

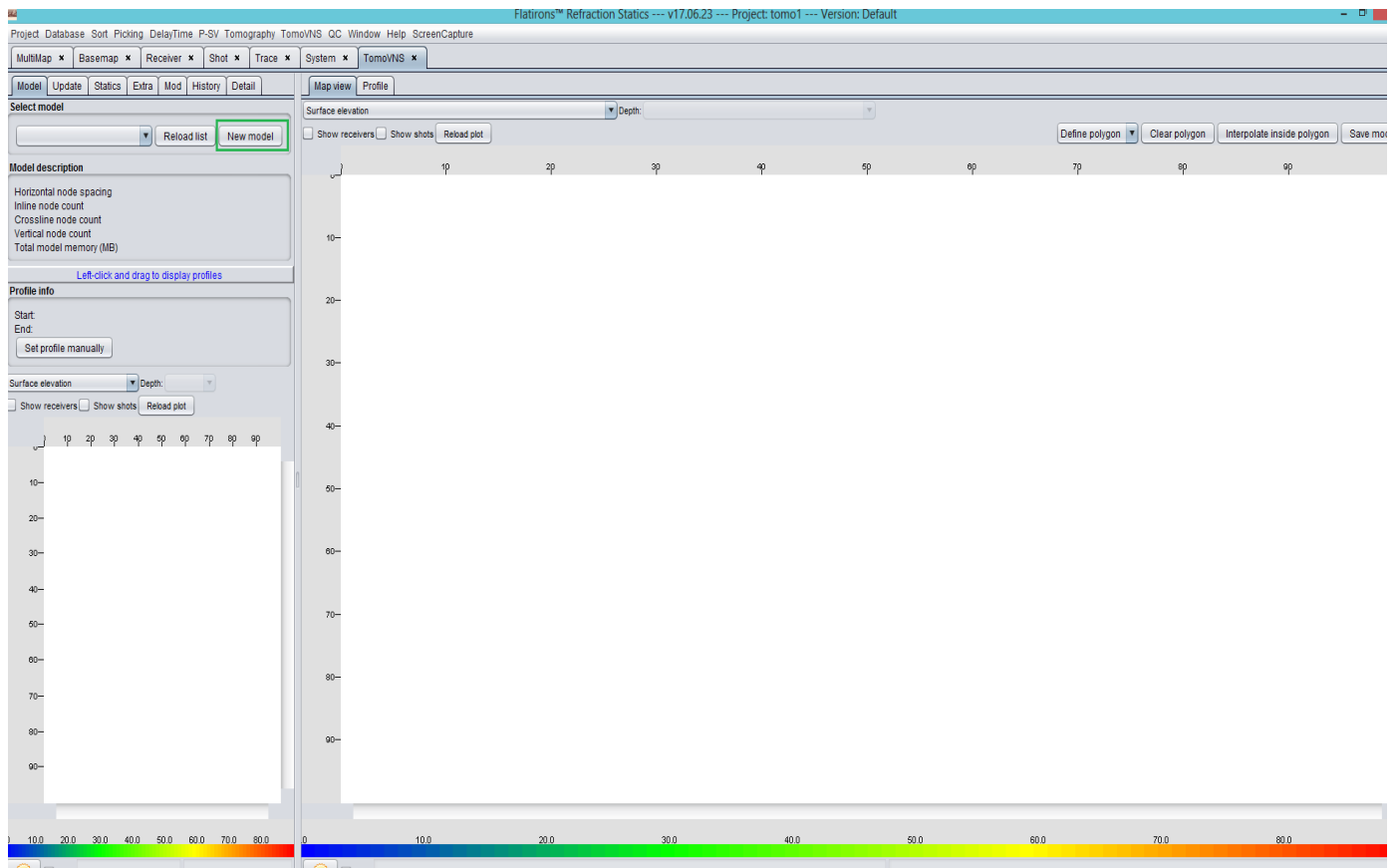
# **VNS Tomography**

## Preparation

- Tomography requires that you have good picks (for all offsets if possible)
- Priority is on near offsets – these are treated as more important
- For the purposes of this tutorial, we will assume you have picks already

## Create Model

- TomoVNS menu → VNS (variable node spacing) Tomography
- Click “Create model”

