Documentation SDR_COHIWizard

Version V1.2.9 for Windows10, 2024/06/06

Hermann Scharfetter

Content

1 DOCUMENTATION

1.1 INSTALLATION

To begin, you must download the zip file 'SDRCOHIWizard_v1.2.9.zip' from the server and unzip it into a directory on your PC for which you have full access rights. This directory will be called 'root' in this documentation. After unpacking, 'root' contains the program SDR_COHIWizard_v1.2.9.exe as well as some subdirectories (directory structure see section 3.1.1) with auxiliary files (e.g. icons) and some reference station tables for the annotation of listings (e.g. MWLIST_Volltabelle.xlsx). All these directories and files must be present for the program to function. Therefore, please do not change the directory structure afterwards!

1.2 STARTING THE APP

Start the app by double-clicking on the file symbol SDR_COHIWizard_v1.2.9.exe. The program window opens on the 'Player' tab and shows an empty diagram window as well as a few control and display elements (Fig. *1-1*).
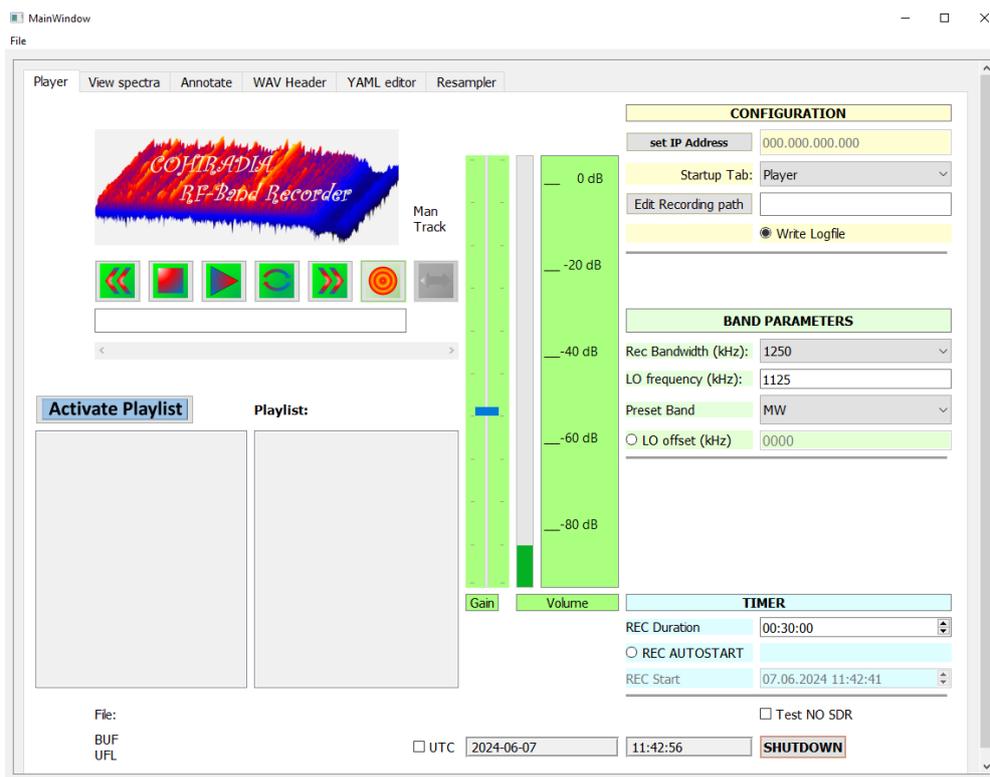
Fig. 1-1: Start view of the Player tab

Before any further action you have to open a file by clicking on the usual 'file'-menu in the left upper corner, see Fig. *1-2*. Alternatively also the shortcut 'Alt-F' can be used on the keyboard.

Fig. 1-2: Opening of a file

1.3   TAB PLAYER

This tab can be used to both play back and record signals. The controls in the recorder field are self-explanatory. The player can be used to play back IQ wav files as well as the old '*.dat' files from the early days of COHIRADIA. The recording functions allow you to record your own RF signals to IQ-wav files.

1.3.1   Player

The **Player** has the following important features (see Fig.1-3) :

(1)   After loading a file, you can use a scroll bar to jump back and forth in the file, making it very easy to locate different points in the recording.
(2)   The current time is displayed correctly in the display field above the scroll bar, corresponding to the wav header information in its time fields. However, this only works with wav files, not with '*.dat' files.
(3)   There is a logarithmic signal strength indicator, which should optimally display between 70 and 80%. If the signal is too weak (bar turns yellow), you can use the 'Gain' control to increase the gain within limits (logarithmically). If you turn up too much, clipping and intermodulation distortion will occur during playback and the bar will turn red.
(4)   You can define a playlist and thus automatically play several different recordings in a directory one after the other, even if they do not belong together.
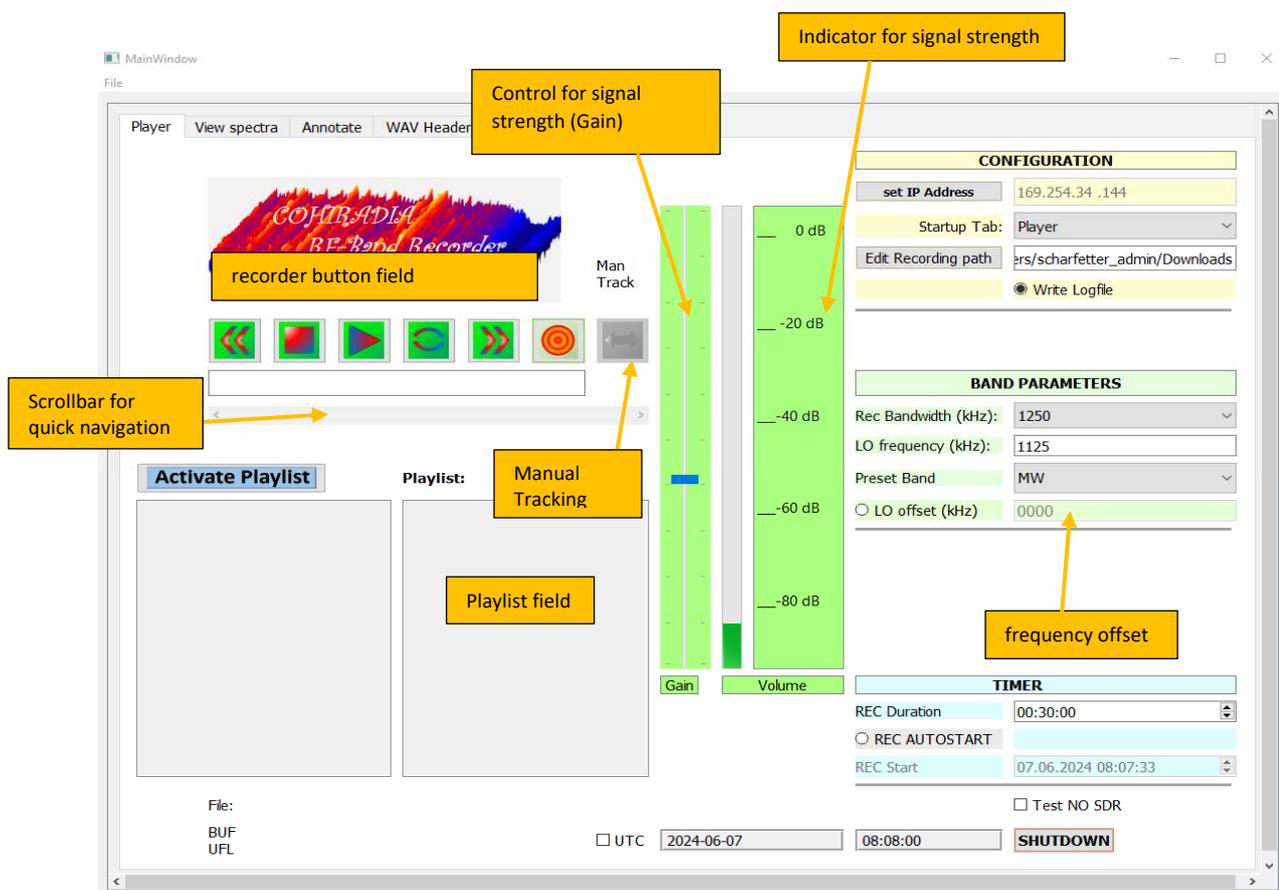
Fig. 1-3: Player and recorder

(5) The play button is a ‚Play/Pause‘ button. (see Fig. 1-4)

(6) There is a button for endless play (siehe Fig. 1-4)

(7) A tracking button allows for manual tracking in case of bit errors in the data stream
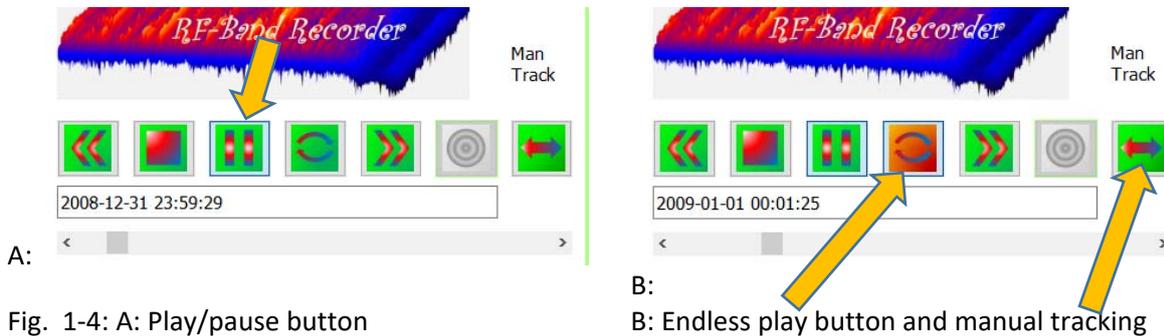
Fig. 1-4: A: Play/pause button   B: Endless play button and manual tracking

The tracking button needs a little explanation: Sometimes it can happen that during playback the stations either sound very disturbed or even just like noise. This sometimes happens due to bit errors during data transmission. The spectra can also change considerably and frequency shifts can occur. Although this can often be 'repaired' by restarting the playback, it is easier to press the tracking button 1 - 3 times. The read counter then jumps by two bytes each time and the signal can be found again.

On the right-hand side of the GUI there are three color-coded fields. In the top, ivory-colored field 'CONFIGURATION', you can change the IP address of the STEMLAB by clicking 'Set STEMLAB address', editing the address and then saving it. (Caution: If you only have to enter 2 instead of 3 digits in a field, you must explicitly delete the preconfigured 3rd digit; unfortunately, pressing 'Tab' will leave the old entries in place). There is also a drop-down menu 'Startup Tab'. If you click on it, you get a list of the currently available tabs and can select the one that should be shown when the program starts. If you mostly use the player and therefore select 'Player', the program will always start in the player view. If you select 'Resample', for example, because you resample a lot, you can set this tab as the start view.

The 'Edit Record Path' button allows you to define the path for files to be recorded. Recordings are then always saved there automatically.

There is also a radio button 'Write Logfile'. If this is activated, a debug log file is written in the background, which is useful for analyzing program errors during further development of the software. This is usually unimportant for users of the software, but can be useful for communication between users and programmers during troubleshooting procedures.

The light-green field 'BAND PARAMETERS' allows you to set a frequency offset to the LO frequency (band center frequency) for playback. This allows you, for example, to play back an LW recording with a center frequency of 180 kHz in the medium wave range of a radio by activating an offset of e.g. 920 kHz. The new center frequency is then 1100 kHz. This can sometimes be useful if the band for a particular recording is not available on a particular receiver or is defective. An activation of the offset is indicated by the input field under the radio button 'center frequency offset (kHz)' being highlighted in yellow. ATTENTION: This function does NOT affect the recorder (see next section), the LO offset is ignored during recordings.

The playlist is located on the left below the recorder button field. It is inactive by default, but can be activated by pressing the 'Activate Playlist' button. You can then drag and drop individual files from the list into the 'Playlist' field. If you then press the play button, the playlist will be played. If you have also activated the 'Autorepeat' button, the playlist has priority over the repeat function, i.e. it is only repeated after the list has been played.

However, if files are selected that have a successor file entered in the 'nextfile' header (typically for series of 2GB files from a longer recording), then this file series is played with priority before skipping to the next file in the playlist. An autorepeat is also subordinate to this automatic function. The order is always:

- Play all files of a series of related recordings

- Play the playlist

- Then return to the beginning with autorepeat

Automatic playback of a contiguous series also takes place if only one file in the series is selected and the playlist is not activated at all.

