XBT Data Management and Quality Control in Japan

Toru Suzuki @ Marine Information Research Center (MIRC)

International Conference on Marine Data and Information Systems 2013, Lucca, Italy, September 24, 2013

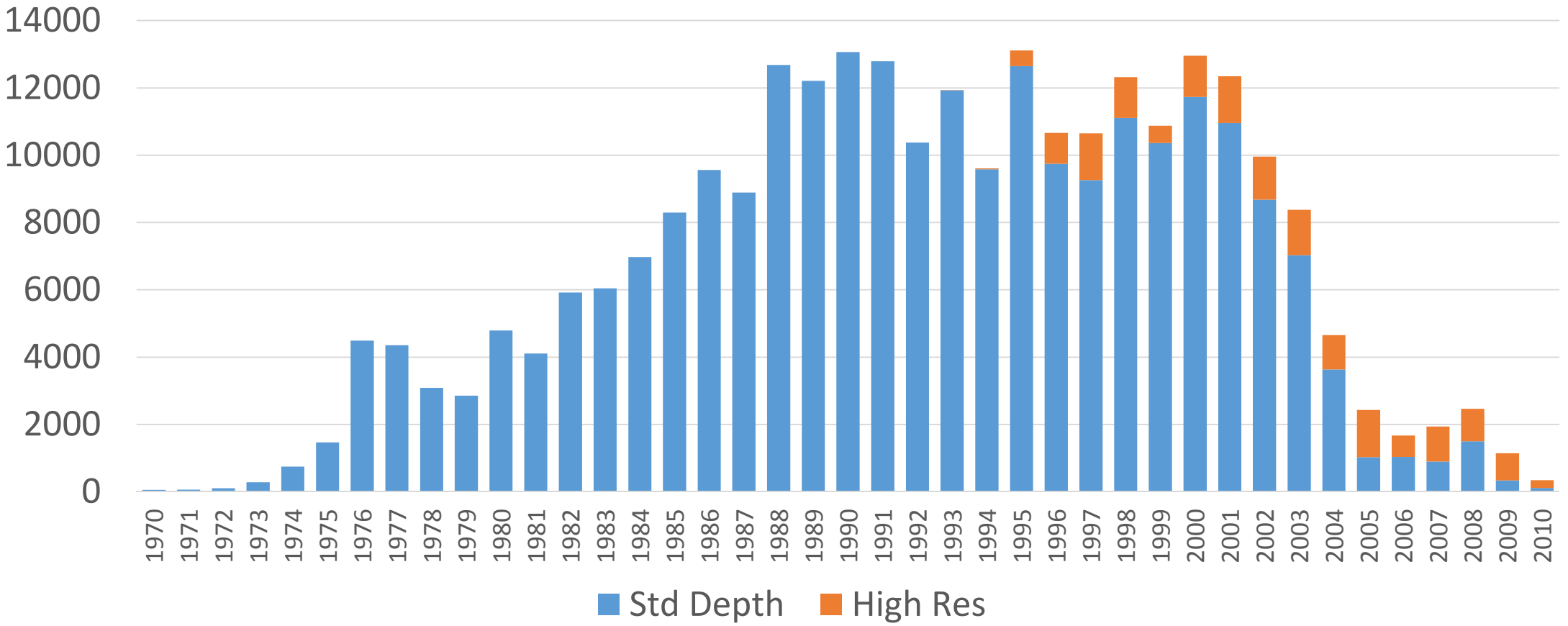
Co-authors

- Masayoshi Ishii @ Meteorological Research Institute (MRI)
- Toshiya Nakano @ Japan Meteorological Agency (JMA)
- Hiroyuki Yoritaka @ Hydrographic and Oceanographic Department, Japan Coast Gurad (JCG)
- Akihiro Seta @ Japan Oceanographic Data Center (JODC)
- Shoichi Kizu @ Tohoku University
- Kanako Sato @ Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
- Yugo Shimizu @ Fisheries Research Agency (FRA)
- Ken-ichi Amaike @ Tsurumi-Seiki Co. Ltd. (TSK)
- Toshio Suga @ Tohoku University
- Yutaka Michida @ Atmosphere and Ocean Research Institute, the University of Tokyo

Introduction

- JODC has archived about 270,000 XBT casts and about 15.5 million temperature data since 1970.
- Recent studies pointed out that the time change of estimated ocean heat content involves a bias against natural variability which is caused by various errors involved in XBT data.
- Working group on reconstruction of QCed XBT database has started to recovery and rescue of XBT data.

