APPENDIX A

Report of the RNODC for Drifting Buoys
Integrated Science Data Management (ISDM)
(August 2008 to July 2009)

Submitted to the DBCP-XXV
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IOC of UNESCO, Paris, France

Introduction

The Integrated Science Data Management (ISDM), previously the Marine Environmental Data Service (MEDS), of the Department of Fisheries and Oceans in Canada became a Responsible National Oceanographic Data Centre (RNODC) for Drifting Buoy Data on behalf of the Intergovernmental Oceanographic Commission (IOC) and the World Meteorological Organization (WMO) in January 1986. The RNODC is a national data centre assisting the World Data Centres (WDCs) for Oceanography and was developed to enable the international exchange system to cope with the increasing variety and volume of oceanographic data being collected. As part of its role, RNODC-ISDM acquires, processes, quality controls and archives real-time drifting buoy messages reporting over the Global Telecommunications System (GTS), as well as delayed mode data acquired from other sources. All data are made available to the international scientific community through an online request system. Although ISDM was officially recognized as an RNODC in 1986, its archive started in late 1978 with the First GARP Global Experiment (FGGE) program and is currently growing at a rate of 1 million messages per month.

At IODE-XVIII (Oostende Belgium, April 2005) a resolution was adopted to abolish the system of RNODC's. This was in response to a review of IODE activities and in particular, the lack of understanding and use of the RNODC system. The resolution instructed the Chair of IODE to discuss with RNODC host centres how their operations, if considered essential for the international community, could be maintained and properly acknowledged. The services provided by ISDM as the RNODC for drifting buoys were determined to be essential for the international community and as such will continue operating as an RNODC until the proper accreditation has been established.

Overall annual statistics summary

All statistics, with the exception of the maps and unless otherwise stated, refer to data received in BUOY code which includes both drifter and moored buoys.

During the period August 2008 to July 2009, ISDM archived an average of 930,000 BUOY reports per month (Figure 1) and received reports from an average of 1487 drifting and moored buoys per month (Figure 2), which is about the same as last year. On average each buoy is reporting 21 messages per day (Figure 3). Figure 4 shows the number of some of the meteorological/oceanographic observations posted on the GTS and Figure 5 shows the number of drifting buoys that reported Sea Surface Temperature (SST) and other meteorological observations. Drifting buoy tracks during the year can be seen in Figure 6. Of the BUOY messages received, 99% of the locations were quality flagged as good (Figure 7) and required on average 29 days

from observation to reach the archive (Figure 8) (See Data Flow to ISDM). The size of the drifting buoy archive is approximately 34 GB with 75 million drifting and moored buoy records from 1978 to July 2009.

Summary of work carried out during the year

DBCP QC Guidelines for Location Data

ISDM sent its first message on the BUOY-QC distribution list (buoy-qc@vedur.is) in October 2002 and continues to participate by sending monthly statistics on the number of erroneous positions on the distribution list. Maps displaying buoys tracks of the previous month for the Arctic, Antarctic and the rest of the world can be seen here: http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Prog_Int/RNODC/Buoy-QC/Buoy-QC.htm. The maps serve as a visual aid to the statistics file and allows the user to "mouse over" tracks to determine which buoys are reporting erroneous locations. Figure 7 shows quality control percentages of all position data during this past year.

Implementing New BUFR Software

Drifting buoy data is now being reported on the GTS in both BUOY and BUFR (Binary Universal Form for Data Representation) format. Decoding software for both compressed and uncompressed BUFR formats has been tested and verified against BOUY Code received through our connection with Environment Canada. Stress testing the new Java processing system and results comparisons against the operational system will begin shortly. We do not anticipate any problems moving to an operational system using BUFR source data. The software has been further developed to decode and encode Argo data reported in BUFR.

Update SVP Data Submission

ISDM is, along with Atlantic Oceanographic and Meteorological Laboratory (AOML), the Data Assembly Centre (DAC) for Surface Velocity Profile (SVP) data collected by drifting buoys. AOML handles the initial processing of the data received through Service Argos. They carry out quality control on the data and generate the interpolated files. On a regular basis, they forward the data (krigged, edited and raw) to ISDM who function as the archive and distribution centre.

All AOML RAW and KRIG/P&S SVP submissions and data products up to 2007 are now processed to the ISDM archives and available for download from our web site (http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/drib-bder/index-eng.htm). After recent organizational and system improvements we expect a quick turn around of future AOML submissions.

Goals for 2009/2010

Receive process and update 2007/2008 SVP submission from AOML.

ISDM has a proposal in to the Canadian IPY office for funding to enhance our ability to display and provide access to polar data and products. This would include new polar projection capabilities within GeoPortal and enhanced WMS registry services. Arctic drifting and moored data is being considered for early pilot testing and system development.

Significant progress within DFO and ISDM has been made to move towards a more centralized IT service architecture. Over the past year ISDM has made significant enhancements internally to our main archive servers and data processing environments. This has given us increased capacity and new technologies that will carry us forward with new opportunities for system developments and online offerings. Although much work remains to complete the migration from our relatively independent operations to Departmentally centralized services we expect to be able to reallocate resources back to system development and enhancements again over the coming years.

ISDM and DFO Science continue to enhance and improve the structure, navigation and online offerings of our web services. The Drifting Buoy Programme and RNODC content and organization have been improved and we look forward to adding additional functionality and online offerings in the coming months and years. We are currently looking into replacements of SVG maps with Google Map/Earth products and links through Web Mapping Services like ISDM's GeoPortal.

If there is still a need for the Buoy QC archive of messages to the BUOY-QIR email distribution we will update the online application that failed due to email attachments and a Departmental switch to exchange mail services.
http://www.meds-sdmm.dfo-mpo.gc.ca/MEDS/Databases/DRIBU/buoyqc/search_e.asp

Working with IABP and Ignatius Rigor we hope to produce updates in the form of a web site and DVD to the CD produced in 2000.

Data flow to ISDM

In the real-time drifting buoy processing system, GTS data are ftp'd to ISDM every half hour from the Canadian Ice Service, a branch of the Meteorological Service of Canada (MSC) of Environment Canada (EC). Every hour, these messages are sorted through to extract BUOY messages, as well as other oceanographic reports such as BATHY and TESAC. Once a day, the BUOY messages are decoded into an in-house format after which automated tests are run to check for acceptable ranges of values in several measurements (SST, atmospheric pressure, air temperature, wind direction/speed, sub-surface temperature/salinity and wave height/period) and meta-data (date/time, latitude and longitude). The data are stored in a file for a month at which time software to detect duplicates is run making the data available for quality control. Trained scientific personnel review plots of buoy time series of the measurements, drift tracks and speed graphs. Flags are set according to the international QC flag definitions derived from IGOSS, now JCOMM. Once completed, the data are added into the archive and the website is updated.

With a monthly QC system, it takes anywhere between one and eight weeks for BUOY data to be added into the archive. Last year on average, the delay between reception and update was 32 days. Frequency of the data arriving into the archive as compared to observation date and time can be seen in Figure 8. With the increasing number of messages received each month, the QC process takes longer and therefore increases the time it takes to update the archive. This, along with a growing need for real-time drifter data in a more timely manner, is prompting ISDM to look at increasing the frequency of its archive updates.

Data distribution

ISDM continues to distribute the data upon request, on a regular basis and via the web. Last year, ISDM received over 40 requests for drifting buoy data. Requests come from universities, government organizations, private consulting companies and individuals.

Regular data distributions include sending raw drifting buoy GTS messages daily to the US National Oceanographic Data Center (NODC) by FTP, as well, a yearly file of all the QC'd drifting buoy data on DVD. Specialized services and products of raw data can be made available before normal monthly QC and archive updates on a case by case basis where not more appropriately available elsewhere.

ISDM website is updated after monthly quality control processing and contains many trajectories, inventories and statistics of the buoy archives by month and year on a global scale, as well as for specific regions such as the Arctic, Antarctic, North Pacific, Southern Atlantic, EGOS (European Group on Ocean Stations) and Indian Ocean. Except for Arctic data for the current month, data are not available on the website and must be requested through the on-line Data Request Form. The current month's data for the Arctic is made available through a special application designed for the IABP region which shows real-time tracks of Arctic floats on a scalable map with the option to view specific buoy data. The URL for drifting buoy data and information at ISDM is http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Databases/DRIBU/drifting_buoys_e.htm.
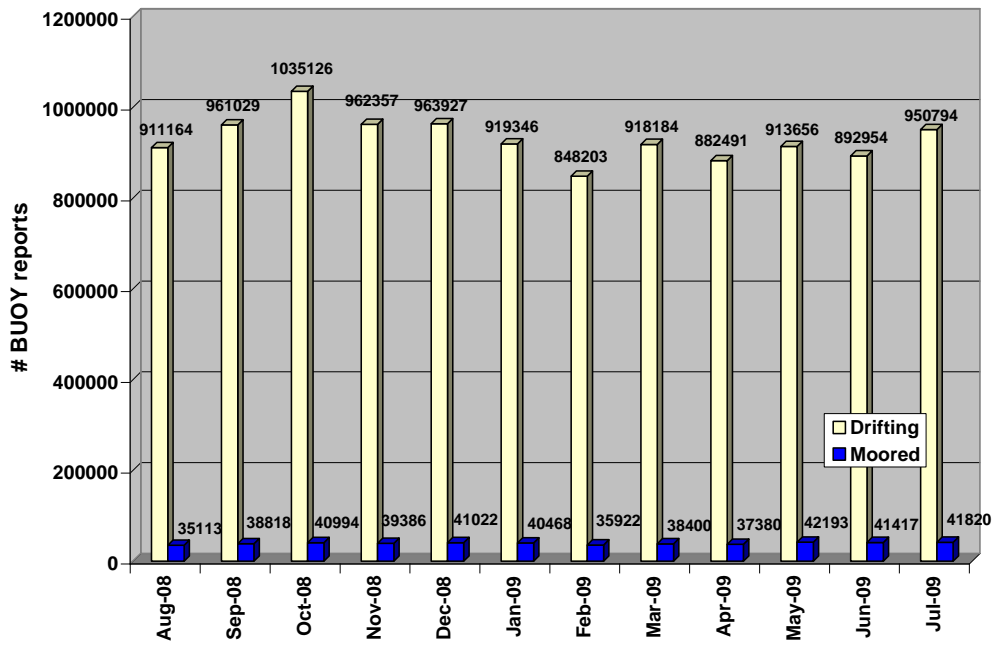
Number of BUOY Reports from Drifting and Moored Buoys