1.3.2   Recorder
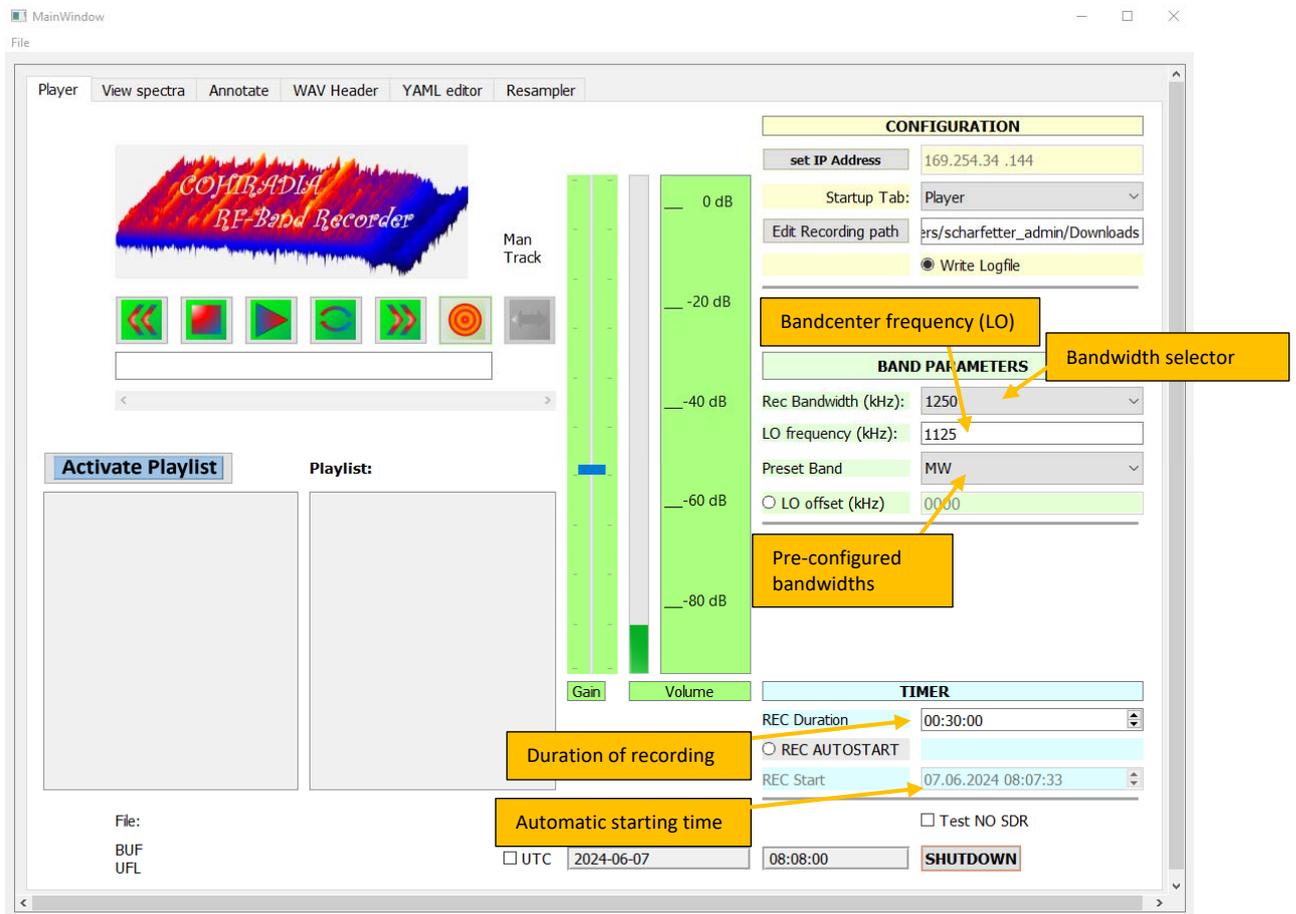
Fig. 1-5: Recorder and timer functions

You can start your own recording by pressing the orange-red Rec button in the player button field. The recording only runs for a certain amount of time to prevent unintentional overflowing of the storage medium. This time is set in the light-blue 'TIMER' field at the bottom right (see Fig. 1-5). The default setting is 30 minutes, which must be adjusted for your own purposes. The desired recording duration must be entered in the format hh:mm:ss. Every recording, regardless of whether it is started manually or automatically by timer, ends after this time.

It should be noted here that recordings require a lot of memory, namely

Memory requirement (bytes) = 4 x bandwidth (Hz) x time (s).

For 30 minutes of MW recording you typically need 1250000 x 4 x 1800 = 9,000,000,000 bytes = 9 GBytes!

The other buttons in the 'TIMER' field allow you to set a time for automatic recording. If you activate the radio button 'REC Autostart', the 'REC Start' field is highlighted in yellow and activated. A time is automatically entered there that is 15 minutes after the current system time. You now have 15 minutes to enter the desired recording time in the 'REC Start' field. However, the entire date must be set correctly in the form DD:MM:YYYY hh:mm:ss. Recording will then start automatically at the set time. Until then, a countdown will run in the time display field below the player button group (see Fig. 1-6).
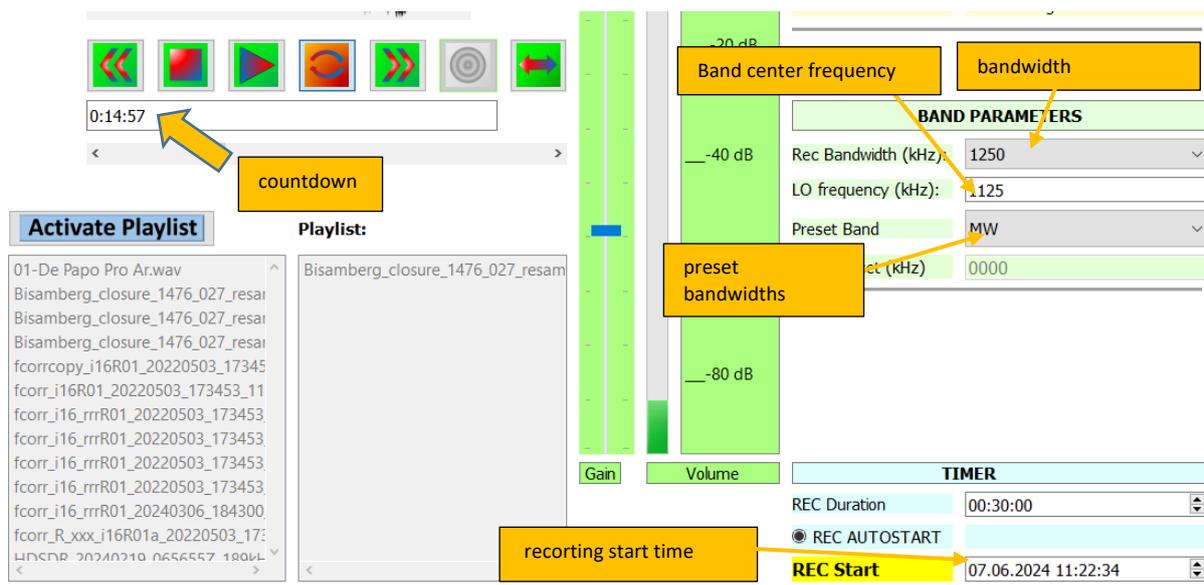
Fig. 1-6: Setting the parameters and the starting time for the recording.

The green 'Band Parameters' field allows you to set the recording parameters for recordings. These are the bandwidth (20 to 2500 MHz for STEMLAB) and the band center frequency (LO or Local Oscillator) in kHz. The 'Preset Band' option allows you to conveniently select a number of preconfigured AM bands with their characteristic settings for bandwidth and center frequency.

During a recording, the logarithmic 'Volume' display serves as an indicator for the level of the STEMLAB. You should select the input signal level so that you do not overdrive under any circumstances, but also make good use of the SDR's dynamic range. A level of up to max. -15dB (volts), preferably -20dB, but preferably not below -40dB, has proven to provide good intermodulation resistance. The 'Gain' control is not available for recordings, as the STEMLAB has no adjustable preamplifier. Suitable preamplifiers are therefore required for recordings from an antenna.

1.3.3 Special functions

Below the timer field there is the special function 'Test NO SDR', which you may tick for test purposes if you want to test the player without having an SDR connected. This function is normally only required when developing programs and is therefore of no interest to most users.

In the bottom line of the GUI there are the time display elements on the right with the option to switch the displayed time to UTC and the shutdown button. It is recommended to shut down STEMLAB's LINUX at the end of a session by pressing that button before turning off the power; you will receive a pop-up message as soon as the system is ready to be switched off.

1.4 TAB 'VIEW SPECTRA': VISUAL SIGNAL CHECK OF RECORDINGS

In the 'View Spectra' tab, you can scan through the recording with a scroll bar and display the spectrum at different points in time. To do this, a wav file with the SDRUno format (SDR standard IQ data file) or a raw STEMLAB 'dat' file (headerless raw IQ file) must have been opened. The file name is displayed at the bottom of the window. The spectrum is updated at the corresponding time point when the scroll bar button is released. As shown in *Fig. 1-7*, you can zoom in via the tool bar above the graphic (magnifying glass), zoom/pan with the mouse buttons (cross symbol for pan/zoom) and change some graphic properties. It is also possible to save the graphic in a separate file.
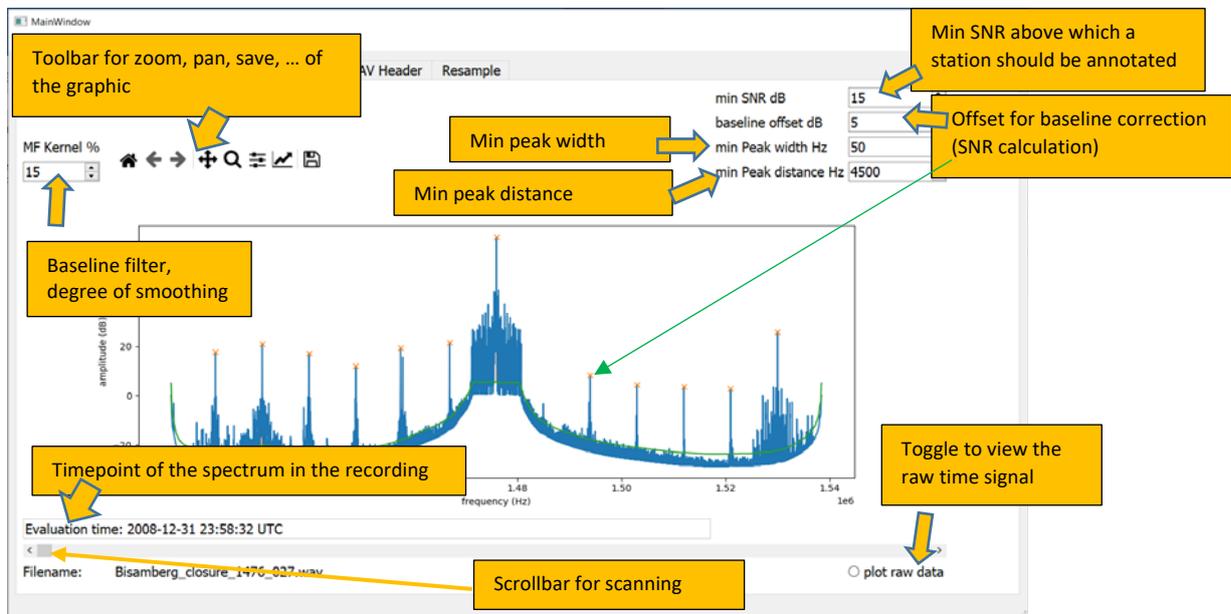
Fig. 1-7: Viewing the spectrum of a recording.

The time point of the spectrum is displayed in the gray field below the graphic in UTC, but is only correct in absolute terms if it stems from a wav file. For dat files, only the time difference relative to the start is displayed.

If you move the mouse pointer over individual peaks of the spectrum, the coordinates of the mouse pointer are displayed so that you can roughly 'measure' the spectrum. With the scroll bar above the 'Filename' display field you can scan through the recording, but you have to use the button of the scroll bar, clicking on > or < unfortunately does not work (at present).

