Topics in Australian Marine Science

Ocean Data View (ODV)

Manual V1.3

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for the Sydney Institute of Marine Science.

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1 Introduction to Ocean Data View

1.1 What is Ocean Data View

Ocean Data View (ODV) is a program designed for the interactive graphical display of oceanographic data. The software is freely available for Windows, Mac OS X, Linux, and UNIX systems. To download ODV you must register for free on the website http://odv.awi.de (go to the 'Software' tab). Different types of graphs can be produced including: time series, profiles and maps of water temperature, salinity, current velocity and chlorophyll-a concentration. ODV also enables you to estimate derived variables such as potential density, dynamic height and the Brunt-Vaisala frequency. A generic ODV User's Guide can be downloaded for more information under the website's 'Documentation' tab.

1.2 How to Install ODV

The ODV installation files can be downloaded from the website. You have to register and use your personal login to access the download pages. Once the registration is done, select *ODV Application*, *Latest Version* and then select the adequate operating system (Linux, Mac or Windows). Download the file (odv_4.7.6_w64.exe for example for Windows), and start the installation following the instructions. Note that you should also download and read the INSTALL.txt and README.txt files for more information.

1.3 How to run ODV

- Open the program Ocean Data View (ODV) to arrive at the ODV home screen window (Figure 1). When working with a dataset, you can load it in ODV by dragging the data from its folder to the ODV home screen window. It is also possible to open a local dataset by selecting *File* and *Open*. You can also open a remote dataset using *File*, *Open Remote* and the data URL.

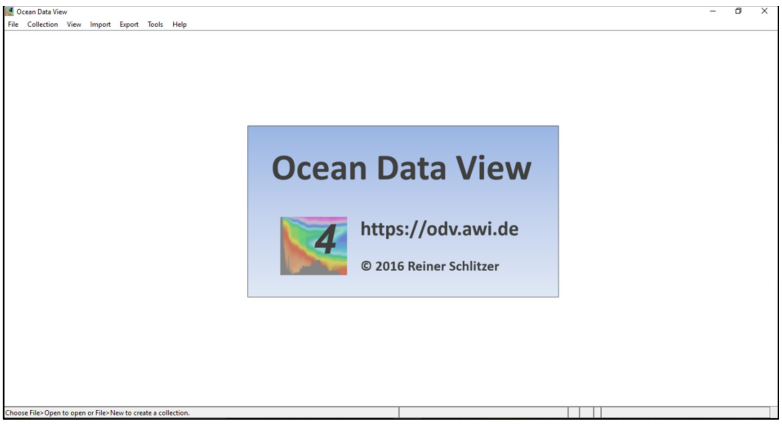


Figure 1: Ocean Data View home screen.

- The following windows enable you to select dimensions, associate meta variables, primary variable and subset dimensions (Figure 2). If the dataset was previously opened and previous settings were automatically saved in the same folder, it will be loaded by default. It is possible to ignore previous settings by selecting *Collection* then *Properties* and *NetCDF Setup*.

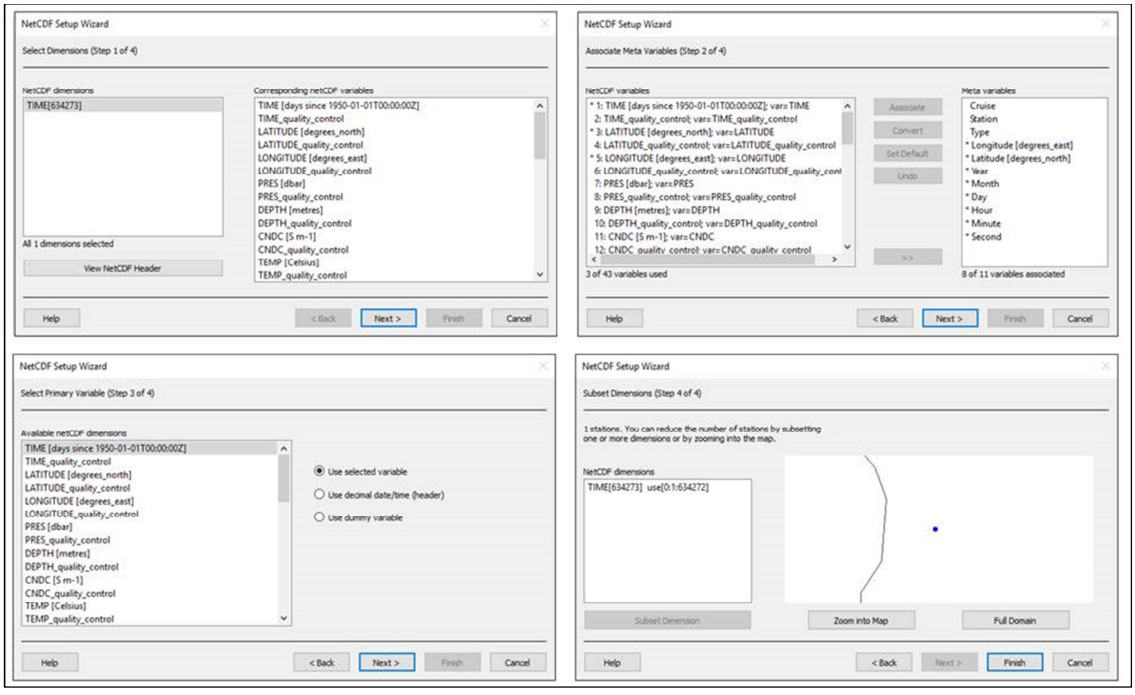


Figure 2: NetCDF Setup Wizard will be opened to select dimensions, associate meta variables, the primary variable and subset dimensions.

1.4 How to organize Window Layout

- Define your layout using *View*, *Window Layout* and right click on the window to remove or modify them, then click Enter (Figure 3).

