2.3: GLOSS

Introduction

The focus of this chapter is on the sea level, and associated data that are collected through the GLOSS [1] programme of JCOMM [2]. Its objectives are “…the establishment of high quality global and regional sea level networks for application to climate, oceanographic and coastal sea level research.”. Its main component, the “global core network, GCN” consists of 290 sea level stations distributed around the world. The present list of stations in the network [3] has more than 90 countries participating [4]. GLOSS includes a subset of mostly island stations that provide altimeter calibration data. Country contacts for GLOSS are also available [4] (Rec 1).

No other group in JCOMM is concerned with sea level, but there are many more installations of tide gauges around the world. These are operated by national agencies, as are the gauges in GLOSS, and a user interested in all data from a particular area or time frame would need to pursue these other sources. This will be discussed further in the section on data dissemination below.

The following sections offer detail about GLOSS. Much of this was derived from the GLOSS and associated web sites which provide documentation on all aspects of the programme.

Data Providers

GLOSS provides a link to basic information on sea level measurement in IOC Manual and Guide 14, Volumes 1-3 plus a 2006 update [5]. The different volumes have material updated from previous versions with some extensions. Not all of the material appearing in Vol 1, for example, is repeated in other volumes.

The Manual covers aspects such as types of gauges, siting, datum control and benchmarks, and communications from gauges in some detail providing valuable information for those wishing to set up a tide gauge. As well, it lists a number of technical experts relevant to the different topics covered that can be consulted. This Manual also lists in its appendix the GLOSS requirements for sea level measurements. Sea level gauges are operated by national agencies. The requirements placed on contributors are described in the GLOSS Implementation Plan [6] last updated in 2012. It notes that “all GCN stations are required to report data in near-real time …” and “continuous measurements of the Global Navigation Satellite System (GNSS) … in the vicinity of the tide gauge benchmark (TGBM) are required for all GCN stations …”. The Implementation Plan defines the obligations of participation and there are 11 of them (Rec 2).

GLOSS divides the GCN into 4 categories [7] that separate out the timeliness of reporting from the stations. Based on the map, there are more than 40 stations that have provided no data after 1996 [Rec 3].

The sea level gauges that operate within GLOSS are dependent on the country and so vary from analogue gauges to more modern ones that record digitally and can report through satellite telecommunications systems in real-time. The characteristics of each gauge are well described in the station handbook pages [8], one for each gauge (Rec 4,5). The Implementation Plan remarks that different accuracy is needed for different applications, but it did not state those requirements.

Under the “Technical forum” tag on the GLOSS home page, there are presentations provided from two meetings [9]. These are useful in describing operations, technology, etc., as function at various agencies. There is no general information that sets out how data get from gauges to GLOSS (Rec 6).

The University of Hawaii Sea Level Center, UHSLC, [10] assists countries in the installation and maintenance of a world wide network of tide gauges for the purposes that range from tsunami warning to global sea level rise. The PSMSL also is “…closely involved in the delivery of sea level hardware and technical support for a number of stations in Africa and the western Indian Ocean …”.

As noted before, there are many more sea level measurements made than those described on GLOSS pages (information is available from PSMSL and BODC). The series of deep ocean buoys put in place to monitor tsunamis is one example. These will be described briefly in the data dissemination section. Additional data reside in national archives. Sometimes the records are short and designed to acquire enough data to identify principle tidal constituent information, sometimes the gauges are placed for a few months or years and then discontinued. Such data may be of valuable to a user with another purpose. In addition, many modern sea level
gauges also measure properties of the water such as temperature and salinity (Rec 7).

Data Assembly

Data from national gauges are assembled internationally in a number of places. The data assembly at each of these is described here.

The University of Hawaii Sea Level Center [10] serves multiple roles. It provides assembly facilities to make data available to a “Fast Delivery” (FD) system. Fast delivery data have minimal calibration and quality control applied (see next section for greater detail). The data are hourly or daily values released within 1-2 months of acquisition. In addition, UHSLC hosts the JASL [11], in collaboration with the U.S. NODC, acquiring hourly data from other countries and assembling these with the FD data to prepare a research quality data set after greater scrutiny. The 2011 Annual Report for JASL [12] provides more background information about its origins and holdings. As research data are produced they replace the data presented through the FD facilities. More information is provided in a later section of this report.

