WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERMENTAL OCEANOGRAPHIC COMMISSION (of Unesco)

DRIFTING BUOY CO-OPERATION PANEL

Fourth session

(New Orleans, 18-21 October 1988)

FINAL REPORT

GENERAL SUMMARY SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE SESSION (agenda item 1)

1.1 Opening of the session

1.1.1 The fourth session of the Drifting Buoy Co-operation Panel was opened by the chairman of the panel, Mr. C. Billard, at 10 a.m. on Tuesday 18 October 1988, in the meeting room of the Sheraton New Orleans Hotel, New Orleans, USA. Mr. Billard welcomed participants to this fourth session and, on behalf of all panel members, expressed his sincere appreciation to the United States National Oceanic and Atmospheric Administration (NOAA) for hosting the session in New Orleans. He expressed the hope that the session would be successful in finding a long-term solution to the question of employment status and funding for the technical co-ordinator's position, as well as reach agreement on the many technical questions facing the panel. He then called on the representative of NOAA, Dr. G. Hamilton, to address the panel.

1.1.2 On behalf of NOAA and the three contributing host offices, the National Weather Service, the National Ocean Service, and the office of Oceanic and Atmospheric Research, Dr. Hamilton welcomed all participants to the session and to New Orleans. He expressed the pleasure of all three offices at being able to contribute to the panel and its activities through hosting the session at a venue very close to the technical centre-point for USA drifting buoy activities at the National Data Buoy Center, to which a visit was being arranged for participants after the session. Dr. Hamilton then wished all participants a very fruitful meeting and an enjoyable stay in New Orleans.

1.1.3 On behalf of the Secretary-General of WMO, Professor G.O.P. Obasi, and the Secretary IOC, Dr. Mario Ruivo, the representative of WMO then also welcomed participants to the session. In doing so, he particularly offered the sincere thanks of the two organizations to NOAA for hosting the session and for the very fine facilities and hospitality which had been provided. The representative of WMO then underlined the importance which the Executive Councils of WMO and IOC attached to the work of the panel, and its technical co-ordinator, in support of the Organizations' programmes and the appreciation which had already been expressed for the achievements so far. He briefly outlined the main items for consideration at the present session, which included the status of and funding for the technical co-ordinator, GTS data distribution and quality control matters. Finally, he wished the panel a very productive and successful session.

1.1.4 The list of participants in the session is given in Annex I.

1.2. Adoption of the agenda

1.2.1 The panel adopted the agenda for the session, which was unchanged from the provisional agenda. This agenda is given in Annex II.

1.3 Working arrangements

1.3.1 Under this agenda item the panel decided on its hours of work and other working arrangements for the session. The list of documents for the session was also introduced by the Secretariats.

2. REPORTS (agenda item 2)

2.1 Report by the chairman of the Drifting Buoy Co-operation Panel

2.1.1 The chairman reported that he had been involved in action related to the employment of the technical co-ordinator. He briefly explained the reasons why it was finally decided to sign a contract with the Scottish Marine Biological Association (SMBA) so as to secure the services of Mr. Meldrum in a part-time capacity for a second annual period until 31 May 1989. The chairman mentioned various other activities such as finalizing the first issue of the panel's report, and technical contacts on a regular basis with the technical co-ordinator. Finally, he informed the panel about the different meetings he had attended as chairman and their main results with regard to the panel: COST-43 bi-annual meetings, the most recent session of the IOC Executive Council and the fourth meeting of the Committee for OWSE-NA * (CONA).

2.2 Report by the technical co-ordinator

2.2.1 The panel was informed of the activities undertaken by the technical co-ordinator (Mr. D. Meldrum) in the inter-sessional period and their relation to the work plan and objectives laid down by the panel at its previous session. Approximately one third of the technical co-ordinator's time had been devoted to assisting and encouraging Argos users to disseminate their data on the Global Telecommunication System (GTS). With most sensor formats this can be quite a complex process and has not been a service normally provided by Argos. As a result, about fifty platforms, which would not otherwise have done so, now transmit data via the GTS. A considerable effort has also been directed towards improving GTS facilities offered by Argos, mainly by modifying the Argos computer software, but also by implementing and co-ordinating various inter-centre procedures related to GTS usage. Here the technical co-ordinator has been in the unique position of having the time, the facilities and the authorization to undertake these actions.

2.2.2 As requested by the panel, the technical co-ordinator has kept a close watch over the quality of drifting buoy data circulating on the GTS. In a number of cases this has resulted in sensor data either being deleted or, in a few instances, the data being re-scaled. Attention has also been directed to the problems of how quality control procedures might be integrated into the data path between drifting buoy and GTS user. Regular contact has been maintained with a number of organizations involved in quality control, including the National Data Buoy Center (NDBC) and the European Centre for Medium-range Weather Forecast (ECMWF), and the monitoring of GTS data streams has been initiated at a number of levels, both within Argos and, less frequently, at the Regional Telecommunication Hubs (RTH) of Paris and Bracknell.

* OWSE-NA = Operational World Weather Watch Systems Evaluation in the North Atlantic

2.2.3 Data emanating from Local User Terminals (LUT), both Argos-operated and independent, have been examined by the technical co-ordinator on several occasions and a number of problems identified and rectified. It was noted that only a small percentage of the real-time data sets from Gilmore Creek are made available to Argos and the panel recommended that every effort be made to increase this percentage. Other activities undertaken by the technical co-ordinator have included the cataloguing of drifting buoy programmes, the preparation of documentation for the DBCP and the Argos user-community, the stimulation of improvements to the service offered by Argos, liaison with the WMO on matters relative to GTS regulation and participation in OWSE-NA.

2.2.4 The panel members, the Secretariats and CLS/Service Argos all expressed their considerable appreciation to the technical co-ordinator for both the quantity and quality of his achievements during the sixteen months of his employment. It was noted that he had already made major contributions to improving buoy data flow on the GTS and to assisting all drifting buoy users, and the panel wished to record its formal thanks to Mr. Meldrum for his excellent work on its behalf. The full report of the technical co-ordinator is given in Annex IV.

2.3 Report by the Secretariats

2.3.1 The WMO Secretariat representative reported to the panel on activities undertaken by the WMO Secretariat in support of the panel during the past intersessional period. He noted that the fortieth session of the WMO Executive Council (Geneva, June 1988) had received the annual report of the panel with appreciation and had undertaken the following specific actions on this report:

(a) Approved the two recommendations of the third panel session;

(b) Stressed the importance of quality control of drifting buoy data and of maintaining the Argos system on polar orbiting satellites;

(c) Approved the adherence of COST-43 as a panel Action Group;

(d) Requested Members to continue supporting the technical co-ordinator's position.

Other actions undertaken by the WMO Secretariat included the updating of the list of national focal points for drifting buoy programmes, co-operation with the technical co-ordinator on technical matters, preparation and publication of various panel documents and maintenance of the buoy identifier number system.

2.3.2 The IOC Secretariat representative reported to the panel on activities undertaken by the IOC Secretariat in support of the panel during the past intersessional period. The twenty-first session of the IOC Executive Council (Paris, March 1988) had welcomed the report of the panel and emphasised the usefulness of drifting buoys to many marine scientific and operational activities. The Council also reaffirmed that the legal aspects of drifting buoys and other ODAS were important, and remained to be defined, and it had therefore taken steps to initiate relevant studies on this matter in consultation with IMO and WMO. Other activities of the IOC Secretariat included the negotiation, establishment and servicing of contracts related to the employment of the technical co-ordinator, publication of the panel's annual report, liaison with the panel chairman and publication of the Guide to Drifting Data Buoys.

2.3.3 The panel noted both reports and expressed its appreciation to both Secretariats for their very valuable support.

2.4 Report of the chairman of COST-43

2.4.1 The panel noted that this year is the last under the COST-43 agreement. The main activities have centered around the continuation and development of the joint programmes (in particular the SOBA and SCOS drifting buoy projects) and planning for a successor group to continue the activities of COST-43 for the foreseeable future.

2.4.2 The successor group is to be called "EGOS" (European Group on Ocean Stations). It is expected that the current COST-43 Members will participate and, owing to the flexible and relatively informal mechanisms for accession, it is hoped that other European countries will join in due course.

2.4.3 The purpose of EGOS is to provide a forum for exchange of information on and co-operation in the establishment and operation of marine stations for meteorological and oceanographic purposes in European and adjacent waters.

The main tasks of EGOS are:

(a) To continue the COST-43 drifting buoy and other joint programmes;

(b) To act as an Action Group of the DBCP;

(c) To provide a mechanism, if required, for joint funding of drifting buoy and other programmes and provide a channel for financial contributions to assist in the support of the technical co-ordinator of the DBCP;

(d) To provide a forum for the exchange of views and information on scientific, technical and operational aspects of marine meteorological and oceanographic data acquisition systems.

2.4.4 The structure of EGOS will be less formal than COST-43. EGOS will be directed by a management committee consisting of one representative of each participating country. EGOS membership will be open to any institute in a European country which expresses the desire to join in the activities of EGOS and is unanimously acceptable to the EGOS Managament Committee. No rigid funding arrangement is proposed but it is planned that financial contributions to joint projects and/or co-ordination activities will be facilitated through a suitable "banking" organization.

2.4.5 EGOS will come into being on 1 December 1988. A number of present COST-43 Members have already agreed to join the group and it is hoped that EGOS will prove to be a worthy successor to COST-43.

2.4.6 The panel noted this report with interest and expressed its support for the formation and success of EGOS in its stated objectives. It also expressed its agreement to accept EGOS as an Action Group of the panel in succession to COST-43.

3. FINANCIAL AND ADMINISTRATIVE MATTERS

3.1 Financial situation

3.1.1 The panel first considered the final accounts for the period 1 June 1987-31 May 1988 (first year of employment of the technical co-ordinator (see Annex V) and gave the Secretary IOC formal discharge from his financial administration of the funds for that period. The panel then considered the financial situation for the second year of employment of the technical co-ordinator (see Annex VI). It again agreed that the assumptions under which the figures for expected expenditure had been computed met its requirements as far as possible, account being taken of the negotiations undertaken with SMBA (see below paragraph 3.2).

3.2 Review of contracts

3.2.1 The panel discussed the contract established with the Scottish Marine Biological Association (SMBA), the employer of Mr. D. Meldrum, to provide the services required to fulfill the functions of technical co-ordinator of the panel, and with CLS/Service Argos, to provide for the logistic support of the technical co-ordinator when at CLS in Toulouse, France. As for the former, the panel agreed that the solution adopted was far from ideal in respect of meeting the panel's requirements, but that it was the best of the alternatives considered. In fact, under the terms of this contract, Mr. Meldrum was to work roughly two thirds of his annual working time as technical co-ordinator of the panel during the second period. As for the latter, the panel was informed that CLS/Service Argos had little possibility to negotiate its terms, which were directly taken from the agreement reached at the panel's second session and which did not include any provision for inflation nor any compensation for the "non-use" of office space when the technical co-ordinator was not present in Toulouse. The panel thanked CLS/Service Argos for nevertheless agreeing to sign the contract without any amendment. Copies of the two contracts are in Annex VII.

3.3 Commitments for future funding

3.3.1 The panel recalled that, whatever solution be adopted for the future employment status of the technical co-ordinator, this solution would in any case prove more costly than for the first and second year of his employment. Commitments for future funding would therefore have to cope with the expected increased expenditures if the panel wanted to maintain the services of a technical co-ordinator.

3.3.2 The panel first expressed strongly the opinion that it needed a technical co-ordinator in order to successfully achieve its objectives. The participants therefore were requested to make commitments for future funding, it being understood that such commitments should be considered as for the third period only (1 June 1989-31 May 1990). The following were listed: Australia: US $5,000; Canada: US $15,000 (to be confirmed); Greece: US $2,000 (to be available probably during the second-half of 1989); Iceland: US $2,000; United Kingdom: US $10,000 (to be confirmed); USA: half the cost of the position. The delegate from France was not yet in a position to make any commitment, even on a tentative basis, but assured the panel that his country was considering contributing to the funding.

3.3.3 From these figures, and estimates relative to the cost of the position in future, the panel considered it possible that a technical co-ordinator could be recruited and given the means to properly fulfill his functions in future, provided some caution be taken with regard to his future status (see below).

3.4 Future employment status of the technical co-ordinator

3.4.1 After a careful review of existing possibilities with regard to the future employment status of the technical co-ordinator, and of the associated costs and procedures of recruitment, the panel decided to adopt the proposal made by the representative of the USA: a contract would be sought with the University Corporation for Atmospheric research (UCAR), a US non-profit private organization well aware of the type of procedure the panel had in mind; the other signatory of such a contract would be either the IOC or the WMO Secretariat (represented by the officer entitled to sign such contracts) on behalf of the panel; to that effect, appropriate letters of request and agreement would need to be exchanged between the panel's chairman and the Secretary IOC or the Secretary-General of WMO; the Secretariat signatory of the contract would manage the remaining part of the funds to provide for the logistic support of the technical co-ordinator and for his travels on mission.

3.4.2 UCAR, for its part, would recruit the technical co-ordinator under such terms and conditions as negotiated between UCAR and the panel. To that purpose, the panel entrusted Mr. T. Bryan and Dr. K. Mooney with pursueing all necessary negotiations. It was made clear that in any event the chain of command regarding the technical co-ordinator would remain unchanged, viz. that his work would be supervised by the panel's chairman assisted by the IOC and WMO Secretariats.

3.4.3 The panel agreed that the selection procedure for the technical co-ordinator would remain the same as previously, viz. that selection would be undertaken by a selection panel comprising the chairman, representatives of panel Member States contributing to the position and representatives of the Secretariats.

3.4.4 The panel further considered different options with regard to the place where the technical co-ordinator was to work. It appreciated the kind offer by the USA to host the technical co-ordinator, free-of-charge, at the NOAA National Meteorological Center of the USA, but decided that it was preferable to have the technical co-ordinator co-located with one of the Argos Global Processing Centres (GPC) in Toulouse, France, or Landover, MD, USA. It finally decided on the latter, at least for a trial period of one year. Finally, Service Argos Inc. kindly agreed to provide the required logistic support (office, clerical suppport, communications, computer support, stationery, etc.) for a yearly amount of US $12,000, provided this amount be re-negotiated at the next panel session on the basis of the actual costs incurred.

3.4.5 The panel discussed and agreed on an approximate break-down of the costs to be incurred during the third and any subsequent years of employment of the technical co-ordinator. This break-down is given in Annex VIII, which also includes a summary of the existing funding commitments and contributions requested by the panel from individual contributing Member States sufficient to meet this proposed level of expenditure.

3.4.6 Finally, on this question, the panel noted the view expressed at its third session regarding the need to ensure long-term employment of a technical co-ordinator and the consequent need for long-term funding commitments, where possible. The panel strongly reiterated this opinion.

4. RELATIONSHIP WITH INTERNATIONAL PROGRAMMES/ORGANISMS (agenda item 4)

4.1. World Climate Research Programme (WCRP)

4.1.1 The panel recalled that WCRP requirements for drifting buoy data are focussed through its major projects TOGA and WOCE. With regard to TOGA, it was noted that the requirements remained essentially unchanged from those stated in the TOGA Implementation Plan and that, as of June 1988, the approximate status of the TOGA drifting buoy programme was as follows:

- Southern Ocean: 51 buoys reporting on the GTS
- Tropical Pacific: 25 buoys reporting on the GTS (no pressure sensor)
- Indian Ocean: One buoy reporting on the GTS.

4.1.2 The WOCE plans for drifting buoy deployments are still in the formulation rather than implementation stage. They are given in some detail in the recently published implementation plan for WOCE and the panel noted that according to this plan initial WOCE deployments of drifting buoys may be summarized as:

- Surface velocity	Atlantic	705 buoys
	Indian	280
	Pacific	495
	Southern	240
- Surface flux	Atlantic	16 buoys
	Indian	16
	Pacific	16
	Southern	200 drifters to measure also surface pressure and SST.

4.1.3 The panel agreed that data from these buoys would be of considerable value to operational meteorology and oceanography, and to other research programmes in addition to WOCE, if they were to be made available on the GTS. It was noted however that there was considerable reluctance within the WOCE community for such real-time global distribution of data. The panel therefore agreed that considerable efforts needed to be made in the next two years to inform and educate the WOCE community on the procedures for and value of GTS data distribution and, in particular, to assist WOCE researchers wherever possible in gaining access to the GTS. It was also felt that questions of quality control needed to be actively addressed in response to the concerns of oceanographic buoy deployers. The panel felt that the technical co-ordinator had a key role to play in this matter, in particular through his contacts with the Argos user community, and that he, the chairman of the panel and the Secretariats, should also actively pursue contacts with the WOCE International Project Office, to inform them of the panel, its objectives and activities.

4.1.4 Finally on this question, the panel noted that the US Navy programme for deployment of substantial numbers of meteorological and oceanographic buoys might be regarded as a good prototype for WOCE and that the efforts of this programme in making available large quantities of buoy data for GTS distribution should be communicated to the WOCE community for information and possible follow-up.

4.2 World Weather Watch (WWW) including the operational WWW systems evaluation for the North Atlantic (OWSE-NA)

4.2.1 The panel noted that the WMO Commission for Basic Systems (CBS) had, at its ninth session (Geneva, February 1988), expressed its strong support for the panel and its work in providing for a vital element of the Global Observing System (GOS) of the WWW of WMO. Among specific items mentioned by CBS, the panel noted that questions of quality control were already under consideration (see agenda item 6.1) as was the problem of ensuring the free availability of all drifting buoy data for global use over the GTS (see, for example, agenda item 6.3).

4.2.2 The technical co-ordinator presented a brief report to the panel describing his activities during the previous year in support of the OWSE-NA. Despite concern expressed by the panel, at its previous session, about the level of efforts expected of the technical co-ordinator by the OWSE-NA and some uncertainty as to the input to be provided by COST-43, it had been subsequently agreed that he should attend the OWSE-NA section analysts meeting in the provisional role of section analyst for drifting buoy data. It had also been agreed, with the data manager for the OWSE-NA, that it would be unreasonable to expect the technical co-ordinator to comply with the full list of reporting requirements as these reports would simply be used by himself alone in performing his section analysis.

