User Manual CHM Data Viewer

precision · passion pour la précision · pasión por la precisión · passione per la precisione · a passion for precision · passio

www.lufft.com

Lufft

an OTT HydroMet brand

OTT HydroMet Fellbach GmbH

Fellbach Office:
Gutenbergstraße 20
D-70736 Fellbach
Phone: +49 711 51822-0
Fax: +49 711 51822-41
www.lufft.com
met-info@otthydromet.com

Berlin Office:
Richard-Willstätter-Straße 14
D-12489 Berlin
Phone: +49 711 51822-831
Fax: +49 711 51822-944

Press date: 29th April 2021
Revision number: 1.6

Note

CHM Data Viewer

User Manual

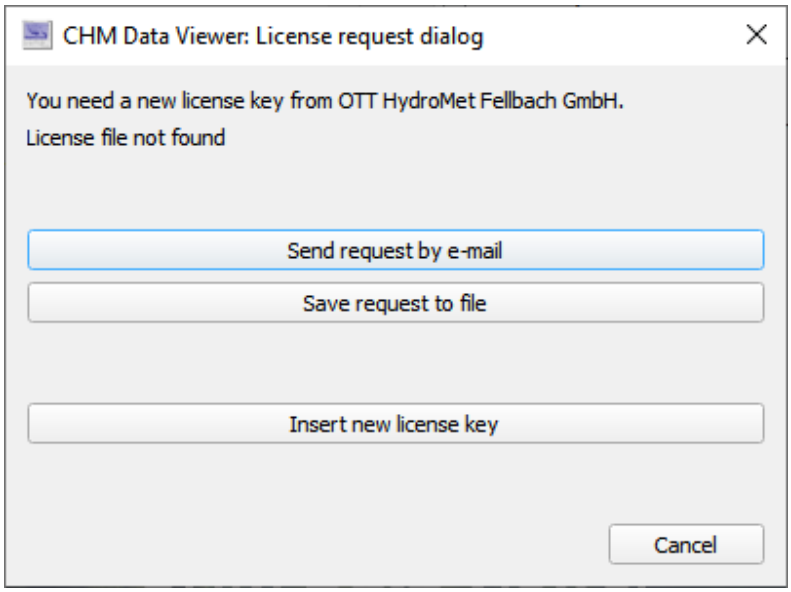
Contents

1 Installation

Unpack the `chmviewer.zip` in a folder with writing permissions for the end user. A folder `ChmDataViewer` will be created, containing the viewer executable `chmviewer.exe`.

2 First start

The CHM Data Viewer requires a valid license key issued by OTT HydroMet Fellbach GmbH. When starting the application for the first time, the `License request dialog` will open to either start a license key request or to enter an already existing key.



If you have already received a license file `chmviewer-xxxxxx.lic`, enter it under `Insert new license key` to unlock your program. If you do not have a license file, you can use the `request` fields to request a license key from OTT HydroMet Fellbach GmbH by e-mail, see section 3.

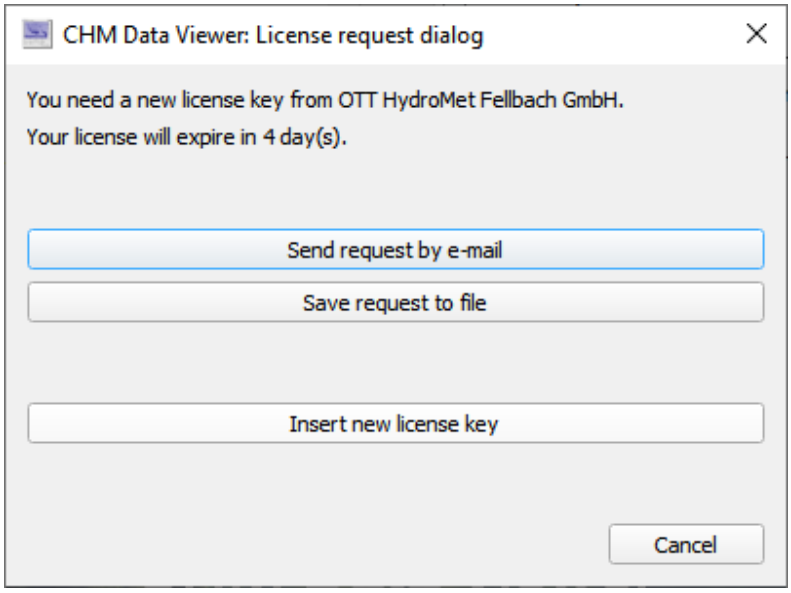
If the input is correct, the `Options dialog` opens to let you specify Overlap and NetCDF paths. The Overlap path specifies a folder containing corrective functions (`TUB*_4096.cfg`) for your laser optical units. The corrective functions of all laser optical units can share a folder. The NetCDF path specifies the default folder for the NetCDF data file selection dialog in case the program is started without a NetCDF file parameter.

After adjusting options, see 4.4.2, you can save them to avoid re-setting at each program start.

After finishing the `Options dialog` by selecting the `Ok` button, the NetCDF file selection dialog opens to let you select the NetCDF file you wish to examine in CHM Data Viewer.

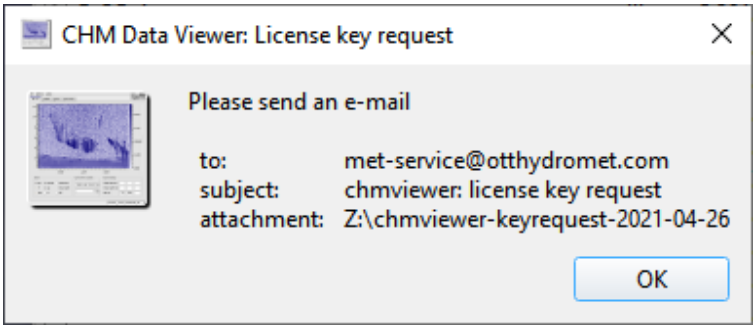
3 Extending licenses

Licenses to run the program are time-limited. Once per year you need to re-activate your license from OTT HydroMet Fellbach GmbH. The expiry date is visible in the `About license` item of the `About` menu. Beginning at 30 days before expiry, the `License request dialog` will be shown at program start. The dialog allows you to extend your license free of charge for another year.