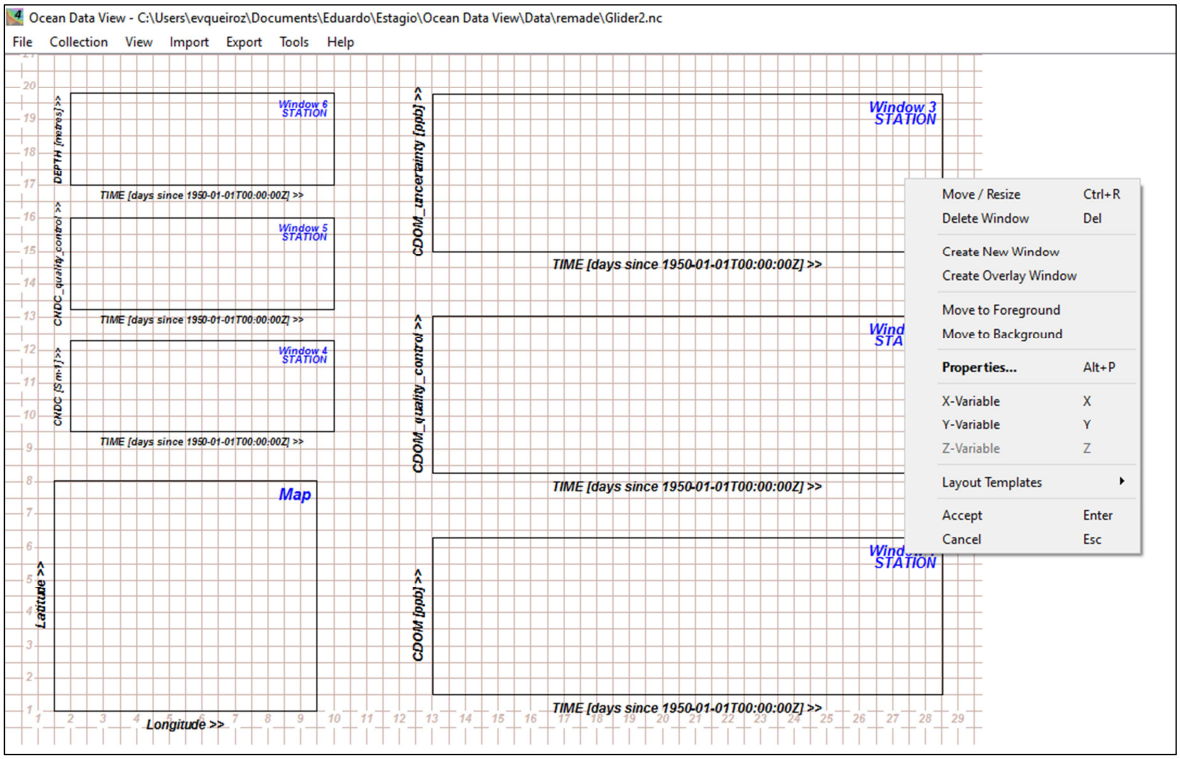


Figure 3: Defining windows layout.

2 How to plot IMOS data

In the following we give examples to manipulate and plot different types of oceanographic data collected through the IMOS program (e.g. moorings, radar, gliders, SST, Argo floats and drifters). See your Lab handbooks for additional information.

IMOS data are available at the IMOS Thredds Server website http://thredds.aodn.org.au/thredds/catalog.html or through IMOS portal (https://imos.aodn.org.au). You can then use ODV to open and analyse the dataset.

- To see the information of the input data click *Collection* and *Browse Info File*.

- To define the type of graph for each window, use *View* and *Window Properties* (or right click on the graph window and choose *Properties*).
- In the *Data* tab you can choose from STATION, SCATTER or SURFACE plots and define the parameters for the different axis (Figure 4).
- More options are available in other tabs (General, Display Style, Contours, Color Mapping and DIVA Settings).

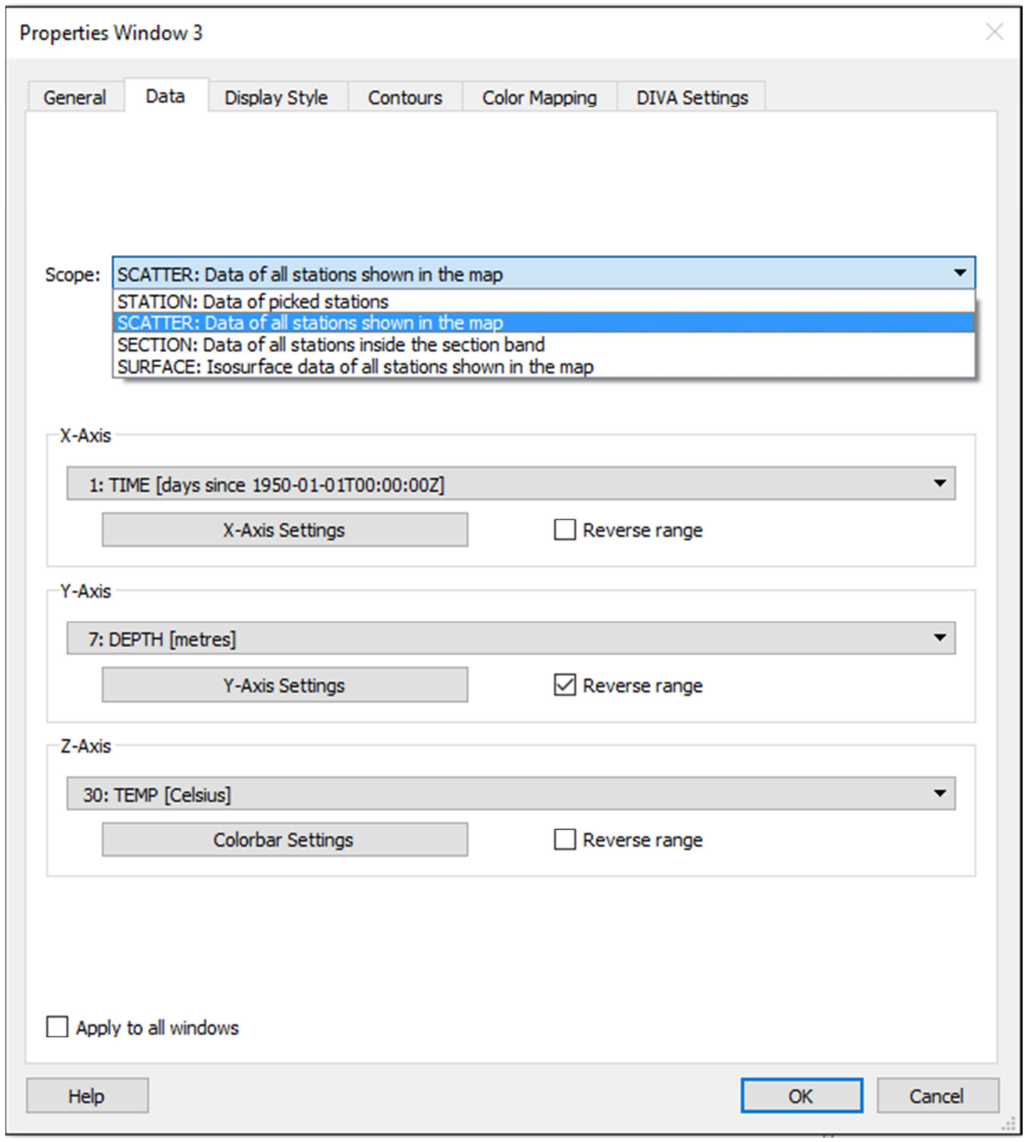


Figure 4: The plot Properties Window allows you to select the type of graph and parameters for the different axis.

