Thinning of Geospatial Data using Right Triangulated Irregular Networks (RTIN)

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OBJECTIVE

R&D Objective: Create the ability to 'compress' geospatial data that maintains morphological fidelity (the shape of the compressed surface) according to a user specified metric.

Approach: Right Triangulated Irregular Networks were chosen since it is a mature technology that has yielded computationally efficient methods for the graphics community. This mechanism was adapted to meet the accuracy requirements of global geospatial data and to enable the operator to trade-off between fidelity of the thinned surface and its storage size.

Results: An application has been created and demonstrated that thins a regular rectangular grid by eliminating points that are not required to maintain the fidelity of the original surface

- Thinning (point elimination) is controlled by the user through the specification of a 1) fixed threshold and 2) percent of value threshold.
- The application is fast: Thinning of a 1025x1025 grid requires about 90 seconds. Reconstruction of the original grid from the thinned grid is also about 90 seconds.
- Testing with bathymetric and topographic data has typically yielded reduction in data sizes of 80% or more while retaining reasonable morphologic fidelity
- This method is applicable to ANY geospatial data field. Thinning results will vary with the spatial variation of the data.

Impact : Dramatic reduction in geospatial data size results in

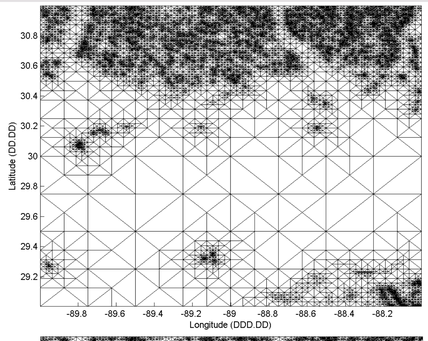
- Reduced storage expense
- Ability to transmit data sets with greater spatial extent
- Reduced processing load for models that can use irregular grids

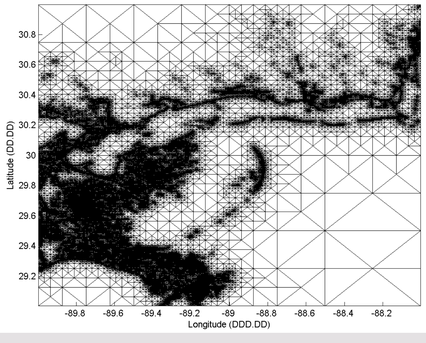
Fixed and Percent thinning criteria

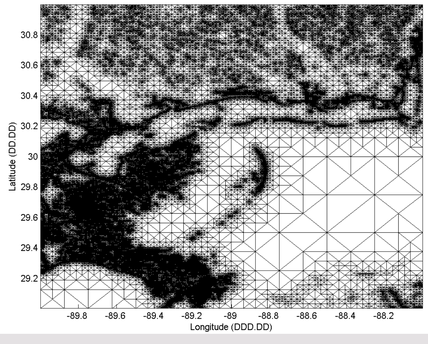
The figure to the right shows the remaining triangles with a fixed height criteria of 10m – i.e. all points that are within 10m of their neighbors are removed. Note the removal of topographic detail in the areas near sea level (Mississippi Delta).

The figure below shows the remaining triangles with a percent of height criteria of 10%. For this criteria, all points whose value differ from their neighbors by more than 10% are kept. Note that this criteria retains points in the areas near sea level.

The bottom right figure shows the combination of both the 10m and 10% criteria**. The result is that good fidelity is retained in both the shallows and deep areas.**





