



Report of the  
**Indian Ocean Argo  
Implementation**  
Planning Meeting  
Hyderabad, India  
July 26–27, 2001

**Sponsored by**

Department of Ocean Development (DOD), India  
National Oceanic and Atmospheric Administration (NOAA), USA  
World Meteorological Organization (WMO)  
Intergovernmental Oceanographic Commission (IOC)  
and International Argo Science Team (IAST)

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National Oceanic and Atmospheric Administration (NOAA), USA  
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## Introduction

An Implementation Planning Meeting for Argo in the Indian Ocean was held in Hyderabad, India on July 26 and 27, 2001. Conceived just three and a half years ago, Argo – an international effort to provide real-time observations of the upper-ocean temperature and salinity field – has made significant progress toward its goal of deploying 3,000 profiling floats to cover the global ocean by the year 2005.

Argo is very timely, given existing and planned satellite coverage of the sea surface, a communications capability to collect observations in real time, and the computer power to assimilate the resulting data to produce improved analyses and forecasts. What is required is a routine capability to collect real-time subsurface observations of the ocean – over the long term – to complement satellite observations, so that the job of assimilation may begin in earnest. Argo is planned to meet that requirement, and as such is a first step toward the implementation of an operational observing system for the global ocean.

With financial support from thirteen countries and the European Commission, funding for Argo floats has grown from 55 floats in 1999 and 255 in 2000, to 535 in the present year; 703 are proposed for 2002. If a rate of funding ~825 floats per year can be sustained, global coverage at full Argo density could be achieved by the end of the year 2005.

The sponsors have recognized Argo as an important pilot “operational” Ocean Observing System, capable of serving both the research planned by the Climate Variability and Predictability Program (CLIVAR) and the operational demonstrations as part of the Global Ocean Data Assimilation Experiment (GODAE). Led by the International Argo Science Team (IAST), Argo will be coordinated internationally through the Joint Technical Commission on Oceanography and Marine Meteorology (JCOMM) recently established by the WMO and IOC.

## Organization of the Hyderabad Meeting

The Department of Ocean Development (DOD), Government of India and the United States National Oceanic and Atmospheric Administration (NOAA) - together with the World Meteorological Organization (WMO), Intergovernmental Oceanographic Commission (IOC), and IAST - sponsored the Hyderabad meeting. This provided an opportunity to initiate formal planning for coverage of the Indian Ocean by Argo floats.

Participants in the meeting included representatives from

- 17 countries viz. Australia, Canada, France, India, Iran, Japan, Kenya, Madagascar, Malaysia, Mauritius, Mozambique, Pakistan, Seychelles, South Africa, Tanzania, United Kingdom, United States;
- Four Regional organizations viz. the African Center of Meteorological Applications Development in Niamey (Niger), the Association of South East Asian Nations (ASEAN) Regional Meteorological Center in Singapore, and Drought Monitoring Centers in Harare (Zimbabwe) and Nairobi (Kenya); and
- WMO/IOC/JCOMM Operational Support Office in Toulouse (France).

The list of participants is given as Annex-1. The Program of the Meeting is given in Annex-2.



## Results of the Meeting

### What was discussed?

There was an overall recognition of the importance of Argo and an acceptance of its potential for improving long-range forecasts. Various countries presented plans and needs for Argo data to address applications in addition to seasonal forecasting, such as fisheries applications and local coastal processes. Although capacity building is not necessarily available at the present time, it will be required for the analysis and utilization of Argo data.

Countries were ready to help, and offers were made to the Argo program to assist in various ways. The existence of several regional user bodies was brought to the attention of the group, and this presented an opportunity to Argo to create an awareness of the program through the utilization of Argo data.

### What was agreed on?

Argo is useful step moving in the direction of operational oceanography. Participants were in agreement that the Argo data policy will be 'full and open,' making data accessible to all and with no period of exclusive use in real-time and delayed mode.

Although Argo is a collection of individual national contributions, a uniform international approach to the data system is needed – such as quality control on a basin scale, formats, protocols, etc. In order to contribute to the ongoing effort directed toward meeting this need, participants were invited to participate in the meeting of the Argo Data Management Group in Ottawa, September 17 and 18, 2001 (a meeting which was postponed and subsequently held in Brest, France on November 12-14, 2001). The participants highlighted the following technical issues related to the Argo floats and sensors that need to be addressed by IAST.