After a license has expired, the program needs to be unlocked again to be used.

In case no e-mail application opens after using the `Send request by e-mail` button, or if the generated e-mail does not contain an attachment, please use the `Save request to file` button and send the generated file `chmviewer-keyrequest-yyyyMMdd` to the e-mail address `met-service@otthydromet.com`.



You will receive a response containing the file `chmviewer-keyanswer-yyyyMMdd`. This file can be used in the `License request dialog`, `Insert new license key` to unlock the program.

4 Program description

4.1 Command line parameters

The program can be started from a command shell using the following optional parameters:

`-c <config file>` defines a configuration file that will be used instead of the default configuration file `settings.ini`.

`-o <overlap file>` defines a alternative overlap correction function file that will be used instead of the automatically chosen overlap correction file to display the backscatter signals on the `2D Data` tab, see 4.4.2.

`<netcdf file>` defines a NetCDF file to view. This also prevents the NetCDF file selection dialog from being shown.

The CHM Data Viewer can be used to open NetCDF files in some file managers (e.g. Windows Explorer) by dragging a NetCDF file to `chmviewer.exe`.

4.2 Configuration file (`settings.ini`)

At program start, the `*.ini` configuration file passed with the `-c` command line option is read. If no such file was specified, the file `settings.ini` in the folder containing `chmviewer.exe` will be used instead. If this file does not exist, a dialog asking to specify a configuration file, or to use the Options dialog will be shown.

A valid configuration file might look as follows:

```
[file_settings]
overlap_path=C:\\Lufft\\CHM\\Overlap
netcdf_path=C:\\Lufft\\CHM\\Measure\\CHM090104\\2013\\06
time_period_in_h=48
time_tolerance_in_s=300
show_one_file=true
memory_limit_in_MB=250
collection_file=C:\\Temp\\collection.pdf

[misc]
bind_plots=true
1d_customer\size=3
1d_customer\1\nc_variable=prf_kHz
1d_customer\2\nc_variable=temp_int
1d_customer\3\nc_variable=state_optics

[plot_settings]
colormap=Custom
color_stops\1\pos=0.4
```

```
color_stops\1\color=#6f8a0e
color_stops\2\pos=1
color_stops\2\color=#aa00ff
color_stops\size=2
```

The settings in the `[plot_settings]` section relate to the colors used in the `2D-Data tab`. They can be changed and saved using the `Plot` dialog, section `Colormap`.

Most of the parameters can be changed and saved using the `Options` dialog, see 4.4.2. Others, like `collection_file`, are handled in the `Collection` dialog (Menu `File`, `Create collection...`).

Saving the settings in the `Options dialog` also saves the current `plot_settings` into the configuration file. The `colormap` setting specifies the used color palette. The `color_stops` values refer to the colors in the `Custom` color palette.

The individual settings are described in more detail in 4.4.2.

4.3 Folder structure of NetCDF files

When opening a NetCDF file a list of all NetCDF files of the same device will be created. The search will be performed recursively, with the maximum recursion depth depending on actual folder structure.

If the selected NetCDF file is located in a folder hierarchy with yearly and monthly subfolders, or only yearly subfolders, matching the patterns `path/yyyy/MM/*.nc` or `path/yyyy/*.nc`, the folder `path` and all of its subfolders will be searched for NetCDF files of the same device. In order to minimize program startup time it is advisable to keep only NetCDF files belonging to a single device under `path`.

If the folder structure does not match the mentioned patterns, only the folder containing the currently opened NetCDF file will be searched, without recursing into any subfolders.

4.4 Menu bar

4.4.1 File menu

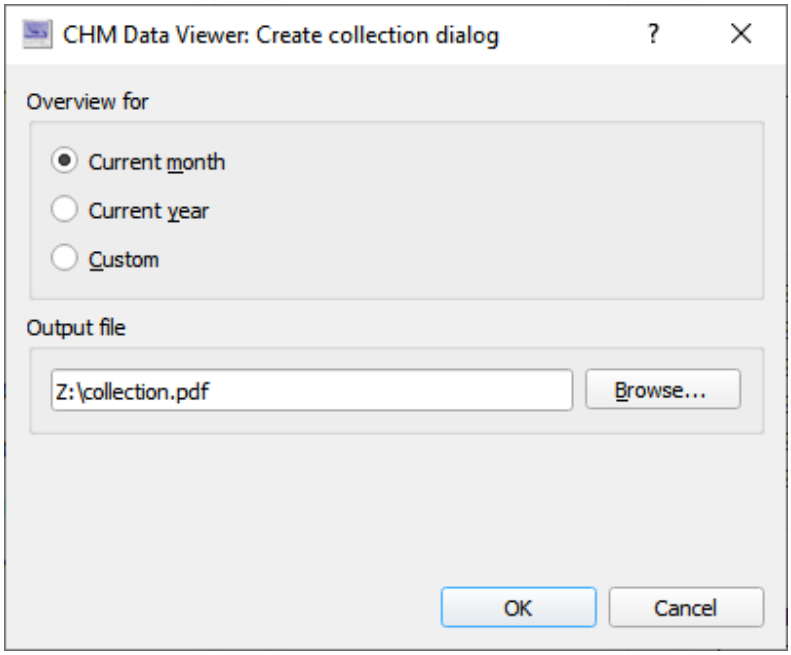
The `File menu` contains three entries.

`Open NetCDF file...` opens a new NetCDF file using a standard file selection dialog. NetCDF files of the same device located in the same path can also be opened using the combo box in the status bar, see 4.6.

