WaterScope documentation

WATERSCOPE

Waterscope is an EHMP research tool website

Version: 1.7
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Date of last edits: 21/01/2025

Scientific Modelling

Table of Contents

Introduction and overview

The Ecosystem Health Monitoring Program

The South-East Queensland, Australia EHMP is a unique monitoring program, running for over 23 years (and already about 5 years before that with a limited number of locations) and taking water samples monthly at about 75 locations in Moreton bay, and 191 along the major river/estuarine systems. Followed by laboratory analysis and data entry, the program has already amassed a major data set on water quality over space and time in South-East Queensland.

It also contains 138 freshwater sampling sites with its own set of indicators. Table 2 and Table 3 show the indicators as recorded on the database. Currently there is also a test page for the third part of the EHMP program: the Water Quality

This dataset ranks in the top of its kind in the world. By making the data available in a structured way it invites us to turn this unique data into invaluable information used to improve our understanding and management of these crucial ecosystems and their services to us.

The aim is to turn the water sample collection by the Ecosystem Health Monitoring Program (EHMP) into a tool for learning and decision making. To reach its full potential, this dataset is to be made readily accessible for visualisation, and analyses. It should also be easily combined with other, non-EHMP, data. Currently rainfall, river discharge at 6 stations each and SOI (Southern Oscillation Index) are also accessible through the website. The results should be presented in a concise and easy to understand way. These goals are the foundation of the *Waterscope* website.

The website is in a pilot project/proof of concept phase to show the potential for making the EHMP estuarine, marine and freshwater data sets accessible in a more structured way to all involved in the resource management and research process, including the broader public. Universal access is facilitated by using a web-based application (website) as the main mode of access.

The set of indicators is restricted to a subset of the existing indicators but available between mid-2000 and the end of 2023, see the Data Availability table on Data availability. The vision is to open up all datasets in the near future, if support for further development can be found.

Overview of current functions implemented.

The Waterscope website contains a broader range of data, analysis tools and information, but this manual concentrates on the *Estuarine and Bay* data. The website can be accessed using the https://www.waterscope.info address. A fallback server can be found on http://www.ehmpscope.info . Note that the fallback website is slower to respond.

The two main functional areas in the *Estuarine and Bay* data section of the website are a map section to allow the selection of sample locations and a chart section to visualise and analyse the data.

There are a (growing) range of visualisation and analysis functions available. These functions are implemented around plots as to visualise results. Options to export results into other formats are available for some results and are expected to be extended in the future. The user interface the between *Estuarine and Bay* (Figure 1), *Freshwater* (Figure 2) and

WQI (Figure 3) differs only in the choices available the for the locations and indicators. This document focusses on the *Estuarine and Bay* user interface.

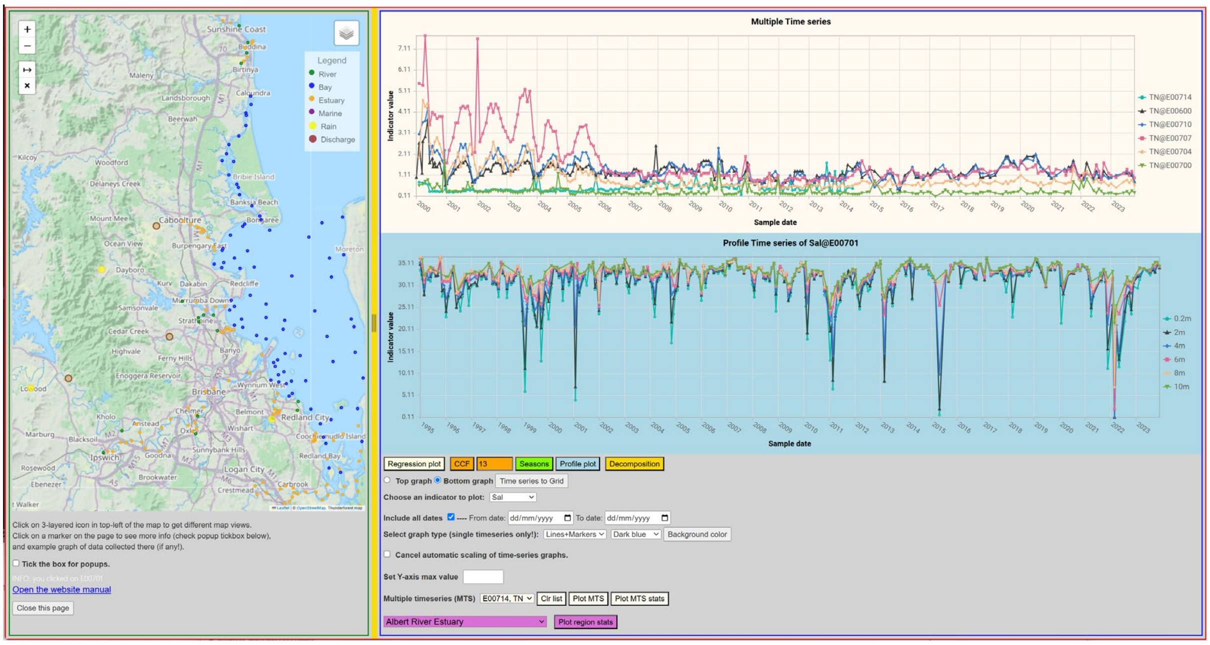


Figure 1 Overview of the user interface of the Estuarine and Bay data part of the Waterscope website.

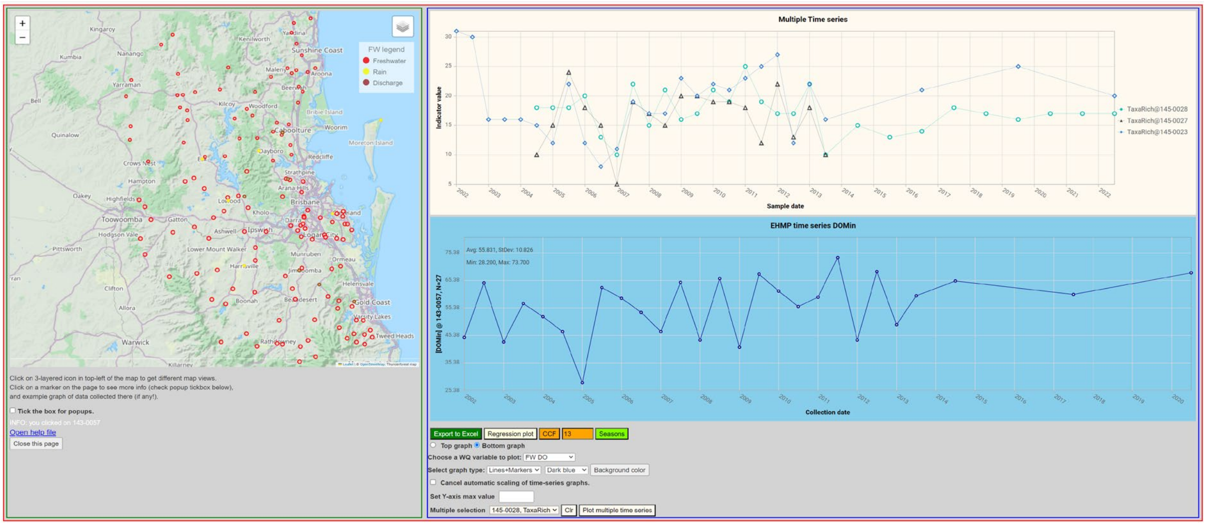


Figure 2 Overview of the user interface of the Freshwater data part of the Waterscope website.

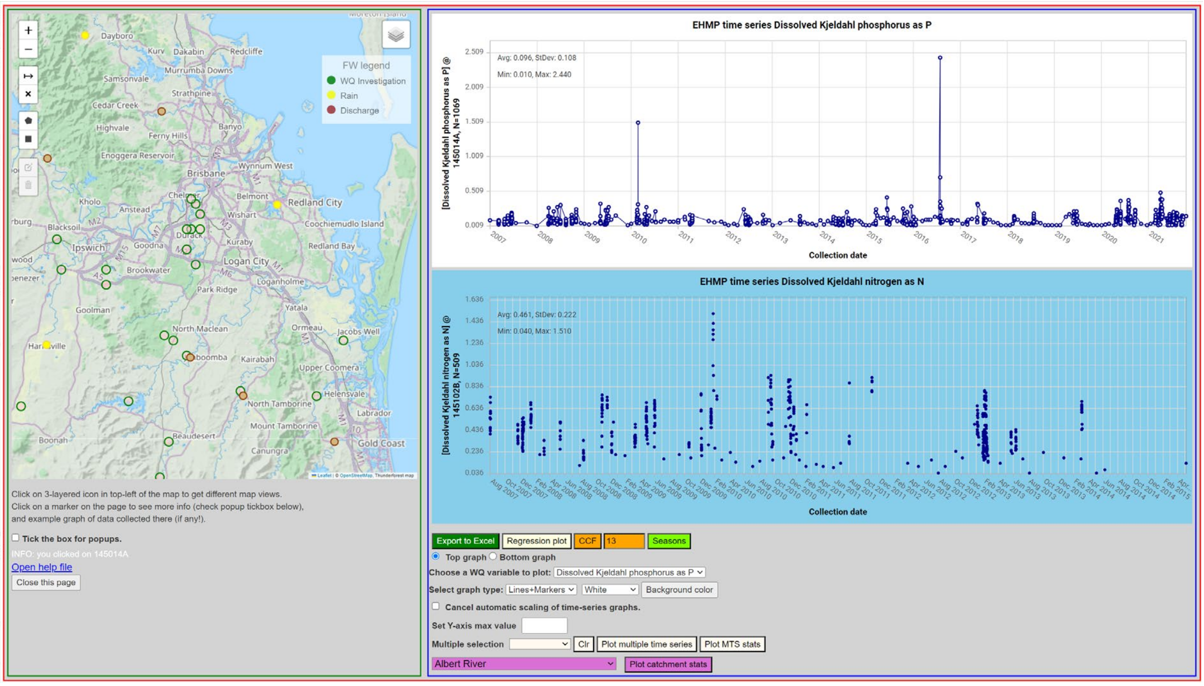


Figure 3 Overview of the user interface of the WQI data part of the Waterscope website.

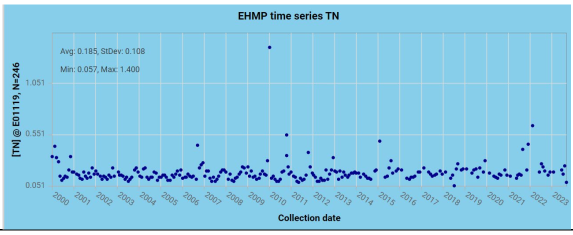
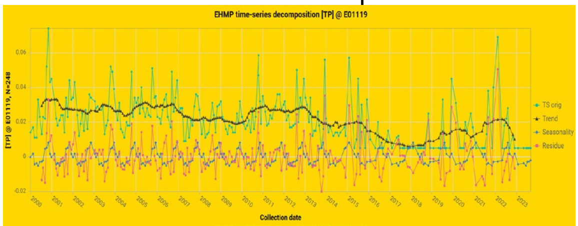
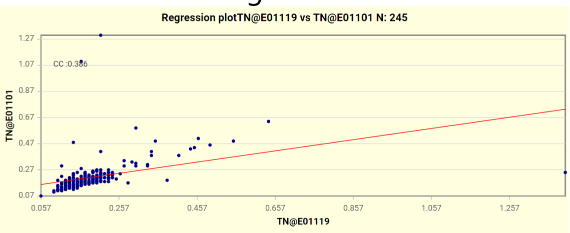
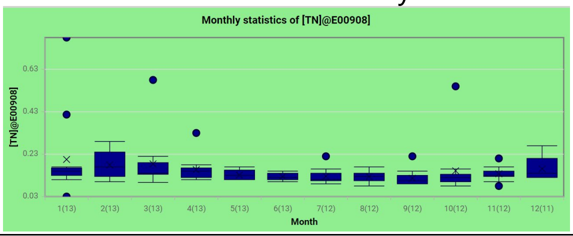
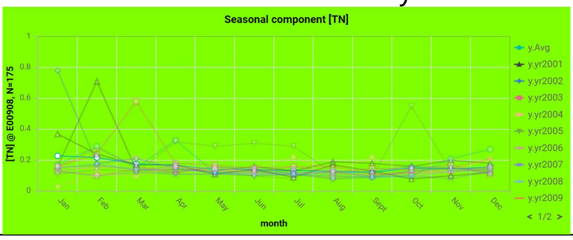
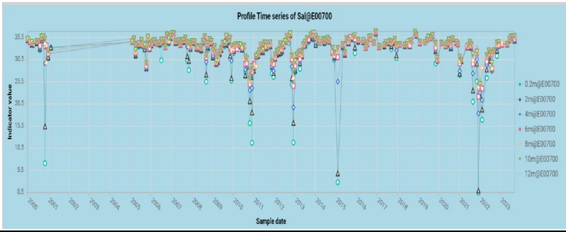
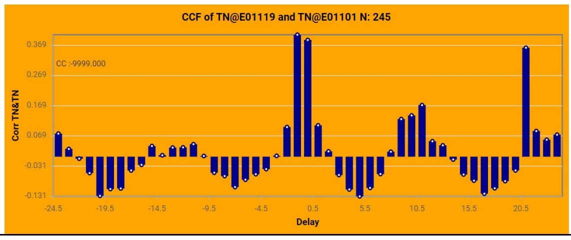
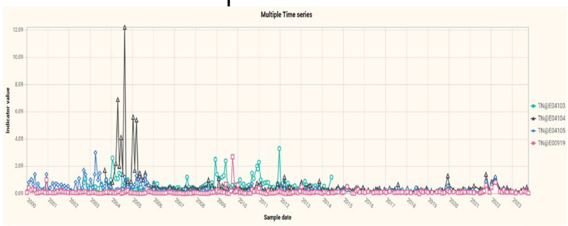
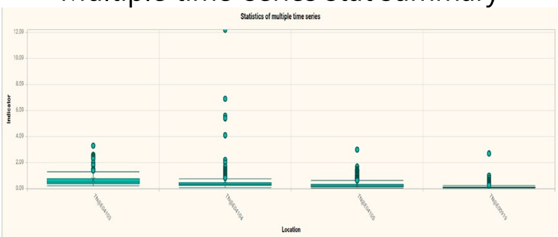
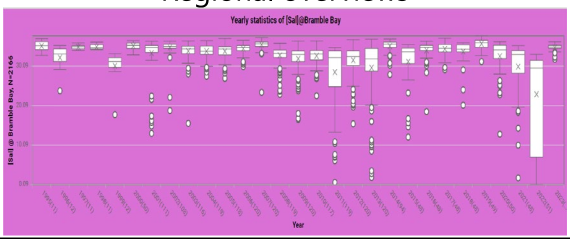
21/01/2025

Visualisation and analysis functions

This section summarises the main visualisation and analysis tool currently available, exemplified by a series of plots. Combining in different ways the various indicators from the many sample locations opens up a very rich and easy to obtain learning about the rivers, estuaries and bays in SE-Qld. See the Multi-time series example on page 26 that was created within minutes.

- Single time series of water quality indicators from a selected sampling location
- Time-series decomposition gives an instant insight into the time series components
- Regression of two time series
- Multiple time series from multiple sampling locations
- Seasonality contributions within one time series
- Box-Whisker plot from a single sampling location and WQ indicator.
- Depth profile time series for selected (physical) indicators
- Reporting regions temporal statistics (Box-Whisker plots)
- Auto- and cross-correlation function (ACF/CCF) between two time series

Table 1 The plots in this table show the current stage of play of the Waterscope Estuarine and Bay section with their standard background colour. Background colours can be changed via the UI.

Time-series 	Time-series decomposition 
Regression 	Statistical summary 
Seasonal variablility 	Profiles 
Correlation function 	Multiple time series 
Multiple time-series stat summary 	Regional overviews 

Data availability

The *Estuarine and Bay* dataset currently consists of 19 indicators of which eight are currently available via the *Waterscope* website. This data set consists of almost 2 million records of measurements since 1995.

The *Freshwater* dataset consists of 22 indicators of which six are currently available. The *Freshwater* dataset currently contains over 52,000 records of indicator values. Both data sets also include rain, river discharge and SOI time series.

Table 2 The Waterscope Estuarine and Bay data set of potentially available indicators. The red text indicates the ones already available.

Indicator	Comments	Units
Chl_a	Chlorophyll-a	microgr/L
Conductivity	Electrical conductivity	mS/cm
DO	Dissolved oxygen	mg/L
DOsat	% DO saturation	%
FRP	Filterable Reactive Phosphorus	mg/L
NH3	Ammonia	mg/L
Norg	Organic nitrogen	mg/L
NOx	Nitrogen oxides	mg/L
pH	Acidity	unitless
PheoPigm	Phaeopigment	microgr/L
Ptot	Total phosphorous	mg/L
Sal	Salinity	g/L
Secchi	Secchi depth	m
Temp*	Temperature	°C
TN	Total nitrogen	mg/L
Turb	Turbidity	NTU
Rain	Rainfall at station	mm/month
River Discharge*	River discharge at station	ML/month
SOI	Southern Oscillation Index	unitless

Table 3 The Waterscope Freshwater data set of potentially available indicators. The red text indicates the ones already available.

Indicator	Comments	Units
ChlA	Chloropyll-a	mg Chl- a/m2/day
Cond	Electrical conductivity	mS/cm
DelC	Ratio of the stable carbon isotopes 13C and 12C	delta units
DelN	Ratio of the stable carbon isotopes 14C and 15C	delta units
DOMin	Dissolved oxygen minimum	mg/L
DORange	Dissolved oxygen max-min	mg/L
GPP	Gross primary production	gC/m2/day
NPtoC	Non Purgeable Total Organic Carbon	mg/L?
OE50	The ratio species found to the expected number of species at a given probability 50%	ratio
PET	Aquatic insects species richness of three orders	number
pH	Acidity	N/A
PONSE	Percent of native species expected	%
PropAlien	The proportion of non-endemic fish individuals in a river reach	%
R24	Respirtion rate	gC/m2/day
SIGNAL	Stream invertebrate grade number average level	number
TaxaRich	Family richness	number
TempMax	Max temperature	°C
TempRange	Max-min temperature	N/A
Rain	Rainfall at station	mm/month
River Discharge*	River discharge at station	ML/month
SOI	Southern Oscillation Index	unitless

WaterScope website manual

This pdf demonstrates the main features of the website, focussed on the *Estuarine and Bay Data* section. The Freshwater and Water Quality Investigations functionality mirror many of these functions and their implementations.

To ensure the latest version of Waterscope, try Ctrl-F5 within the login screen.
The website login page url: http://waterscope.ddns.net/.

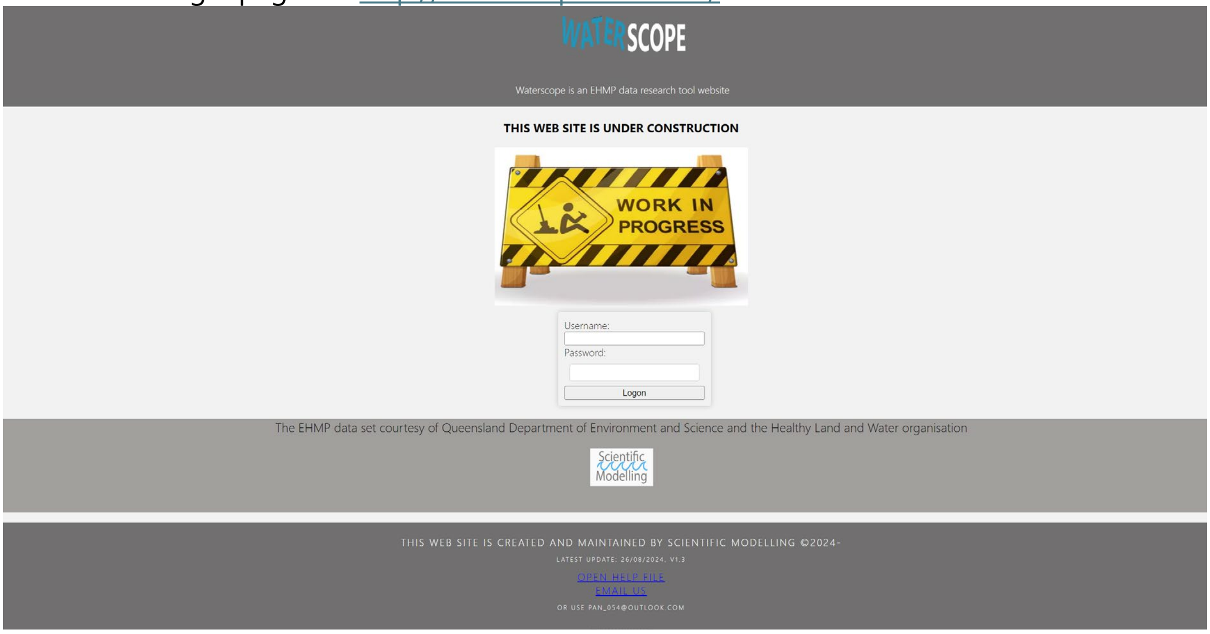


Figure 4 The login page of the Waterscope website. Please note the latest update date and version.

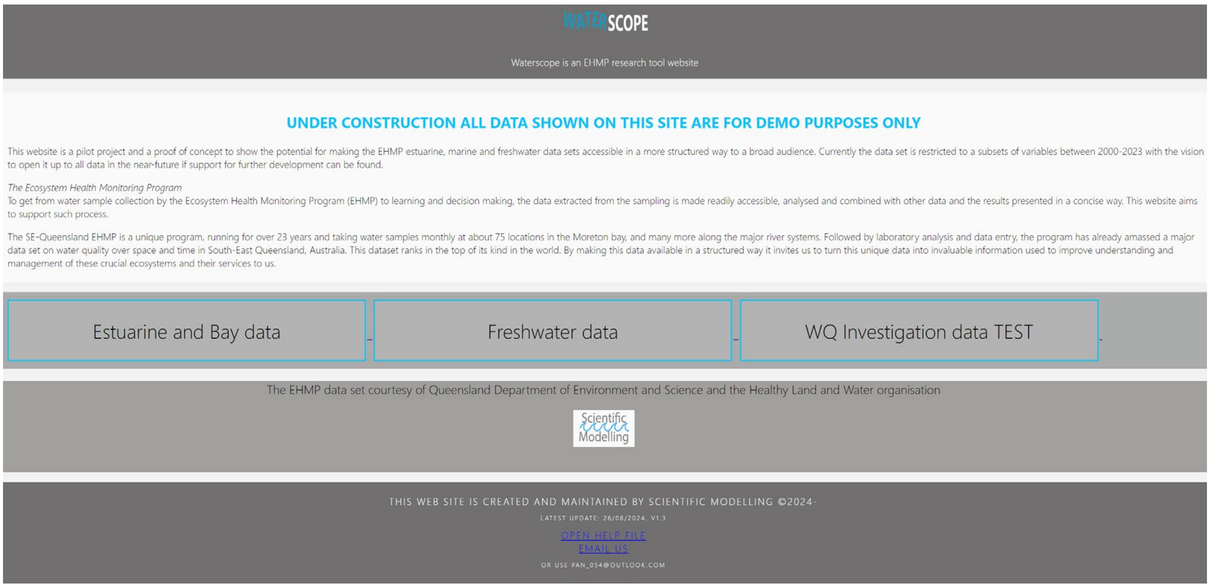


Figure 5 The home page of the website.

The login page asks for a *username* and a *password*, both need to be presented to get access. Currently, the username is just a name or ident that the user chooses. It needs to be at least five characters long, excluding leading or trailing spaces. Once a username is filled in, it will be automatically recalled after the first login.

After login, the home page opens, and the main menu will be represented by the blue-edged buttons on the middle of the page. The *Estuarine and Bay data* button opens the page that gives you access to a map with estuarine and bay EHMP registered sample locations and a variety of options to view and analyse the water quality data as collected by the EHMP program. See for EHMP program details: https://www.hlw.org.au/portfolio/ecosystem-health-monitoring-program#gsc.tab=0.

The yellow slider between the map and graph section allows changing how much width is used for either section.

The next section explains how to use the *Estuarine and Bay data* access and analysis web page.

