WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)

JOINT WMO/IOC INFORMAL PLANNING MEETING ON DRIFTING BUOY PROGRAMMES

GENEVA, 3-5 DECEMBER 1979

FINAL REPORT

(This page left intentionally blank.)

GENERAL SUMMARY OF THE WORK OF THE MEETING

1. ORGANIZATION OF THE MEETING (Agenda item 1)

1.1 Opening of the meeting

1.1.1 The Joint WMO/IOC Informal Planning Meeting on Drifting Buoy Programmes was opened by Dr. G.K. Weiss, Director, World Weather Watch Department, at 10 a.m. on 3 December 1979 at the headquarters of WMO in Geneva, Switzerland. Dr. Weiss, after having welcomed the participants, referred to the decisions by the governing bodies of WMO and IOC which led to the convening of the joint informal planning meeting. He mentioned that the success of the FGGE Drifting Buoy Programme clearly demonstrated the considerable potential value that similar undertakings would present to operational and research programmes sponsored by WMO and IOC. Dr. Weiss then recalled the efforts by the two organizations to strengthen co-operation between Meteorological and Oceanographic Services, particularly through the joint venture IGOSS. He felt that this joint informal planning meeting would mark another step forward towards closer collaboration between meteorologists and oceanographers. In closing, he expressed special appreciation to Mr. D.P.D. Scott, Secretary of IOC, who is due to leave IOC at the end of the year, for his presence and paid tribute to his untiring efforts to promote the co-operation between WMO and IOC.

1.1.2 Mr. D.P.D. Scott, Secretary of IOC, responded to Dr. Weiss that he was very pleased with the present relationship between IOC and WMO which had considerably improved during his term of office and thanked Dr. Weiss for his invitation to attend the opening session. Mr. Scott stated that IOC attached special importance to the development of drifting buoy projects for its oceanographic research and services programmes and hoped that the meeting would achieve its primary objective to establish an international mechanism to co-ordinate drifting buoy initiatives.

1.1.3 The list of participants is given in Annex I.

1.2 Election of the chairman

The meeting unanimously elected Dr. J. Garrett as chairman.

1.3 Adoption of the agenda

The agenda as adopted by the meeting and the list of documents considered are given in Annexes II and III, respectively.

1.4 Working arrangements

Under this item the meeting considered and agreed on the work programme, working hours and other matters related to the conduct of the business of the meeting.

2. REPORT ON THE FGGE DRIFTING BUOY PROGRAMME (Agenda item 2)

2.1 This item was introduced by Dr. John Garrett, chairman of the Joint WMO/ICSU Committee of Participants for the FGGE Drifting Buoy System. In introducing this item he referred to the recent fifth session of the Committee of Participants (Geneva, 26-30 November 1979) and in particular the report produced at this meeting entitled: "Critical Review of the Performance of the FGGE Drifting Buoy System". The following comments summarize this report.

2.2 Between October 1978 and July 1979, countries supplied some 368 buoys measuring at least barometric pressure and sea surface temperature. These buoys were deployed in the Arctic, North Atlantic, equatorial zones and including 301 in the southern hemisphere 20°S to 65°S. Deployment was achieved by 41 ships volunteered from some 15 countries. Airplane deployments were used for some reseeding purposes.

2.3 In the southern hemisphere region more than 60% of the ocean was within 500 km of a buoy providing good pressure from early January until the end of November 1979. On this basis, more than 70% coverage was achieved between late March and August. At the end of November 1979, over 100 buoys are still transmitting useful data.

2.4 Data from these buoys were collected through the TIROS-N satellite and processed (including buoy position) by the Argos System in France. The data was distributed by the GTS and a delayed-mode higher quality FGGE II-b buoy data set was prepared.

2.5 The Argos data collection and location system performed nearly perfectly, meeting or exceeding all previously announced specifications. Nevertheless because of the minimum delay of approximately two hours inherent in the processing system, coupled with other delays in GTS transmission, the real-time level II-a data usually arrived at meteorological centres too late to be used in the initial surface analyses. In general, however, it was used in updating the analysis prior to preparation of the charts for the succeeding synoptic hour. In spite of the late receipt the data were found to be extremely useful by several countries and to have permitted a much improved quality of forecast. For future systems it was recommended that the WMO Commission for Basic Systems (CBS) be consulted to optimize GTS data exchange, thereby minimizing data delay time.

2.6 Dr. Garrett noted that it was interesting to examine the cost of such a buoy system particularly in view of its apparently highly successful performance. As a very rough estimate the following figures were provided:

Buoys	$ 2,000,000
Data processing	$ 1,000,000
Dedicated ship time $ 3,000/day	$ 600,000
Airplane	$ 200,000
	$ 3,800,000

÷ 301 buoys x 192 days (average of time when good data were achieved)

= $ 66/day or, in mid-latitudes about $ 8/ report

2.7 It was pointed out that international co-ordination action on the recovery of buoys which have washed ashore might reduce the costs of operating any permanent network.

2.8 Dr. Garrett noted that this buoy system was designed with meteorological objectives in mind and the future would tell if the oceanographers would find the data from the network useful. This is primarily due to the lack of sea surface temperature verification information and the lack of information on the relationship of the drift of these buoys to the ocean current.

2.9 Although the time available did not permit a complete evaluation of the buoy array performance a number of specific topics for study was suggested.

2.10 The overall evaluation was that the buoy array had performed very well and had more than met all expectations. It was regretted that so far no means have been found to continue the exploitation of the data from the remaining buoys after the end of the FGGE Operational Year.

3. REVIEW OF PRESENT AND PLANNED NATIONAL DRIFTING BUOY PROGRAMMES (Agenda item 3)

3.1 The meeting noted with appreciation reports by experts and representatives of international organizations on their present and planned drifting buoy programmes. From these reports the meeting could derive the following two distinct conclusions:

(i) There are a number of drifting buoy programmes directed towards serving operational meteorological purposes and meteorologists see a need for having an international mechanism to co-ordinate these initiatives;

(ii) On the other hand, oceanographers are still cautious about the capabilities offered by presently available drifting buoys particularly with respect to current and sea temperature measurement, and felt it was premature to consider any routine operational programme in the near future, although mechanisms to assist the co-ordination of individual development and research initiatives are highly desirable.

