TS Editor 3.0

User Manual for Environmental Time-series Processing Software

© Miloš Gregor, PhD. / milos.gregor@hydrooffice.org
HydroOffice.org – software for water science

Contents at a Glance

Table of Contents

1 Introduction

This is the user manual for the TS Editor tool in version 3.0. The program name was created from the words "**Time Series Editor**", which implies its focus and specialization. The first two versions were developed by the author for personal use especially in areas where computing capabilities of other applications, such as MS Excel and other spreadsheets or statistical packages, were insufficient. These versions were used for more narrowly focused operations (Fig. **1**). Gradually, development of HydroOffice package enabled data preparation in the form of time series for each of its applications and provided result processing and visualization.

Therefore, it was decided to finalize this application to the stage where it is offered as a separate installable tool. In the progress, this tool has been re-programmed with its architecture, functionality and scope completely redesigned. All information and instructions contained in the previous programs are incorporated in this new development, thus making this the most sophisticated and useful tool in the HydroOffice software package. This program reads data from files much faster and the calculation speed and visualization features are significantly superior to other systems. This was achieved through the use of new technology and programming techniques. However, since this program has not been optimized to run on Windows XP, for best results it must be run on the newer operating system of MS Vista/7/8.
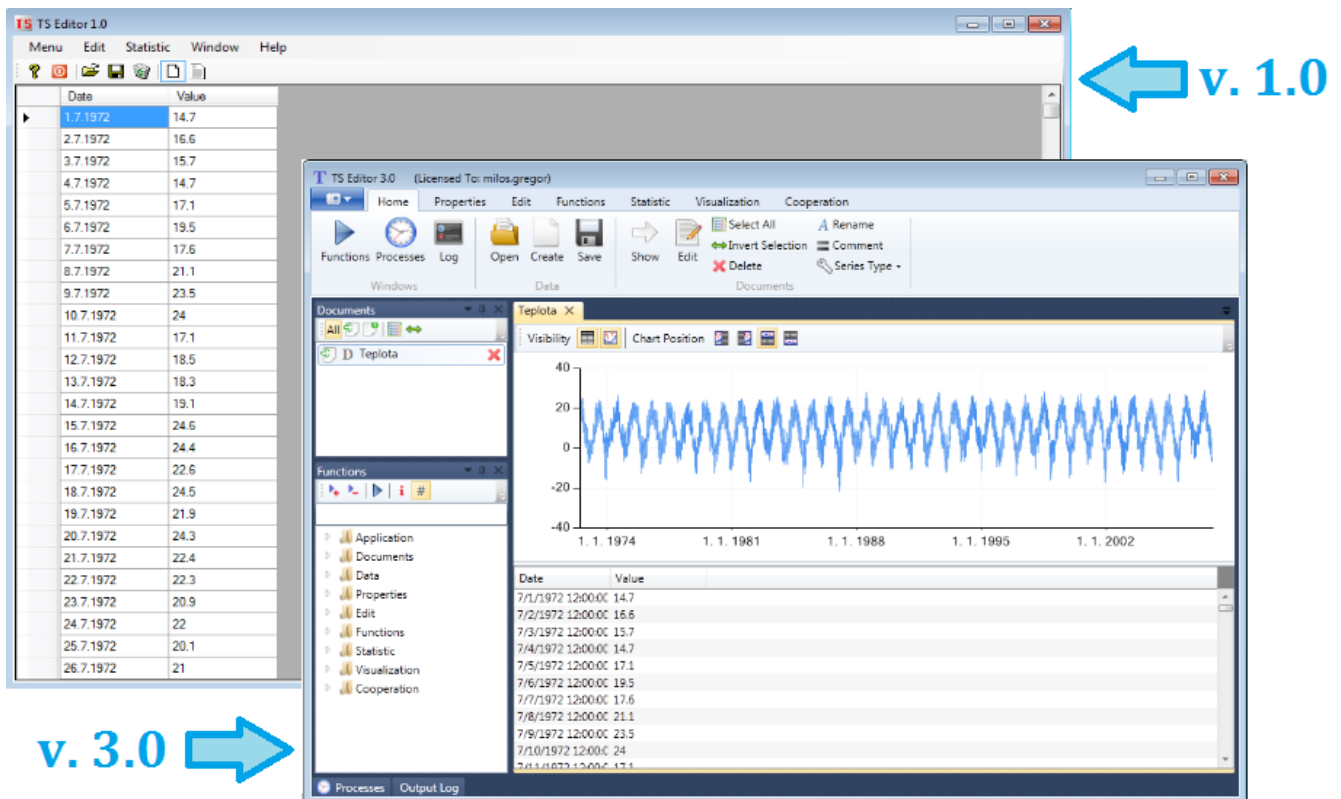
Fig. 1: *TS Editor in versions 1.0 and 3.0.*

The following text describes the functionality of this program, the user interface and possibilities and limitations for its use. If you work in the field of hydrology, hydrogeology, meteorology or climatology, this program is designed for you. It saves time spent in processing data such as measured values of river discharges, springs' yields, observed groundwater level changes, air temperatures, precipitation and wind speed/directions. This TS Editor 3.0 latest version offers over 2,000 functions which can be combined in different ways. You have vast possibilities immediately you understand the principles of working with this program. All functions are run using the buttons in the menu, from the functional tree to specialized applications, and this program includes a very simple scripting interface. This not only makes your work much quicker and easier

but it also especially focuses on features lacking in other programs. Please check out the following options and functionality.

I am sure that this program will simplify your work, and if you have problems using it, please feel free to contact me in the forum section on the web (http://hydrooffice.org), or please email me. I will be extremely grateful for your comments, questions and future references.

2 Starting the program

Program TS Editor 3.0 is not distributed as separate software, but as a part of HydroOffice 2012 software (Fig. **2**).
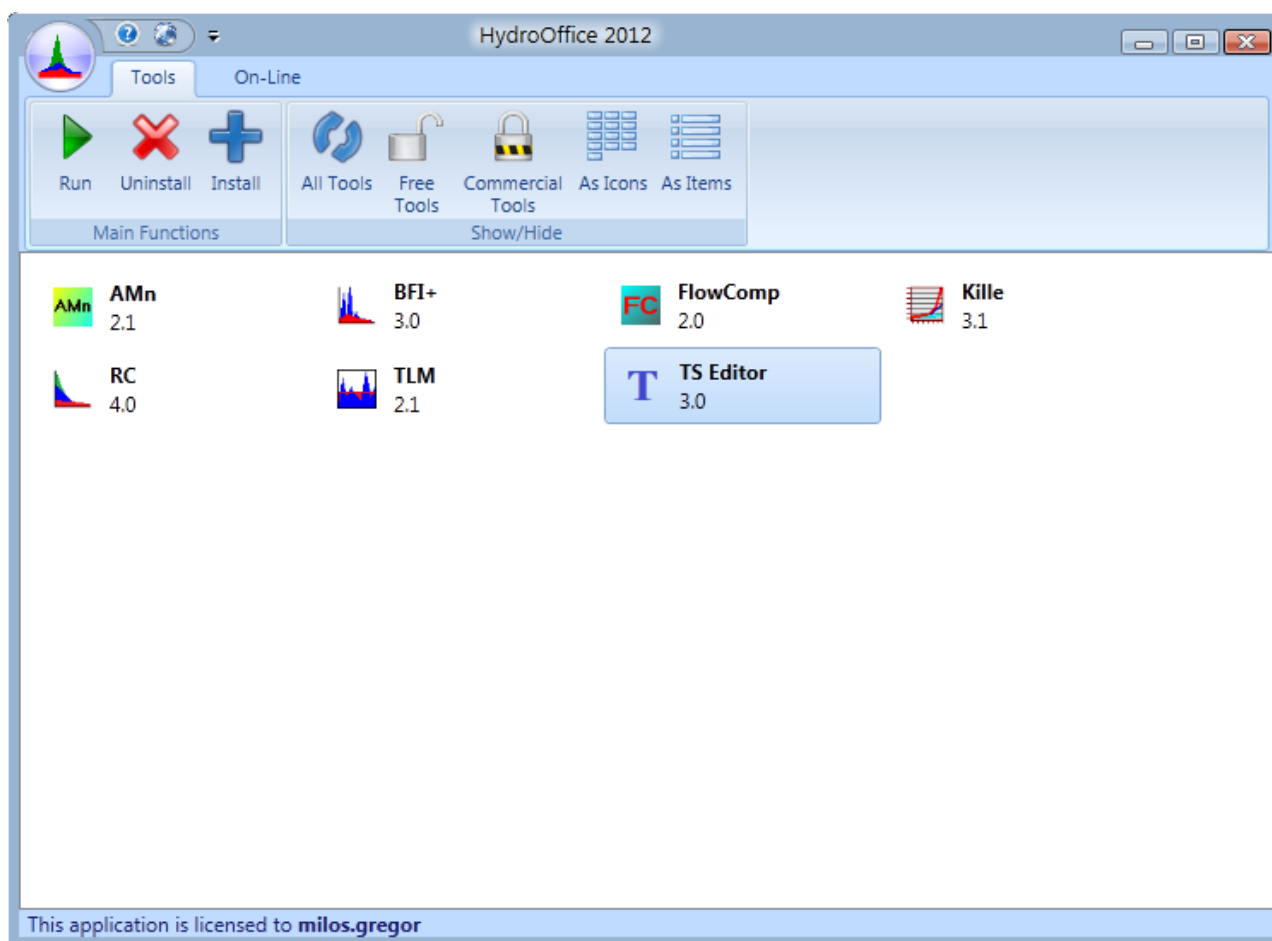
Fig. 2: *Main window of HydroOffice 2012 software with the TS Editor 3.0 tool.*

It is therefore installable and executable as other tools of the HydroOffice package and if you have purchased a license for its use, its installation option appears in the list of installable tools. The overall process of purchasing, licensing, installation and startup of the program is described in the separate user manual for using the HydroOffice 2012 software. Therefore, at this point the process is not described in deeper detail. If, you have not purchased a licence for TS Editor 3.0, you can always buy it at http://hydrooffice.org , or at your dealer.

TIP: *If you wish to try the program before buying it, you can install the "Demo" Version. This version includes all the functionality of the program. Its only limitation is that for test purposes you can only use time series which are automatically loaded into the program. Your processed results can be exported from the program without any restrictions.*

3 User Interface of TS Editor

      The program user interface was developed using the latest technology and practices, and it consists of three main parts – The Ribbon, and the Panels and Documents Area (Fig. **3**).
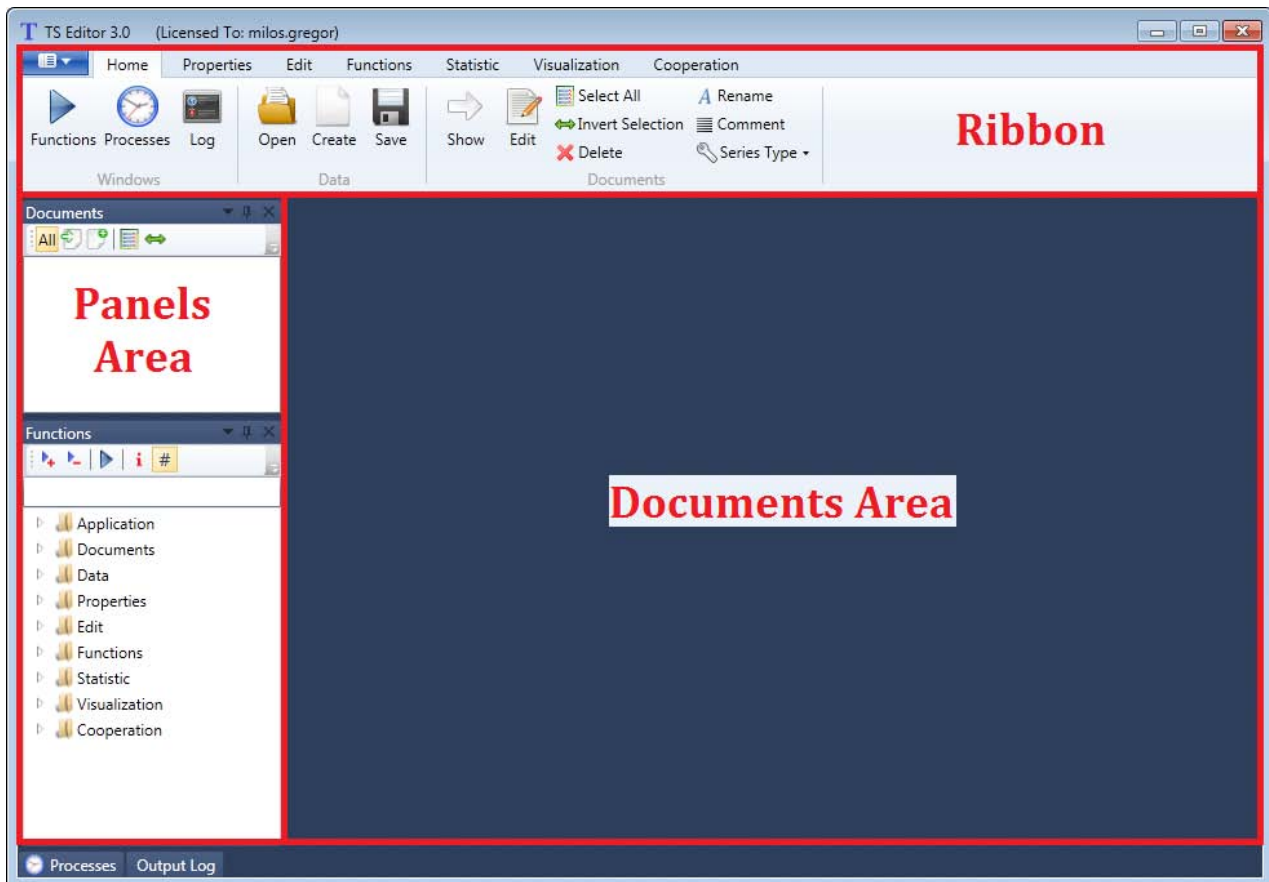
Fig. 3:   *Main window of TS Editor 3.0.*

      The basis of the program window is **Ribbon** (Fig. **3**). This software element is relatively new, but when users adopt it, this layout allows relatively quick and efficient work with the program. Ribbon is located at top of the window. Almost all program functions are hidden under individual **Tabs**. The core functionality for working with TS Editor is grouped on the **Home** tab and all other functions are divided into separate logical categories on the remaining tabs. In addition, it is also possible to control the functions from the functional tree in the panel named **Functions**. This operation of this feature is further explained in chapter **3.3.2**.

      The second part of the program consists of separate panels on the left side of the window (Fig. **3**). These panels can be relocated by the user in a window, separate to the main window, with "hide" and "close". The only panel which cannot be closed is the **Documents** panel which is a permanent part of the program. After starting the program, there are two panels docked in the right window pane (the **Documents** and **Functions** panels), and two more are docked at the bottom edge of the window (**Processes** and **Output Log**). These two latter panels have an *AutoHide* parameter set to "**TRUE**", which means that if they aren't active, or the user does not focus on them with the mouse, they are automatically hidden. A functionality description of these panels is described in chapters **3.3.1** – **3.3.4**.

      The last and largest part of the program window is designed to display separate documents. When the user loads input files or processes, the required calculation, results are shown in this section. Similar to the panels, all individual documents can be shown, docked in the main window, switched between each other, re-located from the main window into separate windows and closed. These functions are all described in detail in the following sections of the manual.

3.1 Ribbon Main Menu

The basis of the TS Editor 3.0 user interface is **ribbon**. It has a privileged status-control called the **Ribbon Main Menu** button (Fig. **4a**). Clicking this shows all basic functions of the program (Fig. **4b**). The first option is to show the **user manual** in PDF format. The second item displays basic information about the program and licence. The **HydroOffice Online** command shows the project website. This feature is similar to the one in the basic HydroOffice 2012 program. When you click on the last item named **Settings**, the option for user interface settings is displayed. The current version allows you to set only two parameters of user interface – visibility of the ribbon toolbar and setting for functions dialogs
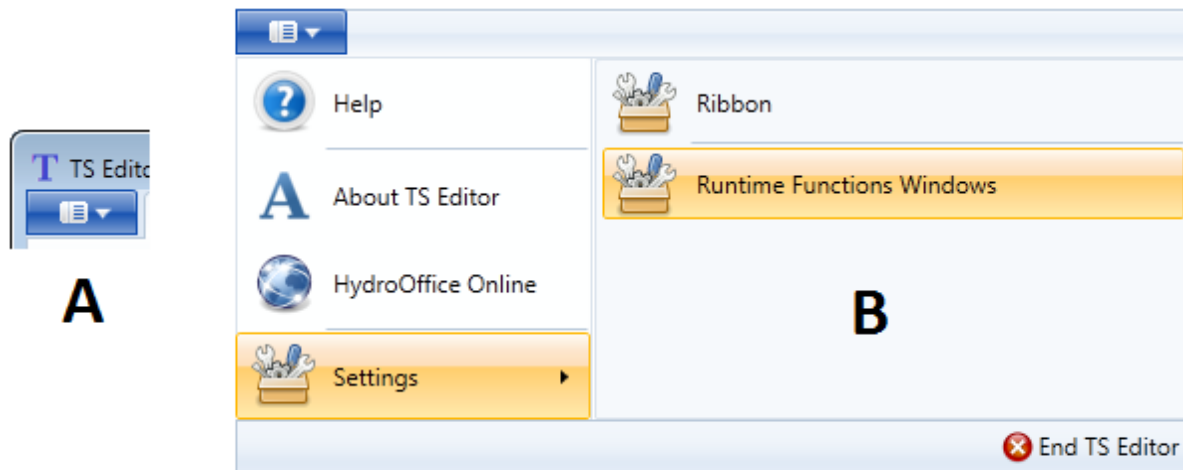
Fig.4: Ribbon Main Menu in TS Editor 3.0 (A – Ribbon Main Menu button; B – Functions of the Ribbon Main Menu).
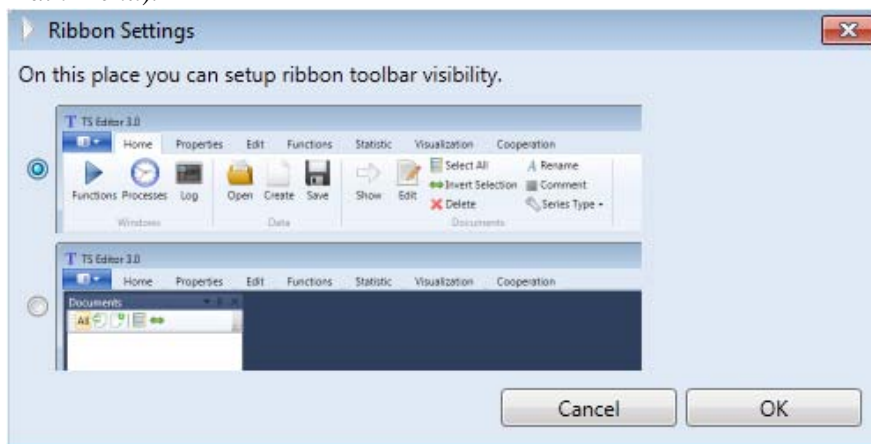
Fig. 5: Window for Ribbon toolbar visibility setup.

The window shown in Figure **5** appears when you click on **Settings > Ribbon**. You can set the visibility of the ribbon toolbar in this window, and this setting has two states. The first option is to have the ribbon toolbar entirely visible so that the application appears exactly at it does when you start the program. In this state, the ribbon automatically hides and the program is visually similar to older software types based on menu control. In this case, automatically selected functions will be displayed when you click on the selected item in the menu. But when you focus on a different part of the

Fig. 6: Dialog for setup of the AutoClose parameter for functions dialogs.

window, the toolbar is automatically hidden. This option is appropriate for use if you have small screen resolution, or if you want to see multiple documents in parallel.

When you click on the second item, **Settings > Runtime Functions Window**, the window

shown in Figure **6** appears. With this function you can set the parameter **AutoClose** for functions dialog. Default value is "**TRUE**". This setting is used for a specific purpose. If you click any function under **AutoClose**, a separate dialog is shown for setting parameters called "function". After setting these parameters and further processing of "function", these windows can be automatically closed or they can be preserved for changing parameters of the function and re-launching. If this AutoClose parameter is set to "true", the windows automatically close after the first execution of the function. However if you want the window to remain open, you set this parameter to "FALSE", so that the window will not close and you can execute the selected function again. The function of this AutoClose parameter will become clearer after reading this manual, If you have any difficulty in understanding its function you can run some functions under both states (**AutoClose** = TRUE / FALSE) and the difference will be apparent.

3.2 Ribbon Toolbar

As mentioned earlier, all the functions for time series processing are in the ribbon toolbar in the main program window. All ribbon tabs are highlighted in Figure **7**. Overall, functions are divided into seven tabs. The first Tab – **Home -** displays functions for individual application Panels, importing / exporting data and manual definition of time series plus features for working with individual documents.

Using functions on the **Properties** tab allows the user to acquire the basic technical and structural information about the selected time series (meta-data), such as the total number of records, the number of records satisfying a special condition, determining the time range of the series, the gaps in time series, information on the uniformity and continuality of the document and information about increasing, decreasing and constant segments of your values.

Functions of the **Edit** tab are used to edit the actual time series. With these features it is possible to filter the data using multiple methods and approaches, in bulk edit values or to delete them. Additional features allow you to fill gaps in time, transform the time series, move the values in time and to convert units or to combine two series into a single series.

The tab **Functions** contains specialized functions, including the calculations of single or double mass curves, linear interpolation of time series, creation of a single table from multiple time series, document unification on the basis of the one selected or visualization of time series in the profile (examples of this are; the relationships between 'water temperature and the depth of a well' or between 'precipitation and altitude').

Functions on the **Statistic** tab are prepared for variable statistical processing of values in time series. Examples include – 'monthly averages, annual maximums, long-term minimums and seasonal statistical characteristics'. In addition, this tab includes functions for automatic production of various statistical reports to be used in final reports and articles.

The penultimate tab – **Visualization -** contains functions for visualizing the time series. The program allows you to create highly variable time series visualizations, to form simple line charts in predefined range charts or rainfall-runoff graphs.

The last tab is - **Cooperation -** which contains tools for working with external programs and files. The current version of TS Editor includes features for co-working with the hydraulic model 'Feflow'. The program allows you to import data from Feflow or to export data from the application into formats supported by Feflow software. The last feature is a function to import /export data from /in the CSV format (comma separated values).

TIP   To quickly switch between individual ribbon tabs, focus the mouse on ribbon and rotate the wheel on the mouse. This is a little- known trick to quickly switch ribbon tabs. :-)
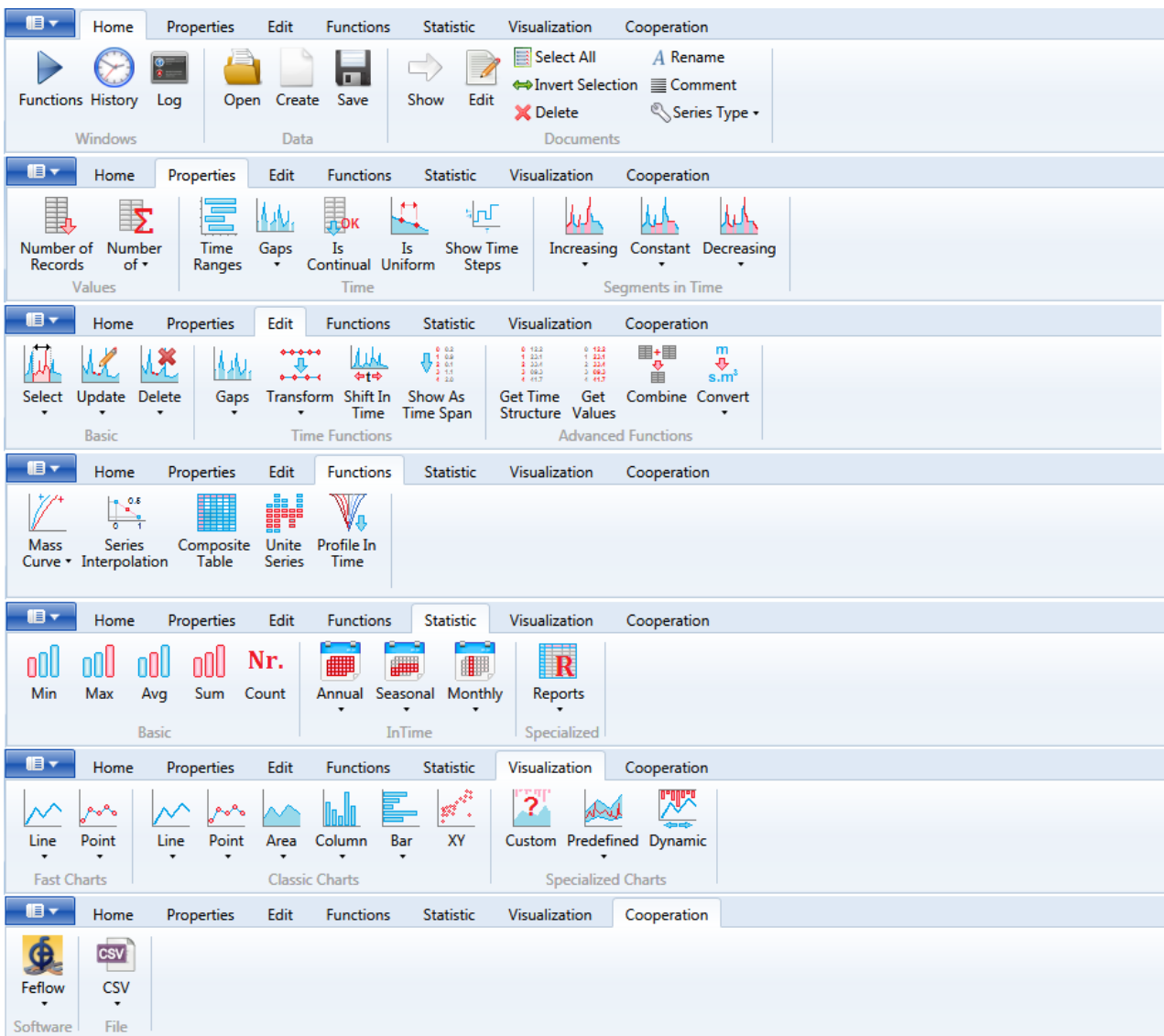
Fig. 7: *Ribbon toolbar with all the functions.*

The Ribbon toolbar is not as static as it appears. The character and structure is fundamentally changed when you double-click on the graph in your document (Fig. **8**). After double-clicking, the basic functions of the program are hidden, but the functions for visual setting of your selected graph appear.

Individual tabs of the ribbon toolbar are shown in Figure **9**. The **Main** tab contains the basic settings of the chart together with the functions for graph export to an image file, or the option of direct printing. The second tab called **Background** includes options for setting the chart background. Using functions in the next tab allows you to setup chart area properties, and the functions for setting axis properties are listed on the following tab. The **Legend** tab allows you to set properties in the chart legend. The next tab contains a collection of settings for individual graph series, and using functions on the last tab lets you define, align, adjust and set your graph titles.

A complete description of all the features and how to set up the chart will be explained in a separate chapter **(3.5.2)**. If you want to hide tabs for chart visual setting and show the basic functions of the application, just activate a different part of the window by clicking on any panel, or click on the first button displayed on each tab - called "**Close**".
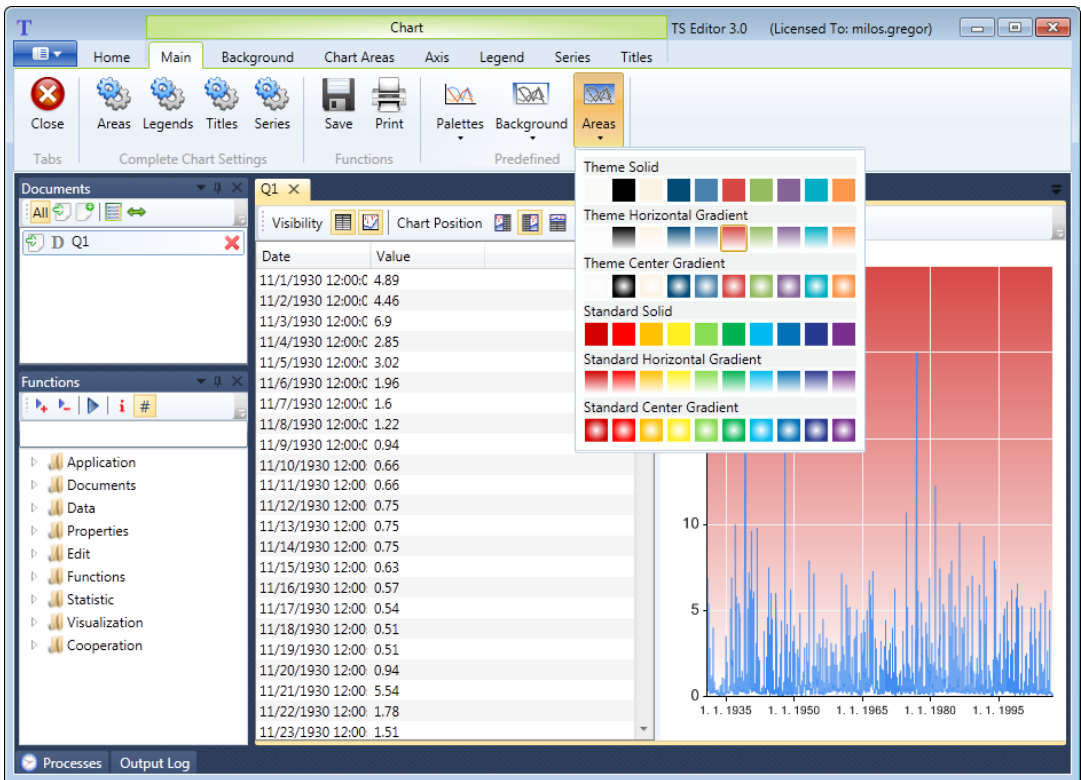
Fig. 8: *Ribbon toolbar structure after double-clicking on the chart in the displayed document.*
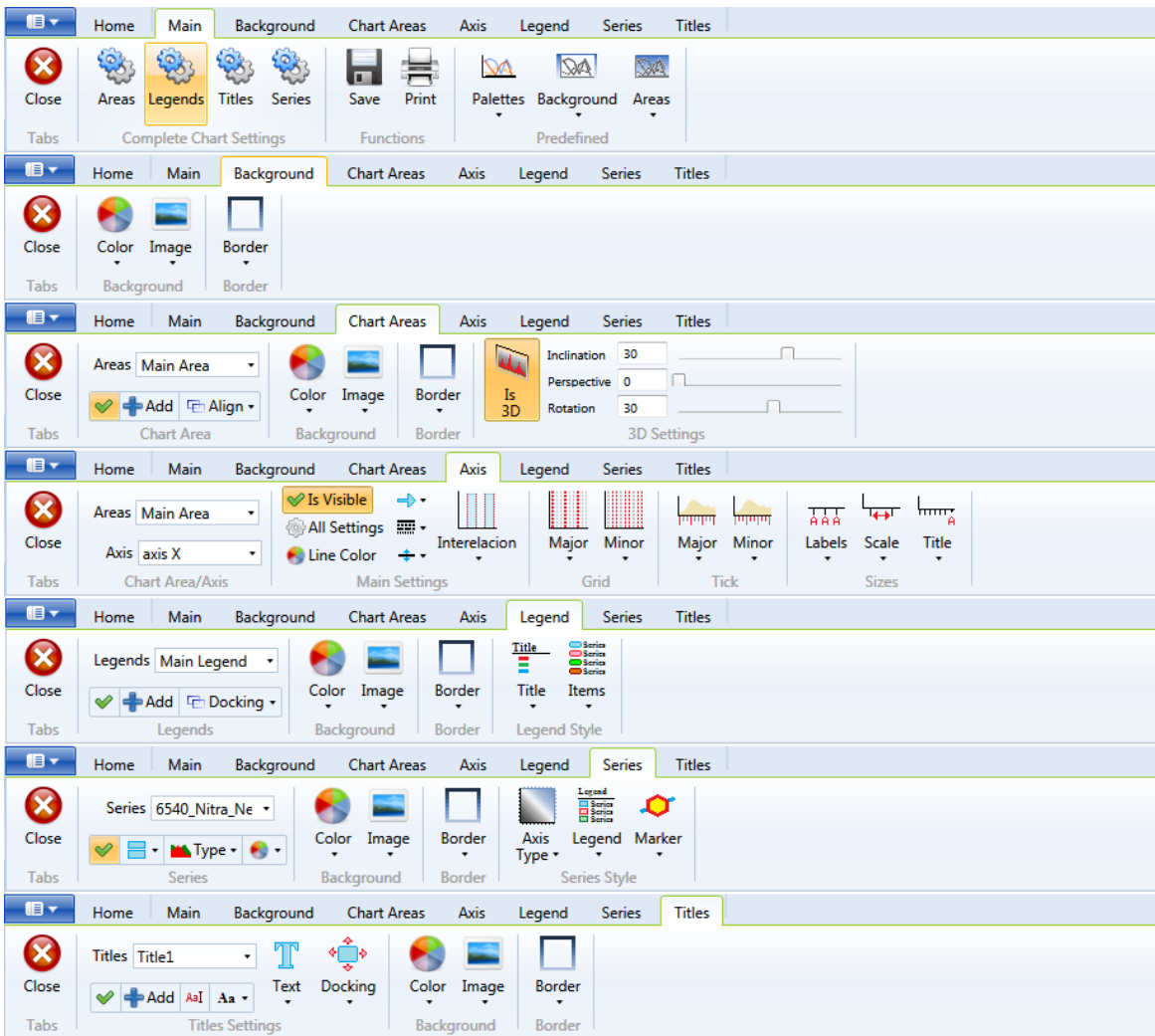
Fig. 9: *Ribbon toolbar tabs for configuration of the chart's visual properties.*

3.3 Panels

The panels form a very important part of the program because most work in the program is performed through them. After starting the program, two of these are docked on the left side of window and two are docked on the bottom edge of the window and are automatically minimized. This chapter now explains their functionality and importance. As the first the **Documents Panel** is presented first. In this panel, the user has access to all documents that were imported into the program or generated by the selected function. This is followed by the **Functions Panel** where all application functions are displayed in a tree structure. Finally, the assistance Panels named **Processes** and **Output Log** are introduced.

3.3.1 Documents Panel

The Panel titled **Documents** (Fig. **10 a**) is one of the most important panels in the program, because all documents stored in computer memory are listed therein. Therefore, this panel can not be closed, only relocated or minimized. Individual documents are displayed as items in the list. Each document is represented as an individual item in one line and is presented by three elements. The first element is an icon. This icon defines the document type. When this icon has a small arrow, this means that the document has been loaded from the file onto the disk. If the icon is displayed with a small "plus" picture the document was created directly inside the program using any function on the selected document. This icon is followed by a letter that defines the type of time series stored in the document. If the document does not have this letter, it means that the document does not have the time series character. One example of such a document could be a result table with calculated statistical parameters. Determination of the document type is carried out automatically, and the document can be defined by the letter **W** (weekly time series), **D** (daily time series), **H** (hourly time series) and finally **U** (undetected time series). The name of document is displayed after these two icons, and the given document name must be unique for this list.

This panel also contains five commands in the toolbar (Fig. **10 b**). With the first three buttons, you define which documents you want to see. You have the following choices; (1) display all documents in memory, (2) display only those which have been loaded from computer disk, or (3) display only those which were created directly in the program using its built-in functionality.

You must be certain which of these documents you wish to use before you perform a program function. Then, you click on the document to be used and select the required function from the ribbon toolbar. Now the fourth and fifth toolbar commands come into play. If you want to use a function for multiple documents simultaneously, press the Ctrl or Shift key and click on all the required documents. Using this approach, you can process multiple documents simultaneously. If you want to select all the documents at once, click on the penultimate button in the toolbar. If you want to invert the document selection, click on the last button.

*Fig. 10: Panel Documents (**Left** – general view of the panel; **Right** – description of the panel toolbar commands).*

After selecting the documents and clicking on the desired function, one or more new documents will be created containing your result. Processed results immediately appear in separate document windows. These windows can be closed, but they are still retained in the memory. If you want to see them again, just double click on the selected document in the panel and it will be displayed in a separate window. If you keep the mouse over the document, tooltip information for the document will be displayed (Fig. 11).
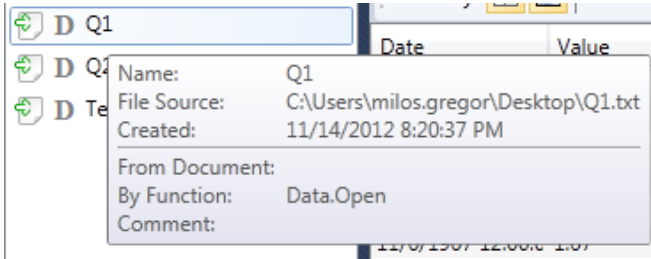
Fig. 11:   Tooltip information for the selected document.

This element shows information about the document. (1) The first line contains the name of the document (2) the second details the primary file source it is based on, (3) the third line shows the time stamp, which defines the time when the document was loaded into memory, (4) If the selected document is created from another document using any built-in function, its name appears on the fourth line, and (5) The function used is recorded on the fifth line. Finally, if the program or user has added comments to the document, these are displayed on the last line.

The following features of this panel appear when you right-click the mouse on the selected document (Fig. 12).
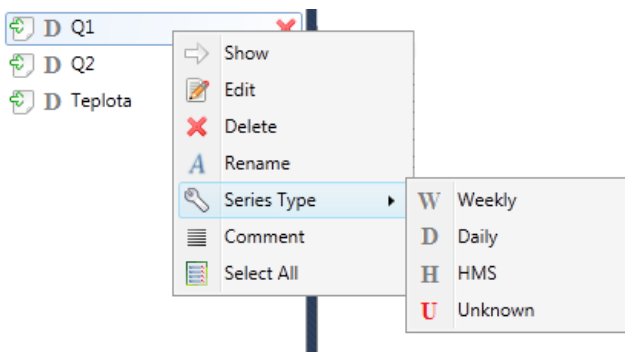
Fig. 12:   Popup menu items for the selected document.

