INTERNATIONAL COUNCIL FOR SCIENCE

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

WORLD METEOROLOGICAL ORGANIZATION

# WORLD CLIMATE RESEARCH PROGRAMME

## INTERNATIONAL PROGRAMME FOR ANTARCTIC BUOYS (IPAB)

### REPORT ON THE THIRD MEETING OF PROGRAMME PARTICIPANTS

**(Fairbanks, Alaska, USA, 26-28 June 2000)**

**WCRP Informal Report No. 5/2002**

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## 1. Opening and organisation of the meeting

The third session of the WCRP International Programme for Antarctic Buoys (IPAB) was opened at the International Arctic Research Centre, Fairbanks, Alaska, USA by the Chairman of the IPAB Executive Committee, Dr C. Kottmeier, at 09:30 am on Monday, 26 June 2000. The Chairman welcomed everybody to the meeting and introduced the attendees, which included 10 of the 19 Participants. A list of attendees is given in Appendix A. An agenda was agreed which is detailed in Appendix B.

## 2. Report of the IPAB Co-ordinator

Dr I. Allison presented a report on IPAB activities during 1999-2000, together with an overview of IPAB activities during 1995-2000, which are included as Appendix C.

## 3. Reports from Participants

National reports on current activities were presented from the following countries:

Australia
Finland
Germany
South Africa
United Kingdom
United States of America.

The complete reports are included as Appendix D.

## 4. Review of IPAB progress to date

Dr Kottmeier reviewed the progress of IPAB to date, amplifying the report of Dr Allison (see Appendix C) and commenting on the success of what essentially had been an informal arrangement among nations who carried out Antarctic buoy programmes to ensure that maximum scientific benefit is obtained from the total datasets. As stated in the Operating Principles of IPAB (see section 4.4 of Appendix E of WCRP Informal Report No. 5/1999), after an initial phase of the Programme commencing in 1994, the Participants of the third IPAB biennial meeting would review the development of the International Programme for Antarctic Buoys.

The high justification for the Programme is reflected in recommendations taken by the joint common meeting of the ACSYS Numerical Experimentation Group, the ACSYS Data Management and Information Panel, and the ACSYS Observation Products Panel held in Koblenz, Germany from 28 June - 1 July 1999 as well as by the twentieth session of the Joint Scientific Committee for the WCRP (WMO/TD No. 976, 1999), and by thirteenth World Meteorological Congress. All of them gave strong encouragement to the IPAB activities.

Participants agreed that important progress was made in establishing and maintaining a data network in the Antarctic sea-ice zone, and in supporting research of the global climate change. Additional effort is required in transmitting all valuable real time data onto the GTS. It has transpired that the data buoy network is adequate for certain purposes, such as providing ground truth for satellite sensors, but that it will be very difficult to establish and maintain a network with a target spacing of 500 km. Large seasonal variability of the ice cover, its average offshore divergent motion, and the limited number of new buoys available for deployments make the problem even more difficult.

Proper data archiving procedures have been established by means of the research data base and by transmitting the data regularly to the NSIDC. All data available on the GTS are also archived at MEDS/Canada. Liaising and co-operating with other institutions is mainly being made by individual Participants, depending on their research objectives. The data base should be continuously developed to make use of the full IPAB data set for other purposes, such as sea-ice modelling and provision of ground truth for satellite sensors.

The operational area of the Programme as well as the variables measured by the buoys is considered adequate, though new sensor and data transmission developments should be reviewed and adopted as appropriate.

The Participants decided that the International Programme for Antarctic Buoys should continue its efforts to establish and maintain an operational *in-situ* data network in the Antarctic sea-ice zone.

Supportive messages and endorsements from other organisations were provided to the meeting by Dr V. Savtchenko and are included as Appendix E.

The meeting resolved to continue the Programme as a long-term one.

## 5. Status of membership role

There was a discussion on the results of the request made to Participants to renew their commitment to IPAB. Dr V. Savtchenko reported that at the time of the meeting only six replies had been obtained but that a number of further replies are expected. The meeting resolved to give continuing Participants time until 30 September 2000 if they wish to be listed as Participants. Intended new participants will also be considered by the Executive Committee up to that time. Reminders will be sent to individuals.

The membership list is given in Appendix F.

## 6. Related observational programmes

Dr E. Horton described the work of the Data Buoy Co-ordination Panel (DBCP) in co-ordinating the work of ocean drifters. Dr E. Couture gave a presentation on the web site being developed for both International Arctic Buoy Programme (IABP) and IPAB by the Marine Environmental Data Service (MEDS), Ottawa, Canada, and a CD being prepared for IABP data. Her initiative in presenting both IPAB and IABP results on the same web site was warmly welcomed.

Dr I. Allison gave a presentation on the Science and Co-ordination plan for the WCRP CliC programme (Climate and Cryosphere). The meeting resolved that IPAB should report its activities to the JSC of the WCRP through the ACSYS/CliC SSG.

## 7. Review of Operating Principles of the Programme

Changes were proposed to the Operating Principles and accepted by the meeting in conformity with the continuation of the Programme, to include participation of individual investigators with relevant buoy programmes. The revised Operating Principles are enclosed as Appendix G.

## 8. Activities to improve visibility of the IPAB within the scientific community

Dr I. Allison reported that the brochure advertising the nature and work of IPAB, requested at the second session of Programme Participants, was not yet complete. It was resolved to complete a brochure before the end of the year 2000.

Dr. I. Allison reported that he was preparing a note on IPAB for "ARGOS Newsletter" which might provide a starting base for the intended brochure. He will provide a copy of this and other information for Dr P. Wadhams to prepare a first draft of the brochure, which will be refined through the professional help of a graphic artist provided by Dr I. Allison. The Joint Planning Staff for WCRP will be requested to provide support to produce and distribute the finished brochure.

The IPAB web site www.antcrc.utas.edu.au/antcrc/special/buoys/buoys.html will be transferred to the Scott Polar Research Institute, Cambridge, UK by the end of the year 2000.

The meeting resolved to produce an Antarctic buoy bibliography, comprising all known papers and reports published using results from Antarctic drifting buoys. Dr P. Heil offered to assist in the compilation of the bibliography, which will appear on the web site.

The meeting resolved that an article in "EOS" would also be an appropriate way of bringing the work of IPAB to wider attention. Dr Allison undertook to lead the preparation of such an article.

## 9. Joint session of IPAB with IABP and technical presentations

On the morning of Tuesday, 27 May 2000, a joint session was held with the International Arctic Buoy Programme (IABP), which was meeting concurrently with IPAB. Appendix H contains the agenda of the joint IPAB/IABP session.

The session included a presentation to IABP by Dr I. Allison regarding the work of IPAB; a presentation by Dr I. Rigor on the work of IABP; a presentation by Dr Kikuchi on the J-CAD multi-sensor buoy recently deployed at the North Pole; a presentation by Dr T. Kvinge on the air-deployable ICEX buoy manufactured by Christian Michelsen Research; and a presentation by Mr M. Doble on the design of Antarctic ORBCOMM buoys.

The technical presentation that was of special relevance to IPAB was that Mr M. Doble, whose design of a low-cost multi-sensor buoy using the ORBCOMM satellite system to achieve large data transmission rates and frequent position fixes at low cost was felt to be of significant value for future IPAB buoy design; and of Dr T. Kvinge, since possible future data acquisition from remote sites in the Antarctic unconnected with particular research projects could well involve the use of air-dropped buoys. Dr E. Zambianchi mentioned that Italy might be able to provide some aircraft facilities for such drops.

Dr C. Geiger also gave a presentation on the use of buoy and satellite data together in resolving details of ice dynamics.

## 10. Future activities and any other business

The fourth IPAB meeting will be held in June-July 2002. Dr J. van der Merwe extended an invitation to hold the meeting in Cape Town, South Africa. This invitation was noted with thanks, and a decision deferred until it could be determined whether another appropriate scientific meeting is being held at approximately the same time, to which IPAB could be added on as a way of minimising travel costs for the participants in the IPAB-IV.

## 11. Administrative aspects of the IABP

In accordance with the management structure outlined in the IPAB Operating Principles, the meeting elected a new Executive Committee. Dr Kottmeier wished to not be considered for a further term as the Chairman, and was thanked for the enormous contribution, which he had made to the success of IPAB during his tenure as Chairman. The committee was elected as follows:

| | |
|---|---|
| Chairman | Dr E. Zambianchi |
| Vice-Chairman | Dr J. Launiainen |
| Member | Dr S. Ushio |
| Member | Dr I. Allison |
| Member | Dr C. Kottmeier. |

The meeting approved the transfer of the work of co-ordinator from Dr I. Allison to Dr P. Wadhams (appointed joint Co-ordinators at the second session of the Programme Participants). The transfer will begin in September and will be complete by 1 January 2001, when the Co-ordination centre will be the Scott Polar Research Institute, Cambridge, UK. The meeting thanked Dr Allison for the excellent work that he has done in running the operational side of IPAB's work since 1995.

The meeting also thanked Dr P. Heil for the work that she has done to assist Dr I. Allison in the conduct the business of co-ordination.

## 12. Adoption of the meeting report

The draft report and minutes of the meeting were accepted by the participants in the meeting. The meeting resolved to complete a final version of the meeting report and send it to the WCRP office in time for the first session of the ACYS/CliC SSG.

## 13. Closure of the meeting

Dr Kottmeier thanked all the attendees for their presence and all those associated with the work of the organisation. He thanked the International Arctic Research Centre for supplying the venue.

The third session of the WCRP International Programme for Antarctic Buoys closed at 12:00 on Wednesday, 28 June 2000.

**14. References**

WCRP Informal Report No. 5/1999: Report on the second session of the IPAB (Naples, Italy, 11-13 May 1998)

WCRP Informal Report No. 6/2000: Summary report of ACSYS meeting on data and data management in support of sea-ice/ocean modelling (Koblenz, Germany, 28 June – 1 July 1999).

WMO/TD No. 976 , 1999: Annual review of the World Climate Research Programme and Report of the twentieth session of the Joint Scientific Committee (Kiel, Germany, 15-19 March 1999).

WMO-No. 902, 1999: Thirteenth World Meteorological Congress (Geneva, 4-26 May 1999), abridged final report with resolutions. Secretariat of the World Meteorological Organization, Geneva, Switzerland.

WCRP Informal Report No. 10/2000: Summary report of the eighth session of the WCRP ACSYS Scientific Steering Group (Louvain-la-Neuve, Belgium, 15-19 November 1999).

WCRP-114, 2001: Climate and Cryosphere (CliC) project: Science and Co-ordination Plan (version 1). Eds: I. Allison, R.G. Barry and B.E. Goodison. WMO/TD No. 1053.

# APPENDICES

# Appendix A

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**Appendix B**

## Final Agenda and explanatory memorandum

### 1. Organisation of the Session

The third session of the WCRP International Programme for Antarctic Buoys (IPAB) will be opened in the Globe Room of the Geophysical Institute of the University of Alaska Fairbanks (903 Koyukuk Drive, Fairbanks, Alaska, USA) on Monday, 26 June 2000 at 09.30 am by Dr Christoph Kottmeier, the Chairman of the Executive Committee for the IPAB. The session will be held in English and is expected to continue until the afternoon of Wednesday, 28 June 2000.

The meeting will be invited to review the provisional agenda (IPAB-III/Doc. 1) and agree on the organisation of its work during the session.

### 2. Report of the IPAB Co-ordinator

Dr I. Allison, the Co-ordinator of the Programme, will deliver a report on the IPAB developments in 1998-2000 (since the second session of the Programme Participants in Naples, Italy, in May 1998).

### 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 IPAB progress to date

Dr C. Kottmeier, the Chairman of the IPAB Executive Committee, will review the progress of the Programme from June 1994 to June 2000.

### 5. Status of the Membership Role

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

### 6. Related Research, Observational and Data 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, observational programmes related to the IPAB. In particular, the meeting will be briefed on developments of the WCRP Climate and Cryosphere (CliC) project.

### 7. Review of the Operating Procedures of the Programme

The Operating Procedures of the IPAB (Appendix E to the report of the second session of the IPAB Programme - WCRP Informal Report No 5/1999) will be reviewed and amended, if required.

### 8. Activities to Improve the Visibility of the IPAB within the Scientific Community

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.

### 9. Joint IPAB/IABP Session

The tenth session of the International Arctic Buoy Programme (IABP) is scheduled to be held in Fairbanks, Alaska, USA from 26-28 June 2000. A joint IPAB/IABP meeting will be organised on Tuesday, 27 June 2000 in order to discuss common problems and share the experience gained by each programme. A detailed agenda for the joint session will be developed by the Chairmen of the IPAB and IABP and provided by them directly to the attendees at both meetings. The participants in the joint session may wish to deliver reports on technology innovations for drifting buoys used for collection and transmission of atmospheric, sea-ice and oceanic data in the polar regions.

### 10. Future Activities and any 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.

### 11. 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.

### 12. Adoption of the Meeting Report

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

### 13. Closure of the Meeting

The IPAB-III is expected to close in the afternoon of Wednesday, 28 June 2000.

**Appendix C**

## Report of the IPAB Co-ordinator
## (The report was delivered by Dr I. Allison)

### Introduction

A total of 120 buoys contributing data to IPAB have been deployed south of 55°S in the six-year period between 1995 and 2000. While this number falls well short of the optimum array, the data from IPAB platforms have had a significant impact on operational meteorological products, and on our understanding of the dynamics of Antarctic sea ice.

Analysis of the impact of data sources on the Australian Bureau of Meteorology operational forecast model, GASP, shows the importance of the IPAB buoy data. The first eight of the ten Southern Hemisphere buoys that had the greatest impacts on GASP analyses of sea level pressure (on the basis of ensemble root-mean-square impacts) for January to March 2000 were at latitudes higher than 55°S. These buoys had rms impacts on the forecast pressure of between 1.4 and 1.9 hPa, and a maximum impact of up to 6.4 hPa. For the period April to June 2000 the first six of the buoys with greatest impact were at latitudes higher than 55°S. These had rms impacts of 2.6 to 2.1 hPa and a maximum of 9 hPa.

IPAB data have been used to derive climatologies of sea-ice drift in the Weddell Sea and off East Antarctica, and in support of a wide variety of studies of the Antarctic sea-ice zone, including initialization and validation of numerical climate modelling, and for the validation of satellite remote-sensing techniques for determining sea-ice motion. These data have demonstrated the highly dynamic nature of Antarctic sea-ice and shown the major role that ice drift and deformation have in determining the ice-thickness distribution.

Continuation of the IPAB programme was reviewed at the 3rd meeting of Programme Participants (Fairbanks, AK, USA June 2000), and the Co-ordinating Office is to be transferred from the Antarctic CRC, Hobart, Australia, to the Scott Polar Research Institute, Cambridge, UK. It is timely, with these changes, to present an overview of IPAB activities since inauguration in 1995. This is given as an Annexes to this report.

### Buoy activity, 1999-2000

The greatest number of IPAB buoys deployed in any single year was launched in 1999. Many of these were position-only platforms used to study sea-ice drift as part of an Australian study of the Mertz Glacier Polynya (67°S, 145°E). Of the 36 platforms deployed in 1999, 15 reported real-time pressure and temperature data via the Global Telecommunications System (GTS). In contrast, only 11 platforms were deployed during 2000, but almost all of these reported via the GTS. The average number of IPAB platforms active in any month was 16 for 1999 (many of the position-only platforms were designed for a short life) and 11 for 2000, compared with the long-term average of about 13. Geographically, there was some reduction of buoy activities in the Weddell Sea region, particularly in 2000, but a corresponding increase in the Ross and Bellingshausen Seas. Full details of 1999 and 2000 deployments are in the Annexes. The drift tracks of IPAB buoys operating during 1999 and 2000 are shown in Figures 1 and 2 respectively (green - tracks of buoys deployed by the Alfred Wegener Institute, Germany; blue - tracks of buoys deployed by the Australian Antarctic Division; red – tracks of buoys deployed by the Scott Polar Research Institute, UK).

During 2000 a sophisticated new type of sea-ice buoy reporting both location and comprehensive environmental data at high frequency was used in the Weddell Sea in a collaborative project between the Scott Polar Research Institute and the Dunstaffnage Marine Laboratory, UK.

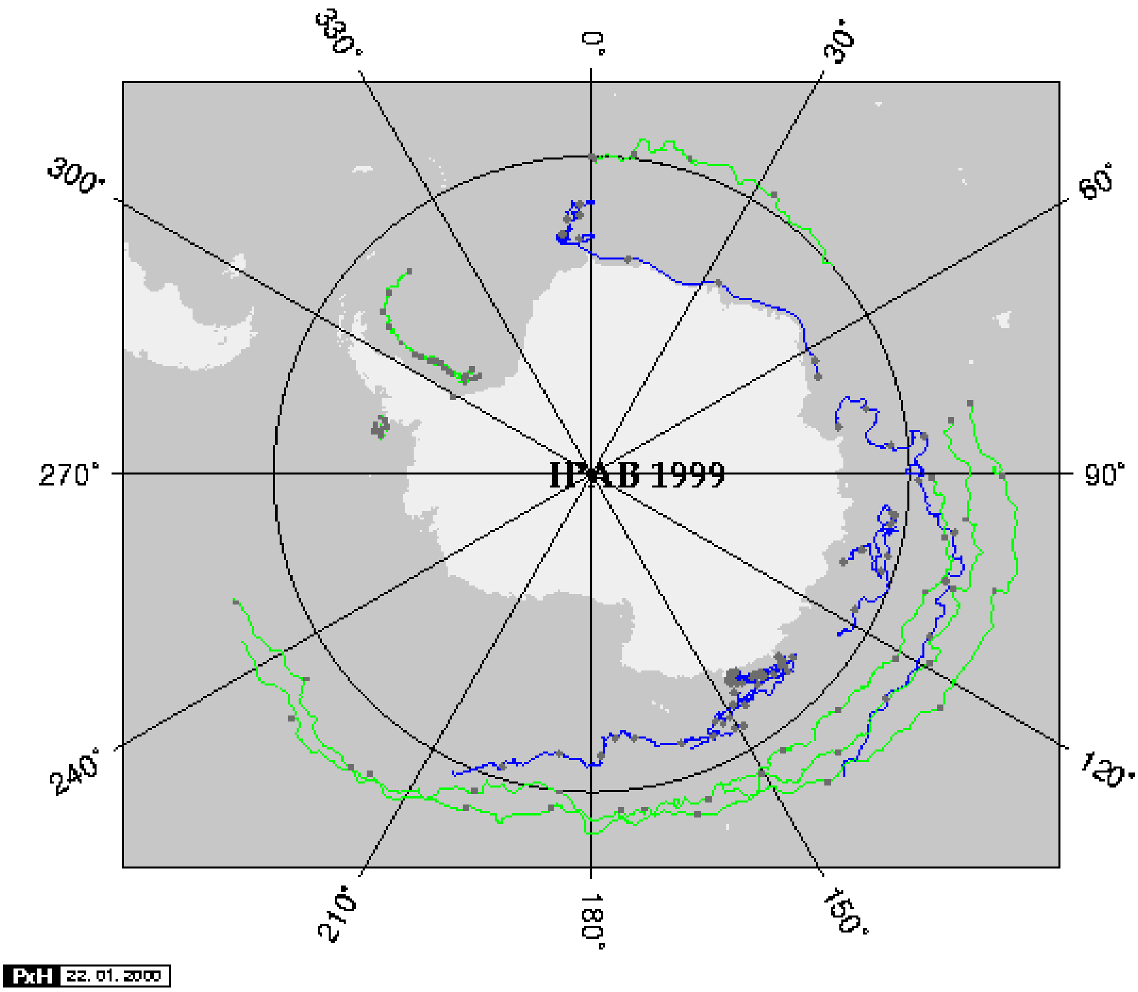



**Figure 1: Drift tracks of IPAB buoys in 1999**

Despite the demonstrated importance of high-latitude Southern Hemisphere buoy data to model prognoses, and despite also a letter signed by the Secretary-General of WMO inviting National Meteorological Services (NMS) to join the IPAB, buoy deployments in 1999 and 2000 were all made by a small number of research agencies. The year to year fluctuation in IPAB activities is a consequence of the dependence of buoy funding on individual research grants, and the involvement of NMS in IPAB is one of the major issues facing the Programme for the future.