- a) A need for further inter-comparison studies among floats of different manufacture.

- b) A need for further study of sensor stability characteristics in tropical water under different bio fouling conditions.
- c) A need to determine whether the present sensors meet the accuracy targets of 0.01 deg. centigrade and 0.01 psu. Scientists will continue their efforts to develop models to utilize data of this accuracy for the ocean circulation and air sea interaction studies.
- d) Further study of the issue of whether all floats should dive to 2000 m on all cycles.

It was agreed that any unanswered questions could be referred to the International Argo Science Team.

There was much discussion on the fate of floats that drift into a nation's EEZ. A reading of IOC Resolution XX-6 clarified that concerned coastal states would be informed in advance of all deployments of profiling floats which might drift into waters under national jurisdiction, indicating the exact locations of such deployments. Both India and Pakistan stated that they would like to be informed whenever a float was to drift into their EEZ. The Argo Information Centre informed the group that, in addition to notification per the IOC Resolution, it was also creating an informative web site that would enable all nations to track floats and access their data via the Internet.

Real-time data will be subjected to automated quality control (QC) and made available via the Global Telecommunications System within 24 hours. Delayed-mode data will be subjected to scientific QC and made available via the Internet within three months of collection.

Working through regional bodies appears to be an efficient mechanism to reach individual governments, and participants agreed to take advantage of them wherever possible and appropriate. Countries can participate in Argo in a variety of ways. In addition to providing floats, ways to contribute include helping to deploy floats, providing complementary observing systems, and utilizing their resulting data.



The meeting included a discussion of anticipated deployments in the Indian Ocean through 2002 by seven float-providing countries. At the present rate of progress, the area of Indian Ocean north of 20° South will be covered by the end of 2004. Because there are sufficient floats proposed for a global array by the end of 2005, coverage of the southern Subtropics and Southern Ocean will be realized once priority regional arrays elsewhere have been established. The deployment in any given latitudinal band should ensure coverage of important zonal features in the ocean.

Actual and Planned Deployments for the Indian Ocean

	Equatorial Tropics (N of 20°S)	Southern Subtropics (20°S-40°S)	Southern Ocean (>40° S)	Total
Australia	15	14		29
Canada	1			1
France <sup>1</sup>				
Germany <sup>2</sup>				
India <sup>3</sup>	31			31
Japan <sup>4</sup>	13			13
UK	10	30		40
USA	30			30
Total plan (2000 – 02)	100	44		144
Target (By 2005)	160	200	250	610

[Note 1: - France proposes 40, but with earliest deployment in 2003; latitude TBD

Note 2: - Germany proposes 20, but with earliest deployment in 2003, latitude TBD

Note 3: - India proposes 50 - 60 per year beginning in 2003 for Equatorial Tropics

Note 4: - Japan proposes 15 - 25 per year beginning in 2003 along 20°S]

The target number of 160 floats covering the tropics can be reached in 2004, assuming some significant fraction of the proposed plans for 2003 are realized.

Participants agreed that India could act as a Regional Coordinator for the Indian Ocean to ensure that float-providing nations are able to plan efficient deployments and that India can serve as a Regional Data Centre for the Indian Ocean region.

What are the future issues?

The meeting concluded with a series of broad questions that extend well beyond the purview of the immediate Argo Program. These included:

- Where is the Argo program leading?
- What is the most effective way of utilizing the data?
- What capacity needs to be built in order to use the data?
- How is the global array maintained on a sustainable basis?

One approach to addressing the third question would be to consider establishing distributed data assimilation and product centers, and existing organizational mechanisms could be used to develop such a capability.

At the conclusion of the meeting, participants agreed that operational oceanography is becoming a reality and Argo program would make significant contributions in the area of weather and climate prediction, as well as the associated applications to fisheries and food security.