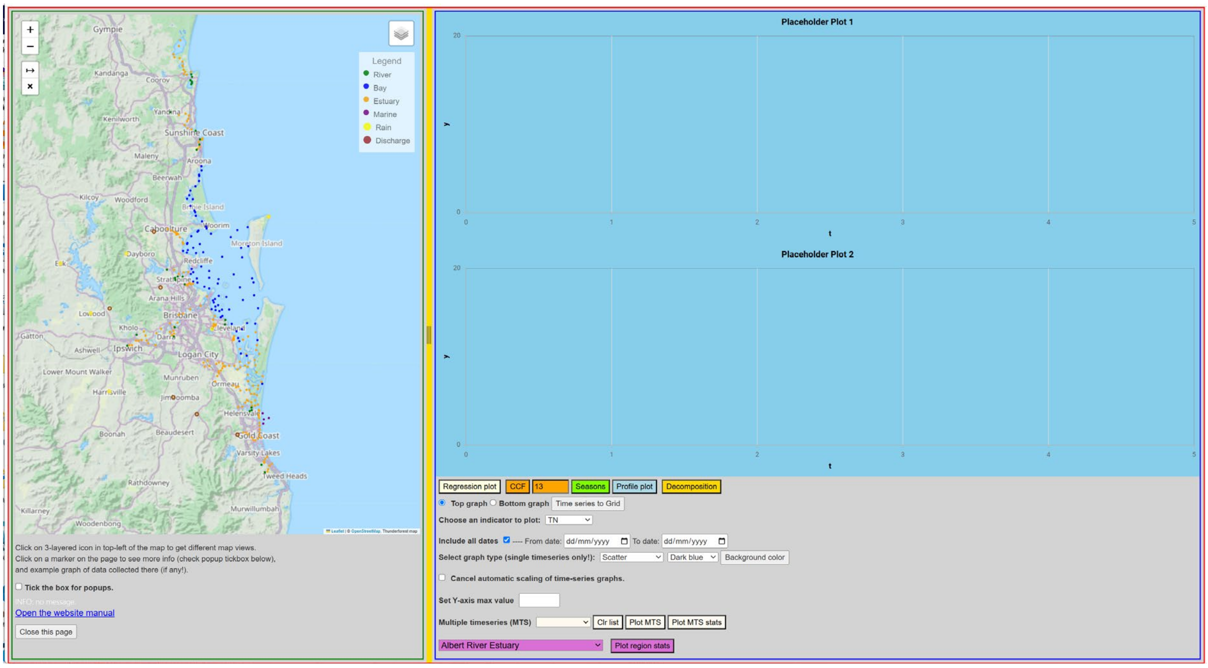


Figure 6 The Estuarine and Bay data initial screen is the main access and analysis area of the website. Most user interface elements (e.g. buttons, dropdown lists) show some explanatory text (tooltip) when hovering over them with your mouse pointer.

Estuarine and Bay Data access section

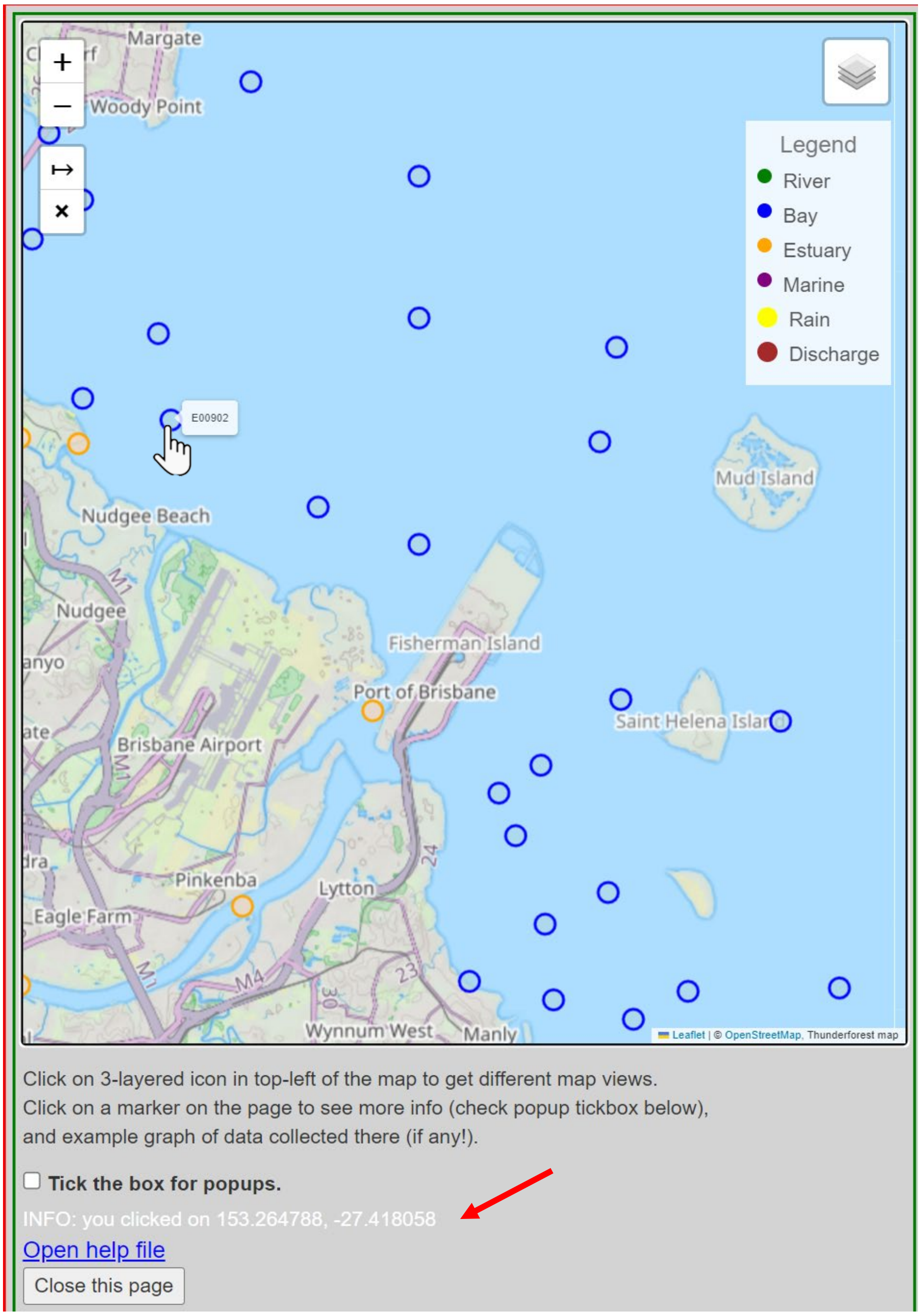
The map part of the user interface (UI)

The two main parts of the data access page are a *map* and an *analysis*/plotting area (see **Error! Reference source not found.** for an overview of the UI).

The map section is fairly intuitive as it main function is to allow users 'on-the-fly' access to the Marine and Freshwater part of the EHMP water quality data set .

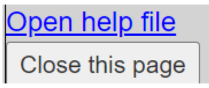
- Zooming with the mouse wheel (or the +/- box at the top left of the map), panning is done by dragging with the left mouse pointer pressed. TIP: zoom into an area of interest before trying to select a location when working on a tablet of phone without a mouse or stylus pen.

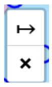
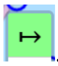
- Selecting an EHMP sample location: when hovering with a mouse pointer over one of the locations (zoom in for easier selections), two things happen:
    - 1: the mouse pointer changes to a hand, and
    - 2: a label with the location ID appears.



- Clicking on a location while the pointer looks like a hand should result in a graph on the graph section and some info in the INFO box. TIP: not all locations have a full set of water quality indicators. If the requested indicator is missing, it will say so in the info box. It also marks the position on the map.
- Clicking anywhere else on the map will show the geographic position in latitudes and longitudes. INFO: you clicked on 153.226089, -27.252595

-  **Tick the box for popups.** allows popup with more info to appear when a location is selected. As the popups are bulky, the are switched off by default.
- **Open help file** opens this pdf. Some browser pdf reader plugins (e.g. Chrome) may turn the text into gibberish and downloading the file would be the way around it.
- **Close this page** will open the previous web page.



- The  icon on the map shows different maps, e.g. Google earth maps, hybrid maps.
- The  allows to measure poly-line distances on the map, Clicking the arrow box activates the distance measuring feature, indicated by its green colour . Double-clicking the last point of the polyline stops the further addition of points. Selecting the X-icon clears the polyline. Selecting the arrow again and deactivates the distance-measuring activity and the box turns white again.

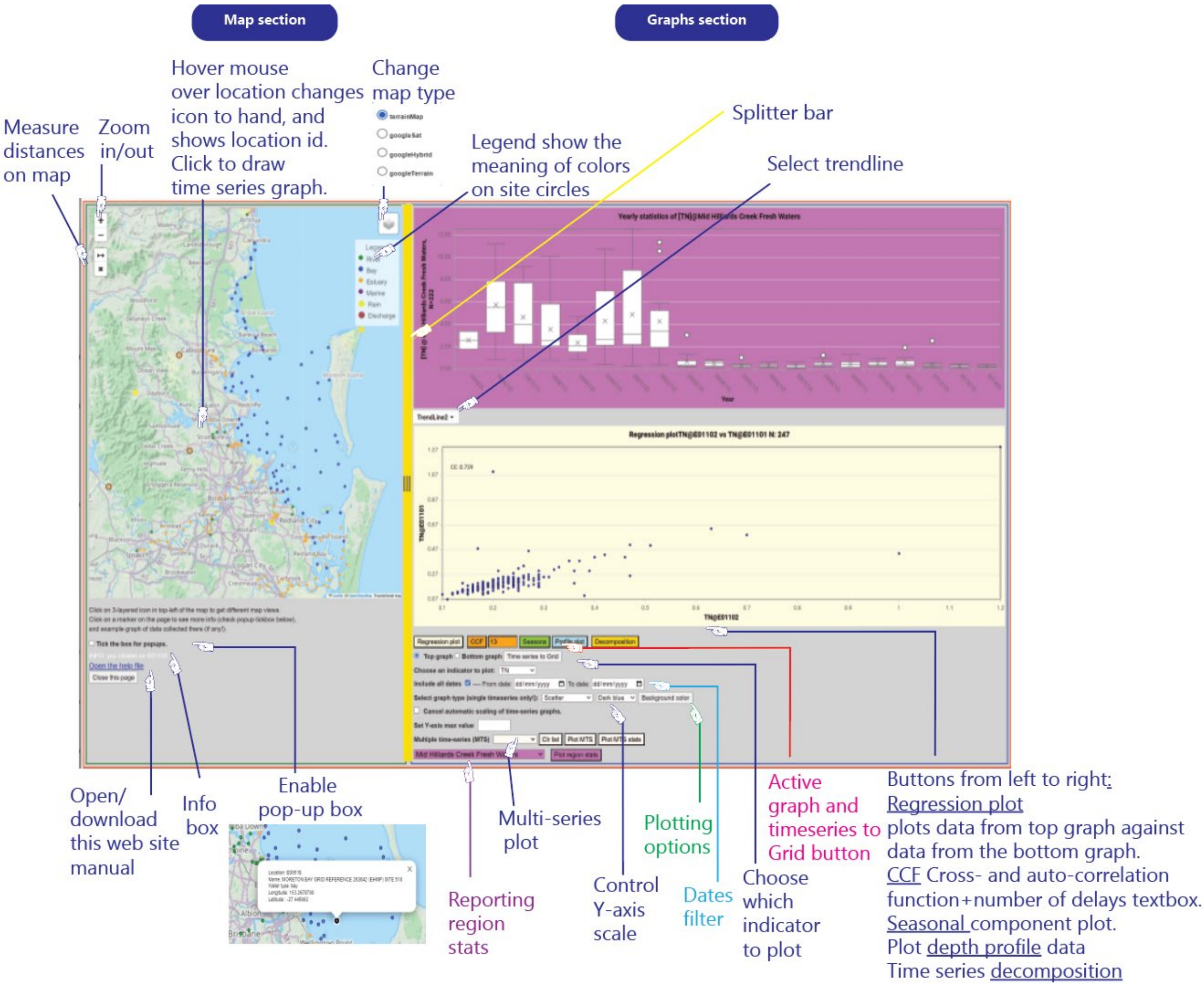


Figure 7 Overview of WaterScope data access web page.

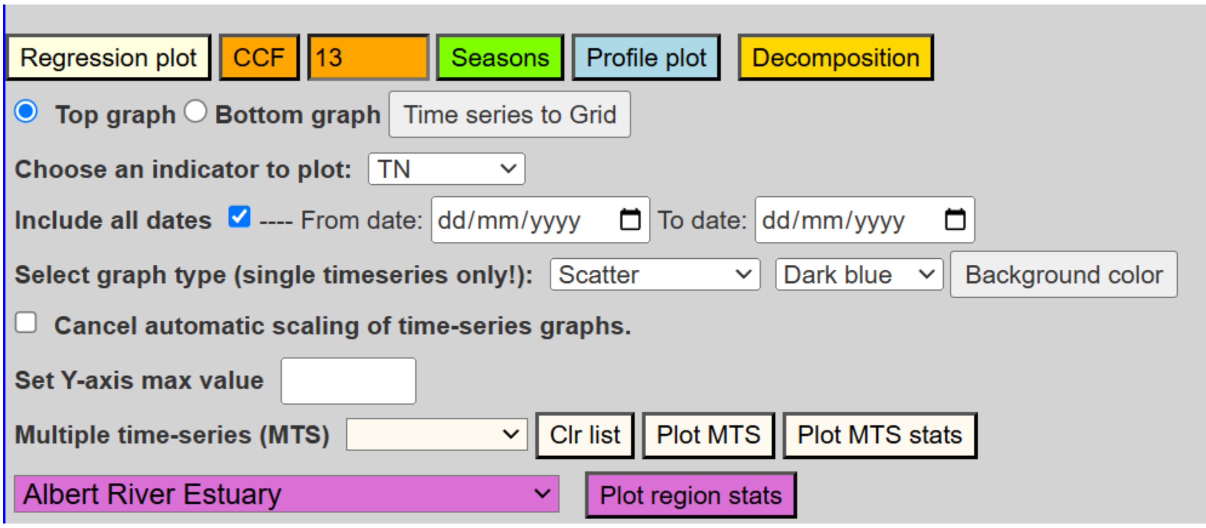
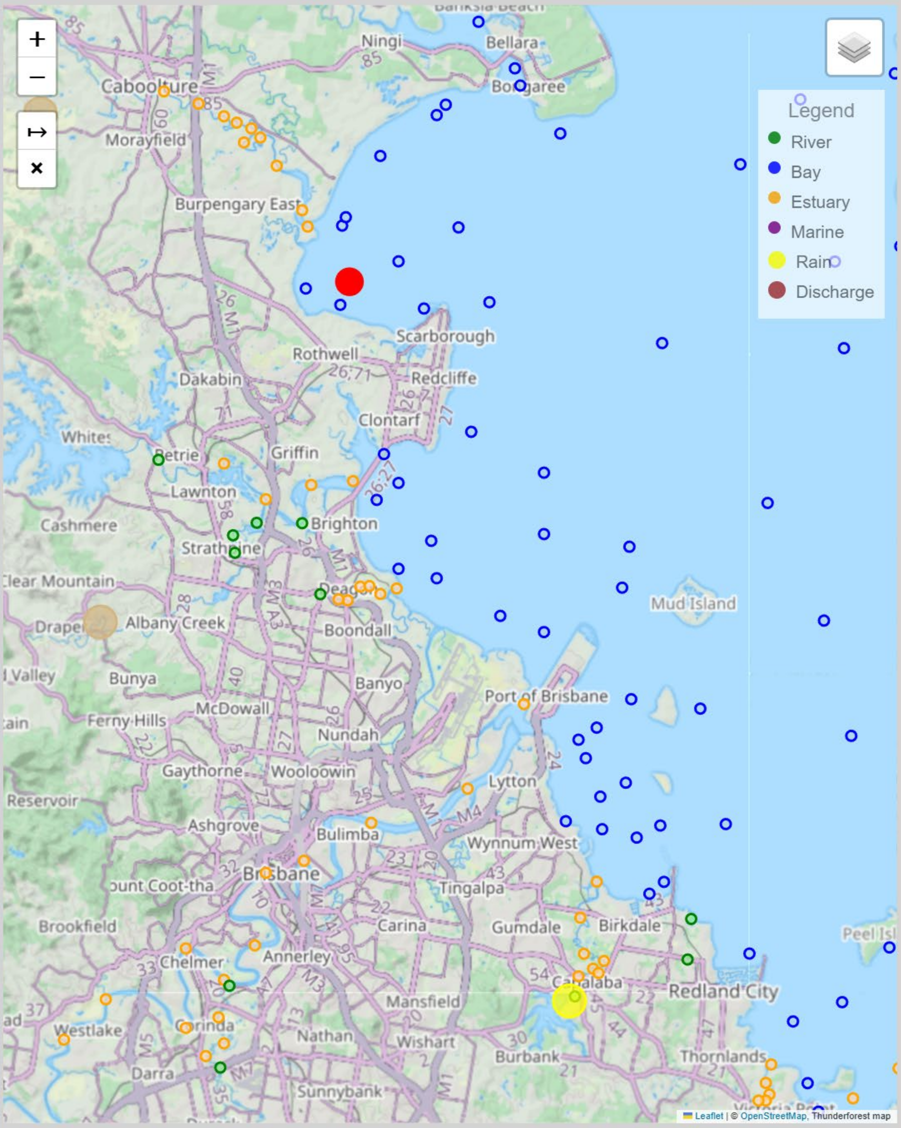


Figure 8 Graph functions dashboard.

Selecting (clicking on) a location, also changes the size and colour of the marker to red.



Click on 3-layered icon in top-left of the map to get different map views.
Click on a marker on the page to see more info (check popup tickbox below), and example graph of data collected there (if any!).

☐ **Tick the box for popups.**

INFO: you clicked on E01102

Open the website manual

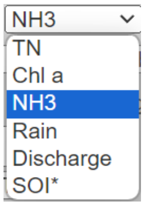
Close this page

Using the Estuarine and Bay Data

Time series plots

This section allows access to water quality date collected for almost 23 years in bays and rivers in SE-Queensland, Australia. As the main measurements are monthly, all the data shown here has a resolution of one month.

How to select the spatial (location) aspect of the data was already explained in the previous section. This section gives an overview of what can be done with the selected data.

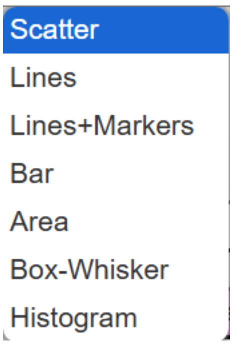


There are a (currently limited) range of water quality indicators available and can be selected from a dropdown list labelled ***Choose an indicator** to plot*. The default value is TN.

External drivers such as rain, river discharge can are also available as monthly totals of daily data. The SOI (Southern Oscillation Index) is already been reported as a monthly value, see http://www.bom.gov.au/climate/enso/soi/ .

To plot time series data, the following steps are recommended:

1 Select top or bottom graph using the radio buttons underneath the graphs
2 Select the water quality indicator to plot from the dropdown list
3 Select the type of graph and the colour used for the markers and lines
4 Select the sample location on the map resulting in the time series to be plotted.
5 The default way to visualise the time series of data measured at a location is to plot the selected water quality indicator against the collection date. The ***Top graph*** and ***Bottom graph*** radio buttons determine which graph slot is active.



After a graph has been produced, its appearance can be altered by using the graph type drop-list again without having to re-select the time series on the map.

Note that the Box-Whisker plot does not result in a simple time-series plot. Depending on the choice of graph type and colour from the dropdown lists, the graphs can be customised to an extent.

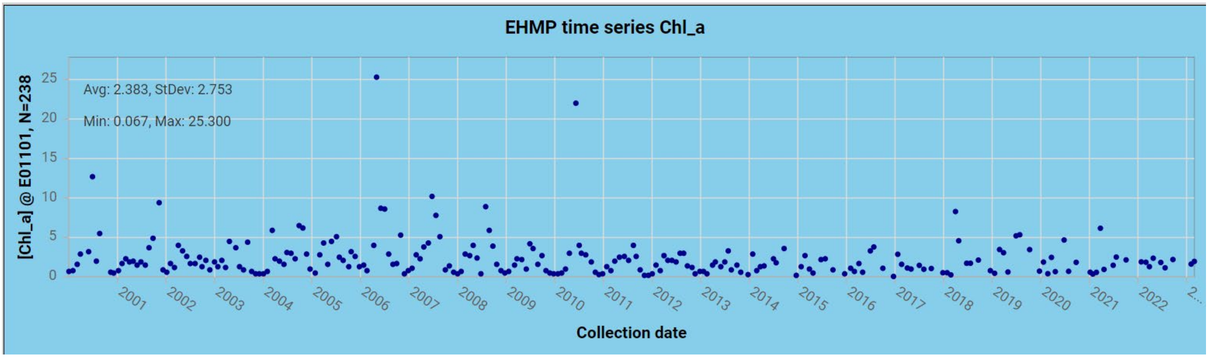
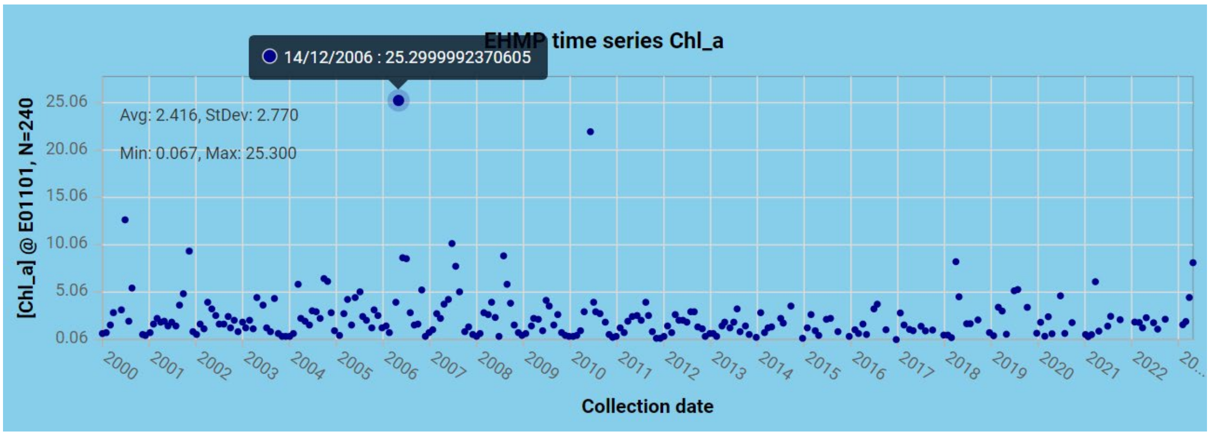


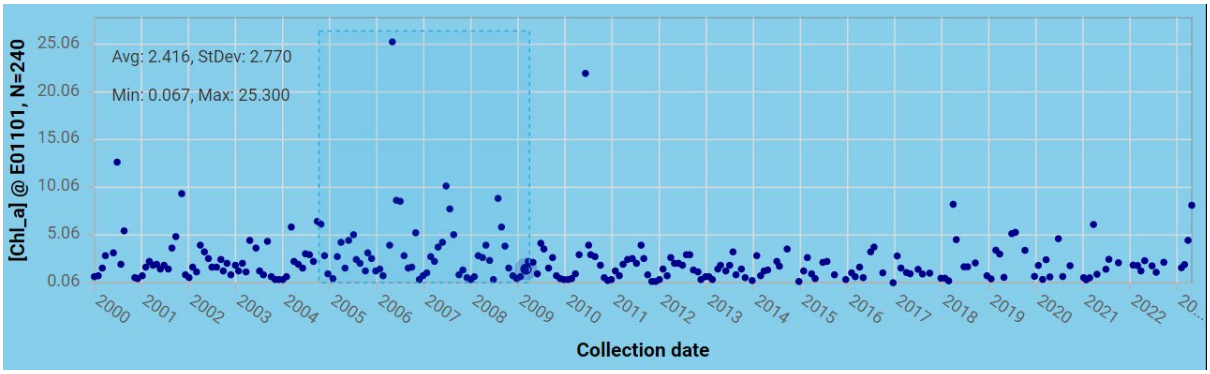
Figure 12 shows some examples of the various ways time-series plots can be formatted. Hovering over a value on the graph **shows details** of a single sample. The graphs also allow **zooming** (drag with mouse cursor, left button pressed and released) and **panning** by dragging the mouse pointer left button pressed. Timeseries graphs show some **basic stats** in the top-right corner.