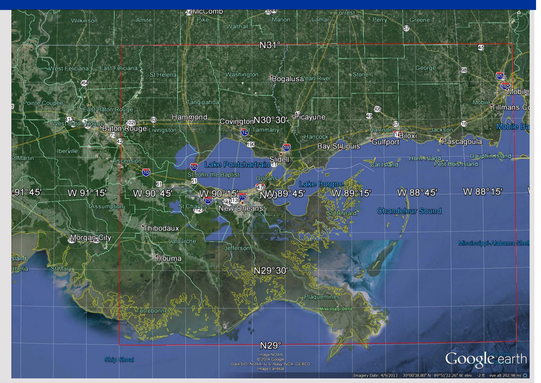


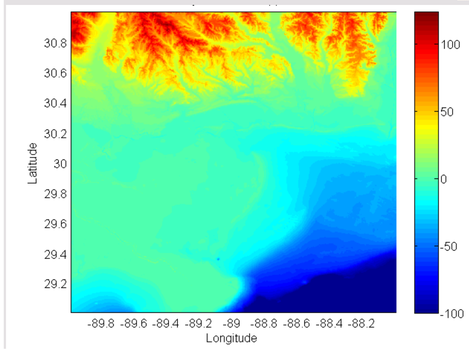
Demonstration Area and Data

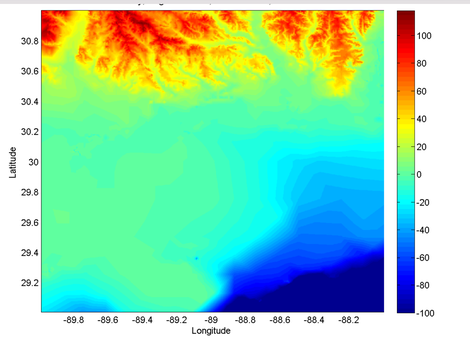
The extent of the grid used for the Hurricane Katrina testing area is designated in the figure to the right by the red box. The grid is 1025 points by 1025 points covering a 2 degree by 2 degree area including both land and ocean.

The bottom left figure shows a color contour of the original grid for this area. The data is clipped for depths greater than 100m (bottom right) to retain detail in the shallow and low altitude areas.

The bottom right figure shows a color contour of the regridded, thinned grid that was created using a thinning metric of 10m. **Note the relatively minor variations between the two.**





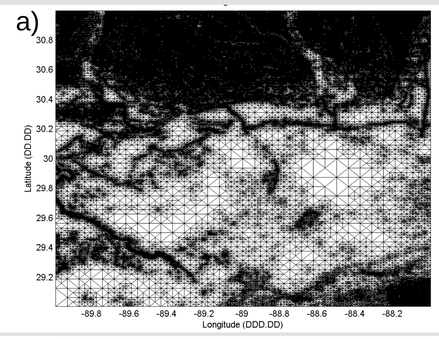


Comparison of compression and fidelity

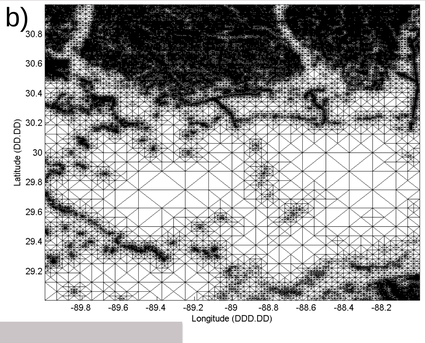
Case	Threshold	Compression	RMS Residual
a)	1m	0.195	0.3m
b)	3m	0.085	0.84m
c)	10m	0.013	2.5m

- These pictures show the triangles remaining after thinning the fully populated 1025x1025 grid
- The threshold is the thinning criteria – For 1m, any point that is within 1m of its neighbors can be eliminated
- Compression = thinned #points / original #points
- RMS residual is the difference between the original grid and the regridded thinned grid.
- **Note thinning of greater than 80% with small RMS residual.**

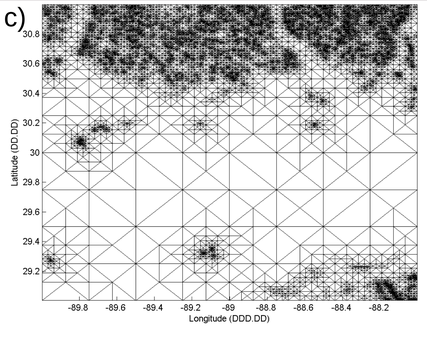
a)



b)



c)



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