

**DEVELOPMENTS IN BUOY TECHNOLOGY, COMMUNICATIONS  
AND DATA APPLICATIONS**

**PRESENTATIONS AT THE DBCP  
SCIENTIFIC AND TECHNICAL WORKSHOP**

**(Victoria, Canada, October 2000)**

**DATA BUOY COOPERATION PANEL**

**DEVELOPMENTS IN BUOY TECHNOLOGY, COMMUNICATIONS  
AND DATA APPLICATIONS**

**PRESENTATIONS AT THE DBCP  
SCIENTIFIC AND TECHNICAL WORKSHOP**

(Victoria, Canada, October 2000)

**DBCP Technical Document No. 19**

**2001**

## NOTE

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariats of the Intergovernmental Oceanographic Commission (of UNESCO), and the World Meteorological Organization concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

## FOREWORD

The success of the technical workshops, beginning at the eleventh session of the Data Buoy Cooperation Panel (DBCP), encouraged the panel to make such workshops a regular feature of its annual session, as a practical means of promoting cooperation and information exchange amongst all sections of the global buoy community, including buoy deployers, data users and communication systems providers.

Consequently, a technical workshop on *Developments in Buoy Technology, Communications and Data Applications* took place during the first day and a half of the sixteenth session of the panel, held in Victoria, British Columbia, Canada, October 2000. A total of twenty-five papers were presented to more than sixty participants during the workshop. The texts of seventeen papers and four abstracts, and slides of four presentations are included in this DBCP technical publication. In all cases the papers and slides have been reprinted as received, without additional editorial intervention.

## TABLE OF CONTENTS

### FOREWORD

### TABLE OF CONTENTS

### AGENDA

### PRESENTATIONS

1.	Jeffrey Wingenroth and Henry White, Technocean, Inc., FL, USA <i>Developments in the Technocean SVP-Barometer Drifter</i> .....	1
2.	Andy Sybrandy, Pacific Gyre; Peter Niiler, Scripps Institution of Oceanography, USA <i>Calibrated Minimet Technology</i> .....	10
3.	Sergey Motyzhev, Marlin Scientific Manufacturing Company, Ukraine Elizabeth Horton, Naval Oceanographic Office, MS, USA <i>Marlin SVP-B drifters evaluation after one-year operation in situ</i> .....	11
4.	Sergey Motyzhev, Marine Hydrophysical Institute NASU, Ukraine Elizabeth Horton, Naval Oceanographic Office, MS, USA <i>New generation of Argos-2(3) SVP buoy series as instrument for DBCP Implementation Strategy. Matter for discussing</i> .....	16
5.	Eric Meindl, NOAA/NDBC, USA <i>An update to an SVP-B Performance and Cost Analysis</i> .....	20
6.	W. Gary Williams, Clearwater Instrumentation, Inc., MA, USA <i>Autonomous Ocean Observing System (ADOS)</i> .....	27
7.	Michel Taillade, CLS, France <i>Getting ready for the Argos Downlink</i> .....	43
8.	Tetsuya Uwai, Japan Meteorological Agency, Japan <i>Drifting Wave Buoy using ORBCOMM Data Transmission</i> .....	57
9.	David Meldrum, Duncan Mercer and Oil Peppe, Dunstaffnage Marine Laboratory, UK <i>ORBCOMM - an Antarctic evaluation</i> .....	61
10.	Jim Hanlon, Seimac Limited; Brian Day, Campbell Scientific Corp., Canada <i>A New High Data Rate GOES DCP</i> .....	77
11.	Wynn Jones and Simon Koegh, The Met Office, UK <i>Some preliminary results from a Met. Office Open Ocean Buoy fitted with a TRIAXYS Wave Sensor</i> .....	85
12.	Bernard G. Petolas, METOCEAN data Systems Ltd., Canada <i>Neptune- METOCEAN's Deep-Diving Profiling Floats</i> .....	108
13.	Howard Freeland, Institute of Ocean Sciences, Canada <i>Project Argo, moving towards the implementation phase</i> .....	121
14.	Richard W. Reynolds, NOAA/NCDC; D.E. Harrison, NOAA/PMEL Diane C. Stokes, NOAA/NWS, USA <i>Specific Contributions to the Observing System: Sea Surface Temperatures</i> .....	122

