INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

WORLD METEOROLOGICAL ORGANIZATION

DATA BUOY CO-OPERATION PANEL

Annual Report for 1994

DBCP Technical Document No. 1

INTERGOVERNMENTAL OCEANOGRAPHIC
COMMISSION (OF UNESCO)

WORLD METEOROLOGICAL
ORGANIZATION

DATA BUOY CO-OPERATION PANEL

ANNUAL REPORT FOR 1994

DBCP Technical Document No. 1

1994

NOTE

TABLE OF CONTENTS

FOREWORD

I am pleased to present this 1994 Annual Report for the Data Buoy Co-operation Panel.

The work of the panel has continued at a high level. Two further action groups representing important programmes in data-sparse regions have been established and the quantity and quality of data increased steadily.

I give my sincere thanks to all those who have participated in the work of the panel and contributed to this eighth annual report.

Derek Painting
Chairman, DBCP

SUMMARY

Introduction

The Drifting Buoy Co-operation Panel (DBCP) was established in 1985 by WMO Resolution 10 (EC-XXXVII) and IOC Resolution EC-XIX.7. In 1993 the governing bodies of IOC and WMO agreed to change the name of the panel to Data Buoy Co-operation Panel (DBCP) and to slightly modify its terms of reference, so that the panel might also provide any international co-ordination required for moored buoy programmes supporting major WMO and IOC programmes (IOC Resolution XVII-6 and WMO Resolution 9 (EC-XLV)).

1. **Current and planned programmes**

Thirteen countries, two action groups and two data management centres submitted reports of their data buoy activities. Two programmes were established and adopted as **action groups of the panel** namely the International South Atlantic Buoy Programme (ISABP) and the WCRP International Programme for Antarctic Buoy (IPAB).

2. **Real-time data flow**

The number of buoys reporting in real-time continues to grow. By September 1994, 587 buoys (47.1% of the total operational buoys) were reporting on the GTS. Compared with the same period last year the total number of active buoys had decreased whereas the proportion reporting on GTS had significantly increased partly due to the increased flexibility of the new Argos GTS sub-processing system that was introduced in 1993.

Data reception delays through the Argos system increased slightly over the year largely through increases in the total number of platforms processed.

3. **Data quality**

The Omnet **Bulletin Board** Q/C system introduced by the panel was replaced by an Internet distribution list on 1 December 1994. This change was necessitated by the impending closure of the Omnet system on 31 December 1994.

4. **Data archival**

The Marine Environmental Data Service (MEDS) in Canada acts as the RNODC for drifting buoys on behalf of the IOC and WMO. MEDS archived approximately 95,000 buoy messages per month throughout the year. The IGOSS Specialised Oceanographic Centre for Drifting Buoys (SOC) operated by Météo France collects and archives buoy reports daily. Amongst the products produced by the French SOC are monthly global maps of the distribution of ship and drifter reports of wind, pressure, air temperature and sea surface temperature. These reports are included in the regular bi-monthly report of the DBCP technical co-ordinator.

5. **Technical developments**

The low cost SVP barometer (SVP-B) drifter developed in conjunction with the Global Drifter Centre at the Scripps Institution of Oceanography is now in commercial production. Operational deployments were made in the Southern Ocean and South Atlantic Ocean during the year.

The Panel has decided to implement a DBCP World Wide Web Internet server on a trial basis. The server will be implemented by NOAA/NOS and will permit exchange of a wide range of buoy information including quality control data.

6. **Communication system status**

The Argos system has provided a reliable service throughout for recovery and processing of drifting buoy real-time data. In addition many moored buoys report through the Meteosat GOES IDCS system. Interference on some IDCS channels continues to cause some data loss from moored buoys in the North-East Atlantic.

7. **Administrative matters**

The panel has now four action groups: the European Group on Ocean Stations (EGOS); the International Arctic Buoy Programme (IABP); the International Programme for Antarctic Buoys (IPAB) and the International South Atlantic Buoy Programme (ISABP).

Countries contributing on a voluntary basis to the financial support of the panel in 1994 were: Australia, Canada, France, Greece, Iceland, Ireland, Netherlands, Norway, United Kingdom and USA.

The panel's technical co-ordinator, Mr Etienne Charpentier, has continued to be employed by UNESCO/IOC as a **fund-in-trust** expert and located with CLS/Service Argos in Toulouse, France.

For the panel's next financial year (1 June 1995 to 31 May 1996), a total budget of US$ 144,300.- is planned to be allocated as follows:

	US$
IOC salary of technical co-ordinator	90,000.-
Travel of technical co-ordinator	15,000.-
CLS/Service Argos contract	15,000.-
WMO costs	300.-
Travel of chairman and publications	15,000.-
Contingencies	9,000.-
	144,300.-

RÉSUMÉ

Introduction

Le Groupe de coopération pour la mise en oeuvre des programmes de bouées dérivantes (DBCP) a été créé en 1985 en vertu de la résolution 10 du Conseil exécutif de l'OMM (EC-XXXVII) et de la résolution EC-XIX.7 du Conseil exécutif de la COI. En 1993, les organes directeurs de la COI et de l'OMM ont décidé de rebaptiser le groupe "Groupe de coopération pour les programmes de bouées de mesure" (DBCP) et d'en modifier légèrement le mandat afin qu'il puisse également assurer la coordination internationale nécessaire à la mise en oeuvre des programmes de bouées ancrées qui sont au service des grands programmes de la COI et de l'OMM (voir résolution XVII-6 de la COI et résolution 9 (EC-XLV) de l'OMM).

1. **Programmes en cours et prévus**

Treize pays, deux groupes d'action autonomes et deux centres de gestion des données ont présenté des rapports concernant leurs activités de collecte de données à partir de bouées de mesure. Deux programmes ont été établis et adoptés en tant que groupes d'action du DBCP à savoir le Programme international de bouées dans l'Atlantique Sud (ISABP) et le Programme international de bouées dans l'Atlantique (IPAB), qui relève du PMRC.

2. **Flux de données en temps réel**

Le nombre de bouées qui transmettent leurs données en temps réel continue d'augmenter. En septembre 1994, 587 bouées (soit 47,1% des bouées opérationnelles) transmettaient leurs données sur le SMT. Le nombre total de bouées en service avait diminué par rapport à la même période l'année précédente alors que le pourcentage de bouées transmettant sur le SMT s'était nettement accru en raison de la plus grande souplesse du nouveau système de traitement des données ARGOS transmises sur le SMT, instauré en 1993.

Les délais de communication des données par l'intermédiaire du système ARGOS ont légèrement augmenté dans le courant de l'année, essentiellement en raison de l'accroissement du nombre de plates-formes.

3. **Qualité des données**

Le Groupe avait instauré un système de contrôle de la qualité des données via un panneau d'affichage, sur le réseau OMNET. Ce système a été remplacé le 1er décembre 1994 par une liste de destinataires sur le réseau INTERNET, vu que la fermeture du réseau OMNET était prévu pour le 31 décembre de cette même année.

4. **Archivage des données**

Le Service de données sur l'environnement marin (MEDS), au Canada, fait office de CNDOR chargé des bouées dérivantes au nom de la COI et de l'OMM. Ce service a archivé mensuellement quelque 95 000 messages de bouées tout au long de l'année. Le centre océanographique spécialisé (SOC) dans les bouées dérivantes, exploité par Météo-France dans le cadre du SMISO, reçoit et archive tous les jours des messages de bouées. Parmi les produits élaborés par ce centre, on peut citer les cartes mensuelles de la répartition, à l'échelle du globe, des messages de navires et de bouées

dérivantes portant sur le vent, la pression, la température de l'air et la température de surface de la mer. Ces messages sont incorporés dans le compte rendu bimestriel établi par le coordonnateur technique du DBCP.

5. **Réalisations techniques**

Le nouveau flotteur dérivant peu coûteux doté d'un capteur de pression destiné au Programme concernant la vitesse des courants en surface, qui a été mis au point en collaboration avec le Centre mondial des bouées dérivantes à l'Institut Scripps d'océanographie, est entré dans sa phase de commercialisation. Des mises à l'eau ont été effectuées en 1994 dans l'océan Antarctique et dans l'Atlantique Sud.

Le Groupe a décidé de mettre en place à titre d'essai un serveur Internet World Wide Web. Ce serveur sera exploité par le National Ocean Service de la NOAA et permettra l'échange d'un large éventail de renseignements concernant les bouées et notamment les contrôles de qualité.

6. **Etat du système de communication**

Le Service ARGOS s'est révélé fiable tout au long de l'année s'agissant de la collecte et du traitement en temps réel des données de bouées dérivantes. En outre, de nombreuses bouées ancrées transmettent leurs données via le système IDCS du satellite GOES de METEOSAT. Des interférences sur certaines voies de transmission de ce système continuent d'empêcher certaines données provenant de bouées ancrées dans le nord-est de l'Atlantique d'arriver à destination.

7. **Questions administratives**

Le Groupe comprend désormais quatre groupes d'action : le Groupe européen sur les stations océaniques (EGOS), le Programme international de bouées dans l'Arctique (IABP), le Programme international de bouées dans l'Antarctique (IPAB) et le Programme international de bouées dans l'Atlantique Sud (ISABP).

Les pays qui ont contribué volontairement au financement du Groupe en 1994 sont : l'Australie, le Canada, les Etats-Unis, la France, la Grèce, l'Irlande, l'Islande, la Norvège, les Pays-Bas et le Royaume-Uni.

Le coordonnateur technique du Groupe, M. Etienne Charpentier, est employé par l'UNESCO/COI à titre d'expert financé sur des fonds-en-dépôt, au CLS/Service Argos à Toulouse (France).

Pour le prochain exercice financier (1er juin 1995 - 31 mai 1996), un budget total de 144 300 dollars est prévu qui devrait être réparti comme suit :

	$
Traitement COI du coordonnateur technique	90 000
Voyages du coordonnateur technique	15 000
Contrat CLS/Service ARGOS	15 000
Dépenses OMM	300
Voyages du président et publications	15 000
Dépenses imprévues	9 000
	144 300

РЕЗЮМЕ

ВВЕДЕНИЕ

Группа экспертов по сотрудничеству в области программ по дрейфующим буям (ГЭСДБ) была учреждена в 1985 г. резолюцией ВМО 10 (ИС-XXXVII) и резолюцией МОК ИС-XIX.7. В 1993 г. руководящие органы МОК и ВМО решили изменить название группы, которая стала называться Группой сотрудничества по буям для сбора данных (ГСДБ) и решили также изменить в незначительной степени круг ее обязанностей, с тем чтобы она также могла обеспечивать любую необходимую международную координацию для программ по заякоренным буям, поддерживающим основные программы ВМО и МОК (резолюция МОК XVII-6 и резолюция ВМО 9 (ИС-XLV)).

1. Текущие и запланированные программы

Тринадцать стран, две группы действий и два центра по управлению данными представили отчеты по своей деятельности, связанной с буями для сбора данных. Были приняты две программы и, соответственно, учреждены две группы по осуществлению, а именно Программа по дрейфующим буям в Южной Атлантике (ИСАБП) и Программа ВМО по антарктическим буям (ИПАБ).

2. Поток данных в реальном масштабе времени

Количество буев, передающих данные в реальном масштабе времени, продолжает возрастать. К сентябрю 1994 г. 587 буев (47,1% от общего количества оперативных буев) передавали данные в ГСТ. По сравнению с тем же периодом прошлого года, общее количество активных буев уменьшилось, в то время как часть их, передающих данные в ГСТ, значительно увеличилась, частично в связи с повысившейся гибкостью новой подсистемы обработки Аргос ГСТ, которая была введена в 1993 г.

Задержки в получении данных через систему Аргос несколько увеличились в течение года, главным образом за счет увеличения общего количества платформ, по которым обрабатываются данные.

3. Качество данных

"Информационный бюллетень" системы контроля качества в рамках сети Омнет, введенный группой экспертов, был заменен 1 декабря 1994 г. перечнем адресатов для распространения информации о контроле качества в рамках сети Интернет по запросу. Это изменение было обусловлено ожидающимся закрытием системы Омнет 31 декабря 1994 г.

4. Архивация данных

Служба данных о морской среде (МЕДС) в Канаде выступает в качестве ОНЦОД по дрейфующим буям от имени МОК и ВМО. МЕДС архивировала в месяц в течение года приблизительно 95 000 сообщений с данными по буям. Специализированный океанографический центр ОГСОС по дрейфующим буям (СОЦ), эксплуатируемый МетеоФранс, собирает и архивирует ежедневные сводки по буям. Продукция, производимая французским СОЦ, помимо прочего, включает в себя ежемесячные глобальные карты распространения сводок с судов и дрейфующих буев с данными по ветру, давлению, температуре воздуха и температуре поверхности моря. Эти сводки включаются в регулярный отчет технического координатора по ГСДБ, который выходит раз в два месяца.

5. Технические аспекты деятельности

Недорогой дрейфующий буй для установки СВП-барометра (СВП-Б), разработанный совместно с Глобальным центром по дрефующим буям в Скрипсоновском институте океанографии, в настоящее время запущен в серийное производство. Оперативные установки таких буев были произведены в Южном океане и в южной части Атлантического океана в течение года.

Группа экспертов приняла решение о внедрении на экспериментальной основе работающего для всемирной сети Интернет процессора ГСДБ. Этот процессор будет внедряться НОС/НУОА и позволит обеспечивать обмен широким кругом информации по буям, включая данные о контроле качества.

6. Состояние системы связи

Система Аргос предоставляла надежное обслуживание, обеспечивая выборку и обработку данных по дрейфующим буям в реальном масштабе времени. Помимо этого, многие заякоренные буи передают сводки через систему МССД МЕТЕОСАТ ГОЕС. Интерференция на некоторых каналах МССД продолжает приводить к потере некоторого количества данных по заякоренным буям в северо-восточной части Атлантики.

7. Административные вопросы

Группа экспертов в настоящее время располагает четырьмя группами действий: Европейская группа по океанским станциям (ЕГОС); группа по Международной программе по буям в Арктике (ИАБП); группа по Международной программе по буям для Антарктики (ИПАБ) и группа по Международной программе по буям для Южной Атлантики (ИСАБП).

Следующие страны оказали в 1994 г. финансовую поддержку группе на добровольной основе: Австралия, Канада, Франция, Греция, Исландия, Ирландия, Нидерланды, Норвегия, Соединенное Королевство и США.

Технический координатор группы г-н Етьен Шарпантье по-прежнему работал в качестве эксперта целевого фонда ЮНЕСКО/МОК и находился в КЛС/Службе Аргос в Тулузе, Франция.

В следующем финансовом году (1 июня 1995 г. - 31 мая 1996 г.) предполагается использовать бюджет группы в размере 144 300 долл. США следующим образом:

	долл. США
Оклад технического координатора МОК	90 000,00
Оплата проезда технического координатора	15 000,00
Контракт с КЛС/Службой Аргос	15 000,00
Расходы ВМО	300,00
Проезд председателя и публикации	15 000,00
Непредвиденные расходы	9 000,00
	144 300,00

RESUMEN

INTRODUCCIÓN

El Grupo de Cooperación sobre Boyas a la Deriva (DBCP) se creó en 1985 por la Resolución 10 (EC-XXXVII) de la OMM y la Resolución EC-XIX.7 de la COI. En 1993, los órganos de gobierno de la COI y de la OMM acordaron cambiar el nombre del grupo por el de Grupo de Cooperación sobre Boyas de Acopio de Datos (GCBD) y modificar ligeramente su mandato, de manera que el Grupo pudiera proporcionar también la coordinación internacional necesaria para los programas de boyas fondeadas que sirven de apoyo a los principales programas de la OMM y de la COI (Resolución XVII-6 de la COI y Resolución 9 (EC-XLV) de la OMM).

1. Programas actuales y previstos

Trece países, dos grupos de acción y dos centros de gestión de datos presentaron informes sobre sus actividades en materia de boyas de datos. Se establecieron dos programas, que se adoptaron como grupos de acción del Grupo, a saber, el Programa de Boyas a la Deriva del Atlántico Sur (PIBAS) y el Programa de Boyas del Antártico (PIBA) del PMIC.

2. Flujo de datos en tiempo real

El número de boyas que informan en tiempo real sigue creciendo. En septiembre de 1994 informaban por el SMT 587 boyas (47,1% de las boyas operativas totales). En comparación con el mismo período del año pasado, el número total de boyas activas había disminuido, en tanto que la proporción de las que informan por el SMT había aumentado considerablemente, debido en parte a la mayor flexibilidad del nuevo sistema de subproceso del SMT Argos introducido en 1993.

Las demoras en la recepción de datos a través del sistema Argos aumentaron ligeramente durante el año, debido en gran medida al incremento del número total de plataformas procesadas.

3. Calidad de los datos

El sistema de control de calidad por "Boletín Informatizado" Omnet introducido por el Grupo se sustituyó por una lista de distribución de Internet, el 1 de diciembre de 1994. Este cambio era necesario ante el inminente cierre del sistema Omnet, el 31 de diciembre de 1994.

4. Archivado de datos

El Servicio de Datos sobre el Medio Marino, (MEDS) de Canadá actúa como Centro nacional responsable de datos oceanográficos para las boyas a la deriva en nombre de la COI y de la OMM. El MEDS archivó unos 95.000 mensajes de boyas mensuales durante el año. El Centro Oceanográfico Especializado (COE) de Boyas a la Deriva del SGISO, operado por Météo France, reúne y archiva diariamente informes sobre boyas. Entre los productos producidos por el COE francés figuran mapas mundiales mensuales de la distribución de informes de buques y derivadores sobre viento, presión, temperatura del aire y temperatura en la superficie del mar. Esos informes se incluyen en el informe quincenal regular del coordinador técnico del GCBD.

5. Evolución técnica

El derivador del barómetro SVP (SVP-B) económico desarrollado con el Centro Mundial de Derivadores en el Instituto Oceanográfico de Scripps se fabrica ya con fines comerciales. Durante el año se hicieron despliegues operativos en el Mar del Sur y en el sur del océano Atlántico.

El Grupo ha decidido poner en práctica un servidor Internet de la red mundial del GCBD con carácter experimental. El servidor será operado por NOAA/NOS, y permitirá el intercambio de una amplia gama de información sobre boyas, incluidos datos de control de calidad.

6. Situación del sistema de comunicaciones

El sistema Argos ha proporcionado un servicio fiable y completo para la recuperación y el proceso de datos de boyas a la deriva en tiempo real. Además, numerosas boyas fondeadas informan a través del sistema internacional de acopio de datos GOES de Meteosat. La interferencia en algunos canales de dicho sistema sigue originando algunas pérdidas de datos procedentes de boyas fondeadas al NE del Atlántico.

7. Cuestiones administrativas

El Grupo tiene ahora cuatro grupos de acción: el Grupo Europeo sobre Estaciones Oceánicas (EGOS), el Programa Internacional de Boyas en el Ártico (PIBA), el Programa Internacional de Boyas en el Antártico (PIBAn) y el Programa Internacional de Boyas en el Atlántico Sur (PIBAS).

Los países que contribuyeron con carácter voluntario al apoyo financiero del Grupo en 1994 fueron: Australia, Canadá, Francia, Grecia, Islandia, Irlanda, Países Bajos, Noruega, Reino Unido y Estados Unidos.

La UNESCO/COI han seguido empleando al coordinador técnico del Grupo, Sr. Etienne Charpentier, como experto del **fondo fiduciario**, destinado en el CLS/Servicio Argos de Toulouse, Francia.

Para el próximo ejercicio financiero del Grupo (1 de junio de 1995 a 31 de mayo de 1996), está previsto un presupuesto total de 144.300 $ EE.UU., distribuido como sigue:

	$ EE.UU.
Sueldo del coordinador técnico de la COI	90.000,-
Viaje del coordinador técnico	15.000,-
Contrato CLS/Servicio Argos	15.000,-
Costos de la OMM	300,-
Viajes del Presidente y publicaciones	15.000,-
Gastos varios	9.000,-
	144.300,-

REPORT

1. CURRENT AND PLANNED PROGRAMMES

Reports on national and international data buoy programmes are attached as Annexes I and II and reports on data management centres as Annex III.

2. REAL-TIME DATA FLOW

2.1 Number of boys reporting over the Global Telecommunication System (GTS)

During September 1994, data from a total of 1246 buoys were collected and processed at the Argos Global Processing Centres of Toulouse, France, and Landover, Maryland, USA, for distribution in real-time and deferred-time to the respective Principal Investigators. These buoys were operated by eighteen countries. A detailed breakdown by organization/country is given in Annex IV. At the same time, in 1993, the equivalent number of buoys was 1269.

Some 47% (587) of the 1246 buoys transmit their data over the GTS in real- or quasi real-time. Compared to last year, the total number of buoys operational decreased but the proportion of these reporting on the GTS increased.

The graph in Annex IV, page 3, shows the total number of drifting buoys per country. It also gives the percentage of those buoys that were reporting to the GTS during the week ending 2 September 1994. Annex V indicates, by Marsden square, the number of reports received at RTH Toulouse during December 1994.

Since February 1994 Météo-France has produced data availability index maps on a monthly basis in order to identify data sparse ocean areas for each kind of geophysical variable and therefore to assist the various data buoy programmes in adjusting deployment strategies. They are now producing the maps routinely. The June 1994 set is shown in Annex III, figure 8. Each map takes the Marsden square areas into account, includes SHIP and DRIFTER (***replaced by BUOY on 2 November 1994, 00.00 UTC***) reports, and is for a single geophysical variable only. Maps are produced for air pressure, air temperature, sea surface temperature and wind. The top number printed in each square is an index which is representative of how the requirements (WWW, WCRP or GOOS) are met: an index of 100 means that an average of eight observations per day per five hundred km area has been received during the month. In addition, the percentage of DRIFTER/BUOY reports from the total of SHIP plus DRIFTER/BUOY reports received is printed below the index number in each square.

2.2 Data reception

The Argos Global Processing Centres (GPCs) in Toulouse and Landover both receive real-time and delayed-mode data from the ground stations in Fairbanks, Wallops Island and Lannion. There were no significant changes introduced into the Argos processing system during 1994, hence data reception performance was similar to 1993.

Roughly 60% of Argos platforms are within the real-time coverage of Fairbanks, Wallops Island and Lannion. For these platforms over 90% of the reports are provided in under one hour (see Figure 1). For the other 40% of the transmitters, 70% of the data are available to the users within three hours (see Figure 2).

Figure 1 - Real-time coverage

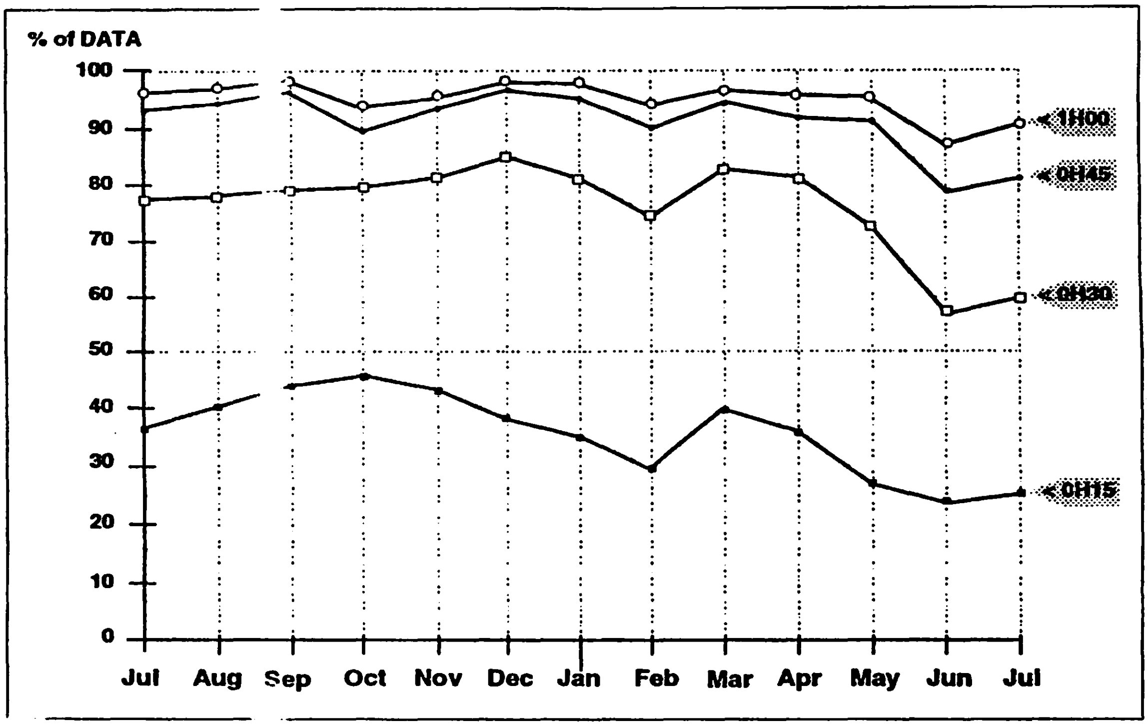
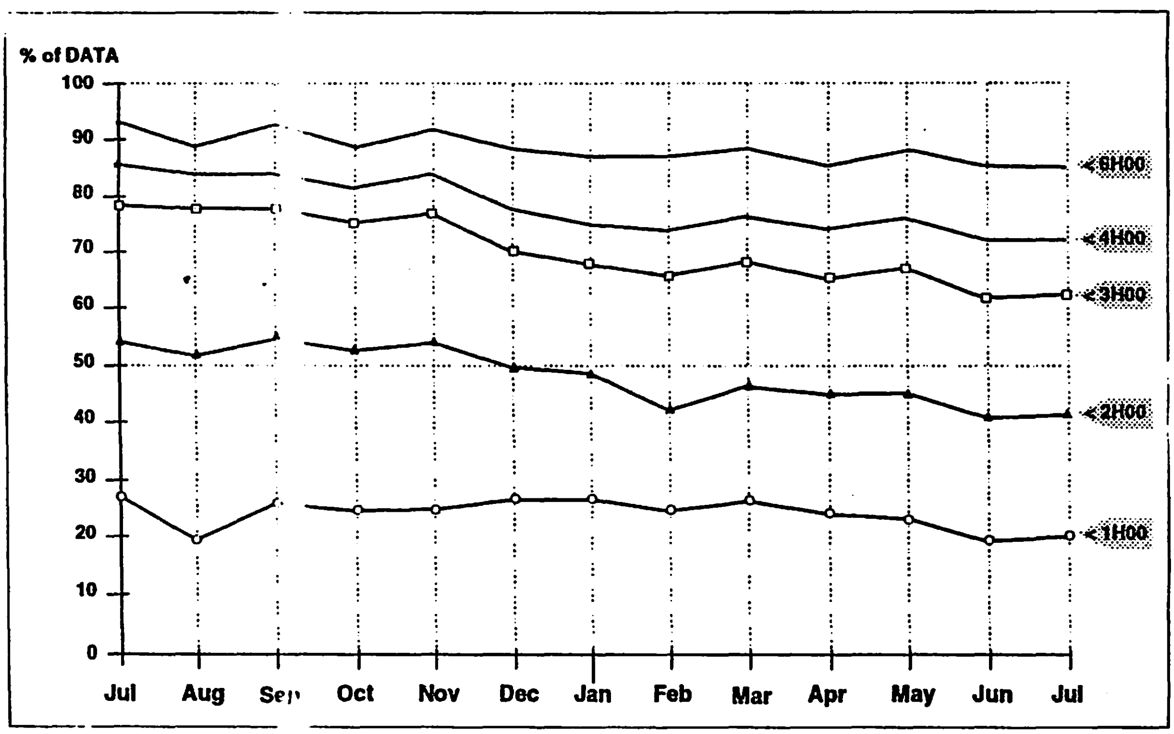


Figure 2 - Global coverage



3. DATA QUALITY

One of the principal aims of the panel is to encourage operators of drifting buoys and users of buoy data to improve the quality of data at source and through the processing chain.

The statistics gathered throughout the year show the improvement in quality of surface pressure data disseminated over the GTS noted last year has been maintained and mean RMS differences of the data compared with ECMWF analyses have stabilized at around 1.6 hPa (see Annex VI).

It is probable that improvement in data quality was, in part, due to the introduction of new quality control guidelines, which were implemented on 1 January 1992 by the DBCP in order to rationalize and speed up the status change process for buoys reporting bad data on the GTS. These were based on an electronic bulletin board where the principal meteorological or oceanographic centres responsible for GTS buoy data quality control (PMOC) could deposit status change proposals. The proposals were then forwarded by the technical co-ordinator of the DBCP to the owner of the buoys, or designated principal GTS co-ordinator (PGC), who could, in turn, request Service Argos to implement the required change. The technical co-ordinator showed that the guidelines had been very effective since implementation. For the period July 1993 to June 1994 for a total of 1267 buoys that reported on the GTS, 517 status change proposals were posted by the various PMOCs and these led to actual status modifications for 181 buoys. The following meteorological centres acted as PMOCs: Bureau of Meteorology (Australia), European Centre for Medium Range Weather Forecasts, Centre de météorologie marine (France), Japan Meteorological Agency (Japan), Meteorological Service (New Zealand), National Data Buoy Centre (USA), Ocean Products Center (USA) and Meteorological Office (United Kingdom). The South African Weather Bureau had also offered to act as a PMOC.

At its tenth session, the DBCP decided to implement an Internet distribution list from 1 December 1994, as Omnet disappeared on 31 December 1994, and amended QC guidelines accordingly (see Annex VII). The panel also decided to establish a DBCP world wide web Internet server on a trial basis. The server will be implemented at the NOAA/NOS and will permit the exchange of all types of buoy information among buoy users.

4. DATA ARCHIVAL

The Marine Environmental Data Service (MEDS) in Canada became a Responsible National Oceanographic Data Centre (RNODC) for drifting buoy data on behalf of IOC and WMO in January 1986.

During the 19-month period (January 1993 to July 1994), MEDS received a total of 1,846, 818 messages transmitted from drifting buoy platforms sending their data through the GTS (an average of 97,201 messages per month). The average number of messages per month (95,731) for the first seven months in 1994 has decreased by 2.4% from the 1993 monthly average, which shows that slightly less data are being reported by drifting buoys.

The average number of buoys reporting on the GTS (according to Argos statistics) has decreased from 1,137 in 1993 to 1,096 in 1994, more than a 3% drop. The percentage of data which MEDS receives through the GTS has also decreased as shown in Annex III, page 4. When compared to previous years, there is still a small upward trend but the last few months statistics indicate a below "normal" situation.

Since the FGGE programme, and since January 1986, when MEDS became the RNOC for drifting buoy data, the archive has grown constantly. It now contains a total of 7,783,285 messages from 48,960 different buoy-months of which close to 80% has passed MEDS critical quality control procedures.

MEDS issues an annual report summarizing the data received and processed during the previous year and showing the locations of the buoys. Every month, global maps are issued displaying the location for the buoys reporting over the GTS (see Annex VIII). In addition, MEDS also deliver data for a user specified area, time and range of buoys on computer magnetic tape in GF-3 format. If the volume of data requested is small enough, it can be obtained on computer diskette (5¼- or 3½-inch). If the volume is too large, the data can be copied onto Exabyte cartridge or can be transmitted through Internet via anonymous FTP. Displays of buoy tracks are also available for any ocean area and time-frame. The MEDS monthly DRIBU/DRIFTER/BUOY track chart is also published in the IOC/WMO IGOSS Products Bulletin quarterly publication.

MEDS had completed the development and installation of a computer file containing information about the operators of the buoys as well as the programme under which the buoy has been deployed. Other information, such as the programme manager or organization and characteristics of the buoy are also kept if this information is made available to MEDS.

