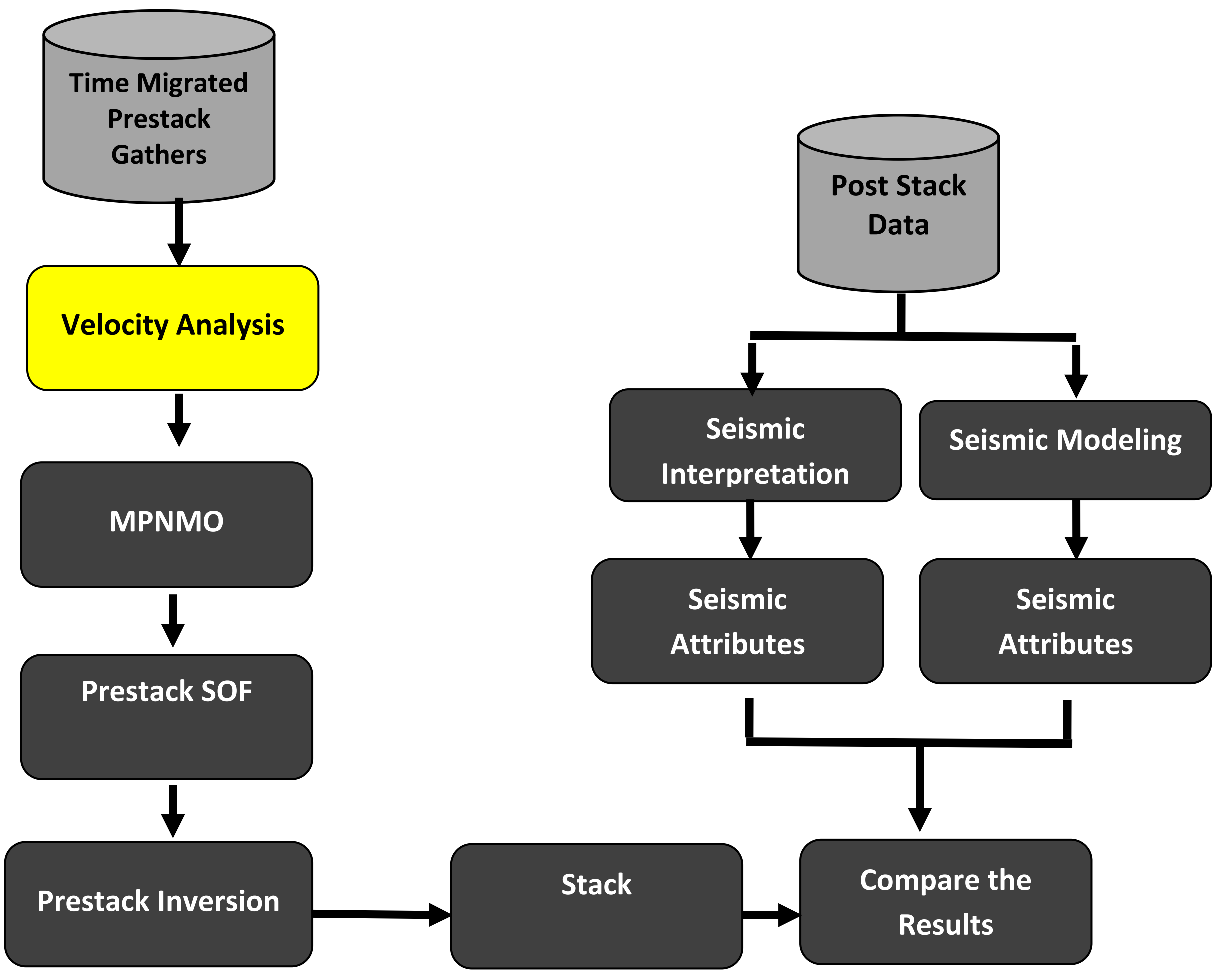
INTERACTIVE VELOCITY ANALYSIS (AASPI_IVA) – PROGRAM
Precompute Velocity Semblance
Interactive Velocity Analysis
Velocity Interpolation

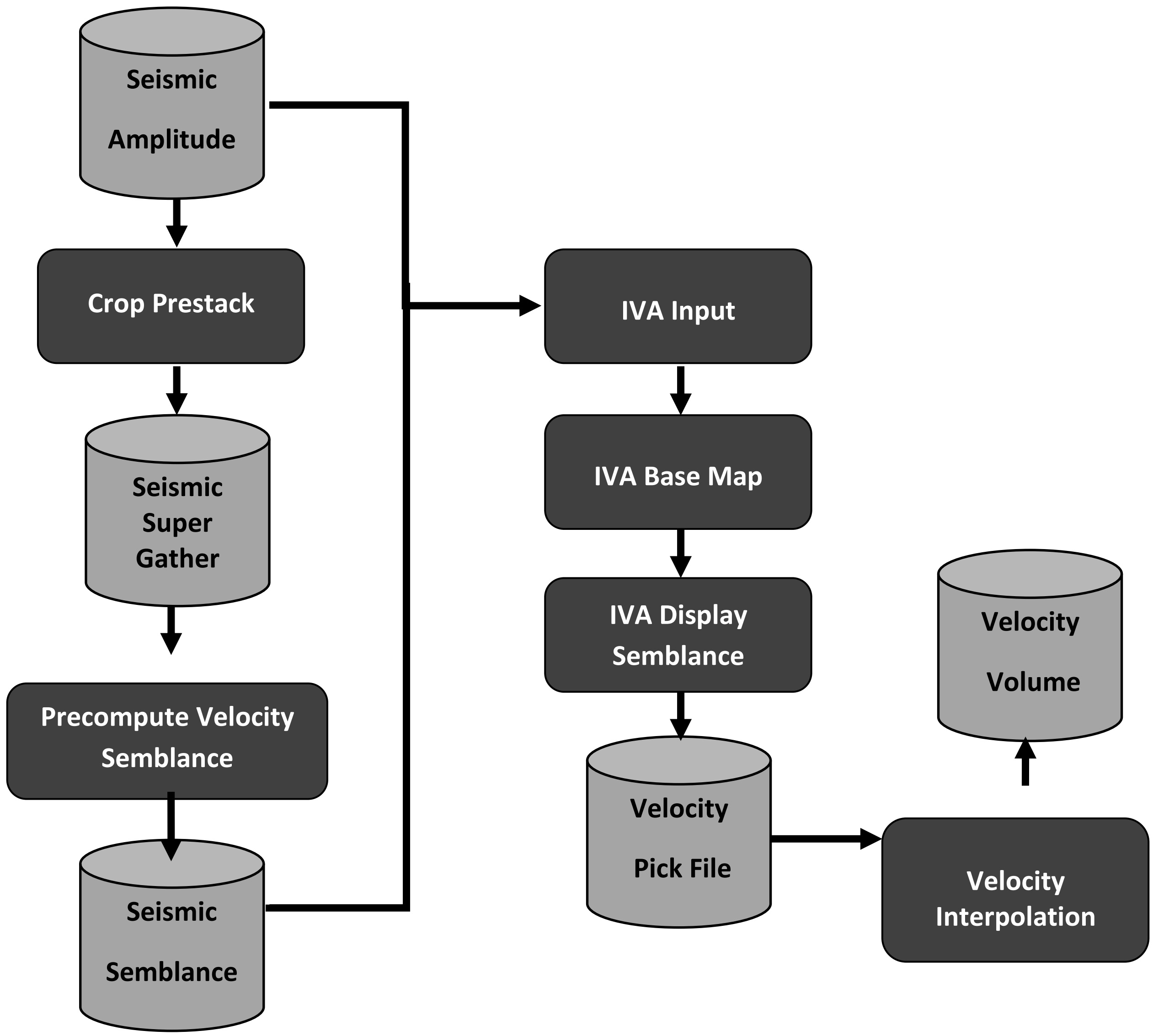
Contents

Computational Flowchart

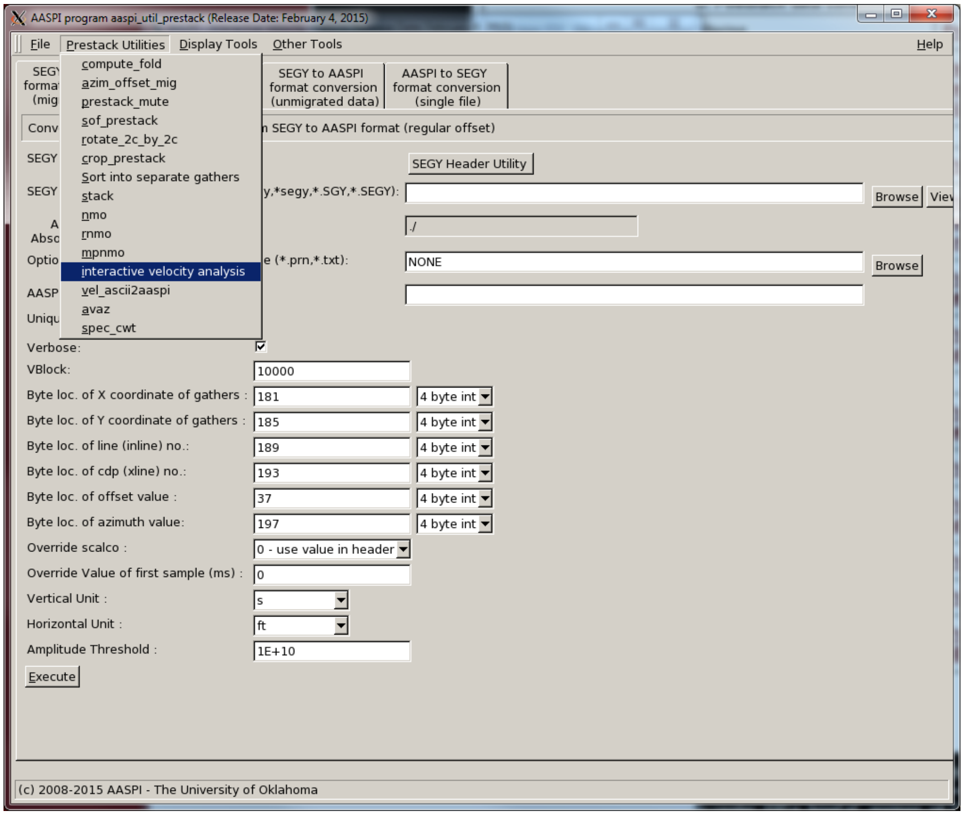


<u>Here, in this section we are performing Velocity analysis</u>

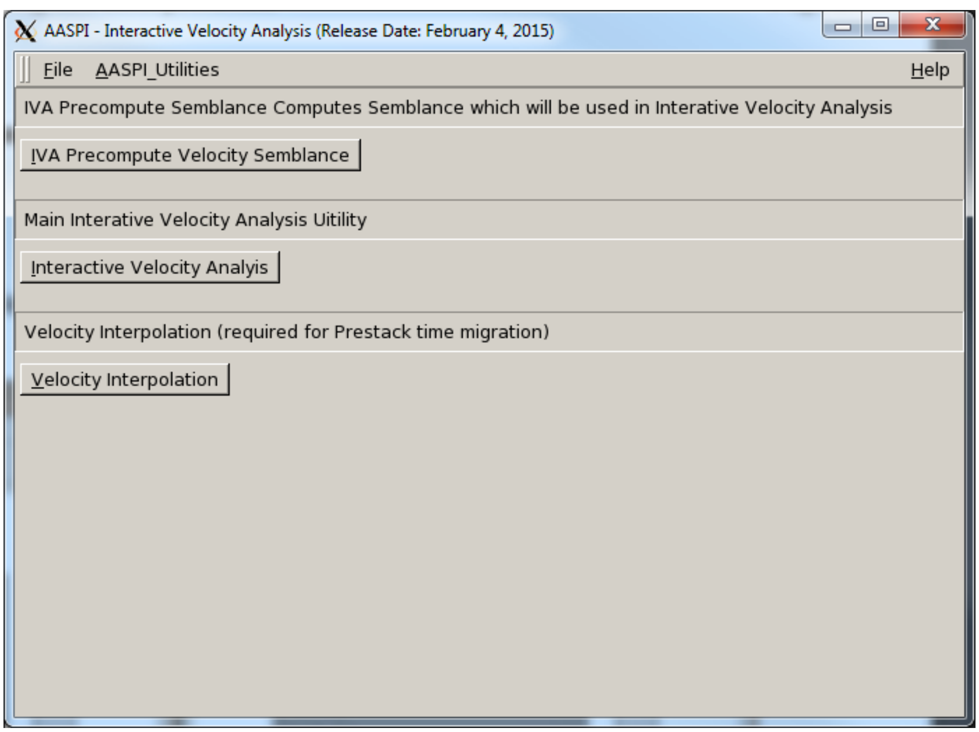
Flowchart for Interactive velocity



There are three main utilities in IVA or Interactive velocity analysis, 1. Precompute velocity semblance, 2. Interactive velocity analysis, and 3. Velocity Interpolation. You can launch interactive velocity analysis by selecting **interactive velocity analysis** <u>(see the next image on the following page)</u> on the aaspi prestack utility or by typing **aaspi_iva** on the terminal window.