`Reload NetCDF file` reads the current NetCDF file again. The records of the current NetCDF file will be removed from the memory and then re-read from the file. As a result, data which are newly added after the program start to the NetCDF file can be reloaded.

`Create collection...` opens a dialog for the creation of a PDF document with colored signal plots of selected NetCDF files. The items `Current month` and `Current year` in the dialog save all data plots belonging to the current month or year, respectively, of the current

NetCDF file. Using the `Custom button`, NetCDF files can be selected using a file dialog. The `Output file` input field specifies the name or full path of the generated PDF document.



The name of the generated output file is stored in the configuration file when saving the program settings using the `Options dialog`, and read back when reading the configuration file, see `collection_file`.

`Exit` exits the program.

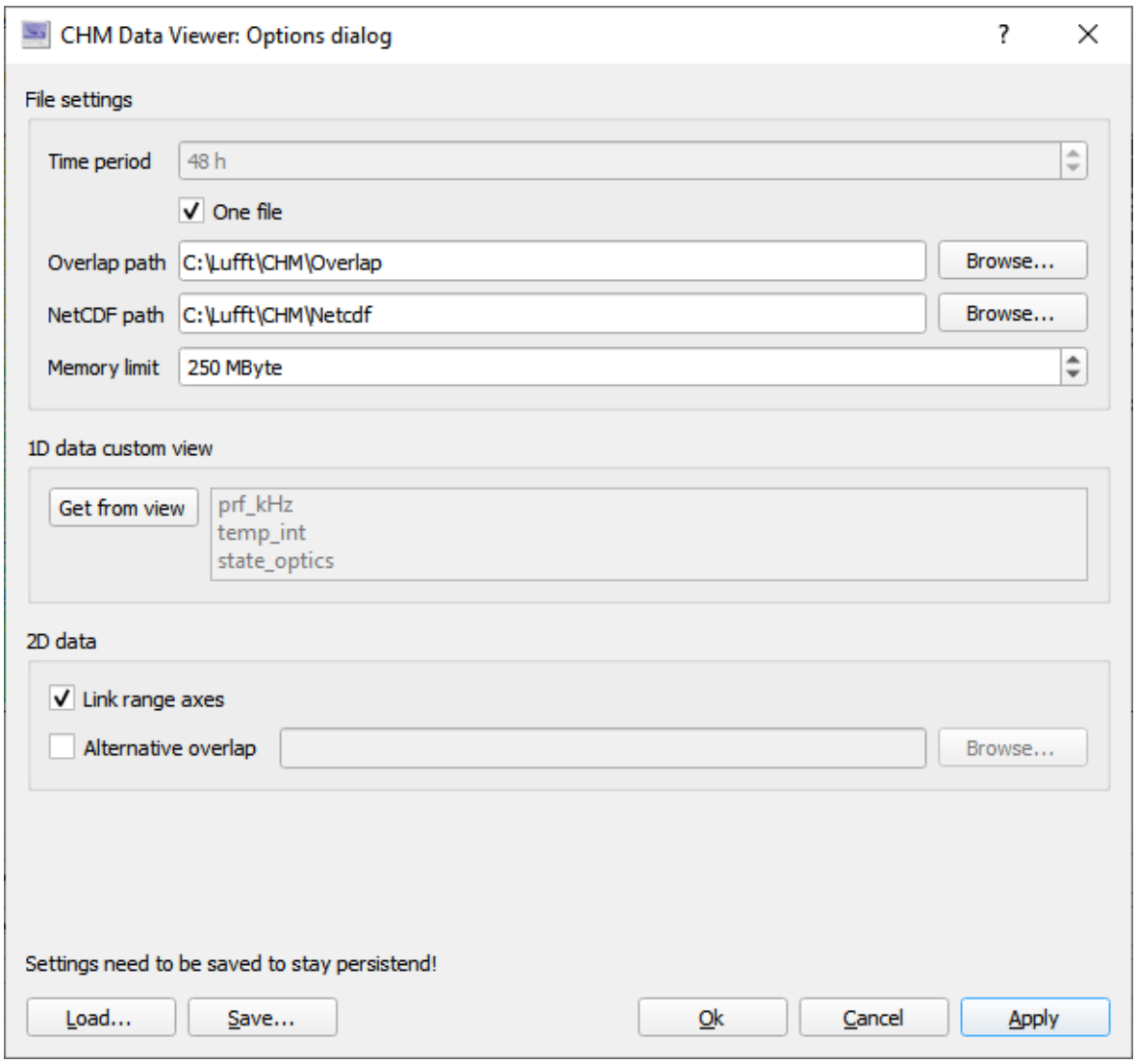
4.4.2 Options menu and Options dialog

Using the `Options menu` the `Options dialog` can be opened. In the `Options dialog` values of the current configuration file can be displayed, edited and saved or setting from other configuration files be loaded.

Time period (`time_period_in_h`) This value specifies the number of hours for which data will be examined, ranging backwards from the last entry in the selected NetCDF file, possibly restricted by the amount of the available memory.

One file (`show_one_file`) If this option is selected, only the current NetCDF file will be displayed, independent of the `time_period_in_h` setting.

Overlap path (`overlap_path`) The overlap path specifies a folder containing overlap correction function files for your laser optical units. The functions of all laser optical units can be located in the same folder. You obtain the overlap correction function files (`TUB*_4096.cfg`) for your measuring units from G. Lufft Mess- und Regeltechnik GmbH.



If for a measuring unit used in a NetCDF file no overlap correction function is available, no overlap correction/reverse correction will be performed. This is equivalent to using an overlap correction function with a constant value of 1.

NetCDF path (`netcdf_path`) If at program start no NetCDF file is given as parameter, a file selection dialog to specify a NetCDF file is opened, starting in the folder specified with `netcdf_path`.

