PostProc 2 Manual

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1. Overview

PostProc 2 is a software for the analysis and post-processing of *time-dependent* data, as they are generated in dynamic simulation programs (e.g. DELPHIN, THERAKLES, NANDRAD, MASTERSIM, and any other simulation programs). It is also well suited for the analysis of *measured* and experimental data. *PostProc 2* therefore necessarily requires a time reference in the data set (see data formats/data types), and for most diagrams the X-axis is the time axis.

For data with additional coordinate reference (e.g. field outputs), it is of course also possible to display only the data of a time point. In this case the X-axis is always a coordinate axis, and if necessary the Y-axis as well, for example in colour gradient diagrams.

1.1. Overview of functionality

The post-processing provides/supports:

- Import of data in different input data formats
- Data display, zoom in, unit conversion, linear/log scales for the axes, ...
- flexible and fast diagram formatting and export to vector or bitmap graphics (with precise size and scaling settings for correct print display)
- Analysis and transformation of data with models
- Calculations with data sets
- Updating the view/diagrams when the source data changes without losing formatting (live view of the results while the simulation is still running)

1.1.1. Specialities and nice functions

An essential feature of *PostProc 2* is the *separation of data and their visualisation*. It allows the updating of data/files and thus also a *live* view of the calculation results (see section Data update).

In a **session** (something like a project file) different diagram configurations are stored. The session file with extension `p2` is itself an XML file and can therefore be easily edited in a text editor. You can also easily duplicate diagram configurations in the text editor, or make changes in several places by search-and-replace. One could also create and adapt session files automatically via a script.

You can open the current session file in a text editor with the keyboard shortcut `F2`. The editor to be used can be configured in the program preferences (`File - Settings`).

The actual data is not stored in the session file, but referenced in external files. This allows the latter to be easily updated and *PostProc 2* will simply display the new data when reading/updating the session file. Very practical!

Session files, as XML files in ASCII format, work well in version control systems.

The diagram export can also be executed automatically via a command line command. This makes it possible to create a `p2` session file completely automatically and then generate a pdf/svg/png diagram via command line. This is very practical if you want to automatically create a large number of similar diagrams, each with different data (see Command line reference).

1.1.2. Diagram types

Different types of diagrams can be created. Basically, one can distinguish between 2D and 3D diagrams, whereby in 3D diagrams the third dimension is represented as a colour or isoline. Vector field outputs (e.g. of flow fields) are also possible.

Time-value diagrams

In time-value diagrams, the X-axis is the time axis and several curves are displayed above it, although two different Y-axes can also be used.

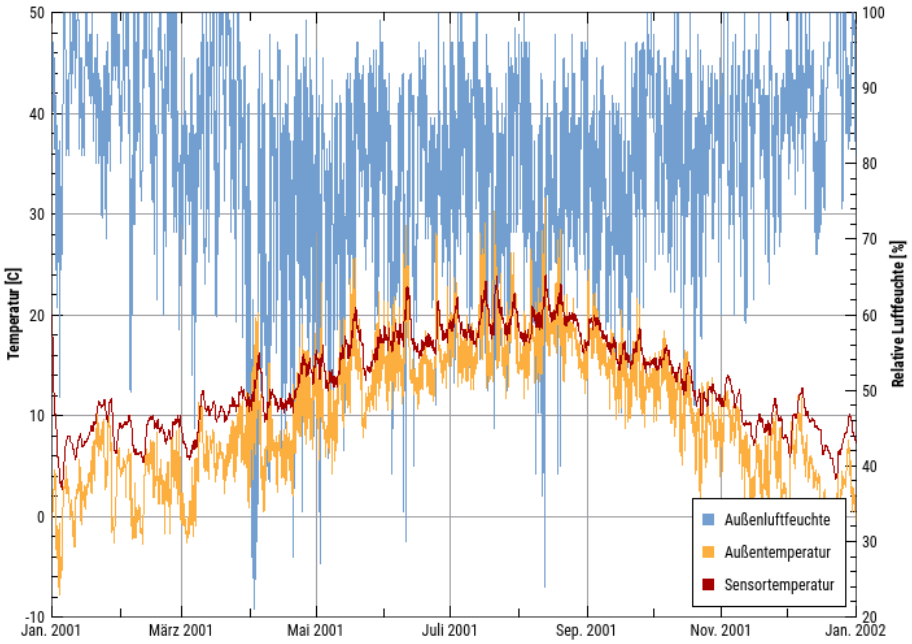


Figure 1. Representation of temperature/relative humidity

This is a typical time-value diagram, with the time axis formatted as a date axis, and two Y-axes for temperature and humidity respectively. Any number of lines can be displayed here, as long as their physical units correspond to one of the two Y-axes.

Profile plots (coordinate-value diagrams)

3D data (i.e. time-coordinate-value) can also be displayed in classic 2D diagrams, where the X-axis is the coordinate and the values are displayed *at a certain point in time*.

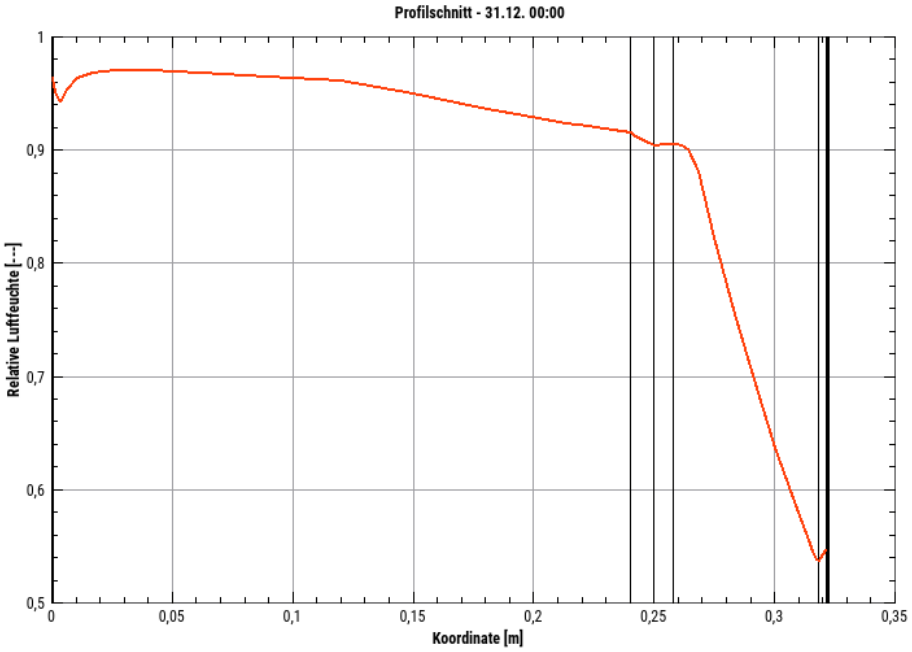


Figure 2. Representation of coordinate/time/relative humidity

This is a 2D diagram showing a time-animated profile of one (or more) physical quantities over the geometry for a selected point in time. In this representation construction lines/material layers can be drawn by thin lines. The point in time can be easily changed in the surface and can thus show an animation.

Colour gradient/spectral diagrams

3D data as above can also be displayed as colour gradient diagrams:

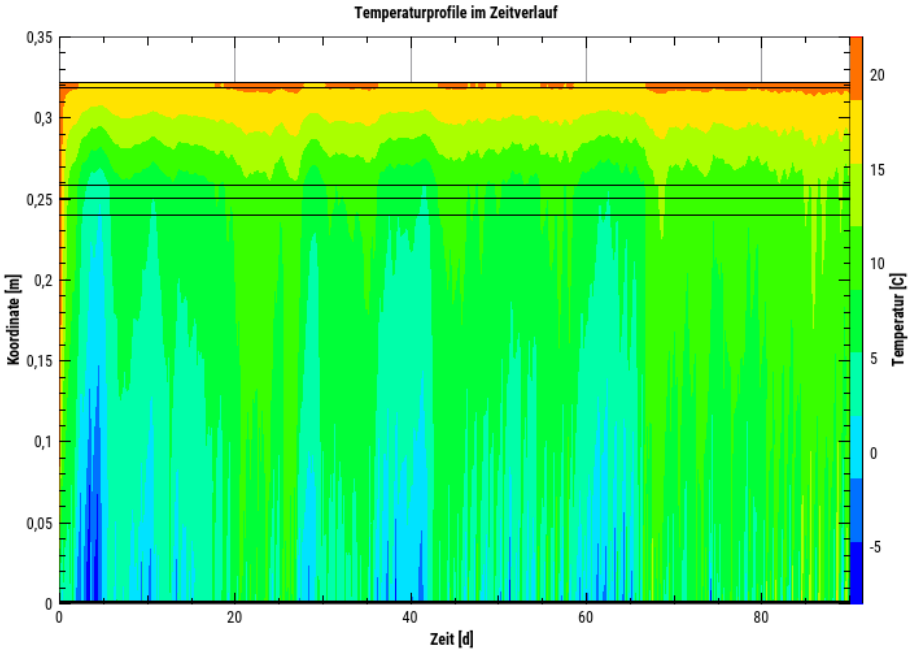


Figure 3. Representation of coordinate/time/temperature as colour gradient diagram

A colour gradient diagram (3D), which shows the temporal course of temperature profiles. The X-axis is a time axis, the Y-axis is the coordinate and the colour represents the numerical values (e.g. a temperature).

Representation of 2D geometries as time-animated colour gradient diagrams

4D data (i.e. time-coordinate-coordance-value) can be displayed in time-animated colour gradient diagrams.

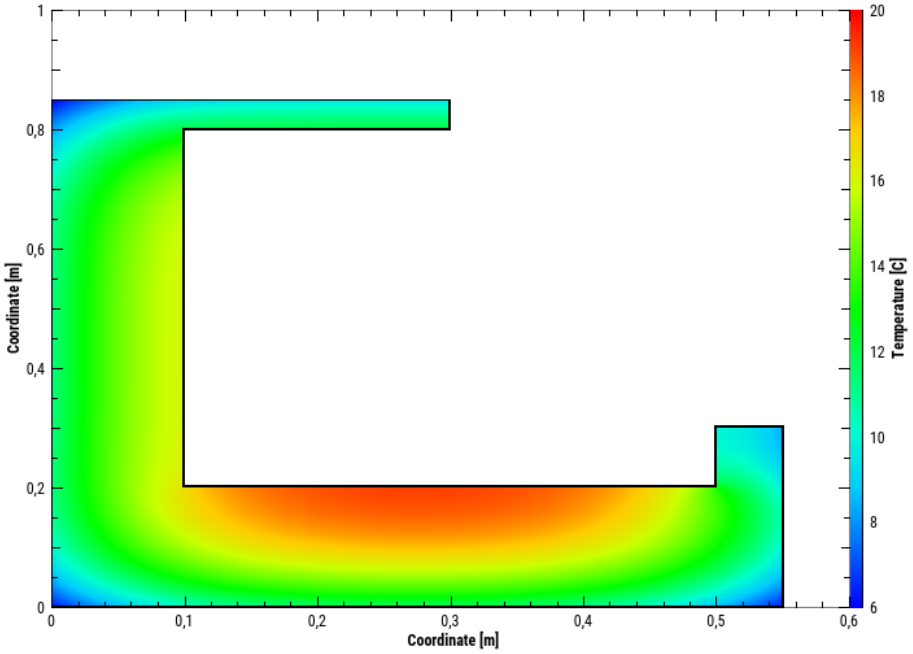


Figure 4. Representation coordinate/coordinate/temperature

In such a colour gradient diagram, which here shows a temperature field for a selected simulation time, the axes here represent the coordinates, and the colour the respective value.

1.1.3. Display configurations

In *PostProc 2*, several diagrams can be displayed simultaneously. In the case of time-animated diagrams, it is possible to change the time in several or all diagrams equally. In this way, related physical effects can be easily analysed.

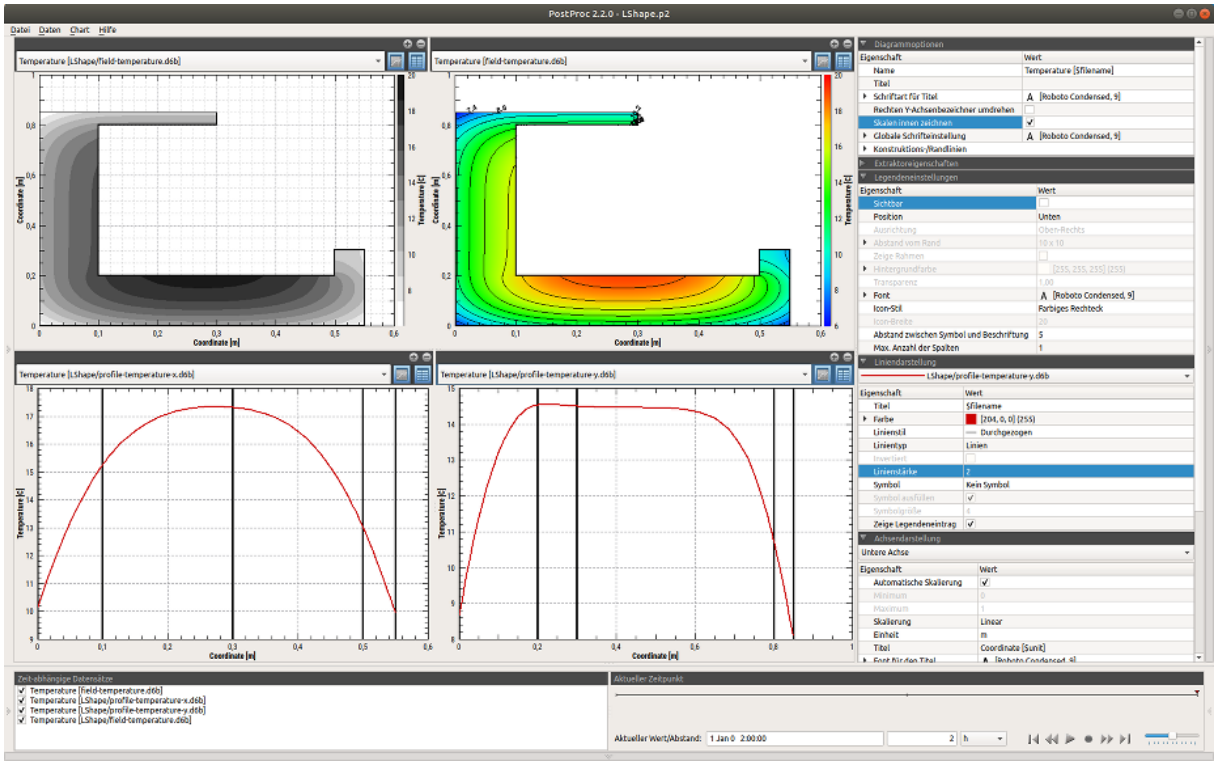


Figure 5. Screen layout with 4 diagrams

2. Program interface

The user interface is divided into the main window with one or more diagrams and the panels on the sides and at the bottom.

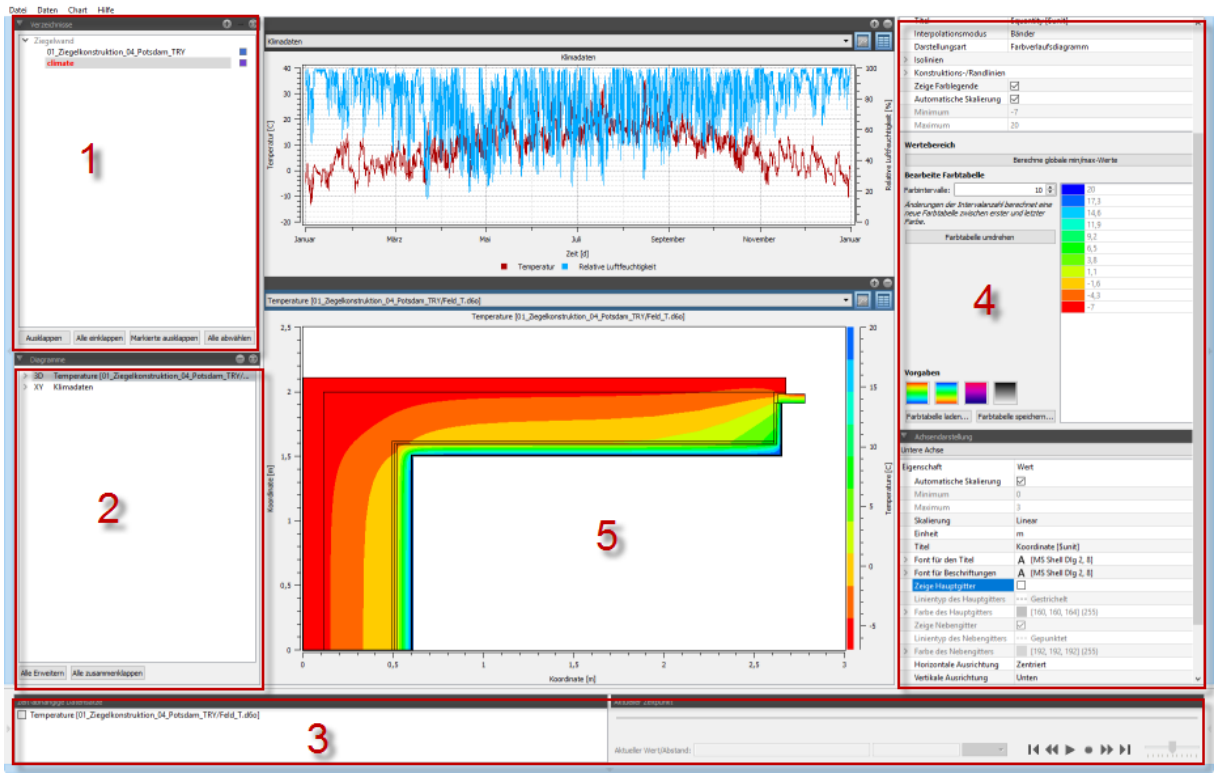


Figure 6. Program interface

2.1. Elements of the program interface

1. Directory tree to manage the directories with data records/files (see Data management)
2. Overview of created diagrams and curves/series contained therein (see diagram management)
3. List of all time animated diagrams and control of the currently displayed time (see diagram animation)
4. Diagram properties (see diagram formatting)
5. Diagram or diagrams (see diagram window)

The panels on the left (1 and 2), right (4) and bottom (3) can be folded away by clicking on the buttons at the edge:

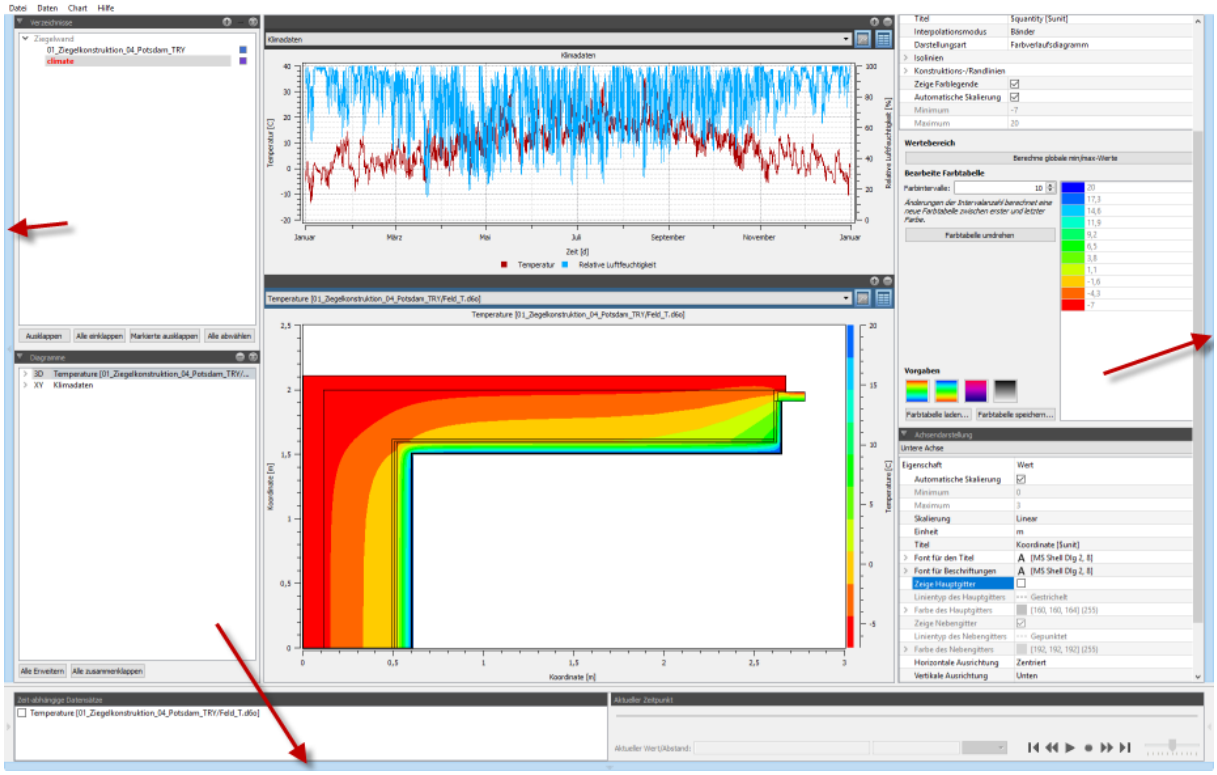


Figure 7. Panel buttons

With the shortcut command `F11` (or menu command `View - Full screen`) all panels can be folded away at once and switched on again.

