

ANÁLISES/RELATÓRIOS

ANALYSES/REPORTS

USE OF SATELLITE TRACKED OCEANOGRAPHIC BUOYS IN BRAZIL

Merritt Stevenson & Milton Kampel

Satellite tracked drifting buoys have become an important field component in several international studies of ocean circulation and related marine climate programs over the past 19 years. The First GARP Global Experiment (FGGE) took place in 1978-1979 and utilized about 365 drifting buoys in the southern hemisphere oceans. About 10 years then passed, during which time the buoy technology underwent significant improvements that were used in smaller scale research activities. The first large program to use modern drifting buoys, or drifters as they are often called, occurred during the Surface Velocity Programme (SVP) of the World Ocean Circulation Experiment (WOCE), during the early to mid 1990's. In contrast, buoy development and use in Brazilian field studies began in the mid 1980's, within the national antarctic research program (PROANTAR). Brazilian participation in international programs began with SVP/WOCE and is continuing within CLIVAR, the follow-on program to WOCE. Because of its interest in Antarctica, Brazil is also a member of the International Program for Antarctic Buoys (IPAB) and more recently of the International South Atlantic Buoy Programme (ISABP). A new national buoy program (PNBÓIA) has been approved and acquisition and deployment of WOCE/TOGA type drifters should begin in 1997. In another large project, PETROBRAS, the national oil company, will be collaborating with INPE in the launch of similar drifters, also planned for 1997.

Key words: Oceanographic buoys; Oceanographic drifters; Telemetry; CLS Argos.

UTILIZAÇÃO DE BÓIAS OCEANOGRÁFICAS RASTREADAS POR SATÉLITE NO BRASIL - Bóias de deriva rastreadas por satélites tem se constituído em um importante componente de trabalhos de campo realizados durante diversos estudos internacionais da circulação oceânica e de programas climáticos oceânicos ocorridos nos últimos 19 anos. O experimento First GARP Global Experiment (FGGE), realizado em 1978-1979, utilizou cerca de 365 bóias de deriva nos oceanos do Hemisfério Sul. Passados 10 anos do FGGE, a tecnologia das bóias oceanográficas evoluiu significativamente, tendo sido empregada em atividades de pesquisa de menor escala. O primeiro grande programa a utilizar modernas bóias de deriva, ou derivadores como são normalmente denominados, foi o Surface Velocity Programme (SVP), do World Ocean Circulation Experiment (WOCE), ocorrido na primeira metade da década de 1990. Por outro lado, o desenvolvimento e aplicação de bóias oceanográficas, em estudos de campo no Brasil, foram iniciados em meados da década de 1980, no âmbito do Programa Antártico Brasileiro (PROANTAR). A participação brasileira em programas internacionais foi iniciada com o SVP/WOCE, tendo sua continuidade mantida no âmbito do CLIVAR, que vem a ser o sucessor do WOCE. Devido ao interesse nacional na Antártica, o Brasil é membro do International Program for Antarctic Buoys (IPAB), e mais recentemente, tornou-se membro do International South Atlantic Buoy Programme (ISABP). Um novo programa nacional de bóias (PNBÓIA) foi recentemente aprovado, e a aquisição e lançamento de derivadores padrão WOCE/TOGA deverá ser iniciada em 1997. Em outro grande projeto de colaboração entre o INPE e a PETROBRÁS, serão também lançados derivadores padrão WOCE/TOGA, ainda em 1997.

Palavras-chave: Bóias oceanográficas; Derivadores oceanográficos; Telemetria; CLS Argos.

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INTRODUCTION

Each year an increase is seen in the use of data collection platforms (DCPs) for the transmission of environmental data from anchored and drifting oceanographic buoys. The first big advance in the utilization of this technology occurred during the First GARP Global Experiment (FGGE) in 1978-1979. During a period of approximately 24 months, more than 365 drifting buoys were launched in the southern hemisphere oceans, a region known to be oceanographically undersampled (see Fig. 1). The data base obtained from the FGGE Program continues being utilized until today, in the development of scientific studies that seek to describe and understand the spatial and temporal variability of the surface oceanic circulation, and the distribution of kinetic energy in this vast region of the planet.

