

How to correct for moving bed using SonTek ADCPs



The challenge

In hydrology, a moving bed refers to sediment on the bottom of a river, channel, or stream that is actively transported downstream by flowing water rather than remaining fixed in place. This movement can occur as particles roll, slide, or bounce along the channel bed, especially during higher-flow conditions.

A moving bed matters because it can affect flow measurement accuracy, particularly when using acoustic instruments such as ADCPs, since the instrument may incorrectly interpret bed movement as boat movement or flow velocity distortion. Correcting for a moving bed is therefore necessary to ensure discharge measurements are accurate, especially in sediment-laden or fast-flowing rivers where bedload transport is significant.

When using bottom track, a moving bed appears as an artificial upstream movement of the of the boat (or boat track) relative to the riverbed. This happens because the instrument assumes the bed is stationary, but if sediment on the bottom is actually moving downstream, the ADCP interprets that motion as if the boat were drifting upstream. As a result, the measured water velocity and discharge can be biased low unless a moving-bed correction is applied.

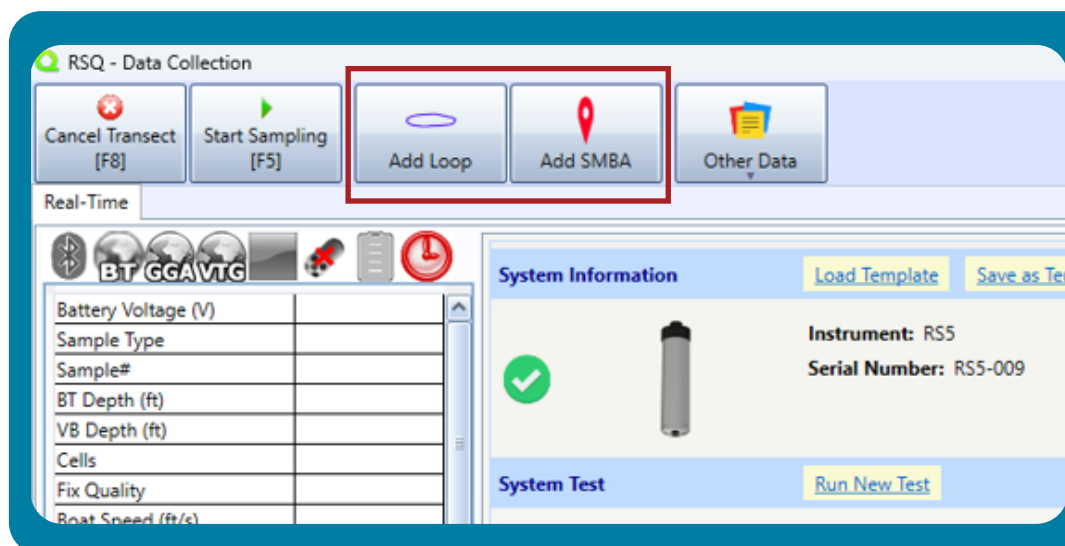
SonTek ADCP solutions and how-to's

The SonTek M9 and RS5 have two options for detecting and correcting for moving bed: the loop method and the Stationary Moving Bed Analysis (SMBA) method. For details on how to perform the loop or SMBA method specifically, please see the following references:

Loop method: <https://pubs.usgs.gov/sir/2006/5079/>

SMBA: https://water.usgs.gov/water-resources/software/SMBA/SMBA_Algorithms.pdf

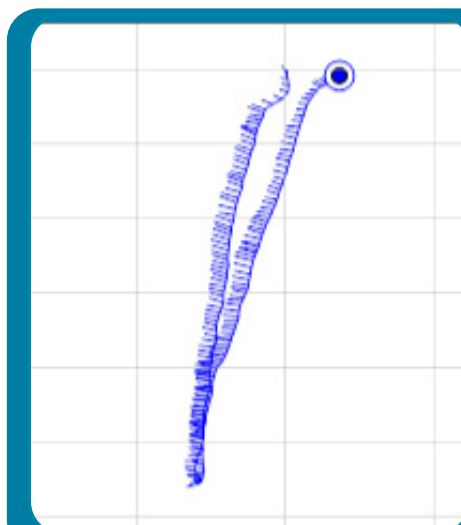
In the SonTek RSQ software, either moving bed test method can be accessed from the top left button banner during a Moving Boat measurement:



Loop Method

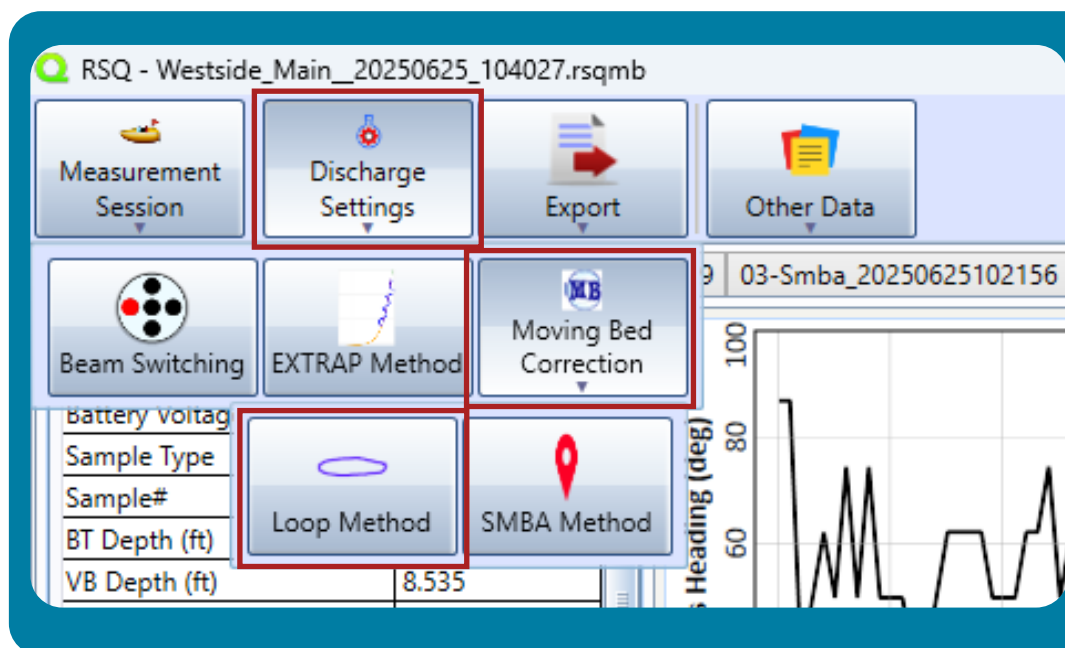
Ship track data using Bottom Track as the track reference will look similar to the following when a moving bed is present during a loop test.

Here, the endpoint of the test (highlighted with the circle) is upstream of the starting point, suggesting a moving bed.



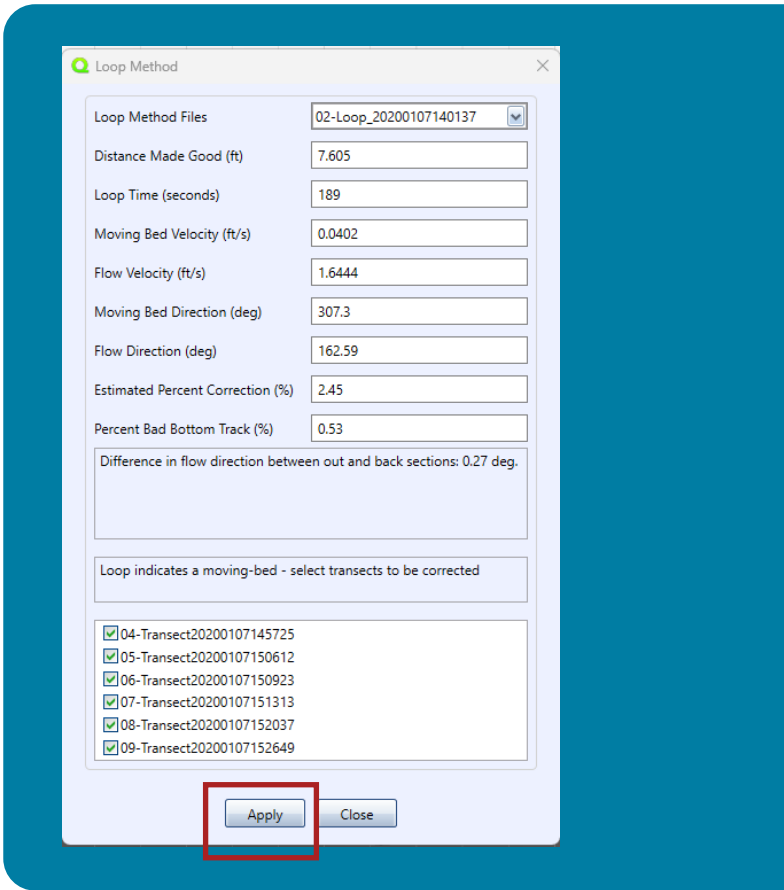
In order to apply a moving bed correction, first collect the moving bed correction measurement(s) according to processes outlined in the examples above.