15.	François Gérard, Météo-France <i>The potential of data buoys in support of numerical weather prediction: The EUCOS initiative.....</i>	139
16.	Peter Niiler, Scripps Institution of Oceanography, USA <i>World Ocean Surface Circulation .....</i>	143
17.	Simon Skey and Mark Blaseckie, Axys Environmental Systems, Canada; Jim Gower, IOS, Canada; Val Swail, Environment Canada, Canada <i>SEA SURFACE TEMPERATURE MEASUREMENT from ODAS Buoys .....</i>	144
18.	Christian Ortega, CLS, France <i>New Argos User interface on the Web .....</i>	153
19.	M. Ravichandran, M. Harikrishnan, Tata Sudhakar, M. Muralidhar and K. Premkumar National Institute of Ocean Technology, Chennai, India <i>Inter comparison of sea surface meteorological data from two different buoys and with ship observations.....</i>	159
20.	Dario Stucchi, Institute of Ocean Sciences, Canada <i>Use of GPS drifters for measurement of near surface currents in a wide strait .....</i>	167
21.	Owen S. Lange, Environment Canada, Canada <i>A buoy network for complex mesoscale weather .....</i>	168
22.	Jim Gower, Institute of Ocean Sciences, Canada <i>Physical and biological monitoring with the western Canadian ODAS marine buoy network .....</i>	176
23.	Craig Engler, NOAA/AOML, USA <i>Status of the global drifter array, and the Hurricane array deployments .....</i>	185
24.	Mayra Pazos, NOAA/AOML, USA <i>Drifter Data Assembly Center .....</i>	190
25.	Ignatius G. RIGOR *, Roger L. COLONY**, John M. WALLACE*, Seelye MARTIN*** *Department of Atmospheric Science, University of Washington, Seattle, WA, USA ** International Arctic Research Center, University of Alaska Fairbanks, Fairbanks, AK, USA *** School of Oceanography, University of Washington, Seattle, WA, USA <i>Variations in Surface Air Temperature Over the Arctic Ocean .....</i>	193

## LIST OF PARTICIPANTS

**AGENDA FOR THE SCIENTIFIC AND TECHNICAL WORKSHOP  
OF THE DATA BUOY COOPERATION PANEL, SIXTEENTH SESSION**

**VENUE: Victoria, British Columbia, Canada**

**DATE: 16th-17th October 2000**

**THEME: DEVELOPMENTS IN BUOY TECHNOLOGY, COMMUNICATIONS  
AND DATA APPLICATIONS**

**WORKSHOP CHAIR: Wynn Jones, The Met. Office, UK**

**Monday, October 16, 2000**

**Session 1      Developments in moored and drifting buoy design, sub-surface floats, sensors,  
communications, and operational programs  
Chair: Julie Fletcher, Metservice, NZ**