By clicking on the first menu item (**Show**), the user can view the selected document in a separate window. The second item is used for manual editing of the selected document. You must take care when editing, because you directly edit the document in memory without cancelling the changes. The **Delete** command can immediately delete the document from computer memory. The **Rename** command changes the name of the selected document. The menu item called **Series Type** is used to change the time series type if the program has determined it incorrectly. The **Comment** command enables you to manually assign comments to the document, and these are then displayed in the tooltip information (Fig. 11). Finally, the last command allows you to select all documents in memory.

TIP   At work it is very important to know how you have named your documents, especially for documents that are generated directly in the program. Appendix 1   details Document Naming Conventions.

3.3.2 Functions Panel

The second panel is called **Functions** (Fig. 13). This panel contains every function of the TS Editor 3.0 software in a tree structure.

Exactly as you found in the ribbon toolbar, all functions in this panel are divided into logical groups. The only difference here is that the functions from the ribbon **Home** tab are divided into three different groups, namely **Application**, **Documents** and **Data**. The remaining basic tree items are the same as those in the ribbon tabs headers. The individual functions were described according to this tree structure in the previous chapter - Chapter 4. The user can choose whether to run the required functions from the ribbon toolbar or from this panel, or to use a combination of both. Figure 13 defines the commands from the panel toolbar. The first button serves to expand the tree
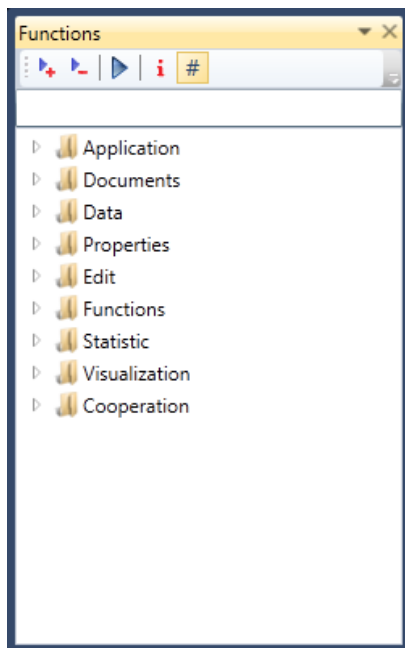
Fig. 13:   Panel Functions (*Left* – general view of the panel; *Right* – description of the panel toolbar commands).
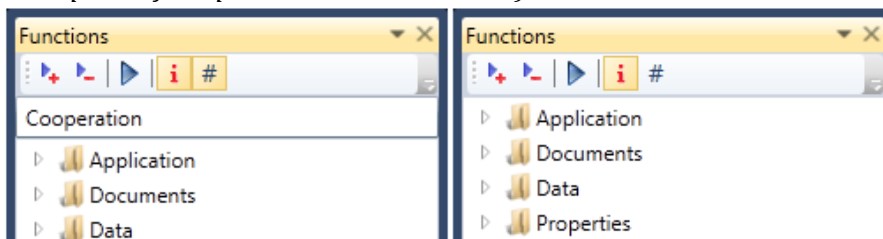
Fig. 14:   Displayed (*Left*) and hidden (*Right*) script text box.

levels. Each click on this button expands the next tree level. Activating the second button collapses the tree, and immediately following the first click the tree is collapsed at the highest level. The third command runs a function defined by selecting the tree item or entering script into the text box. The script text box can be hidden or displayed using the last button, and Figure **14** shows how the panel looks when the script text box is displayed or hidden.

You can launch the function you wish to run by writing it in the script text box, and the text box will then automatically complete the name of the desired function (Fig. **15**).

The function of the last button on the toolbar is now explained. This "Cooperation" button is used to display the **Info bar** that serves as a help for the selected function (Fig. **16**). When you click on the selected item in the tree you automatically loads its name and description.
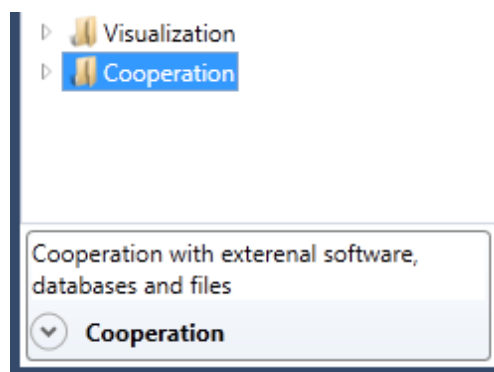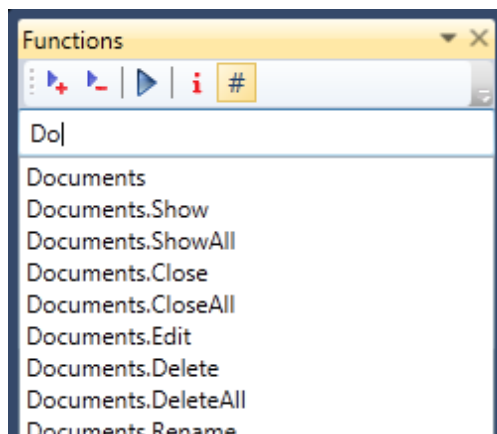
Fig. 15:   Auto-completion functionality of the script text box.

Fig. 16:   Panel Information bar.

A second method for obtaining information about the selected item in the tree is to keep the mouse cursor over it until the tooltip is displayed (Fig. **17**). This program function can be run in three ways. (1) You can double-click on the selected item in the tree, (2) you can press the **F5** key after writing your script in the text box or (3) you can press the third button in the panel toolbar. Using this panel is quite simple, but detailed description of the individual functions is contained in chapter **4**.

Fig. 17. *Tooltip help for the selected tree item.*

3.3.3 Processes Panel

The first two panels are minimized in the bottom left corner of the application (Fig. **18**), and the structure and properties of the **Processes** panel are now described.
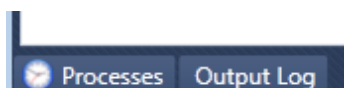
Fig. 18: *Minimized application Panels.*

The Processes panel stores the history of your used functions and documents. If you want to view this panel, click on its header. This panel is always empty when you run the application (Fig. **19**).

Fig. 19: *Empty Processes panel after application start.*

When you import multiple files into the program and you process them by selected functions, the table is filled with information (Fig. **20**). The table consists of four columns. The first column (**ID**) defines the number of the process. The second column (**Source**) defines the document or file on your computer disk used in your actual processing. Your existing file name, or the new file name you give it, and its directory path appear in this cell.

The third column (**Function**) defines the name of function used in your current process - for example; **Data.Open**. The last column (**To Document**) defines the name of the document created by a given function in your current process. Using this table, you can also control how individual documents are created in the program (from document or file >>> by function >>> to document).

The example, Figure **20** shows that two files were imported into the program using the **Data.Open** function. The names of these documents are **Q1** and **Q2**. Subsequently, the following two functions were performed on document **Q1**; (1) Annual maximum values were calculated from the time series and the result is stored in document **Q1.3**, and (2) the average monthly values and the result are stored in document **Monthly_Avg.4**.

Fig. 20:   Processes panel with the history of used functions and documents.

One advantage of storing this history is that when you import multiple files into the program you can check for gaps in your data, find missing values and create statistical results based on these documents. Using this panel you can therefore create a large number of new documents without losing track of their process history.

3.3.4 Output Log Panel

The final panel of the TS Editor 3.0 is the **Output Log** panel (Fig. **21**). This contains only a simple text box where application logs are stored. Each record has the time you created it, its type and the log message.

Fig. 21:   Screenshot of the Output Log panel.

The log type is labelled with **OK** or **Error**. If the type is OK, this shows that the process, function or initialization was without any detected error. The Error label indicates that an error occurred in the process. The log message then contains information such as the name of the function which created the error message or a detected bug. In addition to automatically generated logs, you can also add comments or notes here.

3.4 Script Window

The command line in this program called **Script Window** has a very useful function (Fig. **22**). When you use TS Editor on a daily basis, you will quickly know the required commands because they are simple, logical and self explanatory. The command line tool is implemented in this program for professional users.
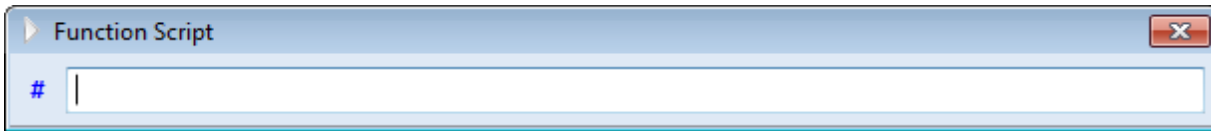
Fig. 22: *Screenshot of the Script Window.*

You use this tool by pressing the hot key **CTRL+F**, and a new window appears containing a simple text box where you enter your script command. When you begin typing a command, the text program automatically scans more than 2,300 commands and displays all options to complete your demand. This script text box operates differently to the one in the **Functions** panel. In this script text box you only need to write the first fragment of your command and the program scanning-display allows you to select any command similar to your requirement. Figure **23** provides an example.
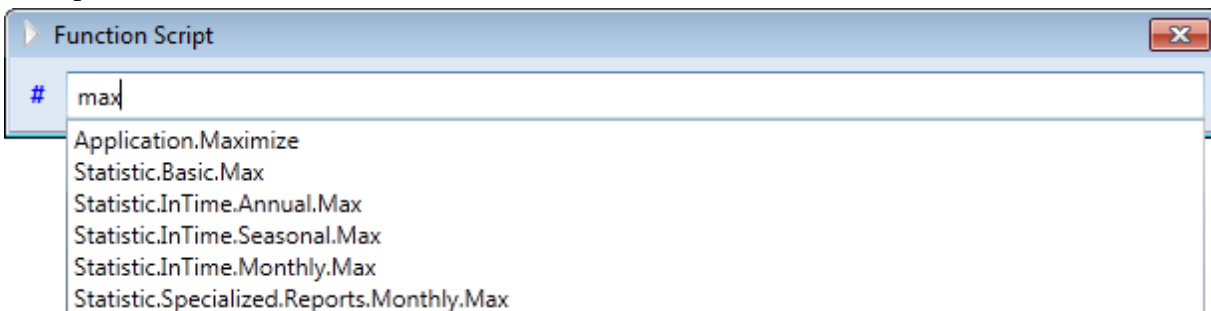
Fig. 23: *Example from the auto-complete command process.*

If you imagine that you want to determine the maximum monthly values in a selected document, you don't need to write the whole command **Statistic.InTime.Monthly.Max**. You can simply write the string **'max'**, and the program automatically finds all commands that contain this string and displays them in a drop-down list. You select the one you want and press the **F5** key. The program checks that the command is entered correctly, and if it is, the program closes the window and runs the desired function.

3.5 Documents

The most important elements of the user interface are **documents**. As mentioned previously, the data contained in your documents is stored in computer memory. This may consist of a time series of values or a table with processed results. These data objects can be visualized in the form of documents. The example in Figure **24** shows three documents displayed in three separate windows. The currently visible document is named Q1. The document itself consists of three elements – **toolbar** with functions, plus a **table** and **graph**. This example shows a document containing a time series of values for the course of river discharges. The first of the table's two columns stores the date-time values and the second column has the actual measurements. The second part of the window displays the data as a linear graph of values over time.

Documents are automatically listed as **tabs**, and individual documents can be activated by clicking on the document header. A second method of switching the visible documents is by holding down the **CTRL** key and pressing the **TAB** key (Fig. **25**).

Documents are automatically listed as **tabs**, and individual documents can be activated by clicking on the document header. A second method of switching the visible documents is by holding down the **CTRL** key and pressing the **TAB** key (Fig. **25**).

In addition to automatic document tabbing, you can switch, dock and align individual documents. Figure **26** shows examples of working with documents. The left-hand example shows document separation from the main application window into a separate window, while the one on the right shows multiple documents in parallel display and alignment in one window, so they are all visible together.
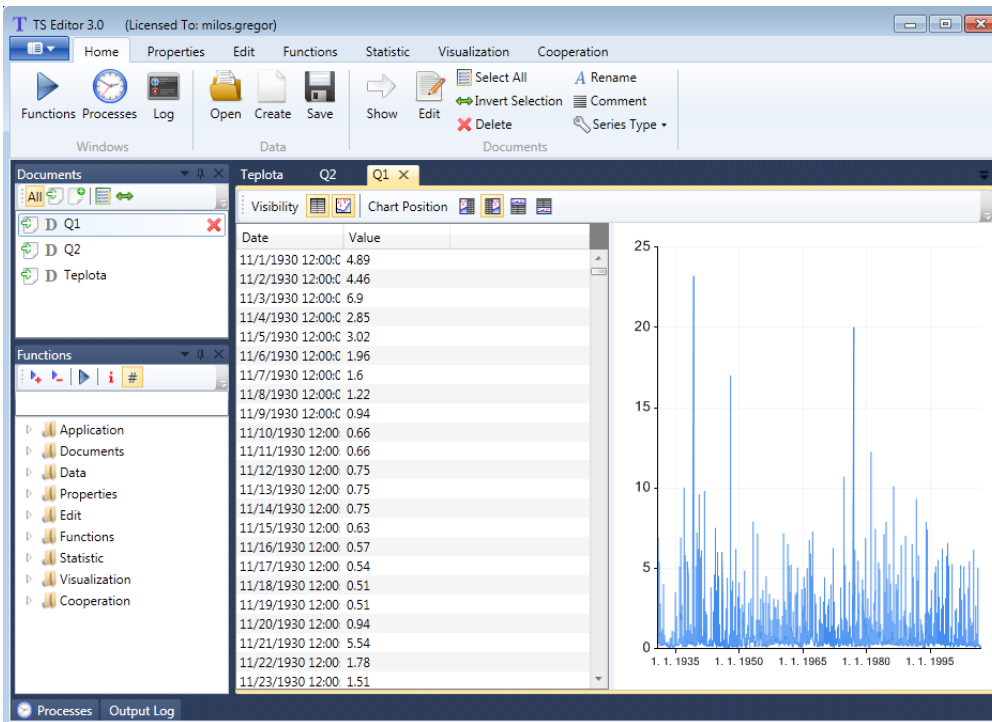
Fig. 24: *Example of an opened document in the program.*
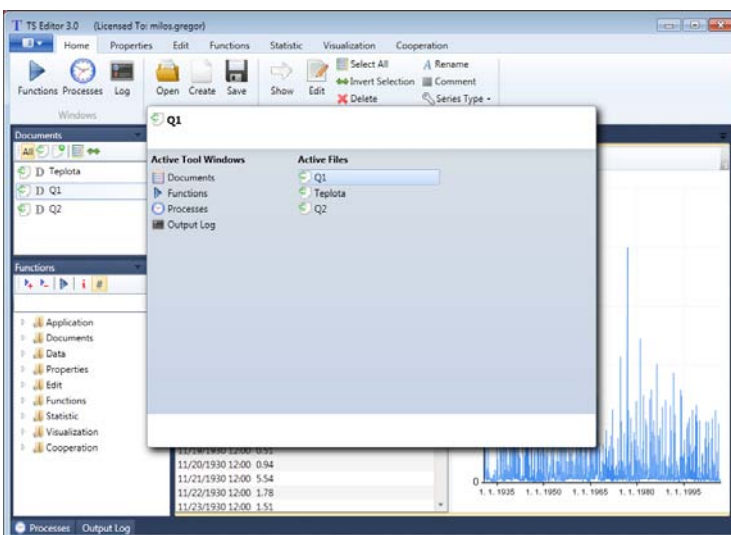
Fig. 25: *Document-switching using the CTRL+TAB hot-key.*
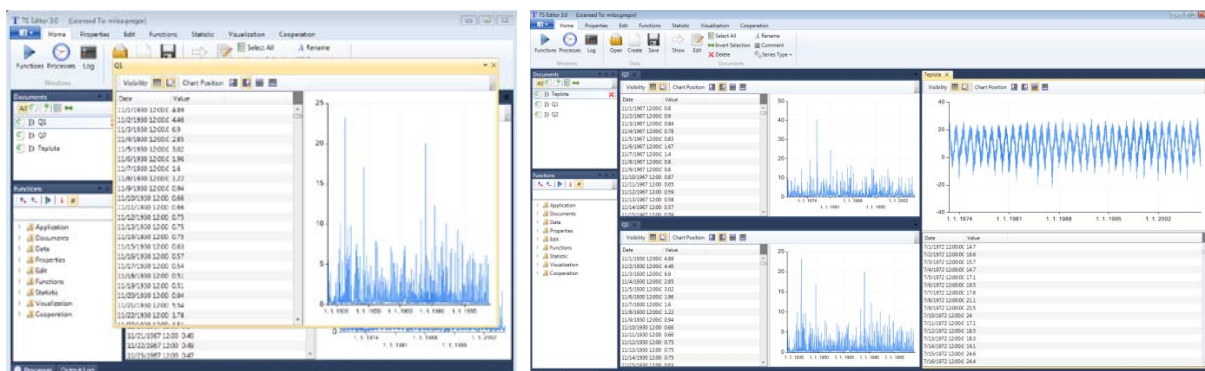
Fig. 26: *Moving document (Left) and parallel view of multiple documents on the screen (Right).*

A separate part of the document features the toolbar (Fig. 27). Using this toolbar you can set the **graph** and **table visibility** with the first two buttons below.
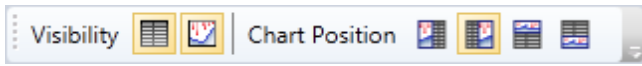
Fig. 27: *Toolbar from the document window.*

Examples of these settings can be seen in Figure **28**. With these two buttons, you show or hide the table and graph so that either element fills the entire document. In "document display" both elements are visible in the document area. The only two application functions that generate documents without graphs are "*IsContinual*" and "*HasUniformStep*". All other functions create table and graph visualization.
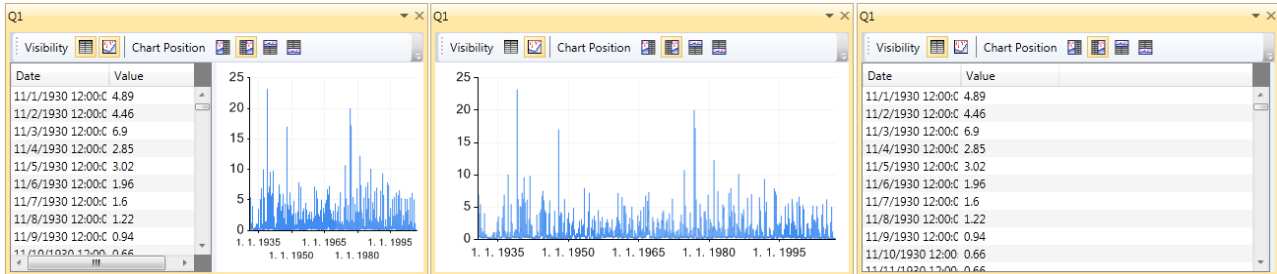
Fig. 28: *Options for table and graph display in the document (Left – table and graph parallel display; Middle – hidden table; Right – hidden chart).*

Besides this option of hiding selected objects in the document, other toolbar buttons can alter their position. An example is shown in Figure **29** where the chart can be dragged horizontally or vertically before or after the table.

Additional methods of document table and graph control are explained in the next two subsections
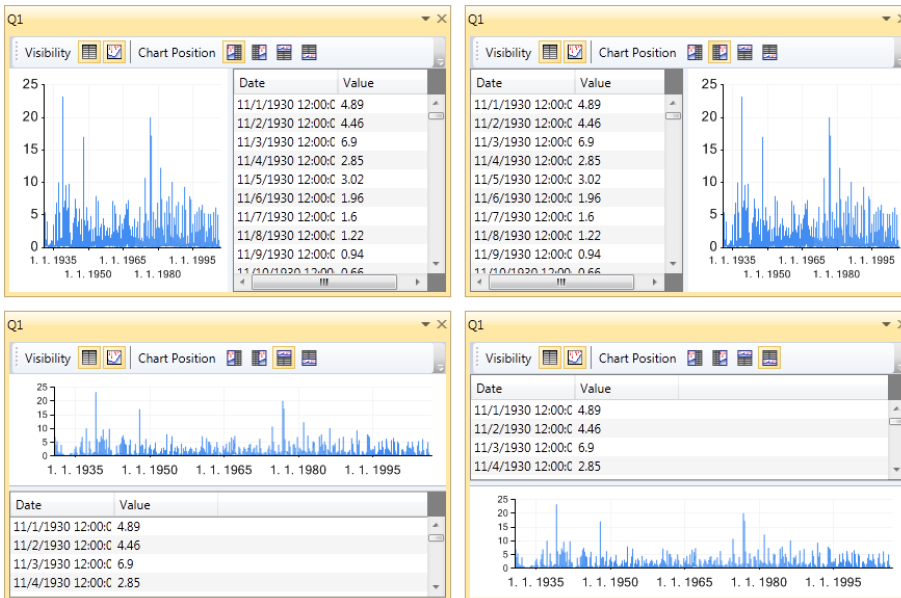
Fig. 29: *Chart setting options to position the table.*

3.5.1 Table

The table has less processing capabilities than the graph because the table view is not editable and it only allows values of the time series or calculated parameters to be shown. Basically, data in the table can only be **saved** or **copied to clipboard** (Fig. **30**).

Right-click on the table and a pop-up menu appears showing the above described functions. If you copy the table

Fig. 30: *Working with the table in a selected document.*

to the clipboard, you can directly insert it into another program such as MS Excel. Otherwise, using the 'save' command stores your data on disk, and its function is identical to *Data.Save* which is shown on Figure **38**.

3.5.2 Chart

Graphic sections of the documents are more diverse and offer more customization. Examples of graphs in TS Editor are shown in Figure **31**. Each program function which creates a new document also contains a precisely defined graphic visualization.

Fig. 31: *Examples of graphic visualizations in TS Editor.*

Only two features in a document graph can be controlled. You can **zoom** or **scroll** a selected part of the graph or activate functions to set the graphic properties. Examples of zooming and scrolling are shown in Figure **32**.
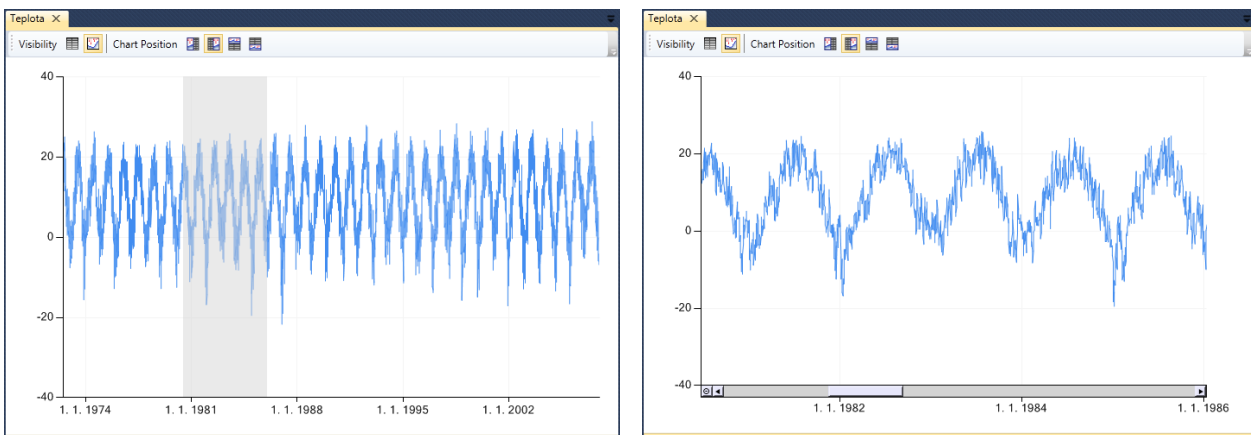
Fig. 32: *Example of graph zooming and scrolling.*

This figure graphs a time series of temperature measurements over an extended period. If you want to display only a selected part of this period, press the left mouse button and select the section you want to view (Fig. **32 Left**). When selected, leave the mouse button and the selected part is displayed separately (Fig. **32 Right**). This procedure can be repeated as long as you see only the part you exactly want to see. Use the scrollbar on the bottom axis and move over the "time". If you want to return to the previous scale of display, just click on the small button located to the left of the scrollbar on the X-axis. Using this method, graphs in documents can be zoomed and scrolled only over the X-axis. However, it is possible to zoom and scroll graphs over both X and Y axes using the function group called **Visualization**. An example is shown in Figure **33**.
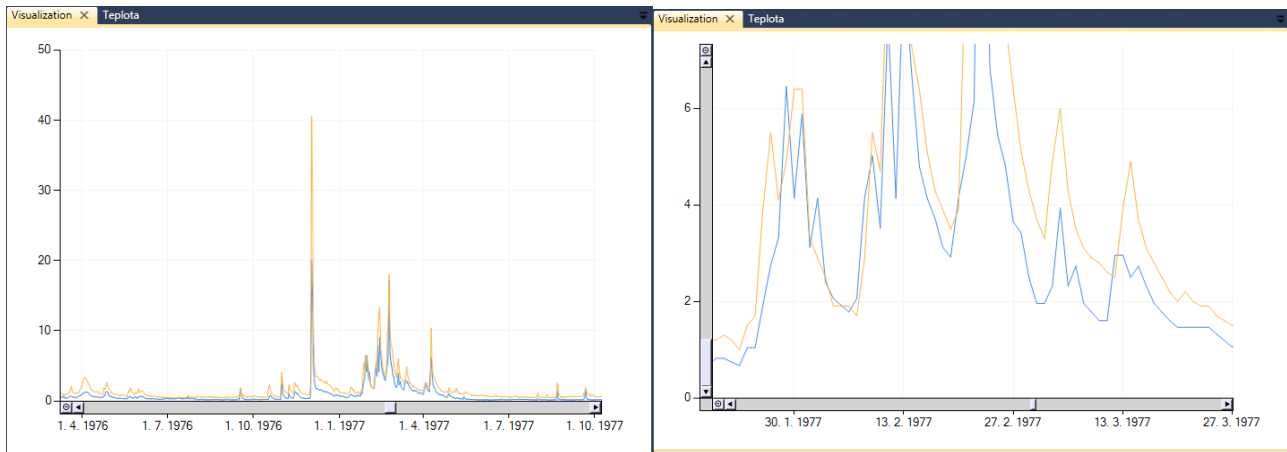
Fig. 33:   *Example of graphs that can be zoomed and scrolled on both axes.*

These documents don't contain the table portion and therefore they are not listed in the **Documents panel**. In addition, all have the same header – **Visualization**- and under this option, any parts of your graph can be zoomed. The visual properties of chart are chosen by **double-clicking on the chart area,** thus changing the ribbon toolbar as seen in Fig. **34**.
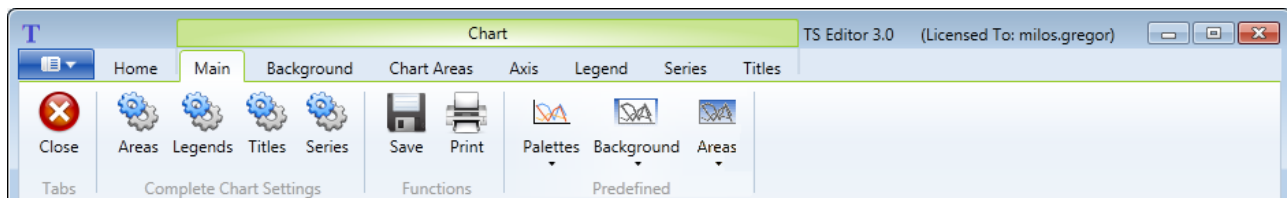
Fig. 34:   *Functions for setting the graph's visual properties.*

This double-click hides the classic functions of the program, and graph setting options are displayed. These settings are grouped in seven ribbon tabs, and the available options allow you to completely adjust the visualization. You will appreciate that this software is a very powerful visualization tool. An example of what can be done with the graph is shown in Figure **35**. This visualization was created by several "tricks" and when you become conversant with working with all graph properties functions, you will have no problem in creating your own similar graph. These tricks comprise; (1) visualization of two documents created in one window, and (2) the background is composed by changing the image and position of chart areas and also changing their size and transparency.

The following text describes the functionality of each button in the ribbon toolbar. It begins with examining the settings and functions offered by the **Main ribbon tab** (Fig. **36**).

The following text describes the functionality of each button in the ribbon toolbar. It begins with examining the settings and functions offered by the **Main ribbon tab** (Fig. **36**).

Figure **36** shows four buttons for setting complete graph properties. The graph ribbon toolbar itself does not contain all functions and settings you can use for working with graphs. Although the major commands are included, for some purposes you may need additional commands which are available using the following four buttons in the ribbon toolbar.

With these settings, you can edit individual **Chart Areas**, **Legends**, **Chart Titles** and **Series**. Clicking on any of these buttons displays their properties in a new window (Fig. **37**). This window consists of three parts – (1) the 'combo' (combination) box is at the top, (2) the property grid is in the middle and (3) the label is at the bottom. When the selected graph contains a number of objects (**Chart Areas**, **Titles**, **Series**), these are listed in the upper combo box, where you select the object you want to modify - and its properties are loaded into the property grid and setup. When you click in the property grid on the selected cell, a brief description is shown in the bottom label. If you change any properties in the property grid, this is automatically reflected immediately in the graph.

Hundreds of properties can be set, so although every possibility is not described here, all properties are easily mastered because they are logically labelled and fully described in the bottom label.
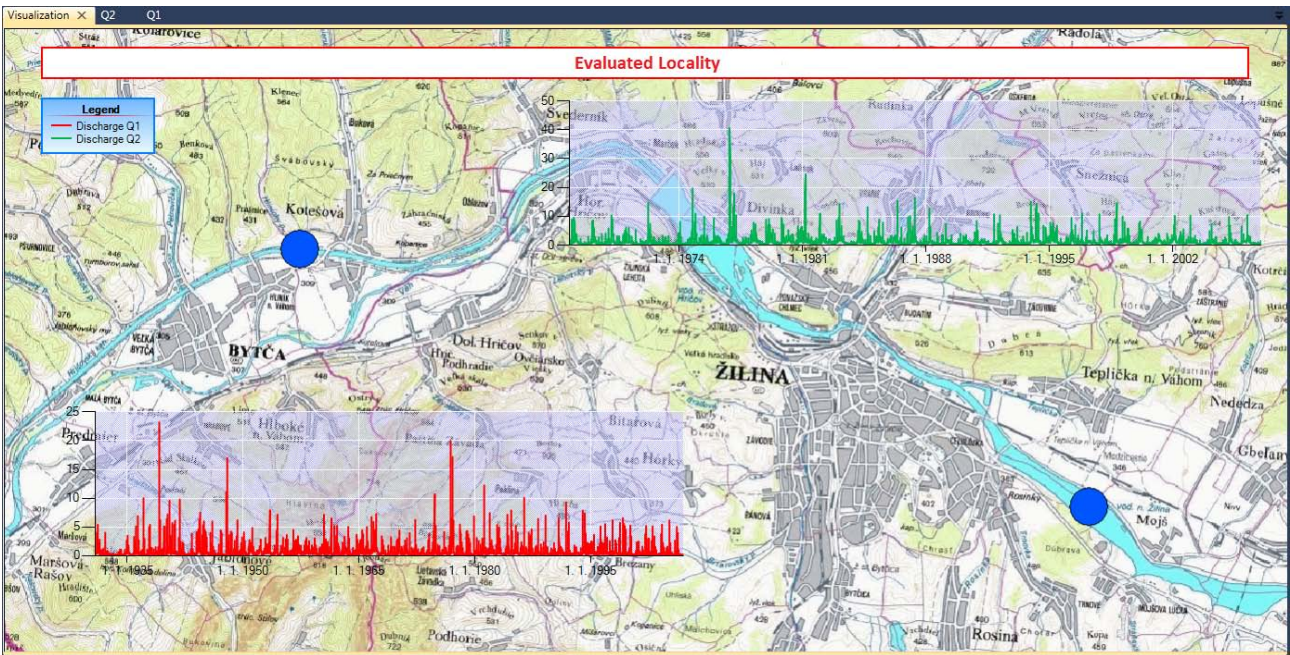
Fig. 35: Example of graph properties setting using several tricks.
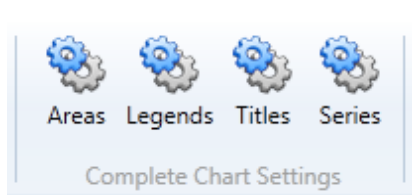
Fig. 36: Buttons used to display complete chart settings.
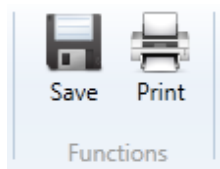
Fig. 38: Functions for chart export.

The next features in the ribbon tab are used to export the chart from the program (Fig. **38**). The first function **Save** is used to save the current graph to an image file and you can select one of eight image file formats.

The second function **Print** allows direct print of the graph from the program (Fig. **39**).

After launching this function, you set your basic parameters such as paper size, margins and orientation and click the **OK** button. The **Print Preview** form is displayed for your direct graph printing. Finally, the next three features for visual settings are on this ribbon tab (Fig. **40**).
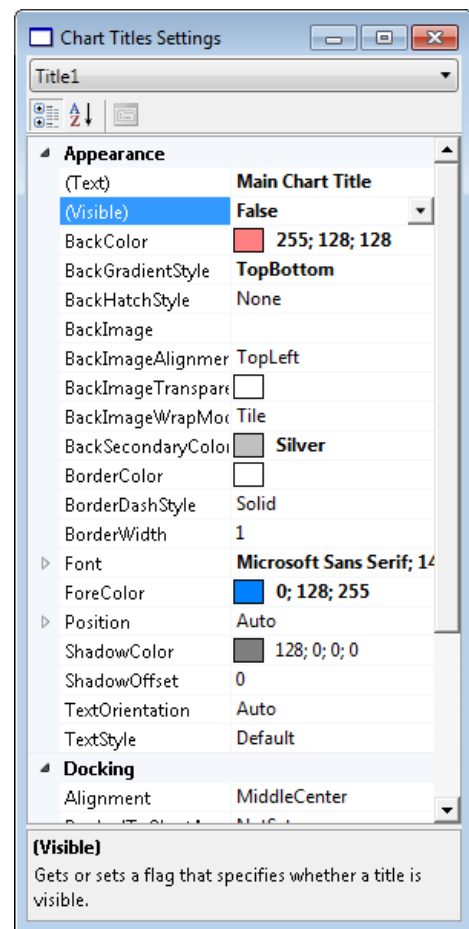
Fig. 37: Window showing complete properties of chart objects.
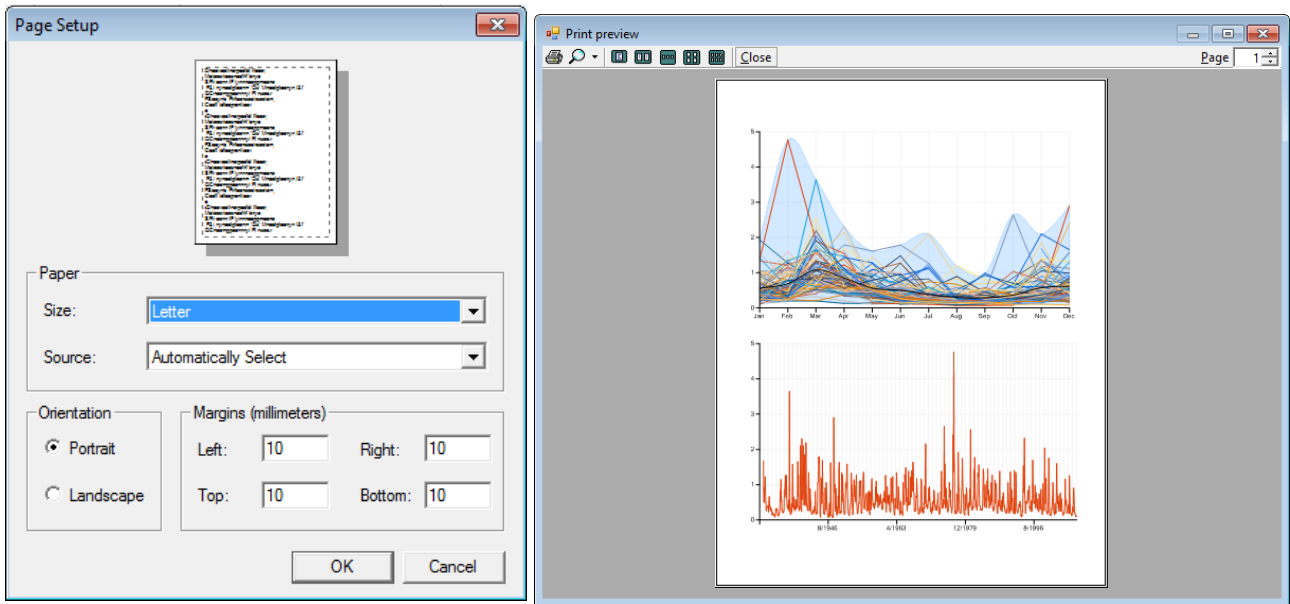
Fig. 39: Function for direct graph printing.
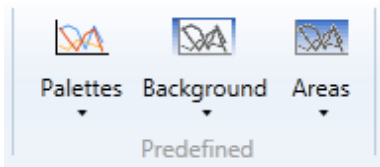
Fig. 40: Features for predefined visual settings.