2.2. Switch between data manager view and chart view

By clicking on the directory tree (1), the data manager view appears, i.e. a table with evaluable data records (see data management):

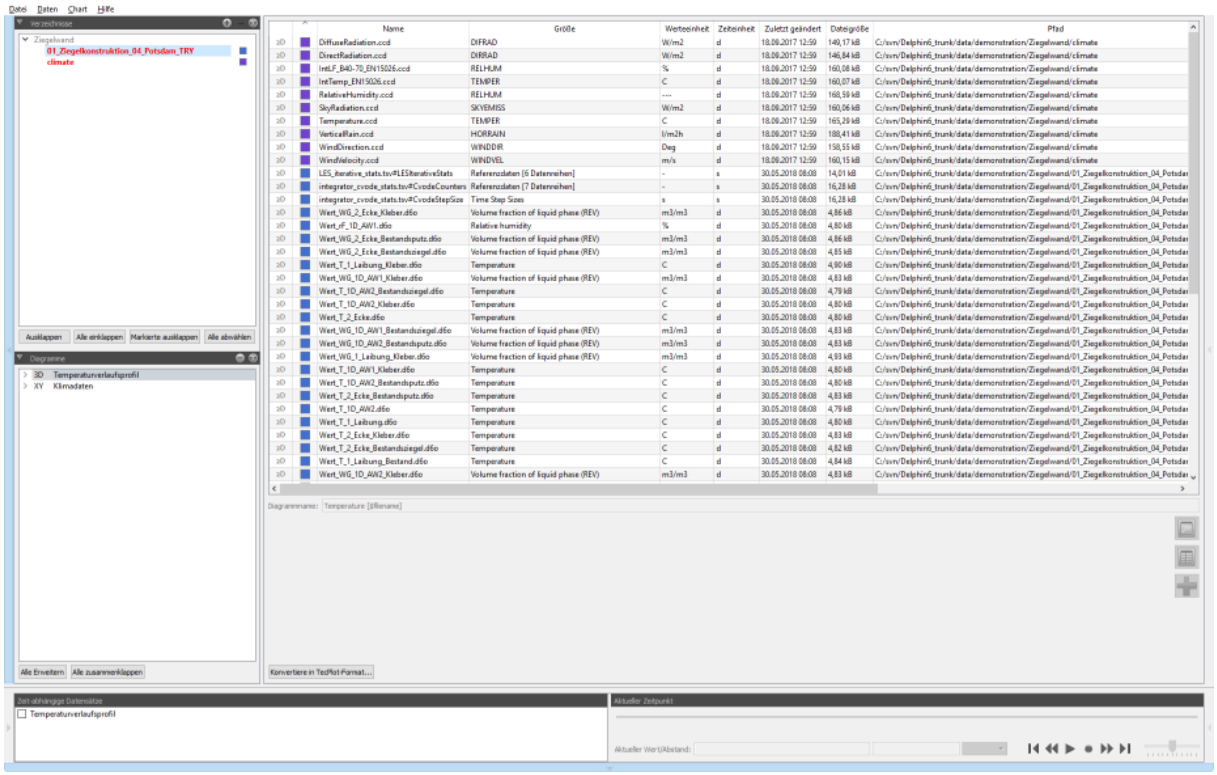


Figure 8. Screenshot data manager

By clicking on the `Diagram tree structure/diagram management` the post-processing switches to diagram editing mode (shows the available diagrams).

2.3. Sessions

The term *session* refers to all the data currently displayed in *PostProc 2*. This includes:

- added and selected data directories (and their unfolding state),
- created diagrams, their type and configuration,
- source data referenced by the diagrams and information for extracting the data, and
- program interface settings.

A session can thus be compared to a project management file. Sessions are saved in session files with the extension `p2` (XML format).

2.4. Session file format

The session files are written in XML format. Normally only the changed data is written to the file. However, if you want to adjust your own parameters, you can first have all parameters written out. To do this, you have to activate the option *Write complete session file* in the settings dialog (`File - Settings`).

Section Session file format gives a short overview of the file structure with links to the respective manual sections with the format details.

2.5. Edit session files in external text editor

It is possible to adapt these session files externally in the editor and then reload them. In this way, script-based evaluation sessions can be generated. Formatting settings of one diagram can also be easily transferred to another diagram.

The external text editor can be opened via the menu command `File - Edit session file in text editor` or via the keyboard shortcut `F2`. If the session file has been saved externally, the *PostProc 2* will ask at the next activation whether the modified file should be loaded.

The text editor to be used can be selected in the settings dialogue.

`F2` is also used as keyboard shortcut for *Edit project file in text editor* in the DELPHIN or MASTERSIM programs.

2.6. Open selected session file at program start

By default, *PostProc 2* attempts to reload the last session file when the program starts. This behaviour can be changed in the settings dialog so that an empty session is started instead.

If you want to start the post-processing with a selected session directly, you can specify it on the command line, e.g:

```
> PostProcApp.exe C:\Path\to the\session.p2
```

See also command line reference.

2.7. User settings/data directory

Configuration data and user data in general are stored in the user-specific data directory.

For example, if the user name is `simulant`, this user directory can be found in the following locations depending on the operating system:

Table 1. Paths to user-specific data directories

Platform	Path

Windows	`%LOCALAPPDATA%\IBK\PostProcApp`
	
	Example:
	`c:\Users\simulant\AppData\Local\PostProcApp`

Linux	`$HOME/.local/share/IBK/PostProcApp`
	
	Example:
	`/home/simulant/.local/share/PostProcApp`

MacOS	`$HOME/Library/Application Support/PostProcApp`
	
	Example:
	`/Users/simulant/Library/Application Support/PostProcApp`

2.8. Error analysis/log file

The post-processing works with user data, which can be faulty or unsuitable in many ways. If errors occur during the management and analysis of the data, these are not reported to the user via error message windows, but are written into a log file or into the log window. The content of the log file is also helpful for error reports.

The log file is displayed by means of the menu command: `Data - Show log file...`

The log file is located in the user specific data directory.

2.9. Log window in the programme

The log window is located in the lower panel and is normally not visible. It can be shown and hidden again by clicking on the lower left panel button:

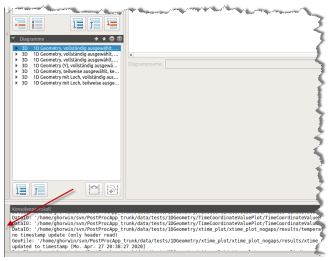


Figure 9. Location of the log window

There are messages of varying degrees of urgency; some are only informative, some are progress messages. You can set the desired level of detail of the messages for both the log file and the log window output independently. For this purpose, there is a tab `General Settings` in the settings dialog `File - Settings`. The path to the log file is also listed in this dialog.

3. Data import and data management

The first step in creating charts and data analysis is the selection of data sets and files.

3.1. The directory tree

3.1.1. Adding directories with files to be evaluated

First, a (basic) directory for data evaluation is added to the directory tree (see Fig. Directory tree), which is then searched for supported data files.

Directories are added using the ⊕ button and are then searched for supported result files. With ⊖ they are removed again.

When adding a directory, the directory itself and all subdirectories are searched for evaluable files in known file formats.

If you add a directory containing *no* evaluable files, the directory tree remains unchanged. In principle, directories without evaluable files are not displayed in the directory tree.

The directory tree now contains all directories (and their subdirectories) which contain result data. Directories

written in grey do not contain result data themselves, but at least one of the subdirectories does (see figure Colour assignments to directories). All directories with data are assigned a colour, which makes it easy to recognise the assignment of the individual files later.

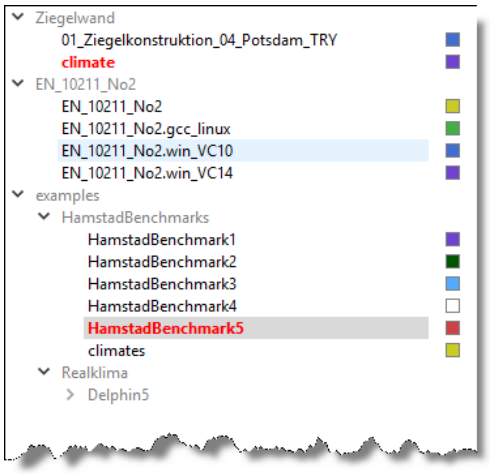


Figure 10. Colour assignments to directories

Any number of directories can be added. However, it is not possible to add a directory within an already added directory hierarchy. Similar to adding empty directories, nothing happens.

In the directory tree, only the directories relative to the selected directory are added. However, the absolute path can be displayed as a tooltip:

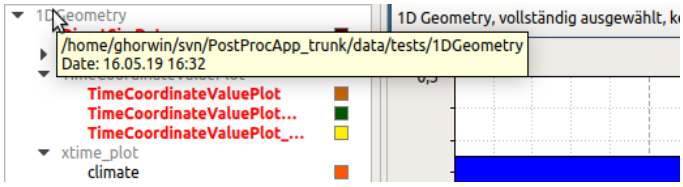


Figure 11. Tooltip shows absolute path of the inserted directory

Simulation results from the IBK simulation programmes are stored in a project-specific directory structure. PostProc 2_ recognises this and summarises the data clearly:

Directory hierarchies from NANDRAD, DELPHIN, THERAKLES, MASTERSIM etc.

A special feature are simulation output directories from the IBK simulation programmes DELPHIN, THERAKLES, NANDRAD and MASTERSIM. The project directory contains further subdirectories with the actual data. Starting from a project file *RealKlima.d6p*, DELPHIN would create the following directory structure for example:

```
projects/
 ├──── RealKlima.d6p
 └──── RealKlima
     ├──── log
     │   ├──── integrator_cvode_stats.tsv
     │   └──── ...
     ├──── results
     │   ├──── Flux_Humidity_NORD.d6o
     │   ├──── ...
     │   └──── TemperatureSensor.d6o
     └──── var
```

```
├── ...
└── restart.bin
```

If the parent directory *projects* was selected, only *RealKlima* would appear in the directory tree below the *projects* node and no further subdirectories. All evaluable files from the subdirectories *log*, *results* and *var* would then be assigned to the directory *RealKlima*. This makes the directory tree clearer.

Figure 12. Directory tree after adding the parent directory of a simulation directory

If you select the directory *RealClimate* when adding, the node *RealClimate* will be displayed in the directory tree, and below it the subdirectories *log*, *results*, and *var* will be displayed as child elements, depending on which directory contains evaluable files.

Figure 13. Directory tree after adding the simulation directory itself

It is therefore recommended to add the parent directory of the simulation project files for analysis.

3.1.2. Mark directories for data analysis

In the next step, the directories selected for analysis are marked (**double click** on the directory). This causes the files/data records that can be evaluated in the directories to appear in the data record table. At the same time the marked directories are written in red in the directory tree (see screenshot in fig. directory tree). A further double click on the red marked directories removes the content of these folders again.

		Name	Größe	Werteeinheit	Zeiteinheit	Zuletzt geändert	Dateigröße	Pfad
3D		Temperature profile (teilweise).d6o	Temperature	C	h	22.04.19 15:43	828 B	/home/ghorwin/sv...ests/1DGe
3D		Temperature profile.d6o	Temperature	C	h	22.04.19 15:43	1,48 kB	/home/ghorwin/sv...ests/1DGe
3D		Temperature profile_only_one_timepoint.d6o	Temperature	C	h	21.04.19 20:53	559 B	/home/ghorwin/sv...ests/1DGe
3D		Temperature profile (teilweise).d6o	Temperature	C	h	22.04.19 15:56	1,49 kB	/home/ghorwin/sv...ests/1DGe
3D		Temperature profile.d6o	Temperature	C	h	22.04.19 15:56	2,50 kB	/home/ghorwin/sv...ests/1DGe
3D		Temperature profile.d6o	Temperature	C	h	22.04.19 15:41	1,48 kB	/home/ghorwin/sv...ests/1DGe
2D		temp.tsv?1	Temperature	C	d	06.11.18 03:59	43 B	/home/ghorwin/svn...metry/Pr
3D		Temperaturprofil_horizontal.d6o	Temperature	C	h	06.11.18 04:31	29,56 kB	/home/ghorwin/svn...etry/Pro
3D		Temperaturprofil_vertikal.d6o	Temperature	C	h	06.11.18 04:31	29,56 kB	/home/ghorwin/svn...etry/Pro
2D		states.tsv?15	Occupancy sched...upants (1 room	---	d	12.01.18 13:34	1,75 MB	/home/ghorwin/svn/...ts/Refe
2D		states.tsv?1|2|12|13|14	Referenzdaten [5 Datenreihen]	C	d	12.01.18 13:34	1,75 MB	/home/ghorwin/svn/...ts/Refe
2D		states.tsv?3|4	Referenzdaten [2 Datenreihen]	d	d	12.01.18 13:34	1,75 MB	/home/ghorwin/svn/...ts/Refe
2D		states.tsv?5|6|7	Referenzdaten [3 Datenreihen]	-	d	12.01.18 13:34	1,75 MB	/home/ghorwin/svn/...ts/Refe
2D		states.tsv?8|9|10|11	Referenzdaten [4 Datenreihen]	W/m2	d	12.01.18 13:34	1,75 MB	/home/ghorwin/svn/...ts/Refe
2D		wall_fluxes.tsv?1|2|3|...|22|23|24|25|26|27|28|	Referenzdaten [45 Datenreihen]	W/m2	d	12.01.18 13:34	3,41 MB	/home/ghorwin/svn/...ts/Refe

Figure 14. Display of selected directories in the data manager

The buttons at the bottom of the directory tree are also used to select/deselect directories.

Table 2. Directory tree buttons

	Select currently marked directory for analysis (mark it like **double-click** on a directory)

	deselect the selected directory (as with **double-click** on a selected directory)
	Unfold all directory nodes
	Fold all directory nodes
	Unfold the directory nodes so that all marked directories are visible

3.1.3. The data manager view

In the data manager the different data sets with essential parameters are displayed in a table. The first column indicates the data type (see data formats/data types). The colour column shows from which directory the file originates (or from which project).

The colour associated with a directory can be changed by double-clicking on the colour square next to the directory node in the directory tree. In this way, the individual output files can be easily distinguished even if they have the same file name (e.g. in a variant study).

The column **size** indicates the *physical size* given in the file (not file size!). Depending on the file type, this can be a keyword, a character string or a generic text, e.g. **reference data [2 data series]**. Then follow two columns with the physical units (unit of value and unit of time), which are used in the data set. Then follow file attributes.

For reference data or generic table data (e.g. [csv] or [tsv], see data formats/data types) different columns can have different physical units, e.g. C for degrees Celsius for a temperature and Pa for Pascal for print variables. Since only one value unit is allowed per data record / line, one data record is created from the original file for each physical unit. The specified file name then has the format '<file name>?<suffix>'. In further use, however, such data records are treated exactly like others.

3.1.4. Updating the directory structure

External programs can be used to add new result data to the directory structure managed by post-processing or directories can be removed. Post-processing does not automatically monitor the directories, but if necessary, the directory structure can be re-read by using the update button  to update both the directory tree and the data manager view.

Figure 15. Refresh button for directory tree and data record list

3.2. Data formats/data types

PostProc 2_ can import data from various file formats, which are then interpreted as data records with different formats depending on their content. For this purpose, it is helpful to know the data types and file formats that *PostProc 2* supports and how to prepare your own data for analysis.

This chapter is somewhat lengthy, as the individual file and data formats are explained in detail. You can also jump straight to the chapter diagram creation and if necessary read on here as in a

reference.

Interesting is the chapter Import of own 2D datasets, in which some methods are described how to get own data from any source into the post-processing the fastest way.

3.2.1. Data formats

2D data sets

These are time-value pairs from which 2D diagrams (time, value) can be created. Examples are sensor values, i.e. outputs of physical quantities at certain coordinates or measurement data, integral flow quantities or generally scalar, time-dependent outputs.

3D data sets

These are data sets with 3 independent variables, specifically: time-coordinate-value, where the coordinate stands for one coordinate axis each. Examples would be time X-value data or time Y-value data.

3D data sets can be created as result data of simulation programs with partial differential equations, and correspond to profile sections in X, Y or Z direction.

In contrast to 2D data sets there are at least 2 different coordinates with assigned values for each point in time.

Using a cutting operation in a 2D construction, e.g. when defining an output in DELPHIN, does not necessarily lead to a 3D data set. For example, in a 1D simulation with grid in X-direction, you could define a Y-cut. As only one Y-coordinate per point in time is used in the output, you only get one 2D data set.

In *PostProc 2* it is possible to cut a 2D data set from a 3D data set by fixing a point in time or a coordinate. By fixing a point in time (*time cut*) you get a 2D diagram with coordinate on the X-axis and the value on the Y-axis.

Depending on the data set available, the coordinates of a time slice can be either X, Y or Z coordinates. In *PostProc 2* the coordinate *always* is nevertheless displayed on the X-axis, even if in the case of Y-coordinates (e.g. from a horizontal roof construction) it leads to a rotated construction view.

By defining a coordinate (*value cut*) a classic 2D sensor diagram is obtained, with time on the X-axis and value on the Y-axis. It is also possible to display such a *value cut* together with other 2D data sets in one diagram.

The complete 3D data set can be displayed in a colour gradient diagram, where the X-axis is the time and the Y-axis is the coordinate, and the value is displayed as a colour.

4D data sets

These are data sets with 4 independent variables, specifically: time-coordinate-coordinate-value. Also here the assignment of an axis to the coordinate is arbitrary, so XY, YZ, XZ are possible.

A representation of 4D data sets in a diagram is not possible, therefore at least one of the variables must be recorded. By fixing the point in time, the first or second coordinate, a 3D data set can be extracted. The most common way is to fix the point in time, which results in time-animated colour gradient diagrams.

When fixing *two* variables, a 2D data set is extracted.

5D data sets

Such time-X-Y-Z value data are generated during field outputs in simulations of 3D geometries. Similar to 4D data, 3D or 2D data sets must first be extracted by fixing variables in order to be able to display them.

3.2.2. File types and file extensions

PostProc 2_ supports a wide range of file formats for the specification of 2D data records. For the specification of 3D, 4D and 5D data sets the DataIO format is used exclusively.

Files with the following file extensions are read by *PostProc 2* and checked for evaluable data

Table 3. Supported files/file extensions

File extension(s)	Description
`out`, `d6o`,`d6b`	ASCII or binary output files of DELPHIN 5/6 (see DataIO file format)
`tsv`	tab-delimited columns with header
`csv`	Comma-separated columns with header
`csv`	monitoring tools variant of the csv format (several headers, ...)
`c6b`, `epw`, `wac`	climate data container (see climate files and climate data container)
`ccd`	climate data from DELPHIN 5/6 (see also climate files and climate data containers)
`cvode_monitors`	CVODE Solver statistics files from DELPHIN 5

There are also special data format readers for the generic time integration solver outputs (from DELPHIN, NANDRAD, THERAKLES and MASTERSIM):

- `integrator_cvode_stats.tsv`
- `integrator_ImplicitEuler_stats.tsv`
- `progress.tsv`
- `LES_direct_stats.tsv`
- `LES_iterative_stats.tsv`

The requirements for *csv* and *tsv* files (easy to copy from Excel, LibreOffice etc.) are described in the following section import of own 2D datasets.

The special `csv` monitoring file format (is recognised by the special header and is evaluated fundamentally different from "normal" `csv` files) is described in the following publication:

Vogelsang, S. ; Sonny, A.: *Monitoring Tools File Specification*, 2016, link:http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-199034 [http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-199034]

3.2.3. Import of own 2D data records/generic *csv/tsv* files

The use of own time series in post-processing is very easy. For example, you can simply copy a table from a spreadsheet (Excel etc.) into a file. The individual columns are automatically separated by tabulator characters. Such a file should then have the file extension *tsv*. Table data can also be saved as a *csv* file and then read into *PostProc 2*.

In the following the small differences in the handling of *csv* and *tsv* files are described.

In order for the post-processing to display and assign the data, these table files must have a header line with a column heading.

Example 1. Example of a simple `tsv` file with 3 data series and one time column

Example file: temperatures.tsv

```
Time [h] Tout [C] Version 1 [C] Version 2 [C]
0 20 20 20
1 20 20 20
2 20 20 20
3 20 20 20
4 20 20 20
5 20 20 20
6 20 20 20
7 20 20 20
8 20 20 20
9 20 20 20.0694
10 20 20 20.2651
11 20 20 20.4782
12 20 20 20.783
13 20 20 21.1447
...
```

With the *tsv* format, it is irrelevant whether the numbers are directly below each other as long as they are separated by tabulator characters.

You get such a file automatically if you copy a table from a spreadsheet, as shown in the following screenshot.