The two spin boxes 'min SNR' and 'baseline offset' are not yet of central importance in this window, but are important later if you wish to annotate the file. The 'SNR' value is calculated automatically as the difference between a carrier peak and the green baseline drawn in the spectrum, as shown in Fig. 1-9. The values should therefore already be set here: 'baseline offset' can be used to shift the green baseline up/down if it does not fit well (see Fig. 1-8). You can use the arrow keys on the spin boxes to

jump in 5 dB steps; for intermediate values, you must enter the corresponding numbers in the number field.
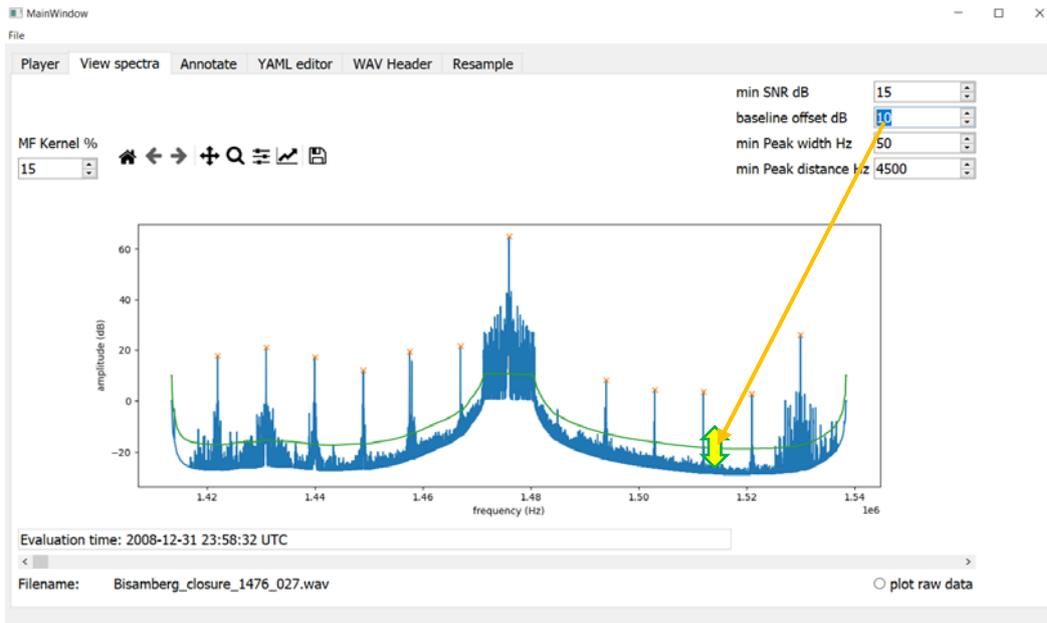
Fig. 1-8: Shifting the baseline for the SNR calculation.
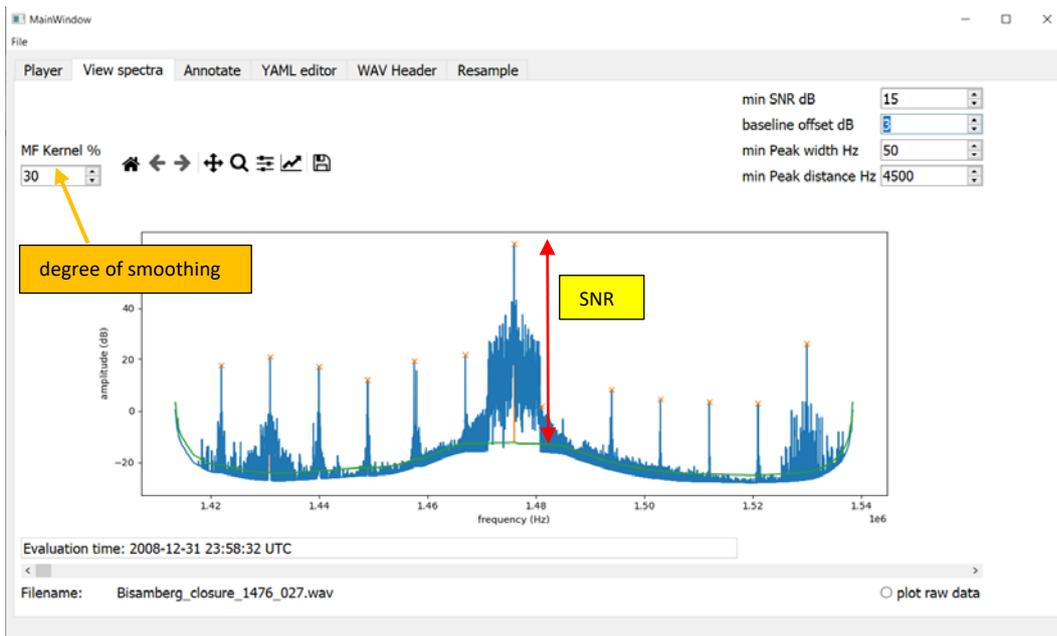
Fig. 1-9 Changed filter kernel (baseline smoothing), changed baseline, Definition of 'SNR'

The first suggestion for the baseline is determined from the spectrum using a smoothing filter. Ideally, the line should represent the noise level, but depending on the data set loaded, it may be slightly too high or too low and/or follow the peaks too closely, as in Fig. 1-8. In this case, it can be shifted up and down with 'baseline offset' and the degree of smoothing can be adjusted with 'MF-kernel'. The comparison is shown in Fig. 1-8 and Fig. 1-9.

In the 'min SNR' spin box, set the threshold value above which a peak is to be identified as a transmitter during annotation. IMPORTANT: Peaks below this value are ignored by the annotation tool.

The two spin boxes 'min Peak width' and 'min Peak distance' define the minimum width and the minimum distance to the neighbors a peak should have. However, values below 1 Hz and 100 Hz, respectively, cannot be set. The default settings are 50 Hz and 4500. This means that long-wave, medium-wave and short-wave radio patterns can normally be covered without any problems. Each time one of these two values is changed, the graphic is updated so that you can see what effect the setting has on peak detection: Peaks recognized as valid are marked with an orange cross.
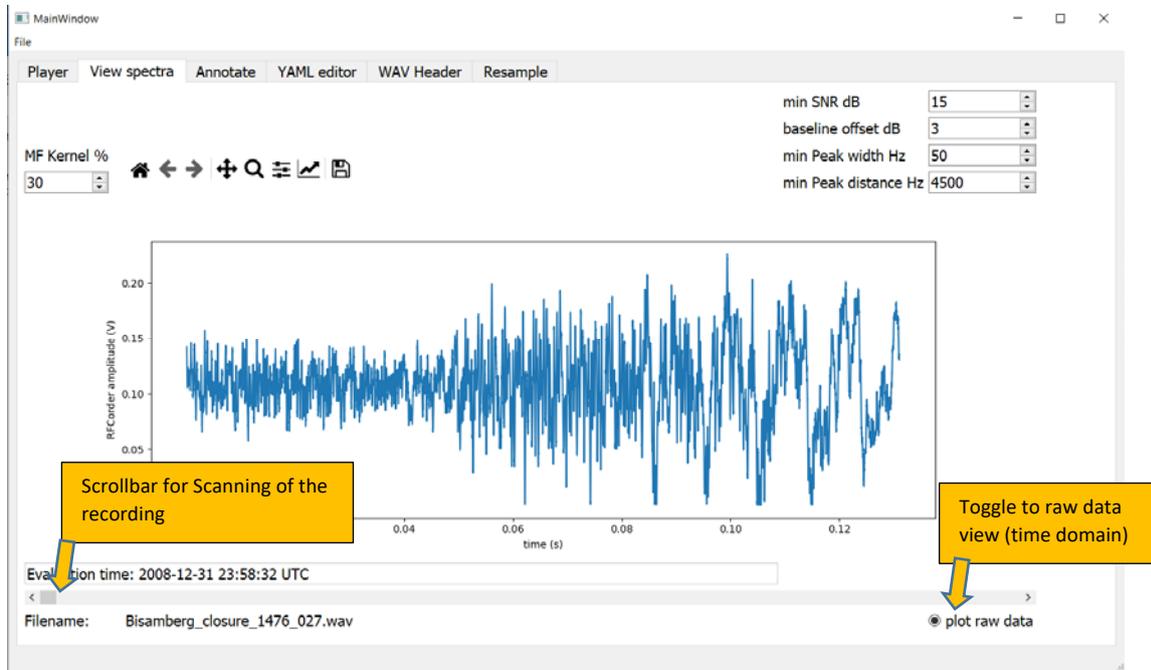
Fig. 1-10: Display of raw data.

If the radio button 'plot raw data' is activated, a section of the time signal is displayed, as shown in Fig. 1-10. This view is used to check for any clipping effects (if the signal exceeds the value 1) or, conversely, whether the signal is very weak and should possibly be amplified. This post-amplification can be of interest in the case of resampling, for example, and can be checked here.

The scroll bar below the window 'evaluation time' is also used in this mode to 'jump' through the recording, allowing you to scan through the file over time.

Please note: If the 'Manual Gain (dB)' field in the 'Resample' tab (see section 1.8) is set to a value other than zero, the spectrum shifts up or down on the ordinate axis. If the raw data is displayed, its amplitude increases/decreases according to the set gain. This function is used for level control when resampling.

1.5   TAB ‚ANNOTATE': IDENTIFICATION OF STATIONS AND ANNOTATION

After loading a file, you can automatically search for AM-carriers here and assign information on the corresponding stations to the peaks. The control elements of this tab are only enabled if a valid wav file has been loaded and the annotation for this file has not already been completed at an earlier time. Fig. 1-11 shows the operating window with some important setting elements.
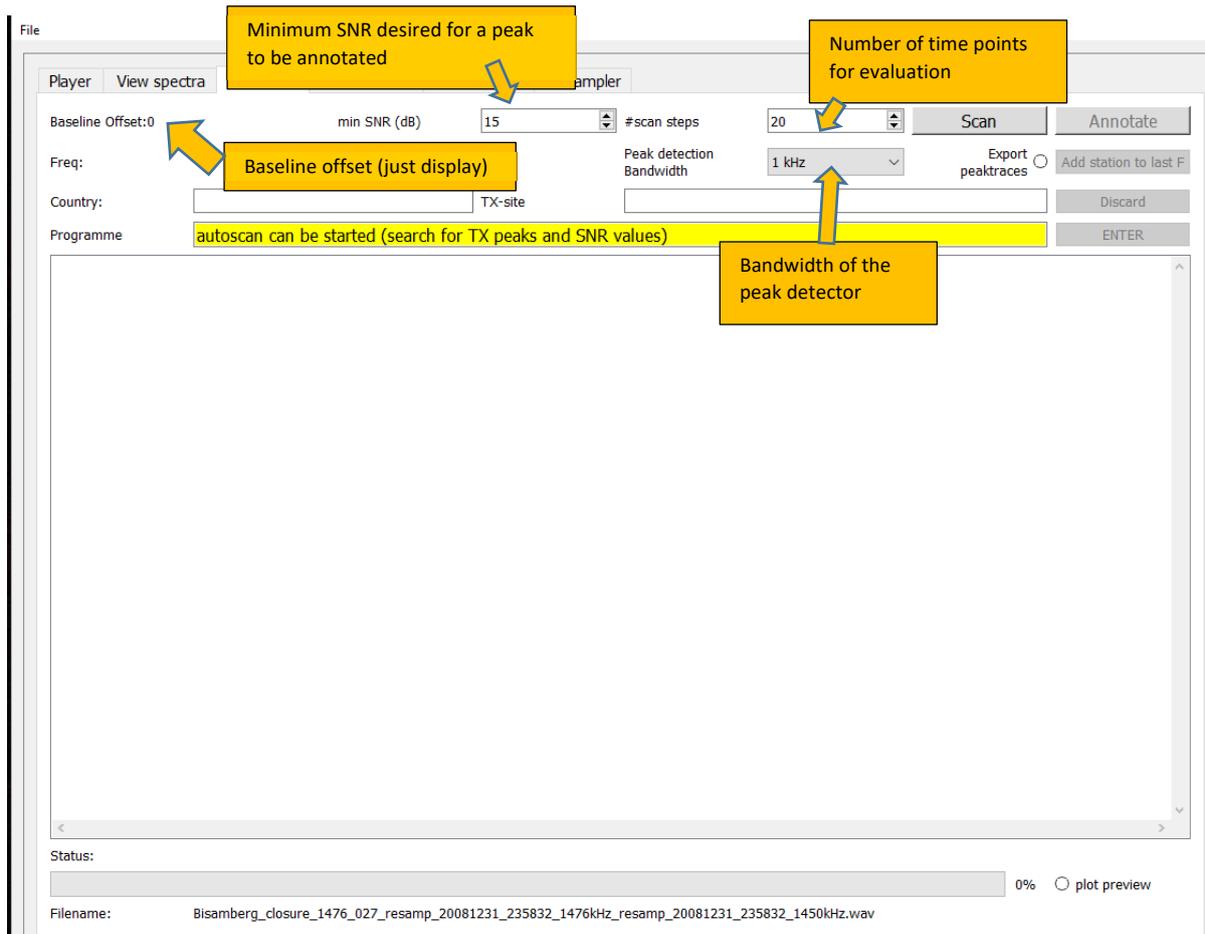
Fig. 1-11: Tab ‚Annotation' with the elements for setting relevant parameters.

Before annotating, you should check the values of the two spin boxes 'min SNR' and '#scan steps' and adjust them if necessary. 'min SNR' has the same function as in the 'Scanner'-tab, so can be set here as there. '#scan steps' determines the number of (equally spaced) points in time at which the recording is to be evaluated with regard to carrier peaks; the default setting is 20 points. The baseline offset is only displayed here. If you have not already done so, you should check in the 'Scanner'-tab whether the baseline is set satisfactorily (see notes in section 1.4). The evaluation is carried out in such a way that peaks that reach the minimum SNR (here 15dB) at least once at the selected times are considered valid. **IMPORTANT:** The SNR for the entry in the annotation yaml file is averaged over all evaluation time points in the current version.

Programmer's note: If this is not considered adequate, it may be changed in future versions, a selection option is also conceivable in principle, e.g. 'max SNR', 'min SNR' etc.). For helpful hints please contact the author.

