# How to schedule an R1 session in VieSched++

This exercise shows how to generate a simple schedule for an R1 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.

First, you have to select your catalog files. VieSched++ will automatically download the newest set of catalog files on startup. They are automatically stored in the *"./AUTO_DOWNLOAD_CATALOGS/"* folder (check the *"README.md"* file in your installation directory to make sure that the automated download works). For a simple R1 schedule, the default catalogs can be used.
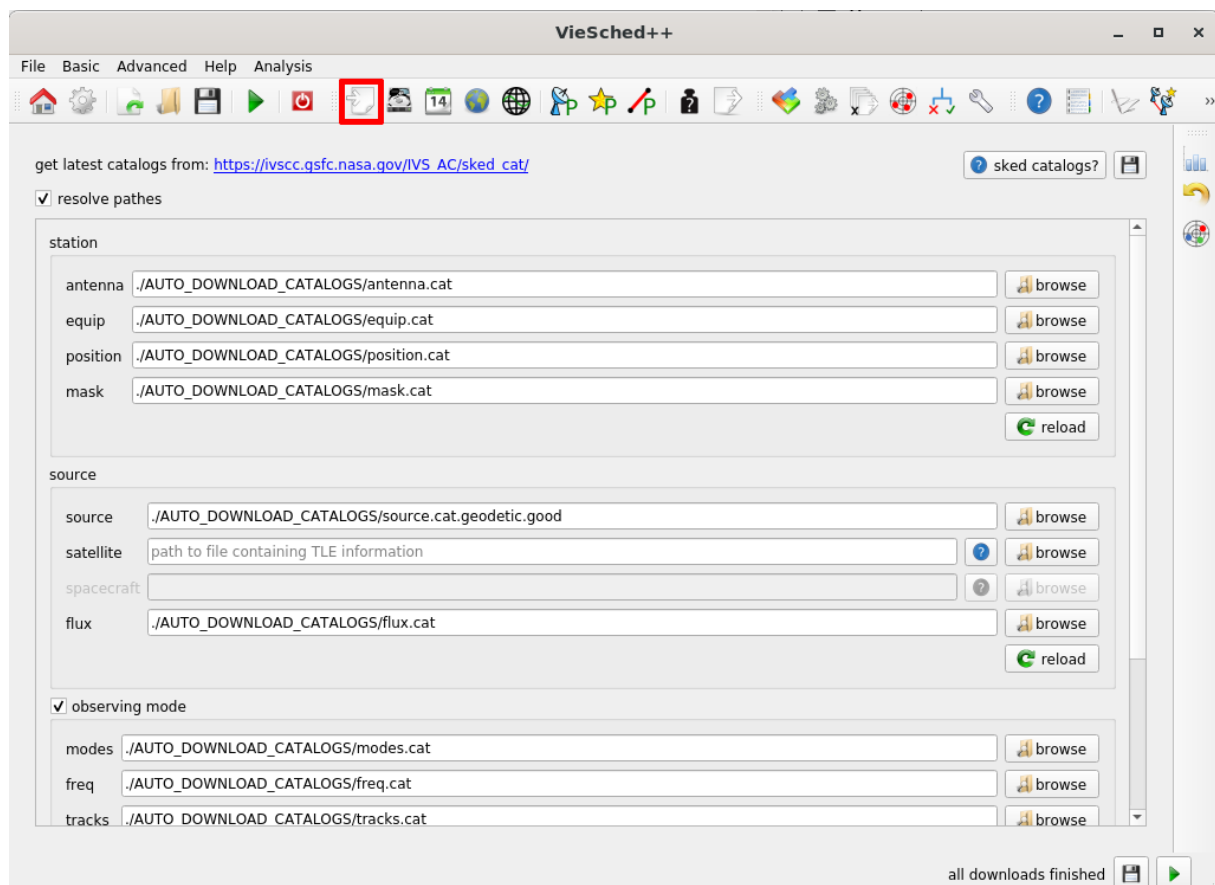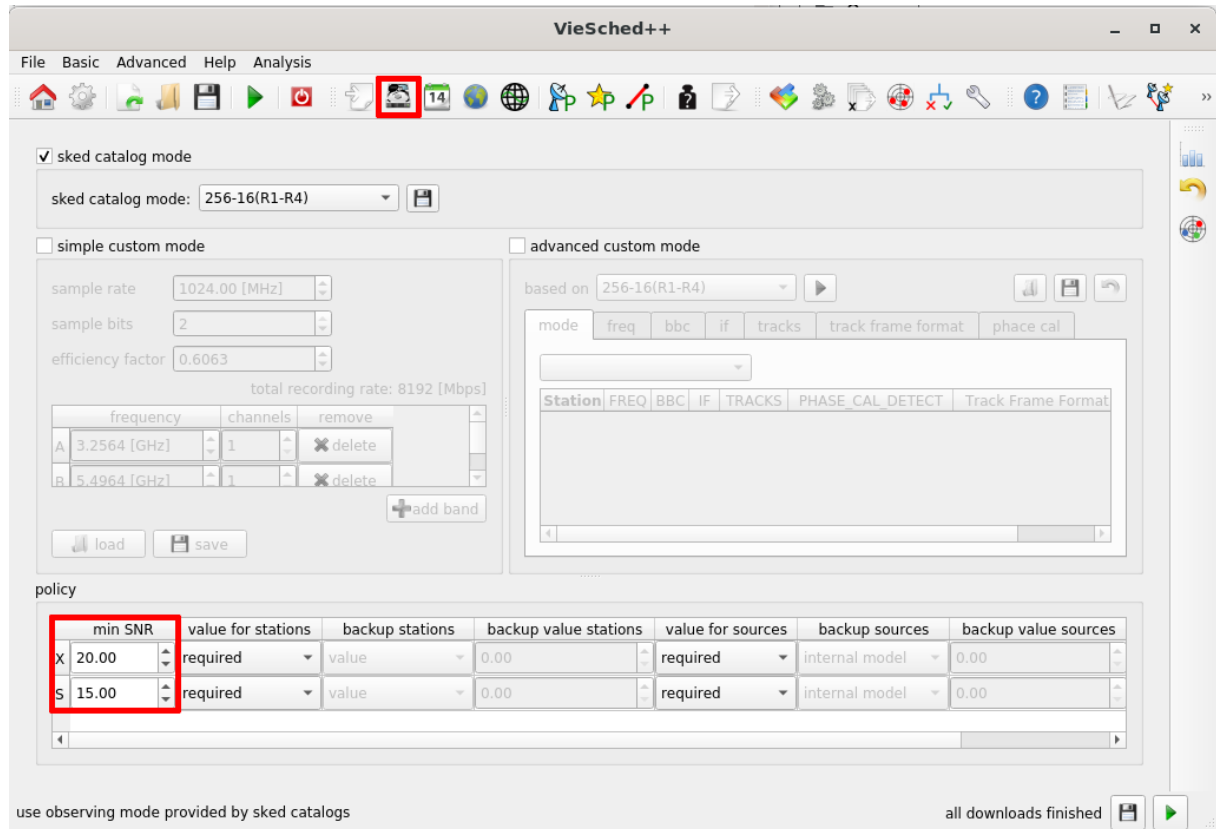

