

SOP: Multibeam Data Acquisition with Kongsberg SIS

Adapted from AWI 'Polarstern-HSDS3-Survival_Guide_v3_6'

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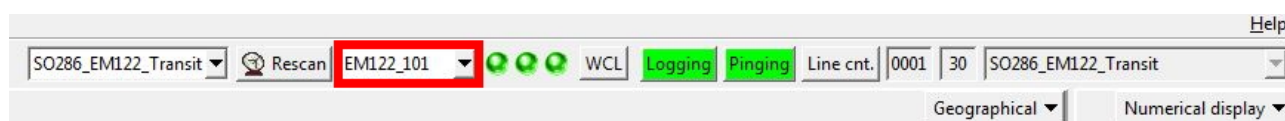
HI!	3
MULTIBEAM DATA ACQUISITION WITH KONGSBERG SIS	3
ADDING TEMPLATES IN SIS	3
CREATE A NEW SURVEY TEMPLATE	4
CREATE A NEW SURVEY	5
SIS ACQUISITION PROPERTIES	6
CHANGE RUNTIME PARAMETERS	6
CHANGE LOGGING INTERVAL	7
START PINGING/LOGGING	7
APPLYING SOUND VELOCITY PROFILES (SVP)	8
SSM TOOLS AND VIEWS	8
CREATE A NEW PROJECT	9
USE ONLINE SERVER FOR TRANSIT SVP	10
IMPORT SVPS TO SSM	11
PROCESSING SVPS	11
EXPORT AND APPLY SVPS	13
FILE SYNCHRONISATION WITH SYNCBACK	14

Hi!

Welcome to the Geomar SOP for multibeam data acquisition. If you made it to here, you're probably in the hydrolab of some research vessel and are as keen about bathymetry as we are and willing to follow a useful workflow (: This guide is based on user experiences and best practises. The part for sound speed processing is adapted from AWI manual XXX. This SOP comprises the workflow of setting up the Kongsberg Seafloor Information Software (SIS) for operating the Kongsberg EMXXX Multibeam family. As we aim towards a seamless data flow within the Geomar data management, we put quite an emphasis on the importance of naming conventions and folder/storage locations. So please consider to use the structure that we propose here. Note that *click-advice*s are printed in *italic* and **processing steps or important stuff** are in **bold**. Also SIS uses some icons, a list of which you can find at the end of this manual. Let's begin!

Multibeam data acquisition with Kongsberg SIS

Kongsberg Seafloor Information System (SIS) is the software that lets the user steer data acquisition. Most of the parameter changes will **directly affect the raw data**. Generally, SIS is set up with different views that can also be customised. It has proven useful to have the main windows displaying the data from a bird's view, the parameters used on the side, isolated pings on the other side and optionally, the control menu at the bottom. There is also a waterfall view for side scan and a window for water column data that can be displayed additionally. The upper panel is fixed, which shows the **current selected survey template**, the **status of the echo sounder** in use as well as **toggles for pinging and logging**. Below is a description of the main SIS panel:



1: SIS main panel

From left to right:

- Current selected survey template
- Rescan button if transducers cannot be found
- Multibeam system connected to SIS (one for each EM122/120 and EM710/712)
- Status lamps
- Toggle for water column data logging
- Toggle for bathymetry data logging
- Toggle to start/stop pinging
- Toggle start new line count
- Current line number within survey template
- File length in [minutes]
- Select survey template (only work when pinging/logging is off!)

Adding templates in SIS

To make life easier for later-on processing and data curation, the data should follow a **useful naming convention** to avoid confusion with file names and storage. This can be **set up using automatised file naming** for data acquisition already within the Kongsberg Seafloor Information System (SIS) software that is used for data recording and display by adding templates. Using templates not only means that

the file names are given automatically but also that a folder structure is created where files are stored. This path structure should look something like 'Cruisename/Device/' (e.g. M133/EM122/). **It's very important to set up these templates correctly before any data have been recorded.** If files are named incorrectly and/or are stored in different folders, it can become really messy. This should be done for every echo sounder (i.e. EM122/120 and EM710/712).

The raw data file names should then be given out in the following format:

{LineNumber}_{Date}_{Time}_{Cruise}_{MBES}.all

Where:

{LineNumber} = continuous number per line

{Date} = YYYYMMDD

{Time} = HHMMSS

{Cruise} = Cruise name

{MBES} = MBES System

Example: 0001_20180212_051724_M133_EM122.all

Creating templates to automate file naming is a bit tricky and not too intuitive in SIS. Below are the steps to create a template:

Create a new survey template

1. Select the **current echo sounder** in the main tool bar (right of the 'Rescan' button)
2. Open the '**Survey administration**' view
3. Under '**survey templates handling**', go to '**Storage options**' sub-tab:
 - If necessary, change **storage location** for survey and raw data
 - Adjust '**Shipname**', e. g. SO286_EM122
 - Click 'Apply to all survey templates'
4. Now, select the '**Basic Parameters**' sub-tab:
 - Give a reasonable name for '**New Survey template**' following the **naming convention**: {Cruise}_{MBES}, e.g.: SO286_EM122
 - Under 'Select survey-template': select 'Default'
 - Click '**Update**'

Survey administration

User handling | Background data | Survey templates handling

Basic Parameters | **Storage options** | Advanced options

Survey data storage location: G:\sisdata\grids

Raw data root location: D:\sisdata\raw

New rawdata storage structure

Current rawdata storage structure: SURVEYNAME

Use current structure | Clear new structure

Build rawdata storage structure from tickboxes

☐ SHIP ☐ YEAR ☐ MONTH
☐ SOUNDERTYPE ☐ SERIALNUMBER ☐ DAY

New rawdata storage structure:

Shipname: SO286_EM122 ☒ Use as postfix in filename

Apply to all survey templates

2: SIS Survey administration - Storage

Survey administration

User handling | Background data | Survey templates handling

Basic Parameters | Storage options | Advanced options

Add/Change survey template

New Survey template: SO286_EM122

Select survey-template: Default

User: SIS user

Comment:

Update

Delete survey template:

3: SIS Survey administration - Parameters

Create a new survey

1. Open the 'New survey' view
2. Under 'User handling' tab, go to 'Basic Parameters' sub-tab:
 - Give a reasonable name for 'New Survey name' following the **naming convention**: {Cruise}_{MBES}_{Mode}, e. g. SO286_EM122_transit
 - Under 'Select survey-template', chose the template created before (e.g. SO286_EM122) (see above)
 - Click 'Save new survey'
3. Sometimes it is necessary to **delete a survey**:
 - Click in the main menu on 'File' > 'Remove Survey from Database'
 - Select survey
 - Click 'Accept'

4: SIS Create a new Survey

SIS Acquisition Properties

You can change most of the multibeam parameters during data acquisition without having to stop pinging. This may become important when the data quality worsens and/or the ground changes. **If the multibeam runs stable and the data look good, leave the settings as recommended for default values below!**

Change Runtime parameters

Select the **'Runtime parameters'** view from the drop down menu of the lower centered panel.