The spin box 'Peak Detection Bandwidth' defines the resolution with which separate peaks are detected. The default setting here is 1 kHz, which is practically always suitable for the annotation of radio stations on MW and LW, as the frequencies are integer kHz values. However, if you want to annotate e.g. time signal stations or even peaks in the VLF band, the transmission frequencies are often not integer in kHz, but e.g. 129.1 or similar. The value would then be rounded to the nearest whole kHz value, which leads to incorrect entries (you would then have to edit the yaml files manually). If you

want to prevent this, you can also set 100Hz or even 10 Hz, which leads to a correct display up to the first or second decimal place of the kHz specification.

WARNING: The options for 10 and 100 Hz have not yet been tested excessively, so they may still lead to unexpected SNR values. These settings should be regarded as experimental and hence be used with care.

Now you should also specify whether you would like to see brief plots of the spectra at the scan times during the scan. To do this, you can activate the radio button 'plot preview' at the bottom right of the window. This function only serves for diagnostic purposes and is hence switched off by default to enable faster scans.

For advanced users, the 'Export peaktraces' function is also available. This allows the amplitudes of the carriers found at the set times to be output to an Excel '.xlsx' file. This is an experimental and not extensively tested additional function that is not relevant for most users and is therefore not documented in detail.

The annotation itself takes place in 2 major steps:

1.5.1 Step 1: ‚Scan': Automatic identification of carrier peaks

As soon as you press the 'Scan' button, the program runs through the recording with the number of set steps and identifies the peaks. The progress is indicated by the status bar.

A file dialog window then opens and asks which reference station list you would like to use. If you have already annotated once, the last list used is automatically pre-selected by default. You can now select from a list of existing *.xmls files as shown in Fig. 1-12. Currently, only a European/African list is fully available, experimentally also one for New Zealand and surroundings and one for USA. These lists are supplied together with the installation files.
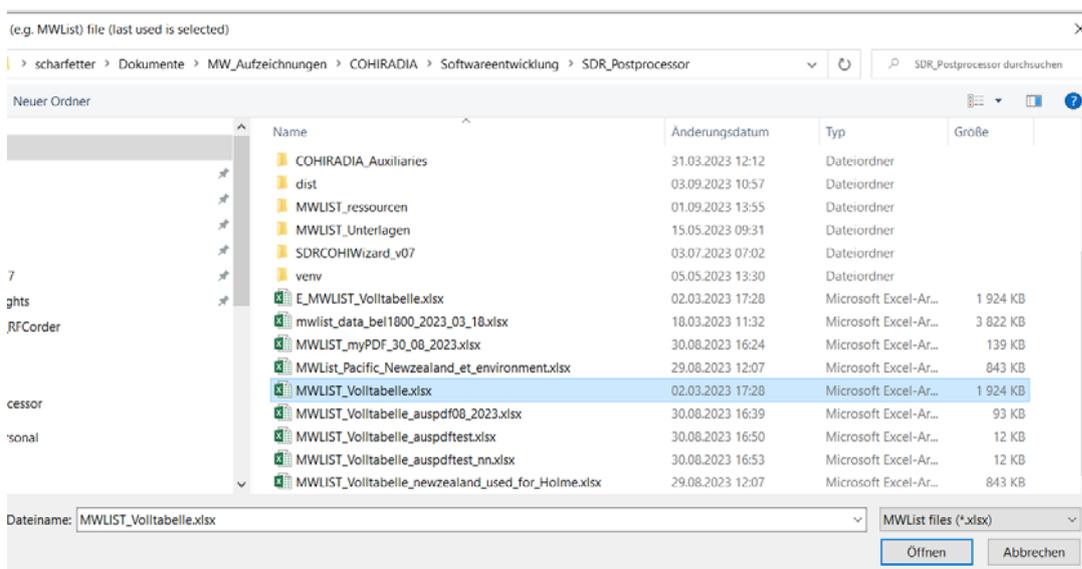
Fig. 1-12: Quest for choosing a stations list

After selection and confirmation, the reference station list is read and then the candidate stations for each carrier peak are saved in an auxiliary file (this file can be found in the

root/ANN_[filename]/stations_list.yaml folder, if you are interested). As soon as this process is accomplished, the line 'Programme' turns yellow and displays the information 'autoscan has been completed, peaks and SNRs identified' (see Fig. 1-13). Furthermore, the 'Scan' button turns green and the 'Annotate' button is enabled.
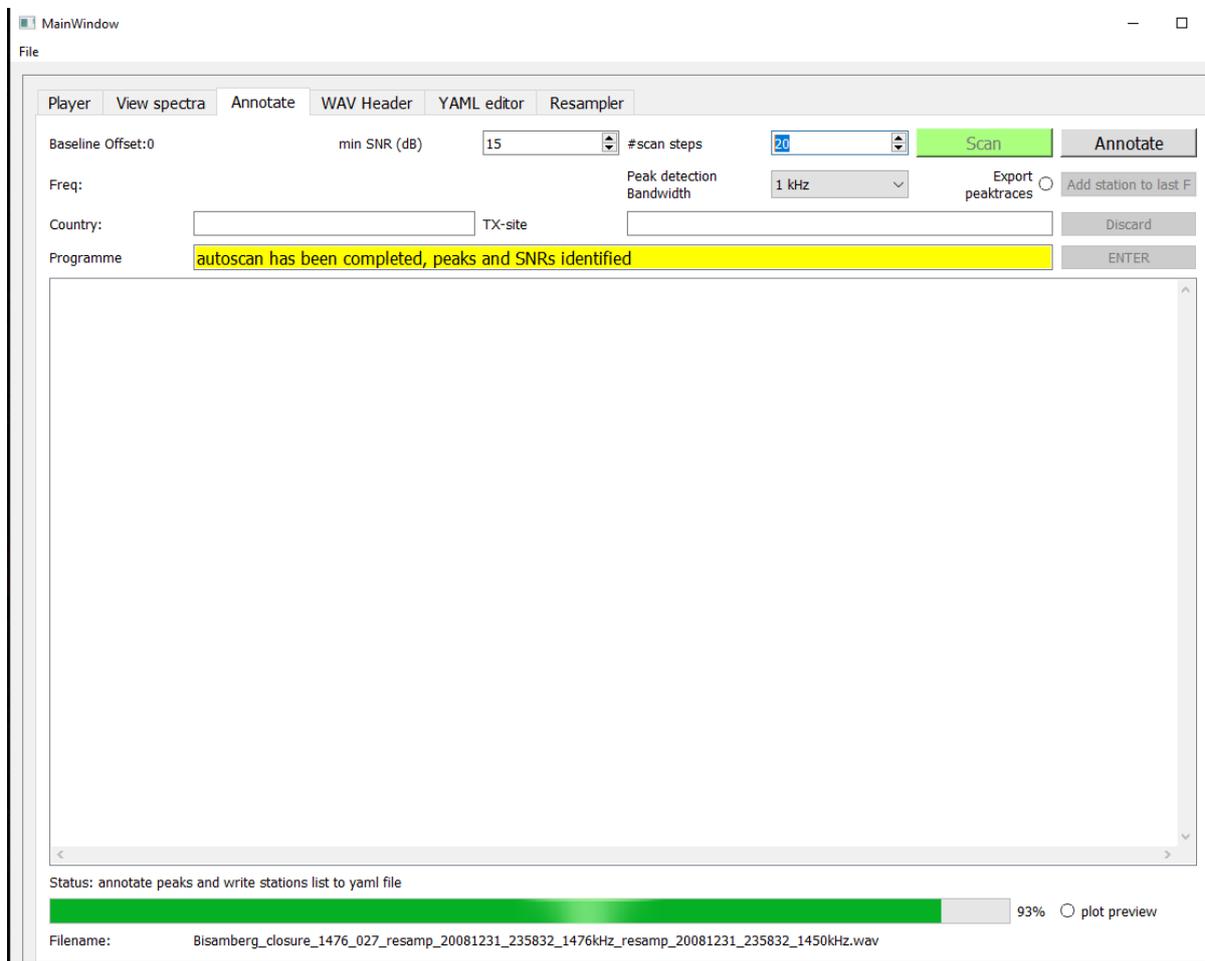
Fig. 1-13: Status after generation of the candidate station's list.

Please note: If you exit the selection of the reference station list file by clicking 'Cancel', you cannot continue with the annotation. You must reload the recording file (File open) and restart the annotation.

1.5.2   Step 2: ‚Annotate': Assignment of the correct stations

If you click on 'Annotate', the list of candidate stations for the next peak that has not yet been annotated is displayed. Ideally, it should look like Fig. 1-14.
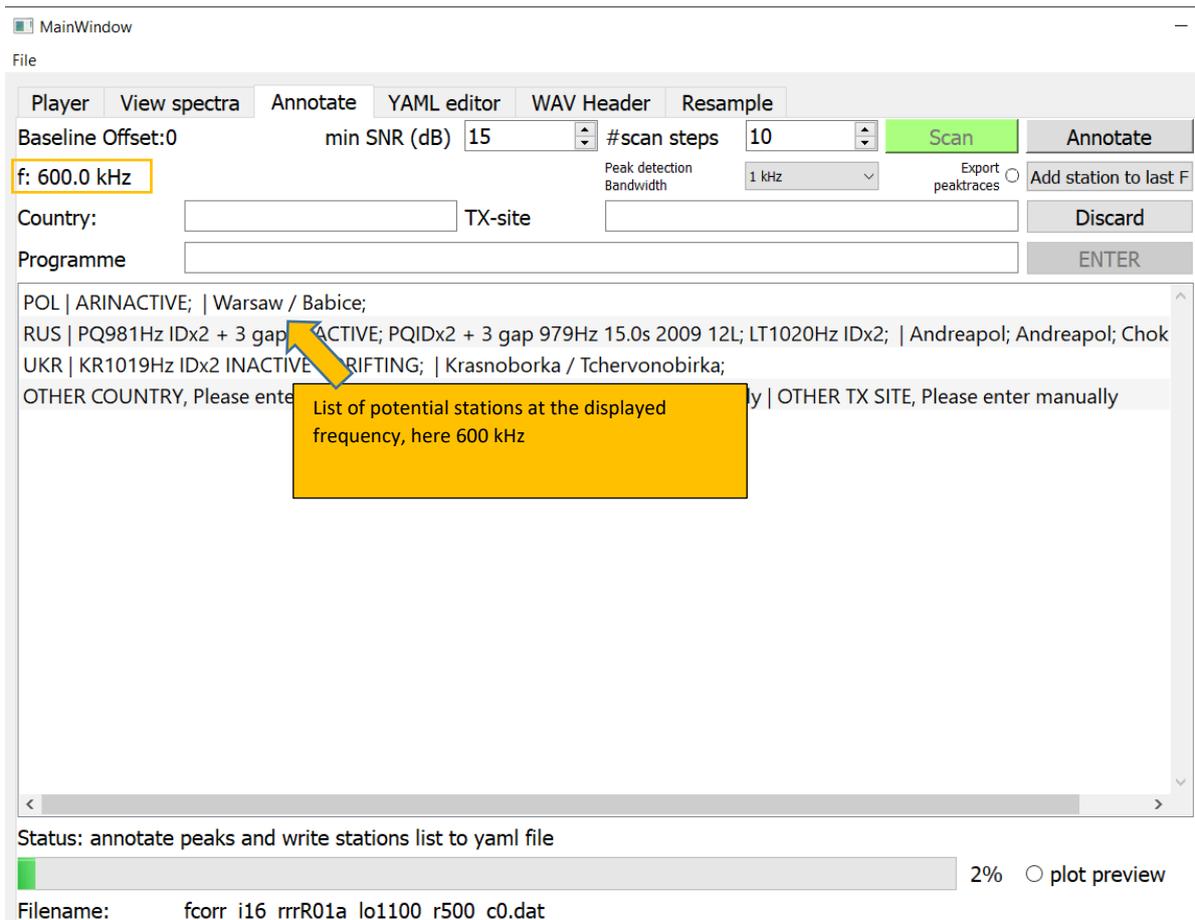
Fig. 1-14: List of the recommended stations at the displayed frequency

However, if no entry was found in the list of stations for the displayed frequency, only a line with 'not identified | not identified | not identified' appears, see Fig. 1-15. An annotation must be entered manually in the yaml file if it is a known signal.

Fig. 1-15: Display of a unidentified carrier

If one of the displayed stations is correct, you can click on it to select it. The name of the selected station, the country and the transmitter site are now shown in the display fields within the orange marked area in Fig. 1-16, next to the frequency. The texts in these display fields can be edited (often the suggestions are still in a very rough form, possibly even incorrect), see Fig. 1-17. If you cannot find the actual station in the list, you can select the last option offered, 'OTHER COUNTRY', and then edit the entries manually with the correct details.

If you have clicked on the wrong station by mistake, you can reselect it at any time. If you do not want to accept a frequency at all (e. g. because you know that there is no carrier), you can click on the 'Discard' button without selecting one of the stations offered. Otherwise, confirm the entry with 'Enter' and it will be transferred to the yaml file. This can be done either by clicking on the button or by pressing the 'Enter' key on the PC. The program then jumps to the next peak. Alternatively, 'Discard' can also be triggered by the shortcut 'Alt →' (Alt - arrow key on the right).

