How to schedule a VGOS session in VieSched++

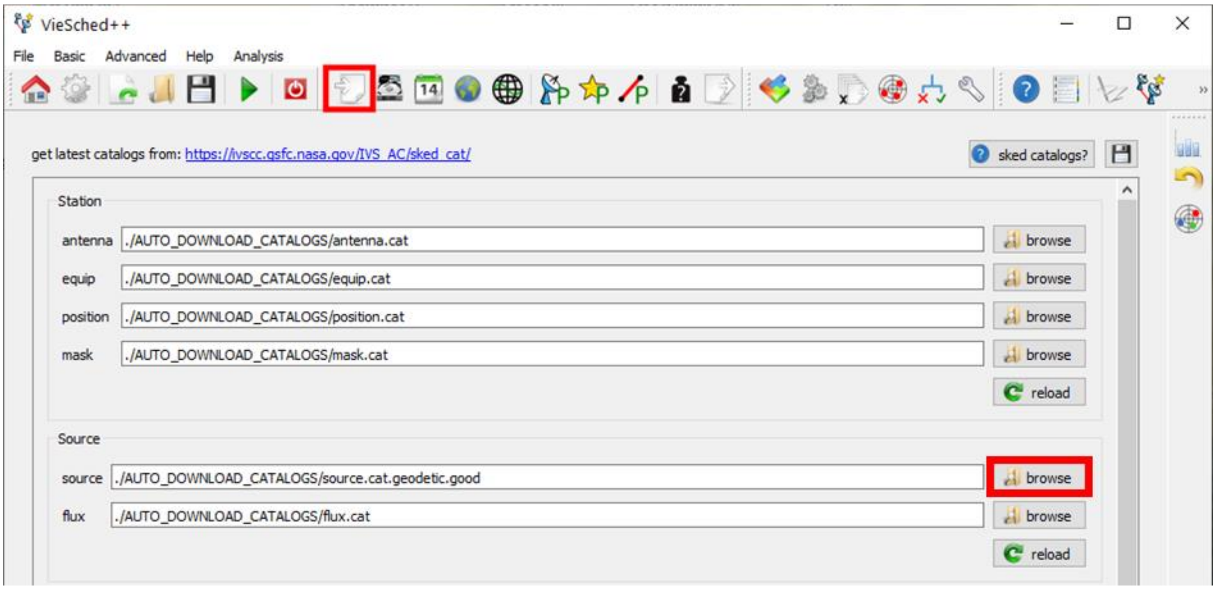
This exercise shows how to generate a simple schedule for a VGOS session. In case you have further questions or troubles using VieSched++ contact *mschartner@ethz.ch*.

HINT:
Throughout this document, inputs you have to make highlighted by an orange vertical bar. Optional inputs are highlighted by a green vertical bar. Alternative ways of doing things are highlighted by a blue vertical bar. Hints and tips are highlighted by a gray vertical bar.

If you are unsure what a button or field in VieSched++ does, you can enter the *"What's this?"* mode by hitting the F1-key on your keyboard or by clicking on the ? icon in the menu bar. You will notice that your mouse-icon changed. You can now click any element in VieSched++ to display a short help text.

A more detailed discussion of many of the options VieSched++ offer is discussed in my dissertation http://repositum.tuwien.ac.at/obvutwhs/content/titleinfo/4655766 as well as on the VieVS YouTube channel https://www.youtube.com/channel/UCl2VPe7OrnznNtrh0_lwrqQ.

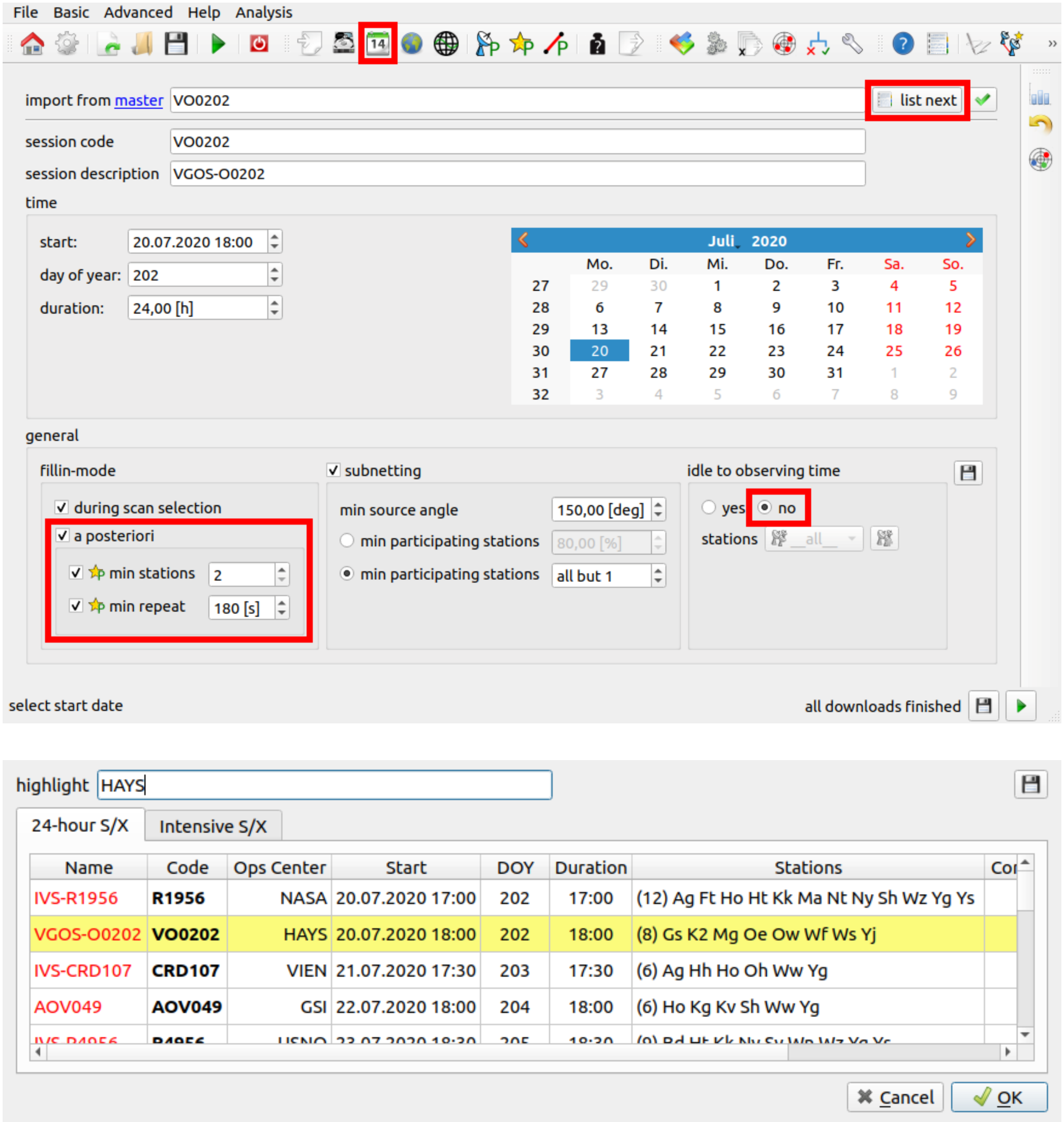
OPTIONAL – LOAD DIFFERENT SOURCE CATALOG
First, you have to select your catalog files. The default source catalog might not be ideal for VGOS sessions. Click on the *"browse"* button next to the source catalog and select the source catalog you would like to use. If you are unsure, then you can simply extract the $SOURCE block in one of the IVS VGOS schedules to a new file and load this as the source catalog.
If you click on the "reload" button right below, the catalog is load into VieSched++ and the new sources will be listed in the GUI.



HINT:
If you are unsure which source list to use, then you can simply extract the $SOURCE block content in one of the IVS VGOS .skd files to a new file and load this as the source catalog. Have a look at https://ivscc.gsfc.nasa.gov/sessions/ to see the IVS VGOS schedules.

Load experiment data:

Now, you have to define some general settings. Since we want to schedule an official IVS session, we can read the session setup from the IVS schedule master. Click the “list next” button to list all sessions for the next 30 days. You can double-click any session to load it. This will automatically set up the right session code/description, start date, duration, antenna network, scheduling and correlation center as well as downtimes due to IVS intensive sessions. In this exercise, we want to schedule session *“VO0202”*.



Alternatively:

You can simply enter the IVS session code in the input field next to “Import from master” and hit enter to read the setup of any IVS session. This also works for past sessions as well as for future sessions listed in the IVS master file.

Of course, you can also simply enter all the settings by hand. Session name and start time can be entered here, the network can be defined at the network page.

Optional – Reduce amount of recorded data

It might be advantageous to select *"idle to observing time"* to *"no"*. The idle to observing time algorithm checks if it is possible to extend the observing time beyond the minimum required observing time in case stations are idling. This works similarly to the sked *"fill"* command. For VGOS sessions you typically do not want to use this option since transferring data is one of the major bottlenecks in the process chain.

Optional – Enable fillin-mode a posteriori

You can use the fillin-mode a posteriori to try to increase the number of observations. This algorithm will start after the main schedule is already finished. It will check in between two occurring scans if there is time to squeeze in an additional scan. This might be possible since you can loosen the constraints for a valid scan. For example, you can specify that the software is allowed to schedule two station scans (during the main scheduling phase the software will always schedule a minimum of three stations by default) and you can reduce the minimum time between two scans to the same source.

Hint:

Remember, that you can click on the small button (on the right) to save these settings on startup.