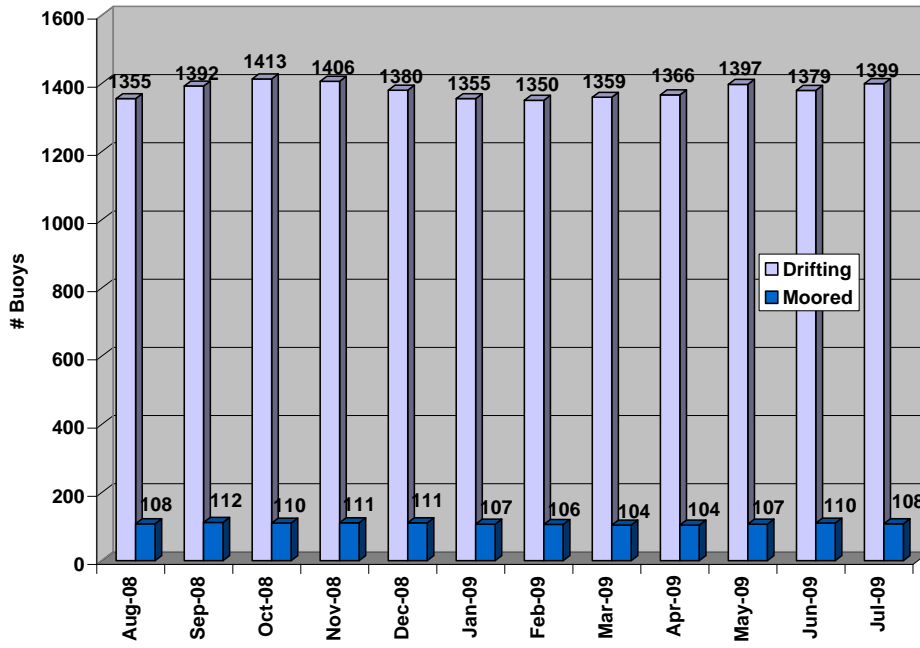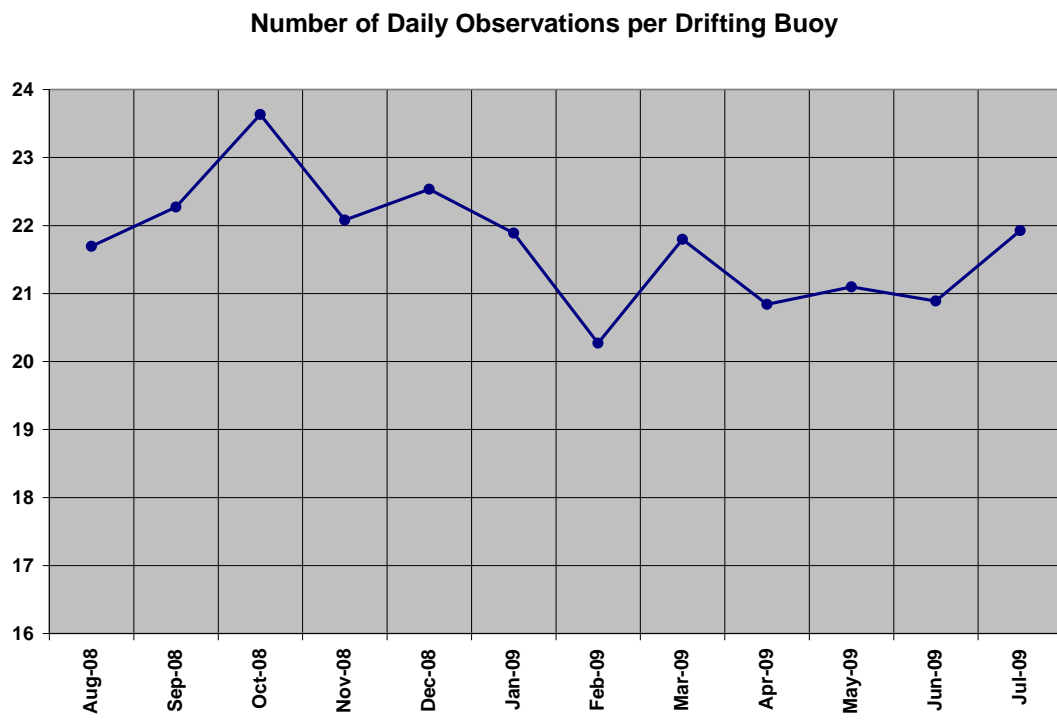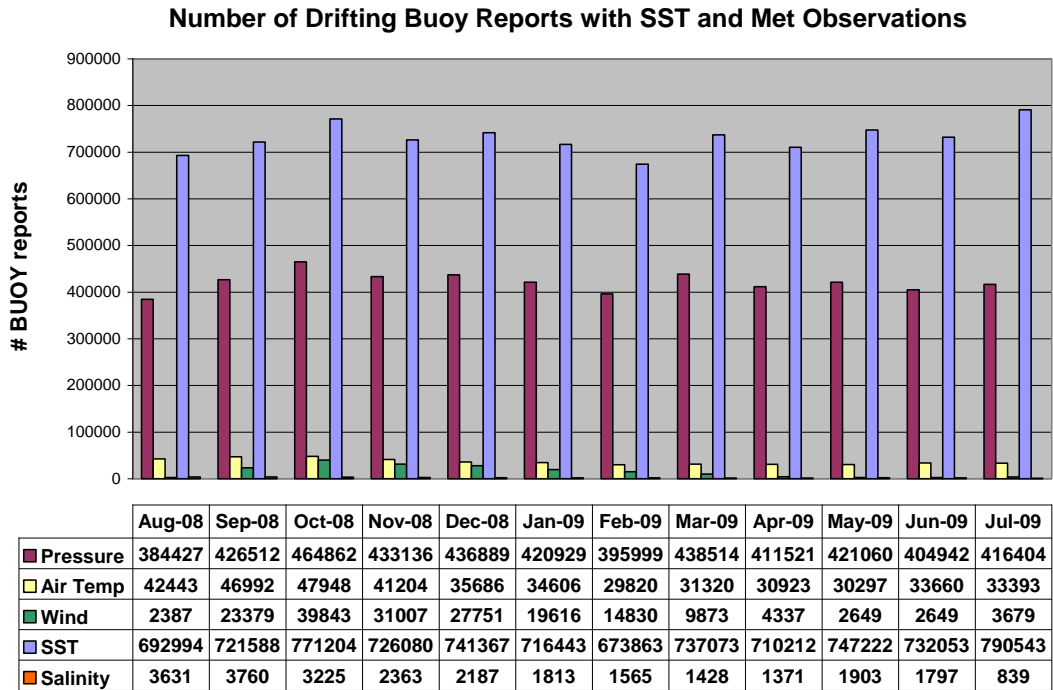
Figure 1

Number of Drifting and Moored Buoys

Figure 2

Number of Daily Observations per Drifting Buoy

Figure 3

Number of Drifting Buoy Reports with SST and Met Observations

	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09
■ Pressure	384427	426512	464862	433136	436889	420929	395999	438514	411521	421060	404942	416404
□ Air Temp	42443	46992	47948	41204	35686	34606	29820	31320	30923	30297	33660	33393
■ Wind	2387	23379	39843	31007	27751	19616	14830	9873	4337	2649	2649	3679
■ SST	692994	721588	771204	726080	741367	716443	673863	737073	710212	747222	732053	790543
■ Salinity	3631	3760	3225	2363	2187	1813	1565	1428	1371	1903	1797	839