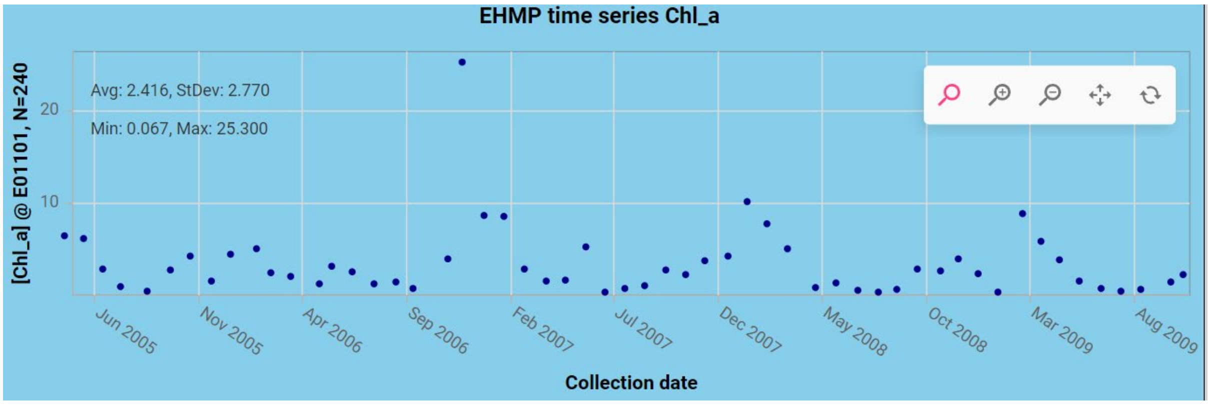
Interacting with graphs

Show value of a measurement: Hover cursor over the measurement and the date and measurement value is shown on the graph.



Zooming in/out and panning left-to-right (v.v.): Dragging the mouse pointer over the area of interest on the graph while pressing the left mouse button creates a rectangle indicating the area of interest (first graph below). Releasing the mouse button shows the actual zoomed-in area (second graph below). A little menu appears on the graph with tooltips explaining the various buttons.

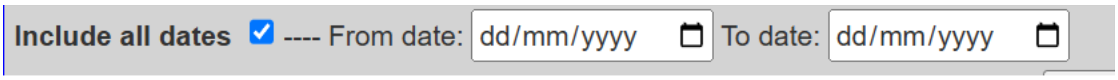


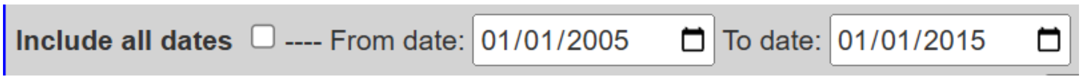


When a multi-line is used, such as the season plot, a legend will appear on the right-hand side of the plot allowing more graphing options.

Dates filter

This options allows time series to be filtered using a dates interval. Selecting the *From date* dd field and start typing the start date. The cursor will automatically go to the month and year parts. Use the tab key or your mouse pointer to jump to the *To date* field.





The *Include all dates* checkbox will override the *from/to date* fields.

Time series decomposition

To better understand the information 'hidden' within a time-series, it helps to decompose the time-series into a couple of fundamental parts: trend, seasonality (cyclic) and residuals (random) components.

The decomposition analysis overlaps with the season plots. The season plots however show better the year-to-year variation.

The decomposition is implemented in the EHMP website by links to R-'system', a very powerful open-source programming language for statistical software and data analysis tools. This means that the first time the analysis is used during a session, the delay is a bit longer due to the download time for the R-system and the packages needed to do the analysis.

Trend

A *trend* represents is a long-term change in the data. The trend time-series is generated by filtering out the higher-frequency components of the data using a moving-average algorithm. This results in data loss for 6 time points at the start and the end of the trend time series.

Seasonality

Trends in the data that return to about the same values after the length of a seasonal pattern, in our case 12 months indicate that there are seasonal patterns driving that data.

Residual

After subtracting the trend and seasonality influences, we are left with a residual, often also named 'random', component. The term 'random' is here used loosely to indicate 'not seasonal or trend'.

The temporal decomposition is implemented within the EHMP website using R stats packages connected directly to the EHMP tools website. Currently there is no imputation of absent data implemented, so the accuracy it decomposition results depends on (almost) gap-less time-series.

Decomposition examples

As the trend, seasonality and residue components add up to the original time-series, the values of each of the series also indicates the importance of the component.

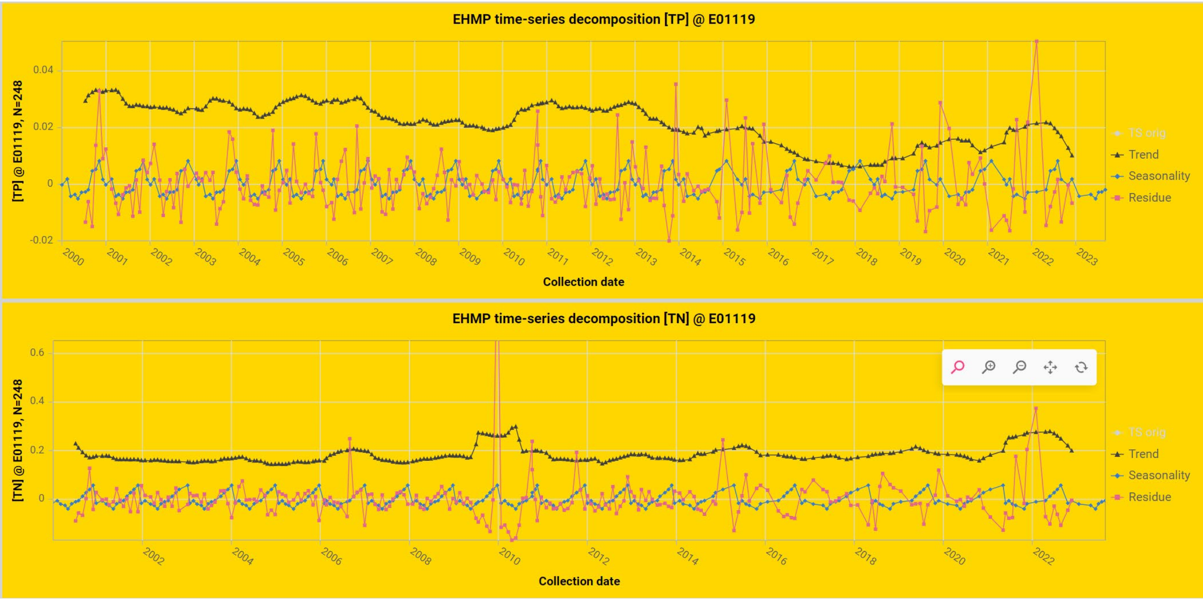


Figure 9 Examples of time-series decomposition. The top graph indicates a decreasing long-term trend of total phosphate concentration, at location E01119. The lower graph of total nitrogen concentration does not show a clear trend.

Some more info re time-series analysis, see also:

https://otexts.com/fpp2/tspatterns.html

Regression plot

After having selected two time series, the regression plot (light-yellow background) shows the two time series plotted against each other to reveal any if all relationships between the indicators. The top plot is represented on the x-axis, bottom plot on the y axis

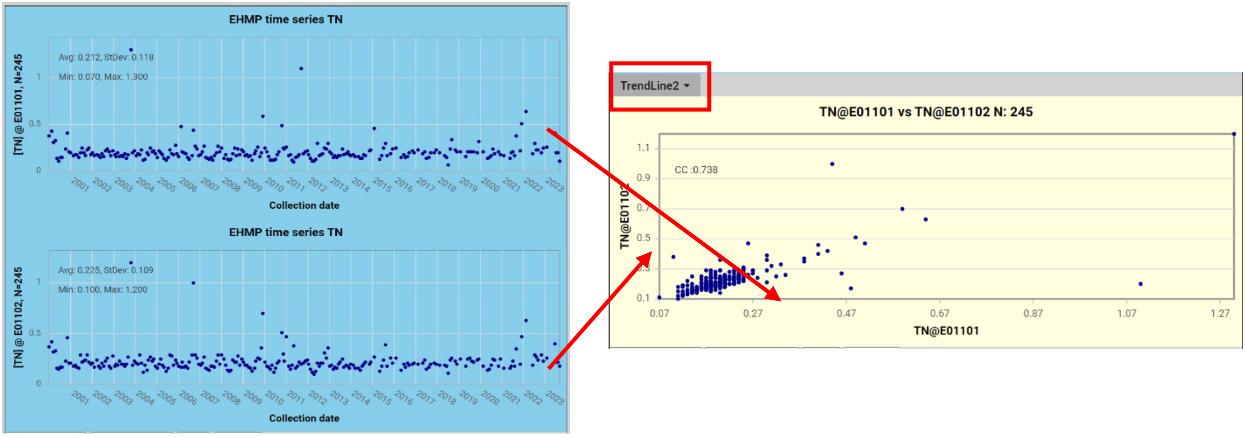
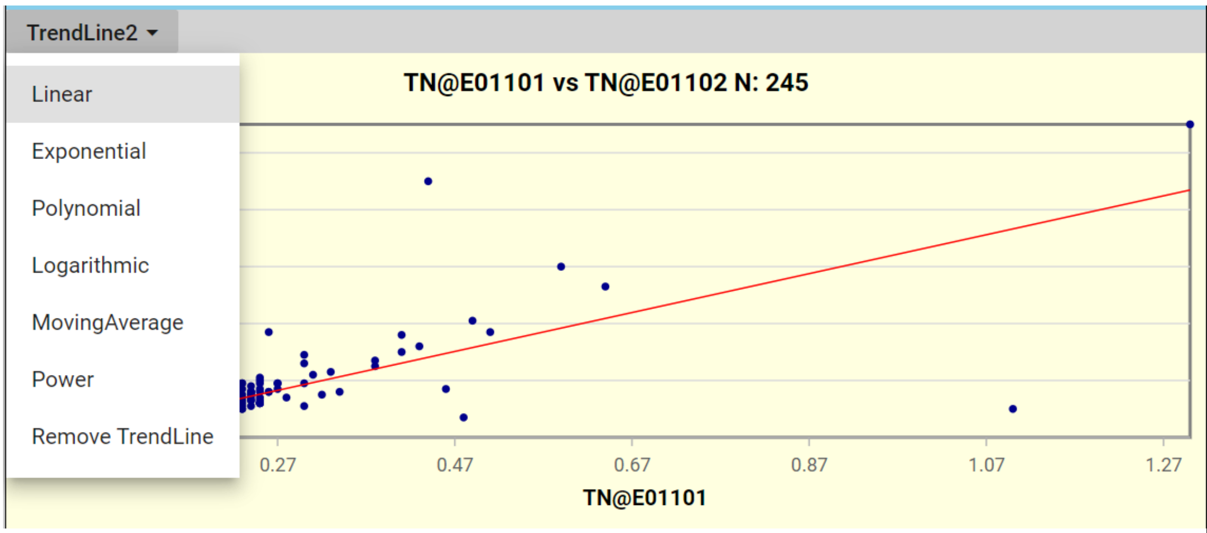


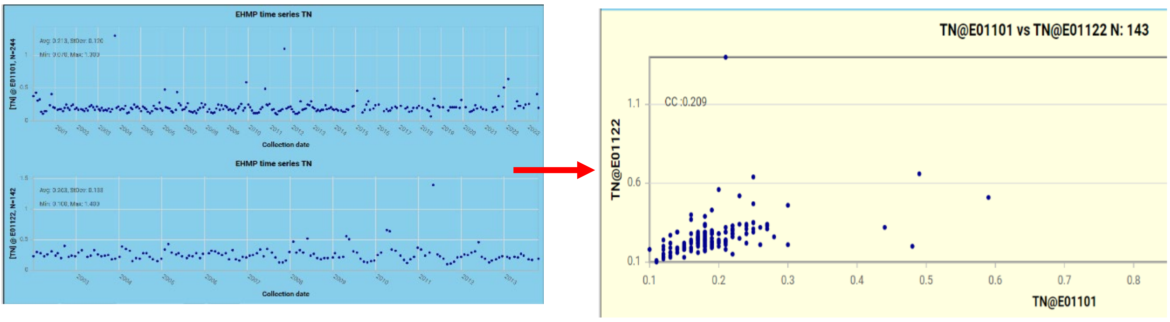
Figure 10 Creating a regression plot based on two time-series.

To create a regression plot, the sample collection months for each sample have line up. That means that the samples in the two time series that are not collected in the same month will not be represented in the regression plot. The number of samples in the regression plot can be found as N in the plot title. In the example above, the TN indicator at side E01102 and at location E01102 were consistently sampled over the years. Both time series contain 244 samples, and the regression plot also contains 244 samples. The correlation coefficient of the resulting two (possibly reduced) time series is noted in the top-left corner of the graph. The correlation coefficient expresses the strength of a *linear* relationship between two indicators. Care should be taken to over-interpret this measure especially when delayed links between indicators exists (see CCF)!

The Trendline dropdown lists a set of trendlines that can be plotted onto the regression graph. Currently the equation and R^2 values of the regression line are not plotted onto the graph. It is on the 'to-do' list.

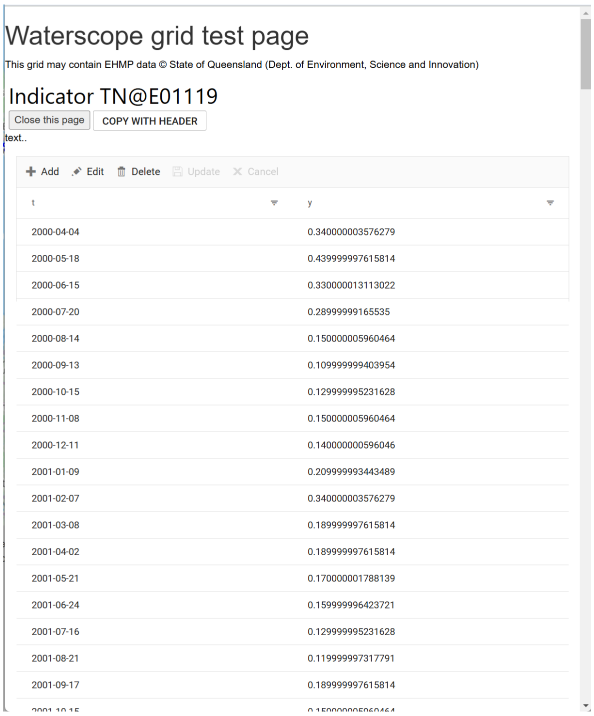


Sampling at location E01122 was discontinued after 2014, so if we were to plot location E01101 against location E01122 with only 143 samples, the regression plot would only show 143 points.



Exporting using a grid

The button next to the active graph radio buttons, labelled *Time series to Grid* shows the numeric data in a grid . The grid can be copies to the clipboard and pasted into other applications (e.g. Excel). <u>NOTE: this function works only for single time series plots.</u>



Waterscope grid test page

This grid may contain EHMP data © State of Queensland (Dept. of Environment, Science and Innovation)

Indicator TN@E01119

Close this page | COPY WITH HEADER

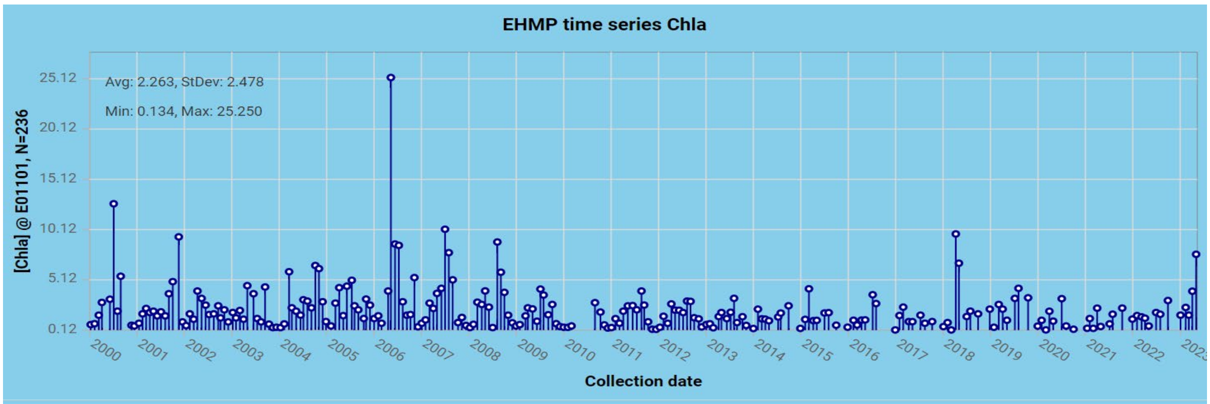
text..

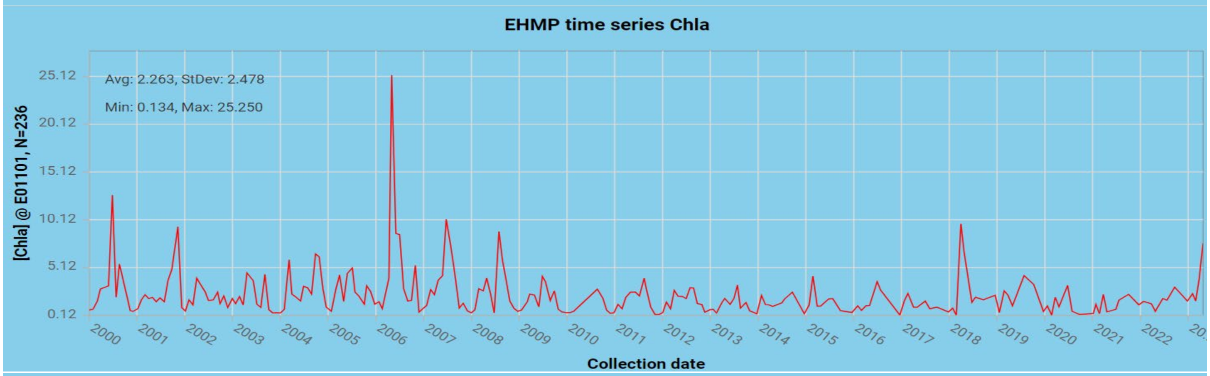
Add Edit Delete Update Cancel

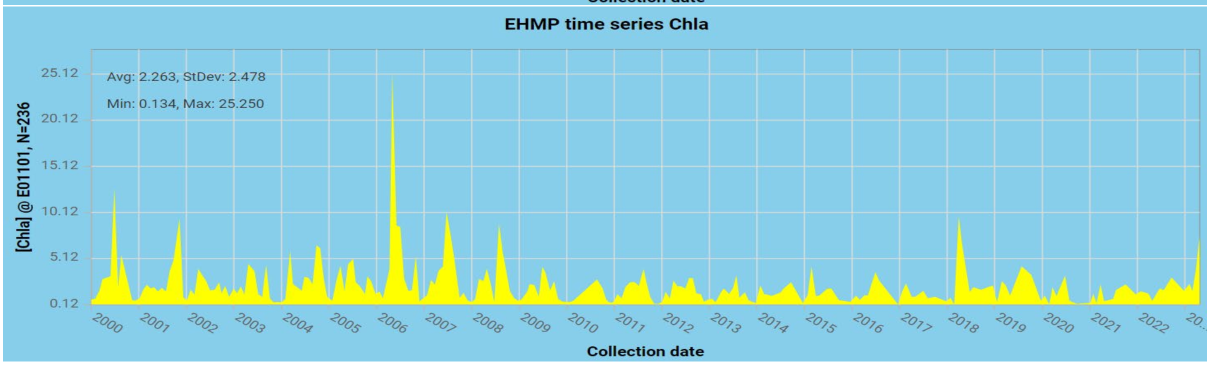
t	y
2000-04-04	0.340000003576279
2000-05-18	0.439999997615814
2000-06-15	0.330000013113022
2000-07-20	0.28999999165535
2000-08-14	0.150000005960464
2000-09-13	0.109999999403954
2000-10-15	0.129999995231628
2000-11-08	0.150000005960464
2000-12-11	0.140000000596046
2001-01-09	0.209999993443489
2001-02-07	0.340000003576279
2001-03-08	0.189999997615814
2001-04-02	0.189999997615814
2001-05-21	0.170000001788139
2001-06-24	0.159999996423721
2001-07-16	0.129999995231628
2001-08-21	0.119999997317791
2001-09-17	0.189999997615814

Figure 11 Grid-view of time series data

Some examples of time-series graphing options.







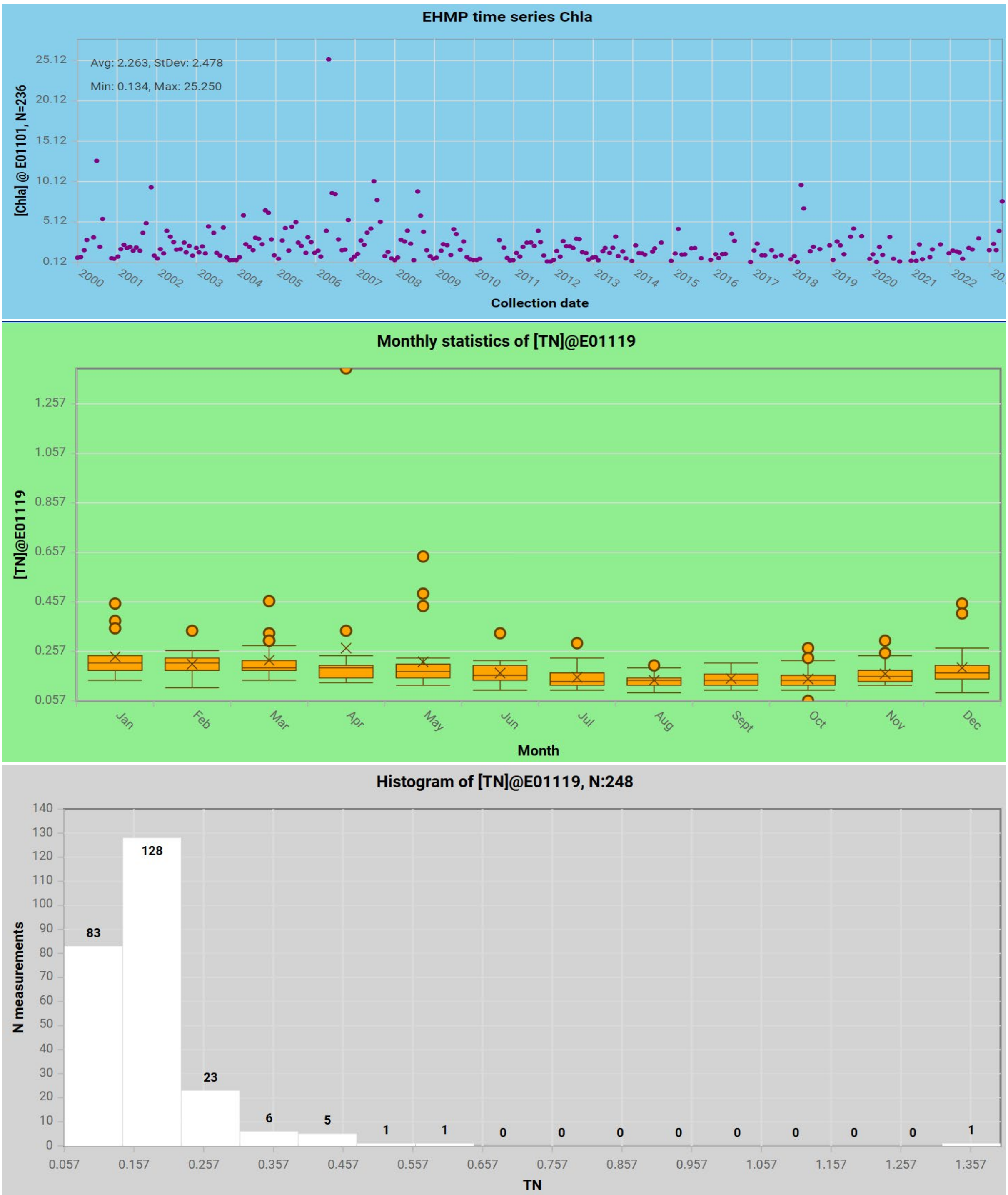


Figure 12 Various time series graphing options

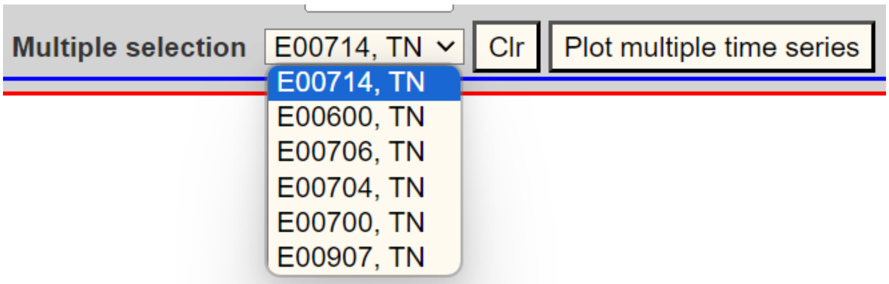
Multi-series plots

Adding sample locations to the multiple selection dropdown box is done by holding down the Ctrl (Control) key and selecting locations on the map. Clear the content of the dropdown box pressing the *Clr*-button. More details in the example below.

