

Intergovernmental Oceanographic Commission
technical series

23

Operational sea-level stations

Unesco 1983

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ISBN 92-3-102104-4

French edition 92-3-202104-8

Spanish edition 92-3-302104-1

Russian edition 92-3-402104-5

Published in 1983

by the United Nations Educational,
Scientific and Cultural Organization,
7, place de Fontenoy, 75700 Paris

Composed and printed in

Unesco's workshops

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Printed in France

Preface

Coastal and island tide records comprise some of the largest and most reliable oceanic time series data in existence. Used in conjunction with wind, atmospheric pressure, sea-surface temperature or other water property measurements they can yield valuable information on non-tidal oceanic variability, particularly ocean transport over seasonal and interannual time scales. Changes in sea-level have many other applications, such as to give a better picture of the mechanisms and predictability of storm surges and an integrated indication of changes in ocean conditions that affect fisheries, for example the intensity and time of the annual upwelling of the Malabar coast.

Discussions between the Intergovernmental Oceanographic Commission and its subsidiary bodies, the SCOR/IOC Committee on Climatic Changes and the Ocean (CCCCO) and the Joint WMO/IOC Working Committee for the Integrated Global Ocean Services System (IGOSS) and the Permanent Service for Mean Sea-Level (PSMSL) have identified a need for an expanded network of tide gauges and an enhanced system of sea-level data exchange for studies of the influence of the oceans on climate change and subsequent operational schemes for forecasting such changes.

As a first step in support of the effort to expand the network and enhance the data exchange system, the PSMSL has

undertaken this survey to determine the present state of sea-level monitoring throughout the world. It will be used by those planning ocean research and service projects to define their ocean monitoring system requirements and to foster the submission of sea-level data to the PSMSL.

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The Permanent Service for Mean Sea-Level is a member of the Federation of Astronomical and Geophysical Services (FAGS) established by the International Council of Scientific Unions. Under the aegis of the International Association for the Physical Sciences of the Ocean, PSMSL is charged with the collection, dissemination and analysis of mean sea-level data. Financial support for PSMSL is received from Unesco through FAGS and through the Intergovernmental Oceanographic Commission, and from the United Kingdom Natural Environment Research Council.

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Introduction

Discussions over the past two years, between PSMSL and several international organisations, including the Inter-governmental Oceanographic Commission and its related bodies, the Committee on Climatic Changes and the Ocean (CCCCO), and The Integrated Global Ocean Services System (IGOSS), have identified a possible need for an enhanced system of sea-level data exchange, as an input both to studies of the influence of the oceans on climate change, and to subsequent operational schemes for forecasting such changes.

Although the relationships between changes in mean sea-level and changes in climate are neither simple nor direct, there are several advantages when considering sea-level as a representative oceanographic input to studies of climate change. Sea-level records, many of which extend over 100 years, are among the longest available series of ocean measurements. Also, sea-levels are relatively cheap and easy to measure continuously, when compared with programmes to monitor currents or thermohaline variations. By careful site selection it is possible to obtain values which are likely to be more representative of oceanographic processes over an extensive area, than are current or temperature/salinity measurements made at a single station.

For studies of climate changes, three potential applications of sea-level, corrected for vertical land movements, may be identified:

- (1) Long-term trends in the global mean level over several decades due to changes in the volume of water in the oceans. A rise of 0.12 m over the past century has been estimated. Such changes may be due to a rise in the average ocean temperature, or to a melting of grounded ice caps, both of which imply climatic change.
- (2) Shorter-term variations, of more local extent, over periods from several days to years. These are due to changes in the ocean's density structure and to changes in circulation patterns. In the case of changes in current patterns, mean sea-level will respond through changes in the sea-surface gradients which balance the geostrophic accelerations.
- (3) Measurements of instantaneous sea-level at specific

locations under the tracks of satellites which are making altimetry measurements, may be used for making 'ground truth' zero adjustments.

These three applications imply an increasing urgency for the data transmission, but a progressive decrease in the accuracy required. Over long periods the need is for stable datum control to within as few millimetres, but delays of a year or more before the data are available, are quite acceptable. At the other extreme, for 'ground truth' applications, an accuracy of a few centimetres may be acceptable, but the data are needed within days.

Traditionally PSMSL has collected, checked and published monthly mean sea-levels, and has paid particular attention to problems of datum definition and stability. Data are now received after a delay which varies from one to several years, from a network of national authorities, principally hydrographic departments, mapping agencies and oceanographic data centres. If there is a need for mean levels averaged over periods shorter than a month, and for more immediate data availability, then the active participation of such authorities is essential: no central international agency could be responsible for the technicalities of local measurement, or for the labour involved in the attendant data reduction.

At the request of its Advisory Committee, the IAPSO Committee on Tides and Mean Sea-Level, PSMSL has conducted a survey of all past, present and potential suppliers of sea-level data. The aims were to establish details of existing gauges, and to determine which authorities would be willing to co-operate in more rapid data transmission and in the installation of new equipment. Apart from its relevance to CCCC considerations, this survey has proved timely and valuable for PSMSL in the re-establishment of broken contacts with previous data sources, and in the identification of new sources.

A similar survey was published by PSMSL, under the auspices of IOC, in 1964, in an attempt to improve the global coverage of sea-level stations. The progress made as a result of this earlier survey is summarised in Appendix 3 to the present report.

Survey design

A copy of the questionnaire, entitled 'International Survey of Sea-Level Measurements' may be found in Appendix 1. The two main objectives: to gain a detailed inventory (as well as an overall impression) of the number and position of tide gauges currently in operation, and to explore the likely support of national authorities for participation in more extensive and rapid international data exchange, were covered in six questions, five of which required short (e.g. YES/NO) answers. The first question asked for details of the gauges currently in operation, and the completion of a table giving these details including what data (i.e. hourly, daily and monthly sea-levels) was available from these gauges. Questions 2, 3 and 4 were concerned with the willingness and ability of the authorities in question to participate in near-real-time data exchange (question 2), to participate in an international experiment to furnish a global data set of mean sea levels (question 3), and to extend the network of sea-level stations by co-operating in the installation of equipment in their countries at international expense (question 4). Question 5 asked for further organisations we could approach about these matters, and question 6 was to identify user interest in data exchange rather than just

the supply of data.

It was stressed that no definite commitment would be implied from the responses to the questionnaire. Therefore the numbers quoted are only preliminary indications of the support for the activities suggested.

An explanatory letter was sent with each questionnaire (also in Appendix 1) which gave the reasons for the survey and urged a positive response.

A copy of the questionnaire was sent with the accompanying letter to 204 addresses. Most of these addresses were those of individuals or organizations with whom we had had some contact in the past: 61 were regular suppliers of data, some had provided data previously but had lost contact, and some were recipients of data from PSMSL who were likely to know of further sources of information even if they could not help us themselves. All these addresses were already on the PSMSL address list. Other sources of addresses were the Pacific tsunami warning system network, and the questionnaires themselves (see question 5). We have not yet received replies from the addresses obtained from the latter source.

In all, questionnaires were sent to 98 countries.

Summary of response

From the 204 questionnaires sent to organizations and individuals, 82 replies were received by 1 July 1982 (40 per cent). Of those who replied, 16 had not completed the questionnaire as they were not responsible for gauges; a further 8 who did not operate gauges had completed the questionnaire as far as they were able.

Fifty-eight organizations who replied are currently running a

total of 743 gauges. Seven of these organizations are responsible for gauges not just on the coastline of their own nation but elsewhere. These include Prof K. Wyrki (U.S.A.) who has a network of gauges on Pacific islands.

Names and addresses of the 82 organizations who replied to the questionnaire are given in Appendix 2.

Details of gauges

The responses to question 1 are summarised in Tables 1 (a to e). Table 1a gives a complete list of the gauges known to be operating from replies to the questionnaire, sequenced round the world coastlines in an easterly direction from Europe to eastern and northern Canada. Also in this table are the index numbers of the authorities responsible for the gauges (a list of whom appears as Appendix II), and the details, if given/known, of the types of gauges in use and the methods of reduction used.

In addition, Table 1a has appended a list of gauges known, through recent correspondence with the appropriate authorities, to be functioning, although their replies to the questionnaire have not yet been received.

The positions of all these gauges are plotted on maps 1-7:

Map 1 Europe

2 Africa and Middle East

3 Far East

4 Australia

5 New Zealand and Pacific Ocean

6 North America

7 Central and South America, Antarctica

Table 1b gives a summary, by country, of the number of gauges in operation. Tables 1c to 1e give details, by country, of the number of gauges from which hourly, daily and monthly mean values are available, and whether these are available in computer compatible format.

What would be the shortest time delay between measurement and sending the data to PSMSL?

At present, national authorities send monthly and annual mean values to PSMSL annually (regular suppliers) or every three to five years (on reminder or request). All of this data has, until very recently, been sent in tabulated form (i.e. not computer compatible), although we are now beginning to receive data from some larger organizations on magnetic tape. Hourly and daily mean values are not currently banked by PSMSL.

Tables 2 a), b), c) represent the response to this question, in conjunction with details of data available gleaned from question 1. Of the 37 organizations who replied to this question from whom hourly data is available, 12 can provide this data within a month of measurement, and 26 within 3 months.

Roughly half of the organizations (representing over 2/3 of the gauges) would send data in computer compatible format. The same proportions are true for daily mean values, where the organizations concerned overlap but are not all the same. Two organizations responsible for gauges who are not currently reducing the data from their gauges indicated that data could be provided within a month of measurement if reduction was started, which is an encouraging indication of willingness to co-operate.

Would you be prepared to send hourly data to PSMSL in a computer compatible format for the period of an international experiment extending over 3-5 years?

Fifty-one organizations replied to this question. Twenty-eight were willing to participate in such a venture (Table 3) and 23 were not willing. Many of those who said no do not presently have the facilities to send data in a computer compatible format, and this may have been the reason for their response.

Would you be prepared to co-operate in the installation, if necessary, of new equipment in your coun-

try, at international expense, in order to facilitate data exchange?

Table 4 lists 52 organizations who would be interested in this suggestions.

Which other organizations in your country, having responsibility for sea-level measurement and data reduction, could PSMSL approach?

Following the replies to this question, questionnaires were sent to a further 14 organizations. Replies from these have not yet been received.

Would you be interested in receiving sea-level data at more frequent intervals, through PSMSL, from other countries?

Thirty-five organizations expressed an interest in receiving sea-level data at more frequent intervals. Eight of these organizations particularly requested data from neighbouring countries. One organization was keen to receive regular updates to existing data.

Comment

The following countries, from whom no reply to the questionnaire has been received, are known, through recent correspondence, to have gauges in operation.

	No. of gauges known
Iceland	1
USSR	8
East Germany	3
Yugoslavia	?
Seychelles	2
Kenya	1
India	?
Sri Lanka	1
Argentina (+ Antarctica)	8 (+2)

Many national authorities are now reviewing their tide gauge networks, and introducing automatic data transmission and computerised data reduction procedures. This is involving them in major upheavals and consequent difficulty in making any commitment to international work. Such authorities include those in Denmark, Turkey, New Zealand, Norway and Mexico.

We know that gauges are running in India and in Yugoslavia but at present there are difficulties in getting the data and details of these gauges to us.

Conclusions

The response to the questionnaire was very encouraging: not only have we re-established contact with some organizations with whom we had lost touch, but we have also made new contacts. It is disappointing not to know the present situation around the African coast, India and Brazil. In the latter two cases we have good contacts who may respond to more specific proposals.

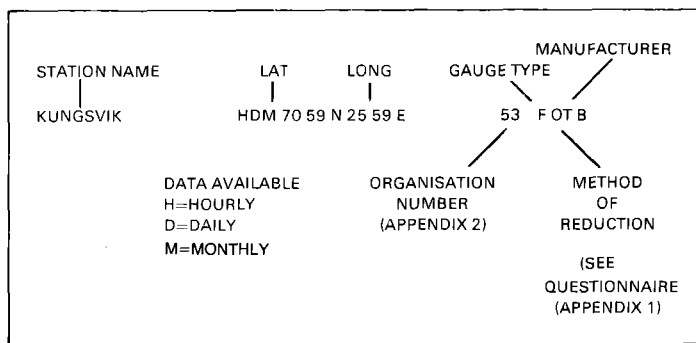
Although we did not ask about practical help for other countries, the Canadian Hydrographic Service in their reply,

suggested that they would be prepared to assist other agencies in installing new equipment if some of the expenses were paid by an international organization. There may well be other countries which are willing to help in this or similar ways.

Full details of the replies to the questionnaire are available from PSMSL, and maps of gauges reported to be functioning in a particular area can be prepared on request.

