International Council of Scientific Unions

Intergovernmental Oceonographic Commission

World Meteorological Organization

WORLD CLIMATE RESEARCH PROGRAMME

Organization of an International Programme for Antarctic Buoys

Summary report of the meeting
on a WCRP International Programme for Antarctic Buoys
(Cambridge, U K, 1-3 August 1996)

DRAFT

AUGUST 1996

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MINUTES OF THE MEETING

1. Opening and Organisation of the Meeting

The first session of the International Programme for Antarctic Buoys (IPAB) was opened at the Scott Polar Research Institute (SPRI), Cambridge, UK, by the Chairman of the Executive Committee, Dr. Christoph Kottmeier, at 9.30 am on Thursday 1 August 1996.

Dr. Peter Wadhams from the SPRI welcomed the attendees and briefly outlined the tradition and aims of the Institute, the museum, and the world-renowned library.

A list of the attendees at the meeting is given in Appendix A. The agenda of the meeting is detailed in Appendix B.

2. Report of the IPAB Co-ordinator

Dr. Ian Allison, Co-ordinator of the IPAB, summarised the activities of the Programme. He outlined the progress of the IPAB and reported on the number of drifters deployed during 1995 and 1996. He identified a considerable increase in Antarctic buoy activities, although most buoys had been operated in the Weddell Sea or off the coast of East Antarctica. In 1995, 24 Antarctic buoys operated and reported via the GTS, with a further 8 buoys providing data to the IPAB data base, but not the GTS. In 1996 to date, there have been 21 buoys south of 55¡S reporting via the GTS, and an additional 6 non-GTS drifters. The Co-ordinator identified some issues to be addressed later in the meeting. These included:

· The short life and high failure rate of some drifters deployed in the sea ice zone.
· The tendency for buoys to drift northward out of the area of interest after only a few months.
· The inability to distinguish whether buoys were in ice or water.
· The lack of guidelines on the release of IPAB research data.
· The need for better communication between Participants and the Co-ordinator, particularly regarding forward advice of deployment plans, and on details of buoy characteristics.

Dr. Allison stressed the need for better co-ordination of the disparate programmes within the IPAB and emphasised the lack of data from west Antarctica.

The IPAB data base is maintained at the Antarctic CRC. Since February 1995, data from buoys deployed by Participants have been received monthly from Service Argos and processed and archived at the CRC. A data base of deployment details, and the buoy and sensor characteristics of IPAB platforms has also been compiled. The full report of the Co-ordinator is attached as Appendix C .

3. Reports from Participants

3.1 The Participants at the meeting reported on their programmes of buoy and data collection platform deployments over the first two years of the IPAB. Summaries of the reports given by Participants from Germany, Australia, South Africa, the United Kingdom, Italy, Finland and Brazil are presented in Appendix D1, along with descriptions of their intended future deployments.

3.2 The Russian Federation had deployed no platforms since the launching of the Programme in 1994. Financial constraints made buoy deployments over the next two years unlikely. A report was presented, however, on possible future contributions by Russian Participants to the Programme. This report is also included in Appendix D2.

3.3 Ms. Claire Hanson of the World Data Centre A for Glaciology presented a report outlining the archiving and distribution responsibilities of WDC-A (Appendix D3). Ms. Hanson requested that copies of data reports and research papers arising from individual buoy programmes should be sent to WDC-A for inclusion in the library. It was agreed that WDC-A would assume responsibility for distribution of

IPAB data to the worldwide scientific community.

4. Review of Operating Principles of the Programme

The Operating Principles of the IPAB, including the Letter of Intent, the Terms of Reference for the Co-ordinator and the General Principles of Data Archiving were reviewed and partly modified. The updated versions of these documents are presented in Appendices E and G.

5. Status of the Membership Roll

There were thirteen Participants (organisations which have submitted a Letter of Intent [Appendix E, Annex 1]) to the Programme as of 31 July 1996. A further three organisations subscribed to the Programme at, or shortly after the meeting. A full list of Participants is attached as Appendix F. Eleven of them were represented at the meeting.

6. Related Observational Programmes

Under this item on the agenda possible collaboration with and the relationship to other programmes was considered. Mr. Etienne Charpentier, Technical Co-ordinator for the Data Buoy Co-operation Panel (DBCP) summarised the activities and function of the DBCP in relation to the IPAB (Appendix H1). He presented the outline for the proposed DBCP Global Implementation Programme. The meeting agreed to support the proposal in the form that it was presented. It was also agreed that Mr. Piet le Roux would represent the IPAB at the next meeting of the DBCP, scheduled for 22 to 25 October 1996. All attendees were also invited to the Technical Workshop of the DBCP, to be held at Henley-on-Thames, UK, on 21 to 22 October 1996.

Mr. Charpentier requested input from the IPAB on the requirements of the Programme from Service Argos. The meeting agreed on a number of items to be presented by the Co-ordinator of the IPAB to the Technical Co-ordinator of the DBCP by 1 September 1996, for communication to Service Argos. These points were:

· Service Argos should increase the quantity of data, stored for on line access, from the 4 days presently available to 7 or even 14 days.
· Service Argos should utilise CD ROM or DAT tape for the distribution of off line data, instead of the reel to reel tape presently used.
· An FTP site should be established for online access to data for Argos users.

Dr. Victor Savtchenko briefed the meeting on WCRP Antarctic Ice Thickness Project (AnITP) and on WCRP involvement in Antarctic research (Appendix H2), as well as on GCOS and GOOS developments.