MEDS has developed an archiving mechanism for the Drifting Buoys Bulletin Board messages available under the DBCP QC guidelines. For a particular buoy or set of buoys, all messages (if any) regarding its operational behaviour are available upon request on paper or on computer diskette.

A more complete MEDS report, including a full list of services, agreed procedures and charges, is given in Annex III, pages 1 to 4.

5. TECHNICAL DEVELOPMENTS

5.1 Combined meteorological/oceanographic drifting buoys

Since its third session, the DBCP has been increasingly involved in efforts to persuade meteorologists and oceanographers to collaborate on combined meteorological and oceanographic drifting buoys. The Global Drifter Centre (GDC) at the Scripps Institution of Oceanography, La Jolla, of the WOCE and TOGA Global Surface Velocity Programme (SVP) was responsible for the development of a low-cost Lagrangian drifter equipped with a barometer port. The DBCP collaborated actively with the GDC in the field test of some 25 prototype "barometer" drifters (SVP-B). Meteorological agencies of Australia, Canada, France and the United Kingdom, as well as the GDC purchased and deployed a number of units during the period August 1992 to October 1993. New design changes were later proposed by the GDC. At its ninth session, October 1992, the DBCP recognized that the design was successful and commercial production began. Forty-four barometer drifters had consequently been deployed in September 1994 by France, South Africa and the USA. The approximate purchase cost of the SVP-B drifters is US dollars 5,000.- A list of manufacturers is given in Annex IX.

5.2 Lifetime of drifting buoys

As during previous years, the technical co-ordinator made a study of the lifetime of drifting buoys based on that of their air-pressure sensors. The histogram reproduced in Annex X shows the results of this study.

5.3 Impact of drifting buoy data on meteorological analyses

A recent study by Mr R.S. Seaman (Australia) published in the Australian Meteorological Magazine, Vol. 43, 1994, *inter alia*, identified the Southern Ocean drifting buoy network as having a disproportionately large positive impact on meteorological analyses in that region. In view of the importance of this study and of the encouragement which it provides for the continuation and enhancement of such buoy networks, with the kind permission of the author and editor of the Australian Meteorological Magazine, this paper is reproduced in its entirety in Annex XI.

6. COMMUNICATION SYSTEM STATUS

6.1 Argos system

6.1.1 *Space segment* - Three satellites are operational: NOAA-12(D), NOAA-11(H) and NOAA-9(F). NOAA-10(G) is in back-up. Everything is working well on-board in spite of the age of some of the satellites.

6.1.2 *Ground segment* - The ground stations are fully operational. Because of the failure of NOAA-13, SAI developed a special task so that NESDIS receives the real-time telemetry from Lannion ground station as soon as possible.The communication link between France and the USA is working well.

The Argos Global Processing Centres (GPCs) in Toulouse, France, and Landover, MD, USA, were operational over 99.5% of the time. The hardware of the processing centres was upgraded in 1994 and it is now more powerful and reliable. The implementation of a distributed architecture is now completed.

Development of the last part of the GTS sub-system has been completed during 1994 and now that sub-system is fully operational and working well. Since June 1994 new algorithms for location have been developed and used. The software to process the Argos GPS platforms has been developed and became operational in June 1994. The new BUOY code replaced DRIFTER on 2 November 1994 as scheduled.

6.2 Directions in satellite communication systems

Space-based methods currently in use rely on geostationary earth orbiting (GEO) satellites, the Geostationary Operational Environmental Satellite (GOES) for example, and the polar or near polar orbiting satellites in low-earth orbits (LEO) such as NOAA-11 and NOAA-12. The communications industry is on the verge of rapidly expanding. By the year 2000 there will be several competing mobile satellite systems (MSS). The specifications of many current and planned satellite communication services are given in Table 1. INMARSAT A and B have been excluded from the table since their terminal/antenna weight of more than 100 kilograms makes them impractical for data buoy application.

Mobile satellite systems fall into one of three possible orbital configurations, GEO, Mid-altitude earth orbiting (MEO) and LEO satellites. The altitude of GEO satellites is on the order of 35,000 kilometres. MEO satellites are at an altitude of about 10,000 kilometres. LEO satellite orbits are on the order of 1000 kilometres or less. A large percentage of the recent commercial activity in MSS is focused on LEO satellites as a personnel communication tool. LEO satellites can be separated into Big LEO and Little LEO categories. Big LEO's will offer voice, fax, telex, paging, and data capability. Little LEO's will offer data capability only. Since the satellite foot print is dependent on the satellites' altitude, LEO and MEO systems require larger constellations than GEO satellites to achieve global coverage and avoid data delays. Less power is required for LEO and MEO satellite transmitters due to their lower orbit.

Some satellite communication systems will primarily focus on land masses and populated areas of the oceans. This suggests that some configurations may not be acceptable for global ocean monitoring. Several MSS currently under development will be interoperable with existing public switched telephone and cellular networks. This structure serves as an extension and enhancement to existing networks. This service may include additional charges if data are channelled to local cellular or regular local or long-distance companies. While the technical capabilities for these new MSS exist, expect delays due to government licensing, company financing, and availability of launch vehicles. It is also important to consider the infrastructure necessary to disseminate on GTS the data received with these MSS.

Depending on the need of a data buoy programme, some systems will offer enhanced data coverage and communication capability over existing methods. Potential advantages from these emerging MSS include two-way communication, more timely observations, and greater data volume. The panel is continuing to monitor the evolution of these systems and will provide further advice to buoy operators as appropriate.

7. ADMINISTRATIVE MATTERS

7.1 Action groups

7.1.1 *European Group on Ocean Stations* - EGOS was formally established on 1 December 1988 and was *de facto* an action group of the panel as the successor to COST-43. EGOS now has the following membership:

Denmark	Danish Meteorological Institute
Germany	Deutscher Wetterdienst
Iceland	Icelandic Meteorological Office
Ireland	Irish Meteorological Service
Netherlands	Royal Netherlands Meteorological Institute
Norway	Norwegian Meteorological Institute
Sweden	Swedish Meteorological and Hydrological Institute
United Kingdom	United Kingdom Meteorological Office

Mobil Satellite Systems

System	Implemen-tation	Orbit Type	Buoy Position	Message Type	Terminal size	Power (watts)	Unit Cost	Service Cost	Comments
ARGOS	Active	LEO	Doppler shift	data 32 bytes	handheld	1	$500-900	see JTA	with GPS & data collection only 50% potential cost saving
EYETEL	Planned 1995+	Little LEO	GPS required	data 60 bytes	handheld	5	$500-1,500	TBD	1 satellite 1995 5 satellites 1996+
Final Analysis	Planned 1995+	Little LEO	GPS required	data 128 bytes	handheld	10	$100-500 est.	$.25 per message service fee TBD	24 satellites 2000+
Globalstar	Planned 1997+	Big LEO	GPS required	voice/data no max.	handheld	1	$750 est.	$.30/min, monthly service fee TBD	48 satellites 1998+
INMARSAT C	Active	GEO	GPS required	data no max	5.5 kilograms	15	$4,000 avg.	$.28 per 32 bytes	
INMARSAT P	Planned 2000+	MEO	GPS required	voice/data no max.	handheld	1	TBD	TBD	
Iridium	Planned 1998+	Big LEO	GPS required	voice/data no max.	handheld	1	$3,000 est.	$3/min. +$50/mo service charge	66 satellites 1998+
Odyssey	Planned 1998+	MEO	GPS required	voice/data no max	handheld	1	$300 est.	$.65/min, monthly service fee TBD	12 satellites 1998+
ORBCOMM	Planned 1995+	Little LEO	Doppler shift	data no max.	handheld	5	$100-400 est.	$.25 + .007/byte + $30./month service charge	2 sattellite 1995+ 26 satellites 1996+ 36 satellites 1997+
Starsys	Planned 1996+	Little LEO	Doppler shift & ranging	data 27 bytes mult. messages	handheld	2	$50-200 est.	$25 reg.fee $6 monthly fee $.15/data msg. $.45/data+position	12 satellites 1998+ 24 satellites 2000+
VITASAT (gemstar)	Planned 1995+	Little LEO	GPS required	data no max.	laptop size	10	$2,000 est.	$1 per kilobyte + $250/yearly	1st satellite 1995+ 3 satellites by 1997+

Table 1 - Mobile satellite systems

EGOS maintains an operational drifting buoy programme in the North Atlantic.

Buoys are deployed in two areas, north of 50°N referred to as EGOS North and an area to the south of 50°N referred as EGOS South. About 20 new deployments are made annually. As at 30 June 1994 (for example) a total of 16 EGOS drifting and five moored buoys were operational. The full report by EGOS is attached as part of Annex II.

7.1.2 *International Arctic Buoy Programme* - IABP was formally established on 18 September 1991 and became officially an action group of the panel at the seventh session of the DBCP (October 1991). The following organizations are participating in IABP:

Canada	Environment Canada, Canadian Coast Guard, Institute of Ocean Science, Marine Environmental Data Service
Finland	Arctic Centre, University of Lapland
France / USA	Service Argos
Germany	Alfred Wegener Institute for Polar and Marine Research
Japan	Japan Marine Science and Technology Center
Norway	Chr. Michelsen Research AS, Nansen Environmental and Remote Sensing Centre, Norske Polarinstitutt, Norwegian Meteorological Institute
Russian Federation	Arctic and Antarctic Research Institute, Russian Federal Service for Hydrometeorology and Environmental Monitoring
United Kingdom	Scott Polar Research Institute, United Kingdom Meteorological Office
USA	Pacific Marine Environmental Laboratory, Polar Science Centre, University of Washington, U.S. Naval Oceanographic Center, U.S. Naval Oceanography Command, U.S. National Ice Centre (representing several U.S. agencies)
International organizations	World Climate Research Programme

7.1.3 *International Programme for Antarctic Buoys* - At the tenth session of DBCP the panel noted that the IPAB was now formally in place as a WCRP activity, and that all data from IPAB buoys were to be inserted on the GTS. At its second meeting (Helsinki, June 1994), the IPAB had agreed to apply to be an action group of the DBCP, and its chairman had subsequently written to the chairman of the DBCP in this regard.

The panel accepted with pleasure this application by the IPAB. It also supported the recommendation by the IPAB that ice beacons should report on the GTS.

7.1.4 *International South Atlantic Buoy Programme* - Following an initiative by he DBCP in 1993, supported by GCOS and two preparatory meetings (Buenos Aires, December 1993 and October 1994), an International South Atlantic Buoy Programme was formally established, and held its first meeting in October 1994. Eleven institutions or agencies, from five countries (Argentina, Brazil, South Africa, United Kingdom, USA) have agreed to be initial participants in the programme whose technical co-ordination is undertaken by the South African Weather Bureau. In late 1994, some 45 buoys (all SVP-B drifters) were deployed under the programme, and this number is expected to increase to around 70 in 1995. A fuller report on the ISABP is to be found in Annex II.

7.2 Membership

7.2.1 *IOC Member States and WMO Members directly involved in the panel's activities*
The following countries were represented at the recent sessions of the panel:

- Seventh session (Toulouse, October 1991) - Canada, France, Greece, Iceland, Netherlands, United Kingdom, USA

- Eighth session (Paris, October 1992) - Australia, Canada, China, France, Iceland, Madagascar, Mexico, United Kingdom, USA

- Ninth session (Athens, October 1993) - Australia, Canada, France, Greece, Iceland, Netherlands, United Kingdom, USA

- Tenth session (La Jolla, November 1994) - Australia, Brazil, Canada, China, France, Greece, Iceland, Netherlands, South Africa, United Kingdom, USA.

7.2.2 *National focal points* - The present list of national focal points for the DBCP is attached as Annex XII.

7.3 Technical co-ordinator

The panel's technical co-ordinator continues to be Mr Etienne Charpentier (France). Since 1 June 1993, he has been employed by UNESCO/IOC as a **Fund-in-Trust Expert** and located at Collecte Localisation Satellite (CLS)/Service Argos in Toulouse, France.

7.4 Finances

Overall management of the panel's finances has continued to be undertaken by WMO during 1994, while IOC/UNESCO has arranged contracts for the employment of the technical co-ordinator as well as for his logistic support. Annex XIII contains financial statements as follows:

(a) Finalized WMO Statement of Account for the biennium 1992-1993;

(b) Interim WMO Statement of Account for the period 1 January to 31 December 1994;

(c) Finalized IOC Statement of Account for the period 1 June 1993 to 31 May 1994.

For the financial year 1995-1996, the panel agreed the following draft budget, to which contributions will be made by eleven countries (Australia, Canada, France, Greece, Iceland, Ireland, Netherlands, Norway, South Africa, United Kingdom, USA):

A. Expenditures

	US dollars
IOC salary	90,000.-
Travel of the technical co-ordinator	15,000.-
CLS/Service Argos	15,000.-
WMO costs	300.-
Travel of chairman and publications	15,000.-
Contingencies	9,000.-
TOTAL	144,300.-

B. Income

Contributions	134,650.-
Carry-over 1994-1995	9,650.-
TOTAL	144,300.-

(**Note:** Official UN exchange rate in September 1994, $1 = FF 5.38)

ANNEX I

NATIONAL REPORTS ON DATA BUOY ACTIVITIES

The following pages contain national reports on data buoy activities submitted by the following countries:

COUNTRIES page

Report on Current and Planned Programmes for the Australian Bureau of Meteorology and CSIRO Division of Oceanography.

Country: **AUSTRALIA**

Year: 30 September 1993 - 1 October 1994

Organization: **BUREAU OF METEOROLOGY**

1. CURRENT PROGRAMMES

1.1 Operational Drifting Buoy Programme

(i) Purpose of the Programme:

Drifting buoy data are used operationally, primarily as input to global and regional models, and for ground truth validation of satellite-based remote sensing. In addition, the data are used for monitoring ocean wind fields by the Bureau's operational forecasting centres. They are of critical importance in data sparse ocean areas. Recent studies have demonstrated the importance of drifting buoy pressure and sea surface temperature data to the operation of the Bureau's analysis and prediction models.

(ii) Number and type of buoys:

The Bureau of Meteorology deployed two new FGGE style drifting buoys for operational use in the last 12 months, together with six TOGA buoys on behalf of the US National Data Buoy Center (NDBC). All buoys were manufactured by Metocean Data Systems (Canada) and were instrumented for barometric pressure, pressure tendency, sea surface temperature and air temperature. The Bureau's two buoys were drogued (100 m weighted-line), and the TOGA buoys undrogued. Five other Bureau drifters continued to operate from previous year's deployments. Two fixed DCPs continue to operate in the Gulf of Carpentaria and at Heard Island (see 1.2 below). All buoy data is currently disseminated on the GTS.

(iii) Main Deployment Areas:

Deployments were generally between latitudes 12°S to 55°S, and longitudes 70°E to 120°E in the Indian and Southern Oceans, however, two buoys were also placed near the Antarctic sea ice zone at co-ordinates 62°S, 95°E, and 63°S, 65°E. Deployment areas are largely determined by the availability of vessels of opportunity.

1.2 Fixed Buoys

The Bureau of Meteorology continued operation of two fixed DCPs under its

operational drifting buoy program:
(i) In November 1992, buoy 2937 / 52621 was located in a semi-moored situation at 14°S, 138°E in the Gulf of Carpentaria. Mooring was accomplished by placing an unmodified FGGE type drifting buoy fitted with a weighted line drogue, in water shallow enough for the weight to drag on the bottom. It remained in place for ten months before its mooring line failed. The buoy was recovered, refurbished, and returned to service in the Gulf in December 1993, where it is currently operating. The purpose of these initial deployments is to investigate the feasibility of using drifters as a cost effective alternative to full size moored buoys in the Gulf for the early detection of tropical cyclone development. A second buoy will be placed in service in November 1994 to provide a back-up during the next cyclone season.

(ii) A drifting buoy, modified for use as a fixed data collection platform, was located at Spit Bay on Heard Island at 53.1°S, 73.7°E (WMO 56003). Severe weather prevented it being located at Atlas Cove to replace the existing exhausted DCP.

1.3 GTS Distribution

The Bureau currently has fifteen Argos platforms reporting on the GTS, including seven drifting buoys, two fixed buoys, and six Argos equipped ships.

2. PLANNED PROGRAMMES

Year: 30 September 1994 - 1 October 1995

2.1 Operational Drifting Buoy Programme

(i) Number and type of buoys:

Over the next 12 months, the Bureau of Meteorology plans to deploy three standard Metocean buoys and two further prototype TURO SVP style buoys, to maintain it's existing network. A further seven NDBC TOGA buoys will also be deployed. Bureau buoys will continue to be fitted with the same instrumentation as previously, with one possibly being fitted with wind speed and direction sensors.

(ii) Main Deployment Areas:

Deployment locations for Bureau of Meteorology buoys are generally expected to continue in the same regions of the Indian and Southern Oceans. The Australian Antarctic Co-operative Research Center (CRC) will deploy three TURO SVP type buoys in the Antarctic sea-ice zone during the 94/95 summer in support of FROST and the International Program for Antarctic Buoys (IPAB) .

3. TECHNICAL DEVELOPMENTS

3.1 Low Cost SVP Barometer Drifter Development Program

(i) In April 1994, the Bureau deployed one SCRIPPS prototype low cost barometer drifter (1371 / 56515) as part of its participation in the WOCE/TOGA SVP barometer drifter development programme. This was the Bureau's third deployment of one of the earlier 13 inch models, supplied by SCRIPPS. It operated satisfactorily for two months before both pressure sensors became erratic, the symptoms strongly suggesting a blocked pressure inlet port. The buoy transmitted data for a further three and a half months until early October when all sensor data disappeared. Its transmissions are continuing to be received by the satellite system.

(ii) The Bureau also deployed two prototype barometer drifters manufactured by Australian company TURO Technology. These buoys are based on the SCRIPPS design, using the DBCP pressure port, but are slightly larger (500mm diameter), and for the purpose of the trials were fitted with weighted line drogues only. New prototypes currently on order will be fitted with holey sock drogues in conformance with current SVP buoys. Both buoys were deployed off the Western Australian coast in May 1994, and comparisons of pressure and sea surface temperature data with nearby TOGA buoys and observing ships showed very encouraging results. One buoy is continuing to perform satisfactorily after five months, while the other was picked up prematurely by a passing fishing vessel, and has been returned to the Bureau for examination.

3.2 Buoy Life-time and Reliability

The Bureau's Metocean drifters have been achieving nominal lifetimes of about 32 months, with one exception currently operating after 48 months. However, several premature failures have been experienced, believed to have been caused by water entry through the sensor mast mounting flange. Evidence of significant water entry has been found in two recovered Metocean buoys. This type of failure is characterised by an initial loss of air temperature data, as water contaminates the air temperature sensor bulk-head cable connector. The manufacturer has revised its assembly procedures to rectify the problem.

Organization: **CSIRO Division of Oceanography**
submitted by Dr. G Cresswell

1. CURRENT PROGRAMME

Drifters are used by the CSIRO Division of Oceanography as part of Australia's contribution to WOCE. The drifters are similar to those used by Peter Niiler and they are built by Moonraker in Hobart. They are drogued at 15 m depth with a holey sock; they measure sea surface temperature but not atmospheric pressure.

Due to financial constraints in calendar year 1995 only 4 drifters are likely to be released.

Notes on Antarctic Deployments

The Bureau of Meteorology, together with the Antarctic CRC, deployed three drifters in the Antarctic sea-ice zone early in 1994 as follows:

Argos/WMO ID	Lat/Long	Buoy Type	Drogue
2932/73504	62°S, 95°E	Standard Metocean drifter	weighted line
1982/74801	63°S, 65°E.	Metocean TOGA drifter	undrogued
6551/56514	60°S, 88°E.	Prototype TURO SVP drifter	holey sock

(i) Buoy 2932 has operated almost faultlessly since its deployment, with some doubt about the air temperature sensor after 6 months. Sea temperatures encountered by this buoy were not as low as for the other two.

(ii) Buoy 1982 operated satisfactorily for 6 months until the sea temperature dropped to the ice point of sea water (approx -1.85°C), when it ceased transmission. Transmissions re-started when the sea temperature climbed above freezing two months later, and the buoy again appears healthy, .

(iii) CRC buoy 6551 failed after about 5 months when the temperature fell to below freezing. It is hoped that this too will recover as the temperature rises.

It should be noted that none of these drifters was specifically designed for use at low temperatures.

Country: China
Year:1994
Current programmes:
A. Agency: North China Sea Branch, SOA(State Oceanic Administration)
Number and type of buoys:
(a) deployed during year: 1986-1994
(b) operational at 31,August: 1 buoy (10m diameter)
(c) reporting on GTS at 31,August: 1 buoy
Purpose of programme:
(a) operational: yes
(b) met/ocean research: yes
(c) development : main deployment areas: Yellow Sea
B. Agency: East China Sea Branch, SOA
Number and type buoys
(a) deployed during year: 1986-1994
(b) operational at 31,August: 1 buoy (10m diameter)
(c) reporting on GTS at 31,August: 1 buoy
Purpose of programme:
(a) operational: yes
(b) met/ocean research: yes
(c) developmental: main deployment areas: East China Sea
C. Agency: South China Sea Branch, SOA
Number and type of buoys:
(a) deployed during year: 1986-1994
(b) operational at 31,August: 1 Marex DS14 buoy
(c) reporting on GTS at 31,August: 1 Marex DS14 buoy
Purpose of programme
(a) operational: yes
(b) met/ocean research: yes
(c) development: main development areas: South China Sea
Planned programme
The same buoys will be continue in the near future.
Technical development
(a) Buoy design:
4 small size buoys with 3m diameter, 5 large size buoys with 10m diameter, 2 large size deep sea buoys with 10m diameter are developed and built during the past 10 years. They are all of disc type and multiple parameter data buoys.
(b) Instrumentations:
Many sensors used in data buoy are developed and produce in the Marine Technical Institute. They include wind, air temperature, air pressure, water temperature, wave, and current.
(c) Others:
The solar power techniques were used once for additional power supply on a deep sea data buoy.
Publications
Many special technical reports have been finished. Many paper dealt with buoy technic are published in the Journal of Marine Technology.
Special comments
(a) The Argos system for data transportation sometimes can not meet the need of on-time communication well. the practical techniques of GPS positioning and stationary satellite data transportation in data buoy is needed.

(b) The solar power in data buoys is recommended for additional power supply.

FINLAND

A. FINNISH INSTITUTE OF MARINE RESEARCH

- Program no 815: Finnarp 89; meteorological observations for air-sea interaction studies
  Platforms: 1994; moored buoy , 1
  1995; testing , 2

  Estimated PTT-years: 1994 ; 0,06
  1995 ; 0,05

- Program no 1001: Ocean current research in the Gulf of Finland
  Platforms : 1994 : drifting-buoy 3
  1995 : drifting-buoy 3

  Estimated PTT - years: 1994 ; 0,4
  1995 ; 0,15

B. FINNISH METEOROLOGICAL INSTITUTE

- Program no 740: Finnarp weather program; meteorological observations
  Platforms: 1994: fixed station 1
  1995: fixed station 1

  Estimated PTT - years: 1994 ; 0,5
  1995 ; 0,5

C. MINISTRY OF ENVIRONMENT

- Program no xxx: Fell goose migration
  Platforms: 1994: animals 2
  1995: animals 2

  Estimated PTT - years: 1994 ; 0,42
  1995 ; 0,35

FRANCE

CEA - Commissariat à l'Energie Atomique
Estimated PTT-years in 1995 : 3

- Program 475: study of water bodies in French Polynesia
2 fixed location-and-data-collection transmitters

- Program 1262: monitoring Taal volcano, Philippines
2 fixed data-collection-only-transmitter

CNES - Centre National d'Etudes Spatiales
Estimated PTT-years in 1995 : 7

- Program 351: measuring water depth in River Niger
48 data-collection-only-transmitters, backup

- Program 1154: stratospheric balloons
2 location-and-data-collection transmitters

DREIF - Seine river basin, Normandy
Estimated PTT-years in 1995 : 3

- Program 274: flood warnings
15 data-collection-only transmitters, backup

EPALA - Loire river basin, Brittany
Estimated PTT-years in 1995 : 2.7

- Program 144: measuring water levels in River Loire
3 data-collection-only transmitters, standard, and 7 data-collection-only transmitters backup.

Finistère lighthouses and beacons
Estimated PTT-years in 1995 : 0.5

- Program 120:
Monitoring a lighthouse buoy in Brest, data-collection-only, standard

IFREMER
Estimated PTT-years in 1995 : 10.5

-Program 687: XBT.TOGA program
7 location transmitters

- Program 1009: Nivmer
1 fixed data-collection-only station

- Program 1108 - 1309 : Samba
65 drifting buoys and Rafos

- Program 1381 : Sefos
6 drifting buoys

IFRTP - Institut Français pour la Recherche et la Technologie Polaires
Estimated PTT-years in 1995 : 6

- Program 830: stratospheric monitoring
2 fixed stations for measuring ozone and nitrogen dioxide in Terre Adélie

- Program 203: meteorological measurements in the sub-Antarctic
3 location transmitters on ships Marion Dufresne, Astrolabe and La Curieuse

- Program 738: Albatross tracking
16 location transmitters for studying Crozet albatrosses and other birds in the Kerguelen Islands

- Program 952: Penguin tracking
6 location transmitters for studying royal penguins on Crozet Island and emperor penguins on Terre Adélie

- Program 1331 : Penguin tracking
6 location transmitters for studying royal penguins on Crozet Island

INSU OCEAN ATHMOSPHERE
Estimated PTT-years in 1995 : **11,78**

- Program 672 : ARGOCET
Whale tracking in Mediterranean sea

- Program 1830: PAMOY stratospheric monitoring
5 data-collection-only transmitters

- Program 1074 : PAMOS
30 drifting buoy + 45 Rafos

LMD: Laboratoire De Météorologie Dynamique
Estimated PTT-years in 1995 : **0.5**

- Program 286: wave dynamics
Tracking about 10 instrumented balloons (launch schedule not yet finalized).

Meteorologie Nationale Francaise
Estimated PTT-years in 1995 : 14

- Program 44 : Drifting Buoys (research)
Marisonde GT drifting buoys in meteo-oceanographic experiments (SEMAPHORE in 1993). Technological tests in 1994 and 1995 in preparation to future campaigns.

- Program 53 : Snow data stations (operational)
10 snow data stations to provide meteorological observations in real time to Weather Forecasting Centers.

- Program 115 : Moored Buoys (operational)
1 moored nuoy to provide meteorological observations off France in real time to Weather Forecasting Centers (co-operation with the UK Meteorological Office).

- Program 435 : Drifting Buoys (operational)
SIMBAD network, 5 to 7 permanent drifting buoys to provide meteorological observations off France in real time to Weather Forecasting Centers.

- Program 452 : Rainfall measurements (operational)
3 rainfall stations in French Caribbea. this program, presently operated by ORSTOM, will be transfered to METEO-FRANCE in 1995.

- Program 8044 : Waverider Buoys (research and operational)
1 directional waverider in Gaudeloupe

- Program 9435 : drifting buoys (test then operational)
3 to 5 low-cost lagrangian drifters fitted with barometer (co-operation with SCRIPPS)

ORSTOM
Estimated PTT-years in 1995 : 7

- Programs 299, 448, 570,753, 936, 940,1025
Rainfall and hydrometric measurements in French Guiana, New Caledonia, Caribbea, Martinique, Benin, Guinea, Madagascar. Several programs stops this year. Data-collection-only transmitters, backup

SHOM
Estimated PTT-years in 1995 : 17.5

- Program 720 : ATHENA
Locating 3 instrumented buoys (drifting and moored)

- Program 1170: RAFOS
* SEMAPHORE 93 : 36 RAFOS-type floats and 4 VCMs are to come up in the first quarter of 1995. Each will send 50 days of data.
* INTERAFOS : 9 RAFOS-type floats are to come up in October 1995. Each will send 50 days of data.

- Program 1171: SURDRIF
* SEMAPHORE : the remaining SURDRIF drifters, deployed during SEMAPHORE 93, are inactive.
* INTERAFOS : 20 SURDRIF drifters will be deployed along the Portuguese coast in July through December 1995.

TOTAL ESTIMATED PTT-YEARS FOR FRANCE IN 1995 = 83,48

GREECE

Through the years Greece has been an active supporter of the work of the Data Buoy Co-operational Panel. Participating the DBCP sessions, we get experience on the Drifting and Moored buoys programmes. There is a plan for deployment and use moored buoys in the next years, the purpose of which will be operational, as well as, for meteorological and oceanographic research. The deployment area will be the off shore Greek coastal zone. An Automated Coastal Weather Stations Network (on land) has already been started.

We believe that the deployment and use of Drifting buoys and the problems they may cause, should be a subject to international law for all sea areas. We support the procedure of activities which have been started by the IOC, concerning the definition of the legal status for the use of Drifting buoys.

ICELAND

CURRENT PROGRAMMES

The Icelandic Meteorological Office participates in the European Group on Ocean Stations - EGOS. A majority of EGOS drifting buoys are deployed from Icelandic ships sailing from Iceland to USA. A predeployment test is given to these buoys in Reykjavik with special emphasis on the pressure sensor and the satellite communication. During the first 10 months of 1994 fifteen out of twenty three EGOS buoys have been deployed from Icelandic ships. One PTT-year is provided by the Icelandic Meteorological Office for use for refurbished EGOS buoys.

Considerable near-real-time quality control of buoys in the EGOS North Programme is carried out by the Icelandic Meteorological Office, including coparison of the data received via the three LUTs used in the Programme. Errors and malfunctioning of EGOS buoys are reported to the Technical Secretary of EGOS for further action.

The Marine Recearch Institute in Reykjavik has in 1994 deployed 8 surface velocity drifters (WOCE/SVP) for investigation of surface currents in Icelandic Waters

PUBLICATIONS

Flosi Hrafn Sigurdsson: Diurnal Variation in Data Availability from EGOS Buoys Drifting in the North Atlantic. EGOS Techn. Doc. No. 90. December 1993.

Country: KOREA, REPUBLIC OF

Year: **1995**

A. **Agency or programme:** Korea Ocean Research and Development Institute

Purpose of programme: To study the East China and Yellow Sea circulation

Numbers and types of platforms: (a) deployed current year: 12

(b) planned next year: 15

Estimated number of PTT-years (a) current year: 2

(b) next year: 4

B. Agency or programme:

(as above, repeat as often as necessary)

Special comments (if any) Five of the 15 drifters in 1995 are for the WOCE Surface Velocity Programme

THE NETHERLANDS

Year: 1994

CURRENT PROGRAMMES

A. Agency or programme: Royal Netherlands Meteorological Institute (KNMI)

Number and type of buoys:
(a) deployed during year: one (CS);
(b) operational at 31 August: one;
(c) reporting on GTS at 31 August: one.

Purpose of programme: Operational meteorology and oceanography.

Main deployment areas: North Atlantic.

B. Agency or programme: Netherlands Institute for Sea Research (NIOZ)

Number and type of buoys:
(a) deployed during year: Six (clear water drifters);
(b) operational at 31 August: Six;
(c) reporting on GTS at 31 August: Six.

Purpose of programme: Oceanographic research.

Main deployment areas: North Atlantic.

PLANNED PROGRAMMES

A. Agency or programme: Royal Netherlands Meteorological Institute (KNMI)

Number and type of buoys planned for deployment in next 12 months: two CS buoys.

Purpose of programme: Operational meteorology and oceanography.

Main deployment areas: North Atlantic.

B. **Agency or programme:** NIOZ, DUTCH-WARP

Number and type of buoys planned for deployment in next 12 months: Up to six drifters.

Purpose of programme: Oceanographic research.

Main deployment areas: North Atlantic.

