Tide Tool is a software application that provides end users with the ability to decode, display, and manipulate sea level data broadcast over the Global Telecommunications System (GTS) of the World Meteorological Organization (WMO). Data download through the internet is also available, but is not recommended because timely, complete delivery of all data packets cannot be guaranteed. Tide Tool is enabled by the Tide.tcl script and region-specific map clients that provide simple-to-use graphical user interfaces to the continuously-incoming sea level data streams; the tool uses the Tcl/Tk software package and its BLT extension. Tsunami travel times can be calculated and a contour map overlayed onto the map client; estimated tsunami arrival times (ETA) at mouse-selected locations are provided. Tcl/Tk is an open source, platform-independent software package offering a powerful shell programming language and graphical toolkit. getTide, also included with Tide Tool, is a BLT script that can be used to read and analyze archived sea-level data log files.

The software application was developed and is supported by the US NOAA NWS Pacific Tsunami Warning Center (PTWC) as an operational tool for the real-time continuous tsunami monitoring in the Caribbean, Indian and Pacific Oceans. The travel time calculation software was developed by Geoware, and its algorithm is used by PTWC. The primary users of Tide Tool and is accompanying tools are National Tsunami Warning Centres, such as the National Meteorological and Hydrological Service (NMHS), or other agencies acting in this capacity, and with a downlink from the GTS or to a data file containing those data formatted in a similar manner. It has been tested under Unix/Linux, Windows 2000/XP/Vista/Windows 7/10 (32- and 64-bit) environments since 2005, and implemented using a non-GTS ‘ftp’ data transmission protocol in Linux and Windows systems for tsunami centers without GTS links. The ‘ftp’ method should be considered non-operational if commercial internet service is utilized since connection reliability and timeliness, especially during tsunami emergencies, cannot be guaranteed. A Tide Tool Manual is available providing information on its installation and use.

The primary use of this software is as an operational programme run by tsunami warning centres, or other operational centres, which need to continuously monitor sea levels for tsunamis. Features of the tool include time series display, wave arrival time, height and amplitude measurement, tide prediction removal, de-spiking, and station state-of-health and metadata. Accompanying software calculates predicted tsunami travel times. Users are able to select which stations to receive and display through edits to input files or by mouse-selection from a station map. Mouse-clickable functions include the expansion of the time series to enable easy measurement and logging of the arrival time, wave height and wave period from the incoming signal. Station and data transmission information, raw data packets, and station health reports can be viewed from within Tide Tool. Calculated travel time contours can be overlain.

Requirements:
In order to decode and display the data, the following are required:
- Computer running Tcl/Tk software with BLT extension, or WIZE software package
- Sea level data that are continuously archived into a data file
- Tide.tcl and associated map client software.

Computer and Tcl/Tk software with BLT extension
The software requires the installation of the Tcl/Tk software package and the BLT extension, both of which are freely available for download and easy to install. The software is able to run under Unix/Linux, Windows 2000/XP/Vista/Windows 7/10, and Macintosh OSX (under BSD Unix) operating systems; the preferred platform is Unix or Linux because of its stability. For Windows 7/10, it is recommended to install the WIZE software package, which includes the newer Tcl/Tk v8.5.9. Use on other platforms is possible as it only depends on Tcl/Tk and BLT softwares being available. The software does not require substantial computing power, and can thus run easily on a
Pentium III or higher PC system.

**Sea level data**

The input is assumed to be a continuously-appended, ascii text file containing transmissions of data from different sea level stations. Each station and its data transmission is described by a unique set of parameters, including a Satellite Product Headers, Station Platform ID, method of transmission and transmission time, and file formats (Figure 1).