**Developments in the Technocean SVP-Barometer Drifter**

Jeffrey Wingenroth, Henry White, Technocean, Inc., Cape Coral, Florida, USA

**Calibrated Minimet Technology**

Andy Sybrandy, Pacific Gyre

Peter Niiler, Scripps Institution of Oceanography, USA

**Marlin SVP-B drifters evaluation after one-year operation in situ**

Sergey Motyzhev, Marlin Scientific Manufacturing Company, Ukraine

Elizabeth Horton, Naval Oceanographic Office, USA

**New generation of Argos-2(3) SVP buoy series as instrument for DBCP  
Implementation Strategy. Matter for discussing**

Sergey Motyzhev, Marine Hydrophysical Institute NASU, Ukraine

Elizabeth Horton, Naval Oceanographic Office, USA

**An update to results on SVP-B performance and cost analysis presented at  
DBCP XII, Henley 1996**

Eric Meindl, NOAA/NDBC, Stennis, USA

**Autonomous Ocean Observing System (ADOS)**

W. Gary Williams, Clearwater Instrumentation, Inc. Watertown, MA, USA

**Getting ready for the Argos Downlink**

Michel Taillade, CLS General Manager, Toulouse France

**Drifting Wave Buoy using ORBCOMM Data Transmission**

Tetsuya Uwai, Japan Meteorological Agency, Japan

**ORBCOMM Performance - results of an Antarctic evaluation**

D T Meldrum, D J L Mercer and O C Peppe, Dunstaffnage Marine Laboratory, UK

**A New High Data Rate GOES Satellite Transmitter for Buoy Applications**

Jim Hanlon, President, Seimac Limited

Brian Day, General Manager, Campbell Scientific Corp., Canada

**Preliminary results from a Met. Office Open Ocean Buoy fitted with a TRIAXYS Wave Sensor**

D W Jones and S J Keogh, The Met. Office, UK

**Neptune- METOCEAN Data Systems Limited 's Deep diving profiling floats**

Bernard G. Petolas, P. Eng, METOCEAN data Systems Ltd., Dartmouth, NS, Canada

**Session 2**

**Data requirements relating to operational oceanography and meteorology, including, in particular, case studies related to weather forecasting**

**Chair: Jean Rolland, Météo-France, France**

**Project Argo, moving towards the implementation phase.**

Howard Freeland, Institute of Ocean Sciences, Sidney, B.C., Canada

**Specific Contributions to the Observing System: Sea Surface Temperatures**

Richard W. Reynolds, D.E. Harrison, and Diane C. Stokes, NOAA/OGP, USA

**The potential of data buoys in support of numerical weather prediction: The EUCOS initiative**

François Gerard, EUCOS Programme manager, Météo-France, France

**World Ocean Surface Circulation**

Peter Niiler, Scripps Institution of Oceanography, USA

**SEA SURFACE TEMPERATURE MEASUREMENT from ODAS Buoys**

Jim Gower, Institute of Ocean Sciences, Sidney, BC, Canada

Simon Skey and Mark Blaseckie, Axys Environmental Systems, Sidney, BC, Canada

Val Swail, Meteorological Service of Canada, Downview, ON, Canada

**Tuesday, October 17, 2000**

**Session 3**

**Buoy data applications in oceanographic and meteorological modelling, global climate studies, and as a complement to remote sensing.**

**Chair: Louis Vermaak, SAWB, South Africa**

**New Argos User interface on the Web**

Christian Ortega, CLS, Toulouse, France

**Inter comparison of sea surface meteorological data from two different buoys and with ship observations**

M. Ravichandran, M. Harikrishnan, Tata Sudhakar, M. Muralidhar and K. Premkumar  
National Institute of Ocean Technology, IIT Campus, Chennai, India

**Use of GPS drifters for measurement of near surface currents in a wide strait**

Dario Stucchi, Institute of Ocean Sciences, Sidney, B.C., Canada

**A full buoy network for complex mesoscale weather**

Owen S. Lange, Environment Canada, MSC, Vancouver, BC, Canada

**Physical and biological monitoring with the western Canadian ODAS marine buoy network**

Jim Gower, Institute of Ocean Sciences, Sidney, BC, Canada

**Status of the global drifter array, and the Hurricane array deployments**

Craig Engler, AOML, Miami, FL, USA



**The Global Drifter Array- New Data products and the Year 2000 Hurricane Drifter Array**

Mayra Pazos, AOML, Miami, FL, USA

**Observed Changes in Arctic Climate**

Ignatius Rigor, Department of Atmospheric Science, University of Washington, Seattle, USA

# **PRESENTATIONS**

**The Scientific and Technical Workshop of the  
Data Buoy Cooperation Panel, Sixteenth Session  
(Victoria, BC, Canada, 16-17 October 2000)**

LIST OF PARTICIPANTS

Mr Stephen J. Auer  
NOAA Office of Global Programs  
Office of Oceanic and Atmospheric  
Research  
1100 Wayne Avenue, Suite 1201G  
SILVER SPRING, MD 20910  
USA  
Telephone: +1-301 427 2089  
Telefax: +1-301 427 2222  
E-mail: [auer@ogp.noaa.gov](mailto:auer@ogp.noaa.gov)

Mr Robert Bassett  
National Environmental Satellite, Data,  
and Information Service  
(NESDIS/NOAA)  
Route: E/SP3, BLDG FB4, RM 3320  
5200 Auth Road  
SUITLAND, MD 20746-4304  
USA  
Telephone: +1-301 457 5681  
Telefax: +1-301 457 5620  
E-mail: [Robert.Bassett@hdq.noaa.gov](mailto:Robert.Bassett@hdq.noaa.gov)

