

Report of the first planning meeting on a WCRP International Antarctic Drifting Buoy Project (Hobart, Australia, 5-7 April 1993)

1. Opening of the Meeting

1.1 The first planning meeting on a WCRP International Antarctic Drifting Buoy Project (IANDBP) was opened by the Director of the Cooperative Research Centre for the Antarctic and Southern Ocean Environment (Antarctic CRC), Professor G Paltridge, at 9.00am on 5 April 1993 at the CRC. The list of the participants in the meeting is given in Appendix 1

1.2 Dr. I. Allison was nominated by the participants as the Chairman of the meeting.

1.3 The meeting agreed on the agenda to be followed, the arrangements of its work and its working hours. Appendix 2 contains the final agenda of the meeting.

2. The need for an IANDBP

2.1 Background to organization of the meeting

The WMO/ICSU Joint Scientific Committee for WCRP Working Group on Sea Ice and Climate (WGSIC) has studied the requirements for improving sea ice and coupled ocean-sea ice-atmosphere models during the recent years in considerable detail. Among others, it became distinctly obvious that realistic surface forcing fields are needed to test and improve the present sea-ice models and to reasonably simulate the annual and interannual development of Arctic and Antarctic sea ice covers. Intercomparisons between atmospheric model surface analysis with and without assimilation of surface buoy data in the Arctic Ocean provided convincing evidence that a network of automatic stations with air pressure and air temperature measurements would lead to significantly better surface wind and surface temperature fields. This would result in more realistic determinations of the sea ice kinematics and in improvements of the modelled atmospheric circulation.

It was subsequently decided in 1991 to build on the informal multi-national (U.S.A., Canada, Norway) cooperative drifting buoy program in the Arctic and to establish an International Arctic Buoy Program (IABP). Encouraged by the positive reaction of a number of national agencies to support the IABP, WCRP has made further efforts to establish an adequate program also for the Antarctic seasonal sea ice zone.

2.2 Requirements of International environmental programmes for Antarctic drifting buoy data

The participants were informed on the requirements for drifting buoy data in the Antarctic of the WMO/IOC World Climate Research Programme (WCRP), The WMO World Weather Watch (WWW), the SCAR regional programme on global change in the Antarctic (GLOCHANT), and the SCAR First Regional Observational Study of the Troposphere (FROST).

(i) WMO/ICSU/IOC World Climate Research Programme:

The fourth session of the WMO/ICSN Joint Scientific committee for WCRP Working Group on Sea Ice and Climate (Rome, Italy, November 1989) came to a conclusion that a network of drifting buoys with a basic grid-scale of 500 km would be the most cost-effective means to obtain surface atmospheric pressure data and sea-ice drift observations over the Antarctic sea-ice zone, thus providing accurate wind field and upper ocean current information, as required to test sea-ice models (See WCRP-41 : WMO/TD-No 377). A network of some 50 drifting buoys would provide adequate surface pressure observations over the ice-covered zone of the Southern Ocean for both global weather forecasting and climate research. Real-time data transmission through satellite-borne argos data collection and positioning system, linked to the WWW global telecommunication network, is required in order to incorporate the information into existing operational meteorological analyses products, a prerequisite for their effective use in global climate research. Atmospheric pressure measurement and buoy location are minimum requirements. In addition, a number of more difficult measurements of surface and upper-ocean quantities, as well as sea-ice properties, are needed.

(ii) World Weather Watch:

The Manual on the Global Observing System (WMO No 544) includes a basic set of global observational data required to be met by the Global Observing System by the late 1990s (for both *in situ* observations and remotely sensed data). These requirements have been developed, principally, to satisfy synoptic scale models. For the basic surface variables of atmospheric pressure, air temperature and wind vector, a horizontal resolution of 250km is desired with a frequency of observations of four per day (at the main standard times). The accuracy requirements, stated in terms of the r.m.s. observational error are 1 hPa, 0.5°C and 1-2m/s respectively. For oceanic areas the minimum acceptable horizontal resolution for surface data is given as 500km. In the relevant Antarctic region WWW requirements would be satisfied by a network of about 50 buoy stations together with an appropriate network of observation stations on the Antarctic continent.