1. 'Sounder Main' tab:

- Adjust **'max. angle'** (default 65°) for port and starboard **according to data quality** (leave as wide as possible, watch edges -> reduce if **outer beams become frayed**)
- Adjust **'Beam Spacing'** (default: **'IN-BETWEEN'**, for strong topography differences: **'EQANGLE'**), don't use **'EDISTANT'** mode.
- Adjust **'Min. Depth'** (e. g. 500 m) and **'Max. Depth'** (e. g. 6000 m) according to actual depth range. This needs adjustment when the echo sounder 'loses' ground. In this case, you can *press the 'Force depth' button* to re-compute ground.
- If necessary, *disable* **'Dual swath mode'** (sometimes this option created weirdness in the data)

2. 'Filter and Gains' tab:

- Adjust **TX power level (dB)** for **mammal protection**; keep as quiet as possible according to data quality, the recommended **default here is -20dB**. This may not be sufficient for deep water (> 3000m).

5: SIS Runtime Parameters

There are further settings or e.g. automatic data cleaning and transducer sound speed, but we don't usually change these.

Change logging interval

- In the main menu, under 'Tools', click 'Custom' and 'Set parameters' to open a new window
- Select the 'Logging' parameter on the left
- Adjust value for the 'Interval for line counter in sec.' parameters (1800s, i.e. 1/2h has proven to be a good value here)

Parameter Name	Data type	Value
Interval for line counter in sec.	Integer	1800
Put all depths in grid if set to 1, save selected depths if set to 0	Integer	0
Hotkey for logging on/off	String	F2
Hotkey for New line	String	F5
Hotkey for Ping on/off	String	F10
Enable or disable support for rawdata logger. (0=disable, 1=enable)	Integer	0
Eiva compatible start/stop datagram = 1. SIS default = 0	Integer	0
Water column disk. (Default: Raw data disk.)	String	
SVP change should generate new logged line (No=0, Yes=1)	Integer	0
Enable EA raw data logging (No=0, Yes=1)	Integer	1
Gives current data cleaning method, 1-GridEngine, 2-CUBE	Integer	1
Send range and bearing for objects to address (IP:port)	String	
Initial watercolumn logging off or on (0=off, 1=on)	Integer	0
Highest approved swath density in percent of requested density (0=no checking, 110-2500=highest approved density in %)	Integer	0

Note: Please restart SIS to effectuate.

Start Pinging/Logging

To start the data acquisition, simply click 'Not Pinging' and 'Not Logging' in the main tool bar (upper panel). It can take a while until the transducer have woken up, but at some point the **light should turn green**. If not, the system might be switched off entirely, then go talk to the WTD (:).

Applying Sound Velocity Profiles (SVP)

If you have CTD files, that's great and usually the best choice. You can pre-process them with Sound Speed Manager (SSM). The cool thing about SSM is that it can **read data from multiple instruments and also retrieve data from World Ocean Atlas (WOA)** – which is great when no CTD is taken e.g. during transit. Further, SSM can **directly stream sound speed data to SIS**, the Kongsberg acquisition software, which is very handy. This procedure is described in the KongsbergSIS_DataAcquisition_Geomar.docx. For now, this section describes the procedure for Seabird CTD samples only.

SSM Tools and Views

Below is a list explaining the icons used in SSM. These are referred to within the next section on how to use SSM.



6: SSM view tabs

From left to right:

- Editor
- SSM profile database (list of all imported profiles)
- Survey Data Monitor
- Synthetic Profile Server (Live Server connection to Kongsberg SIS)
- Setup
- Info



7: SSM Tools

From left to right:

- Add new data (opens data import dialogue)
- Extend active profile with reference profile (can be set in the settings tab)
- Show/edit active profile as spreadsheet
- Show/edit metadata of active profile
- Magic wand: Filter/smooth active profile
- Retrieve transducer sound speed
- Extend profile based on reference cast as selected in setup
- Reduce points in active profile ('thinning')
- Restart processing active profile
- Export active profile
- Transmit active profile to SIS
- Save active profile to SSM database



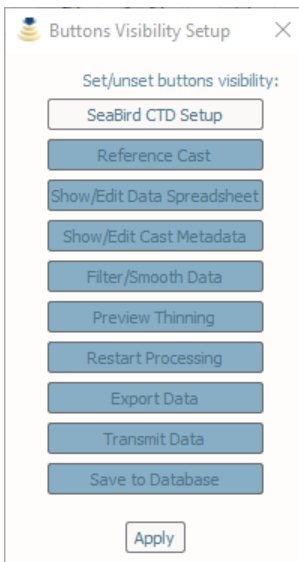
8: Toggles for active SV profile

From left to right (You probably won't need the toggles in light grey):

- Reset plot view/zoom level
- Go to previous/next plot view
- Grab and drag profile plot
- Scale plot
- Zoom in/out
- Flag/Unflag sample point
- Insert point
- Show/hide flags
- Toggle grids
- Toggle legends
- Config subplots
- Edit plot parameters (axes etc.)
- Save plot

