J1.6 MONITORING AND ANALYZING THE GLOBAL OCEAN OBSERVING SYSTEM WITH THE OBSERVING SYSTEM MONITORING CENTER

Kevin M. O'Brien[1*],S. Hankin[2], R. Schweitzer[3], K. Kern[4], M. Little[4],T. Habermann[5], N. Auerbach[5,] J.Cartwright[5] J. LaRocque[5]

[1]Jisao/University of Washington, [2]NOAA/PMEL
[3]Weathertop Consulting, [4]NOAA/NDBC, [5]NOAA/NGDC

1. INTRODUCTION

Understanding climate variability requires the development, maintenance and evaluation of a sustained global climate observing system. The purpose of the Observing System Monitoring Center (OSMC), which is being funded by the National Oceanic and Atmospheric Administration's (NOAA) Office of Climate Observation (OCO), is to provide a tool that will assist managers and scientists with monitoring the performance of the global in-situ ocean observing system, identifying problems in real-time, and evaluating the adequacy of the observations in support of ocean/climate state estimation, forecasting and research.

2. BACKGROUND

The Observing System Monitoring Center (OSMC) system was initially developed as an information gathering, decision support, and display system for the National Oceanic and Atmospheric Administration's (NOAA) Office of Climate Observations (OCO) located in Silver Spring, MD. It is an essential component of a sustained Ocean Observing System for Climate, that permits many discrete components to be visualized and managed as a system. The OSMC system displays current and historical status of globally distributed meteorological and oceanographic data collection systems. The OSMC system provides data visualization tools to identify the coverage of any given collection of platforms and parameters. These visualization tools are available via the internet and can be used to present information from OSMC to other NOAA centers, national partners, and international partners.

3. OSMC COMPONENTS

The OSMC is primarily built of two components -- a data base of metadata and tools to assist with the interpretation of that metadata.

3.1. A DATABASE OF METADATA

At its core, the OSMC is a database of metadata, which is focused on both real time and historical metadata

The primary source of the real time metadata is the Global Telecommunications System (GTS). On a daily basis, metadata (and some data) is pulled from the GTS and ingested into an Oracle database. This database is then used to drive the different OSMC tools to assist in monitoring the global ocean observing system.

As previously mentioned, the OSMC is primarily about metadata (what observations were taken), but "data" must be included to some degree, too, for a couple of reasons:

1. the all-important quality assessment metadata is generally missing, so "data" must substitute
2. Knowledge of underlying variability is fundamental to observing system design

Currently we are utilizing two streams of GTS data. Doing so allows us to compare how GTS feeds might differ – especially given the common knowledge that the GTS "firehouse" can be extremely leaky.

3.2 OSMC TOOLS

The tools for interpretation of the metadata include those that give the user a visual overview of the global ocean observing system, as well as the ability to drill down and discover metadata associated with specific observations. These tools provide both observing system managers and scientists insight as to where the global ocean observing system is meeting expectations as well as identifying regions which may be excellent candidates for observing system expansion.

In addition, there is an "Analysis mode' which allows for users to assess the performance of the observing system. These observation count summaries are based upon 1x1,3x3,5x5 or 10x10 degree grids. Using these summaries, it is possible to see quite clearly where observations are, or are not, adequate.

There are several tools which serve to give the user a visual overview of the global ocean observing system.

**Corresponding authors address:* Kevin M. O'Brien, University of Washington, Joint Institute for the Study of the Atmosphere and Ocean, Seattle, WA, 98115; email: Kevin.M.O'Brien@noaa.gov

3.2.1 LAS ACCESS TO THE OSMC

The first tool is one which is built on the Live Access Server (LAS) technology (more information at www.ferret.noaa.gov/LAS). From the main console (Figure 1a and 1b) of this tool the user can chose from among several different platforms and variables, as well as constrain observations by domain, country of origin, and date, among others. Observations, as well, can be colored by either platform type, country of origin, or date.

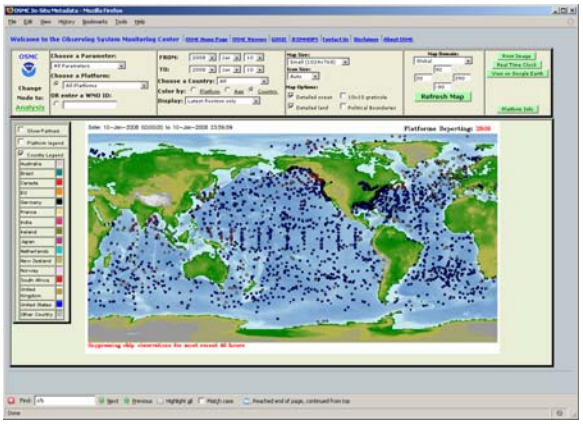


Figure 1a. OSMC LAS main console page with one day's observations colored by country

