

Key to Oceanographic Records Documentation No. 16



JEDA Center

**Annual Report on Tropical Pacific
Subsurface Thermal Data Management -
1986**

Issued by the Joint Environmental Data Analysis (JEDA) Center
in support of the Tropical Ocean/Global Atmosphere (TOGA) Program

**National Oceanographic Data Center
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**U.S. DEPARTMENT OF COMMERCE
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National Oceanic and Atmospheric Administration

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Abstract. As one prototype model for handling ocean data--in particular to ensure their scientific quality and timeliness--the U.S. National Oceanographic Data Center and the Scripps Institution of Oceanography have formed a Joint Environmental Data Analysis Center (JEDA). One of the Center's functions is to support subsurface thermal data management for the Pacific Ocean portion of the U.S. Tropical Ocean-Global Atmosphere (TOGA) program. JEDA tracks, acquires, quality controls, and merges all subsurface thermal data for the tropical Pacific. These data include near-real-time data received through the IGOSS system, as well as delayed mode data in analog (strip chart) or digital (cassette) form from national and international sources. NODC assembles, reformats, and initiates quality control of the data; Scripps performs further quality control by using the data set to produce bimonthly oceanographic products. These data and products are available to TOGA investigators monthly, either at Scripps or NODC. Recent enhancements include some data base distribution through NASA's SPAN/Ocean Network. Future plans may involve an on-line data inventory.

Introduction

In the fall of 1985, the U.S. National Oceanographic Data Center (NODC) was requested to assist investigators in the Tropical Ocean-Global Atmosphere (TOGA) program by serving with the Scripps Institution of Oceanography (SIO) as a focal point for management of subsurface thermal data from the tropical Pacific Ocean. Many of the data required by the TOGA program are collected under the auspices of other countries, the military, academia, and various volunteer observing systems. Therefore, effective data management requires an active program to seek out all possible data sources and combine all data for the area of interest into a single data set. In fulfilling its mission and functions, the NODC has historically been in contact with most major ocean data collection programs. The NODC brings to the TOGA program its data management experience and network of national and international data sources. The SIO contributes its contacts in the scientific community and its unexcelled expertise in quality control and analysis of oceanographic data. The strengths of these two institutions are being combined by establishment of a Joint Environmental Data Analysis (JEDA) Center. This report summarizes the results to date in compiling the 1985 and 1986 data sets.

Scope of the TOGA Effort

Initially, the TOGA Pacific thermal data base is being limited to bathythermograph (BT) data, as that is the bulk of the data available. STD/CTD and thermistor chain data will be added at a later time. Geographically the data set covers the

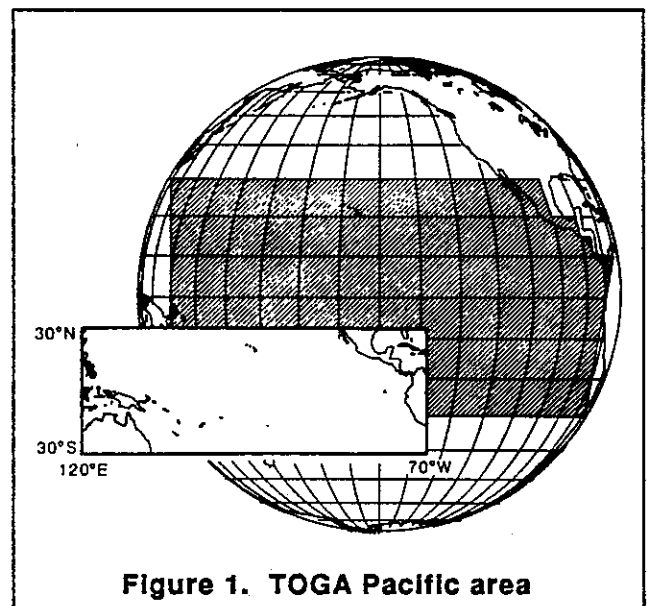


Figure 1. TOGA Pacific area

tropical Pacific between 30°N and 30°S from the coast of South America to 120°E (figure 1). The time period of the data set begins with January 1, 1985. It should be noted that although these limits have been applied to the actual TOGA data base, the NODC is giving priority to processing tropical ocean data from all oceans and time periods.

NODC TOGA Data Management System Requirements

The initial requirements of the data management system were as follows:

- The system had to be put together rapidly since the TOGA program had already begun

- As much as possible, the system must use existing NODC procedures, systems, and formats.
- The system must meet the needs and requirements of the scientific community and involve the scientific community in the data quality control process.
- To meet the scientific requirements of TOGA, the system must allow the data base to be updated frequently in order to provide near-real-time data for predictive and modeling efforts.
- Because TOGA is a 10-year program, the system must be flexible to accommodate growth of data and information needs.
- Each month the system must generate a data set that contains all available near-real-time and delayed mode data.

Data Collection

Data collection requirements for TOGA have been determined by the U.S. TOGA Program Office in concert with the scientific community. The NODC is informed of all data collection funded by TOGA, and TOGA data policy encourages these data to be submitted to NODC. By furnishing information about the temporal and spatial distribution and other characteristics of data already collected, the data management system can serve as a feedback mechanism to help TOGA scientists modify or refine further data collection efforts. Furthermore, by producing an updated data set and a group of products in a timely fashion, the NODC and SIO hope to encourage data collectors to submit their data as promptly as possible.

Data Acquisition

Appendices A and B present summaries of TOGA Pacific BT data for years 1985 and 1986 received to date by NODC. As of July 1, 1987 the NODC TOGA Pacific thermal data set contained 21,985 upper ocean temperature profiles. These data include:

- XBT data received by the National Meteorological Center (NMC) at Suitland, Md. via the IGOSS (Integrated Global Ocean Services System) telecommunications

network. Data from this source currently comprises 6,584 casts or 24% of the total.

- Unclassified XBT data received at the Fleet Numerical Oceanography Center (FNOC) via their communications network. The FNOC receives some data from sources that do not reach the NMC. These data amount to 9,061 traces (33% of the total).
- Applicable data collected by the National Oceanic and Atmospheric Administration (NOAA) fleet.
- Delayed mode data from volunteer observing systems including those operated by the U.S. Navy, NOAA, SIO, France, and Australia.
- Data from U.S./People's Republic of China cruises.
- Foreign data received routinely in delayed mode at the NODC from countries such as Australia, Japan, New Zealand, Peru, and Ecuador.

The delayed mode data, which are almost entirely from U.S. sources, represents 44% of the data set (see Figures A1 and B1). This number will increase over time as more data arrives from foreign sources. Delayed mode data typically arrive at the NODC over 5 years after observation. For the TOGA experiment, a major goal of the NODC is to decrease this lag time to one year or less. One measure of JEDA's success to date is that delayed mode data already comprise 62% of the 1986 TOGA data set.

NODC Processing

The joint NODC/SIO system for TOGA Pacific thermal data enables both near-real-time and delayed mode data to be assimilated, quality controlled, and disseminated to TOGA scientists and other users as merged data sets and analytical data products (figure 2). The NODC receives delayed mode data on different media in different formats with varying levels of quality control. The first steps in the processing cycle are to convert all data to a common format and initiate data quality control.