3.2 The summary of statements by the participants on their drifting buoy programme is given in Annex IV.

4. CONSIDERATION OF ARRANGEMENTS FOR DATA COLLECTION AND DISSEMINATION (Agenda item 4)

4.1 A report on the results being obtained with the Argos Location and Data Collection System carried on the TIROS-N and NOAA-A satellites was presented. The accuracy of position determination was particularly interesting with 98% of the calculated positions for a platform with an oscillator stability of 10^{-9} over 20 minutes within 1,000 metres of the true position. However with an oscillator stability of 10^{-8}, only 67% of the locations would be within 1,000 m of the true location and for a stability of 10^{-7} 67% would be within 5,500 metres.

4.2 There was considerable discussion of local read-out stations for obtaining data and position information directly from the information broadcast on the satellite beacon. One such station was described by Service Argos, others by the United States, Norway and Canada. It was felt that the use of such stations was just beginning and that it was too early to be sure of their real value. It seemed clear that they would permit data collection over a wide area with a minimum delay and with fairly low cost. However the area over which positions could be obtained was much smaller and the services were unlikely to be as good as with the Service Argos central processing system, although it could be improved by using reference platforms in known positions close to the buoys being followed. The number of platforms for which locations could be determined in real-time is limited by the computer facilities associated with the station. Several countries reported that they were evaluating such stations for use in providing real-time data for use in regional analysis or forecasts and oceanographic programmes.

4.3 A number of points relating to the eventual operational use of such stations in a global observing system were noted. It would be necessary for the operator of the direct station to insert the data onto the GTS, which would itself require some effort. In addition it would require the ability to convert transmissions received into meteorological parameters. If the area of coverage included several types of buoys this might involve several different algorithms. It could easily happen that the same data were inserted on the GTS at two or more points, such as by the direct station operator and by the Service Argos processing centre and some thoughts should be given to whether this is a problem and how to deal with it. GTS codes were discussed but it was felt that the various codes available covered all immediate requirements.

4.4 Other systems for data retrieval and buoy position determination were mentioned, with the U.S. expert reporting on a study of the possibilities of using geostationary satellites which had indicated this was unlikely to provide accurate positions and also to be quite expensive. It was generally felt that the Argos system offered the best alternative presently available.

4.5 The question was raised as to whether the data collected by the Argos system would continue to be inserted on the GTS through the Regional Telecommunication *Hub Paris*. It was pointed out that to be carried on the GTS data had to be of overall meteorological or oceanographic interest and had also to be in an appropriate code. Service Argos indicated that it was prepared to develop additional software needed for coding the data if there was sufficiend demand. The normal procedures for requesting transmission over the GTS should be followed. The meteorological agency of the country operating the buoy should contact the French Meteorological Service directly.

4.6 Following the recommendation of WMO Resolution 6 (EC-XXXI) and IOC Resolution EC-XI.12 the meeting considered the problem of arranging for the processing and dissemination of data from those FGGE buoys continuing to transmit after the end of the FGGE Operational Year. The following points were noted:

(1) Buoy life was longer than initially expected, so that an unexpectedly large number of buoys are still reporting good data;

(2) This data had proven to be of significant value in weather forecasting;

(3) The data processing was provided free of charge during the FGGE Operational Year and December 1979 as part of the French contribution, but cannot be continued on that basis after the end of 1979;

(4) In view of the delays in the delivery of the data reported by some centres, it would be desirable to test strategies for distributing the data over the GTS;

(5) Extraordinary measures are required in view of the urgency of the situation and that the arrangements made should in no way be considered as a precedent.

4.7 Service Argos provided an estimate of the costs involved, based on observed buoy failure rates and predicted battery life. They indicated that they would be prepared to accept an amount equal to the estimated cost on a "prix forfaitaire" basis, that is the amount would remain fixed whether the buoys failed earlier or later than estimated. The expected number of platform years expected from buoys of each of the major suppliers is shown in Table 4.1, together with the portion of the total cost attributed to buoys of that type.

4.8 The representative of France added that the continued processing of French buoys would be arranged internally within France. The representative of the US expressed a willingness to include the remaining US and Australian FGGE buoys in the overall US contract recently negotiated with Service Argos. The representative from the Canadian Atmospheric Environment Service stated that although his agency had no direct interest in the southern hemisphere they were willing to contribute 67,000 French Francs in order that the array would continue to be exploited as long as possible so that the assessment of reliability and performance could be completed.

4.9 The representative of ICSU said that he would raise the question with Member Countries known to be concerned with continued receipt of data from the buoy array and that he was confident that 20,000 French Francs would be found. Thus a further contribution of 55,000 French Francs is required in order to ensure the continued processing and dissemination of the data from the array. The various representatives agreed that they would implement the actions promised by making suitable arrangements directly with Service Argos except in cases where other arrangements already exist. They expressed the hope that means would be found to cover the outstanding 55,000 French Francs perhaps using unspent international funds previously allocated for FGGE.

Table 4.1

Predictions for remaining FGGE buoys, by supplier

Supplier	Platform years after 31 December 1979	Extimated processing cost (French Francs)
Australia	2.75	33,600
Canada	4.80	67,000
France	6.52	91,350
Norway	3.33	46,700
United Kingdom	0.58	8,100
USA	9.42	132,000
Others	1.45	20,300
Total	28.85	404,050

4.10 Noting that means had been found to continue the processing of the remaining FGGE buoys, the idea was expressed that it would be useful to test alternative schemes for distributing the data on the GTS to find out whether they would be more satisfactory to meteorologists trying to make operational forecasts. In particular the meeting requested the Secretariat to invite Service Argos to take action to distribute all FGGE buoy data as soon as it is available, i.e. at the completion of the processing of the data from each satellite orbit. This could be done without fear of overloading the Tokyo-Melbourne link of the GTS since this has recently been upgraded. Meteorological Services using the data in real-time were asked to compile statistics on arrival time of buoy data, and to forward those statistics to the World Weather Watch Department of the WMO, so that the merit of this strategy could be evaluated. The Secretariat was requested to take any measures necessary to expedite this experiment taking into account the rapidly diminishing number of buoys transmitting data and the readiness of the WMC Melbourne to accept the new arrangements.

4.11 The meeting noted the fact that the FGGE Data Management Plan does not cover the collection and archiving of those FGGE buoy data on a global and regional level received after 1 December 1979. It therefore recommended that similar arrangements as used during the FGGE Operational Year should continue to apply to these data and encouraged countries concerned to continue these activities.

