# 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 <sup>(2)</sup> 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 <u>http://repositum.tuwien.ac.at/obvutwhs/content/titleinfo/4655766</u> 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.

1	▫◢◻ ▶ थ [2]♀ ਘ ♥ ₩ № ᄵ / 8 2 ♥ ≫ ↓ ♥	S 0	125
atest cata	ogs from: https://ivscc.gsfc.nasa.gov/IVS_AC/sked_cat/	o sked catalogs?	8
Station			^
antenna	./AUTO_DOWNLOAD_CATALOGS/antenna.cat	browse	
equip	./AUTO_DOWNLOAD_CATALOGS/equip.cat	a browse	
position	./AUTO_DOWNLOAD_CATALOGS/position.cat	browse	
mask	./AUTO_DOWNLOAD_CATALOGS/mask.cat	J browse	
		C reload	
		- TCIOGG	
Source		10000	

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 <a href="https://ivscc.gsfc.nasa.gov/sessions/">https://ivscc.gsfc.nasa.gov/sessions/</a> 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".

nport from <u>mas</u>	ter VO0202	2								📄 list	next <
ession code	VO0202	2								]	
ession descripti	on VGOS-O	0202								]	
ime											
start: 2	0.07.2020 18	3:00 ‡		<			Juli	2020			>
day of year: 2	02	÷		27	Mo.	Di.	Mi.	Do.	Fr.	Sa. 4	So.
duration: 2	4,00 [h]	\$		28	6	7	8	9	10	11	12
				29	13	14	15	16	17	18	19
				30	20	21 28	22 29	23 30	24 31	25	26 2
				32	3	4	5	6	7	8	9
eneral											
fillin-mode			subnetting				idle to o	bserving	time		8
✓ during sca	n selection		min source angle		150 00 [de	al â	O ves	) no			
✓ a posterio	ri			stations		▲ 16	station	ns 🕅	all 👻	22	
✓ ∲ min s ✓ ∲ min r	repeat 18	\$0 [s]	<ul> <li>min participating</li> </ul>	stations	all but 1	<b>*</b>					
ect start date					2			;	all dowr	lloads fin	ished 🗎
ghlight HAYS					J						
24-hour S/X	Intensive	e S/X									
Name	Code	Ops Center	Start	DOY	Duration			Stat	ions		(
IVS-R1956	R1956	NASA	20.07.2020 17:00	202	17:00	(12) A	g Ft Ho	Ht Kk M	1a Nt N	ly Sh Wz	z Yg Ys
	VO0202	HAYS	20.07.2020 18:00	202	18:00	(8) Gs	K2 Mg	De Ow I	WfWs	Yj	
VGOS-00202	CRD107	VIEN	21.07.2020 17:30	203	17:30	(6) Ag	Hh Ho	Oh Ww	Yg		
VGOS-O0202 IVS-CRD107											
VGOS-00202 IVS-CRD107 AOV049	AOV049	GSI	22.07.2020 18:00	204	18:00	(6) Ho	o Kg Kv S	on ww y	g		

#### 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.

<b>ķ</b>	VieSche	ed++													_			×
File	Basic	Advanced	Help	Analysis														
1	<b>}</b> ∰	2	-	Þ 🙋		S 14	6	ֆ 쳐	<b>/</b> P	2	<b>\$</b>	<b>D</b>	🕏	, ۹		1/2	<b>\$</b>	>>
																	1	
	<mark>∕ sked</mark>	catalog mode	2															ala.
	use this	sked cataloo	mode:	256-16(R1-R	4)	~	P											5
					<i>.</i>													Æ

#### DEFINE FIXED OBSERVATION DURATION:

Next, you can set the fixed 30 second observing duration. Go to the source-based parameters  $2^{+}$  and change the *"default"* parameters by clicking the  $2^{-}$  button next to the parameter name.

)VieSched++	
2 💽 🛃 🛅 🕨 🔯 🐑 🏧 🐿 🖤 🏠 🏞 🗚 💈	2 🤜 🖗 💭 🧐 🎝 👋 🚺 🗁 4
nipulate setup	
nember       member     parameter     start       varameter     default     20.07.2020     00:00       tart     20.07.2020     00:00     #       and     21.07.2020     00:00     #	end         transition         color           0:00         21.07.2020         00:00         hard         Image: Color           0:00         21.07.2020         00:00         hard         Image: Color
you can set the fixed observation duration of 30 second VieSched++	ls and click on <i>" VOk"</i>
t parameters you want to add:	🕗 🛄 load 💾 save
min SNR	
X 0.00 [Jy] available	selected
s 0.00 [Jy]	
ixed scan duration	
available	selected
ixed minimum time between scans	
ne 1800 [s] 🗘	