	A	B	C	D
1	Zeit [h]	Tout [C]	Variante 1 [C]	Variante 2 [C]
2	0	20	20	20
3	1	20	20	20
4	2	20	20	20
5	3	20	20	20
6	4	20	20	20
7	5	20	20	20
8	6	20	20	20
9	7	20	20	20
10	8	20	20	20
11	9	20	20	20.0694
12	10	20	20	20.2651
13	11	20	20	20.4782
14	12	20	20	20.783
15	13	20	20	21.1447

Figure 16. Spreadsheet with marked cell range, which is copied and pasted into a text file (.tsv) recognised by _PostProc 2*

It is important to give the files the extension *tsv* or *csv*. When searching the directories for displayable files, *PostProc 2* sometimes has to analyse a lot of files. In order to avoid this taking too long, text files in table format are only looked for *tsv* and *csv* files. This means that even if a *txt* file contains a valid table, *PostProc 2* will not display/use it.

Supported format variants

All variants of *csv* and *tsv* files use numbers in English format without thousands separators, for example *12.2*, *12e5*

or *-1.23e-12*.

The following formats are supported:

Tab-delimited, tsv or csv extension, units in header, relative time column

```
Time [h] Tout [C] Version 1 [C] Version 2 [C]
0 20 20 20
10 20 20 20.2651
13 20 20 21.1447
```

Tab-delimited, tsv or csv ending, units in header, time column with date/time stamp

```
Date/Time Tout [C] Variant 1 [C] Variant 2 [C]
2001-01-01 00:00 20 20 20
2001-06-24 05:00 20 20 20.0694
2001-06-27 05:00 20 20 20.783
```

Actually, files with tab characters as column separators should always have the file extension *tsv*. But there are some simulation programs that write tab-delimited ASCII data as *csv* files. To avoid having to rename the files each time, simply check for tab-delimited columns by checking both `tsv' and `csv' files equally. If this does not work for `csv` files, the next two formats are tested as well - maybe it is a comma separated file?

Comma-separated, csv ending, without unit recognition, time column always relative in seconds (no matter if or which time unit is given)

```
time [h],Tout [C],variant 1 [C],variant 2 [C]
0,20,20,20
9,20,20,20.0694
12,20,20,20.783
```

Specifying a time unit in the time column such as [h]` in the above example has no effect on comma-separated files. Comma-separated files always have *always* seconds as the time unit.

Comma-separated, csv ending, inverted commas in header line, without unit recognition, time column always relative in seconds

```
"time","outputs[1]","outputs[2]"
0,25,20
0.001,25,20.01
0.002,25,20.02
0.003,25,20.03
0.004,25,20.04
```

For files with comma-separated columns, assume that any [] is part of the variable name as in the previous example. To avoid an error message during the unit check, a unit search is not performed in the header line of comma-separated files.

Therefore, when using units in the header line (see following chapter), it is essential to use the tab-delimited *tsv* variant. The use of date/time stamps in the time column *not* is also supported

for *csv* files.

Format and content of the header for *tsv* files

A text data file must contain a header (and *only* one). From the 2nd line on, the data follows without any further blank line.

The first column is always the time column, where you can either specify relative time intervals or timestamps (see time column).

All other columns are data columns.

The number of columns is determined from the header line (number of strings separated by tabs). All data rows must necessarily have *the same number* of columns (i.e. the same number of tabulator characters).

To enable *PostProc 2* to distribute output sizes sensibly on axes or to convert units into each other, a unit should be specified for each column (=physical size). For this purpose you can specify a unit within square brackets in the column header. An example for such a header is:

```
Time [d] <tab> outdoor temperature [C] <tab> indoor temperature [C] <tab> indoor humidity [%]
```

('<tab>' corresponds to the tab character).

In the data manager table this file would be displayed in two lines, one with the unit *C* and one with the unit *%*.

If a column header does not contain square brackets, the variable is managed as a unitless -.

Time formats in *tsv* files

In *tsv* files, the time of a data point can basically be specified in 2 different ways:

1. time points are given relatively by specifying a *time interval* in a given unit. This unit (s, min, h, d, a, ...) *must* be specified in the header of the first column, for example "time [h]". If you want to display such a relative defined dataset in a date/time axis, you have to define a zero point in time (see Axis display).
2. time points are specified as absolute time points by means of time stamps. In this case, the heading of the first column may not contain *no* time unit, and the points of time must therefore be specified as character strings in the format *yyyy-MM-dd hh:mm* or *yyyy-MM-dd hh:mm:ss*. An example of such a time column is shown above.

3.2.4. Climate files and climate data containers

The data contained in a climate file are presented as individual data records.

		Name	Größe	Werteeinheit	Zeiteinheit	Zuletzt geän
2D		DE-04-TRY-2010__Potsdam__Jahr_00000K0_00081m.c6b?Pa	Atmospheric pressure	Pa	d	04.06.18 10:35
2D		DE-04-TRY-2010__Potsdam__Jahr_00000K0_00081m.c6b?rad	Referenzdaten [3 Datenreihen]	W/m2	d	04.06.18 10:35
2D		DE-04-TRY-2010__Potsdam__Jahr_00000K0_00081m.c6b?rain	Rain flux density on horizontal plane	l/m2h	d	04.06.18 10:35
2D		DE-04-TRY-2010__Potsdam__Jahr_00000K0_00081m.c6b?RH	Relative Humidity	%	d	04.06.18 10:35
2D		DE-04-TRY-2010__Potsdam__Jahr_00000K0_00081m.c6b?T	Temperature	C	d	04.06.18 10:35
2D		DE-04-TRY-2010__Potsdam__Jahr_00000K0_00081m.c6b?winddir	Wind direction	Deg	d	04.06.18 10:35
2D		DE-04-TRY-2010__Potsdam__Jahr_00000K0_00081m.c6b?windvel	Wind velocity	m/s	d	04.06.18 10:35
2D		DEU_Berlin.103840_IWEC.epw?Pa	Atmospheric pressure	Pa	d	04.04.19 11:30
2D		DEU_Berlin.103840_IWEC.epw?rad	Referenzdaten [3 Datenreihen]	W/m2	d	04.04.19 11:30
2D		DEU_Berlin.103840_IWEC.epw?rain	Rain flux density on horizontal plane	l/m2h	d	04.04.19 11:30
2D		DEU_Berlin.103840_IWEC.epw?RH	Relative Humidity	%	d	04.04.19 11:30
2D		DEU_Berlin.103840_IWEC.epw?T	Temperature	C	d	04.04.19 11:30
2D		DEU_Berlin.103840_IWEC.epw?winddir	Wind direction	Deg	d	04.04.19 11:30
2D		DEU_Berlin.103840_IWEC.epw?windvel	Wind velocity	m/s	d	04.04.19 11:30
2D		Hof_Bemessung(8Jahre)_vonLokalklimagenerator.wac?Pa	Atmospheric pressure	Pa	d	04.06.18 10:35
2D		Hof_Bemessung(8Jahre)_vonLokalklimagenerator.wac?rad	Referenzdaten [3 Datenreihen]	W/m2	d	04.06.18 10:35
2D		Hof_Bemessung(8Jahre)_vonLokalklimagenerator.wac?rain	Rain flux density on horizontal plane	l/m2h	d	04.06.18 10:35
2D		Hof_Bemessung(8Jahre)_vonLokalklimagenerator.wac?RH	Relative Humidity	%	d	04.06.18 10:35
2D		Hof_Bemessung(8Jahre)_vonLokalklimagenerator.wac?T	Temperature	C	d	04.06.18 10:35
2D		Hof_Bemessung(8Jahre)_vonLokalklimagenerator.wac?winddir	Wind direction	Deg	d	04.06.18 10:35
2D		Hof_Bemessung(8Jahre)_vonLokalklimagenerator.wac?windvel	Wind velocity	m/s	d	04.06.18 10:35
2D		RelativeHumidity.ccd	RELHUM	---	d	04.04.19 11:30
2D		Temperature.ccd	TEMPER	C	d	04.04.19 11:30

Figure 17. display of climate data from climate data containers, grouped by value unit

Climate data are always interpreted as instantaneous values. For example, in an EPW file the first time is 2000,01,01,1,60 and means 01.01.2000, 1st hour, 60th minute of the 1st hour, i.e. end of the first hour. This means that the climate data given in this line are displayed at the time *01.01.2000 1:00*.

If a different interpretation is desired, e.g. assumption of mean values etc., the data must be edited beforehand (e.g. in a spreadsheet) and shifted in time.

3.2.5. The DataIO format

The file format of the *out*, *d6o* and *d6b* files including the referenced geometry files (*g6o* and *g6b* files) is described in the following publication:

Vogelsang, S.; Nicolai, A.: *Dolphin 6 Output File Specification*, http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-70337

Compared to the tsv format described above, 2D DataIO containers contain additional header data, but are otherwise comparable in content (*tsv* files are usually easier to create).

3D, 4D and 5D data sets can only be stored in DataIO containers. The *PostProc 2* example data and diagrams can be used here as a template and additional explanation to the technical report cited above.

3.2.6. Grouping of data records by unit of value

Regardless of the data source, *PostProc 2* tries to display columns (i.e. data series) grouped with the same physical unit. The order of the data series in the file does not matter.

In figure display of climate data you can see very clearly how several data sets are extracted from a single file. The radiation data (all with unit W/m2) are grouped per data file and displayed in one data record. The text *Reference data [3 data sets]* in the column *Size* indicates that this data set contains several data series.

The grouping of similar physical quantities in one row of the dataset table is very practical for analyses of large buildings with many zones. In this case, all zone temperatures are summarised

in one data record each and an overview is maintained in the data record table.

The selection of one or more data series from a grouped data set is made when creating a diagram (see Creating Diagrams).

3.2.7. Column identification for grouped data records

Grouping records by unit can cause different columns of an *tsv* file to appear in different rows (records). Then the name of the original file appears several times and differs in the attached column numbers.

For example, a file *sensor data.tsv* with content:

Example file: sensor data.tsv

```
Time [h] T1 [C] T2 [C] RH 1 [%].
0 20 12 55
1 22 13 56
```

is displayed in the file list as follows:

```
Sensor data.tsv?1|2
Sensor data.tsv?3
```

The question mark that only individual columns from the file are combined in this data record row. Then follow column numbers separated by |, where the first column (after the time column) has the index 1. So in the example above the two temperature columns are grouped in the first data record and the second data record contains the humidity column *RH 1*.

3.2.8. Error analysis

It occasionally happens that own evaluation files in *PostProc 2* are regarded as faulty and are not displayed. Mostly you can get a tooltip with a short error message by holding the mouse over the file name:

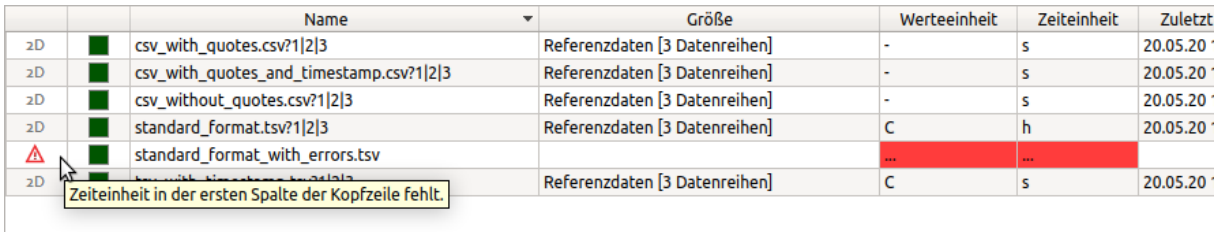


Figure 18. Highlighting of faulty/unsupported file formats in the data set table and tooltip with error message

Additionally you can look into the log window:

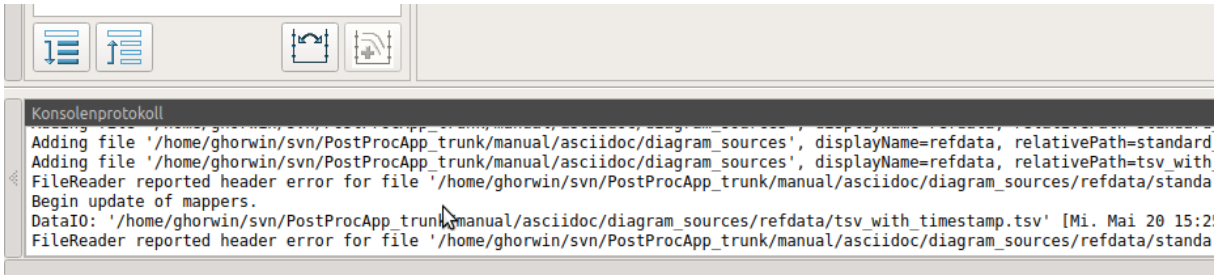


Figure 19. Console log window (bottom left) with additional error information

4. Creation of diagrams

Once data sets are visible in the data management window, they can be used to create charts or tables.

In principle, diagrams can be created from *single* or *several* data sets. The latter is useful if several lines are to be displayed simultaneously in a 2D diagram. You can select several data sets/data series immediately when creating the diagram, or later add data series to an existing diagram add.

4.1. Creating a chart

To create a diagram, first select a data set from the data set list. A range of adjacent datasets can be selected using `Shift+Click` or `Shift+Hold and Cursor Key Move`. Individual data sets can be added by using `Ctrl+Click`.

It is only possible to create a diagram if the selected data sets are compatible in type. Also, 3D colour gradient diagrams can only display one data set at a time, so multiple selection is not allowed here.

If individual data sets or matching data are selected, the 2D or 3D configurator for data extraction is displayed under the data set table. Depending on the source data, certain settings can be made here. These determine the way in which, for example, a 2D data set is to be extracted from a 4D data file. Details on these settings are explained on the pages for 2D diagrams and 3D diagrams.

Finally, an identifier can be specified for the diagram, whereby the name can contain placeholder. For 2D diagrams you can also specify a default name for the individual lines, whereby the use of Placeholder/ text replacement is of course useful.

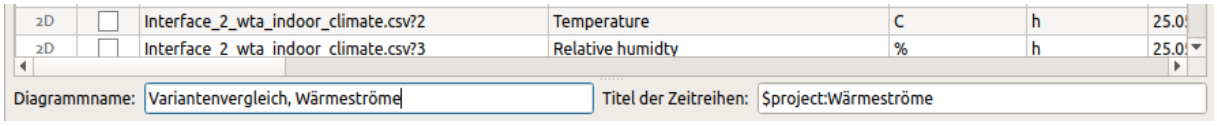


Figure 20. Example for the input of diagram and series identifiers

Once all entries have been made, a diagram can be created by clicking on the diagram symbol  at the bottom right. Afterwards *PostProc 2* switches to the diagram view.

Background information about diagrams and extractors

A diagram and the corresponding table view ultimately describe *how* the raw data is to be interpreted and presented. This information is ultimately instructions on how to extract and display the data from a data set file. This includes unit conversions, and information on how to cut data from data fields or whether model calculations are made.

These instructions can be reapplied at any time if the raw data changes, which makes it very convenient to update the data *without* having to specify all settings again.

The first step in this type of data handling is to *cut* (or extract) the data from the raw data. To do this, *extractors* are configured when the diagram is created (or when a data set is added to an existing diagram). These *extractors* are part of the data series property. For example, it is specified that a 2D data set (time-value curve) is cut out of a 3D data set by cutting at a certain x-coordinate.

In addition to the extraction information, it is specified *separately* how_ the extracted data is to be displayed. In the case of line diagrams, for example, these are the numerous line properties, and also the assignment to the left or right diagram axis.

The information about the creation and configuration of diagrams is stored in the session file, and is then applied to changed input data (data sets).

4.2. 2D diagrams

In post-processing, 2D diagrams are always line diagrams (even if their appearance can be changed). This means that several series with the same X-axis but possibly different Y-axes are displayed in one diagram. A maximum of 2 Y-axes are possible. If only one is used, this is only the left Y-axis.

The terms *line, series, curve, data series* are all used synonymously in this context.

Each series is assigned a Y-axis, whereby all curves of a Y-axis must also have the same physical unit. Thus, a maximum of two different value units can be used in a diagram.

The X-axis can either be a time axis, e.g. if scalar quantities such as sensor data are displayed over time. Or it can be a coordinate axis, if profiles over a 1D-geometry are displayed animated in time. In this case all displayed series correspond to a selected point in time.

When creating a 2D-diagram you have to select the desired series from the data sets. For datasets with several columns it is also possible to exclude individual columns (=series) or to select only certain ones. This selection is made in the 2D-diagram configuration window, which is displayed below the data set table:

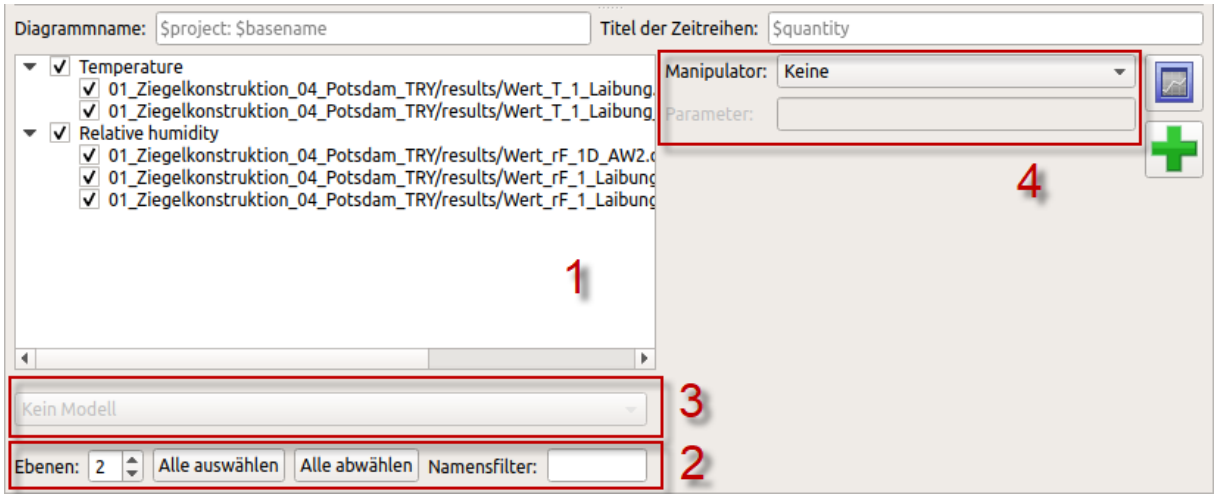


Figure 21. Screenshot of 2D diagram configuration window

This window contains a number of items:

[1] The series to be used can be selected in the tree window

[2] Filter and grouping options (2); the name filter searches for series identifiers containing the entered filter text and displays only these identifiers, the display in levels enables a grouped selection or deselection of series (see section grouping rules).

[3] Below the tree window a model conversion can be selected in the selection list for suitably selected data series (see section models)

[4] To the right of this is a selection list with options for *manipulators*, i.e. calculation and conversion rules for individual data records (see section manipulators)

4.2.1. Grouping rules

First of all, all series identifiers containing a '.` (dot) are separated at this point and sorted into grouping levels. If the identifiers of a level of 2 or more series match, one level is displayed (up to the maximum level level specified in the window).

Example: A total of 6 series are selected from two files with the identifiers for temperature (LT) and relative humidity sensors (LR):

```
file: grouping.tsv

  Ground floor.LT1
  ground floor.LT2
  Top floor.XL1
  ground floor.LR1
  ground floor.LR2

File: grouping2.tsv
  ground floor.LT3
```

This results in the following grouping:

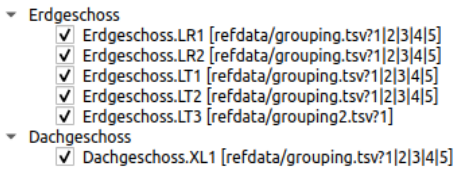


Figure 22. Sample grouping of 2D data records

If the series identifiers are the same, for example in variant studies, the series identifier is created as the top level and the concrete file names as the second level. If only data records from one file are selected, the specification of the source file is omitted.

The numbers *1|2|3|4|5* following the file name in the example indicate which columns of the file are grouped together in this data record (see also column identification for grouped data records).

4.2.2. Selection of the Y-axes

If several physical quantities are to be displayed in the diagram, the axes are assigned according to the order of the

added series. The series added first is assigned to the left Y-axis and accordingly a unit is assigned to this axis. If a further series is added whose unit can be converted into this axis unit, the left Y-axis is also used. If the unit does not fit to the left Y-axis unit, the series and its unit is then assigned to the right Y-axis. All further series are assigned to the axes according to their units.

You can swap the left and right axis later, see section swap Y-axis assignment.

The unit conversion and the units supported in *PostProc 2* are described in the section system of units.

4.2.3. Invalidly added series

If the selected data sets have more than 2 incompatible value units, series are added to the diagram until both Y-axes are occupied. All others are marked as incorrect and a tooltip (hold mouse over it) shows the reason for the error:

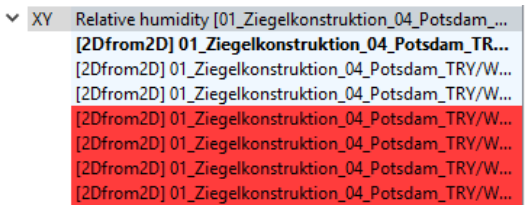


Figure 23. Invalid data sets in the diagram

4.2.4. 2D diagrams from 3D/4D/5D data sets

2D diagrams can also be created from 3D data sets (or 4D or 5D data sets). In this case a sectional plane must be defined, which usually results in a time-animated 2D profile diagram.