Table 1a
Gauges running - 1982

KEY



NORWAY										LOWESTOFT	HDM	52 28 N	01 19 E	75	F	OT	C
HONNINGSVAG	HDM	70 59 N	25 59 E	53	F	OT	B			FELIXSTOWE	HDM	51 57 N	01 21 E	75	B	AA	C
TROMSO		69 39 N	18 58 E	53	F	OT	B			SOUTHEND	HDM	51 31 N	00 44 E	75	F	KE	B
HARSTAD		68 48 N	16 33 E	53	F	OT	B			TILBURY	HDM	51 28 N	00 22 E	75	F	KE	B
RORVIK		64 52 N	11 15 E	53	F	OT	B			TOWER PIER	HDM	51 30 N	00 05 E	75	F	KE	B
KRISTIANSTUND N		63 07 N	07 44 E	53	F	OT	B			SHEERNESS	HDM	51 27 N	00 45 E	75	B	OT	C
ALESUND		62 28 N	06 09 E	53	F	OT	B			DOVER	HDM	51 07 N	01 19 E	75	F	OT	C
MALØY		61 56 N	05 07 E	53	F	OT	B			FORTSMOUTH	M	50 48 N	01 07 W	76			
SWEDEN										DEVONPORT	M	50 22 N	04 11 W	76			
KUNGSVIK	HDM	59 00 N	11 08 E	70	F		B			NEWLYN	HDM	50 06 N	05 33 W	75			
SMOGEN	HDM	58 22 N	11 13 E	70	F		B			ILFRACOMBE	HDM	51 13 N	04 07 W	75	F	OT	C
GÖTEBORG —										MILFORD HAVEN	HDM	51 42 N	05 01 W	75	F	MU	B
TORSHAMNEN	HDM	57 41 N	11 48 E	70	F		B			FISHGUARD	HDM	52 01 N	04 59 W	75	F	LE	B
RINGHALS	HDM	58 15 N	12 07 E	70	F		B			HOLYHEAD	HDM	53 19 N	04 37 W	75	F	OT	C
VIKEN	HDM	56 09 N	12 34 E	70	F		B			HILBRE ISLAND	HDM	53 23 N	03 13 W	75	F	MU	B
KLAGSHAMN	HDM	55 31 N	12 54 E	70	F		B			LIVERPOOL PRINCES							
YSTAD	HDM	55 25 N	13 49 E	70	F		B			PIER	HDM	53 25 N	03 00 W	75	F	LG	B
KUNGHOLMSFORT	HDM	56 06 N	15 35 E	70	F		B			HEYSHAM	HDM	54 02 N	02 55 W	75	F	LE	B
OLANDS NORRA UDDE	HDM	57 12 N	17 06 E	70	F		B			PORTPATRICK	HDM	54 51 N	05 07 W	75	F	LE	B
VISBY	HDM	57 59 N	18 18 E	70	F		B			MILLPORT	HDM	55 45 N	04 56 W	75	F	LE	B
MARVIKEN	HDM	58 33 N	16 50 E	70	F		B			ULLAPOL	HDM	57 54 N	05 10 W	75	F	MU	B
LANDSORT	HDM	58 45 N	17 52 E	70	F		B			STORNOWAY	HDM	58 12 N	06 23 W	75	B	OT	C
STOCKHOLM	HDM	59 19 N	18 05 E	70	F		B			SCRABSTER	HDM	58 37 N	03 33 W	75	B	AA	C
FORSMARK	HDM	60 24 N	18 13 E	70	F		B			IRE							
SPIKARNA	HDM	62 22 N	17 32 E	70	F		B			MALIN HEAD	HDM	55 22 N	07 20 W	23	F	OT	A
RATAN	HDM	64 00 N	20 55 E	70	F		B			KILLYBEGS		54 37 N	08 26 W	25	F	OT	U
FURUOGRUND	HDM	64 55 N	21 14 E	70	F		B			ROSSAVEEL		53 16 N	09 33 W	25	F	OT	U
KALIX	HDM	65 42 N	23 06 E	70	F		B			BLENNERVILLE		52 15 N	09 44 W	25	F	OT	U
POLAND										DUNMORE EAST		52 08 N	06 59 W	25	F	OT	U
GDANSK/NOWY PORT	HDM	54 24 N	18 50 E	60	F		A			DUN LAOIRE		53 17 N	06 08 W	25	F	OT	U
WLADYSLAWOWO	HDM	54 48 N	18 25 E	60	F		A			DUBLIN		53 21 N	06 13 W	24	F	KV	A
USTKA	HDM	54 35 N	16 52 E	60	F		A			CHANNEL ISLANDS							
KOŁOBRZEG	HDM	54 11 N	15 13 E	60	F		A			ST. HELIER	M	49 11 N	02 07 W	77	F	MU	A
SWINOUJSCIE	HDM	53 56 N	14 17 E	60	F		A			FRANCE (ATANTIC)							
DENMARK										DUNKERQUE	HDM	51 03 N	02 22 E	28	F	OT	B
HESNAES	H	54 38 N	12 08 E	20	F	OT	C			CALAIS	HDM	50 58 N	01 51 E	28	F	OT	B
SPODSBJERG	H	54 56 N	10 50 E	20	F	OT	C			BOULOGNE	HDM	50 44 N	01 36 E	28	F	OT	B
BALLEN	H	55 49 N	10 38 E	20	F	OT	C			DIEPPE	HDM	49 56 N	01 05 E	28	F	OT	B
GRENA	H	56 25 N	10 55 E	20	F	OT	C			ANTIFER	HDM	49 39 N	00 09 E	28	F	OT	B
NETHERLANDS										LE HAVRE	HDM	49 29 N	00 07 E	28	F	OT	B
DELFIJIL	H	53 20 N	06 56 E	50	F	TN	B			CHERBOURG	HDM	49 39 N	01 38 W	28	F	OT	B
LAUVERSOOG	H	53 25 N	6 12 E	50	F	TN	B			ROSCOFF	HDM	48 43 N	03 58 W	28	F	OT	B
TERSCHELLING	H	53 22 N	05 13 E	50	F	TN	B			LE CONQUET	HDM	48 22 N	04 47 W	28	F	OT	B
HARLINGEN	H	53 10 N	05 25 E	50	F	TN	B			BREST	HDM	48 23 N	04 30 W	28	F	OT	B
DEN HELDER	H	52 58 N	04 45 E	50	F	TN	B			PORT TUDY	HDM	47 39 N	03 27 W	28	F	OT	B
IJMUIDEN	H	52 28 N	04 35 E	50	F	TN	B			POINTE ST GILDAS	HDM	47 09 N	02 15 W	28	F	OT	B
SCHEVENINGEN										LA PALLICE	HDM	46 10 N	01 13 W	28	F	OT	B
NOORDERSLUIS	H	52 06 N	4 16 E	50	F	TN	B			SOCOA	HDM	43 23 N	01 40 W	28	F	OT	B
HOEK VAN HOLLAND	H	51 59 N	04 07 E	50	F	TN	B			SPAIN (ATLANTIC)							
HARINGVIJLT	H	51 50 N	4 03 E	50	F	TN	B			SANTADER	HDM	43 28 N	03 48 W	69	F	OT	
STAVENISSE	H	51 36 N	4 00 E	50	F	TN	B			LA CORUNA	HDM	43 22 N	08 24 W	69	F	OT	
VLIETEPOLDER	H	51 36 N	3 45 E	50	P		B			VIGO	HDM	42 14 N	08 44 W	69	F	OT	
OOSTKAPELLE	H	51 36 N	3 33 E	50	F	TN	B			PORTUGAL							
VLISSINGEN	H	51 27 N	3 36 E	50	F	TN	B			V CASTELO	HDM	41 41 N	8 50 W	62	F	OT	B
HANSWEERT	H	51 27 N	4 01 E	50	F	TN	B			LEIXOES	HDM	41 11 N	8 42 W	62			B
BATH	H	51 24 N	4 13 E	50	F	TN	B			AVEIRO (FOZ)	HDM	40 39 N	8 45 W	62	F	OT	B
TERNEUZEN	H	51 20 N	3 49 E	50	F	TN	B			CASCAIS	HDM	38 42 N	9 25 W	62	F	BO	B
CADZAND	H	51 23 N	3 23 E	50	F	TN	B			SETUBAL (TR)	HDM	38 30 N	8 54 W	62	F	OT	B
UNITED KINGDOM										SINES	HDM	37 57 N	8 53 W	62	F	OT	B
LERWICK	HDM	60 09 N	01 08 W	75	F	LE	A			LAGOS	HDM	37 06 N	8 40 W	62	F	BO	B
WICK	HDM	58 26 N	03 05 W	75	F	LE	B			FARO-OLHAO	HDM	36 58 N	7 52 W	62	F	OT	B
BUCKIE	HDM	57 40 N	02 58 W	75	F	OT	C			GIBRALTAR							
ABERDEEN I	HDM	57 09 N	02 05 W	75	F	MU	B			GIBRALTAR	HDM	36 07 N	05 21 W	76	F	LE	
ROSYTH	M	56 01 N	03 27 W	76						SPAIN (MEDITERRANEAN)							
LEITH	HDM	55 59 N	03 10 W	75	F	OT	C			CADIZ	HDM	36 32 N	06 17 W	69	F	OT	
NORTH SHIELDS	HDM	55 00 N	01 27 W	75	F	OT	C			TARIFA	HDM	36 00 N	05 36 W	69	F	OT	
WHITBY	HDM	54 29 N	00 36 W	75	B	AA	C			ALGECIRAS	HDM	36 07 N	05 26 W	69	F	OT	
IMMINGHAM	HDM	53 37 N	00 11 W	75	F	MU	B			MALAGA	HDM	36 43 N	04 25 W	69	F	OT	

JAPAN (AMAMI GUNTO)								GEELONG								H	38 06 S	144 36 E	2	F	MU	A							
NAHA								DM	26 13 N	127 40 E	42	F	FU	A	GEELONG								H	38 08 S	144 30 E	2	F	MU	A
ISHIGAKI								DM	24 20 N	124 09 E	42	F	FU	A	GEELONG								H	38 09 S	144 22 E	2	F	MU	A
JAPAN								PORTLAND								H	38 21 S	141 37 E	2	F	MU	A							
(HONSHU -JAPAN SEA)								BURNIE								H	41 03 E	145 55 E	2	F	GE	A							
SHIMONOSEKI I								DM	33 58 N	130 57 E	42	F	FU	A	DEVONPORT								H	41 09 S	146 16 E	2	F	LE	A
TONOURA								DM	34 54 N	132 04 E	42	F	FU	A	GEORGETOWN								HDM	41 04 S	146 48 E	2	F	KE	A
SAKAI								DM	35 33 N	133 15 E	42	F	FU	A	BELL BAY									41 08 S	146 52 E	2	F	U	
SAIGO								DM	36 12 N	133 20 E	42	F	FU	A	LAUNCESTON								H	41 26 S	147 08 E	2	F	KE	A
MAIZURU II								DM	35 28 N	135 23 E	42	F	FU	A	SPRING BAY								H	42 33 S	147 56 E	2	F	LS	A
TOYAMA								DM	36 46 N	137 13 E	42	F	FU	A	HOBART								HDM	42 50 S	147 19 E	2	F	KE	A
FUKAURA								DM	40 39 N	139 56 E	42	F	FU	A	PORT MACDONNELL II								HDM	38 03 S	140 42 E	2	F	LS	A
AOMORI								DM	40 50 N	140 46 E	42	F	FU	A	CAPE JAFFA								HDM	36 57 S	139 41 E	2	P	BM	C
JAPAN								VICTOR HARBOUR								HDM	35 34 S	138 38 E	2	F	LS	A							
(OGASAWARA GUNTO)								VIVONNE BAY								HDM	36 00 S	137 11 E	2	P	BM	C							
CHICHIJIMA								DM	27 06 N	142 11 E	42	F	FU	A	PORT GILES								H	35 03 S	137 46 E	2	F	LS	A
PHILIPPINES								PORT ADELAIDE																					
MANILA								HDM	14 35 N	120 58 E	59	F		A	(INNER HB)								HDM	34 51 S	138 30 E	2	F	LS	A
LEGASPI								HDM	13 09 N	123 45 E	59	F		A	PORT ADELAIDE														
CEBU								HDM	10 18 N	123 54 E	59	F		A	(OUTER HB)								HDM	34 47 S	138 28 E	2	F	BA	A
DAVAO								HDM	07 05 N	125 38 E	59	F		A	PORT WALLAROO								H	33 56 S	137 38 E	2	F	LS	A
JOLO								HDM	06 04 N	121 00 E	59	F		A	PORT PIRIE								H	33 09 S	138 01 E	2	F	LS	A
PAPUA NEW GUINEA								PORT AUGUSTA								H	32 30 S	137 46 E	2	F	NZ	A							
VANIMO									02 41 S	141 17 E	57	F	LS	A	PORT LINCOLN								HDM	34 49 S	135 52 E	2	F	LS	A
RABAU									04 12 S	152 11 E	57	F	LS	A	ELLISTON								HDM	33 38 S	134 57 E	2	P	BM	C
RABAU								HDM	04 12 S	152 11 E	79	F	FP	C	THEVENARD								HDM	32 09 S	133 39 E	2	F	LS	A
MADANG									05 12 S	145 47 E	57	F	LS	A	FOWLERS BAY								HDM	32 00 S	132 26 E	2	P	BM	C
LAE									06 44 S	147 00 E	57	F	LS	A	EUCLA								HDM	31 43 S	128 53 E	2	P	BM	C
PORT MORESBY									09 29 S	147 08 E	57	F	LS	A	ESPERANCE								HDM	33 52 S	121 54 E	2	F	LS	A
AUSTRALIA								ALBANY								HDM	35 02 S	117 53 E	2	F	LS	A							
BOOBY IS.								H	10 36 S	141 55 E	2	F	LS	A	BUSSELTON								H	33 38 S	115 20 E	2	F	LS	A
DARWIN								HDM	12 29 S	130 58 E	2	F	LS	A	SAMPHIRE BAY								H	33 18 S	115 42 E	2	F	FP	C
SNAKE BAY								H	11 24 S	130 40 E	2	F	LS	A	BUNBURY								HDM	33 17 S	115 38 E	2	F	LS	A
AURARI BAY								H	11 44 S	133 15 E	2	F	LS	A	MANDURAH								H	32 32 S	115 43 E	2	F	LS	A
MELVILLE BAY								H	12 12 S	136 40 E	2	F	LS	A	FREMANTLE								HDM	32 03 S	115 44 E	2	F	LS	A
MILNER BAY								H	13 52 S	136 25 E	2	F	LS	A	BARRACK ST														
CENTRE ISLAND								H	15 45 S	136 49 E	2	F	LS	A	(SWAN RIVER)								H	31 58 S	115 51 E	2	F	LS	A
KARUMBA								H	17 29 S	140 50 E	2	F	LS	A	GERALDTON								HDM	28 47 S	114 35 E	2	F	LS	A
WEIPA								H	12 41 S	141 53 E	2	F	MU	A; F LS A	DENHAM								H	25 56 S	113 32 E	2	F	FP	C
COOKTOWN								H	15 28 S	145 15 E	2	F	LS	A	HAMELIN								H	26 23 S	114 09 E	2	F	FP	C
CAIRNS								H	16 56 S	145 47 E	2	F	LS	A	CARNARVON								HDM	24 53 S	113 37 E	2	F	LS	A
MOURILYAN HBR								H	17 36 S	146 07 E	2	F	MU	A; F LS A	DAMPIER								HDM	20 38 S	116 42 E	2	F	MU	A
CLUMP POINT								H	17 50 S	146 05 E	2	F	LS	A	PORT HEDLAND								HDM	20 19 S	118 34 E	2	F	LS	A
CARDWELL								H	18 16 S	146 02 E	2	F	LS	A	BROOME								HDM	17 58 S	122 14 E	2	F	LS	A
LUCINDA								H	18 32 S	146 20 E	2	F	MU	A; F LS A	KOOLAN IS.									16 09 S	123 45 E	2	U		
TOWNSVILLE I								HDM	19 20 S	146 50 E	2	F	AM	A; F LS A	WYNDHAM								HDM	15 27 S	128 06 E	2	F	LS	A
CAPE FERGUSON								H	19 20 S	147 00 E	2	F	LS	A	PORT KEATS								H	14 11 S	129 34 E	2	F	LS	A
BOWEN								H	20 01 S	148 15 E	2	F	MU	A; F LS A	NEW ZEALAND														
THOMAS IS.								H	20 05 S	148 18 E	2	D	FO	A	AUCKLAND									36 51 S	174 49 E	52	F	MU	A
SHUTE HARBOUR								H	20 30 S	148 55 E	2	F	LS	A	TAURANGA									37 39 S	176 11 E	52	F	MU	A
MACKAY								HDM	21 06 S	149 13 E	2	F	AM	A; F LS A	NAPIER									39 29 S	176 55 E	52	F		
HAY POINT								H	21 20 S	149 20 E	2	F	LS	A	WELLINGTON HARBOUR									41 17 S	174 47 E	52	F	EV	A
PORT ALMA								H	23 35 S	150 53 E	2	F	LS	A	PICTON HARBOUR									41 17 S	174 02 E	52	D	FO	A
GLADSTONE								H	23 50 S	151 15 E	2	F	MU	A; F LS A	PORT LYTTELTON									43 36 S	172 43 E	52	F	EV	A
BUNDEBERG								HDM	24 46 S	152 22 E	2	F	LS	A	TIMARU HARBOUR									44 24 S	171 16 E	52	F	EV	A
URANGAN								H	25 17 S	153 55 E	2	F	LS	A	DUNEDIN									45 53 S	170 31 E	52	B	PH	A
MARYBOROUGH								H	25 32 S	152 43 E	2	U			BLUFF														
ALEXANDRA HEADS								H	26 41 S	153 07 E	2	B	NE	C	(SOUTHLAND HARBOUR)									46 36 S	168 21 E	52	F	MU	A
MOOLOOLAH RIVER								H	26 41 S	153 07 E	2	F	MU	A; F LS A	PORT NELSON									41 15 S	171 36 E	52	B	PH	A
CALOUNDRA HEAD								H	26 48 S	153 09 E	2	B	NE	A	PORT TARANAKI									39 03 S	174 02 E	52	F	EV	A
TANGALOOMA								H	27 11 S	153 23 E	2	F	OT	C	ONEHUNGA									36 56 S	174 47 E	52	F	MU	A
BRISBANE CAIRNCROSS								H	27 27 S	153 04 E	2	F	MU	A	PORT WHANGAREI									35 46 S	174 21 E	52	F	MU	A
BRISBANE MOGGILL								H	27 35 S	152 53 E	2	U	A		WHANGAREI HARBOUR									35 50 S	174 29 E	52	F	MU	A
BRISBANE PORT OFFICE								H	27 28 S	153 02 E	2	B	NE	A	MARIANAS ISLANDS														
BRISBANE PINKENBA								H	27 26 S	153 07 E	2	F	OT	C	APRA HARBOR, GUAM								H M	13 26 N	144 39 E	80	F	FP	C; B MCC
BISHOP IS.								H	27 52 S	153 10 E	2	D	FO	C	SAIPAN								HDM	15 14 N	145 45 E	79	F	FP	C
SOUTHPORT								H	27 57 S	153 25 E	2	F	LS	A	CAROLINE ISLANDS														
SNAPPER ROCKS								H	28 10 S	153 33 E	2	D	FO	A	KAPINGAMARANGI								HDM	01 06 N	154 47 E	79	F	FP	C
TWEED HEADS								H	28 10 S	153 33 E	2	F	FI	A	PONAPE								HDM	06 59 N	158 14 E	79	F	FP	C
BALLINA								H	28 52 S	153 35 E	2	F	FP	C	MALAKAL								HDM	07 20 N	134 28 E	79	F	FP	C
NORFOLK ISLAND								H	29 04 S	167 56 E	2	F	LS	A	TRUK, MOEN ISLAND								H M	07 27 N	151 51 E	80	F	FP	C; B MCC
COFF'S HARBOUR I								H	30 20 S	153 00 E	2	F	FI	A	YAP								HDM	09 31 N	138 08 E	79	F	FP	C
CROWDY HEAD								H	31 49 S	152 45 E	2	F	LS	A	MARSHALL ISLANDS														
NEWCASTLE II								HDM	32 55 S	151 48 E	2	F	GE	A	MAJUORO								HDM	07 06 N	171 22 E	79	F	FP	C
NEWCASTLE III								H M	32 55 S	151 48 E	2	F	ES	A	KWAJALEIN								H M	08 44 N	167 44 E	80	F	FP	C; B MCC
SYDNEY, FORT DENISON								HDM	33 51 S	151 14 E	2	F	HS	A	ENIWETOK								HDM	11 22 N	162 21 E	79	F	FP	C
CAMP COVE								HDM	33 50 S	151 17 E	2	F	HS	A	WAKE ISLAND								H M	19 17 N	166 37 E	80	F	FP	C; B MCC
BOTANY BAY								H	33 59 S	151 13 E	2	F	FI	A	GILBERT IS. (KIRIBATI)														
PORT KEMBLA								H	34 28 S	150 55 E	2	F	MU	A	NAURU								HDM	00 32 S	166 54 E	79	F	FP	C
PORT STEPHENS								H	34 28 S	150 55 E	2	F	FP	C	TARAWA								HDM	01 22 N	172 56 E	79	F	FP	C
JERVIS BAY								H	35 07 S	150 42 E	2	F	LS	A	ELLICE IS. (TUVALU)														
MERIMBULA								H	36 54 S	149 54 E	2	F	FI	A	FUNAFUTI								HDM	08 32 S	179 13 E	79	F	FP	C
EDEN								H	37 05 S	149 59 E	2	F	FI	A	SOLOMON ISLANDS														
LAKES ENTRANCE															HONIARA														
(INNER)								H	37 53 S	147 58 E	2	F	MU	A	VANUATU								HDM	09 26 S	159 57 E	79	F	FP	C
LAKES ENTRANCE															(NEW HEBRIDES)														
(OUTER)								H	37 54 S	147 58 E	2	F	MU	A	PORT VILA								HDM	17 45 S	168 18 E	81	F		
PORT ALBERT								H	38 41 S	146 41 E	2	F	MU	A	NEW CALEDONIA														
PORT WELSHPOOL								H	38 42 S	146 28 E	2	F	MU	A	NOUMEA								HDM	22 18 S	166 26 E	79	F	FP	C
STONY POINT								H	38 22 S	145 13 E	2	F	MU	A	FIJI														
WILLIAMSTOWN								HDM	37 52 S	144 55 E	2	F	LS	A	SUVA								HDM	18 08 S	178 26 E	79	F	FP	C
POINT LONSDALE								HDM	38 18 S	144 37 E	2	F	MU	A	WESTERN SAMOA														