3 Saving graphs and layout

- To save all graphs from your screen in the same picture select *File* and *Save Canvas As.*
- To save each graph individually right-click on the graph and *Save Plot As*.
- To save the layout that you have been working on with ODV, select *View* and *Save View As*. To open the layout again, select *View* and *Load View*.

4 DATASET 1: **Argo floats (vertical profiles)**

The Argo program is an international program using floats that measure temperature and salinity from 2000 m depth to the surface around every 10 days (see http://www.argo.ucsd.edu/ and the TAMS Practical 1 for more details).

Download the dataset from IMOS portal or from the IMOS Thredds Server and open in ODV.

For example:
http://thredds.aodn.org.au/thredds/catalog/IMOS/Argo/aggregated_datasets/south_pacific/catalog.html?dataset=IMOS/Argo/aggregated_datasets/south_pacific/IMOS_Argo_TPS-20130101T000000_FV01_yearly-aggregation-South_Pacific_C-20130501T180000Z_hires.nc

- You can save the data locally using Access HTTP Server or open it remotely using OPENDAP to get the Data URL.
- The layout can be organized to plot 4 graphs: (a) Temperature, (b) Salinity, (c) Density, and (d) Brunt-Vaisala frequency. These 4 variables are plotted as a function of depth, together with a map of the measurement locations (Figure 5).

Example of graphs: Profile of (a) Temperature, (b) Salinity, (c) Density, and (d) Brunt-Vaisala frequency over depth.

- Choose the domain of the map using *View*, *Window Properties, Map* and *Domain.* Define the domain around eastern Australia: North 25°S, South 40°S, West 148°E and East 160°E.
- Create *derived variables* of Density, Brunt-Vaisala frequency and Depth from Pressure (See Section 10: Hints and Tips “k”).
- Select a Window to generate the profiles (Right-click, select *Properties* and *Data*). Then select the variables below.

Scope: STATION.

Xaxis: TEMP_ADJUSTED (Temperature), or PSAL_ADJUSTED (Salinity), or **drvd:** In situ Density Anomaly, or **drvd:** Brunt-Vaisala Frequency.

Yaxis: **drvd:** Depth from Pressure (Pressure), Select *Reverse Range*.

- Take out the highlighting (see Hints and Tips "b").
- Choose a point (double click at 33°S for example) and the profile of the new point will be generated in the same figure.
- Fill the coast line. See Hints and Tips "d" how to change the layers of the map.

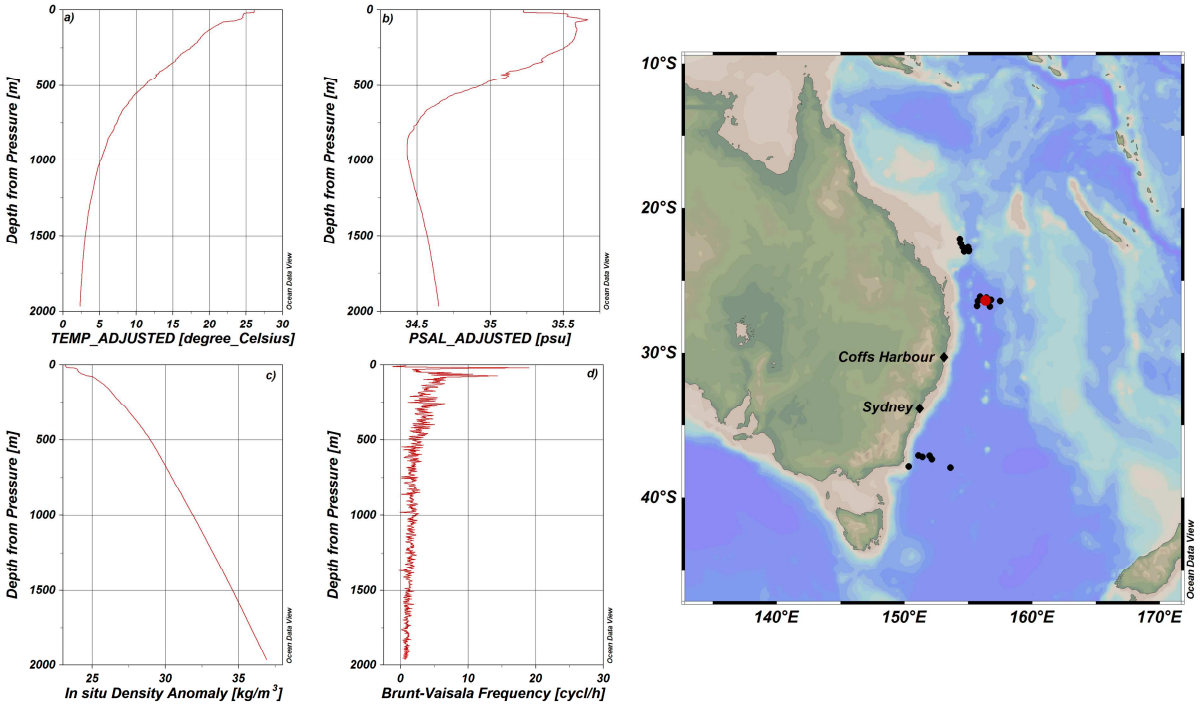


Figure 5: Profiles of (a) Temperature, (b) Salinity, (c) Density, and (d) Brunt-Vaisala frequency over depth, and the map of measurement locations using Argo data.

5 DATASET 2: **Drifter data**

Drifters are buoys that drift with the ocean currents, recording their position regularly with an integrated GPS (see TAMS Practical 1 for more details).

Download the Drifter data (driftertrajGPS.nc) from the NOAA website ftp://ftp.aoml.noaa.gov/pub/phod/buoydata/hourly_product/v1.00/ and open the file in ODV.

- When you are opening the data choose *Use dummy variable* at the 3rd step (*Select Primary Variable*).
- Create derived variables of latitude and longitude (See Hints and Tips "k").
- The layout can be organized to plot 4 graphs: (a) Map of the drifter track, and (b) Speed, (c) velocity component U, and (d) V, over time and colour coded by drogue status (1 = drogue on, 0 = drogue lost, see Figure 6).

Example of graph A: Map with drifter track.

Scope: SCATTER.

Xaxis: **drvd:** Longitude.