5. ESTABLISHMENT OF DRIFTING BUOY PROGRAMMES WITHIN AN INTERNATIONAL FRAMEWORK (Agenda item 5)

5.1 Review of requirements for drifting buoy data

Meteorological

5.1.1 For operational meteorological purposes the time requirements for the reception of drifting buoy reports is very stringent. The meeting considered it necessary to give an appropriate priority to the transmission of drifting buoy data over the GTS and in this connexion stressed the need for consultation with the WMO Commission for Basic Systems (CBS). As for the parameters which were desirable it was felt that the requirements for marine meteorology, tempered by the capability of the drifting buoy technology, should be used for guidance. Considering this, the following parameters were emphasized: air pressure, wind speed and direction,

sea surface temperature and waves. As to the accuracy of these parameters the meeting suggested that the accuracy requirements as given in standard WMO documentation could be used as a departure point.

Oceanographic

5.1.2 The oceanographic participants of the meeting agreed that it was too early to discuss specific requirements for oceanographic data from drifting buoys. In the next few years therefore, the oceanographic requirement is that Service Argos or its equivalent be maintained with flexibility to handle data from oceanographic research buoys carrying a variety of sensors. Work in the near future will concentrate on developing measurement techniques and in particular in trying to understand how best to formulate ocean monitoring requirements in view of the performance of drifting buoys. The response of the buoys to wind waves and ocean current remains an important issue to understand before ocean currents can be inferred from drifting buoy tracks. The two most often mentioned parameters under investigations are currents and surface and sub-surface temperature. It was noted that oceanographers, as well as meteorologists, will need measurements of wind speed and direction from drifting buoys.

5.1.3 Although it was stressed that it was premature to specify operational requirements, some oceanographers did see the need for the exchange of data, and certainly information regarding the development of drifting buoy technology and applications. In the context of data exchange it was noted that many countries, as data user, desired some types of oceanographic data to be exchanged over the GTS and in this connexion reference was made to IGOSS programme requirements (General Plan and Implementation Programme for 1977-1982). The meeting further noted that COST-43 in setting up the data requirements for its buoy networks, both drifting and moored, have stipulated that both oceanographic and meteorological data would be exchanged in real-time.

5.1.4 The meeting further noted the increasing emphasis on ocean monitoring as reflected in recent meetings of the Pilot Ocean Monitoring Study (POMS) and the Joint SCOR/IOC Committee on Climatic Change and the Ocean. It was felt that these climate activities would be the driving force behind future statements of requirements to be provided during the coming several years. Further elaboration of the oceanographic research communities requirements is to be found in the report of the SCOR delegation in Annex IV.

5.2 Planning and operational strategy for the establishment of buoy networks

5.2.1 The meeting was in general agreement that for both oceanographic and meteorological and operational and research purposes it would be of benefit to consider international co-ordination and co-operation in the following areas:

(i) Exchange of information on drifting buoy developments and applications;

(ii) Co-ordination of deployments, when needed. Also perhaps, the publication of a list of buoy deployments;

(iii) Exchange of data on an operational basis (primarily applies to operational meteorological data collection programmes at present, but the oceanographic community would be prepared to provide their data for exchange);

(iv) An international dialogue between oceanographers and meteorologists, on buoy operations for both research and operational purposes seems useful. It was also desired that the interests of both small and large users would be taken into account;

(v) Co-ordination of tracking of the buoys from one region to another;

(vi) Co-ordination and study of matters of legal implications such as buoy recovery, buoy markings, customs clearances, etc.

(vii) The design of a practical composite meteorological observing system based on operational experience during FGGE.

The meeting noted that to achieve this international co-ordination it would be desirable to establish an interim international co-ordination group. The meeting also noted in this context the background provided by and the recommendations of the seventh session of the WMO EC Intergovernmental Panel on the FGGE (see Annex V), and in particular the establishment of a drifting buoy co-ordinating mechanism as soon as possible. The meeting stressed that this group should be of an implementation co-ordination nature and one which receives its operational and scientific guidance from qualified bodies.

5.2.2 In discussing possible terms of reference for this proposed group, the meeting noted that buoys will be increasingly valuable as part of composite observing systems for the needs of the WWW, IGOSS, international oceanographic programmes, the World Climate Programme, and other applications and research programmes. Experience has shown that for the proper administration, financial optimization and management of complicated global and regional systems (such as the drifting buoys communication through polar-orbiting satellites), there is a need for international co-operation through a consortium of participating Member States. It would be necessary for this body (panel, committee or board) on drifting buoy activities to meet at least once a year for the planning and co-ordination for related operational and research programmes. In addition to the participation of Members authorized to make programme committments for their respective Member States, other meeting participants may include representatives of appropriate bodies of the WMO, IOC and ICSU, including CBS, CMM, IGOSS and SCOR. The terms of reference of this body would include (but not be limited to):

(a) Points (i) through (vi) above;

(b) To establish system requirements based on scientific and operational guidance and review buoy standards;

(c) To co-ordinate the implementation of buoy arrays for operations and research;

(d) To provide for needs of individual buoy researchers;

(e) To co-ordinate data processing contracts, as appropriate;

(f) To develop strategies for buoy arrays based on scientific and operational guidance;

(g) To develop deployment plans and contingency plans;

(h) To provide technical advice.

The meeting recommended that the sessions of the Executive Committee of WMO, and of the Executive Council of IOC, review the needs as described herein for such a body, and to take appropriate action for its establishment as soon as possible.

5.2.3 The meeting felt that it should point out that the proposed body would require continuing staff support to enable it to carry out effectively its terms of reference. Some of the tasks for such a support staff would include:

(a) Collection and dissemination of information regarding the intentions, implementation status, schedules and operational status of the programmes of the various participating countries;

(b) Promotion of and assistance to participating countries in the deployment of buoys in cases where international co-operation is required;

(c) Co-ordination, as necessary, of the national and regional deployment plans of participating countries to facilitate economy and maximum coverage;

(d) Dissemination of basic information required for the planning and deployment of networks including network spacing between buoys, ocean current drift information, admittance procedures (Argos), parameter requirements, technical standards, etc.;

(e) Maintaining of a drifting buoy register and an up-to-date buoy system status so that requirements for the maintenance of networks (i.e. fill holes in a network) can be detected at an early stage and appropriate action initiated as necessary;

(f) Determination of projected requirements for Service Argos buoy data processing to facilitate the bulk purchase of such data processing. Negotiation of a contract with Service Argos for such processing on behalf of participating countries including participating user countries;

(g) Carrying out of planning and operational liaison with WWW elements responsible for the GTS, GDPS and GOS, IGOSS and ICSU elements.