It was agreed that the possible relationship of the IPAB with GCOS would need to be considered by the Executive Committee. In the meantime members of the Executive Committee would maintain contact with GCOS developments, principally at a national level, and report back at the next meeting of the IPAB. It was also agreed that a letter would be sent by the IPAB Co-ordinator to Dr. Thomas Spence, Director of the Joint Planning Office of the GCOS programme, informing him that the IPAB was aware of the requirements of GCOS, and on the possibility of IPAB contributing to some of these requirements.

Ian Allison outlined the proposal for the ASPECT programme (Appendix H3), to be presented to SCAR XXIV for approval. Dr. Allison detailed the intention to link ASPECT with a number of other existing programmes, in particular the IPAB.

7. IPAB Publicity

It was agreed by the meeting that it was necessary to achieve a higher profile for the Programme. Producing a brochure on the Programme was discussed but not adopted. It was agreed that Mr. David Crane would produce a short description of the IPAB and a brief summary of the first meeting for

inclusion in a forthcoming edition of the WOCE International newsletter. The document would be submitted following approval by the members of the Executive Committee. A more detailed summary of the proceedings of IPAB-1 would also be prepared by Mr. Crane and presented for publication in the WCRP newsletter.

The possibility of opening a World Wide Web site specific to the Programme was proposed, to improve the information already existing at the DBCP and Antarctic CRC Web sites. It was felt, however, that a better alternative would be to gradually expand the information held at the Antarctic CRC site and to establish a page at the DBCP pointing to this site. The meeting also agreed to the inclusion of IPAB information on a page at the WCRP Web site.

8. Technical Presentations

Technical presentations were given by Mr. David Meldrum and Professor Merritt Stevenson, outlining new developments which could be applicable to the Programme. Summaries of these are presented in Appendix I.

9. Future Activities and Other Business

It was decided that the next meeting of the IPAB should take place in 1998. The Chairman read out a letter from Dr. Roger Colony, describing the intention to hold the 20th anniversary meeting of the IABP in Seattle, US, in August 1998 and suggesting that IPAB-2 could be held there at the same time. It was agreed to leave the exact date and location of IPAB-2 open for the present time but to maintain communication with Dr. Colony over the possibility of arranging a mutually beneficial time and place for both meetings.

Dr. Ian Allison pointed out the benefits of the continuous automatic sea ice drift monitoring offered by the Radarsat GPS system. It was agreed that support could be offered for geophysical data processing systems to allow analysis of this data alongside IPAB drifter data.

Dr. Christoph Kottmeier presented a report entitled Wind and Ice Motion Statistics in the Weddell Sea, produced with contributions from many IPAB participants. It was agreed that Dr. Kottmeier should request WCRP to allow the work to be published as a WCRP White Cover Report. Mr. Jon Shanklin suggested the inclusion of iceberg drifter tracks, readily available on the British Antarctic Survey database, in the report. It was agreed that iceberg tracks should not be included in this report but that they could provide valuable information for future work.

10. Administrative Aspects of the IPAB

In accordance with the management structure outlined in the Operating Principles, the meeting elected the Executive Committee:

Chairman	Dr. Christoph Kottmeier, Germany
Vice-Chairman	Mr. David Crane, United Kingdom
Member	Mr. Piet le Roux, South Africa
Member	Dr. Andrea Pellegrini, Italy

The meeting appointed Dr. Ian Allison, Australia, as Co-ordinator.

Dr. Allison stated that he would be willing to act as Co-ordinator for the next two years, but that other commitments would prevent him continuing after this time. He said that another person from the Antarctic CRC assuming the role was a possibility, but could not be guaranteed. Mr. David Crane

proposed Dr. Peter Wadhams, United Kingdom, as a suitable successor to Dr. Allison. Mr. Jon Shanklin suggested that the role could be adopted jointly by the SPRI and the BAS, both in Cambridge, U.K. It was decided to see how the Programme developed over the next year and Dr. Allison suggested that, if necessary, he could then begin a gradual transfer of the Programme co-ordination to Cambridge.

11. Adoption of the Meeting Report

The participants to the meeting reviewed and agreed the draft report.

12. Closure of the Meeting

The Chairman of the meeting stated that the IPAB would become a viable programme with visible progress being made. He stressed that co-operation was essential to counter the technical and logistical problems. Dr. Kottmeier thanked all of the attendees for being present at the meeting and all those who were involved in the organisation. He thanked the Scott Polar Research Institute for supplying the venue.

The First Session of the WCRP International Programme for Antarctic Buoys was closed at 12:50, Saturday, 3 August 1996.

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Final Agenda

1. Opening and Organisation of the Meeting

1.1 The first biennial session of the International Programme for Antarctic Buoys (IPAB) will be opened at the Scott Polar Research Institute, Cambridge, UK, on Thursday 1 August 1996 at 9.30 am, by Dr. Christoph Kottmeier, the Chairman of the Executive Committee for the IPAB. The meeting will be held in English and will continue until 3 August 1996.
1.2 Dr. Peter Wadhams (SPRI) will welcome the meeting to the Institute.
1.3 The meeting will adopt its agenda and agree on working arrangements for the session.

2. Report of the IPAB Co-ordinator

Dr. Ian Allison, the Co-ordinator of the Programme, will deliver a report on the IPAB developments in 1994-1996 (since the launching meeting of the Programme in Helsinki, Finland, in June 1994).

