The Effects of Resolution on Digital Elevation Models
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Abstract
The resolution of DEM models greatly affects the detail and accuracy when representing a localized region. In this case we compared 30m and 90m resolution DEMs for the St. Olaf lands. In doing so we were able to clearly demonstrate the benefits of a finer resolution DEM when examining local topography.

Introduction
Variations in map projection, resolution, and scale all influence the two-dimensional representation of a geographic area. In this project we focus on resolution. A larger resolution displays broad changes in elevation and presents an image that may appear to have less relief than would be apparent at a smaller resolution. Likewise the details of localized topography are better represented at smaller resolutions. This project focuses on the effects map and data resolution have on the detail and accuracy of digital elevation models (DEM), particularly the differences between 30m and 90m resolution DEMs for St. Olaf lands. We also examine how elevations relate to watershed boundaries and the locations of wetlands.

Methods and Materials
• Downloaded the following data files from the MN DNR Data Disk:
  • 30m resolution DEM for Dakota and Rice Counties
  • 90m resolution statewide DEM for MN
  • 1995 watershed basins for Dakota and Rice Counties
  • NWS wetland polygons for the Northfield area
• Viewed the DEMs as grid themes using ArcView Spatial Analyst
• Merged the two county files for the 30m DEMs and the watershed using ArcView Geoprocessing
• Reprinted a step at numerous data along the county border by importing/exporting the merged 30m DEM as an ASCII file
• Clipped DEM grid themes using Spatial Tools
• Clipped watershed and wetland themes using ArcView Geoprocessing
• Created 30m DEM grid values from feet to meters using ArcView Spatial Analyst
• Created 2m interval contour lines based on 30m DEM using ArcView Spatial Analyst
• Shaded a copy of the 30m DEM theme 120 meters west to align it with the 90m DEM theme for comparison
• Created arithmetic overlay in ArcView Model Builder to compare elevation differences between the 90m and 30m DEMs

Discussion
If resolution affects the detail and accuracy of digital elevation models, especially in regard to localized topography, then we should see a significant difference between the 30m and 90m resolution DEMs for the St. Olaf lands. In viewing the maps, we can see a general difference in the overall detail of the map. For example, the points of “The Hill” near Thoren, Old Main, and Kellesby are clearly visible under the 30m resolution, but only the basic features of “The Hill” are apparent under the 90m resolution.

In comparing the elevation values between the two themes, we found that overall the 90m DEM has a greater elevation than the 30m DEM. This is shown in the arithmetic overlay map. Near the hill, and in particular on the northeast half, the 30m DEM has higher values than the 90m. The greatest differences in elevation between the two models seems to occur in areas where the topographic relief is greatest such as around the hill or in the valley containing the wetland northwest of Skylan park lot. Logically, a coarser resolution is not going to show subtle changes in elevation and will be less accurate in representing the extreme changes in elevation. A finer resolution should then be able to display both the subtle and extreme changes in topographic relief. However over a larger region, such as MN, a coarse resolution becomes less effective in displaying trends in elevation.

In comparing the location of contour lines with watershed boundaries, we concluded that they matched quite well. The distribution of wetlands also seems to correspond with the low regions of the 30m DEM based maps, but it did not correspond well with the 90m DEM. We noticed a discrepancy in the horizontal alignment of the 30m and 90m DEMs, and after comparing these DEMs to similarly projected themes, it became apparent that the 90m DEM was shifted approximately 120m to the west. To accurately compare the difference in elevation, we attempted to shift the 90m DEM 120m to the east. Due to computer hardware limitations, we were instead required to shift a copy of the 90m DEM 120m west. Even though the shift was accurate to our best estimation, it is important to recognize this as a possible source of error.

To further understand the relationships of resolution, digital elevation models, wetlands, and watersheds, we recommend analyzing watershed boundaries based upon digital elevation models and hydrologic run-off patterns that may influence current wetlands. Analysis of the St. Olaf Lands in this way could possibly lead to recommendations for future wetland restoration projects. Undoubtedly, this would involve other research than just what we have specified, such as examining soils and geologic data.

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