Utility

ParkSEIS

PS

User Guide

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Park Seismic

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1. Overview

Non-standard processing modules that are not part of the normal MASW processing procedure, but often necessary and useful, are included under "Utility" in the main menu.
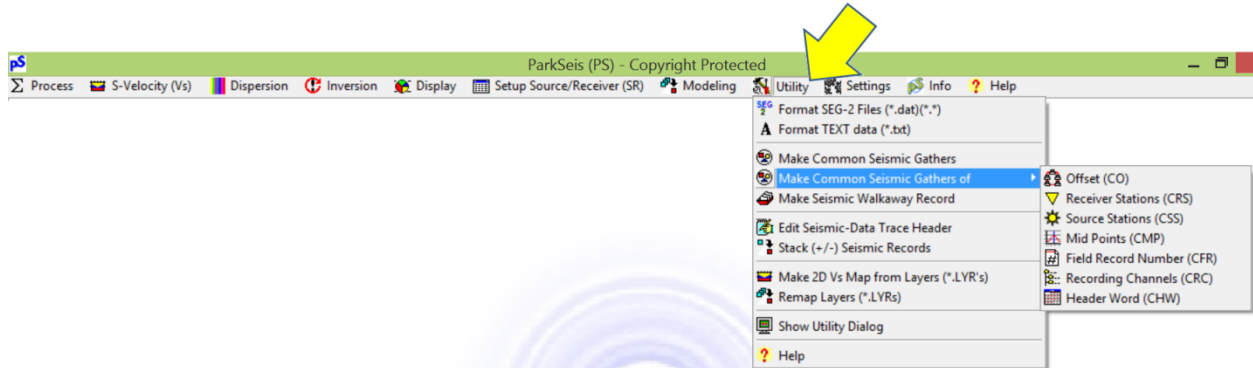
These modules will be used more often as the user becomes more familiar with the standard processing flow and therefore becomes more creative in handling those processing results obtained at various stages. The ultimate goal of using the utility modules will be to understand more precisely about data set at different stages of the processing sequence through various approaches of non-conventional non-standard evaluation procedures.

Most modules, except for "Format TEXT data" and "Make Common Seismic Gathers", are accessible within the same "Utility" dialog (Figure 1). The other two modules have their own separate dialogs as illustrated in Figure 2. The type of task each module performs is briefly explained below.

Format SEG-2 Files

The basic and minimum input data element for PS is one record that consists of a suite of an individual channel's recordings, called "traces." The field records should be saved in the SEG-2 format (Pullan, 1990), which is an engineering standard that most engineering seismograph have adopted as the default output format. Other text data files can be converted to the PS format by using a conversion module ("TXT2PS") that can be foud under "Utility" in the main menu. All SEG-2 records are internally converted to PS format as soon as they are imported by the program, and all intermediate and final outputs of seismic data sets will be in this PS format.

All SEG-2 records imported by the ParkSEIS (PS) software are first internally converted to another format called "PS format" that is a modification of the "KGS format (or modified SEG-Y format)" (WinSeis User's Manual, 1997). This conversion is necessary to handle seismic data in a faster and more accurate manner for advanced and non-conventional wavefield operations commonly used in various stages of MASW data processing. In PS format, each channel's data set (called a "trace") is saved as a combination of a header (of 120 elements of 2-byte integer each), followed by data samples (of 4-byte floating-point value each). A complete listing of the "PS Header" can be displayed by choosing "PS Header" on the main menu's "Info" item. All output of seismic data are saved in PS format with the "DAT" extension (e.g., "Output.dat").

Format TEXT data

Sometimes, seismic data are prepared from a variety of different sources that may include seismographs from different manufacturers, output from numerical modeling, etc. In spite of different data formats adopted in each case, they can be at least prepared in text format. When that is done, these text data samples can be converted to PS format by using this module.

Make Common Seismic Gathers

A normal seismic record in either SEG-2 or PS format has a collection of seismic data that were generated from the same seismic source ("shot"). Therefore, it is also called a "common shot gather." A collection of multiple common shot gathers (i.e., a normal seismic data file in PS format) can be rearranged into different types of "common" gathers based on the primary sorting index. This module can rearrange input seismic data of any type (e.g., common-shot gathers, common-offset gathers, etc.) into the following types of common gathers: offset (CO), receiver station (CRS), source station (CSS), source-receiver mid points (CMP), field record number (CFR), recording channels (CRC), and header word (CHW). In the case of common header word (CHW) gathers, a header word number is specified that is used as the primary sorting index to generate different output records. Usefulness of the common-offset (CO) gathers is further explained in the PS User Guide "Back-Scattering Analysis (BSA) and Common-Offset (CO) Sections."

Make Seismic Walkaway Record

It is sometimes useful to make a seismic record of an extended offset (i.e., source-receiver distance) range simply by combining multiple records obtained at the same surface location but with different source offsets. This "extended offset" record is called a walkaway (or noise analysis) record (Telford et al., 1976; Sheriff, 2002). In seismic data analysis, a walkaway record can be extremely useful in understanding the behavior of seismic body and surface waves in their propagation velocities and attenuation properties. Furthermore, it can produce a dispersion image of an increased resolution achieved by the extended aperture (i.e., offset) of measurement that can delineate multi-modal dispersion patterns more clearly.

Edit Seismic-Data Trace Header

It is sometimes necessary to change one or more of trace header elements to accommodate some experimental modifications or to rectify some minor error introduced during the previous processing (e.g., changing distance unit from feet to meters). This module can accomplish such a task.

Stack (+/-) Seismic Records

This module can stack two different records by summing (+) or subtracting (-) data values. A scaling factor can be applied to each record, if necessary, before the operation. This module can be useful when handling seismic records and dispersion image records (also called "overtone" records) to meet some experimental purposes.

Make 2D Vs Map from Layers

Inversion of one dispersion curve (*.dc) will generate its own output of one layered-earth model (*.LYR). The 2D shear-wave velocity (Vs) cross section is created by combining a multiple number of such LYR files at the end of the inversion that processed a multiple number of input dispersion curves. This module can generate such a 2D Vs cross section from a multiple number of LYR files of your own selection.

Remap Layers

One or more layered-earth model (*.LYR) files can be remapped according to a common depth model, which is defined by another "reference" LYR file. This remapping can be useful when comparing files (LYR's) of different depth models, or constructing a 2D Vs cross section from multiple LYR files to bypass some unfavorable interpolation effects introduced by the plotting module.
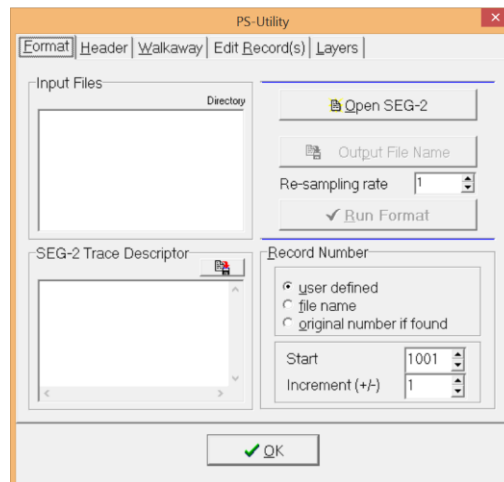
Figure 1. Utility dialog.
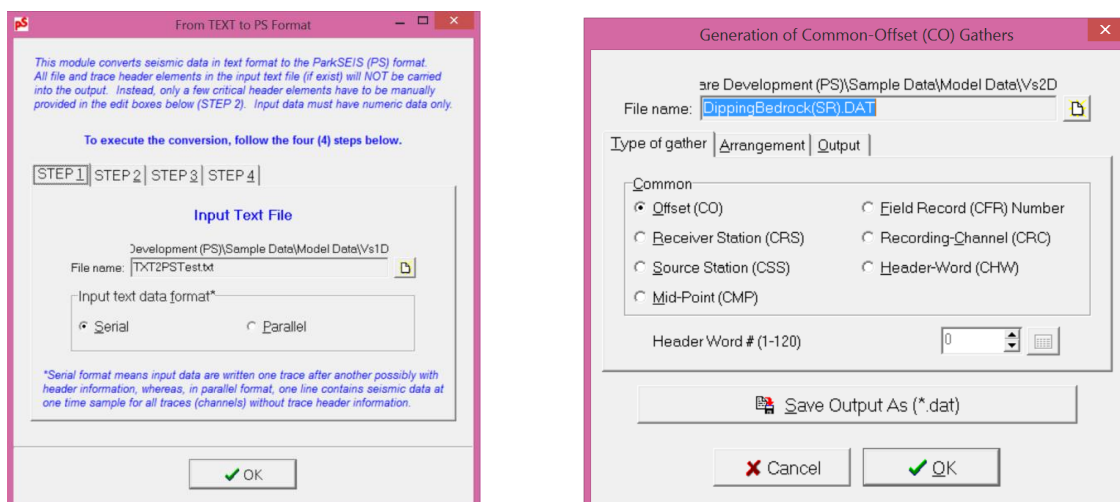
Figure 2. Dialogs for "Format TEXT data" (left) and "Make Common Seismic Gathers" (right) modules.
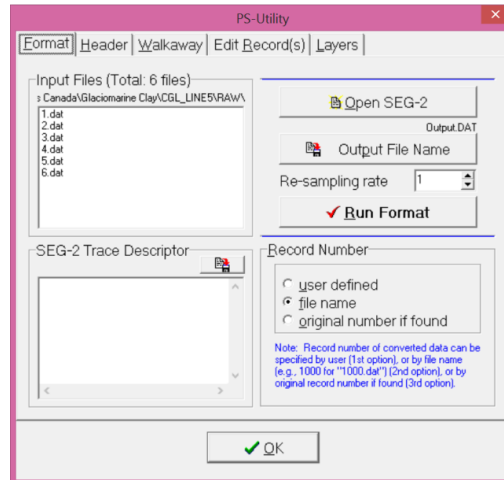
2. Format SEG-2 Files