4.2.3 The meeting, held in Geneva in April 1988, had addressed the key issues relevant to each observing system and had established a timetable for the completion of the various tasks assigned to the section analysts. The issues of critical importance in the use of drifting buoy data, mostly ensuing from the atypical system of collection and dissemination of these data, had been identified by the technical co-ordinator as timeliness, availability, data quality and impact. In particular, in the opinion of the technical co-ordinator, the impact, positive or negative, of drifting buoy data on the quality of numerical forecasts had not, so far, been adequately assessed.

4.2.4 The panel noted this report with interest. It agreed that the OWSE-NA was an important exercise in helping to establish the value of drifting buoy systems as part of the overall GOS of WMO and that, therefore, the technical co-ordinator should continue to perform the tasks already established for him within OWSE-NA. In this regard, it was noted that the final report on the OWSE-NA was expected to be completed by the end of 1989.

4.3 Integrated Global Ocean Services System (IGOSS)

4.3.1 The panel recalled that, at its second session, it had suggested that the IGOSS regular information service bulletin on ocean data buoys and other ocean data acquisition systems (ODAS) could be restricted to non-drifting ODAS in view of the rapid changes in status of drifting buoys with which an annual publication could obviously not cope. The IGOSS community had agreed to this proposal provided that information regarding drifting buoys be circulated on a quarterly basis, as CLS/Service Argos had kindly offered to do at no cost to the panel.

4.3.2 The following procedure was therefore adopted: CLS/Service Argos would ask all their users permission to publicize information regarding their drifting buoys; with the assistance of the technical co-ordinator, CLS/Service Argos would then, on a quarterly basis, encode the appropriate information in a format as close as possible to the example provided in Annex IX and provide it to the Secretariats for circulation to all those potentially interested.

4.3.3 The panel welcomed the kind offer by the Canadian Marine Environmental Data Service (MEDS) to assist in the preparation of the quarterly bulletin. It finally decided to review the results achieved at its forthcoming sessions.

5. REPORTS ON CURRENT AND PLANNED DRIFTING BUOY PROGRAMMES (agenda item 5)

5.1 Under this agenda item, participants in the session gave brief reports on their countries' or organizations' present and/or future drifting buoy activities. Such reports were made by Canada, France, Greece, Iceland, Norway, United Kingdom, United States of America, COST-43 and SCAR. In addition, some countries who were unable to attend the session, viz. Australia and Japan, had provided written statements. Summaries of all these reports are collected and attached as an appendix to the panel's annual report as agreed at the panel's third session.

6. CO-ORDINATION ACTIVITIES (agenda item 6)

6.1 Quality control of drifting buoy data

6.1.1 The panel recalled that, at its third session, it had agreed that studies should be continued on the real-time quality control of drifting buoy data, in close consultation with the US National Data Buoy Center (NDBC). It also noted that the Executive Councils of both WMO and IOC had stressed the importance of quality control for buoy data, in particular for those circulating on the GTS for operational applications.

6.1.2 In this context, the panel noted with considerable interest the presentations by D. Gilhousen (NOAA/NDBC) and by C. Noe (NOAA/Ocean Products Center (OPC) of, respectively, the off-line quality control procedures now in place at NDBC for buoy data quality control and the on-line quality control procedures presently being introduced by OPC, which will be applied to ship and BATHY/TESAC reports as well as buoy data. It was further noted that, in both cases, the procedures are applied only to data from USA buoys received through the Argos US GPC in Landover, with the specific permission of the principal investigators. Details of these presentations are given in Annex X.

6.1.3 While agreeing generally on the need for, and value of, interactive quality control of buoy data for operational purposes, in particular for use with numerical models which goes beyond basic error checking procedures, the panel nevertheless expressed some reservations about applying such quality control to research data. It was noted that researchers normally wanted to retain access to original, unmodified data, and the panel therefore stressed that any data modification as a result of quality control should only be undertaken with the permission of the data owners. At the same time, it was also noted that a problem remained for researchers using GTS data which may have been changed but with no quality control flags to indicate such changes (although the flags are included with archived data).

6.1.4 The technical co-ordinator for the panel then presented the results of two studies of quality control issues undertaken by him during the intersessional period. The first study used the monthly lists, sent to the technical co-ordinator by the ECMWF, which identify those platforms which report unacceptable pressure observations on the GTS. It could be seen that the numbers of such platforms had fallen dramatically over the previous year, from an inital total of about 15 to a present level of only three, and that reports originating from LUTs no longer accounted for a disproportionately large share of the notifications.

6.1.5 The second study focussed attention on the serious implications for data availability of delays in the data dissemination chain, in particular those resulting from quality control procedures. Because of the present necessity to store data received from the majority of platforms onboard the satellite, for at least part of an orbit, much of those data already risk being too late for use by operational numerical models. The study had shown that the quality control measures adopted by NDBC introduced a further delay of between 15 and 20 minutes, which could seriously reduce the quantity of data remaining usable by forecasters. Further delays, which might result from the planned activities of OPC in this field, might reduce data availability to zero in some cases. The panel, having expressed concern about the impact of these delays, noted with appreciation that Dr. Hamilton was pursuing means whereby the delays at NMC would be reduced.

6.1.6 Finally, the technical co-ordinator explained to the panel that such delayed reports face a further danger in that they are, in some cases, likely to have been preceded by uncontrolled reports originating from other sources and so may well be entirely disregarded by numerical models. In this case, there exists a clear need for quality-controlled reports to be flagged in some way so that they may be identified by the models.

6.1.7 The panel noted with interest the response from WMO to a request from the chairman of the panel for guidance on the application of climatological range checks to drifting buoy data processed through the Argos GPCs in Toulouse and Landover. In particular it was noted that a WMO workshop on the quality control of meteorological data was to be held in Reading, United Kingdom, in March 1989. This workshop was expected to make recommendations on this topic, for the consideration of the CBS Working Group on the GOS, for eventual inclusion in the Manual on the GOS. In the meanwhile, it was recommended that the introduction of globally consistent climatological range checks, in addition to these noted in IOC Manual and Guides No. 20, be considered by the panel for introduction in both Toulouse and Landover Argos GPCs.

6.1.8 The panel discussed the need for, and value of, such checks in some detail. While reservations were expressed about the possibility to obtain a universally acceptable climatology on which to base such checks, it was nevertheless agreed that climatologically-based range checks could be of value with conservative variables such as SST, in particular in refining existing gross error checks for such variables. The panel therefore decided to establish an expert sub-group to study the question of the possible implementation in the Argos processing chain of real-time climatological range checks for buoy data. The sub-group comprises D. Gilhousen (USA), R. Keeley (Canada) and the technical co-ordinator (convenor), and is to look, in particular, at the possibilities for implementing such checks in a monitoring mode to assist in assessing their value.

6.2 Code matters

6.2.1 The panel recalled that, at its third session, it had noted a requirement for certain modifications to be made to the DRIBU code, to reflect the developing capability for drifting buoys to measure an increasing variety of ocean parameters, and that it had requested a small sub-group, convened by Dr. G. Hamilton (USA), to investigate the matter further and develop an appropriate proposal. It also noted the actions now underway within IGOSS to develop an IGOSS flexible coding scheme which will accommodate new oceanographic variables. In this context, the panel noted with interest the proposal presented by Dr. Hamilton, which involved modifications to the code form FM 13-IX SHIP to include both the surface variable parts of the existing code form FM 14-VIII DRIBU and the modifications to DRIBU suggested at the session. The sub-surface parts of DRIBU would, under this proposal, be henceforth included in the existing code form FM 63-IX BATHY or FM 64-IX TESAC.

6.2.2 In discussing this proposal, the panel noted that the proposed modifications to SHIP would apply only to the transmission of data from automated platforms and would, in no way, affect the coding and transmission of existing ships' observations. At the same time, some concern was expressed that the proposal would effectively split the observations of surface and sub-surface variables recorded by a single platform at a single space/time point into two GTS messages, with possible adverse consequences for oceanographic research and operations.

6.2.3 While recognizing the legitimacy of this concern, the panel nevertheless agreed that a similar situation already existed with other meteorological and oceanographic observations and that, provided CLS/Service Argos was able to support GTS data insertions in related code forms such as BATHY, any difficulties created would not be insurmountable. In addition, it was agreed that the potential benefits of consolidating drifting buoy surface observations in the single code form SHIP were substantial for buoy operators, CLS/Service Argos and data processing centres alike, and that these outweighed the disadvantages noted above.

6.2.4 The panel, therefore, firstly strongly supported the requirement for modifications to existing GTS code forms to accommodate new drifting buoy data and, secondly, agreed on the proposal that this requirement could be satisfied through a modification to the code FM 13-IX SHIP to accommodate certain specific aspects of drifting buoy observations, rather than through patching of the DRIBU code. It was also agreed that existing DRIBU capabilities for reporting sub-surface data could be accommodated through the use of the BATHY/TESAC codes with drifting buoy observations.

6.2.5 The panel noted that certain improvements were still possible in the proposal presented by Dr. Hamilton. These included a possible capability to allow the reporting of both original variable values and those produced through interactive quality control procedures, and also improvements to the method for reporting quality of buoy location. It therefore requested a sub-group of code experts comprising A. Hernhuter (USA) (convenor), R. Keeley (Canada) and D. O'Neill (Canada), to prepare a final detailed proposal for SHIP code modifications, to be circulated to all panel members within three months for comment, before submission to the appropriate WMO channels, hopefully for final adoption by CBS (Ext.) in 1990. Recommendation 1 (DBCP-IV) on this topic was adopted (see Annex III).

6.3 Other co-ordination activities

6.3.1 The technical co-ordinator presented a review of the useful lifetimes of drifting buoys, which had been compiled using data received from the ECMWF. This data set had been chosen as it offered the possibilities for a global study of useful buoy data circulating on the GTS, although this was at present restricted to those platforms which report pressure data. The main findings were that the great majority of platforms report at least six observations per day, but that nearly half fail within 100 days, with an average lifetime of about 160 days. These conclusions were in accordance with the results of similar studies undertaken by COST-43 and by MEDS. The latter offered to assist the technical co-ordinator in undertaking any future studies of this kind. It was felt by the panel that this should be done on a yearly basis. The complete report is attached as Annex XI. In order that the technical co-ordinator might continue with this and other studies the panel requested the chairman to write formally to the ECMWF to request that their monthly statistics and other relevant data be made available to the technical co-ordinator on a regular basis in computer-compatible form.

6.3.2 In accordance with the work plan that had been established by the panel at its previous session, the technical co-ordinator reported on ways and means by which the quantity and quality of drifting buoy data circulating on the GTS might be enhanced. The central idea was the development at Argos of an entirely separate and modular processing chain for GTS data. As regards data quantity, this would have a number of important advantages, both by increasing the flow of data from existing GTS platforms and, more especially, by removing many of the restrictions which currently prevent the great majority of existing platforms from reporting freely on the GTS. In this regard, note was taken of the technical co-ordinator's findings that many scientists would be willing to allow their data to be transmitted on the GTS provided that the necessary processing did not affect the data available to themselves. Special measures had already been implemented by SAI at Landover to allow this to be done for one particular group of moored platforms, but it was recognized by all that the implementation of a separate, flexible processing chain was a more desirable solution.

6.3.3 Moving to the question of data quality control by such a system, the panel noted the willingess of NDBC, OPC, and MEDS to contribute both advice and, where appropriate, computer software to allow this function to be implemented more efficiently and perhaps more economically. The technical co-ordinator added that, in any case, the implementation of quality control modules might be deferred until a later date so as to spread the expense over a longer period.

6.3.4 Finally, having agreed upon the desirability of this new processing chain, the panel moved to the consideration of ways in which CLS/Service Argos might be assisted with the costs. Although several outline proposals for extra funding were considered, none was found to be entirely satisfactory. There was also no indication of what the system might cost.

6.3.5 Nevertheless, the panel felt it important that early consideration should be given to the development of this facility and requested CLS/Service Argos to take the necessary steps to more closely define the system and to obtain firm estimates of its cost. This work should be completed by the end of January 1989 and circulated to all panel members and national focal points for drifting buoy programmes so that they may have time to consider additional means of funding well in advance of the next session.

6.3.6 The representative of WMO drew the panel's attention to irregularities in the content of the abbreviated headings used by Argos and by LUT operators to prefix their GTS bulletins. In particular the "ii" in the data designator group "TTAAii" ought to contain two digits, instead of the single digit in the common usage by most reporting centres.

6.3.7 In other respects also, the use of the "TTAAii" group seldom conformed with WMO rules. However, it was recognized by WMO that unusual operative conditions of drifting buoys might impose the irregular procedures upon the collecting centres. Rather than open the matter to general discussion, the panel was invited to take note of the issues raised and to consider some proposals for rationalization prepared by the technical co-ordinator, so that some action might be agreed at the next session.

7. PUBLICATIONS (agenda item 7)

Annual report

7.1 The panel reviewed the draft second annual report of the panel, as prepared by the chairman, with the assistance of the technical co-ordinator. It expressed some concern to the fact that all the relevant information had not been made available in due time to the chairman and the technical co-ordinator, in particular with respect to Chapter 1 - Current status of drifting buoy programmes; Chapter 2 - Planned programmes; Chapter 3 - Data archiving; Chapter 5 - Technical developments. It therefore requested all concerned to provide the relevant information to the chairman by 15 November 1988 at the very latest, in order to meet the deadline of 30 November for the report to be passed to the WMO Secretariat.

7.2 In order to avoid such shortcomings in future, the panel requested the Secretariats to issue a formal request for inputs to the report well in advance, viz. first in the joint IOC/WMO circular letter to which the previous report was attached and, second, as a reminder in June every year.

Logo for the Drifting Buoy Co-operation Panel

7.3 The panel considered a proposal for such a logo as prepared under the supervison of Dr. G. Hamilton (see Annex XII). It was of the opinion that the proposal met the requirements expressed at its third session. It nevertheless suggested some slight modifications to the design and agreed that the revised logo would be circulated, well before its next session, to the national focal points for drifting buoy programmes for comments and approval.

Guide to Drifting Data Buoys

7.4 The panel welcomed the publication of the Guide to Drifting Data Buoys (IOC Manuals and Guides No. 20, prepared jointly by IOC and WMO) and expressed its thanks and appreciation to Dr. G. Hamilton for the invaluable work he had accomplished in drafting the guide. It requested the Secretariats to provide CLS/Service Argos and the technical co-ordinator with a sufficient number of copies of the guide to allow them to forward it to all principal investigators using the Argos system.

Guide to Data Collection and Location Services using Service Argos

7.5 The panel was informed that the publication of the revised edition of the guide (WMO Report No. 10 in the Marine Meteorology and Related Oceanographic Activities series) had been slightly delayed due to technical problems, but that the guide was to be issued and widely distributed to all those potentially interested during the coming weeks.

Drifting Buoy Co-operation Panel Newsletter

7.6 The panel recognized that the technical co-ordinator had made several inputs to the Argos Bulletin and Newsletter, which are widely distributed, to publicize the panel's activities and promote the wider use of the GTS. It agreed that, subject to the concurrence of CLS/Service Argos, these media should be used rather than a separate newsletter created. CLS/Service Argos kindly agreed to these arrangements.

7.7. In order to complement the technical information provided in Argos publications, the Secretariats agreed to publish a letter on DBCP administrative matters approximately twice a year for distribution to panel members and national focal points for drifting buoy programmes.

8. REVIEW OF THE PANEL'S OPERATING PROCEDURES AND TASKS OF THE TECHNICAL CO-ORDINATOR (agenda item 8)

8.1 The panel recalled that it had agreed to review its operating procedures at every session. It decided that those agreed upon at its second session remained essentially valid and required only minor modifications in the light of discussions at the present session. The modified operating procedures are given in Annex XIII.

8.2 The panel recognized that the workplan established for its third year was essentially an on-going one and therefore made only minor modifications to this workplan in the light of achievements so far and discussions at this session. The modified workplan is also given in Annex XII.

9. ELECTION OF THE CHAIRMAN OF THE PANEL (agenda item 9)

9.1 The panel unanimously re-elected Mr. C. Billard as its chairman for the coming intersessional period. In doing so, it congratulated Mr. Billard for his activities as the panel chairman during the first three years of its existence, which had contributed substantially to the present very healthy state of the panel and its work.

9.2 In view of the expanding nature of the panel's activities, and in particular the increasing workload of the chairman, the panel agreed on the need to establish the position of vice-chairman. It unanimously elected Mr. D. Painting to fill this position. The operating procedures for the panel were modified slightly to reflect this new position.

10. DATE AND PLACE OF THE NEXT SESSION (agenda item 10)

10.1 The panel agreed that its sessions should continue to be of four days. It welcomed the offer by the WMO representative to host the fifth panel session at the WMO headquarters in Geneva. It agreed that the session should be held in conjunction with the ninth meeting on the Argos Joint Tariff Agreement and that, subject to agreement by the eighth meeting on the Argos Joint Tariff Agreement, the dates for the panel's fifth session should be 17 to 20 October 1989. The panel also noted with interest the possibility of the Australian Bureau of Meteorology hosting the sixth panel session in Melbourne, Australia in 1990, again in conjunction with the tenth Meeting on the Argos Joint Tariff Agreement.

11. CLOSURE OF THE SESSION (agenda item 11)

11.1 In closing the session, the chairman of the panel, Mr. C. Billard, expressed his appreciation to all participants for their contributions to the session and to the work of the panel generally. On behalf of the panel he also expressed his appreciation to the technical co-ordinator, Mr. D. Meldrum, for his highly competent and valuable work in support of its objectives; to the Secretariats for their continuing support of the panel and its technical co-ordinator; to NOAA for their considerable hospitality in hosting the session in New Orleans; and to the UCAR representatives for their valuable material support throughout the session. Participants in the session echoed the thanks of the chairman to the technical co-ordinator, the Secretariats, NOAA and UCAR. They also voiced their appreciation to the chairman himself for the very able way in which he had conducted the session and for his efforts, on behalf of the panel, during the intersessional period.