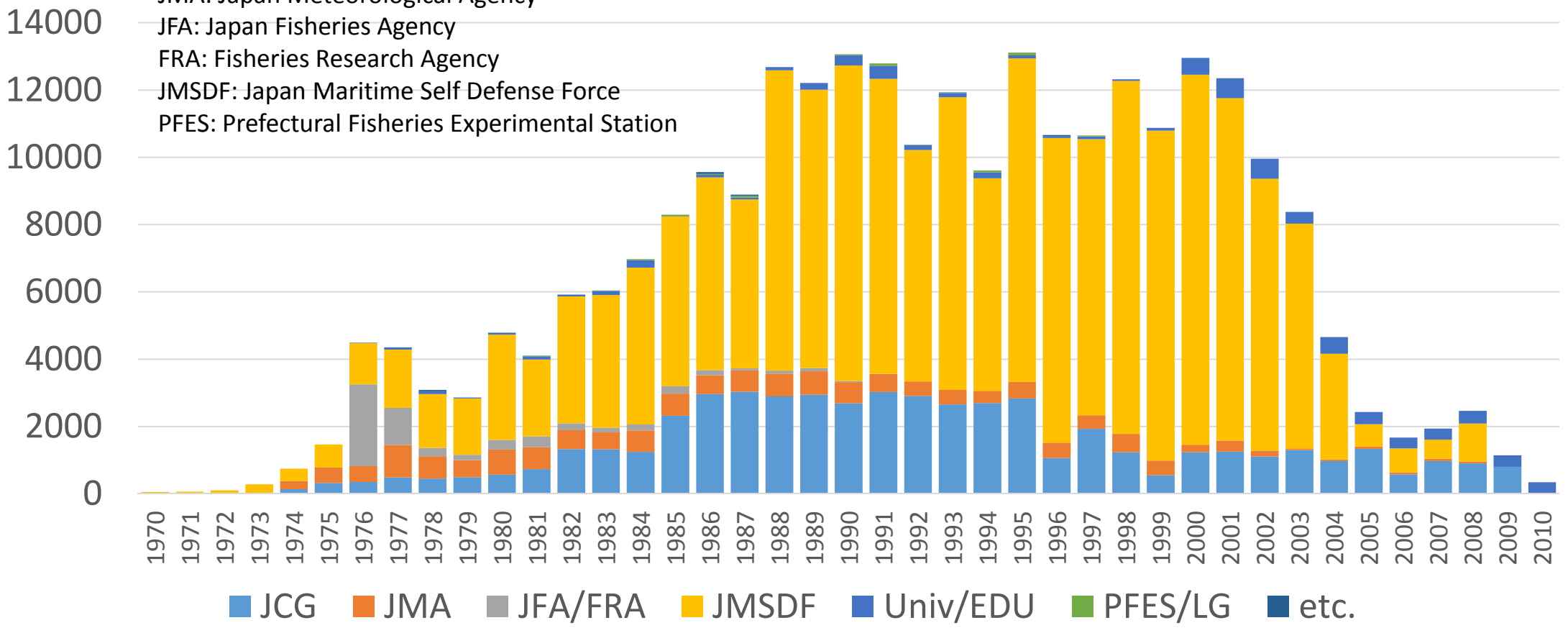
Annual Change of Number of XBT Casts



254,777 + 15,863 = 270,640

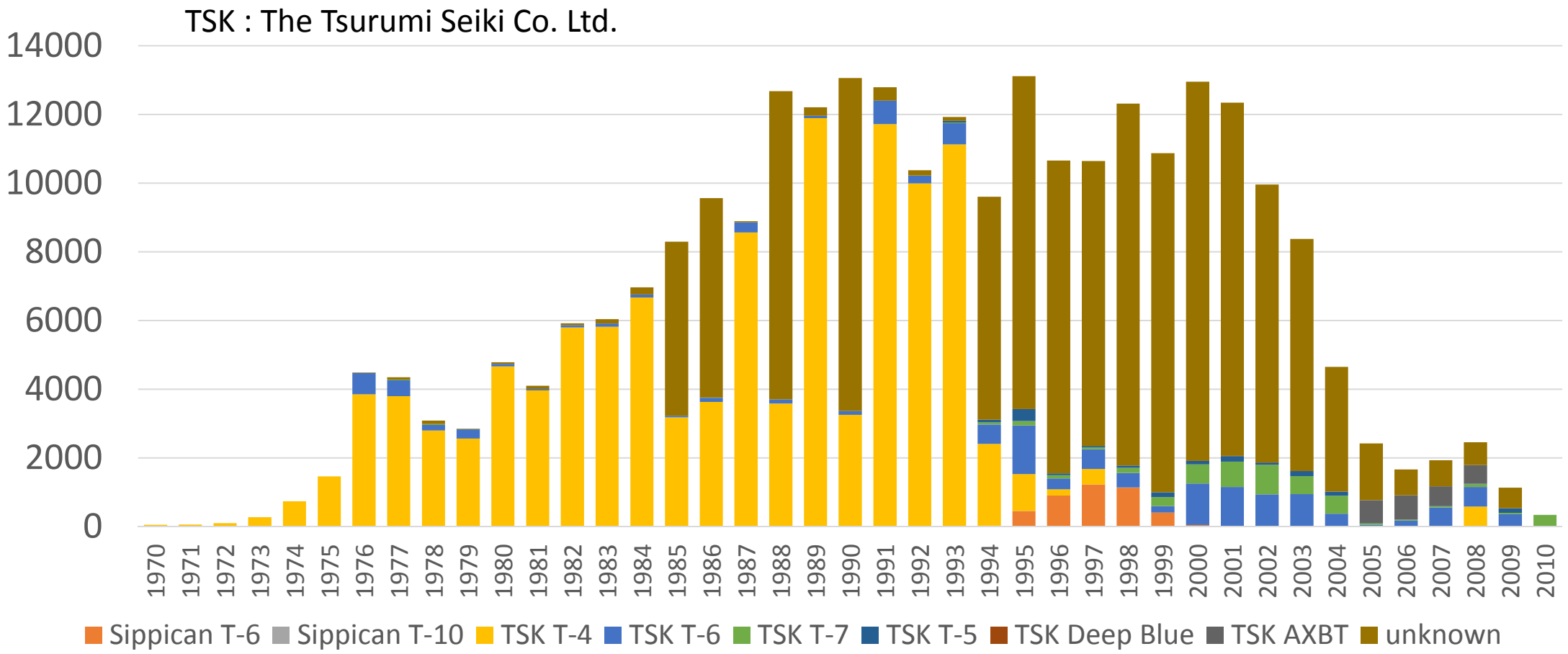
Annual Change of Number of XBT Casts

JCG: Japan Coast Guard
JMA: Japan Meteorological Agency
JFA: Japan Fisheries Agency
FRA: Fisheries Research Agency
JMSDF: Japan Maritime Self Defense Force
PFES: Prefectural Fisheries Experimental Station



