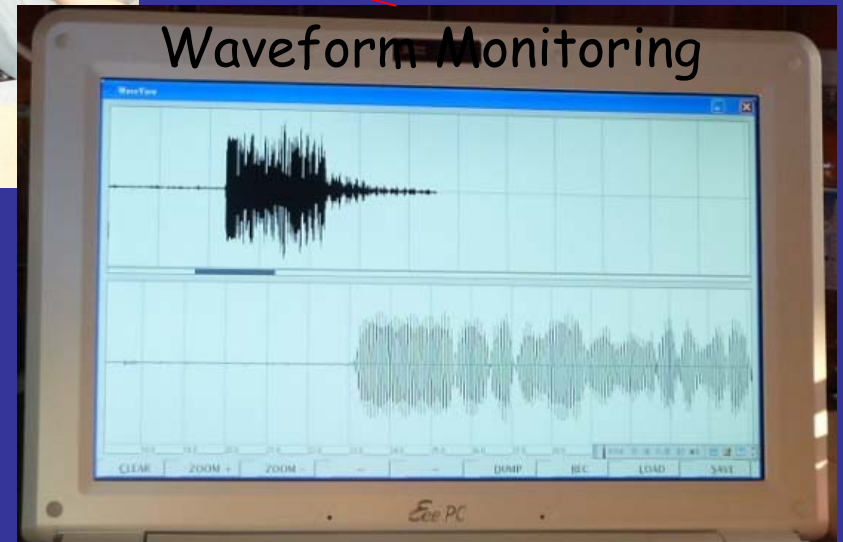
基隆港



Recording and Monitoring System

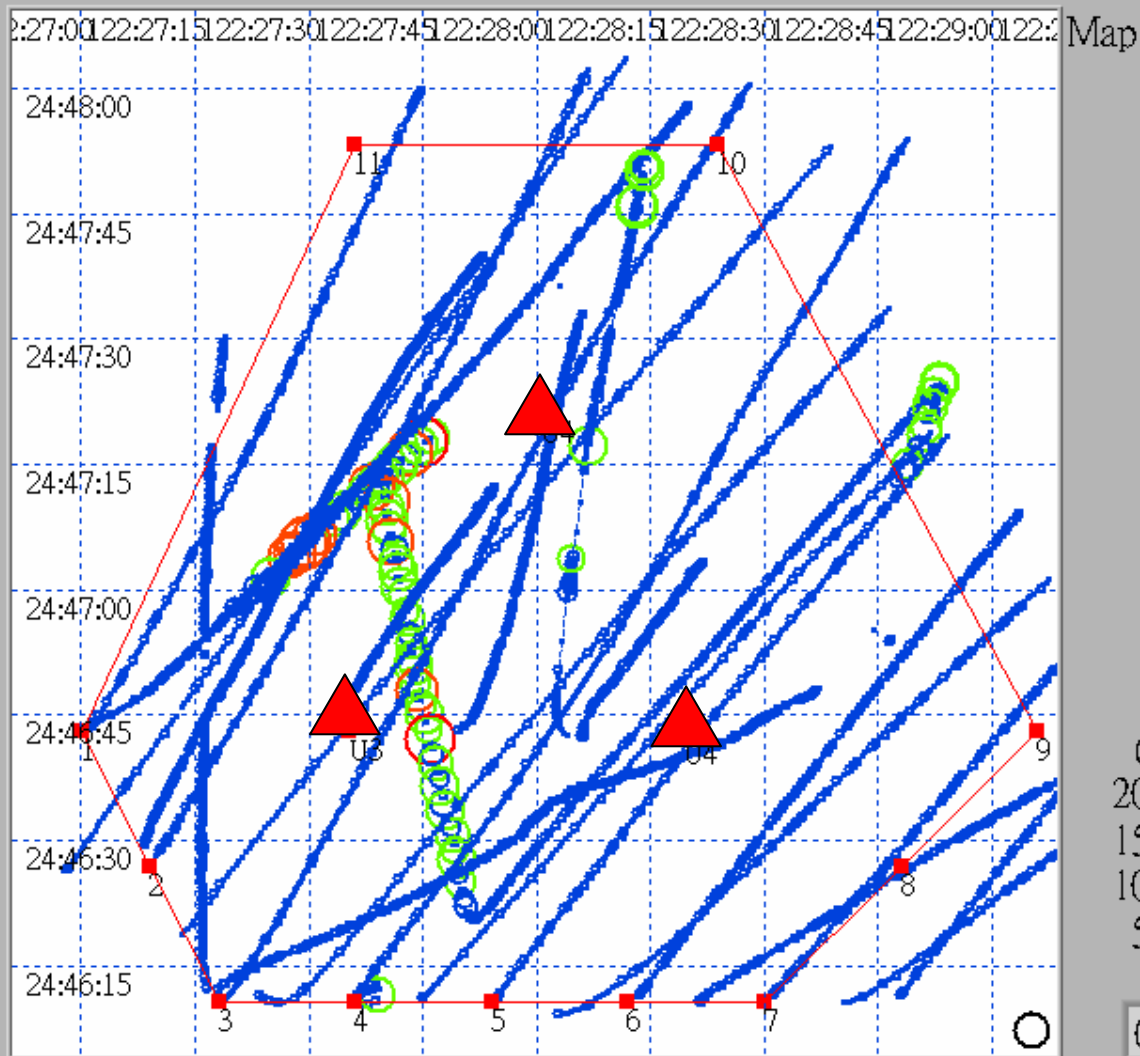


GPS receivers



July 1-2, 2009, Offshore Ilan (宜蘭)

Waveform GPS Map Time-CC I/O Information