# 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  $\mathbb{P}$  and change the *"default"* parameters by clicking the  $\mathbb{P}$  button next to the parameter name.

ation setup	axis limit buffer								
anipulate s	etup	S	etup						
	Ext8	OVB.							
member	₩all	<b>11</b>	member	parameter	start	end	transition	color	
parameter	default 🚽 🥱	4	✓ <sup>N</sup> / <sub>2</sub> all	default	20.07.2020 18:00	21.07.2020 18:00	hard		
			₽ _au_	multi scheduling	20.07.2020 18:00	21.07.2020 18:00	nard		
start	20.07.2020 18:00	÷							
and	21 07 2020 18:00								

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

select parameters you wa	nt to add:			🗿 🚚 load	💾 save
general			scan time		
v weight	1.00		max scan time	600 [s]	\$
✓ min slew time	30 [6]		min scan time	30 [s]	<b>*</b>
/ may slow time				min SNR	
▼ max stew time	600 [s]	<b>•</b>	X 0,00 [Jy]		* *
✓ min slew distance	0,00 [deg]	-	s 0,00 [Jy]		÷

# 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.

#### equip.cat.VGOS \* Antenna ID DAT\_Name Heads Tape\_len A SEFD B SEFD D SEED DBBC\_DDC FlexBuff Ow ONSA13SW 2x56000 17640 A 2723.4 B 1645.6 2110.8 DBBC DDC FlexBuff WETTZ13S WS WETTZ13S 2x56000 17640 A 2142.0 2097.5 3523.0 DBBC MARK6 Yj RAEGYEB 1x56000 17640 A 2089.4 B 2509.0 C D 1660.7 DBBC MARK6 1936.5 1074.3 2507.8 K4-2 K5 3808.9 2704.4 2400.1 3137.6 RDBE MARK6 MACG012M 17640 1728.8 2582.1 2013.0 1716.1 RDBE MARK6 Next, select the new catalog: File Basic Advanced Help Analysis 🚨 🖼 🌑 🌐 🏠 쳐 🌈 🛕 🎅 🤜 🋸 💭 🍪 📩 🗞 😰 🗐 🎶 💱 🟫 😳 🚡 📕 💾 🕨 🔯 get latest catalogs from: https://ivscc.gsfc.nasa.gov/IVS\_AC/sked\_cat/ 🕐 sked catalogs? 🛛 💾

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

**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.

۲

🔏 browse

🔏 browse

#### IMPORTANT:

Station

equip

antenna ./AUTO\_DOWNLOAD\_CATALOGS/antenna.cat

./AUTO\_DOWNLOAD\_CATALOGS/equip.cat

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  $\mathbb{P}$  and change the *"default"* parameters by clicking the  $\mathbb{P}$  button next to the parameter name.

File Basic Advanced Help Analysis				
🏠 🎡 🔓 🚚 💾 🕨 🔯	🕽 🖾 🌒 🄀 🏠 쳐	- 🌈 👔 📝 🛸 🛸 💭 🎯	📩 🗞 🛛 💽 🖒	🤯 😟
station setup axis limit buffer manipulate setup member <u>grall</u> parameter default <u>r</u> start 20.07.2020 18:00 end 21.07.2020 18:00	setup member parameter all_ default all_ multi sche o disk speed to 4Gbp	r start end 20.07.2020 18:00 21.07.2020 1 eduling 20.07.2020 18:00 21.07.2020 1 s and click "VOk".	transition color 18:00 hard 18:00 hard	
	Vie	Sched++		8
select parameters you want t	o add:		🗿 🔳 load	🗄 save