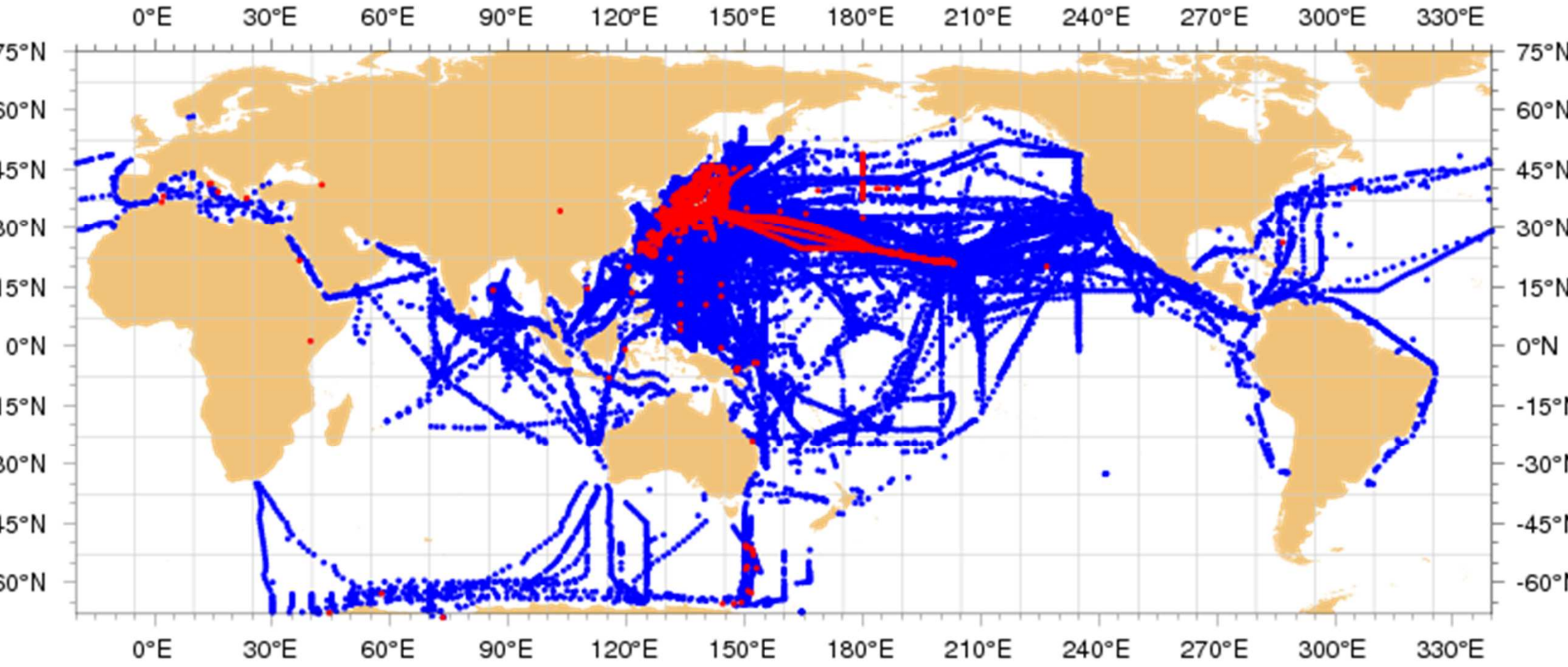
56,630 + 15,430 + 5,727 + 187,933 + 7,276 + 452 + 192 = 270,640

Annual Change of Number of XBT Casts



4,224 + 44 + 114,309 + 13,972 + 4,611 + 1,533 + 10 + 2,497 + 129,440 = 270

Distribution of XBT Casts

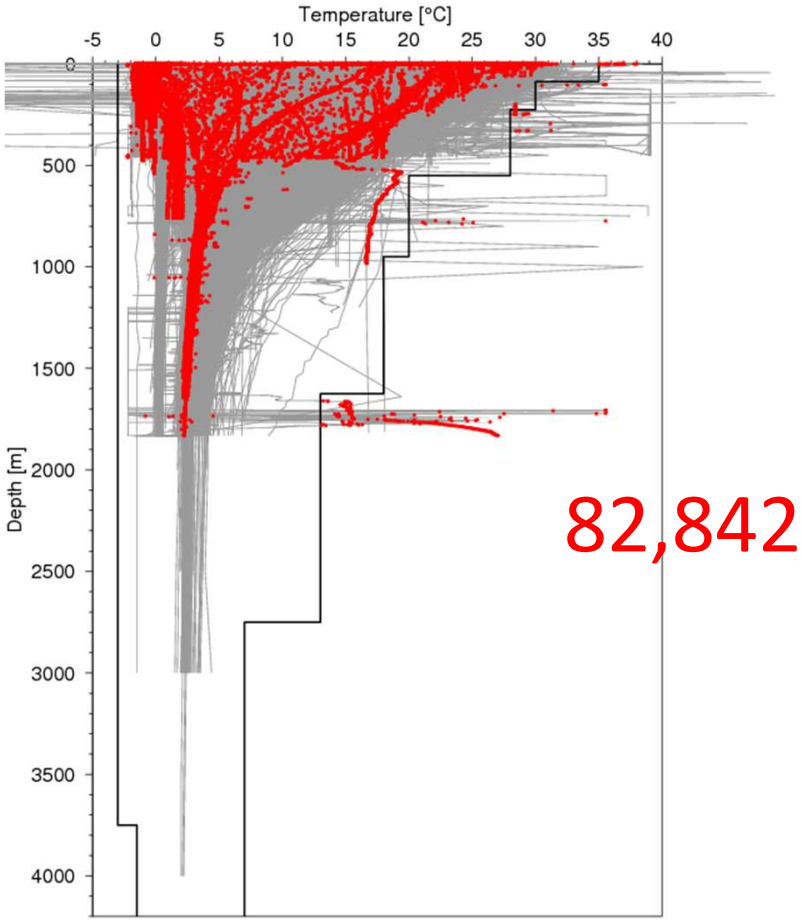


leader check for date/time/position, estimated ship speed, land/near shor

1,365 (0.5%) 216 (0.08%) 1,131 (0.4%)