(iii) SCAR GLOCHANT:

The ICSU Scientific Committee on Antarctic Research (SCAR) is developing implementation plans for a major multi-national, multi-disciplinary research program on "The Role of the Antarctic in Global Change". This program, GLOCHANT, will form an Antarctic regional contribution to the IGBP. One of the six core projects of this program is the investigation of interactions and feedbacks within the Antarctic sea ice zone. Implementation of this project will require data from drifting buoys to provide both data on sea ice motion and on the regional meteorological fields, including wind, for modelling studies. Data requirements for this project are similar to those defined for WCRP.

(iv) SCAR FROST:

FROST is an international program to assess our capability to produce accurate meteorological analyses in the Antarctic. It is based on the assumption of three special observing periods (SOP) (July 1994, mid-October to mid-November 1994, and January 1995). For which high quality analyses will be produced. Nations active in Antarctic meteorology are urged to deploy additional observing systems and increase the frequency of their existing data collection during the SOPs. It is hoped that the deployment of Antarctic drifting buoys can be maximised during the SOPs.

3. Relevant ongoing programs

3.1 The International Arctic Drifting Buoy Program

The International Arctic Buoy program was created in 1991 to establish and maintain a network of drifting buoys in the Arctic Ocean. The IABP is organised to provide baseline meteorological and sea ice motion data to the research, climate monitoring, and operational forecasting communities. The program was preceded by a sequence of research programmes. The IABP is self-sustaining, receiving equipment, services, and monetary contributions from its Participants. The terms of reference are set forth in the IABP Operating Principles. The IABP is an Action Group of the Drifting Buoy Cooperation Panel under WMO and IOC. At present data are received from more than sixty buoys operating in the Arctic Ocean, Barents Sea, and Greenland Sea.

3.2 The Drifting Buoy Cooperation Panel

The DBCP was established jointly by WMO and IOC for ocean data that can be met through drifting buoy programmes and encourage and facilitate cooperation between data users and buoy operators to optimise the benefits obtained through existing and planned operational and research programmes and especially to encourage the exchange of buoy data in real-time. The DBCP has assisted in the development of two ‘action groups’ for the establishment of international drifting buoy programmes.

The first of these, the European Group for Ocean Stations (EGOS) maintains a network of drifting buoys in the NE Atlantic. The second action group is the International Arctic Buoy programme (IABP) formed in September 1991. The IABP maintains a network of buoys in the Arctic to meet operational and research requirements.

The DBCP employs a full-time Technical Coordinator (TC). The TC is currently located in the USA and will shortly transfer to Toulouse, France, co-located with CLS/Argos. The TC has been very active in dealing with day-to-day busy users enquiries and data dissemination problems. He has been closely involved with the development of a new flexible Argos GTS processing system that is jointly funded by some DBCP participants and CLS/Argos. The new GTS processing system which came into operation at the end of January 1993 allows considerable flexibility in transmitted data formats and separates GTS data processing and coding from scientific processing as needed by Principal Investigators. It therefore overcomes many of the constraints of the original system (designed for the FGGE) that have hindered dissemination of much buoy data in the GTS.

The Panel has developed a near real-time Q/C system for buoy data, based on a central bulletin board maintained by the TC. This allows the rapid exchange of quality control information and subsequent remedial action.

Funding for the Panel is by voluntary contributions from panel members. Currently the Panel funds are just sufficient to maintain the services of a full-time technical coordinator. ‘Action Groups’ of the Panel enjoy the formal recognition of WMO and IOC and therefore receive, as far as resources allow, the support of the WMO and IOC secretariats. This can include, for example, the establishment and administration of common funds needed by the action groups to carry out their programmes and the arrangement and hosting of project meetings.

3.1 Previous and ongoing drifting buoy activities in the Antarctic

Participants reported on past and current Antarctic buoy activities within their various national programmes. These reports are summarised at Appendix 3. Additional information on buoy deployments not reported at this meeting are available from the Annual Report of the Drifting-Buoy Cooperation Panel (1991 and 1992) and the Annual Report of the Joint Tariff Agreement.

