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IMS Location Uncertainly Clouds Plugin

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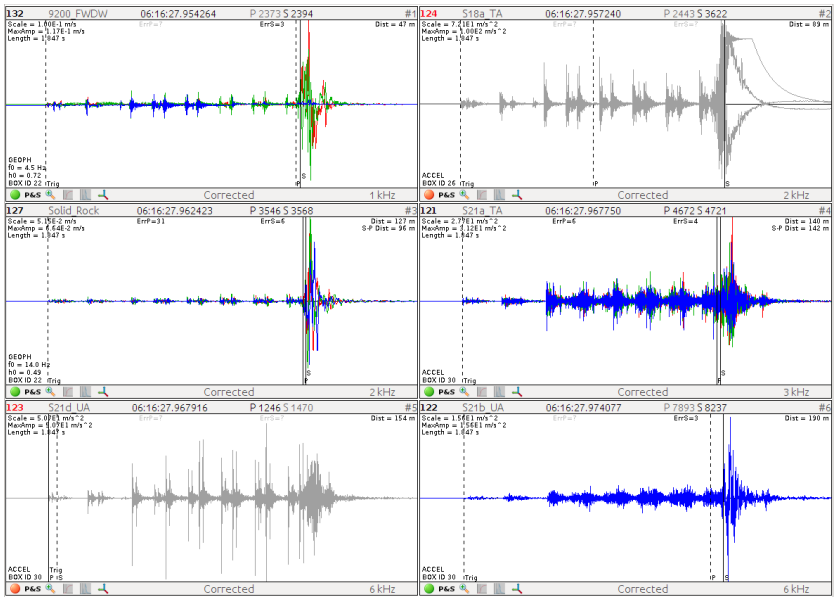
Contents

1 Introduction

Seismic event locations are usually supplied in the format of a single point coordinate in 3 D space. However, in reality events have a size which is described by the area of failure. The point location usually associated with this event may be either the point of rupture of the event, or it may be some location on the area of failure.

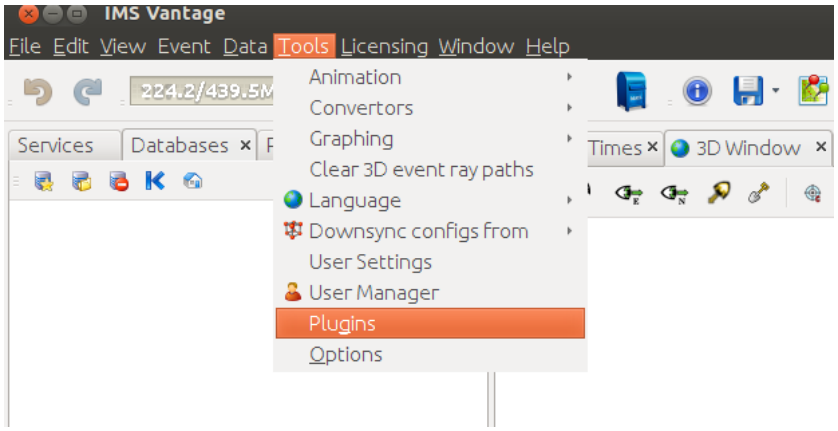
Several factors influence the location accuracy of the event. Some of these factors are the sensitivity of the seismic network, errors in identifying the p- and s-wave arrivals and even the complexity of the waveform. Due to this IMS have developed and algorithm that allows one to analyze the accuracy of the location by identifying a volume of possible locations for the event that depends on an uncertainty in the picking of the p- and s-wave arrivals. An example of a complex seismic event is given below. This event will be used as an illustration of how the seismic event works.



