

GOSUD Annual Report for 2007

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1.0 Introduction

The Global Ocean Surface Underway Data (GOSUD) Project is an Intergovernmental Oceanographic Commission (IOC) programme designed as an end to end system for data collected by ships at sea. The goal of the GOSUD Project is to develop and implement a data system for surface ocean data, to acquire and manage these data and to provide a mechanism to integrate these data with other types of data collected in the world oceans. For the purposes of this Project, the data concerned are those collected as a platform is underway and from the ocean surface down to about 15m depth. All information relative to the project is available from its web site (<http://www.gosud.org>) maintained at IFREMER.

This report briefly describes the project and progress to date.

2.0 Project Objectives

The objective of GOSUD is to organize the surface underway data that are collected presently and to work with data collectors to improve practices to meet the benchmarks of spatial and temporal sampling and data accuracy set forth by GOOS. Specifically, the project has the following goals.

- To build a comprehensive archive for surface underway ocean data. This encompasses data collected by any instrumentation at any time. It will contain sufficient metadata that users will have clear information about accuracy, instrumentation, sampling, etc.
- To add value to the archive by refining and standardizing existing quality assessment procedures carried out on real time and delayed mode data and documenting both what was done and the results.
- To provide data and information to users in a timely fashion. At any time after data collection, a user should be able to access the highest quality, and most recent data available. Users will be able to distinguish "levels" of quality in the archives. Users will be able to utilize the data and easily combine them with data from other sources.
- To work with data collectors to improve the data acquisition systems and to return information to data collectors about the data they provide.
- To work with scientific organizations interested in surface data to provide products to a broader community.

3.0 GOSUD Operations

3.1 Organization

GOSUD has prepared a project plan which is available from its web site maintained at IFREMER (<http://www.ifremer.fr/gosud/documentation.htm>). Additional information about the project can also be found there including documents about how to install and maintain a thermosalinograph, guidelines for handling such data, a brochure and a partial list of scientific publications that have used such data.

The Project has been organized as shown in figure 1.

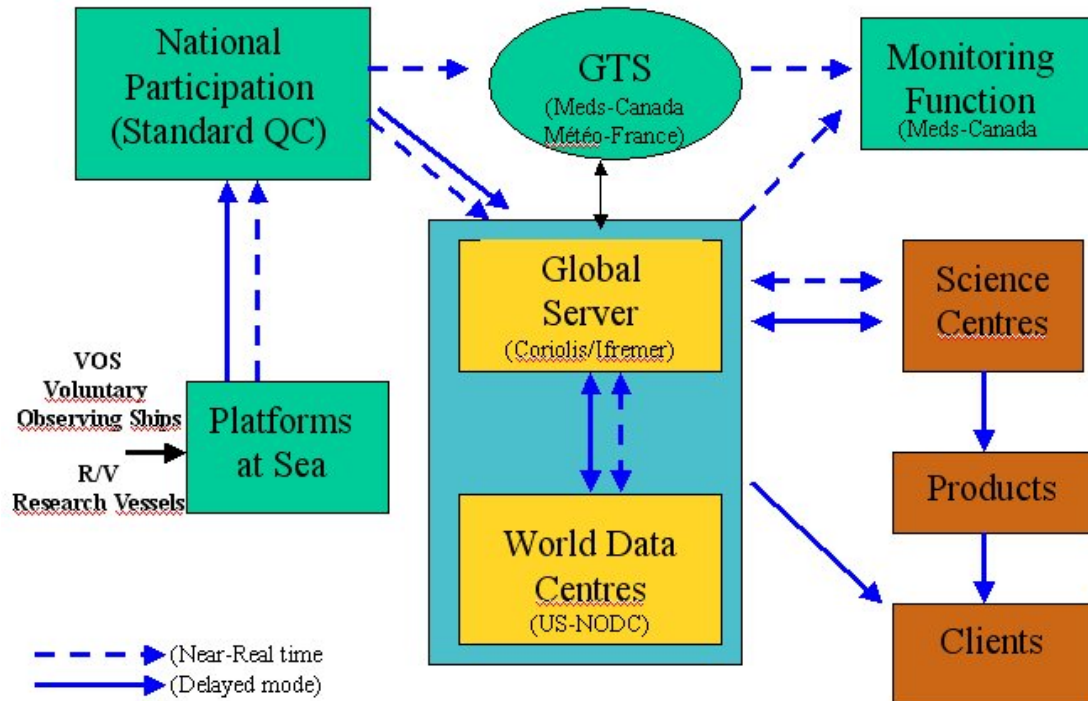


Figure 1: GOSUD Project Data Flow

Everything begins with the platforms at sea making routine, underway measurements. Participants are encouraged to send the data ashore as quickly as possible. It is the desire of the GOSUD Project that these data be available as soon after collection as possible (hours to days) although meeting this target may be difficult for certain kinds of data. The data received in each country will pass through quality control procedures standardized for the project and carried out by each participant or another acting on their behalf. These procedures are automated and sufficiently robust to remove the most serious errors in the data. After such procedures are completed, participants send the data immediately to a global data server set up for the Project. It is from this global server that GOSUD provides users with data. GOSUD participants are also encouraged to send the data to the GTS, either in the existing TRACKOB code form, or in BUFR since some potential users may still wish to use the GTS as a source of data. Since the beginning of the Project, priority has been given to near real time data circulation. During the reporting period, the Project also managed historical.

Initially the GOSUD Project did not intend to manage any data extracted from the GTS as a first priority. But, as the data extracted from the GTS remains a major source of data, it has been decided to integrate data which circulate on the GTS in the TRACKOB format. There is a monitoring function carried out to compare data appearing on the GTS to data received directly at the global server. This function occurs routinely, and identifies differences between the two data streams. Where data are found to appear on the GTS but not on the global server, the originators are contacted and encouraged to submit data directly to the global server. When data do appear on the GTS but cannot be made available directly to the global server, GOSUD takes steps to include these data in the archives. Where data appear on the global server but not the GTS, originators are encouraged to make the data available on the GTS so that traditional GTS users will have access to the data from this distribution system.