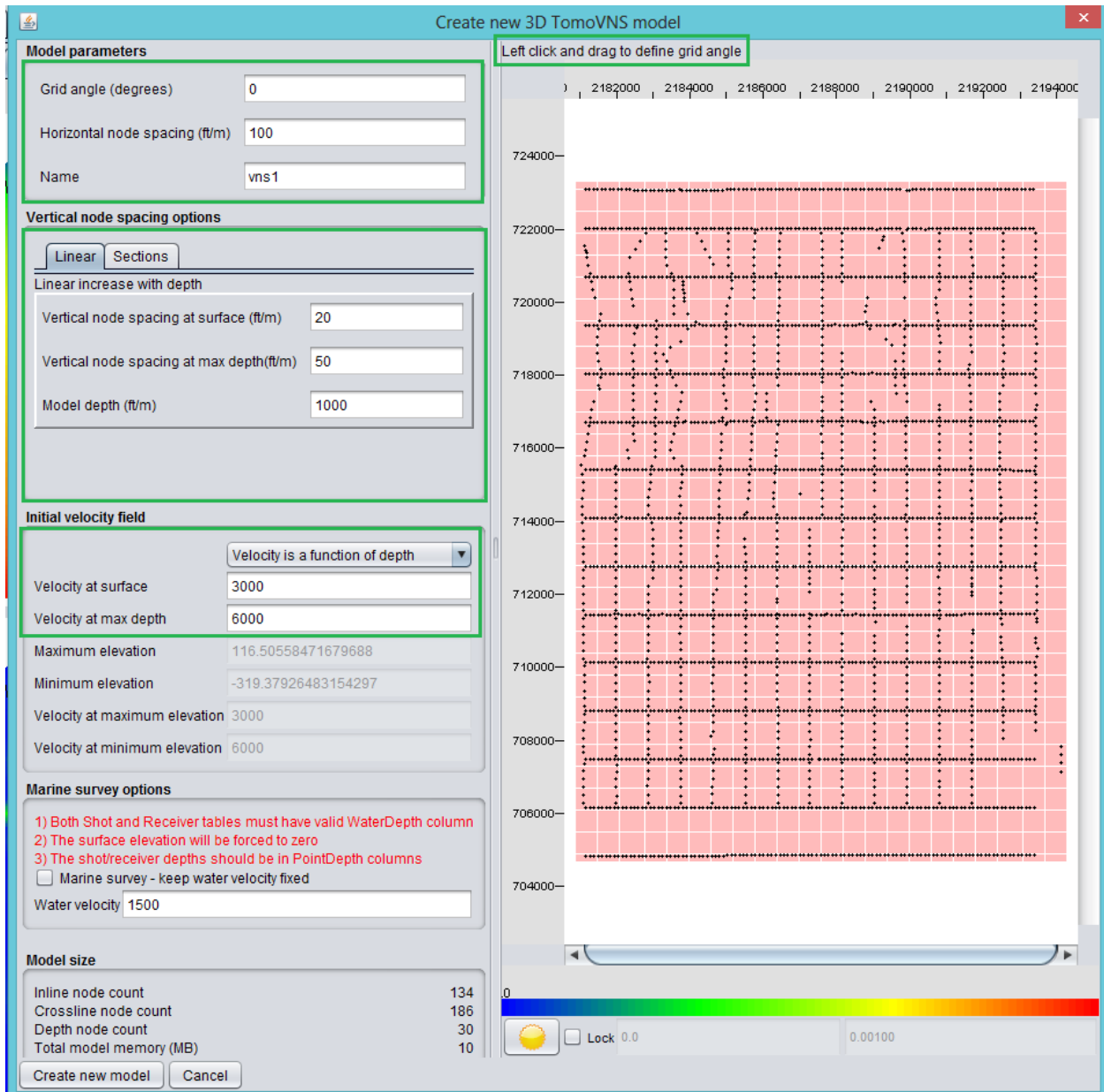


## Create Model

- Set angle of the grid by dragging a line on the map – the idea is to minimize amount of dead space in the model, so you'll probably want to line it up with the Shots or Receivers
- Set horizontal grid spacing and name for the model
- Set vertical spacing at surface, then vertical spacing at depth – this is the key to VNS – the grid spacing is finer near the surface, where the velocity is expected to change more rapidly, but coarser deeper down in the model, where the velocity is expected to change less

# Create Model

- Set velocity at surface and depth – and also select how velocity is set (based on depth or elevation)
- If marine survey, set marine options



## Update Model

- Select the “Update” tab (second from left)
- Set min and max offset (remember, the near offsets are the most important for tomography)
- Select number of iterations – we should start with less of these on our first run (to avoid wasting time if our parameters are not good), then increase as we repeat the process
- Don't change smoothing radius or weight unless you are experienced user
- Select the pick version
- Shift picks if desired (don't do this unless there is a good reason)

## Update Model

- Set number of threads – more threads is faster; the max value is 2X the number of processor cores – but if you use too large a number it will default to max value
- Set accuracy – 2 is lowest accuracy but fastest, 5 is highest accuracy but slowest – use lower accuracy starting out
- Click “Start batch update” to run

# Update Model

Multimap Basemap Receiver Shot Trace Sys

Model Update Statics Extra Mod History Detail

**Batch update options**

Minimum offset	<input type="text" value="200"/>
Maximum offset	<input type="text" value="6000"/>
Number of iterations	<input type="text" value="10"/>
Horizontal smooth radius (nodes)	<input type="text" value="2"/>
Weight at max radius ( <= 1 )	<input type="text" value="0.2"/>
Vertical smooth radius (nodes)	<input type="text" value="0"/>
Pick version	<input type="text" value="FBP_User"/>
Pick shift (ms)	<input type="text" value="0"/>
Number of threads	<input type="text" value="2"/>
	<input type="checkbox"/> Allow velocity inversions
Accuracy (2 - 5)	<input type="text" value="2"/>

Shallow velocity lock Uphole survey

Azimuth Hybrid Decimation

Apply azimuth restrictions

Center azimuth

Azimuth radius

723  
722  
721  
720  
718  
718  
717  
716  
716  
714  
713  
712  
711  
710  
708



# Update Model

- Model will update...

