WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP
ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON OBSERVATIONAL DATA REQUIREMENTS
AND REDESIGN OF THE GLOBAL OBSERVING SYSTEM

FOURTH SESSION

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Current status of *in situ* marine observing systems

(Submitted by the Technical Coordinator of the WMO-IOC Data Buoy Cooperation Panel and Coordinator of the Ship of Opportunity Programme Implementation Panel)

Summary and Purpose of Document

Marine observations continued to be one of the essential components of the current and future GOS. Today, relevant observing platforms include ships, drifting data buoys, moored data buoys in the high seas, sub-surface profiling floats, and expandable bathythermographs (XBT) deployed from ships of opportunity. Detailed information on the status and perspectives of the above marine *in situ* observational programmes is presented in the Appendix to this document

ACTION PROPOSED

The meeting is invited to take into consideration the information contained in this document when discussing current status of surface-based components of the GOS and its redesign issues.

Appendix: **Current status of *in situ* marine observing systems**

Current status of *in situ* marine observing systems

***In situ* marine observing systems**

The JCOMM in situ Observing Platform Support Centre (JCOMMOPS) was recently established by JCOMM at its first session in Akureyri, Iceland, June 2001.

JCOMMOPS (http://www.jcommops.org/) is a centre to provide support at the international level for those in charge of developing and operating marine and oceanographic *in situ* observing systems. Such observational programmes can be research or operational programmes or both. Relevant observing platforms include drifting data buoys, moored data buoys in the high seas, sub-surface profiling floats, and expandable bathythermographs (XBT) deployed from ships of opportunity. JCOMMOPS is placed under the Joint WMO-IOC technical Commission for Oceanography and Marine Meteorology (JCOMM) and includes International Coordination facilities of the Data Buoy Cooperation Panel (DBCP, the Ship Of Opportunity Programme (SOOP), and the Argo Information Centre (AIC). It participates in the JCOMM integration process of marine meteorology and operational physical oceanography activities. Support is provided through coordination at the international level of some implementation and operational aspects of these observational programmes (e.g. acting as a focal point), and through delivery of services such as:

(i) Provision of status information regarding relevant observational programmes (e.g. maps, list of operational observing platforms).
(ii) Provision of information on data requirements expressed in support for GOOS, GCOS, and the WWW.
(iii) Assistance with the development of cooperative arrangements for buoys and sub-surface float deployments, and for the servicing of moored buoys in the high seas (e.g. information on deployment opportunities).
(iv) Assistance as appropriate in relaying quality control information produced by relevant data centres to the relevant observing platforms managers.
(v) Assistance in the standardisation of data formats, etc.
(vi) Provision of information regarding telecommunication systems which can potentially be used for real-time data transmission of data from relevant observing platforms (e.g. Argos, Inmarsat, Orbcomm, METEOSAT, GOES, …); Assist in the clarification and resolution of issues between platform operators and data telecommunication providers.
(vii) Assistance in promoting the insertion of all available and appropriate data into the Global Telecommunications System (GTS).
(viii) Monitoring activities and encouraging the flow of data into appropriate permanent archives.
(ix) Provision of information as required on the functional status of relevant observing platforms.
(x) Operation of a web site, including links to appropriate data centres and operational centres.

From the activities of JCOMMOPS, it is expected to (i) facilitate decision making by programme managers, (ii) facilitate programme implementation, (iii) enhance operational and monitoring aspects, and (iv) offer visibility to private companies (platform or sensor manufacturers, satellite data telecommunication providers) and permit quality evaluation on products and services provided by them.

Table 1: Number of marine stations reporting on GTS and average number of reports per day (based upon GTS reports received at Météo France in November 2001).

Code format	Typical station types	Stations	P	SST	SSS	Wind	AT	Tend	U	Waves	Sub/T	Atm. Profile
SHIP	Met. obs. From ships, coastal moorings	3652	5492	4645	0	5199	5466	4966	4565	4242	0	0
BATHY	XBTs	64	0	19	0	1	2	0	0	0	59	0
TESAC	Sub-surface profiling floats	394	0	3	1	0	0	0	0	0	49	0
TRACKOB	Thermosalinographs	20	0	82	70	0	0	0	0	0	0	0
TEMP-SHIP	ASAP	32	0	0	0	0	0	0	0	0	0	19
BUOY	Data buoys	808	6126	7571	0	1073	1835	3843	343	89	382	0
Total	All marine stations	4970	11618	12333	71	6272	7303	8809	3909	4331	489	19

Figure 1: Marine stations which data had been distributed on GTS in November 2001 (last station position for each type of reporting code form).

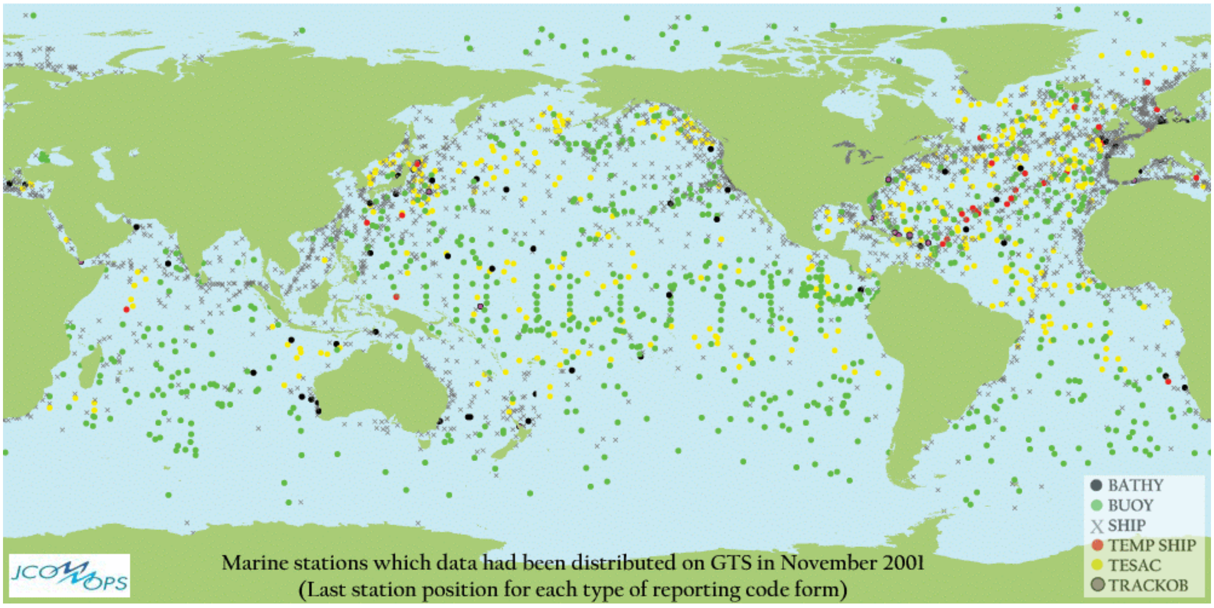
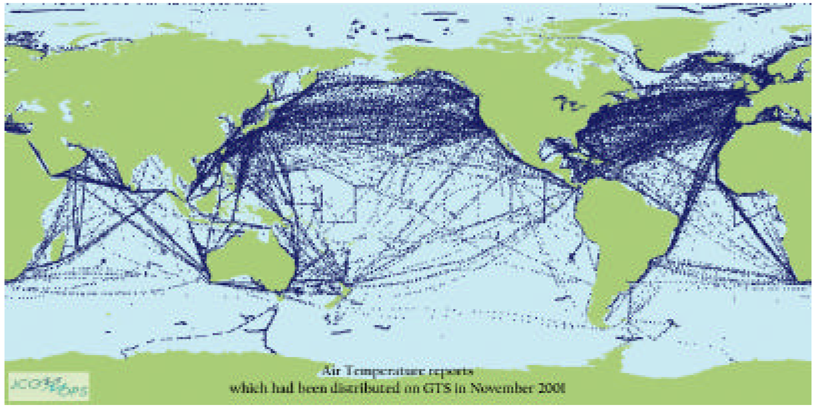
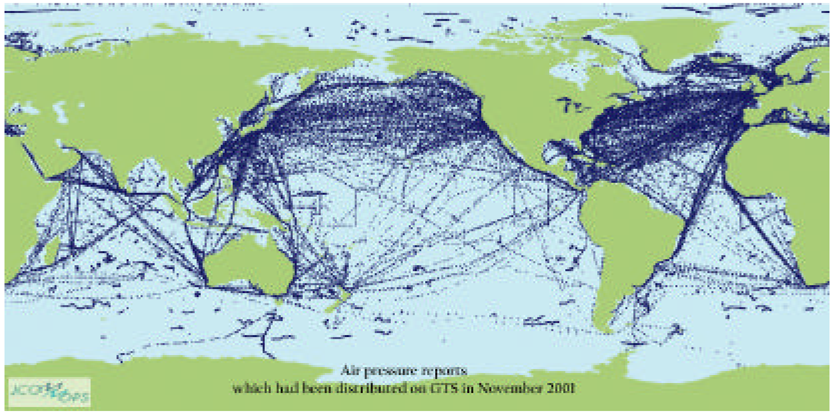