The global server is the central hub of the Project. Its purpose is to act as the archive for the data, and to interface to the World Data Centers, WDCs, that also hold historical underway data. The global server provides data and products to users, and works in collaboration with Project participants to monitor the state of the data system. The global server verifies the integrity of the data being provided, and reconciles data received earlier with the same data received at a later time and with more extensive quality assurance procedures having been employed.

The linkage between the global server and the WDCs is very important. The two parties share the long term archive responsibilities to ensure the ongoing safekeeping of the data. They also share the responsibilities of providing data and products from the start of the GOSUD Project and holdings from the historical past. Since the beginning of the reporting period, the US-NODC acts as a mirror site of the global server. A daily synchronization occurs between the global server and US-NODC.

It is very important for the global server to collaborate with one or more science centres in defining, developing and disseminating scientific products from the Project. It is through these collaborations and products that the Project will be known and some of its success measured.

3.2 Formats and Procedures

Documents that describe the data formats used for delayed mode data can be found at <http://www.ifremer.fr/gosud/documentation.htm>
For a description of the TRACKOB code form, go to http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Prog_Int/J-COMM/CODES/trackob_e.htm or <http://www.wmo.int/web/www/DPS/NewCodesTables/WMO306vol-I-1PartA.pdf> for the official WMO publication.

The same URL at IFREMER that discusses formats also describes the automated quality control tests recommended for underway temperature and salinity data.

4.0 Progress in 2007

4.1 Review of meetings

No meeting has been held during the reporting period.

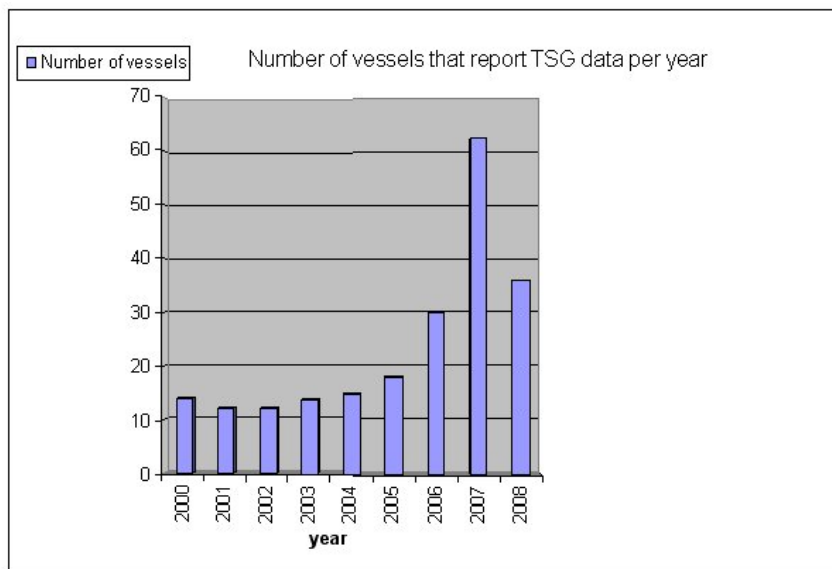
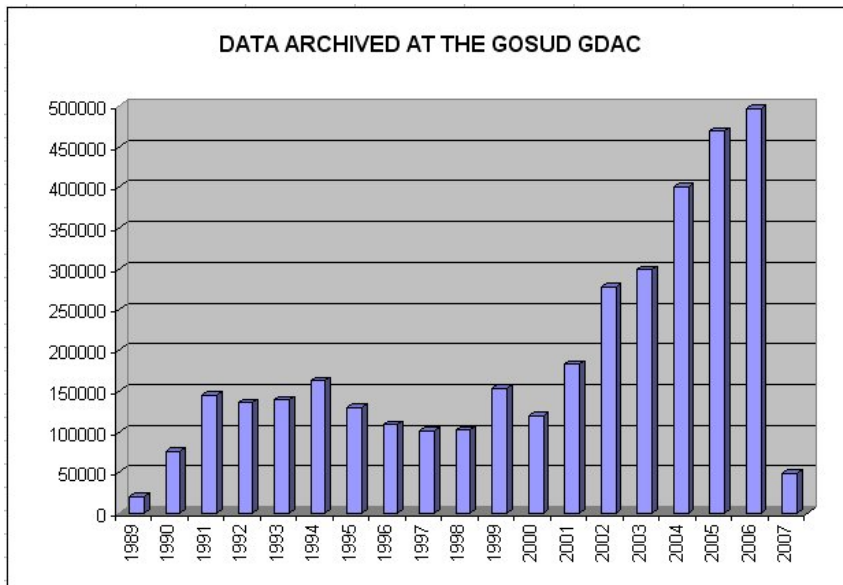
Previous meetings of GOSUD participants have been held in Brest, Ottawa, Monterey and Southampton. Reports of all meetings can be found through the link to documentation described above.

The fifth meeting was held in Boulder, USA, in May 2006. The meeting was held in conjunction with the SAMOS –Shipboard Automated Meteorological and Oceanographic System- project. The meeting was sponsored by the NOAA Office of Climate Observation. The SAMOS initiative is working to improve access to calibrated quality-controlled, surface marine meteorological data collected *in situ* by automated instrumentation mainly on US research vessels. As GOSUD focuses on the collection, quality evaluation and distribution of near surface ocean parameters (mainly salinity and sea surface temperature) from vessels, there is a potential collaboration between the 2 projects. The joint workshop focused on establishing links between SAMOS and GOSUD. The objectives are detailed on http://www.coaps.fsu.edu/RVSMDC/marine_workshop3/ And the final report is available on <http://www.ifremer.fr/gosud/documentation.htm>

A one day informal meeting during the SOT meeting was held in Geneva (April 2007).

- Data archive holdings are as follows.