XBT temperature profiles received by NODC as analog strip charts are digitized on an in-house

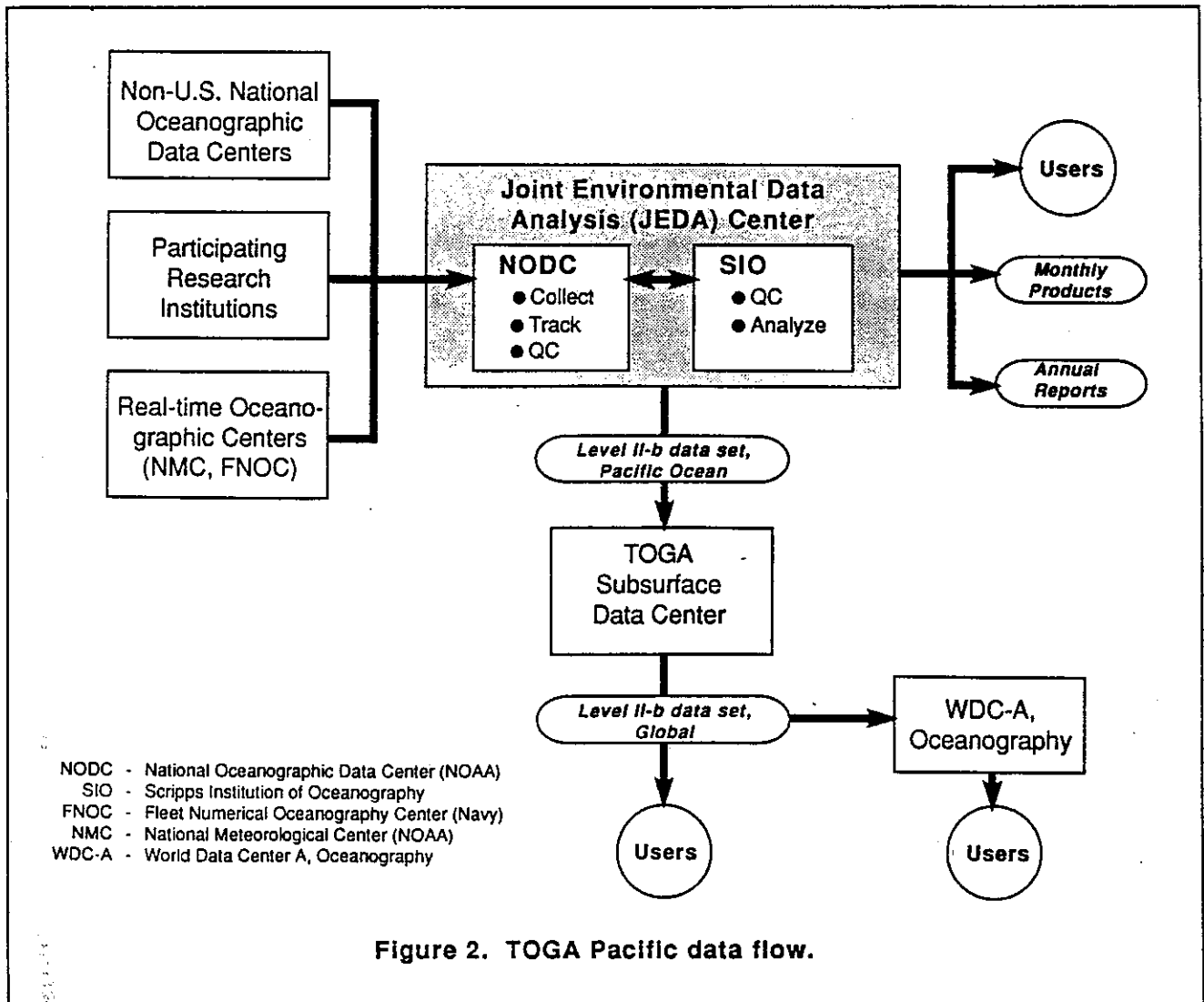


Figure 2. TOGA Pacific data flow.

microprocessor. Data received on cassettes (in one of four formats used by system vendors Sippican, Bathy Systems, Sutron, and SEAS III) are converted to engineering units, smoothed, reduced to inflection points, and converted to a common format. Data in tape or IBM diskettes are converted and if necessary reduced to inflection points.

Quality control procedures for delayed mode data include logic checks for duplicate observations, reasonable ship speed of advance, and other characteristics, plus scientific checks for reasonableness and consistency with ocean temperature climatology.

During the early stage of this effort, the radio message data was received monthly on tape, causing a great rush to process the data and deliver tapes to TOGA scientists so that monthly analyses may be made. Both NMC and FNOG

now create weekly files of quality controlled data that may be accessed via phone lines. The NODC downloads these files on a weekly basis so that the blending, quality control, and dissemination may be done in a timely fashion. Data are converted from the NMC and FNOG formats to the in-house format and then merged with the delayed mode data. If an observation is present both as a radio message and a delayed mode trace, the software discards the radio message data and keeps the delayed mode trace, which is normally of higher quality. Duplicate observations are defined as those with the same latitude, longitude, date, and time regardless of platform.

The merged data set is then downloaded to a personal computer tracking system, which:

- Checks the radio message data in a "cruise" mode to verify a logical speed of advance. Both NMC and FNOG perform

quality control as messages come in, but traces are generally not compared with previous and subsequent messages for continuity during a cruise.

- Checks for complete replacement of radio message data with delayed mode data. In many cases the date, time or position do not match exactly due to transmission problems.
- Checks for duplicate IGOSS data received via the NMC and FNOC networks. A large part of the data is identical and should be eliminated by the in-house software but for somewhat obscure reasons some "near duplicates" are found routinely.

Records with errors or "near duplicates" are corrected in the tracking system and the corrections are fed back into the data tape on NODC's VAX minicomputer. Of the 21,985 BT profiles accumulated after 30 months of system operation, about six percent were corrected after the personal computer system detected errors or discrepancies.

TOGA Data Tracking System

In addition to serving as a preliminary quality control tool, NODC's TOGA data tracking system serves several other functions:

- It is used to maintain an authority file to relate ship name, radio call sign, and country to individual casts. Table 1 shows the country of origin of Pacific TOGA BT data as determined by radio call signs.
- It allows ad hoc searches for generating statistics such as the amount of data received from a given time period or area. These searches are conducted using the report generation capabilities of the data base management system (Dataease) with which the system was implemented. Table 2, a summary of data distribution by longitude bands and year, is an example of such a report.
- By means of a proprietary plot package linked to the database, it generates dot plots showing distribution of data by country, ship, time period, or other search criteria.

Table 1. TOGA Pacific BTs by country, 1985-86 (as of July 1987)