Mr Kent Berger-North  
Director of South American Operations  
AXYS  
P.O. Box 2219  
2045 Mills Road  
SIDNEY, B.C. V8L 3S8  
Canada  
Telephone: +1-250 655 5851  
Telefax: +1-250 655 5810  
E-mail: [kbergernorth@axys.com](mailto:kbergernorth@axys.com)

Ms Deborah Bird  
Naval Oceanographic Office, N32  
(NAVOCEANO)  
1002 Balch Blvd  
Stennis Space Center, MS 39529  
USA  
Telephone: +1-228 688 5677  
Telefax: +1-228 688 5514  
E-mail: [BirdD@navo.navy.mil](mailto:BirdD@navo.navy.mil)

Mr Mark Blaseckie  
Production Manager  
Meteorological Systems  
Axys Environmental Systems  
2045 Mills Road  
P.O. Box 2219  
SIDNEY, BC  
Canada  
Telephone: +1-250 655 5853  
Telefax: +1-250 655 5810  
E-mail: [mblaseckie@axys.com](mailto:mblaseckie@axys.com)

Mr Graeme Brough  
Chairman, DBCP  
Bureau of Meteorology  
G.P.O. Box 1289 K  
MELBOURNE, Vic. 3001  
Australia  
Telephone: +61-3 9669 4163  
Telefax: +61-3 9669 4168  
E-mail: [g.brough@bom.gov.au](mailto:g.brough@bom.gov.au)

Mr Etienne Charpentier  
JCOMMOPS  
8-10 rue Hermes  
Parc Technologique du Canal  
31526 Ramonville St. Agne  
France  
Telephone: +1-33 5 61 39 47 82  
Telefax: +1-33 5 61 75 10 14  
E-mail: [charpentier@jcommops.org](mailto:charpentier@jcommops.org)

Mr Steve Cook  
NOAA/OAR/AOML  
GOOS Center  
8604 La Jolla Shores Dr.  
La Jolla, CA 92037  
USA  
Telephone: +1-858 546 7103  
Telefax: +1-858 546 7185  
E-mail: [SKCOOK@UCSD.EDU](mailto:SKCOOK@UCSD.EDU)

Ms Estelle Couture  
Marine Environmental Data Service  
(MEDS)  
12W082 - 200 Kent St.  
Ottawa, ON K1A 0E6  
CANADA  
Telephone: 1-613 990 0259  
Telefax: 1-616 993 4856  
E-mail:  
couture@meds-sdmm.dfo-mpo.gc.ca

Mr Alaor Moacyr Dall' Antonia Jr  
Head, Meteorological and  
Agrometeorological General Coordination  
Instituto Nacional de Meteorologia-Inmet  
Eixo Monumental - Via S1  
70670-400 Brasilia, DF  
Brazil  
Telephone: +55-61 344 9955  
Telefax: +55-61 343 1487  
E-mail: alaor@inmet.gov.br.

Mr Brian Day  
Campbell Scientific (Canada) Corp.  
11564 149 Street  
Edmonton, AB T5M 1W7  
CANADA  
Telephone: 1 780 454 2505  
Telefax: 1 780 454 2655  
E-mail: brian@campbellsci.ca

Dr P.E. Dexter  
World Weather Watch-Applications  
Department  
World Meteorological Organization  
7 bis, Avenue de la Paix  
Case postale No 2300  
CH-1211 GENEVE 2  
Switzerland  
Telephone: +41-22 730 82 37  
Telefax: +41-22 730 80 21  
E-mail: dexter@www.wmo.ch

Mr Ford Doherty  
Meteorologist, Pacific Weather Centre  
Meteorological Service of Canada  
Pacific and Yukon Region  
200 - 1200 West 73<sup>rd</sup> Avenue  
Vancouver, BC V6P 6H9  
CANADA  
Telephone: +1-604 664 9385  
Telefax: +1-604 664 9004  
E-mail: ford.doherty@ec.gc.ca

Mr Craig Engler  
Manager, Global Drifter Center (GDC)  
Physical Oceanography Division  
Atlantic Oceanographic and  
Meteorological  
Laboratories (AOML/OAR/NOAA)  
4301 Rickenbacker Causeway  
MIAMI, FL 33149-1026  
USA  
Telephone: +1-305 361 4439  
Telefax: +1-305 361 4366  
E-mail: Craig.Engler@noaa.gov