Number of stations at:	GOSUD GDAC	MEDS
To end of 2002	1 852,439	610,000
In 2003	298,652	110,000
In 2004	400,428	275,000
In 2005	468,588	260,092
In 2006	496,849	20,053
In 2007	538,425	116,341



- In 2007, the GDAC has hosted data from 38 vessels (14 research vessels and 24 voluntary ships) See list of the vessels at the end of this document. The number of vessels that have reported data (directly or through the GTS) to the GDAC has doubled between 2006 and 2007.
- 17 vessels report their data directly to the GDAC and 21 vessels report their data on the GTS.
- During the reporting period, a daily synchronization process occurred between the GDAC hosted by IFREMER and the global repository center hosted by US-NODC. See <http://www.ifremer.fr/gosud/gdac.htm> to view where the GOSUD data are distributed. A data selection web interface is available at <http://www.coriolis.eu.org/cdc/GosudSelection/cdcGosudSelections.asp> By default, the data that have been collected during the previous month are displayed. The GDAC is also receiving data directly from some countries and these data form the content of the archives.
- MEDS has developed software which performs the comparison of data circulating on the GTS and submitted directly to the GDAC.
- The French organization IRD has taken a lead role in developing products. They have produced a number, so far mostly for the tropical oceans (see <http://www.legos.obs-mip.fr/observations/sss/>). They maintain a network of 13 vessels including one research vessel.
- American colleagues (AOML) have prepared an US dataset collected on the US research Vessels that is planned to be transferred to the global server early 2007
- The SeaKeepers Society maintains equipment mainly on yachts or cruise ships. Its is planned to strengthen the links between Seakeepers and GOSUD. See <http://www.seakeepers.org/> The Seakeepers data are inserted from 3 vessels on the GTS under ID KS060-KS064-KS067. Since, Ifremer has established a link to the GTS through Meteo-France, the Seakeepers TRACKOB data are retrieved and archived at the GDAC.
- Germany has implemented data transmission on one research vessels and plans to equip more vessels.
- The VOS Nippon project has contacted GOSUD to transmit their data. They want their call signs masked. GOSUD must decide how to implement those masked call signs according the SOT recommendations.
- Australia plan to provide data.
- A call to the IODE national representative to get data that resides in the NODCs has not produced any results. It will be done again at the next IODE meeting.
- Interest in GOSUD is still shown by the NASA Aquarius and by the ESA SMOS projects.

4.2 Data Received

MEDS continues to capture and store the real-time data circulating on the GTS in TRACKOB code form. It maintains a web site where all the TRACKOB data are displayed on monthly geographic maps.

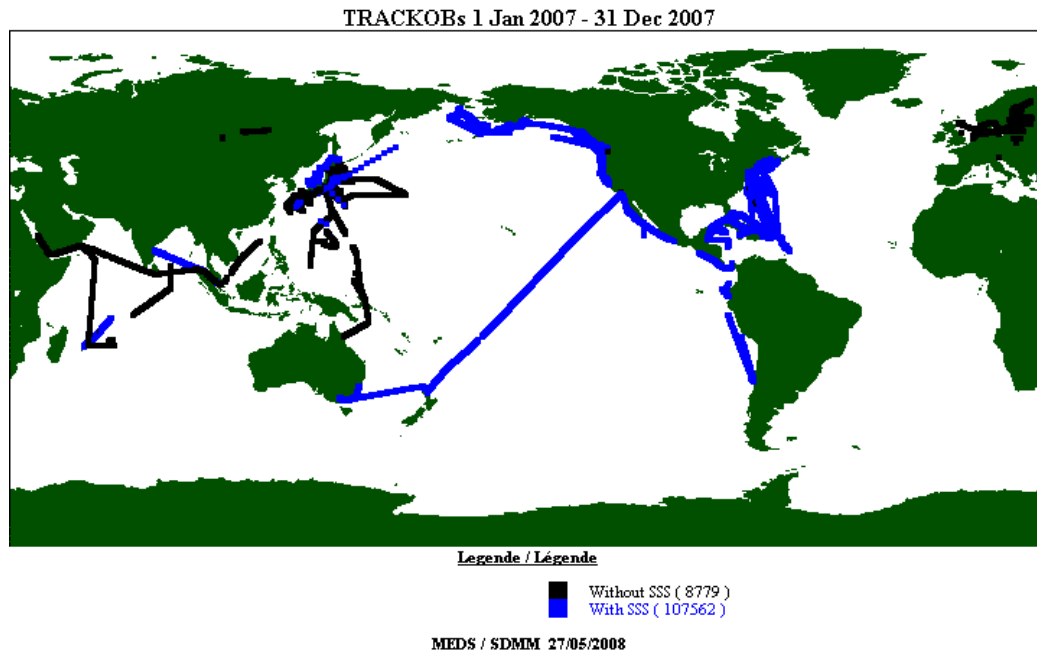


Figure 2: TRACKOBs collected from the GTS in 2007

It is evident that there are real-time data circulating that do not report salinity measurements or salinity measurements transmitted in real-time (via Inmarsat for example) that do not appear on the GTS. GOSUD would like to encourage operators to report as many variables to the GTS as possible. It is also evident that there were a significant number of measurements collected over the year

Figure 3 (below) shows the locations of underway data collected in 2007 that reside at the global server. A comparison of figures 2 and 3 makes it clear that some of the data to be found on the GTS have not reached the GOSUD server. Conversely, some of the data found on the GOSUD server (e.g., the ship lines in the western tropical Pacific) do not appear on the GTS. Indeed, it is known that because of operational procedures in some countries, data will only be sent to the GTS. It is therefore important to both identify the observation programs and for data circulating on the GTS only, to provide them to the global server.