## IPAB Data

Three-hourly synoptic data from drifters included in the Programme are routed by Service Argos directly onto the GTS, from where they are taken for archiving by the Marine Environmental Data Service, Canada, acting as the Responsible National Oceanographic Data Centre for drifting buoy data. Up to date information on those IPAB buoys reporting via the GTS is available from MEDS at:

http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Prog_Int/RNODC/RNODC_e.html

The IPAB Co-ordinating Office also maintains a separate research data base of data from all buoys, including those that do not report via the GTS and those that measure location only. These data have recently been transferred to the National Snow and Ice Data Center, Boulder, Colorado, USA and will be eventually released to the research community on CD-ROM.

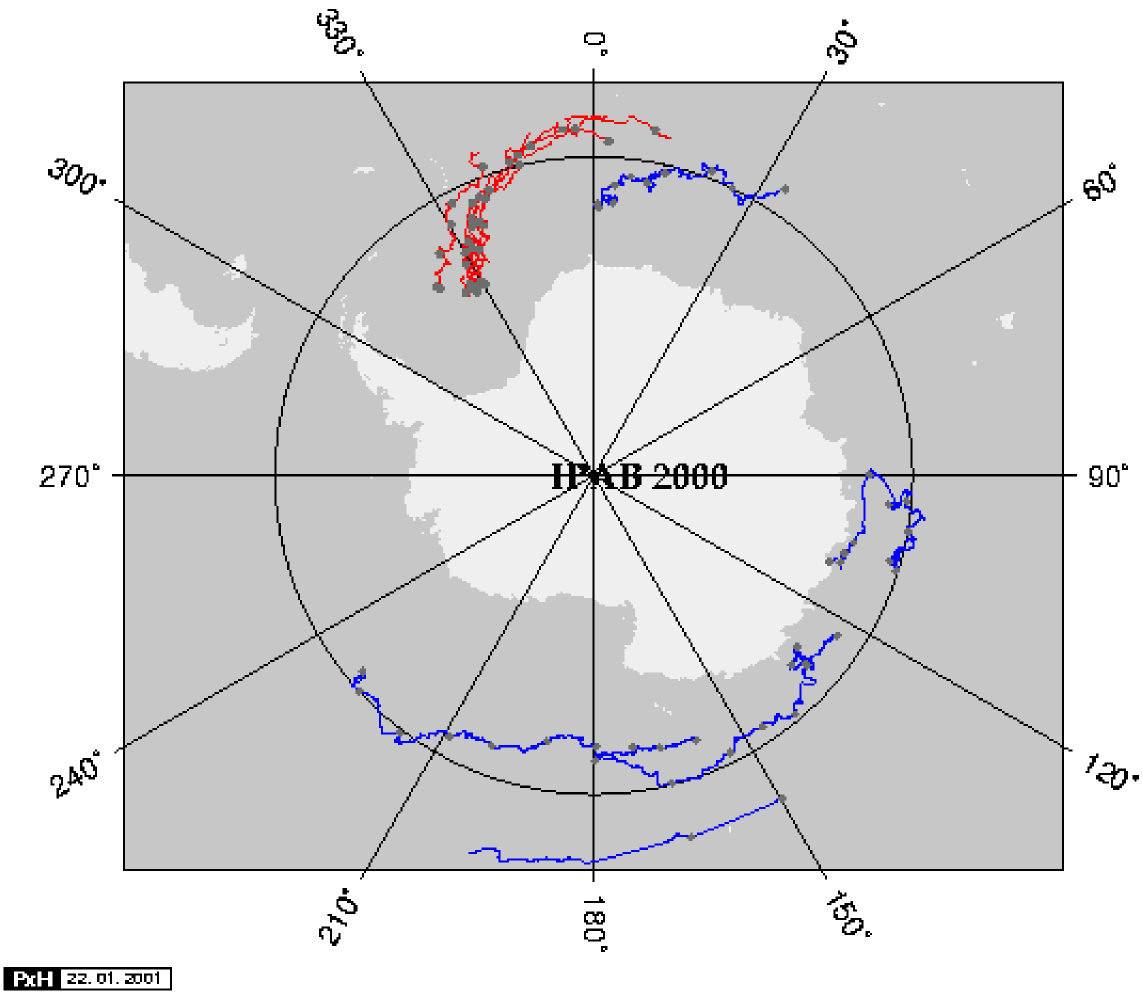



**Figure 2: Drift tracks of IPAB buoys in 2000**

## Reporting IPAB activities

IPAB is a self-sustaining programme of the WCRP and reports to the WCRP JSC through the Arctic Climate System Study (ACSYS)/Climate and Cryosphere (CliC) Scientific Steering Group (SSG). The co-ordinator attended the eighth session of the ACSYS Scientific Steering Group (Louvain-la-Neuve, Belgium, 15-19 November 1999) and the first session of the ACSYS/CliC SSG (Kiel, Germany, 23-27 October 2000) and reported on IPAB activities. IPAB is also an action group of the WMO/IOC Data Buoy Co-operation Panel (DBCP). The co-ordinator attended the Scientific and Technical Workshop associated with the 15th meeting of DBCP (Wellington, New Zealand, 1999) and submitted a written report on IPAB activities to DBCP-XVI (Vancouver, Canada, October 2000).

An article on IPAB activities was published in Argos Newsletter No. 57 (September 2000) and web site providing information on IPAB is maintained at http://www.antcrc.utas.edu.au/antcrc/buoys/buoys.html

## Acknowledgement

Much of the work associated with processing buoy data, maintaining the Research Data Base, and producing the tables and figures in this report, was done by Dr P. Heil at the Antarctic CRC. Matt Paget and Vito Dirita also assisted with archiving and processing Argos files.

## OVERVIEW OF IPAB ACTIVITIES: 1995-2000

Drift tracks for all IPAB buoys for the period 1995-2000 are shown in Figure 3. Points along the track represent the positions of the buoys at the start of each month. Details of those buoys operating during each year, and their period of activity, are given in the tables in Annex 2.

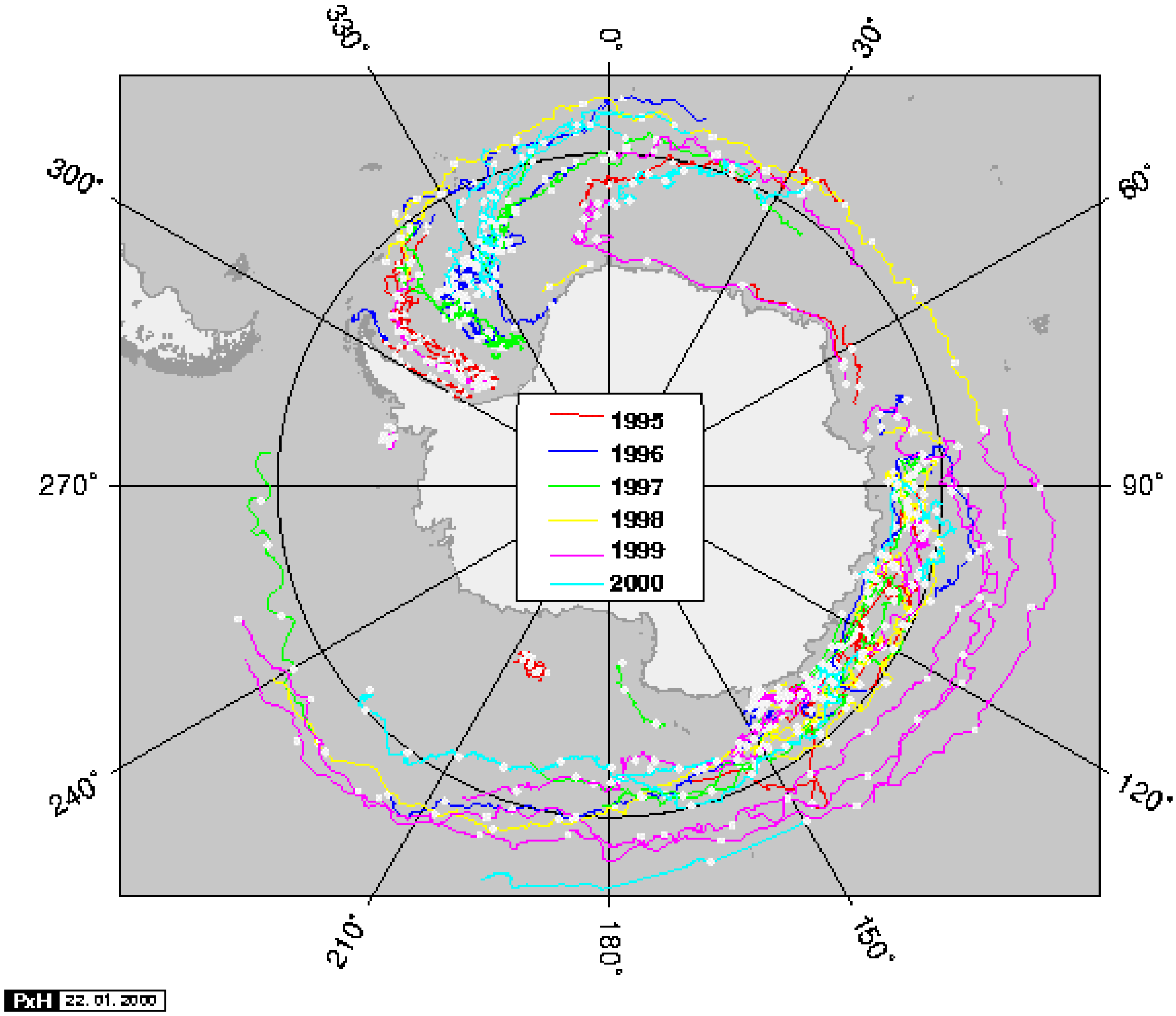



**Figure 3: Drift tracks of IPAB buoys in 1995-2000**

Figure 4 shows the number of new buoys deployed each year broken down into 3 regions: the Weddell Sea (20°E to 60°W); East Antarctica (170°E to 20°E); and the Bellingshausen, Amundsen and Ross Seas (60°W to 170°E). Figure 5 shows the seasonal distribution of these deployments. Almost all deployments are made onto ice floes or into newly forming ice from ships, typically vessels re-supplying Antarctic bases. In the Weddell Sea, the deployments have usually been made in January and February, while off East Antarctica they are made from late March to early May as the ice edge starts to advance northward from its summer minimum almost at the coast. Most early IPAB deployments were concentrated in the Weddell Sea and off the coast of East Antarctica, but there have been new initiatives in the Ross and Bellingshausen Sea region since 1998. The large peak in deployments in East Antarctica in 1995 and 1999 are due to short-term position-only buoy arrays deployed as part of winter sea-ice process studies in August of those years.

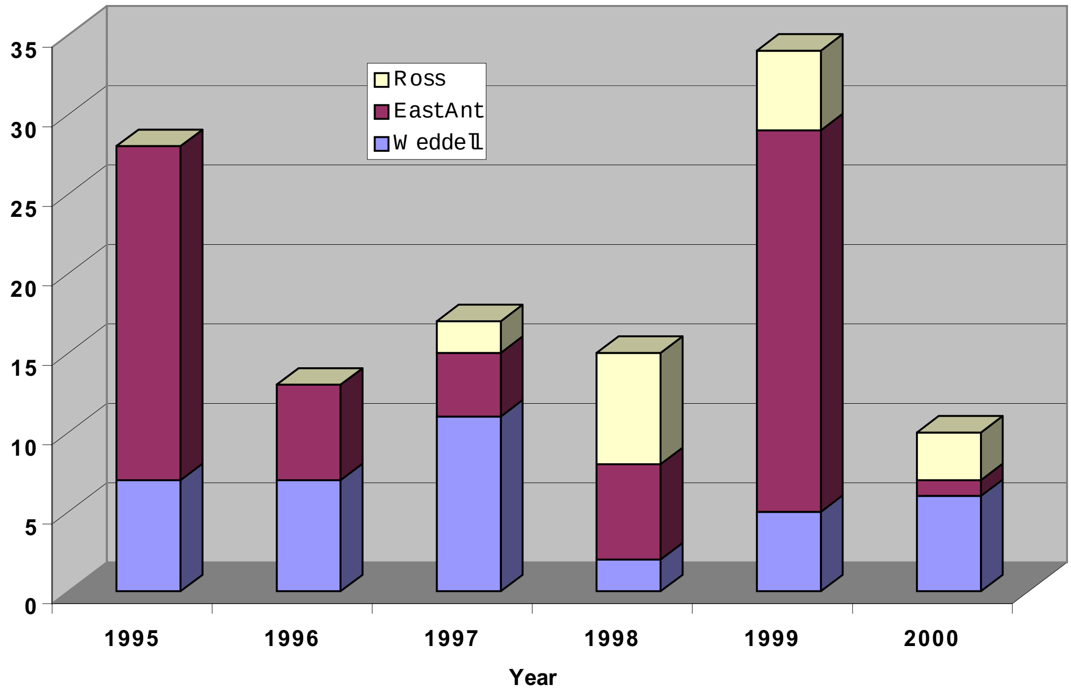



**Fig. 4: New buoys deployed each year, 1995-2000**

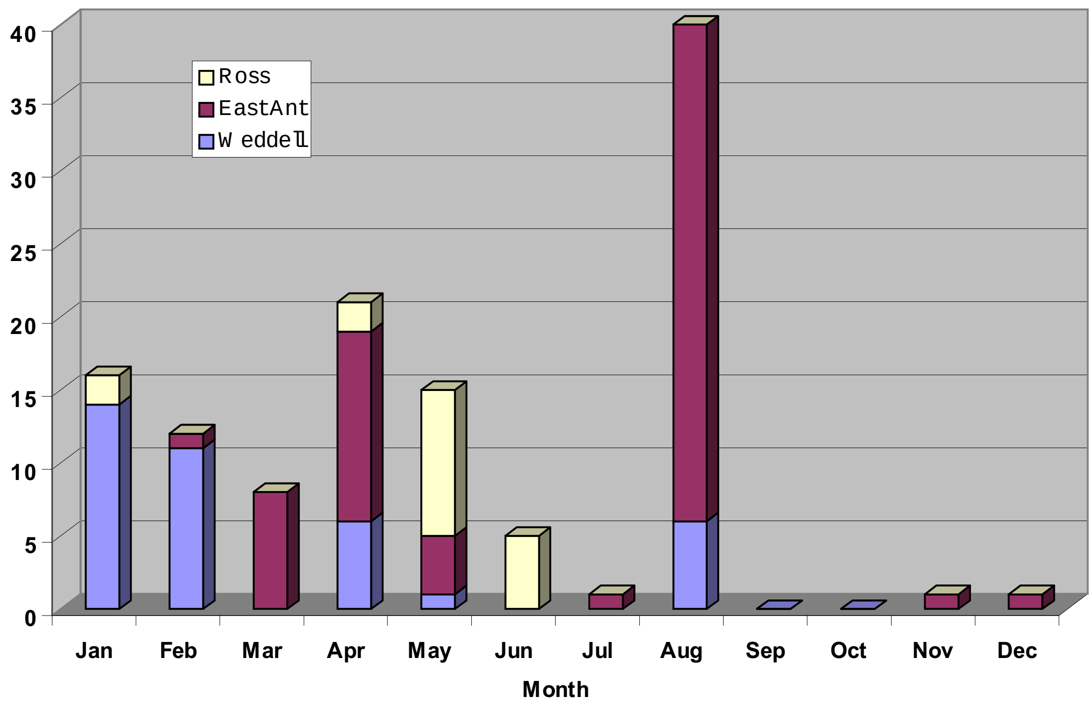



**Fig. 5: Total new deployments by month 1995-2000**

Figures 6 and 7 respectively show the average number of IPAB buoys reporting each year, and the seasonal distribution of active buoys. The number of platforms with meteorological sensors, and reporting via the GTS has remained fairly constant at 12 to 18 per year since 1995, but even at a peak, the number of active drifters falls far short of the optimum requirement. Seasonally the buoy numbers show a peak in late autumn after the new deployments. Buoy numbers drop steadily after the maximum due both to instrument failures, and to northward divergence, which takes many buoys out of the region of interest to IPAB. Although many drifters have sufficient battery power to operate for 2 or more years, most drift northward out of the ice and only a few survive within the Antarctic pack for a second winter.