Example 2. Example for the creation of a time-animated profile diagram (time slice) from a 3D data set

A 1D geometry (e.g. vertical wall) is simulated and a 3D data set with time, coordinates (along the X-axis) and values is created. If the X-value plane or a *time-cut* (TimeCut) is defined as a sectional plane, a 2D diagram (profile) results for each point in the data set. The coordinate is displayed on the X-axis and the value scale on the Y-axis.

The currently displayed time can be changed via the time animation control in the lower panel.

When a 3D/4D/5D data set is selected, a diagram configuration window is displayed below, in which you can first choose between *colour gradient diagram* and *line/profile diagram*. To create a 2D diagram, *Line/Profile Diagram* must be selected here. If several 3D data sets are selected, a *line/profile diagram* is the only choice.

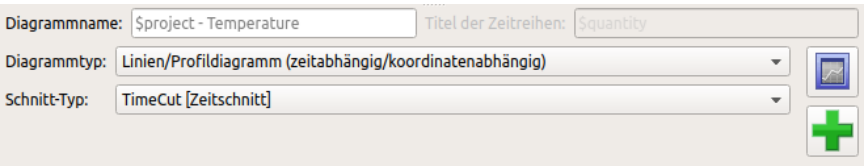


Figure 24. Diagram configuration when selecting a 3D dataset, here a 2D diagram is created from the 3D dataset by fixing a point in time

Finally, the plane section must be defined. Afterwards the diagram can be created as described so far using the button on the right.

Similarly, a 2D diagram is created from a 4D or 5D data set. Two or three coordinates must be defined, which is expressed in the name of the section line. For example, for an *XT-cut* (XTCut) the time and the X-coordinate are recorded.

The cutting coordinates can be adjusted at any time in the Extractor settings.

4.2.5. Adding records to existing charts

In the data management window with the data set list it is possible to add data sets to existing 2D diagrams:

1. first select (activate) a diagram in the diagram tree (bottom left),
2. by clicking on the directory tree (top left), switch to the data manager view in the middle,
3. select one or more records to be added,
4. Click the *Add* button ✚.

As a general rule, you can only add records to 2D diagrams. Furthermore, the unit of value must match one of the two Y-axes, or one Y-axis must not yet be used.

If you try to add an unsuitable record, an error message will appear when you click on the *Add* button.

4.2.6. Data manipulators

To the right of the list of 2D data series to be added are options for configuring data series manipulators.

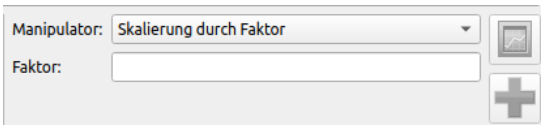


Figure 25. Manipulator configuration, here by scaling with factor

manipulators are instructions on how to change or convert the data series *before* the display in the diagram. These calculation rules are applied for each data update. So if the raw data change and these are read in again during the Updating the data, the manipulation rules are also processed before the data are transferred to the diagram.

When creating a diagram or adding data series, configured manipulators are defined individually for each data series.

The following manipulation operations exist:

Manipulator: difference between current and first value

Here, the first value in a data series (usually time 0) is subtracted from the current value, for example:

```
Time [h] Original [-] Manipulated [-].
5 12 0
6 17 5
8 18 6
10 11 -1
```

This manipulator is useful if mass or energy differences to the initial state are to be determined, e.g. when analysing water absorption experiments.

Manipulator: scaling by factor

Here, the respective numerical value of the original data series is multiplied by a factor.

Example, when using the factor '1

```
Time [h] Original [-] Manipulated [-].
0 0 0
1 2.5 -2.5
2 4.2 -4.2
3 8.5 -8.5
```

This manipulator is useful, for example, if you want to make a sign correction for flow outputs, e.g. to make comparisons between flow quantities with different sign definitions.

Manipulator: Offset (value shift)

With this manipulator data series can be shifted by a constant value.

Example, using a shift value of *2*:

```
Time [h] Original [-] Manipulated [-].
0 0 -2
1 2.5 0.5
2 4.2 2.2
3 8.5 6.5
```

With this manipulator you can move data series vertically. This is useful, among other things, to display tolerance bands. In this case you can add the same data series to the diagram several times using a different displacement value.

In the current *PostProc 2* version, manipulators cannot yet be adjusted/changed in the program interface, or added to data series at a later date. So at the moment you can only remove a data series and add it again with a newly configured manipulator. However, it is more practical to change the manipulator definition directly in the session file. See the documentation in section session file format.

4.3. 3D diagrams

3D diagrams can be created from 3D, 4D or 5D data sets, with a colour gradient diagram always being created.

For diagrams from 3D data sets, the time is plotted on the X-axis, the coordinate (whether X, Y or Z coordinate) on the Y-axis, and the values are displayed converted to colour values.

For diagrams from 4D or 5D data sets, the configuration window again offers the possibility to define a section.

It is not possible (or useful) to display two 4D data sets simultaneously in a colour gradient

diagram. If two or more 4D data sets are selected, the configuration window is therefore deactivated.

4.4. Vector field diagrams

Corresponding vector field diagrams can be created from data sets with vector fields:

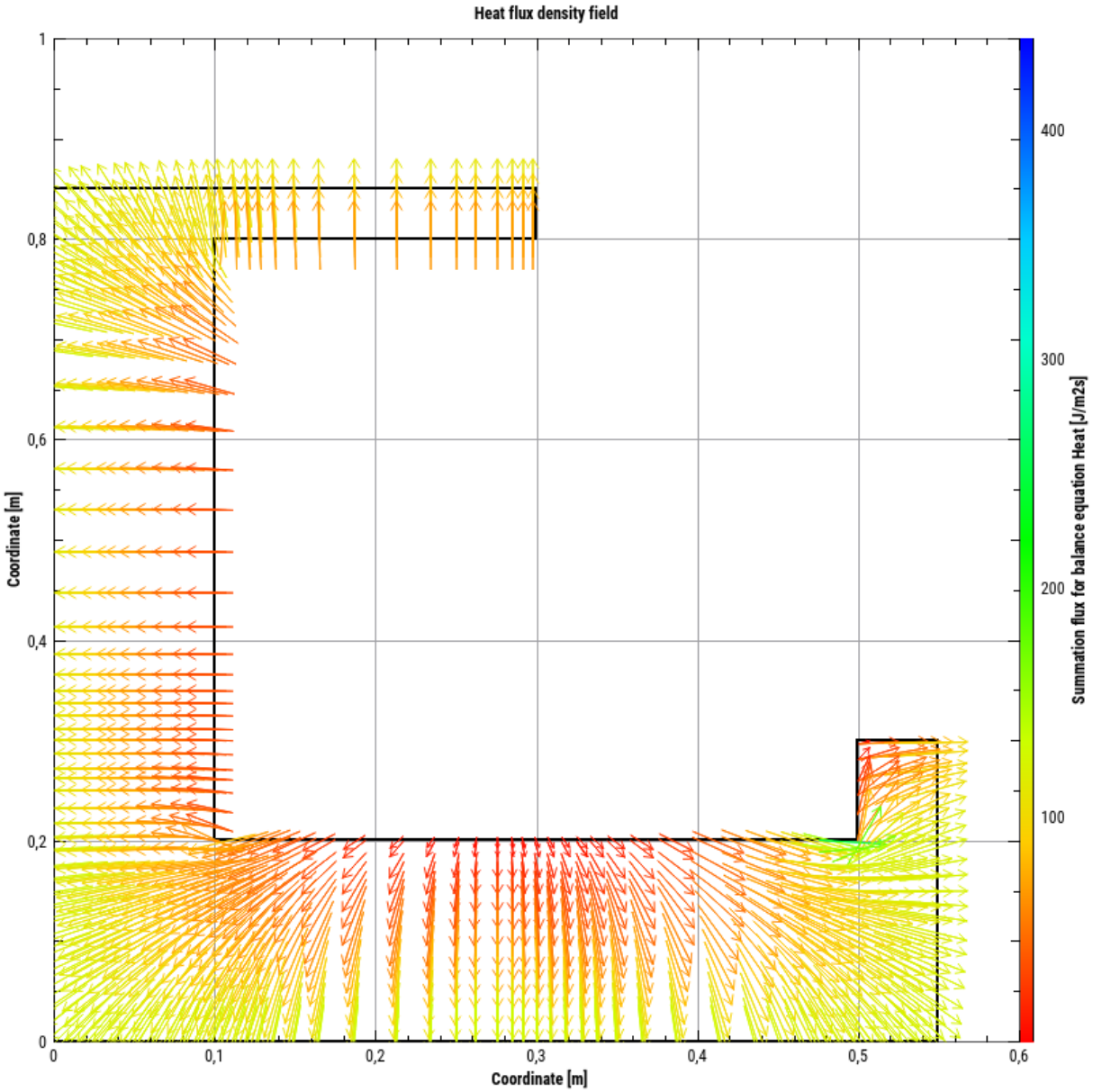


Figure 26. Example for a vector field diagram

For vector field data there are a lot of possibilities to adjust the properties palette:

Eigenschaft	Wert
Vektoren in Raster vereinheitlichen	☑
Rastergröße [pixel]	10
Ursprung des Pfeiles	Zentriert
Dünne Pfeile	☑
Maximale Pfeillänge [pix]	50
Minimale Pfeillänge [pix]	0
Skalierungsfaktor für Pfeile [pix/Wert]	1
Farbe wertabhängig	☑
Pfeilfarbe	[0, 0, 0] (255)
Zeige Farblegende	☑
Automatische Skalierung	☑
Minimum	2
Maximum	440
Einheit	J/m2s

Figure 27. Properties palette for vector fields

Vector field data are usually stored in relation to a calculation grid. If the vector arrows are drawn for each data point, this can lead to a high arrow density where nothing can be seen. Therefore, it is also possible to combine all arrows in a grid and draw the averaged arrow in the centre of the grid in alignment and length. This is switched on by the option *Unify vectors in grid*. The following figure shows the comparison between native and raster-based arrow display:

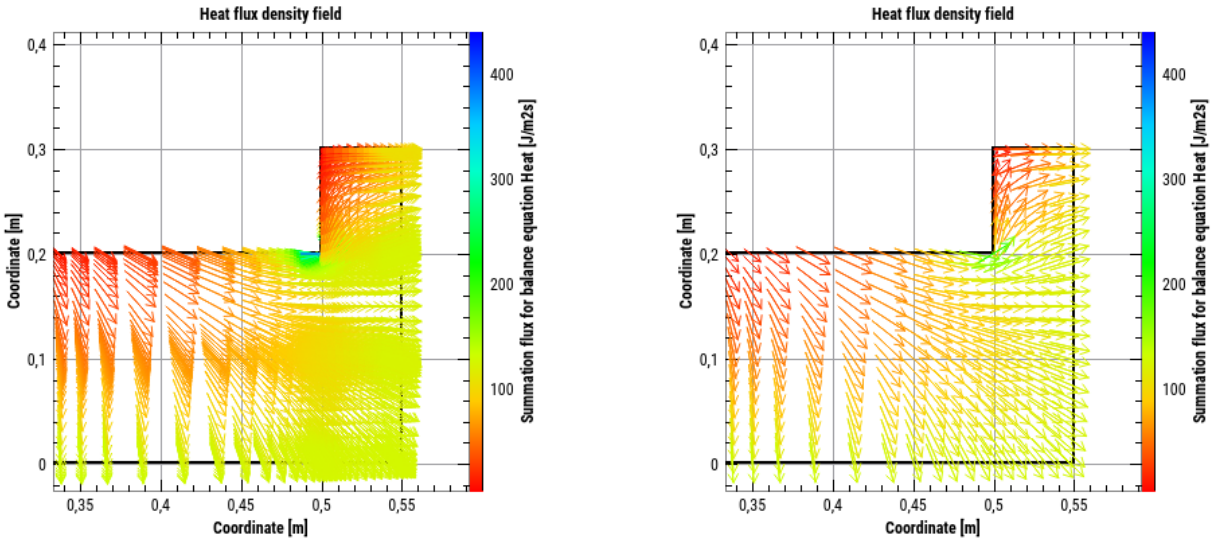


Figure 28. Comparison of the vector field representation with original complete arrow data (left) and raster-based summarised/averaged arrows (right)

5. Diagram management

5.1. diagram tree structure

Below the directory tree the created diagrams are displayed in a tree view. The top level always corresponds to the diagram; the diagram identifier is displayed (property *name* in diagram formatting).

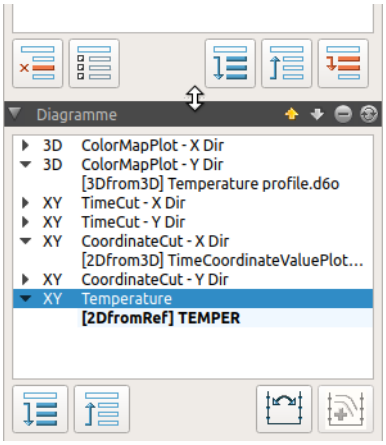


Figure 29. Screenshot of diagram management

The directory tree and diagram tree window can be adjusted in height by dragging the mouse up/down between the two windows on the handle (see changed mouse symbol in the screenshot above).

The buttons can be used to expand or close the contents of each diagram in the tree view.

5.2. Diagrams and series/lines

The lines or series shown in the diagram are shown below the diagram node. Colour gradient diagrams always have only one entry here.

There is always one diagram active/selected. In addition, a dataset is always selected/active, i.e. with line charts one line/series is always active. The selection corresponds to the line selected in the properties window for line charts.

The order in which records or series/lines are added determines the character sequence. The lines are drawn in a diagram in the order they are listed in the diagram management tree.

Moving a line within a diagram affects the order of the lines in the legend as well as the drawing order in the diagram itself.

The two buttons can be used to move both diagrams in the tree view and lines within a diagram.

5.3. Remove series and diagrams

Individual lines/series can be removed using the Minus button . If the last series is removed, the diagram is also deleted. If the diagram node itself is marked, the diagram with all series/lines is deleted.

5.4. Axes exchange and profile doubling

Most chart and data series settings are made in the various properties windows.

For 2D diagrams, the assignment of the Y-axes (if two Y-axes are used) can be exchanged by the button integrated in the diagram tree.

The second button in the diagram tree serves a special function. With time-animated profiles, it can be used to

double the data series and to fix the time for the original data series. This simplifies the creation of profile variant diagrams (see example in the section Extractor Properties).

5.5. Data update

The post-processing reads the source data from the files and keeps this data in memory. In the meantime, the files could change, e.g. a simulation program could append results for further times, or the files could have been completely rewritten. To ensure that the post-processing shows current data again, all diagrams can be updated.

The update is done either by clicking on the update icon in the diagram tree window.

A data update can also be forced by the menu item: `Data - Diagram/Update data`, or by the keyboard shortcut `F5` or `Ctrl+R` (see also shortcuts).

The update is always performed for all diagrams and all data sets contained in them, regardless of the currently selected/active diagram. If different diagrams obtain data from the *same* original data sets/files, the corresponding files are of course only read once again.

Depending on the type of data presented, you can immediately see an influence on the results:

- In 2D-diagrams with time axis and automatic axis scaling, the diagram shows the complete new data (maybe less than before, if the result file was rewritten from scratch and now contains less data points)
- In the case of time-animated colour gradient diagrams, the last time of the newly read-in data file is normally displayed, *but only if the selection on the time scale (in the lower panel) is on the last data point*.

The menu option `Data - Automatic diagram/data update` can be switched on and off. If it is switched on, the update function is executed once per second.

Sometimes it is not possible to update the data, e.g. because the input file is incorrect. In this case the data stored in the memory is not changed. An error message is displayed in the log window or written to the log file (see Error Analysis/Log File).

It is possible that due to incorrect/unsuitable changes to raw data, the data is not updated and old data is still displayed in the diagrams. However, as this data is not saved permanently (the session file itself does not contain any data), the diagrams will be empty the next time the programme is started or the session file is loaded, even though the data is currently still displayed. At this point it only helps to restore or recreate the data set files, e.g. by running the simulation again.

6. Diagram window

The diagram window or windows occupy the main part of the *PostProc 2* application window. Each diagram window has a header:

If it has a blue background, this diagram is active. In the selection list of the diagram title bar the diagram currently to be analysed can be selected. Alternatively (as already described) the current diagram can also be set via Selection in the diagram tree.

6.1. Diagram and table view

The data of a diagram can be displayed in two ways. Once as a graphical diagram, and once in a tabular data view.

The  and  buttons at the top of the chart window switch between chart view and table view. The chapter TableView and Data Interpolation describes the table view in detail.

6.2. Diagram division

It is possible to split the diagram window so that two or more diagrams are visible next to each other or below each other,

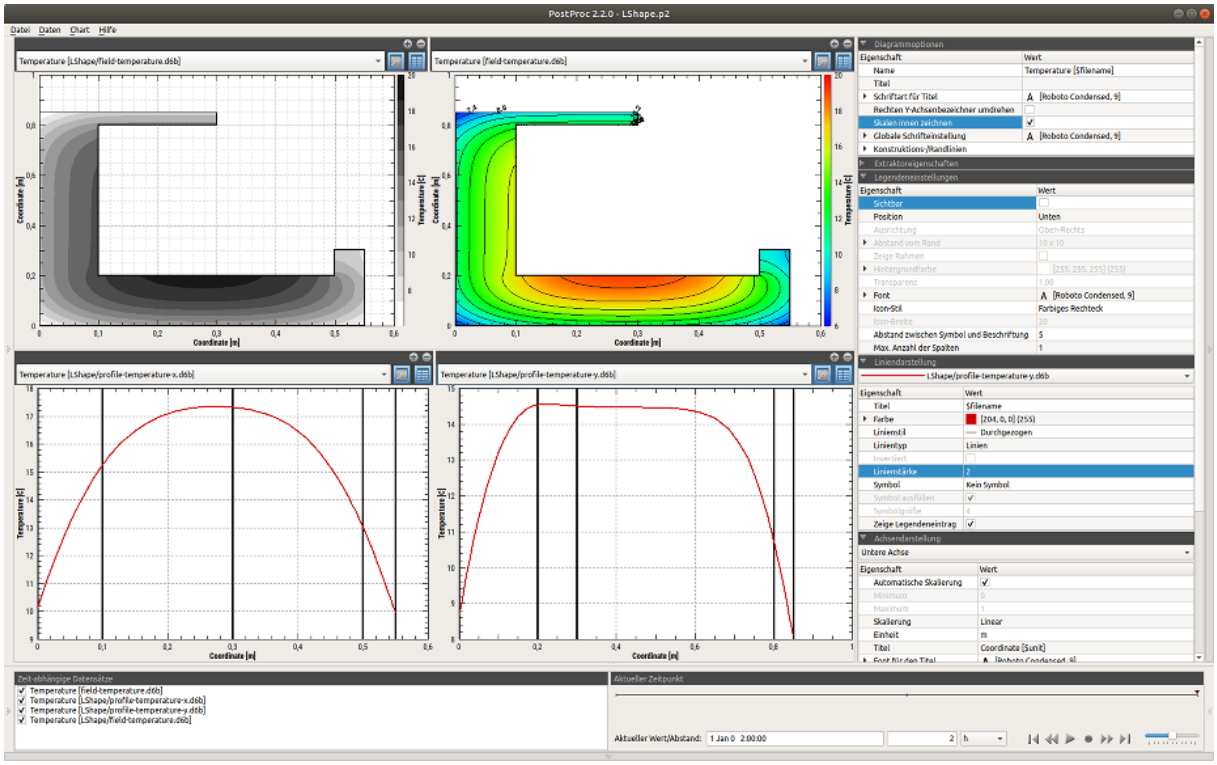


Figure 30. Example for a split diagram view

This is useful for variant analysis or when profiles of more than 2 different physical quantities are to be displayed simultaneously. The division can also be made several times, e.g. temperature and humidity profile at the top, vapour pressure and liquid water content profile in the middle, vapour and liquid water conductivities at the bottom.

The division is carried out via the menu commands: `Chart - Horizontal division` etc. and/or via short commands.

It is also possible to use the divider button ⊞ of the chart window, in which case a vertical or horizontal division is automatically selected depending on the larger dimension.

A diagram window can be made to disappear either by menu commands or by using the close button ⊟.

7. Diagram formatting

The presentation of the diagrams and the lines/colour gradients contained therein can be changed in the respective property windows on the right side of the screen. In the following, the diagram options are first described, which

apply equally to all diagram types.

7.1. Chart options

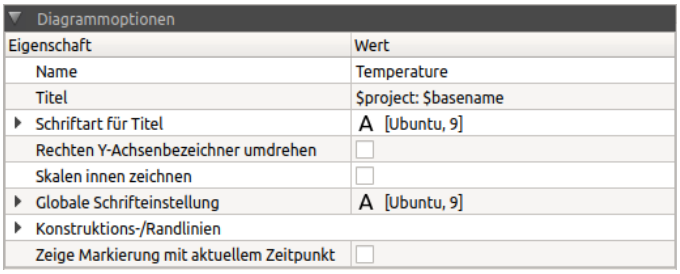


Figure 31. Properties window for general diagram options

The following properties can be adjusted.