In main menu, go to "Utility" → "Format SEG-2 Files (*.dat)(*.*)." Select SEG-2 file(s) at the same time as shown below.
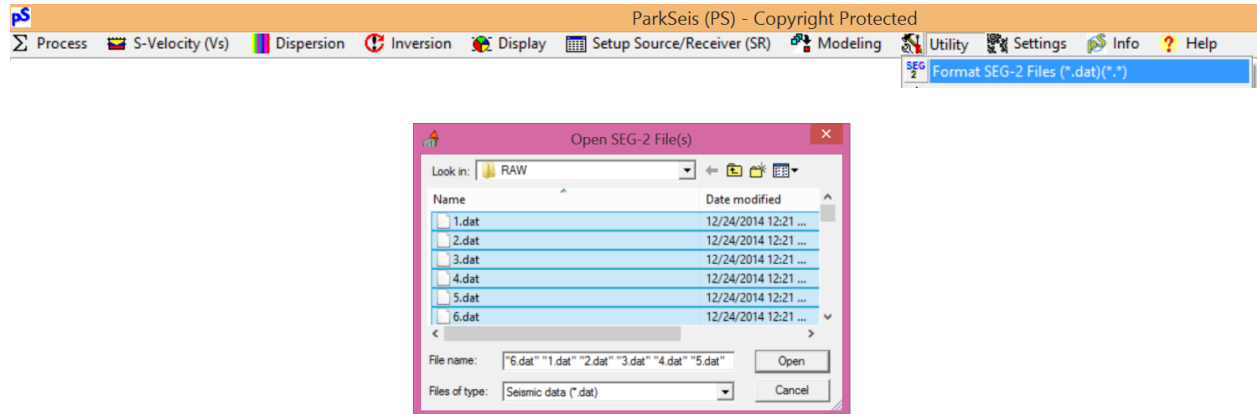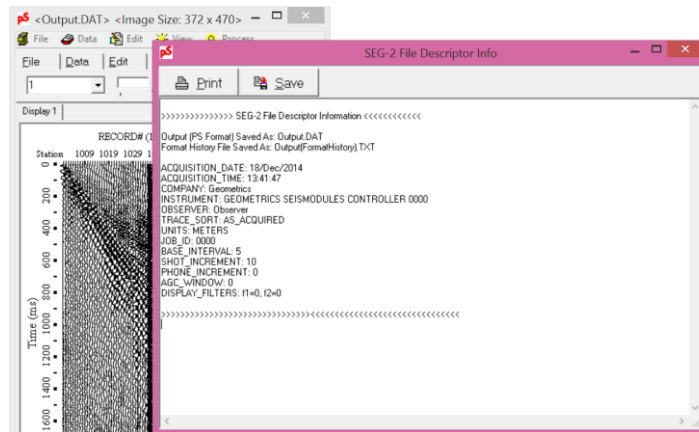

Then, a file save dialog (with a title of "Save Output As") will appear to get the name of the output file that will contain all the formatted files ("records") within the same file.

Imported files are listed in the "Input Files" box on top left corner that shows the order of appearance in the output. Click "Run Format" button to start the format.
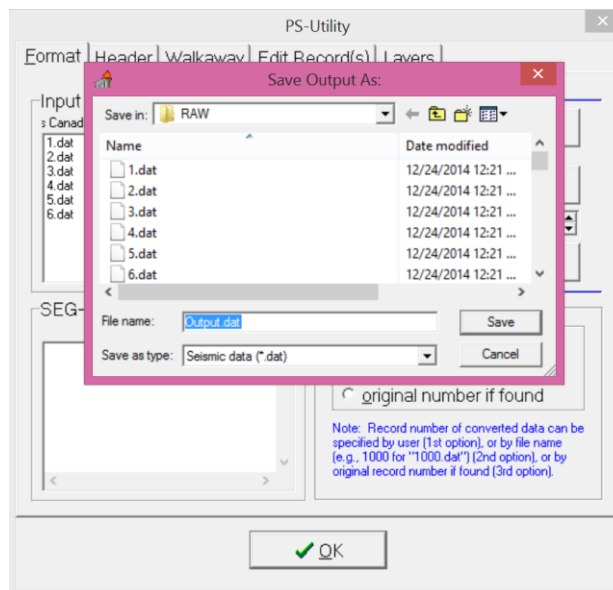
Saved output seismic data of PS format will be displayed. A text window showing the contents of the "File Descriptor" in the first file of the input SEG-2 files will be displayed also. It lists the name of another text file that contains the entire format history contents for all the channel's data (i.e., "traces") ["PS(FormatHistory).TXT"], an example of which is displayed below using the Windows Notepad.

3. Format TXT data

Seismic data in text format can be converted to PS format using this module. In the main menu, go to "Utility" → "Format TEXT data (*.txt)." Then, import a text file that contains seismic data (and possibly with header information) in text format.
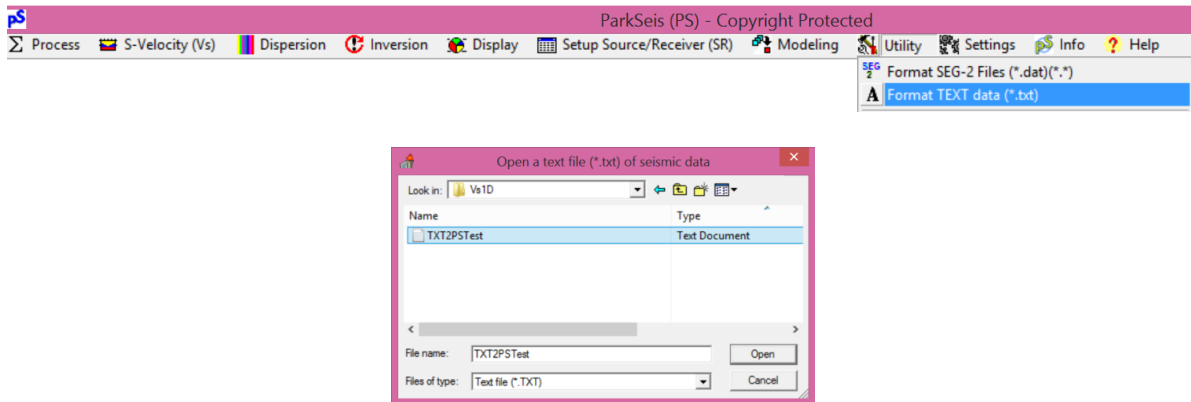
A control dialog will appear that contains all the controls related to input and output formatted data that are grouped into four (4) different steps as shown below.
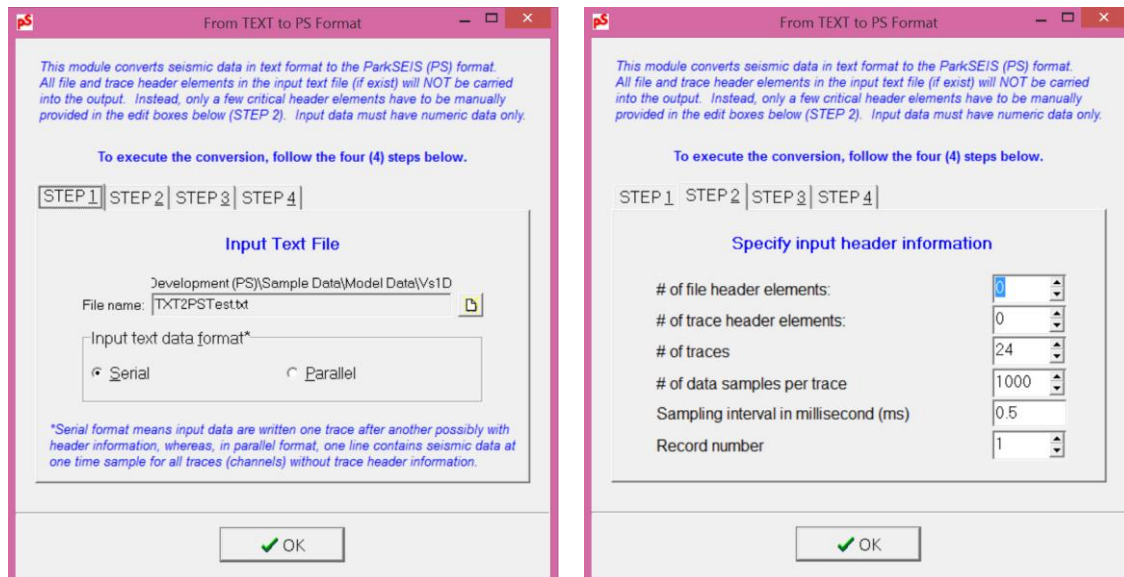

STEP 1

Select the way text data are arranged in the input file. Input text data can be arranged in one of the two formats—serial or parallel. If data values are arranged one trace after another, possibly with a common header at the beginning of each trace, then it is regarded as "serial" format. On the other hand, if one line of text in the input file contains data values for all traces at one time sample without header information, then it is regarded as "parallel" format. Move to the next step by selecting the "STEP 2" tab.