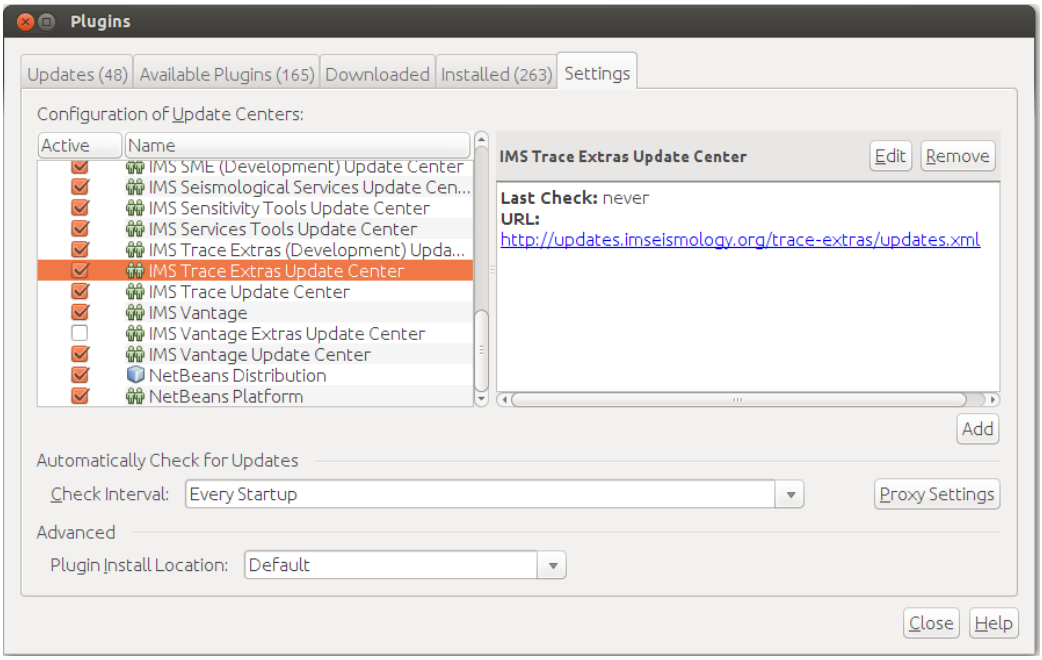
2 Installing the Sensitivity Plug-in

Please note that an IMS application is required that has both Vantage and Trace plug-ins installed. Follow the steps as described below to add the “Location Cloud” plug-in:

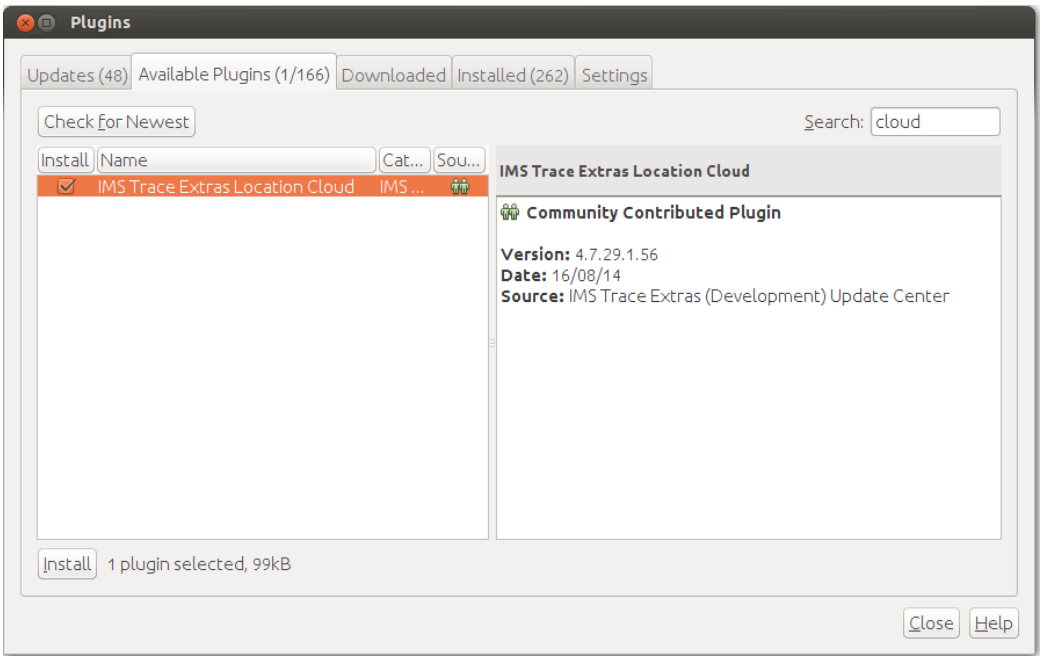
Select the “Plug-ins” action from the Tools menu



Select the "Settings" tab and make sure the "IMS Trace Extras Update Center" is checked.