Data arrive at UHSLC in a variety of formats and either through telecommunications with the individual gauges operated by UHSLC or from agencies in the country where the gauges are located. The JASL accepts hourly data from individual countries in a variety of formats. It also encourages data contributors to provide whatever supplemental documents are available to describe the gauges, sites, data processing, etc.

BODC [13] operates the delayed mode sea level data assembly centre for CLIVAR and the GLOSS data archive centre. They carry out a series of processing steps [14] that are similar for all moored / fixed data sets such as data from tide gauges.

The PSMSL [15], in conjunction with the BODC, assembles sea level data collected at high sampling frequency (defined as hourly or higher) in delayed mode. The primary role of PSMSL (see [16] for a nice description of the service) is to manage and provide monthly mean sea level data to the scientific community. It also assembles data from countries operating their own gauges. The data arrive from individual countries in a variety of formats and at the highest sampling made by the gauges. Good instructions to potential data contributors are provided [17].

Some sea level data circulate in “national only” bulletins (an ASCII format) in the U.S. These are from gauges operated or supported by the U.S. Information about these gauges can be found at the IOC monitoring facility described later.

Processing and Archiving

Manual and Guides 14 Vol 2 and 3 [5] provide some detail about quality control, but not enough to allow a user to know what is actually done. Instead it refers to sources of software that might be used [18]. This approach encourages standardization of processing, but it does not help inform a data user about what detailed processing occurs.

UHSLC carries out format conversions on the data they receive either from the gauges they operate or from other countries. Other countries send data in a variety of formats and these are all converted to a JASL format. If data arrive at higher frequencies than hourly, they are reduced to hourly values. UHSLC have calibration information about the gauges that they operate and this is used to check for time drifts. In addition, they examine the data from all sources.

Operations of the JASL carry out the more extensive processing of data checking to produce the Research Quality Data Set (RQDS) of hourly and daily values. This processing is described in the README file [19] associated with the RQDS files. Further information is provided in a Quality Assessment Policy [20]. Checking includes looking for data spikes and time shifts. Gaps of less than 25 hours are interpolated. Problems noted in reference levels go back to the originator for resolution. If this is not possible, comparisons to adjacent stations are made, or an examination of residuals. Upon completion, the data replace the FD data available from the UHSLC Station Data Handbook. The FD data files and RQDS files are archived separately.

The RQDS of hourly and daily values prepared by JASL are archived within the U.S. NODC and annually updated to the World Ocean Data Center [21] in Silver Spring and to the PSMSL.
The steps undertaken for processing and archiving sea level data at BODC [22] include format conversions, original data and metadata (as received) are archived, standardized parameter codes are assigned, data are visually screened and flagged, documentation compiled from originators and processing at BODC, quality checking and then archiving (Rec 8). BODC encourages providers to send data at the highest frequency sampled, although as yet they do not appear to deal in the 1 minute sampling that occurs at tsunami gauges. Data are standardized in format, and a standard set of parameter coding is used. BODC also manages other data that may come with the sea level measurements. Such data can include temperature, and air pressure. The descriptive article on PSMSL [16] references journal articles to describe its data checking procedures (Rec 9). It acquires data from the 850 or so operating tide gauges around the world, usually annually. Quality checking routines include “buddy checking against nearby stations, visual comparisons of rate changes between neighbouring stations and the data gaps within them, and interactive flagging of questionable data. Additionally, high-level quality control is done through the use of the data in scientific analyses by PSMSL staff”. Again, journal references with greater detail are provided (see Rec 9).

JASL, PSMSL and BODC have arrangements for exchanging data but these are not formalized. It is, therefore, not clear which of these two archives is the one to approach for the highest quality data. A clear difference is that BODC may have higher frequency sampled data and the additional measurements, such as air pressure or water temperature, that are sometimes collected coincidently with sea level. However, since BODC often only receives hourly values, the distinction is unclear (Rec 10).

JASL, PSMSL and BODC also collaborate on data archaeology and are eager to acquire historical records. They accept, digitize and inspect paper chart records. A recent survey has shown that there exists a large store of such records. The work to recover these is ongoing. Details are available [23] and listed by countries.

