

Working with crossplots in RadExPro – seismic survey map, fold and offset sampling maps, and signal-to-noise ratio map

Rev. 22.12.2016

In this tutorial, we will discuss the mapping and QC attribute analysis features provided by the **CrossPlot*** module of RadExPro software. If you want to recreate all the steps described in this document on your own, you should download the CrossPlotDemo project. The project was specially designed for crossplot demonstration:

- Several auxiliary header fields, which are absent by default, were added to the project using the **Database/Edit header fields...** command: OFF_SMPL, AMP, AMP_N, SNR.
- 3D onshore seismic survey data were loaded into the project and had geometry assigned to them;
- The data were binned by CDP using the **3D CDP Binning** tool;
- Fold and offset sampling values were computed using the **Compute Fold** module and saved to their respective headers – TR_FOLD for the fold and OFF_SMPL for offset sampling;
- The data were resorted to FFID:OFFSET, the RMS amplitudes of the useful signal and microseism were evaluated for each shot using the **Ensemble QC** module, and were saved to their respective headers – AMP for the useful signal and AMP_N for the microseism. Their ratio was computed in the Trace Header Math module and saved to the SNR ($SNR=[AMP]/[AMP_N]$) field.

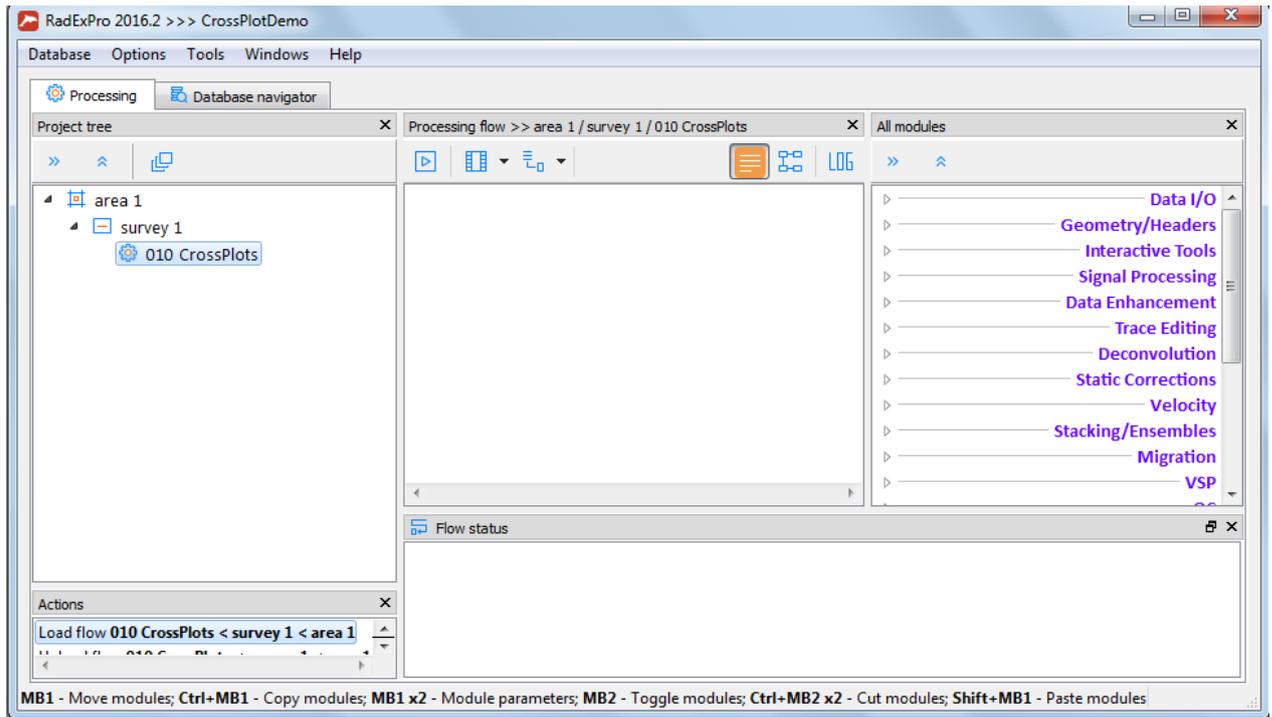
When using your own data, you'll need to complete the above steps before you can start working with crossplots.

- Finally, since the **CrossPlot*** module works with trace headers only and doesn't need the actual traces, we have truncated the traces to the 1st sample using the **Trace Length** module in order to save disk space (and download time). The results were saved to the demo3D_HeaderOnly dataset which will be used further in this manual.

When working with your own data, you can omit the last step, and specify an input dataset with fulllength traces for the **CrossPlot*** module instead. However, this is a useful technique for speeding up the flows which work with headers only and do not require the actual data.

Crossplot processing flow

Open the CrossPlotDemo project. The main project window should look like this:



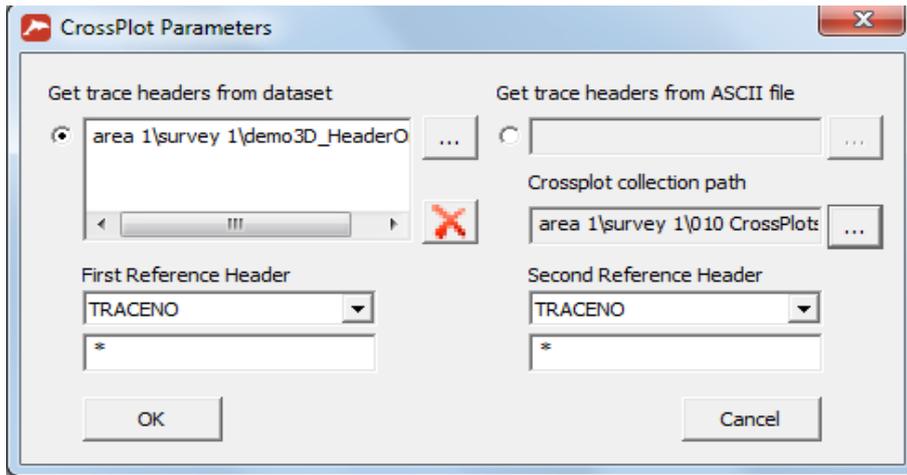
Three levels were created in the project database: “area” (**area 1**), “survey” (**survey 1**) – this is the level containing the dataset we’ll be working with – and “processing flow” for crossplots (**010 CrossPlots**). (for more detailed information about working with projects, see the RadExPro User Manual and [How to create new project...](#) tutorial).

Add the CrossPlot* module to the flow (it is located in the QC group in the module library on the right). The asterisk after the module name means that it should be the only module in the flow, with no data input or output modules.

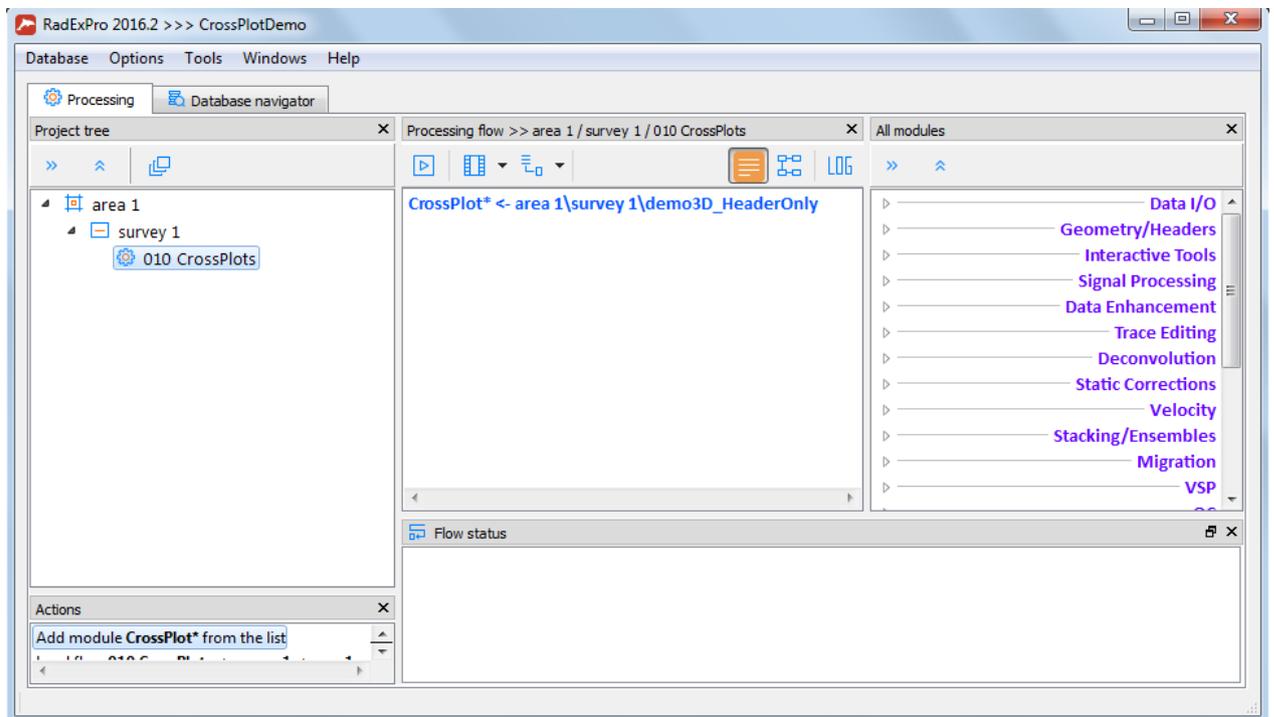
Select the dataset containing the headers we’ll be working with in the module parameter window (area 1\survey 1\demo3D_HeaderOnly).