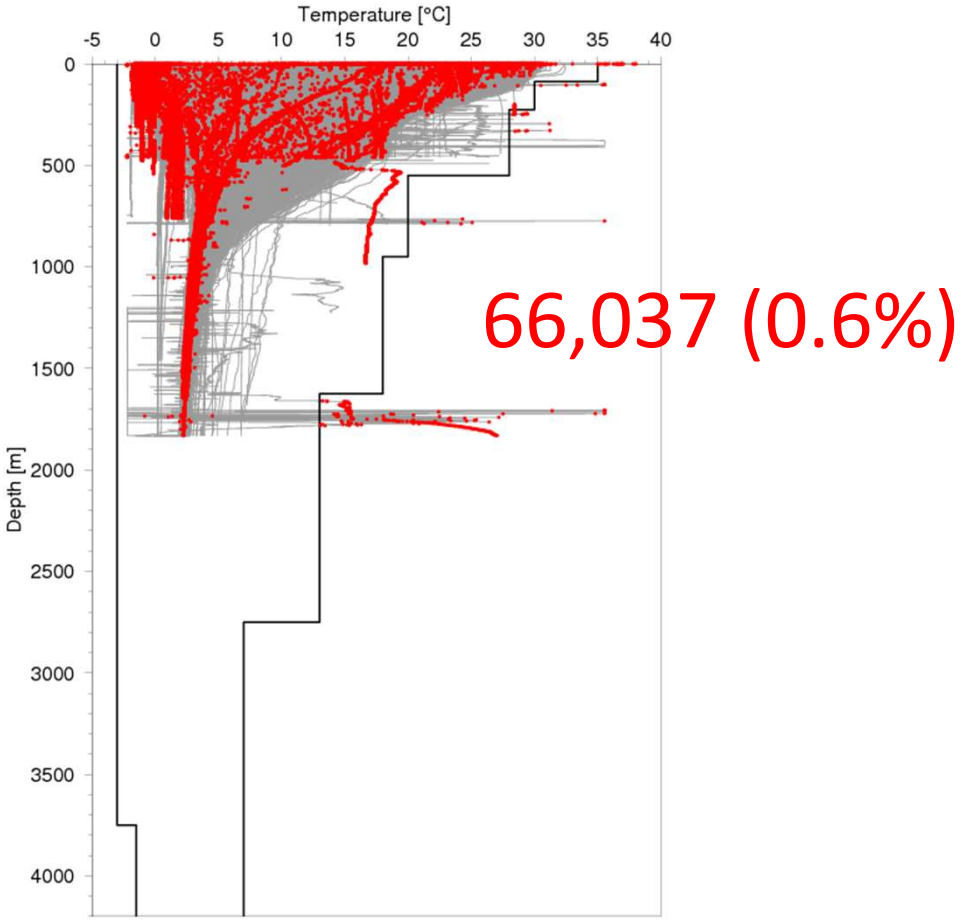
Quality Control for XBT Profiles

- Total 15,544,058 levels
- QC Procedures
  - Temperature range check
    - as a function of depth in each basin
  - Excessive gradient/inversion check
  - Maximum observed level check
    - Comparison with in situ bottom depth or gridded bathymetric data