<u>**STEP 2**</u>

Specify input header information here. If there is a file header at the beginning of the input file, then its number of elements can be specified in **"# of file header elements**" box. If each trace has its own header of common format, then the total number of trace header elements can be specified in the **"# of trace header elements**" box. If there are no file or trace headers, then the corresponding box should show a value of "0". The total number of traces is specified in the "**# of traces**" box, and the total number of data samples per trace is specified in the "**# of data samples per trace**" box. The sampling interval can be specified in the "**Sampling interval in millisecond (ms)**" box. An arbitrary number can be assigned in the "**Record number**" box that will be the output record number. Move to the next step by selecting the "STEP 3" tab.
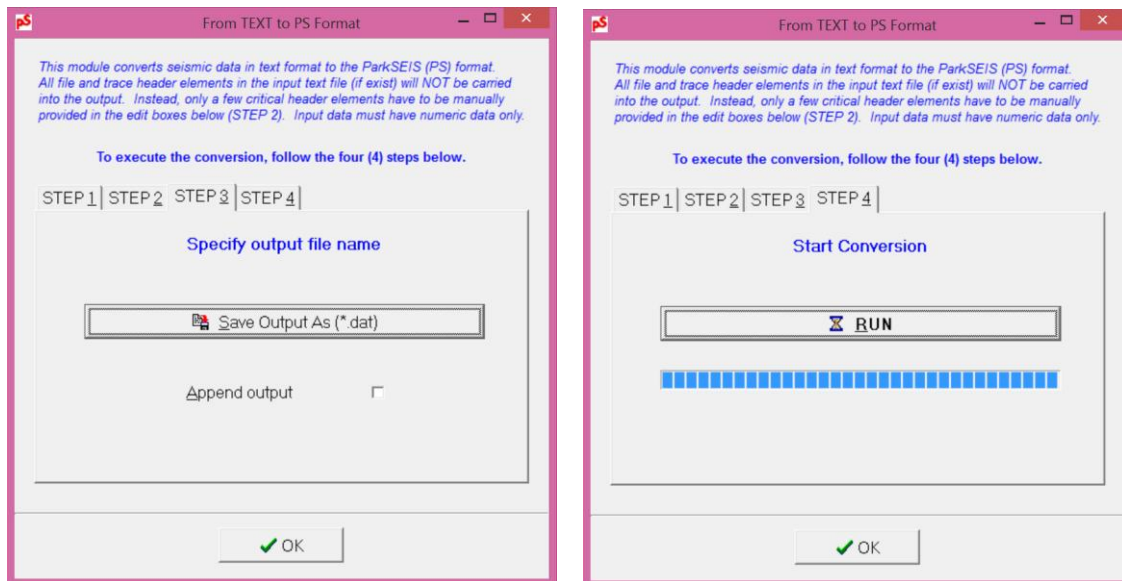

<u>**STEP 3**</u>

Specify output file name here. If formatted output data are to be added at the end of an existing file, then check "Append output" box. Make sure existing data and the new data have the same number of samples per trace and also the same sampling interval.

<u>**STEP 4**</u>

Click "RUN" button to start the conversion. Converted output will be displayed.

4. Make Common Seismic Gathers

In the main menu, go to "Utility" → "Make Common Seismic Gathers" as shown below. Then, the control dialog will appear in which the specific type of output gather (e.g., common-offset gather) can be selected. If the type of output gather is already known, then go to "Utility" → "Make Common Seismic Gathers of" and select the appropriate option as also illustrated below.
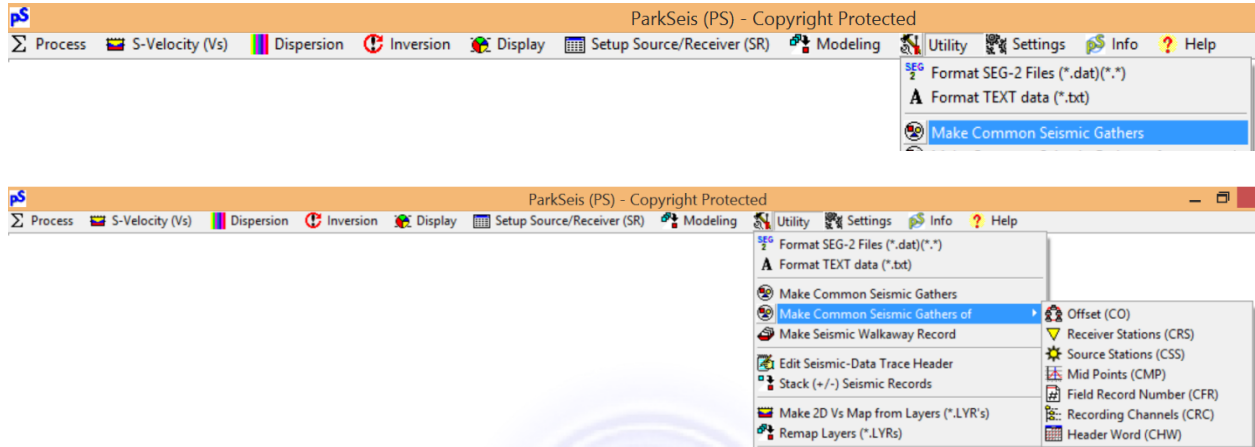
Then, import a normal seismic data file of PS format that has source/receiver (SR) setup encoded [i.e., "*(SR).dat"] as illustrated below. If the input file does not have such information encoded, then the type of output gather will be limited.
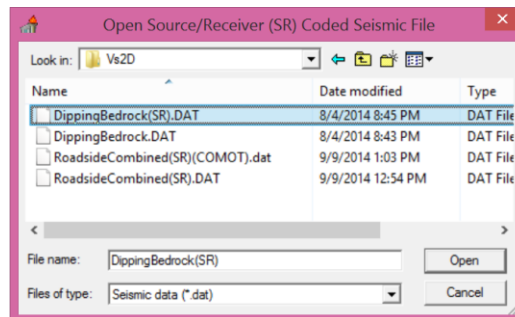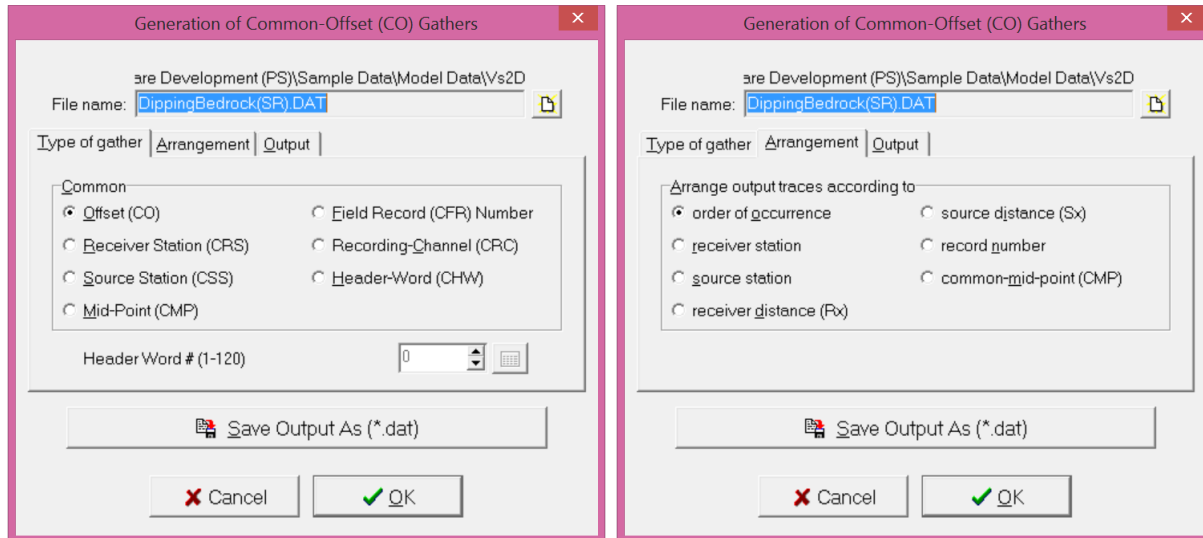
The input file name is displayed in the top box, which can be replaced by clicking the button ( ) placed at the end of the box. All controls are arranged in three (3) tabs.

Type of gather

Type of output gather is selected here. If the type was already known and selected from the main menu, then the corresponding option will have been selected and the next tab, "Arrangement", will be displayed. "Type of gather" will determine the primary information that will be used to make a common collection of traces to be grouped as one "record" in the output file. [Secondary information that will be used to determine the order of arrangement within the same record will be selected next in the "Arrangement" tab.]

|	
Offset (CO)	Traces of the same source distance (also called "offset") will be grouped as one record. Record number will indicate the corresponding offset multiplied by "10" (e.g., 1000 for common-offset of 10 meters). Trace header word #19 will be used as the primary sorting index. Output file name will have "(CO)" appended as postfix [e.g., "Output(CO).dat"].
Receiver Station (CRS)	Traces of the same receiver locations (i.e., the same receiver station numbers) will be grouped as one record. Record number will indicate the corresponding station number. Trace header word #86 will be used as the primary sorting index. Output file name will have "(CRS)" appended as postfix [e.g., "Output(CRS).dat"].
Source Station (CSS)	Traces of the same source locations (i.e., the same source station numbers) will be grouped as one record. Record number will indicate the corresponding station number. Trace header word #87 will be used as the primary sorting index. Output file name will have "(CSS)" appended as postfix [e.g., "Output(CSS).dat"].
Mid-Point (CMP)	Traces of the same source-receiver-mid-point locations will be grouped as one record. Record number will indicate the sum of both source and receiver station numbers. Trace header words #86 (receiver station) and

#87 (source station) will be used as the primary sorting indices. If "Common-Mid-Point (CMP) in surface distance" box displayed in "Output" tab is checked, then the primary sorting indices will be header words #36 (receiver distance) and #39 (source distance), and the output record number will be the sum of both distances multiplied by 10. Output file name will have "(CMP)" appended as postfix [e.g., "Output(CMP).dat"].