## Conclusion



## Participants

	Australia	Dr. Gary Meyers Dr. Graham Jones	Commonwealth Scientific & Industrial Research Organisation Chairman International Buoy Programme for the Indian Ocean, Australian Bureau of Meteorology
	Canada	Dr. Howard Freeland	Institute of Ocean Sciences
	France	Dr. Yves Desaubies Dr. Sylvie Pouliquen	Institut français de recherche pour l'exploitation de la mer Institut français de recherche pour l'exploitation de la mer
	India	Dr. Harsh K Gupta Dr. R. R. Kelkar Dr. K. Radhakrishnan Prof. M. Ravindran Dr. Ehrlich Desa Prof. J. Srinivasan Prof. Sulochana Gadgil Dr. Vinay Chandran Dr. S.V. Singh Mr. S. R. Kalsi Dr. Sathish Shetye Mr. L. V. G. Rao Dr. T. Pankajakshan Prof. S. K. Dube Prof. U. C. Mohanty Prof. B. L. Deekshatulu  Dr. V. Jayaraman Dr. M. S. Narayanan Dr. Abhijit Sarkar Dr. Y. V. N. Krishnamurthy Dr. P. S. Salvekar Cmde. K. K. Rohatgi Dr. Gangan Prathap Dr. Sanjeev Rao Dr. K. J. Ramesh Dr. K. Soma Sundar Mr. Jung Bahadur Mr. P. G. Dastidar Mr. Hiranand Purkait Dr. S. A. S. Naqvi Mr. K. Prem Kumar Dr. M. Ravichandran	Department of Ocean Development India Meteorology Department Indian National Centre for Ocean Information Services National Institute of Ocean Technology National Institute of Oceanography Indian Institute of Science Indian Institute of Science Indian Institute of Science National Center for Medium Weather Forecasting Indian Meteorology Department National Institute of Oceanography National Institute of Oceanography National Institute of Oceanography Indian Institute of Technology, Delhi Indian Institute of Technology, Delhi Centre for Space Science and Technology Education in Asia and the Pacific Indian Space Research Organisation, Head Quarters Space Applications Center, Indian Space Research Organisation Space Applications Center, Indian Space Research Organisation Regional Remote Sensing Service Centre, Indian Space Research Organisation Indian Institute of Tropical Meteorology Directorate of Naval Oceanography and Meteorology Centre for Mathematical Modelling and Computer Simulation Department of Science & Technology Disaster Management Unit, Planning Department, AP Secretariat Indian National Centre for Ocean Information Services, Department of Ocean Development Indian National Centre for Ocean Information Services, Department of Ocean Development Indian National Centre for Ocean Information Services, Department of Ocean Development Department of Ocean Development Department of Ocean Development National Institute of Ocean Technology Indian National Centre for Ocean Information Services

	Iran	Dr. Nasser Hadjizadeh Zaker	Iranian National Center for Oceanography
	Japan	Mr Yoshihiro Matsumoto Dr. Kensuke Takeuchi	Ministry of Education, Culture, Sports, Science and Technology Frontier Observational Research System for Global Change
	Kenya	Dr. David Kirugara	Kenya Marine & Fisheries Research Institute
	Madagascar	Dr. Man Wai Rabenevanana	Institute Halieutique et des Sciences Marines
	Malaysia	Dr. Fredolin T. Tangang	National University of Malaysia
	Mauritius	Mr. Mamad Beebeejan	Meteorological Services Ltd
	Mozambique	Mr. David Chemane	Instituto Nacional de Hidrografia e Navegacao
	Pakistan	Dr. Shaid Amjad	National Institute of Oceanography
	Seychelles	Mr. Rondolph Payet	Seychelles Fishing Authority
	South Africa	Dr. Mark Jury	University of Zululand
	Tanzania	Dr. Alfred N. N. Muzuka	Institute of Marine Sciences
	U K	Mr. Jon Turton	UK Argo Project Manager, The Met Office
	USA	Dr. Stan Wilson Dr. Dean Roemmich Dr. Steve Piotrowicz Mr. Rene Eppi Mr. Elizabeth Horton	National Oceanic and Atmospheric Administration Scripps Institution of Oceanography NOAA NOAA Naval Oceanographic Office