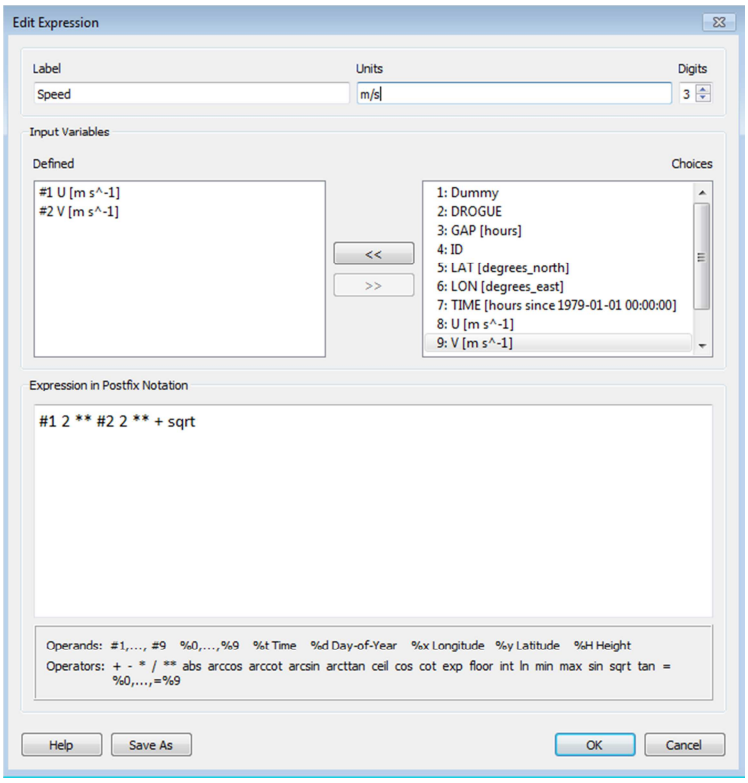
Yaxis: **drvd:** Latitude.

Zaxis: Drogue

- Select a range of Latitude and Longitude (-20 to -45 for Latitude and 145 to 158 for longitude). See Hints and Tips "h" how to do a range of data.
- Select buoy identification (ID) using Sample Selection Criteria (e.g. 60953420) to focus on one particular drifter (Tip: put the ID number as max *and* min value to isolate the one drifter).
- Change the style of the colorbar and use *BlueRed* (See Hints and Tips "m"). Change the line thickness under the tab 'Display Style'.

Example of graph B: Drifter velocity

- Use *Derived Variables* and *Expression* to compute the speed from the meridional and zonal velocity components (#1=U and #2=V): #1 2 ** #2 2 ** + sqrt (See Hints and Tips "n").



Creating the new variable 'Speed', using the U and V components of velocity.

Scope: SCATTER.

Xaxis: Time.

Yaxis: **drvd:** Speed.

Example of graph C and D: U (or V) over Time, colour coded by drogue on/off (1/0)

Scope: SCATTER.

Xaxis: Time.

Yaxis: U (or V).

Zaxis: Drogue.

- Change the style of the colorbar and use *BlueRed* (See Hints and Tips "m").
- Zoom into a shorter time period by right clicking over the figure, and selecting 'Zoom'
- Make sure to only plot data from one drifter, right click and select *Sample Selection Criteria,* then *Range* and use ID=60953420 (input number into max and min values).

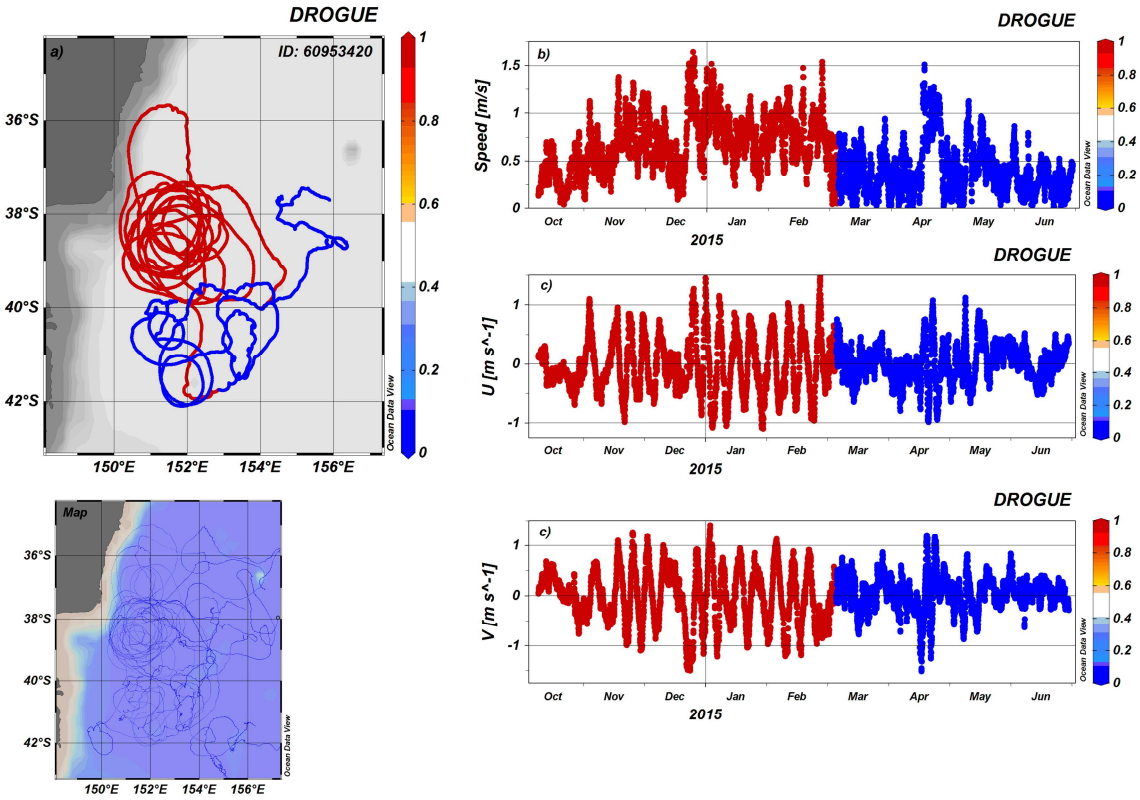


Figure 6: (a) Map of the drifter track, and (b) Speed, (c) velocity component U, (d) V, over time and colour coded by drogue status (1 = drogue on, 0 = drogue lost)

6 DATASET 3: **Glider dataset**

Gliders are autonomous underwater vehicles that use buoyancy to dive up /down in the water column. They navigate following a series of pre-programmed waypoints using GPS, internal dead reckoning and altimeter measurements. The gliders usually provide a large set of data: temperature, salinity, depth, chlorophyll-a, Coloured Dissolved Organic Matter (CDOM), backscatter and Dissolved Oxygen (DO).

Download the dataset from the IMOS portal or from the IMOS Thredds Server website and open in ODV.