Field Record (CFR) Number Traces of the same original field record numbers will be grouped as one record. Record number will indicate the corresponding record number. Trace header word #6 will be used as the primary sorting index. Output file name will have "(CFR)" appended as postfix [e.g., "Output(CFR).dat"].

Recording-Channel (CRC) Traces of the same channel numbers will be grouped as one record. Record number will indicate the corresponding channel number. Trace header word #8 will be used as the primary sorting index. Output file name will have "(CRC)" appended as postfix [e.g., "Output(CRC).dat"].

Header-Word (CHW) Traces of the same value in the specified header word# will be grouped as one record. Record number will indicate the corresponding value in the header. The number (#) of header word will have to be specified in the separate "Header Word # (1-120)" box located below the radio group box. Output file name will have "(CHW)" appended as postfix [e.g., "Output(CHW).dat"].

Arrangement

The secondary sorting index is specified in this tab, which is used to determine the order of output for those traces within the same record.

order of occurrence Output traces will be arranged in the order of their appearance in the original input file.

receiver station Output traces will be arranged in the order of receiver station numbers (header word #86).

source station Output traces will be arranged in the order of source station numbers (header word #87).

receiver distance Output traces will be arranged in the order of receiver distances (header word #36).

source distance Output traces will be arranged in the order of source distances (header word #39).

record number Output traces will be arranged in the order of record numbers (header word #92).

common-mid-point (CMP) Output traces will be arranged in the order of CMP numbers (header word #12).
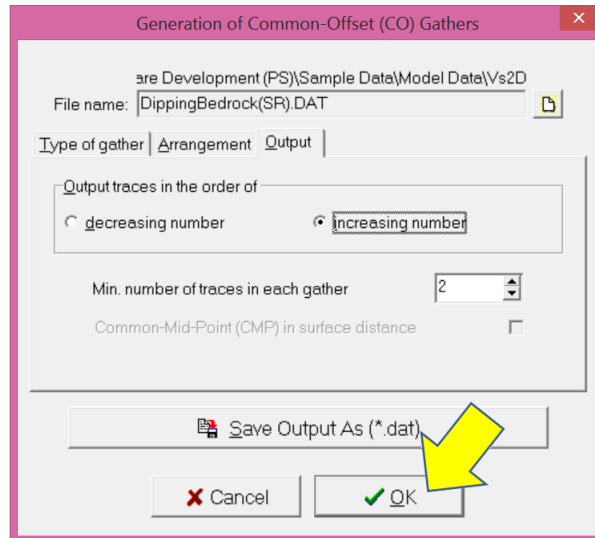
Output

Output traces can be written either in an "**increasing number**" order or a "**decreasing number**" order of the values selected as the secondary sorting index in the "Arrangement" tab. "**Min. number of traces in each gather**" will determine the smallest number of output traces within a record and will not output those records with a lesser number of traces. The "**Common-Mid-Point (CMP) in surface distance**" check box will be enabled if "Common-Mid-Point (CMP)" is selected as the primary sorting index. If this box is checked, the output CMP (header word #12) will be encoded as a sum of source and receiver distances.

Click "OK" to start the process that will ask for the output file name, if not previously specified.
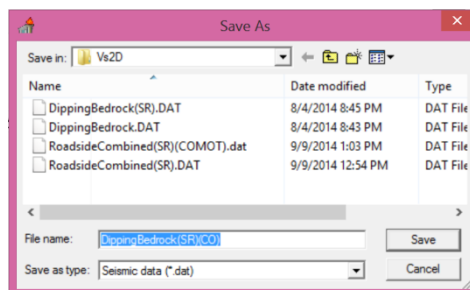
Output will be displayed in a new window. The common-offset gathers will be displayed in the "variable-area" format as default mode of display. Display can be changed back to the normal black & white wiggle-type display by depressing the "Variable Area Display" button in "View" tab of the top tool panel.

5. Make Seismic Walkaway Record

In main menu, go to "Utility" → "Make Seismic Walkaway Record" as shown below. A dialog with all control options will appear with a brief instructional message as illustrated below. Input records are opened in the order of their appearance in the output walkaway record from "left" to "right" as the output is displayed in a separate window.
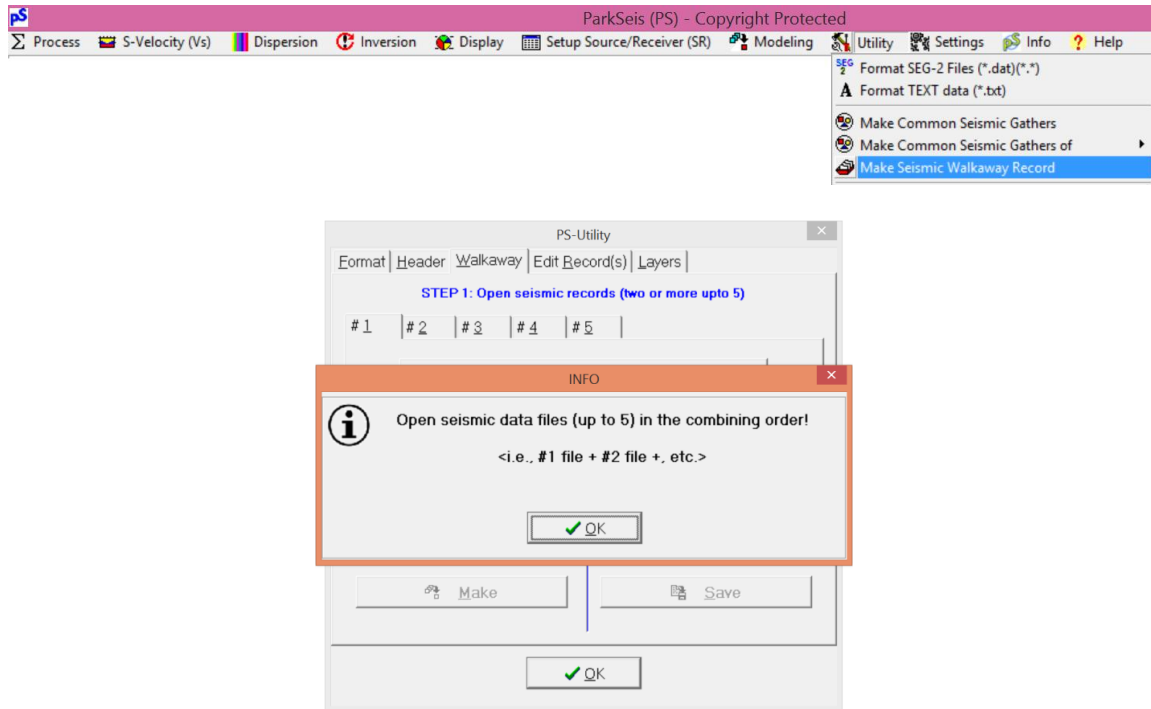
Click the "Open File" button in a separate tab to import one input record. This procedure always starts from "#1" tab and moves to next tab progressively (e.g., "#2", then "#3", etc.) up to maximum five (5) tabs. The same file can be used to open in each tab. Then, different records have to be selected in each of the input display windows (e.g., "Record #1", "Record #2", etc.). The display order of traces in each input window can be changed (i.e., "flipped") by checking the "Flip Horizontally" box in each tab.
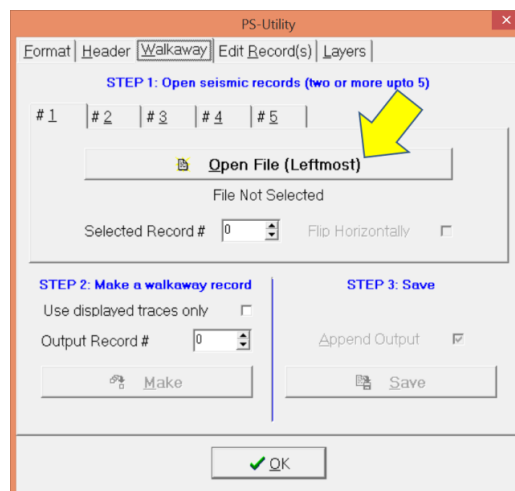
The example below illustrates opening the same file ["Line1(SR).dat"] for "# 1" and "# 2" input files. But records of "5" and "8", respectively, are selected in each of the display windows.