Using these functions you can quickly setup visual parameters for the graph. Simply click on the selected button to drop down the list which displays all predefined themes (Fig. **41**). The **Palettes** function automatically sets the predefined colours for the visual series. The program automatically uses a **Bright Pastel** palette. If you wish to use a different one, just select it from the list. This program offers a choice of nine color palettes. If you have selected one palette but want to manually change the colour of only one series, this is done very simply using the **Series** feature in the ribbon tab.
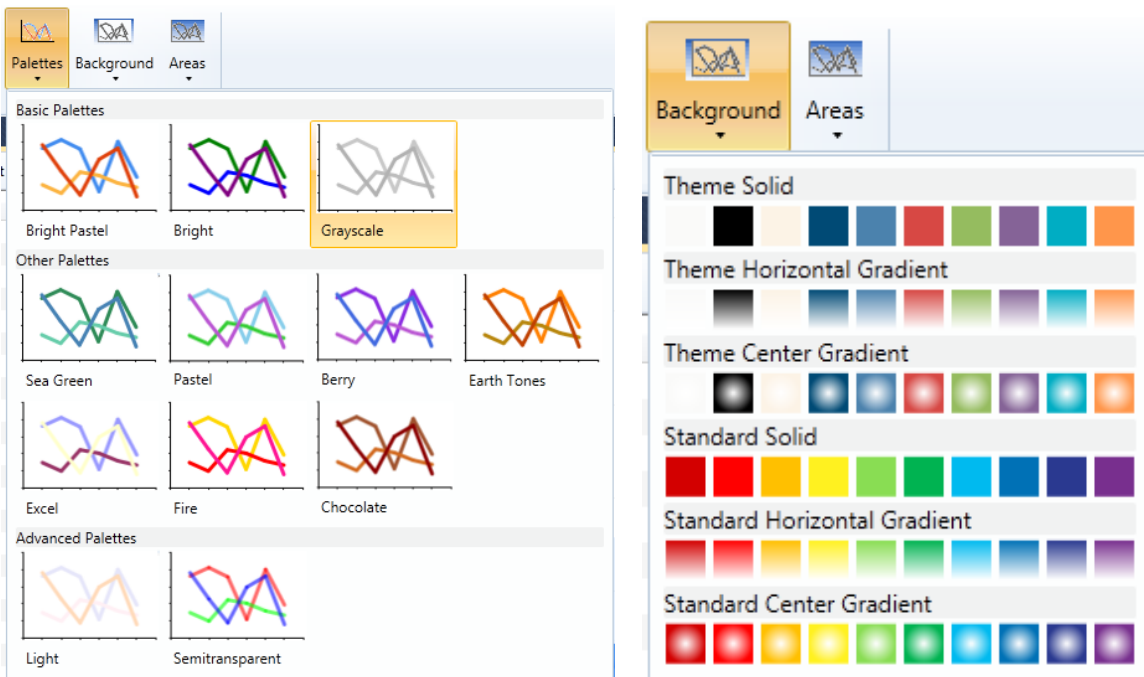
Fig. 41: Predefined themes for the Series, and for Graph and Chart Areas.

Similarly, you can change the background settings for the entire graph and individual **Chart Areas** using the 'background' and 'areas' buttons. Simply click on a selected item in the drop-down list and the program automatically adjusts the graph. If the selected graph contains multiple Chart Areas, the program sets the selected background for all of them. These functions can also subsequently be edited manually exactly as described for the colour palettes.

The remaining ribbon tab allows you to set the **background properties** for the entire graph. Figure **42** shows the functions available for this purpose.
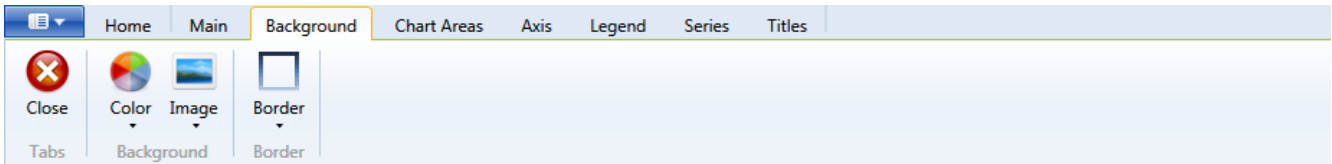
Fig. 42: Ribbon tab for graph background properties.

Using these features, you can adjust the background colour, import images into the background and set the graph borders. The same functions can also be found in other graph objects such as Chart Area, Legend, and other objects as described hereunder.

Use the first button to set the background chart colour. Clicking on this shows additional options (Fig. **43**). The most important setting is **Back Colour**. This parameter adjusts the overall colour of the chart background. If you want to use any gradient, set the **Back Secondary Colour** and choose any type of **Gradient**. The program includes eight basic gradient types.

If you want to load an image into the chart background, use the second button – **Image**. Using the **Open Image** command you can read an image from your hard drive. By **Clear Image** command you can delete the image from the background. The **Alignment**, **Layout** and **Wrap Mode** commands are used to set displays in the graph. The last command **Transparency Colour** sets the colour which will be transparent in the image. One example of using this is to combine the coloured gradient and the image.
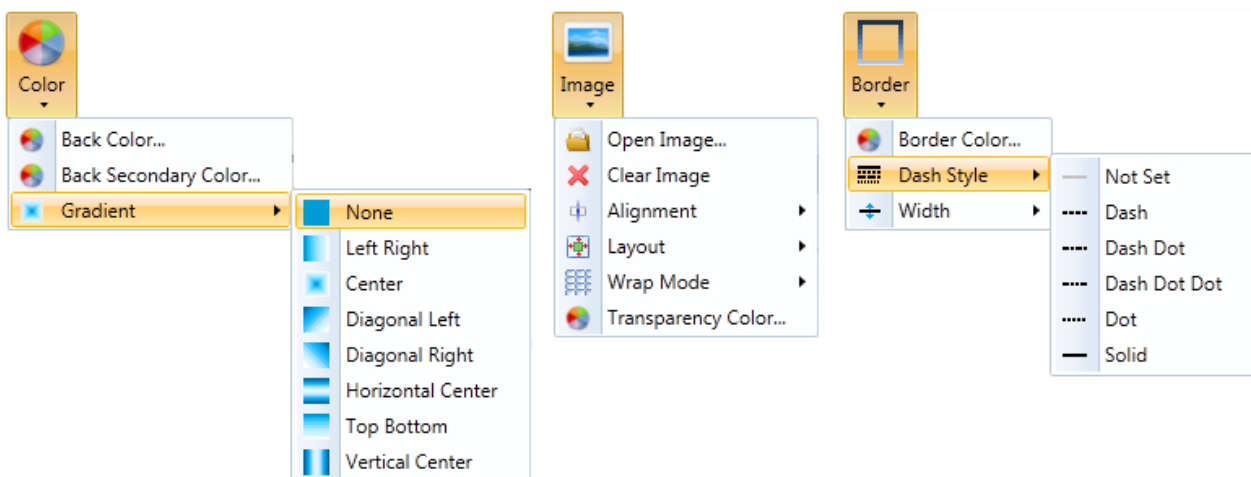
Fig. 43: Individual functions for setting graph background properties.

Finally, the **Border** button enables you to set the colour, style and thickness of the graph edges and the next ribbon tab is used to set the properties of the **Chart Areas**. Individual functions are shown in Figure **44**.
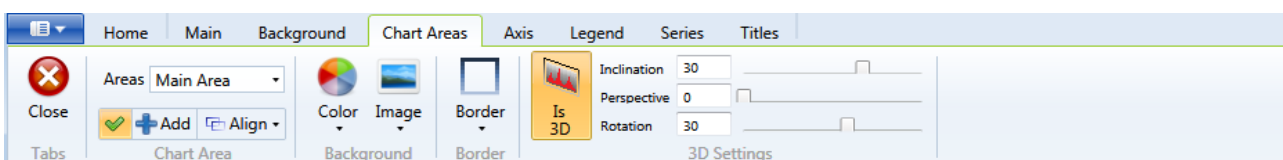
Fig. 44: Ribbon tab for setting the Chart Area properties.

Here, the most important part of the ribbon tab is the first part (Fig. **45**). To configure the properties of the selected Chart Area, you must first select them in the built-in 'Combo' box. The first Chart Area is always named the **Main Area**, and the names of the following Chart Areas depend on the function which created the document. From all setup properties, you set only properties for the Chart Area which is selected in the combo box. The **visibility** of the Chart Area is set using the first button below the Combo box. The second button is **Add**, and its use allows you to add a new Chart Area into your current chart. Additional features are hidden under the **Align** button, and these are used for alignment, orientation and styling of the Chart Area.
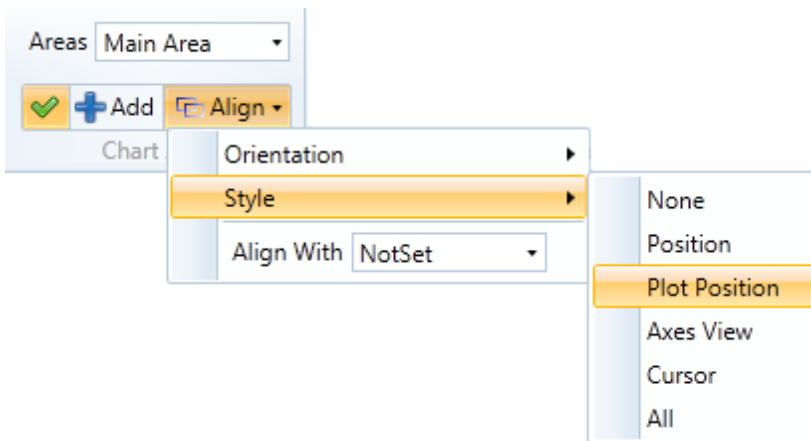
Fig. 45: *Main settings for Chart Area properties.*
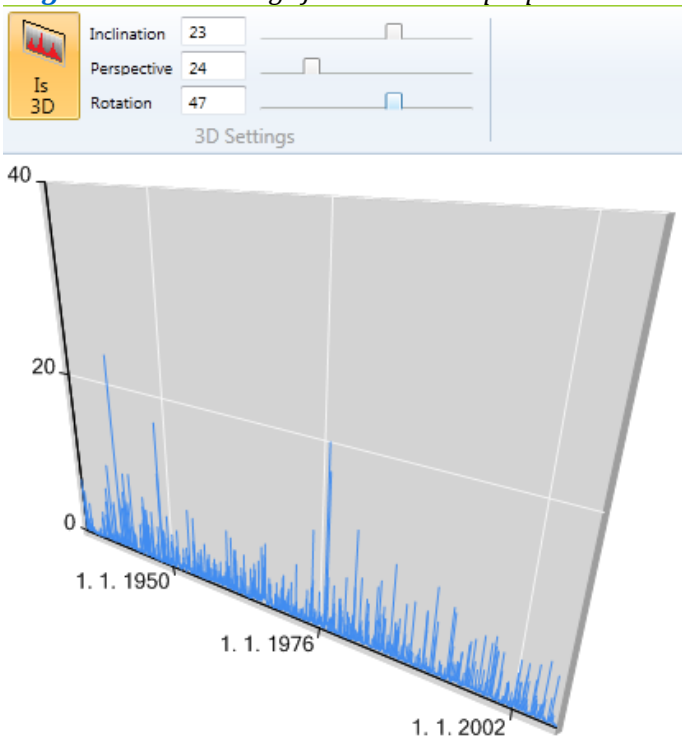
Fig. 46: *3D view settings for the selected Chart Area.*

Other functions, such as **Color**, **Image** and **Border** serve a similar purpose to those used in the Chart Background, but these settings are applied only to your selected Chart Area. Finally, there is one remaining functionality, shown in Figure **46**. Using this last function you can set the **3D view** of the selected Chart Area. Here, you can alter the **Inclination**, **Perspective** and **Rotation** values until you achieve your desired result.

The tools on the **Axis ribbon tab** are used to change the visual setting of the axis (Fig. **47**). When you want to use the features and functions of this tab, you must set the following two parameters. Set both the Chart Area and its Axis you want to edit in the first two combo boxes. If you have only one Chart Area, no setting for this is required because it is already defined, but the actual **Axis** must still be set. The described functions can then be used.

Visibility of the Axis can be set using the button **Is Visible**, and clicking on the **All Settings** button brings up all possible Axis adjustable properties. The following additional commands set the properties of the Axis visually. Functions under the button **Interlacion** enable you to colour the odd segments of the major axis grid, and an example of the **IsInterlaced** setting is shown in Figure **48**.
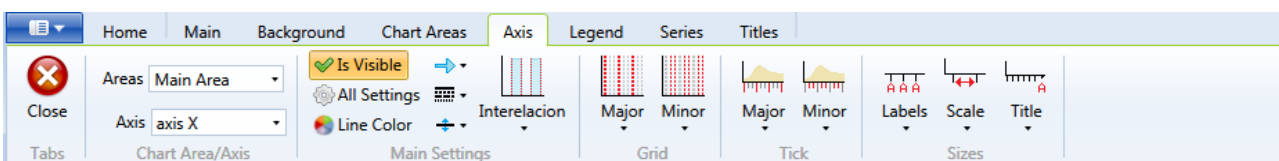
Fig. 47: *Ribbon tab for setting the Axis properties.*
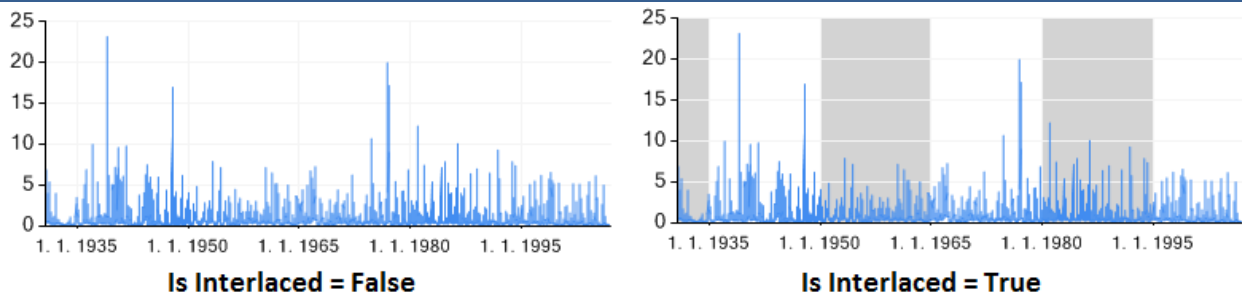
Fig. 48: *Example of using the "IsInterlaced" property.*

Figure **49** shows examples of individual functions logically grouped under the buttons on this tab. The first button shows the functions for setting the **Major Grid** properties. You can set its **visibility**, **interval of display**, **colour**, **line type** and **width**. The same parameters can also be set for **Minor Grid**.

The second button shows possibilities available by setting the **Major Tick Mark** properties. In addition to the properties set for the **Major Grid,** you can also set the size and style of **Tick Mark**. Using Axis **Labels,** you can set additional parameters, such as their **visibility**, **autofit**, **minimum** and **maximum**, **size**, **rotation angle**, **font** and **colour**.
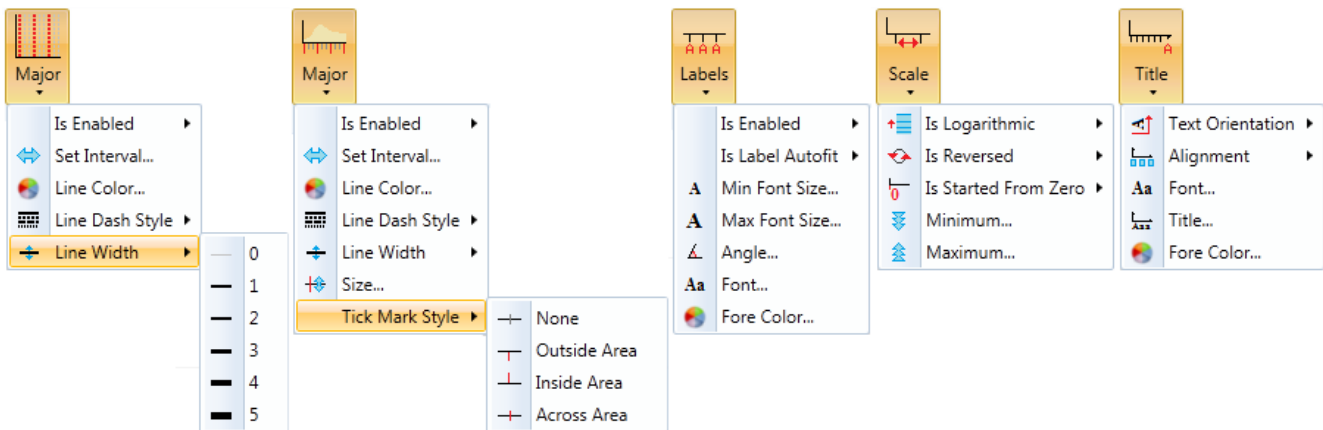
Fig. 49: *Individual functions for setting Axis properties.*

The **Scale** button defines whether the axis is **logarithmic** or **linear**, its orientation and the axis range from zero to minimum/maximum values. Finally, you can define the parameters and properties of the **Axis Title**, such as the axis label **orientation**, **alignment**, **font** and **colour,** and also define a **title text**. An additional ribbon tab is designed for the definition of **legend** (Fig. **50**).
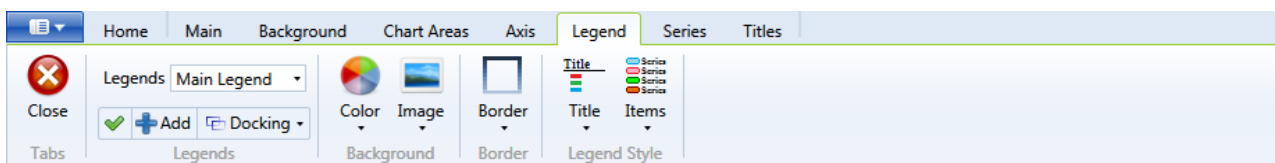
Fig. 50: *Ribbon tab for setting the Legend properties.*

You can set all properties of the legend using this ribbon tab. Each chart automatically includes a legend called **Main Legend**. This is automatically hidden, but if you want to see it, just click on the first button on the tab. As in previous cases, you must define the legend item you want to edit in the combo box. The next button can **add** another **legend** object to the graph. The **Docking** button contains many functions and features (Fig. **51**).

The functions under the **Docking** button align the legend relative to the selected Chart Area. The first item defines the Chart Area where you want to align the legend. The following two commands set the alignment properties, and the last command sets the inside/outside position of the legend in relation to the Chart Area.

Functions and commands under the **Title** button define the legend title properties – its text,

font, alignment, text colour, background, legend border and definition of the type of separator between the legend title and the items. Functions under the **Items** button define the visual characteristics of legend items such as the font, colour, style and order.
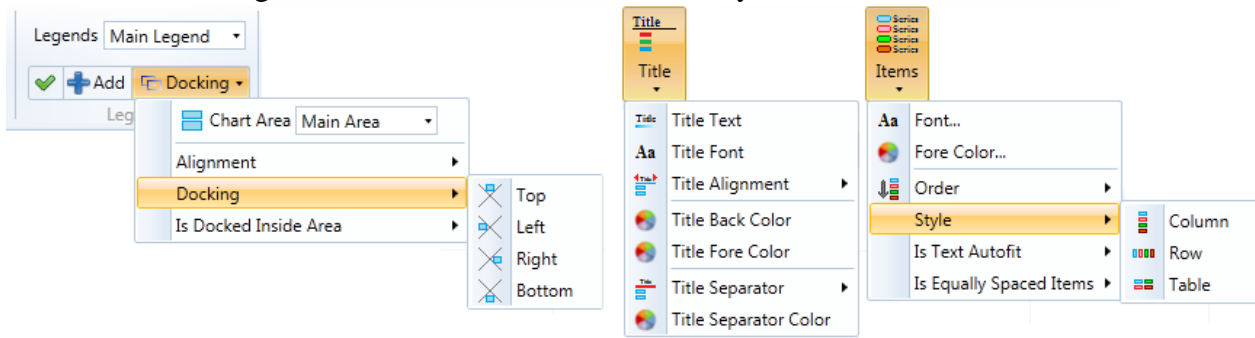
Fig. 51: *Individual functions for setting Legend properties.*

The penultimate and most important ribbon tab is used to set properties of the **Series** shown in the graph (Fig. **52**). Exactly as previously stated, the first step on this tab is the combo box definition of the Series whose properties you want to edit. The first button below the combo box sets the visibility of the selected series in the chart, and the second button defines the Chart Area where you want to render the selected series.
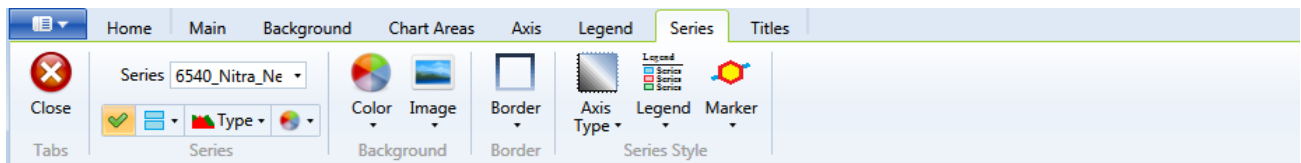
Fig. 52: *Ribbon Tab for setting the Series properties.*

The further button featured in Figure **53** is used to select the display type for the selected series. The program preferably uses the **Fast Line** type because it is the fastest to draw. In addition to this, the program contains 34 other types of series which can be used depending on the function which created the visualized document. If you choose a display type that can not be used, the program will show an error message. For example, you will receive an error message if you try to use the Bubble, Polar or Range type functions to display a single course of water discharges, because these tools are inappropriate for that purpose.
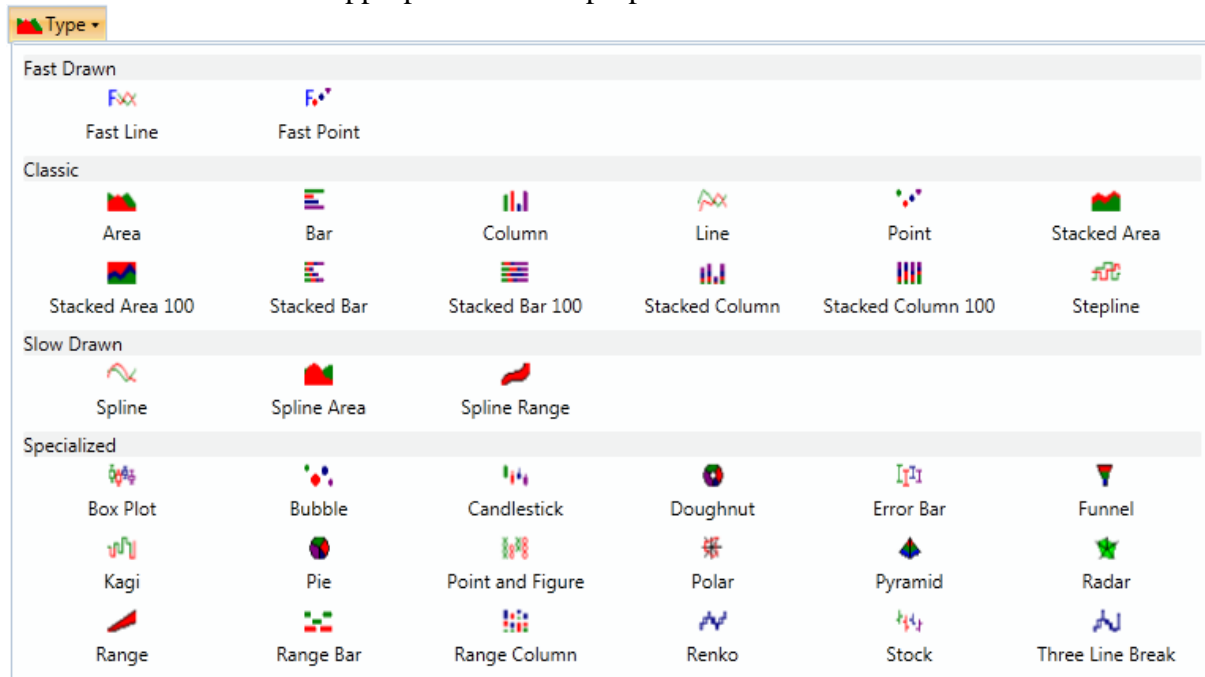
Fig. 53: *Choice of Series display type.*

The next button is used to quickly set the **Series colour** (Fig. **54**). If you want to setup a special type of gradient, such as in an Area type series, this is best defined using the **Colour** button commands. Other features of the Colour, Image and Border buttons operate similarly to the analogous functions in previous tabs. Additional "series-display" functions are shown in Figure **55**.

Using the functions under the **Axis Type** button, you can choose whether the selected Series is related to the **primary** or **secondary** Axis. This is useful if you want to parallel display a graph with river discharges and temperatures. Then, the discharges can be related to the primary axis, with temperatures placed on the secondary axis.

Using the functions under the **Legend** button you can decide if you want the selected Series to be displayed in the legend or the Series description in the legend, and where there are multiple legends in the chart, you can adjust in which legend the Series is to be displayed. The last **Marker** button allows you to set all the parameters of the Series markers, including the marker border, colour, width, size, step and style.

Fig. 54: *Series colour definition.*
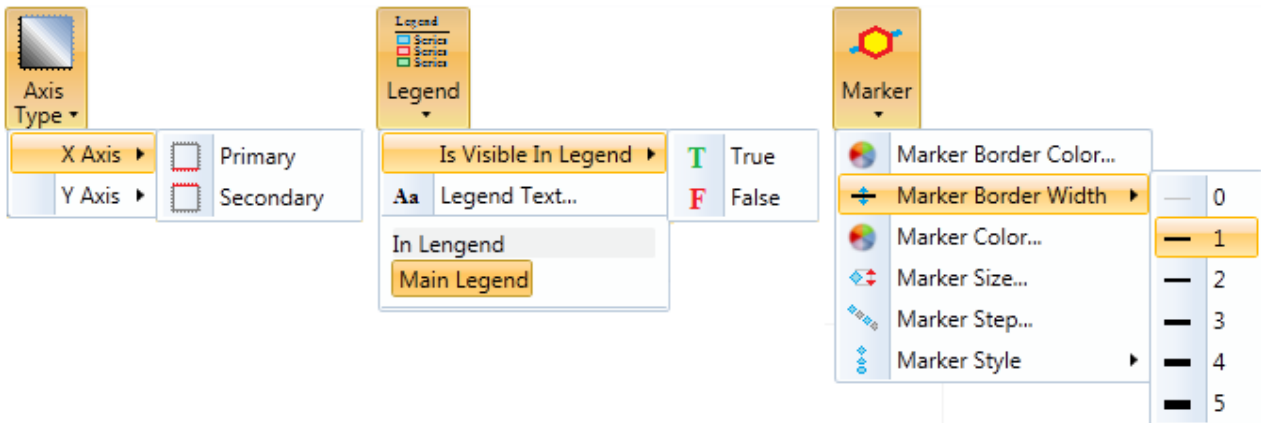
Fig. 55: *Selected features for setting the Series properties.*

Finally, the last ribbon tab in Figure **56** enables you to set the properties of the chart **Title**. You define the title you want to edit in the combo box. The first title is automatically named "Title1" and is not visible unless you set its visibility with the first button. The **Add** button is used to add another title object to the chart, while the third button defines the **title text** and the last buttons set its **font** and **colour**.
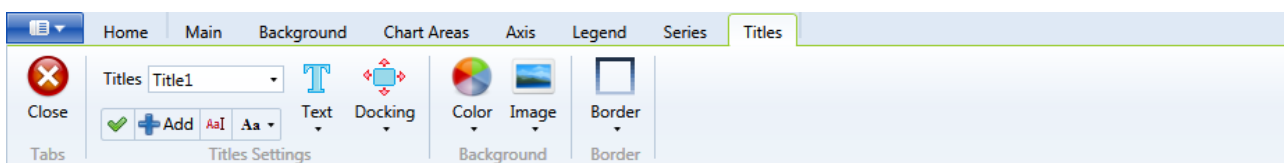
Fig. 56: *Ribbon tab for setting the Titles properties.*

Using the **Text** and **Docking** buttons pictured in Figure **51**, you can set the orientation, alignment, style and other properties of the title. The functioning of the last three buttons is the same as in the previous ribbon tabs, but these are bound to the Title object.

Finally, if you are satisfied with the visual setting of your chart, you can print them or export them using the functions in the **Main ribbon tab**. Although you can display the dialogs for the complete properties for individual chart objects with this tab, only the most often used features and functions are available in the ribbon toolbar.

Having read the manual this far, you understand all the specifics and opportunities available in the program graphic user interface. This knowledge will ensure you efficient and quick work with the program functions contained in the next chapter.

4 Functions

This chapter covers the description of all TS Editor capabilities in version 3.0. Compared to the previous, non-public versions of the program it includes many more functions and options. Its main advantages are:

- The ability of simultaneous multiple document processing
- The capability of merging the results of mass processing
- The speed of calculation and visualization
- The use of command lines
- The ability to combine all functions in variable and effective structures
- The storage of function results in separate documents

The first advantage of the program is described as **mass document processing**. Due to this function, you can import several time series into the program and simultaneously process them using selected functions. When you use a function in your mass processing which determines values for the same object, the results are automatically merged, stored and displayed in a single document. Examples of this are using functions which return; (1) long-term statistical values (min, max and the sum) and (2) logical parameters (the time range of the selected series and the number of values in a document,).

The latest technology and algorithms have been utilized to develop this program, making the import, export and calculations much faster than the older tools in the HydroOffice software package. The speed of this program successfully competes with other program developers' products.

Many functions are single purpose and relatively simple but with their appropriate combination you can achieve high efficiency when working with this program. Here is one example; when you import two time series of river discharges into the program, you can first check whether there are any gaps in the series using **Properties.Gaps.Daily**. If you locate missing records, you include them using "compare interpolation" in the second time series (**Edit.Gaps.FillByComparing**). Then calculate the difference in discharges between these two profiles (**Edit.Combine**). The discharge values can be recalculated from L.sec^{-1} to m^3.day^{-1} (**Edit.Convert**). Select the last three years from the resultant document (**Edit.Select.ByTimeRange**), and you can calculate the monthly maximum values (**Statistic.InTime.Monthly.Max**).

Trying to achieve the same processing in MS Excel takes a long time, but in TS Editor 3.0 it can be done in a minute when you understand the principles of working with this program. Grouping of functions is really intuitive, so in most cases you will be able to use the functions immediately.

In addition, you have access to each intermediate result of your work in the form of documents, and therefore you can return to any step of your processing procedure. All functions are divided into nine groups (Table **1**). The functionality of all tools, commands and functions are described according to these groups which are divided in the tree structure in the **Functions panel**. This panel includes all commands in the program, and these are described in order beneath Table 1.

Table 1   Command groups and their description.

Group of functions	Description
Application	basic functions for working with the program
Documents	functions for working with documents in memory
Data	functions for data import, manual definition and export
Properties	functions for obtaining information about time series (metadata)
Edit	functions for time series editing
Functions	specialized functions of the program
Statistic	statistical features of the program
Visualization	functions for time series visualization
Cooperation	functions for working with external data formats, software and databases

4.1 Application

Commands from the **Application** group allow **fundamental** work with the program. Individual commands can minimize the window, display the user's manual, show or activate individual panels or exit the program.

4.1.1 Application.Help

This command is used to display the **user's manual** for the program, and it is the first item in the Ribbon Main Menu (Fig. **4**).

4.1.2 Application.Minimize

This command is used to **minimize** the window.

4.1.3 Application.Restore

The **Application.Restore** command is used to restore the original size of the window if the window was previously maximized to full-screen.

4.1.4 Application.Maximize

This command is used to **maximize** the window to full-screen. Together with the two previous commands, this command can substitute for the buttons in the upper right corner of the window.

4.1.5 Application.About

This command displays an individual window which gives basic information **about the program**, such as its name, version, description, licence, name of the licenced user and licence identifier (Fig. **57**).
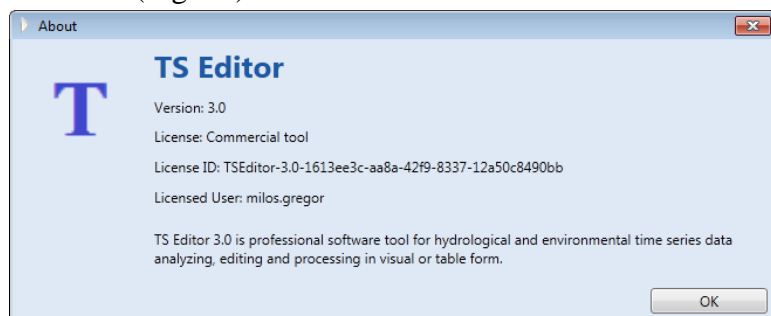
Fig. 57: *Window highlighting information about the program.*

4.1.6 Application.End

This command will **stop** the program immediately while you confirm the message box.

4.1.7 Application.Functions

This command activates the **Functions panel**. When it is closed, this opens it in the defined place. This command, together with the following two, can also be run through the ribbon toolbar.

Their locations are shown in Figure **58**.

Fig. 58: *The position of the "Application.Functions, Application.Processes and Application.Log" commands in the ribbon toolbar.*

4.1.8 Application.Processes

This command activates or displays the **Processes panel** where a list of documents and their functions is displayed.

4.1.9 Application.Log

The **Application.Log** command activates display of the **Output Log panel** where all the program logs are recorded.

4.2 Documents

The commands in this group enable elementary work with documents loaded in the computer memory and displayed in the panel called "Documents".

4.2.1 Documents.Show

This command allows you to **view** all the **documents** selected from the Documents panel in one separate window.

4.2.2 Documents.ShowAll

In contrast to the previous one, this command will **display all documents** in separate windows. The command also displays those documents not selected in the Documents panel.

4.2.3 Documents.Close

The **Documents.Close** command is used to **close** the currently **active document** window, but it does not delete the document from memory.

4.2.4 Documents.CloseAll

This command **closes all** open documents, but does not delete them from memory.

4.2.5 Documents.Edit

The **Documents.Edit** function displays a new window where you can edit a selected document (Fig. **59**). The equivalent of this command is also available in the ribbon toolbar (Fig. **59 Right**).
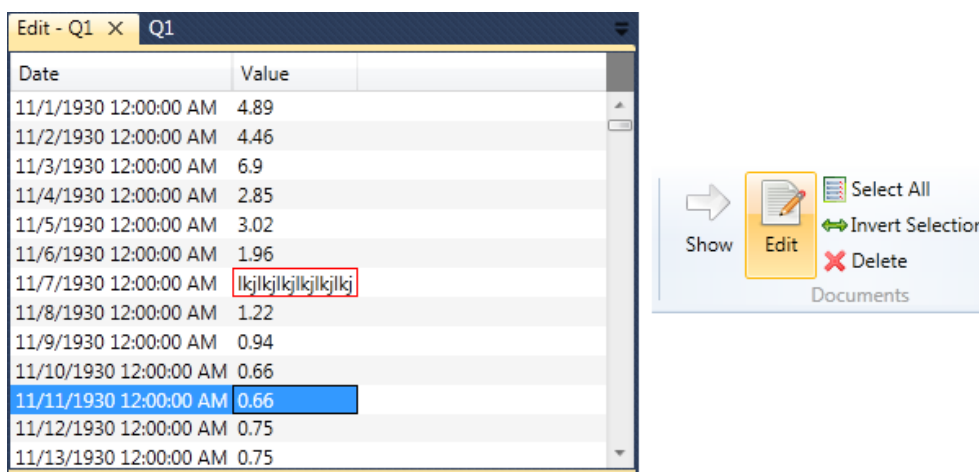
Fig. 59: *Left – this window manually edits the selected document with value format checking; Right –the ribbon button which initiates this feature.*

This function has a special window display where you can **manually edit** document values. The window header text is always composed of the text "**Edit'' -** and the name of the selected document. Here you can edit all types of documents. During editing, the program controls whether the adjusted values meet the defined values format, and editing is recorded directly into the object in computer memory, so changes cannot be returned. If you select an entire row and press the

Delete key, the entire current row will be removed. When you finish editing, just close the window.

4.2.6 Documents.Delete

The **Documents.Delete** command is used to delete selected documents from computer memory. You can also use the **Delete** icon at the end of each item in the Documents panel to achieve the same result (Fig. **60**). If the document is opened as a separate window, the window does not automatically close, but the program asks if you want it closed.

4.2.7 Documents.DeleteAll

In contrast to the previous command, this completely **deletes all documents** from computer memory. However, they still remain open in windows that display them after deletion. You can collectively close them using the **Documents.CloseAll** function. In addition, information about documents still stored remains in the

Fig. 60: Deletion of selected documents by clicking on the delete icon.

"Processes" panel table.

4.2.8 Documents.Rename

The **Documents.Rename** command is used if you want to change the name of the selected document, but you cannot use this if you have selected multiple documents.

4.2.9 Documents.Comment

This command also cannot be used for multiple documents. This function adds a comment to your selected document which appears as an item in the tooltip when you keep your mouse cursor over the document for longer than normal.

4.2.10 Documents.SelectAll

This command selects all documents stored in memory for further processing, and both this command and the next command "**Documents.InvertSelection**" are featured in Figure **61**.

4.2.11 Documents.InvertSelection

The command **InvertSelection** checks all documents in the Documents panel. If the document is not selected the program will select it, and visa versa- if the document is selected the program will dese-

Fig. 61: Examples of the commands "SelectAll" and "InvertSelection".

lect it. An example of this is shown in Figure **61**.

4.2.12 Documents.SeriesType

You can adjust the type of time series you want using **Documents.SeriesType** subgroup commands. The program automatically detects the type. However in very exceptional cases, if the program makes a mistake you can manually redefine your type. You can select time series defined as **Weekly**, **Daily** or **HMS** type. This parameter determines the time-step of measurements in your document. If this time-step is not constant, or where it varies in time or includes gaps in the series, the document is marked as an "**Unknown**" type. The weekly and daily time series types are very valuable in your work. However, the last (**HMS**) time step is less than 1 day, and the step is calculated in hours, minutes or seconds. In most cases, this type of definition only has information value.

4.3 Data

Functions grouped under **Data** in the program are used to create, import and export documents (Fig. **62**). The classic data structures described in the following subchapter are used for import and all other tools of HydroOffice software package**.** Additional program options for importing and exporting data are listed in the **Cooperation** section.

Fig. 62: *Functions of the "Data" command group.*

4.3.1. Data.Open

The **Data.Open** function is the most basic function in the program because it is used to **import the time series** of values into the program. After executing this command, the **Open File Dialog** appears so that you can choose the file you want to import. This file has a format standardized for HydroOffice software, and it must have the extension ***.txt** so it can be edited by the appropriate text editor.

The structure of the file is shown in Figure **63**. The file has two columns, where the first is reserved for date and time values and the second presents the actual measured values. These values can have an integer, decimal, float or double-precision format and columns are separate by tabs.
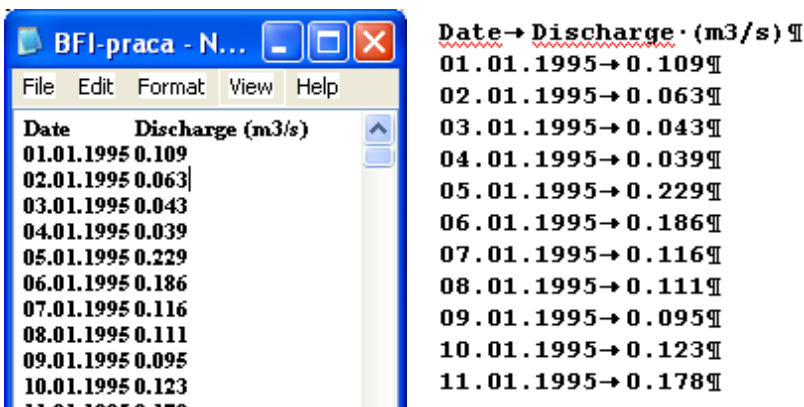
Fig. 63: *Example of a prepared file (**Left** – example of an open file; **Right** – the structure of the time series file).*

Although the first row is **reserved for the description** of values, it has the same format as the other rows, except for the data format string. Your formatted file is imported into the program.