> HINT:
> You will often see small buttons with a save icons 💾 in various parts of VieSched++ (for example, at the top right here, next to the *"sked catalogs?"* button). If you click on this button, your changes will be saved and automatically loaded the next time you start VieSched++.

CHANGE OBSERVING MODE AND TARGET SNR:

The first thing you have to do is to define which observing mode should be used for this session. For real experiments, use one entry from the *"sked catalog mode"*. Next, you can set a minimum signal to noise ratio (SNR) per observing band.


HINT:

If you are unsure what a button or field in VieSched++ does, you can enter the *"What's this?"* mode by pressing F1 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.

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 setup 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 *"R1946"*.
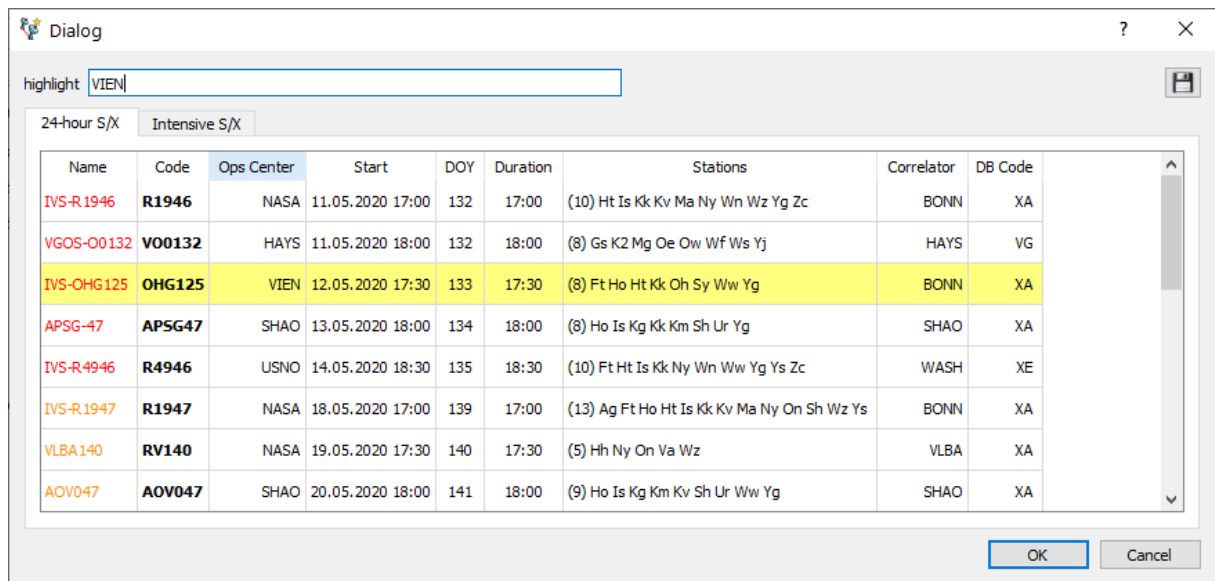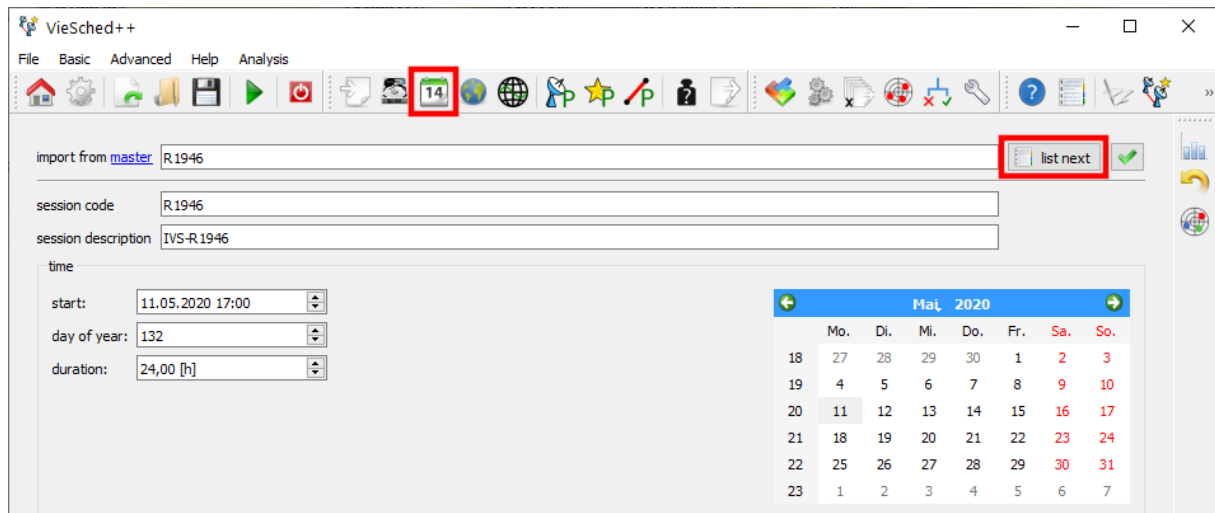
ALTERNATIVELY:

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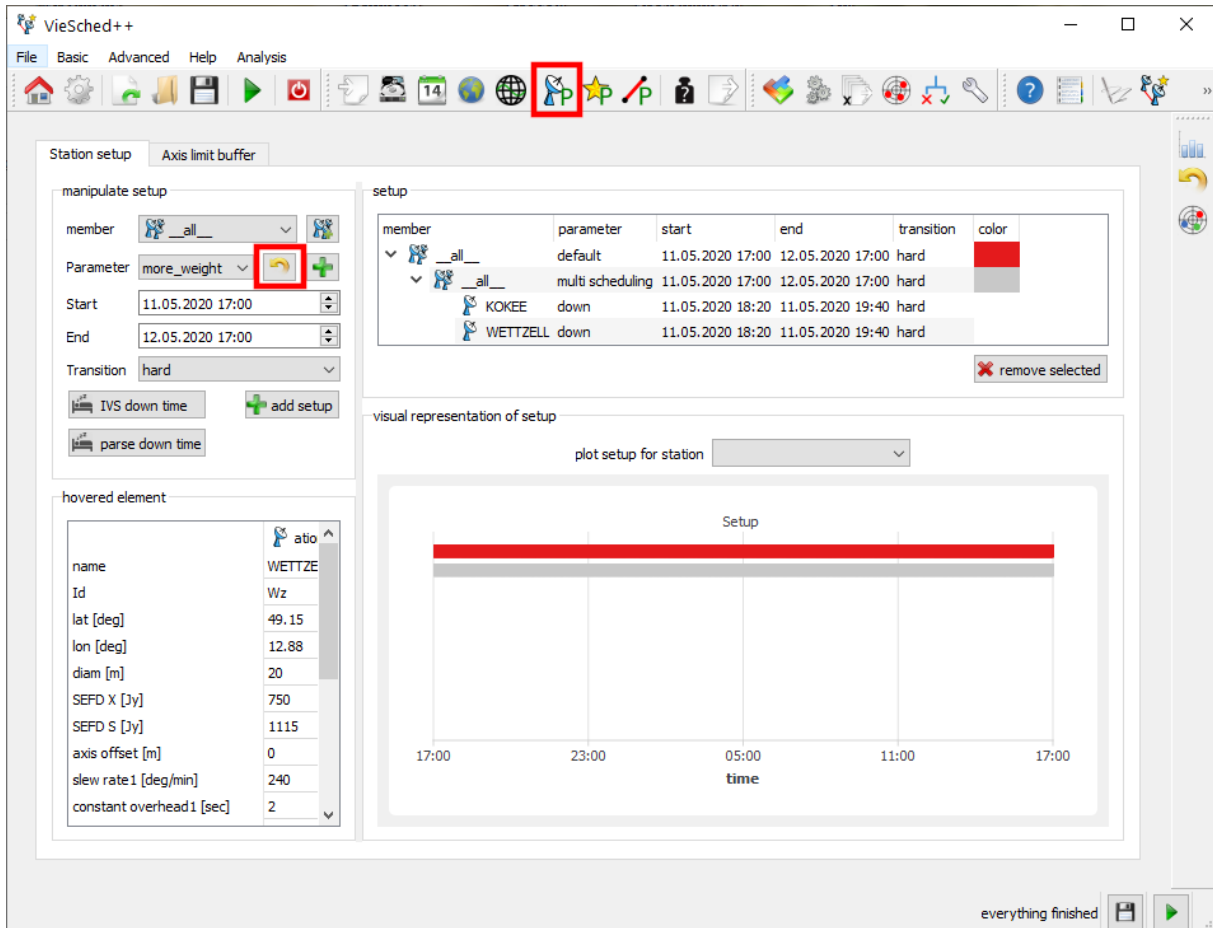
Of course, you can also simply enter all the settings by hand. Session name and start time can be entered here, the network can be defined at the network page 🌐.