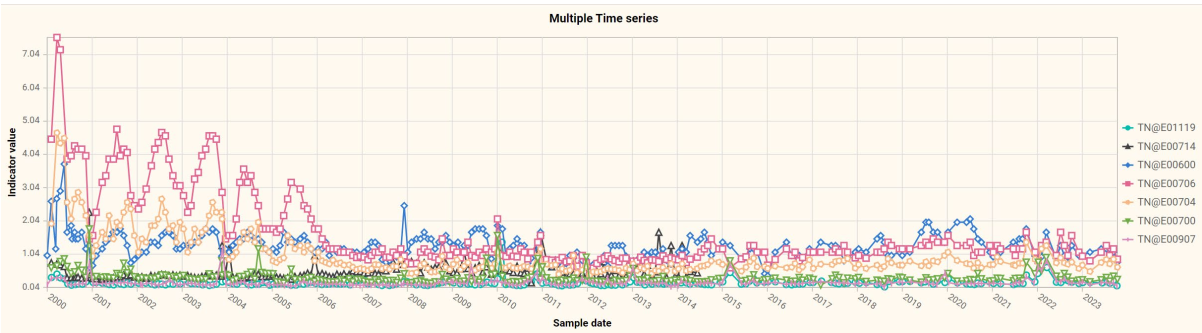
Multi-time series example

For this example, we 'collect' six locations along the Brisbane river from College Crossing, the upper-most EHMP sample location in the Brisbane river, to a sampling location in Moreton Bay, about 9 km from the Brisbane river mouth.

(E00)714=College Crossing, 600=Bremer river inflow, 706=Indooroopilly,704=central Brisbane, 700 = Port of Brisbane, 907= Moreton Bay.



Clicking the *Plot multiple locations* button results in:



The location IDs on the legend are sorted in the order of adding sample locations.

A quick run with the mouse pointer over the location ids in the legend gives an instant story of 23 years of total nitrogen concentration along the Brisbane River. Figure 13 tables the results of this example.

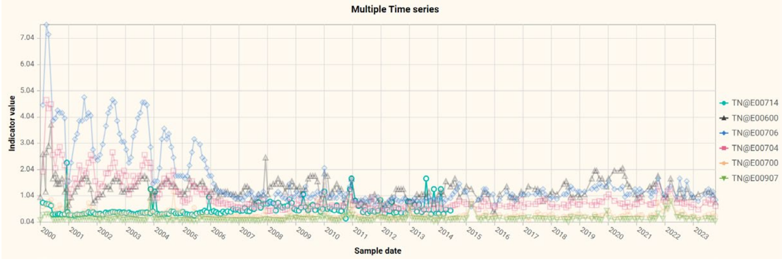
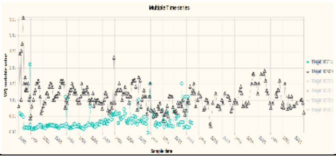
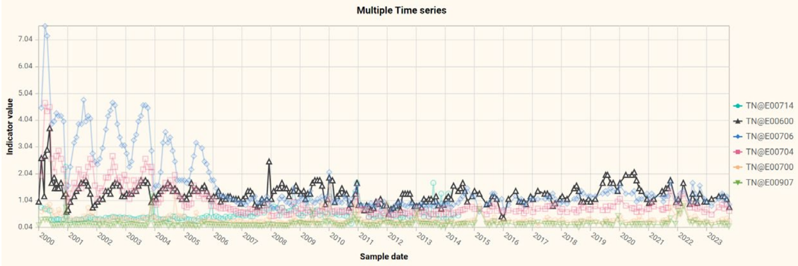
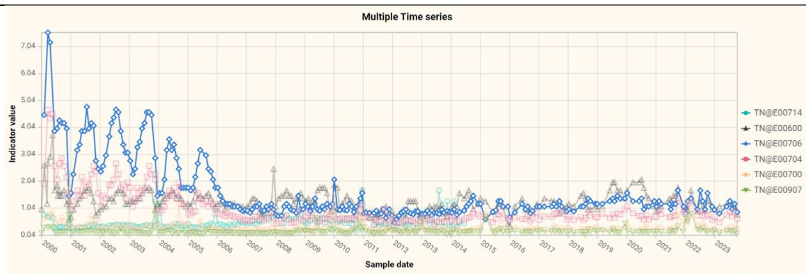
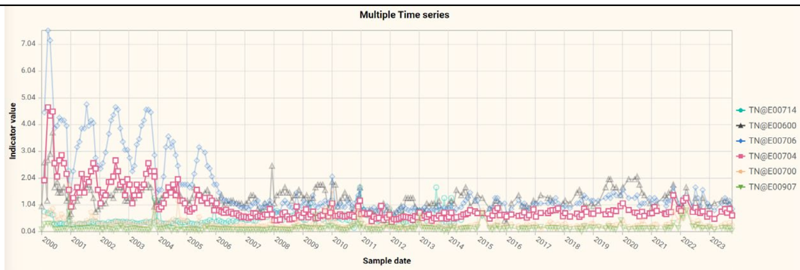
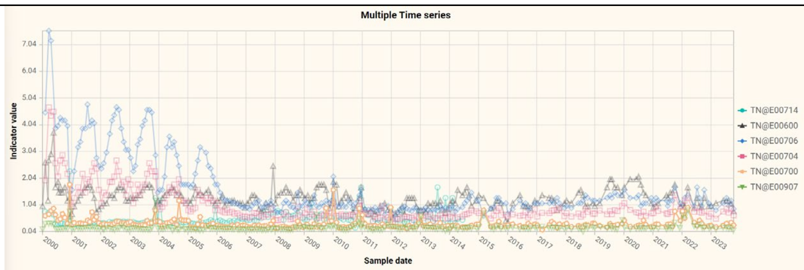
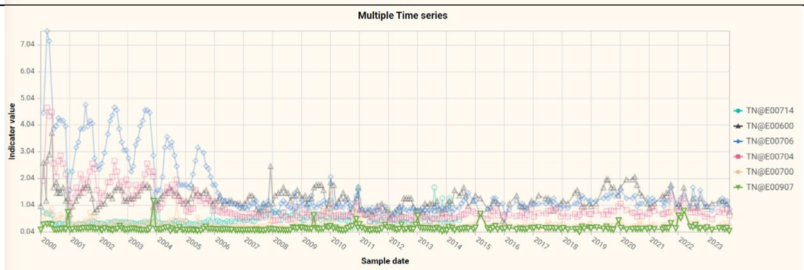
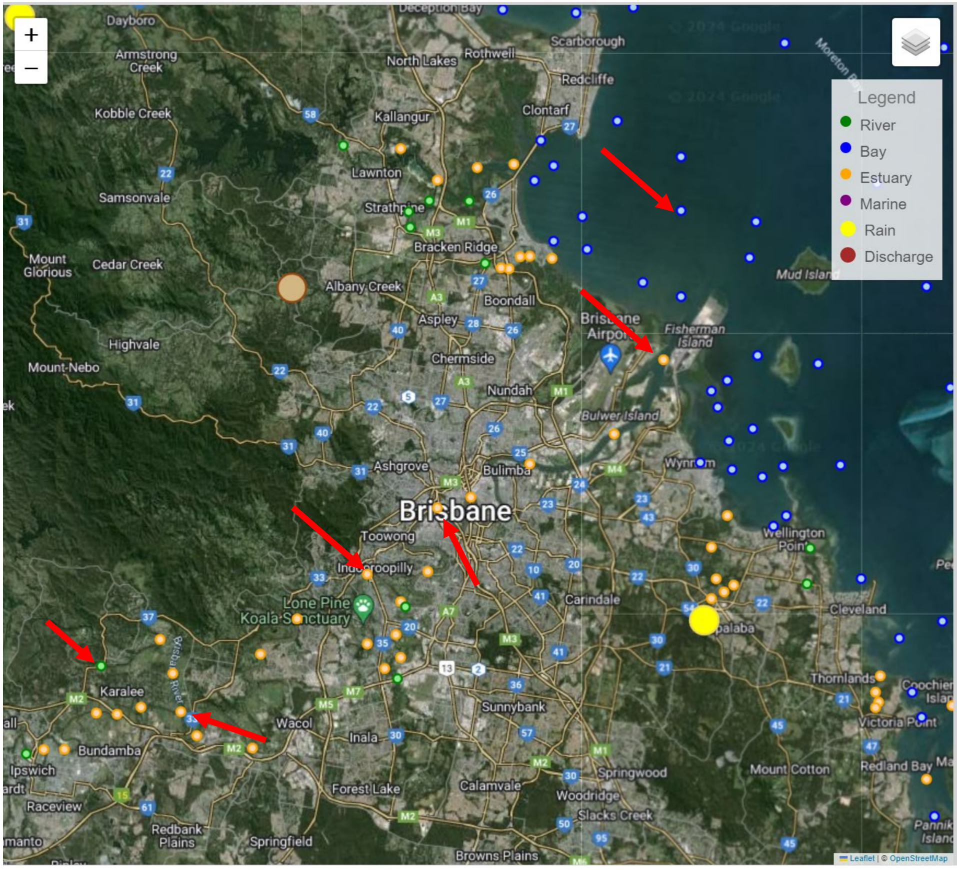
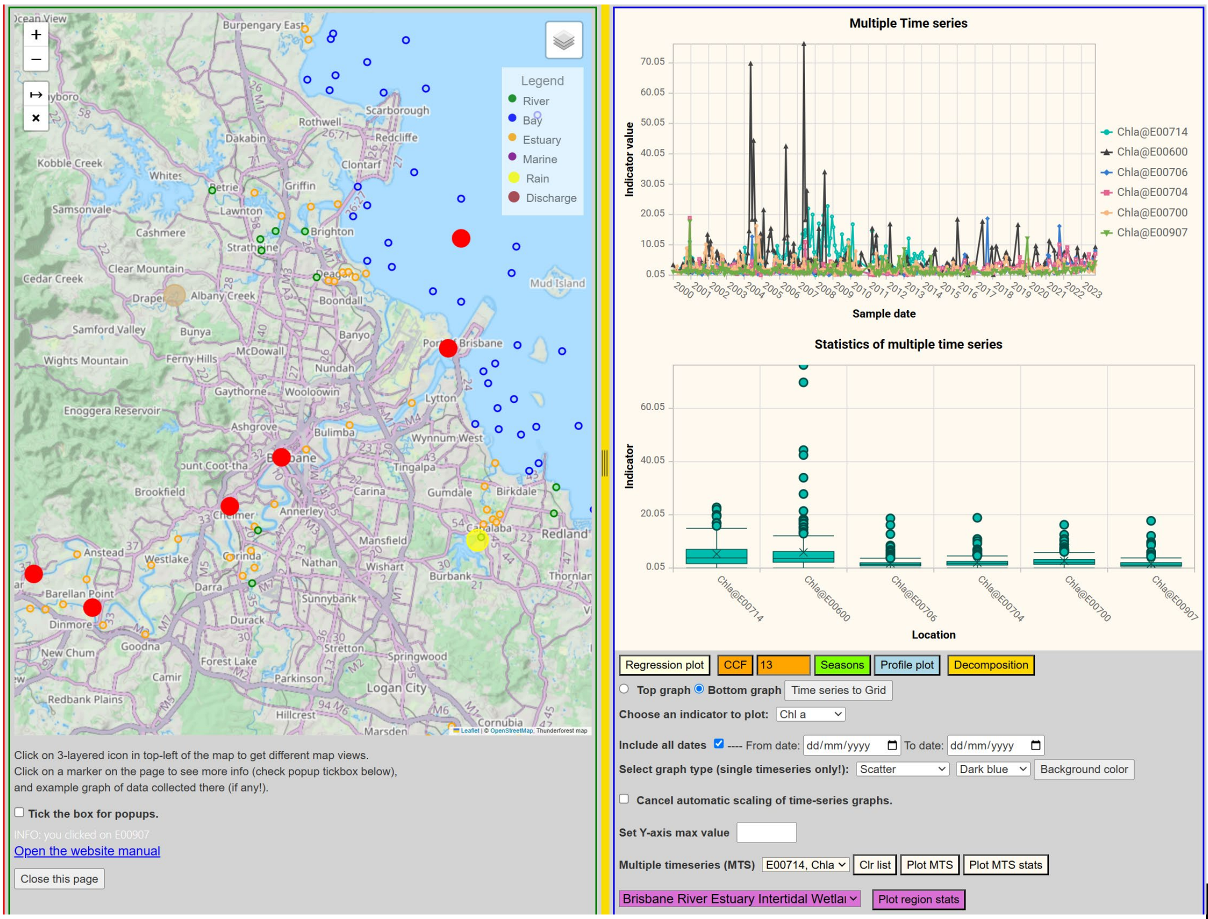
714=College Crossing. [TN] rises after ca. 2007. Unfortunately EHMP sampling stopped after 2014.	
600=Bremer river inflow. Big step-up in [TN] from College Crossing 	
706=Indooroopilly. The very large fluctuations in the data from 2000-2006 needs more investigation.	
704=central Brisbane.	
700 = Port of Brisbane. Daily tides flush these regions.	
907= Moreton Bay. Low concentrations due to dilution, ecological cycling, and export.	

Figure 13 Multi-time series plots often give insights of spatio-temporal dynamics.



When selecting the multiple time series, the selected location markers are automatically enlarged and turn to red.



Multiple time-series Box-Whisker plot

Alternatively, the stats of each location for a selected indicator can be plot as a Box-Whisker plot.

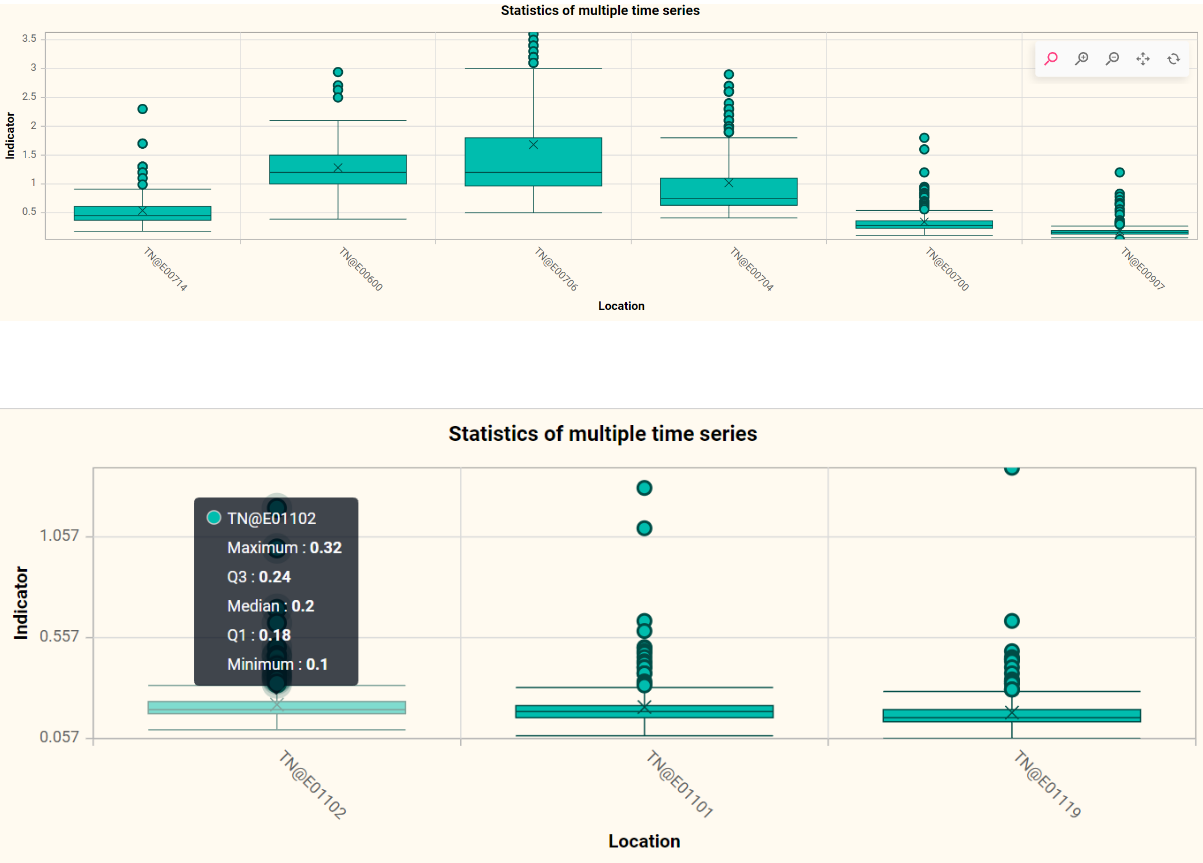


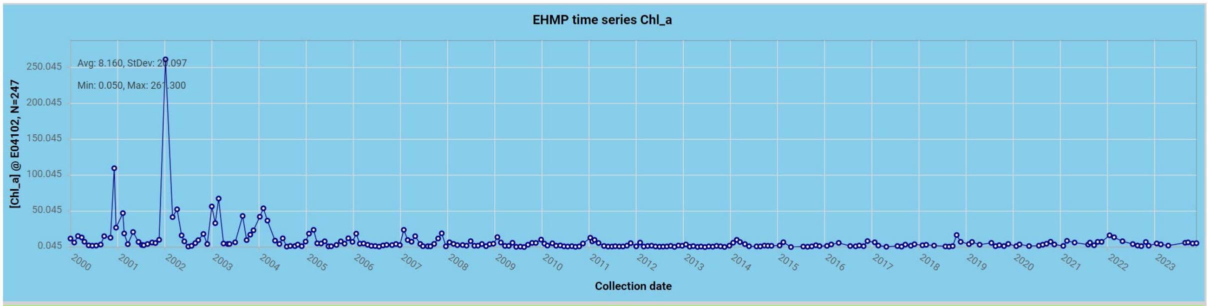
Figure 14 More details of Box-Whisker plot statistics pop up when the cursor hovers over an element.

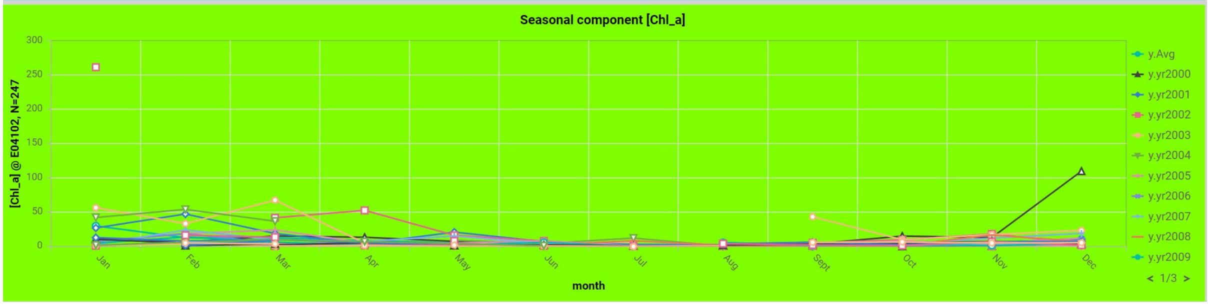
Seasons or epoch plot

To examine inter-annual variation, the seasons-plot is an alternative to the ACF plot. The seasons plot cuts a time series plot (first graph below) into year segments and plots each segment separately on a graph (second graph below).

Seasons plots are just a different way to look at a time series, and can inform us about the variation of an indicator over the year and are akin to Box-Whisker plots.

See also the time-series decomposition section for more information.





The trace at the top of the legend of the *Seasonal Component* plot is the monthly average. For this location and this indicator, it shows very low variability between July and October, but it is not easy to see.

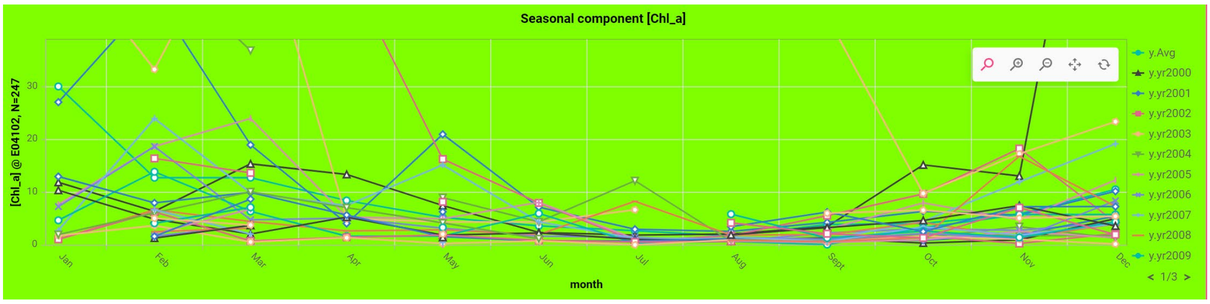
Multi-trace graphs can get cluttered very easily, so there are a couple of options to deal with it:

- Zooming in/out/panning.
- Highlighting one trace.
- Switching some of the traces off.

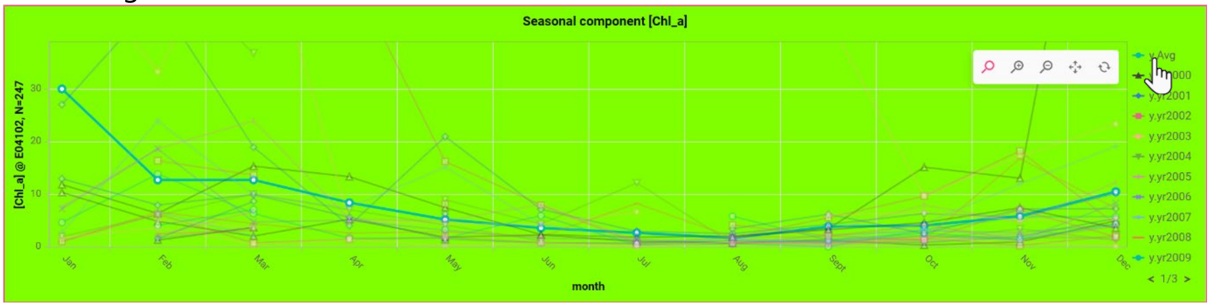
Example

The top (blue) graph shows the Chl_a trace at Cabbage Tree Creek close to the Gateway Motorway (location E04102) between 01/2000 and 12/2023. The bottom (green) shows *Seasonal Component* plot for that time series. In this form it is very hard to interpret.

Zooming into the lower part of the graph results in:



Hovering the mouse icon over the legend, highlights the trace of a specific year, in this case the average trace:



Switching off the other traces is complete 'decluttering'.

Box-Whisker plot

A Box-Whisker plot can be created following the same steps as creating a time series plot by selecting the Box-Whisker option in the dropdown box labelled **Select graph type**, indicator and a EHMP location on the map.

Box-Whisker plots provide a summary of the distribution of the data, showing the central tendency (median and average), spread (Q1, median and Q3), extremes (whiskers), and potential outliers (circles).

Box-Whisker plots show these statistics derived from grouping by month the time series of each year, resulting in several samples per month (numbers in parentheses after month label). Overlaying the annual time series allows to draw some descriptive statistics for each month and plotting those descriptive statistics on a graph. The number of samples the statistic is based on can be seen between brackets on the x-axis labels. Note that some months (Jan, April, June, July) are based on less samples due to the EHMP program sampling effort reduction since 2015.