GPS Position Center



Lat.

24.785

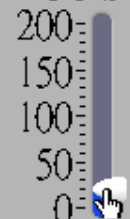
Lon.

122.471

XY

16000

CC Scale



0.5 Scale(CC)

Handy CTD

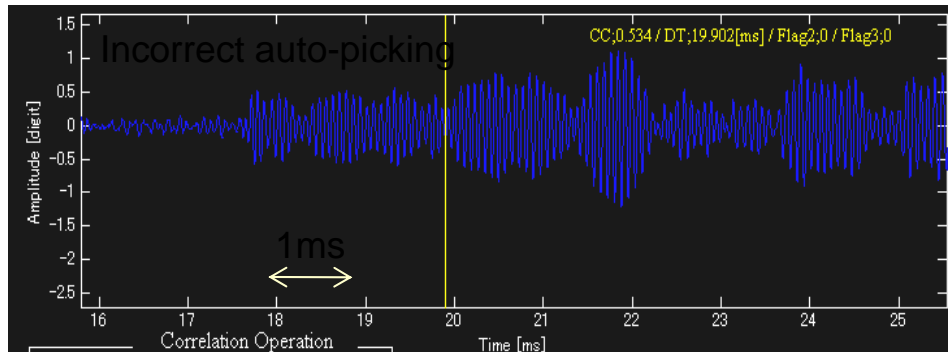
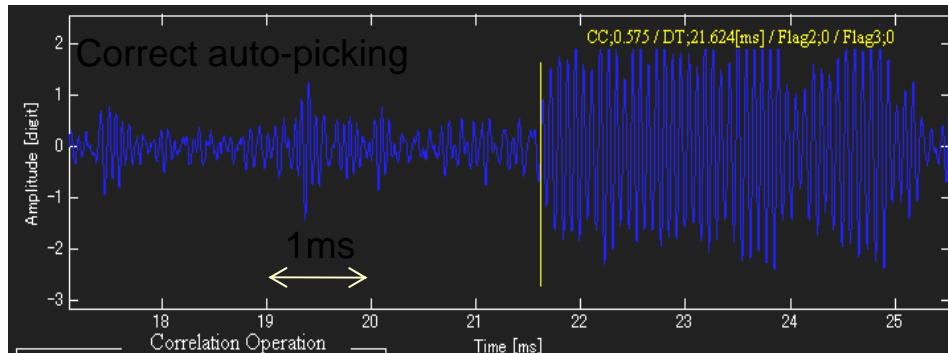