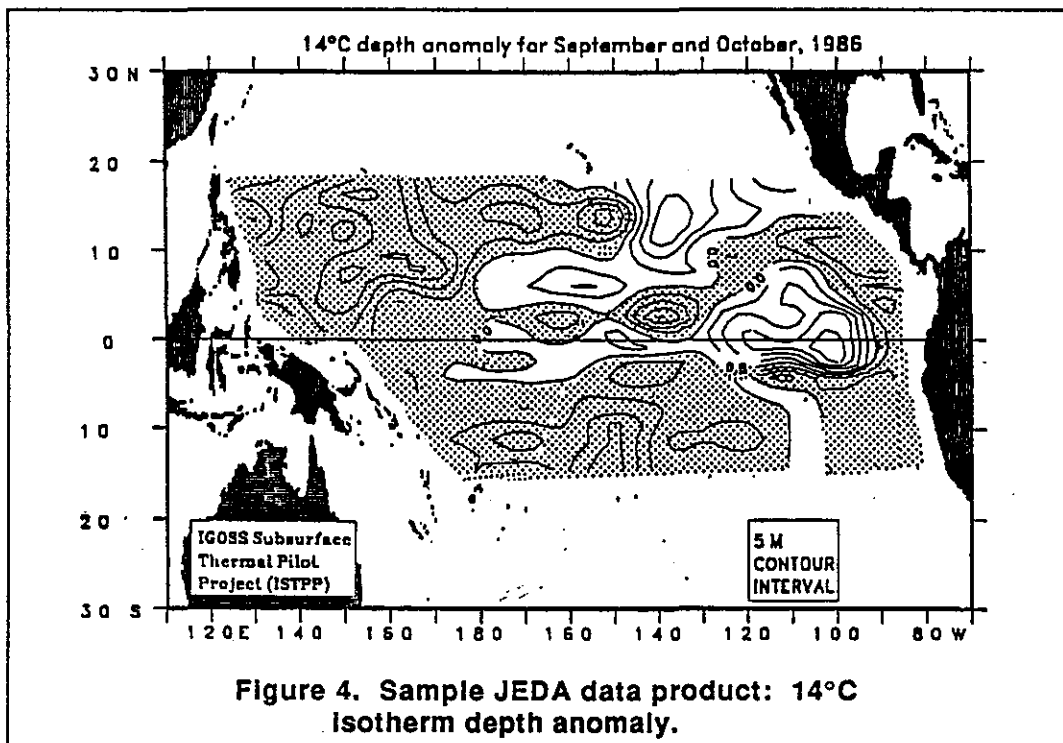
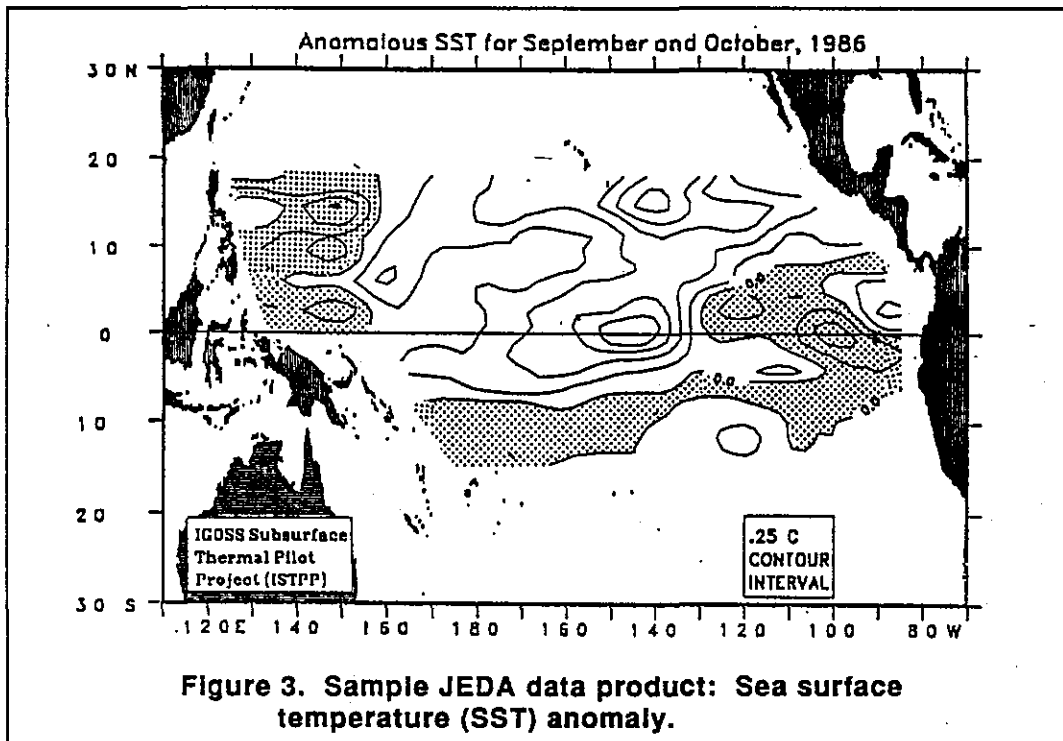
Country	1985	1986	Total
Australia	1019	1101	2120
Canada	10	0	10
China, PR of	57	472	529
Ecuador	68	79	147
France	1895	2724	4619
Germany, FR of	249	262	511
Japan	434	602	1036
New Zealand	96	24	120
Peru	73	152	225
USSR	972	1222	2194
USA	3722	5740	9462
Misc.	432	580	1012
TOTAL	9027	12,958	21,985

Table 2. TOGA Pacific BTs by longitude bands, 1985-86

Year	Longitude						TOTAL
	120°E	150°E	180°	150°W	120°W	90°W	
1985	2,235 (25%)	1,723 (19%)	2,422 (27%)	1,204 (13%)	919 (10%)	524 (6%)	9,027
1986	2,662 (21%)	1,694 (13%)	3,118 (24%)	2,256 (17%)	2,293 (18%)	935 (7%)	12,958
TOTAL	4,897 (22%)	3,417 (15%)	5,540 (25%)	3,460 (16%)	3,212 (15%)	1,459 (7%)	21,985

During the first week of each month, the JEDA Center at Scripps receives the previous month's data. They follow a series of quality control steps that includes comparing the data against itself and against historical models, and creating a series of monthly products for use by the TOGA scientific community. Examples of two such products are shown in figures 3 and 4. As a result

of these procedures, flags are inserted in the data to mark observations that differ from historical values or that cause errors (such as "bullseyes") in the data products. Approximately one year after the end of a data collection year, a delayed mode quality-controlled data set (Level II-b) is created for distribution to the scientific community. The data set for 1985 is now available from the NODC.



Summary

The data management system being used for TOGA Pacific subsurface thermal data is already meeting, in part, its objectives from both a data quality and quantity perspective. A number of factors are contributing to this success:

- NODC, SIO, and the U.S. TOGA Project office are cooperating in an active data acquisition program and are not passively waiting for data to "dribble in".
- Through the cooperation of FNOC, NOS, NMC, and NODC, data from real-time sources are becoming more usable. Digital systems for reporting real-time data--for example, the NOAA Shipboard Environmental Data Acquisition System (SEAS)--are partly responsible for this.
- Activities of the research community--here represented by SIO--are formally incorporated into the data management system. As a result, the data sets are well directed, are of better quality, and can be more widely disseminated and used. Based on the success of this prototype data management model, other data sets may be developed in a similar fashion.

Future Plans

The NODC will continue pursuing ways to increase the flow of tropical Pacific data into the NODC and speed up the process of compiling the monthly TOGA Pacific data tape. At the start of this project the NODC and SIO compiled a list of over 50 countries or agencies that may have held tropical Pacific thermal data not already submit-

ted to the NODC. Many of these sources have already been contacted and are now submitting data. During the coming year SIO or the NODC will contact the remaining sources to ensure that both the historic data base and the TOGA file are as complete as possible.

A number of improvements in data processing are also planned:

- At present the quality control (QC) of the radio message data is initiated by NMC and FNOC, carried forward by NODC during data compilation, and completed by SIO during data analysis and product generation. The NODC and SIO are working with NMC, FNOC, NOS, and others to improve the software presently being used, enhance the QC by adding improved climatology, and include the trace QC in the personal computer operation.
- Plans are also underway to enhance the ship authority file so that the NODC can serve as a focal point for this kind of information. At present files of this type are maintained by several groups.
- Because of the frequent name changes of ships and the constant addition and deletion of ships from various volunteer observing systems, there is a great deal of misinformation on ships, call signs, and dates of operation. Information from the enhanced authority file will be shared with all requestors.

Finally, to keep TOGA scientists aware of the status of the data base, this report will be issued annually.