Mr David K. Evans  
Bureau of Meteorology  
150 Lonsdale Street  
MELBOURNE, Vic. 3000  
Australia  
Telephone: +61-3 9669 4205  
Telefax: +61-3 9669 4168  
E-mail: d.evans@bom.gov.au

Ms Julie Fletcher  
Marine Meteorological Officer  
Meteorological Service of NZ Ltd  
P.O. Box 722  
WELLINGTON, New Zealand  
Telephone: +64-4 4700 789  
Telefax: +64-4 4700 772  
E-mail: fletcher@met.co.nz

Dr Howard Freeland  
Institute of Ocean Sciences  
9860 West Saanich Road  
Sidney, BC V8L 4B2  
Canada  
Telephone: +1-250 363  
Telefax: +1-250 363

Mr H. Paul Freitag  
TAO - Project Manager  
Tropical Atmosphere Ocean (TAO) Array  
Pacific Marine Environmental Laboratories  
(PMEL/OAR/NOAA)  
BLDG 3  
7600 Sandpoint Way NE  
SEATTLE; WA 98115-6349  
USA  
Telephone: +1-206 526 6727  
Telefax: +1-206 526 6744  
E-mail: freitag@pmel.noaa.gov

Mr. Barry Funk  
Supervisor, MSC Programs  
Meteorological Service of Canada  
Prairie & Northern Region  
123 Main St., Suite 150  
Winnipeg, MB R3C 4W2  
CANADA  
Telephone: +1-204 984 2018  
Telefax: +1-204 984 2072  
E-mail: barry.funk@ec.gc.ca

Mr François Gérard  
Vice-chairman, Joint IOC-WMO-UNEP  
Intergovernmental Committee for GOOS  
Chef du Département océan  
Direction générale Météo-France  
1,quai Branly  
75340 PARIS Cédex 07  
France  
Telephone: +33-1 45 56 7024  
Telefax: +33-1 45 56 7447  
E-mail: francois.gerard@meteo.fr

Mr Timothy Goos  
Chairman, IABP  
Director, Meteorological Service of  
Canada  
Prairie & Northern Region  
Room 200  
4999 - 98 Avenue  
Edmonton, AB T6B 2X3  
CANADA  
Telephone: +1-403 951 8847  
Telefax: +1-403 951 8634  
E-mail: tim.goos@ec.gc.ca

Mr A.T. Frank Grooters  
Observations and Modelling Department  
Royal Netherlands Meteorological Institute  
P.O. Box 201  
3730 AE DE BILT  
Netherlands  
Telephone: +31-30 220 6691  
Telefax: +31-30 221 0407  
E-mail: frank.grooters@knmi.nl

Mr Jim Hanlon  
Vice President  
Seimac Limited  
271 Brownlow Avenue  
DARTMOUTH, Nova Scotia  
Canada B3B 1W6  
Telephone: +1-902 468 3007

Telefax: +1-902 468 3009  
E-mail: jhanlon@seimac.com

Ms Elizabeth Horton  
Naval Oceanographic Office, 010  
(NAVOCEANO)  
Stennis Space Center, MS 39529  
USA  
Telephone: +1-228 688 5725  
Telefax: +1-228 688 5514  
E-mail: hortone@navo.navy.mil

Dr Edward Johnson  
Engineering Manager  
SAIC (TSC/NDBC)  
Stennis Space Center, MS 39529  
USA  
Telephone: +1-228 688 1733  
Telefax: +1-228 688 3489  
E-mail: j.edward.johnson@saic.com

Mr Michael Johnson  
NOAA Office of Global Programs  
1100 Wayne Avenue, Suite 1210  
SILVER SPRING, MD 20910  
USA  
Telephone: +1-301 427 2089 ext. 62  
Telefax: +1-301 427 2073  
E-mail: johnson@ogp.noaa.gov

Mr D. Wynn Jones  
Chairman, EGOS  
The Met. Office  
Beaufort Park, Easthampstead  
WOKINGHAM, Berkshire, RG40 3DN  
United Kingdom  
Telephone: +44-1344 855 603  
Telefax: +44-1344 855 897  
E-mail: dwjones@meto.gov.uk