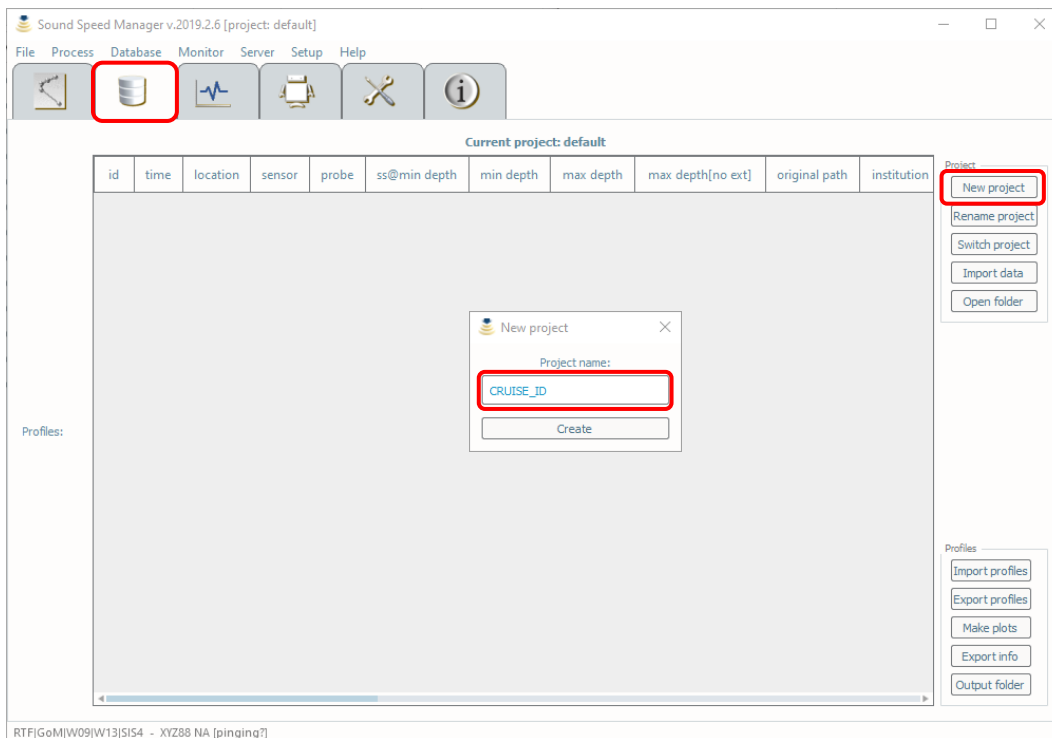
Create a new project

To open SSM, *click the task bar icon*. SSM will open with two windows, one terminal window for output (do not close it!) and one with an easy-to-use graphical user interface. Side note: If you miss any buttons shown here in the screenshots, *go to Process > Change buttons visibility and adjust the buttons that you want to see*.



9: Sound Speed Manager Buttons

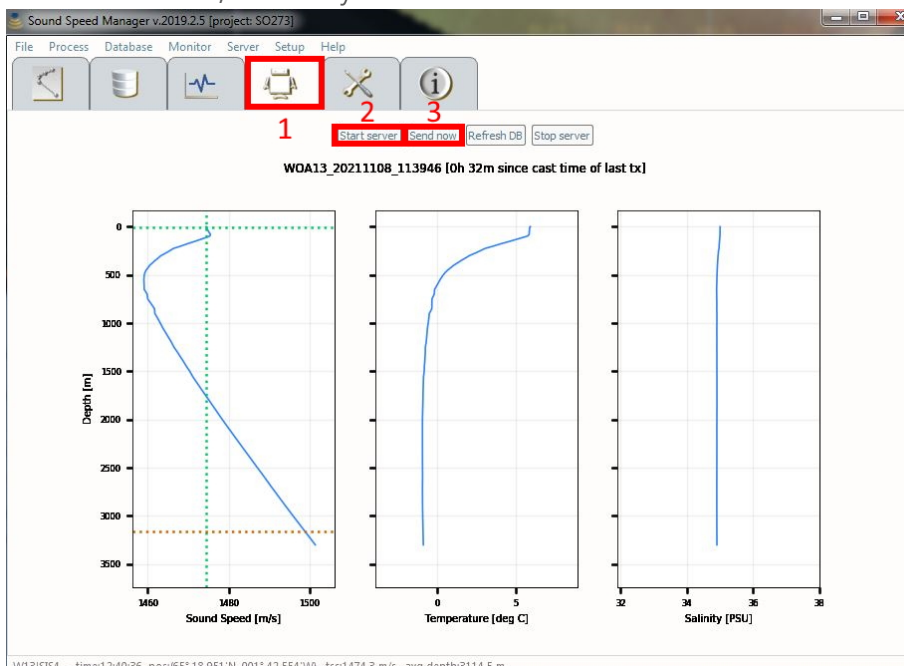
Before you import any SVPs into SSM, please **create a new database** for your cruise by switching over to the second tab with the little database icon and *click New Project on the right, enter a name {CruiseName} and hit Create*.



10: Sound Speed Manager create new project

Use online server for transit SVP

There is a very handy tool in SSM that allows you to **apply WOA SVPs on-the-fly**. Do do so, *click the little robo icon* in the upper panel next to the profile tab. If you're asked to *start the server*, click yes. Now SSM will **automatically transmit updated SVPs pulled from WOA** to SIS and apply it to the raw data. This is recommended during transits when there is no chance to stop for CTD – but please only use it in this case, it is always better to use direct SV measurements!

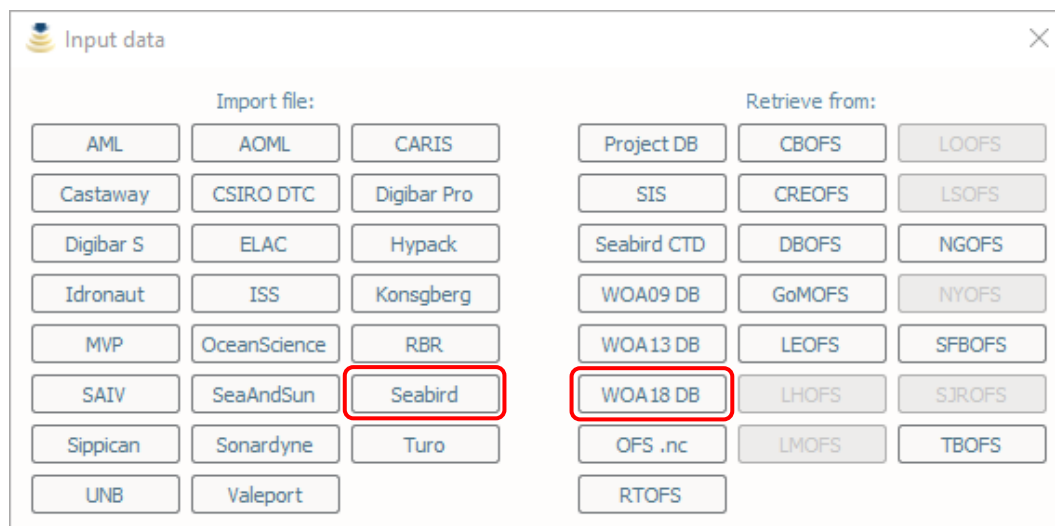


11: Sound Speed Manager Synthetic SVP Server

Import SVPs to SSM

Once the database is created, switch back to the first tab and hit the import button.

A window will open where you need to select the import format. At this point, your selection depends on the device you sampled your SVP with. For the Seabird CTD, click on **Seabird** ('Import file' not 'Retrieve from'). If you want to extract a **synthetic SVP from the WOA18** database, click on **WOA18 DB**.

