GEOCON Software Preview

Dave Zenk
NGS Advisor
April 30, 2013

Coordinate Migration

- Users have always been vexed by having to convert coordinates from one system to another.
- Traditional "rotate, translate, scale factor" not adequate for large collections of coordinates over large geographic extents.
- Need better, more powerful tools.

Coordinate Migration

- Best way (most accurate) is to re-adjust original measurements constraining to new coordinate system.
  - Not practical because most users (foolishly) fail to store measurements in a useful database!

Coordinate Migration

- Second best way is to develop a gridded transformational algorithm to predict, based on surrounding known coordinate shifts, what the shift would be for any other point.
  - Less accurate because it relies on surrounding data to be well-behaved and similar to the point in question.
  - Many examples in MN show that this is not the case!

Coordinate Migration

- Nevertheless, it is often the ONLY way forward.
- Users must accept responsibility for verifying the results as new surveys occur.

Step-by-Step Conversion Tools

- NAD27
- NAD83(1986)
- NAD83(HARN - year varies by state)
- NAD83(2007)
- NAD83(2011)

Step-by-Step Conversion Tools

- NAD27 ← NADCON
- NAD83(1986) ← NADCON
- NAD83(HARN) ← GEOCON
- NAD83(2007) ← GEOCON11
- NAD83(2011)

NADCON

- NADCON was developed in order to facilitate conversion between the North American Datum of 1927 (NAD 27), Old Hawaiian Datum and Puerto Rico Datum to the North American Datum of 1983 (NAD 83 (1986)).
- The grids used by the program are based on more than 150,000 horizontal control points whose coordinates reside in NGS' data base, and provide transformed positions based on the shifts of the control nearest to the input position.
- Advances in the accuracies now obtainable in geodetic surveys, specifically through use of differential GPS, has allowed for the creation of state High Precision Geodetic Networks (HPGNs), also referred to as High Accuracy Reference Networks (HARNs) throughout the country. NAD 83 coordinates based on the HPGN/HARN surveys changed approximately 0.2 to 1.0 meter relative to the original NAD 83 (1986) adjustment. As these high accuracy networks have been completed, the horizontal geodetic network of each state has been re-adjusted to be consistent with its network of A- and B-order control, thus creating a need for grids that allow for the transformation from the NAD 83(86) adjustment to the new adjusted values. These grids carry the designation 'HPGN' to distinguish them from the grids created from the original NAD 83(86) adjustment. The accuracy of transformations between NAD 27 and NAD 83 (1986) are typically 12-18 cm and 5-6 cm between NAD 83 (1986) and HPGN.

NADCON

- NADCON converts NAD83(1986) to/from NAD83(HARN) – the NGS website states:

- Advances in the accuracies now obtainable in geodetic surveys, specifically through use of differential GPS, has allowed for the creation of state High Precision Geodetic Networks (HPGNs), also referred to as High Accuracy Reference Networks (HARNs) throughout the country. NAD 83 coordinates based on the HPGN/HARN surveys changed approximately 0.2 to 1.0 meter relative to the original NAD 83 (1986) adjustment.
- As these high accuracy networks have been completed, the horizontal geodetic network of each state has been re-adjusted to be consistent with its network of A- and B-order control, thus creating a need for grids that allow for the transformation from the NAD 83(86) adjustment to the new adjusted values. These grids carry the designation 'HPGN' to distinguish them from the grids created from the original NAD 83(86) adjustment. The accuracy of transformations between NAD 27 and NAD 83 (1986) are typically 12-18 cm and 5-6 cm between NAD 83 (1986) and HPGN.

NADCON

- NADCON converts NAD83(1986) to/from NAD83(HARN) – the NGS website states:
- In 1992, NADCON capability was expanded to include transformations of latitude and longitude coordinate values between NAD 83 (1986) (includes post NAD 83 adjustments) and state readjustments to HARN projects.
- Latitude and longitude conversions from NAD 83 (1986) to HARN and from HARN to NAD 83 (1986) are computed in the same manner as those conversions between NAD 27 and NAD 83 (1986), but access HPGN (HARN) prepared files instead of the original Conus, Alaska, etc. grid files.
- Prior to 1992 HARNs were referred to as High Precision GPS Networks (HPGN) and that acronym is used in NADCON. Pairs of grid files are available for the following states: (list)

