Source/Receiver (SR) Setup

– For 1-D and 2-D Vs Profiling –

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January 2015

Park Seismic

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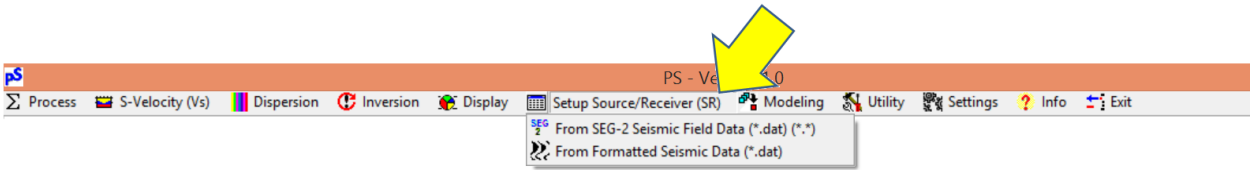
1. Overview

The main purpose of running source/receiver (SR) setup is to encode the proper distance and location information into the header of each channel's data in the recorded field files (records). This setup is usually encoded into original field records during the field operation by the acquisition software if the operator arranges necessary parameters properly at the beginning of data acquisition. This can be checked at the early stage of SR setup when importing field records of SEG-2 format (and, if they are confirmed to have the correct setup encoded, then they can be saved as a single file in the PS-format [*(SR).dat] ready for the regular MASW analysis and this separate setup procedure will be skipped). If the SR setup was ignored during data acquisition or the original setup is in error, then the correct setup can be encoded by running this "Source/Receiver (SR) Setup" module from the main menu.



The overall procedure of SR setup consists of following three (3) steps:

Step 1. Pre-Setup

Prerequisite information is gathered or confirmed at this step such as the unit of distance (feet or meters), number of channels detected from input, survey type [active, passive, and combined (active + passive) surveys], and receiver array (RA) type (1-D or 2-D).

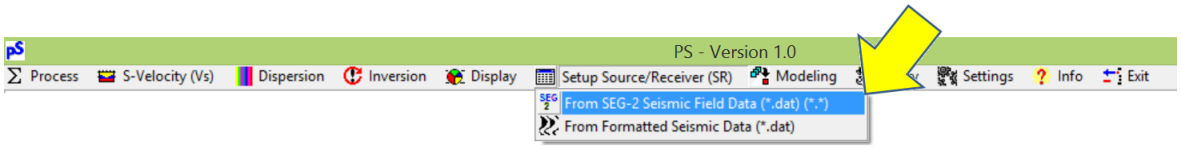
Step 2. Source/Receiver (SR) Specification

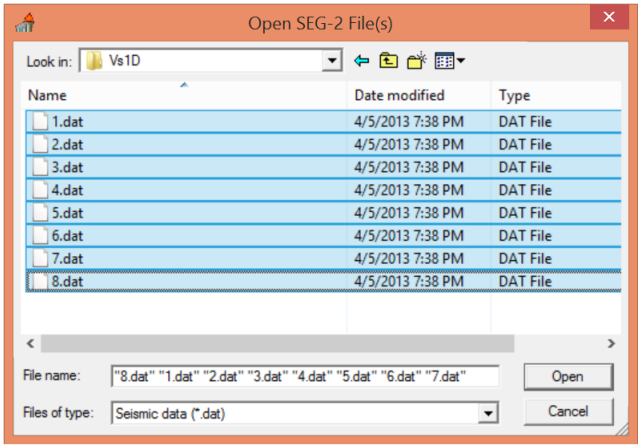
Actual settings of relative location (in distance and station numbers) of the seismic source (for active and combined survey cases) and individual receivers are specified either all at once through one systematic sequence to all input records, or through a multiple sequence of different settings applied to different portions of the records. This SR specification is treated differently for 1-D and 2-D receiver array (RA) types, respectively.

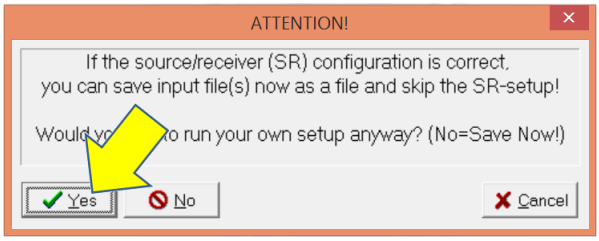
Step 3. Specification of Files To Apply and Running Setup

By default, all setup parameters arranged through the previous two steps will be applied to all input records. Otherwise, the proper range of input records to apply the setup to can be chosen at this step before running the actual setup. In this case, multiple setup sequences can be run for different ranges of input records by repeating all three (3) steps and saving (appending) outputs under the same file name.

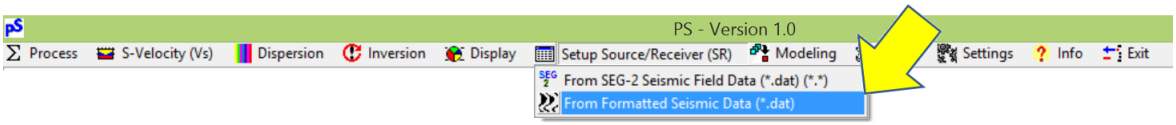
To import multiple seismic files of SEG-2 format from the main menu, go to "Setup Source/Receiver (SR)" → "From SEG-2 Seismic Field Data (*.dat)" and select the files at the same time as illustrated below. Then, the program will detect if any encoded SR setup is found. If so, then you select to view the entire setup in a chart for visual inspection and confirmation. If the displayed setup is confirmed correct, then you can save input record(s) as a single file of PS-format ready for the regular MASW data analysis and skip the separate setup. Otherwise, you need to run your own setup by following the procedures outlined here.

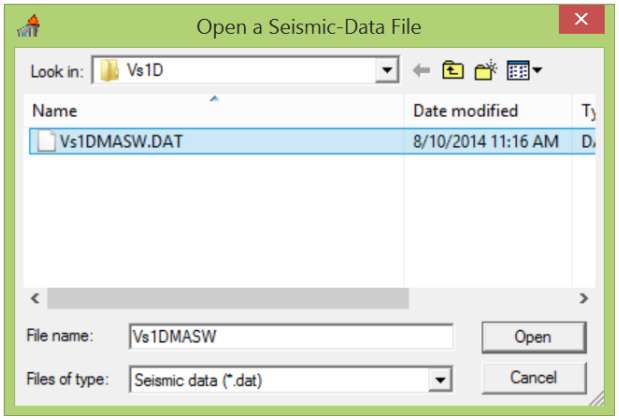




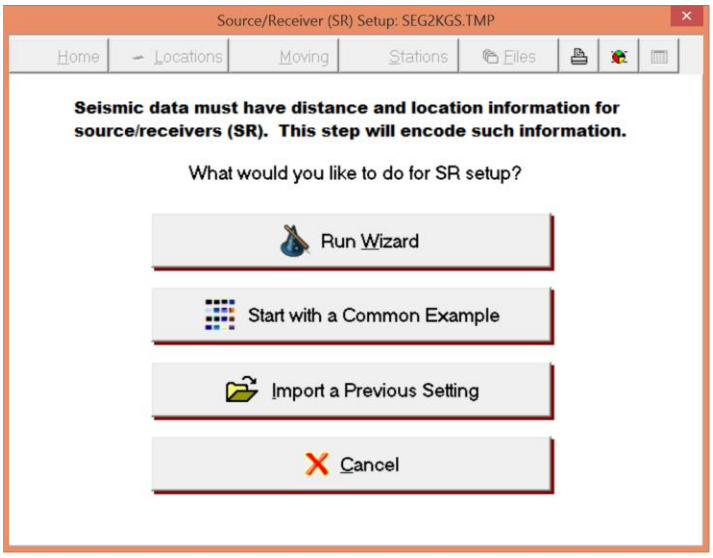


The SR setup can also be applied to a previously saved file of PS-format from the main menu. In this case, only one file is selected for input. To import an input seismic data file of PS-format from the main menu, "Setup Source/Receiver (SR)" → "From Formatted Seismic Data (*.dat)" and select one file as illustrated below.





Once the input data set is imported, then the SR setup main menu will be displayed as shown below.

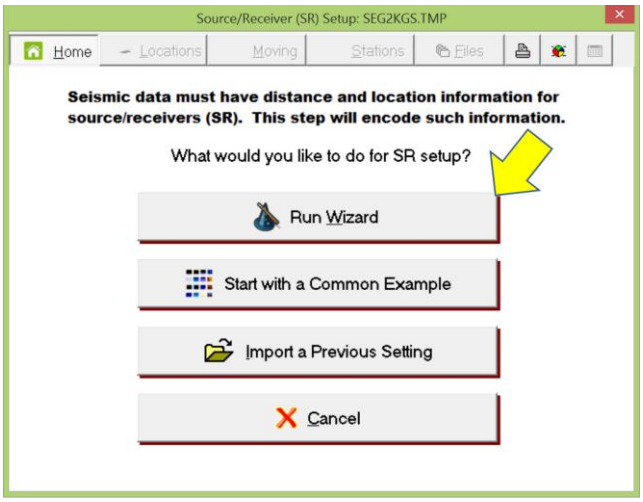


2. Source/Receiver (SR) Setup — Main Menu

Main menu consists of three options; "Run Wizard", "Start with a Common Example", and "Import a Previous Setting", each of which is explained below.

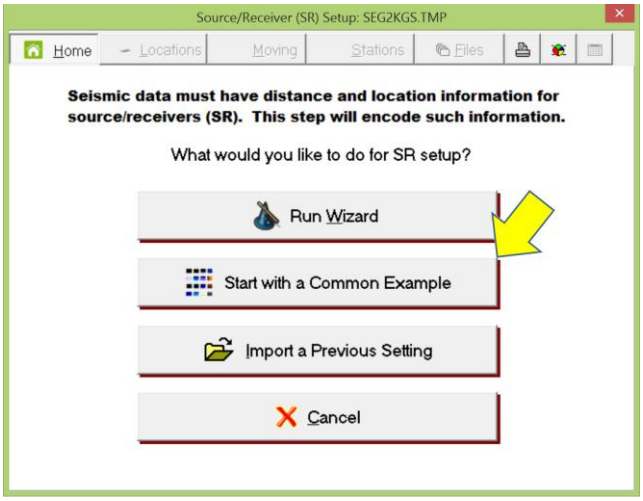
2.1 Run Wizard

This will enable you to follow a sequence of graphical displays to specify all necessary source/receiver (SR) configuration parameters such as receiver spacing (dx), source offset (X1), source location, how the survey proceeded, etc. This option of "Run Wizard" is further explained in the last two sections of "**Source/Receiver (SR) Setup for 1-D Vs Profile**" and "**Source/Receiver (SR) Setup for 2-D Vs Cross Section**."

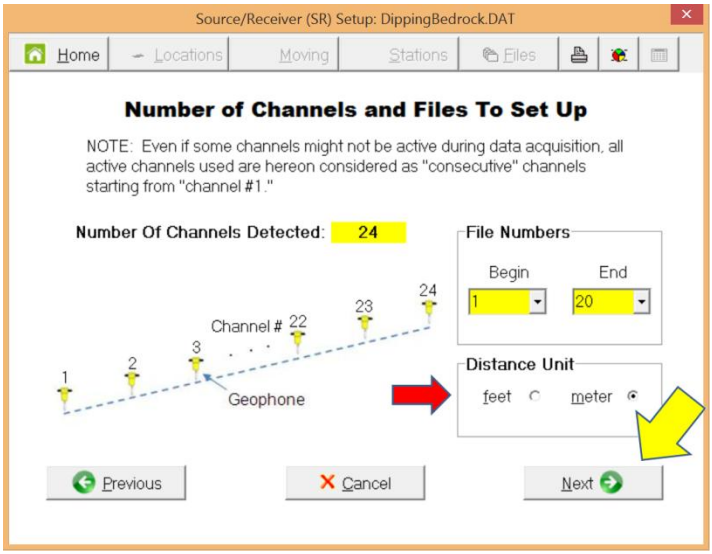


2.2 Start with a Common Example

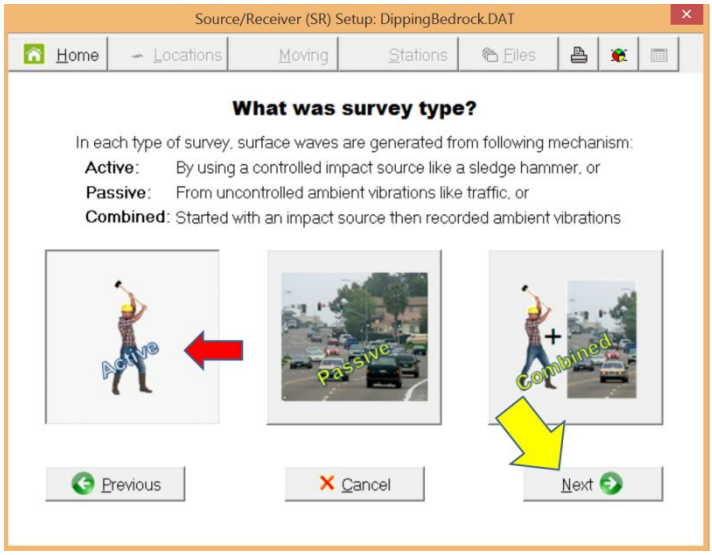
This will enable you to choose one of the typical settings commonly used in MASW surveys (1-D and 2-D).



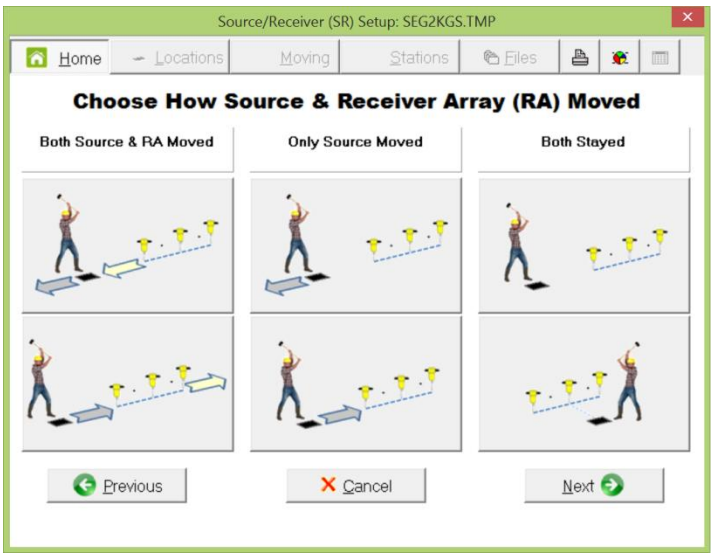
It will first draw attention to a few key parameters related to the specific input data set imported for the setup: total number of channels in each of the input records, range of input file numbers, and distance unit used during data acquisition. Be sure to select the appropriate distance unit before proceeding to the next step. The default unit is the one detected from the input data.



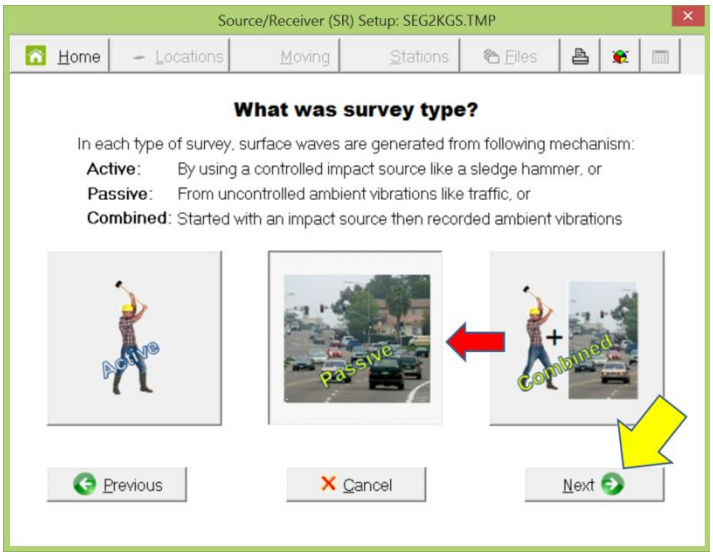
Then, you are to choose one of the three survey types; active, passive, and (active+passive) combined survey. Each of these options is explained. First, select the "Active" button as shown below.



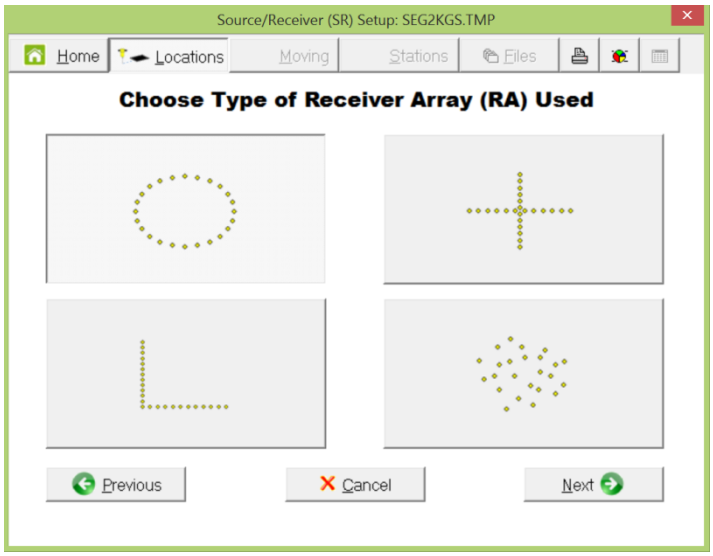
The following six (6) cases are then displayed based on the relative move of source and receivers during the survey, from which you can choose the closest case to the input data. Each case is explained clockwise from the top left case: "**both (source and receivers) moved toward source**", "**only source moved away from receivers**", "**source was located off the end of receiver array (RA)**", "**both moved toward receivers**", "**only source moved toward receivers**", and "**source was located inside the receiver array (RA)**." Depending on the case you choose, the next step will be at the place where the receiver spacing (dx) is to be entered, from which all remaining procedures will be identical (or similar) to the one explained in the corresponding steps in the last two sections for 1-D and 2-D setup.



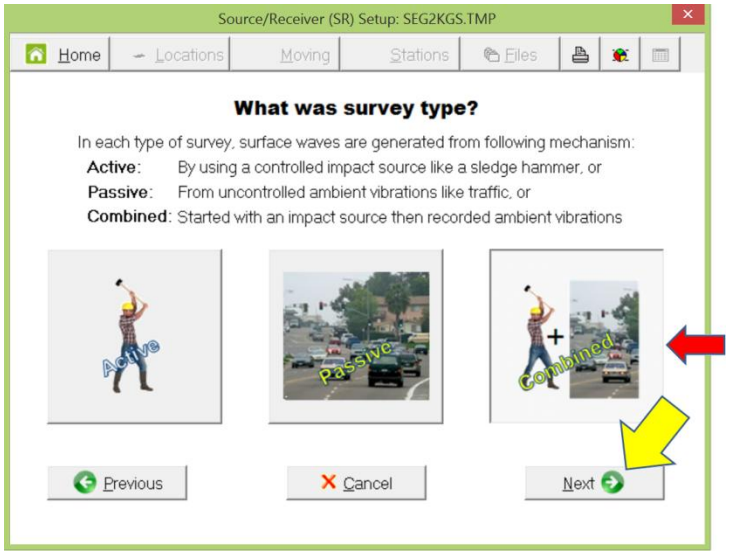
If you selected "Passive" as your survey type in the earlier dialog, the procedure is as follows.



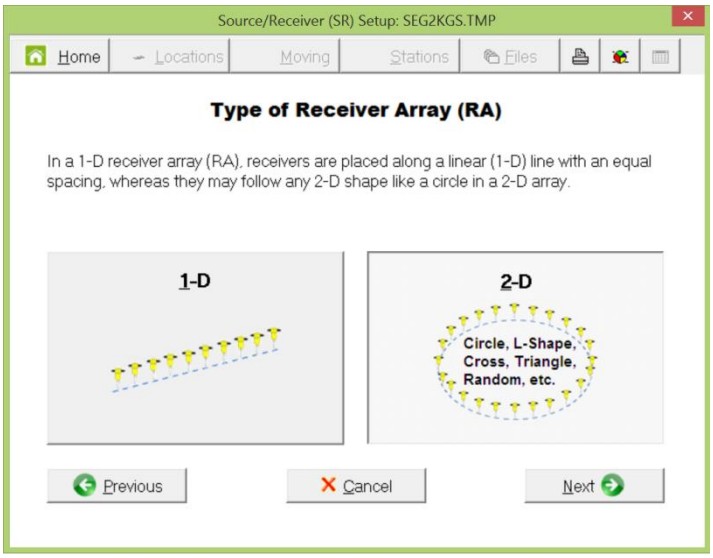
For Passive surveys the following dialog for 2-D receiver array (RA) setup will be displayed. (If the 1-D linear RA was used during the passive survey, then you can choose the "Combined" survey type in the previous dialog by inventing a fictitious source point, which does not affect the processing scheme at all). Once you select a specific type of 2-D RA, then the next step will follow the corresponding procedure outlined in the section "Setting Up a 2-D Receiver Array."