3. Reports from Participants

Biennial status reports will be given by, or on behalf of, the institutions/agencies participating in the Programme.

4. Review of the Operating Principles of the Programme

The Operating Principles of the IPAB (Appendix E of the summary report of the launching meeting of the WCRP International Programme for Antarctic Buoys) will be reviewed and amended, if required.

5. Status of the Membership Roll

The list of Participants will be reviewed and specified, if necessary.

6. Related Observational Programmes

Under this agenda item, reports will be delivered by representatives of the WMO/IOC Data Buoy Co-operation Panel and other national and international programmes related to the IPAB.

7. IPAB Publicity

The session will be invited to discuss the expediency of publication of an IPAB brochure to advertise the goals and achievements of the Programme, as well as to provide details with regard to the operations of, and participation in, the IPAB. Other methods of raising the profile of the IPAB will also be discussed.

8. Technical Presentations

The Participants in the session may wish to deliver reports on technology innovations for the IPAB.

9. Future Activities and Other Business

The session will be invited to determine future activities necessary for the development of the IPAB, as well as any other relevant activities.

10. Administrative Aspects of the IPAB

In accordance with the IPAB Operating Principles, the meeting will elect the Executive Committee of the Programme and appoint the Co-ordinator. The meeting will also discuss other administrative aspects of the IPAB, including the possible establishment and management of a common fund, preparation of reports, etc.

11. Adoption of the Meeting Report

The meeting will be expected to review and agree on the draft report of the meeting.

12. Closure of the Meeting

The IPAB-1 is expected to close in the afternoon of Saturday 3 August 1996.

Germany

Alfred Wegener Institute for Polar and Marine Research

The Alfred Wegener Institute continued its involvement in the Programme by the deployment of sea-ice buoys in 1994 and 1995. No new buoys were installed in 1996 due to the lack of convenient ship cruises. The winter cruise of the US research vessel Nathaniel Palmer in July 1994 in support of the ANZFLUX Programme was used to deploy five meteorological and one oceanographic buoy in the region west of Maud Rise (centred around 5°W, 66°S). The meteorological buoys were equipped to measure surface air temperature and atmospheric pressure and were positioned by the use of GPS receivers. The oceanographic buoys additionally carried a thermistor string of 250m in length, with thermistors spaced at 8.6m intervals, as well as CTDs at depths of 50m and 250m. The buoyÕs drift are displayed in Figure 1. The lifetime of the buoys varied from between 2 months to more than a year.

In 1995 eight meteorological buoys were installed on ice floes in the southern Weddell Sea (Figure 2). Three of these, drifting closest to the eastern coast of the Antarctic Peninsula, in a region of frequent ice pressure events, failed within one month. The others were active for about one year, on average. Their drift repeated a similar experiment, which took place in 1992 in relation to the ISW drift station.

Figure 1. Drift of buoys deployed in July 1994 in the northern Weddell Sea, during the ANZFLUX experiment for the Alfred Wegener Institute. Buoy numbers are given at the final positions of the drift plot.

Figure 2. Drift of buoys deployed in February 1995, by the Alfred Wegener Institute, in the southern Weddell Sea. Buoy numbers are given at the positions of deployment.

Australia

Australian Antarctic Division, Commonwealth Bureau of Meteorology and
Co-operative Research Centre for Antarctic and Southern Ocean Studies

Here will be inserted the Australian report as circulated at the meeting.

South Africa

South African Weather Bureau

It is well known that South Africa has been involved in Antarctic research since approximately 1961. Its basis thus far has been on the ice shelf. Towards the end of the 1980's it was decided to make a permanent investment and to build a new base on the continent. Subsequently a suitable building site was found at Lesves Carvet.

The building of a base on this site started in 1992. Towards 1993/94 it was found the "old" base on the ice shelf was unsafe and because of insufficient progress South Africa had to withdraw its over winter teams during 1995 and 1996. At this point itis still not certain if the accommodation will be ready to house a team during the winter of 1997.

The result of this was that the activities in the Southern Ocean and especially in the Antarctic waters was curtailed over the last two years.

The South African Weather Bureau, however, proceded with the erection of the automatic weather stations on the South Sandwich Islands as envisaged during the 1994 Helsinki meeting. These stations were installed on Zavodovski - and South Thule Islands during the 1994/95 season. The data supplied by these stations are in the form of hourly, three and six hourly sinoptic messages on the GTS. Also during the 1994/95 season 5 SVP drifting buoys were deployed on approximately 57 South at 5 degree intervals from 20 West to 0 degrees East/West. During the 1995/96 season an automatic weather station was operational for the summer season at the construction site at Vesles Carvet. This station provided meteorological data to the scientific workers as well as the construction team while the data was also disseminated on the GTS for a short while. Also during the 1995/96 season the automatic weather station on Bouvet Island was replaced on behalf of our colleagues in Norway while two SVP-B drifters were deployed in the waters south of this island.

During the coming 1996/97 season an all out attempt will be made to get the new base suitable for an overwintering team. The automatic weather station on South Thule will be revisited for maintenance while three to four SVP-B buoys will be deployed in the waters south of the South Sandwich Islands.

At present the South African Weather Bureau is the only participant from South Africa deploying buoys in the Southern Ocean. We hope that when the scientific programme from the new SANAE-base at Lesves Carvet begins there will be more participants in the IPAB programme from our scientific community.