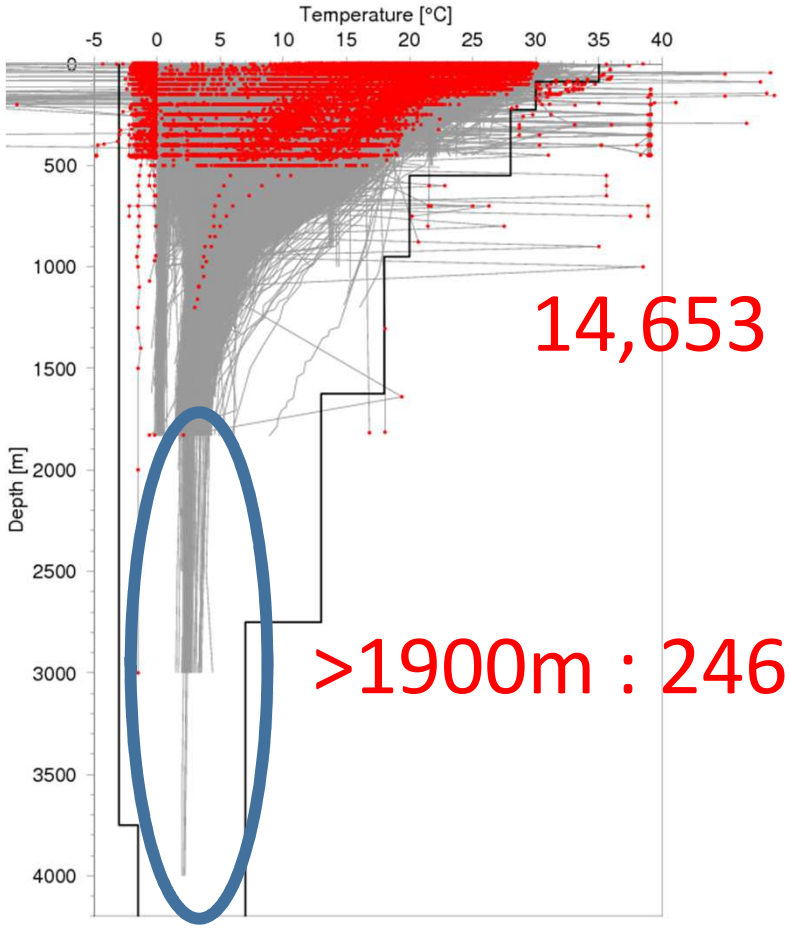
82,842 (0.5

Quality Control for XBT Profiles



66,037 (0.6%)

High Res. : 11,010,184 levels



14,653 (3.2%

>1900m : 246 leve

Std. Depth : 4,533,874 levels

The cause of the deeper data

gacy JODC standard depth data format

```
MEJNQN34438N140004E92021206792000 6                2205118121    22
 154 153 153 153 152 152 152 151 143 127 111 094 084 077 069
 058 055 055 052 049 045 042 039 039 038 036 033 031 028 026
 025 024 024 023 022 021

MEJNQN34432N139399E90030409992001 7                1104230114    11
 155 155 155 155 148 143 137 133 125 114 107 099 090 085 079
 074 068 061 057 055 050 047 046 044 042 040 036 032 031 030
 027 027 025 024 023 022
```

0m	10m	20m	30m	50m	75m	100m	125m	150m	200m	250m	300m	350m	400m	450m
500m	550m	600m	650m	700m	750m	800m	850m	900m	950m	1000m	1100m	1200m	1300m	1400m
1500m	2000m	2500m	3000m	3500m	4000m									