We suggest you use the HTTPServer option

For example:
http://thredds.aodn.org.au/thredds/catalog/IMOS/ANFOG/slocum_glider/Yamba20150210/catalog.html?dataset=IMOS/ANFOG/slocum_glider/Yamba20150210/IMOS_ANFOG_BCEPSTUV_20150210T032919Z_SL209_FV01_timeseries_END-20150225T184400Z.nc.

LOADING THE DATA

- Step 1 Select dimensions (all seven are chosen by default) – press next.
- Step 2 Associate Meta Variables – press next.
- Step 3 *Select Primary Variable*, Choose "use dummy variable". Press Next
- Step 4 Choose the Full Domain (you probably want to subset the time!) and then Press 'Finish'

The data is now loaded into a default window.

CREATE DERIVED VARIABLES – this is an important step (See Hints and Tips "k").

Create 4 derived variables - Select *View and Derived Variables*

LATITUDE AND LONGITUDE (Double click on *Meta Variable* and add *Latitude* and *Longitude*).

DEPTH (Double click on *Physical Properties TEOS-10*, add *Depth from pressure* and identify PRES as the *pressure variable*).

TIME (Double click on *Time,* add *Time (time variable,* identify the *TIME* and press *OK)*)..

** this is because glider dimensions change over the mission.

ORGANISING Your Window Layout – Let's create Figure 7.

Move / Resize the figure by right clicking, then pressing enter.

The layout can be organized to plot 5 graphs: (a) Maps of the glider track, (b) velocity vectors, (c) profiles of temperature, and (d) fluorescence, over time and depth; and (e) T-S diagram (Temperature vs. Salinity) (Figure 7).

Example of graph A: Map with glider track.

- Select a Window to generate the Track of the glider (Right-click, select *Properties* and *Data*). Then select the variables bellow.

Scope: SCATTER.

Xaxis: **drvd:** Longitude.

Yaxis: **drvd:** Latitude.

Graph B: Map with depth-averaged velocity vectors.

Scope: SCATTER.

Xaxis: **drvd:** Longitude.

Yaxis: **drvd:** Latitude.

Zaxis: UCUR.

- Use arrows to see the direction and velocity. (See Hints and Tips "f")

Example of graph C and D: Temperature or fluorescence over time/latitude and depth.

Scope: SCATTER

Xaxis: **drvd** TIME or Latitude (If it is Latitude use *Reverse Range* to keep North on the left side of the graph).

Yaxis: **drvd:** DEPTH (select *Reverse Range*).

Zaxis: CPHL (Chlorophyll-a Fluorescence), TEMP (Temperature), PSAL (Salinity) or CDOM (Coloured Dissolved Organic Matter).

Example of graph E: TS diagram.

Scope: SCATTER.

Xaxis: PSAL (Salinity).

Yaxis: TEMP (Temperature).

Zaxis: **drvd:** DEPTH (select *Reverse Range*).

- Do the Quality control using acceptable range of 0 to 2. See Hints and Tips "i" how to do a quality control.
- Fill the coast line. See Hints and Tips "d" how to change the layers of the map.

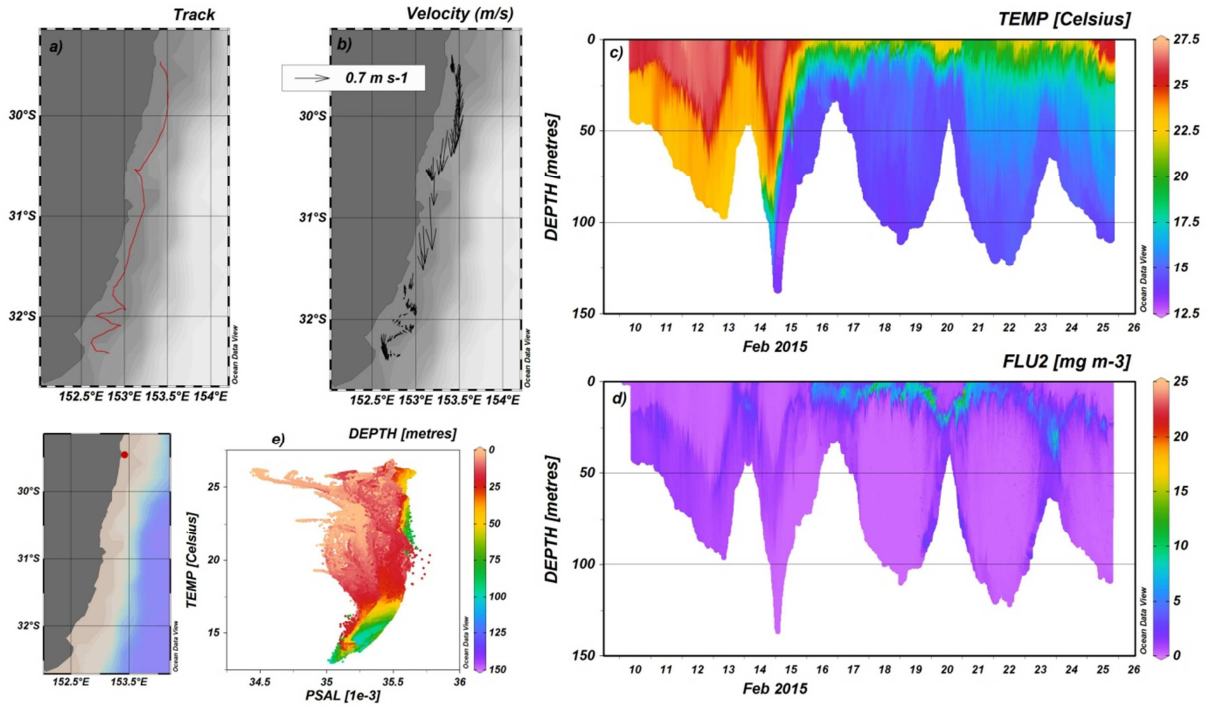


Figure 7: (a) Map of the glider track, (b) velocity vectors, (c) profiles of temperature, and (d) fluorescence, over time and depth; and (e) T-S diagram (Temperature vs. Salinity) color coded by depth

7 DATASET 4: **Mooring oceanographic data**

The IMOS mooring network comprises measurements of current velocity and temperature through the water column.

Temperature

Download the dataset from the IMOS portal or from the IMOS Thredds Server website and open in ODV.

For example:
http://thredds.aodn.org.au/thredds/catalog/IMOS/ANMN/NSW/SYD100/Temperature/gridded/catalog.html?dataset=IMOS/ANMN/NSW/SYD100/Temperature/gridded/IMOS_ANMN-NSW_T_20130107T200000Z_SYD100_FV02_SYD100-1301-gridded_END-20130325T210000Z.nc

- The layout can be organized to plot one graph of temperature over time and depth (Figure 8)

Graph: Temperature over time and depth.