Another feature is the 'Add station to last F' button. As it can happen that two stations transmitting on the same frequency appear at the same time (because both can be received at the recording site), i.e. they overlap, you can create a second entry on the same frequency. To do this, after entering the first station and then pressing 'Enter', press the 'Add station to last F' button. The annotator then jumps back to the frequency just used and allows a further entry. This can be repeated as often as required. The button can also be triggered with the shortcut 'Alt ←' ('Alt - left arrow key')
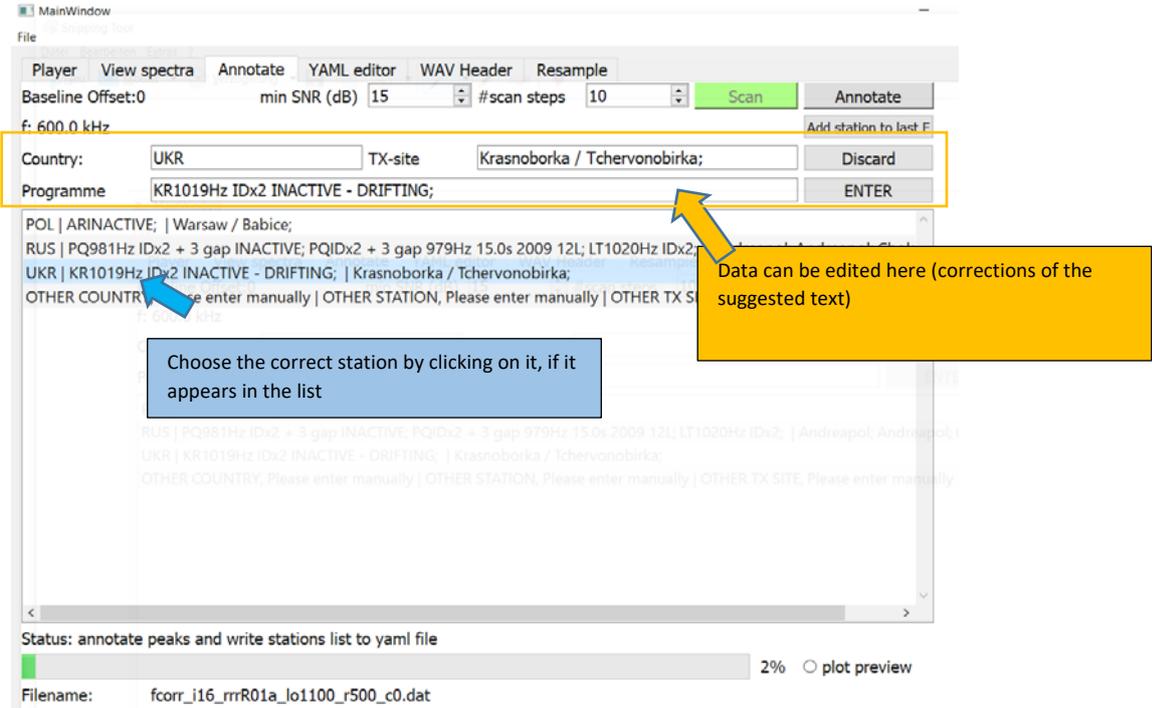
Fig. 1-16: Selection of a station name from the offered list of candidates.
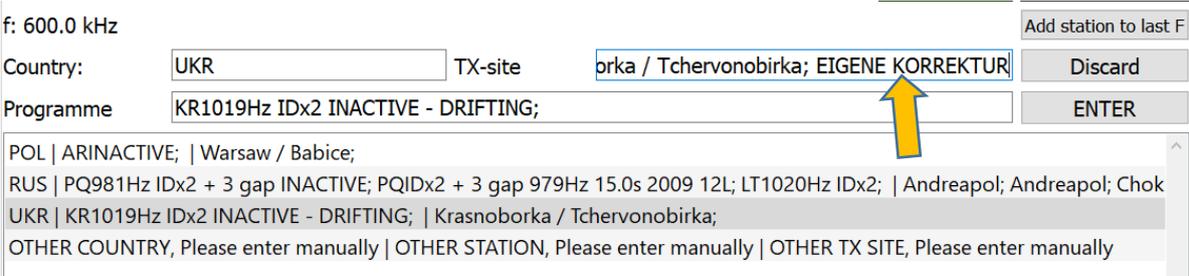
Fig. 1-17: Annotation after editing. In this example the text ‚EIGENE KORREKTUR' has been added.

Important remark: *The automatically suggested stations may well contain unwanted text or even be incorrect. You should therefore always check the information by listening to the recorded stations. The information comes from tables that were exported manually from 'mwlist.org' in 2022 and may no longer be up to date. In principle, each of the lists can also be corrected by the user if necessary by editing the Excel file.*

When you have finished annotating the entire frequency list (status is displayed on the status bar), the following is highlighted in yellow in the line next to the frequency: 'Record has already been annotated. For re-annotation delete annotation folder', see Fig. 1-18. The 'Scan', 'Annotate', 'Enter' and 'Discard' buttons are deactivated. 'Scan' and 'Annotate' now both appear green.
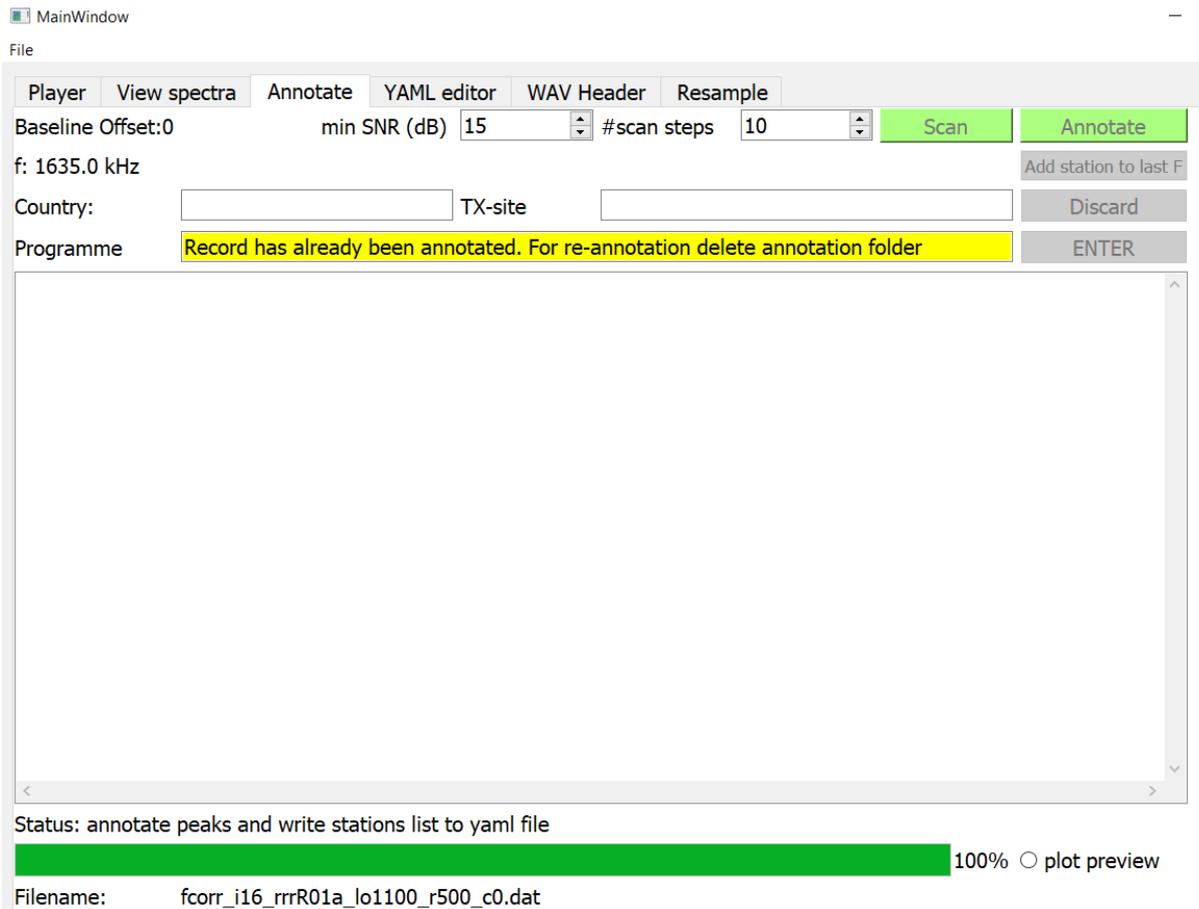
Fig. 1-18: Annotator view after accomplished annotation.

If you are not finished with the annotation in one session, you can close the program at any time and continue at another time. The program remembers the point at which you interrupted and continues from there after restarting.

Hint for experienced users: Unfortunately, there is currently no built-in function that allows you to jump backwards in the list that has already been created, except for a single frequency for double annotation. If you have skipped a station by mistake, you have to enter it manually into the yaml file later. Alternatively you can exit the program, open the file root/ANN_[filename]/status.yaml with a text editor, enter a correspondingly lower value (minimum 0) in the field 'freqindex' and restart the program. This option should be used with caution, as incorrect double entries can occur, which must be corrected manually.

1.6 TAB 'WAV HEADER':

This tab is used to view and edit the wav header of a recording, if necessary. It can also be used to insert a wav header into a dat file which you have generated with the RFCorder, so as to create a valid wav file.

3 tables display the information in the header after loading a wav file and allow it to be edited if necessary and written back into the file. Since programs such as SDRUno or SDR# read this information, you must be very careful when making changes and know what you are doing. Otherwise the playback

of the file may no longer work. For this reason, you must explicitly enable editing of the table with the 'EDIT' radio button.

If you then want to overwrite existing wav headers with the new data, the 'Overwrite header' function is used in the 'File menu', see Fig. 1-19. 'Overwrite header' can also be triggered by the shortcut 'Alt-H'.
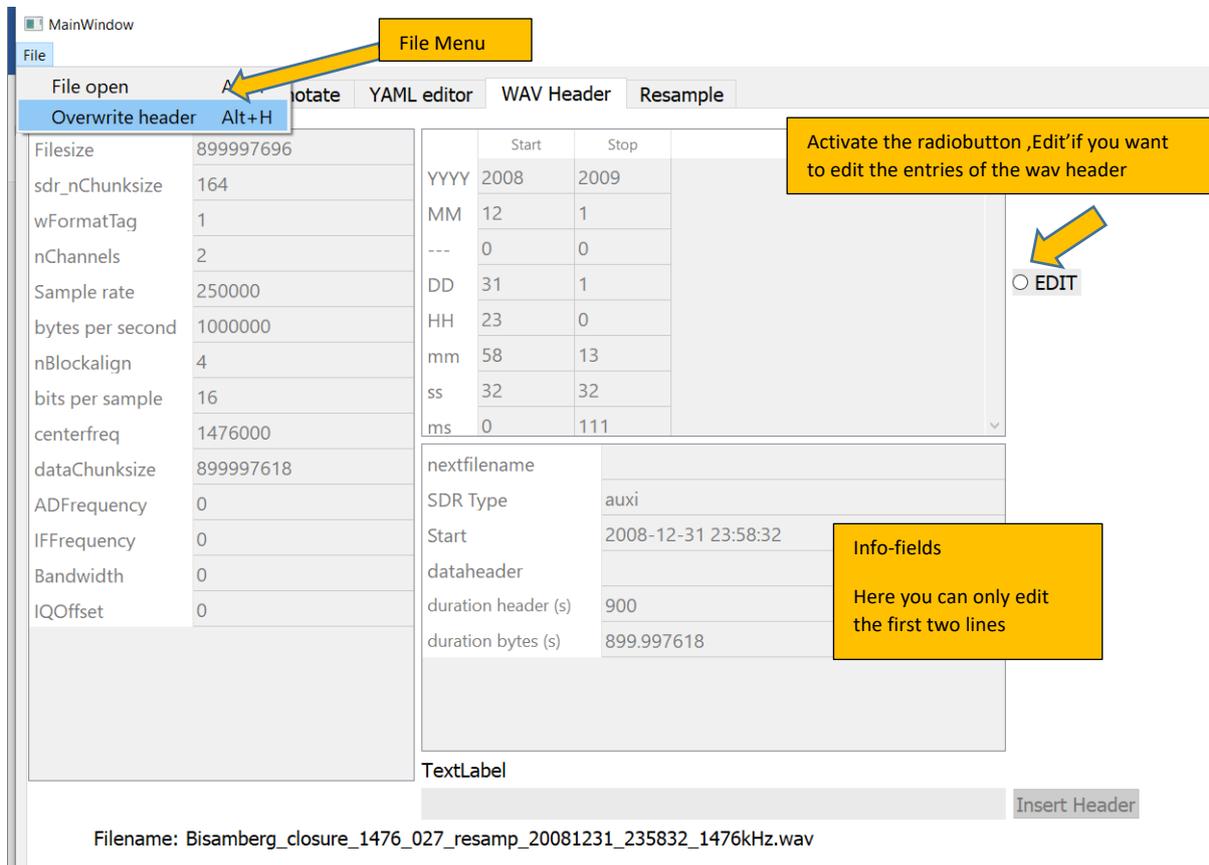
Fig. 1-19: General view of the wav-header editor

The information is displayed in 3 tables. On the left you will find data such as sampling rate, file size, sample size etc. Table 2 at the top right shows the start and end time of the recording in UTC. The third table at the bottom right contains only one really important field: 'nextfilename', i.e. the name of the next file in a series if more than 2 GB were recorded in one go. The fields from 'start' onwards are for information purposes only and are not saved in the header. The 'duration' information in seconds and bytes can be interesting here if you want to edit the yaml files. Be extremely careful with the field SDR-type (here 'auxi'). Changing this field may cause unexpected results and even prevent readability of the file.