If you selected "Combined" as your survey type in the earlier dialog, the procedure is as follows.

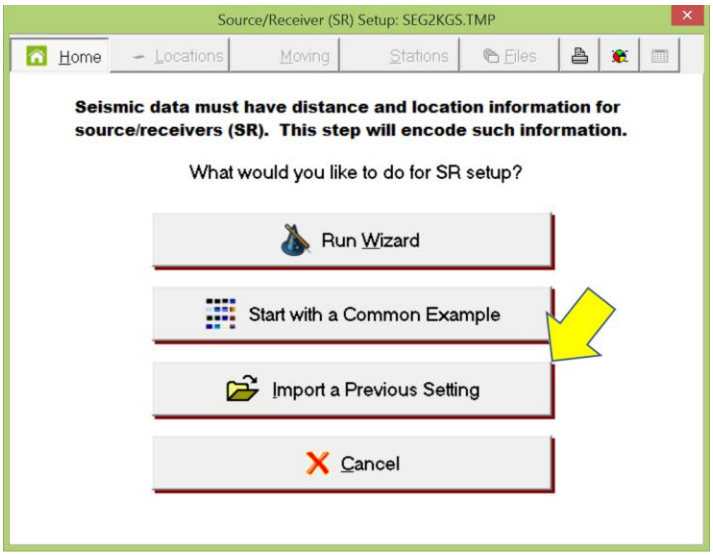


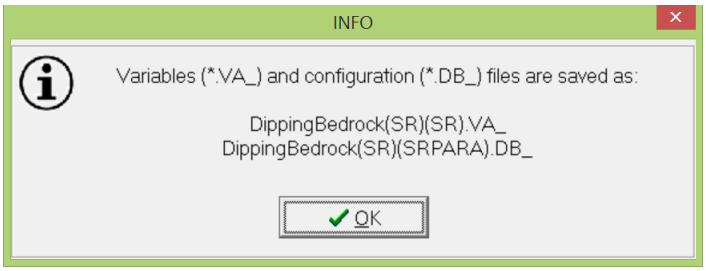
For Combined surveys the following dialog allows you to choose the type of receiver array (1-D or 2-D). If the "1-D" case is chosen, then the remaining procedure will be identical to the case of "Active" survey type, whereas the "2-D" case will be identical to the "Passive" case, with only a couple additional steps such as specification of the source location, and the move of source and/or receiver array after recording at each location.



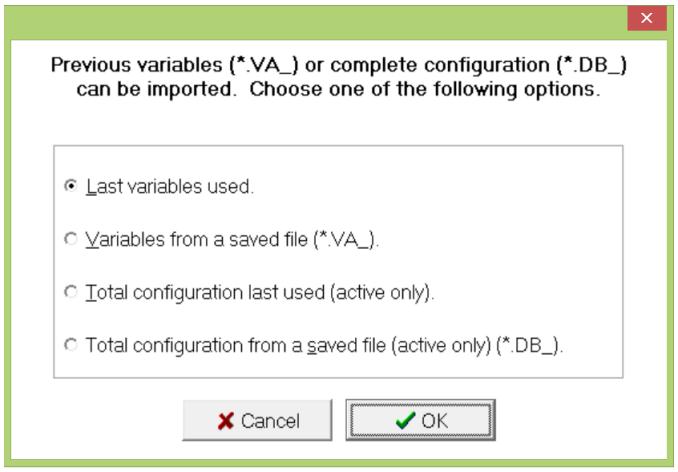
2.3 Import a Previous Setting

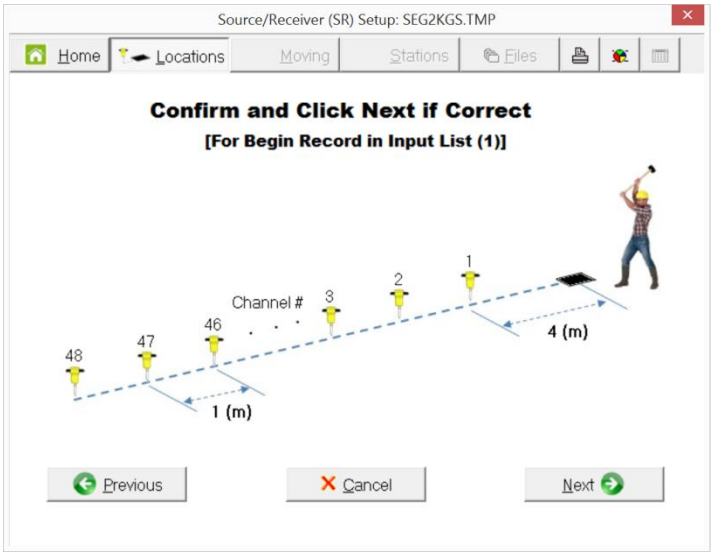
This procedure enables you to import either the settings last used or those previously saved. After completing the setup each time, two types of parameters will be saved in two separate files as shown in the information dialog displayed after the main dialog below; one file (*.VA_) contains all the variables set during the entire procedure [e.g., survey type, receiver spacing (dx), source offset (X1), etc.], and another file (*.DB_) contains surface coordinate information (i.e., distance and station numbers) of source and receivers associated with an individual file (record) number in the input data set.





Once you choose to "Import a Previous Setting" on the main menu, the following dialog will be displayed asking you to choose what type(s) of saved data you want to import. The first option ("Last variables used") will import only those variables last used; the second option ["Variables from a saved file (*.VA_)"] will allow you to choose a saved file from which to import the variables. The third option ["Total configuration last used (active only)"] will import the complete surface coordinates of source and receivers last used; the last option ["Total configuration from a saved file (active only)(*.DB_)"] will let you choose a saved file for this purpose. Depending on which option you choose, the next step will be different. The dialog and figure below are shown after the default option ("Last variables used") has been chosen.

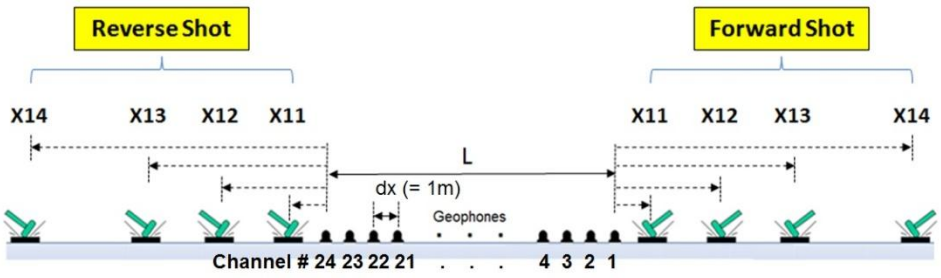




3. Setup for a 1-D Vs Profile (Working with Sample Data "Vs1DMASW.dat")

This sample data set simulates a set of data from an MASW survey to produce a 1-D shear-wave velocity (Vs) profile commonly used to dictate depth variation of stiffness at a fairly confined area. Typical application would be the MASW survey for geotechnical investigation of wind-turbine sites. The data set is an output from a seismic modeling based on the reflectivity method that is also part of the PS software (available under "Modeling" main menu). This data set consists of eight (8) field records of 24-channel acquisition all bundled in one single file of PS-format, i.e., not in SEG-2 format. Two different source orientations (i.e., forward and reverse shots) and four different source offsets (X1's) are used to produce eight (8) unique records. This is a common practice to maximize the robustness of data analysis. For example, use of different X1's minimizes any adverse influence from the near-field effects, whereas acquiring data from both ends of the receiver array tends to average out any lateral variation in the subsurface velocity model (e.g., dipping or uneven bedrock surface) so that the analysis can achieve the highest resolution in vertical variation.

The source/receiver (SR) configuration chart displayed below (Figure 1) shows relative SR location for each record. It shows the receiver array stayed at the same surface location for all eight (8) records, with only the source moving to change offsets (X1's) and orientations. Forward shots refer to those impacts made off the first channel, and reverse shots refer to those made off the last (24th) channel. The table in Figure 2 summarizes locations of source and receivers for each record in the sample data set. The entire procedure to encode the proper SR configuration with this sample data set is demonstrated below. A yellow arrow in the figure indicates a mouse click on the selected place, and a red arrow indicates places and items that need attention.



Source/Receiver (SR) Configuration for All Records (1 - 8)

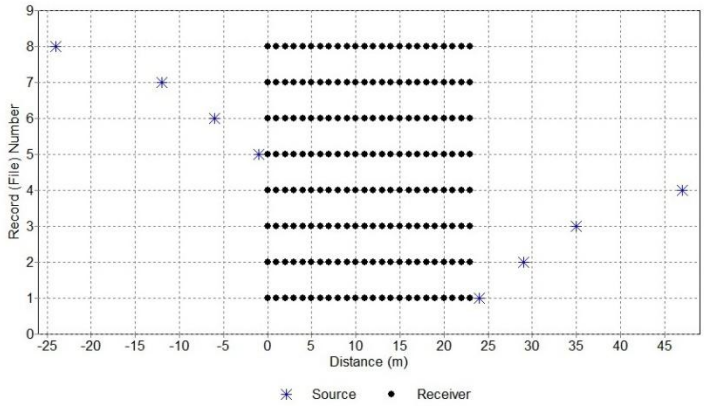
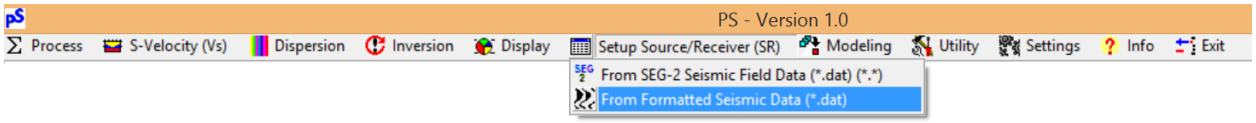


Table: Location and orientation of source and receivers (SR) for each record

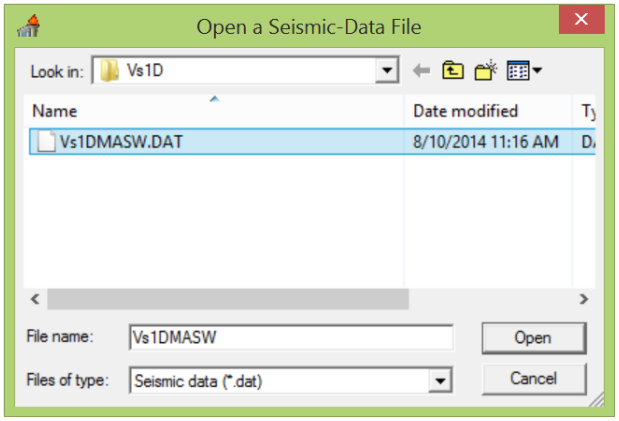
File (Record)	Receiver X (m)		Source		
	Channel #24	Channel #1	Offset (m)	X (m)	Orientation
1	0.0	23.0	1.0	**24.0**	**Forward**
2	0.0	23.0	6.0	**29.0**	**Forward**
3	0.0	23.0	12.0	**35.0**	**Forward**
4	0.0	23.0	24.0	**47.0**	**Forward**
5	0.0	23.0	1.0	**-1.0**	**Reverse**
6	0.0	23.0	6.0	**-6.0**	**Reverse**
7	0.0	23.0	12.0	**-12.0**	**Reverse**
8	0.0	23.0	24.0	**-24.0**	**Reverse**

Figure 2. Source and receiver (SR) configuration used to generate model data set "Vs1DMASW.dat."

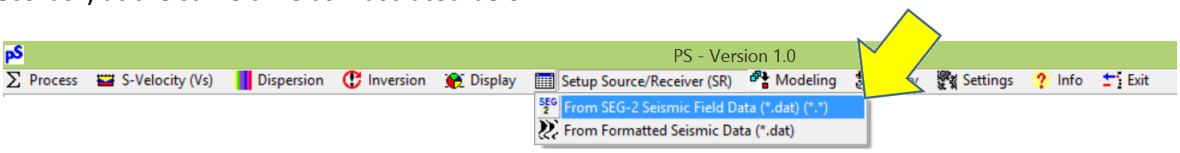
From main menu, "Setup Source/Receiver (SR)" → "From Formatted Seismic Data (*.dat)"

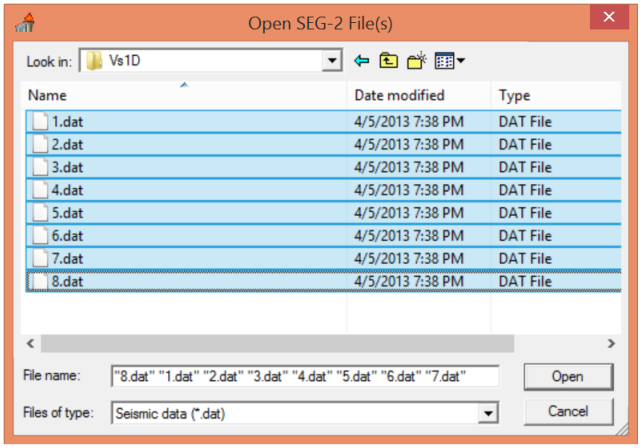


Open " Vs1DMASW.DAT."

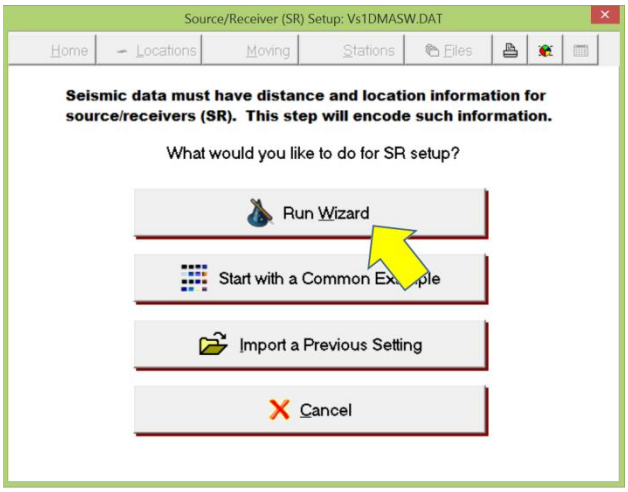


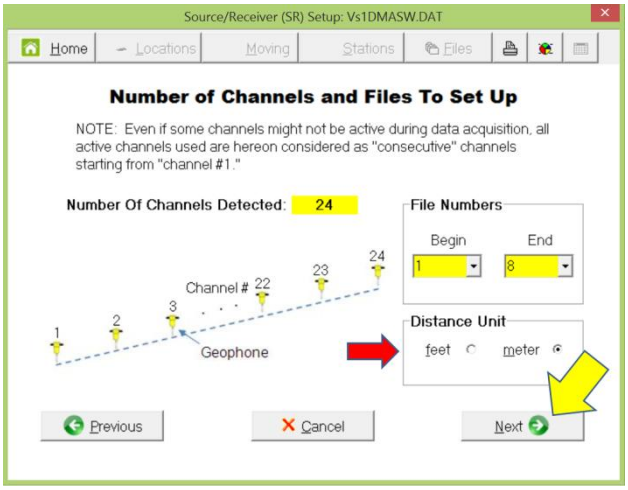
If original field files of SEG-2 format are to be imported instead of a data set already in the PS format, then choose "From SEG-2 Seismic Field Data" as shown below. In this case, import all multiple field files ("records") at the same time as illustrated below.

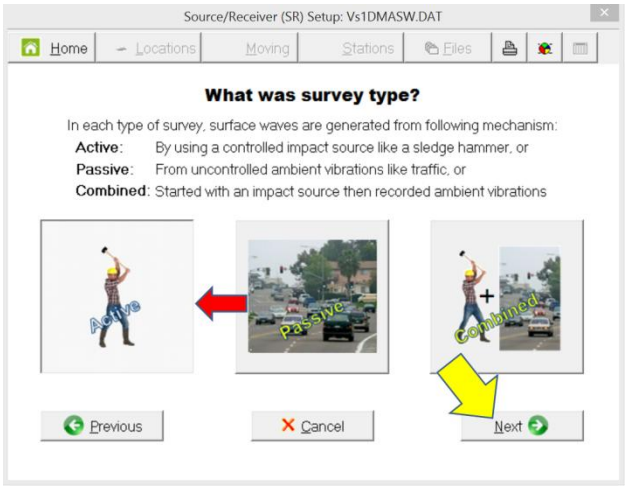


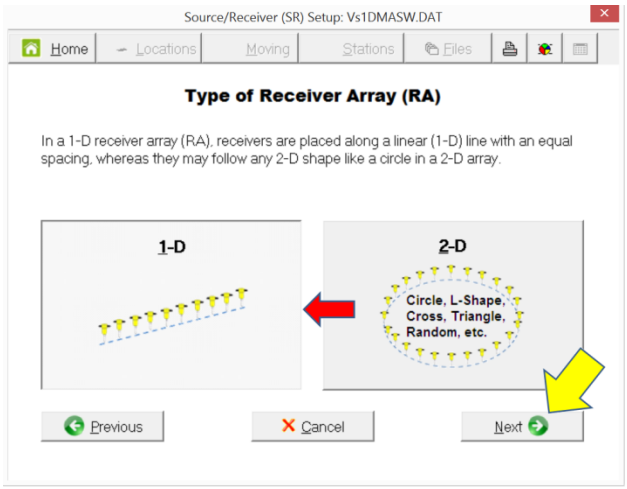


3.1 Pre-Setup

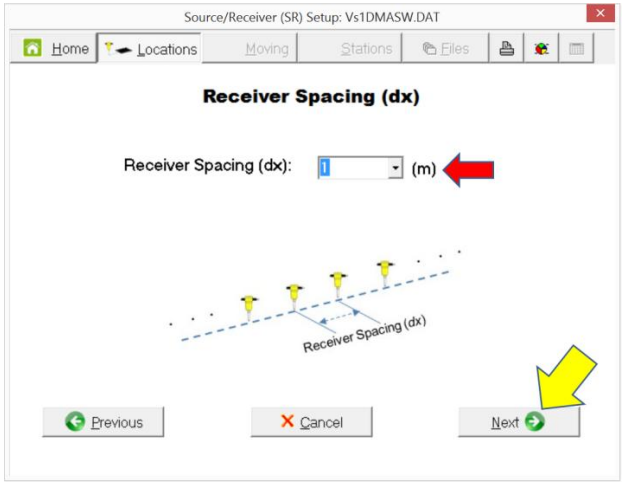

Source/Receiver (SR) Setup: Vs1DMASW.DAT
Home
Locations
Moving
Stations
Files
Seismic data must have distance and location information for source/receivers (SR). This step will encode such information.
What would you like to do for SR setup?
Run Wizard
Start with a Common Example
Import a Previous Setting
Cancel

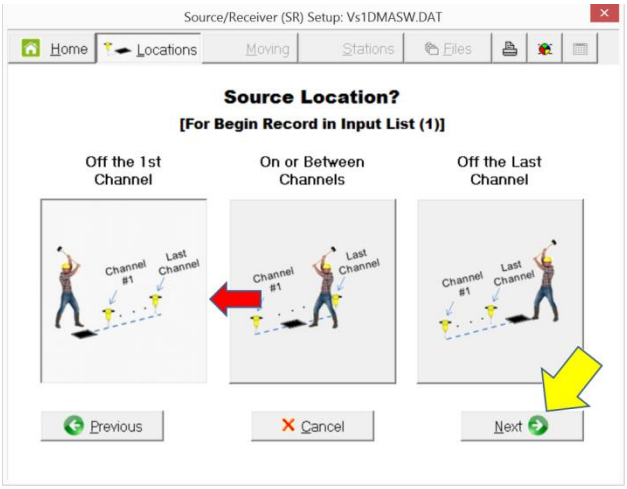

Source/Receiver (SR) Setup: Vs1DMASW.DAT
Home
Locations
Moving
Stations
Files
Number of Channels and Files To Set Up
NOTE: Even if some channels might not be active during data acquisition, all active channels used are hereon considered as "consecutive" channels starting from "channel #1."
Number Of Channels Detected: 24
File Numbers
Begin
End
1
8
Channel #
1
2
3
22
23
24
Geophone
Distance Unit
feet
meter
Previous
Cancel
Next

