Horizontal Positional Accuracy Assessment of 7.5’ Digital Geologic Maps of Part of the Nashville Dome, Central Tennessee

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Abstract

I seek to better understand the horizontal positional accuracy of 7.5' digital geologic maps in general. For example, it has been asserted that the positional accuracy of well-located contacts on some digital 7.5' geologic maps exceeds 15 m. In this project, I quantitatively assessed the horizontal positional accuracy of digital geologic maps. To accomplish this, I began by georeferencing 48 published 7.5' quadrangle geologic maps of Central Tennessee using the ArcGIS program. I was provided with scanned geologic maps. For each scanned map, I matched 10 marked intersections of latitude and longitude with the corresponding points on a USGS 7.5.' digital raster graphic (DRG). I then applied an affine transformation to the scanned geologic map. The mean RMS horizontal positional error was 5.5 m, with a range of 3.1-9.4 m. This could be due to distortions in the scanned maps, and it could be due to human error in assigning matching points. Results will be used in ongoing efforts to quantify uncertainties in the estimated thicknesses of Central Tennessee sedimentary rock formations. The larger research goal is to understand the origin of thickness variations in carbonate strata deposited during Late Ordovician (~453 Ma) tectonic uplift of the Nashville Dome.

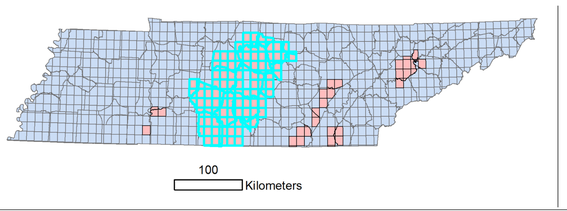


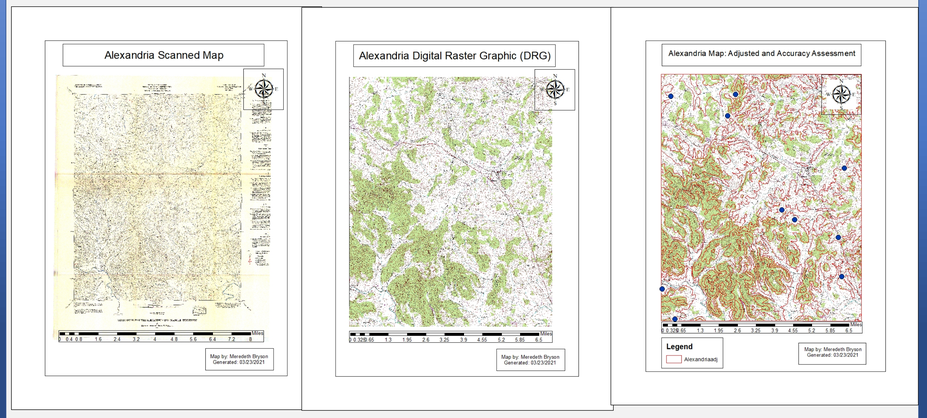
Figure 1: Geographic area (cyan) of project in Central Tennessee. The Hermitage Formation is exposed within the salmon-colored quads.

Objective

- The objective of this project is to assess the horizontal positional accuracy of digital geologic maps.

Background and Study Area

- During the Paleozoic Era tectonic collisions between North America and other plates led to the uplifting of a dome in Central Tennessee, now referred to as the Nashville Dome.
- Over the course of the Paleozoic and Cenozoic Eras the Nashville Dome experienced episodic uplift and erosion, leading to the development of folds within the rocks.
- Due to these folds the rock layers vary in elevation throughout Central Tennessee.
- Digital maps of geologic contacts have the potential to reveal these elevation variations when combined with digital elevation models (DEMs) of the Earth’s surface.
- The study area of this project focuses on part of the Nashville Dome in Central Tennessee, with a primary focus on a collection of rock layers called the Hermitage Formation.



Figures 2, 3, 4: Examples of scanned geologic map, scanned and georeferenced topographic map, and an overlay of digitized and georeferenced geologic contacts (red) on a topographic map.

Methods

- Paper geologic maps were scanned at MTSU.
- Digital maps of geologic contacts were obtained from the U.S. Geological Survey.
- Geologic contacts had been digitized (vectorized) but not accurately georeferenced.
- Scanned and georeferenced 7.5’ topographic maps (digital raster graphics or DRG’s) were downloaded from a federal site.

Methods Cont.

- We utilize ArcGIS to georeference these maps and produce accuracy assessments.
- To georeference scanned geologic maps we match ten intersections of latitude and longitude with the corresponding points on DRG’s.
- To georeference vector geologic contacts we select 20 points and then drag (rubbersheet) them to match the same points on the georeferenced scanned geologic maps.
- We check the link table within ArcGIS to determine the root mean square error (RMS error) which indicates the error associated with our adjusted points (in meters).

Results and Future Works

- The root mean square error (RMS error) is calculated for every map (48 maps)
- The average RMS error is determined to be approximately 5.44 meters, with a minimum RMS error of 3.05 meters and a maximum RMS error of 9.44 meters.
- Findings from this research will contribute to ongoing research, conducted by Dr. Mark Abolins, involving purported thickness variations within the Hermitage Formation.

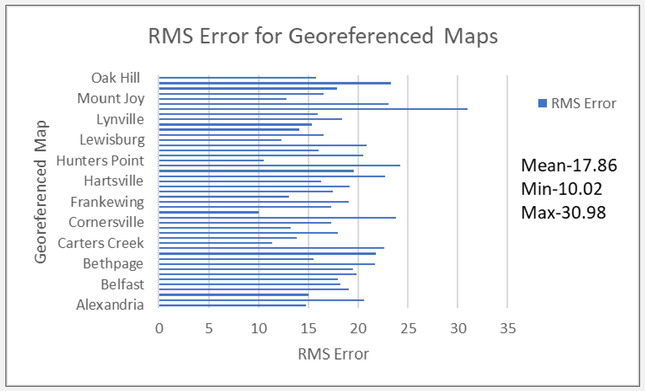


Figure 5: Route Means Square Error for Georeferenced Maps