Figure 4

Number of Drifting Buoys Reporting SST and Met Observations

Figure 5

Drifting Buoys - August 2008 to July 2009

ISDM - GDSI 09-Sep-2009
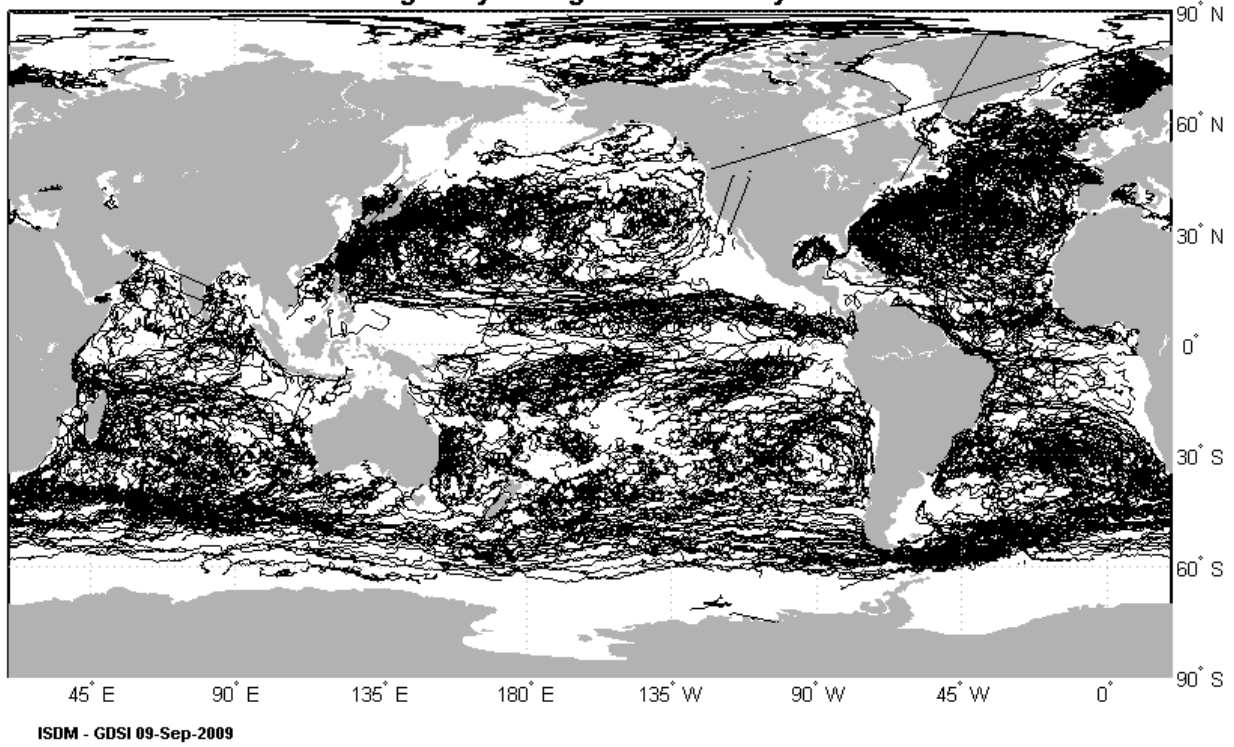
Figure 6

Quality of Location
August 2008 to July 2009

QC 1 - Correct
11,554,972 msgs - 99.3%

QC 4 - Erroneous
77,193 msgs - 0.7%
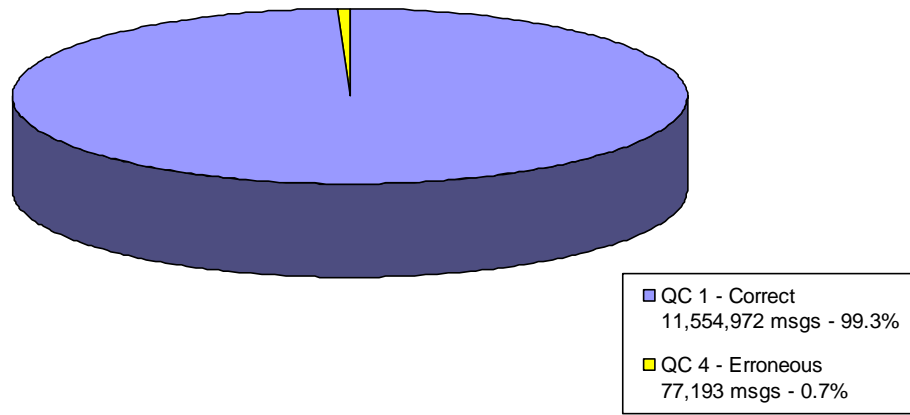
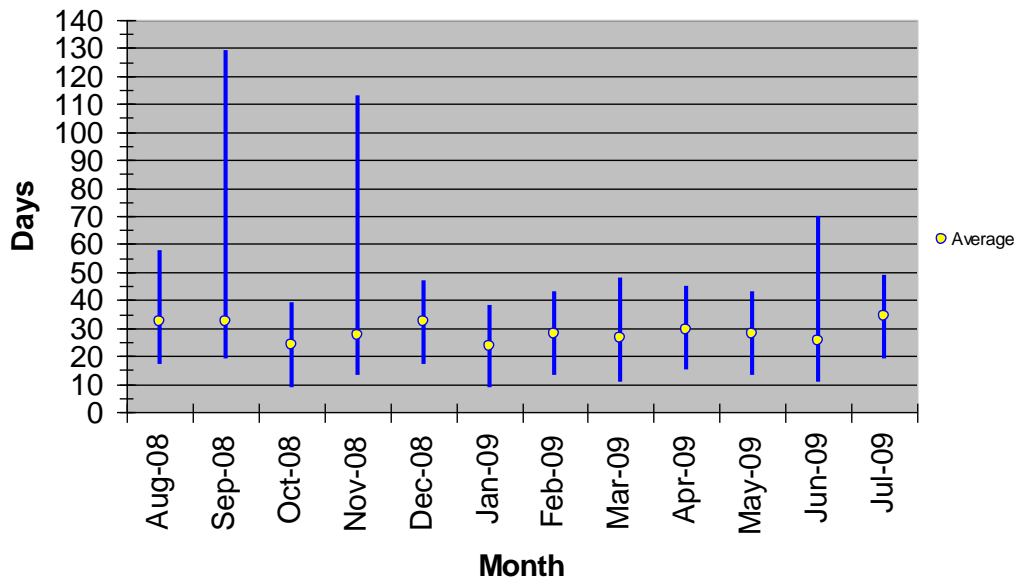**Figure 7**

Timeliness of Data into Archive
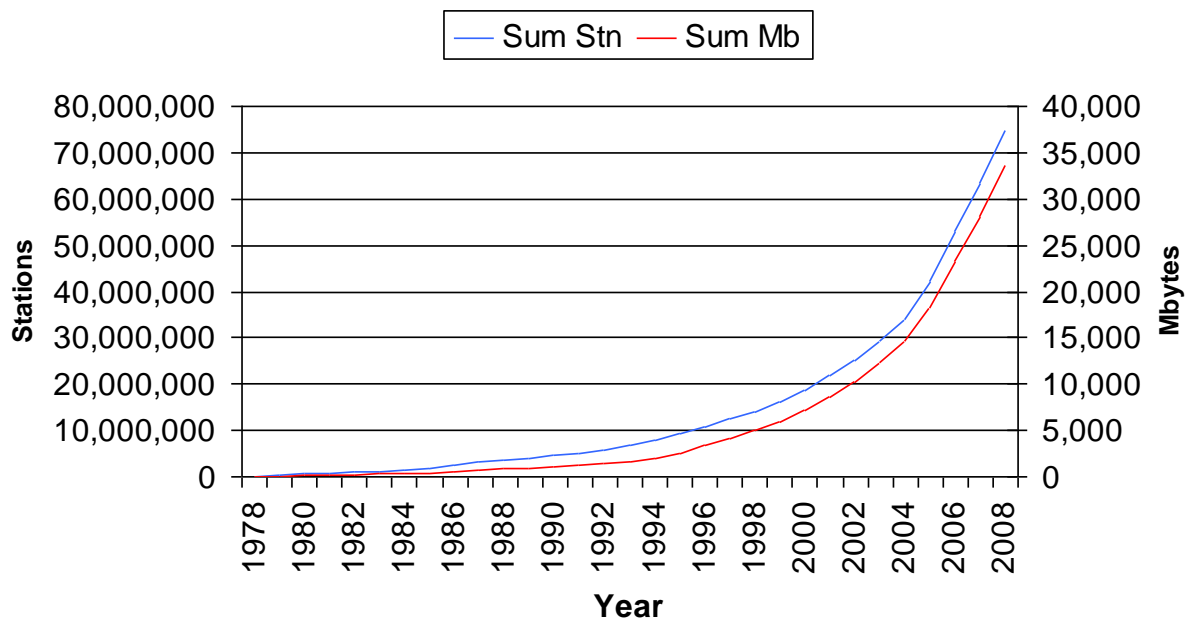

Figure 8

Growth of BUOY Archive

Figure 9

Top 5 Parameter Growth

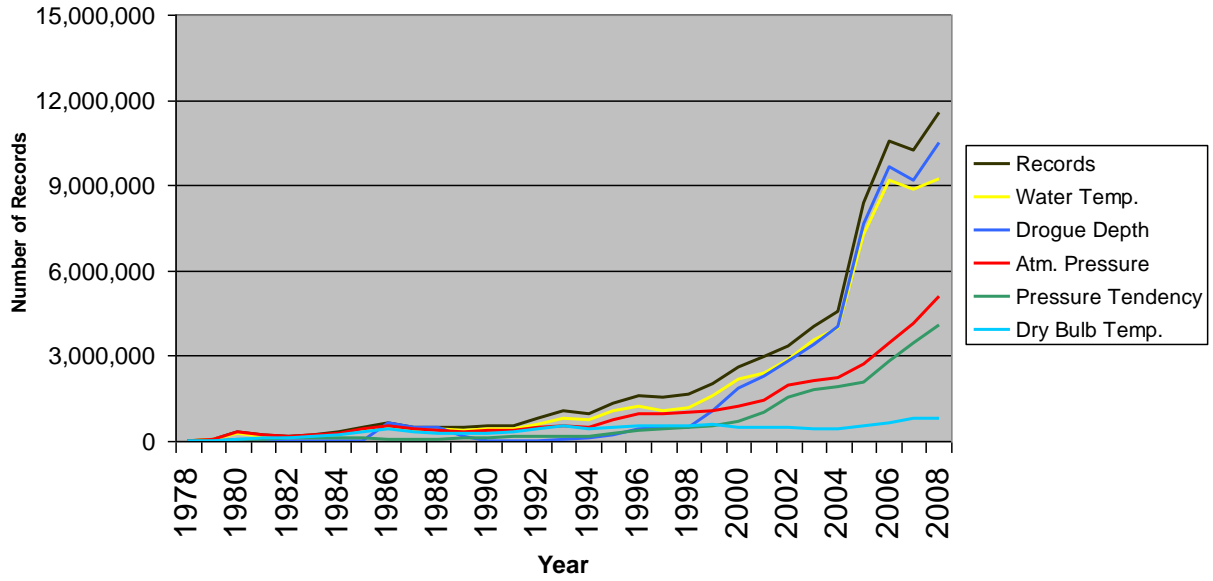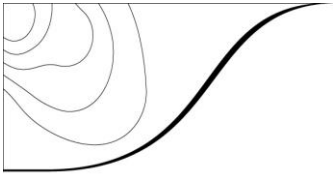**Figure 10**

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METEO FRANCE
Toujours un temps d'avance

SOC for Drifting Buoys Report

2008 – 2009

The Specialized Oceanographic Center (SOC) for Drifting Buoys has been run continuously during year 2008-2009. SOC is made of Météo-France teams in Toulouse and Brest as well as teams involved in the inter-agency program Coriolis (Ifremer leading the program, and in charge for delayed mode aspects, portal to external users, etc). A daily collection and archiving of buoy reports from the global ocean is performed by Météo-France. Collaboration within the Coriolis project (www.coriolis.eu.org), with JCOMMOPS and also CLS-Argos are main aspects of this SOC, beside regular exchanges with other data centres, measurement teams and agencies, and with users.

Météo-France operates quality control (QC) procedures on drifting buoys data. Warning messages are sent to the buoy-qir@vedur.is mailing list of Internet, when a problem appears (e.g. bad location detected, wrong acceleration and loss of drogue, sensor drift, etc) or when a modification seems needed (i.e. to recalibrate or to remove a sensor from GTS) via the JCOMMOPS interface. Statistics on comparisons with analysis fields are set up for each buoy. Monthly statistics are sent to the buoy-qir@vedur.is mailing list too.

Buoy data QC tools developed by Météo-France are available on the Internet (www.meteo.shom.fr/qctools) to help buoy operators to check their own buoys: monthly statistics carried out by 4 meteorological centres for individual buoys; plots of data and differences with model outputs; blacklists of buoys reporting dubious air pressure values or being perhaps ashore can be seen. The TESAC QC has been modified during the second half of 2009 in the following way : previously, reports with incomplete levels (temperature or salinity missing) were fully rejected ; they are now kept, missing data being indicated by slash groups). Few more tenths of reports pass through QC every day.

In addition to the products linked to buoy QC, the SOC for Drifting Buoys produces monthly products for buoys, moored buoys, drifting buoys, ships. Data are delivered on request, or on a regular basis and via Internet (http://esurfmar.meteo.fr/doc/o/daim).

Examples are given for the last year.

Figures 1, 2, 3 and 4 show the time evolution of reports for wind and for pressure respectively for all BUOY reports (showing all buoys, moored buoys and Drifting Buoys) and SHIP reports, since January 2008.

Figure 5 shows the time evolution of WAVEOB reports and sensors since January 2008.

Each month, mapping position plot charts and Marsden square distribution are produced for BATHY, TESAC, SHIP, BUOY and TRACKOB.

Figures 6a,b to 10a,b show these products for June 2009. "a" stands for mapping position plot charts, and "b" for Marsden square distribution. Figures 6a and 6b: BATHY, Figures 7a and 7b: TESAC, Figures 8a and 8b: SHIP, Figures 9a and 9b: BUOY, and Figures 10a and 10b: TRACKOB.

Each month, Marsden square distribution charts of mean monthly data availability (top) and percentage of BUOY reports compared to SHIP + BUOY reports (bottom) for wind, pressure, air temperature, sea surface temperature are produced.

Figures 11 to 14 show such products for June 2009. Figure 11: Wind, Figure 12: Pressure, Figure 13: Air temperature, Figure 14: Sea surface temperature.