To apply a Loop moving bed correction, open the measurement file, and select Loop Method from the drop down menu under Discharge Settings.



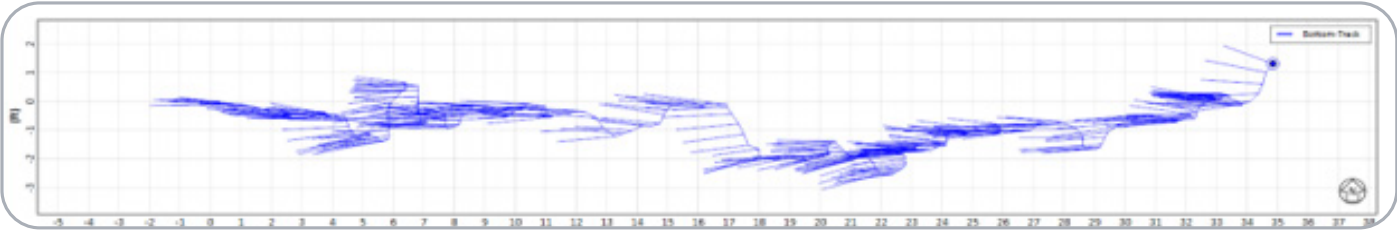
The Loop Method dialog shows options for selecting which Loop measurement to use (if there is more than one), whether or not a moving bed is detected, and gives the user options on which transects to which the correction is applied.

Click “Apply” to use the loop moving bed correction.