United Kingdom

UK Meteorological Office

To date the UK Meteorological office has financed two PTT years as its contribution to the operation of the UK's IPAB drifting buoys. It is expected that finance for a further two PTT years will be available over the next two years. Participants wishing to take advantage of this offer should contact A.N.Bentley at the UK Meteorological Office.

British Antarctic Survey

British Antarctic Survey (BAS) has not deployed any buoys in the 94/95 and 95/96 seasons. There are no plans to purchase buoys for deployment in 96/97 or 97/98 seasons. BAS are willing to deply buoys for other operators from their two research ships on their routine cruises and re-supply voyages. There is also the possibility of deplyment of small buoys by air from the Survey's Twin Otter aircraft.

The BAS Remote Sensing Group is working on deriving drift motions from AVHRR imagery of ice floes and bergs. Data from buoys deployed for TOGA during the early 80s will be made available on the BAS meteorological database in the near

future.

Scott Polar Research Institute, Cambridge

The Scott Polar Research Institute (SPRI) has been involved in the deployment of drifting buoys in the polar regions since the early 1980s. The last Antarctic deployment was in 1994 (see following report). The present Antarctic plans are two-fold.

Firstly, we will be proposing to our funding agency the deployment of an array of six ice drifters in the Bellingshausen Sea in collaboration with Dr M Stevenson (INPE, Brazil), who will deploy three ice-ocean -atmosphere buoys to form an inner array.

Secondly, at present SPRI is developing a number of GPS/Argos drifters for short-term release in the Arctic in early 1997. On-board sensors include sea surface and air temperatures, wind speed and direction, pressure and GPS location. It is expected that thes buoys will be recovered and be available for deployment in the Antarctic for the 1997-8 Austral summer.

In the event that these deployments can take place, SPRI will be gratefully accepting the offers by the Met Office of partial support of PTT costs, and by BAS for assistance in deployment.

IPAB Drifter Deployment in the Amundsen/Ross Seas
September/October 1994

David Crane*
Global Environmental and Ocean Sciences, Swindon, U.K.

Three months after the launching meeting of the IPAB in Helsinki the author, then at the Scott Polar Research Institute, Cambridge, U.K., was able to make the first U.K. contribution to the Programme with the deployment of a number of drifters in the Amundsen/Ross Sea region of Antarctica.

With funding from U.K. WOCE six satellite tracked Argos drifters were purchased for this experiment. Five of these were non-buoyant position only beacons and the sixth an ice strengthened drifting buoy, with sensors to measure atmospheric pressure, air, ice and water temperature, wind speed and direction and current speed and direction. Charges from Service Argos for data collection were met by the U.K. Meteorological Office, courtesy of D. Painting. The intention was to deploy the drifters in an array in the Amundsen and Ross Seas, with the shape of the array dependent upon the cruise track of the ship. The vessel used was the National Science Foundation (NSF) ship 'Nathaniel B. Palmer', on a westward transect across the region in September/October 1994. The trip comprised a joint oceanographic/sea ice programme, led jointly by Martin Jeffries of the University of Alaska, Fairbanks and Hartmut Hellmer of the Lamont Doherty Earth Observatory, U.S.A. The author and a colleague (J. Noneley) were offered places on the trip to deploy the drifters and to carry out experiments to measure the wave energy within the ice cover and to examine the iceberg distribution.

The trip commenced on 10 September 1994, departing from Punta Arenas, Chile. The ship proceeded south west, crossing the ice edge at 64.5S, 74.0W on 14 September, before turning westwards and following the line of the ice edge. The Nathaniel Palmer was continually passing through bands of ice and open water until it reached 108.5W, when it turned southward and headed into the pack. This point marked the start of three dog legs, culminating on 10 October at 67S, 163W, from where the ship headed westward before turning north on 13 October to head out of the ice. The ice edge was crossed at 64S, 171.5W and the Nathaniel Palmer then continued on to reach Auckland on 21 October. Figure 1 shows the cruise track with dates and the position of the ice edge and drifter deployments marked.

The zig-zag pattern of the cruise track provided an excellent opportunity for deploying the stations in a true 2 dimensional array. In tests prior to deployment one of the five position only beacons failed to operate and so an optimum array was configured with the remaining stations. Table 1 summarises the deployment date and position, and the lifetime, of each station. Position only drifter 23009 was the first to be deployed, on 21 September, at the southernmost end of the first transect into the ice cover. This was followed 4 days later by beacon number 23011, at the northern end of the dog-leg, with beacon 23012 deployed on 26 September at the end of the second transect into the ice. Beacon 23012 functioned for 4 days and so provided only a limited data set for analysis alongside the other drifters.

Drifter Number□Deployment Position□Deployment Date□Lifetime (days)□□23009□-69.617 249.064□21 September 94□62□□23011□-67.445 234.620□25 September 94□33□□23012□-70.417 233.089□27 September 94□4□□23008□-70.146 203.580□8 October 94□414□□23013□-68.231 198.705□10 October 94□73□□

Table 1. Deployment and lifetime statistics for drifters

It was intended to deploy the fully sensored drifter (23008) in the Ross Sea at the southernmost point of the cruise track. On

reaching this position on 5 October, however, the ice floes were found to be too small and the pack too loose to allow a confident deployment of the buoy. It was, instead, deployed three days later, in more consolidated ice slightly further to the north. The final position only beacon (23013) was put out on 10 October some 280km to the north west of the ice strengthened buoy.

