Meteorological Teleconnections May Influence the Predictability of Electrical Feeder-Failure Models

Casey P. Dorn[1], Roger N. Anderson[2], Albert G. Boulanger[2], Leon Wu[2, 3]

[1]Department of Meteorology, Pennsylvania State University, State College, PA 16802, USA.

[2]Center for Computational Learning Systems, Columbia University, 475 Riverside Drive, New York, NY 10115, USA.

[3] Department of Computer Science, Columbia University, 1214 Amsterdam Avenue, New York, NY 10027, USA.

We use bivariate Granger Causality and Ordinary Least Squares (OLS) regression analyses to investigate the impacts of synoptic and planetary scale meteorological indicators on power grid reliability in New York City. Power grid reliability is vital to metropolitan electro-centric economies, with outages resulting in great economic loss. In support of a more robust power grid, power grid feeder failure predictability models have been generated to prepare electric companies for impending failures that can lead to outages. Prior research by the Center for Computational Learning Systems (CCLS) smart grid research group (SGRG) found smoothly changing variability in feeder failure predictability using the ODDS model in New York City, which correlated with the NAO. We hypothesize that power grid failure predictability, and therefore reliability, is affected by teleconnections. Teleconnection and mesoscale weather data were obtained from the Climate Prediction Center (CPC) branch of NOAA. Power grid predictability data were obtained from the CCLS database as computed by SGRG. Missing data were interpolated using a previous-value approximation in MATLAB and standardized using two different methods. Exploratory analyses were conducted to detect autocorrelation, normality, correlation, and lagged correlation. OLS, lagged OLS, and ARIMAX models were used in the investigation and run using a variety of filters and restrictions. We found teleconnection data can explain variance in the ODDS model, with the best models producing a 21 percent forecast error and R-squared value of 0.25. Teleconnections are better predictors of ODDS' variance in the winter than the summer, and during NAO (-) and AO (+) events, than the corresponding opposite indices. Additional research is ongoing to refine model results based on the relative lagged influence of given covariates as a function of time of year, and may lead to physical and programmatic improvements in smart grid systems.