Intermezzo: VGOS observation mode and buffer-flush time

Unfortunately, there is not yet an official VGOS observing mode listed in the sked catalogs. Therefore, one has to use hacks to make VGOS observations possible.
As of right now, VGOS sessions are scheduled with a fixed observation duration of 30 seconds for all scans and a fake 256 Mbps observing mode is used as a filler to prevent software packages to crash.
Additionally, two new blocks are added to the .skd file, the $BROADBAND block and the $PROCS block.

If you want to schedule VGOS observations, you have to make sure that you understand the difference between the recording rate assumed for scheduling, the real recording rate and the rate with which the bits are saved to disc.
The recording rate that is assumed for scheduling is required to calculate the proper observation duration to reach a target SNR. If you are using a fixed observation duration, the recording rate is not of interest for scheduling and you can use a fake observing mode.
Currently, the real VGOS observing rate for VGOS is 8 Gbps.
However, the official VGOS sessions are recorded to one module only. Thus, the rate with which the data is stored to disc is only 4 Gbps. Therefore, you have to wait at least for the same amount of time you did observe a source until you can start with the next scan. The additional time between two scans is what I will further call the *"buffer-flush time"*. It is important to note, that during this buffer-flush time it is possible to slew the antennas to the next source. Thus, flushing the buffer and slewing can be done simultaneously.

Depending on your actual VGOS experiment and equipment, you need to define the schedule differently. The key questions are:

- Do you plan to observe with a fixed observation duration?
- Is your recording rate higher than the rate you can store your observation to disk?
  (Do you need to account buffer-flush times during scheduling?)

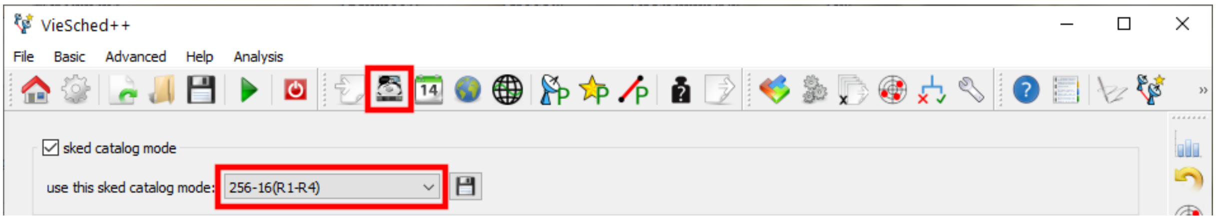
Option A: fixed observation duration

This option refers to the current status of IVS-VGOS observations in case two modules are used to record the data. This is typically not done for 24-hour sessions (see Option B).

The situation is highly simplified since all scans are scheduled with a fixed observation duration. Thus, the scheduled recording rate is not of interest since we do not care about the SNR we get and we can use a dummy 256 Mbps mode for scheduling.
Additionally, we do not expect to run into buffer-flush time issues since the recording rate is assumed to be equal to the rate with which the data is stored to disc.

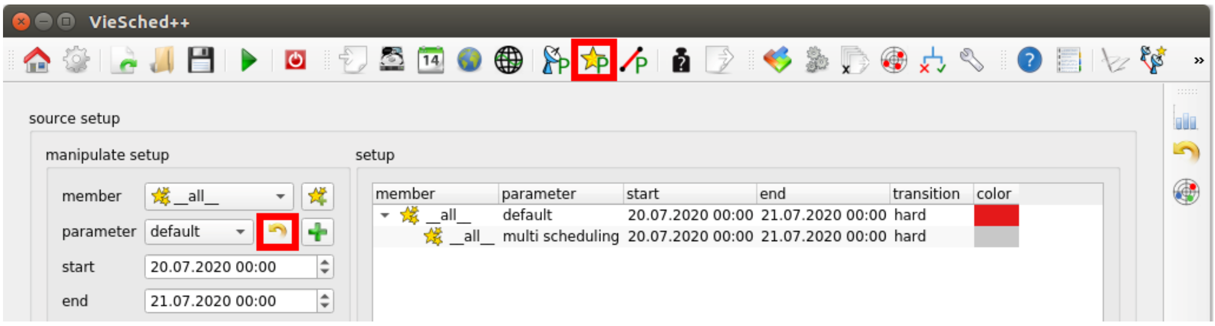
CHANGE OBSERVING MODE:

Make sure that you do select an observing mode where all VGOS antennas are listed to prevent the software to crash. The best option is to use the default *"256-16(R1-R4)"* mode.

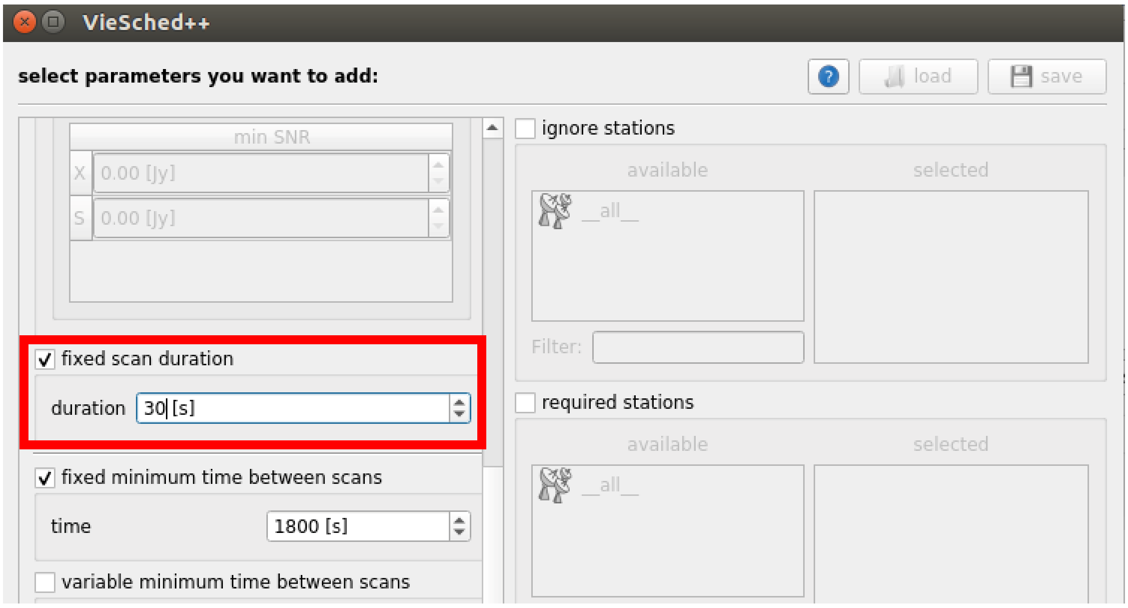


DEFINE FIXED OBSERVATION DURATION:

Next, you can set the fixed 30 second observing duration. Go to the source-based parameters and change the *"default"* parameters by clicking the button next to the parameter name.



Now, you can set the fixed observation duration of 30 seconds and click on "*Ok*".



Option B: fixed observation duration with a reduced buffer-flush rate

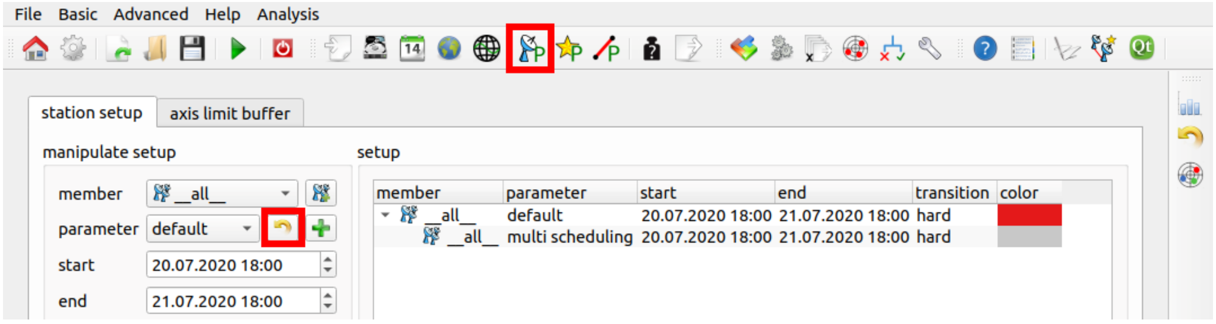
This option refers to the **current status of IVS-VGOS observations** in case one module is used to record the data.

The situation is highly simplified since all scans are scheduled with a fixed observation duration. Thus, the scheduled recording rate is not of interest since we do not care about the SNR we get and we can safely use a dummy 256 Mbps mode.
To address the buffer-flush time, we can exploit the fact that slewing and buffer flushing can be done simultaneously. We will simply define a minimum slew time equal to the fixed observation duration to ensure that there is always enough time to flush the buffer.
In this exercise, we will use a 30 second observing time (as done in today's VGOS sessions).

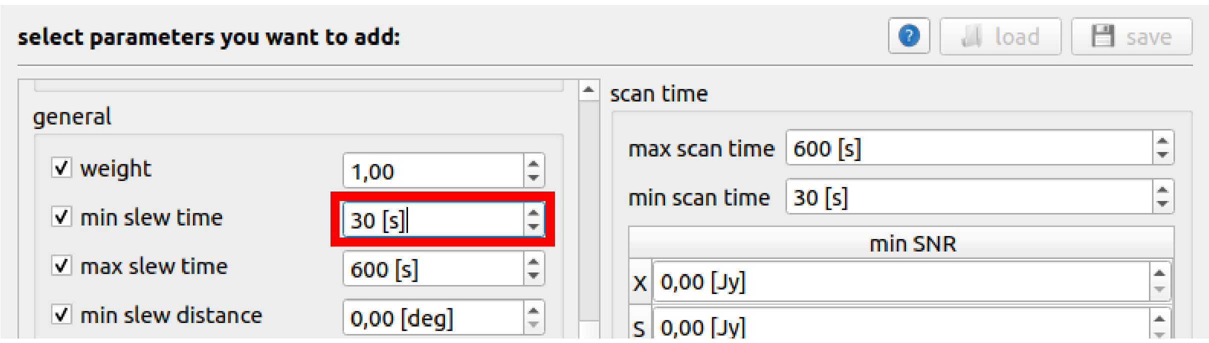
Follow **Option A** to change the observing mode to *"256-16(R1-R4)"* and set a fixed observation duration of 30 seconds.