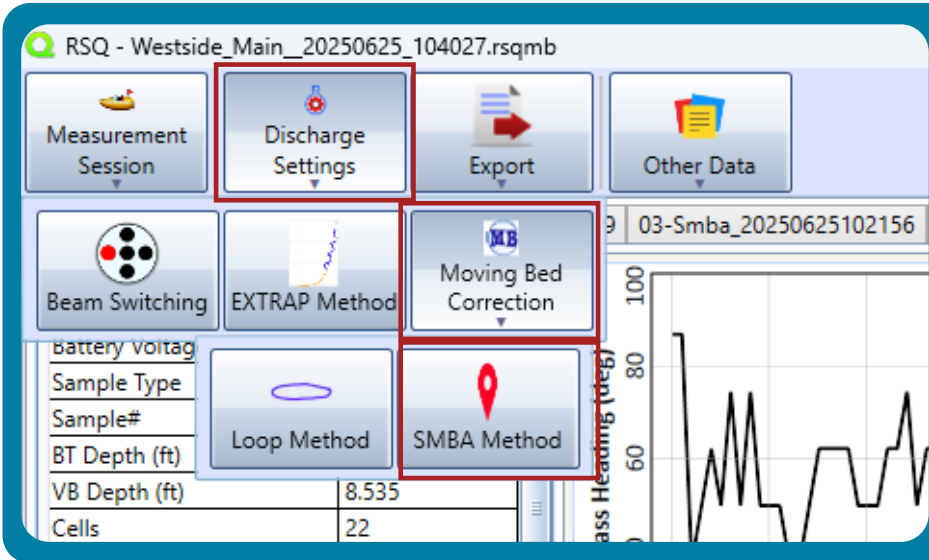


SMBA Method

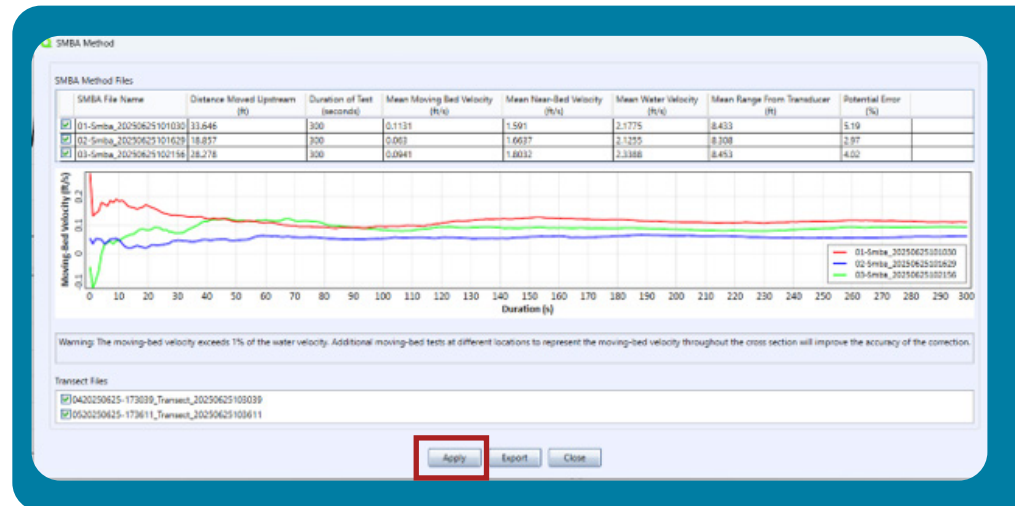
An example of an SMBA test showing a moving bed is below. Notice the upstream apparent movement of the ADCP while it is held stationary:



To apply an SMBA moving bed correction, open the measurement file, and select SMBA Method from the drop down menu under Discharge Settings.



The SMBA dialog gives feedback on whether or not a moving bed is present, recommendations on whether additional SMBA stations are needed, and the option to “Apply” the correction to the measurement transects.



When a moving bed correction is successfully applied, the corrected discharge (Q) values will appear in the “Total Q Corrected” column in the Discharge Summary:

Name	Start Time (UTC-6)	Duration	Total Q (ft ³ /s)	Total Q Corrected (ft ³ /s)	Top Q (ft ³ /s)	Middle Q (ft ³ /s)	Left Q (ft ³ /s)	Right Q (ft ³ /s)	% Measured	Boat Speed (ft/s)	Mean (ft/s)
01-Loop_20200107134829	2020-01-07 13:51	00:06:16	-4.1927		-0.0333	-2.2666	0	0	54.06	0.4299	-0.2558
02-Loop_20200107140137	2020-01-07 14:02	00:03:10	8.2716		0.0861	6.6519	0	0	80.42	0.6102	0.4805
03-Smba_20200107140618	2020-01-07 14:06	00:05:42	-0.0656		0.4025	0.1512	0	0	230.55	0.2339	-0.0024
04-Transect_20200107145725	2020-01-07 15:02	00:03:12	-189.370	-194.1288	30.9543	-126.6377	-0.3378	-0.5559	66.87	0.4198	-1.5337
05-Transect_20200107150612	2020-01-07 15:06	00:03:00	186.6745	192.5099	0.6928	125.921	0.7502	0.2617	67.45	0.4131	1.4848
06-Transect_20200107150923	2020-01-07 15:09	00:03:43	192.6459	197.6072	1.735	130.0699	0.399	0.4107	67.52	0.3765	1.4695
07-Transect_20200107151313	2020-01-07 15:13	00:03:36	179.8674	186.8555	8.5765	121.3498	0.3734	0	67.47	0.4668	1.4009
08-Transect_20200107152037	2020-01-07 15:21	00:03:24	174.0219	177.9774	8.9452	115.6915	0.2212	0.4625	66.48	0.4235	1.4191
09-Transect_20200107152649	2020-01-07 15:27	00:03:16	199.7927	206.3632	2.0828	134.444	0.6195	0.4644	67.29	0.4409	1.5309
Mean			123.9387	127.8641	0.1797	83.4731	0.3376	0.1739	67.18	0.4234	0.962
Std Dev			140.3621	144.266	2.9047	94.1544	0.3475	0.3639	0.38	0.0274	1.1167
COV			1.133	1.128	0.135	1.128	1.029	2.092	0.006	0.065	1.161

Note that original non-corrected Q values will always be preserved in the “Total Q” column, and the “Total Q Corrected” column contains the corrected Q values. If you do not see this column present in your Discharge Summary, right-click on the column titles to toggle on this selection.

In general, we recommend using the Loop or SMBA moving bed methods as a way to detect a moving bed. If a moving bed is detected, the best option is to move to GNSS as a ship track reference when possible for final Q. If GNSS is not possible, then the next best option is to use a moving bed test correction.

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