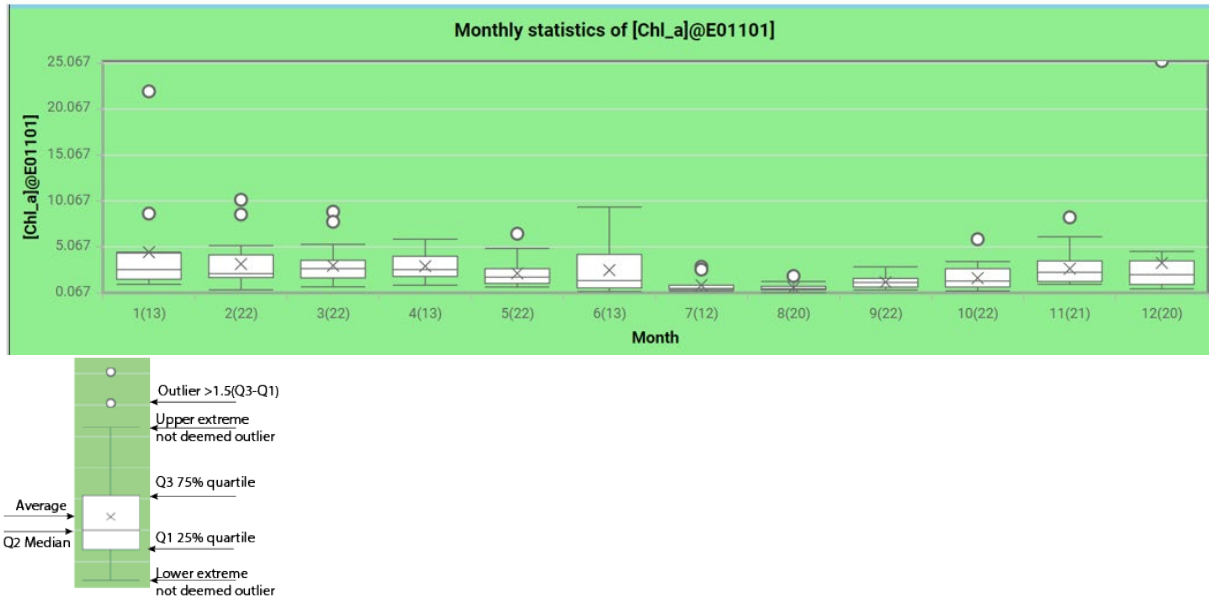


Figure 15 Box-Whisker plots show the variation within each month over all available years of sampling for a selected indicator. The diagram explains how to interpret the Box-Whisker symbol.

More detailed information on Box-Whisker plots and outliers can be found here:

https://www.tableau.com/data-insights/reference-library/visual-analytics/charts/box-whisker

https://www.ncl.ac.uk/webtemplate/ask-assets/external/maths-resources/statistics/descriptive-statistics/other-measures-of-dispersion.html#Outliers

Currently, no outlier analysis has been implemented (yet).

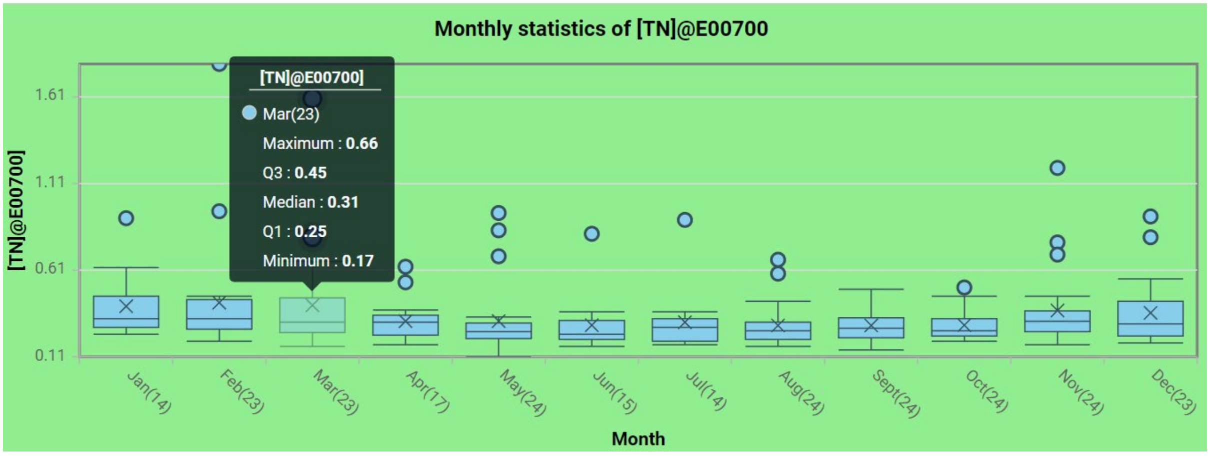
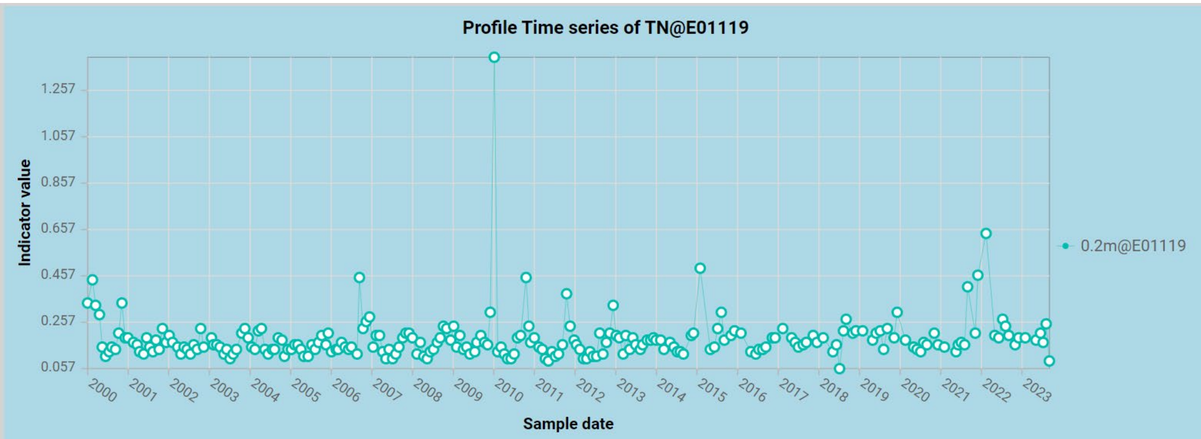


Figure 16 More details of Box-Whisker plot statistics pop up when the cursor hovers over an element.

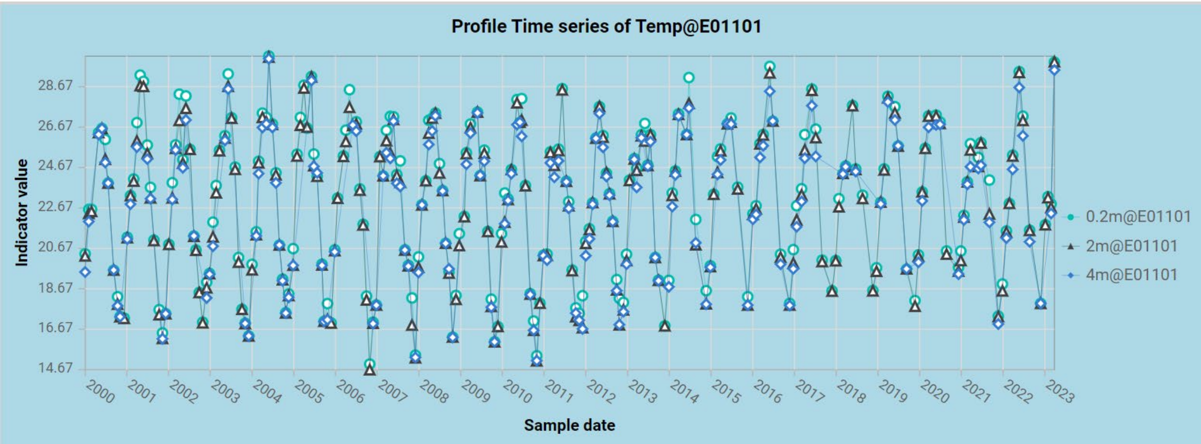
Depth Profile time series plots

Apart from the many samples that were collected at the water's surface (20 cm depth), for some of the indicators, mainly the physical indicators (e.g. temperature, and salinity etc.), data has been collected at a range of depths, often at 2, 4 and 6 m. These are called *depth-profiles* and are also accessible via the Waterscope website. Not all locations have profiles.

Plotting the profile time series s quite simple: just plot a 'normal' time series as described in the previous section and select the [Profile plot] button. If there is no profile data available, only the 0.2m plot (same as the normal time series plot, with different background color) will be shown, see graph below.



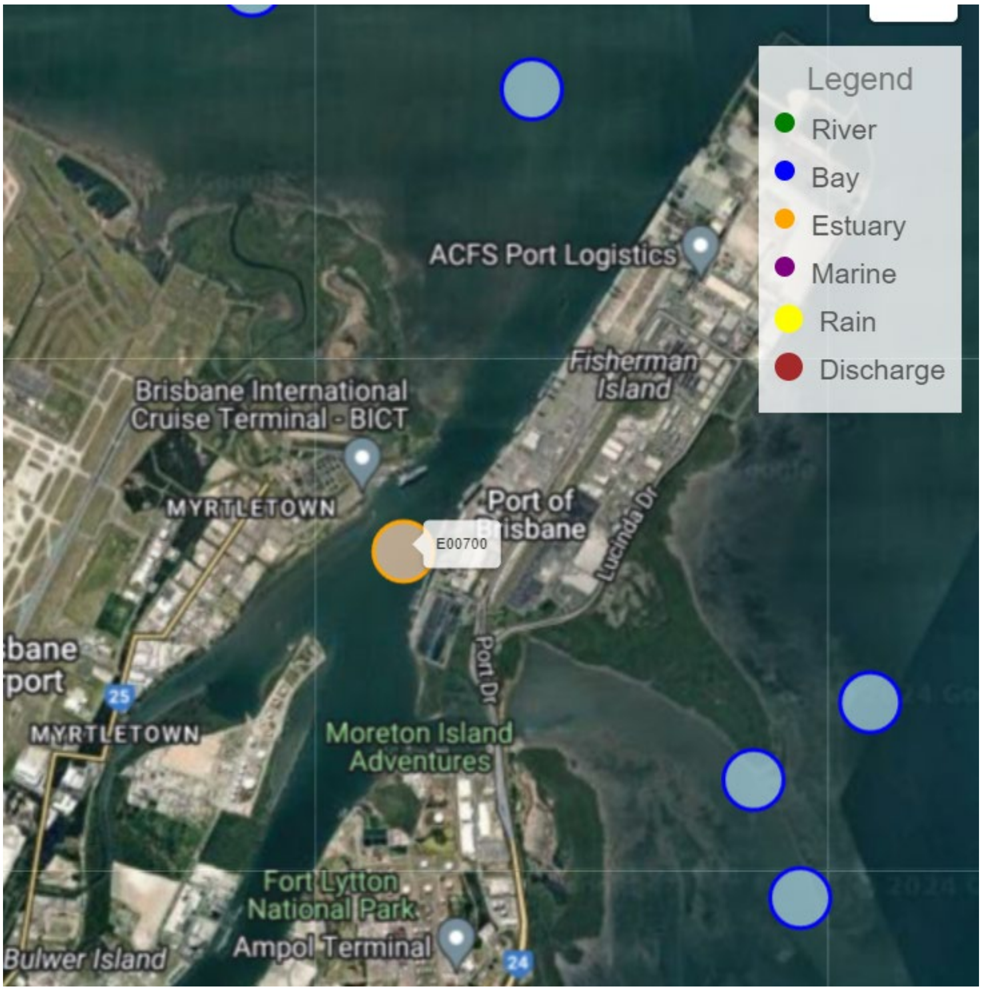
If profiling data is available, the plot will show a set of time series at the various depths, as shown in the graph below.

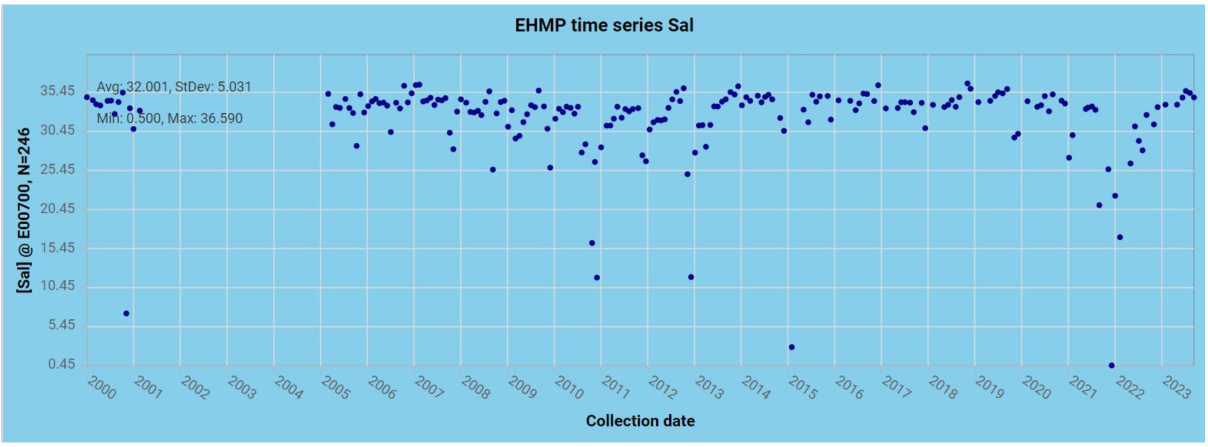


Hovering the mouse over the Profile plot button will also show some instructions of how to use the profile plot.

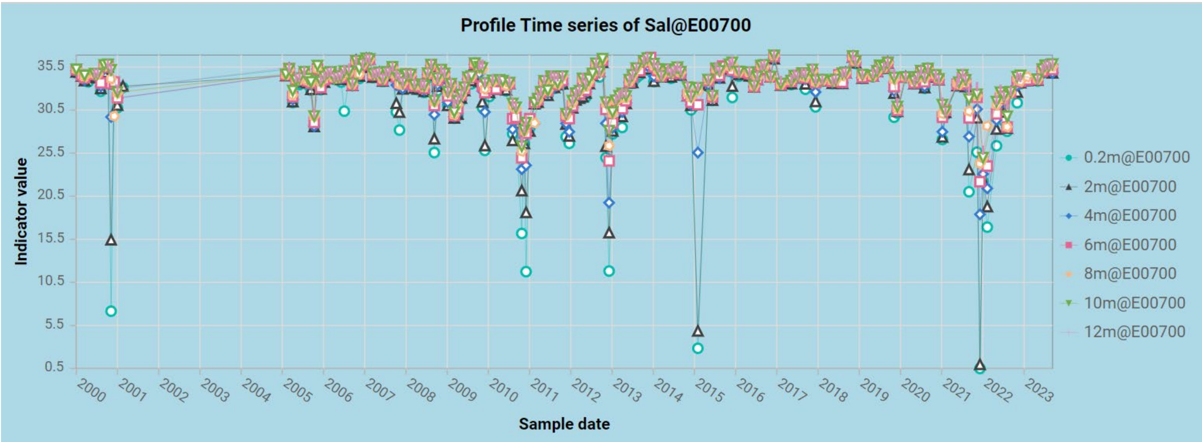
Profile plot example

The profiling data can show the salinity gradient at the Brisbane river mouth. Selecting the salinity (Sal) indicator and plot its time series for location E00700 (see map below) will result in a normal time series graph

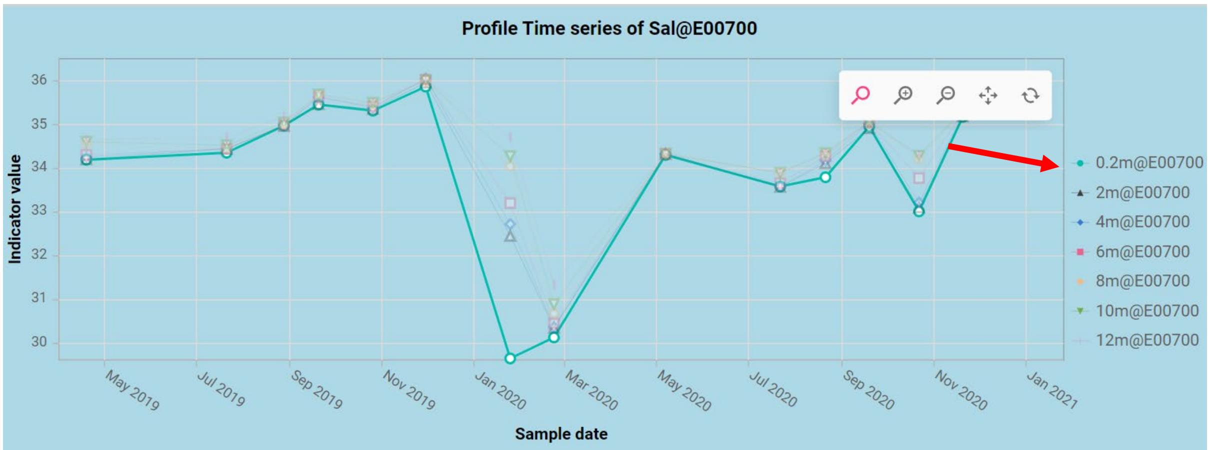




Selecting the Profile plot results in the following plot:



Zooming into some area of the plot (anywhere) and hovering the mouse over the legend of the right (see below), a very clear salinity gradient can be visualised, thus confirming that the freshwater flowing down the Brisbane river stays at the top while the saltwater influx from the Bay (heavier specific gravity) stays at the bottom.



Reporting Region stats plot

The water bodies in SE-Queensland are divided into E(nvironmental)V(alue) regions to allow summaries of results over parts of a bay or rivers to be assessed and reported on. Figure 17 Overview of reporting regions in SE-Queensland, Australia, as published by the Queensland Department of Environment, Science and Innovation (DESI).Figure 17 shows the reporting regions. The pdf can be downloaded here.

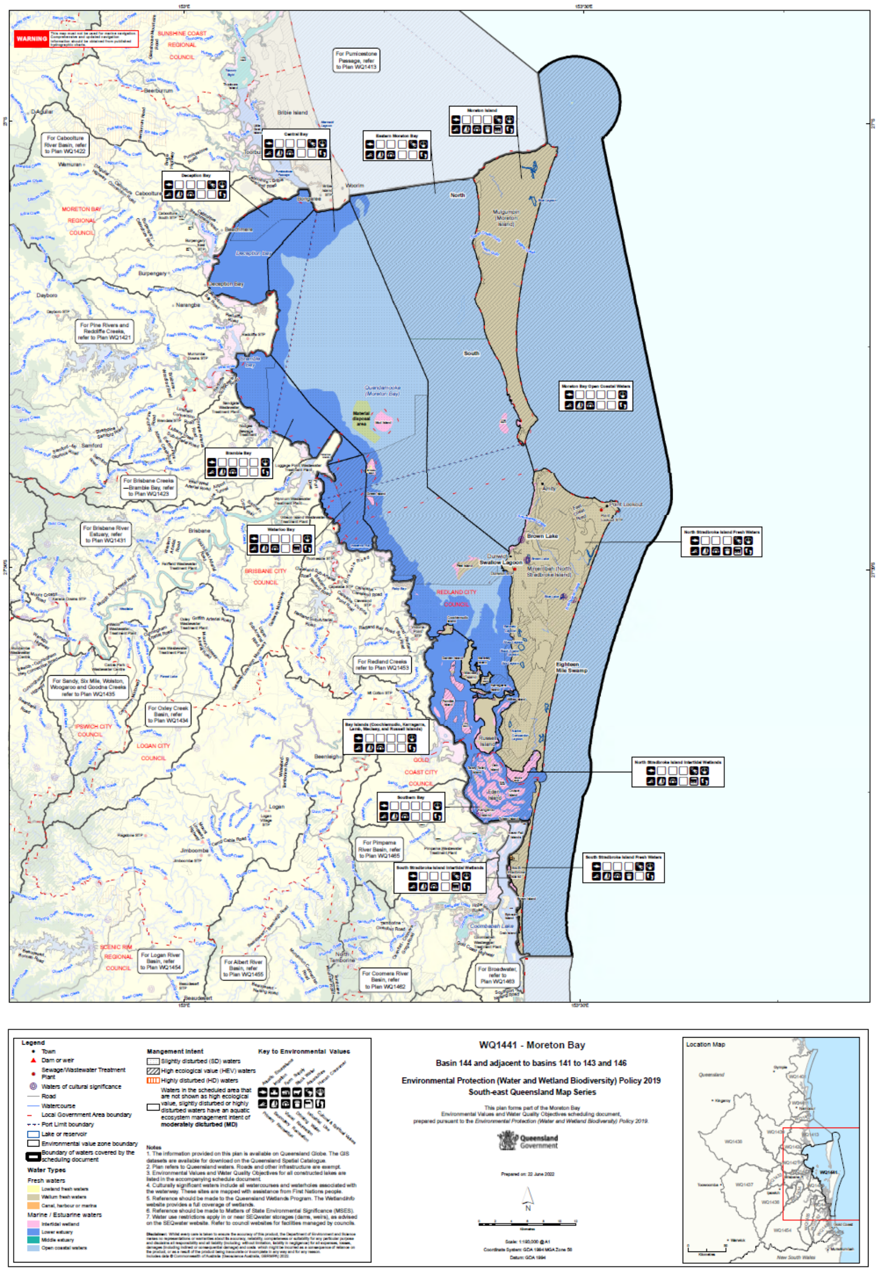
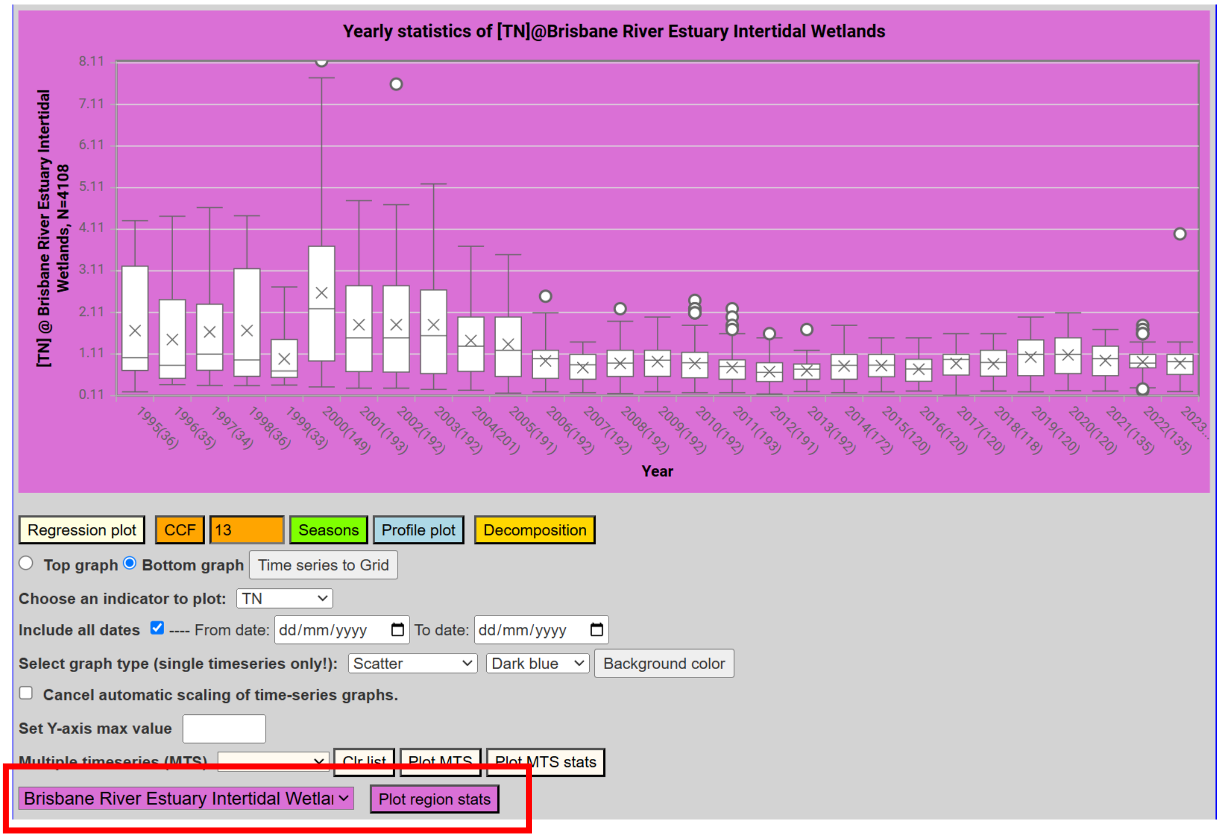


Figure 17 Overview of reporting regions in SE-Queensland, Australia, as published by the Queensland Department of Environment, Science and Innovation (DESI).