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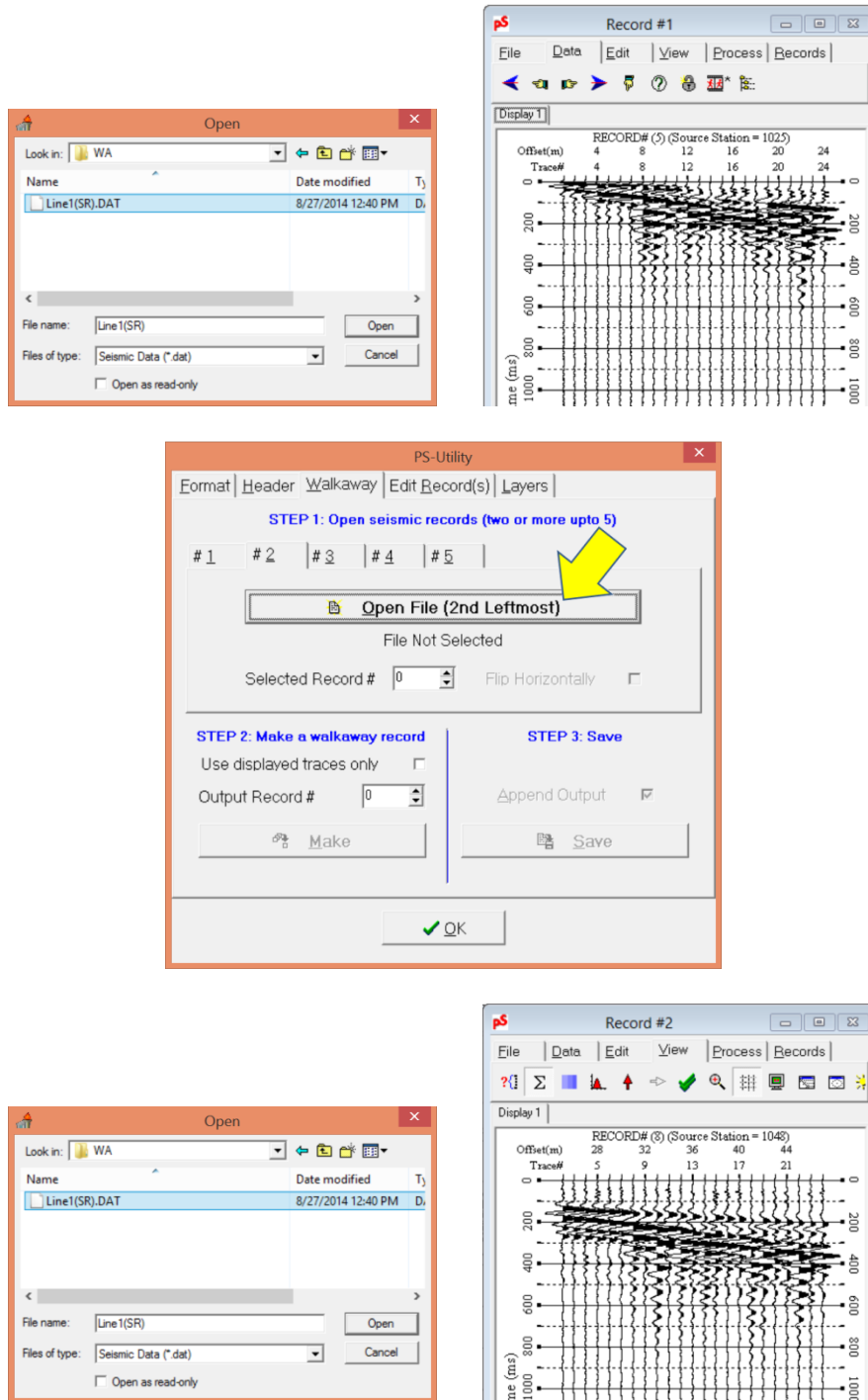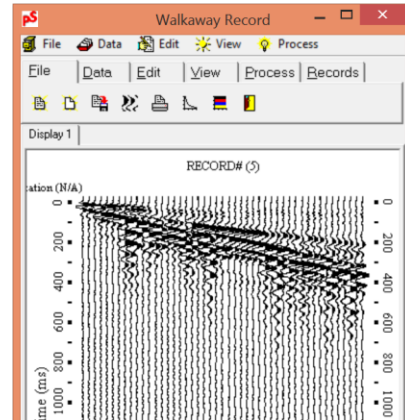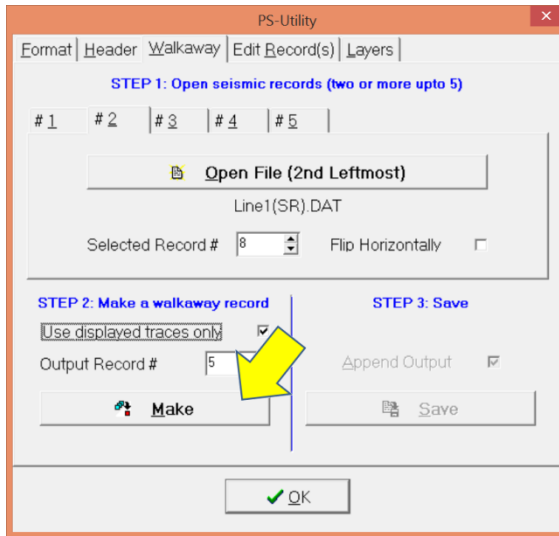
Check the "Use displayed traces only" box to use only part (not full) of the traces in the input record. To select these traces, use the "Zoom In" button in the "View" tab of the top tool panel. Then, only those selected (i.e., displayed) traces will be included for the generation of the walkaway record. The full length of time will be used for these selected traces regardless of the displayed lengths. Record number of the output can be specified in the "Output Record #" box.

Click "Make" button to generate the walkaway record that will be displayed in a separate window as illustrated above.
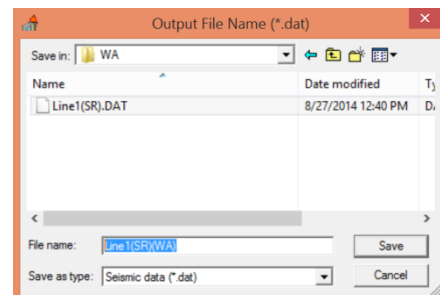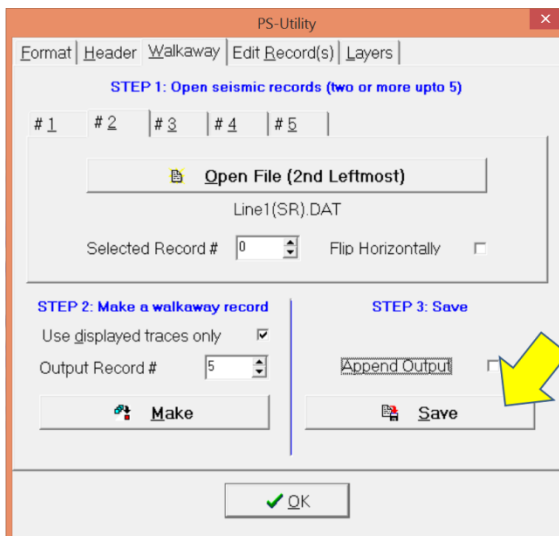
Click "Save" button to save the displayed walkaway record as a separate file. If necessary, it can be appended to an existing file by checking "Append Output" box.

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6. Edit Seismic-Data Trace Header

Value(s) of trace header element(s) can be changed. In the main menu, go to "Utility" → "Edit Seismic-Data Trace Header" to select a seismic data file as illustrated below.
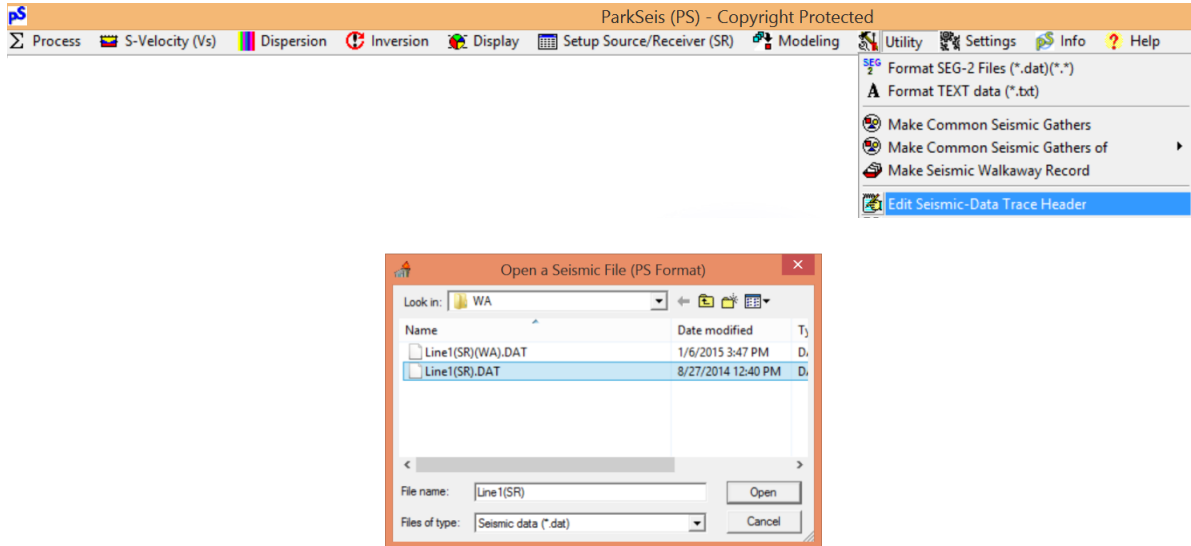
A control dialog will appear with following options available. At any time, the input file can be replaced by a new file by clicking the "Open (*.dat)" button in the dialog. The header word # can be selected in the green box ("Word No.") by selecting or typing an appropriate number (1-120). The content of the selected element will be displayed on the top green bar. The full contents of PS headers can be displayed by clicking the button (📋) placed at the end of this bar. The current value of the selected element will be displayed in "Value" box. If only one header element is to be changed, then specify the new value in this box and click the "Apply" button to start the process. If "Save as a separate file" box has been checked, then it will ask for output file name before starting the process.
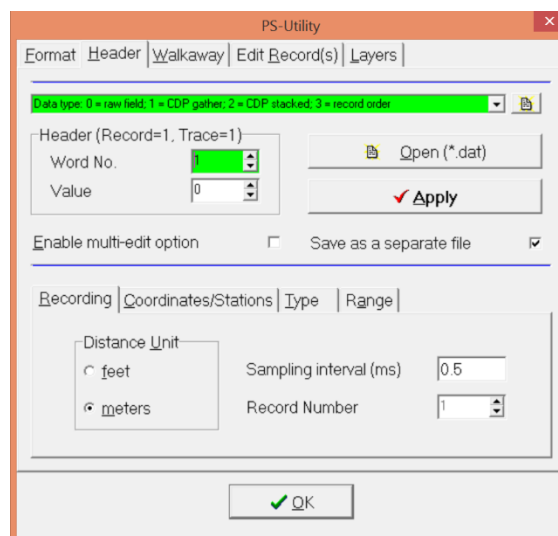
If any common properties such as distance unit, sampling interval, record number, etc., are to be changed, then check the "Enable multi-edit option" box so that the additonal options listed in the separate tabs at the bottom of the page will be enabled.