By the end of 1994 all of the position only beacons had ceased to operate, due to the melting of the ice cover with the onset of spring. The fully sensored buoy transmitted data for over a year, but a hiatus in data collection meant that data were not recorded between 1 January and 17 February 1995. In the following analysis the data are presented in two sections. The first looks at the comparative motions of all of the drifters up until the end of 1994. The second section presents a brief description of data from the fully sensored drifter from February to November 1995.

Figure 2 shows the tracks of the five drifters covering the period from the first deployment up until the end of December 1994. The numbers identify the station and the start of each drifter track. What is immediately apparent is the greater eastward motion of the three position only beacons, compared to that of drifter 23008 further south. This is most probably due the greater influence of the Antarctic Circumpolar Current on the ice further to the north. An initial examination of the first few days of position data of stations 23009, 23011 and 23012, whilst on board the ship, indicated that the motion of these drifters was also strongly influenced by the passage of weather systems across the region. Figure 3 shows ice speed versus wind speed at station 23008 over the period until the end of the year. The dependence of the ice motion on the meteorological conditions is clear, with the ice moving at around 3% of the wind speed and a correlation between wind speed and ice speed of better than 0.9.

The heading data for drifter 23008 (not shown) indicates that the ice floe moved into a free drift situation late in the year, around 20 December, melting out of the ice a few days later. It is interesting, therefore, that the ice at this location responds so readily to the wind forcing and, along with the ice very close to the ice edge (23011), shares the highest mean velocity of 0.25m/s. To examine more closely the nature of the ice motion at the four locations power spectra were produced of the ice speeds. Figure 4 shows the results of the 128 point spectra, giving the power at equally spaced periodicities between 2 and 256 hours. Stations 23009, 23011 and 23013 all exhibit power around the inertial and tidal periods, which is not present in the spectrum for 23008. This would be entirely consistent with the ice bound nature of the most southerly drifter. However, what is also clear from the spectra is that drifter 23008 exhibits considerably more power than the other three stations at higher frequencies, having nearly twice that of drifter 23011, near the ice edge, at periods of less than 10 hours. In summary, ice at station 23008, although consisting of consolidated pack ice and not in a free drift condition, appears to be moving at high frequencies and responding very well to local wind forcing, although showing no inertial or tidal motion. Reasons for these contradictions have not yet been found.

Figure 5 shows the weekly positions of drifter 23008 from 18 February until 18 November 1995. Throughout this entire period the station remained within a 340x220km box, indicating no long term current trend in this region. Hull temperature sensor data indicates that the buoy re-froze back into ice around the end of March and the heading data show that by the middle of April the floe surrounding the buoy had consolidated into the pack. All of the sensors functioned until the end of the buoyÕs lifetime, with the exception of the wind speed sensor which ceased to operate on 11 April 1995. This was most probably due to the anemometer rotor freezing up with the lowering of the air temperature, after an extended period in the moisture rich atmosphere of the open ocean.

Figure 6 presents periodograms of the drifter speed calculated from four consecutive 64 day periods from the start of the 1995 data set. Here it is seen that whilst the drifter was floating free in the water (up to day 110) there was significant power at high frequencies and some evidence of motion around the inertial period. Having frozen into ice the high frequency motion decreased but the power at the inertial period increased by 60%, due to the increased wind drag coefficient of the ice floe. When the pack became fully consolidated both high frequency and inertial power decreased significantly. Although later in the year (days 239 to 302) inertial motion is evident again it is at a lower level than previously.

Summary

As a contribution to the initial phase of the IPAB the drifter deployments described in this report have yielded valuable information in this data sparse region. Some 586 days of ice drift data have been recorded at five different stations, along with over 400 days of sensor data at one station. Some expected features of the ice motion and response to meteorological forcing have been briefly demonstrated, although there remain unexplained properties of some of the ice motion in the Ross Sea.

Sensor data from drifter 23008 are presented in Figures 7 and 8. A full analysis of the ice motion and sensor data is under preparation.

Italy

Instituto di Meteorologia e Oceanografia

Here will be inserted the Italian report circulated at the meeting.

Finland

Finnish Institute of Marine Research and
Department of Geophysics, University of Helsinki

Here will be inserted the Finnish report as circulated at the meeting.

Brazil

National Institute for Space Research

Here will be inserted the Brazilian report, as circulated at the meeting.

Russian Federation

Arctic and Antarctic Research Institute

The Arctic and Antarctic Research Institute (AARI) is responsible for scientific and applied investigations in the Southern Ocean. The scientific ships of the AARI, the Russian Antarctic Expedition (RAE), operate annually in the ice covered zone of the Southern Ocean. The AARI activity in the Antarctic Zone of the Southern Ocean comprises mainly transport operations, oceanographic, meteorological and ice data collection along ship tracks and helicopter flights. It is possible to use the AARI ice class vessels for the deployment of drifting buoys. RAE visits are planned to three Russian stations (Novolazarevskaya, Molodezhnaya, Mirny) and one US station (Mc Murdo) between December 1996 and May 1997. The ships can be used for drifter deployment, around Antarctica, by any agency involved in IPAB activities. It would be possible to use the shipÕs helicopters for buoy deployment, including landing on tabular icebergs.

