Event location using a 3D velocity model

InSite v 3.17 incorporates an interface to import 3D velocity models saved as 3Dvoxels in a .csv file. The grid is expected to be regular in all 3 dimensions and smooth, i.e. no voxels should be blank or with zero velocity value as this would be interpreted as a void and result into reflection or non-propagation of rays through them. The velocity model grid must include all the volume where the location search will be performed and include all the sensors or seismic stations used in the process. An example velocity model file is shown in Figure 1.

	A	B	C	D	E	F	G	H	I	J	K
1	Easting	Northing	Depth (Ft)	Vp (ft/s)	Vs (ft/s)	Vp/Vs	K(Gpa)	Lame(Gpa	G(Gpa)		
2	1759445	411186.8	-2936.3	17000	10000	0	0	0	0		
3	1759945	411186.8	-2936.3	17000	10000	0	0	0	0		
4	1760445	411186.8	-2936.3	17000	10000	0	0	0	0		
5	1760945	411186.8	-2936.3	17000	10000	0	0	0	0		
6	1761445	411186.8	-2936.3	17000	10000	0	0	0	0		
7	1761945	411186.8	-2936.3	17000	10000	0	0	0	0		
8	1762445	411186.8	-2936.3	17000	10000	0	0	0	0		
9	1762945	411186.8	-2936.3	17000	10000	0	0	0	0		
10	1763445	411186.8	-2936.3	17000	10000	0	0	0	0		
11	1763945	411186.8	-2936.3	17000	10000	0	0	0	0		
12	1764445	411186.8	-2936.3	17000	10000	0	0	0	0		
13	1764945	411186.8	-2936.3	17000	10000	0	0	0	0		
14	1765445	411186.8	-2936.3	17000	10000	0	0	0	0		
15	1765945	411186.8	-2936.3	17000	10000	0	0	0	0		
16	1766445	411186.8	-2936.3	17000	10000	0	0	0	0		
17	1766945	411186.8	-2936.3	17000	10000	0	0	0	0		
18	1767445	411186.8	-2936.3	17000	10000	0	0	0	0		
19	1767945	411186.8	-2936.3	17000	10000	0	0	0	0		
20	1768445	411186.8	-2936.3	17000	10000	0	0	0	0		
21	1768945	411186.8	-2936.3	17000	10000	0	0	0	0		
22	1769445	411186.8	-2936.3	17000	10000	0	0	0	0		
23	1769945	411186.8	-2936.3	17000	10000	0	0	0	0		
24	1770445	411186.8	-2936.3	17000	10000	0	0	0	0		
25	1770945	411186.8	-2936.3	17000	10000	0	0	0	0		
26	1771445	411186.8	-2936.3	17000	10000	0	0	0	0		
27	1771945	411186.8	-2936.3	17000	10000	0	0	0	0		

Figure 1: Example csv 3D velocity model. The values in columns F-I are not used in the current version of InSite

The following steps must be followed in order to locate events using a 3D forward velocity model:

1. Import the velocity model into InSite using the 'Fast Sweeping Method Builder' Tool. This is launched from the Tools menu item in the menu bar within InSite's data visualiser (Figure 2). A dialog window is launched (Figure 3). In this dialog, select the 'CSV File' option and browse for the location of the csv velocity model file.

   The dialog will automatically fill with the values for the boundaries of the velocity model from the file. It also automatically fills the values for the boundaries of the 'Lookup table'. Please note the units for this are cell numbers (labelled as grid). The default value includes all the volume defined in the velocity model, however for a faster process, this can be reduced.