<ul> <li>✓ max slew distance</li> <li>175,00 [deg] ↓</li> <li>✓ max wait time</li> <li>600 [s] ↓</li> <li>✓ min elevation</li> <li>✓ 5,00 [deg] ↓</li> <li>✓ max number of scans</li> <li>9999 ↓</li> <li>✓ max total scan duration</li> <li>99999 ↓</li> <li>✓ max total scan duration</li> <li>999999 [s] ↓</li> <li>✓ write to disk speed</li> <li>4096,00 [Mbps] ↓</li> <li>✓ system delay</li> <li>✓ [s] ↓</li> <li>✓ preob</li> <li>10 [s] ↓</li> <li>✓ extra midob</li> <li>3 [s] ↓</li> </ul>	min slew distance	0,00 [deg]	-	max scan time 600 [s]	:
✓ max wait time 600 [s]   ✓ min elevation 5,00 [deg]   ✓ max number of scans 9999   ✓ max total scan duration 999999 [s]   ↓ ↓   ↓ 0,00 [Jy]   ↓ ↓   ↓ 0,00 [Jy]   ↓ ↓   ↓ 0,00 [Jy]   ↓ ↓   ↓ ↓   ↓ 0,00 [Jy]   ↓ ↓ <th>max slew distance</th> <th>175,00 [deg]</th> <th>-</th> <th>min scan time 30 [s]</th> <th>4</th>	max slew distance	175,00 [deg]	-	min scan time 30 [s]	4
✓ min elevation 5,00 [deg]   ✓ max number of scans 9999   ✓ max total scan duration 999999 [s]   ✓ write to disk speed 4096,00 [Mbps]   ✓ system delay 6 [s]   ✓ preob 10 [s]   ✓ extra midob 3 [s]	✓ max wait time	600 [s]	\$	min SNR	4
✓ max number of scans       9999         ✓ max total scan duration       999999 [s]         ✓ write to disk speed       4096,00 [Mbps]         ✓ write to disk speed       4096,00 [Mbps]         ✓ system delay       6 [s]         ✓ preob       10 [s]         ✓ extra midob       3 [s]	✓ min elevation	5,00 [deg]	\$	[vL] 00,0	*
✓ max total scan duration 999999 [s]   Iays   ✓ write to disk speed 4096,00 [Mbps]   ✓ system delay 6 [s]   ✓ preob 10 [s]   ✓ extra midob 3 [s]	I max number of scans	9999	Ŷ	В 0,00 [Ју]	* *
lays ✓ write to disk speed 4096,00 [Mbps] ↓ ✓ system delay 6 [s] ↓ ✓ preob 10 [s] ↓ ✓ extra midob 3 [s] ↓ ✓ filter:	I max total scan duration	999999 [s]	Ŷ	C 0,00 [Jy]	<b>•</b>
✓ system delay         6 [s]           ✓ preob         10 [s]           ✓ extra midob         3 [s]	lays ☑ write to disk speed	4096,00 [Mbps]	¢	ignore sources available selecte	d
✓ preob 10 [s] ✓ extra midob 3 [s] ↓ Filter:	🗸 system delay	6 [s]	•	all	
extra midob     3 [s]   Filter:	✓ preob	10 [s]	\$	☆ 0003-066	
	✓ extra midob	3 [s]		Filter:	

# 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 scan: no002 Source: 032	5 (id: 287 (id:	171490) 33)					consi	idered single scans 37, duration: type: target
station	delay	slew	idle	ргеор	obs	duration	az [deg]	unaz [deg]
	[s]	[s]	[s]	[s]	[s]	start - end	start - end	start - end
GGA012M	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
MACG012M	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	Θ	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   [s]	slew   [s]	idle   [s]	preob [s]	obs [s]	duration start - end	az [deg]   start - end	unaz [deg]   start - end
GGA012M MACG012M ONSA13NE ONSA13SW RAEGYEB WESTFORD WETTZ13S	6 6 6 6 6 6	56 27 42 40 31 55 32	0 50 20 24 42 11 40	4 4 4 4 4 4	47 39 39 38 28 38 47	19:22:07 - 19:22:54 19:22:07 - 19:22:46 19:22:07 - 19:22:46 19:22:07 - 19:22:45 19:22:07 - 19:22:35 19:22:07 - 19:22:45 19:22:07 - 19:22:54	41.6257 - 41.5760 38.3752 - 38.3789 290.2050 - 290.2741 290.2057 - 290.2731 321.6867 - 321.6197 44.2547 - 44.2046 305.3450 - 305.3562	401.6257 - 401.5 398.3752 - 398.3 290.2050 - 290.2 290.2057 - 290.2 681.6867 - 681.6 404.2547 - 404.2 305.3450 - 305.3
depth: 0 scan: no0090 Source: 0808+0	6 (id: 019 (id:	5390) 31)					con	sidered single scans durati type:
GGA012M KOKEE12M MACG012M WESTFORD	6 6 6	47 48 39 65	9 121 25 0	4 4 4 4	20 20 10 17	19:24:00 - 19:24:20 19:24:00 - 19:24:20 19:24:00 - 19:24:10 19:24:00 - 19:24:17	223.8693 - 223.9665   104.1125 - 104.1572   185.9458 - 186.0313   227.5755 - 227.6514	223.8693 - 223.9 464.1125 - 464.1 545.9458 - 546.0 227.5755 - 227.6
scan: no009 Source: 1929+2	7 (id: 226 (id:	5391) 74)						durati type:
ONSA13NE ONSA13SW RAEGYEB WETTZ13S	6 6 6	39 38 28 47	16 18 38 0	4 4 4 4	21 20 18 21	19:23:51 - 19:24:12 19:23:51 - 19:24:11 19:23:51 - 19:24:10 19:23:51 - 19:24:09 19:23:51 - 19:24:12	111.1961 - 111.2842   111.1949 - 111.2788   86.4610 - 86.5077   105.2521 - 105.3325	111.1961 - 111.2   111.1949 - 111.2   446.4610 - 446.5   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  $\mathbb{P}$  and click on the  $\mathbf{+}$  icon right next to *"Parameter"*.

