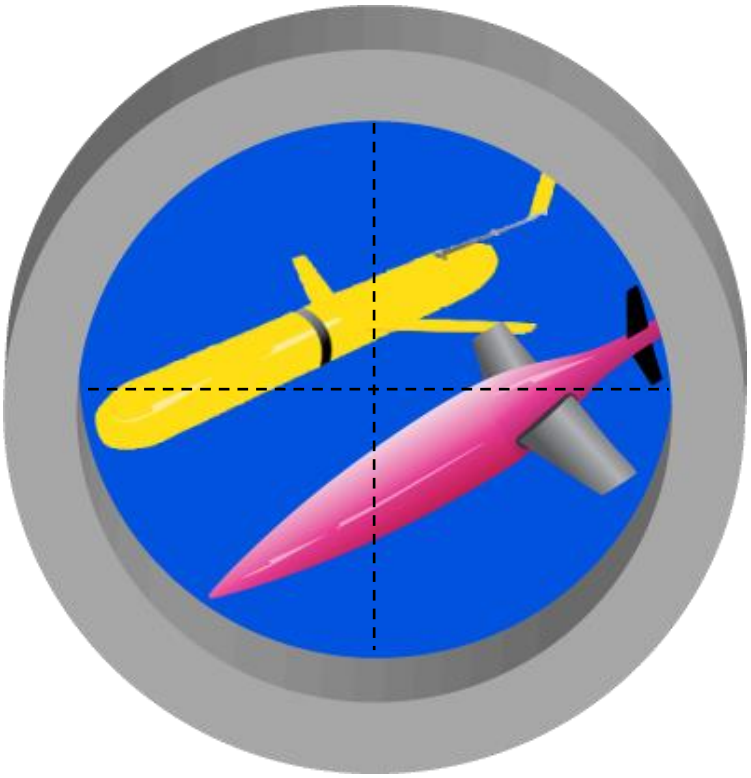
IMOS Integrated Marine Observing System

AUSTRALIAN NATIONAL FACILITY FOR OCEAN GLIDERS (ANFOG)



GLIDERSCOPE v7

User's Manual

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THE UNIVERSITY OF WESTERN AUSTRALIA

Dr Lai Mun Woo
mun.woo@uwa.edu.au

Contents

1 Introduction

GLIDERSCOPE is an Australian National Facility for Ocean Gliders (ANFOG) Windows platform software package designed to allow users quick and easy visualisation of ANFOG's oceanographic data, via a convenient graphical user interface.

In accordance to IMOS (Integrated Marine Observing System) data file convention, ANFOG data formats are based on NetCDF (Network Common Data Form). All of the scientific data are stored with appropriate quality control flags indicating the usability/validity of each data-entry. Although highly informational, NetCDF files can be quite daunting for those who are unfamiliar with the format, or lack the computing set-up to access the data.

Using this *GLIDERSCOPE* software, all users will be able to access the NetCDF files, filter out the bad data and apply a variety of useful data graphical visualisation techniques to examine the data, e.g. using three/four-dimensional plots of water properties, interpolated contour charts, vertical profile plots, water properties comparison charts, etc. Users can easily choose and extract segments of data. Additionally, users can also export their data to text files for easy access in other applications, or into netCDF files to be used with *GLIDERSCOPE* or other applications at a later time.

Useful links:

GLIDERSCOPE software download
http://imos.org.au/gliderscope.html

GLIDERSCOPE sample and tutorial data
http://imos.org.au/gliderscope.html

ANFOG data download
http://imos.aodn.org.au/webportal/
http://thredds.aodn.org.au/thredds/catalog/IMOS/ANFOG/catalog.html

More information about ANFOG
http://imos.org.au/anfog.html

Feedback for *GLIDERSCOPE* software or this *GLIDERSCOPE* v7 USERS MANUAL may be sent to the software's author, Dr Mun Woo, at the Australia Facility for Ocean Gliders (ANFOG): anfog-ecm@uwa.edu.au

2 Installation

2.1First Installation

- Download an appropriate installation package.

  Whether you use a Windows or a Macintosh computer, *Gliderscope* is available for use. It can either be installed as standalone software, or as an App for use in Matlab, if you already have Matlab installed.

  i) Matlab App for computers that have Matlab installed.
  The App version is the most convenient method if you already have Matlab installed. Download *GliderscopeV7.mlappinstall*, open Matlab, navigate to the file in your current folder and double click it to install into Matlab. This will place a *Gliderscope* button in your Apps toolbar, which can be pressed whenever you wish to run *Gliderscope*.

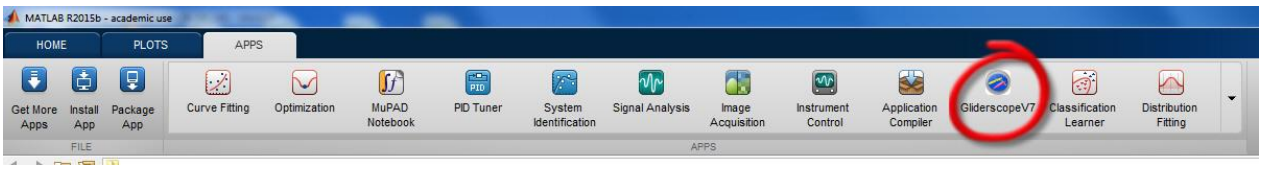
  ii) Standalone software for computers without Matlab installed.
  Download *Gliderscope7_Install.exe* and run it.

  During standalone installation, you may be asked for permission to run *MCRInstaller.exe*. Select *OK* to allow this. (If the question does not appear, then manually run MCRInstaller.exe from your installation folder afterwards.)

2.2 Run the Software

- For the Matlab App, simply click open Matlab and click on the *Gliderscope icon* in the Apps toolbar to run *Gliderscope* (Fig. 1a).
- For standalone versions, double-click on *Gliderscope7.exe* to begin using the software (Fig. 1b).

(a)



(b)

Figure 1. Run Gliderscope by (a) clicking on the Gliderscope icon in the APPS toolbar in Matlab, or (b) starting the software by clicking on the desktop icon.

3 Using *GLIDERSCOPE*

To begin using *GLIDERSCOPE*, double-click on the Matlab App or *Gliderscope7.exe* to start the program.

GLIDERSCOPE first helps you to select and extract the data you want, and then lets you easily visualise your chosen data in a variety of ways. As you go along, *GLIDERSCOPE* 'speaks' to you from its blue talk screen, providing you with useful guidance at every step of the way (Fig. 2).

3.1 Load data

3.1.1 ANFOG netCDF data file

- Click on **[Load data]** button (see Fig. 2) to select which data file you would like to access.

Data files are freely available from http://imos.aodn.org.au/webportal/. A sample data file, *sampledata.nc*, has also been included on the *GLIDERSCOPE* download site (http://imos.org.au/gliderscope.html).

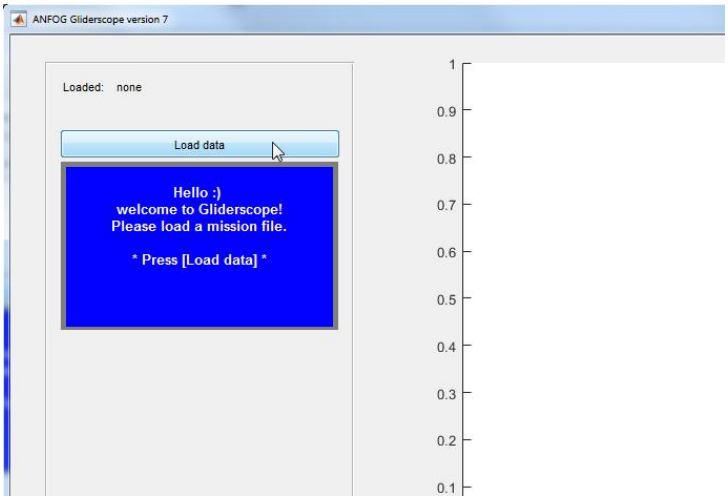
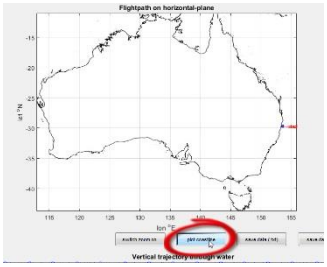


Figure 2. Start by pressing the [Load data] button on the *GLIDERSCOPE* main dashboard.

3.1.2 Plot coastline data (optional)



*optional: Press **[plot coastline]** button to see where the glider mission occurred in relation to the Australian coastline (Fig. 3). Coastline data will take longer to load on first run, but subsequently, **[plot coastline]** will plot much more quickly.

Figure 3: Location can be seen in relation to the Australian coastline by pressing on [plot coastline] button.

- Zoom into the study region by pressing [switch zoom on] and then click-and-drag a box with the mouse (Fig. 4).

  *Handy tips:
  alt-click: zooms out a little
  double-click: zooms out all the way
  mouse-wheel scroll: zooms in/out

- To remove the coastline, press **[clear]** button (right side on Fig. 4).

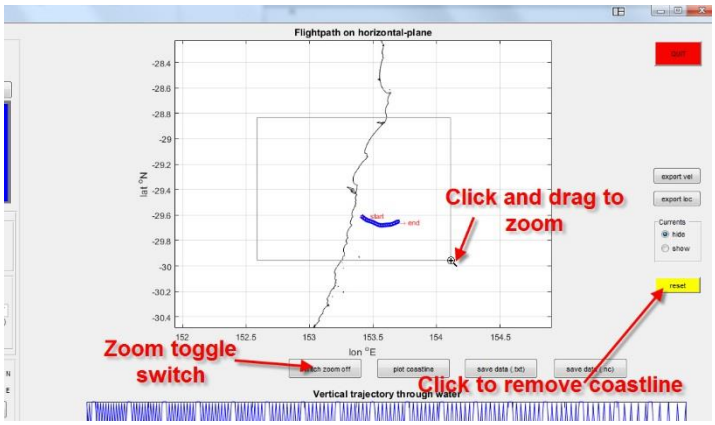


Figure 4. Magnify an area in the map using the zoom function.

3.1.3 Examine glider's path

Two plots are displayed illustrating the path that the glider had taken; from an aerial view (Fig. 5) and side view (Fig. 6).