APIA HARBOUR	H	M	13 50 S	171 45 W	83	F	SD	U	PORT CHICAGO,										
AMERICAN SAMOA									SUISUN BAY	H	M	38 03 N	122 02 W	80	F	FP	C; B	MC C	
PAGO PAGO	H	M	14 17 S	170 41 W	80	F	FP	C; B	POINT REYES,										
PHOENIX ISLANDS									DRAKES BAY	H	M	38 00 N	122 58 W	80	F	FP	C; B	MC C	
CANTON ISLAND	HDM		02 48 S	171 43 W	79	F	FP	C	STOCKTON	H	M	37 57 N	120 17 W	80	F	LS	C		
HAWAIIAN ISLANDS									SAN FRANCISCO	H	M	37 48 N	122 28 W	80	F	LS	C; F	SD	
JOHNSTON ISLAND	H	M	16 45 N	169 31 W	79	F	FP	C; B											C; B
MIDWAY ISLAND	H	M	28 13 N	177 22 W	80	F	FP	C; B	ALAMEDA										MC C
FRENCH FRIGATE									(NAVAL AIR STN)	H	M	37 46 N	122 18 W	80	F	FP	C; B	MC C	
SHOALS	H	M	23 52 N	166 17 W	79	F	FP	C	SAN MATEO	H	M	37 35 N	122 15 W	80	F	FP	C; B	BB C	
NAWILIWILI BAY,									MONTEREY HARBOR	H	M	36 36 N	121 53 W	80	F	FP	C		
KAUAI IS	H	M	21 58 N	159 21 W	80	F	FP	C; B	PORT SAN LUIS WHARF	H	M	35 10 N	120 45 W	80	F	FP	C; B	MC C	
MOKUOLOE ISLAND	H	M	21 26 N	157 47 W	80	B	BB	C	RINCON ISLAND	H	M	34 21 N	119 26 W	80	F	FP	C		
KAHULUI HARBOR,									SANTA MONICA	H	M	34 01 N	118 30 W	80	F	FP	C; B	MC C	
MAUI IS	H	M	20 45 N	156 28 W	80	F	LS	C; B	LONG BEACH	H	M	33 47 N	118 15 W	80	F	FP	C; B	MC C	
HILO, HAWAII ISLAND	H	M	19 44 N	155 04 W	80	F	FP	C; B	LOS ANGELES	H	M	33 43 N	118 16 W	80	F	FP	C; B	MC C	
LINE ISLANDS									NEWPORT BAY	H	M	33 36 N	117 53 W	80	F	FP	C; B	MC C	
CHRISTMAS ISLAND	HDM		01 59 N	157 28 W	79	F	FP	C	LA JOLLA										
FANNING ISLAND	HDM		03 54 N	159 24 W	79	F	FP	C	(SCRIPPS INST)	H	M	32 52 N	117 15 W	80	F	FP	C		
COOK ISLANDS									SAN DIEGO										
RAROTONGA	HDM		21 12 S	159 46 W	79	F	FP	C	(QUARANTINE ST)	H	M	32 43 N	117 10 W	80	F	FP	C; B	MC C	
PENRHYN	HDM		09 01 S	158 04 W	79	F	FP	C	MEXICO (PACIFIC)										
ILES DE LA SOCIETE									ENSENADA			31 51 N	116 38 W	48	F		A		
PAPEETE	HDM		17 32 S	149 34 W	79	F	FP	C	SAN QUINTIN			28 29 N	115 59 W	48	F		A		
MARQUESAS ISLANDS									ISLA GUADALUPE			28 53 N	118 18 W	48	F		A		
HIVA OA	HDM		09 49 S	139 02 W	79	F	FP	C	ISLA CEDROS			28 06 N	115 11 W	48	F		A		
GAMBIER ISLANDS									SAN CARLOS			24 47 N	112 07 W	48	F		A		
RIKITEA	HDM		23 08 S	134 57 W	79	F	FP	C	CABO SAN LUCAS			22 53 N	109 54 W	48	F		A		
EASTER ISLAND									LA PAZ			24 10 N	110 21 W	48	F		A		
EASTER ISLAND	HDM		27 09 S	109 29 W	79	F	FP	C	LORETO			26 01 N	111 22 W	48	F		A		
USA (ALEUTIAN IS.)	HDM		27 09 S	109 29 W	79	F	FP	C	BAHIA DE LOS ANGELES			28 57 N	113 33 W	48	F		A		
ADAK	H	M	51 52 N	176 38 W	80	F	LS	C; B	SAN FELIPE			31 01 N	114 49 W	48	F		A		
UNALASKA	H	M	53 53 N	166 32 W	80	F	FP	C; B	GUAYMAS			27 55 N	110 54 W	48	F		A		
USA (ALASKA)									VALLARTA			20 36 N	105 14 W	48	F		A		
PRUDHOE BAY	H	M	70 23 N	148 30 W	80	F	FP	C; B	MANZANILLO			19 03 N	104 20 W	48	F		A		
SAND POINT	H	M	55 20 N	160 30 W	80	F	FP	C; B	ACAPULCO			16 50 N	99 55 W	48	F		A		
ST. PAUL'S HARBOR,									PUERTO ANGEL			15 30 N	96 30 W	48	F		A		
KODIAK	H	M	57 45 N	152 29 W	80	B	BB	C	EL SALVADOR										
ANCHORAGE	H	M	61 14 N	149 54 W	80	F	LS	C; B	ACAJUTLA	HDM		13 35 N	89 51 W	26	F	SD	A		
NIKISKI	H	M	60 41 N	151 24 W	80	B	BB	C	COSTA RICA										
SELDOVIA	H	M	59 26 N	151 43 W	80	F	FP	C; B	PUNTARENAS	HDM		09 58 N	84 50 W	17	F		A		
SEWARD	H	M	60 06 N	149 27 W	80	F	FP	C; B	QUEPOS	HDM		09 24 N	84 10 W	17	F		A		
VALDEZ	H	M	61 08 N	146 21 W	80	F	FP	C; B	PANAMA (PACIFIC)										
CORDOVA	H	M	60 33 N	145 46 W	80	F	FP	C; B	PUERTO ARMUELLES	M		08 16 N	82 52 W	56	F	SD	U		
YAKUTAT	H	M	59 33 N	139 44 W	80	F	FP	C; B	BALBOA			08 58 N	79 34 W	55	F	FP	C		
SITKA	H	M	57 03 N	135 20 W	80	F	FP	C; B	ECUADOR										
SKAGWAY	H	M	59 27 N	135 19 W	80	B	BB	C	SAN LORENZO	H		01 18 N	78 50 W	22	F	ST	A		
JUNEAU	H	M	58 18 N	134 25 W	80	F	FP	C	ESMERALDAS	H		01 00 N	79 57 W	22	F	ST	A		
KETCHIKAN	H	M	55 20 N	131 38 W	80	F	FP	C; B	BAHIA DE CARAQUEZ	H		00 36 S	80 26 W	22	F	ST	A		
CANADA (PACIFIC)									MANTA	HDM		00 57 S	80 43 W	22	F	SD	A		
PRINCE RUPERT	HDM		54 19 N	130 20 W	12	F		B	GUAYAQUIL	H		02 12 S	79 53 W	22	F	ST	A		
LANGARA POINT	HDM		54 15 N	133 02 W	12	F		B	LA LIBERTAD	HDM		02 13 S	80 54 W	22	F	SD	A		
QUEEN CHARLOTTE CITY	HDM		53 15 N	132 04 W	12	F		B	GALAPAGOS IS.										
BELLA BELLA	HDM		52 10 N	128 08 W	12	F		B	SANTA CRUZ	HDM		00 45 S	90 19 W	79	F	FP	C		
PORT HARDY	HDM		50 43 N	127 39 W	12	F		B	PERU										
ALERT BAY	HDM		50 35 N	126 57 W	12	F		B	BASE NAVAL EL SALTO	M		03 25 S	80 18 W	58	F	SD	A		
CAMPBELL RIVER II	HDM		50 01 N	125 14 W	12	F		B	PTO. DE TALARA	M		04 35 S	81 17 W	58	F	SD	A		
POINT ATKINSON	HDM		49 20 N	123 15 W	12	F		B	PTO. DE PIMENTEL	M		06 50 S	79 56 W	58	F	SD	A		
VANCOUVER	HDM		49 17 N	123 07 W	12	F		B	PTO. DE CHIMBOTE	M		09 04 S	78 38 W	58	F	SD	A		
NEW WESTMINSTER	HDM		49 12 N	122 55 W	12	F		B	PTO. DE CALLAO	M		12 03 S	77 09 W	58	F	SD	A		
STEVESTON	HDM		49 07 N	123 11 W	12	F		B	BASE NAVAL DE SAN										
TSAWWASSEN	HDM		49 00 N	123 08 W	12	F		B	JUAN	M		15 21 S	75 09 W	58	F	SD	A		
FULFORD HARBOUR	HDM		48 46 N	123 27 W	12	F		B	PTO. DE MATARANANI	M		17 00 S	72 07 W	58	F	SD	A		
PATRICIA BAY	HDM		43 39 N	123 27 W	12	F		B	CHILE										
VICTORIA	HDM		48 25 N	123 22 W	12	F		B	ARICA	H		18 28 S	70 20 W	13	F	SD	B		
SOOKE	HDM		48 22 N	123 44 W	12	F		B	ANTOFAGASTA	H		23 39 S	70 25 W	13	F	SD	B		
PORT RENFREW	HDM		48 33 N	124 25 W	12	F		B	CALDERA	H		27 04 S	70 50 W	13	F	SD	B		
BAMFIELD	HDM		48 51 N	125 08 W	12	F		B	COQUIMBO	H		29 56 S	71 21 W	13	B	BB	B		
PORT ALBERNI	HDM		49 14 N	124 49 W	12	F		B	VALPARAISO	H		33 02 S	71 38 W	13	B	BB	B		
TOFINO	HDM		49 09 N	125 55 W	12	F		B	JUAN FERNANDEZ	HDM		33 37 S	78 50 W	13	F	FB	B		
USA (PACIFIC)									R. CRUSOE	H		33 37 S	78 50 W	13	F	FB	B		
CHERRY POINT	H	M	48 52 N	122 45 W	80	F	FP	C; B	TALCAHUANO	H		36 41 S	73 06 W	13	F	SD	B		
FRIDAY HARBOR									PUERTO MONTT	H		41 29 S	72 58 W	13	B	MC	B		
(OCEAN.LAB)	H	M	48 33 N	123 00 W	80	F	FP	C	PUNTA ARENAS	H		53 10 S	70 54 W	13	B	MC	B		
SEATTLE	H	M	47 36 N	122 20 W	80	F	FP	C; B	PUERTO WILLIAMS	H		54 55 S	67 37 W	13	F	SD	B		
PORT TOWNSEND	H	M	48 07 N	122 45 W	80	F	FP	C	URUGUAY										
PORT ANGELES	H	M	48 08 N	123 26 W	80	F	FP	C	COLONIA	HDM		34 28 S	57 51 W	78	F	OT	A		
NEAH BAY	H	M	48 22 N	124 37 W	80	F	LS	C; F	MONTEVIDEO	HDM		34 55 S	56 13 W	78	F	OT	A		
TOKE POINT	H	M	46 42 N	123 58 W	80	F	FP	C	PUNTA DEL ESTE	HDM		34 58 S	54 57 W	78	F	SD	A		
ASTORIA									LA PALOMA	HDM		34 39 S	54 09 W	78	F	OT	A		
(TONGUE POINT)	H	M	46 13 N	123 46 W	80	F	LS	C; F	BRASIL										
DEPOE BAY	H	M	44 49 N	124 04 W	80	F	FP	C	CANANEIA	H		25 01 S	47 56 W	10	F	OT	A		
SOUTH BEACH	H	M	44 38 N	124 03 W	80	F	FP	C	UBATUBA	H		23 30 S	45 07 W	10	F	OT	A		
CHARLESTON II	H	M	43 21 N	124 19 W	80	F	LS	C	FRENCH GUIANA										
PORT ORFORD	H	M	42 44 N	124 30 W	80	F	LS	C; B	CAYENNE	H		05 00 N	52 00 W	29	F	OT	A		
CRESCENT CITY	H	M	41 45 N	124 12 W	80	F	FP	C; B	GUAYANA										
TRINIDAD	H	M	41 04 N	124 09 W	80	F	FP	C	GEORGETOWN	H		06 49 N	58 10 W	33	F	MU	A		
NORTH SPIT,									TRINIDAD AND TOBAGO										
HUMBOLDT BAY	H	M	40 46 N	124 13 W	80	F	LS	C	TRINIDAD			10 41 N	61 37 W	72	P	AM	B		
ARENA COVE	H	M	38 55 N	123 43 W	80	F	FP	C; B	PANAMA (CARIBBEAN)										
SACRAMENTO	H	M	38 35 N	121 30 W	80	F	FP	C	COCO SOLO			09 22 N	79 53 W	55	F	FP	C		
BENECIA	H	M	38 03 N	122 08 W	80	F	LS	C	MARTINIQUE										