Next, change the "system delay" parameter, name the new parameter and click " $\checkmark Ok$ ". 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 *" dd setup"*. On the setup list on the right, a new line should appear with WETTZ13S and sys\_delay\_WETTZ13S.

nanipulate setup		setup			
member 🛛 🖗 WETTZ13S	- 18	membe	er parameter alldefault	start end 20.07.2020 18:00 21.07.2020 18:	transition color 00 hard
parameter sys_delay_WETTZ1:	35 🔹 🔊 📫		_all multi scheduling WETTZ13S sys delay WETTZ13	20.07.2020 18:00 21.07.2020 18: 5 20.07.2020 18:00 21.07.2020 18:	00 hard 00 hard
end 21.07.2020 18:00			e / _ /_		
transition hard					X remove selected
🗯 IVS down time	🚽 add setup	visual rep	resentation of setup		
🚔 parse down time		•	plot setup for stat	ion 🦹 WETTZ13S 🛛 👻	
overed element					
Derem element			S	etup WEITZ13S	
system delay [s] 2	sys_delay_WETT2135				
-					_
VieSched++	_				
ect parameters you want	to add:			👔 📕 load 🛛 💾 save	
			scan time		
max slew time	600 [s]		scan time		
max slew time min slew distance	600 [s] 0.00 [deg]		scan time max scan time 600 [s]		
max slew time min slew distance max slew distance	600 [s] 0.00 [deg] 175.00 [deg]		max scan time 600 [s]		
max slew time min slew distance max slew distance max wait time	600 [s] 0.00 [deg] 175.00 [deg] 600 [s]		max scan time 600 [s] min scan time 30 [s]	in SNR	
max slew time min slew distance max slew distance max wait time min elevation	600 [s] 0.00 [deg] 175.00 [deg] 600 [s] 5.00 [deg]		scan time           max scan time         600 [s]           min scan time         30 [s]           x         0.00 [Jy]	in SNR	
max slew time min slew distance max slew distance max wait time min elevation max number of scans	600 [s] 0.00 [deg] 175.00 [deg] 600 [s] 5.00 [deg] 9999		scan time           max scan time         600 [s]           min scan time         30 [s]           x         0.00 [Jy]           s         0.00 [Jy]	in SNR	
max slew time min slew distance max slew distance max wait time min elevation max number of scans max total scan duration	600 [s] 0.00 [deg] 175.00 [deg] 600 [s] 5.00 [deg] 9999 999999 [s]		scan time           max scan time         600 [s]           min scan time         30 [s]           x         0.00 [y]           s         0.00 [Jy]	ain SNR	
max slew time min slew distance max slew distance max wait time min elevation max number of scans max total scan duration	600 [s] 0.00 [deg] 175.00 [deg] 600 [s] 5.00 [deg] 9999 999999 [s]		scan time         max scan time       600 [s]         min scan time       30 [s]         x       0.00 [Jy]         s       0.00 [Jy]         ignore sources	hin SNR	
max slew time min slew distance max slew distance max wait time min elevation max number of scans max total scan duration elays write to disk speed	[600 [s] [0.00 [deg] [175.00 [deg] [600 [s] [5.00 [deg] [9999 [999999 [s] [4096.00 [Mbps]		scan time max scan time 600 [s] min scan time 30 [s] x 0.00 [y] s 0.00 [y] ignore sources available	in SNR	
max slew time         min slew distance         max slew distance         max wait time         min elevation         max number of scans         max total scan duration         elays         write to disk speed         v system delay	600 [s] 0.00 [deg] 175.00 [deg] 600 [s] 5.00 [deg] 9999 999999 [s] 4096.00 [Mbps] 3 [s]		scan time         max scan time       600 [s]         min scan time       30 [s]         x       0.00 [Jy]         s       0.00 [Jy]         ignore sources         available         igal	selected	
max slew time         min slew distance         max slew distance         max wait time         min elevation         max number of scans         max total scan duration         elays         write to disk speed         v system delay         preob	600 [s] 0.00 [deg] 175.00 [deg] 600 [s] 5.00 [deg] 9999 999999 [s] 4096.00 [Mbps] <b>3 [s]</b> 10 [s]		■ scan time max scan time 600 [s] min scan time 30 [s] x 0.00 [Jy] S 0.00 [Jy] ignore sources available available available	selected	
max slew time min slew distance max slew distance max wait time min elevation max number of scans max total scan duration elays write to disk speed ✓ system delay preob extra midob	600 [s] 0.00 [deg] 175.00 [deg] 600 [s] 5.00 [deg] 99999 999999 [s] 4096.00 [Mbps] 3 [s] 10 [s] 3 [s]		scan time         max scan time         600 [s]         min scan time         30 [s]         x         0.00 [Jy]         5         0.00 [Jy]         ignore sources         available         2	in SNR	
<ul> <li>max slew time</li> <li>min slew distance</li> <li>max slew distance</li> <li>max wait time</li> <li>min elevation</li> <li>max number of scans</li> <li>max total scan duration</li> <li>lays</li> <li>write to disk speed</li> <li>system delay</li> <li>preob</li> <li>extra midob</li> </ul>	[600 [s] 0.00 [deg] 175.00 [deg] 600 [s] 5.00 [deg] 99999 999999 [s] 4096.00 [Mbps] 3 [s] 10 [s] 3 [s]		scan time         max scan time       600 [s]         min scan time       30 [s]         min scan time       30 [s]         x       0.00 [Jy]         s       0.00 [Jy]         ignore sources         available         ignore sources         ignore sour	in SNR	