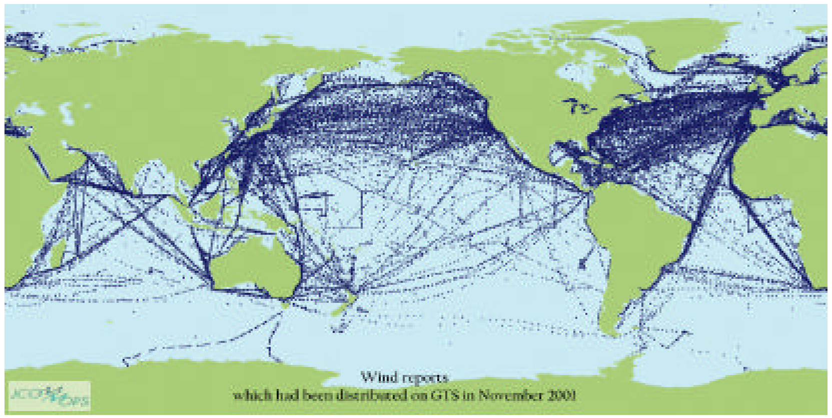
Figure 2: GTS reports containing specific variable and distributed in November 2001 (AT, AP, Wind, U)



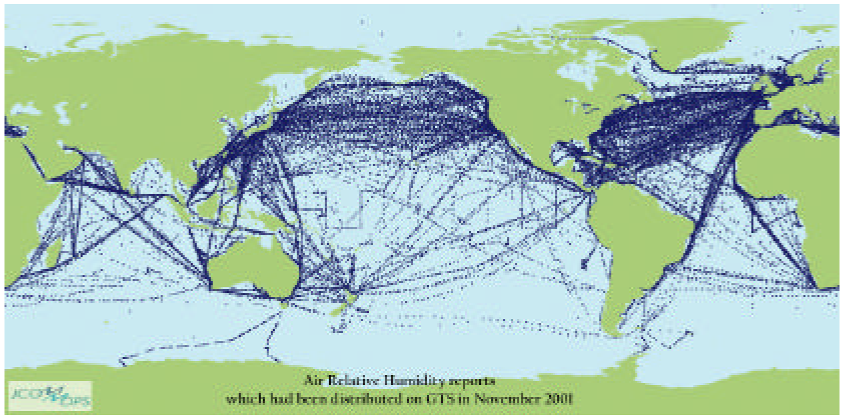
Air temperature



Air Pressure

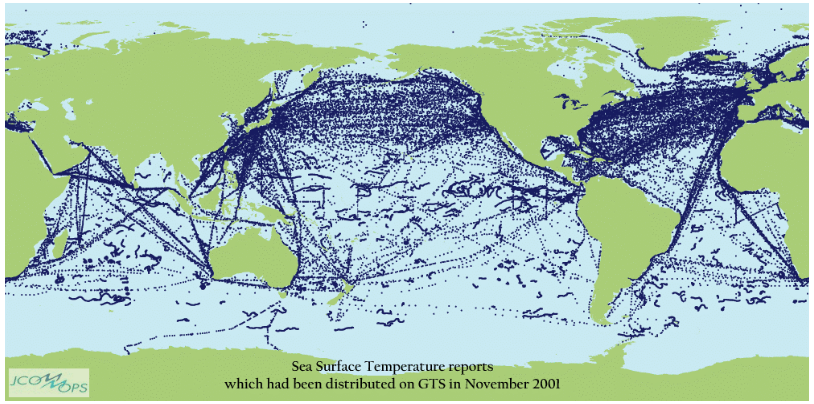


Wind

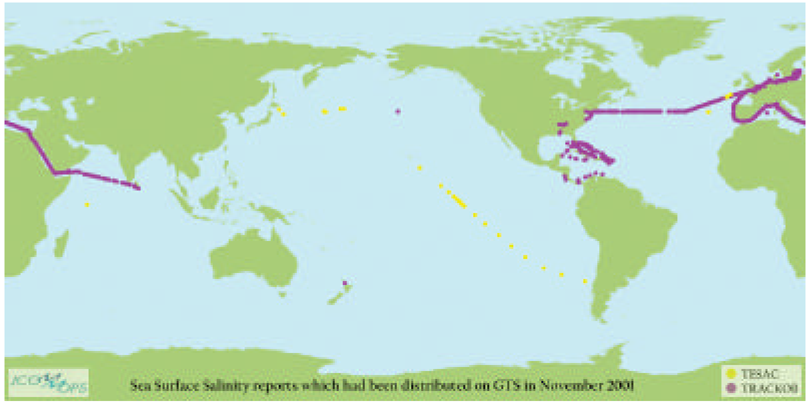


Air Relative Humidity

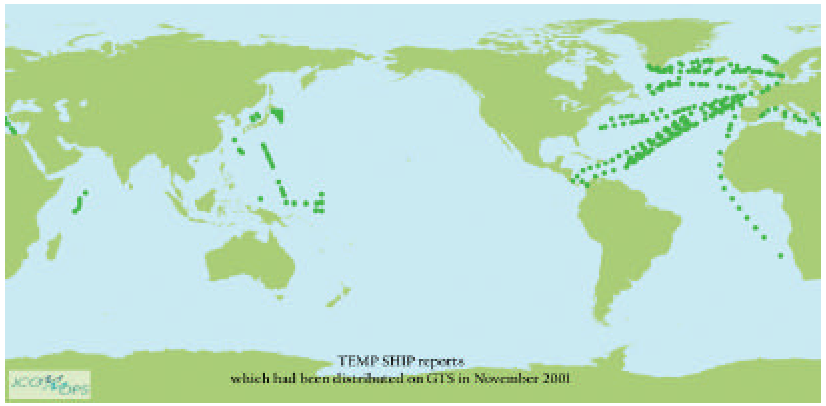
Figure 3: GTS reports containing specific variable and distributed in November 2001 (SST, SSS, Atm. Soundings, Sub-surf. Temp. profiles)



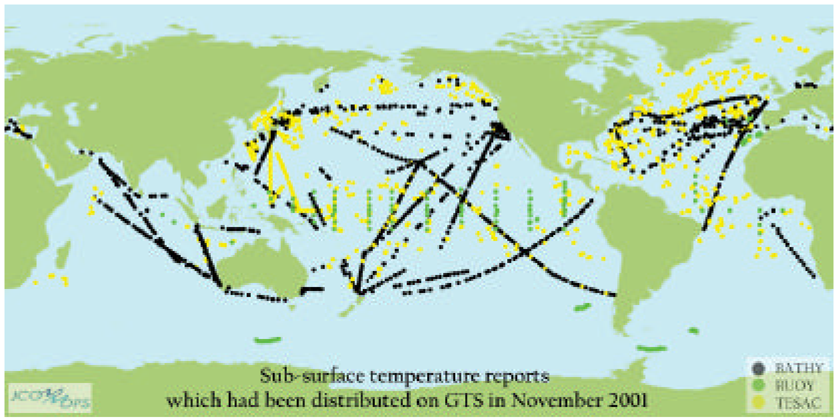
Sea Surface Temperature



Sea Surface Salinity



Atmospheric soundings



Sub-surface temperature profiles

1) Data Buoy Cooperation Panel (DBCP)

http://dbcp.nos.noaa.gov/dbcp/

Implementation

Implementation of drifting data buoys and moored buoys in the high seas is being managed by the Data Buoy Cooperation Panel which is participating in the JCOMM Observation Programme Area. The Panel defined its implementation strategy in a way consistent with requirements expressed by the WWW, GOOS, and GCOS. The strategy provides provide an overall framework for the Panel's work, in the light of developing requirements for marine observations, and especially buoy data, to support operational meteorology and oceanography, marine scientific research and global climate studies. For example, deployments take availability of other *in situ* marine observing systems into account (e.g. VOS). The Panel is working at increasing the quantity of buoy data available from data sparse areas (e.g. the Panel is tentatively maintaining an array of 80 barometer drifters between 40S and the Antarctic Circle).

Implementation is based upon so called Action Groups. There are presently seven Action Groups:

- The European Group on Ocean Stations (EGOS)
- The International Arctic Buoy Programme (IABP)
- The International South Atlantic Buoy Programme (ISABP)
- The International Programme for Antarctic Buoys (IPAB)
- The International Buoy Programme for the Indian Ocean (IBPIO)
- The Global Drifter Programme (GDP)
- The Tropical moored buoy Implementation Panel (TIP)

Status

In December 2001, data from over 1200 drifting buoys were collected through Service Argos (see figures 1, 2, and 3). Among those buoys, nearly 55% had their data distributed on GTS (table 1). However, it is becoming increasingly difficult to achieve GTS distribution for the remaining 45% either for practical reasons (short duration programmes, not relevant) or because the managers of the buoy programmes would not provide authorization (confidentiality). Thus priority had now been given to direct technical assistance in facilitating GTS distribution of buoy data for those relevant buoy programmes for which authorization has been given. Based upon GTS reports received at Météo France during the period 30 November to 6 December 2001, table 2 indicates for typical variables, number of buoys reporting in BUOY format, average number of reports per day, and average delay (reception-time - observation time). For those data, table 3 provides data availability statistics for typical variables in each DBCP area. Figure 4 shows the definition of these DBCP areas.

Data management

Buoy data are archived by the IOC International Oceanographic Data and Information Exchange (IODE) Responsible National Oceanographic Data Centre (RNODC) for drifting buoys, operated by the Marine Environmental Data Service (MEDS) of Canada, and by the JCOMM Specialized Oceanographic Centre (SOC) for drifting buoys, operated by Météo-France. The JCOMM Sub-group on Marine Climatology will be the overall repository of metadata for all ocean observing systems, including drifting and moored buoys. The Panel is taking steps to eventually provide the JCOMM Sub-Group with appropriate metadata in required format.