6. CLOSURE OF THE MEETING (Agenda item 6)

Dr. Garrett, chairman of the meeting, thanked all the participants for their assistance and co-operation shown during the meeting. Mr. Delalande, speaking on behalf of the participants, thanked Dr. Garrett for his able guidance which led to the success of the meeting. The meeting closed at 5.30 p.m. on 5 December 1979.

LIST OF PARTICIPANTS

ARGENTINA	AMATURO, L.R. Servicio Meteorologico de la Armada Com. PY Y Corb. URUGUAY Ed. Libertad: piso 15 Buenos Aires
AUSTRALIA	DELALANDE, R.S. Acting Assistant Director (Facilities) Bureau of Meteorology P.O. Box 1289 K Melbourne Vic. 3001
	FREEMAN H.R. Permanent Mission of Australia to the UN 56-58 rue de Moillebeau 1209 Geneva (Switzerland)
CANADA	GARRETT, J. Head, Offshore Oceanography Institute of Ocean Sciences P.O. Box 6000 Sidney, B.C. V8L 4B2
CHILE	GINOUVES C., J. Direction: Servicio Meteorologico de la Armada Correo Naval Valparaiso
FRANCE	HYACINTHE, J.-L. Chef du Service environnement physique et climatique Direction de la programmation et de la coordination du CNEXO Boîte postale 107.16 75763 Paris CEDEX 16
	LOITIERE, B. Ingénieur en chef de la météorologie Météorologie nationale 77 rue de Sèvres 92106 Boulogne-Billancourt CEDEX
GERMANY, FEDERAL REPUBLIC OF	MEINCKE, J. Institut für Meereskunde der Universität Kiel Düsterbrooker Weg 20-22 D-2300 Kiel
JAPAN	NITTA, T. Electronic Computation Center Japan Meteorological Agency 1-3-4, Otemachi- Chiyoda-ku Tokyo 100

NORWAY	BREMNES, O.H. Det Norske Meteorologiske Institutt Postboks 320 - Blindern Oslo 3
	JENSEN, C.K. Det Norske Meteorologiske Institutt Postboks 320 - Blindern Oslo 3
POLAND	MICHALCZEWSKI, J. Scientific Secretary of the Institute of Meteorology and Water Management Podlesna 61 01-673 Warszawa
SENEGAL	GALLARDO, Y. Institut Sénégalais de recherches agronomiques Section environnement du centre de recherches océanographiques de Dakar-Thiaroye B.P. 2241 Dakar
UNION OF SOVIET SOCIALIST REPUBLICS	VASILIEV, K.P. Chief of the Marine Forecasts Division Hydrometeorological Centre of the U.S.S.R. 9-13 Bolshevistskaya Street Moscow 123376
UNITED STATES OF AMERICA	FLEMING, R.J. Acting Director, US GARP Office 6010 Executive Blvd. Rockville MD. 20852
	HALL, J.M. Chief scientist NOAA Office of Ocean Engineering 6010 Executive Blvd. Rockville MD 20852
	PATZERT, W.C. Scripps Institution of Oceanography La Jolla California 92093
ORGANIZATIONS	
ARGOS	BESSIS, J.-C. Service Argos 18 Av. Ed. Belin 31055 Toulouse CEDEX (France)
	GOASGUEN, A. Service Argos 18, Av. Ed. Belin 31055 Toulouse CEDEX (France)

ARGOS (contd.)	TAILLADE, Service Argos 18, Av. Ed. Belin 31055 Toulouse CEDEX (France)
COST-43	KVINGE, T. Project leader COST-43 The Chr. Michelsen Institute Dept. of Science and Technology Fantoftvegen 38 N-5036 Fantoft (Norway)
ICSU	STAVROPOULOS, C. C. International Council of Scientific Unions 53, Boulevard de Montmorency 75016 Paris (France)
IOC	TABATA, S. Department of Fisheries and Oceans Institute of Ocean Sciences, Patricia Bay P.O. Box 6000 Sidney, B.C. V8L 482 (Canada)
IGOSS	TREGLOS, Y. Centre national pour l'exploitation des océans (CNEXO) 66, Av. d'Iéna, Boîte postale 107.16 75763 Paris CEDEX 16 (France)
JOC	JATILA, E. GARP Activities Office WMO, Case postale No 5 1211 Genève (Switzerland)
SCOR	POLLARD, R.T. Natural Environment Research Council Institute of Oceanographic Sciences Wormley Godalming Surrey GU8 5UB (United Kingdom)
	TCHERNIA, P. Laboratoire d'océanographie physique du Musée 43, rue Cuvier 75005 Paris (France)

SECRETARIATS

WMO	WEISS, G.K. Director, WWW Department WMO, Case postale No 5 1211 Genève 20 (Switzerland)
	MIZUNO, S. Chief, Ocean Affairs Division WWW Department WMO, Case postale No 5 1211 Genève 20 (Switzerland)

WMO (contd.)	BELIAEV, V. Chief, Ocean Activities Branch WWW Department WMO, Case postale No 5 1211 Genève 20 (Switzerland)
IOC	SCOTT, D.P.D. Secretary IOC Place de Fontenoy 75700 Paris (France)
	WITHEE, G.W. Assistant-Secretary IOC, place de Fontenoy 75700 Paris (France)

AGENDA

1. ORGANIZATION OF THE MEETING

   1.1 Opening of the meeting

   1.2 Election of the chairman

   1.3 Adoption of the agenda

   1.4 Working arrangements

2. REPORT ON THE FGGE DRIFTING BUOY PROGRAMME

3. REVIEW OF PRESENT AND PLANNED NATIONAL DRIFTING BUOY PROGRAMMES

4. CONSIDERATION OF ARRANGEMENTS FOR DATA COLLECTION AND DISSEMINATION

5. ESTABLISHMENT OF DRIFTING BUOY PROGRAMMES WITHIN AN INTERNATIONAL FRAMEWORK

   5.1 Review of meteorological and oceanographic requirements

   5.2 Planning and operational strategy for the establishment of buoy networks

6. CLOSURE OF THE MEETING

(This page left intentionally blank.)