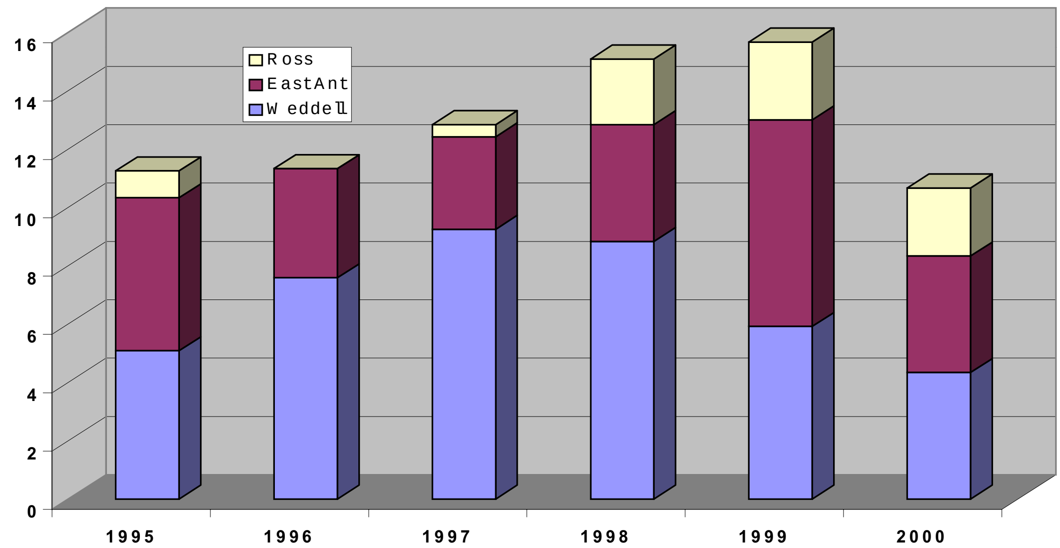



**Fig. 6 Average number of active buoys per year**

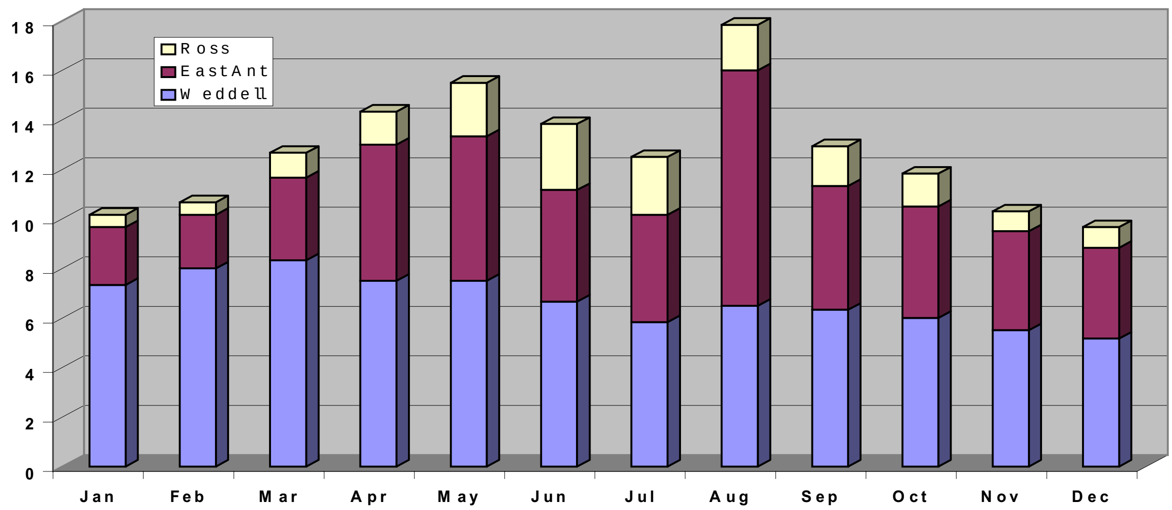



**Fig. 7 Average monthly distribution of active buoys in 1995-2000**

## Appendix C, Annex 2

# IPAB BUOY ACTIVITIES: 1995-2000

Tabulated metadata for IPAB buoys are as follows:

**IPAB No.** Unique identifier given to each IPAB Buoy. Includes code for responsible agency :

| | |
|---|---|
| AWI | Alfred Wegener Institute, Germany |
| AAD | Australian Antarctic Division |
| CRC | Cooperative Research Centre, Aus |
| FIN | Finnish Institute of Marine Research & Dept. of Geophysics, U. Helsinki |
| GIA | Geophysical Institute, U. Alaska, USA |
| LDO | Lamont-Doherty Earth Observatory, Colombia University, New York, USA |
| SPRI | Scott Polar Research Institute, UK |

**tba** Data not available at present. (To be announced.)

**ND** No data

**Argos User # (not shown)**

| | |
|---|---|
| AWI | 0919 |
| AAD | 1155 |
| CRC | 8301 |
| FIN | 0815 |
| GIA | 1824 |
| LDO | tba |
| SPRI | 0533 |

**Argos PTT** Argos transmitter number. Numbers may be reused for a different platform.

**Deployment** Date and location of deployment

**Buoy Type** Manufacturer and model number:

| | |
|---|---|
| AAD | Aust. Antarctic Division with Telonics PTT |
| CMI | Christian Michelsen Research AS, Bergen |
| DSI | Defense Systems Incorporated |
| MO | MetOcean Data Systems, Nova Scotia |
| PRL | Polar Research Laboratory |
| S&K | Sellman and Kruse, Bremerhaven, Germany |
| TO | Technocean, Florida |
| Turo | Tasmanian Underwater Res. & Oceanog. |
| DML/SPRI | Dunstaffnage Marine Laboratory/Scott Polar Research Institute |

**GTS** WMO Number for buoys reporting via the GTS

**Drogue** Ocean drogue fitted

| | |
|---|---|
| yes | Y - or depth of drogue in metres |
| no | N |

**Deployed** Ice conditions where the buoy was deployed:

| | |
|---|---|
| on ice | directly onto or in a floe >0.3m thick |
| new ice | within frazil/pancake ice field |
| thin ice | within thin ice (<0.3 m) floe or field |
| pancakes | leads between new pancake ice |
| in lead | in a lead in ice >0.3 m thick |
| ow in ice | in open water amidst ice >0.3 m thick |
| open ocean | outside the pack ice |

**GPS** Y = GPS receiver fitted.
**GPS positions are used in preference to Argos when available. (Y) – in brackets – indicates GPS receivers were fitted, but data have not been released to IPAB. In this case only Argos positions are archived.**

**Sensors (standard)**

| | |
|---|---|
| P | Atmospheric pressure |
| Ta | air temperature |
| SST | sea surface or ice temperature (Usually a buoy-hull sensor, rather than specific ice or water sensor) |

**Other (sensors)**

| | |
|---|---|
| W | wind speed and direction |
| At | other atmospheric parameters |
| Ti | ice temperature |
| Tw | water (thermistor chain) temperatures |
| Hd | buoy heading |
| SP | wave spectrum |

**NOTE** The following tables indicate what sensors were fitted to the buoys, rather than what data are available in the IPAB archive.

The standard IPAB data are position, P, Ta and SST. Data from other sensors are also processed if the relevant calibrations are provided to IPAB, but are not provided to the archiving data centres.

Sensor labels in brackets indicate that the sensor had failed, or that these data were not available to IPAB.

**Contact buoy owner for further information**.

Buoys are sub-divided into 3 regions depending on initial deployment location:

| | |
|---|---|
| East Antarctica | 170°E to 20°E |
| Weddell Sea | 20°E to 60°W |
| Bellingshausen, Amundsen and Ross Seas | 60°W to 170°E |

# IPAB buoys, 1995

| IPAB No. | Argos PTT | Deployment | | | Buoy Type | GTS | Drogue | Deployed | GPS | P | Ta | SST | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First date | Lat | Long | | | | | | | | | |
| CRC03 | 23380 | Feb-95 | -62.4 | 90.1 | Turo T-701 | 74531 | y | open ocean | | y | | y | |
| CRC05 | 6550 | Dec-95 | -62.0 | 79.6 | Turo T-701 | 74537 | y | open ocean | | y | | y | |
| AAD15 | 4475 | Mar-95 | -66.0 | 70.0 | Turo T-AN-301 | 74532 | y | ow in ice | | y | y | y | |
| AAD16 | 6983 | Mar-95 | -65.9 | 145.2 | Turo T-AN-302 | 73510 | y | ow in ice | | y | y | y | |
| AAD17 | 6984 | Mar-95 | -66.0 | 62.0 | Turo T-AN-302 | 73533 | y | ow in ice | | y | y | y | |
| AAD18 | 4471 | Apr-95 | -64.6 | 110.9 | CMI | 73507 | n | on ice | | y | y | | |
| AAD19 | 4473 | Apr-95 | -64.6 | 120.0 | CMI | 73508 | n | on ice | | y | y | | |
| AAD20 | 4474 | Apr-95 | -65.2 | 127.8 | CMI | 73509 | n | on ice | | y | y | | |
| AAD21 | 24663 | Aug-95 | -64.6 | 140.3 | MetOcean Ice TOGA | 74534 | n | on ice | | y | y | y | |
| AAD22 | 24773 | Aug-95 | -64.7 | 141.7 | AAD/Telonics | n | n | on ice | y | | | | |
| AAD23 | 24774 | Aug-95 | -65.0 | 141.5 | AAD/Telonics | n | n | on ice | y | | | (y) | |
| AAD24 | 24775 | Aug-95 | -65.1 | 141.3 | AAD/Telonics | n | n | on ice | y | | (y) | (y) | (W) |
| AAD25 | 24776 | Aug-95 | -65.1 | 141.4 | AAD/Telonics | n | n | on ice | y | | | | |
| AAD26 | 24771 | Aug-95 | -65.1 | 141.3 | AAD/Telonics | n | n | on ice | y | | | | |
| AAD27 | 24772 | Aug-95 | -65.0 | 141.6 | AAD/Telonics | n | n | on ice | y | | | | |
| AAD28 | 24770 | Aug-95 | -65.0 | 141.8 | AAD/Telonics | n | n | on ice | y | | (y) | (y) | (W) |
| AAD29 | 24777 | Aug-95 | -64.9 | 141.3 | AAD/Telonics | n | n | on ice | y | | | | |
| AAD30 | 24777 | Aug-95 | -64.7 | 139.5 | AAD/Telonics | n | n | on ice | y | | | | |
| AAD31 | 24774 | Aug-95 | -65.1 | 139.7 | AAD/Telonics | n | n | on ice | y | | | (y) | |
| AAD32 | 24665 | Aug-95 | -64.6 | 141.2 | MetOcean Ice TOGA | 74535 | n | on ice | | y | y | y | |
| AAD33 | 24664 | Aug-95 | -64.5 | 141.0 | MetOcean Ice TOGA | 74536 | n | on ice | | y | y | y | |
| AWI63 | 8060 | Jul-94 | -67.9 | 354.9 | MetOcean | 71545 | n | on ice | (y) | y | y | | |
| AWI66 | 8064 | Feb-95 | -75.9 | 313.8 | DSI | 71557 | n | on ice | | y | | | |
| AWI67 | 14954 | Feb-95 | -75.2 | 308.8 | MetOcean | 71547 | n | on ice | (y) | y | y | | |
| AWI68 | 14955 | Feb-95 | -74.6 | 312.2 | MetOcean | 71548 | n | on ice | (y) | y | y | | |
| AWI69 | 14956 | Feb-95 | -76.0 | 310.6 | MetOcean | 71549 | n | on ice | (y) | y | y | | |
| AWI70 | 14957 | Feb-95 | -74.7 | 302.7 | MetOcean | 71550 | n | on ice | (y) | y | y | | |
| AWI71 | 14958 | Feb-95 | -73.9 | 300.0 | MetOcean | 71553 | n | on ice | (y) | y | y | | |
| AWI72 | 14959 | Feb-95 | -73.8 | 302.6 | MetOcean | 71555 | n | on ice | (y) | y | y | | |
| SPRI01 | 23008 | Oct-94 | -70.1 | 204.3 | MetOcean | n | n | on ice | | (y) | (y) | (y) | (W, At) |

# 1995 IPAB buoys activity

| IPAB No. | Argos PTT | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CRC03 | 23380 | | X | X | X | X | X | X | | | | | |
| CRC05 | 6550 | | | | | | | | | | | | X |
| AAD15 | 4475 | | | X | X | X | | | | | | | |
| AAD16 | 6983 | | | X | X | X | X | X | X | X | | | |
| AAD17 | 6984 | | | X | X | X | | | | | | | |
| AAD18 | 4471 | | | | X | X | X | X | X | X | X | X | X |
| AAD19 | 4473 | | | | X | X | X | X | - | - | X | X | X |
| AAD20 | 4474 | | | | X | X | X | X | X | | | | |
| AAD21 | 24663 | | | | | | | X | X | | | | |
| AAD22 | 24773 | | | | | | | | X | | | | |
| AAD23 | 24774 | | | | | | | | X | | | | |
| AAD24 | 24775 | | | | | | | | X | | | | |
| AAD25 | 24776 | | | | | | | | X | | | | |
| AAD26 | 24771 | | | | | | | | X | | | | |
| AAD27 | 24772 | | | | | | | | X | | | | |
| AAD28 | 24770 | | | | | | | | X | | | | |
| AAD29 | 24777 | | | | | | | | X | | | | |
| AAD30 | 24777 | | | | | | | | X | | | | |
| AAD31 | 24774 | | | | | | | | X | | | | |
| AAD32 | 24665 | | | | | | | | X | X | X | X | X |
| AAD33 | 24664 | | | | | | | | X | X | X | X | X |
| AWI63 | 8060 | X | X | X | X | X | X | X | X | | | | |
| AWI66 | 8064 | | X | X | X | X | X | X | X | X | X | X | X |
| AWI67 | 14954 | | X | X | X | X | X | | | | | | |
| AWI68 | 14955 | | X | X | X | X | X | X | X | X | X | X | X |
| AWI69 | 14956 | | X | X | X | X | X | X | X | X | X | X | X |
| AWI70 | 14957 | | X | X | X | X | X | X | X | X | X | X | X |
| AWI71 | 14958 | | X | X | | | | | | | | | |
| AWI72 | 14959 | | X | X | | | | | | | | | |
| SPRI01 | 23008 | X | X | X | X | X | X | X | X | X | X | X | |
| Buoys reporting | | 2 | 10 | 13 | 14 | 14 | 12 | 12 | 22 | 9 | 9 | 9 | 9 |

# IPAB buoys, 1996

| IPAB No. | Argos PTT | Deployment | | | Buoy Type | GTS | Drogue | Deployed | GPS | P | Ta | SST | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First date | Lat | Long | | | | | | | | | |
| CRC05 | 6550 | Dec-95 | -62.5 | 79.7 | Turo T-701 | 74537 | y | open ocean | | y | | (y) | |
| AAD18 | 4471 | Apr-95 | -64.6 | 110.9 | CMI | 73507 | n | on ice | | y | y | | |
| AAD19 | 4473 | Apr-95 | -64.6 | 120.0 | CMI | 73508 | n | on ice | | (y) | (y) | | |
| AAD32 | 24665 | Aug-95 | -64.6 | 141.2 | MetOcean Ice TOGA | 74535 | n | on ice | | y | y | (y) | |
| AAD33 | 24664 | Aug-95 | -64.5 | 141.0 | MetOcean Ice TOGA | 74536 | n | on ice | | y | y | y | |
| AAD34 | 24669 | Mar-96 | -65.7 | 150.0 | Turo T-AN-302 | n | y | ow in ice | | y | y | (y) | |
| AAD35 | 24673 | Mar-96 | -65.7 | 149.9 | Turo T-AN-302 | n | y | ow in ice | | y | (y) | (y) | |
| AAD36 | 24672 | Apr-96 | -65.2 | 79.3 | Turo T-AN-302 | n | y | new ice | | y | y | (y) | |
| AAD37 | 24674 | Apr-96 | -64.3 | 89.7 | Turo T-AN-302 | n | y | ow in ice | | y | y | (y) | |
| AAD38 | 24670 | Apr-96 | -63.7 | 99.9 | Turo T-AN-302 | n | y | ow in ice | | y | y | (y) | |
| AAD39 | 24671 | Apr-96 | -64.4 | 114.4 | Turo T-AN-302 | n | y | new ice | | y | y | y | |
| AWI68 | 14955 | Feb-95 | -74.6 | 312.2 | MetOcean | 71548 | n | on ice | Y | y | y | | |
| AWI69 | 14956 | Feb-95 | -76.0 | 310.6 | MetOcean | 71549 | n | on ice | Y | y | y | | |
| AWI70 | 14957 | Feb-95 | -74.7 | 302.7 | MetOcean | 71550 | n | on ice | Y | y | (y) | | |
| FIN04 | 25161 | Jan-96 | -73.7 | 323.1 | MetOcean T-916 | 71558 | n | on ice | | y | y | | (W, At) |
| FIN05 | 25933 | Jan-96 | -73.5 | 321.8 | Technocean | 71560 | n | on ice | | y | | (y) | |
| FIN06 | 25932 | Jan-96 | -73.9 | 321.5 | Technocean | 71559 | n | on ice | | y | | (y) | |
| FIN07 | 10855 | Jan-96 | -73.9 | 324.0 | CMI | n | n | on ice | | | | | |
| FIN08 | 10856 | Jan-96 | -73.9 | 324.0 | CMI | n | n | on ice | | | | | |
| FIN09 | 5895 | Feb-96 | -73.4 | 322.4 | PRL Met. | 71591 | n | on ice | | y | y | (y) | (W, At) |
| FIN10 | 10858 | Feb-96 | -72.5 | 343.5 | CMI | n | n | on ice | | | | | |

# 1996 IPAB buoys activity

| IPAB No. | Argos PTT | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CRC05 | 6550 | X | X | X | X | | | | | | | | |
| AAD18 | 4471 | X | X | X | X | X | X | X | X | X | X | X | X |
| AAD19 | 4473 | X | | | | | | | | | | | |
| AAD32 | 24665 | X | | | | | | | | | | | |
| AAD33 | 24664 | X | X | X | X | X | X | X | X | X | X | X | X |
| AAD34 | 24669 | | | X | X | X | | | | | | | |
| AAD35 | 24673 | | | X | X | | | | | | | | |
| AAD36 | 24672 | | | | X | X | X | | | | | | |
| AAD37 | 24674 | | | | X | X | X | | | | | | |
| AAD38 | 24670 | | | | X | X | | | | | | | |
| AAD39 | 24671 | | | | X | X | | | | | | | |
| AWI68 | 14955 | X | | | | | | | | | | | |
| AWI69 | 14956 | X | X | X | X | X | X | X | | | | | |
| AWI70 | 14957 | X | X | X | X | X | | | | | | | |
| FIN04 | 25161 | X | X | X | X | X | X | X | X | X | X | | |
| FIN05 | 25933 | X | X | X | X | X | X | X | X | X | X | X | X |
| FIN06 | 25932 | X | X | X | X | X | X | X | X | X | X | X | X |
| FIN07 | 10855 | X | X | X | X | X | X | X | X | X | X | | |
| FIN08 | 10856 | X | X | X | X | X | X | X | X | X | X | X | X |
| FIN09 | 5895 | | X | X | X | X | X | X | X | X | X | X | X |
| FIN10 | 10858 | | X | X | X | X | X | X | X | X | X | X | X |
| Buoys reporting | | 13 | 12 | 14 | 18 | 16 | 12 | 10 | 9 | 9 | 9 | 7 | 7 |