The second important pass occurred with the implementation of the World Ocean Circulation Experiment (WOCE), in the beginning of the 1990's. Within the ambit of the recently concluded WOCE, a significant effort was made to collect surface current data with global coverage, represented by the Surface Velocity Programme (SVP). The SVP had as one of its principal objectives, the installation

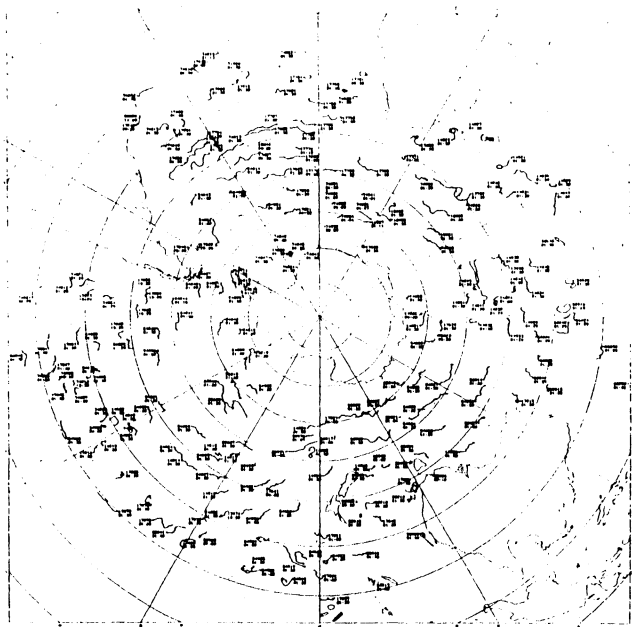


Figure 1 - Data obtained by the FGGE Program. (Source- Keeley & Taylor, 1981, p169).

Figura 1 - Dados obtidos pelo programa FGGE. (Fonte- Keeley & Taylor, 1981, p169).

of a network of drifters spaced at 500km intervals (in latitude and longitude), over the ocean. This sampling methodology was considered adequate to generate a consistent data base, necessary for the description of the horizontal circulation in the upper layer of the ocean. Figs. 2a, 2b and 2c provide an indication of the data density obtained from the SVP drifters. While some regions show a satisfactory data density, the South Atlantic still appears with sparse or nonexistent data. During the year 1995, SVP formally closed its activities. However, the participants of the program noted that the maintenance of this network of drifters is important, and should be continued for some more years within a Global Drifter Program (WOCE/SVP-8, 1996), in the ambit of the new Climate Variability (CLIVAR) Program. The actual geographic distribution of these drifters is shown in Fig. 3.

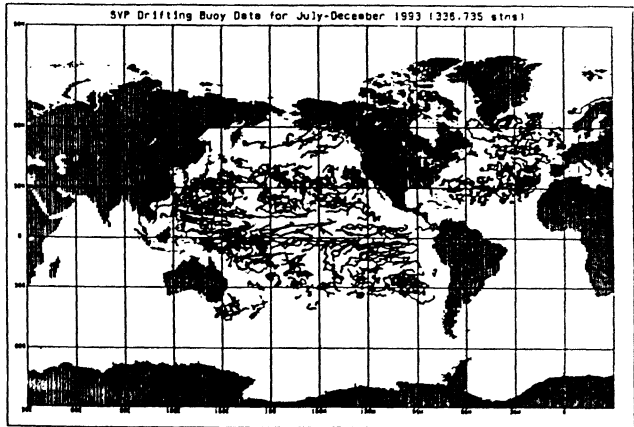


Figure 2a - Data from SVP/WOCE 1993. (Source- WOCE Data Handbook, 1995, Fig.5).

Figura 2a - Dados do SVP/WOCE 1993. (Fonte- WOCE Data Handbook, 1995, Fig.5).