PUBLICATIONS

Statistics of buoys in the EGOS programme are taken up in the quarterly reports (United Kingdom Meteorological Office) and the monthly statistics (Météo-France).

SPECIAL COMMENTS

(a) Quality of buoy data: See statistics under **Publications** above;

(b) Communications: All buoys are tracked by the Argos system;

(c) Buoy lifetime: See relevant EGOS technical documents (Thor Kvinge);

(d) Other: DUTCH-WARP is a contribution to WOCE, repeat section AR-7 (east). In addition, it is planned to study the hydrography in the Iceland Basin in order to investigate the deep circulation and the upper circulation in the various branches of the North Atlantic Current.

Year 1995

A. Agency or programme: Royal Netherlands Meteorological Institute

Purpose of programme: EGOS Drifting Buoy Programme (0436)

Numbers and types of platforms:
(a) deployed current year (1993): 1 CS drifter
(b) planned next year (1994): 2 CS drifters

Estimated number of PTT-years:
(a) current year: 3
(b) next year: 3

B. Agency or programme: Netherlands Institute for Sea Research

Purpose of programme: Dutch WARP under WOCE (0878)

Numbers and types of platforms:
(a) deployed current year (1993): 3 Clear Water drifters
(b) planned next year (1994): --

Estimated number of PTT-years:
(a) current year: 1
(b) next year: --

C. Agency or programme: Centre of Environmental Science, Leiden University

Purpose of programme: (i) Dugong conservation (1157)
(ii) Elephant Migration (1158)

Numbers and types of platforms:
(a) deployed current year (1994): 4 Telonics PTTs
(b) planned next year (1995): 3 Telonics PTTs

Estimated number of PTT-years:
(a) current year: 1
(b) next year: 0.5

D. Agency or programme: Institute for Marine and Atmospheric Research, Utrecht University

Purpose of programme: Land Ice and Sea Level Monitoring (1238)

Number and types of platforms:
(a) deployed current year (1994): 1 Telonics PTT
(b) planned next year (1995): 3 Telonics PTTs

Estimated number of PTT-years:
(a) current year: 2.5
(b) next year: 2.5

E. Agency or programme: Institute for Forestry and Nature Research (new)

Purpose of programme: Population Ecology of Geese from the Taimyr Peninsula in relation to natural and human Prediction Pressure (new)

Number and types of platforms:
(a) deployed current year (1994): --
(b) planned next year (1995): 5 (?) PTTs

Estimated number of PTT-years:
(a) current year: --
(b) next year: 0.35

Country **NEW ZEALAND**
Year **1994**

A. Agency or Programme: **Meteorological Service of New Zealand Ltd (MSNZ)**

Purpose of programme: **Drifting Buoy Data for Forecasting**

Number and types of platforms: (a) deployed current year: **3 WSD buoys**
(b) planned next year: **5 basic buoys**

Estimated number of PTT-years (a) current year: **7 years**
(b) next year: **7 years**

B. Agency or Programme: **Department of Zoology, University of Otago**

Purpose of programme: **Foraging Ecology of New Zealand Fur Seal**

Number and types of platforms: (a) deployed current year: **3 PTTs 90 days each**
(b) planned next year: **unknown**

Estimated number of PTT-years (a) current year: **.633 years**
(b) next year: **unknown**

C. Agency or Programme: **National Institute of Water and Atmosphere**

Purpose of programme: **Moored Met buoy**

Number and types of platforms: (a) deployed current year: **1**
(b) planned next year: **1**

Estimated number of PTT-years (a) current year: **0.5 years**
(b) next year: **unknown**

Special Comments

Several scientific organizations have indicated that they plan to use the ARGOS system for the first time in 1995. These will be new JTA customers and they will be tracking birds (namely, Molymawks and Petrels) and seals.

NORWAY

Agency or programme: Chr. Michelsen Research
Purpose of programme: Program 0655 SOBA (Data collection and positioning. Drifting buoys).
Number and types of platforms: a) deployed current year: ~ 10
b) planned next year: ~ 10
Estimated number of PTT-years: a) current year: 3
b) next year: 2.5
Special comments: Two types 1) drifting buoys for real-time acquisition of meteorological data and 2) capsules on the Arctic ice for observation of icedrift and meteorological data.

Purpose of programme: 9655 Nordic WOCE
Number and types of platforms: a) deployed current year:
b) planned next year:
Estimated number of PTT-years: a) current year:
b) next year: 0.5

Agency or programme: Norwegian Meteorological Institute
Purpose of programme: Program 154 NOROBS meteorology
Program 198 MONI/SEANOR meteorology
Program 314 ARNO meteorology
Program 428 SOBA NW meteorology
Program 9154 AURORA meteorology
Number and types of platforms: a) deployed current year:
b) planned next year: 8-9
Estimated number of PTT-years: a) current year:
b) next year: 5.15

Agency or programme: Norwegian Polar Institute
Purpose of programme: Tracking marine mammals
Number and types of platforms: a) deployed current year: 23
b) planned next year: 15
Estimated number of PTT-years: a) current year: 8
b) next year: 6

Purpose of programme: Monitoring activity and distribution of Arctic fox and Svalbard reindeer
Number and types of platforms: a) deployed current year: 8
b) planned next year: 0
Estimated number of PTT-years: a) current year: 1
b) next year: 1.5
Purpose of programme: Tracking sea birds
Number and types of platforms: a) deployed current year:
b) planned next year: 5
Estimated number of PTT-years: a) current year: 0
b) next year:0.5

Purpose of programme: Program 29 Ice drift experiment (ICEX)
Number and types of platforms: a) deployed current year: 7
b) planned next year: 13
Estimated number of PTT-years: a) current year: 7
b) next year: 8

Agency or programme: Marine Research Institute
Purpose of programme: Programme 0209 Fish and larvae drifters
Number and types of platforms: a) deployed current year:
b) planned next year:
Estimated number of PTT-years: a) current year: 4
b) next year: 2

Agency or programme: Defence Research Establishment
Purpose of programme: Programme 926 Icenoice
Number and types of platforms: a) deployed current year: 1
b) planned next year: 0
Estimated number of PTT-years: a) current year: 0.2
b) next year: 0

Agency or programme: SINTEF NHL
Purpose of programme: Programme 702 NORID (transfer data or position from measurement platforms)
Number and types of platforms: a) deployed current year: 4
b) planned next year: 1
Estimated number of PTT-years: a) current year: 1
b) next year: 0.5

Agency or programme: Norwegian Institute of Nature Research
Purpose of programme: Programme 1166 Satellite tracking of south polar skua
Number and types of platforms: a) deployed current year:
b) planned next year:
Estimated number of PTT-years: a) current year: 0.5
b) next year: 0.15

Agency or programme: University of Tromsø
Purpose of programme: Programme 768 Harp seal positioning
Number and types of platforms: a) deployed current year:
b) planned next year:
Estimated number of PTT-years: a) current year: 2.5
b) next year: 3.5

SOUTH AFRICA

The South African Weather Bureau deployed 20 drifting weather buoys during the period September 1993 to August 1994. All these drifters were manufactured by Meteocean, Canada. Three were of the TOGA-type and the rest CMOD-type. Five TOGA buoys were supplied by the USA National Data Buoy Center for deployment on their behalf in the South Atlantic. Unfortunately, two developed a defect and had to be brought back for inspection and repairs.

Of the 17 CMOD-drifters, 12 were deployed in the South Atlantic during October 1993. Two were deployed in the vicinity of South Georgia Island during July 1994. The remaining three were air deployed in the South Indian Ocean during navigational training flights of the South African Air Force to Marion Island. During the training flight, which took place in March 1994, one CMOD was air deployed while another two were air deployed during July of the same year.

The refurbished drifting buoy placed on Inaccessible Island during October 1993 reported air temperature and air pressure data for most of the said period while the refurbished TOGA buoy placed on South Thule of the South Sandwich Island group reported good pressure and temperature values throughout the period.

All the data from drifting weather buoys as well as fixed stations were disseminated on the GTS on a regular basis.

UNITED KINGDOM

1. CURRENT PROGRAMMES

1.1 Institute: Meteorological Office

Programme: EGOS
Number & type of buoys

a) deployed during year: 17 drifters + 8 moored
b) operational at 31 August: 11 drifters + 10 moored
c) reporting on GTS at 31 August: 11 drifters + 10 moored

Purpose of programme: Operational meteorology and oceanography

Main deployment areas: North Atlantic

1.2 Institute: Meteorological Office

Programme: IABP
Number & type of buoys

a) deployed during year: 1 ice buoy (air dropped)
b) operational at 31 August: 2
c) reporting on GTS at 31 August: 2

Purpose of programme: Operational meteorology and oceanography, climate research

Main deployment areas: Arctic Ocean

1.3 Institute: Meteorological Office

Programme: Low cost drifter evaluation
Number & type of buoys

a) deployed during year: 2 WOCE barometer drifters
b) operational at 31 August: 1
c) reporting on GTS at 31 August: 1

Purpose of programme: Evaluation

Main deployment areas: Central North Atlantic

1.4 Institute: Institute of Oceanographic Sciences - Deacon Laboratory (IOS-DL)

Programme: Prog 296
Number & type of buoys

a) deployed during year: 1 (prototype "sonic" buoy)
b) operational at 31 August: 0
c) reporting on GTS at 31 August: 0

Purpose of programme: Development

Main deployment areas: Carmarthen Bay, UK

1.5 Institute: NERC Research Vessel Services (RVS)

Programme: Prog 711
Number & type of buoys

a) deployed during year: 7 (Decca/Argos buoys)
b) operational at 31 August: 0
c) reporting on GTS at 31 August: 0

Purpose of programme: Met/Ocean research

Main deployment areas: UK continental shelf

1.6 Institute: Plymouth Marine Laboratory (PML)

Programme: Prog 780
Number & type of buoys

a) deployed during year: 11 (5 Moonraker, 4 Met O, 1 Serpe, 1 IDB)
b) operational at 31 August: 3
c) reporting on GTS at 31 August: 1

Purpose of programme: Development and met/ocean research

Main deployment areas: NE Atlantic

1.7 Institute: University College of North Wales , Menai Bridge

Programme: Prog 563
Number & type of buoys

a) deployed during year: 4 (2 position only, 2 with thermister chains and optical sensors)
b) operational at 31 August: 2
c) reporting on GTS at 31 August: 0

Purpose of programme: Met/ocean research

Main deployment areas: Irish Sea and Canary Island region

2. PLANNED PROGRAMMES

2.1 Institute: Meteorological Office

Programme: EGOS

Number and type of buoys planned for deployment during next 12 months: Up to 18 drifters and 13 moored buoys including 3 new positions

Purpose of programme: Operational met/ocean

Main deployment areas: NE Atlantic

2.2 Institute: Meteorological Office

Programme: IABP

Number and type of buoys planned for deployment during next 12 months: 1 ice drifter

Purpose of programme: Operational met/ocean and climate research

Main deployment areas: Arctic Ocean

2.3 Institute: Meteorological Office

Programme: ISABP

Number and type of buoys planned for deployment during next 12 months: 1 "wsd" drifter

Purpose of programme: Operational met/ocean

Main deployment areas: S Atlantic

2.4 Institute: Meteorological Office

Programme: EGOS

Number and type of buoys planned for deployment during next 12 months: 5 WOCE barometer drifters

Purpose of programme: Evaluation

Main deployment areas: N Atlantic

2.5 Institute: IOS-DL

Programme:

Number and type of buoys planned for deployment during next 12 months: 4 (1 "sonic" buoy for wind stress, 1 wave buoy, 1 current profiling buoy, 1 met buoy)

Purpose of programme: Met/ocean research

Main deployment areas: Carmarthen Bay

2.6 Institute: Dunstaffnage Marine Laboratory (DML)

Programme: NERC Land-Ocean Interaction Study (LOIS)

Number and type of buoys planned for deployment during next 12 months: 20 (to measure various oceanic parameters,inc some met variables)

Purpose of programme: met/ocean research

Main deployment areas: Shelf edge west of Scotland

2.7 Institute: NERC-RVS

Programme:

Number and type of buoys planned for deployment during next 12 months: about 4 (Decca/Argos buoys)

Purpose of programme: met/ocean research

Main deployment areas: UK Continental Shelf

2.8 Institute: PML

Programme:

Number and type of buoys planned for deployment during next 12 months: 14 (4 Met O, 3 Moonraker, 2 Serpe, 3 IDB, 2 Turo)

Purpose of programme: Development and met/ocean research

Main deployment areas: NE Atlantic

2.9 Institute: UCNW

Programme:

Number and type of buoys planned for deployment during next 12 months: 2

Purpose of programme: met/ocean research

Main deployment areas: European shelf areas

3 PUBLICATIONS

3.1 Meteorological Office: Quarterly Reports on "Drifting Buoys in the North Atlantic".

D J Painting
Met Office, UK Oct 1994

UNITED STATES OF AMERICA

In support of marine weather forecasts, ocean, coastal, and climate studies, the United States had 2,585 drifting buoys reporting through Argos at least once during the period October 1993 to September 1994. Among these buoys,1,018 reported on GTS. For the period 16 October 1994 to 26 October 1994, the United States had 928 operational drifting buoys reporting at least once through Argos. Of these, 473 reported on GTS. The United States also maintains a network of 125 moored data buoys located in waters around the Continental United States, Alaska, Hawaii, Guam, and the Tropical Pacific. All of the moored data buoys are reported on GTS. Of the moored buoys, 65 transmitted data through GOES and 60 transmitted data through Argos. The United States sponsors of the programs supporting these data buoys include the National Science Foundation, the National Oceanographic and Atmospheric Administration, the Department of Transportation, the Department of Defense, the Department of Interior, the Department of Energy, and State Institutions.

In 1995, as shown in the accompanying table, over 2800 drifting buoys are planned to be deployed. The distribution of these buoys by ocean basin are: 1351 - Pacific, 1013 - Atlantic, 270 - Indian, 78 - Arctic, 81 - Gulf of Mexico, 12 - Great Lakes, and 27 at locations in coastal waters to be determined. In addition, about 212 moored buoys are planned for deployment as follows: 119 - Pacific, 5 - Atlantic, 4 - Indian, 1 - Arctic, 1 - Great Lakes, and 82 in coastal waters.

The following is a comprehensive list identifying 1995 expected U.S. drifting and moored buoys by program:

A. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

1. National Data Buoy Center

Purpose: To provide operational meteorological and oceanographic data.

Location and No.: (a) Drifters:

Atlantic - 76
Pacific - 30
Emergency Response - 8

(b) moorings:

Coastal U.S. - 78

2. Pacific Marine Environmental Laboratory

Purpose: To study biological and physical processes which cause variability of recruitment to commercially valuable fish and to describe sea ice deformation fields.

Location and No.: (a) Drifters:

Arctic - 24
Pacific - 7

(b) Moorings:

Arctic - 1
Pacific - 1

3. **Great Lakes Environmental Research Laboratory**
Purpose: Surface wave and current measurements in the Great Lakes.
Location and No.: (a) Drifters:
Great Lakes - 12

4. **Office of Global Programs**
(Funding for Pacific Marine Environmental Laboratory, Scripps Institution of Oceanography, and various Universities.)
Purpose: To provide meteorological and oceanographic observations for the monitoring and prediction of climate change and circulation studies.
Location and No.: (a) Drifters:
Atlantic - 342
Pacific - 695
Indian - 66
(b) Moorings:
Pacific - 94
Atlantic - 3

5. **Office of Ocean and Earth Sciences, NOS**
(In collaboration with the National Data Buoy Center and the Navy/NOAA Joint Ice Center)
Purpose: To provide meteorological and oceanographic observations for TOGA and Arctic analysis and forecasting.
Location and No.: (a) Drifters:
Atlantic - 15
Pacific - 10
Indian - 4
Arctic - 17

B. **NATIONAL SCIENCE FOUNDATION**
(Funding for several Universities and Institutions)

Purpose: To provide meteorological and oceanographic observations for TOGA and WOCE Surface Velocity Program, circulation studies, and biological and chemical oceanography programs.
Location and No.: (a) Drifters:
Atlantic - 326
Pacific - 372
Indian - 200
(b) Moorings:
Pacific - 15
Atlantic - 2

C. **DEPARTMENT OF DEFENSE**

1. **Naval Oceanographic Office**
Purpose: Collection of real-time data for operational analysis and forecasting.
Location and No.: (a) Drifters:
Atlantic - 121
Pacific - 130
Arctic - 21

2. **Office of Naval Research**
Purpose: Physical oceanography studies.
Location and No.: (a) Drifters:
Atlantic - 40
Pacific - 20
(b) Moorings:
Indian - 5

3. **Naval Research Laboratory**
Purpose: Real-time meteorological/oceanographic data collection.
Location and No.: (a) Drifters:
Atlantic/Mediterranean - 17
Pacific - 17
Arctic - 16

4. **Navy Post Graduate School**
Purpose: Physical oceanography studies, particularly in the California Current.
Location and No.: (a) Drifters:
Pacific - 40
(b) Moorings:
Pacific - 4

D. **U.S. COAST GUARD**
Purpose: To collect current and sea surface temperature data for ice berg movement and deterioration and search and rescue operations.
Location and No.: (a) Drifters:
Atlantic - 66

E. **DEPARTMENT OF INTERIOR, MINERALS MANAGEMENT SERVICE**
Purpose: To study circulation patterns in the continental shelf areas.
Location and No.: (a) Drifters:
Pacific - 20
Gulf of Mexico - 81
(b) Moorings:
Pacific - 5

F. **DEPARTMENT OF AGRICULTURE, FOREST SERVICE**
Purpose: To track the movement of log rafts in channels and ocean areas.
Location and No.: (a) Drifters:
Pacific - 5

G. **NON-PROFIT INSTITUTIONS/ORGANIZATIONS**

1. **Rosensteil School of Marine and Atmospheric Studies**
Purpose: Determine the recruitment pathways of fish and lobster larvae in the offshore circulation and wind driven routes in the Straits of Florida.
Location and No.: (a) Drifters:
Straits of Florida - 12

2. **Woods Hole Oceanographic Institution**
   Purpose: Develop drifting acoustic receivers for global temperature mapping.
   Location and No.: (a) Drifters:
   Atlantic - 5

3. **University of Texas Applied Research Laboratories**
   Purpose: Shallow water oceanographic studies.
   Location and No.: (a) Moorings:
   Coastal - 4

4. **Draper Laboratory**
   Purpose: Subsurface observations in the Arabian Sea
   Location and No.: (a) Moorings:
   Indian Ocean - 2

5. **Webb Research Corporation**
   Purpose: Ocean Deployment of SLOCUM profilers
   Location and No.: (a) Drifters:
   Atlantic - 6

ANNEX II

REPORTS FROM THE DBCP ACTION GROUPS

EUROPEAN GROUP ON OCEAN STATIONS

CURRENT PROGRAMMES:

Agencies of programme:	**Danish Meteorological Institute** **Deutscher Wetterdienst** **Icelandic Meteorological Office** **Irish Meteorological Service** **Royal Netherlands Meteorological Institute** **The Norwegian Meteorological Institute** **Swedish Meteorological and Hydrological Institute.** **United Kingdom Meteorological Office**
Number and types of buoys:	**a) Deployed in 1993 33 Drifting buoys** **b) Deployed in 1994 Jan-June: 13 Drifting buoys** **c) Operational at June 30 1994:** **16 Drifting buoys** **5 Moored buoys**
Purpose of programme:	**a) To provide meteorological and oceanographic data on a near real-time basis from data sparse areas in the North Atlantic.**
Deployment area:	**North Atlantic, between 25 N to 63 N , east of 45 W.**

PLANNED PROGRAMMES:

a) The programme will continue with deployment of about 20 drifting buoys per year.

b)The currently moored buoy stations will be maintained, in addition more moored stations may be established in the North Sea and west of the Hebrides.

TECHNICAL DEVELOPEMENTS:

a)Testing on various types of barometers

b)Implementation of GPS navigation receivers in the drifting buoys.

PUBLICATIONS: EGOS Technical Document series: 1 - 104
In 1993. Techn Docs. Nos. 73 - 91
In 1994. Techn Docs. Nos. 92 - 104

a) Monthly report on EGOS buoy status
b) Annual Reports
c) Reports on Meetings
d) Reports on Technical subjects

SPECIAL COMMENTS:

a) Quality of buoy data: Quality control of EGOS buoy data is based on:

1) A quasi-real-time control made at the Icelandic Meteorological Service.

2) Data quality control is also made at the UK Meteorological Office, Central Forecast Branch in BracknellAnalysis. Statistics on the weekly and monthly average air pressure and sea surface temperatures bias for each buoy is calculated relative to the background field.

3)Statistics on the air pressure data quality is also provided by the DBCP Technical Co-ordinator.

b) Communication: The buoy data are transmitted via the Argos System and received by three LUTs; Toulouse,
Oslo and Søndre Strømfjord respectively.
All three LUTs disseminate the data in real-time via the GTS.

c) Buoy lifetimes: In EGOS the buoy operational lifetime is defined as the number of days during which the buoy provide usefull air pressure data, regardless of the reason why it fails. Statistics on the average operational lifetime for the EGOS buoys are worked out on a semi annual and an annual basis:

In 1991 , 165 days
In 1992 , 312 days
In 1993 , 200 days
In 1994 , 216 days (Jan 1 - June 1 1994)

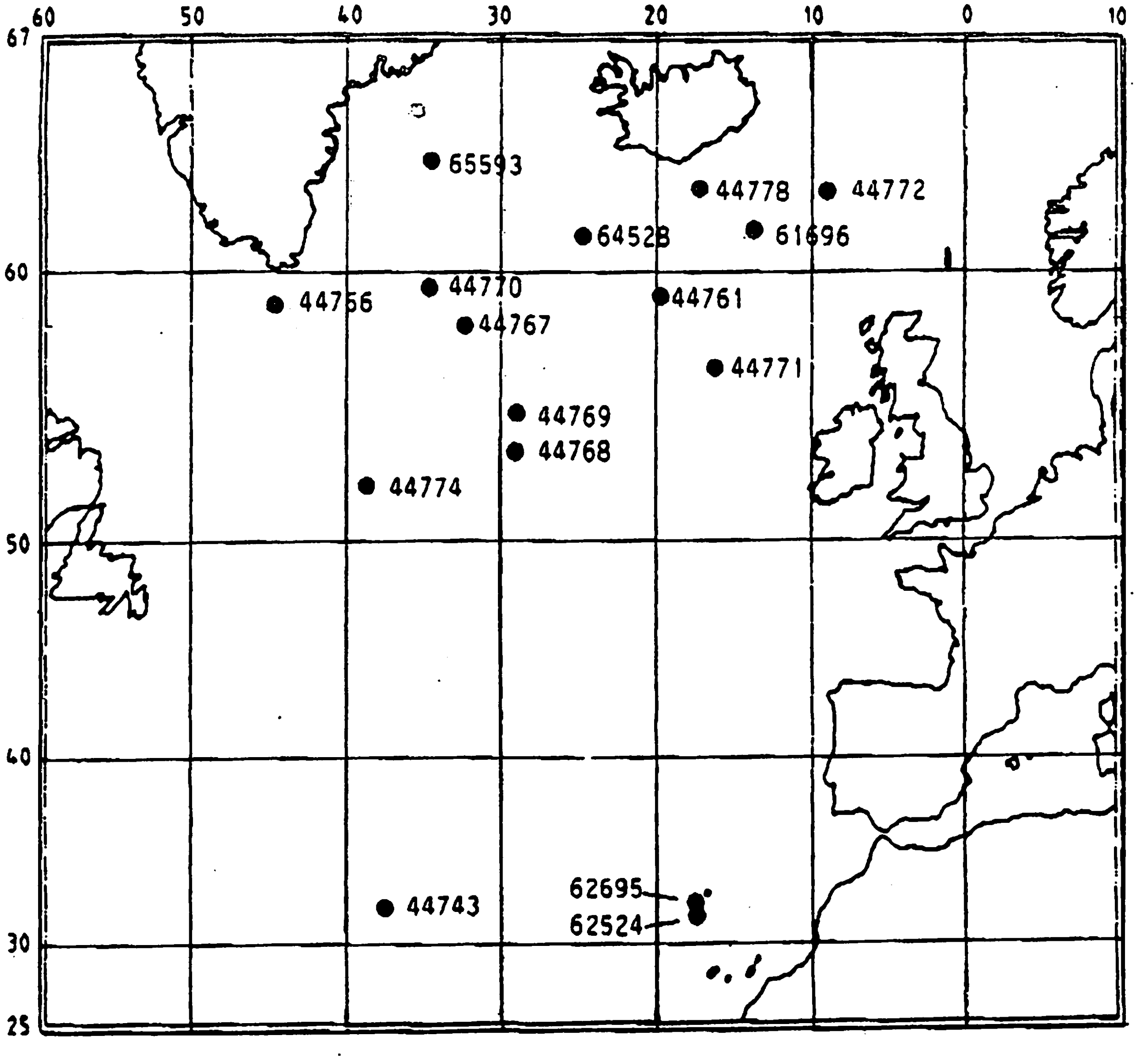


Figure 1: EGOS buoy status as at June 30, 1994.

INTERNATIONAL SOUTH ATLANTIC BUOY PROGRAMME

Status report: 3 November 1994

Data sparseness in the South Atlantic Ocean have been a topic of conversation amongst meteorologists and oceanographers for a very long time. Amongst the members of the Data Buoy Co-operation Panel it has been discussed since the early days of the panel's existence. During the panel ninth session in Athens in 1993, it was decided that the DBCP, assisted by WMO, should host a meeting in Buenos Aires to determine the interest in an international South Atlantic drifting weather buoy programme.

The interest in this meeting, which took place in mid-December 1993, was good and the participants decided to have a second preparatory meeting in September 1994. During the first preparatory meeting a steering committee was elected.

During the intersessional period, before the second preparatory meeting, the steering committee developed a buoy deployment plan and at the time, when the second meeting took place, i.e. early October 1994, the deployment of some 42 drifting weather buoys was underway in the South Atlantic.

The second preparatory meeting was immediately followed by the first meeting of the Committee of the ISABP. During this meeting an intersessional steering committee was elected and a programme co-ordinator was appointed.

The ISABP was off to a very good start. A few challenges were identified soon after and the steering committee started with its assignments:

(a) It was important that there should be no delay in obtaining the data from drifters in the South Atlantic. The possibility of a LUT in Buenos Aires and/or Gough Island therefore needs to be investigated;

(b) Delays in the transfer of data on the GTS needs to be investigated and corrected if it should prove to be true;

(c) There are only a very few islands in the South Atlantic and it is therefore important that they be exploited to the full in obtaining wether data from the.

As of 2 November 1994, the ISABP applied to the DBCP to be recognized as a regional action group. The application was accepted with pleasure by the panel.

The next important step would be to recruit participants to the ISABP.

ANNEX III

REPORTS ON DATA MANAGEMENT CENTRES

MARINE ENVIRONMENTAL DATA SERVICE

Introduction

The Marine Environmental Data Service (MEDS) in Canada became a Responsible National Oceanographic Data Centre (RNODC) for Drifting Buoy Data on behalf of the Intergovernmental Oceanographic Commission (IOC) and the World Meteorological Organization (WMO) in January 1986. The purpose of this report is to describe the activities of the RNODC-MEDS in acquiring and making drifting buoy data available to the scientific community during the last nineteen months (January 93 - July 94).

Data Flow

We show in the attached table various statistics derived for this 19-month period of activity. The first column of the table gives the month and year number, the second column provides the number of messages received by MEDS for this particular month-year. The next two columns provide the statistics on the buoys themselves; it shows first the number of buoys reporting on the GTS and for which MEDS is receiving the data while the second one gives the number of operating drifting buoys according to Service ARGOS. The last column gives an estimate of the success by MEDS in acquiring the drifting buoy data. Figure 1 is an illustration of the same information as it displays on the right Y-axis the number of buoys for which MEDS receives the data (continuous line) while the left Y-axis illustrates the number of messages received each month (bar chart) by MEDS.

During this 19-month period, MEDS received a total of 1,846,818 messages transmitted from drifting buoy platforms sending their data through the GTS (an average of 97,201 messages per month). The average number of messages per month (95,731) for the first seven months in 1994 has decreased by 2.4 % from the 1993 monthly average, which shows that slightly less data are being recorded by drifting buoys.

The average number of buoys reporting on the GTS (according to ARGOS statistics) has decreased from 1137 in 1993 to 1096 in 1994, more than a 3 % drop. The percentage of data for which MEDS receives the data through the GTS has also decreased as shown by Figure 2 of this report. When compared to previous years, there is still a small upward trend but the last few months statistics indicate a below "normal" situation. Again, Principal Investigators are strongly encouraged to forward their buoy data onto the GTS.

The following table illustrates the increase (negative numbers indicate a decrease) for the last three years with regard to the traffic of messages on the GTS from Drifting Buoy as the second column indicates the increase or decrease of MEDS success in the acquisition of data through the GTS while the last column indicates a general decrease of Drifting Buoys floating on the Ocean, according again to Service ARGOS.

% ± Over Previous Year **Year**	**Number of messages received by MEDS**	**Number of buoys for which MEDS received data**	**Number of operational buoys ARGOS**
1992	43.3 %	56.8 %	42.2 %
1993	50.4%	22.0%	18.1 %
1994	-2.4 %	-11.9 %	-3.6 %

Historical Data Acquisition

Since the FGGE program and since January 1986 when MEDS became the RNODC for Drifting Buoy data, the archive has grown constantly. It now contains a total of 7,783,285 messages from 48,960 different buoy-months of which close to 80 % has passed MEDS critical quality control procedures.

Services

MEDS issues an annual report summarizing the data received and processed during the previous year and showing the locations of the buoys. The 1993 annual report has already been published and distributed. Every month, global maps are issued displaying the location for the buoys reporting over the GTS. In addition MEDS also deliver data for a user specified area, time and range of buoys on computer magnetic tape in GF-3 format. If the volume of data requested is small enough, it can be obtained on computer diskette (5 1/4 or 3 1/2-inch). If the volume is too large, the data can be copied onto Exabyte cartridge or can be transmitted through Internet via Anonymous FTP. Displays of buoy tracks are also available for any ocean area and time frame. The MEDS monthly DRIBU track chart is also published in the IOC/WMO IGOSS Products Bulletin quarterly publication.

MEDS has completed the development and installation of a computer file containing information about the operators of the buoys as well as the program under which the buoy has been deployed. Other information, such as the program manager or organization and characteristics of the buoy are also kept if this information is made available to MEDS.

MEDS has developed an archiving mechanism for the Drifting Buoys Bulletin Board messages available each day on ScienceNet. For a particular buoy or set of buoys, all messages (if any) regarding its operational behaviour are available upon request on paper or on computer diskette.

Cost Recovery

According to the Canadian Department of Fisheries and Oceans Policy on cost recovery, MEDS levy a small charge to recover the incremental cost when fullfilling a particular request. The total cost is usually small. For Drifting Buoys data, the cost may be estimated as follows in Canadian currency:

1) Computer drawn map:

Basic Fee:	$28.00
Labour Fee:	$29.51
Map:	$ 6.90
Plot:	$ 1.00

2) Data retrieval:

Basic Fee:	$28.00
Labour Fee:	$29.51
Data point:	$ 0.65 per 1,000 data points.

In addition, when an output medium is required to supply the data, the following cost must be added:

$22.50 for computer magnetic tape (6250 BPI);
$ 1.75 for computer diskette (3 1/2 inches);
$25.00 for an Exabyte tape.

FTP transmission through Internet is free of charge.

How to contact MEDS

MEDS can be contacted through various ways. Feel free to contact us by mail, telephone, facsimile, or electronic mail.