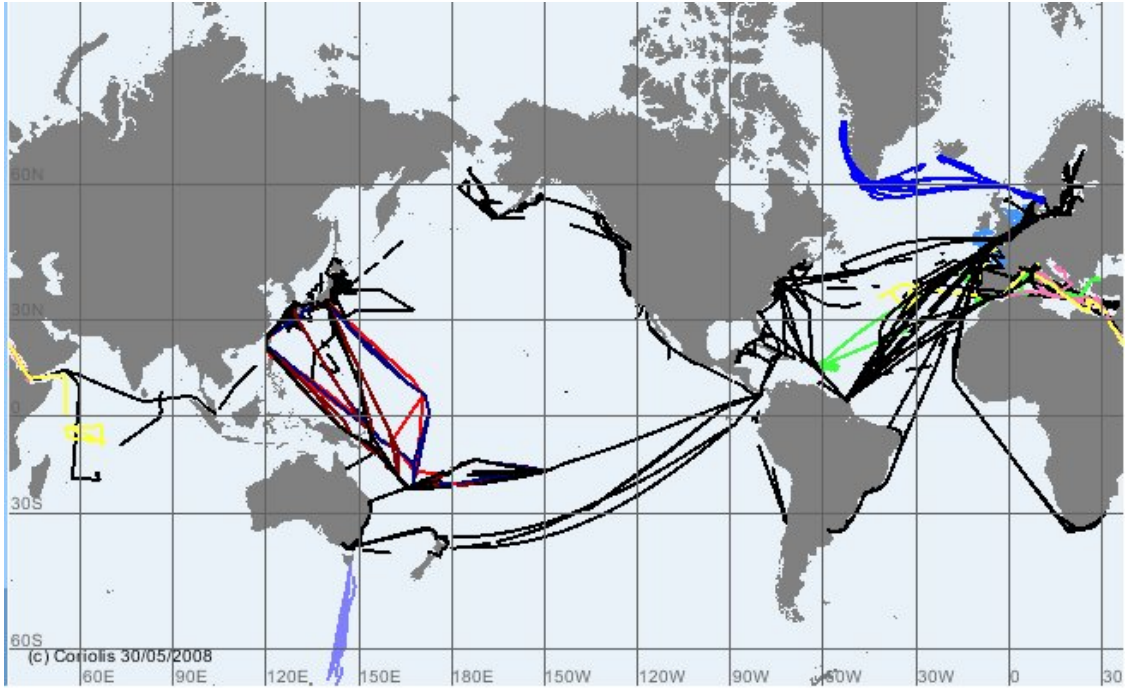


Figure 3: Locations of stations from 1st January 2007 to 31st December 2007 that are present at the global server.

Figure 4 below shows the locations of all data at the global server with observation dates from beginning of 2000 to the end of 2007. 2000 can be considered as the starting date of the GOSUD project.

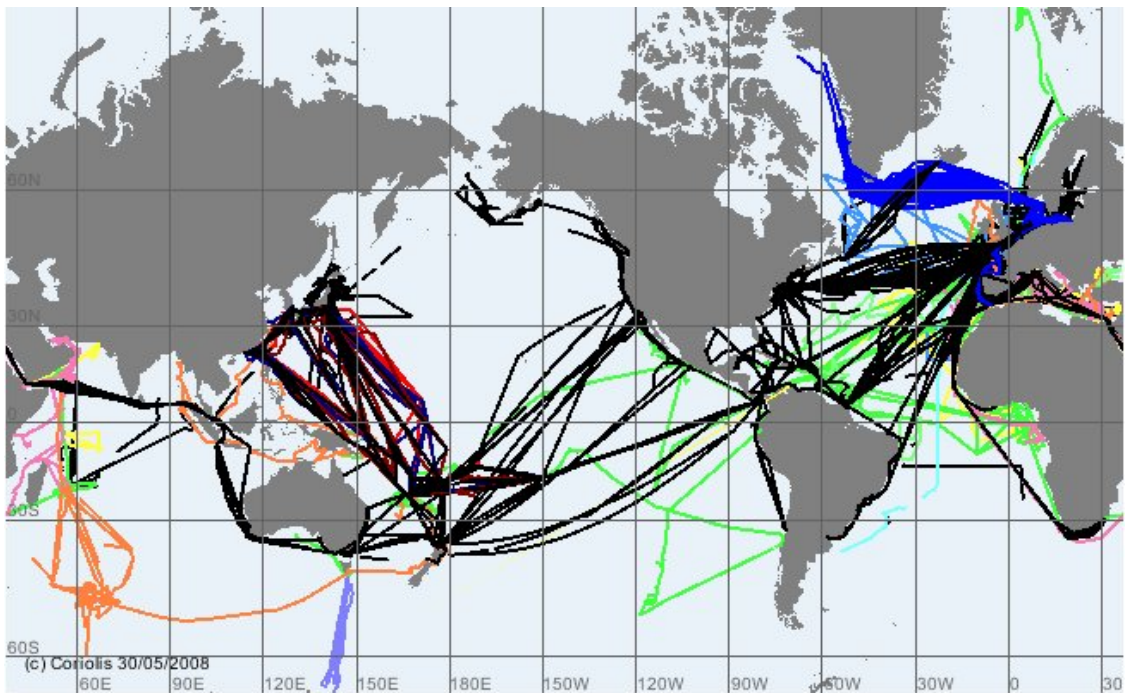


Figure 4: Data residing on the GOSUD ftp server with observation dates from 2000 to the end of 2007.

In figure 5 a plot is shown of the number of individual TRACKOB messages reported on the GTS and the number of stations received directly at IFREMER. The numbers reported by MEDS begin in 1984, but are so small that they are not visible. IFREMER began to acquire delayed mode underway data starting in 2002. The earliest records they now have start in 1989 and continue to the present. Numbers have been growing substantially over the years, with 2004 exceeding 250,000 in real-time and even larger in delayed mode. Of note, though, is that the number of ships that are sending data directly to IFREMER is still quite low. With the establishment of both the ftp and www sites for GOSUD and therefore the greater availability of data, it is expected that participation will increase.