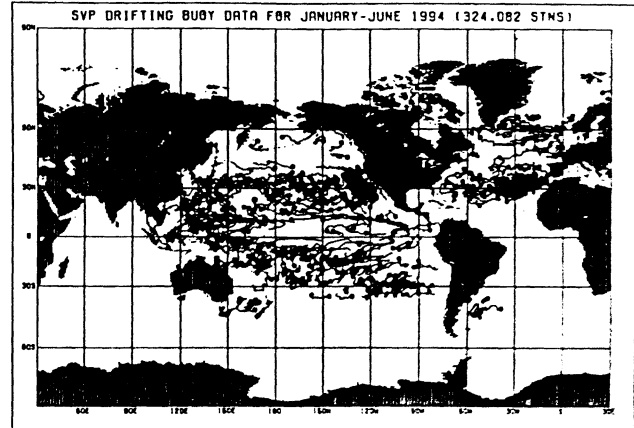


Figure 2b - Data from SVP/WOCE 1994. (Source- WOCE Data Handbook, 1995, Fig.6)

Figura 2b - Dados do SVP/WOCE 1994. (Fonte- WOCE Data Handbook, 1995, Fig.6).

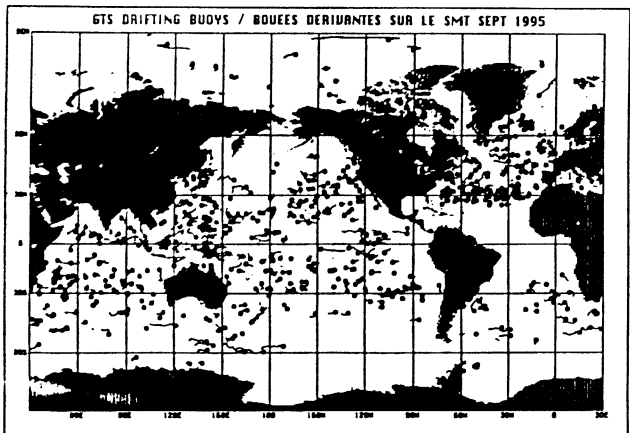


Figure 2c - Data from SVP/WOCE GTS, 1995. (Source- WOCE Data Handbook, 1995, Fig.7)

Figura 2c - Dados do SVP/WOCE no GTS, 1995. (Fonte- WOCE Data Handbook, 1995, Fig.7).

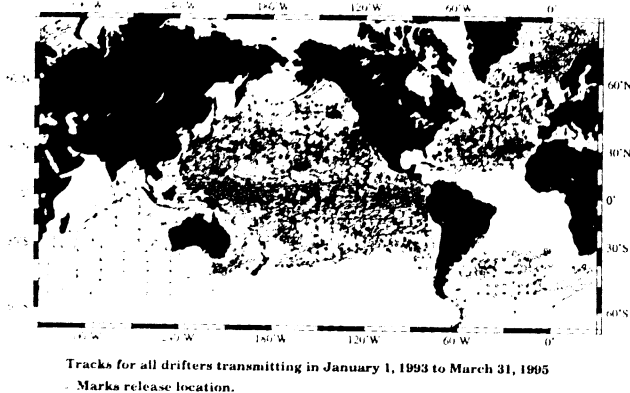


Figure 3 - Actual Distribution of SVP drifters. (Source- Niiler, 1995, p.4).

Figura 3 - Distribuição atual dos derivadores SVP. (Fonte- Niiler, 1995, p.4).

In parallel with these activities, other international programs restricted to more specific geographic areas began to be organized, such as the International Programme for Antarctic Buoys (IPAB), and the International South Atlantic Buoy Programme (ISABP).

As a country with maritime characteristics, Brazil should participate in these types of programs, principally when the geographic regions are of national interest. Within this context, the general objectives of Brazilian participation in satellite tracked drifter programs should emphasize surface layer oceanic circulation and the heat transported by this process. The temporal and spatial variations of kinetic energy which play an important role in studies of climatological change can also be inferred from these data sets. Further, the results of these physical

measurements can be applied to solving ongoing problems in our regional fisheries. In the next section, the participation of Brazil in two actual international programs will be discussed, as well as plans for participation in a new and important international program.

BRAZILIAN PARTICIPATION IN INTERNATIONAL BUOY PROGRAMS

Research in Antarctica

A Brazilian representative participated in the meeting for the creation of IPAB (International Programme for Antarctic Buoys), in Hobart Tasmania, between 05 and 07 April of 1993. At that meeting, national interest was shown in participating in the program, even though available resources would be limited. Since a national project already existed in the ambit of the Brazilian antarctic program (PROANTAR), it was agreed that our participation in IPAB should be represented by work developed in PROANTAR. In November of 1993, a drifting buoy was launched in antarctic waters, marking the Brazilian contribution to IPAB for that year. Even though new buoys or drifters had not been launched in antarctic waters during 1994-1995, the data obtained during these years from the buoy launched in 1993, and that continues transmitting to today (see Fig. 4), were considered as the Brazilian contribution during those years.