Glider's horizontal path (aerial view)

- In *GLIDERSCOPE*'s right plot (Fig. 5), an aerial view of the glider's journey is shown as a blue line with white arrows pointing the direction of travel. (White arrows may be more obvious when you zoom in closer. *use **[switch zoom on]** and click and drag on the chart.)

- In addition to the glider path, you can also ○**show** or ○**hide** arrows which point the direction of average seawater flow[1].

- Press **[export loc]** if you would like to export latitude and longitude data as a text file for use in other applications.

- Press **[export vel]** if you would like to export the estimated depth mean current velocities as a text file.

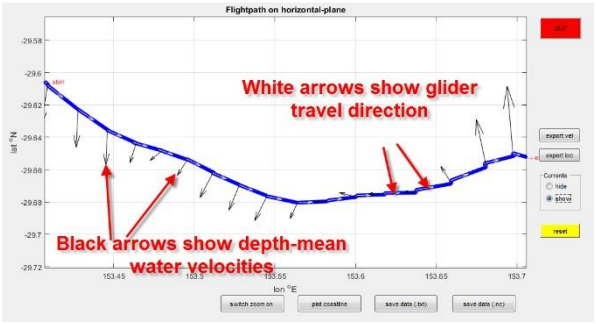


Figure 5. The plot on the right of the dashboard shows an aerial view of the glider path. Using the controls right of the plot, users may choose whether to also display the direction of currents as computed by the glider during its journey.

[1] ANFOG gliders do not carry any current velocity measuring devices. Current velocities are only very rough estimates which the glider has derived using onboard engineering parameters and GPS (Global Positioning System) fixes each time it surfaced. These are not quality controlled.

The exported text files can then be used in other programs, e.g. Excel. The files are named for what the columns of data contain,

e.g.‘ *lat_lon_time.txt’* contains
- column 1: Latitude (*lat*)
- column 2: Longitude (*lon*)
- column 3: Time (*time*)

'ucur_vcur_lat_lon_time.txt' contains
- column 1: Eastward seawater velocity (*ucur*)
- column 2: Northward seawater velocity (*vcur*)
- column 3: Latitude (*lat*)
- column 4: Longitude (*lon*)
- column 5: Time (*time*)

(* Note: Units of measurement are as shown in Table 1.)

Glider’s vertical path (side view)

- In *GLIDERSCOPE’s* bottom plot (Fig. 6), the vertical glider trajectory is displayed. You may choose to view this chart with data indices or dates on the x-axis.
- To zoom in, use **[switch zoom on]** and drag with mouse to zoom. If the x-axis is showing dates, it will automatically update to either show time or date where appropriate to the zoomed scale.

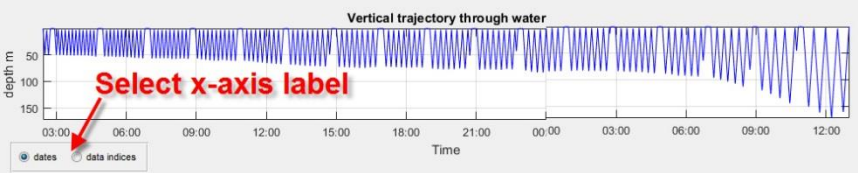


Figure 6. Bottom plot shows the dive paths on a vertical plane.

3.2 Extract data

3.2.1 Use all available data

- Press **[DONE]** button (Fig. 7) now or after pressing [**reset**] to proceed with all of the data intact. Use with caution because every glider mission typically produces enormous volumes of high-resolution data which may tax your computer's resources if processed all at once.

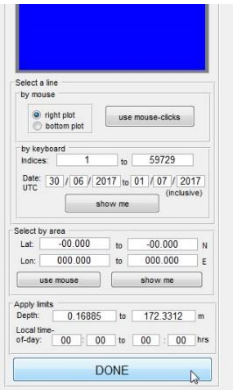


Figure 7. Use [DONE] to proceed with the data to the plotting wizard.

3.2.2 Use part of the data

If you are only interested in a segment of the data, you may isolate your data in a few easy ways. You may:

(i) Select a line

This option is especially useful for extracting data to make an oceanographic transect line. Selection can be made by any of the following methods:

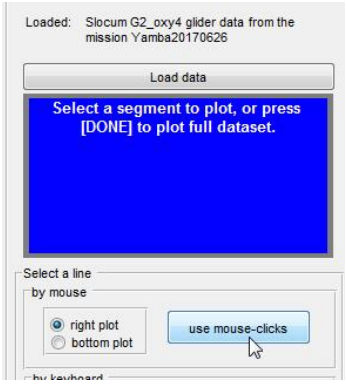


Figure 8. Control panel controls for line selection by mouse.

By mouse

Choose ○**right plot** or ○**bottom plot** to indicate from which display you would like to select data from.

- Press **[use mouse-clicks]** button to enable the mouse.
- Using your mouse, click your desired start and end points over the chosen plot.

Although crosshairs (Fig. 9) are provided to help you position your points, your selections need not be very precise, as *GLIDERSCOPE* will always find the data points closest to your mark.

You may use the **[switch zoom on]**/ **[switch zoom off]** button (Fig. 4) to zoom in for a closer look at any time.

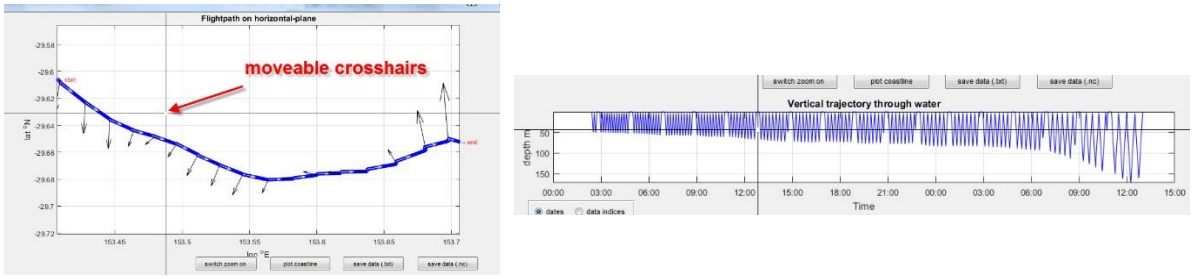


Figure 9. Crosshairs help as your mouse-click the start and end points of your desired line segment; this can be done on either of the 2 charts.

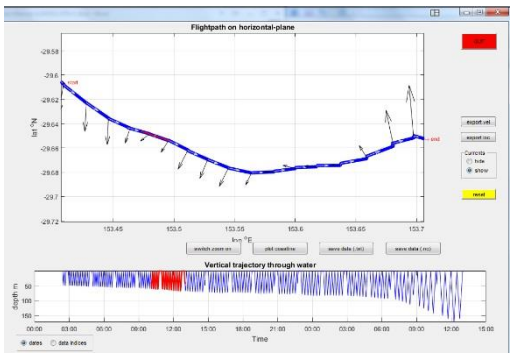


Figure 10. User-selected segment is highlighted in red.

- Finally, your selection is highlighted in red (Fig. 10), and the corresponding data indices, UTC dates and depth range are displayed in the control panel.
- *optional: pressing **[reset]** button removes red highlighting and reinitialises everything in the control panel.
- If you re-do your mouse selection by pressing **[use mouse-clicks]** again, the existing red highlighting will also be cleared.

Using zoom

The zoom feature works in both plots, regardless of which radio button (○**right plot** / ○**bottom plot**) has been chosen.

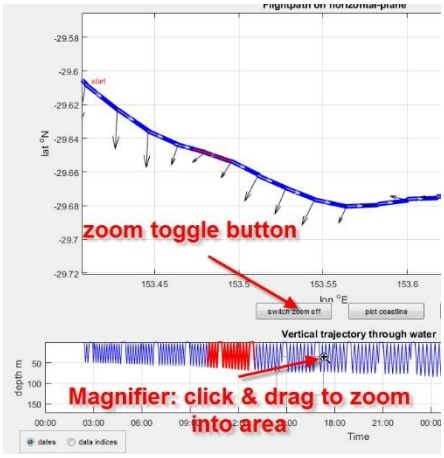


Figure 11. Controls for using zoom.

- To enable/disable zooming, press **[switch zoom on]/ [switch zoom off]** button.
- Zoom controls -
  Zoom in: Hold down mouse button and drag a rectangle into either plot.

  Zoom back out a bit: Hold down ALT-key (on the keyboard) and click once.

  Zoom back out all the way: Quickly double-click over the plot.

If you have a scroll mouse, you can spin the scroll to zoom in or out fast.

If your mouse has a right button, pressing it displays other zoom options.

By keyboard

Using the keyboard, you may further tweak your previous mouse-click selection or define a new segment altogether. This may be done by specifying the segment range by typing into textboxes for **Indices**[2] or **Date** (Fig. 12). (*Note: Having typed into the **Indices** text boxes, the **Date** will automatically be updated to correspond, and vice versa.)

Figure 12. Keyboard input boxes to define start and end points of a segment, and a button to invoke graphical display of segment.

[2] The first entry in the time series is indexed as number 1.

- For a closer look at the data index numbers, you may also use the **[switch zoom on]/ [switch zoom off]** button and zoom into the bottom plot (Fig. 11).
- Press **[show me]** if you need to check where these 2 points lay geographically (Fig. 12).
- The user-selected segment will then be highlighted in red (Fig. 10).
- *optional: pressing **[reset]** button (Fig. 10) removes highlighting and reinitialise all text boxes.

(ii) Select an area

This option is particularly useful when you want to examine data from a specific region, e.g. within a sea canyon or in an ocean eddy. You may indicate the area of interest by mouse or by keyboard.

By mouse

- Press **[use mouse]** button to enable the mouse (Fig. 13).
- Click mouse and drag a box around your area of interest (Fig 14). The shape of this box can be modified using the box handles (little squares on the sides and corners), and the whole box may be moved by placing the mouse pointer within the box and dragging.

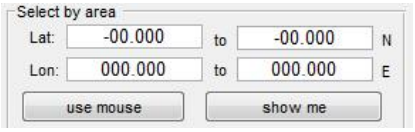


Figure 13. Control panel for extracting data from a geographical area.