Table 4. General diagram settings

Property	Description
Name	diagram identifier, is used to manage the diagram in the diagram manager/diagram tree and in the selection box in the diagram window (can contain placeholder).
Title	Title, which is displayed above the diagram (can contain placeholder). An empty string removes the title.
Font for title	Font and font properties for the title `Reverse right Y-axis designator`. If switched on, the right Y-axis title can be read from the left, otherwise from the right.
Draw scales inside	If switched on, the axis scales are drawn inside the diagram frame.
Global font setting	A change to these font properties affects all fonts used in the diagram and overwrites any font settings previously made. It is therefore advisable to first change the font globally and then make the individual settings for axis titles/legendary entries etc. construction/edge lines (only for 4D data)

7.1.1. Placeholder/ text replacement

Depending on the context, placeholders can be used for text attributes to automatically replace text modules. This is useful, for example, for series and axis titles. Currently the following placeholders are supported, but not all placeholders are (can be) replaced everywhere, see description.

Table 5. Supported placeholders

Placeholder	Replacement text
`$unit`	Physical value unit, useful for axis titles
`$filepath`	Full path to the data file from which the series originates
`$filename`	The file name of the data file from which the series originates. For DELPHIN outputs, the base directory name is also prefixed, i.e. for a data file *Wall1/results/TemperatureProfile.d6o*, *$filename* = *Wall1/TemperatureProfile.d6o*.
`$basename`	file name of the data file without path and extension
`$quantity`	Physical quantity (e.g. *temperature* or *moisture mass density*)

Placeholder	Replacement text
`$currentdate`	Current date (only in diagram title) in format *27.02.2003*.
`$timepoint`	Current selected time for time-dependent data records, displayed as time interval from the start time
`$timepoint([<unit>])`	same as `$timepoint`, but with conversion to an explicitly specified time unit. So if `$timepoint = 1,000 h`, then `$timepoint([min]) = 60,000 min`. **ATTENTION:** pay attention to the nested brackets `([<unit>])`!
`$timepoint(<time/date format>)` `	same as `$timepoint`, but with the absolute time displayed in the timestamp format, so if `$timepoint = 1,000 h` and the start time is 1 Jan 2001, then `$timepoint(dd.MM.yyyy hh:mm:ss) = 01.01.2001 01:00:00`. See also the description of the time formats in section axis properties.
`$cutValue` - time the current section coordinate(s), for profile sections	`$cutIndex` - time the current cut index (i.e. data row/column), for profile cuts

7.2. Extractor properties

This is where cut coordinates/times of a *data series* are defined. This concerns 2D diagram series (data series), which are cut out of 3D/4D or 5D data, or 3D diagram data, which are extracted from 4D or 5D data sets.

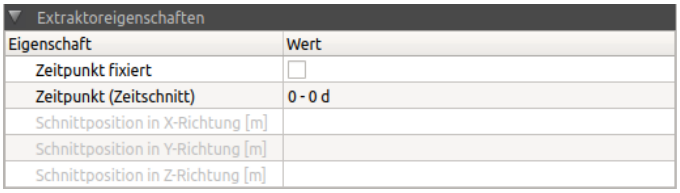


Figure 32. Property window for extractor/cut options

Depending on the type of cut (TimeCut, XCut, YCut, ZCut), different times or cut areas can be defined separately for each of these data sets. In the example picture above a time cut is used. Time points are usually set/changed using the Animation buttons in the lower panel. However, it is also possible to enter and also fix the time point in this tab so that when the animation time point is changed, the time point of this data series remains unchanged.

By fixing the point in time for time-animated profile lines, the profiles can be displayed at different times in the same diagram. To do this, the same data series is added several times and different time points are set and fixed in the extractor properties.

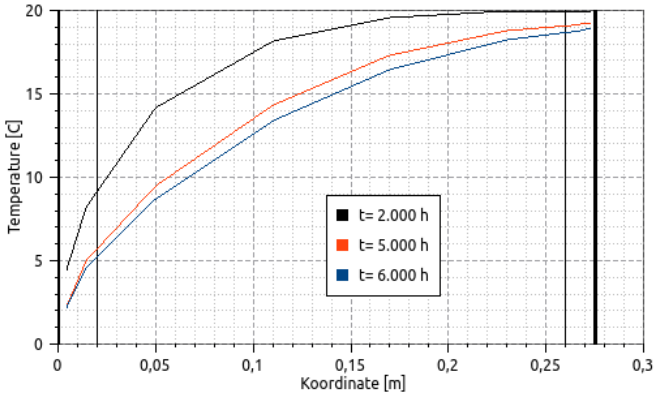


Figure 33. Profile section diagram with several data sets, with different fixed times

Creating such diagrams is simplified by the  button in the Diagram Tree window. This inserts a copy of the currently selected dataset into the diagram and modifies the original dataset by fixing the time and changing the series title, which now contains the fixed time as a prefix.

7.3. Axis representation

The properties window for the axes contains a selection list at the top, from which the axis to be edited can be selected. Different settings are offered depending on the axis and diagram type. Only the lower axis can be configured as date/time axis.

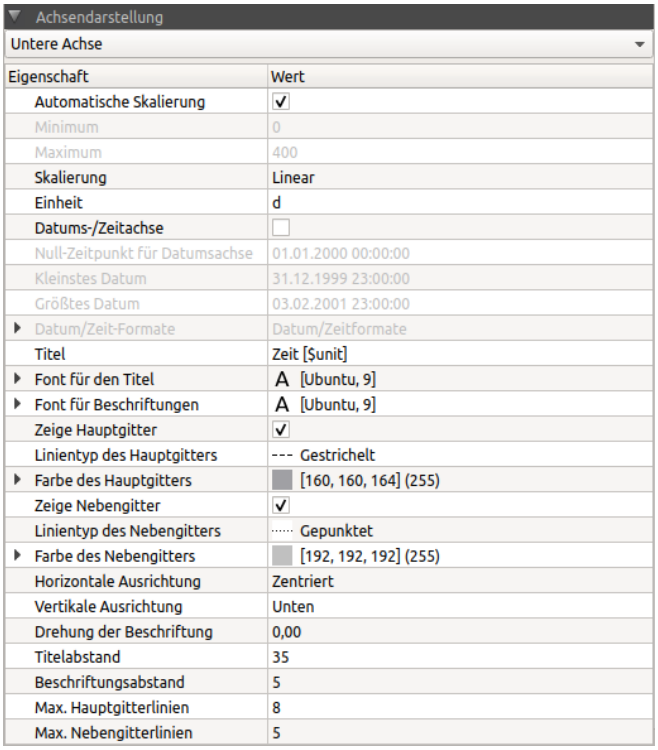


Figure 34. Axis property window, here for the lower axis with options for setting the time axis

Most axis properties are self-explanatory. For some settings special information is given below:

Table 6. Explanations of some axis representations

Property	Description
Scaling	Switches the axis scale between linear and logarithmic display. Data series should not contain 0 values in logarithmic representations. The logarithmic representation is reinforced by suitable selection of the grid lines. Unit
Unit	Unit which is to be displayed on the axis. A change of the unit causes a conversion of the axis scales to the new unit. The unit name is inserted in the placeholder `unit`. The unit is not used for date/time axes.
Date/Time axis	If activated, a concrete date is displayed instead of the time intervals. The type of display is defined by the date/time formats. With automatic axis scaling the scale range is adjusted to even time intervals depending on the resolution.
zero time for date axis	The data records usually contain data as time intervals to a selected reference time. This property allows the definition of this time point.
Date/Time Formats	A different axis labeling is used depending on the zoom level or time range displayed. These labelling texts can be adapted here. The date/time elements are transferred according to a format definition. The following format abbreviations for the definition of time formats are supported: `zzz` (for milliseconds), `ss`, `mm`, `hh` (second, minute, hour), `dd` (day as number), `ddd` (day as day of the week), `MM`, `MMM`, `MMMM` (for months), `ww` (for week number), `yy` and `yyy` (for year numbers). A typical date time format would be for the hourly zoom level: `hh:mm` and for the week/month zoom level: `ddd'. MMM`.
title	axis title, can contain placeholder. An empty text removes the axis title. Multi-line caption texts can be created if `;;` are used as line separators in the text.
Gridline type and colour	Here you can define the appearance of the gridline. Although the main and secondary grid can be switched on and off separately for the X-axis and the left Y-axis, there is only *one* line and colour setting for the main and secondary grid respectively.
Title distance	Actually the distance of the axis scale line from the diagram border and therefore in case of a displayed title also the distance of the title from the axis.

The title spacing setting can be used to set a uniform size and spacing for diagrams that are aligned with each other or side by side (when inserted in a document after diagram export). If the title spacing is the same, e.g. for the left-hand axis, the axis lines of diagrams arranged underneath each other are also exactly aligned with each other, regardless of the length of the axis labels/labels.

7.4. Line charts

In line diagrams the individual *lines* and the *legend* can be formatted.

7.4.1. Legend settings

Line diagrams contain a legend for identifying the individual lines with the following setting options:

Legendeneinstellungen	
Eigenschaft	Wert
Sichtbar	☑
Position	Innen
Ausrichtung	Unten-Rechts
Abstand vom Rand	10 x 10
Zeige Rahmen	☑
Hintergrundfarbe	[255, 255, 255] (255)
Transparenz	1,00
Font	A [Roboto Condensed, 9]
Icon-Stil	Farbiges Rechteck
Icon-Breite	20
Abstand zwischen Symbol und Beschriftung	8
Max. Anzahl der Spalten	1

Figure 35. Properties window for the legend of a 2D diagram

The legend can be placed inside or outside the diagram (property *Position*). Legends on the inside are always anchored to an edge or corner (property *alignment*). The distance from each edge is controlled by the property of the same name. If the diagram is enlarged or reduced, e.g. in the case of diagram export, the legend remains positioned in relation to the anchor point.

An internal legend can be dragged to any position with the mouse (Drag&Drop). Depending on the storage location, the nearest anchor position is selected and the distance calculated.

The following is an example of an inner legend anchored at the bottom right for different diagram sizes:

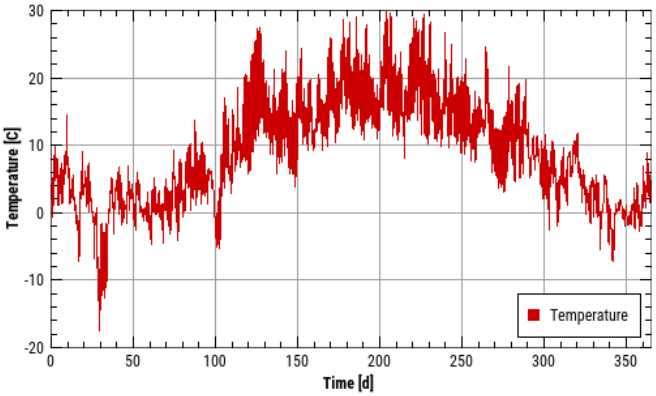


Figure 36. Legend inside, anchored at bottom right, landscape format

Figure 37. Legend inside, varankert right down, portrait format

The properties *frame, background colour* and *transparency* only apply to legends on the inside.

The *icon style* defines whether line style and symbol should be shown in the legend or only a coloured rectangle. The latter is the default setting, as diagrams are created by default with solid lines of equal thickness and without symbol:

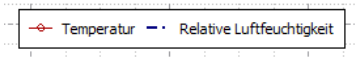


Figure 38. Style variable with solid line

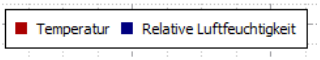


Figure 39. Style variable with rectangles

The width of the line in the line symbol display can be configured via the *Icon Width* property.

If a very large number of lines are to be displayed, the number of legend entries can be selected next to each other via the property Maximum number of columns. A 0 means that a suitable number of columns is determined automatically depending on the diagram width.

The automatic determination of the number of columns in the legend does not work with an inner legend, because there is no information about the allowed width. If the plot area becomes smaller than the legend, it will be cut off to the left or right or top/bottom accordingly. With legends on the inside you should therefore always specify the maximum number of columns.

7.4.2. Formatting the lines

The properties window for line attributes has a selection list in which the current line can be selected. The selection corresponds to the highlighting/marking in the diagram management tree.

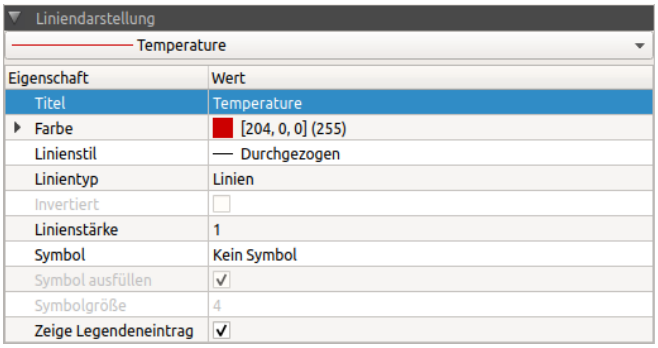


Figure 40. Property window for line formatting

The attributes for the lines correspond to the usual settings for lines in line charts.

The line colour and symbol colour are always the same for a data series/line. If you want to have different line and symbol colours, you can insert the data series a second time and format it once as a line and once as a symbol (without a line). So that the data set does not appear twice in the legend, you can switch off the property Show Legend Entry for a data series.

The following properties have a special meaning:

Table 7. Explanations of some line settings

Property	Description
Line type	Defines the way the X-Y data values are to be interpreted and displayed: **Lines:**_ normal lines, where the individual data points are connected by lines (useful for linear courses between grid points) ***Sticks:*** Vertical lines between data points and the X-coordinate axis ***steps:*** between single data points (i.e. in the interval between two interpolation points) the courses are assumed to be constant. The additional attribute *inverted* determines whether the value at the beginning of the interval or the value at the end of the interval should be used. This is useful, if e.g. abruptly changing values (control parameters, e.g. target temperatures) are to be displayed. ***points:*** at each given data point a filled circle is drawn in the diagram. Here the line thickness defines the diameter of the circle. If other symbols are to be drawn instead, the line style should be set to **No line** and then a symbol should be selected.
Inverted	See line style ***steps***
Show legend entry	If this property is deactivated, no legend entry is shown for the current line. This is also useful if, for example, you want to display the upper and lower limits of a line as symbols, and you do this with additional data series (which of course should not appear in the legend).

If the property *Show legend entry* is switched on again, the legend entry appears at the *end* of the legend. This is independent of the character sequence, i.e. the order in which the series/lines were added to the diagram. Thus legend entries can also be **sorted** as desired. However, this is not saved and the next time the session is loaded the original order is restored.

7.5. Colour gradient/spectral diagrams

There are two types of colour gradient diagrams:

- time progression plots, where the X-axis is the time axis and the time progression of a 1D profile curve is shown, and
- Profile or field diagrams, in which the distribution of values is shown over a 2D geometry for one point in time each.

The latter are always *time animated diagrams* (see diagram animation).

With colour gradient diagrams, a colour legend is always displayed on the right-hand side. This is configured in the axis properties window (*right axis*) in the same way as other axes. However, all properties concerning the colour table are defined in the properties window for the colour table.

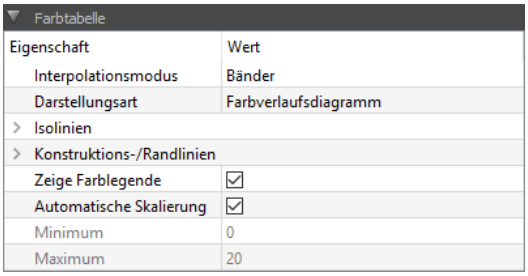


Figure 41. Property window for the colour table of the diagrams

The *interpolation mode* influences the way (colour) values are calculated within grid elements. For the volume/element centric data supported by post-processing, the individual values are defined for the centre of a grid element. There are now different options to display this data. To draw a smooth gradient between these individual values, values are first calculated for the nodes (i.e. grid corner points) by weighted interpolation. Then the colour values within a grid element can be determined by weighting the corner values (linear interpolation).

For the property *interpolation mode* there are 3 options:

- **Raw data:** This representation shows the values actually calculated in the simulation program, i.e. no interpolation takes place. Large differences between adjacent elements may indicate that the grid is too coarse, so this display is especially useful for grid sensitivity studies/accuracy control.
- Bands:** The values calculated by interpolation are assigned to the defined colour bands (see also colour table) by *rounding*. For example, are there colour value assignments for 20, 16, 12, ... °C, and the calculated temperatures are 19.2°C or 17.3°C, these are rounded down to 16°C and thus drawn in the colour of the 16°C band. This representation is best suited to quickly get an overview of the distribution and gradients of the values.
- Interpolated:**The values calculated by interpolation are mapped directly to a colour value, again interpolating between colour table values. For example, are there colour value assignments for 20, 16, 12, ... °C, and a calculated temperature (or one interpolated from key values) is 19.2°C, the colour to be drawn is determined by interpolation between the colour values for 20 and 16°C. For 19.2°C, the colour value of 20°C is therefore weighted correspondingly higher than that of 16°C.

For colour gradient diagrams, isolines can also be drawn, i.e. curves that run along level lines, e.g. lines of the same temperature. The property *type of representation* allows the choice between, colour gradient diagram or colour gradient diagram with isolines. It is also possible to draw only isolines, which can be useful for black and white publications.

Other features are:

Table 8. Explanations of some gradient settings

Property	Description
Isolines	Allows the closer definition of isolines by numerous sub-properties. The sub-property *Interval* determines the number of isolines. Normally this number matches the defined colour bands so that isolines are displayed at the band boundaries.
Construction/Borderlines	In 2D geometry details there are often material borders and construction borders. The way these lines are drawn is configured by this property.
Show colour legend	Switches the right axis with the colour legend visible or invisible.
Automatic scaling	If this is switched on, the value range limits are automatically determined from the currently displayed data set.

7.5.1. Automatic scaling and global minima and maxima

With time-animated colour tables, only the data of one point in time is displayed. However, the values calculated for each point in time can change drastically over time, i.e. the current minimum and maximum values are usually different from the global minimum and maximum values (of all data).

The property *Automatic scaling*, if switched on, always uses only the numerical values of the currently displayed point in time to calculate the maximum/minimum values.

The button *Calculate global min/max values*, on the other hand, runs through the entire data set and enters the maximum and minimum as value range limits.

In the case of time-animated diagrams, post-processing only reads in the times/time ranges actually used for performance reasons (which is very fast, especially with binary data containers). To determine the global maxima and minima, however, the **complete file** must be read into the memory, which can take some time depending on the hard disk speed and also fills the main memory. Therefore there is no option to perform this automatic min/max calculation every time the file is changed.

7.5.2. Definition of the colour table

Colour tables are *always relatively defined* and are then applied to the value range. So if, as in the following example screenshot, 10 colour intervals are defined, the uppermost colour value always corresponds to the maximum numerical value, while the lowest colour value always corresponds to the minimum colour value. The colours in between are defined in equal intervals.

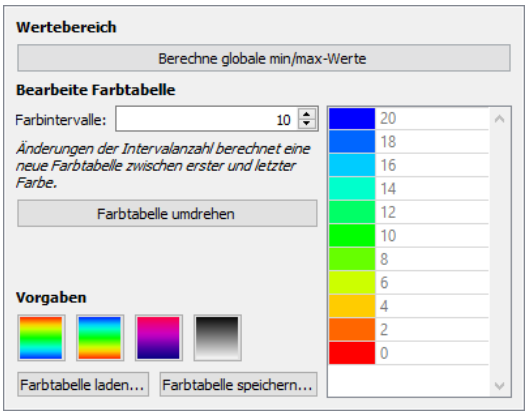


Figure 42. Settings window for the colour table

The number of colour intervals has primarily an effect on the band display and the contour lines. The following screenshots show the difference between 10 and 20 colour intervals. With a very large number of colour bands the representation approaches the *interpolated* mode (see description of the *interpolation mode* property above).

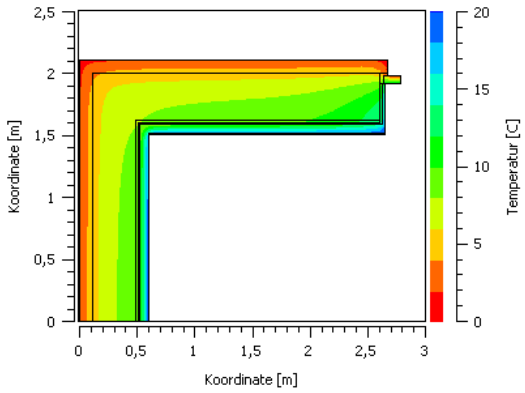


Figure 43. Representation with 10 colour intervals

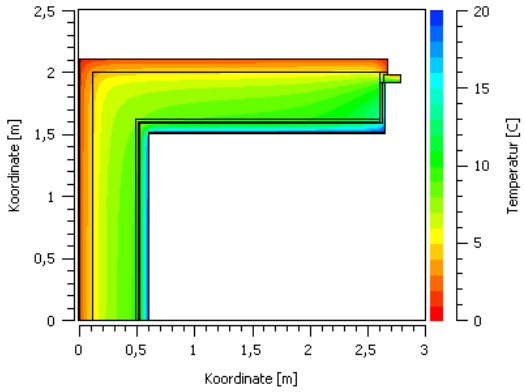


Figure 44. Representation with 20 colour intervals

The colours of the colour chart can also be changed individually. By double-clicking on the individual colours a colour selection dialogue opens. In this way, for example, even critical value ranges can be highlighted:

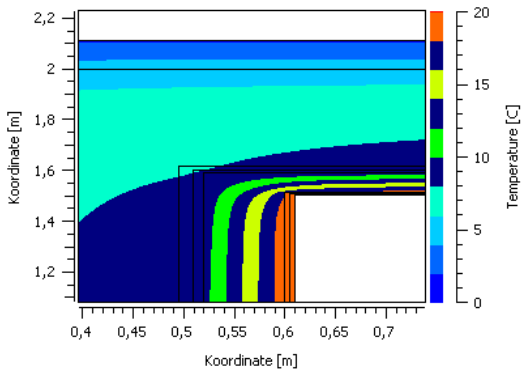


Figure 45. Highlighting after double click

Completely new colour transitions can be created by first selecting *the top and bottom colour* and **then** changing the number of colour intervals. This will recalculate the colours in between based on the colour wheel.

