

Dynamic Modeling of Components on the Electrical Grid

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http://wiki.ornl.gov/sites/rams09/b_young/Pages/default.aspx

Background and Purpose

- FEMA needs a tool to display outage areas in large storms to predict electrical customer outages.
- Electrical outage predictions useful in creating better emergency responses for these outage areas and protection for critical infrastructures
- VERDE (Visualizing Energy Resources Dynamically on Earth): program used to simulate electric grid to provide an operating picture for FEMA emergency responses.

Research Objectives

- Determine electrical customers in predicted outage areas by correcting county population data
- Translate MATLAB code to Java, a program used to estimate electrical substation service and outage areas
- Compare with geospatial metrics, MATLAB output and Java output of predicted substation outage area to determine reliability

Methods

- Number of customers in 2008 per county is found by using the equations:

$$CF = \frac{Pop_{2000}}{House_{2000} + Firms_{2000}}$$

Pop₂₀₀₀ = Population in 2000
Pop₂₀₀₈ = Population in 2008
House₂₀₀₀ = Households in 2000
Firms₂₀₀₀ = Firms in 2000
CF = Correction Factor
Customers = 2008 customers

$$Pop_{2008} / CF = Customers$$

Correction Factor vs. Counties

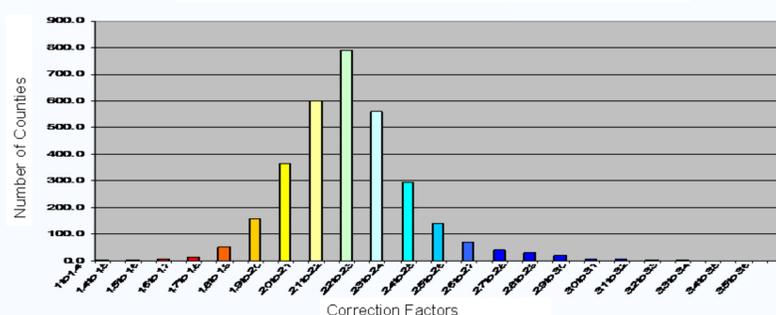


Figure 1. Histogram visual of counties sorted by correction factor

U.S. County Correction Factor

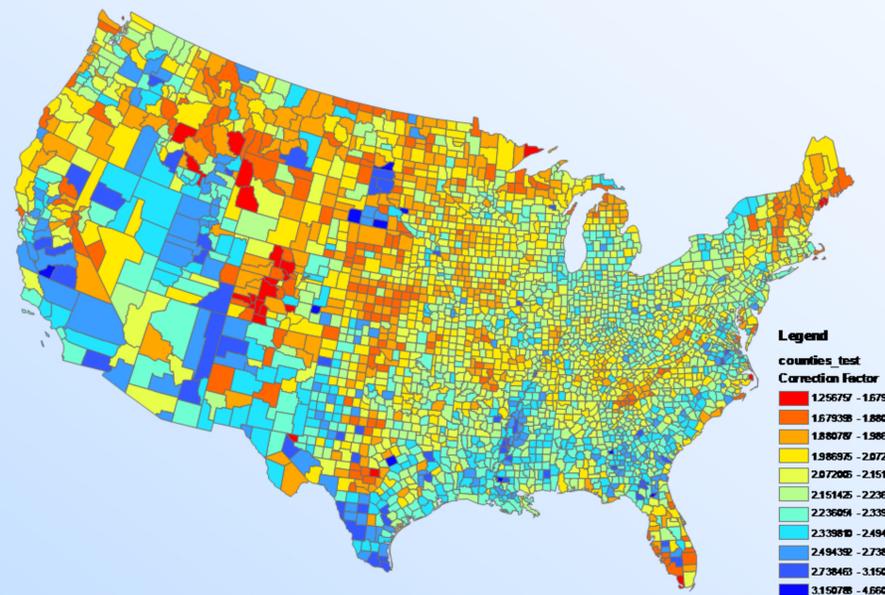


Figure 2. A visual representation of correction factor by county.

- Compare customer estimates from correction factor with known customer data
- Translate original MATLAB code to Java code to predict electrical substation area
- Use researched geospatial metrics to compare substation's area in MATLAB and Java by using electrical substation locations given by CMS energy of Michigan area

Results and Verification

- Compare correction factor estimate with known customer data in seven Florida and Maryland counties
- Use ratio of predicted to actual customer estimates from correction factor in these counties: 100.7% ± 13.6%
- Receive output from Java code
- Compare MATLAB output and Java output of Michigan substation locations (future work to verify code)

Conclusions

- Correction factor data is effective in predicting customer population
- Correction factor data is imported into real time VERDE data to predict the customer population from estimation of outage areas
- Reliability of Java code will be determined after verification

Future Research

- Predict number of materials to be lost (e.g., poles and wires) while determining electrical substation outage area
- Compare Java output with actual substation service data from Michigan

Michigan estimation of electrical substation service areas

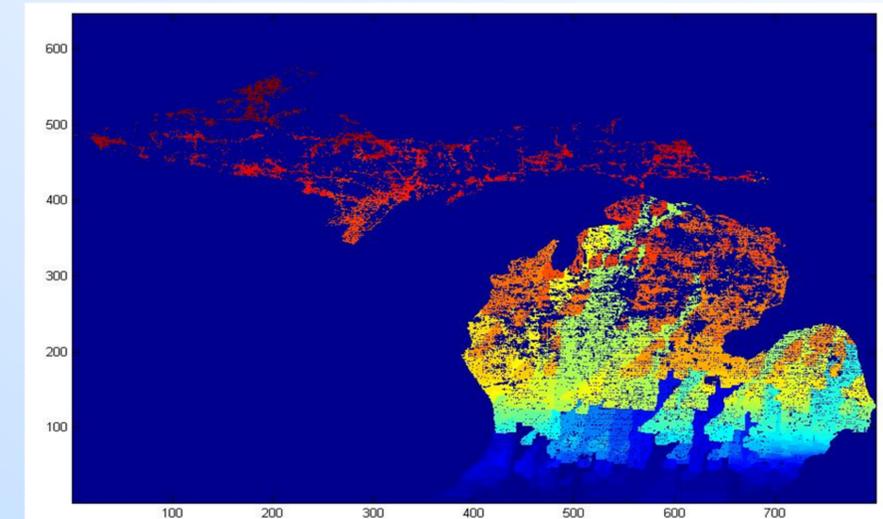


Figure 4. A sample output of code implementation. Displays substation service areas in Michigan

References

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- Sabesan, A, Abercrombie, K., Ganguly, A.R., Bhaduri, B., Bright, E., and Coleman, P. (2007) Metrics for the comparative analysis of geospatial datasets with applications to high-resolution grid-based population data. *GeoJournal*.