To create an annual Box/Whisker stats plot for an EV region, use the purple dropdown list and select the region of interest. Press the *Plot region stats* button to generate the graph.

Figure 20 and Figure 21 can be used as 'lookup' tables to find which sample locations fall within which EV region for the Estuarine/Marine and Freshwater sites respectively.



Example: the graph shows the results of annual stats for the river Brisbane.

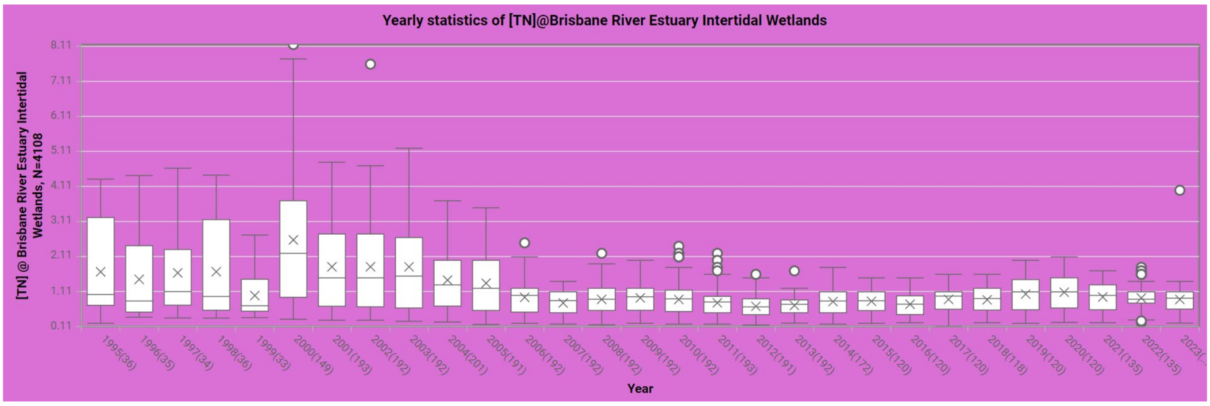


Figure 18 The annual trend of TN for the Brisbane River

Each Box-Whisker symbol represents the statistical description grouping (e.g. total nitrogen, TN) samples taken at all locations within a reporting region (e.g. Brisbane River) for each calendar year.

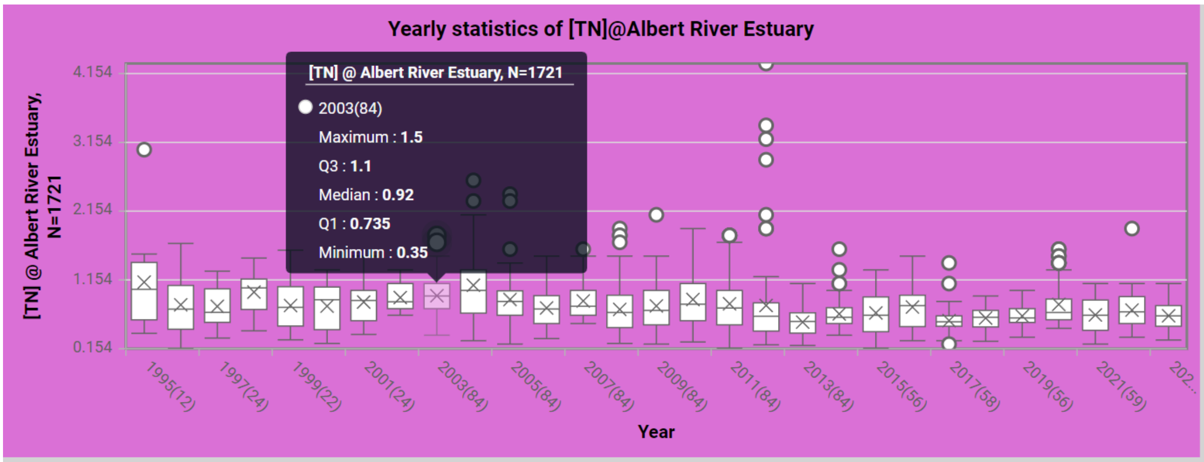


Figure 19 More details of Box-Whisker plot statistics pop up when the cursor hovers over an element.

<u>NOTE: for the profiled indicators, this based on the 0.2m data only</u>.

See the Box-Whisker plot section for details regarding the meaning of the symbols.

When selecting the stats of a region (purple button), the locations that comprise that region will automatically be highlighted by size and colour (red).

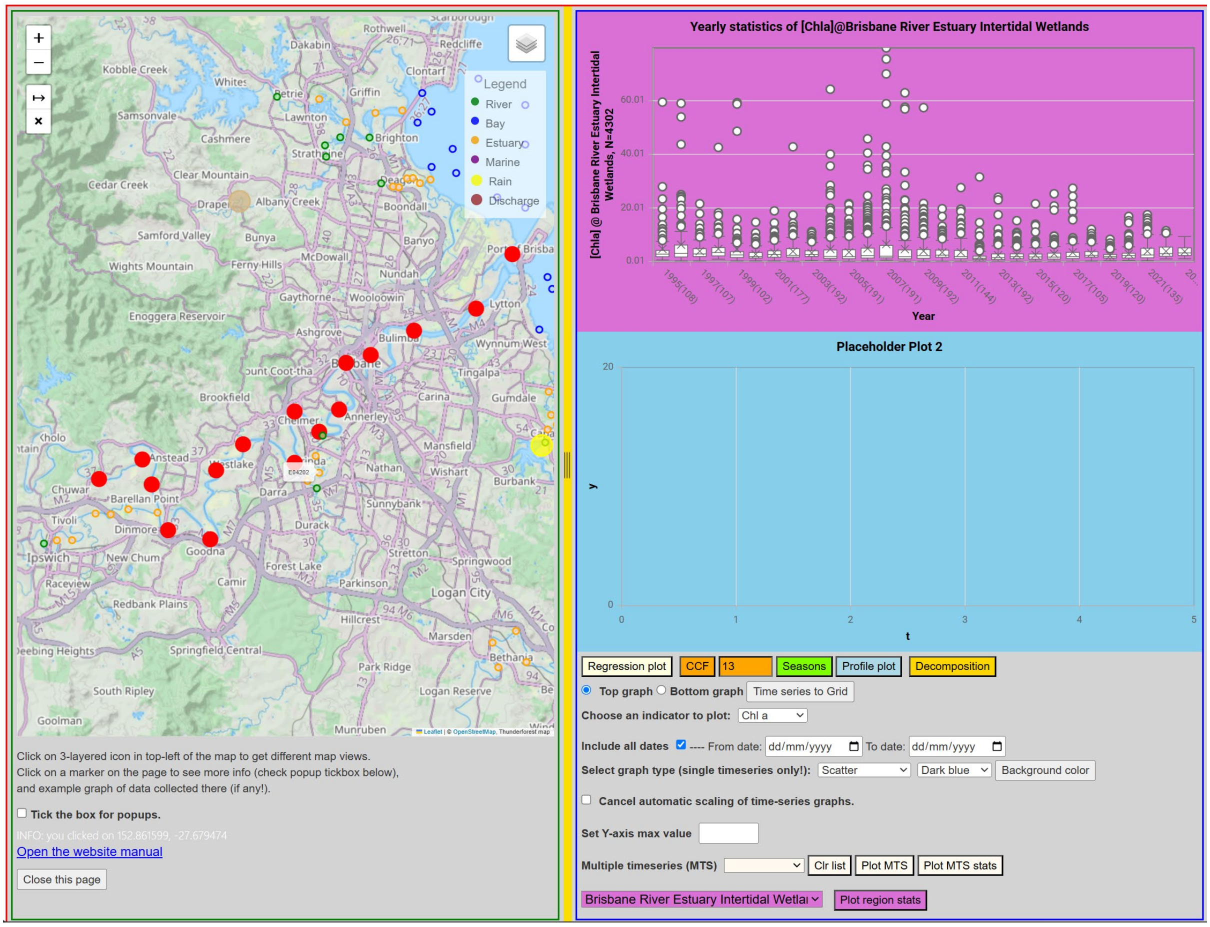


Figure 20 When selecting a regional plot, the locations that comprise that region will automatically be highlighted

EV regions maps and legends

The two Figures below serve as a lookup table to find which sample locations fall within

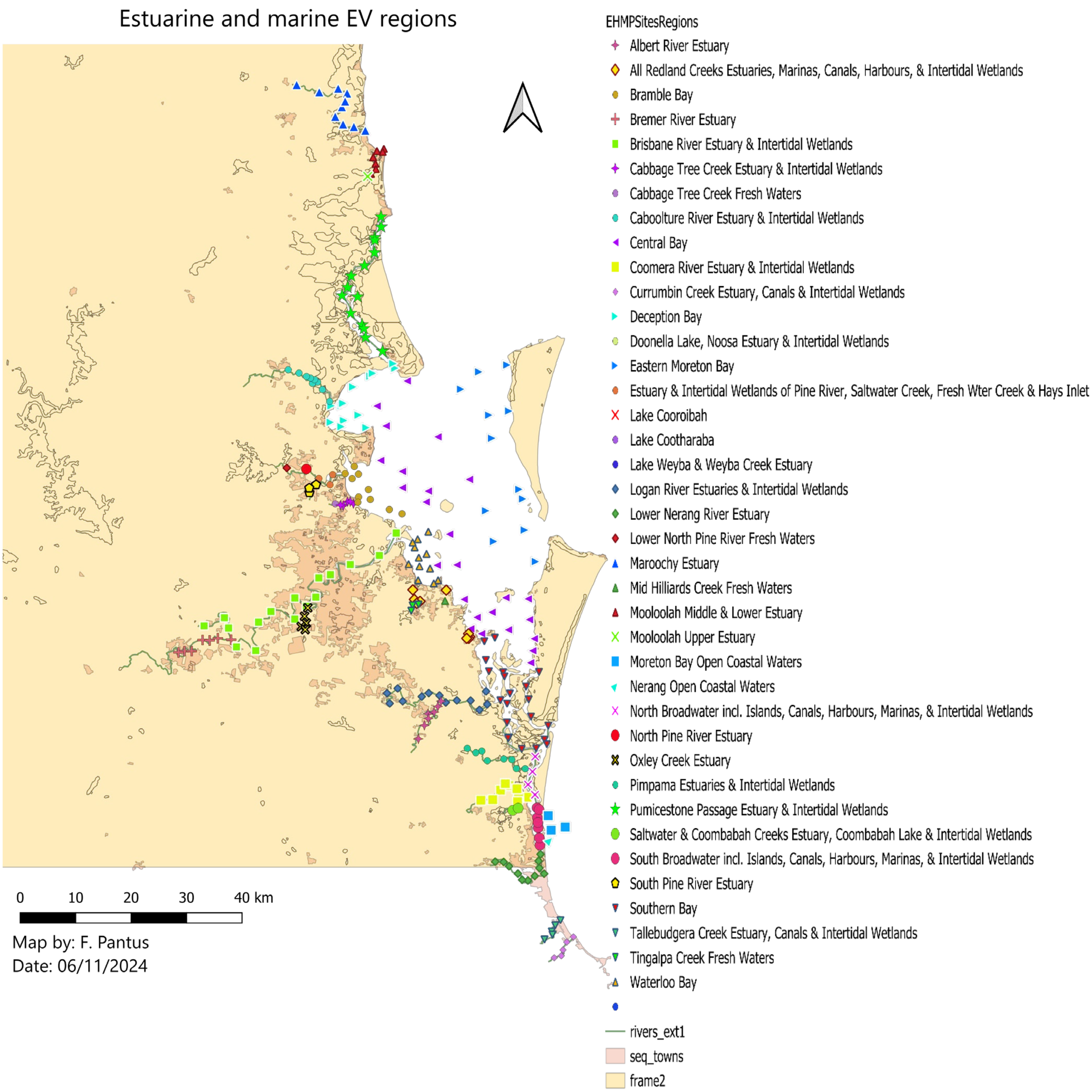


Figure 21 Map of Estuarine/Marine sample locations, grouped in EV regions.

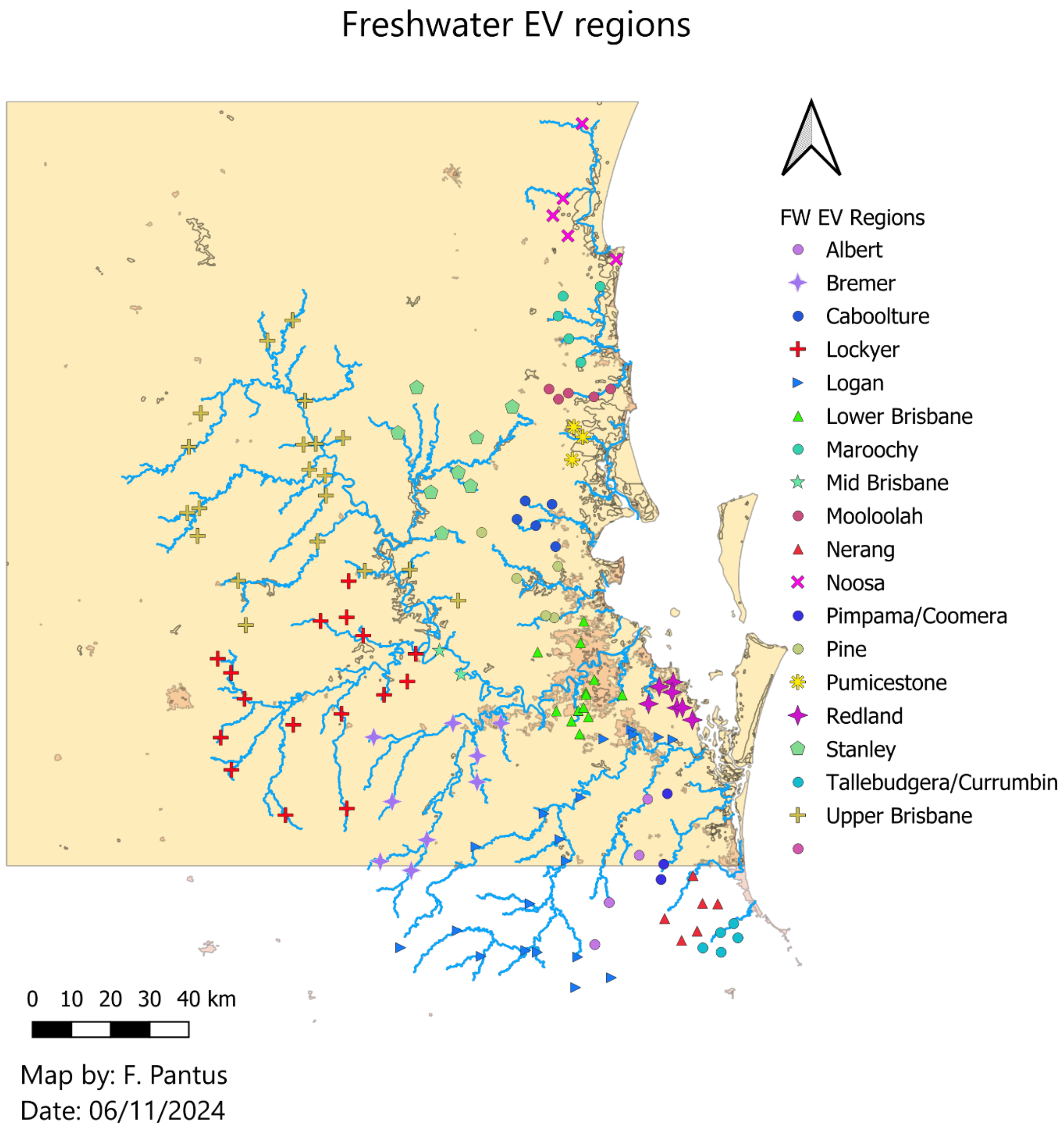


Figure 22 Map of Freshwater sample locations, grouped in EV regions.

Appendix A: Image gallery of graphs and plots

Cross/auto correlation function

We expect the processes that generate the EHMP data not to be in sync. For instance: an increase in nutrients is not expected to have an instantaneous effect on the growth of algae. A rain event in the upper catchments may cause delayed increase in river flows, nutrients or water turbidity. The **CCF** (cross-correlation function) is created by shifting two time series in one months steps and calculates the cross correlation at each step. Peakes (+ or -) in the CCF plot other than at zero-delay may indicate that the underlying processes cause time-shifted responses. But it also may mean periodicity (e.g. seasonal) in the (underlying) processes. These delays may cause totally wrong conclusions about the underlying processes when based on 'normal' regression analysis only, so CCF is a powerful tool to examine relationships within the spatio-temporal EHMP and other data set. Calculating the CCF bases on the same time series is named ACF (Auto-Correlation Function) and tells us something about the periodic (e.g. seasonal) behaviour of an underlying process.

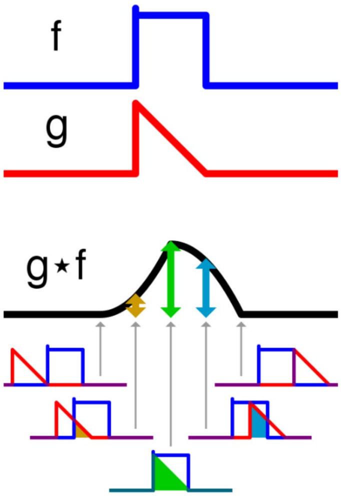


Figure 23 Diagram explaining the basics of the cross-correlation function.

The application of the CCF algorithm shifts the top plot time series along the bottom plot time series from minus-NDelay to plus-NDelays. NDelays is the number of shifts to the right of the CCF-button. Together with the zero delay, there will be 2*NDelay +1 points in the CCF graph.

Peak (+/-) in the negative delay portion (left side) of the graph indicate that the time series in the top graph is delayed (occurs later in time) with respect to the time series in the bottom graph. Visa verse, peaks on the left-side of the CCF graph indicates that the bottom graph time series is delayed wrt the top graph time series. A peak at zero delay can be interpreted that the two time series are in sync.

Example of a cross-correlation function

To create a cross- or auto-correlation function, both graphs must contain data. For a cross correlation function, the date in the two graphs has be from different time series, for an auto-correlation function, both graphs have to contain the same time series.

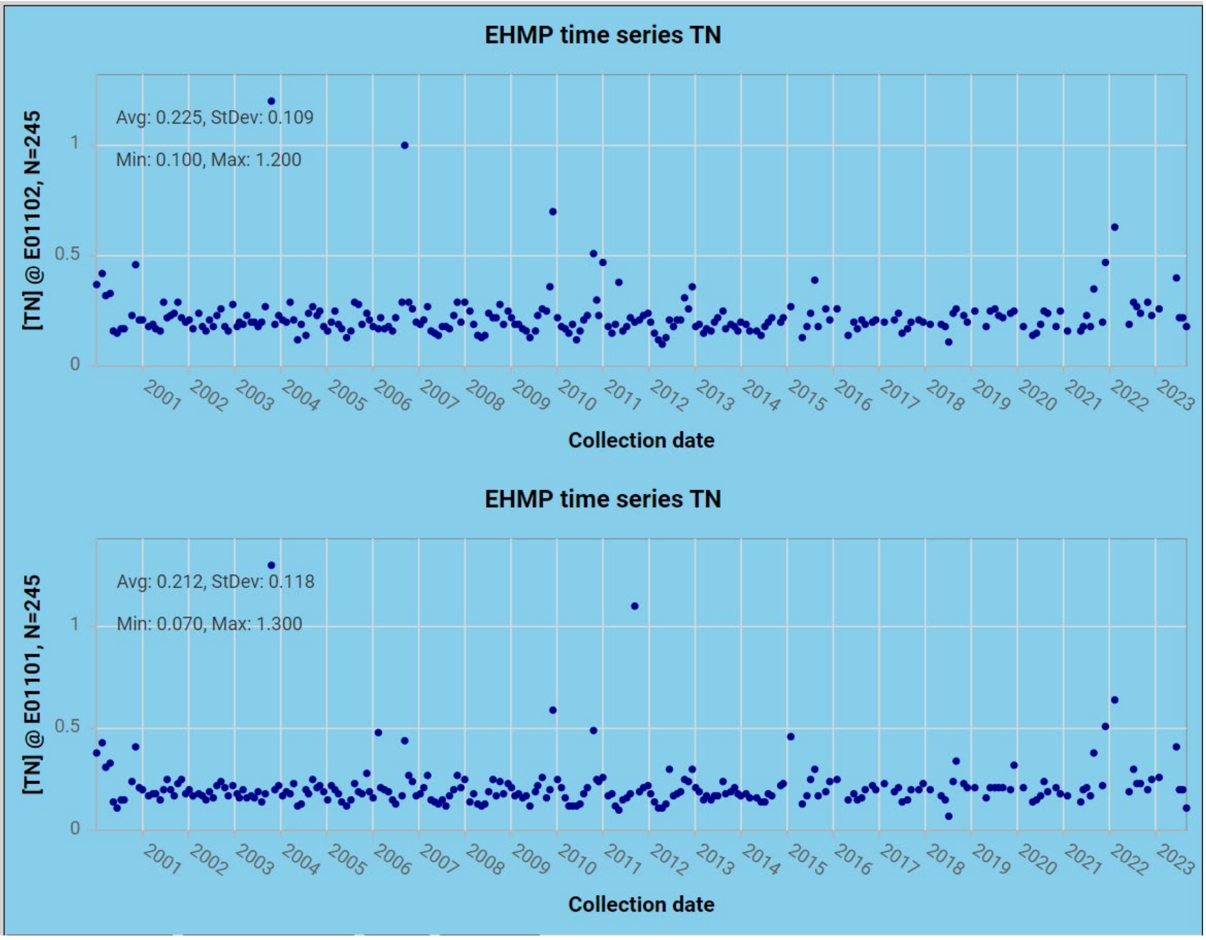
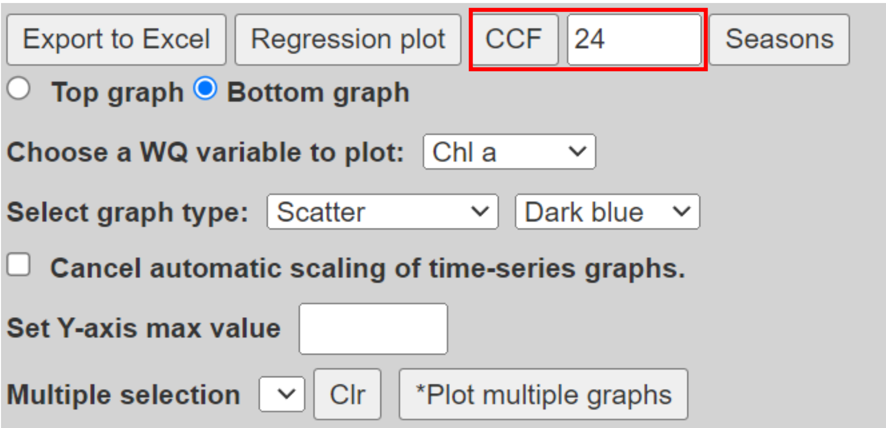


Figure 24 For a cross-correlation function, both graphs should contain a different time series

The number of delays can be typed into the text box to the right of the CCF button.



Depending which graph is active (top or bottom), the CCF (or ACF) function is calculated and plotted there.

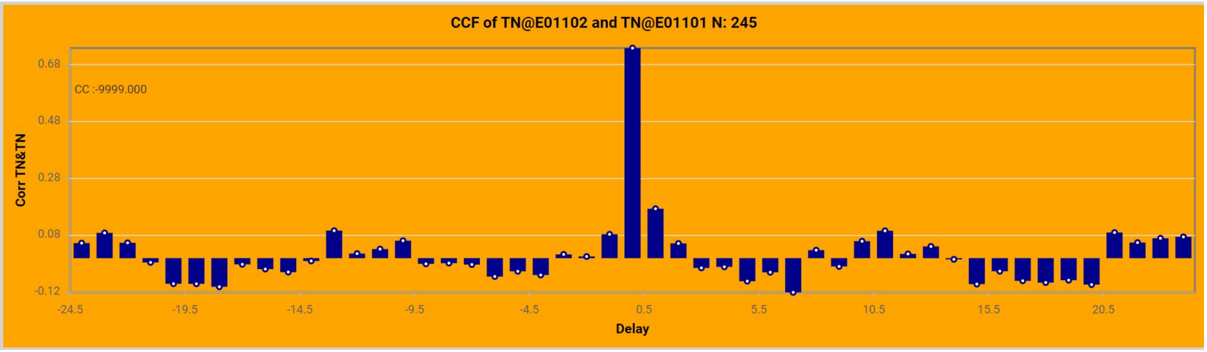


Figure 25A cross-correlation function shows the correlation between two time series that are shifted N delay steps relative to each other. It allows us to examine the strength of the relationship of two time series that may be delayed with respect to each other.