Since the 1st of January 2002, Météo-France has been providing the Coriolis Data Centre with surface current data computed thanks to SVP drifter tracks. Coriolis contributes to the French operational oceanographic project with in-situ data. Buoy positions, obtained from the GTS, are interpolated every 3 hours. Surface current data are computed over 6 hours, on a weekly basis. Data are flagged with drogue presence indexes. Since mid-2004, wind speed and wind stress data from ECMWF analysis model coupled with sampled surface current data are delivered too and used by operational oceanography centres (such as Mercator, French component of the Godae international experiment).

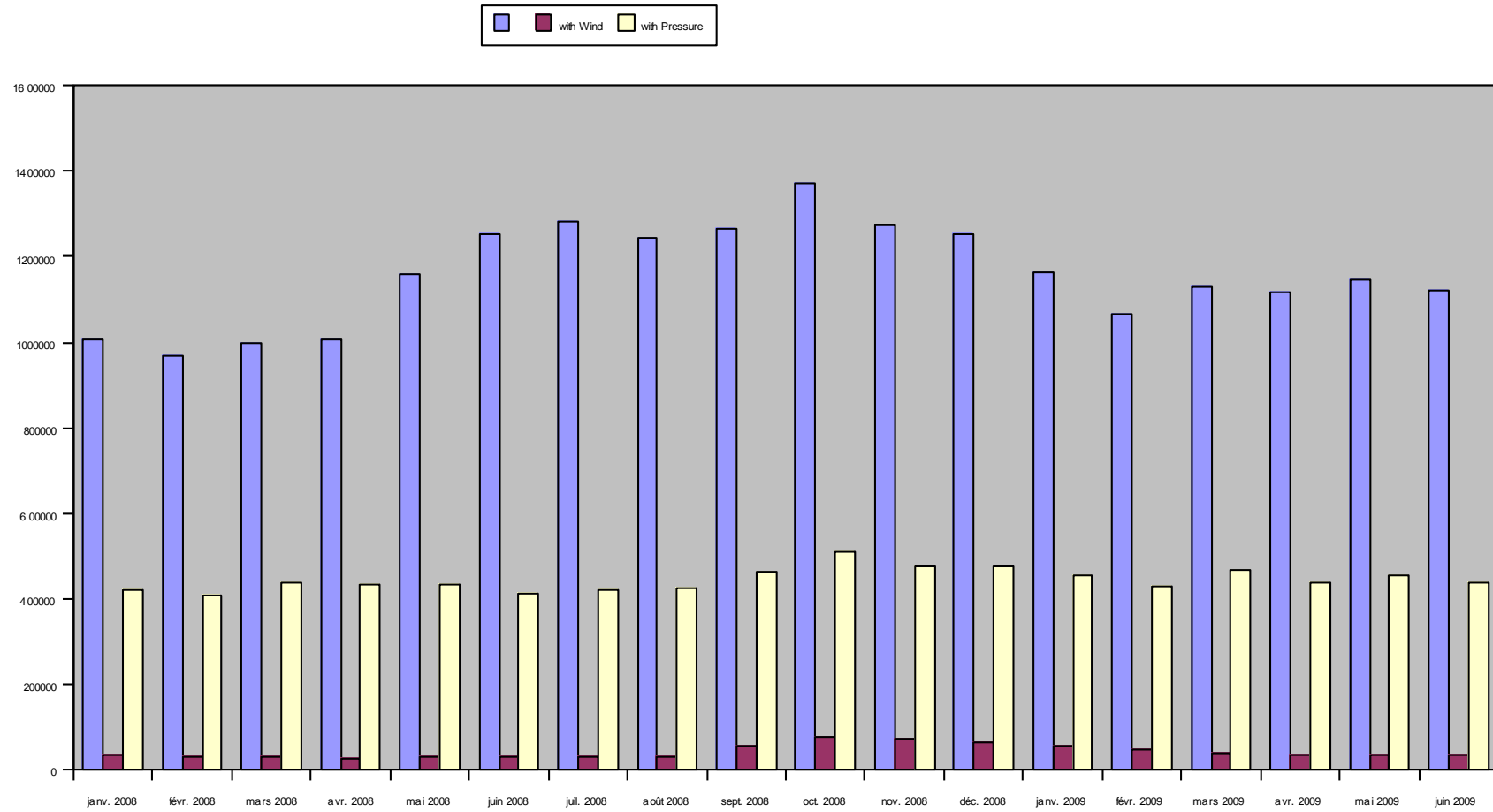**Figure 1. Time evolution of BUOY reports for wind and pressure**

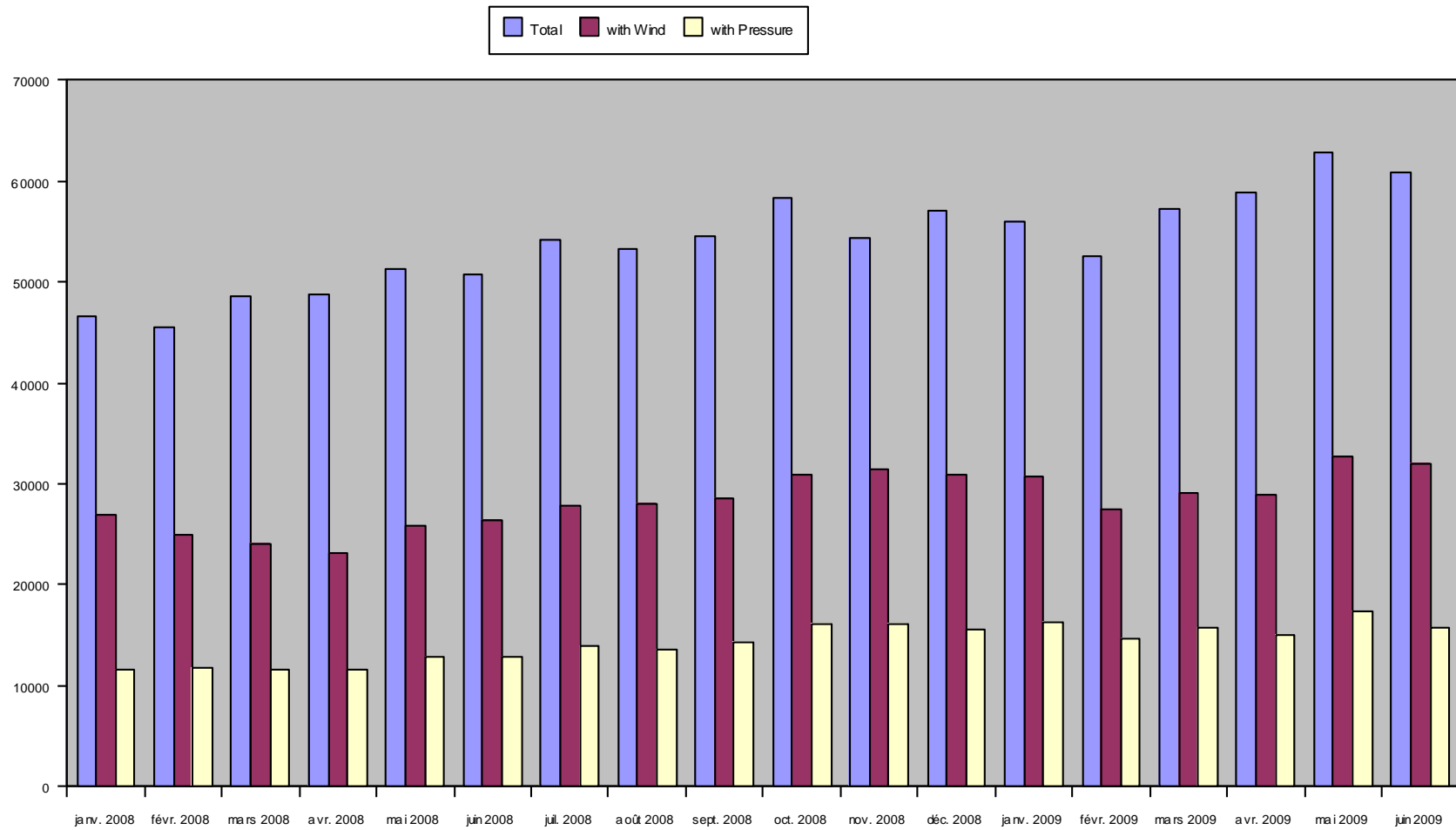**Figure 2. Time evolution of Moored BUOY reports for wind and pressure**