This will display window as seen in the following:

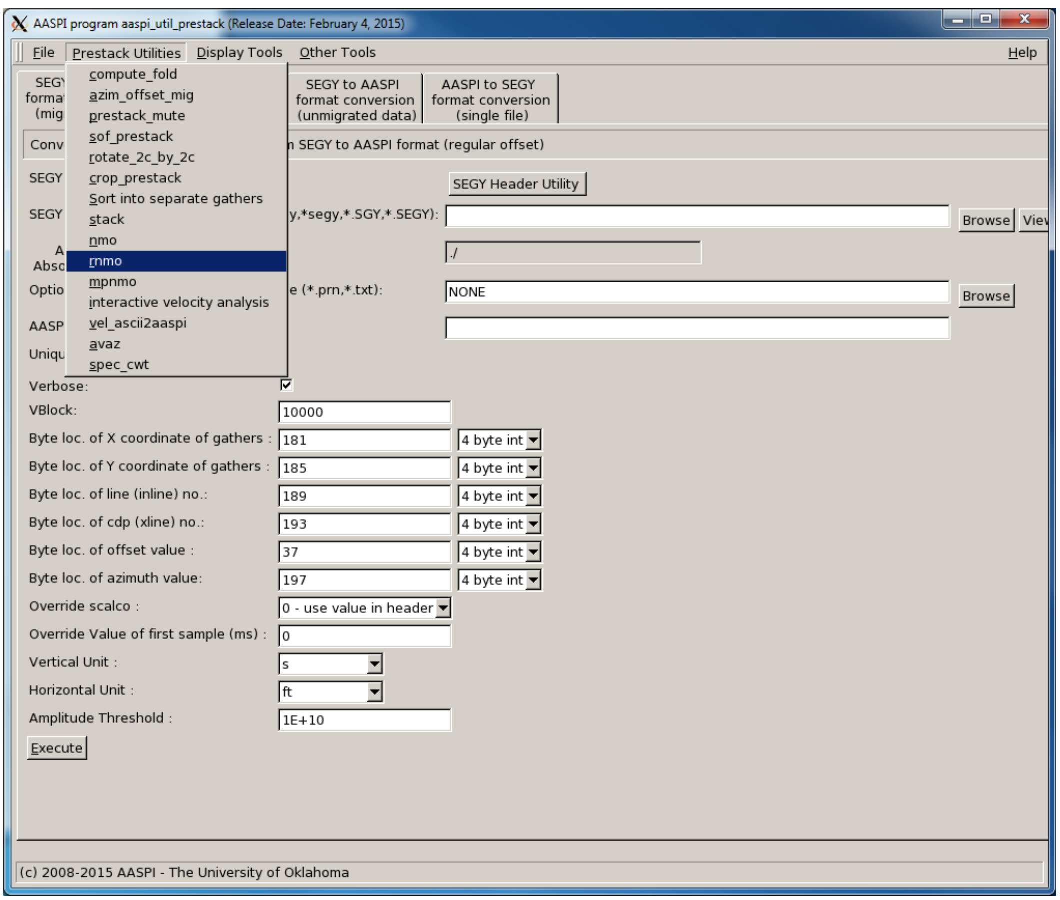


Data preparation for Program Velocity Semblance

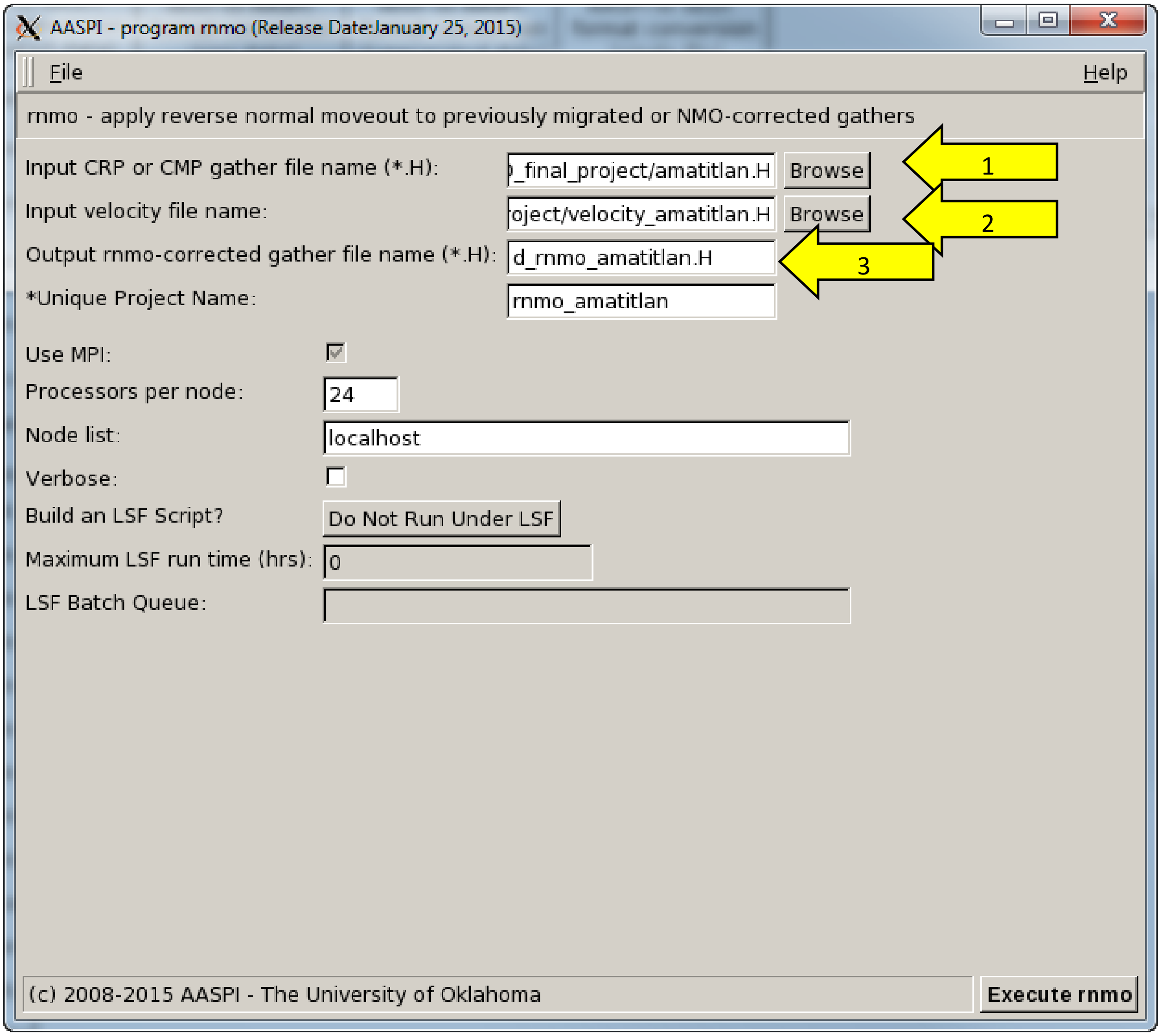
Although this tool is capable of doing velocity analysis on any data set, this utility is mostly used for generating velocity to do Non-stretch NMO by a program called **mpnmo.** In general, we perform **mpnmo** after prestack time migration, and the output of PSTM is a NMO corrected data. Therefore, we apply reverse NMO before doing the velocity analysis.

Program rnmo (Reverse NMO)

Our utility **rnmo** or reverse normal move out removes the NMO effect. The program **rnmo** can be found in the *Prestack Utilities* tab or can be initiated by typing **aaspi_rnmo** on the Linux terminal window. This utility is also descibed in mpnmo document.



Upon selecting **rnmo** the ensuing window will appear:



Click (1) *Browse,* and select *amatitlan.H* for your input seismic data. This should be a 4D migrated volume. You will also need to (2) select a velocity file for performing **rnmo.** In our case we used *velocity_amatitlan.H.* Next (3) give the d_rnmo volume an output file name ending in **.H, d_rnmo_amatitlan.H,* and select *Execute.* The results will be a reverse normal out migrated volume as observed in the image on the next page.

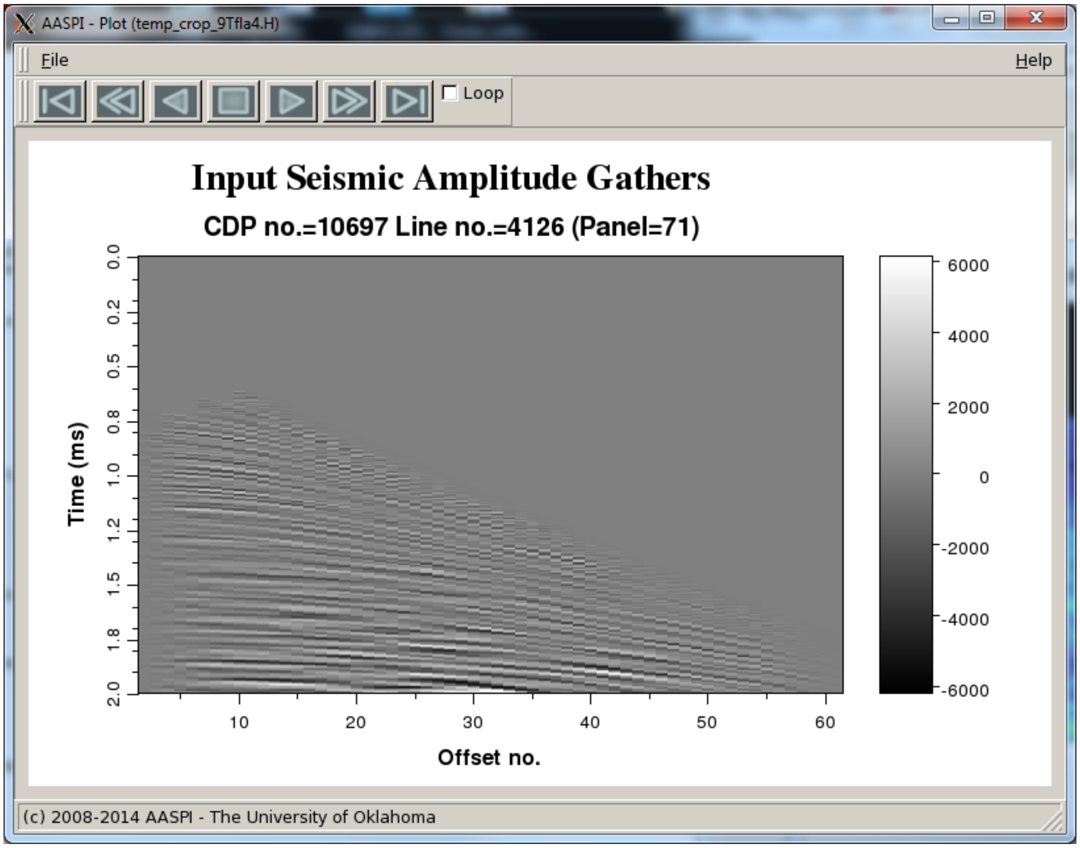
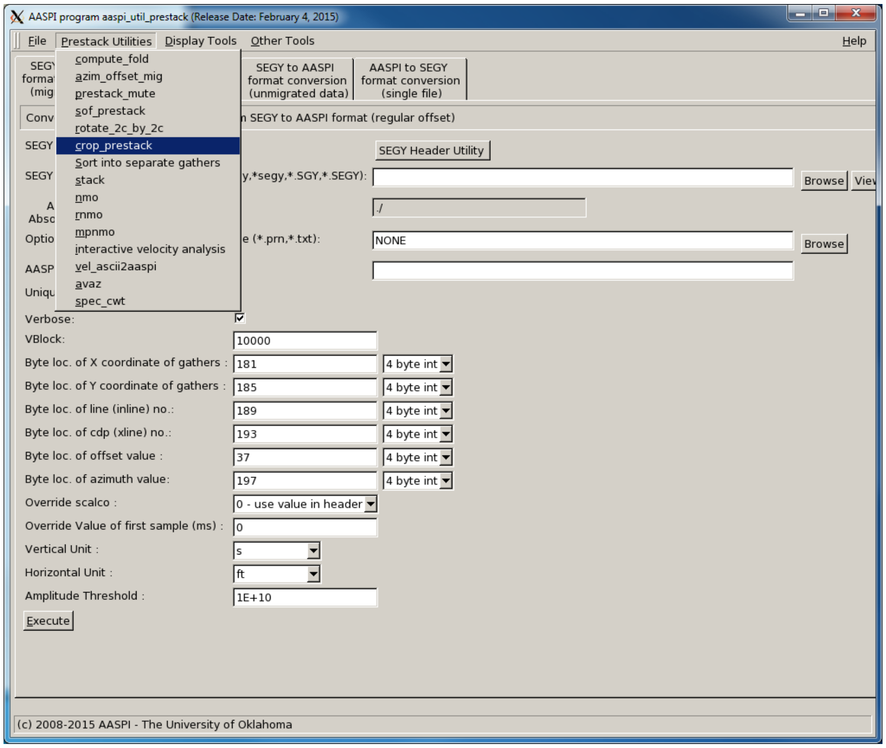