HINT:

You can highlight session sessions designated to your scheduling center. Save your scheduling center name for the future 💾.

DEFINE YOUR PARAMETERS:

Parameters are grouped by station-based parameters 🛰️P, source-based parameters ⭐P and baseline-based parameters ╱P. 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.

You can notice that VieSched++ automatically added down-times for station KOKEE and WETTZELL due to an intensive session taking place at the same time.

HINT:

More information about how the parameters setup works, including some examples, can be found at the FAQ page 📋.
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.

The next section shows how to change the parameters of one station

This section demonstrates how to change the parameters of one station. We will put station KOKEE in tagalong mode. First, we have to generate a new set of parameters and then we have to assign these parameters to a station.

We need to create a new parameter by clicking on the ✚ icon next to *"Parameter"*.

Change the parameters to your need (in this example we will change *"tagalong"* to *"yes"*.

Enter a parameter name (e.g.: *"tagalong"*) and click *"OK"*.
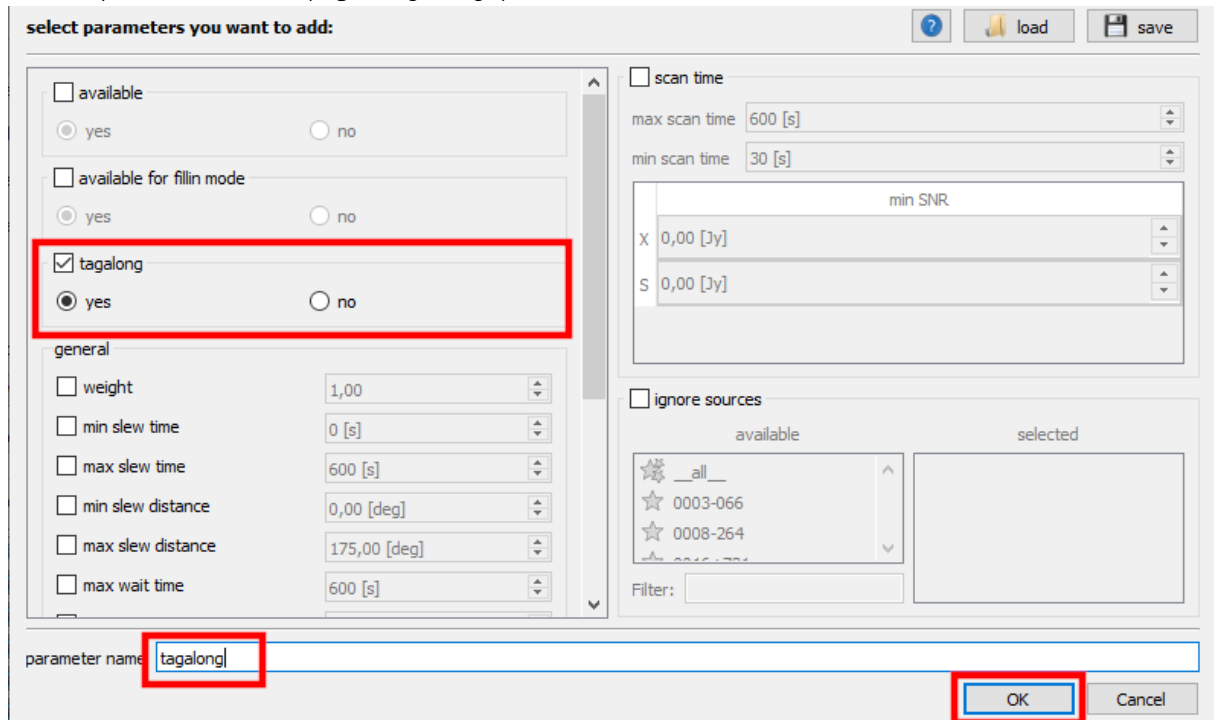
Now you have to select KOKEE as *"member"* and select our parameter *"tagalong"*. We could define a time-span when these parameters should be used, but in this example, we can leave it to the default start- and end-time (which is the full session duration).