(A reviewer remarked that there seems to be little attention paid to the international preservation of information about tide gauge types, operations, siting, changes in operations, etc. These are the assorted metadata that are valuable in examining historical sea level records. There does not appear to be something like a checklist of the sort of information required to be preserved. ICES provides a document on this topic [24], last revised in 2006 that should perhaps be referenced by GLOSS if nothing else (see Rec 6).)

Data Dissemination

Data dissemination of sea level data is organized on the GLOSS website [25] where a potential user can select from monthly mean sea levels from PSMSL, high frequency, delayed mode data available through the GLOSS Station Handbook, and high frequency fast mode data from UHSLC. More detailed explanations are also provided [26]. Access is free.

Access to UHSLC fast mode data [27], provides a list of stations with data at hourly, daily, or monthly sampling. A README file provides a description of the contents of the files, and a format description. Data are delivered in a simple ASCII form (Rec 11). The “Data” link provides useful information on how to download the data and even a few pictures of stations.

Another way to the fast mode data is through the GLOSS Station Handbook [8]. In this case, a selection of a station displays the station information sheet and clicking on the “folder” icon opens up the ASCII data file. The “document” icon opens up the README file noted above.

Yet another link to UHSLC [28] is provided from the pages found on the PSMSL web site [26] that describe “High Frequency Data”. This lands the user on a different set of UHSLC pages described as “not an operational site” (Rec 12).

Access to UHSLC RQDS files is provided through the GLOSS Station Handbook pages [8]. Selecting a station provides a data sheet about the station that gives details about operation of the gauge. Again the document icon opens the README associated with these data, while the “folder” icon delivers the file in a zipped form. In addition a “book” icon provides some quality control information about this station. Data are available 1 to 5 years after observation. The JASL site [29] provides an additional link, “FTP”, that describes how a user can get data from the ftp site. This can be useful when the selection of stations is known and the user wants routine downloads.

All of the data at UHSLC are also available through a THREDDS server [30, 31]. The U.S. NODC maintains a web link that points to all of the UHSLC data as well [32].
Access at PSMSL is available to monthly and annual mean sea level data. The “help file” available on this page explains that there are two files, the “Revised Local Reference”, RLR, (a research quality set that is related to a consistent set of locally defined benchmarks through time), and “Metric” files. There are additional links to pages that explain both of these, and the “notes page” link describes the format, ASCII, for each.

The “Map View” page shows a map of the world with station locations marked and colour coded based on the most recent RLR data received, or length of time series. Clicking on individual pins provides information about the length of the series, etc., as well as providing a link to the monthly or yearly mean file. The display is very nice, but if one wants data from more than one station, a user needs to select each individually.

The “Table view” data page provides a large table listing stations, positions country, etc. And the data in the table may be sorted by all of these. Two columns, titled “coastline” and “station”, seem to group data though the brief explanation is not clear in explaining the differences (Rec 13). Selecting a station ID links to a page showing location on a map, some basic information and plots of the monthly and annual means times series. Links beside each provide a download of the data. A link to the “Metric” version is also available but caution is advised (and reasons explained in the help file). This are additional links to station documentation (Rec 14).

PSMSL also provides a map of anomalies for selected stations since 1950, and trends since 1900.

GLOSS “data” pages pay special attention to tide gauge data from Africa. These data are not available from any other source. Files of 15 minute and 1 minute sampling data are available as is some documentation of data processing, tide gauge characteristics, etc.

BODC supports GLOSS by offering access to the high frequency delayed mode data through the GLOSS Station Handbook. Data are available 1-5 years after collection, although some are available much sooner, all have undergone scrutiny. As noted above in describing the UHSLC fast mode data, the Station Handbook provides a list of GCN stations that a user selects one at a time. A “book” icon provides some quality control information about each station. Clicking on the folder icon downloads a compressed file. Data are divided up into yearly time series and each file is in ASCII with the format description appearing at the beginning of each (Rec 15). It is not clear how a user gains access to the other data types that may accompany sea level measurements (Rec 16).