# IPAB buoys, 1997

| IPAB No. | Argos PTT | Deployment | | | Buoy Type | GTS | Drogue | Deployed | GPS | P | Ta | SST | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First date | Lat | Long | | | | | | | | | |
| AAD18 | 4471 | Apr-95 | -64.6 | 110.9 | CMI | 73507 | n | on ice | | y | y | | |
| AAD33 | 24664 | Aug-95 | -64.5 | 141.0 | MetOcean Ice TOGA | 74534 | n | on ice | | y | y | y | |
| AAD40 | 24668 | Apr-97 | -64.9 | 117.3 | MetOcean Ice TOGA | 73501 | n | on ice | | y | y | y | |
| AAD41 | 18648 | Apr-97 | -65.2 | 128.2 | MetOcean Ice TOGA | 73504 | n | on ice | | y | y | y | |
| AAD42 | 18647 | Apr-97 | -65.2 | 140.0 | MetOcean Ice TOGA | 73503 | n | on ice | | y | y | (y) | |
| AAD43 | 18649 | Apr-97 | -64.3 | 148.8 | MetOcean Ice TOGA | 73502 | n | on ice | | y | y | y | |
| AWI86 | 8059 | Jan-97 | -73.7 | 322.3 | MetOcean Ice Beacon | 71541 | n | on ice | y | y | y | | (Ti) |
| AWI87 | 8060 | Jan-97 | -74.4 | 319.8 | MetOcean Ice Beacon | 71542 | n | on ice | y | y | y | | (Ti) |
| AWI88 | 8061 | Jan-97 | -74.0 | 326.7 | MetOcean Ice Beacon | 71543 | n | on ice | y | y | y | | (Ti) |
| AWI89 | 8064 | Jan-97 | -75.1 | 326.5 | MetOcean Ice Beacon | 71544 | n | on ice | y | y | y | | (Ti) |
| AWI90 | 8068 | Jan-97 | -74.7 | 329.1 | MetOcean Ice Beacon | 71545 | n | on ice | y | y | y | | (Ti) |
| FIN04 | 25161 | Jan-96 | -73.7 | 323.1 | MetOcean T-916 | 71558 | n | on ice | | y | (y) | | (W, At) |
| FIN05 | 25933 | Jan-96 | -73.5 | 321.8 | Technocean | 71560 | n | on ice | | y | | (y) | (At) |
| FIN06 | 25932 | Jan-96 | -73.9 | 321.5 | Technocean | 71559 | n | on ice | | y | | (y) | (At) |
| FIN07 | 10855 | Jan-96 | -73.9 | 324.0 | CMI | n | n | on ice | | | | | |
| FIN08 | 10856 | Jan-96 | -73.9 | 324.0 | CMI | n | n | on ice | | | | | |
| FIN09 | 5895 | Feb-96 | -73.4 | 322.4 | PRL Met | 71591 | n | on ice | | y | (y) | (y) | (W, At) |
| FIN10 | 10858 | Feb-96 | -72.5 | 343.5 | CMI | n | n | on ice | | | | | |
| LDO01 | 4897 | Aug-97 | -62.0 | 316.1 | MetOcean Ice Beacon | n | n | on ice | | y | | | |
| LDO02 | 4893 | Aug-97 | -62.8 | 317.1 | MetOcean Ice Beacon | n | n | on ice | | y | | y | |
| LDO03 | 4894 | Aug-97 | -63.8 | 319.0 | MetOcean Ice Beacon | n | n | on ice | | y | | y | |
| LDO04 | 4895 | Aug-97 | -64.3 | 320.0 | MetOcean Ice Beacon | n | n | on ice | | y | | y | |
| LDO05 | 4898 | Aug-97 | -63.3 | 319.9 | MetOcean Ice Beacon | n | n | on ice | | y | | | |
| LDO06 | 4896 | Aug-97 | -62.3 | 320.0 | MetOcean Ice Beacon | n | n | on ice | | y | | y | |
| AAD44 | 24667 | Apr-97 | -75.6 | 176.2 | MetOcean Ice TOGA | 72503 | n | on ice | | y | y | y | |
| AAD45 | 24666 | Apr-97 | -74.0 | 176.1 | MetOcean Ice TOGA | 72502 | n | on ice | | y | y | (y) | |

# 1997 IPAB buoys activity

| IPAB No. | Argos PTT | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AAD18 | 4471 | X | X | X | X | X | X | X | X | | | | |
| AAD33 | 24664 | X | X | X | X | X | | | | | | | |
| AAD40 | 24668 | | | | X | X | X | X | X | X | X | X | X |
| AAD41 | 18648 | | | | X | X | | | | | | | |
| AAD42 | 18647 | | | | X | X | X | X | X | X | X | X | X |
| AAD43 | 18649 | | | | X | X | X | X | X | | | | |
| AWI86 | 8059 | X | X | (X) | (X) | (X) | (X) | (X) | X | X | X | X | X |
| AWI87 | 8060 | X | X | (X) | (X) | (X) | (X) | (X) | X | X | X | X | X |
| AWI88 | 8061 | X | X | X | X | X | X | X | X | X | X | X | X |
| AWI89 | 8064 | X | X | X | X | X | (X) | (X) | X | X | X | X | X |
| AWI90 | 8068 | X | X | X | X | X | X | X | X | X | X | X | X |
| FIN04 | 25161 | X | X | X | X | X | | | | | | | |
| FIN05 | 25933 | X | | | | | | | | | | | |
| FIN06 | 25932 | X | | | | | | | | | | | |
| FIN07 | 10855 | X | | | | | | | | | | | |
| FIN08 | 10856 | X | X | X | X | X | | | | | | | |
| FIN09 | 5895 | X | X | X | | | | | | | | | |
| FIN10 | 10858 | X | X | X | X | X | | | | | | | |
| LDO01 | 4897 | | | | | | | | X | X | X | X | X |
| LDO02 | 4893 | | | | | | | | X | X | X | X | X |
| LDO03 | 4894 | | | | | | | | X | X | X | X | X |
| LDO04 | 4895 | | | | | | | | X | X | X | X | X |
| LDO05 | 4898 | | | | | | | | X | X | X | X | X |
| LDO06 | 4896 | | | | | | | | X | X | X | X | X |
| AAD44 | 24667 | | | | ND | | | | | | | | |
| AAD45 | 24666 | | | | X | X | X | X | | | | | |
| Buoys reporting | | 14 | 11 | 9 | 14 | 13 | 7 | 7 | 15 | 13 | 13 | 13 | 13 |
| Addnl. without position | | | | +2 | +2 | +2 | +3 | +3 | | | | | |

(X) indicates sensor data only available, no positions. GPS receiver failed and Argos positioning not activated.

# IPAB buoys 1998

| IPAB No. | Argos PTT | Deployment | | | Buoy Type | GTS | Drogue | Deployed | GPS | P | Ta | SST | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First date | Lat | Long | | | | | | | | | |
| AAD40 | 24668 | Apr-97 | -64.9 | 117.3 | MetOcean Ice TOGA | 73501 | n | on ice | | Y | Y | Y | |
| AAD42 | 18647 | Apr-97 | -65.2 | 140.0 | MetOcean Ice TOGA | 73503 | n | on ice | | Y | Y | Y | |
| AAD46 | 18646 | Apr-98 | -66.2 | 143.6 | MetOcean Ice TOGA | 73505 | n | new ice | | Y | Y | Y | |
| AAD47 | 18653 | May-98 | -64.8 | 77.7 | MetOcean Ice TOGA | 74540 | n | new ice | | Y | (Y) | Y | |
| AAD48 | 18654 | May-98 | -63.0 | 96.0 | MetOcean Ice TOGA | 73506 | n | thin ice | | Y | (Y) | Y | |
| AAD49 | 18655 | May-98 | -63.0 | 107.0 | MetOcean Ice TOGA | 73507 | n | new ice | | Y | Y | Y | |
| AAD50 | 18656 | May-98 | -64.5 | 119.0 | MetOcean Ice TOGA | 73508 | n | new ice | | Y | Y | Y | |
| AAD51 | 24771 | Jul-98 | -65.1 | 145.3 | AAD/Telonics | n | n | on ice | | | | | |
| AWI86 | 8059 | Jan-97 | -73.7 | 322.3 | MetOcean Ice TOGA | 71541 | n | on ice | (Y) | Y | Y | | (Ti) |
| AWI87 | 8060 | Jan-97 | -74.4 | 319.8 | MetOcean Ice TOGA | 71542 | n | on ice | (Y) | Y | Y | | (Ti) |
| AWI88 | 8061 | Jan-97 | -74.0 | 326.7 | MetOcean Ice Beacon | 71543 | n | on ice | y | y | y | | (Ti) |
| AWI89 | 8064 | Jan-97 | -75.1 | 326.5 | MetOcean Ice TOGA | 71544 | n | on ice | (Y) | Y | Y | Ti | |
| AWI90 | 8068 | Jan-97 | -74.7 | 329.1 | MetOcean Ice Beacon | 71545 | n | on ice | y | y | y | | (Ti) |
| AWI91 | 8065 | Jan-98 | -56.8 | 355.2 | CMI | 71546 | 200 m | open ocean | (Y) | (Y) | (Y) | | |
| AWI92 | 9356 | May-98 | -69.7 | 355.2 | MetOcean | 71548 | n | on ice | | Y | Y | | |
| LDO01 | 4897 | Aug-97 | -62.0 | 316.1 | MetOcean Ice Beacon | n | n | on ice | | Y | | | |
| LDO02 | 4893 | Aug-97 | -62.8 | 317.1 | MetOcean Ice Beacon | n | n | on ice | | Y | | Y | |
| LDO03 | 4894 | Aug-97 | -63.8 | 319.0 | MetOcean Ice Beacon | n | n | on ice | | Y | | Y | |
| LDO04 | 4895 | Aug-97 | -64.3 | 320.0 | MetOcean Ice Beacon | n | n | on ice | | Y | | Y | |
| LDO05 | 4898 | Aug-97 | -63.3 | 319.9 | MetOcean Ice Beacon | n | n | on ice | | Y | | | |
| LDO06 | 4896 | Aug-97 | -62.3 | 320.0 | MetOcean Ice Beacon | n | n | on ice | | Y | | Y | |
| GIA01 | 13932 | May-98 | -75.2 | 181.9 | MetOcean Ice Beacon | n | n | on ice | Y | | | | |
| GIA02 | 13933 | May-98 | -75.7 | 181.9 | MetOcean Ice Beacon | n | n | on ice | Y | | | | |
| GIA03 | 13934 | May-98 | -75.2 | 178.4 | MetOcean Ice Beacon | n | n | on ice | Y | | | | |
| GIA04 | 13945 | May-98 | -75.5 | 179.9 | MetOcean Ice Beacon | n | n | on ice | Y | | | | |
| GIA05 | 13946 | May-98 | -75.7 | 178.3 | MetOcean Ice Beacon | n | n | on ice | Y | | | | |
| GIA06 | 13930 | May-98 | -75.0 | 180.1 | MetOc wind TOGA | n | n | on ice | Y | Y | Y | | W, Hd |
| GIA07 | 13931 | May-98 | -76.0 | 180.0 | MetOc wind TOGA | n | n | on ice | Y | Y | Y | | W, Hd |

# 1998 IPAB buoys activity

| IPAB No. | Argos PTT | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AAD40 | 24668 | X | X | X | X | X | X | X | X | X | X | | |
| AAD42 | 18647 | X | X | X | X | X | X | X | X | X | X | X | |
| AAD46 | 18646 | | | | X | X | | | | | | | |
| AAD47 | 18653 | | | | | X | X | | | | | | |
| AAD48 | 18654 | | | | | X | X | X | X | X | X | X | X |
| AAD49 | 18655 | | | | | X | X | X | X | X | X | X | X |
| AAD50 | 18656 | | | | | X | X | X | X | - | X | | |
| AAD51 | 24771 | | | | | | | X | X | | | | |
| AWI86 | 8059 | X | X | X | X | X | X | X | X | X | X | X | X |
| AWI87 | 8060 | X | X | | | | | | | | | | |
| AWI88 | 8061 | X | X | X | X | X | X | X | X | X | X | X | X |
| AWI89 | 8064 | X | X | X | X | | | | | | | | |
| AWI90 | 8068 | X | X | X | X | X | X | X | X | X | X | X | X |
| AWI91 | 8065 | ND | | | | | | | | | | | |
| AWI92 | 9356 | | | | | X | X | | | | | | |
| LDO01 | 4897 | X | X | X | X | X | X | X | X | X | X | X | X |
| LDO02 | 4893 | X | X | X | X | X | X | X | X | X | X | X | X |
| LDO03 | 4894 | X | X | X | X | X | X | X | X | X | X | X | X |
| LDO04 | 4895 | X | X | X | X | X | X | X | X | X | X | X | X |
| LDO05 | 4898 | X | X | X | X | X | X | X | X | X | X | X | X |
| LDO06 | 4896 | X | X | | | | | | | | | | |
| GIA01 | 13932 | | | | | X | X | X | X | X | | | |
| GIA02 | 13933 | | | | | X | X | X | X | X | | | |
| GIA03 | 13934 | | | | | X | X | X | X | X | | | |
| GIA04 | 13945 | | | | | X | X | | | | | | |
| GIA05 | 13946 | | | | | X | X | X | X | X | X | X | X |
| GIA06 | 13930 | | | | | ND | | | | | | | |
| GIA07 | 13931 | | | | | X | X | | | | | | |
| Buoys reporting | | 13 | 13 | 11 | 12 | 22 | 21 | 18 | 18 | 16 | 14 | 12 | 11 |

# IPAB buoys 1999

| IPAB No. | Argos PTT | Deployment | | | Buoy Type | GTS | Drogue | Deployed | GPS | P | Ta | SST | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First date | Lat | Long | | | | | | | | | |
| AAD49 | 18655 | May-98 | -63.0 | 107.0 | MetOcean Ice TOGA | 73507 | n | new ice | | Y | Y | Y | |
| AAD51 | 18651 | Mar-99 | -66.5 | 67.1 | MetOcean Ice TOGA | 74531 | n | in lead | | Y | Y | Y | |
| AAD52 | 18652 | Mar-99 | -66.0 | 79.5 | MetOcean Ice TOGA | 74532 | n | ow in ice | | Y | Y | Y | |
| AAD53 | 18659 | Apr-99 | -64.7 | 109.2 | MetOcean Ice TOGA | 73509 | n | on ice | | Y | Y | Y | |
| AAD54 | 10321 | Aug-99 | -67.0 | 144.2 | MetOcean Ice Beacon | n | n | thin ice | Y | | | | |
| AAD55 | 07786 | Aug-99 | -66.7 | 146.0 | MetOcean Ice Beacon | n | n | thin ice | Y | | | | |
| AAD56 | 07785 | Aug-99 | -67.0 | 145.4 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD57 | 07787 | Aug-99 | -67.2 | 144.8 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD58 | 07784 | Aug-99 | -66.5 | 143.6 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD59 | 07788 | Aug-99 | -66.3 | 146.6 | MetOcean Ice Beacon | n | n | thin ice | Y | | | | |
| AAD60 | 24772 | Aug-99 | -65.5 | 146.7 | AAD/Telonics | n | n | on ice | Y | | | | |
| AAD61 | 07938 | Aug-99 | -67.0 | 145.4 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD62 | 24771 | Aug-99 | -65.5 | 144.8 | AAD/Telonics | n | n | on ice | Y | | | | |
| AAD63 | 24773 | Aug-99 | -65.8 | 145.7 | AAD/Telonics | n | n | on ice | Y | | | | |
| AAD64 | 7939 | Aug-99 | -66.3 | 146.6 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD65 | 7940 | Aug-99 | -66.6 | 146.0 | MetOcean Ice Beacon | n | n | thin ice | Y | | | | |
| AAD66 | 7941 | Aug-99 | -67.0 | 145.4 | MetOcean Ice Beacon | n | n | thin ice | Y | | | | |
| AAD67 | 7942 | Aug-99 | -67.2 | 144.8 | MetOcean Ice Beacon | n | n | thin ice | Y | | | | |
| AAD68 | 10324 | Aug-99 | -65.3 | 146.6 | MetOc wind TOGA | 73510 | n | on ice | Y | Y | Y | Y | W |
| AAD69 | 10320 | Aug-99 | -66.3 | 146.6 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD70 | 10319 | Aug-99 | -66.6 | 146.0 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD71 | 10322 | Aug-99 | -67.0 | 145.4 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD72 | 10323 | Aug-99 | -67.1 | 144.8 | MetOcean Ice Beacon | n | n | new ice | Y | | | | |
| AAD73 | 18650 | Aug-99 | -66.3 | 144.2 | MetOcean Ice TOGA | n | n | in lead | | Y | Y | Y | |
| AAD74 | 18657 | Aug-99 | -65.7 | 145.6 | MetOcean Ice TOGA | 73501 | n | thin ice | | Y | Y | Y | |

