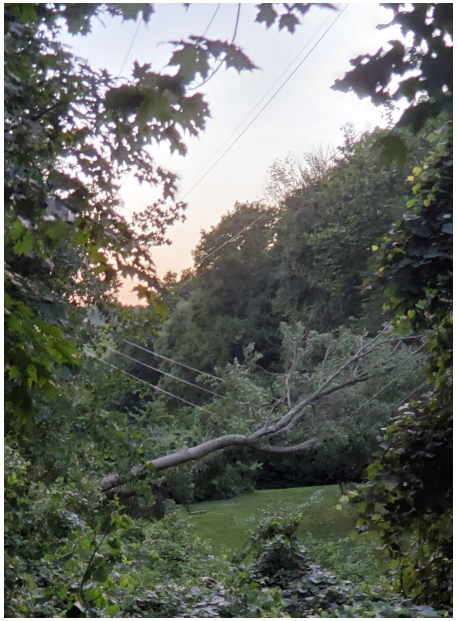
Machine Learning Methods for Transmission Outage Prediction

OBJECTIVE

- To build upon the University of Connecticut's (UConn) Outage Prediction Model (OPM), a model used to predict distribution outages, to create a combined machine learning based and mechanistic damage prediction system for the transmission network.
  - This model will use geolocated information of transmission facilities as well as infrastructure and environmental conditions to predict the probability of failure of individual facilities.
  - Multiple python-based machine learning models will be created and validated using different algorithms to determine the best algorithm for transmission system outages.

MOTIVATION



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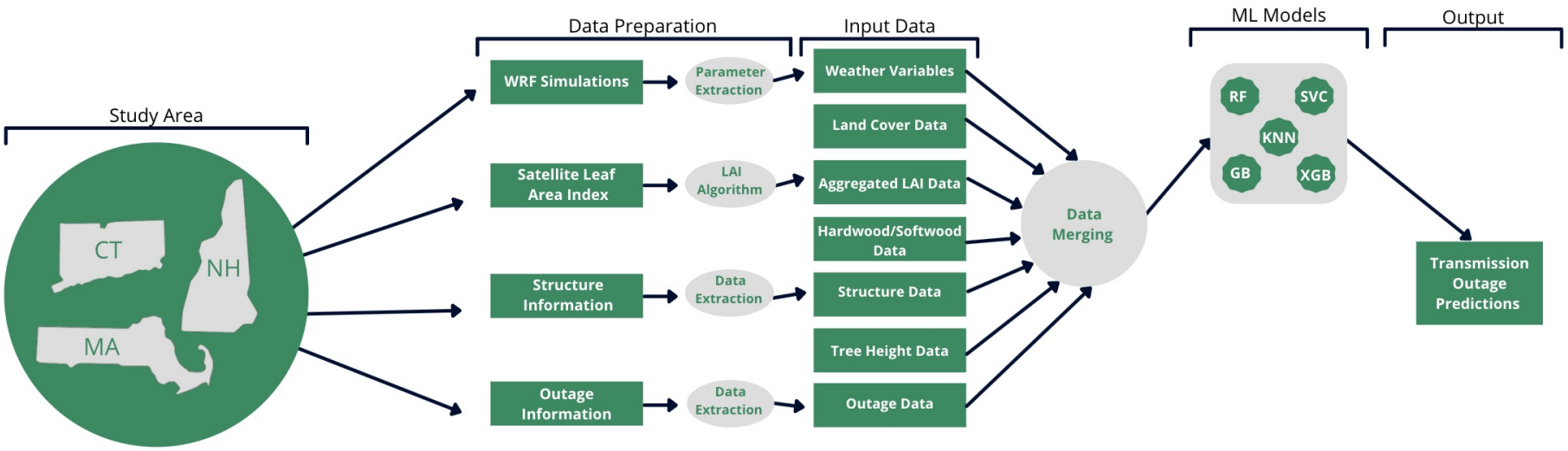
METHODS



Top 5 Storms and Outages					
Storms	2020080400	2018030700	2017102906	2018030200	2018051512
Outages	25	9	8	7	5

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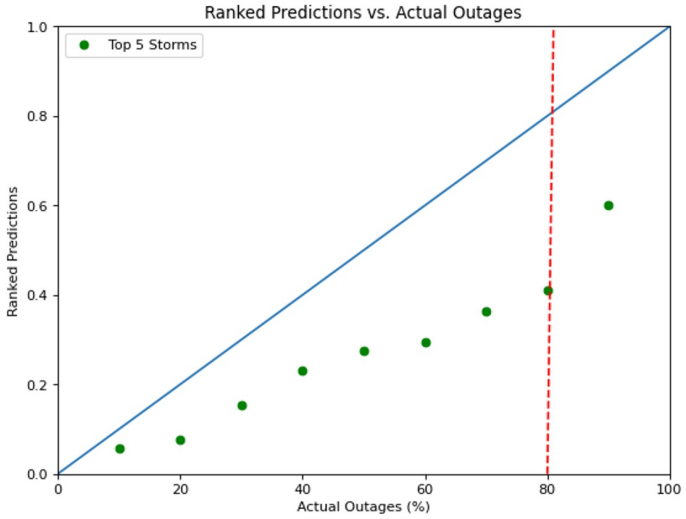
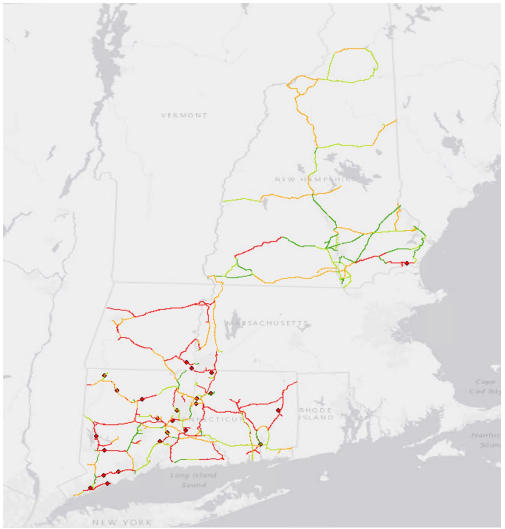
RESULTS AND DISCUSSIONS