There are additional services to sea level data offered by BODC through the PSMSL site that goes beyond what is offered through GLOSS. The stations available here are both the GCN stations, plus all of the data for other tide gauges submitted from stations around the world in support of WOCE and CLIVAR and data from bottom mounted pressure gauges. These undergo the same processing as the GCN stations. The data are available in either ASCII or netCDF (WOCE format), both of which are explained in linked pages of the BODC web site. Gauges are subdivided into five ocean areas and the bottom gauges are separate from these. The user is presented with a list of stations that require separate downloads for each station. A map that supports clicking on a location to jump directly to the table entry is helpful. The same “book” and “folder” icons described earlier are used here to provide the information and data for each station.

Finally, PSMSL offers access to what are called “other long records”. These are described as “not available in the monthly and annual mean format used by the PSMSL, or because they are not true MSL or even MTL”. Depending on the user's purposes these may be of use. Each of these is in a different form of ASCII and would require some manipulation to be used.

A small amount of sea level data is available through the ODP. This is a free data distribution system put in place by the IODE. The ODP aims to provide seamless access to collections and inventories of marine data from the NODCs of the IODE network and allows for the discovery, evaluation (through visualization and metadata review) and access to data via web services. The system architecture uses Web-oriented information technologies to access non-homogeneous and geographically distributed marine data and information. This is a distribution system only, with data sets being provided by IODE members. Users need to consult the provider of the data set to learn what processing has been done.

The data collected by the tsunami monitoring buoys are available through the NDBC and are distributed on the GTS. They provide access to recent and historical records from these buoys as well as information on their operations. These buoys are not part of the GLOSS network, nor do they appear at BODC or PSMSL.
Differences Between Distributed Data Sets

UHSLC fast mode: These data have undergone minimal quality control. Sea level is provided at hourly or lower frequency. The data are from GCN stations usually 1-2 months after the observation date. Data are available one station at a time, in ASCII format or through a THREDDS server.

UHSLC RQDS: These data have undergone calibration and other quality checking procedures. Sea levels are provided at hourly or lower frequency. All data are from GCN stations and available 1-5 years after observation. Data are available one station at a time, in ASCII format or through a THREDDS server. The U.S. NODC provides a link to these data, too.

PSMSL means: These data have undergone quality control procedures. Sea levels are reduced to monthly or yearly means. Data are of two classes, RLR or metric, with only the former being suitable for time series analyses. Data are available 1-5 years after collection although some much more recent than that are also present. A map interface aids data selection, though only one station at a time.

BODC GCN high frequency data: These data, for GLOSS GCN stations, have undergone quality control procedures. Sea levels are available at hourly or at the sampling frequency as provided (except 1 minute data). Data are available 1-5 years after collection although some much more recent than that are also present. A map interface aids data selection, though only one station at a time. Data are available in ASCII, different from the UHSLC format.

BODC high frequency data: These data, for more than but including GLOSS GCN stations, have undergone quality control procedures. Sea levels are available at the sampling frequency as submitted and so may be better than hourly. Data are available 1-5 years after collection although some much more recent than that are also present. A map interface aids data selection, though only one station at a time. Data are available in ASCII (different from UHSLC), or WOCE netCDF.

BODC long time series: These data are of historical interest but require significant work to be used.

ODP: Few sea level data are available here, though these are in near real-time as provided by national agencies.

User Communities

The sea level community has a variety of interests. The routine practice is to define tidal constituents to allow for predictions of the tides at selected locations, often ports. Basic information of this sort can be obtained from short records, as short as one month. Some gauges are maintained for much longer to monitor storm surge and provide warnings to low lying areas. Longer time series are used to study local sea level changes. With proper references to well surveyed benchmarks and in association with modern three axis GPS systems, altimeter data from satellites and Argo data these records can be used for studies of global sea level rise.

Monitoring and Performance Metrics

JCOMMOPS [40] offers a simple monitoring service on behalf of GLOSS. The interface shows all JCOMM types of data, so a user needs to turn off layers other than that showing tide gauges. It is not clear what time period this covers, though it is assumed it is the past month (Rec 17, 18).

GLOSS publishes meeting reports [41] but does not appear to make available any annual reports. PSMSL makes available annual reports [42] and these have some information relevant to GLOSS, but the most recent report available is from 2007 (Rec 19).