- When done, double-click within the box.
- Data that falls within the box will be highlighted in red (Fig. 15), and coordinates of the bounding box will automatically be shown in the **Lat** and **Lon** text boxes (Fig. 13).
- *optional: pressing **[reset]** button (Fig. 10) removes highlighting and reinitialises all text boxes.

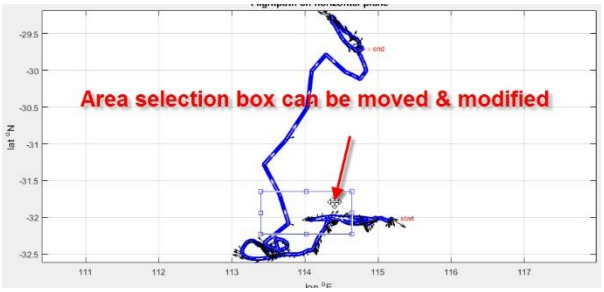


Figure 14. Define an area of interest using the mouse; remember to double-click in the box when done.

By keyboard

- If you prefer to define your area of interest directly by latitude/longitude coordinates, type into the **Lat** and **Lon** text boxes (Fig. 13).
- *optional: pressing **[show me]** (Fig. 13) will highlight the data found within your chosen coordinates.

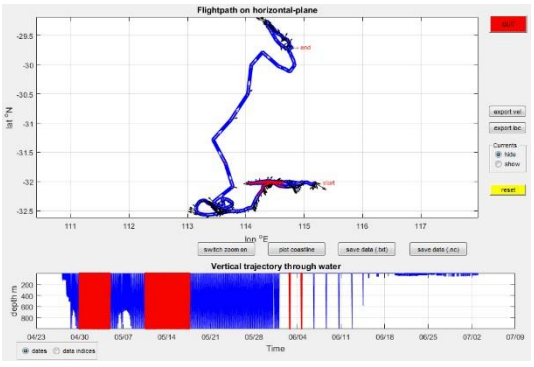


Figure 15. Data within a chosen area is selected.

(iii) Apply depth or time limits

In addition to any of the previous selections, the data may by further limited according to depths or time, to aid your specific analyses. This may be done by typing into the relevant text boxes as shown in Fig. 16.

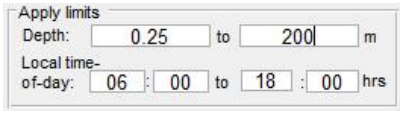


Figure 16. Controls to limit the depth and/or time of day from which to extract data.

Specifying depth range

If you want to examine data from a particular depth within the water column (e.g. to study surface processes, a subsurface current or dense water cascades near the seabed), you may find it useful to be able to specify and limit the depth range. (Alternatively, you can also identify the depth range afterwards when you see the plotted data in the plotting wizard.)

- Using your keyboard, type into the **Depth** boxes to indicate minimum and maximum depths.

- If you accidentally reverse the order of numbers in the **Depth** boxes, do not worry; *GLIDERSCOPE* will automatically sort them out.

Specifying time of day

This option is especially useful if you are interested in examining processes that occur only during certain times of day, e.g. isolating data from daylight hours, we see that the fluctuating pattern of dissolved oxygen in coastal waters may be the result of photosynthetic activity (Fig. 17).

- Using your keyboard, specify the range in the **Local-time-of-day** text boxes. The local time of day may be specified,

*Note: For more intuitive use, you specify Time-of-day in standard local time, *not* UTC time.

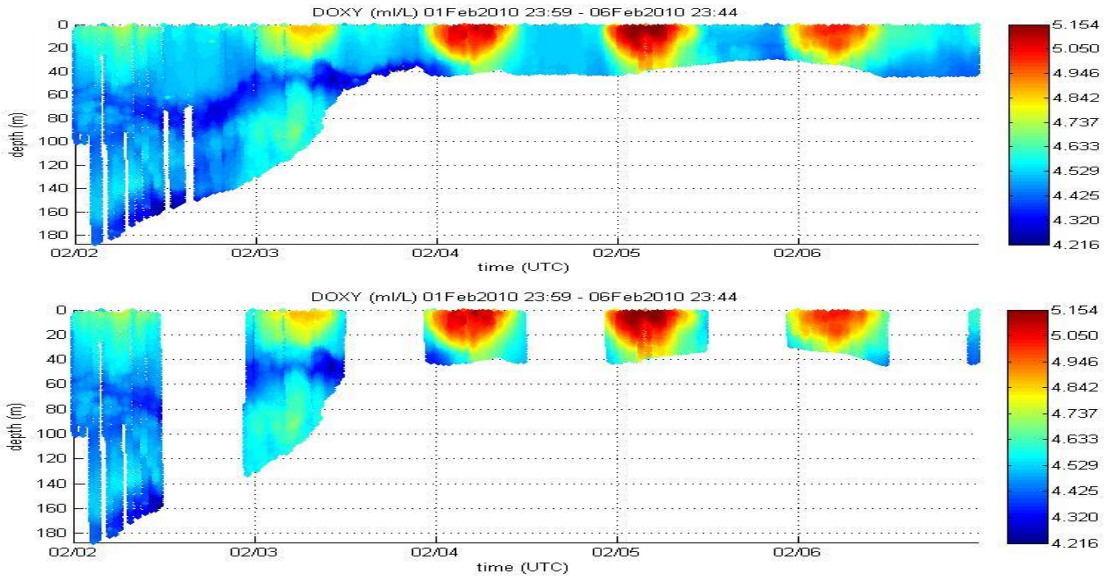


Figure 17. (Top) A segment of data showing coastal fluctuations of dissolved oxygen concentration; (bottom) when data during daylight hours are isolated and plotted, it is seen that dissolved oxygen maxima coincides with daylight hours.

Finalise your selection

Now that data has been extracted, you may proceed to the next stage to visualise the data, or save the data as text files.

- Press **[Done]** when ready to plot up your selected data (Fig. 18).

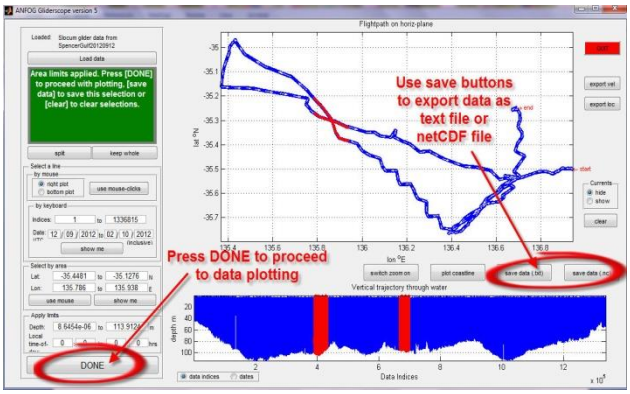


Figure 18. Finalise selection and move on to next stage.

- Optional: Hit **[Save data]** to save the data as text files (.txt) or netCDF (.nc) files (Fig.18). Text files can then be used in other programs, e.g. excel. For the text files, data of each available kind of water property is saved in a separate file with 5 columns of numbers. The files are named for what the columns of data contain. Units of measurement as shown in Table 1.

e.g.'*TEMP_depth_lat_lon_time.txt'* contains
- column 1: Temperature (*TEMP*)
- column 2: Depth (*depth*)
- column 3: Latitude (*lat*)
- column 4: Longitude (*lon*)
- column 5: Time (*time*)

- The netCDF (.nc) files are generated such that you may read them back into Gliderscope[3].

Gliderscope filters the data such that only data that has been quality flagged as 'good' or 'interpolated' data passes into the saved files or into the plotting stage. The only exceptions are data for estimated depth mean current velocities, which receive no quality control. The units of measurement for every type of data is as listed in Table 1.

[3] From Gliderscope v7 onwards, the depth-mean water velocities are also included in the saved netCDF files.

Table 1. Parameters exported in text files.

code	standard name	units
CNDC	Sea water electrical conductivity	S/m
DOX1	Mole concentration of dissolved molecular oxygen in sea water	µmol/L
DOX2	Moles of oxygen per unit mass in sea water	µmol/kg
CPHL	Mass concentration of chlorophyll in sea water	mg/m^3
PSAL	Sea water salinity	psu
TEMP	Sea water temperature	Celsius
CDOM	Concentration of coloured dissolved organic matter	ppb
VBSC	Volumetric scattering coefficient	$m^{-1}sr^{-1}$
BBP	Particle backscattering coefficient	m^{-1}
DENS	Sea water density	kg/m^3
SVEL	Velocity of sound through sea water	m/s
IRRADxxx	Downwelling spectral irradiance in sea water	$\mu W/cm^2nm^{-1}$
depth	Water depth downwards from sea surface	m
lat	Latitude	degrees north
lon	Longitude	degrees east
time	Time	days since 12am, Jan 1st 1950
OCRxxx_x	Downwelling spectral irradiance in seawater at xxx.x nm (e.g. OCR470_3 is taken at 470.3nm)	uW/cm^2/nm
UCUR	Eastward seawater velocity	$m\ s^{-1}$
VCUR	Northward seawater velocity	$m\ s^{-1}$
NTRA[4]	Mole concentration of nitrate in sea water	µmol/L

[4] Gliderscope v7 now has the ability to visualize nitrate data where available.

3.3 Data visualisation

GLIDERSCOPE evokes a plotter wizard (Fig. 19) to make it very simple for you to produce a variety of useful and attractive data plots. If salinity and temperature data are available (along with the depth and location data), *GLIDERSCOPE* immediately calculates corresponding seawater densities and underwater sound velocities and makes them available to you. As before, *GLIDERSCOPE* 'speaks' to you from its blue talk screen, providing you with useful guidance at every step of the way.