Appendix A: TOGA Pacific BT data summary, 1985

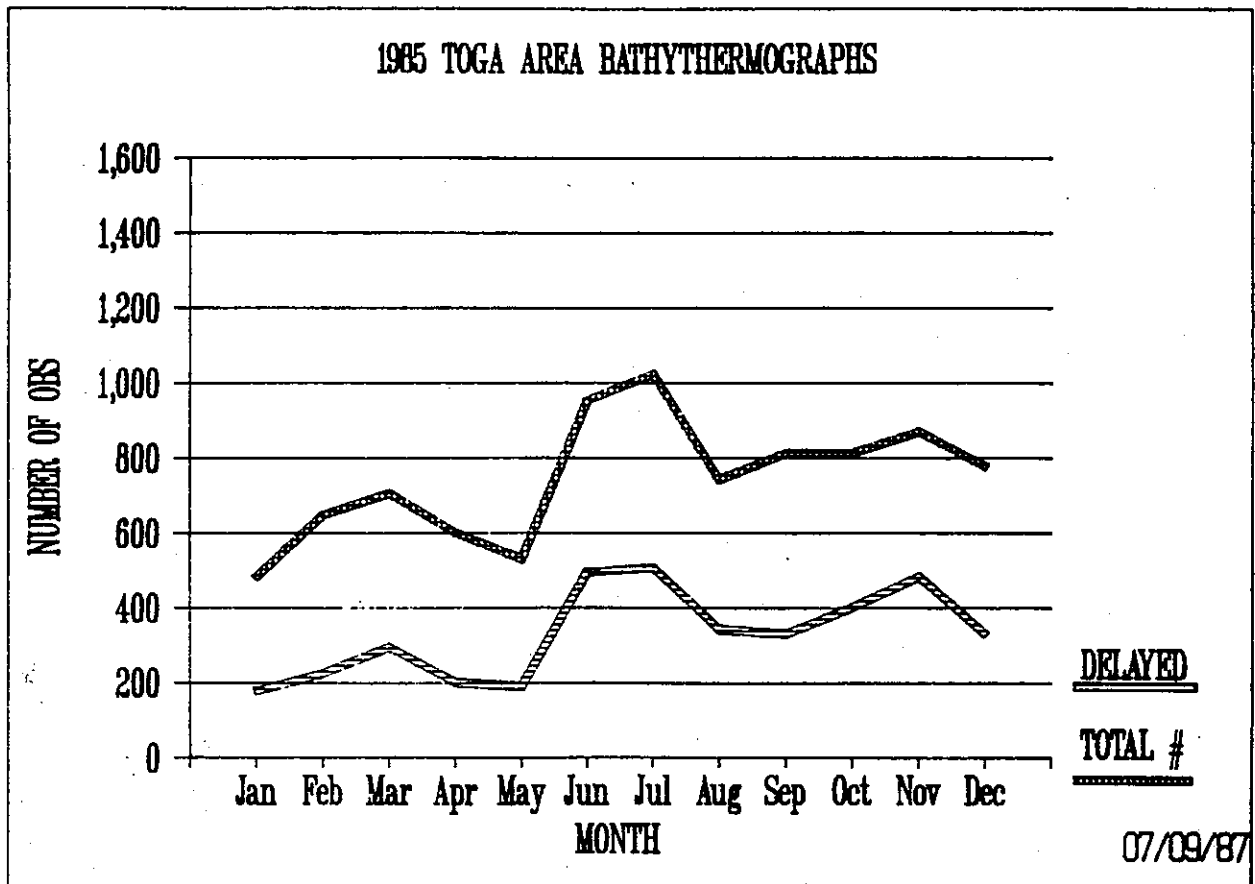


Figure A1. TOGA Pacific BT data 1985: Number of observations by month (delayed mode and total)

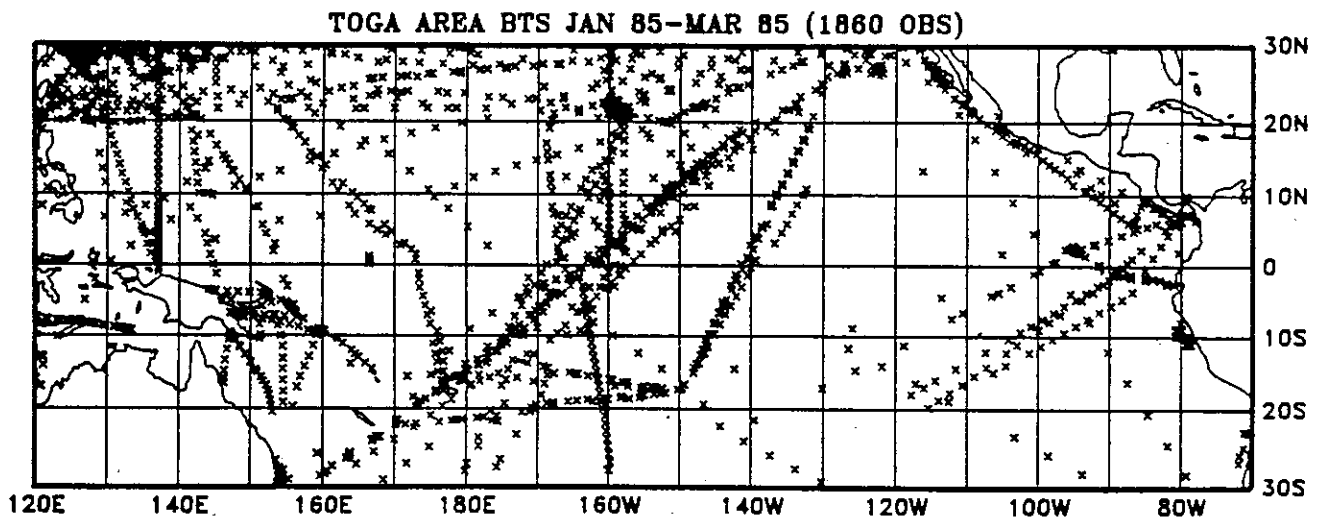
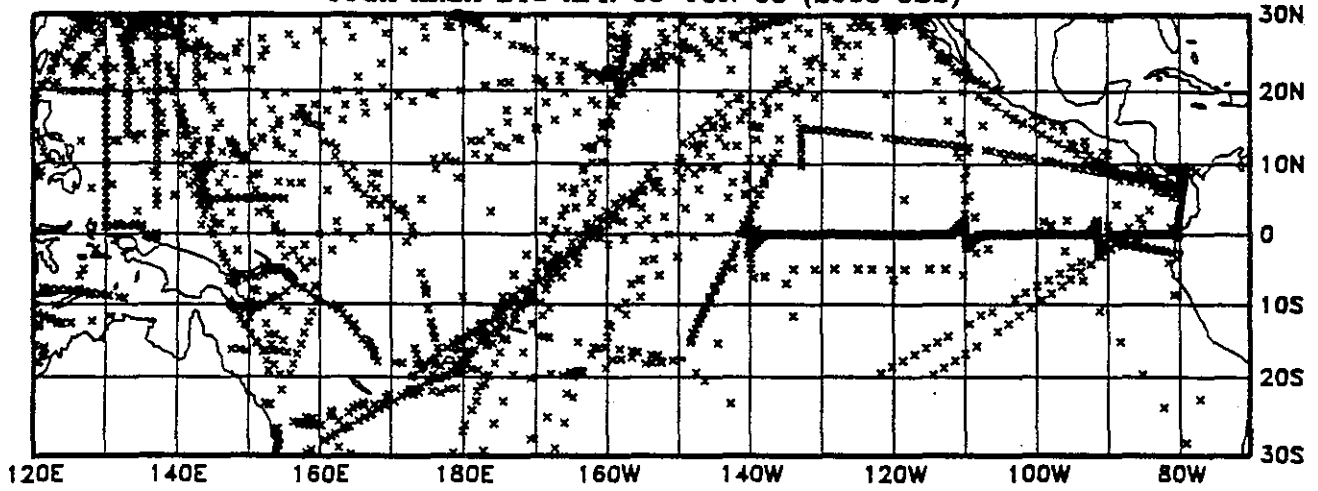
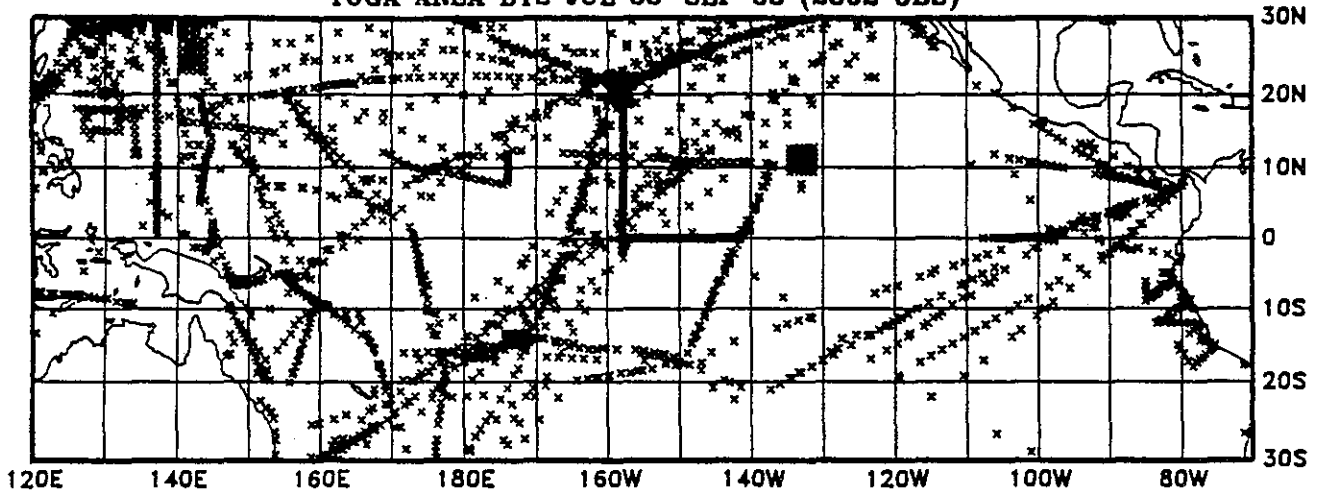