Once certain colour tables have been defined, they can be saved in **.p2colormap* files and loaded again (with the correspondingly named buttons). These files have a simple XML format and can also be generated externally.

8. Save and apply saved chart styles

If you want to configure several diagrams with the same appearance, you can first save the format of one diagram and then later apply it completely or partially to other diagrams.

8.1. Saving diagram styles

The menu command `Chart - Save current diagram format...` opens a dialogue for entering a unique name for the diagram format to be saved. The diagram format is saved in a file and the entered name is used as a file name for the diagram file to be created.

Diagram format files are stored in the user data directory, in the subdirectory *styles*.

After confirming the dialogue, the format of the currently selected diagram is written to the file. Then the diagram format name appears in the menu: *Chart - Apply saved diagram format to*.

8.1.1. Predefined line styles in format/chart style files

In a diagram format file, always *the same number* of diagram styles are saved as in the original diagram. If such a format file is applied to a diagram with *more* lines, only the saved diagram styles are transferred, the other lines are given default settings (colours, line thicknesses etc.). If the target diagram has fewer lines, only the formats for the existing lines are transferred.

8.2. Apply a saved format

When the programme is started the directories for diagram styles are searched and the names of the files (without extension) are displayed in the menu `Chart - Apply saved diagram format to`.

Built-in chart styles are searched in the installation directory, i.e. `{installation directory}/resources/styles`, user-defined chart format files are searched in the directory `{PostProcApp user data}/styles` (see user data directory). Diagram format files have the extension *p2style*.

If there is a file with the same name as a built-in style file in the *user-specific template directory*, only the file in the user directory is displayed in the menu.

As soon as a diagram format has been selected in the menu, a dialogue with selection options opens. The individual format components to be transferred can be selected here. After confirming the dialogue, the changes are applied to the currently selected diagram.

8.3. Apply last used format

Once a chart format has been applied, the name of this file is noted. This format can then be quickly selected again, either by the menu command `Chart - Apply chart format '<name>' on` or by the short command `Ctrl + F`. This allows a format to be quickly applied to newly created charts.

The program remembers this format file as long as the file exists and no other format has been selected and applied.

The short command `Ctrl + F` is very useful if you want to set your own standard format when creating a new diagram. This can save a lot of time for program settings.

8.4. Edit, rename and delete a chart style or chart format file

Chart format files contain a portion of a PostProc session file. Therefore, they can also be created manually or edited with the text editor. The format files `*.p2style` can also be easily renamed or deleted. The next time the programme is started, the menu is updated with the available diagram styles.

9. Diagram animation

Diagrams in which time slices are cut out of the initial data (TimeCuts) can be animated over time. These are, for example, colour gradient diagrams of 2D geometries, whereby the colour gradient is only displayed for one point in time. Or line diagrams from 1D geometries, which are displayed as time-animated profiles.

The term *time animation* initially refers only to the rather convenient setting/changing of the current point in time. For this purpose there is a slider in the lower panel, with which the current time can be moved flexibly. You can also use the animation buttons to control the time change like a movie (and with the small slider on the far right you can adjust the speed). You can also enter the desired time directly as a number.

In the lower panel on the left side all diagrams that can be animated in time, i.e. diagrams without time axis, are listed. As soon as at least one diagram is selected, the time points available in the data set are shown in the scale on the right and the animation buttons are active. As soon as the current time is changed, all diagrams are updated accordingly.

If the time of a data series is fixed in the Extractor Properties, the data set does not change even if the slider is changed.

9.1. Simultaneous animation of several data sets

If several data records are marked at the same time, all marked data records are also animated simultaneously. The time scale shows the *total of all times available in the different data sets*. If, for example, one record contains daily values, but the second contains hourly values, hourly values are shown. However, the unit can be changed. If a time point is selected, either the exact time selected or the next earlier time is used in the respective data record, if available. There is *no interpolation*.

Example 3. Time animation values for 2 data sets with different time scales

For example, 2 data sets are shown, one has the time `0 12 24` in hours, while the other has `0 1 2` in days. When compiling the time animation scale, the time points are first converted into the same unit and then merged, resulting in `0 12 24 48` in h. Rounding errors can also occur when converting time points, which could then lead to a common time axis such as `0 12 24 24.000001 48`.

If, for example, the time point `12 h` is selected with the slider, this time point is selected in the first data record, but this time point does not exist in the second data record. Therefore the time `0 d` is displayed in the 2nd data record.

When updating the data, the time scale is also adjusted if, for example, new points in time are added to a data series due to the simulation progressing. The following rules apply:

- If the last point in time is selected beforehand (slider on the far right), then after the update the slider is automatically set to the last point in time again when new data series are added. This means that the last profile is always displayed when updating - practical for observing the simulation progress.
- If a different time than the last one is selected before the update, this setting remains. Thus, if a certain point in time is selected, the diagram remains unchanged even if the data is updated. If this point in time no longer exists after the update, the nearest point in time is selected.

10. Table view and data interpolation

If you switch to the table view (see Diagram and Table View) the data shown in the diagram is displayed as numbers in a table. So you can read concrete values or simply export the data to another application.

10.1. Data export

The displayed data can be copied to the clipboard. The copied table can then be pasted directly into a spreadsheet program (Excel, LibreOffice, ...). The data are copied as columns separated by tabs (according to the *TSV format*, see TSV files), which can be read by PostProc.

The selection of data or marking of cells is done as in any usual spreadsheet program like Excel/LibreOffice etc.

In the table properties window on the right hand side you can choose whether only the current selection or the whole table should be copied.

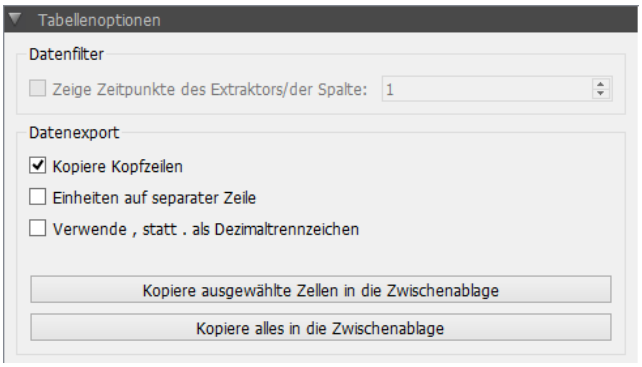


Figure 46. Selection options when copying a table

The button *Copy everything to clipboard* is ultimately only a convenience function. You can also use *Ctrl + A* to select all cells in the table, and then copy the selection.

The following options are available that influence the export:

10.1.1. "Copy headers"

In 2D diagrams, the line headings are copied, so that a generated file looks like this, for example

```
Time [h] Var1.temperature [C] Var2.temperature [C]
0 10 10
1 12 11.5
2 16 13
...
```

If the option is disabled, only the actual data is copied.

For 3D diagrams, if the option is switched on, the coordinates in the headings are copied to the top lines and the left column.

10.1.2. "Units on separate line"

Causes the export in format. This only makes sense if the line headings are very long and the unit is then cut off/not visible in the target application.

```
Time Var1.temperature Var2.temperature
[h] [C] [C]
0 10 10
1 12 11.5
2 16 13
...
```

This format is not supported by *PostProc 2*, see also format specification in the section TSV files.

10.1.3. "Use , instead of . as decimal separator"

This makes it possible to differentiate between German and English number format. Helpful when exporting to Excel/LibreOffice (which requires German number format) and in text files for further use in other tools, whereby English number format is required.

10.2. Data filtering and interpolation

If time series with different points in time are displayed together in a table, the missing values are interpolated linearly between the neighbouring grid points (which corresponds to the graphic representation in line display). Interpolated values are coloured to distinguish them from values actually contained in the data set:

	Zeit [s]	Variable A [-]	Variable B [-]	Variable C [-]
1	0	0	0	1
2	1	4	1	1
3	2	2	2	3,66667
4	2,5	6	3,33333	5
5	3	10	4,66667	9,9999
6	3,00001	10	4,66669	10
7	4	10	7,33333	10
8	5	10	10	10

Figure 47. Tabular representation of interpolated values

Interpolation is particularly helpful if, after export to a spreadsheet, you want to perform further calculations (difference formation, etc.) with the data series.

The rules used for this are explained below.

The following data sets are used in the above example:

Dataset A for column 'Variable A

```
Time [s] Variable A [-]
0 0
1 4
2 2
3 10
4 10
```

Record B for column 'Variable B

```
Time [s] Variable B [-]
0 0
2 2
5 10
```

Record C for column 'Variable C

```
Time [s] Variable C [-]
1.00000000001 1
2.5 5
3.00001 10
4 10
```

These data sets contain different time series. In data set C the situation is simulated which occasionally occurs in numerical simulations, i.e. due to rounding errors in glide number calculations, time 1 is sometimes not exactly 1 but minimally greater or smaller, in this case 1.00000000001.

In further processing of the data, these points in time should nevertheless be treated identically, which is why all points in time with a relative distance of less than 1e-9 are considered to be the same.

The exact formula is:

```
TOLERANCE = |t_i|*1e-9 + 1e-7
```

Points in time are considered to be different if

```
t_{i-1} + TOLERANCE > {t_i}
```

is.

In the case of time points 3 and 3.00001 the distance is greater and the time points appear individually listed in the table.

In the time column, the times of all data series are displayed sorted. For the data sets for which these time points do not exist, the time points are approximated according to the rules described below. Values calculated in this way are coloured for differentiation (see screenshot above).

10.2.1. Interpolation of intermediate values

If values are not available in a data set, they are interpolated linearly. For example, for data set B, t=1 results in the interpolated value 1.

10.2.2. Extrapolation

If values are missing at the beginning or end, they are extrapolated *constantly* from the next or previous value. For example, dataset C does not contain values for time 0 nor for the last time 5, so the first available value (from time 1) is displayed for time 0. And for time 5 the last one (from time 4).

10.3. Filter time points

For the analysis, it is sometimes necessary to use the time points of a time series as reference (e.g. hourly values) and not to use intermediate time points from other time series. In this case, the time points of a data set can be selected as filters.

Filtering is activated via the selection box *Show times of the extractor/column*. Then the column number corresponding to the data set is selected (numbering starts with 1 for the first data set after the time column). If, for example, column 1 (data set A) is selected, only the times of this data set will appear in the table:

	Time [s]	Variable A [-]	Variable B [-]	Variable C [-]
1	0	0	0	1
2	1	4	1	1
3	2	2	2	3,66667
4	3	10	4,66667	10
5	4	10	7,33333	10

Figure 48. Table view with time filter

10.4. Adjust time unit

The time column in the table view normally shows the same unit as used for the X-axis in the diagram. If you want to use a different time unit when exporting data or searching for a specific time, you can set this in the selection list.

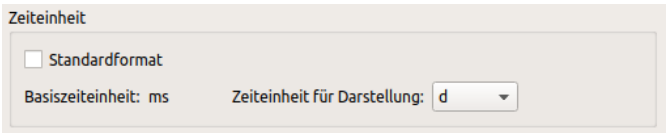


Figure 49. Selection of the unit for the time column in the table view

When the standard unit is used for display, the numbers are displayed with standard value formatting, usually with 6-digit accuracy. However, if a time unit is selected from the drop-down list, then a number formatting typical for this time unit is chosen.

If the times are displayed with date/time stamps, the base unit is *ms* (milliseconds), since time is internally managed in milliseconds since the reference year.

11. Models - damage prognosis

In *PostProc 2* there is the possibility to apply models to selected data. This is currently possible for 2D data in the form of time series. The models are selected from a list in the lower part of the main window of the data management view (see [3] in Figure 2D diagram configuration window).

To select a model, exactly one 2D data set of **temperature values** and one 2D data set of **relative humidity** data must be selected. A model selection is only possible if exactly these two data sets are selected.

In the current version of *PostProc 2* the following models are implemented and can be selected in the selection list:

- Isopleth model
- VTT Schimmel models
- WTA wood destruction model

- VTT wood destruction model
- Algae growth model for bricks

A click on the *Create Diagram* button creates a diagram according to the selected type with the basic settings. If *No Model* is selected, a line diagram is created with the two selected datasets (see section 2D Diagrams).

The data sets do not necessarily have to have the same time unit and step size for use in models. However, hourly values are recommended.

11.1. Isopleth model

The isoplethene model is used to estimate the risk of mould growth on freely weathered surfaces. More detailed information on this model can be found in the

WTA leaflet 6.3

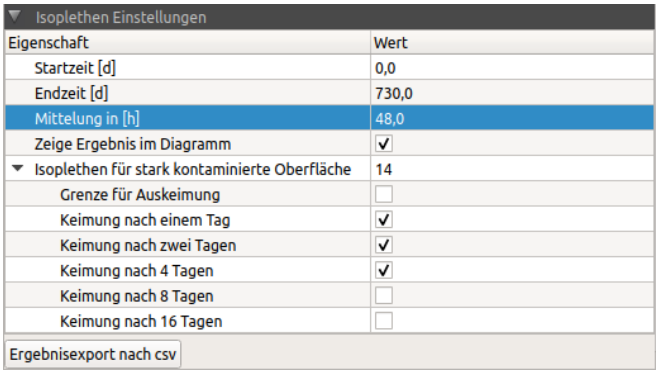
and in

Sedlbauer, K. : *Evaluation of mould formation on and in building components.* Dissertation University of Stuttgart (2001).

This model shows the relative humidity (y-values) against the temperature (x-values) at the same time. Immediately after creation, a diagram as shown in the following picture is displayed.

You can now adjust the appearance of the diagram with diagram settings (properties window at the bottom right):

Settings for the isopleth diagram



Among other things, you can display the isopleths for different germination periods and thus configure the following isopleth diagram, for example:

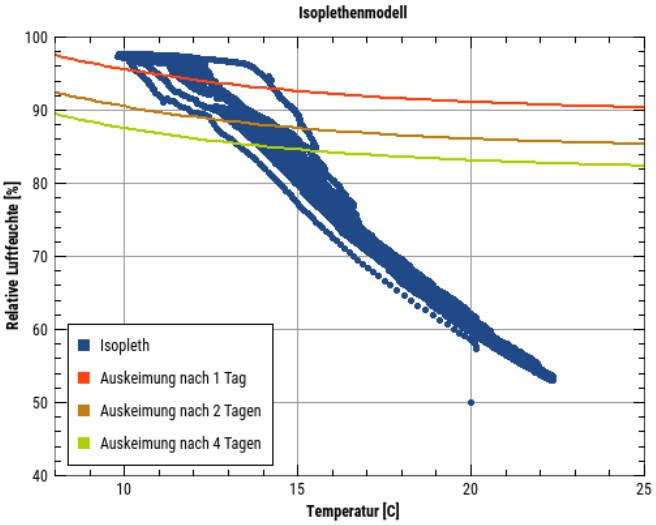


Figure 50. Diagram of the isopleth model

The settings are described in detail below:

11.1.1. Start time/end time

Only the values in the specified period are considered. For the evaluation it is usually useful to hide the first year so that transient processes do not distort the result.

If you stay with the mouse briefly over the input fields for start/end time, the possible range is shown in the corresponding *tooltip*.

11.1.2. Averaging

Usually hourly values (instantaneous values at the end of the hour) are used for the calculation and are also displayed.

For a mould formation the used limit values must be exceeded for a longer period of time. Accordingly, the germination isopleths are also defined for certain periods of time, e.g. 1 day or 2 days. For a *visual evaluation* of the calculation results it is therefore recommended to average the individual values in a similar time interval, e.g. by using 24 h as an averaging interval (enter 24 h in the field *averaging*). In case of longer germination intervals, the averaging period should be increased accordingly.

The averaging interval only has an effect on the diagram displays, but not on the numerical calculation of the exceedance frequencies/overrun periods.

11.1.3. Show result in diagram

If the check mark is set in this field, the exceedance periods for each selected isoplethe are also shown in the legend.

11.1.4. Isopleths

In this area the different isopleths can be selected. Here, a distinction is made according to the nutrient supply at the surface and the duration of possible growth. There are isopleths for one day, two days, 4 days, 8 days and 16 days. This means that the conditions at the surface must be above the limit line (isopleth) for the period mentioned above in order for mould to grow. There is also a line for the germination limit. This describes the lower limit for the

germination of mould spores. Below this line, the risk of mould formation is zero. In the picture above the isopleths for germination limit, one day and two days are selected.

11.1.5. Export of results to csv

This button at the bottom of the dialogue exports a table with the exceedance frequencies for all isopleths as a csv data record to the clipboard. From there it can be transferred to a word processing program or spreadsheet (Excel/LibreOffice-Calc/etc.):

Isoplethenname	Gesamtzeit über der Linie [d]	Maximale Zeitdauer über der Linie [h]
Auskeimung nach 1 Tag	71.9434	505.239
Auskeimung nach 2 Tagen	92.8107	1180.92
Auskeimung nach 4 Tagen	132.691	1280.52
Auskeimung nach 8 Tagen	128.625	1344.56
Auskeimung nach 16 Tagen	133.254	1434.36
Auskeimungsgrenze	297.16	2069.82

Figure 51. Transfer of the csv-data record into a spreadsheet

Two columns are displayed:

Total time How many days were the values above the limit line in the whole selected period. A transgression is only calculated if the time of each single transgression exceeds the value of the isoplethe.

Maximum time This is the longest time in hours for exceedings with this Isoplethe. This value can also be shorter than the time span of the corresponding Isoplethe. In this case the exceeding time would be zero.

11.2. VTT mould model

The VTT mould model is a mathematical model for the dynamic calculation of mould growth from temperature and relative humidity of a surface. It was developed by Hannu Viitanen of VTT in Finland. More information can be found e.g. in

Hukka A.; Viitanen H.: *A mathematical model of mould growth on wooden material.* Wood Science and Technology 33(6). 1999, S. 475-485.

The result of this model is a time course of a mould index:

Mould index and associated criteria

Mould index	Growth	Description
0	no growth	spores not active
1	microscopically visible, low growth	germination
2	microscopically visible, <10% coverage	-
3	visually visible, 10-30% coverage	new spores are produced
4	visually visible, 30-70% coverage	medium growth
5	visually visible, >70% coverage	strong growth
6	Coverage 100%	Very strong and dense vegetation

A mould evaluation diagram for the *VTT mould model* is created in the same way as for the isopleth model. The

created diagram can be adjusted with the corresponding diagram properties (at the bottom right of the properties palette).

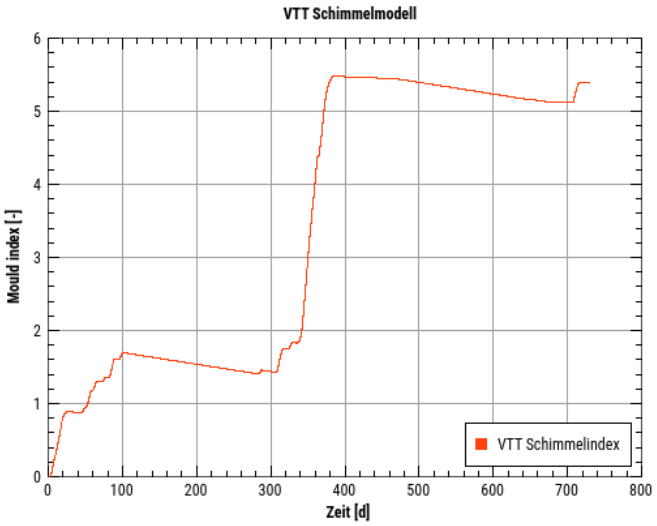


Figure 52. Settings in the mould model

Three parameters can be set in the option dialogue.

Type of material

- Very sensitive: sapwood pine
- Sensitive: spruce, derived timber product board, glued laminated timber
- Medium resistant: concrete, mineral wool, cellular concrete
- Durable: EPS

Type of surface

- Very sensitive; untreated, rich in nutrients
- Sensitive: planed material, paper-coated products, wood-based materials
- Medium resistance: cement-based materials, plastics, mineral wool
- Durable: Glass and metal, coated with protective agents

Type of mould growth

- Almost no regression: lightweight concrete, PE, EPS
- relatively low regression: concrete, glulam, polished surfaces
- considerable regression: cellular concrete
- short-term regression: untreated wood

11.3. WTA wood destruction model

This model is used to demonstrate wood degradation by wood-destroying fungi. It is described in

WTA Leaflet 6.8 (2016) Chap. 6.4.1.

It applies to solid wood (including solid structural timber, glued and dowelled timber products, glued laminated timber, etc.) Here a kind of linear isoplethe is used for the temperature range 0°C to 30°C. A risk of wood destruction is considered to exist if the surface values are above this line as a one-day mean value. The mean value is calculated in the model.