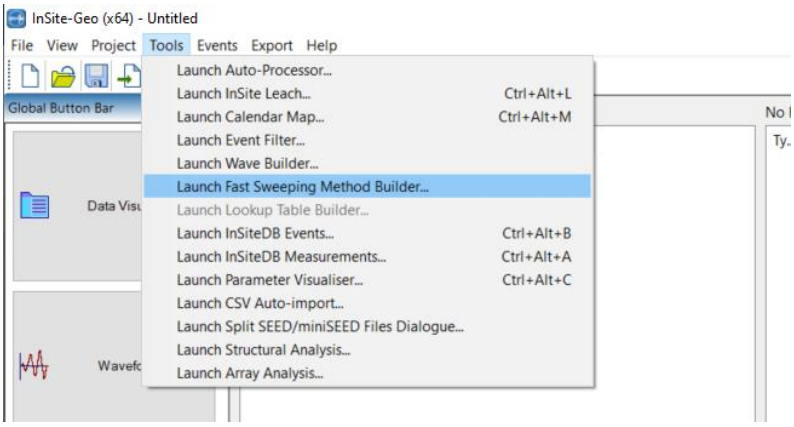

Figure 2: Launch fast sweeping Method builder

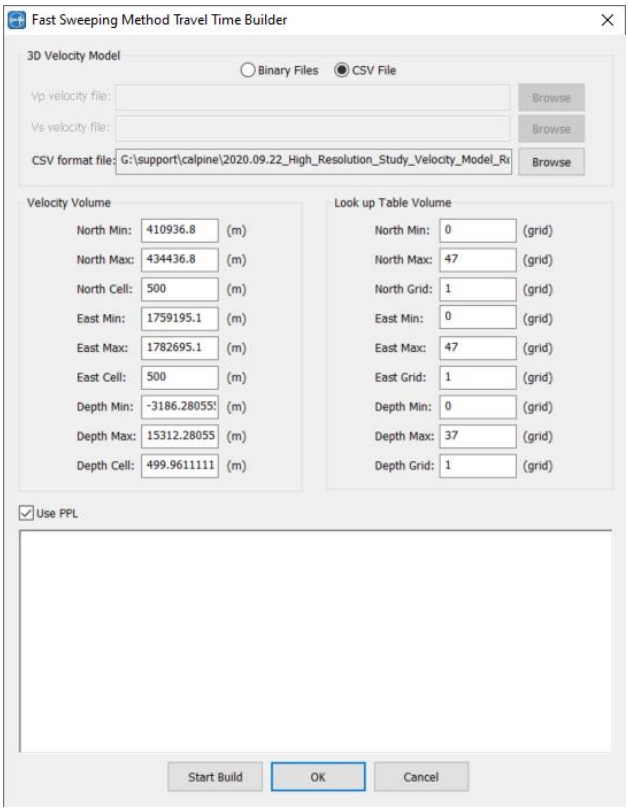

Figure 3: Fast Sweeping Method Travel Time Builder

2. Build the Travel Time Lookup table by clicking 'Start Build'. The info panel at the bottom will inform about the progress. When the process is complete the info panel will show

'Operation Complete' (Figure 4). An hdf5 binary file (extension .h5) containing the travel times is automatically created in the folder containing the csv velocity model. If any warnings have been raised during the process, they will be stored in a log file (Fast Sweeping Method.log) at: C:\ProgramData\ASC\InSite