GEOCON

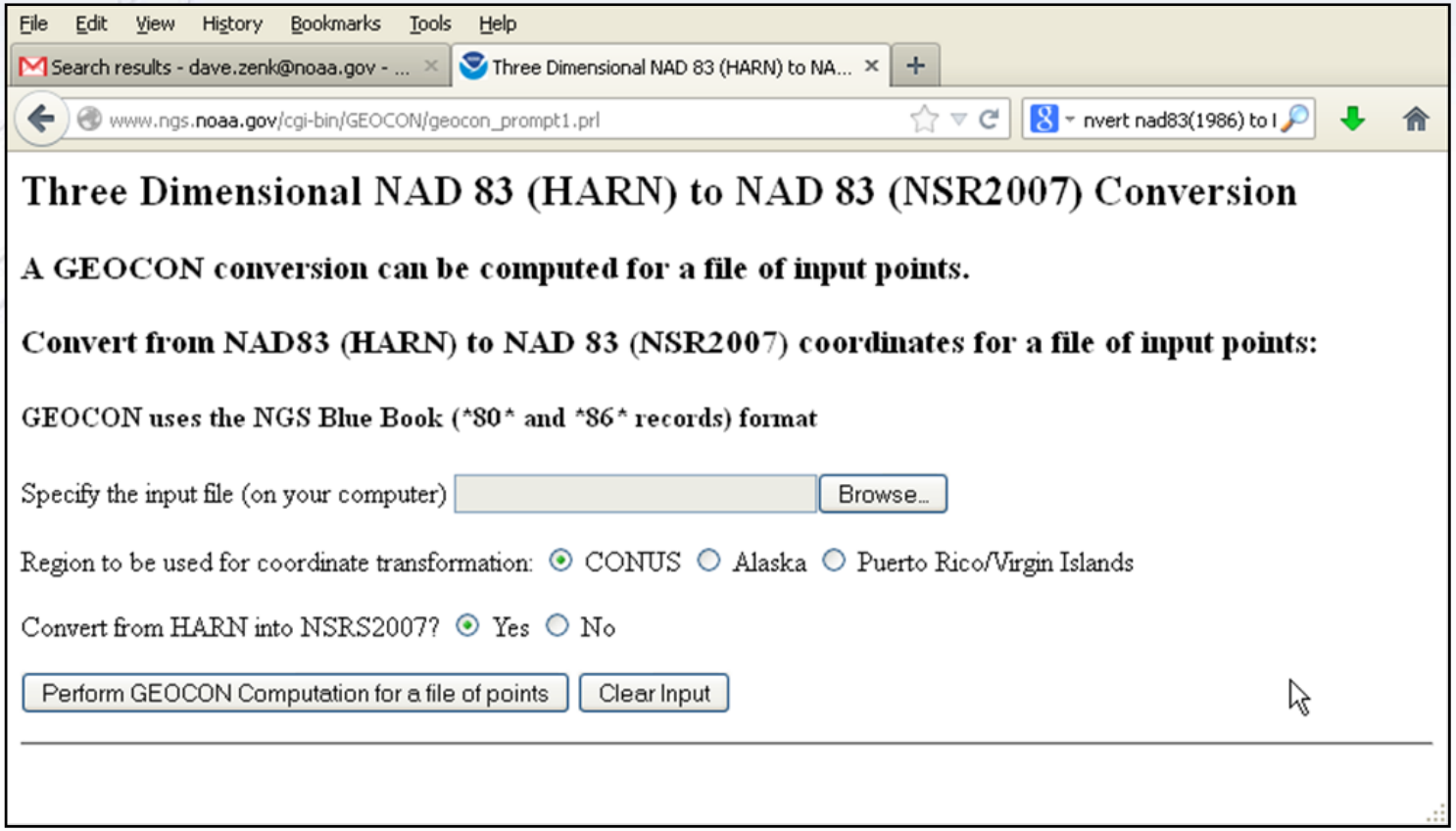
- GEOCON performs three-dimensional coordinate transformations between NAD 83 (HARN) coordinates and NAD 83(NSRS2007) coordinates. GEOCON also issues information about the quality of the transformation at each point, and notifications regarding poor quality results.
- GEOCON is written as a simple demonstration program that recognizes the NGS Blue Book *80* and *86* position records. The coordinate transformation and the associated quality values are obtained through biquadratic interpolation within a series of grids. Third party applications may obtain identical results if they use the same grids and algorithms.
- GEOCON employs high resolution grids (1 foot by 1 foot) to obtain unprecedented fidelity in modeling coordinate differences. Frequently, one may see that the reported quality is extremely high (e.g. 1 cm or better), and could be considered comparable to a geodetic readjustment of survey measurements. Nonetheless, the National Geodetic Survey considers actual readjustment of survey measurements, and not coordinate transformations, as "best practice"