The IODE offers a service for monitoring the operations of tide gauges [43]. At present there are reports available from more than 700 gauges around the world (as of August, 2013). The gauges are polled every 5 minutes and simple data displays are provided. The site provides a variety of views of different categories of gauges, for example GCN only, stations reporting on the GTS, stations supporting web services (Rec 20).

NDBC also provides a way to monitor the current operation of tsunami gauges. It does not appear that these are duplicated by the same gauges available through IODE (Rec 21).

The Unites States funded Observing System Monitoring Center [44] provides a variety of tools to examine the status of observing systems. The “Main Console” page allows selection of tide gauge stations and a time frame and displays locations of stations reporting during that time. The “Metrics” page shows statistics on real-time and GLOSS reporting by country and time frame. The “Observing System Metrics” tab allows a display by time frame and parameter. The criterion for inclusion of a tidal station can be regulated by setting the “Threshold for % calculation”. There is no facility to separate out GLOSS GCN stations from all others (Rec 22).
There does not appear to be any documentation that describes the origins of the data used for these displays, or other information that would help a user to know how these are derived. It also provides some capability to display on Google Earth projections. Some additional comments follow.

- Under the “In Situ Monitoring” tab, there are some deficiencies (such as using programme names that are not necessarily clear to all users – NWLON, inclusion of US programmes, though this site obviously has a dual purpose, missing some JCOMM observing systems – GLOSS and others). However, when “all programs” is selected and a particular parameter it seems quite good.
- Under the “Observing System Metric Reports” tab and after selecting “Tide Gauges” there is a useful listing of statistics on gauges operating in total and by country.
- Presentations based on all platforms for a selected parameter is approaching what is needed for an ECV perspective and will be dealt with in that chapter.

**GCOS-IP (2010) Performance Indicators**

Within the GCOS-IP (2010 update) [45] the GLOSS operations are mentioned in Action 9, listed here.

**Action O9 [IP-04 O11]**

**Action:** Implement the GLOSS Core Network of about 300 tide gauges, with geocentrically-located high-accuracy gauges; ensure continuous acquisition, real-time exchange and archiving of high-frequency data; put all regional and local tide gauge measurements within the same global geodetic reference system; ensure historical sea-level records are recovered and exchanged; include sea-level objectives in the capacity-building programmes of GOOS, JCOMM, WMO, other related bodies, and the GCOS system improvement programme.

**Who:** Parties’ national agencies, coordinated through GLOSS of JCOMM.

**Time-Frame:** Complete by 2014.

**Performance Indicator:** Data availability at International Data Centres, global coverage, number of capacity-building projects.

**Annual Cost Implications:** 1-10M US$ (70% in non-Annex-I Parties).

**Report:** It is not possible to evaluate how close GLOSS is to fully meeting the action. This is partly because there is no active (annual) reporting of which stations met GCN objectives over time. Looking at the network status map presented on the GLOSS site, and guessing based on the colour of the dots, it would seem that there are perhaps 25% that have not reported since 2005 (see Rec 19).

**Recommendations**

**Rec 1:** The Implementation Plan discusses the tsunami warning network as a component of GLOSS, and so this includes the many open ocean sea level gauges of this network. There are some references to the DART (tsunami) gauges on the DBCP as well. It is recommended that OCG working with DBCP and GLOSS decide on which of these programme’s web pages to place the primary description of this system. This aspect is not discussed at all on the GLOSS web site nor really on DBCP and it should be somewhere. Perhaps the various subgroups of GLOSS, such as PSMSL, ITWS, should be treated as “action groups” the way DBCP operates, and space provided on web pages for each of these. This assumes that these activities fall under the general coordination of GLOSS, which the Implementation Plan suggests.

**Rec 2:** The obligations are clearly stated in the Implementation Plan. However, these are deep in the Plan, and it is recommended that these be placed on a separate page on the GLOSS web pages. It is not totally clear what are the responsibilities of membership in the GCN. The text quoted came directly from the Implementation Plan, but the text on the home page, “Another component is the GLOSS Long Term Trends (LTT) set of gauge sites (some, but not all, of which are in the GCN) for monitoring long term trends and accelerations in global sea level. These will be priority sites for Global Positioning System (GPS) receiver installations.” The second quoted text in the body of this report seems to refer to the LTT stations. A clear statement on objectives and member responsibilities (are these different from those of GLOSS noted in the Implementation Plan?) should appear on the GLOSS home page.