DEFINE MINIMUM SLEW TIME:

Next, you have to set a minimum slew time of 30 seconds for all stations. Go to the station-based parameters and change the *"default"* parameters by clicking the button next to the parameter name.



Now, you can set the minimum slew time of 30 seconds and click on "*Ok*".



Option C: SNR-based observation duration

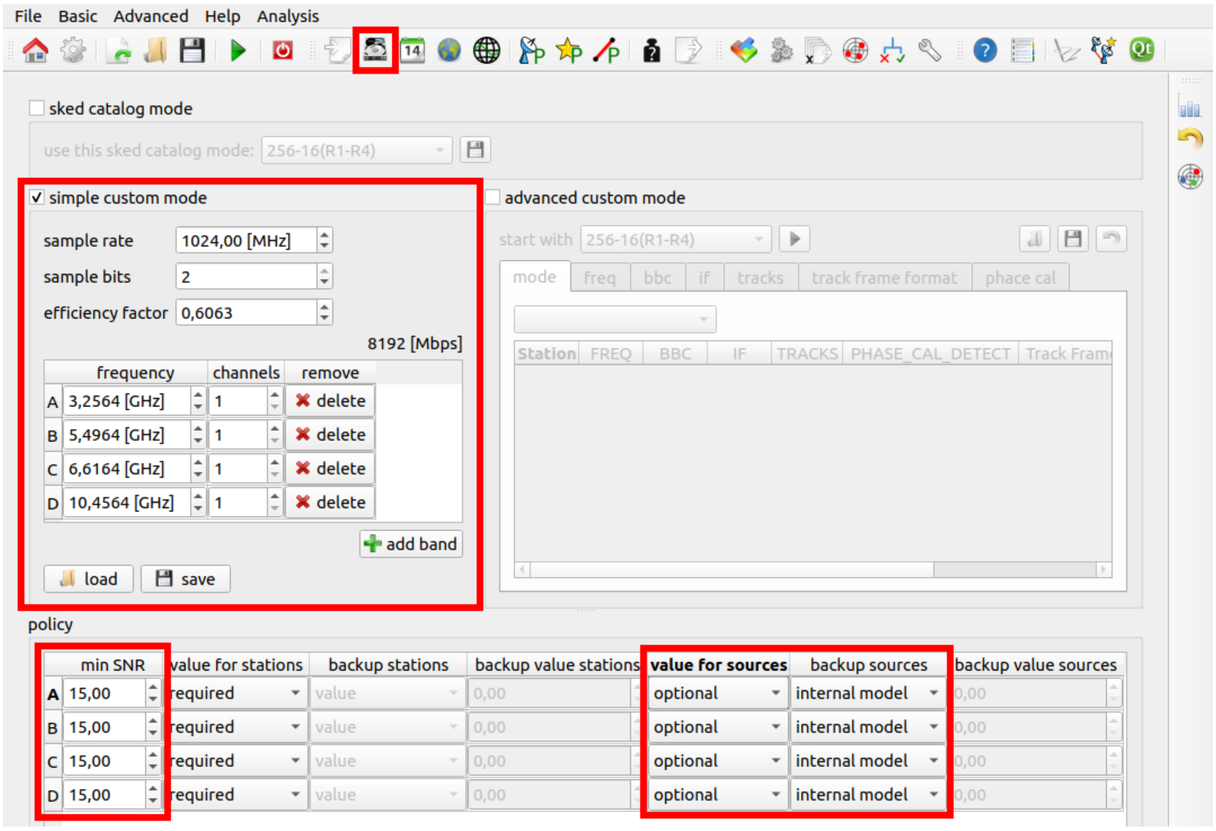
Now, things become a bit more complicated since there is not official VGOS mode in the sked catalogs and we have to use many hacks to make it work.
You have to solve the following issues:

- define an observing mode with four bands A, B, C and D
- provide antenna SEFD values for the four bands A, B, C and D
- provide source flux densities for the four bands A, B, C and D

CHANGE OBSERVING MODE:

The easiest way to fake a 4 band VGOS mode is by using the "simple custom mode" option. With this option, it is possible to define the bands you would like to observe.
The most important thing is to provide information about the recording rate for each band. In this example, I simply defined one channel per band with a sample rate of 1 Gbps per channel and 2-bit sampling. Therefore, the scheduling software assumes that we will record 2 Gbps per band.
This information is only required to calculate the theoretical SNR values per observation. Thus, you do not have to be super precise with the reference frequency and it is only important that the total recording rate per channel is correct, independent of the actual number of channels and sample rate per channel.

Next, you can define the target SNR per band in the form at the bottom. In this example, I did set the target SNR to 15 for each band.



IMPORTANT:
Since you are using a *simple custom mode*, you will not get a proper $CODES block in the final .skd file and no information about the observing mode in the .vex file. You have to manually copy it in. If you use the *"advanced custom mode"* you will get a proper .vex file but the $CODES block in the .skd file will still remain empty. However, using the advanced custom mode is subject of a different exercise.

OPTIONAL – PROVIDE SOURCE FLUX DENSITIES

This step is most likely not optional but rather mandatory since you most likely do not have source flux densities for band A, B, C and D. However, in the future, it might become optional.

There are a couple of ways to provide source flux densities for the four bands. The easiest is, to use an internal model provided by VieSched++ that inter-/extrapolates the flux densities for band A, B, C and D based on the flux densities for band S and X based on a simple (exponential) model.
To use this option, you have to change the *"value for sources"* option to *"optional"* and select the *"internal model"*.

NOTE: The internal model might not reflect reality perfectly and it is likely that the estimated flux densities are not completely accurate. However, they might be accurate enough for first tests and until source flux density information is available for all bands.

OPTIONAL – PROVIDE ANTENNA SEFD INFORMATION

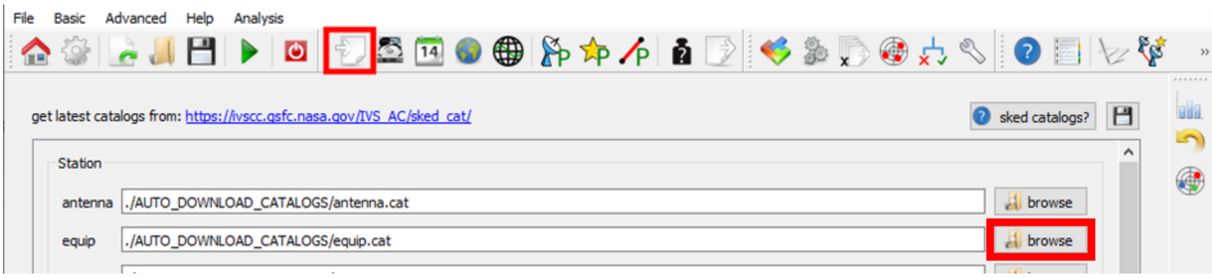
Next, you have to provide antenna SEFD information to calculate the proper SNR per observation.
It is best to request this information from the stations directly and store it in a new equip.cat catalog and use it.

First, define a new catalog. It might look somewhat like this:

equip.cat.VGOS

```
* Antenna  ID  DAT_Name  Heads Tape_len  A  SEFD     B  SEFD     C  SEFD     D  SEFD     Equip
*                        den/spd ft/min     (Jy)        (Jy)        (Jy)        (Jy)
ONSA13NE   Oe  ONSA13NE  2x56000  17640  A  2860.1   B  2556.4   C  1894.6   D  2163.1   DBBC_DDC FlexBuff
ONSA13SW   Ow  ONSA13SW  2x56000  17640  A  2723.4   B  1645.6   C  1452.9   D  2110.8   DBBC_DDC FlexBuff
WETTZ13S   WS  WETTZ13S  2x56000  17640  A  2142.0   B  3407.5   C  2097.5   D  3523.0   DBBC MARK6
RAEGYEB    Yj  RAEGYEB   1x56000  17640  A  2089.4   B  2509.0   C  1611.9   D  1660.7   DBBC MARK6
ISHIOKA    Is  ISHIOKA      1       100  A  1074.3   B  2238.1   C  1936.5   D  2507.8   K4-2 K5
GGAO12M    Gs  GGAO12M   2x56000  17640  A  3808.9   B  2704.4   C  2400.1   D  3137.6   RDBE MARK6
MACGO12M   MG  MACGO12M  2x56000  17640  A  1728.8   B  2582.1   C  2013.0   D  1716.1   RDBE MARK6
```

Next, select the new catalog:



NOTE: The official sked catalogs do not support providing four bands. Thus, other software packages might break in case you do define four SEFD values in the .skd $STATIONS block.