Scope: SCATTER.

Xaxis: TIME.

Yaxis: DEPTH (select *Reverse Range*).

Zaxis: TEMP (Temperature).

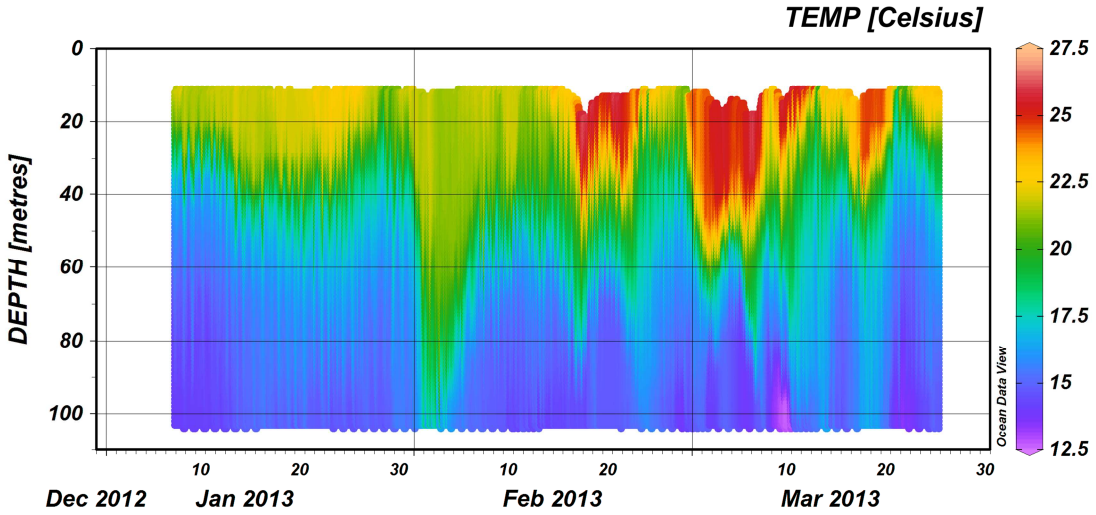


Figure 8: Moored temperature over time and depth.

Velocity

Download the dataset from the IMOS portal or from the IMOS Thredds Server website and open in ODV.

For example:

http://thredds.aodn.org.au/thredds/catalog/IMOS/ANMN/NSW/SYD100/Velocity/catalog.html?dataset=IMOS/ANMN/NSW/SYD100/Velocity/IMOS_ANMN-NSW_AETVZ_20150406T190000Z_SYD100_FV01_SYD100-1504-Sentinel-or-Monitor-Workhorse-ADCP-102.5_END-20150701T013000Z_C-20160810T021935Z.nc

- The layout can be organized to plot 3 graphs of velocity (U component, V component and vectors) over time and height above sensor (Figure 9).

Graph A: Variable velocity, using arrows, over time and height above sensor.

Scope: SCATTER.

Xaxis: TIME.

Yaxis: HEIGHT_ ABOVE_SENSOR (select *Reverse Range*).

Zaxis: UCUR(Velocity).

- Use arrows to see the direction and intensity of the velocity. (See Hints and Tips "f").

Graph B and C: Component U (or V) over time and height above sensor.

Scope: SCATTER.

Xaxis: TIME.

Yaxis: HEIGHT_ ABOVE_SENSOR (select *Reverse Range*).

Zaxis: UCUR (Velocity) or VCUR(Velocity).

- Change the style of the colorbar and use *BlueRed* (See Hints and Tips "m").
- Do the Quality control using acceptable range of 0 to 2. See Hints and Tips "i" how to do a quality control.
- Use gridded data for U and V components (See Hint and Tips "o").

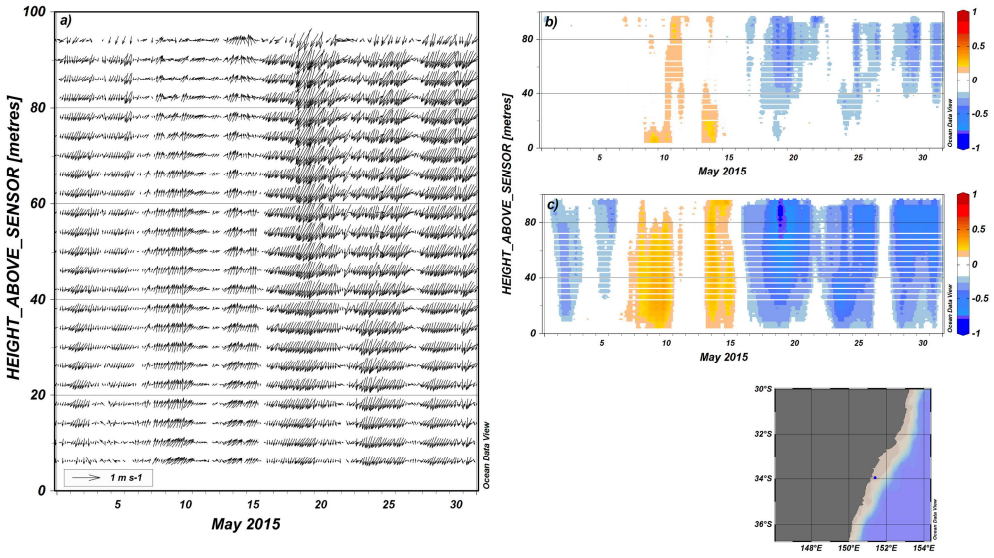


Figure 9: Current velocity vectors (a), U (b) and V (c) components over time and height above sensor.

8 DATASET 5: **HF Radar data**

High frequency (HF) radar systems use electro-magnetic waves to measure the surface currents in the coastal ocean. The radar can measure surface currents up to 200 km away with resolutions ranging from 500 m to 6 km depending on the radar settings. The observations of the currents are usually 1-hour averaged and available in near real time.

You can download the hourly dataset from IMOS portal or from the IMOS Thredds Server and open in ODV.

If you want to use a longer time period, you use IMOS Portal to concatenate the hourly data into a single file following the steps bellow.

Open the IMOS Ocean Portal (https://imos.aodn.org.au) and click on *Get Ocean Data Now*. Select Radar at the Platform section then select WERA beam forming HF radar. Find *IMOS - ACORN - Coffs Harbour HF ocean radar site (New South Wales, Australia) - Delayed mode sea water velocity* then click *Select*. Choose the Time in *Temporal Extent* then click *Next*. Download as NetCDF. Give your email and read the licence and use limitations then download the data. The file containing the data will be sent to your email.