# IPAB buoys 1999, continued from previous page

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AWI86 | 8059 | Jan-97 | -73.7 | 322.3 | MetOcean Ice TOGA | 71541 | n | on ice | Y | Y | Y | | Ti |
| AWI88 | 8061 | Jan-97 | -74.0 | 326.7 | MetOcean Ice Beacon | 71543 | n | on ice | y | y | y | | (Ti) |
| AWI90 | 8068 | Jan-97 | -74.7 | 329.1 | MetOcean Ice Beacon | 71545 | n | on ice | y | y | y | | (Ti) |
| AWI93 | 8066 | Jan-99 | -60.0 | 000.0 | CMI | 71547 | 200 m | open ocean | Y | Y | Y | | |
| AWI94 | 9360 | Jan-99 | -74.8 | 311.0 | S&K | 71566 | n | on ice | Y | Y | Y | | |
| AWI95 | 9362 | Jan-99 | -75.7 | 311.0 | S&K | 71557 | n | on ice | Y | Y | Y | | |
| AWI96 | 8056 | Feb-99 | -74.7 | 298.9 | MetOcean | 71554 | n | on ice | Y | Y | Y | | |
| AWI97 | 9358 | Feb-99 | -75.3 | 308.2 | S&K | 71555 | n | on ice | Y | Y | Y | | |
| LDO01 | 4897 | Aug-97 | -62.0 | 316.1 | MetOcean Ice Beacon | n | n | on ice | | Y | | | |
| LDO02 | 4893 | Aug-97 | -62.8 | 317.1 | MetOcean Ice Beacon | n | n | on ice | | Y | | Y | |
| LDO03 | 4894 | Aug-97 | -63.8 | 319.0 | MetOcean Ice Beacon | n | n | on ice | | Y | | Y | |
| LDO04 | 4895 | Aug-97 | -64.3 | 320.0 | MetOcean Ice Beacon | n | n | on ice | | Y | | Y | |
| LDO05 | 4898 | Aug-97 | -63.3 | 319.9 | MetOcean Ice Beacon | n | n | on ice | | Y | | | |

# 1999 IPAB buoys activity

| IPAB No. | Argos PTT | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AAD49 | 18655 | X | X | X | X | X | X | X | X | X | | | |
| AAD51 | 18651 | | | X | X | X | X | X | X | X | X | X | X |
| AAD52 | 18652 | | | X | X | X | X | X | X | X | X | X | X |
| AAD53 | 18659 | | | | X | X | X | X | X | X | X | X | X |
| AAD54 | 10321 | | | | | | | | X | | | | |
| AAD55 | 07786 | | | | | | | | X | X | | | |
| AAD56 | 07785 | | | | | | | | X | | | | |
| AAD57 | 07787 | | | | | | | | X | | | | |
| AAD58 | 07784 | | | | | | | | X | - | - | X | |
| AAD59 | 07788 | | | | | | | | X | X | | | |
| AAD60 | 24772 | | | | | | | | X | X | | | |
| AAD61 | 07938 | | | | | | | | X | | | | |
| AAD62 | 24771 | | | | | | | | X | X | X | X | |
| AAD63 | 24773 | | | | | | | | X | X | X | X | X |
| AAD64 | 7939 | | | | | | | | X | | | | |
| AAD65 | 7940 | | | | | | | | X | X | | | |
| AAD66 | 7941 | | | | | | | | X | | | | |
| AAD67 | 7942 | | | | | | | | X | | | | |
| AAD68 | 10324 | | | | | | | | X | X | X | | |
| AAD69 | 10320 | | | | | | | | X | | | | |
| AAD70 | 10319 | | | | | | | | X | X | X | X | X |
| AAD71 | 10322 | | | | | | | | X | X | X | X | |
| AAD72 | 10323 | | | | | | | | X | | | | |
| AAD73 | 18650 | | | | | | | | X | - | X | | |
| AAD74 | 18657 | | | | | | | | X | X | X | X | X |

## 1999 IPAB buoys activity, continued from previous page

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AWI86 | 8059 | X | X | X | X | X | X | | | | | | |
| AWI88 | 8061 | X | X | X | X | X | X | X | X | X | X | X | X |
| AWI90 | 8068 | X | X | X | X | X | X | X | X | X | X | X | X |
| AWI93 | 8066 | X | X | X | X | X | X | X | | | | | |
| AWI94 | 9360 | X | X | X | X | X | X | | | | | | |
| AWI95 | 9362 | X | X | X | X | X | X | X | X | X | X | X | X |
| AWI96 | 8056 | | X | X | X | X | X | | | | | | |
| AWI97 | 9358 | | X | X | | | | | | | | | |
| LDO01 | 4897 | X | X | | | | | | | | | | |
| LDO02 | 4893 | X | | | | | | | | | | | |
| LDO03 | 4894 | X | X | X | | | | | | | | | |
| LDO04 | 4895 | X | | | | | | | | | | | |
| LDO05 | 4898 | X | X | | | | | | | | | | |
| AWI98 | 9363 | | | | | | X | X | X | X | X | X | |
| AWI99 | 9365 | | | | | | X | X | | | | | |
| AWI100 | 9357 | | | | | | X | X | | | | | |
| GIA08 | 13947 | X | X | X | X | X | X | X | X | X | X | | |
| GIA09 | 13948 | X | X | X | X | X | X | X | X | X | X | X | X |
| Buoys reporting | | 14 | 14 | 14 | 13 | 13 | 16 | 13 | 31 | 20 | 16 | 14 | 10 |

# IPAB buoys, 2000

| IPAB No. | Argos PTT | Deployment | | | Buoy Type | GTS | Drogue | Deployed | GPS | P | Ta | SST | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First date | Lat | Long | | | | | | | | | |
| AAD51 | 18651 | Mar-99 | -66.5 | 67.1 | MetOcean Ice TOGA | 74531 | n | in lead | | Y | Y | Y | |
| AAD52 | 18652 | Mar-99 | -66.0 | 79.5 | MetOcean Ice TOGA | 73532 | n | ow in ice | | Y | Y | Y | |
| AAD53 | 18659 | Apr-99 | -64.7 | 109.2 | MetOcean Ice TOGA | 73509 | n | on ice | | Y | Y | Y | |
| AAD74 | 18657 | Aug-99 | -65.7 | 145.6 | MetOcean Ice TOGA | 73501 | n | thin ice | | Y | Y | Y | |
| AAD75 | 18658 | Mar-00 | -65.0 | 110.7 | MetOcean Ice TOGA | 73502 | n | on ice | | Y | Y | Y | |
| AAD76 | n/a | Nov-00 | -65.2 | 109.4 | Beset vessel | n | n | in ice | Y | Y | Y | | W |
| SPRI02 | 19080 | Apr-00 | -68.7 | 330.0 | DML/SPRI pancake | 71581 | n | pancakes | Y | Y | Y | Y | W, SP |
| SPRI03 | 19076 | Apr-00 | -69.1 | 327.8 | DML/SPRI pancake | 71512 | n | pancakes | Y | Y | Y | Y | W, SP |
| SPRI04 | 19075 | Apr-00 | -68.7 | 327.5 | DML/SPRI pancake | 71511 | n | pancakes | Y | Y | Y | Y | W, SP |
| SPRI05 | 19079 | Apr-00 | -68.3 | 327.2 | DML/SPRI pancake | 71513 | n | pancakes | Y | Y | Y | Y | W, SP |
| SPRI06 | 16187 | Apr-00 | -68.6 | 325.4 | DML/SPRI pancake | 71583 | n | pancakes | Y | Y | Y | Y | W, SP |
| SPRI07 | 19081 | Apr-00 | -66.7 | 319.9 | DML/SPRI pancake | 71582 | n | pancakes | Y | Y | Y | Y | W, SP |
| GIA09 | 13948 | Jan-99 | -73.0 | 225.0 | MetOcean Ice Beacon | n | n | on ice | Y | | | | |
| AWI102 | 9358 | Mar-00 | -71.1 | 253.1 | S&K | 71555 | n | on ice | Y | Y | Y | | |
| AWI103 | 9361 | Mar-00 | -72.1 | 254.4 | S&K | 71556 | n | on ice | Y | Y | Y | | |
| AWI101 | 9364 | Mar-00 | -71.1 | 256.3 | S&K | 71554 | n | on ice | Y | Y | Y | | |

# 2000 IPAB buoys activity

| IPAB No. | Argos PTT | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AAD51 | 18651 | X | X | X | X | X | X | X | X | X | X | X | X |
| AAD52 | 18652 | X | X | **n** | **n** | **n** | **N** | **n** | **n** | **n** | **n** | **n** | **n** |
| AAD53 | 18659 | X | X | X | X | X | X | X | X | X | X | X | X |
| AAD74 | 18657 | X | X | X | X | X | X | X | X | X | X | X | X |
| AAD75 | 18658 | | | X | X | X | X | X | X | X | X | X | X |
| AAD76 | n/a | | | | | | | | | | | X | X |
| SPRI02 | 19080 | | | X | X | X | X | X | X | X | X | X | |
| SPRI03 | 19076 | | | X | X | X | X | X | X | X | X | X | |
| SPRI04 | 19075 | | | X | X | X | X | X | X | X | X | | |
| SPRI05 | 19079 | | | X | X | X | X | X | X | X | | | |
| SPRI06 | 16187 | | | X | X | X | | | | | | | |
| SPRI07 | 19081 | | | X | X | X | X | X | X | X | | | |
| GIA09 | 13948 | X | | | | | | | | | | | |
| AWI101 | 9358 | | | X | X | X | X | X | X | X | X | X | X |
| AWI102 | 9361 | | | X | X | X | X | X | X | X | X | X | X |
| AWI103 | 9364 | | | X | X | X | X | X | X | X | X | X | X |
| Buoys reporting | | 5 | 4 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 10 | 10 | 8 |

**n =** buoy still rerting, but north of -55

**Appendix D**

# Reports from Participants

**(i) AUSTRALIA** (The report was delivered by Dr I. Allison)

Three Australian organisations contribute as Participants in IPAB: the Australian Antarctic Division (AAD), the Bureau of Meteorology (BOM), and the Co-operative Research Centre for Antarctic and Southern Ocean Studies (Antarctic CRC). Their area of activity is that part of the Southern Ocean south of Australia in the Indian and Western Pacific oceans. The Bureau of Meteorology and the Antarctic CRC generally deploy drifting buoys north of the sea-ice zone to provide high-latitude surface meteorological data, while the Antarctic Division deploys buoys within the sea-ice zone, generally in the East Wind Drift and south of the Antarctic Divergence. Only the Antarctic Division deployed buoys in the IPAB area of interest (south of 55°S) during 1999 and 2000.

The drifting buoy deployments are part of an overall study of Antarctic sea ice within the Australian Antarctic programme. The programme also contributes to the WCRP Antarctic Sea Ice Thickness Project (ANSITP), as well as to the SCAR programme on Antarctic Sea-ice Processes and Climate (ASPeCt). The programme has deployed eight bottom-moored upward-looking sonar instruments to monitor ice thickness as part of ANSITP, and regularly undertakes research cruises in that sector of the Antarctic between 60°E and 160°E to study sea ice characteristics and processes as part of ASPeCt.

## Buoy deployments in 1999 and 2000

A total of 21 buoy deployments were made from the ice–breaking research vessel *Aurora Australis* in July-August 1999 as part of a joint oceanographic-glaciological study of the Mertz Glacier Polynya (MGP). The MGP, centered near 67°S 145°E, is one of the largest persistent winter polynyas on the Antarctic coast. Processes here have been shown to be implicated in the production of Adelie Land Bottom Water (ALBW) which represents a significant fraction of the total volume of Antarctic Bottom Water. This study investigated both the processes of atmosphere-ocean-ice interactions within this active Antarctic coastal polynya in winter, and the effects of these processes on sea ice distribution, dense water production, and the biological regime.

Three different basic buoy types were used during the MGP experiment. Fifteen small, *Metocean* position-only surface drifters ("Spice-buoys"), with both GPS and Argos positioning systems, were deployed in three batches in newly forming ice on the upwind edge of the polynya, along the Mertz Glacier tongue. These had a differential GPS capability, which gave relative position between buoys to an accuracy of 10m (over a limited separation). The Spice-buoys were used to determine the rate of export of new ice from the polynya, and the longitudinal strain associated with ice compaction downstream. The buoys were "hunted" and revisited by the ship every 4-5 days in order to measure the development of ice characteristics and thickness in their vicinity, and hence to provide one estimate of ice production in the polynya. Initial ice drift speed as high as 60 km in a 12-hour period (1.4 m/s) was measured in Buchanan Bay, in the southeast part of the polynya where very strong and persistent katabatic winds funnel down the Mertz Glacier. The Spice buoys were deliberately designed with a lifetime of only one month as data was only required when they were in the immediate area of the polynya.

Ice produced within the polynya merges with a stream of thicker ice moving westward across the front of the Mertz Glacier tongue. This stream contains some very thick (8m) multiyear floes. An array of three buoys (one *Metocean* ice-TOGA with wind sensors, and two position-only platforms built "in-house", but using *Telonics* transmitters) were deployed to measure the drift and deformation of this ice. All these buoys had GPS positioning.

Finally, just before the research vessel left the polynya region, longer-lived and instrumented *Metocean* ice-TOGA buoys were co-located with three of the Spice-buoys to track the eventual fate of the ice produced in the MGP. In addition to the buoys, an automatic weather station was deployed on an offshore island in the southwest part of the polynya.

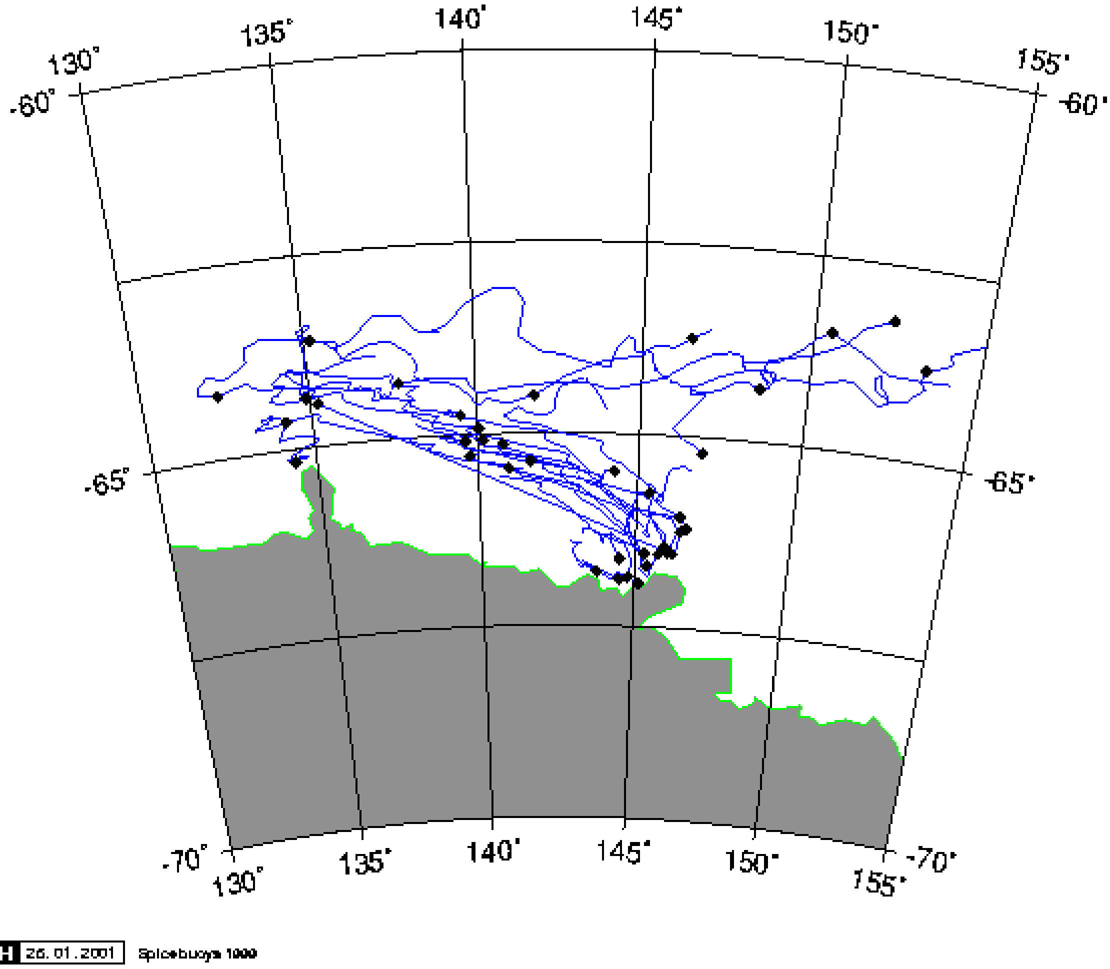



**Figure 1: Initial drift tracks of buoys deployed in the Mertz Glacier Polynyas.**

The initial drift tracks of all buoys deployed in the MGP are shown in Figure 1. The Mertz Glacier tongue is the protuberance in Figure 1 extending from the coast at 145°E. Ice from the polynya was generally exported to the northwest, and some eventually ended up in the eastward moving Antarctic Circumpolar Current once it was north of the Antarctic Divergence.

The AAD also undertook other general buoy deployments around the East Antarctic coast and south of the Antarctic Divergence. Three buoys were deployed in March/April 1999 and one buoy in March 2000. All these were *Metocean* Ice TOGA-buoys.

**Proposed Future deployments**

The AAD is committed to continuing buoy deployment in support of IPAB for the next 3 years. An existing stockpile of 10 instrumented buoys is available for this. These buoys will all be used around the East Antarctic coast. Specific deployment locations will depend on scientific priorities and shipping schedules.

## (ii) FINLAND (The report was delivered by Dr J. Launiainen)

### Summary of FIMR (Finnish Institute of Marine Research) IPAB buoy activities

*Past activities*

Three field campaigns in 1990 - 91, 1992 - 93, 1996 - 1997 under the Finnish Antarctic Research Programme (FINNARP). Totally, 12 Argos buoys were deployed, 6 buoys having a full set of meteorological sensors. Technical data reports were given (Launiainen et al., 1991;Launiainen et al., 1994; Vihma et al., 1997) and data archives delivered abroad, in addition to IPAB data base. In 1996 - 1997, data from 4 buoys transmitted via GTS.

Scope of the studies carried out by the buoy data cover:

1. Sea-ice kinematics and dynamics and meteorological forcing and sea-ice transport from the Weddell Sea.

2. Air-ice coupling; determination of surface fluxes, heat flux through the ice, ice/snow surface temperature and air modification over the sea and ice fields.

3. Sub-grid (GCM) estimation of sensible heat, latent heat and momentum fluxes between the surface and the air.

4. Comparison of buoy observations with ECMWF and NCEP/NCAR model analysis fields.

As outcome, six refereed and several (14) other reports have been published.

Comparison of buoy (observed) data with the a GCM model analysis shows that the GCMs describe the surface pressure very well but the other quantities (wind, air temperature, moisture, turbulent fluxes) tend to be rather poor and, therefore better parameterizations are needed for the models.

*Future activities*
In future, we plan to run the buoy programme as the FINNARP activity together with the Finnish Meteorological Institute (FIMR). 2 to 4 buoys are planned to be deployed every second to three years.

In connection of the planned SCAR/ASPECt drifting ice station field campaign in 2003-2004, at least 2 meteorological buoys are planned to be deployed.