MEXICO (GULF)							DUCK PIER OUTSIDE	H M	36 11 N	75 45 W	80 F LS	C; B BB C
PROGRESO		21 18 N	89 39 W	48 F	A		PORTSMOUTH	H M	36 49 N	76 18 W	80 F FP	C
CIUDAD DEL CARMEN		18 38 N	91 51 W	48 F	A		HAMPTON ROADS	H M	36 57 N	76 20 W	80 F FP	C; B BB C
COATZACOALCOS		18 09 N	94 25 W	48 F	A		CHESAPEAKE BAY					
ALVARADO		18 46 N	95 46 W	48 F	A		BRIDGE	H M	36 58 N	76 07 W	80 F FP	C
VERACRUZ		19 11 N	96 07 W	48 F	A		KIPTOPEKE BEACH	H M	37 10 N	75 59 W	80 F FP	C
TUXPAN		21 00 N	97 20 W	48 F	A		GLOUCESTER POINT	H M	37 15 N	76 30 W	80 F FP	C
CIUDAD MADERO		22 15 N	97 48 W	48 F	A		WACHAPREAGUE	H M	37 36 N	75 41 W	80 F FP	C
PUERTO RICO							LEWISSETTA	H M	38 00 N	76 28 W	80 F FP	C
MAGUEYES ISLAND	H M	17 58 N	67 03 W	80 F FP	C; B MC C		COLONIAL BEACH					
SAN JUAN	H M	18 27 N	66 05 W	80 F FP	C; B MC C		POTOMAC	H M	38 15 N	76 58 W	80 F FP	C
VIRGIN ISLANDS							SOLOMON'S ISLAND	H M	38 19 N	76 27 W	80 F FP	C; B MC C
WEST INDIES LAB,							OCEAN CITY	H M	38 20 N	75 05 W	80 F FP	C; B MC C
ST CROIX	H M	17 45 N	64 36 W	80 F FP	C		CAMBRIDGE	H M	38 34 N	76 04 W	80 F FP	C; B MC C
CHARLOTTE AMALIE	H M	18 21 N	64 55 W	80 F FP	C		INDIAN RIVER INLET	H M	38 37 N	75 04 W	80 F FP	C
USA (GULF)							LEWEES					
PORT ISABEL	H M	26 04 N	97 13 W	80 F FP	C; B BB C		(BREAKWATER					
PADRE ISLAND	H M	26 04 N	97 09 W	80 B BB	C; B BB C		HARBOR)	H M	38 47 N	75 06 W	80 F FP	C; B BB C
CAMERON COUNTY							WASHINGTON DC	H M	38 52 N	77 01 W	80 F FP	C
FISHING	H M	26 08 N	97 10 W	80 B BB	C		CAPE MAY	H M	38 58 N	74 58 W	80 F FP	C; B MC C
PORT MANSFIELD	H M	26 33 N	97 26 W	80 F FP	C		MATAPEAKE	H M	38 58 N	76 21 W	80 F FP	C
PORT ARANSAS	H M	27 49 N	97 04 W	80 F FP	C		ANNAPOLIS					
ROCKPORT	H M	28 01 N	97 03 W	80 F FP	C		(NAVAL ACADEMY)	H M	38 59 N	76 29 W	80 F FP	C; B BB C
FREEPORT	H M	28 57 N	95 19 W	80 F FP	C; B MC C		BALTIMORE	H M	39 16 N	76 35 W	80 F FP	C; B MC C
GALVESTON I	H M	29 17 N	94 47 W	80 F FP	C; B BB C		ATLANTIC CITY	H M	39 21 N	74 25 W	80 F FP	C; B BB C
GALVESTON II	H M	29 19 N	94 48 W	80 F FP	C; B BB C		MAYS LANDING,					
MORGAN'S POINT,							GREAT EGG	H M	39 27 N	74 44 W	80 F LS	C
GALVESTON	H M	29 41 N	94 51 W	80 F FP	C		CHESAPEAKE CITY	H M	39 32 N	75 49 W	80 F FP	C
SABINE PASS	H M	29 42 N	93 51 W	80 F FP	C; B BB C		HAVRE DE GRACE	H M	39 32 N	76 05 W	80 F FP	C; B MC C
GRAND ISLE	H M	29 17 N	89 58 W	80 F FP	C; B MC C		REEDY POINT	H M	39 34 N	75 34 W	80 F FP	C
SOUTH PASS	H M	28 59 N	89 08 W	80 F FP	C; B MC C		GREEN BANK,					
WEST PASCAGOULA							MULLICA R	H M	39 37 N	74 35 W	80 F LS	C
RIVER	H M	30 23 N	88 37 W	80 F LS	C		WARETOWN,					
BAYOU CUMBEST	H M	30 23 N	88 27 W	80 F LS	C		BARNEGAT BAY	H M	39 48 N	74 11 W	80 F LS	C; F FP C
PEARLINGTON, PEARL							PHILADELPHIA					
RIVER	H M	30 15 N	89 37 W	80 F LS	C		(PIER 9N)	H M	39 57 N	75 08 W	80 F FP	C; B MC C
BAY WAVELAND YACHT CLUB	H M	30 20 N	89 20 W	80 F LS	C		TRENTON TERMINAL	H M	40 11 N	74 45 W	80 F FP	C; B BB C
BACK BAY							LONG BRANCH					
(POPPS FERRY)	H M	30 25 N	88 59 W	80 F LS	C		FISHING PIER	H M	40 18 N	73 59 W	80 F FP	C; B BB C
CADET POINT, BILOXI	H M	30 23 N	88 51 W	80 F LS	C		SANDY HOOK	H M	40 28 N	74 01 W	80 F FP	C; B MC C
DAUPHIN ISLAND	H M	30 15 N	88 04 W	80 F FP	C; B MC C		PORT ELIZABETH	H M	40 40 N	74 08 W	80 F LS	C
PENSACOLA	H M	30 24 N	87 13 W	80 F FP	C; B MC C		NEW YORK	H M	40 42 N	74 01 W	80 F LS	C; B MC C
NAVARRE BEACH	H M	30 23 N	86 52 W	80 F LS	C; B BB C		WILLETS POINT	H M	40 48 N	73 47 W	80 F FP	C; B MC C
PANAMA CITY	H M	30 09 N	85 40 W	80 F LS	C; B MC C		NEW ROCHELLE	H M	40 54 N	73 47 W	80 F FP	C; B MC C
APALACHICOLA	H M	29 43 N	84 59 W	80 F LS	C; B MC C		PORT JEFFERSON	H M	40 57 N	73 05 W	80 F FP	C; B MC C
TURKEY POINT	H M	29 56 N	84 31 W	80 F LS	C		MONTAUK	H M	41 03 N	71 58 W	80 F FP	C; B MC C
SHELL POINT	H M	30 04 N	84 17 W	80 F LS	C; B MC C		BRIDGEPORT	H M	41 10 N	73 11 W	80 F FP	C
CEDAR KEYS II	H M	29 08 N	83 02 W	80 F LS	C; B MC C		NANTUCKET	H M	41 17 N	70 06 W	80 F FP	C; B MC C
CLEARWATER BEACH	H M	27 59 N	82 50 W	80 F LS	C; B MC C		NEW LONDON	H M	41 22 N	72 06 W	80 F FP	C; B MC C
ST. PETERSBURG	H M	27 46 N	82 37 W	80 F LS	C; B BB C		NEWPORT	H M	41 30 N	71 20 W	80 F FP	C; B MC C
FORT MYERS	H M	26 39 N	81 52 W	80 F LS	C; B MC C		WOODS HOLE					
VACA KEY	H M	24 43 N	81 06 W	80 F FP	C		(OCEAN, INST)	H M	41 32 N	70 40 W	80 F FP	C; B MC C
NAPLES	H M	26 08 N	81 48 W	80 F LS	C; B MC C		PROVIDENCE					
KEY WEST							(STATE PIER)	H M	41 48 N	71 24 W	80 F FP	C; B MC C
(NAVAL BASE)	H M	24 33 N	81 48 W	80 F LS	C; B BB C		BOSTON	H M	42 21 N	71 03 W	80 F FP	C; B BB C
MARATHON SHORES	H M	24 44 N	81 02 W	80 F LS	C; B MC C		SEAVEY ISLAND	H M	43 05 N	70 45 W	80 F FP	C; B BB C
BERMUDA							PORTLAND	H M	43 40 N	70 15 W	80 F FP	C; B MC C
ST. GEORGES	H M	32 22 N	64 42 W	80 F FP	C; B MC C		ROCKLAND	H M	44 06 N	69 06 W	80 F FP	C; B MC C
USA (ATLANTIC)							BAR HARBOR	H M	44 23 N	68 12 W	80 F FP	C; B BB C
HAULOVER BEACH							CUTLER	H M	44 39 N	67 13 W	80 F FP	C; B MC C
PIER	H M	25 54 N	80 07 W	80 F LS	C		EASTPORT	H M	44 54 N	66 59 W	80 F FP	C; B BB C
PALM BEACH	H M	26 42 N	80 03 W	80 F LS	C		CANADA					
TITUSVILLE,							(ATLANTIC AND ARCTIC)					
INDIAN RIVER	H M	28 37 N	80 48 W	80 F LS	C		ST. JOHN N.B.	H M	45 16 N	66 04 W	12 F	C
DAYTONA BEACH							SPENCER ISLAND	H M	45 18 N	64 47 W	12 B	B
SHORES	H M	29 09 N	80 58 W	80 F LS	C; B BB C		PARKERS COVE	H M	44 48 N	65 32 W	12 B	B
MAYPORT	H M	30 24 N	81 26 W	80 F LS	C; B MC C		YARMOUTH	H M	43 50 N	66 08 W	12 F	C
FERNANDINA	H M	30 41 N	81 28 W	80 F LS	C; B MC C		BOUTILIER POINT	H M	44 40 N	63 58 W	12 F	B
FORT PULASKI	H M	32 02 N	80 54 W	80 F LS	C; B MC C		HALIFAX	H M	44 40 N	63 35 W	12 F	C
BEAUFORT	H M	32 26 N	80 40 W	80 F FP	C		POINT TUPPER	H M	45 36 N	61 22 W	12 F	C
EDISTO BEACH	H M	32 30 N	80 18 W	80 B MC	C		NORTH SYDNEY	H M	46 13 N	60 15 W	12 F	C
BLUFF PLANTATION,							PICTOU	H M	45 41 N	62 42 W	12 F	C
COMBAHEE	H M	32 41 N	80 44 W	80 F FP	C		CHARLOTTETOWN	H M	46 14 N	63 07 W	12 F	C
COMBAHEE	H M	32 42 N	80 50 W	80 F LS	C		RUSTICO	H M	46 28 N	63 17 W	12 B	B
CHARLESTON I	H M	32 47 N	79 56 W	80 F FP	C; B BB C		POINTE-DU-CHENE	H M	46 15 N	64 32 W	12 F	C
GENERAL DYNAMICS							LOWER ESCUMINAC	H M	47 05 N	64 53 W	12 F	B
PIER	H M	33 01 N	79 55 W	80 F LS	C		DALHOUSIE	H M	48 04 N	66 23 W	12 P	B
SOUTH SANTEE RIVER	H M	33 11 N	79 24 W	80 F LS	C		RIVIERE-AU-RENARD	H M	49 00 N	64 23 W	12 F	B
BRIDGE							STE-ANNE-DES-MONTS	H M	49 08 N	66 29 W	12 F	B
WINYAH BAY							POINTE-AU-PERE	H M	48 31 N	68 28 W	12 F	B
SOUTH IS.	H M	33 14 N	79 12 W	80 F LS	C; B BB C		RIVIERE-DU-LOUP	H M	47 51 N	69 34 W	12	
BUCKSPORT,							ST-JEAN-PORT-JOLI	H M	47 13 N	70 17 W	12	
WACCAMAW R	H M	33 39 N	79 06 W	80 F FP	C		ST-FRANCOIS	H M	47 00 N	70 49 W	12	
SPRINGMAID PIER	H M	33 40 N	78 54 W	80 F LS	C; B MC C		QUEBEC CITY	H M	46 50 N	71 10 W	12	
SOUTHPORT	H M	33 55 N	78 01 W	80 F LS	C; B MC C		CAP A LA ROCHE	H M	46 34 N	72 06 W	12	
WILMINGTON	H M	34 14 N	77 57 W	80 F FP	C; B MC C		TROIS-RIVIERES	H M	46 20 N	72 33 W	12	
ATLANTIC BEACH	H M	34 42 N	76 43 W	80 F FP	C; B MC C		CHAMPLAIN	H M	46 26 N	72 24 W	12	
DUKE MARINE LAB							BATISCAN	H M	46 30 N	72 15 W	12	
BEAUFORT	H M	34 43 N	76 40 W	80 F FP	C; B MC C		GRONDINES	H M	46 35 N	72 02 W	12	
CAPE HATTERAS	H M	35 13 N	75 38 W	80 F LS	C; B MC C		PORTNEUF	H M	46 41 N	71 53 W	12	
CURRITUCK SOUND	H M	36 10 N	75 46 W	80 B MC	C		NEUVILLE	H M	46 42 N	71 34 W	12	
							ST-JOSEPH-DE-LA-RIVE	H M	47 27 N	70 22 W	12	