LIST OF DOCUMENTS

Doc. No.	Title	Agenda item	Submitted by
Doc. 1	Provisional agenda	1.3	WMO and IOC Secretariats
Doc. 2	Explanatory memorandum relating to the provisional agenda	1.3	WMO and IOC Secretariats
Doc. 3	Review of present and planned national drifting buoy programmes	3	WMO and IOC Secretariats
Doc. 4	Establishment of drifting buoy programme - Meteorological and Oceanographic requirements -	5.1	WMO and IOC Secretariats
Doc. 5	Planning and operational strategy for the establishment of buoy networks	5.2	WMO and IOC Secretariats
Doc. 6	Review of present and planned national drifting buoy programmes - Requirements for receipt of data from FGGE drifting buoys after 1 December 1979 -	3	WMO and IOC Secretariats
Doc. 7	Review of actions taken by the seventh session of FGGE Panel concerning future observing systems	5	WMO Secretariat
Doc. 8	The post FGGE international co-ordination of drifting buoys	5	Australia
Doc. 9	Critical review of the performance of the FGGE drifting buoy system	2	Committee of Participants FGGE Drifting Buoy System
Doc. 9, ADD. 1	Report on the FGGE drifting buoy programme - Summary of "Critical Review of the Performance of the FGGE Drifting Buoy System" -	2	Chairman of Committee of Participants FGGE Drifting Buoy System
Doc. 10	Japan's experience in the use of drifting buoys and future programmes	3	Japan
INF. 1	The Argos satellite-based data collection and platform location system		
INF. 2	- Preliminary report on the performance of the FGGE drifting buoy system during SOP-I (April 1979) - Preliminary report on the performance of the FGGE drifting buoy system from 6 March to 30 June 1979 (September 1979)		

Doc. No.	Title	Agenda item	Submitted by
INF. 3	FGGE buoys providing good data at the end of the FGGE Operational Year		Service Argos
INF. 4	Use of direct read out stations		Australia
INF. 5	Operational data collection and platform location by satellite		CNES
INF. 6	Draft report on the possible utilization of the International Maritime Satellite System (INMARSAT) for the collection and dissemination of marine meteorological and oceanographic data		WMO Secretariat

STATEMENTS ON: (1) PRESENT AND PLANNED NATIONAL DATA BUOY PROGRAMMES
(2) NEED FOR INTERNATIONAL CO-OPERATION ARRANGEMENTS (INCLUDING TECHNICAL AND FINANCIAL ASPECTS)

Argentina - Servicio Meteorologico Nacional
- Servicio Meteorologico de la Armada

(1) Argentina intends to implement the operation of the present FGGE Drifting Buoy System beyond November 30, and also future similar experiences, by contributing towards the deployment of buoys from ships and aircraft in accordance with the specific outlines stated in the first paragraphs of document No. 3. The present response involves both points /(1) and (2)/.

Australia

(1) The Bureau has a proposal to establish and maintain a regional network of about 20 buoys from 1982 for a period of three years. The implementation of this programme (which would have a lead time of two years from approval) is very dependent on governmental approval and budgetary decisions.

The proposed network would be deployed in the area south of 10°S and between about 70°E and 180 longitudes. Parameters to be reported would be atmospheric pressure, sea surface temperature and possibly wind direction. Its purpose would be to support our real-time meteorological analysis programmes.

In addition to the Bureau programme it is understood that the Commonwealth Scientific and Research Organization (CSIRO) is considering a 20 buoy oceanographic programme and Melbourne University, in conjunction with the Antarctic Division of this Department, a 5 buoy programme to study sea ice movements in the Antarctic area.

Chile

(1) The data obtained from buoys are used (and may continue being used if provided) for the surface analysis of charts on a delayed basis. These studies provide a better knowledge of the positions of cyclones and anticyclones in the Pacific Ocean, which eventually affect the Chilean territories. This analysis is made in conjunction with information provided by satellite photographs. The main use is for more than 48-hour forecasts (due to delays in the reception of data). Real-time use could be envisaged if data would arrive within 4-8 hours, which at present is not the case. The data is also widely used for climatological purposes, these data being the only one available in a great oceanic area.

(2) Very regretfully Chile will not be able to continue to use the buoy derived data because of its inability to pay for them. Chile is a developing country which does not have funds as would be required in this case. Nevertheless, Chile would be prepared to continue to

participate in the programme if an agreement is reached to cover such expenses. Furthermore, Chile is prepared to continue to provide help in the deployment of buoys, should this be necessary, especially in the area for which Chile has a maritime responsibility.

Canada

(1) Canada plans a number of drifting buoy programmes. These include oceanographic research programmes studying ice and water movement in the Canadian Arctic and in ocean waters on both east and west coasts. Also included as a part of the study of alternatives to the weather-ships at Ocean Weather Station "P" is a programme to maintain a small network of FGGE type drifters in the north-east Pacific. The first deployments will take place in December 1979. The use of a station capable of directly receiving the data rebroadcast by the satellite to provide the observations from these buoys within the shortest possible delay is being evaluated at the same time.

(2) A need for international co-ordination is seen in the establishment of a more comprehensive meteorological array to the North Pacific, where both the U.S. and Japan are also planning programmes, and in arranging the most effective use of the buoys. For example, buoys released on the Canadian east coast may drift across the Atlantic into regions of interest to European countries who might be willing to undertake the data recovery and processing during the period when the buoys were in European waters. Also Canada might assist in deployments of buoys provided by other countries if the data were of interest to Canada and available to Canada.

France - Direction de la Météorologie

(1) The French Meteorological Service has no plans for operational use of buoys in the immediate future, but the current research and development programmes of the Research Department will be conducted in three directions:

- Observation programmes: Some buoys will be deployed in the North Atlantic Ocean for tests of meteorological analysis and forecast. On the other hand a few experimental buoys may be launched in 1980 in the southern hemisphere.
- Vehicle - platform development: Significant efforts will be dedicated to anchored buoys and mooring techniques. A new kind of drifting buoy called Navisonde is under development in the form of a small sail boat, which is hoped to be a reliable wind direction sensor. Experiments are planned to delineate for both Marisonde and Navisonde the relative influence of wind and current over their trajectories.
- New sensor developments: projects were initiated in 1979 and will be continued in the field of wind speed and direction; wave height, period and direction; pressure trends. An approximate amount of 10 to 20 buoys will be used to accomplish these programmes.

Beside these specific buoys activities, the opportunity of developing the capability for the Center of Space Meteorology in Lannion to perform direct data acquisition is presently being considered.

(2) As far as international co-ordination is concerned, it is considered that special attention should be given to data dissemination procedures (including GTS performance). Otherwise, the desirable amount of international co-ordination should be determined for any specific programmes, depending upon its objectives and logistics requirements.