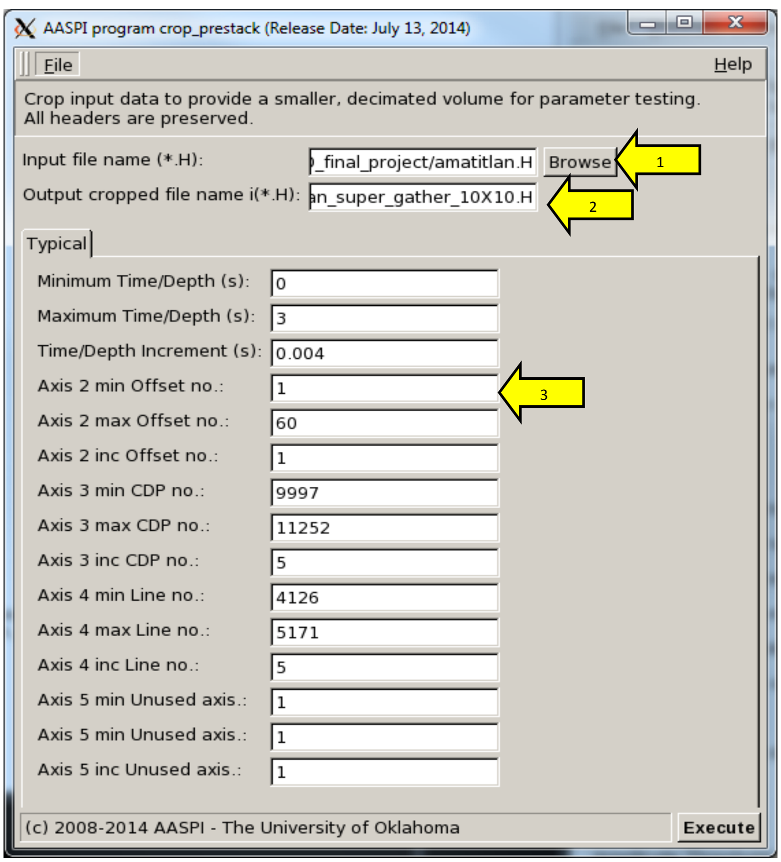
Figure 1. *d_rnmo_amatitlan.H*

Forming a supergather

The first step after we have our rnmo data is to create a super gather using **crop prestack**, which is found under the *Prestack Utilities tab*:



Upon selecting **crop_prestack** the ensuing window will appear:



Click (1) *Browse,* and select *d_rnmo_ amatitlan.H* for your input seismic data. This should be a 4D reverse normal moveout migrated volume. Next (2) give the cropped volume an output file name, in our case*, d_rnmo_amatitlan_super_gather_10X10.H.* Check that the (3) time, offset, CDP and Line values are correct for your survey. The results will be a supergather of your reverse normal out migrated volume (shown below), in which we can carry out semblance and IVA.

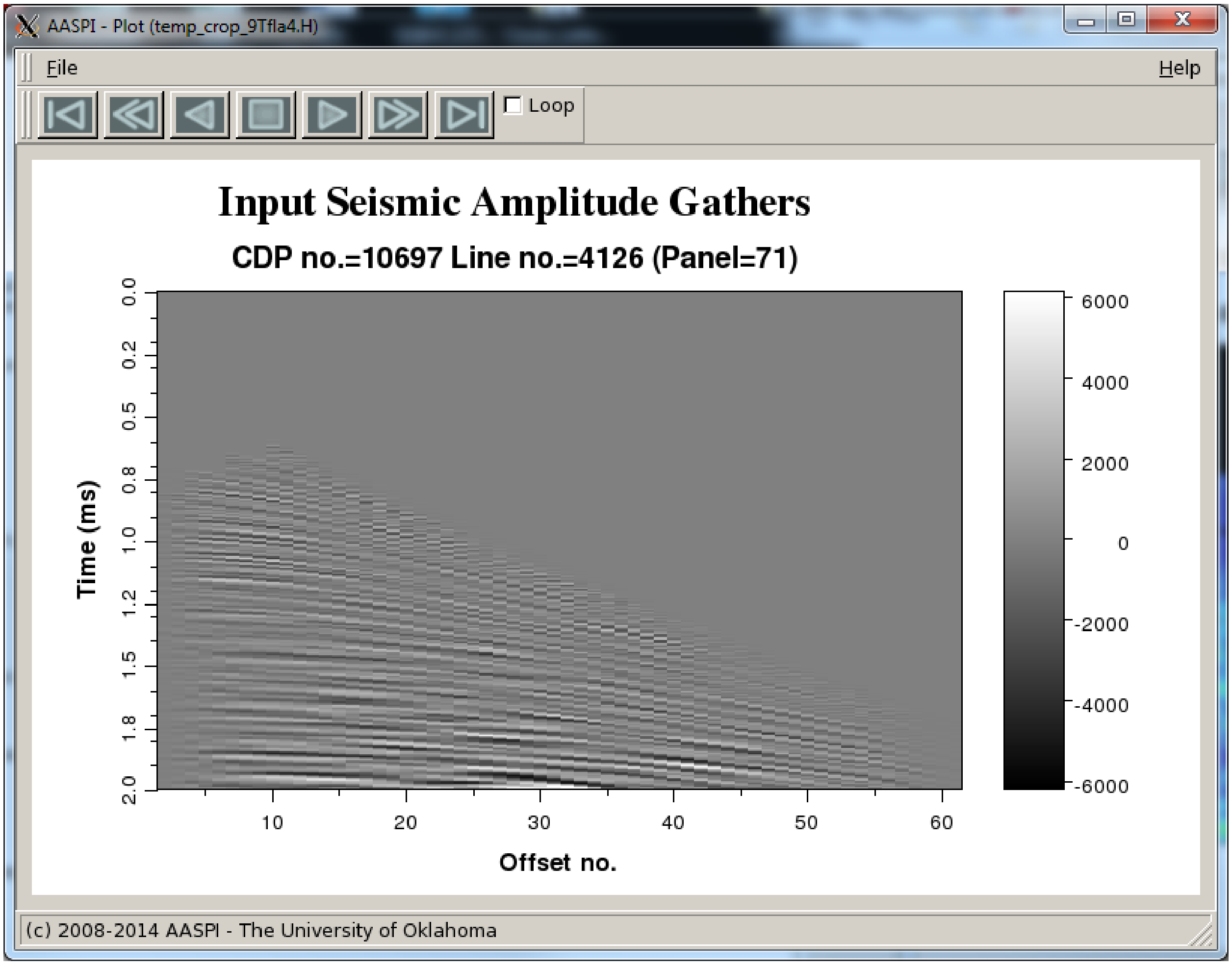
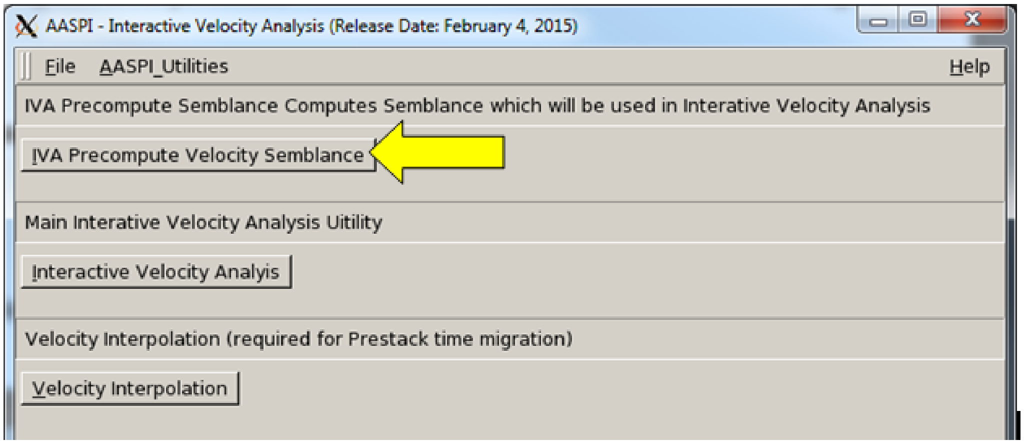
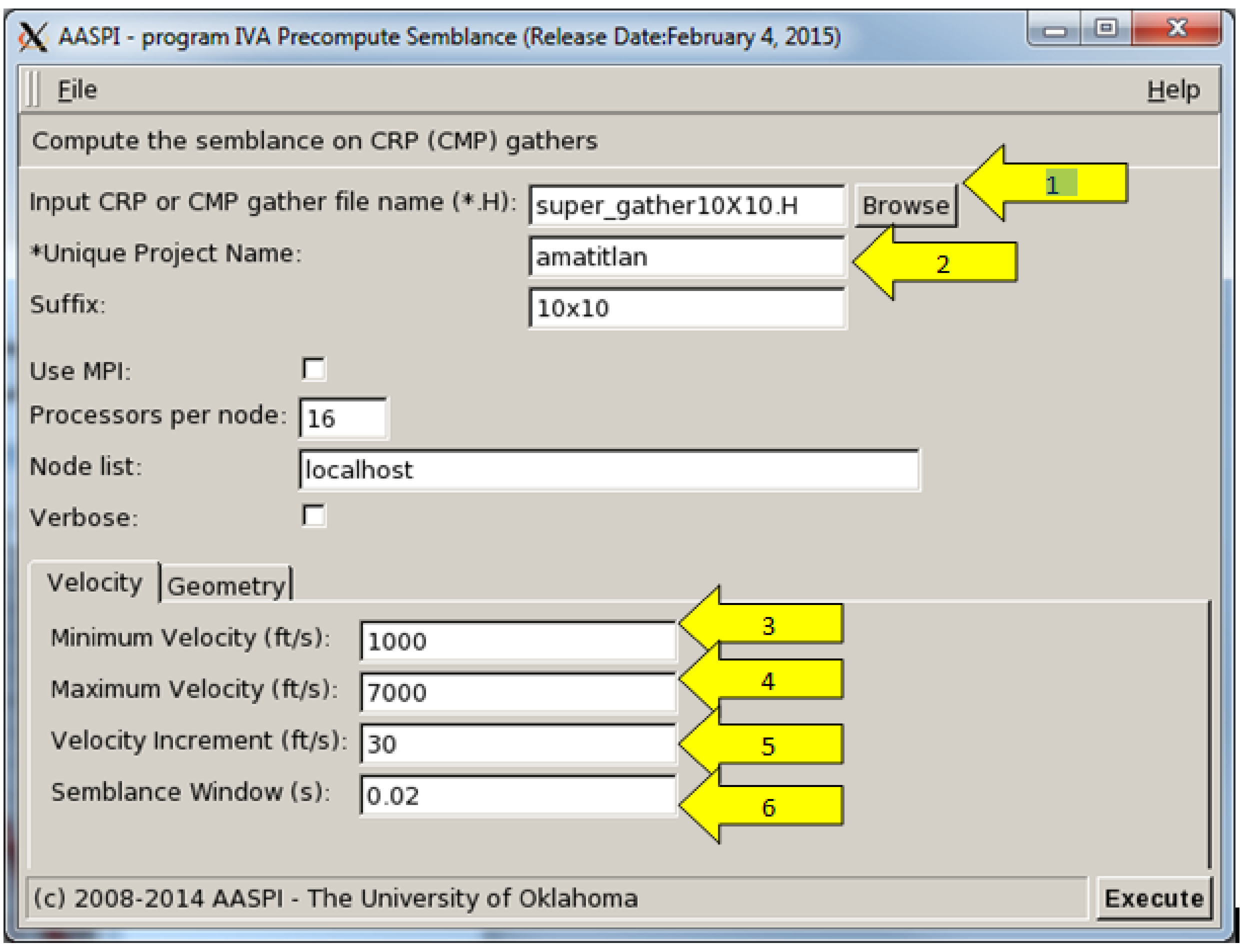