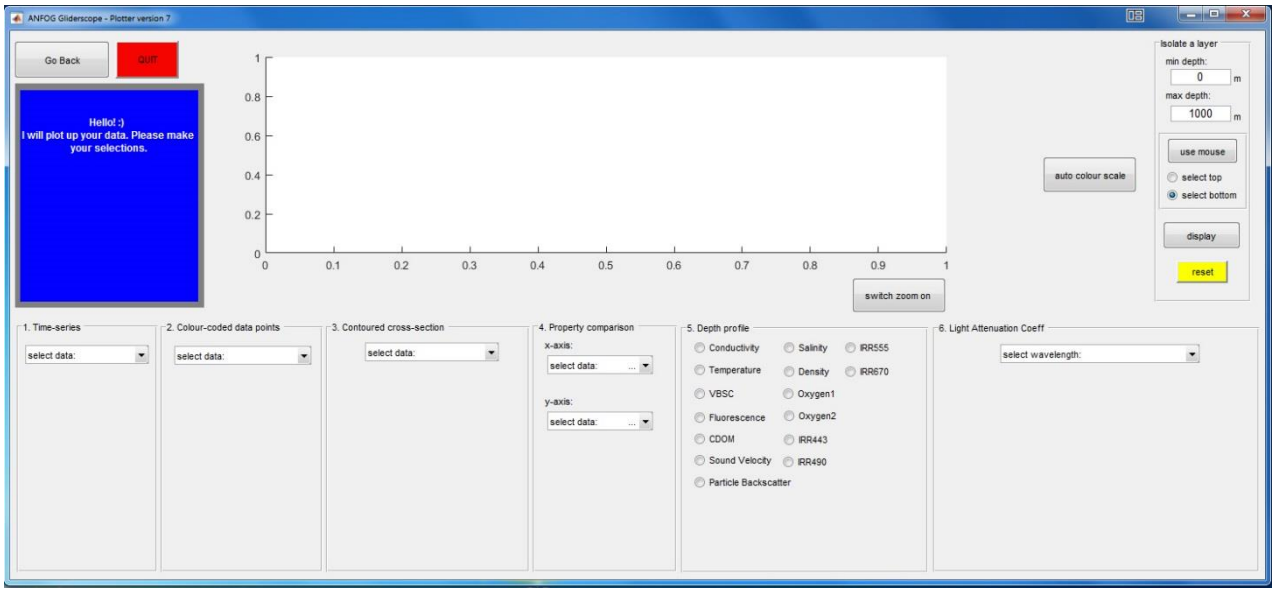


Figure 19. *GLIDERSCOPE*'s plotter dashboard

From each of the 6 plotting control panels of this dashboard (Fig. 19), you will be able to produce the following styles of plots:

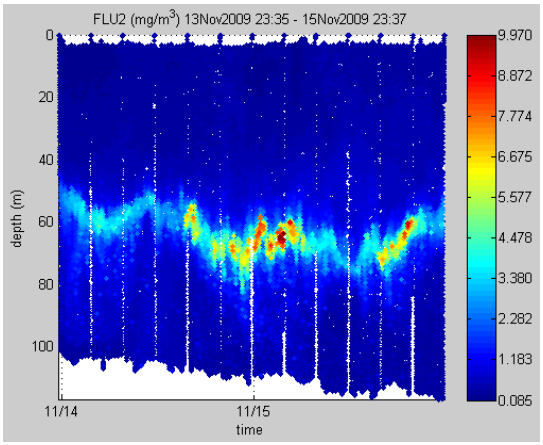


Figure 20. Panel 1 example output: Time-series plot of fluorescence; colour range is user-adjustable.

1. Time-series

- Time-series of water property data is plotted with time vs. depth axes (Fig. 20). This plot type is particularly useful when the glider performs repeated transect lines, because then it becomes obvious how the seawater's properties evolve with time. (See Section 3.3.1 for instructions to make such a plot.)

2. Colour-coded data points

- Glider data are shown as colour-coded points spatially positioned where their measurements had been taken within the ocean (Fig. 21). This type of plot is especially useful for analysing vertical transects of the ocean. (See Section 3.3.2 for instructions to make such plots.)

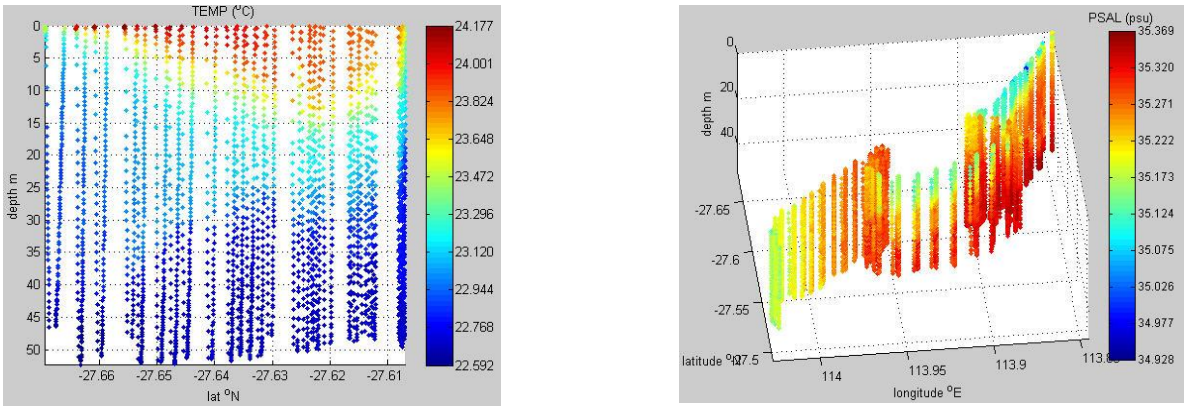


Figure 21. Panel 2 example outputs: Temperature data plotted in two-dimensional space (left) and salinity data in three-dimensional space (right); range of colour is user-adjustable and plots (right) can be rotated spatially using the mouse.

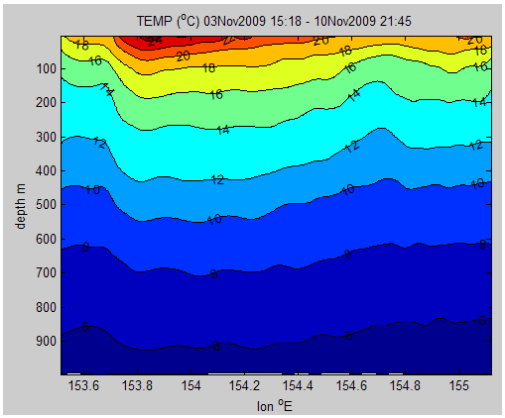


Figure 22. Panel 3 example output: contoured cross-sectional view of temperature data.

3. Contoured cross-section

- Glider data across transect lines can also be displayed contoured (Fig. 22). Because data is interpolated, the resulting plot allows you to get an overall visualisation of the general distribution and patterns of the water property.

(See Section 3.3.3 for instructions to make such a plot.)

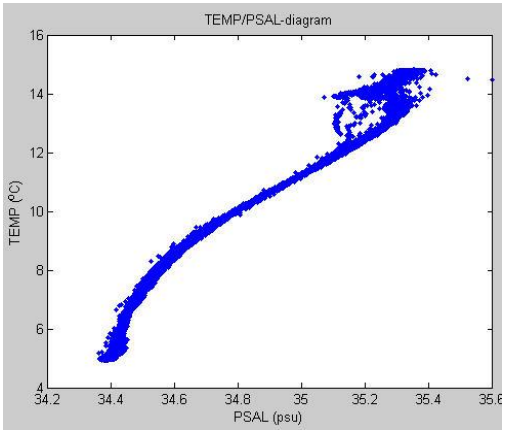


Figure 23. Panel 4 example output: Temperature compared to salinity data in a T/S diagram.

4. Property comparison

- Comparison between any 2 kinds of water properties can be plotted (e.g. TS-diagram, see Fig. 23). This allows you to examine the water property signatures and identify different water masses found in the water column.

(See Section 3.3.4 for instructions to make such a plot.)

5. *Depth profile*

- Data from single dives can be viewed as vertical profiles of water property (Fig. 24). This is handy for locating the depth of thermoclines and pycnoclines, or determining the thickness of water masses, deep-chlorophyll maxima, etc.

(See Section 3.3.5 for instructions to make such a plot.)

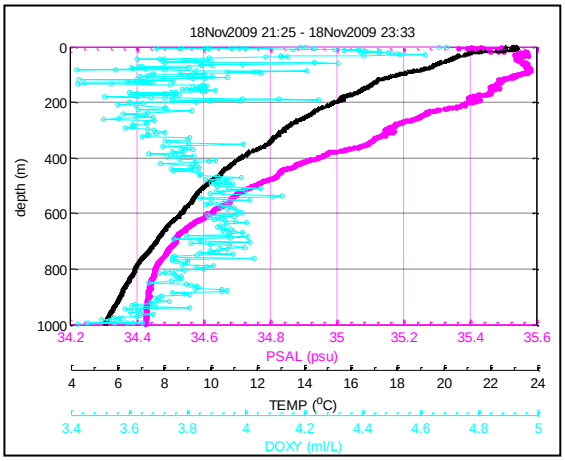


Figure 24. Panel 5 example output: Vertical profiles of water properties sampled in the water column.

6. *Light attenuation coefficient*

- Gliderscope version 7 now has the ability to calculate light attenuation coefficients (K) from the different frequencies of downwelling spectral irradiance available in ANFOG Slocum glider data. Using this software, you can now examine how K varies with time (Fig. 25) or location, and also analyse how K may be affected by depth-averaged coloured dissolved organic matter (CDOM), chlorophyll (CPHL) and volumetric backscatter (VBSC). Additionally, the comparison can also be made with CDOM, CPHL and VBSC calculated to the 1% photic depth only.

(See Section 3.3.6 for instructions to make such plots.)

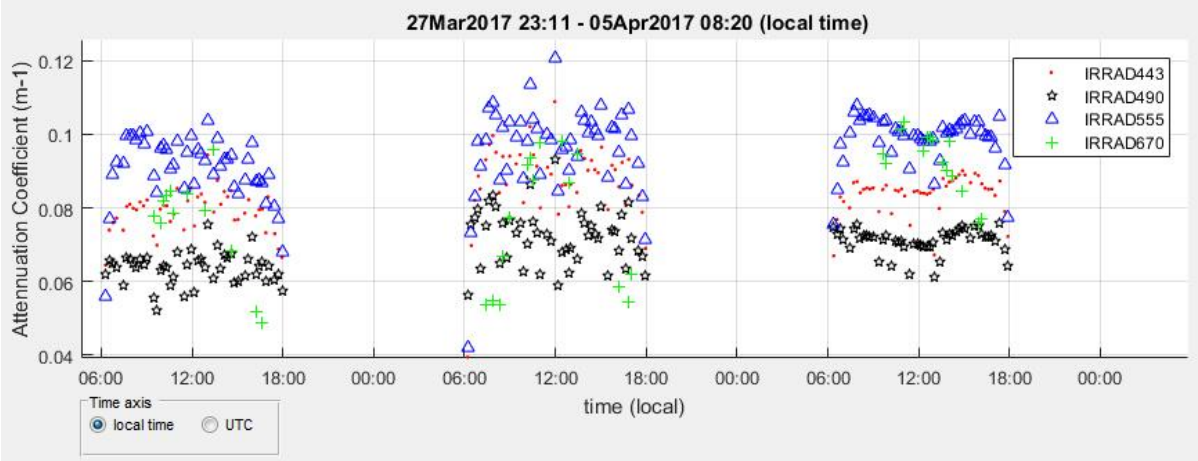


Figure 25. Panel 6 example output: Comparisons of light attenuation coefficients of different frequencies of light over three days.