IMPORTANT:
It is very important to note that neither the sked catalogs nor the .skd file support the use of four bands. Thus, the .skd file you produce can most likely not be used by drudge. It is best, to simply copy parts of the .skd file you have just generated into a .skd file that works for VGOS. You have to copy the beginning of the $PARAM block, the $SOURCES block and the $SKED block. (Make sure that the one-letter code defined in the $STATIONS block matches the one-letter-code used in the $SKED block)

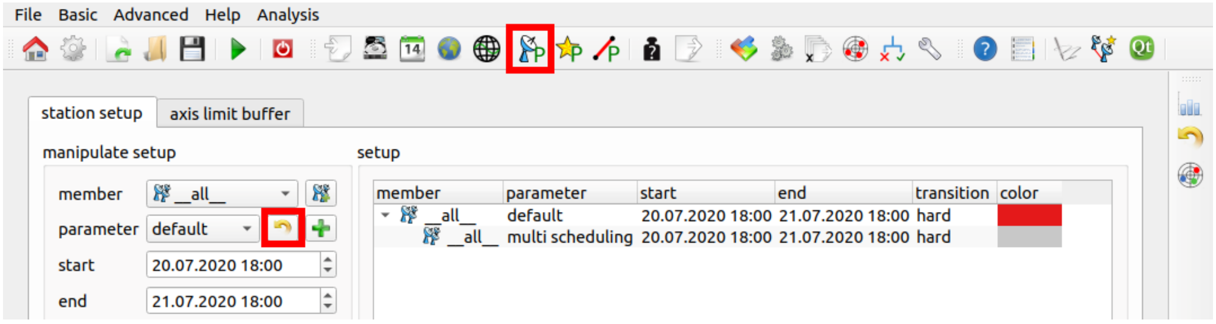
Option D: SNR-based observation duration with a reduced buffer-flush rate

Follow **Option C** to define a new observation mode and set the source flux densities and antenna SEFD information for band A, B, C, and D.

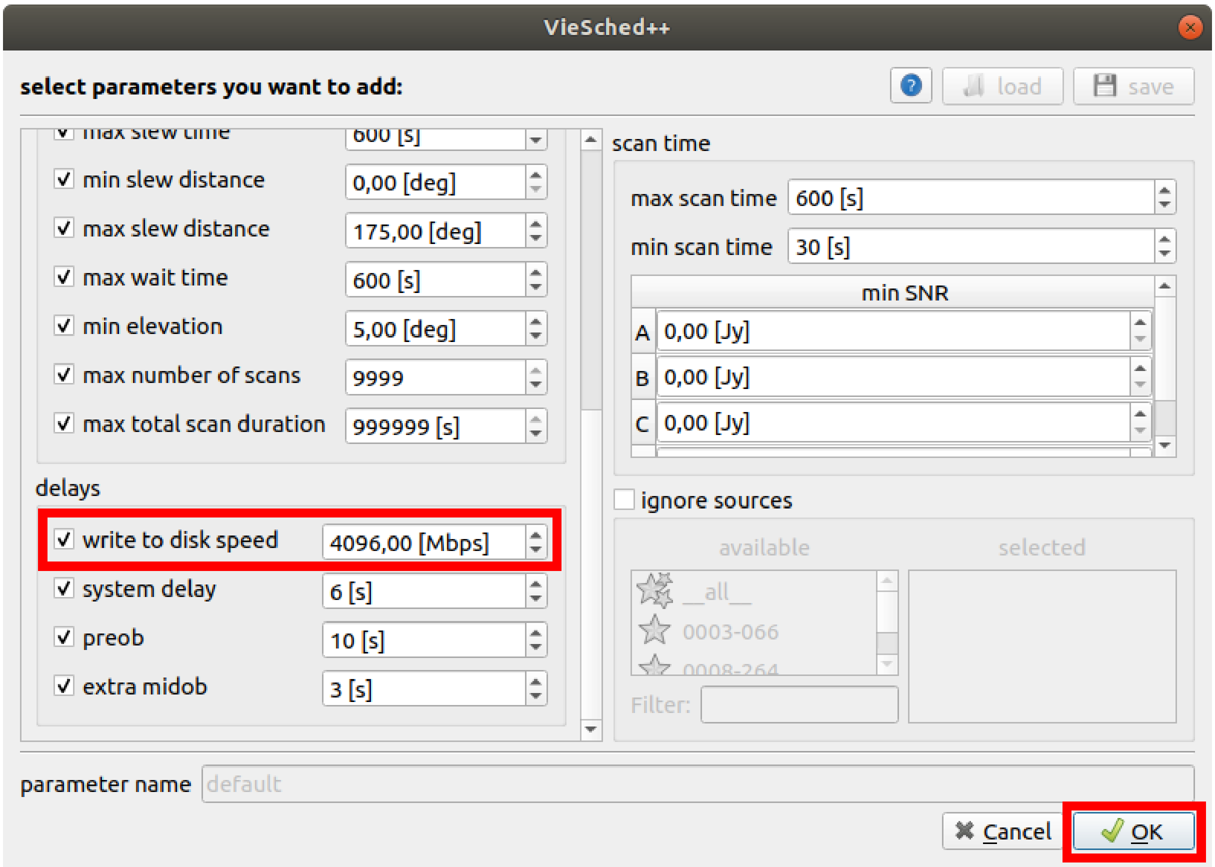
Next, you need to solve the data buffer-flush time issue, since you will record with 8 Gbps but only save the data with 4 Gbps to disk.

DEFINE BUFFER-FLUSH RATE:

Go to the station-based parameters and change the *"default"* parameters by clicking the button next to the parameter name.



Now, you can set the write to disk speed to 4Gbps and click "*Ok*".



Verify that observing mode is set correctly

To verify that the observing mode and buffer-flush times are set correctly, it is best to simply start a schedule and have a look at the *"*session*_iteration0.txt"* file.

In this file, you get a list of all scans including the observing and slew time per station.

In the picture below, you can see that the slew time of all stations is at least 30 seconds (the slew time of WESTFORD is even 36 seconds) and the observing time is 30 seconds as well. This is the expected behavior for **Option B**.

```
|-----------------------------------------------------------------------------------------------------------
| depth:  0                                                                       considered single scans 37,
| scan:   no0025   (id: 171490)                                                                    duration:
| Source:    OJ287 (id: 33)                                                                     type: target
|-----------------------------------------------------------------------------------------------------------
|    station    | delay   slew    idle | preob   obs        duration          |     az [deg]        |      unaz [deg]
|               |  [s]    [s]     [s]  |  [s]    [s]     start - end         |   start - end       |    start - end
|---------------|-------------------------|-------------------------------------|---------------------|--------------------
|    GGAO12M    |     6      30      6 |     4      30   18:22:40 - 18:23:10 | 190.9871 - 191.3390 |  550.9871 -  551.3390
|    KOKEE12M   |     6      30     88 |     4      30   18:22:40 - 18:23:10 |  74.8452 -  74.8830 |  434.8452 -  434.8830
|    MACGO12M   |     6      30      6 |     4      30   18:22:40 - 18:23:10 | 111.3372 - 111.4916 |  471.3372 -  471.4916
|    ONSA13NE   |     6      30      6 |     4      30   18:22:40 - 18:23:10 | 283.2101 - 283.3114 |  283.2101 -  283.3114
|    ONSA13SW   |     6      30      6 |     4      30   18:22:40 - 18:23:10 | 283.2096 - 283.3109 |  283.2096 -  283.3109
|    RAEGYEB    |     6      30      6 |     4      30   18:22:40 - 18:23:10 | 278.0079 - 278.0839 |  638.0079 -  638.0839
|    WESTFORD   |     6      36      0 |     4      30   18:22:40 - 18:23:10 | 201.7275 - 202.0057 |  201.7275 -  202.0057
|    WETTZ13S   |     6      30      6 |     4      30   18:22:40 - 18:23:10 | 285.9517 - 286.0414 |  285.9517 -  286.0414
|-----------------------------------------------------------------------------------------------------------
```

In the next picture, you can see the expected results for **Option D**. The slew time of the next scan is at least as long as the observation time of the previous scan. This ensures that there is enough buffer-flush time.

```
|-----------------------------------------------------------------------------------------------------------
|    station    | delay |  slew |  idle | preob   obs        duration          |     az [deg]        |     unaz [deg]
|               |  [s]  |  [s]  |  [s]  |  [s]    [s]     start - end         |   start - end       |   start - end
|---------------|-------|-------|-------|-------------------------------------|---------------------|------------------
|    GGAO12M    |     6 |    56 |     0 |     4      47   19:22:07 - 19:22:54 |  41.6257 -  41.5760 | 401.6257 -  401.5
|    MACGO12M   |     6 |    27 |    50 |     4      39   19:22:07 - 19:22:46 |  38.3752 -  38.3789 | 398.3752 -  398.3
|    ONSA13NE   |     6 |    42 |    20 |     4      39   19:22:07 - 19:22:46 | 290.2050 - 290.2741 | 290.2050 -  290.2
|    ONSA13SW   |     6 |    40 |    24 |     4      38   19:22:07 - 19:22:45 | 290.2057 - 290.2731 | 290.2057 -  290.2
|    RAEGYEB    |     6 |    31 |    42 |     4      28   19:22:07 - 19:22:35 | 321.6867 - 321.6197 | 681.6867 -  681.6
|    WESTFORD   |     6 |    55 |    11 |     4      38   19:22:07 - 19:22:45 |  44.2547 -  44.2046 | 404.2547 -  404.2
|    WETTZ13S   |     6 |    32 |    40 |     4      47   19:22:07 - 19:22:54 | 305.3450 - 305.3562 | 305.3450 -  305.3
|-----------------------------------------------------------------------------------------------------------
| depth:  0                                                                       considered single scans
| scan:   no0096   (id: 5390)                                                                       durati
| Source: 0808+019 (id: 31)                                                                         type:
|-----------------------------------------------------------------------------------------------------------
|    GGAO12M    |     6 |    47      9 |     4 |    20 | 19:24:00 - 19:24:20 | 223.8693 - 223.9665 | 223.8693 -  223.9
|    KOKEE12M   |     6 |    48    121 |     4 |    20 | 19:24:00 - 19:24:20 | 104.1125 - 104.1572 | 464.1125 -  464.1
|    MACGO12M   |     6 |    39     25 |     4 |    10 | 19:24:00 - 19:24:10 | 185.9458 - 186.0313 | 545.9458 -  546.6
|    WESTFORD   |     6 |    65      0 |     4 |    17 | 19:24:00 - 19:24:17 | 227.5755 - 227.6514 | 227.5755 -  227.6
|-----------------------------------------------------------------------------------------------------------
| scan:   no0097   (id: 5391)                                                                       durati
| Source: 1929+226 (id: 74)                                                                         type:
|-----------------------------------------------------------------------------------------------------------
|    ONSA13NE   |     6      39     16 |     4 |    21 | 19:23:51 - 19:24:12 | 111.1961 - 111.2842 | 111.1961 -  111.2
|    ONSA13SW   |     6      38     18 |     4 |    20 | 19:23:51 - 19:24:11 | 111.1949 - 111.2788 | 111.1949 -  111.2
|    RAEGYEB    |     6      28     38 |     4 |    18 | 19:23:51 - 19:24:09 |  86.4610 -  86.5077 | 446.4610 -  446.5
|    WETTZ13S   |     6      47      0 |     4 |    21 | 19:23:51 - 19:24:12 | 105.2521 - 105.3325 | 105.2521 -  105.3
|-----------------------------------------------------------------------------------------------------------
```