Depth < 1000m

List of observation sites, ships and results

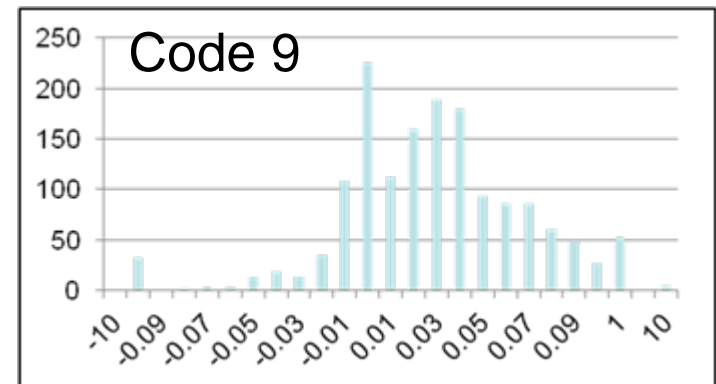
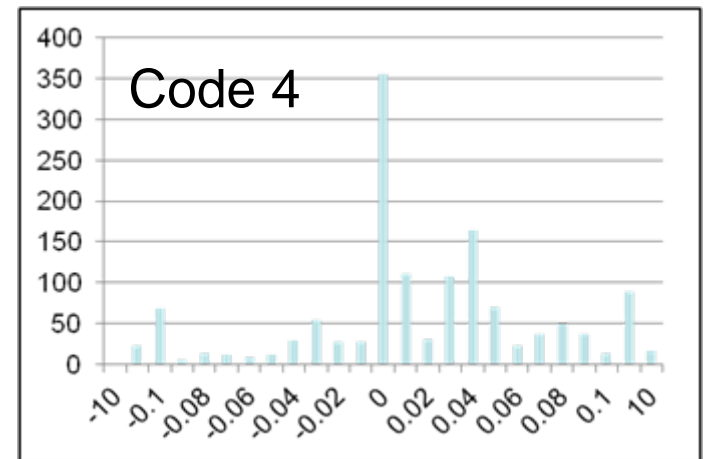
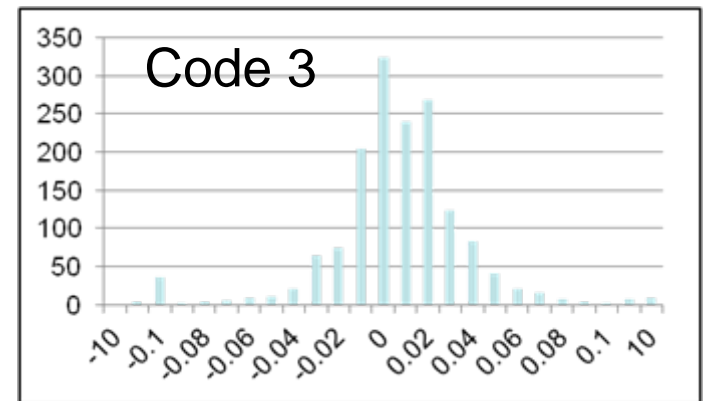
Location	Av. Depth	Obs No.	Vessel	Transducer attachment	Quality 1>2>3
Off Ilan	1,300m	1	Leisure Fishing A	Side	1
		2	Leisure Fishing A	Side	1
		3	OR2	Buoy	2
Off Hualien	3,500m	1	OR1	Buoy	2
		2	Whale Watching B	Side	1
		3	Whale watching C	Side	3
		4	OR3	Side	3
Off Chenkong	4,800m	1	OR3	Buoy	3
		2	OR3	Side	3