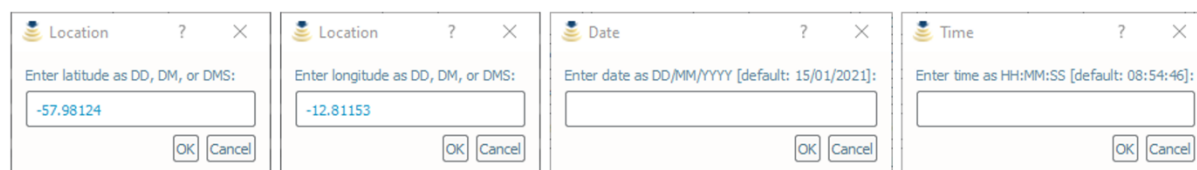


Import file:			Retrieve from:		
AML	AOML	CARIS	Project DB	CBOFS	LOOFS
Castaway	CSIRO DTC	Digibar Pro	SIS	CREOFS	LSOFS
Digibar S	ELAC	Hypack	Seabird CTD	DBOFS	NGOFS
Idronaut	ISS	Kongsberg	WOA09 DB	GoMOFS	NYOFS
MVP	OceanScience	RBR	WOA13 DB	LEOFS	SFOFS
SAIV	SeaAndSun	Seabird	WOA18 DB	LHOFS	SJOFS
Sippican	Sonardyne	Turo	OFS .nc	LMOFS	TBOFS
UNB	Valeport		RTOFS		

12: Sound Speed Manager import or retrieve data

SSM populates every imported profile with a bunch of metadata, most importantly, the **geographic location** of the cast as well and its **date and time**. Some of the profiles have this information in the header of their output files (e.g. the CTD), but for those which do not have it or for WOA retrieval, you need to enter it manually. Therefore, depending on your choice above, SSM might import the SVP right away, or present you with some extra input windows (see below). Please enter those accurately as this will become important for SVP processing and data processing later on!

Side note: **South Latitudes** and **West Longitudes** have to be entered **negative** (:



Location (Latitude)	Location (Longitude)	Date	Time
Enter latitude as DD, DM, or DMS: -57.98124	Enter longitude as DD, DM, or DMS: -12.81153	Enter date as DD/MM/YYYY [default: 15/01/2021]: 15/01/2021	Enter time as HH:MM:SS [default: 08:54:46]: 08:54:46

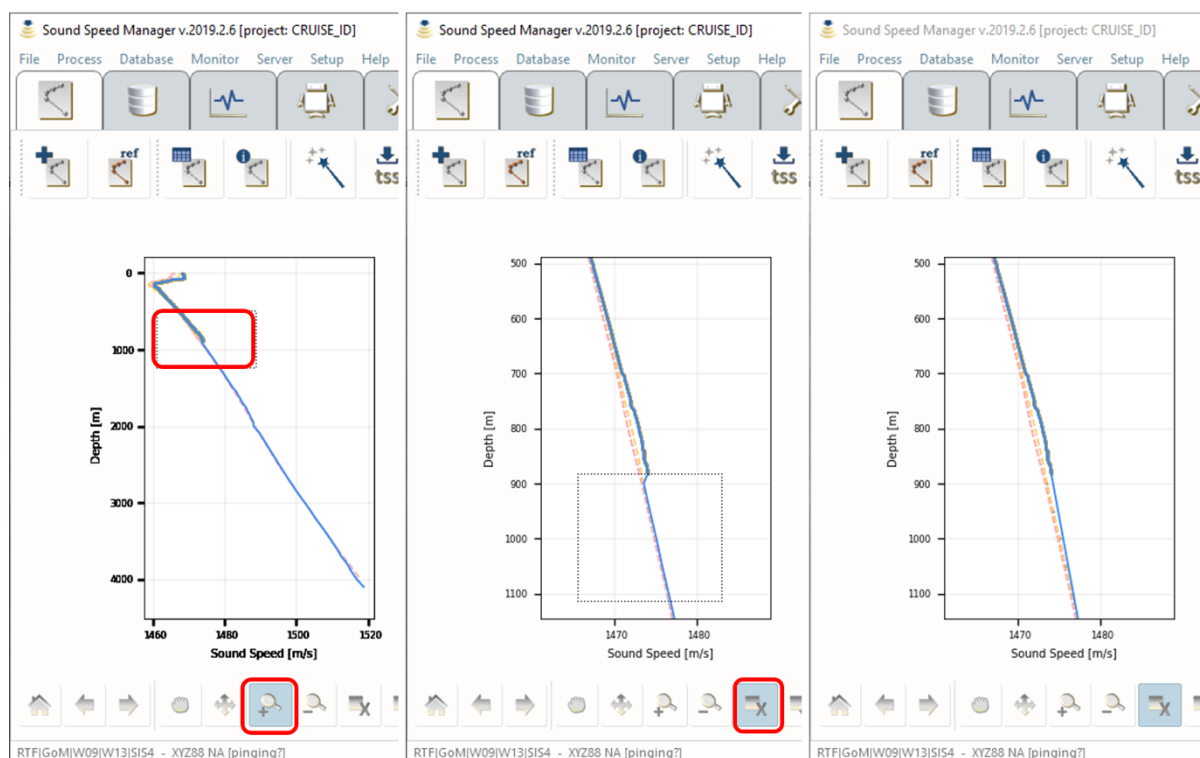
13: Sound Speed Manager enter coordinates and date/time

Processing SVPs

After import, you should be presented with a plot of the imported SV cast. The blue line is the actual data and the orange lines are reference casts from WOA (min/max/avg). Now you can inspect the cast for spikes or other erroneous measurements and manually clean them if necessary. Then use the magic wand one or more times (Filter/Smooth Data), to **filter out smaller spikes and reduce data density**.

Next, click *Extend Profile*. This will **extend the profile with the WOA18 data** down to the approximate depth at the location of the cast.

Sometimes there is a **“jumpy” transition** between the actual cast and the extension data. If so, zoom in and visually inspect this part of the profile. Use the *Flag samples* tool to delete some points from the extension data to smooth out the transition to create a nice and **realistic SVP**. The example below has a very tiny jump. Depending on the variability of your local SV situation, these can be quite significant. Take your time to figure out how to model a decent SV profile.



14: SVP Data Jumps

Finally, use the *Insert samples* tool to **manually extend** the profile down to 12000 m. Don't worry too much why this is done – SIS and also most post processing softwares needs this to make sure that all depths are possibly covered. At 12000 m, 1675 m/s is a good value.

Pro-Tip:

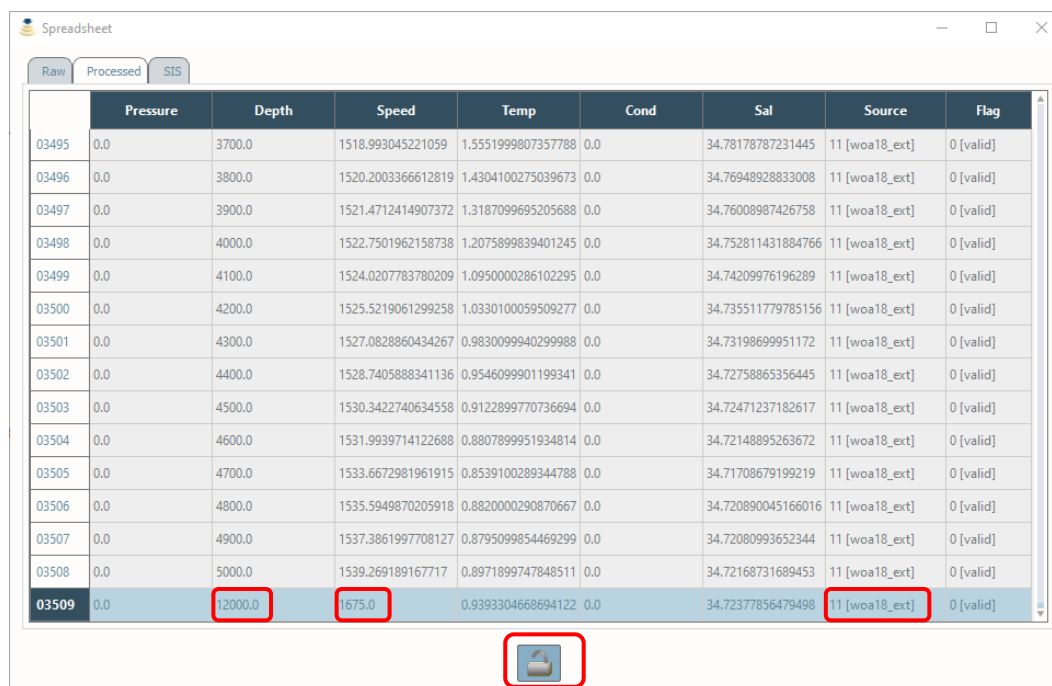
If you did the following manual extension before, you can also set your last profile as a **Reference Cast**, go to the **SSM Settings, Input** tab, change the **Extend with** option to **ref** and extend your profile again with the **Extend Profile** button in the **Editor** tab. Then please change the **Extend with** option back to **WOA18** to avoid confusion.

If you are unsure whether you understand what's happening here, just follow the manual steps below.

A quick way to extend the profile to 12000 m is to simply *add a random point somewhere BELOW the end of your extended profile* first.

Next, open the table view via the top toolbar (or **Process > Show/Edit Data Spreadsheet**) and unlock the edit mode.

Now, scroll down and manually change the **Depth** and **Speed** values in the last row to 12000 and 1675. To go crazy on details, you can change the **Source** value of that last point from 1 (user) to 11 (woa18_ext) to make sure that the **max depth[no ext]** value in the Database tab is shown correctly.



Spreadsheet

Raw Processed SIS

	Pressure	Depth	Speed	Temp	Cond	Sal	Source	Flag
03495	0.0	3700.0	1518.993045221059	1.5551999807357788	0.0	34.78178787231445	11 [woa18_ext]	0 [valid]
03496	0.0	3800.0	1520.2003366612819	1.4304100275039673	0.0	34.76948928833008	11 [woa18_ext]	0 [valid]
03497	0.0	3900.0	1521.4712414907372	1.3187099695205688	0.0	34.76008987426758	11 [woa18_ext]	0 [valid]
03498	0.0	4000.0	1522.7501962158738	1.2075899839401245	0.0	34.752811431884766	11 [woa18_ext]	0 [valid]
03499	0.0	4100.0	1524.0207783780209	1.0950000286102295	0.0	34.74209976196289	11 [woa18_ext]	0 [valid]
03500	0.0	4200.0	1525.5219061299258	1.0330100059509277	0.0	34.735511779785156	11 [woa18_ext]	0 [valid]
03501	0.0	4300.0	1527.0828860434267	0.9830099940299988	0.0	34.73198699951172	11 [woa18_ext]	0 [valid]
03502	0.0	4400.0	1528.7405888341136	0.9546099901199341	0.0	34.72758865356445	11 [woa18_ext]	0 [valid]
03503	0.0	4500.0	1530.3422740634558	0.9122899770736694	0.0	34.72471237182617	11 [woa18_ext]	0 [valid]
03504	0.0	4600.0	1531.9939714122688	0.8807899951934814	0.0	34.72148895263672	11 [woa18_ext]	0 [valid]
03505	0.0	4700.0	1533.6672981961915	0.8539100289344788	0.0	34.71708679199219	11 [woa18_ext]	0 [valid]
03506	0.0	4800.0	1535.5949870205918	0.8820000290870667	0.0	34.720890045166016	11 [woa18_ext]	0 [valid]
03507	0.0	4900.0	1537.3861997708127	0.8795099854469299	0.0	34.72080993652344	11 [woa18_ext]	0 [valid]
03508	0.0	5000.0	1539.269189167717	0.8971899747848511	0.0	34.72168731689453	11 [woa18_ext]	0 [valid]
03509	0.0	12000.0	1675.0	0.9393304668694122	0.0	34.72377856479498	11 [woa18_ext]	0 [valid]

15: Sound Speed Manager tabular Data View

Export and apply SVPs

Once done, close the spreadsheet and save the profile to the database.

Now if you're using Kongsberg systems, there is a very handy tool in SSM that can **directly talk to SIS** to apply the processed SVPs. So once you're done with the processing, click the 'transmit data' button in the upper panel.

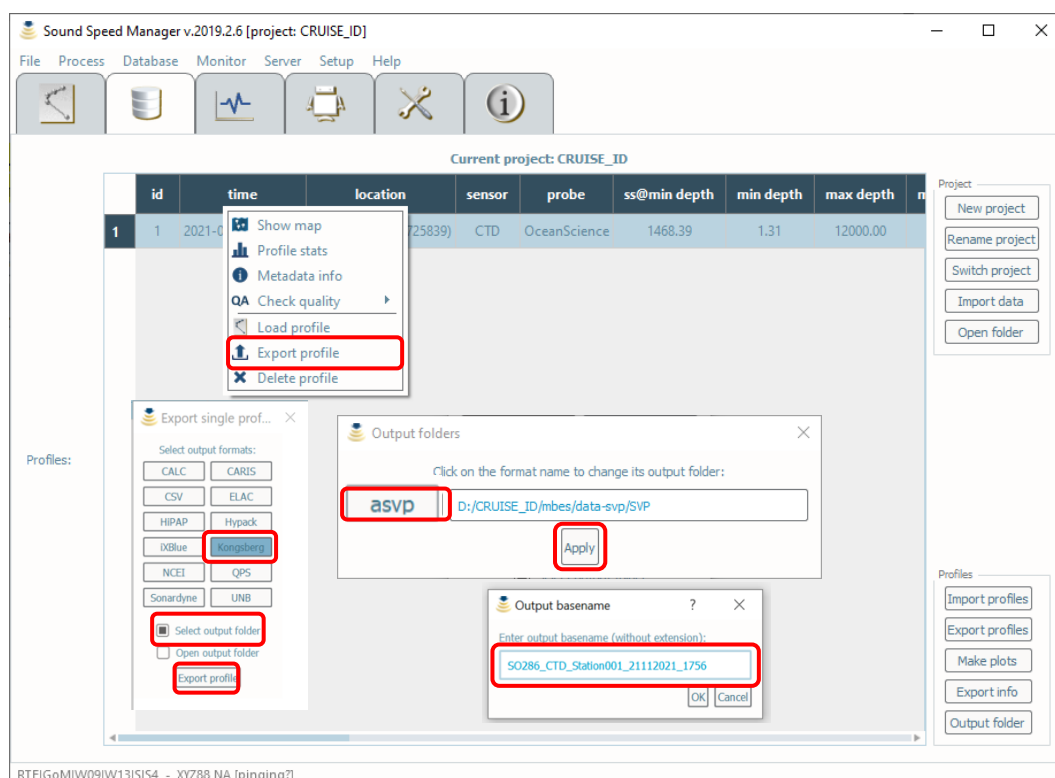
But for data post-processing, you also need to export the profile to **a format the processing software understands**. As you're using Kongsberg systems, it is best to export each profile to Kongsberg format.