You can choose to browse the plots via *GLIDERSCOPE*'s plotter display window (Fig. 19), or export them as separate figure files to be saved, edited or just placed side by side on screen for easy comparisons.

Data from each plot can also be extracted and saved into text files by pressing **[save data]** [5]at the bottom of respective control panels.

At any time, should you wish to select a different leg of the flight path or load up a different data file altogether, press **[Go Back]** (Fig. 26).

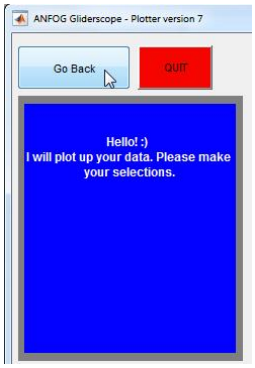


Figure 26. Go back to grab a different segment of data, or load up a different glider data file.

[5] Gliderscope v7 now allows [save data] to be used even when 'all available data' is selected.

3.3.1 Using Control Panel 1: Time-series

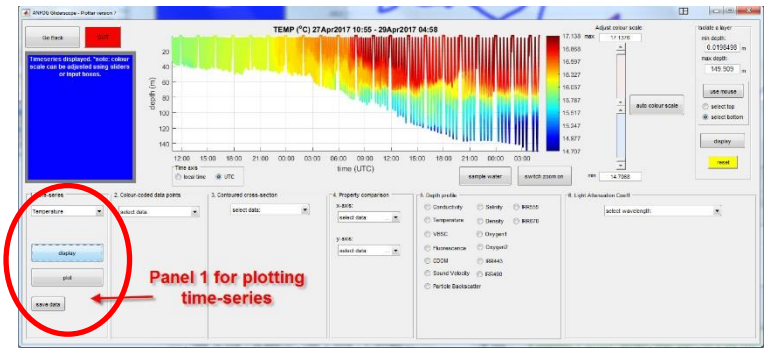


Figure 27. Time-series control panel and control panel chart display area. The drop-down menu is populated with data types available for plotting.

- Select a data type from the drop-down menu (Fig. 27). This menu is populated only with data types found to be available in the glider mission (and possibly the addition of density and sound velocity data calculated by *GLIDERSCOPE*).

- Press **[display]** to view time-series plot in the control panel, or press **[plot]** to plot in a separate saveable figure (Fig. 27).

- Colour range can be adjusted either by

  (i) moving the sliders up and down and then pressing **[display]** or **[plot] (Fig. 28)**, or

  (ii) by manually typing numbers into the **max** and **min** text-boxes, and then pressing **[display]** or **[plot]**.

  (iii) Alternatively, if you have made changes to the colourscale, pressing **[auto colour scale]** will once again optimise your colour scale.

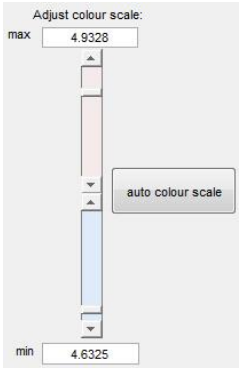


Figure 28. Controls for adjusting the colour-scale for cross-sectional plots.

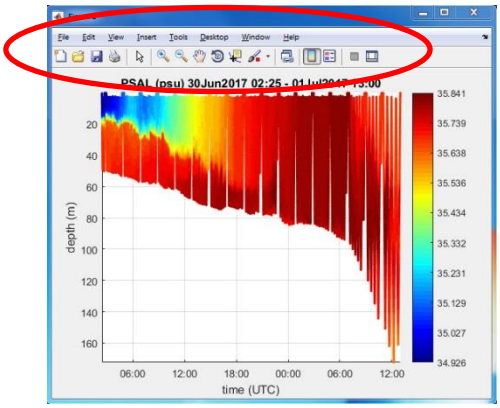
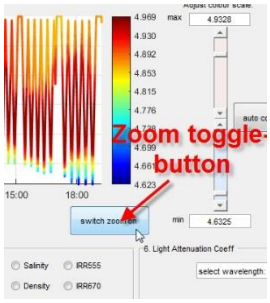


Figure 29. The chart menu and toolbar allows user to do various things to the chart; click on the menu items or roll the mouse over icons to find out what each does.

• If plotted separately, use the chart's toolbar to save, print, manipulate or edit the chart (Fig. 29). A helpful description for each toolbar button appears as you roll your mouse over it.

- Upon viewing the cross-sectional display, you may identify a layer of water that is of particular interest (e.g. a surface layer or a subsurface water mass). You can use the zoom button for a closer look (Fig. 30).



(i) To zoom in, press the **[switch zoom on]** button, and then click and drag the mouse to indicate a box within the chart display to zoom into.

(ii) Double-click to return to the original view if required.

(iii) Press the zoom button again **[switch zoom off]** to end zooming.

Figure 30. Zoom button that toggles on and off, allows users to have a closer look at the chart displayed.

Isolate a layer

- A new feature of Gliderscope V7 is the additional functionality of isolating data by depth from within the plotter, and then producing the plots based on your depth selection. Although you can also isolate the depth levels from the Gliderscope main control panel, it is useful to be able to select the depths while actually seeing the data visually in charts.

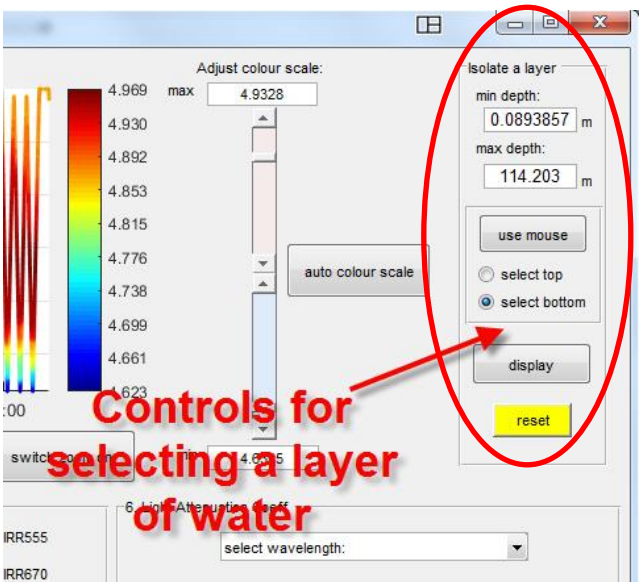


Figure 31. Controls for selecting a layer of interest.

The depth limits of a specific layer can be specified using the keyboard or the mouse (Fig. 31).

By Keyboard:

- type directly into the ***min depth*** and ***max depth*** text boxes (Fig. 31).
- press the **[display]** button
- press **[auto colour scale]** to automatically optimised the colour range of the display.

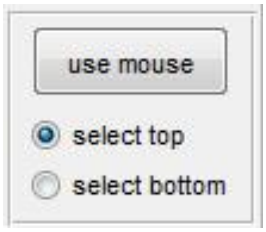


Figure 32. Controls for using the mouse to indicate the layer of interest.

By mouse:

- Select either ○**select top** or ○**select bottom** radiobutton (Fig. 32) to indicate whether you now want to specify the upper or lower depth limit respectively.
- Press **[use mouse]**
- Position the mouse over the display chart and click at where the level should be.
- Repeat until the red lines define your chosen layer (Fig. 33).
- Press the **[display] or [plot]** button
- press **[auto colour scale]** to automatically optimised the colour range of the display.

(* Hint: Take note of the depths automatically shown in the text boxes if you would like to use these values again, e.g. when doing a T-S plot later to visualise the water property signature of this water body.)

For example, if surface coastal water circulation is the focus of your study, you may choose to isolate the topmost ~200m of water using a mouse, as shown in Fig. 33.

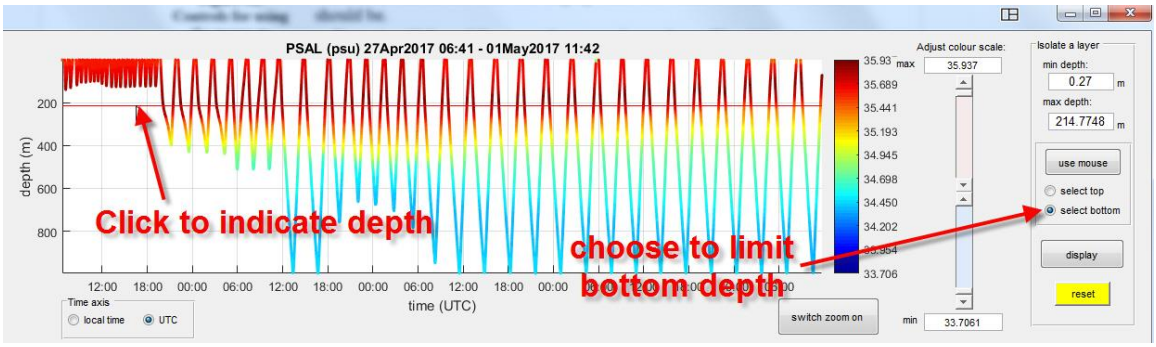


Figure 33. User-selected red line limits the salinity data to depths of 200m.

Subsequently, fine-tuning the colour scale (by using the slider, colour scale text boxes or the **[auto colour scale]** button) and pressing **[display]** or **[plot]** produces a display which shows more clearly the salinity patterns seen in the surface layer (Fig. 34).