- Centre national pour l'exploitation des océans (CNEXO)

(1) A national oceanographic programme about drifting buoys cannot be defined before the complete technical achievement of usable oceanographically instrumented drifting buoys; we can only hope that it will not be done by the end of the year 1980. The possible first programmes will be of an operational type (real-time and transmission by GTS through special standard codes; large number of uniformly instrumented buoys with a nearly global repartition) but may be occasionally of interest for systems like IGOSS (by IOC/WMO) or COST 43. Probably these first programmes will be developed on an international co-operation basis for the oceanographic component of the World Climate Programme, equilibrating the systematic observation with the study of mesoscale phenomena (non-real-time, small space scale and specially instrumented buoys in strong association with other oceanographic tools like instrumented moorings, satellite data ....). The singificant number of buoys for such programmes is by the wider 10 to 20 and the area of chief interest will be the north and equatorial Atlantic Ocean. At the present time we can distinguish the use of instrumented buoys with a need of less accurate position, and the use of calibrated drifters with the maximum position accuracy.

(2) An international frame is possibly existing for scientific oceano-meteorological pilot programmes but we encourage the development of responsibility of intergovernmental bodies or the co-ordination of the circulation of the information, on progressively developing tool like IGOSS to the level of WWW, on supporting logistical centres like Argos, for the use of meteorology, and later for oceanography.

Germany, Federal Republic of

(1) Meteorology: No interest at present to set up operational array of drifting buoys. Rather spend that money on improvement of moored stations.

Oceanography: In the period 1980-1982 plans for use of 50-60 drifting buoys. The scientific objectives are (a) Trajectories of the North Atlantic Current System in the area Azores/Ireland/Canary Isles; (b) Synoptic sea surface pressure distribution to estimate near sea surface wind fields and relate it to satellite-derived low cloud trajectories. The driftinb buoys are only one out of several experimental components in a longer-term study of circulation and heat transport in the upper layer of the Northeast Atlantic. (Institut für Meereskunde, Univ. of Kiel)

(2) (a) Information exchange on experience and technical development in the drifting buoy system and its sensors;

(b) Inventories on ongoing drifting buoy experiments and on regions of scientific interest to individual researchers/institutions to assure possible arrangements for continuous tracking of drifters during their whole life-time independent on restrictions to areas of national/individual interest;

(c) Pooling of drifting buoys for certain regions (e.g. North Atlantic) to obtain reduced rates for central processing services and to economize deployment.

Japan
- Japan Meteorological Agency
- The Maritime Safety Agency
- The Fishery Agency
- The Ocean Research Institute of Tokyo University
- The Institute of Physical and Chemical Research

(1) Japan Meteorological Agency (JMA)

Deploying drifting buoys in the western North Pacific in the future network of meteorological and oceanographical ovservations on a routine basis is under consideration. The buoys are planned to measure sea surface temperature, atmospheric pressure, air temperature, ocean waves (period and height) and sub-surface temperature and to make transmission of the observations.

The Maritime Safety Agency

Will release five or so drifting buoy (with sensors of sea surface temperature) at the end of 1979 and continue this work in order to obtain trajectories of the Kuroshio Current.

The Fishery Agency

Use of drifting buoys for survey of fisheries environment in under consideration.

The Ocean Research Institute of Tokyo University

Plans to operate a drifting buoy for observation of geomagnetism in the western North Pacific in the near future and further to operate another drifting buoy in coastal waters of Japan to investigate relations between the movement of sea water and fisheries.

The Institute of Physical and Chemical Research

Plans to make sea surface current observations by a drifting buoy (together with a sensor of sea surface temperature) around the site of deep sea current (30^{o}N, 147^{o}E) off the east of Honshu in November 1979.

(2) We consider that international co-ordination is necessary. At the same time we propose to establish a full exchange system of buoy data between the international community in the future.

Norway - The Norwegian Meteorological Institute

(1) At present no definite short-or long-term plans have been set up. However, some buoy equipment is available, and will most probably be used as operational buoys as follows:

Anchored buoys (transmitting on HF and through ARGOS system)

Southwest of Iceland, equipped with meteorological sensors only; In the Norwegian Sea equipped with meteorological and oceanographic sensors.

Free drifting buoys

The present three drifting FGGE buoys southwest of Iceland to be operating until battery expires (April 1980). If possible they will be recovered earlier.

Norway is interested in participating in a North Atlantic buoy programme, and may contribute to the maintenance of an array of automatic stations in the Arctic.

Shore stations

On the Bouvet Island to be continued until battery expires. If possible the mountain station will be recovered and if possible the battery on the sea side will be replaced.

(2) An international co-ordination is highly desirable in order to be able to standardize the basic technical equipment and operational programme. Further the deployment and the recovery of free drifting buoys might be facilitated by either having a co-ordinating committee, or some kind of close co-operation between countries concerned.

United Kingdom

(1) Five of the FGGE buoys set by the Institute of Oceanographic Sciences are still in operation, and it is intended to track them for their remaining lifetime. Sic further systems are budgeted for the financial year 1980/81. These will be deployed in support of circulation and mesoscale eddy studies, probably in the Eastern Atlantic south of the Azores. Development work to make the buoys more useful in measuring currents will continue (better dragcharacteristics, reliable drogue loss sensors) and other sensors (e.g. mixed layer temperature) may be added.

The Scottish Marine Biological Association hopes to purchase three systems in the next year. These will be used as prototypes to improve tether and drogue characteristics for reliable long-term current measurements. Further expansion is intended the expected area of operation being to the west of the British Isles, both in the Rockall Trough and further west.

In addition, the United Kingdom has strong interest in continuing the tracking of deployed buoys (four at the time of writing) that drift into the Eastern Atlantic once they have passed outside the Canadian area of interest.

Union of Soviet Socialist Republics

(1) The USSR oceanographic community at present uses moored buoys for research purposes within the area of the operation of research vessels. These buoys are equipped with sensors measuring currents (speed and direction) down to 1000 m as well as sea surface temperature). By 1982, it is planned to use both moored and drifting buoys for hydrographic observations in some areas of the World Ocean together with research vessels with the objective of studying water circulation and dynamics. thermal structure, processes of sea/air interaction and space and time variability of hydrophysical fields.

(2) For international co-operation to be needed it is necessary to establish an operational monitoring system based on drifting and moored buoys. Such a system can be established on the basis of national contributions in the form of either equipment (buoys), deployment means (ships, aircraft), means of data collection and their initial treatment (satellites, receiving centers, processing centers, dissemination of products (GTS)or in the form of financial support of the programme.