Figure A2. TOGA Pacific BT data, 1985: Point plots of observations by quarter

TOGA AREA BTS APR 85-JUN 85 (2095 OBS)



TOGA AREA BTS JUL 85-SEP 85 (2592 OBS)



TOGA AREA BTS OCT 85-DEC 85 (2480 OBS)

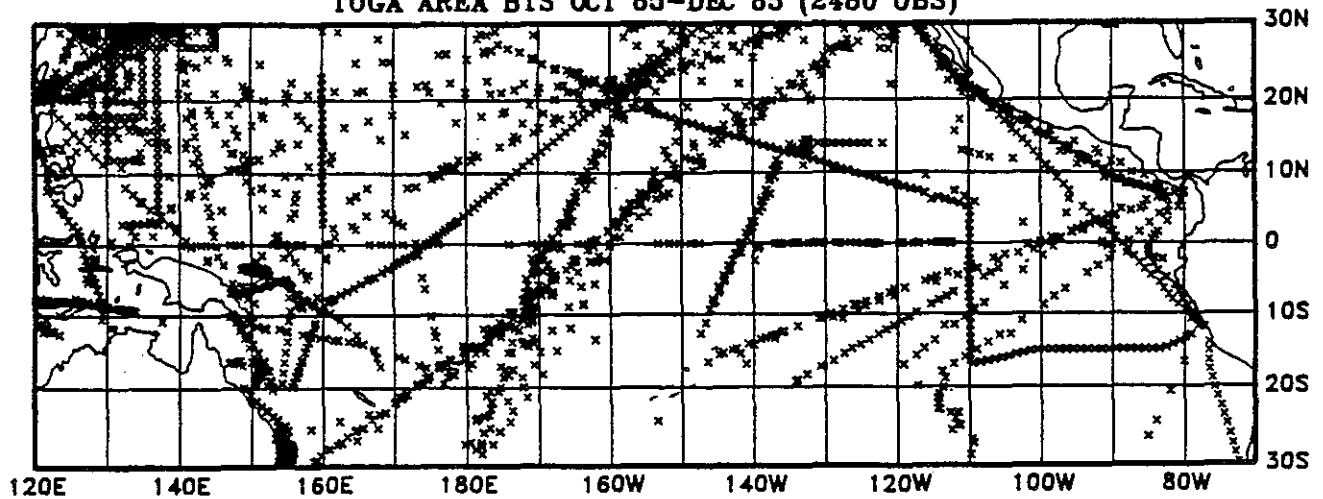


Figure A2. --Continued

Table A1. TOGA Pacific BT data, 1985: Summary listing
by country, project, and ship

COUNTRY	OP. AGENCY	SHIP	RADIO	DELAY
AUSTRALIA				
	CSIRO VOS			
		ANRO AUSTRALIA	0	80
		NIMOS	0	361
	Total for CSIRO VOS		0	441
	NAVY			
		ADELAIDE (F-1)	0	16
		BRISBANE (D-41)	19	4
		CANBERRA (F-2)	0	68
		COOK (A-219)	50	10
		DARWIN (F-4)	2	44
		FLINDERS (A-312)	0	64
		HOBART (D-39)	6	109
		PERTH (D-38)	44	44
		STUART (D-48)	0	8
		SYDNEY (F-3)	5	13
		YARRA (D-45)	2	25
	Total for NAVY		128	405
	UNKNOWN			
		CAPE PILLAR	0	45
	Total for UNKNOWN		0	45
	TOTAL for AUSTRALIA		128	891
CANADA				
	NAVY			
		PROVIDER (ADR-508)	10	0
	Total for NAVY		10	0
	TOTAL for CANADA		10	0
CHINA, P.R.				
	STATE OCEANIC ADMINISTRATION			
		XIANG YANG HONG 10	30	0
		XIANG YANG HONG 14	0	23
		XIANG YANG HONG 16	4	0
	Total for STATE OCEANIC ADMINISTRATION		34	23
	TOTAL for CHINA, P.R.		34	23
ECUADOR				
	INOCAR-AOML			
		BUCCANEER	5	45
		ISLA FLOREANA	18	0
	TOTAL for ECUADOR		23	45

Table A1. --Continued

FRANCE			
	NAVY		
		BORY, COMMANDANT (F-726)	14 0
	Total for NAVY		14 0
	ORSTOM-SIO		
		ACT 3	77 0
		ACT 4	74 0
		ACT 6	62 0
		CORIOLIS	19 0
		DILKARA	199 0
		JEBSEN SOUTHLAND	122 0
		LILLOOET	62 0
		MICRONESIAN COMMERCE	161 0
		MICRONESIAN INDEPENDANCE	93 0
		PACIFIC ISLANDER	216 0
		PARALLA	69 0
		POLYNESIA	223 0
		RODIN	137 0
		ROSTAND	34 0
		ROUSSEAU	75 0
		SIRIUS	20 0
		SOUTH ISLANDER	236 0
	Total for ORSTOM-SIO		1879 0
	UNKNOWN		
		POINTE MADAME	1 0
		UNKNOWN	1 0
	Total for UNKNOWN		2 0
	TOTAL for FRANCE		1895 0
GERMANY, F.R.			
	NAVY		
		DUREN (M-1079)	1 0
		SPIEKEROOG (A-1452)	0 202
	Total for NAVY		1 202
	UNKNOWN		
		NEDLLOYD VAN DIEMEN	25 0
		SONNE	21 0
	Total for UNKNOWN		46 0
	TOTAL for GERMANY, F.R.		47 202
JAPAN			
	NAVY		
		SHOYO (HL-01)	39 0
	Total for NAVY		39 0
	UNKNOWN		
		CHOFU MARU	78 0
		KAIYO MARU	12 0
		KEIFU MARU	37 0
		RYOFU MARU	161 0
		SHUMPU MARU	35 0
		SOYO MARU	45 0

Table A1. --Continued

	TAKUYO	26	0
	YOKO MARU	1	0
Total for UNKNOWN		395	0
TOTAL for JAPAN		434	0

NEW ZEALAND			
	UNKNOWN		
	CANTERBURY	0	58
	SOUTHLAND	0	24
	WAIKATO	0	14
Total for UNKNOWN		0	96
TOTAL for NEW ZEALAND		0	96

PERU			
	DHNM/AOML		
	SNP-1	0	73
Total for DHNM/AOML		0	73
TOTAL for PERU		0	73

U.S.S.R.			
	NAVY		
	FROLOV, VYACHESLAV	24	0
	KHROMOV, PROFESSOR	197	0
	KOROLEV, ADADEMIK	88	0
	OKEAN	248	0
	PRIBOY	187	0
	PRILIV	60	0
	SHIRSHOV, AKADEMIC	115	0
	SHOKALSKIY, AKADEMIK N.	27	0
	URYVAYEV, VALERIAN	8	0
Total for NAVY		954	0
	UNKNOWN		
	NOVOULYANOVSK	1	0
	TYMOVSK	1	0
	VOYEYKOV, A. I.	16	0
Total for UNKNOWN		18	0
TOTAL for U.S.S.R.		972	0

UNITED STATES			
	COAST GUARD		
	BOUTWELL (WHEC-719)	7	0
	GLACIER (WAGB-4)	30	51
	JARVIS (WHEC-725)	7	45
	MELLON (WHEC-717)	2	0
	MIDGETT (WHEC-726)	15	0
	MORGENTHAU (WHEC-722)	31	0
	MUNRO (WHEC 724)	12	93
	POLAR SEA (WAGB-11)	0	33
	POLAR STAR (WAGB-10)	2	106
	RUSH (WHEC 723)	1	9
Total for COAST GUARD		107	337

Table A1. --Continued

FNOC-Cooperative program		
CALIFORNIA STAR	8	0
COLUMBIA STAR	7	0
COLUMBUS VICTORIA	2	318
COLUMBUS VIRGINIA	9	248
COLUMBUS WELLINGTON	127	0
FALSTRIA	16	2
JOHNSON, AXEL	3	0
KOREAN FIR	6	0
KOREAN PRIDE	2	0
MELVILLE (AGOR-14)	7	0
MISPELLION (AO-105)	2	0
NEDLLOYD KEMBLA	27	31
NEDLLOYD KIMBERLY	3	89
NEDLLOYD KINGSTON	41	92
NEDLLOYD KYOTO	1	0
PACBARON	34	0
PACDUCHESS	19	0
PACDUKE	20	0
PACMERCHANT	1	20
RAINIER (NOAA)	2	0
SEALIFT ARCTIC (AOT-175)	25	0