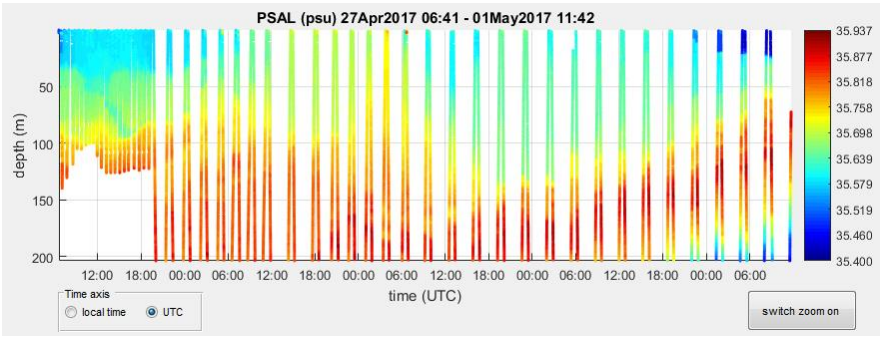


Figure 34. Salinity patterns in the surface waters clearly shown after surface waters have been isolated.

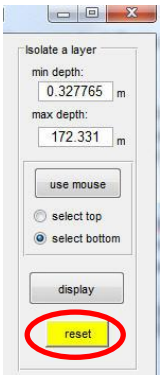


Figure 35. The reset button reinitialises the depths and colourscale.

- To clear off your user-defined depths and colour scale values, simply press on the yellow **[reset]** button.

- Optional: If you require a copy of the data illustrated in your plot, press the **[save data]**[6] button (Fig. 36, bottom of panel 1).

Each saved file contains 3 columns of numbers. The file name reflects which control panel produced it, as well as what data each column contains,

e.g. '*chart1_DENS_time_depth.txt'* contains
- column 1: Density (*DENS*)
- column 2: Time (*time*)
- column 3: Depth (*depth*)

(* Note: Units of measurement are as shown in Table 1.)

Figure 36. The save data button saves the data used in the plot.

Sample Water

Another new feature in Gliderscope V7 is the **[sample water]** button (Fig. 37). Using this button, you can quickly fire a virtual Niskin Bottle to sample for Temperature, salinity, dissolved oxygen, CDOM, chlorophyll and nitrates (where data is available) anywhere in the water column.

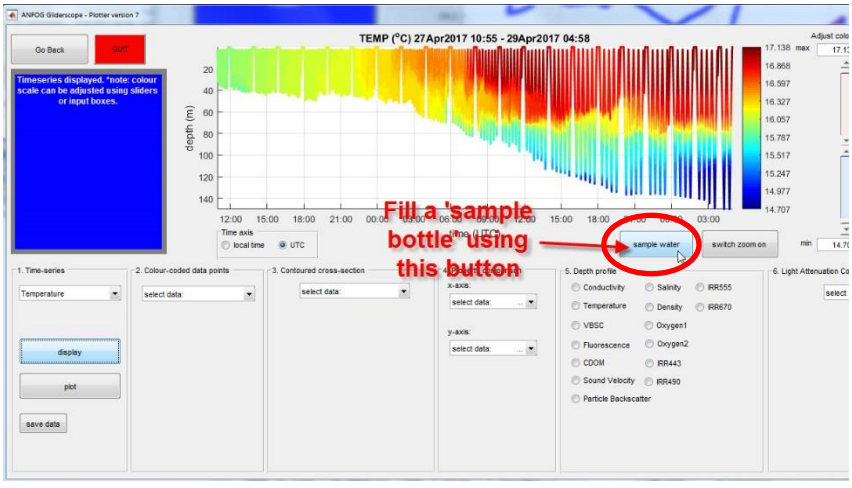


Figure 37. The [sample water] button allows users to quickly drop a box into the display and find the range of each water property there.

[6] From Gliderscope version 7 onwards, the save data function is also available when you choose all available data, so all the data can be saved with one press of the button.

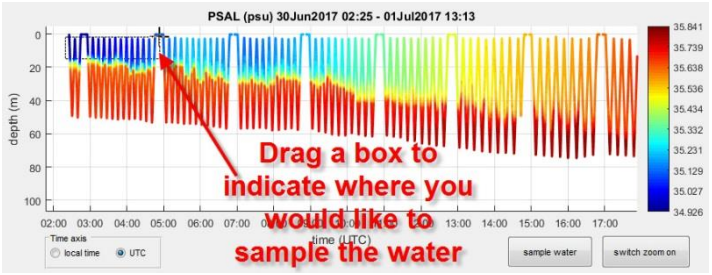


Figure 38. The user can use the mouse to drag a box around the area of interest.

- Make a display using panel 1
- Press on the **[sample water]** button (Fig. 37)
- Using the mouse, drag a rectangle onto the display to indicate where you would like the water sampled (Fig. 38)

On the blue talkscreen (Fig. 39), the plotter will now report to you the ranges of water properties in the sampled water.

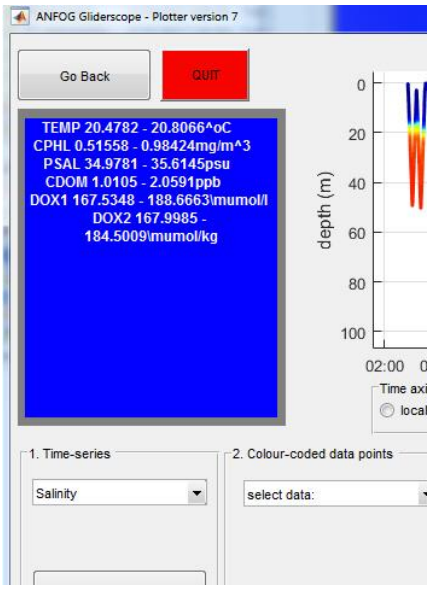


Figure 39. Read the talk screen to see what the water properties are.

3.3.2 Using Control Panel 2: Colour-coded Data Points

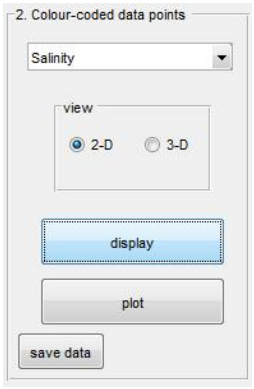


Figure 40. Colour-coded data points control panel.

- Select a data type from the drop-down menu (Fig 40). This menu is populated only with data types found to be available in the glider mission (and possibly the addition of density and sound velocity data calculated by *GLIDERSCOPE*).

- Select either ○**2-D** or ○**3-D** radiobutton (Fig. 40). This refers to the spatial dimensions in which you want to visualise the data. Data will be plotted as dots in an additional dimension of colour.

- Press **[display]** to produce the plot in the display area, or press **[plot]** to plot in a separate saveable figure (Fig. 40).

(*Note: *GLIDERSCOPE* automatically detects the orientation of the transect and chooses the more appropriate (longer) x-axis to plot on.)

- Colour-range can be adjusted either by
  - (i) moving the sliders (Fig. 41) up and down and then pressing **[display]** or **[plot]**, or
  - (ii) by manually typing numbers into the **max** and **min** text-boxes, and then pressing **[display]** or **[plot]**.
  - (iii) Alternatively, if you have made changes to the colour scale, pressing **[auto colour scale]** will once again optimise your colour scale.

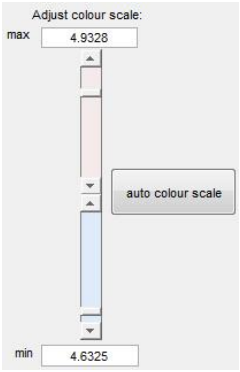


Figure 41. Text boxes and sliders for adjusting colour scale.

- Upon viewing the cross-sectional display, you may identify a layer of water that is of particular interest to you (e.g. a surface layer or a subsurface water mass). Use the zoom function to take a closer look (Fig. 42).

  - (i) To zoom in, press the **[switch zoom on]** button (Fig. 42), and then click and drag the mouse to indicate an imaginary box within the chart display to zoom into.
  - (ii) Double-click to return to the original view if required.
  - (iii) Press the zoom button again **[switch zoom off]** (Fig. 42) to end zooming.

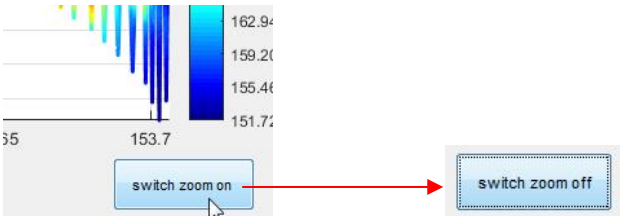


Figure 42. Zoom toggle button switches from 'switch zoom on' to 'switch zoom off'.

- To produce a plot of a specific layer of water, isolate it using the 'Isolate a layer' control panel on the far right of the plotter dash board (Fig. 43). Depth can be limited – the top, bottom or both, using the keyboard or mouse, as previously described in section 3.3.1. (See Fig. 44 for an example).

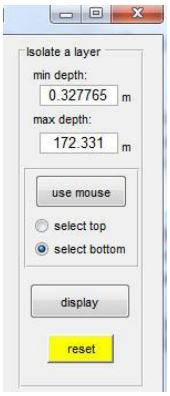


Figure 43. Control panel for limiting the depth range of the data.

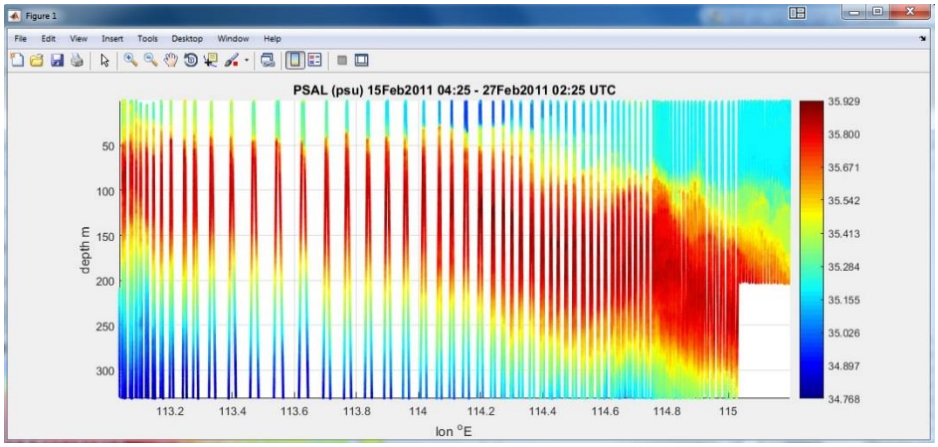


Figure 44. The downward extension towards the coast, of a subsurface layer of high salinity water (SICW), is effectively highlighted by limiting the depth of the plot from 10m to 320m.