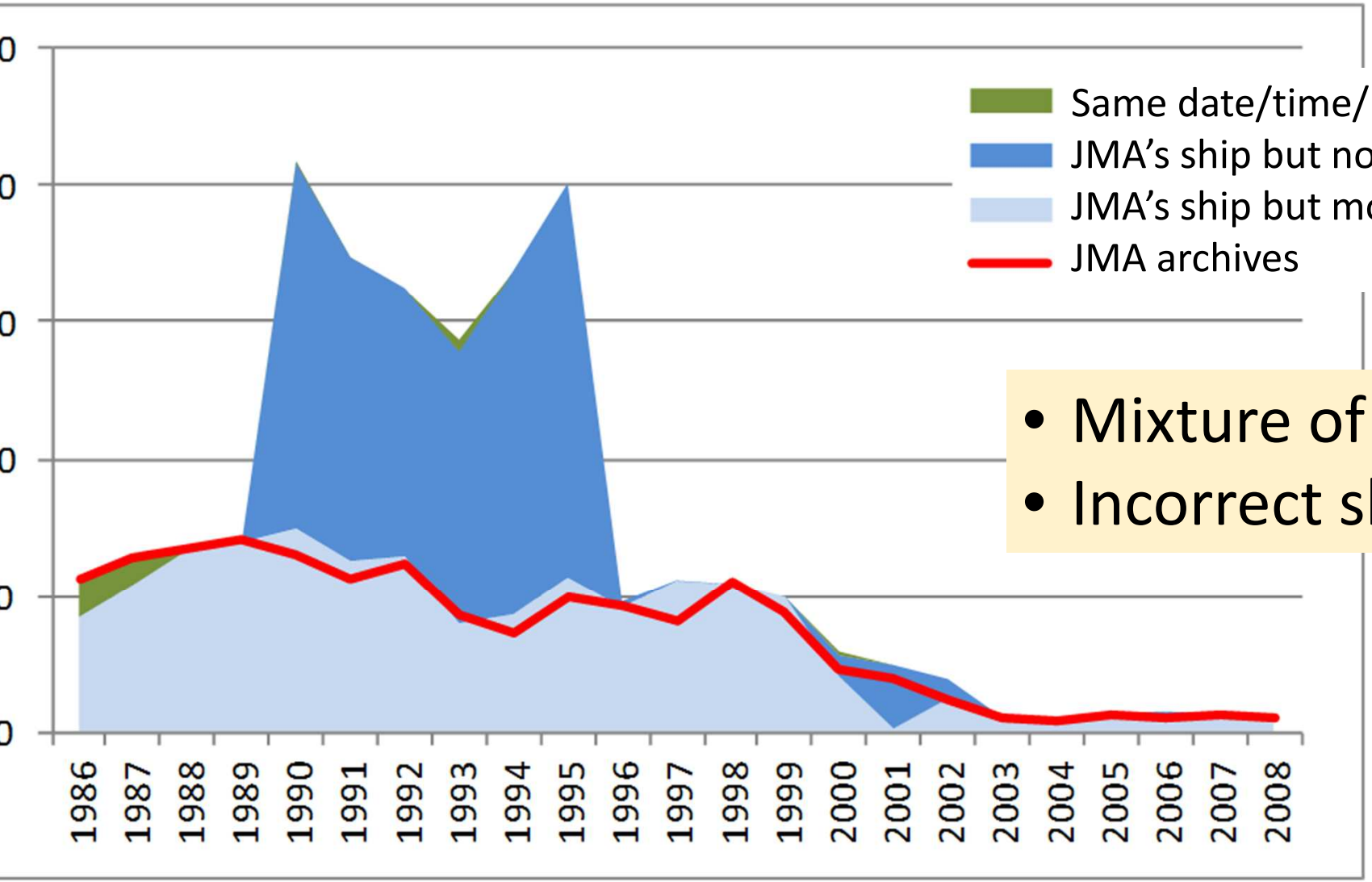
1600m 1700m 1800m 1900m 2000m

Mismatch depth

Recovery and Rescue of XBT Data

- Search digital high resolution data
  - Japan Meteorological Agency (JMA) found high resolution profiles which can replace with std. depth profiles.
- Scan/digitize from strip charts
  - JMA found many strip charts in container boxes, but needs a support and budget
- Verify and synchronize with JODC DB and WOD
  - JMA has verified data in JODC DB and WOD.
  - Some JMA’s data did NOT match up with WOD09.

Verification of JMA's XBT Data in WOD09



- Mixture of DBT and/or CTD
- Incorrect ship code?

Example of History of Ship Name/Call Sign

(in Japanese)

					OCL, NODC, ship name
	ふじPS02	1st Reg. CG HQ	2nd Reg. CG HQ		4689,49FJ,FUJI II or 4743,49HZ,FUJI
		Mar.1951 - Mar.1960	Mar.1960 - Jan.1975		
		JAJO / 232GT			
	ふじPM25			5th Regional Coast Guard HQ	4689,49FJ,FUJI II or 4743,49HZ,FUJI
				Feb.1975 - in service	
				JIPR / 496.76GT	
	富士丸	Shizuoka Prefectural Fisheries Experimental Station			4738,49HU,FUJI-MARU
		May 1927 - Sep. 1950	Oct.1950 - 1962	Jul.1973 - Jan.1988	Feb.1988 - in service
		JCFA / 128GT	JIPI	JCRM / 491GT	JHOK / 311GT
	ふじAGB5001	Japan Maritime Self Defense Force / Icebreaker			4689,49FJ,FUJI II or 4743,49HZ,FUJI
		Jul.1965-Apr.1984			
		JSTY / 5489 GT			
	第十八富士丸	VOS by Toyama Prefectural Fisheries Experimental Station			8084,49GX,FUJI NO.18 (03/1968 to present)
		Mar. 1968 (one time)			
		JMHR / 96 GT			

Metadata for XBT Data Quality Control

For cruise/header

- Date/Time/Position (required)
- Ship name, ship code, and/or call sign (required; prev. slide)
- Institution name (if possible)
- Cruise summary (name and date are required for EXPOCODE)