	Top 5 Largest Storms			All Storms		
Model	**70% of Outages in top X% of Preds:**	**80% of Outages in top X% of Preds:**	**90% of Outages in top X% of Preds:**	**70% of Outages in top X% of Preds:**	**80% of Outages in top X% of Preds:**	**90% of Outages in top X% of Preds:**
Baseline	58.8	62.2	69.5	47.1	52.0	54.6
Default XGBoost + All Inputs	56.3	66.5	73.3	38.8	46.4	48.5
All Vars + Overfit Reduc. Iteration 1	45.7	49.8	56.0	38.8	42.4	44.9
All Vars + Overfit Reduc. Iteration 2	58.8	64.6	69.6	**35.3**	41.0	45.6
Mean Vars + Overfit Reduc. Iter. 1	**36.3**	**41.1**	**60.2**	35.9	**40.8**	**43.9**





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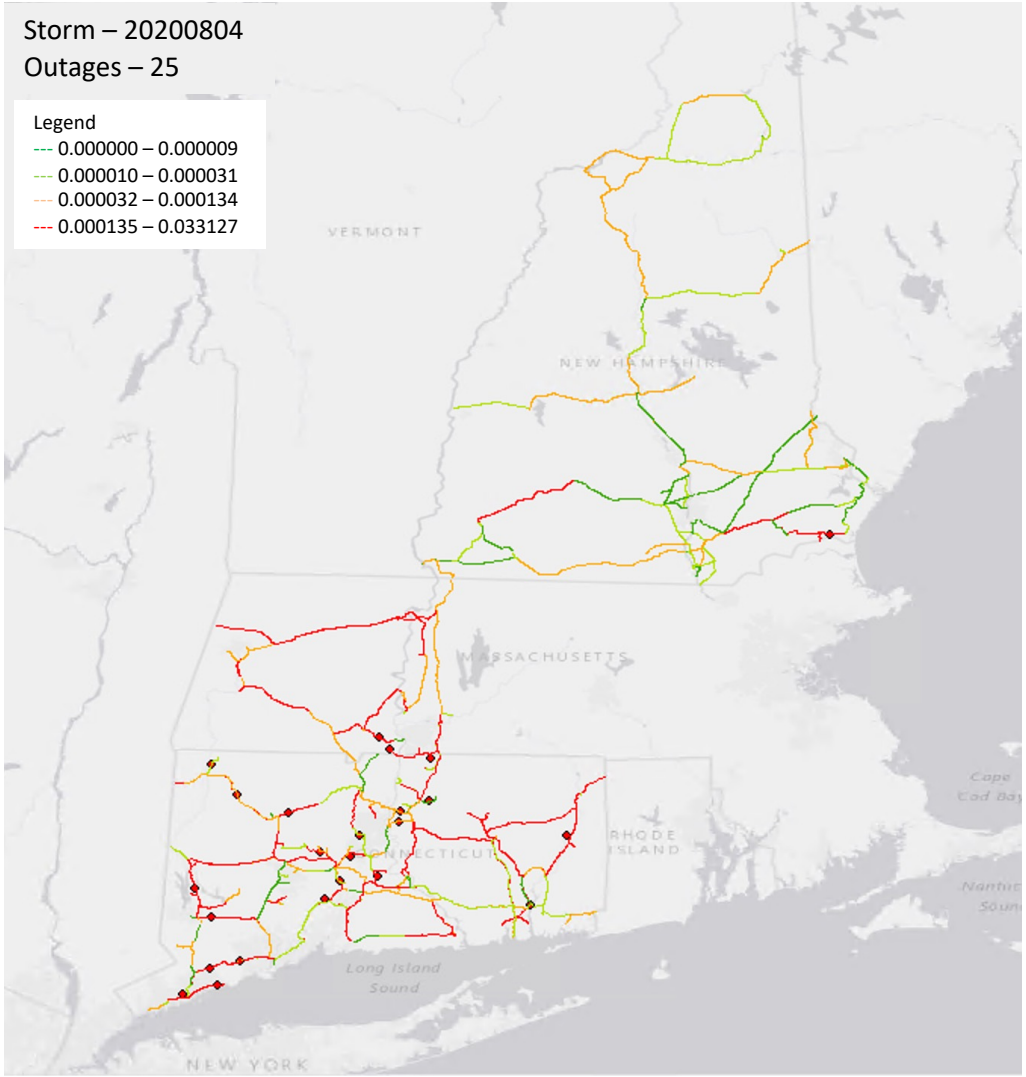

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CONCLUSION

- Developed ML framework prototype to predict outages in transmission systems
- Trained on 5 years of transmission failures in the Eversource service territories
- ML framework shows some skill and great potential considering the limited amount of data available so far

FUTURE WORK

- Looking to expand training dataset in time and space through collaborations with other utilities
- Create unified model by combining ML model with structural model
- Improve variable selection and adding in snow variables
- Adding finer resolution for trees

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