Further details can be found in the following literature:

Kehl, D.: *Humidity-related dimensioning of timber constructions according to WTA - Hygrothermal evaluation of the other kind.* In: HOLZBAU - die neue quadriga, issue 06-2013, Kastner Verlag, Wolnzach 2013.

This model is also referred to in *DIN 4108-3 of 2018 (Chap.D.7.4 p. 72)*.

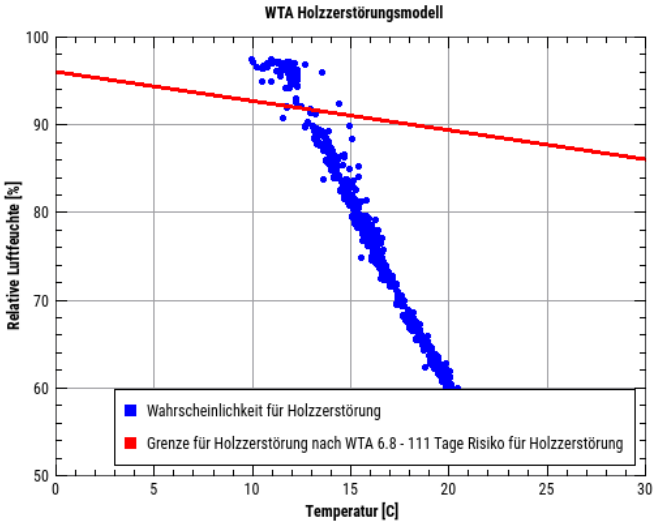


Figure 53. Wood destruction model

The only parameter that can be entered here is the evaluation period. This is done analogously to the isopleth model. Just like there, an overrun period in days can be shown in the legend. It is also possible to export a table as a csv (see result export to csv).

11.4. VTT wood destruction model

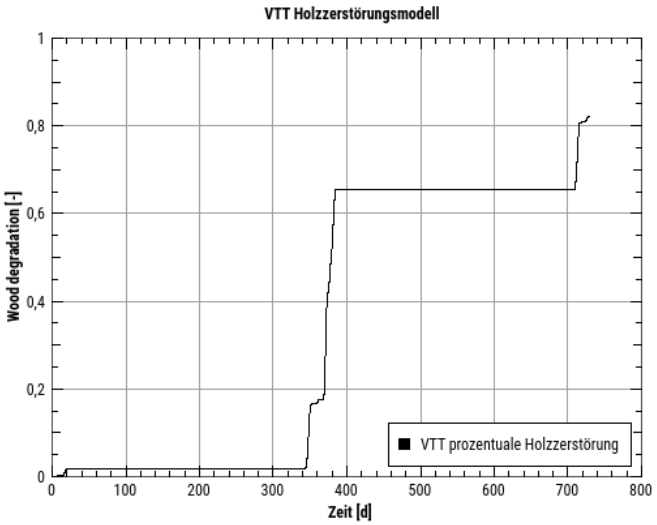


Figure 54. Wood destruction model according to VTT

11.5. Algae growth on a brick surface

The present model describes the increasing coverage of an outer surface for brick masonry with algae. A final documentation of this model is still pending. A first description can be found here:

Quagliarini, E.; Gianangeli, A.; D'Orazio, M.(among others): *Effect of temperature and relative humidity on algae biofouling on different fired brick surfaces.* Mater. 199. 2019, p. 396-405., doi:10.1016/J.CONBUILDMAT.2018.12.023.

The temperature and relative humidity on an external surface are also to be used as input variables. Hourly values are preferable here. The diagram shows the coverage of the surface with algae, which over time approaches the maximum value for the material used.

The parameters are the porosity of the material on the surface and the roughness of the surface. The porosity can be taken from the material properties of the simulation model used. The parameters are entered in the option dialogue in the lower right corner of the diagram properties palette.

The parameters have the following limits:

Porosity 0.19m³/m³ to 0.44m³/m³

Roughness 2.95µm to 7.6µm

12. Diagram export

One of the strengths of *PostProc 2* is the print-ready diagram export, whereby precise size and scaling settings can be made depending on the target application.

Diagrams can optionally be exported as:

- bitmap graphics (pixel/raster-based, ideal for web pages), and
- Vector graphics (pdf, svg, emf) for printed publications

can be created.

Diagrams can be exported in two ways:

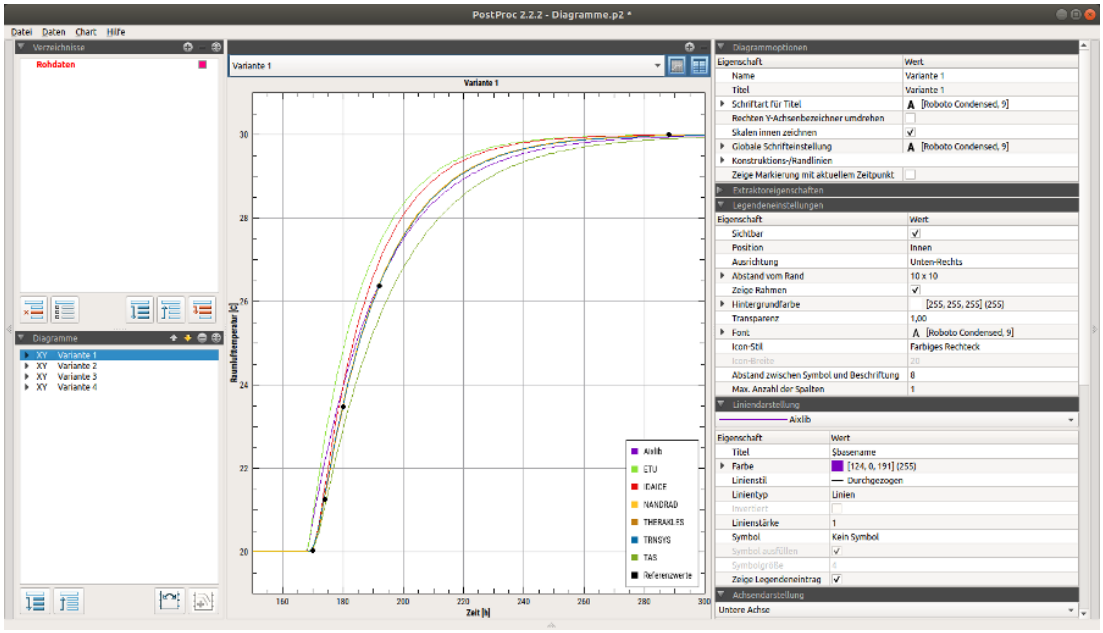
- quick direct copy to the clipboard with default settings, and
- by using the export dialogue with very detailed export settings.

To export a diagram, the respective diagram window must be selected.

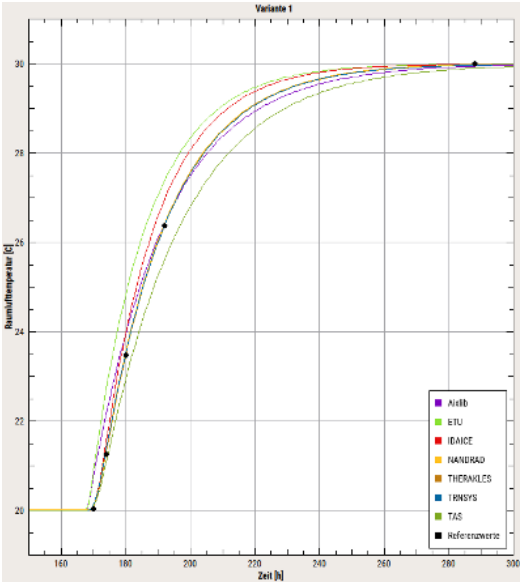
12.1. Quick copy to clipboard

When executing the menu command: `Chart - Copy current chart to clipboard` an EMF vector file is automatically copied under Windows and a bitmap image (like a screenshot) under Linux/MacOS. This will export the diagram with the current size.

For example, the diagram displayed on the screen in this way:



exported as a nearly 1-to-1 image when using the copy to clipboard command:



12.2. Using the export dialog/diagram layout for publications

Often, however, detailed export settings are required with regard to target size, resolution, etc. These can be selected in the diagram export dialogue. The export dialogue can be opened with the menu command: `Chart - Export current diagram` or with the short command `Ctrl+E`.

The diagram export differs fundamentally between pixel-based bitmap images and vector graphic images. In the dialogue, this basic setting can first be made by selecting the `Bitmap` or `Vector Graphics` tab.

After selecting the format-specific settings (see following sections) the diagram can either be saved as a file or copied to the clipboard.

12.2.1. Selection of the diagram destination

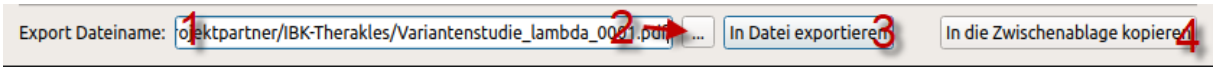


Figure 55. Destination file name and export buttons

To save in a data file, the data path including *extension* must be entered in the file name line (1). The selection button (2) can also be used for this purpose. Depending on the file extension entered (note lower case!), the target format is determined.

Currently supported are

Vector graphic formats:

- `pdf` - PDF file
- `emf` - (Windows only) - Enhanced MetaFile image file
- `svg` - SVG vector graphics file

Bitmap graphic formats:

- `png` - PNG image
- `jpg` - JPG image
- `bmp` - BMP image

The actual image is written by the button (3) *Export to file*.

When the file is saved, any existing file is overwritten *without* further confirmation. However, if you use the file name selection dialogue, if you select an existing file, you will be asked whether this file should be overwritten. This does not immediately lead to overwriting the file, but only when the *Export to file* button is pressed.

Alternatively you can copy the image to the clipboard (button (4) *Copy to clipboard*).

12.3. Vector graphic export

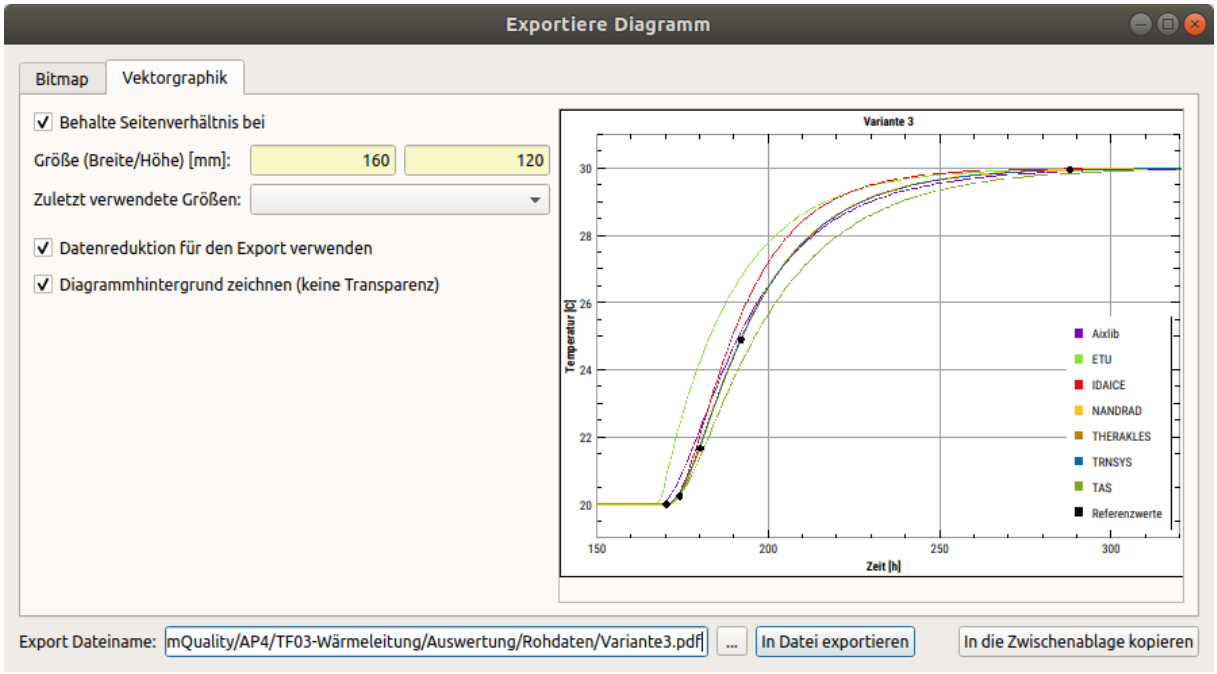


Figure 56. Export dialogue in vector graphics mode

Vector graphics have the advantage that the quality is maintained when the image is scaled. This is therefore also the recommended format for diagrams to be printed. You can then create a PDF file, for example, or integrate the graphic as an EMF file (Windows) or SVG file into other documents.

It is essential to ensure that the format settings of the lines and titles are taken into account exactly when exporting. This means that if you have set the font size to 10pt, the text will also be written with 10pt when exporting diagrams - regardless of whether you export a 10x10cm or 150x150cm diagram.

The appearance of an exported chart differs from the on-screen display depending on the settings, so a preview is displayed.

For publications it is often important to specify font sizes in illustrations in the exact size required, for example Arial 9pt. PostProc 2 supports this by allowing you to set individual sizes for font and line thicknesses in the diagram configurations and then use these exactly as they are when exporting. If, for example, you insert a 12x7cm diagram with exactly this size into another document, the characters will be exactly the same size when the document is printed.

When the diagram is exported, the diagram is redrawn with the specified size, although the propertions and axis scaling may of course change. Therefore a preview of the diagram is displayed.

The vector export also adjusts the line thickness. If you draw a line with 1px width on a FullHD screen with 1920x1080 resolution and this is also clearly visible, a 1px line scaled accordingly will appear as very thick (e.g. 0.8 mm thick) when exported to a printable diagram. Therefore line thicknesses are halved when exporting vectors.

The most important setting for vector export is the target size. If *Keep aspect ratio at* is activated, the other size is automatically adjusted proportionally when the width or height is changed. Previously selected aspect ratios can be accessed via the drop-down menu *Recently used sizes*.

In addition to setting the target size of the diagram (in mm), there are two further options.

12.3.1. Use data reduction for export

An additional data reduction algorithm can be switched on when exporting line charts with a large number of data points as vector graphics. This removes all points which are approximately on the connecting line between the neighbouring points and therefore do not add any value to the diagram. The Douglas-Peucker-Algorithm is used here.

Data reduction can help to drastically reduce the size of the created PDF/SVG/EMF files without any visible loss of quality, for example, a line graph with 180000 points from 18 Mb to 0.2 Mb.

During data export, only the number of segments in the line (*polyline*) is reduced. Symbols are drawn for each point, if visible. The operation therefore results in a visually equivalent diagram representation.

When copying a vector graphic to the clipboard via the menu command *copy current diagram to clipboard* a *data reduction* is always applied.

12.3.2. Draw diagram background (no transparency)

By default, this option is enabled and a white, single-colour area is drawn under the diagram. This is necessary for the PDF-A export, among other things, since transparent vector drawings are not permitted here.

If, however, you want to have a transparent diagram explicitly, for example to insert it into a presentation with a different colour background, you can switch off this option.

12.4. Export as pixel-based graphic/raster image

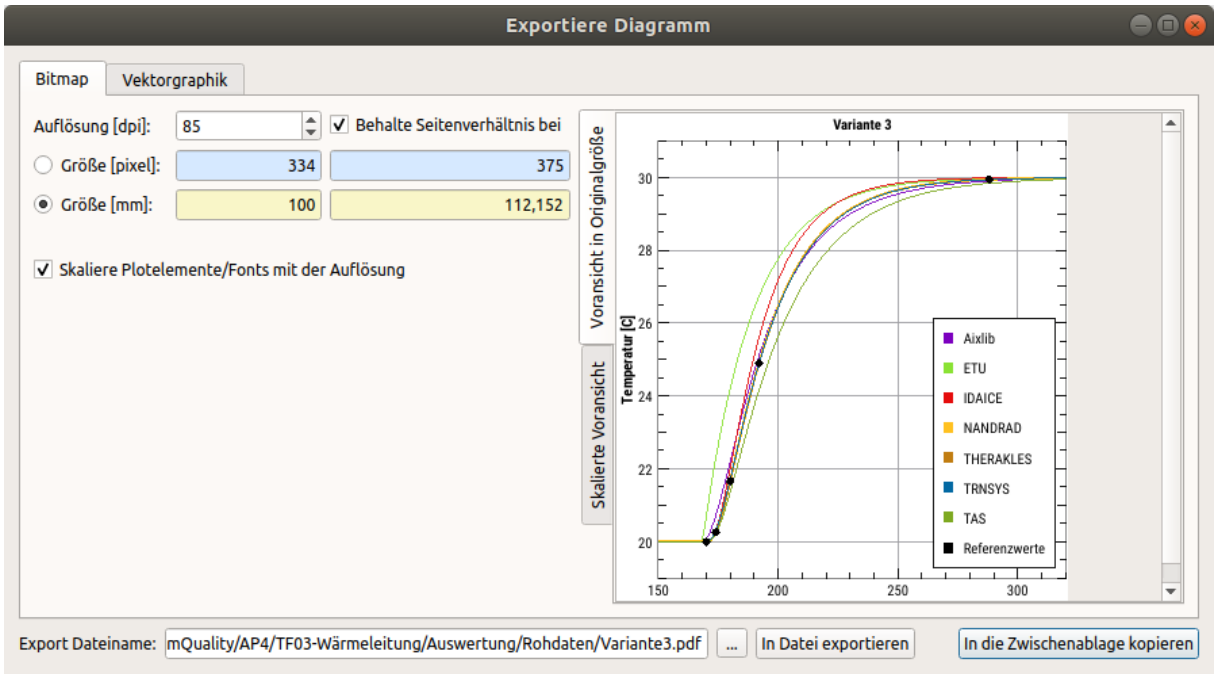


Figure 57. eExport dialogue in bitmap mode

Diagrams are usually only exported as raster images if they are needed, for example, in web pages or other raster-based display formats. Since a precise representation is often desired here, there is an exact preview of the exported image.

For resolutions larger than the export dialogue window, progress bars are displayed in the original size preview.

You can also select the proportional preview.

Since raster graphics can also be used for printing, the size can be set once by pixel dimension and once by size and resolution.

12.5. Tips and tricks for creating charts for publications/printing

Diagrams for printing (for publications, books etc.) should always be exported as vector graphics.

The following procedure is recommended:

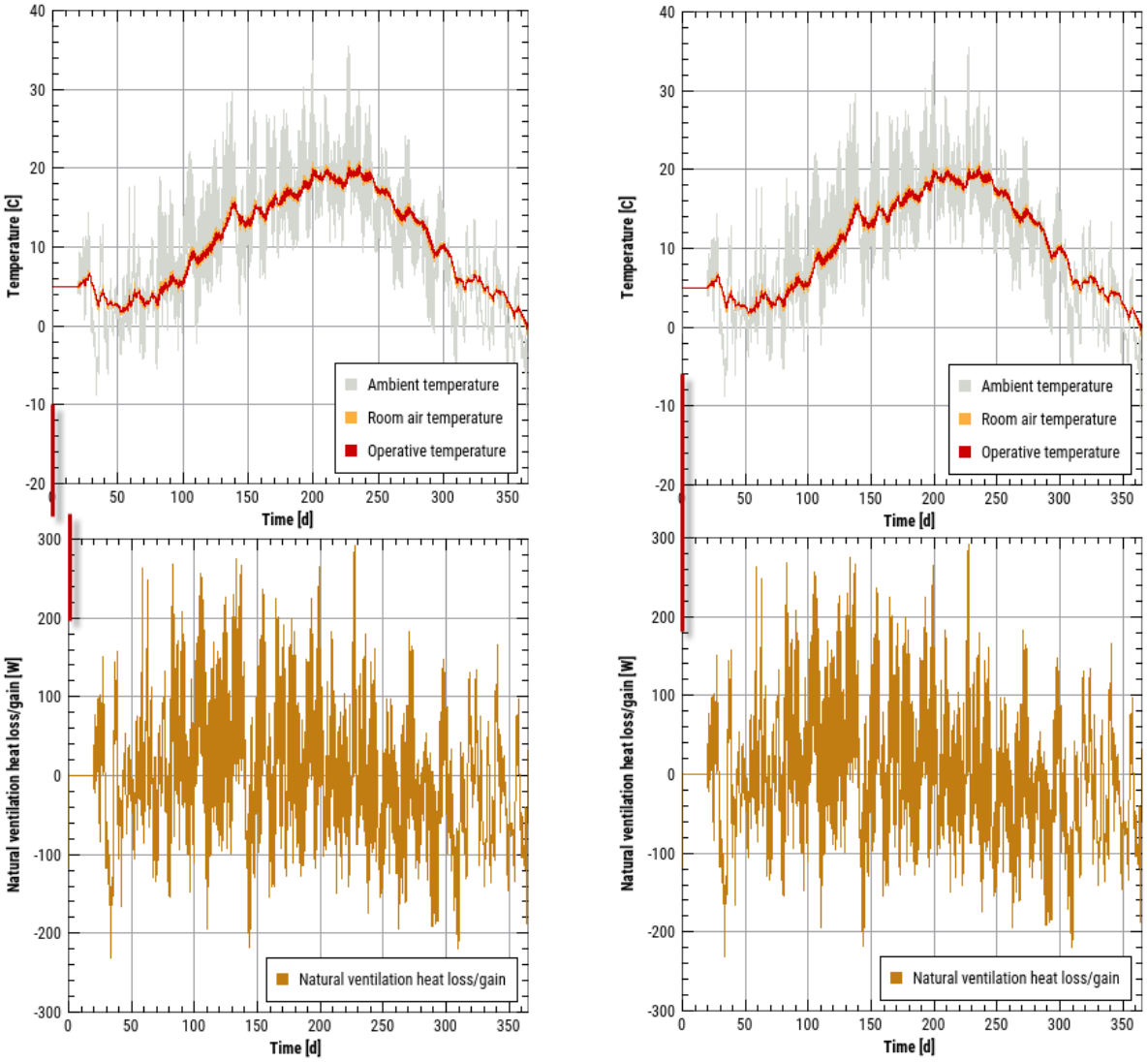
1. configuration of the diagram in the screen view
2. define the font and size, can be done centrally for the whole diagram via global diagram options
3. open the export dialogue
4. define the diagram size, e.g. 16 cm width for normal A4 paper or 8 cm for double-column printing. Select the height in the same way.
5. preview - this shows the proportions of the diagram to be exported, which may well differ from the screen proportions. If necessary, close the export dialogue window and adjust fonts and line thicknesses.
6. export the diagram and define the size accordingly when inserting it into the target document.