*Principal investigators*
Jouko Launiainen
Timo Vihma

*Publications*

**Launiainen, J., T. Vihma, J. Aho and K. Rantanen:** Air-Sea Interaction Experiment in the Weddell Sea. Argos-Buoy Report from FINNARP-5/89, 1990-1991. Antarctic Reports of Finland. Report No. 2. Ministry of Trade and Industry. Helsinki, 27 + 19 p., 1991.
**Launiainen, J., J. Uotila, K. Rantanen, and T. Vihma:** Air-sea interaction experiment in the Weddell Sea, 2nd meteorological Argos-buoy data report from FINNARP, 1991-1993, Antarctic Reports of Finland, 3, Ministry of Trade and Industry, Helsinki, 23 + 23 p., 1994.
**Vihma, T., J. Launiainen, J. Uotila, and A. Kotro**, FINNARP air-sea-ice interaction experiment in the Weddell Sea in 1996-1997; Antarctic Reports of Finland, 7, Ministry of Trade and Industry, Helsinki, 30 + 30 p., 1997.
**Vihma,T.; Uotila, J.; Cheng, B. and Launiainen, J**.: Surface Heat Budget over the Weddell Sea: Buoy results and comparison with large scale models.- Submitted to J. Geophys. Research, 2000.

### (iii) Germany (The report was delivered by Dr C. Haas)

AWI activities in the framework of IPAB for the period 1999 to 2001:

1. Buoys deployed in 1999:

| No. | Start | First Lat | First Lon | Stop | Last Lat. | Last Lon. | Sensors |
|---|---|---|---|---|---|---|---|
| **8056** | 02.02.99 | 74.712S | 61.098W | 05.06.99 | 74.708S | 61.139W | P,Ta,GPS |
| **8059** | 27.01.97 | 73.711S | 37.733W | 17.06.99 | 58.436S | 158.003E | P,Ta,GPS |
| **8061** | 24.01.97 | 73.961S | 33.326W | 26.12.99 | 53.650S | 115.105W | P,Ta,GPS |
| **8068** | 24.01.97 | 74.653S | 30.908W | 03.12.99 | 54.086S | 109.100W | P,Ta,GPS |
| **8066** | 16.01.99 | 60.000S | 0.000W | 29.06.99 | 62.945S | 47.786E | P,Ta,GPS |
| **9357** | 24.06.99 | 68.687S | 78.637W | 08.07.99 | 69.259S | 78.991W | P,Ta,GPS |
| **9358** | 08.02.99 | 75.263S | 51.755W | 16.03.99 | 74.541S | 55.369W | P,Ta,GPS |
| **9360** | 30.01.99 | 74.750S | 49.000W | 26.06.99 | 70.115S | 55.345W | P,Ta,GPS |
| **9362** | 30.01.99 | 75.742S | 48.993W | 10.01.00 | 64.479S | 40.196W | P,Ta,GPS |
| **9363** | 20.06.99 | 68.857S | 77.142W | 15.11.99 | 69.634S | 75.807W | P,Ta,GPS |
| **9365** | 20.06.99 | 69.198S | 78.253W | 28.07.99 | 69.499S | 79.075W | P,Ta,GPS |

2. Buoys deployed in 2000 (Amundsen Sea):

| No. | Start Date | Start Lat. | Start Lon. | Sensors |
|---|---|---|---|---|
| 9358 | 22.03.00 | 71.095S | 106.894W | P,Ta,GPS |
| 9361 | 22.03.00 | 72.134S | 105.558W | P,Ta,GPS |
| 9364 | 23.03.00 | 71.076S | 103.734W | P,Ta,GPS |

3. Buoy deployments planned for 2000/01:

- Sea ice buoys (P,Ta,GPS) west of the Antarctic Peninsula
- Iceberg markers (GPS), to be deployed on icebergs passing the Greenwich Meridian from December 2000 to January 2001.
- APEX Floats (750 m depth), and
- APG Floats (750 m depth) to be deployed along the Greenwich Meridian north of Maud Rise.

4. Publications:

**Harms, S., E. Fahrbach, and V. H. Strass** 2000: Ice transports in the Weddell Sea (accepted by Journal of Geophysical Research).
**Hellmer, H. H. and L. Sellmann** 2000: Data Report on Sea Ice Buoys and Automatic Weather Stations Operated by the Alfred Wegener Institute from 1997 to 1999, Berichte aus dem Fachbereich Physik, 102, Foundation Alfred Wegener Institute, Bremerhaven.
**Timmermann, R**., 2000: Sea-ice ocean interaction in the Weddell Sea: Numerical studies with a coupled ice ocean model for the Southern Ocean (in German), PhD thesis, Fachbereich Physik, Universität Bremen.
**Timmermann, R., A. Beckmann, and H. H. Hellmer** 2000: The role of sea ice in the fresh water budget of the Weddell Sea, submitted to Annals of Glaciology.

**(iv) South Africa (The report was delivered by Mr J. van der Merwe)**

## SOUTH AFRICAN WEATHER BUREAU (SAWB)

### 1. BACKGROUND

The South Atlantic Ocean is the origin for weather systems approaching South Africa and the area is fairly empty of meteorological data. Therefore the SAWB attempts to obtain as much meteorological information as possible from the area by means of island weather stations and drifting weather buoys. Real time data are essential for forecasting purposes and the island stations (Gough and Marion) have become most valuable for climatic research purposes.

The SAWB is involved in three international buoy deployment programmes: ISABP, IPAB and IBPIO, but they are managed as one programme. Drifting buoys are deployed mainly during voyages to Gough and SANAE. As buoys in the Southern Ocean generally drift eastwards, we prefer to deploy as far to the west as we can.

### 2. GOUGH AND MARION ISLANDS

Two manned weather stations are maintained on Gough and Marion islands, doing hourly surface observations which are backed by 5-minute data from automatic weather stations and upper air soundings twice a day. Both islands are equipped with LUTs for re-distribution of buoy data.

### 3. SANAE - ANTARCTICA

Meteorological observations at SANAE were terminated in the early nineties when the base was evacuated. A new base has now been built some 200 km inland and a manned weather station has been in operation since January 2000. Only surface operations, backed by 5-minute data from an automatic weather station, are done. (Upper air is not required due to the close proximity of other Antarctic bases.)

While the new base was being built, we maintained an automatic weather station at the site, with various degrees of success. The main problem was that during winter the base was unmanned and if anything went wrong there was nobody to fix it.

## 4. DCPs ON REMOTE ISLANDS

There are not many islands in the South Atlantic but we erected DCPs on Tristan da Cunha (close to Gough) and on two of the South Sandwich islands - Zavadovski, the most northern, and Southern Thule, the most southern island. All the DCPs have been removed from the islands and they are now being refurbished for re-deployment. As a temporary measure, drifting buoys were fixed on Tristan da Cunha and on Southern Thule islands. The unit on Zavadovski was removed completely and it is unlikely that we will erect it there again, the reason being that Zavadovski can be accessed only by helicopter and we do not always have air support when we are in the area.

## 5. BUOY DEPLOYMENTS

**Summer 1998-1999**
Five drifting buoys were deployed south of 55°S, including one from the air by the USN and one was fixed on Southern Thule (Figure 2). All these buoys have since stopped transmitting. The fixed buoy on Thule transmitted every second instead of every ninety seconds. This caused problems at ARGOS and it was removed from the system.

**Summer 1999-2000**
Three drifting buoys were deployed south of 55°S and the fixed buoy on Southern Thule was replaced by a similar unit (Figure 3). Two drifters have since stopped transmitting.

## 6. THE SA AGULHAS

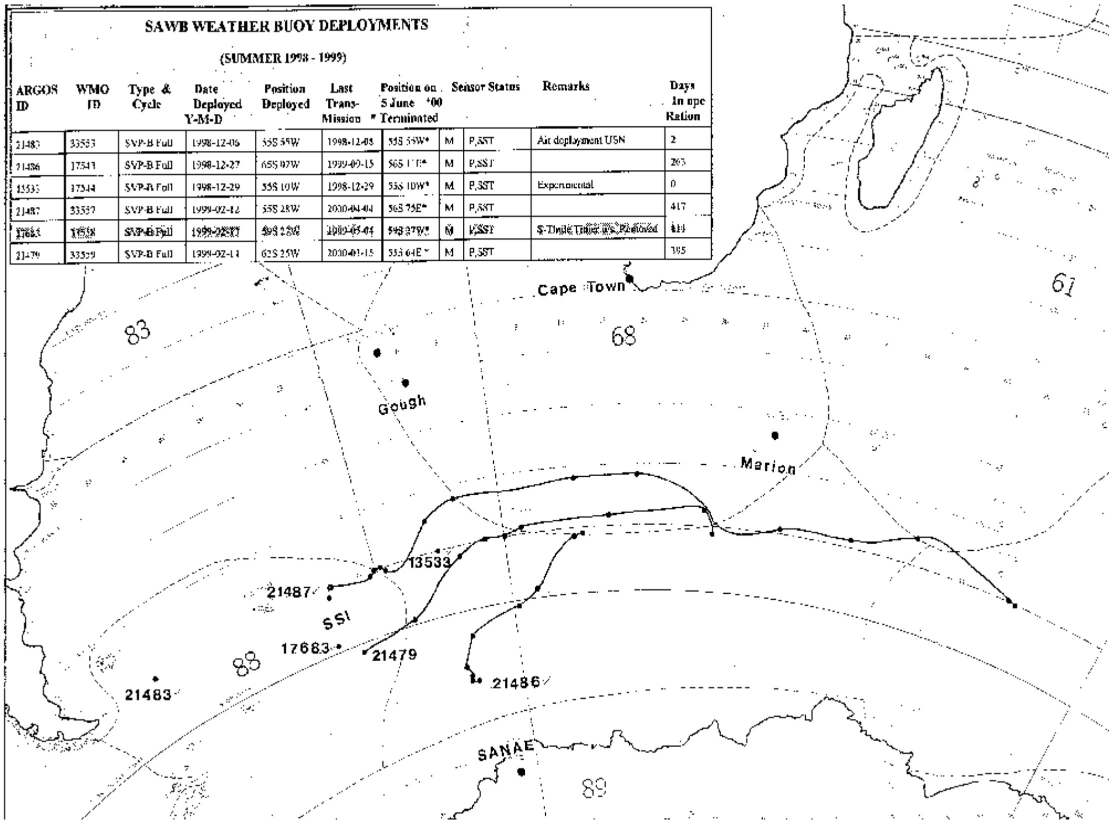
Three-hourly synops are done on the SA Agulhas for the duration of relief voyages to the islands and SANAE and also during buoy deployment voyages.

## 7. LOGISTIC SUPPORT

Cape Town has suitable facilities for ships and long-range aircraft, and drifters can be deployed from the SA Agulhas for other organisations. The SA Agulhas can also be chartered by outside organisations.

## 8. FUTURE ACTIVITIES

We intend to continue as in the past. Approximately 25% of our drifting buoys will be deployed south of 55°S. We intend to maintain a DCP on Southern Thule. Due to financial constraints, we had to reduce the number of buoys deployed, as well as the duration of deployment voyages. However, steps to privatise the SAWB (as well as other government departments) are under way and this will hopefully lead to a better financial situation in the future.



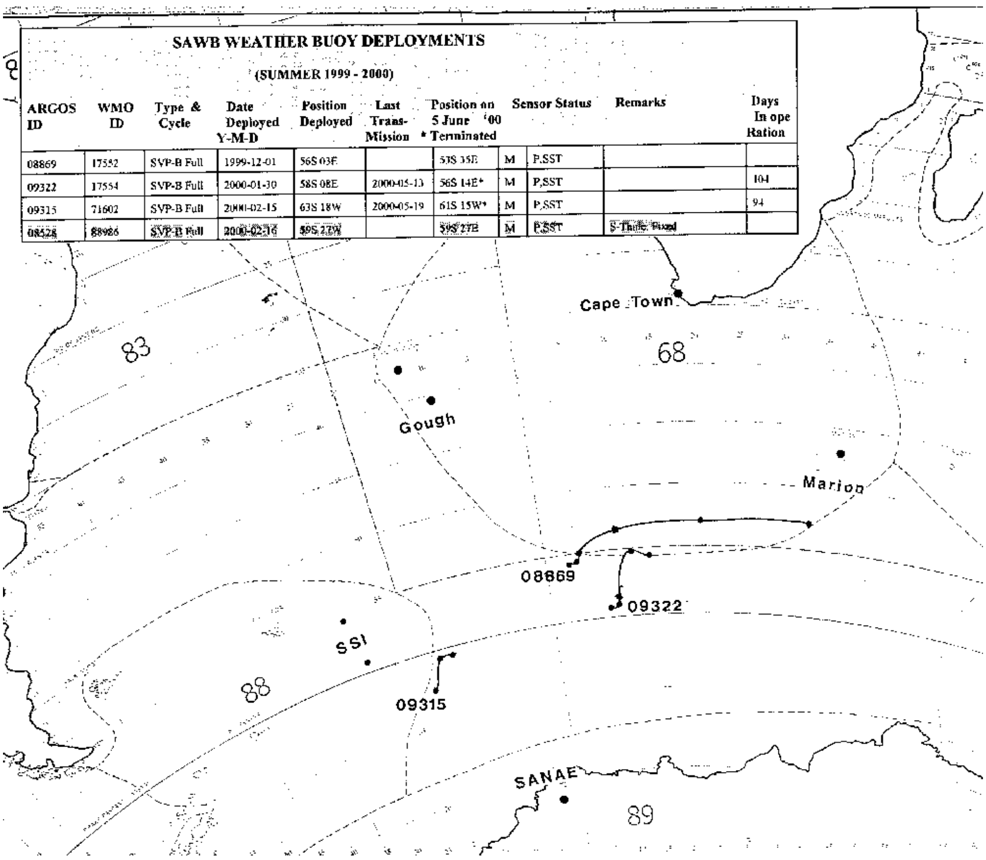
SAWB WEATHER BUOY DEPLOYMENTS

(SUMMER 1998 - 1999)

| ARGOS ID | WMO ID | Type & Cycle | Date Deployed Y-M-D | Position Deployed | Last Trans-Mission | Position on 5 June '00 * Terminated | Sensor Status | | Remarks | Days In ope Ration |
|---|---|---|---|---|---|---|---|---|---|---|
| 21483 | 33553 | SVP-B Full | 1998-12-06 | 55S 55W | 1998-12-08 | 55S 55W* | M | P,SST | Air deployment USN | 2 |
| 21486 | 17543 | SVP-B Full | 1998-12-27 | 65S 07W | 1999-09-15 | 56S 11E* | M | P,SST | | 263 |
| 13533 | 17544 | SVP-B Full | 1998-12-29 | 55S 10W | 1998-12-29 | 55S 10W* | M | P,SST | Experimental | 0 |
| 21487 | 33557 | SVP-B Full | 1999-02-12 | 55S 28W | 2000-04-04 | 56S 75E* | M | P,SST | | 417 |
| [illegible] | [illegible] | SVP-B Full | [illegible] | [illegible] | [illegible] | [illegible] | M | P,SST | [illegible] | [illegible] |
| 21479 | 33559 | SVP-B Full | 1999-02-14 | 62S 25W | 2000-03-15 | 55S 64E* | M | P,SST | | 395 |



**Figure 2:** Summer 1998-1999 deployments.



SAWB WEATHER BUOY DEPLOYMENTS

(SUMMER 1999 - 2000)

| ARGOS ID | WMO ID | Type & Cycle | Date Deployed Y-M-D | Position Deployed | Last Trans-Mission | Position on 5 June '00 * Terminated | Sensor Status | | Remarks | Days In ope Ration |
|---|---|---|---|---|---|---|---|---|---|---|
| 08869 | 17552 | SVP-B Full | 1999-12-01 | 56S 03E | | 53S 35E | M | P,SST | | |
| 09322 | 17554 | SVP-B Full | 2000-01-30 | 58S 08E | 2000-05-13 | 56S 14E* | M | P,SST | | 104 |
| 09315 | 71602 | SVP-B Full | 2000-02-15 | 63S 18W | 2000-05-19 | 61S 15W* | M | P,SST | | 94 |
| 08528 | 88926 | SVP-B Full | 2000-02-16 | 59S 27W | | 59S 27E | M | P,SST | [illegible] | |



**Figure 3:** Summer 2000-2001 deployments.

**(v) United Kingdom (The report was delivered by Dr P. Wadhams)**

The British contribution to IPAB activities in the period 1999-2000 consisted of buoys, deployed into the central Weddell Sea during the ANT-XVII/3 cruise leg of F/S *Polarstern*, in April 2000. Buoys were deployed as a square array of five buoys (with one central buoy) on a scale of 100 km, with a long-scale buoy 300 km further west along the ice edge. The drifters were designed and built in a collaborative project between the Scott Polar Research Institute (SPRI), Cambridge and the Dunstaffnage Marine Laboratory (DML), Oban, as part of the UK government funded "Short Timescale Motion of Pancake Ice", or STiMPI, project. The study focuses on the transition from unconsolidated frazil and pancake ice cover to first year pack ice.

The buoys were designed to move with the free-drift pancake motion, and thus mimicked their typical dimensions, being 1.25 m diameter discs, with 0.3 m draft and 0.1 m freeboard. A one-metre high tripod provided mounting for sensors and antennae. The buoys used the Orbcomm low-earth-orbit satellite system for increased data throughput and two-way communication. The buoys also incorporated MetOcean SVPB drifters as a backup to the innovative main system, and these transmitted air pressure and Argos position to the GTS. Parameters transmitted via Orbcomm are set out below:

- Meteorological: Wind speed and direction (1m ASL), air temperature (1m ASL).
- Ocean: SST (hull temperature), both narrow (-3$^o$C to +2$^o$C at 0.001$^o$C resolution) and wide range (-50$^o$C to +30$^o$C at 0.02$^o$C resolution).
- Waves: Vertical wave spectrum at 3 hour intervals, 0.025 – 0.6 Hz in 55 frequency bins, derived from a 1,536-second time series. Spectral moments ($m_{-4}$ to $m_2$) and diagnostic parameters are also transmitted.
- Other: DGPS position, battery voltage, buoy heading.

The array survived many storms in the growing marginal ice zone and became successfully consolidated into the first year pack ice. Three buoys survived the entire winter season, and melted out into the Antarctic Circumpolar Current (ACC). Mean lifetime of the buoys was 87 days. Tracks of the arrays are shown in the Figure 4.