Coordinates/Stations

To change coordinate(s) (i.e., distances) of source and/or receivers, select the "Coordinates (X, Y, Z)" tab, check the appropriate box(es) ("Receiver" or "Source"), and enter the amount of change in the "Value" box. Select the type of change by selecting the proper type ["Add (+)" or "Multiply (x)"].

To change station(s) of source and/or receivers, select the "Stations" tab and check the appropriate box(es) ("Receiver" or "Source") and enter the amount of change in the "Value" box. Select the type of change by selecting the proper type ["Add (+)" or "Multiply (x)"].

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Type/Range

The type of data (determined by the value in header word #1) can be changed by selecting an appropriate type in the "Data" radio group box. The type of receiver array (1D or 2D) can be selected in the "Rcv array" box. The MASW survey type (e.g., active, passive, and active/passive combined types) can be changed by selecting an appropriate option in the "MASW survey" radio box.

The range of records and traces to which the change will be applied can be specified in the "Record" and "Trace" boxes, respectively.
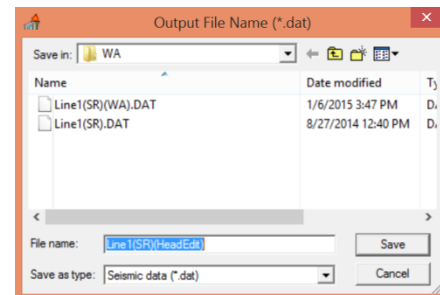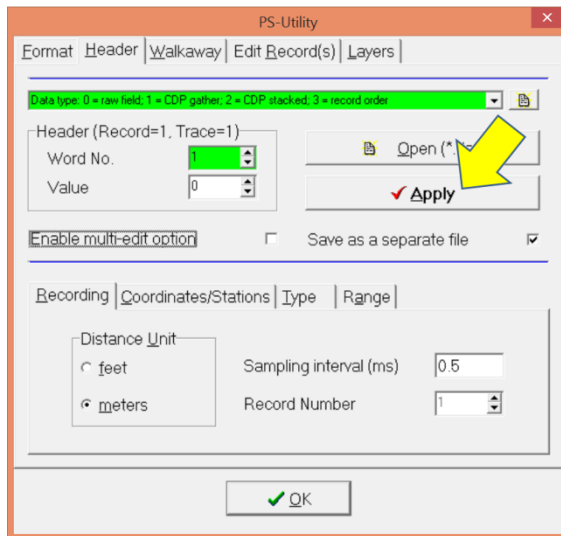
Click the "Apply" button to start the process. If "Save as a separate file" box has been checked, then the program will ask for output file name.

7. Stack (+/-) Seismic Records

Two seismic records can be stacked on top of each other by either summing two amplitudes or subtracting one from the other. In the main menu, go to "Utility" → "Stack (+/-) Seismic Records" and the utility form with the "Edit Record(s)" tab selected will appear as shown below.
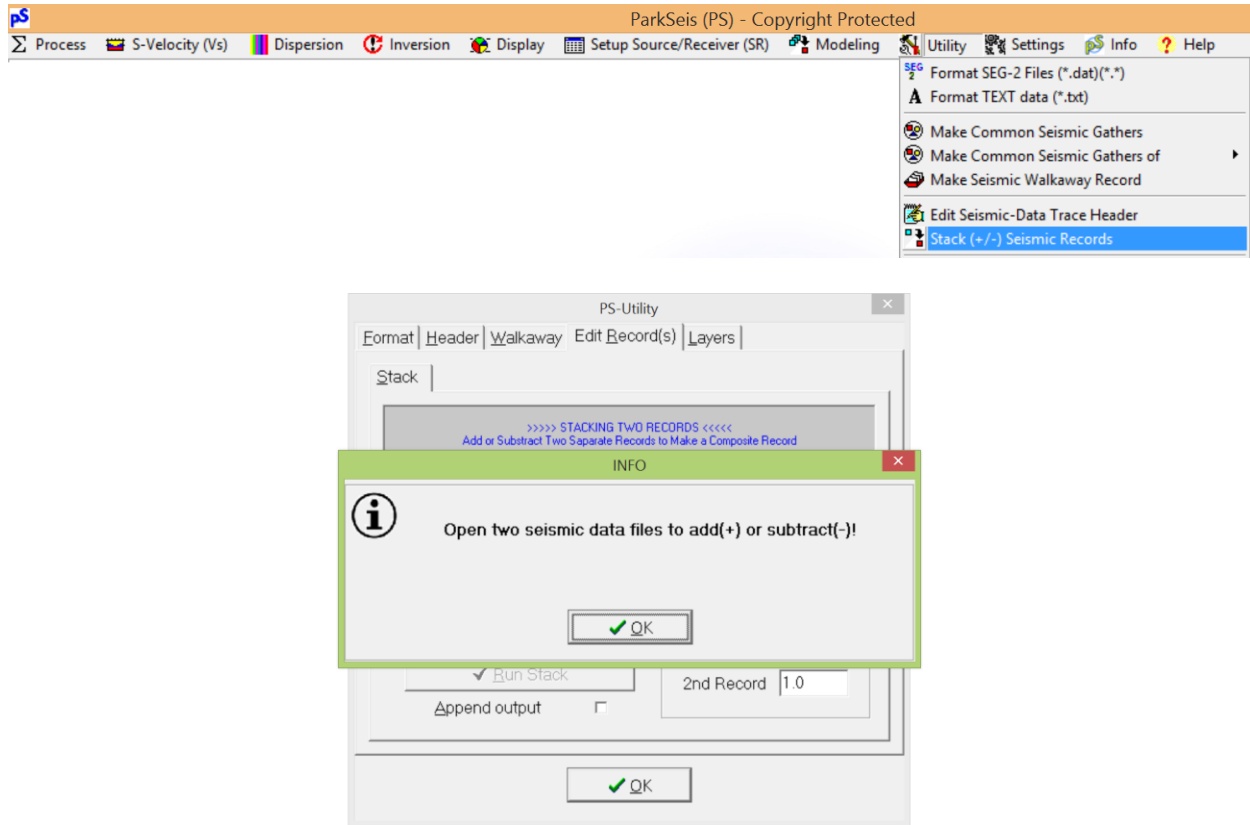

Open two seismic data files by clicking "Open 1st Record" and "Open 2nd Record" buttons, respectively, as illustrated below. Each file will be displayed in a separate window.
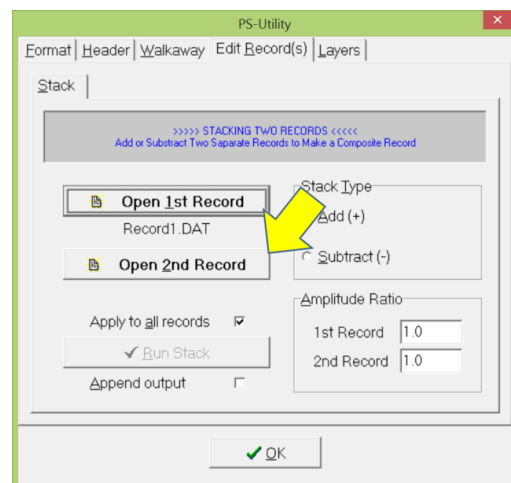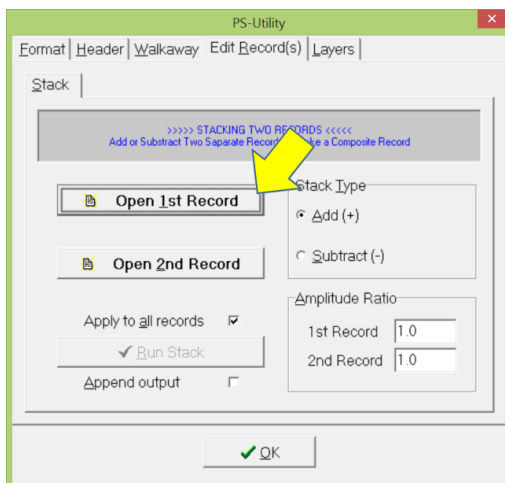
Check the "Apply to all records" box if individual records are to be stacked on top of each other in the order they appear in each file. Otherwise, the records displayed in each window will be stacked. Choose the "Stack Type" (i.e., + or -) and adjust relative amplitude ratios, if necessary, in the "Amplitude Ratio" box. These ratios will be applied to each record before the operation. Check the "Append output" box if output records are to be added at the end of an existing file.