- The radar data is usually very large and takes more time to be opened and processed. You might need to subset Time (e.g. increment 5), Latitude and Longitude (e.g. increment 7) at the 4th step (Subset dimensions).
- Create Derived Variables of time, latitude, and longitude (See Hints and Tips “k”).
- The layout can be organized to plot 3 graphs of velocity U and V over time and spatial vectors using arrows (Figure 10).

Graphs A and B: Velocity component U and V over time.

Scope: STATION.

Xaxis: **drvd** Time (time variable) [years since 1950-01-01].

Yaxis: UCUR (or VCUR).

Graph C: Velocity vectors over latitude and longitude.

Scope: SCATTER.

Xaxis: **drvd** Longitude(Derived Variable).

Yaxis: **drvd** Latitude (Derived Variable).

Zaxis: UCUR or VCUR (Velocity).

- Use arrows to see the direction and intensity of the surface current velocity. (See Hints and Tips “f”).
- Do the Quality control using acceptable range of 0 to 2. See Hints and Tips “i” how to do a quality control.
- Select a specific day. See Hints and Tips “h” how to do a range of the date.
- Fill the coast line. See Hints and Tips “d” how to change the layers of the map.

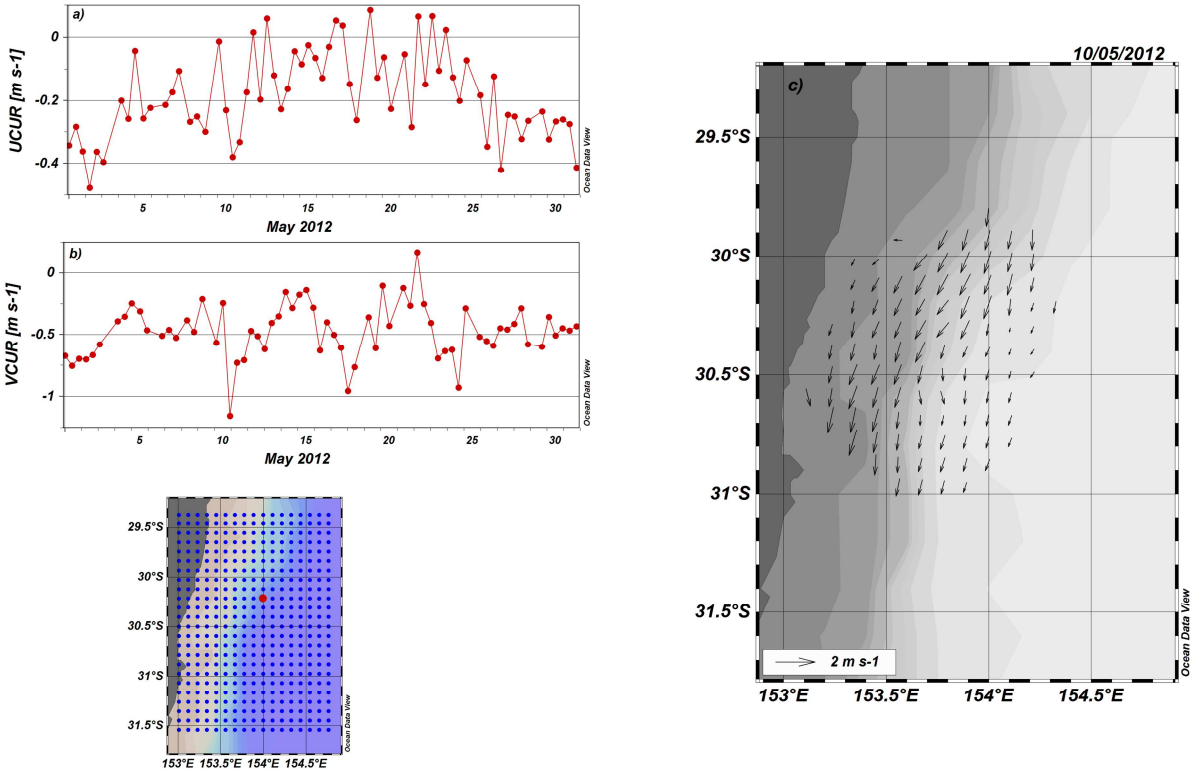


Figure 10: (a) UCUR velocity, (b) VCUR velocity, and (c) Vector map of surface currents at one time observation over the continental shelf off of Coffs Harbour.

9 DATASET 6: **Remote Sensed Sea Surface Temperature data**

Download the dataset from the IMOS portal or from the IMOS Thredds Server website and open in ODV.

For example:

http://thredds.aodn.org.au/thredds/catalog/IMOS/SRS/SST/ghrsst/L3S-1m/dn/2015/catalog.html?dataset=IMOS/SRS/SST/ghrsst/L3S-1m/dn/2015/20150131092000-ABOM-L3S_GHRSST-SSTfnd-AVHRR_D-1m_dn.nc

- When you are opening the dataset you may zoom at the east Australian coast at the 4th step (Subset Dimensions). Also subset the data at the 4th step if it is too heavy (e.g. increment 10 for latitude and longitude).
- Create derived variables of latitude and longitude (See Hints and Tips “k”).
- Convert the temperature unit from Kelvin to °C creating a derived variable of Sea Surface Temperature (See Hints and Tips “n”).
- The layout can be organized to plot a graph of Sea Surface Temperature (Figure 11).

Graph : Sea Surface Temperature.

Scope: SCATTER.

Xaxis: **drvd** Longitude (Derived Variable).

Yaxis: **drvd** Latitude (Derived Variable).

Zaxis: **drvd** Sea Surface Temperature (°C).

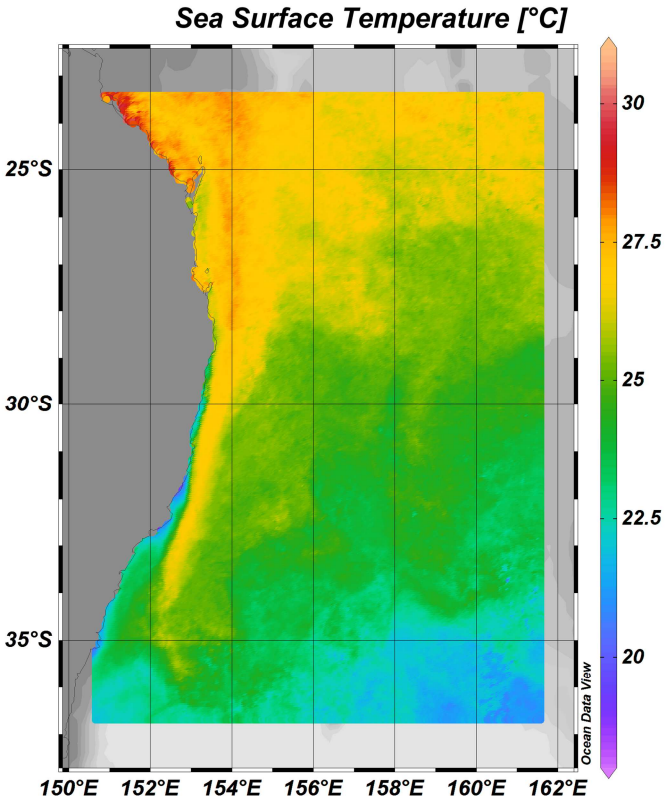


Figure 11: Sea surface temperature off eastern Australia.