There are 2 important manipulation elements:

(1) 'EDIT' allows the entries to be changed when activated, should this be necessary.
(2) Insert Header' is still inactive and, once activated, allows you to convert a 'dat' file recorded with STEMLAB and RFCorder into wav-format.

You now have the following options:

1.6.1 Changing the header of a file:

To do this, a file must be loaded and the 'EDIT' button activated. After changing the header entries, you can click on 'Overwrite header' in the file menu. You will be asked if you really want to do this and if you confirm, the original header will be overwritten. As already said, you should only do this if you know exactly what you are doing. Hint: As the original wav format does not support file sizes > 2GB, the program does not accept entries > 2147483648 in the field 'Filesize' In larger files this entry will thus be invalid by default. The 'dataChunksize' field must have a value that is by 208 smaller, i.e. a maximum of 2147483440. If the difference is not 208, the SDR software SDRUno may abort any playback attempt.

1.6.2 Converting 'dat' file to SDR-Uno format:

This function is only available if the file type 'Raw IQ' (*.dat, 'raw') is selected when opening a file, see Fig. 1-20.
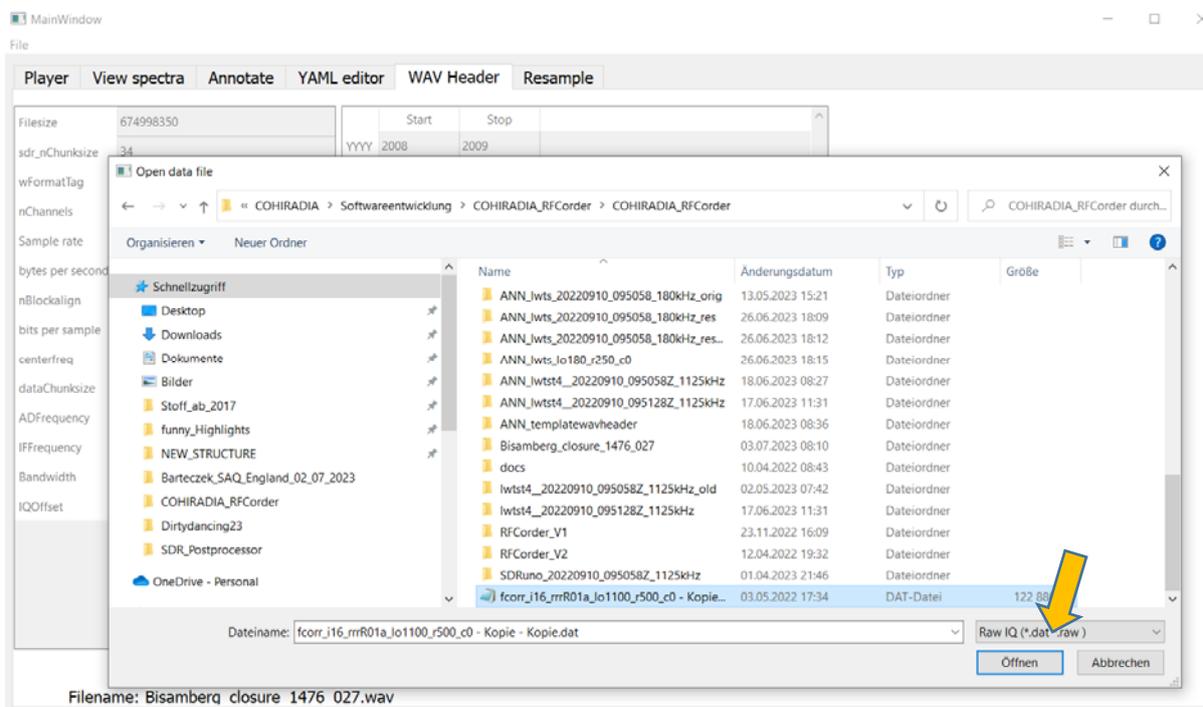
Fig. 1-20: Selection of the file format ‚dat' or ‚raw', respectively, after having opened a file.

The program automatically creates a basic wav header and then asks for the three parameters 'Center Frequency', 'Bandwidth' and 'bits per sample' via pop-up menus (see Fig. 1-21). 'Center frequency' corresponds to the local oscillator frequency of the SDR in kHz (band center frequency, coded with '_LO####' in the previous STEMLAB files) and can be entered within certain limits (0 and 60000). This entry determines whether other programs such as SDRUno display the frequency axis correctly and whether STEMLAB plays back at the correct frequency. The 'Bandwidth' menu corresponds to the sampling rate and provides a drop-down list of the sampling rates permitted by STEMLAB. The default setting is 1250kHz for typical MW recordings.

Finally, 'bits per sample' is queried. Here you can select the values '8', '16', '24' and '32' via dropdown. For COHIRADIA, ONLY the preset '16' should be used, so simply confirm with OK.

CAUTION: You can also enter numbers manually in the 'Bandwidth' and 'bits per sample' menus instead of selecting from the drop-down list, but this is not recommended. Manual entries may result in incorrect wav headers in the event of invalid entries (e.g. 1536 kS/s). This is not yet automatically prevented in the current version, so please ALWAYS select from the drop-down lists.
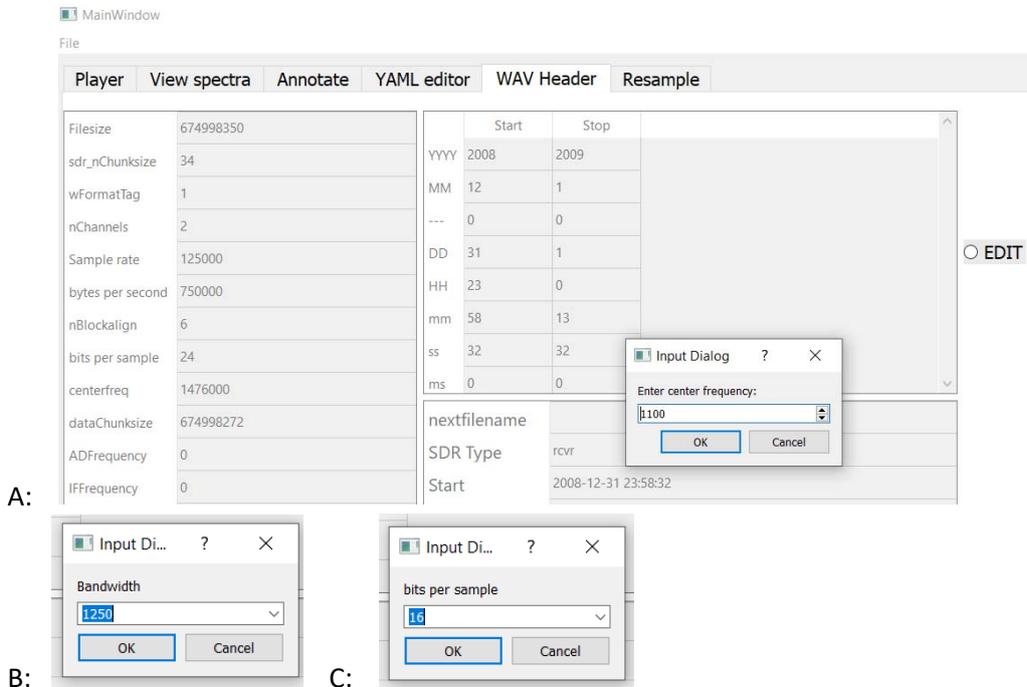
Fig. 1-21: Query for the parameters ‚center frequency', 'Bandwidth' and ‚bits per sample'

After the template header has been created, it can be edited via the tables. As shown in Fig. 1-22 in orange, you must now edit the start and stop times, as the automatically generated values are just extracted from the file modification times on the PC and do not correspond to the true recording times:
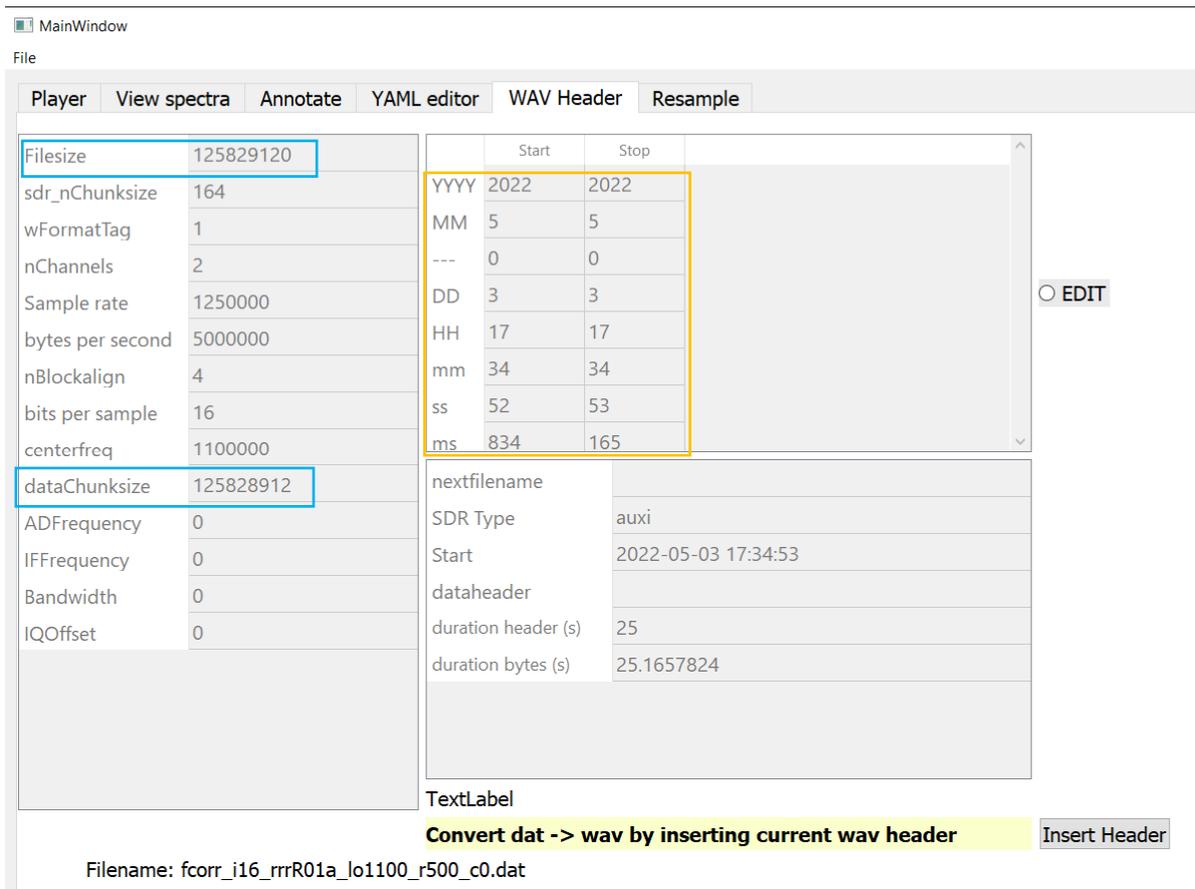
Fig. 1-22: Fields to be edited when converting dat → wav.

The start and end times of the recording must be entered in this time table, in a self-explanatory manner with date (YYYY, MM, DD) and UTC time (HH, mm, ss). The 'ms' field can be ignored. The 3rd line, which is marked with '-', has no meaning, it is filled with meaningless numbers in the SDR-Uno header (reason unknown).

The two blue marked entries 'Filesize' and 'DataChunksize' are automatically entered based on the file size. However, if the 2 GB limit is exceeded (which can easily be the case with STEMLAB recordings made with older versions of COHIWIzard and RFCorder), you may receive an error message later. So please check if values > 2147483648 appear there. In this case, simply enter the maximum for Filesize (i.e. 2147483648) and enter 2147483440 in DataChunksize. Programs such as SDRUno will still play correctly, but SDR# will only play the first 2GB.