Regarding real-time GTS distribution of buoy data, the Panel is taking steps to initiate distribution in BUFR code. Required software developments have been included within the Argos development programme for implementation in early 2003.

Evaluation, quality control

The DBCP evaluation group is monitoring the quality of buoy data and suggesting ways to improve buoy design. At the Panel's 17th session the group reported that the life-time of SVP Barometer drifters (SVPB) significantly increased in the last 12 months especially regarding infant mortality and air deployment success rates. Deferred time quality control guidelines also permit to rapidly fix problems reported by meteorological centres (e.g. removing data from GTS). Thanks to improvements in data assimilation and modelling, comparisons of buoy data with first guess field show that the quality of buoy data is good (e.g. 1 hPa RMS for air pressure data).

Table 2: For each variable, number of buoys reporting in BUOY format during the period 30 November to 6 December 2001 (GTS reports received at Météo-France), average number of reports per day, and average delay (reception-time - observation time).

Variable	Buoys	Reports/day	Average Delay (min.)	Remark
Air pressure	287	6027	195	
Sea Surface temperature	682	7601	160	
Air temperature	148	1732	147	
Wind	113	1063	219	Mainly TIP moored buoys; small number of coastal buoys reporting in BUOY format
Air pressure tendency	205	3846	184	
Air relative humidity or dew point temperature	76	347	270	
Sub-surface temperatures	89	2845	273	Mainly TIP moored buoys; small number of drifting buoys with thermistor strings
Waves (height, period)	13	107	214	Small number of buoys

Remark: There are more than 200 moored buoys which transmit in SHIP format (e.g. USA, Canada). Most of these moored buoys are coastal buoys which measure basic meteorological variables such as air pressure, air temperature, and wind. Statistics for such buoys are not included above because the DBCP deals with drifting buoys and moored buoys in the high seas. Only a very small number of moored buoys in the high seas actually transmit in SHIP format.

Table 3: Data availability statistics per DBCP area for buoy data received from GTS in BUOY format at Météo-France during the period 30 Nov. 2001 to 6 December 2001.

Index "Idx" is computed as following:

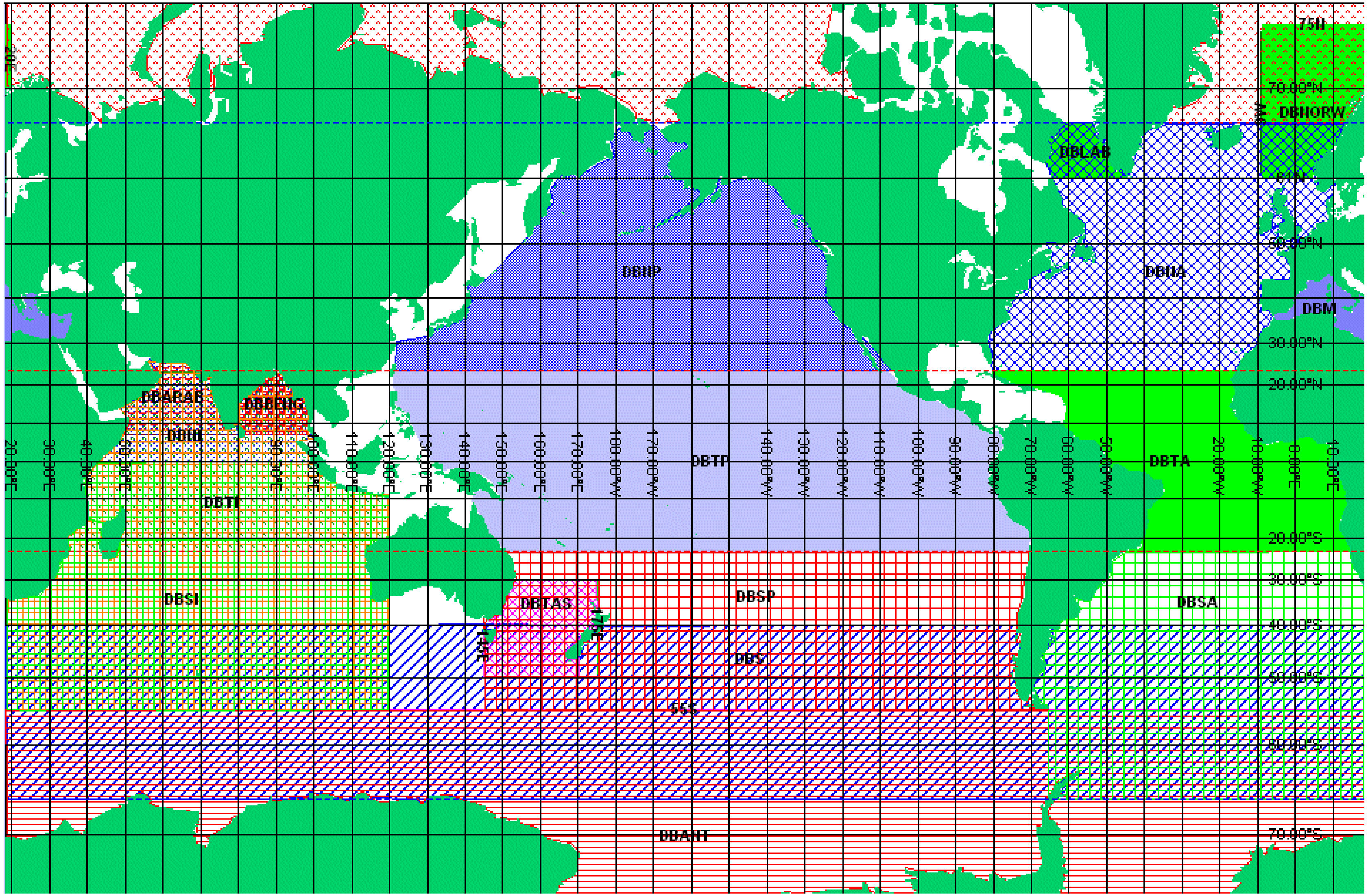
Idx buoys: (Number of buoys) * 500 km * 500 km / Area
(i.e. Idx=1 when we have 1 buoy per 500 km * 500 km area in average)

Idx for each geo-physical variable: (Number of reports) * 500 km * 500 km / (8*Area*Days)
(i.e. Idx=1 when 8 observations per day are received in an area of 500 km * 500 km in average)

Color code: **Blue: Idx >= 0.5, Green: 0.25 <= Idx < 0.5, Red: Idx < 0.25**

Ocean area	Area km^2	Buoys	Idx buoys	Obs. P	Idx P	Obs. SST	Idx SST	Obs. AT	Idx AT	Obs. WS	Idx WS	Obs. U	Idx U	Obs. Sub/T	Idx Sub/T
DBA	81 650 000	198	0.61	16 045	0.88	18 593	1.02	2 710	0.15	2 933	0.16	396	0.02	2 356	0.13
DBANT	34 042 000	8	0.06	1 079	0.14	1 313	0.17	541	0.07	0	0	0	0	46	0.01
DBARAB	4 253 000	8	0.47	250	0.26	304	0.32	65	0.07	48	0.05	0	0	0	0
DBARC	11 760 000	32	0.68	4 482	1.70	0	0	4 132	1.57	0	0	0	0	0	0
DBBENG	2 581 000	4	0.39	319	0.55	300	0.52	17	0.03	17	0.03	0	0	0	0
DBI	60 483 000	97	0.40	8 043	0.59	8 391	0.62	481	0.04	148	0.01	86	0.01	2 396	0.18
DBLAB	523 762	1	0.48	156	1.33	0	0	0	0	0	0	0	0	0	0
DBNA	23 882 000	87	0.91	8 952	1.67	10 347	1.93	2 180	0.41	918	0.17	0	0	1 682	0.31
DBNI	11 889 000	15	0.32	787	0.30	821	0.31	82	0.03	65	0.02	0	0	0	0
DBNP	32 636 000	97	0.74	2 653	0.36	6 608	0.90	454	0.06	581	0.08	0	0	0	0
DBP	154 241 000	393	0.64	10 799	0.31	23 086	0.67	4 221	0.12	4 113	0.12	2 070	0.06	15 349	0.44
DBS	68 736 000	57	0.21	6 548	0.43	7 225	0.47	1 455	0.09	0	0	0	0	106	0.01
DBSA	28 437 000	50	0.44	5 100	0.80	4 128	0.65	257	0.04	125	0.02	123	0.02	36	0.01
DBSI	48 594 000	82	0.42	7 256	0.67	7 570	0.70	399	0.04	83	0.01	86	0.01	2 396	0.22
DBSP	41 287 000	62	0.38	4 869	0.53	5 635	0.61	1 562	0.17	0	0	0	0	24	0
DBTA	29 331 000	58	0.49	1 504	0.23	3 629	0.55	273	0.04	1 410	0.21	273	0.04	638	0.10
DBTAS	4 544 000	10	0.55	1 556	1.53	1 608	1.58	1 119	1.10	0	0	0	0	0	0
DBTI	32 273 000	50	0.39	3 683	0.51	4 206	0.58	229	0.03	148	0.02	86	0.01	2 396	0.33
DBTP	80 318 000	234	0.73	3 277	0.18	10 843	0.60	2 205	0.12	3 532	0.20	2 070	0.12	15 325	0.85

Figure 4: Map of DBCP areas:



2) Ship Of Opportunity Programme (SOOP)

http://www.brest.ird.fr/soopip/

Implementation

The primary goal of the Ship-of-Opportunity Programme (SOOP) is to fulfil upper ocean data requirements which have been established by GOOS and GCOS, and which can be met at present by measurements from ships of opportunity (SOO). SOOPIP is establishing itself as an operational programme and is therefore participating in the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) and particularly in its Ship Observations Team which first meeting of SOT will be held in Goa, India, 25 February to 2 March 2002.