Description	Status	Message	Run time
VNS tomography model update	Running		


Current action: [VNS tomography model update](#)

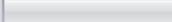
Status: Working on iteration 3 of 11

Status: Iter 2, error = 16.249637

Time, memory: Run time: 1 min, 14 sec Free memory (MB) = 5859

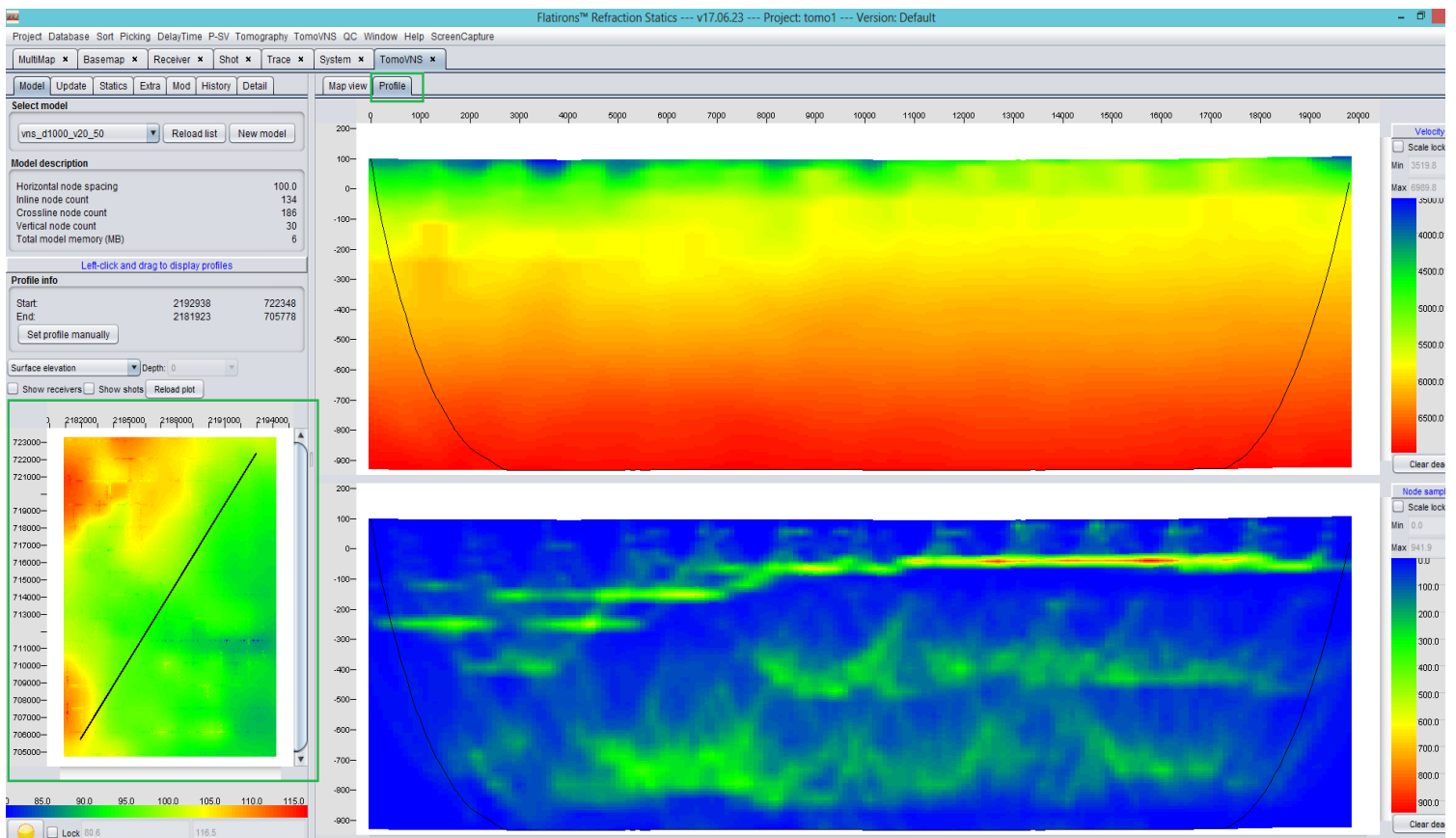
Estimated time left: 3 min, 53 sec for this task