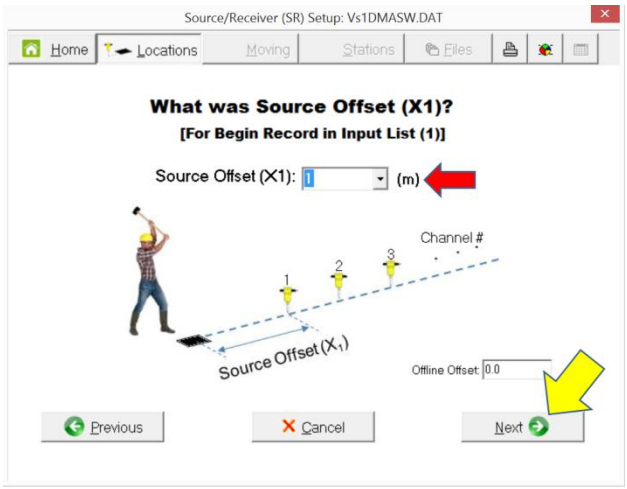

Source/Receiver (SR) Setup: Vs1DMASW.DAT
Home
Locations
Moving
Stations
Files
What was survey type?
In each type of survey, surface waves are generated from following mechanism:
Active: By using a controlled impact source like a sledge hammer, or
Passive: From uncontrolled ambient vibrations like traffic, or
Combined: Started with an impact source then recorded ambient vibrations
Active
Passive
Combined
Previous
Cancel
Next

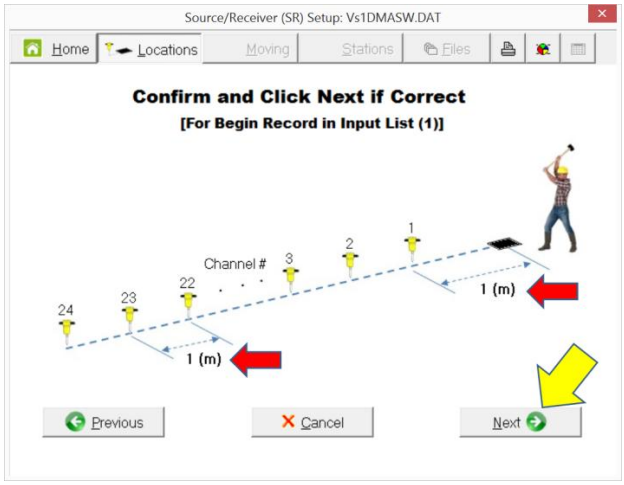


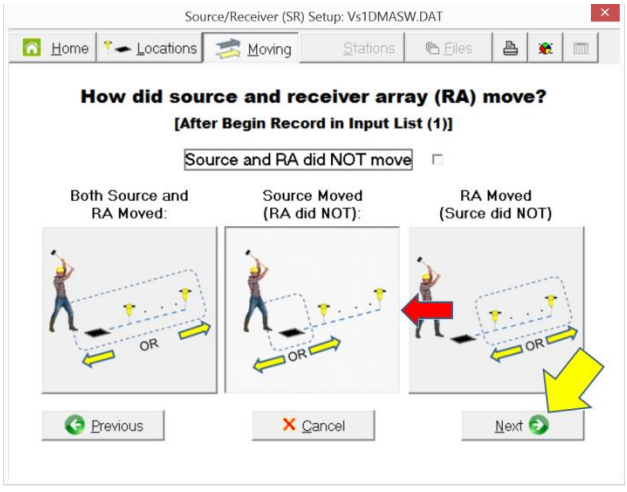
3.2 SR Specification

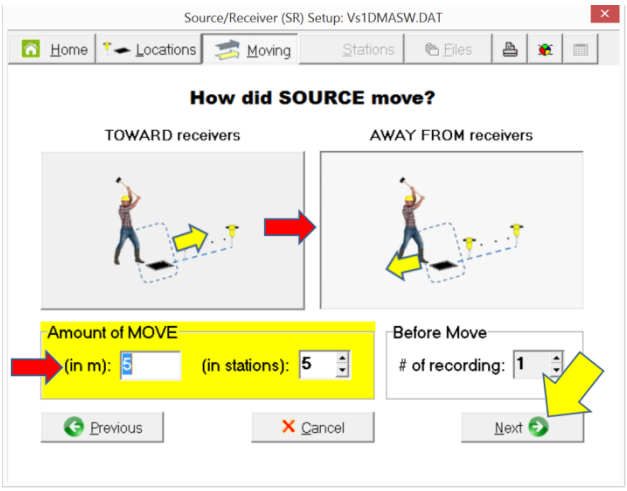





Source/Receiver (SR) Setup: Vs1DMASW.DAT
Home
Locations
Moving
Stations
Files
What was Source Offset (X1)?
[For Begin Record in Input List (1)]
Source Offset (X1): 1 (m)
Channel #
1
2
3
Source Offset (X1)
Offline Offset: 0.0
Previous
Cancel
Next

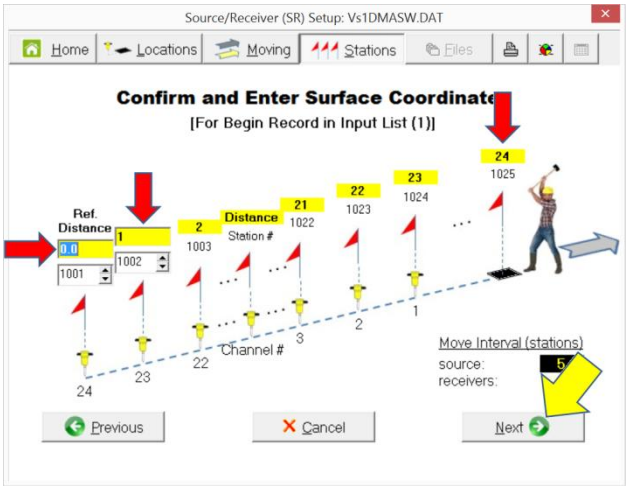

Source/Receiver (SR) Setup: Vs1DMASW.DAT
Home
Locations
Moving
Stations
Files
Confirm and Click Next if Correct
[For Begin Record in Input List (1)]
Channel #
24
23
22
3
2
1
1 (m)
1 (m)
Previous
Cancel
Next


Source/Receiver (SR) Setup: Vs1DMASW.DAT
Home
Locations
Moving
Stations
Files
How did source and receiver array (RA) move?
[After Begin Record in Input List (1)]
Source and RA did NOT move
Both Source and RA Moved:
Source Moved (RA did NOT):
RA Moved (Surce did NOT)
OR
OR
OR
Previous
Cancel
Next

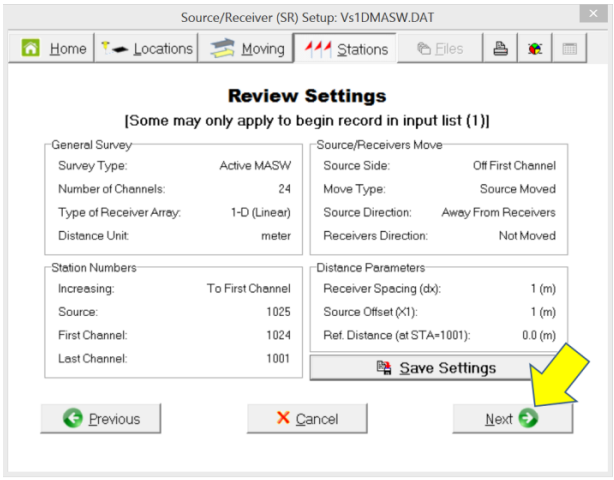


Enter "0.0" for "Ref. Distance" and then "1.0" for next distance.

"Ref. Distance" is an arbitrary surface distance coordinate used as a reference point. Therefore, it can be any number. But, the distance for the next channel should be offset (+ or -) by one receiver spacing (dx). Enter "1001" and "1002" for the station numbers for the first two channel positions. Then, click "Next" button. These are arbitrary "station" numbers that must be consecutive. The general convention for station numbering is "1001, 1002, etc." for line 1, and "2001, 2002, etc." for line 2, and so on. They can also decrease instead of increase.

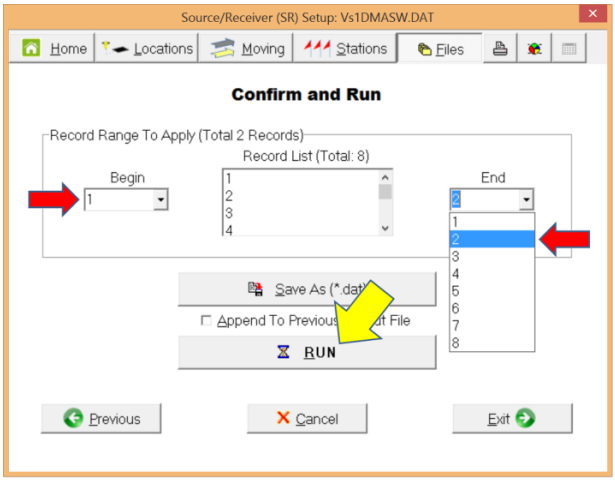


Review and click "Next" button.

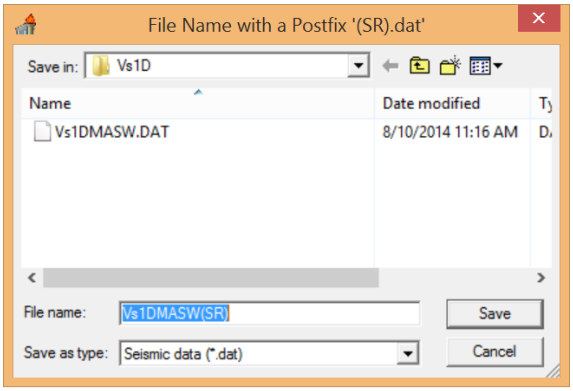


3.3 Specification of Input Records and Running Setup

Make sure to specify begin and end record numbers correctly here. The previous specification of moving 5 meters (5dx) is valid only for next record (2), and therefore the end record number should be '2'. The other records will be handled separately (two records at a time) after completion of these two records. Click "Run" to launch the SR setup process.

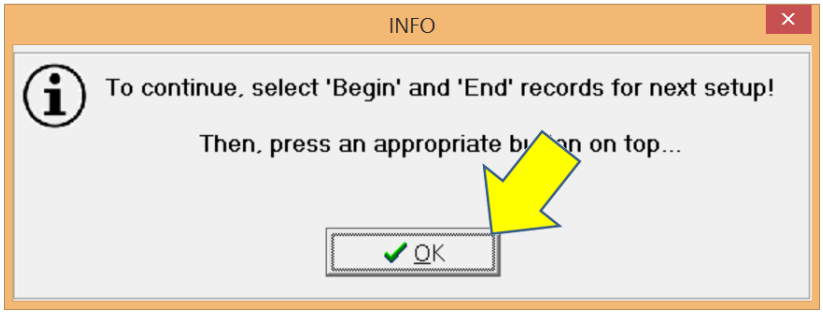


It will ask for output file name first. Default output file name is "Vs1DMASW(SR).DAT."



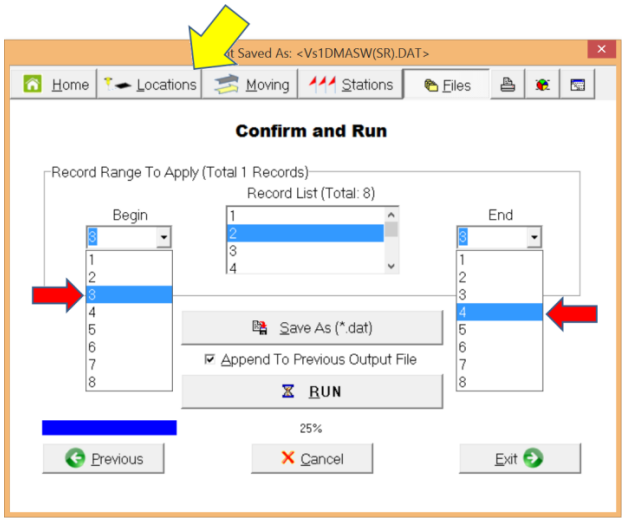
The source/receiver (SR) configuration chart will be displayed that shows the relative location of source and receivers for the first two records (1 and 2). The configuration can also be displayed in "Stations" by clicking the button on top menu. Close the chart.

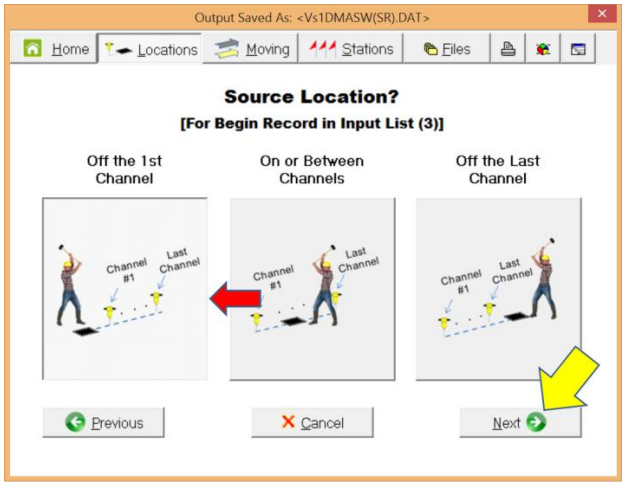
It is now time to set up SR for next two records (3 and 4). The box shown below reminds you of this.

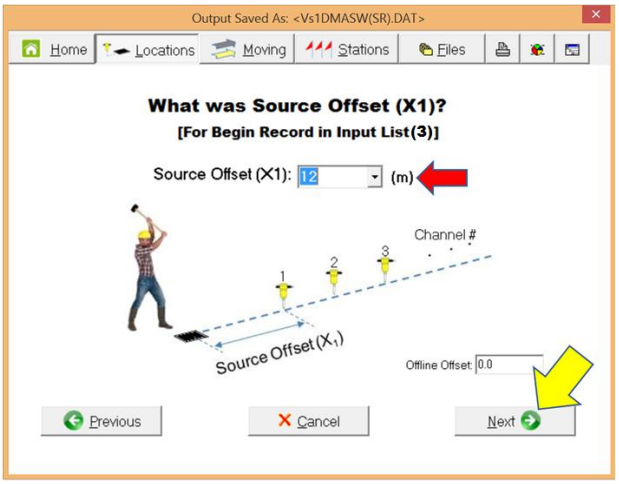


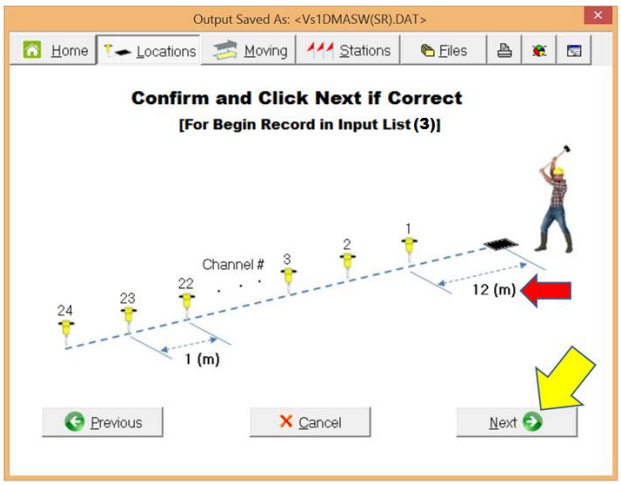
3.4 Repeating Setup for Different Records

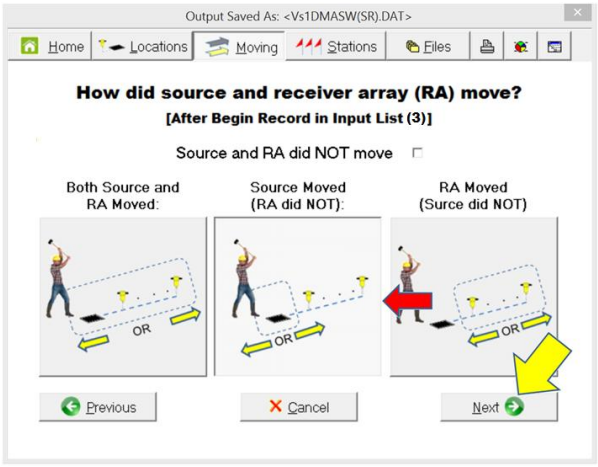
Select '3' and '4' for the begin and end records, respectively. Then, click 'Locations' button at the top.

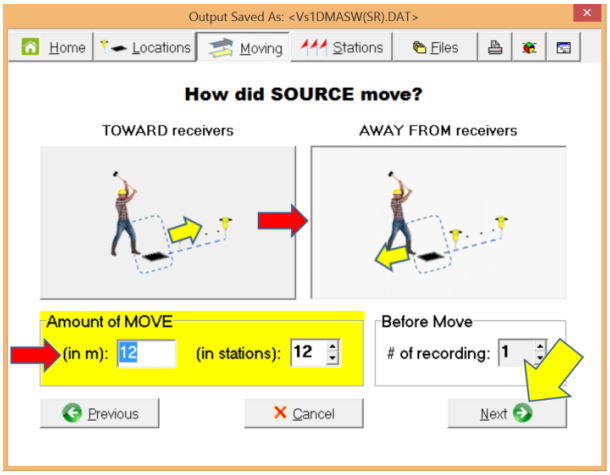




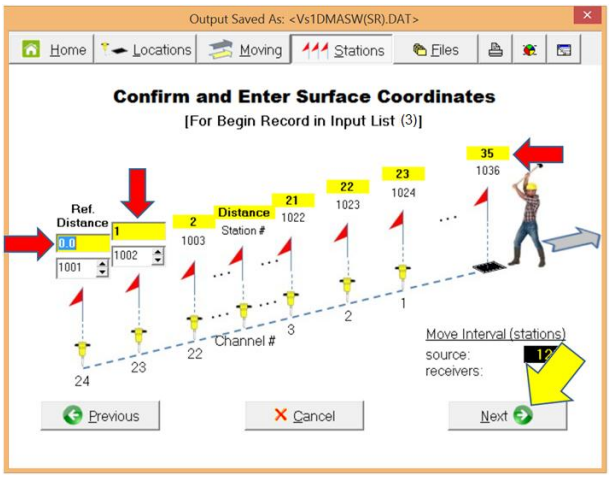


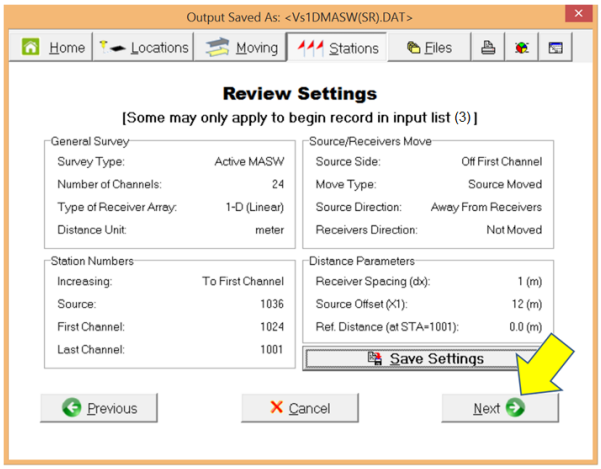

Output Saved As: <Vs1DMASW(SR).DAT>
Home
Locations
Moving
Stations
Files
Confirm and Click Next if Correct
[For Begin Record in Input List (3)]
Channel #
24
23
22
3
2
1
12 (m)
1 (m)
Previous
Cancel
Next

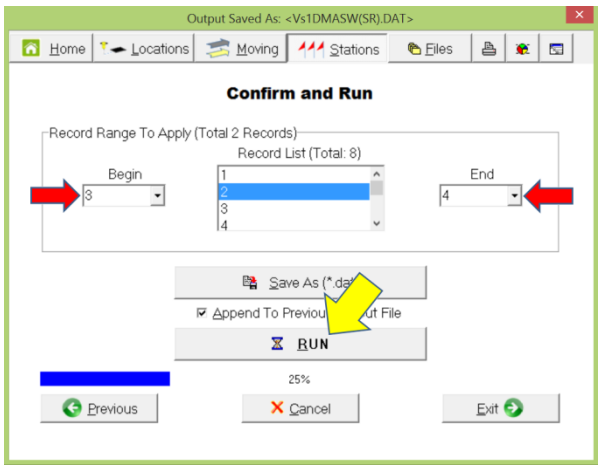

Output Saved As: <Vs1DMASW(SR).DAT>
Home
Locations
Moving
Stations
Files
How did source and receiver array (RA) move?
[After Begin Record in Input List (3)]
Source and RA did NOT move
Both Source and RA Moved:
Source Moved (RA did NOT):
RA Moved (Surce did NOT)
OR
Previous
Cancel
Next


Output Saved As: <Vs1DMASW(SR).DAT>
Home
Locations
Moving
Stations
Files
How did SOURCE move?
TOWARD receivers
AWAY FROM receivers
Amount of MOVE
(in m): 12
(in stations): 12
Before Move
# of recording: 1
Previous
Cancel
Next

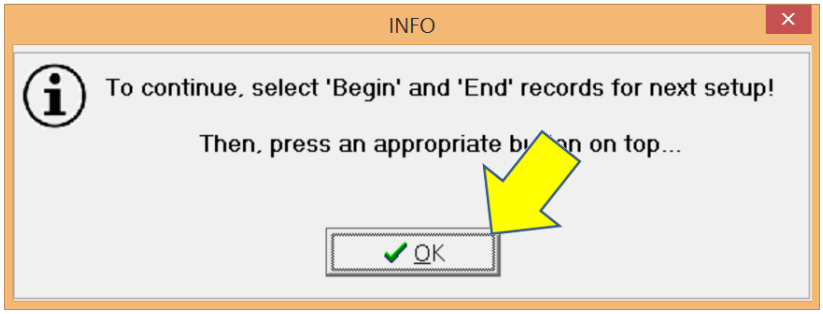
Make sure you use the same convention previously used for distance and station numbering; x = 0.0 m (station number = 1001) at 24th channel, and x = 1.0 m (station number = 1002) at 23rd channel, etc.