Figure 3. Time evolution of Drifting BUOY reports for wind and pressure
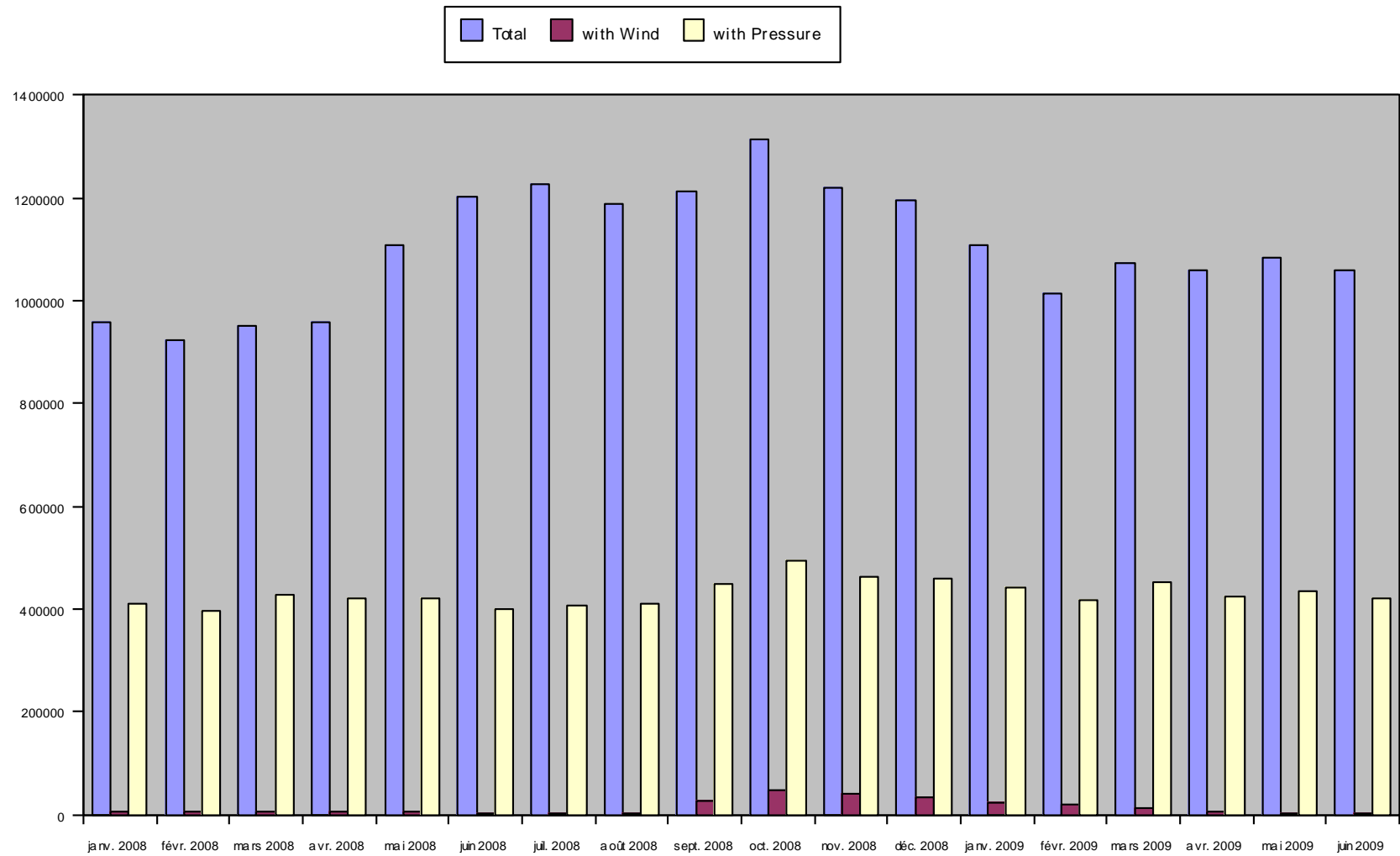
Figure 4. Time evolution of SHIP reports for wind and pressure
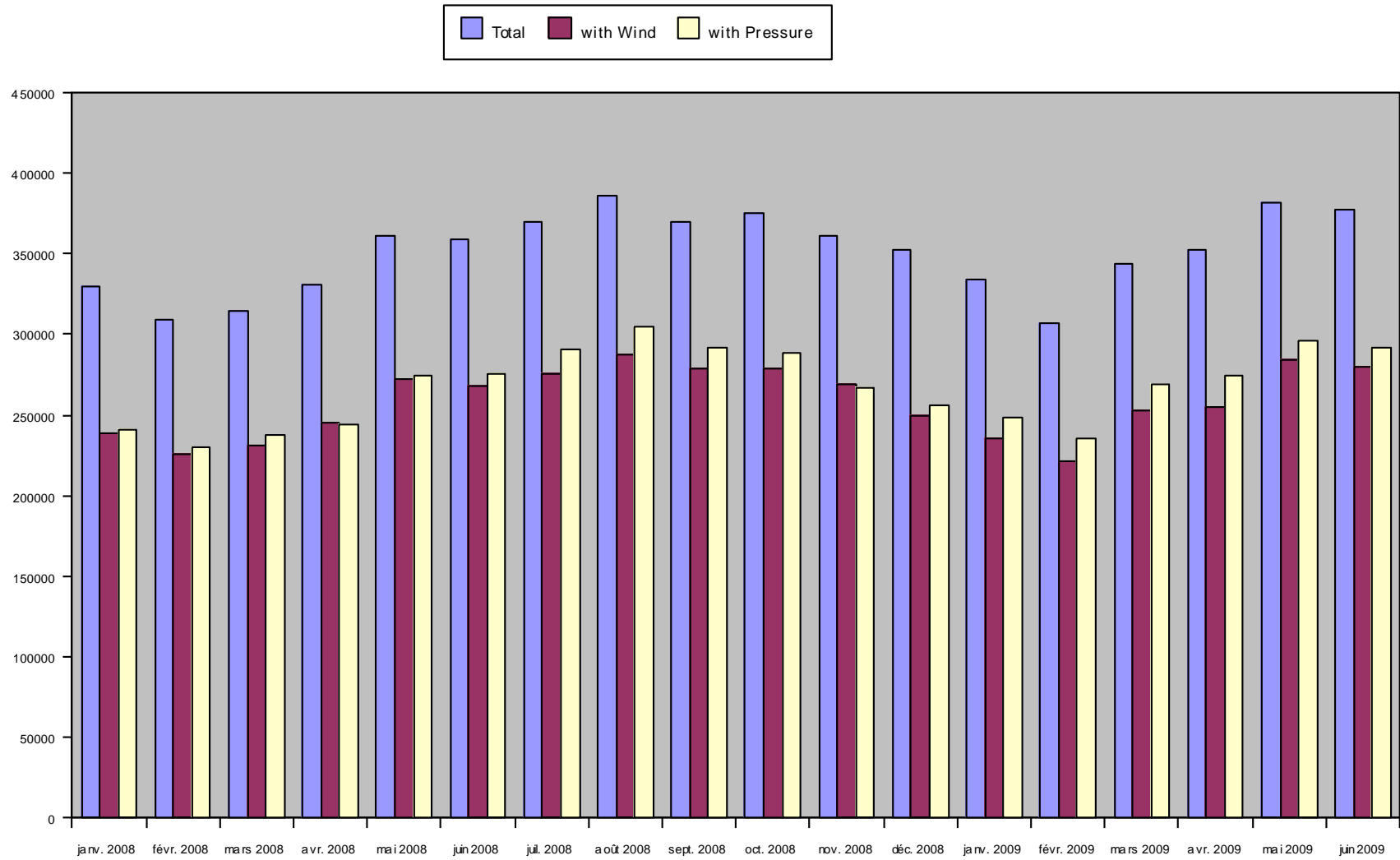
Figure 5. Time evolution of WAVEOB reports and sensors

Figure 6 (a). Mapping position plot chart of data received during June 2009 (BATHY)

Carte de pointage des observations recues en juin 2009

Mapping position plot chart of data received during June 2009

Messages : BATHY   **Total : 2526**

Figure 6 (b). Marsden square distribution chart of data received during June 2009 (BATHY)

Repartition par carre Marsden des observations recues en juin 2009

Marsden square distribution chart of data received during June 2009

Messages : BATHY   **Total : 2526**
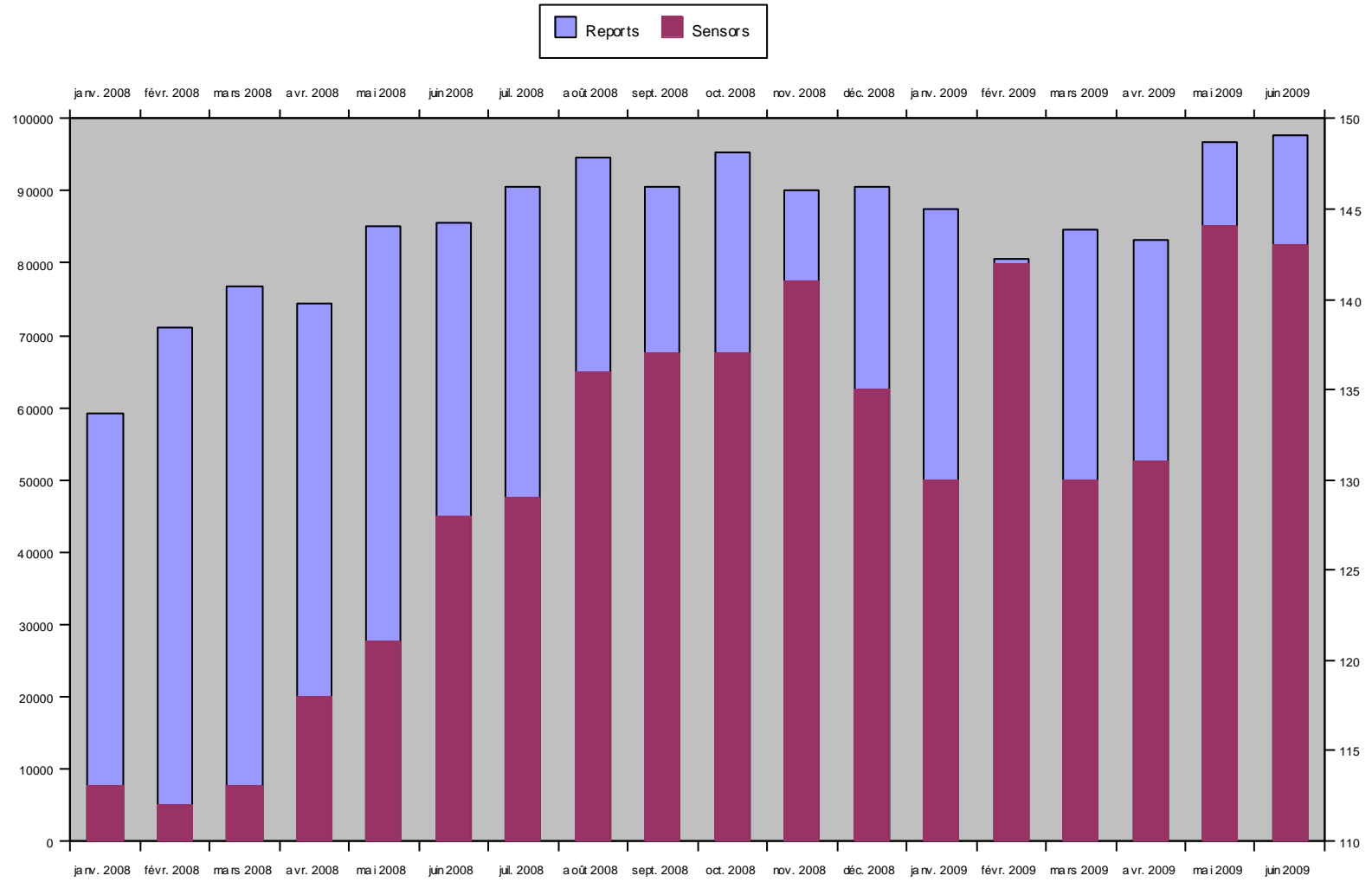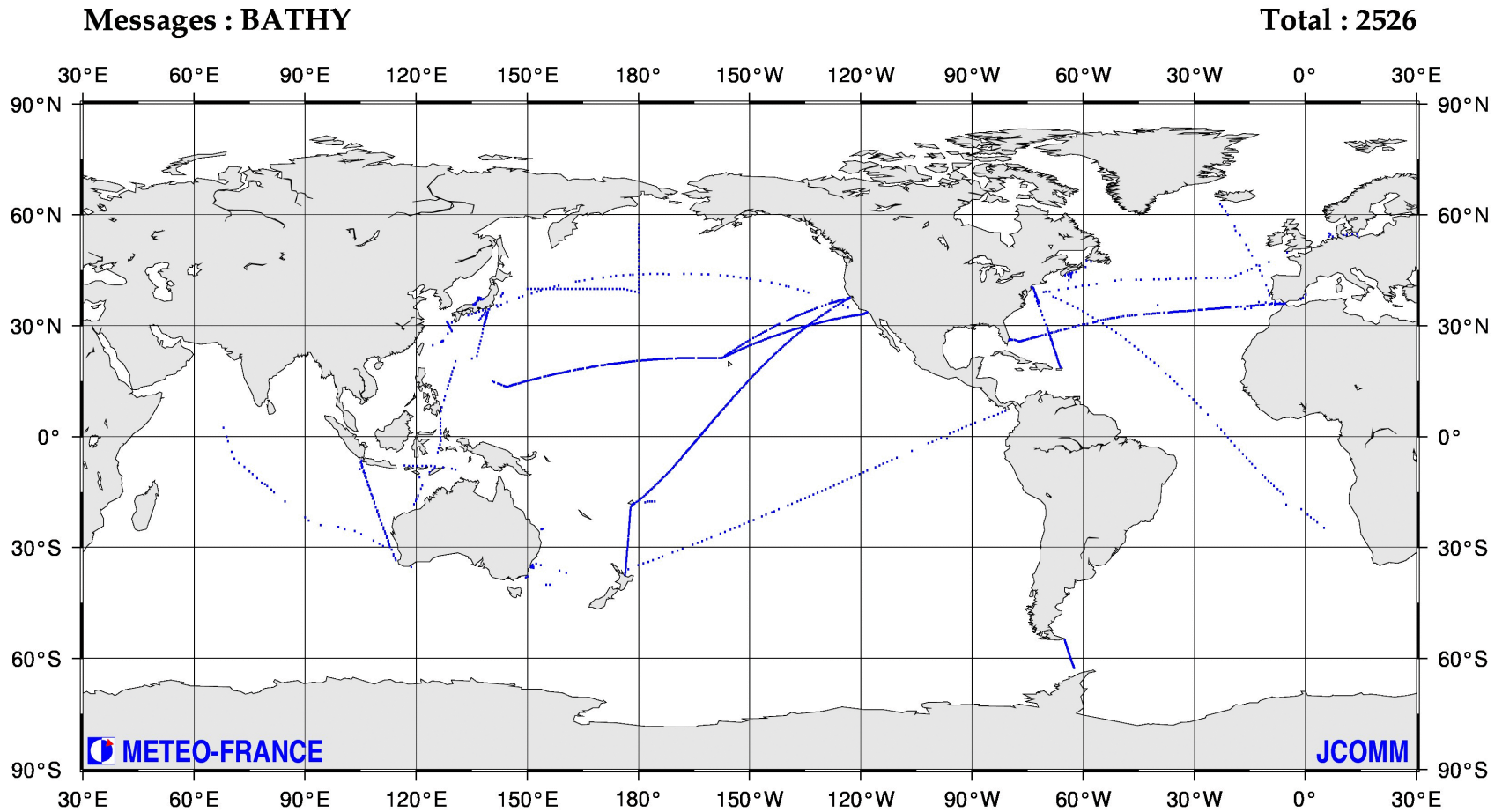
Figure 7 (a). Mapping position plot chart of data received during June 2009 (BUOY)