Figure 2. *d_rnmo_amatitlan_super_gather_10X10.H*

Program **IVA Precompute Velocity Semblance** is first utility on IVA, you can also initiate the utility by typing **aaspi_iva_precompute_semblance** on the terminal window:



Upon selecting the ensuing window will appear:

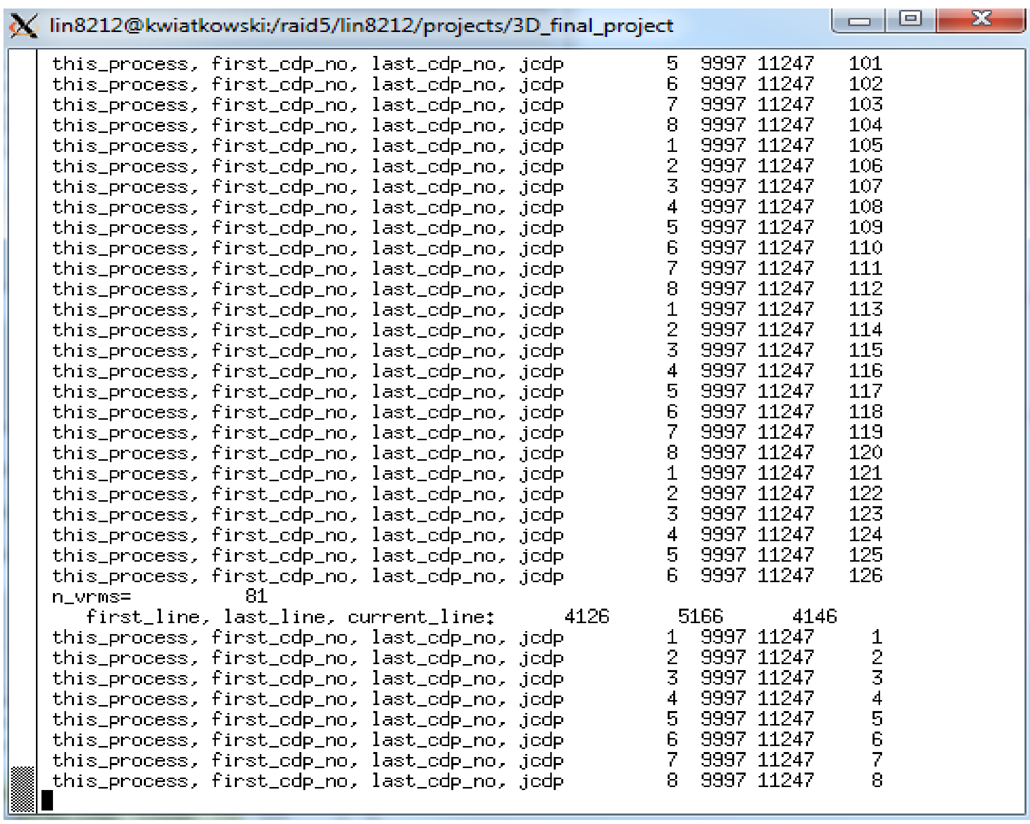


Click (1) *Browse* to select your seismic amplitude volume; for our example we have *amatitlan_super_gather_10X10.H.* Next, (2) give the project a *Unique Project Name* and *Suffix*. We chose *amatitlan* and *10X10* respectively.

Next, the user can define parameters under the Velocity tab. The (3) Minimum Velocity, (4) Maximum Velocity, (5) Velocity Increment and (6) Semblance window were set to 1000, 7000 and 30m/s and 0.02s in our example. Parameters (3) and (4) are chosen by considering the velocity range of your seismic data. Parameter (5) can be increased to minimize computation time.

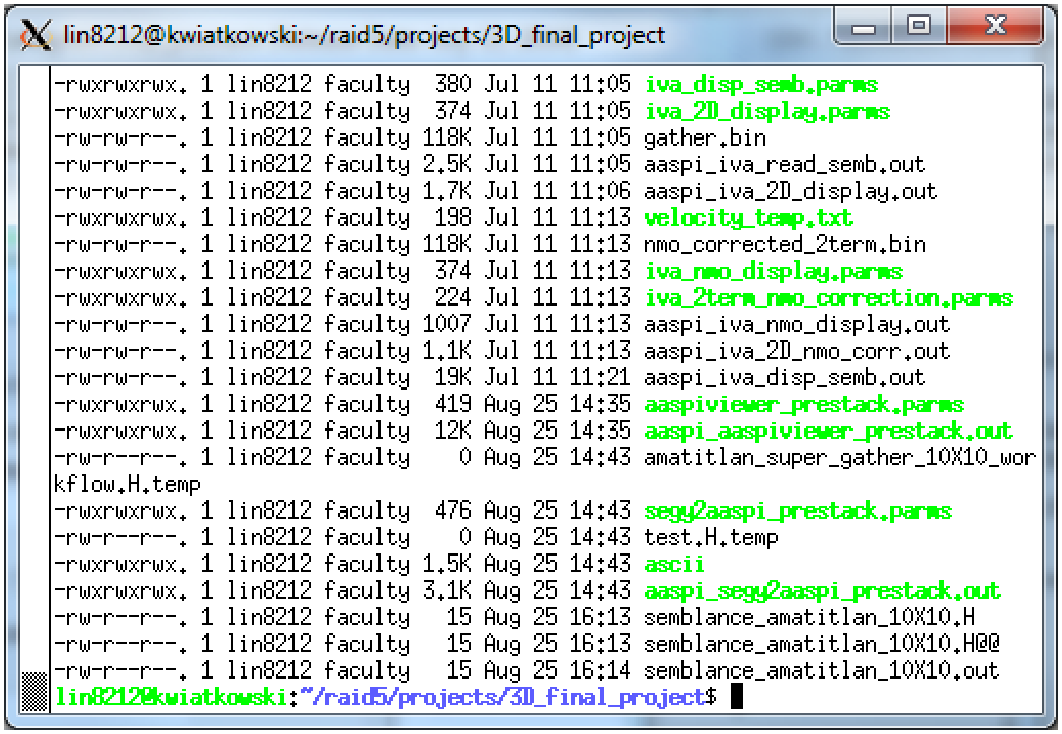
The Geometry tab will allow the user to inspect the geometry of the survey; however, no parameters can be changed in this window.

As in all AASPI codes, program progress is echoed to the *xterm* from which **aaspi_util_prestack** was launched. The end of the print-out looks like the following image:



```
lin8212@kwiatkowski:/raid5/lin8212/projects/3D_final_project
this_process, first_cdp_no, last_cdp_no, jcdp          5  9997 11247   101
this_process, first_cdp_no, last_cdp_no, jcdp          6  9997 11247   102
this_process, first_cdp_no, last_cdp_no, jcdp          7  9997 11247   103
this_process, first_cdp_no, last_cdp_no, jcdp          8  9997 11247   104
this_process, first_cdp_no, last_cdp_no, jcdp          1  9997 11247   105
this_process, first_cdp_no, last_cdp_no, jcdp          2  9997 11247   106
this_process, first_cdp_no, last_cdp_no, jcdp          3  9997 11247   107
this_process, first_cdp_no, last_cdp_no, jcdp          4  9997 11247   108
this_process, first_cdp_no, last_cdp_no, jcdp          5  9997 11247   109
this_process, first_cdp_no, last_cdp_no, jcdp          6  9997 11247   110
this_process, first_cdp_no, last_cdp_no, jcdp          7  9997 11247   111
this_process, first_cdp_no, last_cdp_no, jcdp          8  9997 11247   112
this_process, first_cdp_no, last_cdp_no, jcdp          1  9997 11247   113
this_process, first_cdp_no, last_cdp_no, jcdp          2  9997 11247   114
this_process, first_cdp_no, last_cdp_no, jcdp          3  9997 11247   115
this_process, first_cdp_no, last_cdp_no, jcdp          4  9997 11247   116
this_process, first_cdp_no, last_cdp_no, jcdp          5  9997 11247   117
this_process, first_cdp_no, last_cdp_no, jcdp          6  9997 11247   118
this_process, first_cdp_no, last_cdp_no, jcdp          7  9997 11247   119
this_process, first_cdp_no, last_cdp_no, jcdp          8  9997 11247   120
this_process, first_cdp_no, last_cdp_no, jcdp          1  9997 11247   121
this_process, first_cdp_no, last_cdp_no, jcdp          2  9997 11247   122
this_process, first_cdp_no, last_cdp_no, jcdp          3  9997 11247   123
this_process, first_cdp_no, last_cdp_no, jcdp          4  9997 11247   124
this_process, first_cdp_no, last_cdp_no, jcdp          5  9997 11247   125
this_process, first_cdp_no, last_cdp_no, jcdp          6  9997 11247   126
n_vrms=          81
   first_line, last_line, current_line:      4126      5166      4146
this_process, first_cdp_no, last_cdp_no, jcdp          1  9997 11247     1
this_process, first_cdp_no, last_cdp_no, jcdp          2  9997 11247     2
this_process, first_cdp_no, last_cdp_no, jcdp          3  9997 11247     3
this_process, first_cdp_no, last_cdp_no, jcdp          4  9997 11247     4
this_process, first_cdp_no, last_cdp_no, jcdp          5  9997 11247     5
this_process, first_cdp_no, last_cdp_no, jcdp          6  9997 11247     6
this_process, first_cdp_no, last_cdp_no, jcdp          7  9997 11247     7
this_process, first_cdp_no, last_cdp_no, jcdp          8  9997 11247     8
```

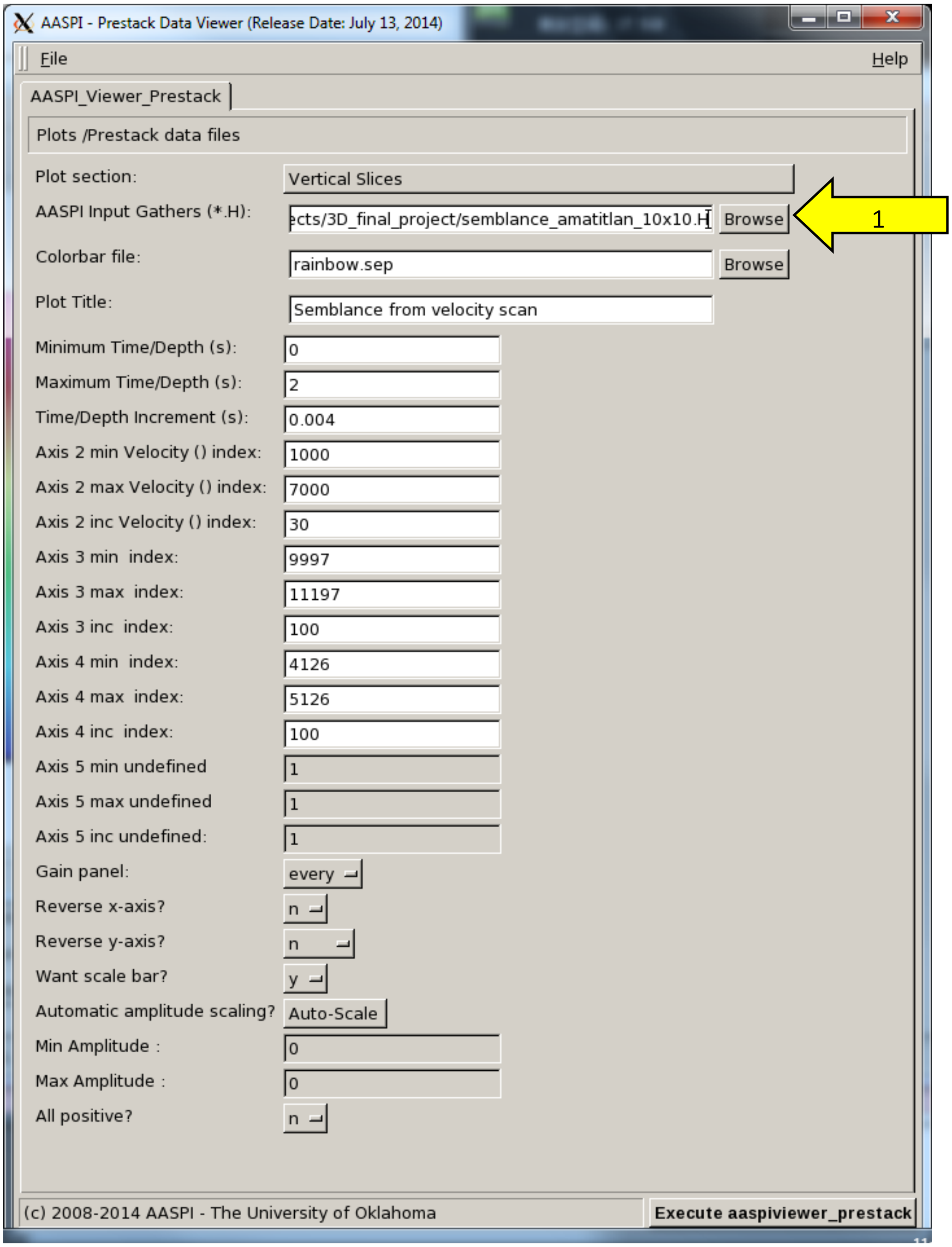
If you type *'ls-ltr'* in the above *xterm,* you find the most recent files to be:



This will show use that the output of program **Precompute Velocity Semblance** is called *semblance_amatitlan_10X10.H*.