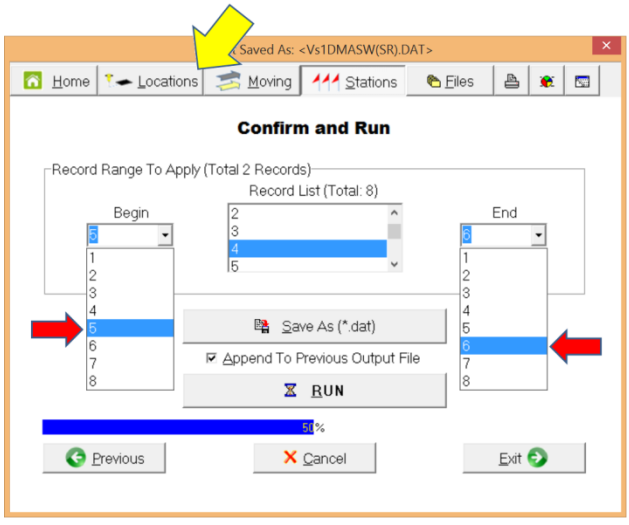




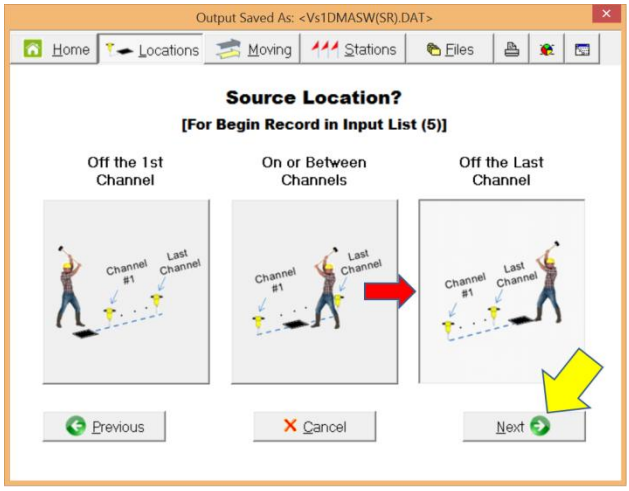
It is now time to set up SR for next two records (5 and 6). The box shown below reminds you of this.

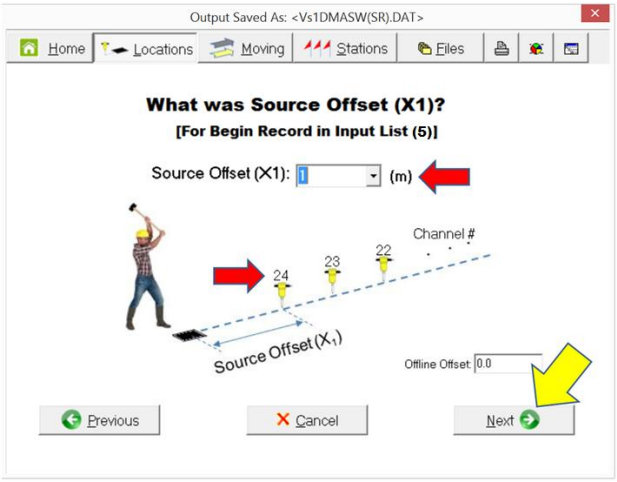


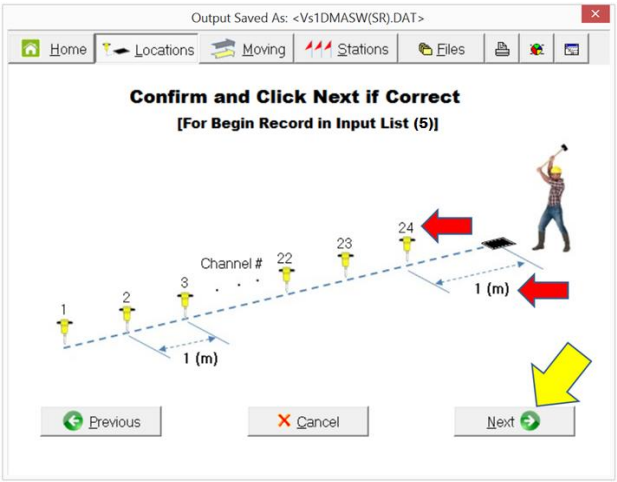
Select '5' and '6' for the begin and end records, respectively. Then, click 'Locations' button at the top.

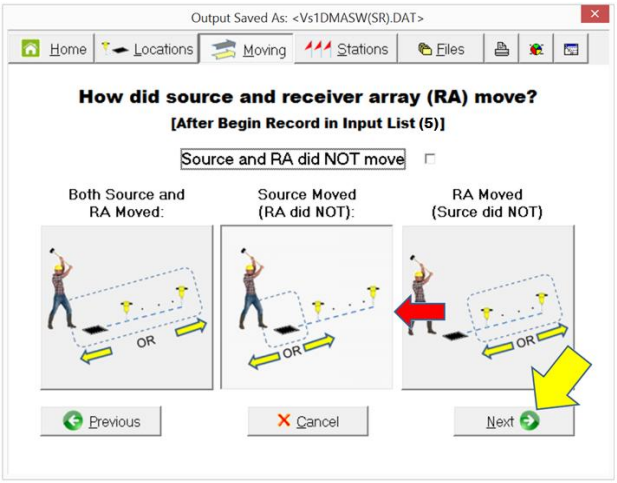


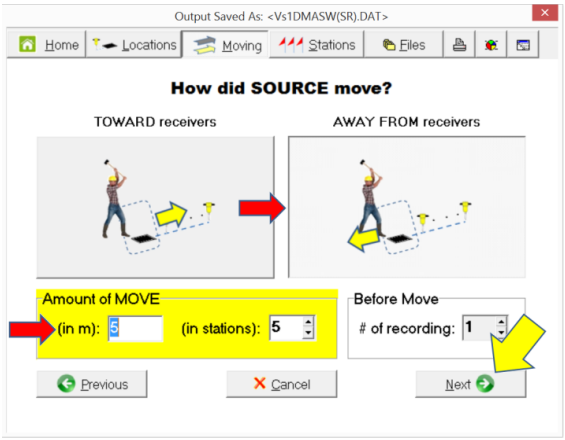
Now, make sure "Off the Last Channel" button is selected because the two records were acquired with the source on the opposite side of receiver array (i.e., "reverse shots"). Click "Next" button.



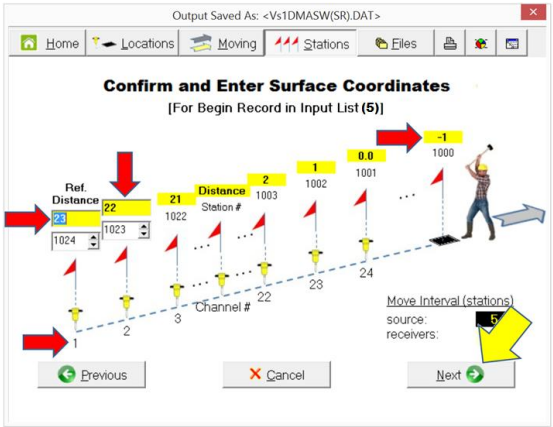


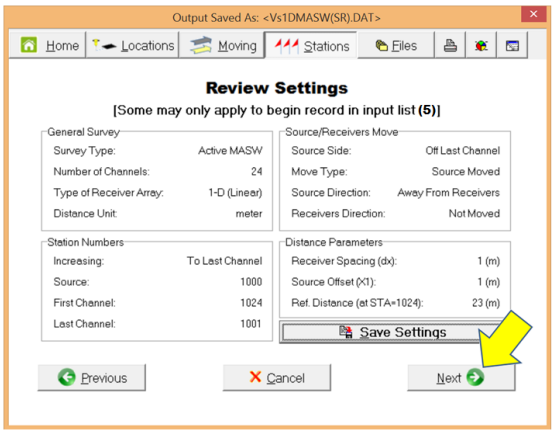




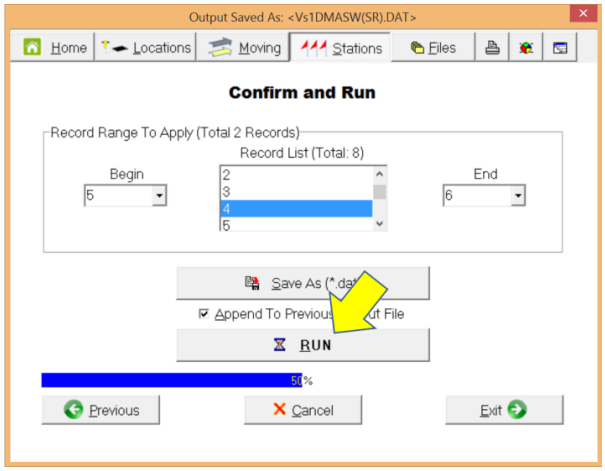


Make sure you use the same convention previously used for distance and station numbering; x = 0.0 m (station number = 1001) at 24th channel, and x = 1.0 m (station number = 1002) at 23rd channel, etc. Now, displayed configuration requires this information to be set for the first two channels (1st and 2nd). Therefore, enter "23" ("1024") and "22" ("1023") for distance (station number) of the first two channels, respectively.

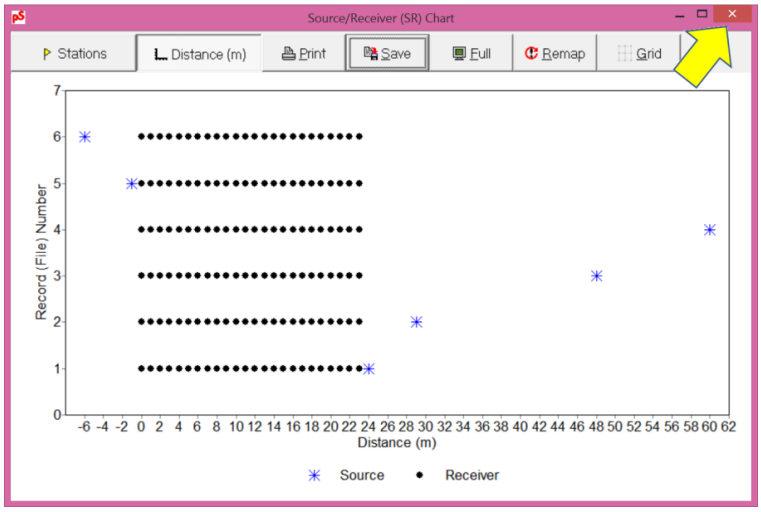




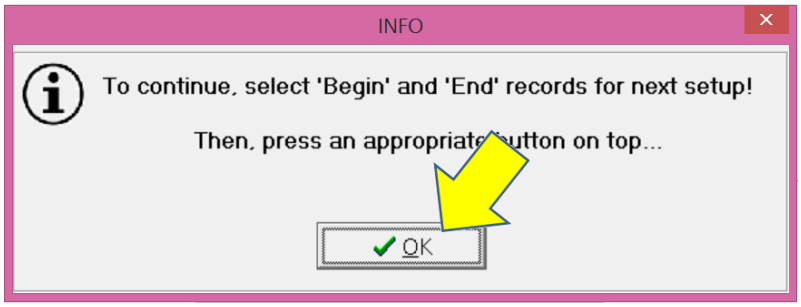
Make sure begin and end records are set to '5' and '6,' respectively. Then, click 'Run' button.

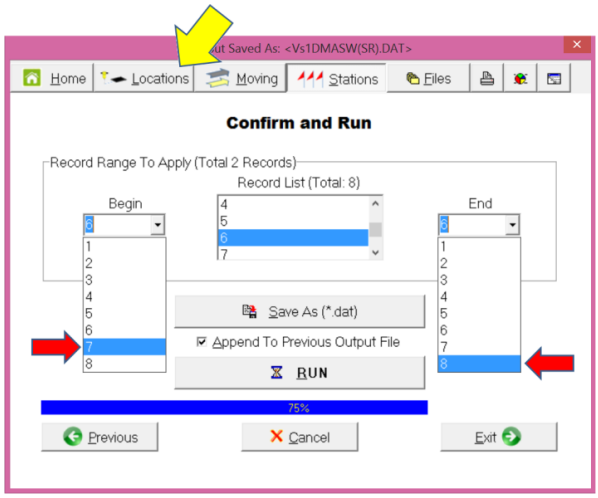


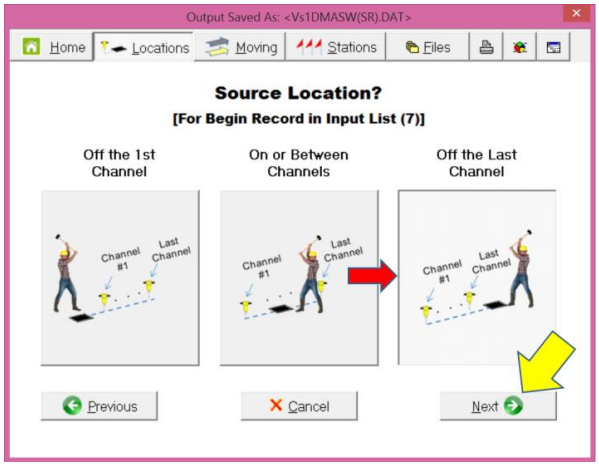
The source/receiver (SR) configuration chart will be displayed that shows relative location of source and receivers for all records saved in the output file (1, 2, 3, 4, 5, and 6). Make sure the last two records (5 and 6) have source located at a negative distance because they are "reverse" shots. Close the chart.



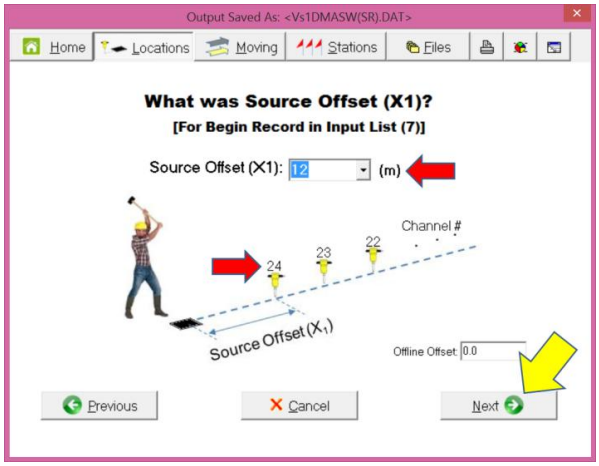
Now, it is time to set up SR for the last two records (7 and 8). The box shown below reminds you of this.

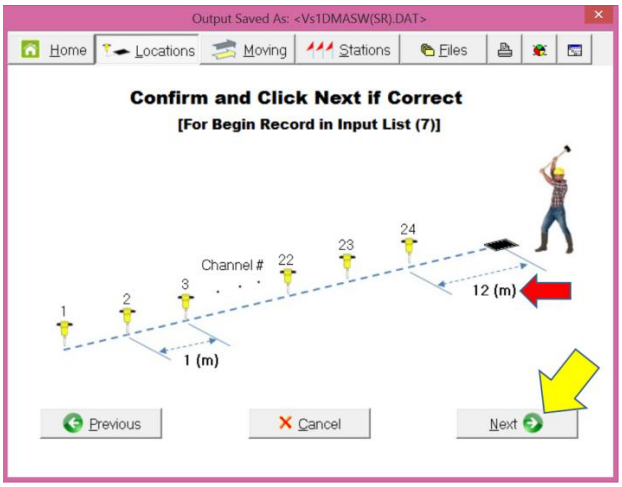


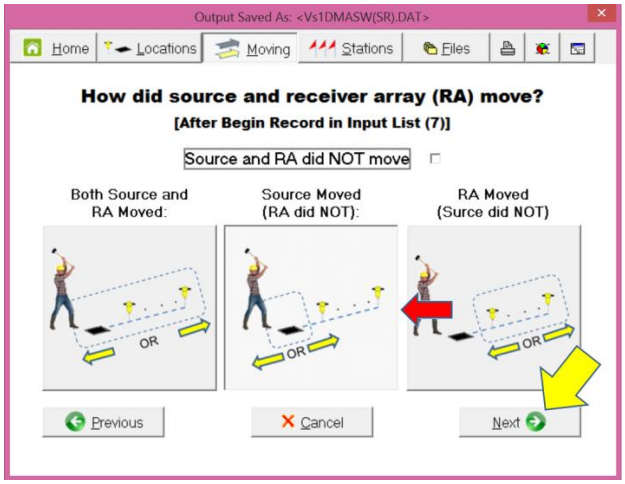


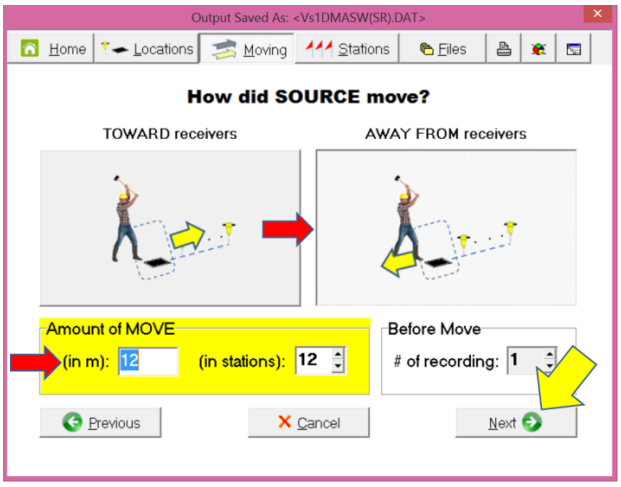


Confirm source location and enter "12" for the source offset (X1). Click "Next" button.

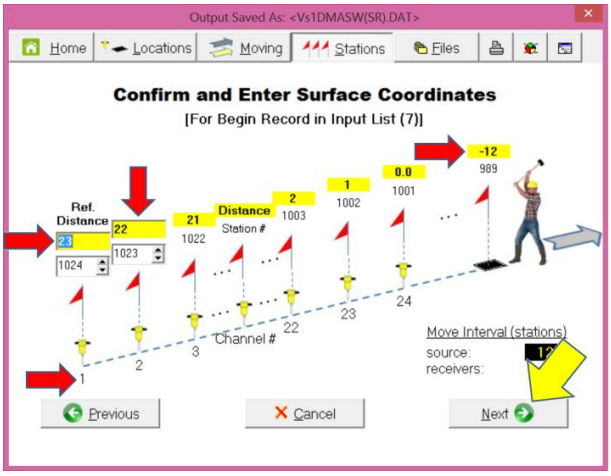


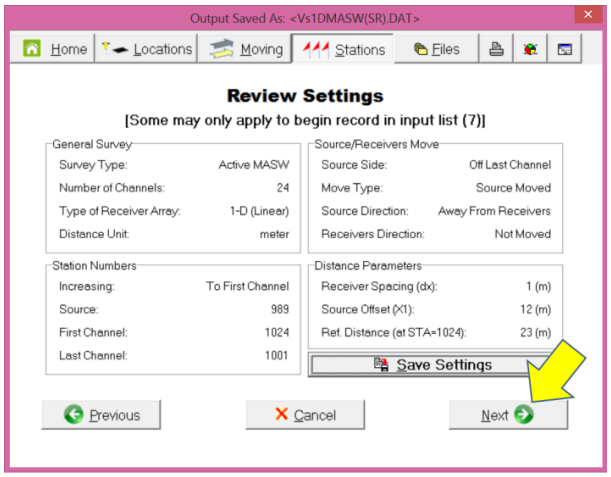




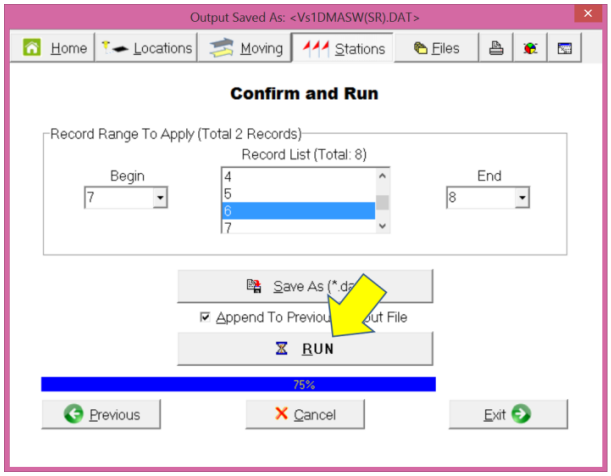


Make sure you use the same convention previously used for distance and station numbering; x = 23 m (station number = 1024) at 24th channel, and x = 22 m (station number = 1023) at 23rd channel, etc.