A problem exists, when your file contains values in a different format to that defined in the computer's operating system. The most common example is when you have different settings for the decimal separator in the system and in the file. This occurs with "**,**'" and "**.**". This must be equally set in operating system and also in input file.

4.3.2. Data.Create

The **Data.Create** command allows you to prepare a document directly and manually in the program. There are two methods of entering data into a table (Figs. **64** and **65**). A specialized window is displayed when you click on this command. This window consists of two parts; one part from the toolbar and one from the table. You have a choice of two buttons on the toolbar, and the program includes this simplified function for entering your data manually.

This feature appears when you click on the **Define** button in the toolbar and assists you in defining the "start" and "end" time characteristics. When this is defined you must also define the time steps in days, hours, minutes or seconds. Each value is finally summated to the resultant time step measurements. This step can be defined, for example, as 0 days, 2 hours, 30 minutes and 0

seconds. The final step will then read 2:30. When these parameters are set, click on the **Generate** button and the program automatically fills in the time column with your temporal values, from your defined "start" to "end" of your chosen time step. This accelerates work with manual data entry, because you only need to add your measured values. If you want to delete the selected row, press the **Delete** key.

The second method of data entry is more interesting. When you have defined values in any spreadsheet application (for example in MS Excel or OO Calc.) these can be transferred into the program using **Ctrl + C** and **Ctrl + V**. Copied values must have the same character as that of the file structure, so you must select two columns. The first column contains date-time values and the second has the measured values. For this purpose, the selection does not include the header row.
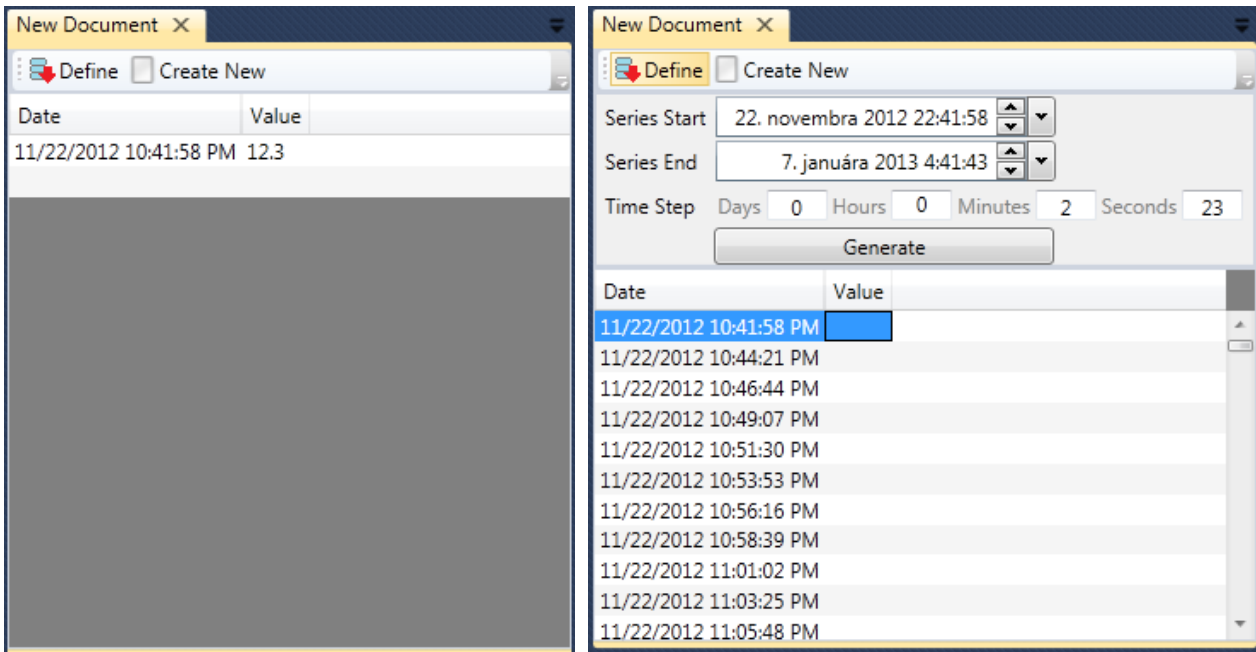
Fig. 64: *Manual time series definition and generation.*
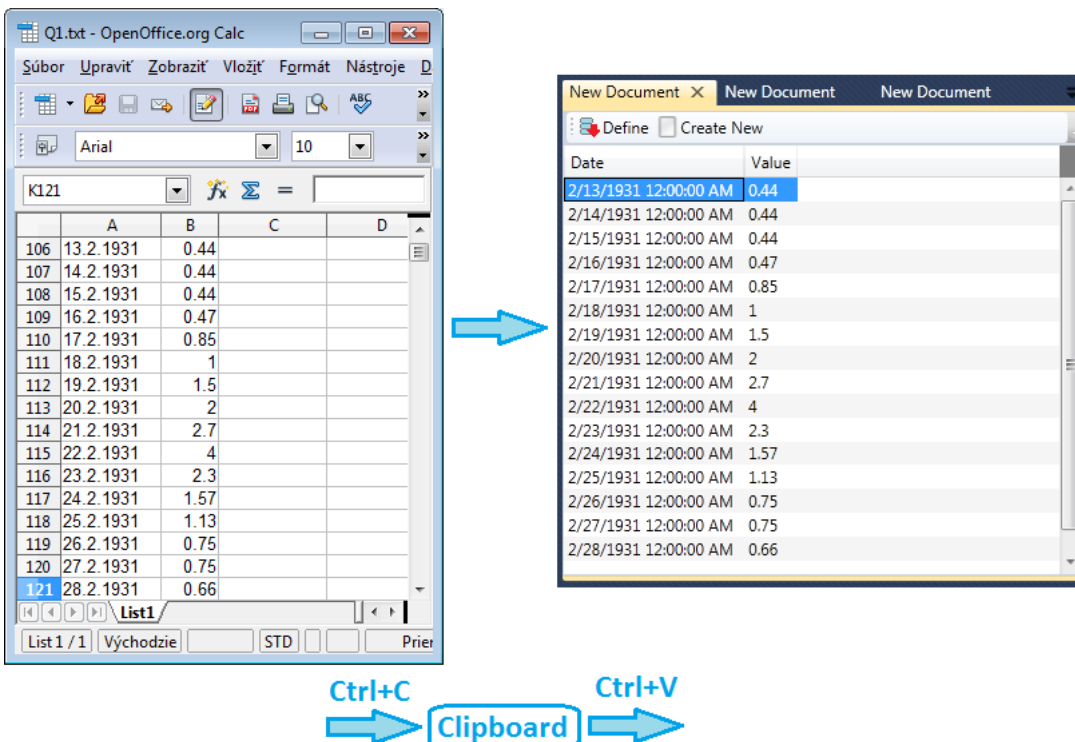
Fig. 65: *Document creation using the Ctrl + C / Ctrl + V function.*

When you have made your selection, press **Ctrl + C** and switch to the TS Editor. If you mouse-click on the table, you can press **Ctrl + V**. The program reads the data from the **clipboard** transfers it line by line and adds it to the table. If the table is empty, the program begins adding from the first row, and if there is already data in the table, the program adds it to the end of your table.

Now that your data is prepared in the table, just click on the **Create New** button in the toolbar and the program first asks you to define a name for the new document and then adds it into memory. The only requirement here is that the new document must have **more than 15 rows**. You can then work with this new document using all standard functions, tools and commands.

4.3.3. Data.Save

The **Data.Save** function is used to **save** your selected document to a file **on disk**. After initiating this function, the program displays the classic **Save File Dialog** where you define the disk place, name and format of the resultant file. Four file types are formatted; **txt**, **rtf**, **doc** and **xls**. The last two are not actual **doc** or **xls** files; they are **ASCII** text formatted and automatically opened in a predefined program. This approach was chosen because of version compatibility problems with MS Office programs.

As previously noted you can also **copy** the document content **into** the **clipboard** by right-clicking on the document table and selecting the **Copy** function in the popup menu.

4.4 Properties

Functions grouped under **Properties** are used to obtain information about the properties of the time series – **metadata**. You can ascertain the number of values in the document, the number of records with zero value and the number of values in a defined range. In addition, you can locate gaps in your time series and also control your measurement time-steps.

4.4.1 Properties.NumberOfRecords
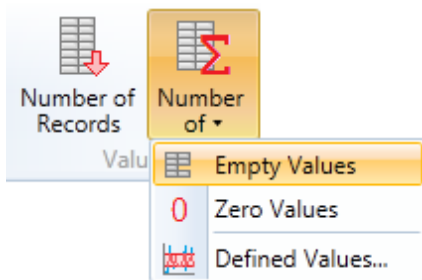
Fig. 66: Commands in the "Properties.NumberOfRecords" group.

You can determine the total **number of records** in the time series with this command. The equivalent of this command is located in the ribbon toolbar where you commence work on this program (Fig. **66**).

This command can be used simultaneously for multiple documents if all selected documents are in a natural time series. Your processed results are displayed in a single merged document, as shown in the example in Figure **67**. This table shows the list of processed documents arranged in the first column and the "records count" values from individual documents are in the second column. The results are also shown in a column graph, where a bar on the X axis is reserved for each document and the values are on the Y axis.
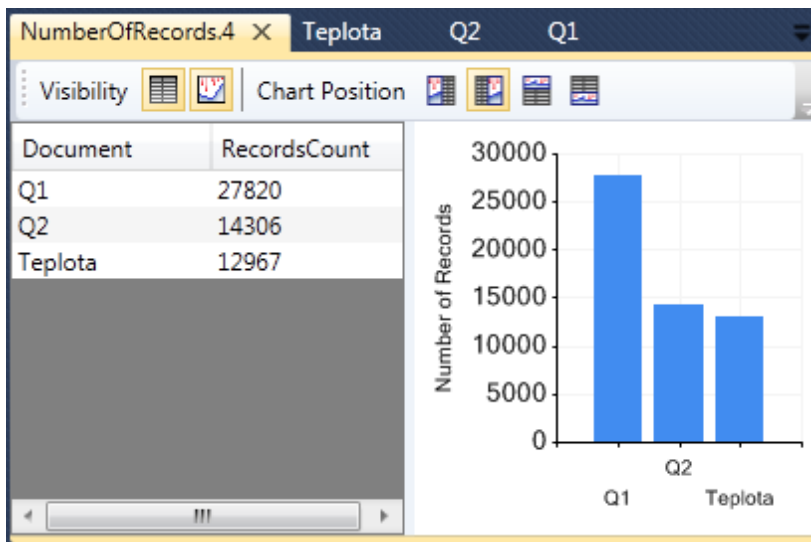
Fig. 67: *Example of a document created by the "Properties.NumberOfRecords" function.*

4.4.2 Properties.NumberOf

The commands in the **NuberOf** group calculate the number of specific values in your document. The three separate functions of this group are now described.

4.4.2.1 Properties.NumberOf.EmptyValues

This function counts the number of records for which you have defined the time, but not the specific values: and therefore the cell in the **Value column is empty**. This empty cell has specific functions which are described later**.**

4.4.2.2 Properties.NumberOf.ZeroValues

This function counts the number of zero values (**Value = 0**). Examples of this can occur in time series such as for air temperature and daily precipitation totals.

4.4.2.3 Properties.NumberOf.DefinedValues

You obtain the number of values in a **user-defined range** with this function. Their definition appears as a discrete dialog where you can define the **upper** and/or **bottom value range** (Fig. **68**). Defining only one threshold allows you to determine the number of all values above the lower threshold of the defined value or below its upper threshold. When you define and activate both thresholds using the **IsUsed** check box, you can determine the number of values in a specific range. When their definition appears, click on the **Calculate** button and the program calculates your count and displays the result in a new document. You can use this function simultaneously on multiple documents.
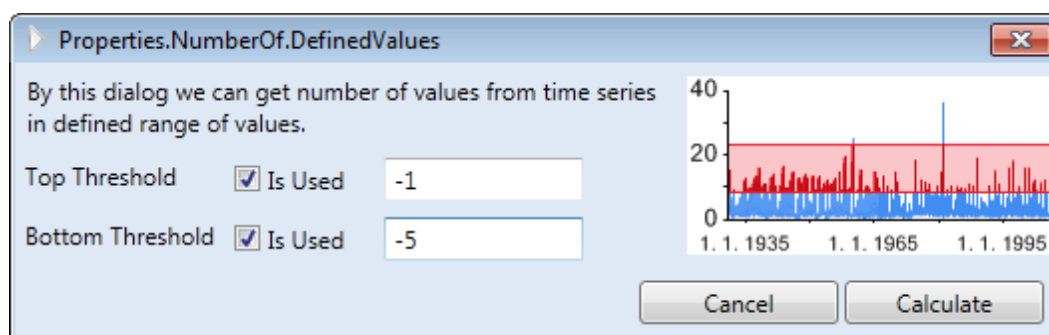
Fig. 68: *Dialog for defining the range of values you want to count.*

4.4.3 Properties.TimeRanges

The **Properties.TimeRanges** function shows the beginning and end of your time series from selected documents in the one table. Although this table structure is similar to tables used in previous functions, the time series ranges in this chart are displayed as bar ranges (Fig. **69**). This function simply copies the date and time values from the beginning and end of your document.
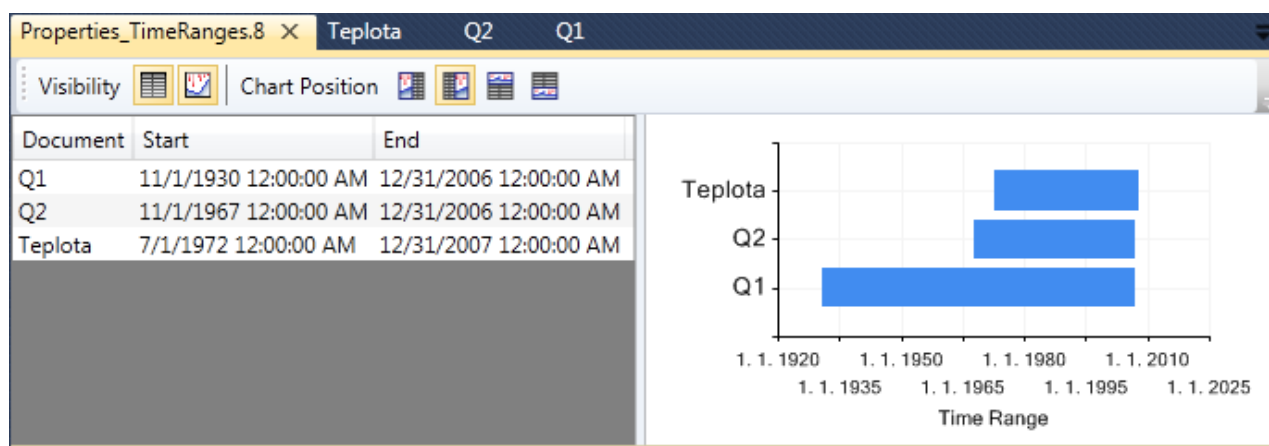
Fig. 69: *Document showing the obtained beginning and end temporal values for each selected document, together with its visualization.*

4.4.4 Properties.Gaps

The **Properties.Gaps** functions are used to locate gaps in your time series and search for varying gap lengths. These functions are hidden under the Gaps button on the ribbon (Fig. **70**).
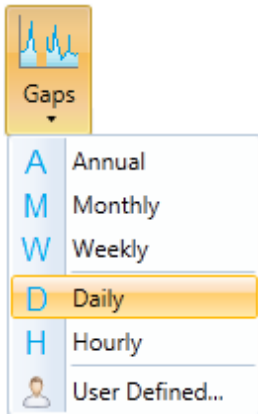
Fig. 70: *Commands in the "Properties.Gap"s group.*

4.4.4.1 Properties.Gaps.Annual

This command allows you to search for gaps in your time series which are longer than **1 year**. When such missing records are located, the start and end of this period are entered on your table.

4.4.4.2 Properties.Gaps.Monthly

This command is similar to the previous one, except here your document search covers periods of at least **1 month** with missing values.

4.4.4.3 Properties.Gaps.Daily

This command also searches for missing values, but the length of the gaps without measurements must be at least **1 day**. An example of gap results is shown in Figure **71**.

The table shows the time range of these gaps with their length in the number of days. The highlighted gap periods in the graph time line are shown as a series of range bars. For this type of command we can also select multiple documents simultaneously, but the results are displayed in a separate document for each time series.

Fig. 71: *New document with a list of periods with missing values in the time series.*

4.4.4.4 Properties.Gaps.Weekly

This command searches for missing values, and the minimum length of this period must be at least **1 week**.

4.4.4.5 Properties.Gaps.Hourly

The command **Properties.Gaps.Hourly** searches for valueless periods in the time series

which must cover at least **1 hour**.

4.4.4.6 Properties.Gaps.UserDefined

This command is user specific, so it allows you to search gaps in the time series according to your own precisely defined time range. You can define your time step as in the dialog in Figure **72**.
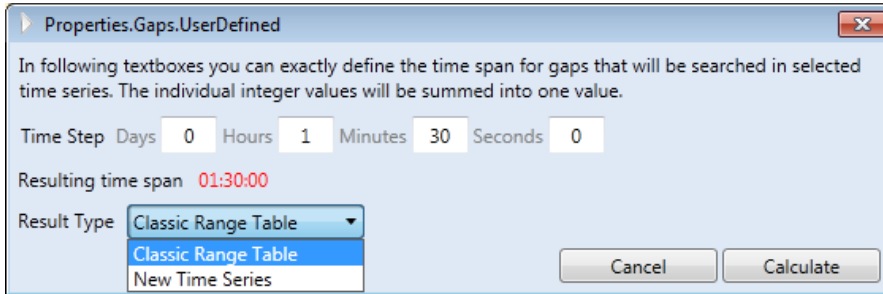
Fig. 72: *Window for locating user-defined gaps in the time series.*

Use the text boxes at the top of the window and define the length of your gaps in days, hours, minutes and seconds. The resulting value is then displayed in the next line. In the combo box (last line) define the **type of output table**. Your output can define the **classic range table** or a document containing your **new time series**. The classic range table for missing values was described in previous section. The result in the form of the new time series is shown in Figure **73**.
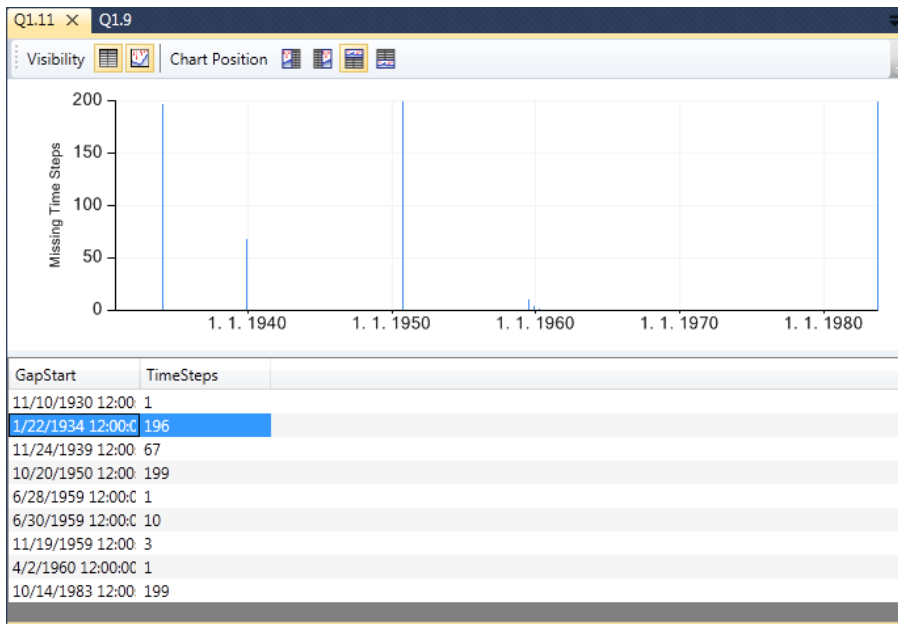
Fig. 73: *The check for missing values in your time series; in the form of a new time series.*

In this type of output, you can define the missing values using the date where your gap commences and the number of days with missing values. Since this is a chaotic time series and cannot be displayed as a linear graph series, it is shown in a bar arrangement. The advantage of this is that the output result can be used as a new document for further analysis. An appropriate example of this is the annual average count of days with missing values (**Statistic.InTime.Annual.Avg**),

4.4.5 Properties.IsContinual

This command function is quite simple. It checks whether the records in your document are **continuous in time**. The program runs through the individual records in your document and checks whether each record is later in time that the previous one. If this condition is **True** for all records, the program notifies this in the new document. Again, multiple documents can be simultaneously selected and the results merged into a new document. This is a simple check of your time series continuality, but it also notifies you if two separate series have been merged into the one document.

4.4.6 Properties.HasUniformStep

Unlike the previous functions, this checks whether the **spacing between** the time measurements is **uniform**. If it is uniform, the program returns **True** for the selected document. If the measurement frequency changes over time or a document contains gaps, it shows **False**. Multiple documents can again be processed simultaneously and results merged in a single summary document.

4.4.7 Properties.ShowTimeSteps

This function is related to the previous one which determined whether the values in your document are measured in the same time step. When this program indicates that the spacing is not uniform, the measurement time step can be visualized using this command. The example in Figure **74** shows measurement time step changes during your experimental period; The first half of the period until 1964 has values measured in a 7-day step, the series then has a gap where the step = 0, and finally values until the end of document have a one-day interval.
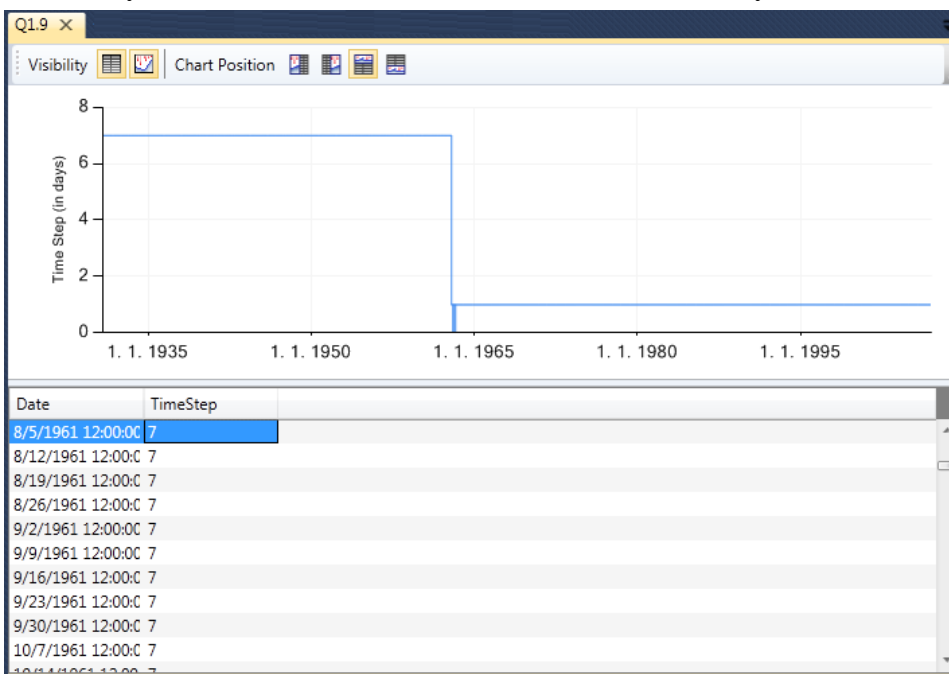
Fig. 74: *Example of results from the "Properties.ShowTimeSteps" function.*

4.4.8 Properties.IncreasingSegments

Functions in the **Properties.IncreasingSegments** group detect information about the segments in the time series which have increasing character. This function is found at the end of the ribbon tab in the ribbon toolbar (Fig. **75**).

4.4.8.1 Properties.IncreasingSegments.AverageLength

This function determines the average length of increasing segments in your time series. The result is a value of the average length. You can select multiple documents simultaneously for these functions and your results are summarized in a single document.

Fig. 75: *Functions for determining parameters of increasing sections in the time series.*

4.4.8.2 Properties.IncreasingSegments.Length

This function shows the length of the increasing segments over time. The table in Figure **76** illustrates the date and time of commencement of your segments and the second column gives the values of your segment length in the number of days. The average values of discharges here usually increase for 3 days. Segments longer than 5 days occur only rarely and a maximum increased value of 15 consecutive days is shown.
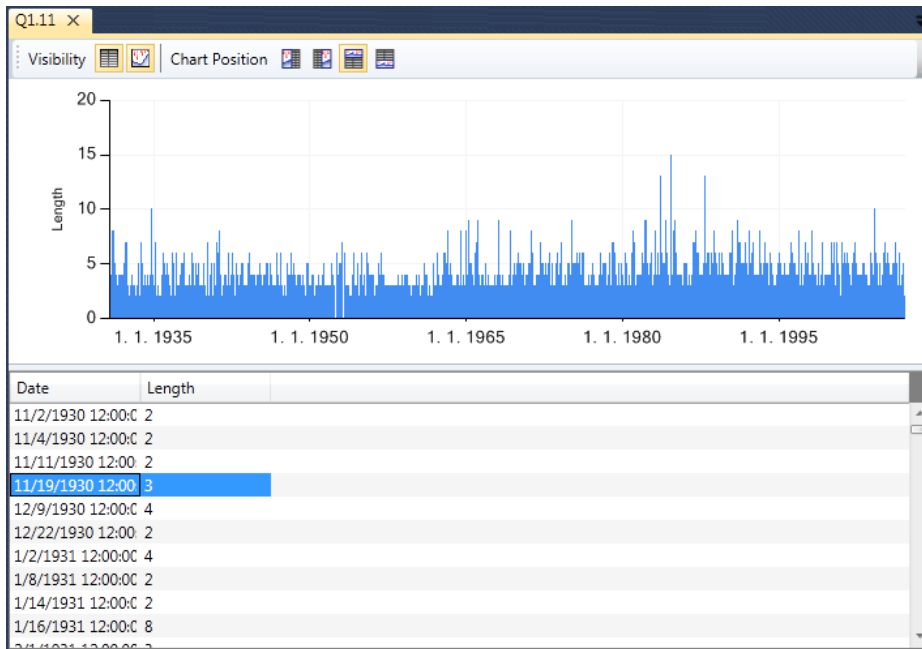
Fig. 76: *Visualization of increasing segment length over time.*

4.4.8.3 Properties.IncreasingSegments.TotalLength

This function presents the **total length** of increasing segments as a single number for the entire series.

4.4.8.4 Properties.IncreasingSegments.Count

Unlike previous function, this command finds the **total number of segments** with increasing values in your selected document. Multiple documents can be manipulated simultaneously and results combined in one document.

4.4.9 Properties.ConstantSegments

This group includes commands similar to the previous one, except that it analyzes the characteristics of **segments with constant values**. This function allows simultaneous multiple document processing.

4.4.10 Properties.DecreasingSegments

Four functions in this group are designed for segments with **decreasing values over time**. Since these functions have already been sufficiently described in previous subsections (4.4.8), they will not be described in detail here.

4.5 Edit

Functions of the **Edit** group are used to **adjust the time series**. This group of commands and tools has the richest value in processing your results. These commands allow you to **select** and **filter** time series, **fill** gaps, **delete** selected sections or **combine** two time series into one using a number of parameters. The individual functions are described in the following subsections.

Fig. 77: *Commands in the "Edit.Select" group.*
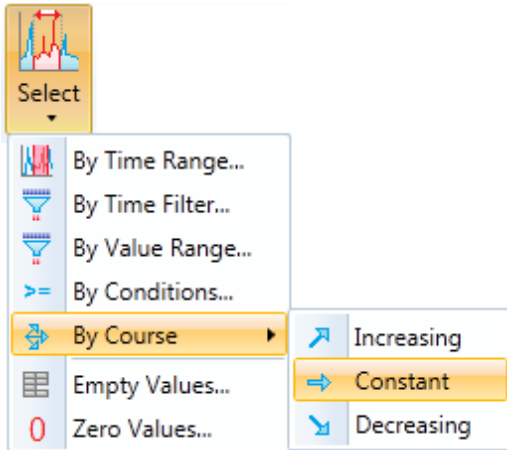
4.5.1 Edit.Select

The **Edit.Select group** includes tools which enable you to select parts of your time series data into a new document. They can be selected by **time range**, **values range**, using **special filter** or according to **user-defined conditions**.

Most features here can be used simultaneously in multiple documents, resulting in creation of several new documents. This means that the results are not merged into a single document. The first selection option is used for editing by "time range" selection.

4.5.1.1 Edit.Select.ByTimeRange

The **Edit.Select.ByTimeRange** function allows you to import part of your time series from the selected document into a new one. Here, however, you can select only one document. Click on this function and your selected document is displayed in a separate window. Using bottom **sliders**, you **define time range** to be copied into the new document (Fig. **78**). The selected graph segment is highlighted in red colour. The beginning of your time range is defined by the upper slider and the end by the lower slider. The dates of your selected beginning and end are shown on the right side of the sliders. When you have defined this time range, your selected values are copied into a new document (Fig. **79**).
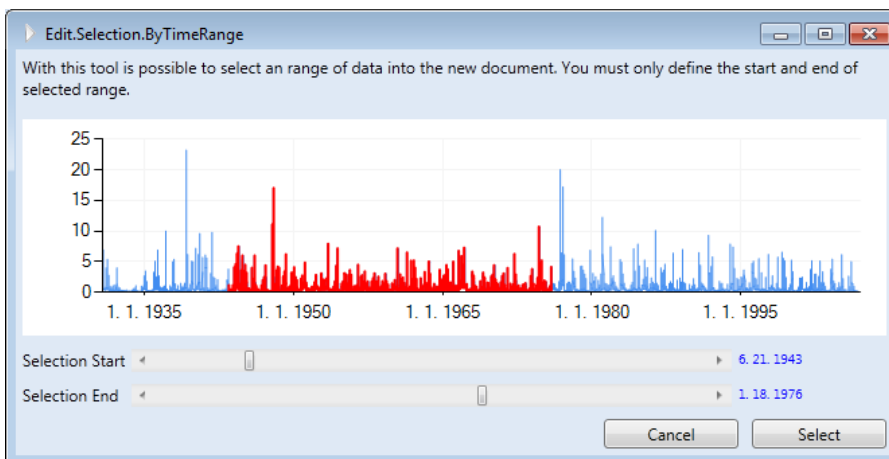
Fig. 78: *Your choice of time series imported into a new document, using the defined "time range".*

The following specific visualization in Figure **79** results from using any commands in the **Edit.Select**. The graph portion of the document window is displayed in the original document (**blue**) and values from new documents are displayed as points (**orange**). The table portion shows only the selected values. This view was selected because it is clear that the values come from the **Edit.Select** function. However, if the original document is deleted from memory, this document is visualized as a classic linear series of values over time.
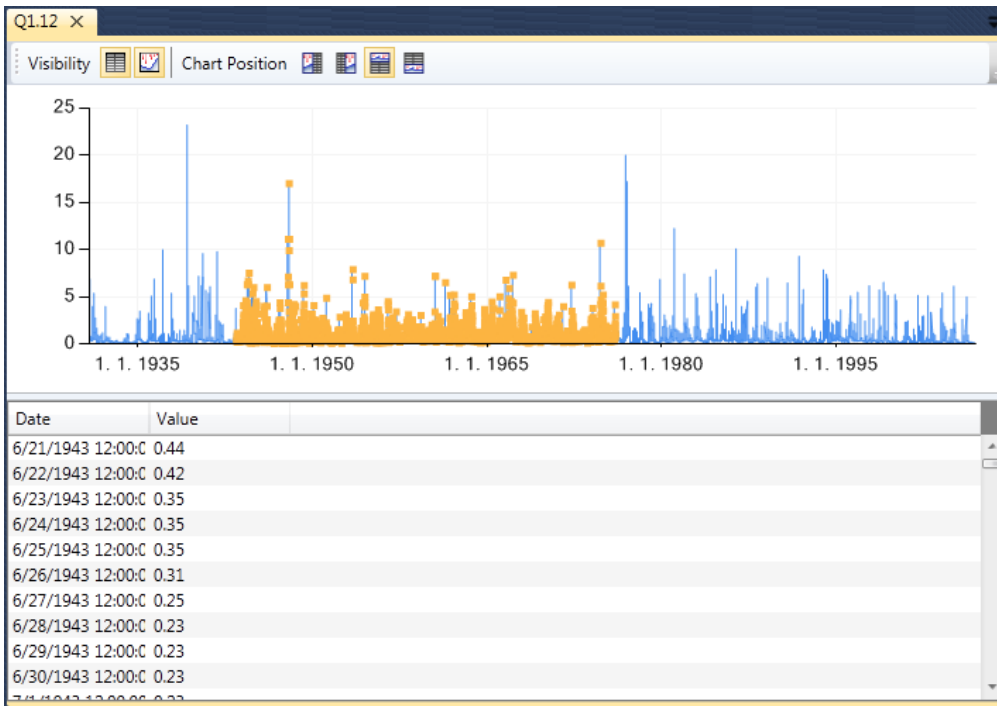
Fig. 79: Example of a document created by the "Edit.Select" command.

4.5.1.2 Edit.Select.ByTimeFilter
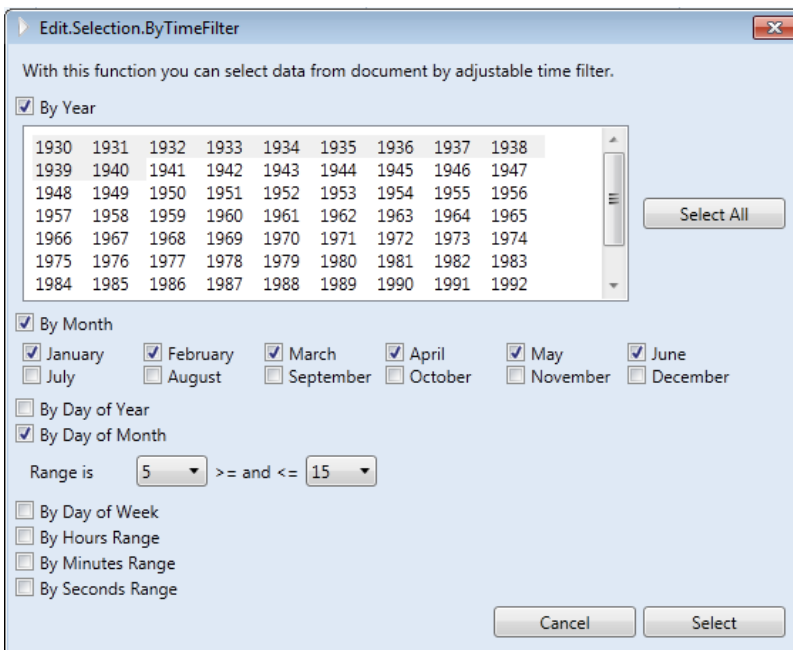
Fig. 80: Tool used for selecting data according to its temporal characteristics.

The second choice for time series data selection is based on **temporal characteristics and parameters** of the time series. The dialog shown in Figure **80** is displayed when you click on this command. You can vary filtering of your series quite considerably using the settings in this window, and this function can be used simultaneously for several documents. Data can be filtered according to eight parameters. When you select the parameter you want activated, click on the **check box** to activate the filter. If you do not want to use the selected filter, the **IsChecked** parameter must be set to False. You can also use a combination of different filters here, as shown in Figure **80**.

(1) The first filter selects your data **by year**. From the list of years, select those you want to copy from the existing document, (2) The second filter sorts the data **by month of the year**.(3) The third filter lets you select data according to the **day of year** (1 – 366). During the selection process, the program reads the current date. If the value meets your defined range conditions, copy the current row from the series into a new document. (4 -8) the remaining filters let you filter the data by **day of month**, **day of week**, **hours**, **minutes** and **seconds ranges**.

The example of combining these filters in Figure 80 allows you to copy the records in your current document from the years 1930-1940, from the months January – June and from the 5th to the

15th day of those months. When you define these filters, the program copies the data that meets your specified parameters into a new document.

4.5.1.3 Edit.Select.ByValueRange

Fig. 81: *Data selection according to value range definition.*

ties.NumberOf.DefinedValues.

With this filter you can create a new one from the current document that meets the **condition of values range** defined by one or two thresholds (Fig. **81**). If you want to activate the upper or lower limit, just click on the check box **IsUsed** and define the required value. This command is set similarly to the function **Proper-**
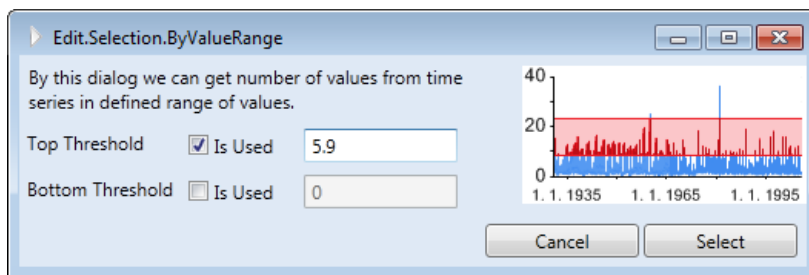
4.5.1.4 Edit.Select.ByConditions

Using this tool, you can select data from any type of document based on a **user-defined filter**. Example of dialog is shown in Figure **82**.
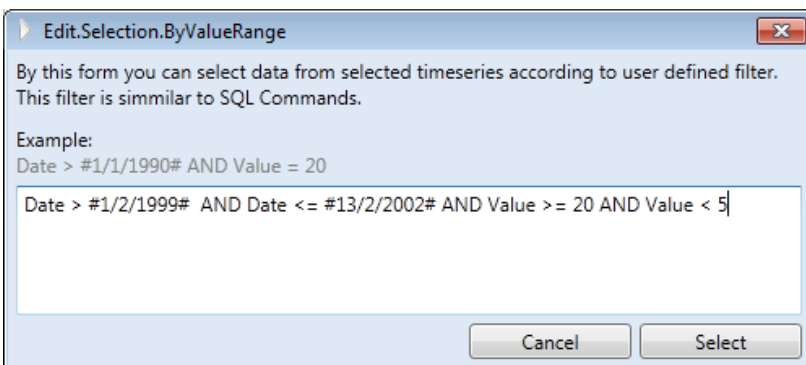
Fig. 82: *Data selection according to user-defined filter.*

In this dialog, you write your user-defined filter script in the text box. Its structure is the same as for a **SQL** command after the **WHERE** clause. You can use this tool for both time series, and any other type of document. Each condition consists of a **column name** (e.g. Date) **operator** (e.g. >, =, <=) and **value** (12.2; #13/2/2002#; 'Document_Name'). If the value has a string character, it must be enclosed in **'quotation marks'**. If it is a numerical value, you write it without the quotation marks and if it is date-time it is enclosed by **#**. If you use multiple conditions you must join them by the operator **AND** or **OR**. For example, you can use the following command:

> **Date** > #1/1/1999# AND **Date** <= #31/12/2000# AND **Value** <= 20 AND **Value** > 5

As shown in the box above, this command selects values greater than 5 and equal to or less than 20 from the 1999-2000 time series. Using this function, you can define highly customized scripts for your data selection.