The SOOP is directed primarily towards the continued operational maintenance and co-ordination of the XBT ship of opportunity network but other types of measurements are being made (e.g. TSG, XCTD, CTD, ADCP, pCO2, phytoplankton concentration). This network in itself supports many other operational needs (such as for fisheries, shipping, defense, etc.) through the provision of upper ocean data for data assimilation in models and for various other ocean analysis schemes. It is considered most important to have the SOOP focused on supporting climate prediction in order to ensure the continued operation of the present network.

The OOPC&COOP Upper Ocean Thermal Review clarified the role of SOOP in the context of other existing and/or developing ocean observing programmes such as TIP, Argo, and Jason. The review recommended (i) maintaining the network to support climate observations, and (ii) gradually (i.e. 5 year transition while Argo is implemented) evolving from broadcast sampling (low density network) to line sampling (frequently repeated and high density lines).

However, SOOP is now facing the following problems, including (i) XBT probe cost increased, (ii) financial constraints in face of national priorities with regard to *in situ* and remote sensing ocean observations leading to reduced budgets for some of the national XBT ship of opportunity programmes, (iii) national priorities within the national XBT SOO programmes to address specific scientific and/or operational issues, (iv) logistical problems (e.g. availability of shipping, ships changing ownership, changes in ship crews), and (v) concerns with regard to the Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol) since governments may restrict research activities south of 60S where doubts exist on possible environmental impacts.

Status

SOOP is doing its best to find solutions to these problems but could not avoid activity reduction since 1999 especially in the Atlantic and Indian oceans. About 28000 XBT probes were dropped in 1999 in global oceans (excluding the Mediterranean sea with 2000 drops). During the fist 6 months of 2000, about 12000 probes were dropped (figures 5, and 6) from 77 different ships. It is estimated that to support the sampling recommended by the Upper Ocean Thermal review, about 35000 probes would be needed every year. Figures 1, 3, and 6 show that the Equatorial Atlantic and North Atlantic are well covered as is the North Pacific. The South Atlantic and Southern Oceans are under-sampled . The Indian Ocean is partially sampled.

Figure 14 also shows coverage for November 2001 of water temperature profile data in 3°x3° box with indication of origin of the data (i.e. BATHY, TESAC). Considering that XBT data are basically reported in BATHY format, and profiling float data reported in TESAC format, this map shows how the SOOP and Argo programmes are complementary. Figure 3 also shows how SOOP data are complementary with moored buoys equipped with thermistor strings and which report in BUOY format.

Data management

The data management activities of the program are undertaken in collaboration with the Global Temperature and Salinity Profile Programme (GTSPP) and the WOCE Upper Ocean Thermal Data Assembly Centre (UOT/DAC) Program. GTSPP supports the real-time data exchange and quality control mainly via MEDS , Canada. This is the data provided for operational applications, such as ENSO prediction. The Science Centres (AOML, SIO, CSIRO/BMRC JAFOOS), which are jointly operated by the GTSPP and the WOCE UOT/DAC Program, are responsible for the scientific quality control and delivery of products from the high-resolution, delayed mode data set. This data set is managed by the global archive for both programmes (NODC), as is used for scientific research and Climatology development. NODC agreed to make developments to permit access to the data via the Distributed Oceanographic Data system (DODS) and will therefore establish a DODS server in the next 6 to 12 months. Data distributed via DODS (in NetCDF) will be the best current copy of GTSPP data and will be updated on a monthly basis. An Upper Ocean Thermal data CD-Rom procuded by WOCE contains all SOOP observations collected until 1999 plus other types of upper ocean thermal data (e.g. TAO). A version 3 of this CD-Rom will soon be published. All data on the CD will be corrected for XBTs for which old fall rate equation coefficients were used. 1999 and 2000 SOOP data will be included in version 3.

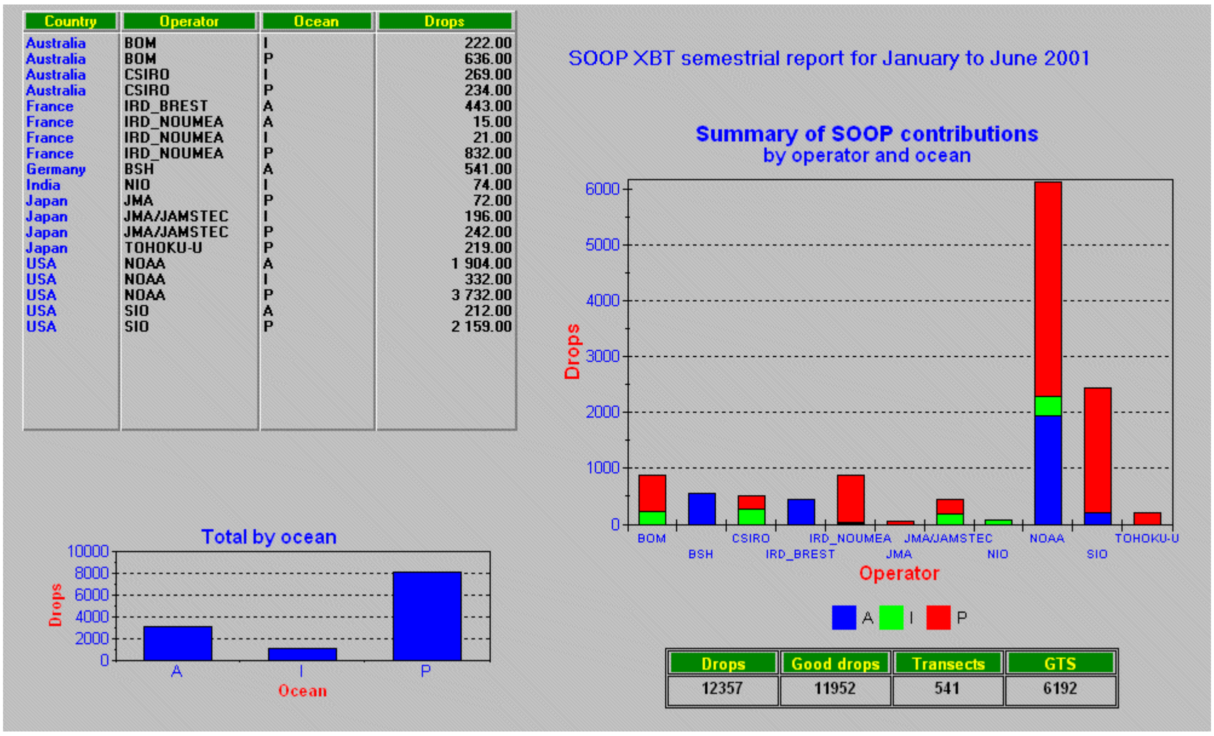
In addition to GTS distribution of the data in BATHY format (table 1, figures 1 and 3), quality controlled real-time data are also sent from MEDS to US/NODC and other clients three times each week. Real-time data provided by MEDS to clients are either for the whole world or a a specific area. Both MEDS and US/NODC have clients that receive regular dispatches of data. Once a year, all data collected two years previously are divided into three oceans and forwarded for scientific QC in the US (AOML and Scripps) and Australia, (CSIRO/BoM/Joint Australian Facility for Ocean Observing Systems (JAFOOS)). The results are returned to US/NODC and updated into the archives. These centres also contribute to the WOCE DAC activities.

Evaluation, quality control

Extensive programme monitoring and data quality activities are implemented in conjunction with the Global Temperature Salinity Profile Programme (GTSPP). Feedback mechanisms have been instigated to ensure data flow and quality. Once a year, all data collected two years previously are divided into three oceans and forwarded for scientific QC in the US (AOML and SIO), and Australia (JAFOOS). These mechanisms have proven to be effective in increasing the amount of real-time data flow and data quality. Delayed mode data submissions are also being tracked to increase the amount of high-resolution data being made available to the global archives in a timely manner. GTSPP is introducing a data state indicator scheme where it will be easier for the users of the data to identify the type of data processing and quality control which was applied to the data. The use of unique data tags associated to every observation will also permit to filter duplicates out more easily.

SOOP is making available several publications. For example, the Quality Control Cookbook for XBT data proposes methods to facilitate identification of erroneous features, the GTSPP real-time Quality Control Manual (WMO-IOC manual and guides No. 22) sets standards for quality control of real-time data and describes exactly the screening process that is employed, and the "Guide to operational procedures for the collection and exchange of JCOMM oceanographic data" (WMO-IOC manual and guides No. 3, UNESCO 1999) provides general guidance on operational procedures for the collection, encoding, quality control and exchange of oceanic surface and sub-surface temperature, salinity and current (BATHY, TESAC and TRACKOB) data.