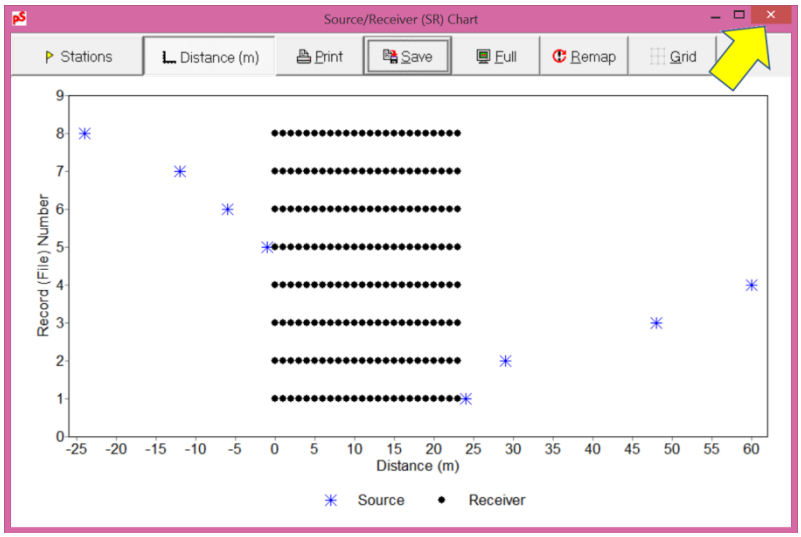




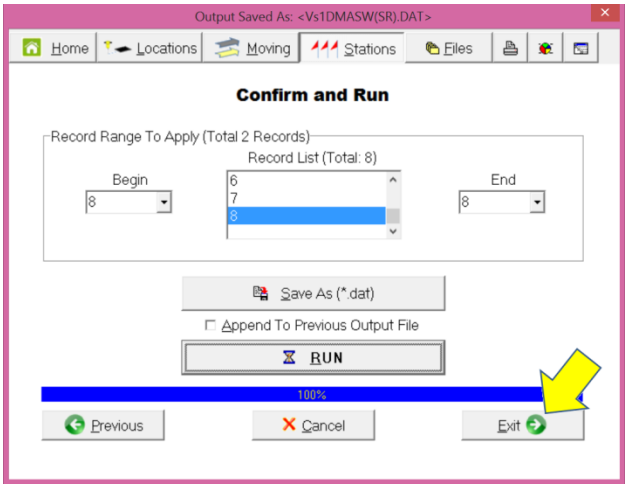
Make sure begin and end records are set to '7' and '8,' respectively. Then, click 'Run' button.



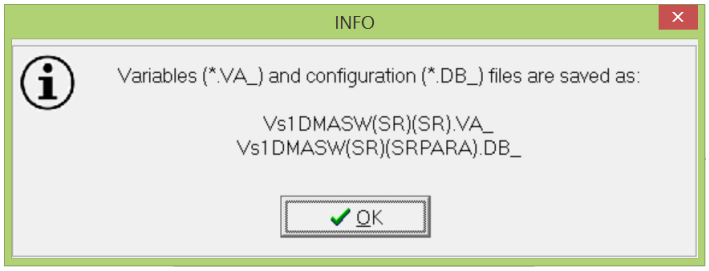
The source/receiver (SR) configuration chart will be displayed that shows relative location of source and receivers for all the records saved in the output file (1 - 8). Close the chart.



Now, SR setup is complete. Click "Next" button.



All variables (*.VA_) and configuration (*.DB_) information will be saved for future use.



4. Setup for a 2-D Vs Cross Section (Working with Sample Data "DippingBedrock.dat")

The sample data set for 2-D Vs cross section generation ("DippingBedrock.dat") is an output from a seismic modeling using the reflectivity method that is also part of the PS (available under "Modeling" main menu). It consists of twenty (20) field records of 24-channel acquisition all bundled in one single file of PS-format, i.e., not in SEG-2 format. The source/receiver (SR) configuration chart displayed below (Figure 1) shows relative SR location for each record included the sample data set within the surveyed (i.e., modeled) surface distance. It shows the receiver spacing (dx) of 1.5-m was used with the source offset (X1) of 9-m (6dx). It also shows the entire SR configuration moved by 9 meters (6dx) each time after acquiring a record at one location. The entire procedure to encode the proper SR configuration with this sample data set is demonstrated below. A yellow arrow in the figure indicates a mouse click on the selected place, and a red arrow indicates places and items that need attention.

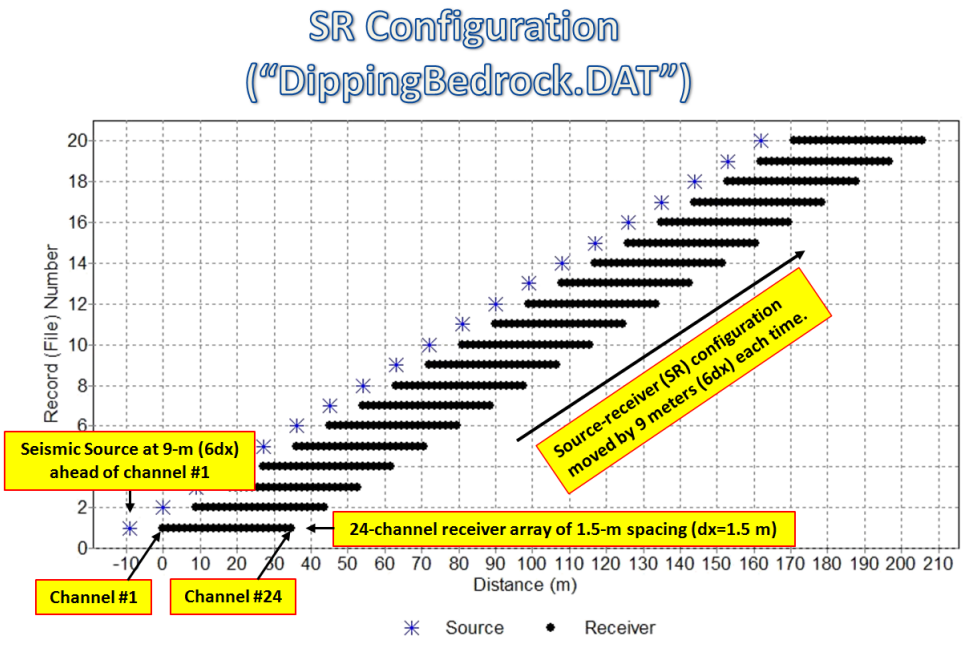
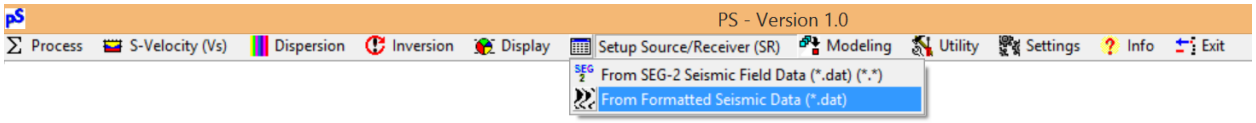
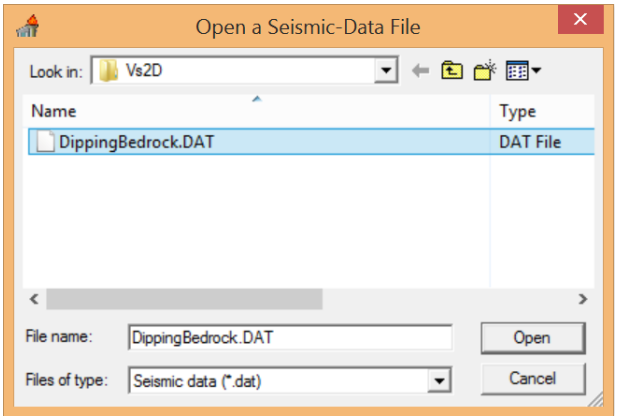


Figure 1. Velocity (Vs) model used produce the sample data set ("DippingBedrock.dat") and the source/receiver (SR) configuration used during the modeling.

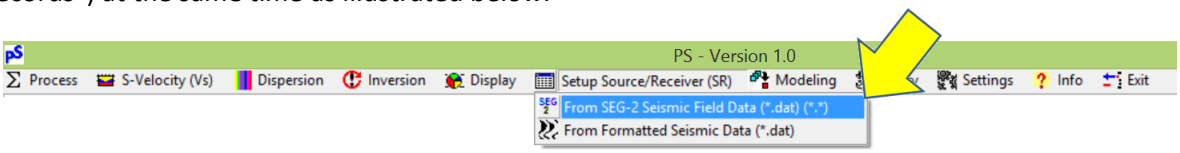
From the main menu, "Setup Source/Receiver (SR)" → "From Formatted Seismic Data (*.dat)"

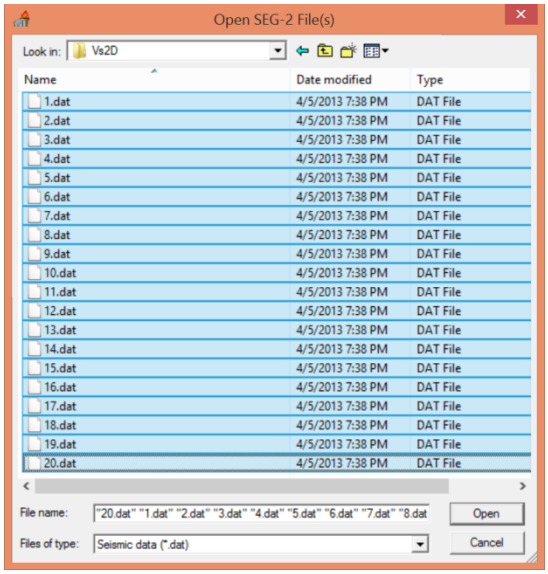


Open "DippingBedrock.DAT."

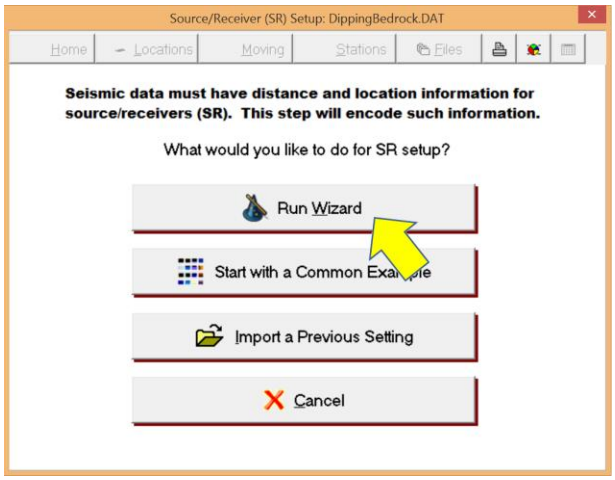


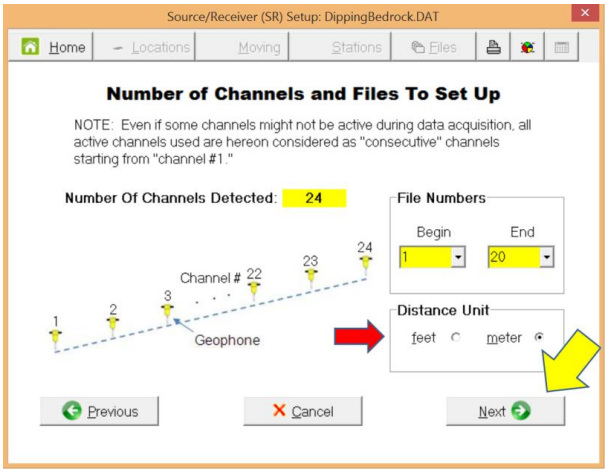
If original field files of SEG-2 format are to be imported instead of a data set already in the PS format, then choose "From SEG-2 Seismic Field Data" as shown below. In this case, import all multiple field files ("records") at the same time as illustrated below.

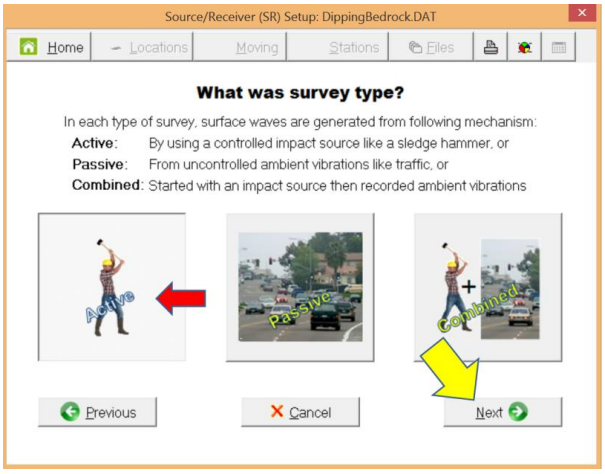


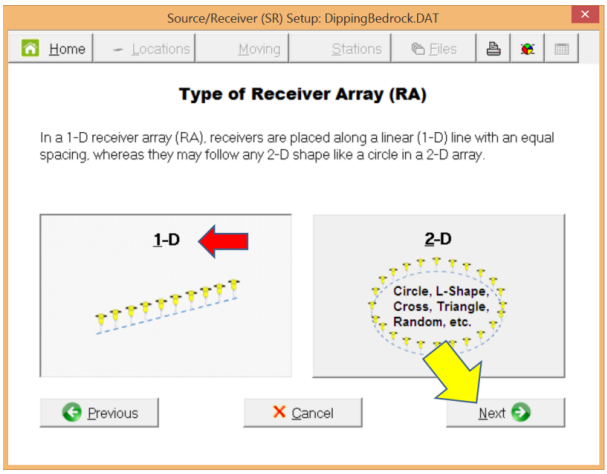


4.1 Pre-Setup

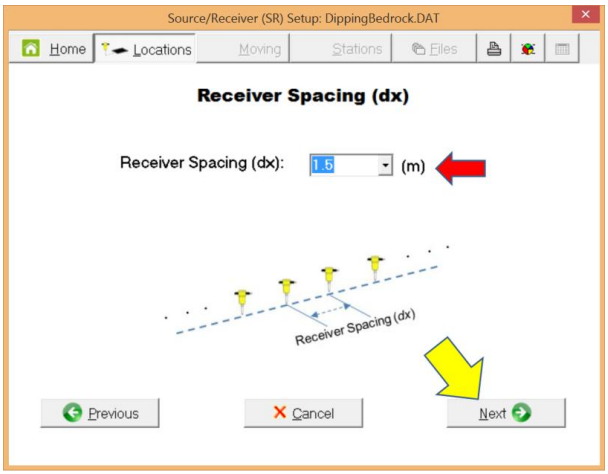

Source/Receiver (SR) Setup: DippingBedrock.DAT
Home
Locations
Moving
Stations
Files
Seismic data must have distance and location information for source/receivers (SR). This step will encode such information.
What would you like to do for SR setup?
Run Wizard
Start with a Common Example
Import a Previous Setting
Cancel

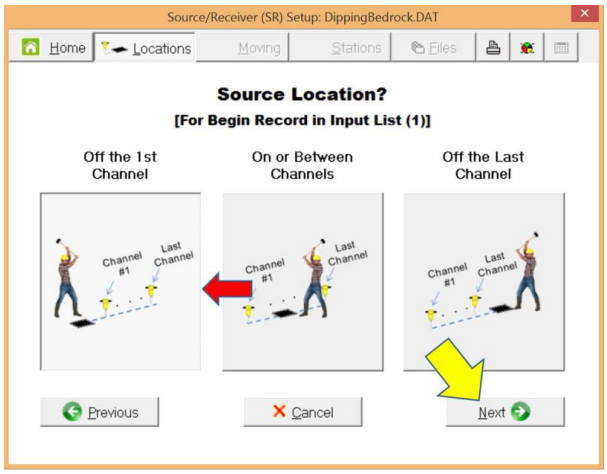

Source/Receiver (SR) Setup: DippingBedrock.DAT
Home
Locations
Moving
Stations
Files
Number of Channels and Files To Set Up
NOTE: Even if some channels might not be active during data acquisition, all active channels used are hereon considered as "consecutive" channels starting from "channel #1."
Number Of Channels Detected: 24
File Numbers
Begin
End
1
20
Channel #
1
2
3
22
23
24
Geophone
Distance Unit
feet
meter
Previous
Cancel
Next

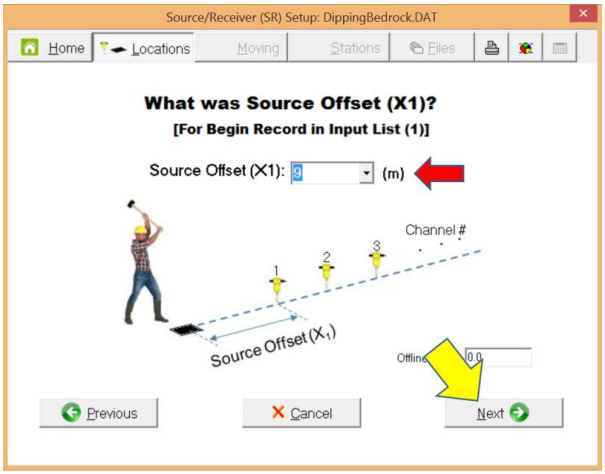

Source/Receiver (SR) Setup: DippingBedrock.DAT
Home
Locations
Moving
Stations
Files
What was survey type?
In each type of survey, surface waves are generated from following mechanism:
Active: By using a controlled impact source like a sledge hammer, or
Passive: From uncontrolled ambient vibrations like traffic, or
Combined: Started with an impact source then recorded ambient vibrations
Active
Passive
Combined
Previous
Cancel
Next

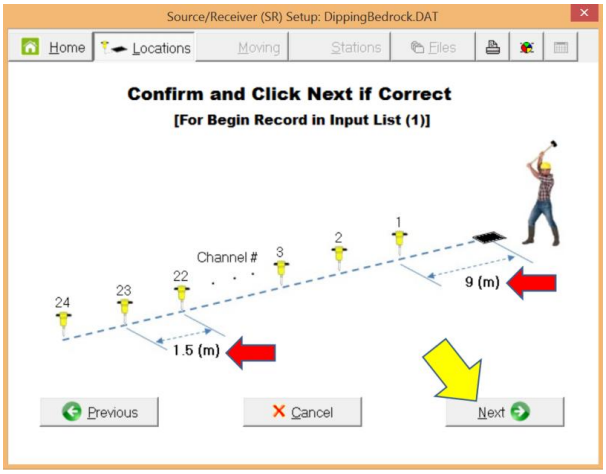


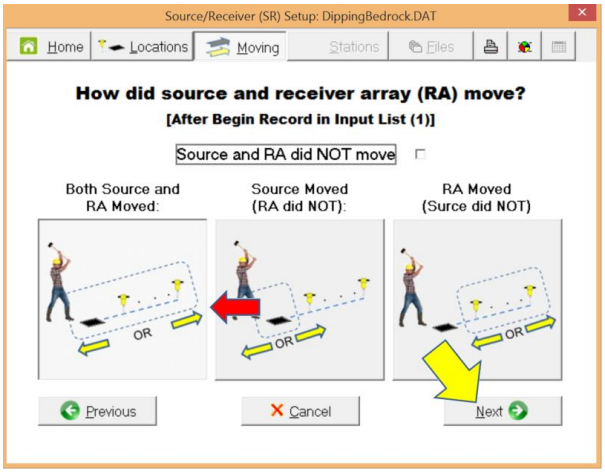
4.2 SR Specification

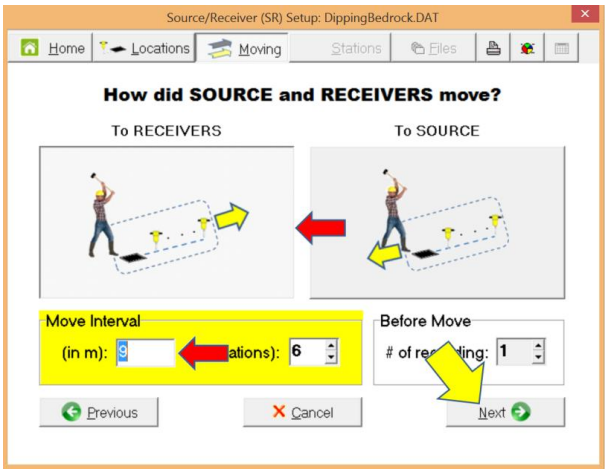





Source/Receiver (SR) Setup: DippingBedrock.DAT
Home
Locations
Moving
Stations
Files
What was Source Offset (X1)?
[For Begin Record in Input List (1)]
Source Offset (X1):
0
(m)
Channel #
1
2
3
Source Offset (X1)
Offline
0.0
Previous
Cancel
Next