RNODC for Drifting Buoys
Marine Environmental Data Service
Mr. Paul-André Bolduc
1202-200 Kent Street
Ottawa, Ontario
CANADA K1A 0E6

Telephone: (613)990-0231
Facsimile: (613)990-5510
OMNET: A.BOLDUC
InterNet: BOLDUC@OTTMED.MEDS.DFO.CA

Table: Monthly statistics on number of buoys and number of messages received at MEDS from January 93 to July 94

Month/Year	# Messages received in MEDS	# Buoys reporting on GTS	# Buoys according to ARGOS	% received in MEDS
Jan 93	76,445	688	1,027	67.0
Feb 93	63,463	690	1,632	42.3
Mar 93	95,015	688	1,097	62.7
Apr 93	98,311	703	1,103	63.7
May 93	102,554	717	1,053	68.1
Jun 93	98,353	673	1,096	61.4
Jul 93	100,192	666	1,088	61.2
Aug 93	101,599	654	1,081	60.5
Sep 93	94,538	656	1,075	61.0
Oct 93	111,201	703	1,085	64.8
Nov 93	112,804	693	1,136	61.0
Dec 93	122,228	715	1,174	60.9
Jan 94	100,857	659	1,191	55.3
Feb 94	82,655	625	1,118	55.9
Mar 94	99,998	590	1,110	53.2
Apr 94	95,561	593	1,058	56.1
May 94	94,964	587	1,036	56.7
Jun 94	95,333	590	1,043	56.6
Jul 94	100,747	592	1,113	53.2

Report prepared by:

Paul-André Bolduc
Marine Environmental Data Service
August 1994
Updated November 7, 1994.

SPECIALIZED OCEANOGRAPHIC CENTRE FOR DRIFTING BUOYS

Report 1993-1994

A daily collection and archiving of buoy reports from the world ocean is performed by the French Meteorological service.

As usual the french SOC produces monthly graphic products for buoys, moored buoys, drifting buoys, ships.

Figures 1, 2, 3, 4, show the time evolution of reports for wind (direction and speed) and for pressure respectively for all buoys, moored buoys, drifting buoys and ships since the 1st of January 1993.

Figure 5 shows the time evolution of waveobs reports since the 1st of January 1993.

Each month mapping position plot charts and Marsden square distribution are produced for Drifter and Ship and are sent to 70 users in the world. Figures 6, 7, 8, 9 show products for June 1994.

The SOC has increased its activities, Figures 10, 11, 12, 13 show Marsden square distribution chart of mean monthly data availability (top) and Percentage of Drifter reports compared to ship + drifter reports (bottom) for wind, pressure, air temperature, sea surface temperature for June 1994.

French SOC Representative

Joël POITEVIN

Time evolution of BUOY reports for wind and pressure

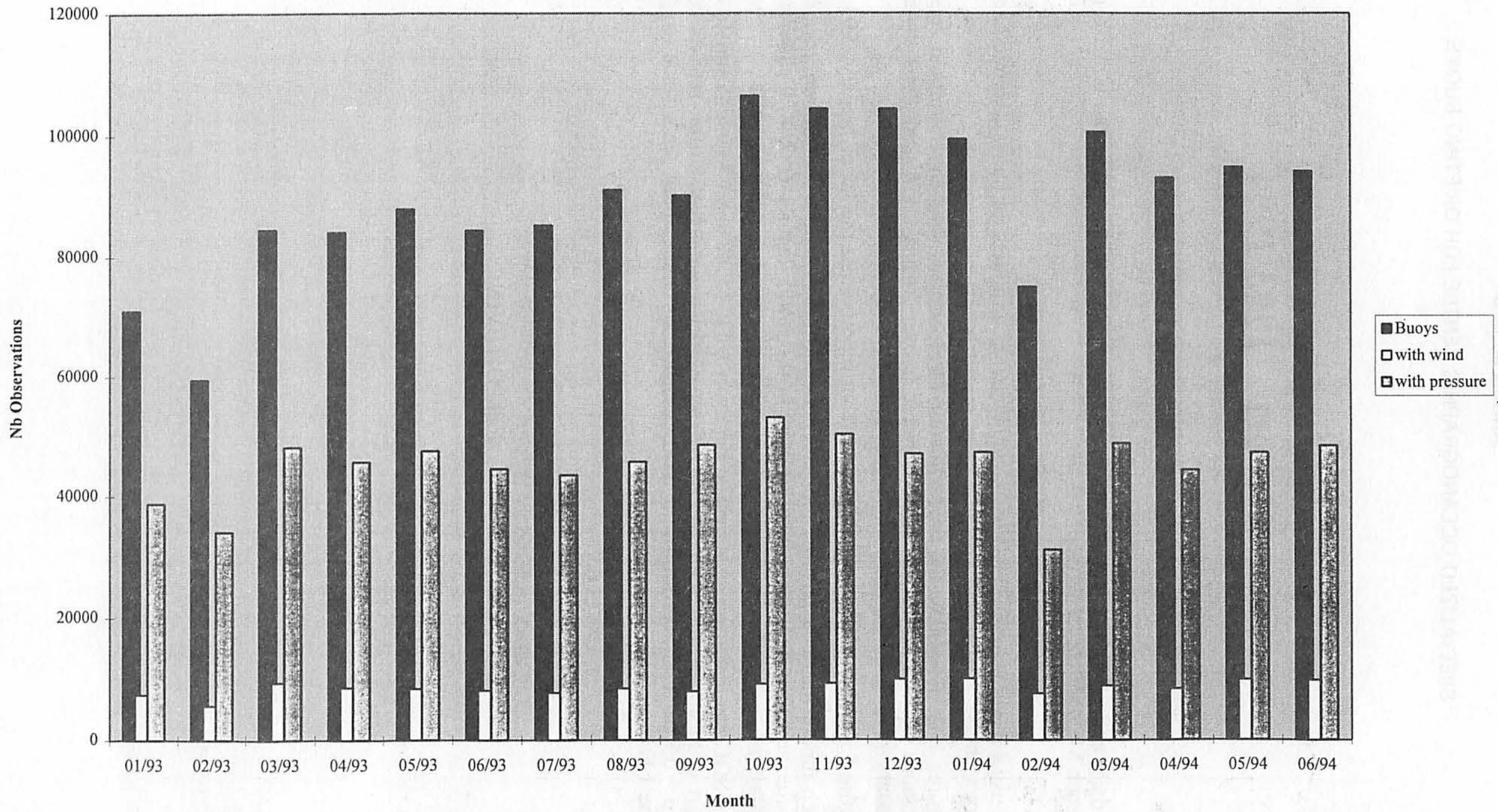


Figure 1

Time evolution of Moored BUOY reports for wind and pressure

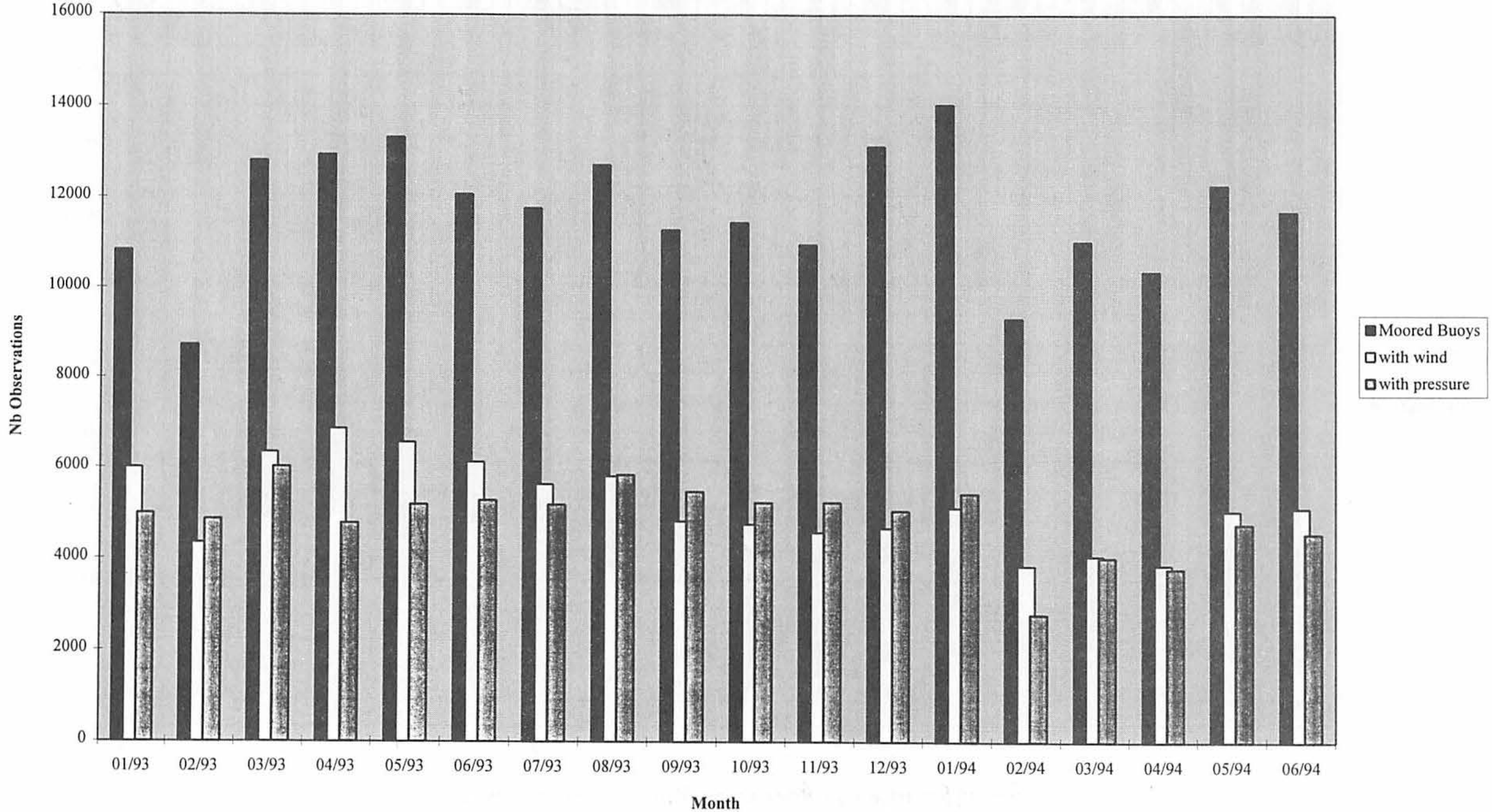


Figure 2

Time evolution of Drifting BUOY reports for wind and pressure

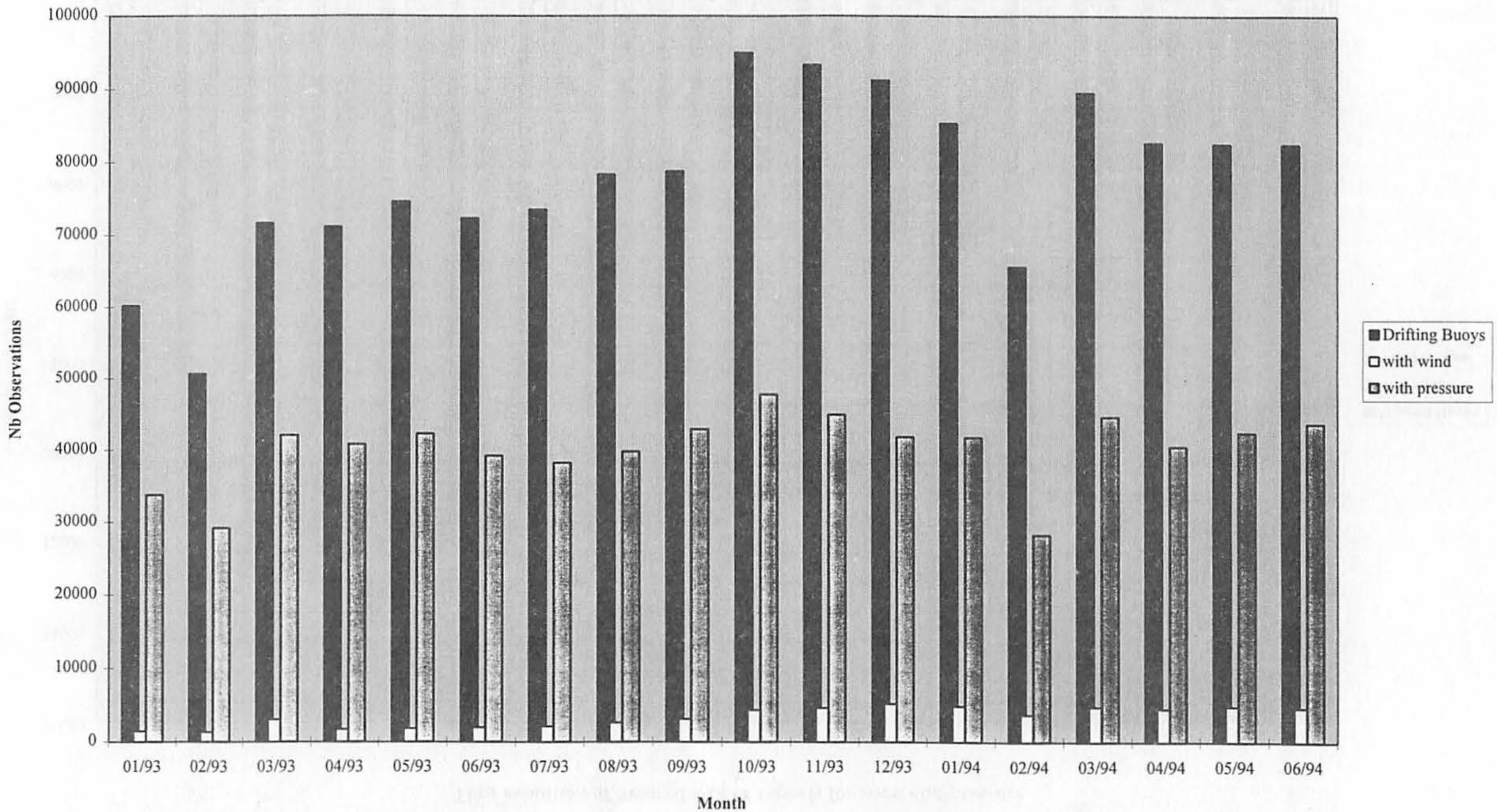


Figure 3

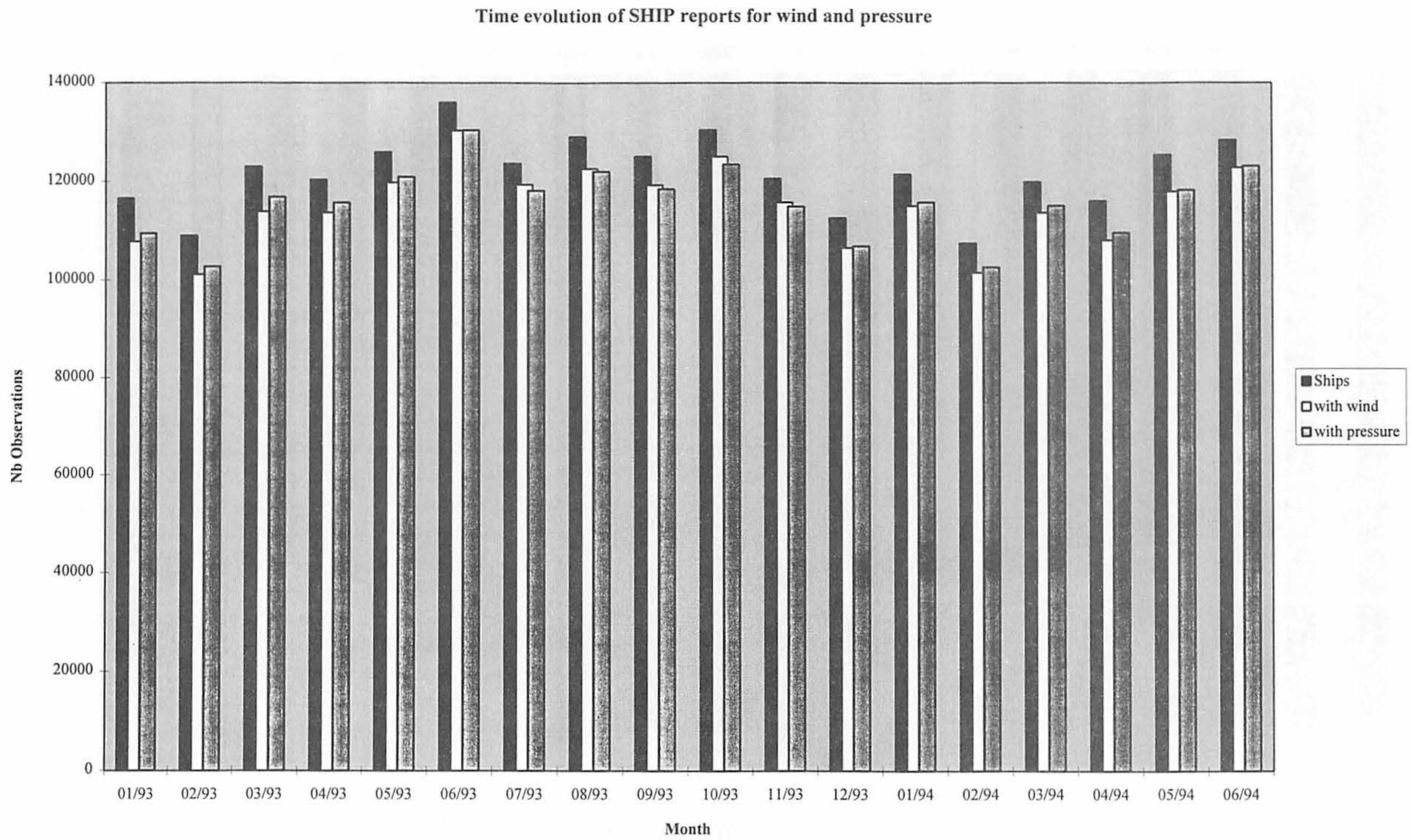

Time evolution of SHIP reports for wind and pressure
140000
120000
100000
80000
60000
40000
20000
0
Nb Observations
01/93
02/93
03/93
04/93
05/93
06/93
07/93
08/93
09/93
10/93
11/93
12/93
01/94
02/94
03/94
04/94
05/94
06/94
Month
Ships
with wind
with pressure

Figure 4

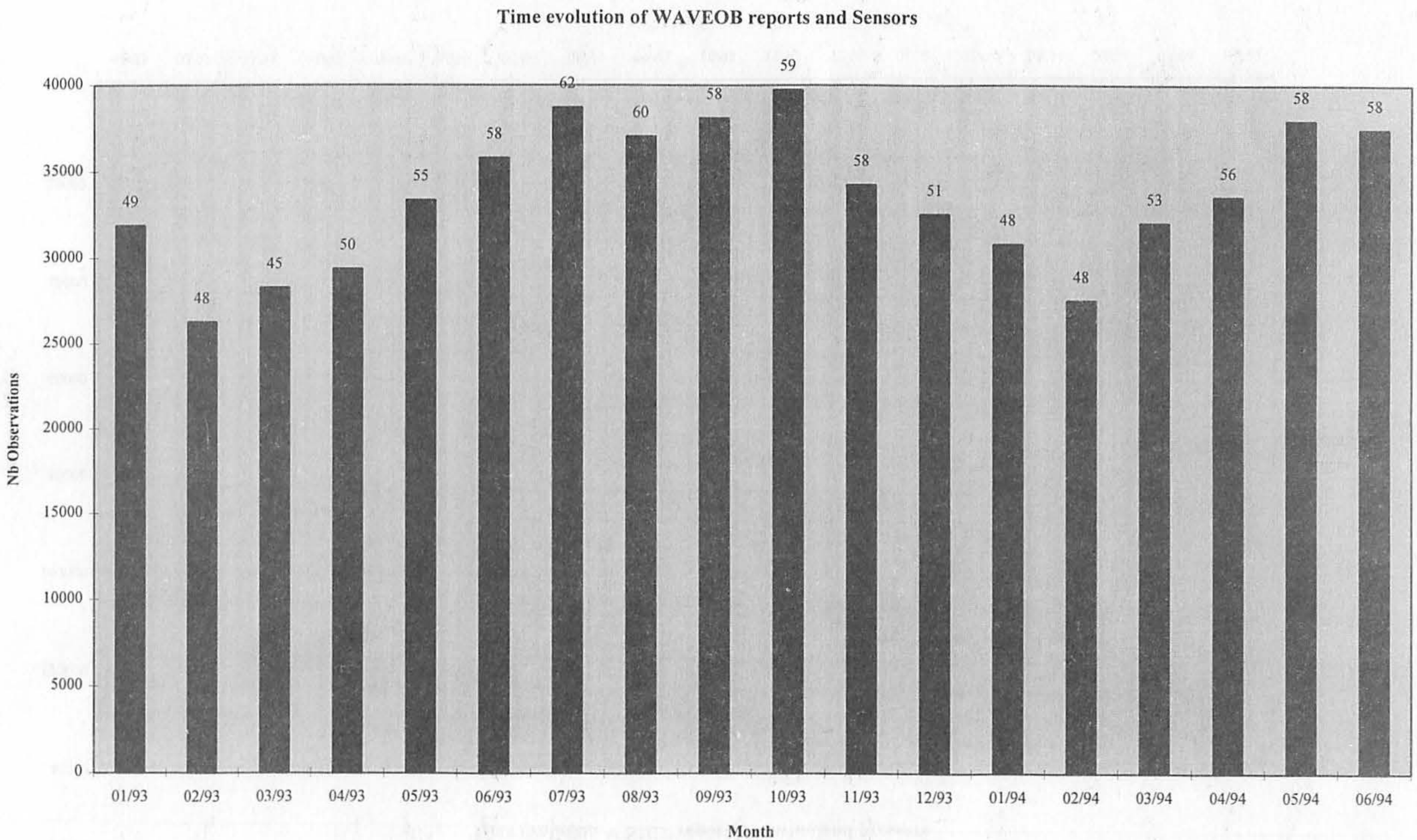

Time evolution of WAVEOB reports and Sensors
Nb Observations
40000
35000
30000
25000
20000
15000
10000
5000
0
49
48
45
50
55
58
62
60
58
59
58
51
48
48
53
56
58
58
01/93
02/93
03/93
04/93
05/93
06/93
07/93
08/93
09/93
10/93
11/93
12/93
01/94
02/94
03/94
04/94
05/94
06/94
Month

