Tools, Tips and Workflows

LP360 Under the Hood - The Conflation Point Cloud Task

LP360

B S A U | A W G

Lewis Graham
February 2014
Revision 1.0

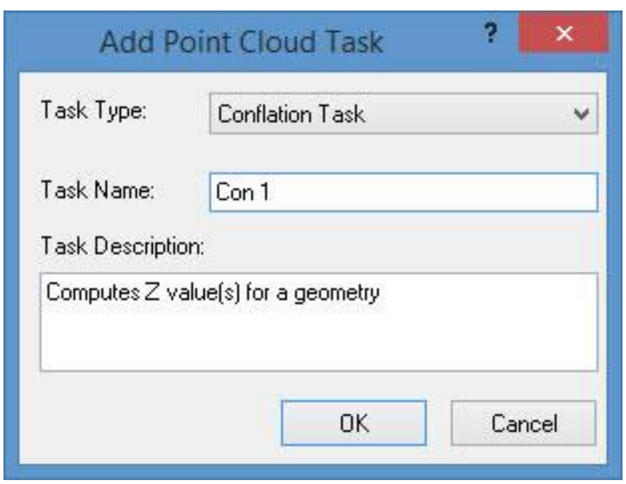
In the January issue of GeoCue News, we discussed the new Point Cloud Task (PCT) overhaul that we released in LP360 2013.2. The focus of the last article was on the new Input/Output Manager (IOM) for setting the inputs and outputs of the various PCTs that LP360 provides.

In this month's article I will describe the new implementation of the Z Conflation PCT. Z conflation allows you to add elevation (Z) values to a point, line or polygon feature. Currently these features must be represented by 2D or 3D Shape files. In a future version of LP360, we will extend this to GeoDatabase features.

Z (elevation) conflation in LP360 comprises a comprehensive collection of algorithms for added or modifying the third dimension of feature data. This Z value is derived, using various algorithms, from the Z values of the underlying point cloud. The Z value can be added as an attribute to a feature (nearly always used for features that exhibit a constant Z) or as the Z value in the shape file.

Z Conflation is available in both the standalone and ArcGIS for Desktop versions of LP360. It requires licensing at the Standard level of LP360. The Z Conflation tool remains available on the Classify toolbar in both versions of LP360. We added Z Conflation as a Point Cloud Task to support workflows that need conflation as part of a Macro series. The immediate driver was the new Volumetric Analysis tools that were released in LP360 2014.2 (to be covered in the next addition of GeoCue News).

The Conflation Task is set up similar to any other task in the Point Cloud Task system. Select "Conflate Task" from the drop down menu "Point Clouds Tasks" on the Point Cloud tabs of the Table of Contents (see Figure 1). Give the task a name (I've called mine "Con 1") and press OK.



QCoherent Software LLC
www.LP360.com
256-461-8289 (phone)
256-461-8249 (fax)

Figure 1: Adding a Conflation PCT

A new conflation point cloud task will be created from the Conflate task template.

The conflation PCT requires an input geometry. This geometry can be supplied in one of three ways:

- Digitize with the new PCT digitize tools (“Tool Geometry”)
- From a 2D or 3D shape file
- From a layer in the Table of Contents (TOC) that maps to a shape file

The new Tool Geometry option allows you to simply sketch a feature (point, polyline or polygon). During the drawing operation LP360 will probe the point cloud and assign an elevation value to the feature. This is extremely handy for quickly sketching 3D shapes. For example, I often use this tool for interactively collecting spot elevations from LIDAR data. Using the line tool, you can quickly cut 3D cross sections.

Using the file or layer option allows you to process an entire file/layer of features. An example would be converting a file of 2D building footprints to 3D footprints by computing an average elevation for each feature (all potentially different, of course) from a ground classified LIDAR data set.

Let’s do a quick run through of the parameter settings for the task and then spend some time on the available conflation methods. Refer to Figure 2.