Select the "Available Plug-ins" tab and type "cloud" in the search box. A plug-in called "IMS Trace Extras Location Cloud" will be listed. Select that module and then select the install button to install.

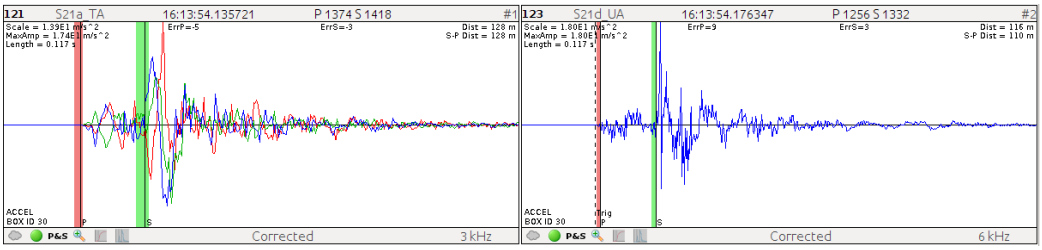


Restart the application for the changes to take effect.

3 Using the Plug-in

3.1 Selecting Uncertainty Regions

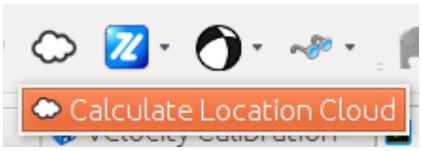
Open the seismic event saved in the seismic database and place p- and s-picks on the waveforms as per usual. Once completed select an interval around the picks which may represent possible arrivals of the p- and s-waves. This may be done by keeping the “Crtl” key selected while using the mouse to drag in area around the event. The p-wave intervals will be marked by red bands and the s-wave intervals will be marked by green bands.



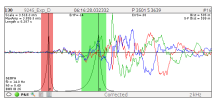
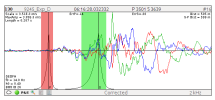
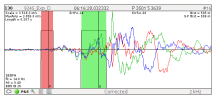
Save the seismic event once uncertainty intervals have been selected for all the seismograms have been selected. Make sure this event stays loaded for the duration of the remaining steps.

3.2 Performing Simulation

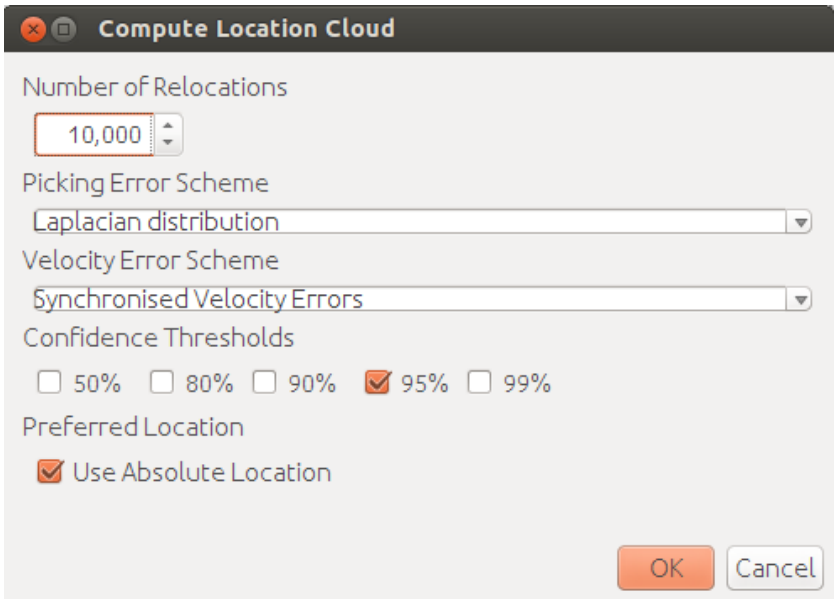
Select the "Cloud" button on the main toolbar and then select "Calculate Location Cloud"



A settings dialog appears.