11.2 The fourth session of the Drifting Buoy Co-operation Panel closed at 12.30 p.m. on Friday 21 October 1988.

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LIST OF ANNEXES

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PROVISIONAL AGENDA

1. ORGANIZATION OF THE SESSION

   1.1 Opening of the session
   1.2 Adoption of the agenda
   1.3 Working arrangements

2. REPORTS

   2.1 Report by the chairman of the Drifting Buoy Co-operation Panel
   2.2 Report by the technical co-ordinator
   2.3 Report by the Secretariats
   2.4 Report by the chairman of COST-43

3. FINANCIAL AND ADMINISTRATIVE MATTERS

   3.1 Financial situation
   3.2 Review of contracts
   3.3 Commitments for future funding
   3.4 Future employment status of the technical co-ordinator

4. RELATIONSHIP WITH INTERNATIONAL PROGRAMMES/ORGANISMS

   4.1 World Climate Research Programme (WCRP)
   4.2 World Weather Watch (WWW, including the operational WWW systems evaluation for the North Atlantic (OWSE-NA))
   4.3 Integrated Global Ocean Services System (IGOSS)

5. REPORTS ON CURRENT AND PLANNED DRIFTING BUOY PROGRAMMES

6. CO-ORDINATION ACTIVITIES

   6.1 Quality control of drifting buoy data
   6.2 Code matters
   6.3 Other co-ordination activities

7. PUBLICATIONS

8. REVIEW OF THE PANEL'S OPERATING PROCEDURES AND TASKS OF THE TECHNICAL CO-ORDINATOR

9. ELECTION OF THE CHAIRMAN OF THE PANEL

10. DATE AND PLACE OF THE NEXT SESSION

11. CLOSURE OF THE SESSION

RECOMMENDATIONS ADOPTED BY THE SESSION

Rec. 1 (DBCP-IV) - CODE MODIFICATIONS TO ACCOMMODATE NEW DRIFTING BUOY DATA

The DRIFTING BUOY CO-OPERATION PANEL,

NOTING:

(1) Existing WMO code forms FM 13-IX SHIP, FM 14-VIII DRIBU, FM 63-IX BATHY and FM 64-IX TESAC which relate to the GTS transmission of data from automatic ocean platforms;

(2) The final report of the third session of the Drifting Buoy Co-operation Panel;

(3) The proposal presented to the fourth session of the panel by its sub-group of experts on codes;

(4) The development within IGOSS of a flexible coding scheme to accommodate new oceanographic variables,

CONSIDERING:

(1) That rapid developments in drifting buoy technology are increasing the possibilities for new types of data to be available operationally from drifting buoys;

(2) That these developments necessitate some changes to existing code forms to enable the transmission of these data on the GTS;

(3) That the existing SHIP code already includes many of the surface elements reported by drifting buoys;

(4) That the existing BATHY and TESAC codes could accommodate all the sub-surface elements reported by drifting buoys,

RECOMMENDS that the most effective way to accommodate the new requirements for reporting data from drifting buoys will be:

(a) To incorporate both existing and future requirements for reporting surface data from drifting buoys into the SHIP code;

(b) To incorporate both existing and future requirements for reporting sub-surface data from drifting buoys into the BATHY or TESAC codes;

(c) Thereby to eliminate the requirement for continued use of DRIBU, REQUESTS its subgroup of experts on codes:

(1) To develop a detailed proposal for modifications to the SHIP code based on that given in the annex to this recommendation, within three months;

(2) To circulate the proposal to members of the panel for further comments;

(3) To submit the final proposal of the panel to the appropriate WMO channels for adoption, hopefully by CBS (Ext.) in 1990,

NOMINATES the following experts to comprise the Sub-group on Codes for the purposes of the exercise:

A. Hernhuter (USA) convenor
R. Keeley (Canada)
D. O'Neill (Canada)

Annex to Recommendation 1 (DBCP-IV

PROPOSAL FOR MODIFICATIONS TO THE SHIP CODE

PART 1 - THE PROBLEM

The present form of the drifting buoy reporting code (WMO code form FM 14-VIII DRIBU) has changed little since it was first developed as a temporary code form in the early 1970's. The WMO, recognizing its continuing importance, adopted it as a permanent code form at CBS-VIII in 1983.

Recent and anticipated developments in sensor capability create a need for changes in the basic format. These changes could be accomplished as in the past, by tacking on new groups at the end of the data section, or by making a complete change to the code. A practicable solution is to include the drifting buoy reporting code in the same format used for reports from manned ships (and moored buoys), code form FM 13-IX SHIP.

This paper indicates changes that would be required to merge DRIBU and SHIP. In many cases parameters (meteorological and oceanographic data) already exist in SHIP. Other data groups, such as quality control flags and groups showing engineering status, do not exist in SHIP and must be developed. The straight-forward approach seems best in these cases: continue the same basic format for those groups as in DRIBU, in which case the problem is reduced to finding a location for them within the code. The DRIBU code also includes subsurface data, using a primitive form of BATHY which only allows the reporting of temperatures at significant depths. My own feelings are that this information should be transmitted as a separate message using the BATHY code. This is one of many points that need to be discussed at the October meeting of the Drifting Buoy Co-operation Panel.

The second part of this paper outlines the changes that would be required in the present SHIP code, and the third shows the revisions to the regulations necessary to include reports from drifting buoys. Additional editorial changes (e.g. references to specific code forms in the Specifications of Symbolic Letters) should be handled by the Secretariat.

PART 2 - CHANGES TO THE SHIP CODE TO INCLUDE DRIBU

An explanation of the added groups follows the revised code form.

1. In section 0, change the last groups to:

   IIiii

   or

   $99L_aL_aL_a\ Q_cL_oL_oL_oL_o$

   or

   $\underline{Q_cL_aL_aL_aL_a\ L_oL_oL_oL_oL_o\ JMMgg}$ — time obs (mn)

   year month Quadran

2. In section 2, add the new group immediately after group $(70H_{wa}H_{wa}H_{wa})$:

   $(70H_{wa}H_{wa}H_{wa})\ \underline{(71P_{wa}P_{wa}P_{wa})}$

   Surface waves Period waves

3. Add these new groups to section 3, immediately following the present group (80000):

   $\underline{(0Q_NQ_L//)}$ or $\underline{(Q_cL_aL_aL_aL_a\ L_oL_oL_oL_oL_o)}$

   $\underline{(H_LV_BV_Bd_Bd_B)}$ drift direction.

   quality of the buoy Sat transmission speed cm/s H_L heures avant. nombre d'heures avant l'heure d'obs pour laquelle la pos est donnée.

4. Add a new section 6 as follows:

SECTION 6 666 $(1Q_PQ_2Q_{TW}Q_4)$ $(8V_iV_iV_iV_i)$ $(9i_dZ_dZ_dZ_d)$

Explanation of added groups:

$Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$ JMMgg

These groups, added to section 0, give the position of the buoy (latitude and longitude in degrees and minutes) and give additional data about the time of the report (J, units digit of the year; MM, month and gg, minutes). The primary time group ($YYGGi_w$) is included in the report immediately before the position.

There is a question whether the position should be given more accurately, in tenths of minutes, or whether whole minutes are sufficient. This needs to be discussed at the October meeting of the Drifting Buoy Co-operation Panel.

Also note the buoy identifier ($A_1b_wn_bn_bn_b$), which is included in a separate seciton at the <u>end</u> of the DRIBU report, is included in section 0.

$(71P_{wa}P_{wa}P_{wa})$

This new group, not now included in DRIBU, is used to report the period of the wave observed by the drifting buoy in tenths of seconds.

$(Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o)$

$(0Q_NQ_L//)$ or

$(H_LV_BV_Bd_Bd_B)$

These groups are taken directly from section 2 of the DRIBU code (Q_N, quality of buoy satellite transmission; Q_L, quality of location; $Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$, second possible location; and $H_LV_BV_Bd_Bd_B$, buoy movement during the period indicated by H_L). The only change is the identifier of the first group has been changed from 2 to 0. The groups are only included when quality is doubtful.

SECTION 6 666 ($1Q_PQ_2Q_{TW}Q_4$) ($8V_iV_iV_iV_i$) ($9i_dZ_dZ_dZ_d$)

A new section has been added to the SHIP code as a catch-all for data not included in other parts of the code (Q_P, quality of pressure measurement; Q_2,* quality of housekeeping parameter; Q_{TW}, quality of surface water temperature measurement; Q_4,* quality of air temperature measurement; $V_iV_iV_iV_i$, engineering data; i_d, type of drogue; and $Z_dZ_dZ_d$, length of drogue cable. These groups could also have been included at the end of the existing section 3. This is another point that needs to be discussed further at the October meeting. There are advantages to both approaches.

PART 3 - CHANGES TO THE SHIP REGULATIONS TO INCLUDE DRIBU

1. Change NOTE (3) (after code form):

(3) A SHIP report from a sea station other than a drifting buoy is identified by the symbolic letters $M_iM_iM_jM_j$ = BBXX. A SHIP report from a drifting data buoy is identified by the symbolic letters $M_iM_iM_jM_j$ = ZZXX,

* Secretariat note: see Recommendation 13 (CBS-IX).

which are included in each individual drifting data buoy report even if the report is part of a bulletin of such reports.

2. Revise NOTE (5) to define the new section 6, as follows:

Section number	Symbolic figure group	Contents
...	...	...
6	666	Data concerning quality of buoy measurements, engineering status, and drogue.

3. Revise the present last sentence in regulation 12.1.3.2, and then add a new last sentence:

The position of a sea station other than a drifting buoy shall be indicated by the groups $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$. In a report from a drifting buoy the position and additional data about the time of the observation shall be indicated by the groups $Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$ JMMgg.

4. There are two approaches to revising the regulations to include the drifting buoy identifier. The first is to add a new regulation 12.1.8:

12.1.8

A drifting buoy shall be identified by the group $A_1b_wn_bn_bn_b$, and 500 shall be added to the original $n_bn_bn_b$ number.

NOTES:

(1) A_1b_w normally corresponds to the maritime zone in which the buoy was deployed. The WMO Secretariat allocates to Members, who request and indicate the maritime zone(s) of interest, a block or blocks of serial numbers ($n_bn_bn_b$) to be used by their environmental buoy stations.

(2) The Member concerned registers with the WMO Secretariat the serial numbers actually assigned to individual stations together with their geographical positions of deployment.

(3) The Secretariat informs all concerned of the allocation of serial numbers and registrations made by individual Members.

This approach includes the notes from the DRIBU code explaining the method for assigning buoy identifiers. It is questionable whether these notes are still necessary in the regulations. If, after further discussion at the October meeting, it is decided they are not, a much simpler solution would be to amend the present regulation 12.1.7(a), as follows:

12.1.7

(a) The identification of stations located at sea on a drilling rig or an oil- or gas-production platform shall be indicated by the group $A_1b_wn_bn_bn_b$. The identification of a drifting buoy shall be indicated by the group $A_1b_wn_bn_bn_b$, wherein A_1b_w normally refers to the maritime zone in which the buoy was deployed and 500 shall be added to the original $n_bn_bn_b$ number.

5. Add a new regulation 12.3.1.2(b)(iii):

12.3.1.2

This group shall be encoded as:

:

(b) 222// for:

:

(iii) A drifting buoy.

6. Add a new regulation 12.3.3.7 as follows:

12.3.3.7

The group $71P_{wa}P_{wa}P_{wa}$ shall be reported in addition to the group $1P_{wa}P_{wa}P_{wa}H_{wa}H_{wa}$ when the following conditions have been met:

(a) The sea is not calm;

(b) $P_{wa}P_{wa}$ has not been reported as //;

(c) The station has the capability of accurately measuring instrumental wave period in units of 0.1 second.

7. Add new regulations under 12.4.11:

12.4.11

Groups (80000 $0Q_NQ_L$//)

12.4.11.1

These groups, and the groups following (either ($Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$) or ($H_LV_BV_Bd_Bd_B$)) shall only be included when Q_N and Q_L have a value other than 0.

12.4.11.2

Groups ($Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$)

These groups shall only be transmitted when $Q_L = 2$, and shall give the location of the second possible solution symmetrical to the satellite sub-track.

12.4.11.3

Group ($H_LV_BV_Bd_Bd_B$)

This group shall be transmitted only when $Q_L = 1$. H_L indicates the time in hours since the last position fix. $V_BV_Bd_Bd_B$ indicates the direction and speed of the buoy in cm/s at the time of the fix.

((IMPORTANT NOTE!!! H_L is now defined in terms of whole hours, which limits the period to 9 hours or less. There are plans to include this group less frequently, for example once a day. If this happens we will either need to change H_L to H_LH_L (making this a 6 digit group) or develop a code table for H_L. My own preference is to expand the group, even though it results in a "nonstandard" length group. This should be another topic for discussion at the October meeting.))

8. Add a new set of regulations covering the proposed section 6:

12.7

Section 6

12.7.1

The use of this section is limited to reports from drifting buoys.

12.7.2

Group ($1Q_PQ_2Q_{TW}Q_4$)

12.7.2.1

These groups shall be included to report quality control data of the buoy.

12.2.7.2

When the value of any measurement is outside specified limits, as indicated by the coding of the quality control indicator in this group as 1, that data group shall not be included in the report.

((QUESTION: Just where is the housekeeping parameter, quality indicated by Q_2, included (or <u>not</u> if Q_2 = 1) in this report? Present DRIBU regulation 14.3.4.1 indicates it's in there somewhere. If not, why not (my own curiosity)?))*

12.7.3

Group ($8V_iV_iV_iV_i$)

12.7.3.1

No more than three groups $8V_iV_iV_iV_i$ shall be included in any report.

* Secretariat note: see Recommendation 13 (CBS-IX)

NOTES:

(1) The physical equivalent of the value $V_iV_iV_iV_i$ will vary from buoy to buoy.

(2) Knowledge of the engineering status of the buoy, indicated by $V_iV_iV_iV_i$, is not necessary for use of the meteorological data groups.

12.7.4

(Group $9i_dZ_dZ_dZ_d$)

12.7.4.1

This group shall only be included in reports from buoys which have been deployed as drogued buoys.

12.7.4.2

This group shall not be included in a report from a buoy on which a drogue has never been installed.

REPORT BY THE TECHNICAL CO-ORDINATOR TO THE FOURTH SESSION OF THE DRIFTING BUOY CO-OPERATION PANEL

1. INTRODUCTION

1.1 This report covers the period 1 October 1987 - 30 September 1988. Until 31 May 1988, the Technical Coordinator (TC) worked full-time for the DBCP, normally based at Toulouse, but with two visits to Geneva to attend the OWSE-NA Section Analysts meeting (13 - 14 April 1988), and to assist with GTS and Secretariat issues (19 - 20 May 1988).

Since 1 June 1988 the TC has been working part-time for the DBCP by means of a contract with the Scottish Marine Biological Association (SMBA). Until 31 August, this resulted in the equivalent of 13 full days work at SMBA, using on-line access facilities to Argos computers, and 5 full days at Toulouse. Since 7 September the TC has worked continuously at Toulouse.

2. ACTIVITIES DURING THE PERIOD

2.1 The percentage of the TC's time devoted to various activities is indicated in Figure 1. Work related directly to the GTS accounts for about 75% of the total effort. Each activity is described separately in the following paragraphs.

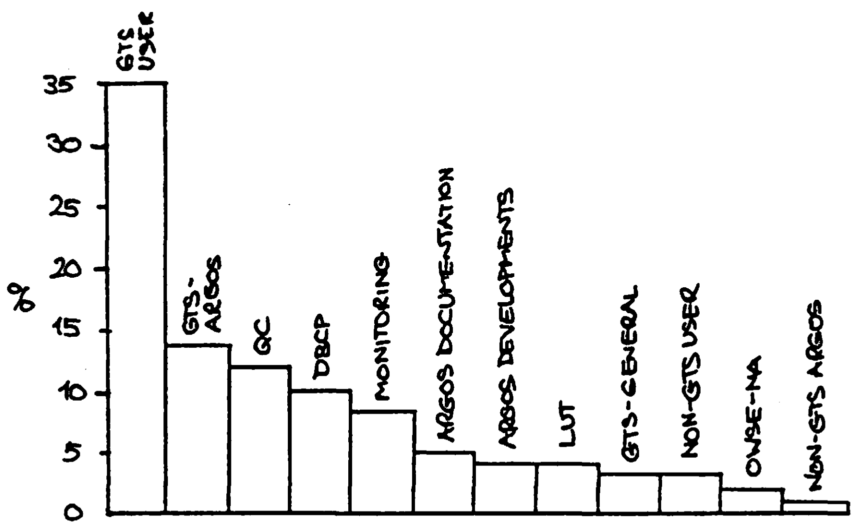

Figure 1 - Allocation of TC's time by activity

3. GTS USER ASSISTANCE

3.1 The category 'GTS User' refers largely to individuals or agencies, operating Argos platforms, whose data is destined (at least partially) to be routed to the GTS. Also included are the Marine Environmental Data Service (MEDS) of Canada, and manufacturers of drifting buoy systems with GTS applications. European users whose programmes are part of COST-43 are included in that sub-category. The percentage breakdown of the TC's time within the 'GTS User' classification is shown in Figure 2. As might be expected, the US accounts for the largest fraction, although this is proportionately much less than their 75% share of active GTS drifters. Conversely, a considerable effort was focused on one South African platform, a fixed station on Inaccessible Island in the South Atlantic. This posed some unusual and interesting problems. Normally user assistance was in one of the following areas.

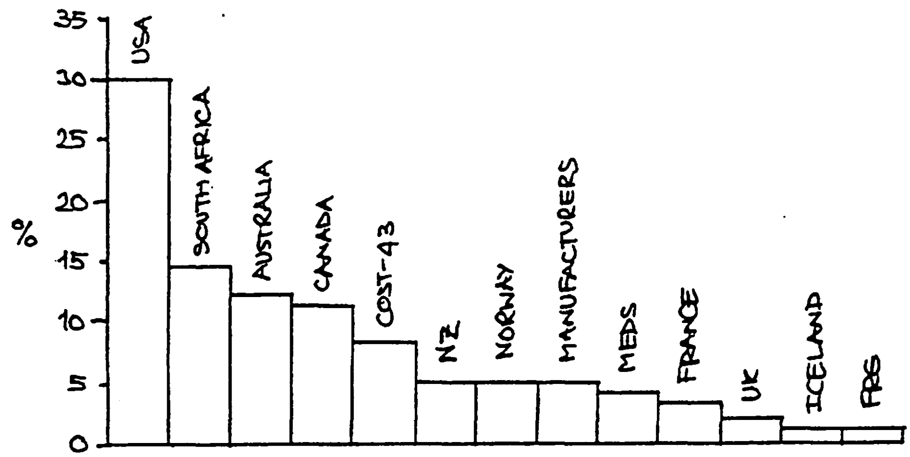

Figure 2 - Breakdown of user assistance by country

3.2 Formatting (or re-formatting) of sensor descriptions to suit the recommended order specified by Argos. This can be quite a complex operation and has not been a service normally offered by Argos.