Differences in reading s between two pickers are negligibly small



Unit: ms

	Code3	Code4	Code9
MEAN	0.01	0.03	0.02
STD	0.25	0.60	0.19

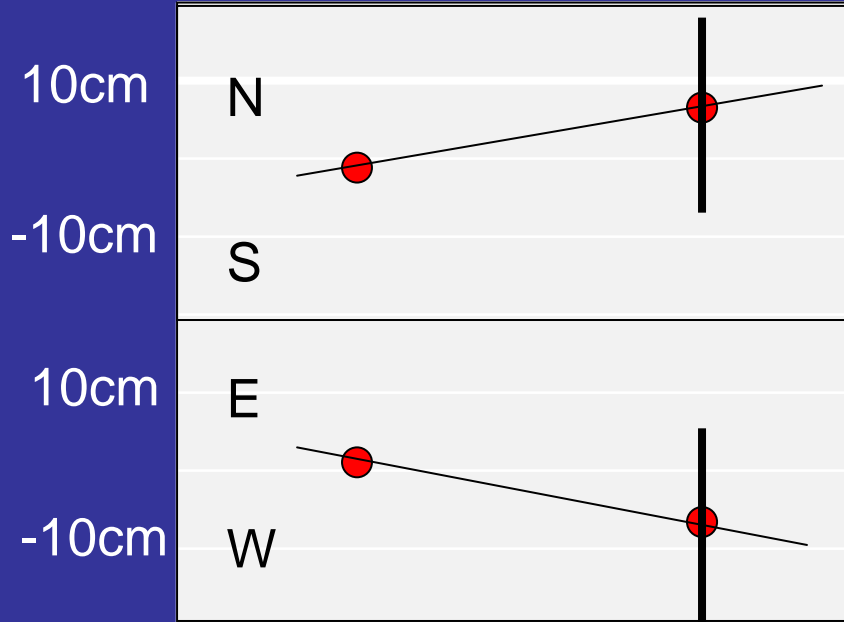


Difference, ms

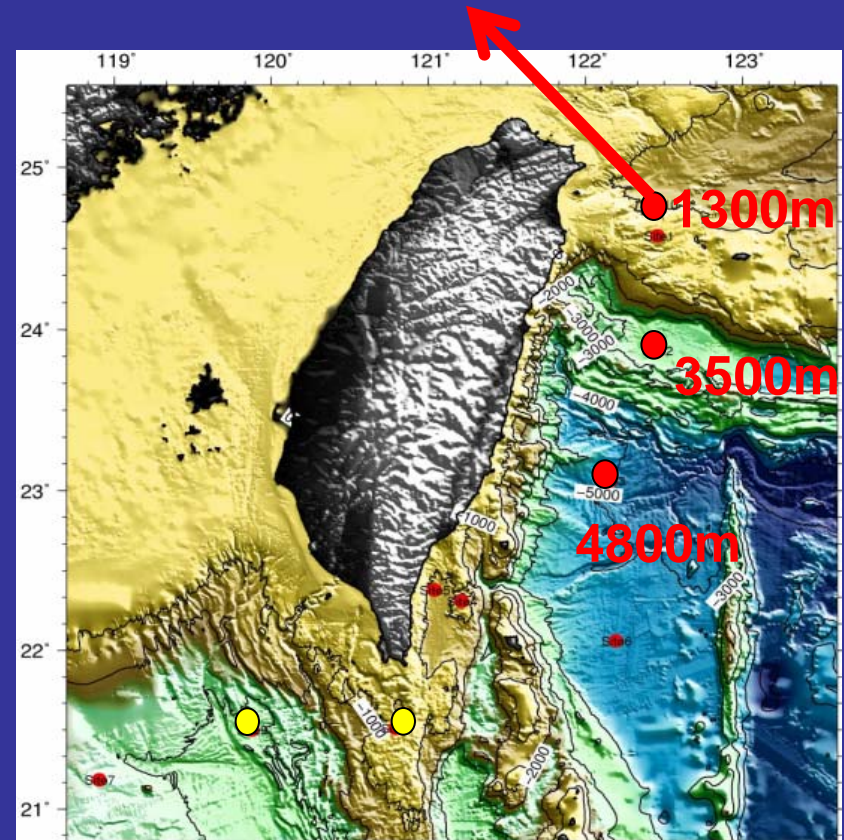
Offshore Ilan (宜蘭)

12-13 May09

1-2 Jul09



11cm (1.5 months)