4. Design of an Antarctic Drifting Buoy Program

An International Antarctic drifting Buoy Program should be designed to provide a long term surface data set to support sea ice and climate modelling as well as to improve the surface fields of operational weather prediction models in the Antarctic sea ice zone. An optimal buoy array in the antarctic seasonal sea ice zone meeting these requirements would consist of about 50 buoys with a 500 km x 500 km spacing. However, due to the specific drift pattern as well as the relatively rapid movement observed around the Antarctic continent, a special deployment schedule would have to be considered by the project coordinator. Moreover, the observed divergence in the area indicates that the buoys will escape from the seasonal sea ice zone several months to two years after deployment. This means that new buoys will have to be supplied every year. Most of the deployment would probably take place from ships during the short austral summer. Therefore, to keep up a reasonable array during the whole year, winter deployments from aircraft is highly recommended. The necessary parachuting techniques has successfully been used in the Arctic for many years.

The most important quantities to be measured are surface air pressure, buoy position, and air temperature. The desired absolute accuracy of these variables is ± 1 hPa for pressure, ± 1 km for position, and $\pm 0.5^\circ\text{K}$ for air temperature. Extra information on air pressure change over the last three hours together with the pressure tendency and maximum and minimum temperatures during the last six hours could be measured as well. Due to the high latitudes there is a frequent coverage of satellites and data should be transmitted as frequently as possible. The minimum transmission interval should meet the synoptic observation periods of at least every six hours and preferably every three hours. The synoptic values should be stored in the buoy and transmitted to the satellite on a number of occasions until next synoptic data collection takes place.

Because buoys deployed in the Antarctic pack ice will not always remain within the ice, the displacement of the buoys is not necessarily a measure of ice motion. For ice dynamic studies consideration will need to be given to identifying when buoys are in ice and when in the open ocean. It may be possible to do this by integrating buoy data files with microwave derived data sets of sea ice concentration held by World Data Centers, or by reference to the temporal variability of the motion measured by the buoys. Consideration must also be given to droguing those buoys that will drift into the open ocean so that they provide a reasonable measurement of surface currents.

5. Arrangements for collection and management of IAnDBP data

At present there are a limited number of individual research projects that involve the collection of data from drifting buoys in the Antarctic sea-ice zone. however, few of those data are

available to the general research community and very little is provided on the GTS for general real-time use.

Over the next few years, a number of research groups are planning to deploy drifting buoys in the Antarctic sea-ice zone. It is therefore appropriate to establish arrangements to optimise the use of the data from those buoys. In particular, the proposed project would:

- increase awareness in the international research community of drifting buoy data in the sea-ice zone;
- encourage researchers to allow the real-time transmission of basic meteorological data on the GTS; and
- provide focus for data management and the generation of basic data products.

The inclusion of data on the GTS provides researchers with rapid feedback from NWP centres on the quality of meteorological data on buoys. All basic meteorological data transmitted in the GTS will be archived by the Marine Environmental Data Service as the IOC/WMO Responsible Data Centre for Drifting Buoys.

In addition to the MEDS archive, a uniform, quality-controlled data base for ice motions and surface meteorology will be established and managed by IANBP. The basic requirements of data management for the research community are:

- provision of regular (annual) inventory of data collected, including information on PI and original research program;
- acquisition of monthly data (surface pressure, air temperature and ice movement) from Argos;
- execution of basic quality control, including QC flagging; and
- combination of ice movement, surface pressure and geostrophic wind analyses to form data set for submission to World Data Centres.

Additional requirements for data management include to recovery and combination of historical data sets from the region, and the generation of further and improved products.

Several data centers have expressed interest in archiving the research data sets generated by an IANDBP. The Scott Polar Research Institute (SPRI) of the United Kingdom, which is a repository for drifting buoy data collected in the Weddell Sea, has offered the services of the World Data Centre C for Glaciology (WDC-C) based at SPRI for archiving all Antarctic drifting buoy data. The Antarctic Institute of Argentina has proposed that any final buoy data from the Southern Ocean might be archived by the Responsible National Oceanographic Data Centre for the Southern Ocean, based in Argentina.

6. Prospects for establishment of a co-operative IANDBP

6.1 Participating organizations and prospective level of commitment to an IANDBP over the next 3-5 years.

Participants to the meeting outlined the levels of support to the project that were either planned or likely from within their institutional and national programmes within the next several years. These are detailed in Appendix 3. The meeting was encouraged by the comparatively high level of support that appears likely. Approximately 15 buoys are likely to be available each year for the next three

years, and several possible participants were either not at the meeting or not yet in a position to be able to make an estimate of likely commitment. Although this does not meet the desired coverage in either number or geographical distribution of the buoys it was considered a promising start to the project aims.