3.3 Generation of suitable transfer functions to convert raw sensor data to the requisite physical values, incorporating calibration corrections as necessary. Once again, Argos have not usually had the resources available to provide this service.

3.4 Procurement of appropriate WMO identifiers ('WMO numbers').

3.5 Performance analysis of problem drifters in order to diagnose and, where possible, circumvent defects in transmitter or sensor behaviour.

3.6 Ensuring that certain DRIBU message types or groups (e.g. those for pressure tendency), which are not presently quality-controlled by NDBC, are not blocked by NDBC software.

3.7 Preparation of a proposal to allow certain Antarctic automatic weather stations to report on the GTS.

3.8 Communication of technical information to platform manufacturers to improve the compatibility of their products with existing Argos GTS requirements.

4. GTS - ARGOS

4.1 This is a wide-ranging category which covers most of Argos's GTS activities, both in France and in the USA. As in the previous category, the TC was in the unique position of having the time, the facilities and the authorisation to study carefully defects in the system, to pinpoint their sources and to propose remedies. Argos has continued to give this activity their full support. Some of the work is difficult to classify, but the following headings cover the major aspects.

4.2 Identification of software errors ('bugs') in the processing of data for the GTS, and testing of subsequent modifications. More than a dozen bugs were identified: mostly they were cured by a new version of the DRIBU coding software which was installed in March. Some more subtle (and less destructive) bugs related to the updating of the file containing messages scheduled for GTS transmission still await correction.

4.3 Coordination of GTS aspects of the division of workload between the French and US Argos processing centres (the FRGPC and USGPC), and the prior merging of their user files.

4.4 Assisting with the changeover of GTS dissemination of North-American sponsored platforms from Paris to NDBC/NWS Washington. Owing to initial difficulties with the routeing of the Washington collectives, distribution ex Paris was ultimately not terminated. This duplication continues at present. The lack of real-time access to raw GTS data was a serious set-back during the changeover period.

4.5 Outlining of procedures to be followed for correct routeing of GTS data in the event that either processing centre assumes the workload of the other following a major breakdown. This has not yet been completed.

4.6 Education of Argos Useroffices in various aspects of the GTS. Creation and installation of monitoring software at Toulouse to allow the Useroffice to analyse recent GTS output in the absence of the TC.

4.7 Initiation of a process of rationalisation and modernisation of the abbreviated headers in use for GTS bulletins.

4.8 Establishment of a regular procedure for the removal of unused WMO identifiers from Argos real-time files after 3 months of inactivity.

5. QUALITY CONTROL

5.1 In this category I mainly include the day-to-day quality control (QC) of data from individual platforms, coming to my attention through my own monitoring activities, or by means of the regular data quality reports produced by ECMWF, NDBC, COST-43 and the UK Met Office. Also mentioned here are efforts to develop more general QC guidelines.

5.2 QC of individual platforms. Day-to-day activity includes:

- checking for failed sensors which have not been trapped by limits tests;
- deletion of unserviceable platforms, or those which have wrongly appeared on the GTS;
- identification, and rectification where possible, of platforms with poor location update performance;
- checking for beached platforms on the basis of locations and 'water' temperature;
- comparison of NDBC status reports, listing failed sensors etc, with corresponding status of Argos platform files;
- initiation of action on the basis of ECMWF monthly pressure statistics, including re-calibration of pressure sensors where appropriate;
- relaying of QC information from GTS users to appropriate agencies.

5.3 Education of Argos users and Useroffices in the suitable selection of individual limits in order to trap defective sensors.

5.4 Development, with CLS, of proposals to use the QC groups in DRIBU, taking into account that Argos generally does not have executive powers to suppress data.

5.5 Arranging, in coordination with Argos and NDBC, the implementation of a standard set of gross error checks for Argos data entering the GTS.

5.6 Encouraging the establishment of a procedure between NDBC and Service Argos Inc detailing how, where and when sensor deletion or re-scaling, deemed necessary by NDBC, will be implemented.

6. DBCP

6.1 This section includes a number of functions in support of the Chairman and Secretariat, and in the fulfilment of contractual obligations.

6.2 Preparation of documentation for and attendance at DBCP meetings.

6.3 Preparation of the TC's monthly reports.

6.4 Assistance with the negotiation of the contract with SMBA.

6.5 Compilation of a catalogue of drifter programmes and platforms, with associated address list of programme owners.

6.6 Drawing up of briefing notes for use by the DBCP Chairman.

6.7 Liaison with the Internationa Toga Office on GTS matters.

6.8 Circulation to National Focal Points of some information relating to the disposal of two UK data buoys.

7. MONITORING

7.1 Monitoring has been conducted at a number of levels, special software being written as required. Typical activities have included the following.

7.2 Daily check of Argos GTS output (at Toulouse) to detect obvious formatting errors, location problems, etc.

7.3 Occasional comparisons of US and French GTS output to identify inter-centre discrepancies. Since the installation by Argos of automatic procedures to interconnect the two sets of user files, few differences have been found.

7.4 Monitoring of the use of WMO identifiers by regular updating of a cross-reference list of active and inactive WMO numbers, Argos identifiers, country of ownership, etc, using information provided by Argos, LUT operators and the WMO.

7.5 Use of on-line facilities at the French Met Office to monitor GTS reports originating elsewhere than at Argos. Similar monitoring has been performed from time to time by contact with the UK Met Office.

7.6 Analysis of magnetic tapes of GTS data received at Paris and Bracknell to identify particular problems such as communications delays.

8. ARGOS DOCUMENTATION

8.1 Although this may be considered to be outwith the TC's remit, it was felt appropriate (and sometimes essential) to make contributions in a number of areas.

8.2 Argos Bulletin. A variety of short pieces, encouraging and explaining GTS usage, were published in this monthly bulletin, which is circulated to all

Argos users and elsewhere.

8.3 Argos User Manual, Technical File and XBT Manual. Several suggestions were made, mainly relating to the technical sections of these new documents.

8.4 WMO Guide No. 10. As the staff situation at Argos was delaying the revision of this document, several technical sections of this guide were redrafted by the TC in order to more accurately reflect current Argos requirements and capabilities.

8.5 Regular assistance was given with other Argos documents, such as the monthly status report to the WMO, and some internal reference literature.

9. LOCAL USER TERMINALS

9.1 This category includes both independent local user terminals (LUTs), and the LUT services provided by Argos.

9.2 Arctic drifters. Considerable effort was directed towards resolving calibration and other discrepancies in LUT reports for these drifters. The situation now seems to be satisfactory.

9.3 S-band quasi-LUTs. The performance of the new direct read-out service from Wallops Island and Gilmore Creek was evaluated, with particular regard to data availability and delay. Attention was drawn to the large percentage of missing Gilmore datasets.

9.4 Toulouse LUT. A comparison was made between the results of a CLS study on the theoretical performance of this LUT, and several days of real data. This showed that while the actual coverage of the station was close to the that predicted by theory, many messages were lost due to noise. An unusual 'black hole' effect was identified whereby, in certain circumstances, GTS report availabilty was worsened by the presence of this LUT. This has now been corrected.

10. ARGOS DEVELOPMENTS

10.1 This category lists areas in which assistance has been given with the development of new facilities at Argos.

10.2 New GTS processing chain. This is highly desirable in order to separate GTS and User processing and to allow installation of further facilities such as QC. A fuller discussion will be found elsewhere. Feasibility studies have been initiated by Argos. Help was given with the development of a new GTS module at SAI for the processing of thermistor string data.

10.3 Other enhancements that have been stimulated include the new DRIBU coding software, the extension of the permissible precision of calibration data to allow up to 7 significant figures, and some relaxation of the processing requirements for non-GTS sensors embedded amongst GTS sensors.

11. GTS - GENERAL MATTERS

11.1 In this category I list GTS issues which are not necessarily specific to Argos.

11.2 DRIBU routeings at Paris and Bracknell. These were found to contain a number of inconsistencies, leading to the loss of some collectives and the duplication of others.

11.3 Abbreviated headers. A list of headers in use was compiled. Some proposals for rationalising the list used by Argos were submitted to the WMO.

11.4 Pressure tendency characteristic. In response to a user request, a ruling was sought from the WMO as to the permissible values of this characteristic in DRIBU reports.

11.5 DRIBU ex Washington. Some formatting anomalies were noted in the Argos datasets inserted on to the GTS by NWS Washington.

12. NON-GTS USER ASSISTANCE

12.1 Buoy recovery. Problems with a faulty North Sea drifter were diagnosed. The buoy was successfully located and recovered on going aground in Norway.

12.2 Relative positions of enhanced accuracy may well be possible using Argos locations derived from the same satellite pass. This is of interest in the study of ice dynamics, and elsewhere. Some relevant data was gathered for an Argos user.

12.3 Pirated Argos Identifiers. Two reports of 'stolen' IDs were investigated. One was due to a faulty transmitter emitting wrong codes, the other to unintentional transposition of components when assembling a platform.

12.4 Repetition rates. Advice was given to a transmitter manufacturer on the optimal selection of transmission repetition rates.

13. OWSE-NA

13.1 Some data was gathered to assist the Chairman in compiling reports requested by OWSE-NA.

13.2 An OWSE-NA meeting was attended in the provisional role of Section Analyst for drifting buoy data.

14. ARGOS (NON-GTS)

14.1 A number of bugs were identified in the user distribution and in the management of updates.

FINAL ACCOUNTS: 15 JUNE 1987 - 31 MAY 1988

Period : 1 June 1987 - 31 May 1988

CONTRIBUTIONS

Australia	(11.06.86)	5 000.00	
Canada	(28.10.86)	10 000.00	
France	(30.10.86)	6 338.02	
Iceland	(26.12.86)	2 000.00	
USA	(24.02.87)	38 000.00	61 338.02

EXPENDITURES

Remuneration technical co-ordinator 12 x 3 144.00		37 728.00	
Travel technical co-ordinator			
Paris/Geneva (01-12.06.87)	1 612.72		
Brest (14-19.06.87)	765.07		
USA/Canada/UK (13.09-03.10.87)	4 982.10		
Paris (20-28.10.87)	1 279.59		
Geneva (12-15.04.88)	608.55	9 248.03	
Contract CLS/Service Argos		13 102.00	60 078.03

BALANCE (unspent) 1 259.99

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FINANCIAL STATEMENT FOR THE SECOND YEAR OF THE TECHNICAL CO-ORDINATOR

Period : 1 June 1988 - 31 May 1989

CONTRIBUTIONS

Australia	(09.10.86)	5 000.00		
Canada	(07.10.87)	10 000.00		
UK	(07.10.87)	5 000.00		
France	(26.11.87)	4 784.15		
Iceland	(10.02.88)	2 000.00		
USA	(30.06.88)	38 000.00	64 784.15	
Unspent during previous period(s)			1 259.99	66 044.14

EXPENDITURES (expected)

Contract SMBA	48 000	
Travel technical co-ordinator	10 000	
Contract CLS/Service Argos	3 600	61 600

BALANCE (expected unspent, or "flexibility") 4 400

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Sector/Bureau ref.: SC/FIT/293.070.8
BOC ref.:

ANNEX VII

CONTRACTS FOR EMPLOYMENT AND SUPPORT OF THE TECHNICAL CO-ORDINATOR FOR THE SECOND YEAR

between

THE UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
(hereinafter called 'Unesco')
the headquarters of which are situated in Paris

of the first part

and

The Scottish Marine Biological Association (SMBA)
Dunstaffnage Marine Research Laboratory
P.O. Box 3, Oban Argyll PA34 4AD
Scotland
United Kingdom
(hereinafter called 'the Contractor')
of the other part

Hereby agree as follows:

Article I.

The Contractor shall: (describe work)

1. provide the services required to fulfil the functions of Technical Co-ordinator of the Drifting-Buoy Co-operation Panel (DBCP) jointly established by the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC), as specified in the terms of reference attached as Annex 1 and in accordance with the work plan agreed by the DBCP and attached as Annex 2. Under the terms of this contract, "services" shall be understood as no more than 130 working days of a specialist (Mr. D. Meldrum) split as required by the Chairman of the DBCP during the period 1 June 1988 to 31 May 1989 inclusive.

To fulfil the functions of Technical Co-ordinator of the DBCP, the specialist shall be posted at the Dunstaffnage Marine Research Laboratory in Oban, United Kingdom, for a total duration of no less than 25 and no more than 30 working days, and at Collecte-Localisation-Satellite (CLS)/Service Argos in Toulouse, France, for a total duration of no less than 60 and no more than 70 working days, and shall travel on mission as required by the Chairman of the DBCP for a total duration not exceeding 30 working days. In addition, he shall be authorized by the Contractor to travel twice by car from Oban to Toulouse and back.

The Contractor shall be responsible to the Secretary IOC for providing the above services and the specialist, while legally an employee of the Contractor, shall act under the technical guidance of the Chairman of the DBCP. In particular, he shall provide the Secretary IOC and the Chairman of the DBCP with reports on his activities as Technical Co-ordinator of the DBCP, at least every two months or on a monthly basis in case he would continuosly fulfil the functions of Technical Co-ordinator of the DBCP for more than one month.

2. In collaboration with the division or unit concerned, supply in writing, with a view to the preparation of evaluation statements, data (*quantitative* as far as possible) on: (a) the main achievements of the activity or activities and the practical results obtained thereby or the final outcome of the activity or activities (e.g. training, innovations, the promotion of research or policies, the improvement and transfer of knowledge, the exchange of experience and information, greater participation by women, the strengthening of regional or international co-operation, etc.); (b) unforeseen results; (c) the difficulties encountered in implementing the activities; (d) the lessons learnt (more successful adaptation of activities to the needs of the Member State(s), greater efficiency, impacts on target groups, other forms taken by the implementation of the activities); (e) other information concerning evaluation of the activities.

~~The work shall be completed by XXXXXXXXXXXXXXXXXXXXXXXXXX at the latest.~~
On completion the ownership in the property shall rest in Unesco.

Article II.

Unesco shall pay to the Contractor a fee as follows: *[Insert the total fee in words and figures, the currency and the instalments and conditions of payment where applicable].*

The equivalent of a maximum amount of $48,000 (forty eight thousand US dollars) split as follows:

1. The equivalent of $20,000 (twenty thousand US dollars) upon submission by the Contractor and approval by the Secretary IOC of an estimated plan of expenditure of the funds;
2. The equivalent of $20,000 (twenty thousand US dollars) upon submission by the Contractor and approval by the Secretary IOC of an interim statement of expenses on 31 December 1988;
3. The equivalent of a maximum amount of $8,000 (eight thousand US dollars) upon submission by the Contractor and approval by the Secretary IOC of a statement of expenses showing the total use of funds on 31 May 1989.

Any amount unspent or uncommitted by 31 May 1989 shall be returned to IOC.

The rate of exchange for conversion into the currency of payment shall be the official rate applicable in Unesco on the date of payment.

Article III.

The final payment shall not be made until the work has been approved by Unesco.

Article IV.

Unless otherwise provided herein, the Contractor shall bear all the expenses of carrying out the work.

Article V.

Neither the Contractor, nor anyone whom he may employ to carry out the work is to be considered as an agent or member of the staff of Unesco and, except as otherwise provided herein, they shall not be entitled to any privileges, immunities, compensation or reimbursements, nor are they authorized to commit Unesco to any expenditure or other obligations.

Article VI.

The Contractor undertakes full responsibility for the purchase of any insurance which may be necessary in respect to any loss, injury or damage occurring during the execution of the work.

Article VII.

All disputes arising out of, or in connection with the present contract or the breach thereof, shall be settled primarily by mutual understanding. However, if at the expiration of a six-months period starting from the date the dispute arises, no amicable settlement has been arrived at, or even before the end of this period if Unesco formally certifies in writing that in its opinion there is no reasonable possibility that an amicable settlement will be reached by the parties, either of the two parties shall have the right to submit the dispute concerned to an arbitrator chosen by their common accord. Failing agreement on the choice of an arbitrator, the latter shall be designated by the First Chairman of the 'Cour d'Appel de Paris' at the request of the most diligent party. The arbitration proceedings shall take place in Paris and shall be in accordance with such rules and procedures as may be established and adopted by the arbitrator. The decision of the arbitrator shall, taking into account relevant scales established in respect of similar arbitrations by the International Chamber of Commerce, determine the expenses of the arbitration which may be ordered to be either apportioned between the two parties or paid by one of them only. The award rendered shall be final, conclusive and without further recourse.

Signed on behalf of Unesco .... Date ....

Contractor .... Date ....

Annex 1 to Contract 293.070.8

Terms of reference for the Technical Co-ordinator of the Drifting Buoy Co-operation Panel

The Technical Co-ordinator of the Drifting Buoy Co-operation Panel shall:

1. Under the direction of the Drifting Buoy Co-operation Panel take all possible steps within the competence of the panel to assist in the successful achievement of its aims;

2. Assist in the development and implementation of quality control procedures for drifting buoy systems;

3. Assist in setting up suitable arrangements for notifying the appropriate user communities of changes in the functional status of operational drifting buoys;

4. Assist in the standardization of drifting buoy data formats, sensor accuracy, etc.;

5. Assist when requested with the development of co-operative arrangements for drifting buoy deployment;

6. Assist in the clarification and resolution of issues between Service Argos and drifting buoy operators;

7. Assist in promoting the insertion of all available and appropriate drifting buoy data into the Global Telecommunication System;

8. Supply information about drifting buoy developments and applications to the WMO and IOC Secretariats and assist the Drifting Buoy Co-operation Panel to promote an international dialogue between oceanographers and meteorologists;

9. Co-ordinate and monitor the flow of drifting buoy data into appropriate permanent archives.

Signed on behalf of Unesco .... Date 1.7.88.........

Contractor .... Date 3.8.88.........

Annex 2 to Contract SC/FIT/293.070.8

DRIFTING-BUOY CO-OPERATION PANEL WORK PLAN
AND OBJECTIVES FOR THE THIRD YEAR

PART A

Summary of the tasks

1. Maintain summary of requirements for drifting-buoy data to meet expressed needs of the international meteorological and oceanographic communities.

2. Maintain a catalogue of existing on-going drifting-buoy programmes.

3. Maintain a list of focal points for national contributions and within other relevant bodies with potential for involvement in drifting-buoy programmes.