4.5.1.5 Edit.Select.ByCourse

The commands in this subgroup can be selected from time series segments which have a certain characteristic; such as segments of values with a constant or increasing trend. These commands can be used on several documents simultaneously, and the same number of new documents will be created.

4.5.1.5.1 Edit.Select.ByCourse.Increasing

This function **selects segments with a growing trend** of values from the current time series and copies them into a new document. Examples are shown in Figure **83**. The original time series is shown by the blue line and the selected increasing segments are highlighted by red dots.
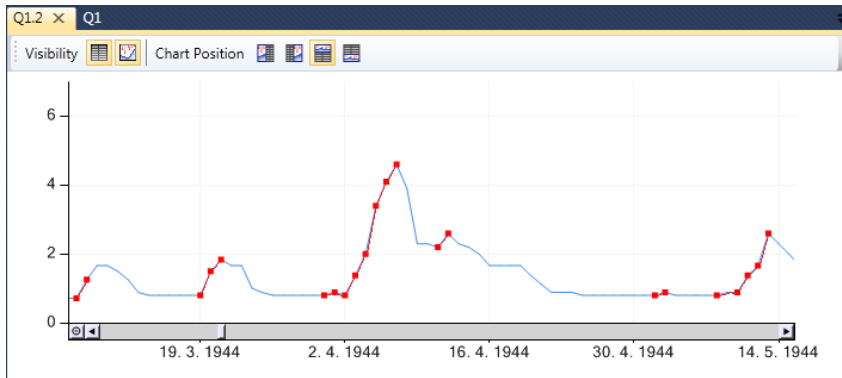
Fig. 83: *Example of result from the 'Edit.Select.ByCourse.Increasing' function.*

4.5.1.5.2 Edit.Select.ByCourse.Constant

Similar to the previous function, this also **selects** data into a new document according to their course. This function selects segments with a **constant course** of values.

4.5.1.5.3 Edit.Select.ByCourse.Decreasing

This function has the same characteristics as the previous two, but the time series **selects** segments with a **decreasing trend** in values.

4.5.1.6 Edit.Select.EmptyValues

The **Edit.Select.EmptyValues** function **selects** an **empty cell** in the **Values column** in your document record. These empty cells occur when some commands are used.

4.5.1.7 Edit.Select.ZeroValues

This command allows the user to **select** records in a time series which contain **zero value**. For example, zero values are typical in air temperature and precipitation time series.
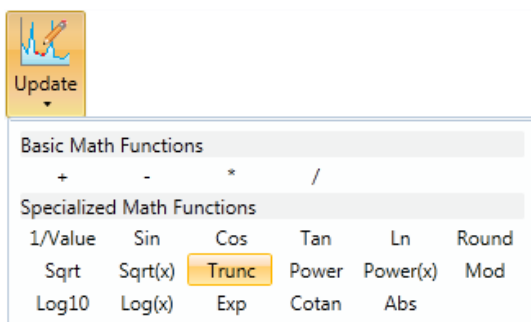
Fig. 84: *Functions in the Edit.Update group.* mathematical functions.

4.5.2 Edit.Update

Functions in the **Edit.Update** subgroup can be used to edit data by selecting simple functions. These functions are under the **Update** button on the ribbon toolbar (Fig. **84**). Again, you can select a number of documents and the results will be stored in the same number of new documents. You can use these functions to adjust the values in your current document using simple

4.5.2.1 Edit.Update.+

This function is used for **addition** of your defined value to current values in the time series.

When you click on a function in this group, an input box is displayed. Here you enter your required value and the program automatically performs the selected mathematical operation with all values in your document.

4.5.2.2 Edit.Update.-

In contrast to the previous function, this allows you to **deduct** your value from the values in the time series.

4.5.2.3 Edit.Update.*

Using this function, you **multiply** the time series values by a defined amount.

4.5.2.4 Edit.Update./

This final basic function allows you to **divide** time series values by a defined amount.

4.5.2.5 Edit.Update.Math

The **Edit.Update.Math** subgroup of commands contains 17 mathematical functions used in the same way as the previous functions. They are described in Table **1** below.

Table 1   Functions in the Edit.Update.Math subgroup of commands.

Name	Description
1/Value	Returns 1 / current value in the time series
Sin	Returns the sine of the number
Cos	Returns the cosine of the number
Tan	Returns the tangent of a number
Ln	Calculates the natural logarithm
Round	Rounds the number to a defined accuracy
Sqrt	Returns the square root of the number
Sqrt(x)	Returns the X_{th} root of the number
Trunc	Removes decimals
Power	Returns the square number
Power(x)	Returns the X-squared number
Mod	Computes the remainder after dividing by number
Log10	Calculates the logarithm of the number
Log(x)	Calculates the logarithm to the base
Exp	Calculates the square of the "e"
Cotan	Returns the co-tangent number
Abs	Returns the absolute value of a number

4.5.3 Edit.Delete

Functions in the **Edit.Delete** group are used to **records deleting** from the time series of the selected documents (Fig. **85**). These commands are exactly the **opposite of Edit.Select** commands. Individual features and tools are the same in both groups, except one group selects the data and the other deletes it. The function and use of each tool was previously explained in detail in chapter **4.5.1**.
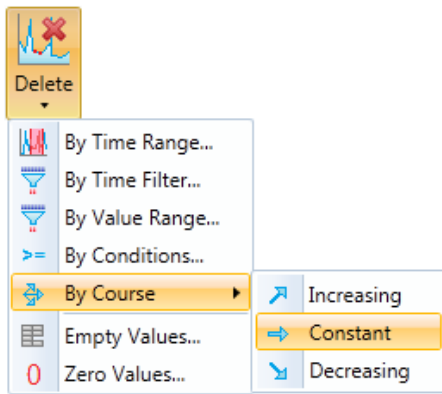
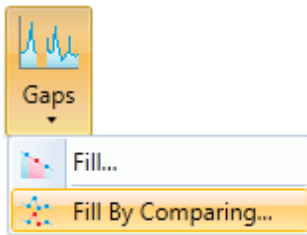Fig. 85: *Functions to delete data from your time series.*

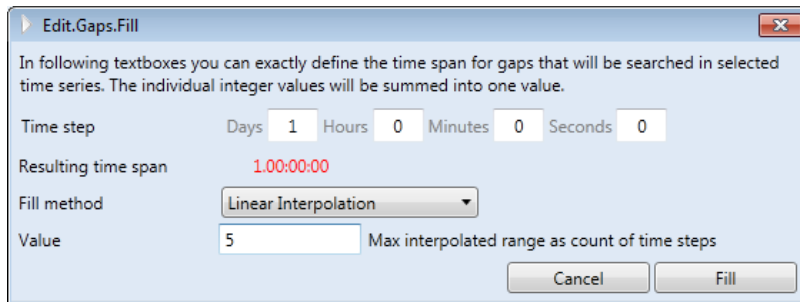Fig. 86: *Functions for filling gaps in your time series.*

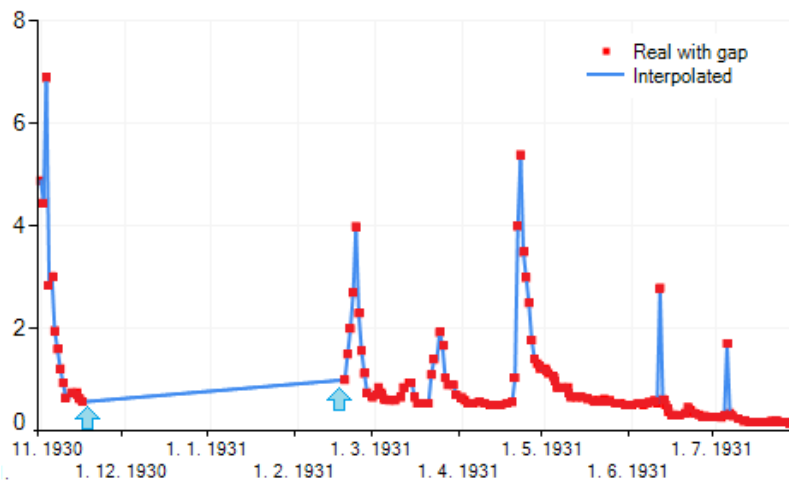Fig. 87: *Form for filling gaps in your time series.*

Fig. 88: *Example of gap filling in the time series of river discharges using linear interpolation.*

The only thing you must remember is that these functions work in reverse; these delete your selected values.

4.5.4 Edit.Gaps

There are two tools to fill the gaps in time series in the subset of **Edit.Gaps** commands (Fig. **86**). The first function is used to fill gaps with simple linear interpolations from the last two values, while the second command works on a comparative interpolation basis. Their functions are presented in the following text.

4.5.4.1 Edit.Gaps.Fill

The first function displays the form in Figure **87**. With this tool, you can **fill the gaps** in the time series using a simple method. First, you set the time step which defines the step of values measured in the time series. Setting the **Time Step** parameter has been described several times above, but in addition to entering values manually, you can increase or decrease the values in the text boxes using the **mouse wheel**. When you rotate the wheel in one direction, the values are reduced, and values increase with wheel rotation in the opposite direction. If you have defined the time step for value measurement in your document, then you only need to define a gap filling method.

This method is selected using four options in the **combo box**. Missing records can be inserted using the following options; **linear interpolation**, **empty cells in Values column**, or **zero** or **user-defined constant value**.

If you select a linear interpolation, the program interpolates the missing values from the last existing ones. In addition, the user can set the **maximum length of the interpolated period** in the next text box. If the time series is in daily step and you set this value to 5, this gives you the maximum length of the interpolated segment of 5 * time step = 5 days. If the gap is longer than this defined value, the records will be added, but cells in the "Values column" remain empty. An example of values interpolated in the gap is shown in Figure **88**.

If you select the **Nothing** item in the combo box, gaps in the time series will be filled by

empty cells in the Values column. If you choose **Zero**, the cells are filled with zero value, and if you select **User Defined**, the missing records in the time series will be added, but your user-defined values will be substituted.

These tools can be used for multiple documents simultaneously, but the user must be sure that the selected documents have an equal time step. Your results are then stored in separate new documents.

4.5.4.2 Edit.Gaps.FillByComparing

Alternatively, you can **fill gaps** in the time series using the **comparative interpolation** method (Figs. **89** and **90**).
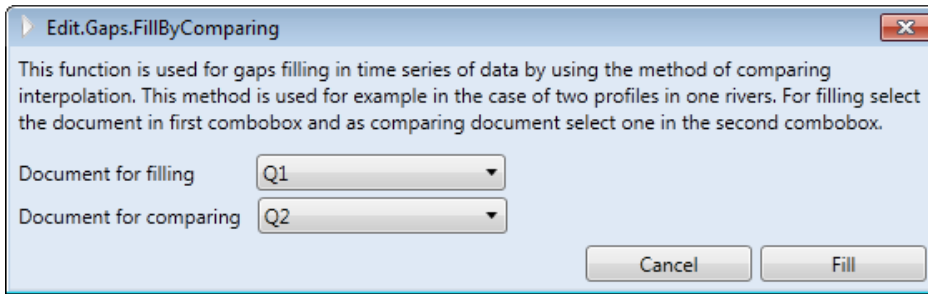

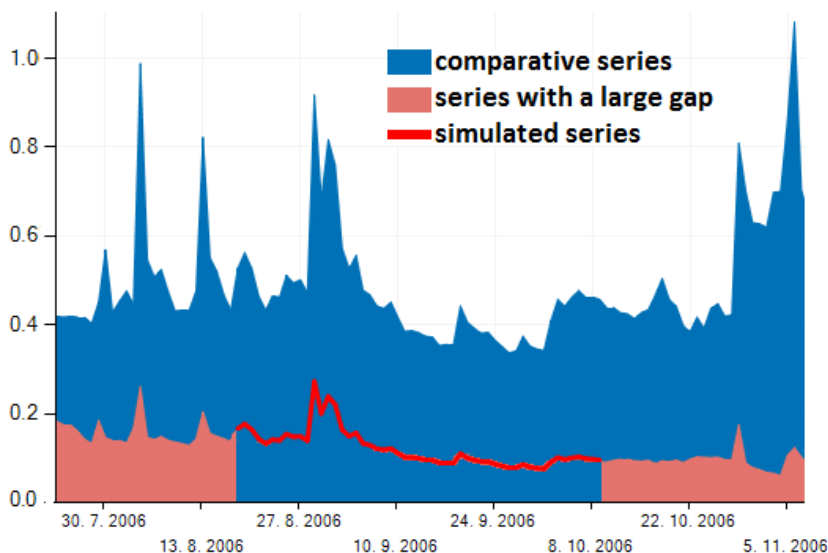*Fig. 89:* *Dialog for setting gap-filling by comparative interpolation.*

Fig. 90: *Example of filling missing values by "comparative interpolation".*

Clicking on this function gives a dialog where you set only two parameters in the combo boxes. In the first combo box you select the document in which you want to fill gaps. In the second combo box you set the document according to the values you want to insert. This gap-filling method is used, for example, when you have the time series of discharges from two profiles in a river – two series with a similar course of values. An example is shown in Figure **90**. Here, a gap was found in the selected time series (**light red series**). The program finds the same time segment in comparative time series (**blue series**) and based on these values, the missing values are filled (**red line**). For this conversion, the program calculates the ratio between the first and last available values in both time series. These two ratio coefficients are interpolated in the missing segment and finally these calculated values of conversion coefficient are multiplied by values from the comparative time series. In this way, the program obtains simulated missing values, and this procedure continues for the next gaps. This method is preferred for longer gaps. A prerequisite for using this method is that the comparative series is complete – without gaps, and the measurement time steps are equal in both series. Where the comparative series also contain gaps, the program copies these into your new document.

4.5.5 Edit.Transform

Functions in the *Edit.Transform* group serve for temporal transformations of time series. For example, daily time series can be converted to weekly series using these functions. These functions
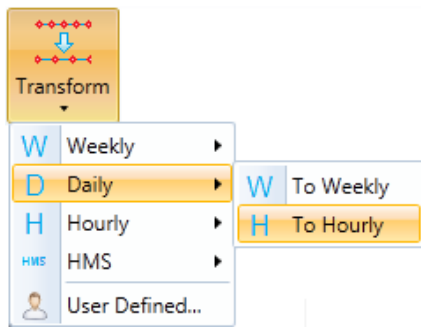
Fig. 91: *Functions for temporal transformation of time series.*

can be found in the ribbon toolbar under the **Transform** button (Fig. **91**). The individual functions are described in the following subsections.

4.5.5.1 Edit.Transform.Weekly.ToDaily

When you click on this command, the dialog in Figure **92** is displayed. With this tool you can change the **weekly type** of time series **to** a **daily type**, and multiple documents can be transformed simultaneously.
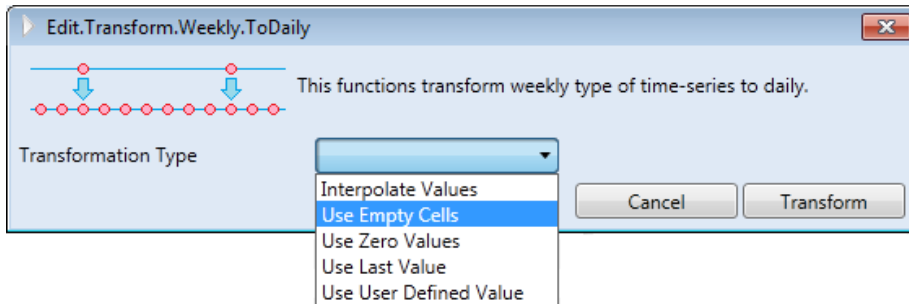

Fig. 92: *Tool for transformation from weekly to daily time series.*

This dialog allows you to set how the values will be added. This option is in the **combo box**. To fill values between weeks you set the **linear interpolation** from existing ones, and new records can be filled by the **last measured value** or **zero**. Alternatively, you can leave the cell in the Value column **blank** or fill it by the **constant user-defined** value. Visual representation of these methods is shown in Figure **93**.

4.5.5.2.1 Edit.Transform.Daily.ToWeekly

Another tool from the transformation group is shown in Figure **94**. This is used to transform daily time series to weekly ones. You can create a weekly time series from the selected daily one and you can set what values you want used. You can set all the following; the **value from the current time step**, the **average weekly** value, the **minimum** and **maximum** value of the week or a **summary** value for the whole weekly step.

4.5.5.2.2 Edit.Transform.Daily.ToHourly

This tool allows you to create a new time series **from a daily time series** to an **hourly** step. After selecting your documents and executing the command, the dialog appears as in Figure **95**. In this dialog you set several parameters. Firstly, set the **hour**, **minute** and **second** to use the current daily value from your selected time series. The other values in hourly steps will be then be generated up to the next day. These values can be defined in a few ways, and this filling method is defined in the combo box. These other values can be filed by **linear interpolation**, by **empty cell**, **zero** or **user-defined** value, or they can be filed by the **last measured** values.

4.5.5.3.1 Edit.Transform.Hourly.ToDaily

In reverse, you can create the daily time series from hourly ones using this function (Fig. **96**). As in the previous cases, you must only choose documents you want to transform and then define the method for completing the values. Here, you can use the **average daily** value, or the **minimum**, **maximum** or **summary** value for your daily time step.
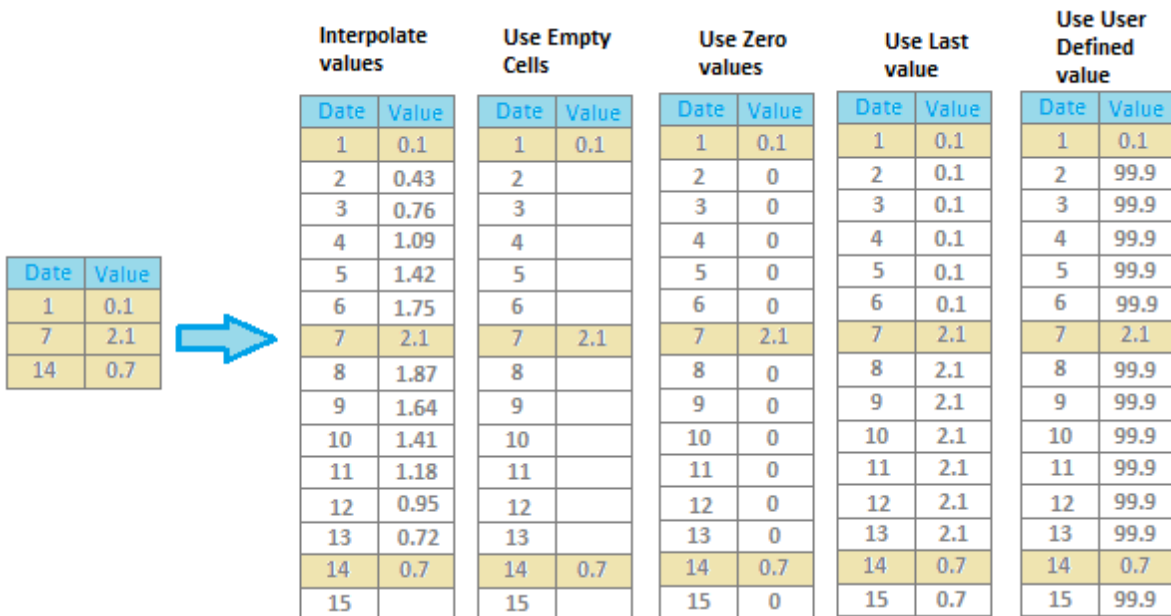
Input:

Date	Value
1	0.1
7	2.1
14	0.7

Interpolate values		Use Empty Cells		Use Zero values		Use Last value		Use User Defined value	
Date	Value	Date	Value	Date	Value	Date	Value	Date	Value
1	0.1	1	0.1	1	0.1	1	0.1	1	0.1
2	0.43	2		2	0	2	0.1	2	99.9
3	0.76	3		3	0	3	0.1	3	99.9
4	1.09	4		4	0	4	0.1	4	99.9
5	1.42	5		5	0	5	0.1	5	99.9
6	1.75	6		6	0	6	0.1	6	99.9
7	2.1	7	2.1	7	2.1	7	2.1	7	2.1
8	1.87	8		8	0	8	2.1	8	99.9
9	1.64	9		9	0	9	2.1	9	99.9
10	1.41	10		10	0	10	2.1	10	99.9
11	1.18	11		11	0	11	2.1	11	99.9
12	0.95	12		12	0	12	2.1	12	99.9
13	0.72	13		13	0	13	2.1	13	99.9
14	0.7	14	0.7	14	0.7	14	0.7	14	0.7
15		15		15	0	15	0.7	15	99.9

Fig. 93: *Methods of transforming weekly to daily time series*
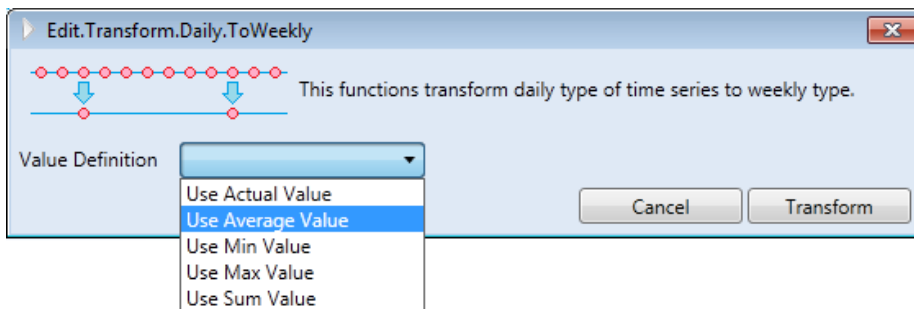

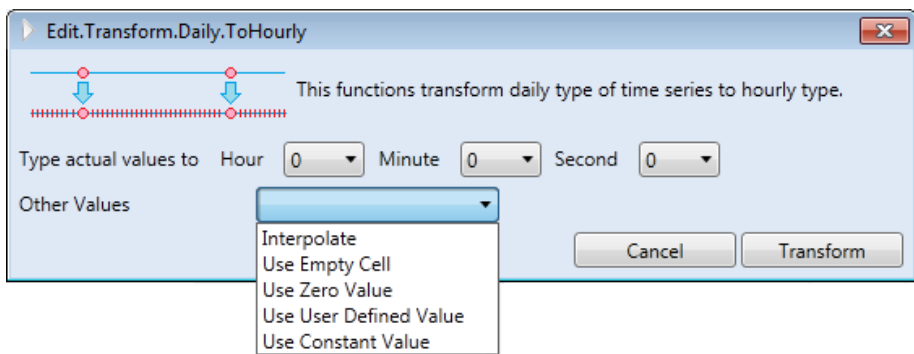*Fig. 94:* *Tool for transforming the daily time series to a weekly one.*

Fig. 95: *Tool for transforming daily time series to hourly ones.*
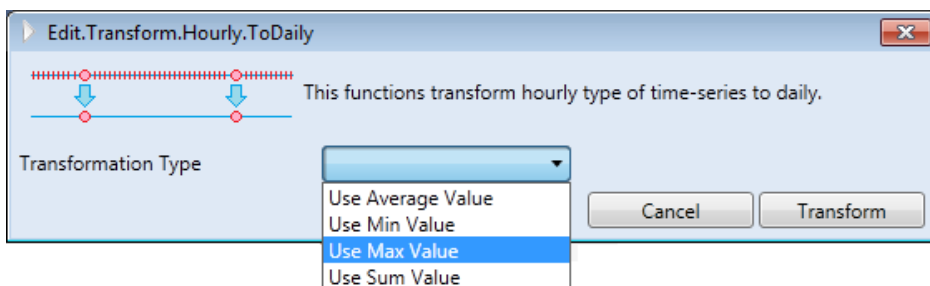

Fig. 96: Tool for transforming hourly time series to daily ones.

4.5.5.3.2 Edit.Transform.Hourly.ToHMS

Using this tool, you can transform the hourly time series to time series with the smaller steps of minutes or seconds. This dialog appears in Figure **97**. Here, you set three parameters; (1) set the minute and second values into what you want copied in the current hourly value, (2) set the method of generating the next values. These values between existing hourly values can be filled by **linear interpolation** from existing values or can be defined as in the previous cases with **zero**, **empty cell**, **user-defined value** or by copying the **last existing** value, and (3) Using the **Time Step** parameter, set the measurement steps in the new document by minutes and/or seconds. Finally, press the **Transform** button and the program generates a new time series from the existing hourly one with the shorter time steps and values according to your defined settings.
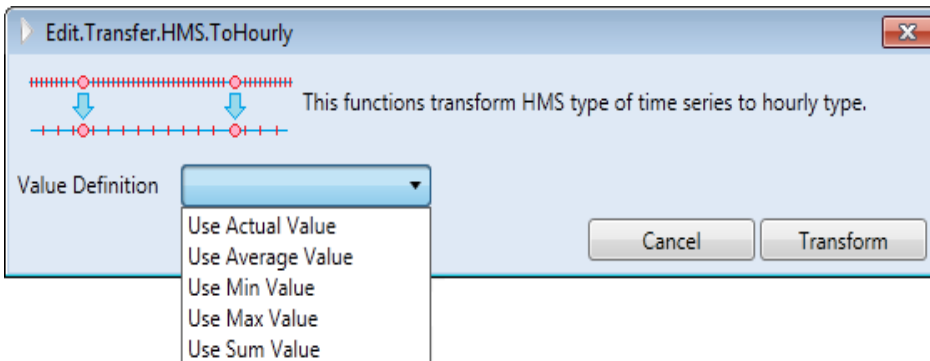

Fig. 97: *Tool for transforming hourly time series to smaller time steps.*

4.5.5.4 Edit.Transform.HMS.ToHourly

This tool allows you to reverse time series with small measurement steps, from Hours/Minutes/Seconds (HMS) to hourly time series (Fig. **98**). With this dialog, you only need to set the method of generating your values in the new document, and click on the **Transform** button.
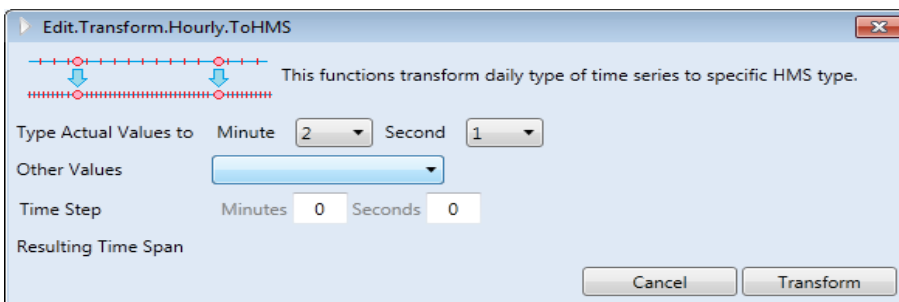

Fig. 98: *Tool for transforming small measurement time steps to hourly time steps.*

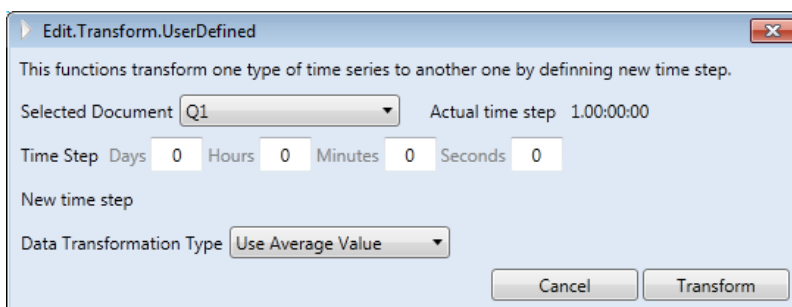### 4.5.5.5 Edit.Transform.UserDefined

Fig. 99: *Tool for user-defined time series transformations.*

User-defined transformations can be performed with the last tool in this group. When you set this transformation, the following dialog appears (Fig. **99**).

From the combo box, you first set the document you want to transform. Following your selection, the program automatically determines the document's current measurement step and displays it next to the combo box. You then define the time step of values for your

new document. This new time step can be shorter or longer than in the selected document. Finally, define the method of generating values in the last combo box. Thus, you can **interpolate** these values, or you can use different statistical values such as **minimum**, **maximum**, **average** or **summary** values. The method you select depends on the transformation character. For example, if you create weekly time series from daily ones, you can use statistical values such as minimum or average weekly values. But if you transform the weekly type to daily, you can not use any of these summary values (min, max, average). To get these you must use the "linear interpolation" method.
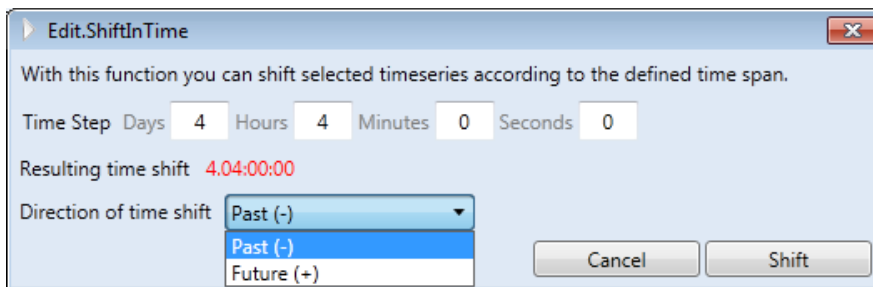
4.5.6 Edit.ShiftInTime

This function is used to move the values of time series over a time span. To set this offset, use the dialog in Figure **100**. On the first line you define the time shift. These values can be defined in days, hours, minutes or seconds,

Fig. 100: *Tool for time series values moving over a time span.*

and they are summed to the resulting **time shift**.

Finally, you must set the **direction of the shift**, depending on whether you want to move the values to the **past** or **future**. Example of a shifted time series is shown in Figure **101**. The blue line shows the source document if this was not deleted from your computer's memory. The yellow line shows the new document, which was moved in this case for 5 days in the future. This tool creates a new document using a simple function to shift your values to the past or future, whichever you want.
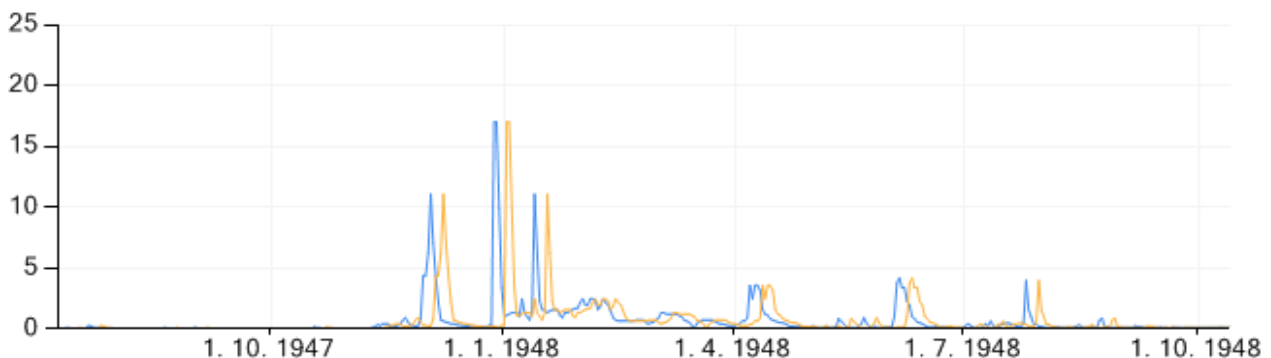
Fig. 101: *Example of values shifted in time.*

4.5.7 Edit.ShowAsTimeSpan

With this tool, you can change the display type of time values in your document. After setting all the parameters in the dialog, your temporal values are displayed in the form of decimal values (Fig. **102**).

Here, you first set the **initial value** (t_0) in days, hours, minutes and seconds. This starting time is set to the first row in your document. If this parameter isn't set, the first value will be equal to $t = 0$. Then you set the type of time values. Based on this setting, values can be displayed as a decimal number in days, hours, minutes or seconds. Finally, click on the **Show** button and the results are displayed in a defined format (Fig. **103**).

4.5.8 Edit.GetTimeStructure

This function has the very specific purpose to **copy the time structure** of your selected document into a new one. This new document will contain a table with two columns. The **DateTime** values are in the first column and the second column is empty. There is no graphical
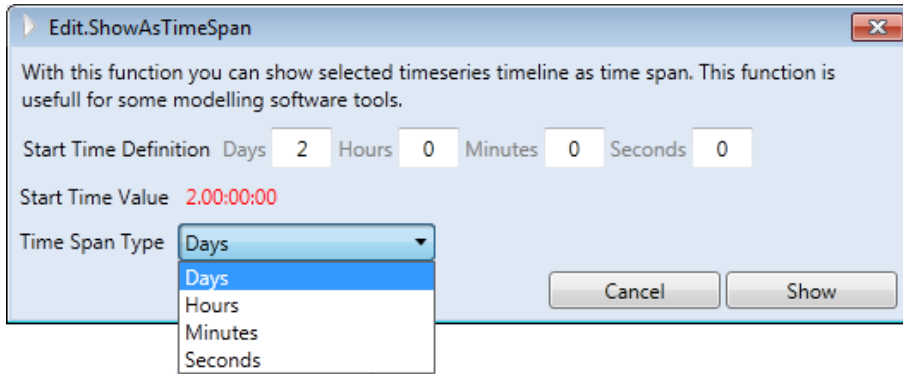
visualization in this document.

Fig. 102: *Dialog for setting the display of time parameters in your document.*

Fig. 103: *Examples of results from the described function under various settings.*

4.5.9 Edit.GetValues

This function is used to **copy values from one document to another** by using the dialog in Figure **104**. You set the documents you want to use in two combo boxes. In the first combo box, set the document into which you want to copy the values. Here, the time structure is important because this sets the values copied from the second document – in the bottom combo box. Your third document can then be created from the time structure contained in the first document and the values in the second document.
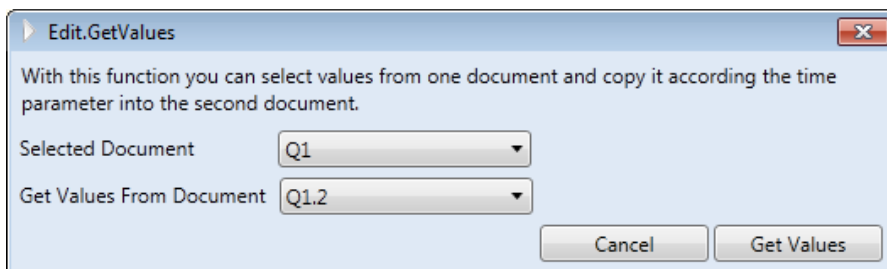

Fig. 104: *Tool for copying values from one document to another.*

The use of this tool is appropriate when you want to create a document with the time structure identical to your first document, together with all its gaps and temporal characteristics. It is important to remember that these values will be copied only if the time records are identical in both documents. This means that if measurements are shifted in one document even by only 1 second they cannot be copied into a new document.

4.5.10 Edit.Combine

This additional function **Edit.Combine** is used for **merging two documents into one**. This is a very powerful tool that you can use to combine two documents using really interesting approaches and features. After running this function, the dialog displayed in Figure **105** appears.
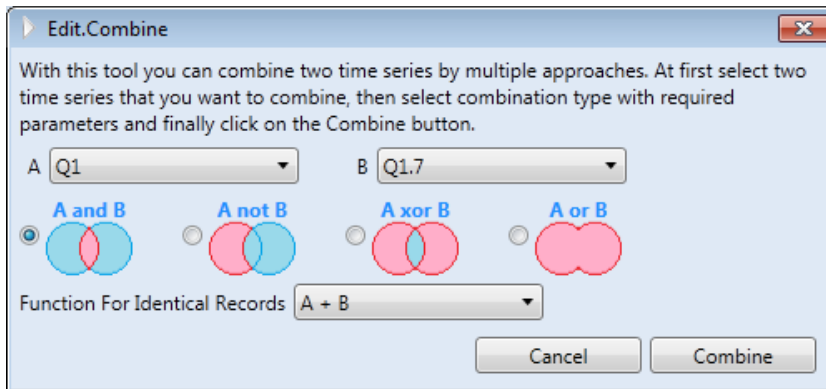

Fig. 105:   *Tool used to combine time series.*

In the top combo boxes you select the two documents you want to combine. These documents should be of similar nature and character. For example, they can be two time series of river discharges. These two documents can be combined using one of the four procedures displayed on the option buttons. Its function is described in Figure **106**.

These methods are similar to those used in the combination of two layers in a GIS program. The only difference here is that time series are used to combine the time characteristics in your selected documents. Method **"A and B"** creates a new document from the values contained in both your existing documents. Method "**A not B**" creates a document only from values contained in your document A. Method **"A xor B"** is used to create a document from records that are unique and not included in both documents. The last method "**A or B"** simply merges the records of both series. In methods **A and B** and **A or B**, two records with identical time can be created in relation to the time structure. The function used to merge these **identical records** into one is set in the last combo box. This **combo box** contains a number of **combining functions**. Among other possibilities, for example, these records can be added-up, multiplied, averaged or higher values can be selected.

4.5.11 Edit.Convert

This final editing function is used to **convert values**. More that 2,000 functions for converting values are located under the last button on the Edit ribbon tab (Fig. **107**). You select the type of conversion you want in the menu, and the program includes **11 basic types of conversions**. These include conversions for temperature, velocity, pressure and density, as well as for the many other factors listed in Figure 107.