Total for FNOC-Cooperative program	362	800
NAVY		
AIRCRAFT	66	0
BREWTON (FF-1086)	1	0
BROOKE (FFG-1)	1	0
CALIFORNIA (CGN-36)	3	0
CALLAGHAN (DDG-994)	0	86
CHAUVENET (AGS-29)	1	0
COCHRANE (DDG-21)	1	0
CONSTELLATION (CV-64)	1	0
CROMMELIN (FFG-37)	1	20
DAVIDSON (FF-1045)	0	18
DOWNES (FF-1070)	6	0
ELLIOT (DD-967)	0	28
ENGLAND (CG-22)	1	0
FANNING (FF-1076)	2	9
FIFE (DD-991)	0	31
FOX (CG-33)	0	27
GOLDSBOROUGH (DDG-20)	2	0
GRIDLEY (CG-21)	4	0
HALSEY (CG-23)	1	0
HEPBURN (FF-1055)	1	0
HOEL (DDG-13)	1	0
HORNE (CG-30)	1	0
JARRETT (FFG-33)	0	35
JOUETT (CG-29)	0	8
KITTY HAWK (CV-63)	2	0
KNOX (FF-1052)	2	0
MCCCLUSKY (FFG-41)	17	0
MCCORMICK, LYNDE (DDG-8)	1	40
MOORE, JOHN A. (FFG-19)	2	18
PEARY, ROBERT E. (FF-1073)	0	18
PELILEU (LHA-5)	6	0
PULLER, LEWIS B. (FFG-23)	1	0
RATHBURNE (FF-1057)	1	12
REASONER (FF-1063)	1	0
SAMPLE (FF-1048)	0	16
SCHOFIELD (FFG-3)	1	0
SOUTH CAROLINA (CGN-37)	1	0

Table A1. --Continued

	STERETT (CG-31)	1	0
	STUMP (DD-978)	1	0
	TEXAS (CGN-39)	1	0
	TISDALE, MAHLON S. (FFG-27)	0	1
	U.S.NAVAL OCEANOGRAPHIC OFFICE	1	0
	VINSON, CARL (CVN-70)	23	0
Total for NAVY		168	373
NOAA			
	ARCO RESOLUTION	8	0
	CROMWELL, TOWNSEND (NOAA)	54	208
	DE STEIGUER (AGOR-12)	2	0
	DISCOVERER (NOAA)	59	1
	MOANA WAVE (AGOR-22)	3	492
	OCEANOGRAPHER (NOAA)	2	0
	RESEARCHER (NOAA)	72	128
	THOMPSON, THOMAS G.	17	76
Total for NOAA		217	905
PACIFIC MISSILE RANGE			
	PACIFIC MISSILE RANGE	116	0
Total for PACIFIC MISSILE RANGE		116	0
SIO-Transpac			
	ASIA MARU	5	0
	CHEVRON CALIFORNIA	16	35
	ELBE EXPRESS	0	75
	EXXON JAMESTOWN	0	143
	HAKUSAN MARU	2	0
	HIEI MARU	2	0
	HIKAWA MARU	3	0
	HIRA MARU	1	0
	PACIFIC ARROW	3	0
	PACIFIC TRADER	1	0
	QUEENS WAY BRIDGE	1	1
	RICHMOND BRIDGE	1	0
	SHOYO MARU	9	0
	WESER EXPRESS	0	34
Total for SIO-Transpac		44	288
UNKNOWN			
	SOUTH GLORY	5	0
Total for UNKNOWN		5	0
TOTAL for UNITED STATES		1019	2703

UNKNOWN	UNKNOWN	UNKNOWN	290 0
Total for UNKNOWN		290	0
TOTAL for UNKNOWN		290	0

Appendix B: TOGA Pacific BT data summary, 1986

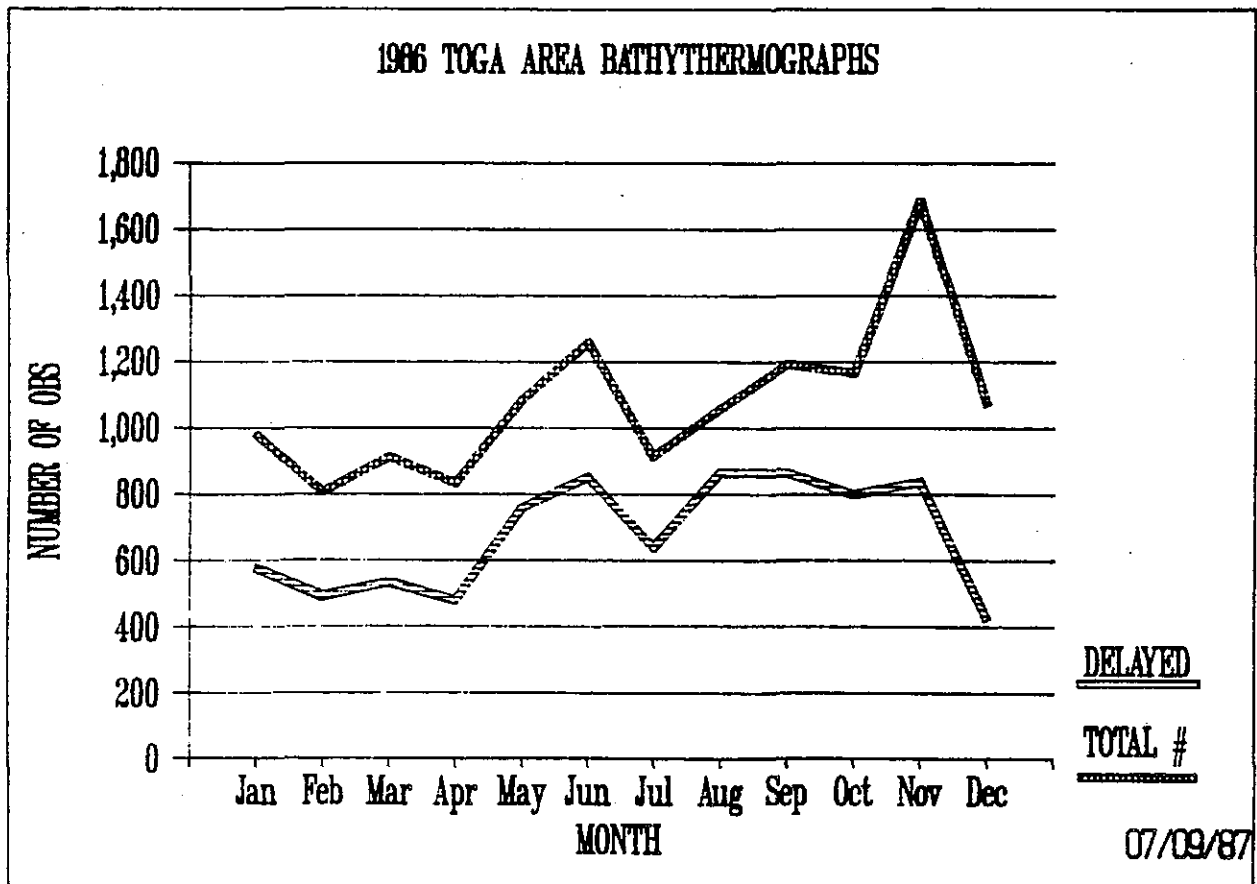


Figure B1. TOGA Pacific BT data, 1986: Number of observation by month (delayed mode and total)