Now we need to click "✚ *add setup*" to assign this parameter set to KOKEE. It should now appear at the list at the right, as well as at the time-depending plot for KOKEE at the bottom.
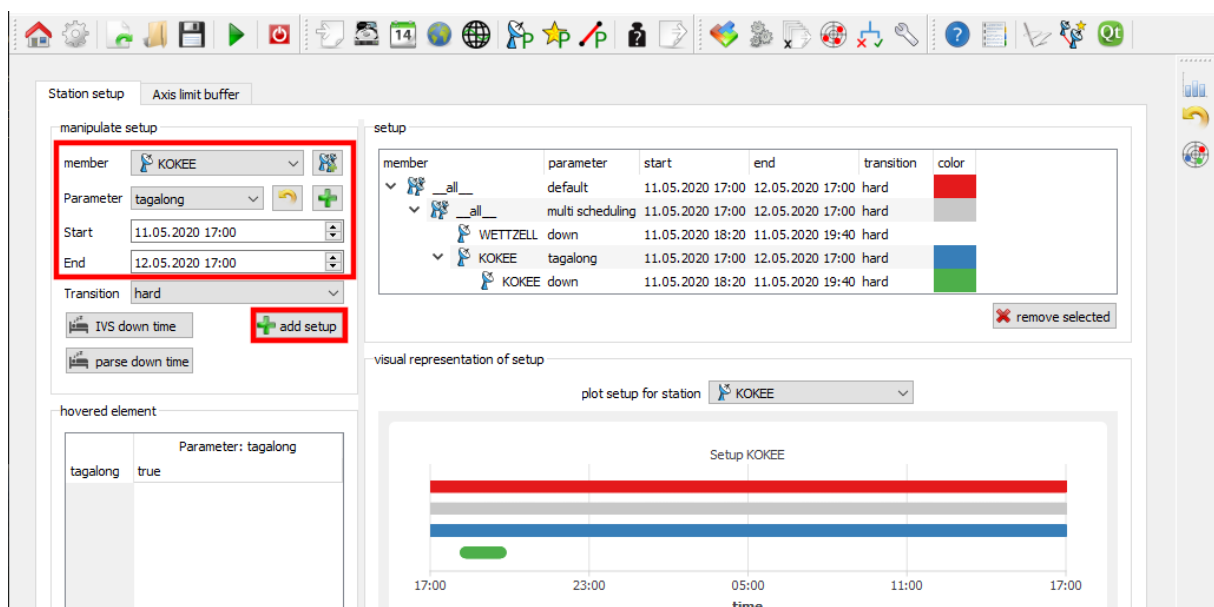
We will optimize our schedule by using the multi-scheduling feature. This will automatically generate a high number of different schedules which can be compared to select the best one. The most important parameters to optimize are the *"weight factors".*, in particular the *"sky coverage"*, *"number 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.
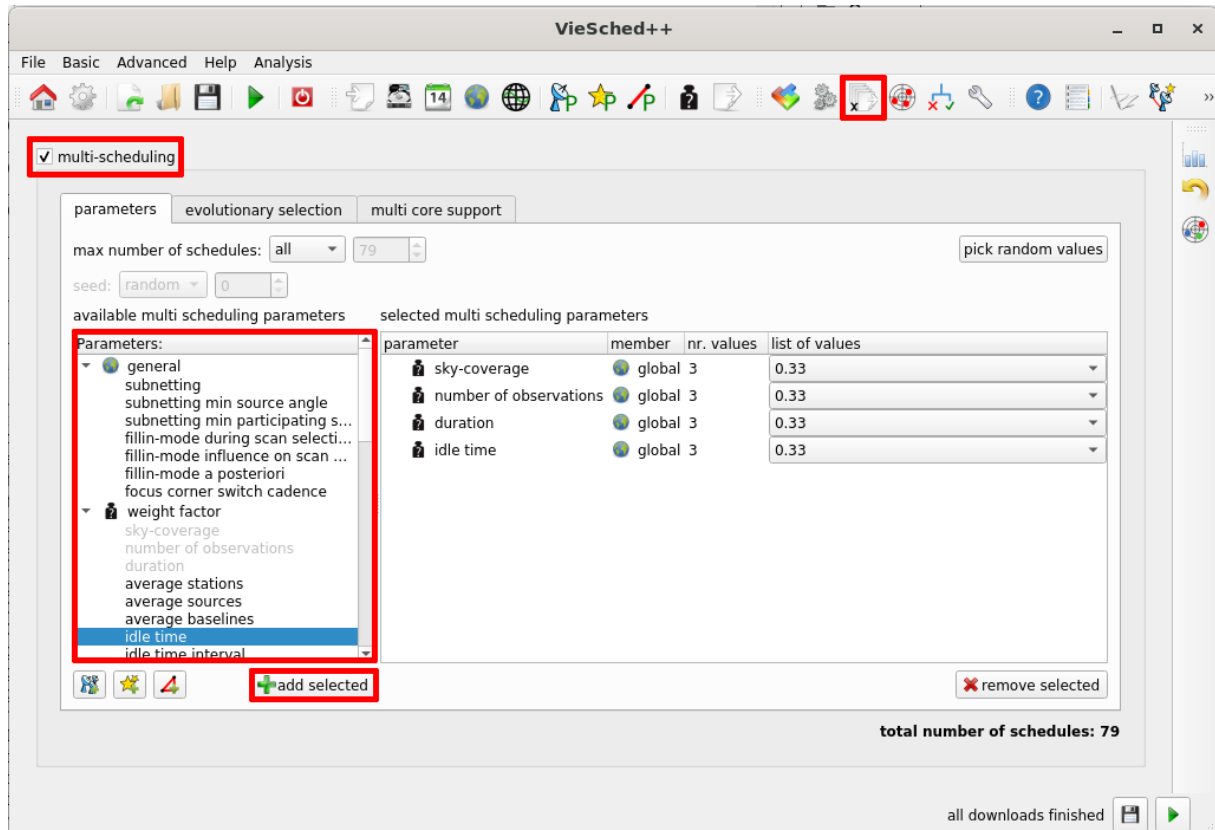
HINT:

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.
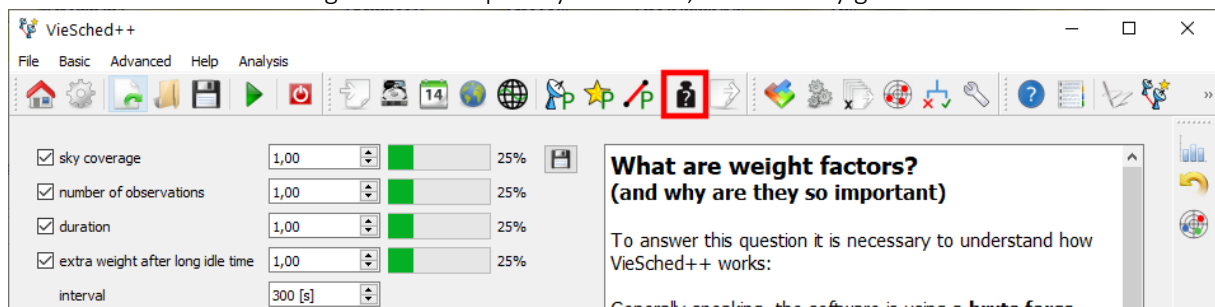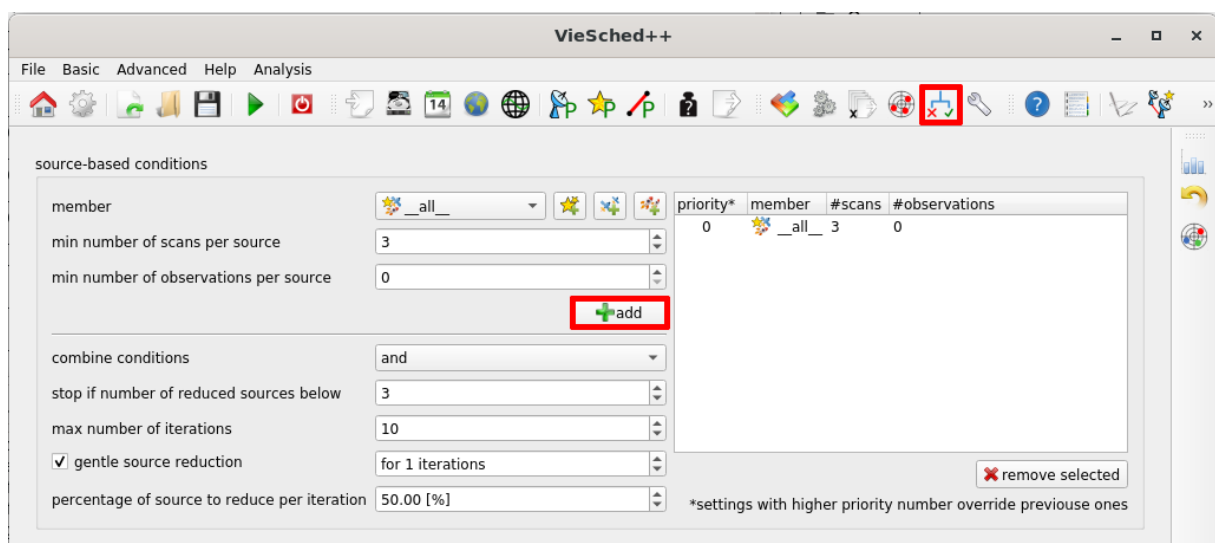
DEFINE OUTPUT:

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.
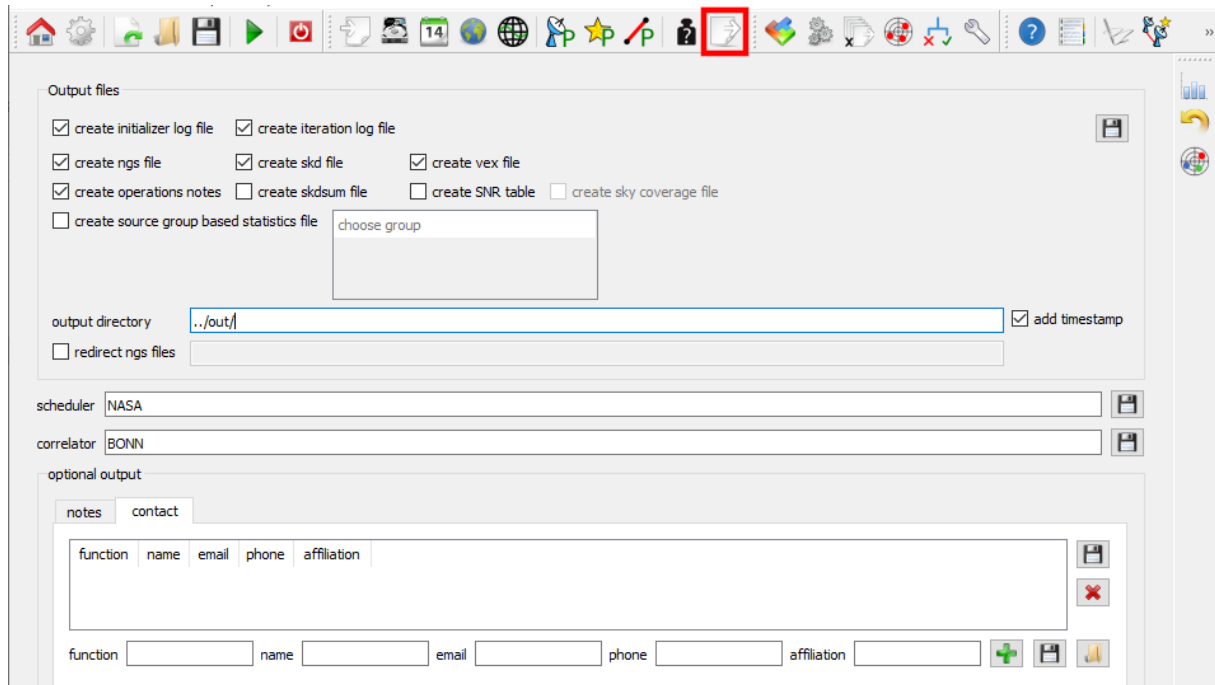
ITERATIVE SOURCE SELECTION:

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.