Carte de pointage des observations recues en juin 2009

Mapping position plot chart of data received during June 2009

Messages : BUOY   Total : 1119395

Figure 7 (b). Marsden square distribution chart of data received during June 2009 (BUOY)

Repartition par carre Marsden des observations recues en juin 2009

Marsden square distribution chart of data received during June 2009

Messages : BUOY

Total : 1119395

Figure 8 (a). Mapping position plot chart of data received during June 2009 (SHIP)

Carte de pointage des observations recues en juin 2009

Mapping position plot chart of data received during June 2009

Messages : SHIP

Total : 377812

Figure 8 (b). Marsden square distribution chart of data received during June 2009 (SHIP)

Repartition par carre Marsden des observations recues en juin 2009

Marsden square distribution chart of data received during June 2009

Messages : SHIP   **Total : 377812**
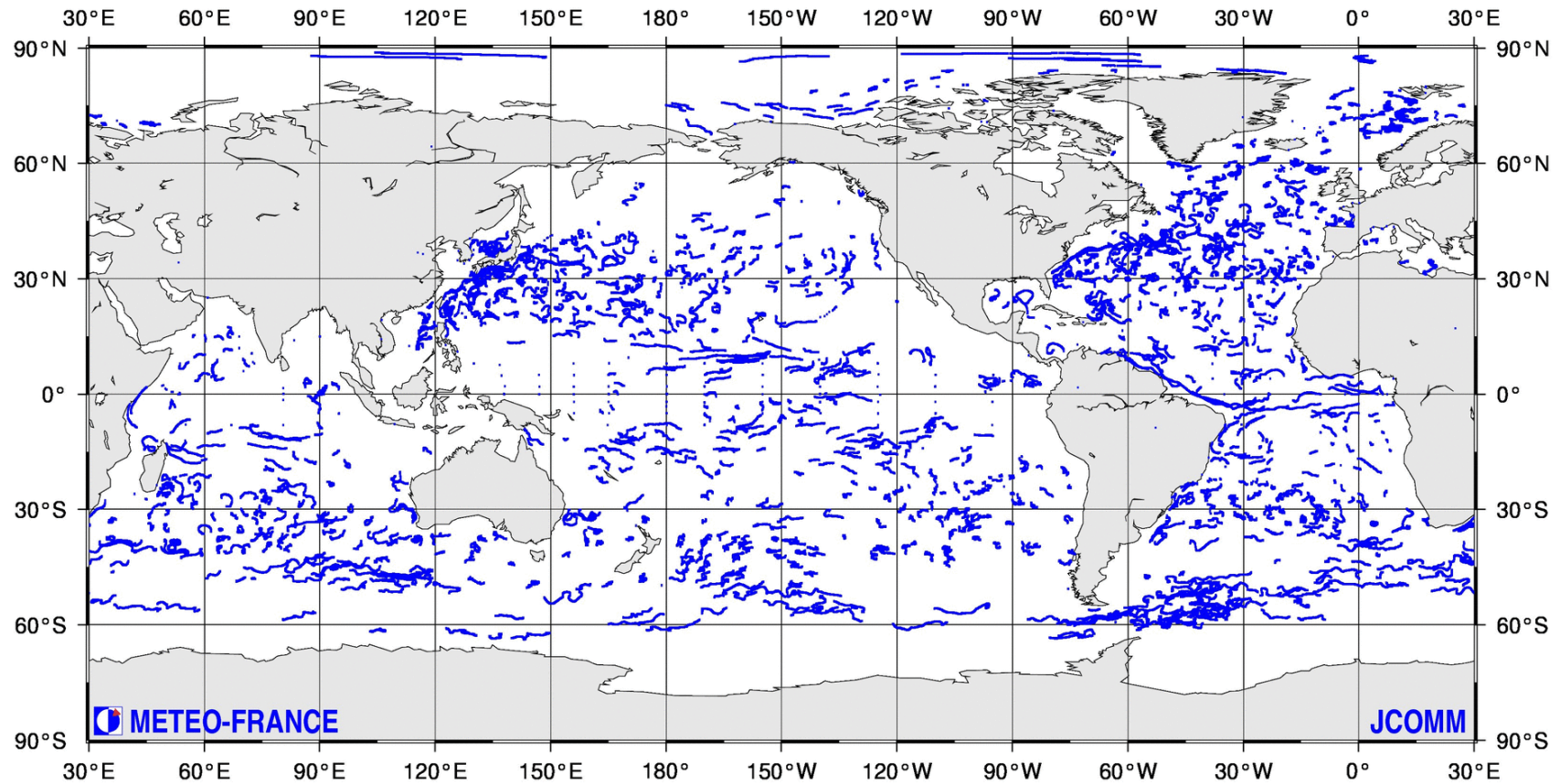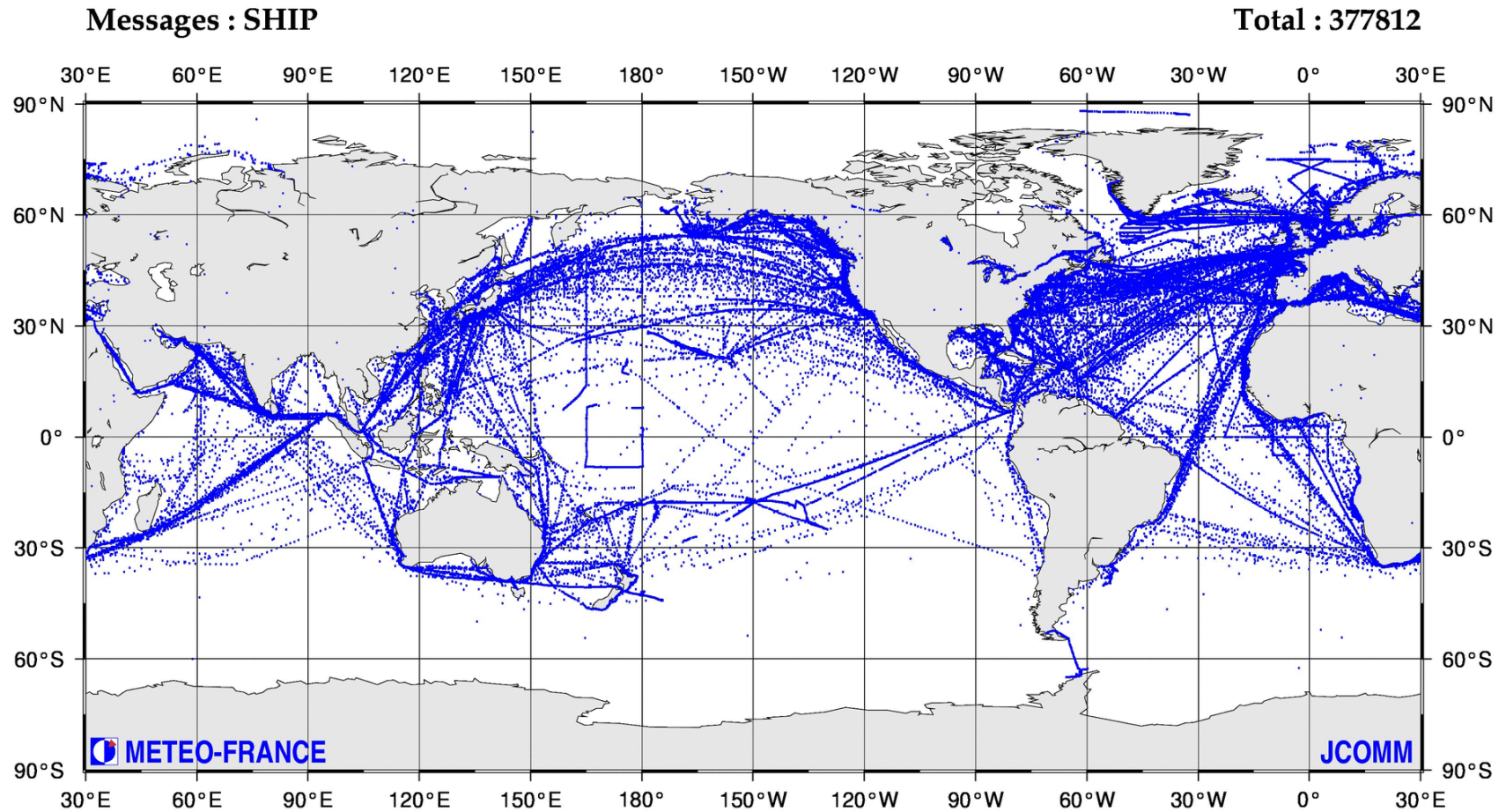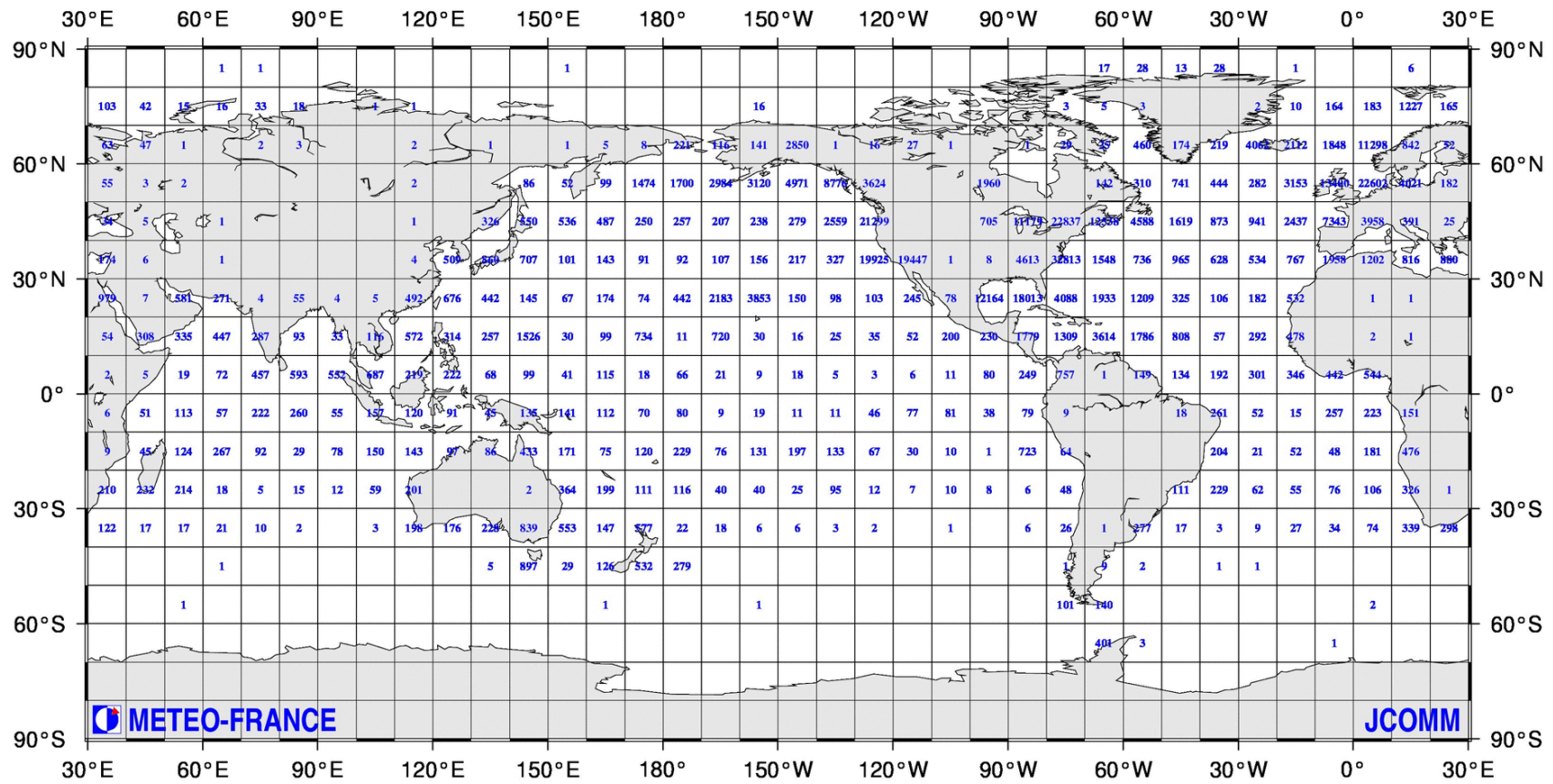
Figure 9 (a). Mapping position plot chart of data received during June 2009 (TESAC)