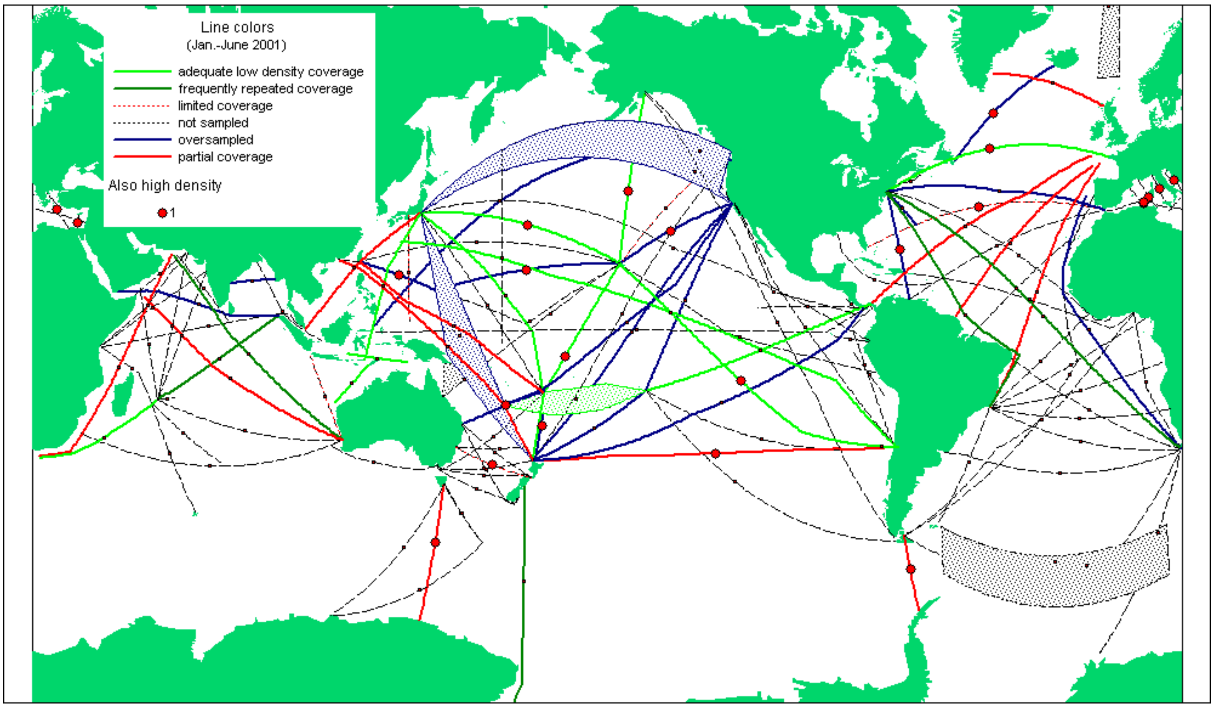
Figure 5: Summary of SOOP contributions for the first 6 months of 2000.



Country	Operator	Ocean	Drops
Australia	BOM	I	222.00
Australia	BOM	P	636.00
Australia	CSIRO	I	269.00
Australia	CSIRO	P	234.00
France	IRD_BREST	A	443.00
France	IRD_NOUMEA	A	15.00
France	IRD_NOUMEA	I	21.00
France	IRD_NOUMEA	P	832.00
Germany	BSH	A	541.00
India	NIO	I	74.00
Japan	JMA	P	72.00
Japan	JMA/JAMSTEC	I	196.00
Japan	JMA/JAMSTEC	P	242.00
Japan	TOHOKU-U	P	219.00
USA	NOAA	A	1 904.00
USA	NOAA	I	332.00
USA	NOAA	P	3 732.00
USA	SIO	A	212.00
USA	SIO	P	2 159.00

Drops	Good drops	Transects	GTS
12357	11952	541	6192

Figure 6: Coverage of XBT SOOP lines in terms of number of transects per month for the first 6 months of 2000.



3) Voluntary Observing Ship (VOS) programme

Implementation

Surface meteorological data are collected through the VOS programme which is now participating in the JCOMM Ship Observations Team of the JCOMM Observations Programme Area. First meeting of SOT will be held in Goa, India, 25 February to 2 March 2002. The VOS Programme provides surface marine meteorological observations from a comprehensive network of ships and is supported mainly in its activities by National Port Meteorological Officers (PMO).

"The Voluntary Observing Ships scheme, a framework document" (JCOMM Technical Report No. 4, WMO/TD-No. 1009) provides VOS operators with a global framework in which to develop and maintain their national VOS programmes. The document outlines VOS implementation strategy. The document describes current WWW and OOSC requirements, in terms of spatial and temporal resolution, and in terms of sensor accuracy, provides information about the current and past status of VOS programme. It also provides details about data management and real-time and non-real time data quality control for VOS instrumentation and data (e.g. PMOs visits at ports to check instrumentation, QC at the UKMO, etc.).

Status

Since the mid 1980s, there is a significant decrease in the number of VOS participants due in large part to the increase in ship size and the decrease in crew numbers affecting the worlds' fleet (figure 8).

There are now about 5500 SHIP reports distributed every day on GTS (table 1) from about 3650 ships (November 2001). On the other hand, the fleet reaches a level of about 7000 equipped ships (figure 8). Most ships report atmospheric pressure, SST, air temperature, wind, air pressure tendency, and wave data (table 1). An increasing trend in the total number of ship observations available on the GTS (figure 7) has been observed due in part to more days at sea for ships and an increased use of INMARSAT to transmit observations to shore.

Data management

All VOS data are distributed on GTS in SHIP format. Metadata information are available through WMO Publication No. 47 . Improvements are being realized with regard to this publication. A web accessible relational database is being developed at WMO which among other things will include information required by the VOSCLIM programme (e.g. IMO ship number, digital ship imagery, type and location of shipboard instrumentation). These products should be available by the end of the first quarter of 2002.

Evaluation, quality control

RSMC Bracknell has long assumed responsibility for quality monitoring of surface marine data leading to measurable enhancement of atmospheric pressure data from the VOS available on the GTS.

VOSCLIM

The activities undertaken in the VSOP-North Atlantic Project have been expanded in the new VOS Climate Project 1 (VOSCLIM I). Project objectives are to establish a subset of the VOS which will provide high quality marine data and metadata and serve as a reference data set for air-sea flux computations used in support of global climate studies. It is recognized that the success of this project depends on the cooperation of many people and institutions including well motivated ships officers and crew. Member nations involved in contributing to this project are recognized with great appreciation for their efforts in supporting this vital project. It also recognized that it would be of extreme benefit to combine high quality marine observations with upper ocean data. It therefore supports the suggestion that existing SOOP ships might be encouraged to participate in this project through the assistance of the Ship of Opportunity Programme Implementation Panel (SOOPIP). A project Data Assembly Center (DAC) located at NCDC/NOAA and a Real Time Monitoring Centre (RTMC) located at the UK Met. Office have been established . VOS operators and initial ship participants have been identified and the finalization of form generation and publicity material is in progress. A complete description of project objectives can be found in Annex V, Final Report, Subgroup on Marine Climatology, Eighth Session. which reflect the results of meetings held in Southampton, UK in Nov 1999 and Asheville, NC, USA in Oct-Nov 2000.

Figure 7: Monthly SHIP Reports Received by the French Meteorological Service since 1989

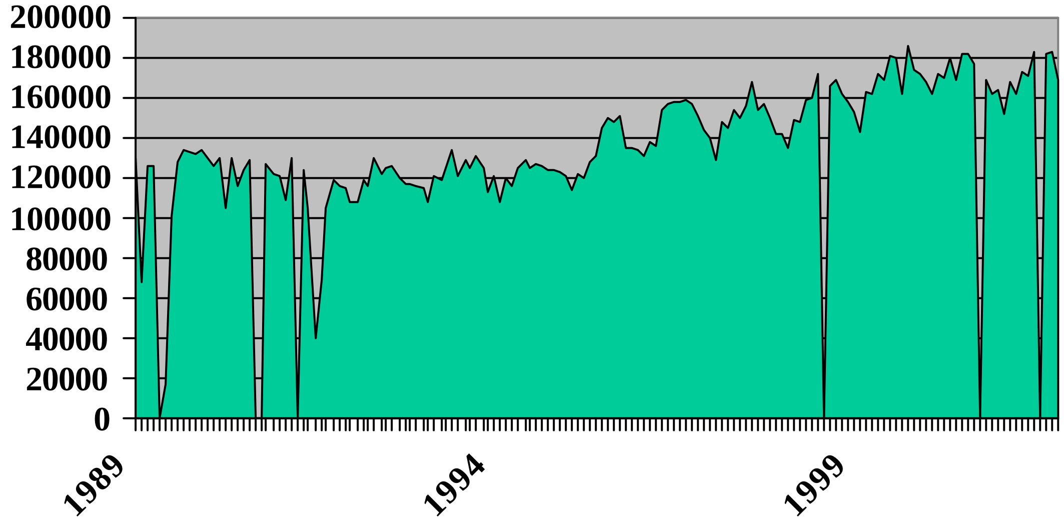
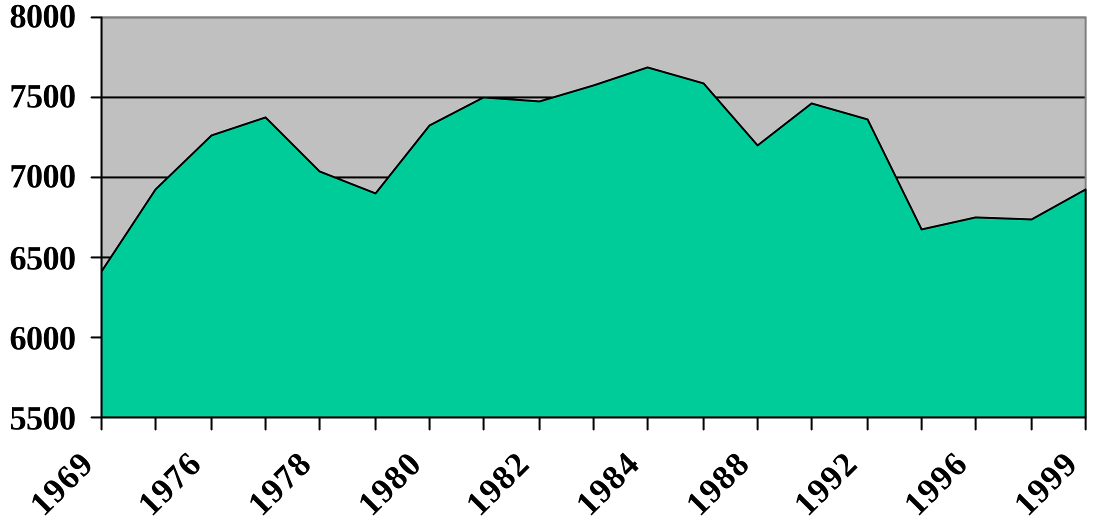


Figure 8: Development of the WMO Voluntary Observing Ships scheme (1969-1999)



4) ASAPP

Implementation

The ASAP Panel (ASAPP), formerly called the ASAP Co-ordinating Committee (ACC), consists of a group of national operators along with ECMWF and EUMETSAT. ASAPP is now participating in the JCOMM Ship Observations Team of the JCOMM Observations Programme Area. First meeting of SOT will be held in Goa, India, 25 February to 2 March 2002.