4. Identify sources of drifting-buoy data not currently reported on the GTS and determine the reason for their non-availability.

5. If deemed necessary, make proposals to the Panel for co-ordination activity as a result of the above actions to address items 2 to 5 and 7 in the terms of reference for the Drifting-Buoy Co-operaton Panel.

6. Initiate and arrange for the circulation of quarterly newsletter containing information on the Panel's activities, current and planned drifting-buoy programmes and related technical developments, including the results of the work undertaken by SCOR Working Group 88.

7. Pursue tasks appropriate to satisfy the requirements of the OWSE-NA of WMO with regard to drifting buoys.

8. Develop proposals for the implementation of global real-time quality control procedures for drifting-buoy data processed by the Argos processing centres.

9. Continue the arrangements (including finance) to secure the services of a Technical Co-ordinator.

10. Review programme and establish working priorities of the Technical Co-ordinator.

11. Prepare annual report of the Drifting-Buoy Co-operation Panel.

Task	Carried out by *	Supported / Assisted by	Reported to / Action by	Relevant terms of reference of the panel
1	Technical co-ordinator (1, 8)	Panel members and WMO/IOC Secretariats	Chairman for presentation to panel	1, 2
2	Technical co-ordinator (1, 3, 8)	Panel members and WMO/IOC Secretariats	Chairman and panel for information	1, 2
3	Technical co-ordinator (1, 3, 5, 8)	Panel members and WMO/IOC Secretariats	Chairman and panel for information	1, 2, 7
4	Technical co-ordinator (1, 7)	Panel members and WMO/IOC Secretariats	Chairman and panel for information	5
5	Technical co-ordinator and chairman (1, 3, 4, 5, 8, 9)	WMO/IOC Secretariats and others as appropriate	To panel for consideration and appropriate action or for direct action by chairman	1, 2, 3, 4
6	Technical co-ordinator (1, 3, 4, 5, 8, 9)	Chairman and WMO/IOC Secretariats	Wide circulation by WMO/ IOC Secretariats	6, 7
7	Technical co-ordinator (1, 5, 7)	Chairman, WMO Secretariat, COST-43 Technical Secretary	Chairman for presentation to Committee for the OWSE-NA	1, 3 7
8	Technical Co-ordinator (1, 2)	Panel members, WMO Secretariat	Chairman and panel	1, 2
9	Chairman and sub-committee	WMO/IOC Secretariats	WMO/IOC Secretariats	8
10	Chairman/panel		Panel (at next session)	8
11	Chairman	Technical Co-ordinator	Executive Councils of WMO and IOC	9

* When the technical co-ordinator is involved in carrying out a task, the figures in parenthesis relate to the terms of reference for the technical co-ordinator.

Signed on behalf of Unesco .... Date ..1.7.86.........

Contractor .... Date ..3.6.86.........

CONTRAT

entre

L'ORGANISATION DES NATIONS UNIES POUR L'ÉDUCATION, LA SCIENCE ET LA CULTURE (ci-après dénommée « l'Unesco »), ayant son siège à Paris

au nom de la Commission Océanographique Intergouvernementale (COI)
d'une part

et

Collecte Localisation Satellites
(C.L.S.)
18, avenue Edouard Belin
31055 Toulouse Cédex France
(ci-après dénommé(e) « le contractant »)
d'autre part

Il a été convenu ce qui suit :

Article premier.

Le contractant s'oblige à : (Description du travail demandé)

1. fournir au Coordinateur technique du "Drifting-Buoy Co-operation Panel" le soutien logistique suivant :

(i) un bureau (espace et mobilier), mis gracieusement à disposition ;

(ii) le soutien dactylographique requis, mis gracieusement à disposition ;

(iii) le libre accès aux divers moyens de télécommunication en usage (téléphone, télex, télégramme, courrier électronique, etc.) ;

(iv) l'accès aux moyens informatiques du Service Argos, y compris la libre jouissance : (a) d'un terminal donnant accès au centre de traitement Argos, et (b) d'un micro-ordinateur avec les logiciels usuels ;

(v) les fournitures de bureau et les moyens de fonctionnement (photocopies, affranchissement postal, etc.) usuels ;

ce, pendant deux périodes séparées ne pouvant chacune dépasser deux mois et ne pouvant, à elles deux, dépasser trois mois.

2. En collaboration avec la division ou l'unité concernée, et en vue de la rédaction des exposés d'évaluation, le consultant fournira, par écrit, des données (*quantitatives* dans toute la mesure du possible) sur : *a*) les principales réalisations de la mise en œuvre de l'activité ou des activités ainsi que sur les résultats tangibles obtenus grâce à ces réalisations ou produits finals de l'activité ou des activités (par exemple : formation, innovations, promotion de recherches ou de politiques, amélioration et transfert des connaissances, échanges d'expériences et d'information, amélioration de la participation des femmes, renforcement de la coopération régionale ou internationale, autres); *b*) les résultats non prévus; *c*) les difficultés rencontrées dans la mise en œuvre des activités; *d*) les enseignements tirés (meilleure adéquation aux besoins de l'État membre ou des États membres, amélioration de l'efficacité, effets sur les groupes-cibles, autres modalités de mise en œuvre des activités); *e*) autres informations sur l'évaluation des activités mises en œuvre.

Le travail devra être terminé le 31 mai 1989 au plus tard.
Le produit de ce travail deviendra alors la propriété de l'Unesco.

Article II.

L'Unesco versera au contractant la somme suivante : *[Indiquer le montant total en lettres et en chiffres, la monnaie dans laquelle il sera payé, le nombre de versements et les conditions de paiement s'il y a lieu.]*

l'équivalent au maximum de 3 600 $ US (trois mille six cents dollars des Etats-Unis) en francs français, en un versement effectué après soumission par le Contractant et approbation par l'Unesco d'un état financier des dépenses encourues au titre des services indiqués à l'Article I, paragraphes (iii), (iv) et (v).

Le taux de change appliqué pour convertir ces sommes en la devise de paiement sera celui en vigueur à l'Unesco à la date du paiement.

Article III.

Le solde définitif ne pourra être versé qu'après approbation du travail par l'Unesco.

Article IV.

Sous réserve de dispositions contraires du présent contrat, le contractant prendra à sa charge toutes les dépenses afférentes à l'exécution du travail.

Article V.

Ni le contractant ni aucune personne employée par lui en vue de l'exécution du travail ne sera considéré comme un agent ou un membre du personnel de l'Unesco, ne pourra jouir d'aucun avantage, immunité, rétribution ou remboursement qui ne soit expressément prévu dans le présent contrat, et ne sera autorisé à engager l'Unesco dans quelque dépense que ce soit, ni à lui faire assumer d'autres obligations.

Article VI.

Le contractant assume l'entière responsabilité des dispositions qu'il jugerait bon de prendre pour s'assurer contre tous préjudices, pertes ou dommages survenant pendant l'exécution du travail.

Article VII.

Toute contestation relative à l'exécution ou à l'interprétation du présent contrat sera réglée à l'amiable. Toutefois, si à l'expiration d'un délai de six mois à compter de la date de la survenance du litige, les parties ne parvenaient pas à un tel règlement ou si, avant l'expiration de ce délai, l'Unesco faisait savoir par écrit qu'à son avis il n'y a pas de possibilité raisonnable de parvenir à un tel réglement, l'une ou l'autre des parties pourra soumettre le litige à un arbitre choisi par les parties d'un commun accord. A défaut d'un accord sur le choix de l'arbitre, la désignation sera faite par le Premier Président de la Cour d'Appel de Paris sur simple requête à lui présentée par la partie la plus diligente. L'arbitrage aura lieu à Paris, conformément aux règles et à la procédure adoptées par l'arbitre. L'arbitre déterminera les frais de l'arbitrage en se référant aux barèmes établis par la Chambre de commerce internationale dans les cas similaires. Les frais d'arbitrage pourraient être répartis entre les parties ou mis à la charge de l'une d'entre elles. La sentence arbitrale sera définitive et sans appel.

Pour l'Unesco .... Date ....

Le contractant .... Date ....

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SUMMARY OF ESTIMATED INCOME AND EXPENDITURES FOR THE THIRD YEAR OF EMPLOYMENT OF THE TECHNICAL CO-ORDINATOR

Estimated costs

For the employment contract established through UCAR and location at Service Argos Inc., Landover, USA

	US national	Non-US national
	US$	US$
Salary support - Package (includes salary, benefits package, and UCAR administrative costs)	63,000	71,000
Service Argos Inc. contract	12,000	12,000
Travel	20,000	17,000
Removal costs	3,000	8,000
Change-over costs	2,000	2,000
Total	100,000	110,000
Total (recurrent)	95,000	100,000

Estimated income to meet costs (US$)

	Confirmed	Possible requirement (to be confirmed)
Australia	5,000	10,000
Canada	10,000	15,000
France		10,000
Greece		2,000
Iceland	2,000	2,000
United Kingdom	5,000	10,000
USA	50,000 - 55,000	50,000 - 55,000
Total		99,000 - 104,000

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DRAFT FORMAT FOR REGULAR DISTRIBUTION OF DATA ON DRIFTING BUOYS

INFORMATION ON DRIFTING BUOYS

Country :

Date :

IDENTIFIER		LOCATION				VARIABLES MEASURED									DROGUE	CODE FORM	DATA AVAILABILITY	STATUS	COMMENTS
		DEPLOYMENT		LAST															
WMO	Argos	POSITION	DATE	POSITION	DATE	Air Temp.	Air Press.	Press. Tend.	Wind (DD)	Wind (FF)	Waves	S.S.T.	S/Surf. Temp.	Others (spec.)					

INFORMATION ON DRIFTING BUOYS

NOTES

IDENTIFIER

In column "WMO", enter the WMO identifier allocated to the drifting buoy, if any (WMO code: $A_1b_wn_bn_bn_b$).

In column "Argos", enter the Argos identifier number.

LOCATION

Enter the actual or planned deployment position ($L_aL_a.L_aL_a$ N or S/$L_oL_oL_o.L_oL_o$ E or W) and date (DD/MM/YY), and similarly (if relevant) the last position known and date.

VARIABLES MEASURED

Enter in the appropriate column the number of observations reported per day and (if relevant) the number of observational levels for sub-surface measurements. Specify in column "COMMENTS" if the column "Others" is used.

DROGUE

If the buoy is drogued, enter the depth of the drogue in meters. Otherwise, leave in blank.

CODE FORM

Enter:

S for SHIP (FM 13-VIII Ext.)

D for DRIBU (FM 14-VIII)

B for BATHY (FM 63-VIII Ext.)

U for BUFR (Binary Universal Form for Representation of meteorological data) (FM 94-IX)

O for any other code form used (then specify in column "COMMENTS")

DATA AVAILABILITY

Enter:

- G if data are circulated over the GTS
- M if data are available on micro-computer-compatible carrier
- C if data are available on computer-compatible carrier
- L if data are available on listings (or equivalent media)
- R if data availability is restricted
- O in other cases (then specify in column "COMMENTS")

STATUS

Enter:

- O for operational
- E for experimental
- P for planned
- F for failed (during the last 6 months)

Use more than one letter if necessary.

COMMENTS

Enter any relevant comment in plain language.

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QUALITY CONTROL PROCEDURES AT NOAA/NDBC AND NOAA/OPC

A STATUS REPORT

David B. Gilhousen

Several examples were shown where bad sea level pressure data from drifting buoys produced incorrect initial analysis used for numerical weather prediction. An approach to data quality control of selected drifting buoys originating at the US Argos Processing Center was given. This approach is elaborated in the attached paper presented at the Fourth AMS Conference on Interactive Information and Processing Systems.

Quality control of these drifters was initiated by NDBC on March 30, 1988. A large number of drifters reporting inaccurate data were immediately withheld from dissemination. This resulted in a substantial improvement in several data quality statistics compiled from ECMWF reports. For example, the percent of sea level pressure reports from drifters which were rejected at ECMWF decreased from 1.4% in April 1987 to 0.1% in April 1988. Similarly, the number of drifters whose monthly sea level pressure bias was greater than 2 hPa decreased from 9.4% to 3.2% in the same period. Identical statistics were computed for non-NDBC drifters. Though the percentages were considerably higher than NDBC's, a similar data quality improvement was noted. This improvement is attributed to the efforts of the IOC/WMO Drifting Buoy Technical Coordinator.

The number of drifting buoys undergoing quality control has increased from 99 to 123 from March 30 to September 30, 1988. These drifters include TOGA drifters in the Southern Hemisphere, U. S. Navy drifters in the Western Pacific, U. S. Coast Guard drifters in the North Atlantic, and buoys deployed by the Polar Science Center, Woods Hole Oceanographic Institute, and the Atlantic Oceanographic and Meteorological Laboratory in tropical regions. Most of the increase has come from drifters which solely measure sea surface temperature.

In this six month period, 16 buoys were beached and their sea surface temperatures were withheld from distribution. In addition five wind direction sensors, three sea level pressure sensors, four water temperature sensors, and one air temperature sensor were withheld. Reports from drifting buoys near Antartica continue to be the most difficult to monitor.

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9.10

QUALITY CONTROL OF METEOROLOGICAL DATA FROM AUTOMATED MARINE STATIONS

David B. Gilhousen

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1.0 INTRODUCTION

As part of the National Weather Service (NWS). the National Data Buoy Center (NDBC) develops and operates automated data acquisition systems from moored buoys and Coastal-Marine Automated Network (C-MAN) stations. A recent description of NDBC programs was provided by Hamilton (1986). Because 50 percent of all NWS marine warnings are based primarily on NDBC data. an extensive data quality effort is necessary

Data monitoring during and after field evaluations produces a variety of beneficial results. Bad data are withheld from real-time distribution and edited prior to archival. Often. the failure mode helps technicians diagnose component failure prior to service visits. and chronic failures are reported to engineers for further investigation. Data from new sensors. new data collection packages. and new buoys undergo field evaluation before they are used operationally (Gilhousen. 1987). Extensive station climatologies are produced from archived data (National Weather Service. 1986) as well as performance statistics. This paper will concentrate on the data monitoring and control systems that form the heart of this program.

2.0 REAL-TIME DATA VALIDATION

Moored buoy data have been transmitted through the Geostationary Operational Environmental Satellite (GOES) system since 1976 Data from C-MAN stations have been transmitted through GOES since 1983. Real-time processing occurs on the NWS IBM 4341 computer in Suitland. Maryland. Several validation procedures are performed every 20 minutes before real-time distribution. Data are checked for transmission parity errors. gross range and time-continuity checks are performed. and wind gust-to-speed ratios are examined Furthermore. an NDBC-maintained status file is read to determine sensor calibration coefficients. which sensors are permanently failed. and which sensors are primary when two duplicate sensors exist.

The formula used for performing the time-continuity check is.

$$M = 0.58\,\sigma\sqrt{\Delta T}. \qquad (1)$$

where M is the maximum allowable difference. σ is the standard deviation of each measurement. and ΔT is the time difference in hours since the last acceptable observation. ΔT is never greater than three hours regardless of the actual time difference. This limits the maximum allowable difference and reduces the chance of disseminating bad data

The time-continuity algorithm is based on a formula that relates the time rate of change of a normally distributed measurement to an autocorrelation coefficient. NDBC obtained a variety of time-rate-of-change statistics for sea level pressure at several of our moored buoys We discovered that the autocorrelation was proportional to the $\sqrt{\Delta T}$ The coefficient. 0 58. was then determined empirically and represents a time change likely to be seen only once every 2 to 3 years at any given site

Table 1 lists the upper and lower limits that the data must fall between and the standard deviation for each element for typical moored buoys These parameters vary somewhat depending on location All limits are removed well ahead of tropical storms because the maximum change of pressure allowed in one hour. 12.2 hPa. can easily be exceeded near the eye. Obviously. no range or time-continuity checks are performed on wind direction. Wind gusts are checked by computing the gust-to-speed ratio and ensuring that the ratio lies between 1 and 4.

These real-time checks are very effective at removing the large errors caused by intermittent data transmission problems between the station and the satellite. These errors typically account for 0.5 percent data loss and our checks remove over 99 percent of these errors. On the other hand. these checks do a poor job of detecting errors caused by sensor degradation. Examples of sensor degradation include cases where the pressure suddenly drops 10 hPa due to ice accretion and the wind speed drops 15 percent due to worn anemometer bearings. Only about 25 percent of these problems are caught by our real-time checks. yet these problems cause persistently bad data. In order to remove these bad data from distribution. more stringent quality control is performed at NDBC within 24 hours via a man-machine mix. When sensor deficiencies are detected. the status file on the IBM 4341 is updated to withhold release of that sensor's data.

3.0 NDBC DATA VALIDATION

Data quality control at NDBC is philosophically different from real-time quality control. Real-time validation detects only gross errors. As explained above. it catches a small percentage of bad data caused by sensor degradation. However. what is detected is virtually certain to be wrong. This approach is necessary because real-time validation is completely automated. On the other hand. data validation algorithms at NDBC are more stringent. Only one-third of the data they flag as suspicious are really bad data. About 98 percent of sensor degradation errors are detected by these algorithms. The different approach was taken because of a man-machine mix. Five different validation algorithms are used at NDBC.

First. more stringent range and time-continuity limits are applied. These limits are station-specific for each month. Limits chosen are extremes likely to occur once every 2 or 3 years.

Second. measurements obtained from duplicate sensors are checked to make sure that they track along together. For example. if the pressure from the first sensor is 0.5 hPa higher than that obtained from the second sensor. but for the next report the first sensor reads 0.2 hPa lower. the data are flagged as suspect. The analyst must then decide which sensor is more erratic.

Table 1. Typical limits used for range checks and standard deviations used for time-continuity checks for real-time validation.

Measurement	Units	Lower Limit	Upper Limit	Standard Deviation
Sea level pressure	hPa	905.0	1060.0	21.0
Air temperature	°C	-14.0	40.0	11.0
Water temperature	°C	- 2.0	40.0	8.6
Wind speed	m/s	0.0	60.0	25.0
Significant wave height	m	0.0	15.0	6.0
Average wave period	s	1.95	26.0	31.0

Third, the wind gusts are checked by the following scheme. An expected gust-to-mean speed ratio, G, is calculated

$$G = 1 + 1/(1.98 - (1.89\, e^{-0.18\, g})) \qquad (2)$$

where g is the measured wind gust. The actual gust-to-mean speed ratio is then compared to the expected ratio. If the ratios disagree by more than a tolerance factor, the data are flagged as suspect. The tolerance factor is higher at low wind speeds where gustiness is more sporadic. Equation (2) was empirically obtained by Kaufman (1977).