Memory limit (`memory_limit_in_MB`) The program caches data read from the NetCDF file to allow quick switching between records. The value `memory_limit_in_MB` specifies how many MB of NetCDF data will be buffered. In case the limit reached, the least-recent used record will be dropped from the cache. This can lead to a displayed time period smaller than specified by `time_period_in_h`. Only NetCDF data is counted towards the specified limit, not memory or auxiliary data otherwise used by the program.

1D data custom view (`1d_customer`) A user defined 1D view can be shown by choosing the `Custom` entry of the combo box in the `1D Data` tab of the main window. This view allows the selection and plotting of up to five 1D data fields. The list of selected variable can be saved through the `Options Dialog` after fetching it from the view using the `Get from view` button.

Link Y axes (`bind_plots`) If this option is selected, the height axes of the colored signal plot and the profile plot in the `2D Data` tab will be kept synchronized. If the height range in one of the view is changed manually, the other is adjusted automatically such that both views always show the same height range.

Alternative overlap This field allows the specification of an file containing an overlap correction function which will be used instead of the default overlap correction function when displaying backscatter signals in the `2D Data` tab.

This option is only available when a default overlap correction function for the current NetCDF data file has been found. The default overlap correction function is selected automatically by the program, depending on the overlap_path of the measurement unit and the NetCDF file.

The alternative overlap correction function settings are not saved in the configuration file. If the program should use an alternative overlap from startup, the `-o` command line options can be used, see 4.1

When opening NetCDF files belonging to an device different to the current one, this option is will be deactivated, and needs to be re-enabled manually next time it is wanted.

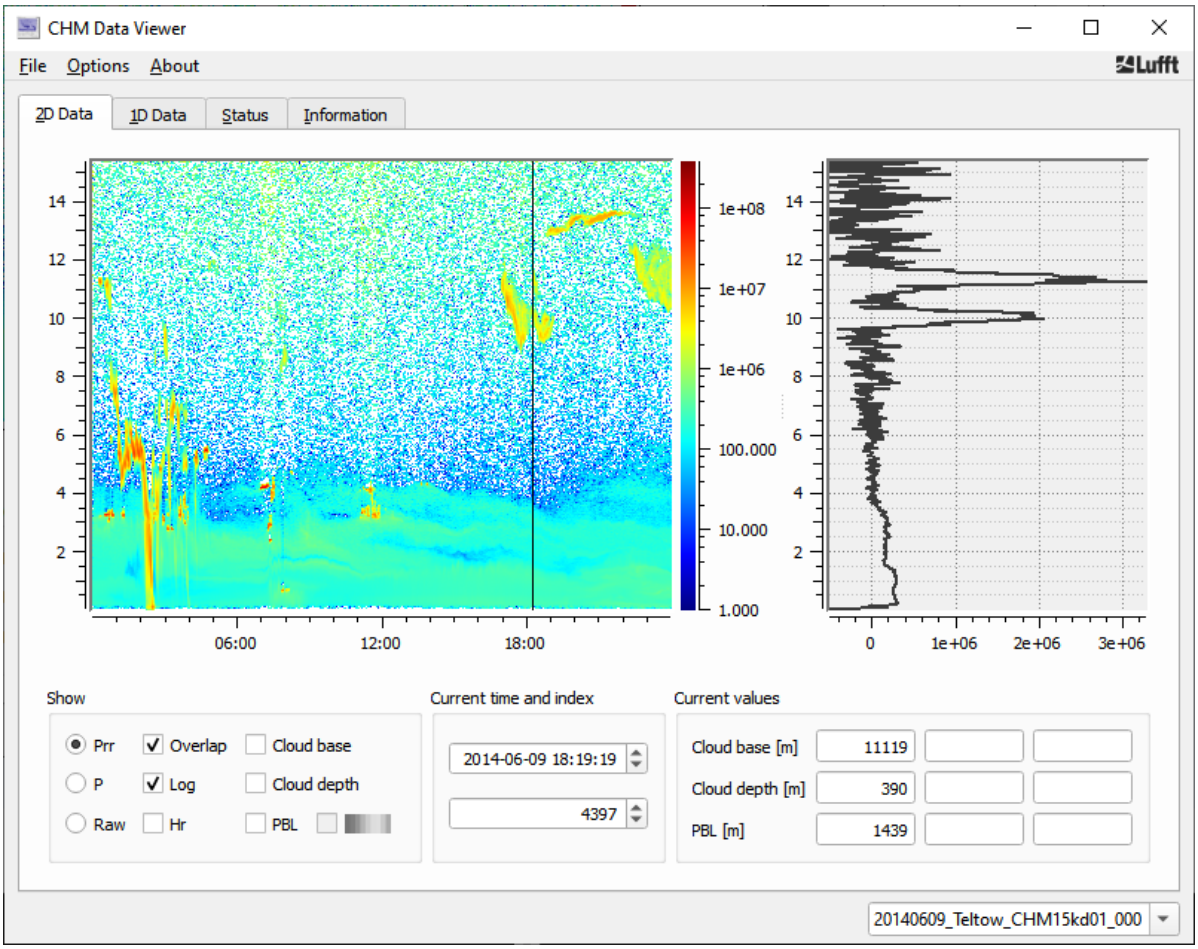
4.4.3 About menu

The `About menu` contains information about the program, the license, and the expiry date of the license.

4.5 Main window

The main window contains views in four tabs to display the measurement data and device characteristics stored in NetCDF files. The views are named `2D Data`, `1D Data`, `Status` and `Information`.

4.5.1 2D Data



The `2D Data` tab displays the backscatter signal. On the left, the signal intensity is displayed in a colored plot, ranging over time and height in km. The switches in the first column of the `Show` group control the processing level of the backscatter data.

Depending on whether the NetCDF contain the variable beta_raw or beta_att, the first button is named Prr or $\beta_{\mathtt{att}}$. If `Prr` is selected, the normalized and range-corrected signal will be displayed, if $\beta_{\mathtt{att}}$ is selected the attenuated backscatter is displayed. If `P` is selected, the normalized signal is displayed without range correction. If `Raw` is selected, the laser shot-corrected raw data is shown.

