CueTip

Ground Coordinate Systems

Applies to GeoCue 2011 and above.

GeoCue Group Support
April 15, 2015
Revision 2.0

Purpose:

This technical note explains Grid-to-ground projections (AKA “ground coordinates”, “surface coordinates”, “localized coordinate networks”, etc.) within GeoCue. A ground coordinate system is a local coordinate system created by modifying the origin and scale of an existing projected coordinate system, such as a state plane or UTM grid system. The ground system is tied to the grid system at the specified origin (specified in grid system coordinates) and scale corrections are applied. Ground measurements will more closely match measurements in this local system than in the standard grid system on which it is based. However, scale distortions will increase as the distance from the local origin increase, and with changes in elevation.

In order to define a ground coordinate system the user needs to know:

- ground-to-grid scale factor (**If the scale factor represents the grid-to-ground instead, make sure to take the reciprocal before entering the information in the GeoCue dialog)**
- a local origin for the ground system (easting/northing) in the selected state plane coordinate system
- ***optionally***, an additional false easting/northing pair to “add” at the end

Introduction

Grid-to-ground projections are important because they allow data collected using conventional survey techniques to be incorporated in GIS-type environments, such as GeoCue, and likewise GeoCue projected grid data to be exported to those ground systems. These data can be displayed in GeoCue by modifying a standard projection coordinate system definition file. Also, LAS data can be populated to/from ground projections in GeoCue, without the need for additional conversion processing.

Identifying the scale and shift values

As described above, grid-to-ground projections provide a way to "tie" survey (ground) data to a projected system, such as state plane or UTM ("grids"). The two coordinate systems are tied together at a point identified as the local origin: E_{LO}, N_{LO}. The two systems share the same coordinate at this point. The scaling between the two coordinate systems happens about this point and the mapping is described by:

$$E_g = (E_{sp} - E_{LO})*\text{scale} + E_{LO}$$

$$N_g = (N_{sp}-N_{LO})*\text{scale} + N_{LO}$$

Where E_g and N_g are easting and northing ground values, and E_{sp} and N_{sp} are state plane, or other grid coordinates.

The scale parameter in these equations is the grid-to-ground scale at the local origin, and must be provided by the surveyor. Note however that the surveyor is typically considering how to move from ground-to-grid and hence the scale factor he determines is the reciprocal of that identified above. The factor that the surveyor calculates has two components: one for reducing the ground values to the ellipsoid, and a second for reducing the ellipsoid values to the projection surface. The product of these is known as the "combined factor" (CF), or if calculated from multiple control points, the "average combined factor" (ACF). Again, if a CF or ACF is provided, the reciprocal must be used in the equations above.

Specifying the Ground System

A ground coordinate system is a local coordinate system created by modifying the origin and scale of an existing projected coordinate system, such as a state plane or UTM grid system. In the *Horizontal Coordinate System* section of the *Select/Create Coordinate Reference System* dialog (**Figure 1**) select the projected coordinate system upon which you wish to base the ground coordinate system. Then check the *Create Custom Coordinate System from Selection* checkbox to open the Custom Coordinate System Settings portion of the *Select/Create Coordinate Reference System* dialog. Check the *Create Ground Coordinate System* checkbox item. The dialog will expose fields to allow you to enter a name for the new ground system (for an existing GeoCue project, a default name based on the project name is provided, but you may override the default and enter an alternate name).

Specify the location of the origin for the local system (in the original grid system coordinates) and the factor to use for scale correction. You may optionally enter additional False Easting and False Northing offset amounts (e.g. an additional 100,000 foot offset in each direction can aid in distinguishing ground coordinates from standard grid coordinates).

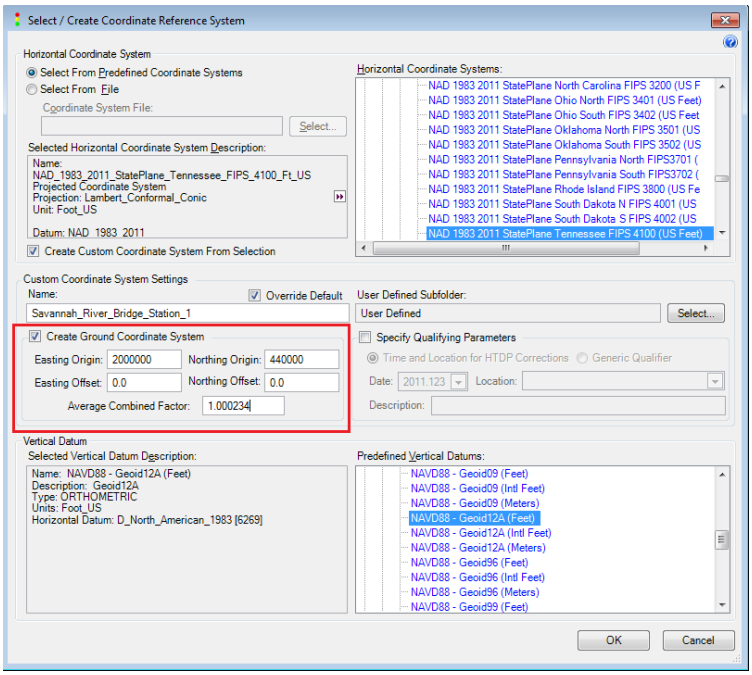

Figure 1 - Create Ground Coordinate System

A new coordinate system with the indicated name will be created and will appear in the User Defined folder, or a selected subfolder, of the *Horizontal Coordinate Systems* section of the *Select/Create Coordinate Reference System* dialog for future use.

Tips to keep in mind

1) If the user has a scale factor that represents the grid-to-ground factor instead, take the reciprocal before entering in the GeoCue dialog.
2) When entering Easting/Northing Origin/Offset values, make sure they are in the same ground units as the selected horizontal coordinate system.
3) If instead of the inputs enumerated above, the user simply wants to apply a scale to state plane (grid) data to get ground values, then simply enter the ground-to-grid factor, and zero elsewhere.
4) If instead of the inputs enumerated above, the user wishes to *subtract* an offset (i.e. easting/nothing values), then apply a scale, do the following:
    a. Enter the offset values as the Easting/Northing Origin values
    b. Enter the *negative* of the offset values as the Easting/Northing Offset values
    c. Enter the ground-to-grid scale

In all cases, the resulting ground values from the new GeoCue ground coordinate system will be calculated as follows:

EastingGround = (EastingGrid – EastingOrigin) * 1/ground-to-grid + EastingOrigin + EastingOffset

Where EastingGrid is a State Plane easting, EastingOrigin is the ground system origin, and EastingOffset is that "optional" additional false easting. Northing coordinate calculations follow similarly.

For information on this CueTip, contact:

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