*Figure 1. Sample of transmissions from field station Data Collection Platform (DCP) in formats used by the University of Hawaii Sea Level Center, Australia National Tidal Centre, and US National Ocean Service, respectively.*

In general, sea level data is digitized and sampled at the field station. Ideally, the data transmitted for tsunami monitoring will be 1-minute (or better) averaged data values that are transmitted at least every 15 minutes, or more frequently for stations in tsunami source zones; currently, stations transmit every 3-60 minutes and data averages are at 1-15 minute sampling intervals. The data are transmitted over a number of different satellites to regional telecommunications hubs of the WMO, and onwards to customers such as the Pacific Tsunami Warning Center, the Japan Meteorological Agency (JMA), and to any requesting National Meteorological and Hydrological Service (Figure 2).

*Figure 2. Transmission from the Data Collection Platform at the field station to the warning centres.*

In the Indian Ocean, the primary satellites used for transmission from the field station are the Japanese MTSAT for the eastern Indian Ocean and the EUMETSAT operational satellite system for the central and western Indian Ocean. In the Pacific, the US GOES and Japan MTSAT satellite systems are used. The PTWC receives its data through the USA GOES satellite system and the US National Weather Service Telecommunications Gateway (NWSTG) and other dedicated communications links. The satellites are part of the GTS. The GTS is a semi-private, reliable communications system supported by the 187-member WMO for the transmission of environmental data, and information messages and / warnings. The GTS is the primary means by the PTWC and JMA receive sea level data.
and issue tsunami advisories and warnings.

**Tide.tcl**
The program is started by typing wize Tide.tcl. The program decodes the received sea level data that are found in a single data logging file, creates individual station files containing the decoded data, and starts a graphical user interface display that allows each station to be displayed as a plot (Figures 3-5). Map clients for the Atlantic, Caribbean, Indian, and Pacific Oceans display a map from which the user may select several stations to show their time series. A strip chart window displaying multiple stations simultaneously is an option. V10.0 enables overlay of calculated travel time contours to graphically show wave propagation from the source. When the mouse is moved over the map, the Estimated Tsunami Arrival time (ETA) is displayed in the lower right (in Zulu time).

![Tide Tool Client V2.6 (Pacific Ocean)](image)

**Figure 3a.** Caribbean, Indian, and Pacific Map clients showing the coastal and DART stations, with color indicating when data last received (green = data received within last 7 hrs). Travel time contours overlayed on Pacific Map, with ETA shown in lower right. Sea level records can be plotted by mouse-selecting the station and choosing the sensor to plot, or by enabling a

*US NOAA PTWC, UNESCO-IOC/NOAA ITIC*
‘zoom’ client to choose and automatically plot several close-by stations. Station names can be displayed on the map if desired.

Figure 3b. Tide.tcl GUI showing all stations that were decoded, arranged by region. Station sensor types, station metadata, and the raw data packet can also be viewed.

Each time series can be displayed with or without the tidal signal removed, can be manipulated using a mouse in order to zoom/enlarge the time series and to pick an amplitude or wave period (Figure 4a), and can be ‘despiked’ to remove spurious ‘bad’ points (Figure 4b). A postscript plot of the time series window can be made and printed.

Figure 4a. Sea level time series showing observed and tide-removed time series. A mouse is used to select the part that should be enlarged to pick the arrival time.

Figure 4b. De-spike feature.
Tide.tcl operates continuously once started. It will check every 20 seconds to see if any new data has arrived, and if so, it will decode and update the station time series that is plotted. When Tide.tcl is started it will read data from the current day data log. Tide.tcl will keep up to 24 hours of data. As more data arrives beyond what Tide.tcl is supposed to hold, it will discard the older data to make room for the new. For each station, multiple sensors are often available and decoded. The sensor code is given by three letters, where prs stands for pressure sensor, bub indicates bubbler, rad indicates radar.

Tide Tool can also be used to viewing older or archived data log files.

To obtain the software, and for further information and questions, please contact Stuart Weinstein, Asst Director, NOAA Pacific Tsunami Warning Center (stuart.weinstein@noaa.gov), or Laura Kong, Director, UNESCO/IOC-NOAA International Tsunami Information Center (laura.kong@noaa.gov).