PORT-ALFRED	HDM	48 20 N	70 52 W	12			IGLOOLIK	HDM	69 23 N	81 48 W	12	P	C
TADOUSSAC	HDM	48 08 N	69 43 W	12			RESOLUTE	HDM	74 41 N	94 53 W	12	P	C
BAIE COMEAU	HDM	49 14 N	68 08 W	12	F	B	ALERT	HDM	82 30 N	62 19 W	12	P	C
SEPT-ILES	HDM	50 12 N	66 24 W	12	F	B	CAMBRIDGE BAY	HDM	69 07 N	105 04 W	12	B	B
HARRINGTON HBR	HDM	50 30 N	59 29 W	12	F	B	CAPE PARRY	HDM	70 09 N	124 40 W	12	B	B
SAVAGE COVE	HDM	51 20 N	56 42 W	12	B	B	SACHS HARBOUR	HDM	71 58 N	125 15 W	12	B	B
LARK HARBOUR	HDM	49 06 N	58 22 W	12	F	B	TUKTOYAKTUK	HDM	69 25 N	132 58 W	12	B	B
PORT-AUX-BASQUES	HDM	47 34 N	59 08 W	12	F	B	ANTARCTIC						
ARGENTIA	HDM	47 18 N	53 59 W	12	F	C	BASE O'HIGGINGS	H	62 12 S	58 45 W	13	P	MC B
ST. JOHN'S, NFLD.	HDM	47 34 N	52 43 W	12	F	C							
WEST ST. MODESTE	HDM	51 36 N	56 42 W	12	F	B							
NAIN	HDM	56 33 N	61 42 W	12	F	B							
FROBISHER BAY	HDM	63 45 N	68 32 W	12	P	C							
LAKE HARBOUR	HDM	62 51 N	69 53 W	12	P	C							
CHURCHILL	HDM	58 46 N	94 11 W	12	F	B							
CORAL HARBOUR	HDM	64 08 N	83 10 W	12	B	B							
HALL BEACH	HDM	68 45 N	81 13 W	12	P	C							

NOTES

GAUGE TYPE : BLANK = NOT GIVEN, OR MANUFACTURED LOCALLY

METHOD OF REDUCTION : BLANK = NOT GIVEN

U = DATA NOT CURRENTLY REDUCED

GAUGE TYPES

F = FLOAT
P = PRESSURE
B = BUBBLER
D = DIAPHRAGM

GAUGE MANUFACTURES

AA = AANDERAA
AK = AMETEK
AM = AMSLER
AW = ALPINA WERK
BA = BALLAUF

BB = BRISTOL BUBBLER
BM = BOTTOM MOUNTED
BO = BOREL
ES = ESDAILE
EV = EVERSHED & VIGNOLES
FI = FIELDMAN
FO = FOXBORO
FP = FISCHER & PORTER
FU = FUESS
GE = GENTS
HS = HARRISON
KE = KENT
KV = KELVIN
LE = LEA
LG = LEGE

LS = LEUPOLD & STEVENS
MC = METERCRAFT
MU = MUNRO
NE = NEYRPIC
NZ = NEGRETTI ZAMBRA
OT = OTT
PH = PHILIPS
SB = SEBA DELT
SD = STANDARD
ST = STEVENS
TN = TNO 1975
U = UNKNOWN
ZG = ZAVOD
GRIDOMETPRIBOROV RIGA, USSR

Table 1a (continued)
Gauges thought to be running — 1982

ICELAND					USSR (PACIFIC)				
REYKJAVIK		64 09 N	21 56 W		YUZHNO KURILSK		44 01 N	145 52 E	
SPITSBERGEN					NAGAEVA BAY		59 44 N	150 42 E	
BARENTSBURG		78 04 N	15 14 E		PETROPVLOVSK		53 01 N	158 38 E	
USSR					ARGENTINA				
RUSSKAYA GAVAN		76 14 N	62 39 E		USHUAIA II		54 49 S	68 13 W	
MURMANSK		68 58 N	33 03 E		COMODORO RIVADAVIA		45 52 S	87 29 W	
KALININGRAD		54 57 N	20 13 E		PUERTO MADRYN		42 46 S	65 02 W	
EAST GERMANY					QUEQUEN II		38 35 S	58 42 W	
SASSNITZ		54 32 N	13 40 E		MAR DEL PLATA (PUERTO)		38 02 S	57 32 W	
WARNEMUNDE		54 11 N	12 05 E		MAR DEL PLATA (CLUB)		38 00 S	57 33 W	
WISMAR		53 54 N	11 28 E		BUENOS AIRES		34 36 S	58 22 W	
USSR (BLACK SEA)					PALERMO		34 34 S	58 24 W	
PORT TUAPSE		44 06 N	39 04 E		ANTARCTICA				
SEYCHELLES					BAHIA ESPERANZA		63 18 S	56 55 W	
PORT VICTORIA		04 37 S	55 27 E		ARGENTINE IS.		65 15 S	64 16 W	
KENYA					ALMIRANTE BROWN		64 54 S	62 52 W	
KILINDINI		04 04 S	39 39 E						
SRI LANKA									
COLOMBO		06 57 N	79 51 E						

Table 1b
Summary of gauges currently operating.

<i>Country</i>	<i>Organisation No. (Appendix 2)</i>	<i>No. of stations</i>	<i>Country</i>	<i>Organisation No. (Appendix 2)</i>	<i>No. of stations</i>
Norway	53	7	Korea	43	17
Sweden	70	18	Japan	42	57
Poland	60	5	Philippines	59	5
Denmark	20	4	Papua N G	57	5
Netherlands	50	17	Australia	2	104
United Kingdom	75, 76	31	New Zealand	52	15
Eire	23, 24, 25	7	Pacific Islands	79, 80,	
Channel Is	77	1	(inc. Hawaii)	81, 83	36
France	28	15	USA (Alaska)	80	16
Spain	69	7	Canada (Pacific)	12	20
Portugal	62	8	USA (Pacific)	80	33
Gibraltar	76	1	Mexico (Pacific)	48	15
Majorca	69	1	El Salvador	26	1
Monaco	49	1	Costa Rica	17	2
Italy	39, 40	2	Panama (Pacific)	55, 56	2
Greece	32	16	Ecuador	22	6
Romania	63	3	Peru	58	7
Israel	38	1	Chile	13, 79	11
Algeria	1	1	Uruguay	78	4
Spanish N. Africa	69	1	Brasil	10	2
Azores	62	4	French Guiana	29	1
Madeira	62	1	Guyana	33	1
Canary Is.	69	3	Trinidad & Tobago	72	1
Ivory Coast	28	1	Panama (Caribbean)	55	1
Ghana	31	2	Martinique	28	1
Togo	29	1	Mexico (Caribbean)	48	7
Congo	28	1	Puerto Rico	80	2
Namibia	65	2	Virgin Islands	80	2
South Africa	65, 66	11	USA (Gulf)	80	34
Madagascar	28	1	Bermuda	80	1
Reunion	28	1	USA (Atlantic)	80	72
Pakistan	54	1	Canada (Atlantic & Arctic)	12	53*
Bangladesh	9	8	Antarctica	13	4
Thailand	71	10			
Macau	62	1			
China	14	14			
Hong Kong	34	4			

* 14 of these gauges are river gauges not included in the response to the questionnaire but known to be running.

Table 1c
**Gauges from which hourly values
are available**

<i>Country</i>	<i>Organisation No. (Appendix 2)</i>	<i>No. of gauges</i>	<i>Country</i>	<i>Organisation No. (Appendix 2)</i>	<i>No. of gauges</i>
Norway	53	9	Bangladesh	9	8
Sweden	70	18*	Thailand	71	10
Poland	60	5	Macau	62	1*
Denmark	20	4*	China	14	4*
Netherlands	50	17*	Hong Kong	34	4
United Kingdom	75	28*	Korea	43	17
Eire	23	1	Japan	42	57
France	28	15*	Philippines	59	5
Spain	69	7*	Papua N G	57	1
Portugal	62	8*	Australia	2	112
Gibraltar	76	1	USA (Wyrkti)	79	26*
Majorca	69	1*	USA (NOAA)	80	172*
Monaco	49	1	El Salvador	26	1*
Italy	39, 40	2*	Costa Rica	17	2
Greece	32	16*	Ecuador	22	6
Israel	38	1	Chile	13, 79	11*
Spanish N Africa	69	1*	Uruguay	78	4
Azores	62	4*	Brasil	10	2
Madeira	62	1*	French Guiana	29	1*
Canary Is	69	3*	Guyana	33	1
Ivory Coast	28	1*	Martinique	28	1*
Ghana	31	2	Puerto Rico	80	2*
Togo	29	1*	Virgin Islands	80	2*
Congo	28	1*	Bermuda	80	1*
Namibia	65	2*	Canada	12	73*
South Africa	65	10*	Antarctica	13	1*
Madagascar	28	1*			
Reunion	28	1*			
Pakistan	54	1*			

* Computer compatible data.

Table 1d
Gauges from which daily mean values
are available

<i>Country</i>	<i>Organisation No. (Appendix 2)</i>	<i>No. of gauges</i>	<i>Country</i>	<i>Organisation No. (Appendix 2)</i>	<i>No. of gauges</i>
Norway	53	9	Reunion	28	1 *
Sweden	70	18 *	Pakistan	54	1 *
Poland	60	5	Thailand	71	10
United Kingdom	75	28 *	Macau	62	1 *
Eire	23	1	China	14	4 *
France	28	15 *	Korea	43	17
Spain	69	7	Japan	42	57
Portugal	62	8 *	Philippines	59	5
Gibraltar	76	1	Australia	2	112
Majorca	69	1	USA (Wyrki)	79	26 *
Monaco	49	1	USA (NOAA)	80	172 *
Italy	39, 40	2 *	El Salvador	26	1 *
Greece	32	16 *	Costa Rica	17	2
Roumania	63	2 *	Ecuador	22	2
Spanish N. Africa	69	1	Uruguay	78	4
Azores	62	4 *	French Guiana	29	1 *
Madeira	62	1 *	Martinique	28	1 *
Canary Is	69	3	Puerto Rico	80	2 *
Ivory Coast	28	1 *	Virgin Islands	80	2 *
Ghana	31	2	Bermuda	80	1 *
Togo	29	1 *	Canada	12	73 *
Congo	28	1 *			
Namibia	65	2 *			
South Africa	65	10 *			
Madagascar	28	1 *			

* Computer compatible data.

Table 1e
Gauges from which monthly mean values
are available

<i>Country</i>	<i>Organisation No. (Appendix 2)</i>	<i>No. of gauges</i>	<i>Country</i>	<i>Organisation No. (Appendix 2)</i>	<i>No. of gauges</i>
Norway	53	9	Madagascar	28	1 *
Sweden	70	18 *	Reunion	28	1 *
Poland	60	5	Pakistan	54	1 *
United Kingdom	75	28 *	Thailand	71	10
	76	3	Macau	62	1 *
Eire	23, 24	2	China	14	4 *
Channel Is	77	1	Hong Kong	34	4
France	28	15 *	Korea	43	17
Spain	69	7	Japan	42	57
Portugal	62	8 *	Philippines	59	5
Gibraltar	76	1	Papua N G	57	1
Majorca	69	1	Australia	2	104
Monaco	49	1	USA (Wyrki)	79	26 *
Italy	39, 40	2 *	USA (NOAA)	80	172
Greece	32	16 *	El Salvador	26	1 *
Romania	63	1	Costa Rica	17	2
Israel	38	1	Ecuador	22	2
Spanish N. Africa	69	1	Peru	58	7
Azores	62	4 *	Uruguay	78	4
Madeira	62	1 *	French Guiana	29	1 *
Canary Is	69	3	Martinique	28	1 *
Ivory Coast	28	1 *	Puerto Rico	80	2
Ghana	31	2	Virgin Islands	80	2
Togo	29	1 *	Bermuda	80	1
Congo	28	1 *	Canada	12	73
Namibia	65	2 *			
South Africa	65	10 *			

* Computer compatible data.

Table 2
Time lag between measurement
and sending data to PSMSL

Table 3
Response to a 3 to 5 year experiment
— summary

	<1 month		1-3 months		3 months - 1 year		>1 year	
	A	G	A	G	A	G	A	G
a) HOURLY DATA								
Computer compatible	6	44	6	89	5	234	4	116
not " "	6	20	8	35	1	104	1	17
b) DAILY DATA								
Computer compatible	6	52	5	77	2	27	3	44
not " "	3	11	6	22	3	117	2	74
c) MONTHLY DATA								
Computer compatible	5	50	6	78	1	26	3	44
not " "	7	21	7	28	2	116	2	74

The following 26 organisations, representing 22 countries, would be prepared to send hourly data to PSMSL in a computer compatible format for the period of an international experiment extending over 3 to 5 years :

	<i>Organisation No.</i> <i>(Appendix 2)</i>		<i>Organisation No.</i> <i>(Appendix 2)</i>
Sweden	70	China	14
Poland	60	Korea	43
Netherlands	50	Australia	2
United Kingdom	75	New Zealand	52
Eire	23, 25	U.S.A.	79, 80
France	28, 29	El Salvador	26
Spain	69	Panama	55
Portugal	62	Ecuador	22
Italy	39, 40	Chile	13
S. Africa	65	Brasil	10
Pakistan	54	Canada	12

A = number of authorities
G = number of gauges

In addition, Cyprus (18) would be prepared to send data, but they have no gauges of their own running; and Bangladesh (9) could send data tabulated from analogue charts.

Table 4
Countries interested in new equipment

The following organisations would be interested in the installation of new equipment, at international expense.
Those marked * do not currently have gauges operating, although other organisations within the same country may have gauges operating.

	<i>Organisation No.</i> <i>(Appendix 2)</i>		<i>Organisation No.</i> <i>(Appendix 2)</i>
Norway	53	Thailand	71
Sweden	70	China	14
Poland	60	Korea	43, 44*
Denmark	20	Indonesia	36*
Netherlands	50	Philippines	59
United Kingdom	75	Papua N G	57
Eire	23, 24, 25	Australia	2
Channel Islands	76	New Zealand	52
France	28, 29	Vanuatu	81
Spain	69	U S A	79, 80
Portugal	61, 62	Mexico	48
Italy	39, 40	El Salvador	26
Greece	32	Costa Rica	17
Romania	63	Panama	56
Cyprus	18*	Ecuador	22
Lebanon	54*	Peru	58
Algeria	1	Chile	13
Ghana	31	Uruguay	78
South Africa	65, 66	Brasil	10
Pakistan	54	Guyana	33
India	35*	Trinidad	72
Bangladesh	9	Canada	12