In this example, the slew time of GGAO12M towards source 0808+019 is 47 seconds because the observing time in the previous scan was also 47 seconds. Thus, buffer flushing is the limiting factor here. Instead the slew time of WESTFORD is 65 seconds and larger than the previous observing time of 47 seconds – here, the slew time is really the limiting factor.

Intermezzo: system delays

Besides defining a proper observing mode, it might also be advantageous to properly adjust the antenna system delays in case this information is available.

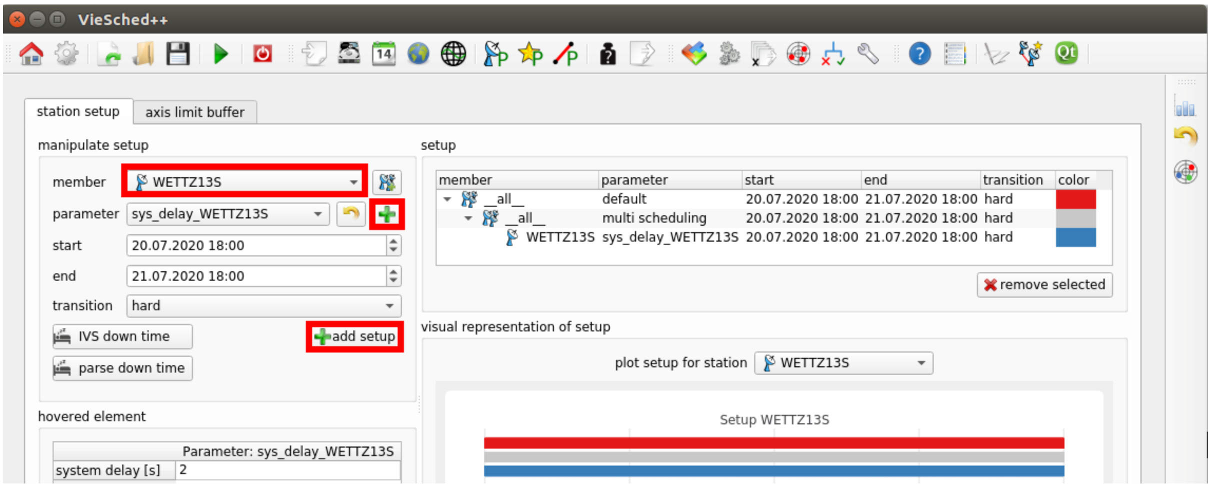
System delays are constant overhead times added in between all scans for executing field system commands and running tests. Currently, it might be that the system delay is rather high for some stations. However, this is subject to change and maybe it is not even necessary to adjust these system delays for your schedule.

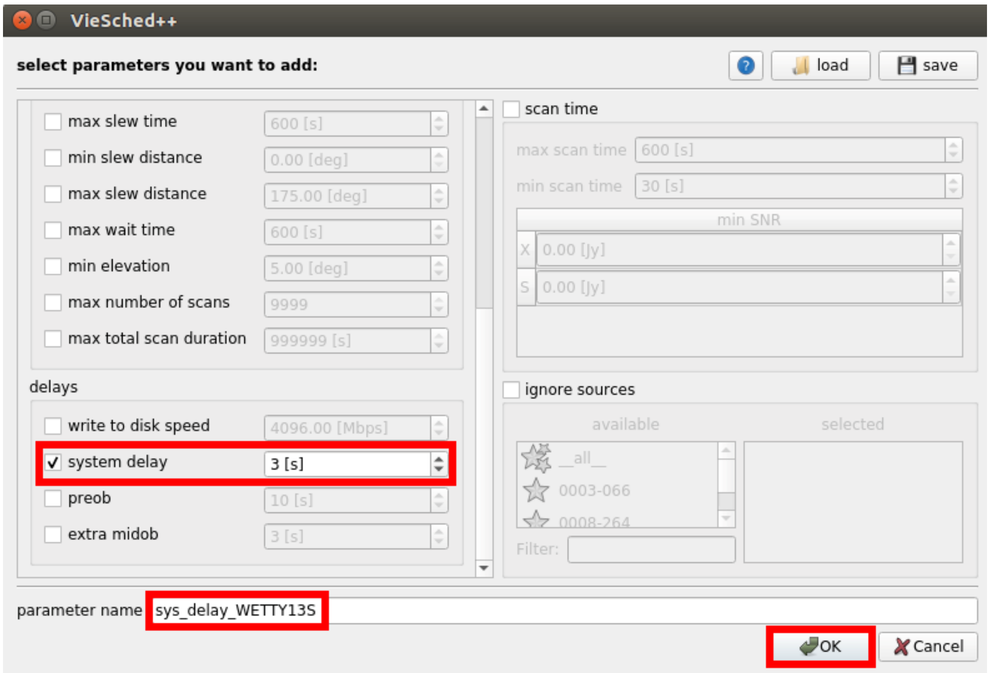
OPTIONAL – SYSTEM DELAY FOR A STATION

To change the system delay for a station, we need to define a new parameter and assign it to this station: Go to the station-based parameters and click on the icon right next to *"Parameter"*.

Next, change the *"system delay"* parameter, name the new parameter and click *"Ok"*. In this example, I named the parameter *"sys_delay_WETTZ13S"*.

Now you can select station WETTZ13S from the box right of *"Member"* and click on *" add setup"*. On the setup list on the right, a new line should appear with WETTZ13S and sys_delay_WETTZ13S.





You can redo this step multiple times for all antennas if required.

NOTE:

The system delays are additional constant overhead times added to the slew time. Thus, it is assumed that your station cannot slew at the same time as it executes the commands/checks that lead to the system delay. Instead, if the station can slew at the same time, define a “minimum slew time” instead of a “system delay” as done before.

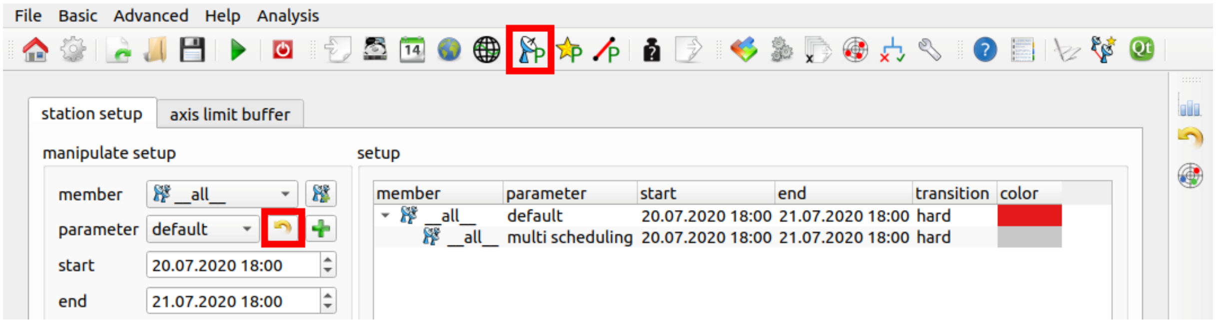
Continue with general scheduling

Now, that the observing mode is properly defined and you (optionally) optimized the system delays, it is time to move on with the general scheduling.