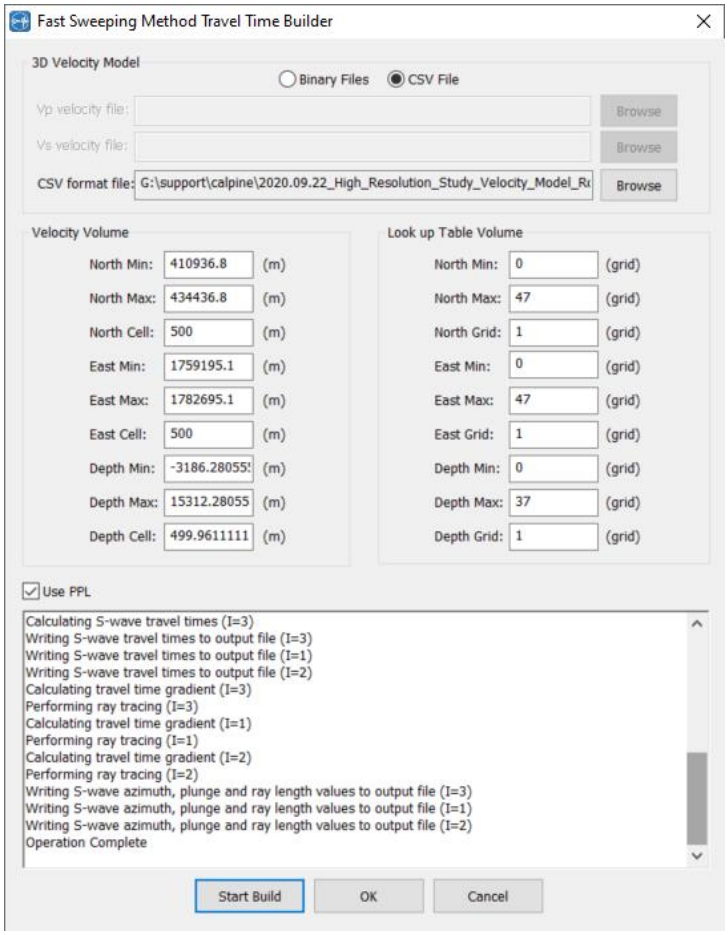

Figure 4: Running the Travel Time table builder

3. Import the Travel time table: The created travel time file (extension .h5) is imported into InSite from Project->Import Travel Time Data… Please note that once the project is closed, the travel time data is not saved into the project and will need to be reloaded the following time the project is opened.

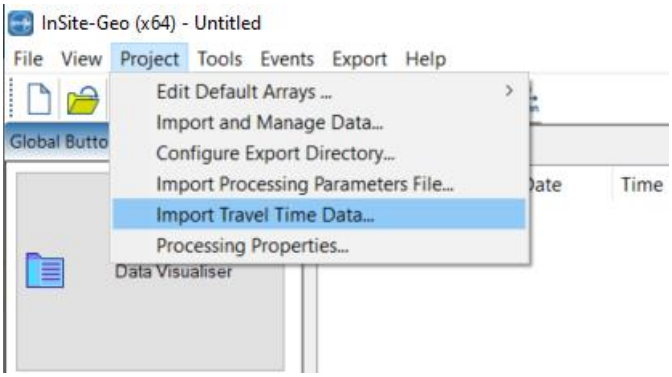

Figure 5:Import Travel Time File

4. Select the Location algorithm in the 'Locater' tab of InSite's processing settings. Event location using complex velocity models can be inverted using one of the two location algorithms:
    a. Collapsing Grid Search
    b. Source Scan

5. Select the Velocity Structure: Complex (Travel Time Grid method)

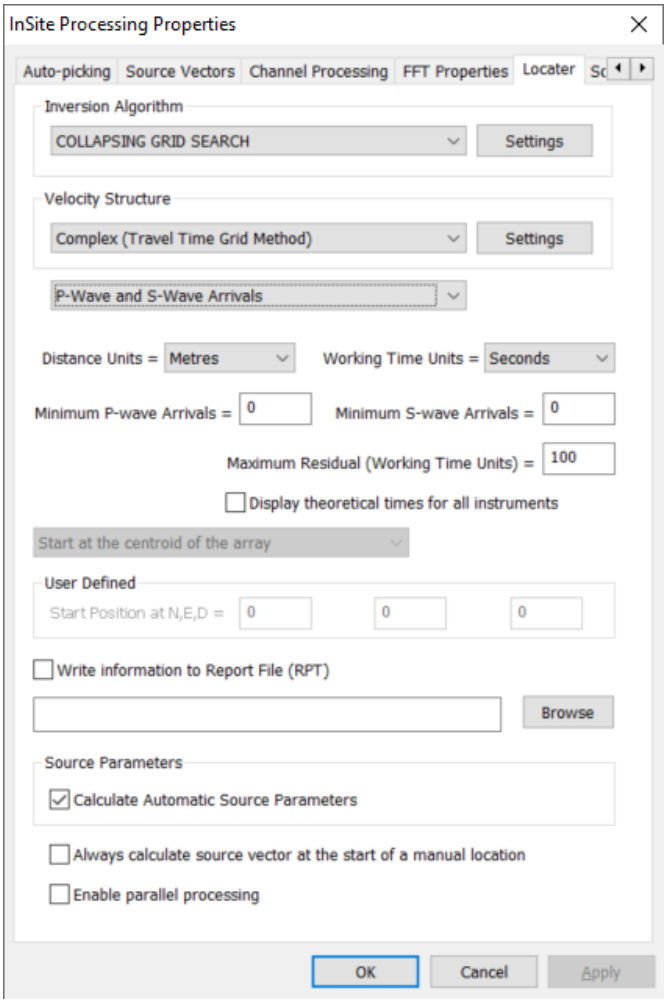

Figure 6: Settings in the Locater tab of InSite's Settings dialog