The `Overlap` switch determines whether the signal will be displayed with or without overlap correction. The `Log` switch selects a logarithmic intensity scale. The switch `log` is automatically turned off, if the to displayed signal contains no positive values. It `Hr` is selected, the

high-resolution data of the lower height interval (beta_raw_hr instead of beta_raw respectively beta_att_hr instead beta_att, available only with firmware > 0.700) will be displayed.

The plot on the right side displays the signal profile at the current time index. The time index can be changed by dragging the black line in the plot, or by double-clicking at the desired position. Alternatively, the time index can be adjusted using the input fields in the Current time and index group.

If in the Plot Dialogs of the color plot, see 4.7.1, an averaging is selected the graphics on the right hand side will contain the profile of the averaged signal.

The switches described above always affect both plots. If this is unwanted, e.g. when using the logarithmic view, the scales can be adjusted individually using the Plot Dialogs of the respective plots, see 4.7.1.

The remaining three switches in the Show group govern the visibility of the cloud bases (Cloud base), the penetration depths (Cloud depth) and the aerosol layers (PBL) in both plots. The height values of the selected items are show as horizontal lines with the width of the corresponding time entry in the colored signal plot, and as horizontal lines spanning the whole x range in the profile plot. If both cloud bases and penetration depths are selected, their values are displayed as rectangles.

In the Current values group, cloud bases, penetration depths and aerosol layers belonging to the current time index (Current time and index) are shown.

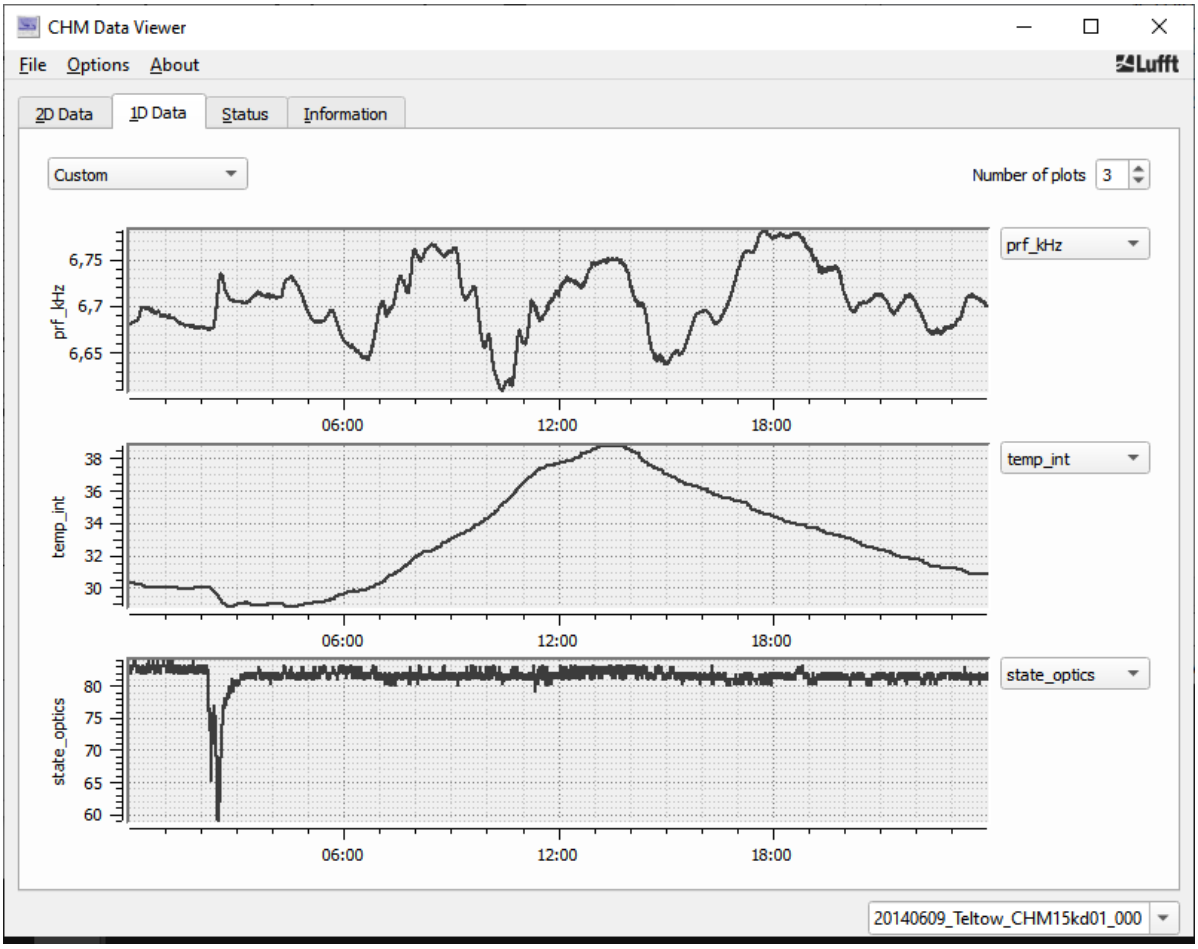
In case older NetCDF files without beta_raw_hr data are visualized, the Hr switch is deactivated. The same holds true for files without clouds or aerosol layers.

If there is no overlap correction function file for the laser optical unit found in the overlap-path, the Raw and Overlap switches are deactivated, too.

The option Link Y axes in the Options dialog controls whether the height axes of the colored signal plot and the profile plots are kept synchronized, see 4.4.2.

The height axes of the plots are determined from the range vector, the zenith angle (zenith), and the cloud height offset (cho) stored in the NetCDF file. It is not necessarily the same as the distance of the signal event from the device.