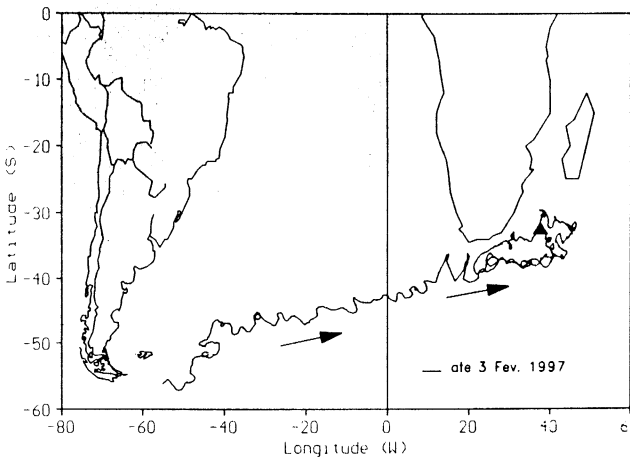


Figure 4 - Brazilian LCD used in PROANTAR & IPAB. (Source- adapted from Stevenson & Lorenzzetti, 1996, p.14).

Figura 4 - LCD's brasileiros utilizados no PROANTAR & IPAB. (Fonte- Adaptado de Stevenson & Lorenzzetti, 1996, p.14).

Within Project MEDICA, a drifter was launched in Antarctic waters on 19 November 1996, somewhat to the south of the drifter launched in 1993. This drifter represents the Brazilian contribution to IPAB for 1996.

After almost three years of preparations, the realization of a sea ice experiment in the Weddell or Bellingshausen Sea (the locale still to be confirmed) is being planned. The utilization of three sea ice buoys, designed and fabricated in the Oceanographic Instrumentation Laboratory (OIL) of the National Institute for Space Research (INPE), is planned. Each of these buoys will have the capacity to collect wind (speed and direction), air temperature, atmospheric pressure over the ice and water temperature at eight (8) levels below the sea ice (to 100m depth). The data collected by the buoys will be transmitted and acquired by means of system CLS Argos. A group from the Scott Polar Research Institute, University of Cambridge, United Kingdom should participate and will furnish 3 to 6 sea ice beacons (small buoys that transmit their geographic positions) transmitting via Argos. This "buoy garden" will need to be distributed in a region of the sea ice on the order of 100 km by 100 km.

Besides the utilization of the CLS Argos system in the conventional mode, our oceanography group at INPE is studying the possibility of using the GPS (Global Positioning System) together with Argos compatible DCP's installed in buoys and drifters. One of the principal advantages of this new methodology is that it becomes possible to obtain geographic locations with a significantly higher frequency than in the conventional mode, due to the employment of GPS. The GPS positioning and the environmental data are then transmitted together via Argos.

Research in the waters of the South Atlantic

At the end of the year 1992, Project COROAS (Oceanic Circulation for the Western Region of the South Atlantic) was implemented. This multi-institutional project was composed of six (6) subprojects, one of them being the completion of a series of experiments with drifters. Project COROAS represented a significant Brazilian contribution to WOCE and to SVP. A total of 15 drifters tracked by system Argos were launched during this project, 5 were launched in February of 1993, another 5 drifters were launched in July of the same year, and finally, the last group of 5 drifters were launched in January of 1994.