4.3 Real-time and Delayed Mode Comparisons

The primary source of data for the GOSUD Project is the data transferred directly to IFREMER. However, the Project is also encouraging data collectors to send their data through the usual real-time facilities of the GTS using TRACKOB code form for the present. It is important, therefore, to compare what is received in real-time on the GTS to what is received directly by IFREMER. For those platforms that report in real-time only, the Project will make contact and have them submit their data, perhaps higher resolution and more variables, directly to IFREMER. For those reporting directly to IFREMER but not on the GTS, the Project will encourage them to provide the data in real-time.

Since MEDS acquires the real-time data, it is undertaking the comparison. There are a number of factors that need to be considered in doing the comparison. These include the following.

- At present there is no quality control carried out on the data received in real-time. Because real-time data are not the primary source for GOSUD, and because of resource requirements, MEDS will only carry out automated quality control on the data. They are working on implementing that now.
- IFREMER posts all of the data received on their ftp server. However, there is no easy way to know what data are new, what modified and what already seen. Therefore, doing a comparison on a regular basis is complicated.
- IFREMER also posts an index file describing the data on their ftp site but this only gives the start and stop dates and the rectangle enclosing the station locations on a monthly time scale.

With no easy way to determine what data are new and no QC done at MEDS for the moment, the comparison of what is present at IFREMER and what have been received at MEDS is complicated. A comparison scheme has been devised for which MEDS is presently completing testing and will convert to a routine process.

4.4 Sample Products

A substantial amount of work has been done with the TSG data collected in different oceans with a lead role being played by IRD, France.

See <http://www.legos.obs-mip.fr/en/observations/ssss/datadelivery/products/>

The products can be split in 4 main categories:

- Validated Data
- Mean Monthly Year and climatology
- 2D gridded files
- 3D gridded files

In Delcroix, T., S. Cravatte, and M. McPhaden, Decadal variations and trends in tropical Pacific sea surface salinity since 1970. *J. Geophys. Res.*, in press have begun to analyze the time and space scales of surface salinity variability. They have begun in the tropical oceans since this is still the location where there is the greatest volume of data. They have used not simply data derived from surface underway measurements, but all surface salinities that are available.

They restricted their analyses to the period from 1970 to 2001 and along 13 well sampled tracks as shown in figure 6.

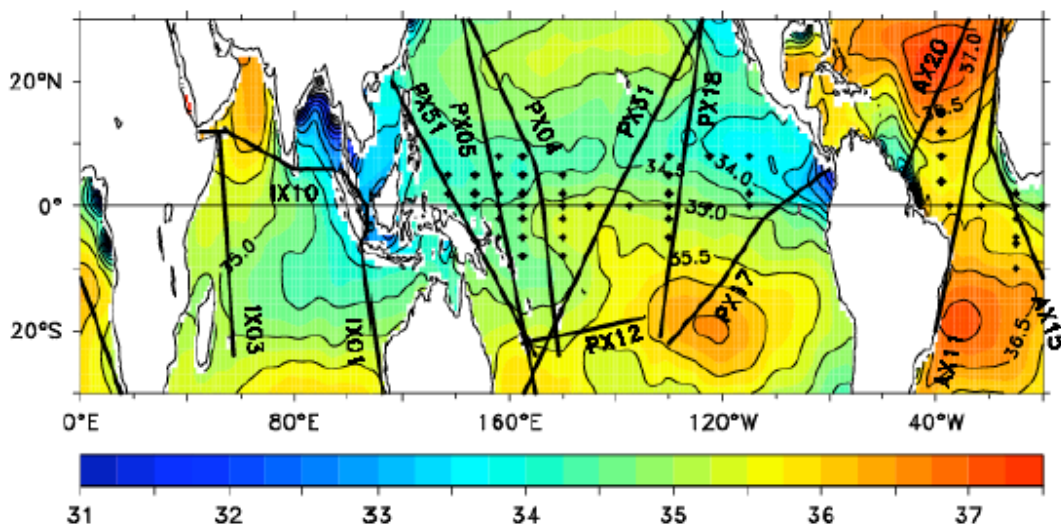


Figure 6: Track lines used in the analysis (from Delcroix et. al, Time and Space Scales for Sea Surface Salinity in the Tropical Oceans – DSR accepted)

They show, an example is figure 7, the mean SSS for each of the selected lines noting that the results are “reminiscent of the mean distribution of the evaporation minus precipitation budget. Finally, (shown in figure 8) they present characteristic scales of SSS.

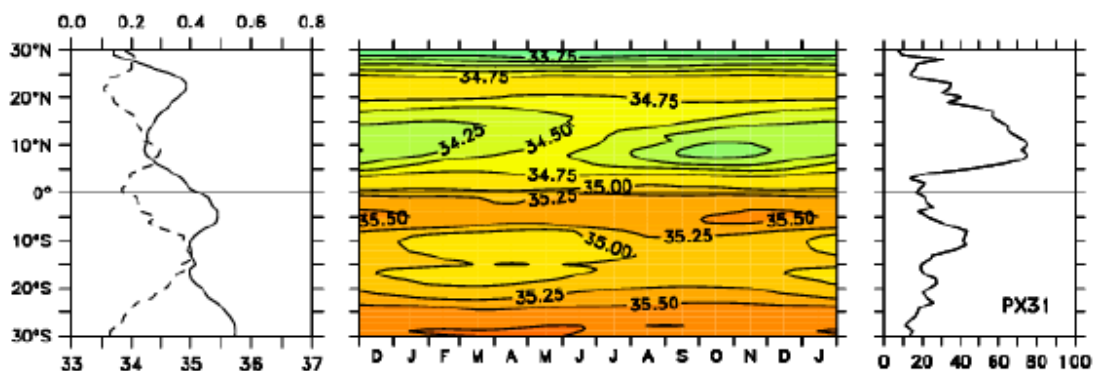


Figure 7: The mean SSS along line PX31 (from Delcroix et. al, Time and Space Scales for Sea Surface Salinity in the Tropical Oceans – DSR accepted)