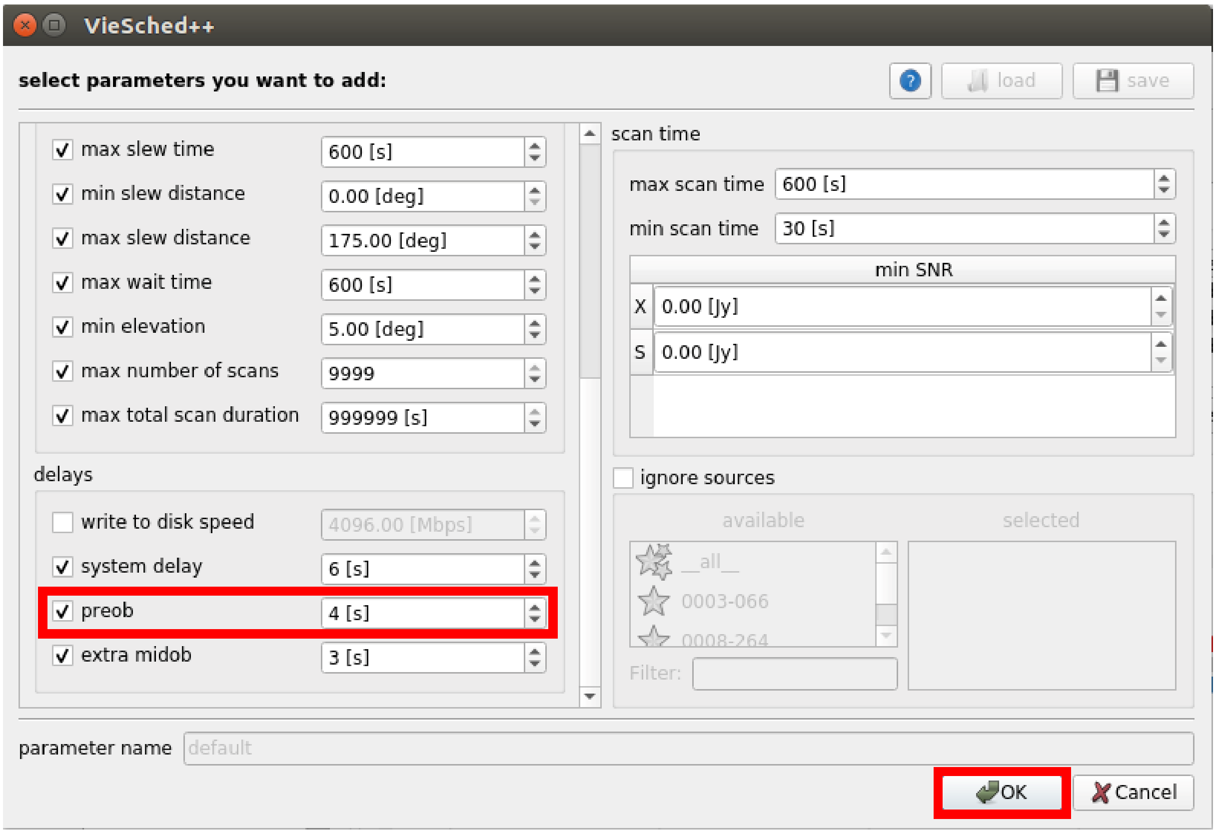
CHANGE CALIBRATION TIME:

For VGOS observations, the calibration time is typically set to 4 seconds in contrast to the 10 seconds used for S/X observations.

Go to the station-based parameters and change the *“default”* parameters by clicking the button next to the parameter name.



Now, look for the parameter *“preob”*, change it to 4 seconds and click *“Ok”*.



OPTIONAL - CHANGE MORE PARAMETERS:

Depending on your schedule, it might be desired to change more parameters. Parameters are grouped by station-based parameters, source-based parameters and baseline-based parameters. To change some parameters, click on the button next to the parameter name. **The default parameters should work well for most sessions.** However, it might be worth having a look at the available parameters to see what is available.

HINT:

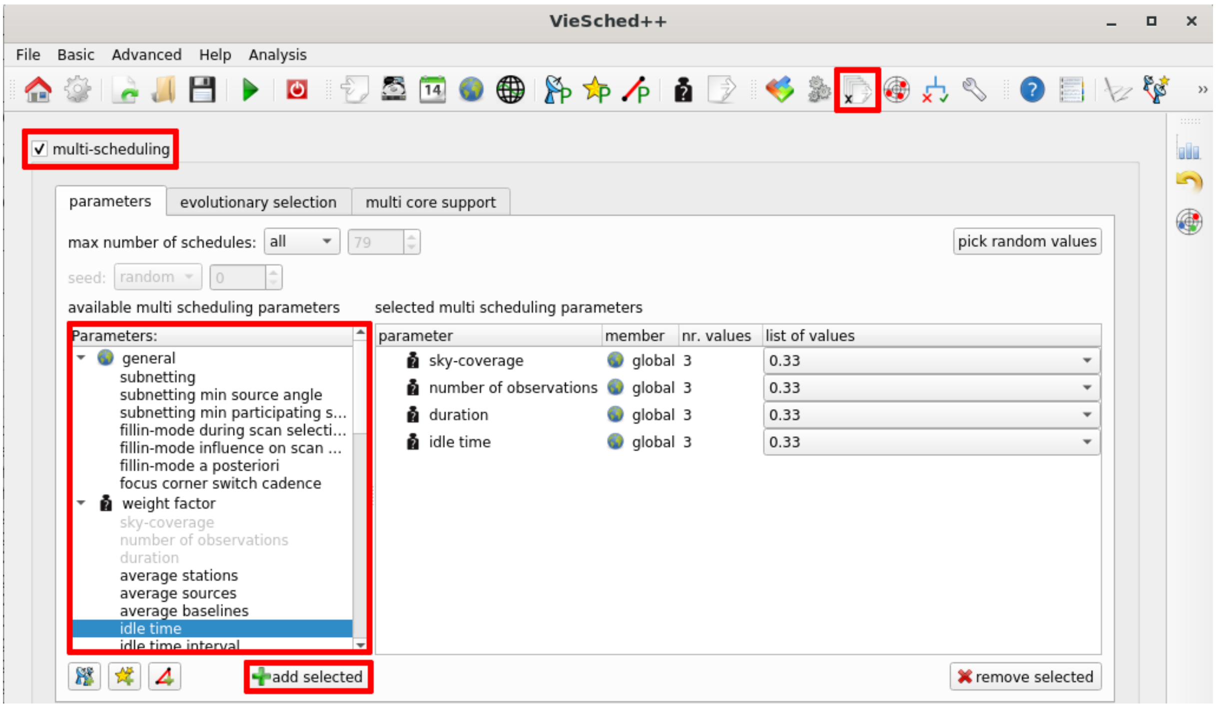
More information about how the parameters setup works, including some examples, can be found at the FAQ page and in the *"How to schedule an R1 session in VieSched++"* exercise.
In a nutshell: It is possible to give every station, source and baseline their own parameters. Additionally, it is possible to group elements and change the parameters for this group. The parametrization follows a tree-based setup.

There might be some reasons to change the parameters of one station:

- to add a station in tagalong mode
- to add additional down-time
- to limit the number of scans a station is allowed to observe (e.g.: for Svetloe)
- to increase the weight of a station to better include them in the schedule.

OPTIMIZE YOUR SCHEDULE:

We will optimize our schedule by using the multi-scheduling feature. This will automatically generate a high number of different schedules which can be compared to select the best one. The most important parameters to optimize are the *"weight factors"*, in particular the *"sky coverage"*, *"number of observations"*, *"duration"* and *"idle time"* weight factor.
You have to select one of the weight factors on the left and click *" add selected"*. A new window should appear where you can input the values that should be used to generate the schedules. We will use three different values (0.33, 0.66 and 0.99) for all four weight factors. This will in total generate 79 different schedules as a grid wise combination of all values.

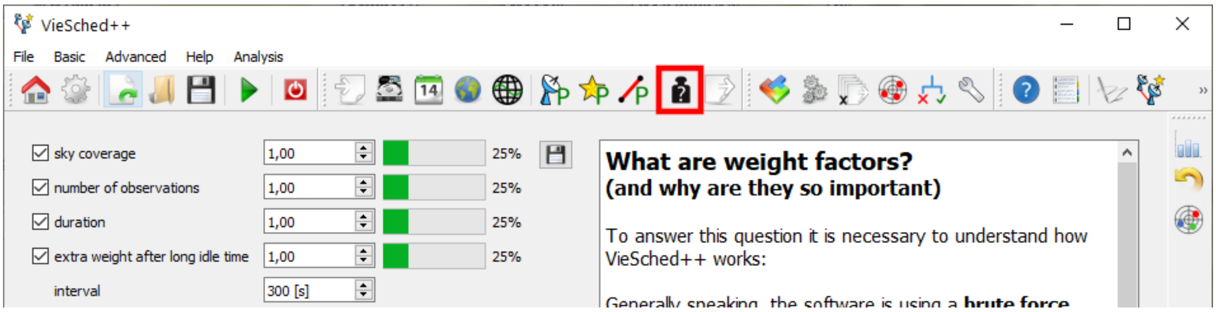


HINT:

You can automatically generate values if you like. Just define your start- and stop-value as well as your step size. In this example, the start would be 0.33, the step would be 0.33 and the end could be left to 1.00. If you click on “ generate” the values are automatically added to the list.