The participants agreed that formalising a cooperative International Antarctic Drifting Buoy Program, with coordinated deployments and some central management of data would further advance the aims of the program as outlined in this report.

6.2 Definition of the scope and duration of the project.

Participants agreed that the proposed program should aim to provide the level and accuracy of data defined in agenda item 4. An initial phase of 5 years was proposed for the program, during which time the network density of buoys would be developed as far as practicable to the optimum defined in item 4, and the impact of these data would be evaluated.

The participants further agreed that the formal program should be renamed the International Program for Antarctic Buoys (IPAB) to avoid confusion with the International Arctic Buoy Program.

6.3 Operational and logistic issues (network design, buoy deployment, data quality control, etc.),

Optimum network design will be constrained by the number of buoys available and opportunities for buoy deployment. Resolution of many of the practical problems will only be possible with firm commitments from the participants and with experience based on data gained from initial deployments. The meeting agreed that the pilot program proposed in item 7 would provide a framework for discussion of some of the more technical problems at a future meeting of participants.

6.4 Outline of a draft agreement between participants, and administrative framework of the project.

The participants were provided with a copy of the Operating Principles for the International Arctic Buoy Program. This was considered as a suitable model for an agreement and administrative framework for IPAB. Draft Operating Principles for an IPAB are attached as Appendix 4.

6.5 Association with the Drifting-Buoy Co-operation Panel

Recognizing the advantages of an affiliation with the WMO/IOC Drifting-Buoy Co-operation Panel, the meeting resolved to seek status as an Action Group of DCBP for IPAB. This will be done on inauguration of the Program

7 Future activities

The meeting agreed that the IPAB program would commence in a pilot phase at the close of the meeting. The pilot phase would include development of a prototype research data base (see section 5) using data from buoys currently operating under several national programs. Agreement

to incorporate these data in the research data base would be initially obtained by informal agreement between the Principal Investigators.

The report of this meeting will be submitted to the JPS to seek endorsement from WCRP of the scope and plans of the International Program for Antarctic Buoys. The meeting also requested the JPS to disseminate this report to other relevant international organisations and national agencies.

Dr. I. Allison was appointed by the participants as interim Chairman for the pilot phase of the Program. During this phase the JPS, in consultation with the interim Chairman, would be asked to seek further commitments to the program and to a next planning meeting.

Dr. Allison also undertook to check that available facilities within the partners of the Antarctic Cooperative Research Centre in Hobart were adequate to provide the level of data management proposed at item 5. If facilities are adequate, Dr. Allison offered to coordinate the IPAB pilot program.

The participants agreed that a suitable venue and time for the second planning meeting and inaugural meeting of the Program would be in conjunction with the proposed meeting of the sea ice implementation group for SCAR/GLOCHANT, Venice, Italy, June 1994. Dr. A. Pelligrini agreed to investigate the possibility of holding the IPAB meeting in Venice. It was proposed that these meetings should review results of the pilot program, and use these to develop the future IPAB in more detail.

8 Closure of the meeting

The first planning meeting of the International Program for Antarctic Buoys was closed on Wednesday, 7 April 1993.

REFERENCES

- WCRP-41 Report of the fourth session of the Working Group on Sea-Ice and Climate (Rome, Italy, 20-23 November 1989). July 1990. (WMO/TD-No 377)
- WMO 1992 Third long-term plan, Part II, Vol. 1.
- WMO 1988 Manual on the Global Observing System (WMO - No. 544)
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- SCAR 1993 The Role of Antarctica in Global Change: An International Plan for a Regional research Programme. ICSU Press/SCAR.
- DBCP 1991 Drifting-Buoy Co-operation Panel Annual report for 1991. IOC/WMO
- DBCP 1992 Drifting-Buoy Co-operation Panel Annual report for 1992. IOC/WMO
- JTA 199x Joint Tarriff Agreement report 199x. Service Argos.

Appendix 1

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Final Agenda

1 Opening and working arrangements for the meeting

1.1 Opening of the meeting

Meeting to be opened at 09:00 by Professor G. Paltridge, Director of the host institute, the Cooperative Research Centre for the Antarctic and Southern Ocean Environment.