4.5.2 1D Data



The `1D Data` tab displays one-dimensional time-dependent variables from the NetCDF file. The combo box in the upper left corner selects one of the four following predefined scenarios:

Voltages (for CHM 8k only)
Visualizes the voltages variables of the NetCDF file (`voltage_dc`, `voltage_det`, `voltage_las`, `voltage_led`, `nn2`)

Temperatures
Visualizes the four temperature variables of the NetCDF file (`temp_ext`, `temp_int`, `temp_lom`, `temp_det`). In the case of the CHM 8k, `temp_las` is also specified.

States
Visualized the three quality states of the optical unit, the detector and the laser (`state_optics`, `state_detector`, `state_laser`) .

Baseline, Stddev, Pcalc
Visualizes the variables `base`, `stddev` und `p_calc`. In theCHM 8k case, instead of p_calc the variable background is displayed.

User defined
Visualizes up to five variables. The number of variables is selected in the `Number of plots`

box in the upper right corner. Next to each plot there is a combo box to select the variable visualized in the plot. Depending on the format of the read NetCDF file (CHM 8k, CHM 15k with `beta_att` format oder CHM 15k with `beta_raw` format) different variables for the graphical display are available:

`average_time`[1]	Time over which measurement data is averaged
`background_det`[3]	Background light signal of the detector in millivolts
`base`	Baseline height of the raw signal in photons per laser shot
`bcc`	Cloud amount in the lowest cloud layer
`error_ext`	Standard status bit sequence (31 bit service code)
`fan`[2,3]	Fan activity
`laser_power`[3]	Average laser power in the measurement interval in watts
`laser_pulses`	Laser pulse count during the measurement interval
`life_time`	Laser operating time in hours
`mxd`	Maximum detection range
`nn1` - `nn4`[2]	Vendor defined fields
`p_calc`[1], `p_cal`[2,3]	Calibration pulse to normalize the measuring unit over time
`p_ref`[3]	Reference pulse for normalizing the measuring unit over time
`p_window`[3]	Window reflex
`prf_kHz`	Pulse repetition frequency of the laser
`sci`	Sky condition index (precipitation, fog ...)
`state_detector`	Receiver quality in percent
`state_laser`	Laser quality in percent
`state_optics`	Quality of the optical unit in percent (glass stain)
`stddev`	Standard deviation of the raw signal in photons per laser shot
`tcc`	Total degree of coverage
`temp_det`	Receiver temperature in degree Celsius
`temp_ext`	Outer casing temperature in degree Celsius
`temp_int`	Inner casing temperature in degree Celsius
`temp_las`[3]	Temperature of the laser in degrees Celsius
`temp_lom`	Temperature of laser optical module in degree Celsius
`time`	End time of measurement (UTC)
`time_diff`	Difference between neighboring measurements in seconds
`voe`	Impreciseness of vertical visual range
`voltage_dc`[3]	Main board supply voltage in volts
`voltage_det`[3]	Detector high voltage in volts
`voltage_las`[3]	Laser bias voltage in volts

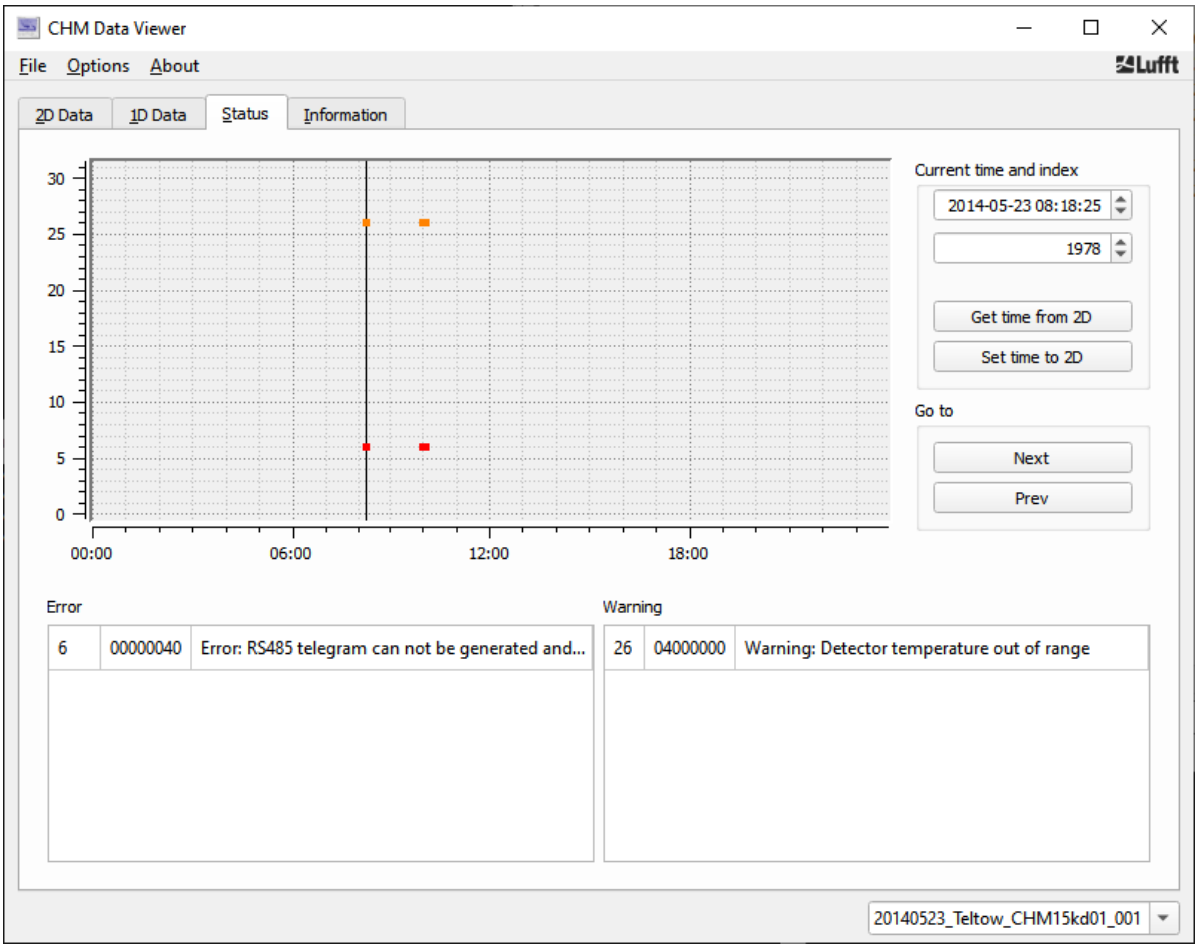
[1] only for CHM 15k with netCDF format `beta_raw`
[2] only for CHM 15k with netCDF format `beta_att`
[3] only for CHM 8k

