



## ***NGS Toolkit, Part 9: The National Geodetic Survey VERTCON Tool***

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The National Geodetic Survey (NGS) role in managing and defining the National Spatial Reference System (NSRS) includes the responsibility to develop tools allowing users to transform data between different systems.

To support users needing to transform data between the National Geodetic Vertical Datum of 1929 (NGVD 29) and the North American Vertical Datum of 1988 (NAVD 88) NGS has developed the VERTCON program. The magnitude of the differences between the two height systems is shown in Figure 1.

VERTCON, currently version 2.0, is available as an element of the NGS Geodetic Toolkit and is available for download from the NGS website.

The web-based version of VERTCON does not allow users to upload a file of points. The version available for download includes this feature. Operation of the download version will not be discussed here.

### **What Data Was Used to Create VERTCON?**

VERTCON computes the modeled difference in orthometric height for a given location specified by its latitude and longitude.

The model was derived from 381,833 datum difference values. These differences reflect not only the physical differences in the height systems but also the removal of distortions in the level data.

Models of the refraction effects on geodetic leveling and the gravity and elevation influences on the new NAVD 88 datum were used to improve the accuracy of the model.

The datum difference values were converted to a grid. VERTCON interpolates the datum transformation at a user-specified coordinate using these grids.

### **Where Can it Be Used?**

VERTCON is not considered to be reliable beyond the boundaries of the lower 48 United

States.

Because the grid structure extends beyond the conterminous states, it is possible to obtain values in Canada, Mexico, and in offshore regions. As these values do not contain important model components, they should not be considered to be reliable.

### **When Should it Be Used?**

Users with a need to transform height data between NGVD 29 and NAVD 88 can use the VERTCON tool. Because the VERTCON model can be considered accurate at the 2 cm (one sigma) level, it is suitable for a variety of mapping and charting purposes. As a model, it can not maintain the full vertical control accuracy of geodetic leveling. Users needing high accuracy should adjust their observations using published NAVD 88 values.

### **Problem Lines in VERTCON**

In rare cases, local distortions of 20 cm or more were found in the NGVD 29 network. The existence of these distortions can be determined by performing transformations around the project area. If dramatically different transformations are obtained over a small area, the presence of a problem NGVD 29 line is indicated. Users encountering these problem lines should contact NGS for further assistance.

### **Using the VERTCON Tool**

Data for a bench mark in Maryland illustrates the use of VERTCON. Current data for a first-order bench mark, 106 A, is shown in Figure 2. The height in the superceded system, NGVD 29, is shown in Figure 3.

Selecting the VERTCON tool will display the page (Figure 4). Selecting "Height Conversion" will open the form (Figure 5). Enter the position and height for bench mark 106 A here.

The program uses a user-entered geographic position to interpolate the shift at that point. The entry of an orthometric height is optional.

As most of the horizontal positions used to generate VERTCON were scaled from topographic maps, the uncertainty in the scaling exceeds the difference between NAD 27 and NAD 83. The latitude and longitude you enter can be either NAD 27 or NAD 83. Users can convert a height or merely determine the shift at a point. Heights can be entered in either meters or feet. The default unit is the meter. When entering heights in units of feet you must add either "ft" or "FT" to the value.

The output from our conversion of an NAVD 88 height to its NGVD 29 value is shown in Figure 6. The output shows our input values as well as the datum shift and the transformed height for the location we specify.

If the conversion were performed from NGVD 29 to NAVD 88 the datum shift value would be the same. The output will always show the shift in the sense NAVD 88 minus NGVD 29.

If no height had been entered for the conversion, only the datum shift value would have been shown. Remember that when subtracting negative numbers, we add them together.

### **Concluding Remarks**

In the exercise above a point with adjusted heights in both NAVD 88 and NGVD 29 was transformed using VERTCON. In this case we transformed the published NAVD 88 height (44.901 meters) to its NGVD 29 value. A comparison of the published NGVD 29 height (45.121 meters) with the transformed height (45.118 meters) shows excellent agreement (0.003 meters). Your results may vary. Like all transformation packages based on grids of differences, the accuracy of the transformations is dependent on the quantity and quality of the underlying data.

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