1.2 Working arrangements

- nomination and election of chairman
- acceptance of the agenda
- working plan and arrangements

2 The need for an IAnDBP

2.1 Background to organization of the meeting

2.2 Requirements of international environmental programmes for Antarctic drifting buoy data

- WMO/ICSU/IOC World Climate Research Programme
- World Weather Watch
- SCAR regional programme of global change research in the Antarctic (GLOCHANT)
- SCAR First Regional Observational Programme of the Antarctic Troposphere (FROST)

3 Relevant ongoing programmes

3.1 The International Arctic Drifting Buoy Programme

3.2 The Drifting Buoy Cooperation Panel (DBCP)

3.3 Previous and ongoing drifting buoy activities in the Antarctic

Reports from participants of relevant national and multi-national programmes

4 Design of an Antarctic Drifting Buoy Programme

Technical overview of the data requirements: optimal buoy array, measured parameters, accuracy, data frequency, etc. for buoys in the Antarctic seasonal sea ice zone.

5 Arrangements for collection and management of IAnDBP data

Report from participants on current relevant activities and plans. Data collection, management and distribution requirements (including historic buoy and other data). Possibilities for an IAnDBP data centre.

6 Perspectives for establishment of a cooperative IAnDBP

- (i) definition of the scope and duration of the project,
- (ii) operational and logistic issues (network design, buoy deployment, data quality control, etc.),
- (iii) participating organizations and prospective level of commitment to an IAnDBP over the next 3-5 years,
- (iv) outline of a draft agreement between participants,
- (v) administrative framework of the project.

7 Future activities

Possible future meeting: venue and time.

8 Closure of the meeting

The first International Antarctic Drifting Buoy planning meeting is scheduled to close on the afternoon of Wednesday 7 April 1993.

Reports by participants on past, current, and possible future drifting buoy activities in the Antarctic seasonal sea ice zone.

ARGENTINA

The Antarctic Institute of Argentina is prepared to assist with the deployment of buoys of any agency which will participate in the WCRP International Antarctic Drifting Buoy Project (within the constraints of the Institute's ship-based logistic programme).

AUSTRALIA

The Australian Antarctic Division deployed three ice buoys in Prydz Bay, East Antarctica, in March 1985 and a further six in March 1987. These buoys were caught within the advancing ice edge and drifted within the pack for up to 8 months, continuing to operate as open ocean buoys after they escaped from the pack. The buoys measured atmospheric pressure, air and water temperature and some were additionally fitted with 100 m thermistor chains. Data was reported on the GTS.

A new generation of ice buoys, fitted with 200 m thermistor chains, are now being deployed by the Antarctic Division. Two of these were deployed in Prydz Bay in October 1992 and a further 3 to 4 will be deployed within the new season's ice between 140°E and 155°E in April 1993. For the future further sea ice deployments are proposed in the Bellingshausen Sea (2-3 buoys August 1993), 140°E to 155°E (2 buoys September 1994; 2 buoys March 1995; 2 buoys August 1995) Prydz Bay (4-6 buoys August 1996; 3 buoys March 1997). Several additional buoys may be available from the Antarctic Cooperative Research Centre.

The Australian Bureau of Meteorology has for the past ten years routinely deployed three to four meteorological drifting buoys annually in high latitudes. Two are deployed near 110 deg E between latitudes 40 and 55°S (courtesy of NIPR RV Shirase), and one to two at longitude 72°E between 52 and 55°S (courtesy of ANARE resupply vessels). The Bureau also deploys six to eight buoys in the Indian Ocean north of 35°S. About six of the annual deployments are TOGA buoys deployed on behalf of the US National Data Buoy Centre.

The Bureau is also participating in the international program for the development of a low cost combined oceanographic/meteorological drifter (WOCE/SVP) being coordinated by the Drifting Buoy Cooperative Panel.

BRAZIL

Brazil has used nationally developed drifting buoys through its program PROANTHE. For each of the 6 mesoscale experiments made during 1985-1991, one to 3 sophisticated buoys have been deployed. Sensor towers carrying anemometers and air temperature sensors have been used with the buoys for the 3 most recent experiments.