In order to expand the ASAP globally, the work programme of the ASAP Panel includes support to selected countries in the Southern Hemisphere to encourage and assist implementation of ASAP in these data sparse ocean areas. The Worldwide Recurring ASAP Project (WRAP) was recently established with with an ASAP on a route passing both the Cape of Good Hope and Cape Horn, calling at ports in Australia, New Zealand, Brazil and Western Europe and therefore permitting soundings from the Indian and Southern Oceans and the Tasman Sea, approximately every 3 months.

EUMETNET, which is a network grouping of 18 European National Meteorological Services, has started a programme on ASAP, called E-ASAP. In 2000 an ASAP on a route within the Mediterranean was established. In 2001 another one on a route between the English Channel and the Southeastern Seaboard of the United States is expected to become operational. E-ASAP is jointly funded by the EUMETNET Members, taking into account existing activities providing upper-air profile data from the oceans.

Status

The number of radio-soundings taken within the framework of the Automated Shipboard Aerological Programme (ASAP) averages around 5300 soundings annually in the period 1994 to 2000 (Table 4, Figure 9). There are fairly large fluctuations from year-to-year, mainly through the influence of enhanced activities in specific observational programmes such as FASTEX in 1997. Year 2000 showed a decrease of 22% in the number of soundings compared to 1999, and it is the lowest number of soundings in the last 7 years. This decrease can largely be ascribed to a large decrease in the number of soundings carried out by the United States, but a slight decrease in the German ASAP activity also plays a part. The total number of ASAP units operated in 2000 was 21.

The total number of ASAP soundings in 2000 corresponds approximately to the number of soundings which could be performed annually by a little more than 6 ocean weather ships. Their geographical distribution is presented in Figure 10. It displays the location of all the TEMP SHIP messages that were received in Toulouse, France, during 2000. Clearly, in 2000, most of the soundings were taken in the northern Atlantic Ocean.

Figure 3 shows the soundings which were distributed on GTS in TEMP SHIP format in November 2001. Table 1 shows that these soundings were made from 32 different ships.

The frequency of reception for TEMPSHIP platforms from January 1995 to December 2000 is shown in figure 11 for 500 hPa and 200 hPa levels and 00/12 UTC and 06/18 UTC cycles. The normal frequency maximum during the Northern Hemisphere summer shows a decreasing trend whereas the amount of reports received during the Northern Hemisphere winter in 2000 is smaller than the number of reports in the previous winter. The number of reports received at 06 and 18 UTC has been stable during year 2000.

Data management and quality control

Data quality control and monitoring is done by ECMWF. In its summary 2000 report on the evaluation of ASAP ships report, ECMWF reported that corrupted call-signs can be found with the same rates as in previous years. Only two cases of misplaced observations have been detected since January 2000. In both cases the observations were rejected and had no impact on the model analysis.

Computed RMS (i.e. observations compared with ECMWF first guess) values show a good quality standard with maximum RMS values around 0.6-0.9 degrees, which are reasonable figures. The comparison with similar statistics for the period January-August 1999 shows similar values. Similar statistics have been computed also for the COSNA area in order to compare TEMPSHIP with land based stations. The comparison shows that the quality of the TEMPSHIP observations is comparable or even better than land based stations.

Similar results were obtained with wind data. For example, for 400/100 hPa layer, the statistics have been carried out in terms of vector difference RMS in m/s. The stations have been then sorted by decreasing VRMS. The computed VRMS values range from 3 to 7 m/s showing high quality standards . Again the comparisons for the COSNA area shows that the TEMPSHIP quality standards are comparable to land based stations.

Comparisons between land-based Sondes and ASAP for temperature, humidity and wind (COSNA area, all cycles included) for January 2001 showed similar performance for both groups of platforms.

Table 4: ASAP soundings from 1994 to 2000 and contributions

	1994	1995	1996	1997	1998	1999	2000	Average
Denmark	806	772	772	954	701	752	768	789
EUMETNET							27	27
France	1389	1336	1249	1383	1364	1421	1360	1357
Germany	1925	2147	2061	1439	1139	1210	956	1654
Japan	530	630	707	747	956	1098	871	778
Russia			109	84	209	138	69	108
Spain	77	174	130	175	0	0	3	80
Sweden-Iceland		35	259	331	265	174	117	197
United Kingdom	287	110	145	53	0	151	220	138
United States		366	277	418	167	752	25	334
Total	5014	5570	5709	5584	4801	5696	4416	5256
Change to previous year		11%	2%	-2%	-14%	19%	-22%	