Progress:  24.1%

Subtask Progress:  0%

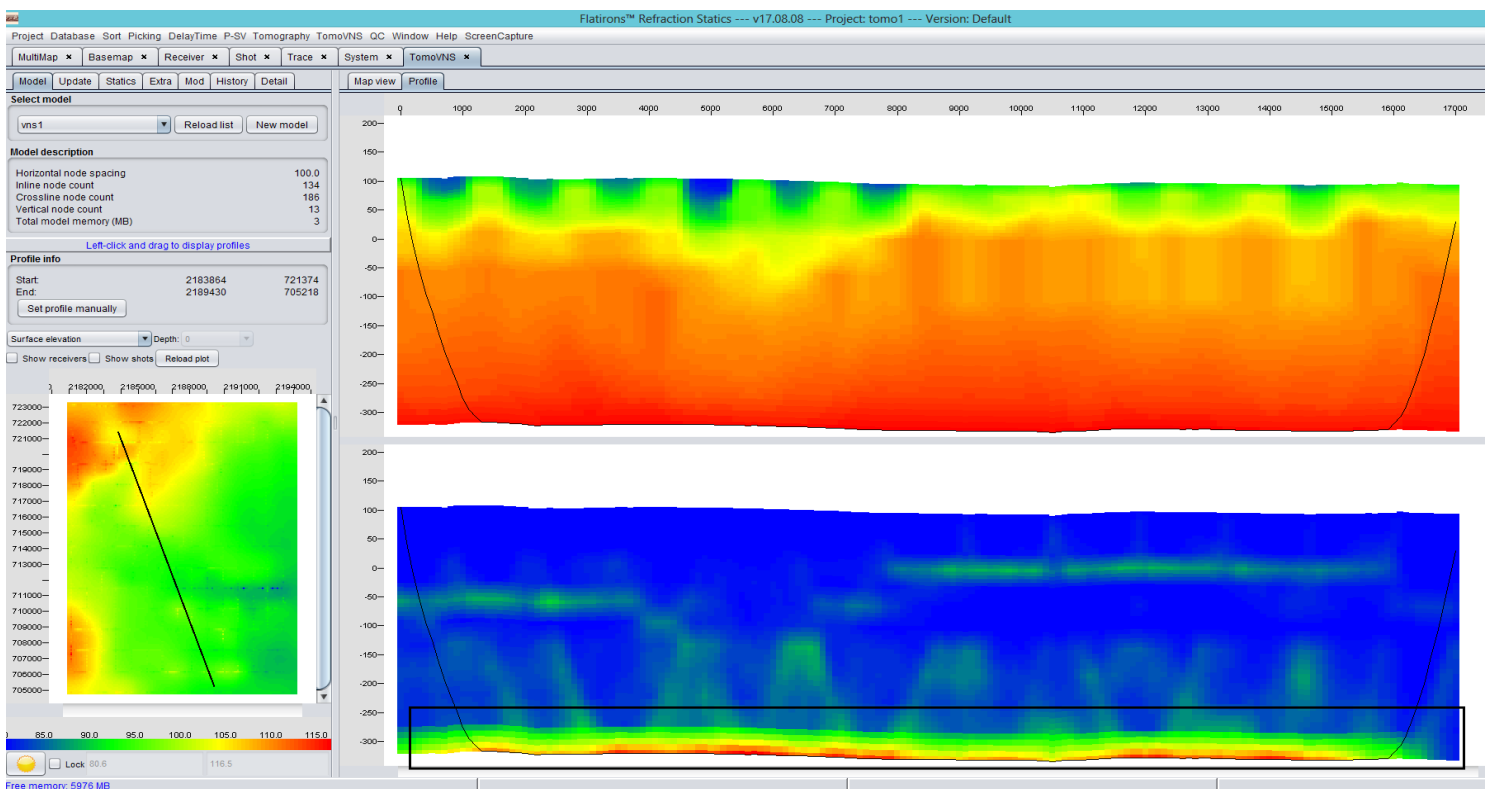
# View Model

- Select “Profile” tab, then click and drag along basemap to draw profile
- Velocity displayed on top, node hit counts displayed on bottom
- The black line is the computed travel path