If you want to view the semblance result, you can do so using the **Prestack Data Viewer** which can be found in the **Prestack Utilities** window under the *Display Tools* tab.

Program **Prestack Data Viewer** is found under the *Display Tools* tab:



Select (1) *Browse* to find your semblance data, in our case, *semblance_amatitlan_10X10.H.* Upon confirmation that all other parameters have been automatically filled correctly select the *Execute* button.

The following image is the result of **IVA Precompute Velocity Semblance:**

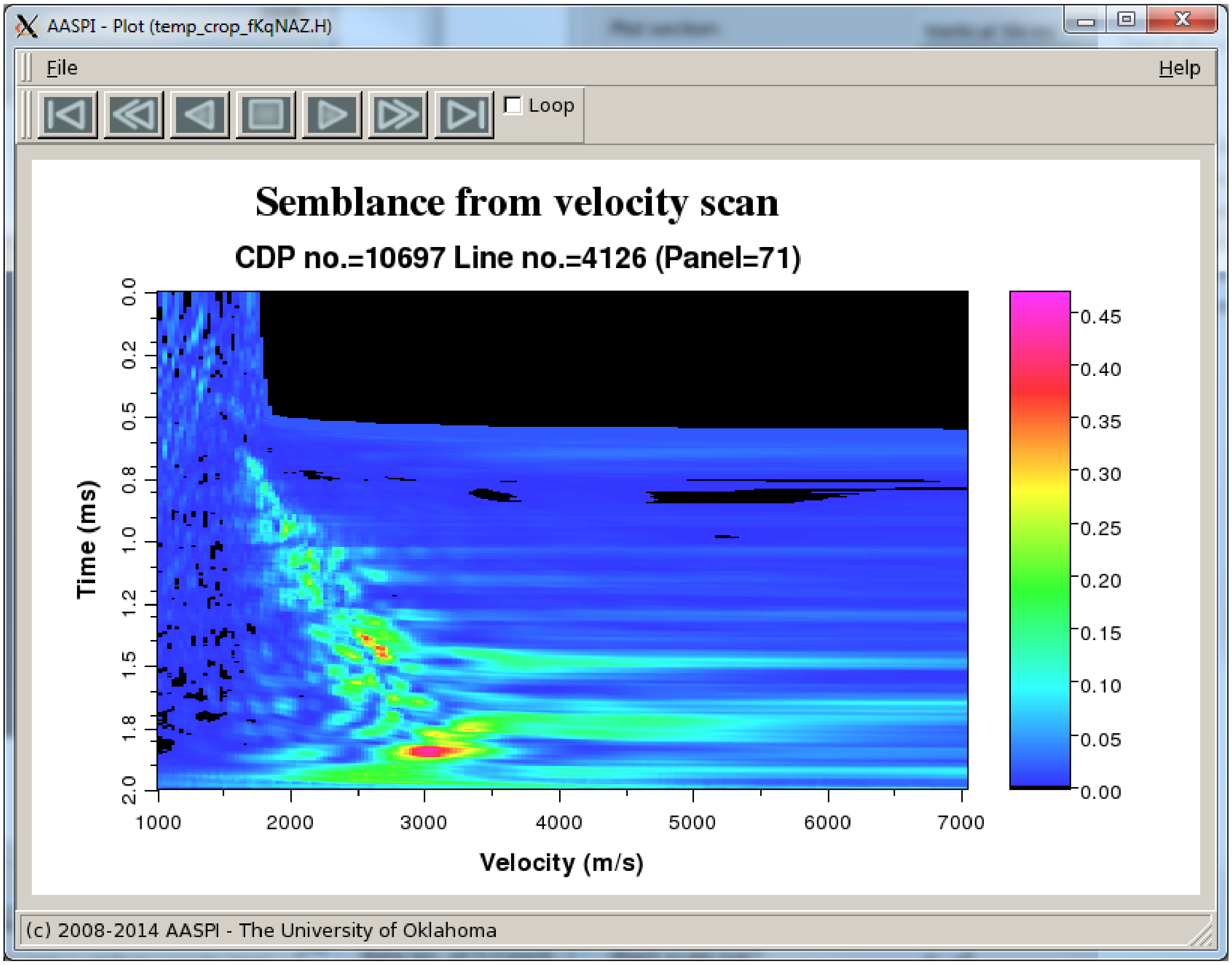


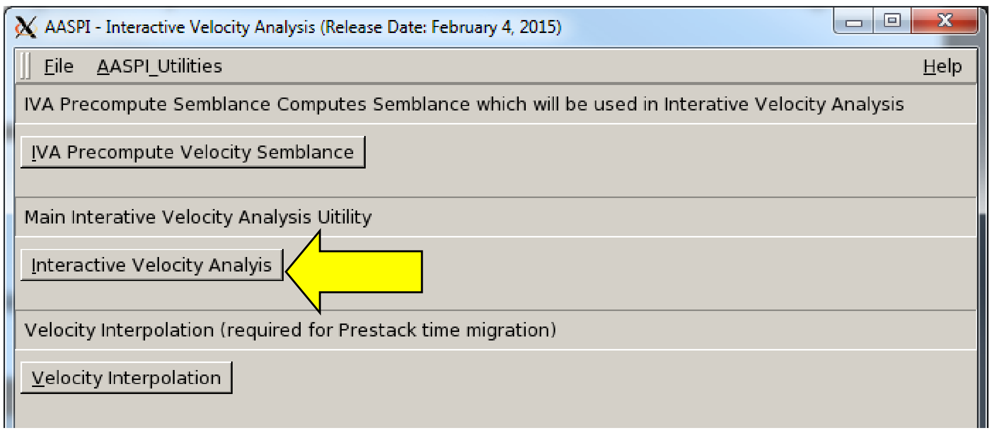
Figure 3.

This computed semblance will be the input to **IVA**.

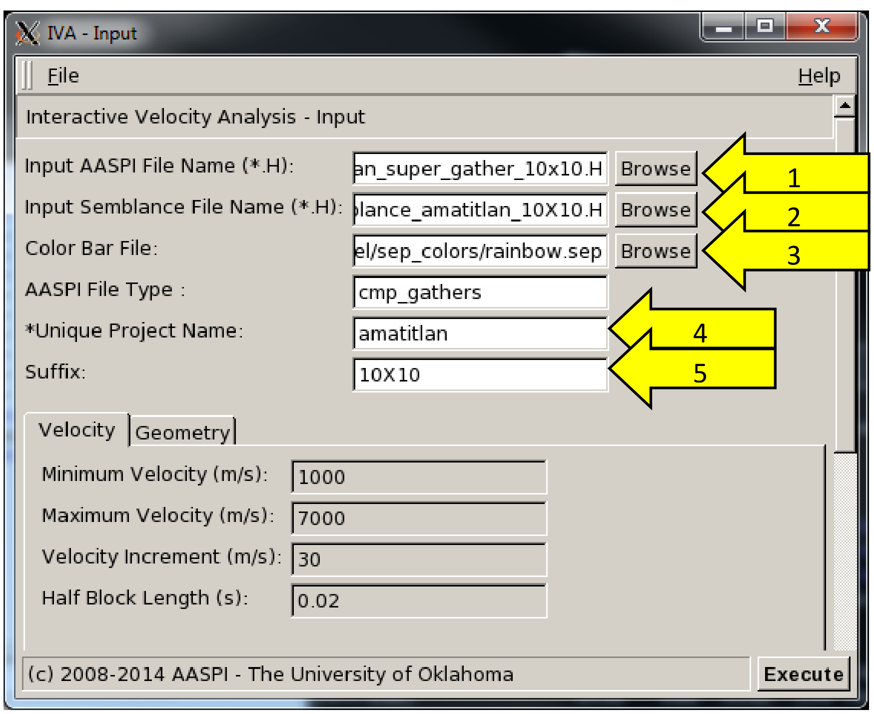
Program Interactive Velocity Analysis

Program **IVA** or Interactive Velocity Analysis is used for creating a velocity model for automatic non-hyperbolic velocity analysis after prestack migration. Program **IVA** eliminates the need to import/export large prestack data and 3D velocity models that may be saved in a different format from a different commercial data base.

For **IVA**, the inputs include seismic amplitude and semblance. The output is a velocity pick file. Interactive Velocity Analysis utility can be initiated by clicking on **Interactive Velocity Analysis** or by typing **aaspi_iva_input_output**:



The following GUI appears:



Select (1) *Browse* and input the super gather of the reverse normal moveout prestack seismic data, which in this example is *amatitlan_super_gather_10X10.H*. Next, select (2) *Browse* and locate the semblance file previously generated in program **semblance velocity** scan, in our example *semblance_amatitlan_10X10.H*. The (3) color bar will be automatically set as *'rainbow'*. The output velocity file name will concatenate the (4) *unique project name* and (5) *suffix* to create an ASCII file called *'velocity_amatitlan_10X10.txt'*. The *Velocity* tab and *Geometry* tab can show you previously selected parameters for QC but cannot be changed in this window. By clicking *Execute* another GUI, **Basemap Application,** will appear.

Interactive Basemap Application

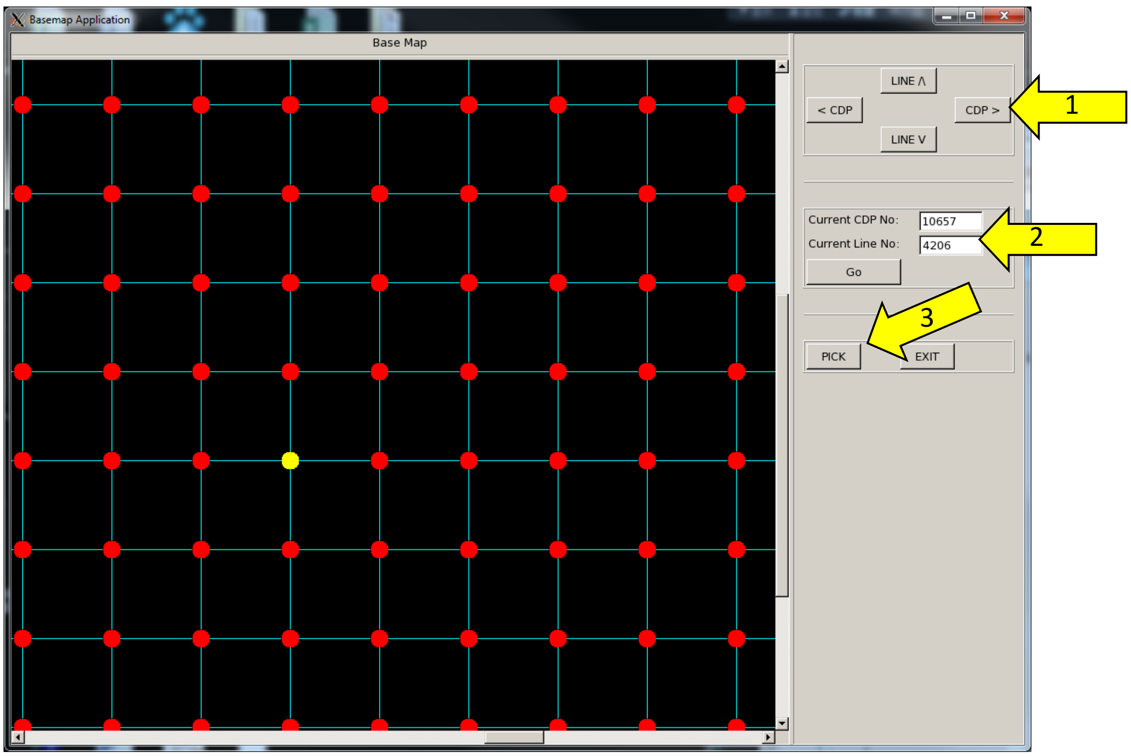


Figure 4.

Using the **Basemap Application** the user can now select a CDP and Line intersection, display the subsequent semblance panel and pick velocities of that intersection. To do this: (1) Click the "CDP" or "Line" button to move the velocity analysis location (yellow circle). Alternatively, you can move the yellow circle to a specific location by (2) filling in the "Current CDP No" and "Current Line No". When you are ready to pick velocities, (3) click "PICK" to start the velocity analysis in the next GUI. The seismic gather and semblance windows will show up together.