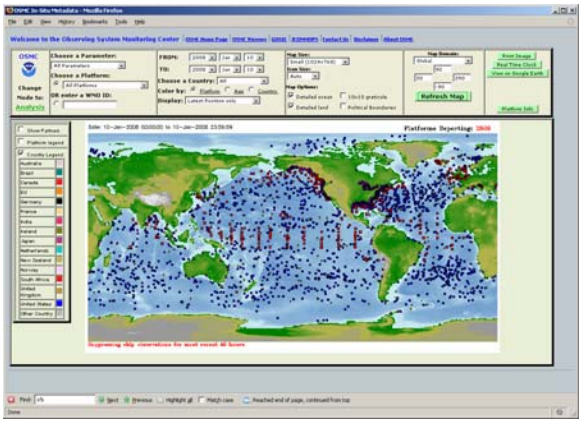


Figure 1b. Same daily observations as above, but colored instead by platform

Once an area of concern or interest has been identified, a user may then drill down to the metadata of a particular platform using the observations map, as in Figure 2.

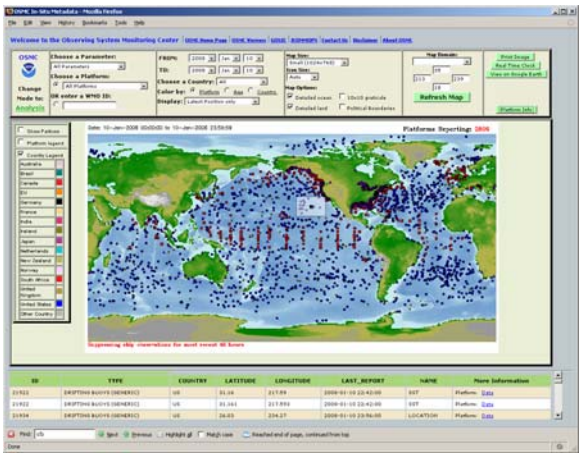


Figure 2. OSMC LAS with region selected and metadata displayed for those platforms

Other tools exist to view observations colored by age of last report, as well as employing "tails" to show direction of movement. Figure 5 shows an example of three weeks of drifter observations in the Pacific Ocean.

Figure 3. OSMC displaying Hurricane drifters, with track lines and metadata, for the month of October 2007

The user can easily select regions for zooming, or platform selection, just by clicking and dragging the mouse on the map image. Also, as figures 4 and 5 illustrate, the OSMC has the ability to very easily access profile and time series data directly from a particular platform.

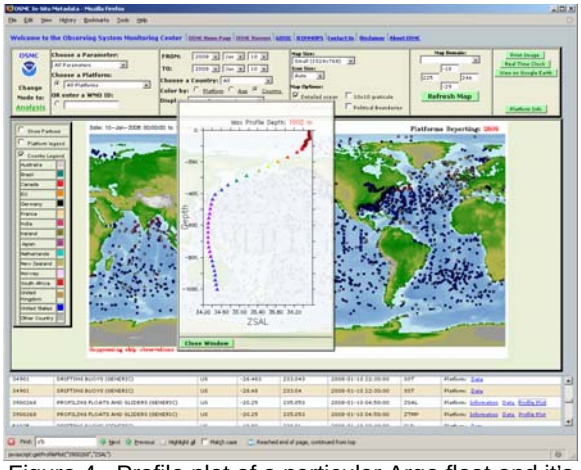


Figure 4. Profile plot of a particular Argo float and it's temperature data

Figure 5. Time series of air temperature data from a particular moored buoy.

3.2.2 GIS ACCESS TO THE OSMC

Another tool that the OSMC utilizes is a GIS-based system using ArcView. This tool gives the user a look at the most recent 5 days of data that are available in the OSMC database. Users can view layers containing different types of data, adding reference information such as continents, rivers, and political boundaries if desired.