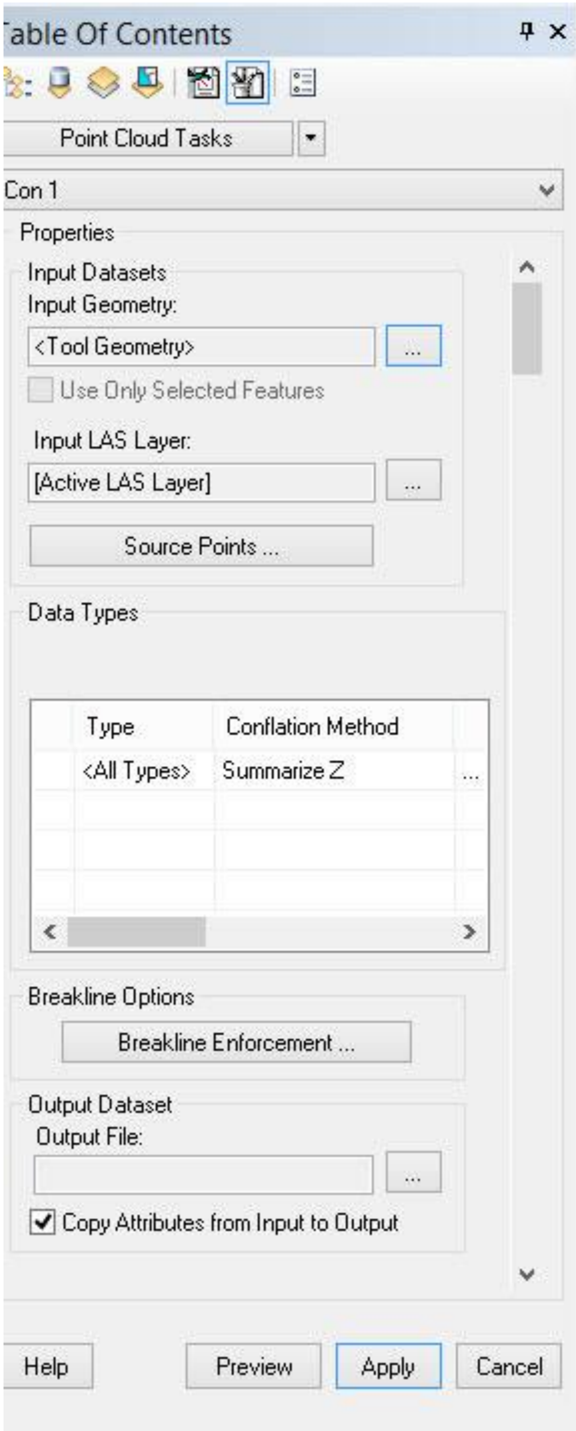


Figure 2: The Conflation Task Settings

- Input Geometry – This brings up the Input/Output Manager (IOM). Use of the IOM was covered in the January issue of GeoCue News (you can access this from either geocue.com or lp360.com).

Remember that it is most convenient to use the environment variable "LP360_PROJECT_PATH" in the IOM definitions. By setting this variable via Project Settings, you can use the same task/macro for all of your projects.

- Use Only Selected Features – Check this box if you are using a Layer as input and you only want to process features that you have selected on that layer.
- Input LAS Layer – you can always simply accept the default of "Active Layer" if you have only one layer of LAS files in your project. If you have created more than one layer (not the usual configuration), select the layer to be used for Z probing using the IOM.
- Source Points – This allows you to filter the LAS points that will be probed for Z computation. For example, if you were conflating Z onto building footprints, you would only want to use the Ground class.
- Data Type – Discussed below. This is where the conflation algorithms and Z storage locations are set.
- Breakline Enforcement - This allows you to set breakline enforcement that differs from that set for the display (something that you cannot do with the Classify Tool Bar version of Conflation).
- Output File – The Conflation task always generates a new output file in Shape File format. As with all PCT input/output functions, this invokes the IOM. Recall from last month's article that you can check the box in IOM to automatically add the result to the Table of Contents. With this option checked, you will immediately see features added to the Map View as you digitize those features.
- Copy Attributes from Input to Output – If you are conflating features contained in an input file, you may want to copy the attributes associated with that file to the new output file that is being created by the conflation task. You can think of this as a "Retain Attributes" option.

Let's drill down into the Data Type settings (see Figure 3).