Fourth, an elaborate algorithm was developed by NDBC to check the consistency between wind speeds and the energy in the wind-wave part of the sea spectrum (0.20 – 0.27 Hz). The algorithm was developed using regression to estimate the wave energy based on the average wind speed in the last 3 hours. The development sample consisted of 22 months of good data from a variety of NDBC buoys. If the observed wave energy between 0.20 and 0.27 Hz differs greatly from the estimated, the data are flagged, providing that the average wind speed is above 4 m/s and that the sea is building. Further details are available from NDBC.

Finally, NDBC developed a procedure to check that a sensor's output is not stuck. Eight consecutive hours of data are examined, and the data are flagged if they do not change by more than a certain tolerance.

Though all of the validation procedures detect sensor failures, several are most powerful. The duplicate sensor check is often the first to spot problems with anemometers and barometers. This is important because anemometers have the highest failure rate of any component installed in the field. Therefore, all NDBC stations have duplicate anemometers; many have duplicate barometers and air temperature sensors. The wind-wave algorithm is helpful in several situations. It can detect anemometer problems at a station with a single working anemometer. Also, it can detect low significant wave heights, usually caused by processing with the wrong set of coefficients.

After the data analysts review flagged data, they can produce a variety of computer graphics to help them distinguish between true sensor or system failures and legitimate data (Gilhousen, 1985). Time-series plots of multiple measurements from two nearby stations have proven to be a powerful tool. Surface observations from non-NDBC stations are also available for plotting (Gilhousen, 1987). Also, plotting measurements whose time variability are often highly correlated, such as temperature and wind direction, can help determine the legitimacy of the data. For example, rapid changes in air temperature on the Great Lakes are often related to wind shifts due to land-sea breezes and thunderstorm downdrafts.

A sample time-series plot is shown in Figure 1. Air temperatures measured by duplicate sensors on board a buoy stationed in Lake Superior, 45001, are plotted with air temperatures reported by a C-MAN station at Passage Island, Michigan, PILM4, located about 60 kilometers from 45001. The duplicate sensor check for 45001 air temperatures failed at 1400 UTC on November 26. The plot clearly shows that temperatures from PILM4 agree well with temperatures from the first sensor and that temperatures from the second sensor are substantially in error for about 30 hours. The cause of the failure appears to be a cracked thermistor shield, which allowed rain to reach the thermistor during the previous day. Then, after the wind increased, evaporative cooling caused the thermistor to act as a wet bulb. An equipment failure report was written instructing technicians to replace the thermistor (with its shield) on the next service visit. The status file on the IBM 4341 was sent instructions to withhold the release of data from this sensor, and air temperatures from the first sensor were archived.

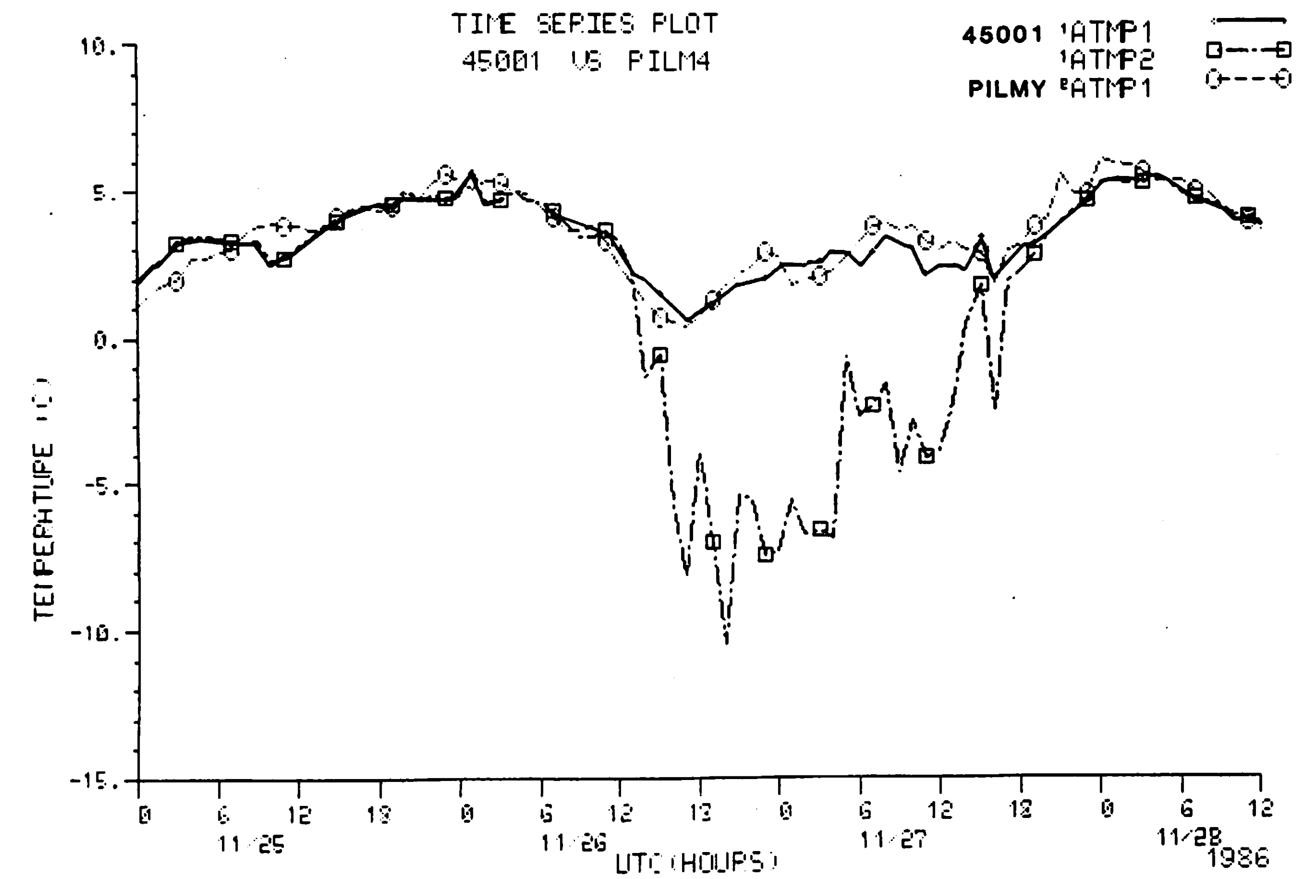


Figure 1. A time-series plot comparing duplicate air temperature sensors at buoy station 45001 in Lake Superior with air temperatures measured at a nearby C-MAN station, PILM4.

4.0 DRIFTING BUOY DATA PROBLEMS

Though extensive arrays of drifters were deployed for FGGE in 1978-1979 and beginning in 1985 for TOGA, no data quality effort was funded. Bad sea level pressures from drifters have, on occasion, wreaked havoc with analyses used for numerical weather prediction. One example is the analysis of 1200 UTC, October 22, 1986, performed by the U.S. Navy Fleet Numerical Oceanographic Center (FNOC) shown in Figure 2. A low pressure report from a drifter located between New Zealand and Australia resulted in an intense, small, low-pressure area. Six hours later, when no report was received from the drifter, no low-pressure area was produced and the analyzed pressures were about 14 hPa higher. This analysis is shown in Figure 3. Six months earlier, the U.S. National Meteorological Center (NMC) reported that a similarly erroneous report from a drifter east of Tahiti produced a ficticious easterly wave. Postanalysis showed that the pressures had been at least 10 hPa low for the previous 2 weeks.

Several other problems have been noted with drifting buoy data. One problem concerns position fixes transmitted on the Global Telecommunications System (GTS) from Local User Terminals (LUTs). These are less accurate than the fixes obtained by CLS Service Argos, frequently differing by several tenths of a degree latitude. Data from the same drifter are often transmitted on the GTS from both an LUT and Service Argos, then archived without recording its source. Oceanographers then have difficulty reconstructing the tracks. Occasionally, positions reported by LUTs are in gross error. Table 2 contains an example of reports from the same drifting buoy from duplicate sources. The observation times are within 10 minutes of each other. Positions differ by many degrees longitude. Sea level pressure observations are also given, and the reports transmitted by the Norwegian LUT are obviously in error. These large position errors are remarkable because many LUTs are capable of locating a buoy within 1 to 2 kilometers. Perhaps human error in entering the ephemeris data or encoding the DRIBU (real-time) message is an error source. It is also possible that LUTs attempt to assign a position based on an inadequate number of reports when the satellite is low on the horizon. These large errors occurred frequently enough that an FNOC meteorologist spent considerable time in diagnosing the problems. FNOC eventually decided to not use any data transmitted by several LUTs.

5.0 DRIFTING BUOY DATA QUALITY

Recognizing these quality control problems, NDBC will start to quality control North American drifting buoy reports that enter the GTS in Washington, DC. By "North American," I mean reports from drifters sponsored by North American countries, even though the buoys may be deployed in the Southern Hemisphere. These observations will be placed in DRIBU code by the U.S. Argos Processing Center and sent to the National Weather Service IBM 4341 computer complex. The approach used for quality control is similar to the one used for moored buoys. Gross checking will be performed in real time on the IBM 4341 before the data are disseminated on the GTS. More stringent checks will be performed at NDBC via a man-machine mix within the next 24 hours. When errors are identified, NDBC will update a status file on the IBM 4341 to subsequently remove bad data from GTS distribution. These unacceptable sensor data will be transmitted as slashes or missing groups depending on the coding convention. The "61616" group provided for data quality information in DRIBU will not be used.

Table 2. Concurrent reports from the same drifting buoy from duplicate sources revealing LUT position errors.

Drifter	Source	Latitude	Longitude	Pressure (hPa)
17807	S. African LUT	40°27'S	4°16'W	1019.3
	Argos	40°48'S	24°25'W	1019.4
25525	Canadian LUT	85°16'N	140°00'E	1031.4
	Norwegian LUT	85°22'N	127°32'E	950.0
25523	Canadian LUT	84°19'N	168°23'E	1032.8
	Norwegian LUT	85°31'N	161°00'E	950.0

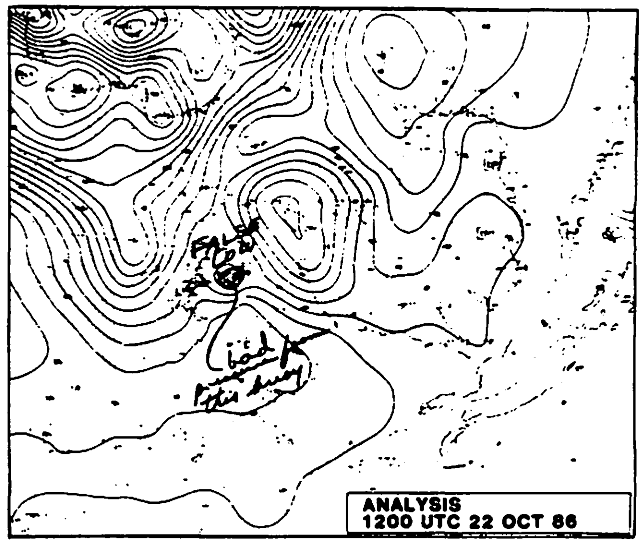


Figure 2. The FNOC analysis of sea level pressure at 1200 UTC on October 22, 1986. The small, low-pressure center between New Zealand and Australia resulted from a bad drifting buoy report.

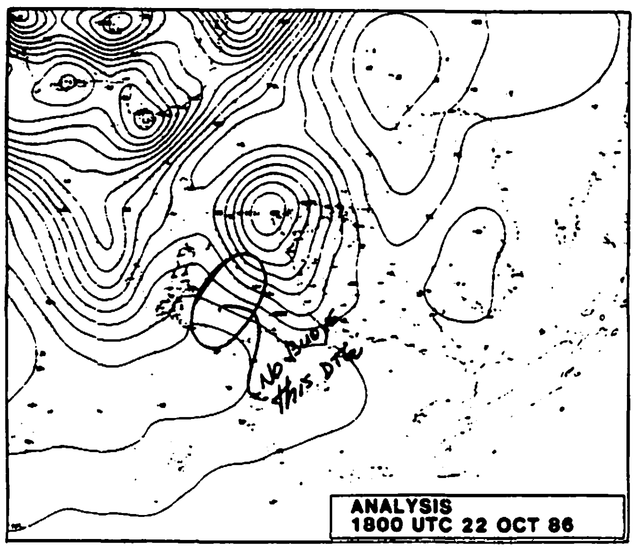


Figure 3. The FNOC analysis 6 hours later showing the removal of the spurious low.

Real-time quality control checks will consist of range and time-continuity checks for environmental measurements and an acceleration check to validate the position. The environmental measurements consist of sea level pressure, air temperature, water temperature, and wind speed and direction (though no drifters currently report wind). No time-continuity checks will be performed for wind direction. The functional form of the time-continuity check is the same for drifters as it is for moored buoys.

The limits and standard deviations (used for the time-continuity check) shall be data base entries for each station, which we can quickly change from NDBC. Drifters located outside tropical cyclone belts in high latitudes will have broader limits and higher standard deviations, like most of our moored buoys.

Accelerations will be computed in both the north-south and east-west directions to validate locations. Acceleration was chosen because locations that are slightly in error result in high accelerations. but may not result in high velocities. If the acceleration exceeds about 4 knots per hour (0.0006 m/s^2) in either component. that report will be removed from distribution and will not be used in subsequent acceleration computations.

If any drifters report subsurface temperatures. we will delete the section that contains them because we do not have the extensive water mass climatology needed to quality control them. However. subsurface temperatures will be passed to the National Ocean Service's Ocean Products Center who will quality control and disseminate the data.

At NDBC. additional validation efforts fall into two broad categories. First. more stringent range. acceleration. and time-continuity limits will be applied. Second. the observed pressures and temperatures will be compared to NMC analysis and "first guess" fields. Ponting and Sarson (1984) use a somewhat similar approach in comparing automatic weather station data to analysis data in the United Kingdom.

The range and time-continuity limits were provided by the National Climatic Data Center. They are the mean values plus and minus four standard deviations for each 2.5-degree. latitude-by-longitude cell and are based on their archive of ship data. Time continuity limits will be computed using equation 1 with the standard deviation set to 0.12 times the difference between the range limits. The position check will be identical to the one performed in real-time. but with a maximum acceleration of half the real-time limit.

The NMC sea level pressure. air and water temperature analysis fields valid at 0000 and 1200 UTC are being acquired for comparison with drifting buoy data. These fields are sent on a 2.5-degree-latitude by 5-degree-longitude grid. If a drifter observation time is within two hours of 0000 or 1200 UTC. a spatial interpolation will be performed on the relevant fields to obtain an analysis value at the drifter location. These analysis values will then be compared to the drifter observation.

One problem that clouds this comparison is that the analysis could be contaminated by a bad drifter observation. We plan to overcome this problem by using 12-hour forecasts from the previous model run as an alternate analysis field. This is somewhat analagous to using a "first guess" field. If a bad observation contaminated the surface analysis. 12 hours of model time would tend to reduce the error. On the other hand. a bad forecast could ruin the comparison. However. this is much less likely to occur and is primarily limited to areas of explosive cyclogenesis. Hard copies of both the analysis and forecast fields as well as drifter data will be plotted to help the analyst determine these errors. These forecasts are not available for sea surface temperature.

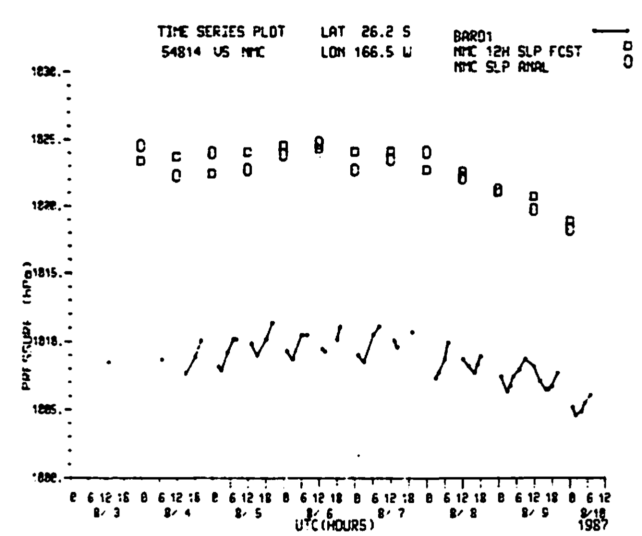


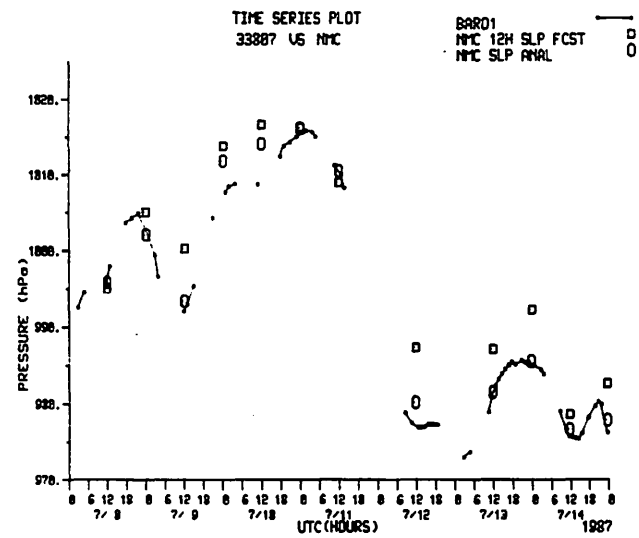
Figure 4. Sea level pressures reported by drifter 54814 are compared to NMC analyses and 12-hour forecasts.

6.0 EXPERIENCE IN USING NMC ANALYSIS FIELDS

Some failures are easy to detect by comparing the observations with analysis and short-range forecast values. One such failure is depicted in the time-series plot shown in Figure 4. The sea level pressure observed by 54814 is about 14 hPa lower than both the NMC 12-hour sea level pressure forecasts and analysis values.