United States of America

(1) Present United States buoy plans are already summarized in the IGOSS/ WWW Regular Information Service Bulletin on Ocean Data Buoys and in various places in the FGGE literature. Future plans are described below.

The United States advocates the establishment of an international buoy programme and to that end intends to deploy drifting buoys with sea surface temperature and pressure in the northern hemisphere (Northeast Pacific Ocean in the fall of 1980) and in the southern hemisphere (Pacific Ocean in the fall of 1981) for the purpose of improved weather analysis and forecasts.

For operational and research activities in oceanography and climate, there are several other buoy projects planned. These include:

(a) a continuation of FGGE ice buoys in the Arctic Ocean for another five years;

(b) four FGGE drifting buoys with wind sensors and six new thermistor chained buoys as part of the USA/Canada Storm Transfer and Response Experiment (STREX) in the Northeast Pacific in the fall of 1981;

(c) various ocean and ocean/climate studies involving the use of drifters (both drogued and undrogued) in a variety of scientific programmes (e.g. NORPAX deployments of 30 oceanographic buoys drogued to 30 m depth in the tropical Pacific and 20 buoys drogued to various depths ranging from 30 to 150 m in the mid-latitude Pacific.).

A single contract has been established between Argos and a consortium of United States agencies to provide data processing services for one year. Platforms covered include those buoys mentioned above and a variety of other environmental platforms (e.g. monitoring the position of icebergs and marine mammals). In addition to the above "central processing approach" of Argos, the United States plans to study the use of Local User Terminals (LUTs) for some applications.

(2) It is clear that buoys will be increasingly valuable as part of composite observing systems for the needs of the WWW, IGOSS, the World Climate Programme, and other applications and research programmes. It is the experience of the United States that for the proper administration, financial control and management of a complicated global system (such as the drifting buoys communicating through polar-orbiting satellites), there is a need for international co-operation through a consortium of participating Member States. It would be necessary for this body (Panel, Committee or Board) of Member States to meet at least once a year for the planning and implementation of operational and research programmes. In addition to delegates empowered to commit resources for their respective Member States, other meeting participants should include appropriate elements of the Secretariats of the WMO and IOC who would co-ordinate the meetings and activities of this body of Member States.

Scientific Committe on Oceanographic Research (SCOR)

(1) The oceanographic community has been impressed by the demonstrated ability of Service Argos to provide data from drifting platforms to the user within a short time (spot values within hours, full data within weeks) and with fixes accurate to a kilometre or better. Such a system has stimulating implications for oceanographic research, pilot ocean monitoring studies to examine the role of the ocean in climate and at some later date for operational monitoring of the oceans for climate prediction.

However, detailed research is required into the ability of sensors on drifting platforms to measure useful oceanographic parameters. Drogue and tether design and optimal buoy drag characteristics for measurement of surface and subsurface currents have yet to be perfected. Sensors for reliable long-term meaurement of subsurface temperatures temperature profiles, surface wind stress, surface waves, and other parameters have still to be developed and evaluated.

Even after such technical problems have been overcome, questions of areal coverage and scientific interpretation remain. How dense a horizontal distribution of drifting buoys is necessary if useful estimates of, say, upper ocean heat content and heat fluxes are to be obtained in the presence of small-scale horizontal temperature variability and mesoscale eddies ? What measurements have to be made to distinguish between wind-induced and geostrophic currents ?

(2) In the next few years therefore, the oceanographic requirement is that Service Argos or its equivalent be maintained, with flexibility to handle data from oceanographic research buoys carrying a variety of sensors.

There is also a need for information exchange and international co-operation at several levels, including:

(a) exchange of information on technical developments related to drifting buoy systems and sensors, and on experience gained in trial deployments;

(b) inventories on drifting buoy experiments planned and ongoing to facilitate scientific interaction; co-ordination of plans for experiments in the same geographic areas; co-operation to ensure buoys are tracked throughout their lifetime even if they drift out of the initiator's area of interest; financial benefits through joint contracts with the processing agency; and agreements on procedures to recover and redeploy buoys of other investigators or nations.

It is emphasized that these co-ordinating requirements are, for some years to come, purely in support of oceanographic research programmes. It is likely to be a decade or more before routine large-scale operational monitoring of the oceans can be contemplated.

International Council of Scientific Unions (ICSU)

(2) International co-operation would be of value in:

(a) Data processing: to group together to reduce Service Argos costs;

(b) Hardware: purchase of "standard" type buoys to reduce costs;

(c) Deployments, say from South America, for buoys to be for a longer time resident in the area of interest.

European Co-operation in the Field of Scientific and Technical Research (COST-43)

(1) The COST-43 is a project initiated by the Intereuropean Organization (Co-operation within the Field of Science and Technology) - COST.

- The objective of COST-43 is to set up an experimental European network of ODAS for the purpose of providing meteorological and oceanographical data on a real-time basis.
- The project is based on an International Agreement which presently is signed and ratified by the following nations: Denmark, Finland, Ireland, Norway, United Kingdom, Portugal, Sweden. In addition, Belgium, France, Italy, Spain, Netherlands and Iceland intend to acceed to the project.
- The present programme covers a period of four years, starting 29 June 1979.
- During this phase of the programme, the contribution is based on concerted action, i.e. the nations will contribute with their own equipment, and there will be no common fund, except a small fund for co-ordination service.
- Another phase is foreseen when the project will be based on common funds.
- A contract is established with the Chr.- Michelsen Institute in Bergen, Norway, for the full-time service of Mr. T. Kvinge as programme co-ordinator and a technical secretariat.
- The Project covers the area: the Azores to Spitzbergen from 32^{o}W to the Coast of Europa including the Western Mediterranean and the Western part of the Baltic.
- Inventory lists of ODAS in operation are issued at regular intervals. Presently about 20 ODAS are in operation as part of the COST-43 network. Data are available in real-time, mainly through the GTS. These ODAS are all moored or towed.
- A Portuguese programme will be started in March 1980 in the Azores area using 10 drifting buoys. These buoys will measure meteorological parameters and sea temperature to 300 m. The data will be transmitted to shore via Argos and disseminated via GTS.
- Three programmes for operational buoys will be started in 1980 and 1981, based on multilateral co-operation.