Figure 1 Distribution of gauges - Europe

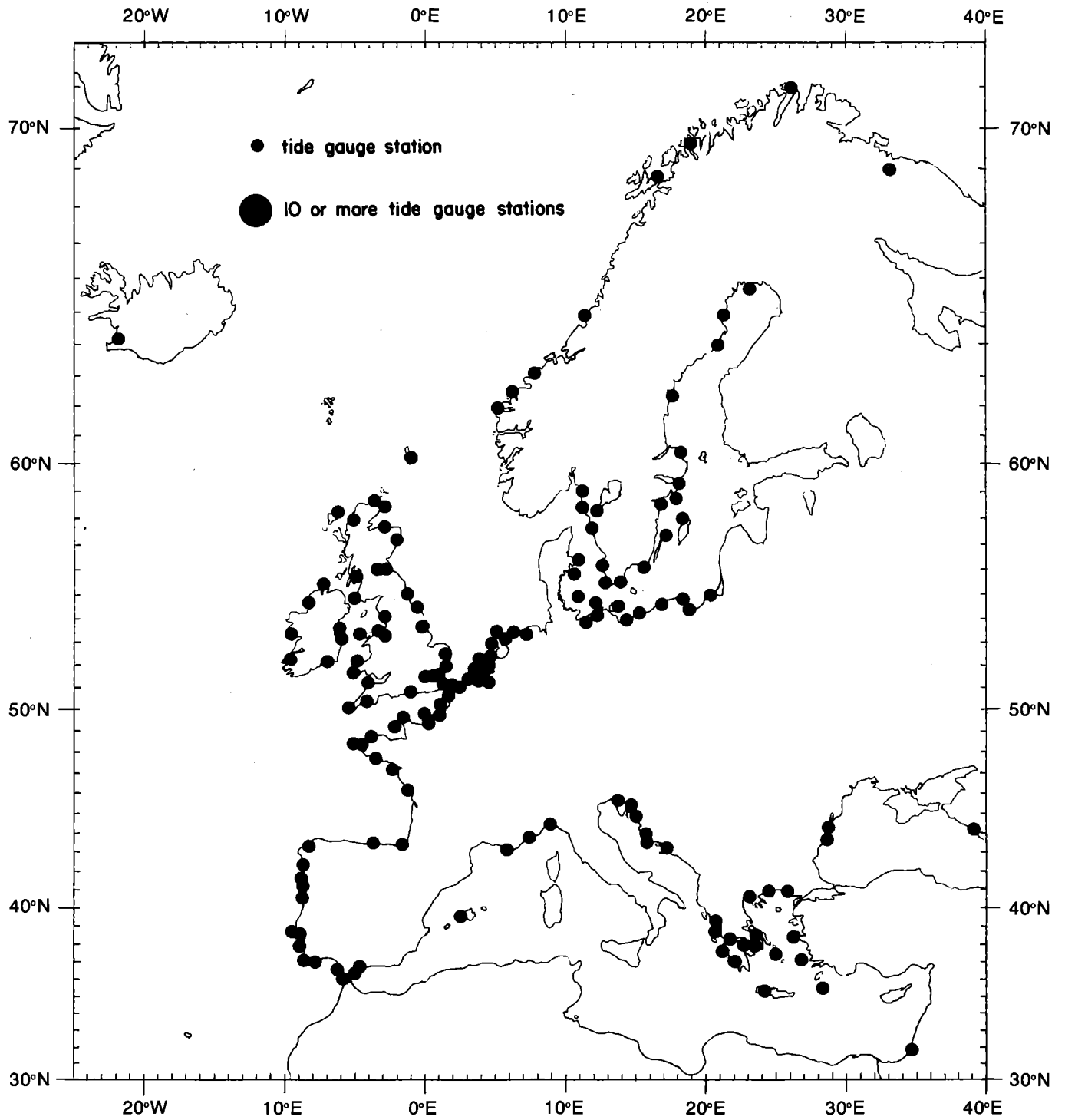


Figure 2 Distribution of gauges - Africa and Middle East

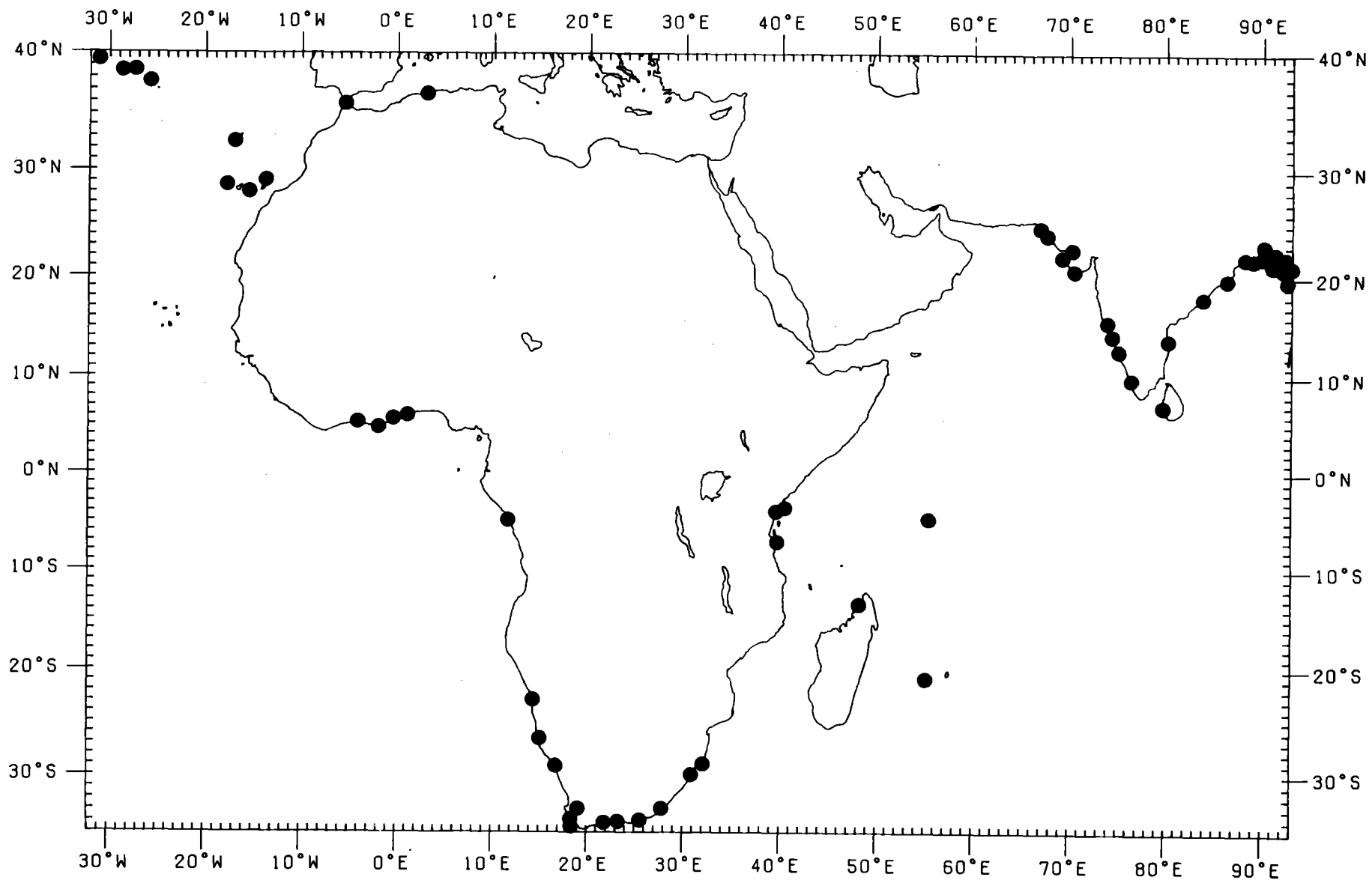
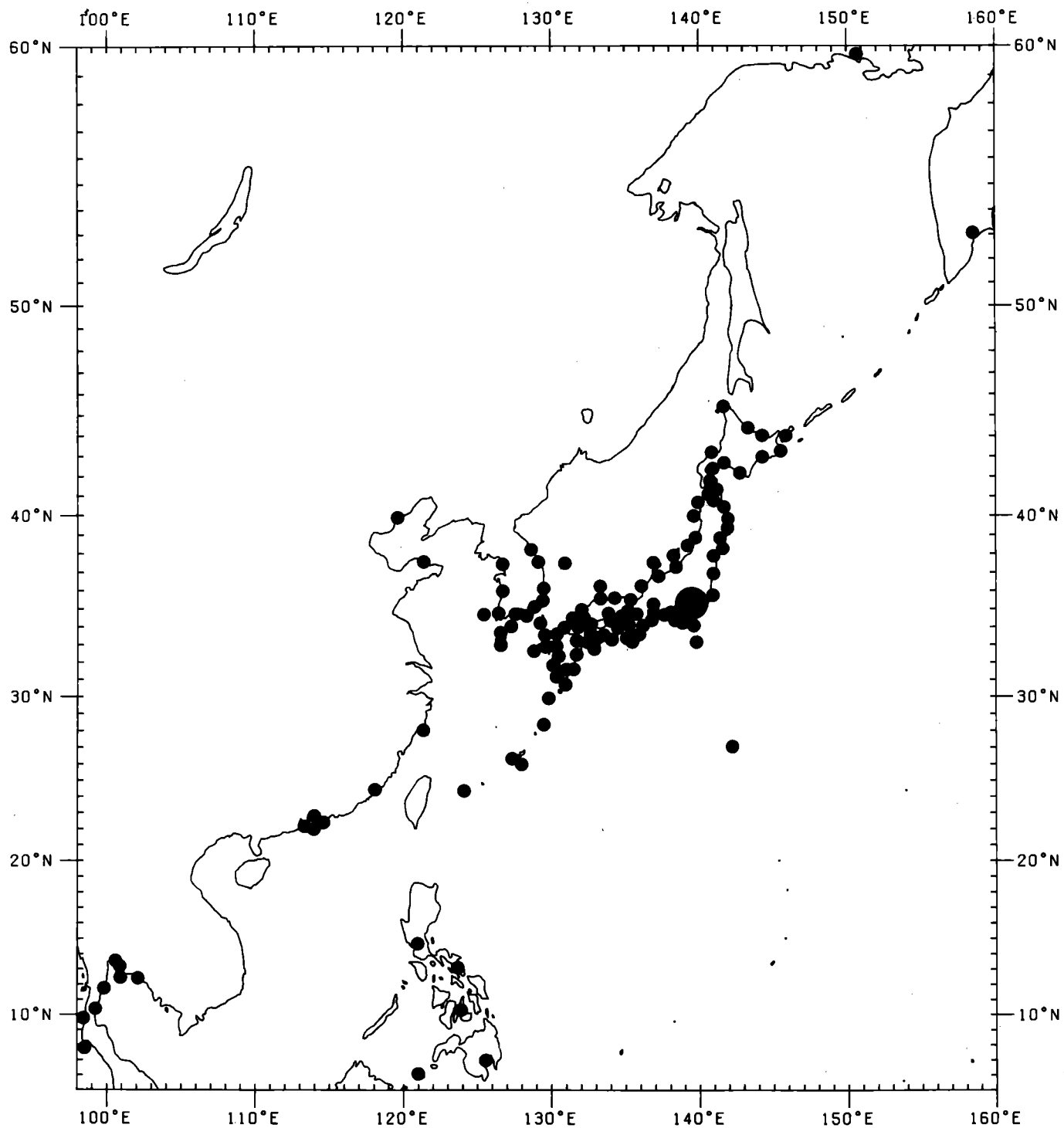