Other less dramatic failures are more difficult to detect. especially in deep. low-pressure areas south of 40°S. The NMC fields are often too conservative. The pressures are top high in cyclones and too low in anticyclones. This is especially apparent in the 12-hour forecasts. The time-series plots. given in Figure 5. illustrate this point by comparing drifter 33807. located at 52°S. 69°E. with the NMC analysis and forecast values. These 5- to 10-hPa differences between the NMC values and the observations are typical of many drifters in this latitude. Clearly. individual differences would have to exceed 10 hPa to be flagged as suspicious.

Failures of magnitudes less than this would be detected by looking at statistical summaries or scatterplots showing these comparisons over at least a 2-week period. Figure 6 shows a scatterplot comparing the sea level pressure observation minus analysis versus the sea level pressure observation. Data plotted are from 22 selected



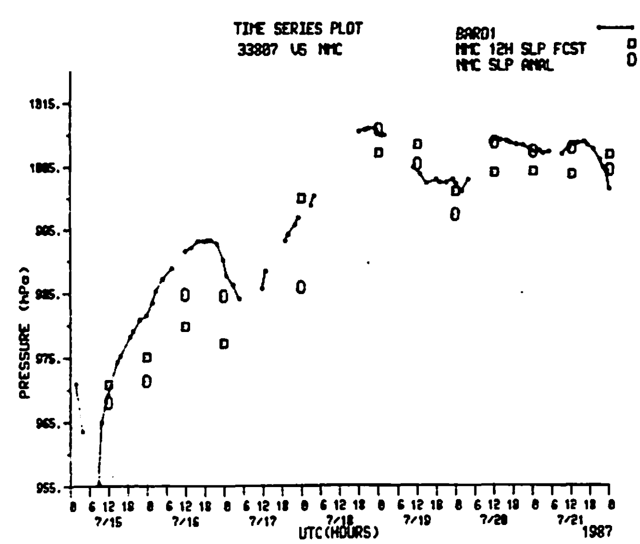


Figure 5. Sea level pressures reported by 33807 are compared to NMC analyses and 12-hour forecasts.

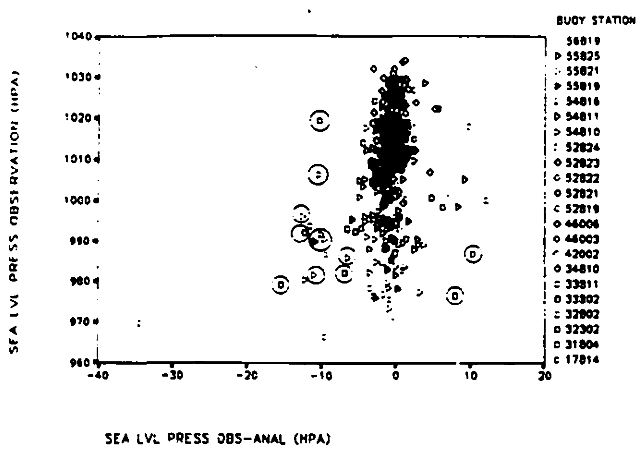


Figure 6. Sea level pressure observations minus analysis values plotted against the sea level pressure observation for 22 selected buoys during July 1987.

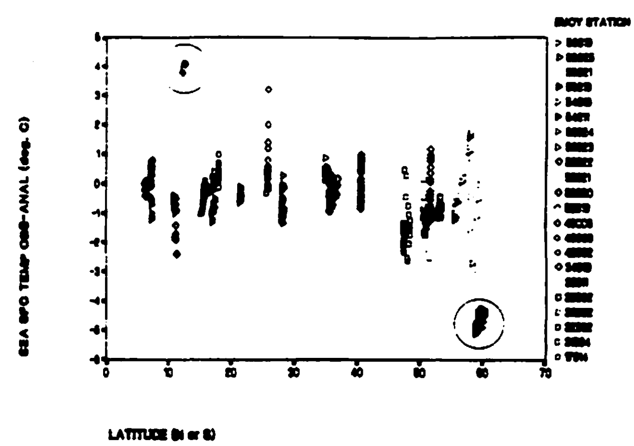


Figure 8. The sea surface temperature observation from 22 selected buoys minus the NMC analysis during July 1987.

buoys located in a variety of different latitudes in both hemispheres during 2 weeks of July 1987. The general pattern shows good agreement between the buoys and analysis values at high pressures and increasing scatter at low pressures. Two buoys. 54810 and 33802. have a large number of outliers. some of which are at higher pressures. Therefore. these drifters appear to be reporting erroneous pressures. The time-series plot shown in Figure 7 confirms that pressures reported by 54810 are 2 to 7 hPa higher than the NMC values. As a supplemental check. biases and root mean square error computed against "first guess" fields used at the European Centre for Medium Range Weather Forecasts are also sent to us monthly. The biases and RMS error for 54810 and 33802 were considerably higher than for most drifters.

Systematic biases in other measurements can be detected with these type graphics. Figure 8 shows a plot of sea surface temperature observations minus analysis values versus latitude. Two groups of outliers located in the upper left and lower right corner of the plot represent data from 52821 and 55825. Both drifters were reporting water temperatures beyond the range observed by ship data in the climatic atlases.

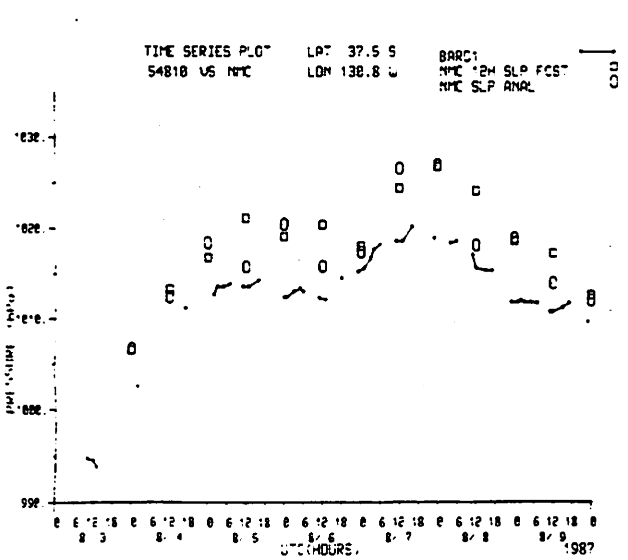


Figure 7. Sea level pressures reported by drifter 54810 are compared to the NMC analyses and forecast values.

Use of the NMC 1000-hPa air temperature analyses and forecasts posed a problem. The fields were not in good overall agreement with either the moored or drifting buoy observations. The analysis was 3.5°C warmer than the observations with a standard error of estimate of 1.8°C. The NOS OPC reports similar problems with this field and uses a diagnostic boundary layer model to provide an estimate of surface air temperature. Our solution was to use multiple regression to estimate the surface air temperature based on the 1000-hPa air temperature analyses. observed sea surface temperatures. and sea level pressures. Obviously erroneous data were discarded before developing the regression. The estimated temperatures had a standard error of estimate of 1.3°C.

Based on this experience we have established some comparison limits shown in Table 3. If the observation differs from the analysis by more than these limits. the data will be flagged for manual review.

Table 3. Limits used to compare drifting buoy measurements with NMS analyses.

	Comparison Limits		
Measurement	**Individual Comparison**	**Weekly Bias**	**Weekly Drift**
Sea level pressure	**4.0-10.0 hPa[1]**	**2.0 hPa**	**4.0 hPa**
Air temperature	**3.5°C**	**2.0°C**	**3.0°C**
Water temperature	**2.5°C**	**1.5°C**	**2.0°C**

[1]Varies with latitude and sea level pressure observation

7.0 SUMMARY

Though these data quality procedures are extensive. they were mostly an "after thought" in the system development process. NDBC started as an engineering development activity in 1970. but it wasn't until several buoys were deployed in 1975 that much thought was given to data monitoring. Similarly. with drifting buoys. extensive arrays were deployed in 1979 and 1985 before real-time quality control was planned. The data quality effort now involves three meteorologists. two data technicians. and two engineering analysts who work seven days per week. Considerable programming and computer operator support is needed.

Within the last few months. NDBC has started to quality control North American drifting buoy reports entering the GTS at Washington. DC. This quality control delays real-time dissemination by a maximum of 20 minutes. The quality-controlled data are transmitted under communications headers SSVX2 KWBC. SSVX6 KWBC. and SSVX8 KWBC. Data received under headers SSVX90 KDCA — SSVX99 KDCA contain DRIBU data originating at the U.S. Argos Processing Center that have not been quality controlled.

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In December, 1988, the NOAA Ocean Products Center (OPC), co-located with the National Meteorological Center (NMC), will begin real-time quality control for surface ship and drifting-buoy data. Observations will undergo automated routines to validate character format and platform call sign, test reports for valid ranges and internal consistency, provide time continuity checks, make comparisons with numerical forecast fields, and test for duplicate reports.

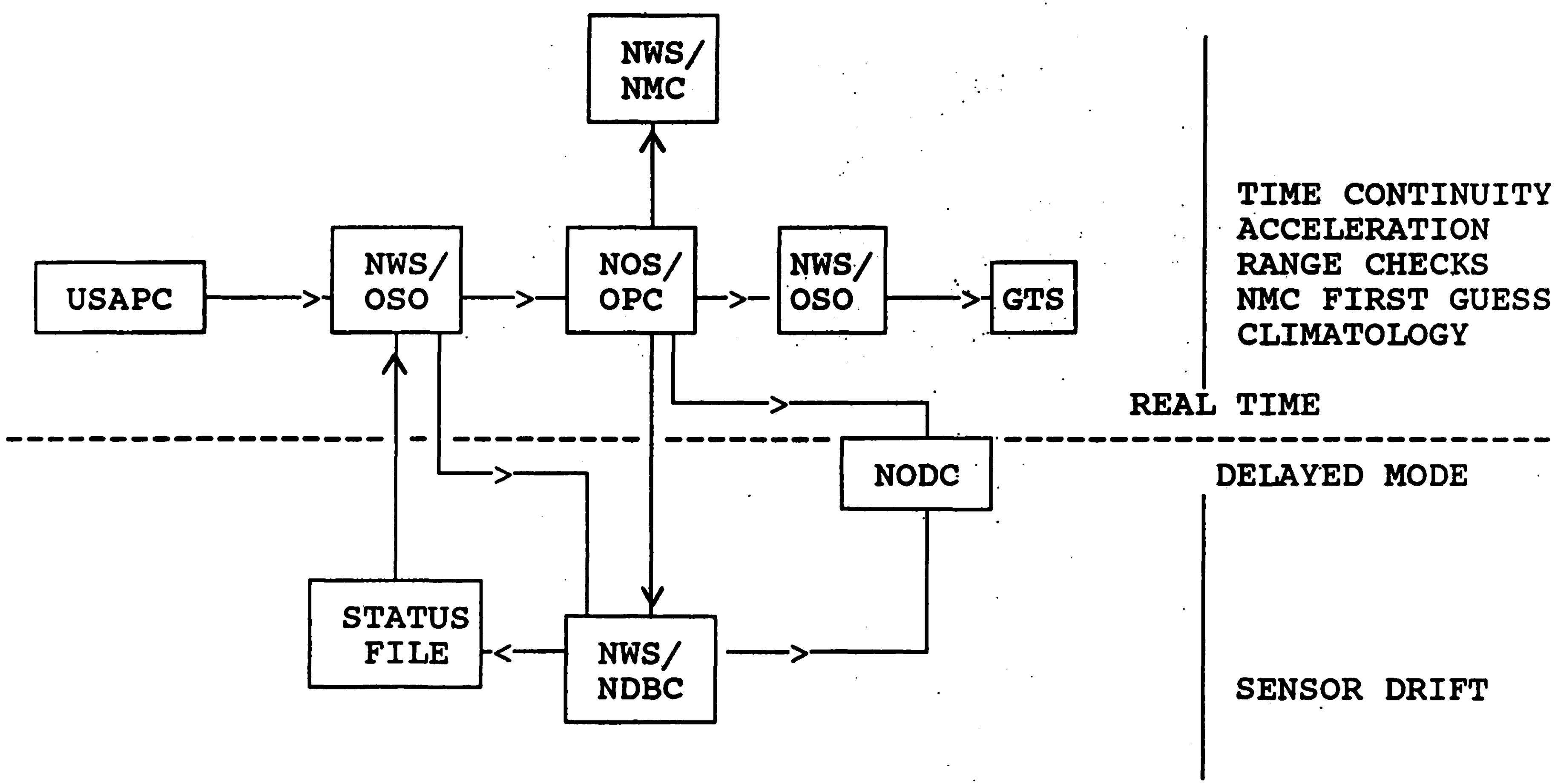
Observations which pass these automated tests will be routed to the GTS and numerical assimilation files without additional delay. Observations which fail the automated tests will be reviewed and subjected to more rigorous interactive tests by OPC meteorologists prior to GTS transmission or model assimilation.

The interactive procedures will be prioritized to maximize the utility of observations in data sparse areas first (typical regions where drifting buoys are deployed), and data rich areas (shipping lanes) last. Additional tests will be performed to ensure internal and time continuity, to compare observations with numerical forecast fields and neighboring observations (buddy check), and to ensure platform location/track consistency.

Final flags and any corrections will be applied by meteorologists. These flags/changes will be used in numerical data assimilation, for archiving at the appropriate data archive centres, and for platform management at NDBC. As BUFR becomes available for GTS use, "changes" and "flags" to observations will be encoded such that the original observation will be retrievable; in the mean time, only the corrected observation or the original with deleted elements will be available via GTS.

OPC will coordinate with NDBC to perform stringent, near-real-time quality checks. In this regard, NDBC will review all drifting-buoy data, as well as the error information provided by the OPC. NDBC meteorologists will consult with the OPC on the final determination of validity of the data. Also, NDBC will determine the cause of all erroneous data and will take corrective action, if appropriate.

FUTURE U. S. DRIFTING BUOY
QUALITY CONTROL PROCEDURES



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REVIEW OF USEFUL LIFETIMES OF DRIFTING BUOYS

1. There are many ways of estimating buoy lifetimes. Most studies are based on the experiences gained within a particular programme, or with a particular make of buoy. A global study should in theory be possible using data held at Argos, but this is not in a readily usable form, nor would it indicate the length of time that the buoy reported useful data.

2. The statistics published in the ECMWF monthly reports on the quality of DRIBU pressure observations were attractive for a number of reasons, although they were, unfortunately, only available as listings and had to be re-input manually prior to analysis. Advantages of this dataset included:

- Availability for the preceding 21 months,
- Inclusion of non-Argos DRIBU data circulating on the GTS,
- Indication of the duration of useful data from each platform,
- Listing of pressure quality statistics, thus permitting other studies.

Table 1 summarises the input data. Months for which the r.m.s. deviation of the platform observation from the ECMWF first-guess field was more than 5 hPa are marked by a '*'. There is a noticeable tendency for observation quality to be bad early in a platform's lifetime (prior to installation of correct calibration data at the processing centre), and also at the end of its life (prior to deletion from the GTS, battery failure, beaching, etc).

3. The average number of observations per day is shown in Figure 1, with most platforms reporting at least 6 times daily. Platforms at high latitudes, which are seen more frequently by the satellites, and those which additionally report via non-Argos LUTs, may produce up to 30 observations per day on the GTS.

4. Buoy lifetimes are more difficult to estimate as the sample window (21 months) is comparable with the expected lifetime. This gives misleading results as long-lived buoys are more likely to fall across either end of the sample window and so have their lifetimes under-estimated. Nonetheless the figures for all platforms (including fixed stations which may have external power sources) are shown in Figure 2; drifting buoys alone are shown in Figure 3. Although the figures should be regarded as minimum lifetimes, it can be seen at once that there is a high early mortality rate.

5. A potentially more accurate estimate was attempted by considering only those platforms whose lives fall entirely within the sample window, and by assuming a random distribution of deployment dates. For a lifetime L and a window of size W, the probability that the lifetime will cut a window boundary is L/W. Therefore, those lives which fall entirely within the window represent a fraction (1-L/W) of the total actually present with life L. This reasoning was used to derive the projected lifetimes given in Figure 4. It is seen that 50% of buoys fail in less than 100 days, but that nearly 20% exceed 300 days of GTS data. The mean lifetime is of the order of 165 days.