Proposed Brazilian participation in IPAB during 1993/94 and 1994/95 will consist of one of two options: a) deployment of one national (bi-conic) buoy equipped with air temperature, water

temperature and atmospheric pressure sensors each year, or b) deployment of 3 WOCE-SVP drifters modified for use in sea ice each year. The same level of effort will be proposed to Brazilian funding agencies for 1995/96.

GERMANY

Several German research institutions have deployed automatic surface buoys on ice floes in the Weddell Sea since 1986. The instrumentation of the individual stations varied considerably. The most simple version measured only the position, surface air pressure and surface air temperature. The most sophisticated type was additionally equipped with an anemometer, a wind vane, an acoustic snow depth sensor, thermister strings through the ice (high spatial resolution) and through the upper 300 m of the water column (low spatial resolution), two conductivity sensors for salinity and a current meter. The main purpose of the buoy programme was to study the sea ice development under various atmospheric and oceanic forcing conditions. But since the basic data were transferred into the GTS the observations simultaneously were assimilated in some of the operational weather prediction models.

Comparisons of analyses of the surface pressure fields derived only from buoy data and from the model of the European Centre for Medium Range Weather Forecast when the buoy data had been assimilated show a rather good agreement. In cases when no data assimilation was possible in the model analysis, significant differences between the actual observations and the model products became obvious.

The automatic buoy data were furthermore used as ground truth information for ice drift calculations from AVHRR and SAR satellite data. Finally the buoy observations are used to test and to improve coupled ocean-sea ice models in the Weddell Sea area.

ITALY

Although the Italian Antarctic Research Program (ITALIANTARTIDE) is not currently undertaking any specific experimental study on the Sea-Ice Zone, the importance of that area in the meteorological system is recognized within the Five-year Plan of the Program, whose Core Projects include the 'Ice-Sea-Atmosphere Interaction' Project. Within that Project, a major effort will be devoted to atmospheric forcing and ice production in the Terra Nova Bay Polynya, however the importance of the Sea-Ice Zone in general will be taken into account, and other specific research proposal can be included in the yearly plans.

Additionally, operational meteorologists at the Italian Station have asked for (at least) two buoys to be deployed in the northern part of the Ross Sea, to increase data available for the local weather analysis and forecasting, and to contribute data to improve the performance of global scale forecasting models. Therefore, it is not unlikely that two or three buoys will be released and maintained in the northern part of the Ross Sea, from late 1994. In that case, the buoys will meet the technical and operational requirements of IPAB concerning accuracy of measurement, transmission via ARGOS and availability on GTS.

Further, the Italian Antarctic Program can support any other Party in deploying buoys along the route of the ship(s) used by Italian Expeditions, both for cargo and oceanographic campaigns; details on routes can be provided on yearly basis as soon as the Operational Plan for the expedition is approved.

JAPAN

- (1) a vessel icebreaker Shirase of the JARE

- (2) period every summer since 1987
- (3) regions (A) the Antarctic Circumpolar Current region (2 buoys per year)
(B) the coastal region off the Syowa Station in 1992 by the overwintering party (special case)

In this winter (March 1993), two buoys were deployed in a large scale, cyclonic eddy region (its centre; 115°E, 63.5°S) off the Wilkes Land.

The Japanese Antarctic Research Expeditions (JARE) have made the deployments of drifting buoys every summer since 1987, aboard an icebreaker Shirase, mainly in the Antarctic Circumpolar Current region. The JARE has also carried out the deployments of two buoys of the Australia Meteorology Agency in the ACC region on the way for the Syowa Station every summer.

After the re-supply to the Syowa Station, the Shirase goes back to Tokyo via Sydney, taking a course off the Wilkes Land. The Shirase's course fortunately covers two interesting areas in oceanography of the Southern Ocean, the Antarctic Circumpolar Current and the Antarctic Divergence zones.

Future Plans::

- title Drifting Buoy Deployments in the Eddy Regions of the Antarctic Divergence off the Wilkes Land, Antarctica.
- time 1997-1999
- buoy 10 buoys with 300m depth of T&S chains and air temperature and surface pressure, every summer.

NORWAY

Norway will continue to keep an automatic station on the Bouvet Island measuring air pressure and air temperature.