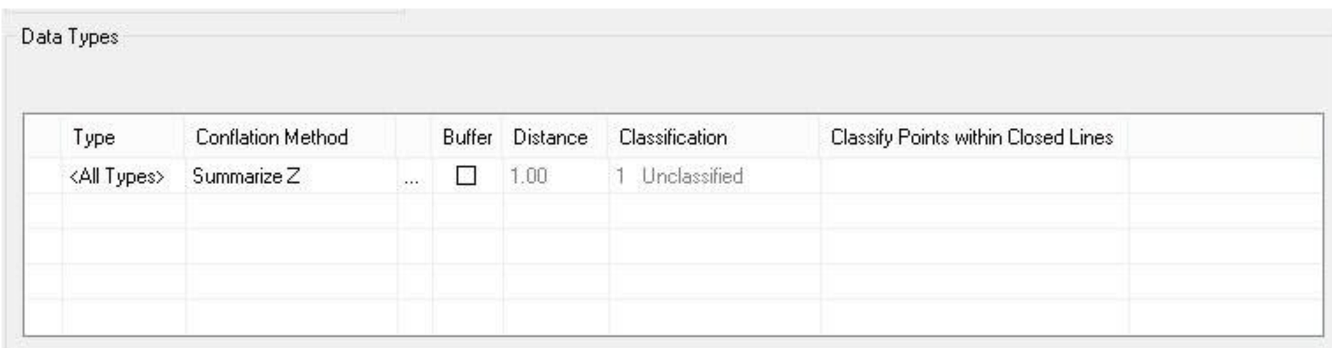


Figure 3: Data Type Settings

The Types column allows you to set different conflate methods for features contained in a file or the TOC based on an attribute field associated with the feature. For example, if you had an attribute named "Water Body Type" that was set for different features in the file as "Lake", "Pond" and "Stream", you could use this field value to select different conflation techniques. This is a very handy option when you are dealing with files containing heterogeneous data.

The Conflation Method will be described below (it takes us to another settings dialog).

"Buffer" is a misnomer (I don't know why we have not yet fixed this!). It should actually read "Classify." If checked, points within "Distance" of the geometry (Point, Line, Polygon) will be set to the classification value set in the Classification section. This is very handy, for example, if you are conflating water body polygons. You can set these fields to reclassify everything within the water body polygons to the Water class. I personally do not use this option since I like to see the results of the conflation prior to reclassifying. Note that if you do use this feature, the LAS files must be loaded for Read/Write.

The Conflation Method (Figure 4) allows you to set the method by which Z values will be computed and/or constrained.

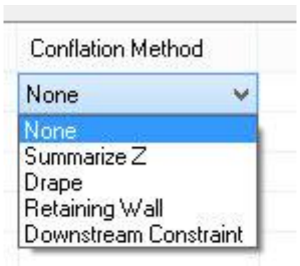


Figure 4: Conflation Method

These methods are detailed in the LP360 on-line help and summarized here:

- Summarize Z – This computes a Z value using a variety of methods (to be described below) and assigns a value in the attribute table of the feature or on a per-vertex basis.
- Drape – This method creates vertices derived from draping the feature on a Triangulated Irregular Network (TIN) constructed from the LAS data. If you choose the Pure Drape method, use with care since very dense point data (such as from Mobile Laser Scanning, MLS) can create a lot of vertices!
- Retaining Wall – This method creates a double, parallel line feature with a user specified distance between the lines. You can set one line to conflate to maximum Z and the other to minimum Z. Using this to digitize along features such as a seawall will provide parallel 3D lines at the base and top.
- Downstream Constraint – This method modifies the input line to ensure that a monotonic decrease in Z occurs along the line. You can set the maximum deviation permitted for a vertex to be moved above or below the underlying point cloud surface. As you may have recognized, this is the same tool available in the breakline digitizing tool set.

Finally, the "…" column of Data Types is double clicked to set parameters for the Conflation Method. The dialog displayed when this column is double clicked is a function of the Conflation Method. These are fully described in the on-line help but I want to take a bit of time with the option available on the Summarize Z method. These options are depicted in Figure 5.