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  $\mathbb{P}$  and change the *"default"* parameters by clicking the  $\mathbb{P}$  button next to the parameter name.

FIL	e Basic Adva	anced Help Analys	SIS								
1	👌 🍪 I 🛃 🧯	J 💾 🕨 🖸		S 🖪 🌒 🌐	🏠 쳐 🌈	1 📝 📢	🛧 🗐 🛴 🖏	& ?	1	Qt	
	station setup	axis limit buffer		setup							5
	maniputace se	cop		secup						_	
	member		8	member	parameter	start	end	transition	color		
				- 📲 _all	default	20.07.2020 18:00	21.07.2020 18:00	hard			
	parameter	derault •	<b>*</b>	🎊 _all_	multi scheduling	20.07.2020 18:00	21.07.2020 18:00	hard			
	start	20.07.2020 18:00	\$								
	end	21.07.2020 18:00	*								

Now, look for the parameter "preob", change it to 4 seconds and click " $\sqrt[4]{Ok"}$ .

✓ max slew time	600 [s]	÷ *	scan time	
✓ min slew distance	0.00 [deg]		max scan time 600 [s]	
✓ max slew distance	175.00 [deg]		min scan time 30 [s]	
✔ max wait time	600 [s]	•	m	in SNR
✓ min elevation	5.00 [deg]	•	X 0.00 [Jy]	
✔ max number of scans	9999	÷	S 0.00 [Jy]	-
✓ max total scan duration	999999 [s]	\$		
elays			ignore sources	
write to disk speed	4096.00 [Mbps]	٥	available	selected
✔ system delay	6 [s]	\$	all_	-
✔ preob	4 [s]	\$	0003-066	
🗸 extra midob	3 [s]	\$	Filter:	
		-		

#### **OPTIONAL - CHANGE MORE PARAMETERS:**

Depending on your schedule, it might be desired to change more parameters. Parameters are grouped by station-based parameters  $\stackrel{\text{res}}{\longrightarrow}$ , source-based parameters  $\stackrel{\text{res}}{\longrightarrow}$  and baseline-based parameters  $\stackrel{\text{res}}{\longrightarrow}$ . To change some parameters, click on the  $\stackrel{\text{res}}{\longrightarrow}$  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.

	VieS	ched++		-		×
File Basic Advanced Help Analysis						
🟫 🎡 🔓 🚚 💾 🕨 🔯 👘	🚨 强 🌒 🌐 🏠 🗲	p 🌈 🛔 📝	🤜 🐉 🚺 🌚 🛵	y 🗞 🛛 🕐 🔚 🔛	Notes	>>
v multi-scheduling						
parameters evolutionary selection	multi core support					<b>S</b>
max number of schedules: all 👻 7	9			pick random values		1
seed: random × 0						
available multi scheduling parameters	selected multi scheduling para	neters				
Parameters:	parameter	member nr. values	list of values			
👻 🕥 general	👔 sky-coverage	global 3	0.33	•		
subnetting subnetting min source angle	number of observations	🌑 global 3	0.33	-		
subnetting min participating s	n duration	💿 global 3	0.33	•		
fillin-mode during scan selecti fillin-mode influence on scan	n idle time	🔘 global 3	0.33	•		
fillin-mode a posteriori focus corper switch cadence						
<ul> <li>in the switch cadence</li> <li>in weight factor</li> </ul>						
sky-coverage						
duration						
average stations						
average baselines						
idle time idle time interval						
🗱 🛱 👍 📲 add selected				× remove selected		