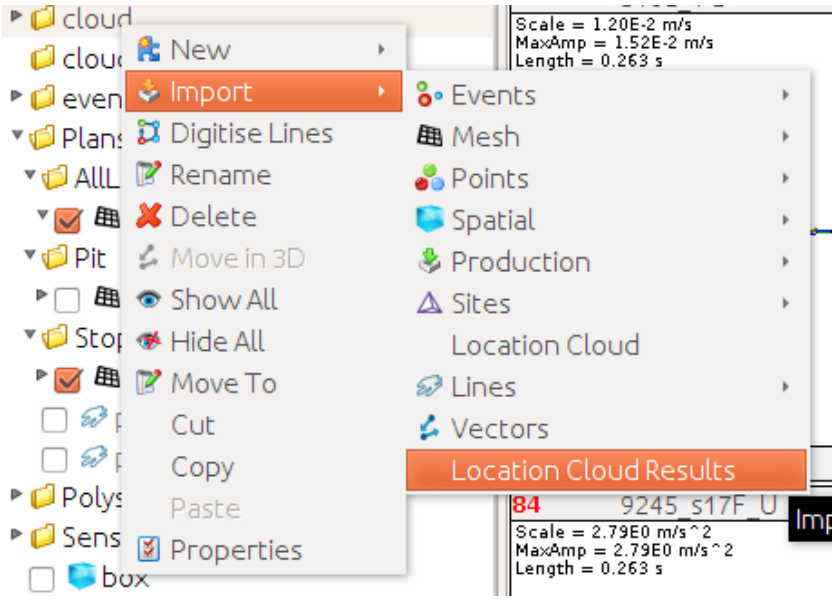
- Number of Relocations: number of relocations to perform using the error schemes defined below
- Picking Error Scheme: The distribution of error in picking
  - Laplacian distribution: 
  - No Picking Error: 
  - Uniform distribution: 
- Velocity Error Scheme: Note that the velocity errors are set in the system and is usually the result of calibration work then needs to be performed.
  - Synchronized Velocity Errors: All sites have the same velocity error for every simulation
  - No Velocity Error: No velocity errors are assumed for the all sites in the simulation
  - Independent Velocity Errors: each site can have independent velocity errors for each simulation

- Confidence Thresholds: this action creates isosurfaces of confidence regions for visualization purposes
- Preferred Location: the location algorithm used for a single location

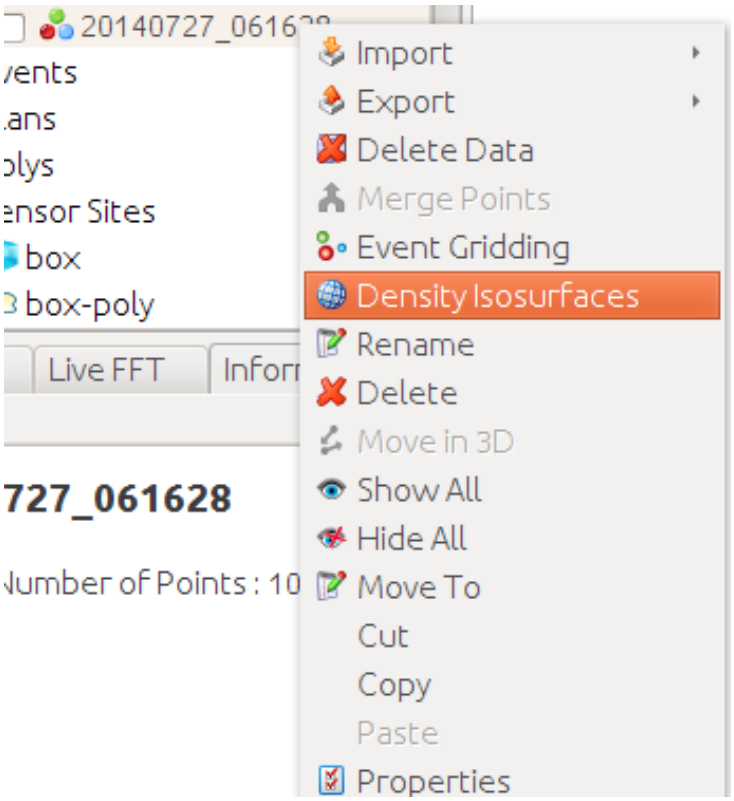


3.3 Viewing Results

Open a Vantage project using the same application in which the event is loaded. Select any folder in the project and “Right-click - Import - Location Cloud Results”.