12.5.1. Uniform alignment of several diagrams in the document

If several diagrams are used in a document, it is recommended that the same font and size be used for all diagrams. The export sizes should also be the same.

In addition, the axis property *title distance* can be used to set a uniform distance between axis and diagram title (and thus also diagram border). This is useful, for example, if two diagrams with different scale sizes are displayed one below the other.

Example for vertically aligned diagrams: on the left (standard formatting) there is an offset due to the different scale sizes, on the right the title spacing in the upper diagram was set to the same distance as in the lower diagram, and both diagrams are aligned exactly vertically



12.6. Automated diagram export

It is also possible to export the diagram automatically via a command line command, see section Automated diagram creation via command line command.

13. reference

13.1. shortcuts

Many post-processing functions can be executed by double-clicking or using a keyboard shortcut:

Short Command/Action	Function
Double click (*on data set in data manager table*)	Create a graph for the currently selected data set with default options
Ctrl+N	Create new empty session
Ctrl+O	Open session
Ctrl+S	Save session

Short Command/Action	Function
Ctrl+A	Select all, in lists and tables, e.g. in the table view of the diagram data
Ctrl+E	Export of the currently selected diagram, diagram must have focus (click with mouse on it)
Ctrl+F	Apply last selected chart format to current diagram
F5 / Ctrl+R	Update data (reload)
F2	Open current session file in text editor
Ctrl+1	Split current diagram horizontally (2 diagrams below each other)
Ctrl+2	Split current diagram vertically (2 diagrams side by side)
Ctrl+0	close diagram window/undo division
F11	full screen mode on/off (in full screen mode all panels are folded away)

13.2. Command line reference

The following command line arguments are supported:

Syntax:

```
> PostProcApp [<Options>] [<Session File>]
```

Possible options are shown with the argument *---help*:

```
syntax: PostProcApp [flags] [options] arg1 arg2 ...

flags:
  --help Prints the help page.
  --man-page Prints the man page (source version) to std output.
  --cmd-line Prints the command line as it was understood by the command
                   line parser.
  --options-left Prints all options that are unknown to the command line
                   parser.
  --no-splash Disables splash screen.

options:
  --long=<en;en;de;it;...>
                   Specify the program language using a 2 character language
                   ID.
  --generate-chart=<n:bxh:fn>
                   Export chart #n, with dimensions 'width x height' and
                   filename fn like 'diagram1.pdf'.
  --generated charts=<exportSpecsFile>
                   Exports several charts using export specs from given file.
```

If a session file is transferred, the post-processing restores this session at program start. Under Windows/Linux the file extension `p2` is linked to _ PostProc 2_, so that when a session file is double-clicked, the PostProc starts with this session.

The main optional arguments are:

`--no splash`	Disables the splash screen
`--lang=<language-id>`	Indicates the programme language with which the programme is to be started. Possible language IDs: **de**, **en**, **it**
`--generate-chart`	opens *PostProc 2*, reads the session file passed, generates a chart according to the argument options and closes the program again
`--generate-charts`	In principle like `--generate-charts`, except that the specifications for the diagram generation for several diagrams are read from one file.

13.2.1. Automated diagram creation using command line command

The above mentioned command line arguments `--generate-chart` and `--generate-charts` can be used to create charts automatically. In combination with a script-based creation of a session file it is possible to generate charts completely automatically.

The argument `--generate-chart` is used to export a single diagram. For example, the command

```
> PostProcApp --generate-chart=2:160x100:diagram1.pdf diagramme.p2
```

executes the following work steps:

1. start *PostProc 2*
2. open the session file `diagrams.p2`
3. change to diagram #2
4. create the PDF file `Diagram1.pdf` with 160x100 mm resolution of Diagram #2
5. close the program and return to the command line

If you want to create several charts of the same session file, you can do this in principle by starting the application several times with the `generate-chart` argument. However, this can take a long time with larger session files. You can therefore create a text file with one export definition per line instead. An example of this would be:

Example file export-spec.txt for a chart export specification file

```
1:160x120:../report/diagrams/variants1.pdf
2:160x120:../report/diagrams/variants2.pdf
3:160x120:../report/diagrams/variants3.pdf
4:160x120:../report/diagrams/variants4.pdf
```

Each line contains the same parameters as would be passed to the `--generate-chart` argument. Now start the postprocessing with:

```
> PostProcApp --generate-charts=exportSpec.txt diagrams.p2
```

where the argument `--generate-charts` defines the absolute or relative path to the specification file.

13.3. System of units and list of units

PostProc 2 has a built-in unit system which is used for unit conversion. This allows, for example, data series with units that can be converted into each other to be displayed in a diagram.

Example 4. Enit conversion example

A data series contains laboratory measurement data, which are logged in minute steps: unit of value=*g* (gram), unit of time=*min* (minute)

If you now create a 2D diagram from such a data series, the X-axis will be given the unit *min* and the Y-axis the unit *g*.

Now add another data series (from a simulation), using the standard SI unit *kg* as the unit of value and *s* as the unit of time. PostProc 2_ now tries to determine the conversion factor from *kg* to *g* by using the table of units, and likewise for *s* to *min*. Then the values of the data series are converted accordingly and displayed in the diagram.

The unit system is based on direct 1-to-1 conversions. In most cases these are scales, and in the case of *C* to *K* a shift of values. Special unit conversions like *sqrt(s)* to *s* are directly integrated.

Correlations between units, e.g. m2/s resulting from the calculation of m * m/s, are not integrated, as such calculations are not carried out in *PostProc 2*.

13.3.1. List of units

The following table lists all units supported in *PostProc 2*, i.e. units that can be used as value and time units in data files.

Supported units:

Base SI unit	Convertible units
-	
---	%, 1
---/d	%/d
1/K	
1/logcm	
1/m	1/cm
1/Pa	
1/s	1/min, 1/h
J	kJ, MJ, MWh, kWh, Wh
Y/K	kJ/K
J/kg	kJ/kg
J/kgK	kJ/kgK, Ws/kgK, J/gK, Ws/gK
J/m2	kJ/m2, MJ/m2, GJ/m2, J/dm2, J/cm2, kWh/m2

Base SI unit	Convertible units
J/m2s	W/m2, kW/m2, MW/m2, W/dm2, W/cm2
J/m3	Ws/m3, kJ/m3, MJ/m3, GJ/m3, J/dm3, J/cm3, kWh/m3
J/m3K	kJ/m3K
J/m3s	kJ/m3s, MJ/m3s, J/dm3s, J/cm3s, J/m3h, W/m3, kW/m3, MW/m3, W/dm3, W/cm3, W/mm3
J/mol	kJ/mol
J/s	J/h, J/d, kJ/d, W, kW, MW, Nm/s
K	C
K/m	
K/Pa	
kg	g, mg
kg/kg	g/kg, mg/kg
kg/m	g/m, g/mm, kg/mm
kg/m2	kg/dm2, g/dm2, g/cm2, mg/m2
kg/m2s	g/m2s, g/m2h, g/m2d, kg/m2h, mg/m2s, µg/m2s, mg/m2h, µg/m2h
kg/m2s05	kg/m2h05
kg/m3	kg/dm3, g/dm3, g/cm3, g/m3, mg/m3, µg/m3, log(kg/m3), log(g/m3), log(mg/m3), log(µg/m3)
kg/m3s	g/m3s, g/m3h, kg/m3h, mg/m3s, µg/m3s, mg/m3h, µg/m3h
kg/m3sK	g/m3sK, g/m3hK, kg/m3hK, mg/m3sK, µg/m3sK, mg/m3hK, µg/m3hK
kg/mol	g/mol
kg/ms	
kg/s	kg/h, kg/d, g/d, g/a, mg/s, µg/s
kWh/a	
kWh/m2a	
l/m2s	l/m2h, l/m2d, mm/d, mm/h
l/m3s	l/m3h
logcm	
logm	
logPa	
Lux	kLux
m	mm, cm, dm
m/s	cm/s, cm/h, cm/d
m/s2	
m2	mm2, cm2, dm2
m2/kg	
m2/m3	

Base SI unit	Convertible units
m2/s	cm2/s, m2/h, cm2/h
m2K/W	
m2s/kg	
m3	mm3, cm3, dm3
m3/m2s	m3/m2h, dm3/m2s, dm3/m2h
m3/m2sPa	m3/m2hPa
m3/m3	Vol%
m3/m3d	Vol%/d
m3/s	m3/h, dm3/s, dm3/h
m3m/m3m	m3mm/m3m
mm/m	
mol	mmol
mol/kg	mol/g
mol/m3	mol/ltr, mol/dm3, mol/cm3
Pa	hPa, kPa, Bar, PSI, Torr
Pa/m	kPa/m
person/m2	
wheel	deg
s	min, h, d, a, sqrt(s), sqrt(h), ms
s/m	kg/m2sPa
s/s	min/s, h/s, d/s, a/s
s2/m2	
W/K	
W/m2K	
W/m2K2	
W/m2s	W/m2h, kW/m2s, MW/m2s, W/dm2s, W/cm2s
W/mK	kW/mK
W/mK2	
W/person	kW/person
undefined	

The entities `undefined` and `-` have special meaning. The latter is used for variables without units. *PostProc 2* gives the unit `-` to all data from input files without specified unit.

The unit `undefined` stands for *not initialised* and should therefore generally *not* be used in input files.

13.4. Session file format

The session file is structured as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>
<PostProc version="2.2.1">
    <!--List of all directories-->
    <Directories
        ...
    </Directories

    <!--All mappers.-->
    <Mappers>
        ...
    </Mappers>

    <!--Split window state.-->
    <Splitting>
        ...
    </Splitting>
</PostProc>
```

13.4.1. XML element <Directories>

The information about the directories imported into the session and which of them are currently selected, i.e. content and state of the directory tree is stored in the session file in the section <Directories>.

Example of the section of the session file that describes the imported directories

```
<!--List of all directories-->
<Directories
    <Directory>
        <Path>1DGeometry</Path>
        <SubDir Color="#550000" Checked="1">DirectSimData</SubDir>
        <SubDir Color="#ffaaff" Checked="0">FluxFieldTest/horizontal_flux_field</SubDir>
        <SubDir Color="#c66300" Checked="0">TimeCoordinateValuePlot/TimeCoordinateValuePlot</SubDir>
        <SubDir Color="#005500" Checked="0">TimeCoordinateValuePlot/TimeCoordinateValuePlotYDir</SubDir>
        <SubDir Color="#ffee00" Checked="1">TimeCoordinateValuePlot/TimeCoordinateValuePlot_withGap</SubDir>
        <SubDir Color="#ff5500" Checked="0">xtime_plot/climate</SubDir>
        <SubDir Color="#aa55ff" Checked="0">xtime_plot/xtime_plot_nogaps</SubDir>
        <SubDir Color="#aaaa00" Checked="0">xtime_plot/xtime_plot_nogaps.results</SubDir>
        <ExpandedSubDir>TimeCoordinateValuePlot>/ExpandedSubDir>
        <ExpandedSubDir
        <ExpandedSubDir>xtime_plot</ExpandedSubDir>
    </Directory>
    <Directory>
        <Path>/home/ghorwin/svn/PostProcApp_trunk/data/Examples/2DGeometry</Path>
        <SubDir Color="#ffee00" Checked="0">LShape</SubDir>
        <ExpandedSubDir
    </Directory>
</Directories>
```

Each directory added will appear in its own <Directory> element, with the path specified as either a relative or absolute path:

- as a relative path to the session file directory, if the selected directory is located below this session directory
- as absolute path if the selected directory is located elsewhere (parent directory, different directory hierarchy,

different drive, etc.)

In the example above, the session file is saved as `/home/ghorwin/Simulation/1DSim.p2`, and thus the first imported directory `1DGeometry` is located in the path `/home/ghorwin/Simulation/1DGeometry`. The paths given in the xml-tags `<SubDir>` are to be understood relative to this directory. The second imported directory is specified with absolute path, because this directory is stored outside the session directory structure (starting with `/home/ghorwin/Simulations`).

If you want to copy/move an entire directory structure with session file and records, or use it in a version control system, you should place the session file in the top directory. This way all directories are created relative to the session file path and the session file can be used directly on different computers without further path adjustments.

The attributes of `<SubDir>` are self-explanatory. The optional `<ExpandedSubDir>` tags are used to store the expanded state of the directory tree.

13.4.2. XML element `<Mappers>`

This element ultimately contains a list of `<mapper>` elements, each representing a diagram.

13.4.3. XML elements `<Mapper>`

A `<Mapper>` XML tag contains all data for a diagram and the data series displayed in it. Two XML tags are included:

```
<Mapper name="Surface temperature">
    <Extractors>
        <!-- Definition how data is extracted from source files -->
    </Extractors>
    <ChartModel chartType="2D">
        <!-- Definition of how data and graphs are to be presented -->
    </ChartModel>
</Mapper>
```

In data storage, too, there is a separation between the description of *how the data is extracted from source files* and the definition of *how the data is to be presented*.

For each data series in the chart there is an `Extractor` tag within the parent `Extractor` tag.

XML elements `<Extractor>`.

Each `Extractor` element defines a data series. An example of a 2D data set is shown below:

```
<Extractor>
    <DataIOFileName>1DGeometry/DirectSimData/surface_temperature.d6o>/DataIOFileName>
    <CutType>NoCut>/CutType>
    <DataFormat>DF_2D</DataFormat>
</Extractor>
```

And here is an example of a 2D data series, extracted as a time slice from a 3D data set

```
<Extractor>
```

```
    <DataIOFileName>1DGeometry/DirectSimData/temperature_field.d6o>/DataIOFileName>
    <CutType>TimeCut>/CutType>
    <DataFormat>DF_3D</DataFormat>
    <CutIndexT locked="no">218</CutIndexT>
</Extractor>
```

The path to the source file is relative to the session file path if the data file is located below this directory structure (recommended if you want to pass on session file and data files completely). If the data file is outside the session file directory structure, an absolute path is used.

For 2D data sets with several data series per file, the information about the contained grouped data columns is appended to the file name, for example

```
<Extractor>
    <DataIOFileName>SimQuality_Case05/results/states.tsv?1|2|12|13|14/DataIOFileName>
    <CutType>NoCut>/CutType>
    <DataFormat>DF_2D</DataFormat>
    <DataType>T_REFERENCE>/DataType
    <ColumnIndex>2</ColumnIndex>
</Extractor>
```

Here the suffix `1|2|12|13|14` indicates that from the selected file `states.tsv` the data columns 1, 2, 12, 13 and 14 are grouped (see also grouping of data records by value unit).

The XML tag `ColumnIndex` specifies the *how many* columns are to be extracted. This index is 0-based, so in the example above

Table 9. column selection for data record with grouped columns (suffix ?1|2|12|13|14)

ColumnIndex	Column in the source file
0	1
1	2
2	12
3	13
4	14

13.4.4. XML element `<ChartModel>`

This XML element describes all diagram formatting. The XML element has an important attribute `chartType`, which can be either `2D`, `3D` or `Vector`.

For 2D diagrams the `ChartModel` XML element contains series format descriptions, e.g:

```
<SeriesProperties>
    <Series>
        <TitleText>$quantity</TitleText>
        <MarkerColor>#000000</MarkerColor>
    </Series>
    <Series>
        <TitleText>$quantity</TitleText>
        <PenColor>#ff420e</PenColor>
```

```
        <MarkerColor>#ff420e</MarkerColor>
    </Series>
    .
    .
    .
</SeriesProperties>
```

There should always be as many `Series` elements as there are `Extractor` elements. If there are fewer `Series` tags, the missing definitions are filled with default values. If there are more `Series` elements than `Extractor` elements, the surplus `Series` definitions are discarded.

The format definitions are very diverse. It is helpful to configure a diagram in the interface accordingly, save the session file and then adjust it if necessary.

13.4.5. XML element `<Splitting>`

This element describes the diagram division and assignment of the diagrams to the individual diagram windows. To be able to restore the diagram division and selection of the diagrams in the individual areas when reopening a session, a corresponding data structure is stored.

Section from a session file with an example of a 4-section view

```
<!--Split window state.-->
<Splitting>
    <Widget id="1" parent="0" viewTable="0" mapperIndex="6" size1="498" size2="497" orientation="2" />
    <Widget id="2" parent="1" viewTable="0" mapperIndex="5" size1="498" size2="497" orientation="1" />
    <Widget id="3" parent="1" viewTable="0" mapperIndex="0" size1="485" size2="484" orientation="2" />
    <Widget id="4" parent="2" viewTable="0" mapperIndex="1" size1="485" size2="484" orientation="2" />
    <FocusedWidget>1</FocusedWidget>
</Splitting>
```

For each diagram window, one XML element `<Widget>` is created. The sizes specified therein are to be interpreted as *suggestions*, since the total size is limited by the current application window size, and each diagram itself requires a minimum size. The element `<FocusedWidget>` indicates which diagram window is currently active (number = WidgetID - 1).

It is important to consider the parent-child relationship. Similar to the manual splitting of diagrams, split windows are always assigned to a parent window as children. In the project file this information is stored in the attribute *parent*.

An example should clarify this. A standard session with a diagram window results in the following split data structure. The size is stored as 1x1, since the actual size of the windows depends on the application window.

```
<Splitting>
    <Widget id="1" parent="0" viewTable="0" mapperIndex="0" size1="1" size2="1" orientation="2" />
    <FocusedWidget>0</FocusedWidget>
</Splitting>
```

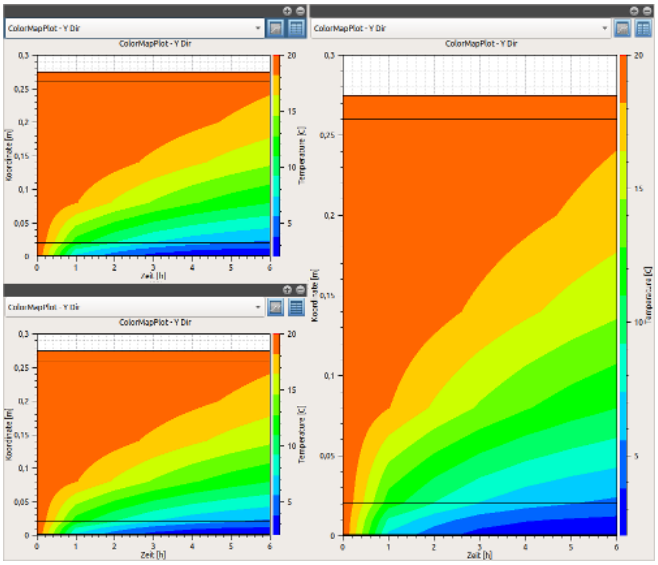
If the window is now divided vertically, the result is for example

```
<Splitting>
    <Widget id="1" parent="0" viewTable="0" mapperIndex="1" size1="498" size2="497" orientation="2" />
```

```
    <Widget id="2" parent="1" viewTable="0" mapperIndex="1" size1="498" size2="497" orientation="1" />
    <FocusedWidget>1</FocusedWidget>
</Splitting>
```

Here the 2nd widget (=diagram window) indicates that it has been divided by the parent window with ID 1 (`parent="1"`) by vertical division (`orientation="1"`).

If you now divide the left window horizontally you will get the following diagram division:



The corresponding part of the session file is:

Extract from the session file in the case of a three-part diagram screen

```
<Splitting>
    <Widget id="1" parent="0" viewTable="0" mapperIndex="1" size1="466" size2="529" orientation="2" />
    <Widget id="2" parent="1" viewTable="0" mapperIndex="1" size1="466" size2="529" orientation="1" />
    <Widget id="3" parent="1" viewTable="0" mapperIndex="1" size1="485" size2="484" orientation="2" />
    <FocusedWidget>1</FocusedWidget>
</Splitting>
```

The size specifications are to be understood as recommendations. If the program window is opened in the same size as when the session was saved, the appearance of the post-processing is restored to (almost) identical.