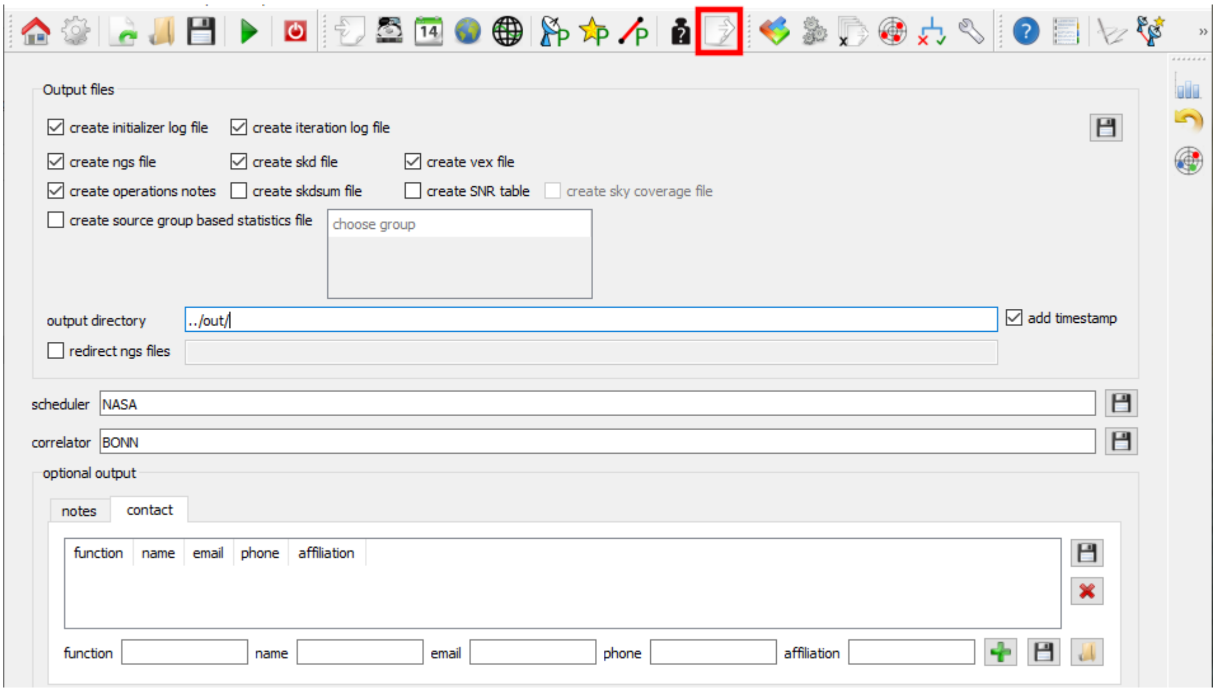
ALTERNATIVELY:

You can also select the weight factors explicitily. However, this will only generate one schedule.



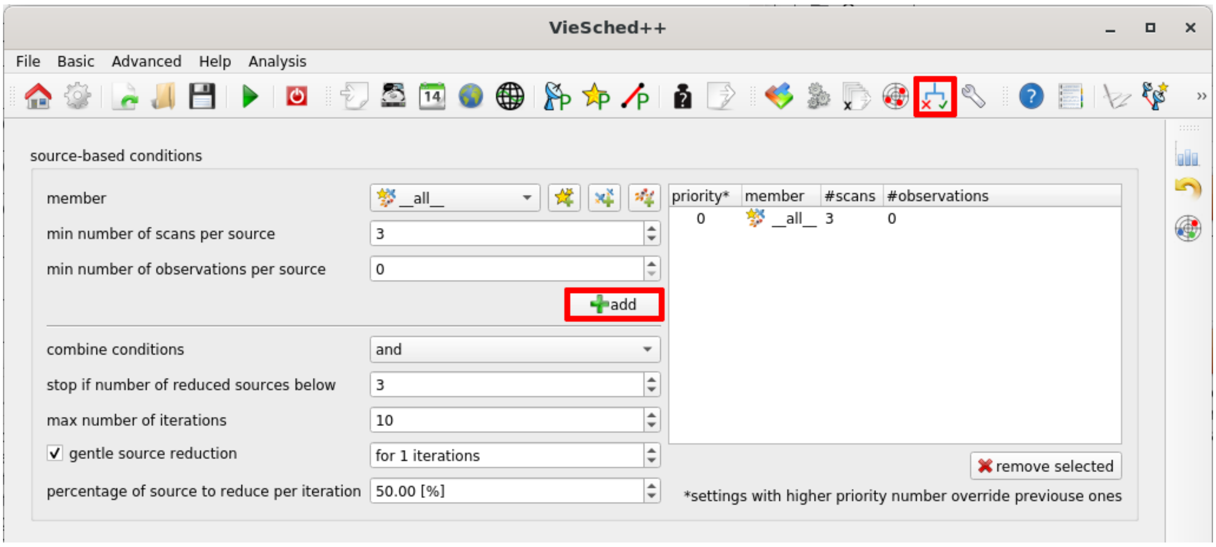
DEFINE OUTPUT:

In principle, you can **leave the default values** here. It might be good to add contact information as well as provide some notes. They will appear in the operation notes file. (Information about down-time and tagalong time is automatically added to the operation notes file and does not have to be listed here.



ITERATIVE SOURCE SELECTION:

You might want to use an iterative source selection to avoid scheduling many sources with only a few scans. Therefore simply click on " add" to add a new rule to the iterative source selection algorithm. The default rule says that you want to at least observe each source three times. This is reasonable for most sessions.

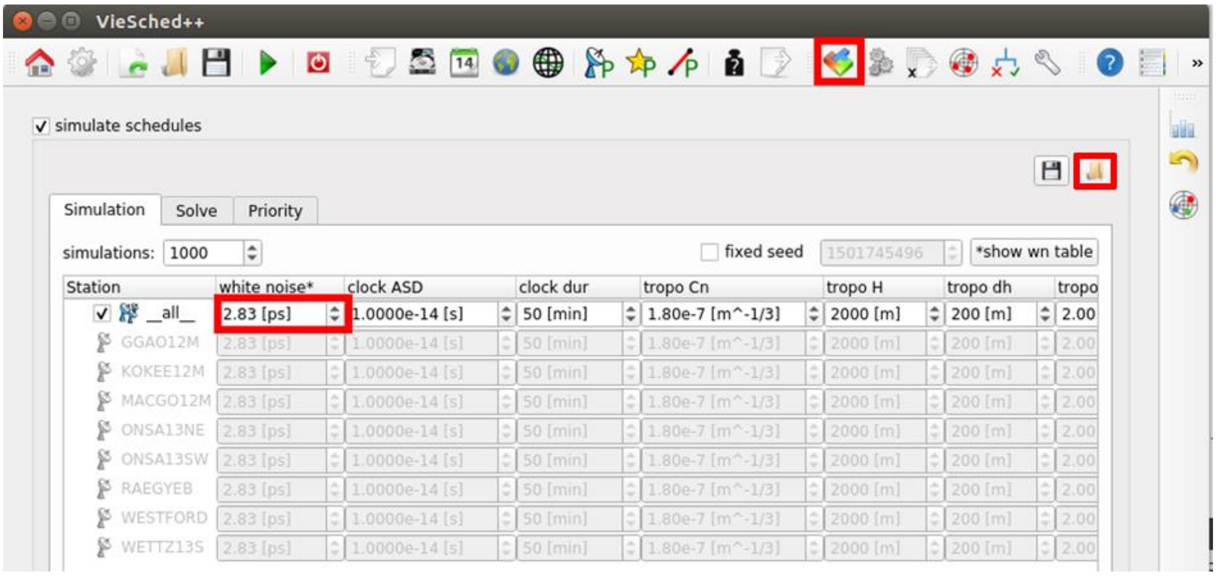


SIMULATE YOUR SESSIONS:

If you want to simulate your schedules, simply click on the "simulate schedules" checkbox. The default simulation parameters, as well as estimated parameters, should work well for a 24 hour S/X session but might need to be adjusted for VGOS sessions.

Here, you can define your simulation parameters, the estimated parameters during analysis, as well as define the priorities of the session to output recommendations.

The default parameters should work well for 24-hour S/X sessions. For VGOS session, you might want to lower the white noise from 17.68 picoseconds per station (25 ps per observation). In this example. I did set it to 2.83 ps (4 ps per observation).

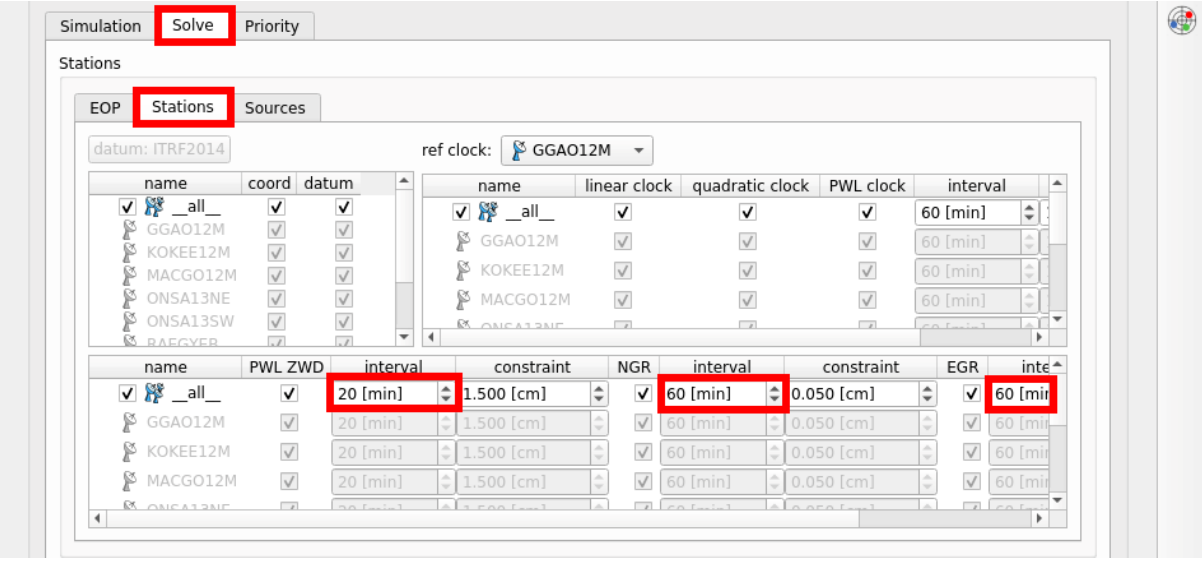


HINT:

If you click on the load icon on the top right, then you can load some predefined simulation/estimation settings. There is one called "24_hour_VGOS" that you can use.