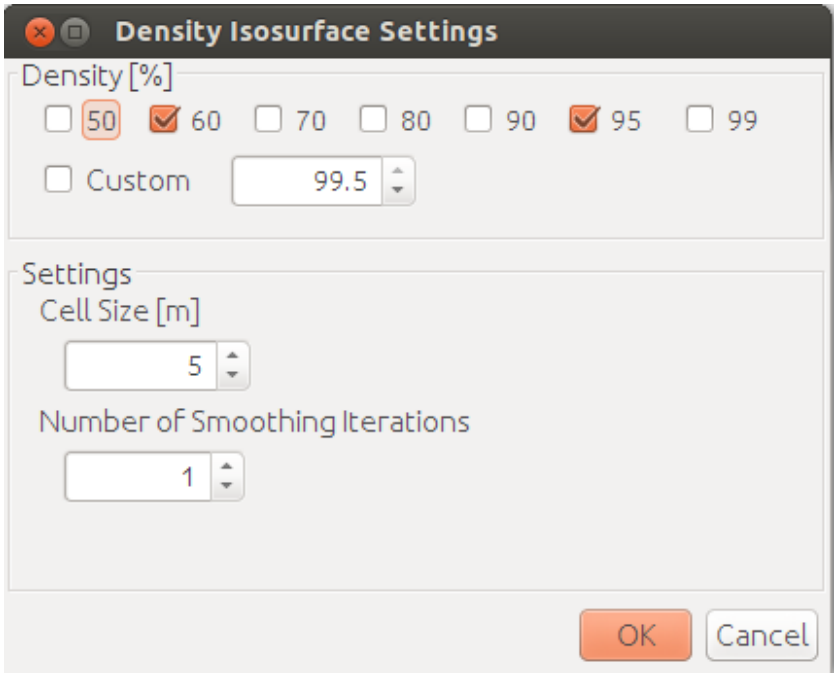


This will import the density point cloud of the locations. To display wireframes of confidence regions right-click on the imported point cloud and select "Density Isosurfaces"

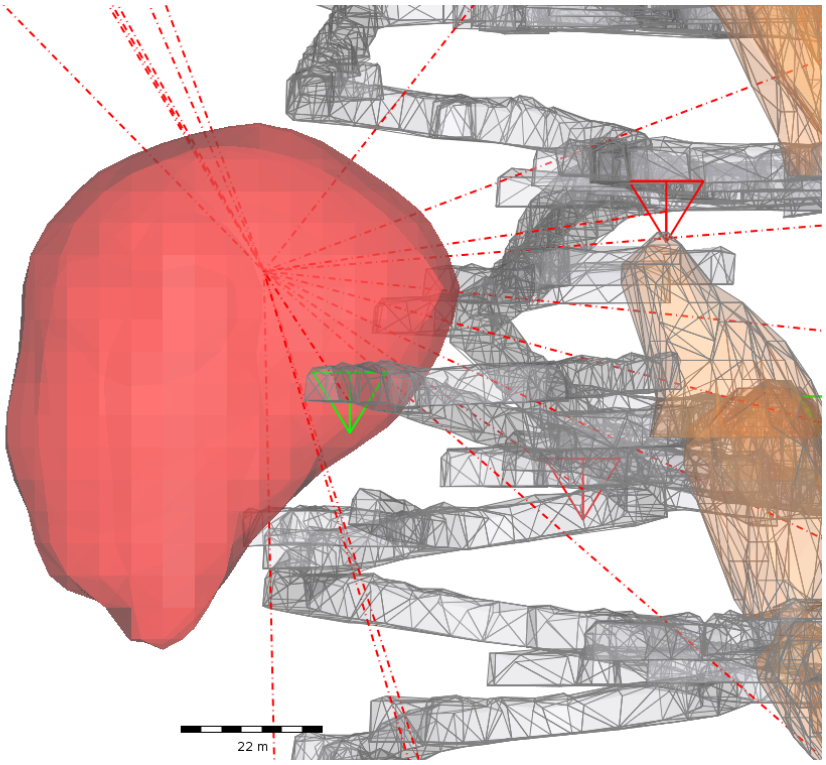


A settings dialog appears.

- Checkboxes representing density regions. Wirefrimes will be created for each checkbox that is selected.
- Cell Size: the cell size of the background grid that will be used for calculations
- Smooting iterations: in some cases the generated wireframe iso-surfaces may not be sufficient for visualisation purposes. By smooting the isosurface it may yield better results.



Select the “OK” button. This will display the wireframes in the 3 D viewer.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