Figure 3 Distribution of gauges - Far East



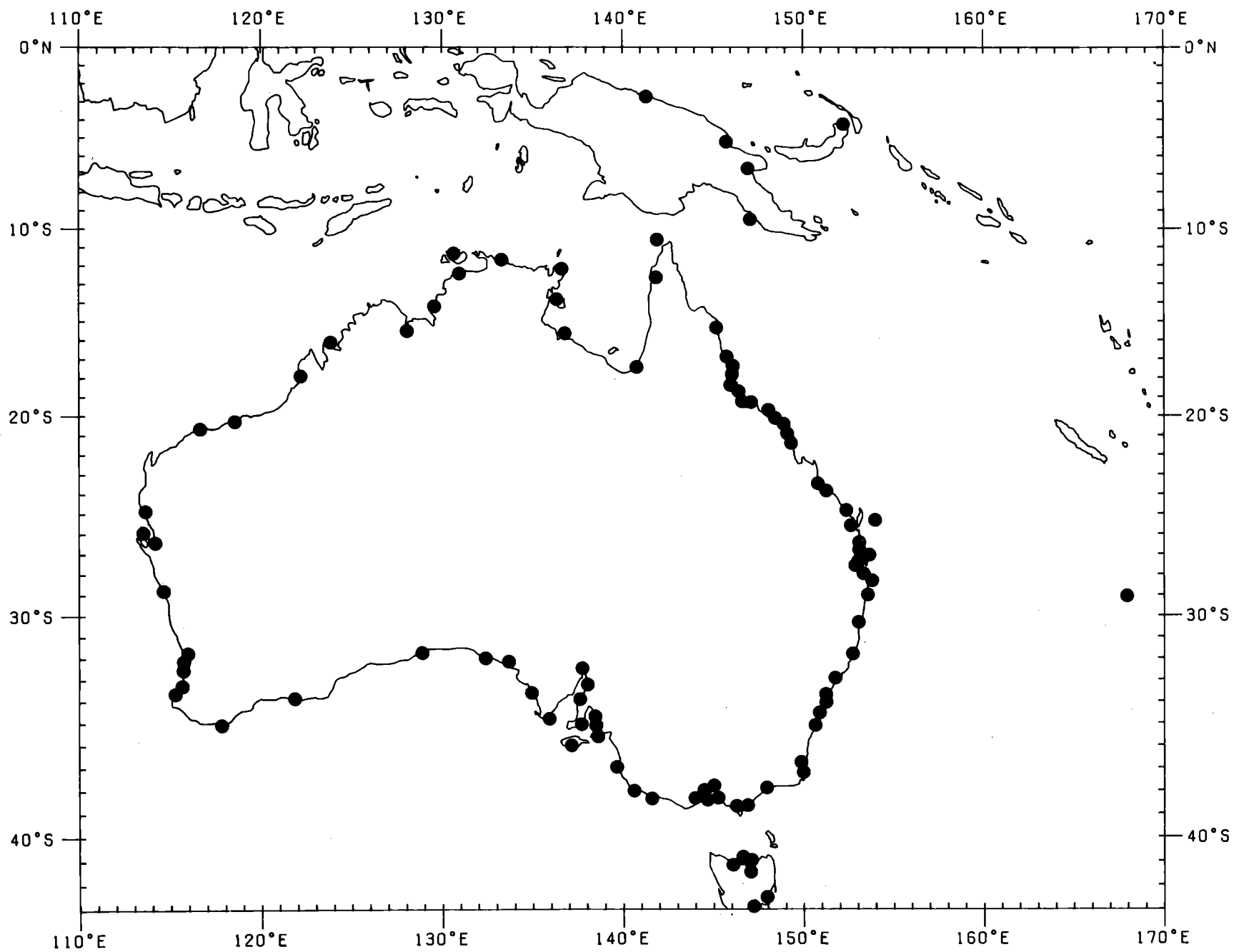


Figure 4 Distribution of gauges - Australia

Figure 5 Distribution of gauges - New Zealand and Pacific Ocean

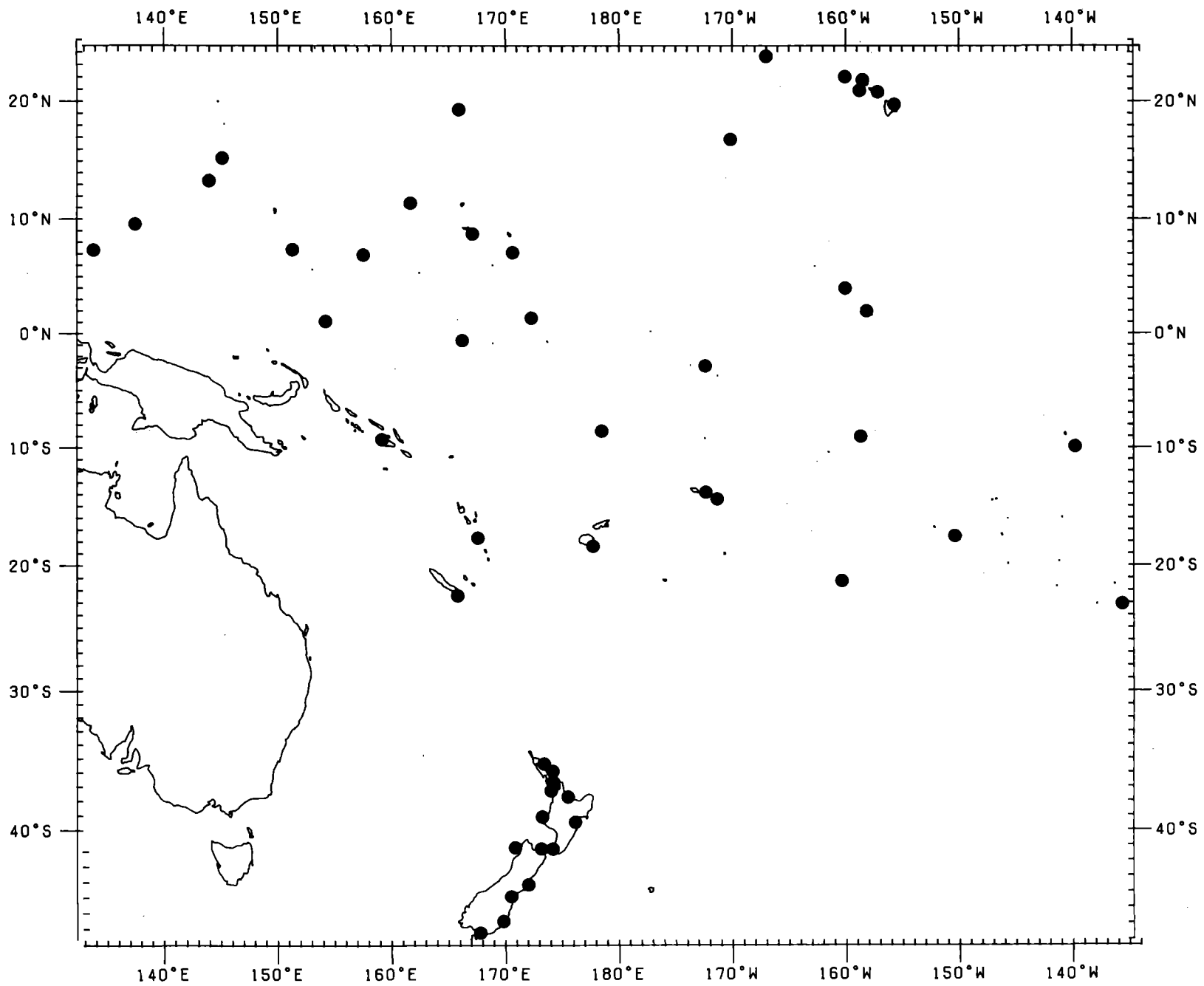


Figure 6 Distribution of gauges - North America

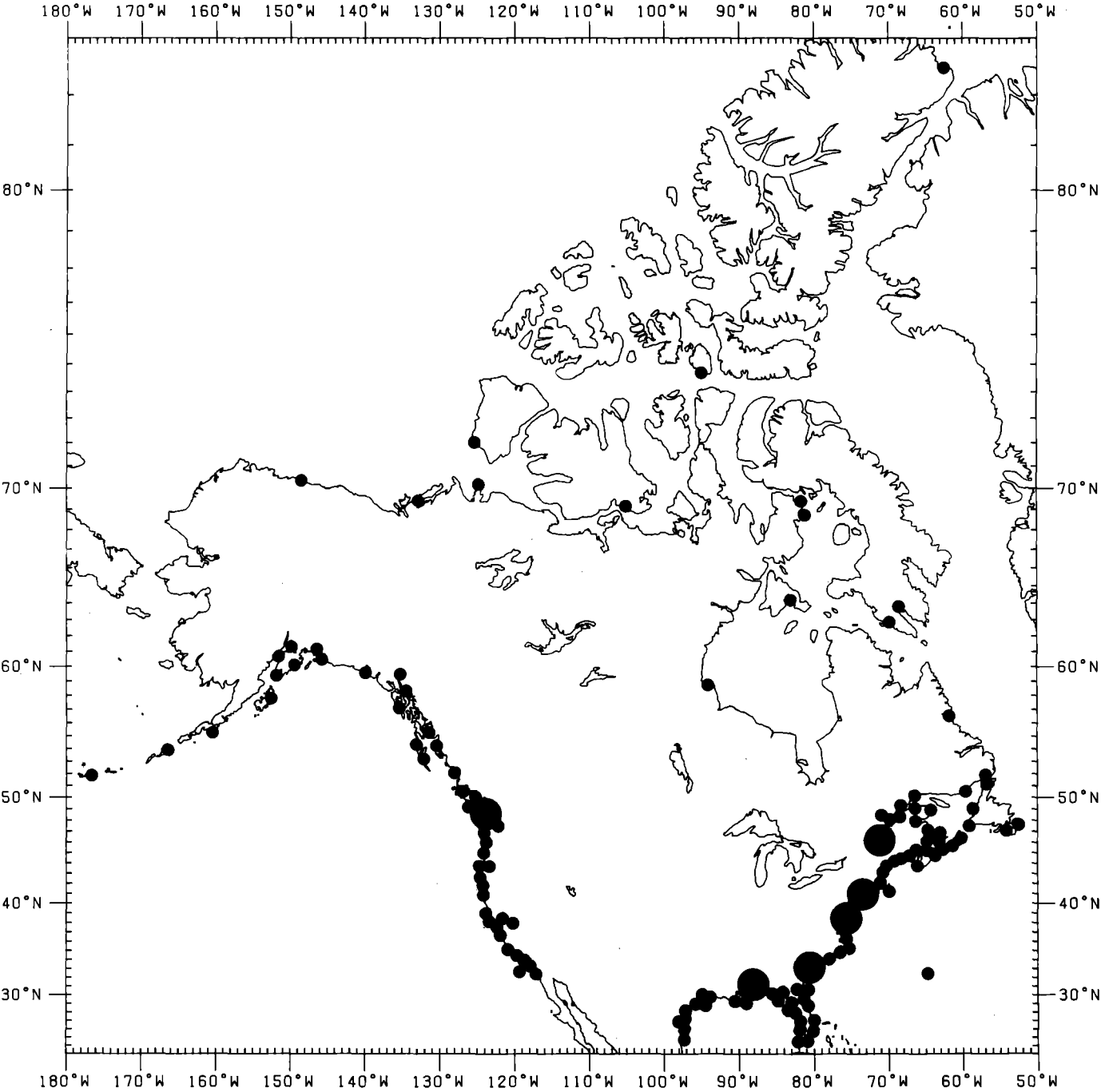
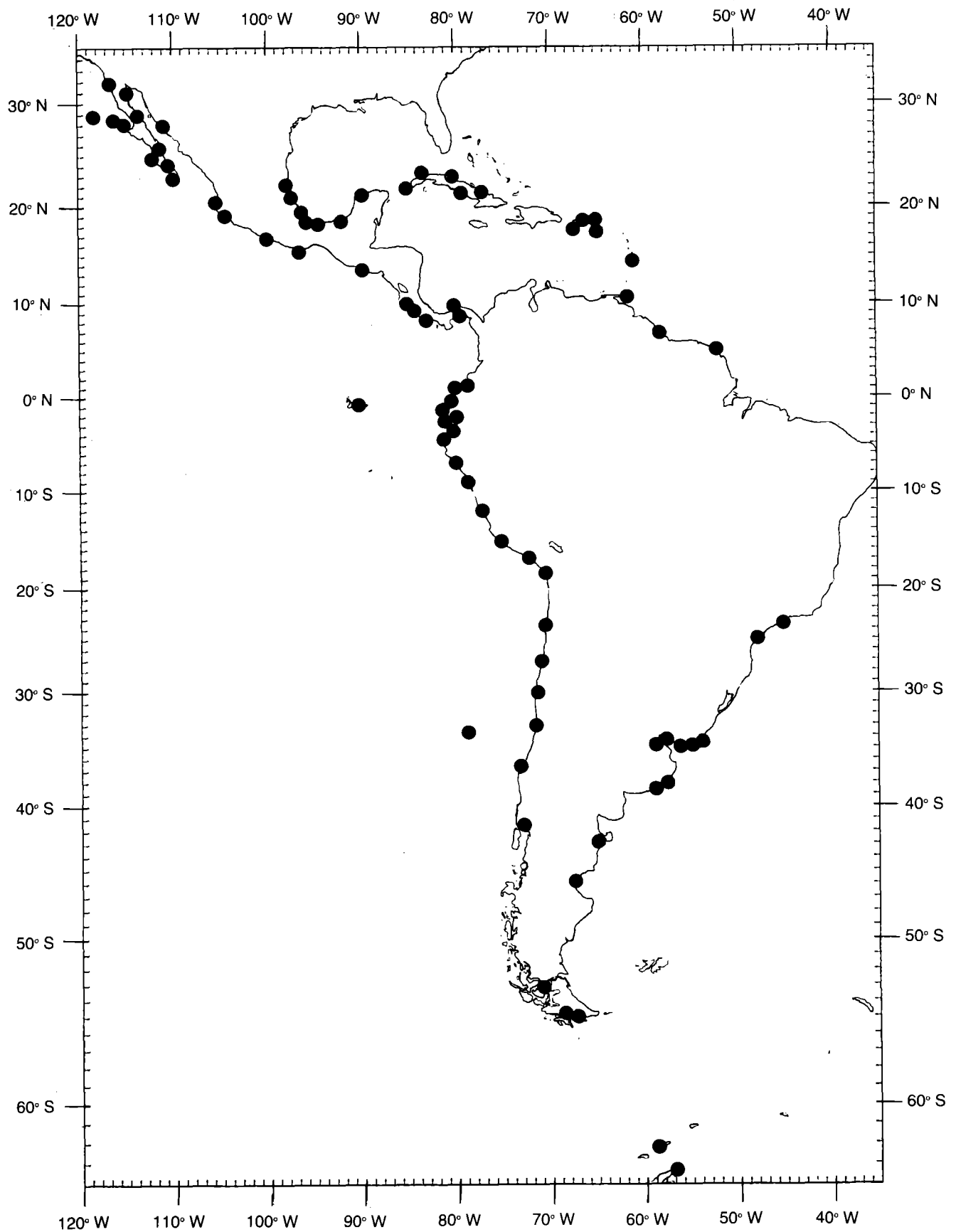


Figure 7 Distribution of gauges - Central and South America



Appendix 1

Copy of questionnaire sent to authorities

International Survey of Sea-Level Measurements

Your co-operation in this survey is greatly appreciated. Only provisional answers are required and no definite commitment will be implied.

Name and address of organization:

.....

.....

.....

.....

1. The attached table concerns the gauges for which your organization has responsibility. Please complete it as far as you are able.

- A Name of station
- B Geographical coordinates
- C Type of gauge - manufacturer, method of operation (float, bubbler, etc.)
- D Method of data reduction
- (a) tabulated from analogue charts
- (b) automatic digitisation from analogue charts
- (c) direct computer entry and editing
- E Data available
- computer compatible - i.e. on computer punched cards
- or magnetic tape

2. What would be the shortest time delay between measurement and sending the data to PSMSL?

.....

.....

.....

.....

3. Would you be prepared to send hourly data to PSMSL in a computer compatible format for the period of an international experiment extending over 3-5 years?

YES/NO

4. Would you be prepared to co-operate in the installation, if necessary, of new equipment in your country, at international expense, in order to facilitate data exchange?

YES/NO

5. Which other organizations in your country, having responsibility for sea-level measurement and data reduction, could PSMSL approach?

.....

.....

.....

.....

6. Would you be interested in receiving sea-level data at more frequent intervals, through PSMSL, from other countries?

.....

.....

.....

.....

Please send completed questionnaires to

Permanent Service for Mean Sea-Level
Bidston Observatory
Birkenhead
Merseyside L43 7RA
United Kingdom

International Survey of Sea-Level Measurements

A	B		C	D			E							
Name of station	Geographical co-ords		Type of gauge	Method of Data reduction			Data available							
	Latitude	Longitude		a	b	c	Hourly		Daily		Monthly		Computer compatible	Computer compatible
	° ' "	° ' "					Available	Computer compatible	Available	Computer compatible	Available	Computer compatible		
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

Appendix 2

List of organizations who have replied to the questionnaire

1. Service hydrographique de la Marine nationale
Institut national de cartographie
123, rue de Tripoli
B.P. 69
Hussein dey
Alger
Algeria
2. The Secretary
PCTMSL - National Mapping Council
Unit 3 Cameron Offices
P.O. Box 31
Belconnen Act 2616
Australia
3. The Director
CSIRO
Division of Fisheries & Oceanography
P.O. Box 21
Cronulla
NSW 2230
Australia
4. Prof. G.W. Lennon
Flinders University
Bedford Park
S. Australia 5042
Australia
5. The Director
Dept. of Harbours & Marine
Edward Street
Box 2195
Brisbane
Queensland 4001
Australia
6. Maritime Services Board of NSW
CNR. Newcomen and Scott Streets
Newcastle 2300
NSW
Australia
7. Maritime Services Board of NSW
BOX 32 GPO
Sydney 2002
NSW
Australia
8. Dept. of Marine & Harbors
Box 19 P.O. Port Adelaide
South Australia 5015
Australia
9. Department of Hydrography
Biwta Bhaban
141-143 Motijheel Commercial Area
Dacca - 2
Bangladesh
10. Prof. A.R. De Mesquita
Instituto Oceanográfico
da Universidade de São Paulo
Cidade Universitaria Butanta
05508 São Paulo S.P.
Brasil
11. Dr. Alberto Dos Santos Franco
Instituto de Pesquisas Tecnológicas
Cidade Universitaria Butanta
Caixa Postal 7141
São Paulo
Brasil
12. Canadian hydrographic Service
615 Booth Street
Ottawa K1A OE6
Ontario
Canada
13. Director
Instituto Hidrográfico de la Armada
Casilla 324
Valparaiso
Chile
14. Mr. Luo Chuanwei
Deputy Director
Institute of Marine Scientific &
Technical Information
National Bureau of Oceanography
118 Qi Wei Road
He Dong District
Tianjin
China
15. Agence Transcongolaise des Communications
Direction du Port de Pointe-Noire
B.P. 711
Pointe-Noire
Congo
16. Dept. of Survey
P.O. Box 114
Rarotonga
Cook Islands
South Pacific
17. Instituto Geográfico Nacional
Apartado 2272
San José
Costa Rica, C.A.
18. Department of Merchant Shipping
Ministry of Communications and Works
Limassol
Cyprus