**Rec 3:** The map of GCN identifies that it was last updated in 2010. While changes from year to year may be small, a more up-to-date map should be presented. Also, there is no easy way to know how many stations fall into each of the categories. Both of these should be easy to get (the 2012 Implementation Plan shows one such figure and count) and should appear on the basic GCN network status map.
Rec 4: It is recommended that another useful summary of the GLOSS network would be a map portraying the different basic gauge capabilities. A categorization of analogue gauges with strip chart, analogue with A to D converter, digital, digital with GPS, and so on should be considered. Perhaps such information should be added to the station information sheet that accompanies each gauge. The intent is to tell a reader the state of capability of instrumentation in a succinct way.

Rec 5: The accuracy of sea level measurement is unstated in the station information sheets. The data file descriptions describe data to millimetre precision. If there is any variation between gauges, this should be recorded on the individual station sheets. If there is not, such information on gauge characteristics could be included in a general description of gauge capabilities.

Rec 6: IOC M&G in its various volumes provides advice on getting data from gauges to national agencies and thence to assembly centres. This is buried too deeply in documentation and needs to be brought to the forefront on the GLOSS pages (with pointers to greater detail as does exist). Included in this should be basic information about obligations of data providers, with a pointer to the pages that do treat this but are more buried on the web site. The apparent lack of a checklist of metadata that should be preserved with each gauge could also be addressed in the same way.

Rec 7: Reading the GLOSS pages, it seems that the GCN is the focus. In the data sections, particularly to BODC and PSMSL, they describe accepting data from more than GCN gauges. While it is good that access is provided to these other gauges as well, it is a bit confusing to a potential data users. It is recommended that the GLOSS web pages provide some text that describes what is part of GLOSS and what additional information and data are available from the GLOSS gauges.

Rec 8: More detail about the BODC quality control procedures for sea level data is needed. The more detail provided, the better able a user will be to assess what additional work may be required before the data are usable. As well, BODC makes no statement about how they deal with data in the variety of sampling frequencies. In the past, hourly values were the norm, but many gauges now report at 15 minutes, 5 minutes, 1 minute, and the tsunami gauges can operate at 1 second sampling. It is recommended that BODC state if they have an upper limit to sampling frequency for their archives, and if so, what happens to the higher frequency sampled data when they are received and processed.

Rec 9: It is very good that the data processing procedures appear in journal articles. However, it is recommended that PSMSL describes the data processing steps on its own web site and in sufficient detail to allow a user to know if he will need to carry out further work to suit his objectives.

Rec 10: A user should be able to distinguish which of the JASL or BODC archives is the one to go to with a data request. Except that BODC holds higher frequency data than hourly intervals, it is unclear which is the one to choose. It is recommended that JASL and BODC provide commonly agreed text on both websites that explain the attributes of each other's archives so that a user can decide from where to acquire data.

Rec 11: Access to fast mode data is easy and the file format simple. Station positions, latitudes and longitudes, are provided for each station in the list. This is good enough if a user is only interested in a single station. There is no map interface and no easy way to download all data from an area. Nor is there any way to subset by time, though this may not be a issue. It is recommended that the interface be improved to allow for easier downloads of data from an area.

Rec 12: It is not clear why there are different ways to the fast mode data at UHSLC. There is a direct link, a link through the GLOSS Station Handbook, and the link as described here. There is a page on the JASL site that explains how to get data and it shows that this is an old site. However, this link has a map of station locations. It is confusing to have two different pages pointed to. It is recommended that unless there is a good argument for keeping the different links, that only one be supported.

Rec 13: At the PSMSL mean sea level data download page, the columns marked coastline and station are not adequately described. A map the shows what is coastline “10”, or any other number would be helpful. Likewise the station number is not unique, though apparently within a coastline it is. It is not immediately clear why this type of sort criterion is helpful. It is recommended that either the columns be removed, or their utility be better explained.