Carte de pointage des observations recues en juin 2009

Mapping position plot chart of data received during June 2009

Messages : TESAC   Total : 44311

Figure 9 (b). Marsden square distribution chart of data received during June 2009 (TESAC)

Repartition par carre Marsden des observations recues en juin 2009

Marsden square distribution chart of data received during June 2009

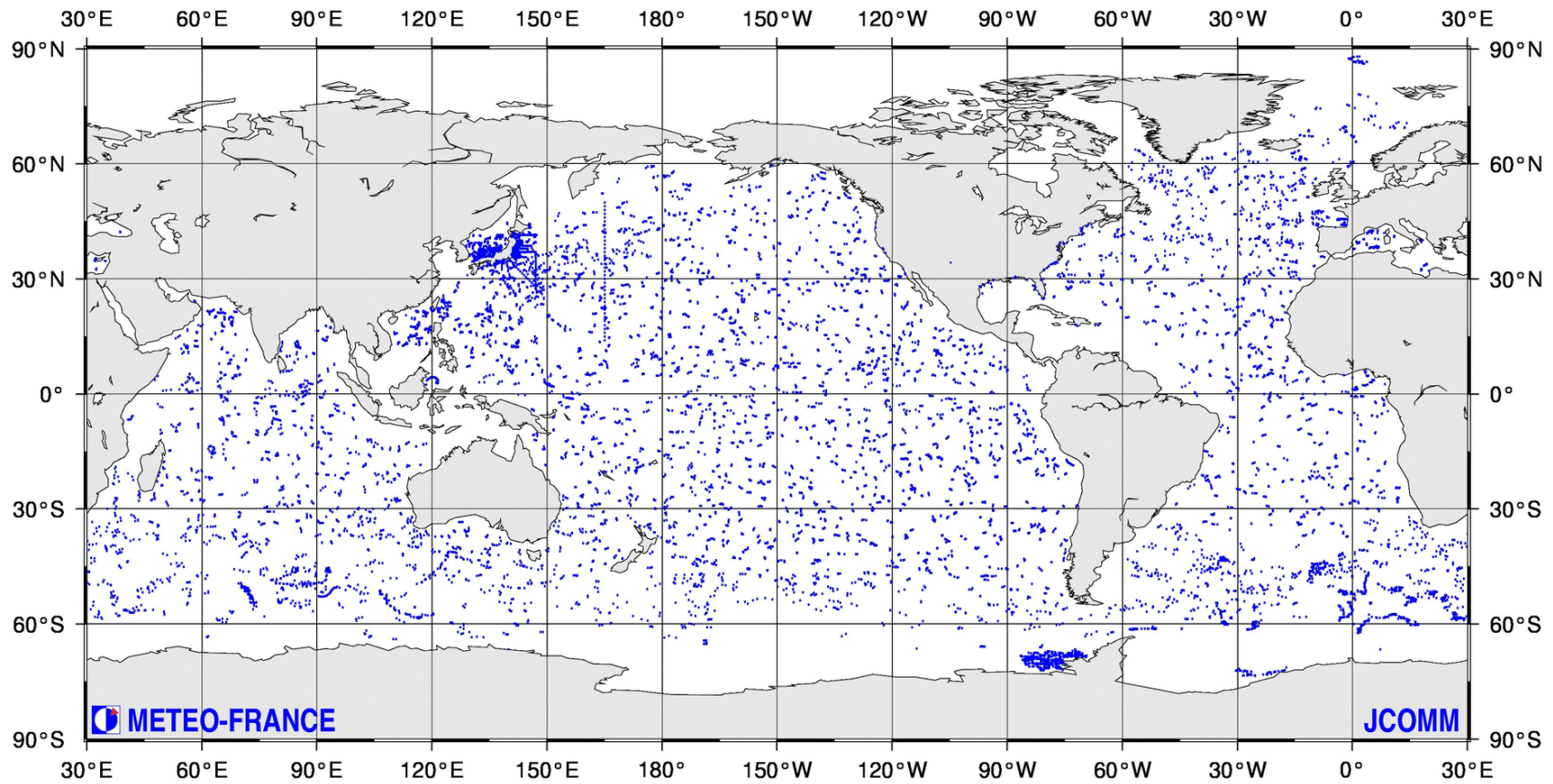**Messages : TESAC**   **Total : 44311**

Figure 10 (a). Mapping position plot chart of data received during June 2009 (TRACKOB)

Carte de pointage des observations recues en juin 2009

Mapping position plot chart of data received during June 2009

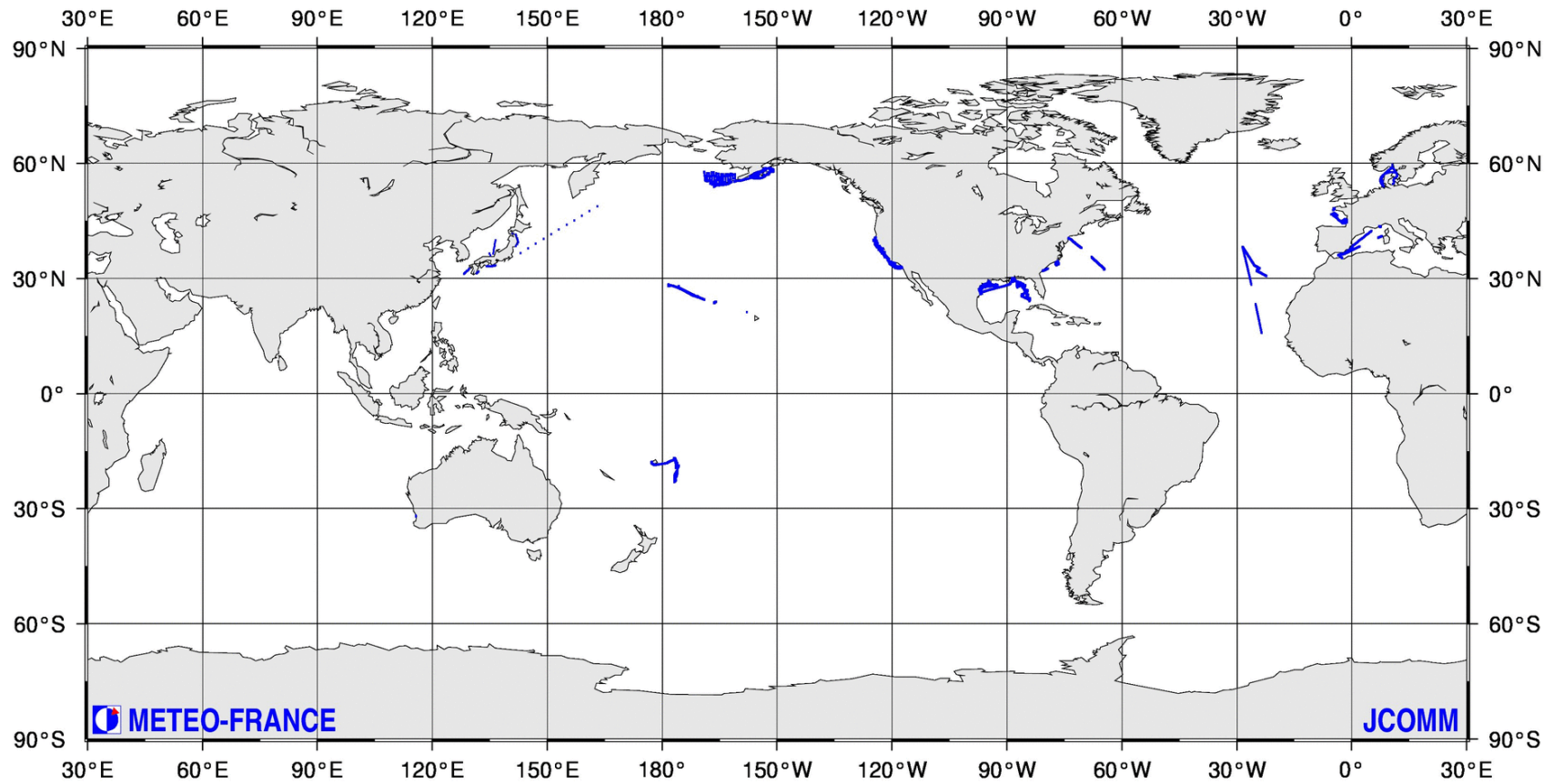**Messages : TRACKOB**   **Total : 71621**