Results of acoustic ranging measurements at each transponder

Site	Sur. Vessel	N	Date	TN	S	%	TN	S	%	TN	S	%	TN	S	%
Ilan				C3			C4			C9			C12		%
宜蘭	Fish B. A	1	12-May-09	970			795			953					
	Fish B. A	2	9-Sep-09	1579	1563	99	1382	1227	88	1558	1545	99			
	OR1 Buoy	3	21-Jun-10	760	248	32				1145	1098	96	1113	1028	92
Hualien				C6			C7			C8					
花蓮	OR1 Buoy	1	21-Oct-08	947	444	46	1071	514	48						
	Whale B	2	11-Mar-09	2132	1592	74	2097	1518	72	2005	1493	74			
	Whale C	3	9-Sep-09	1481	1011	68	1388	541	39	1401	542	39			
	OR3 side	4	10-Nov-09	1419	463	33	2029	502	25	2110	465	22			
Cheng gong				C10			C11			C13					
成功	Buoy	1	7-Sep-09	1199	712	59	1199	790	65	1255	822	65			
	OR2 side	2	9-Nov-10	300	40	13	317	51	16	298	138	46			

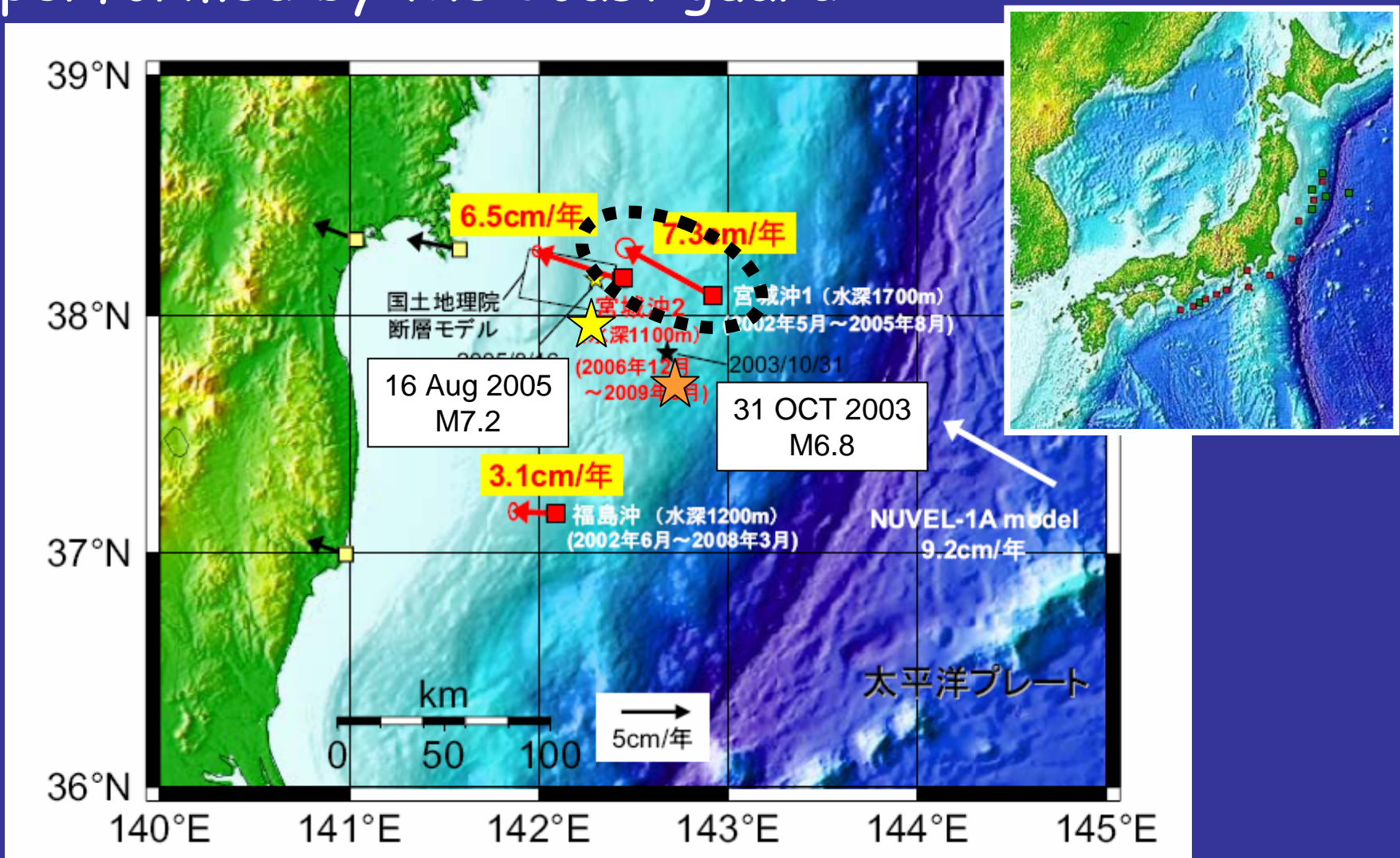
Summary of seafloor geodetic Survey in Taiwan