The AARI can produce Argos type buoys jointly with another agency. Such co-operation was employed in conjunction with the University of Washington (Seattle) and the Alfred Wegener Institute, for deployments in the Arctic Ocean.

The AARI has a comprehensive oceanographic data base for the Southern Ocean (34000 stations) and modern numerical models of the Southern Ocean circulation. The wind driven model, extending from 30S to the Antarctic coast, is based on a finite difference discretisation of the primitive equations, with 24 levels of different thickness (from 10m to 500m) and a horizontal grid size of about 100km. Model computations have been performed using climatological mean data from the ÒHydrographic Atlas of the Southern OceanÓ as initial stratification. The velocity field produced in the numerical experiments are in good agreement with existing observations. On the basis of model calculations, one can determine optimum positions for the deployment of drifting buoys in the Southern Ocean.

World Data Centre A for Glaciology
Data Archiving and Distribution

Here will be included the report from WDC-A.

OPERATING PRINCIPLES
of the
WCRP INTERNATIONAL PROGRAMME FOR ANTARCTIC BUOYS

1. This paper sets forth the principles and a set of operating procedures for the WCRP International Programme for Antarctic Buoys (IPAB).

2. Objective

The objective of the WCRP International Programme for Antarctic Buoys is to establish and maintain a network of drifting buoys in the Antarctic sea-ice zone in order to:

(i) support research in the region related to global climate processes and to global change, and, in particular, to meet research data requirements specified by the WCRP and relevant SCAR programmes;

(ii) provide real-time operational meteorological data meeting the quality requirements of the WMO/World Weather Watch (WWW) programme;

(iii) establish a basis for on-going monitoring of atmospheric and oceanic climate in the Antarctic sea-ice zone, in particular contributing to the aims of GCOS;

The Programme will build upon co-operation among those agencies and institutions with Antarctic and Southern Ocean

interests.

3. Programme principles

The IPAB will:

3.1 Promote the development of an adequate Antarctic buoy network through National Antarctic programme agencies, research and operational institutions, SCAR National Committees, and other relevant bodies.

3.2 Co-ordinate the development and maintenance of an optimum observational network for near-surface meteorological and oceanographic data within the Antarctic sea-ice zone, using drifting buoys and other appropriate data collection systems.

3.3 Distribute in real-time over the Global Telecommunication System (GTS) the buoy position and air pressure data from the network, plus relevant additional real-time data approved by the principal investigators for public dissemination;

3.4 Ensure that all data from the network are appropriately archived; and

3.5 Liaise and co-operate with other operators of buoys and data collection systems.

4. Observation Programme

4.1 Operational Area:

The operational area of the Programme is south of 55 degrees S and includes that region of the Southern Ocean and Antarctic marginal seas within the maximum seasonal sea-ice extent. (see Figure E1).

4.2 Variables:

Position, atmospheric pressure and (for those buoys in water) sea surface temperature will be collected as basic data. Some systems will be equipped to additionally measure other variables, such as air temperature, ice and/or snow temperature, atmospheric pressure tendency, wind speed and direction, snow and sea-ice properties, and oceanographic variables.

4.3 Basic Network Density:

Requirements stated by international environmental programmes (in particular, by WCRP, WWW, and SCAR/FROST) are for a basic network with observational points spaced at about 500km. It is the aim of IPAB to have sufficient buoy deployments to achieve and maintain this density over the operational area.

4.4 Duration of Programme:

The Programme is proposed as a long-term on-going one. After a five year initial phase, commencing in 1994, subsequent development will be 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 Service Argos.

5.2 Coding:

Data will be coded in a form suitable for extraction of basic meteorological variables. Participants will provide Service Argos, and the IPAB Co-ordinator, with necessary information to decode these data.

5.3 Global Telecommunication System:

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

6. Data Archiving

6.1 Operational Archiving

All basic data transmitted on the GTS should be archived by the Marine Environmental Data Service (MEDS) in Canada, as the IPC/WMO Responsible National Oceanographic Data Centre for drifting buoy data.

6.2 Research Data Base:

A uniform, quality-controlled data base for ice motion, surface meteorology and oceanography, as required by the Antarctic research community, will be established. Commencing in 1997 this data base will be annually submitted to appropriate data centres for archiving (in particular, to MEDS and WDC-A for Glaciology).

7. Management Structure

7.1 Participants:

Participants in the WCRP International Programme 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 Antarctic sea-ice zone studies and who contribute actively to the Programme. Intending Participants will indicate their contribution to, and involvement in, the Programme by means of a Letter of Intent (Annex 1) to be submitted to the Chairman of the Programme, with a copy sent to the Director, WCRP. Letters of Intent will be considered by the Executive Committee in consultation with the Co-ordinator and the accepted Participants will be notified by letter.

The full roll of Participants will be reviewed at each biennial meeting.

7.2 Management:

The Programme will be co-ordinated by the Participants. The Participants will arrange for the implementation of the Programme within the framework of the stated objectives. on a biennial basis the Participants will elect a Chairman and Vice-Chairman and appoint a Co-ordinator. 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 per cent of Participants. In case a quorum is not present, at a biennial meeting of Participants, elections shall be decided by unanimous vote.

A Participant who is unable to attend the biennial meeting may register a proxy vote delivered by an 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 Programme within the guidelines set at the biennial meeting of Participants, and will provide guidance and support to the Co-ordinator. The Executive Committee will share responsibility with the Co-ordinator for encouraging participation in the IPAB, and liaising with principal investigators of individual buoy programmes and with international organisations. During inter-sessional periods however, the Co-ordinator will act as the focal point for matters related to the operation of the Programme.