## Representatives of Regional Organisations

Mr. Mohammed Sadeck Boulahya	Directeur General de l'ACMAD, Niger
Dr. Chew Kian Hoe	ASEAN Specialized Meteorological Center , Singapore
Mr. Bradwell J. Garanganga	Drought Monitoring Centre Harare, Zimbabwe
Mr. Etienne Charpentier	JCOMMOPS, AIC, France
Mr. Mathieu Belbeoch	JCOMMOPS, AIC, France
Prof. L. A Ogallo	Drought Monitoring Centre Nairobi

**INAUGURAL SESSION**

Welcome	Dr. K. Radhakrishnan
Introductory Remarks	Dr. R. R. Kelkar
Inaugural Address	Dr. Harsh K. Gupta
Key Note Address {Introduction to Argo}	Prof. Dean Roemmich
Meeting Objectives and Vote of Thanks	Dr. Stan Wilson
Inauguration of Exhibition – An Argo Float and On-Line Access to Argo Data	

**Technical Session 1: The Need for Improved Long-range Forecasting and Prospective Contributions of Real-time Upper-Ocean Observations**

<b>CHAIR: DR. R. R. KELKAR</b>	<b>RAPPORTEUR: MR. ETIENNE CHARPENTIER</b>
What is Known About The Indian Ocean?	Dr. Satish Shettye
Needs & Prospects for the Indian Subcontinent	Prof. Sulochana Gadgil
Needs & Prospects for South East Asia	Dr. Chew Kian Hoe
Needs and Prospects for Africa	Prof. Laban Ogallo
Needs & Prospects for Australia and Summary Recommendations from SOCIO Meeting	Dr. Gary Meyers

**Technical Session 2: National Plans for the Deployment of Argo Floats in the Indian Ocean**

<b>CHAIR: PROF. DEAN ROEMMICH</b>	<b>RAPPORTEUR: DR. P. VINAYCHANDRAN</b>
Australia	Dr. Gary Meyers
Canada	Dr. Howard Freeland
France	Dr. Yves Desaubies
India	Dr. K. Radhakrishnan
Japan	Dr. Kensuke Takeuchi
UK	Mr. Jon Turton
USA	Prof. Dean Roemmich

**Technical Session 3: Argo Float Technology, Data Management, and Deployment Options**

<b>CHAIR: DR. HOWARD FREELAND, IOS, CANADA</b>	<b>RAPPORTEUR: DR. T. PANKAJAKSHAN</b>
Float Systems, Sensors & Calibration, Experimental Design Trade-Offs, and Technical Challenges — Round Table	Dr. Howard Freeland with Dr. Yves Desaubies, Prof. Dean Roemmich, Dr. Kensuke Takeuchi and Mr. Jon Turton
Float/Sensor Production — Prospects in India	Prof. M. Ravindran
Argo Information Centre (Service Argos Data Collection & Positioning System, Data Access Communications & Notification)	Mr. Etienne Charpentier & Mathieu Belbéoch
Data Management (Quality Control, Products, Availability & Distribution)	Dr. Sylvie Pouliquen and Dr. Pankajakshan
DBCP/SOOP Regional Organisation & Potential Application to Argo Deployments	Mr. Graham Jones

**Technical Session 4: National Perspectives on Argo Implementation in the Region**

<b>CHAIR: DR. STAN WILSON</b>	<b>RAPPORTEUR: MR. K. PREMKUMAR</b>
Iran	Dr. Nasser Hadjizadeh Zaker
Kenya	Dr. David Kirugara
Madagascar	Dr. Man Wai Rabenevanana
Malaysia	Prof. Fredolin T. Tangang
Maldives	Mr. Abdullahi Majeed
Mauritius	Mr. Mamad Beebeejan
Mozambique	Mr. David Chemane
Niger	Mr. Mohammed Sadeck Boulahya
Pakistan	Dr. Shahid Amjad
Seychelles	Mr. Rondolph Payet
South Africa	Prof. Mark Jury
Tanzania	Dr. Alfred N. N. Muzuka
Zimbabwe	Mr. Bradwell J. Garanganga

**Concluding Session and Recommendations**

<b>CHAIR: DR. EHRLICH DESA</b>	<b>RAPPORTEURS: DR. STAN WILSON and DR. K. RADHAKRISHNAN</b>
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