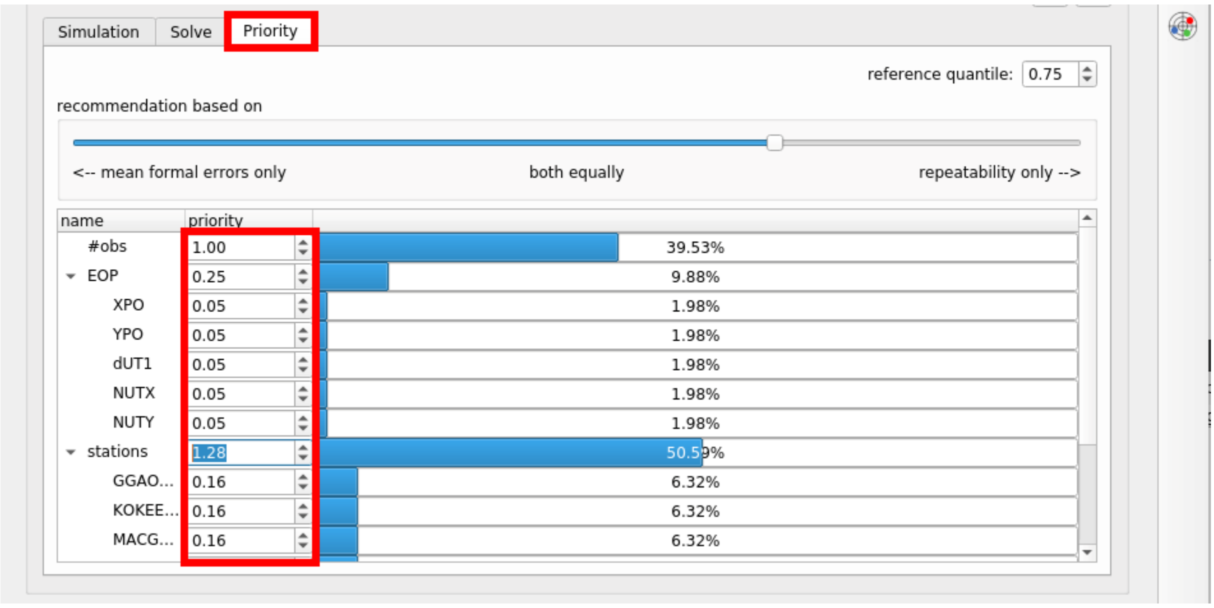
OPTIONAL – CHANGE TROPOSPHERE ESTIMATION INTERVALS:

You might want to reduce the estimation interval of the tropospheric parameters for this VGOS session. In this example, I want to estimate ZWD every 20 minutes and gradients every hour instead of the default 30 minutes for ZWD and 3-hours for gradients.



OPTIONAL – OUTPUT PRIORITIES:

Next, you can define the priorities of the session. Note that this does not affect your scheduling in any way. The idea is, that you generate multiple different schedules via the multi-scheduling feature. After the scheduling is done, VieSched++ will report which version is the best one based on the priorities you set. A high priority value for one parameter means that VieSched++ will recommend a schedule performing well for this parameter. Always include a high number of observations ("#obs") as one of the main goals of your session.



START SCHEDULING:

You can start the scheduling process by clicking on the ▶ button at the bottom right of VieSched++.
Generating all schedules might take some time. If it takes too long consider reducing the number of schedules generated with the multi-scheduling tool.
The log file lists the scheduling progress (check if there are any warnings or errors).
If you did use the option to output a recommended schedule, VieSched++ will list it at the end of the log file (as well as some alternatives).
A more general way to compare schedules is by using the statistics tool in VieSched++.
To view statistics and plots of one explicit schedule, use the VieSched++ Analyzer.

VieSchedpp log

processing file: ../out/20200720103831_VO0202/VieSchedpp.xml

```
[2020-07-20 10:41:19.404328] (0x00007ff1c946e700) [info] version 6: finished
[2020-07-20 10:41:19.630467] (0x00007ff1c4c65700) [info] version 4: finished
[2020-07-20 10:41:20.990339] (0x00007ff1cbc73700) [info] version 8: finished
[2020-07-20 10:41:26.162398] (0x00007ff1df1ba8c0) [info] version 18: finished
[2020-07-20 10:41:26.266588] (0x00007ff1df1ba8c0) [info] recommended schedule: version 40 (score: 0.8464 # obs: 22514)
[2020-07-20 10:41:26.266631] (0x00007ff1df1ba8c0) [info] alternative schedule: version 54 (score: 0.8297 # obs: 20850)
[2020-07-20 10:41:26.266645] (0x00007ff1df1ba8c0) [info] alternative schedule: version 23 (score: 0.8229 # obs: 23171)
[2020-07-20 10:41:26.266803] (0x00007ff1df1ba8c0) [info] VieSched++ is closing
[2020-07-20 10:41:26.267167] (0x00007ff1df1ba8c0) [info] created scans: 13366420
[2020-07-20 10:41:26.267175] (0x00007ff1df1ba8c0) [info] created observations: 75413865
[2020-07-20 10:41:26.267182] (0x00007ff1df1ba8c0) [info] created antenna pointings: 87096673
[2020-07-20 10:41:26.268354] (0x00007ff1df1ba8c0) [info] execution time: 2m 53s 790ms
```

Besides scheduling related files, VieSched++ outputs some general files which might be of interest:

- ***VieSchedpp.xml:*** input file for VieSched++. Includes all settings and can be used to regenerate schedule.
- ***VieSchedpp_*datetime*.log:*** copy of the log file. It can be used to browse for warnings and errors.
- ***statistics.csv:*** machine-readable file including many statistics of each generated schedule. It can be used to write a script to select the best schedule
- ***simulation_summary.txt:*** human-readable file summarizing simulation result:

mean formal errors:

v	score	#obs	XPO	YPO	dUT1	NUTX	NUTY	GGAO12M	KOKEE12M	M
1	0.5938	22480	48.1384	42.9735	1.5709	16.3128	14.8442	1.2290	1.8137	
2	0.5084	22021	46.7943	41.9854	1.5468	16.2783	15.4356	1.2024	1.7686	
3	0.2734	21891	46.9044	43.0662	1.5321	16.9124	15.5278	1.2517	1.7418	
4	0.5393	21800	46.7913	41.9123	1.5460	16.6936	15.3911	1.2400	1.7963	
5	0.4867	21959	46.7131	42.5554	1.5519	16.3312	15.1899	1.2197	1.7849	
6	0.2521	21810	46.5940	43.0417	1.5100	16.6740	15.8426	1.2707	1.7581	
7	0.4395	21635	47.2765	42.5091	1.5667	16.8429	15.4186	1.2101	1.8236	
8	0.0000	21783	47.9615	44.9499	1.5980	16.7303	15.4962	1.3187	1.8638	
9	0.3894	21667	45.7347	42.4362	1.5071	16.5955	15.4102	1.2256	1.7357	
10	0.7181	22958	52.5804	42.9616	1.6535	15.9427	15.1924	1.1489	1.8679	
11	0.6185	22696	51.7034	42.9549	1.6497	16.2134	14.9940	1.1619	1.8714	
12	0.3828	22108	52.4273	42.6549	1.6957	16.6195	15.2259	1.1694	1.8630	
13	0.6654	22941	50.0131	43.7894	1.6174	16.0916	15.1744	1.3103	1.8456	
14	0.8566	22867	47.5418	42.3288	1.5353	15.9383	14.8817	1.2320	1.7503	
15	0.6963	22523	47.5322	42.3553	1.5361	16.3441	15.1988	1.2291	1.7432	
16	0.6895	22124	48.6486	41.8415	1.5986	16.6417	15.4695	1.1543	1.8465	
17	0.7322	22616	46.6654	41.7469	1.5535	16.1433	15.0089	1.2723	1.7576	
18	0.7015	22547	46.2567	42.1760	1.4988	16.4908	15.3454	1.2485	1.7649	
19	0.5309	23221	57.7069	44.0250	1.7734	15.5261	15.0689	1.1867	2.0006	
20	0.4498	22975	55.8610	43.4144	1.7556	15.7371	15.1106	1.1952	1.9766	
21	0.4669	22743	54.9049	43.4793	1.7274	16.0534	15.1329	1.1514	1.9374	
22	0.7461	23300	55.4821	44.2983	1.7529	15.6153	14.8497	1.2151	2.0004	
23	0.7683	23171	52.0148	42.8785	1.6348	15.8005	15.2986	1.1864	1.8707	
24	0.9627	23142	49.3132	41.9715	1.5841	16.0940	15.1252	1.1903	1.7790	
25	1.0000	23349	52.5976	42.4132	1.6811	15.4422	14.9546	1.1487	1.9411	
26	0.8975	22977	50.8610	42.1831	1.6488	15.5504	15.1498	1.1694	1.8770	
27	0.6934	22885	49.3757	43.3076	1.5920	16.2428	14.9930	1.2476	1.8436	
28	0.4686	21483	47.2846	41.7145	1.5322	16.4436	15.3734	1.1961	1.7509	

HINT:

If you regularly schedule VLBI sessions, especially for IVS, have a look at ***"VieSched++ AUTO"***, a simple python program that automatically does the scheduling and uploading for you. VieSched++ AUTO is meant to run as a daily cronjob and notifies you per mail in case it did run any session (including statistics and plots that let you decide immediately if the schedule is good or not).
https://github.com/TUW-VieVS/VieSchedpp_AUTO