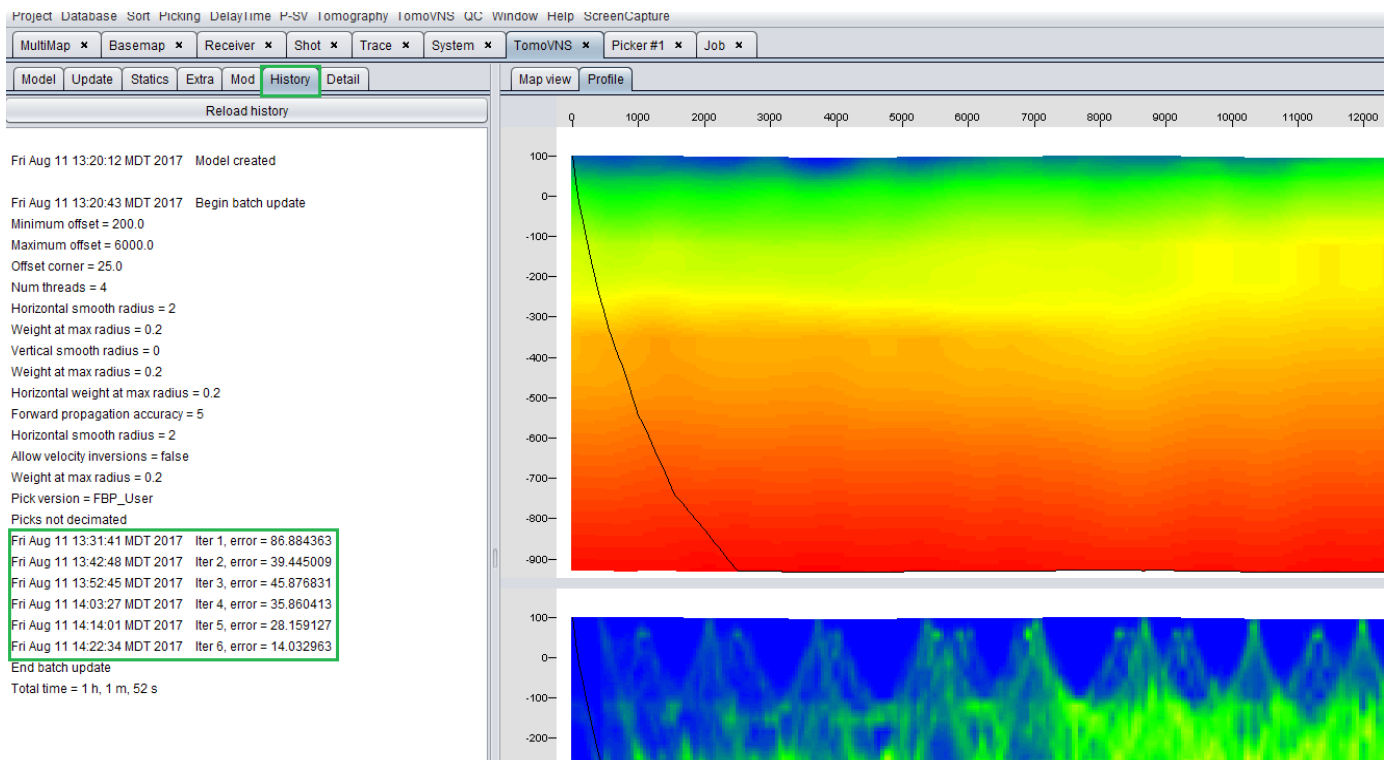
## Common Mistakes

- Note the bottom of the hit count display – the rays are going all the way to the bottom of the model
- We don't know if they should be going even lower, because we're at the lower limit
- This tells us that our model is too shallow – create a new one with more depth and start over



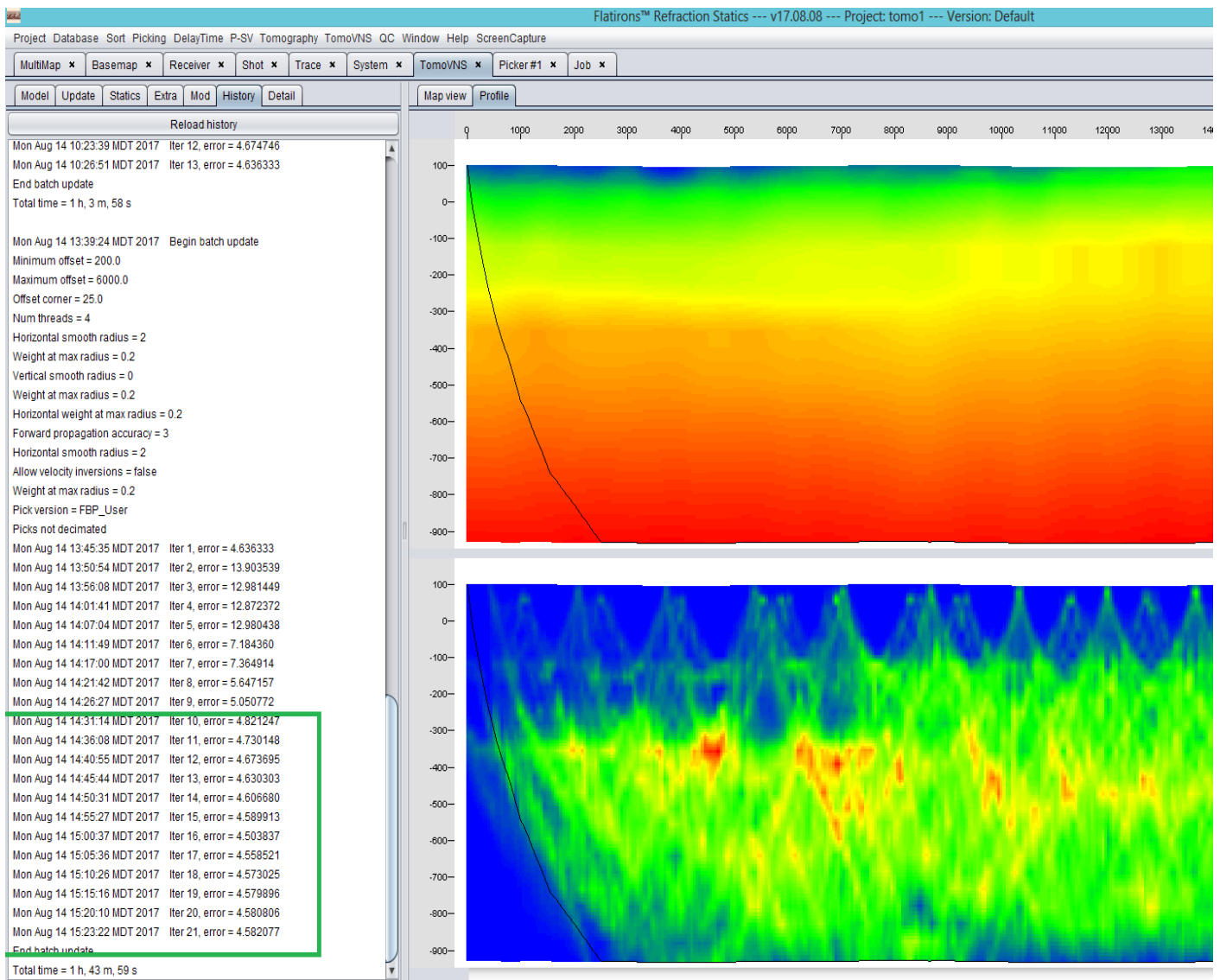
# Model QC - Error

- Select the “History” tab
- You may need to reload the history
- The average error in each iteration is listed
- Here, we see that the error is still changing (getting lower) every iteration
- This means the model has not converged yet, and we need more iterations