In the database tab, right-click the profile in question and click 'Export profile'. In the export window make sure **Kongsberg** is active, check 'Select output folder' and click 'Export profile'. Now click on 'kongsberg' and navigate to the desired output location (**{Cruise}/mbes/data-svp/svp/**). Click 'Select Folder' (luckily, this selection sticks, so you need to do this only once). Enter a significant name, following the **SVP naming convention**:

{Cruise}_{SVP}_{Mode}_{ddmmyyyy}_{hhmm} where:
 {SVP} = one of CTD or WOA
 {Mode} = StationXXX/Transit

Example: SO286_CTD_Station001_21112021_1756

Usually, during transit, you use WOA and CTD during station work. The cool thing is that even after the cruise, you can still draw SVPs from WOA, e.g. if people have forgotten to apply SVP on transit.



16: Export SVP profiles in Sound Speed Manager

The procedure described above can be used both online (on the vessel) and during post-processing. For online application, please refer to the above section how to send SVP to SIS. For post-cruise use, this procedure should be repeated **for all available CTD files** to bring them into one format. Once this is done, all SVPs can be imported to Qimera.

File Synchronisation with SyncBack

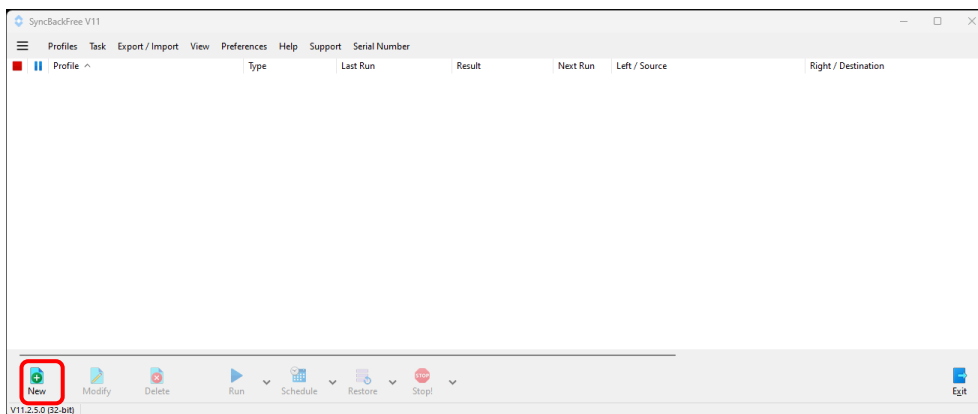
To make sure that no data is lost and that every file reliably is where it is supposed to be, you can use SyncBack. This software can be used to **synchronise folders between different PCs**, for example via network shares. This comes in handy if you frequently need to copy files from one PC to the other (e.g. SVP files) or files from one hard drive to another (e.g. raw files from the acquisition PC to back-up hard drives). You could also do those operations by hand with the **Windows File Explorer**, but synchronising folders eases the process and, once set up correctly, reduces potential for human error.

Important note before you continue reading:

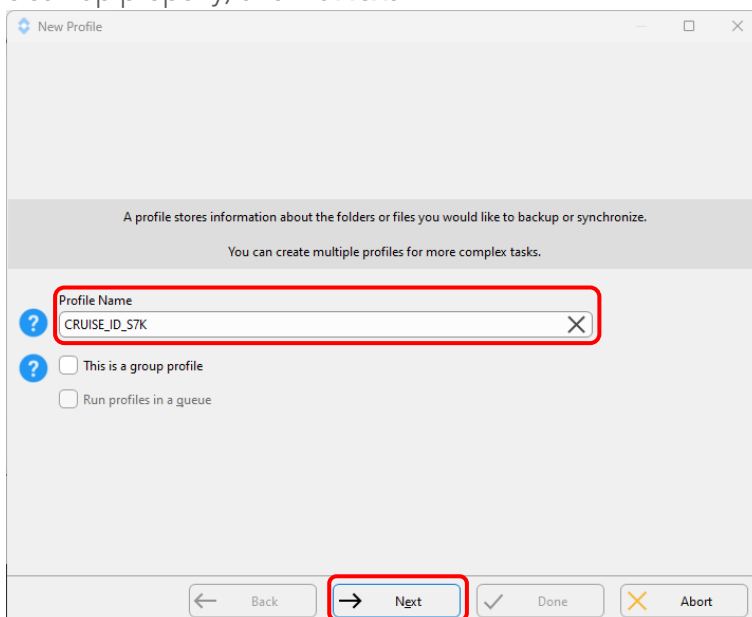
The following section is entirely taken from the AWI Multibeam Survival Guide and describes the procedure as implemented on Polarstern. On the other vessels, as of now (03/2024), SyncBack is only installed and used on MARIA S. MERIAN. However, to ensure uniform data flow and management, SyncBack shall be used on all vessel in a similar manner. The below section can be used as a guide to be implemented on other vessels.

Check out this example setup of SyncBack (running on PC1) to clone S7K files from **MSPC1DS3/Data_SSD** to your cruise folder on **PC1-E550**. Start by opening SyncBack from the taskbar. SyncBack should always be open and if you close it, it will vanish down to a tray icon next to

the clock. You are presented with the main window where all your different profiles are shown (or none like here). Start by creating a new profile in hitting the **New** button in the lower left corner.



Enter a significant name (maybe add your cruise ID so we know which profiles to delete if you did not clean up properly) and hit **Next**.