10 Hints and Tips

a) Zoom: Right-click on the track graph and select *Zoom, Zoom out* or *Zoom in*.

b) Take out the highlighting (line colour on the graph): Select *View and Window properties (*or click right on the window and select *properties)*, *General,* Highlighting Style and then choose *none*.

c) Identify data position on the Track graph: Click at the data point on the graph (Temperature at 15/Feb for example) and the position will be marked with a "+" on the Track graph.

d) Change the layers of the maps: Select *View*, *Window properties*, *Map* and *Layers* tab.

e) Change the scales: Select *View*, *Window Properties*, *Window*, *Data* tab, *X-axis* or *Y-axis* or *Colorbar Settings* and defining *Minimum* and *Maximum*.

f) Use arrows to represent current or wind vectors: Select *View*, *Window Properties* and *Display Style* and choose *Arrows* instead of *Colored Dots*. *X component* is U and *Y component* is V.

g) Data statistics: Right-click on the graph, select *Extras* and *Statistics*. It is possible to see the histograms and descriptive statistics (max, min, mean and std) and compute linear regression using *Least-squares line*, *Construct Curve* and *Show Curve* to see the trend.

h) Select the range of the data:

For the range of the axis: Right-click on the graph, choose *Set Ranges.* Then select the Variable (e.g. Latitude) and your desired range.

For a subset of the data plotted (e.g. specific time): To select only specific time observation (rather than plotting everything), choose *Sample Filter* and *Customize Settings,* then *Range,* select the *variable* and the *acceptable range.* The unit of time is given on the right menu of the main screen, under the metadata description. Pick a time you want to plot and input it into both the *min* and *max* boxes. Tip: to get the time you want in the correct units, you can plot a timeseries of the data, and click on the time you want, it will show the time in the metadata description on the right of the main screen, in the correct units (e.g. Time in days since 1950).

i) Quality Control: Right-click on the graph, choose *Sample Selection Criteria* and *Range* tab. Then select the Variable_quality_control (Temp_quality_control for example) and Acceptable range (e.g. 0 to 2). Then click Ok. It is possible to select more than one Variable_quality_control. Note, Salinity often has spikes.

j) Change labels: Right-click on the existing label (or title) and choose option *Copy Object*. This will create editable and moveable copies of the existing annotations. Uncheck the *Automatic axis titles* box with right-click on the graph, *Properties* and *General* tab. Drag the annotations created to their desired positions and change the text by right clicking on the annotation and choosing *Properties*.

k) Create Derived Variables: Select *View* and *Derived Variables*, select one of the Choices and *add*.

- Metadata Select *Latitude* and *Add*, then select *Longitude* and *Add then select Ok*.
- Meta Variable Value: When you include a NetCDF variable (opening the data 2nd step) in the metadata (TEMP for example) it will be available to create derived variable in *Meta Variable Value*.
- Physical Properties (TEOS10):
  For example, for *Depth from Pressure [m],* you might need to identify Pressure (PRESS_ADJUSTED) and click *Ok*. The derived variable will be available in the Data tab.
  For *In situ Density Anomaly,* you might need to identify Pressure (PRESS_ADJUSTED), Temperature (TEMP_ADJUSTED) and Salinity

(PSAL_ADJUSTED) and click *Ok*. This is only if you have not identified them before. See "*Hints and Tips s*". The derived variable will be available in the Data tab.

- Time: Select *Time* (It is the last in the list of *Choices*) then select *Time (time variable)* and *TIME [days since 1950-01-01 00:00:00 UTC]*. In Time Variable Settings define Time since 1950 - 01 – 01 (or anything else).

l) Create annotations: Right click on the graph*, Extras*, *Add Graphic Object* and then *Annotation*. Click on the graph where you want to put the label and then write the text. You can choose the position with more precision defining *X* and *Y* position. It is also possible to create a dot on the defined position using right click on the graph*, Extras*, *Add Graphic Object* and then Symbol. Click the position on the graph. You can change the symbols (square, triangle, dots, etc.) and choose the position in *X* and *Y* (Longitude and Latitude for example).

m) Change the colorbar style: Right-click on the graph, *Properties*, *General*, *Palette* and choose the style (e.g. BlueRed).

n) Convert variables and create expressions: To set up an expression, select *View* and *Derived Variables*, choose *Expression* from the *Choices* list and press *Add*. In the *Expression* box you must write the expression in *Postfix.* For more information about *Postfix* see the ODV User's Guide (section 6). The expression to convert temperature from Kelvin to Celsius degrees is: #1 273.15 –. That means: variable defined 1 (e.g. Sea Surface Temperature) – 273.15.

o) Gridded data: Select *View*, *Window Properties* and *Display Style*, then select *Gridded field*. It is possible to change the scale lengths unselecting the *Automatic scale length*.

p) Animation: Right-click on the graph, select *Extras* then *Animation* and *Variable range*. Select the variable (usually time) and click Ok. You can then save the animation as a gif file and play it with your media player.

q) Isobaths: To highlight isobaths on a map at 100m, 500m, 1000m, 2000m, 4000m and 5000m: Go to *View->Window Properties->Map->Layers*, then unclick *Automatic selection*. You want to plot 'Ocean Bathymetry', then click "Compose", highlight the isobaths (listed above in the "available" tab), then click the "<<" button and tick "draw colourbar" to see the corresponding isobaths on the map.

r) Section:
1st to define a section, right click on the Map plot (map usually found in the bottom left hand corner). Go to *Manage Section -> Define Section*, and then you will be able to mouse-click on the grid the start and end of your section (e.g. at a specific latitude), and press the enter key.

Then plot in a new window: Scope="SECTION", X="drvd:Section Distance [km]", Y=SPEED (or whatever you want to plot), Z=(none).

s) Variable identification:
When creating derived variables or using ODV calculations, you need to specify the name used in your dataset for key variables (e.g. pressure, salinity etc…). On the tab *Collection*, *Identify Key Variables*, you can add or undo associations (variables with a * have already been associated).