Calculating Errors of Interpolation Methods for Bathymetric Surveys
A Geographic Information Systems (GIS) Approach

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Introduction

• Globally high water demand
  - Drinking water
  - Irrigation in agriculture
  - Power generation

• Reservoirs used to meet this demand

• Reservoir lifetime is limited
Sediment accumulation

• Sediment decreases storage capacity and shortens reservoir lifetime
• Evaluation of reservoir sedimentation is important
• Imperative to manage surface water resources
Bathymetric Maps

• Map of the bottom of the lake
• Typically generated using point data
  Location (GPS) & Depth (elevation)
• Surface created by interpolation
Interpolation Methods

- Inverse Distance Weighting (IDW)
- Kriging
- Natural Neighbor
- Spline
Objectives

• Compare point data with different densities
• Explore error associated with different methods of interpolation
Study Area: Central Illinois
2014 Equipment: HydroLite-TM set up

- RTK-GPS
- SonarMite BT echo sounder
- SonarMite transducer
- Trimble GeoExplorer GeoXT
Methods

• Data collected and put into a GIS (ArcMap)
  Hanson Engineers Inc. 1999 – low density
  Collect current data 2014 – high density

• Designate 10% as observation sites by random selection

• Run the interpolation methods available in ArcMap
  Interpolations create a continuous surface (raster grid)
Methods continued

• Created model in ArcGIS to run multiple iterations
  
  Calculate RMS at observation points for each method of interpolation’s raster surface
  
  Change the mathematical parameters until lowest RMS achieved

• Create final surface with the complete data set

• Ultimately, contrast 1999 and 2014 surfaces to estimate sediment accumulation
Point Designations

1999 Low Density Data

2014 High Density Data
Results:
Low Density- Lowest RMS for Interpolation Methods

<table>
<thead>
<tr>
<th>Interpolation Method</th>
<th>RMS (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDW</td>
<td>4.9</td>
</tr>
<tr>
<td>Kriging</td>
<td>4.9</td>
</tr>
<tr>
<td>Natural Neighbor</td>
<td>3.6</td>
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<tr>
<td>Spline</td>
<td>3.6</td>
</tr>
<tr>
<td>Spline Boundary</td>
<td>3.7</td>
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<tr>
<td>Topo to Raster</td>
<td>3.7</td>
</tr>
<tr>
<td>Trend</td>
<td>9.2</td>
</tr>
</tbody>
</table>
High Density - Lowest RMS for Interpolation Methods

Interpolation Method

- IDW: 1.4
- Kriging: 1.4
- Natural Neighbor: 1.2
- Spline: 1.2
- Spline Boundary: 1.2
- Topo to Raster: 1.3
- Trend: 9.5

RMS (ft)
Conclusion

• Bathymetrics can be very inaccurate
• Spline & Natural Neighbor, interpolation methods with lowest RMS error
• Will use these surfaces to calculate volume of sediment accumulation
• Higher point density can lower RMS errors dramatically (60%)
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Questions?