7.4 Co-ordinator:

Specific responsibilities and duties of the Co-ordinator are contained in Annex 2, Terms of Reference for the Co-ordinator of the WCRP International Programme for Antarctic Buoys.

7.5 Funding Provisions:

The Programme will be self sustaining, supported by contributions in the form of equipment, services (such as communications, deployment, archiving, co-ordination, 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 Programme. Other funding arrangements made between Participants will be recognised as contributions to the IPAB if they further the objectives of the Programme.

7.6 Programme Review:

The management structure and operation of the Programme shall be reviewed at the meeting of Participants.

8. Meetings

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

9. Glossary

Basic Meteorological Data - Atmospheric Pressure and buoy location

Antarctic sea-ice zone - that portion of the Southern Ocean and Antarctic marginal seas within the sea-ice edge at the time of its maximum seasonal extent (see Figure E1 on page 5).

Suggested form of Letter of Intent

Dear Colleague

(...Insert name of Agengy here...) proposes to participate in the WCRP International Programme for Antarctic Buoys to pursue the maintenance of a network of data platforms within the Antarctic sea-ice zone.

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

It is expected that our agency's contribution to the Programme will take the form of .....* during the first year of our participation, and .....* in subsequent years.

The contribution is made with the understanding that it be applied to the objective of the Programme.

Yours faithfully

---

* Please specify likely agency contribution to the Programme. Contributions might take the form of:

* data buoys (detail probable number and parameters measured)
* data acquisition and processing charges
* monetary contribution
* logistic support for deployment
* data communication services
* data archiving
* scientific or technical advice

This Letter of Intent should be sent to :

IPAB Chairman
WCRP International Programme for Antarctic Buoys
Alfred Wegener Institut fur Polar and Meeresforschung
Am Handelshafen 12
27619 Bremerhaven
Germany

with a copy to :

Terms of Reference for the Co-ordinator of the
WCRP International Programme for Antarctic Buoys

The Co-ordinator shall facilitate the implementation of the WCRP International Programme for Antarctic Buoys. The Co-ordinator will be appointed at the biennial 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;

2. co-ordinate with operators of non-Argos buoy programmes and other field operations;

3. liaise with principal investigators and managers of individual buoy programmes in the Antarctic sea -ice zone**;

4. arrange for the establishment and maintenance of a research quality data base of ice motion and surface meteorological and atmospheric data from the buoy network, and annually submit it to appropriate data centres for archiving (in particular to MEDS and WDC-A for Glaciology);

5. develop a deployment strategy to maintain an optimal buoy network in the Antarctic;

6. co-ordinate opportunities for buoy deployment;

7. liaise on technical aspects of buoy development;

8. prepare an annual summary of resources committed to the Programme;

9. liaise with the Technical Co-ordinator of the WMO/IOC Data Buoy Co-operation Panel to ensure that Antarctic data are properly processed and quality controlled for GTS distribution;

10. arrange for the purchase of buoys and ancillary equipment, and for the payment of expenses for Argos data acquisition and Argos processing fees, as authorised;

11. prepare and distribute bimonthly status report of buoy positions and an annual data summary;

12. maintain a distribution list for bi-monthly status reports and annual data summaries;

13. respond to requests from WCRP, SMO, and the Scientific Committee on Antarctic Research (SCAR) for technical and scientific information on the Programme**;

14. prepare and distribute a semi-annual newsletter of activities and plans;

15. organise the biennial meeting of Participants, present a report of the preceding 2 years' activities, and prepare a plan for the following 2 years;

16. promote the WCRP International Programme for Antarctic Buoys to potential Participants**;

General principals of data archiving for the WCRP International Programme for Antarctic Buoys

As outlined in the Operating Principles of the IPAB, data from the network will be archived in two data streams: an operational data archive, and a research data base.

Operational Archive:

The operational archive should include all basic data from the Programme transmitted in real-time on the GTS. participants should ensure that, as far as possible, all platforms deployed for the Programme are issued with an WMO ID number, and that data are inserted to the GTS. These data will be archived routinely by the Marine Environmental Data Service (MEDS) in Canada, as the IOC/WMO Responsible National Oceanographic Data Centre for drifting buoys data. The DBCP Technical Co-ordinator will assist IPAB investigators in getting their data on to the GTS.

Research Data Base:

A uniform, quality controlled data base for ice motion and surface meteorology and oceanography, as required by the Antarctic research community, will also be established. The Programme Co-ordinator will be responsible for maintenance of this data set at a designated data assembly centre.

This data set will take the form of time series, for each platform, of data from all available sensors and for all valid transmissions from the platform. The set should be established to include all data from buoys deployed after the inaugural IPAB meeting. Available data from earlier buoy deployments should be retrospectively included in the data set.

Consideration needs to be given to including a flag indicating whether the platform is in ice or open water at each observation time. Data will be input to the data set directly from the Argos files, and Participants should issue the appropriate authority for the Co-ordinator to obtain the monthly "Dispose" format files for their platforms from Service Argos. Participants should also provide the Co-ordinator with all necessary information to decode the data, information on the buoy and sensor characteristics, and notification of any change in sensor status.

A data base, containing information on buoy characteristics and history, (metadata) will be established and maintained for each platform.