Rec 14: The additional information part of the page uses the acronym SONL which did not seem to be explained. This needs to be explained.

Rec 15: Similar to UHSLC fast mode data access, there is no map nor any way to download more than one station at a time. It is recommended that this capability be added to the data query interface.

Rec 16: It is known that BODC stores the other data that sometimes accompany sea level measurements (e.g. water temperatures). However, these variables are not mentioned anywhere. It is recommended that BODC provide some text on their web site to explain that these other variables are welcome, that these data are also archived, and that explains how these other data may be accessed by a user.

Rec 17: The monitoring product from GLOSS does not state what is the time frame for display of the interactive map. It is assumed to be data received within the last calendar month, or perhaps last 30 days. For tide
gauges, if a gauge reports one hourly value, is it displayed? It is recommended that some explanatory information relevant to tide gauges be provided. The data reporting criteria are weak. Clearly a single hourly value is inadequate for any purpose. It is recommended that a more sensible criterion be used.

Rec 18: The monitoring facility of JCOMMOPS is very limited. The services offered by IODE is much better. It is recommended that JCOMMOPS provide references to the IODE site from the GLOSS pages. Likewise, assuming the tsunami network is a component of GLOSS, a link to the NDBC site for monitoring the performance of these buoys is recommended.

Rec 19: There does not appear to be any annual reporting from GLOSS. At the very least, there should be some reckoning of how well stations in the GCN performed, and perhaps how well GLOSS is meeting GCOS-IP actions. It is recommended that OCG discuss reporting and monitoring requirements with GLOSS to better explain how well the program is meeting its objectives.

Rec 20: Although the IODE monitoring facilities are not evidently a part of GLOSS, they are very good. What is lacking, though, are explanations of the short form text that is used. For example, what does “pr1” or “rad” mean? It is recommended that OCG approach IODE and suggest such explanations be provided and that discussions with JCOMMOPS begin to decide what capabilities JCOMMOPS should be providing that do not overlap the IODE facility.

Rec 21: Monitoring of the operation of tsunami gauges is available through the NDBC. These do not appear to be the same gauges available through the IODE, but this is not clear. It is recommended that NDBC and IODE be approached to request that their sites make clear what overlap there is (or is not) and perhaps point to each other as available monitoring sites.

Rec 22: It is unclear which of the tidal stations represented at OSMC are GCN stations of GLOSS. This could be taken care of by specifying GCN as one of the available programs to be selected. However, the IODE site looks to do a much better job than OSMC, and so the discussions recommended in recommendation 21 should be followed up with OSMC as well.

Acronyms

BODC: British Oceanographic Data Centre
CLIVAR: Climate Variability and Predictability
DART: Deep-ocean Assessment and Reporting of Tsunamis
DBCP: Data Buoy Cooperation Panel
ECV: Essential Climate Variable
FD: Fast Delivery
FTP: File Transfer Protocol
GCN: GLOSS Core Network
GCOS-IP: Global Climate Observing System – Implementation Panel
GLOSS: Global Sea Level Observing System
GNSS Global Navigation Satellite System
GOOS: Global Ocean Observing System
GPS: Global Positioning System
ICES: International Council for the Exploration of the Seas
IOC: Intergovernmental Oceanographic Commission
IODE: International Oceanographic Data and information Exchange committee
ITWS: International Tsunami Warning System
JASL: Joint Archive for Sea Level
JCOMM: Joint Commission on Oceanography and Marine Meteorology
JCOMMOPS: JCOMM Observing Platform Support centre
MSL: Mean Sea Level
MTL: Mean Tide Level
netCDF: network Common Data Format
NODC: National Oceanographic Data Centre
OCG: Observations Coordination Group
ODP: Ocean Data Portal
OSMC: Observing System Monitoring Center
PSMSL: Permanent Service for Mean Sea Level
RLR: Revised Local Reference
RQDS: Research Quality Data Set
TGBM: Tide Gauge Benchmark
THREDDS: Thematic Realtime Environmental Distributed Data Services
UHSLC: University of Hawaii Sea Level Center
References

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2. JCOMM home: http://www.jcomm.info/
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