Applying Transfer Learning to Improve Machine Learning Impact Model at Extremes

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Machine learning can be useful for modeling the impacts of natural hazards on infrastructural systems. By relying on empirical observations, these methods lack the prohibitive complexity of large-scale physical models, but can also operate in high-dimensional spaces: where a large number factors contribute to the observed damages to the system. However, modeling extreme events can be challenging with machine learning. Unlike parametric models, the dynamic range of these models is constrained to the training data, and the training data from extreme events is as rare as the events themselves. However, transfer learning, where a model trained on data from one system is retrained for another system, may enable the use of additional training data to improve the prediction of extreme events. This would allow for more examples of extreme events from more places to be included in the training data, and should improve the performance of machine learning based impact models at the extremes. In this study, we apply transfer learning methods to the University of Connecticut's Outage Prediction Model (OPM), a machine-learning based electrical power outage model. The OPM has a large domain that spans three states in the US: Connecticut, Massachusetts, and New Hampshire, and there is much more training data available for Connecticut than the other states. We investigate the effects of applying this additional data on the accuracy and dynamic range of models for the other states using transfer learning methods, in an effort to better predict the impacts of the most extreme weather events.

Keywords: Machine Learning, Impact Model, Transfer Learning, Extreme Events, Power Outage, Infrastructure