GEOCON11

- GEOCON performs three-dimensional coordinate transformations between NAD 83 (2007) coordinates and NAD 83(2011) coordinates. GEOCON also issues information about the quality of the transformation at each point, and notifications regarding poor quality results.
- GEOCON is written as a simple demonstration program that recognizes the NGS Blue Book *80* and *86* position records. The coordinate transformation and the associated quality values are obtained through biquadratic interpolation within a series of grids. Third party applications may obtain identical results if they use the same grids and algorithms.
- GEOCON employs high resolution grids (1 foot by 1 foot) to obtain unprecedented fidelity in modeling coordinate differences. Frequently, one may see that the reported quality is extremely high (e.g. 1 cm or better), and could be considered comparable to a geodetic readjustment of survey measurements. Nonetheless, the National Geodetic Survey considers actual readjustment of survey measurements, and not coordinate transformations, as "best practice"

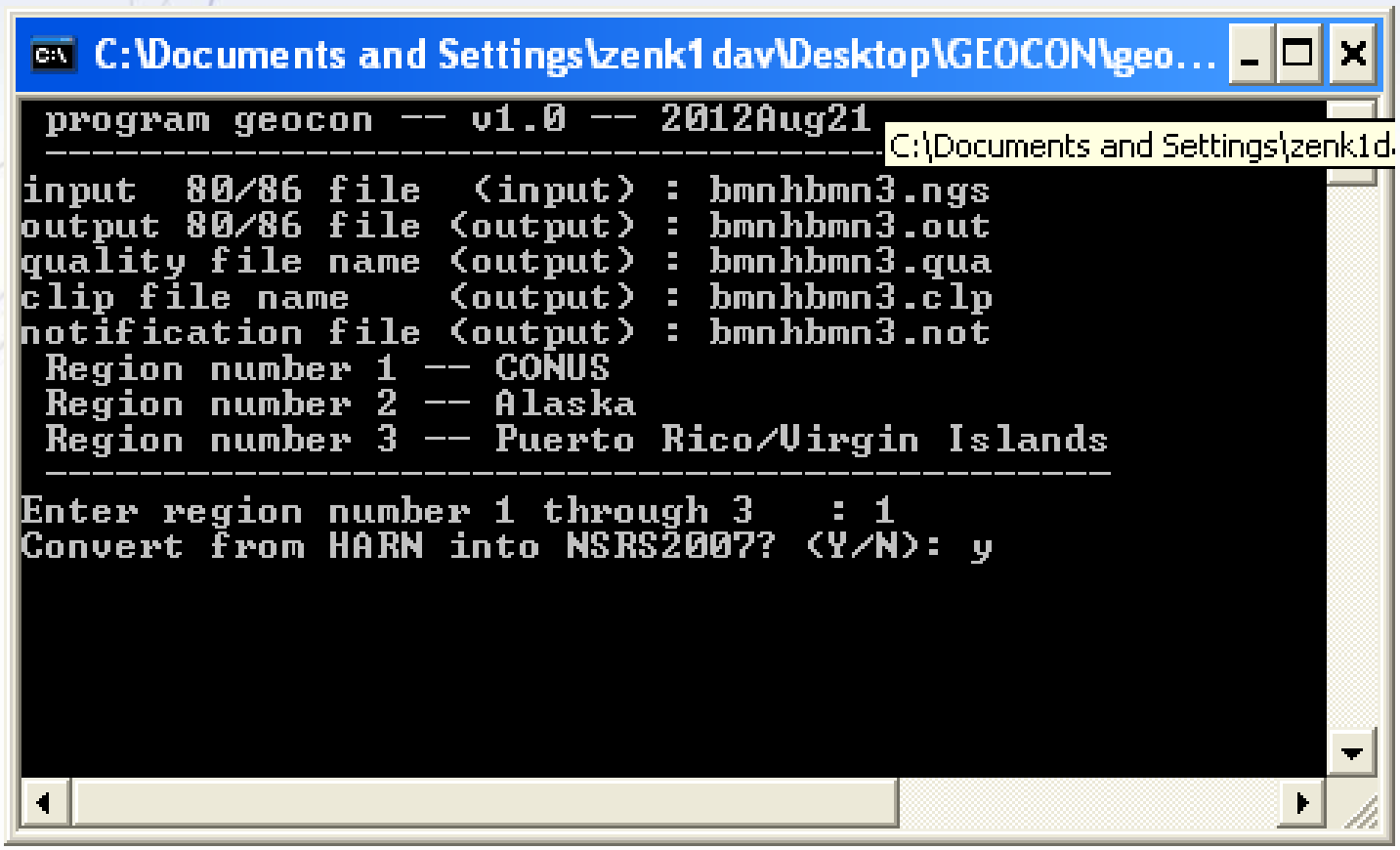
GEOCON Interface

- Online Interactive Interface



GEOCON Interface

- Off line (PC) Interface – can anyone say 1980?