Seismic Gather of user-defined CDP No. and Line No.:

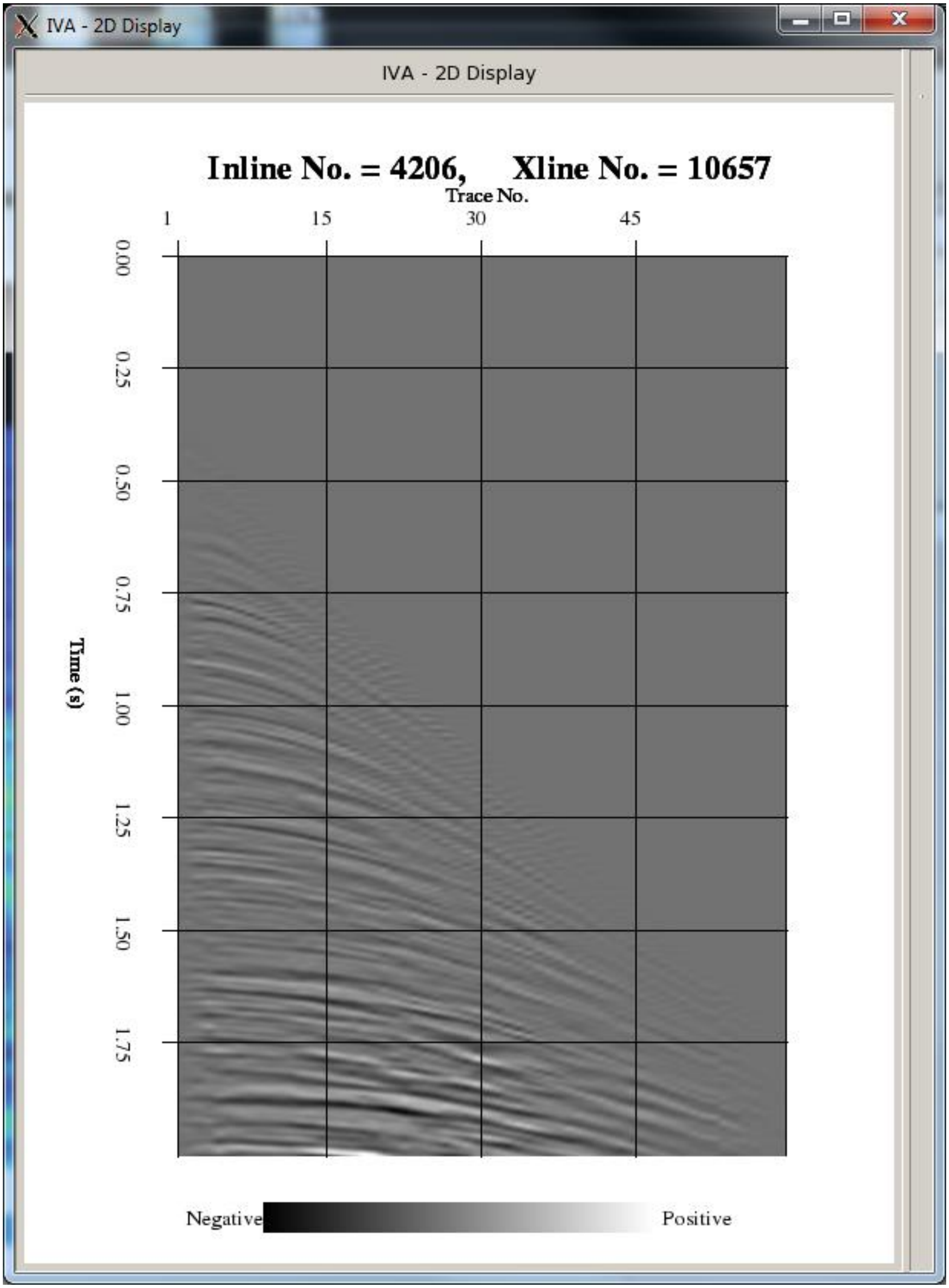


Figure 5.

Semblance display of user-defined CDP No. and Line No.:

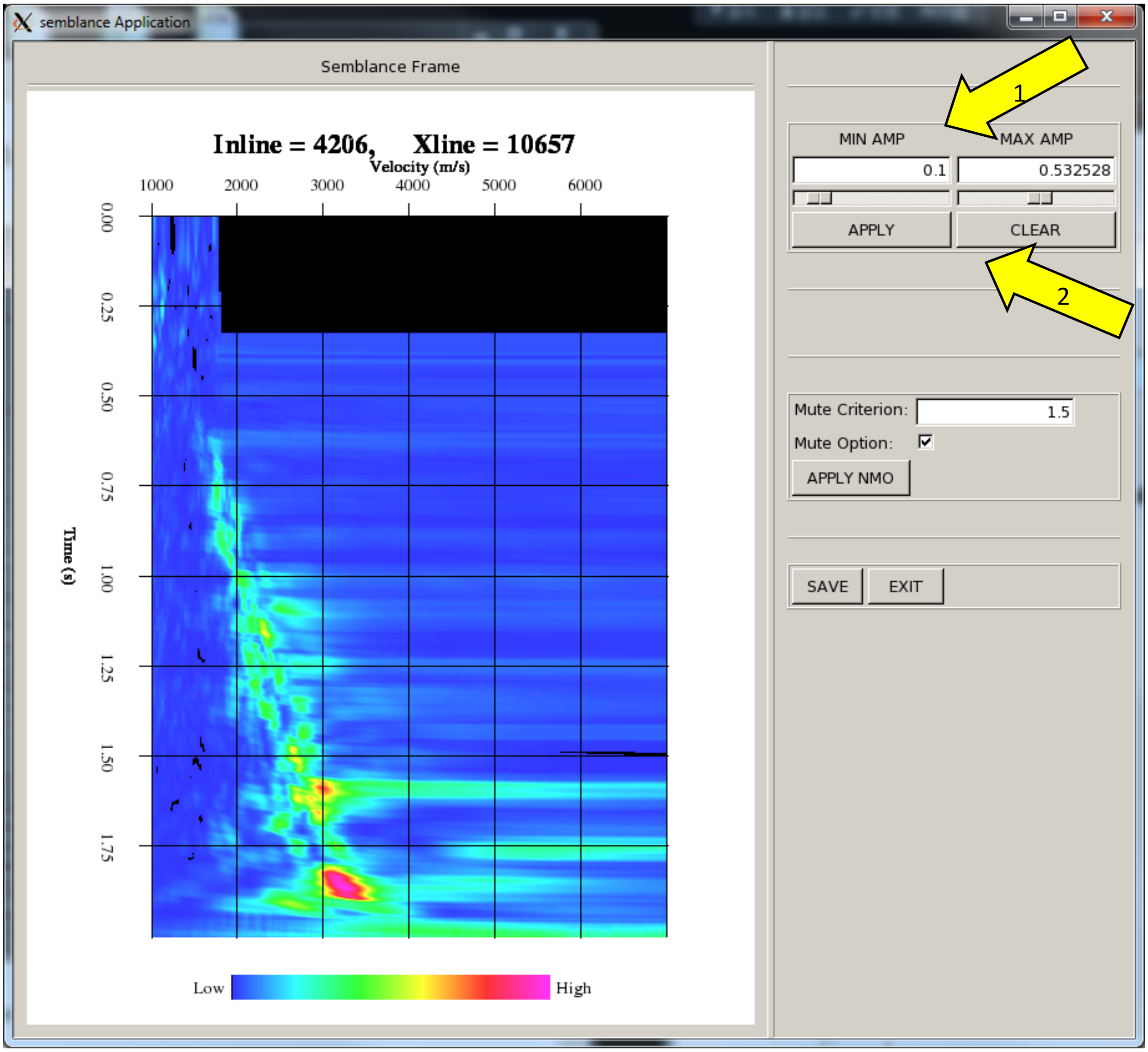


Figure 6.

The (1) amplitude threshold can be changed to increase visibility of the semblance gather. After clicking "APPLY" the changes will be made on the gather. If you want the software to auto-scale the amplitude, (2) click "CLEAR".

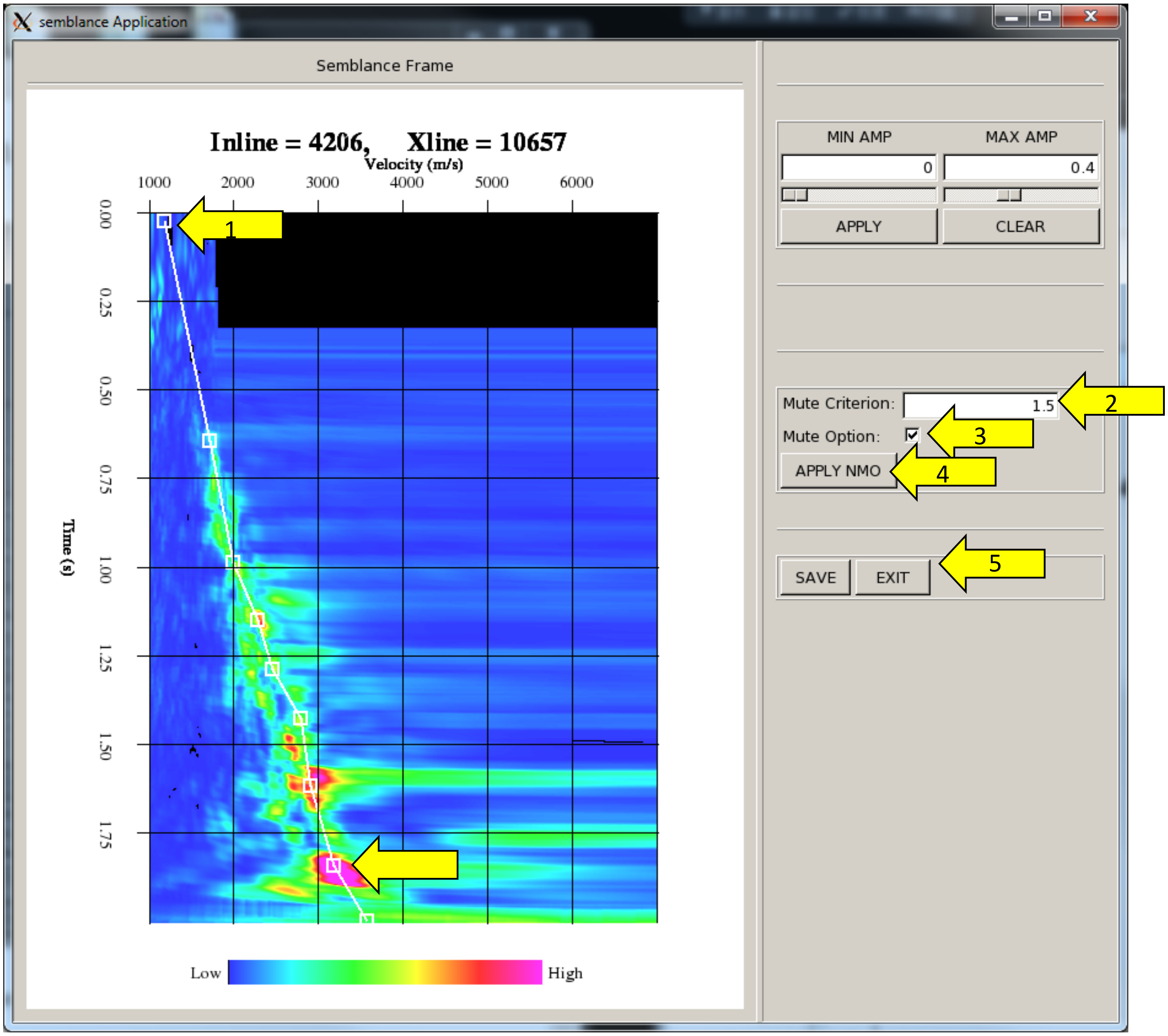


Figure 7.

(1) To begin picking, place your mouse on the semblance panel and *LEFT* click. A white square will appear in the semblance display. Repeat this for as many locations as seen necessary. The results will be the white velocity curve connecting your semblance picks. If we want to remove an erroneous pick, put the mouse near it and *RIGHT* click.

A stretch mute can be applied by selecting (2) “Mute Criterion” parameter. We have decided that 1.5 appears adequate for our gather. To apply the mute (3) place a checkmark in the “Mute Option” and click (4) “APPLY NMO”. A new window will appear showing the NMO corrected gather with your velocity picks applied.