A data summary containing daily values of position at 00Z (interpolated by spline), daily mean drift velocity, interpolated air pressure at 00Z and 12Z, and daily mean air temperature and ice/water temperature (the average of interpolated 3-hourly values) will be generated from the primary data set. Monthly mean values of these variables will also be derived. These data will form the basis of the annual data summary produced by the Co-ordinator. The annual data summary might also include mean monthly pressure fields generated by one of the numerical meteorological centres.

All research data base products will be biannually submitted to appropriate data centres for archiving and public access (in particular, to MEDS and to WDC-A for Glaciology). No data will, however, be released to the data archiving agencies, or publicly disseminated by the Co-ordinator, until at least 6 months after collection. Participants may request the Co-ordinator to withhold data dissemination for a longer period, up to a maximum of 2 years, or to exclude inclusion of data from specific sensors in the research data base.

ASPECT (Antarctic Sea Ice Processes, Ecosystems and Climate)
A proposed programme of multi-disciplinary Antarctic sea ice zone research within the SCAR Global Change Programme.

EXECUTIVE SUMMARY

Despite the growth of activities in global-change research in the Antarctic, both from SCAR programmes and from other international programmes, such as those of IGBP and WCRP, there remain key deficiencies in our understanding and data from the sea ice zone that are not addressed by current or planned research programmes. Important problems not adequately covered by existing research programmes include:
1. The broad climatology of sea ice physical characteristics.
2. Pack ice ecology, a key component of the polar marine environment.
3. Processes such as ice formation, water mass modification, the maintenance of polynyas, ice edge and coastal fronts, gas exchange, and air-sea interaction.
4. Modelling sea-ice processes (physics and ecology) in coupled atmosphere-ice-upper ocean models. Linking scales (local scale to regional scale to global scale models).

There is a special role for the SCAR Global Change Programme in the shelf to ice-edge area (pack ice) that is not being adequately covered by other programmes. Hence SCAR GLOCHANT proposes to establish a programme of multi-disciplinary Antarctic sea ice zone research called Antarctic Sea Ice Processes, Ecosystems and Climate (ASPECT).

The broad objectives for ASPECT are
I. To establish the distribution of the basic sea ice properties important to air-sea interaction and biological processes within the Antarctic sea-ice zone (ice and snow cover thickness distributions; structural, chemical and thermal properties of the snow and ice; upper ocean hydrography; floe size and lead distribution) in order to derive forcing and validation fields for models.
II To understand key sea-ice zone processes for further model development and in order to improve parameterisation of these processes in coupled models.

A major thrust of the ASPECT programme is its multi-disciplinary focus on the sea-ice zone; combining research on physical sea ice processes, ocean-atmosphere interaction and sea-ice biology. An inter-disciplinary research approach to the ecology of the sea-ice zone is vitally important in the overall programme. As a SCAR programme, ASPECT is focused towards the role of the unique regional environment of the Antarctic sea ice zone, but it is essential that this is closely linked to the international global change research agenda. Hence inter-disciplinary components of ASPECT are designed to contribute to, and extend, international open ocean programmes such as JGOFS. ASPECT will also maintain close scientific links with the SCAR CS-EASIZ programme, a study of the ecology of the Antarctic coastal and continental-shelf zones.

Many physical elements of ASPECT will contribute to the objectives of the WCRP CLIVAR Programme, a study of Climate Variability and Predictability, which involves investigations of atmosphere, ocean and land at a variety of time scales. ASPECT plans are particularly relevant to the CLIVAR-DecCen component-programme, concerned with decadal to centennial climate variability and predictability. The ASPECT programme will initiate implementation of parts of the sea ice zone research requirements of CLIVAR, and will collaborate closely with CLIVAR and other WCRP programmes to ensure the essential global integration of Antarctic regional research. It will be appropriate for some research elements of ASPECT to eventually become a sub-component of CLIVAR, but because of the unique logistic requirements of work in the Antarctic sea ice zone, ongoing SCAR involvement and sponsorship are important.

The ASPECT programme will build on existing and proposed research programmes, and the shipping activities of National

Antarctic operators. The implementation plan includes some components that can be undertaken as part of normal resupply voyages; for example a system of simple but quantified shipboard observations that provide statistical ice and snow thickness distributions. ASPECT will also include a component of data-rescue of valuable historical sea ice zone information. The ASPECT programme will achieve its aims by:

- defining a framework of the priority Antarctic sea ice zone research required to address global change and related issues
- promoting and fostering co-ordinated contributions to this plan from within National research programmes and by building on ongoing projects
- liaising with other international programmes requiring data and research products from the Antarctic sea ice zone, and
- organizing workshops to co-ordinate implementation through contributory projects.

Appendix A-1

Appendix A-2

Appendix A-3

Appendix B-1

Appendix B-2

Appendix D1-1

Appendix D1-2

Appendix D1-7

Appendix D1-8

Appendix D1-9

* Formerly at Scott Polar Research Institute

Appendix D1-10

Appendix D1-11

Appendix D1-26

Appendix D2-1

Appendix D3-1

Appendix E-1

Appendix E-2

Appendix E-3

Appendix E-4

Appendix E, Annex 1

Appendix E, Annex 2

** The Executive Committee will share responsibility with the Co-ordinator in liaising with principal investigators of individual buoy programmes and with international scientific organisations, and for promoting the Programme.

Appendix G-1

Appendix H3-1

Appendix I-1