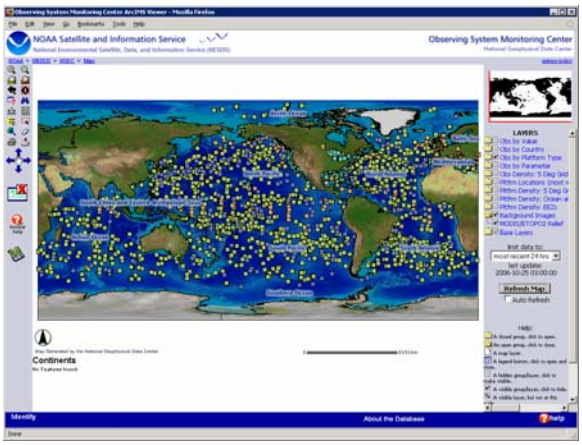
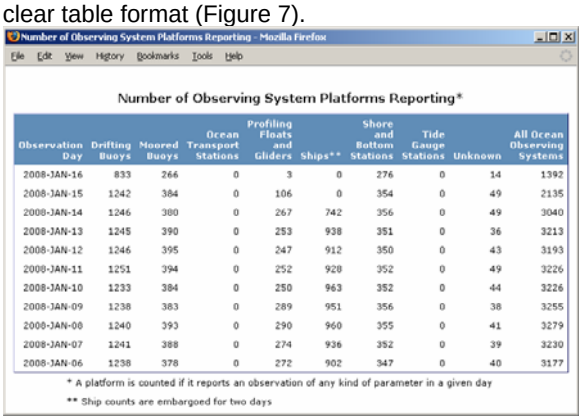


Figure 6. GIS Access to most recent 5 days of data in the OSMC

The GIS system also allows drill down for data discovery once a region or platform of interest is identified.

3.2.3 DIRECT ACCESS TO OSMC VALUES

Often times it may be more efficient to look at the data in the OSMC as numeric rather than graphic overviews. The OSMC has the capability to list the last several days of data for platforms reporting in a clear table format (Figure 7).



Number of Observing System Platforms Reporting*

Observation Day	Drifting Buoys	Moored Buoys	Ocean Transport Stations	Profiling Floats and Gliders	Ships**	Shore and Bottom Stations	Tide Gauge Stations	Unknown	All Ocean Observing Systems
2008-JAN-16	833	266	0	3	0	276	0	14	1392
2008-JAN-15	1242	384	0	106	0	354	0	49	2135
2008-JAN-14	1246	380	0	267	742	356	0	49	3040
2008-JAN-13	1245	390	0	253	938	351	0	36	3213
2008-JAN-12	1246	395	0	247	912	350	0	43	3193
2008-JAN-11	1251	394	0	252	928	352	0	49	3226
2008-JAN-10	1233	384	0	250	963	352	0	44	3226
2008-JAN-09	1238	383	0	289	951	356	0	38	3255
2008-JAN-08	1240	393	0	290	960	355	0	41	3279
2008-JAN-07	1241	388	0	274	936	352	0	39	3230
2008-JAN-06	1238	378	0	272	902	347	0	40	3177

* A platform is counted if it reports an observation of any kind of parameter in a given day

** Ship counts are embargoed for two days

Figure 7. Table listing of last 11 days of data

It is also possible to retrieve platforms and observation counts which occur in predefined, delineated ocean basins, as in Figure 8.

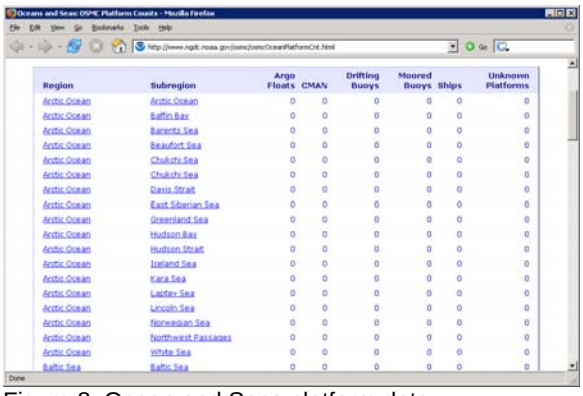


Figure 8. Ocean and Seas platform data

3.2.4 GOOGLE EARTH ACCESS TO THE OSMC

Google Earth has become a widely known and often used software tool for displaying geospatial data. We have included the ability to view global ocean observations through Google Earth in the OSMC, as in Figures 9a and 9b.

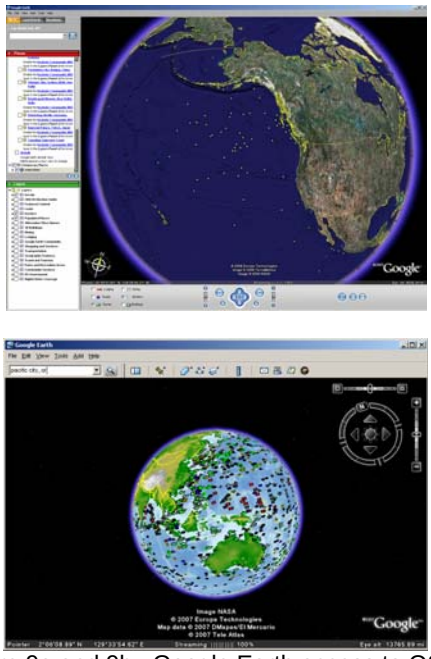


Figure 9a and 9b. Google Earth access to OSMC data

3.2.5. ACCESS TO OBSERVING SYSTEM METRICS THROUGH THE OSMC

We have added an "Analysis Mode" to the OSMC this year which allows users to get some feedback as to how the observing system is performing. The metrics that we have available are for