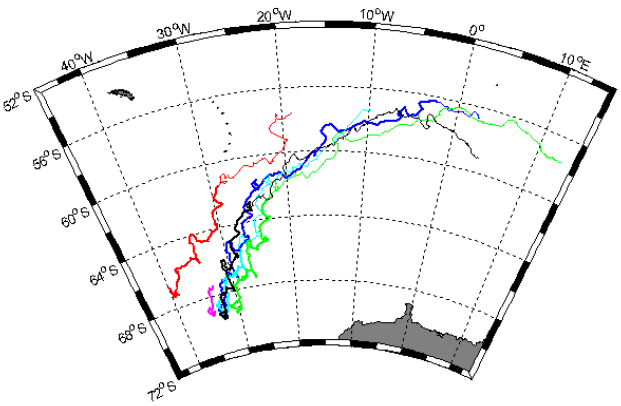



**Figure 4:** Drift tracks of the six SPRI/DML pancake buoys.

The UK contributed further to IPAB in February 2001, with three air-dropped MetOcean CALIB drifters deployed onto the late summer pack ice of the Bellingshausen Sea by the British Antarctic Survey (BAS), flying by Twin Otter from the Fossil Bluff airstrip on Alexander Island. The drifters survived until March 4th, March 15th and May 3rd. These drifters do not transmit to the GTS, though tracks are available on the Web at http://www.nbs.ac.uk/icd/argos/. A fourth non-GTS CALIB was deployed by SPRI on April 23rd, using a helicopter from the F/S *Polarstern* during her ANT-XVIII/5b cruise to the Bellingshausen Sea, and this was still transmitting at the time of writing of this report(15 May 2001 ).

SPRI also deployed three MetOcean SVPB drifters into the Bellingshausen Sea ice from the same *Polarstern* cruise, on 25 April. These were provided by the UK Meteorological Office, and dug into multi-year floe pieces in the consolidated pancake ice cover in the region of 70°S, 87°W. Unlike the CALIB beacon, these were placed off the continental shelf in deep water and are expected to track northwards with the ACC, in contrast to the generally southwestward movement of the CALIBs with the coastal current. Initial deployment locations are shown in Figure 5.

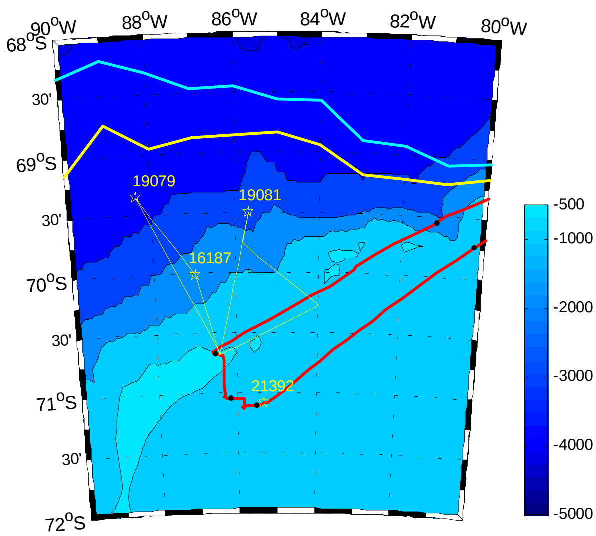



**Figure 5:** The area of Bellingshausen Sea buoy deployments. The cruise track shown in red, with dots indicating the position at 0000UTC each day, overlaid on bathymetry in metres. Helicopter flights on April 25th are shown as thin yellow lines, with the buoy deployment locations indicated as stars next to their Argos IDs. The 60% ice concentration limit, derived from passive microwave satellite images, is shown as a thick yellow line. The 30% ice concentration limit is indicated by the cyan line.

**Future Deployments**: None planned at present.

## (vi) United States of America (The report was delivered by Drs M. O. Jeffries & N. Kozlenko)

Buoy Deployments in the Ross Sea Pack Ice, 1998 and 1999

### Introduction

Under the auspices of a grant from the US National Science Foundation, Office of Polar Programmes (Grant No. OPP 9614844), buoys were deployed in the Ross Sea in May 1998 and January 1999 from the research vessel *Nathaniel B. Palmer*. The purpose of the deployments was to obtain data for an investigation of ice motion and deformation and their role in the dynamic thickening of the Ross Sea pack ice.

The buoys were manufactured by METOCEAN Data Systems Limited, Dartmouth, Nova Scotia, Canada. Seven buoys were Ice Beacons equipped with GPS and hull temperature sensors (Ice Beacon, Table 1). Two buoys were Ice Beacons equipped with wind speed and direction, air temperature, barometric pressure, hull temperature and GPS sensors (Ice/Met. Beacon, Table 1). The GPS position was recorded hourly at 10 seconds past the hour. The meteorological data were recorded for 11.6 minutes each hour beginning on the hour. All data were transmitted via Système Argos. No data were inserted into the GTS.

### May 1998 Deployment and Drift

Seven buoys were deployed in the south-central Ross Sea on 18-20 May 1998 in a roughly hexagonal array with six buoys at the perimeter and one in the centre (Figure 6). The deployment location and time for each buoy are summarised in Table 1. The buoys were deployed on thin to moderately thick first-year ice floes (Table 1) located in a 10/10 concentration ice cover. Additional details on the composition and characteristics of the pack ice surrounding the floes are given in Table 2.

Within 18 days of the initial deployment, three buoys had ceased to function (Table 3). They were probably destroyed by the ice and included one Ice Beacon and two Ice/Met. Beacons. During those 18 days, the ice drifted north-northwestward at roughly 90° to the right of the surface wind (Figure 7).

The remaining four buoys functioned continuously until early September when three ceased to transmit data from locations close to the southeastern end of the Balleny Islands chain (Figure 7). They too were probably destroyed by the ice. The final buoy (13946) continued to drift, first to the west of the Balleny Islands until November, when it reversed course and drifted north-eastward until 21 December when it ceased to transmit data at a location close to the ice edge (Figure 7). The mean ice drift speed each month typically exceeded 10 km $d^{-1}$ (Table 4).

**January 1999 Deployment and Drift**

Two Ice Beacons were deployed in the south-eastern Ross Sea on 28 and 29 January 1999 (Table 5, Figure 8). The buoys were deployed on thick first-year ice floes (Table 5) located in a high concentration ice cover. Additional details on the composition and characteristics of the pack ice surrounding the floes are given in Table 6.

Buoy 13947 drifted northward until April 1999, when the direction of motion turned eastward (Figure 8). The buoy continued to function until October 1999 when it ceased to transmit at a location close to 115° W in the Amundsen Sea (Figure 8, Table 7). Apart from February 1999, the mean drift speed of buoy 13947 always exceeded 10 km $d^{-1}$ each month (Table 8).

Buoy 13948 drifted westward until late September 1999, when the direction of motion turned north-eastward (Figure 8). North-eastward motion continued until December 1999, when the direction changed to eastward (Figure 8). The buoy continued to function until January 2000 when it ceased to transmit at about 142.5°W in the Ross Sea. The mean drift speed of buoy 13948 each month was always lower than that of buoy 13947 (Table 8).

All data from the 1998 and 1999 buoy deployments are now in the IPAB database.

**Table 1.** Information on buoys deployed in the south-central Ross Sea in May 1998.

| Argos ID No. and Buoy Type | Latitude (°,',") | Longitude (°,',") | Time (GMT) | Mean Ice Thickness (cm ± 1 s.d.) | Mean Snow Depth (cm ± 1 s.d.) | Mean Freeboard (cm ± 1 s.d.) |
|---|---|---|---|---|---|---|
| 13930 Ice/Met. Beacon | -74, 59, 17 | -179, 51, 32 | 0348, 18 May | 62 ± 1.0 | 4.0 ± 0.5 | 5.0 ± 0.5 |
| 13932 Ice Beacon | -75, 13, 47 | -178, 07, 34 | 0758, 18 May | 53 ± 1.0 | 5.0 ± 0.5 | 3.0 ± 0.5 |
| 13933 Ice Beacon | -75, 42, 54 | -178, 09, 35 | 1300, 18 May | 42 ± 2.0 | 7.5 ± 1.0 | 0.5 ± 0.5 |
| 13945 Ice Beacon | -75, 28, 04 | 179, 53, 25 | 1740, 18 May | 38 ± 1.0 | 6.0 ± 0.5 | 0.5 ± 0.0 |
| 13934 Ice Beacon | -75, 12, 51 | 178, 21, 52 | 2219, 18 May | 34 ± 1.0 | 5.0 ± 0.5 | 0.0 ± 0.0 |
| 13946 Ice Beacon | -75, 42, 43 | 178, 19, 42 | 0300, 19 May | 27 ± 2.0 | 7.5 ± 1.5 | -1.0 ± 1.0 |
| 13931 Ice/Met. Beacon | -75, 58, 06 | 179, 59, 18 | 0200, 20 May | 38 ± 3.0 | 8.5 ± 1.0 | 0.5 ± 0.5 |

**Table 2.** Pack ice characteristics in the vicinity of the buoys deployed in the south-central Ross Sea in May 1998.

| Argos ID No. | Total Ice Concentration | Primary Ice Type | Secondary Ice Type | Tertiary Ice Type |
|---|---|---|---|---|
| 13930 | 10/10 | 9/10<br>50 cm<br>Medium floes<br>10-20% ridging | 1/10<br>20 cm<br>Small floes<br>Unridged | None observed |
| 13932 | 10/10 | 10/10<br>50 cm<br>Large floes<br>10-20% ridging | None observed | None observed |
| 13933 | 10/10 | 10/10<br>40 cm<br>Small floes<br>0-10% ridging | None observed | None observed |
| 13945 | 10/10 | 10/10<br>40 cm<br>Large floes<br>0-10% ridging | None observed | None observed |
| 13934 | 10/10 | 10/10<br>40 cm<br>Large floes<br>0-10% ridging | None observed | None observed |
| 13946 | 10/10 | 2/10<br>40 cm<br>Small floes<br>0-10% ridging | 8/10<br>20 cm<br>Large floes<br>0-10% ridging | None observed |
| 13931 | 10/10 | 8/10<br>30 cm<br>Large floes<br>10-20% ridging | 1/10<br>25 cm<br>Brash/broken ice<br>Unridged | 1/10<br>5 cm<br>Sheet ice<br>Unridged |

**Note:** The primary, secondary and tertiary ice types are the thickest, second thickest and third thickest ice types, respectively. Four characteristics of each ice type are listed: concentration, mean thickness of unridged ice, floe size and areal extent of ridging.

**Table 3.** Duration of operation of buoys deployed in the south-central Ross Sea in May 1998.

| Argos ID No. | First Day of Operation | Final Day of Operation | No. of Days of Operation |
|---|---|---|---|
| 13930 | 18 May 1998 | 26 May 1998 | 9 |
| 13932 | 18 May 1998 | 6 September 1998 | 112 |
| 13933 | 18 May 1998 | 9 September 1998 | 115 |
| 13945 | 18 May 1998 | 4 June 1998 | 18 |
| 13934 | 18 May 1998 | 5 September 1998 | 111 |
| 13946 | 19 May 1998 | 21 December 1998 | 216 |
| 216 | 20 May 1998 | 2 June 1998 | 14 |

**Table 4.** Mean ice drift speed each month determined from buoys operating in the Ross Sea between May and December 1998. Values in italics have units of km $d^{-1}$.

| Argos ID No. | May | June | July | August | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 13930 | 0.09 m $s^{-1}$<br>*7.8 km $d^{-1}$* | | | | | | | |
| 13932 | 0.12 m $s^{-1}$<br>*10.4 km $d^{-1}$* | 0.16<br>*13.8* | 0.17<br>*14.7* | 0.15<br>*13.0* | 0.12<br>*10.4* | | | |
| 13933 | 0.13 m $s^{-1}$<br>*11.2 km $d^{-1}$* | 0.07<br>*6.1* | 0.17<br>*14.7* | 0.15<br>*13.0* | 0.22<br>*19.0* | | | |
| 13945 | 0.12 m $s^{-1}$<br>*10.4 km $d^{-1}$* | | | | | | | |
| 13934 | 0.15 m $s^{-1}$<br>*13.0 km $d^{-1}$* | 0.17<br>*14.7* | 0.16<br>*13.8* | 0.13<br>*11.2* | 0.04<br>*3.5* | | | |
| 13946 | 0.16 m $s^{-1}$<br>*13.8 km $d^{-1}$* | 0.17<br>*14.7* | 0.16<br>*13.8* | 0.13<br>*11.2* | 0.18<br>*15.6* | 0.09<br>*7.8* | 0.15<br>*13.0* | 0.19<br>*16.4* |
| 13931 | 0.15 m $s^{-1}$<br>*13.0 km $d^{-1}$* | | | | | | | |

**Table 5.** Information on buoys deployed in the south-eastern Ross Sea in January 1999.

| Argos ID No. and Buoy Type | Latitude (°,’,”) | Longitude (°,’,”) | Time (GMT) | Mean Ice Thickness (cm ± 1 s.d.) | Mean Snow Depth (cm ± 1 s.d.) | Mean Freeboard (cm ± 1 s.d.) |
|---|---|---|---|---|---|---|
| 13947<br>Ice Beacon | -71, 58, 56 | -135, 00, 10 | 0316,<br>28 January | 254.0 ± 100 | 61.0 ± 15.0 | 1.5 ± 14.0 |
| 13948<br>Ice Beacon | -73, 00, 07 | -134, 59, 40 | 0244,<br>29 January | 122.0 ± 116.0 | 21.0 ± 12.0 | 5.0 ± 9.0 |

**Table 6.** Pack ice characteristics in the vicinity of the buoys deployed in the south-eastern Ross Sea in January 1999.

| Argos ID No. | Total Ice Concentration | Primary Ice Type | Secondary Ice Type | Tertiary Ice Type |
|---|---|---|---|---|
| 13947 | 8/10 | 7/10<br>120 cm<br>Medium floes<br>30-40% ridging | 1/10<br>30 cm<br>Large floes<br>10-20% ridging | None observed |
| 13948 | 9/10 | 6/10<br>80 cm<br>Medium Floes<br>10-20% Ridging | 3/10<br>60<br>Large floes<br>0-10% ridging | None observed |

**Note:** The primary, secondary and tertiary ice types are the thickest, second thickest and third thickest ice types, respectively. Four characteristics of each ice type are listed: concentration, mean thickness of unridged ice, floe size and areal extent of ridging.

**Table 7.** Duration of operation of buoys deployed in the south-eastern Ross Sea in January 1999.

| Argos ID No. | First Day of Operation | Final Day of Operation | No. of Days of Operation |
|---|---|---|---|
| 13947 | 28 January 1999 | 8 October 1999 | 254 |
| 13948 | 29 January 1999 | 24 January 2000 | 361 |

**Table 8.** Mean ice drift speed each month determined from buoys operating in the south-eastern Ross Sea and western Amundsen Sea between February 1999 and January 2000. Values in italics have units of km $d^{-1}$.

| Argos ID No. | 13947 | 13948 |
|---|---|---|
| February 1999 | 0.08 m $s^{-1}$<br>*6.9 km $d^{-1}$* | 0.09 m $s^{-1}$<br>*7.8 km $d^{-1}$* |
| March 1999 | 0.13<br>*11.2* | 0.09<br>*7.8* |
| April 1999 | 0.18<br>*15.1* | 0.10<br>*8.6* |
| May 1999 | 0.18<br>*15.6* | 0.08<br>*6.9* |
| June 1999 | 0.16<br>*13.8* | 0.13<br>*11.2* |
| July 1999 | 0.17<br>*14.7* | 0.13<br>*11.2* |
| August 1999 | 0.20<br>*17.3* | 0.13<br>*11.2* |
| September 1999 | 0.24<br>*20.7* | 0.12<br>*10.4* |
| October 1999 | 0.21<br>*18.1* | 0.11<br>*9.5* |
| November 1999 | | 0.09<br>*7.8* |
| December 1999 | | 0.12<br>*10.4* |
| January 2000 | | 0.14<br>*12.1* |

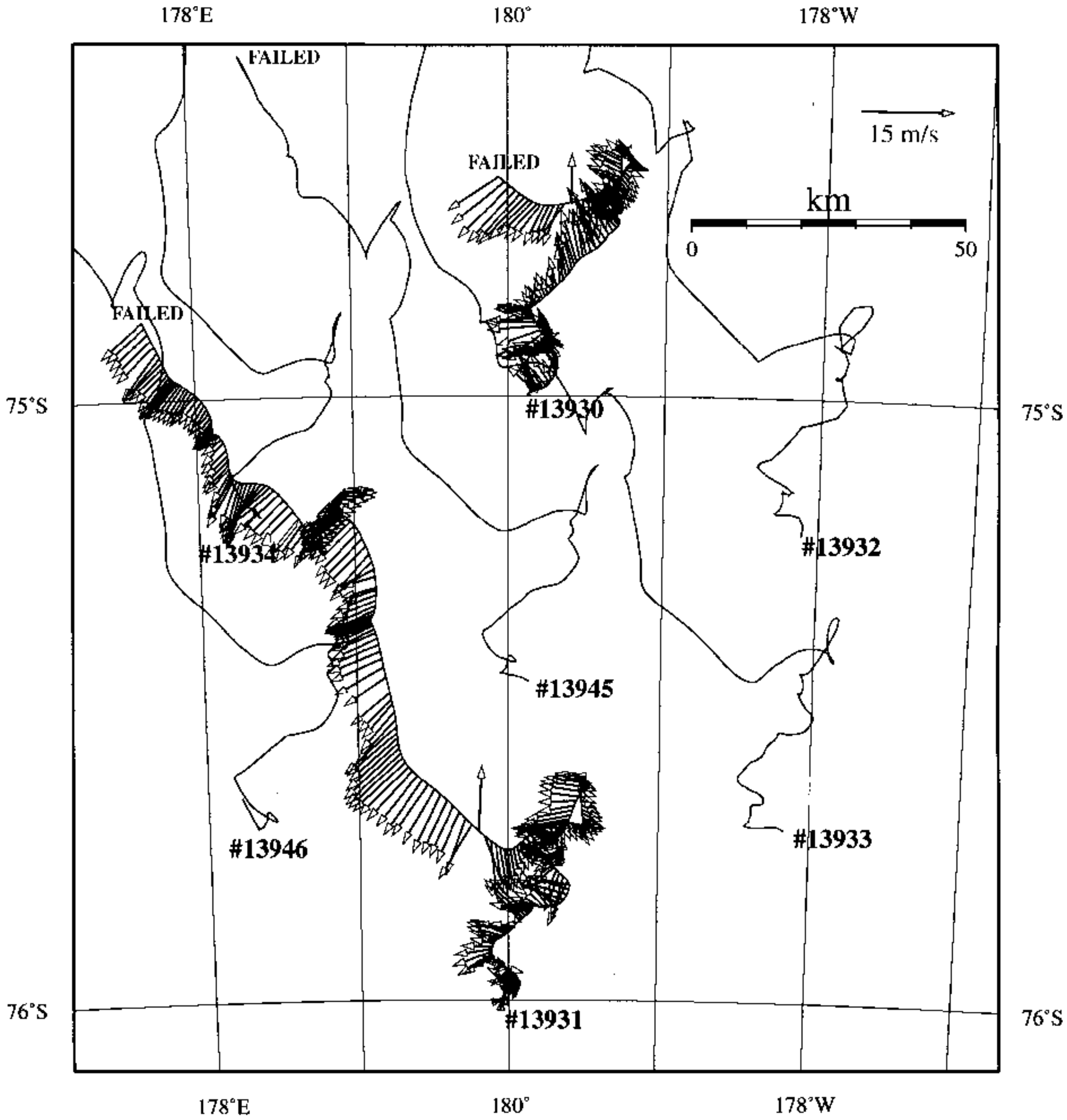



**Figure 6.** Initial drift of five Ice Beacons (13932, 13933, 13934, 13945, 13946) and two Ice/Met. Beacons (13930, 13931) in the south-central Ross Sea from 18 to 4 June 1998. The wind vectors along the drift tracks of buoys 13930 and 13931 are plotted at 3 hour intervals and scaled to the arrow in the top right corner.