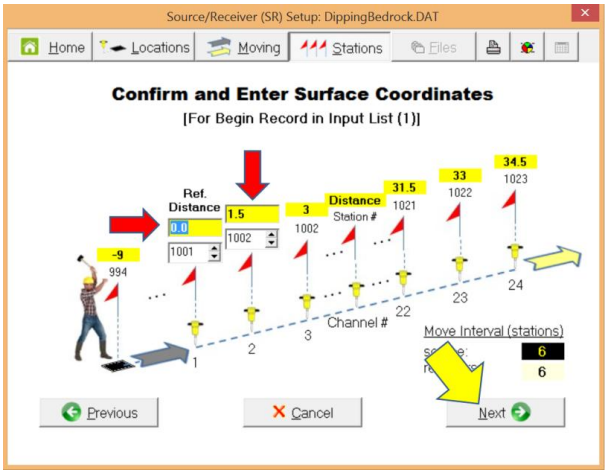

Source/Receiver (SR) Setup: DippingBedrock.DAT
Home
Locations
Moving
Stations
Files
Confirm and Click Next if Correct
[For Begin Record in Input List (1)]
Channel #
1
2
3
22
23
24
9 (m)
1.5 (m)
Previous
Cancel
Next

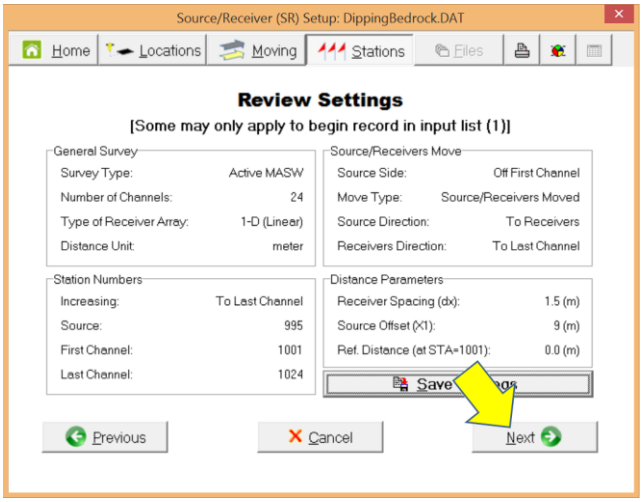

Source/Receiver (SR) Setup: DippingBedrock.DAT
Home
Locations
Moving
Stations
Files
How did source and receiver array (RA) move?
[After Begin Record in Input List (1)]
Source and RA did NOT move
Both Source and RA Moved:
Source Moved (RA did NOT):
RA Moved (Surce did NOT)
OR
OR
OR
Previous
Cancel
Next



Enter "0.0" for "Ref. Distance" and then "1.5" for next distance.

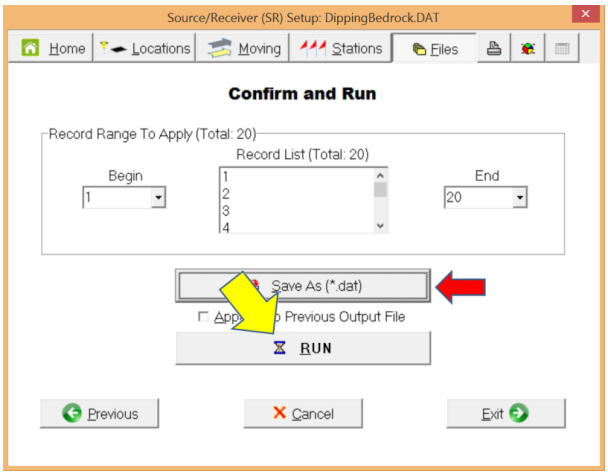
"Ref. Distance" is an arbitrary surface distance coordinate used as a reference point. Therefore, it can be any number. But, the distance for the next channel should be offset (+ or -) by one receiver spacing (dx). Enter "1001" and "1002" for the station numbers for the first two channel positions. Then, click "Next" button. These are arbitrary "station" numbers that must be consecutive. The general convention for station numbering is "1001, 1002, etc." for line 1, and "2001, 2002, etc." for line 2, and so on. They can also decrease instead of increase.



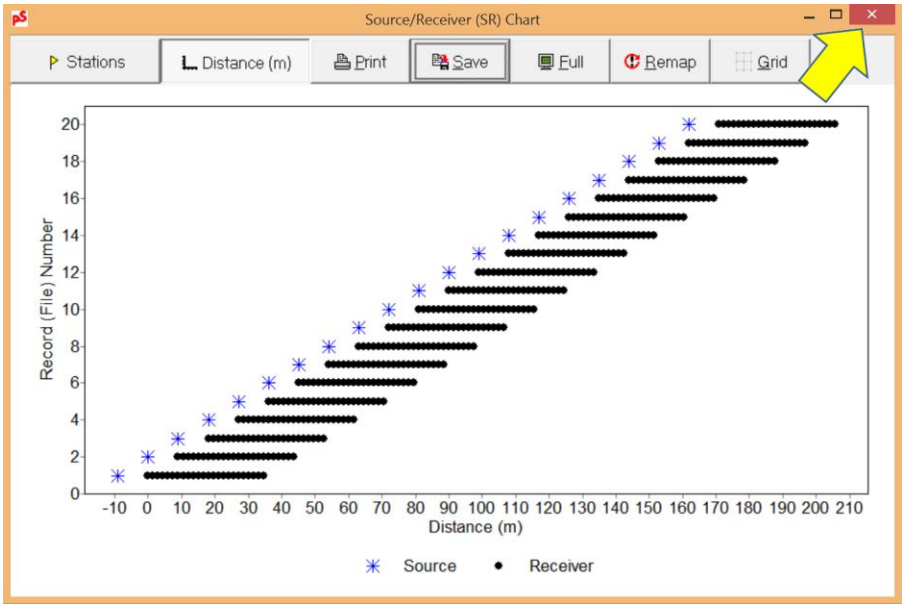


4.3 Specification of Input Records and Running Setup

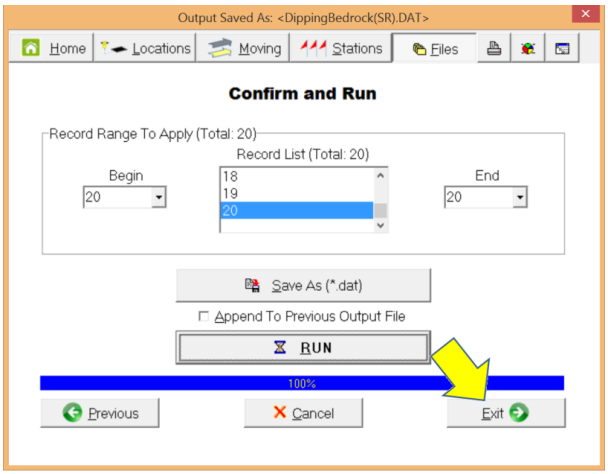
Click "Run" to launch the SR setup process. It will ask for the output file name first. Default output file name is "DippingBedrock(SR).DAT."



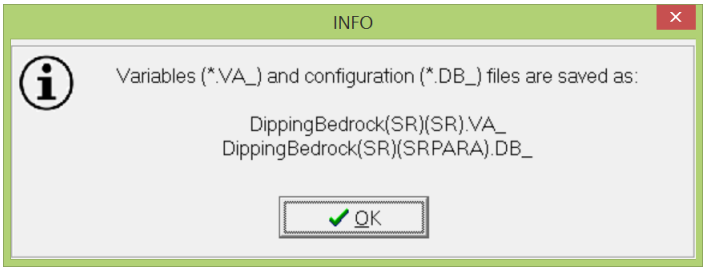
At the end of the process, the SR configuration chart will be displayed that shows relative locations of source and receivers within the entire distance of survey. The configuration can also be displayed in "Stations" by clicking the button on top menu. Close the chart.



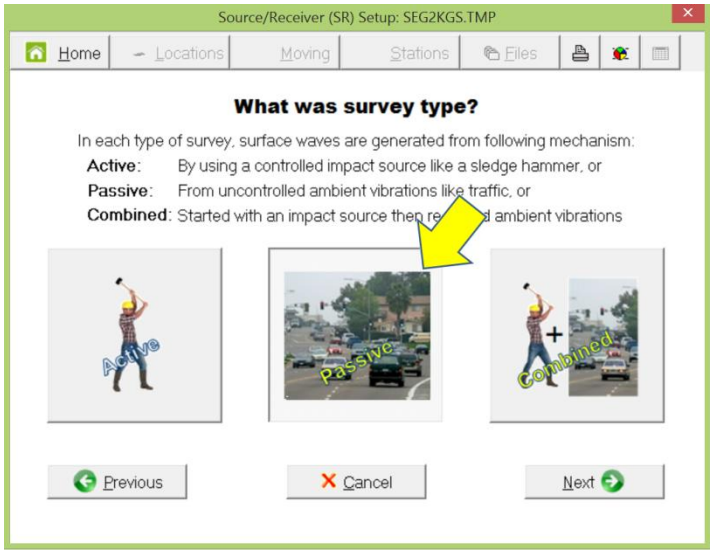
Click "Exit" button. It will show the file name where all the setup parameters will be saved so that you can import them by opening the file at the beginning of the next SR setup process.



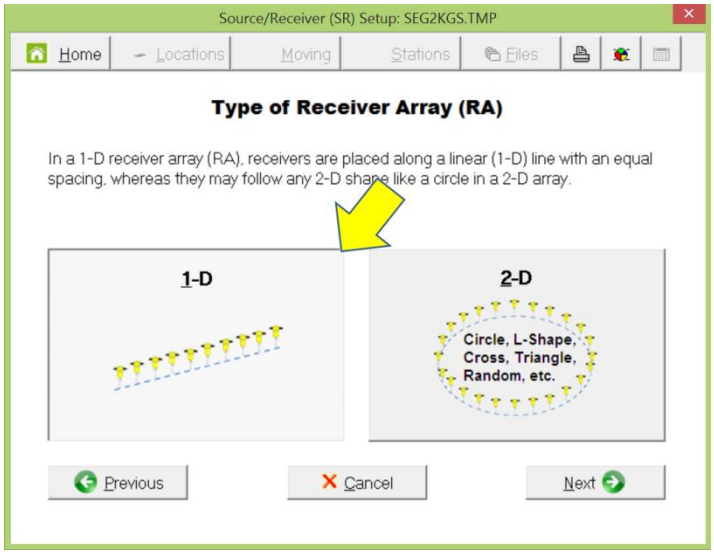
All variables (*.VA_) and configuration (*.DB_) information will be saved for future use.



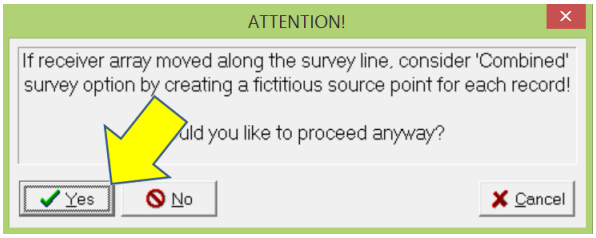
5. Setup for a Passive Survey

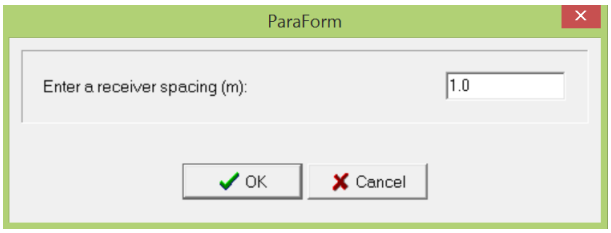


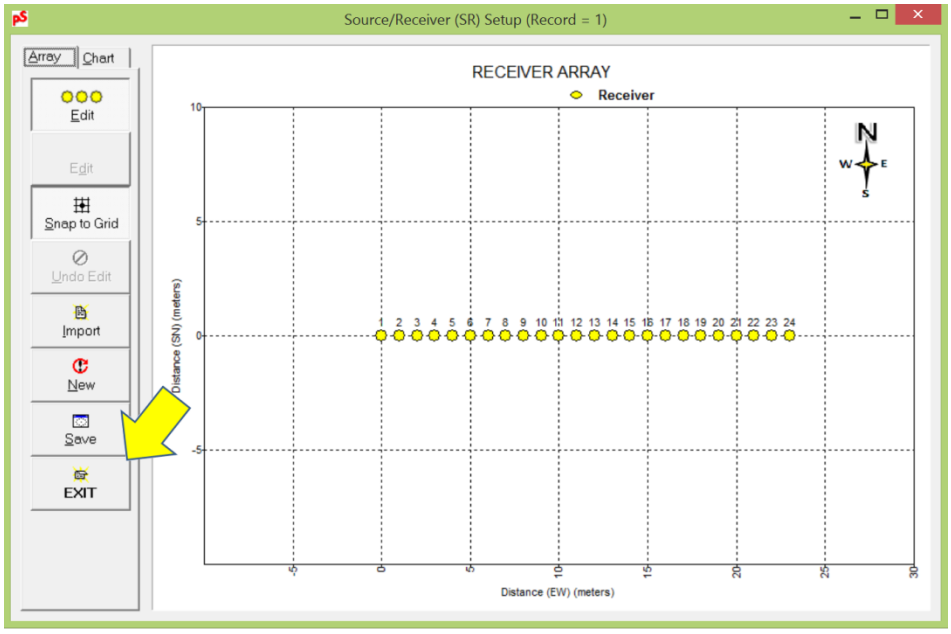
5.1 Passive Survey with 1-D Receiver Array (RA)



If the receiver array moved regularly like an active survey, then you can treat the input as a data set from a "combined" survey that will make the entire setup procedure more intuitive. Otherwise, you can proceed with the current "passive survey" option.

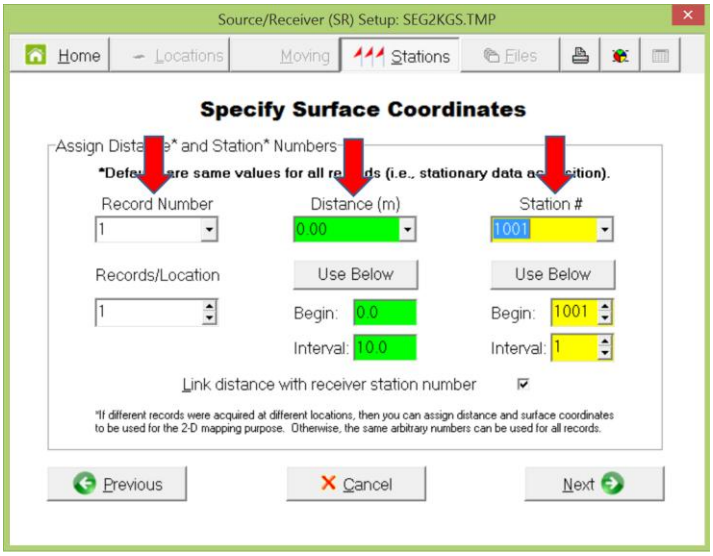


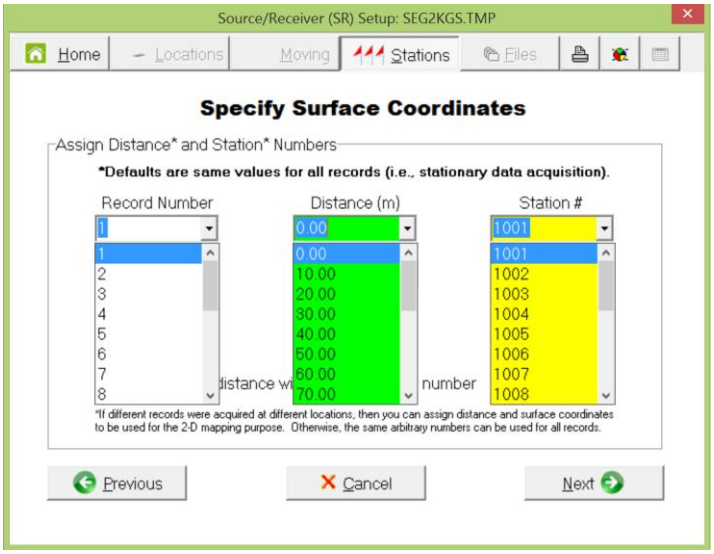




5.1.1 Specification of Surface Location

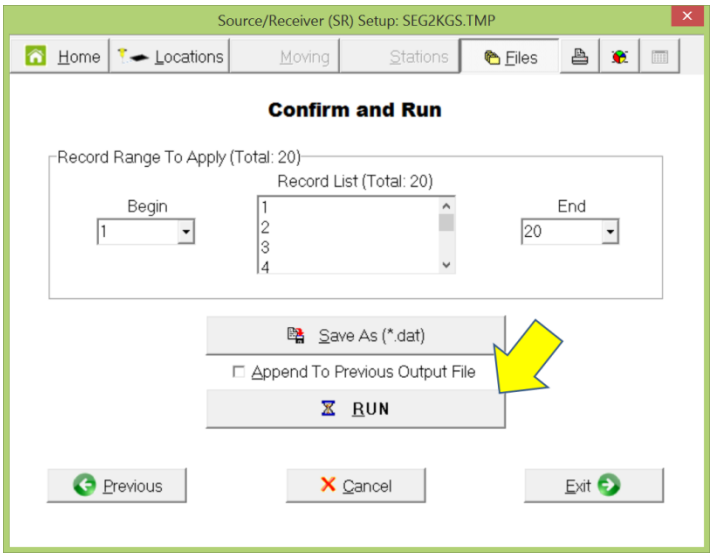
Record numbers are associated with surface distance and station numbers as shown below. If more than one record was acquired at a given location, then it can be specified so in the "Records/Location" edit box. The "Use Below" buttons under "Distance" and "Station #" will enable the automatic listing of values in the corresponding combo boxes by calculating distances and station numbers based on the values specified in the "Begin" and "Interval" edit boxes. The "Link distance with receiver station number" check box will force (if checked) the station numbers to change by the distance interval. The dialog with all three combo boxes expanded shows item values set by clicking the "Use Below" buttons.



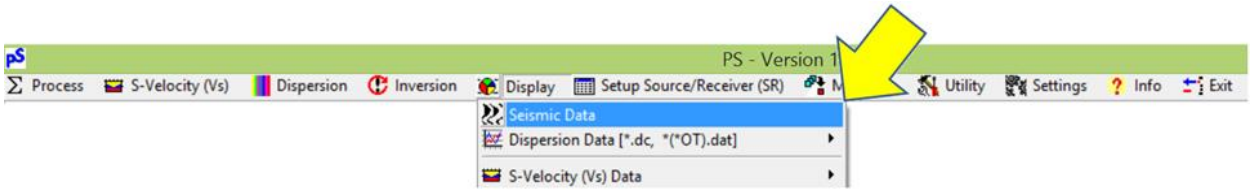


5.1.2 Run and Check

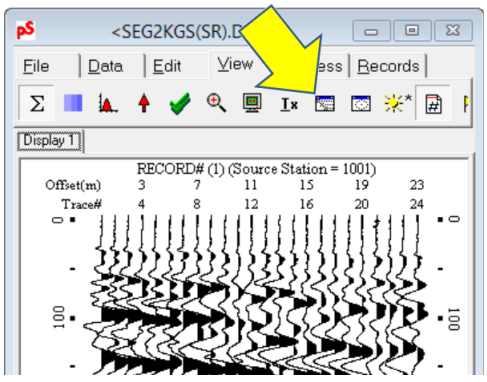
Click "Run" and output will be saved as a single file of PS-format [*(SR).dat].