- 3 transponders were installed at three sites.
- 2-4 times were surveyed at each site.
- Noise levels were high, mainly originated from ships
- Numbers of acoustic shots used are not sufficient.
- At the Ilan site, the location accuracy is highest about 10 cm.

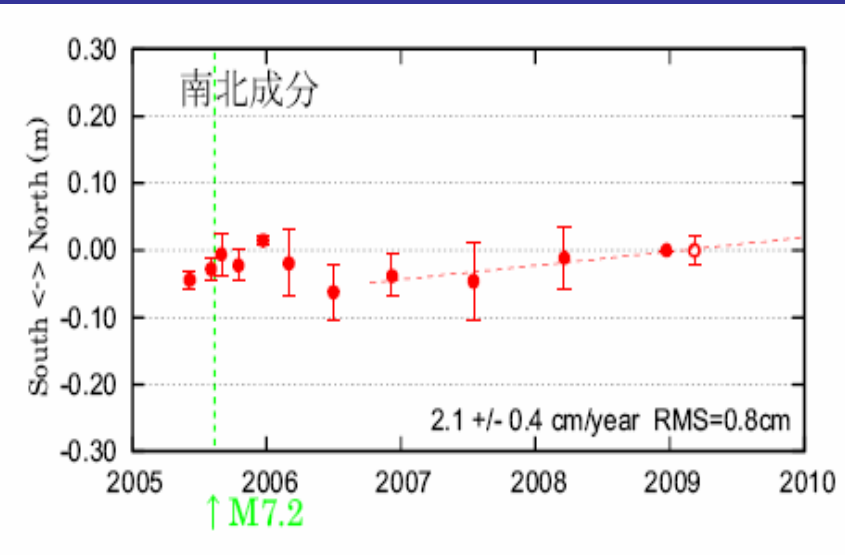
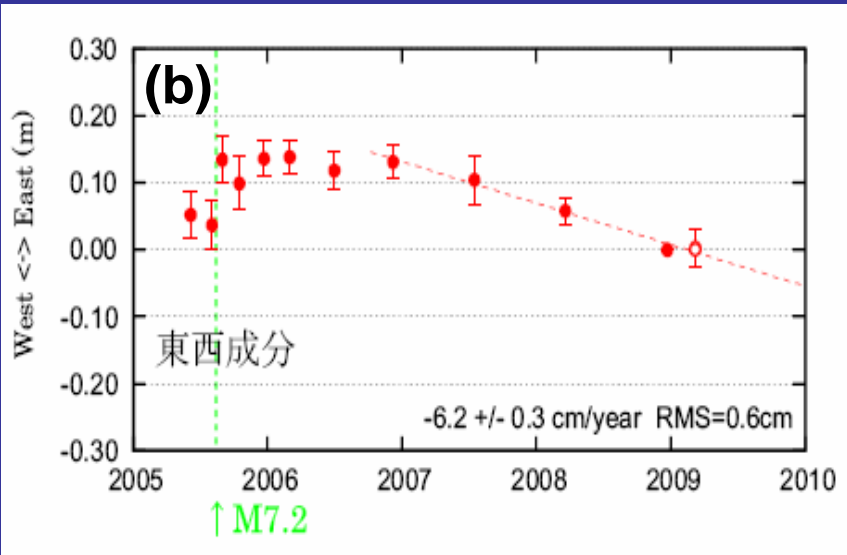
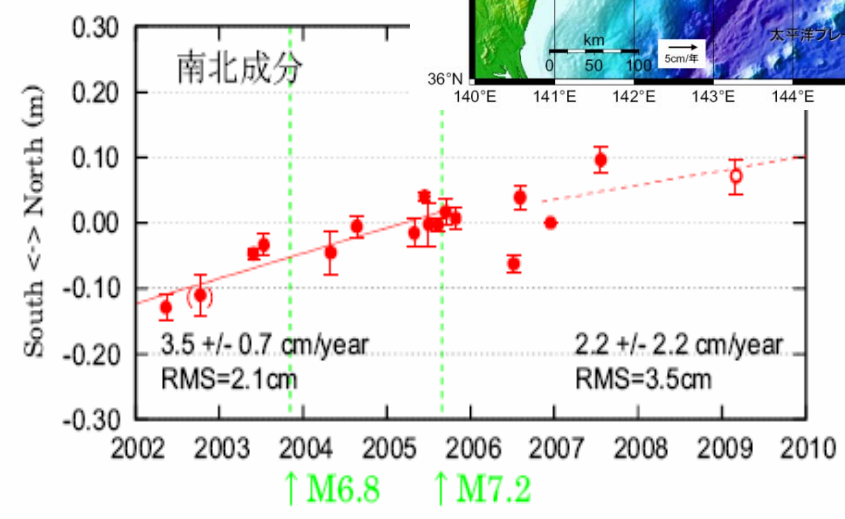
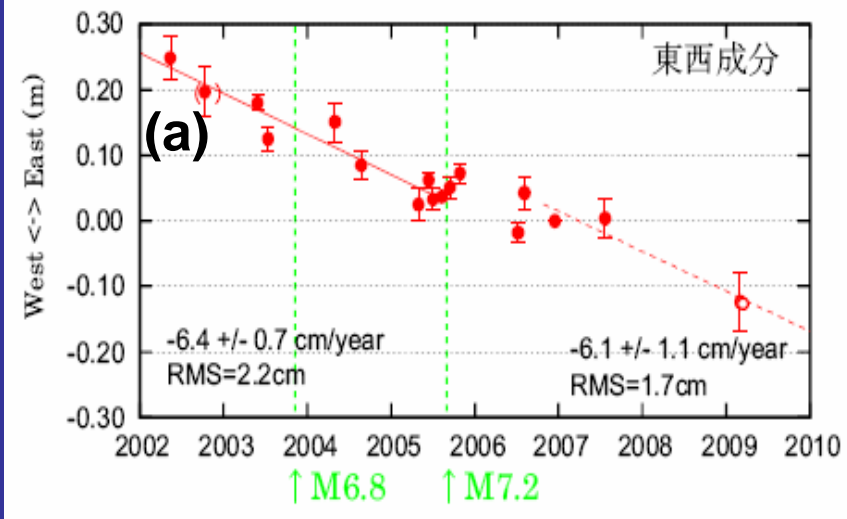
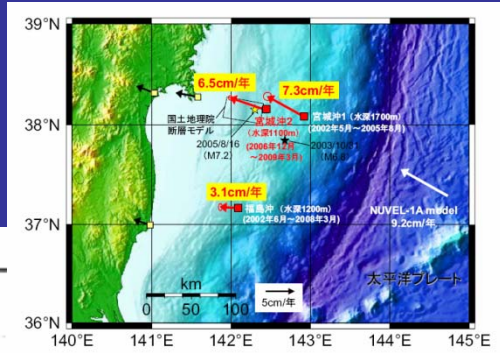
Comparison of the four groups