You might want to consider scheduling calibrator scans.

You can simply click on the "Schedule calibration scans" checkbox to enable this option. There are plenty of options to customize your calibration blocks. The default settings will schedule two calibrator blocks, one 10 minutes after the session start and one close to the session end. Within each calibrator block, two scans are scheduled with a fixed observation duration of 300 seconds. The observed sources are chosen to reach a very high SNR with many stations.

The default settings should work well for R1 (and similar) sessions. In case you have a low recording rate, it might be better to increase the scan duration.
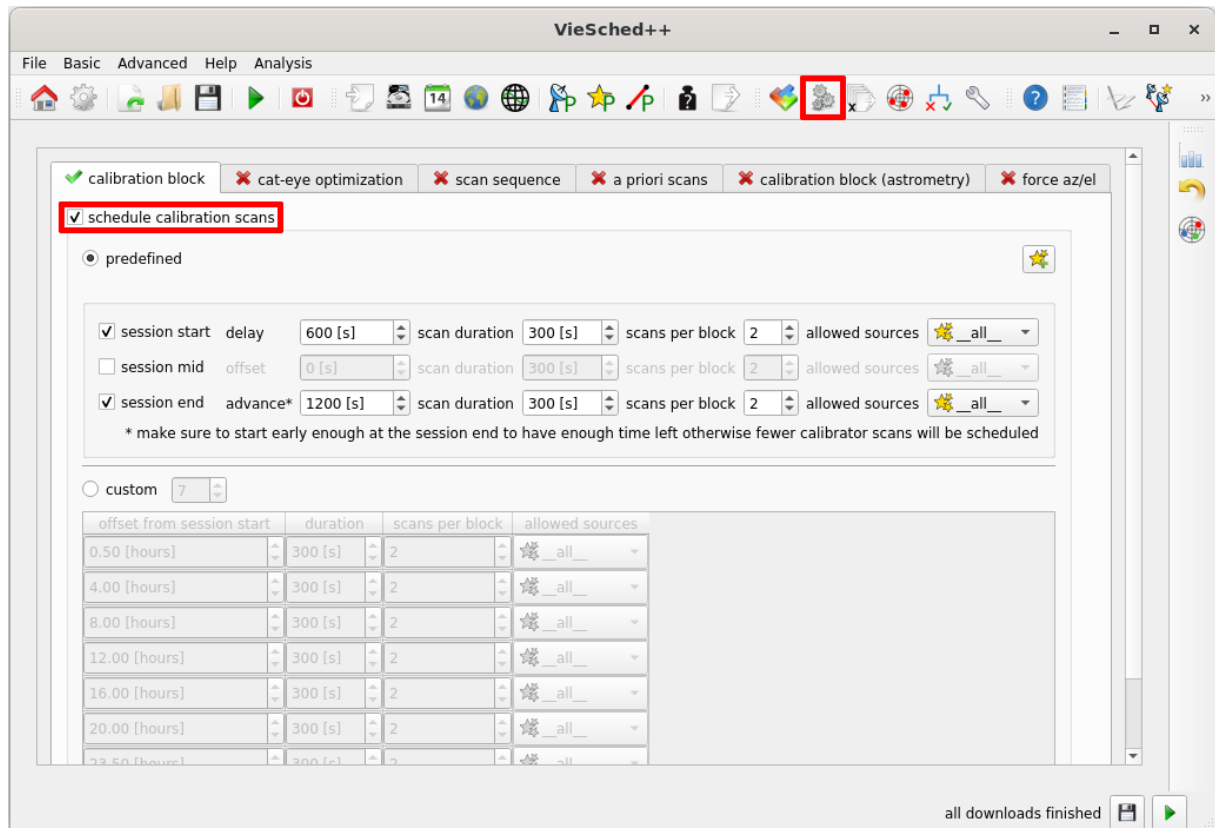
If you want to simulate your schedules, simply click on the "simulate schedules" checkbox. **The default simulation parameters, as well as estimated parameters, should work well for a 24-hour S/X session.**
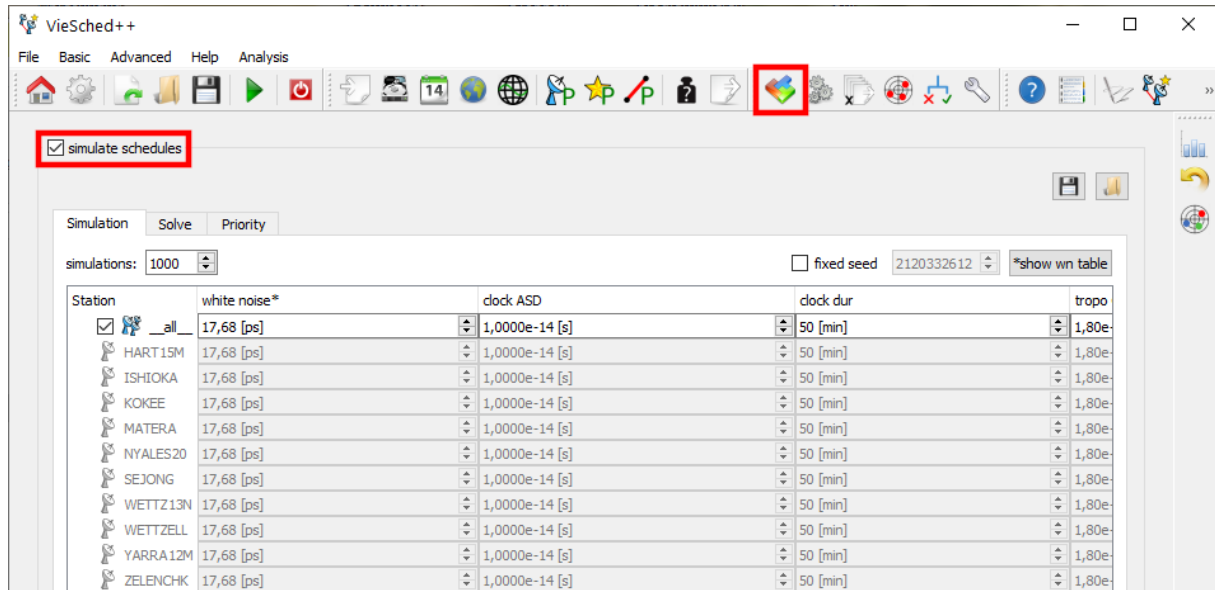
It is possible to output a recommendation of which schedule to use. To enable this, check *"output recommendation"* in the *"Priority"* tab. Note that this will not affect your scheduling in any way. It will simply list the version number of which schedule VieSched++ thinks is the best one to the log file.