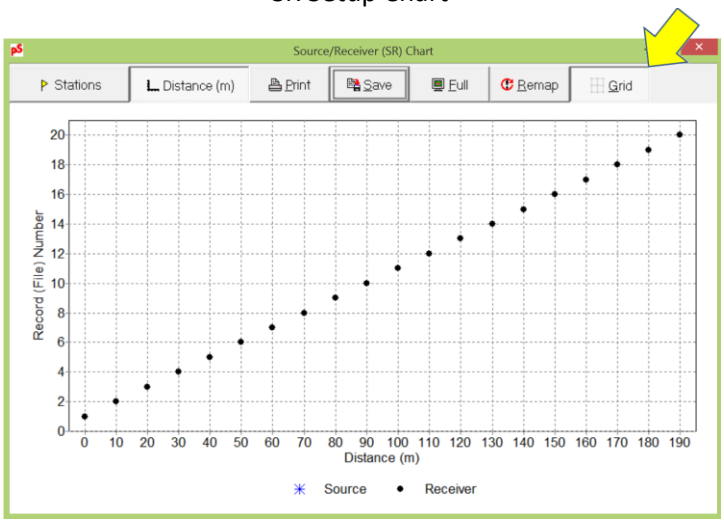
The saved file can be opened for display by going to "Display" → "Seismic Data"



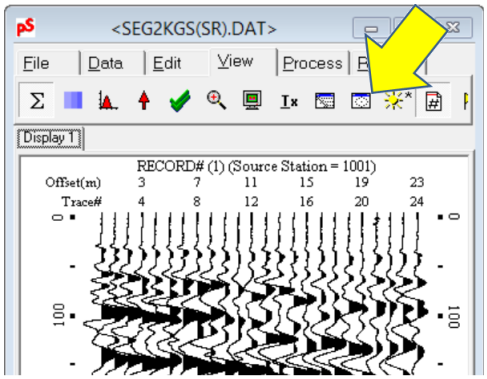
Once the file is displayed, its encoded SR setup can be displayed by clicking "SR setup" button.



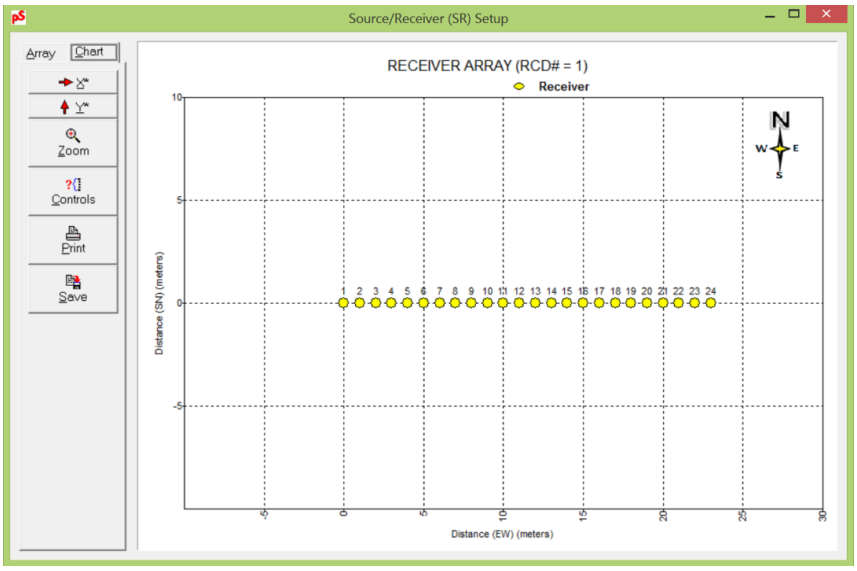
SR Setup Chart



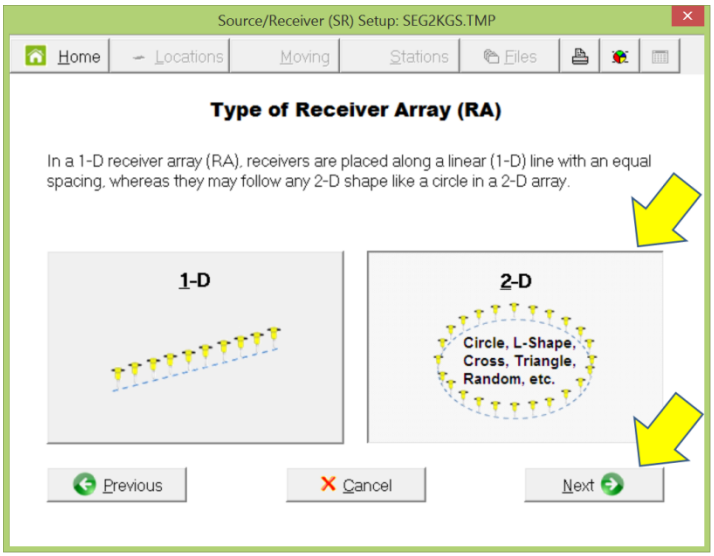
Configuration of the receiver array (RA) can also be displayed by clicking "Receiver Array" button.



Receiver Array (RA) Chart

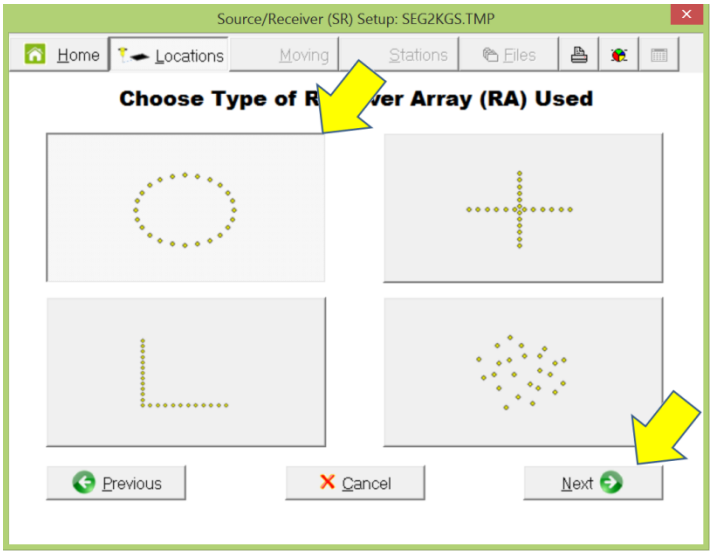


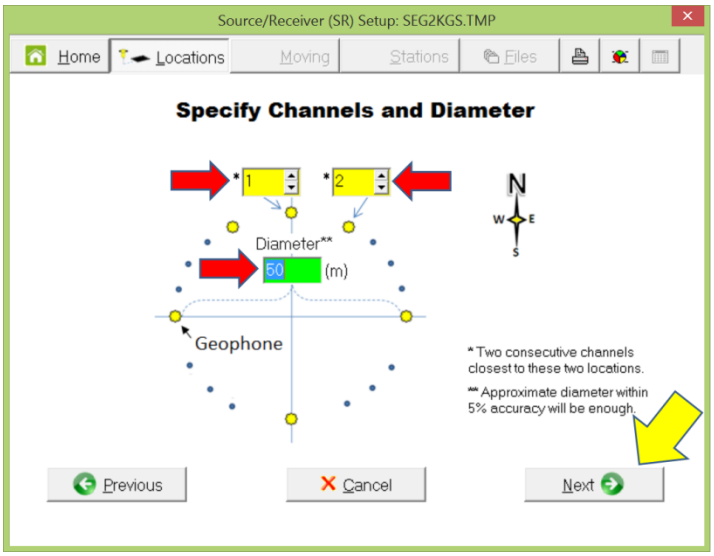
5.2 Passive Survey with 2-D Receiver Array (RA)

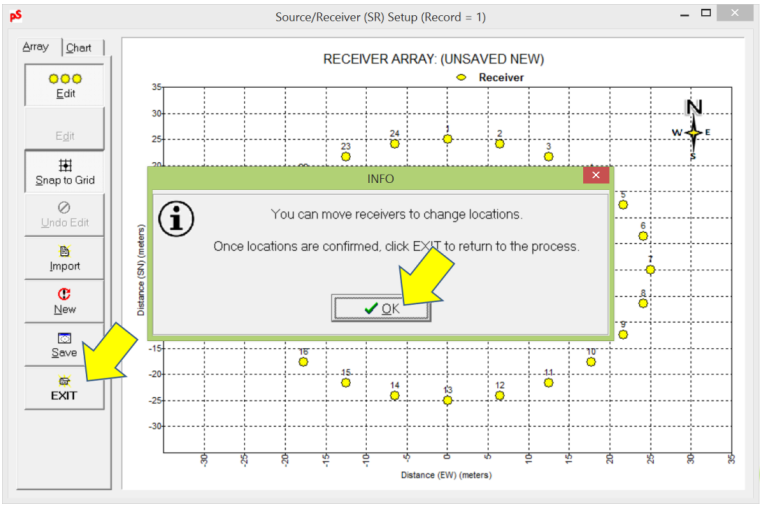


5.2.1 Setting Up 2-D Receiver Arrays (RA's) (Circle, Cross, L-Shape, and Random Arrays)

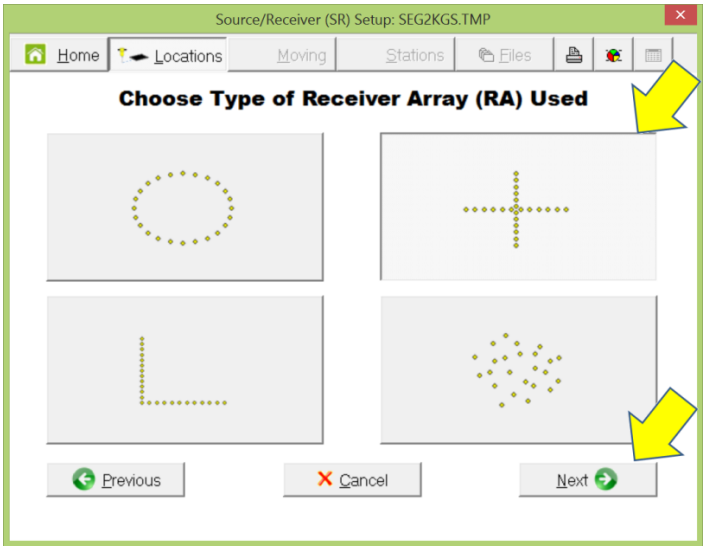
Example of Circular RA

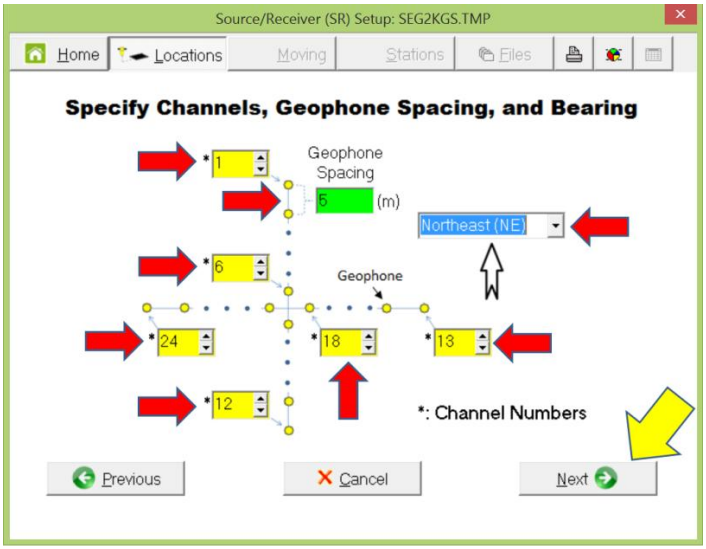


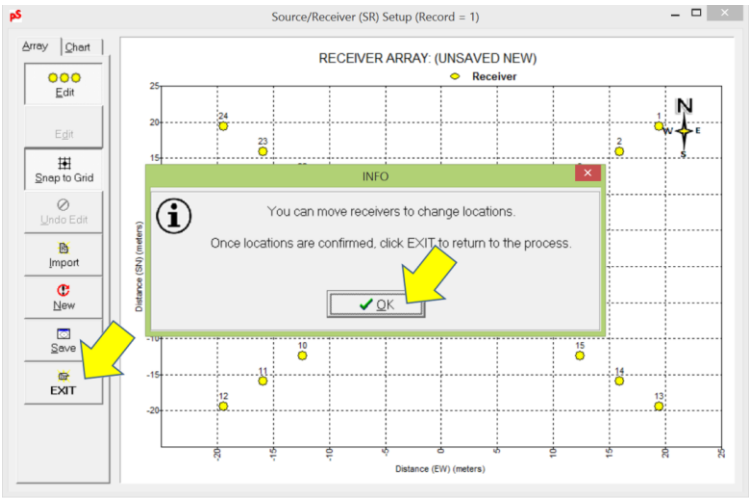

Source/Receiver (SR) Setup: SEG2KGS.TMP
Home
Locations
Moving
Stations
Files
Specify Channels and Diameter
*1
*2
Diameter**
50
(m)
Geophone
N
W
E
S
* Two consecutive channels closest to these two locations.
** Approximate diameter within 5% accuracy will be enough.
Previous
Cancel
Next


Source/Receiver (SR) Setup (Record = 1)
Array
Chart
Edit
Edit
Snap to Grid
Undo Edit
Import
New
Save
EXIT
RECEIVER ARRAY: (UNSAVED NEW)
Receiver
INFO
You can move receivers to change locations.
Once locations are confirmed, click EXIT to return to the process.
OK
Distance (SN) (meters)
Distance (EW) (meters)