You select the unit you want from the sub-menu and the type of conversion you require in your selected documents. The program then recalculates the values according to the defined conversion and stores the results in new documents for you.
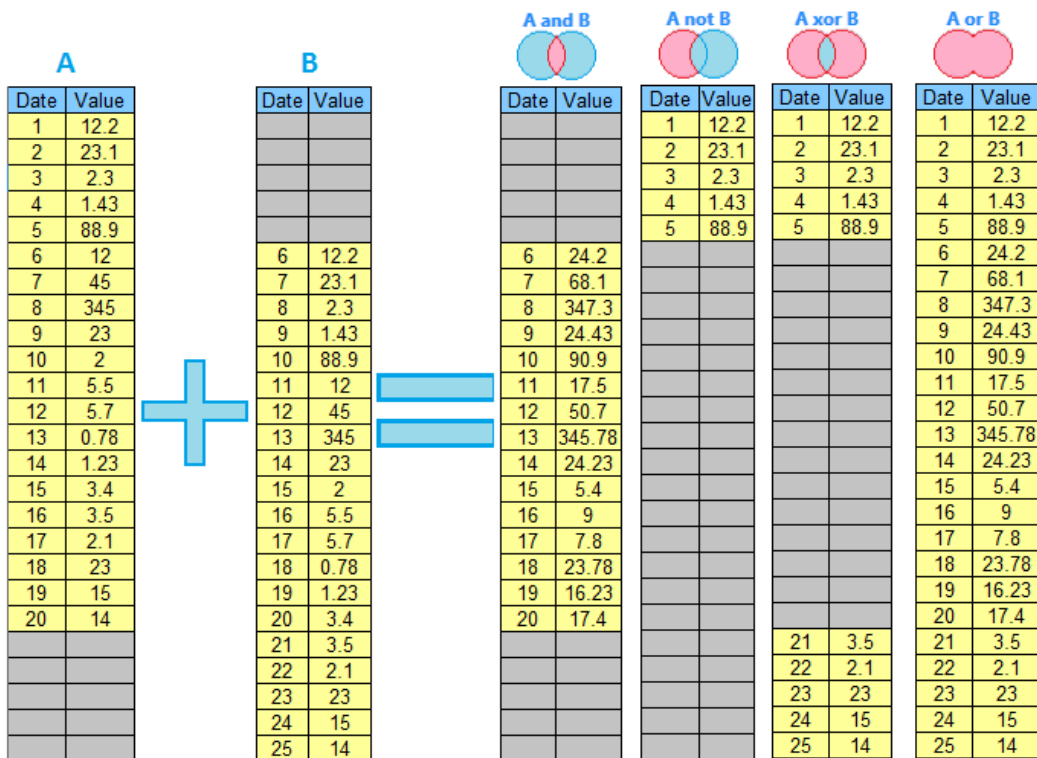
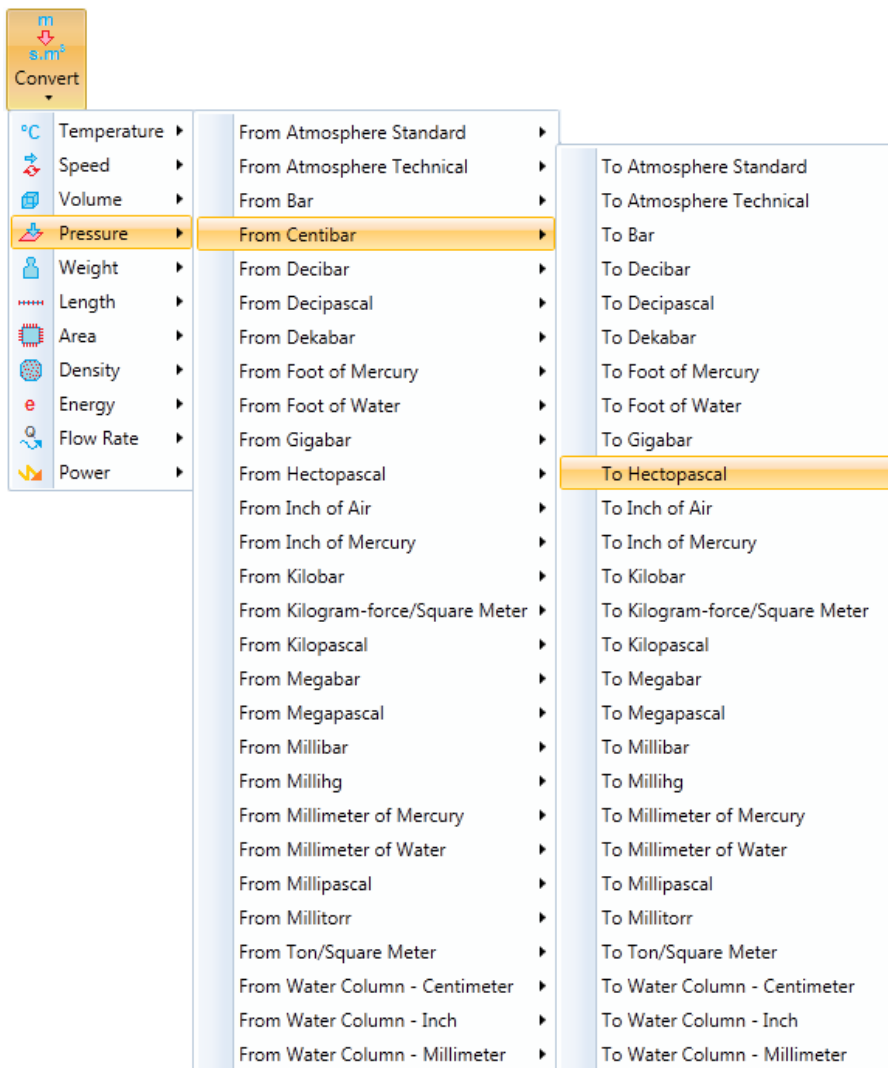**Fig. 106:** *Description of methods used to combine time series.*

Fig. 107: *Conversion options in TS Editor software.*

4.6 Functions

Tools included in this ribbon tab have a specific position and purpose. These are not in other groups of commands and therefore they have their own separate group. Figure **108** shows the individual tools in the **Functions** group.
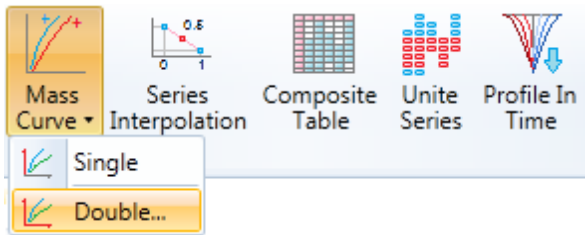

*Fig. 108:   Tools and commands in the Functions tab on the ribbon toolbar.*

Examples of the uses of these tools include; to create mass **curves**, **interpolate the entire series**, to form **composite tables** from multiple documents, to **unite multiple documents** simultaneously and to create statistical **profile visualizations**. These various tools and functions are now described in detail in the following text.

4.6.1 Functions.MassCurve

Tools in the **Functions.MassCurve** sub-group allow you to create single or double mass curves, as described in the next two sub-sections.

4.6.1.1 Functions.MassCurve.Single

An example of **single mass curves** creation is processed in Figure **109**.
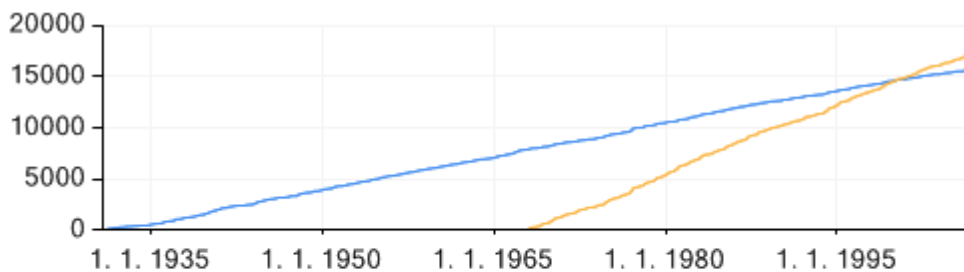
Fig. 109:   Example of single mass curves creation..

This command can process multiple documents simultaneously with results merged into one new document. After documents selection and execution, the program finds time ranges in your selected documents and creates a new table from these values, where the first column contains the date and time values. Existing values are then added in each document and the resultant mass curves are stored in a new table. If the documents begin at different dates, the resultant curves are offset from one another. In the resultant document you can analyze and evaluate the individual mass

curves. If you separate the mass curves into individual documents, you must select and process each document individually.

4.6.1.2 Functions.MassCurve.Double

This function is used to create **double mass curves**. Clicking on this command displays a dialog with settings (Fig. **110 Left**). This dialog allows you to set the X-axis in the selected document and select the documents where you want the Y-axis drawn.
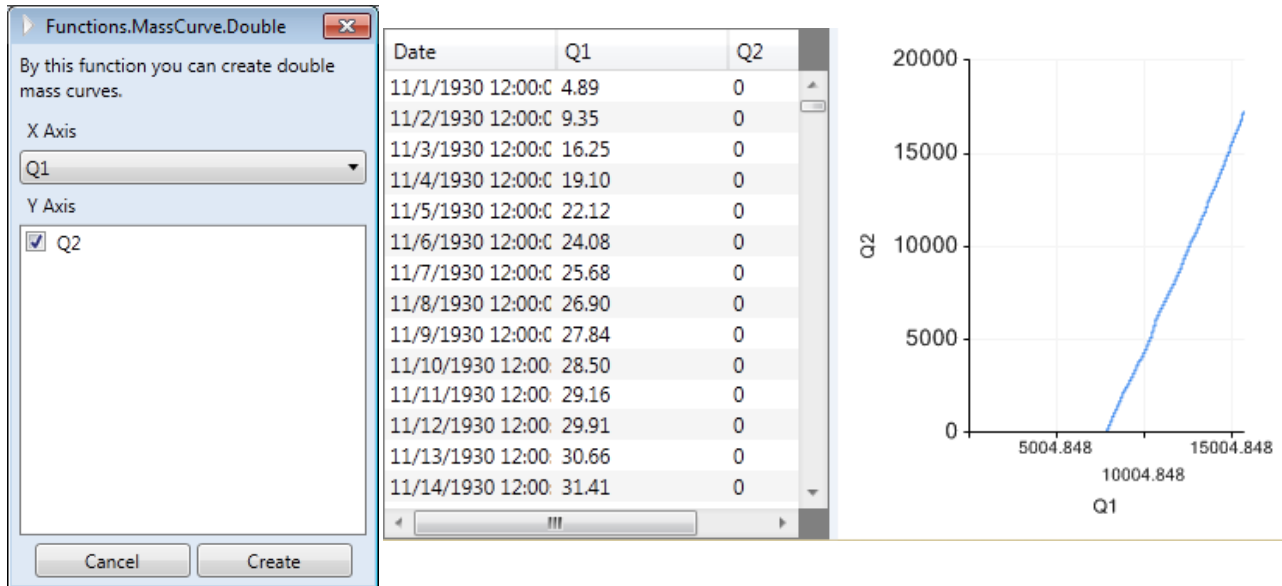

Fig. 110:   *Left – dialog for double mass curves; **Right** – resultant document with a double mass curve.*

When you click on the **Create** button, a new document is created with a table and graph for the result (Fig. **110 Right**). These double mass curves are used, for example, when you want to investigate the effects of changes in precipitation on river discharges. There are numerous opportunities to use mass curves and you will find other applications in books and papers.

4.6.2 Functions.SeriesInterpolation

This function can be used to create a new document by **interpolation between two time series**. This function is set by displaying dialog Figure **111**. You set the two time series you want to interpolate in the combo boxes. Then, just set the **Scale** parameter. To create a new time series as the average between these two series, leave this setting on value 50. If you want to increase the impact of one document and decrease the impact of a second one, this can be done with this parameter. This is useful, for example, when you want to create a time series of discharges between two measured profiles where the distance between them is set as a percentage of the length (in profile A) of the total length (between profiles A and B). After setting these parameters and clicking the **Interpolate** button, a new document is created. If any part of time series is missing in either of the two selected documents, the program automatically copies the values from the time series in the document where these values are not missing. An example of this function is shown in Figure **111 Right**.

This picture shows interpolation between documents A and B in the red lines. Three interpolations were calculated with the **Scale** parameter set to 25 (green line), 50 (blue line) and 75 (yellow line).
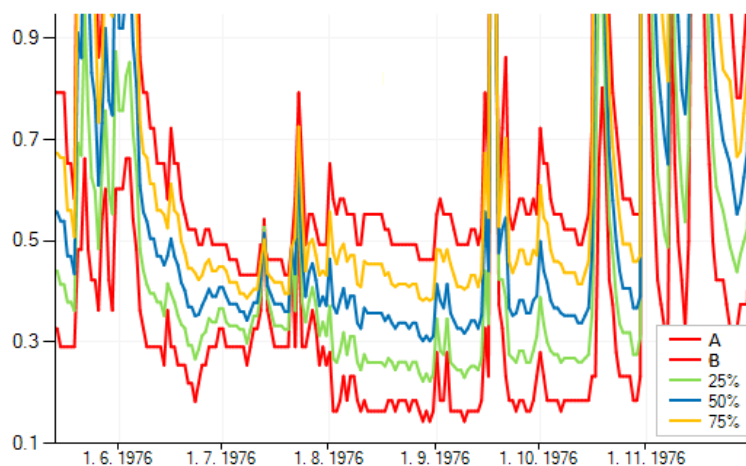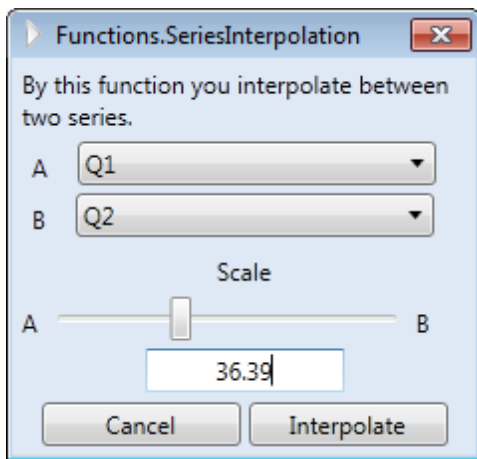
Fig. 111: *Left* – *dialog for setting the interpolation function;* *Right* – *an example of the interpolation results.*

4.6.3 Functions.CompositeTable

A further function allows you to create a composite table using settings in a separate dialog (Fig. **112**).
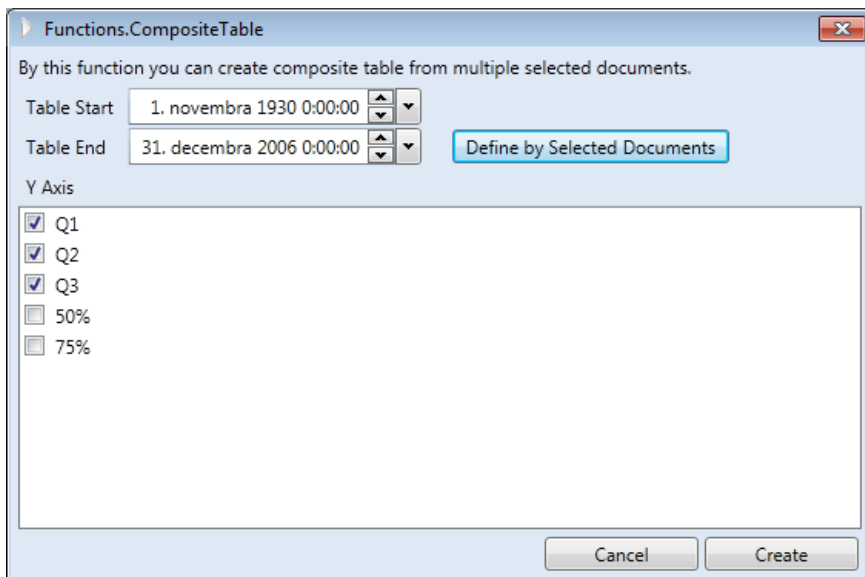

Fig. 112: *Dialog for composite table creation.*

In this dialog, select the documents from the list with values you want to see in a single table. Using the parameters **Table Start** and **Table End** set the time range for the resulting table. If you want to use a range specified in selected documents, simply click on the **Define by Selected Documents** button. The program automatically finds the time range of each document and uses these values, [or these parameters can also be defined manually]. When you click on the **Create** button, a new document will be processed as in Figure **113**.

The first column of the table is reserved for the Date/Time component. Values from selected documents are stored in the remaining columns. The course of these values from merged documents is then displayed in a graph.

4.6.4 Functions.UniteSeries

The penultimate function of this group is reserved for **documents unification according to one**, which you then select. The dialog in Figure **114** depicts its use. In this dialog, set the time series in the combo box that you want to use to unite other series.
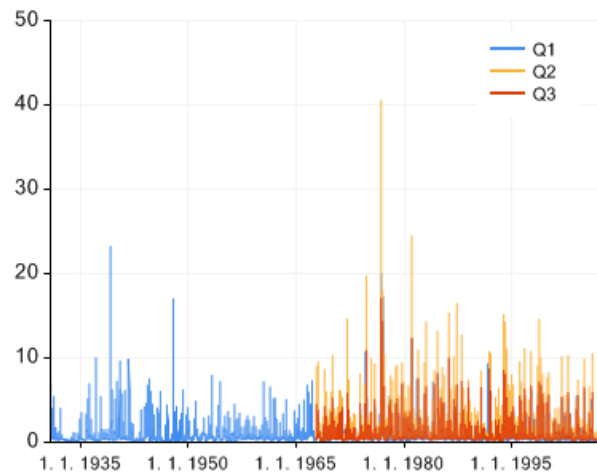
Fig. 113: *Example of a document created using the CompositeTable function.*
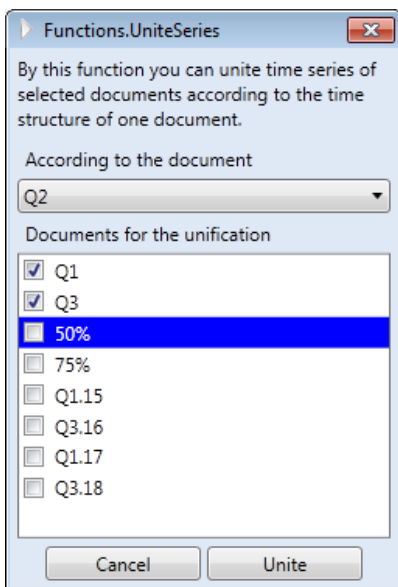

Fig. 114: *Tool for series unification according to your selection.*

This unification is based on the same time structure as your selected document. This means that the selected documents from the list will have the same size, the same step and the same gaps in time as your selected document. Then choose the documents from the list that you want to unite and click on the **Unite** button. The program automatically unites these selected documents over time, and saves the results in new documents.

4.6.5 Functions.ProfileInTime

The last function is used for the **analysis** of time series values, **depending on the vertical parameter**. To set this function, use the dialog in Figure **115**.

This function is used for specific analysis of time series, depending on the selected vertical parameter. You can use this feature, for example, to analyze **precipitation depending on altitude** or **groundwater temperature changes depending on the depth below the surface**.

Choose the documents you want to analyze and add the vertical value where you want it located. After setting this parameter in the text box, click on the **Add** button to add the document into the table. Documents listed in this table will be used in subsequent analysis. When you define this, select the parameter in the bottom combo box you want to calculate and visualize. You have a choice of **10 statistical parameters**. For example, if you want to analyze the relationship between altitude and long-term annual average precipitation or long-term monthly average values, just click on the **Process** button and the defined analysis is processed into a new document (Fig. **116**).

In this example the time series of daily precipitation from four stations is used (altitudes from 300 to 800 m a.s.l.). The chosen statistical parameter is the long-term average daily precipitation totals. After processing, a new document is displayed in which the average values were calculated for each station at different altitudes. The result is also rendered as a graph in vertical profile, and it shows that the values of average daily precipitation increase with increasing altitude. This tool is very useful if you have other vertical parameters in addition to the time series. It is also possible to analyze other factors such as latitude or altitude with this tool.
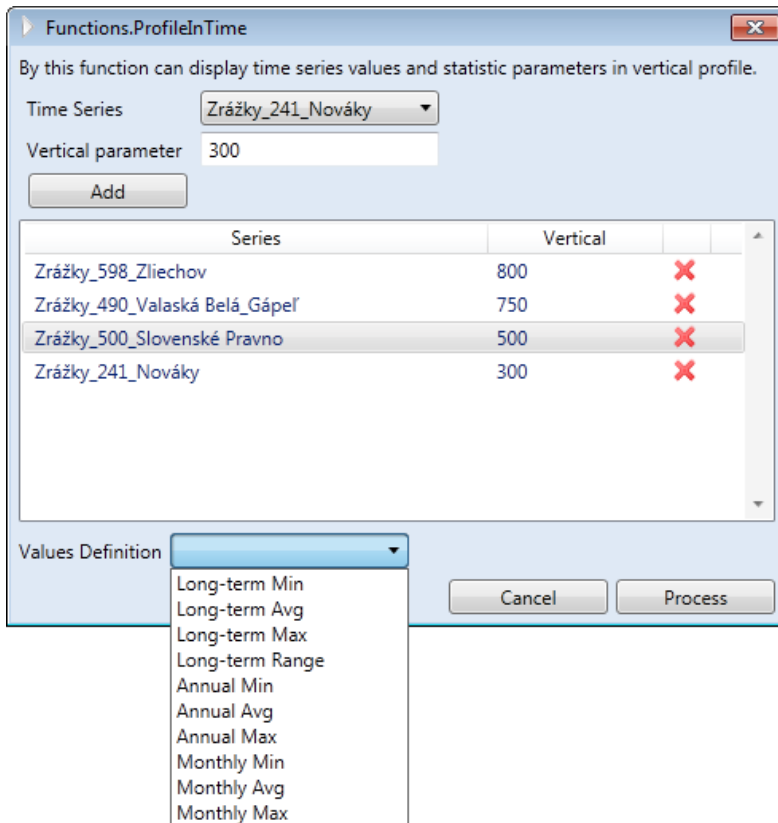
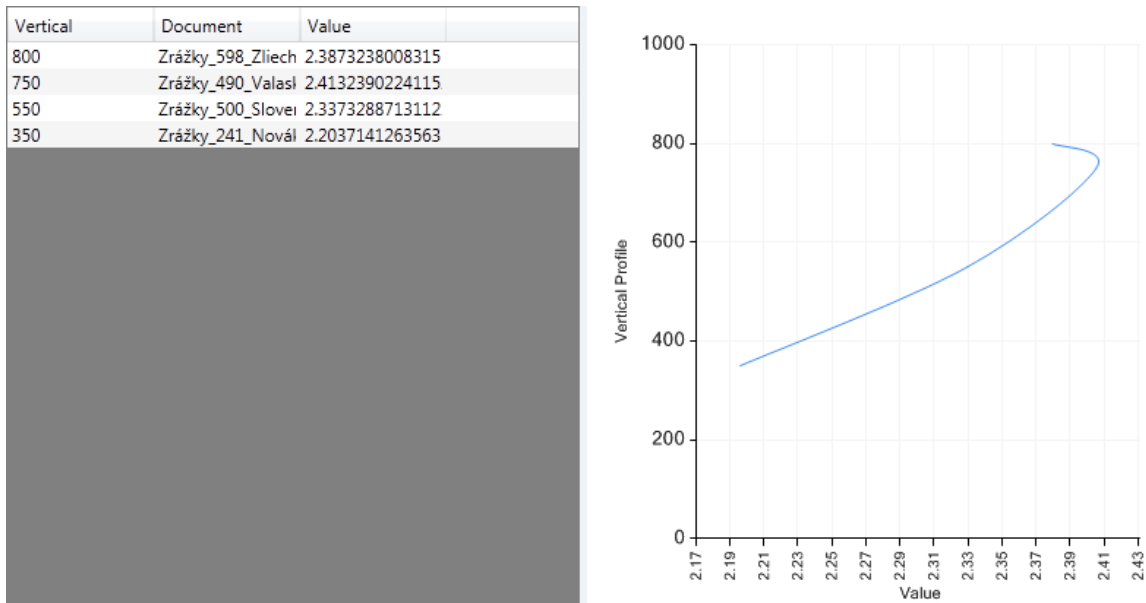*Fig. 115: Time series analysis based on a vertical parameter.*

Fig. 116: Document showing the relationship between the values of selected time series and the vertical parameter.

4.7 Statistic

Statistic tools are the most important functions in TS Editor 3.0 and you will use these functions very frequently. The individual statistical functions are displayed logically in the ribbon toolbar, according to their character (Fig. 117).
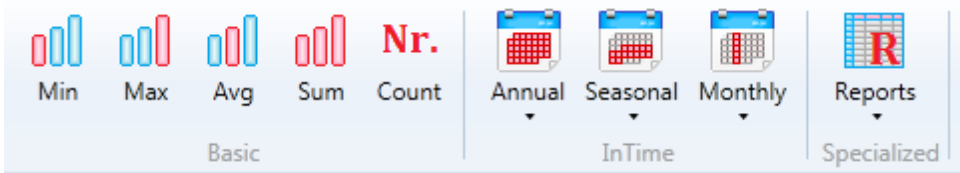

Fig. 117: *Statistical tools in the ribbon toolbar.*

Individual commands are sequentially described in the following text. The program calculates the long-term, annual, seasonal and monthly statistical characteristics. In addition, the program also includes functions for creating statistical reports which can be used for fast and efficient development of material for your final reports.

4.7.1 Statistic.Basic

The subgroup Basic includes functions for calculating long-term minimum, maximum or average values. With these commands, you can process multiple documents together,, with results merged into a single final document.

4.7.1.1 Statistic.Basic.Min

This function allows you to calculate the long-term minimum value from selected documents. After selecting the required documents and executing the function, a new resultant document will be created as shown in Figure 118. Selected documents are listed in the first column of the table, and obtained values are in the second. Resulting values are shown in the graph as a column series. Your documents always have the same character when you use the following functions in this group of commands.
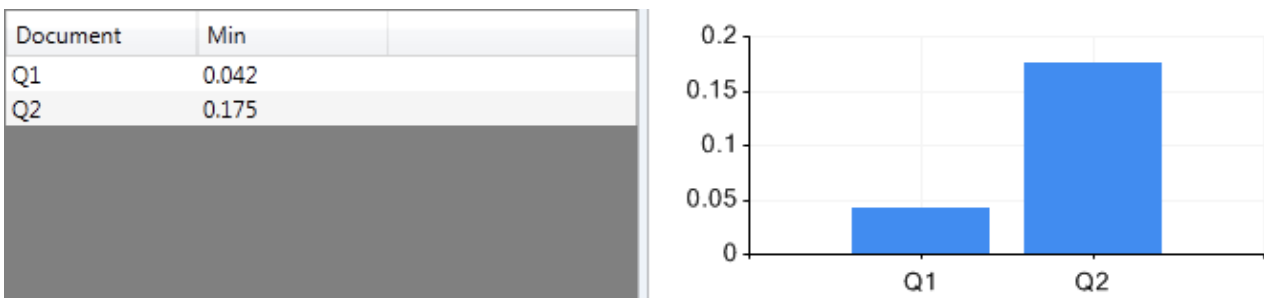

Fig. 118: *Example of document created by a described function.*

4.7.1.2 Statistic.Basic.Max

The Statistic.Basic.Max function is used to determine the maximum long-term value from your time series.

4.7.1.3 Statistic.Basic.Avg

The Statistic.Basic.Avg is used to determine the long-term average value of your time series.

4.7.1.4 Statistic.Basic.Sum

The **Statistic.Basic.Sum** is used to determine the **summation value** of all the values in your time series.

4.7.1.5 Statistic.Basic.Count

The **Statistic.Basic.Count** function is used to determine the number of values in the selected time series. This function is the same as **Properties.NumerOfRecords**, and it is included here for uniformity of statistical functions. The structure of the resultant document is the same as for previous functions.
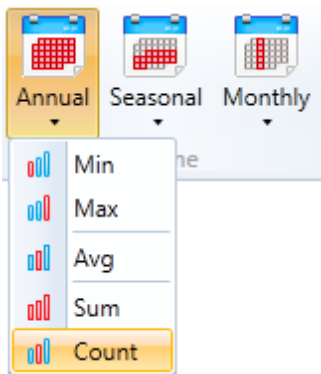
4.7.2 Statistic.InTime

Fig. 119: *Statistical commands for annual periods.*

This group of commands enables you to calculate statistical parameters of selected regular intervals, such as for the **years**, **months** and **seasons in the year**. The **minimum**, **maximum**, **average**, **sum values** and **the number of values** in your defined time interval can be analyzed in these intervals. Individual commands are described in detail in the following sections.

4.7.2.1 Statistic.InTime.Annual

This group of commands enables you to calculate **statistical parameters for individual years**. These commands are in the ribbon toolbar shown in Figure **119**. With these commands, it is possible to handle multiple documents together, with results merged in one resulting document.
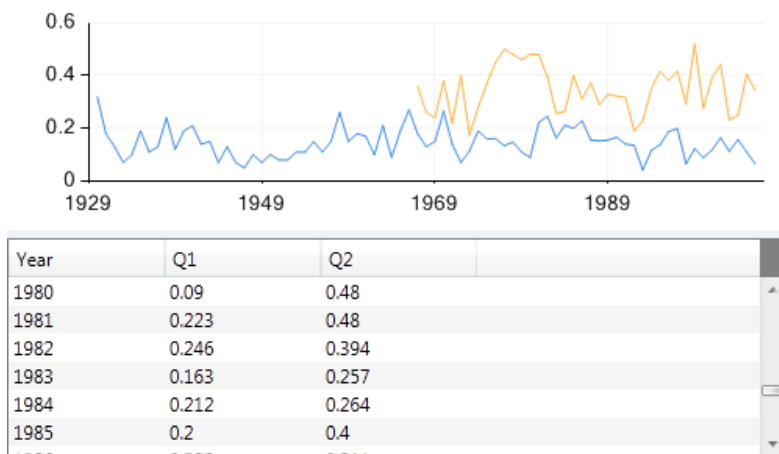
4.7.2.1.1 Statistic.InTime.Annual.Min

Year	Q1	Q2
1980	0.09	0.48
1981	0.223	0.48
1982	0.246	0.394
1983	0.163	0.257
1984	0.212	0.264
1985	0.2	0.4

This command allows you to calculate the **annual minimum values** from the time series. Using this command you can handle multiple documents together, with results merged in one document. An example document created by this command is shown in Figure **120**.

The individual years are listed in the first column of this table, and minimum annual values are shown in the following columns. Individual series are shown in the graph by the lines over time. This has the

Fig. 120: Sample of minimum annual values processed from two time series.

same character as documents created by other commands in this sub-group.

4.7.2.1.2 Statistic.InTime.Annual.Max

This function allows you to determine the **maximum annual values** from the time series.

4.7.2.1.3 Statistic.InTime.Annual.Avg

This command allows you to determine the annual values from your selected documents. Here, these are, the **annual average values**.

4.7.2.1.4 Statistic.InTime.Annual.Sum

The **Statistic.InTime.Annual.Sum** function lets you calculate **summary annual values** from the time series. This is useful, for example, when you want to determine annual precipitation totals.

4.7.2.1.5 Statistic.InTime.Annual.Count

With this function you can get the **number of records** in the time series **for individual years**.

4.7.2.2 Statistic.InTime.Seasonal

This subgroup of commands allows you to calculate **seasonal statistical parameters** of the selected time series. As usual, you can process multiple documents together, with results merged in one final document. After running any command in this sub-group, there is the dialog shown in Figure **121**.
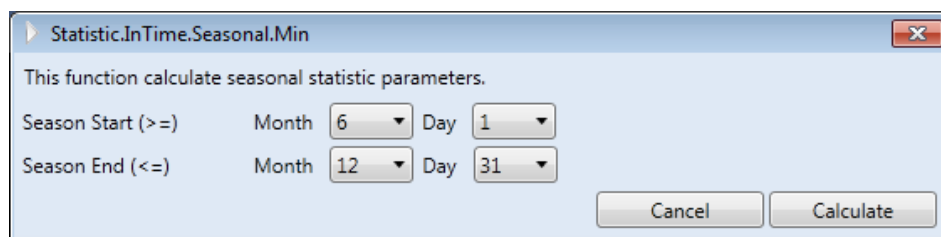

Fig. 121:   *Dialog for determining the start and end of an annual season.*

In this dialog, you **define the season** in which you want to calculate a selected statistical parameter. The season is defined by season **beginning** and **end**, using **month** and **day of month** settings. The example shows the defined season as the second half of the year – from the first day of the sixth month to the last day of the twelfth month.

This subgroup of commands has the **interesting functionality** of **ability** to define seasons **exceeding the calendar year**. If you define the **start time** as greater than the **end time**, the program calculates statistical parameters between the date in the current year and the date defined in the following year. In this way, for example, you can compute the statistical parameters for the **hydrological year**, which in Central Europe starts on November 1st (month – 11; day – 1) and ends on October 31st the following year (month – 10; day – 31).

4.7.2.2.1 Statistic.InTime.Seasonal.Min

This command specifies the **minimum values of** a defined **season**.

4.7.2.2.2 Statistic.InTime.Seasonal.Max

This command delivers a list of the **maximum** achieved **values** in a defined period of the year.

4.7.2.2.3 Statistic.InTime.Seasonal.Avg

The *Statistic.InTime.Seasonal.Avg* command calculates the **average values** within the defined period of the year.

4.7.2.2.4 Statistic.InTime.Seasonal.Sum

This command calculates **summary values** within a defined period of the year.

4.7.2.2.5 Statistic.InTime.Seasonal.Count

The last command delivers the **number of values** in the time series recorded within a defined period of the year.

4.7.2.3 Statistic.InTime.Monthly
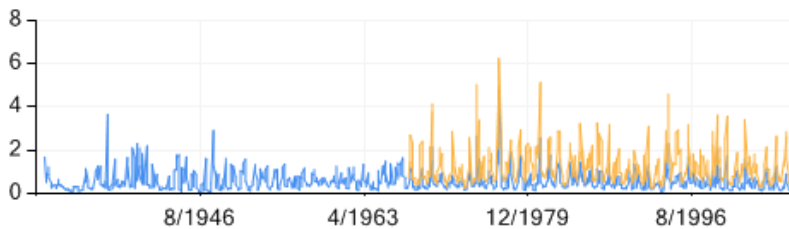
Fig. 122: Example of document containing the average monthly values.

This subgroup of commands has similar character to the previous one. The difference here is that the commands calculate statistical parameters calculated **for individual months**. The example document created by these commands is shown in Figure **122**. The first column of the table contains the individual years, while the second one contains information about the months of the year. The remaining columns contain the actual values of the statistical parameters for individual documents.

4.7.2.3.1 Statistic.InTime.Monthly.Min

This function determines the **minimum monthly values** from selected documents.

4.7.2.3.2 Statistic.InTime.Monthly.Max

Conversely, this function delivers a table and graph with **maximum monthly values**.

4.7.2.3.3 Statistic.InTime.Monthly.Avg

The **Statistic.InTime.Monthly.Avg** function calculates the **average monthly values** of the selected documents.

4.7.2.3.4 Statistic.InTime.Monthly.Sum

The penultimate command calculates **monthly summary values**.

4.7.2.3.5 Statistic.InTime.Monthly.Count

This last command determines the **number of records in each month**.
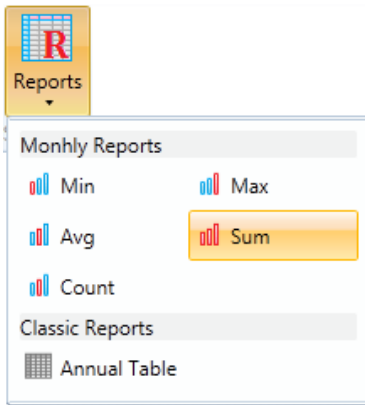
4.7.3 Statistic.Specialized.Reports

The sub-group of **reporting** tolls is a special part of the program's functions and tools. These tools were developed for the direct production of outputs that can be used in **final reports**. These commands are under the **Reports** button in the ribbon toolbar (Fig. **123**). In the current version of the program you can create reports for monthly or daily values in the selected document. These tools are described in the following text.

4.7.3.1 Statistic.Specialized.Reports.Monthly

This group of reporting functions allows you to generate standard statistics, arranged and visualized for fast insertion into your final reports. Using these functions, you can manage multiple documents together and create an equal number of new documents. An example document created in this way is shown in Figure **124**.

Fig. 124: *Example of a monthly minimum values report.*

Individual years are listed in the first column of the table. Columns two to thirteen contain monthly values of selected statistical parameters. Minimum monthly values are used in this example. The last column contains the value of the selected statistical parameter for the entire year. The end of the rows contains the minimum, maximum and average values for all months, and for the entire time series. Two chart areas are displayed in the graphic part of this document. The upper chart area contains the monthly values in **annual courses** (thin lines), the **long-term average monthly values**

(thick black line) and documented **minimum and maximum range** of monthly values (light blue area). The lower chart area contains the course of calculated **monthly values** over time. The series in the bottom chart area can be mouse-zoomed or scrolled. If you want to hide one of the chart areas, you must use the classic chart setup options which appear when you double-click on the graphs. These features were described in the first section of the manual. This chart and table have the same structure as all commands in this group, and it varies only in the selected statistical parameter.

4.7.3.3.1 Statistic.Specialized.Reports.Monthly.Min

This function allows you to generate **reports for minimum monthly values**.

4.7.3.3.2 Statistic.Specialized.Reports.Monthly.Max

This function creates **reports** of **maximum monthly values**.

4.7.3.3.3 Statistic.Specialized.Reports.Monthly.Avg

This function generates **reports for monthly average values**.

4.7.3.3.4 Statistic.Specialized.Reports.Monthly.Sum

This function allows you to create a report for the **monthly summarized values** of the selected time series. This tool is used primarily for generating reports of **monthly precipitation totals**.

4.7.3.3.5 Statistic.Specialized.Reports.Monthly.Count

Fig. 125: Dialog for setting annual report tables.

The last function in this sub-group allows you to create a report that processes the **number of records in individual months** available in your time series.

4.7.3.2 Statistic.Specialized.Reports.Classic.AnnualTable

If you need to see the **annual course of daily values** in table form, this function has been created exactly for that purpose. After running this function, the dialog in Figure **125** appears.