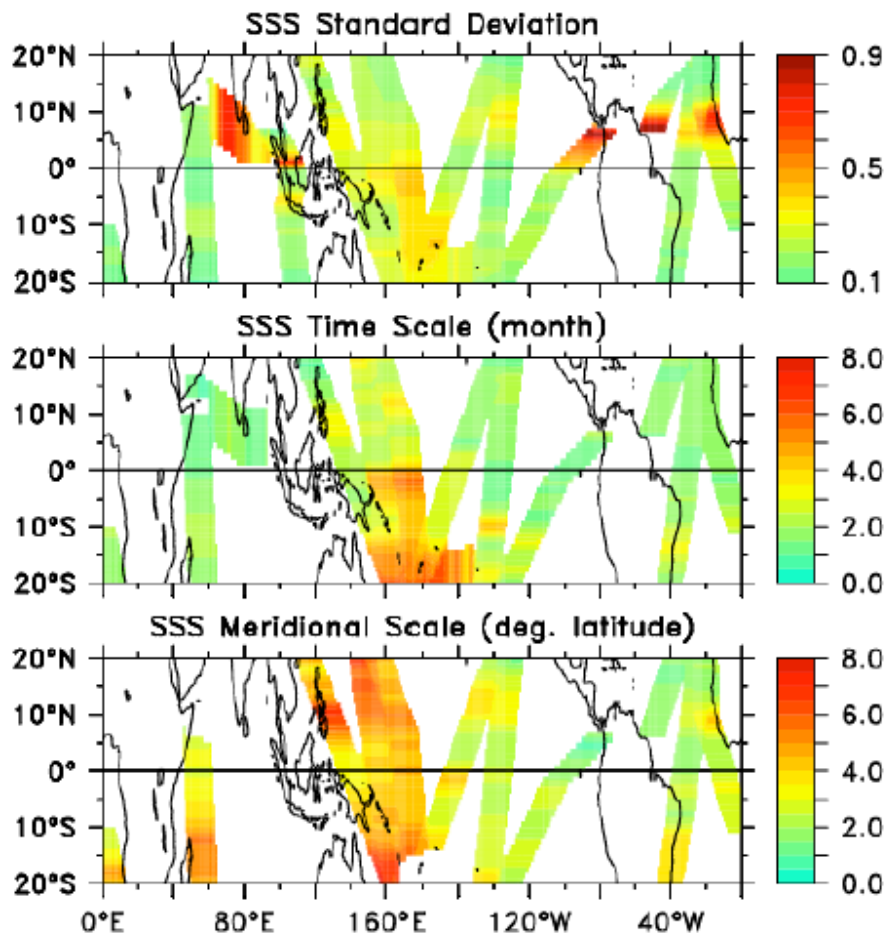


Figure 8: Standard deviation and characteristic scales of SSS (from Delcroix et. al, Time and Space Scales for Sea Surface Salinity in the Tropical Oceans – DSR accepted).

In this study, the long time sampling and high spatial frequency along repeated ocean tracks was exploited to extract a first analysis of SSS scales. Data collected by other instruments were considered, but because of the scarcity of data, sources other than underway data were minor contributors.

5.0 Partnerships

Within the European funded project Mersea, some research vessels have been equipped with TSG data acquisition and near time data transmission. Since the project has ended, European partners are encouraged to continue their efforts.

5.1 Shipboard Automated Meteorological and Oceanographic Systems (SAMOS) Project

A collaboration has been formed between the Shipboard Automated Meteorological and Oceanographic Systems (SAMOS) project (formerly the High Resolution Marine Meteorology Project) and GOSUD. Discussions have taken place about unifying the metadata that will be requested, and how to exchange surface ocean or meteorological data collected by each program. Talks are ongoing to streamline our respective data handling procedures so that data providers need contact only one or other project when they have data of interest to both. We are

also considering how to ensure that it will be straightforward to link meteorological and oceanographic observations taken at the same time and location even when the data management and archiving functions are carried out in separate locations.

5.2 ESA and NASA

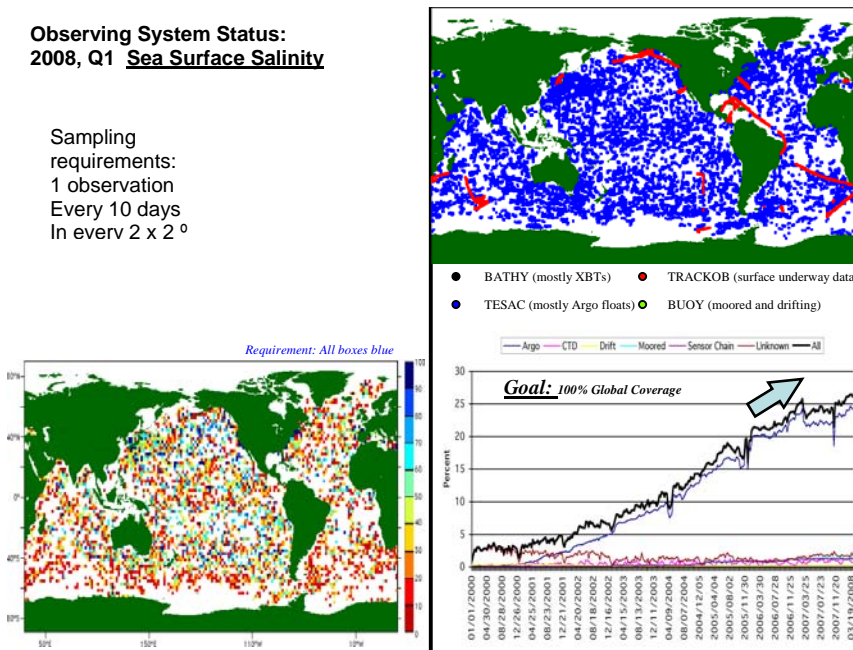
A representative of the NASA Aquarius project has attended the most recent GOSUD meetings to keep us informed of progress on this project. They are very interested in the surface salinity data that are coming through GOSUD as they will be used in calibrations and validations of satellite derived measurements. On the part of GOSUD, it is very helpful to have a client contributing their opinions about how the project needs to function to meet their needs. Ongoing discussions with ESA SMOS project representatives indicate a strong interest in the GOSUD data as well. One critical point will be the ability of the project to deliver metadata of good quality especially the depth at which the temperature and salinity have been measured.

