Data Article

Long duration underwater glider dataset: Indian Ocean from Perth, Australia to Mirissa, Sri Lanka

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ABSTRACT

This data was collected using an underwater research vehicle, Slocum glider. The glider is an autonomous robot that is able to measure several water properties from surface to 1000 m depth. The duration of missions for underwater gliders are on the order of 1 month to over a year. Detailed here is the live satellite telemetered dataset as transmitted during mission. Dataset includes positional data, vehicle engineering, attitude, temperature, salinity, and depth averaged currents. Raw data as well as some derived variables from the raw data are included in this dataset. This data is transmitted every couple hours and comprises of a subset of the data stored on the vehicle's internal memory.

The data is returned in segmented files which comprises of an underwater segment bookended by GPS positions. Because most analysis require longer time series, effort has been taken to conglomerate the segment datasets into a single continuous dataset stitching together the segments. The platform chosen for this is currently MATLAB.

This data can provide the community with an example dataset of underwater glider data pertinent to a long duration and low energy glider mission. It also includes ocean measurements of temperature, salinity, and ocean currents. Built into the dataset object are various functions designed to help the user navigate and display a glider's collected data.

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Specifications table

| Subject | Oceanography |
|---------|--------------|
| Specific subject area | Underwater robotic survey of western Indian ocean from Perth, Australia to Mirissa, Sri Lanka. Measurements from surface to 1000 m water depths. |
| Type of data | Live satellite telemetered data |
| How data were acquired | Teledyne Webb Research Slocum glider |
| Data format | Raw, MATLAB dbdgroup structure Derived, MATLAB dbdgroup structure |
| Parameters for data collection | GPS position, vehicle attitude, depth, temperature, salinity, currents, amongst several others. |
| Description of data collection | Ocean gliders telemeter a subset of the collected data real time during the mission. This data was used as a diagnostic regarding vehicle performance as well as scientific analysis. |
| Data source location | Western Indian Ocean (Perth, AUS to Mirissa, LKA) – surrounding 6° 59.642′ S 97° 29.307′ E |
| Data accessibility | With the article Also 2007 and beyond glider data available here: http://slocum-data.marine.rutgers.edu/erddap/index.html This dataset will be hosted here as well: https://marine.rutgers.edu/~dkaragon/glider_data/hosted/ru29-492/ In 2 additional formats not requiring DBDgroup are provided above as well. Profiles and structured timeseries. |
| Related research article | Mike Eichhorn, David Aragon, Yuri A.W. Shardt, Hugh Roarty: Modeling for the Performance of Navigation, Control and Data Post-Processing of Underwater Gliders, Journal Applied Ocean Research, APOR_2019_976 |

Value of the Data

- Oceanographic data, specifically underwater data, has been limited to bi-weekly profiling sparse drifters and oceanographic vessels. Underwater robots are developed enough to cross ocean basins and provide measurements on the timeline of hours on controlled routes not determined by drifting.
- Anyone looking for a long time series of ocean temperature or salinity in the western Indian Ocean or example data set of long duration underwater glider data.
- Further flight analysis of the data could result in more efficient underwater movement facilitating long duration missions. Detection of changes in buoyancy, sensor drift, etc. over long time periods could be analysed. [1]
1. Data Description

Area of study:

The data provided here is a MATLAB object that can be loaded and utilized after downloading and installing the Slocum Power Tools Toolbox here: (see bottom of this section for options not utilizing SPT toolbox) https://github.com/kerfoot/spt

Examples exist at link above on how to use the dataset within the MATLAB environment.

Options exist to export variables in time series, depth format or in profiles format. Profiles contains individualized dive and climb manoeuvres which provide near vertical measurements of temperature and salinity.

You may also find you need a reference of variable names and units. The best reference to that would be masterdata listing here: https://marine.rutgers.edu/~kerfoot/slocum/masterdata/source/masterdata_08_03.html

Sensors that start with drv_ or plain English, not listed above, are derived variables. For instance timestamp could be m_present_time or sci_m_present_time already converted to matlab time for your convenience. Drv_sea_water_density is another example of a derived value for water density from temperature, conductivity, and depth.

In order to utilize the dbdgroup file, proceed with the following steps and be sure to reference the github cookbook as well.

1. Add slocum power tools toolbox to MATLAB path
2. Load in ru29-492_DbdGroup_sci-qc0.mat
3. To export is a simple timeseries file, utilize the command: lvl0 = dgroup.toDbdStruct;
4. To export to scientific profiles (ocean casts) profiles = dgroup.toProfiles;
5. To plot a simple time series of CTD sensor depth: plot(epoch2datenum(lvl0.data(:,lvl0.sci_m_present_time)), lvl0.data(:,lvl0.sci_water_pressure),'b.'
6. To plot a simple time series of vehicle depth: plot(epoch2datenum(lvl0.data(:,lvl0.m_present_time)), lvl0.data(:,lvl0.m_pressure),'k-')

Example of the space and time extents of glider data:
At the link above I have provided several other additional formats of the data: https://marine.rutgers.edu/~dkaragon/glider_data/hosted/ru29-492/

- Profiles – data is broken into upcast and downcast profiles primarily for use in plotting oceanographic data vs depth
- Lv0 & structured data set: both similar but the lvl0 will have a bit more meta inside. I recommend lvl0 as it allows you to break into the mission segment by segment

2. Experimental Design, Materials, and Methods

Raw data is decoded using manufacturer provided executables for glider operators. These executables decode the binary data logged on the glider into ascii or MATLAB files. Keep in mind these are provided on a segment basis which is normally GPS dive position, underwater segment, GPS surface position. In order to stitch the files together John Kerfoot has written the Slocum Power Tools toolbox for MATLAB. This creates an object, DBDGroup, which can be used to assist in plotting and extracting specific data from a glider mission. Details are available on the slocum power tools github site below.

Users of this data are urged to read the SPT wiki: https://github.com/kerfoot/spt/wiki

Glider variables are used to reference specific data inside the DBDGroup files and will assist the user in plotting the correct timestamp and depth for instance. Derived variables such as seawater salinity are provided with the drv_ prefix and are not variables that are logged on the vehicle but derived on shore side.

Website for variable references: https://marine.rutgers.edu/~kerfoot/slocum/masterdata/source/masterdata_08_03.html

Examples are given in the previous section. Please see accompanying work for another example utilizing the data, Modeling for the Performance of Navigation, Control and Data Post-Processing of Underwater Gliders, an Applied Ocean Research article.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.
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Reference

[1] Associated research article: Mike Eichhorn, David Aragon, Yuri A.W. Shardt, Hugh Roarty: Modeling for the Performance of Navigation, Control and Data Post-Processing of Underwater Gliders, Journal Applied Ocean Research, APOR_2019_976.