Accuracy Test

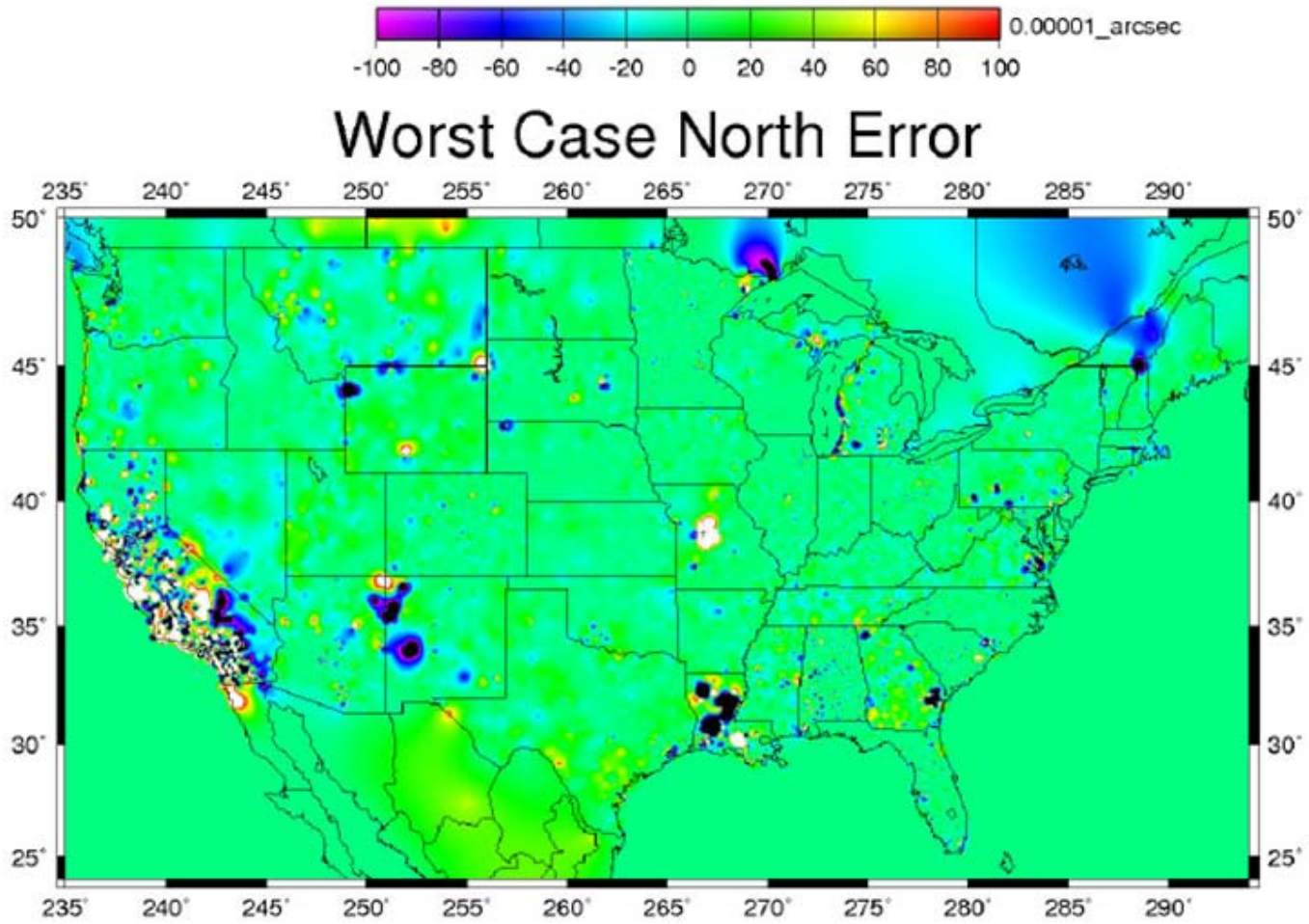


Figure 9.1. Worst Case Cross Validation Error, Latitude.

GEOCON → NADCON

- Accuracy testing shows 1 cm to 4 cm in many parts of the country. See GEOCON Technical Report for details:
- Strong Suggestions:
  - Roll GEOCON, GEOCON11 into the NADCON product to provide a simple single solution for coordinate transformation.
  - Provide many more input/output data formats.

The End