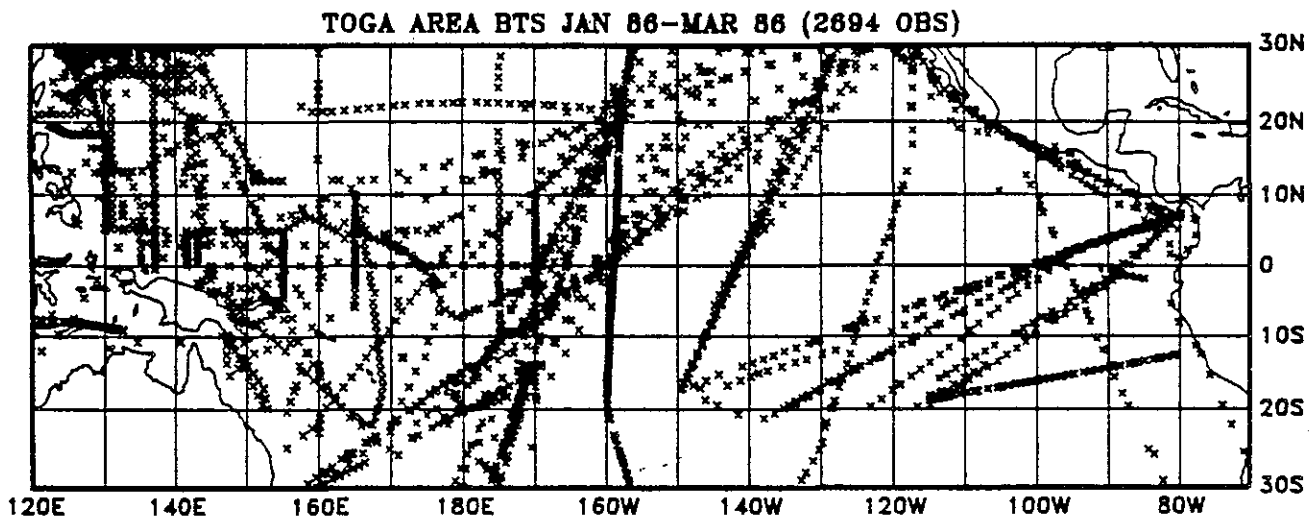
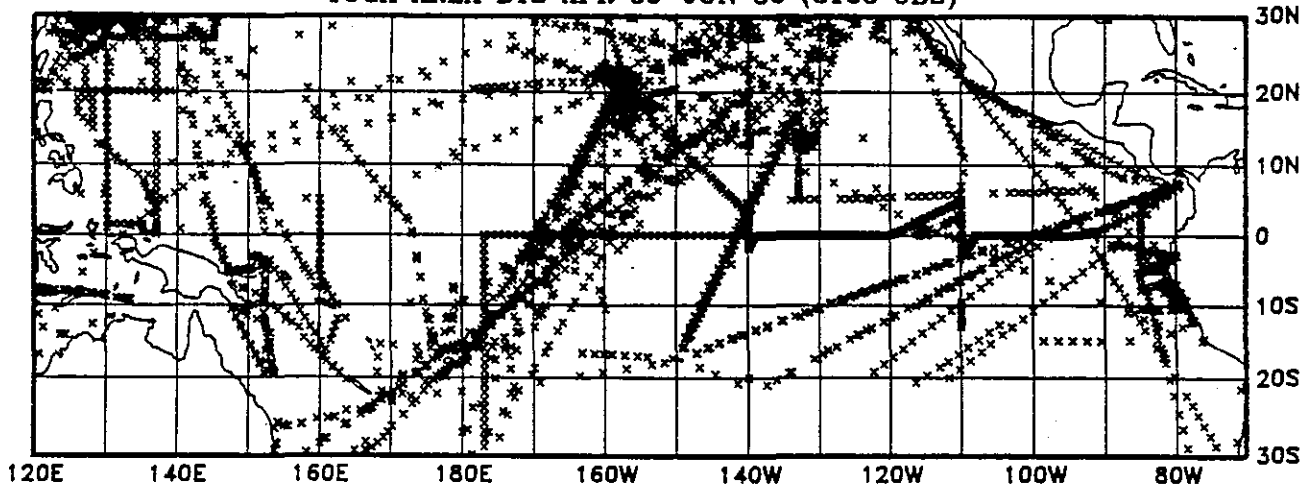
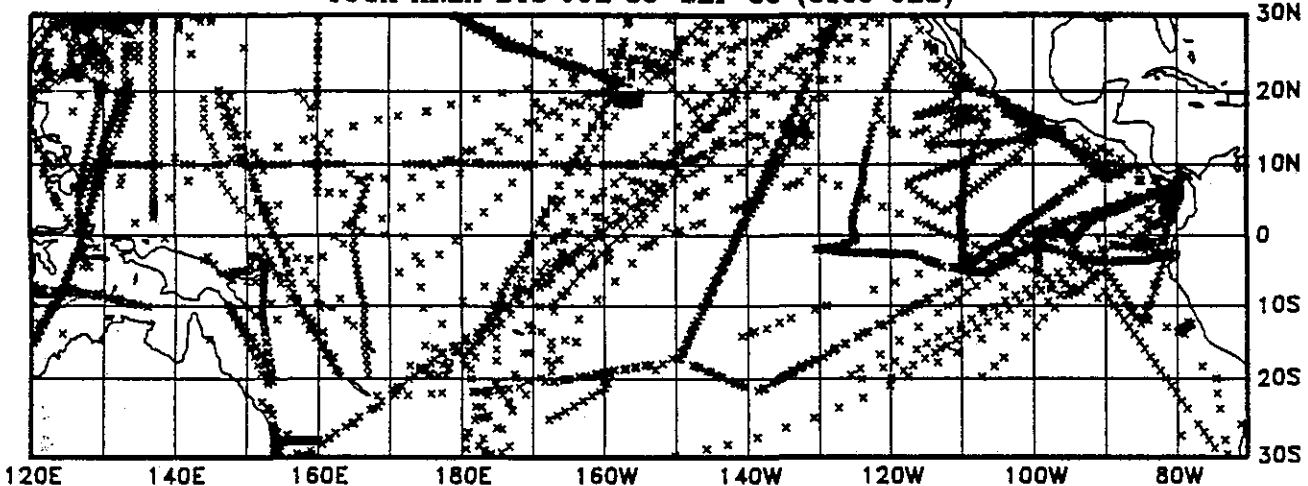


Figure B2. TOGA Pacific BT data, 1986: Point plots of observations by quarter

TOGA AREA BTS APR 86-JUN 86 (3183 OBS)



TOGA AREA BTS JUL 86-SEP 86 (3169 OBS)



TOGA AREA BTS OCT 86-DEC 86 (3912 OBS)

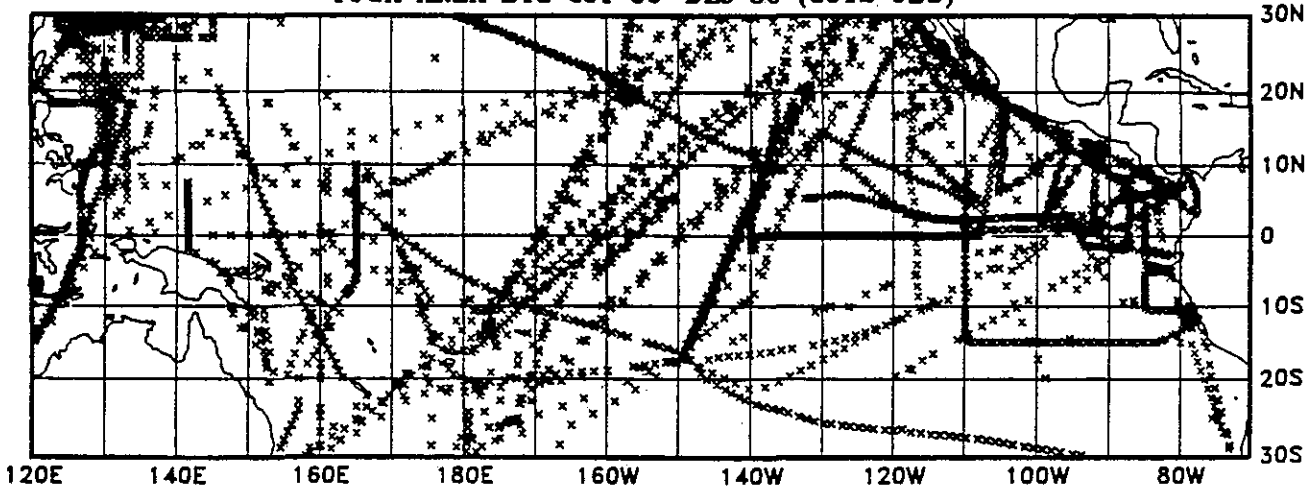


Figure B2. --Continued

Table B1. TOGA Pacific BT data, 1986: Summary listing
by country, project, and ship