You can define the focus of your session by changing the "priority" value in the list below. 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 observation (*"#obs"*) as one of the goals of your session.
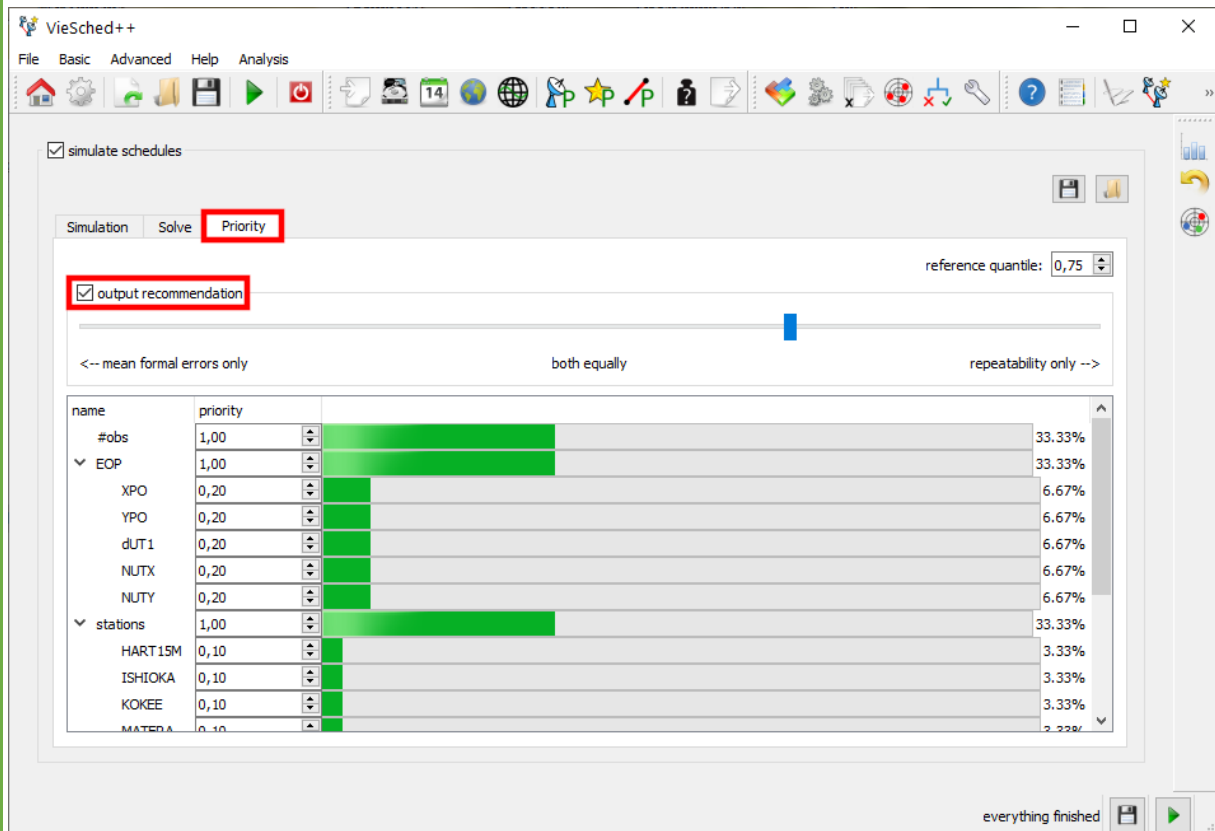
START SCHEDULING:

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 🎯.

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:

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