5.3 JCOMM

The JCOMM Operations Program Area reports quarterly the data that have been collected in the context of meeting the targets posed by OOPC for an ocean climate observing system. The reports take the form of a single page that summarizes what kind, where, when and how much data are available from the previous 3 months. Such a form is concise enough to be used to advantage when funding proposals are being considered. The report for sea surface salinity is being produced by MEDS on behalf of GOSUD and the JCOMM OPA. The summary for the last quarter of 2005 AND 2006 is shown in figures 9 and 10. [rk1]

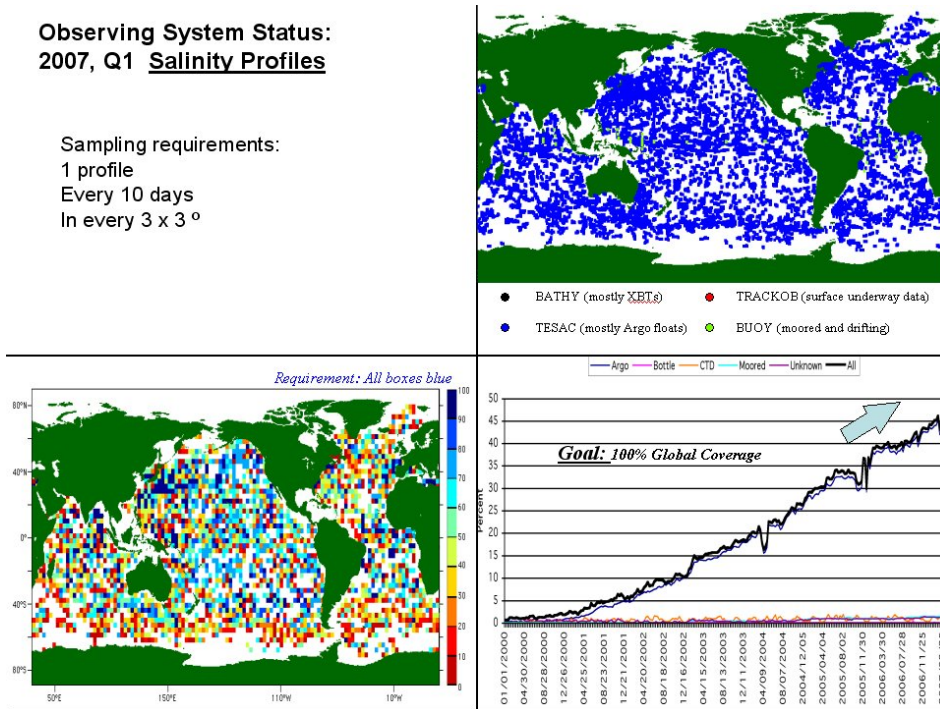
**Observing System Status:
2008, Q1 Sea Surface Salinity**

Sampling requirements:
1 observation
Every 10 days
In every 2 x 2°



**Observing System Status:
2007, Q1 Salinity Profiles**

Sampling requirements:
1 profile
Every 10 days
In every 3 x 3 °



**Observing System Status:
2006, Q4 Temperature Profiles**

Sampling requirements:
1 profile
Every 10 days
In every 3 x 3 °

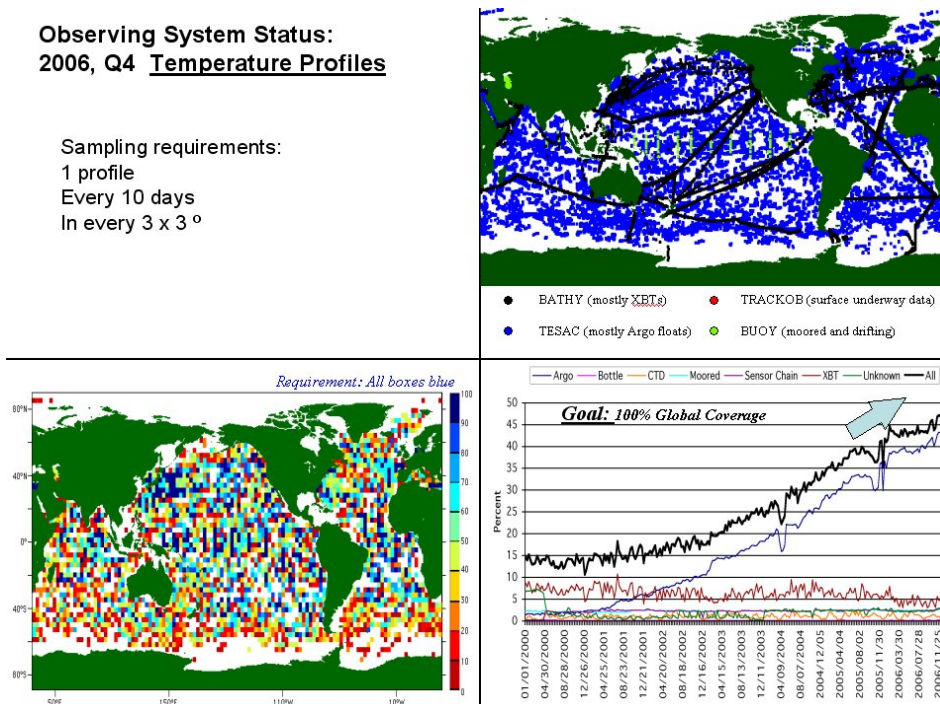


Figure 9-10: A sample of the quarterly report prepared for JCOMM that summarizes the observing system for sea surface salinity and sea surface temperature

See

http://www.oco.noaa.gov/index.jsp?show_page=page_status_reports.jsp&nav=observing where all the quarterly reports are available.