UNITED KINGDOM

The British Antarctic Survey and Scott Polar Research Institute (University of Cambridge) have an ongoing collaboration to deploy buoys in the Eastern Weddell Sea. The plan is to deploy one buoy per year into a suitable ice flow off the coast from the British "Halley" Research Station (75°S, 25°S). The buoys will be deployed from the RMS Bransfield during its annual re-supply of Halley in December/January and the data will be collected via the ARGOS system. Funds to deploy buoys over the coming years is dependent on bids to the research councils.

UNITED STATES OF AMERICA

In each of the years 1986-88 buoys were parachuted onto sea ice in the Ross Sea during the Antarctic Mid-Winter Airdrop Mission. The project was funded by the US National Science Foundation with logistical support from the US Department of Defence. Eighteen buoys were successfully deployed during the program.

Additional buoys have been deployed in the Weddell Sea at various times since 1978 by several US institutes.

**DRAFT OPERATING PRINCIPLES
of the
WCRP INTERNATIONAL PROGRAM FOR ANTARCTIC BUOYS**

1. This paper sets forth the principles and a set of operating procedures for the International Program for Antarctic Buoy (IANBP).

2 Objective

The objective of the International Program for Antarctic Buoy is to establish and maintain a network of drifting buoys in the Antarctic seasonal sea ice zone to provide data for meteorological and oceanographical research purposes and to meet real-time operational requirements. Such data will contribute to the World Climate Research (WCRO) and the World Weather Watch (WWW) Programs. The Program will build upon cooperation among those agencies and Institutions with Antarctic interests.

3 Program principles

The IANBP will:

3.1 Promote the development of an adequate antarctic buoy network through SCAR National Committees and other relevant bodies.

3.2 Maintain an observational data network within the Antarctic seasonal sea ice using drifting buoys and other appropriate data collection platforms as defined in the glossary.

3.3 Distribute basic meteorological data as defined in the glossary from the network in real-time over the global Telecommunication System plus relevant additional real-time data approved for public dissemination;

3.4 Ensure data from the network are archived; and

3.5 Liaise and cooperate with other Antarctic buoy operators.

4 Observation Program

4.1 Operational Area:

The operational area of the Program includes that region of the Southern Ocean and Antarctic marginal seas within the maximum seasonal sea ice extent.

4.2 Variables:

Basic meteorological variables as defined in the glossary will be measured. Some systems will be equipped to measure in addition atmospheric pressure tendency, wind speed and direction, snow, sea ice properties as well as subsurface oceanographic variables.

4.3 Basic Network Density:

Requirements stated by the WCRP and WWW, are a basic network with observational points spaced at about 500km. It is the aim of IAnBP to have sufficient buoy deployments to achieve and maintain this density over the operational area. the buoys will be deployed so that they operate for at least part of their life within the area.

4.4 Duration of Program:

The program will operate for a initial phase of five years with subsequent development as agreed by the Participants.

5 Data Distribution

5.1 Transmitters:

All buoys in the basic network will be equipped with transmitters to enable basic meteorological data to be transmitted in real time (synoptic and asynoptic mode). As a preferred approach, data will be collected and located via the Argos system using the TIROS-N series of satellites or their replacement.

5.2 Coding:

Data will be coded in a form suitable for extraction of basic meteorological parameters. participants will provide service Argos, and the IAnBP Coordinating Centre with necessary information to decode these data.

5.3 Global Telecommunications System:

Data will be inserted by Service Argos to the Global Telecommunication System. Data collected by participants by other means may also be inserted into the GTS.

6 Data Archiving

6.1 Operational Archiving

All basic meteorological data transmitted on the GTS will be archived by the Marine Environmental Data Service as the IOC/WMO Responsible Data Centre for Drifting Buoys.

6.2 Research Data Base:

A uniform quality controlled data base for ice motion and surface meteorology as required by the Antarctic research community will be established. Periodically this data base will be submitted to appropriate data centres.

7 Management Structure

7.1 Participants:

Participants in the International Program for Antarctic Buoys will be national Antarctic programme agencies, meteorological and oceanographic institutes, research and operational agencies and non-governmental organisations who are interested in the Antarctic seasonal sea ice zone and who contribute actively to the Program. Participants will indicate their participation in the Program by means of a Letter of Intent (Appendix 1).