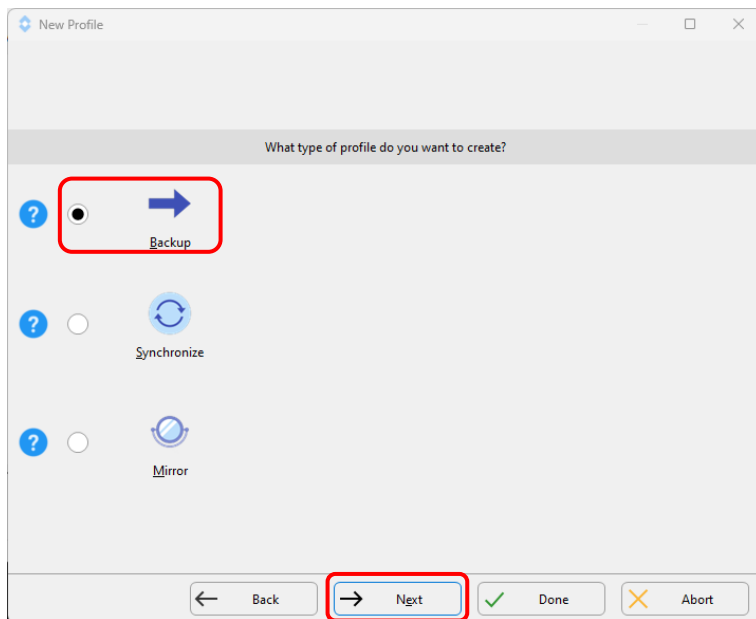
Select your type of profile.

Backup will use the destination as a data grave. All new files in the source will be copied over, changed files will be updated, but deleted files will not be deleted in the destination.

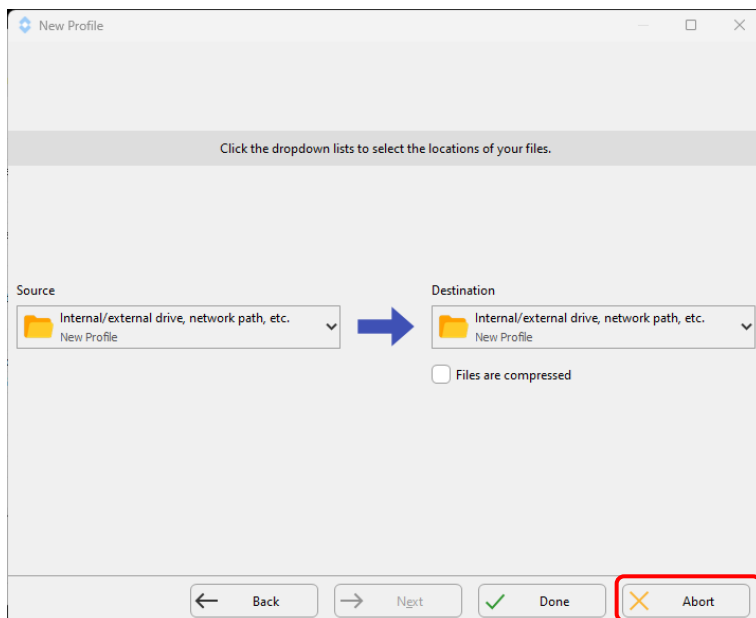
Synchronize will create a two-way folder sync. Every change on either side will be synced to the other.

Mirror will use the source as a master folder and create a mirrored copy at destination. New files and changed files in source will be copied over or updated in destination. Deleted files in source will be deleted in destination and manual changes in destination will be overwritten on the next sync.

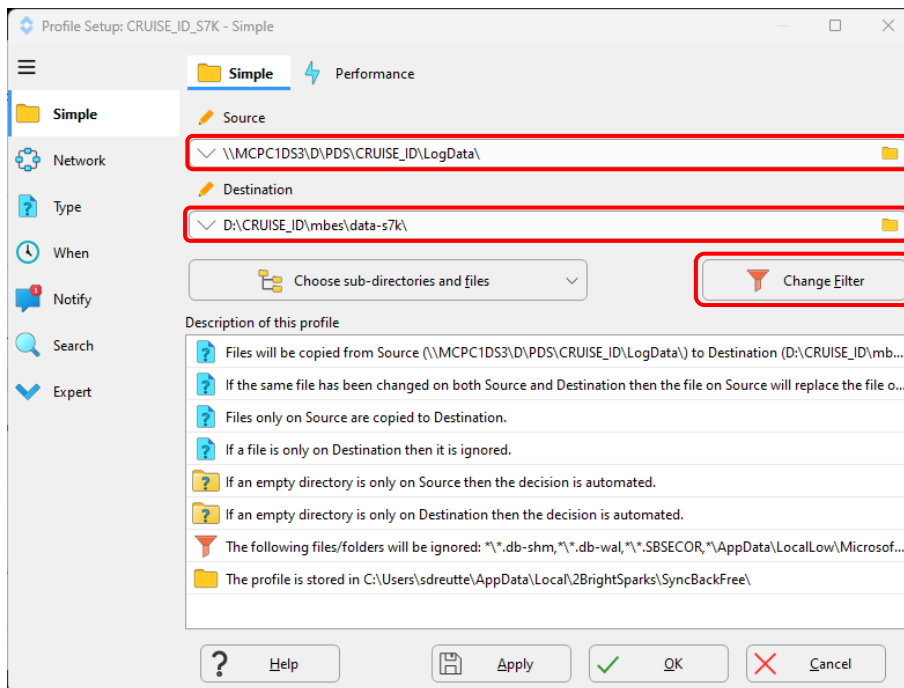
Mirror is generally a good choice as it never harms your source folder and no data corpses will pile up in destination. However, if you are unsure, use **Backup** first, and at the end of the cruise, manually check your source folders. If you are certain, that source still contains everything you need (nothing has been deleted accidentally along the way) you can still change the profile to Mirror and in this way clean up your destination. **Next**.



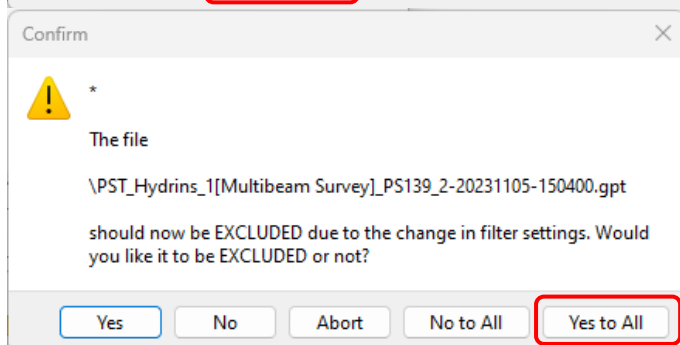
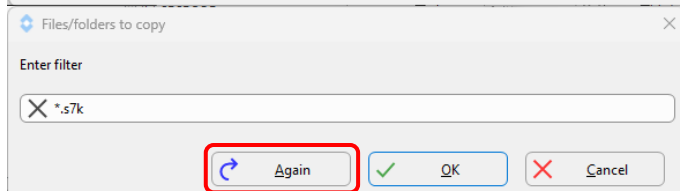
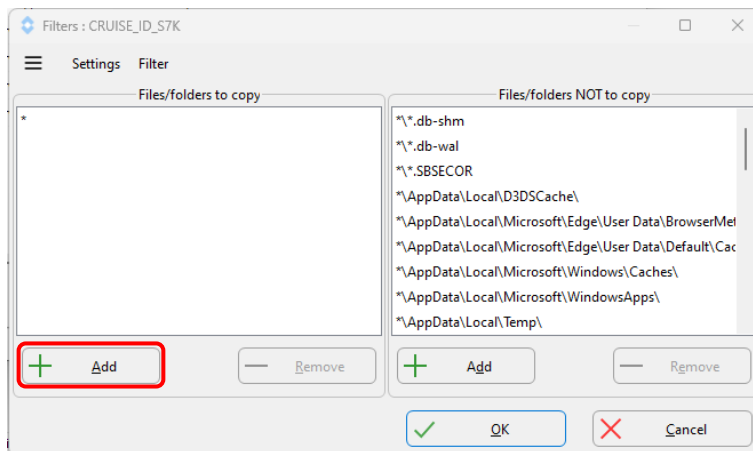
In the next window just hit **Done** as you will only be working with "normal" drives.