Several parameters are set in this dialog. Firstly, in the combo box you select the document from which you want to create a report. The list shows the years you can generate your reports. Check the years for your report and select the statistical parameter you want to see. You can choose the daily **minimum**, **maximum**, **summary**, **average values** or the **number of records in days**. If the measurement time-step in your time series is equal to or greater than 1 day, you can select any statistical parameter except the number of records in the day (**Count**). Depending on how many years you select, this number of new documents will be created. Click on the **Create** button and the document will be created as in Figure **126**.

Fig. 126: Example of report document describing the annual course of values.

Values are displayed in this table in a well-defined structure. The first column defines the **day of the month** (1 – 31). The remaining twelve columns contain **daily statistical parameters** for each month. Finally, statistical parameters for each month are displayed in the last four rows (minimum, average, maximum and summary values). There are three chart areas in the graph part of the document. The first – the uppermost chart area – documents the **monthly ranges** (**minimum** and **maximum**) of values and the **average monthly values** in the year. The central chart area displays monthly summary values in column series. Finally, the bottom chart area shows the **daily course** of selected values in the year. As in the previous case, you can easily set individual graph properties using the built-in functions.

When you create a number of annual reports simultaneously, you may not recognize which document belongs to which year, so this information is recorded as a comment in the tool tip for the selected document in the **Documents Panel** (Fig. **127**).
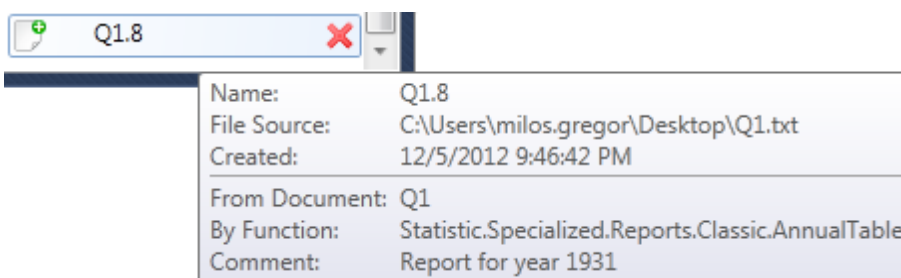
Fig. 127: Information on the year for which the annual report was created.

4.8 Visualization

Another important class of functions in the TS Editor are commands for **time series** values **visualizing.** This group contains a number of useful visualizations. However, these commands **can be used only for** documents that have the character of the **time series**. A further specific is that these commands generally do not produce new documents inside the documents Panel. Therefore, if the active window created by these functions is closed, it can not be reopened and you must create a new one. The basic division of visualization functions in the ribbon toolbar is shown in Figure **128**.

Fig. 128:   Tools and functions for visualizing time series.

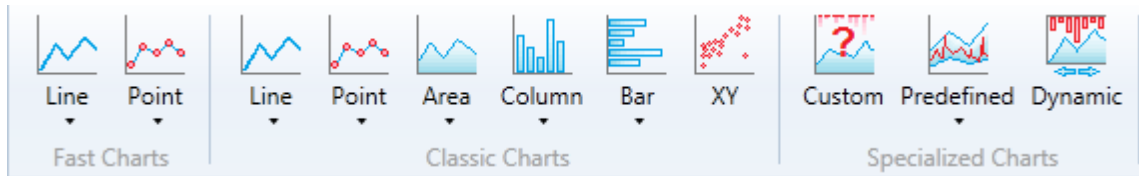The visualization tools are divided into three main groups – **Fast Charts**, **Classic Charts** and **Specialized**. The functions of the **Fast Charts** group are designed to **display an extremely long time series** because of very fast rendering. Although these are really fast, they lack some specialized settings and properties. In contrast, functions in the **Classic Charts** group allow you to set a number of additional visual properties; although this method of rendering very long time series is significantly slower. The functions of the **Specialized Charts** group allow you to make predefined and specialized graphs. All these commands and features are described in the following sections.
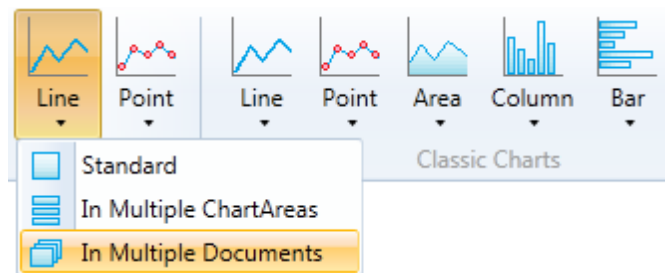
Fig. 129:   Functions from the Fast Charts group.

4.8.1 Visualization.FastCharts

The functions of the **Fast Chart** group allow rendering graphs quickly, and let you **view extremely large amounts of data**. Therefore, these types of views are often used to visualize classical documents. This group allows rendering the graphs using two types of series – by **lines** or by **points** (Fig. **129**).

This figure shows the possibility of rendering line series in a graph by the following three functions: **Standard**, **In Multiple Chart Areas** and **In Multiple Documents**. These options are the same as rendering time series using **Fast Point** series and also for rendering commands from the **Classic Charts** group (commands from **Line** to **Bar**). These options relate to the number of documents you selected for visualization in the documents Panel. If you choose only one document, the **Standard** view is automatically used. This means that the series will be **plotted** on the graph as **one chart area**. If you select multiple documents for parallel rendering, you choose one of the described commands, and the result will resemble Figure **130**.

It is clear from this figure that if you choose three documents and use the **Standard** command, three series will be plotted **in one chart area** of the window. If you choose **In Multiple Chart Areas**, the plot will be **in individual chart areas** in one window. If you choose the last option (**In Multiple Documents**), the selected time series will be **plotted in** three **separate windows** (each series in one window). This also works in the same way for other functions in the Fast Charts and Classic Charts groups.

However, if you want to change this view, and want to move the displayed series between chart areas, you can also do it using the chart properties setting described earlier in this manual.

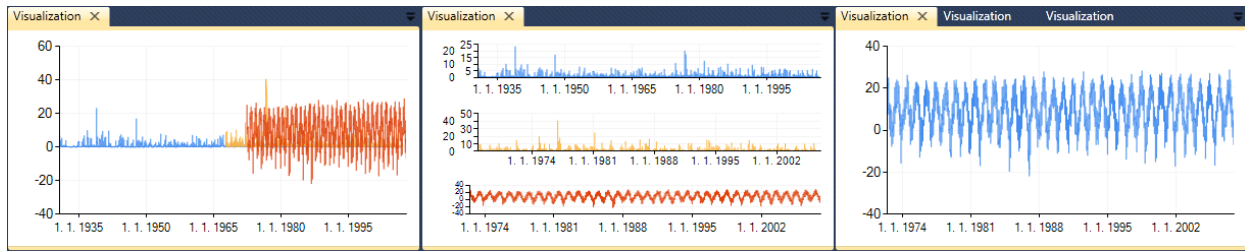*Fig. 130:* *Options of simultaneous multiple documents visualization (**Left** – using Standard view; **Middle** – view using In Multiple Chart Areas command; **Right** – display using the command In Multiple Documents).*

4.8.1.1 Visualization.FastCharts.Line

This function allows you to render selected multiple documents using the **Fast Line** type of series. Each series in the chart automatically has a different colour, as in Figure **130**.
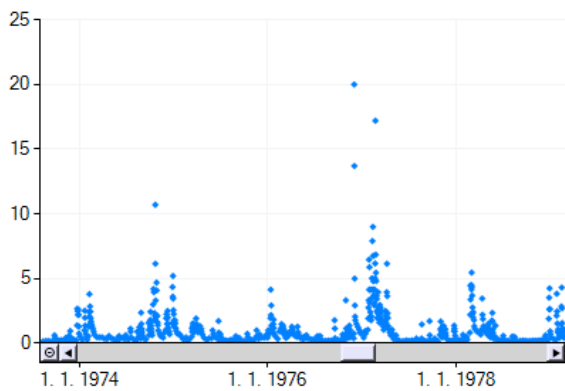
Fig. 131: *Example of river discharge visualization using the FastCharts.Point command.*

Fig. 132: *An example of a series displayed by the Classic Charts.Line command with 'next properties' adjustments.*

4.8.1.2 Visualization.FastCharts.Point

The **FastCharts.Point** command allows fast rendering of large amounts of data from a long time series using the simple Point series. A visualization example is shown in Figure **131**.

4.8.2 Visualization.ClassicCharts

As already said, the visualization possibilities of the **Classic Charts** group are similar to the previous case, but they **are rendered significantly slower**, because they allow you to use **many more variable settings**. In addition, this group has several other types of series. The individual types of series displayed in the graph can be changed using features accessed by double-clicking on the chart. The following text describes the individual functions.

4.8.2.1 Visualization.Classic Charts.Line

The **Line type** of time series display is similar to the previous one, however it is not suitable for very long series. On the other hand, it allows you to set multiple visual properties not available in the previous group. An example of an adjusted series is shown in Figure **132**, **markers and labels** are added for the actual time series. Labels can not be set in the ribbon toolbar, so you must display the complete set of properties from the **Main** ribbon tab.

4.8.2.2 Visualization.ClassicCharts.Point

The classic type of view using **points** allows visualization of a series of values. Although you get these slower, they are very adjustable.
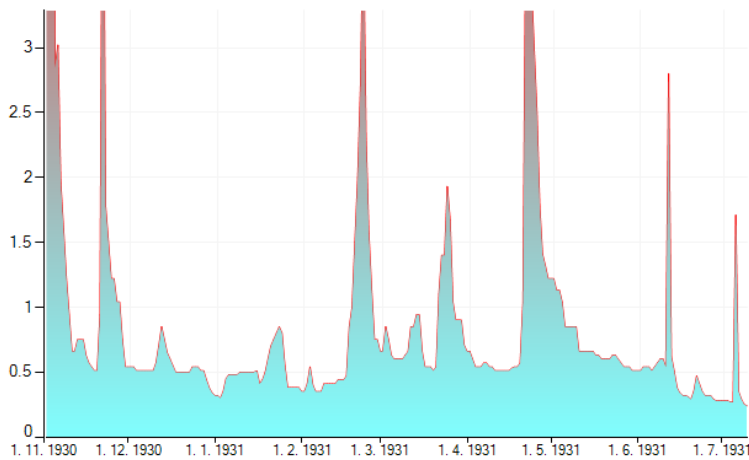
Fig. 133: *Time series view using the ClassicCharts.Area command.*
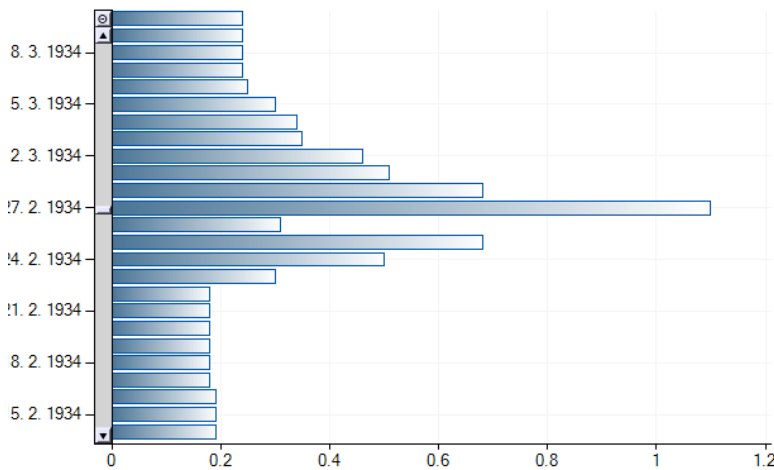
Fig. 134: *An example of a series view using the Classic Charts.Bar command.*
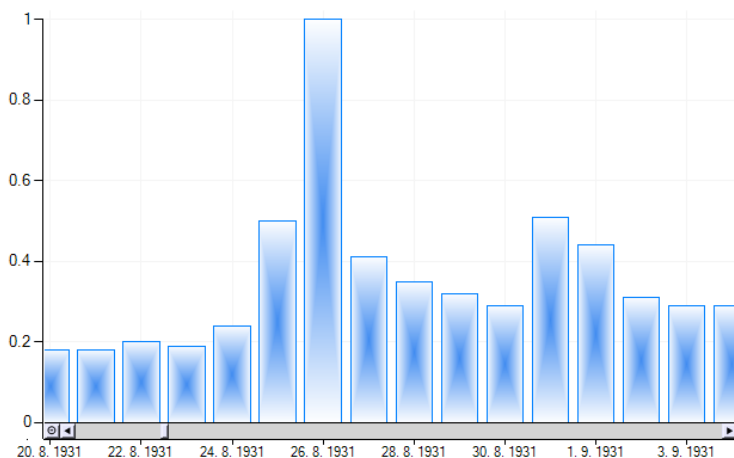
Fig. 135: *Example of a time series view using the Classic Charts.Column command.*

Example of this type of chart is shown in Figure **135**.

4.8.2.3 Visualization.Classic Charts.Area

This function displays the time series of values as **Areas series**. The example of a visually modified graph is shown in Figure **133**. You can set them any way you want and export them from the program as an image file.

4.8.2.4 Visualization.Classic Charts.Bar

Another type of time series display is available in the **Bar** chart shown in Figure **134**. As in the previous cases, you can display a number of documents in a single window or in multiple windows. Furthermore, with these series it is possible to view one or more chart areas. Time values in this chart type are rendered on the Y-axis, with measured values on the X-axis.

4.8.2.5 Visualization.Classic Charts.Column

This similar type of graph creates the function **ClassicCharts.Column**. The only difference is that the time values are represented on the X-axis and the measured values on the Y-axis. This type of chart is similarly adjustable as the previous type. It is also possible to view multiple selected documents in one or more chart areas in a single window.

4.8.2.6 Visualization.ClassicCharts.XY

The last type of chart from the Classic group is the graph of the **relationship between two time series**. Figure **136** displays the dialog to setup this visualization and also an example of the resultant graph.

Fig. 136: Left – dialog for graph setting; Right – an example of an X-Y graph

In this dialog, it is necessary to set the dependent time series to be shown on the X-axis and also documents that will be displayed on the Y-axis. On the Y-axis, you can set several documents simulta-neously and each series is displayed in a different color. When you set these two parameters, you only need to click on the **Display** button to see the r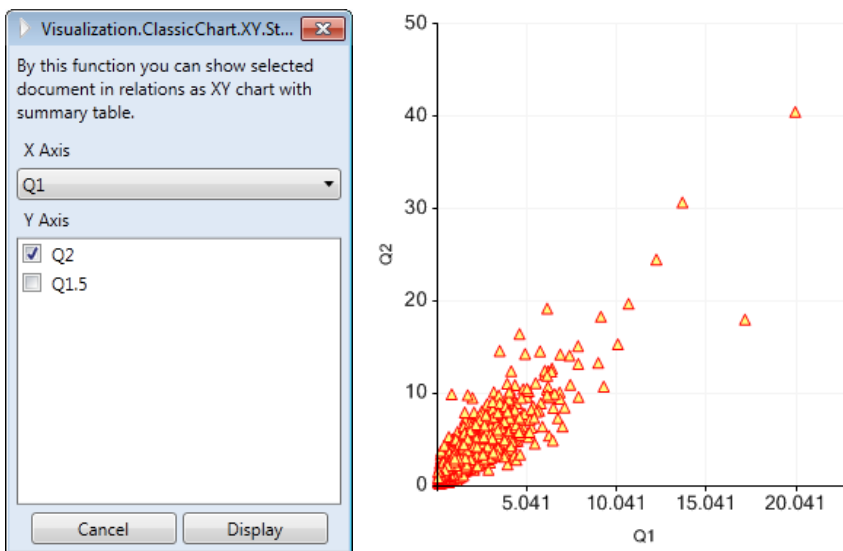esult. Unlike previous visualizations, this creates a new document which stores time-synchro-nized measurements from the selected documents.
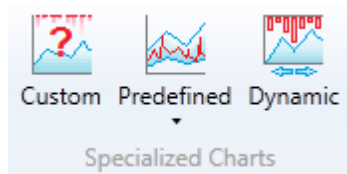
4.8.3 Visualization.SpecializedCharts

Fig. 137: Tools and commands for creating specialized charts.

In this group of visualization functions and tools – **Visualization.SpecializedCharts**, you have features that allow you to create **complex and predefined charts**. The commands in this group are divided into three types (Fig. **137**). The **Custom** function allows you to create a custom graph that is completely adjustable, such as a combination of the Fast Line, Point and Column types of series. Under the **Predefined** button there are hidden commands to create very specific and predefined chart types. Using the **Dynamic** command creates a graph in which you can simultaneously scroll and zoom multiple series in multiple chart areas. The functions from this group are described below.

4.8.3.1 Visualization.SpecializedCharts.Custom

Creating a chart using this dialog is shown in Fig. **138**. In this dialog you can set multiple parameters before displaying the chart itself. You, set the **number of chart areas** you want in a single graph in this dialog. After setting this parameter, it is possible to **add individual series**. In the first combo box, select the document you want to view. You can use the same document multiple times with different settings. In the second combo box, set the chart area where you want to view the document and finally set the series type. When all these parameters are set, simply click on the **Add** button and your defined series will be added to the table. If you make any mistakes, you can delete the selected series from the table and click on the **Delete** icon. The resultant graph will look like the example in Figure **139**.

This example shows two created chart areas with three displayed documents. In the first chart area, you show the course of daily air temperature and in the second you can put river

discharges in two profiles, with the first one shown as **Area** and second as **Line**.
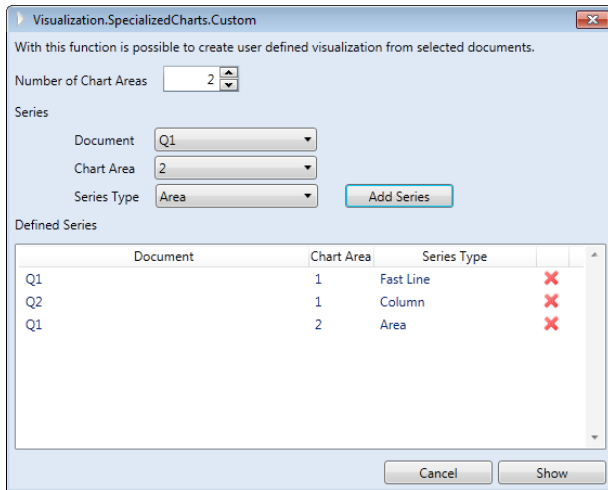
Fig. 138: *Dialog for setting your defined graph.*
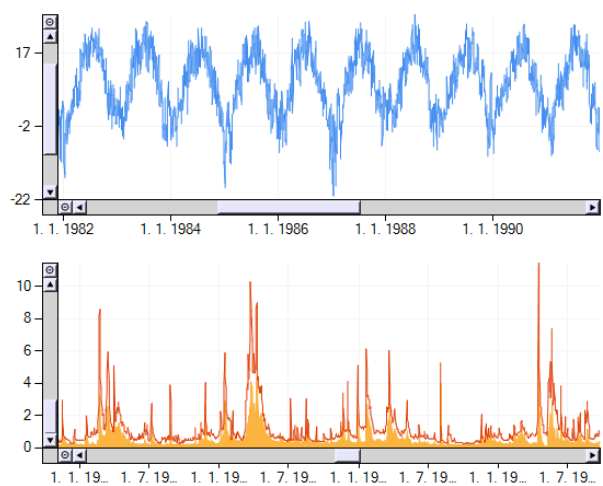
Fig. 139: *Example of your own defined chart.*
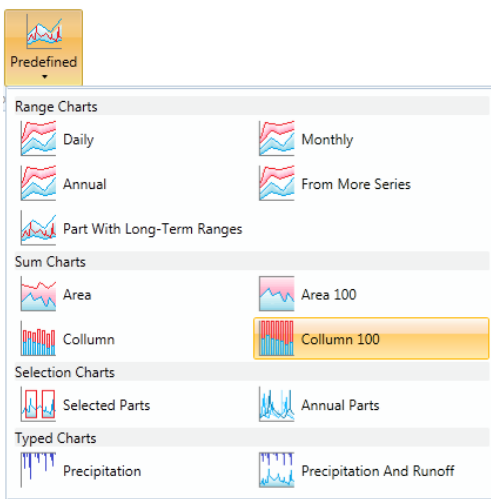
Fig. 140: *Individual functions from predefined types of visualizations.*

4.8.3.2 Visualization.SpecializedCharts.Predefined

Here, 13 functions can be used in the predefined types of visualization depicted in Figure **140**.

Clicking on each command gives a separate dialog which tells you where to set the properties and parameters. Using these functions, you can create different types of **range charts**, graphs of **summarized series**, visualizations of **selected segments of documents** or charts that show **precipitation series** and graphs of **rainfall-runoff** conditions. All the types of range-charts that can be generated in TS Editor software are described in the next chapter.

4.8.3.2.1 Visualization.SpecializedCharts.Predefined.RangeCharts

Functions in the **RangeCharts** group allow you to display the range of values in defined periods. An example is shown in Figure **141**.

You can view ranges of values in **daily**, **monthly** and **annual periods** in these range-charts. In addition, you can view multiple documents simultaneously in one graph. The following text describes individual commands for creating your range-charts.

Fig. 141: *Range-chart example which shows oscillations in minimum and maximum monthly air temperatures over time.*

4.8.3.2.1.1 Visualization.SpecializedCharts.Predefined.RangeCharts.Daily

The first command lets you view **daily ranges**. This function assumes that you select documents you want to visualize which have time-step measurements of less than 1 day. If all values in that one day are constant, or you select a document with a daily time step, the series is displayed as a line.

4.8.3.2.1.2 Visualization.SpecializedCharts.Predefined.RangeCharts.Monthly

This function is similar to the previous one, except that **ranges** are rendered in a **monthly step**.
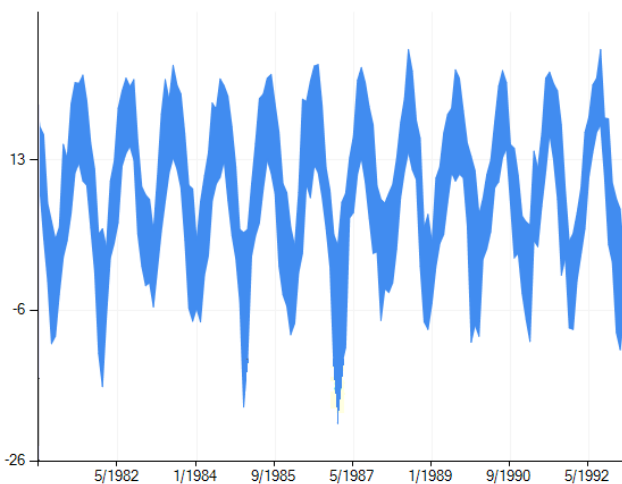
4.8.3.2.1.3 Visualization.SpecializedCharts.Predefined.RangeCharts.Annual

This command is similar to the previous two. It lets you show the range of minimum and maximum values in **the time step of 1 year**.

4.8.3.2.1.4 Visualization.SpecializedCharts.Predefined.RangeCharts. FromMoreSeries

A further type of range chart allows you to create the above command. When you use this, you can create a **range chart from two separate documents** (Fig. **142**).
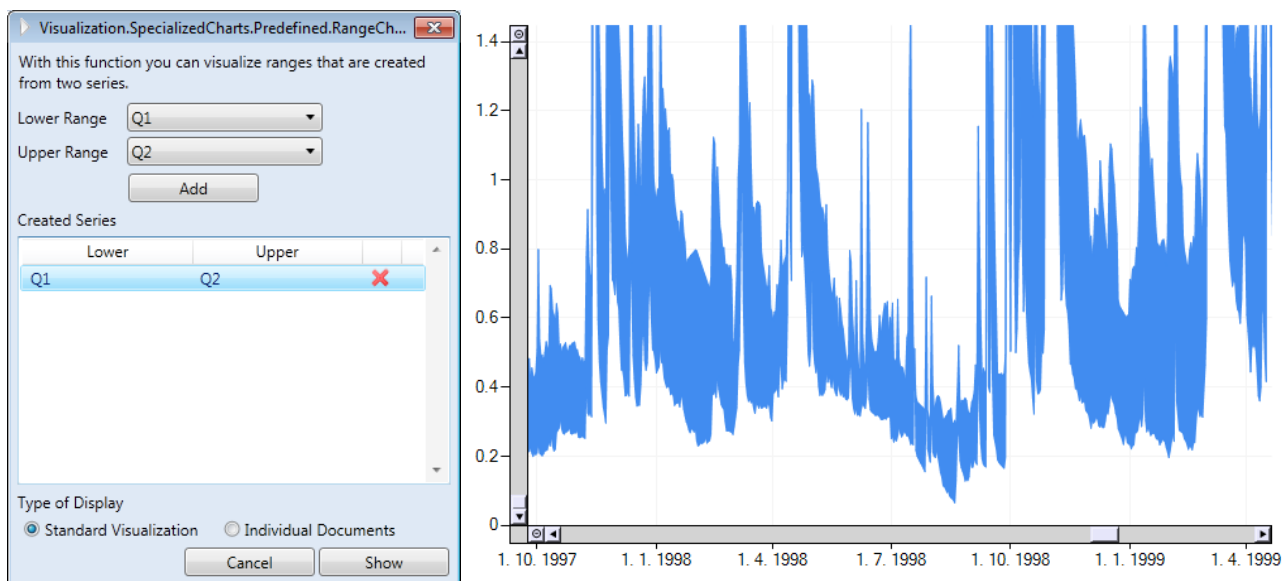
Fig. 142:   Setting and display of the range chart combined from two separate time series.

Two series for each range object are defined in this display dialog, and **the range between the two defined documents** is shown for each series. Set your documents with upper and lower range limit by selection in the combo boxes. Click on the **Add** button and your selected range is added into the table. Finally, choose whether you want to display the result as a simple visualization or you want to create a new document. An example of visualization formed in this way is shown on the right side in Figure **142**. A range chart was created here using two documents with time series for river discharges. The resultant visualization gives you discharge changes between two river profiles over a period of time.

4.8.3.2.1.5 Visualization.SpecializedCharts.Predefined.RangeCharts. PartWithLong-TermRanges

This function allows you to create a **very specific type of Range visualization**. Using the dialog in Figure **143,** one graph can show your **long-term average range** (daily, weekly, monthly) **from one document** and the **real course of measured values** from a defined time of the **same or another document**. Example of this visualization is shown in Figure **144**. Select the document from which you want to render the actual values in the form of line series from the dialog in the upper combo box. The start and end date of the time series are then entered in the lower two controls. If you want to see only a part of the time series in the graph, you can adjust these values manually. Then, in the next combo box, select the document from which you want to create a series of range values. Then define the range you want to use in the last combo box. You can create a range from long-term values, daily, weekly or monthly values. Finally, choose whether you want to see the visualization or if you want to create a new document. Then, press the **Show** button, and your defined data is automatically processed and the result is displayed.
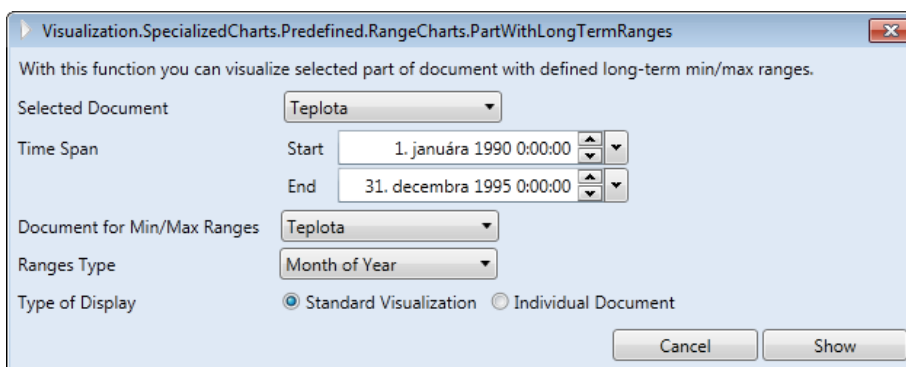
Fig. 143: Long-term range visualization.

Fig. 144: Example of graph generated by the function described above.

Very interesting visualizations can be generated when other functions are combined with this one.

4.8.3.2.2 Visualization.SpecializedCharts.Predefined.SumCharts

Sometimes you may want to create graphs with **Column** and/or **Area** series, where **these objects do not overlap**, but where these objects have previously been rendered in addition graphs**.**
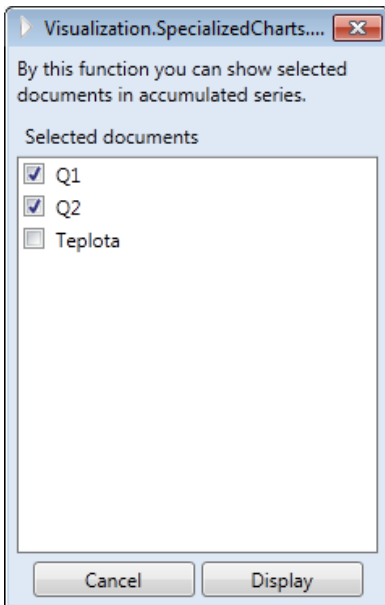
These types of graphs are not easy to create, because visualized documents must have the same measurement step and should not contain gaps or have different time scales. Therefore, commands that automate this work for you are prepared here. When you click on each command in this group, a small dialog as shown in Figure **145** is displayed.

Using this, select the documents you want to see and click on the **Display** button. Selected documents will be automatically synchronized and rendered in the form of non-overlapped column or area series. All four possible types of visualization are described below.

4.8.3.2.2.1 Visualization.SpecializedCharts.Predefined.SumCharts.Area

The first function **Predefined.SumCharts.Area** allows you to view selected documents in the form of Area series that do not overlap but are added to each other. An example is shown in Figure **146**.
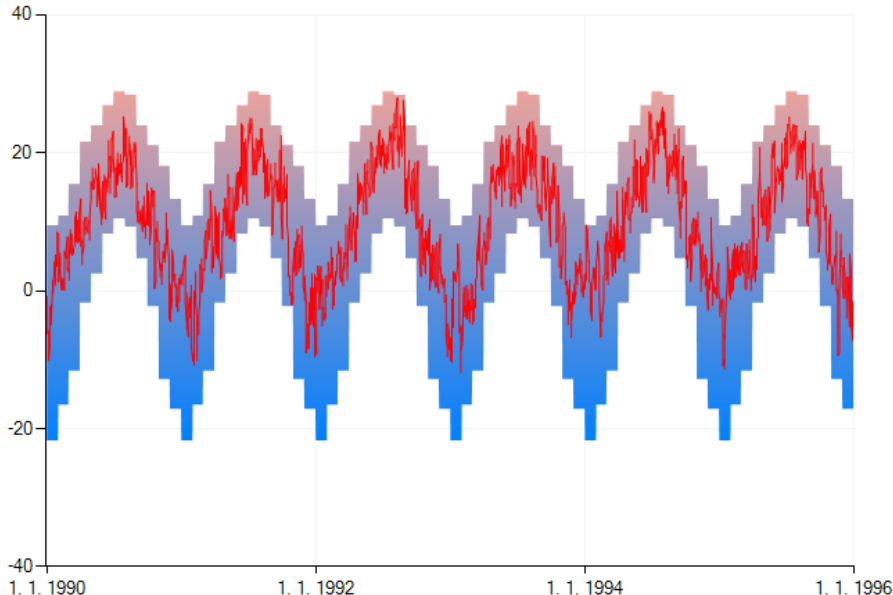
4.8.3.2.2.2 Visualization.SpecializedCharts.Predefined.SumCharts.Area100

This second type of graph is similar to the previous one, but allows you to view selected documents in the form of Area series (Fig. **147**). The difference here is that values from individual time series are recalculated from absolute values to percentage values, (where the total is 100 %), and your values are displayed as percentages of the total amount.
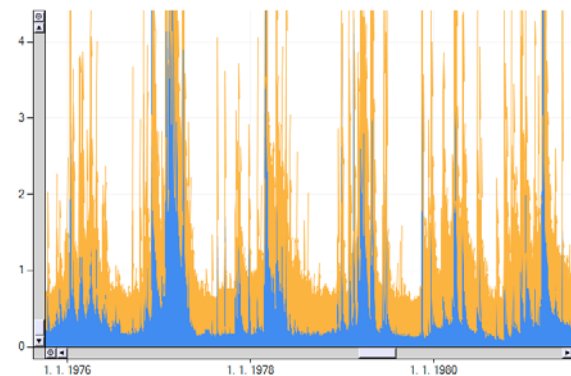
Fig. 146: *Example of a graph created by Predefined.SumCharts.Area function.*
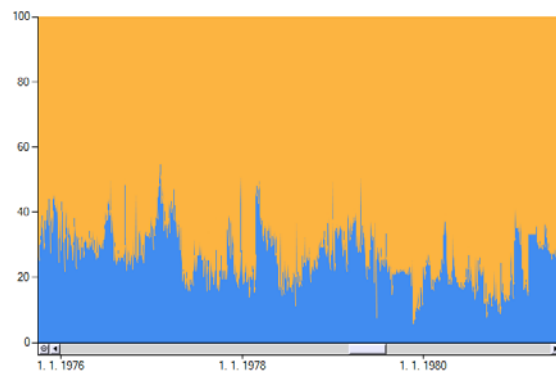
Fig. 147: *Example of graph created by Predefined.SumCharts.Area100 function.*

4.8.3.2.2.3 Visualization.SpecializedCharts.Predefined.SumCharts.Column

This command allows you to view the values of selected time series in the form of columns, where the values of the individual documents are aggregated. Example visualization created by this command is illustrated in Figure **148**.

4.8.3.2.2.4 Visualization.SpecializedCharts.Predefined.SumCharts.Column100

The last command in this group allows you to render series in columns. Unlike the previous
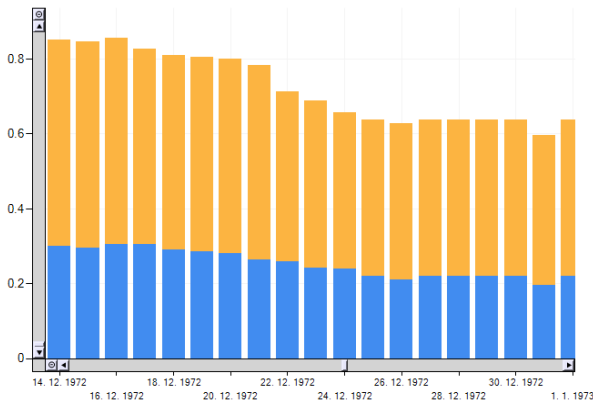
Fig. 148: *Example of graph constructed using the Predefined.SumCharts.Colunm function.*

function, values here are shown in relative form as a percentage of the total sum.

4.8.3.2.3 Visualization.SpecializedCharts. Predefined.SelectionCharts

The functions of the **Selection Charts** group allow you to render selected sections from several documents in one chart. Here, you use two commands with different character. These two commands and the results you get from using them are described below.

4.8.3.2.3.1 Visualization.SpecializedCharts.Predefined.SelectionCharts. SelectedParts

The **Selected Parts** function allows you to render selected segments from several documents as separate series in one graph (Fig. **149**). The selected segments are defined in the dialog, where the uppermost combo box lets you select the document from which you want to select segments. Based on this selection, the start and end of the time series are automatically entered in the lower date time choices. These controls define the segment of the document, so then just click on the **Add** button. The definition of selected sections is shown in the table, and these described steps can be repeated for other segments or documents. When all the segments are defined, click on the **Show** button and your graph is displayed. Its character will be similar to that shown in Figure **149**. All segments of the selected documents are displayed as separate series.
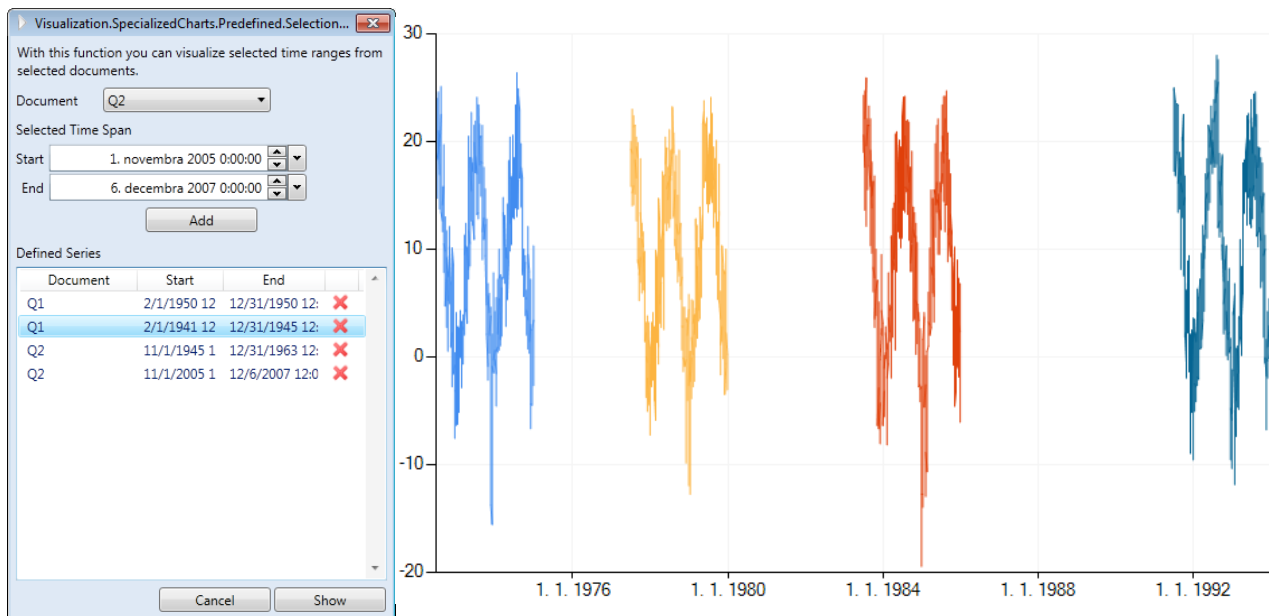

Fig. 149: **Left** – *definition of segments from selected document;* **Right** – *final display of selected time series segments.*

4.8.3.2.3.2 Visualization.SpecializedCharts.Predefined.SelectionCharts. AnnualParts

The second function uses a different approach, allowing you to **view annual periods** from selected documents. An example is shown in Figure **150**.
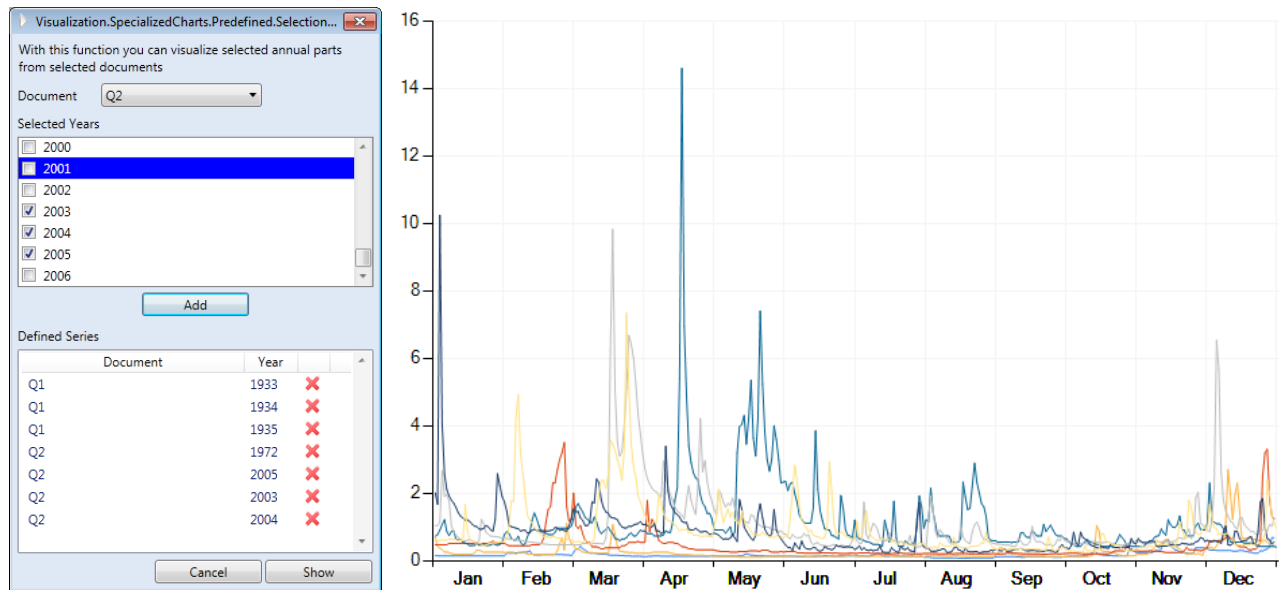

Fig. 150:   Left – *dialog for annual segments selection and definition;* **Right** – *resultant visualization.*

First, select your document from which you want to select some annual periods in the combo box. After document selection, the years are loaded into the checked list box and you select what you want to view and press the **Add** button. This procedure can be repeated with other documents, until all segments from all documents are defined. Then, simply click on the **Show** button and the program displays all selected annual courses according to your defined settings, as shown in the example above.