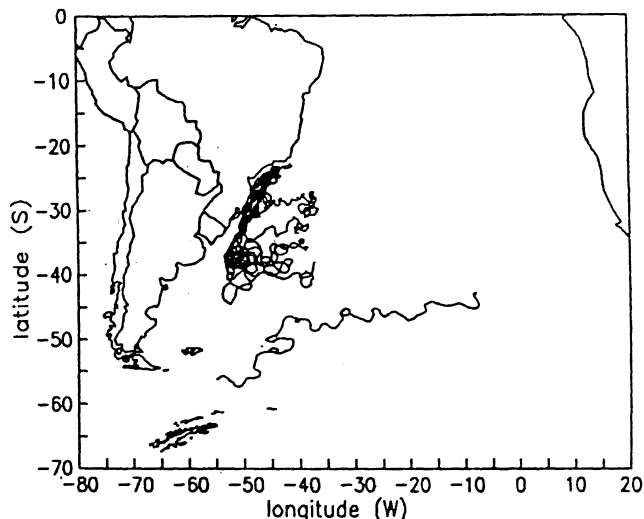


Figure 5 - LCD's from Project COROAS.

(Source: adapted from WOCE/TOGA SVP-7, 1994, p.4).

Figura 5 - LCD's do Projeto COROAS.

(Fonte- Adaptado de WOCE/TOGA SVP-7, 1994, p.4)

The geographic coverage obtained from these 15 drifters can be observed in Fig. 5. The major part of this set of drifters started to cease its transmissions of data in July of 1994. The last drifters from this same group stopped its transmission in April of 1996.

During the year of 1995, a large effort was made in Brazil for the creation of new projects and programs that would include the utilization of drifters and anchored buoys to furnish data collected in the marine environment with various finalities, among them weather and climate studies. Each one of these programs or projects will be briefly treated in turn.

National Program for Buoys (PNBÓIA) - is the largest and most sophisticated of the new programs. Basically, PNBÓIA is composed of two parts: one part is formed by a network of drifters, to be launched two each time, each month, during 12 consecutive months. It is hoped that these drifters tracked by system Argos will begin to cover a large region of the South Atlantic. A second part will be initially composed of a network of three ATLAS type anchored buoys.

Project INPE/PETROBRÁS - This project establishes a joint collaboration between INPE and PETROBRÁS, for an initial period of two (2) years. PETROBRÁS will furnish the resources for the fabrication of up 24 drifters, and the floating platforms for their launchings. INPE will be responsible for the acquisition and processing of the data transmitted via CLS Argos.

Program REVIZEE - This federal program deals with the evaluation of the sustainable potential of living resources in the exclusive economic zone (EEZ). The principal objectives of this program are the survey of the biomass and of the sustainable potential of living resources of the Brazilian EEZ, and the characterization of the principal biotic and abiotic factors that can contribute to the understanding of its dynamics. The launch of a small number of drifters along the south-southeast Brazilian coast is projected, this number can increase as a function of the new launches in other regions of the coast also included in the ambit of REVIZEE. These data will be of great importance not only for the physical oceanographers, but also for the other researchers involved in the program.

Project IEAPM- One of the interests of this research institute of the Navy (IEAPM) is to discover and understand the circulation in the surface layer of a specific area of the SE continental platform of Brazil. For this purpose a project was established that projects the launch of a small number of drifters during the years 1997 and 1998.

An estimative of the utilization of new drifters in the period between 1996 and 1998 is presented in the following Tab. 1.

PROJ/ PROGRAM	N° OF BUOYS	PARAMETERS	YEAR
PNBOIA	24	POSITION & SST	1997-1998
INPE/PETROBRAS	24	POSITION & SST	1997-1998
REVIZEE	6	POSITION & SST	1997
IEAPM	6	POSITION & SST	1997-1998
MEDICA	1	POSITION & SST	1996
MEDICA	3	POS & DATA MET/OC	1997
TOTAL	64		1996-1998

SST = Sea Surface Temperature

Table 1 - Launch of Drifting Buoys for 1996-1998
Tabela 1 - Lançamento de derivadores entre 1996-1998

CONCLUDING REMARKS

Brazilian participation in international projects and programs for satellite tracked drifting buoys is very important, not only because of the associated technical and scientific development associated with these activities, but also for the encouragement of projects and programs at the national level aimed at the solution of Brazilian problems.

ACKNOWLEDGMENTS

The authors wish to express their thanks to the national Program for Antarctic Research (PROANTAR) of the National Council for Scientific and Technological Research (CNPq) for their support to Project MEDICA (through contracts 481303/95-2 and 480721/96-3).

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Submetido em: 10/02/97

Revisado pelo(s) autor(es) em: 25/04/97

Aceito em: 15/05/97