COUNTRY	OP. AGENCY	SHIP	RADIO	DELAY
AUSTRALIA				
	CSIRO VOS			
		ANRO ASIA	0	22
		ANRO AUSTRALIA	0	47
		AUSTRALIAN PROGRESS	166	172
		NIMOS	21	247
	Total for CSIRO VOS		187	488
	NAVY			
		ADELAIDE (F-1)	5	0
		CANBERRA (F-2)	3	2
		COOK (A-219)	97	0
		DARWIN (F-4)	2	114
		DERWENT (D-49)	22	0
		HOBART (D-39)	2	0
		PARRAMATTA (D-46)	13	0
		PERTH (D-38)	9	0
		SWAN (DE-50)	0	3
		SYDNEY (F-3)	7	140
		TORRENS (D-53)	7	0
	Total for NAVY		167	259
	TOTAL for AUSTRALIA		354	747
CHINA, P.R.				
	STATE OCEANIC ADMINISTRATION			
		JIDA	114	0
		XIANG YANG HONG 05	32	83
		XIANG YANG HONG 09	6	0
		XIANG YANG HONG 10	0	50
		XIANG YANG HONG 14	0	136
		XIANG YANG HONG 16	51	0
	Total for STATE OCEANIC ADMINISTRATION		203	269
	TOTAL for CHINA, P.R.		203	269
ECUADOR				
	INOCAR-AOML			
		BUCCANEER	62	2
		ISLA FLOREANA	15	0
	Total for INOCAR-AOML		77	2
	TOTAL for ECUADOR		77	2

Table B1. --Continued

FRANCE			
	ORSTOM-SIO		
	ACT 3	16	55
	ACT 4	2	74
	ACT 6	24	98
	CORIOLIS	0	58
	DILKARA	2	195
	JEBSEN SOUTHLAND	108	162
	LILLOET	85	193
	MICRONESIAN COMMERCE	55	85
	MICRONESIAN INDEPENDANCE	1	118
	MOANA PACIFIC	28	335
	PACIFIC ISLANDER	2	137
	POLYNESIA	7	312
	RODIN	5	180
	ROSTAND	22	105
	ROUSSEAU	76	194
	Total for ORSTOM-SIO	433	2291
	TOTAL for FRANCE	433	2291
GERMANY, F.R.			
	NAVY		
	SPIEKEROOG (A-1452)	0	219
	Total for NAVY	0	219
	UNKNOWN		
	SONNE	43	0
	Total for UNKNOWN	43	0
	TOTAL for GERMANY, F.R.	43	219
JAPAN			
	NAVY		
	SHOYO (HL-01)	110	0
	Total for NAVY	110	0
	UNKNOWN		
	CHOFU MARU	121	0
	KAIYO MARU	41	0
	KEIFU MARU	51	0
	KOFU MARU	1	0
	RYOFU MARU	184	0
	SHUMPU MARU	33	0
	SHUNYO MARU	10	0
	SOYO MARU	10	0
	TAKUYO	30	0
	YOKO MARU	11	0
	Total for UNKNOWN	492	0
	TOTAL for JAPAN	602	0

Table B1. --Continued

NEW ZEALAND			
	UNKNOWN		
	CANTERBURY	2	21
	MONOWAI	1	0
	Total for UNKNOWN	3	21
	TOTAL for NEW ZEALAND	3	21
PERU			
	DHNM/AOML		
	SKRIM	90	0
	SNP-1	0	62
	Total for DHNM/AOML	90	62
	TOTAL for PERU	90	62
U.S.S.R.			
	NAVY		
	FROLOV, VYACHESLAV	23	0
	KHROMOV, PROFESSOR	209	0
	KOROLEV, ADADEMIK	202	0
	OKEAN	107	0
	PRIBOY	65	0
	PRILIV	47	0
	SHIRSHOV, AKADEMIC	146	0
	SHOKALSKIY, AKADEMIK N.	159	0
	URYVAYEV, VALERIAN	35	0
	USHAKOV, GEORGY	77	0
	ZUBOV, PROF.	26	0
	Total for NAVY	1096	0
	UNKNOWN		
	BYKOVSKIY, VALERIY	5	0
	SHAPOSHNIKOVE	1	0
	VOYEYKOV, A. I.	120	0
	Total for UNKNOWN	126	0
	TOTAL for U.S.S.R.	1222	0
UNITED STATES			
	COAST GUARD		
	GLACIER (WAGB-4)	91	0
	JARVIS (WHEC-725)	19	12
	MIDGETT (WHEC-726)	58	0
	MORGENTHAU (WHEC-722)	9	0
	MUNRO (WHEC 724)	47	0
	POLAR SEA (WAGB-11)	44	0
	POLAR STAR (WAGB-10)	5	30
	RUSH (WHEC 723)	19	0
	Total for COAST GUARD	292	42
	FNOC-Cooperative program		
	AVON (EX MONTE SARMIENTO, COL.T	60	53
	CALIFORNIA STAR	24	0
	COLUMBUS VICTORIA	30	244
	COLUMBUS VIRGINIA	33	210

Table B1. --Continued

COLUMBUS WELLINGTON	185	0
GAUGUIN	0	110
MELVILLE (AGOR-14)	70	0
NEDLLOYD KEMBLA	33	77
NEDLLOYD KIMBERLY	26	83
NEDLLOYD KINGSTON	36	124
PACBARON	7	0
PACMERCHANT	13	5
PACPRINCESS	1	11
SAXON STAR	19	72
SEALIFT ARCTIC (AOT-175)	8	24
SEALIFT PACIFIC (AOT-168)	19	0
Total for FNOC-Cooperative program	564	1013
NAVY		
AIRCRAFT	5	0
BRADLEY (FF-1041)	1	0
CHAUVENET (AGS-29)	88	13
CURTS (FFG-38)	8	0
FOSTER, PAUL F. (DD-964)	3	0
GOLDSBOROUGH (DDG-20)	2	0
HOLT, HAROLD E. (FF-1074)	2	0
JOUETT (CG-29)	0	39
MERRILL (DD-976)	1	66
MEYERKORD (FF-1058)	1	0
NICHOLSON (DD-982)	1	0
PEARY, ROBERT E. (FF-1073)	0	28
RATHBURNE (FF-1057)	0	58
STANDLEY, WILLIAM H. (CG-32)	3	0
THACH (FFG-43)	0	26
TISDALE, MAHLON S. (FFG-27)	1	50
TOWERS (DDG-9)	0	11
VINSON, CARL (CVN-70)	52	0
WHIPPLE (FF-1062)	0	6
WORDEN (CG-18)	5	0
Total for NAVY	173	297
NOAA		
ANDERSON, PETER	1	0
BALD EAGLE	5	33
CHEVRON MISSISSIPPI	4	13
CROMWELL, TOWNSEND (NOAA)	222	238
DAY STAR	4	26
ELGAREN	44	176
JORDAN, DAVID STARR (NOAA)	1	553
MCARTHUR (NOAA)	5	541
MOANA WAVE (AGOR-22)	19	175
MOUNT MITCHELL (NOAA)	5	31
NAVIGATOR	2	0
OCEANOGRAPHER (NOAA)	16	683
RESEARCHER (NOAA)	1	0
SEA HAVEN	0	9
SURVEYOR (NOAA)	1	222
Total for NOAA	330	2700

Table B1. --Continued

SIO-Transpac			
	ASIA MARU	1	0
	CAP ANAMUR	2	0
	CHEVRON CALIFORNIA	1	75
	ELBE	1	80
	EXXON JAMESTOWN	9	128
	HIKAWA MARU	1	0
	LIONS GATE BRIDGE	2	0
	SEAL ISLAND	14	0
	SHOYO MARU	15	0
Total for SIO-Transpac		46	283
TOTAL for UNITED STATES		1405	4335

UNKNOWN	UNKNOWN	441	0
Total for UNKNOWN		441	0
TOTAL for UNKNOWN		443	0