Display of NMO corrected gather with (Left) no mute applied and (Right) with a mute applied:

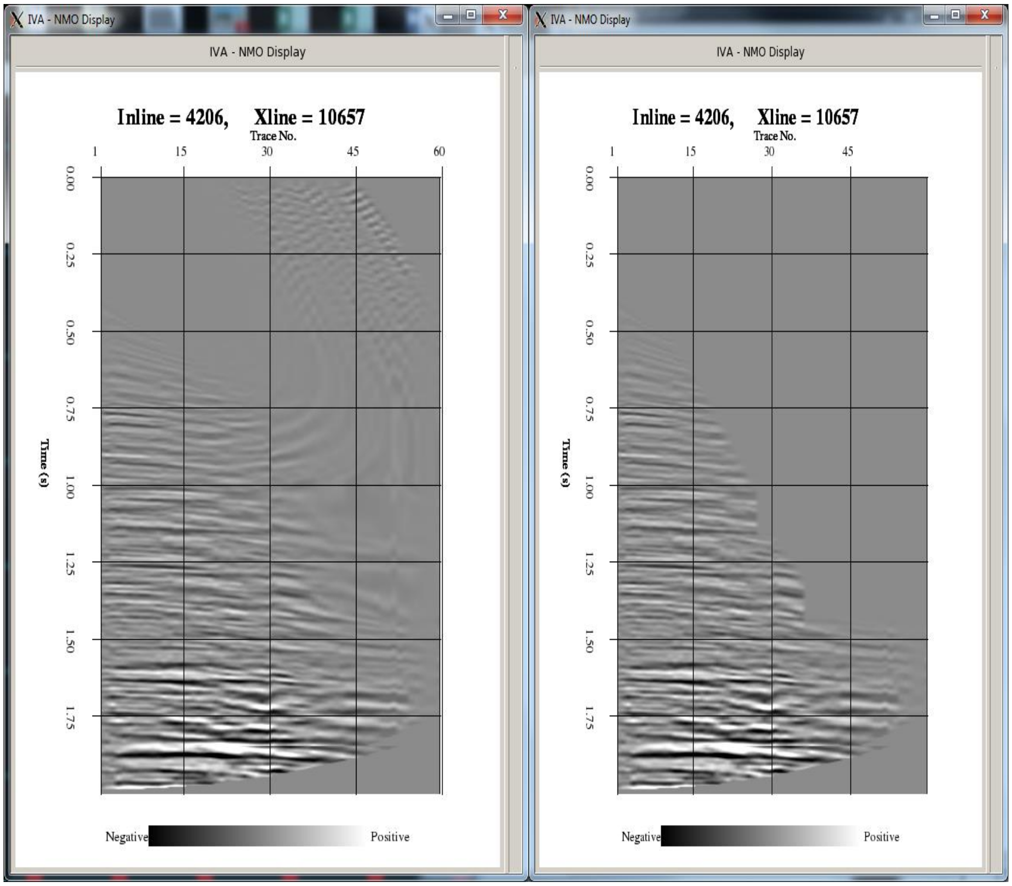
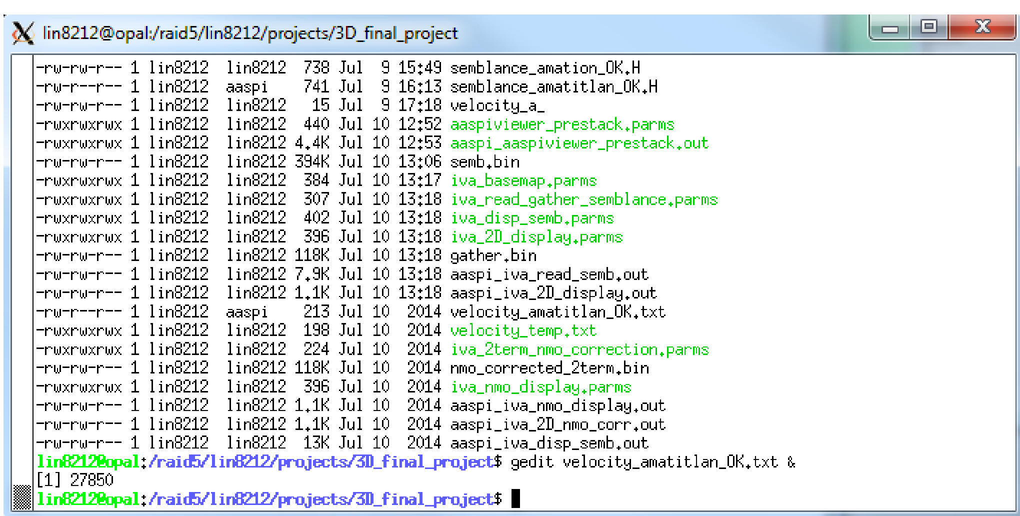


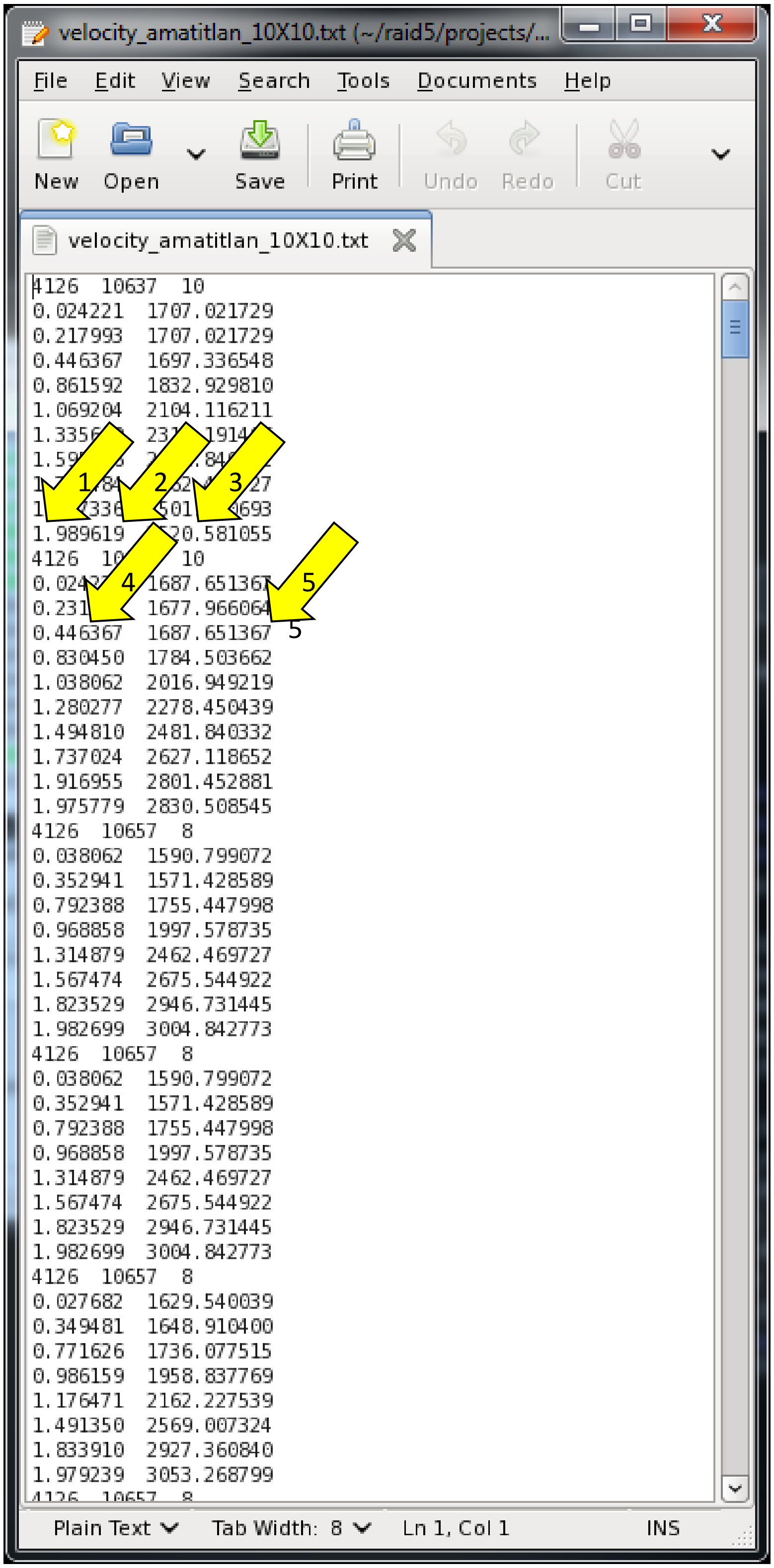
Figure 8.

Once you have inspected and are satisfied with the NMO result, (5) click "SAVE" and "EXIT" to close the semblance window and save you picks into an ASCII velocity pick file.

Let's examine the ASCII format velocity pick file:



To open the file type gedit *"velocity_amatitlan_10X10.txt"* into the xterm window. A document will appear with your velocity picks :



The value of "5000" indicated the line no; "10000" indicated the CDP no; and "9" indicated by arrow 3 is the number of picked time – velocity pairs. (4) The first column is the time of the pairs, and (5) the second column is the velocity of the pairs.

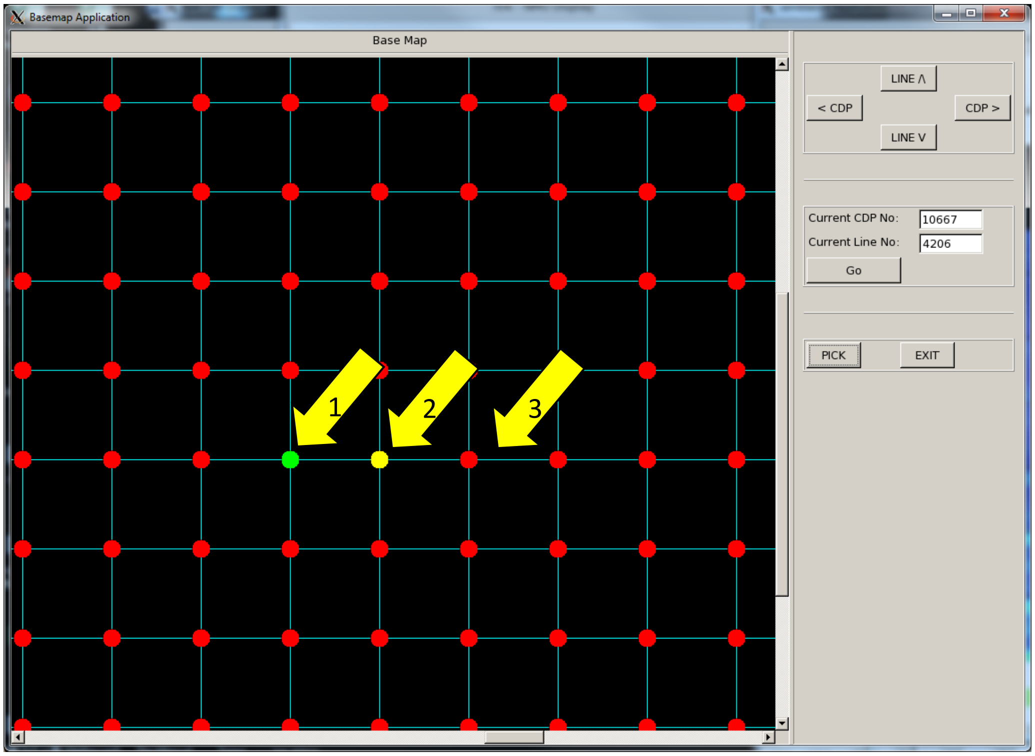
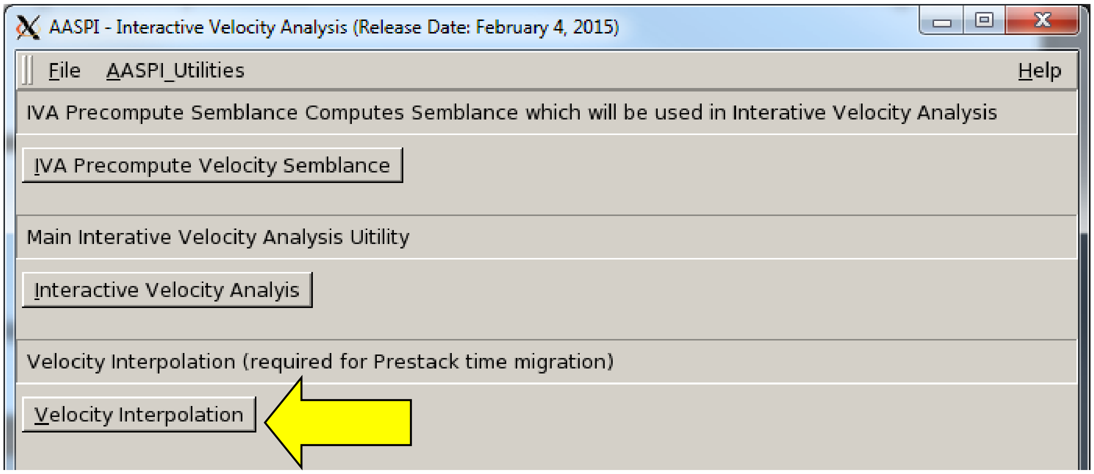


Figure 9.