Now create a new database object – crossplot collection. This is where the module will store all crossplot settings between the runs. We recommend creating the crossplot collection object at the same level as the flow within which you’ll be working with the crossplot set. Let us name the collection cp1: area 1\survey 1\010 CrossPlots\cp1

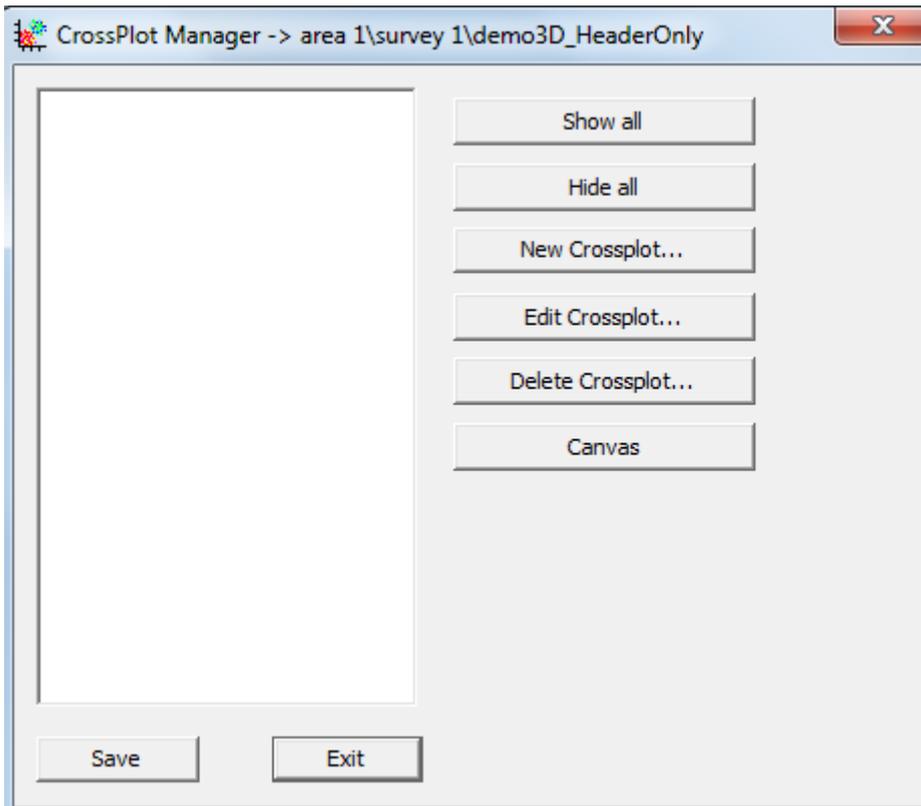
The module parameter window should look like this:



Press **OK**. Our crossplot processing flow is now ready:



Press **Run** to execute the flow. The **CrossPlot Manager** window will open:

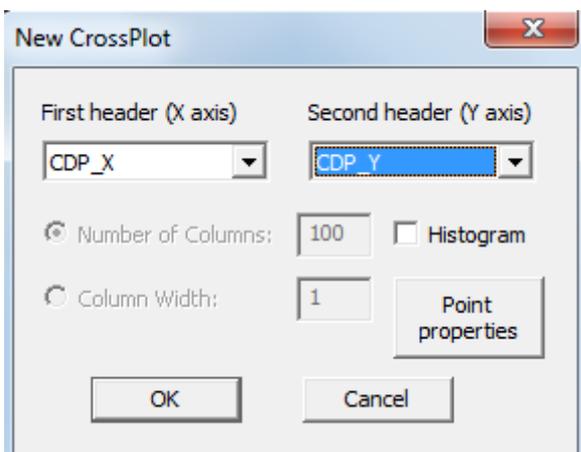


The crossplot list is displayed on the left – it is empty for now. The control buttons are available on the right.

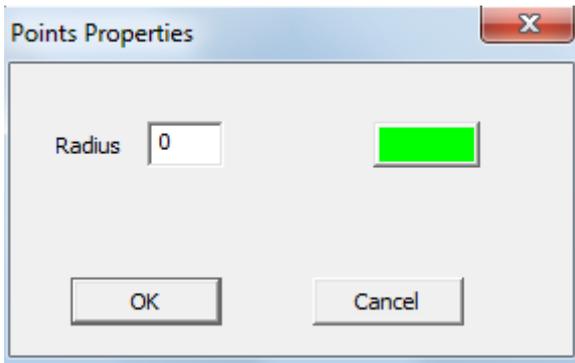
Seismic survey map

We want to create a map showing the positions of shot points (SP), receiver points (RP) and common depth points (CDP).

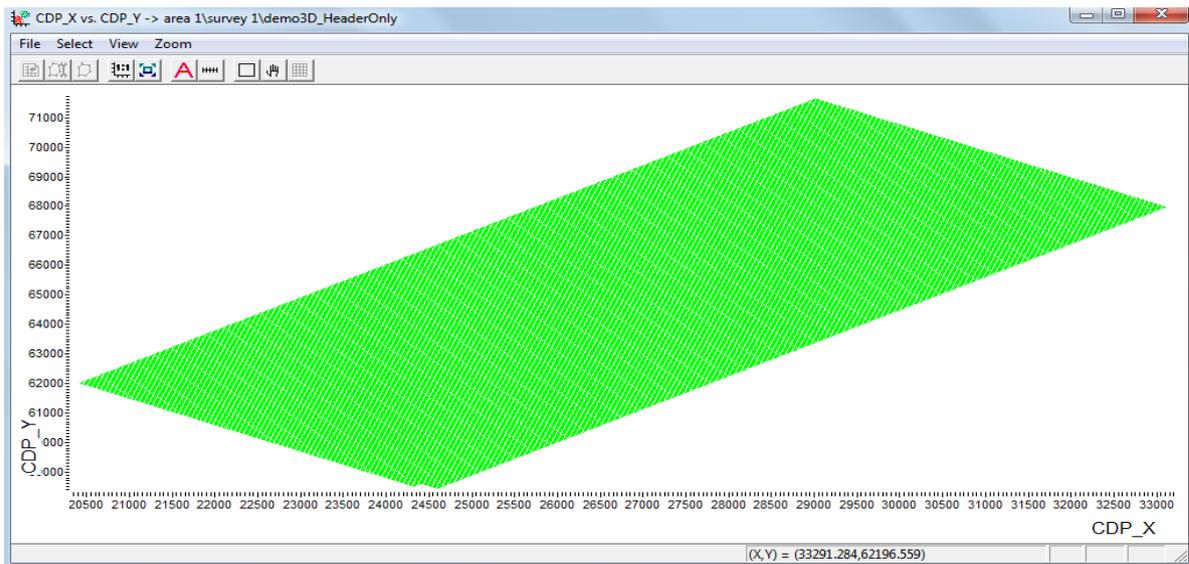
First let us build a CDP map. Press the **New Crossplot...** button and select the headers to be mapped on the crossplot axes in the dialog box. In our case it is the CDP coordinates: CDP_X and CDP_Y.



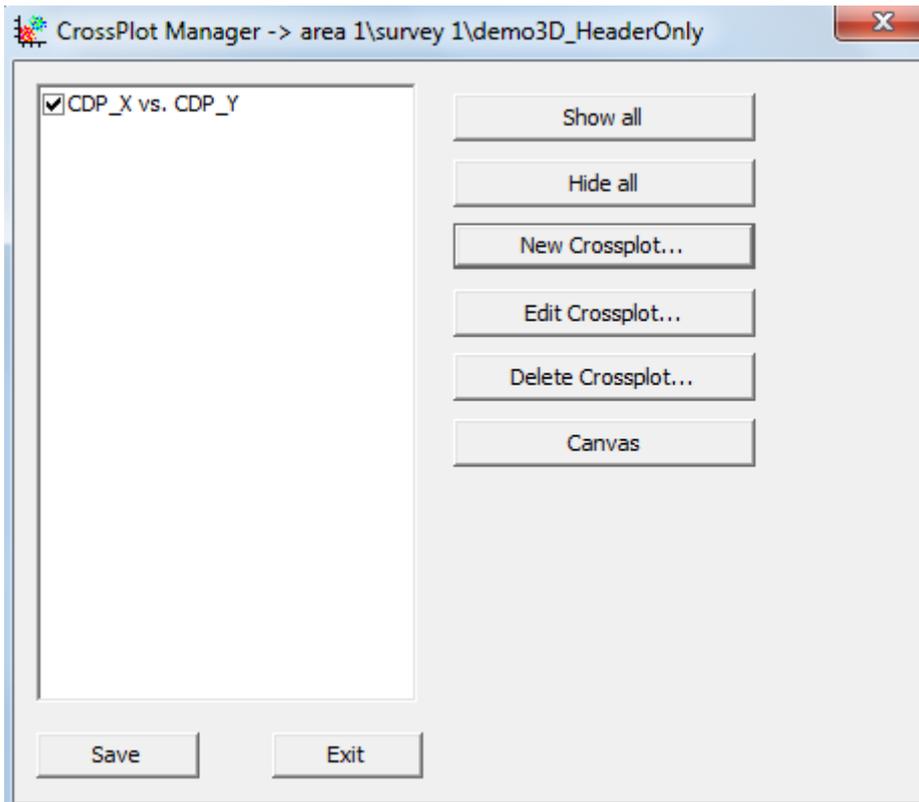
Press the **Point properties** button and specify the crossplot point display parameters: point radius – 0 (minimum possible radius, since there are a lot of CDP points), color – green (or any other color you like):



Press **OK** here and in the **New CrossPlot** dialog box. The newly created crossplot will be displayed on the screen.