Mr Owen Lange  
Meteorologist, Pacific Weather Centre  
Meteorological Service of Canada  
Pacific and Yukon Region  
200 - 1200 West 73<sup>rd</sup> Avenue  
Vancouver, BC V6P 6H9  
CANADA  
Telephone: +1-604 664 9385  
Telefax: +1-604 664 9004  
E-mail: ford.doherty@ec.gc.ca

Mr Ben Lemon  
Technical Services  
Port Met. Officer for NWT  
Meteorological Service of Canada  
Michael J. Greenwood Centre  
9345 - 49 Street  
Edmonton, AB T6B 2L8  
CANADA  
Telephone: +1-780 495 6442  
Telefax: +1-780 495 7739  
E-mail: ben.lemon@ec.gc.ca

Mr Jim Mattock  
Senior Electronics Engineer  
Axys  
2045 Mills Road  
P.O. Box 2219  
SIDNEY, BC  
Canada  
Telephone: +1-250 655 5850  
Telefax: +1-250 655 5810  
E-mail: jmattock@axys.com

Mr. Pat McLain  
NOAA/PMEL  
TAO - Project Engineer  
Bldg 3  
7600 Sandpoint Way NE  
Seattle, WA 98115  
USA

Mr Ron McLaren  
Head, Marine Services  
Meteorological Service of Canada  
Pacific and Yukon Region  
Environment Canada  
Suite 700-1200 West 73rd Avenue  
VANCOUVER, B.C., V6P 6H9  
CANADA  
Telephone: +1-604 664 9188  
Telefax: +1-604 664 9195  
E-mail: Ron.McLaren@ec.gc.ca

Mr Eric A. Meindl  
Vice-chairman, DBCP  
Chief, Operations Branch  
National Data Buoy Center (W/OPS52)  
(NDBC/NWS/NOAA)  
Stennis Space Center, MS 39529  
USA  
Telephone: +1-228 688 1717  
Telefax: +1-228 688 2869  
E-mail: Eric.Meindl@noaa.gov

Mr David Meldrum  
Vice-chairman, DBCP  
Programme Leader, Technology  
Development  
Dunstaffnage Marine Laboratory  
Dunbeg  
OBAN PA37 1QA  
Scotland  
United Kingdom  
Telephone: +44-1631 559 273  
Telefax: +44-1631 565 518  
E-mail: dtm@dml.ac.uk

Dr Sergey Motyzhev  
Marine Hydrophysical Institute NASU  
2, Kapitanskaya Street  
SEVASTOPOL 99000  
Ukraine  
Telephone: 380-692 540450  
Telefax: +380-692 540450  
E-mail: marlin@stel.sebastopol.ua

Prof. Peter Niiler  
Scripps Institution of Oceanography  
La Jolla, CA 92093-0213  
USA  
Telephone: +1-858 534 4100  
Telefax: +1-858 534 7931  
E-mail: pniiler@ucsd.edu

Mr Brian O'Donnell  
Regional Director  
Meteorological Service of Canada  
Pacific and Yukon Region  
Environment Canada  
Suite 200, 1200 West 73rd Avenue  
Vancouver, BC V6P 6H9  
CANADA  
Telephone: +1-604 664 9090  
Telefax: +1-604 664 9004  
E-mail: Brian.O'Donnell@ec.gc.ca

Mr Christian Ortega  
CLS/Argos  
8-10 rue Hermes  
Parc Technologique du Canal  
31526 Ramonville St. Agne  
Telephone: +1-33 561 39 47 29  
Telefax: +1-33 561 39 47 97  
E-mail: christian.ortega@cls.fr

Mr. Derek J. Painting  
Chairman, Argos JTA  
5 The Sycamores  
Darby Green  
Blackwater  
Camberley, UK GU17 0EE  
Telephone: +44 1252 876804  
Telefax: +44 1252 654612  
Email: djpainting@compuserse.com

Ms Mayra C. Pazos  
Drifter Data Assembly Center (DAC)  
Physical Oceanography Division  
Atlantic Oceanographic and  
Meteorological  
Laboratories (AOML/OAR/NOAA)  
4301 Rickenbacker Causeway  
MIAMI, FL 33149-1026  
USA  
Telephone: +1-305 361 4422  
Telefax: +1-305 361 4412  
E-mail: pazos@aoml.noaa.gov