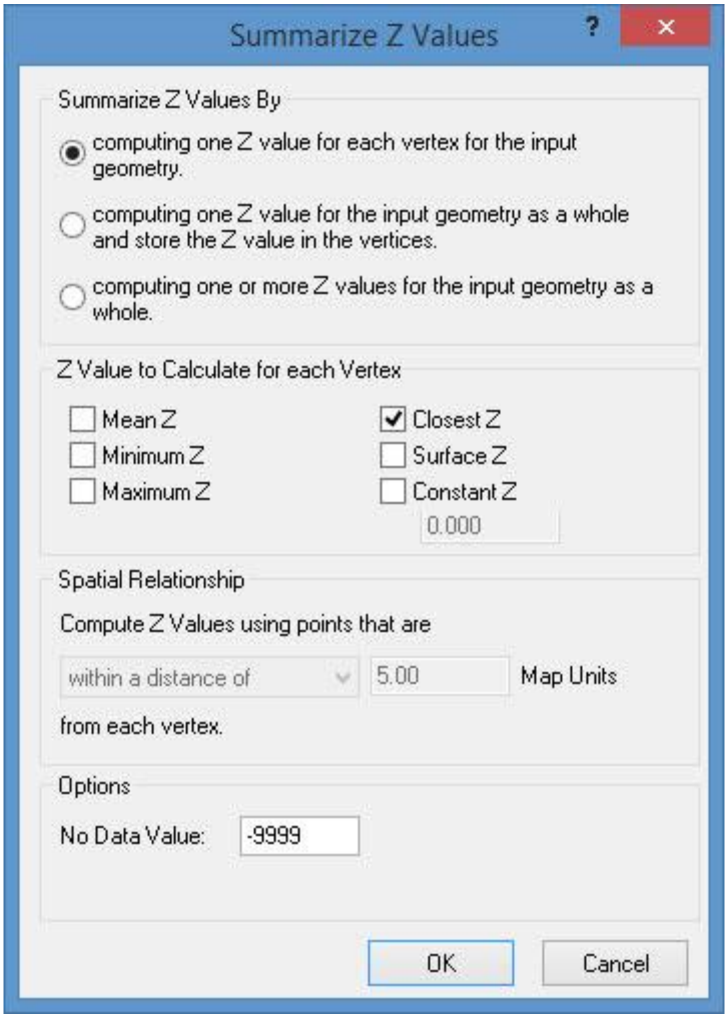


Figure 5: Summarize Z Options

The first section specifies how Z will be computed and where it will be stored:

1. The first option stores a Z value per vertex in the Output file. Each of these Z values will be, in general, a different value except when “Constant Z” is chosen in the Z Value to Calculate section.
2. The second option computes a Z value and stores that same Z value on each vertex. This creates a horizontal, planar feature. Note that when this option is selected, the computations methods of Closest Z and Surface Z are removed from the computation options (since these would make no sense for a planar feature). This (and the next option) are typically used for Water Body Flattening. Note that they are useful any time all vertices of a shape must be at the same height (for example, this is usually the case for generalized building footprints).
3. The third option operates the same as the second option above except the constant Z value is stored in the Attribute table of the feature. Note that this option will allow you to select multiple calculation methods. In this case, a separate attribute is created for each option you select. This option is useful when you want to be able to use the Z values in a table-driven analysis or visualization.

The next section of the dialog allows you to specify the method that will be used in the computation of the Z value. If you chose Mean, Max or Min, the “Within a Distance of” parameter is enabled. For these computations, the software considers all points within the specified distance of the vertex under consideration and performs the indicated operation (for example, compute mean). You need to be careful of the distance that you apply for this computation since it can cause unexpected results. For example, if you are digitizing a base around a gravel pile for a volumetric computation and specify a large distance, many of the points included in the computation will actually be on the gravel pile rather than in the base area. On the other hand, if you specify a distance much smaller than the nominal point spacing of the point cloud data, you will produce a lot of voids. Fortunately, with our new PCT digitize tools, it is very easy to experiment with these settings and analyze the result.

Finally, the No Data Value allows you to specify the value of Z that should be used if no point cloud data meet the parameters that you have specified in the previous sections. This could occur, for example, if you pick a method such as Mean, specify a radius of 5 but no points (filtered by the Source Points filter) are within 5 units of the vertex being computed.

As with all software, the very best way to become proficient in its use is to practice. Using the interactive geometry tools method makes this very easy to do. I recommend experimenting with the standalone version of LP360 since you can immediately inspect the values applied to the vertices of features with the inspector tool.

In the next edition of *LP360: Under the Hood*, we will examine using the new Conflate PCT to create a base for a volumetric computation. Until then, happy conflations.