Figure 5

METEO FRANCE

METEO-FRANCE/SMISO FRENCH MET OFFICE/IGOSS

Repartition par carre Marsden des observations recues en Juin 1994

Marsden square distribution chart of data received during June 1994

Messages : SHIP Total : 128419

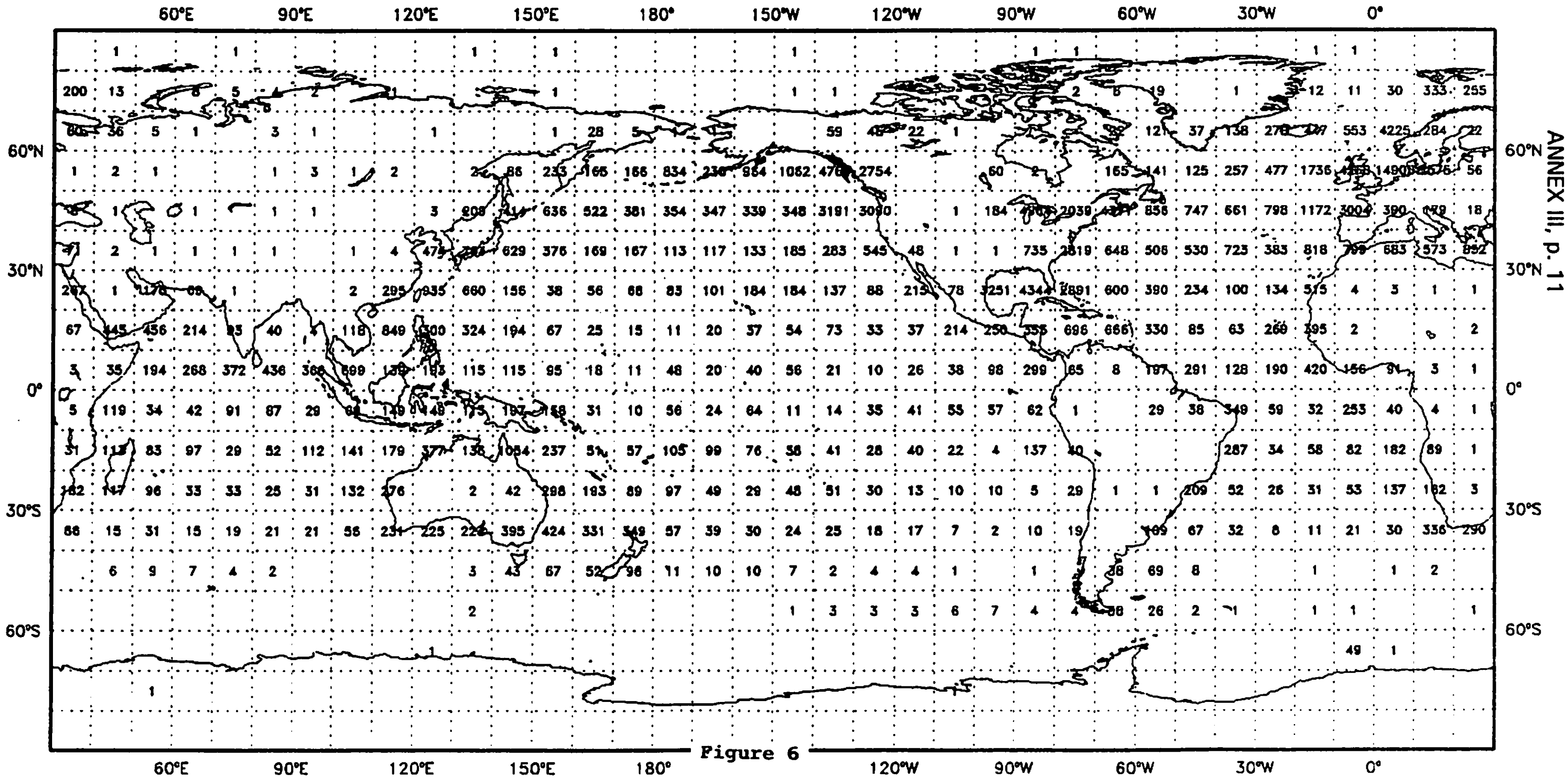


Figure 6

MAGICS 4.0 NOS/VE - SMISO23 15 July 1994 09:42:46

METEO FRANCE

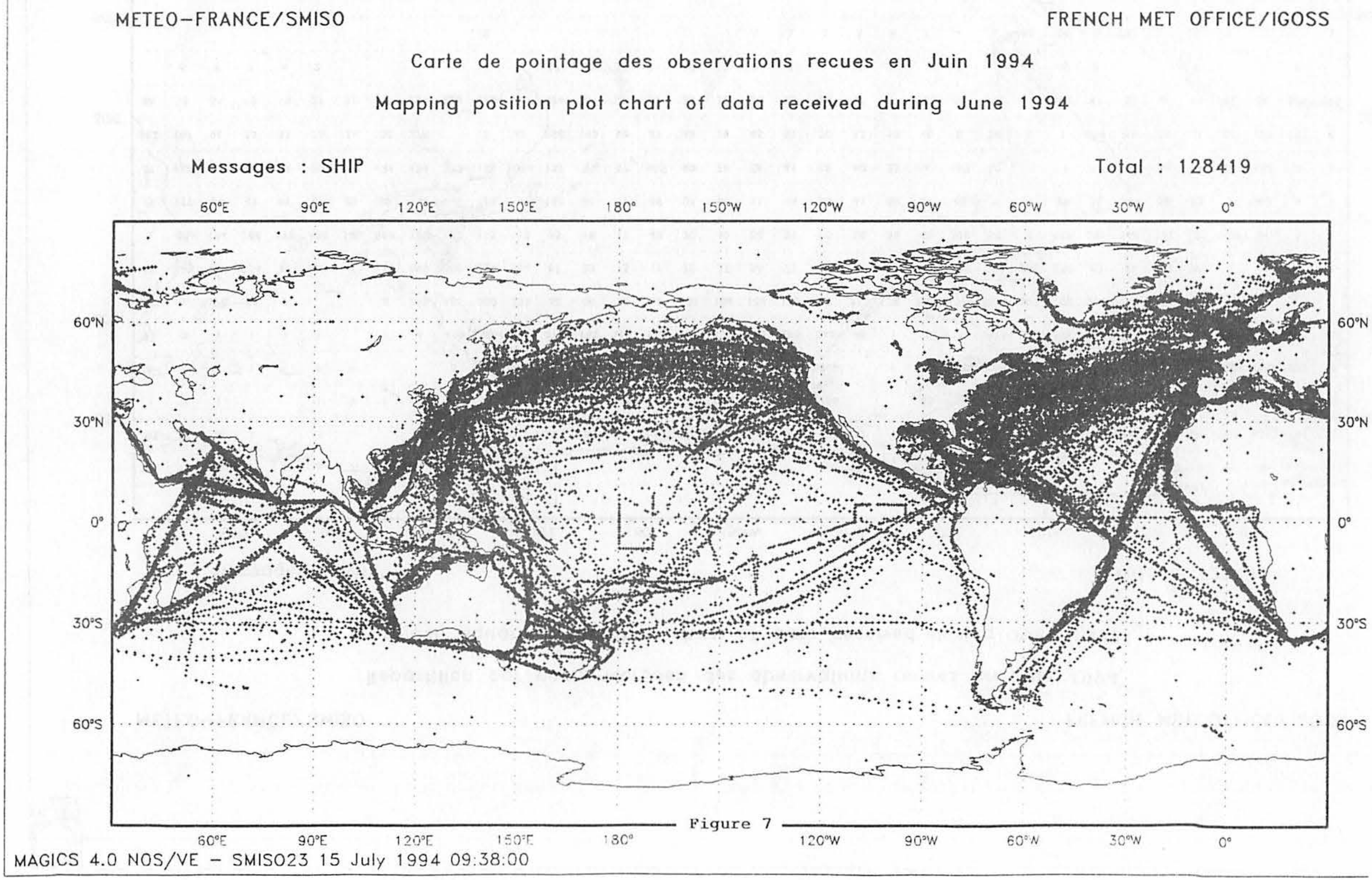


Figure 7

METEO FRANCE

METEO-FRANCE/SMISO

FRENCH MET OFFICE/IGOSS

Repartition par carre Marsden des observations recues en Juin 1994

Marsden square distribution chart of data received during June 1994

Messages : DRIFTER

Total : 94168

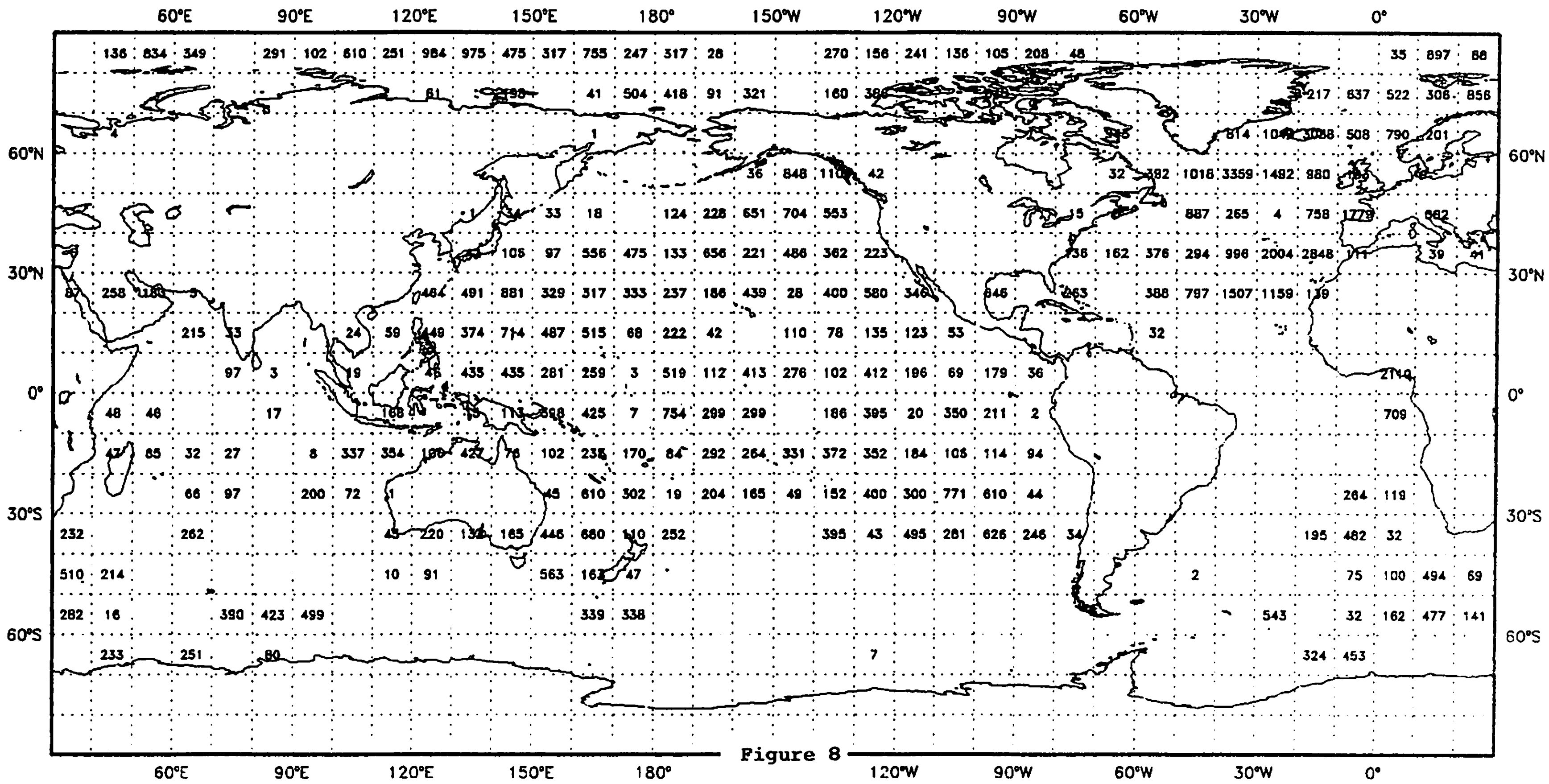


Figure 8

MAGICS 4.0 NOS/VE - SMISO23 15 July 1994 08:06:35

METEO-FRANCE/SMISO

FRENCH MET OFFICE/IGOSS

Carte de pointage des observations recues en Juin 1994

Mapping position plot chart of data received during June 1994

Messages : DRIFTER

Total : 94168

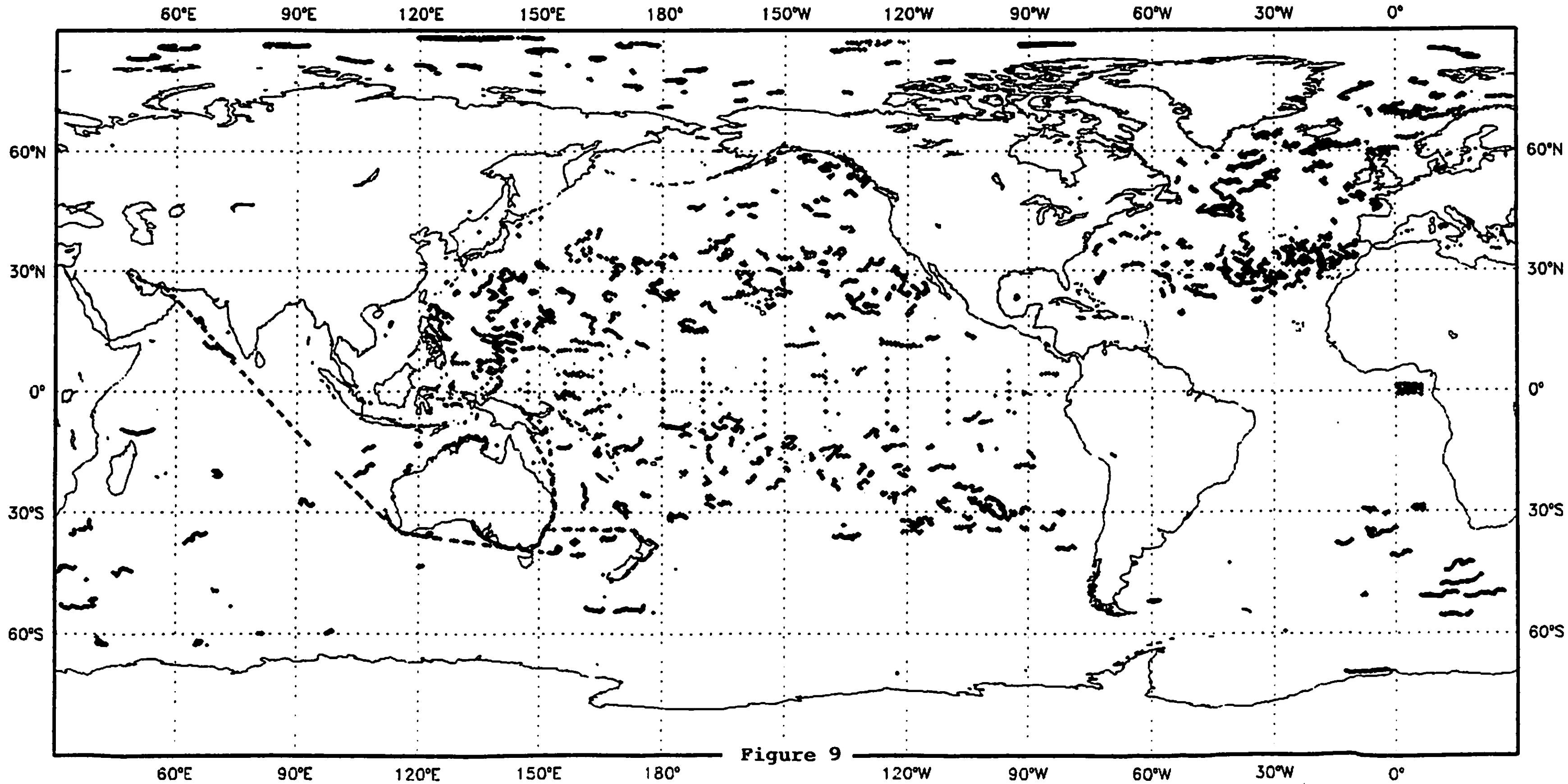


Figure 9

MAGICS 4.0 NOS/VE - SMISO23 15 July 1994 08:05:42

METEO
FRANCE

METEO - FRANCE **WIND** **JUNE 1994**

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and DRIFTER reports)
and
Percentage of DRIFTER reports compared to SHIP+DRIFTER reports (bottom)

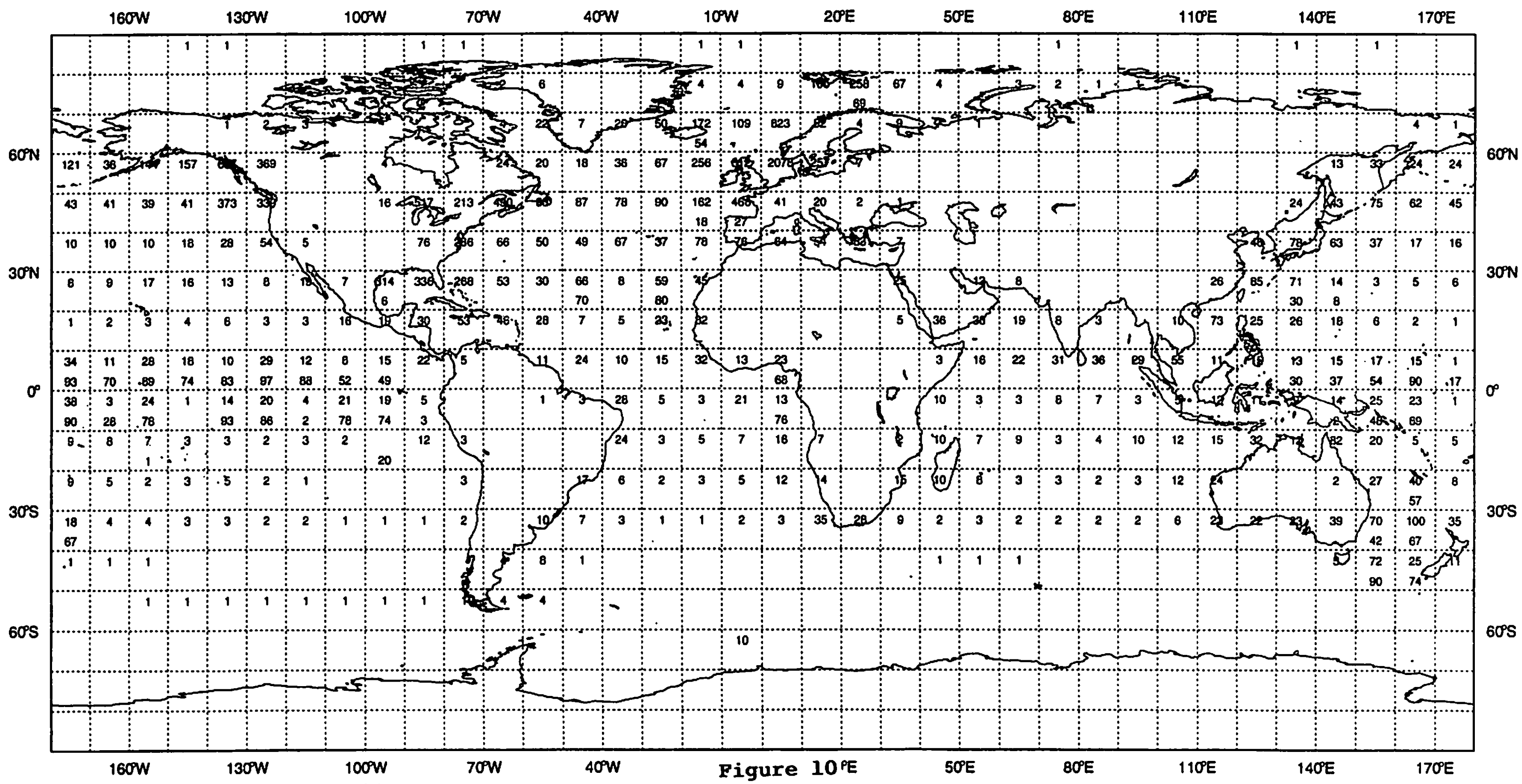


Figure 10

METEO FRANCE

METEO - FRANCE **PRESSURE** **JUNE 1994**

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and DRIFTER reports)
and
Percentage of DRIFTER reports compared to SHIP+DRIFTER reports (bottom)

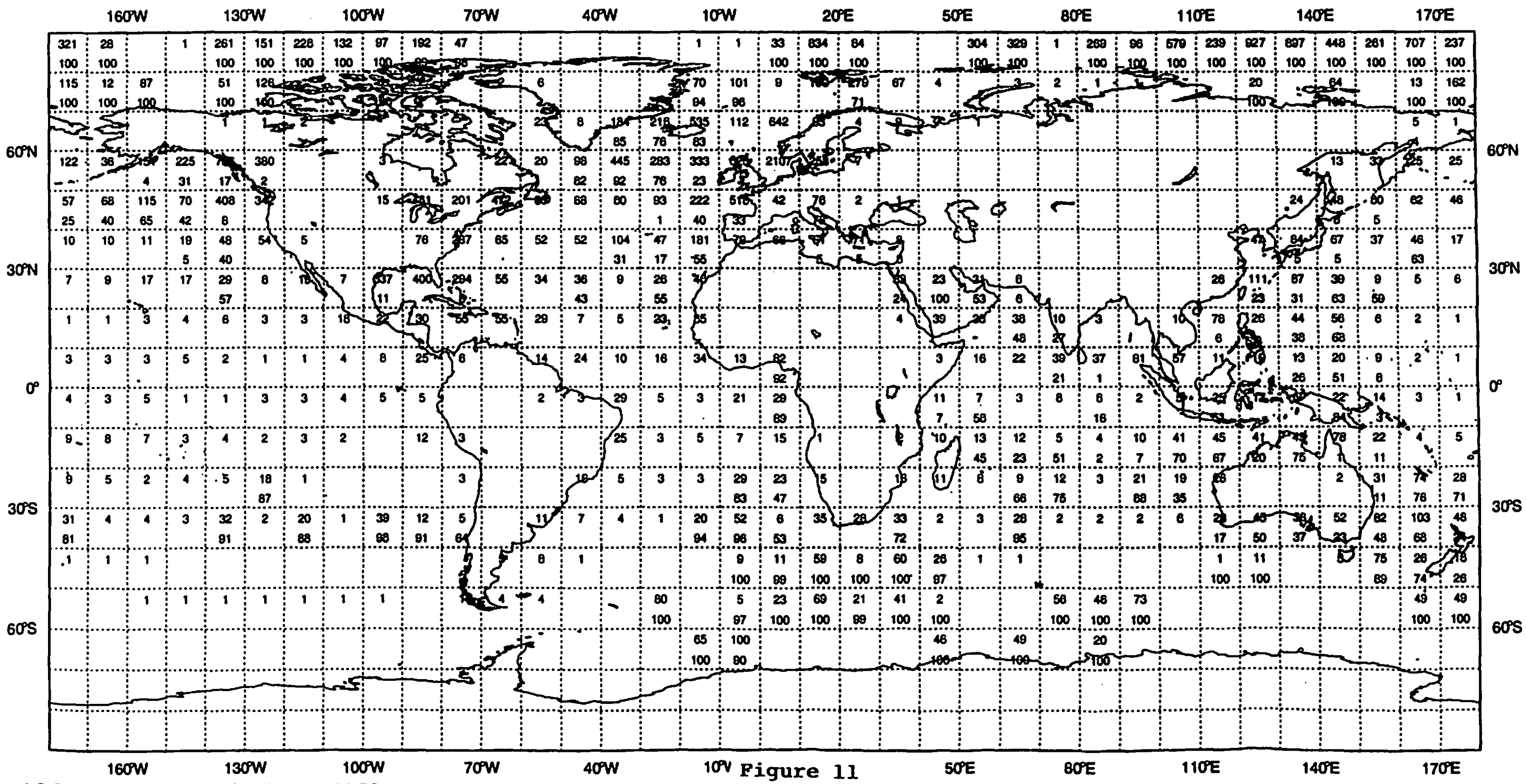


Figure 11

MAGICS 4.2 Solaris - ludjet - 4 July 1994 11:44:52

METEO FRANCE

METEO-FRANCE **TEMPERATURE** **JUNE 1994**

Marsden square distribution chart of mean monthly data availability index (top) (Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and DRIFTER reports) and Percentage of DRIFTER reports compared to SHIP+DRIFTER reports (bottom)

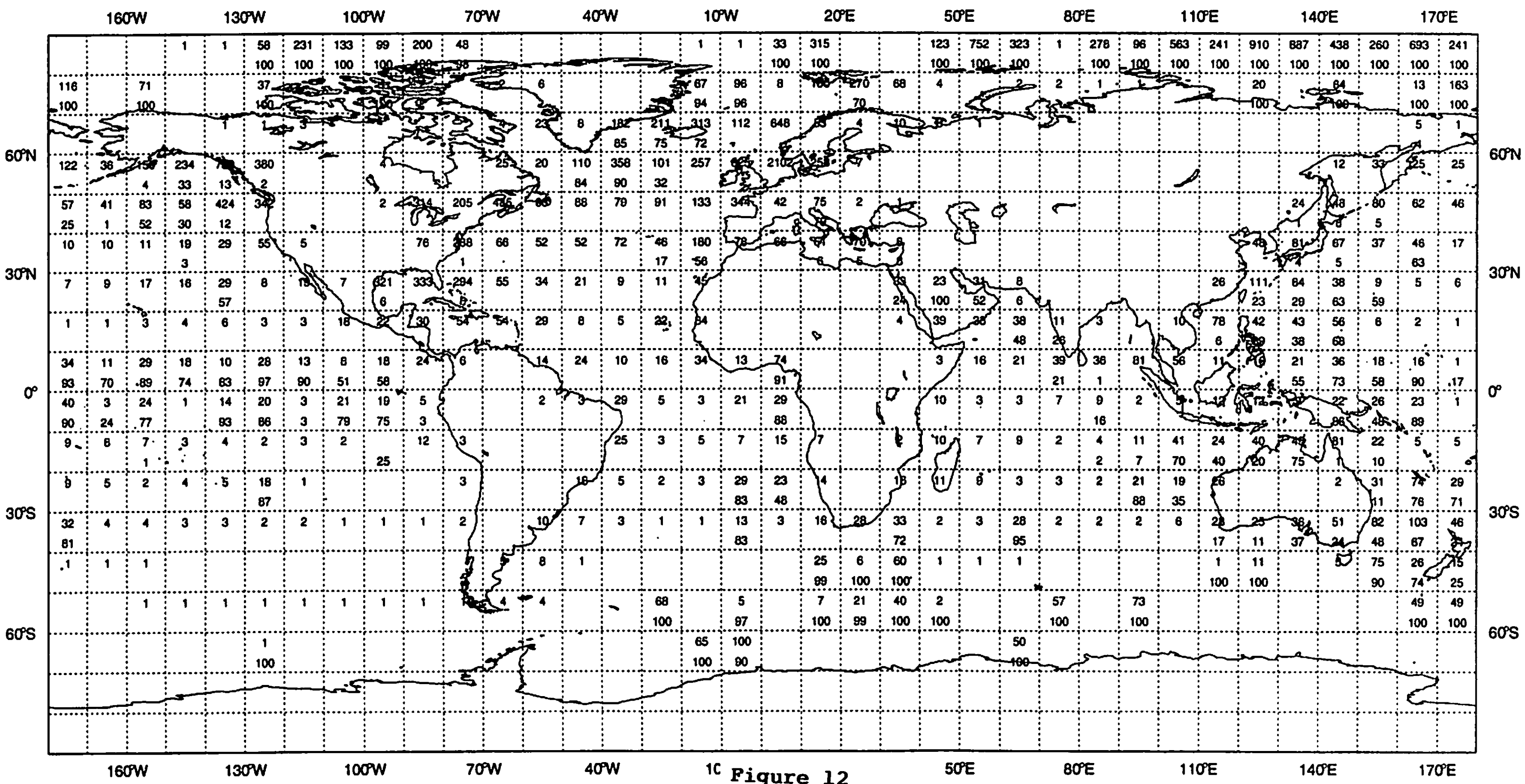


Figure 12

MAGICS 4.2 Solaris - ludjet - 4 July 1994 11:45:10

METEO FRANCE

METEO-FRANCE **SEA SURFACE TEMPERATURE** **JUNE 1994**

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and DRIFTER reports)
and
Percentage of DRIFTER reports compared to SHIP+DRIFTER reports (bottom)

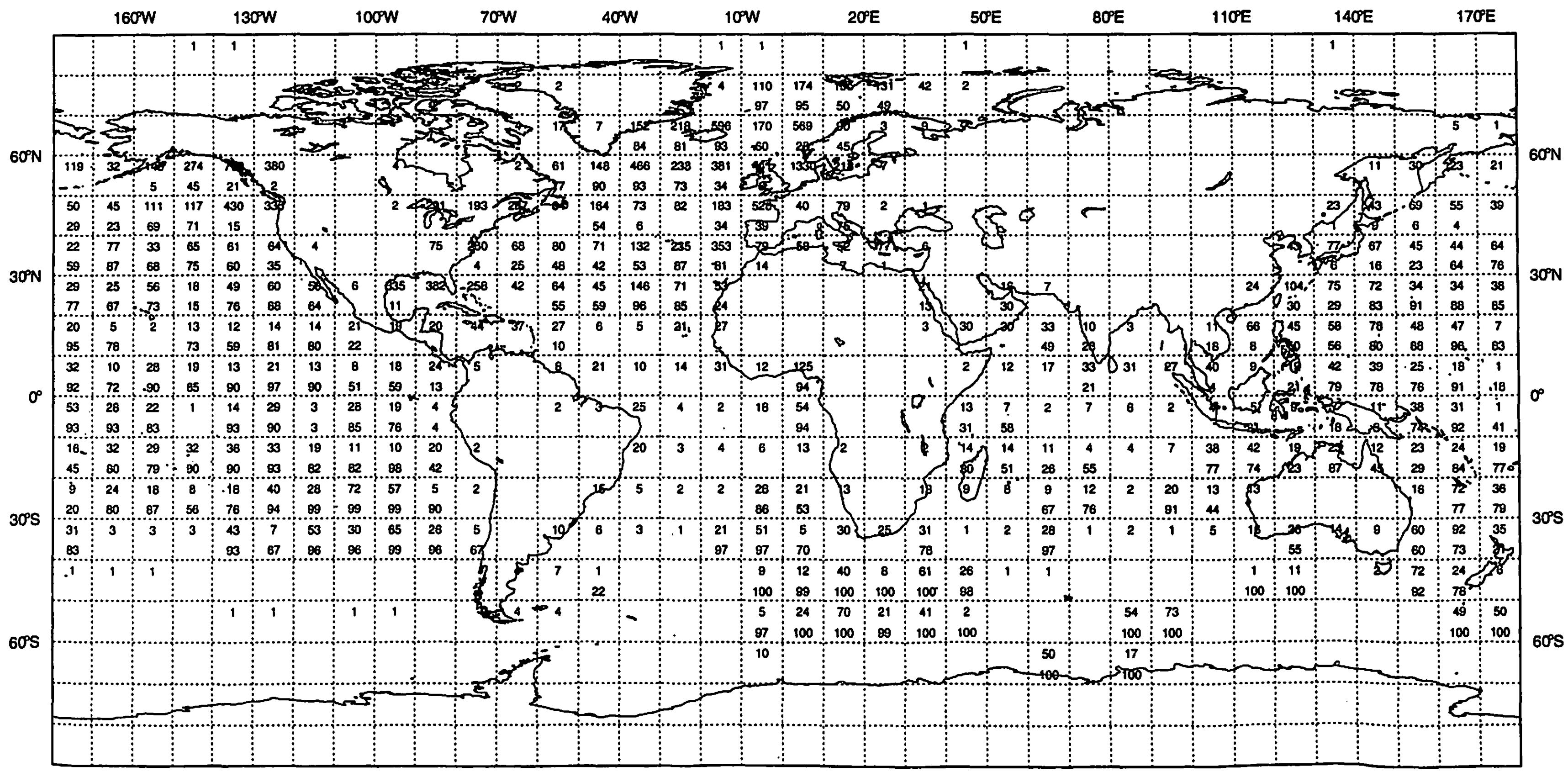


Figure 13

MAGICS 4.2 Solaris - ludjet - 4 July 1994 11:44:58

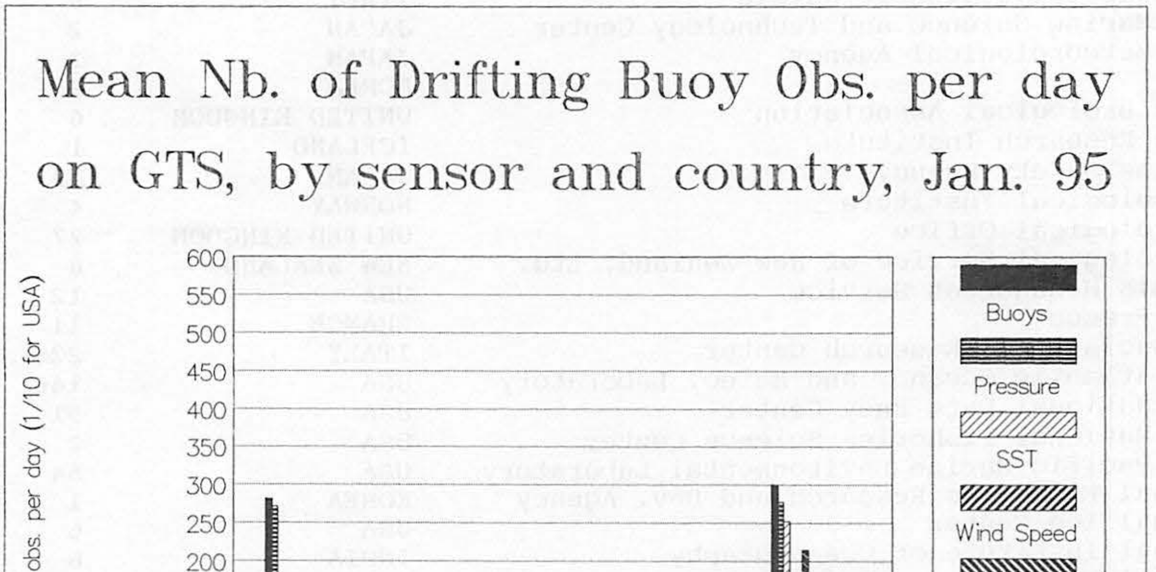
ANNEX IV

NUMBER OF DRIFTING BUOYS BY COUNTRY AND THOSE REPORTING VIA THE GTS

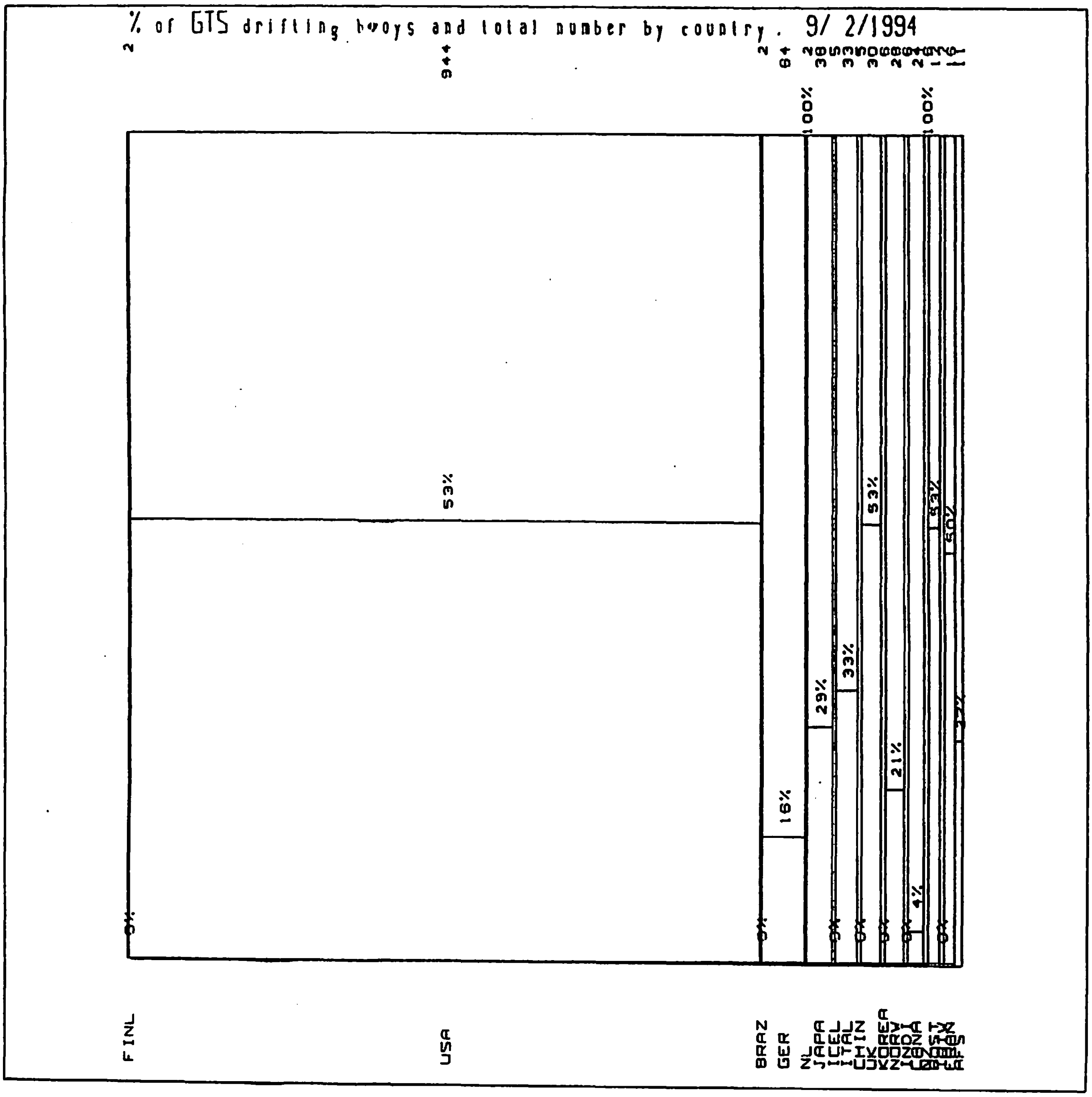
(as of January 1995 based on actual transmissions between 6 and 16 January 1995)

Organization	Country	Total	GTS
Antarctic CRC	AUSTRALIA	1	1
Bedford Institute of Oceanography	CANADA	6	0
Bermuda Biological Station for Research, Inc.	USA	1	0
Bureau of Meteorology	AUSTRALIA	10	9
CSIR - EMATEK	SOUTH AFRICA	31	0
CSIRO	AUSTRALIA	4	0
Christian Michelsen Research	NORWAY	3	2
Department of Fisheries and Oceans	CANADA	16	0
Environment Canada	CANADA	3	1
Fisheries Agency	JAPAN	1	0
IFREMER	FRANCE	5	0
INPE	BRAZIL	1	0
Institute of Marine Research	NORWAY	1	0
Institute of Ocean Sciences	CANADA	23	0
Instituto Universitario Navale	ITALY	9	0
Japan Marine Science and Technology Center	JAPAN	2	0
Japan Meteorological Agency	JAPAN	3	3
KORDI	KOREA	9	0
Marine Biological Association	UNITED KINGDOM	6	0
Marine Research Institute	ICELAND	1	0
Maritime Safety Agency	JAPAN	19	0
Meteorological Institute	NORWAY	4	3
Meteorological Office	UNITED KINGDOM	27	18
Meteorological Service of New Zealand, Ltd.	NEW ZEALAND	8	8
Minerals Management Service	USA	12	0
Météo France	FRANCE	11	7
NATO Saclant ASW Research Center	ITALY	22	17
NOAA, Atlantic Oceano. and Meteo. Laboratory	USA	146	108
NOAA, National Data Buoy Center	USA	51	43
NOAA, National Fisheries Science Center	USA	2	0
NOAA, Pacific Marine Environmental Laboratory	USA	54	21
National Fisheries Research and Dev. Agency	KOREA	1	0
National Ice Center	USA	6	2
National Institute of Oceanography	INDIA	8	0
National Taiwan Ocean University	TAIWAN	7	0
North Americal CLS, Inc.	USA	2	0
OCEANOR	NORWAY	11	0
Pohang Regional Marine and Port Administration	KOREA	2	0
Polar Institute	NORWAY	5	0
Royal Netherland Meteorological Institute	NETHERLANDS	3	3
Science Applications International Corporation	USA	8	1
Scripps Institution of Oceanography	USA	372	218
South African Weather Bureau	SOUTH AFRICA	22	18
South China Sea Sub-Bureau Of NBO	CHINA	2	0
Tokai University	JAPAN	3	0

US Naval Oceanographic Office	USA	92	48
US Coast Guards, International Ice Patrol	USA	25	4
US Naval Postgraduate School	USA	7	0
Univeristy of Hannover	GERMANY	7	6
University of Cambridge	UNITED KINGDOM	1	0
University of Hamburg	GERMANY	4	4
University of Hawaii	USA	27	14
University of Kiel, IFM	GERMANY	23	0
University of Miami	USA	26	0
University of New Hampshire	USA	1	0
University of Oregon	USA	11	2
University of Rhode Island	USA	2	0
Woods Hole Oceanographic Institution	USA	38	11
Total		1208	572
(% of Total)			(47.3



Distribution of GTS and non-GTS platforms by country



Total number of drifting buoys: 1246
Total number of drifting buoys reporting to the GTS: 587= 47.1%

ANNEX V

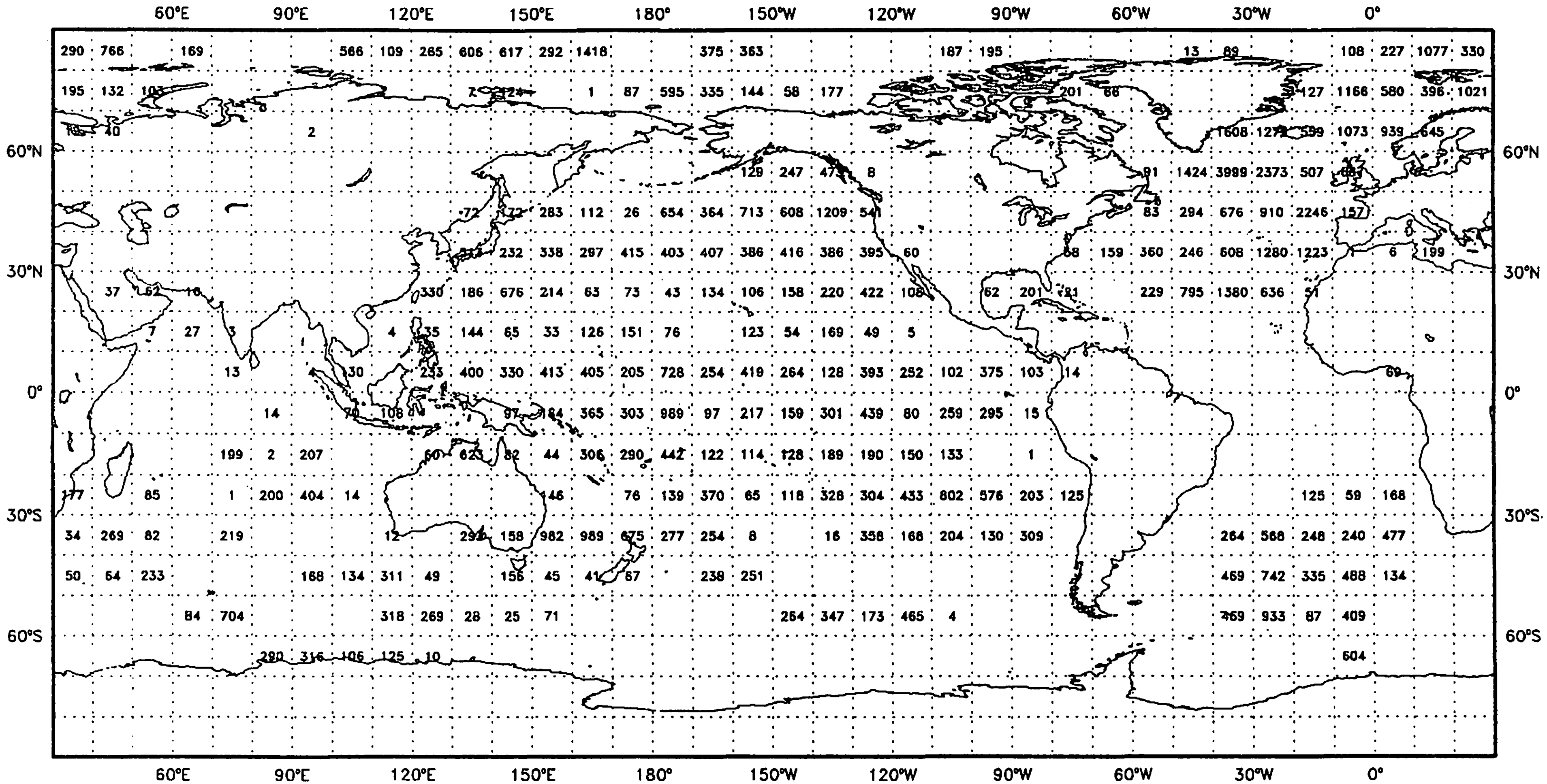
NUMBER OF BUOY REPORTS RECEIVED AT TOULOUSE DURING DECEMBER 1994

METEO–FRANCE/SMISO FRENCH MET OFFICE/IGOSS

Repartition par carre Marsden des observations recues en Decembre 1994

Marsden square distribution chart of data received during December 1994

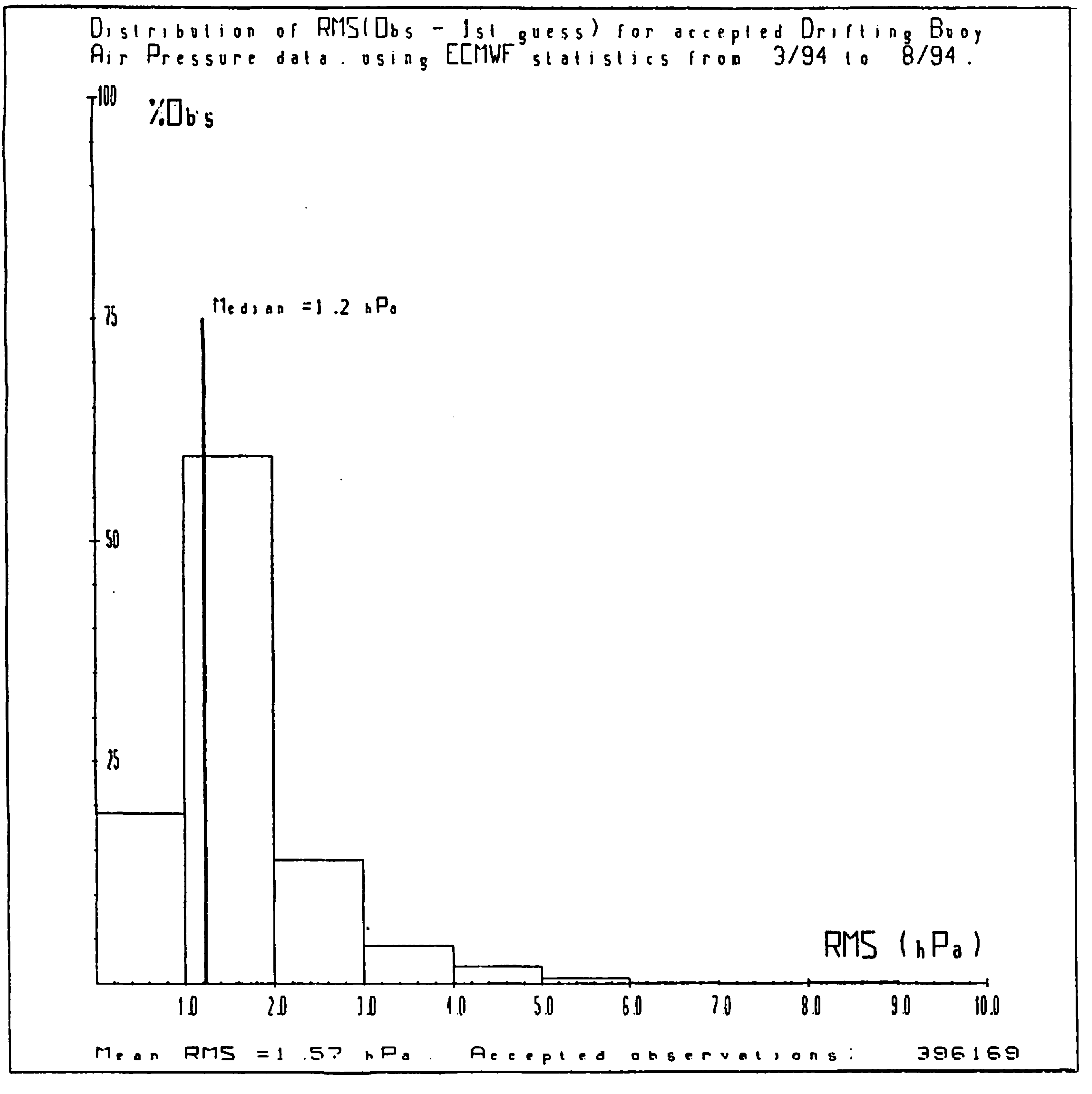
Messages : DRIFTER Total : 89218



ICS 4.0 NOS/VE – IGOSS23 4 January 1995 13:54:03

ANNEX VI

DISTRIBUTION OF STANDARD DEVIATION (RMS) FOR AIR PRESSURE DATA



ANNEX VII

AMENDED QUALITY CONTROL GUIDELINES FOR GTS BUOY DATA

These are principles adopted during previous DBCP sessions:

(i) Meteorological Centres are in the best position to undertake data Quality Control (DBCP VI).

(ii) Principal Investigators and Meteorological Centres share the responsibility of data Quality Control (DBCP VI).

(iii) The Technical Co-ordinator is in the best position to act as a focal point between GTS users and Principal Investigators (DBCP V, VI).

(iv) Argos is responsible for assuring that gross errors are automatically eliminated from reports distributed on GTS (DBCP VI).

In order to realize these principles, the following operating procedures or actions are proposed:

1. PGCs

Each Principal Investigator (PI) of an Argos buoy programme reporting data on GTS, designates a person responsible for making changes on PTT or sensor information present in the Argos GTS sub-system. This person is named the Programme GTS Co-ordinator (PGC). The PGC can, of course, be the PI himself but could also be a designated programme Technical Co-ordinator, as is done for the EGOS programme. If such a person does not exist as yet, for a given Argos Programme, the Technical Co-ordinator of the DBCP would contact the Principal Investigator and discuss the issue in order to find one. In a few cases, when a PI allows his platforms being distributed on GTS but does not want to be involved in the process, the Technical Co-ordinator could act as a PGC (i.e. the Technical Co-ordinator of the DBCP can directly ask Argos to make status changes).

2. PMOCs

The DBCP requests one or more Agencies or Institutions to volunteer for acting as Principal Meteorological or Oceanographic Centre responsible for deferred time GTS buoy data Quality Control (PMOC). PMOCs work on an operational basis, for given physical variables, either regionally or globally. The following centres are presently acting as PMOCs:

- The Australian Bureau Of Meteorology (BOM, Melbourne, Australia);
- The Centre de Météorologie Marine (Météo-France, Brest, France);
- The European Centre for Medium Range Weather Forecasts (ECMWF, Reading, United Kingdom);

- The Icelandic Meteorological Office (IMO, Reykjavik, Iceland);
- The Japan Meteorological Agency (JMA, Tokyo, Japan);
- The Meteorological Center of New Zealand, Ltd. (NZMS, Wellington ,New Zealand);
- The National Data Buoy Center (NOAA/NDBC, Stennis Space Center, Mississippi, USA);
- The Ocean Product Center (NOAA/OPC, Camp Spring, Maryland, USA);
- The United Kingdom Meteorological Office (UKMO, Bracknell, United Kingdom).

The participation of the following centres is desired for acting as PMOC:

- The South African Weather Bureau (SAWB, Pretoria, South Africa).

National Focal Points for Drifting Buoy Programmes are requested to designate National PMOCs, and possibly to act themselves as PMOCs.

3. INTERNET distribution list.

It is proposed that the mechanism for exchanging QC information among the Guidelines Participants shall be an INTERNET distribution list. PMOCs send the proposed messages to a unique INTERNET address which name is BUOY-QC@node_path. "node_path" depends upon who actually operates the distribution list. The full INTERNET address of the Distribution List shall be circulated among the Guidelines participants. The messages are then automatically forwarded to all the individual addresses from a maintained distribution list. Adding, reading, modifying, or deleting a name form the list can be done via INTERNET messages according to an agreed format.

3.1 ECMWF, OPC, METEO FRANCE, and UKMO monitoring statistics are delivered onto the INTERNET Distribution List.

3.2 Any suggestion for modification (i.e. recalibrate or remove sensor from GTS) or any problem noticed (e.g. bad location) on a drifting buoy reporting data on GTS should be placed on the Distribution List. Meteorological Centres are encouraged to make such suggestions.

3.3 Any feed back available on a recalibration actually implemented shall be placed on the distribution list.

4. Operating Procedures for dealing with Potential Problems on GTS (Drifting and Moored Buoy data)

4.1 PMOCs noticing potential problems on GTS can suggest an action via the INTERNET Distribution List. A standardized, telegraphic format is proposed (see Appendix): one message per platform or per sensor, showing the WMO number and the proposed change, directly in the "subject" line, with additional comments appearing in the text itself, using a free format if felt necessary by the PMOC (see example in Appendix).

4.2 PMOCs noticing bad location or bad sensor data episodically appearing on GTS message can copy the message on the INTERNET Distribution List, indicating from which source the message was transmitted. Although it is recommended that LUT operators access to the INTERNET Distribution List as well, if not possible, the Technical Co-ordinator of the DBCP or the responsible PGC or a designated PMOC (see paragraph 4.7.2) would keep them informed by telefax or another mean.

4.3 A 7-day delay is respected by the Technical Co-ordinator of the DBCP before he actually contacts the PGC to propose the change, so that other meteorological centres may also have the opportunity to comment on the suggestion. In that case, the Technical Co-ordinator of the DBCP is given the responsibility to decide which request to consider. Other data users who are on the INTERNET Distribution List are encouraged to check the received messages regularly.

4.4 Then, if the PGC accepts the modification, he requests the adequate Argos center (i.e. CLS or SAI) to make the change. In order to keep the GTS user community informed, Service Argos announces the change as soon as possible by means of the INTERNET Distribution List (a standardized message is proposed in the Appendix) and also effects the change as prescribed. It is recommended that the PGC also requests appropriate LUTs to implement the same changes.

4.5 If the PGC is not willing to go ahead with a proposed change, the Technical Co-ordinator of the DBCP deposits a standardized message on the INTERNET Distribution List (see Appendix) in order to inform PMOCs.

4.6 Local User Terminals are urged to adopt these Quality Control Operating Guidelines.

4.6.1 It is desirable that LUTs not willing to participate should distribute drifting buoy data on GTS only to local users (i.e. no global GTS distribution).

4.6.2 LUT operators participating and registered on the INTERNET Distribution List are encouraged to inform the participants back by the mean of the Distribution List each time a change is implemented, using the same format as Argos (see paragraph 4.4). If LUTs are not on the Distribution List, they would be encouraged to inform the Technical Co-ordinator of the DBCP of actual changes so that he can forward adequate messages onto the Distribution List.

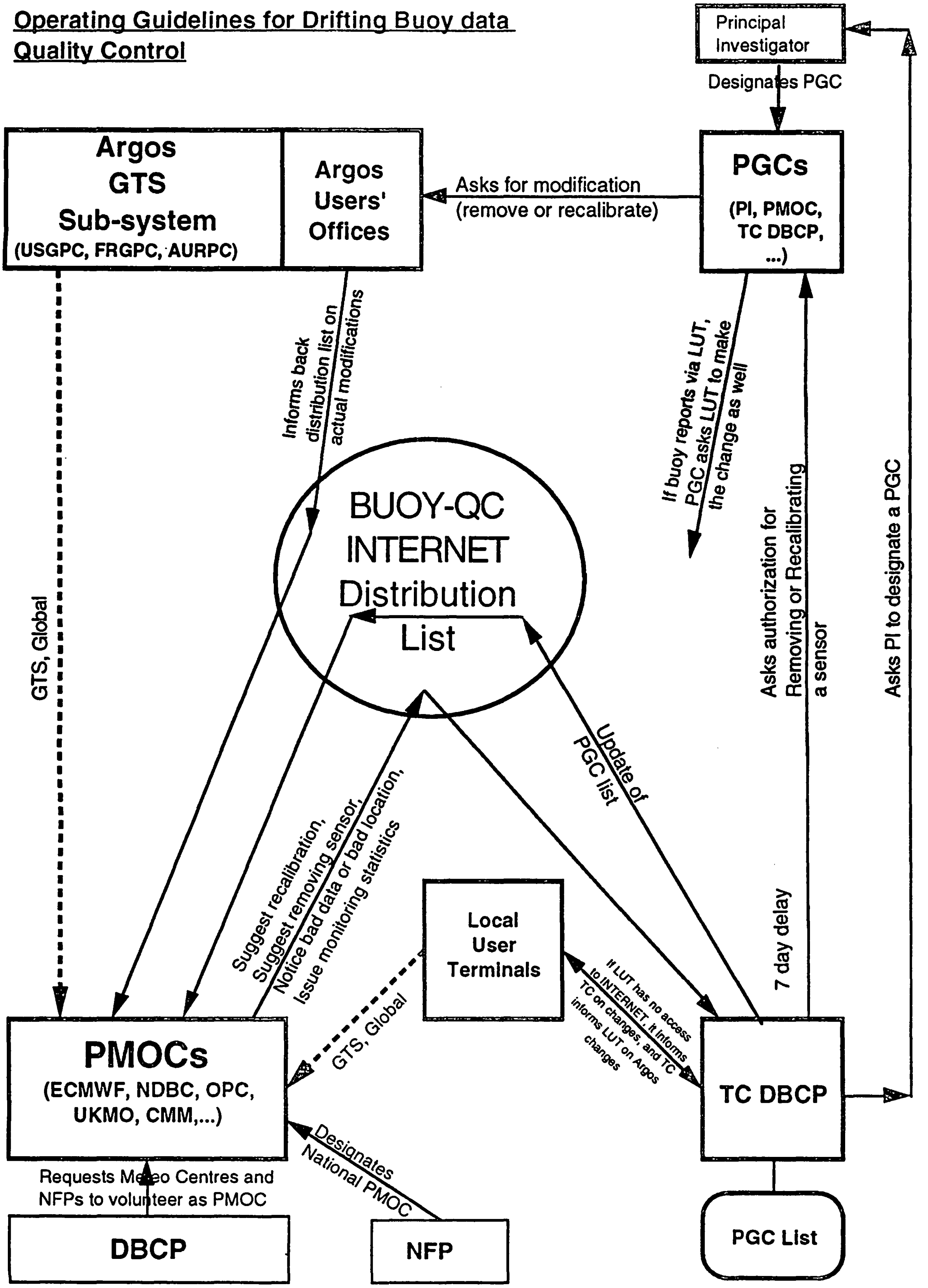
5. List of PGCs

This list is published by the Technical Co-ordinator of the DBCP on a monthly basis. It is forwarded onto the INTERNET Distribution List and sent by regular mail.

6. DBCP, WMO and IOC Secretariats

They will promote these Quality Control operating guidelines and encourage participation in this scheme.

Operating Guidelines for Drifting Buoy data Quality Control



ANNEX

Standardized Format for Information Deposited on the INTERNET Distribution List

<u>Notations</u>:

-1- UPPERCASES in **bold** are constant field values and will appear "as shown" in the subject line; e.g. **ASK** will appear as the 3 characters 'ASK' in the subject line.

-2- Lowercases are used to designate variable data fields; If the name of the field is on 5 characters, then the field value must be coded using 5 characters (completed with spaces if necessary); e.g. ttt can be coded as '**AP** ' to indicate Air Pressure or as '**SST**' to indicate Sea Surface Temperature.

-3- The line 12345678901234567890123456789012 is just here to indicate the number of characters used (32 maxi) and their position; It has no other specific meaning.

1. <u>Proposals for status change</u> (by Meteo Centres, i.e. PMOCs):

When detecting bad data circulating on GTS, Meteorological Centres can propose changes on buoy status (remove or recalibrate sensor) via the INTERNET Distribution List. Proposals are done using a standardized telegraphic format in the subject line. Comments can be added in the body text.

Format:

1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
h	**A**	**S**	**K**		t	t	t		w	m	o	#	#	p	p	p		o	v	a	l	u	e					

Meaning:
It is proposed to remove or recalibrate one or more sensors for one given buoy.

h : One figure, **1** to **9**, to indicate the number of the request for the same buoy, for example, the first proposal would be coded **1ASK**..., and if another Meteo Centre feels necessary to comment on the same proposal, it can suggest another action and name it **2ASK**, etc...

ttt : Type of proposal:
- **RMV** : for removing sensor data from GTS
- **REC** : for recalibrating a sensor
- **CHK** : for checking data carefully; in that case, it is recommended to add in the body text of the message: (1) Example(s) of the suspicious or erroneous GTS message(s), (2) the GTS bulletin header that was used (i.e. originating centre for the bulletin), (3) a description of the problem and (4) if possible, proposed action to solve it.
- **COM** : for commenting on a particular problem. Explanation is given in the body text of the message.

wmo## : WMO number of the buoy ($A_1 b_w n_b n_b n_b$) or **LIST** if more than one buoy are concerned.

It is preferable to make status change proposals for different buoys on distinct messages. However, in case the **LIST** option is used, proposals can be detailed in the body text of the message: it is recommended to state the proposal for each buoy by starting with a line encoded according to the standard format followed by the comments on a few lines included inside brackets; then the next proposal can be listed etc.. General comments can be included in free format after the last proposal.

Example for the body text in case more than one proposal are included (subject line could be 1ASK CHK LIST AP):

1ASK CHK 61412 AP
(this buoy has been transmitting erroneous data
in the last 2 week)

1ASK CHK 54814 AP
(this buoy shows strong departure of Air Pressure
from the first guess field)
...
Mr. W. Xyz., National Meteorological Service.

ppp : Physical variable (sensor) to consider:

- **AP** : Air Pressure (coded as '**AP** ')
- **AT** : Air Temperature (coded as '**AT** ')
- **SST** : Sea Surface Temperature
- **WD** : Wind Direction (codes as '**WD** ')
- **WS** : Wind Speed (coded as '**WS** ')
- **APT** : Air Pressure Tendency
- **POS** : Position of the buoy
- **TZ** : Subsurface temperatures (coded as '**TZ** '): The depths of the probes and proposed actions should be placed in the body text, not in the subject line (not enough room)
- **ALL** : All buoy sensors (e.g. remove all buoy data from GTS)
- **Blank** : (coded as 3 space characters, i.e. '   ') Informations are detailed in the body text.

o : Operator to use for proposed recalibration (mandatory and used only when ttt='**REC**'):

- + : Add the following value to the calibration function
- - : Subtract the following value from the calibration function
- * : Multiply the calibration function by the following value (e.g. rate for recalibrating wind speed sensor)

value: Value to use for proposed recalibration (mandatory and used only when ttt='**REC**'); the value is coded on 5 characters and completed with space characters if necessary. It is provided using the following physical units:

Air Pressure : Hecto Pascal

Temperatures :	Celsius degrees
Wind speed :	m/s
Wind Direction :	Degrees
Air Pressure Tendency :	Hecto Pascal
Positions :	Degree + Hundredth
Rate :	No unit

Examples:

From	Date	Subject				
FLETCHER@METDP1.MET.CO.NZ	10-Oct-1994	1ASK	REC	17804	AP	+2.2
ARADFORD@EMAIL.METO.GOVT.UK	11-Oct-1994	1ASK	RMV	62501	ALL	
BLOUCH@IFREMER.FR	11-Oct-1994	2ASK	REC	17804	AP	+2.4
MBURDETTE@NDBC.NOAA.GOV	11-Oct-1994	1ASK	CHK	44532	POS	
GXB@ORVILLE.HO.BOM.GOV.AU	12-Oct-1994	1ASK	REC	44704	WS	*1.5

Message1: NZMS proposes to recalibrate Air Pressure sensor of buoy 17804 by adding 2.2 hPa.

Message2: UKMO proposes to remove buoy 62501 from GTS distribution. Explanations are given in the body text.

Message3: Meteo France comments (2ASK) on NZMS proposal for recalibrating air pressure sensor of buoy 17804. Meteo France suggests to add +2.4 hPa instead of +2.2 hPa. Argumentation is provided in the body text.

Message4: NDBC suggests to check positions of buoy 44532. Details are given in the body text, including copy of one suspicious GTS message, the GTS bulletin header, and a description of the error.

Message5: BOM proposes to recalibrate Wind speed sensor of buoy 44704, by multiplying data by 1.5.

2. Argos or LUT answer for changes actually implemented

When a change is implemented on GTS platforms, a message is normally forwarded to the INTERNET Distribution List, by Argos or the considered LUT, no later than 24 hours after the change was implemented. All the information is encoded in the subject line, the body text is empty. The format of the subject line is as follow:

Format:

```
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
c c c c   t t t   w m o # # p p p   o v a l u e   y y m m d d h h m m
```

Meaning:
Argos (i.e. the French Global Processing Center of Toulouse (FRGPC) or the US Global Processing Center of Landover (USGPC)) or Local User Terminals (LUT) inform the INTERNET Distribution List each time a change is actually implemented on a buoy status.

cccc : Originating Center:
- **LFPW** = FRGPC, Toulouse
- **KARS** = USGPC, Landover
- **ENMI** = Oslo LUT
- **BGSF** = Sondre Stromfjord LUT
- **CWEG** = Edmonton LUT

ttt, wmo##, ppp, ovalue: Same as for paragraph 1. In addition, for recalibrations, when the transfer function has been completely modified, ovalue can be coded as a question mark followed by 5 space characters, i.e. '?   ' , to indicate that the change is not as simple as a +X, -X or *X transformation.

yymmddhhmm: UTC time the change was implemented: Format=Year (2 digits), Month (2 digits), Day of the month (2 digits), Hour (2 digits), and Minutes (2 digits).

Example:

From	Date	Subject
GTS@GTSVAX.ARGOSINC.COM	14-Oct-1994	KARS REC 17804 AP +2.3 9410141216
GTS@GTSVAX.ARGOSINC.COM	14-Oct-1994	KARS REC 33809 AP ? 9410141306

Message6: Buoy 17804 Air Pressure sensor was recalibrated by adding +2.3 hPa. the change was implemented at 12h16 UTC the 14 October 1994. As you may notice, two proposal had been made for this buoy: NZMS proposed +2.2 hPa and Meteo France proposed 2.4 hPa. The Technical Co-ordinator of the DBCP contacted both agencies and it was then decided to apply a 2.3 hPa correction.

Message7: Buoy 33809 Air Pressure sensor was recalibrated. The change was implemented at 13h06UTC the 14 October 1994. The question mark '?   ' indicates that the transfer function was completely modified.

3. PGC Answer if the proposal was denied

Format:

```
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
D E N I   t t t   w m o # # p p p   o v a l u e
```

Meaning:
The proposal was denied by the Principal GTS Co-ordinator (PGC) of the drifting buoy programme. No action was taken. Complementary information can be included in the body text.

ttt, wmo##, ppp, ovalue: same meaning as in paragraph 1. ovalue is mandatory and used only when ttt='**REC**'.

Example :

From	Date	Subject
BLOUCH@IFREMER.FR	15-Oct-1994	DENI RMV 62501 ALL

Message8: In the body text: Data were sent on GTS before deployment by mistake. The buoy is now deployed and data look good. There is therefore no need for removing data from GTS distribution.

4. Monitoring Statistics

Format:

```
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
S T A T   c e n t e r   p p p   y e a r   m m   d d
```

Meaning:
The monitoring statistics are available in the body text. Format is free for the moments but it is recommended that each center uses the same format all the time.

center: Name of the center producing the statistics, e.g.
- **ECMWF** = European Center for Medium Range Weather Forecasts
- **OPC** = NOAA Ocean Products Center
- **CMM** = Météo France, Centre de Météorologie Marine
- **UKMO** = United Kingdom Meteorological Office

ppp: Type of physical variable concerned or **ALL** if many variables are included. Same as for paragraph 1 (i.e. **AP, AT, WD, WS, SST** ...)

year: Year concerned (e.g. **1994**)

mm: Month concerned (e.g. **08** for August)

dd: Last day of the 1-month period concerned. It is optional and used only if the 1-month period does not end on the last day of the month. For example dd=**15** if the 1-month period concerned is 16 July to 15 August.

Example :

From	Date	Subject
BLOUCH@IFREMER.FR	02-Oct-1994	STAT CMM ALL 1994 09

Message9: The September 1994 monitoring statistics for many geo-physical variable and produced by the Centre de Météorologie Marine of Météo France are available in the body text.

5. WMO/Argos cross reference list

Format:

1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
W	M	O	S		y	e	a	r		m	m													

Meaning:
The WMO/Argos cross reference list sorted by WMO numbers is available in the body text.

year: Year concerned (e.g. **1994**)

mm: Month concerned (e.g. **08** for August)

Example :

From	Date	Subject
CHARPENTIER@ATLAS.CNES.FR	02-Oct-1994	WMOS 1994 09

Message10: The September 1994 WMO/Argos cross reference list is available in the body text.

6. Principal GTS Coordinators (PGC) list

Format:

1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
P	G	C	S		y	e	a	r		m	m													

Meaning:
The list of Principal GTS Cordinators (PGC) sorted by Argos program number is available in the body text. The Principal GTS Coordinators are designated by the owners of the buoys for being responsible to request Service Argos and/or LUT operators to implement required status changes.

year: Year concerned (e.g. **1994**)

mm: Month concerned (e.g. **08** for August)

Example :

From	Date	Subject
CHARPENTIER@ATLAS.CNES.FR	02-Oct-1994	PGCS 1994 09

Message11: The September 1994 list of Principal GTS Coordinators is available in the body text.