Table 1. GTS activity based on ECMWF monthly pressure statistics. Months where the r.m.s. error between the platform observation and the ECMWF first-guess field was greater than 5 hPa are marked '*'.

id	days	obs/day	87 88 jfmamjjasondjfmamjjas
14801	375	9.9	`-------------`
14802	405	9.5	`--------------`
15501	435	4.8	`---------------`
15502	375	4.6	`-------------`
15521	495	6.6	`*--------------*-`
15804	75	4.8	`-**`
15809	195	4.6	`-------`
15810	255	5.8	`            ---------`
16021	630	4.8	`*-**********---------`
16802	330	12.6	`  -----------`
16803	60	10.7	`             ---`
16804	15	22.2	`                    -`
16805	15	17.1	`                    -`
17001	45	17.1	`*-`
17002	255	10.1	`-----*-*-`
17003	195	5.2	`              ------*`
17011	480	1.3	`**********    -------`
17801	45	0.3	`-*`
17802	105	0.3	`-*-*`
17803	45	12.9	`--`
17804	135	3.7	`-----`
17806	435	11.1	`--*------------`
17807	435	10.4	`---------------`
17808	375	11.1	`-------------`
17809	495	4.9	`-----------------`
17810	435	10.8	`---------------`
17811	495	9.9	`-------*---*-----`
17812	555	9.3	`-------------------`
17813	525	7.9	`------------------`
17814	465	11.2	`*---------------`
17815	285	2.3	`           ------*---`
17816	285	9.2	`           ----------`
17817	285	10.7	`           ----------`
17818	15	10.9	`            -`
17819	255	6.9	`            ---------`
25501	45	0.2	`             *   *  *`
25502	225	16.1	`             ---*----`
25521	435	6.9	`*******--***---`
25522	555	4.4	`**------*----------`
25523	630	6.0	`*********----**------`
25524	630	5.9	`*********-**-*---*---`
25525	495	6.9	`********-------*-`
26521	255	15.6	`*****-***`
31804	285	2.6	`-*--------`
31805	195	6.8	`-------`
31806	285	4.8	`*---------`
31808	255	5.4	`---------`
31810	165	6.7	`               ------`
32801	630	9.4	`---------------------`
32802	525	9.3	`------------------`
32803	510	10.4	` ----*------------`
32804	90	6.4	` --**`
32805	330	9.7	` -------*****`
32806	585	10.7	` --------------------`
32807	435	6.7	`      ---------------`
32808	15	0.1	`  -`
32809	75	11.6	`---`
32810	105	9.0	`----`
32811	225	13.5	`             -------`
32812	225	10.9	`             --------`
32813	225	10.5	`             --------`
33801	435	5.5	`---------------`
33802	630	13.5	`---------------------`
33803	435	5.4	`---------------`
33804	585	11.6	` -*------------------`
33807	225	13.2	`-------*`
33808	15	0.1	`  -`
33809	165	16.7	`------`
33811	255	12.4	`-----*---`
33813	210	6.7	`------- -`
33814	465	9.7	`--*-------------`
33815	315	8.6	`          -----------`
33816	285	8.8	`           *---------`
33817	60	4.4	`           ---`
33818	285	6.7	`           ----------`
33819	285	6.2	`           ----------`
33820	90	10.2	`             ---*`
33821	225	11.9	`             --------`
33822	165	7.2	`               ------`
34807	195	8.9	`-------`
34808	165	14.0	`--*---`
34809	345	10.5	`------------`
34810	450	10.4	` --------------**`
34811	585	11.2	` --------------------`
34812	585	10.3	` ------*-------------`
34813	285	13.9	`           *---------`
34814	225	13.2	`             --------`
40503	15	0.1	`-`
40545	15	0.1	`-`
41509	30	0.1	`          -       -`
42502	15	14.8	`  *`
42504	60	11.8	`** *`
42506	150	7.0	`        ---   ----`
44515	15	1.7	`              -`
44516	15	1.9	`               -`
44517	15	5.6	`               -`
44518	45	13.3	`                   --`
44519	45	12.6	`                   --`
44603	225	19.2	`             -*------`
44604	75	16.6	`                  ---`
44611	45	0.3	`     -     *      -`
44612	360	23.4	`       -------------`
44622	15	0.1	`          *`
44676	15	0.1	`               *`
44705	15	1.7	`                    -`
44721	300	24.7	` -------*-*-`
44722	270	9.4	`       -*--**----`
44723	120	19.5	`       ---**`
44724	180	17.7	`        -*-***-`
44725	330	20.8	`        -*--*-----*-`
44726	315	21.0	`          --**-----*-`
44733	30	3.7	`             **`
44734	60	5.7	`             ---`
44741	165	19.5	`               ----*-`
44742	165	16.7	`               ----*-`
44747	15	0.1	`                -`
46665	165	12.8	`------`
46677	75	7.0	`---`
46683	540	4.4	` ------------------`
46685	30	16.0	`   --`
46688	465	4.9	`     ----------------`
46689	60	5.6	`         ---`
46690	30	4.5	`         --`
46691	60	9.6	`           **   --`
46694	105	7.4	`                 ----`
46695	75	3.7	`                  ---`
46696	15	7.5	`                    -`
46697	105	3.5	`                 ----`
46703	165	4.4	`               -----*`
46751	60	11.7	`          --*`
46752	15	0.3	`         -`
47501	15	0.1	`*`
47502	45	18.4	`**`
47503	180	13.2	`------              *`
47504	60	6.6	`     ---`
47505	225	6.8	`--*-----`
47507	180	1.3	`     ------       - -`
47508	300	3.4	`----------       -`
47509	105	3.7	`                 ----`
47510	105	3.5	`                 ----`
48511	45	12.1	`                   --`
48531	105	3.7	`                 ---*`
48532	45	5.9	`                   --`
48534	30	7.1	`                  --`
48540	345	3.6	`         ------------`
48545	315	3.9	`-----------`
48546	210	4.0	`     -*------`
48547	360	4.5	`     ------------*`
48548	210	5.0	`     --------`
48550	135	5.8	` *            -----`
48551	150	4.6	`           ------`
48552	90	6.9	`               ----`
52501	75	6.2	`                  ---`
52502	75	5.8	`                  ---`
52503	75	4.9	`                  ---`
52504	75	4.5	`                  ---`
52521	75	6.2	`                  ---`
52522	75	6.2	`                  ---`
52523	75	7.0	`                  ---`
52524	75	7.1	`                  ---`
52819	300	5.8	`     -----------`
52820	330	3.2	`     ------------`
52821	90	5.1	`     ----`
52822	150	4.1	`     ------`
52823	210	6.1	`     --------`
52824	180	5.3	`      -------`
53811	225	6.8	`          --------  -`
54803	375	11.3	`-------------`
54810	375	9.7	`-----********`
54811	315	5.9	`----------*`
54813	435	9.0	`---------------`
54814	375	4.9	`*************`
54815	450	7.3	`   ---------------`
54816	510	6.5	`  -----------------`
54817	330	5.1	`       -----------`
54818	405	5.3	`       --------------`
54819	315	6.7	`          --*--------`
54820	315	13.4	`          *----------`
54821	255	10.2	`            ---------`
54822	255	13.1	`            ---------`
54823	225	11.2	`             --------`
54824	225	9.5	`             --------`
54825	225	4.9	`             --------`
54826	225	7.1	`             --------`
54827	225	6.0	`             --------`
54828	165	9.0	`               ------`
55511	45	7.3	`                   --`
55531	630	10.8	`---------------------`
55532	630	8.5	`---------------------`
55533	630	13.3	`-*-------------------`
55537	15	6.9	`          -`
55540	75	14.6	`--*`
55545	225	13.1	`--------`
55547	285	6.6	`----------`
55548	195	8.1	`-------`
55550	285	4.1	`--*-------`
55551	585	8.4	`-----------------*--`
55552	300	4.9	`    -----------`
55553	375	4.7	`        -------------`
55554	105	6.4	`*---`
55555	300	5.4	`    -----------`
55556	315	5.1	`          ---*-------`
55558	75	5.7	`--             **`
55560	75	4.8	`--            **`
55571	60	5.2	`          ---`
55573	195	2.2	`              -------`
55574	30	0.2	`                  - -`
55575	105	6.1	`                 ----`
55576	15	0.5	`                   -`
55802	15	0.1	`*`
55816	165	3.8	`-----*`
55817	135	4.7	`-----`
55818	75	4.6	`-*-`
55819	195	4.0	`-------`
55821	225	16.7	`--------`
55822	285	7.8	`----------`
55823	255	10.0	`----*----`
55824	15	8.0	`-`
55825	555	11.5	`  **-*--------*------`
55826	150	4.2	`       ------`

Table 1 contd.

id	days	obs/day	87 88 jfmamjjasondjfmamjjas
55827	405	4.5	--------------
55828	285	9.8	----** -----
56503	75	8.1	---
56526	360	14.5	**---------**
56527	120	10.7	*****
56530	30	4.8	* *
56531	120	11.4	*****
56801	165	11.4	*-----
56805	315	5.2	- -***********
56806	375	7.9	-------------
56807	45	10.4	--
56808	375	10.8	-------------
56809	405	10.1	--*-----------
56810	45	17.2	--
56811	300	9.8	-----------
56813	45	6.4	--
56815	135	9.1	-----
56816	360	10.1	------------ -
56817	45	11.3	-*
56818	225	10.3	--------
56819	480	9.1	-----------------
56820	345	10.4	-----------*-
56821	345	13.0	-------------
56822	345	12.0	-------------
56823	195	16.5	-------
62004	90	4.9	----
62501	405	2.5	**-------------
62502	120	4.1	-----
62503	240	4.5	---------
62505	225	5.5	--------
62507	30	7.5	--
62508	45	5.5	--
62509	30	5.2	--
62510	30	4.9	--
62551	180	9.3	-------
62552	60	4.5	---
62591	45	8.5	**
62592	30	2.2	-*
62596	120	27.0	-----
62601	75	14.2	-- --
62603	60	4.0	***
62606	30	4.9	**
62607	60	3.6	--*
62608	60	4.5	--*
62609	15	8.9	-
62611	75	13.2	-- --
62612	60	3.0	--*
62614	30	4.7	-*
62615	135	9.0	-----
62616	75	15.1	-- --
62620	15	2.0	*
62621	15	7.6	-
62622	30	4.4	-*
62626	75	13.7	-- --
62627	60	3.2	--*
62629	60	3.3	--*
62630	30	4.2	-*
62631	60	3.1	--*
62632	30	3.6	**
62633	105	7.2	----
62634	60	2.6	--*
62635	60	3.0	***
62636	135	8.9	-----
62637	60	3.1	---
62638	135	8.7	-----
62639	135	9.2	-----
62643	15	1.2	*
62645	135	9.1	-----
62646	60	3.0	--*
62647	60	2.4	---
62648	15	5.7	-
62649	15	7.9	*
62650	90	3.1	*-**
62651	75	11.2	-- --
62654	30	0.7	--
62656	15	0.1	-
62661	135	9.0	-----
62663	15	0.4	-
62666	60	2.1	--*
62667	135	10.7	-----
62671	75	12.6	-- --
62672	135	8.8	-----
62673	15	1.3	*
62678	30	3.6	-*
62682	135	4.1	-----
62683	30	4.3	-*
62684	60	3.0	--*
62685	60	2.9	-**
62688	30	3.4	--
62690	15	1.1	-
62692	45	3.1	- --
62693	60	3.4	---
62696	30	5.9	-*
62697	30	0.8	--
62701	60	2.6	***
62702	75	14.0	-- --
62704	60	2.3	--*
62705	30	1.0	--
62710	15	0.7	-
62711	135	9.0	-----
62712	60	3.8	--*
62716	60	2.5	*-*
62722	90	2.9	--**
62724	60	3.1	*-*
62725	60	4.6	--*
62801	90	3.6	----
62802	60	11.8	- --
62803	15	1.9	-
63001	375	8.3	----*-*--****
63002	15	0.2	-
63004	60	0.2	* * --
63005	285	8.6	***-*-*-**
63014	15	0.3	-
63020	15	0.1	-
63503	255	6.8	---------*
63510	135	7.8	* --**-
63515	165	8.4	**--- -*
63525	15	0.1	-
63528	195	19.2	--***-*
63529	195	19.0	-*--**-
63530	60	7.2	** -
63531	75	12.8	* -**
63532	60	0.2	-- --
63533	45	11.6	-*
63534	60	1.4	---
63535	105	2.6	* ----
63536	15	6.3	*
63537	225	6.6	--*-----
63538	240	6.3	* --*-----
63539	75	2.4	- ---
63552	120	6.6	-----
63553	150	7.0	--**--
63554	195	5.2	----*-- *
64043	405	15.3	*---*-------*-*
64511	45	7.2	--
64512	15	15.3	*
64515	180	25.7	------*
64521	15	0.1	*
64522	45	7.1	* -*
64523	105	20.0	----
64524	15	0.4	*
64525	105	0.2	** ** **
64532	15	9.7	*
64533	195	13.3	-------
64535	60	6.4	---
64546	15	1.5	*
64547	60	19.9	---
64550	15	1.1	*
64560	225	28.3	-*------
64725	15	0.1	-
65503	15	2.3	*
65514	285	20.2	-----------
65561	285	22.7	----------*
65570	135	13.1	**--*
65571	240	16.2	-------**-
71001	465	14.9	*- --**-----------
71513	105	17.4	----
71514	105	20.6	----
71515	270	15.7	------- - ---
71516	315	13.4	**----- *----
71517	315	15.9	--*---- -----
71518	315	17.3	-*----* -----
71520	315	16.5	*------ *----
71521	15	22.5	*
71801	195	15.2	-------
71804	255	15.8	---------
72807	75	9.1	---
72808	75	20.2	-*-
72809	75	19.6	-*-
72810	75	20.4	---
72811	75	19.9	---
73651	75	13.3	-*-
73652	75	18.0	-*-
73655	75	19.7	---
74507	195	15.5	-------
74508	30	1.6	- *
74509	225	15.0	-------**
74510	255	13.7	--*-----**
74512	195	14.8	-------
74513	225	15.1	--------*
74514	225	14.2	------** **
74515	120	12.2	---* -
74516	195	15.1	-------
74517	195	11.3	-------
74807	210	14.7	--------

total ptts = 405   total obs = 679831

Figure 1

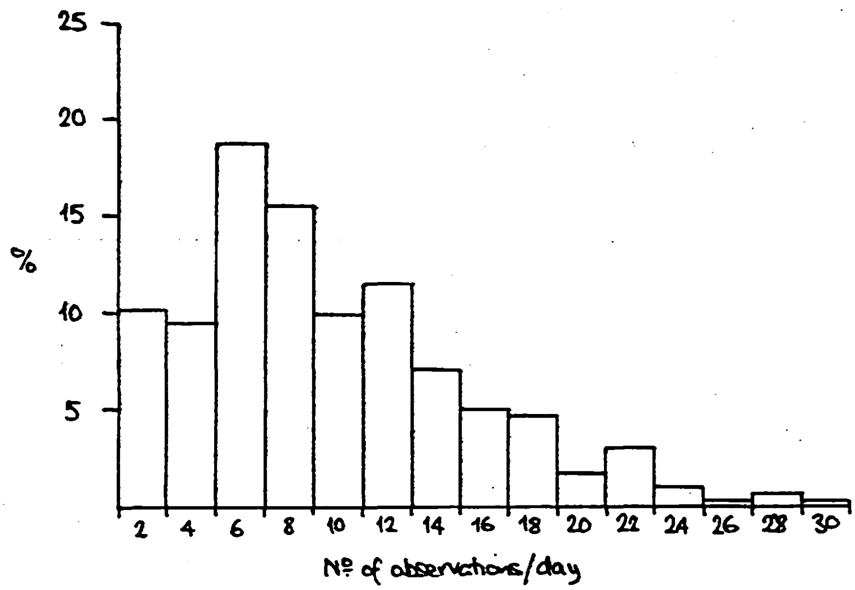


Figure 2

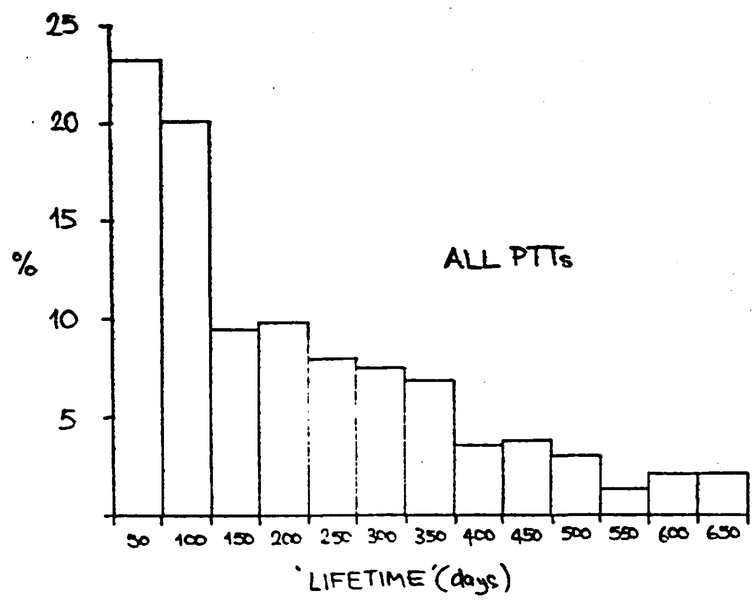


Figure 3

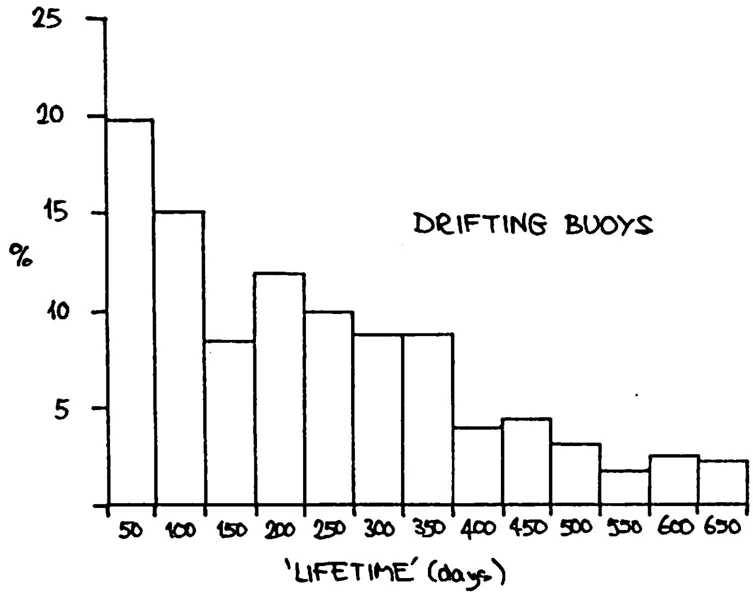
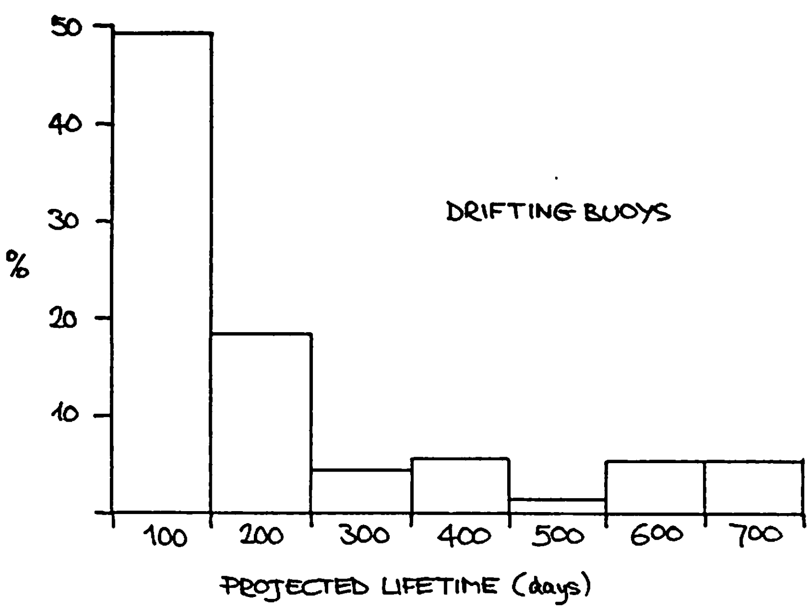


Figure 4



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PROPOSED LOGO FOR THE DRIFTING BUOY CO-OPERATION PANEL

DBCP

WMO / IOC