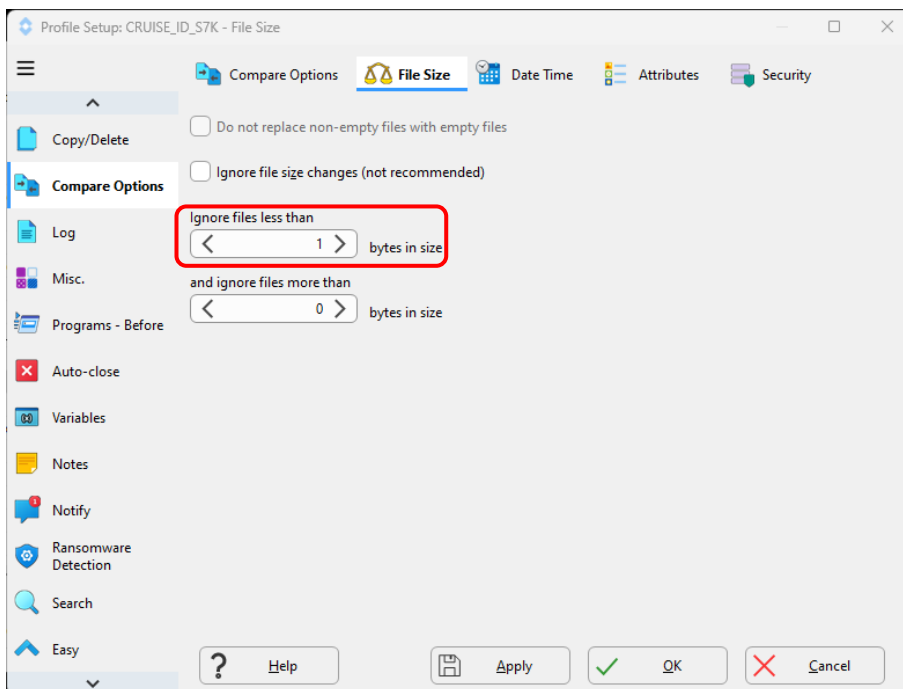
In the Profile Setup window set the path for **Source** and **Destination**. Depending on your use, you can specify the subfolders that should be synced, or set filters for a more detailed control.



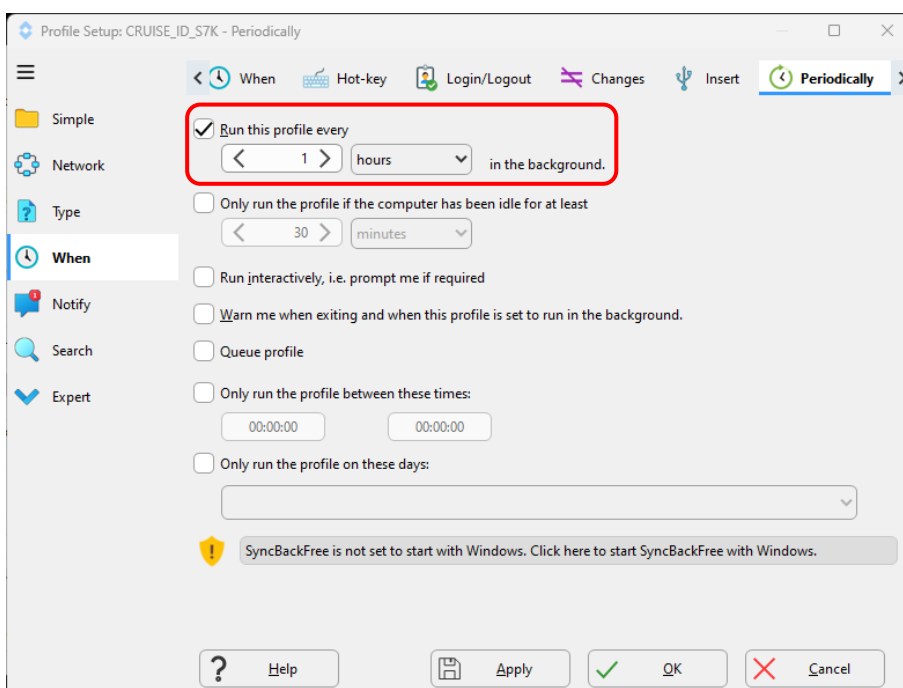
In this example we'll set some filters by clicking **Change Filter**. The S7K files are logged in the *LogData* folder in your PDS project together with all the other log files. To only copy the S7K files, click **Add** in the **Files/folder to copy** section (left). Add a filter for S7K files (*.s7k). Then just follow the screenshots and finally click **OK** and confirm with **Yes to All**.



To further improve your profile, you can enter the **Expert** settings (lowest button on the left side), go to **Compare Options > File Size**, and set the **Ignore files less than** value to 1 byte. This will prevent copying files with 0 bytes files size as these (in case of S7K files) are files that are currently written. And you generally don't want to touch those, and you also don't want to sync half written files and import them to HIPS before the file is fully done.



Now your profile is ready. You can go out by hitting **OK** a couple of times. When you reach the main window, **Run** your profile. **SyncBack** will open a dialog which shows you, what files are to copied/updated/deleted. That is a good failsafe to make sure you set everything up nicely. If you are happy with the result you can either use **Run (Unattended)** in the future, or set an automatic sync. To do this, just **Modify** your profile. On the left side click on **When > Periodically** and set your desired time interval. Done!



With these settings you are ready to set up your automatic data flow. See **Error! Reference source not found.** for an example setup. But first, let's understand where all this data come from and where it needs to go.

Pro Tip:

If you have profiles that do not run periodically, but should be run manually, like synchronizing your SVP files, you can also set up a hot key for quick and easy profile running. On the left side click on **When > Hot-key** and set your desired hot key. For SVPs we used Alt-S in the past. Now check the **Run unattended** box below and you are good to go. Done!