7. Information message

Format:

```
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
I N F O   s u b j e c t . . .
```

Meaning:
An information message in free format is included in the body text.

subject...: Subject of the message (free format)

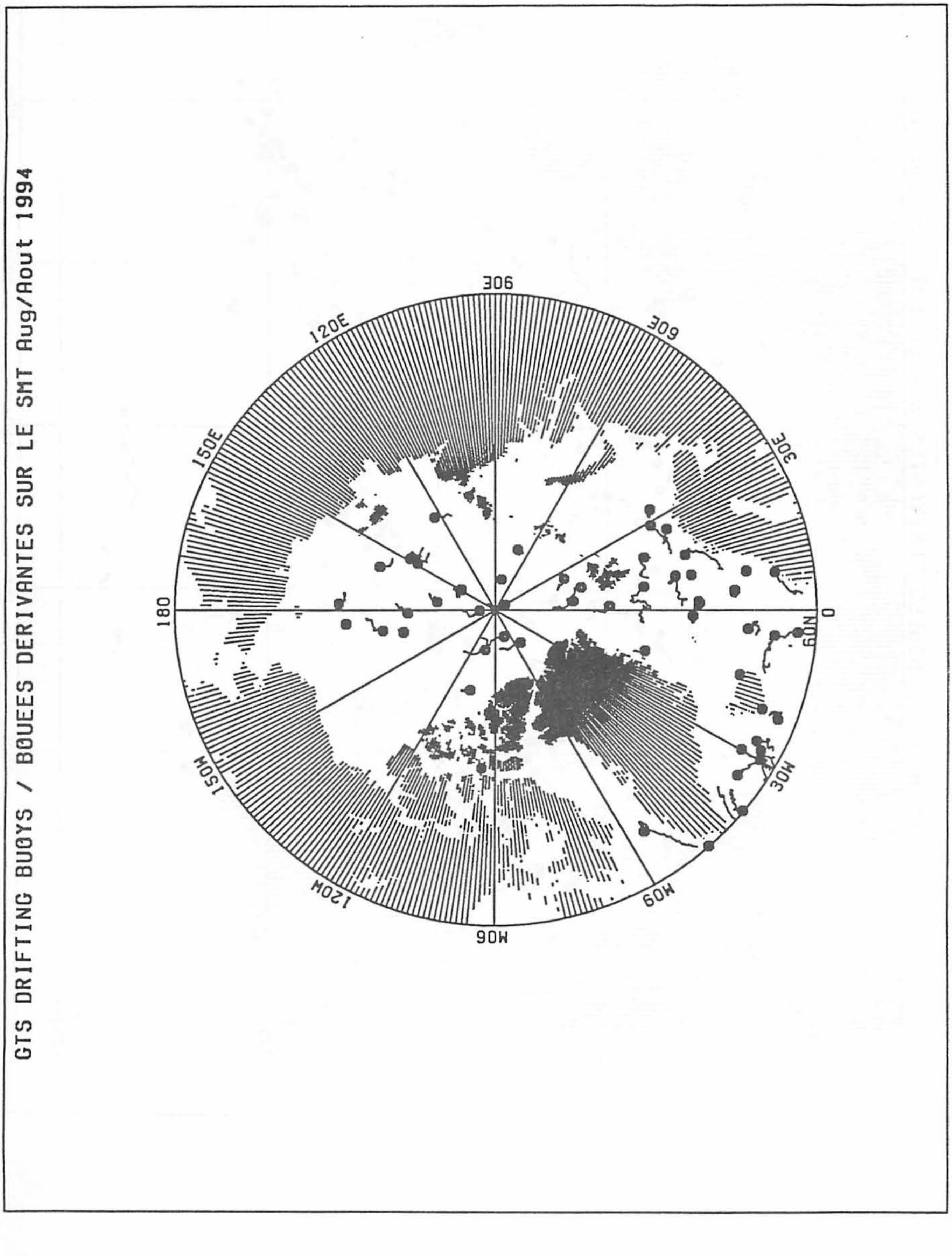
Example :

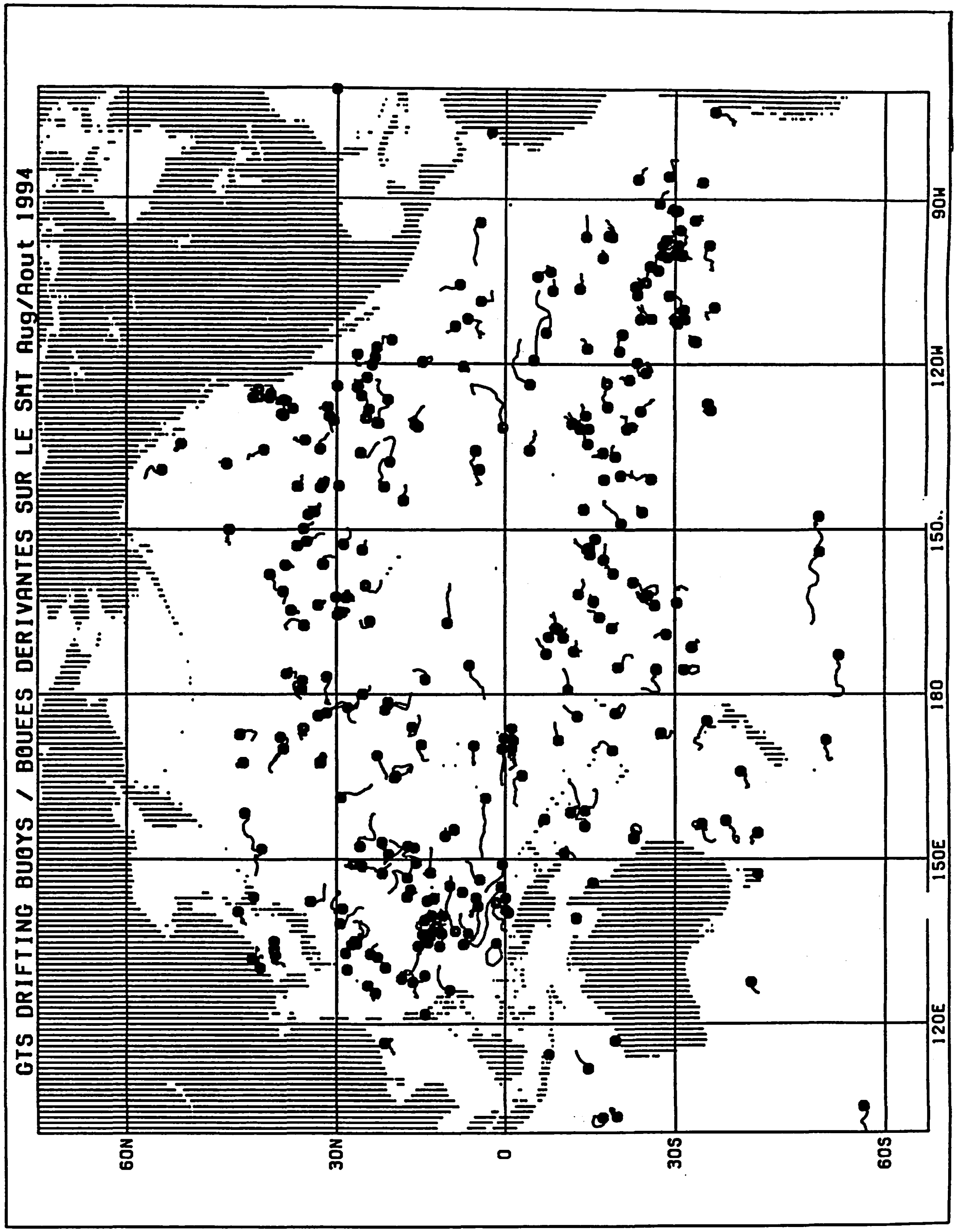
From	Date	Subject
CHARPENTIER@ATLAS.CNES.FR	02-Oct-1994	INFO Modif. of the PGC list format

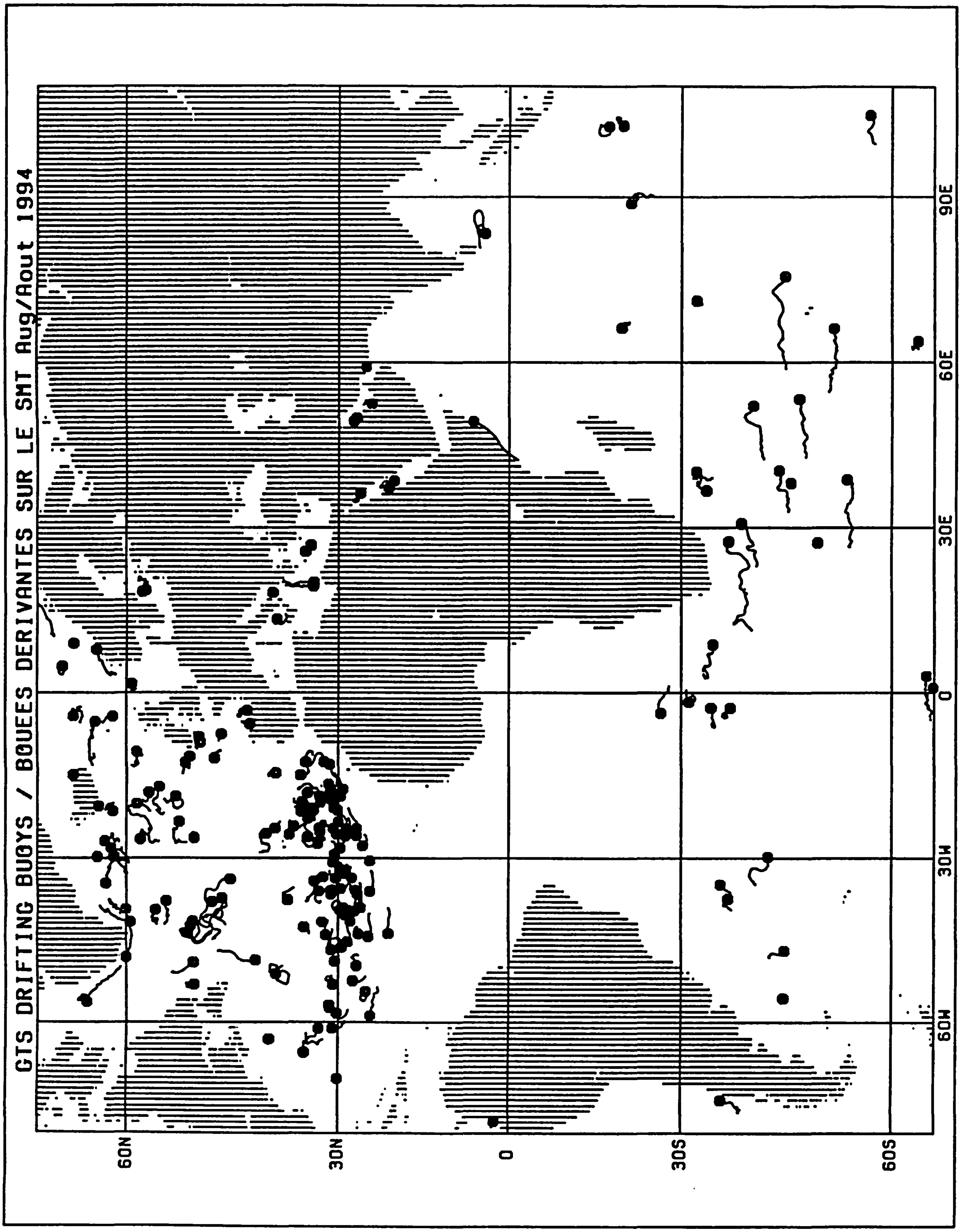
Message12: This message is to indicate a change in the format of the monthly PGC list. Details are given in the body text.

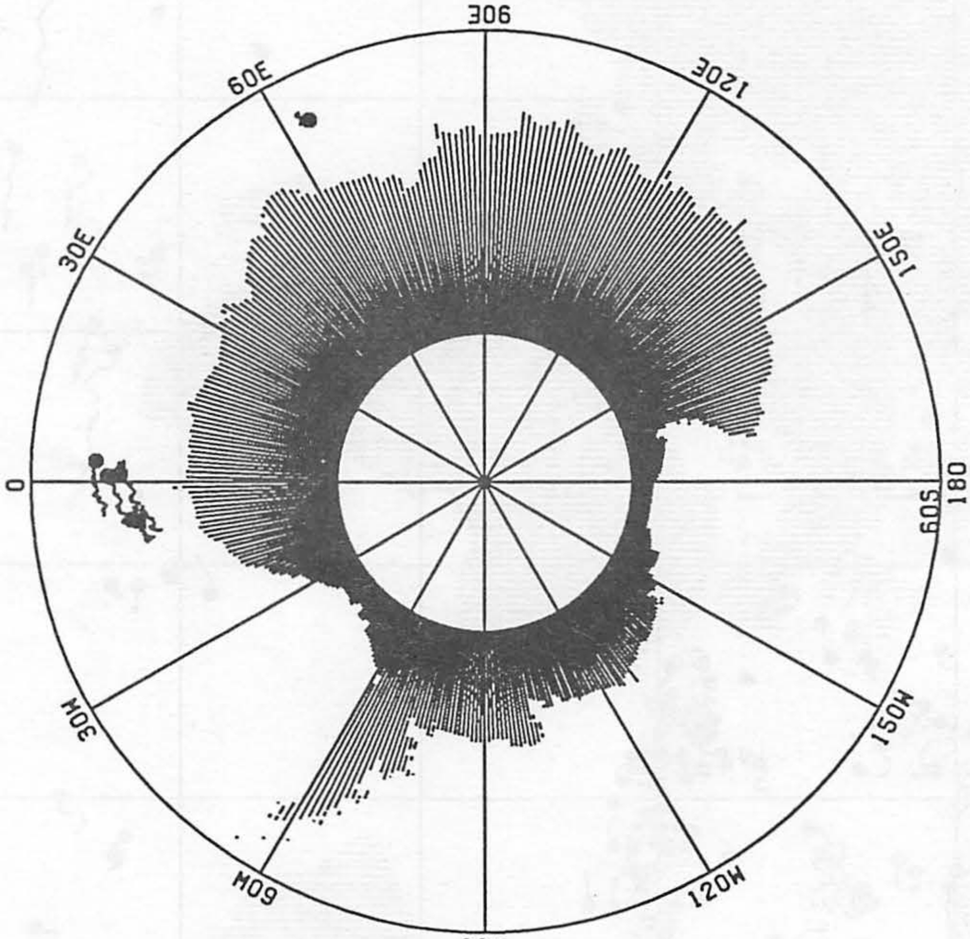
ANNEX VIII

GLOBAL DRIFTING BUOY TRACK CHARTS FOR AUGUST 1994




GTS DRIFTING BUOYS / BOUEES DERIVANTES SUR LE SMT Aug/Aout 1994
60N
30N
0
30S
60S
90W
120W
150..
180
150E
120E


GTS DRIFTING BUOYS / BOUEES DERIVANTES SUR LE SMT Aug/Aout 1994
60N
30N
0
30S
60S
60W
30W
0
30E
60E
90E



GTS DRIFTING BUOYS / BOUEES DERIVANTES SUR LE SMT Aug/Aout 1994

ANNEX IX

MANUFACTURERS OF SVP BAROMETER DRIFTER

Clearwater Instrumentation, Inc.
49 Walnut Park
Bldg. #2
Wellesley Hills, MA 02181
USA

Gary Williams
tel +1 617 2393305 or 1 800 2374387
fax +1 617 2393314
Internet: wgwill@world.std.com

Metocean Data Systems Ltd.
40 Fielding Avenue
Dartmouth, Nova Scotia
CANADA B2B 1E4

tel +1 902 4682505
fax +1 902 4684442

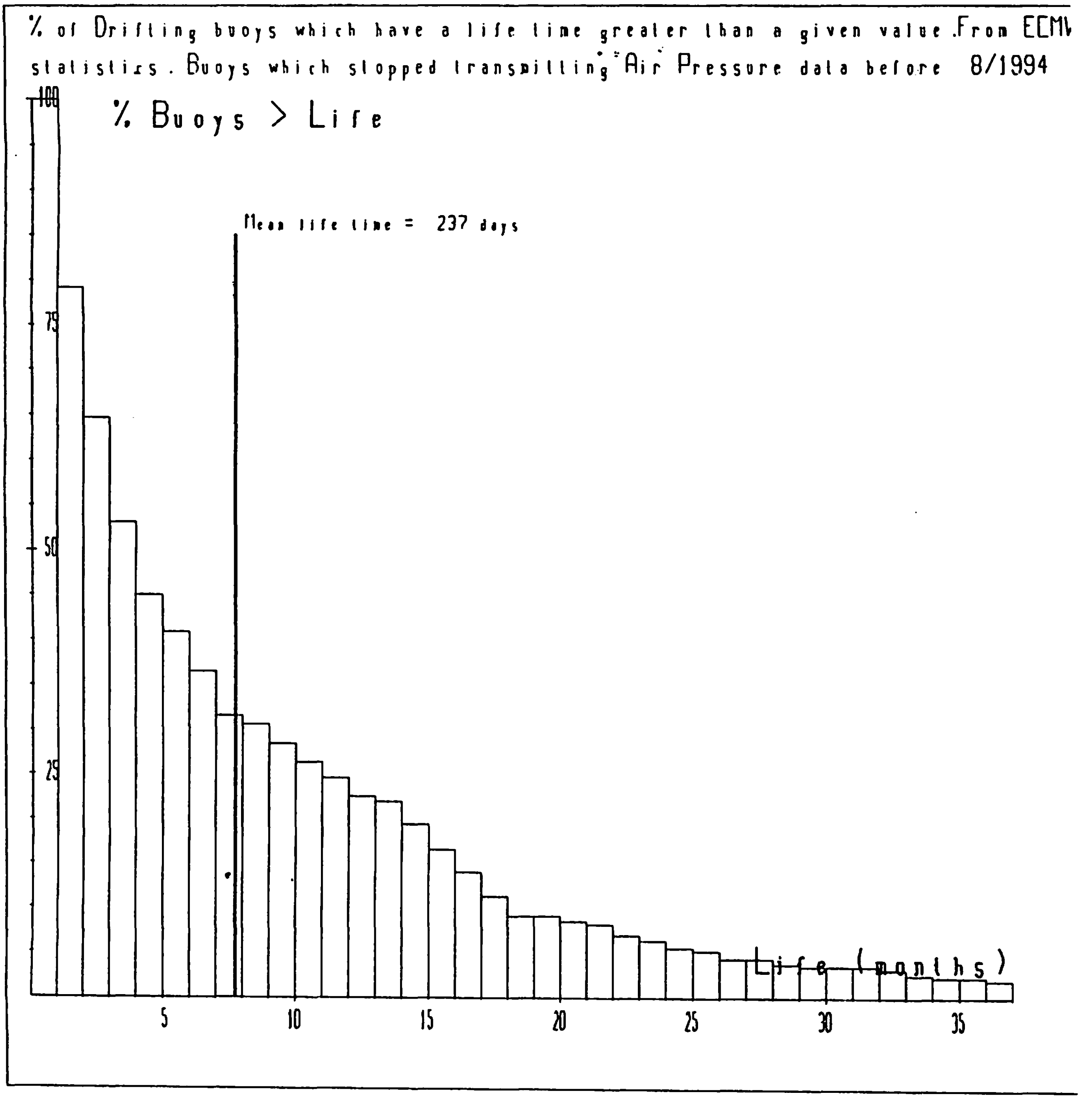
Technocean
820 N.E. 24th Lane
Unit 112
Cape Coral, FL 33909
USA

Hank White
tel +1 813 7729067
fax +1 813 5745613

ANNEX X

LIFETIME OF DRIFTING BUOYS

Distribution of the Life Time of the Air Pressure sensor:



Aust. Met. Mag. 43 (1994) 41–48

Monitoring a data assimilation system for the impact of observations

R.S. Seaman
Bureau of Meteorology Research Centre, Australia
(Manuscript received August 1993; revised September 1993)

The impact of an observation upon analysis is defined as the difference between the analysis using the observation and the analysis not using the observation. The statistical interpolation method of objective analysis enables the efficient computation of such observational impacts. Impact calculations provide a rigorous quantitative method of identifying the most influential observations, both upon individual analyses, and in an ensemble sense. They also enable the identification of data that, although rejected by quality control, would have had a large impact if they had been used. This report describes the computational algorithm for impact assessment, and presents examples of such assessments made within the framework of the Australian Bureau of Meteorology's global data assimilation system. The examples include the identification of the most influential southern hemisphere sea-level pressure data, a ranking of Australian upper air stations with respect to analysis impact, and the identification of important quality-control decisions.

Introduction

Most manual synoptic analysts will recall cases where a single observation has substantially changed their best prior estimate of the analysis in a particular area. Often, however, a single observation will alter the analysis only slightly from what it would have been otherwise. Numerical data assimilation systems respond in a rather similar way, and it is useful to be able to identify the most influential data. These remarks introduce the theme of this report, namely the quantitative assessment of the impacts of individual observations upon analyses produced by a numerical data assimilation system.

One application of impact information is in the area of observational resource management and network planning. For such purposes, it is often necessary to assess the benefits obtained from different observing stations. Ideally one might wish to equate the incremental benefit from a station with some measure of the corresponding incremental improvement in *forecasts*, or otherwise expressed, one might wish to assess the degradation in forecasts likely to result from the station's removal. An obvious way to assess such forecast impact is to run parallel analysis-forecast cycles, one with and the other without the benefit of the observing station in question. However, impacts of individual observing stations are often small, and the case-to-case variation typically large, so that a large number of independent forecasts may be necessary to obtain statistically reliable results.

On the admittedly heuristic basis that stations which most influence the analysis will usually have the largest impact on forecasts, an alternative to forecast impact assessment is a corresponding analysis impact assessment. The impact of an observation upon analysis is defined here as the difference between the analysis using the observation and the analysis not using the observation. It will be shown that when objective analyses are performed by the method of statistical interpolation (Gandin 1963), analysis impact calculations require only a small amount of computation in addition to that needed for the analysis itself. Therefore, impact statistics may be computed conveniently in the course of normal data assimilation operations. The specific algorithm for impact calculation is identical to one used by Lorenc (1981), in a statistical interpolation setting, but not specifically for the purpose of calculating analysis impacts.

It is emphasised that analysis impact is a measure of *sensitivity*, and is not inherently a measure of improvement. Moreover, it is a measure that is specific to a particular system. The

Corresponding author address: Mr R.S. Seaman, Bureau of Meteorology Research Centre, GPO Box 1289K, Melbourne, Vic. 3001, Australia.

extent to which analysis impact is correlated with forecast improvement depends upon several aspects of the particular data assimilation and prediction system, including (a) quality control of data, (b) analysis methodology, and (c) prediction model initialisation. Broadly expressed, a necessary condition for analysis impacts to translate into forecast improvements is that the data be assimilated in a sensible way. Also, while analysis impact can measure the effects upon many individual analyses of leaving out an observation, it cannot measure the cumulative or compounding effects of leaving out an observing station for all time in an ongoing analysis-forecast data assimilation cycle. The latter limitation may be important when interpreting absolute, as opposed to relative impacts. Nevertheless, despite the preceding caveats, its ease of computation and its quantitative rigour make analysis impact a useful diagnostic.

In addition to applications discussed in the second paragraph of this section, impact calculations may be useful synoptically. For example, a change in the timewise continuity of analyses and, perhaps, forecasts from a numerical data assimilation system in a particular region may be ascribable to a single particularly influential datum. Impacts are also useful for identifying critical quality-control decisions. A borderline decision may be of little consequence where there is considerable data redundancy, but its impact may be substantial in other circumstances.

In following sections, the theory and method for the computation of analysis impact are set out, and specific examples of impact assessments within the framework of the Australian Bureau of Meteorology's global data assimilation system (Bourke et al. 1990; Seaman et al. 1993) are presented. These examples are drawn from the parallel testing, over several months, of the version of the system that was to be implemented operationally during 1994.

Theory and computational method

The following theory is similar to that presented by Lorenc (1981), but is included for completeness. When using statistical interpolation in an analysis-forecast cycle, the normalised increments f_G from a short-range (~six-hour) forecast at prediction model grid-points are estimated as a linear weighted sum of N observed normalised increments f_i at N data locations by

$$f_G = \sum^{N} w_i f_i \qquad \ldots 1$$

Here, normalisation denotes division by the prespecified root mean square (rms) error of the short-range forecast ('prediction error'). In a multivariate statistical interpolation scheme, both the f_G and the f_i may represent increments of more than one type of variable; commonly, increments of geopotential and wind components are analysed simultaneously. A standard least squares minimisation of ensemble error yields a system of linear equations for the weights. In vector (lower case) and matrix (upper case) notation

$$\begin{aligned} w &= (P+O)^{-1}g \\ &= M^{-1}g \end{aligned} \qquad \ldots 2$$

where P and O are respectively the prespecified normalised covariance matrices of prediction error and of observational error for all pairs of observed data points, and g is the vector of prespecified normalised prediction error covariances between observing points and a grid-point.

The matrix M depends upon the geographical positions of the observational data, but does not depend upon the positions of the grid-points. Therefore, if the same selection of observational data is used to interpolate to many grid-points, the matrix M needs to be inverted only once for that entire set of grid-points. Such a strategy is used in the Bureau's operational global data assimilation system. Typically, a selection of N (100 to 500) observational data is used to analyse all grid-points within a subvolume of about 1000 km horizontal dimension and spanning several model levels in the vertical (usually all model levels, for southern hemisphere subvolumes).

The relevance of the analysis strategy just described to the problem of assessing data impact is as follows. Suppose the observation whose impact is to be assessed contains n pieces of data (e.g. the geopotentials and wind components at several levels in a rawinsonde). One way of recalculating the analysis, *not* using the observation, would be simply to apply Eqns 1 and 2 again, using the (N-n) remaining data. This would require the inversion of a new matrix, of dimension (N-n), which is the same as M except that the n rows and columns corresponding to the withheld data are omitted. However, when n is much less than N, it is computationally advantageous not to directly invert another large matrix of dimension (N-n), but rather to calculate a new matrix L from the inverse of M which is already known. As shown by Lorenc (1981, Eqn 27), when the weights corresponding to the n omitted data are constrained to be zero, a new weights vector w is given by Lg, where

$$L = M^{-1} - M^{-1}D(D^TM^{-1}D)^{-1}D^TM^{-1} \qquad \ldots 3$$

and D is a (N by n) matrix whose columns are the vectors d_k, in which the kth element is one and the other elements are zero, and k is the index (in N) of the datum to be omitted. The matrix inside the brackets in Eqn 3 is of dimension n, and D is sparse (mostly zeros), so evaluation of Eqn 3, despite its complicated appearance, requires very much less computation than does the direct inversion of a matrix of order (N-n), when n is much less than N. In fact, Lorenc (1981) did not use his counterpart to Eqn 3 to calculate data impact, but rather used it for the purpose of grid-point analysis while omitting data flagged as suspect, and (in a slightly different form) for quality control. However the computational algorithm used here is the same as Lorenc's.

A further consideration in the computation of data impact is the geographical location of the 'grid-points' at which the impact should be calculated. A comprehensive assessment of impact should probably evaluate a volume integral of impact at all prediction model grid-points within the influence of the observation. However, for application within the Bureau's global data assimilation system, it was decided to evaluate the impact only at the actual location of the observation. In other words, two evaluations, one with and the other without the observation, are made at the locations of some or all of the n data points (e.g. at a few standard levels of a rawinsonde) within the observation. A shortcoming of this procedure is that when an observation is on the edge of a data void, the maximum impact on analysis may occur at a short distance into the data void, rather than at the location of the observation itself. However, extra sophistication was not considered justified in this initial implementation.

The case n = 1 is of particular interest. It corresponds to the assessment of the impact of a single datum, such as a sea-level pressure from a drifting buoy or a ship. In this extreme case of n being much less than N, the computation in Eqn 3 is minimal. It is therefore computationally feasible to compute routinely the individual impact of every sea-level pressure report selected for use, thereby identifying those reports having the greatest impact. Examples of such computations are presented in the next section. The case of a single sea-level pressure datum may also be viewed as a least squares problem of combining two independent pieces of information, namely (a) the analysis at the location of the datum without the use of the datum, and (b) the datum itself, to obtain an improved estimate, namely the analysis using the datum. An impact result identical to that using Eqns 1 to 3 is obtained via this alternative route.

Examples

The following examples of impact assessments are some of those that have been implemented in the Bureau's global data assimilation system at the time of writing. These examples are by no means exhaustive, and other applications should come readily to mind.

Throughout this section, impacts are presented and ordered in dimensional units. It could well be argued that, before ordering, some form of normalisation is appropriate. For example, an impact of a given magnitude in the tropics may be more significant than a similar impact at higher latitude. Similarly, impacts upstream of a particular forecast area may be of special significance. The decision not to normalise was dictated by the view that the most appropriate form of normalisation is best decided by the user. The main purpose of the section is simply to convey the flavour of some of the possible applications.

The 'top ten' southern hemisphere sea-level pressure data impacts

At each analysis time, the analysis impact is calculated for every sea-level pressure datum selected for use. The magnitudes of the impacts are sorted, and the ten largest southern hemisphere impacts listed, thereby identifying the ten data that, individually, were the most influential at that particular time. Such information may sometimes reveal the causes of temporal discontinuities in the sequence of sea-level pressure analyses and, possibly, forecasts produced by the data assimilation system. A listing for a particular time is shown in Table 1. Most of the stations listed are in relatively data-sparse areas. This is usually, but by no means always the case. When the background field in a data-sparse area is in good agreement with an isolated observation, the impact of the latter will be small. Conversely, an observation in a relatively data-dense area may reveal a small-scale feature not present in the background field. On the average, however, to the extent that there is more redundancy and background fields are most reliable in data-dense areas, the impacts there should be correspondingly smaller.

Table 1. The top ten southern hemisphere sea-level pressure impacts at 1700 UTC, 22 June 1993.

Station	*Latitude*	*Longitude*	*Impact (hPa)*
Buoy 33021	59.5	332.7	−4.5
Young I.	66.3	162.3	4.3
Marion I.	46.9	37.9	−3.7
Macquarie I.	54.5	158.9	3.4
Grytviken	54.3	323.5	−2.9
Buoy 71552	61.0	48.7	−2.4
Port Moresby	9.4	147.2	−2.2
Buoy 33835	57.8	0.6	−2.0
Buoy 71554	57.2	49.4	2.0
Amsterdam I.	37.8	77.5	2.0

Table 2. **Average numbers of southern hemisphere sea-level pressure data types at the major synoptic times, and average occurrences in the top ten most influential sea level data, based on 29 days during June 1993. PAOBs are manual bogus data.**

Synoptic time		*1100 UTC*				*2300 UTC*		
Observation type	*Synop*	*Ship*	*Buoy*	*PAOB*	*Synop*	*Ship*	*Buoy*	*PAOB*
Average number per synoptic time	857	93	78	224	959	100	88	224
Average occurrences in top ten	4.17	0.34	2.58	2.90	3.52	0.38	3.07	3.03
Relative likelihood of appearing in top ten	1.00	0.76	6.81	2.66	1.00	1.03	9.48	3.70

One would expect that observing platforms deliberately deployed into data-sparse areas should figure prominently among the larger impacts. Table 2 confirms that over a period of a month, pressures from drifting buoys appeared in the top ten impacts with a frequency well out of proportion to their total numbers. Such a result indicates the importance of the drifting buoy observing system, a conclusion that will be further underlined in a later subsection.

Identification of critical quality-control decisions
Occasionally the appearance of a station in the top ten impacts may indicate a quality-control problem. In the Bureau's global data assimilation system, clearly unreasonable data are flagged for rejection at an early stage. Then a more refined quality-control check is performed, by means of cross-validation. During cross-validation, an observed datum is compared with an estimate obtained from nearby data (if any) and the background field. See Lorenc (1981, section 3c) for details. There will inevitably be cases just within or just outside tolerance, and the former may have large analysis impacts. In Table 1, for example, all of the top ten impacts are from drifting buoys and isolated island stations with the exception of Port Moresby, a tropical station not in a particularly data-sparse area. One might suspect that station to be a borderline quality-control case, and it is discussed in more detail in a later subsection.

Similarly, impact calculations may assist in identifying data that *were* rejected by cross-validation, but which would have had a large impact had they been used. These cases usually comprise only a minority of cross-validation rejects, because cross-validation detects many errors in data-dense areas by means of spatial consistency, and in such areas the use or non-use of a datum is often of little consequence. The most difficult quality-control decisions are those where a datum in an otherwise data-sparse area differs substantially from the background field, in which case the datum is either very valuable, or wrong. A typical case is shown in Table 3 where, at a particular synoptic time, among the sea-level pressure rejects in the southern hemisphere only two would have had impacts of more than 2.5 hPa (the arbitrary lower limit for a large impact). Both of these data, one from Marion Island (68994) and the other a manual bogus observation (PAOB), are in data-sparse areas.

In cases like these, it may be difficult to 'second guess' the quality-control decisions without a careful post-analysis. Nor would time schedules usually permit a rerun in any case. Nevertheless the user should be aware of the quality-control decisions that were in fact critical, so that resultant predictions may be interpreted accordingly. Of course, should a particular station appear consistently, further investigation would be warranted.