7.2 Management:

The program will be coordinated by the participants. The participants will arrange for the implementation of the Program within the framework of the stated objectives. On a bi-annual basis the Participants will elect a Chairman and vice Chairman and appoint a Coordinator. The Chairman and Vice Chairman plus two other elected persons from the participants shall form the Executive Committee.

Elections shall be decided by a simple majority provided that a quorum of Participants is present. A quorum shall consist of at least fifty percent of participants. In case a quorum is not present, at an annual meeting of Participants, elections shall be decided by unanimous vote.

A Participant who is unable to attend the annual meeting may register a proxy vote delivered by n attending Participant if such authority is signified in writing to the Chairman.

7.3 Executive Committee:

The Executive Committee will be responsible for the management of the program on a day-by-day basis within the guidelines set at the annual meeting of participants. The Executive Committee is responsible for developing terms of reference for the Coordinator for approval by Participants. The Executive Committee will provide guidance and direction to the Coordinator who will act as the focal point for the Program during intersessional periods on matters related to the operation of the Program.

7.4 Coordinator:

Specific responsibilities and duties of the Coordinator are contained in Appendix 2, Terms of Reference for the Coordinator of the International Program for Antarctic Buoys.

7.5 Funding Provisions:

The Program will be self sustaining, supported by contributions in the form of equipment, services (such as communications, deployment, archiving, coordination, scientific or technical advice) or monetary contributions. As necessary the Participants shall establish a budget and make appropriate provisions for the management of this budget in order to implement the Program. Other funding arrangements made between Participants will be recognised as contributions to the IANBP if they further the Objective of the Program.

7.6 Program Review:

The management structure and operation of the Program shall be reviewed at the bi-annual meeting of Participants.

8 Meetings

A bi-annual meeting of the Participants will be held at a time and location to be determined by them.

9 Glossary

Basic Meteorological Data - Atmospheric pressure, air temperature and buoy location.

Antarctic seasonal sea ice zone - that portion of the Southern Ocean within the sea ice edge at the time of its maximum extent.

Appendix 4, Annex 1

Suggested form of letter of intent

Dear Colleague:

I propose that our agency will participate in the International Program for Antarctic Buoys to pursue the maintenance of a network of data platforms within the Antarctic seasonal sea ice zone.

This participation is regulated by the terms of the Operating Principles of the IAnBP and other terms attached to this letter.

I expect that our Agency will contribute . . . to the IAnBP for the first year of our participation and . . . in subsequent years.

The contribution is made with the understanding that it be applied to the objectives of the Program.

Yours faithfully

Terms of Reference for the Coordinator of the
International Arctic Buoy Program

The Coordinator shall facilitate the implementation of the International Program for Antarctic Buoys. The Coordinator will be appointed at the bi-annual meeting of the Participants and will be directed by the Executive Committee. Specific responsibilities include:

- 1) monitor and receive appropriate Argos and non-Argos data from the buoy network and prepare bi-monthly status report of buoy positions;
- 2) coordinate with operators of non-Argos buoy programs and other field operations;
- 3) liaise with Principal Investigators and managers of individual buoy programs in the Antarctic seasonal sea ice zone;
- 4) arrange for the maintenance of a research quality data base of ice motion and surface meteorological data, and submit it to the appropriate Data Centres;
- 5) develop a deployment strategy to maintain an optimal buoy network in the Antarctic;
- 6) coordinate opportunities for buoy deployment;
- 7) liaise on technical aspects of buoy development;
- 8) prepare an annual summary of resources committed to the Program;
- 9) liaise with Technical Coordinator of the Drifting Buoy Cooperation Panel to ensure that Antarctic data are properly quality controlled and distributed over GTS;
- 10) arrange for the purchase of buoys and ancillary equipment as authorised;
- 11) arrange for the payment of expenses for Argos data acquisition and Argos processing fees as authorised;
- 12) prepare and distribute an annual data report;
- 13) maintain a distribution list for bi-monthly status reports and annual data reports;
- 14) respond to requests from WMO, WCRP, and the Scientific Committee on Antarctic Research (SCAR) for information on the program;
- 15) prepare and distribute a semi-annual newsletter of activities and plans;
- 16) organise the bi-annual meeting of participants, present a report of the preceding 2 years' activities, and prepare a plan for the following 2 years;
- 17) promote the International Program for Antarctic Buoys to potential participants.