`voltage_led`[3]	Reference LED bias voltage in volts
`vor`	Vertical visual range
`win_param`[3]	Scaling parameters for the window reflex correction

The currently active variables of the `Custom` view are listed in the `Options dialog` and can be saved to the configuration file from there.

The time axes of the visible plots are kept synchronized.

4.5.3 Status



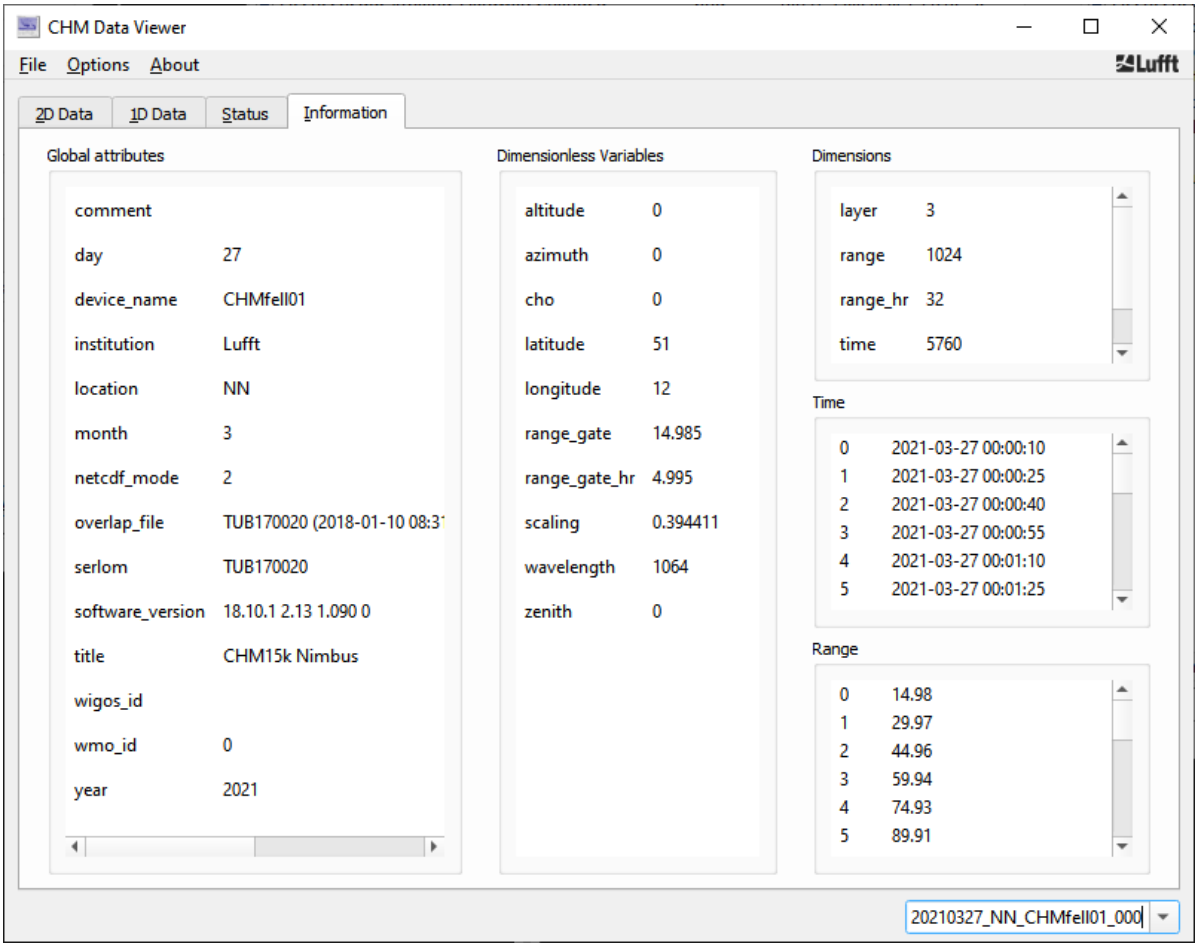
In the `Status` tab, the 31 bit status codes are visualized. In the time raster plot all bits set in the status code are shown as solid lines, error bits are red, warnings orange. The two tables in the lower part display the set error and warnings bits at the current time index, respectively. The current time index can be changed using the black link in the plot or the `Current time and index` input fields.

To examine the impact of errors on signal data, the buttons `Get time from 2D` and `Set time to 2D` can be used to copy the current time index between the Status and the 2D Data views.

[3] only for CHM 8k

The buttons in the `Go to` group can be used to navigate to the next, or previous time index with different status bit combinations. This simplifies scrolling through error events and reduces the risk to miss changes.

4.5.4 Information



The `Information tab` shows tables of global attributes, dimensionless variables, dimensions with values, and time and range vectors of the NetCDF file selected in the status bar combo box, see 4.6.

4.6 Status bar

The `Status bar` is located In the lower part of the main application window. The `Status bar` displays status messages and contains a combo box for the selection of NetCDF file. The combo box displays the name of the current Netcdf file and can be used to select one of the NetCDF files found for the device (see 4.3). Scrolling up in the box using the mouse wheel selects the previous NetCDF file from the list, scrolling down selects the next. By editing the file name in the combo box any other NetCDF file of the device can be selected.