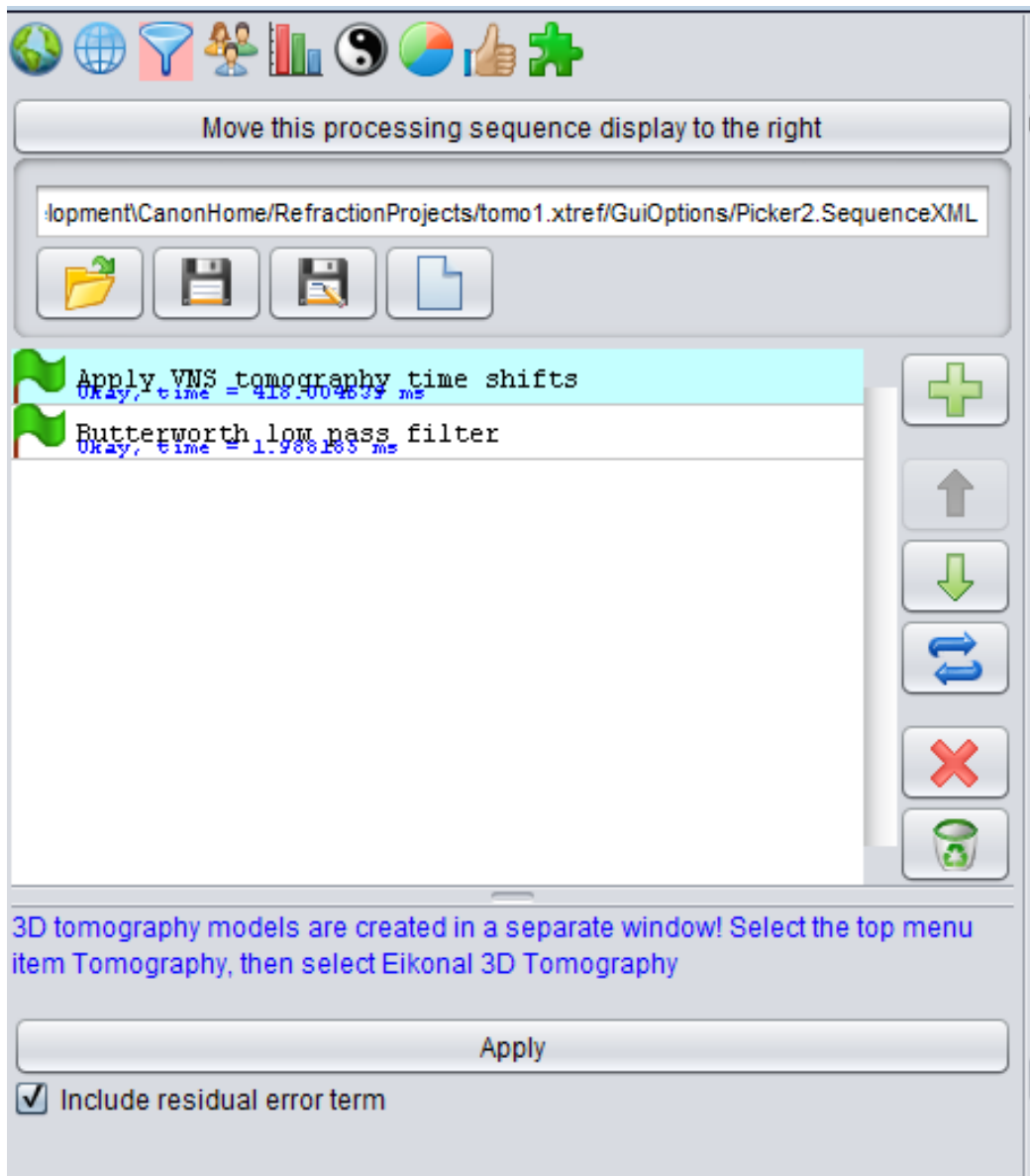
# Model QC - Error

- We want to run enough iterations such that the error is relatively stable



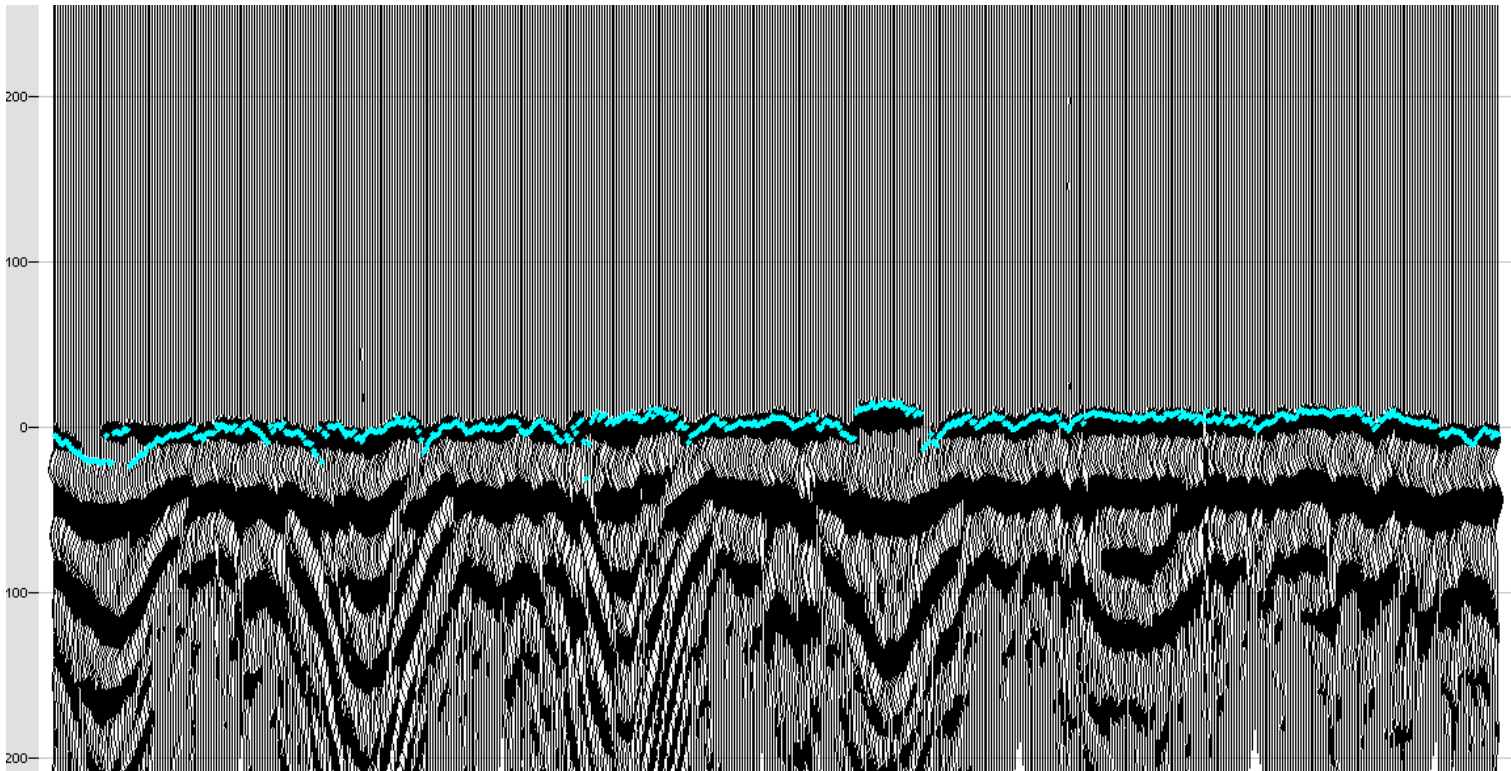
## Model QC - Picker

- In the picker window, select Defaults → Prepare options for TomoVNS analysis



## Model QC - Picker

- The model currently selected in the TomoVNS window will be used for the shifts
- QC your model based on how well gathers flatten