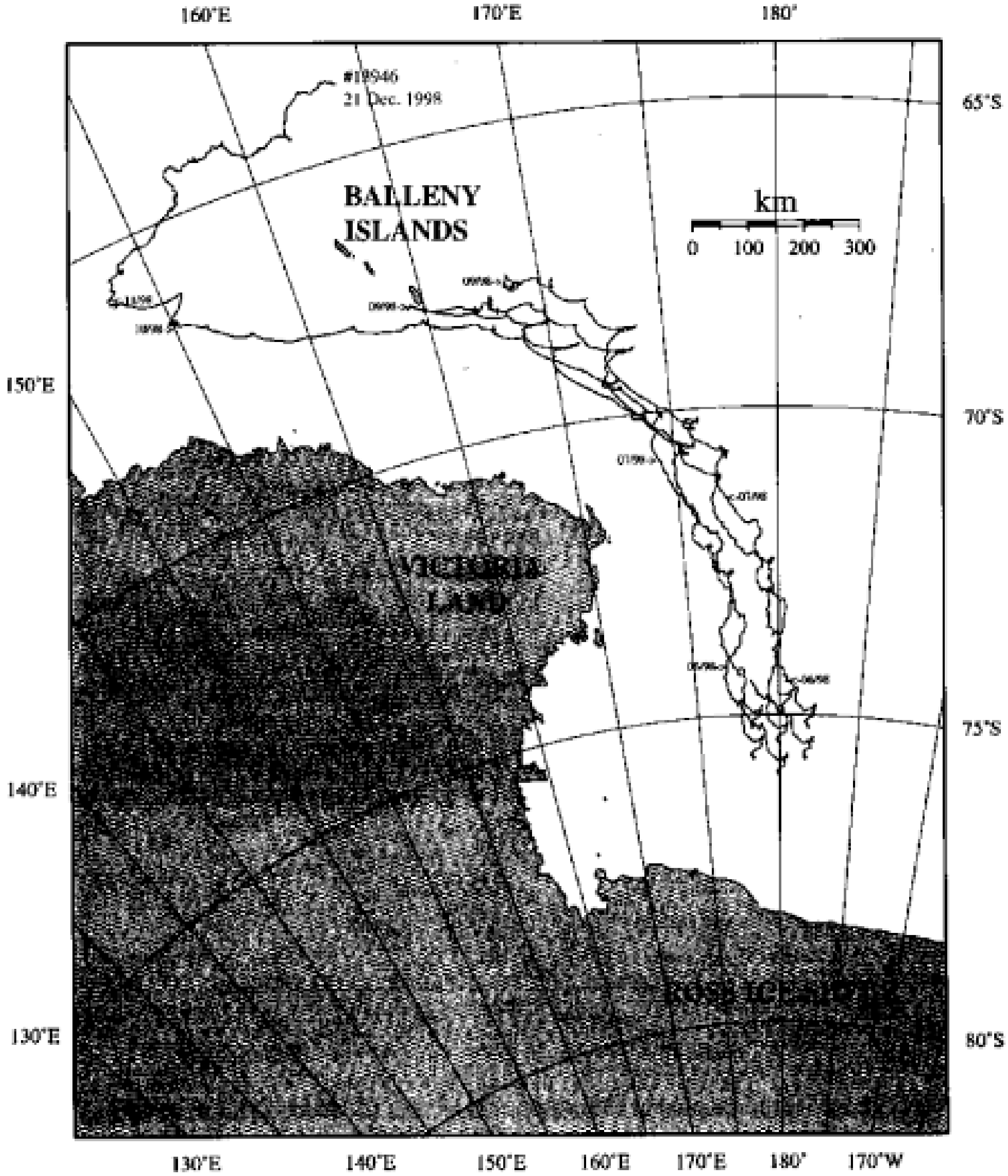



**Figure 7.** Drift tracks of buoys originally deployed in the south-central Ross Sea in May 1998.

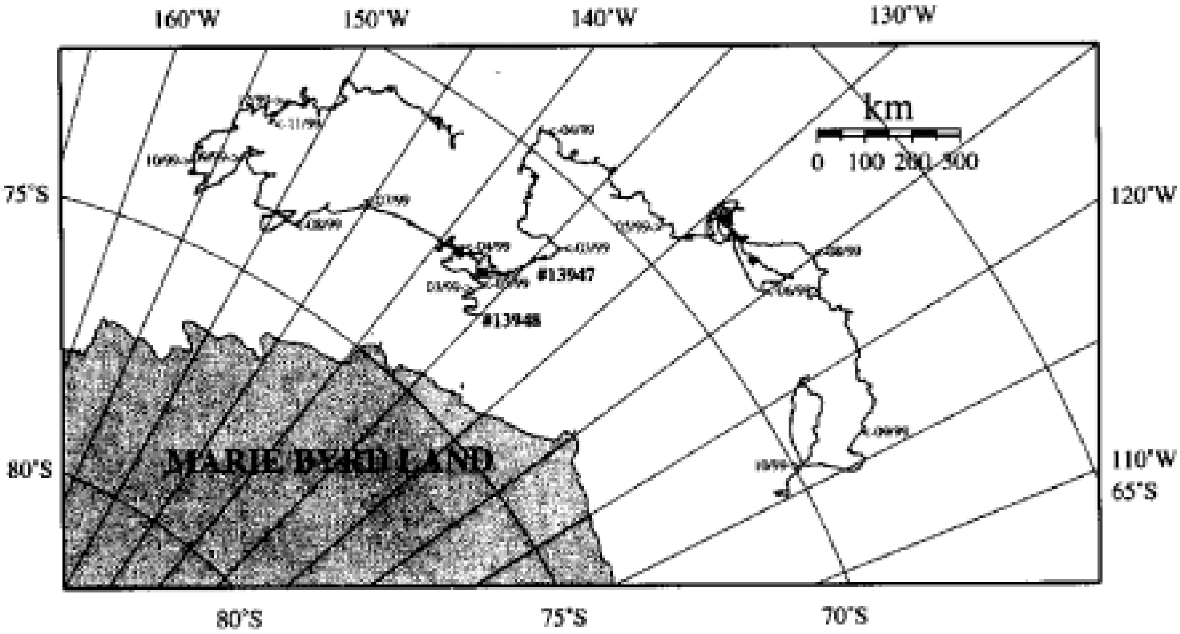



**Figure 8.** Drift tracks of two buoys originally deployed in the southeastern Ross Sea in January 1999.

**Appendix E**

## IPAB endorsements

1. An **ACSYS** meeting on data and data management in support of sea-ice/ocean modelling was held in **Koblenz, Germany from 28 June-1 July 1999**. The meeting was organised as a combined meeting of the ACSYS Numerical Experimentation Group (NEG), the ACSYS Data Management and Information Panel (DMIP), and the ACSYS Observation Products Panel (OPP). The meeting made the following recommendation concerning the IPAB:

"Sea-ice velocity, atmospheric pressure and temperature data are essential in support of research related to global climate processes, in providing real-time operational meteorological data for numerical weather forecast centres, and in establishing a basis for on-going monitoring of atmospheric and oceanic climate in the Antarctic sea-ice zone. These data are of special importance for satellite and model verification. The combined meeting strongly recommends the continuation of the IPAB, since the measured parameters are not available from any other data source, including satellite-derived products."

A report on the combined ACSYS meeting was published as WCRP Information Report No 6/2000.

2. The **ACSYS SSG-VIII (Louvain-la-Neuve, Belgium, November 1999)** underlined the importance of the continuance of the IPAB. They recommended that metadata on IPAB be provided to the IACPO and the National Snow and Ice Data Centre (NSIDC), USA."

3. The **WMO Thirteenth World MeteorologicalCongress (Cg-XIII, 1999)** gave strong encouragement to the IPAB. The following is an extract from the section 3.2.7.13 of the final Cg-XIII/PINK 3.2.7 document (World Climate Research Programme):

"Congress ... particularly appreciated the value of the data being collected in the WCRP International Programme for Antarctic Buoys (IPAB), not only to support research in the region, but also in providing valuable operational meteorological data in real-time and establishing a basis for monitoring atmospheric and oceanic changes in the Antarctic sea-ice zone. Congress urged national Meteorological Services having interests in the Southern Ocean and Antarctic to participate actively in IPAB by providing ice-resistant drifting buoys or by other appropriate means."

4. *Encouraging participation of National Meteorological Services (NMS) in the WCRP International Programme for Antarctic Buoys (IPAB)*: Statement by the **Joint Scientific Committee (JSC) for the WCRP** (Twentieth session, Kiel, Germany, March 1999):

"The WCRP International Programme for Antarctic Buoys (IPAB) was established in June 1994. IPAB builds upon co-operation among agencies and institutions with Antarctic and Southern Ocean interests to develop and maintain an optimum observational network for near-surface meteorological and oceanographic data within the Antarctic sea-ice zone, using drifter buoys and other appropriate data collection systems. The operational area of the Programme is south of 55°S, and includes that region of the Southern Ocean and Antarctic marginal seas within the maximum seasonal sea-ice extent. IPAB has a strong research component, and is endorsed as a self-sustaining project of the WMO/ICSU/IOC World Climate Research Programme. IPAB is also an Action Group of the WMO/IOC Data Buoy Co-operation Panel.

The objective of the IPAB 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 actually has 19 participating institutions. The IPAB is mainly supported by research agencies, although three National Meteorological Services (NMS) with regional and global interests contribute actively to the programme (Bureau of Meteorology, Australia; South African Weather Bureau; Meteorological Office, United Kingdom). IPAB presently maintains an array of 5-15 buoys in the region south of 55°S, all reporting on the GTS in real time. The number of IPAB buoys is obviously not sufficient to meet the requirements of the WWW and the need of the medium range weather forecasting using global models.

Recent research into the impact of surface buoy data on the analysis and forecasts by means of Numerical Weather Prediction Models (Turner *et al*: The Antarctic First Regional Observing Study of the Troposphere (FROST) project, Bull. Am. Meteorol. Soc., 1996; Kottmeier *et al*: Wind, temperature, and ice motion statistics in the Weddell Sea, WMO/TD-No 797, 1997) has demonstrated strong potential impact of such drifting buoys on pressure and wind analyses.

WCRP IPAB therefore seeks more commitments from National Meteorological Services which would participate in the programme. This mainly concerns the provision of additional buoys and contribution to the Argos transmission costs, whereas the deployment of buoys would be done by research agencies during Antarctic research vessel activities.

The JSC-XX recalled Resolution 11 (WMO EC-XLVI, 1994) "Organisation of an International Programme for Antarctic Buoys" and confirmed the value of the IPAB data for meeting the WMO World Weather Watch, WCRP and GCOS objectives. The Committee requested the WMO Congress-XIII (May 1999) to urge those National Meteorological Services which have Antarctic and Southern Ocean interests to participate actively in the implementation of the WCRP International Programme for Antarctic Buoys by providing ice-resistant drifting buoys, or by other appropriate means."

5. The sixth Co-ordination meeting (5-7 May 1999, Mar del Plata, Argentina) of the International Antarctic Zone (iAnZone) Program gave strong support to the IPAB. The full report on the iAnZone-VI is available at the following web site:
http://www.ldeo.columbia.edu/physocean/ianzone/6th_mtg/meetingreport.html

The following is an extract from a letter dated 16 March 2000 from Dr R.D. Muench, a co-chair of the iAnZone, to Dr H. Cattle, Chairman of the ACSYS/CliC SSG:

"Current oceanic, including sea ice, and lower atmospheric research in the Southern Ocean south of the Antarctic Circumpolar Current relies heavily upon direct observations of atmospheric forcing and sea ice motion. These measurements can only be obtained with the required data density and from these very remote areas by drifting buoys, as currently provided under the auspices of the *International Programme for Antarctic Buoys* (IPAB). We are strongly concerned by recent reports from Dr V. Savchenko that activity under the IPAB is diminishing. A number of contributors to the IPAB are also participants in iAnZone and so are addressing this issue independently. We see a need, nonetheless, for high level WCRP and ACSYS support for the IPAB. We especially strongly support any efforts to lead the IPAB from a primary research into a long-term operational mode, and feel that this goal can be advanced by incorporation of scientific bodies that more appropriately address operational work than research."

**Appendix F**

**Participants of the**
**World Climate Research Programme**
**International Programme for Antarctic Buoys**

At August 1997, **16 organisations**, representing **11 countries**, had subscribed to **IPAB** by submitting letters of intent to participate in the programme.

| | | |
|---|---|---|
| Alfred Wegener Institute | Germany | 22 July 1994 |
| Antarctic CRC | Australia | 19 September 1994 |
| Australian Antarctic Division | Australia | 31 August 1994 |
| British Antarctic Survey | UK | 14 May 1995 |
| Commonwealth Bureau of Meteorology | Australia | 20 October 1994 |
| INPE -National Institute for Space Research | Brazil | 3 August 1996 |
| Institute for Marine Research, University of Helsinki | Finland | 1 June 1995 |
| Hydrographic Department, Maritime Safety Agency | Japan | 26 April 1996 |
| National Ice Center | USA | 4 August 1995 |
| National Institute of Polar Research | Japan | 26 April 1996 |
| Programma Nazionale di Ricerche in Antardtide | Italy | 21 July 1994 |
| Scott Polar Research Institute | UK | 14 May 1995 |
| Service Argos | France | 20 July 1996 |
| South African Weather Bureau | South Africa | 3 August 1995 |
| United Kingdom Meteorological Office | UK | 14 May 1995 |
| World Data Center A, Glaciology | ASA | 14 December 1994 |

**Appendix G**

# 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 data network in the 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), using *in situ* platforms and in particular drifting buoys, 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 other relevant international programmes;

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

(iii) Establish a basis for on-going monitoring and 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 Antarctic buoy network throughout 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 optimised observational network for near-surface meteorological and oceanographic data within the Antarctic sea-ice zone, using drifter 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°S and includes that region of the South Ocean and Antarctic marginal seas within the maximum seasonal sea-ice extent.

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:

IPAB recognises the requirements stated by international environmental programmes (in particular, by WCRP and WWW) for a basic surface observation network with observational points spaced at about 500 km. IPAB buoy deployments will aim to achieve and maintain, as far as possible, this density over the operational area.

4.4 Duration of Programme:

The Programme is proposed as a long-term one, subject to on-going support from 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 a system (for example Service Argos) that inputs synoptic data directly to the GTS.

5.2 Coding:

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

5.3 Global Telecommunication System:

All relevant data collected by Participants should 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 IOC/WMO Responsible National Oceanographic Data Centre for drifting buoy data.

6.2 Research Database:

A uniform, quality-controlled database for ice motion, surface meteorology and oceanography, as required by the Antarctic research community, will be established. This database 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 include 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. Principal investigators or relevant buoy programmes may also contribute, with agreement from the Executive Committee, as Individual Participants. Intending Participants will indicate their contribution to, and involvement in, the Programme by means of a Letter of Intent to be submitted to the IPAB Chairman and copies 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. Annex 1 to this document contains a suggested Letter of Intent.

The full role 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 three other elected persons representing 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 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 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 Participants' Meetings.

## 8. Meetings

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

## 9. Glossary

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

**Appendix G, Annex 1**

# Suggested form of Letter of Intent

Dear Colleague,

(..Insert name of Agency 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:

Dr Enrico Zambianchi
Chairman of the IPAB Executive Committee
Istituto Universitario Navale
Istituto di Meteorologia e Oceanografia
Via Acton 38
80133 Napoli
Italy

With a copy to:

Dr David Carson
Director of the WCRP
c/o WMO
7 bis, avenue de la Paix
Case postale N° 2300
CH-1211 Geneva 2
Switzerland

# 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. The Co-ordinator's specific responsibilities are to:

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 set of ice motion and surface meteorological and atmospheric data from the buoy network, and annually submit it to appropriate data centres for archiving (such as World Data Centres 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. maintain up to date information on the Programme and status of deployments on the IPAB web site;
12. respond to requests from WCRP, WMO, and the Scientific Committee on Antarctic Research (SCAR) for technical and scientific information on the Programme;
13. organise the biennial meeting of Participants, present a report of the preceding 2 years' activities, and prepare a plan for the following 2 years;
14. promote the WCRP International Programme for Antarctic Buoys to potential Participants.

**Appendix H**

# Agenda of the Joint IABP/IPAB Session

1. Status Reports of each Programme

    1.1 IPAB (I. Allison)

    1.2 IABP (I. Rigor)

    1.3 CliC (I. Allison)

2. Joint IPAB and IABP Technical Session

    2.1 JCAD buoy (T. Kikuchi)

    2.2 ICEX buoy (T. Kvinge)

    2.3 IABP and Arctic Drifting Buoy data CD (E. Couture)

    2.4 IPAB buoy development (M. Doble)

    2.5 Twenty Year Review of IABP data (I. Rigor)

    2.6 North Pole Environmental Observatory (I. Rigor)