Figure 9: Number of ASAP soundings by country from 1994 to 2000

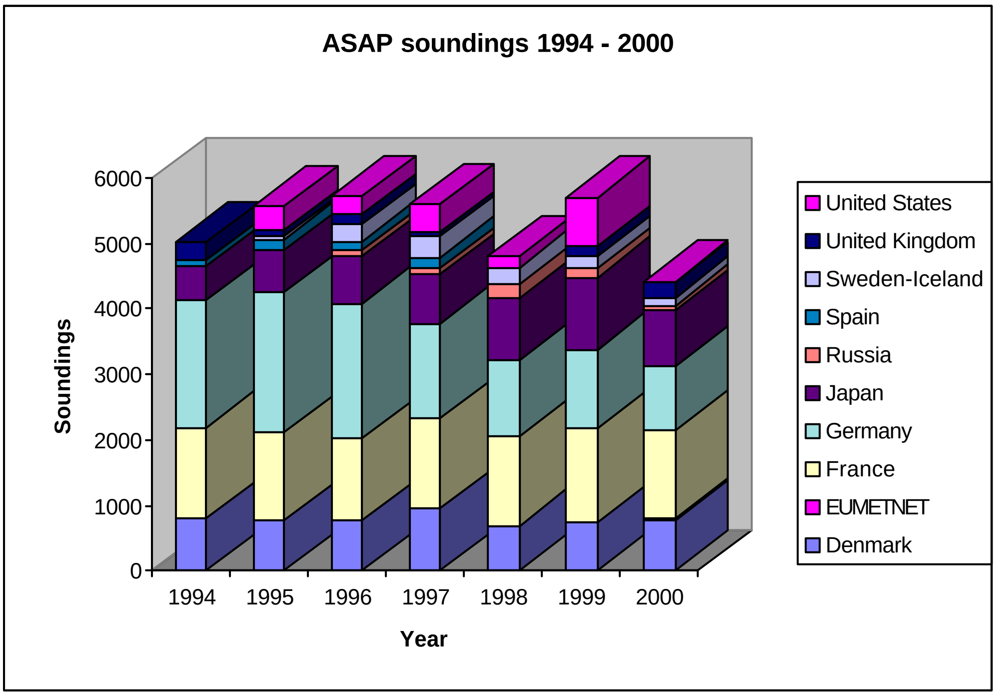


Figure 10: TEMP SHIP reports received at Météo France in 2000

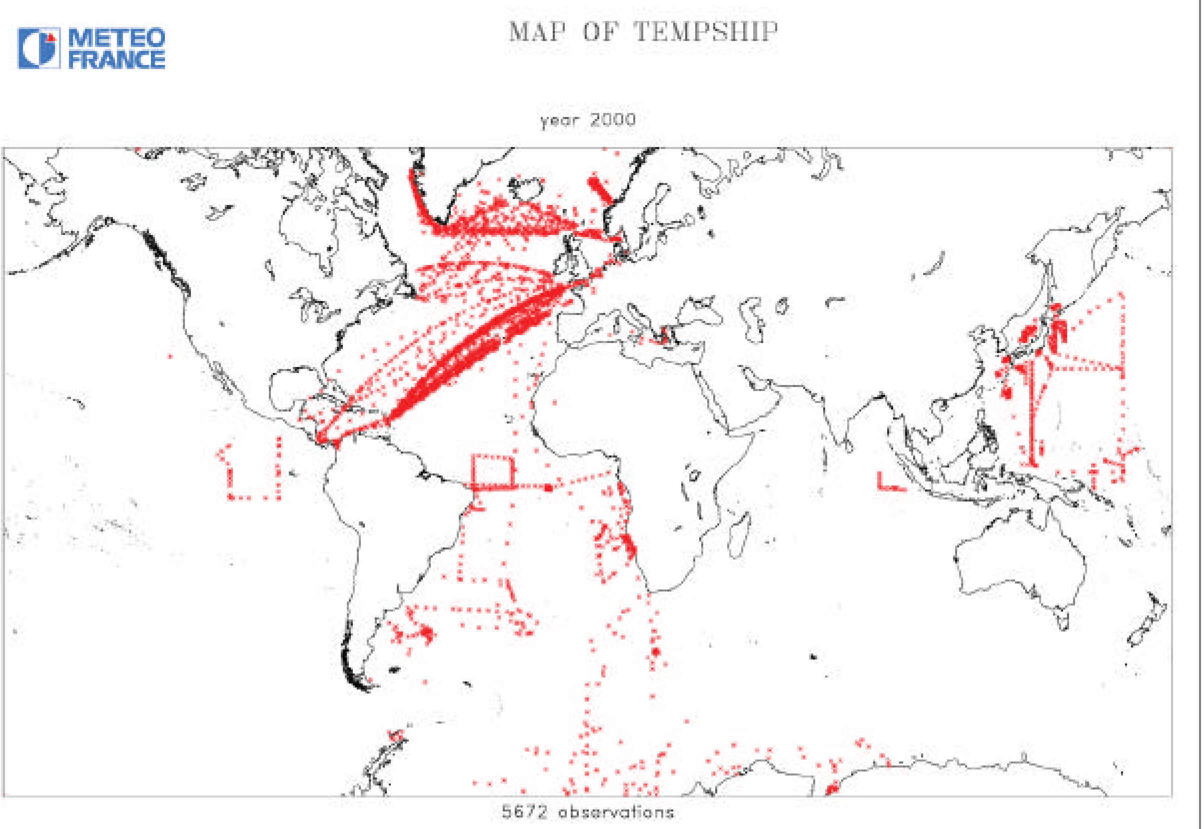
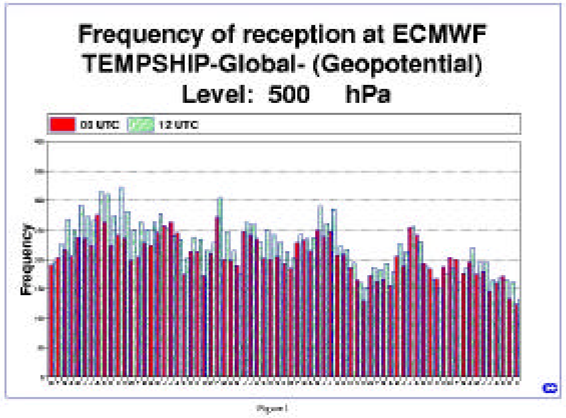
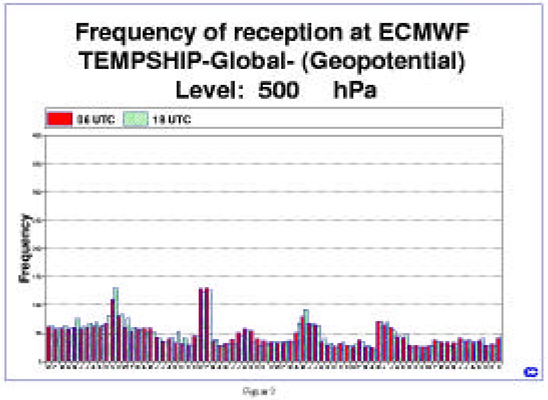


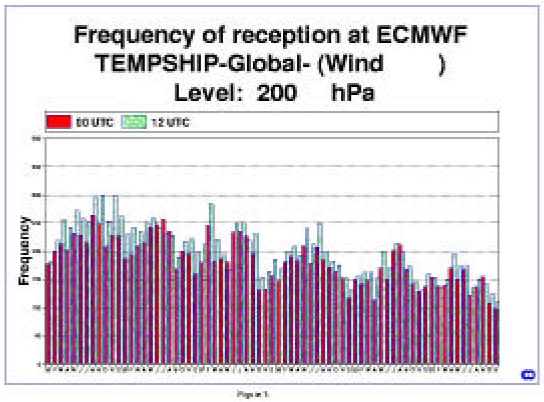
Figure 11: Frequency of reception for TEMPSHIP platforms from January 1995 to December 2000 for 500 hPa and 200 hPa levels and for 00/12 UTC and 08/18 UTC cycles.



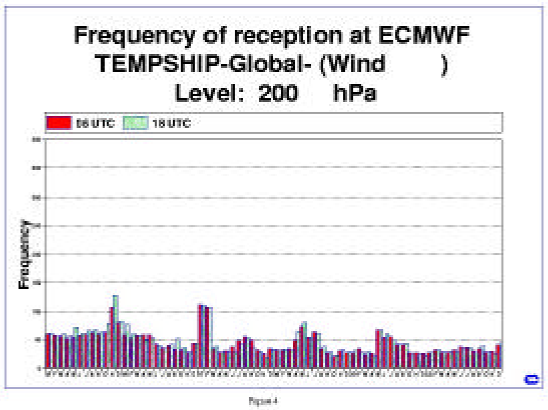
500 hPa, 00/12 UTC cycles



500 hPa, 06/18 UTC cycles



200 hPa, 00/12 UTC cycles



200 hPa, 06/18 UTC cycles

5) Argo

Implementation and planning

Argo is an internationally coordinated project managed by the Argo Science Team (AST, http://www.argo.ucsd.edu). Coordination includes project planning, including sampling and technical issues.

Countries presently having Argo plans that included float procurement or production included Australia, Canada, China, Denmark, France, Germany, India, Japan, New Zealand, the Republic of Korea, the Russian Federation, Spain, the United Kingdom and the USA, plus a European Union project Gyroscope. Combined deployments from these nations were planned to exceed 700 floats per year by 2002.

Float deployments are being planned and coordinated on a regional basis. The first Pacific Ocean implementation planning meeting was held in Tokyo in April 2000, hosted by the Japan Meteorological Agency (JMA), Ministry of Transport and the Science and Technology Agency. The first Atlantic Ocean implementation planning meeting was held in Paris in July 2000, at the invitation of IFREMER. The first Indian Ocean implementation planning meeting was held in Hyderabad, India in July 2001, hosted by the Indian Department of Ocean Development.

Are presently participating in Argo Australia (CSIRO, BOM), Canada (MEDS, IOS), France (Coriolis including participation from IFREMER, SHOM, IRD, Météo-France, IFRTP, CNES, and CNRS), Denmark (NBIA), Germany (BSH, IFM-Kiel), Japan (JAMSTECT, JMA, Japan Coast Guards), New Zealand (NIWA), Republic of Korea (METRI, KMA), Russia (cooperation of JAERI and FERHRI with Japan), UK (SOC, UKMO, UKHO, BODC), USA (SIO, AOML, PMEL, WHOI, University of Washington, Navoceano). The European Union Gyroscope project which involves participation from France, Germany, Spain, and UK is also a component of Argo. China and India are now planning to participate in Argo.

The table below reflects the year in which funds are provided for floats; it takes on the order of a year until such floats are available for deployment. To achieve a global array of 3,000 operating floats (assuming that 90% of the floats have an average lifetime of four years (the other 10% fail early)) it is necessary for the international community to provide floats at a sustained rate of 825 per year. A “Float Equivalent” is defined as a float (while not funded under the Argo Program) whose data are available consistent with the Argo Data Policy and provides the information equivalent to one Argo float. This table has been reviewed and updated by the International Argo Science Team at its meeting in Sidney, BC, Canada March 20-22, 2001.

Table 5: Funding plan of Argo float array, 1999-2001

Number of	Argo	Float	Argo	Float	Argo	Float	Proposed	Prop Float
Floats by Country	Funded	Equiv's	Funded	Equiv's	Funded	Equiv's	over next	Equiv's
	FY99	FY99	FY00	FY00	FY01	FY01	3 years	over 3 yrs
Australia			10		10		90	
Canada			10		42		90	
China					10		80	
Denmark						5		30
European Commission					80			
France		8	70		65		200	
Germany				18		22	100	35
India					6		150	
Japan			20		90		300	
New Zealand					2		10	
Republic of Korea					20		90	
Spain							24	
United Kingdom			13		50	5	150	40
U.S.A.	55		132	51	150	40	825	60
TOTALS	55	8	255	69	525	72	2109	165
TOTALS BY YEAR	FY99 =	63	FY00 =	324	FY01 =	597	Ave/Yr =	758

The Argo Information Centre (AIC, http://argo.jcommops.org/) is participating in the activities of the JCOMM *in situ* Observing Platform Support centre (JCOMMOPS) which *inter alia* provides integrated information on programme status and logistical opportunities available for marine platform deployments (e.g. deployment of floats and drifting buoys, servicing of moored buoys, ships-of-opportunity, air deployments, etc.). The Argo Coordinator who operates the AIC is supporting the Argo project in a number of ways including (i) float deployment notification (IOC res. XX-6), (ii) assistance to reach agreement for deployments within EEZ of Member States, (iii) recovery and refurbishment of floats after their operational life-time, (iv) programme promotion and provision of information on programme activities, and (v) assistance with regard to programme implementation.

The AIC is therefore building a web information system and associated database to provide dynamic information on the programme. This includes for example list of operational platforms, their locations (dynamic maps), information on telecommunication systems used, parking depth, list of sensors, contact points, programs status and organization, GTS statistics, deployment opportunities, etc. **The AIC does not provide float data**, it provides only statistics and programme information. However, AIC provides a "gateway" to guide users on how to download the data from the official GDACs. On another hand, the AIC provides mailing lists (argo@jcommops.org & argo-tech@jcommops.org) , a forum (http://forum.jcommops.org) and a monthly newsletter which informs the community on the status of the program.