6.0 Plans for 2008

The 6th GOSUD meeting will be held in Seattle (9-12 June 2008). It will be held in conjunction with the SAMOS –Shipboard Automated Meteorological and Oceanographic System- project (<http://samos.coaps.fsu.edu>).

Contacts have been taken with FerryBox project. An open FerryBox meeting will be held in Southampton 2008 September 30th. It is planned to have a GOSUD representative.

A new format will be proposed during the next meeting. It should be able to hold both near-real time data and when available the delayed mode data. It should also host the ancillary data such as water samples, calibration coefficients, date of calibration and serial number. It is available on the web site <http://www.ifremer.fr/gosud/documentation.htm>

IRD has developed a method to elaborate the delayed mode datasets. It will be presented at the next meeting.

Meetings in the past have been held around the same time as Argo Data Management Team meetings and in the same location. The last meeting was held in conjunction with SAMOS (see above).

When GOSUD was first proposed, the idea was to manage surface temperature, salinity and current data. Later on, the Project was encouraged to expand its consideration to a larger suite of variables. We have taken initial steps in this direction by contacting other groups, such as those working to build a system for pCO₂ observations, to make our presence known and to seek ways to collaborate. Indeed it was through just such outreach activities that the link to the SAMOS project was made. Other contacts have been taken with the EU project Ferry Box <http://www.ferrybox.com> and with the CARBOOCEAN project <http://www.carboocean.org/> CARBOOCEAN operates a carbon dioxide measurement network in the Atlantic Ocean that is based on the use of commercial vessels.

There is still much work to do in collaborating with SAMOS. At this point SAMOS is concentrating its efforts towards data collected from US vessels, but has strong interest to expand its operations to global collections of such data. GOSUD has a global perspective now, but has always recognized the weakness of its connections to data collected within the U.S. Our mutual objective is to mesh activities to streamline how each of us handles data and permits ready integration of the surface oceanography and meteorology observations. An important advantage to GOSUD of this collaboration is that it provides an entry point to the wealth of underway data collected by US vessels that now go both unreported and often are not provided to archives. In return, SAMOS gains an entry point to the meteorological data collected by other nations.

The immediate future work will be to convert new operations to routine so that GOSUD becomes a smooth running program. There is work to do at the global server and at MEDS to accomplish a better connection between data reported on the GTS and data provided directly to the global server.

We recognize that real-time exchange of surface ocean data is limited by the present character code form TRACKOB. It will be necessary to use BUFR for real-time exchange on the GTS and so we are working towards a BUFR template for TRACKOB data. As this develops, we will then have the framework for exchanging many other kinds of surface observations in a single BUFR message.

Products derived directly from the observations are an important goal for GOSUD. As more data become available we anticipate being able to derive gridded fields, etc. We will continue to pursue these.

It is clear that there will be a need to manage duplications of data. Some work is underway by MEDS to address this problem. We have also been discussing implementing a scheme analogous to the one used by the SOOP. Work will continue on this.

7.0 Annex

List of the ships that have transmitted TSG data during 2007

PLATFORM_CODE	NAME	LABEL
FMCY	POURQUOI PAS?	RESEARCH SHIP
JCCX	CHITA MARU	RESEARCH SHIP
FNFP	THALASSA	RESEARCH SHIP
JFCL	SHINYO MARU	RESEARCH SHIP
JGQH	RYOFU MARU	RESEARCH SHIP
FZVN	LE SUROIT	RESEARCH SHIP
JDSS	HAKUHO-MARU	RESEARCH SHIP
JPBN	KEIFU MARU	RESEARCH SHIP
FNIN	MARION DUFRESNE	RESEARCH SHIP
FHZI	L'ASTROLABE	RESEARCH SHIP
ELWX5	EXPLORER OF THE SEAS	RESEARCH SHIP
EDSV	CORNIDE DE SAAVEDRA	RESEARCH SHIP
FABB	BEAUTEMPS-BEAUPRE	RESEARCH SHIP
FNCM	L'ATALANTE	RESEARCH SHIP
SHIP	UNIDENTIFIED PLATFORM	SHIP
HPEW	PACIFIC ISLANDER	SHIP OF OPPORTUNITY
FNAV	MN TOUCAN	SHIP OF OPPORTUNITY
ELVZ5	WASHINGTON	SHIP OF OPPORTUNITY
PJJU	OLEANDER	SHIP OF OPPORTUNITY
OXYH2	NUKA ARCTICA	SHIP OF OPPORTUNITY
KS067	SEAKEEPERS	SHIP OF OPPORTUNITY
3FEW5	KYOWA CATTLEYA	SHIP OF OPPORTUNITY
JDWX	KOFU MARU	SHIP OF OPPORTUNITY
JIVB	SEIFU MARU	SHIP OF OPPORTUNITY
WTDM	MILLER FREEMAN	SHIP OF OPPORTUNITY
3EVS	SOUTH ISLANDER	SHIP OF OPPORTUNITY
C6VL5	MATISSE	SHIP OF OPPORTUNITY
FNHO	COLIBRI	SHIP OF OPPORTUNITY
DBFO	SEEFALKE	SHIP OF OPPORTUNITY
DJOK	BARBARA	SHIP OF OPPORTUNITY
C6SE4	EXPLORER OF THE SEAS	SHIP OF OPPORTUNITY
KS063	SEAKEEPERS	SHIP OF OPPORTUNITY
C6TN4	EXPLORER	SHIP OF OPPORTUNITY
3FMF4	KYOWA HIBISCUS	SHIP OF OPPORTUNITY
KS060	SEAKEEPERS	SHIP OF OPPORTUNITY
DAJC	MONTE OLIVIA	SHIP OF OPPORTUNITY
MGJS8	NOKWANDA	SHIP OF OPPORTUNITY
KS054	SEAKEEPERS	SHIP OF OPPORTUNITY