### 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 explicitly. However, this will only generate one schedule.

💱 VieSched++		— 🗆	×
File Basic Advanced Help Ana	alysis		
🏠 🎡 🔁 📕 🕨	🕨 😰 💆 💁 🚯 🏠	p 🌈 👔 🕑 🤜 🛸 💭 🎯 😓 🗞 😰 🗐 🗁 💱	>>
🗹 sky coverage	1,00 🗘 25% 💾	What are weight factors?	
number of observations	1,00 25%	(and why are they so important)	5
duration	1,00 25%	To answer this question it is necessary to understand how	۲
extra weight after long idle time	1,00 25%	VieSched++ works:	
interval	300 [s]	Generally speaking, the software is using a <b>brute force</b>	

### 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.

🟫 🎯 🔓 🥼 💾 🕨 😰 🔁 🖾 🜑 🌑 🔀 🏠 ≁ 🍊 🛔 📝 🤜 🕲 🕁 🗞	2 📑 🔁	× 🛐
Output files		
✓ create initializer log file ✓ create iteration log file	8	5
✓ create ngs file ✓ create skd file ✓ create vex file		۲
✓ create operations notes ☐ create skdsum file ☐ create SNR table ☐ create sky coverage file		
create source group based statistics file choose group		
output directory/out/	🗹 add timestamp	
redirect ngs files		
scheduler NASA	8	
correlator BONN	8	
optional output		
notes contact		
function name email phone affiliation	*	
function name email phone affiliation •	🛉 💾 📕	

#### **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.

	VieSched++ –		×
File Basic Advanced Help Analysis			
🏠 🎡 🔓 🚚 💾 🕨 💆 🔮	) 🖾 🔟 🌒 🌐 🏠 쳐 🌈 👔 🕞 🤞 🌦 🌑 🎯 😓 🛇 🗐 🏷	2 💱	Š >>
source-based conditions			
member	🗱 all 👻 💥 🙀 priority* member #scans #observations		5
min number of scans per source	3 0 <sup>*</sup> _all_ 3 0		۲
min number of observations per source	0		
	add		
combine conditions	and		
stop if number of reduced sources below	<b>3</b>		
max number of iterations	10 \$		
✓ gentle source reduction	for 1 iterations		
percentage of source to reduce per iteration	50.00 [%]  *settings with higher priority number override previouse ones		

#### 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).

Image: Solve Priority         Simulation       Solve Priority         imulations:       1000       Image: Station Number of the state of the															
imulations:       1000       ↓       interview	Simulation	Solve	Priority	1										e	
Station       white noise*       clock ASD       clock dur       tropo Cn       tropo H       tropo dh       tropo	simulations:	1000	•						fixed see	d	150174549	6	\$ *show	wn	able
<sup>A</sup> GGA012M <sup>A</sup> I.0000e-14 [S] <sup>A</sup> S0 [min] <sup>A</sup> I.0000e-14 [S] <sup>A</sup> S0 [min] <sup>A</sup> I.000e-14 [S] <sup>A</sup> S0	Station	-11	white noise	*	clock ASD		clock dur		tropo Cn		tropo H		tropo dh		tropo
SGAOTZM       2.83 [ps]       1.0000e14 [s]       50 [min]       1.00e7 [m -1/3]       2000 [m]       200 [m]       2.00         KOKEE12M       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e-7 [m^-1/3]       2000 [m]       200 [m]       2.00         MACGO12M       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e-7 [m^-1/3]       2000 [m]       200 [m]       2.00         MACGO12M       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e-7 [m^-1/3]       2000 [m]       200 [m]       2.00         ONSA13NE       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e-7 [m^-1/3]       2000 [m]       2.00         ONSA13SW       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e-7 [m^-1/3]       2000 [m]       2.00	N GGAG	an	2.85 [bs]	-	1.00002-14 [S]	•	50 [min]	•	1.80e-7 [m -1/3]	•	2000 [m]	¥	200 [m]	•	2.00
MACGO12M       2.83 [ps]       1.0000e-14 [s]       50 [min]       1.00e-7 [m -1/3]       2000 [m]       200 [m]       2.00         MACGO12M       2.83 [ps]       1.0000e-14 [s]       50 [min]       1.80e-7 [m ^-1/3]       2000 [m]       200 [m]       2.00         ONSA13NE       2.83 [ps]       1.0000e-14 [s]       50 [min]       1.80e-7 [m ^-1/3]       2000 [m]       200 [m]       2.00         ONSA13NE       2.83 [ps]       1.0000e-14 [s]       50 [min]       1.80e-7 [m ^-1/3]       2000 [m]       200 [m]       2.00         ONSA13SW       2.83 [ps]       1.0000e-14 [s]       50 [min]       1.80e-7 [m ^-1/3]       2000 [m]       2.00	P GOAC	C1204	2.03 [ps]	-	1.0000e-14 (5)	11	Su (min)	1	1.80e-7 [m -1/3]	1	2000 (m)	1	200 [m]	×	2.00
MACCO12M       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e7 [m -1/3]       2000 [m]       200 [m]       2.00         ONSA13NE       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e7 [m^-1/3]       2000 [m]       200 [m]       2.00         ONSA13NE       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e7 [m^-1/3]       2000 [m]       200 [m]       2.00         ONSA13SW       2.83 [ps]       1.0000e14 [s]       50 [min]       1.80e-7 [m^-1/3]       2000 [m]       2.00	R MACO	ELZM	2.80 (ps)	×	1.00000-14 [5]	7	50 (min)	1. 	1.80e-7 (m -1/3)	1.	2000 [m]	17	200 [m]	1	2.00
POINSALINE       2.83 [ps]       1.0000e-14 [s]       50 [min]       1.80e-7 [m^-1/3]       2000 [m]       2000 [m]       2.00         POINSALINE       2.83 [ps]       1.0000e-14 [s]       50 [min]       1.80e-7 [m^-1/3]       2000 [m]       2000 [m]       2.00	MACC M ONEA	1 DALE	2.85 [ps]	×	1.0000e-14 [s]	~	50 [min]		1.80e-7 [m -1/3]	1	2000 [m]	1	200 [m]		2.00
ONSAL35W     Z.83 [ps]	CINSA CONSA	I DOWN	2.83 [ps]		1.0000e-14 (s)	1	Su [min]	- T.	1.80e-7 [m -1/5]	¥.	2000 [m]	1	200 [m]	-	2.00
	P ONSA	135W	2.83 [ps]		1.0000e-14 [S]	Y	50 [min]	Ψ.	1.80e-7 [m -1/3]	Ψ.	2000 [m]	14	200 [m]		2.00
	P WEST	FORD	2.83 [ps]	0	1.0000e-14 [s]	Ŷ	50 [min]	÷.	1.80e-7 [m^-1/3]	Ŷ	2000 [m]	÷.	200 [m]	9	2.00
WESTFORD 2.83 [ps] 1.0000e-14 [s] 50 [min] 1.80e-7 [m^-1/3] 2000 [m] 200 [m] 2.00	EX ILITY	7135		~	1.00000 141-1	-	C.O. London I	1.0	1 000 7 [m0 1/2]	10.	2000 [m]	1.4	200 Log 1	1.44	3 66