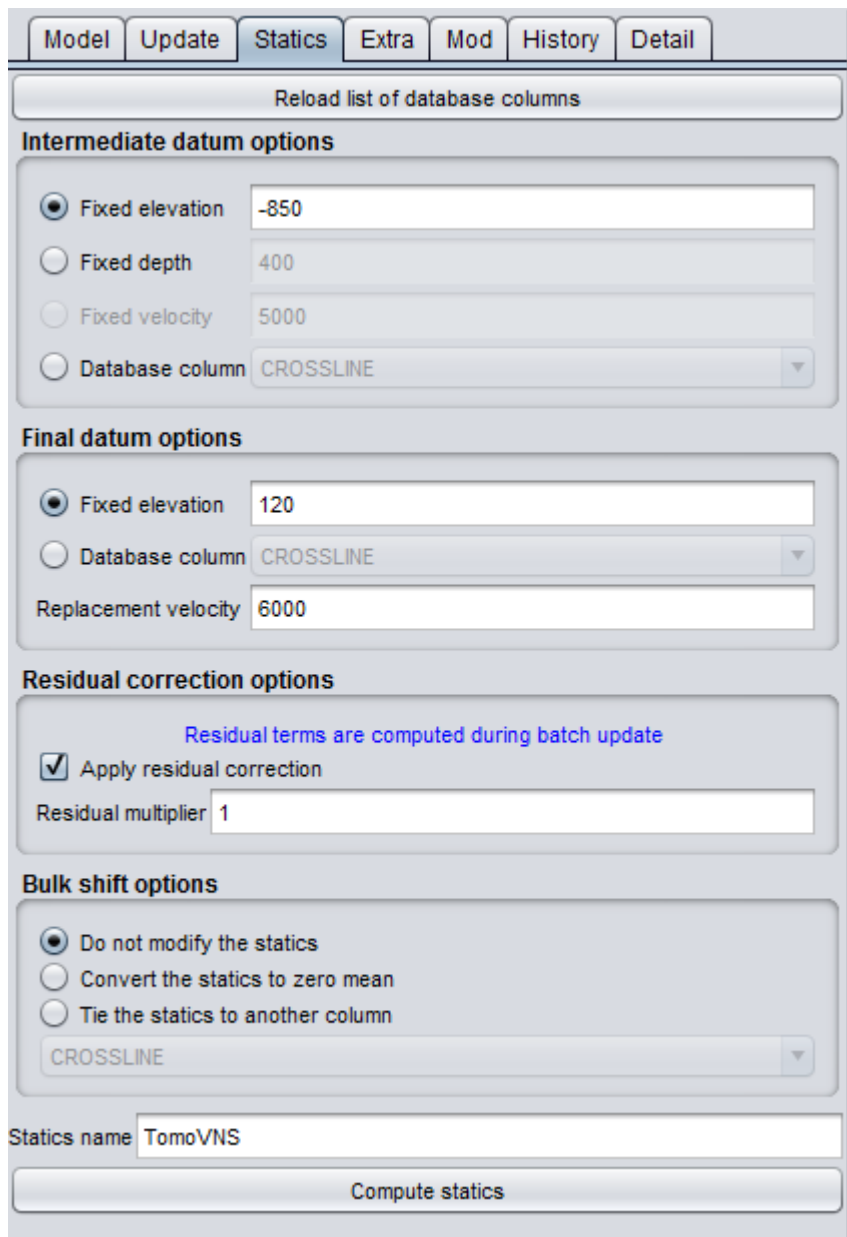
## Model QC - S/R Stack

- TomoVNS menu → Shot and receiver stacks using TomoVNS solution
- Make sure the correct model is selected in the TomoVNS window before creating stacks
- Unlike Delay Time stacks, you cannot iteratively pick and restack these
- You can pick them once to get a residual error term
- This is primarily a QC tool; a better solution should flatten the stacks on their own



# Statics

- Click the “Statics” tab in the TomoVNS window
- All parameters are edited on this page

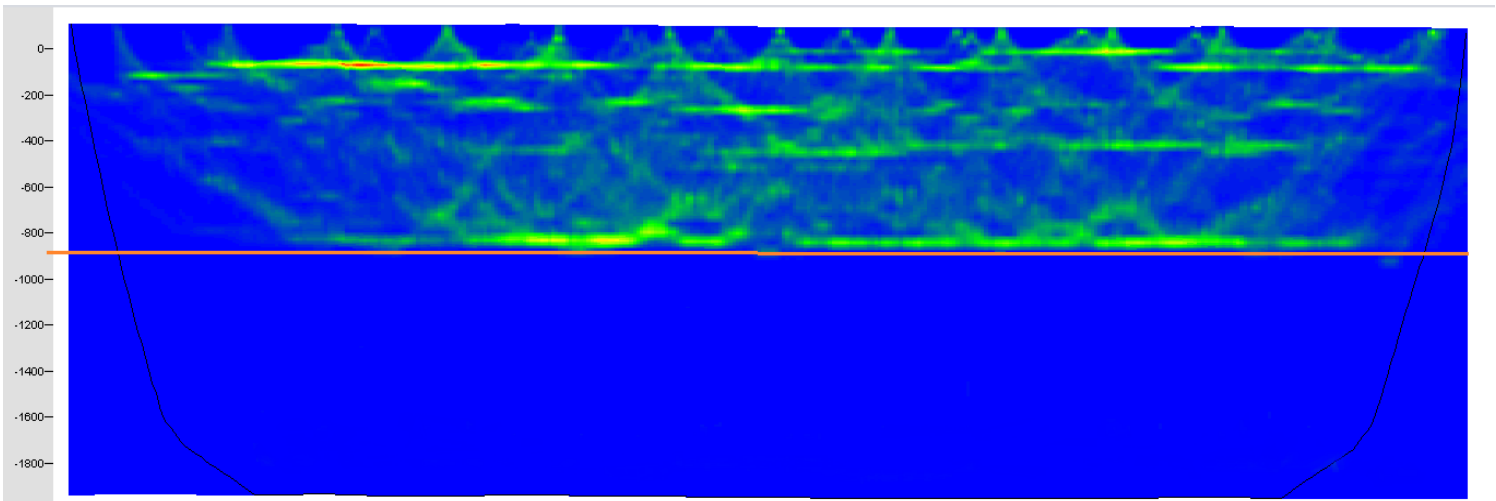
A screenshot of the TomoVNS software interface, specifically the "Statics" configuration window. The window has a tabbed interface with tabs for "Model", "Update", "Statics" (which is selected), "Extra", "Mod", "History", and "Detail". Below the tabs is a button labeled "Reload list of database columns". The main area is divided into several sections: "Intermediate datum options" with radio buttons for "Fixed elevation" (set to -850), "Fixed depth" (400), "Fixed velocity" (5000), and "Database column" (CROSSLINE); "Final datum options" with radio buttons for "Fixed elevation" (120) and "Database column" (CROSSLINE), and a "Replacement velocity" field (6000); "Residual correction options" with a checked box for "Apply residual correction" and a "Residual multiplier" field (1); and "Bulk shift options" with radio buttons for "Do not modify the statics" (selected), "Convert the statics to zero mean", and "Tie the statics to another column" (CROSSLINE). At the bottom, there is a "Statics name" field containing "TomoVNS" and a "Compute statics" button.

## Statics

- Refer to the node hit count graph
- If we do not have any rays updating the bottom part of the model, we should not use that part of the model for computing statics, because it has not been updated based on our picks – all it has is the starting model
- In the case shown in the next slide, we set our intermediate datum at -850 or -900 feet, because we have no rays traveling below that

# Statics

- Orange line marks where intermediate datum should be placed, roughly



## Model Export

- TomoVNS allows you to export your model as an interval velocity SEG-Y
- These options are available in the “Extra” tab
- Set elevation at top and bottom datums, as well as sample interval
- You may export either the velocity field or the node hit counts
- 3 options for output grid:
  - Tomography grid (x and y spacing defined at model creation)
  - Project grid (uses Inlines and Crosslines in Flatirons project)
  - User defined grid (a dialog will pop up asking for a 3 corner definition)

# Model Export

## SEG-Y model export options

Top datum (ft/m)

Bottom datum (ft/m)

Sample size (ft/m)

## Select output SEG-Y file



## These export options use the tomography grid

## These export options use the project grid

## These export options use a user-defined grid