To summarize the fields that may need to be checked:

- Filesize in bytes
- dataChunksize must ALWAYS be Filesize - 208
- Sample rate is what is encoded in the RFCorder as '_r####', e.g. '_r1250', but in S/s, i.e. x1000. '_r1250' must therefore be '1250000'.
- Bytes per second: Must ALWAYS be 4 x sample rate, i.e. '_r1250' must be '6000000'
- centerfreq is the LO frequency in Hz, which is coded in the RFCorder as '_lo####', e.g. '_r1100'. For '_r1100' this must therefore be '1100000'

Once you have made these entries, all you have to do is click on the 'Insert Header' button and that's it. The converted file is given a new name according to the SDRUno convention, namely:

[stem of the old filename (without _LO, _r, _c)] + DATE_STRING + TIME_STRING + FREQUENCY_STRING + '.wav'

Example:

‚Samplefile_LO1200_r1250_c0.dat' will be renamed to
‚Samplefile_20220503_173453_1200kHz.wav‚

in case the entered starting time and date have been set to 17:34:53 and 2022-05-03, respectively, and the LO frequency is 1200 kHz.

Now programs like SDRUno should play back the resulting file correctly.

1.7   TAB ‚YAML EDITOR‚

To automatically generate a yaml file after annotation, the general part must be filled with the individual station data of the recorder. The table in this tab is used for this purpose, see Fig. 1-23.

	please enter wanted text
Content	TESTNAME
remarks	### Notable details in the spectrum
Band	### LW - MW - SW - others
Antenna	### brand/type of antenna
recorder	### SDR type or other devices
filters	### used filters between antenna and recorder
preamp settings	### preamplifiers: type and settings
RX Longitude	### RX coordinate
RX Latitude	## RX coordinate
QTH locator	### alternative to RX coordinates
Country	### RX Country
City of RX	### RX CITY
Member ID	### RM ID if any
Repository Prefix	### Folder name in data directory of COHIRADIA server

Fig. 1-23: Table for entering the station data and button for automatically creating the yaml header.

The fields should be self-explanatory, simply insert the corresponding texts and finally press 'Write YAML'. The finished YAML is called COHI_YAML_FINAL.yaml and is saved in the directory root/ANN_[filename]/.

If you annotate a new recording, you do not necessarily have to regenerate this information if the station data is the same or similar. You can copy the two files

      root/ANN_[Alter_Filename]/cohiradia_metadata_header.yaml

and

      root/ANN_[Alter_Filename]/cohiradia_metadata_tailer.yaml

into the new annotation directory

      root/ANN_[New_Filename] .

When the COHIWizard is restarted and the file to be annotated is reopened, the information is then loaded automatically.

Programmer's note: New versions will automatically load a copy of the last station profile used, but this is currently still a work in progress.

1.8 TAB RESAMPLE

This tab is still under development and thus some planned features are not yet enabled, though pre-configured in the GUI (e.g. cutting tool, frequency correction for originally analogue VCR recordings) .

IMPORTANT ! Absolute requirement: The freely available command line program 'sox' must also be installed on the PC. Sox can be downloaded for free at:

https://sourceforge.net/projects/sox/files/sox/14.4.2/

It is best to install sox in the installation directory of COHIWizard. Alternatively, the system path must be set to the installation directory of sox.

Fig. 1-24 shows the interface of the resampler after loading a file with 'open File'. The spectrum is displayed in the plot window, the current center frequency and the bandwidth are marked by the orange thread and the red rectangle. Outlined in blue you can see the fields for setting important target parameters like the new sampling rate, the new center frequency and optional setting of the gain.
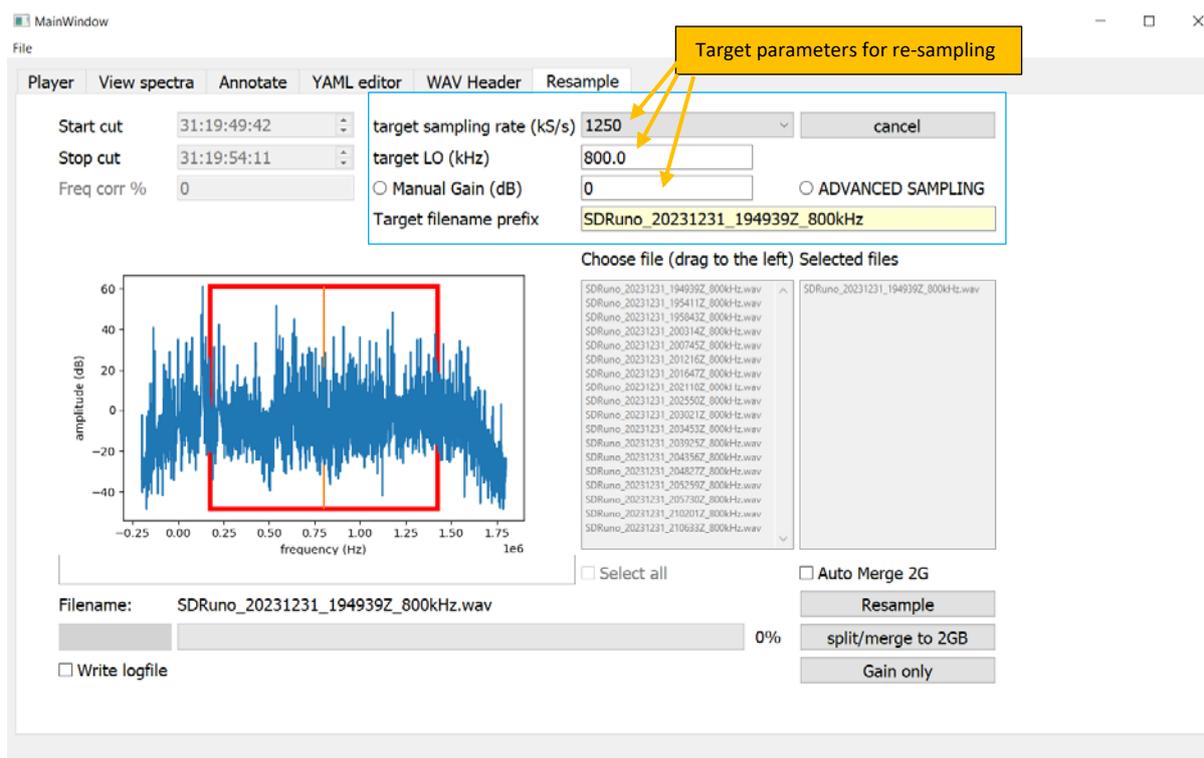
Fig. 1-24: GUI of the resampler

1.8.1 Standard application:

The most common application is probably to recode a recording if its sampling rate does not correspond to one of the values allowed for STEMLAB (e.g. RSP1a, long wave: SR = 150kHz). The spinbox 'target sampling rate' should be set to the next higher available rate, e.g. 250 kHz in case of an original bandwidth of 150kHz. The center frequency (= target LO) should be left as it is. This increases the size of the file, but is necessary for playing back the whole band. If you then press the button

'Resample' in the bottom right corner, the conversion procedure starts and creates the new file, which gets a new name containing the string '_resamp'. The conversion requires several steps and takes some time, but of course it has to be done only once. The progress of the procedure is displayed with a progress bar below the spectrum window. After successful conversion the new file can be loaded and played back.

During the conversion, the file is automatically converted to 32bit COMPLEX, i.e. 16bit per sample. This means that originals with 24bit (e.g. many recordings made with PERSEUS) or 32bit can also be converted to COHIRADIA format.
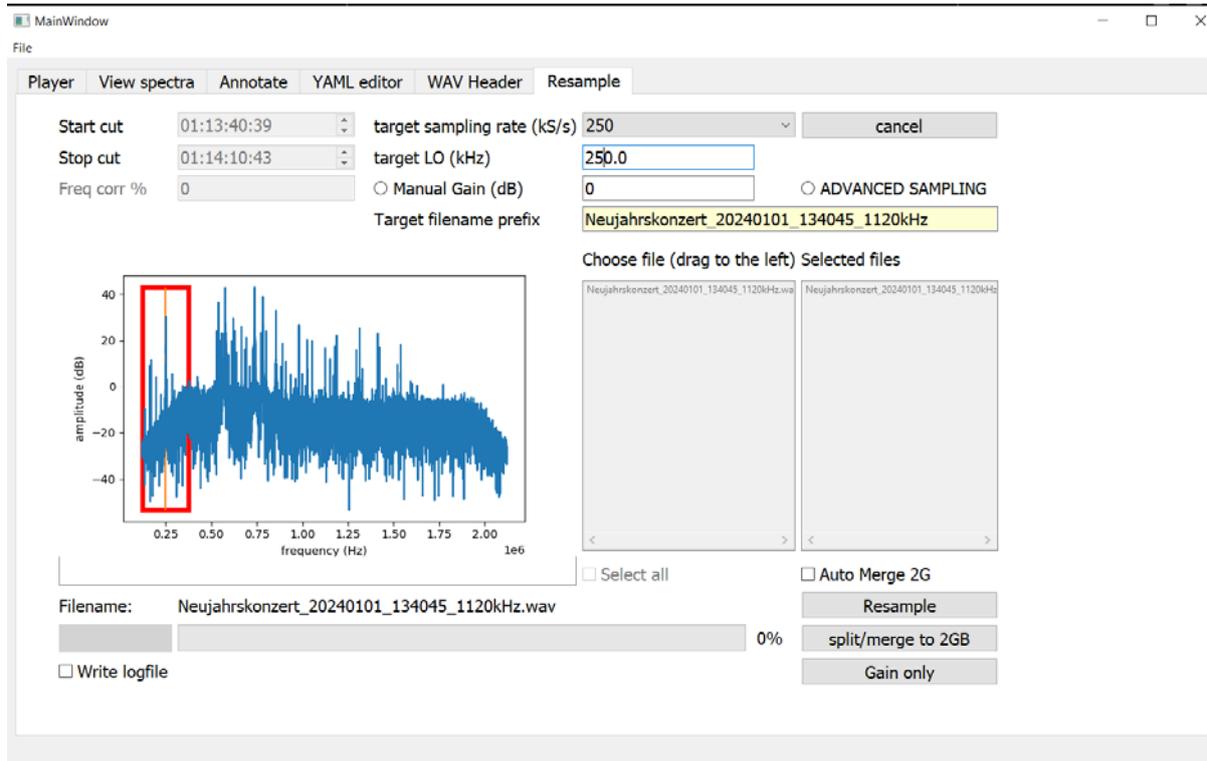
Fig. 1-25: Cutting the LW-Band out of a 2MHz broad recording made with a PERSEUS SDR.

1.8.2   Advanced Applications:

For 'advanced use' there is also the option of selecting a different sampling rate and even shifting the center frequency if necessary. This is usually not required by the standard user, but if you want e.g. to cut out only the LW band from a very broad spectrum ranging 0 to 2000 kHz (typical e.g. for PERSEUS-SDRs), this function is useful. This case is illustrated in Fig. 1-25. With 'target sampling rate' you can set the target sampling rate for playback on the STEMLAB. For LW, 250kHz makes sense, as this then covers more than the entire band. The LO frequency selected here is 250 kHz, which results in a target band of 250 +/- 125 kHz, i.e. 125 - 375 kHz. If, alternatively, you only want to cut out the medium wave band, it is advisable to set the sampling rate to 1250 kS/s and the target LO to 1100 kHz. If you now click on 'Resample', a two-stage procedure begins in which the spectrum is first shifted and then resampled. The procedures may differ depending on whether the IQ data is 16, 32 or 24 bit. You now have the following options:

A) Resampling a single file

B) Resampling an entire list of related files

C) Splitting an existing file into 2GB tranches without resampling

1.8.2.1 Case A: Resampling of a single file:

Resampling is carried out by simply clicking on 'Resample' after loading a file. The resulting file is copied to a new directory 'out' (subdirectory of the directory where the source file is located) and has a file size that has been changed according to the ratio between the source and target sampling rate. The file is named [old filename]_"resamp"_[new date]_[new time]_[LO frequency] "kHz.wav".

In the specific case in Fig. 1-25, the name of the target file is: 'New Year's Concert_20240101_134045_1120kHz_resamp_20240101_134045_250kHz.wav'.

Everything is fine if the output file is not more than 2GB in size and the target sampling rate is not greater than the output rate (downsampling). In many cases, however, this is not the case. If you want to ensure that the target files do not exceed 2GB, you should therefore check the 'Auto Merge 2G' option. Then 2GB files will always be created and the filenames will take the form [Target filename prefix]_[Number]_[date]_[time]_[LO frequency]"kHz.wav". The intermediate files with prefix '_resamp_' are deleted at the end.