For data

- Probe type (required)
- Fall rate (required)
- Serial number or lot number (if possible)
  - 10% grams of probe weight difference changes to 1 or 1.5% in fall rate.
- Launching Height (if possible)
  - Changes depth bias by probe angle at sea surface
- Recorder/converter (if possible)

History of TSK XBT Recorder/Converter

1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
MK-2A (Chart Recorder; Accuracy = 0.2 deg. C)														
			MK-2S (Chart Recorder; Accuracy = 0.1 deg. C)											

1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998		
MK-30							MK-30N (called 'Digital Converter')							

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
MK-130 (support for XCTD)														
				MK-130 Ver. 2.0.6										
				MK-130 Ver. 3.0.2 (support for XCTD-2; update fall rate of TSK T-10)										
									MK-130 Ver.3.0.7					
									MK-150 (support USB device)					
										MK-150N (update USB device)				

Quality Control Procedures for XBT Data

Primary for original casts by Originator/Data Center

- Format conversion
- Date/Time/Position check
- Estimated ship speed check
- Maximum obs. level check
  - Bottom depth
  - Measuring depth of each Probe
- Land/near shore check
- Temperature range check
- Excessive gradient/inversion check

Secondary for database/product by Scientist/Expert

- Fall rate equation
- Determination of depth bias and adjustment

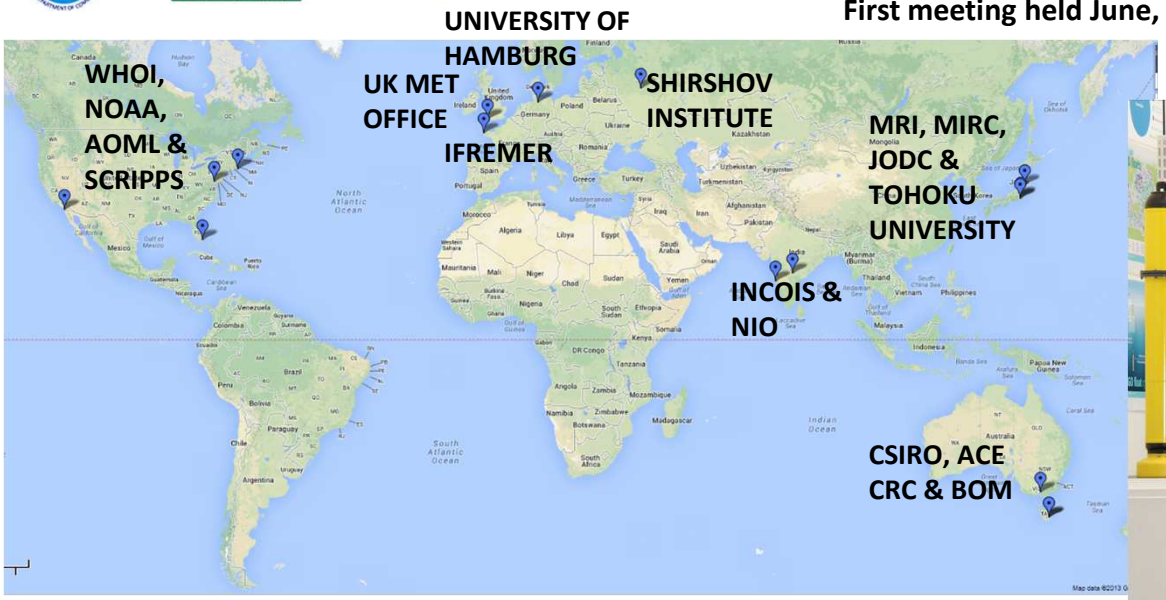
IODE Data Quality Flag Scheme

- Ocean Data Standards Vol. 3, IOC Manuals and Guides No.54
- Primary level:
  - Good
  - Unknown/Not evaluated or available
  - Questionable/Suspect
  - Bad
  - Missing data
- Secondary (or lower) level: results of quality control procedures by originator, data center, and/or scientist/expert

International QUality controlled Ocean Database

A coordinated, international effort to 'clean up' the ocean temperature profile database

First meeting held June, 2013, Hobart, Tasmania, Australia



Aims over 5 years:

1. To generate the definitive high quality ocean subsurface temperature data set suitable for climate research activities.
2. To provide best possible uncertainty estimates on individual profile observations.
3. Maximise the efficiency of the international global QC effort by pooling these resources/expertise into a single product.
4. Agree on and implement the best possible automated and manual/expert QC procedures (provides direct benefit to both operational data assimilation and research activities)