Figure 10 (b). Marsden square distribution chart of data received during June 2009 (TRACKOB)

Repartition par carre Marsden des observations recues en juin 2009

Marsden square distribution chart of data received during June 2009

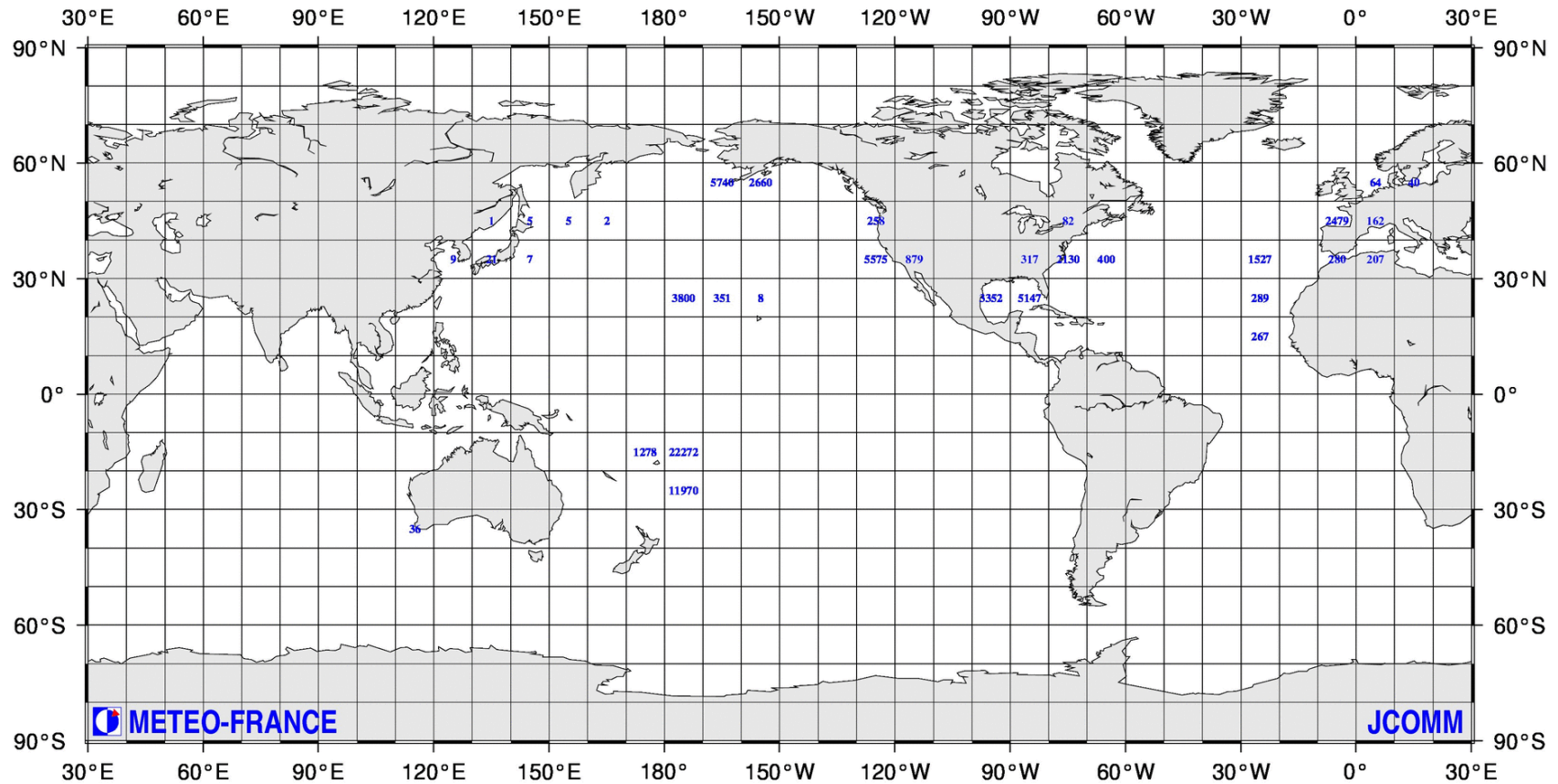**Messages : TRACKOB**   **Total : 71621**

Figure 11. Data availability index map for wind, June 2009

METEO-FRANCE

WIND

JUNE 2009

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and BUOY reports)
and
Percentage of BUOY reports compared to SHIP+BUOY reports (bottom)

Figure 12. Data availability index map for pressure, June 2009

METEO-FRANCE   PRESSURE   JUNE 2009

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and BUOY reports)
and
Percentage of BUOY reports compared to SHIP+BUOY reports (bottom)

Figure 13. Data availability index map for temperature, June 2009

METEO-FRANCE　　　　TEMPERATURE　　　　JUNE 2009

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and BUOY reports)
and
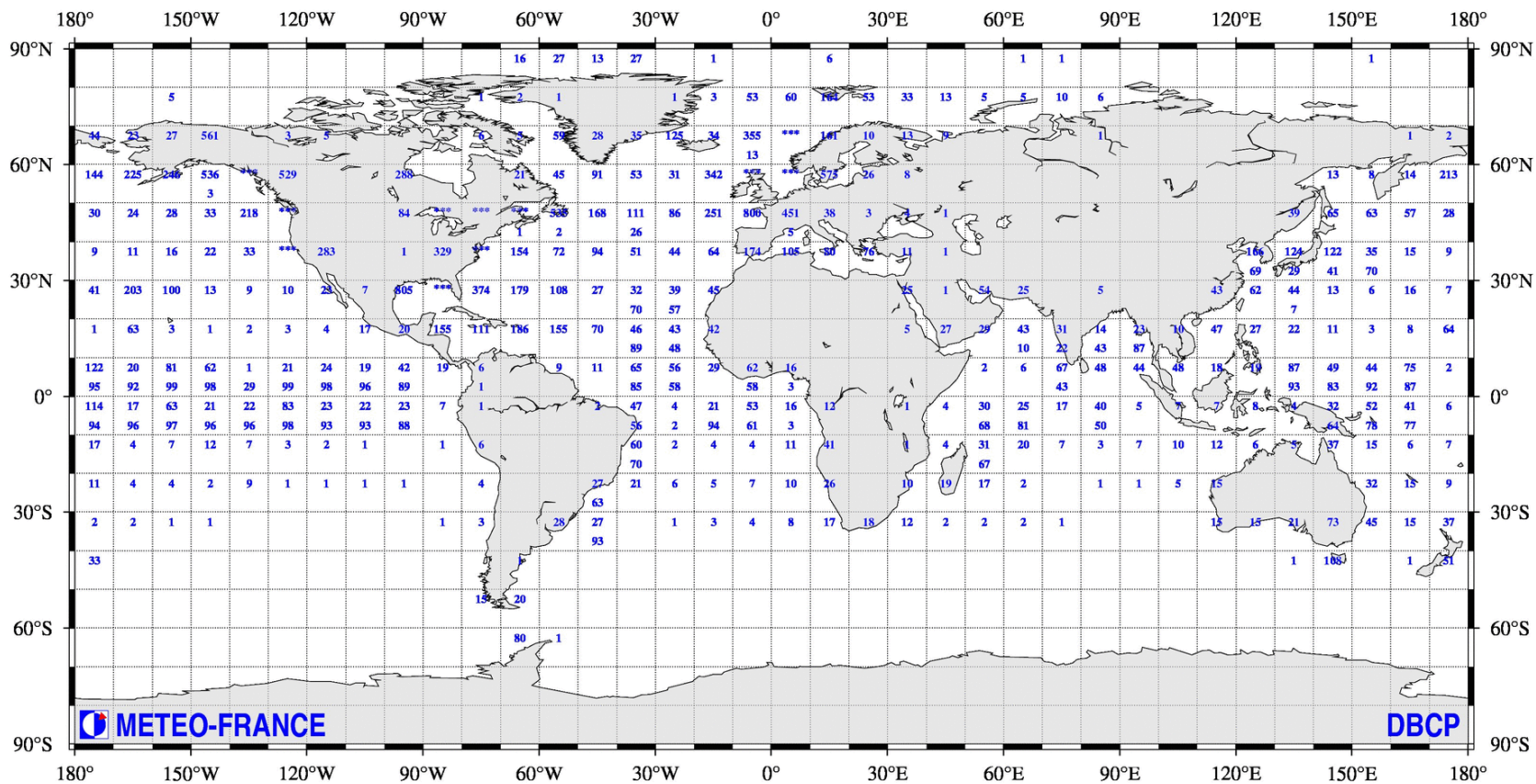Percentage of BUOY reports compared to SHIP+BUOY reports (bottom)

Figure 14. Data availability index map for sea surface temperature, June 2009

METEO-FRANCE   SEA SURFACE TEMPERATURE   JUNE 2009

Marsden square distribution chart of mean monthly data availability index (top)
(Index 100 = 8 obs. per day per 500kM * 500kM area of SHIP and BUOY reports)
and
Percentage of BUOY reports compared to SHIP+BUOY reports (bottom)