Mr Ronald G. Perkin  
Institute of Ocean Sciences  
9860 West Saanich Road  
Sidney, BC V8L 4B2  
CANADA  
Telephone: +1-250 363 6584  
Telefax: +1-250 363 6746  
E-mail: perkinr@pac.dfo-mpo.gc.ca

Mr Bernie Petolas  
METOCEAN Data Systems Ltd.  
21 Thornhill Dr.  
Dartmouth, NS B2W 4A5  
CANADA  
Telephone: +1-902 468 2505  
Telefax: +1-902 468 4442  
E-mail: bpetolas@metocean.ns.ca

Mr Reo Phillips  
Product Development Manager Axys  
2045 Mills Road  
P.O. Box 2219  
Sidney, BC  
CANADA  
Telephone: +1-250 655 5865  
Telefax: +1-250 655 5810  
E-mail: rphillips@axys.com

Dr Stephen R. Piotrowicz  
Office of Oceanic and Atmospheric  
Research (OAR)  
SSMC-3, Rm 11554  
1315 East-West Highway  
Silver Spring, Maryland 20910  
USA  
Telephone: +1-301 713 2465 ext. 124  
Telefax: +1-301 713 0158  
E-mail: Steve.Piotrowicz@noaa.gov

Mr K. Prem Kumar  
Programme Director  
National Data Buoy Programme  
National Institute of Ocean Technology  
(Dept. Of Ocean Development,  
Govt. of India)  
Pallikaranai, Chennai  
India, P.C. 601302  
Telephone: +1-91 44 2460678  
Telefax: +1-91 44 2460661  
E-mail: prem@niot.ernet.in

Mr Timo Ranta-aho  
Product Manager  
Vaisala Oyj  
P.O. Box 26  
FIN-00421 HELSINKI  
Finland  
Telephone: +358-9 894 9490  
Telefax: +358-9 894 9485  
E-mail: timo.ranta-aho@vaisala.com

Mr Ignatius Rigor  
Coordinator of the IABP  
Polar Science Center  
Applied Physics Laboratory  
Univ. of Washington  
1013 NE 40<sup>th</sup>  
Seattle, WA 98105  
USA  
Telephone: +1-206 685 2571  
Telefax: +1-206 616 3142  
E-mail: ignatius@apl.washington.edu

Mr Jean Rolland  
Météo-France  
13 rue du Chatellier  
29273 BREST CEDEX  
France  
Telephone: +33-2 98 22 18 53  
Telefax: +33-2 98 22 18 49  
E-mail: jean.rolland@meteo.fr

Mr Steve Santoro  
Sales Manager  
Vaisala Inc.  
100 Commerce Way  
WOBURN, MA 01801  
USA  
Telephone: +1-888 824 7252 ext. 279  
Telefax: +1-781 933 8029  
E-mail: [steve.santoro@vaisala.com](mailto:steve.santoro@vaisala.com)

Mr Simon Skey  
Vice President  
Axys Consulting, Ltd.  
P.O. Box 2219  
2045 Mills Road  
SIDNEY, B.C. V8L 3S8  
Canada  
Telephone: +1-250 655 5866  
Telefax: +1-250 655 5810  
E-mail: [sskey@axys.com](mailto:sskey@axys.com)

Mr Dario Stucchi  
Institute of Ocean Sciences  
9860 West Saanich Rd.  
P.O. Box 6000  
Sidney, BC V8L 4BL  
CANADA  
Telephone +1-250 363 6588  
Telefax: +1-250 363 6746  
E-mail: [stucchi@pac.dfo-mpo.gc.ca](mailto:stucchi@pac.dfo-mpo.gc.ca)

Mr Val Swail  
Climate Research Branch  
Meteorological Service of Canada  
4905 Dufferin St.  
Downsview, ON MCH 5T4  
CANADA  
Telephone: +1-416 739 4347  
Telefax: +1-416 739 5700  
E-mail: [val.swail@ec.gc.ca](mailto:val.swail@ec.gc.ca)

Mr. Andy Sybrandy, President  
Pacific Gyre Inc.  
7460 Capstan Drive  
Carlsbad, CA 92009  
USA  
Telephone: +1-760 918 9798  
Telefax: +1-760 476 9170  
[www.pacificgyre.com](http://www.pacificgyre.com)  
E-mail: [asybrandy@pacificgyre.com](mailto:asybrandy@pacificgyre.com)