Plots in 3-D space are always created as separate figures to allow you access to tools for 3-D rotating, zooming, etc.

- To rotate the figure, first click on the 'rotate 3D' icon (as indicated in Fig. 45).
- Then use the mouse to click and drag the figure around, rotating it freely in any direction.
- The chart's toolbar can also be used to save, print, manipulate or edit the chart (Fig. 45).
- Optional: If you require a copy of the data illustrated in the plot, press **[save data]** button (Fig. 40).

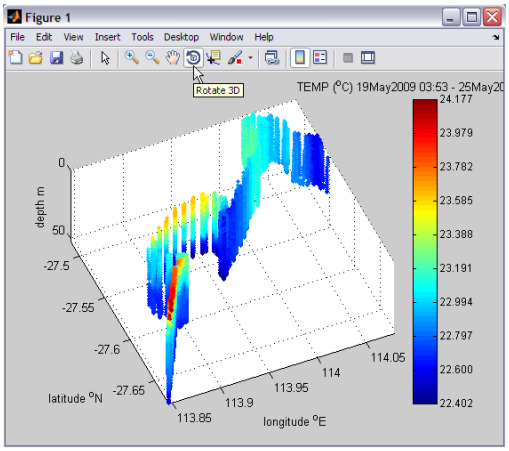


Figure 45. Data plotted in 3-D space can be freely rotated using the mouse.

File names reflect which control panel produced them, as well as what data is contained therein,

2-D :
e.g. '*chart2_TEMP_depth_lon.txt*'
- column 1: Temperature (*TEMP*)
- column 2: Depth (*depth*)
- column 3: Longitude (*lon*)

3-D :
e.g. '*chart2_TEMP_depth_lat_lon.txt*'
- column 1: Temperature (*TEMP*)
- column 2: Depth (*depth*)
- column 3: Latitude (*lat*)
- column 4: Longitude (*lon*)

(* Note: Units of measurement are as shown in Table 1.)

3.3.3 Using Control Panel 3: Contoured Cross-section

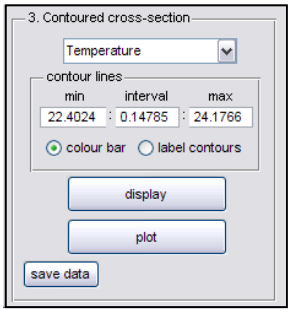


Figure 46. Contoured cross-section control

- Select a data type from the drop-down menu. This menu is populated only with data types found to be available in the glider mission (and possibly the addition of density and sound velocity data calculated by *GLIDERSCOPE*).

- Contour values can be user-defined. Just alter the values in the text boxes by typing directly into them (Fig. 46).

- Use radio buttons for a chart with a colour bar, or to have contours labelled (Fig. 46).

- Press **[display]** to produce the plot in the display area, or press **[plot]** to plot in a separate figure (Fig. 46). The figure can be kept for comparison with other figures that you plot subsequently, or saved for further editing later.

- If plotted separately (Fig. 47), use the chart's toolbar to save, print or edit the chart. A helpful description for each toolbar button appears as you roll your mouse over it.

- You may zoom into the display chart for a closer look (Fig. 48):
  - i) To zoom in, press the **[switch zoom on]** button, and then click and drag the mouse to indicate a box within the chart display to zoom into.
  - ii) Double-click to return to the original view if required.
  - iii) Press the zoom button again **[switch zoom off]** to end zooming.

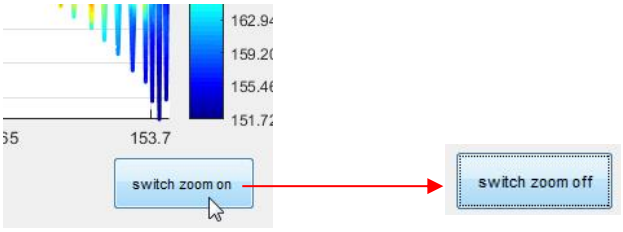


Figure 48. Zoom toggle button switches from 'switch zoom on' to 'switch zoom off'.

(iv) Depth can be limited by mouse or keyboard. This has been described in detail in section 3.3.1.

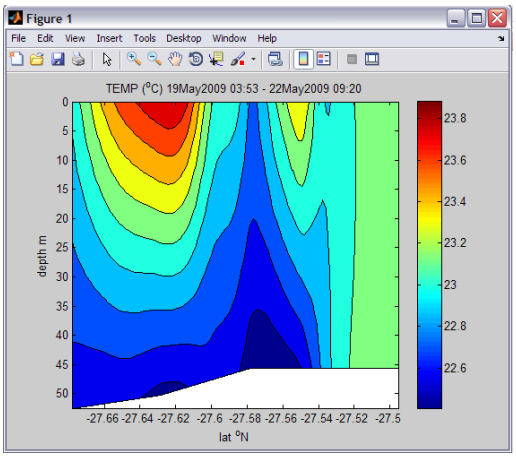
- Optional: Press **[save data]** if saving the plotted data to a text file is required (Fig. 46).

The plotted data is then saved in a three text files for every data type that is selected,

e.g. - '*1chart3_interpTEMP.txt'* contains an *n* x *m* matrix of interpolated temperature data.
- '*1chart3_lon.txt'* contains longitudinal positions for each data point in the above file.
- '*1chart3_depth.txt*' contains depth positions for each data point.

Because all avalaible data can now be saved at once using the -*all available data*- selection, the text files begin with a number to group each data type into a set of three (data file together with its related lat/lon file and depth files).

The units of measurement for each type of data is as listed in Table 1.



** Note that in contour plots, data interpolation is performed between sampled points. As such, the user is cautioned when interpreting the contour chart. It is suggested that users also plot the data using colour-coded data points, so they may better conceptualise where the real sampling positions lay.

Figure 44. Contour plot provides an overview of water property patterns; the white section beneath the plot indicates the limit of glider data, not bathymetry.

3.3.4 Using Control Panel 4: Property Comparison

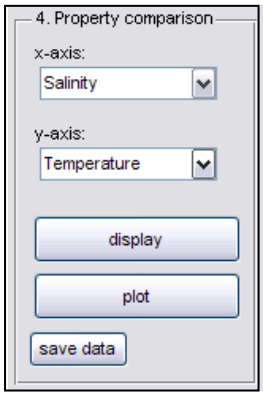


Figure 49. Property comparison control panel.

- Select your required data types for each of the x- and y- axes from the respective drop-down menus. These menus are populated only with data types found to be available in the glider mission (and possibly the addition of density and sound velocity data calculated by *GLIDERSCOPE*).

- Press **[display]** to produce the plot in the display area, or press **[plot]** to plot in a separate saveable figure (Fig. 49).

If plotted separately, use the chart's toolbar to save, print or edit the chart. A helpful description for each toolbar button appears as you roll your mouse over it (Fig. 50).

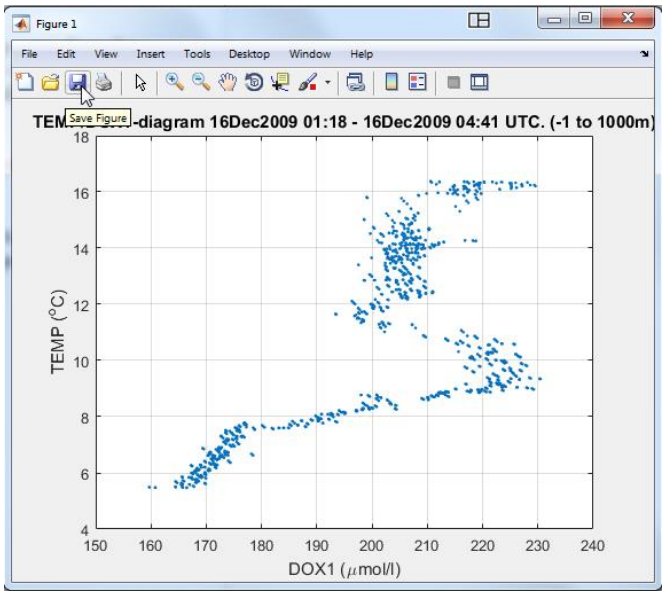


Figure 50. An example of Temperature vs Dissolved Oxygen plot for a single dive's data taken off Bicheno, Australia. The toolbar above the figure allows you to edit, zoom, save, etc.

(** Hint: This type of chart may sometimes provide clearer patterns if smaller segments of data (e.g. from a specified depth range or area) are examined.)

- Optional: Use **[save data]** if saving the plotted data to a text file is required (Fig. 49).

  The selected data are then saved in a text file with 2 columns of numbers, one for each axis plotted. The file is named for what the columns of data contain,

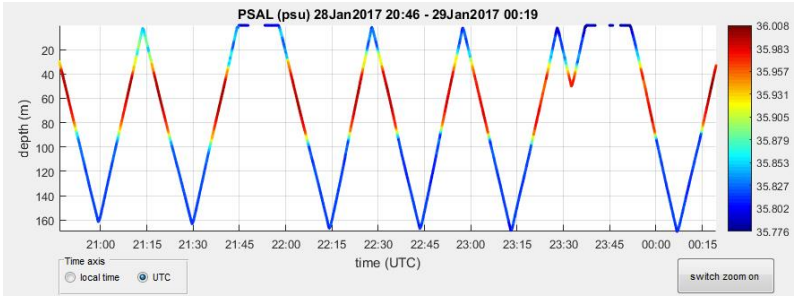
  e.g. '*chart4_PSAL_TEMP.txt*' contains
  - column 1: Salinity (*PSAL*)
  - column 2: Temperature (*TEMP*)

  (The units of measurement for each type of data is as listed in Table 1.)