[Target filename prefix] is the string entered in the "Target filename prefix" field. For the prefix 'my_new_file' entered in Fig. 1-26, the only possible target file is 'my_new_file_1_20240101_134045_250kHz.wav'. If the source file had a significantly greater length (e.g. 20GB), then a further 2GB file 'my_new_file_2_20240101_141632_250kHz.wav' would be created.
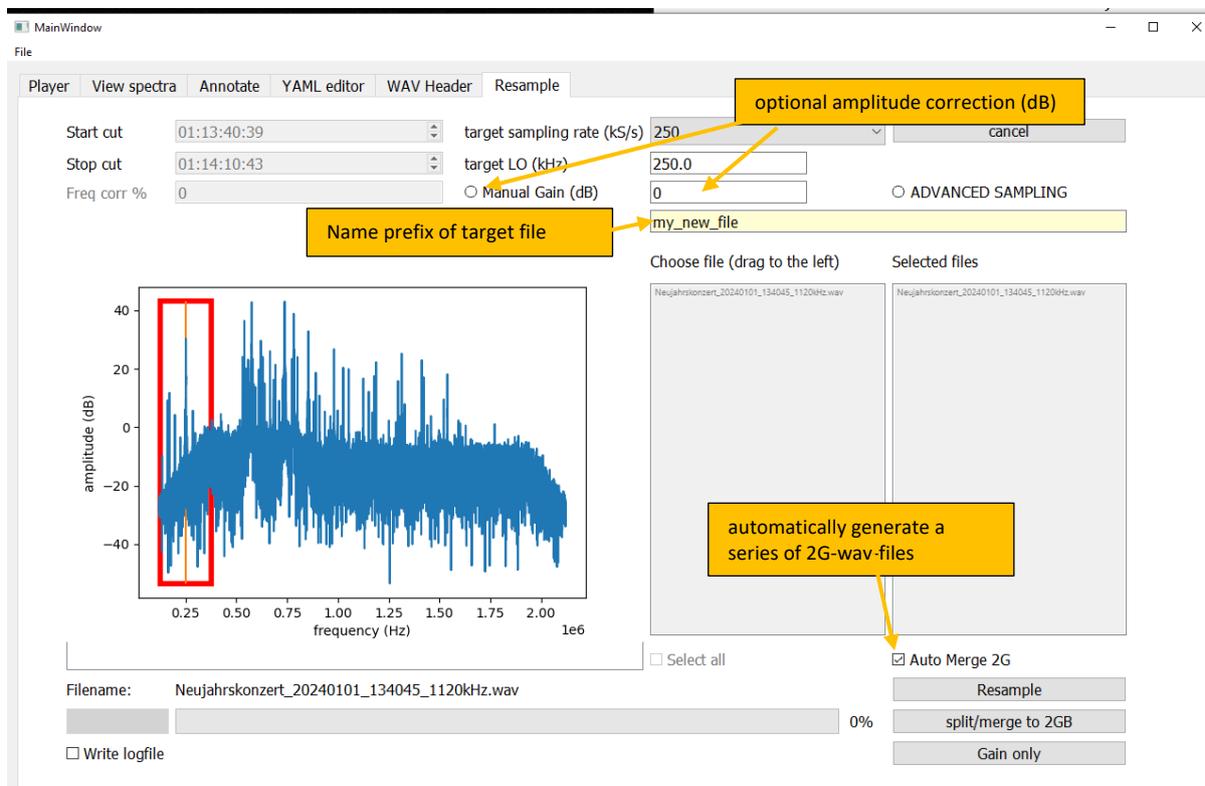
Fig. 1-26: Activation of the automatic segmentation in 2-GB files and setting the prefix of the target filename.

If you have forgotten to check 'Auto Merge 2G', you have to reload the 'resamp' files and then combine them with 'split/Merget o 2GB'. However, the '_resamp_' intermediate files are then not deleted in the process and you have to remove them manually, if wanted.

The tool also gives you the option of correcting the amplitude of the RF signal if it is too small. Such a small amplitude occurs more often than it may be expected and then any playback in the Player may results to unsatisfactorily low volumes. In the newer software versions you can then use the volume control to increase the volume, but this option is not yet available in the oldest RFCorder versions. It is therefore advisable to check and, if necessary, correct the amplitude. This can be done by clicking on the radio button 'Manual Gain (dB)' (see Fig. 1-26). The value must be entered in dB in the adjacent text field. To check whether the amplitude is correct, you should switch to the 'View spectra' tab and tick the 'plot raw data' option, see Fig. 1-27. The correct amplitude AFTER applying gain is always displayed there. The signal should ideally be between 0.1V - 0.7V, but in any case remain below 1 V, i.e. better with a safety margin, otherwise bad intermodulation distortions will occur. If, on the other hand, the signal is mostly below 0.001V, you should definitely amplify the signal.

ATTENTION: The Gain function is only active when resampling, it does not take effect if you only execute 'Split/Merget o 2GB'.
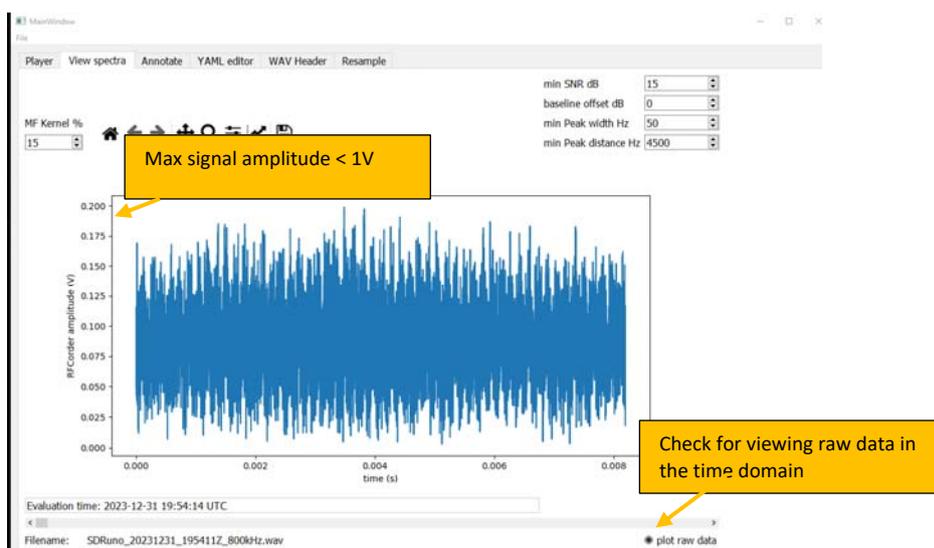
Fig. 1-27: Checking for correct signal amplitude e.g. when setting the gain before resampling. The signal values need always to remain below 1V to prevent clipping. It is recommendable to leave some margin for reducing intermodulation artifacts.

1.8.2.2   Case B: Resampling of a list of associated files:

Often you have made a longer recording with an SDR, which then typically consists of several wav files, each 2GB in size. As one example SDRUno creates such file series, in which the header of each file refers to the next one, so that the software can play back the entire series without interruption. This philosophy has also been adopted for the player of the COHIWizard.

If you want to resample such a whole series, it is advisable to copy all the related files into a separate directory and open any one of them with 'File open'. All the wav files in the directory are then displayed in the 'Choose files' list, although they are initially grayed out. If you now activate the 'ADVANCED SAMPLING' option, you can drag and drop individual files into the 'Selected Files' field, see Fig. 1-28 A.

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If you want to resample the entire list, you can also check 'Select all'. If you have selected a file by mistake, you can move it back again by dragging with the mouse, or you can deselect the entire list by unchecking 'Select all', see Fig. 1-28 B.
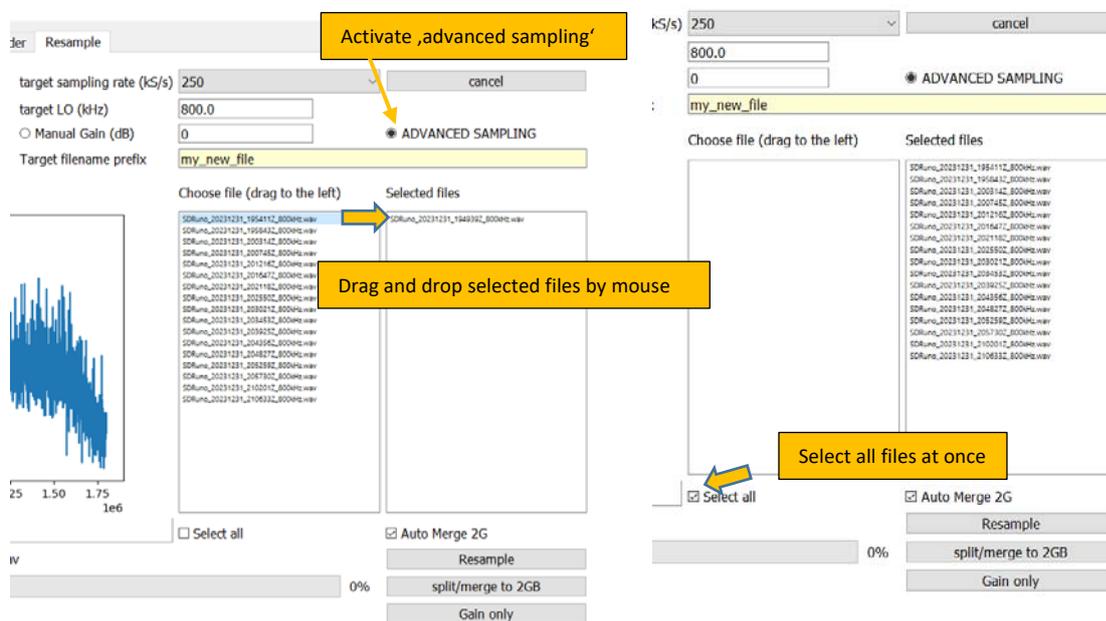
Fig. 1-28A: Selection of files to be resampled by drag and drop by the mouse.

B: Select/unselect all files of the list at once by checking/unchecking the corresponding checkbox, respectively.

ATTENTION: the files in the 'Selected Files' list must appear in the correct chronological order, as the target files are of course also created in this order. If this is not observed, not only will the result not be correct, there may also be unforeseen complications when writing the new wav-headers. The system does not currently check excessively whether the listed files fit together correctly. Currently, the system only checks whether there is a time difference of no more than 300s between the start time of a file and the stop time of the previous file. If this is not the case, the program aborts the process, but only during the resampling process.

Special feature for treating 'holes' in recording series: The tolerance of 300s can be used if, for some reason, you have produced a small time delay between two consecutive files during recording. This could be because you had to stop and restart the recording due to an error, or because the recording software itself was too slow when switching to the next file (this can happen with large bandwidths and slow PC hardware). In this case, the time display of the target recording would be incorrect because segments are missing. In this case, COHIWizard inserts an 'empty signal' into the target series at the relevant points (the signal then just consists of silence) in order to ensure a target file with the correct duration and correct time stamps. In such cases, gaps of up to 300s are tolerated and replaced by silent sequences.

1.8.2.3   Case C: Splitting of an existing file into 2GB segments without resampling:

If, for example, you have created a file with a size of more than 2GB with the old RFCorder or another tool and you want to split it into 2BG tranches with correct wav headers, you can proceed as follows:

(1) If it is a dat file, it must first be provided with a wav header, see section 1.6.2.
(2) If it is a wav file, simply click the 'Split/Merget to 2GB' button and a corresponding file series will be created in the 'out' folder.

However, as the name of the button suggests, this function can also be used to copy series of files with more or less than 2GB into a series with 2GB per file. All time stamps in the wav headers are automatically converted and entered correctly.

ATTENTION: The 'Gain' function is only executed when resampling, it does not take effect if you only execute 'Split/Merget o 2GB'.

ATTENTION: You should ensure that you have sufficient disk space in the target directory, as resampling can produce relatively large result files. Some temporary files are also created. The program does check the available space at some points and should issue warning messages if there is too little available, but the reliability of these displays has not yet been tested excessively.

Remarks on inactive buttons/fields: Functions for cutting recordings, i.e. trimming start and end times, have not yet been activated. Although these functions are already provided in the GUI (Stop cut, Start cut), they are still grayed out. They will be activated in future releases. Also planned for the future, but still inactive, is a 'Frequ corr %' function. This allows the carrier frequencies to be corrected if the original recording was made analog on a video recorder and the playback speed during playback is not quite correct. However, this is probably a rarely used special application.

The 'Gain only' option, which allows amplitude correction without resampling, is also not yet enabled.

2 KNOWN BUGS

The following problems can occur in version 1.2:

2.1 GENERAL:

If you try to open a file that is currently open in another application, the program crashes. Please always close recording or playback in all other applications first.

3 ANNEX:

3.1 FILESYSTEM:

3.1.1   Installation file system

From version 1.2.9 on the COHIWizard has the following basic file system within 'root':

```
annotator
        ressources
            icons
core
    ressources
        icons
logos
player
    ressources
        icons
```

This system must not be changed (e.g. by renaming), otherwise the software will not work correctly.

3.1.2   Annotation files

A folder with the name of the recording and the prefix 'ANN_' is created in the recording directory (RECORDINGDIR). If the recording e.g. has the name 'Bisamberg_closure_1476_027.wav', a folder

    ANN_Bisamberg_closure_1476_027.wav

appears.

The following files are created in this folder:

    cohiradia_metadata.yaml
    cohiradia_metadata_header.yaml
    cohiradia_metadata_tailer.yaml
    snrannotation.yaml
    stations_list.yaml
    status.yaml
    COHI_YAML_FINAL.yaml

The current annotation status is saved in status.yaml, i.e. the information on where the program should continue in the event of interruptions. snrannotation.yaml and stations_list.yaml are temporary files required by the system. cohiradia_metadata_header.yaml and cohiradia_metadata_tailer.yaml contain the station data entered in the YAML editor, cohiradia_metadata.yaml is a temporary file and COHI_YAML_FINAL.yaml is the finished yaml file for the landing page.