- The COST-43 will provide data to IGOSS and work in close co-operation with WMO and IOC as noted in recommendations. Further information may be obtained through:

T. Kvinge
COST-43 Technical Secretariat
The Chr.- Michelsen Institute
Fantoftvegen 38
N-5036 Fantoft
Bergen
Norway

(This page left intentionally blank.)

Extract from the report of the seventh session of the
WMO EC Inter-governmental Panel on the FGGE

DESIGN OF THE FUTURE OBSERVING SYSTEMS FOR THE PREDICTION OF THE LARGE SCALE ATMOSPHERIC MOTION

6.1 Introduction

6.1.1 One of the basic objectives of the FGGE is to design an optimum composite meteorological observing system for routine numerical weather prediction of the larger-scale features of the general circulation. Within the FGGE Operational Year the value of the data provided has been demonstrated. The geostationary satellites, ocean ships and aircraft have provided an unprecedented coverage of the evolution of weather systems in the entire tropical belt. The polar orbiting satellites, drifting buoys and ASDAR systems have made direct improvements in day to day analyses and forecasts. Thus, in the short term, it is at least highly desirable to maintain these systems in operation to the greatest extent possible. In the Annex, various members have indicated the extent of their commitment towards this need. However, it is obvious that these commitments will not maintain the full composite observing system established during the FGGE.

6.1.2 The Panel fully recognized that the final design of a new composite WWW Global Observing System in accordance with one of the aims of FGGE must await the outcome of observing system experiments (OSEs) presently under way. Results will become successively available and it is anticipated that by 1982 comprehensive assessment based on numerical studies will be possible.

6.2 Interim Requirements

6.2.1 It is obvious that the future GOS has to satisfy a variety of needs, extending from nowcasting to long range forecasting as well as those requirements yet to be stated in detail for climate monitoring. At this time the Panel only considered the requirements for regional and global forecasting on a broad scale. It is necessary in this regard to distinguish between the tropics and the extra tropical zones due to different degrees of coupling and relative importance of wind and mass-field information.

In the extra tropics the following additional observations will be vital:

- improved satellite temperature soundings and a network of high quality radiosounding particularly over ocean areas
- surface pressure observations particularly in data sparse land areas and over the oceans.

6.2.2 The surface pressure observations are needed in order to provide the necessary reference level data. If we do not have surface pressure data the value of satellite temperatures will seriously be reduced. Recent investigations have shown that an efficient usage of co-located radiosoundings of high quality, and available in representative areas including ocean regions, will improve the quality of satellite temperature soundings.

6.4.2 The Panel foresaw that the design and implementation of the required network will have to proceed in the following way:

(i) The execution of a vigorous observing systems experiment (OSE) programme for the re-definition of the data requirements for the prediction of the large-scale atmospheric motions. This work will be based on the FGGE Level II-b data sets.

(ii) The interpretation of the results of the OSE programme in terms of improvements in the accuracy and range of forecasts of the large scale atmospheric motions which will result from the implementation of systems which would fulfil the data requirements.

(iii) The design of a practical composite meteorological observing system based on operating experience gained during FGGE. Clearly in this regard it will be necessary to take into account the observational needs for shorter period forecasting as well as those of the World Climate Programme which is certain to require oceanographic and other observations.

(iv) The design of this system will require the establishment of an appropriate body to oversee the interaction between various components from a scientific and technical viewpoint. It appears likely that sub-bodies will be needed to co-ordinate individual national efforts to deploy and maintain components of the total system perhaps on the lines of the NAOS Board.

6.4.3 The Panel requested the JSC to plan and carry out the Observing Systems Experiments (see above) and inform the Panel.

6.4.4 The Panel suggested that the Executive Committee may wish to allocate to an appropriate body the task of co-ordinating all activities relating to:

(i) the short term planning for the continuation of those observing systems, the usefulness of which have been clearly demonstrated during the FGGE

(ii) the long term planning for the implementation of a future composite global observing system for prediction of the large scale motion of the atmosphere and for climate studies of the ocean-atmosphere system.

6.4.5 The Panel was of the opinion that the responsible body for these tasks should be of the same type as the present Inter-governmental Panel for the FGGE, i.e. it should include representatives of those Members, who can be expected to make a significant contribution to one or more of the components of the future global observing system, which will require international co-ordination.

6.4.6 The Panel stressed the need for obtaining scientific and technical advice from the JSC and other international bodies.

6.4.7 The Panel also recognized that from time to time failures can be expected to occur in parts of the integrated system. Any organization(s) established to operate the systems must be able to react quickly and take appropriate measures.

6.2.3 In the tropics, on the other hand, the following additional observations are the most vital:

- satellite wind observations and when available aircraft winds
- a network of vertical wind soundings
- surface pressure observations

6.2.4 The geostationary satellites, which provide quantitative wind information, are presently the only available system covering the entire tropical belt and must consequently constitute the major part of the tropical observing system.

6.2.5 Vertical wind profiles are necessary for reference purposes and for supporting the vertical interpolation of the wind vectors provided by the geostationary satellites and by aircraft.

6.3 Interim Actions

6.3.1 The Panel noted the successful performance of the ARGOS system in providing buoy and balloon data and expressed its appreciation to participating Member countries, and in particular to the Government of France for the provision of free processing of this data during the FGGE year. In the interest of stimulating the continuation of the buoy programme in both the southern and northern hemisphere, and as a step toward the implementation of drifting buoys as part of the WWW, the Panel strongly urged that France continue to provide free processing for those buoys already in operation.

6.3.2 The Panel further recommended that France be invited to provide the lowest possible price for buoy data processing associated with future drifting buoy applications which support WMO and IOC activities.

6.3.3 The Panel noted the operational requirements of Member Countries and urged that meteorological and oceanographic data from drifting buoys be inserted on the GTS with minimum delay.

6.3.4 The Panel noted that the WMO/IOC Informal Planning Meeting on Drifting Buoy Programmes, which will be held 3-5 December in Geneva, will recommend procedures for establishing an operational drifting buoy programme (e.g. strategies for funding, deployment, data management, maintenance, etc.) and suggested that these recommendations be submitted to the next session of the Executive Committee with the purpose of establishing a WWW/IGOSS drifting buoy programme as soon as possible as a first step in the implementation of a future composite observing system.

6.4 Long Term Planning

6.4.1 For the reasons outlined in the introduction it is not at present possible to define the final integrated observing network, but it is reasonable to suppose that this will consist of systems in various combinations which were tested and used in FGGE. More permanent institutional arrangements will have to be established for the deployment and maintenance of this integrated system.

(This page left intentionally blank.)