Click the "Run Stack" button to start the process. The program will ask for the output file name and then display output in a separate window as illustrated below.
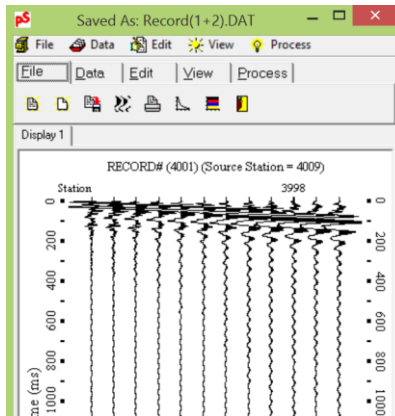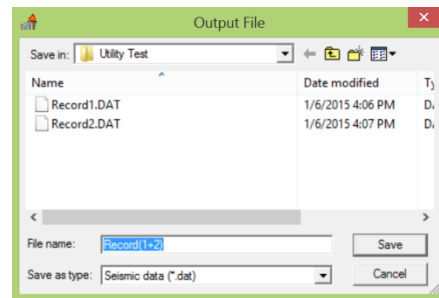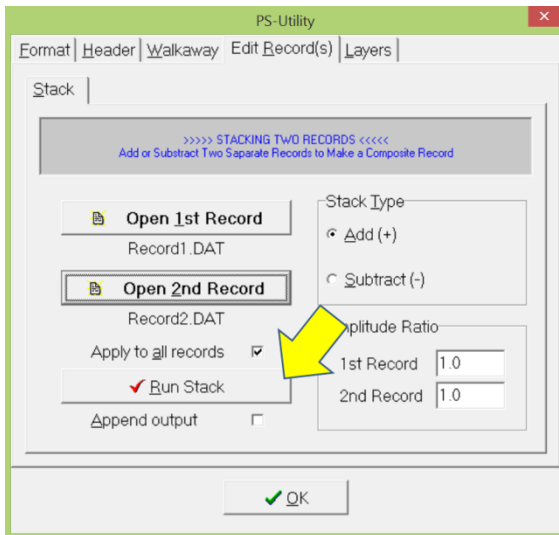
8. Make 2D Vs Map from Layers

A 2-D shear-wave velocity (Vs) cross section can be generated from a multiple number of layered-earth models (*.LYR). In the main menu, go to "Utility" → "make 2D Vs Map from Layers (*.LYR's)" that will request to import multiple files of LYR extension. The files can also be imported from the utility form by clicking the "Import Layer Models (*.LYR)" button as illustrated below.
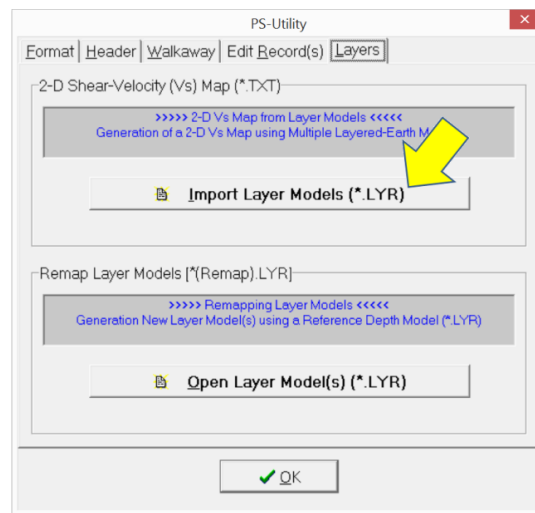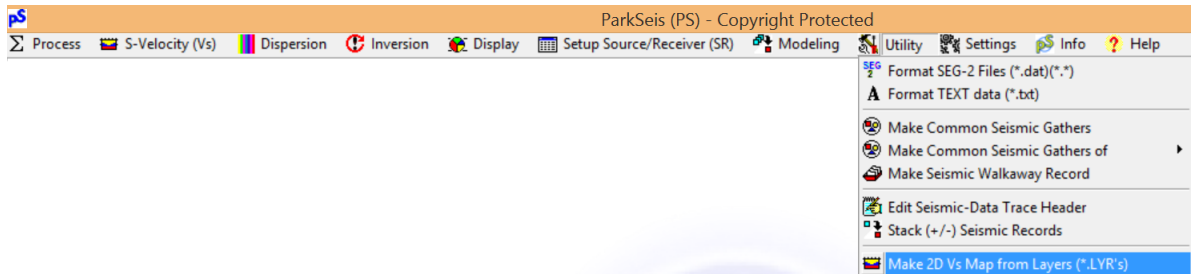

Select multiple files (*.LYR's) at the same time as illustrated below.
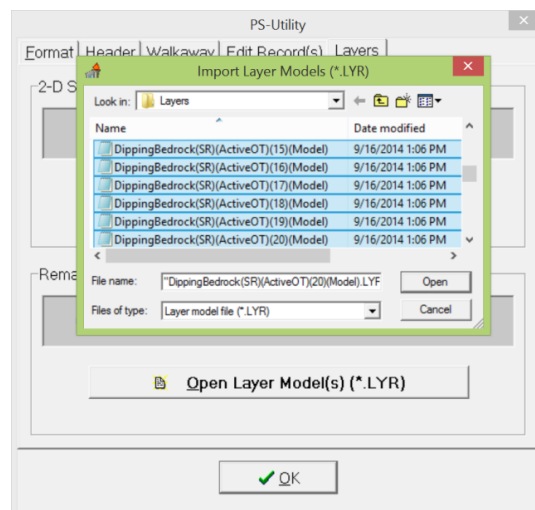
The following control dialog will appear. Click the "Output File Name [*(2DVs).txt]" button to specify the name of the output file that will be saved as a text file.
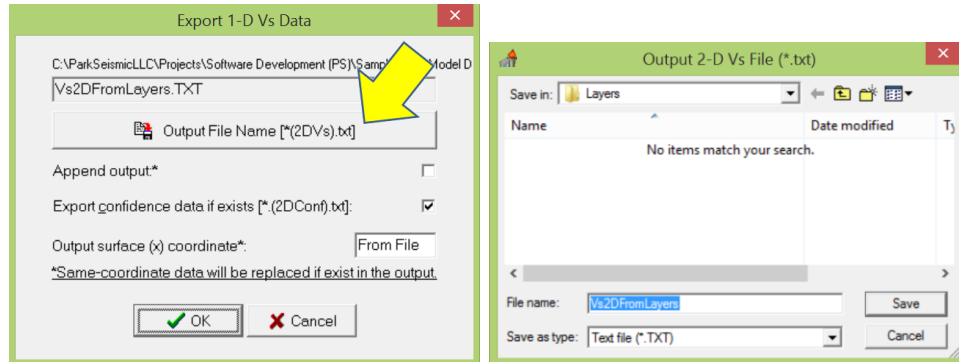

Check "Export confidence data if exists [*(2DConf).txt]" box to make the corresponding 2D confidence (%) cross section map. If input layered-earth files were created from the inversion process, then each of them will contain the inversion confidence information (as well as the surface coordinate of the original seismic record) that will be used to generate the map. Output will be appended to an existing file (*.txt) if "Append output*" box is checked. In this case, the existing data for the same surface coordinate(s) will be replaced by the new output data. Click the "OK" button to start the process that will display the output in a separate window as illustrated below.


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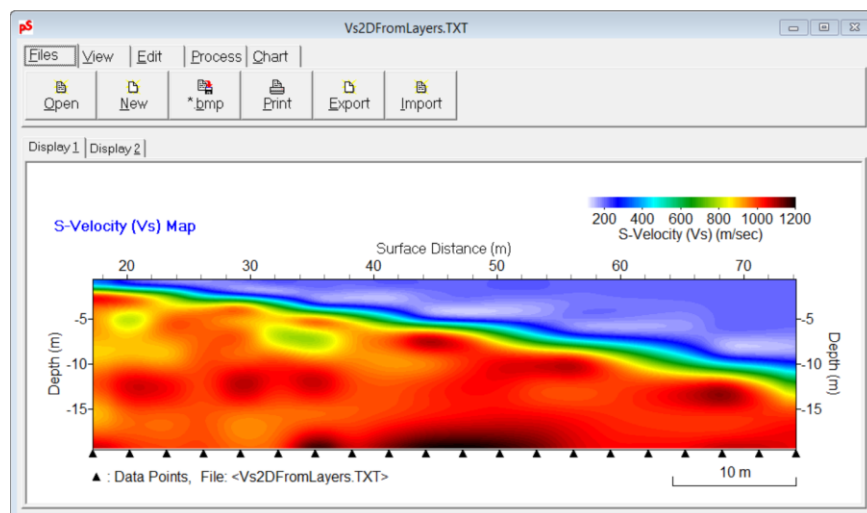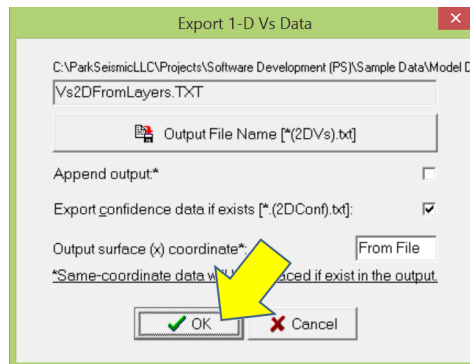
9. Remap Layers

One or a multiple number of layered-earth models (*.LYR's) can be "remapped" based on the new depth model, which is defined by another "reference" model (*.LYR).