Status

In December 2001, 10% of the Argo network was filled (~300 floats). The maps below show the actual operational status of the program, by 1st December 2001and for November 2001.

Figure 12: Last positions and age of last transmission of operational Argo floats as of 1 December 2001.

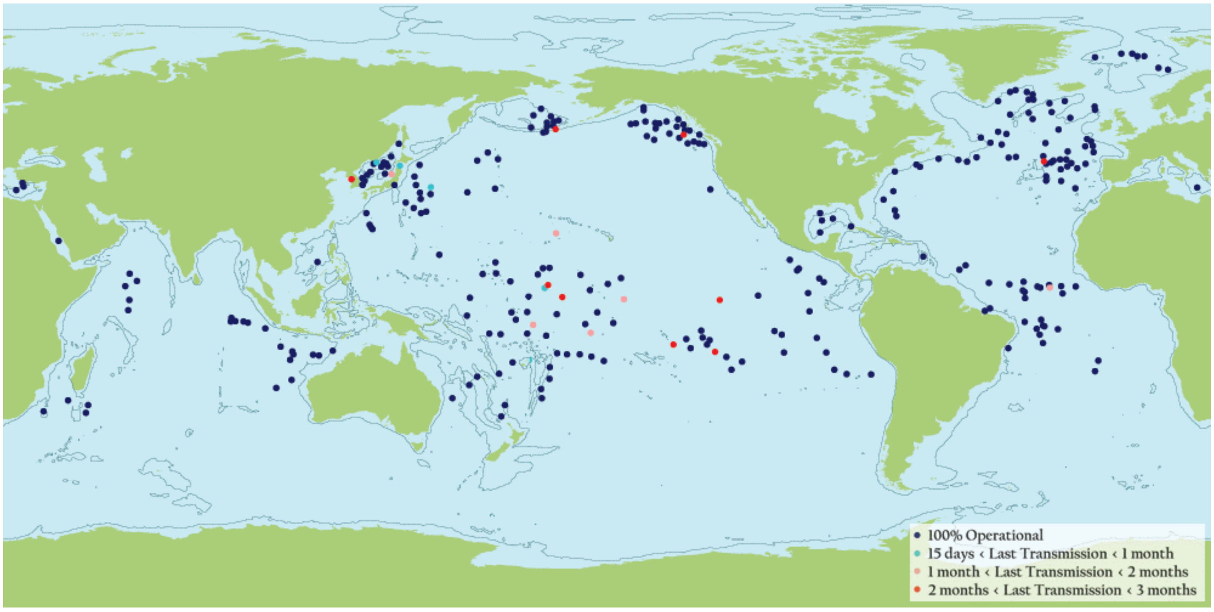


Figure 13: Last positions of operational Argo floats by country as of 1 December 2001.

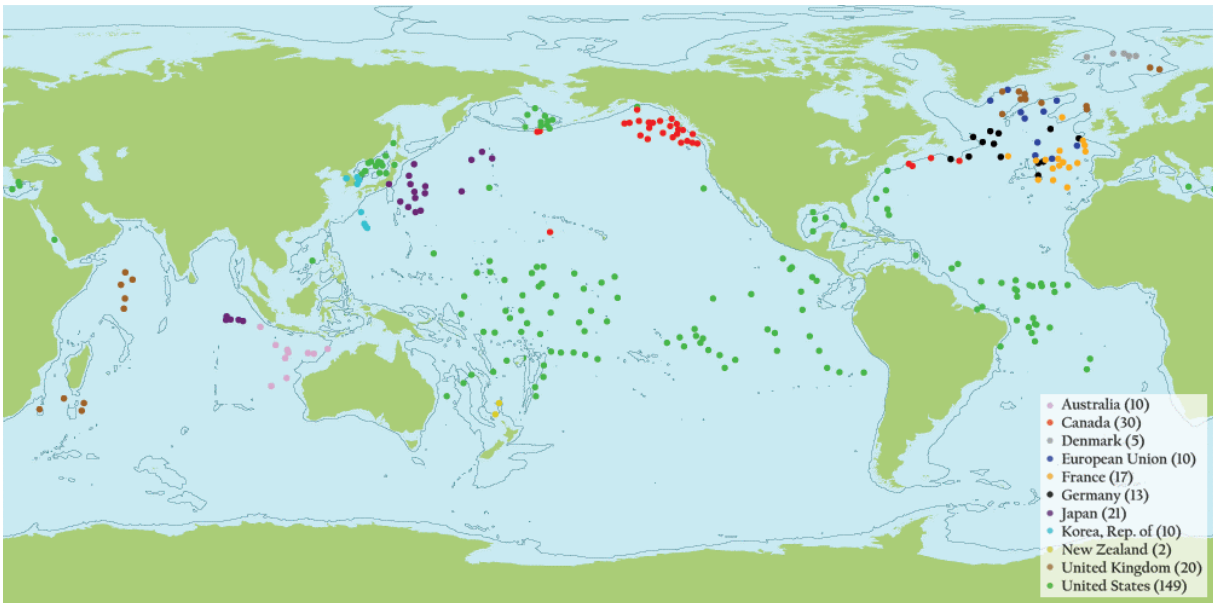
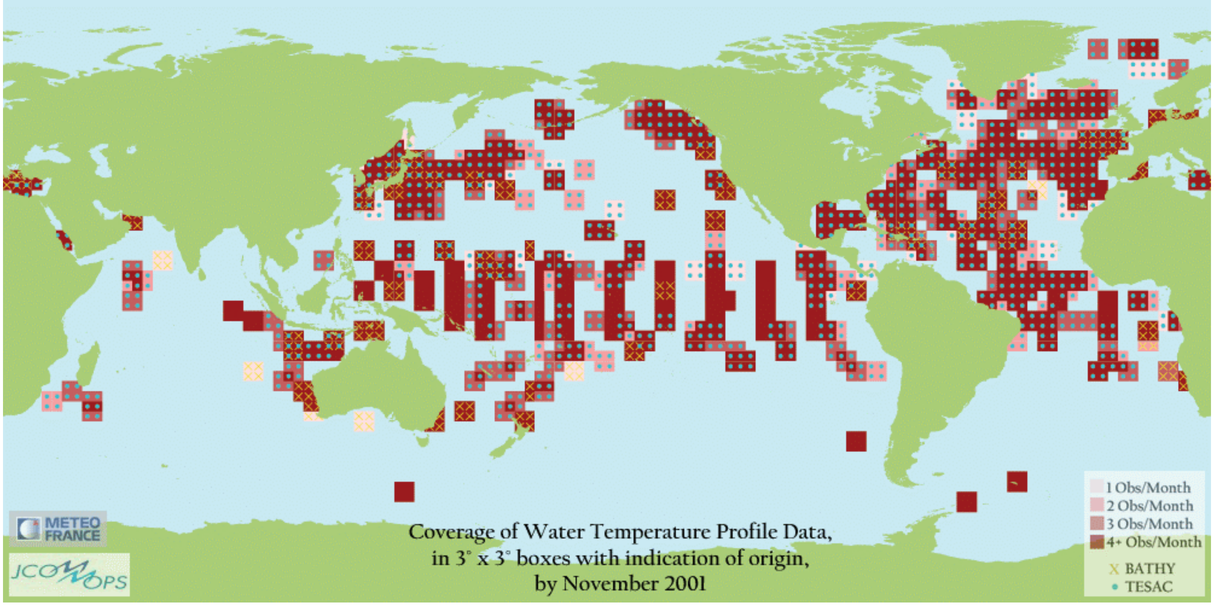


Figure 14: Coverage for November 2001 of water temperature profile data in 3°x3° box with indication of origin of the data (i.e. BATHY, TESAC)



Remark: Profiling float data are basically provided in TESAC format while XBT data are basically provided in BATHY format.

Data management, Evaluation, quality control

Access to Argo float data is free and unrestricted with no period of exclusive use. Argo data are distributed globally in real-time over the Global Telecommunication System (GTS) of WMO within 24 hours of the pop-up time. Simple automatic quality control checks are applied before GTS distribution of the data. Scientifically quality controlled data will be available within 3 months via the Internet. Because of the requirements for delivering data to users within 24h of the float reaching the surface, the quality control procedures on the real-time data are limited and automatic. Presently the TESAC code form is used to send the float data on the GTS. In the future BUFR code will replace TESAC.

The first Argo data management meeting was held in Brest, France, in October 2000; the second one, which was the first session of the newly established Argo Data Management Subcommittee, was held in Brest in November 2001. The Data management workgroup agreed to make the US GODAE and IFREMER Data Servers, the two official data sources for the Argo program (GDACs). The goal is for these two servers to be fed automatically by all DACs with the latest version of their scientific data (profiles). Both servers should be synchronized to ensure consistency between the two data sets. The two GDACs will distribute data through ftp and http.
On the other hand a Global Argo Data Repository will be build by NOAA/NODC to assure long-term archival of the Argo data and to provide unified graphical user interface-based tools for efficient access, retrieval and display of the Argo data via the Internet. All Argo data management aspects are confined in the Argo data management handbook, which is being updated regularly (http://www.meds-sdmm.dfo-mpo.gc.ca/meds/About_MEDS/Meetings/ArgoDM/V3DMHandbook.doc).