19. Det Danske Meteorologiske Institut
Lyngbyvej 100
2100 Kobenhavn 0
Denmark
20. The Royal Danish Administration
of Navigation and Hydrography
Nautical Division
Esplanaden 19
1263 Copenhagen k
Denmark
21. Dr. O. Bedsted Andersen
Geodaetisk Institut
Geodaetisk Afdeling 1
Gamelehave Alle 22
2920 Charlottenlund
Denmark
22. F.A. Echeverria
Director
Instituto Oceanográfico de la Armada
Casilla N.º 5940
Avenida 25 de julio - Vía Puerto Marítimo
Guayaquil
Ecuador
23. Ordnance Survey Office
Phoenix Park
Dublin
Eire
24. Dublin Port & Docks Board
Engineer's Office
Port Centre
Alexandra Road
Dublin 1
Eire
25. Mr P. Corish
Hydrometric Section
Office of Public Works
17/19 Lower Hatch St.
Dublin 2
Eire
26. Instituto Geográfico Nacional
Ingeniero Pablo Arnoldo Guzmán
Apartado postal N.º 06-247
San Salvador
El Salvador, C.A.
27. Le Directeur
Centre national pour l'exploitation
des océans
66, avenue d'Iena
75116, Paris
France
28. Le Directeur
Etablissement principal de S.H.O.M.
13, rue du Chatellier
B.P. 426
29275 Brest Cedex
France
29. Le Directeur
Office de la recherche scientifique
et technique outre-mer (O.R.S.T.O.M.)
24, rue Bayard
75008 Paris
France
30. Le Directeur
Institut scientifique et technique
des pêches maritimes (I.S.T.P.M.)
Rue de l'Île d'Yeu
B.P. 1049
44037 Nantes Cedex
France
31. Survey Department
P.O. Box 191
Cantonments
Accra
Ghana
32. Hydrographer of the Navy
Hydrographic Service
BST 902
Athinai
Greece
33. Transport and Harbours Dept.
Hydrographic Office
Water Street
Stabroek
Georgetown
Guyana
34. Port Works Division
Civil Engineering Office
8/f, Empire Centre
Salisbury Road
Kowloon
Hong Kong
35. The Chief Hydrographer
to the Government of India
Naval Hydrographic Office
Post Box No. 75
107 A Rajpur Road
Dehra Dun 248 001
India
36. Dr. Aprilani Soegiarto
Directeur
Lembaga Oceanologi Nasional
of the Indonesian Institute of Sciences
P.O.B. 580/DAK
Jakarta Utara
Indonesia
37. Director
National Cartographic Centre
P.O. Box 1844
Tehran
Iran
38. The Director
Coast Study Division
Israel Ports Authority
P.O.B. 20121 Tel-Aviv
Israel

39. Istituto Talassografico di Trieste
Viale R, Gessi 2
1 34123 Trieste
Italy
40. The Director
Istituto Idrografico della Marina
Passo Osservatorio 4
16134 Genova
Italy
41. Harbourg Master's Dept.
P.O. Box 116
Newport East
Kingston
Jamaica, W.I.
42. Director, Marine Dept.
Japan Meteorological Agency
1-3-4 Ote-Machi, Chiyoda-Ku
Tokyo 100
Japan
43. Republic of Korea
Hydrographic Office
C.P.O. Box 1578
Seoul
Korea
44. The Director (NODC)
Korean Ocean Research
& Development Institute
P.O. Box 17
Yeongdong
Seoul
Korea
45. Marine Research Centre
National Council for Scientific Research
P.O.B. 123
Jounieh
Lebanon
46. The Chief Hydrographer
Royal Malaysian Navy
Naval Staff Division
Ministry of Defence
Jalan Padang Tembak
Kuala Lumpur Malaysia
47. The Director-General
Mauritius Marine Authority
P.O. Box 379
Port Louis
Mauritius
48. Sr. Manuel Almazan Soria
Jefe del Departamento de Investigaciones
de la Dirección General de Estudios
del Territorio Nacional
Secretaría de Programación y Presupuesto
San Antonio Abad 124 P.B.
Col. Tránsito
06820 México D.F.
49. Service des travaux publics
Division des travaux maritimes
Rue Louis Notari
MC-98000
Monaco
50. Rijkwaterstaat
Directie Waterhuishouding en Waterbeweging
Postbus 20907
2500 Ex's-Gravenhage
Hooftskade 1
Netherlands
51. The Director
New Zealand Oceanographic Institute
P.O. Box 12-346
Wellington North
New Zealand
52. The Hydrographer
Royal New Zealand Navy
Hydrographic Office
P.O. Box 33-341 Takapuna
Auckland 9
New Zealand
53. Norges Sjøkartverk
Klubbgt 1
Postboks 60
4001 Stavanger
Norway
54. Hydrographer of the Pakistan Navy
Hydrographic Dept.
Naval Headquarters
Islamabad
Pakistan
55. Panama Canal Commission
Meteorological and Hydrographic Branch
Apo Miami 34011
USA
56. Instituto Geográfico Nacional
Tommy Guardia
Ministerio de Obras Públicas
Apartado 5267
Panamá 5
57. Dept. of Transport and Civil Aviation
Marine Division
Hydrographic Section
P.O. Box 457
Konedobu
Papua New Guinea
58. The Director
Dirección de Hidrografía
y Navegación de la Marina
Av. Gamarra n.º 500
Chucuito
Callao 1
Perú

59. Director
Bureau of Coast & Geodetic Survey
421 Barraca St.
San Nicolás
Manila
Philippines
60. Institute for Meteorology
& Water Economy
01-673 Warszawa ul Podlesna 61
Poland
61. Instituto Geográfico e Cadastral
Praça da Estrela
Lisboa
Portugal
62. Instituto Hidrográfico
Rua des Trinas 49
Lisboa 2
Portugal
63. Ing. Gheorghe Serpoianu
Institutul Roman de Cercetari Marine
Bulevardul Lenin No. 300
Constantza 8700
Romania
64. Director, Meteorological Service
41 Hillcrest Road
Singapore 1128
Republic of Singapore
65. Hydrographic Office S.A. Navy
Maritime Headquarters
Private Bag
Tokai
7965
South Africa
66. Dr C.L. Merry
University of Capetown
Dept. of Surveying
Rondesboch 7700
Republic of South Africa
67. Chief Director of Surveys and Mapping
Dept. of Community Development
Private Bag
7705 Mowbray
South Africa
68. Director
Instituto Hidrográfico de la Marina
Tolosa Latour N.º 1
Cádiz
Spain
69. Director del Centro Español
de Datos Oceanográficos
Instituto Español de Oceanografía
Alcalá 27
Madrid 14
Spain
70. Sveriges Meteorologiska
och Hydrologiska Institut
Box 923
S601 19 Norrköping
Sweden
71. The Director
Hydrographic Dept.
Royal Thai Navy
Bangkok 6
Thailand
72. Dr D. Ramsaroop
Data Aquisition Programme
Institute of Marine Affairs
Carenage Post Office
Carenage
Trinidad & Tobago W.I.
73. Director General
Turkish State Meteorological Service
P.O.B. 401 Ankara
Turkey
74. Mr Svekiet Gucluer
Department of Navigation
& Hydrography
Seyir ve Hidrografi Daire Baskanligi
Cubuklu - Istanbul
Turkey
75. Dr D.E. Cartwright
IOS Bidston
Bidston Observatory
Birkenhead
Merseyside L43 7RA
United Kingdom
76. CDR. N.C. Glen
Tidal Branch
Hydrographic Unit
M.O.D.
Tauton
Somerset TA1 2DN
U.K.
77. Dept of Public Building & Works
States Offices
South Hill
Jersey
Channel Islands
U.K.
78. Servicio de Hidrografía de la Armada
Capurro 980
Montevideo
República Oriental del Uruguay
79. Prof. K. Wyrtki
University of Hawaii at Manoa
Dept. of Oceanography
2525 Corea Road
Honolulu
Hawaii 96822
U.S.A.

80. Office of Marine Surveys & Maps
U.S. Dept. of Commerce
Noaa National Ocean Survey
Rockville
Maryland 20852
U.S.A.

81. Mr A. McFarlane
Dept. of Geology, Mines and
Rural Water Supplies
G.P.O.
Port Vila
Vanuatu

82. Ministry of Transport
Marine and Shipping Division
P.O. Box 1607
Apia
Western Samoa

83. Superintendent
Apia Observatory
Private Bag
Apia
Western Samoa

Appendix 3

The progress of the 1964 PSMSL report on 'A global network of tide gauge stations'

Resolution 9 of the Second Session of the Intergovernmental Oceanographic Commission, held in Paris during September 1962, requested PSMSL, in consultation with appropriate organizations, to submit to the Third Session of the Commission:

- (a) a report on the existing distribution of properly maintained tidal stations;
- (b) a proposal for an improved network of such stations; and
- (c) any further information which would enable the Commission to take further action in promoting such a network.

This report identified over 100 sites where new installations were desirable for mean sea-level research. When this report was submitted to the Intergovernmental Oceanographic Commission at its Third Session in June 1964, the Commission responded by passing a Resolution (III - 7), (copy attached), which requested Member States to consider the possibility of filling gaps in the network and to report their findings to the Secretariat of the Commission. It recommended that a Symposium on Tide gauge instrumentation be organized, and asked Member States who had surplus gauges that they were

willing to lend or present to other countries to make the information available for promulgating in 'International Marine Science'.

PSMSL has no record of the response of Member States to the request that gaps be filled. At best the improvement was only marginal.

A Symposium on 'Tidal instrumentation and predictions of tides' was held in Paris in May 1965, the Proceedings of which were published by Unesco.

The Canadian Government responded to the Resolution by making fifteen gauges available for distribution through IOC; with the co-operation and advice of PSMSL, these gauges were eventually distributed to eight countries. These were Argentina (3), Brazil (4), Philippines (1), United Arab Republic (1), Australia (2), Israel (1), Tunisia (1) and Cuba (2). Data from the Argentina Antarctic installation at Almirante Brown have been received by PSMSL since 1966, and Brazil is known to operate a gauge on Fernando de Noronha Island, one of their proposed sites. We have no further information about the remaining gauges.

Resolution adopted by the Intergovernmental Oceanographic Commission at its Third Session

(June 1964)

Resolution III-7

TIDE GAUGES

The Intergovernmental Oceanographic Commission,

Having studied the report UNESCO/IOC/III-9, prepared for the Commission by the Permanent Service for Mean Sea-Level, and believing that a greater knowledge of sea-level is vital to both oceanographic and meteorological research;

Requests Member States (i) to study the existing network of permanent tide gauges shown in the above report, (ii) to inform the Permanent Service for Mean Sea-Level, through the Secretariat of the Commission, of any errors in the 'Index of Gauges' and also to report details of any additional gauges as and when established, and (iii) *to consider the possibility of filling gaps in the network and to report findings to the Secretariat of the Commission;*

Recommends further that Member States arrange for close liaison to be maintained between agencies operating tide gauges and scientists working in the field of sea-level studies

to ensure that research requirements are considered when new gauges are installed and in the processing of sea-level records.

Recommends that a Symposium on Tide Gauge Instrumentation be held in Paris in May 1965, jointly by Unesco and IAP0, and that standardization of presentation of data for automatic processing and the need for offshore oceanographic buoys and platforms to be fitted with tide gauges where practical, to be discussed.

Considers that the installation of gauges and the presentation of data should take into account all uses to which sea-level data are put, both scientifically such as in the theoretical relationships between coastal levels and those in the open sea and for such practical purposes as tidal prediction, port operation, coastal engineering, tsunami warning, etc.

Asks Member States who may have surplus gauges that they are willing to lend or present to other countries to inform the Secretariat of the Commission so that this information may be promulgated in 'International Marine Science'.

Addendum

The following replies to the questionnaire
were received between 1 July and 20 September 1982.
These stations are included on the maps

Belgium

Dienst der Kust - Hydrografie
Residentie «De Mast»
E. Feysplein 15
B-8400 Oostende
Belgium

3 gauges

Shortest time delay before sending data?

1 month

Prepared to participate in an international experiment

Yes

Willing to accept equipment installed at international expense?

Yes

Belgium

Antwerpse Zeediensten
Loodsgebouw
Tavernierkaai 3
2000 Antwerpen
Belgium

2 gauges

Shortest time delay before sending data?

3 months

Prepared to participate in an international experiment?

No

Willing to accept equipment installed at international expense?

—

Cuba

Instituto de Oceanología
Ira. N.º 17406 e/ 184 y 186
Rpto. Flores, Playa
Ciudad de La Habana
Cuba

5 gauges

Shortest time delay before sending data?

3-6 months

Prepared to participate in an international experiment?

No

Willing to accept equipment installed at international expense?

Yes

Cyprus

Department of Land and Surveys
Ministry of the Interior
Nicosia
Cyprus

No gauges

Willing to accept equipment installed at international expense?

Yes

Hong Kong

Royal Observatory
Nathan Road
Kowloon
Hong Kong

3 gauges

Shortest time delay before sending data?

1 month

Prepared to participate in an international experiment?

Yes

Willing to accept equipment installed at international expense?

Yes

India

The Director
Geodetic and Research Branch
Survey of India
Post Box No 77
Dehra Dun - 248001 U.P.
India

13 gauges

Shortest time delay before sending data?

1 year

Kenya

Kenya Port Authority
PO Box 95009
Mombasa
Kenya

1 gauge

Shortest time delay before sending data?

1-2 weeks

Prepared to participate in an international experiment?

Yes

Willing to accept equipment installed at international expense?

Yes

Pakistan

National Institute of Oceanography
37-K, block 6
P.E.C.H.S.
Karachi
Pakistan

1 gauge

Shortest time delay before sending data?

3 months

Prepared to participate in an international experiment?

Yes

Willing to accept equipment installed at international expense?

Yes

Tanzania

Tanzania Harbours Authority
P.O. Box 9184
Dar es salaam
Tanzania

No gauges

Willing to accept equipment installed at international expense?

Yes

Yugoslavia

Institute for Oceanography and Fisheries
58000 Split Box 114
Mose Pijade 63
Yugoslavia

5 gauges

Shortest time delay before sending data?

1 year

Prepared to participate in an international experiment?

Yes

Willing to accept equipment installed at international expense?

Yes

List of gauges from recent replies to questionnaire

Belgium

Nieuwpoort	HDM	51	09	N	02	44	E	F	OT	B
Oostende	HDM	51	14	N	02	56	E	F	OT	B
Zeebrugge	HDM	51	21	N	03	12	E	F	OT	B
Antwerp (Prosperpolder)		51	21	N	04	14	E	F	OT	B
Antwerp (Loodsgebouw)		51	14	N	04	24	E	F	OT	B

Cuba

Cabo San-Antonio	HDM	21	54	N	84	54	W	F	SB	A
Siboney	HDM	23	05	N	82	45	W	F	SB	A
La Isabela	HDM	22	56	N	80	00	W	F	SB	A
Gibara	HDM	21	06	N	76	07	W	F	SB	A
Casilda	HDM	21	45	N	79	59	W	F	SB	A

Hong Kong

Kau Lau Wan	H	22	28	N	114	22	E	B	VE	A
Waglan	H	22	11	N	114	18	E	B	VE	A
Lok On Pei	H	22	22	N	114	00	E	F	MU	A

India

Kandla	HDM	23	01	N	70	13	E	F		A
Okha	HDM	22	28	N	69	05	E	F		A
Veraval	HDM	20	54	N	70	22	E	F		A
Bombay	HDM	18	55	N	72	50	E	F		A
Marmagao	HDM	15	25	N	73	48	E	F		A
Karwar	HDM	14	48	N	74	07	E	F		A
New Mangalore	HDM	12	55	N	74	48	E	F		A
Cochine	HDM	09	58	N	76	16	E	F		A
Nagappatinam	HDM	10	46	N	79	51	E	F		A
Madras	HDM	13	06	N	80	18	E	F		A
Vishakhapatnam	HDM	17	41	N	83	17	E	F		A
Paradip	HDM	20	16	N	86	42	E	F		A
Haldia	HDM	22	02	N	88	06	E	P		A

Kenya

Mombasa	DM	04	02	S	39	38	E	F	MU	A
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Pakistan

Manora Tidal Observatory	HDM	24	48	N	66	58	E	F	MU	A
--------------------------	-----	----	----	---	----	----	---	---	----	---

Tanzania

Dar-es-Salaam		06	50	S	39	18	E	T		
---------------	--	----	----	---	----	----	---	---	--	--

Yugoslavia

Split Luka	H	43	30	N	16	26	E	F	OT	B
Split Rt Marjana	H	43	30	N	16	23	E	F	OG	B
Dubrovnik	H	42	39	N	18	04	E	F	OT	B
Bakar	H	45	18	N	14	32	E	F	OG	B
Rovinj	H	45	05	N	13	38	E	F	OT	B