An exclamation mark (!) displayed on the left of the combo box for the selection of the NetCDF file indicates a problem during data processing. A typical problem is a missing correction function file, resulting in reduced functionality: In the 2D Data tab the switches Raw and Overlap cannot be used, and neither the Alternative Overlap in the Options dialog.

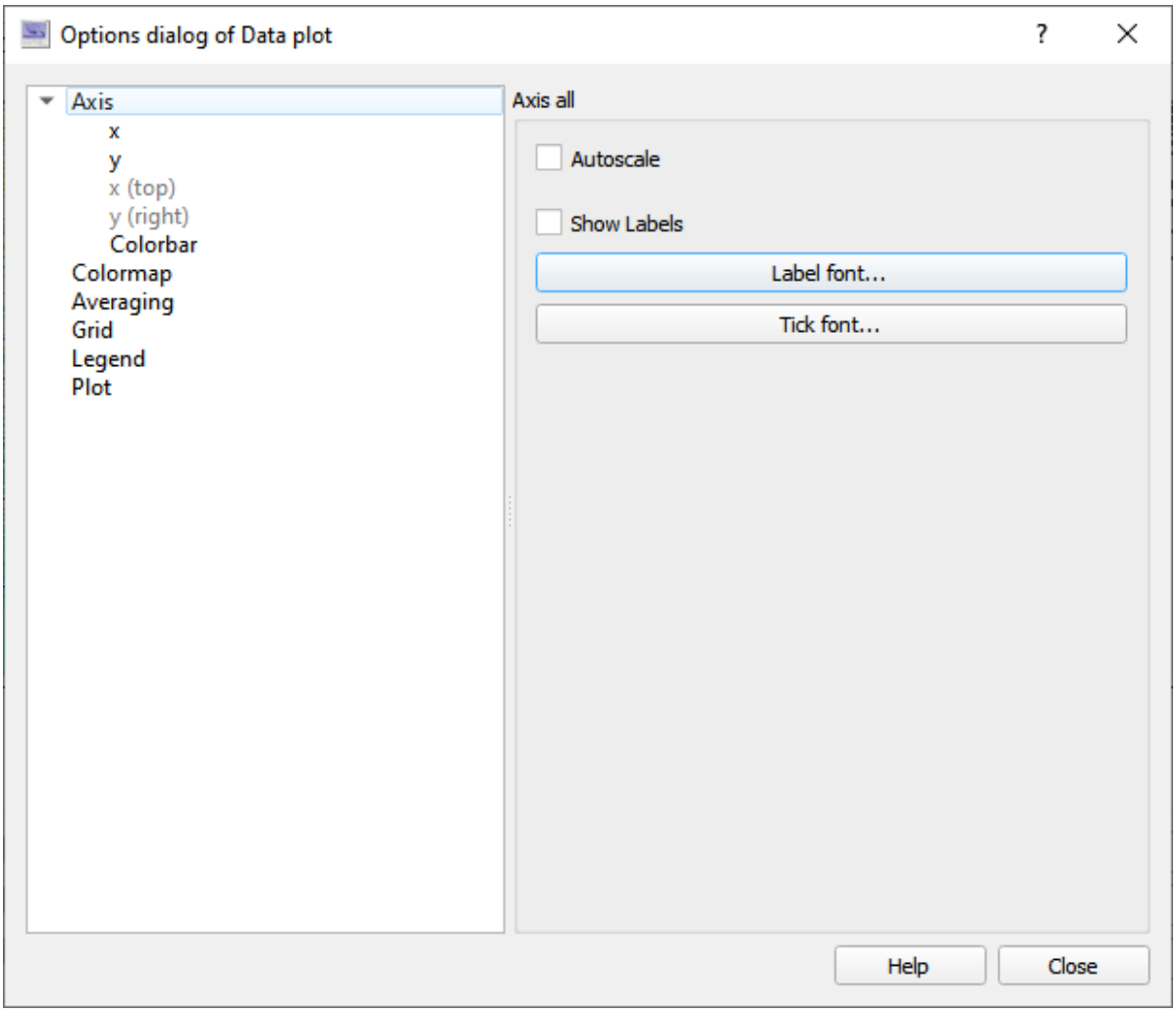
Clicking on ! opens a dialog giving more precise information on the current problem.

4.7 Data plots

All data plots in the program are interactive, allowing e.g. zooming or panning using the mouse. Each view has a `Plot dialog` to adjust axes and color palettes, to print, to save, etc.

4.7.1 Dialog

The options dialog can be opened by `Ctrl - right click` on the plot. If the mouse cursor is close to the plot axes, a simple `right click` suffices.



4.7.2 Axes area

If mouse cursor is near one of the plot axes, the following actions are available:

`right mouse button`	open plot dialog
`Ctrl - right mouse button`	open plot dialog

4.7.3 Data area

If the mouse cursor is inside the data area, the following actions are available:

`left mouse button`	**Show position, select zoom area, select index**
press	activate position display
hold and drag	update coordinates
release	start zoom area selection
press again	end zoom area selection, and zoom
click on line, drag	move index selection (optional)
double click	set index to cursor position (optional)
`right mouse button`	**Zoom**
click (while zooming)	cancel zoom area selection
click	undo one zoom step
`Shift` - click	redo one zoom step
`Alt` - click	show initial zoom area
`Ctrl` - click	open plot dialog
`middle mouse button`	**Pan**
press and drag	pan visible area
`mouse wheel`	**Zoom**
up	zoom out
down	zoom in

In case of further questions do not hesitate to contact: met-service@otthydromet.com.

a passion for precision · passion pour la précision · pasión por la precisión · passione per la precisione · a passion for

OTT HydroMet

Lufft

an OTT HydroMet brand

Subject to technical modifications