	No. of sites	transponders/site	Accuracy single trend in cm	Vessel	TD attach	No. of shots/transponder	AC data picking
Taiwan	3	3	10-20cm ?	different even at same site	buoy or ship side	400-1500	manual
Coast Guard	16	4	2-3cm 1-2cm	same at all sites	ship bottom	1300	auto
Nagoya Univ.	7	3	5cm 3cm	same at same site	ship side	1000-2000	auto
Ryukyu Univ.	1	3	5cm 5cm	same	ship side	700-2000	manual

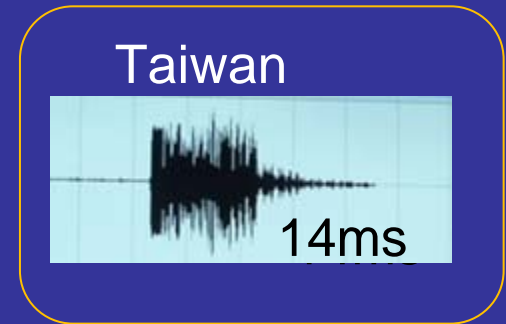
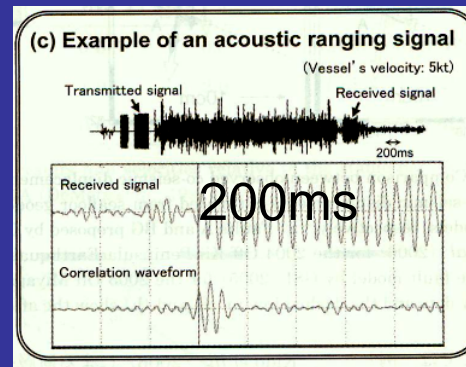
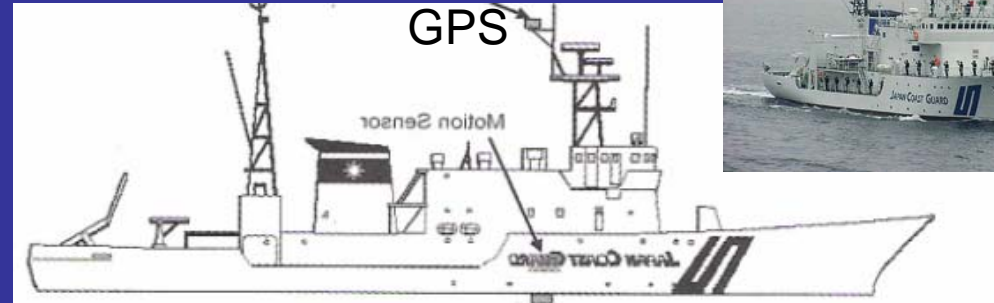
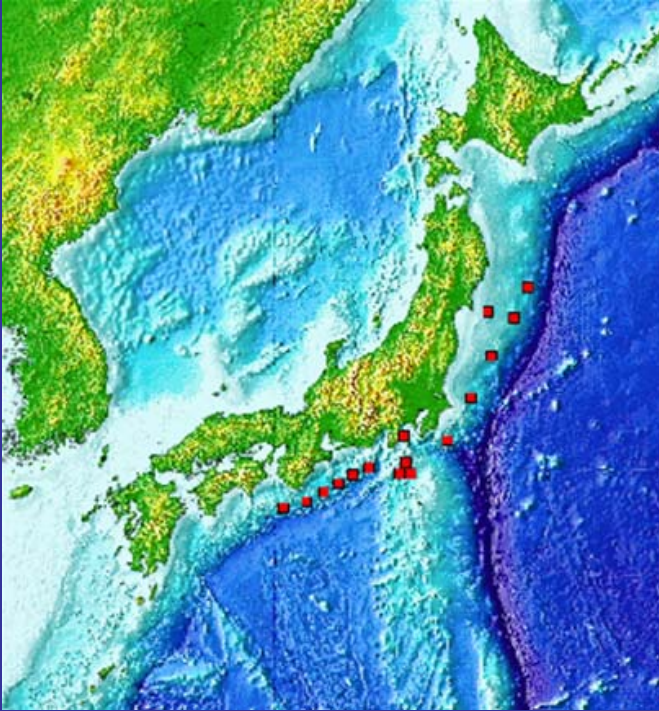
Accuracy of the Seafloor Geodetic Observations performed by the Coast guard



Off Miyagi, Northern Honshu, 100% Coupling



Why has the Coast Guard of Japan obtained the high accuracy?



1. Systematic observation: one subset of 4 hours x 2 times x 6 sites x 2 (round trip) x 2 regions (north and west) x 3 seasons =96 days/year
2. Ship-bottom transducer
3. Long duration of transmitting signals

Our future plan

- Another site will be installed south of Taiwan.
- More shots are necessary for each survey.
- Low noise-level conditions are required:
 - Use of low noise-level fishing boats
 - Produce of a new manageable buoy
- A ship-bottom transducer is favorable for effective and high-accuracy surveys.
- A new PC-base system should be established.