- It may also be useful to limit the depth to isolate a body of water and examine its water property signature.

  For example, seeing that there is a layer of subsurface high salinity water between the depths of 40m-80m (Fig. 51a), you may introduce this depth limit by typing into the 'isolate a layer' text boxes (Fig. 51b) and pressing the **[display]** button to view the TS-diagram for this layer alone (Fig. 51c).

(a)



(b)

(c)

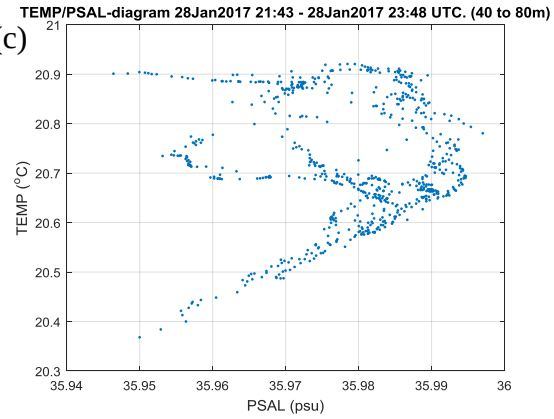


Figure 51. (a) Subsurface layer of raised salinity water seen in time-series data, (b) depth limits of the high-salinity water are entered into the text boxes, (c) TS-diagram shows the TS-signature of the layer of water.

3.3.5 Using Control Panel 5: Depth-profile

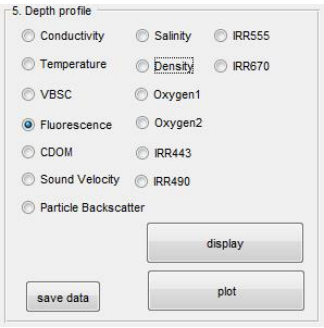


Figure 52. Depth-profile control panel

- Select your required data types by clicking on the radio buttons (Fig. 52). Radio buttons will appear according to which data types are available in the segment of data you have selected in the Gliderscope mean control panel.

- Press **[display]** to produce the plot in the display area (this option is only available for single data type selection), or press **[plot]** to plot in a separate saveable figure (Fig. 54). If plotted separately, use the chart's toolbar to save, print or edit the chart. A helpful description for each toolbar button appears as you roll your mouse over it.

- You may zoom into the display chart for a closer look:
  - i) To zoom in, press the **[switch zoom on]** button (Fig. 53), and then click and drag the mouse to indicate a box within the chart display to zoom into.
  - ii) Double-click to return to the original view if required.
  - iii) Press the zoom button again **[switch zoom off]** to end zooming.
  - iv) Depth can also be limited using the mouse or keyboard, as previously described in detail (section 3.3.1).

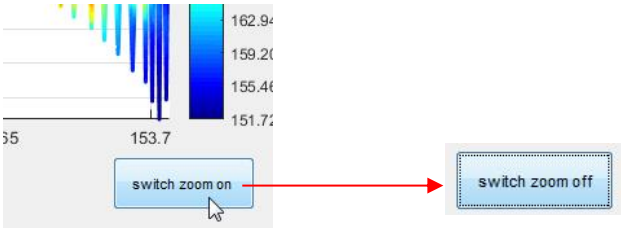


Figure 53. Zoom toggle button switches from 'switch zoom on' to 'switch zoom off'.

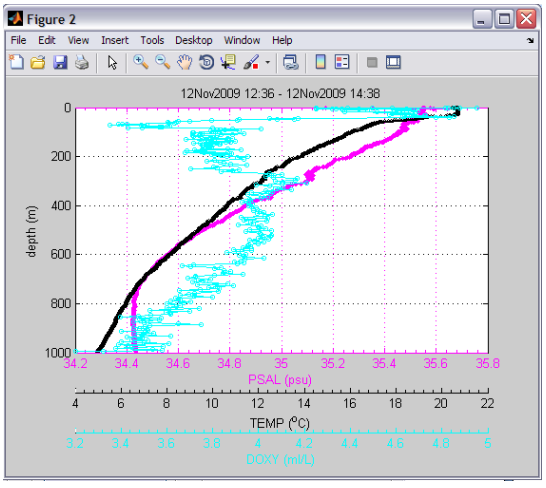


Figure 54. Depth profiles taken from a single dive.

Optional: Use **[save data]** if saving the plotted data to text files is required (Fig. 52).

The selected data are then saved into text files with 2 columns of numbers, one for each axis plotted. The file is named for what the columns of data contain,

e.g. '*chart5_TEMP_depth.txt*' contains
- column 1: Temperature (*TEMP*)
- column 2: Depth (*depth*)

The units of measurement for each type of data is as listed in Table 1.

(** Hint: This plotting method is best used with data from a single glider-dive.)

3.3.6 Using Control Panel 6: Light attenuation

Calculation and visualising light attenuation coefficients are new functions introduced in this version of Gliderscope.

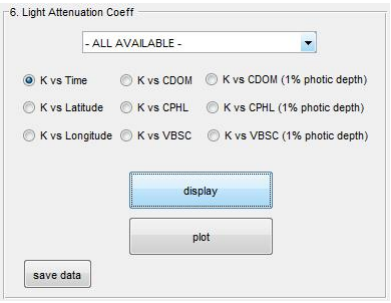


Figure 55. Light attenuation coefficient control panel.

- Select your required data types by clicking on the radio buttons (Fig. 55). A light attenuation coefficient (K) is calculated for each profile made in daylight, using:

$$ln\,E_o - ln\,E = Kz$$

Where

E_o = irradiance measured at the shallowest available position
E = irradiance measured at depth z
z = depth

CDOM, CPHL and VBSC are depth averaged either for the whole profile depth or from the surface down to 1% photic depth (d), which is calculated as:

$$d = \frac{ln\,E_o - ln(E_o * 0.01)}{K} = \frac{ln\,100}{K}$$

- Press **[display]** to produce the plot in the display area or press **[plot]** to produce a separate saveable figure (Fig. 56). Having the plot in a separate figure window is also handy because then these plots can be used to compare with other plots you might want to generate on the display area.

- For K vs Time plots, it is often useful to be able to look at the data in terms of local standard time rather than UTC, so you see when daytime/night time are (Fig. 56). To do this, use the radio buttons (○**local time** / ○**UTC**) in the **Time axis** panel (Fig. 57).

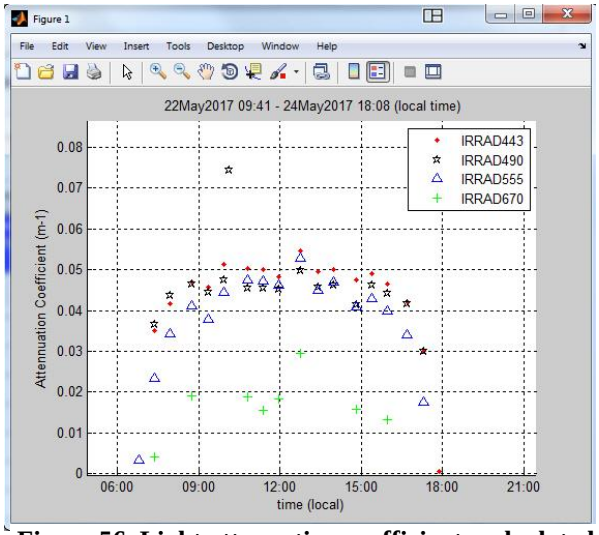
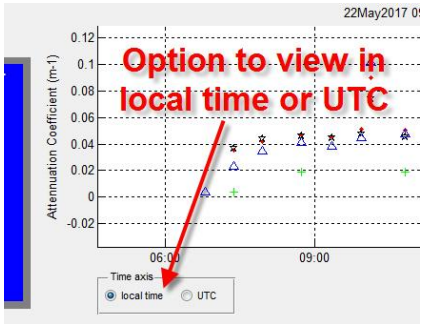


Figure 56. Light attenuation coefficients calculated at four frequencies of light; the local time axis indicating these occurred between 7am and 6pm.



- If plotted separately, use the chart's toolbar to save, print or edit the chart. A helpful description for each toolbar button appears as you roll your mouse over it (Fig. 55).

Figure 57. Controls to switch between UTC and local time view on the x-axis.

- You may zoom into the display chart for a closer look:

i) To zoom in, press the **[switch zoom on]** button (Fig. 58), and then click and drag the mouse to indicate a box within the chart display to zoom into.

ii) Double-click to return to the original view if required.

iii) Press the zoom button again **[switch zoom off]** to end zooming.

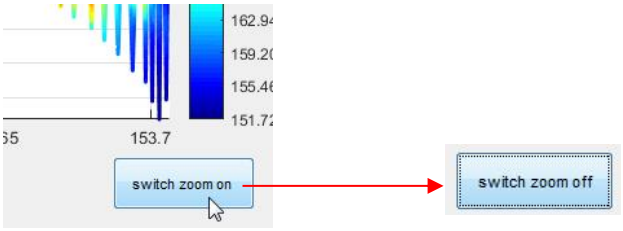


Figure 58. Zoom toggle button switches from 'switch zoom on' to 'switch zoom off'.

- Optional: Use **[save data]** if saving the plotted data to text files is required (Fig. 55).

  The selected data are then saved into text files with 2 columns of numbers, one for each axis plotted. The file is named for what the columns of data contain,

  e.g. '*chart6_K(IRRAD443)_CPHL.txt*' contains
  - column 1: Light attenuation coefficient of light at 443nm (*K*)
  - column 2: Depth-averaged chlorophyll (*CPHL*)

  The units of measurement for each type of data is as listed in Table 1.

3.4 Finish

When you have finished plotting and examining your data, you may:

- Press the **[go back]** button (Fig. 59) to select another leg of the mission or load a different data file altogether; or

- Finally press the red **[QUIT]** button to end the *GLIDERSCOPE* program.

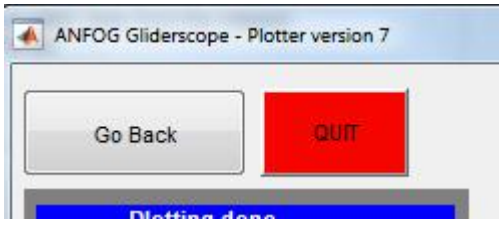


Figure 59. Control buttons to leave the plotter.