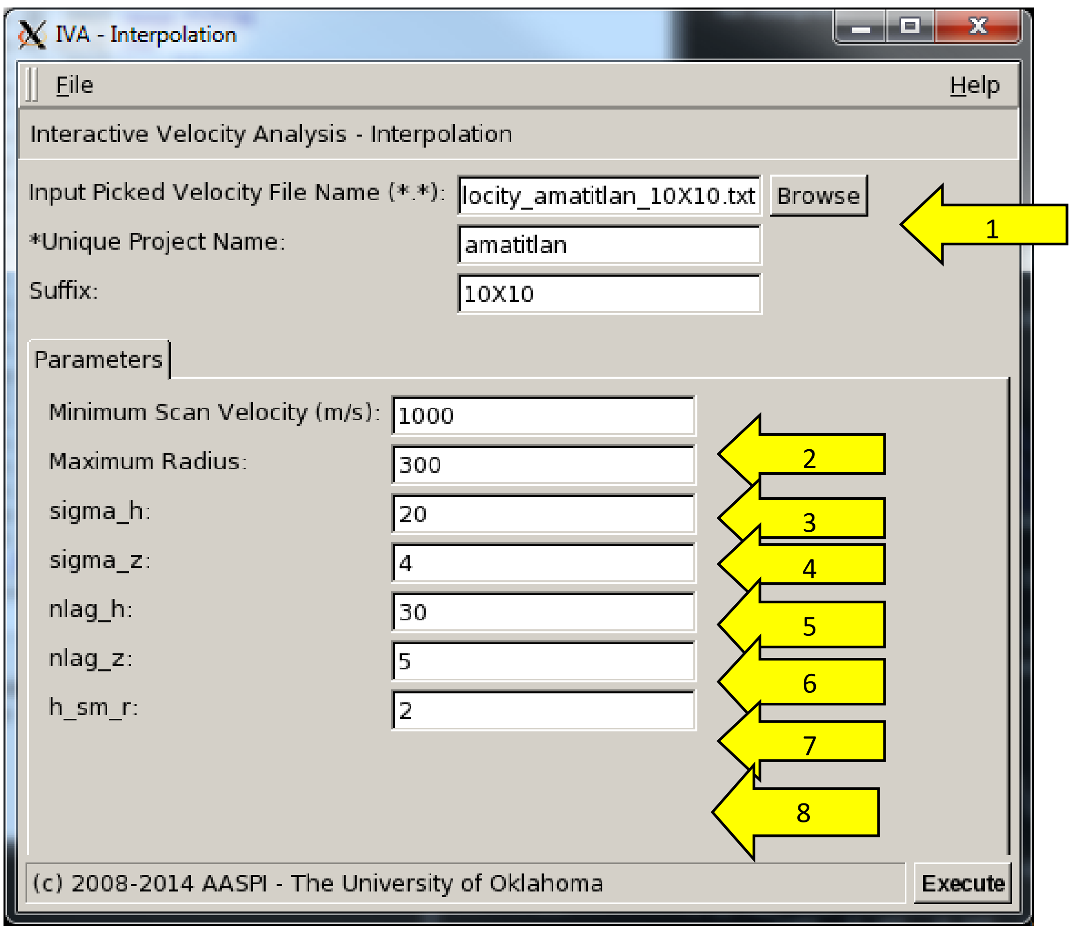
Returning to the base map, (1) the green analysis point shows that it has been picked, (2) the yellow analysis point now is active, and (3) the red analysis points are currently unpicked. You can continue to navigate through the basemap until all or an adequate number of semblances are picked, where you can then move on to **velocity interpolation**

Program Velocity Interpolation

Once we have finished picking a grid of semblance panels, we need to interpolate them to generate a 3D velocity model. Select, program **Velocity Interpolation**, the third utility on the IVA utility. You can also initiate it by typing **aaspi_iva_velocity_interpolate** on the terminal window (see next page).

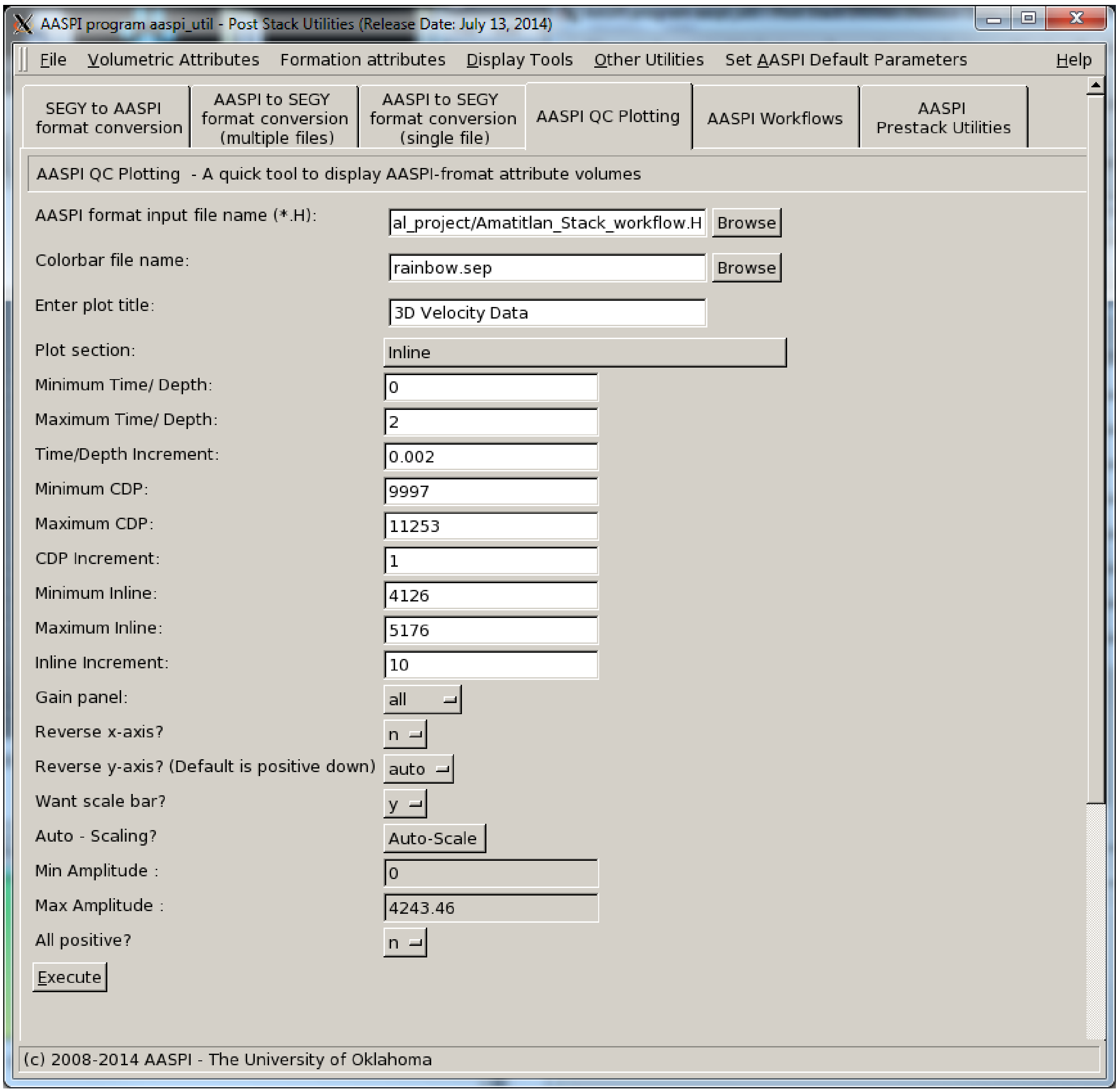


The following GUI appears:



Select (1) *Browse* and input the **.txt* file with your velocity picks. Next assign a *Unique Project Name* and *Suffix.* Add the (2) Minimum Scan Velocity to be the same value as used in the previous programs. Next, infill the (3) Maximum Radius, which is the radius for searching for picked velocities. The (4) sigma_h and (5) sigma_z define the half-length for a Gaussian filter in the horizontal and vertical directions, respectively. The (6) *nlag_h* and (7) *nlag_z* are the number of lag steps in the horizontal and vertical direction, respectively. Finally, (8) the *h_sm_r* is a smoothing operator in the horizontal direction. Upon filling the interpolation parameters select *Execute.*

To display your 3D velocity field, open the **AASPI QC Plotting** under the *Post Stack Utilities* tab. Select *Browse* and find your interpolated velocity field. Then select *Execute* to obtain the following velocity panels.



The following GUI will appear:

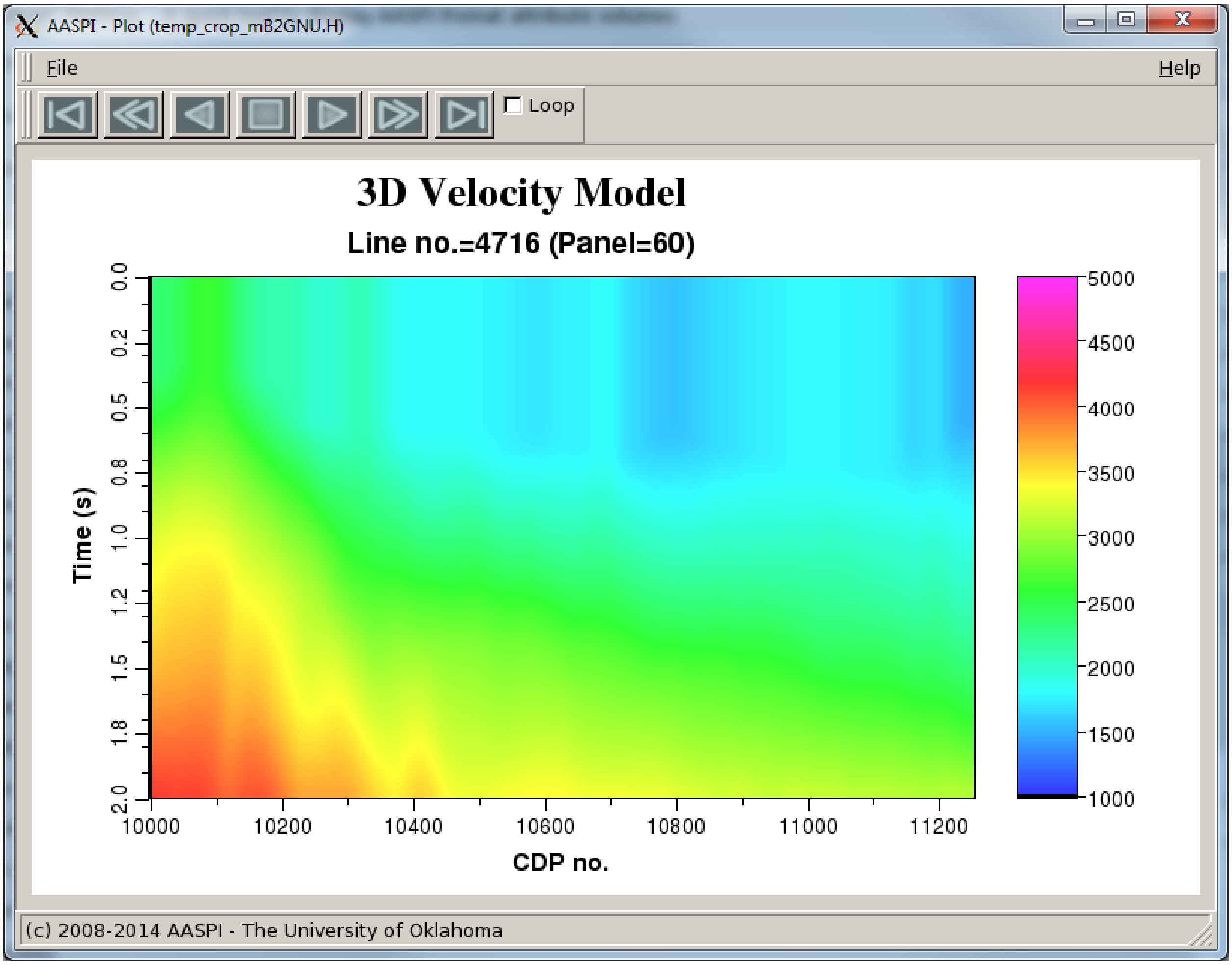


Figure 10. 3D Velocity Filed

The end result is a new 3D velocity model which can now be used for a prestack migration.