HINT:

If you click on the load icon  $\downarrow \downarrow$  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.

EOP	Stations	Sources							
datur	n: ITRF2014			ref clock: 🏼 🎽 GGAO	12M -				
	name	coord da	atum 🔺	name	linear cloo	k quadratic clo	ock PWL clock	inter	val 🔺
V	🎊 _all_	<b>v</b>	V	✓ 🎊 _all_	✓	✓	<b>v</b>	60 [min]	\$
2	GGAO12M	$\checkmark$	$\checkmark$	🖗 GGAO12M	$\checkmark$	$\checkmark$	$\checkmark$	60 [min]	¢ [
F	MACG012M	$\checkmark$	V	🎤 KOKEE12M	$\checkmark$	$\checkmark$	$\checkmark$	60 [min]	
Ē	ONSA13NE	$\checkmark$	$\checkmark$	MACGO12M	$\checkmark$	$\checkmark$	$\checkmark$	60 [min]	
2	ONSA13SW	$\checkmark$	√ ▼		1	1	2		
	name	PWL ZWD	) interva	constraint	NGR	interval	constraint	EGR	inte 📤
<b>v</b>	🎊 _all_	~	20 [min]	\$ 1.500 [cm]	\$ ✓	60 [min] 🗘	0.050 [cm]	¢ 🗸	60 [mir
F	GGA012M	$\checkmark$	20 [min]	\$ 1.500 [cm]	\$ V	60 [min] 🗘	0.050 [cm]	\$ V	60 [mir
F	KOKEE12M	$\checkmark$	20 [min]	\$ 1.500 [cm]	÷ 🗸	60 [min] 🏮		\$	60 [mir
F	MACGO12M	$\checkmark$	20 [min]	\$ 1.500 [cm]	¢ 🗸	60 [min]		¢ 🗸	60 [mir
R*	ONCATONE	1	[20.[:-1			collected Al	0.050 []		Co Laste

### **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.

imulation S	olve Pri	ority		
ecommendatio	n based on			reference quantile: 0.75 🜲
< mean form	nal errors o	nly	both equally	repeatability only>
name	priority			
#obs	1.00	¢	39.53%	
▼ EOP	0.25	\$	9.88%	
XPO	0.05	\$	1.98%	
YPO	0.05	\$	1.98%	
dUT1	0.05	\$	1.98%	
NUTX	0.05	\$	1.98%	
NUTY	0.05	\$	1.98%	
<ul> <li>stations</li> </ul>	1.28	\$	50.5 <mark>9%</mark>	
GGAO	0.16	\$	6.32%	
KOKEE	0.16	\$	6.32%	
MACG	0.16	<b>A</b>	6.32%	

#### **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++  $\mathbf{\omega}$ .

To view statistics and plots of one explicit schedule, use the VieSched++ Analyzer 4.

viescheupp 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 18: finished [2020-07-20 10:41:26.162398] (0x00007ff1df1ba8c0) [info] version 18: finished [2020-07-20 10:41:26.162398] (0x00007ff1df1ba8c0) [info] recommended schedule: version 40 (score: 0.8464 # obs: 22514) [2020-07-20 10:41:26.266588] (0x00007ff1df1ba8c0) [info] alternative schedule: version 54 (score: 0.8297 # obs: 20850) [2020-07-20 10:41:26.2666631] (0x00007ff1df1ba8c0) [info] alternative schedule: version 23 (score: 0.8229 # obs: 23171) [2020-07-20 10:41:26.2666645] (0x00007ff1df1ba8c0) [info] alternative schedule: version 23 (score: 0.8229 # obs: 23171) [2020-07-20 10:41:26.266613] (0x00007ff1df1ba8c0) [info] reated scans: 13366420 [2020-07-20 10:41:26.267187] (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:

۷	Į.	score	#obs	I XPO	YPO	dUT1	NUTX	NUTY	GGA012M	KOKEE12M
1	17	0.5938	22480	48.1384	42.9735	1.5709	16.3128	14.8442	1.2290	1.8137
2	L.	0.5084	22021	46.7943	41.9854	1.5468	16.2783	15.4356	1.2024	1.7686
3	L.	0.2734	21891	46.9044	43.0662	1.5321	16.9124	15.5278	1.2517	1.7418
4	L.	0.5393	21800	46.7913	41.9123	1.5460	16.6936	15.3911	1.2400	1.7963
5	L.	0.4867	21959	46.7131	42.5554	1.5519	16.3312	15.1899	1.2197	1.7849
6	L.	0.2521	21810	46.5940	43.0417	1.5100	16.6740	15.8426	1.2707	1.7581
7	L.	0.4395	21635	47.2765	42.5091	1.5667	16.8429	15.4186	1.2101	1.8236
8	1	0.0000	21783	47.9615	44.9499	1.5980	16.7303	15.4962	1.3187	1.8638
9	1	0.3894	21667	45.7347	42.4362	1.5071	16.5955	15.4102	1.2256	1.7357
10	L.	0.7181	22958	52.5804	42.9616	1.6535	15.9427	15.1924	1.1489	1.8679
11	L.	0.6185	22696	51.7034	42.9549	1.6497	16.2134	14.9940	1.1619	1.8714
12	L.	0.3828	22108	52.4273	42.6549	1.6957	16.6195	15.2259	1.1694	1.8630
13	I.	0.6654	22941	50.0131	43.7894	1.6174	16.0916	15.1744	1.3103	1.8456
14	L.	0.8566	22867	47.5418	42.3288	1.5353	15.9383	14.8817	1.2320	1.7503
15	1	0.6963	22523	47.5322	42.3553	1.5361	16.3441	15.1988	1.2291	1.7432
16	1	0.6895	22124	48.6486	41.8415	1.5986	16.6417	15.4695	1.1543	1.8465
17	1	0.7322	22616	46.6654	41.7469	1.5535	16.1433	15.0089	1.2723	1.7576
18	L.	0.7015	22547	46.2567	42.1760	1.4988	16.4908	15.3454	1.2485	1.7649
19	L.	0.5309	23221	57.7069	44.0250	1.7734	15.5261	15.0689	1.1867	2.0006
20	1	0.4498	22975	55.8610	43.4144	1.7556	15.7371	15.1106	1.1952	1.9766
21	L	0.4669	22743	54.9049	43.4793	1.7274	16.0534	15.1329	1.1514	1.9374
22	I.	0.7461	23300	55.4821	44.2983	1.7529	15.6153	14.8497	1.2151	2.0004
23	L.	0.7683	23171	52.0148	42.8785	1.6348	15.8005	15.2986	1.1864	1.8707
24	L.	0.9627	23142	49.3132	41.9715	1.5841	16.0940	15.1252	1.1903	1.7790
25	L	1.0000	23349	52.5976	42.4132	1.6811	15.4422	14.9546	1.1487	1.9411
26	L	0.8975	22977	50.8610	42.1831	1.6488	15.5504	15.1498	1.1694	1.8770
27	I.	0.6934	22885	49.3757	43.3076	1.5920	16.2428	14.9930	1.2476	1.8436
28	1	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