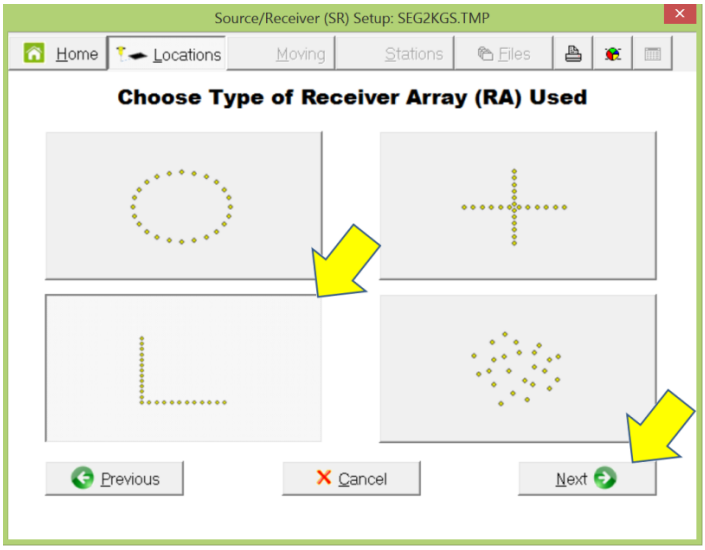
Example of Cross RA

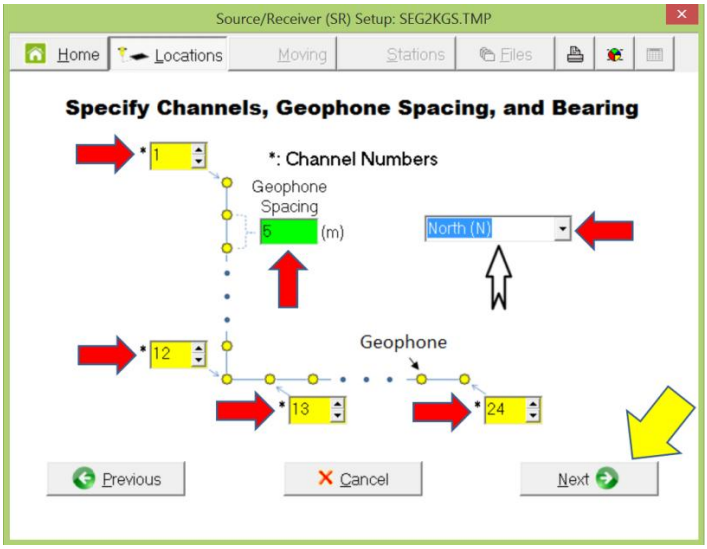


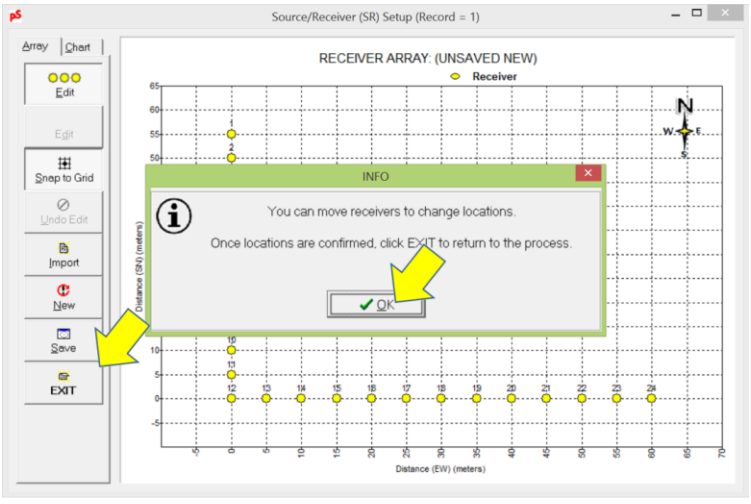




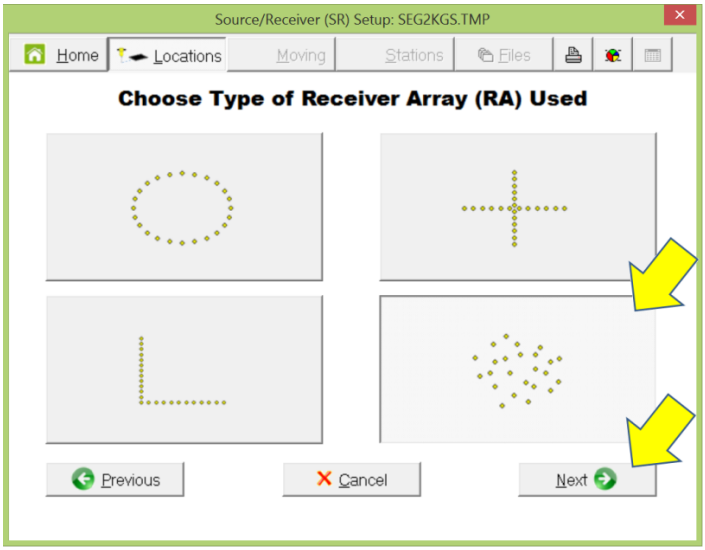
Example of L-shaped RA

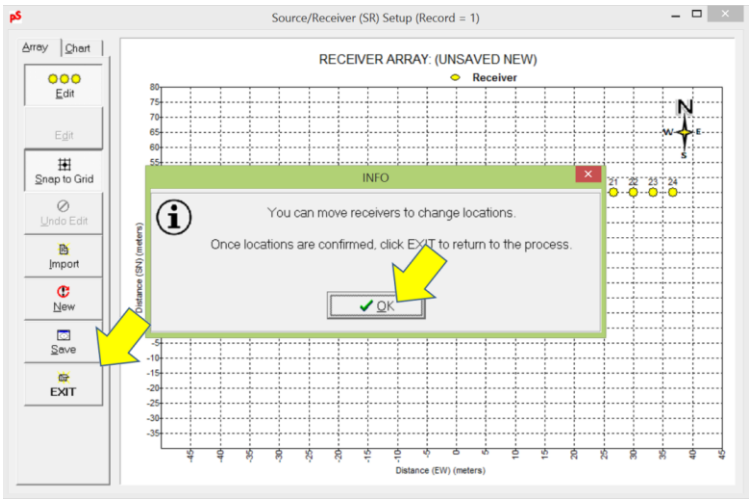


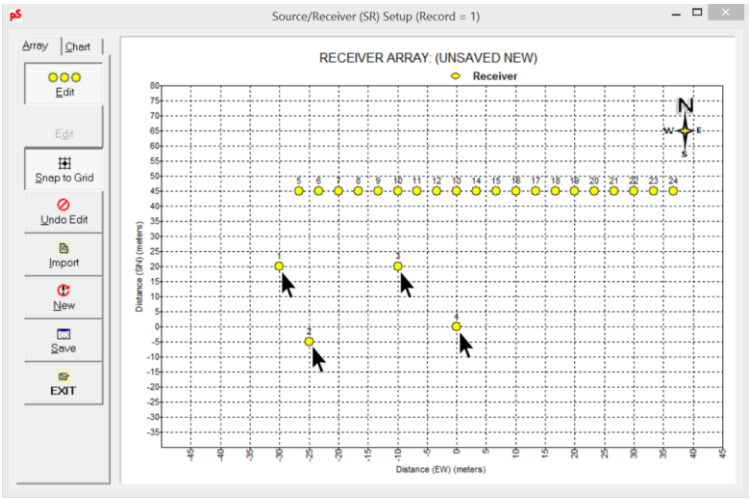




Example of Random RA

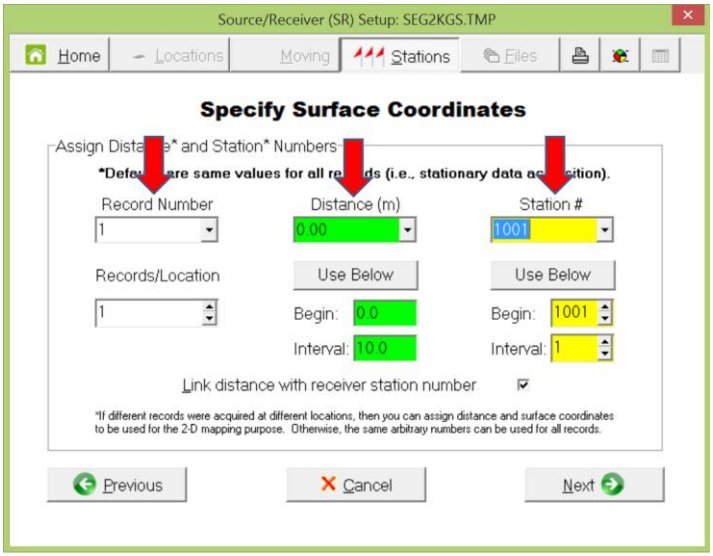


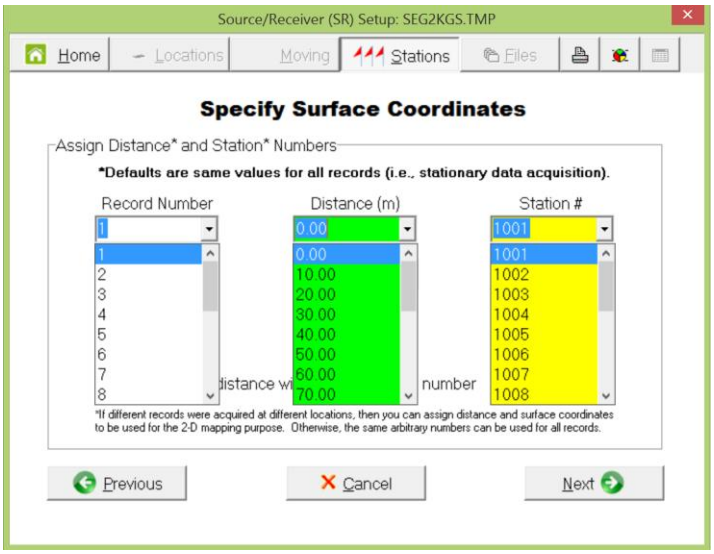




5.2.2 Specification of Surface Location

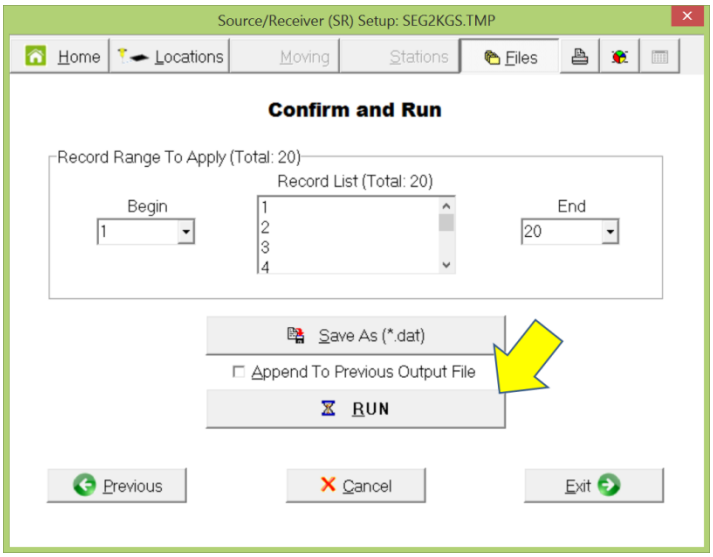
Record numbers are associated with surface distance and station numbers as shown below. If more than one record was acquired at a given location, then it can be specified so in the "Records/Location" edit box. The "Use Below" buttons under "Distance" and "Station #" will enable the automatic listing of values in the corresponding combo boxes by calculating distances and station numbers based on the values specified in the "Begin" and "Interval" edit boxes. The "Link distance with receiver station number" check box will force (if checked) the station numbers to change by the distance interval. The dialog with all three combo boxes expanded shows item values set by clicking the "Use Below" buttons.



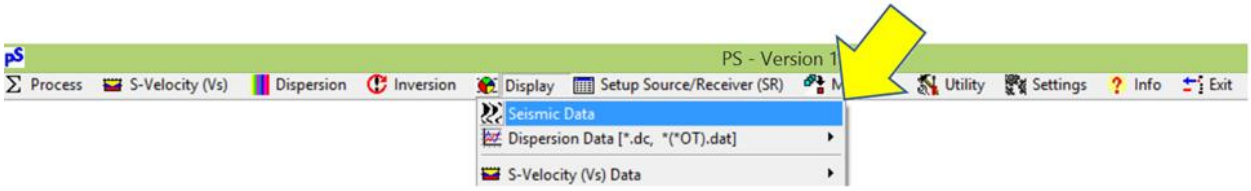


5.2.3 Run and Check

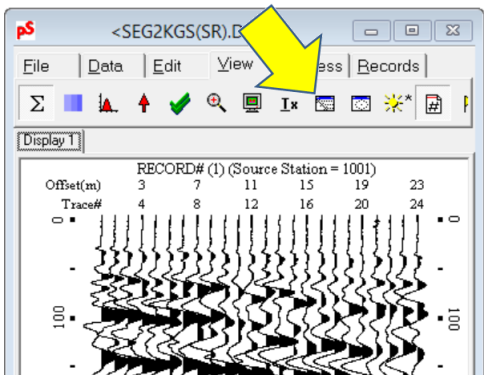
Illustrated below is for the case of "Circular" receiver array (RA)



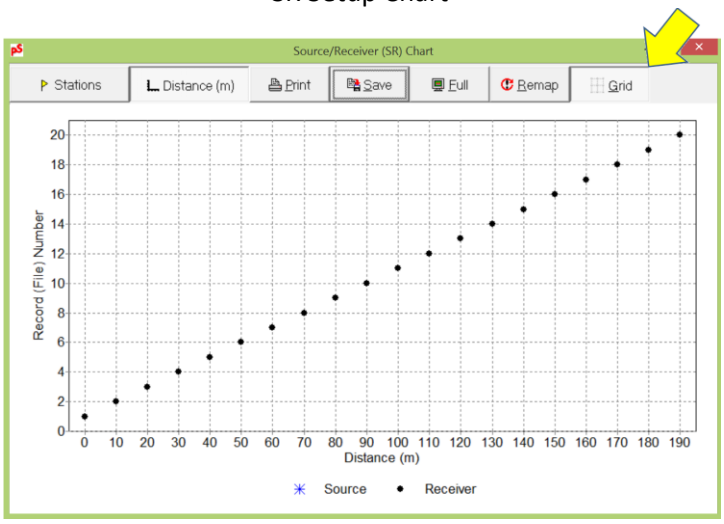
The saved file can be opened for display by going to "Display" → "Seismic Data"



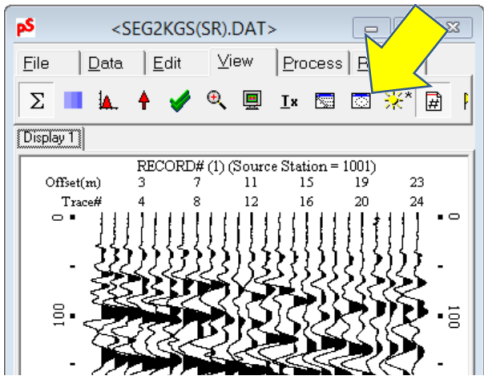
Once the file is displayed, its encoded SR setup can be displayed by clicking the "SR setup" button.



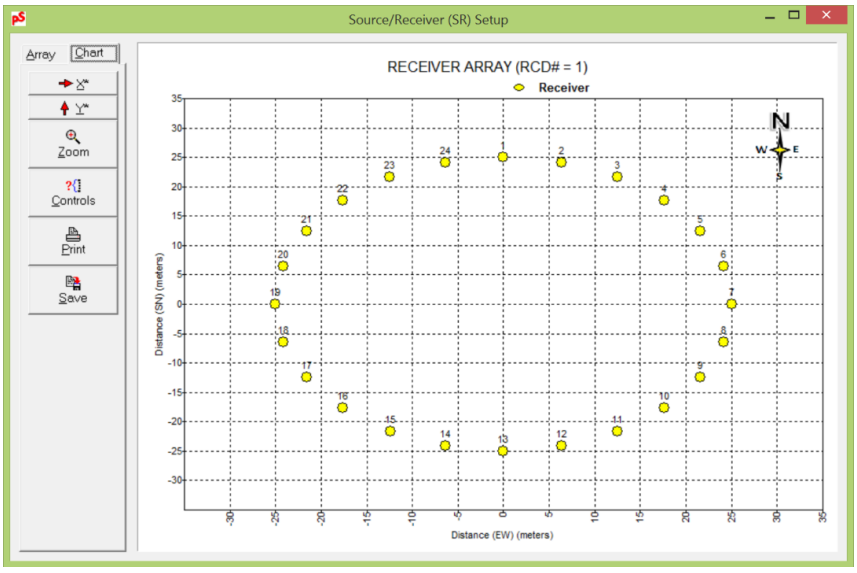
SR Setup Chart



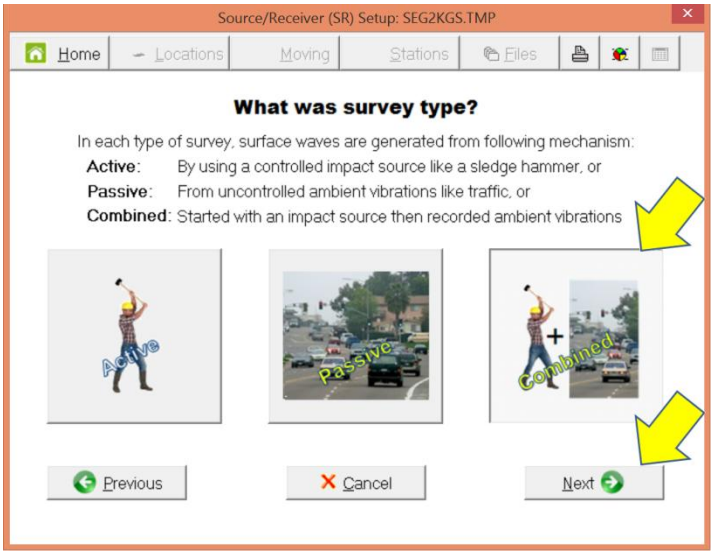
Configuration of the receiver array (RA) can also be displayed by clicking the "Receiver Array" button.



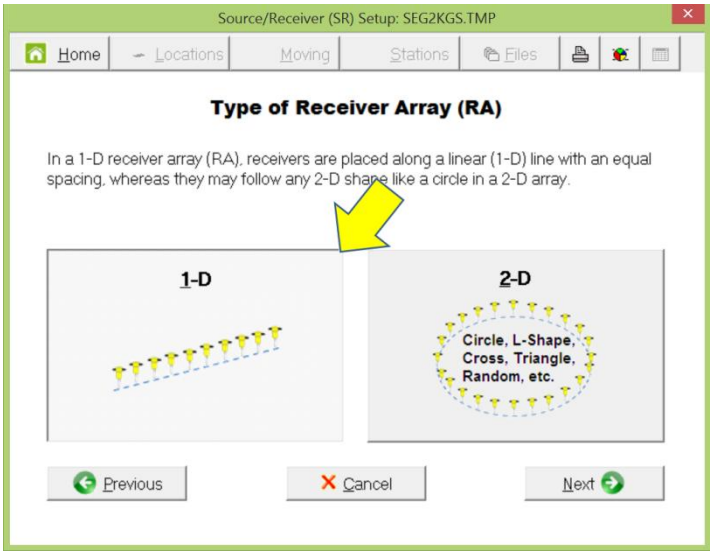
Receiver Array (RA) Chart



6. Setup for (Active/Passive) Combined Survey

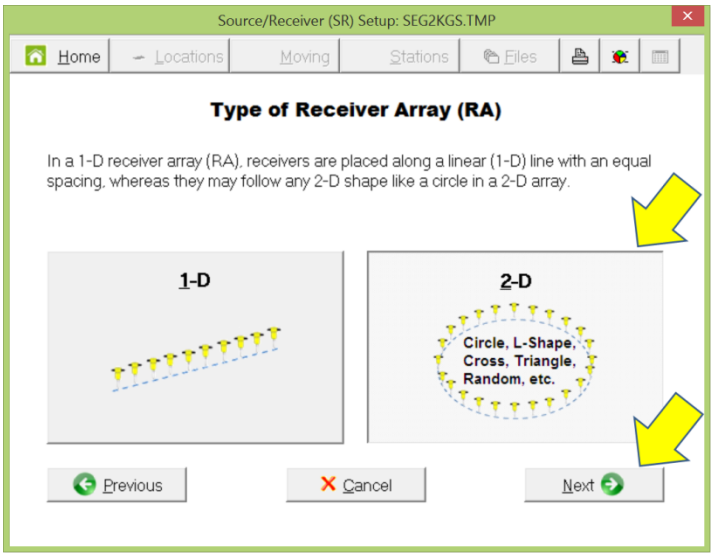


6.1 Combined Survey with 1-D Receiver Array (RA)

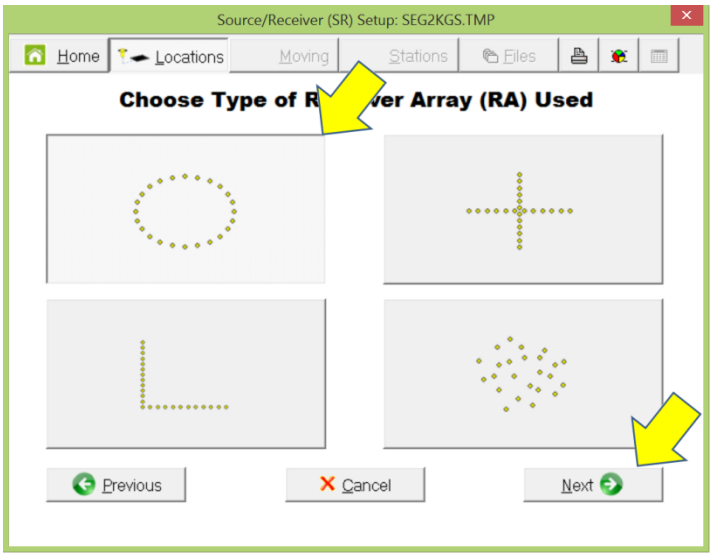


This case will be identical to the active survey with 1-D RA described in sections 3 and 4.

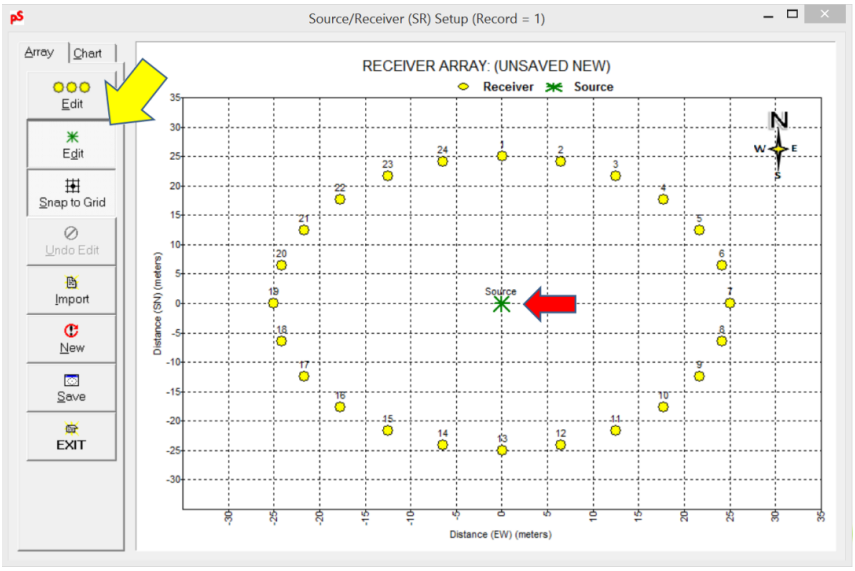
6.2 Combined Survey with 2-D Receiver Array (RA)



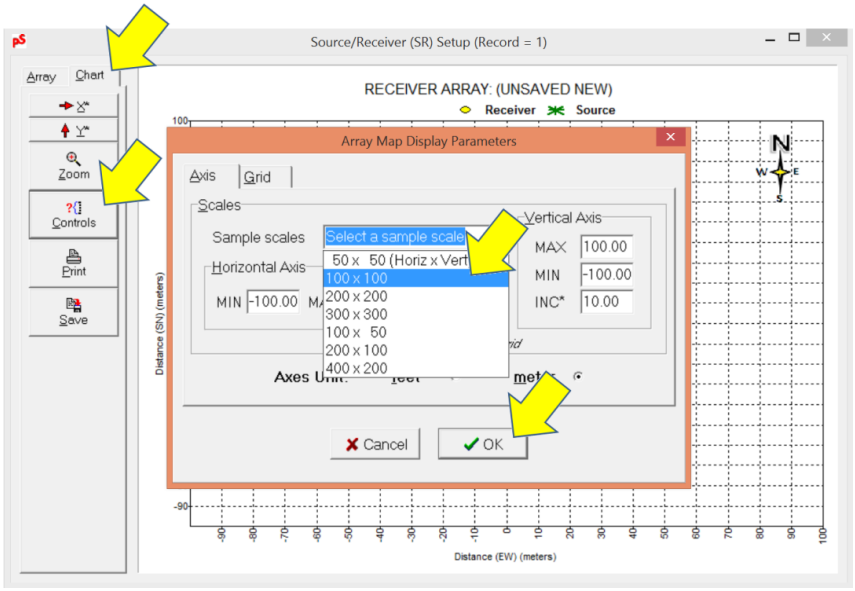
Receiver array (RA) types will be identical to those described in section 5.2 ["Passive Survey with 2-D Receiver Array (RA)"] and the remaining procedure will be identical to that described in the same section. The only difference is specification of the source location in the array chart as illustrated below.



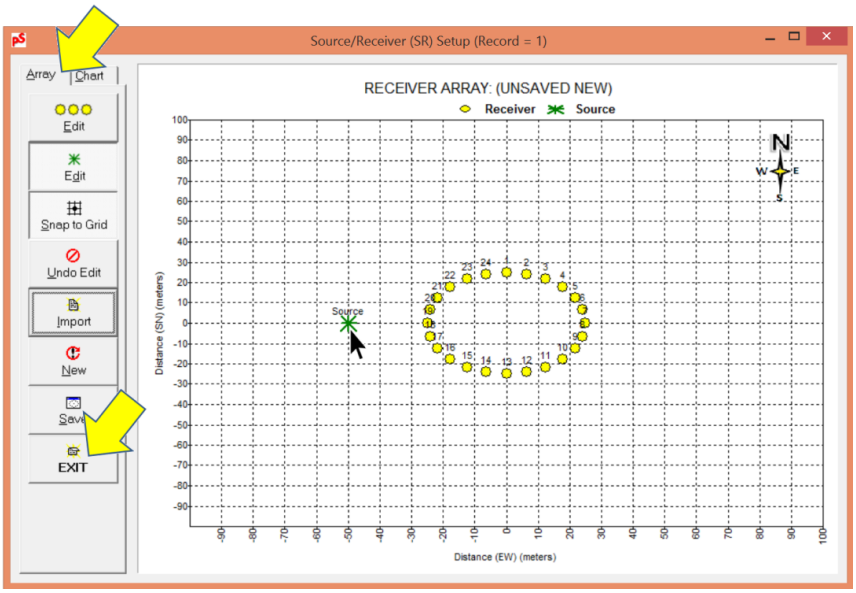
Select (depress) the "source edit" button in the tool panel so you can click and drag the source to a proper location.



First, it may be necessary to have a larger scale for the chart display. To change the scale of the chart display, select the "Chart" tab and click the "Controls" button in the tool panel of the chart form. Then, select one of the sample scale presets.



After setting the source at the proper location, click "Exit" to return to the setup dialog.



From here the remaining procedure is identical to that of the "Passive Survey with 2-D Receiver Array (RA)" described in sections 5.2.2 and 5.2.3.