Table 3. **The southern hemisphere sea-level pressure data (hPa) at 2300 UTC, 28 June 1993, rejected by cross validation, which had they been used would have had an impact of over 2.5 hPa.**

Station	*Latitude*	*Longitude*	*Observed*	*Impact*
Marion I.	46.9	37.9	1011.9	−3.9
PAOB	67.0	205.0	983.0	17.5

Table 4. **Geopotential and wind ensemble impacts at Rockhampton (WMO identifier 94374; 23.4 south, 150.5 east) during June 1993. Column headers are standard levels (hPa). Legends to rows are: NZ — number of geopotential reports, ZAV — mean geopotential impact (m), ZRMS — rms geopotential impact, ZMAX — maximum geopotential impact; NUV — number of wind reports: UAV, URMS, VAV, VRMS — statistics similar to ZAV, ZRMS but for west–east and south–north wind components (m s^{-1}); VCRMS — rms vector impact, VCMAX — maximum vector impact.**

94374	*1000.*	*850.*	*500.*	*200.*	*100.*	*50.*
NZ	29	29	29	29	29	29
ZAV	−0.4	−0.6	−0.7	2.7	−4.0	−4.8
ZRMS	2.3	2.4	4.6	5.8	7.6	7.0
ZMAX	4.4	5.0	12.2	11.3	17.5	17.3
NUV	57	112	114	113	101	20
UAV	−1.1	−0.6	0.1	2.1	−3.5	−3.1
URMS	1.5	1.4	3.2	5.3	6.3	4.2
VAV	−0.2	0.3	0.5	−2.1	−1.0	−0.7
VRMS	1.0	1.5	3.0	5.7	5.0	2.8
VCRMS	1.8	2.1	4.4	7.8	8.1	5.0
VCMAX	3.0	4.3	11.2	24.1	24.0	8.4

Ranking of Australian upper air stations

The two preceding subsections dealt mainly with synoptic diagnostics of analysis impact. The ensemble characteristics of impacts over many analyses may be equally useful. As discussed in the introduction, network reductions are sometimes inevitable, and in such situations it is helpful to have quantitative assessments of the impacts of different network options.

With such applications in mind, the impact of the complete upper air report (height, if observed, and wind at all levels) is calculated at all Australian upper air stations at each analysis time (0500, 1100, 1700 and 2300 UTC). The number of data (n) selected for use from a rawinsonde is typically about 30, so the calculation in Eqn 3 requires the inversion of a matrix of that order. The computational overhead is therefore more than for sea-level pressure data ($n = 1$) but is not excessive since such computations are performed only at about 40 stations per analysis time.

Table 4 shows an example of the ensemble impact statistics for Rockhampton (World Meteorological Organization (WMO) identifier 94374; 23.4 degrees south, 150.5 degrees east) during June 1993, for all four analysis times. The statistics correspond to the impact of removing the *complete sounding* of both height and wind, upon the height and wind at each level. While the rms vector impact (VCRMS) at subtropical jetstream level was about 8 m s^{-1}, the extreme impact was much larger (24.1 m s^{-1} at 200 hPa).

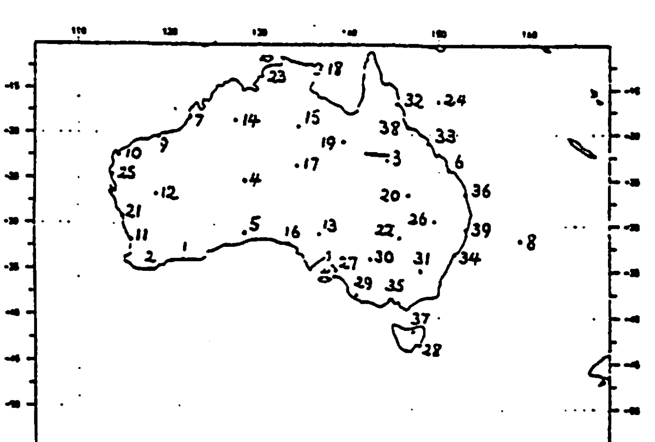
A comparison of the ensemble statistics at the location of each station enables these stations to be ranked with respect to rms analysis impact. Table 5 shows the rankings of Australian upper air

Table 5. **Australian upper air stations in average rank order with respect to 500 hPa wind impact. The second column is the WMO station identifier. The impacts (m s^{-1}) and ranks are shown for individual months. See Fig. 1 for station locations. Gladstone (6) closed and was replaced by nearby Rockhampton (23.4 south, 150.5 east) before May 1993.**

		Station	*Aug 92*		*Dec 92*		*May 93*		*Average Rank*
1	94638	Esperance	6.4	1	4.2	1	4.8	2	1.3
2	94802	Albany	6.2	2	4.1	2	5.1	1	1.7
3	94346	Longreach	5.1	7	3.6	9	4.0	3	6.3
4	94461	Giles	5.0	11	3.5	10	3.9	4	8.3
5	94646	Forrest	5.0	10	3.9	4	3.8	12	8.7
6	94380	Gladstone	4.5	19	3.7	6	3.9	6	10.3
7	94203	Broome	5.1	8	3.4	11	3.7	13	10.7
8	94995	Lord Howe Island	5.6	3	3.1	24	3.9	5	10.7
9	94312	Port Hedland	5.4	4	3.7	8	3.5	20	10.7
10	94302	Learmonth	4.8	12	3.3	14	3.9	8	11.3
11	94610	Perth	4.8	13	3.3	16	3.8	9	12.7
12	94430	Meekatharra	5.0	9	3.2	19	3.8	11	13.0
13	94659	Woomera	4.7	14	3.4	13	3.7	14	13.7
14	94212	Halls Creek	4.6	17	3.2	18	3.9	7	14.0
15	94238	Tennant Creek	4.7	15	3.3	15	3.6	15	15.0
16	94653	Ceduna	5.2	5	3.2	20	3.5	21	15.3
17	94326	Alice Springs	5.2	6	3.2	21	3.2	24	17.0
18	94150	Gove	3.5	31	4.0	3	3.4	22	18.7
19	94332	Mount Isa	3.9	25	3.4	12	3.5	19	18.7
20	94510	Charleville	4.6	16	2.9	25	3.5	18	19.7
21	94403	Geraldton	4.1	22	3.2	22	3.6	16	20.0
22	94711	Cobar	4.2	21	3.2	17	3.2	23	20.3
23	94120	Darwin	3.6	29	3.8	5	3.7	30	21.3
24	94299	Willis Island	3.6	28	3.6	7	2.9	29	21.3
25	94300	Carnarvon	4.1	23	2.4	33	3.8	10	22.0
26	94527	Moree	4.6	18	3.1	23	3.0	26	22.3
27	94672	Adelaide	4.4	20	2.7	30	3.1	25	25.0
28	94975	Hobart	3.3	33	2.9	26	3.6	17	25.3
29	94821	Mount Gambier	3.7	27	2.7	28	3.0	27	27.3
30	94693	Mildura	3.9	24	2.4	32	3.0	28	28.0
31	94910	Wagga Wagga	3.8	26	2.6	31	2.6	31	29.3
32	94287	Cairns	2.8	36	2.7	29	2.5	33	32.7
33	94367	Mackay	3.0	35	2.9	27	2.0	37	33.0
34	94776	Williamtown	3.4	32	2.3	34	2.4	34	33.3
35	94865	Laverton	3.5	30	2.1	37	2.1	36	34.3
36	94578	Brisbane	3.2	34	2.0	38	2.6	32	34.7
37	94968	Launceston	2.6	38	2.1	36	2.2	35	36.3
38	94294	Townsville	2.2	39	2.3	35	1.8	38	37.3
39	94791	Coffs Harbour	2.6	37	1.6	39	1.7	39	38.3

stations (see Fig. 1 for locations) with respect to impact upon 500 hPa wind, for all four analysis times combined, during three months in different seasons. The predominance of higher rankings (smaller numbers) in the western half of the continent is obvious. There is a large measure of consistency between months, although there are interesting differences too, such as the three tropical stations Darwin (94120), Gove (94150) and Willis Island (94299) which are much more highly ranked in December than in the other two months. The stations Nowra (34.9 degrees south, 150.5 degrees east) and Sydney (33.9 degrees south, 151.2 degrees east) are not included in the Table, because their infrequent and/or asynoptic reporting times would invalidate comparison with most other stations. The rankings of stations cannot be explained solely in terms of the spatial distribution of the conventional upper air network itself; it is also necessary to consider the average distributions of other observing platforms. For example, the frequent availability of aircraft winds at many levels in the vicinity of major airports provides some data redundancy at those locations.

Fig. 1 **A location map of the Australian upper air stations in Table 5. The plotted numbers at station locations correspond to the rank order of station impact (first column of Table 5), a smaller number corresponding to a larger impact. Note that Gladstone (6) closed before May 1993 and was replaced by nearby Rockhampton (23.4 degrees south, 150.5 degrees east).**

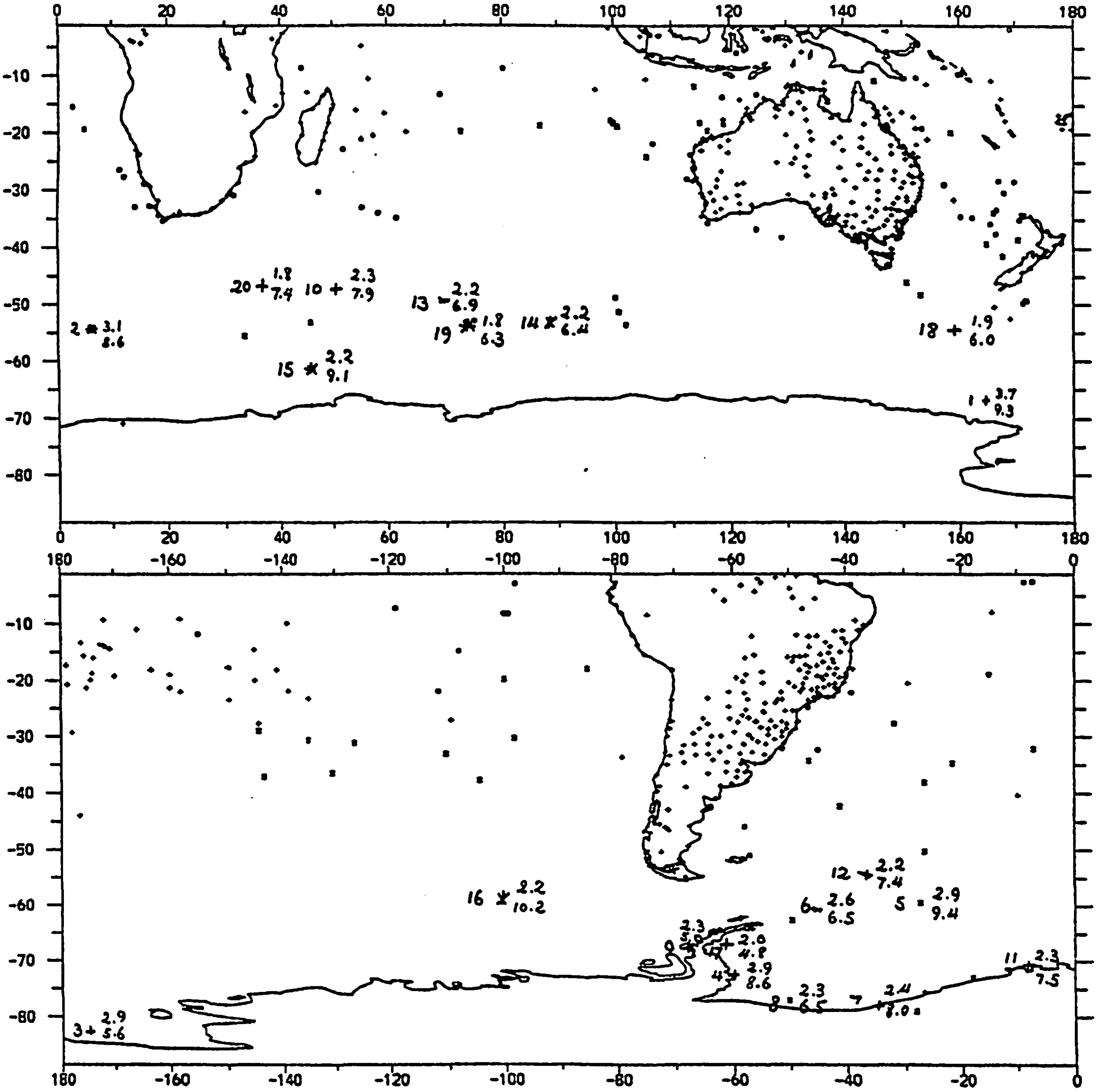


The west-east bias in impacts evident in Fig. 1 warrants careful interpretation, in view of the fact that in December 1992 and May 1993 (but not in August 1992) the upper wind observing program at Western Australian stations was reduced by the omission of most 0500 UTC wind soundings. Table 5 indicates that the general west-east bias in impacts evident in Fig. 1 was present in all three months. However, an analysis of impacts at each synoptic time (not shown) suggests that following the 0500 UTC network reductions, the west-east bias at 1100 UTC was more marked than that shown in Fig. 1. A comparison of impacts in August 1992 (pre-reduction) and August 1993 (post-reduction) also tends to support some influence of the 0500 UTC network reductions. In August 1992, eight of the top ten ensemble impacts at 500 hPa, and five of the top ten at 200 hPa, were in Western Australia, South Australia and the Northern Territory. In August 1993, all of the top ten ensemble impacts at 500 hPa, and nine of the ten at 200 hPa, were in the above areas. While these results may be of doubtful statistical significance, they at least suggest that the 0500 UTC wind network reductions may have accentuated a pre-existing west-east bias in upper air observing station impact. A similar effect may have arisen from the absence of Western Australian 1100 UTC radiosonde geopotentials (except Perth) in December 1992 and May 1993, but this aspect was not investigated.

Ensemble impacts of sea-level pressure data

The disproportionate frequency of buoys in the day-to-day top ten sea-level pressure impacts, mentioned previously, may be explained by the deliberate deployment of many buoys into known data-sparse areas. Land-based sea-level pressure data from individual stations located in what would otherwise be data-sparse areas are of similar value to buoys, but in contrast to buoys a large proportion of land-based pressure data is in already well-observed areas. Figure 2 shows a geographical plot of a typical 1100 UTC network of land, ship and drifting buoy data reporting sea-level pressure, upon which is superimposed the 20 sea-level pressure observing platforms (out of a total of about 1200 at the major synoptic times) that had the greatest rms impacts upon southern hemisphere sea-level pressure analyses during June 1993. Thirteen of the 20 are land-based platforms in data-sparse areas, and seven are drifting buoys. Because of uncertainties in pressure reduction procedures, only platforms below 800 m elevation were included in sea-level pressure impact calculations. This criterion excludes from consideration other potentially valuable pressure data such as automatic stations on the Antarctic plateau. For similar reasons, those stations whose elevations differ from the model topography by more than about 500 m were also excluded. With these provisos, nearly all of the twenty most valuable stations during the month are located in the otherwise data-sparse and synoptically active areas of the circumpolar trough and mid-latitude cyclonic belt. The particular impact of data in these areas was noted by Guymer and Le Marshall (1980) during the Global Weather Experiment of 1979. The platform with the greatest rms sea-level pressure impact during June 1993 was the automatic weather station at

Fig. 2 The largest 20 southern hemisphere rms sea-level pressure impacts during June 1993, superimposed upon a typical 1100 UTC network of synops, ships and buoys. The number to the left of each location is the impact ranking, the upper number to the right is the rms impact (hPa), and the lower number to the right is the extreme impact. A (+) denotes a synop (*) denotes a buoy and (o) denotes a ship.



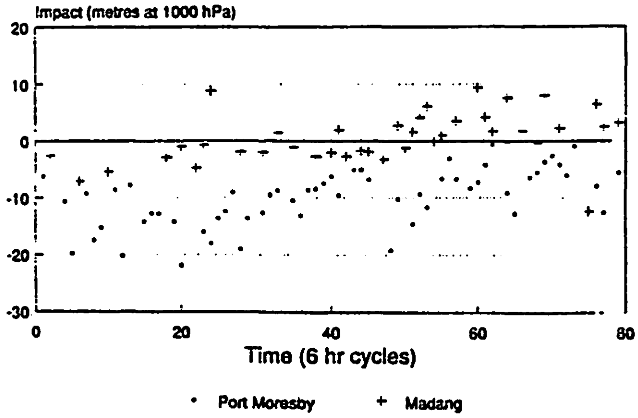
Young Island (66.3 degrees south, 162.3 degrees east). That station also had the greatest or second greatest rms impact in the other months in which impact calculations have been made, namely August and December 1992, and May 1993. Another automatic weather station, Lettau (82.6 degrees south, 174.3 degrees west), was ranked third during June 1993. However, earlier remarks about the need for normalisation are of obvious relevance when considering the results of this subsection.

Ensemble impact statistics and quality control

It has already been discussed how day-to-day impacts can highlight critical quality-control decisions from a synoptic standpoint. Similarly, ensemble statistics of analysis impact can detect systematic biases, which may be due either to the observation or to the background field. In this respect, impact statistics fulfil a similar role to 'observed minus background' statistics, which have been routinely accumulated from the Bureau's global assimilation system for some years (Seaman and Steinle 1992). A comprehensive account of the utility of 'observed minus background' statistics is given by Hollingsworth et al. (1986).

An obvious example of bias from ensemble impact statistics is shown by the time series of sea-level pressure impacts at Port Moresby, Papua

Fig. 3 Time series of analysis impacts of 1000 hPa geopotential (m) at Port Moresby and Madang for 20 days in August 1992.



New Guinea (9.4 degrees south, 147.2 degrees east) during June 1993 (Fig. 3, dotted series). The station Madang (5.2 degrees south, 145.8 degrees east), on the northern coastline of Papua New Guinea, shows no such bias (crossed series). Synoptic analysts confirm that it is often difficult to 'draw to' the Port Moresby pressure without introducing a small-scale perturbation into a manual analysis. There is no reason to suspect any instrumental or observational problem, and a likely explanation is that the observed pressure is simply unrepresentative on the scale of the global assimilation system, due to the local topography.

Summary

Observational data impact, defined as the difference between analyses using and not using the data in question, is efficiently calculated within the framework of statistical interpolation as currently implemented in the Bureau's global data assimilation system. The theory underlying the impact calculations has been set out, and several practical applications of both synoptic and ensemble impacts have been presented. These include:

- the identification of influential observations, to aid the interpretation of numerical forecast output;
- the identification of critical quality-control decisions for a similar purpose;
- the ranking of Australian upper air stations, in terms of their ensemble impacts on analysis, as an aid to network planning; and
- the confirmation of the disproportionately influential role of the drifting buoy network, as an argument for its continuance and extension.

Diagnostics of the types described in the paper had at the time of writing been produced during several months of parallel real-time running in 1992 and 1993, and were expected to be operationally implemented during 1994.

Acknowledgments

Thanks are extended to Bill Bourke, Terry Hart, Graham Mills and Peter Steinle for comments on earlier drafts. An anonymous reviewer's comments about the possible effects on ensemble impacts of Australia upper air network reductions prompted the discussion of that aspect.

References

Bourke, W., Seaman R., Embery, G.. McAvaney, B.. Naughton, M., Hart, T. and Rikus, L. 1990. The BMRC global assimilation and prediction system. *ECMWF Seminar Proceedings*. 'Ten years of medium range weather forecasting, Vol. 2', 221–52. (Available from ECMWF, Shinfield Park, Reading RG2 9AX, U.K.)

Gandin, L.S. 1963. *Objective analysis of meteorological fields.* (Translated from the Russian by the Israeli Program for Scientific Translations, 1965), 242 pp.

Guymer, L.B. and Le Marshall, J.F. 1980. Impact of FGGE buoy data on southern hemisphere analyses. *Aust. Met. Mag., 28,* 19–42.

Hollingsworth, A., Shaw, D.B., Lonnberg, P., Illari. L., Arpe, K. and Simmonds, A.J. 1986. Monitoring of observation and analysis quality by a data assimilation system. *Mon. Weath. Rev., 114,* 861–79.

Lorenc, A.C. 1981. A global three-dimensional multivariate statistical interpolation scheme. *Mon. Weath. Rev., 109,* 701–21.

Seaman, R. and Steinle, P. 1992. Global data assimilation in the Bureau of Meteorology. In *BMRC Research Report No. 33,* 33–43. (Available from BMRC, GPO Box 1289K, Melbourne, Australia.)

Seaman, R., Steinle, P., Bourke, W. and Hart, T. 1993. The impact of manually derived southern hemisphere sea level pressure data upon forecasts from a global model. *Weath. forecasting, 8,* 363–68.

ANNEX XII

NATIONAL FOCAL POINTS FOR THE DATA BUOY CO-OPERATION PANEL

ARGENTINA

Mr Héctor Osvaldo Sosa
Servicío Meteorológico Nacional
25 de mayo 658
1002 Buenos Aires
tel
fax

AUSTRALIA

Dr George Cresswell
CSIRO Division of Oceanography
Hobart, Tasmania 7001
tel +612 325 228
fax +612 325 123
Email george.cresswell@ml.csiro.au

Mr G.W. Jones
Australian Bureau of Meteorology
G.P.O. Box 1289K
Melbourne, Vic. 3001
tel +613 669 4167
fax +613 669 4168
Email g.jones@bom.gov.au

Dr Ian Allison
Leader, Sea Ice Sub-Programme
University of Tasmania
GPO Box 252c
Hobart, Tasmania 7001
tel +61 02 207648
fax +61 02 202973
Email I.Allison@antcrc.utas.edu.au

BRAZIL

Diretoria de Hidrografia e Navegaçâo
Departamento de Serviços Oceânicos
Rua Barâo de Jaceguai, s/no.
CEP 24048 - Niterói - Rio de Janeiro
tel +55 21 7170073
fax +55 21 7187941

CANADA

Dr. J. Garrett
Head, Ocean Physics
Institute of Ocean Sciences
Department of Fisheries
P.O. Box 6000
Sydney, British Colombia V8L 4B2
tel +1 604 363 6574
fax +1 604 363 6479

Fred Herfst
Director, Monitoring and Systems Branch
Pacific and Yukon Region
Environment Canada
Suite 700 - 1200 W. 73rd Ave
Vancouver, B.C. V6P 6H9
tel +604 664 9160
fax +604 664 9195
Email herfstf@aesvan.dots.doe.ca

CHILE

Lcdr Alejandro Cabezas
Head, Department of Oceanography
Servicío Hidrográfico y Oceanográfico de la Armada
Errázuriz 232, Playa Ancha
Valparaíro
tel +56 32 282697
fax +53 32 283537
Email shoa@huelen.reuna.cl

CHINA

Division of Station and Forecast
Department of Marine Monitoring and Services
State Oceanic Administration
1, Fuxingmenwai Ave.
Beijing
tel-
fax +861 853 3515

DENMARK

B. Rasmussen
Danish Meteorological Institute
100 Lyngbyvej
DK-2100 Copenhagen
tel
fax

ECUADOR

Instituto Oceanográfico de la Armada
Base Naval Sur (Avenida 25 de Julio)
Casilla No. 5940
Guayaquil
tel
fax

FRANCE

Pierre Blouch
Centre de météorologie marine
c/o IFREMER
BP 70
29280 Plouzané Cédex
tel +33 98 224 454
fax +33 98 224 536
Email: blouch@meteo.ifremer.fr (internet)

FRANCE

Mr F. Gérard
Ingénieur en chef de la météorologie
Chef du Département "réseau" de la
Direction générale des opérations de Météo-France
1, quai Branly
75340 PARIS Cédex 07
tel +33 1 4556 7024
fax +33 1 4556 7005
Email: francois.gerard@meteo.Fr

GAMBIA

Director
Department of Water Resources
7 Marina Parade
Banjul
tel +220 228216
fax +220 225009

GERMANY

Prof. Dr. Wolfgang Krauss
Institut für Meereskunde der
Universität Kiel
Düsterbrooker Weg 20
D-24105 Kiel 1
tel +49 431 597 3800
fax +49 431 565 876

Mr U. Liepelt
Deutscher Wetterdienst, Zentralamt
Postfach 100 465
D-63004 Offenbach
tel +49 69 8062 2832
fax +49 69 8062 2801

GREECE

Hellenic National Meteorological Service
Marine Meteorology Branch
P.O. Box 73502
GR 166 03 Hellinikon
Athens
tel +30 1 962 1116
fax +30 1 962 8952

ICELAND

Director
Icelandic Meteorological Office
Bústadavegi 9
150 Reykjavik
tel +354 1 600 600
fax +354 1 28121

IRELAND

Ms Evelyn Murphy
Marine Unit
Meteorological Service
Glasnevin Hill
Dublin 9
tel +353 1 842 4411
fax +353 1 375 557

JAPAN

Dr. Takeshi Uji
Director, Oceanographical Division
Marine Department
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku
Tokyo 100
tel +81 3 3211 4966
fax +81 3 3211 3047

JORDAN

Dr Ahmad Abu-Hilal
Director
Marine Science Station
P.O. Box 195
Aqaba
tel +962 3 315144 and 315145
fax +962 3 313674

KENYA

Mr A.J. Mafimbo
Port Meteorologist
P.O. Box 98512
Mombasa
tel
fax

KUWAIT

Dr Abdullah Al-Salem
Manager, Hydraulics and Coastal
Engineering Department
Kuwait Institute for Scientific Research (KISR)
P.O. Box 24885
13109 Safat
tel +965 4847093
fax +965 4815192

MAURITIUS

Mr S. Ragoonaden
Marine meteorologist
Meteorological Service
St. Paul Road
Vacoas
tel +230 686 1031/32
fax +230 686 1033
telex 4722 METEO IW

NETHERLANDS

Mr A.T.F. Grooters
Royal Netherlands Meteorological Institute
Postbus 201
NL- 730 AE De Bilt
tel +31 30 206 691
fax +31 30 210 407
Email grooters@knmi.nl

NEW ZEALAND

Mr A.M. Quayle
Meteorological Service of New Zealand Ltd.
P.O. Box 1515
Paraparaumu Beach
tel +64 4 2973 237
fax +64 4 2973 568

NORWAY

Director
Det Norske Meteorologiske Institutt
P.O. Box 320, Blindern
0314-Oslo 3
tel
fax

PERU

Capitán de Corbeta
César del Carmen de la Torre
Servicio Nacional de Meteorologia e Hidrologia
Avenida Republica de Chile 295, Apartados 1308
4862 Lima
tel
fax

Capitán de Corbeta
Héctor Soldi Soldi
Servicio Nacional de Meteorologia e Hidrologia
Avenida Republica de Chile 295, Apartados 1308
4862 Lima
tel
fax

ROMANIA

Vasile Diaconu
Chef, Laboratoire océanographique
Institut des recherches marines
Boulevard Mamaia No. 300
8700 Constanta
tel +40 41 643288
fax +40 41 831274

RUSSIAN FEDERATION

Dr. E.A. Kulikov
Committee for Hydrometeorology
12 Pavlik Morozov Street
123376 Moscow D-376
tel
fax

SAUDI ARABIA

Saleh Omar Baazim
Director of Observations and System
P.O.Box 1358, MEPA
Jeddah
tel
fax

SOUTH AFRICA

Piet Le Roux
Director, Observations and Communication
South African Weather Bureau
Private Bag X97
Pretoria 0001
tel +27 12 290 2998
fax +27 12 290 2170
Email pleroux@cirrus.sawb.gov.za

UNITED KINGDOM

D. Meldrum
Dunstaffnage Marine Laboratory
P.O. Box 3
Oban, Argyll PA34 4 AD
tel +44 631 62244
fax +44 631 65518
Email dtm@dml.ac.uk

UNITED ARAB EMIRATES

H.E. Mohamed Yahya Al-Suweidi
Assistant Undersecretary for Civil Aviation
Ministry of Communications
P.O. Box 900
Abu Dhabi
tel
fax

USA

Eric A. Meindl
National Data Buoy Center, NOAA
Building 1100
Stennis Space Center, Mississippi 39529-6000
tel +1 601 688 1720
fax +1 601 688 3153
Email: NDBC.CENTER (Omnet)

URUGUAY

Capitán de Navío (C.G.) Don Guillermo Ramis
Direccíon Nacional de Meteorología
Javier Barrios Amorín 1488
Casilla de Correo 64
11200 Montevideo
tel +5982 405177
fax +5982 497391

ANNEX XIII

FINANCIAL STATEMENTS PROVIDED BY WMO AND IOC

Statement by WMO for biennium 1992-1993

	US$		US$
Balance from 1991	6,585		
Contributions received for prior biennium	15,000		
Contributions received for 1992/1993	246,048		
Contributions received for 1994	22,650		
Total			290,283
Obligations Incurred			
UCAR	89,109		
Technical Co-ordinator	117,342		
Service Argos	14,500		
Prep Meeting South			
Atlantic Buoy System	8,489		
Experts	1,035		
Travel	29,259		
DBCP Ties	(961)		
Administration direct	930		259,703
Balance of Fund		US $	30,580
Represented by.			
Cash at Bank			31,755
less: Unliquidated Obligations			1,175
		US $	30,580

Contributions received for prior years

Canada	US $	15,000

Contributions received	for 1992/1993			for 1994
	1992	1993	Total	1994
Australia	11,000	12,500	23,500	
Canada	16,500	18,000	34,500	18,000
France	11,513	13,028	24,541	
Greece	2,100		2,100	
Iceland	2,100	2,100	4,200	1,500
Ireland	499	516	1,015	
Netherlands	1,575	1,575	3,150	1,575
Norway	1,575	1,575	3,150	1,575
UK	11,000	15,000	26,000	
USA	55,000	68,000	123,000	
GTS Chain Fund		892	892	
TOTAL	112,862	133,186	246,048	22,650

Interim account as at 31 December 1994

		US$		US$
Balance from 1993				30,580
Contributions Paid for Current Biennium		125,334		
less: Received in 1993		22,650		102,684
Total Funds Available				133,264
Obligations Incurred				
	UCAR	0		
	Technical Co-ordinator	90,000		
	Service Argos			
	Prep Meeting South			
	Atlantic Buoy System	3,532		
	First planning meeting			
	Baltic observing system	1,094		
	Experts	0		
	Technical co-ordinator travel	16,077		
	DBCP Ties	0		
	Administration direct	0		110,703
Balance of Fund			US $	22,561
Represented by.				
Cash at Bank				22,561
			US $	22,561

Contributions received for prior years

Contributions	Received In 1993	Received 1994/95		US $
	1994	1994	1995	Total
Australia		12,500		12,500
Canada	18,000			18,000
France				0
Greece		4,200		4,200
Iceland	1,500			1,500
Ireland		1,409		1,409
Netherlands	1,575	1,575		3,150
Norway	1,575			1,575
UK		15,000		15,000
USA		68,000		68,000
TOTAL	22,650	102,684	0	125,334

Statement by IOC for the year 1 June 1993 to 31 May 1994

Period : 1 June 1993 - 31 May 1994

FUNDS TRANSFERRED FROM WMO :

104 500	(28.04.93)	
10 000	(15.07.93)	
5 000	(08.11.93)	$ 119 500
75 000 FF	(08.11.93)	75 000 FF

EXPENDITURES

Technical Co-ordinator's employment:			
- Salary:	54 771		
- Allowances:	19 039		
- Relocation:	18 105		91 915
Technical Co-ordinator's missions:			
- Athens (18-29 October 1993):		2 375	
- Paris (6-8 December 1993):		813	
- Buenos Aires (11-18 December 1993)[1]:		-	
- USA (14-20 May 1994):		3 914	7 106
	Total:		$ 99 021
Contract with CLS/Service Argos:			75 000 FF

BALANCE $ 20 419

[1] *The mission to Buenos Aires was fully funded by CLS/Service Argos.*