- Total number of observations
- Average number of observations per day
- Maximum and Minimum observations per day
- Percentage of weeks that the number of observations was above a particular threshold (threshold supplied by user)

This metrics can be applied to the global ocean on a 1x1, 3x3, 5x5 or 10x10 degree basis (See figures 10a and 10b) Currently, only drifting buoys, moored buoys and ships observations are calculated for these metrics, though we are working on including all platform types in the OSMC database.

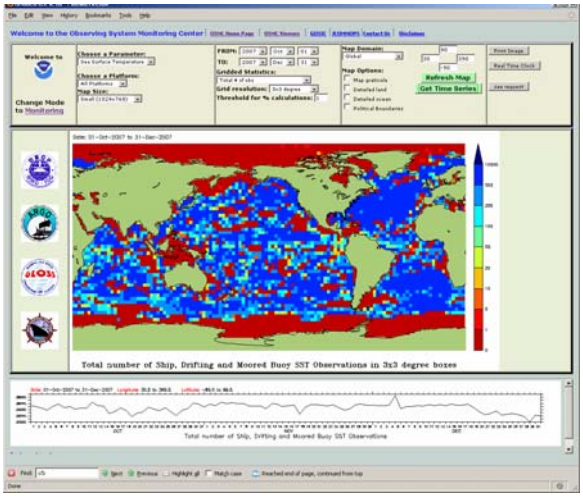


Figure 10a – Total number of SST observations in 3x3 degree boxes for Oct – Dec, 2007.

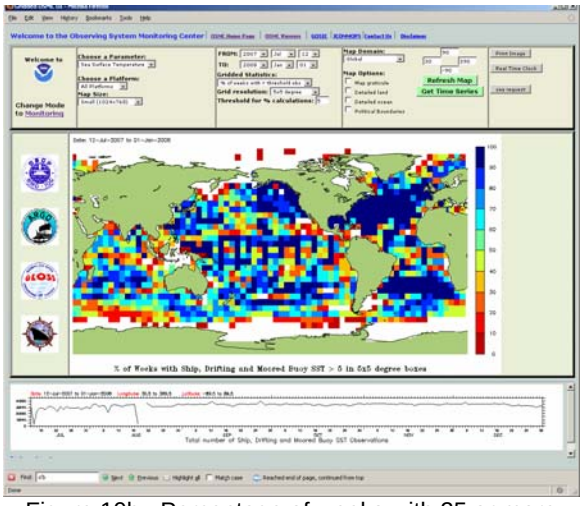


Figure 10b. Percentage of weeks with 25 or more SST observations in a 5x5 degree box for Jul – Dec, 2007

4. Future plans

As the OSMC continues to move forward, so do the plans for additional capabilities. We continue to seek out sources of oceanographic data to add to the system. Some of the platforms we are currently working towards adding include SAMOS ships, additional VOS ships, as well as carbon observations and coral measurements. We continue to nurture a partnership with Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology Observing Platform Support Center (JCOMMOPS). This partnership is crucial for fleshing out and enriching the metadata information available in the OSMC. We are also planning on adding support for the Open Geospatial Consortium web services WMS and WFS. Working with the Office of Climate Observation, as well as other climate scientists, we plan to continue investigating and implementing metrics into the OSMC which will assist in the evaluation of both ocean observing systems, as well as the climate models which attempt to describe those systems.

5. CONCLUSION

The global ocean observing system is a very complex system of systems. Such complexity can be eased by tools which are developed to help monitor those systems. The OSMC is designed for such a purpose – to provide insight into the performance of the global ocean observing system as well as to assist in identifying areas where performance is either meeting or not meeting expectations. The OSMC provides visualization and assessment tools for the international observing system as a whole as well as representing an important step towards the fulfillment of commitments to the Ten Climate Monitoring Principles.

6. AKNOWLEDGEMENTS

This publication is partially funded by the Joint Institute for the Study of the Atmosphere and Ocean (JISAO) under NOAA Cooperative Agreement No. NA17RJ1232, Contribution #1464, as well as NOAA/PMEL Contribution #3178.