In the main menu, go to "Utility" → "Remap Layers (*.LYR's)" as shown below. This will be identical to clicking the "Open Layer Model(s) (*.LYR)" button in the corresponding tab ("Layers") of the utility form. The program will invoke a file open dialog to import one or more layer model (*.LYR) files.
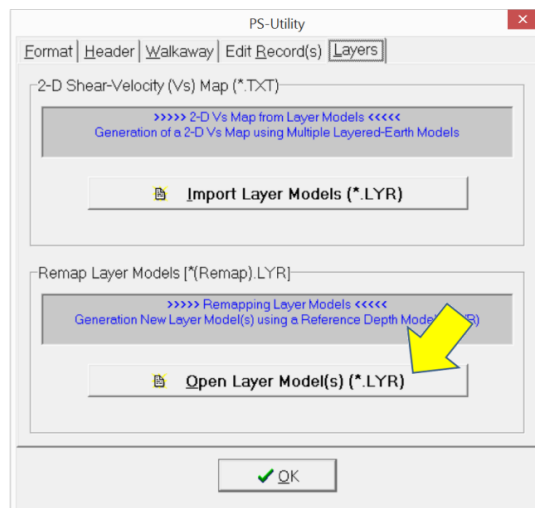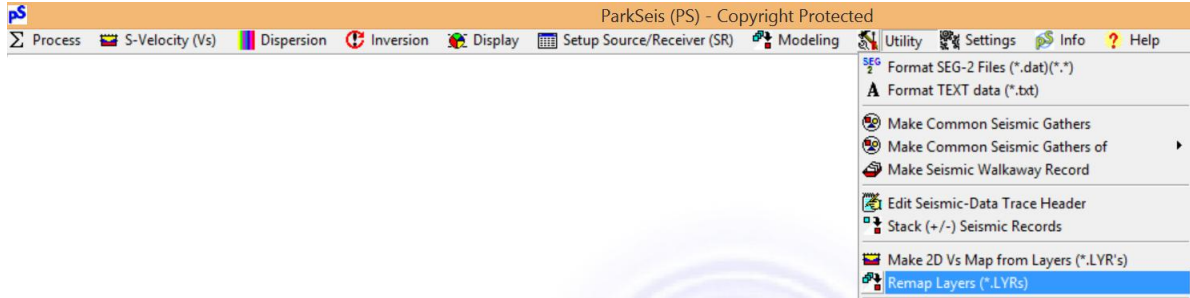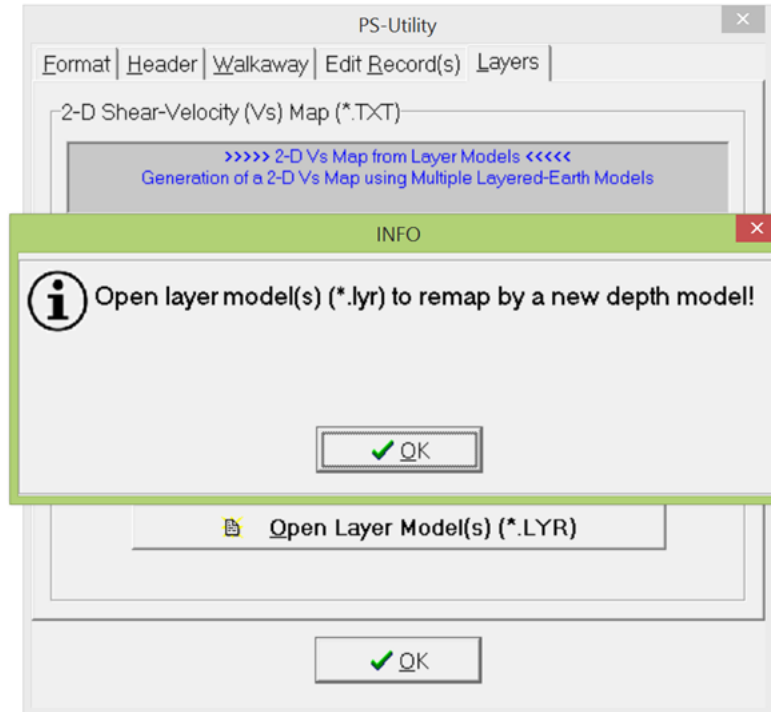
Select all files at the same time as illustrated below. After that, the program will ask to open another file (*.LYR) for the reference depth model.
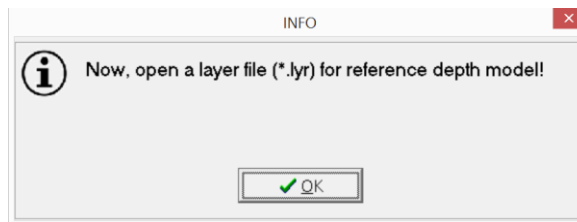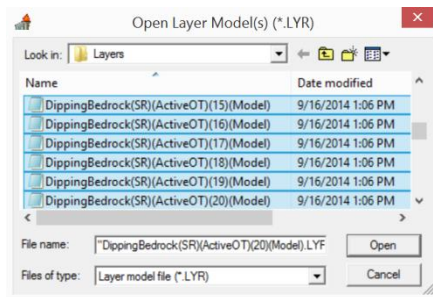

Once the "reference" file is imported, then all the previously imported input files (*.LYR's) will be remapped in their depth model according to the depth model in the reference file. They will be saved with "(Remap)" postfix appended at the end of the original file name.
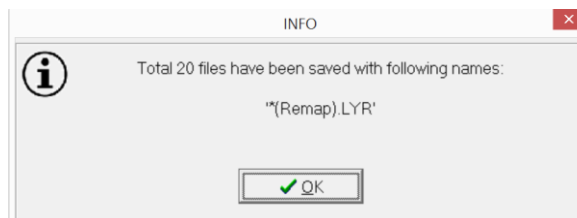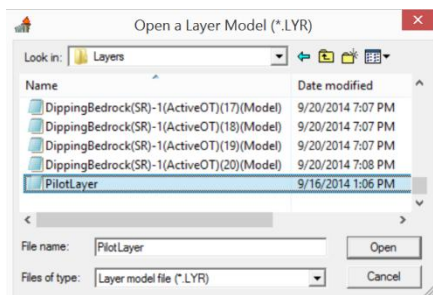
10. Show Utility Dialog

All previously explained tasks, except for "3. Format TEXT data" and "4. Make Common Seismic Gathers", can be accessed in the utility form. To open these tasks from the main menu, go to "Utility" → "Show Utility Dialog" to display the form as illustrated below.
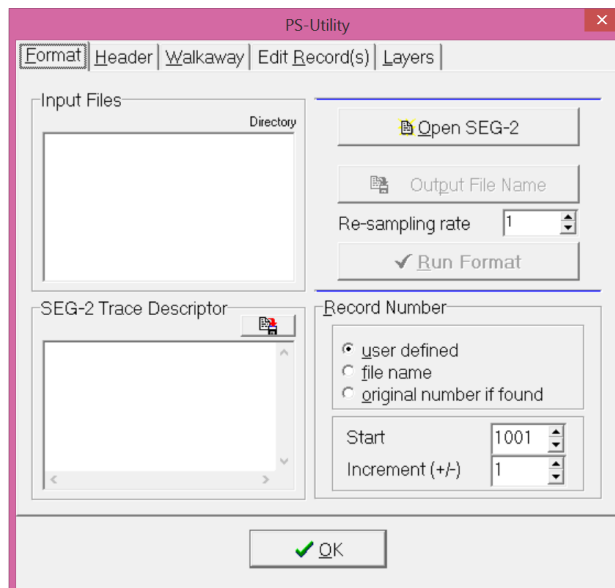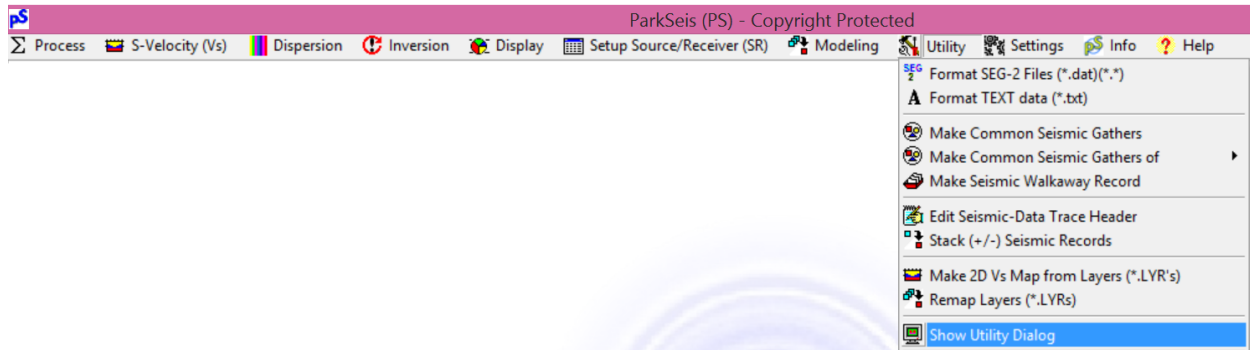
Each tab in the utility form is explained below.

Format This tab contains the module to perform the task of "Format SEG-2 Files" explained in section 2.

Header The module to perform "Edit Seismic-Data Trace Header" explained in section 6 is in this tab.

Walkaway "Make Seismic Walkaway Record" explained in section 5 can be performed in this tab.

Edit Record(s) The task of "Stack (+/-) Seismic Records" can be performed in this tab, which is explained in section 7.

Layers The two tasks of "Make 2D Vs Map from Layers" (section 8) and "Remap Layers" (section 9) can be performed in this tab.

11. References

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