Mr Michel Taillade  
CLS General Manager  
8-10 rue Hermes  
31526 Ramonville Cedex  
FRANCE  
Telephone: +1-33 5 61 39 47 02  
Telefax: +1-33 5 61 75 10 14  
E-mail: [mtaillade@CLS.FR](mailto:mtaillade@CLS.FR)

Dr Sidney W. Thurston  
NOAA Office of Global Programs  
Level 14, Hibiya Central Building  
1-2-9 Nishi-Shinbashi Minato-ku  
Tokyo  
JAPAN 105-0003  
Telephone: +81 3 5532 7249  
Telefax: +81 3 5532 7373  
E-mail: [thurston@ogp.noaa.gov](mailto:thurston@ogp.noaa.gov)

Mr Yves Tréglos  
Intergovernmental Oceanographic  
Commission  
1, rue Miollis  
75732 PARIS Cédex 15  
France  
Telephone: +33-1 45 68 39 76  
Telefax: +33-1 45 68 58 12  
E-mail: [y.treglos@unesco.org](mailto:y.treglos@unesco.org)

Mr Tetsuya Uwai  
Oceanographical Division  
Climate and Marine Department  
Japan Meteorological Agency  
1-3-4, Otemachi, Chiyoda-ku  
TOKYO 100-8122  
Japan  
Telefax: +81-3 3211 3047  
E-mail: [uwai@met.kishou.go.jp](mailto:uwai@met.kishou.go.jp)  
E-mail: [buoyunit@hg.kishou.yo.jp](mailto:buoyunit@hg.kishou.yo.jp)

Dr Tom Vandall  
Director of Sales and Marketing  
Axys  
2045 Mills Road  
P.O. Box 2219  
SIDNEY, BC  
Canada  
Telephone: +1-250 655 8868  
Telefax: +1-250 655 5810  
E-mail: [tvandall@axys.com](mailto:tvandall@axys.com)



Mr Louis Vermaak  
Technical Coordinator, ISABP  
South African Weather Bureau  
Private Bag X97  
PRETORIA 0001  
South Africa  
Telephone: +27-12 309 3834  
Telefax: +27-12 309 3020  
E-mail: vermaak@weathersa.co.za

Mr Al Wallace  
Manager, Meteorological Operations  
Meteorological Service of Canada  
Pacific and Yukon Region  
200 - 1200 West 73<sup>rd</sup> Avenue  
Vancouver, BC V6P 6H9  
CANADA  
Telephone: +1-604 664 9333  
Telefax: +1-604 664 9004  
E-mail: al.wallace@ec.gc.ca

Mr David Watson  
Manager, Atmospheric Monitoring  
Meteorological Service of Canada  
Pacific and Yukon Region  
700 - 1200 West 73<sup>rd</sup> Avenue  
Vancouver, BC V6P 6H9  
CANADA  
Telephone: +1-604 664 9187  
Telefax: +1-604 664 9195  
E-mail: dave.watson@ec.gc.ca

Mr Gary Williams  
Clearwater Instrumentation Inc.  
304 Pleasant Street  
Watertown, MA 02472  
USA  
Telephone: +1-617 924 2708  
Telefax: +1-617 924 2724  
E-mail: wgwill@clearsat.net

Mr Jeffrey L. Wingenroth  
General Manager  
Technocean, Inc.  
820 NE 24th Lane, Unit 112  
CAPE CORAL, FL 33909  
USA  
Telephone: +1-941 772 9067  
Telefax: +1-941 574 5613  
E-mail: jw@technocean.com

Mr Andrew L. Wood  
President  
AXYS Technologies Inc.  
Post Office Box 2219  
SIDNEY, B.C.  
Canada V8L 3S8  
Telephone +1-250 655 5850  
Telefax: +1-250 655 5810  
E-mail: awood@axys.com

Mr William E. Woodward  
Service Argos Inc.  
1801 McCormick Drive, Suite 10  
LARGO, MD 20774  
USA  
Telephone: +1-301 925 4411  
Telefax: +1-301 925 8995  
E-mail: woodward@argosinc.com