4.8.3.2.4 Visualization.SpecializedCharts.Predefined.TypedCharts

These types of graphs are used in **specific cases**. For example, this current version of program allows you to display graphs of **precipitations** in the form of reverse column series and the graph of **rainfall-runoff dependencies**.

4.8.3.2.4.1 Visualization.SpecializedCharts.Predefined.TypedCharts. Precipitation

This visualization illustrates the time series of **precipitations**. For this type of visualization, use the dialog shown in Figure **151**.

First, set the display type in the top combo box. With this setting, you can view documents in one or multiple chart areas. Then choose the documents you want to see from the list. A graph displaying the time course of precipitation in the typical form is shown. The values on the Y axis are reversed, and zero value starts at the top of the chart area.
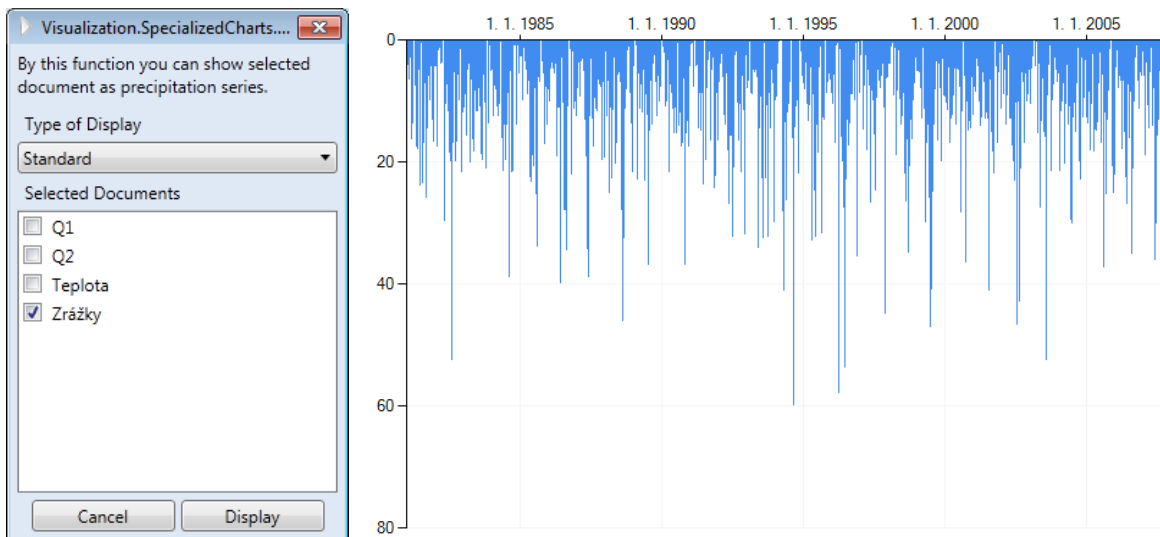
Fig. 151:   Left – setting the described visualization; Right – display of daily precipitations.

4.8.3.2.4.2 Visualization.SpecializedCharts.Predefined.TypedCharts. PrecipitationAndRunoff

Using the last function from these predefined visualizations, you can view the **relationship between precipitation and river discharges** on multiple profiles. Here, the precipitations are shown as in the previous function, except that the values are displayed on the secondary Y-axis. This visualization is set in the separate dialog shown in Figure **152**. Select your document containing the precipitation time series in the top combo box, and select the documents with river discharge values you want to see in the box in the list. Discharge values are displayed on the primary Y-axis. Click the **Display** button and your set visualizations appear. Precipitations are shown as a Column series and selected river discharges as a series of Fast Lines. Although only one series of river discharges is illustrated in the example in Figure **152**, you can display multiple discharges simultaneously.
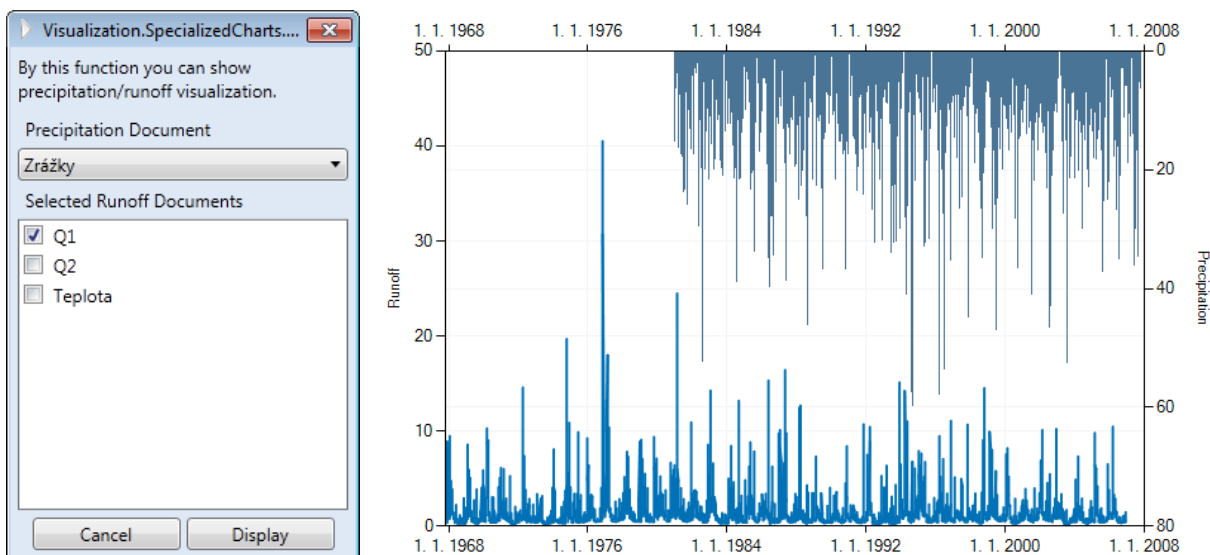

Fig. 152:   Left – dialog setting the visualization; Right – the prepared sample visualization.

This described visualization is called **PrecipitationAndRunoff,** but you display other values, such as temperatures, changes in groundwater levels or spring yields, depending on your work.

4.8.3.3 Visualization.SpecializedCharts.Dynamic

The last option in visualization functions is the **SpecializedCharts.Dynamic** command. When you use this command, the dialog in Figure **153** is displayed.
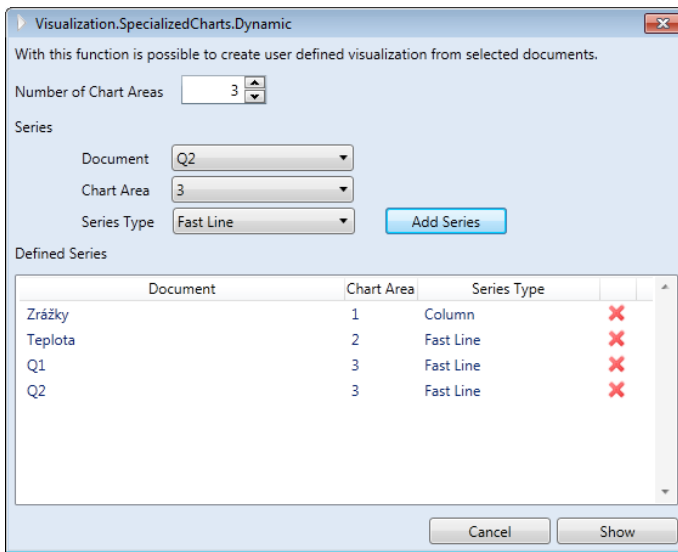
Fig. 153:   *Setting a dynamic type of visualization.*

This dialog is similar to that of the *SpecializedCharts.Custom* function. Here, you set the number of chart areas to be created in the resulting graph window and define the documents you want to see in the graph and the display types you want. After setting these parameters and clicking on the **Display** button the window in Figure **154** appears.
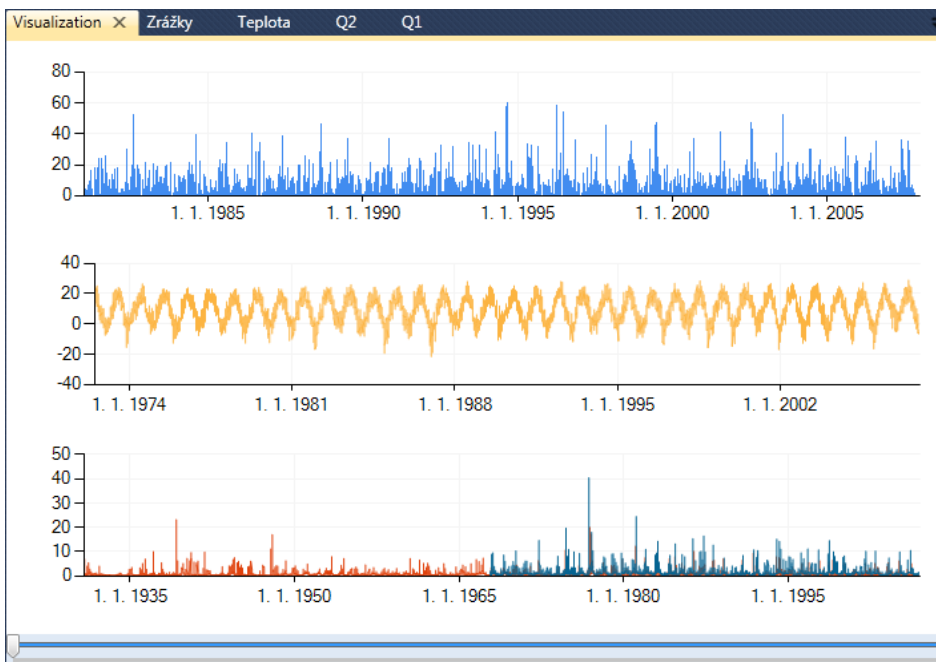
Fig 154:   *Initial view of this dynamic visualization.*

In this visualization you render precipitations in daily time-step in the first chart area. The second area includes daily air temperatures. Finally, river discharges from two profiles are in the third chart area. When you look at the time range on the Y-axes, you see that each series has a different range. Some start in 1930 and others much later. If you want these initial and final time **ranges synchronized** in any of the earlier visualizations using built-in graph settings, this will take quite a long time. Therefore, a function has been created for you, where time synchronization is

simple and fast. For this purpose you use the slider displayed at the bottom of the window (Fig. **155**).

Fig. 155:   Slider which allows you to define the time range of displayed series.

The position of the slider determines the **start of displayed range**. The highlighted dark blue portion of the slider shows the **range of displayed data** in the graph. When you first open this window, the full length of the slider is highlighted, so that all available records from documents are rendered. If you want to change the range of visible records just **right-click** your mouse in the area of the **slider**. The input box displays your defined number of days. The example below defin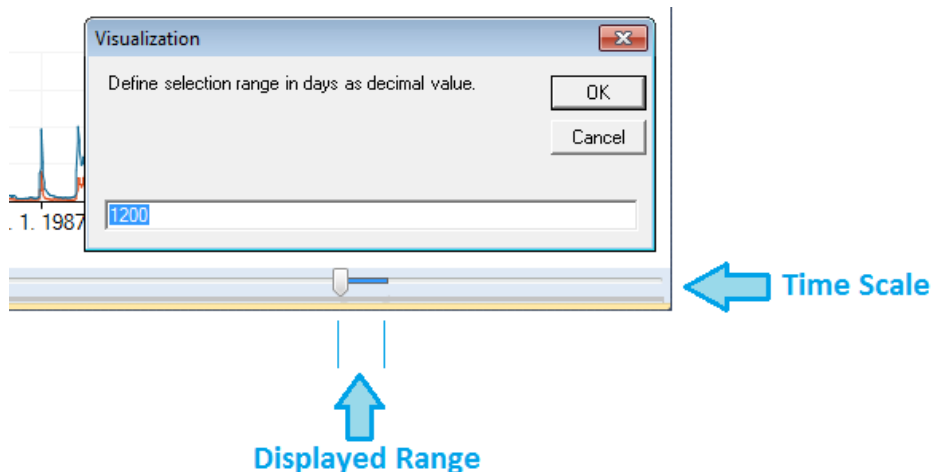es 1,200 days. Click the **OK** button and the defined range of values is rendered and also the highlighted part of the slider will be changed. Then just move the slider pointer over the time and the series is automatically adjusted. An example of this process is shown in Figure **156**.
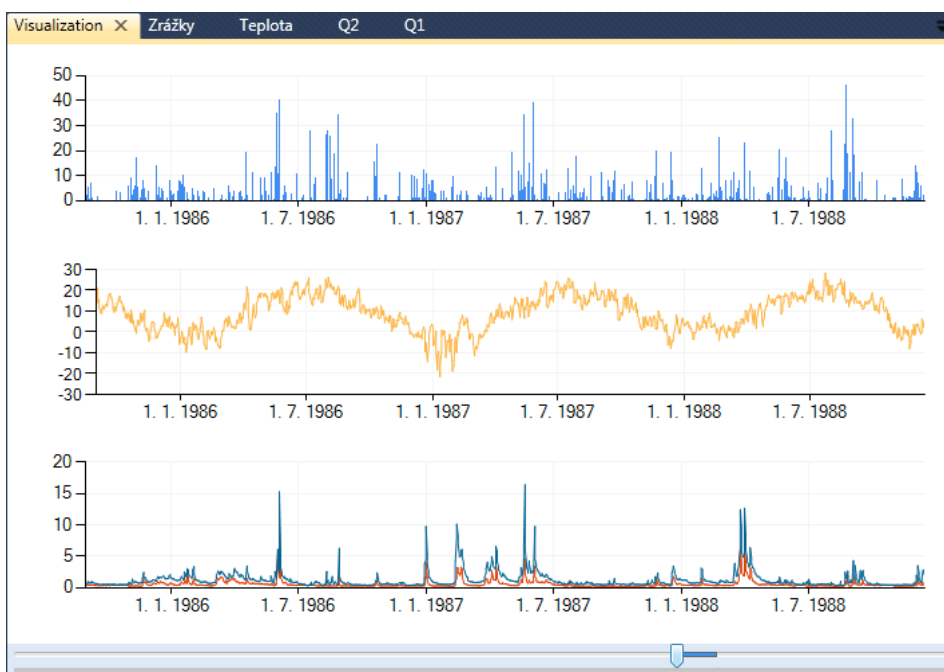
Fig. 156:   Example of synchronized series rendering for the range of 1,200 days.

This example shows the predefined visualization range of 1,200 days starting at 1.9.1985. This visualization feature is most functional when you need to show multiple series in several chart areas, and your same time ranges must be defined or changed for display. This is the last tool for time series visualization in the current version of TS Editor. Now your complete options for cooperation with other programs or file types will be described: using the final group of commands.

4.9 Cooperation

Functions in the **Cooperation** group communicate between TS Editor and **external programs, databases and files**. This function will most likely be extended in future versions. The current version allows you to work with **(A)** a third-party program – the **Feflow** software from WASY. This program models water, heat and solute transport in rock environments. This software is extremely practical, so the author of HydroOffice software uses it continually; and **(B)** the second function of TS Editor allows you to **import** time series from **CSV** files, with very variable character and it also allows created document **export** from this program into CSV files. The following subsections describe these two cooperation functions.

4.9.1 Cooperation.Software.Feflow

Almost every hydro-geologist recognizes **Feflow software** (Fig. **157**). This program allows you to model transport of water, heat and dissolved solids in a two or three dimensional defined model. Different types of time series of measured values can be used to model and calibrate results. These include river discharges, yields of springs or technical objects such as wells, and also the changes in groundwater levels. These values must be imported into the program using a specific file with ***.pow** extension. This single file can contain one or multiple time series and these values are stored in the well-defined structure described in the software's documentation.
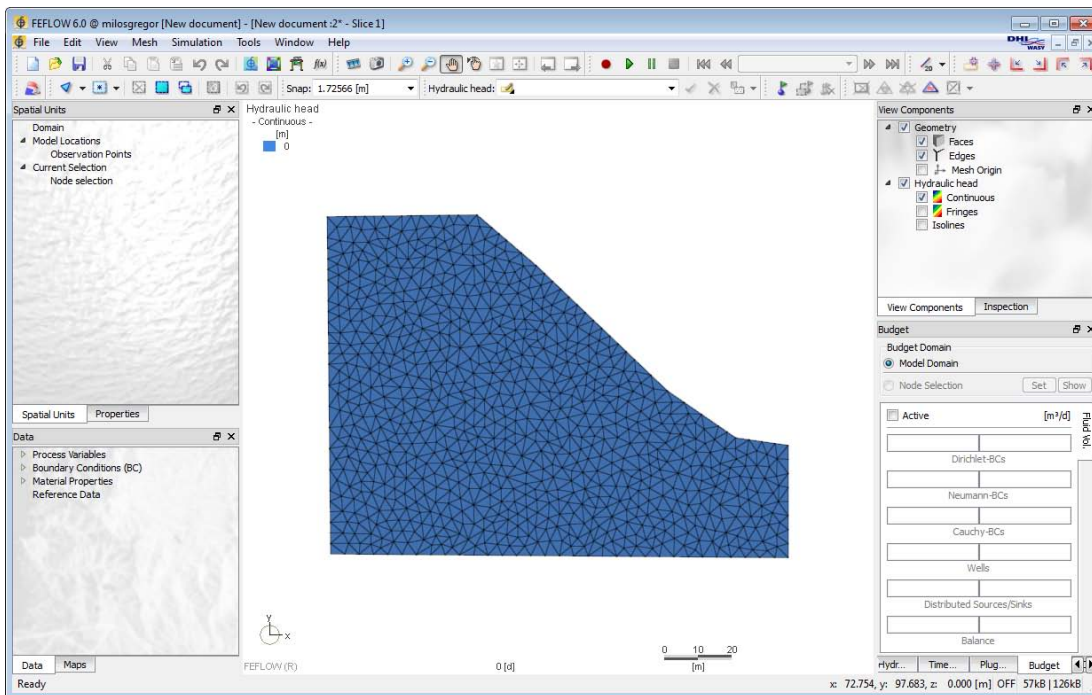
Fig. 157:   *Screenshot from Feflow software.*
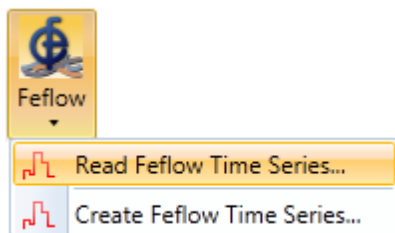
Fig. 158:   *Functions for working with Feflow software.*

However, the Feflow program does not include any specialized instrument for the preparation of your files. Therefore, TS Editor has created all functions necessary for all your files to be read and the processed values delivered in the form required in Feflow software. For these purposes, you use the features illustrated in Figure **158**.

Using these functions, you can **import** *.pow files into the program or **prepare** a **new** file. The following two sections describe these options.

4.9.1.1 Cooperation.Software.Feflow.ReadFeflowTimeSeries
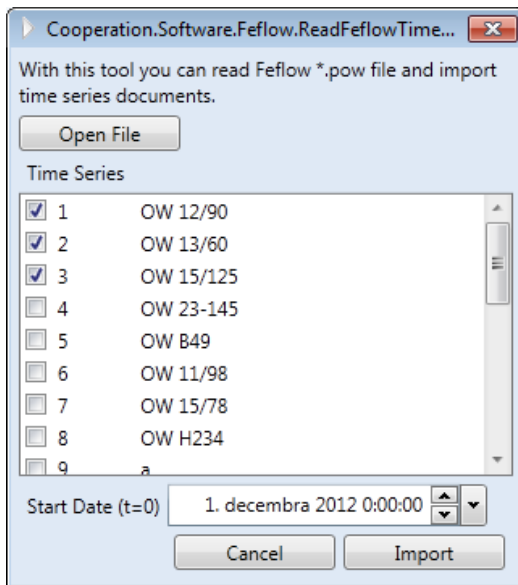
Tool for time series parsing and importing from *.pow file.

Firstly, we describe the function prepared **to parse and import** time series from the **Feflow *.pow file**. For this purpose we use the dialog shown in Figure **159**.

Using this function, you can **parse *.pow file** into individual time series. Firstly load the file using the upper **Open File** button, and select the *.pow file from the disk. When you open the file, the program reads and parses it. Individual time series are displayed as a list of series in the checked list box. Select from this list what you want to import into the program as separate documents. Then you must **define initial time** T_0. Since the series are presented in the Feflow program in the form of decimal numbers of days, the program does not know which day is at time T_0. Therefore, set this parameter in the date time choice under the list of series. If you don't know the date for T_0, or this is not important for your work, define it with any random value. However, **it must be defined** in some way. Then click on the **Import** button. The defined time series from the *.pow file are selected with the time structure defined according to your original time definition, and this prepared data is transferred into a new document.

4.9.1.2 Cooperation.Software.Feflow.CreateFeflowTimeSeries
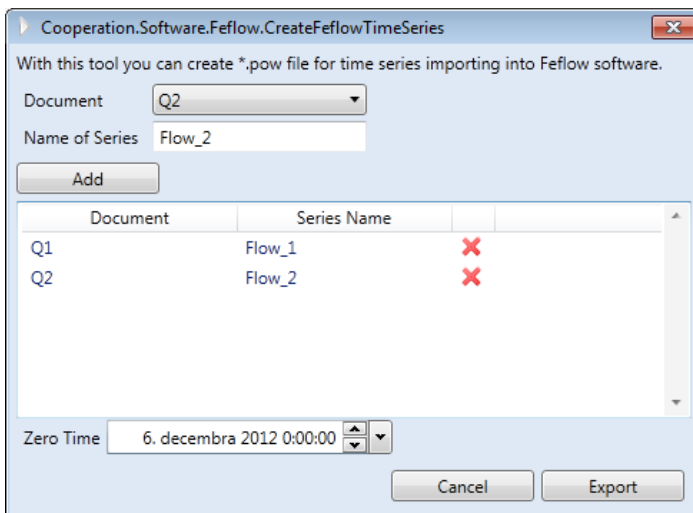
Tool for creating a *.pow file with time series.

The second function is used for the opposite purpose. If you have a time series in TS Editor that you want to use for modelling in Feflow software, we use this feature for **creating the *.pow file**. When the command starts, a new dialog is shown where you define the documents to be used and compiled into a resultant file (Fig. **160**). Define the document you want to use in the top combo box. After selecting it, type its new name in the lower text box. Then just simply press the **Add** button and the program adds your document definition into the table. This procedure is repeated until you have defined all the time series you want to use in your table. Finally, you must define the parameter called **Zero Time**. This is automatically set to the earliest date you have in all your selected documents. Zero time will be set as (T_0) in the final document. If you want to modify this parameter, do it in the date time choice under the table. If you enter a lower value than the predefined one, the first value with the earliest date in any series will be set at time $T_0 > 0$. If you enter a later date, the first time value will be set to a negative value ($T_0 < 0$). After defining all necessary parameters, you must press the **Export** button and the program will display a **save file dialog** to create the *.pow file on disk.

If the file is saved on disk, you can import it into the Feflow program using the built-in tool – **Time Series Editor** (Fig. **161**). Here you load it by pressing the **Import** button. Your prepared file will be automatically loaded with the defined names of the individual time series. Then you can

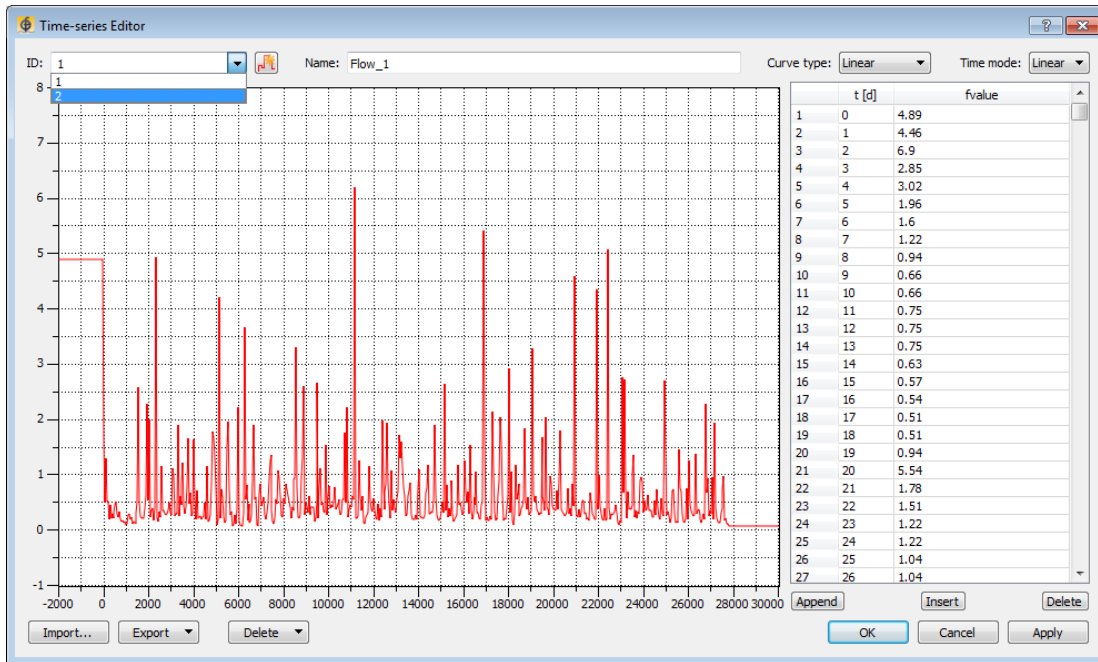safely use these series for further modelling work.

Fig. 161: *Loading time series values from a sample *.pow file in Feflow.*

In this way, the program allows you to communicate with the external Feflow program, and this gives you greater opportunity to accelerate your modelling work, especially where you want to compare discharge levels or report measured or modelled discharge levels.

Future versions of TS Editor are planned which will allow cooperation with many other software and modelling programs.
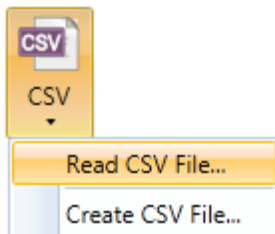
4.9.2 Cooperation.File.CSV

Fig. 162: *Functions for working with CSV files.*

This chapter explains the possibilities and capabilities of working with **CSV files**. These files are the standard for data exchange between different types of data storage, programmes, or they are the result of data exports of various types of environmental data-loggers. Therefore, support for this file type is included in TS Editor. Moreover, the program is used to import data and to export CSV files where the values in line are separated by the tab chart. We use two commands to work with CSV files (Fig. **162**). One is used to **import and parse data from a CSV file** and the second is to **export data from a program** in the form of a CSV file.

4.9.2.1 Cooperation.File.CSV.ReadCSVFile

Firstly, we presented the ability to **import data from a CSV file** into the program. For this purpose we use a stand-alone dialog (Fig. **163**). We use a specific procedure to process CSV files. First, load the document from the disk using the topmost button **Open;** this loads the file into the upper text box as plain text. This is imported in the form of plain text so that you can see the structure and nature of your file before setting up file parsing.

Now set the **parameters of parsing**. These parameters are located under the text box. First, set the **column delimiter** that defines the values separator in line. There are several types of separators you can choose. In this Figure, the **semicolon** is set. But, if the values are **enclosed in quotes,** you select the next check box. If the file contains **column headers** in the first line, you also mark the following check box. After setting these parameters, press the **Parse** button and the
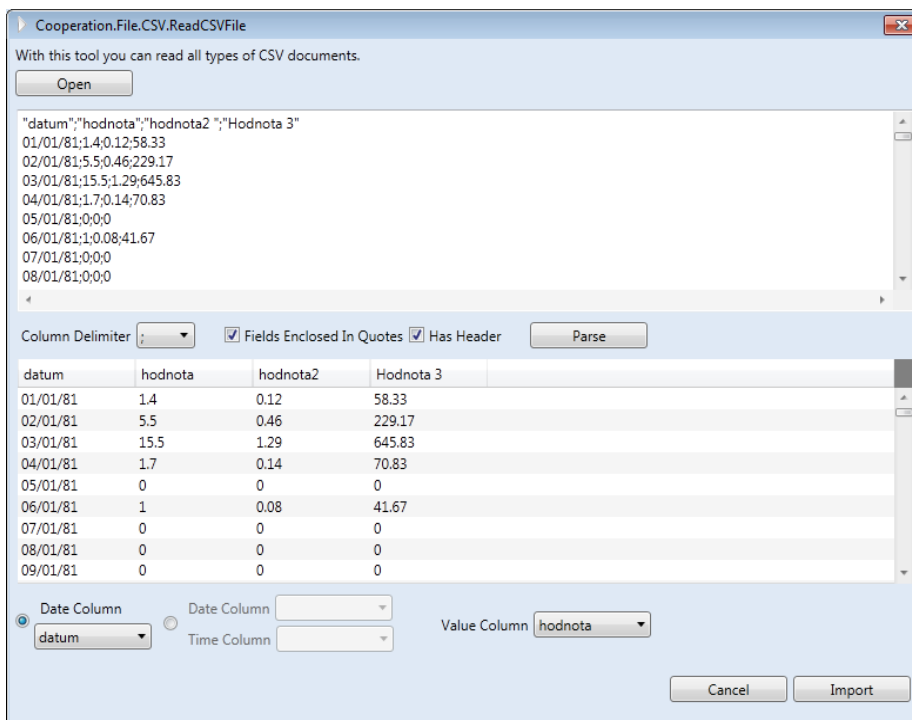
Fig. 163:   *Tool for time series parsing and import from CSV files.*

program will take care of parsing lines and values from the file, and then insert it into the table cells in the bottom part of the window. When the values are correctly parsed, proceed to import the time series into the new documents.

From the table, use the combo boxes to select the columns that include the **values of time** and the column which stores the **measured values**. Where you have columns with values, you choose only one column. You now have a choice for the time values. If the datetime values are defined only by date or one column contains the date and time value, you define the date column by the first combo box under the table. If the date and time values are divided into separate columns, define them by the second group of two combo boxes. This separation of date and time values is most common, for example, in CSV files from data-loggers. When you have defined all parameters, just click on the **Import** button. A new document will be created from the selected values in the table. If the table contains multiple columns with the measured values you want to import, just repeat this procedure. These variable settings let you import all different types of CSV files into the program, and all these can be parsed into individual single documents.
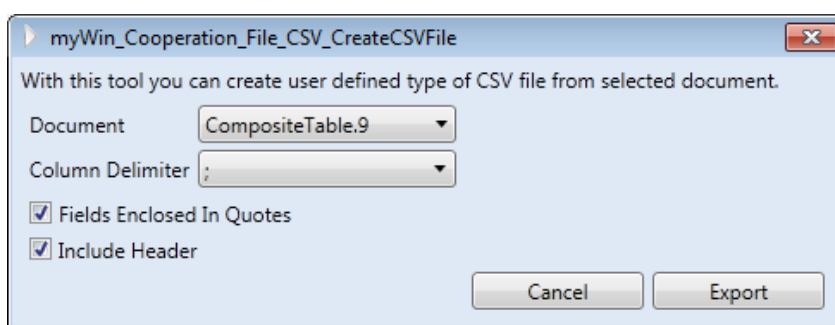
4.9.2.2 Cooperation.File.CSV.CreateCSVFile

Fig. 164:   *Tool for exporting selected documents into the CSV file.*

Export of documents from the program also uses the very same principles, with the dialog shown in Figure **164**.

Firstly, select the document you want to export in the top combo box. At this point it is not possible to combine multiple documents into a single one, so for this purpose you use other functions in the program, such as the **Functions.CompositeTable**. When you have selected your document, you must set the **column delimiter**, which separates the values in a row. Then, you have the choice of the following check boxes. You can **enclose values into quotes** and/or you can **include the table headers** in the new CSV document. After setting all parameters, just simply press the **Export** button and choose the location on the disk where you want your file saved.

5 Conclusion

The previous text describes how to use the graphics interface of TS Editor version 3.0. This program is used to process the time series of values and environmental characteristic such as river discharges, changes in groundwater levels, air temperatures, water mineralization and precipitation totals.

You can apply this program for all your needs, and it allows you to use more than 2,000 functions and commands that are logically divided into separate groups. A rapid speed of function processing and results display has been developed in this program. For professional users, the program also includes a number of improvements such as built-in scripting language and a simple tree structure.

This program is currently the flagship of the HydroOffice software package and the program will be developed further in the future. Therefore, if you have any comments, notes or you lack some function, you want installed in up-graded versions of this program, they will be greatly appreciated. Please feel free to contact me via my email address on the user forum or in the contact form on the site. I will be happy to receive criticisms and any advice you want to offer. If any errors are found, these will be removed and you can re-install an update of the current version. Most active users will be rewarded for cooperation by a free licence which will be given to you for the next version.

I hope that this program and all other tools in the HydroOffice package help you in your daily work and simplify all manual and time-consuming tasks, so that you can focus on the core material of your work.

Appendix I: Document Naming Conventions

When working with this program, it is very important to know the way the names of the documents have been generated. It is especially important to know how the documents were created, which function was used for them and from which document the function was actually generated. This knowledge is schematically described in Figure **1**.

Processing a single document
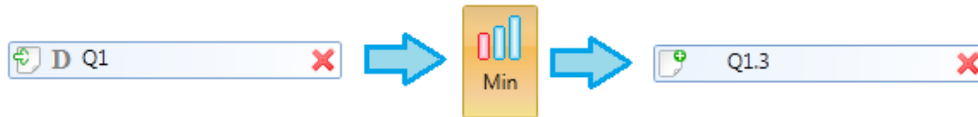
Processing of multiple documents at once
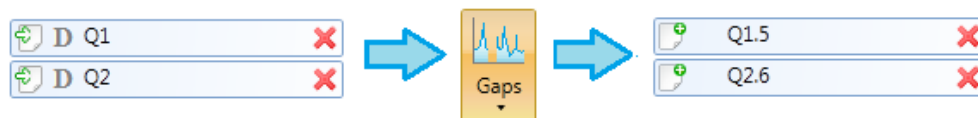
Mode A
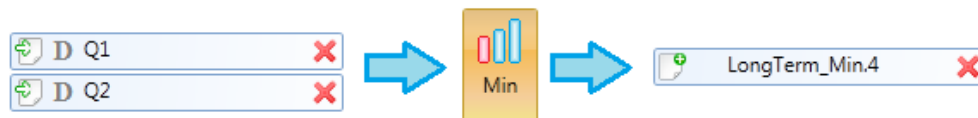
Mode B

Fig. 1:   *Schematic representation of document naming in this application.*

The base of the document name consists of the name of the text file from which data was loaded into the program. Two documents that were loaded from the disk can be clearly seen in the Figure above – **Q1** and **Q2**. The first icon makes it clear that they were imported from the disk. These two documents are then used in further work in the program with a variety of commands for their processing

Basically, it is necessary to distinguish whether you are working with documents individually or you are processing multiple documents simultaneously. When you work with an individual document, the names of your new documents created using commands (such as **Statistic.Basic.Min**) are composed of the name of the source document and the unique number of processes involved. These two parameters are joined by dots. This means that if we used document **Q1** and it was the third process in the program, the name of the final document will be **Q1.3**. From the resulting document name you know that the document was created from document Q1. If you use this document (**Q1.3**) for further processing, the name of your subsequent document will consist of the name of the source document Q1 and another number; the first time it will be **4**. The final document name is then **Q1.4**.

When processing multiple documents at once, this convention is sometimes changed. If the result of processing of N documents gives the same number of new documents, the names are generated in the same manner as in single document processing. However, if all your results are merged from multiple documents into a single document, the naming convention varies. In this case, the name is created from a combination of the function name and process number. An example would be the name **LongTerm_Min.4**. From this name we know that this document contains the minimum long-term values from selected documents, and then the Process number is added. This numbering is important, because the program architecture requires that each document must have a unique name. If you use the same command again for other documents, the name will be **LongTerm_Min.5**. From their names, and especially from the last number, you can tell which document was created earlier.