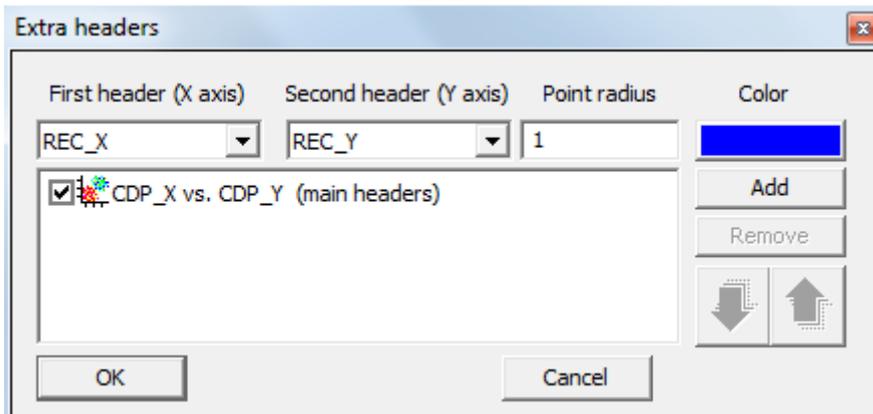


In addition, the CDP_X vs CDP_Y crossplot will appear in the **CrossPlot Manager** list.

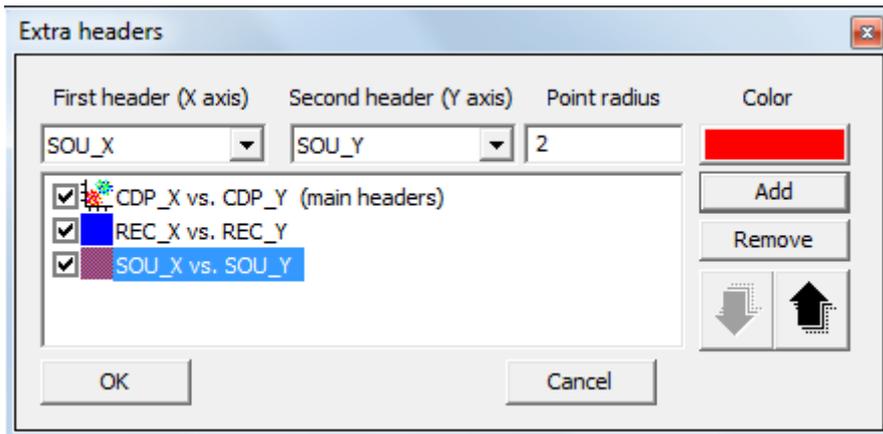


Now let us add additional points corresponding to the SP and RP positions to this crossplot. To do this, select the **View/Extra headers** menu item in the crossplot window. This command allows adding any header pairs to the existing crossplot (presuming that the measurement units and scale are the same, but this something that should be taken care of by the user).

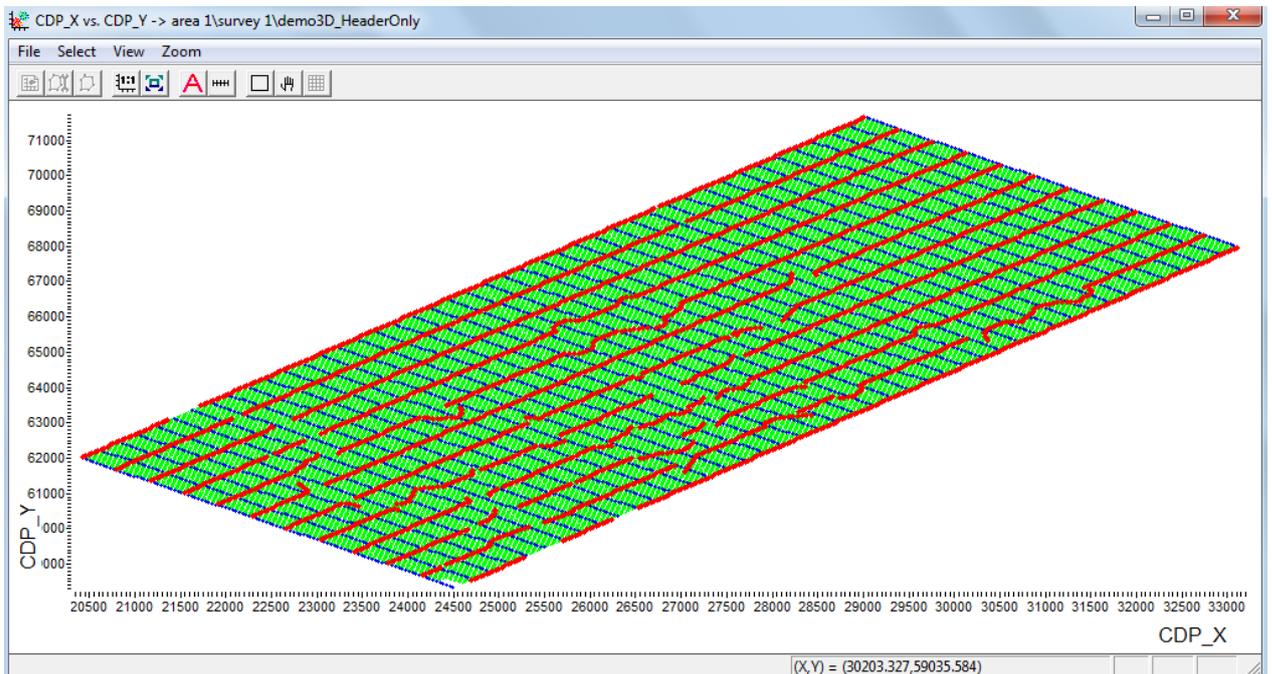
Select the headers containing the RP coordinates for the X and Y axis: REC_X and REC_Y. Select the point radius of 1 and blue point color, and press **Add**. The REC_X vs. REC_Y crossplot will appear in the list of additional crossplots displayed in this dialog box:



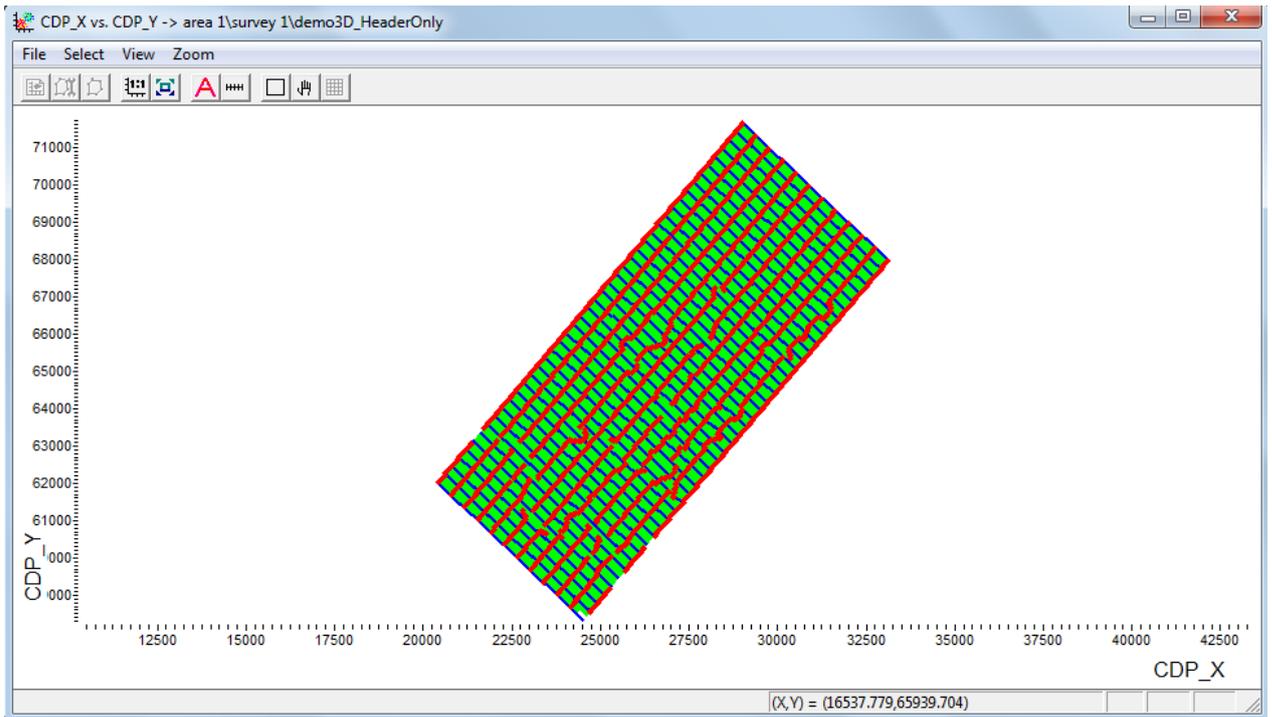
In a similar manner, let us add an additional SP crossplot. Select the SP coordinates SOU_X and SOU_Y for the axes, point radius of 2, and red point color. Press the **Add** button. Now there should be two additional crossplots in the list:



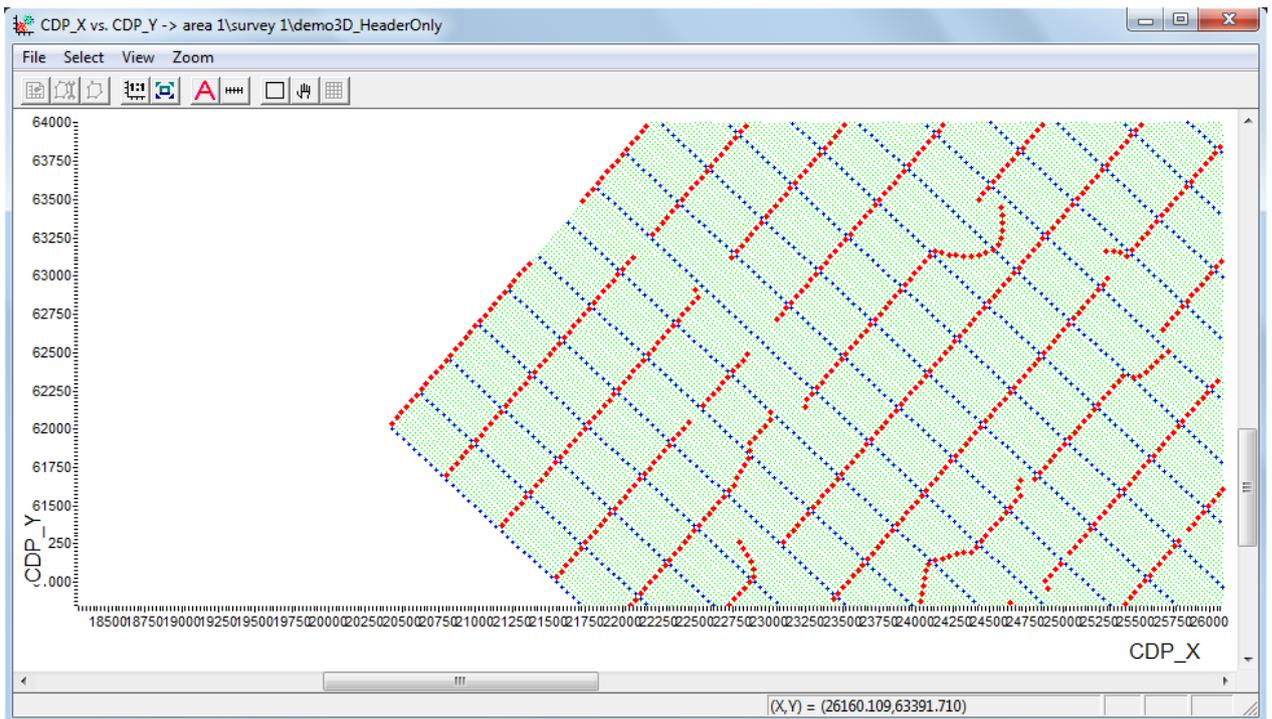
Press **OK** to view the result:



You can press the **1:1** button on the toolbar to display the entire map on the same X and Y scale:



To zoom into a map fragment, select any rectangular area on the screen with the left mouse button (hold down Ctrl while selecting to maintain the same X and Y scale when zooming in):

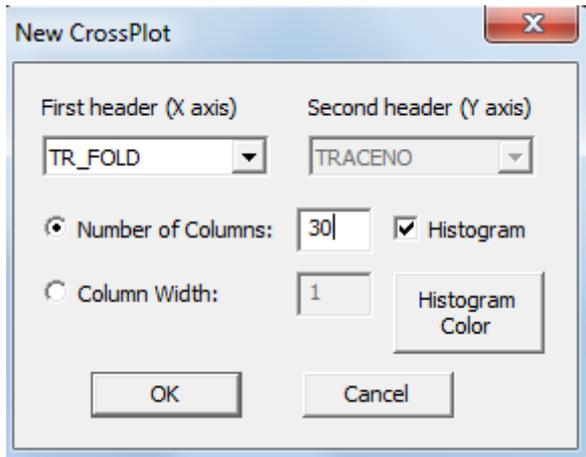


Total fold and offset sampling maps

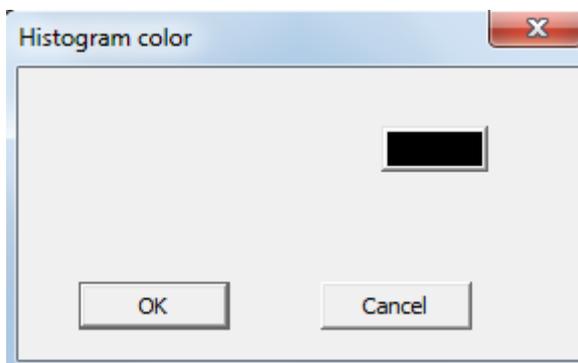
Let us build a total fold map highlighting the CDPs in different colors depending on the fold value stored in the TR_FOLD header field. To do this, we'll first need to create a TR_FOLD histogram.

Open the **CrossPlot Manager** window, press the **New crossplot** button, check the **Histogram** field in the dialog box (to indicate that you are going to create a histogram rather than a crossplot), select the

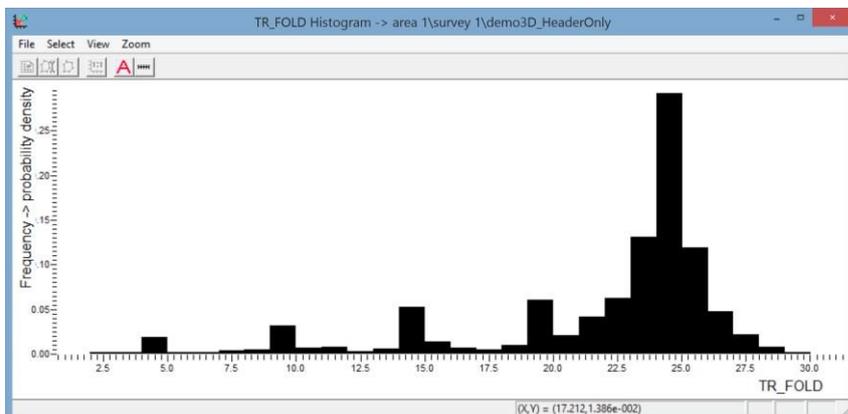
header to build the histogram from (TR_FOLD), and specify a reasonable number of histogram columns (for example, 30):



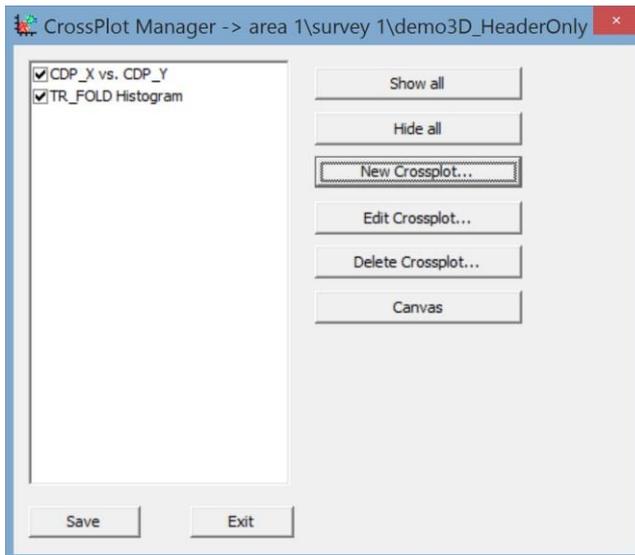
Press the **Histogram Color** button and select black as the histogram display color.



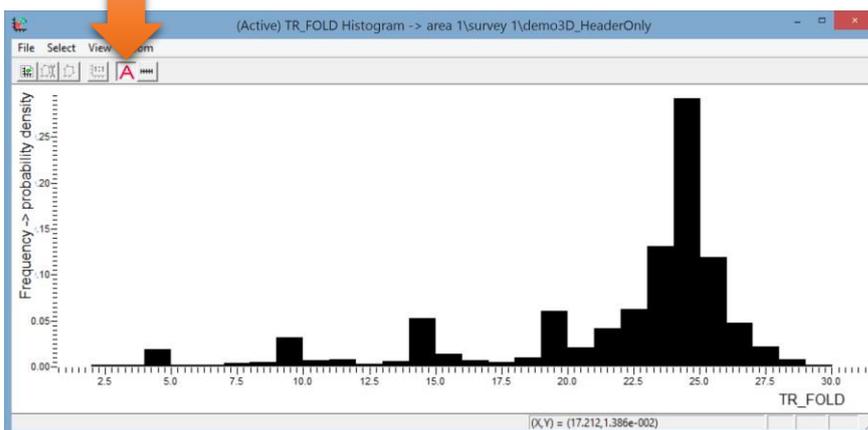
Press **OK** to close all dialog boxes and view the result – the fold histogram:



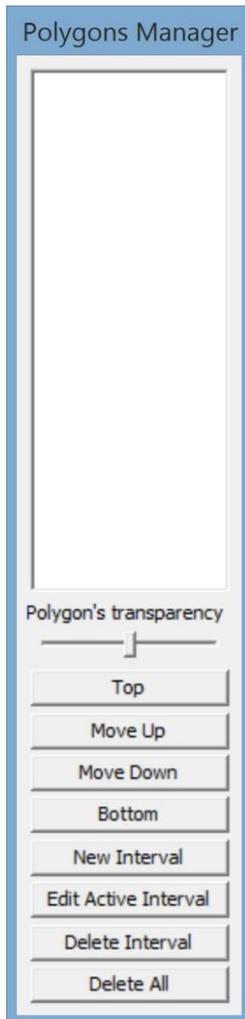
The histogram name should appear in the **CrossPlot Manager** list:



Now we need to split the histogram into ranges, assign a color to each one, and apply the resulting color scheme to the CDPs displayed on the previously created CDP_X vs CDP_Y crossplot. To do this, we'll first need to make the histogram "active" – an active histogram (or crossplot) in the module defines the point display colors for all other crossplots. Only one histogram/crossplot can be active at any given time. To make the fold histogram active, press the **A** button on the histogram toolbar.