Example of auto-correlation functions (ACF).

After loading two time series (same location, same indicator), and setting the number of delays to 24 (two years) and selecting the CCF button, the result is plotted on the active (top or bottom) graph.

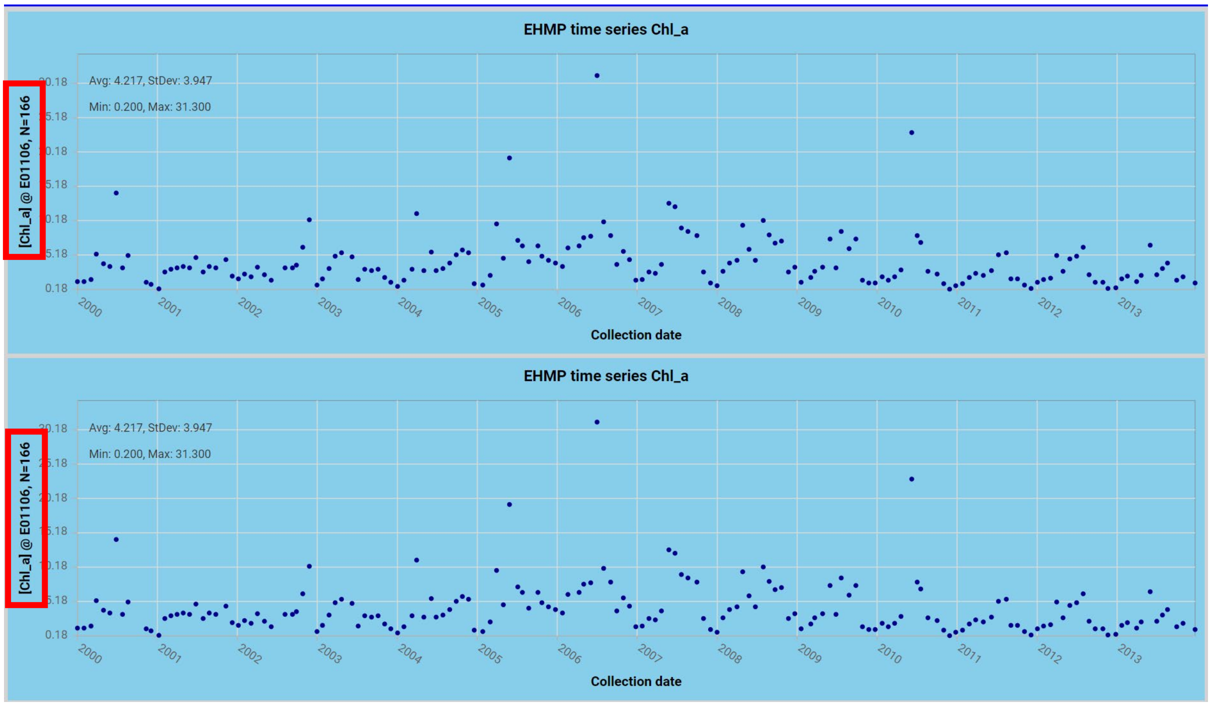


Figure 26 To calculate an auto-correlation function, both graphs must contain the same time series.

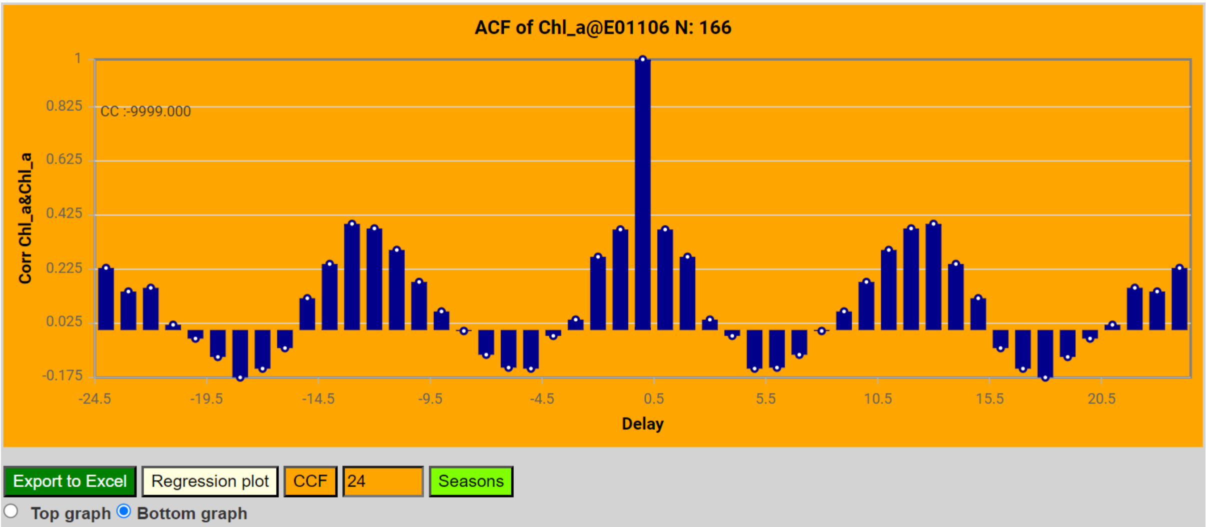
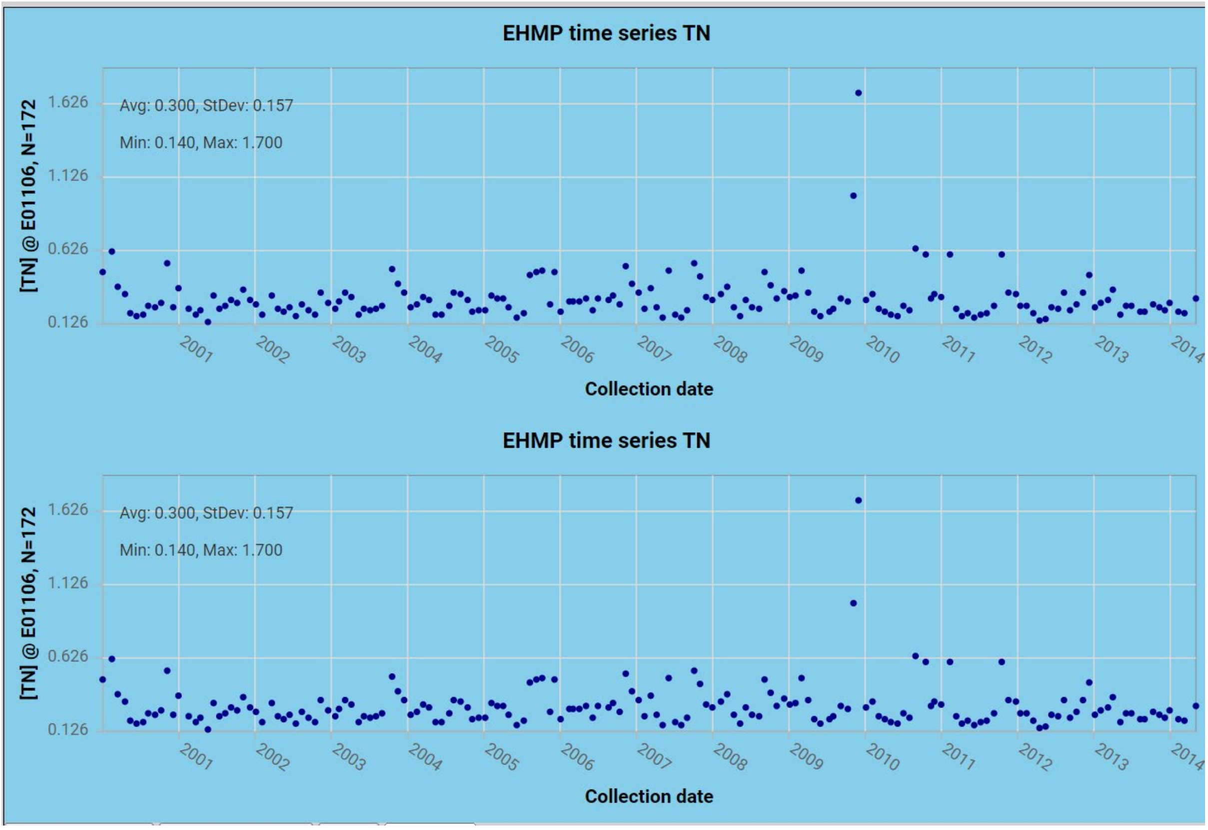


Figure 27 An auto-correlation function reveals the presence (or absence) of periodicity in a time series. This Chl_a time series near the mouth of the Caboolture river (location E1106) shows a clear annual (+/- 12-13 months, +/- 25 months) periodicity, reminiscent of a biological boom/bust cycle based on available light and water temperature. Currently the X-axis labels are a bit confusing and should have integer values.



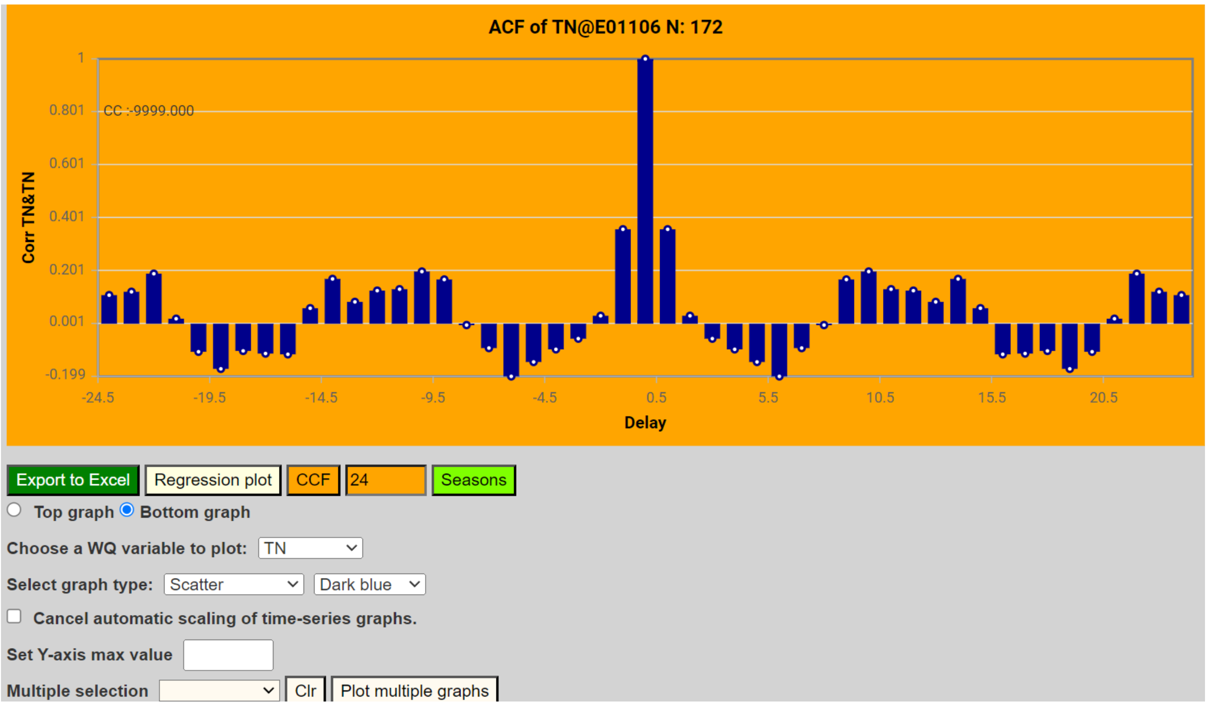


Figure 28 The ACF of TN at the Caboolture river mouth (location E1106) shows a more 'smeared' correlation function annual cycle, possibly driven by the inter-annual variation of rainfall and river discharge.

The ACF reveals recurrent dynamics (periodicity) in a time series, e.g. seasonality, regular man-made disturbances etc..

This is a fairly simple replacement of more detailed frequency domain analysis such as discrete Fourier transforms.

Appendix: Some comments on the data

Temporal granularity

The temporal granularity of the sampling intervals of the EHMP data is in months.

To keep data in some kind of sync, daily data such as rain and river discharges are represented as monthly sums. To keep things simple, the representation date is the 28th of each month as all month, including February, will contain that date.

Spatial granularity

The spatial granularity is at the EHMP sample sites, both for the river/estuarine/bay as well as the freshwater programs. Except for the Southern Oscillation Index(SOI) data which is only available for the whole of Australia. Selecting any site will access the same SOI data.

Detection level

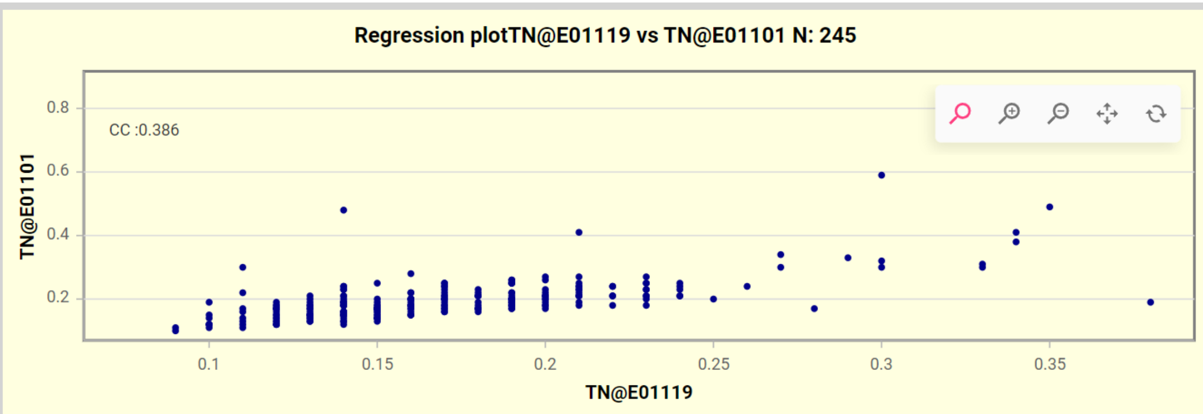
All indicators that are found to be below the detection level, are represented at half that detection level.

Secchi depth

Secchi depth found to be more than the available depth at a station are represented as NODATA.

Apparent discrete classes in data

Notably the Total N data shows up in graphs as discrete classes (columns in the graph below). The reason is that the laboratory supplies that data with two decimal precision only.



EVZones

DESI EVZones field in the locations table is being used to delineate the various reporting zones.

To allow the reporting zone names as part of SQL queries, the ‘&’ character has to be removed with the following query:

UPDATE `ehmplocations` SET `EVZone` = Replace(`EVZone`," &","");

Depth values

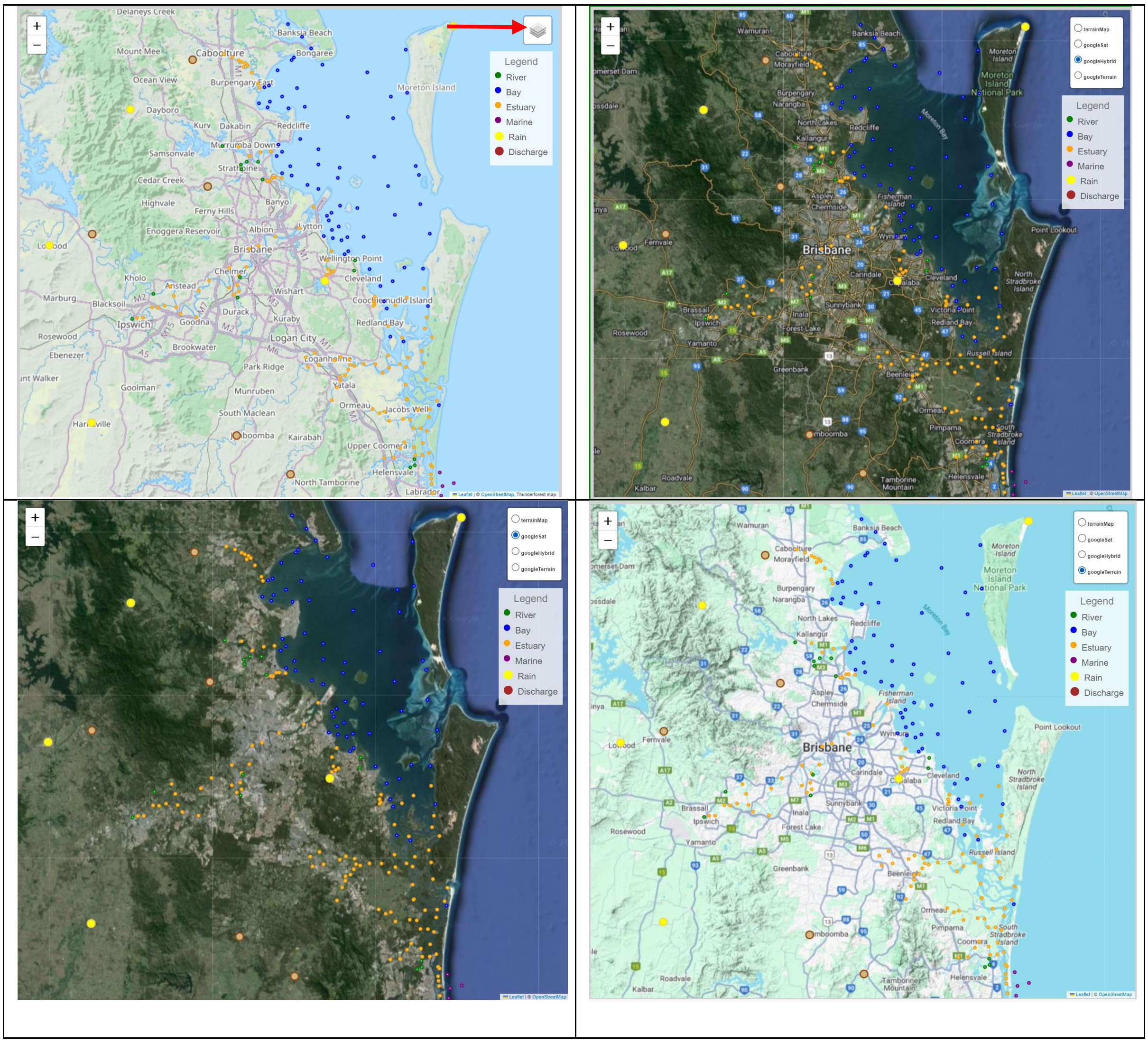
The Depth value in the web-based ehmpindicators table in the mySQL DB is set to 0.200000002980232 (due to some formatting problems during transfer) and must be updated to 0.2:

UPDATE `ehmpindicators` SET `Depth`= 0.2 WHERE `Depth`=0.200000002980232

Appendix: Maps and Plots Gallery

Maps

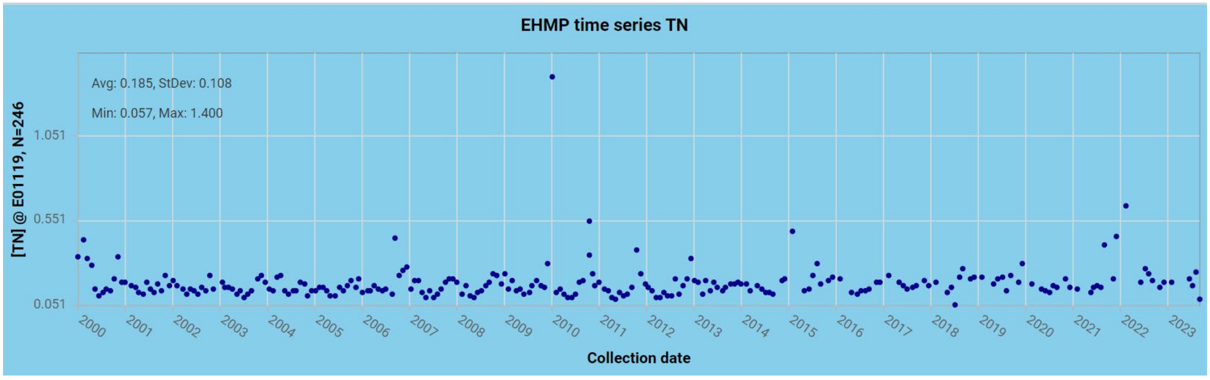
Various ways to view the selection map



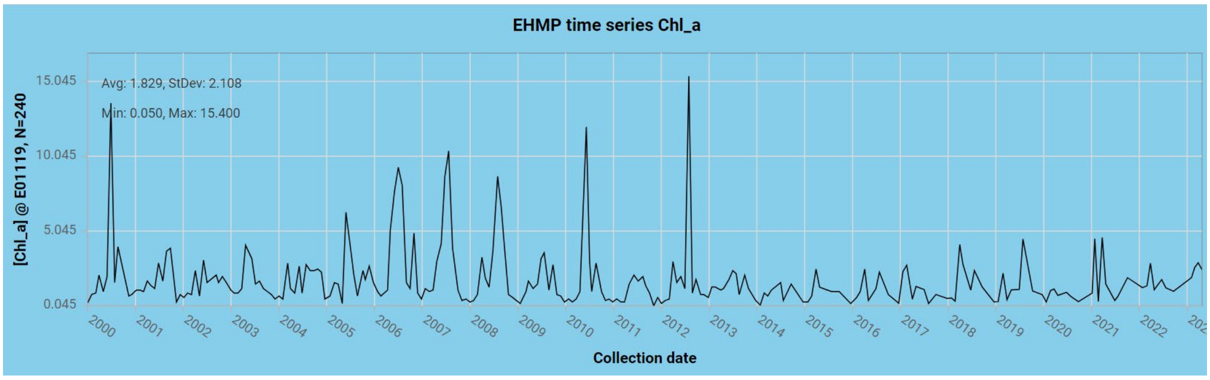
Plot types

Time series

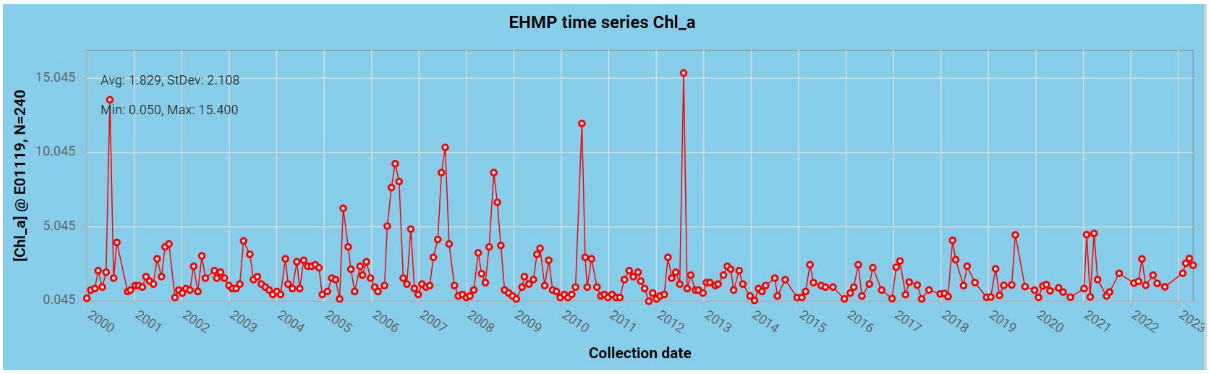
Scattter



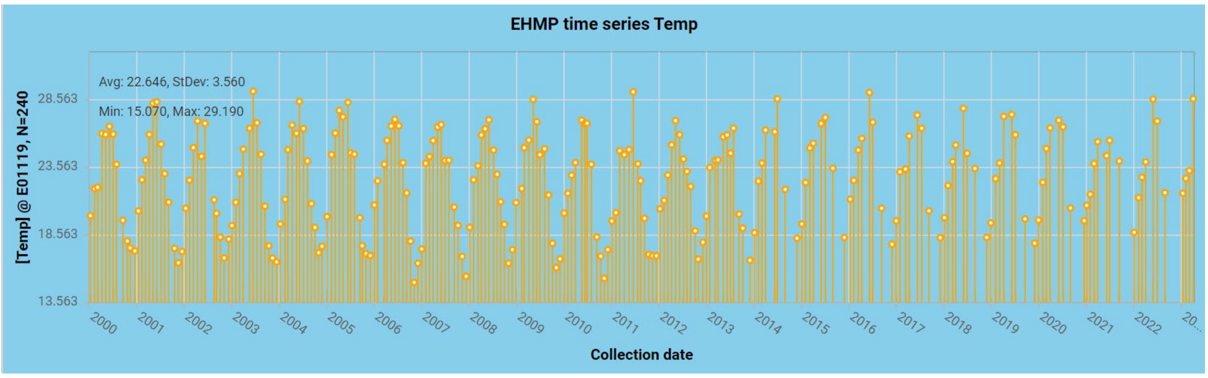
Line



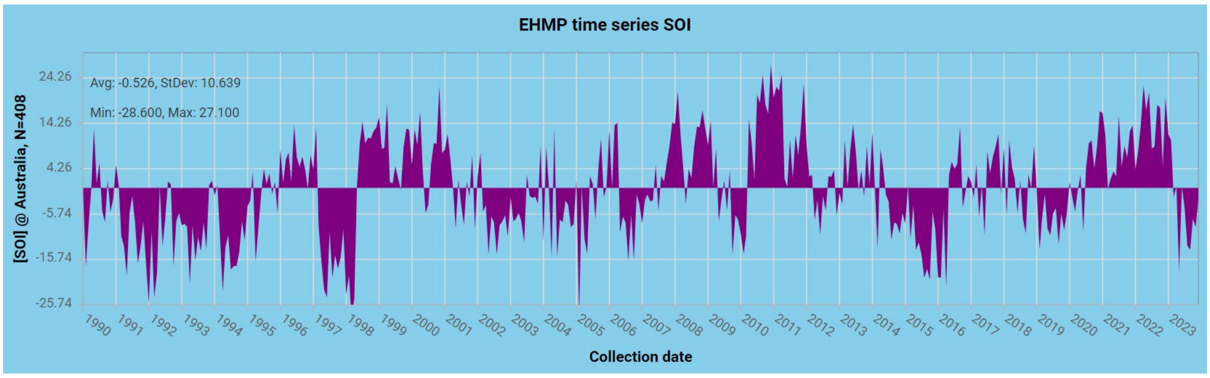
Line with markers



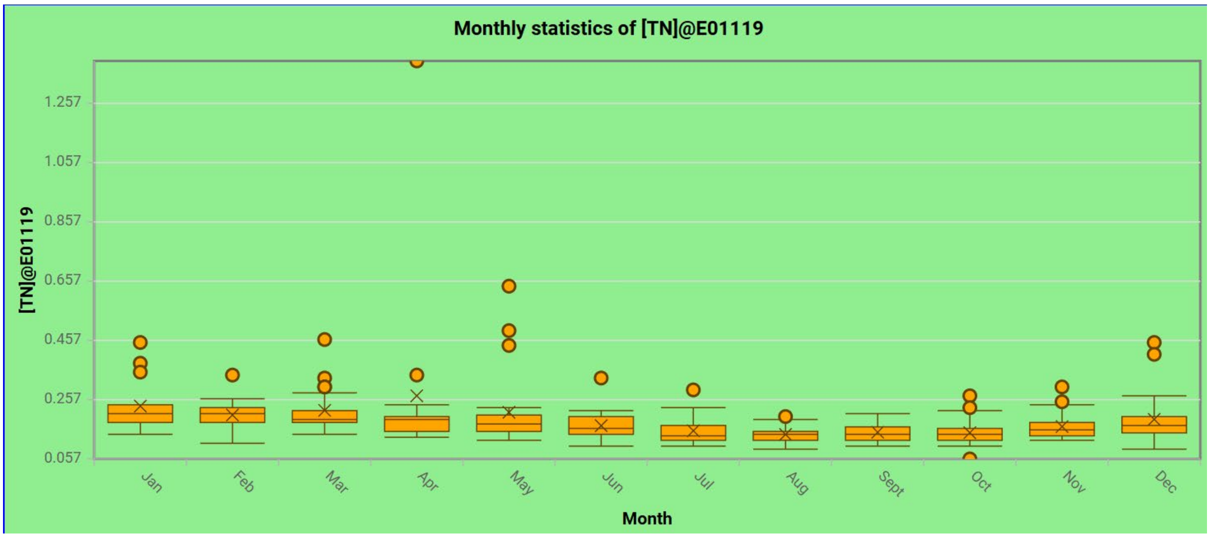
Bar



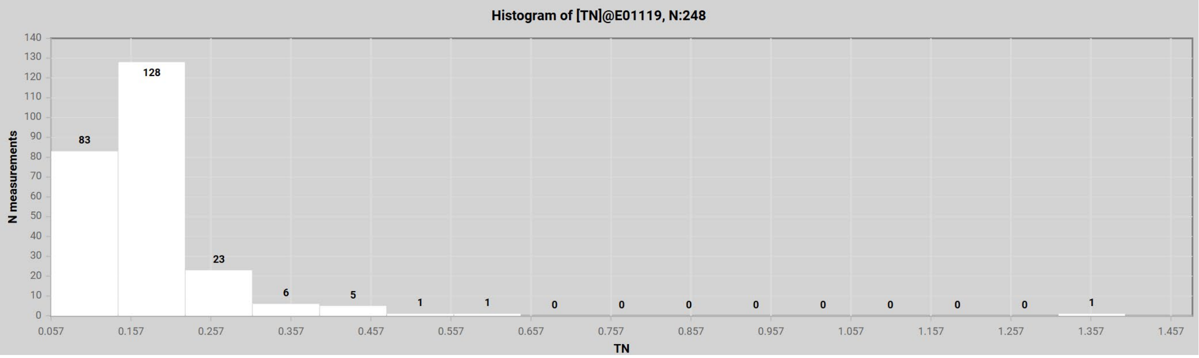
Area



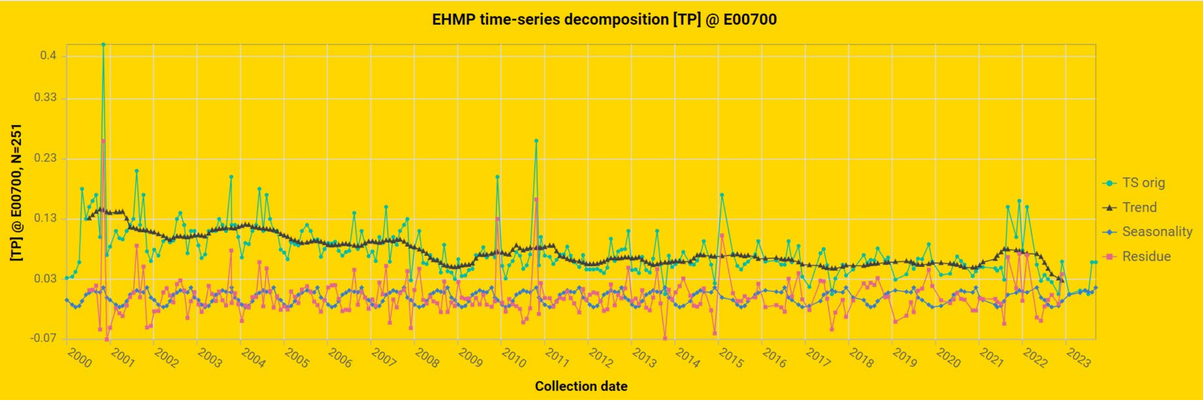
Box and Whisker

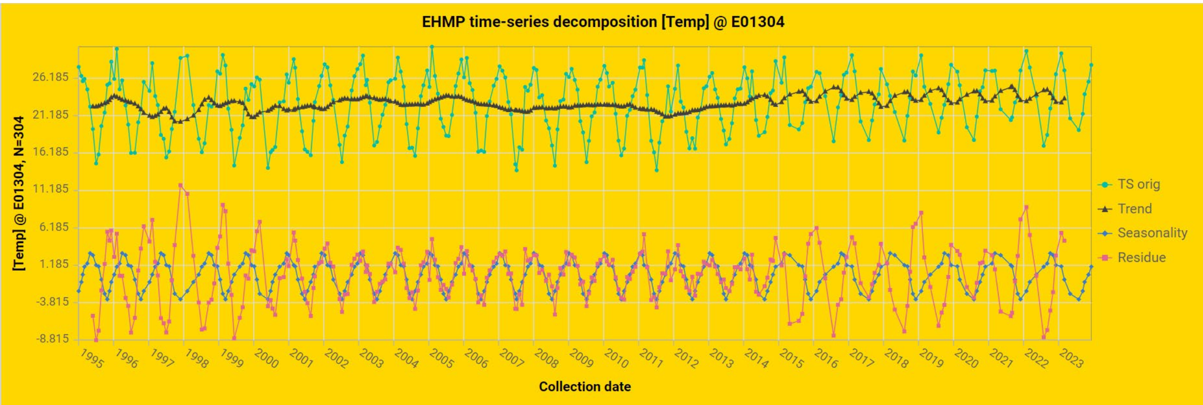


Histogram

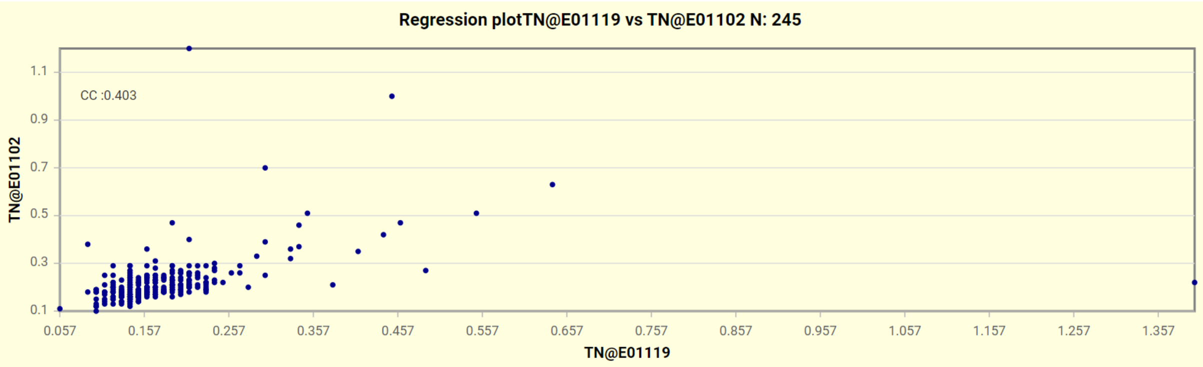


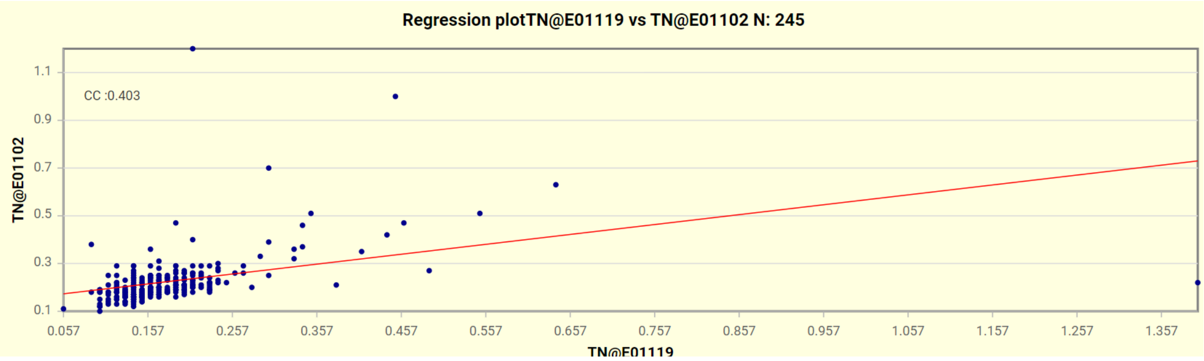
Time-series decomposition





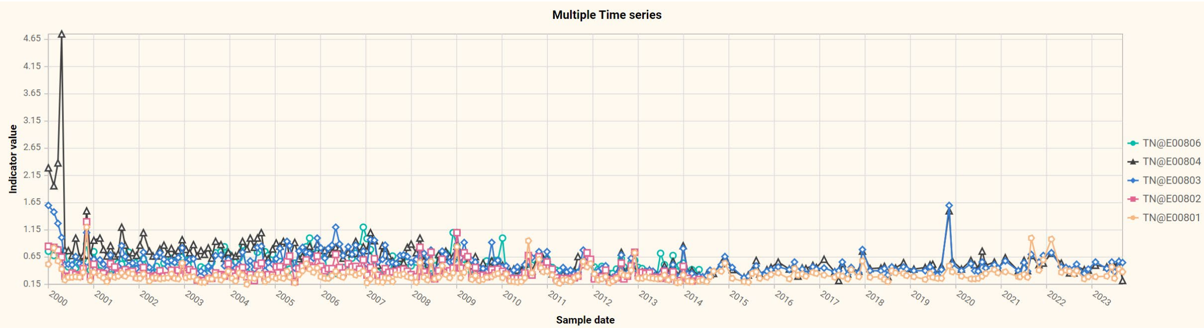
Regressions

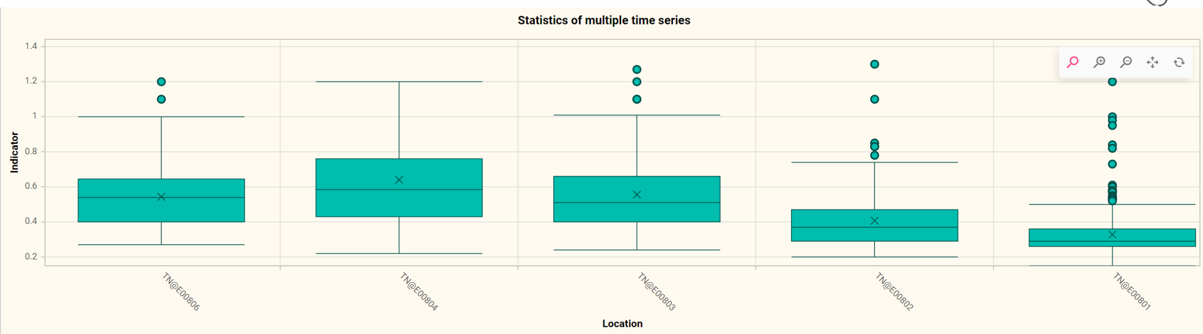




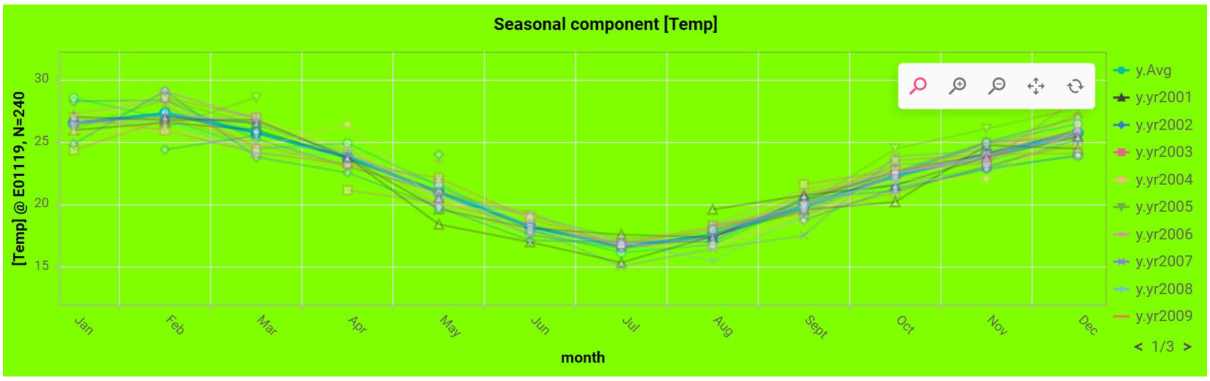
21/01/2025

Multiple time-series

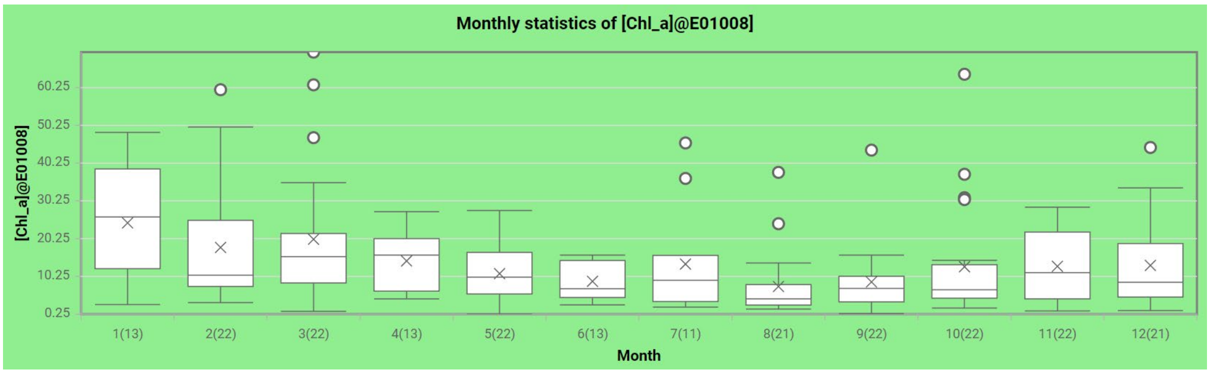




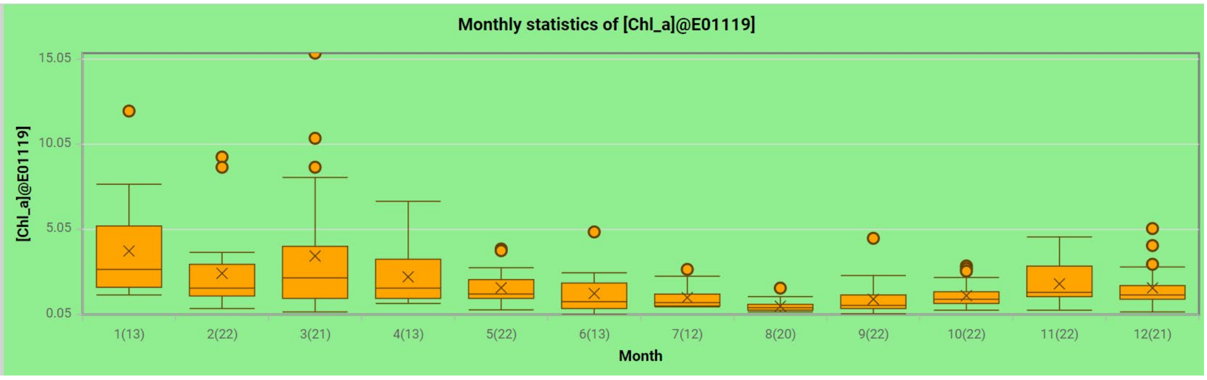
Seasonality component



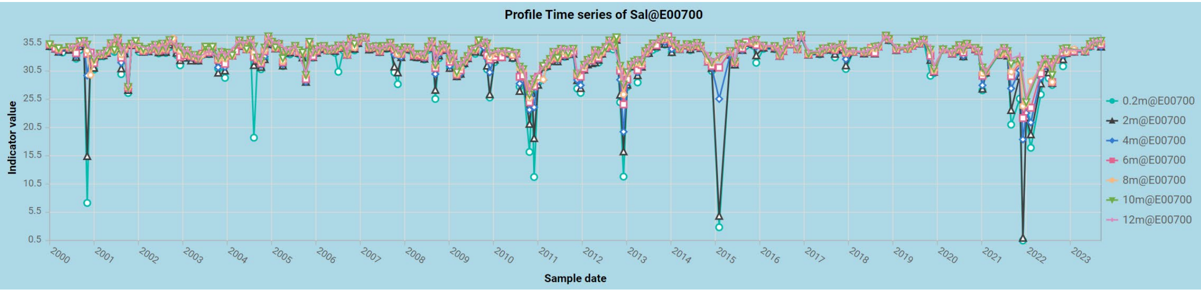
Box-Whisker



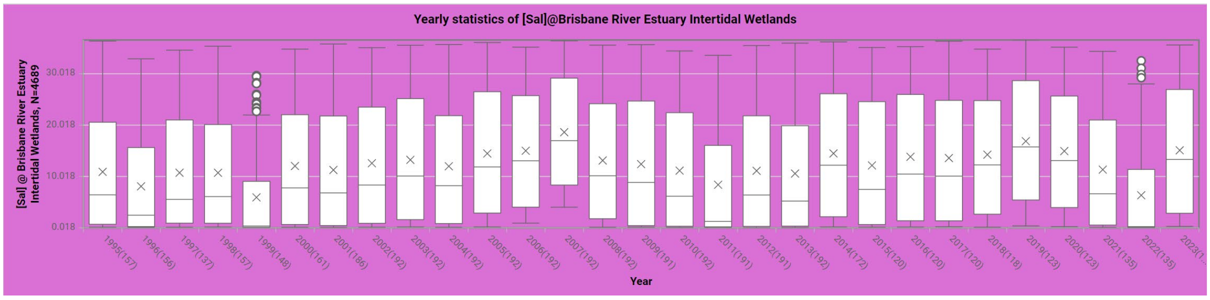
Box-Whisker, different colours



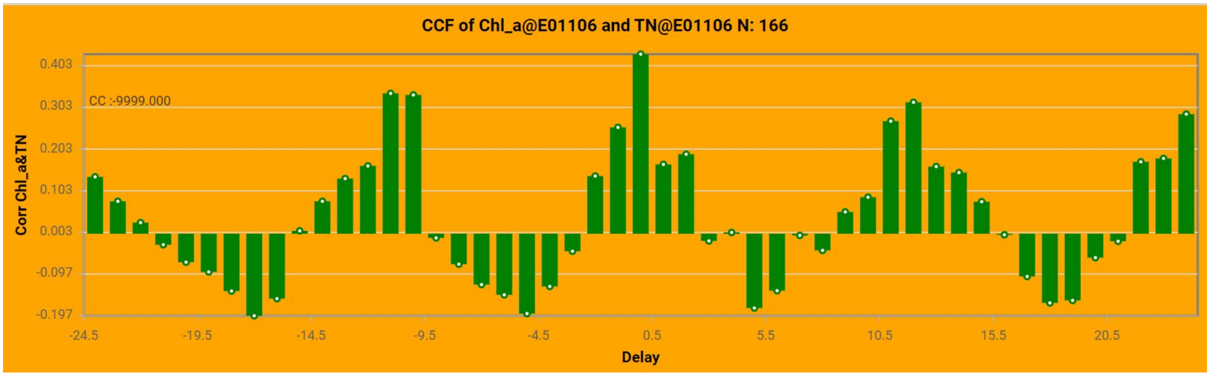
Depth profile



Reporting Regions



Correlation function



Autocorrelation function

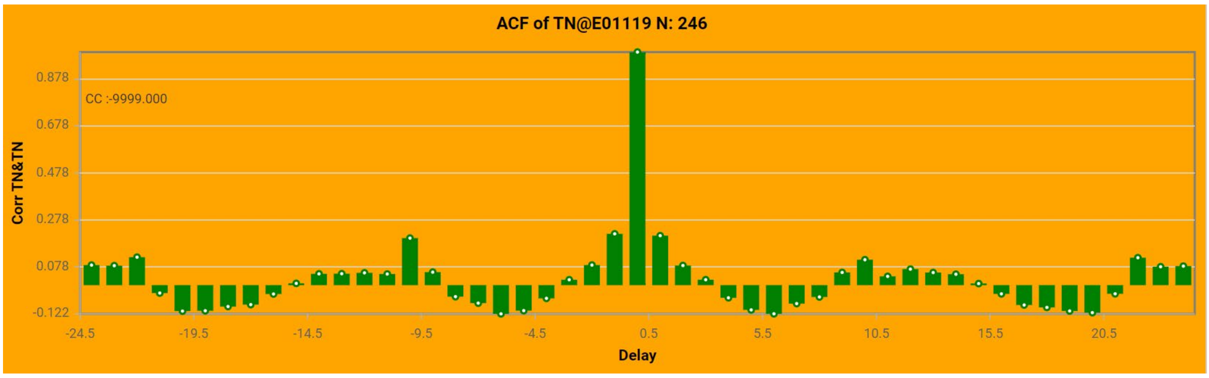


Table of Figures