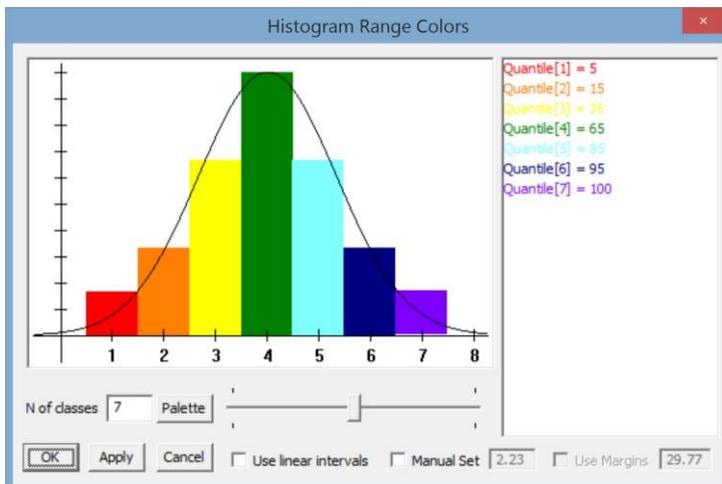


The **Polygons Manager** window will open on the right. It contains the histogram interval list (empty for now) as well as the control buttons.



Now let us define the intervals. This can be done manually, one by one (by pressing the **New interval** button and selecting the interval on the histogram with the mouse), but in this case it will be more practical to use the automatic interval generation function. To do this, select the **Select/Auto add intervals** menu command in the histogram window.

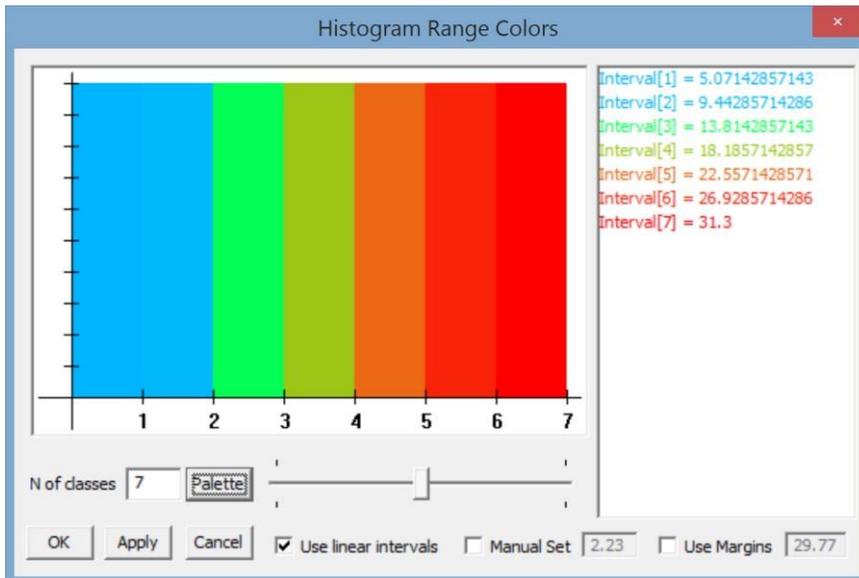
The automatic interval generation dialog box will open.



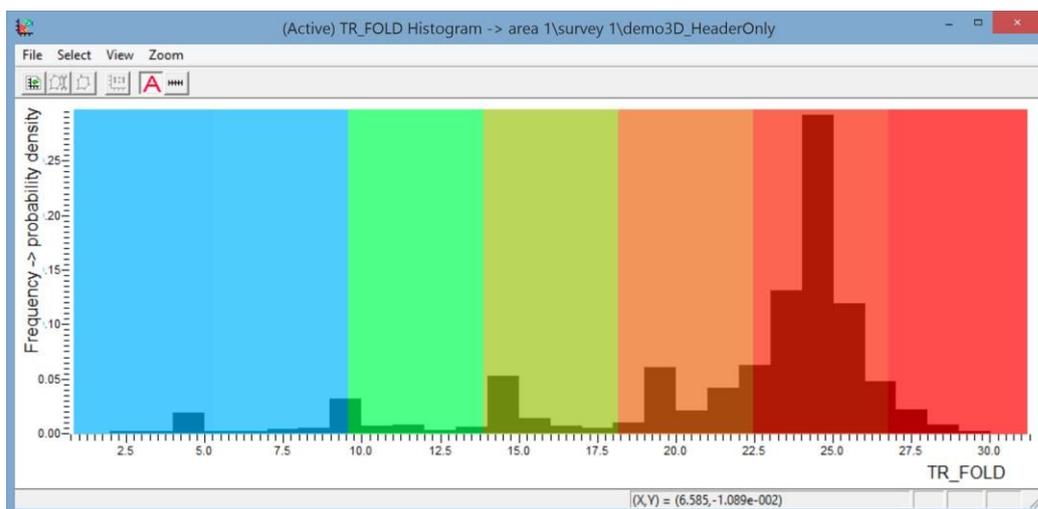
By default, the software splits the histogram into intervals by quantiles corresponding to the Gaussian distribution. However, in this case linear splitting into intervals of the same length would be more convenient. To do this, check the **Use linear intervals** box at the bottom of the dialog box.

Press the **Palette** button to select the color palette for the intervals. We suggest using the palette from the foldmap.pal file located in the root directory of the CrossPlotDemo project. Press **Load palette...** in the palette editing window and select the foldmap.pal containing the palette from the disk (of course, you can use any other palette, edit this one, or create your own).

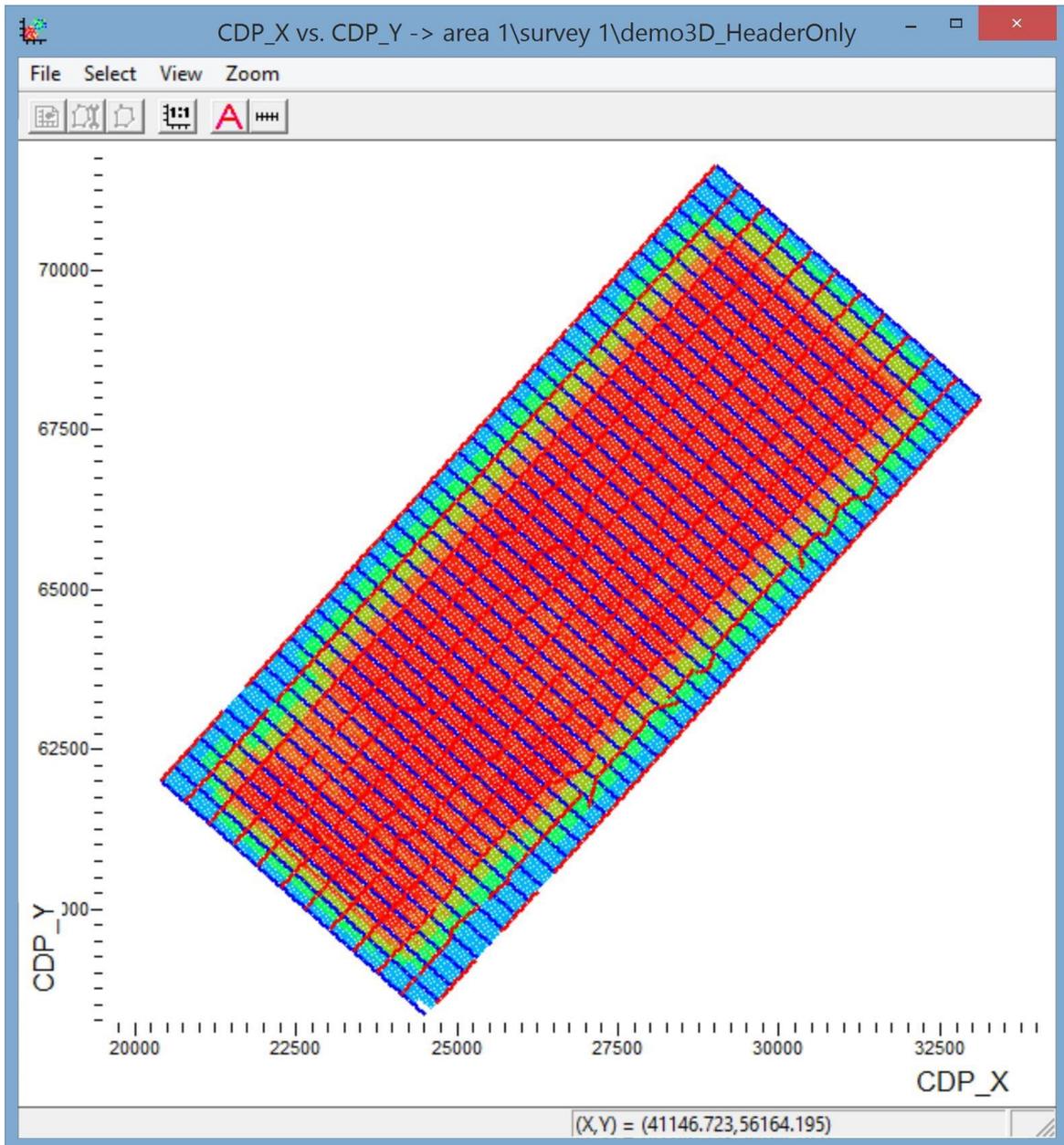
After you specify the linear split method and select the palette, the automatic interval generation dialog box should look like this:



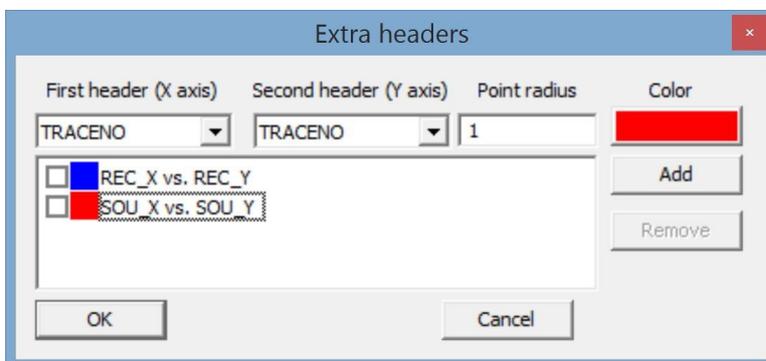
The right limit values for each interval are listed on the right. Press **OK** to view the intervals added to the histogram:



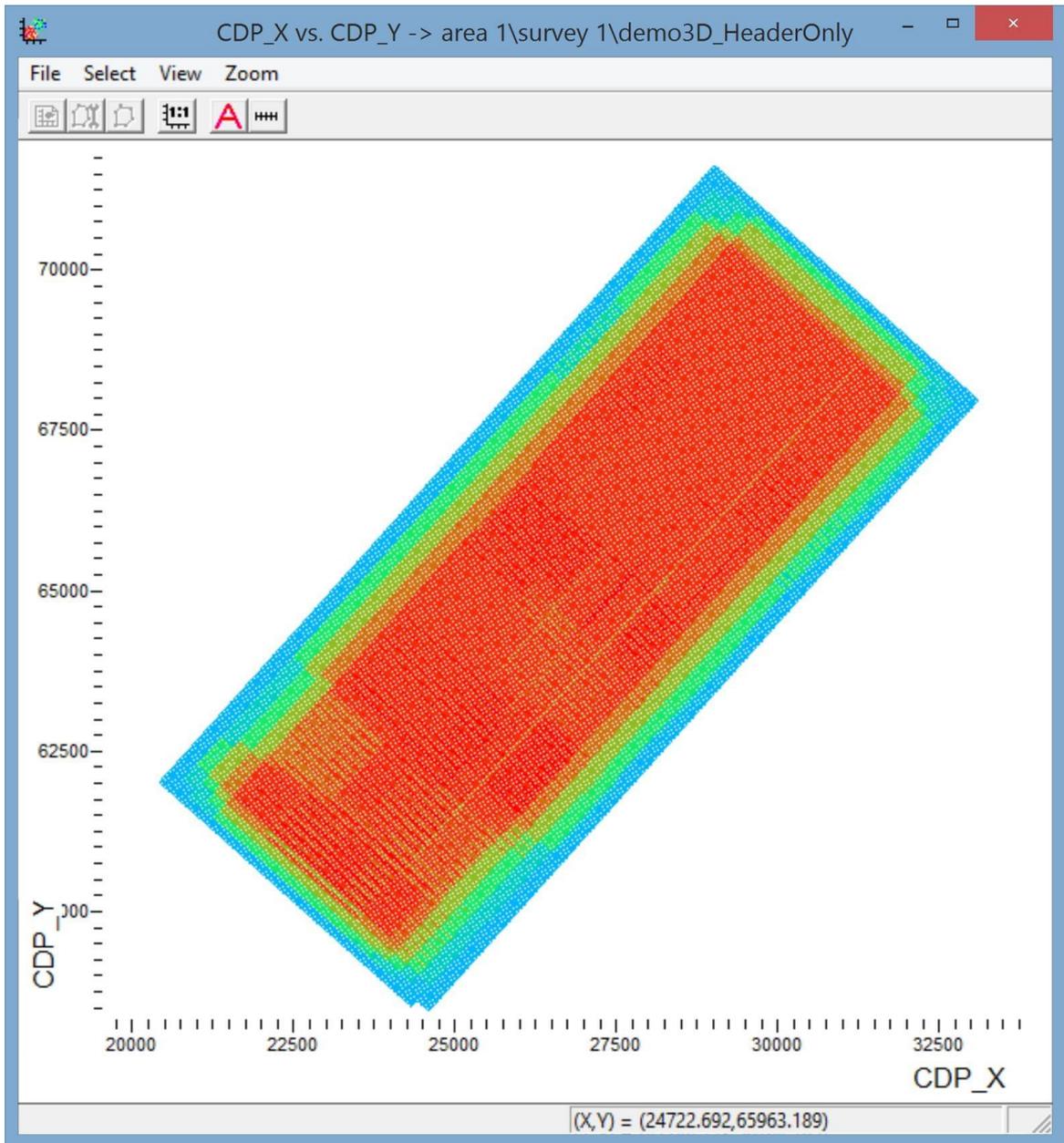
Now let us switch to the shooting configuration map – you can see that the CDPs are now colored according to their fold values:



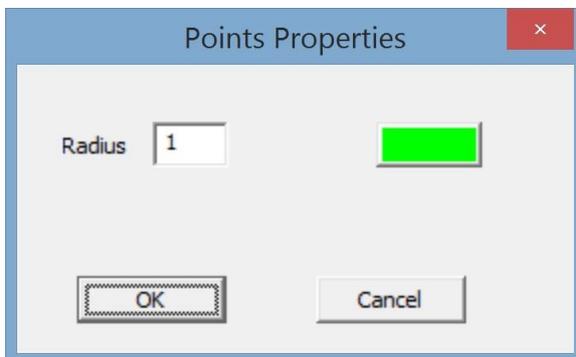
Finally, we should disable the SPs and RPs which are no longer needed. Open the **Extra headers** dialog box and uncheck the additional crossplots:



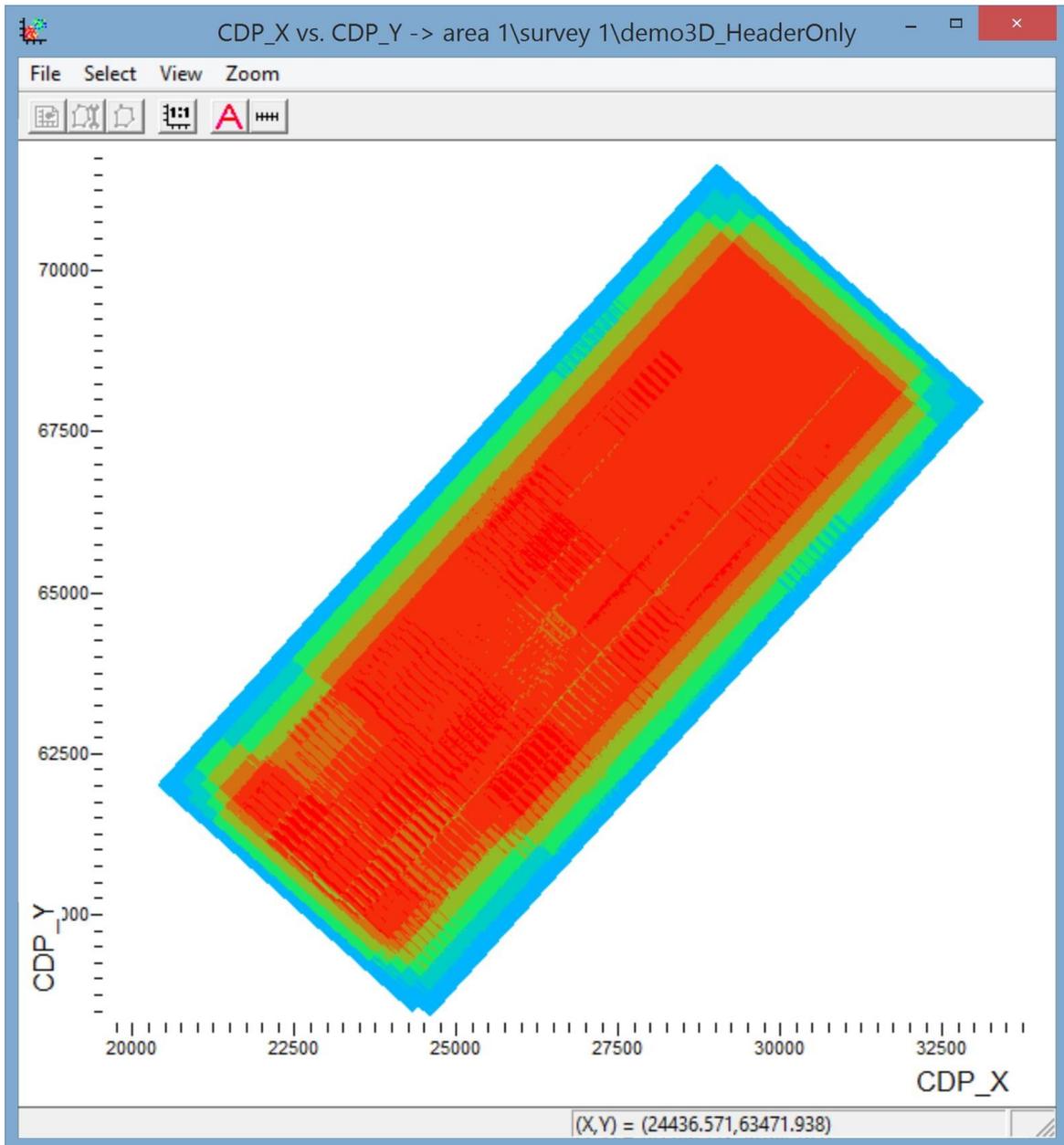
The result is shown below:



To get rid of the “ripple” pattern, let us increase the CDP display size. To do this, open the **View/Point properties** menu and specify the point radius of 1:

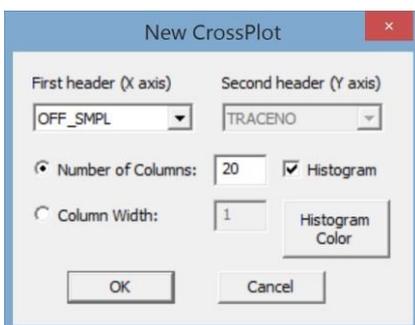


Now the total fold map should look like this:

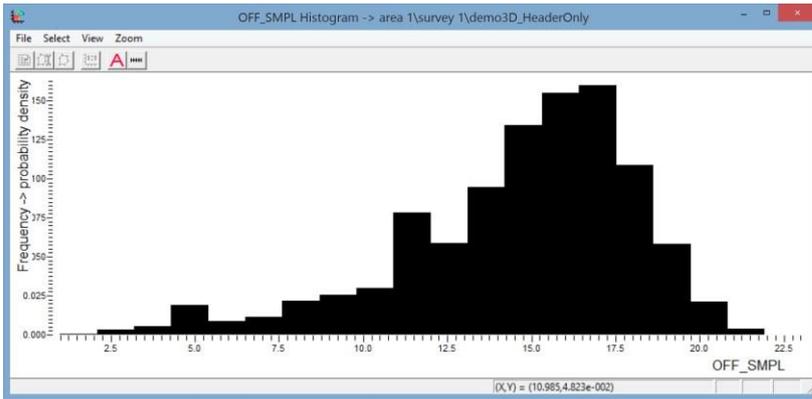


The next step is to build an offset sampling map (here offset sampling is the number of different offset bins in each CDP bin; it is directly related to the appearance of footprints).

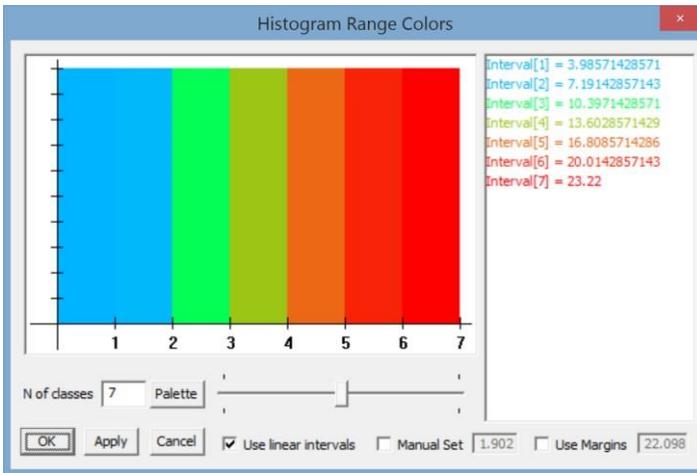
The offset sampling values are stored in the OFF_SMPL header. Therefore, we need to build a histogram from this header. The procedure is the same as for the total fold histogram:



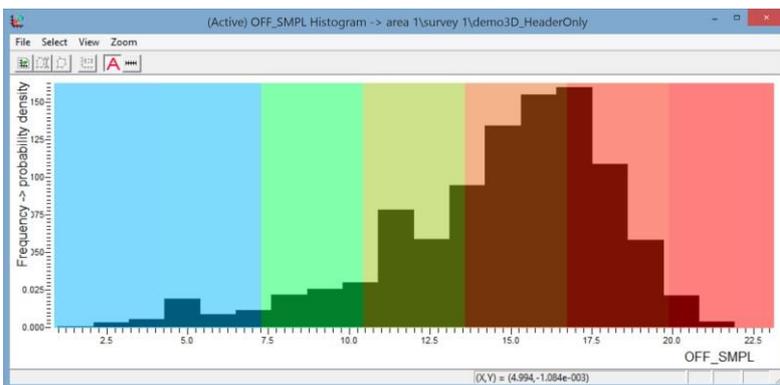
The resulting histogram is shown below:



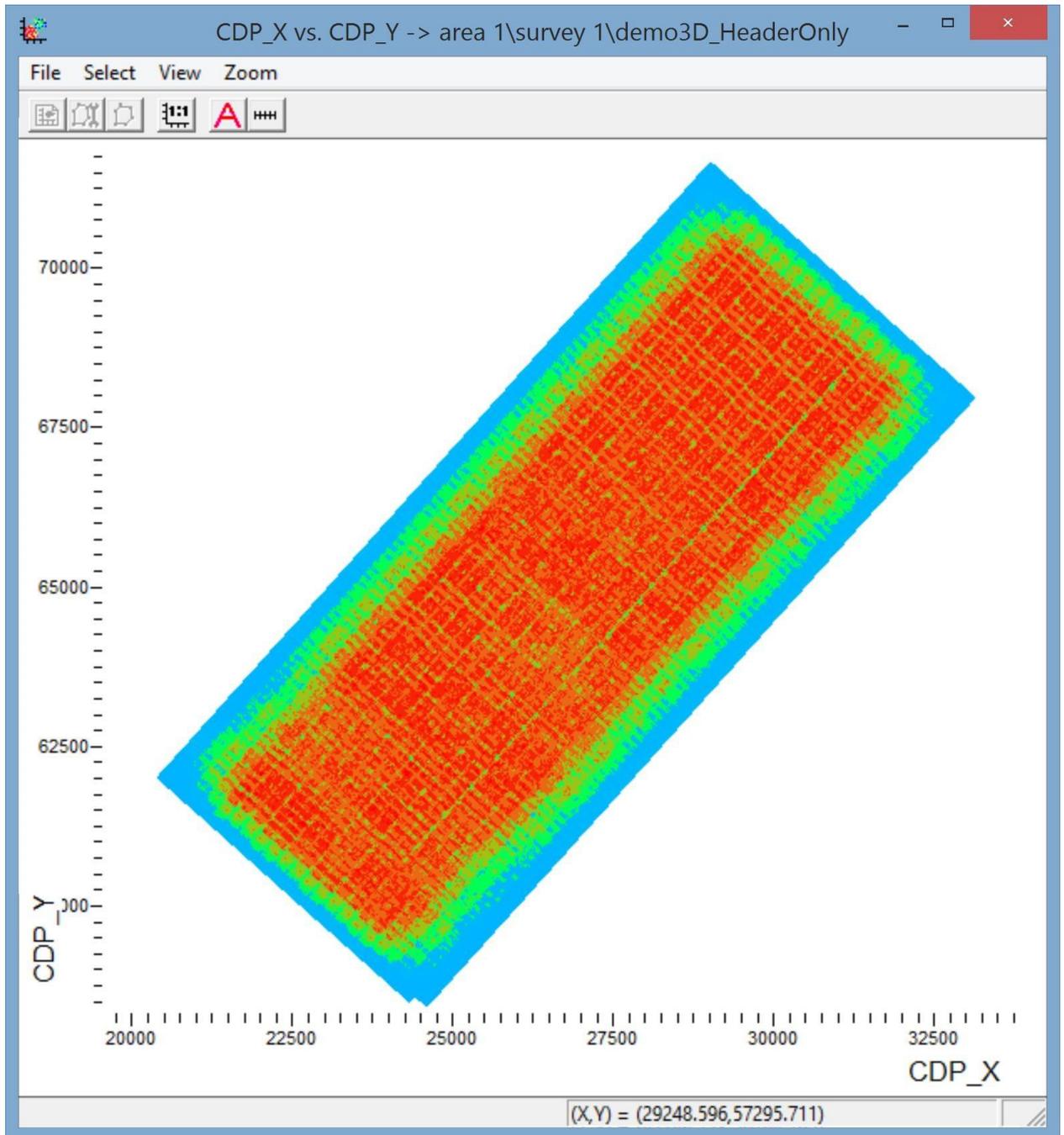
Let us make this histogram active and split it into intervals (using the same parameters and the same palette):



This is how it looks on the histogram:



And this is how the CDP_X vs CDP_Y crossplot looks – now it is the offset sampling map:

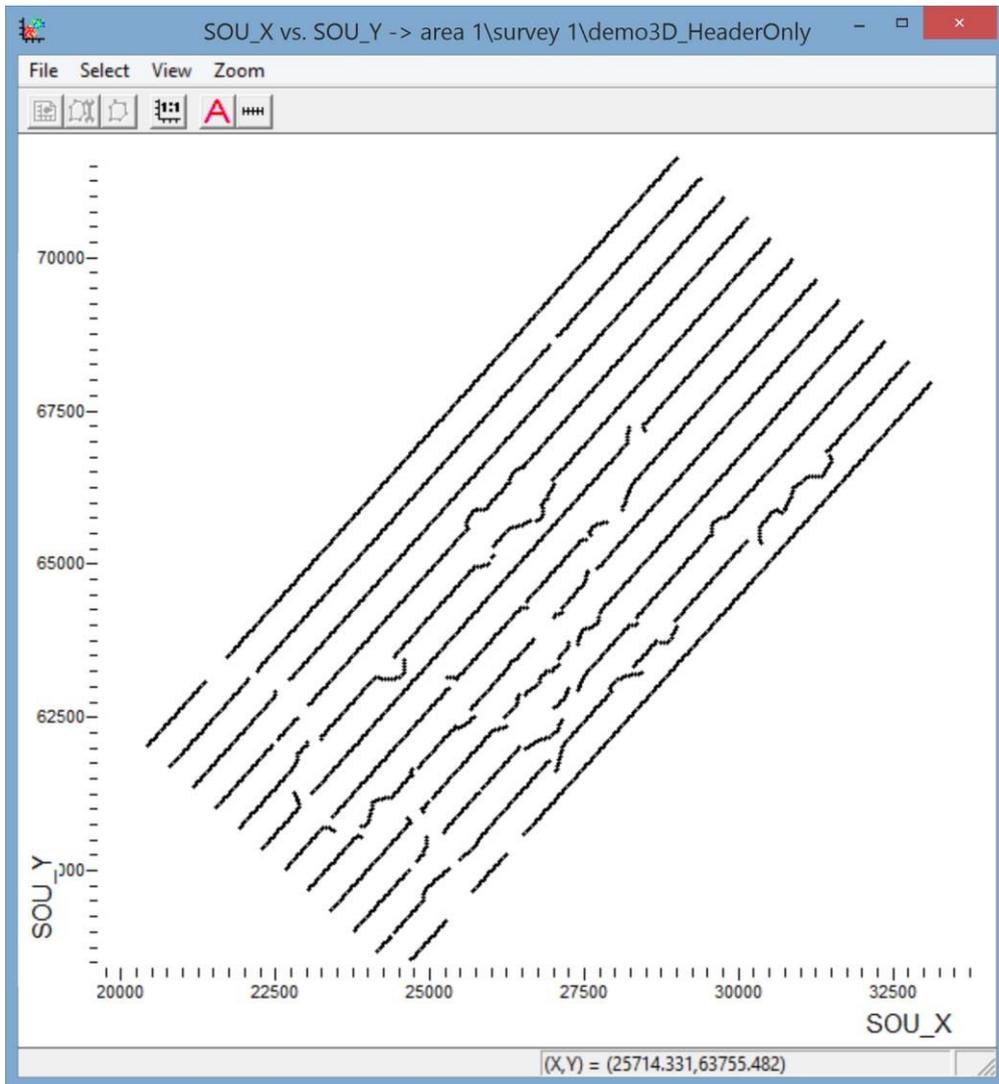
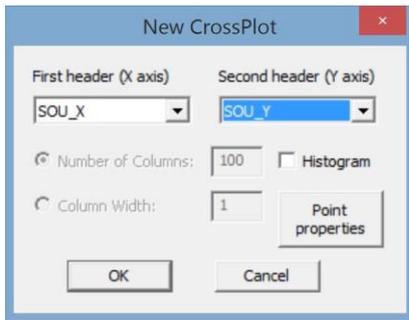


Now that we have two histograms each of which is split into intervals, we can make them active alternately. The colors on the CDP crossplot will correspond either to the total fold or to the offset sampling, depending on the active histogram.

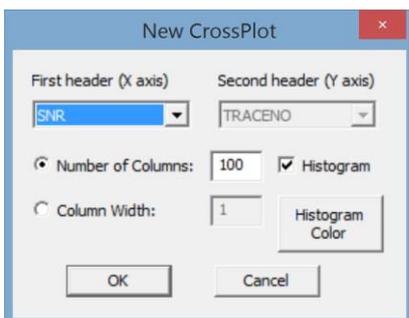
Signal-to-noise ratio map

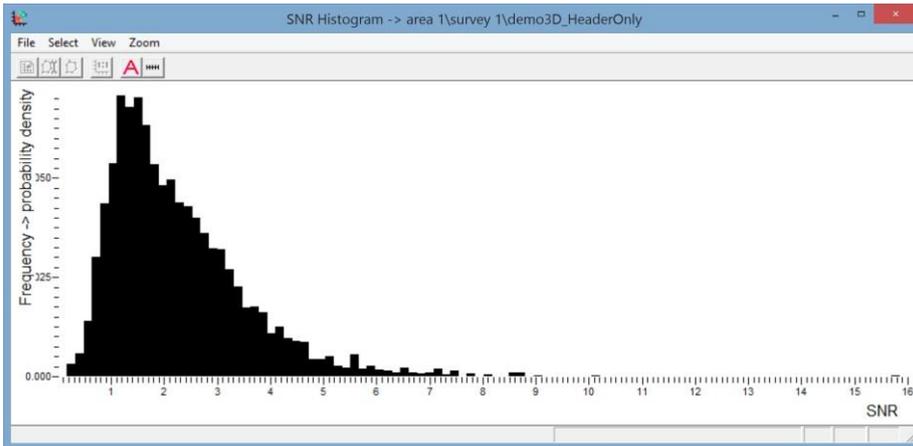
The SNR header field in our dataset contains the signal-to-noise values computed for each shot as the ratio of the RMS amplitude in the target reflection window (AMP header) to the RMS amplitude in the microseism window (AMP_N header). Let us build a map showing the areal distribution of the signal-to-noise values.

For this, we'll first need to create a basis for such a map – an SP crossplot. Let us create the new SOU_X vs SOU_Y crossplot:

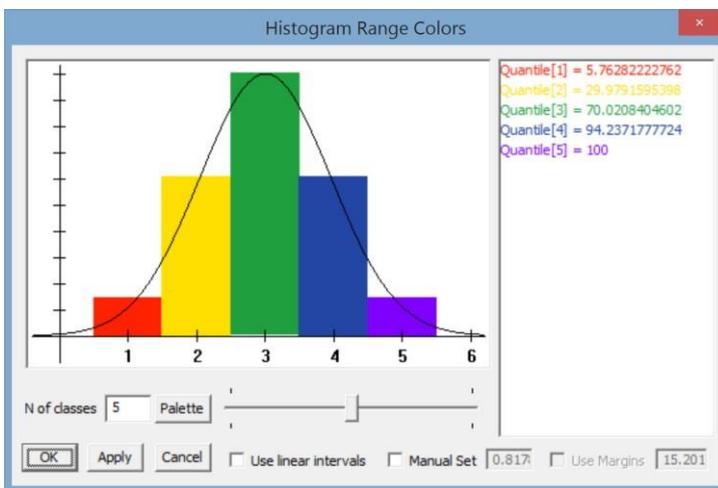


Now let us create the signal-to-noise ratio histogram:

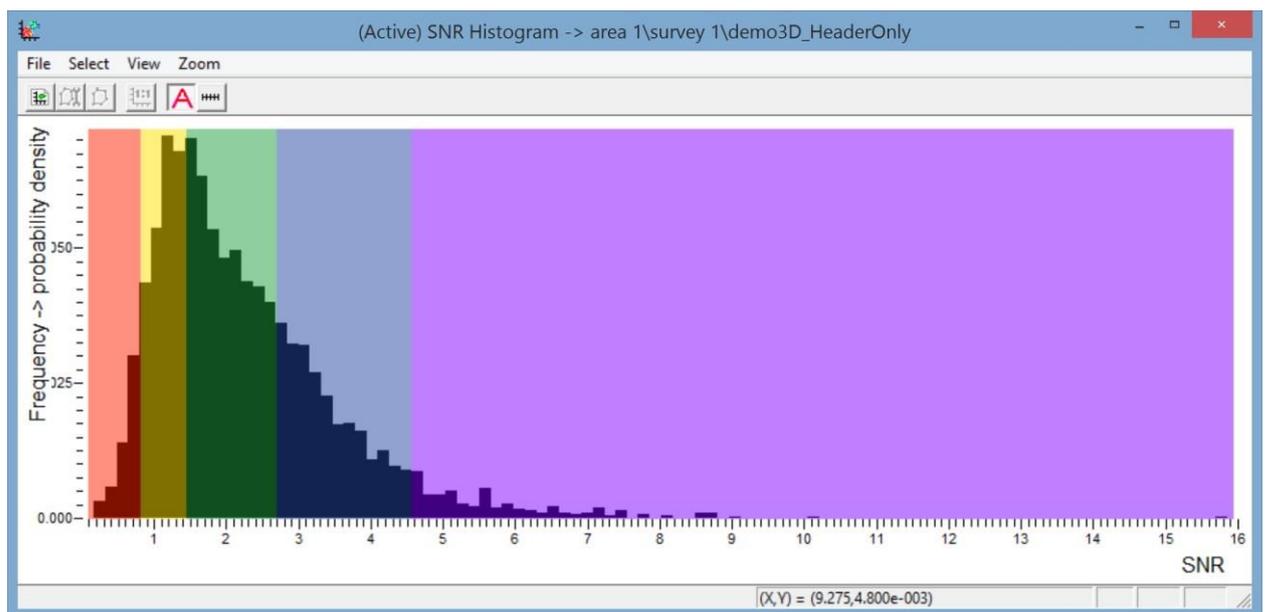




Let us make it active and split it into intervals. This time we'll use the default quantile-based splitting as well as the default palette. The number of intervals will be reduced to 5:



The Quantile[1] interval will correspond to the lowest (i.e. worst, in our case) 5.76% of the signal-to-noise values; together with the Quantile[2] interval, they will cover the worst 30% of the values, together with the Quantile[3] interval – the worst 70% of the values etc. The split looks like this on the histogram:



And this is how the SP map colored according to the signal-to-noise values looks:

